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BEFORE THE IDAHO PUBLIC UTILITIES COMMISSION

IN THE MATTER OF THE APPLICATION	)	CASE NO. AVU-E-12-08
OF AVISTA CORPORATION FOR THE	)	
AUTHORITY TO INCREASE ITS RATES	)	
AND CHARGES FOR ELECTRIC AND	)	
NATURAL GAS SERVICE TO ELECTRIC	)	DIRECT TESTIMONY
AND NATURAL GAS CUSTOMERS IN THE	)	OF
STATE OF IDAHO	)	ROBERT J. LAFFERTY
	)	

FOR AVISTA CORPORATION

(ELECTRIC ONLY)

I. INTRODUCTION

Q. Please state your name, employer and business address.

A. My name is Robert J. Lafferty. I am employed as the Director of Power Supply at Avista Corporation, located at 1411 East Mission Avenue, Spokane, Washington.

Q. Would you briefly describe your educational and professional background?

A. Yes. I received a Bachelor of Arts degree in Business Administration and a Bachelor of Science degree in Electrical Engineering from Washington State University, both in 1974. I began working as a distribution engineer for Avista in 1974 and held several different engineering positions with the Company. In 1979, I passed the Professional Engineering License examination in the state of Washington. I have held management positions in engineering, marketing, demand-side-management and energy resources. I began work in the Energy Resources Department in March 1996, and have held various positions involving the planning, acquisition and optimization of energy resources. I became the Director of Power Supply in March 2008, where my primary responsibilities involve management and oversight of the short- and long-term planning and acquisition of power resources for the Company.

Q. What is the scope of your testimony in this proceeding?

A. My testimony provides an overview of Avista's resource planning and power supply operations. This includes summaries of the Company's generation resources, the current and future load and resource position, and future resource plans, including the power purchase agreement with Palouse Wind, LLC. As part of an overview of the Company's risk management policy, I will provide an update on the Company's hedging practices. I will address hydroelectric and thermal project upgrades, followed by an update on recent developments regarding hydro licensing.

A table of contents for my testimony is as follows:

Q. Are you sponsoring any exhibits?

A. Yes. Exhibit No. 4, Schedule 1 includes Avista's 2011 Electric Integrated Resource Plan and Appendices, Schedule 2 provides a forecast of Company load and resource positions from 2013 through 2032. Confidential Schedule 3 includes Avista's Energy Resources Risk Policy. Schedule 4 is a Map showing the location of the Palouse Wind Project. Schedule 5 contains Avista's 2009 Electric Integrated Resource Plan and Appendices. Confidential Schedule 6C includes presentations to the Avista Board concerning the Palouse Wind project. Confidential Schedule 7C is the 2011 Request for Proposal Process and Results, and Confidential Schedule 8C is the Palouse Wind Power Purchase Agreement.

II. RESOURCE PLANNING AND POWER OPERATIONS

Q. Would you please provide a brief overview of Avista's owned-generating resources?

A. Yes. Avista's resource portfolio consists of hydroelectric generation projects, base-load coal and natural gas-fired thermal generation facilities, wood-waste fired generation, natural gas-fired peaking generation, long-term contracts, including wind, and Mid-Columbia hydroelectric generation, and market power purchases and exchanges. Avista-owned generation facilities have a total capability of 1,777 MW, which includes 56% hydroelectric and 44% thermal resources.

Illustration No. 1 below summarizes the present net capability of Avista's owned-generation resources:

<u>Illustration No. 1: Avista's Owned-Generation</u>

Avista-Owned Generation					
Hydroelectric Generation	**MW**	**Thermal Generation**	**MW**	**Natural Gas Peaking Generation**	**MW**
Noxon Rapids	557	Colstrip Units 3 & 4	222	Northeast CT	56
Cabinet Gorge	255	Coyote Springs 2	278	Kettle Falls CT	7
Post Falls	18	Kettle Falls	50	Boulder Park	24
Upper Falls	10			Rathdrum CT	149
Monroe Street	15				
Nine Mile	18				
Long Lake	83				
Little Falls	35				
Total Hydroelectric	**991**	**Total Base-Load Thermal**	**550**	**Total Peaking**	**236**
Total Owned Generation	**1,777 MW**				

Q. Would you please provide a brief overview of Avista's major generation contracts?

A. Yes. Avista's contracted-for generation resource portfolio consists of Mid-Columbia hydroelectric, PURPA, a tolling agreement for a natural gas-fired generator, and contracts with wind generation facilities.

The Company currently has long-term contractual rights for 165 MW from Mid-Columbia hydroelectric projects in 2012, owned and operated by the Public Utility Districts of

Chelan, Douglas and Grant counties. Details about the Mid-Columbia hydroelectric contracts are located in Illustration No. 2 and other contracts are shown in Illustration No. 3. Avista also has a long-term power purchase agreement (PPA) in place entitling the Company to dispatch, purchase fuel for and receive the power output from the 275 MW Lancaster combined-cycle combustion turbine project located in Rathdrum, Idaho. In 2011, the Company executed a 105 MW power purchase agreement to purchase the output and all environmental attributes from the Palouse Wind, LLC wind generation project, which is under construction and expected to begin generation in late 2012. Details about the Palouse Wind PPA are discussed in Section III of my testimony.

Illustration No. 2: Mid-Columbia Capacity Contracts

Counter Party – Hydroelectric Project	Start Date	End Date	Estimated Capacity (MW)	Annual Energy (aMW)
Grant PUD – Priest Rapids	12/2001	12/2052	34	16
Grant PUD – Wanapum	12/2001	12/2052	37	18
Chelan PUD – Rocky Reach	11/2011	06/2012	57	32
Chelan PUD – Rocky Reach	7/2011	12/2014	38	21
Chelan PUD – Rock Island	7/2011	12/2015	19	11
Douglas PUD - Wells	2/1965	8/2018	29	15
Total			**165**	**86**

Illustration No. 3: Energy Contracts

Contract	Contract Type	End Date	Winter Capacity (MW)	Summer Capacity (MW)	2012 Annual Energy (aMW)
Clearwater	PURPA	6/2013	75	75	52
Douglas Settlement	Purchase	9/2018	2	3	3
Lancaster	Purchase	10/2026	290	249	222
Palouse Wind	Purchase	12/2042	0	0	42
Small Power	PURPA	Varies	2	1	2
Stateline	Purchase	3/2014	0	0	9
Stimson Lumber	Purchase	11/2016	4	5	4
Upriver (net load)	Purchase	12/2011	8	-1	6
Spokane Waste to Energy	Purchase	12/2016	16	16	15
WNP-3	Purchase	6/2019	82	0	42
Total			**479**	**348**	**397**

Q. Would you please provide a summary of Avista's power supply operations and acquisition of new resources?

A. Yes. Avista uses a combination of owned and contracted-for resources to serve its load requirements. The Power Supply Department is responsible for dispatch decisions related to those resources for which the Company has dispatch rights. The Department monitors and routinely studies capacity and energy resource needs. Short- and medium-term wholesale transactions are used to economically balance resources with load requirements. Longer-term resource decisions such as the acquisition of new generation resources, upgrades to existing resources, demand-side management (DSM), and long-term contract purchases are generally guided by the Integrated Resource Plan (IRP) and will typically include a Request for Proposals (RFP) and/or other market due diligence process.

Q. Please summarize the current load and resource position for the Company.

A. Avista's 2011 electric Integrated Resource Plan (IRP) shows forecasted annual energy deficits beginning in 2019, and sustained annual capacity deficits beginning in 2020[1]. These capacity and energy load/resource positions are shown on pages 2-27 and 2-29, respectively of Exhibit 4, Schedule 1. Exhibit 4, Schedule 2 shows our most recent load and resource projection. Avista's current projection shows an annual energy deficit beginning in 2019 of about 9 aMW, and increasing to a 467 aMW deficit in 2032. The Company's January capacity resource position, based on an 18-hour peak event (6 hours per day and over 3 days), is currently projected to be surplus through 2022. Sustained annual capacity deficiencies, based on a January peak, begin at 76 MW in 2022 and increase to a 656 MW deficit in 2032. The Company's August capacity resource position, based on an 18-hour peak event, is currently projected to

[1] The Company has a 150 MW capacity exchange agreement with Portland General Electric that ends in December 2016 which results in short-term annual capacity deficits in 2015 and 2016. Sustained annual capacity deficits begin in 2020.

be surplus through 2018. Sustained annual capacity deficiencies, based on an August peak, begin at 43 MW in 2019 and increase to a 669 MW deficit in 2032.

Q. How does the Company plan to meet future energy and capacity needs beginning in 2020?

A. The Company will be guided by the 2011 Preferred Resource Strategy. The current Preferred Resource Strategy is described in the 2011 Electric IRP, which is attached as Exhibit 4, Schedule 1. The IRP provides details about resource needs, specific resource costs, resource operating characteristics, and the scenarios used for evaluating the mix of resources for the Preferred Resource Strategy.

The Company's 2011 Electric IRP was submitted to the Commission on August 26, 2011, following the completion of a public process involving six Technical Advisory Committee meetings from May 27, 2010 through June 23, 2011. The Commission acknowledged the 2011 Electric IRP on January 23, 2012 in Case No. AVU-E-11-04. The IRP represents the preferred plan at a point in time, however, the Company continues evaluating resource options to meet future load requirements, including, but not limited to, medium-term market purchases, participation in hydroelectric capacity auctions, generation ownership, hydroelectric upgrades, renewable resources, distribution efficiencies, conservation measures, long-term contracts, and generation lease or tolling arrangements in between IRPs. As stated earlier, longer-term resource decisions are generally made in conjunction with the Company's IRP and RFP processes, although the Company may acquire some resources outside of formal RFP processes.

Avista's 2011 Preferred Resource Strategy includes 28 MWs of distribution efficiencies, 419 MWs of cumulative energy efficiency, 4 MWs of upgrades to existing thermal plants, 752 MWs of natural gas fired plants (212 MWs of simple cycle and 540 MWs of combined-cycle combustion turbine (CCCT)), and 240 MWs of nameplate wind located in the Pacific Northwest. The timing of these resources as published in the 2011 IRP is in Illustration No. 4 below.

Illustration No. 4: 2011 Electric IRP Preferred Resource Strategy

Resource Type	By the End of	Nameplate	Energy
Northwest Wind	2012	120	35
SCCT	2018	83	75
Thermal Upgrades	2019	4	3
Northwest Wind	2019-2020	120	35
SCCT	2020	83	75
CCCT	2023	270	237
CCCT	2026	270	237
SCCT	2029	46	42
Total		996	739

Efficiency Improvements	By the End of Year	Peak Reduction (MW)	Energy (aMW)
Distribution	2012-2031	28	13
Energy Efficiency	2012-2031	419	310
Total Efficiency		447	323

Q. Can you provide a high-level summary of Avista's risk management program for energy resources?

A. Yes. Avista Utilities uses several techniques to manage the risks associated with serving load and managing Company-owned and controlled resources. The Energy Resources Risk Policy provides general guidance to manage the Company's energy risk exposure relating to electric power and natural gas resources over the long-term (more than 41 months), the short-term (monthly and quarterly periods up to approximately 41 months), and the immediate term (present month).

The Energy Resources Risk Policy is not a specific procurement plan for buying or selling power or natural gas at any particular time, but is a guideline used by management when making procurement decisions for electric power and natural gas fuel for generation. Several factors, including the variability associated with loads, hydroelectric generation, and electric power and natural gas prices, are considered in the decision-making process regarding procurement of electric power and natural gas for generation.

The Company aims to strategically develop or acquire long-term energy resources as suggested by the Company's Integrated Resource Plan acquisition targets, while taking advantage of competitive opportunities to satisfy electric resource supply needs in the long-term period. On the other end of the time spectrum, electric power and fuel transactions in the immediate term are driven by a combination of factors that incorporate both economics and operations, including near-term market conditions (price and liquidity), generation economics, project license requirements, load and generation variability, reliability considerations, and other near-term operational factors.

For the short-term timeframe, which falls between the long-term and immediate term periods, the Company's Energy Resources Risk Policy guides its approach to hedging financially open forward positions. A financially open forward period position may be the result of either a short position situation, for which the Company has not yet purchased the fixed price fuel to generate, or alternatively purchased fixed price electric power from the market, to meet projected average load for the forward period or a long position, for which the Company has generation above its expected average load needs and has not yet made a fixed price sale of that surplus to the market in order to balance resources and loads.

The Company employs an Electric Hedging Plan to guide power supply position management in the short-term period. The Risk Policy Electric Hedging Plan is essentially a price diversification approach employing a layering strategy for forward purchases and sales of either natural gas fuel for generation or electric power in order to approach a generally balanced position against expected load as forward periods draw nearer.

III. PALOUSE WIND POWER PURCHASE AGREEMENT ACQUISITION

Q. Please explain the Palouse Wind Power Purchase Agreement?

A. The Palouse Wind Power Purchase Agreement (Palouse Wind PPA) is a 30-year agreement to purchase all of the generation output and all environmental benefits associated with the Palouse Wind, LLC wind power project. The agreement also includes a purchase option after year ten. Avista's 2009 Integrated Resource Plan (IRP) indicated an approximate need for 50 aMW of qualifying renewable energy credits prior to 2016 in order to meet Washington’s renewable portfolio standard (RPS). In early 2011, the 2011 IRP was well into development and identified a slightly lower need level of 42 aMW of qualifying renewable energy credits. In February 2011, Avista decided to issue a request for proposals (RFP) that would meet the Company’s 2016 need for qualifying renewable energy credits prior to the December 31, 2012 expiration of federal and state tax incentives and other benefits, and also take advantage of the low equipment and construction costs that appeared to be available at the time. The Palouse Wind Project provides a 30-year long-term energy resource for our electric retail customers, and is located inside our utility service area.

Q. Please briefly describe the Palouse Wind Project.

A. The Palouse Wind Project consists of 58 Vestas 1.8 MW wind turbines that are located between Oakesdale, Washington and State Route 195 and with a total capacity of approximately 105 MWs. The project will be directly connected to the Avista electric system and is expected to begin commercial operation towards the end of 2012.

Exhibit 4, Schedule 4 contains a map showing the location of the project.

Q. Can you provide some background regarding why the Company initiated an RFP for renewable resources in 2011.

A. Yes. The Company had a need for qualified renewable energy beginning in 2016. Avista had continued to monitor renewable resource market conditions, particularly with respect to projects bid into its 2009 renewable resource RFP after the Company decided not to select a resource out of that process. In late 2010 and early 2011, Avista was made aware of a significant drop in prospective project costs associated with construction of new wind generation facilities that were still in position to be constructed, and also take advantage of available near-term tax incentives for projects brought on-line prior to December 31, 2012. The material drop in project cost, and the availability of significant known tax advantages for renewable resource projects constructed prior to December 31, 2012, were among the factors considered in the Company's decision to issue a new request for proposals (RFP) for up to 35 aMW of renewable energy in February 2011. The 2011 renewable resource RFP sought qualifying projects or project output for the 2012 – 2032 time period.

Avista stated in the RFP that Avista would not submit a self-build option. Analysis indicated that the combination of the significant drop in project cost and the substantial tax incentives available for renewable projects completed by December 31, 2012 yielded long-term benefits for customers compared to waiting until tax incentives, attractive project pricing, and particular attractive wind project sites may no longer be available to Avista.

Q. At the time of the 2011 RFP, please explain how the Company determined that a new resource was necessary.

A. The need for the type and size of resource provided by the Palouse Wind PPA was demonstrated in the 2009 Integrated Resource Planning process. (See Exhibit 4, Schedule 5) The need was also confirmed in the 2011 IRP, which was nearing completion when the Palouse Wind PPA was executed. (See Exhibit 4, Schedule 1) The Company's 2009 IRP, developed in conjunction with the Technical Advisory Committee, showed that Avista's first annual energy needs would occur in 2018 and sustained capacity need in 2019. The first projected annual REC need of 48.1 aMW identified in the 2009 IRP occurred in 2016. Illustration No. 6 shows Avista's projected energy needs, capacity needs, and REC needs presented in the 2009 IRP.

Illustration No. 6: 2009 IRP Load, Resource, and REC Tabulations

Net Position	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Energy (aMW)	309	185	123	110	93	59	38	31	(27)	(35)
Capacity (MW)	293	124	53	31	0	(45)	(74)	45	11	(46)
REC Need (aMW)	19.0	19.9	0.3	2.2	2.0	1.7	(48.1)	(49.1)	(50.3)	(51.6)

Q. How did the Company determine the amount and type of resource needed?

A. The Company's energy, capacity and REC needs were used as inputs to the development of the Preferred Resource Strategy (PRS). The PRS is developed using a proprietary linear programming model called PRiSM. The PRiSM model helps select the PRS and uses:

1. load deficits (energy and capacity);
2. RPS requirements;
3. Avista's existing portfolio's costs (loads and resources) and operating margins (resources);
4. Fixed operating costs, return on capital, interest and taxes for each resource option;
5. Generation levels for existing resources and new resource options; and

6. Carbon emissions levels for existing resources and new resource options.

Additional details about the development of the PRS and the PRiSM model can be found in Chapter 8 of the 2009 IRP (Exhibit 4, Schedule 5). The 2011 IRP used a similar methodology and an updated version of the PRiSM model to develop the 2011 PRS can be found in Exhibit 4, Schedule 1.

Q. Is this resource consistent with the 2009 Preferred Resource Strategy?

A. Yes. The 2009 PRS indicated a need for 48.0 aMW of renewable energy in 2012 represented by 150 MW of nameplate wind capacity. At the time of the 2011 RFP, work was also well underway in the 2011 IRP. The PRS in the Company's 2011 IRP reaffirmed the need for qualifying renewable resources in 2012 with requirements for 35.0 aMW of qualifying renewable energy obtained through 120 MW of nameplate wind capacity located in the Northwest. A somewhat lower need for renewable energy in the 2011 IRP was indicated based on a lower load forecast as compared to the 2009 IRP and a change in planning margin criteria. A higher expected capacity factor reduced further the equivalent nameplate wind capacity required.

Q. Were there other circumstances that influenced the timing of the 2011 renewable resource RFP?

A. Following the termination of the 2009 RFP process, the Company continued to receive project and cost updates from some of the RFP bid developers and from other projects. In early 2011, indications were that wind turbine prices and project construction costs were declining significantly. Avista made the decision to move forward with an RFP to take advantage of the substantially reduced equipment and construction costs prior to the December 31, 2012 expiration of federal and state tax incentives and other benefits.

Q. How did Avista evaluate and consider alternatives to the Palouse Wind PPA?

A. The Company issued an RFP in February 2011, for 35 aMW of renewable energy to be online by the end of 2012. (See Confidential Exhibit 4, Schedule 7C). The Company indicated in the RFP that a self-build option would not be included in the RFP process. The fast-track nature of the 2011 RFP did not allow for sufficient time for the Company to secure equipment and construction bids for a project at the Company-owned Reardan site that would fit into the RFP timeline and meet the December 31, 2012 federal tax credit deadline.

On March 7, 2011, the Company received eleven proposals totaling 774 MW in response to the RFP. The proposals included 769 MW of wind and 5 MW of landfill gas. The Company evaluated potential projects both quantitatively and qualitatively against one another based on predetermined criteria that had been vetted with the Idaho and Washington Commission Staffs. Analysis demonstrated that the highest ranked bid was the Palouse Wind Project. The Palouse Wind proposal was for an approximately 100 MW project located near Avista's Transmission System (30 miles south of Spokane, Washington) and with an expected 39.5 percent capacity factor (estimated to be about 38.4 aMW to 39 aMW depending upon final turbine selection and configuration). The project committed to reach commercial operation by the end of 2012 to qualify for federal tax benefits.

The RFP evaluation process included two screening levels which resulted in a short list of four bidders. After completion of due diligence of the short-listed projects, the Palouse Wind Project was the highest overall ranked resource.

Q. How was transmission considered in this decision?

A. The Palouse Wind Project will be directly interconnected to Avista's system, so no third-party transmission is required for this project to serve our customers. At the time of the RFP, Palouse Wind had made an interconnection request, and received project scope and cost information from Avista transmission. Subsequently, Palouse Wind signed a contract for the construction of Avista transmission required for interconnection. The evaluation process included the transmission interconnection cost in the case of projects with proposed direct interconnection with the Avista transmission system or transmission and losses for projects proposed to interconnect to third party transmission systems and wheeling power to the Avista system.

Q. What documentation for the analysis and decision-making process has the Company provided regarding the decision to enter into a contract for the Palouse Wind Project?

A. The documentation provided concerning the analysis and decision-making process regarding the decision to execute a contract for the Palouse Wind Project are included in the following: Exhibit 4, Schedule 1, includes

Avista's 2011 Electric Integrated Resource Plan and Appendices; Exhibit 4, Schedule 4, is a map of the location of the Palouse Wind Project; Exhibit 4, Schedule 5, is Avista's 2009 Electric Integrated Resource Plan and Appendices; Confidential Exhibit 4, Schedule 6C, provides the Palouse Wind Board documentation; Confidential Exhibit 4, Schedule 7C, provides details about the 2011 Renewables Request for Proposal process and results; and Confidential Exhibit 4, Schedule 8C, contains the Palouse Wind Power Purchase Agreement.

Q. Does the Company believe that the Palouse Wind PPA was a prudent acquisition?

A. Yes. My testimony and exhibits demonstrate the long-term need for the Palouse Wind PPA and provide specific supportive details regarding the Company's analysis. The Palouse Wind PPA is consistent with the Preferred Resource Strategy in the Company's 2011 Electric IRP, which is discussed earlier in my testimony. The Board of Directors agreed with the recommendation to issue the RFP for 35 aMW of renewable energy in 2011, and subsequently approved the recommendation to negotiate a PPA with Palouse Wind, LLC under terms and conditions consistent with their bid proposal. The Company has provided and explained all of the analytical work completed for this acquisition.

IV. GENERATION CAPITAL PROJECTS

Q. Please describe the upgrade projects for the Noxon Rapids generating units.

A. The Company recently completed a multi-year program to upgrade the Noxon Rapids generating units from 1950's era technology. The upgrades improved reliability and increased efficiency, by adding 30 MW of additional capacity and approximately 6 aMW of energy to the Noxon Rapids project. Illustration No. 7 summarizes the upgrade schedule, additional capacity and efficiency gains by unit.

Illustration No. 7: Noxon Rapids Upgrades

Noxon Rapids Unit #	Schedule of Completion	Additional Capacity	Efficiency Improvement
1	April 2009	7.5 MW	4.16%
3	April 2010	7.5 MW	4.15%
2	May 2011	7.5 MW	2.42%
4	May 2012	7.5 MW	1.49%

The Noxon Unit #1 work consisted of the replacement of the stator core, rewinding the stator, installing a new turbine and performing a complete mechanical overhaul. This upgrade increased the Unit's energy efficiency by 4.16%, and increased the unit rating by 7.5 MW. The upgrade also fixed several reliability concerns for the Unit including mechanical vibration and stator age. This work was completed in 2009. The costs and additional generation of this project were approved for recovery in Case No. AVU-E-09-01.

The Noxon Unit #3 upgrade, completed in May 2010, increased energy efficiency by 4.15%, and improved the unit rating by 7.5 MW. The costs and additional generation for Unit #3 were approved for recovery in Case No. AVU-E-10-01[2].

The Noxon Unit #2 upgrade, completed in May 2011, included a new turbine and complete mechanical overhaul. This upgrade increased the efficiency of Unit #2 by 2.42% and increased the unit rating by 7.5 MW. The costs and additional generation for Unit #2 were approved for recovery in Case No. AVU-E-11-01[2].

The Noxon Unit #4 upgrade was completed in May 2012. The Unit #4 upgrade will cost approximately $8.3 million (system). The increased generating capability from these units is reflected in Mr. Kalich's AURORA$_{XMP}$ modeling of pro forma power supply costs for the test period.

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[2] The last general rate cases (Docket Nos. AVU-E-10-01 and AVU-E-11-01) were resolved through a "black-box" settlement, the costs and additional generation represents the amounts included in the original filing.

The upgrade work at Noxon Unit #4, which is the final project in the Noxon upgrades, involves the installation of a new turbine, a complete mechanical overhaul, and GSU (Generation Step Up) upgrades. The project started in August 2011 and was completed in May 2012. The Unit #4 upgrade is projected to increase efficiency by 1.49 percent and increased the unit capacity rating by 7.5 MW. The costs and additional generation for Unit #4 were included in the Company's 2011 general rate case (AVU-E-11-01)[3].

Q. Would you please provide a brief description of the capital projects at Coyote Springs 2?

A. Yes. There are four main capital projects completed in 2012 at Coyote Springs 2 (CS2) which total $9,130,000 (system). The first project involved the installation of a hydrogen generator. The electrical generators for both the Gas Turbine and the Steam Turbine are cooled by hydrogen gas. Even though this is a closed system, some hydrogen gas escapes the system and make-up gas must be added so the generator operates properly. An evaluation was performed and it was determined that it would be cost-effective to install a hydrogen gas generator at the plant to create the necessary make-up gas for

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[3] Id.

generator cooling purposes, instead of purchasing hydrogen gas.

The second capital project at Coyote Springs 2 replaced the Steam Turbine Generator Exciter. The existing excitation system was provided as original equipment from Alstom, who no longer supports this system. The only service providers available to provide assistance are located in Europe. This project replaced the Alstom unit with a GE unit that is compatible with the other excitation system in the plant, which minimize spare parts requirements and capitalizes on staff expertise.

The third capital project is the Gas Turbine Compressor Upgrade. The original GE 7EA turbine compressor series installed at CS2 exhibited an embedded risk due to failure of a section of the compressor blades. This project included the installation of a set of GE supplied compressor blades to address this concern. All three of these capital projects at CS2 were in service by July of 2012.

The last CS2 capital project is the major overhaul on the steam and gas turbines performed by GE under the long term service agreement (LTSA). This major overhaul was an hours-of-operation based maintenance performed on the steam turbine at CS2. In addition, there were a few upgrades performed that were outlined by the OEM in Service Bulletins. This part of the capital projects at CS2 was $5,100,000, and the project was completed in June of 2012.

Q. Would you please provide a brief description of the other generation-related capital projects that are planned for in 2012 and 2013?

A. Yes. As shown in Illustration No. 8, the total 2012 and 2013 generation projects to be completed, as discussed by Mr. DeFelice, total $40.1 million and $26.7 million, respectively on a system basis. The 2012 Noxon Unit #4 upgrade project discussed above is $8.3 million of this total and the capital projects at Coyote Springs 2 are $9.1 million. In addition, there are 11 other generation capital projects totaling $49.3 million as discussed further below.

Illustration No. 8: Generation Capital Projects Summary

Project Name	2012 Capital Costs (000's)	2013 Captial Costs (000's)	Total (000's)
Noxon Rapids Unit #4 Upgrade	$8,300.00	$ -	$8,300
Coyote Springsw 2 Capital Projects	4,030	-	4,030
Coyote Springs 2 LTSA	5,100	-	5,100
Colstrip	3,154	10,639	13,793
Rathdrum CT	-	917	917
Base Hydro	1,440	800	2,240
Regulating Hydro Program	2,081	2,928	5,009
Kettle Falls Capital Projects	4,245	960	5,205
Little Falls Powerhouse Redevelopment	600	3,939	4,539
Post Falls Intake Gate Replacement	4,688	-	4,688
Nin Mile Redevelopment	-	2,602	2,602
Clark Fork Implementation PM&E Agreement	3,339	3,453	6,792
Spokane River Implementation (PM&E)	2,805	240	3,045
Other Small Capital Projects	321	247	568
Total	**40,103**	**26,725**	**66,828**

Thermal – Colstrip Capital Additions: $13,793,000 ($3,154,000 in 2012 and $10,639,000 in 2013)

Capital work projects at Colstrip includes bushing and blower replacement, rewind spare rotor, prototype scrubber polishing system to improve particulate removal, raise the ash storage pond dam walls, materials for waterwall replacement, materials for final superheat replacement, and miscellaneous small projects.

Thermal – Rathdrum CT: $917,000 in 2013

In 2007, the Mark V controller on Rathdrum Unit 2 failed, taking the unit out of service for several months. A new Mark VI controller was installed in its place. This project replaces the old Mark V controller in Unit 1 with a Mark VI controller to match Unit 2. The Mark V technology in Unit 1 is at the end of its life, is minimally supported by the manufacturer, and is a better solution for our operations.

Hydro – Base Hydro Capital Project: $2,240,000 ($1,440,000 in 2012 and $800,000 in 2013)

Generation Control Center Remodel: The present generation control center utilizes technology that is more than 15 years old to display, control, and monitor all of Avista's generation facilities. This includes controlling seven of the generating plants directly, while closely monitoring the six other plants. The new control room will provide for more efficient movement of operators for control of the plant, lay down space for drawings to assist with operation, local storage of manuals and other data, and an updated and more efficient HVAC system. This project was completed in July of 2012 at a cost of $330,000.

Upper Falls HED Multi-Functional Landing: Over time, the development of Riverfront Park and businesses along the Spokane River have reduced accessibility to the river for maintenance work for our Upper Falls Facilities. This includes the dam safety barrier, spillgates for Upper Falls (commonly referred to as the Control Works), and the emergency generator located near the spillgates for backup power purposes. This project is to construct a permanent landing near the Control Works that will allow barges and equipment to be set in the water to maintain these key facilities. The Multi-Functional Landing will provide permanent access for maintenance activities associated with the Control Works Dam and appurtenant facilities. When not being used by Avista, it is a feature available to park users to view the river. This project was completed in June and July 2012 at a cost of $310,000.

Various Small Projects: $800,000 in 2012 and 2013.

Hydro – Regulating Hydro Program Capital Projects: $5,009,000 ($2,081,000 in 2012 and $2,928,000 in 2013)

Install Rack and Forebay Monitoring at Long Lake HED: This work is to install monitoring systems allowing operators to monitor forebay, tailwater, total dissolved gas, and dissolved oxygen levels. All of these systems involve installation of upstream or downstream instruments in common locations to monitor the water levels and quality. This project involves work required by the FERC license and to enhance dam safety. This project is expected to be completed in December of 2012 at a cost of $805,000.

Sewage Disposal System at Cabinet Gorge HED: The existing sewage disposal system at Cabinet Gorge is not able to maintain the effluent within permitted levels and needs to be replaced with a system that will comply with all permits. This projected should be completed in November of 2012 at a cost of $700,000.

Replace Powerhouse Lighting at Long Lake HED: The current lighting system at the Long Lake powerhouse consists of 1,000 watt incandescent lamps, which are no longer commercially available and provide relatively poor quality lighting. This project will improve work lighting and put a more efficient lighting system in the powerhouse. The project should be completed in April 2013 at a cost of $228,000.

Replace Station Air Compressors at Cabinet Gorge HED: The existing three station air compressors at Cabinet Gorge are all original equipment. The air compressors have been overhauled and re-bored several times, but the bore wall thickness has been thinned to a point where another overhaul is not recommended. Due to the fragile condition of these compressors, blow down capabilities at Cabinet Gorge have been curtailed, reducing the amount of spinning reserve we can provide to serve our needs. This project is expected to be completed in June of 2013 at a cost of $900,000.

Unit 5 Exciter Replacement at Noxon Rapids HED: The existing excitation system was installed in 1977 when the unit was put into service. This GE analog excitation system with Power System Stabilizer (PSS) is 35 years old and parts/labor expertise is becoming very expensive and difficult to acquire. There have been on-going issues with the exciter, most recently with the exciter step-down transformer. There has been no major damage to the unit associated with the issues to this point. This project is to replace the existing GE static excitation system with a new bus-fed excitation system and an excitation control upgrade that meets NERC and operational expectations.

This project is expected to be completed in November of 2013 at a cost of $150,000.

Noxon Rapids Living Facility Additions: With the ongoing work at Noxon Rapids and in the Clark Fork area to serve both the construction work at the plants and in support of the environmental office, additional living and meeting space is being planned for the Noxon Living Facility to support this ongoing work. The cost for the part of this project expected for completion in February 2013 is $800,000 and the cost for the part expected to be completed in November 2013 is $600,000.

Other Small Projects: $826,000 ($576,000 in 2012, $250,000 in 2013)

Thermal – Kettle Falls Capital Projects: $5,205,000 ($4,245,000 in 2012, $960,000 in 2013)

Replace Boiler Controls: The existing boiler control system (Distributed Control System or DCS) is part of the original plant equipment. Over the past decade, we have been replacing different parts of this original system and the turbine controls represent the last stage. The original control equipment is no longer supported by the supplier, third-party suppliers have limited controls on hand, and the operator interface system being used is not compatible with this older control system. A PLC system is being designed and deployed. As part of this effort, we are replacing the present operator interface with a new platform that will allow expansion of systems in the future. This project will retain plant reliability while reducing the chances of an extended forced outage due to a DCS component failure. This project was completed in July of 2012 at a cost of $654,000.

Replace Monitor Control Centers: The present Monitor Control Centers are original equipment. They are still functioning, but we have been experiencing some problems that have used up spare parts. The original manufacturer no longer exists and compatible units that would allow for continued operation of this old gear is no longer available. This project will replace the obsolete equipment to maintain plant reliability. This project is expected to be completed in October of 2012 at a cost of $571,000.

Install New Water Supply System: Kettle Falls receives its water from the City of Kettle Falls through an agreement that dates back to the construction of the plant in the early 1980's. That agreement expires in 2012 and future water rates will be higher. This effort is to secure necessary water rights and a long-term water supply for the plant that is controlled by the Company. A new well, sufficient to provide for plant needs, was developed in 2011. This capital work is for the installation of the water supply piping and distribution system to the existing Kettle Falls plant from the new well. The project involves installing nearly 1,000 feet of water supply line and distribution manifold at the plant. In 2011, water rights were acquired and submitted to the Washington Department of Ecology. The Department of Ecology is investigating those water rights to assure they are unencumbered. This ruling is expected to come in 2012 at which time those would be transferred to Avista. The issuance of the water rights is expected to be completed in September 2012 at a total cost of $1,075,000 and the new water supply system is expected to be completed in December 2012 at a total cost of $549,000.

Purchase D10TQ Caterpillar Tractor: This project involves the replacement of the D10 Fuel Handler at Kettle Falls Generating Station. The existing unit is from 1991 and is in poor mechanical condition. These large bulldozers (fuel handlers) are essential to the operation of the plant. One day of lost production due to inability to load fuel costs $13,337 in comparison to buying power on the open market. Fuel savings of $35,000 per year are expected and a new machine will have much lower emissions. The existing unit should be replaced in December of 2012 at a cost of $1,396,000.

Truck Dumper Dust Containment Building: Hog fuel trucks can create dust plumes during unloading. These plumes have been identified by local air authorities as a concern that will need to be addressed. Attempts to abate the dust by installing hoods and other deflection elements have improved the dust situation, but there are still concerns about the overall particulate emissions associated with this process. This project includes construction of a building around the unloading area to contain the particulates. This project is expected to be completed in November of 2013 at a cost of $680,000.

Replace Grate Drive System: The current grate drive system at Kettle Falls utilizes a hydraulically operated ratchet system to move the traveling grate. The ratcheting action causes the connecting links to wear out. This capital project will replace the hydraulic ratchet with a variable drive system to provide constant tension on the grate to prevent the cyclic wear on the grate system. This project is expected to be completed in July of 2013 at a cost of $280,000.

Hydro – Little Falls Powerhouse Redevelopment Capital Projects – $4,539,000 ($600,000 in 2012, $3,939,000 in 2013)

Bridge Crane Modernization: The 50-ton Niles crane at Little Falls HED is 100 years old and powered off of the 250 volt DC system. This power system is supplied by the rotational exciters. When the rotational exciters are replaced, the ability to generate the 250 volt DC supply will be lost, and the crane will be unusable. This project is to replace all the DC motors with AC motors, and replace all DC controls with modern AC controls. This project is expected to be completed in November 2012 at a total cost of $600,000.

Replace 4kV Switchgear: We have experienced several major failures of the generator breakers within the past five years. Attempts to recondition this old equipment have been unsuccessful and we still experience major failures. This has created a hazardous area for operations personnel when the equipment is energized. This work will replace all of the existing switchgear with new units, removing this concern and hazard. This project is expected to be completed in February of 2013, at a cost of $1,636,000.

Replace Excitation System: The existing excitation equipment is 60 years old. The amplidyne technology is no longer supported by the manufacturer and very few people in the country have the expertise to fix or maintain this system. In the mid-1980's, a Bailey digital controller was fitted to this equipment to keep these systems minimally operable. These systems have failed several times in the past four years causing major generator damage that has been reparable. This project is to replace the amplidyne and rotating exciter systems with new bus fed systems. This project is expected to be completed in February of 2013 at a cost of $1,535,000.

Install Warehouse: Over the next 10 to 12 years, major rehabilitation work is being planned for the Long Lake and the Little Falls plants (Little Falls is six miles from Long Lake). Storage space for major equipment, minor materials, and a construction staging area needs to be built to facilitate these projects. This warehouse will fill this need. Work includes erecting a new warehouse in the Long Lake operator's village and installation of the 30-ton gantry crane from the Little Falls powerhouse into this new warehouse. This project is expected to be completed in April 2013 at a cost of $768,000.

Hydro – Post Falls Intake Gate Replacement Capital Project: $4,688,000 in 2012

Due to the deteriorated condition of the Post Falls HED intake gates and associated hoist mechanisms, Avista has committed to FERC to replace all six head gates and hoisting equipment by the end of 2012. This project will replace the existing wooden timbered head gates with new steel gates and to modify the structure to include a hoist system. Provisions for the gates will be made to pull the gates out for easy maintenance purposes. This work also includes installation of new controls and appropriate emergency power systems. This project is expected to be completed in December of 2012 at a cost of $4,688,000.

Hydro – Nine Mile Redevelopment: $2,602,000 in 2013

During a regular maintenance outage, cracks were found in several buckets of two of the four turbine runners on Unit 4. After investigation, it was determined the blades had cracked due to fatigue. The runners were weld repaired and the unit temporarily placed back into service. The repair is expected to be temporary and new replacement runners were ordered from the Original Equipment Manufacturer. The project also includes planning and engineering costs for a unit overhaul when the new replacement runners will be installed. The Nine Mile Redevelopment Project is expected to be completed in March of 2013 at a total cost of $2,602,000.

Hydro – Clark Fork River Implementation PM&E: $6,792,000 ($3,339,000 in 2012 and $3,453,000 in 2013)

The Clark Fork Implementation PM&E agreement capital expenditures include recreation site improvements, design and construction of fish passage, total dissolved gas abatement faculties, and acquisition of property rights for habitat restoration. We are currently pursuing the acquisition of two separate conservation easements to protect riparian habitat on the Bull River in Montana. Numerous ongoing recreation site improvements include the replacement of boat ramps, docks, and restrooms; upgrading electrical and septic systems; and trail development and improvements. Habitat enhancement projects include improvement and maintenance of existing wetlands on the Noxon Rapids reservoir, tributary habitat enhancements, such as culvert replacement, stream bed reconstruction and riparian re-vegetation and protection to improve passage, spawning and rearing for native salmonids.

Hydro – Spokane River Implementation PM&E: $3,045,000 ($2,805,000 in 2012 and $240,000 in 2013)

The Spokane River Project capital projects fulfill FERC’s license requirements related to wetlands, water quality, recreation, and land use improvements that will lead to improvements located at Nine Mile, and Lake Spokane (the Long Lake Dam reservoir). The water quality improvements and wetland acquisition and/or enhancements are mandatory conditions included in the License as part of the Washington and Idaho 401 Water Quality Certifications, whereas the recreation and land use projects are FERC’s License requirements. This year we will continue modeling a number of potential total dissolved gas remedies for Long Lake Dam, and monitoring low dissolved oxygen (DO) in the tailrace below the dam to determine if the aeration equipment we installed last year will sufficiently meet the State’s water quality standards. We are also installing additional aeration equipment in the Long Lake Powerhouse to further improve DO in the tailrace. We completed the channel modifications at Upper Falls last fall, which were approved by the Washington Department of Ecology. We will work to complete the required Nine Mile and Lake Spokane recreation projects during this year's construction season.

Other Small Capital Projects: $568,000 ($321,000 in 2012 and $247,000 in 2013)

V. HYDRO RELICENSING

Q. Would you please provide an update on work being done under the existing FERC operating license for the Company's Clark Fork River generation projects?

A. Yes. Avista received a new 45-year FERC operating license for its Cabinet Gorge and Noxon Rapids hydroelectric generating facilities on the Clark Fork River on March 1, 2001. The Company has continued to work with the 27 Clark Fork Settlement Agreement signatories to meet the goals, terms, and conditions of the Protection, Mitigation and Enhancement (PM&E) measures under the license. The implementation program, in coordination with the Management Committee which oversees the collaborative effort, has resulted in the protection of approximately 2,694 acres of bull trout, wetlands, uplands, and riparian habitat. More than 37 individual stream habitat restoration projects have occurred on 23 different tributaries within our project area. Avista has collected data on nearly 15,000 individual bull trout within the project area. The upstream fish passage program, using electrofishing, trapping and hook-and-line capture efforts, has reestablished bull trout connectivity between Lake Pend Oreille and the Clark Fork River tributaries above Cabinet Gorge and Noxon Rapids Dams through the upstream transport of 350 adult bull trout, with over 160 of these radio tagged and their movements studied. Avista has worked with the U.S. Fish and Wildlife Service to develop and test two experimental fish passage facilities. Avista, in consultation with key state and federal agencies, is currently developing designs for both a permanent upstream adult fishway for Cabinet Gorge and Noxon Rapids. Design is completed on a permanent tributary trap for Graves Creek (an important bull trout spawning tributary) with construction scheduled for mid to late 2012.

Recreation facility improvements have been made to over 23 sites along the reservoirs. Avista also owns and manages over 100 miles of shoreline that includes 3,500 acres of property to meet FERC requirements to meet our natural resource goals while allowing for public use of these lands where appropriate.

Finally, tribal members continue to monitor known cultural and historic resources located within the project boundary to ensure that these sites are appropriately protected.

Q. Would you please provide an update on the current status of managing total dissolved gas issues at Cabinet Gorge dam?

A. Yes. How best to deal with total dissolved gas (TDG) levels occurring during spill periods at Cabinet Gorge Dam was unresolved when the current Clark Fork license was received. The license provided time to study the actual biological impacts of dissolved gas and to subsequently develop a dissolved gas mitigation plan. Stakeholders, through the Management Committee, ultimately concluded that dissolved gas levels should be mitigated, in accordance with federal and state laws. A plan to reduce dissolved gas levels was developed with all stakeholders, including the Idaho Department of Environmental Quality. The original plan called for the modification of two existing diversion tunnels, which could redirect stream flows exceeding turbine capacity away from the spillway.

The 2006 Preliminary Design Development Report for the Cabinet Gorge Bypass Tunnels Project indicated that the preferred tunnel configuration did not meet the performance, cost and schedule criteria established in the approved Gas Supersaturation Control Plan (GSCP). This led the Gas Supersaturation Subcommittee to determine that the Cabinet Gorge Bypass Tunnels Project was not a viable alternative to meet the GSCP. The subcommittee then developed an addendum to the original GSCP to evaluate alternative approaches to the Tunnel Project.

In September 2009, the Management Committee agreed with the proposed addendum, which replaces the Tunnel Project with a series of smaller TDG reduction efforts, combined with mitigation efforts during the time design and construction of abatement solutions take place. FERC approved the GSCP addendum in February 2010 and in April 2010 the Gas Supersaturation Subcommittee (a subcommittee of the MC) chose five TDG abatement alternatives for feasibility studies. Feasibility studies and design continue on two of the alternatives. Final design and initiation of construction of the spillway crest modification prototype is anticipated to be completed in late 2012.

Q. Would you please give a brief update on the status of the work being done under the new Spokane River Hydroelectric Project's license?

A. Yes. The Company received a new 50-year license for the Spokane River Project on June 18, 2009. The License incorporated key agreements with the Department of Interior and other key parties in both Idaho and Washington. Implementation of the new license began immediately, with the development of over 40 work plans prepared, reviewed and approved, as required, by the Idaho Department of Environmental Quality, Washington Department of Ecology, the U.S. Department of Interior, and FERC. The work plans pertain not only to license requirements, but also to meeting requirements under Clean Water Act 401 certifications by both Idaho and Washington and of other mandatory conditions issued by the U.S. Department of Interior.

In 2011, Avista continued implementing a water quality, fisheries, recreation, cultural, wetland, aquatic weed management, aesthetic, operational and related conditions (PM&E measures) across all five hydro developments. The majority of the PM&E measures are on-going in nature, however a number are one-time improvements, such as the Upper Falls aesthetic spill project located in downtown Spokane. Over 340 acres of wetland mitigation properties were acquired in 2011 on Upper Hangman Creek in Idaho for the Coeur d'Alene Tribe through the Coeur d'Alene Reservation Trust Resources Restoration Fund that Avista established in 2009. We will now begin developing restoration plans for the properties.

Last year, we also developed wetland mitigation plans for our property along the St. Joe River and began restoring the wetlands in 2012 and will continue to be ongoing. During 2012 we continued work with the various local, state, and federal agencies to complete the required recreation projects in Idaho, and will develop up to ten boat-in-only campsites on Lake Spokane, as well as other numerous improvements at boat launches, overlooks and interpretive areas on Lake Spokane and Nine Mile. We are currently assessing potential wetland mitigation properties in the Lake Spokane and Nine Mile areas in order to fulfill the required conditions. In 2012 and going forward, we will continue to implement approved work plans that have been approved by FERC.

A number of the approved work plans require the Company to conduct extensive studies to determine appropriate measures to mitigate resource impacts. The more significant studies and mitigation measures include those for total dissolved gas (TDG) downstream of Long Lake Dam, which we began modeling in 2011 and will continue in 2012, and dissolved oxygen in the tailrace below Long Lake Dam and in Lake Spokane, the reservoir created by the Long Lake Dam. Initial estimates for measures to address TDG range between $7.0 and $17.0 million, and between $2.5 and $8.0 million to address dissolved oxygen in Lake Spokane. These estimates will be further refined as the relevant evaluations and studies are completed.

Q. Does this conclude your pre-filed direct testimony?

A. Yes it does.

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BEFORE THE IDAHO PUBLIC UTILITIES COMMISSION

IN THE MATTER OF THE APPLICATION	)	CASE NO. AVU-E-12-08
OF AVISTA CORPORATION FOR THE	)	
AUTHORITY TO INCREASE ITS RATES	)	
AND CHARGES FOR ELECTRIC AND	)	
NATURAL GAS SERVICE TO ELECTRIC	)	EXHIBIT NO. 4
AND NATURAL GAS CUSTOMERS IN THE	)	
STATE OF IDAHO	)	ROBERT J. LAFFERTY
	)	

FOR AVISTA CORPORATION

(ELECTRIC ONLY)

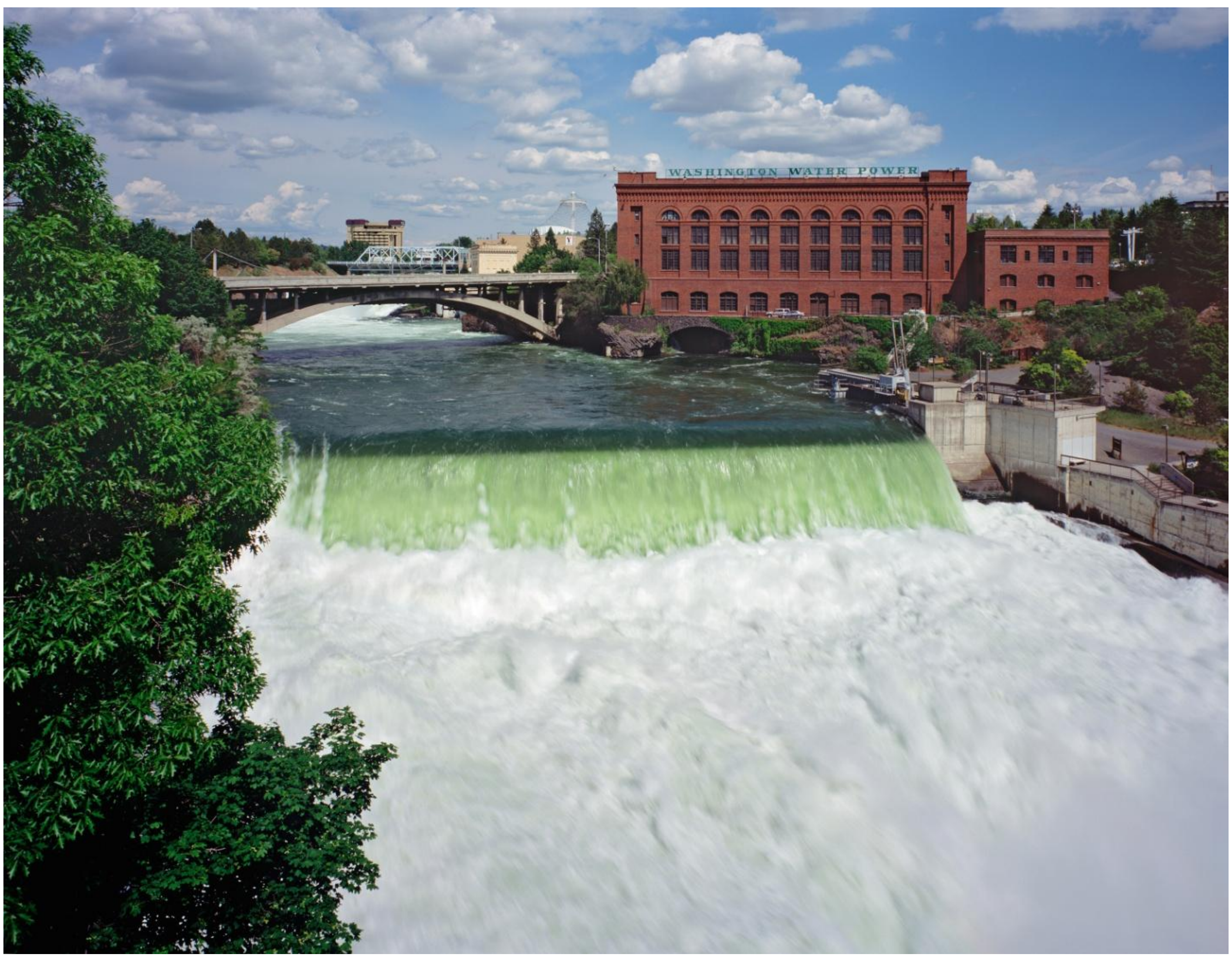
AVISTA

August 31, 2011

2011 Electric INTEGRATED Resource Plan

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1 of 1069

TABLE OF CONTENTS



Safe Harbor Statement

This document contains forward-looking statements. Such statements are subject to a variety of risks, uncertainties and other factors, most of which are beyond the Company's control, and many of which could have a significant impact on the Company's operations, results of operations and financial condition, and could cause actual results to differ materially from those anticipated.

For a further discussion of these factors and other important factors, please refer to the Company's reports filed with the Securities and Exchange Commission. The forward-looking statements contained in this document speak only as of the date hereof. The Company undertakes no obligation to update any forward-looking statement or statements to reflect events or circumstances that occur after the date on which such statement is made or to reflect the occurrence of unanticipated events. New factors emerge from time to time, and it is not possible for management to predict all of such factors, nor can it assess the impact of each such factor on the Company's business or the extent to which any such factor, or combination of factors, may cause actual results to differ materially from those contained in any forward-looking statement.

Table of Figures

Table of Tables

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 8 of 1069

2011 Electric IRP Introduction

Avista has a long tradition of innovation as a provider of clean, renewable energy. The 2011 Integrated Resource Plan (IRP) continues the tradition by looking into the future energy needs of our customers. The IRP analyzes and outlines a strategy to meet projected demand and renewable portfolio standards through energy efficiency and a careful mix of new renewable and traditional energy resources.

Plant upgrades and conservation measures are an integral part of Avista's 2011 IRP resource strategy. Avista expects to add increasing amounts of new renewables to its generation portfolio in the coming years. Renewables represent viable energy sources that diversify our resource mix and reduce the need for fossil fuels.

The challenge of integrating renewable resources such as wind and solar is that they are intermittent resources, meaning the wind does not always blow and the sun does not always shine. Customers expect high reliability; therefore, utilities will still need energy from natural gas and hydropower to keep the lights on. This presents a challenge to resource planners, who must consider reliability as well as rate and environmental impacts.

Avista's electricity sales growth is expected to be 1.6 percent over the next two decades. The Company projects it will have sufficient resources to meet this growth through 2018.

Each IRP is a thoroughly researched and data-driven document to guide responsible resource planning for the Company. The IRP is updated every two years and looks 20 years into the future. This plan is developed by Avista's professional energy analysts using sophisticated modeling tools and input from interested community stakeholders.

The plan's Preferred Resource Strategy (PRS) section covers the Company's projected resource acquisitions over the next 20 years.

Some highlights of the PRS include:

- A newly signed contract for the Palouse Wind project located near Spokane, Washington will fulfill Avista's RPS obligations through 2019.
- An additional 42 aMW of wind or qualified renewable energy credits are required by 2020.
- Energy efficiency reduces load growth by 48 percent. Aggressive energy efficiency measures are expected to save 310 aMW of cumulative energy over the next 20 years.
- 756 MW of clean-burning natural gas-fired generation facilities are required between 2018 and 2031.
- Avista's grid modernization and distribution feeder upgrade programs are projected to reduce load by about five aMW by 2013.

- Transmission upgrades will be needed to carry the output from new generation. Avista will continue to participate in regional efforts to expand the region's transmission system.

This document is mostly technical in nature. The IRP has an Executive Summary and chapter highlights at the beginning of each section to help guide the reader. Avista expects to begin developing the 2013 IRP in early 2012. Stakeholder involvement is encouraged and interested parties may contact John Lyons at 509-495-8515 or john.lyons@avistacorp.com for more information on participating in the IRP process.

Executive Summary

Avista's 2011 Integrated Resource Plan (IRP) guides its strategy over the next two years and indicates the overall direction of resource procurements for the remainder of a 20-year planning horizon. It provides a snapshot of the Company's resources and loads and guidance for future resource acquisitions. The resultant Preferred Resource Strategy (PRS) is a mix of wind generation, energy efficiency, upgrades at existing generation and distribution facilities, and new gas-fired generation.

The PRS balances cost, reliability, rate volatility, and renewable resource requirements. Avista's management and the Technical Advisory Committee (TAC) stakeholders play a central role in guiding the development of the PRS and the IRP as a whole by providing significant input on modeling and planning assumptions, and the general direction of the planning process. TAC members include customers, commission staff, the Northwest Power and Conservation Counsel, consumer advocates, academics, utility peers, government agencies, and interested internal parties.

Resource Needs

Plant upgrades and conservation measures are an integral part of Avista's 2011 IRP resource strategy, but they are ultimately inadequate to meet all expected future load growth. Absent new resource additions or new conservation measures, annual energy deficits begin in 2020, with loads and a planning margin exceeding resource capability by 49 aMW. Energy deficits rise to 218 aMW in 2026 and 475 aMW in 2031. Absent new resource additions or new conservation measures, the Company will be short 98 MW of summer capacity in 2019.[1] In 2026 and 2031, capacity deficits rise to 352 MW and 774 MW, respectively. Winter capacity deficits begin at 42 MW in 2020 and increase to 401 MW in 2026 and 883 MW in 2031.[2]

Increasing deficits are a result of forecasted 1.6 percent energy and capacity load growth through 2031. The expiration of long-term purchase and sale contracts on a net basis also increases deficiencies. Figures 1 through 3 provide graphical representations of projected load and resource balances before the addition of PRS resources. The vertical bars in the figures show Avista's resource mix including hydroelectric, baseload thermal resources (such as Colstrip and Coyote Springs 2), peaking thermals (such as Northeast and Rathdrum), and net market transactions (includes long-term purchases and sales plus our expected short-term market transactions). The lower lines in the figures represent the load forecast and the upper lines include the load forecast plus a planning margin and operating reserves. The load forecast uses sustained 18-hour peaks.[3] The forecasted needs would be higher absent energy efficiency acquisitions. A more thorough discussion of loads and resources position is in Chapter 2.

[1] This position assumes Avista relies on its share of regional power surpluses through 2021 as identified by the Northwest Power and Conservation Council and documented further in Chapter 2.
[2] Ibid.
[3] The 18-hour sustained peak metric assumes six peak hours for three days in a row.

Figure 1: Load-Resource Balance—Winter 18 Hour Capacity

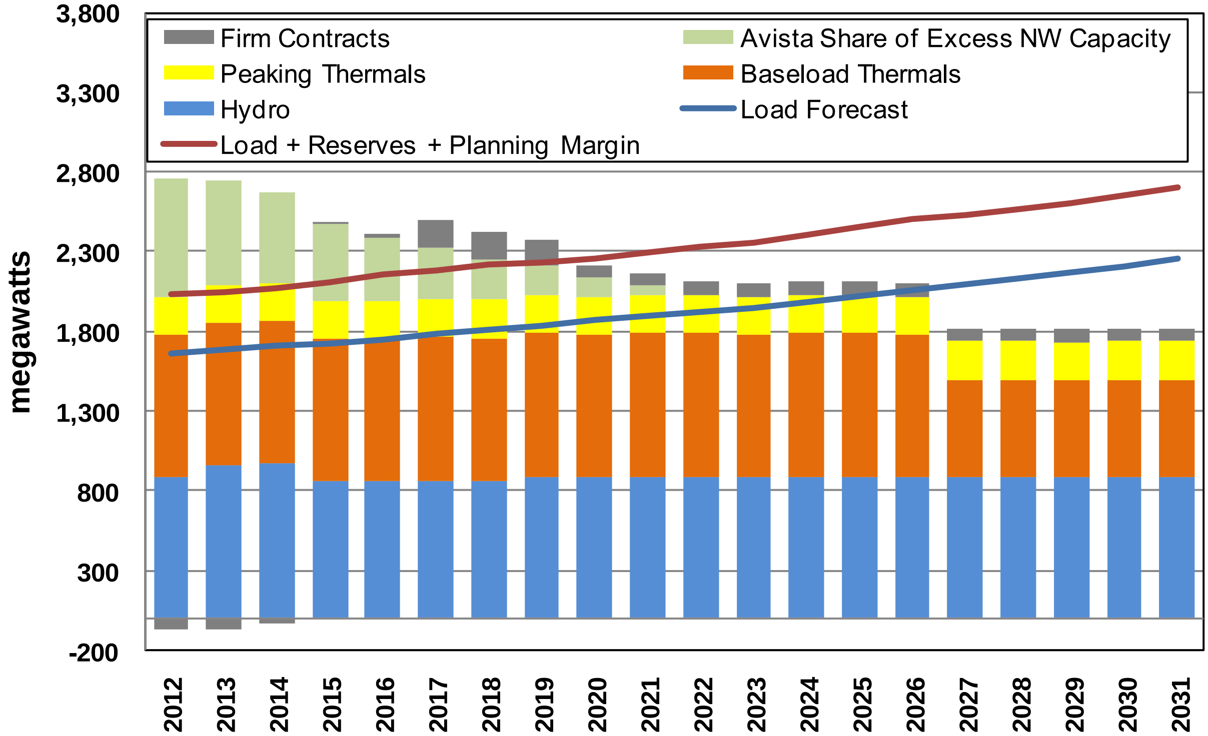


Figure 2: Load-Resource Balance—Summer 18 Hour Capacity

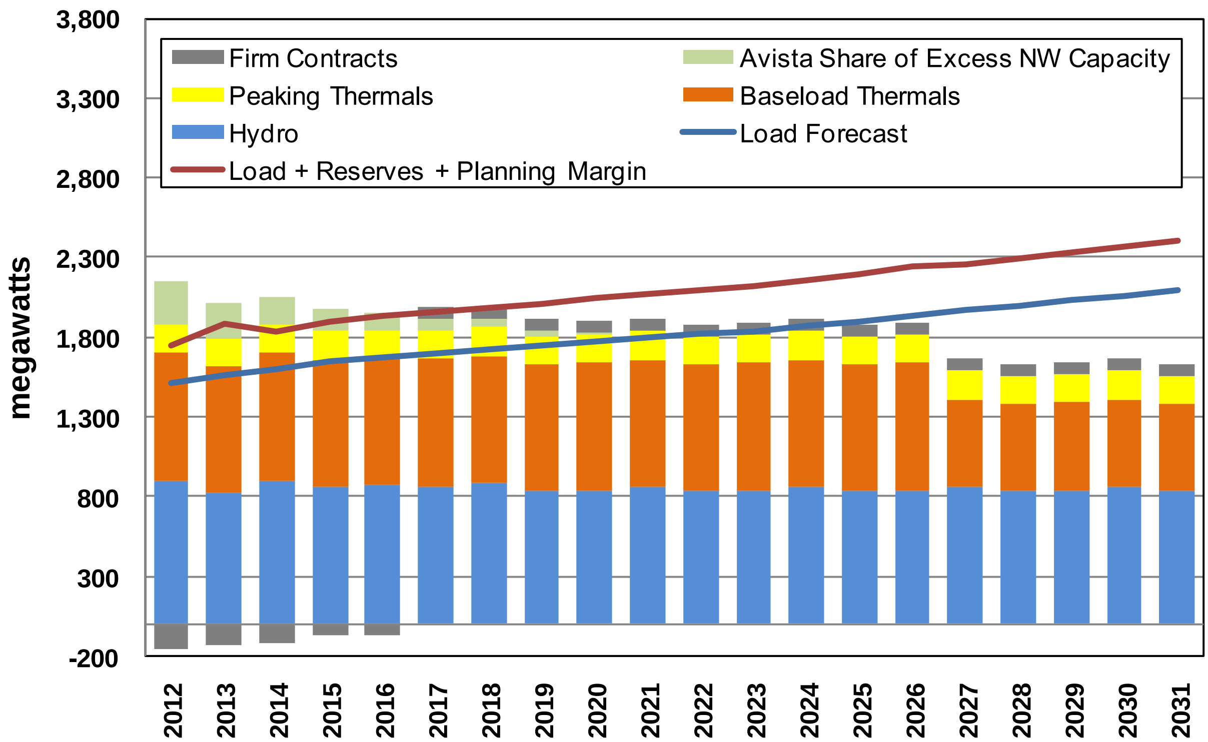
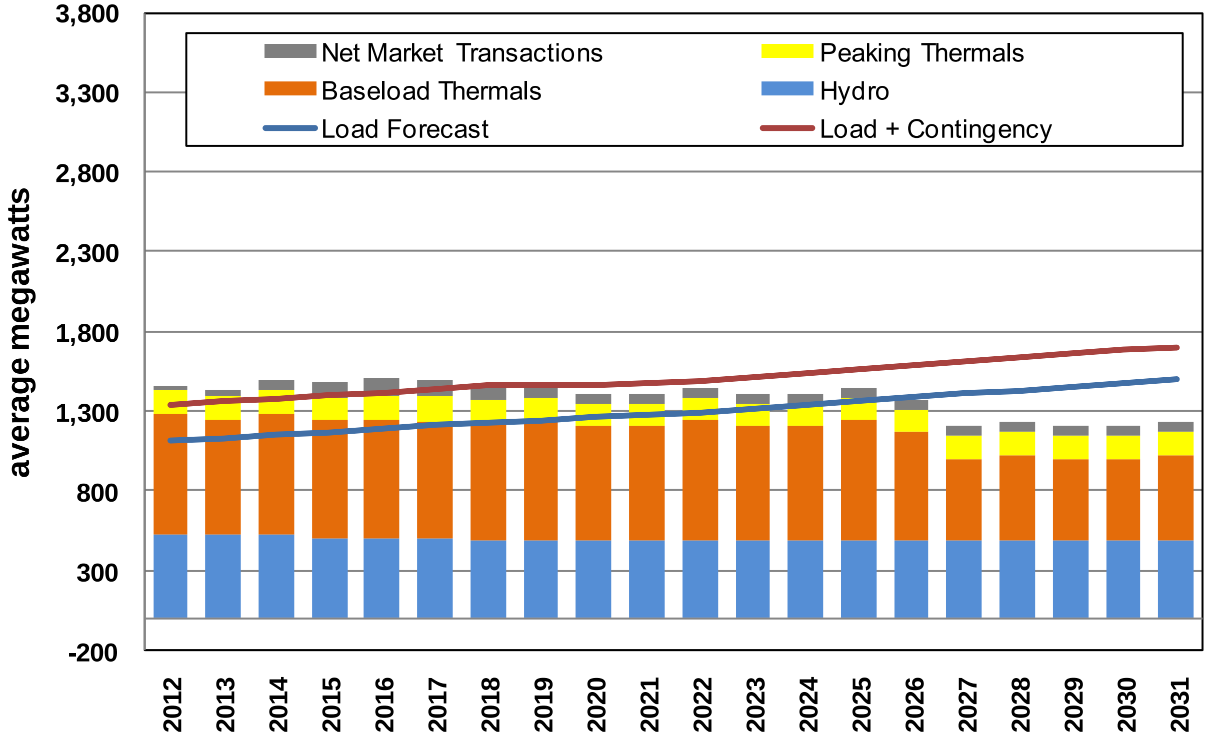


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 13 of 1069

Figure 3: Load-Resource Balance—Energy



Modeling and Results

Avista uses a multiple-step approach to develop its Preferred Resource Strategy. It begins by identifying and quantifying potential new generation resources to serve projected demand needs across the West. A Western Interconnect-wide study explains the impact of regional markets on the Northwest electricity marketplace. Avista then maps its existing resources to the present transmission grid configuration in a model simulating hourly operations for the Western Interconnect from 2012 to 2031.

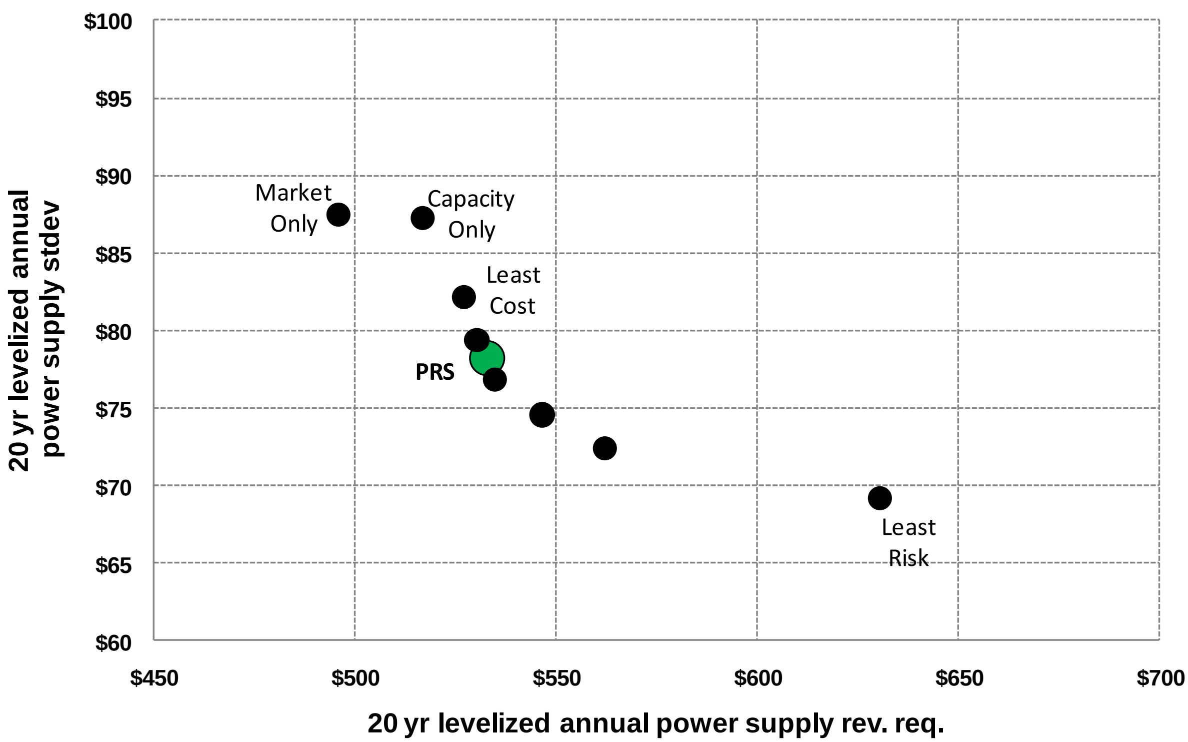
The model adds cost-effective new resources and transmission to meet growing loads. Monte Carlo-style analysis varies hydroelectric generation, wind generation, load, forced outages, greenhouse gas emission cost estimates, and natural gas price data over 500 iterations of potential future market conditions. The simulation estimates Mid-Columbia electricity markets, and the iterations collectively form the IRP Expected Case.

Each new resource and energy efficiency option is valued against the Expected Case Mid-Columbia electricity market to identify its future value to the Company, as well as its inherent risk measured as year-to-year cost volatility. These values, and their associated capital and fixed operation and maintenance (O&M) costs, form the input into Avista's Preferred Resource Strategy Linear Programming Model (PRiSM). PRiSM assists the Company by developing optimal mixes of new resources at each point on an efficient frontier.[4] The PRS provides a "least reasonable cost" portfolio that simultaneously minimizes future costs and risks given legislatively mandated or expected future environmental constraints. An efficient frontier helps determine the

[4] See Chapter 8 for a detailed discussion of the efficient frontier concept.

tradeoffs between risk and cost. The approach is similar to finding an optimal mix of risk and return when developing a personal investment portfolio. As expected returns increase, so do risks. Reducing risk reduces overall returns. Identifying the PRS is similar to an investor's dilemma. There is a trade-off between power supply costs and power supply cost variability. Figure 4 presents the change in cost and risk from the PRS on the Efficient Frontier. Lower power cost variability comes from investment in more expensive, but less risky, resources. The PRS selection is the location on the efficient frontier where the increased cost justified the reduction in risk.

Figure 4: Efficient Frontier

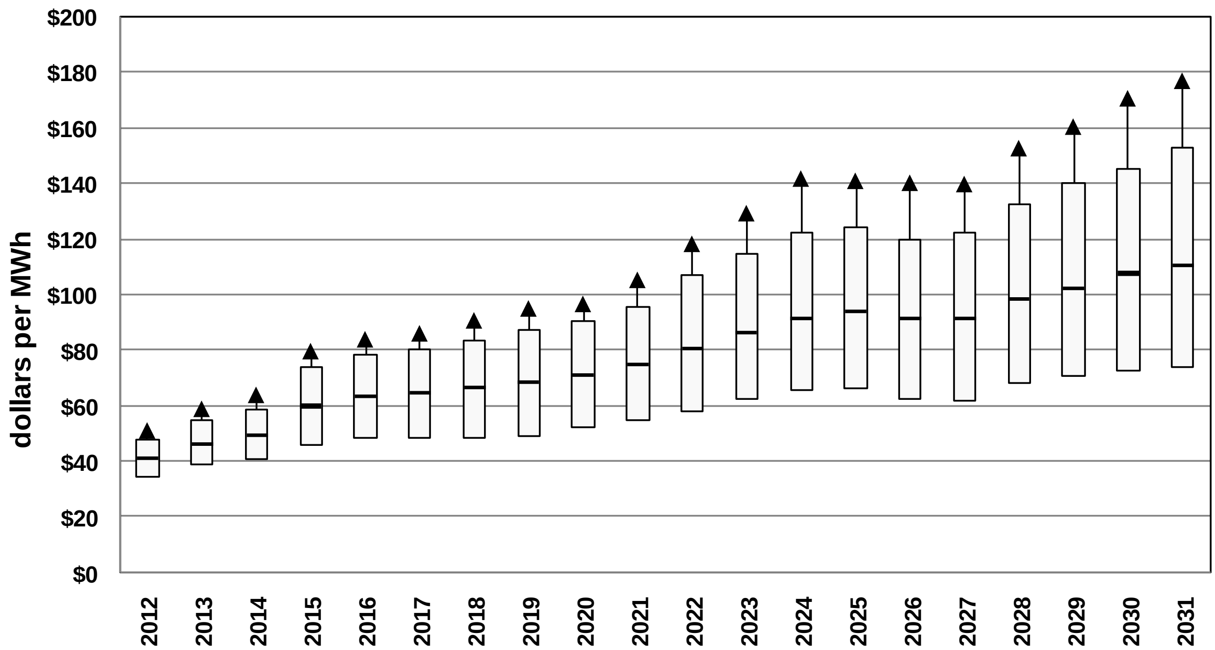


The IRP includes several scenarios that help identify tipping points where the PRS could change under alternative conditions to the Expected Case. Chapter 8 includes scenarios for load growth, capital costs, higher energy efficiency acquisitions, and greenhouse gas policies.

Electricity and Natural Gas Market Forecasts

Figure 5 shows the 2011 IRP electricity price forecast in the Expected Case, including the modeled range of prices over the 500 Monte Carlo iterations described previously. The forecasted levelized average Mid-Columbia market price is $70.50 per MWh in nominal dollars over the next 20 years; the off-peak price is $63.94 per MWh and the on-peak price is $75.42 per MWh. These prices include the market impacts of greenhouse gas mitigation beginning in 2015.[5]

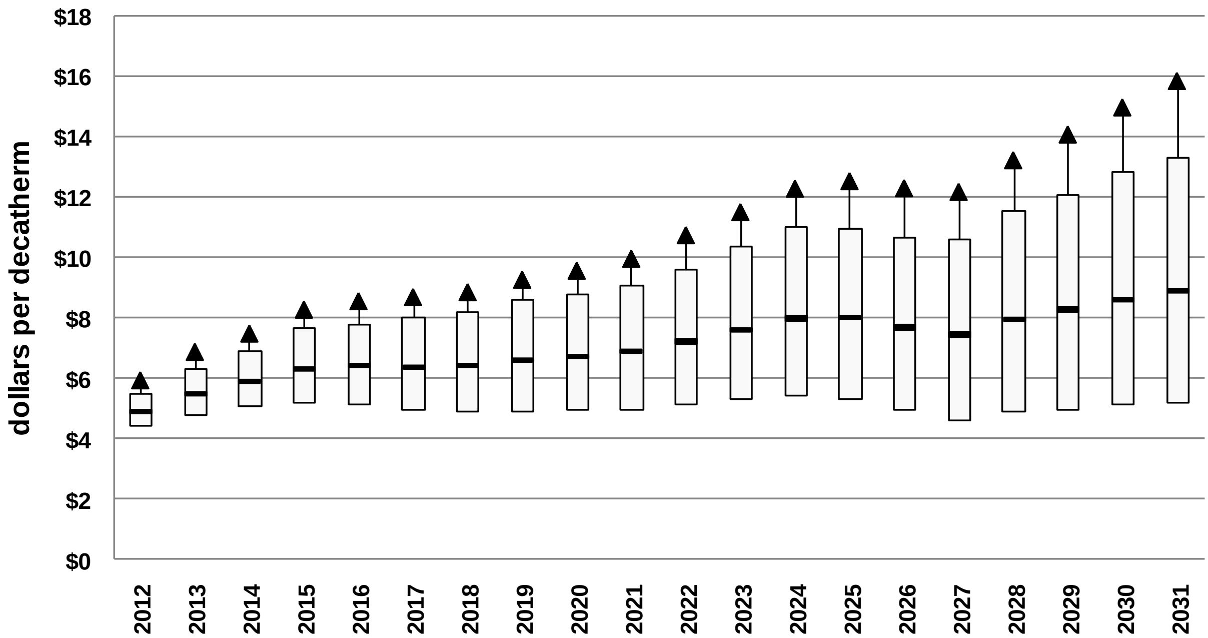
Figure 5: Average Mid-Columbia Electricity Price Forecast



Electricity and natural gas prices are highly correlated because natural gas fuels marginal generation resources in the northwest during most of the year. Figure 6 presents nominal levelized Expected Case natural gas prices at Henry Hub, as well as the range of forecasts from the 500 Monte Carlo iterations performed for the case. The average is $6.70 per decatherm over the next 20 years. See Chapter 7 for more detail on the Company's natural gas price forecast.

[5] The forecast assumes a western region reduction of 14 percent by 2032.

Figure 6: Henry Hub Natural Gas Price Forecast



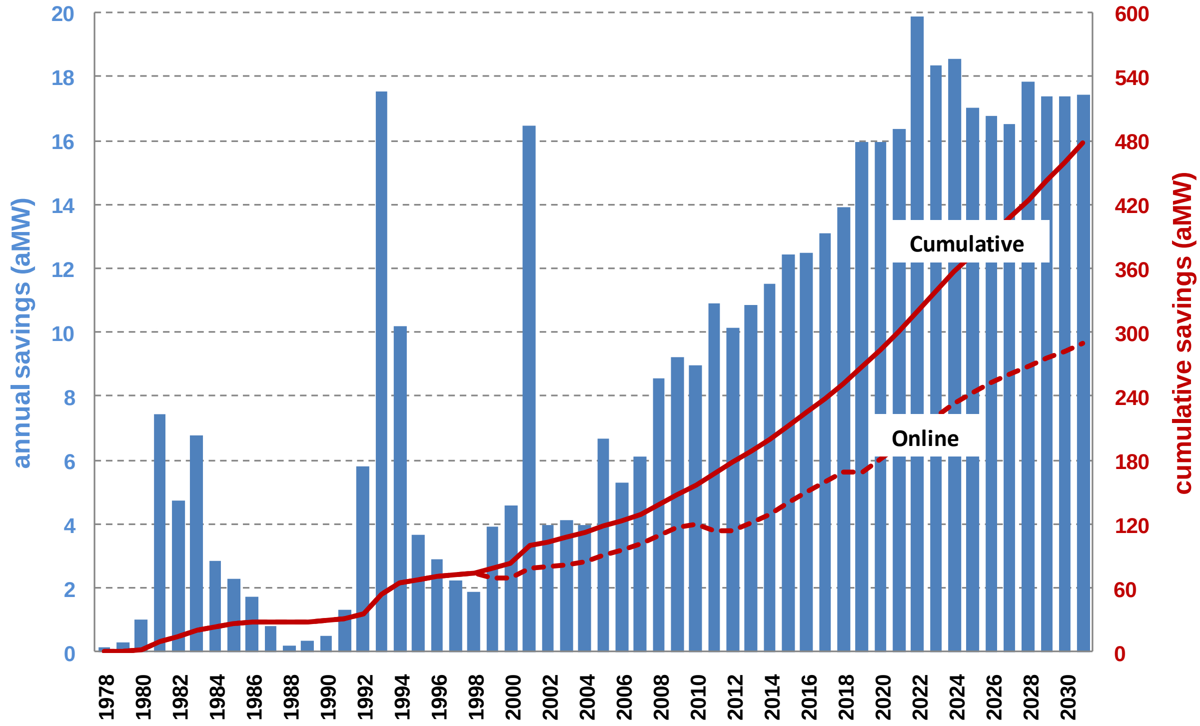
Energy Efficiency Acquisition

Avista commissioned a 20-year Conservation Potential Assessment in 2010. The study analyzed over 4,300 equipment and measure options for residential, commercial, and industrial applications. Data from this study formed the basis of the IRP conservation potential evaluations. Figure 7 shows how energy efficiency decreases Avista's energy requirements by 120.2 aMW, or approximately ten percent.[6] By 2031, energy efficiency reduces load by 310 aMW (288 aMW net after measure life expectancy adjustments). More detail about Avista's energy efficiency programs is contained in Chapter 3.

[6] The Company has acquired 156.3 aMW of conservation since 1978; however, the assumed 18-year average life of the conservation portfolio means that some of the measures have reached the end of their useful lives and are no longer reducing loads. The 18-year assumed life of measures accounts for the difference between the Gross and Net lines in Figure 7.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 17 of 1069

Figure 7: Cumulative Conservation Acquisitions

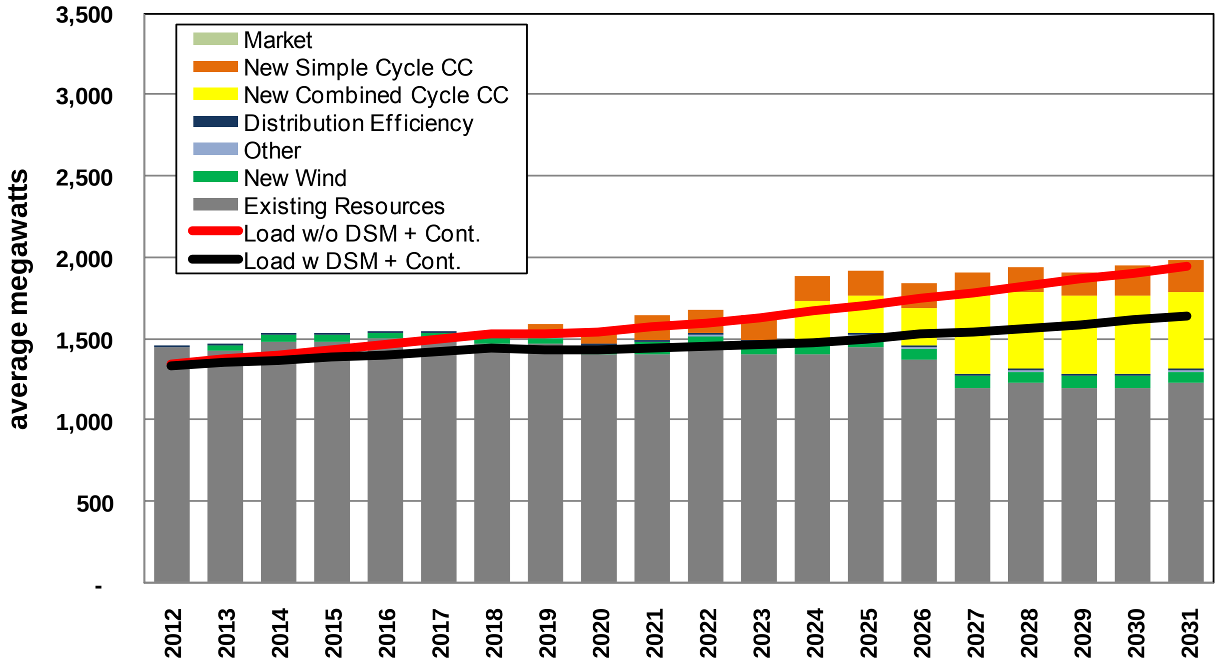


Preferred Resource Strategy

The PRS includes careful consideration by Avista's management and the Technical Advisory Committee of the information gathered and analyzed in the IRP process. It meets future load growth with efficiency upgrades at existing generation and distribution facilities, conservation, wind, and simple- and combined-cycle natural gas-fired combustion turbines. Figure 8 displays the resource mix for the 2011 Preferred Resource Strategy layered on top of Avista's current resources.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 18 of 1069

Figure 8: 2011 Preferred Resource Strategy (Annual Average Energy)



The PRS has changed only modestly from the 2009 IRP. The PRS resources of both the 2009 and 2011 IRPs, on a nameplate capacity basis, are in Tables 1 and 2 below.

Table 1: The 2011 Preferred Resource Strategy

Resource	By the End of Year	Nameplate (MW)	Energy (aMW)
NW Wind	2012	120	35
SCCT	2018	83	75
Existing Thermal Resource Upgrades	2019	4	3
NW Wind	2019-2020	120	35
SCCT	2020	83	75
CCCT	2023	270	237
CCCT	2026	270	237
SCCT	2029	46	42
Total		**996**	**739**
Efficiency Improvements	**By the End of Year**	**Peak Reduction (MW)**	**Energy (aMW)**
Distribution Efficiencies	2012-2031	28	13
Energy Efficiency	2012-2031	419	310
Total		**447**	**323**

Table 2: The 2009 Preferred Resource Strategy

Resource	By the End of Year	Nameplate (MW)	Energy (aMW)
Northwest Wind	2012	150	48
Little Falls Unit Upgrades	2013-2016	3	1
Northwest Wind	2019	150	50
Combined-Cycle Combustion Turbine	2019	250	225
Upper Falls	2020	2	1
Northwest Wind	2022	50	17
Combined-Cycle Combustion Turbine	2024	250	225
Combined-Cycle Combustion Turbine	2027	250	225
Total		**1,105**	**792**
Efficiency Improvements	**By the End of Year**	**Peak Reduction (MW)**	**Energy (aMW)**
Distribution Efficiencies	2010-2015	5	3
Energy Efficiency	2010-2029	339	226
Total		**344**	**229**

The present value of the investment required to support the 2011 PRS is just over $0.84 billion; the nominal total capital expense is $1.7 billion over the IRP timeframe. Avista also forecasts spending $1.4 billion over the IRP timeframe on conservation acquisitions.

Greenhouse Gas Emissions

As with all Avista IRPs since 2007, the costs of greenhouse gas policies are included in the Expected Case for this IRP. Since the 2009 IRP, less certainty exists around the direction of future of greenhouse gas policies. To address this uncertainty, the 2011 IRP considers four policies. Each represents a different policy alternative beginning in 2015. The policies are: 1) a regional cap and trade regime, 2) a national cap and trade regime, 3) a national carbon tax, and 4) the absence of any greenhouse gas policy. The impacts of greenhouse gas policies on the Expected Case are the result of a weighted average of these policies as included in the stochastic analysis of the IRP. Figure 9 presents emissions cost assumptions on a per-short ton basis.

Figure 9: Projected Price of Greenhouse Gas Emissions

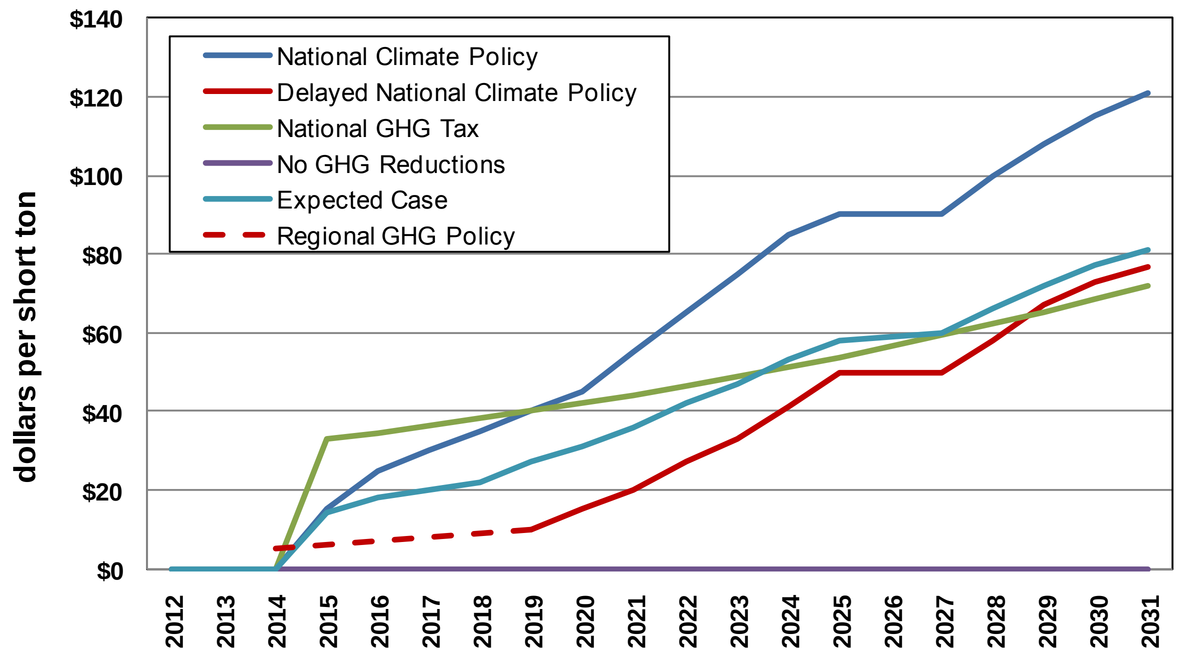
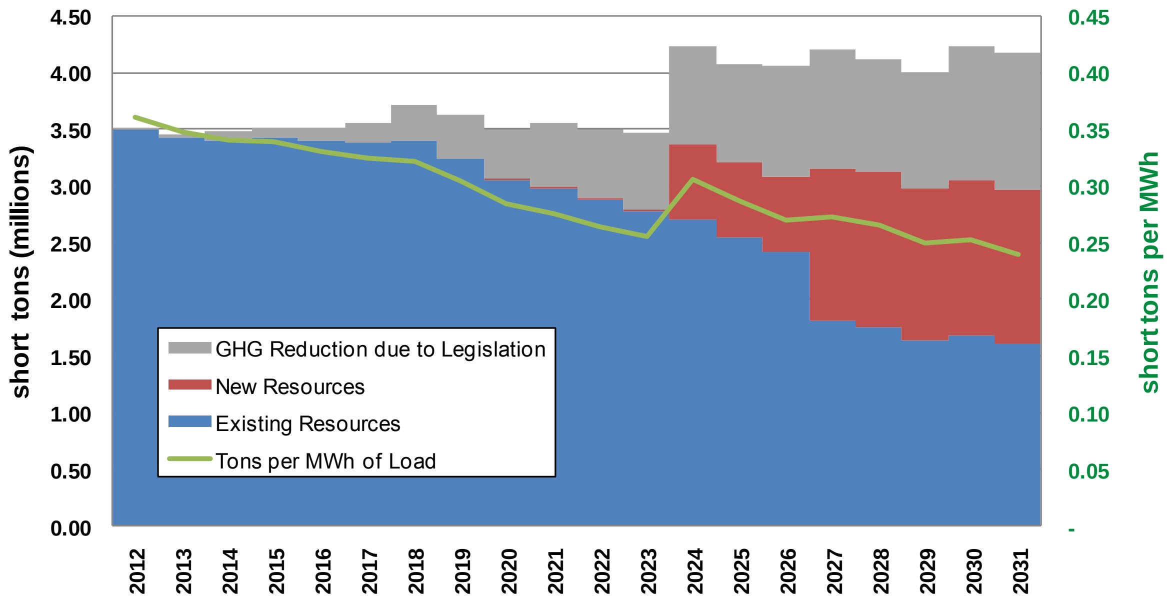


Figure 10 shows projected greenhouse gas emissions for existing and new Avista generation assets.[7] The grey area of Figure 10 represents incremental greenhouse gas emissions where there is no national or regional greenhouse gas policy.[8]

[7] Figure 10 does not include emissions from market or contract purchases. It also does not reduce Company emissions commensurate with market or contract sales.
[8] Existing Avista resources, and those selected to meet load growth, under a scenario without a greenhouse gas policy likely would generate higher emissions due primarily to increased operation at Colstrip.

Figure 10: Avista Owned and Controlled Resource's Greenhouse Gas Emissions



Action Items

The Company's 2011 Action Plan outlines activities and studies between now and the 2013 Integrated Resource Plan. It includes input from Commission Staff, the Company's management team, and the Technical Advisory Committee. Action Item categories include resource additions and analysis, demand side management, environmental policy, modeling and forecasting enhancements, and transmission planning. Chapter 9 contains 2011 IRP Action Items.

1. Introduction and Stakeholder Involvement

Avista Utilities submits a biennial Integrated Resource Plan (IRP) to the Idaho and Washington public utility commissions.[1] The 2011 IRP is Avista's twelfth plan. It identifies and describes a Preferred Resource Strategy (PRS) for meeting load growth while balancing cost and risk measures with environmental mandates.

The Company is statutorily obligated to provide reliable electricity service to its customers at rates, terms, and conditions that are just, reasonable, and sufficient. Avista assesses different resource acquisition strategies and business plans to acquire resources to meet resource adequacy requirements and optimize the value of its current resource portfolio. We use the IRP as a resource evaluation tool rather than a plan for acquiring a particular set of assets. The 2011 IRP continues refining our resource acquisition efforts.

IRP Process

The 2011 IRP is developed and written with the aid of a public process. Avista actively seeks input for its IRPs from a variety of constituents through the Technical Advisory Committee (TAC). The TAC list of 75 individuals includes Commission Staff from Idaho and Washington, customers, academics, government agencies, consultants, utilities, and other interested parties who accepted an invitation to join, or had asked to be involved in, the planning process.

The Company sponsored six TAC meetings for the 2011 IRP. The first meeting was on May 27, 2010, and the last was on June 23, 2011. TAC meetings covered different aspects of the 2011 IRP planning activities and solicited contributions to, and assessments of, modeling assumptions, modeling processes, and results. Table 1.1 contains a list of TAC meeting dates and the agenda items covered in each meeting.

[1] Washington IRP requirements are contained in WAC 480-100-238 Integrated Resource Planning. Idaho IRP requirements are outlined in Case No. U-1500-165 Order No. 22299, Case No. GNR-E-93-1, Order No. 24729, and Case No. GNR-E-93-3, Order No. 25260.

Table 1.1: TAC Meeting Dates and Agenda Items

Meeting Date	Agenda Items
TAC 1 – May 27, 2010	• Work Plan • Load & Resource Balance Update • Resource Planning Environment • 2011 IRP Topic Discussions – Analytical Process Changes, Hydro Modeling, Resource Adequacy, Loss of Load Probability, Energy Efficiency and Scoping the 2011 Plan
TAC 2 – September 8 and 9, 2010	• Lancaster Plant Tour • Upper Falls and Monroe Street Tour • Resource Assumptions • Reliability Planning • Sustainability Report • Combined Heat and Power Generation • Energy Efficiency
TAC 3 – December 2, 2010	• Transmission Costs and Issues • Potential Hydro Upgrades • Potential Thermal Upgrades • Load Forecast • Stochastic Modeling
TAC 4 – February 3, 2011	• Natural Gas Price Forecast • Electric Price Forecast • Resource Requirements Projections • Portfolio and Market Scenario Planning
TAC 5 – April 12, 2011	• Conservation Avoided Cost Methodology • Conservation • Smart Grid • Draft Preferred Resource Strategy • Portfolio Alternatives & Scenarios
TAC 6 – June 23, 2011	• High Wind Market Analysis • Preferred Resource Strategy and Scenario Analysis • IRP Action Items • IRP Section Highlights

Agendas and presentations from the TAC meetings are in Appendix A and on Avista's website at http://www.avistautilities.com/inside/resources/irp/electric. Past IRPs and TAC presentations are also here.

Avista wishes to acknowledge the contributions of a number of external TAC participants in Table 1.2.

Table 1.2: External Technical Advisory Committee Participants

Participant	Organization
Robin Toth	Greater Spokane Inc.
Dave Van Hersett	Resource Development Associates
John Dacquisto	Gonzaga University
Deborah Reynolds	Washington Utilities and Transportation Commission
Steve Johnson	Washington Utilities and Transportation Commission
David Nightingale	Washington Utilities and Transportation Commission
Rick Applegate	Washington Utilities and Transportation Commission
Nancy Hirsch	Northwest Energy Coalition
Kirsten Wilson	Washington State General Administration
Rick Sterling	Idaho Public Utilities Commission
Tom Noll	Idaho Power
Ken Corum	Northwest Power and Conservation Council
Keith Knitter	Grant County Public Utilities District
Becky King	Chelan County Public Utilities District
Villamour Gamponia	Puget Sound Energy
Kevin Rasler	Inland Empire Paper
Mike Connolley	Idaho Forest Group
Rob Haneline	McKinstry

Issue Specific Public Involvement Activities

In addition to the TAC meetings, Avista sponsors and participates in several other collaborative processes involving a range of public interests.

External Energy Efficiency ("Triple E") Board

The Triple E Board, formed in 1995, provides stakeholders and public groups biannual opportunities to discuss Avista's energy efficiency efforts. The Triple E Board grew out of the DSM Issues group. This predecessor group was influential in developing the country's first conservation distribution surcharge in 1995.

FERC Hydro Relicensing – Clark Fork River Projects

Over 50 stakeholder groups participated in the Clark Fork hydro-relicensing process beginning in 1993. This led to the first all-party settlement filed with a FERC relicensing application, and eventual issuance of a 45-year FERC operating license in February 2003. The nationally recognized Living License concept was a result of this process. This collaborative process continues in the implementation phase of the Living License, with stakeholders participating in various protection, mitigation, and enhancement efforts at the projects.

Low Income Rate Assistance Program (LIRAP)

LIRAP is coordinated with four community action agencies in Avista's Washington service territory. The program began in 2001 and reviews administrative issues and needs on a quarterly basis.

Regional Planning

The Pacific Northwest's generation and transmission system is operated in a coordinated fashion. Avista participates in the efforts of many organization's planning processes. Information from this participation supplements Avista's IRP process. Some of the organizations that Avista participates in are:

- Western Electricity Coordinating Council
- Northwest Power and Conservation Council
- Northwest Power Pool
- Pacific Northwest Utilities Conference Committee
- ColumbiaGrid
- Northwest Transmission Assessment Committee
- North American Electric Reliability Council

Future Public Involvement

As explained above, Avista actively solicits input from interested parties to enhance its IRP process. We continue to expand TAC membership and diversity, and maintain the TAC meetings as an open public process.

2011 IRP Outline

The 2011 IRP consists of nine chapters plus an executive summary and this introduction. A series of technical appendices supplement this report.

Executive Summary

This chapter summarizes the overall results and highlights of the key results of the 2011 IRP.

Chapter 1: Introduction and Stakeholder Involvement

This chapter introduces the IRP and details public participation and involvement in the integrated resource planning process.

Chapter 2: Loads and Resources

The first half of this chapter covers Avista's load forecast and related local economic forecasts. The last half describes the Company's owned generating resources, major contractual rights and obligations, capacity, energy and renewable energy credit tabulations, and reserve obligations.

Chapter 3: Energy Efficiency

This chapter discusses Avista's energy efficiency programs. It provides an overview of the conservation potential assessment and summarizes the energy efficiency modeling results for the 2011 IRP.

Chapter 4: Policy Considerations

This chapter focuses on some of the major policy issues for resource planning, such as state and federal greenhouse gas policies and environmental regulations.

Chapter 5: Transmission & Distribution

This chapter discusses Avista's distribution and transmission systems, as well as regional transmission planning issues. The chapter includes detail on transmission cost studies used in the IRP modeling, including a summary of our 10-year Transmission Plan. The chapter includes a discussion of Avista's distribution efficiency and grid modernization projects.

Chapter 6: Generation Resource Options

This chapter covers the costs and operating characteristics of the generation resource options modeled for the 2011 IRP.

Chapter 7: Market Analysis

This chapter details Avista's modeling and analysis of the various wholesale markets applicable to the 2011 IRP.

Chapter 8: Preferred Resource Strategy

This chapter details Avista's 2011 Preferred Resource Strategy (PRS) and explains how the PRS could change in response to scenarios differing from the Expected Case.

Chapter 9: Action Items

This chapter provides an overview of the progress made on Action Items from the 2009 IRP. It details new Action Items to start and/or complete between the issuance of the 2011 IRP and prior to the 2013 IRP.

Regulatory Requirements

The IRP process for Washington has several requirements documented in Washington Administrative Code (WAC). Table 1.3 summarizes where within the IRP the applicable WACs are addressed.

Table 1.1 Washington IRP Rules and Requirements

Rule and Requirement	Plan Citation
WAC 480-100-238(4) – Work plan filed no later than 12 months before next IRP due date. Work plan outlines content of IRP. Work plan outlines method for assessing potential resources.	Work plan submitted to the UTC on August 31, 2010; see Appendix B for a copy of the Work Plan.
WAC 480-100-238(5) – Work plan outlines timing and extent of public participation.	Appendix B
WAC 480-100-238(2)(a) – Plan describes mix of energy supply resources.	Chapter 6- Generation Resource Options
WAC 480-100-238(2)(a) – Plan describes conservation supply.	Chapter 3- Energy Efficiency
WAC 480-100-238(2)(a) – Plan addresses supply in terms of current and future needs of utility ratepayers.	Chapter 2- Loads & Resources
WAC 480-100-238(2)(b) – Plan uses lowest reasonable cost (LRC) analysis to select mix of resources.	Chapter 8- Preferred Resource Strategy
WAC 480-100-238(2)(b) – LRC analysis considers resource costs.	Chapter 8- Preferred Resource Strategy
WAC 480-100-238(2)(b) – LRC analysis considers market-volatility risks.	Chapter 4- Policy Considerations Chapter 7- Market Analysis Chapter 8- Preferred Resource Strategy
WAC 480-100-238 (2)(b) – LRC analysis considers demand side uncertainties.	Chapter 3- Energy Efficiency
WAC 480-100-238(2)(b) – LRC analysis considers resource dispatchability.	Chapter 6- Generation Resource Options Chapter 7- Market Analysis
WAC 480-100-238(2)(b) – LRC analysis considers resource effect on system operation.	Chapter 7- Market Analysis Chapter 8- Preferred Resource Strategy

WAC 480-100-238(2)(b) – LRC analysis considers risks imposed on ratepayers.	Chapter 4- Policy Considerations Chapter 6- Generation Resource Options Chapter 7- Market Analysis Chapter 8- Preferred Resource Strategy
WAC 480-100-238(2)(b) – LRC analysis considers public policies regarding resource preference adopted by Washington state or federal government.	Chapter 2- Loads & Resources Chapter 4- Policy Considerations Chapter 8- Preferred Resource Strategy
WAC 480-100-238(2)(b) – LRC analysis considers cost of risks associated with environmental effects including emissions of carbon dioxide.	Chapter 4- Policy Considerations Chapter 8- Preferred Resource Strategy
WAC 480-100-238(2)(c) – Plan defines conservation as any reduction in electric power consumption that results from increases in the efficiency of energy use, production, or distribution.	Chapter 3- Energy Efficiency Chapter 8- Preferred Resource Strategy
WAC 480-100-238(3)(a) – Plan includes a range of forecasts of future demand.	Chapter 2- Loads & Resources Chapter 8- Preferred Resource Strategy
WAC 480-100-238(3)(a) – Plan develops forecasts using methods that examine the effect of economic forces on the consumption of electricity.	Chapter 2- Loads & Resources Chapter 5- Transmission & Distribution Chapter 8- Preferred Resource Strategy
WAC 480-100-238-(3)(a) – Plan develops forecasts using methods that address changes in the number, type and efficiency of end-uses.	Chapter 2- Loads & Resources Chapter 3- Energy Efficiency Chapter 5- Transmission & Distribution
WAC 480-100-238(3)(b) – Plan includes an assessment of commercially available conservation, including load management.	Chapter 3- Energy Efficiency Chapter 5- Transmission & Distribution
WAC 480-100-238(3)(b) – Plan includes an assessment of currently employed and new policies and programs needed to obtain the conservation improvements.	Chapter 3- Energy Efficiency Chapter 5- Transmission & Distribution

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 30 of 1069

WAC 480-100-238(3)(c) – Plan includes an assessment of a wide range of conventional and commercially available nonconventional generating technologies.	Chapter 6- Generator Resource Options Chapter 8- Preferred Resource Strategy
WAC 480-100-238(3)(d) – Plan includes an assessment of transmission system capability and reliability (as allowed by current law).	Chapter 5- Transmission & Distribution
WAC 480-100-238(3)(e) – Plan includes a comparative evaluation of energy supply resources (including transmission and distribution) and improvements in conservation using LRC.	Chapter 3- Energy Efficiency Chapter 5- Transmission & Distribution
WAC-480-100-238(3)(f) – Demand forecasts and resource evaluations are integrated into the long range plan for resource acquisition.	Chapter 3- Energy Efficiency Chapter 5- Transmission & Distribution Chapter 6- Generator Resource Options Chapter 8- Preferred Resource Strategy
WAC 480-100-238(3)(g) – Plan includes a two-year action plan that implements the long range plan.	Chapter 9- Action Items
WAC 480-100-238(3)(h) – Plan includes a progress report on the implementation of the previously filed plan.	Chapter 9- Action Items
WAC 480-100-238(5) – Plan includes description of consultation with commission staff. (Description not required)	Chapter 1- Introduction and Stakeholder Involvement
WAC 480-100-238(5) – Plan includes description of work plan. (Description not required)	Appendix B
WAC 480-107-015(3) – Proposed request for proposals for new capacity needed within three years of the IRP.	Chapter 8- Preferred Resource Strategy

2. Loads & Resources

Introduction & Highlights

An explanation and quantification of Avista's loads and resources are integral to the Integrated Resource Plan (IRP). The first half of this chapter summarizes customer and load forecasts, including forecast ranges, load growth scenarios, and an overview of enhancements to forecasting models and processes. The second half of the chapter covers Avista's current resource mix, including descriptions of owned and operated generation, as well as long-term power purchase contracts.

Section Highlights

- Historic conservation acquisitions are included in the load forecast; higher acquisition levels anticipated in the IRP reduce the load forecast further.
- Annual electricity sales growth from 2012 to 2031 averages 1.6 percent.
- Expected energy deficits begin in 2020, growing to 475 aMW by 2031.
- Expected capacity deficits begin in 2019, growing to 883 MW by 2031.
- Current conservation programs push the need for resources out by two years for energy and six years for capacity.
- Renewable portfolio requirements drive near-term resource needs.

Economic Conditions in Avista's Service Territory

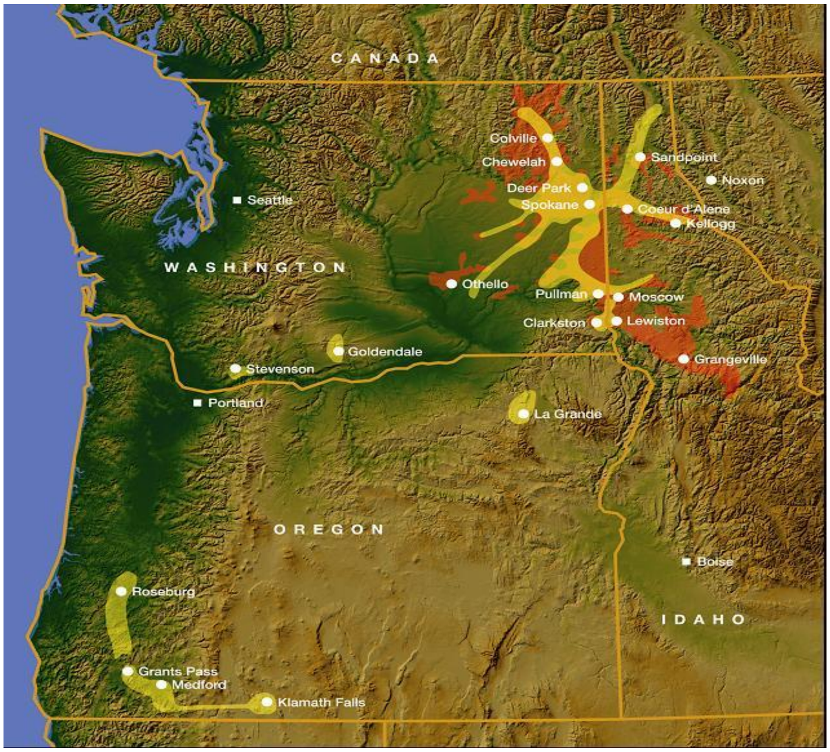
Avista serves electricity customers in most of the urban and suburban areas of 24 counties of eastern Washington and northern Idaho. The service territory is geographically and economically diverse. Figure 2.1 shows the Company's electricity and natural gas service territories.

The Inland Northwest has transformed over the past 25 years, from a natural resource-based manufacturing economy to a diversified light manufacturing and services economy. The United States Forest Service manages a significant portion of the mountainous areas of the region. Reduced timber harvests on federal lands have closed many local sawmills. Two pulp and paper plants served by Avista manage large forest holdings and face stiff domestic and international competition for their products.

Avista's service territory experienced periods of significant unemployment during the two national recessions of the 1980s. The 1991/92 national recession mostly bypassed Avista's service territory, but the 2001 recession greatly affected the area. The IRP Expected Case projects the present recession to end in 2011. The employment data reflects the effects of economic recession and expansion. Avista tracks employment data for the three principal counties in its electricity service territory: Bonner, Kootenai and Spokane.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 32 of 1069

Figure 2.1: Avista's Service Territory and Generation Resources



Population is generally more stable than employment during times of economic change; however, it can contract during severe economic downturns as people leave in search of employment opportunities. Over the past 25 years, the region experienced a net population loss only in 1987. Figure 2.2 details historic and projected annual population changes in Kootenai and Spokane counties. Figure 2.3 shows total population.

Figure 2.2: Population Percent Change for Spokane and Kootenai Counties

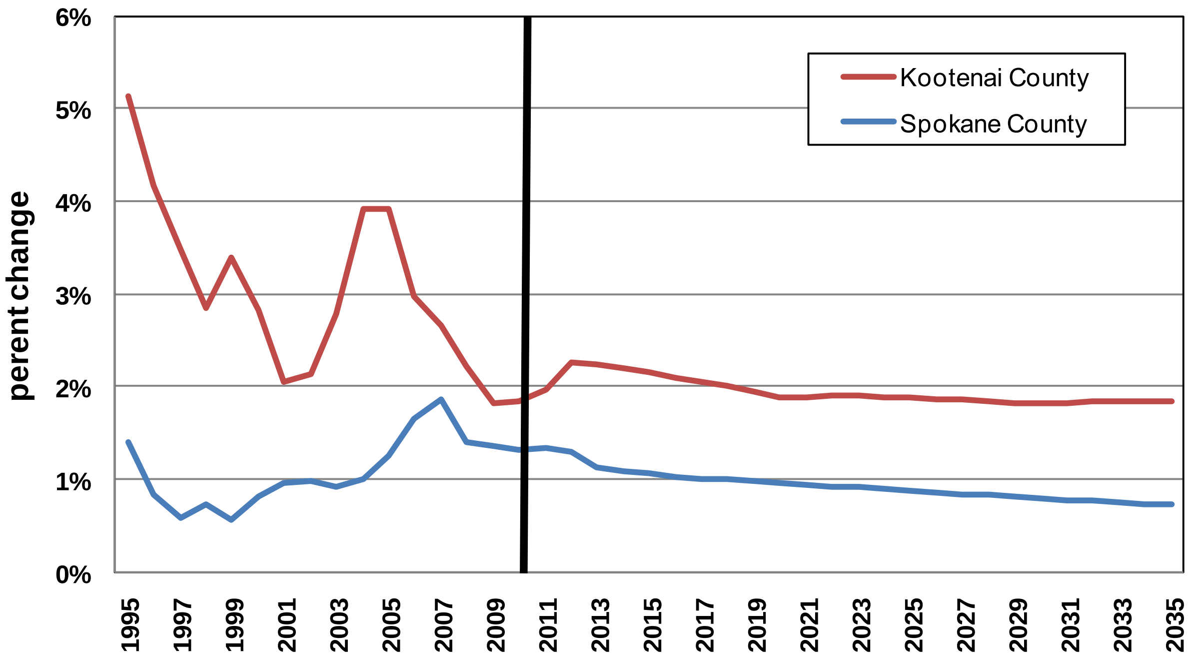
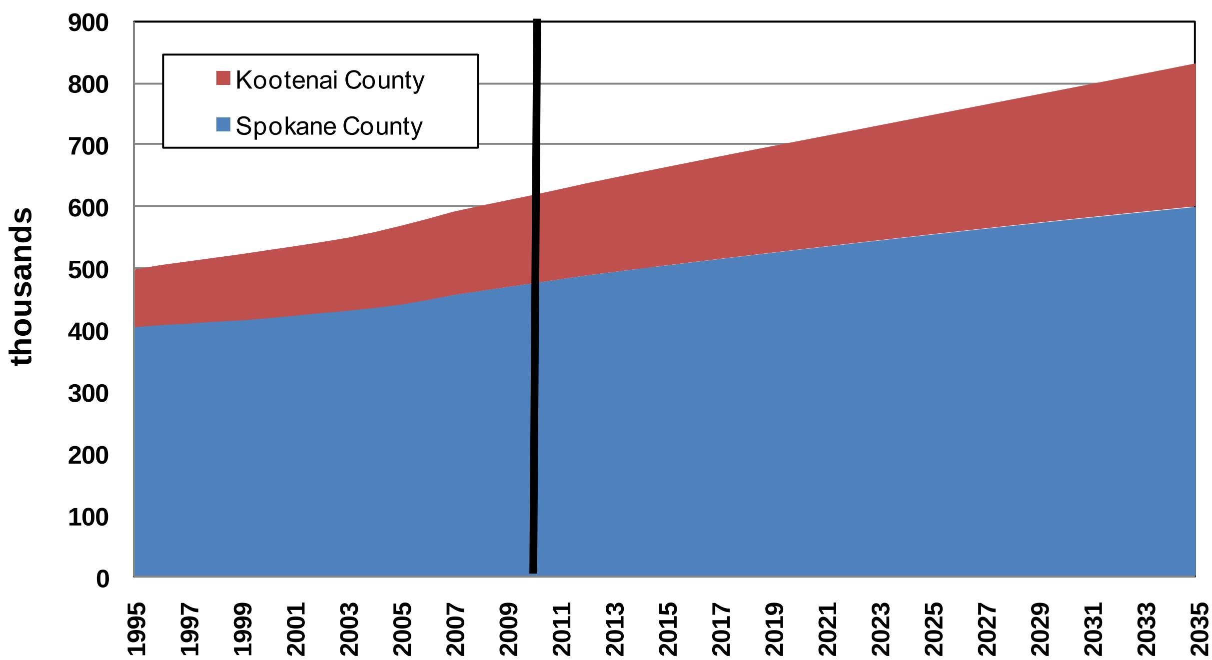


Figure 2.3: Total Population for Spokane and Kootenai Counties



People, Jobs and Customers

The October 2010 IRP forecast relies on an August 2010 national and September 2010 county-level forecasts. The data focus on two counties–Spokane County in Washington, and Kootenai County in Idaho–that comprise more than 80 percent of our service area

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 34 of 1069

economy. Avista purchases the employment and population forecasts from Global Insight, Inc., an internationally recognized economic forecasting consulting firm.

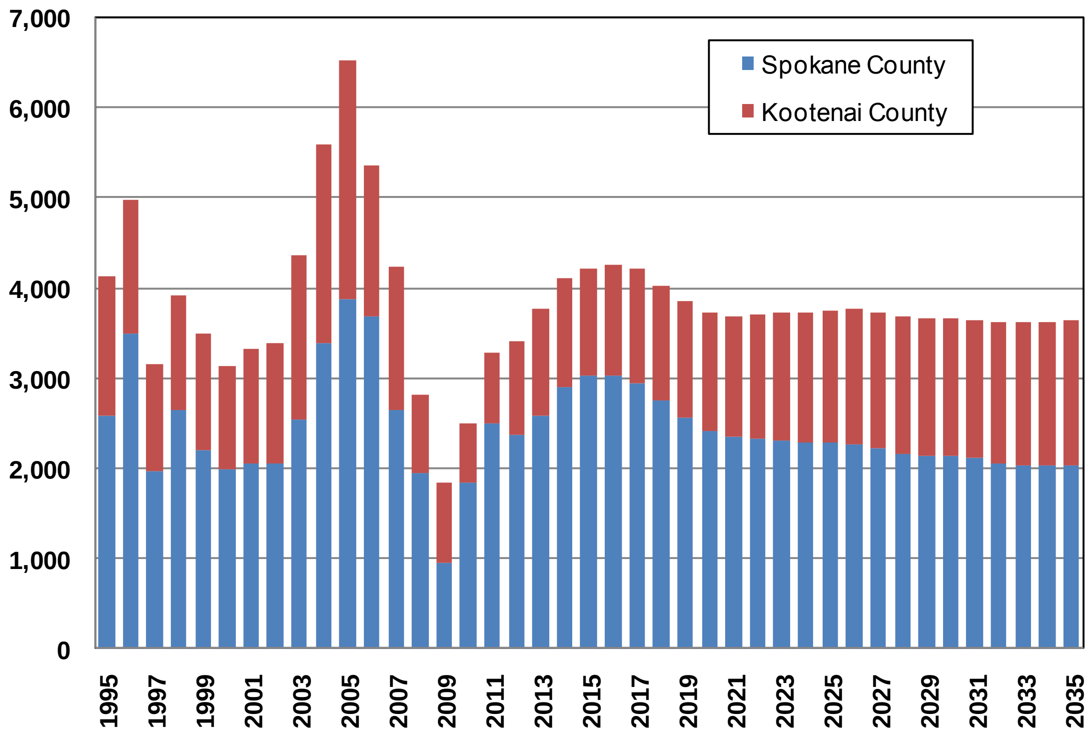
The Third Technical Advisory Committee included sections on the load forecast and its underlying assumptions. Table 2.1 presents the key forecast assumptions presented at that meeting.

Table 2.1: Global Insight National Long Range Forecast Assumptions

Assumption	Average	Assumption	Average
Gross Domestic Product	2.7%	Housing Starts (millions)	1.58/year
Consumer Price Index	1.9%	Job Growth	1.0%/year
Imported Crude 2000$	$70	Worker Productivity	2.0%
Federal Funds Rate	4.75%	Consumer Sentiment	90
Unemployment Rate	5.0%		

In 2010, as part of a revision in materials provided under contract to Avista, Global Insight began producing housing start forecasts consistent with the population and employment forecasts, as shown in Figure 2.4.

Figure 2.4: House Starts Total Private (SAAR)



Employment growth often drives population growth. Figure 2.5 shows historical employment trends from 1995, and forecast growth through 2035. Overall non-farm wage and salary employment over the past 15 years averaged 2.9 percent for Kootenai County and 1.0 percent for Spokane County.

Figure 2.5: Percent Change to Employment

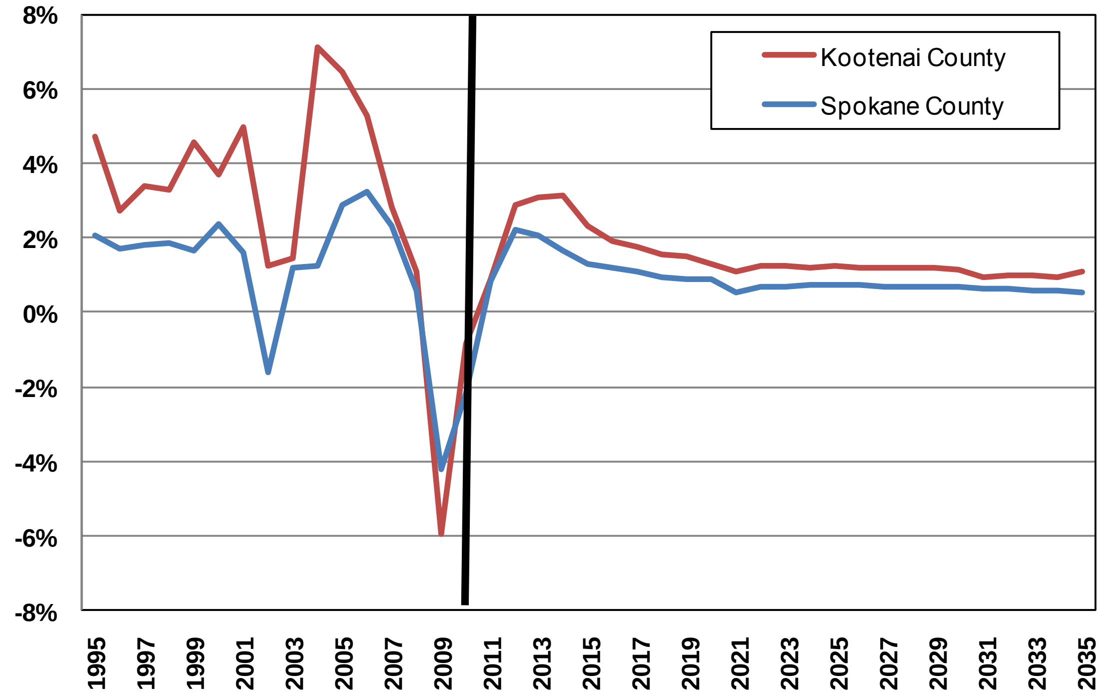
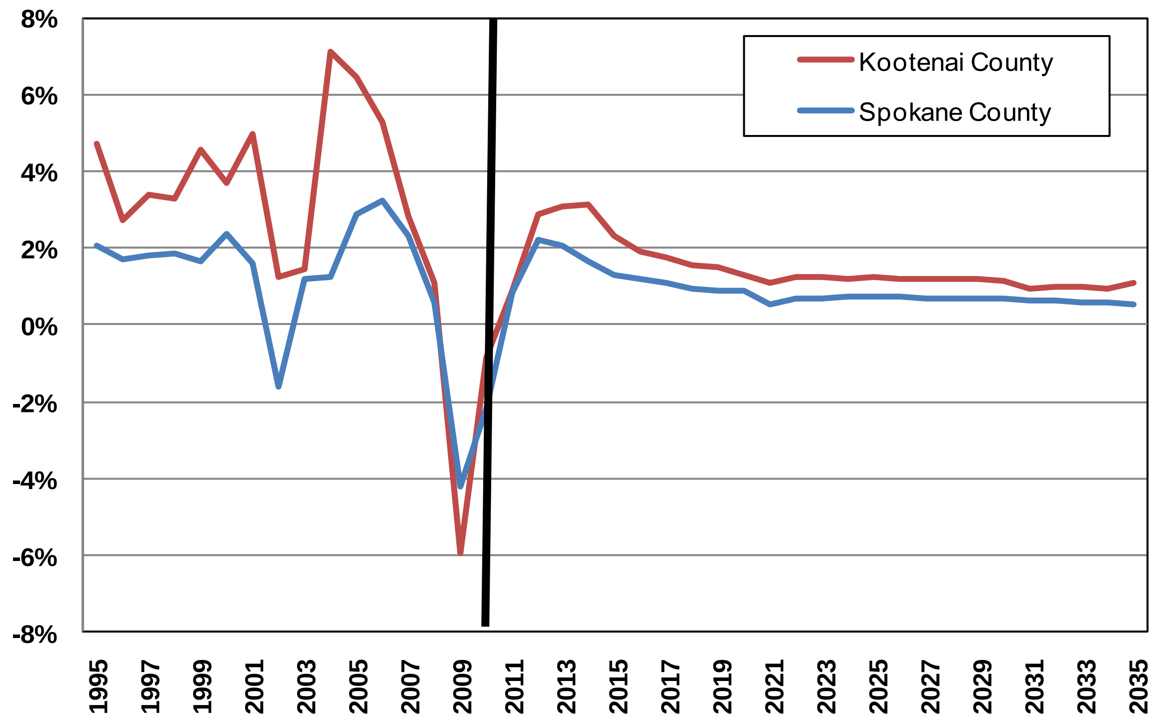


Figure 2.6 provides additional non-farm employment data. Over the forecast period, non-farm employment growth is 1.5 percent and 0.9 percent for Spokane and Kootenai counties, respectively. Employment growth is approximately 3,000 new jobs per year.

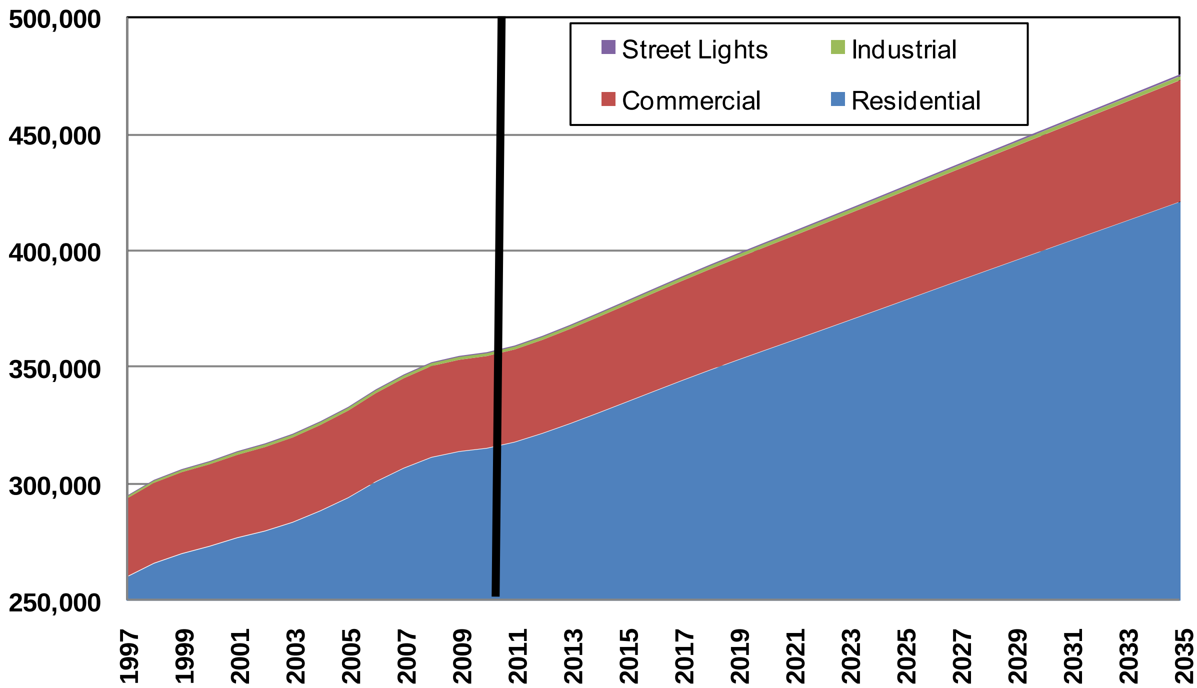
Figure 2.6: Non-Farm Employment



Customer growth projections follow baseline economic forecasts. Employment statistics have the greatest probability of near term change as the region emerges from the recession in 2011. Avista tracks four key customer classes: residential, commercial, industrial, and street lighting. A linear regression using housing starts as the independent variable is the basis for the residential customer forecasts. Commercial forecasts rely on a linear regression of residential growth. Industrial customer growth follows employment growth. Street lighting customer growth is trended with population growth.

Avista forecasts sales by rate schedule. Overall customer forecasts are a compilation of the various rate schedules. For example, the residential class forecast is comprised of separate forecasts prepared for rate schedules 1, 12, 22, and 32 for Washington and Idaho. See Figure 2.7 for annual customer growth levels by rate class.

Figure 2.7: Avista Customer Forecast



On average during calendar 2010, Avista served 356,567 retail customers: 315,275 residential, 39,488 commercial, 1,375 industrial and 449 street lighting. This is a 15 percent increase from 309,871 retail customers in 2000. In 2010, 33.4 percent of residential customers, 42.0 percent of commercial customers, 34.6 percent of industrial customers, and 27.7 percent of street lighting customers were located in Idaho; the balance was located in Washington. The 2035 forecast predicts 474,316 retail customers: 419,739 residential, 52,172 commercial, 1,635 industrial and 770 street lighting. The 25-year compound growth rate averages 1.1 percent, down from 1.7 percent in the 2009 IRP and consistent with a lower population forecast.

Weather Forecasts

The Expected Case electricity sales forecast uses 30-year monthly temperature averages recorded at the Spokane International Airport weather station through 2009. Several other weather stations are located in Avista's service territory, but their data are available for a much shorter duration and high correlations exist between the Spokane International Airport and these weather stations.

Sales forecasts are prepared using monthly data, as more granular load information is not available. Heating degree-days measure cold weather load sensitivity; cooling degree-days measure hot weather load sensitivity.

The load forecast includes projection of climate change impact. Ample evidence of cooling and warming trends exists in the historical record. The recent trend is a warming climate compared to the 30-year average. Avista relies on the University of Washington "Climate Change Scenarios" 2008 study converted to heating and cooling degree-days.[1] This study provides warming to 87.2 percent of the present 30-year average. Cooling degree-days are 144.3 percent.

Price Elasticity

Price elasticity is an important consideration in any electricity demand forecast. It measures the ratio between the demand for electricity and a change in its price. A consumer who is sensitive to price change has a relatively elastic demand profile. A customer who is unresponsive to price changes has a relatively inelastic demand profile. During the 2000-2001 Western Energy Crisis customers displayed increasing price sensitivity and reduced overall usage in response to relatively large changes in the price of electricity.

Cross elasticity of demand, or cross-price elasticity, measures the relationship between the quantities of electricity demanded and to the quantity of potential electricity substitutes (e.g., propane or natural gas for heat) when the price of electricity increases relative to the price of the substitute product. A positive cross elasticity coefficient indicates cross-price elasticity between electricity and the substitute. A negative cross elasticity coefficient indicates the absence of cross-price elasticity, and that considered product is not a substitute for electricity but is instead complementary to it. In other words, an increase in the price of electricity increases the use of the complementary good, and a decrease in the price of electricity decreases the use of the complementary good.

The principal application of cross elasticity impact in the IRP is its substitutability by natural gas in some applications, including water and space heating. The correlation between retail electricity prices and the commodity cost of natural gas has increased in recent years as the industry has become more reliant on gas-fired generation to meet load growth. This increased positive correlation has reduced the net effect of cross price elasticity between retail natural gas and electricity prices.

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[1] http://cses.washington.edu/cig/fpt/ccscenarios.shtml.

Income elasticity measures the relationship between a change in consumer income and the change in consumer demand for electricity. As incomes rise, the ability of a consumer to pay for more electricity increases. The ability to afford electricity-consuming appliances also increases. Simply stated, as incomes rise consumers are more likely to purchase more electricity-consuming equipment, live in larger dwellings that use more electricity, and use the electrical equipment they have more often. Two of the most cited present examples of income elasticity are the increased proliferation of mobile electronic devices and high definition televisions.

The IRP estimates price elasticity by customer class for use in our electricity and natural gas demand forecasts. The price elasticity statistics used in the 2011 IRP are negative 0.15 for residential and negative 0.10 for commercial customers. Natural gas and electricity cross-price elasticity is positive at 0.05. Income elasticity is positive 0.75, meaning electricity is more affordable as incomes rise.

The baseline forecast used in the Expected Case assumes that rising incomes offset rising electricity and natural gas prices. Thus, there is no net expected impact on electricity consumption other than that caused by climate change and energy efficiency programs.

Retail Price Forecast

The retail sales forecast assumes retail prices increase at an average annual rate of eight percent from 2010 to 2018, followed by increases at the rate of general economic inflation thereafter. Carbon legislation and renewable energy targets are responsible for approximately one-fourth of the rate rise.[2]

Conservation

It is difficult to separate the interrelated impacts of rising electricity and natural gas prices, rising incomes, and conservation programs on the load forecast. Avista collects data on total demand, and derives from this data consumption change impacts. Avista has encouraged its customers to conserve electricity by offering conservation programs to its customers since 1978. Electricity usage impacts of these programs affect historical data; therefore, we conclude that the forecast already contains the impacts of existing conservation levels (7.5 aMW per year of new acquisition). As the 2011 IRP forecasts increased levels of conservation acquisition relative to history, the increased quantities reduce retail loads below Expected Case forecast levels.

Use per Customer Projections

A database of monthly electricity sales and customer numbers by rate schedule forms the basis of the usage per customer forecasts by rate schedule, customer class, and state from 1997 to 2010. Historical data is weather-normalized to remove the impact of

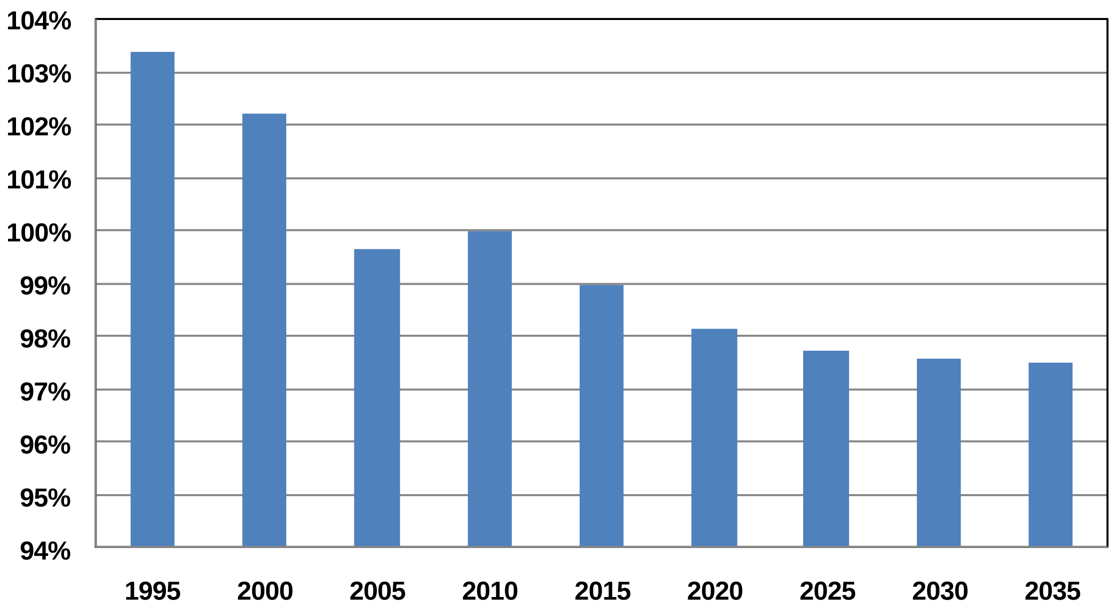
[2] This result assumes that the legislation does not mitigate the impacts of GHG legislation by issuing free utility allocations. Avista develops its load forecast independently of the IRP process. The load forecast mitigation assumption therefore differs from the Expected Case in the IRP where carbon mitigation legislation provides significant offsets and thereby limits the overall rate impact of carbon legislation. Avista does not expect this assumption difference to affect significantly the IRP results.

heating and cooling degree-day deviations from expected normal values, as discussed above. Retail electricity price increases reduce electricity usage per customer.

The 2011 IRP includes a forecast of electric vehicles in the Expected Case based on projections made by the Northwest Power and Conservation Council in its Sixth Power Plan. The electric fleet is a combination of plug-in hybrids and electric-only passenger vehicles.

The residential usage per customer forecast trends flat over the long term. This result is the combination of reductions from embedded conservation, warming temperatures, price elasticity effects, and increases from electricity vehicle use. The forecast of household size decreases over time, as shown in Figure 2.8.

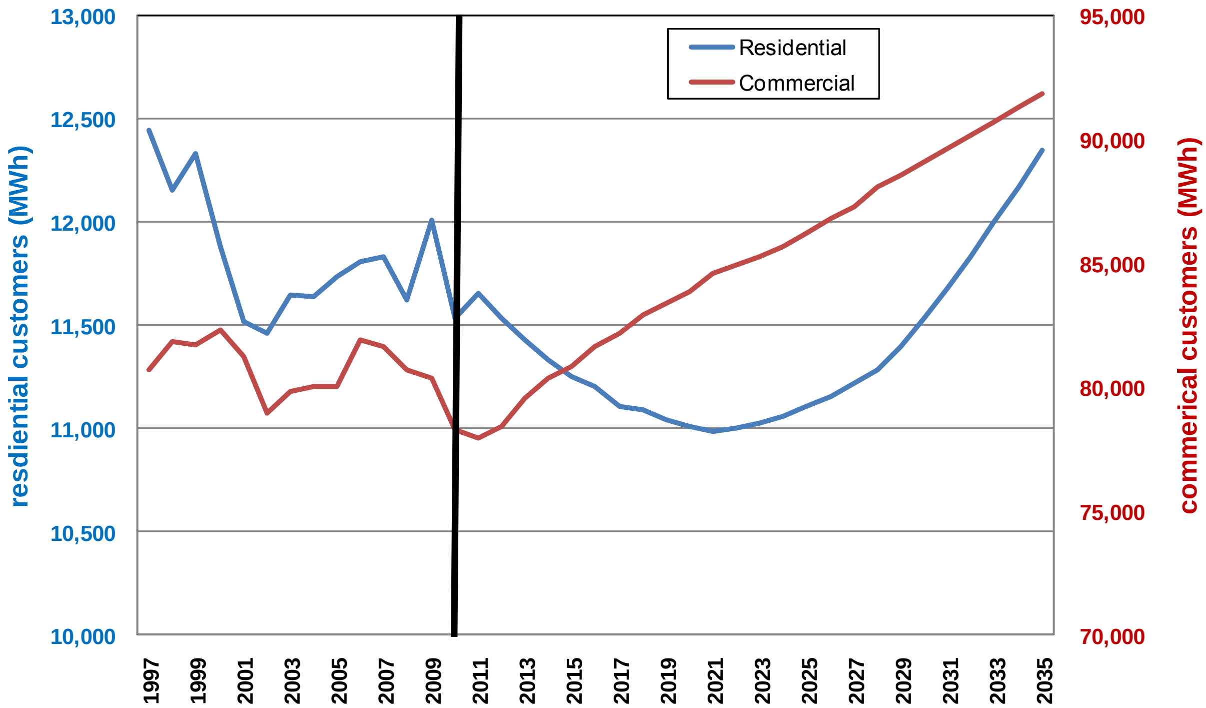
Figure 2.8: Household Size Index



Residential customers tend to be homogeneous relative to size of their dwellings. Commercial customers, on the other hand, are heterogeneous, ranging from small customers with varying electricity intensity per square foot of floor space to big box retailers with generally high intensities. The addition of new large commercial customers, including additions to largest universities and hospitals, can greatly skew average use per average customer statistics. Usage forecasts for the residential and commercial sectors are contained in Figure 2.9.

Estimates for residential usage per customer across all schedules are relatively smooth. Commercial usage per customer increases for several years due to additional existing and new buildings housing very large customers, including Washington State University and Sacred Heart Medical Center. Expected additions for very large customers are included in the forecast through 2015; no additions are included after 2015. Avista includes only publicly announced long lead-time buildings in its load forecast.

Figure 2.9: Electricity Usage per Customer



Retail Electricity Sales Forecast

Major economic changes between 1997 and 2010 affected the region, not the least of which was a marked increase in wholesale and retail electricity prices. The energy crisis of 2000-01 included widespread and permanent conservation efforts by our customers. Several large industrial facilities closed permanently during the 2001-02 economic recession. In 2004, rising retail electricity rates further reinforced conservation efforts. Recently, the economy has experienced a significant recession from which it is slowly emerging. The recession reduced loads below what they otherwise would be.

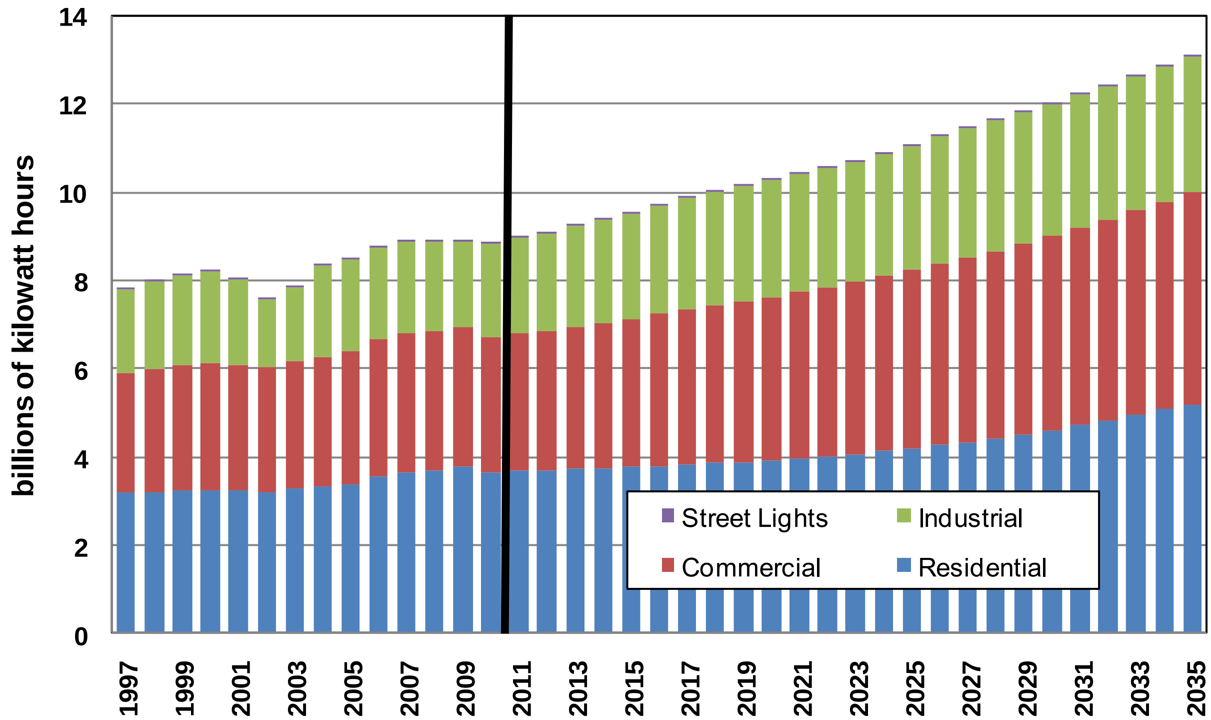
Retail electricity consumption rose from 8.2 million MWh in 2000 to 8.9 million MWh in 2010. This 0.75 percent annual average increase was net of the combined impacts of higher prices and resultant decreases in electricity demand from the Energy Crisis and economic recessions. Loads recover due to stabilizing electricity prices and recovery from the present recession. Forecasted average annual increase in retail sales over the 2010 to 2035 period is 1.6 percent.

The sales forecast takes a "bottom up" approach, summing individual customer class forecasts of customers and usage per customer to produce a retail sales forecast. Individual forecasts for our largest industrial customers (Schedule 25) include planned or announced production increases or decreases. Lumber and wood products industries have slowed down from very high production levels, consistent with the decline in housing starts at the national level caused by the present economic recession. Lumber and wood products sector load forecasts account for decreased production levels.

Anticipated sales to aerospace and aeronautical equipment suppliers have increased, and local plants have announced plans to hire more workers and increase their output.

The forecast for 2035 is 13.11 billion kWh, representing a 1.6 percent compounded increase in retail sales. See Figure 2.10 for Avista's retail sales forecast.

Figure 2.10: Avista's Retail Sales Forecast

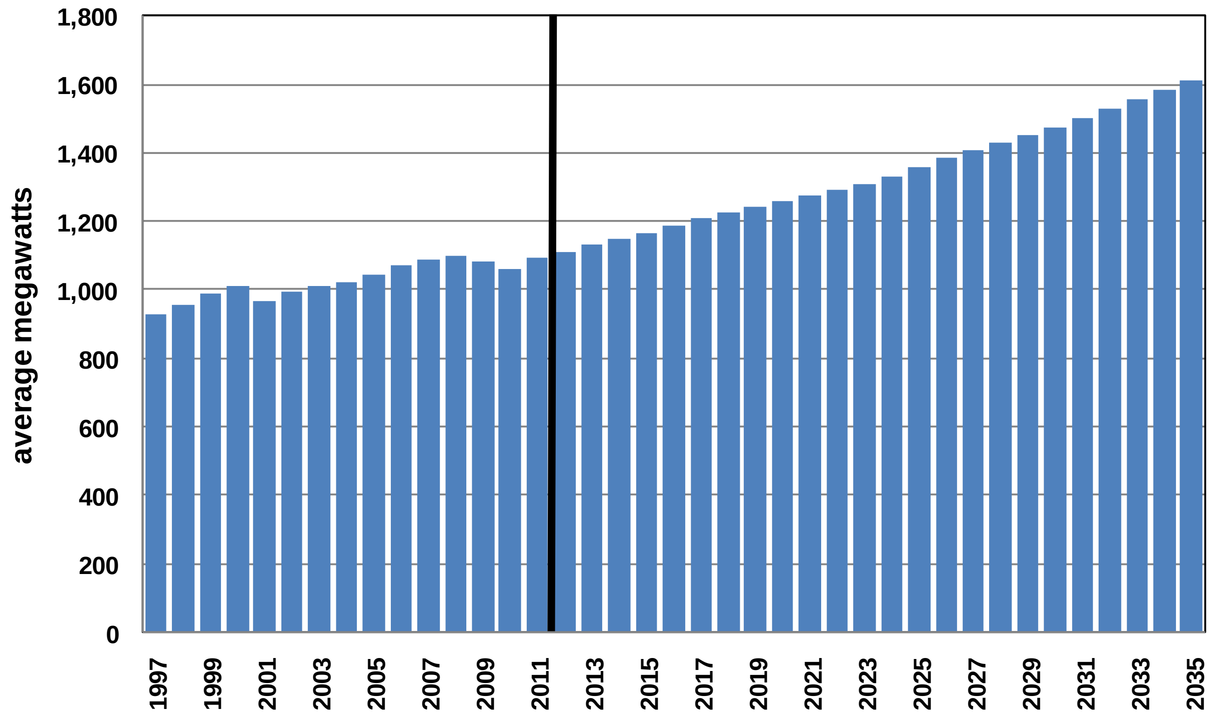


Load Forecast

Retail sales provide the data used to project load. Retail sales translate into average megawatt hours using a regression model ensuring monthly load shapes conform to history. The load forecast is a retail sales forecast combined with line losses across incurred in the delivery of electricity across the Avista transmission and distribution system.

Figure 2.11 presents annual net native load growth. Note the significant drop in the 2000-2001 Western Energy Crisis, and smaller declines in the 2009-10 recession period. Loads from 1997 to 2010 are not weather normalized. Annual growth is expected to be 1.7 percent compounded over the next twenty and twenty-five years, the same growth rate as the 2009 IRP but from a lower base of 2010 instead of 2008.

Figure 2.11: Annual Net Native Load

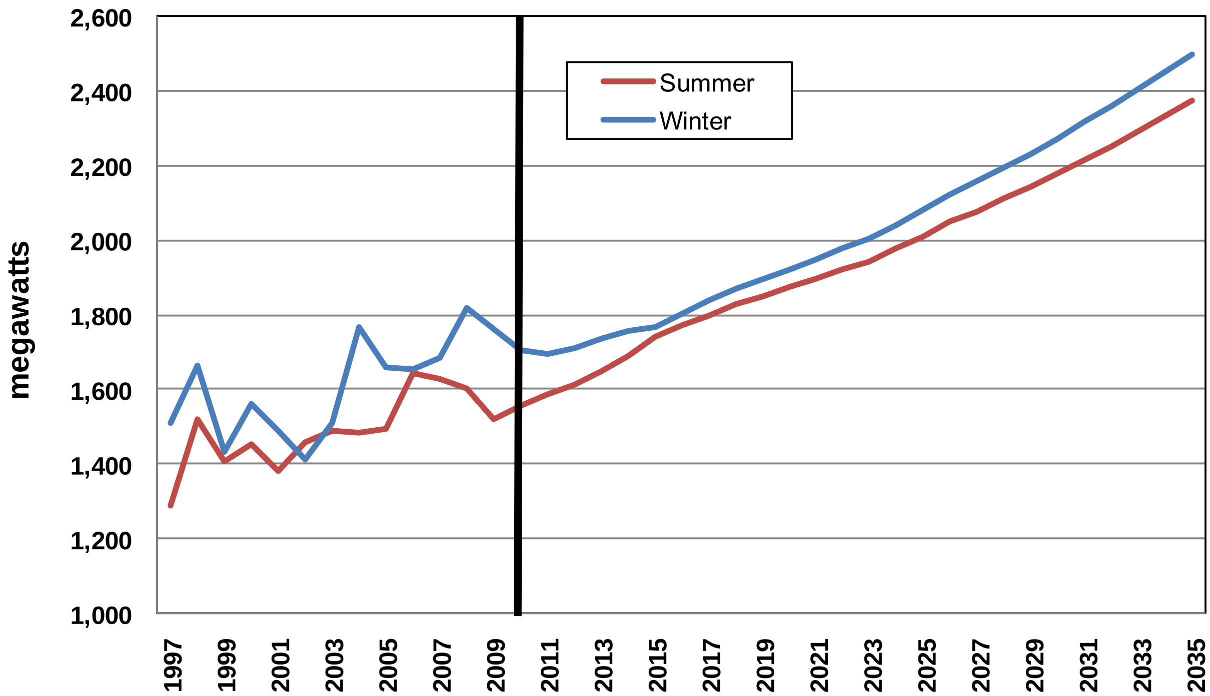


Peak Demand Forecast

The peak demand forecast represent expected peaks for each year of the IRP timeframe, not extreme weather peak demands.[3] The demand forecast is the product of an 11-year regression of actual peak demand and native load. Winter and summer peak demand forecasts are in Figure 2.12.[4] Peak loads grow at 1.2 percent compounded between 2010 and 2020 (219 MW), 1.5 percent over the 20-year IRP period (571 MW), and 1.55 percent over the 25-year forecast (796 MW).

[3] The expected peak demand has a 50 percent chance of exceedance in any year. Historical years present actual peak demands by year.
[4] Ibid.

Figure 2.12: Winter and Summer Peak Demand



Extreme weather events influence historical peak load data. The comparatively low 1999 peak demand figure was the result of a warmer-than-average winter peak day; the peak in 2006 was the result of a below-average winter peak day. The 1999 and 2006 peak demand values illustrate why relying on compound growth rates and forecasted expected peak demand is an oversimplification, and why the Company plans to own or control enough generation assets and contracts to meet peak demand during extreme weather events.

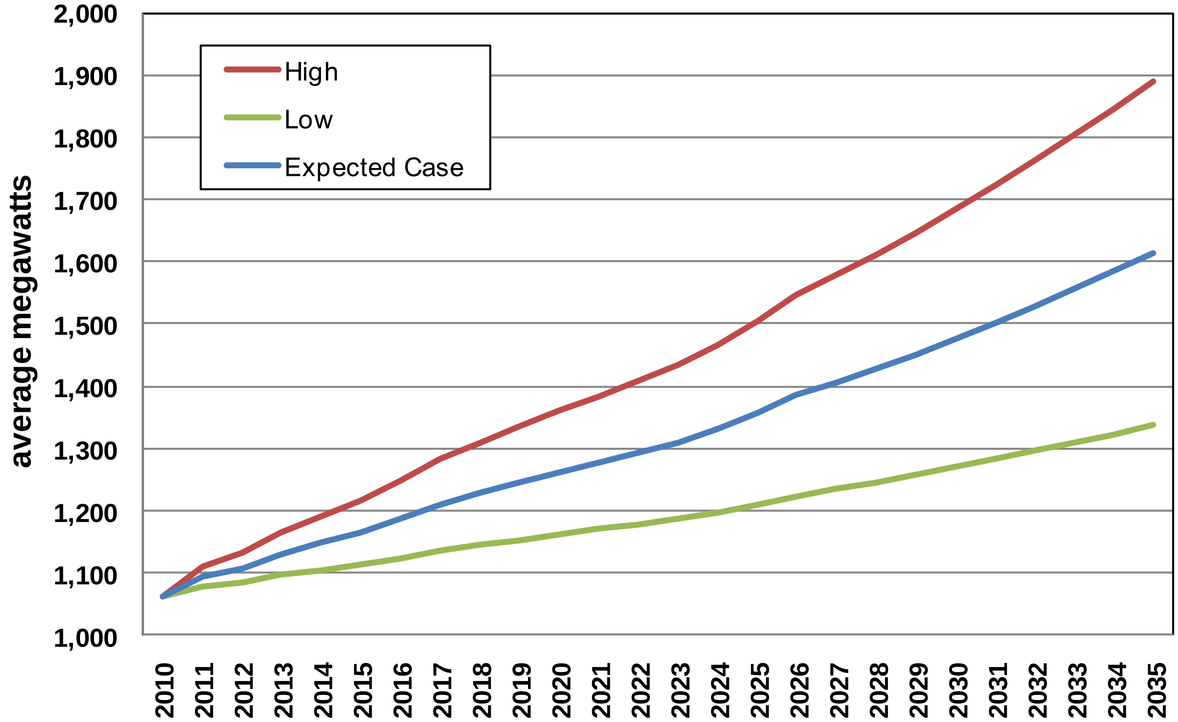
Avista has witnessed significant summer load growth in recent years primarily due to rising air conditioning penetration in its service territory. However, Avista expects to remain a winter-peaking utility in the near future. It is possible, and we have seen it occur as recently as 2001, where very mild winter temperatures combined with extremely hot summer temperatures in a given calendar year results in our summer peak load exceeding our winter demand level.

The Company produced high and low load forecasts to test the IRPs Preferred Resource Strategy. These forecasts are very difficult to create because many factors influence the outcome, and because Avista is unable to obtain alternative economic forecasts at the county level from Global Insight. In past IRPs Avista used ranges from the Northwest Power and Conservation Council's Sixth Power Plan as a guide. This IRP relies on consultation with internal and external advisors and uses a growth multiplier on the Expected Case forecast of 1.5 for the high case and 0.5 for the low case.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 44 of 1069

The Expected Case load growth is 1.6 percent. The high growth case scenario is 2.33 percent and the low growth case scenario is 0.93 percent as shown in Figure 2.13. The Company believes these high and low growth ranges are consistent with the Sixth Power Plan's medium high and medium low ranges.

Figure 2.13: Electricity Load Forecast Scenario



Avista Resources and Contracts

Avista relies on a diverse portfolio of generating assets to meet customer loads, including owning and operating eight hydroelectricity projects located on the Spokane and Clark Fork Rivers. Its thermal assets include partial ownership of two coal-fired units in Montana, five natural gas-fired projects, and a biomass plant located near Kettle Falls, Washington.

Spokane River Hydroelectric Projects

Avista owns and operates six hydroelectric projects on the Spokane River. These projects received a new 50-year FERC operating license in June 2009. The following section describes the Spokane River projects and provides the maximum on-peak capacity and nameplate capacity ratings for each plant. The maximum on-peak capacity of a generating unit is the total amount of electricity a plant can safely generate. This is often higher than the nameplate rating for hydroelectric projects. The nameplate, or installed capacity, is the capacity of a plant as rated by the manufacturer. All six of the hydroelectric projects on the Spokane River connect to Avista's transmission system.

Post Falls

Post Falls is the upper most hydroelectricity facility on the Spokane River. It is located near the Washington/Idaho border. The project began operating in 1906, and during summer months maintains the elevation of Lake Coeur d'Alene. The project has six units, with the last unit added in 1980. The project is capable of producing 18.0 MW and has a 14.75 MW nameplate rating.

Upper Falls

The Upper Falls project began generating in 1922 in downtown Spokane, and now is within the boundaries of Riverfront Park. This project is comprised of a single 10.0 MW unit with a 10.26 MW maximum capacity rating.

Monroe Street

The Monroe Street facility was Avista's first generation facility. It began serving customers in 1890 near what is now Riverfront Park. Rebuilt in 1992, the single generating unit has a 15.0 MW maximum capacity rating and a 14.8 MW nameplate rating.

Nine Mile

A private developer built the Nine Mile project in 1908 near Nine Mile Falls, Washington, nine miles northwest of Spokane. The Company purchased the project in 1925 from the Spokane & Eastern Railway. Its four units have a 17.6 MW maximum capacity and a 26.4 MW nameplate rating.[5] The facility received a rubber dam in 2010, replacing the original flashboard system that maintained higher summer elevations.

The Nine Mile facility presently has major equipment outages. Unit 1 is out of service and Unit 2 is limited to half load. Unit 4 failed in the spring of 2011. Avista is evaluating options to restore the plant to full service. Restoration options include refurbishment of the existing powerhouse, including new turbine runners, or a new powerhouse located downstream from the existing powerhouse. A decision on the final configuration of Nine Mile is not yet determined. The Company expects any new generation at the plant will meet Washington State Energy Independence Act requirements.

Long Lake

The Long Lake project is located northwest of Spokane and maintains the Lake Spokane reservoir, also known as Long Lake. The facility was the highest spillway dam with the largest turbines in the world when completed in 1915. The plant received new runners in the 1990s, adding 2.2 aMW of additional energy. The project's four units provide 88.0 MW of combined capacity and have an 81.6 MW nameplate rating.

Little Falls

The Little Falls project, completed in 1910 near Ford, Washington, is the furthest downstream hydro facility on the Spokane River. A new runner upgrade in 2001 generates 0.6 aMW of renewable energy than the previous runner. The facility's four units generate 35.2 MW of on-peak capacity and have a 32.0 MW nameplate rating.

[5] This is the de-rated capacity considering the outage of unit 1 and de-rate of unit 2

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 46 of 1069

Clark Fork River Hydroelectric Project

The Clark Fork River Project includes hydroelectric projects located near Clark Fork, Idaho, and Noxon, Montana, 70 miles south of the Canadian border. The plants operate under a FERC license through 2046. Both of the hydroelectric projects on the Clark Fork River connect to Avista's transmission system.

Cabinet Gorge

The Cabinet Gorge project started generating power in 1952 with two units. The plant added two additional generators in the following year. The current maximum on-peak capacity of the plant is 270.5 MW; it has a nameplate rating of 265.2 MW. Upgrades at this project began with the replacement of the turbine for Unit 1 in 1994. Unit 3 received an upgrade in 2001. Unit 2 received an upgrade in 2004. Unit 4 received a turbine runner upgrade in 2007, increasing its generating capacity from 55 MW to 64 MW, and adding 2.1 aMW of additional energy.

Noxon Rapids

The Noxon Rapids project includes four generators installed between 1959 and 1960, and a fifth unit added in 1977. The project is in the middle of a major turbine upgrade, with one unit receiving a new runner in each calendar year beginning in 2009. The upgrades add 6.6 aMW of total energy and qualify under Washington State's Energy Independence Act renewable energy goals.

Total Hydroelectric Generation

In total, Avista's hydroelectric plants have 1,065.4 MW of on-peak capacity. Table 2.2 summarizes the location and operational capacities of the Company's hydroelectric projects. This table includes the average annual energy output of each facility based on the 70-year hydrologic record for the year ending 2012.

Table 2.2: Company-Owned Hydro Resources

Project Name	River System	Location	Nameplate Capacity (MW)	Maximum Capability (MW)	Expected Energy (aMW)
Monroe Street	Spokane	Spokane, WA	14.8	15.0	11.6
Post Falls	Spokane	Post Falls, ID	14.8	18.0	10.0
Nine Mile	Spokane	Nine Mile Falls, WA	26.0	17.5	12.5
Little Falls	Spokane	Ford, WA	32.0	35.2	22.1
Long Lake	Spokane	Ford, WA	81.6	89.0	53.4
Upper Falls	Spokane	Spokane, WA	10.0	10.2	7.5
Cabinet Gorge	Clark Fork	Clark Fork, ID	265.2	270.5	124.8
Noxon Rapids	Clark Fork	Noxon, MT	518.0	610.0	198.3
Total			**962.4**	**1,065.4**	**440.2**

Thermal Resources

Avista owns seven thermal assets located across the Northwest. Each thermal plant operates through the 20-year duration of the 2011 IRP. The resources provide dependable energy and capacity to serve base loads and provide peak load serving capabilities. A summary of Avista thermal resources is in Table 2.3.

Colstrip

The Colstrip plant, located in Eastern Montana, consists of four multi-owner coal-fired steam plants connected to the double circuit 500 kV BPA transmission line under a long-term wheeling agreement. PPL Global operates the facilities on behalf of the owners. Avista owns 15 percent of Units 3 and 4. Unit 3 began operating in 1984 and Unit 4 was finished in 1986. The Company's share of each Colstrip unit has a maximum net capacity of 111.0 MW and a nameplate rating of 123.5 MW. In 2006 and 2007 completed capital projects improved efficiency, reliability, and generation capacity at the plants. The upgrades include new high-pressure steam turbine rotors and digital (versus the old analog) control systems.

Rathdrum

Rathdrum is a two-unit simple-cycle combustion turbine. This natural gas-fired plant is located near Rathdrum, Idaho and connects to Avista's transmission system. It entered service in 1995 and has a maximum capacity of 178.0 MW in the winter and 126.0 MW in the summer. The nameplate rating is 166.5 MW.

Northeast

The Northeast plant, located in northeast Spokane, is a two-unit aero-derivative simple-cycle plant completed in 1978 and connects to Avista's transmission system. The plant is capable of burning natural gas or fuel oil, but current air permits prevent the use of fuel oil. The combined maximum capacity of the units is 68.0 MW in the winter and 42.0 MW in the summer, with a nameplate rating of 61.2 MW. The plant is currently limited to run no more than approximately 546 hours per year and provides reserve capacity to protect against reliability concerns and extreme market aberrations.

Boulder Park

The Boulder Park project entered service in Spokane Valley in 2002 and connects to Avista's transmission system. The site uses six natural gas-fired internal combustion reciprocating engines to produce a combined maximum capacity and nameplate rating of 24.6 MW.

Coyote Springs 2

Coyote Springs 2 is a natural gas-fired combined cycle combustion turbine located near Boardman, Oregon. This plant connects to BPA's 500 kV transmission system under a long-term transmission wheeling agreement. The plant began service in 2003. The maximum capacity is 274 MW in the winter and 221 MW in the summer and the duct burner provides the unit with an additional capacity of up to 28 MW. The plant's nameplate rating is 287.3 MW.

Kettle Falls and Kettle Falls Combustion Turbine

The Kettle Falls biomass facility entered service in 1983 near Kettle Falls, Washington and is among the largest biomass plants in North America. The plant connects to

Avista's 115 kV transmission system. The open-loop biomass steam plant uses waste wood products from area mills and forest slash, but can also burn natural gas. A combustion turbine (CT), added to the facility in 2002, burns natural gas and increases overall plant efficiency by sending exhaust heat to the wood boiler.

The wood-fired portion of the plant has a maximum capacity of 50.0 MW and its nameplate rating is 50.7 MW. The plant typically operates between 45 and 47 MW because of fuel quality issues. The plant's capacity increases to 57.0 MW when operated in combined-cycle mode with the CT. The CT produces 8 MW of peaking capability in the summer and 11 MW in the winter. The CT resource is limited in winter when the gas pipeline is constrained; for IRP modeling, the plant does not run when temperatures fall below zero and pipeline capacity serves local natural gas distribution.

Table 2.3: Company-Owned Thermal Resources

Project Name	Location	Fuel Type	Start Date	Winter Maximum Capacity (MW)	Summer Maximum Capacity (MW)	Nameplate Capacity (MW)
Colstrip 3 (15%)	Colstrip, MT	Coal	1984	111.0	111.0	123.5
Colstrip 4 (15%)	Colstrip, MT	Coal	1986	111.0	111.0	123.5
Rathdrum	Rathdrum, ID	Gas	1995	178.0	126.0	166.5
Northeast	Spokane, WA	Gas	1978	68.0	42.0	61.2
Boulder Park	Spokane, WA	Gas	2002	24.6	24.6	24.6
Coyote Springs 2	Boardman, OR	Gas	2003	302.0	249.0	287.3
Kettle Falls	Kettle Falls, WA	Wood/Gas	1983	47.0	47.0	46.0
Kettle Falls CT[6]	Kettle Falls, WA	Gas	2002	11.0	8.0	7.5
Total				**852.6**	**718.6**	**840.1**

Power Purchase and Sale Contracts

The Company utilizes power supply purchase and sale arrangements of varying lengths to meet some load requirements. This chapter describes the contracts in effect during the scope of the 2011 IRP. Contracts provide many benefits including environmentally low-impact and low-cost hydro and wind power. A 2012 annual summary of Avista large contracts is in Table 2.5.

Mid-Columbia Hydroelectric Contracts

During the 1950s and 1960s, public utility districts (PUDs) in central Washington developed hydroelectric projects on the Columbia River. Each plant was oversized compared to the loads then served by the PUDs. Long-term contracts with public, municipal, and investor-owned utilities throughout the Northwest assisted with project financing, and ensured a market for generated surplus power. The contract terms obligate the PUDs to deliver power to Avista's points of interconnection with each utility.

[6] Includes output of the gas turbine plus the benefit of its steam to the main unit's boiler.

Avista entered into long-term contracts for the output of four of these projects "at cost." Later, the Company competed in capacity auctions in 2009 through 2011 to purchase new short-term contracts at market-based prices. The Mid-Columbia contracts provide energy, capacity, and reserve capabilities; in 2012, contracts provide approximately 165 MW of capacity and 86 aMW of energy, see Table 2.4 for further details. Over the next 20 years the Douglas PUD (2018) and Chelan PUD (2015) contracts will expire. Avista may extend these contracts or even gain additional capacity in auctions; however, we have no assurance that we will be successful in extending our contract rights. Due to this uncertainty, the IRP does not include these contracts in the resource mix beyond their expiration dates.

Table 2.4: Mid-Columbia Capacity and Energy Contracts

Counter Party	Project(s)	Percent Share (%)	Start Date	End Date	Estimated Capacity (MW)	Annual Energy (aMW)
Grant PUD	Priest Rapids	3.7	12/2001	12/2052	34	16
Grant PUD	Wanapum	3.7	12/2001	12/2052	37	18
Chelan PUD	Rocky Reach	4.5	11/2011	06/2012	57	32
Chelan PUD	Rocky Reach	3.0	07/2011	12/2014	38	21
Chelan PUD	Rock Island	3.0	07/2011	12/2015	19	11
Douglas PUD	Wells	3.3	02/1965	08/2018	29	15
2012 Total Contracted Capacity and Energy					**165**	**86**

Lancaster Power Purchase Agreement

Avista acquired the output rights to the Lancaster combined-cycle generating station, located in Rathdrum, Idaho, as part of the sale of Avista Energy to Shell in 2007. Lancaster (sometimes referred to in the industry as the Rathdrum Generating Station). The plant connects to the BPA transmission system under a long-term wheeling agreement. Avista is working with BPA to interconnect the plant with Avista's transmission system at the BPA Lancaster substation. Avista has the sole right to dispatch the plant, and is responsible for providing fuel and energy and capacity payments, under a tolling PPA with Energy Investors Funds expiring in October 2026.

Bonneville Power Administration – WNP-3 Settlement

Avista (then Washington Water Power) signed settlement agreements with BPA and Energy Northwest (formerly the Washington Public Power Supply System or WPPSS) on September 17, 1985, ending construction delay claims against both parties. The settlement provides an energy exchange through June 30, 2019, with an agreement to reimburse Avista for WPPSS – Washington Nuclear Plant No. 3 (WNP-3) preservation costs and an irrevocable offer of WNP-3 capability under the Regional Power Act.

The energy exchange portion of the settlement contains two basic provisions. The first provision provides approximately 42 aMW of energy to the Company from BPA through 2019, subject to a contract minimum of 5.8 million megawatt-hours. Avista is obligated to pay BPA operating and maintenance costs associated with the energy exchange as determined by a formula that ranges from $16 to $29 per megawatt-hour in 1987-year constant dollars.

The second provision provides BPA approximately 32 aMW of return energy at a cost equal to the actual operating cost of the Company's highest-cost resource. A further discussion of this obligation, and how Avista plans to account for it, is under the Planning Margin heading of this chapter.

Table 2.5: Large Contractual Rights and Obligations

Contract	Type	End Date	Winter Capacity (MW)	Summer Capacity (MW)	2012 Est. Annual Energy (aMW)
Canadian Entitlement	Sale	n/a	8	8	5
Clearwater	PURPA	06/2013	75	75	52
Douglas Settlement	Purchase	09/2018	2	3	3
Lancaster	Purchase	10/2026	290	249	222
Nichols Pumping	Sale	n/a	7	7	7
PGE Capacity Exchange	Exchange	12/2016	150	150	0
Small Power	PURPA	varies	2	1	2
Stateline	Purchase	03/2014	0	0	9
Stimson Lumber	Purchase	09/2011	4	5	4
Upriver (net load)	Purchase	12/2011	8	-1	6
WNP-3	Purchase	06/2019	82	0	42
Total			**628**	**497**	**352**

Reserve Margins

Planning reserves accommodate situations when loads exceed and/or resource outputs are below expectations due to adverse weather, forced outages, poor water conditions, or other contingencies. There are disagreements within the industry on reserve margin levels utilities should carry. Many disagreements stem from system differences, such as resource mix, system size, and transmission interconnections

Reserve margins, on average, increase customer rates when compared to resource portfolios without reserves, because of the cost of carrying additional generating capacity that is rarely used. Reserve resources have the physical capability to generate electricity, but high operating costs limit their economic dispatch and revenues to offset purchase costs.

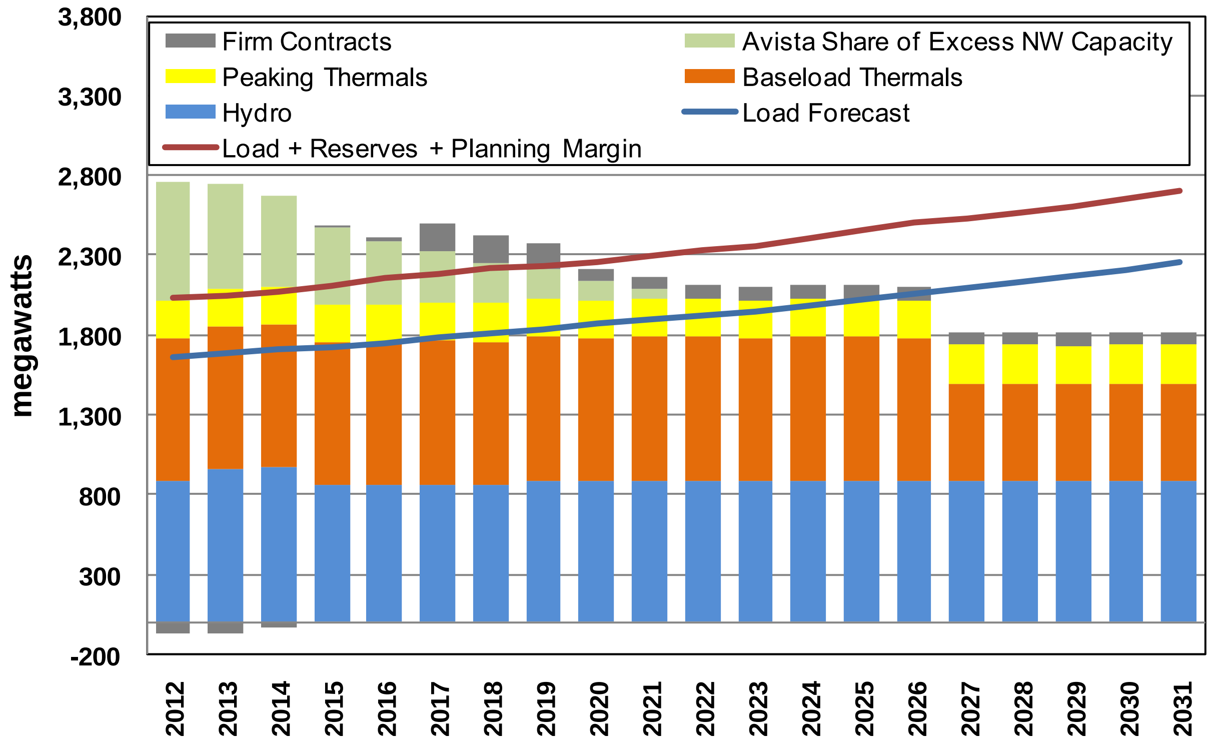
Avista Planning Margin

Avista retains two planning margin targets—capacity and energy. Capacity planning is a traditional metric ensuring that utilities can meet peak loads at times of system strain, and cover variability inherent in their generation resources with unpredictable fuel supplies, such as wind and hydro, and varying loads.

Capacity Planning

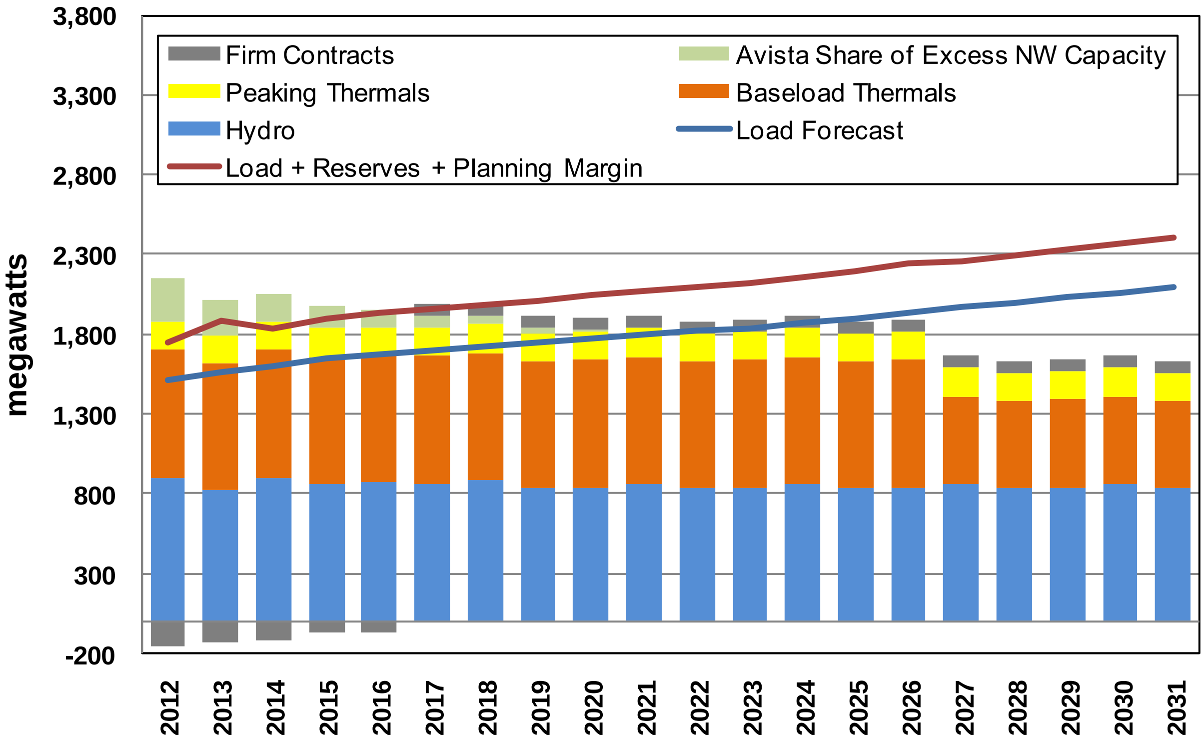
Avista plans for peak load events using the regional standard of an 18-hour peak event covering six hours each day for three consecutive days. Further, the IRP uses a planning margin level approximating the Northwest Power and Conservation Council's targets of 23 percent in the winter and 24 percent in the summer. Avista first estimates operating reserve requirements for on-system generation, load regulation, and wind integration. It then adds a planning margin of 15 percent to summer peak load and 14 percent to winter peak load. Adjustments to the net position include market purchases when surplus capacity exists in the Northwest, as represented by the green bars.[7] The planning margin equals 233 MW in 2012. Additional detail is in Appendix A. Figure 2.14 illustrates the winter peak position and Figure 2.15 shows the summer peak position.

Figure 2.14: Winter 18-Hour Capacity Load and Resources



[7] Avista relied on work by the Northwest Power and Conservation Council in its Resource Adequacy Forum exercises to determine the level of surplus summer energy and capacity. Reliance is limited to Avista's prorated share of regional load. See http://www.nwcouncil.org/energy/resource/Adequacy%20Assessment%2070908.xls. NPCC surplus estimates phase out over 10 years starting in 2013 by reducing its surplus by 10 percent, the 2014 surplus by 20 percent, the 2015 surplus by 30 percent, and so on. The phase out reflects Avista's opinion that outer-year surpluses might not be available for various reasons, including unanticipated load growth, the retirement of existing resources, or transmission interconnections enabling the export of more generation outside of the Northwest.

Figure 2.15: Summer 18-Hour Capacity Load and Resources



Energy Planning

For energy planning, resources must be adequate to meet customer requirements even where loads are high for extended periods or an outage limits the output of a resource. Extreme weather conditions can change monthly energy obligations by up to 30 percent. Where generation capability is not adequate to meet these variations, customers and the utility must rely on the volatile short-term electricity market. In addition to load variability, a planning margin accounts for variations in hydroelectricity generation.

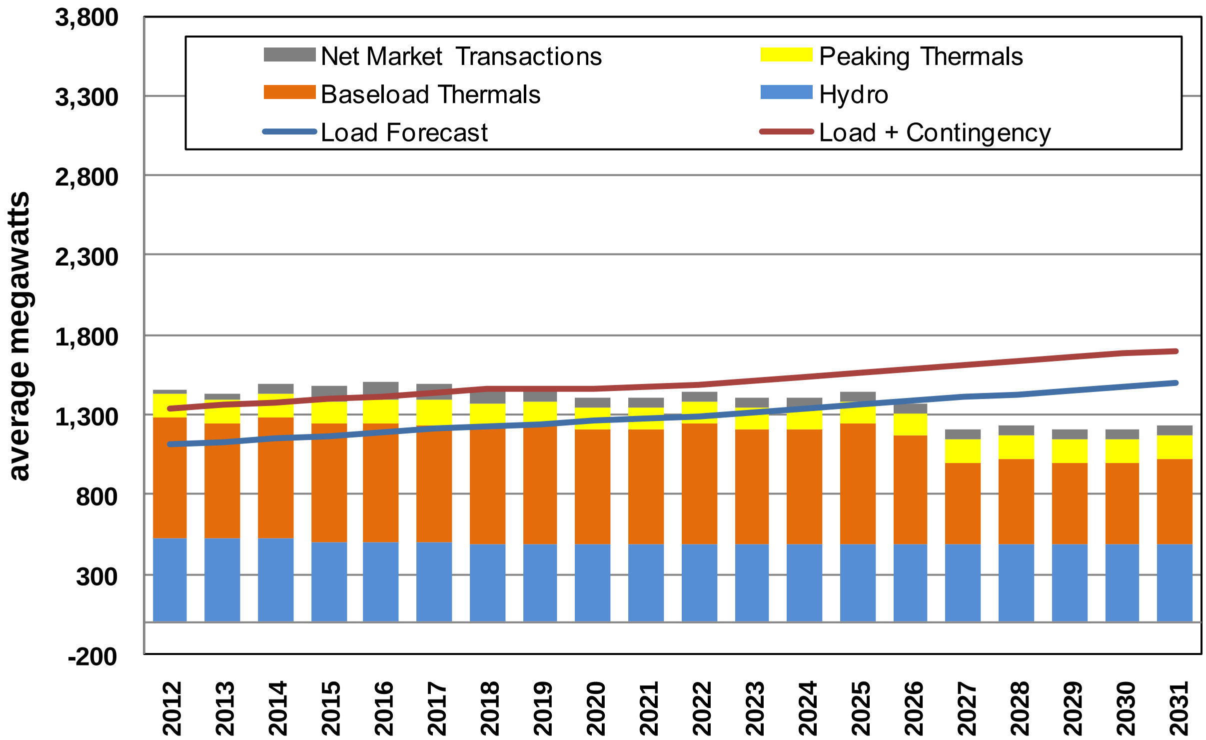
As with capacity planning, there are differences in regional opinion on a proper method for establishing resource planning margins. Many utilities in the Northwest base their planning on the amount of energy available during the critical water period of 1936/37.[8] The critical water year of 1936/37 is low on an annual basis, but it is not necessarily low in every month. The IRP could target resource development to reach a 99 percent confidence level on being able to deliver energy to its customers, and it would significantly decrease the frequency of its market purchases. However, this strategy requires investments in approximately 200 MW of generation in additional to the margins included in Expected Case of the IRP. Such expenditure to support this high level of reliability would put upward pressure on retail rates for a modest benefit. Avista instead targets a 90 percent monthly energy planning margin confidence interval based on load hydroelectricity variability. In other words, there is a 10 percent chance of needing to purchase energy from the market in any given month over the IRP

[8] The critical water year represents the lowest historical generation level in the streamflow record.

timeframe, but on average, the utility would have the ability to meet all of its energy requirements and be selling electricity into the marketplace.

Beyond load and hydroelectricity variability, Avista's WNP-3 contract with BPA contains supply risk. The contract includes a return energy provision in favor of BPA that can equal 32 aMW annually. Under adverse market conditions BPA almost certainly would exercise its rights. BPA last exercised its contract rights in 2001. To account for this contract risk, the energy planning margin is increased by 32 aMW until the contract expires in 2019. With the addition of WNP-3, load and hydroelectricity variability, the total energy planning margin equals 228 aMW in 2012. Additional detail is contained in Appendix A. See Figure 2.16 for the summary of the annual average energy load and resource net position.

Figure 2.16: Annual Average Energy Load and Resources



Loss of Load Analysis

In the Northwest, loss-of-load analysis tools help address the issue of how much planning margin is required. Typical results of these models are Loss of Load Probability (LOLP), Loss of Load Hours (LOLH), and Loss of Load Expectation (LOLE) measures. A reliable system has typically been defined as having no more than one interruption event in twenty years, or 5 percent. These analyses can be helpful, but usually have an inherent flaw due to the need to assume how much out-of-area generation is available for the study. Avista developed a loss of load analysis model to simulate reliability events due to poor hydro, forced outages, and extreme weather conditions on its system, finding that forced outages are the main driver of reliability events. Avista has robust transmission rights to the wholesale energy markets, but the amount of generation actually available for purchase from third parties is difficult to estimate in a model. To address this concern, a sophisticated regional model must estimate required regional planning margins. Avista will continue to monitor and contribute to such regional model development, with the intent of using the regional model when it becomes available.

Washington State Renewable Portfolio Standard

In the November 2006 general election, Washington State voters approved Citizens Initiative 937, now known as the Washington state Energy Independence Act. The initiative requires utilities with more than 25,000 customers to source 3 percent of their energy from qualified non-hydroelectric renewables by 2012, 9 percent by 2016, and 15 percent by 2020. Utilities also must acquire all cost effective conservation and energy efficiency measures. Even though Avista does not require any new generation resources to meet forecasted energy loads through 2019, this new law requires the Company to acquire additional qualified renewable generation, or renewable energy certificates (RECs), to meet the initiative's renewable goals. Table 2.6 at the end of this chapter details the forecast amount of RECs required to meet Washington state law, and the amount of qualifying resources has already in the generation portfolio. The sales forecast uses the current load forecast and does not include additional conservation as detailed in the Preferred Resource Strategy chapter. It also illustrates how the Company will maintain a REC reserve margin of approximately 10 aMW in 2016.

Resource Requirements

The resource requirements discussed in this section do not include additional energy efficiency acquisitions beyond what is in the load forecast. The Preferred Resource Strategy chapter discusses conservation beyond the assumptions contained in the load forecast. The following tables present loads and resources to illustrate future resource requirements.

During winter peak periods (Table 2.7), surplus capacity exists through 2019 after taking into account market purchases.[9] Without these purchases, a capacity deficit would exist in 2012. Avista believes that the present market can meet these minor winter capacity shortfalls and therefore will optimize its portfolio to postpone new resource investments for winter capacity until 2020.

The summer peak projection (Table 2.8) has lower loads than in winter, but resource capabilities are also lower due to lower hydroelectricity output and reduced capacity at natural gas-fired resources due to decreased performance during high-temperature events. The IRP shows persistent summer deficits throughout the 20-year timeframe, but regional surpluses are adequate to fill in these gaps. Many near-term deficits are from decreased hydroelectricity capacity during periods of planned maintenance and

[9] Avista relied on work by the Northwest Power and Conservation Council in its Resource Adequacy Forum exercises to determine the level of surplus summer energy and capacity. Reliance is limited to the Company's prorate share of regional load.

upgrades. Taking into account regional surpluses, the load and resource balance is 54 MW short only in 2016. After 2016, when the Portland General Electricity capacity sale contract expires, the next capacity need is in 2019 at 98 MW.

The traditional measure of resource need in the region is the annual average energy position. The energy position is in Table 2.9. There is enough energy on an annual average basis to meet customer requirements until 2020, when the utility is short 49 aMW. Avista will require 112 aMW of new energy by 2025, and 475 aMW in 2031.

Table 2.6: Washington State RPS Detail (aMW)

	On-line Year	Upgrade Energy	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
WA State Retail Sales Forecast			628	630	636	646	654	663	671	678	687	693	701	708	714	721	730	738	746	754	763	772	782	793
RPS %				0%	3%	3%	3%	3%	9%	9%	9%	9%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
REQUIRED RENEWABLE ENERGY					**19**	**19**	**19**	**20**	**59**	**60**	**61**	**61**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**114**	**115**	**117**
Renewable Resources																								
Purchased RECs				0	6	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long Lake 3	1999	2.2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Little Falls 4	2001	0.6		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cabinet 2	2004	2.9		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Cabinet 3	2001	4.5		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Cabinet 4	2007	2.0		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Noxon 1	2009	2.3		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Noxon 3	2010	1.9		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Noxon 2	2011	1.0		0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Noxon 4	2012	0.9		0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Nine Mile	2012	3.7		0	0	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Total Qualifying Resources				***17***	***23***	***26***	***28***	***28***	***22***	***22***	***22***	***22***	***22***	***22***	***22***	***22***	***22***	***22***	***22***	***22***	***22***	***22***	***22***	***22***
NET REC POSITION				**17**	**5**	**7**	**8**	**8**	**(37)**	**(38)**	**(39)**	**(39)**	**(82)**	**(83)**	**(84)**	**(85)**	**(86)**	**(87)**	**(88)**	**(89)**	**(90)**	**(92)**	**(93)**	**(95)**
REC Bank																								
Previous Year Balance				0	17	21	26	28	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REC's Required				0	(19)	(19)	(19)	(20)	(59)	(60)	(61)	(61)	(104)	(105)	(106)	(107)	(108)	(109)	(110)	(111)	(112)	(114)	(115)	(117)
REC's Generated/Purchased				17	23	26	28	28	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
Expired/Sold RECs					0	(2)	(7)	(8)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NET REC BANK				**17**	**21**	**26**	**28**	**28**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
REC Reserve Requirement (95th PERCENTILE)																								
Load				0	1	1	1	1	3	3	3	3	5	5	5	5	5	5	5	5	5	5	6	6
Existing Hydro Upgrades				0	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Total REC Reserve Requirement				**0**	**7**	**8**	**8**	**8**	**10**	**10**	**10**	**10**	**12**	**12**	**12**	**12**	**12**	**12**	**13**	**13**	**13**	**13**	**13**	**13**
NET REC POSITION				**17**	**14**	**21**	**26**	**28**	**(20)**	**(48)**	**(49)**	**(50)**	**(94)**	**(95)**	**(96)**	**(97)**	**(98)**	**(99)**	**(101)**	**(102)**	**(103)**	**(105)**	**(106)**	**(108)**

Table 2.7: Winter 18-Hour Capacity Position (MW)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
TOTAL LOAD OBLIGATIONS																				
Native Load	-1,661	-1,688	-1,704	-1,718	-1,751	-1,784	-1,814	-1,839	-1,866	-1,892	-1,919	-1,946	-1,982	-2,020	-2,062	-2,094	-2,131	-2,168	-2,208	-2,249
Firm Power Sales	-242	-242	-211	-158	-158	-8	-8	-7	-7	-7	-7	-7	-6	-6	-6	-6	-6	-6	-6	-6
Total Requirements	**-1,903**	**-1,930**	**-1,915**	**-1,876**	**-1,909**	**-1,792**	**-1,822**	**-1,846**	**-1,873**	**-1,899**	**-1,925**	**-1,953**	**-1,988**	**-2,027**	**-2,068**	**-2,101**	**-2,137**	**-2,174**	**-2,214**	**-2,255**
RESOURCES																				
Firm Power Purchases	175	175	175	175	175	175	174	173	90	90	90	90	90	90	90	90	90	90	90	90
Hydro Resources	880	955	965	854	854	865	861	889	881	889	889	881	889	889	881	889	889	881	889	889
Base Load Thermals	895	895	895	895	895	895	895	895	895	895	895	895	895	895	895	606	606	606	606	606
Wind Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peaking Units	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242
Total Resources	**2,192**	**2,267**	**2,277**	**2,166**	**2,166**	**2,177**	**2,172**	**2,199**	**2,108**	**2,116**	**2,116**	**2,108**	**2,116**	**2,116**	**2,108**	**1,826**	**1,826**	**1,818**	**1,826**	**1,826**
Peak Position Before Reserves Planning	**289**	**337**	**362**	**290**	**256**	**385**	**350**	**353**	**236**	**217**	**191**	**155**	**127**	**89**	**40**	**-275**	**-311**	**-356**	**-388**	**-429**
RESERVE PLANNING																				
Required Operating Reserves	-162	-164	-163	-162	-165	-159	-161	-163	-165	-167	-173	-176	-180	-182	-186	-170	-170	-171	-172	-173
Available Operating Reserves	23	42	42	8	8	8	8	34	34	34	34	34	34	34	34	34	34	34	34	34
Planning Margin	-233	-236	-239	-240	-245	-250	-254	-258	-261	-265	-269	-272	-277	-283	-289	-293	-298	-304	-309	-315
Total Reserves Planning	**-372**	**-358**	**-360**	**-394**	**-402**	**-400**	**-407**	**-387**	**-392**	**-398**	**-408**	**-414**	**-423**	**-431**	**-441**	**-429**	**-434**	**-441**	**-447**	**-454**
Peak Position With Reserves Planning	**-83**	**-21**	**2**	**-105**	**-146**	**-15**	**-57**	**-34**	**-157**	**-181**	**-216**	**-259**	**-296**	**-342**	**-401**	**-704**	**-746**	**-796**	**-835**	**-883**
Planning Margin Before NW Market	**16%**	**20%**	**21%**	**16%**	**14%**	**22%**	**20%**	**21%**	**14%**	**13%**	**12%**	**10%**	**8%**	**6%**	**4%**	**-11%**	**-13%**	**-15%**	**-16%**	**-18%**
Avista Share of Excess NW Capacity	737	656	565	477	400	326	255	186	115	56	0	0	0	0	0	0	0	0	0	0
Peak Position With NW Market	**654**	**635**	**567**	**373**	**254**	**311**	**199**	**152**	**-42**	**-125**	**-216**	**-259**	**-296**	**-342**	**-401**	**-704**	**-746**	**-796**	**-835**	**-883**
Peak Position With NW Market	**55%**	**54%**	**51%**	**41%**	**35%**	**40%**	**34%**	**31%**	**21%**	**16%**	**12%**	**10%**	**8%**	**6%**	**4%**	**-11%**	**-13%**	**-15%**	**-16%**	**-18%**

Table 2.8: Summer 18-Hour Capacity Position (MW)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
TOTAL LOAD OBLIGATIONS																				
Native Load	-1,514	-1,556	-1,597	-1,644	-1,673	-1,701	-1,727	-1,748	-1,771	-1,793	-1,815	-1,838	-1,868	-1,900	-1,937	-1,964	-1,995	-2,026	-2,059	-2,094
Firm Power Sales	-243	-218	-212	-159	-159	-9	-9	-8	-8	-8	-8	-8	-8	-7	-7	-7	-7	-7	-7	-7
Total Requirements	**-1,757**	**-1,774**	**-1,809**	**-1,804**	**-1,832**	**-1,710**	**-1,736**	**-1,756**	**-1,778**	**-1,800**	**-1,822**	**-1,846**	**-1,876**	**-1,908**	**-1,944**	**-1,971**	**-2,002**	**-2,033**	**-2,067**	**-2,102**
RESOURCES																				
Firm Power Purchases	85	85	85	85	85	85	85	83	83	82	82	82	82	82	82	82	82	82	82	82
Hydro Resources	900	819	902	859	866	864	885	833	840	859	833	840	859	833	840	859	833	840	859	833
Base Load Thermals	799	799	799	799	799	799	799	799	799	799	799	799	799	799	799	551	551	551	551	551
Wind Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peaking Units	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176
Total Resources	**1,960**	**1,880**	**1,962**	**1,919**	**1,926**	**1,924**	**1,945**	**1,891**	**1,897**	**1,916**	**1,891**	**1,896**	**1,916**	**1,890**	**1,896**	**1,668**	**1,642**	**1,648**	**1,668**	**1,642**
Peak Position Before Reserves Planning	**203**	**106**	**152**	**116**	**94**	**214**	**209**	**135**	**119**	**116**	**68**	**51**	**41**	**-18**	**-48**	**-304**	**-361**	**-385**	**-399**	**-460**
RESERVE PLANNING																				
Required Operating Reserves	-153	-157	-159	-160	-162	-155	-157	-160	-161	-163	-165	-167	-169	-171	-172	-157	-156	-157	-158	-158
Available Operating Reserves	155	66	171	159	159	159	161	158	158	161	158	158	161	158	158	161	158	158	161	158
Planning Margin	-227	-233	-240	-247	-251	-255	-259	-262	-266	-269	-272	-276	-280	-285	-290	-295	-299	-304	-309	-314
Total Reserves Planning	**-227**	**-325**	**-240**	**-248**	**-255**	**-255**	**-259**	**-264**	**-269**	**-271**	**-279**	**-285**	**-289**	**-298**	**-304**	**-295**	**-299**	**-304**	**-309**	**-314**
Peak Position With Reserves Planning	**-24**	**-220**	**-87**	**-132**	**-161**	**-41**	**-50**	**-129**	**-150**	**-155**	**-211**	**-234**	**-249**	**-316**	**-352**	**-599**	**-660**	**-689**	**-708**	**-774**
Planning Margin Before NW Market	**20%**	**10%**	**18%**	**15%**	**14%**	**22%**	**21%**	**17%**	**16%**	**15%**	**12%**	**11%**	**11%**	**7%**	**6%**	**-7%**	**-10%**	**-11%**	**-12%**	**-14%**
Avista Share of Excess NW Capacity	275	221	178	141	107	78	52	31	10	3	0	0	0	0	0	0	0	0	0	0
Peak Position With NW Market	**251**	**1**	**91**	**9**	**-54**	**36**	**2**	**-98**	**-140**	**-152**	**-211**	**-234**	**-249**	**-316**	**-352**	**-599**	**-660**	**-689**	**-708**	**-774**
Peak Position With NW Market	**36%**	**22%**	**28%**	**23%**	**20%**	**26%**	**24%**	**18%**	**16%**	**16%**	**12%**	**11%**	**11%**	**7%**	**6%**	**-7%**	**-10%**	**-11%**	**-12%**	**-14%**

Table 2.9: Average Annual Energy Position (aMW)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
TOTAL LOAD OBLIGATIONS																				
Native Load	-1,109	-1,131	-1,148	-1,165	-1,186	-1,209	-1,228	-1,244	-1,260	-1,277	-1,293	-1,310	-1,333	-1,357	-1,386	-1,406	-1,429	-1,452	-1,477	-1,502
Firm Power Sales	-140	-127	-109	-58	-58	-6	-6	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
Total Requirements	**-1,249**	**-1,258**	**-1,258**	**-1,223**	**-1,244**	**-1,215**	**-1,234**	**-1,249**	**-1,266**	**-1,282**	**-1,298**	**-1,316**	**-1,338**	**-1,362**	**-1,391**	**-1,411**	**-1,434**	**-1,457**	**-1,482**	**-1,507**
RESOURCES																				
Firm Power Purchases	163	164	163	165	163	112	111	91	66	66	65	65	65	65	65	65	65	65	65	65
Hydro	522	525	527	495	495	495	490	481	481	481	481	481	481	481	481	481	481	481	481	481
Base Load Thermals	755	714	751	744	746	741	724	758	721	721	758	721	721	758	684	515	541	515	515	541
Total Resources	**1,441**	**1,403**	**1,442**	**1,405**	**1,404**	**1,348**	**1,325**	**1,330**	**1,268**	**1,268**	**1,304**	**1,266**	**1,267**	**1,304**	**1,229**	**1,060**	**1,087**	**1,060**	**1,060**	**1,087**
Energy Position Before Contingency Planning	**191**	**145**	**184**	**182**	**161**	**133**	**91**	**81**	**2**	**-14**	**6**	**-49**	**-71**	**-58**	**-162**	**-351**	**-347**	**-397**	**-421**	**-421**
CONTINGENCY PLANNING																				
Peaking Resources	153	153	153	138	153	154	153	147	146	145	147	146	145	147	146	145	147	146	145	147
Contingency	-228	-229	-230	-231	-232	-233	-233	-216	-197	-198	-198	-199	-200	-201	-202	-203	-204	-205	-206	-200
Energy Position With Contingency Planning	**116**	**69**	**108**	**89**	**82**	**54**	**11**	**13**	**-49**	**-67**	**-46**	**-103**	**-126**	**-112**	**-218**	**-408**	**-405**	**-456**	**-482**	**-475**
Energy Margin	**28%**	**24%**	**27%**	**26%**	**25%**	**24%**	**20%**	**18%**	**12%**	**10%**	**12%**	**7%**	**6%**	**7%**	**-1%**	**-15%**	**-14%**	**-17%**	**-19%**	**-18%**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 60 of 1069

3. Energy Efficiency

Introduction

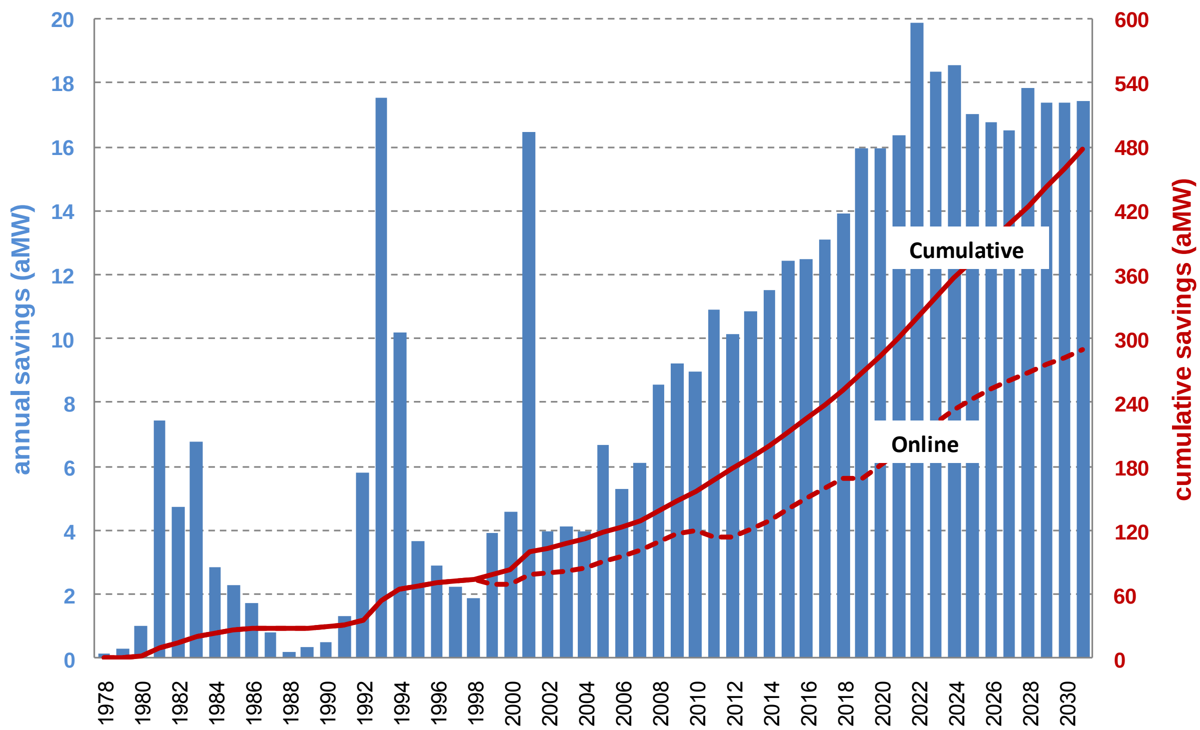
Avista began offering energy efficiency programs in 1978. Some of the most notable efficiency achievements include the Energy Exchanger program. It converted approximately 20,000 homes from electricity to natural gas space and/or water heating from 1992 to 1994. Avista pioneered the country's first system benefit charge for energy efficiency in 1995. Our conservation response during the 2001 Western Energy Crisis exceeded all expectations. Conservation programs regularly meet or exceed regional shares of energy efficiency gains as outlined by the Northwest Power Planning and Conservation Council (NPCC).

Section Highlights

- Avista began offering conservation programs in 1978.
- This IRP includes a Conservation Potential Assessment of the Company's Idaho and Washington service territories.
- Conservation reduces load growth by 48 percent through the IRP timeframe.
- Company-sponsored conservation reduces retail loads by approximately 10 percent, or 120 aMW.
- Avista evaluated over 2,800 equipment options and over 1,500 measure options covering all major end-use equipment, as well as devices and actions to reduce energy consumption for this IRP.

Figure 3.1 illustrates Avista's historical electricity conservation acquisitions. The Company has acquired 156.3 aMW of energy efficiency since 1978; however, the assumed 18-year average life of the conservation portfolio means that some of the measures have reached the end of their useful lives and are no longer reducing loads. The 18-year assumed measure life accounts for the difference between the Cumulative and Online lines in Figure 3.1.

Figure 3.1: Historical and Forecast Conservation Acquisition



Energy efficiency programs provide a range of conservation and education programs to residential, low-income, commercial, and industrial customer segments. The programs are either prescriptive or site-specific. Prescriptive programs, or standard offers, provide cash incentives for standardized products such as the installation of high-efficiency appliances. Prescriptive programs are suitable in situations where uniform products or offerings are applicable for large groups of homogeneous customers. Standardized programs are primarily for residential and small commercial customers. Site-specific programs, or customized services, provide cash incentives for any cost-effective energy savings measure or equipment with an economic payback greater than one year and less than eight years for lighting projects or between one and 13 years for all other end-uses and technologies.

Efficiency programs with paybacks of less than one year are not eligible for incentives, though Avista will assist a customer in program design and implementation. Site-specific programs require customized services for commercial and industrial customers because of the unique characteristics of customers' premises and processes. In some cases, when it can be established that similar applications of energy efficiency measures results in somewhat consistent savings estimates and the technically achievable savings potential is high, a prescriptive approach is offered. An example is prescriptive lighting for commercial and industrial applications. While this application is not purely prescriptive in the traditional sense, such as with a residential program, a more prescriptive approach for these types of similar energy efficiency installations provides for an ease of marketability to customers and vendors.

To be consistent with I-937 conservation targets (WAC 480-109 and RCW 19.285) and the NPCC Sixth Power Plan, Avista supplements its energy efficiency activities by including potentials for transmissions and distribution efficiency measures. More details about the transmission and distribution efficiency projects are in the Transmission & Distribution chapter of this IRP.

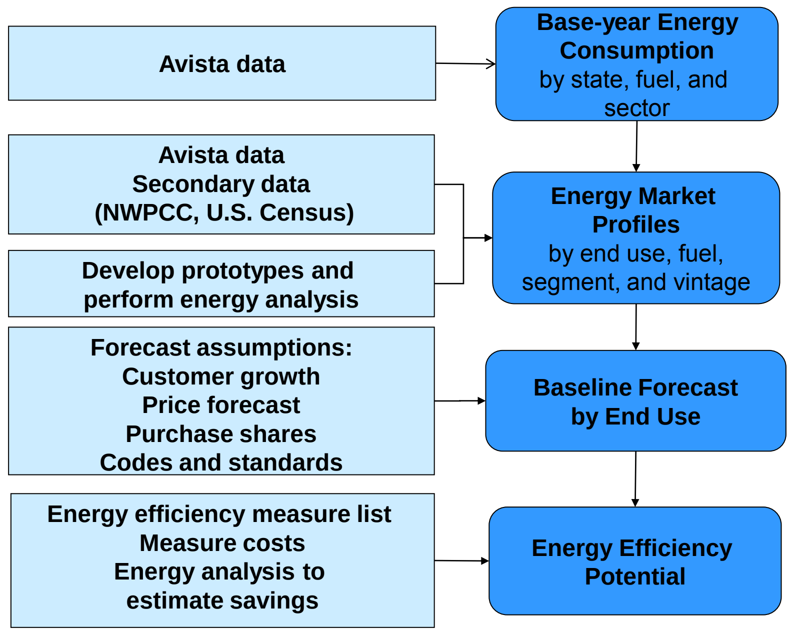
Conservation Potential Assessment Approach

After publication of the 2009 Electric IRP, the Washington Utilities and Transportation Commissions (UTC) requested an external Conservation Potential Assessment (CPA) study for the 2011 IRP. Avista in 2010 retained Global Energy Partners (Global) to conduct this study for its Idaho and Washington electric service territories. The CPA identifies a 20-year potentials study for energy efficiency and demand response and provides data on resources specific to Avista's service territory for use in the 2011 IRP and in accordance with the energy efficiency goals in Washington's Energy Independence Act (I-937). The energy efficiency potentials consider such things as the impacts of existing programs, naturally occurring energy savings, the impacts of known building codes and standards as of 2010, technology developments and innovations, changes to the economy and energy prices.

Global took the following steps to assess and analyze energy efficiency and demand response potentials in the Company's service territory. Figure 3.2 illustrates the steps.

1. Perform a market assessment of base year consumption for the residential (including low income), commercial, and industrial sectors. The assessment uses utility and secondary data to characterize customers' electric usage behavior in Avista's service territory. Global uses this market assessment to develop energy market profiles that describe energy consumption by market segment, vintage (existing versus new construction), end-use, and technology.
2. Develop a baseline energy forecast by sector and by end-use for the entire study period.
3. Identify and analyze energy-efficiency measures appropriate for Avista's service territory, including regional savings from energy efficiency measures acquired through the Northwest Energy Efficiency Alliance (NEEA) efforts.
4. Estimate technical, economic, and achievable energy efficiency potential. Technical potential involves choosing the most efficient measure, regardless of cost. Economic potential involves choosing the most efficient cost-effective measure. Achievable potential adjusts economic potential to account for factors other than pure economics, such as consumer behavior or market penetration rates.

Figure 3.2: Analysis Approach Overview



The CPA uses 2009 calendar year data, the first complete year of billing data available when the study began. Avista's recent load study, which also uses a 2009 baseline year, contributed to the selection of the 2009 baseline year for the CPA. This was Avista's first external CPA for its Idaho and Washington service territories.

The CPA segments Avista customers by state and by rate class. The rate classes used in this study included residential, commercial and industrial, general service, commercial and industrial large general service, extra large commercial, and extra large industrial. The residential class was further segmented into single family, multi-family, mobile home and low income customers. The low-income threshold used for this study was defined as 200 percent of the federal poverty level. Global used the NPCC calculator to determine future efficiency potentials for the pumping rate class, which represents 2 percent of total utility loads. Pumping schedules are included in the calculation of demand response potential, as discussed in the Demand Response section of this chapter. Within each segment, energy use was characterized by end-use (e.g., space heating, cooling, lighting, water heat, motors, etc.) and by technology (e.g., heat pump, resistance heating, or furnace for space heating).

The baseline forecast is the "business as usual" metric without new utility conservation programs. Energy savings from new energy efficiency measures are compared against this baseline. This baseline of annual electricity consumption and peak demand by customer segment and end-use supports projections of energy usage absent future efficiency programs. The baseline forecast includes projected impacts of known building codes and energy efficiency standards as of 2010 when the study was conducted that have direct bearings on the amount of utility program energy efficiency potential that exists over and above the effects of these efforts, including projected market condition changes. Market changes include customer and market growth, income growth, retail rates forecasts, trends in end-use and technology saturations, equipment purchase decisions, consumer price elasticity, income and persons per household, as well as customer potential estimates in the context of total energy use in the future so that projections of available energy efficiency savings can be derived.

The baseline forecast used in the CPA, prior to the consideration of efficiency potentials, projects overall electricity consumption growth of 48 percent. This compounded average annual growth rate of 1.7 percent during this 20-year period is consistent with Avista's current and previous IRP forecasts.

For each customer sector, a robust list of electrical energy efficiency measures was compiled, drawing upon the NPCC Sixth Power Plan, the Regional Technical Forum (RTF), and other measures considered applicable to Avista. This list of energy efficiency equipment and measures included 2,808 equipment options and 1,524 measure options, representing a wide variety of end-use equipment, as well as devices and actions able to reduce energy consumption. A comprehensive equipment list and measure options are in Appendix C. Measure cost, savings, estimated useful life, and other performance factors were characterized for the list of measures and economic screening was performed on each measure for every year of the study to develop the economic potential. Many measures do not pass the economic screen of avoided cost, but some measures might become part of the energy efficiency program as contributing factors evolve during the 20-year planning horizon.

Overview of Energy Efficiency Potentials

Global utilized an approach adhering to the conventions outlined in the National Action Plan for Energy Efficiency (NAPEE) Guide for Conducting Potential Studies (November 2007).[1] The NAPEE Guide represents the most credible and comprehensive national industry practice for specifying energy efficiency potential. Specifically, three types of potentials are in this study:

Technical Potential

Conservation potential uses the most efficient option commercially available to each purchase decision, regardless of cost. This theoretical case provides the broadest and highest definition of savings potential because it quantifies savings that would result if all current equipment, processes, and practices in all market sectors were replaced by the most efficient and feasible technology. Technical potential does not take into account the cost-effectiveness of the measures. Further, this study defines technical potential as "phase-in technical potential," assuming only that the portion of the current equipment stock that has reached the end of its useful life and is due for turnover is changed out by the most efficient measures available. Non-equipment measures, such as controls and other devices (e.g., programmable thermostats) phase-in over time, just like the equipment measures. Lighting retrofits, which are in

[1] National Action Plan for Energy Efficiency (2007). *National Action Plan for Energy Efficiency Vision for 2025:* Developing a Framework for Change. www.epa.gov/eeactionplan.

effect early replacements of existing lighting systems, count as a non-equipment measure in this CPA study.

Economic Potential[2]

Economical conservation results from the purchase of the most cost-effective option available for a given equipment or non-equipment measure. Cost effectiveness is determined by applying the Total Resource Cost (TRC) test using all quantifiable costs and benefits regardless of who accrues them and inclusive of non-energy benefits as identified by the Council.[3] The inclusion of non-energy benefits did not make any of the failing measures pass. Measures that passed the economic screen represent aggregate economic potential. As with technical potential, economic potential calculations use a phased-in approach. Economic potential is a hypothetical upper-boundary of savings potential representing only economic measures; it does not consider customer acceptance and other factors.

Achievable Potential

Achievable Potential refines economic potential by taking into account expected program participation, customer preferences, and budget constraints. For purposes of this particular CPA, Global provided two types of achievable potential – Maximum and Realistic.

Maximum Achievable Potential is the upper boundary of the achievable potential range or the maximum achievable savings that could be achieved through Avista’s energy efficiency programs. Maximum Achievable Potential presumes incentives that are sufficient to ensure customer adoption. Oftentimes, incentives take the form of rebates that typically represent a substantial portion of the customer’s extra cost for the energy efficient measure. These high incentives are combined with substantial administrative and marketing costs that are used for customer awareness campaigns and educational opportunities. It also considers a maximum participation rate by customers for the various energy efficiency programs designed to deliver the various measures. Global also developed a Market Acceptance Rate which is a factor based on the Council’s ramp rate curves used in the Sixth Power Plan. These factors were applied to the estimate of economic potential from the CPA study to estimate Maximum Achievable Potential.

Realistic Achievable Potential represents the lower boundary of achievable potential or a forecast of achievable savings resulting from customer behavior and penetration rates of efficient technologies. It uses a set of Program Implementation Factors, which take into account existing market, financial, political and regulatory barriers that are likely to limit the amount of savings that may be achieved through energy efficiency programs.

[2] The Industry definition of economic potential and the definition of economic potential referred to in this document are consistent with the definition of “realizable potential for all realistically achievable units”.

[3] There are other tests that can be used to represent the economic potential (e.g., Participant or Utility Cost), but the TRC is generally accepted as the most appropriate representation of economic potential because it tends to be most representative of the net benefits of energy efficiency to society as a whole. The economic screen uses the TRC as a proxy for moving forward and representing achievable energy efficiency savings potential for those measures that are most widely cost-effective.

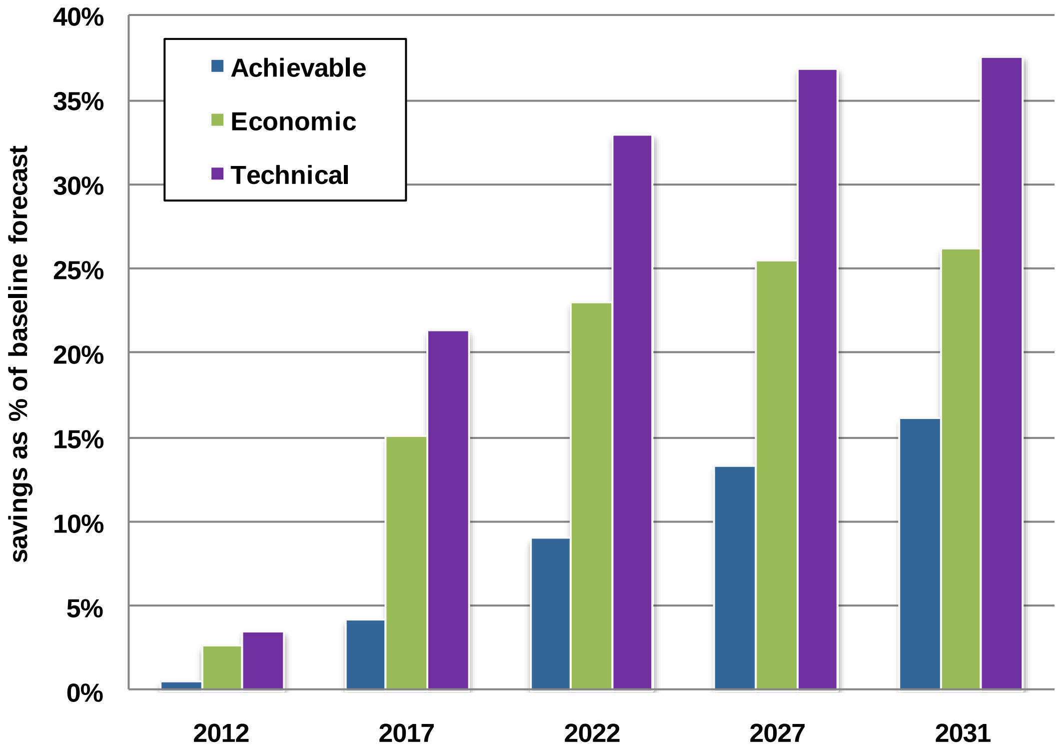
For example, it considers that other goals such as low rates and customer equity influence the development of final program designs and savings targets. It also considers customer incentive levels that are in line with typical industry practice, defined marketing campaigns, and internal budget constraints. Political barriers often reflect differences in regional attitudes toward energy efficiency and its value as a resource. The Realistic Achievable Potential also reflects recent utility experience and reported savings from past and present programs.

The CPA forecasts incremental annual Maximum Achievable Potential for all sectors at 9.8 aMW (85,824 MWh) in 2012, increasing to cumulative savings of 321.4 aMW (2,815,551 MWh) by 2031. The CPA forecasts annual Realistic Achievable Potential for all sectors at 5.7 aMW (or 49,804 MWh) in 2012, increasing to cumulative savings of 231.2 aMW (or 2,025,679 MWh) by 2031. Table 3-1 and Figure 3-3 show the CPA results for baseline energy use, technical, economic, and realistic achievable potential. The projected baseline electricity consumption forecast increases 43 percent during the 20-year planning horizon. Projected achievable energy savings, as a percentage of the baseline energy forecast, grows from 0.6 percent in 2012 to 16.1 percent in 2031. Figure 3.3 compares the technical, economic, achievable potentials, and cumulative first-year savings, at selected years. It is important to note, that in the early years, the difference between Maximum Achievable Potential and Realistic Achievable Potential is minimal and converges at the end of the 20-year planning horizon. Realistic Achievable Potential merely adjusts assumptions regarding the rate at which the savings are estimated to be acquired during the planning period.

Table 3.1: Energy Forecasts and Cumulative Savings (Across All Sectors for Selected Years)

Energy Forecasts (MWh)	**2012**	**2017**	**2022**	**2027**	**2031**
Baseline Forecast	8,799,039	9,463,880	10,417,347	11,536,869	12,574,182
Achievable	8,749,236	9,068,483	9,476,769	9,998,002	10,548,503
Economic	8,569,382	8,037,426	8,018,993	8,594,412	9,282,289
Technical	8,487,766	7,441,765	6,981,872	7,281,206	7,842,616
Energy Savings (MWh)	**2012**	**2017**	**2022**	**2027**	**2031**
Achievable	49,804	395,397	940,578	1,538,868	2,025,679
Economic	229,657	1,426,454	2,398,355	2,942,457	3,291,894
Technical	311,274	2,022,115	3,435,475	4,255,664	4,731,566
Energy Savings (% of Baseline)	**2012**	**2017**	**2022**	**2027**	**2031**
Achievable	0.6%	4.2%	9.0%	13.3%	16.1%
Economic	2.6%	15.1%	23.0%	25.5%	26.2%
Technical	3.5%	21.4%	33.0%	36.9%	37.6%

Figure 3.3: Cumulative Conservation Potentials, Selected Years



Conservation Targets

This IRP process includes conservation targets for Washington's energy efficiency portion of the Energy Independence Act (I-937) goal. Other components including conservation from distribution and transmission efficiency improvements also meeting this target would be additive to this conservation target for a complete target for Washington comparable to what is included in the Sixth Power Plan target. Additionally, since this IRP uses a methodology consistent with the NPCC methodology, the conservation target for Idaho is more aggressive than required.

Based on first year and incremental savings, Table 3.2 illustrates Avista's Realistic and Maximum Achievable Potential for 2012-2013, as well as a comparison with the Sixth Power Plan's calculator option 1. This calculator is intended to provide an approximation of the level of conservation that utilities should target in order to be consistent with the Council's regional goals. The CPA study completed for Avista incorporates this methodology into an Avista-specific estimate of savings potential to be acquired through its programs.

During the first five years, lighting and appliance standards slow residential baseline growth rates, reducing the potential for savings from residential energy efficiency programs. Commercial and industrial potential shows consistent growth.

For the 2012-2013 compliance period, the Sixth Power Plan goal is within the goal range developed in the CPA, with a floor of Realistic Achievable Potential and a ceiling of Maximum Achievable Potential. However, the Sixth Power Plan includes components other than conservation such as distribution system efficiencies. When savings due to these efficiencies are subtracted from the Sixth Power Plan goals, the resulting values are well within the range of the potential study.

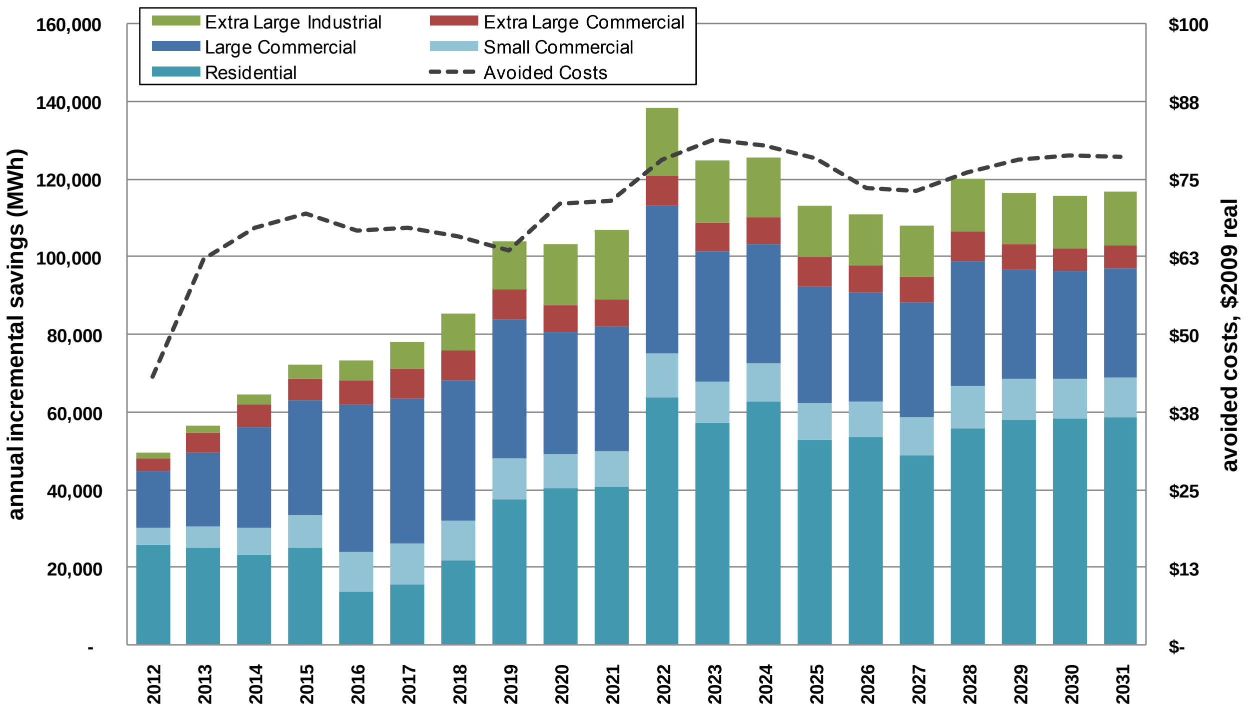
Table 3.2: Incremental Annual Achievable Potential Energy Efficiency (aMW)

	2012	2013
NPCC Sixth Power Plan Target		
Idaho	5.17	5.60
Washington	8.22	8.90
Total	**13.39**	**14.50**
Less Distribution Efficiency from the Sixth Plan		
Idaho	-0.22	-0.28
Washington	-0.47	-0.60
Total	**-0.69**	**-0.88**
Sixth Power Plan Target without Distribution Efficiency		
Idaho	4.95	5.32
Washington	7.75	8.30
Total	**12.70**	**13.62**
Incremental Achievable Potential Range[4]		
Idaho	1.95 – 3.50	2.17 – 4.51
Washington	3.74 – 6.30	4.31 – 8.58
Total	**5.69 – 9.80**	**6.48 – 13.09**
Achievable from Existing Programs		
Idaho	1.58	1.55
Washington	2.93	2.85
Total	**4.51**	**4.40**
Goal Range per Conservation Potential Assessment		
Idaho	3.53 – 5.09	3.72 – 6.06
Washington	6.67 – 9.23	7.16 – 11.43
Total	**10.20 – 14.32**	**10.88 – 17.49**

Figure 3.4 shows incremental annual achievable roughly tracking avoided costs throughout the study period, but factors in addition to avoided cost can influence achievable potential, particularly where programs are ramping up or are ramping down. These impacts are particularly relevant in the early years of the CPA study.

[4] Incremental Realistic Achievable Potential was used for purposes of modeling resource acquisition from conservation. For I-937, a range target will be presented with the ceiling of the range being Maximum Achievable Potential and the floor being Realistic Achievable Potential as determined by the independent CPA.

Figure 3.4: Incremental Annual Achievable Energy Efficiency (MWh) vs. Avoided Cost[5]



Electricity to Natural Gas Fuel Switching

Fuel switching from electricity to natural gas is included in the targets as described above. Tables 3.3 and 3.4 illustrate savings potentials from converting electric furnaces and water heaters to natural gas. Nearly all savings are in the residential sector. Conversion ramps up slowly, but because it removes most of the electricity use from two of the largest residential end uses (water heating and space heating), it accounts for a substantial portion of savings by 2031. For water heating, about one-fourth of the savings from gas conversions occurs in new construction. For furnaces, new construction accounts for roughly one-third of the total.

Table 3.3: Cumulative Achievable Savings from Conversion to Natural Gas

	2012	2017	2022	2027	2031
Water heater - convert to gas potential (MWh)	45.7	4,967	69,406	146,834	201,182
Water heater - convert to gas percentage of total potential	0.1%	1%	7%	10%	10%
Furnace - convert to gas potential (MWh)	10.1	2,527	45,979	108,447	158,470
Water heater - convert to gas percentage of total potential	0.0%	1%	5%	7%	8%

5 Avoided costs are 2009 real dollars and include energy costs, risk, losses, avoided T&D, and the 10 percent Power Act premium.

Table 3.4: Cumulative Achievable Savings from Conversion to Natural Gas by State (MWh)

Washington Conversion Potential	2012	2017	2022	2027	2031
Water heater - convert to gas potential	36	3,966	55,623	117,942	161,411
Furnace - convert to gas potential	1	1,509	31,082	76,213	112,522
Total Washington conversion potential	37	5,475	86,705	194,155	273,933
Idaho Conversion Potential	**2012**	**2017**	**2022**	**2027**	**2031**
Water heater - convert to gas potential	10	1,001	13,783	28,893	39,770
Furnace - convert to gas potential	9	1,018	14,898	32,234	45,948
Total Idaho conversion potential	19	2,019	28,681	61,127	85,718

Comparison with the Sixth Power Plan Methodology

As required by Washington Administrative Code (WAC) Chapter 480-109-010 (3)(c), Avista below describes the technologies, data collection, processes, procedures and assumptions used to develop its I-937 biennial targets, along with changes in assumptions or methodologies used in the Company's IRP or the NPCC Sixth Power Plan. WAC Chapter 480-109-010 (4)(c) requires UTC approval, approval with modifications, or rejection of the targets.

Global met with the NPCC staff to compare methodologies and approaches to ensure methodological consistency. The CPA methodology is consistent with the Sixth Power Plan in several key ways. Both the NPCC Sixth Power Plan and Global's approaches utilized end-use models employing a bottom-up approach. The models draw on appliance stock, saturation levels and efficiencies information to construct future load requirements. Global conducted a thorough review of baseline and measure assumptions used by the NPCC and developed a baseline energy use projection, absent any additional energy efficiency measures while including the impact of known codes and standards currently approved. The study reviewed and incorporated NPCC assumptions when Avista-specific or more updated data was not available.

The CPA study developed a comprehensive list of energy-efficiency technologies and end-use measures, including those in the Sixth Power Plan. Since the efficiency measures, equipment, and other data used in the Sixth Power Plan are somewhat dated, information on measures and equipment specific to Avista were updated for this CPA. Global developed equipment saturations, measure costs, savings, estimated useful lifetimes and other parameters based on data from the Sixth Power Plan Conservation Supply Curve workbook databases, the Regional Technology Forum, NEEA reports, and other data sources. Similar to the Sixth Power Plan, the study accounts for the difference between lost and non-lost opportunities, and how this affects the rate at which energy efficiency measures penetrate the market. The study used the Total Resource Cost (TRC) test as the measure for judging cost-effectiveness. A comprehensive list of measures and equipment evaluated in the CPA study is included in Appendix C. For a more detailed discussion of measures and equipment evaluated within the potential study, please refer to the Conservation Potential Assessment report prepared by Global in Appendix D.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 72 of 1069

After screening measures for cost-effectiveness, the CPA applied a series of factors to evaluate realistic market acceptance rates and program implementation considerations. The resulting achievable potential reflects the realistic deployment rates of energy efficiency measures in Avista's service territory. These factors account for market barriers, customer acceptance, and the time required to implement programs. To develop these factors, Global reviewed the ramp rates used in the Sixth Power Plan Conservation Supply Curve workbooks and considered Avista's experience.

The Sixth Power Plan assesses a 20-year period beginning in 2010, while the CPA study begins in 2012. Where the Sixth Power Plan relies on average regional data, the CPA utilized data from Avista's service territory, as well as more recent economic data. Therefore, an allocation of regional potential based on sales, as applied in the Sixth Power Plan, would not necessarily account for Avista's unique service territory characteristics such as customer mix, use per customer, end-use saturations, fuel shares, current measure saturations, and expected customer and economic growth. In addition, some industries included in the Sixth Power Plan might not exist in Avista's service territory. While the Sixth Power Plan incorporates Distribution System efficiencies, the Avista CPA includes only energy efficiency from energy conservation while Distribution System efficiencies and Thermal System efficiencies would be incorporated into Avista's I-937 targets from other sources.

The Sixth Power Plan assumed that 85 percent of the cost-effective, or economic, non-lost opportunity potential will be achieved over the 20 years covered by the Sixth Power Plan. The projected achievement amount during the first 10 years (consistent with the I-937 timeframe) is approximately 60 percent. For lost opportunities, the plan assumes achievement of approximately 65 percent of the cost-effective, or economic, potential during the 20-year period. Due to ramp rates used within the plan, this equates to only 37 percent achievement within the first 10 years, the period considered for I-937. The CPA study assumed that cost-effective measures reach a maximum saturation level of 85 percent over the 20-year period for lost opportunities, and 65 percent to 85 percent for non-lost opportunities. These figures equal or exceed adoption rates assumed within the Sixth Power Plan.

Sensitivity of Potential to Customer and Economic Growth

The CPA study shows that energy efficiency offsets roughly 50 percent of load growth, whereas the Sixth Power Plan estimates that energy efficiency can offset 80 percent. While Avista's service territory differs from the larger region in many ways, including its climate and particular customer mix, there are other contributing factors to this difference. One significant factor may be the CPA customer and economic growth assumptions. To understand how growth affects the results of the study, Global LoadMAP modeled several scenarios with lower customer and economic growth, as indicated in Table 3.5.

Table 3.5: Varying Growth Scenario Descriptions

	Reference Scenario	Low Growth Scenario 1	Low Growth Scenario 2
Home size (physical size in square feet)	~ 1% per year growth	Capped at 110% of existing household size	Capped at 110% of existing household size
Per capita income growth	1.6% 2011–2015; 2.2% 2016–2020; 2.1% thereafter	1.6% after 2016	1.6% after 2016
Residential sector market growth	1.30% after 2015 (WA) 1.25% after 2015 (ID)	no change	1.0% after 2015 (WA & ID)
Commercial sector market growth, Washington & Idaho	~ 2.0% (varies by segment)	no change	1.0% all segments

Table 3.6 shows that as economic and customer growth decreases, the ability of energy efficiency to offset growth increases. In the reference scenario, energy efficiency offsets 54 percent of growth in consumption, while in the lower growth scenarios, energy efficiency offsets 55 percent and 77 percent of growth. This is the case because with reduced levels of new construction, both load growth and energy savings drop, but savings from the retrofit of existing buildings are a greater proportion of overall growth.

Table 3.6: Varying Growth Scenario Results (MWh)

	Reference Scenario	Low Growth Scenario 1	Low Growth Scenario 2
Baseline forecast 2012	8,799,039	8,799,039	8,799,033
Baseline forecast 2031	12,574,182	12,272,136	11,025,256
Load Growth 2012-2031	3,775,143	3,473,097	2,226,222
Achievable potential case forecast 2031	10,697,432	10,361,667	9,302,736
Achievable potential savings 2031	2,025,679	1,910,469	1,722,519
Percentage of growth offset	54%	55%	77%

Avoided Cost Sensitivities

Global modeled several scenarios with varying avoided costs assumptions in addition to the Expected Case used for the 2011 IRP to test sensitivity to changes in avoided costs. The scenarios included 150 percent, 125 percent, and 75 percent of the avoided costs relative to the Expected Case. Figure 3.5 illustrates the avoided cost scenarios. Overall, due to the technical potential ceiling, energy efficiency proved to be insensitive to avoided cost assumptions. In particular, acquiring incremental energy efficiency becomes increasingly expensive, so that increases in avoided costs do not provide equivalent percentage increases in achievable potential. The Expected Case achievable potential is approximately 16.8 percent of the baseline forecast by 2031. With the 150 percent avoided cost case, achievable potential increases by 15 percent compared with the Expected Case reference scenario, while the 125 percent and the 75 percent avoided cost cases yielded achievable potential equal to 79 percent and 108 percent of the reference scenario respectively. Table 3.5 shows achievable potential under the four avoided cost scenarios.

In 2012, 52 percent of the projected achievable potential is from residential class measures. By 2017, a shift occurs whereby 68 percent of the achievable potential comes from non-residential classes, with the significant portion of these savings, 42 percent, estimated to come through the large general service segment. In the residential sector in 2017, approximately 40 percent of projected savings come from interior lighting, followed by water heating, space heating and electronics. In subsequent years, residential savings from lighting decreases, with space and water heating providing greater relative savings potential.

In the commercial and industrial sectors, lighting accounts for approximately 62 percent of savings potential in 2017 followed by heating, ventilation and air conditioning (HVAC), office equipment, exterior lighting and machine drives. Over time, the savings potential from lighting decreases, but still remains close to half of the savings potential in 2031.

Figure 3.5: Energy Savings, Achievable Potential Case by Avoided Costs Scenario

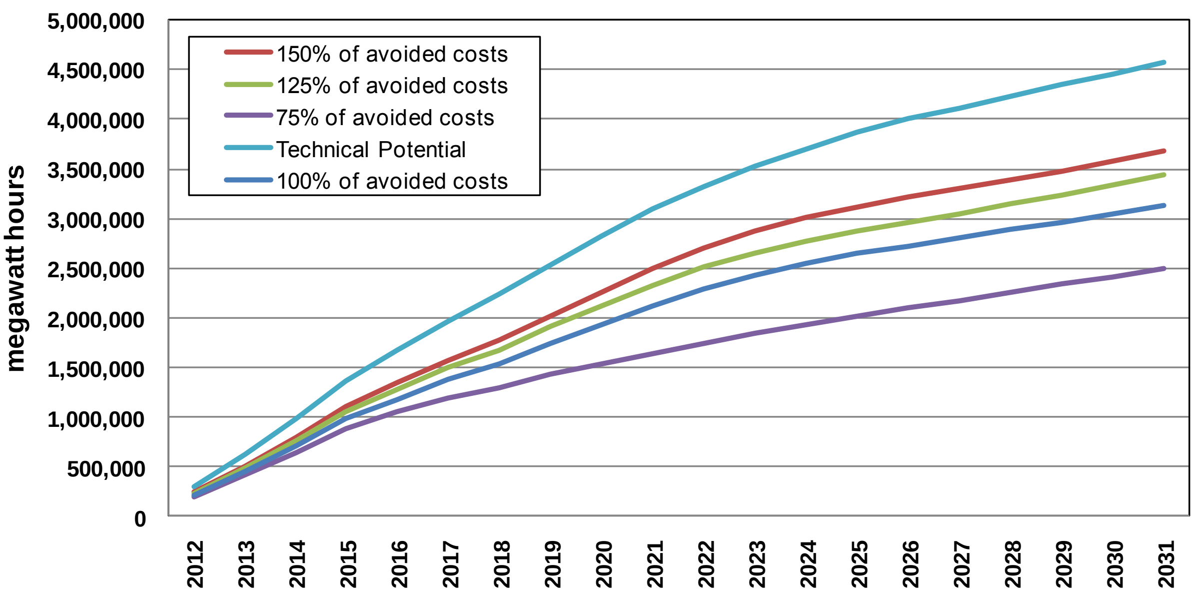


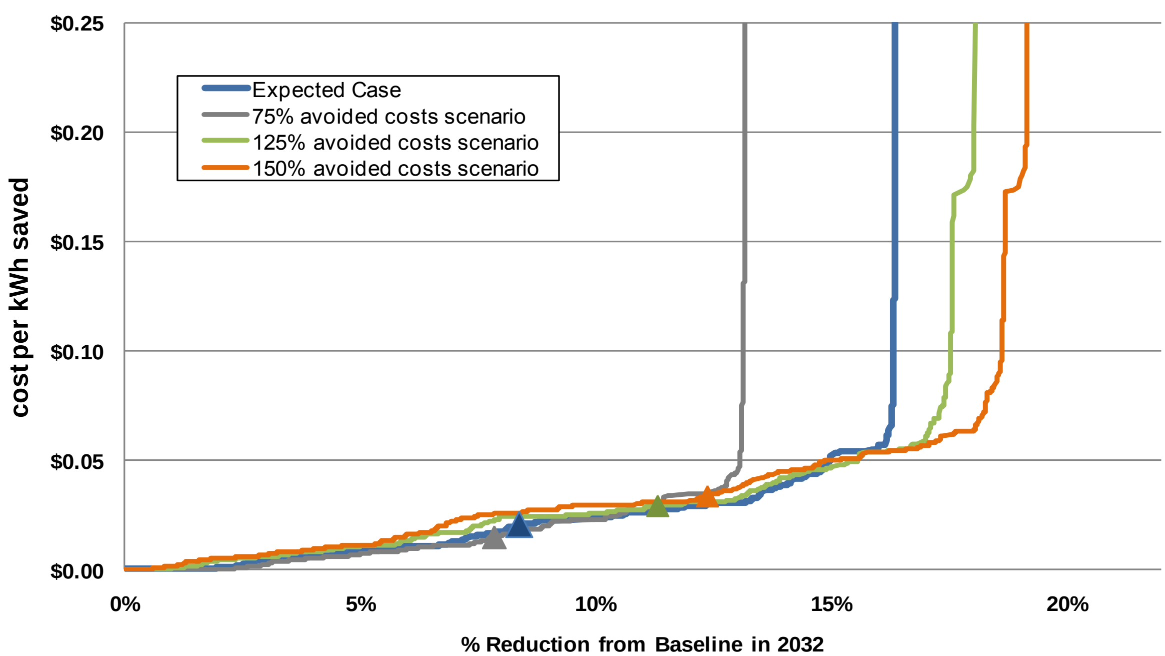
Table 3.7: Achievable Potential with Varying Avoided Costs

	Reference Scenario	75% of Avoided Costs	125% of Avoided Costs	150% of Avoided Costs
Achievable potential savings 2031 (MWh)	2,025,679	1,590,850	2,186,730	2,327,510
Percentage change in savings vs. 100% avoided cost scenario	n/a	-21%	8%	15%

Heat pump water heater measures in the Sixth Power Plan were projected to replace compact fluorescent lights (CFLs) contribution (i.e., significant savings at relatively low costs) in earlier plans. The CPA found that heat pump water heaters are not cost-effective, with the exception of new single-family homes, under the Expected Case. However, the measure becomes cost-effective for more market segments under the 150 percent of avoided cost scenario.

Figure 3.6 shows supply curves composed of the stacked measures and equipment in 2031 in ascending order of avoided cost. Since there is a gap in the cost of the energy efficiency measures moving up the supply curve, the measures with a very high cost cause a rapid sloping of the curve. The portfolio average cost for each case is shown as well. The shift of the supply curve toward the right as avoided costs increase is a consequence of increasing amounts of cost-effective potential, but the average cost of acquiring that potential is increasing also.

Figure 3.6: Supply Curves of the Evaluated Conservation Measures[6]



[6] The triangles in Figure 3.6 indicate the portfolio average cost for each avoided cost scenario.

Energy Efficiency-Related Financial Impacts

I-937 requires utilities with over 25,000 customers to obtain a fixed percentage of their electricity from qualifying renewable resources and to acquire all cost-effective and achievable energy conservation. For the first 24-month period under the law (2010-2011), this equaled a ramped-in share of the regional ten-year target identified in the Sixth Power Plan. Penalties of at least $50 per MWh exist for utilities not achieving Washington targets for conservation resource acquisition.

Regional discussions were under way regarding the definition of “pro-rata” during the 2009 IRP. Avista proposed ramping the 10-year targets identified in the Sixth Power Plan instead of acquiring 20 percent of the first ten-year target identified in the Sixth Power Plan. The “pro-rata” amount would have created drastic ramping challenges, especially in the early years. Due to inconsistencies between the 2009 IRP and the Council’s methodology, the Company elected to use the NPCC’s Option #1 of the Sixth Power Plan to establish its conservation acquisition target, adjusted to include electric-to-natural gas space and water heating fuel conversions. The acquisition target was 11 percent greater than Avista’s IRP energy efficiency target for the same period. In April 2010, the UTC approved the Company’s ten year Achievable Potential and Biennial Conservation Target Report in Docket UE-100176.

The I-937 requirement to acquire all cost-effective and achievable conservation poses significant financial implications for Washington customers. In 2012, the projected incremental annual cost to Washington customers is $2.0 million. This annual amount grows to $41.8 million by the tenth year, representing a total of $199.2 million over this ten-year period for Washington. Figure 3.7 shows the annual cost (in millions) for this acquisition of past and future conservation. As shown in the figure, future cost for new conservation reflects margin returns as compared to historical acquisition.

This incremental level of acquisition driven by Washington I-937 will result in annual rate increases to Washington electric customers of an approximate range of $8 to $302 per average customer across all classes. Figure 3.8 illustrate the annual cost associated with the energy efficiency acquisition required to meet I-937 goals.

Figure 3.7: Cost of Existing & Future Conservation

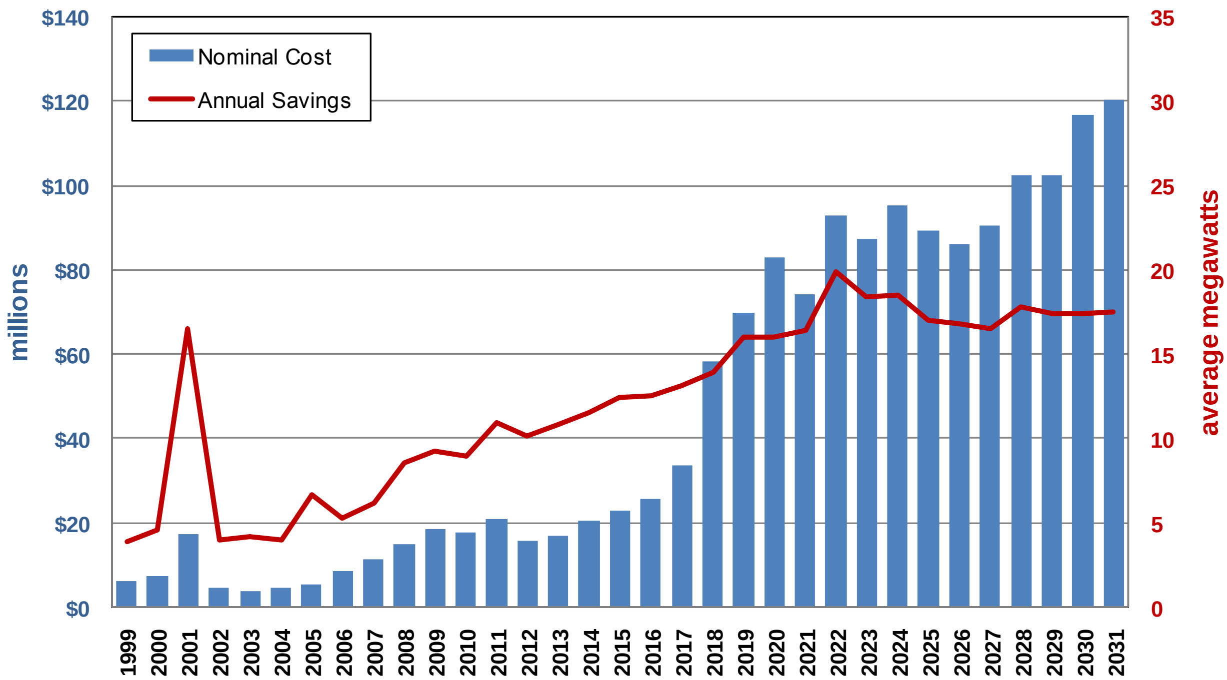
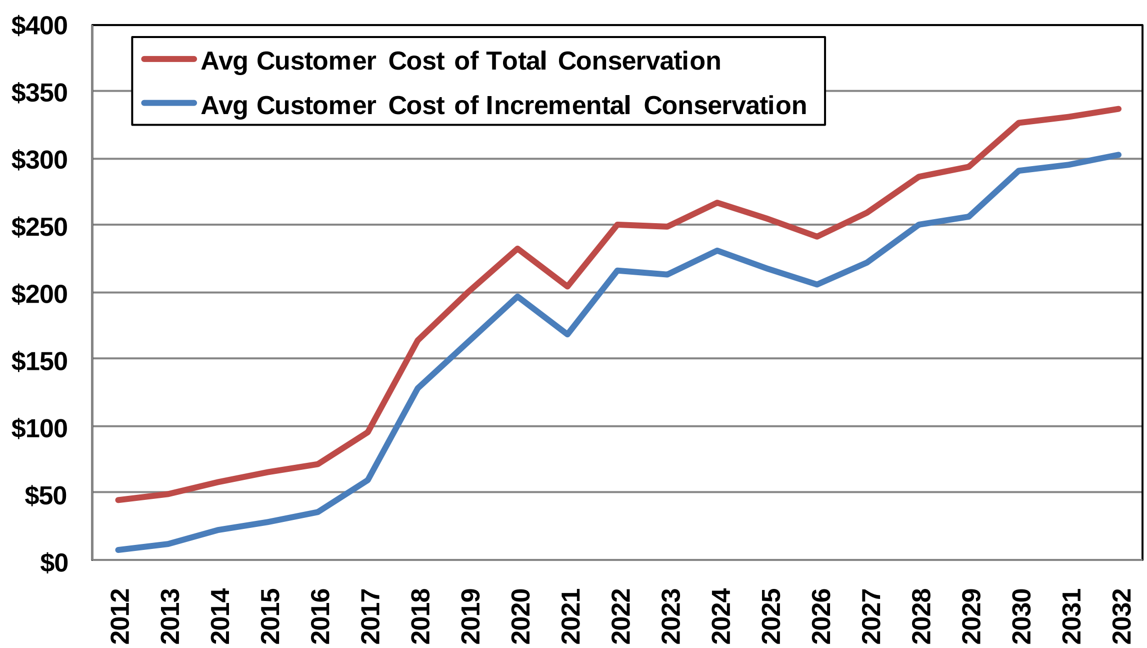


Figure 3.8: Cost of Conservation per Customer per I-937



Integrating Results into Business Planning and Operations

The CPA and IRP energy efficiency evaluation processes provide high-level estimates of cost-effective conservation acquisition opportunities. While results of the IRP analyses establish baseline goals for continued development and enhancement of conservation programs, the results are not detailed enough to form an acquisition plan. Avista uses IRP evaluation results to establish a budget for conservation measures, to help determine the size and skill sets necessary for future conservation operations, and for identifying general target markets for energy efficiency programs. This section provides an overview of recent operations of the individual sectors as well as conservation business planning.

For this IRP, the Company procured its first external conservation potential assessment study for Washington and Idaho from Global Energy Partners. This study is useful for the implementation of energy efficiency programs in the following ways.

- Identifying by sector, segment, end-use and measure where energy savings may come from during the next 20-year timeframe. The implementation staff can use CPA results to determine which segments and end-uses/measures to target through energy efficiency programs.
- Identifying measures with the highest TRC benefit-cost ratios and targeting those lowest cost resources with the greatest benefit.
- Identifying measures that appear to have great adoption barriers by looking at the economic versus achievable results by measure. Implementation staff can then better develop programs around barriers that may exist.
- Improving the design of current program offerings. Implementation staff can review the measure level results by sector and compare the savings with the largest-savings measures currently offered by the Company. This analysis may lead to the elimination of some programs or the addition of other programs. Consideration might be given to identifying lost opportunities (i.e. “low-hanging fruit”) and whether to target one particular measure over another measure. One possibility may be to offer higher incentives on measures with higher benefits and lower incentives on measures with lower benefits.

In addition to how the IRP results and the potential study flow into operational planning, an overview of 2010 and 2011 energy efficiency acquisitions by sector is given below. This is prior to the implementing the actions mentioned above.

Residential Sector Overview

Avista offers most residential energy efficiency programs through prescriptive, or standard offer, programs targeting a range of end-uses. Programs offered through this prescriptive approach by Avista during 2010 included space and water heating conversions, ENERGRY STAR® appliances, ENERGY STAR® homes, space and water equipment upgrades and home weatherization.

Avista offers the remaining residential energy efficiency programs through other channels. For example, a third party administer JACO operates the refrigerator/freezer recycling program. CFL and specialty CFL buy-downs at the manufacturer level provide customers access to lower-priced CFL bulbs. Home energy audits, subsidized by a grant from the American Recovery and Reinvestment Act (ARRA), began in 2010. This program offers home inspections that include numerous diagnostic tests and provides a leave-behind kit containing CFLs and weatherization materials. Finally, Avista provides educational tips and CFLs at various rural and urban events in an effort to reach all areas within its service territory.

Avista processed over 36,000 energy efficiency rebates in 2010, benefiting approximately 25,000 households. Nearly $6.3 million in customer rebates offset the cost of implementing energy efficiency upgrades. Residential programs contributed 24,247 MWh and nearly 1.1 million therms of energy savings.

The results of an Ecotope study resulted in several planned modifications to the 2011 residential programs. These modifications include the discontinuation of the windows program, contractor installed weatherization requirements (eliminating do-it-yourself projects), reducing incentives for electric to natural gas water heater conversion, and the inclusion of the rooftop damper program on the residential form. We address these efficiency program modifications below.

The CPA study illustrates potential markets and provides a list of cost-effective measures analyzed through the on-going energy efficiency business planning process. This review of residential program concepts and their sensitivity to more detailed assumptions will feed into program plans for target markets. Potential measures not currently considered at the time of the CPA that may arise in the future will be reevaluated for possible inclusion in the Business Plan.

Residential Energy Efficiency Offering In Depth

Avista encourages customers to take part in home energy audits. Employees and customers in Spokane County can sign up for a comprehensive home energy audit offered by Avista for as low as $49. Funding for this pilot program comes from a combination of Avista energy efficiency funds and federal stimulus dollars through the Energy Efficiency Community Block Grant program. Avista collaborated with the City of Spokane, Spokane County and the City of Spokane Valley to provide this program at a significantly reduced cost.

The home energy audits use certified professionals with state-of-the-art equipment and techniques to identify home energy use and safety improvements. The auditor discusses existing energy use, if there are any energy efficiency concerns, and areas of the home that are not as comfortable as owners would like them to be. Once the audit is complete, the customer receives a detailed report on the findings, along with recommendations to make their home more energy efficient.

In addition to a wealth of information, participating homeowners receive an energy efficiency/weatherization kit with a retail value of approximately $50. It contains compact fluorescent light bulbs, low-flow showerheads, expanding foam sealant and other energy-saving materials. Customers are able to visit www.avistautilties.com to find out more and to view a video about this and other energy efficiency programs.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 80 of 1069

Limited Income Sector Overview

Six Community Action Agencies (CAAs) administer low-income programs. During 2010 these programs targeted a range of end-uses including space and water heating conversions, ENERGY STAR refrigerators, space and water heating equipment upgrades, and weatherization which are offered site-specifically through individualized home audits. The Company also funds health and human safety investments considered necessary to ensure habitability of homes and protect investments in energy efficiency, as well as administrative fees enabling CAAs to continue to deliver these programs.

During 2010, the Company convened the Low Income Collaborative to explore new approaches promoting low-income conservation, identify barriers to its development and to address issues raised by The Energy Project in Avista's 2009 Washington General Rate Case. On September 1, 2010, the Company filed the conclusions of the Low Income Collaborative as requested by the UTC.

Issues addressed through the low income collaborative included defining the low-income customer class, identifying market barriers to the success of low income energy efficiency programs, identifying measures for success, and identifying low income energy efficiency delivery mechanisms and funding sources.

The CAAs had 2010 budgets of $1.3 million for Washington and $660,000 for Idaho. The Company processed about 1,500 rebates, benefitting approximately 550 households. During 2010, the Company paid $1.7 million in rebates to the CAAs to provide fully subsidized energy efficiency upgrades, health and human safety, and administrative costs for the CAAs to administer these programs. The CAAs spent nearly $144,000 on health and human safety, which was 8.3 percent of their total expenditures and within their 15 percent allowance for this spending category. Low Income energy efficiency programs contributed 2,102 MWh of electricity savings and 61,271 therms of natural gas savings.

All of the CAAs received a funding increase in 2011 resulting from recent rate cases in both Washington and Idaho making the total funding $2 million for Washington, $940,000 for Idaho, and an additional $40,000 for conservation education.

CAAs submitting for reimbursement in 2011 must include the age of the home and square footage to improve billing analysis and other evaluation efforts. Energy savings claims are now consistent with the regular residential programs, rather than CAAs using various models to estimate their energy savings. Impact evaluation led the Company to believe that these models were treating the installation of measures individually, rather than incrementally, resulting in overestimates of savings achieved. This change should provide for higher realization rates since the original estimates should be closer to actual observations in billing analysis. This modification was made in response to Ecotope's 2011 Energy Impact Evaluation Report of Select 2008 Programs.

The CAAs are required to submit marginally cost-effective measures for "pre-approval" to protect the cost-effectiveness of the portfolio. This process has been in effect for the past three years and has allowed the Company to manage on a monthly basis the overall TRC for the Low Income Portfolio. Examples of measures that need pre-approval include natural gas furnaces, natural gas water heaters and ENERGY STAR refrigerators.

Non-Residential Sector Overview

For the non-residential sectors (commercial, industrial and multi-family applications), energy efficiency programs are offered on a site-specific or custom basis. We can offer a more prescriptive approach when treatments result in similar savings and the technical potential is high. An example is the prescriptive lighting program. The applications are not purely prescriptive in the traditional sense, such as with residential applications where homogenous programs are provided for all residential customers; however, a more prescriptive approach can be applied for these similar applications.

Non-residential prescriptive programs offered by Avista include, but are not limited to, space and water heating conversions, space and water heating equipment upgrades, appliance upgrades, cooking equipment upgrades, personal computer network controls, commercial clothes washers, lighting, motors, refrigerated warehouses, traffic signals, and vending controls. Also included are residential program offerings such as multi-family direct install through UCONS (which ended in December 2009, however, a handful of projects were reported in 2010) and multi-family market transformation since these projects are implemented site-specifically unlike other residential programs.

During 2010, the Company processed approximately 2,400 energy efficiency projects resulting in the payment of $7.9 million in rebates paid directly to customers to offset the cost of their energy efficiency projects. These projects contributed 43,430 MWh of electricity and 742,559 therms of natural gas savings.

In January 2011, Avista launched two new prescriptive programs – commercial windows and insulation and commercial natural gas HVAC. Another prescriptive program, for standby generator block heaters, was evaluated and launched April 1, 2011. A survey of various municipalities in 2010 to determine saturation levels of light-emitting diode traffic signals and as a result, this program will end. Participants submitting paperwork by December 15, 2011, will still be eligible to receive an incentive payment. The Leadership in Energy and Environmental Design building rating program ended December 31, 2010. Projects completed by December 31, 2011 with paperwork submitted by March 31, 2012, will be eligible for an incentive.

Energy Smart Grocer is a regional, turnkey program administrated through PECI. This program has been operating for several years. This program will approach saturation levels during the early part of this 20-year planning horizon. We implement the remaining programs in the site-specific sector through the Company's energy efficiency infrastructure.

The programs highlighted by the recently completed CPA study will be reviewed for the development of target marketing and the creation of new energy efficiency programs. All electric-efficiency measures with a simple payback exceeding one year and less than eight years for lighting measures or thirteen years for other measures automatically qualify for the non-residential portfolio. The IRP provides account executives, program managers/coordinators and energy efficiency engineers with valuable information regarding potentially cost-effective target markets. However, the unique and specific characteristics of a customer's facility override any high-level program prioritization for non-residential customers.

Non-Residential Energy Efficiency Example

The scope of this energy efficiency project included a solution to replace an existing compressor used to circulate water in Medical Lake. The existing equipment was a 50 horsepower screw compressor with a 1,750-RPM three-phase motor that operated 24 hours per day, seven days per week from May 1st through October 31st. The proposed replacement for the existing equipment was five Solar Bee solar-powered DC agitators used to circulate the lake. The compressor is projected to be removed after four of the five solar units have been installed. The estimated annual energy savings associated with this energy efficiency project is approximately 128,000 kWh, which is equivalent to the 50 horsepower compressor running at an estimated 80 percent of full load for six months. Non-quantified non-energy benefits (NEBs) associated with this project include improved water quality and reduced (or possibly eliminated) chemical treatment. The energy efficiency incremental measure cost for the customer is approximately $57,000 and estimated savings of $8,916 in annual energy costs at current rates. At completion, the customer would receive an estimated $25,000 incentive, which would reduce their 6.4-year simple payback to 3.6 years.

Demand Response

Prior to the addition of energy efficiency resources, additional capacity resources were estimated to be needed in 2013. Once energy efficiency resources were layered onto existing supply-side resources in the PRiSM model, this capacity need was moved out to 2019 for summer capacity and 2021 for winter capacity. This capacity need comes from expiring contracts as well as native load growth.

As part of the CPA study, Global evaluated typical demand response program options, including direct load control, curtailable and demand bidding/buy-back programs. Using the Company's capacity costs, prior to the inclusion of energy efficiency, Global found that these demand response programs were cost-effective. However, because energy efficiency is assumed to be acquired first consistent with I-937, the savings resulting from energy efficiency removed the need for additional capacity, making demand response not cost effective at this time.

Since Avista does not have an immediate capacity shortage, the Company will not continue to model demand response programs in the near term, but may continue to evaluate some of these demand response programs in the future.

4. Policy Considerations

Many environmental policy issues could significantly affect the operation of the Company's current generation resources and could affect the types of resources it might pursue in the future. Over time, the direction of these expected future policy considerations has changed, sometimes dramatically. The Company expects the nature and impact of future environmental policies to continue changing. The 2009 IRP included an Environmental Policy chapter that mainly focused on greenhouse gas policy and renewable portfolio standards. The current political and regulatory environments have changed significantly since the publication of the last IRP. The immediate prospects for implementation of cap and trade programs to reduce greenhouse gas emissions has diminished, leading to a new focus on regulatory measures pursued by the Environmental Protection Agency (EPA) and on political and legal initiatives commenced by environmental groups to apply pressure on thermal generation – specifically coal-fired generation. The areas of regulation have particular implications, as they involve regulation of emissions affecting regional haze, coal ash disposal, mercury emissions, water quality, as well as greenhouse gas emissions. This chapter provides an overview and discussion about some of the more pertinent environmental policy issues facing the Company.

Chapter Highlights

- Avista supports national greenhouse gas legislation that is workable, cost effective, and fair.
- Avista supports national greenhouse gas legislation that protects the economy, supports technological innovation, and addresses emissions from developing nations.
- The Company is a member of the Clean Energy Group.
- Avista's Climate Change Council monitors greenhouse gas legislation and environmental regulation issues.

Environmental Concerns

Environmental concerns, such as greenhouse gas emissions, present a unique resource planning challenge due to the continuously evolving nature of environmental regulation and its ever-changing projections of the scope and costs of various programs. If environmental concerns were the only issue faced by electric utilities, resource planning would be reduced to a determination of the required amounts and types of renewable generating technology and energy efficiency to acquire. However, the need to maintain system reliability, acquire resources at least cost, mitigate price volatility, meet renewable generation requirements and manage financial risks compound utility planning complexity. Each generating resource has distinctive operating characteristics, cost structures, and environmental challenges. Traditional generation technologies, like coal-fired and natural gas-fired plants, are well understood and provide capacity along with energy.

Coal-fired units have high capital costs, long permitting and construction lead times, and relatively low and stable fuel costs. They are difficult, if not impossible in some jurisdictions, to site due to state laws and local opposition, and environmental issues ranging from the impacts of coal mining to power plant emissions. Further, remote mine locations increase cost by either the transportation of coal to the plant or the transportation of the generated electricity to load. By comparison, natural gas-fired plants have relatively low capital costs as compared to coal, are typically located close to load centers, can be constructed in relatively short time frames, emit less than half the greenhouse gases emitted by coal, and are the only utility-scale baseload resource that can be developed in certain locations. However, fuel price volatility affects natural gas-fired plants. They are also challenged by having diminished performance during periods of hot weather, by the difficulty of securing water rights for their efficient operation, and by the fact that the plants still emit significant greenhouse gases relative to renewable resources.

Renewable energy technologies such as wind, biomass, and solar generation have different challenges. Renewable resources are attractive because they have low or no fuel costs and few, if any, emissions. However, renewable generation can have limited or no on-peak capacity contribution to the operation of the Company's system, and intermittent renewable resources can present integration challenges and require additional non-renewable generation capacity investment. These resources also generally have high upfront capital costs, and have their own environmental challenges to overcome, particularly with respect to siting. Similar to coal plants, renewable resource projects are located near their fuel sources. The need to site renewable resources in remote locations often requires significant investments in transmission interconnection and capacity expansion, as well as raising possible wildlife and aesthetic issues, such as those that utility-scale solar projects in the southwestern U.S. have encountered. Unlike coal or natural gas-fired plants, the fuel for non-biomass renewable resources cannot be transported from one location to another to better utilize existing transmission facilities or to minimize opposition to project development. Biomass facilities themselves can be particularly challenged because of their dependence on the health of the forest products industry and access to biomass materials located in publicly owned forests.

Furthermore, the long-term economic viability of renewable resources is uncertain for at least two important reasons. First, federal investment and production tax credits and direct grants in lieu of tax incentives are scheduled to expire in 2012 or 2013, depending on the technology. The continuation of credits and grants cannot be assumed in light of the impact such subsidies have on the finances of the federal government and the relative maturity of wind technology development. Second, the costs of renewable technologies are affected by many relatively unpredictable factors, such as renewable portfolio standard mandates, material prices and currency exchange rates, the effects of which cannot be accurately predicted. Capital costs for wind and solar have decreased since the 2009 IRP, but there are no guarantees that prices will continue to stay at current levels.

Though there appears to be very little, if any, chance that a national greenhouse gas cap and trade program being implemented soon, there still is a great deal of uncertainty around its regulation. There is strong regional and national support to address climate change. Since the 2009 IRP publication, many changes in the approach and potential for actual greenhouse gas emissions regulation have occurred, including:

- Consideration is presently being given toward a clean energy standard at the federal level, instead of a more direct form of greenhouse gas emission regulation, such as a cap and trade program;
- The current split of control between the U.S. House of Representatives and the Senate effectively postpones national cap and trade legislation for greenhouse gas emissions until after the 2012 election, at the earliest;
- The EPA has commenced actions to regulate greenhouse gas emissions under the Federal Clean Air Act, although some of these efforts have been delayed and the agency 's justification for advancing some of its initiatives are being judicially challenged ; and
- Development of economy-wide cap and trade regulation at the regional level now focus primarily on California and British Columbia rather than on the broader Western Climate Initiative.

Avista's Climate Change Policy Efforts

Avista's Climate Policy Council is a clearinghouse for all matters related to climate change. In regards to climate change, the Council:

- Facilitates internal and external communications on climate policy issues;
- Analyzes policy impacts, anticipates opportunities and evaluates strategy for Avista; and
- Develops recommendations on climate related policy positions and action plans.

The core team of the Climate Policy Council includes a designated chairperson, key officers, and representatives from Environmental Affairs, Government Relations, Corporate Communications, Engineering, Energy Solutions, Legal Affairs, and Resource Planning. Other areas of the Company participate as needed. The monthly meetings for this group include work divided into immediate and long-term concerns. The immediate concerns include such topics as reviewing and analyzing proposed or pending state and federal legislation, reviewing corporate climate change policy, and responding to internal and external data requests about climate change issues. Longer-term issues involve topics such as emissions tracking and certification, providing recommendations for greenhouse gas goals and activities, evaluating the merits of different greenhouse gas policies, actively participating in the development of legislation, and benchmarking climate change policies and activities against other organizations.

Avista maintains its membership in the Clean Energy Group, which includes Calpine, Entergy, Exelon, Florida Power and Light, Pacific Gas & Electric and Public Service Energy Group. This group collectively evaluates and supports different greenhouse gas policies. Avista also participates in national and regional discussions about hydroelectric and biomass issues through membership in national hydroelectric and biomass associations.

Avista's Position on Climate Change Legislation

Avista anticipates the passage of federal greenhouse gas (climate change) legislation in some form within the next five years. A comprehensive national climate change policy could assume the form of a cap and trade program, carbon tax, national portfolio standard, emissions performance standard, or some combination of the four. The Expected Case in this IRP uses 2015 as the starting date for greenhouse gas emissions costs. The 2015 start date was chosen early in the development of the modeling exercises for this plan, and the actual effective date will most likely be after 2015 by the time legislation could be enacted and rules promulgated. The Company chose to develop a weighted cost using four different cases for greenhouse gas emissions because of the uncertainty about the timing and scope of this legislation. The four cases include regional cap and trade, national cap and trade, national carbon tax and no greenhouse gas policies. Details about the different greenhouse gas policies modeled for this IRP are located at the end of this chapter.

The current lack of a definitive greenhouse policy direction makes an uncertain planning environment as Avista plans to meet future customer loads. Avista does not have a preferred form of greenhouse gas policy at this time, but supports federal legislation that is:

- Workable and cost effective;
- Fair;
- Protective of the economy and consumers;
- Supportive of technological innovation; and
- Includes emissions from developing nations.

Workable and cost effective legislation should be crafted to produce actual greenhouse gas reductions through a single system, as opposed to competing, if not conflicting, state, regional and federal systems. The legislation also needs equitable distribution across all sectors of the economy based on relative contribution to greenhouse gas emissions. Protecting the economy and consumers is of utmost importance. The legislation cannot be so onerous that it stalls the economy or fails to have any sort of adjustment mechanism in case the market solution fails causing allowance or offset prices to escalate at unmanageable rates. Supporting technological innovations should be a key component of any greenhouse gas legislation because innovation can help contain costs, as well as provide a potential economic boost to the manufacturing sector. Climate change legislation must involve developing nations with increasing greenhouse gas emissions and legislation should include strategies for working with other nations directly or through international bodies to control worldwide emissions.

Greenhouse Gas Emissions Concerns for Resource Planning

Resource planning in the context of greenhouse gas emissions regulation raises concerns about the balance between the Company's obligations for environmental stewardship and the cost implications for our customers. Consideration must be given to the cost effectiveness of resource decisions as well as the need to mitigate the financial impact of potential future emissions risks.

Complying with greenhouse gas regulations, particularly in the form of a cap and trade mechanism, involves two actions: ensuring the Company maintains sufficient allowances and/or offsets to correspond with its emissions during a compliance period, and undertaking measures to reduce the Company's future emissions. Enabling emission reductions on a utility-wide basis can entail any of the following:

- Increasing efficiency of existing fossil-fueled generation resources;
- Reducing emissions from existing fossil-fueled generation through fuel displacement including co-firing with biomass or biofuels;
- Permanently decreasing the output from existing fossil-fueled resources and substituting it with lower emitting resources;
- Decommissioning or divesting of fossil-fueled generation and substituting lower emitting resources;
- Reducing exposure to market purchases of fossil-fueled generation, particularly during periods of diminished hydropower production, by establishing larger reserves based on lower emitting technologies; and
- Increasing investments in energy efficiency measures.

With the exception of increasing Avista's commitment to energy efficiency, the costs and risks of the actions listed above cannot be adequately, let alone fully, be evaluated until the nature of greenhouse gas emission regulations is known; that is, after a regulatory regime has been implemented and the economic effects of its interacting components can be modeled. A specific reduction strategy as part of an IRP may be forthcoming when greater regulatory clarity and more precise modeling parameters exist. In the meantime, the model for this IRP uses the average cost of the weighted policies discussed at the end of this chapter. The 2011 IRP focuses on the costs and mitigation of carbon dioxide since it is the most prevalent and primary greenhouse gas emitted from fossil-fueled generation sources.

National Greenhouse Gas Emissions Legislation

Several themes have emerged from various climate change legislative proposals considered since publication of the 2009 IRP. These include:

- Climate change is now viewed as largely an anthropogenic or human-developed phenomenon.
- A preference in certain economic sectors towards application of greenhouse gas regulations on an economy-wide basis, rather than on piecemeal regulatory approaches that target specific sectors or technologies.
- Technology will be a key component to reducing overall greenhouse gas emissions, particularly in the electric sector. Significant investment in carbon capture and sequestration technology will be needed because coal will continue to be an important part of the U.S. generation fleet into the near future.

- Developing countries must be involved in reducing global emissions as greenhouse gas emissions generally increase along with economic growth.
- The longer federal legislation takes to enact, the higher the probability of inconsistent state and regional regulatory schemes. A patchwork of regulation may obstruct the operation of businesses serving multiple jurisdictions by causing market disruptions and increasing the uncertainty of how federal and disparate state and regional regulatory systems might interact.

These themes all point toward a need to develop national greenhouse gas legislation in a timely manner to ensure the best environmental and economic outcomes. The Waxman-Markey bill (H.R. 2454), passed in the U.S. House of Representatives in June 2009, importantly acknowledged these multi-jurisdiction problems by proposing to effectively supersede state and regional cap and trade regulation over emissions covered under federal law between 2012 and 2017.

Federal Policy Considerations

The direction of federal policies toward greenhouse gas emissions mitigation has changed since the 2009 IRP. In that document, the Company projected a national cap and trade program would be enacted and effective in 2012. This IRP assumes some version of a national greenhouse gas policy will be in place starting in 2015, but the type of policy is uncertain. If the models for this IRP did not have to be locked down early in the process, we would have pushed the timeframe out even further because of the uncertainty of any federal-level climate change policy with the current split between the House and the Senate, the soft state of the U.S. economy, and the upcoming 2012 elections. Given this low level of certainty, the Company developed four hypothetical greenhouse gas policy models. Details are provided later in this chapter.

Avista's main concern with any potential federal cap and trade legislation involves compliance costs, an issue centering primarily, though not exclusively, on emission allowances. Avista favors the Edison Electric Institute approach where half of the allowances allocated to electric utilities are load-based and the other half are emissions-based. This more equitable compromise would provide prevent a windfall for non-utility generators with large historical greenhouse gas emissions at the expense of utilities, like Avista, that already rely on non-emitting renewable energy. Administrative or direct allocation, at least in the beginning of the program, is also favored because it will mitigate compliance cost impacts on customers while the allowance markets and emissions reductions technologies are developed.

There currently is no pending federal climate change legislation before Congress. In lieu of comprehensive climate change legislation, early in 2011, President Obama endorsed the idea of a Clean Energy Standard that would result in the nation deriving 80 percent of its electricity by 2035 from renewable resources and lower greenhouse gas emitting generation, such as natural gas-fired generation, "clean coal" generation with captured and sequestered emissions, and nuclear power. Formal Clean Energy Standard legislation has yet to be introduced in Congress. At the time this IRP was prepared, members of the U.S. Senate had collected comments on a White Paper on a Clean Energy Standard and Senator Jeff Bingaman (D-New Mexico) was drafting legislation in coordination with the President's staff, which he said in early June 2011, likely would not pass the Senate Energy and Natural Resources Committee. Even greater doubts exist that such a proposal could pass the U.S. House of Representatives. Given that Clean Energy Standard legislation in not likely to be enacted during 2011and 2012, Avista did not model the Clean Energy Standard for this IRP.

The 111th Congress considered renewable energy standard legislation (RES), such as the Waxman-Markey bill; (H.R. 2454) and S. 1462 by Senator Bingaman. Such proposals contemplated a renewable energy standard of between 10 and 25 percent by specific dates. These measures generally included a "hydro netting" provision; this provision excludes loads served by hydropower energy from the RES requirement. For example, if a utility has 1,000 aMW of load, a 10 percent RES goal, and 200 aMW of hydroelectric generation; then the utility's RES goal would only be 80 aMW instead of 100 aMW because of the hydro-netting. Federal legislation has conceptually – and significantly – differed from the Energy Independence Act (I-937) in Washington State, in particular with respect to hydro-netting. The absence of hydro-netting in I-937 makes the Washington law more restrictive than proposed federal renewable energy requirements. Therefore, absent Idaho RPS legislation, Avista would need to meet only the federal renewable energy requirements for its Idaho service territory. National legislation so far also includes existing biomass generation resources, including Kettle Falls, against the renewable energy standard, as well as power from upgrades to hydropower facilities that were effectuated before 1999 (the date established in I-937 to determine resource eligibility). Treatment of renewable resources in federal legislation would not have allowed the Company to use renewable energy credits (RECs) from resources that were only eligible under federal law, but not I-937, to comply with Washington's renewable energy targets. However, Avista would be able to make REC sales from federally eligible facilities into a national market and into states governed solely by federal requirements (i.e., Idaho) and those states whose renewable energy eligibility requirements are similar to federal ones. More details about I-937 are included in the Washington policy consideration section later in this chapter.

The federal Production Tax Credit (PTC), Investment Tax Credit (ITC), and Treasury grant programs are key federal policy considerations for incenting the development of renewable generation. The current PTC and ITC programs are available through the end of 2012 for wind and through the end of 2013 for other renewable resources. We did not model an extension of these tax incentives because of the uncertainty of their continuation due to the current federal budget deficit situation. If extended, the PTC or ITC may accelerate the development of some regional renewable energy projects to meet the extended deadline.

State and Regional Level Policy Considerations

The failure of the federal government to enact greenhouse gas policies during the current decade encouraged several states, such as California and New Mexico, to develop their own climate change laws and regulations. Climate change legislation can take many forms, including economy-wide regulation in the form of a cap and trade system. However, comprehensive climate change policy can also have multiple individual components, such as renewable portfolio standards, energy efficiency standards, and emission performance standards; all of these standards have been enacted in Washington, but not necessarily in other jurisdictions where Avista operates. Individual state actions produce a patchwork of competing rules and regulations for utilities to follow, and may be particularly problematic for multi-jurisdictional utilities such as Avista. There are currently 29 states, including the District of Columbia, with active renewable portfolio standards.

One of the more notable state-level greenhouse gas initiatives outside of the Pacific Northwest include the Regional Greenhouse Gas Initiative (RGGI) agreement between ten northeastern and mid-Atlantic states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont) to implement a cap and trade program for carbon dioxide emissions from power plants. The District of Columbia, Pennsylvania, and some Canadian provinces are also participating as RGGI observers. RGGI's cap and trade regulations have been effective since January 2009. New Jersey's Governor Christie announced in May 2011 that he was withdrawing his state from RGGI at the end of 2011. While the Governor still endorsed the need to reduce greenhouse gas emissions, he argues that RGGI is not the right mechanism for achieving reductions. Some claim that Governor Christie's action may severely undermine the future prospects for RGGI.

The Western Regional Climate Action Initiative, otherwise known as the Western Climate Initiative (WCI), began with a February 26, 2007, agreement to reduce greenhouse gas emissions through a regional reduction goal and market-based trading system. This agreement included the following signatory jurisdictions: Arizona, British Columbia, California, Manitoba, Montana, New Mexico, Oregon, Utah, Quebec and Washington. In July 2010, the WCI released its Final Design for a regional cap and trade regulatory system to cover 90 percent of the societal greenhouse gas emissions within the region by 2015. So far, the only state to enact legislation authorizing the regulation of greenhouse gas emissions under a cap and trade system is California (New Mexico adopted administrative regulations to regulate greenhouse gas emissions in conjunction with other states, but it did so absent legislative authorization).

At the municipal level, there are several cities participating in the U.S. Mayors Climate Protection Agreement to reduce GHG emissions to seven percent below 1990 levels by 2012.

A federal cap and trade program, such as that envisioned by the Waxman-Markey legislation, will not operate in isolation. Members of the Western Climate Initiative, such as Washington, Oregon, and Montana, can – as some of them have already – pursue complementary policies to regulate emission sources covered under cap and trade regulation, as well as those that will not be regulated under a cap and trade program.

The adoption of greenhouse gas goals and any associated regulations by Washington could directly affect the Company's generation assets in the state, which are largely comprised of the Kettle Falls Generating Station and the Northeast Combustion turbines and Boulder Park peaking facilities. Oregon's greenhouse gas goals and potential future regulations could apply to the Coyote Springs 2 project.

Idaho Policy Considerations

Idaho is not a member of the Western Climate Initiative and currently does not regulate greenhouse gases or have a renewable portfolio standard (RPS). However, the Idaho Department of Environmental Quality will be administering greenhouse gas standards under its Clean Air Act delegation from the EPA.

Montana Policy Considerations

Montana has a non-statutory goal to reduce greenhouse gas emissions to 1990 levels by 2020. In 2007, the Legislature passed House Bill 25. This law requires that new coal-fired facilities built in the state to sequester 50 percent of their emissions. Montana's renewable portfolio standard law, enacted through Senate Bill 415 in 2005, requires utilities to meet 10 percent of their load with qualified renewables from 2010 through 2014, and 15 percent beginning in 2015. While involved in the Western Climate Initiative, Montana has not considered any legislation to authorize its participation in and implementation of WCI's regional cap and trade system. The Montana Department of Environmental Quality does not handle regional haze issues affecting coal-fired generation located in the state, as the agency does not have delegation under the Clean Air Act to regulate regional haze. The federal EPA is responsible for the application of regional haze criteria to the Colstrip coal-fired plants.

Montana had already implemented a mercury emission standard under Rule 17.8.771 that applies to Colstrip. The standard requires mercury reductions to 0.9 pounds per trillion Btu beginning January 1, 2010. Avista's generation at Colstrip already has emissions controls that meet Montana's mercury emissions goals.

Oregon Policy Considerations

The State of Oregon has a history of considering greenhouse gas emissions and renewable portfolio standards legislation. The Legislature enacted House Bill 3543 in 2007, calling for reductions of greenhouse gas emissions to 10 percent below 1990 levels by 2020, and 75 percent below 1990 levels by 2050. These reduction goals are in addition to 1997 regulation requiring fossil-fueled generation developers to offset carbon dioxide (CO_2) emissions exceeding 83 percent of the emissions of a state-of-the-art gas-fired combined cycle combustion turbine (CCCT) by paying into the Climate Trust of Oregon. Senate Bill 838 created a renewable portfolio standard that requires large electric utilities to generate 25 percent of annual electricity sales with renewable resources by 2025. Intermediate term goals include five percent by 2011, 15 percent by 2015, and 20 percent by 2020. Oregon is an active member in the Western Climate Initiative, but it has not passed the legislation necessary to implement the WCI's cap and trade proposal. The Boardman Coal Plant, which is the only active coal-fired generation facility in Oregon, plans to cease using coal by 2020. Portland General Electric's decision to make near-term emissions control investments and to discontinue the use of coal serves as an example of how regulatory, environmental, political and economic pressure can culminate in an agreement that results in the early closure of a low-cost coal-fired power plant.

Washington State Policy Considerations

Circumstances similar to those that led to the close of the Boardman coal-fired facility in Oregon encouraged the owners of the Centralia Coal Plant (TransAlta) to agree to shut down one unit at the facility by December 31, 2020 and the other unit by December 31, 2025. The confluence of regulatory, environmental, political and economic pressure brought about the scheduled closure of the Centralia Plant. The State of Washington enacted several measures concerning fossil-fueled generation emissions and generation resource diversification. A law, enacted in 2004, requires new fossil-fueled thermal electric generating facilities of more than 25 MW of generation capacity to mitigate CO_2 emissions through third party mitigation, purchased carbon credits, or cogeneration. Washington's Energy Independence Act (I-937), was passed by the voters in the November 2006 General Election, established a requirement for utilities with more than 25,000 retail customers to use qualified renewable energy or renewable energy credits to serve three percent of retail load by 2012, nine percent by 2016 and 15 percent by 2020. Failure to meet these RPS requirements results in a $50 per MWh fine. The initiative also requires utilities to acquire all cost effective conservation and energy efficiency measures. Additional details about the energy efficiency portion of I-937 are located in the Energy Efficiency chapter.

Avista expects to meet or exceed its renewable requirements between 2012 and 2015 through a combination of qualified hydroelectric upgrades and renewable energy credit (REC) purchases. The 2011 IRP Expected Case ensures that the Company meets all I-937 RPS goals.

Governor Christine Gregoire signed Executive Order 07-02 in February 2007 establishing the following GHG emissions goals:

- 1990 levels by 2020;
- 25 percent below 1990 levels by 2035;
- 50 percent below 1990 levels by 2050 or 70 percent below Washington's expected emissions in 2050;
- Increase clean energy jobs to 25,000 by 2020; and
- Reduce statewide fuel imports by 20 percent.

The goals of this Executive Order became law when the Legislature enacted Senate Bill 6001 in 2007. This law prohibits electric utilities from entering into long-term financial commitments beyond five years duration for fossil-fueled generation with greenhouse gas emissions exceeding 1,100 pounds per MWh. Beginning in 2013, the emissions performance standard can be lowered every five years to reflect the emissions profile of the latest commercially available CCCT. The emissions performance standard effectively prevents utilities from developing new coal-fired generation and expanding the generation capacity of existing coal-fired generation, unless they can sequester emissions from the facility. The Legislature amended Senate Bill 6001 in 2009 to prohibit contractual long-term financial commitments for generation that contain more than 12 percent of the total power from unspecified sources. The Legislature further amended Senate Bill 6001 in 2011 to allow long-term contracts for output from the Centralia Coal Plant in conjunction with that plant making certain emission investments and ceasing to use coal in 2020 for one unit and 2025 for the other unit. This law change occurred after completion of the modeling for this IRP.

Taking the next step to achieve the State's greenhouse gas reduction goals, the governor introduced legislation (Senate Bill 5735 and House Bill 1819) during the 2009 Legislative Session to authorize the Department of Ecology to adopt rules, consistent from recommendations from the Western Climate Initiative, enabling the state to administer and enforce a regional cap and trade program. When that legislation failed, Governor Gregoire signed Executive Order 09-05 directing the Department of Ecology to develop emission reduction "strategies and actions", including complementary policies, to meet Washington's 2020 emission reduction target by October 1, 2010. This directive requires the agency to "provide to each facility that the Department of Ecology believes is responsible for the emission of 25,000 metric tons or more of carbon dioxide equivalent each year in Washington with an estimate of each facility's baseline emissions and to designate each facility's proportionate share of greenhouse gas emission reduction necessary to achieve the state's 2020 emission reduction" goal. The department is also asked, by December 1, 2009, to develop emission benchmarks, by industry sector, for facilities the Department of Ecology believes will be covered by a federal or regional cap and trade program. The state may advocate the use of these emission benchmarks in any federal or regional cap and trade program as an appropriate basis for the distribution of emission allowances. The department must submit recommendations regarding its industry benchmarks and their appropriate use to the Governor by July 1, 2011.

Greenhouse Emissions Measurement and Modeling

Greenhouse gas tracking is an important part of the IRP modeling process because emissions policy poses a significant risk to Avista. Reducing greenhouse gas emissions from power plants will fundamentally alter the resource mix as society moves towards a carbon constrained future. However, there are currently no federal laws limiting greenhouse gas emissions, estimated costs still need to be projected for planning purposes because expectations for greenhouse gas regulation can significantly alter resource decisions.

Figure 4.1 shows the carbon price forecast for this IRP. The 2011 IRP assumes greenhouse gas emissions policies will not take effect until 2015. To simulate the expected impacts of greenhouse gas regulation, the Company developed four policy models and estimated their assumed financial impact on the energy marketplace. Each policy represents a potential path governments could take over the next several years. We assigned weighting factors to each policy and the weighted average price of the policies is included in the Expected Case. The four greenhouse gas policies used in this IRP are defined in Table 4.1.

Figure 4.1: Annual Greenhouse Gas

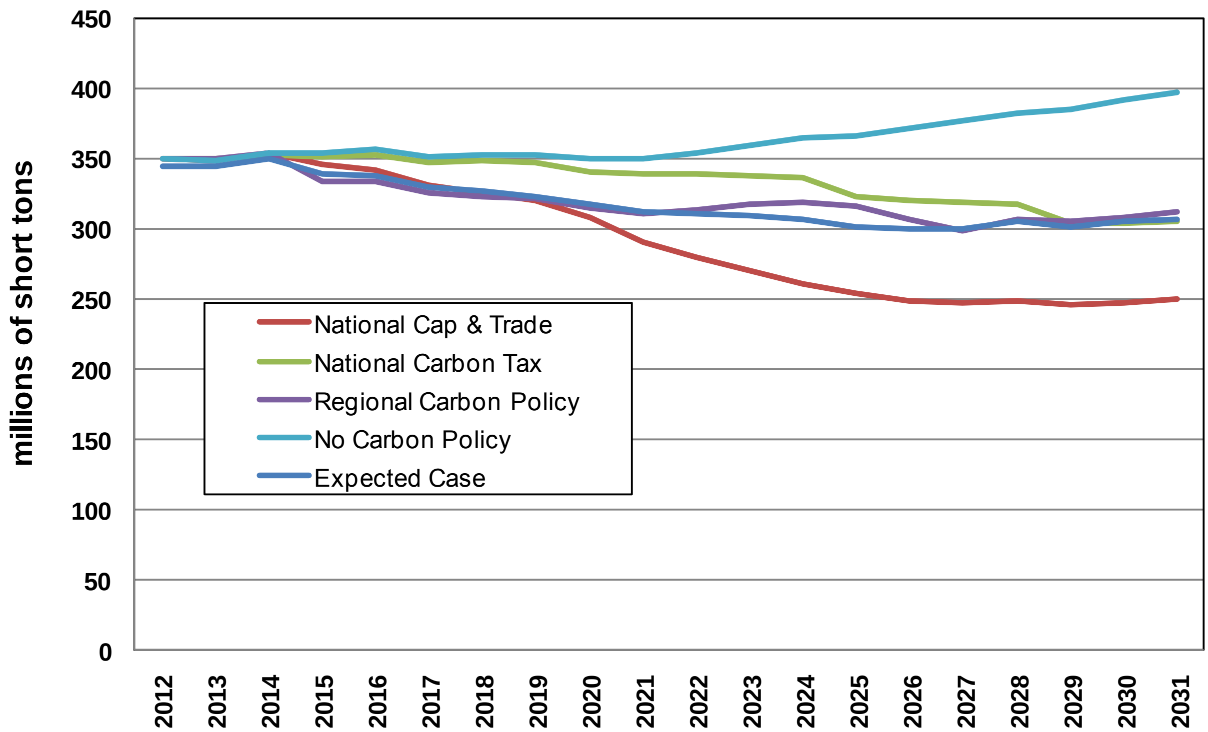


Table 4.1: Modeled Greenhouse Gas Policies

Strategy	Weighting (%)	Details
Regional Greenhouse Gas Policy	30	– Reductions in California, Oregon, Washington, and New Mexico between 2014 and 2019. – Shifts to National Climate Policy in 2020.
National Climate Policy	30	– Federal legislation only applies beginning in 2015 – About 15 percent below 2005 levels by 2020 and about 35 percent below 2005 levels by 2030.
National Carbon Tax	30	– Federal legislation only applies beginning in 2015. – $33 per short ton, then 5 percent per year escalation for the remainder of the study.
No Greenhouse Gas Reductions	10	– No carbon reduction program. – State-level emission performance standards apply and no new coal-plants are added in the Western U.S.

The Regional Greenhouse Gas policy simulates the decision by several western states to require greenhouse gas reductions under the auspices of the Western Climate Initiative (WCI) because a national policy has not been enacted. This policy does not include all of the WCI members because some states have enacted little, if any, legislation to allow their states to participate in the WCI cap and trade market. This policy begins in 2014 and is restricted to California, New Mexico, Oregon and

Washington. The policy is superseded in 2020 by a National Climate Policy, described below. The Regional Greenhouse Gas Policy results in a 10 percent reduction of electric generation greenhouse gas emissions below 2005 levels by 2020. Projected prices start at $5 per short ton of CO_2 in 2014 and escalate by $1 per year up to $9 per short ton in 2019. All greenhouse gas measurements and costs in this chapter are in short tons. In 2020, when the policy switches to a national focus, the price starts at $15 and escalates to $73 per ton in 2030. This policy was weighted by 30 percent in the model.

The National Climate Policy begins in 2015. This scenario assumes no state level cap and trade programs. The greenhouse gas emissions reductions are about 15 percent below 2005 levels by 2020 and about 35 percent below 2005 levels by 2030. Prices start at $15 per ton in 2015 and escalate to $115 per ton in 2030. This policy was weighted 30 percent in the model.

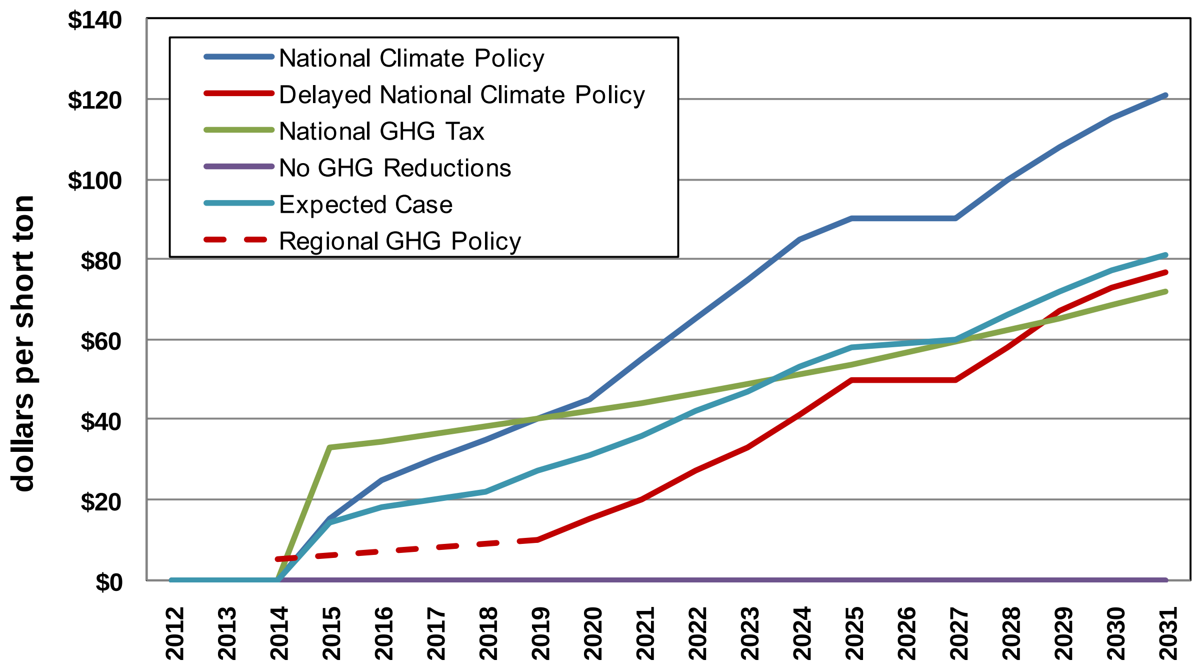
The design of the National Carbon Tax Policy loosely resembles the carbon tax in British Columbia and shows some of the implications of moving to a tax instead of a cap and trade program. The tax would start in 2015 at the national level and would supersede any state-level greenhouse gas cap and trade programs. The tax starts at $33 per ton in 2015 and increases to $69 in 2030. This policy was weighted 30 percent in the model.

The No Greenhouse Gas Reductions Policy is an unconstrained carbon case where there are no national or state-level greenhouse gas emissions reductions policies. This policy was included because there is a small probability of no greenhouse gas taxes or cap and trade program being instituted. This policy is also necessary to be able to determine the cost of the other greenhouse policies, since there is the actual cost of a tax or a credit, plus the additional cost of a less greenhouse gas intensive resource portfolio. Even though this unconstrained carbon policy does not have any national or state-level greenhouse gas policies, state-level emissions performance standards are still applied and no new coal plants were allowed in the model. This policy received a 10 percent weighting in the model.

We also considered the addition of a regulatory model, to represent in spirit of the direction the EPA is using through the Clean Air Act and through other EPA actions that are fostering the early closing of coal-fired plants, such as Boardman and Centralia. These actions include regional haze, mercury abatement, cash ash handling and disposal, among others. The unique nature of each coal-fired facility, combined with the different political and environmental climates in each of the western states, made this type of policy too complex to model at this time. Future IRPs may include some of these EPA-related regulations as they are developed.

Figure 4.2 shows the greenhouse gas emissions costs per short ton under each of the policies and under the Expected Case.

Figure 4.2: Price of Greenhouse Gas Credits in each Carbon Policy



5. Transmission & Distribution

Introduction

This chapter describes Avista's transmission system, completed and planned upgrades, transmission planning issues, and estimated costs and issues of new generation resource integration.

Coordinating transmission system operations and planning activities among regional transmission providers is necessary to maintain reliable and economic transmission service for Avista customers. Transmission providers and interested stakeholders continue to modify the region's approach to planning, constructing, and operating the transmission system under Federal Energy Regulatory Commission (FERC) rules, and state and local siting agencies guidance. This chapter complies with Avista's FERC Standards of Conduct compliance program governing communications between Avista merchant and transmission functions.

Chapter Highlights

- Projected costs of transmission upgrades are included in the 2011 Preferred Resource Strategy.
- The Company received matching federal grants and is investing in three grid modernization programs projected to reduce load by 5.57 aMW by 2013.
- Sixty distribution feeders passed preliminarily economic screening during the IRP timeframe, reducing system losses by 6.1 aMW.
- The Company participates in various regional transmission planning forums.
- Avista will upgrade various transmission paths over the next five years.

Avista's Transmission System

Avista owns and operates a system of over 2,200 miles of electric transmission facilities. This includes approximately 685 miles of 230 kilovolt (kV) line and 1,527 miles of 115 kV line. Figure 5.1 illustrates the Company's transmission system. The Company owns an 11 percent interest in 495 miles of a 500 kV line between Colstrip and Townsend, Montana. The transmission system includes switching stations and high-voltage substations with transformers, monitoring and metering devices, and other system operation-related equipment. The system transfers power from Avista's generation resources to its retail load centers. Avista also has network interconnections with the following utilities:

- Bonneville Power Administration (BPA)
- Chelan County PUD
- Grant County PUD
- Idaho Power Company
- NorthWestern Energy
- PacifiCorp
- Pend Oreille County PUD

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 98 of 1069

Figure 5.1: Avista Transmission Map

Network interconnections enhance reliability and serve as points of receipt for power from generating facilities outside of a utility service area. Avista has interconnections to deliver its Colstrip, Coyote Springs 2, Lancaster, Washington Public Power Supply System Washington Nuclear Plant No. 3 settlement contract, and Mid-Columbia contract power. Avista serves various wholesale loads using government-owned and cooperative utility interconnections at transmission and distribution voltage levels.

Recent Transmission Improvements

Since the 2009 IRP, Avista made the following transmission enhancements:

- Added a 115 kV capacitor bank at Grangeville;
- Installed new 115 kV substation and transmission integration equipment at Idaho Road;
- Replaced a failed transformer at the Avondale 115 kV substation;
- Reconstructed the 115 kV switchyard and distribution substation, and added a capacitor bank to the Nez Perce 115 kV substation;
- Reconductored the Airway Heights to North Fairchild line section of the Airway Heights - Silver lake 115 kV line,
- Installed a new capacitor bank at the Airway Heights substation; and
- Reconductored selected portions of the Moscow area 115 kV system.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 99 of 1069

Future Upgrades and Interconnections

Station Upgrades

As reported in the 2009 IRP, Avista planned to upgrade its Moscow, Noxon, Pine Creek and Westside 230 kV substations. These stations have undersized transformers, do not provide 21st century reliability, and are near the end of their useful lives. The Moscow station upgrades, scheduled for completion in 2014, will result in a new facility with a single 250 MVA 230/115 kV station using a double bus-double breaker configuration for 230 kV service. The 115 kV yard is in a breaker-and-a-half configuration. Over the next five to 10 years, the three remaining stations will be upgraded. Beyond these, plans exist for several new 115 kV capacitor banks throughout Avista's transmission system in the near future.

Transmission Upgrades

Avista plans to complete several 115 kV reconductor projects throughout its transmission system over the next decade. These projects focus on replacing decades-old small conductor with conductor capable of greater load-carrying capability and more efficient (i.e., fewer electrical losses) service. A future IRP will discuss these savings and timeline after further analysis is completed.

South Spokane 230 kV Reinforcement

Transmission studies continue to support a need for an additional 230 kV line to the south and west of Spokane. Avista currently has no 230 kV source in these areas, and instead relies on its 115 kV system for load service as well as bulk power flows through the area. The project scope is under development, and preliminary studies indicate the need for the following (or similar) projects:

- A new 230/115 kV station near Garden Springs. Property acquisition for the Garden Springs station and preliminary geo-technical station design work has commenced;
- Tap of the Benewah-Boulder 230 kV line southwest of the Liberty Lake area and construction of a new 230 kV switching station (for later development of a 230/115 kV substation); alternatively, reconstruction of the 115 kV circuits between Beacon and Ninth & Central, and the installation of a 230/115 kV station at that site could be pursued;
- Connecting the Liberty Lake 230 kV station with the Garden Springs 230 kV station; alternatively, connecting the Ninth & Central station to the Garden Springs station;
- Construction of a new 230 kV line from Garden Springs to Westside; and
- Origination and termination of the 115 kV lines from the new Spokane 230/115 kV station(s).

The South Spokane 230 kV Reinforcement project will be scoped by the end of 2012 with planned energization by the end of 2018. The project will enter service in a staged fashion beginning in 2014

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 100 of 1069

Additional Work Required from the Avista Five and Ten-Year Plans

Following are examples of additional improvements to the Avista System in the next five to ten years. Since load growth rates in the various areas of the system are unknown, items presently on the list may or may not occur in this timeframe; more certainty is gained as time passes.

- West Plains 115 kV Reinforcement
- Irvin 115 kV Project
- Glenrose Tap – Ninth and Central 115 kV line
- Beacon 230/115 kV Station Partial Rebuild
- New Distribution Stations:
    - Otis Orchards (2011)
    - Hillyard (2013)
    - Hawthorne (2013)
    - North Moscow Additional Transformer (2013)
    - Spokane Downtown West (2014)
    - Greenacres (2014)

Canada/Northwest/California 500 kV Transmission Project (CNC) and Devils Gap 500/230 kV Interconnection

The Transmission Coordination Work Group (TCWG, see below) continues to evaluate a new transmission line involving four major projects.

- 500 kV high voltage alternating current facilities from Selkirk in southeast British Columbia to the proposed Northeast Oregon (NEO) Station, with an intermediate interconnection with Avista at a new Devils Gap Substation, located near Spokane;
- 500 kV high voltage AC or high voltage direct current facilities running from the NEO Station to the Collinsville Substation in the San Francisco Bay Area;
- Interconnection near Cottonwood Substation in northern California (a direct current segment);
- Voltage support at the interconnecting substations; and
- Remedial actions for project outages.

The Canada-Northwest-California (CNC) project would allow access to new renewable resources in the Pacific Northwest, Canada, and, at times, the southwestern United States. Immediate and future environmental and resource needs of Avista and other Western interconnected utilities could be aided by this project. Further, Avista expects the project will increase the utilization of its existing transmission facilities. Through its participation in TCWG and other regional and sub-regional forums, Avista makes all project information available to group members, including resource developers, load serving entities, energy marketers, and independent transmission owners.

The CNC project continues to move forward with an altered set of ownership assumptions. The ultimate project size has not been determined. In late 2010, the CNC project was bifurcated into a northern section and a southern section. BC Hydro has taken responsible for the northern segment, comprised of the 500 kV interconnection between Selkirk and the proposed NEO station. The northern segment could be a double circuit 500 kV AC line with 3,000 MW of transfer capability, or a single circuit 500 kV AC line with 1,500 MW of capacity. Preferred line routing for the northern segment remains the “eastern route”, this would utilize the Avista Addy-Devils Gap 115 kV line corridor. A 500 MVA bi-directional 500/230 kV phase shifted interconnection between the CNC project and Avista’s transmission system remains the preferred option and would be the major impact to Avista.

The scope of the southern portion of the project has been reduced from a nominal 3,000 MW of transfer capability to 2,000 MW. Much work remains to determine if the southern portion should be an alternating current or a direct current line, and whether brownfield development (replacement of existing transmission with higher voltage and/or higher capacity facilities) can be accomplished while maintaining reliable system operation. Pacific Gas and Electric (PG&E) is no longer leading the southern segment project; the Western Area Power Administration (WAPA) has assumed its leadership.

Regional Transmission System

BPA owns and operates most of the regional transmission system in the Pacific Northwest. The federal entity operates over 15,000 miles of transmission-level facilities throughout the Pacific Northwest and owns the largest portion of the region’s high voltage (230 kV or higher) transmission grid. Avista uses BPA transmission to transfer output from its remote generation sources to Avista’s transmission system, including its Colstrip units, Coyote Springs 2, Lancaster and its Washington Public Power Supply System Washington Nuclear Plant No. 3 settlement contract. Avista also contracts with BPA for Network Integration Transmission Service to transfer power to 10 delivery points on the BPA system to serve portions of the Company’s retail load.

The Company participates in the BPA transmission and rate case processes, and in BPA’s Business Practices Technical Forum, to ensure charges remain reasonable and support system reliability and access. Avista also works with the BPA and other regional utilities to coordinate major transmission facility outages.

Future development likely will require new transmission assets by federal and other entities. BPA is developing several transmission projects in the Interstate 5 corridor, as well as projects in southern Washington that are necessary for integration wind generation resources located in the Columbia Gorge. Each project has the potential to increase BPA transmission rates and thereby affect Avista’s costs.

FERC Planning Requirements and Processes

The Federal Energy Regulatory Commission (FERC) provides guidance to both regional and local area transmission planning. This section describes several requirements and processes of the federal regulator important to Avista’s transmission planning.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 102 of 1069

Attachment K

FERC approved Attachment K to Avista's Open Access Transmission Tariff (OATT). The attachment satisfies nine transmission principles in FERC Order 890 ensuring open planning processes, and formalizes coordination of local, regional, and sub-regional transmission planning.

Avista regularly develops a biannual Local Planning Report (in coordination with Avista's five- and ten-year Transmission Plans). Avista encourages participation of its interconnected utilities, transmission customers, and other stakeholders in the Local Planning Process.

The Company uses ColumbiaGrid to coordinate planning with sub-regional groups. Regionally, Avista participates in several Western Electricity Coordinating Council (WECC) processes and groups, including Regional Review processes, Transmission Expansion Planning Policy Committee (TEPPC), Planning Coordination Committee (PCC), and the newly formed Transmission Coordination Work Group (TCWG). Participation in these efforts supports regional coordination of Avista's transmission projects.

Western Electricity Coordinating Council

The Western Electricity Coordinating Council (WECC) coordinates and promotes electric system reliability in the Western Interconnection. It also supports efficient and competitive power markets, assures open and non-discriminatory transmission access among its members, provides a forum for resolving transmission access or capacity ownership disputes, and provides an environment for coordinating the operating and planning activities of its members as set forth in WECC Bylaws. Avista participates in WECC's Planning, Operations, and Market Interface Committees, as well as various sub groups and other processes such as the TCWG.

Northwest Power Pool

Avista is a member of the Northwest Power Pool (NWPP). Formed in 1942 when the federal government directed utilities to coordinate operations in support of wartime production, NWPP committees include the Operating Committee, the Pacific Northwest Coordination Agreement (PNCA) Coordinating Group, and the Transmission Planning Committee (TPC). The TPC exists as a forum addressing northwest electric planning issues and concerns, including a structured interface with external stakeholders.

The NWPP serves as an electricity reliability forum, helping to coordinate present and future industry restructuring, promoting member cooperation to achieve reliable system operation, coordinating power system planning, and assisting the transmission planning process. NWPP membership is voluntary and includes the major generating utilities serving the Northwestern U.S., British Columbia and Alberta. Smaller, principally non-generating, utilities participate in an indirect manner through their member systems, such as the BPA.

ColumbiaGrid

ColumbiaGrid formed on March 31, 2006 to develop sub-regional transmission plans, assess transmission alternatives (including non-wires alternatives), provide a decision-making forum, and to provide a cost-allocation methodology for new transmission projects. This group formed in response to several FERC initiatives. Avista joined ColumbiaGrid in early 2007. The ColumbiaGrid agreements help different organizations and groups determine areas of transmission work, and establish agreements to carry out the plans.

Northern Tier Transmission Group

The Northern Tier Transmission Group (NTTG) formed on August 10, 2007. NTTG members include Deseret Power Electric Cooperative, Idaho Power, Northwestern Energy, PacifiCorp, Portland General Electric, and Utah Associated Municipal Power Systems. NTTG members coordinate with state governments to manage their transmission system operations, products, business practices, and high-voltage transmission network planning to meet and improve transmission delivery services. Avista's transmission network has a number of strong interconnections with three of the six NTTG member systems. Due to the geographical and electrical positions of Avista's transmission network related to NTTG members, Avista is evaluating membership in NTTG to foster collaborative relationships with our interconnected utilities.

Transmission Coordination Work Group

The Transmission Coordination Work Group (TCWG) is a joint effort of Avista, BPA, Idaho Power, Pacific Gas and Electric, PacifiCorp, Portland General Electric, Sea Breeze Pacific-RTS, and TransCanada to coordinate transmission project developments expected to interconnect at or near a proposed Northeast Oregon station near Boardman, Oregon. These projects follow WECC Regional Planning and Project Rating Guidelines. Detailed information on projects presently under consideration is at www.nwpp.org/tcwg.

Most of the projects developed through the TCWG transferred to their own Project Review Groups, placed on hold, or terminated. The TCWG work effort has been significantly reduced over the past year because of the number of terminated and on-hold projects.

Avista Transmission Reliability and Operations

Avista plans and operates its transmission system pursuant to applicable criteria established by the North American Electric Reliability Corporation (NERC), WECC and NWPP. Through involvement in WECC and NWPP standing committees and sub-committees, it participates in developing new and revised criteria, and coordinates transmission system planning and operation with neighboring systems.

Mandatory reliability standards promulgated through FERC and NERC, subject Avista to periodic performance audits through these regional organizations. Portions of Avista's transmission system are fully subscribed for retail load service. Transmission capacity not reserved and scheduled to move power to satisfy long-term (greater than one year) obligations is marketed on a short-term basis and used by Avista for short-term resource optimization or by third parties seeking short-term transmission service pursuant to FERC requirements under Orders 888, 889 and 890.

Transmission Construction Costs

The following sections provide an overview of Avista's estimated resource integration costs for the 2011 IRP. Integration points are divided into locations where interconnection study work has been completed and additional points where new resources might be interconnected. Rigorous analyses are not performed for off-system alternatives because of the breadth of study needed for those estimates. Limited study work has been completed, except for projects with existing generation interconnection requests to Avista's transmission group. Completing transmission studies without detailed project parameters is nearly impossible (and any decisions based on such work would be flawed) and it is therefore inappropriate to represent any figures as more than preliminary. Approximate worst-case estimates were developed based on engineering judgment for neighboring system impacts. Generation interconnection costs are for locations within the Avista transmission system. Internal cost estimates are in 2011 dollars and using engineering judgment with a 50 percent margin for error. Construction timelines are from the beginning of the permitting process to line energization.

Integration of Resources External to the Avista System

Avista's load serving entity function must submit generation interconnection and transmission service requests on third party transmission systems. The third party determines transmission system integration and wheeling service costs for delivering new resource power to Avista's system.

At BPA's present wheeling rate, integrating 300 MW (assuming the transmission service were available from the off system resource to the Avista transmission system) would cost about $4.4 million per year plus $2.5 million per year for line losses.

It is likely that the Company would invest $50 million for a 300 MW resource to increase capacity to third-party transmission systems. These investments may not need to be made at the time of interconnect, but will have to be upgraded in time to maintain FERC's market power requirements and maintain present levels of access to the energy market. If Avista acquires a resource located on a third-party network, detailed studies will need to be completed to understand system impacts.

Eastern Montana Resources

A regional study sponsored by the NWPP and Northwest Transmission Assessment Committee (NTAC) found that enhancement of existing 500 kV and 230 kV facilities would be required to integrate additional generation from Montana. Power transfer from eastern Montana to the Northwest is affected by several constraints. A more detailed study effort focusing on relieving constraints from central and eastern Montana continues as a joint effort by Avista, BPA, NorthWestern Energy, PacifiCorp, and Puget Sound Energy. Preliminary results indicate that perhaps as much as 480 MW of additional transfer from Montana can be achieved, however engineering-level construction cost estimates to fix constraints within the various transmission systems have not yet been completed. It should also be noted that various facilities in the Avista transmission system would need to be upgraded to achieve this additional transfer.

Integration of Resources on the Avista Transmission System

The Avista-LSE requested a number of generator interconnection studies in several areas of the Avista transmission system for the 2011 IRP. The following project and cost information was presented at the Third Technical Advisory Committee meeting on December 2, 2010, these cost estimates are presented in Table 5.1.

Table 5.1: New Resource Integration Costs

Location	Notes	Size (MW)	Cost ($ millions)
West of Spokane, WA	No transmission additions	4	0
West of Spokane, WA	Requires new 115 kV line	75	15
West of Spokane, WA	Requires two new 230 kV lines	254	30-55
Benewah, ID	No transmission additions	300	5
Rosalia, WA	No transmission additions	300	8
Rathdrum, ID	Requires generation dropping	300	5
Rathdrum, ID	Requires generation dropping	400	5
Othello, WA	No transmission additions	17	0
Othello, WA	Requires new 115 kV line and substation[1]	100	13-25
Othello, WA	Requires new 230 kV line and substation	250	21-32
Sandpoint, ID	Depends on BPA interconnection	50	2-5
Sandpoint, ID	Cost prohibitive and not studied	100	N/A
Cabinet Gorge, ID	115 kV reconductor	60	2-10
Spokane, WA	Monroe Street hydro project	20	3
Spokane, WA	Monroe Street hydro project	60	3
Post Falls, ID	Post Falls hydro project	14	1
Spokane, WA	Upper Falls hydro project	14	1

After the completion of the IRP's Preferred Resource Strategy and the preference for nearly 500 MW of natural gas capacity in North Idaho. The Resource Planning group requested further study work on specific transmission lines for a more detailed cost of interconnection. This study is in Appendix E. The study shows that in most locations, potential plants can be integrated at similar costs as presented in Table 5.1 as long as a RAS system (generation dropping) is in place. The study further identifies the cost of adding additional network facilities so a RAS system is no longer required.

[1] Note that the 100 MW estimate is for 115 kV integration, and the 250 MW estimate is for 230 kV integration, and does not include mitigation of contractual constraints on the Avista 230 kV system in the area.

Lancaster Integration

Avista has proposed and evaluated an interconnection with BPA at its Lancaster Substation. Avista and BPA have determined that the preferred alternative is to loop the Avista Boulder-Rathdrum 230 kV line into the BPA Lancaster 230 kV station. This interconnection will allow Avista to eliminate or offset BPA wheeling charges for moving the output from Lancaster to Avista's system. Besides reduced transmission payments to BPA by Avista, the interconnection benefit both Avista and the BPA by increasing system reliability, decreasing losses, and delaying the need for additional transformation at the BPA Bell Substation. The proposed plan of service also represents the best option for service from Avista's sole perspective. Studies also indicate that looping the Boulder-Rathdrum 230 kV line into the Lancaster Substation may allow more transfer capability across the combined transmission infrastructure of Avista and BPA. The present Colstrip Upgrade Project study indicates that all of the upgrades (from AVA, BPA, and NWE) could increase the Montana to Northwest path by as much as 800 MW—the associated projects include much more than the Lancaster loop-in work. Construction on the Lancaster project could be completed by the end of 2012 or at some point in 2013, depending on BPA's construction schedule. Avista is working closely with BPA to assure the timely construction of the BPA facilities required to facilitate this interconnection.

Distribution Efficiencies

Avista delivers electrical energy from generators to customer meters through a network of conductors (links) and stations (nodes). The network system is operated at different voltages depending upon the distance the energy must travel to reduce current losses across the system. A common rule to determine efficient energy delivery is one kV per mile. For example, a 115 kV power system commonly transfers energy over a distance of 115 miles while 13 kV power systems are generally limited to delivering energy 13 miles.

Avista's categorizes its energy delivery systems between transmission and distribution voltages. Avista's transmission system operates at 230 kV and 115 kV nominal voltages. Avista's distribution system operates between 4.16 kV and 34.5 kV, but typically at 13.2 kV in its urban service centers. In addition to voltages, the transmission system operates distinctly from the distribution system. For example, the transmission system is a network linking multiple sources with multiple loads, while the distribution system configuration uses radial feeders to link a single source to multiple loads.

System Efficiencies Team

In 2008 an Avista system efficiencies team of operational, engineering and planning staff developed a plan to evaluate potential energy savings from Transmission and Distribution (T&D) system upgrades. The first phase summarized potential energy savings from distribution feeder upgrades. The second phase, beginning in the summer of 2009, combined transmission system topologies with "right sizing" distribution feeders to reduce system losses, improve system reliability, and meet future load growth.

Distribution Feeders

Avista's distribution system consists of approximately 330 feeders covering 30,000 square miles. The feeders range in length from three to 73 miles. For rural distribution, feeder lengths vary widely to meet the electrical loads resulting from the startup and shutdown business swings of the timber, mining and agriculture industries.

The system efficiencies team evaluated several efficiency programs across the urban and rural distribution feeders. The programs consisted of the following system enhancements:

- Conductor losses;
- Distribution Transformers;
- Secondary Districts; and
- Var compensation.

The energy losses, capital investments, and reductions in operations and maintenance (O&M) costs resulting from the individual efficiency programs under consideration were combined on a per feeder basis. This approach provided a means to rank and compare the energy savings and net resource cost for each feeder.

Economic Analysis

Prior to the 2009 IRP an economic analysis was performed to determine the net resource costs to upgrade each feeder for the four program areas listed above. The net resource cost determines the avoided cost of a new energy resource levelized over the asset's life cycle expressed in dollars per megawatt. This economic value is calculated by estimating the capital investment, energy savings, and avoidance of operations and maintenance (O&M) and interim capital investments resulting from feeder upgrades.

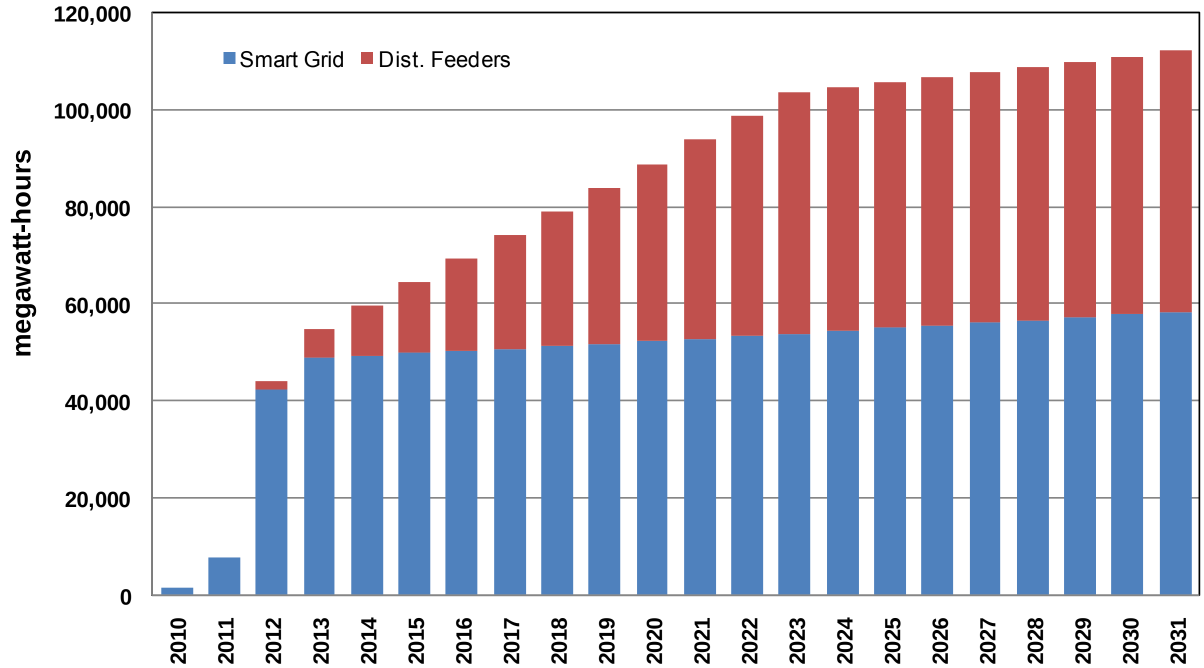
The O&M avoided costs for upgrades were determined by modeling existing feeders in the Availability Workbench program. This program is an expected value model combining a weighted average time and material cost of equipment failure with the probability of failure. The distribution feeder's conductor, transformers, and ancillary equipment were used to develop the failure model for each studied feeder. Customer, material and labor costs incurred by outages, and equipment failure were the parameters used to measure the economic risk of a failure. The results were calibrated to the expected value model by industry indexes and Avista's actual outage history. Many of the projects found to be cost effective in the study are now a part of the grid modernization project discussed below. There were 60 feeders remaining for potential re-builds and based upon preliminary energy and O&M savings estimates. All appear cost effective. However, these projects need further study to develop detailed cost and energy savings estimates, further improved reliability and replacing aging infrastructure may also contribute to the decision to proceed with rebuild projects. Based on the preliminary cost and energy estimates shown in Figure 5.2, losses could be reduced by 6.1 aMW by the end of the IRP planning period.

Grid Modernization

Avista is investing in grid modernization technology with the aid of three federal grants promoting the development of grid modernization applications. These grants require the

Company to invest in grid modernization training and grid improvement. The following is a discussion of the programs, and the progress of the investment. Figure 5.2 summarizes projected energy savings for Grid Modernization (Smart Grid) and Distribution Feeder Rebuild projects over the 20-year IRP planning period. Table 5.2 shows the projected loss savings for 2012 and 2013.

Figure 5.2: Cumulative Distribution Loss Savings from Grid Modernization and Feeder Upgrades



Washington's Energy Independence Act targets for energy efficiency capture first year energy savings. Avista will capture the first year energy savings entirely in the year when the assets are placed in service. The Evaluation, Measurement and Verification process will focus on the 12-month period extending forward from the date assets are place in service.

Table 5.2: Distribution Loss Energy Savings (MWh)

Location	2012	2013
Smart Grid	34,839	6,477
Distribution Feeders	1,626	4,351
Total	**36,465**	**10,828**

Smart Grid Workforce Training Grant

Avista received a three-year, $1.3 million government grant to invest in facility and training programs to educate workers for developing, managing, and maintaining the future grid. Workers are trained at the Jack Stewart Training Center, working in a model neighborhood and substation to learn about grid modernization technology. Avista is also developing a curriculum for local universities and an online portal to provide training opportunities outside of the organization. Another goal of this grant is to share best practices on Smart Grid training.

Smart Grid Investment Grant (SGIG)

The $20 million Smart Grid Investment Grant (SGIG) covers investment to the Spokane area grid improvement project. This project includes upgrades for 59 circuits, 14 substations, and 110,000 electric customers. Avista is contributing $42 million dollars to this project to automate the system. 42,000 MWh or 4.8 aMW of loss savings are expected. Conservation Voltage Reduction (CVR) makes up 83 percent of the loss savings. This project will enable Avista to remotely control and operate the distribution system through a series of wireless controls and fiber communication between switches, reclosers, capacitor banks, and voltage regulators. The Distribution Management System will remotely operate the system and will be able to automatically detect and restore faults.

Smart Grid Demonstration Project (SGDP)

Avista is a partner in the regional Smart Grid Demonstration Project (SGDP). Avista is using an $18.9 million government grant to employ grid modernization technology in Pullman, Washington, as part of the Pacific Northwest Smart Grid Demonstration Project. Avista is contributing $14.9 million to the Pullman project and other parties are contributing an additional $4.0 million. The partners are Itron, HP, Washington State University, and Spirae. This project encompasses 13 circuits, three substations, and includes network automation. The project involves replacement of 14,000 electric and 6,000 natural gas meters with digital meters with wireless communication. Customers with these new meters will be able to use a web portal to track energy usage in near real time. This project should reduce system losses by 6,763 MWh.

Feeder Rebuild Program

Beginning in 2012, Avista will begin rebuilding distribution feeders to capture energy savings from reducing losses, increase reliability, and decrease future O&M costs. In 2012, the Company will begin work on three feeders; the feeders include BEA12F1 and F&C12F2 (urban feeders located in Spokane) and a rural feeder in Wilbur, Washington (WIL12F2).

As an example, an 11-mile section of the Wilbur feeder (WIL12F2) was chosen as one of the initial feeder upgrades because of reliability and operational deficiencies. The Wilbur feeder has several issues. The small diameter conductor sags at unacceptable levels during frequent icing events in the area. The high impedance of this conductor also increases the difficulty of determining where faults occur. The average age of the transformers being replaces is over 50 years. Finally, this feeder is also difficult to repair quickly because of its remote location. Over the last five years, the feeder has averaged 50 outages per year with a 400-minute average outage duration.
The 2012 feeder rebuilds will be completed between June and December 2012 and we expect to reduce losses by 1,626 MWh annually. The schedule of feeders has yet to be determined for 2013, but will likely include five or six feeder upgrades for approximately 3,325 MWh of expected loss savings annually. These estimates range between plus or minus 30 percent depending on construction scheduling, feeder selection, load levels, and other factors. The ultimate scope and timing of the feeder rebuild programs will

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 110 of 1069

depend on the actual results of the first several feeder rebuild projects and on the availability of resources and operational needs of the Company.

Transmission Topologies and Distribution Feeder Sizing

Avista is planning a new modeling system that will incorporate transmissions topology, station locations and load growth. Historically, Avista's power grid was designed and built to adhere to reliability and capacity guidelines resulting in the lowest upfront cost. This approach was reasonable considering the low electricity costs of that time. As the cost of energy increases, life cycle economic analyses are warranted to evaluate power system losses corresponding to different power grid configurations.

The new and comprehensive analysis will review several different transmission topologies to determine the most efficient configuration for moving bulk power through and by Avista's system. The transmission topologies will consider the efficiency between star network, hub and loop, southern loop and southern source. Avista's load service will be incorporated in this analysis by determining ideal substation placement and feeder sizes as well as forecasted load growth. The comprehensive analysis will evaluate many of the items listed below.

- Develop a performance criteria to determine system measures;
- Develop a base case to measure existing system performance;
- Develop a methodology to determine a full build out load case;
- Identify reasonable transmission topologies for evaluation;
- Identify reasonable guidelines for substation placement;
- Identify reasonable guidelines for distribution feeder sizes; and
- Bound the analysis to ensure the system remains reliable, compliant, and operationally flexible.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 111 of 1069

6. Generation Resource Options

Introduction

There are many generating resource options available to meet future resource deficits. Avista can upgrade existing resources, build new facilities, or contract with other energy companies for future delivery. This section describes the resources considered to meet future resource needs. The new resources described in this chapter are mostly generic. Actual resources may differ in size, cost, and operating characteristics due to siting or engineering requirements.

Section Highlights

- Only resources with well-defined costs and operating histories are in the PRS analysis.
- Wind and solar resources represent renewable options available to the Company; future RFPs might identify competing renewable technologies.
- Renewable resource costs assume present state and federal incentive levels, but no extensions.
- For the first time, thermal generation upgrades are included as resource options in the IRP.

Assumptions

For the Preferred Resource Strategy (PRS) analysis, Avista only considers commercially available resources with well-known cost, availability and generation profiles. These resources include gas-fired combined cycle combustion turbines (CCCT), simple cycle combustion turbines (SCCT), large-scale wind, and certain solar technologies proven on a large-scale commercial basis. Several other resource options described later in the chapter were not included the PRS analysis, but their costs were estimated for comparative analysis.

Levelized costs referred to throughout this section are at the generation busbar. The nominal discount rate used in the analyses is 6.8 percent. Nominal levelized costs result from discounting nominal cash flows at the rate of general inflation.

Renewable resources eligible for federal tax incentives receive such incentives based on the current federal law. Wind benefits end in 2012; solar tax benefits end in 2016, and all other renewable benefits end in 2013. The levelized costs in this chapter assume maximum available energy for each year instead of expected generation. For example, wind generation assumes 31 percent availability, CCCT generation assumes 90 percent availability, and SCCT generation assumes 92 percent availability. The following are definitions for the levelized cost components used in this chapter:

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 112 of 1069

- *Capital Recovery and Taxes*: Includes depreciation, return on capital, income taxes, property taxes, insurance, and miscellaneous charges such as uncollectible accounts and state taxes for each of these items pertaining to generation asset investment.
- *Allowance for Funds Used During Construction (AFUDC):* The cost of money for construction payments before the utility can recover costs of prudently acquired generation resources.
- *Federal Tax Incentives:* The estimated federal tax incentive (per MWh), whether in the form of a production tax credit (PTC), a cash grant, or an investment tax credit (ITC), attributable to certain generation options.
- *Fuel Costs*: The cost of fuels such as natural gas, coal, or wood per the efficiency of the generator. Additional details on fuel prices are in the Market Modeling section.
- *Fuel Transport*: The cost to transport fuel to the plant, including pipeline capacity charges.
- *Greenhouse Gas Emissions Adder:* Cost of carbon dioxide (greenhouse gas) emissions based on Wood Mackenzie forecast.
- *Fixed Operations and Maintenance (O&M):* Costs related to operating the plant such as labor, parts, and other maintenance services (pipeline capacity costs are included for CCCT resources) that are not based on generation levels.
- *Variable O&M:* Costs per MWh related to incremental generation.
- *Interconnection Capital Recovery*: Includes depreciation, return on capital, income taxes, property taxes, insurance, and miscellaneous charges such as uncollectible accounts and state taxes for each of these items pertaining to transmission asset investments needed to interconnect the generator.
- *Excise Taxes and Other Overheads:* Includes miscellaneous charges for non-capital expenses.

At the end of this section, various tables show Incremental capacity, heat rates, generation capital costs, fixed O&M, variable costs, and peak credits.[1] Figure 6.2 shows the levelized costs of different resource types in comparison. All costs shown in this section are in nominal dollars unless otherwise noted. Further information on the plant assumptions used in this section is in the Northwest Power and Conservation Council's (NPCC) Sixth Power Plan.

[1] Peak credit is the amount of capacity a resource contributes at the time of system peak load.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 113 of 1069

Gas-Fired Combined Cycle Combustion Turbine (CCCT)

Gas-fired CCCT plants provide a reliable source of both capacity and energy for a relatively inexpensive capital investment. The main disadvantage is generation cost volatility due to a reliance on natural gas.

CCCTs in this IRP are of a “one-on-one” (1x1) configuration, using both water- and air-cooling technologies. The 1x1 configuration consists of a single gas turbine, a single heat recovery steam generator (HRSG), and a duct burner to gain more generation from the HRSG. These plants have nameplate ratings between 250 MW and 300 MW each. A “2x1” CCCT plant configuration is possible with two turbines and one HRSG, generating up to 600 MW. The most likely CCCT configuration for Avista is a 270 MW air-cooled plant located in the Idaho portion of Avista’s service territory. Potential sites for a future combined cycle plant would likely be on the Avista transmission system to avoid third-party wheeling rates. Another advantage of siting a CCCT resource in Avista’s service territory is access to a low cost natural gas pipeline and fuel sources. Within Avista’s area, siting decisions then come down to choosing the state to locate a new plant. Most of Avista’s load is in Washington, but the state’s natural gas excise tax and carbon dioxide mitigation requirements place a gas-fired plant at an economic disadvantage relative to siting the same plant in an adjoining state. Siting a CCCT in Idaho economically benefits ratepayers with a lower sales tax rate, the absence of a natural gas excise tax, and no fees for carbon dioxide mitigation.

Cost and operational estimates for CCCTs modeled in the IRP use data from the NPCC’s Sixth Power Plan, but adjusted to reflect air-cooled technology costs by Avista’s engineering staff. The heat rate modeled for an air-cooled CCCT resource is 6,925 Btu/kWh in 2012. The projected CCCT heat rate falls by 0.5 percent annually to reflect an allowance for anticipated technological improvements. The plants include seven percent of rated capacity as duct firing at a heat rate of 9,690 Btu/kWh. If Avista were able to site a water-cooled plant, the heat rate would likely be two percent lower and net plant output might increase by five MW.

The IRP models forced outages at six percent per year, with 21 days of annual plant maintenance. CCCT plants are capable of backing down to 65 percent of nameplate capacity, and ramping from zero to full load in four hours. Carbon dioxide emissions are 117 pounds per decatherm of fuel burned. The maximum capability of each plant is highly dependent on ambient temperature and plant elevation. For modeling, winter capability is likely to increase by 4 percent and summer capability is likely to decrease by 6 percent, though these estimates are highly dependent upon ambient temperatures.

The capital cost used for this IRP for an air-cooled CCCT located in Idaho on Avista’s transmission system with AFUDC is $1,323 per kW. Fixed O&M is $16 per kW-year. Table 6.1 shows the overnight-levelized cost for an air-cooled CCCT resource in nominal dollars per MWh.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 114 of 1069

Table 6.1: CCCT (Air Cooled) Levelized Costs

Item	Nominal $/MWh
Capital recovery and taxes	20.25
AFUDC	2.69
Federal Tax Incentives	0.00
Fuel Costs	48.81
Fuel Transport	5.18
Greenhouse Gas Emissions Adder	13.65
Fixed O&M	2.67
Variable O&M	2.35
Interconnection Capital Recovery	0.31
Excise taxes and Other Overheads	3.16
Total Cost	**99.07**

Gas-Fired Combustion Turbines and Reciprocating Engines

Gas-fired combustion turbines (CTs) and reciprocating engines, or peaking resources, provide low-cost capacity and are capable of providing energy as needed. Technology advances allow the plants to start and ramp quickly, enabling them to provide regulation services and reserves for load following and for variable resources such as wind generation.

The IRP models four peaking resource options: Frame (GE 7EA) and hybrid aero-derivative (GE LMS 100), Reciprocating Engines (Wartsila 20V34), and Aeroderivative (GE LM 6000). The different peaking technologies range in their abilities to follow load, their costs, their generating capabilities, and their energy-conversion efficiencies. Cost and operational estimates rely on the Northwest Planning and Conservation Council's Sixth Power Plan. Table 6.2 compares some of the peaking resource operating and cost characteristics. All plants assume the same 0.5 percent annual real dollar cost decrease and forced outage and maintenance rates. The levelized cost for each of the technologies is in Table 6.3.

Table 6.2: Simple Cycle Plant Cost and Operational Characteristics

Item	Frame	Hybrid	Reciprocating Engine	Aero-Derivative
Capital Cost with AFUDC ($/kW)	679	1,272	1,308	1,186
Fixed O&M ($/kW- yr)	12.70	9.20	15.00	15.00
Heat Rate (Btu/kWh)	11,841	8,782	8,762	9,276
Variable O&M ($/MWh)	$1.13	$5.63	$11.25	$4.50
Segment Size (MW)	83	94	99	46

The lowest cost resource in Table 6.3 is the hybrid CT technology. However, this comparison can be misleading, as a peaking resource does not operate at its theoretical maximum operating levels. Peaking resources generally operate a small percentage of the time. Therefore, a lower capacity cost resource may be more appropriate than a lower per unit cost resource when considering the number of expected operating hours in the broader IRP modeling process.

Table 6.3: Simple Cycle Plant Levelized Costs per MWh

Item	Frame	Hybrid	Reciprocating Engine	Aero-derivative
Capital Recovery and Taxes	10.33	19.37	19.38	18.06
AFUDC	0.89	1.67	1.67	1.56
Federal Tax Incentives	0.00	0.00	0.00	0.00
Fuel Costs	81.33	60.32	60.18	63.72
Fuel Transport	0.00	0.00	0.00	0.00
Greenhouse Gas Emissions Adder	22.75	16.87	16.84	17.83
Fixed O&M	2.00	1.46	2.30	2.37
Variable O&M	1.38	6.91	13.82	5.53
Interconnection Capital Recovery	0.44	0.44	0.43	0.44
Excise Taxes and Other Overheads	4.67	3.72	4.05	3.89
Total Cost	**123.81**	**110.76**	**118.66**	**113.39**

Wind

Concerns over the environmental impact of carbon-based generation technologies have increased demand for wind generation. Governments are promoting wind generation through a combination of tax credits, renewable portfolio standards, and climate change legislation. The 2009 American Recovery and Reinvestment Act extended the PTC for wind through December 31, 2012, and provided an option for wind generation owners to select a 30 percent investment tax credit (ITC) or cash grant instead of the PTC.

The IRP includes two wind generation resources: on-system and off-system. Both resources have the same capital costs and wind pattern, but differ in the cost of transmission to deliver the energy to Avista's system. On-system projects must pay only transmission interconnection costs, whereas off-system projects must pay both interconnection and third party wheeling costs.

Wind resources benefit from having no emissions profile or fuel costs, but they are not dispatchable, and have high capital and labor costs relative to other resource options. Wind capital costs in 2012, including AFUDC and transmission interconnection, are expected to be $1,850 per kW with annual fixed O&M costs of $51 per kW-yr (including costs due to intermittent generation). These estimates come from Avista's experience in the wind market at the time of the IRP. The capacity factors in the Northwest are likely to vary depending upon the location. Northwest wind has a 31.2 percent average capacity factor; on-system wind projects have a 29.75 percent capacity. A statistical method, based on regional wind studies, derives a range of annual capacity factors depending on the wind regime in each year (see stochastic modeling assumptions for more details.

Levelized costs, using these expected capacity factors and capital and operating costs are in Table 6.4. These wind generation cost estimates assume the use of the federal cash grant for any project brought online by the IRP models before 2013 and assume Avista system interconnection cost of approximately $150 per kW. Actual wind resource cost will vary depending on a project's capacity factor, interconnection point, and the tax incentive eligibility. Further, this plan assumes that any wind resources selected in the PRS include the 20 percent renewable energy credit (REC) apprenticeship adder for Washington State eligible renewable resources. This adder applies only in the state of Washington for compliance in meeting its Energy Independence Act (I-937), requiring 15 percent of the construction labor to be apprentice through a state-certified apprenticeship program to qualify. The costs shown below do not reflect the consumption of (i.e., wind integration) or lack of ancillary services generated by wind relative to other generation technologies.

Table 6.4: Northwest Wind Project Levelized Costs per MWh

Item	On-System	Off-System	Off-System Montana
Capital Recovery and Taxes	77.59	73.98	58.40
AFUDC	8.19	7.80	6.16
Federal Tax Incentives (2012 only)	-23.93	-22.82	-18.01
Fuel Costs	-	-	-
Fuel Transport	-	-	-
Greenhouse Gas Emissions Adder	-	-	-
Fixed O&M	27.59	26.31	22.37
Variable O&M	2.76	2.76	2.76
Interconnection Capital Recovery	7.99	18.67	26.78
Excise Taxes and Other Overheads	1.66	2.07	2.25
Total Cost (without tax incentive)	**125.78**	**131.60**	**118.72**
Total Cost (with tax incentive)	**101.85**	**108.78**	**100.71**

Solar

Solar generation technology costs have fallen substantially in the last several years owing to help from renewable portfolio standards and government tax incentives, both inside and outside of the United States. Solar costs in this IRP are 27 percent lower than in the 2009 IRP. Even with these large cost reductions, solar still is uneconomic when compared to other generation resources because of its low capacity factor and still-high capital cost. Solar does provide predictable on-peak generation that generally complements the loads of summer-peaking utilities.

Utility-scale photovoltaic generation can be optimally located for the best solar radiation. Solar thermal can produce a higher capacity factor than photovoltaic projects (up to 30 percent) and can store energy for several hours. Capital costs in the IRP, including AFUDC, for solar generation technologies are $5,802 per kW for photovoltaic and $5,538 for solar-thermal or concentrating solar projects. A well-placed utility-scale photovoltaic system located in the Pacific Northwest would achieve a capacity factor of less than 20 percent. Two solar technologies were studied for this IRP (photovoltaic and solar-thermal), but only utility-scale photovoltaic was included as an option for the PRS.

Avista does not believe that solar-thermal is an economically viable option in Avista's service territory given our modest solar resource.

The levelized costs of solar resources, including federal incentives, are in Table 6.5. Even with declining prices, solar will continue to struggle as a cost-competitive resource in the Northwest until technology improves capacity factors, installation costs decline at a more rapid pace, or government entities create further policies or tax incentives to make this resource more attractive. One advantage solar has in the state of Washington is if the total plant is less than five megawatts it can generate two RECs that qualify for the Washington State Energy Independence Act for every megawatt hour of generation.

Table 6.5: Solar Nominal Levelized Cost ($/MWh)

Item	Photovoltaic	Concentrating
Capital Recovery and Taxes	370.14	201.85
AFUDC	29.49	22.44
Federal Tax Incentives	(117.60)	(64.58)
Fuel Costs	-	-
Fuel Transport	-	-
Greenhouse Gas Emissions Adder	-	-
Fixed O&M	39.73	30.00
Variable O&M	-	1.38
Interconnection Capital Recovery	1.67	9.75
Excise Taxes and Other Overheads	1.79	1.78
Total Cost (without tax incentive)	**442.82**	**267.20**
Total Cost (with tax incentive)	**325.22**	**202.62**

Coal

The coal generation industry is at a crossroads. In many states, like Washington, new coal-fired generation is unlikely due to emissions performance standards.[2] In other parts of the country, coal remains a viable option, but the risks associated with future carbon legislation make investments in this technology potentially subject to significant upward price pressures. Avista assumes it will not build any new coal-fired generation resources due to the risk of future national carbon mitigation legislation and the effective prohibition in Washington state law. Technologies reducing or capturing greenhouse gas emissions in coal-fired resources might enable coal to become a viable technology in the future, but the technology is not commercially available. Although Avista will not pursue coal in this plan, three coal technologies are shown to illustrate their costs: super critical pulverized, integrated gasification combined cycle (IGCC), and IGCC with sequestration. IGCC plants gasify coal, thereby creating a more efficient use of the fuel lowering carbon emissions and removing other toxic substances before combustion. Sequestration technologies, if they become commercially available, might potentially sequester 90 percent of carbon dioxide (CO_2) emissions, effectively reducing CO_2

[2] The Washington State legislature passed Senate Bill 6001 in 2007, effectively prohibiting in-state electric utilities from developing coal-fired facilities that do not sequester emissions or purchasing long-term contracts from coal-fired facilities.

emissions from 205 pounds per MMBtu to 20.5 pounds per MMBtu. Table 6.6 shows the costs, heat rates, and CO_2 emissions of the three coal-fired technologies based on estimates from the NPCC's Sixth Power plan and adjusted for Avista's projected inflation rates. Table 6.7 shows the nominal levelized cost per MWh based on the capital costs and plant efficiencies shown in Table 6.6.

Table 6.6: Coal Capital Costs (2012$)

Technology	Capital Cost ($/kW includes AFUDC)	Heat Rate (Btu/kWh)	CO_2 (lbs/MMBtu)
Super-Critical	3,583	8,910	205
IGCC	4,001	8,594	205
IGCC with Sequestration	5,334	10,652	25

Table 6.7: Coal Project Levelized Cost per MWh

Item	Super-Critical	IGCC	IGCC w/ Sequestration
Capital Recovery and Taxes	56.82	64.70	86.27
AFUDC	9.66	13.06	17.41
Federal Tax Incentives	0.00	0.00	0.00
Fuel Costs	14.28	13.77	17.07
Fuel Transport	0.00	0.00	0.00
Greenhouse Gas Emissions Adder	30.00	28.93	4.30
Fixed O&M	11.87	12.10	12.10
Variable O&M	3.80	8.70	11.74
Interconnection Capital Recovery	10.31	10.46	4.79
Excise taxes and Other Overheads	3.04	3.20	2.16
Total Cost	**139.79**	**154.94**	**155.86**

Other Generation Resource Options

A thorough IRP considers generation resources that are not generally available in large quantities or those not commercially or economically ready for utility-scale development, but may be over the 20-year IRP planning horizon. This is particularly true for some emerging technologies that are attractive from an environmental perspective, but are currently higher-cost than other resources. Avista analyzed the following resources for this IRP using estimates from the NPCC's Sixth Power Plan but did not select them for the Preferred Resource Strategy: biomass, geothermal, co-generation, nuclear, landfill gas, and anaerobic digesters. It is possible that these resources could compete with those assumed in the IRP. If so, Avista's RFP processes will identify them and their selection will displace resources otherwise included in the IRP strategy. The expected cost of these resource options per MWh is in Table 6.8 and Table 6.9.

Woody Biomass

Avista's Kettle Falls Generation Station is a 50 MW wood-fired plant Avista built and has operated since 1983. The viability of another Avista biomass projects depends substantially on the availability and cost of the fuel supply. Many announced biomass projects fail because of problems securing long-term fuel sources. Where an RFP identifies a potential project, Avista will consider it for a future acquisition.

Geothermal

Northwest utilities have developed an increased interest in geothermal energy over the past several years. Geothermal energy provides renewable capacity and energy with minimal carbon dioxide emissions (zero to 200 pounds per MWh). The federal government has extended production tax credits to this technology through December 31, 2013. Geothermal energy struggles due to high upfront development costs and risks stemming from drilling several holes thousand feet below the earth's crust; each hole can cost over $3 million. Geothermal costs are low once drilling ends, but the risk capital required to locate and prove a viable site is significant. Costs shown in this section do not account for dry-hole risk associated with sites that do not prove to be viable resources after drilling has taken place.

Landfill Gas

The Northwest has successfully developed landfill gas resources. The Spokane area had a project, but it was retired after the fuel source depreciated to an unsustainable level. Based upon costs from the NPCC, landfill gas resources are economically promising, but are limited in their size, quantity, and location.

Anaerobic Digesters (Manure/Wastewater Treatment)

Like landfill gas, the number of anaerobic digesters is increasing in the Northwest. These plants typically capture methane from agricultural waste, such as manure or plant residuals, and burn the gas in reciprocating engines to power electricity generators. These facilities tend to be significantly smaller than utility-scale generation projects (less than five MW). A survey of Avista's service territory found no large-scale livestock operations capable of implementing this technology.

Wastewater treatment facilities can host anaerobic digesters. Digesters installed when a facility is constructed helps the economics of a project greatly, though costs range greatly depending on the system configuration. Retrofits to existing wastewater treatment facilities are possible, but tend to have higher costs. Many of these projects offset energy needs of the facility, so there may be little, if any, surplus generation capability.

Small Cogeneration

Avista has relatively few industrial customers capable of developing cost-effective cogeneration projects. If an interested customer was inclined to develop a small cogeneration project, it could provide benefits including reduced transmission and distribution losses, shared fuel/capital/emissions costs, and credit toward Washington's I-937 targets. The PRS does not include small cogeneration; where a customer pursues this resource, Avista will consider it along with other generation options.

Nuclear

Nuclear plants are not a resource option in the IRP given the uncertainty of their economics, the apparent lack of regional political support for the technology, U.S. policy implications, and the negative experience Avista had with its participation in WNP-3 in the 1980s. Like coal plants, nuclear resources could be in Avista's future because other utilities in the Western Interconnect may be able to incorporate nuclear power in their resource mix and offer Avista an ownership share. Given these considerations, Avista does not include any nuclear generation in its Preferred Resource Strategy. The viability of nuclear power could change as national policy priorities focus attention on de-carbonizing the nation's energy supply. Nuclear capital costs are difficult to forecast, as there have been no new nuclear facilities built in the United States since the 1980s. Projected costs are from industry studies and recent nuclear plant license proposals.

Table 6.8: Other Resource Options Levelized Costs

	Landfill Gas	Manure Digester	Waste Water Treatment
Capital Recovery and Taxes	31.56	67.15	63.40
AFUDC	2.45	4.66	4.88
Federal Tax Incentives	-8.49	-8.49	-8.49
Fuel Costs	32.66	0.00	0.00
Fuel Transport	0.00	0.00	0.00
Greenhouse Gas Emissions Adder	0.00	0.00	0.00
Fixed O&M	4.87	8.42	7.07
Variable O&M	26.25	33.16	41.45
Interconnection Capital Recovery	4.54	4.54	0.34
Excise Taxes and Other Overheads	2.96	2.00	2.11
Total Cost	**96.80**	**111.45**	**110.76**

Table 6.9: Other Resource Options Levelized Costs ($/MWh)

	Small Co-Gen	Wood Biomass	Geothermal	Nuclear
Capital Recovery and Taxes	53.91	57.59	65.86	97.88
AFUDC	5.36	6.02	11.39	27.26
Federal Tax Incentives	0.00	-8.49	-16.98	-16.98
Fuel Costs	30.60	53.59	0.00	10.36
Fuel Transport	3.19	0.00	0.00	0.00
Greenhouse Gas Emissions Adder	8.56	0.00	4.63	0.00
Fixed O&M	0.00	34.80	32.16	16.85
Variable O&M	11.05	5.11	6.22	1.38
Interconnection Capital Recovery	0.36	4.65	4.49	4.55
Excise Taxes and Other Overheads	2.33	4.25	2.06	1.43
Total Cost	**115.36**	**157.52**	**109.83**	**142.72**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 121 of 1069

New Resources Cost Summary

Avista has several resource alternatives to select from for this IRP. Each provides differing benefits, costs, and risks. The role of the IRP is to identify the relevant characteristics and choose a set of resources that are actionable, meet customer's energy and capacity needs, balance renewable energy requirements, and minimize customer costs. Figure 6.1 shows the comparative cost per MWh of each of the new resource alternatives. Tables 6.13 and 6.14 provide detailed assumptions for each type of resource. The ultimate resource selection goes beyond simple levelized cost analyses and considers the capacity contribution (or lack thereof for wind and solar) of each resource, among other items discussed in the IRP.

Figure 6.1: New Resource Levelized Costs

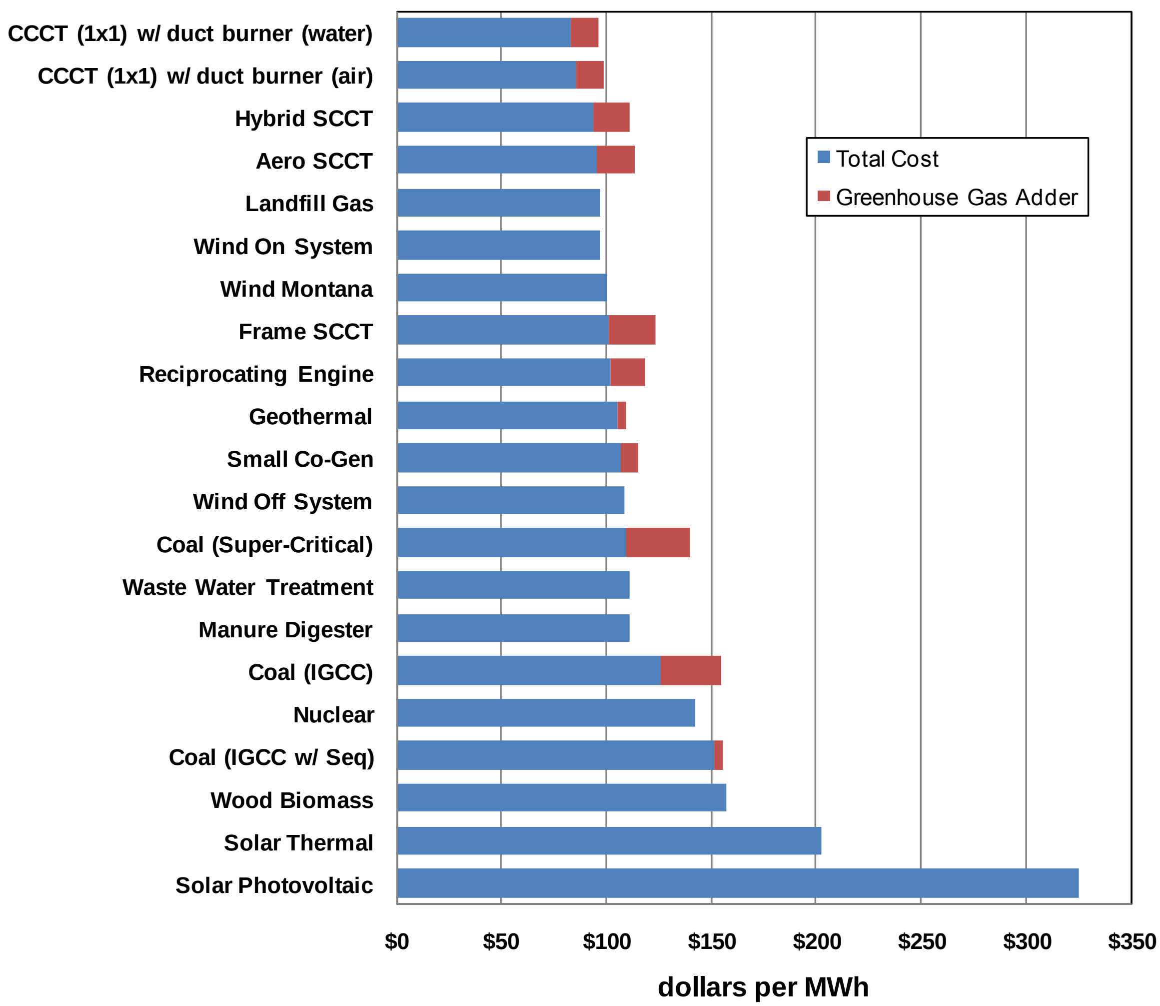


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 122 of 1069

Table 6.10: New Resource Levelized Costs Considered in PRS Analysis

Resource	Size (MW)	Heat Rate (Btu/ kWh)	Capital Cost ($/kW)	Fixed O&M ($/kW-yr)	Variable O&M ($/MWh)	Peak Credit (Winter/ Summer)
CCCT (water cooled)	275	6,722	1,261	16.1	2.14	104/96
CCCT (air cooled)	270	6,856	1,324	16.1	1.91	104/96
Frame CT	83	11,841	708	12.7	1.13	104/96
Hybrid CT	94	8,782	1,326	9.2	5.63	104/96
Reciprocating Engines	99	8,762	1,364	15.0	11.25	100/100
Aero CT	46	9,276	1,237	15.0	4.50	104/96
Wind (on-system)	40	n/a	1,896	51.4	2.25	0/0
Wind (off-system)	40	n/a	1,896	51.4	2.25	0/0
Solar (photovoltaic)	5	n/a	6,092	46.8	0.00	5/60

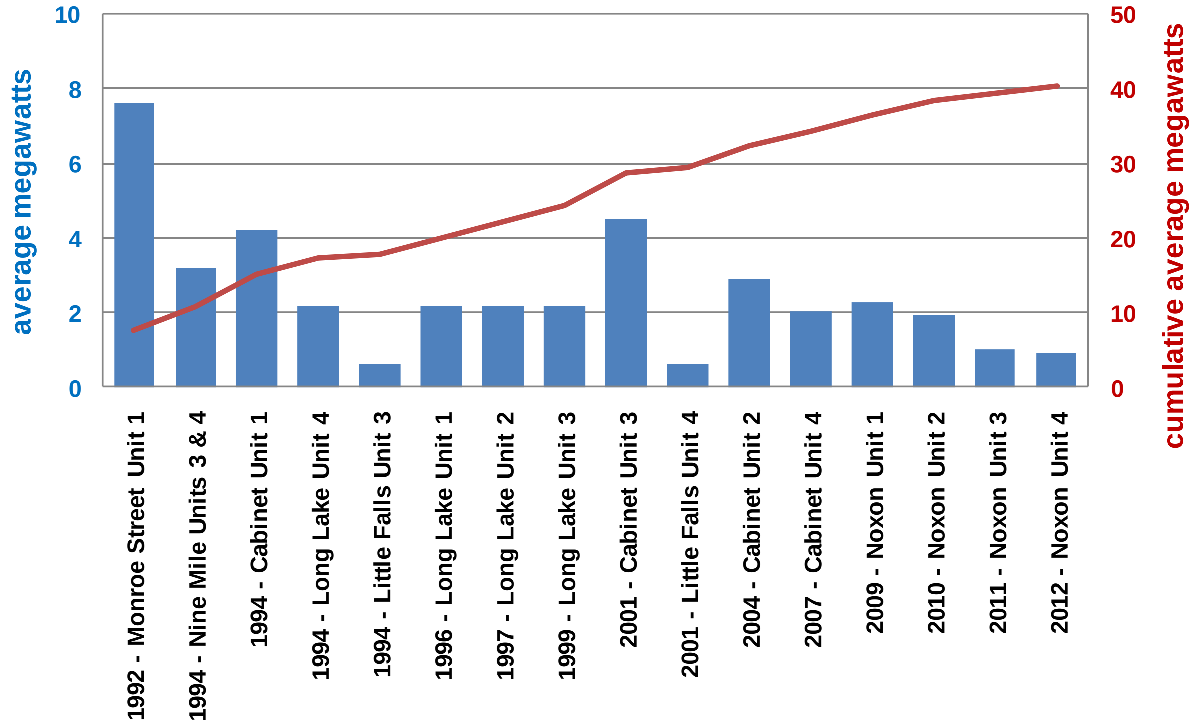
Table 6.11: New Resource Levelized Costs Not Considered in PRS Analysis

Resource	Size (MW)	Heat Rate (Btu/ kWh)	Capital Cost ($/kW)	Fixed O&M ($/kW-yr)	Variable O&M ($/MWh)	Peak Credit (Winter/ Summer)
Pulverized Coal	300	8,910	3,583	69.0	3.09	100/100
IGCC Coal	300	8,594	4,001	69.0	7.09	105/95
IGCC Coal w/ Seq.	250	10,652	5,334	69.0	9.56	100/100
Solar (thermal)	25	n/a	5,646	69.0	1.13	5/100
Wind (off-system MT)	40	n/a	1,760	51.4	2.25	0/0
Woody Biomass	25	13,500	4,170	207.0	4.16	100/100
Geothermal	15	n/a	5,017	201.3	5.06	110/90
Landfill Gas	3.2	10,600	2,285	29.9	21.38	100/100
Manure Digester	0.85	10,250	4,862	51.8	27.01	100/100
Wastewater Treatment	0.85	10,250	4,862	46.0	33.76	100/100
Small Co-Generation	5	4,456	3,922	0.0	9.00	104/96
Nuclear	500	10,400	6,522	103.5	1.13	100/100

Hydroelectric Project Upgrades

Avista continues to upgrade many of its hydroelectric facilities. The latest hydroelectric upgrade added nine MW to the Noxon Rapids Development in April 2011. Upgraded Noxon Rapids Unit 4 will enter service in April 2012. Figure 6.1 shows the history of upgrades to Avista's hydroelectric system in additional average megawatts by year and cumulatively. Avista will have added 40.1 aMW of incremental hydroelectric energy between 1992 and 2013.

Figure 6.2: Historical and Planned Hydro Upgrades



Following upgrades at Noxon Rapids, Avista expects to pursue an upgrade at Nine Mile and annual upgrades to the Little Falls project over a four-year period. The Little Falls upgrades will include new turbine runners, generators, and other electrical equipment. The upgrade at Nine Mile could be a new powerhouse or a replacing the current units. Several other potential hydroelectric upgrades might add capacity and energy at the Long Lake, Cabinet Gorge, Post Falls, and Monroe Street projects. These upgrades are not included in the portfolio analysis and no estimated costs are in this IRP because further study is required. Such studies are part of the IRP's Action Plan. Table 6.8 shows the hydroelectric upgrade studies. Large hydro upgrades can help meet Avista's renewable energy goals under I-937, benefit from federal tax incentives, and help mitigate dissolved gases.

Table 6.12: Hydro Upgrade Potential

Plant	Potential Capacity (MW)	Potential Energy (aMW)
Upper Falls	2	1
Long Lake Second Powerhouse	60 - 120	18 - 20
Cabinet Gorge Second Powerhouse	50	7
Post Falls New Powerhouse	19	4
Monroe Street Second Powerhouse	38	16

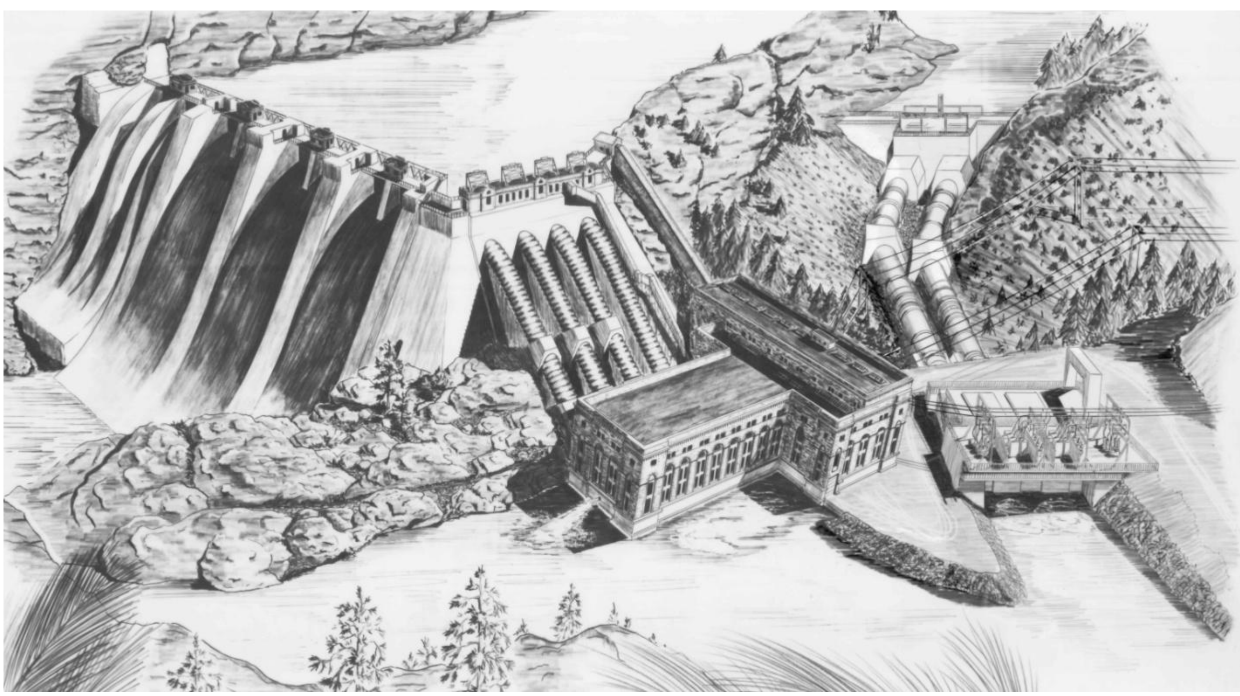
Upper Falls

The Upper Falls hydroelectric upgrade would consist of replacing the single unit's turbine runner and modifying the existing draft tube to improve efficiency. Initial costs estimates are $7 million or $3,500 per kW, for an additional two MW of capacity and 8,760 MWh of energy. This upgrade would require FERC licensing changes and help meet Avista's I-937 renewable energy goals.

Long Lake Second Powerhouse

Avista studied a second powerhouse at Long Lake about 20 years ago using a small arch dam located on the south end of the project site. See Figure 6.3 for a concept of the project. The potential cost of this resource could exceed $120 million and provide an additional 158,000 to 178,000 MWh of energy per year and 60 to 120 MW of added capacity. This project would be a major undertaking and would take several years to complete. It would require major changes to the Spokane River license, but could help reduce total dissolved gas concerns by reducing spill at the project. The incremental capacity would also help meet future winter peak loads, but may not contribute greatly to summer peak needs. The incremental energy might qualify under I-937.

Figure 6.3: Long Lake Second Powerhouse Concept Drawing



Cabinet Gorge Second Powerhouse

Avista is exploring the addition of a second powerhouse at the Cabinet Gorge project site to mitigate total dissolved gas. A new powerhouse would benefit from an existing diversion tube around the dam. The potential cost of this resource could be as high as $115 million. The new powerhouse could provide 57,000 MWh of additional energy per year, and 50 MW of additional capacity. This project would be a major engineering project, take several years to complete, and require major changes to the Clark Fork River FERC license. As with the other potential hydroelectric upgrade projects, this project might help Avista meet its I-937 renewable energy goals.

Post Falls Refurbishment

The Post Falls hydroelectric project is 105 years old. An upgrade to this project includes a total rebuild of the powerhouse and equipment while leaving the exterior intact. The project would remove the existing horizontal units, replacing them with higher efficiency and higher capacity vertical units. The cost of this upgrade could be as high as $75 million. It would add 33,000 MWh of energy each year and provide an additional 19 MW of capacity. Like the other potential hydroelectric projects, this would require a reopening of the Spokane River FERC license and might help meet Avista's I-937 renewable energy goals.

Monroe Street Second Power House

Avista replaced the powerhouse at its Monroe Street project on the Spokane River in 1992. An upgrade option would include the addition of a new powerhouse to capture additional flows and be a major undertaking requiring substantial cooperation with the city because of disruption in the Riverfront Park and downtown Spokane area during construction. This project would require dredging the river on the western edge of the park and creating a tunnel between city hall and the Monroe street substation. The expected cost for this project would be $95 million, and it could create an additional 142,000 MWh of energy per year and 37.5 MW of incremental capacity. The incremental generation of the upgraded facility might help meet Avista's I-937 renewable energy goals.

Thermal Resource Upgrades

Several upgrade opportunities exist in Avista's thermal fleet that would add capacity and/or increase operating efficiency. Avista plans an economic viability study for each option prior to the 2013 IRP. The following is a list of potential upgrades to the Rathdrum and Coyote Springs 2 projects that the Avista may consider. Table 6.9 is a summary of the nominal levelized costs of each of the upgrade options for the Rathdrum CT and Table 6.10 provides nominal levelized costs for the Coyote Springs 2 upgrade options.

Rathdrum CT to CCCT Conversion

The Rathdrum CT has two GE 7EA units in simple cycle configuration built in 1994 with an approximate 160 MW of combined output used to serve customers in peak load conditions. It is possible to convert this peaking facility to a combined cycle plant by adding between 78 and 91 MW of steam-turbine capacity (depending upon temperature) and increasing its operating efficiency from a heat rate of 11,612 Btu/kWh, in its existing configuration, to a heat rate of about 7,986 Btu/kWh. The capital cost for this upgrade is $81.5 million. Two major issues challenge this conversion. The first is cooling water. Avista does not have water rights adequate to cool the plant with water. Therefore, it is likely that air-cooling at the plant is necessary at higher cost. The second major issue is noise. Major residential development now exists at the plant site. Given these concerns, this option is not in the PRS.

Rathdrum CT Water Demineralizer

Another potential upgrade at Rathdrum is to add a water demineralizer to allow inlet fogging in the summer. This upgrade would increase plant capacity by 17.6 MW and increase its operating efficiency by 0.5 percent on hot summer days. The upgrade will cost approximately $1 million.

Table 6.13: Rathdrum CT Upgrade Options ($/MWh)

	Rathdrum CT: Convert to CCCT (Air Cooled)	Rathdrum CT: Convert to CCCT (Water Cooled)	Rathdrum CT: Add Demineralizer
Capital recovery and taxes	18.62	15.39	4.92
AFUDC	1.94	1.61	0.08
Federal Tax Incentives	0.00	0.00	0.00
Fuel Costs	54.31	53.25	80.89
Fuel Transport	5.53	5.42	8.06
Greenhouse Gas emissions adder	15.19	14.90	22.63
Fixed O&M	2.45	2.45	0.00
Variable O&M	1.62	1.87	1.24
Interconnection capital recovery	0.54	0.54	0.00
Other Emissions	0.00	0.00	0.00
Excise taxes and other overheads	3.45	3.39	4.88
Total Cost	**103.64**	**98.80**	**122.72**

Coyote Springs 2 Inlet Chiller

There are two potential inlet chiller options for increasing summer capacity at the Coyote Springs 2 CCCT plant in Boardman, Oregon. One option is to add an inlet chiller to cool the air going into the machine; the second option is to add a thermal unit in addition to a chiller to optimize chiller operations. Avista estimates this upgrade to add 30 MW of capacity on a 100-degree day at a cost of $10 million. Adding the thermal storage technology capacity in conjunction with an inlet chiller would increase plant capacity by an additional 2.2 MW for an additional $1.0 million.

Coyote Springs 2 Cold Day Controls

Another upgrade option at the Coyote Springs 2 plant is to install an upgraded CT control system to increase its operating performance on cold days. This software upgrade could increase capacity by 17.6 MW on a zero-degree day at an estimated cost of $4.5 million.

Coyote Springs 2 Advanced Hot Gas Path Components

Coyote Springs 2 could benefit from the installation of advanced hot gas path components. This upgrade could add approximately 8 MW of capacity around the year and increase efficiency by one percent. The estimated cost for this upgrade is $18 million with additional annual plant maintenance costs of $3.9 million.

Coyote Springs 2 Cooling Optimization Hardware

Adding cooling optimization hardware to Coyote Springs may add 2.6 MW of capacity around the year and improve plant efficiency by 0.5 percent. The estimated cost of this project is $7.2 million.

Table 6.14: Coyote Springs 2 Upgrade Options ($/MWh)

	Inlet Chiller	Inlet Chiller & Thermal Storage	Cold Day Controls	Enhanced Hot Gas Path Comp.	Optional Cooling Package
Capital recovery and taxes	53.23	55.79	20.20	17.41	47.12
AFUDC	0.91	0.95	0.17	0.30	0.80
Federal Tax Incentives	-	-	-	-	-
Fuel Costs	46.42	46.42	46.42	45.91	46.19
Fuel Transport	4.53	4.53	4.53	4.67	4.70
Greenhouse Gas emissions adder	12.99	12.99	12.99	12.84	12.92
Fixed O&M	-	-	-	36.10	-
Variable O&M	-	-	-	-	-
Interconnection capital recovery	4.32	4.32	4.32	4.44	4.44
Other Emissions	-	-	-	-	-
Excise taxes and other overheads	2.95	2.96	2.96	4.50	2.95
Total Cost	**125.35**	**127.96**	**91.60**	**126.18**	**119.13**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 128 of 1069

7. Market Analysis

Introduction
This section describes the electricity and natural gas market environment developed for the 2011 IRP. Contained in this chapter are risks Avista considers when meeting customer demands at lowest reasonable cost. The analytical foundation for the 2011 IRP is a fundamentals-based electricity model of the entire Western Interconnect. The market analysis compares potential resource options on their net value when operated in the wholesale marketplace, rather than on the simple summation of their installation, operation, maintenance, and fuel costs. The Preferred Resource Strategy (PRS) analysis uses these net values when selecting future resource portfolios.

Understanding market conditions in the geographic areas of the Western Interconnect is important, because regional markets are highly correlated because of large transmission linkages between load centers. This IRP builds on prior analytical work by maintaining the relationships between the various sub-markets within the Western Interconnect, and the changing values of company-owned and contracted-for resources. The backbone of the analysis is AURORAxmp, an electric market model that dispatches resources to loads across the Western Interconnect with given fuel prices, hydroelectric conditions, and transmission and resource constraints. The model's primary outputs are electricity prices at key market hubs (e.g., Mid-Columbia), resource dispatch costs and values, and greenhouse gas emissions.

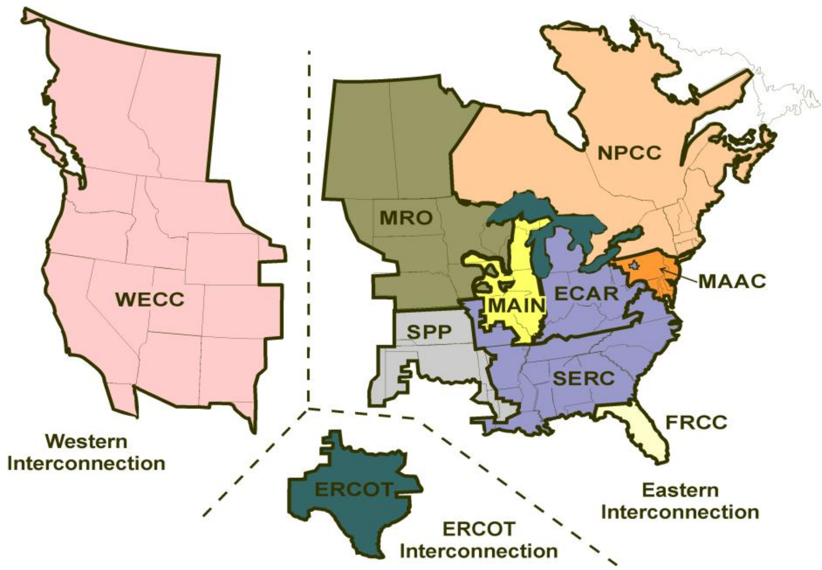
Section Highlights

- Gas and wind resources dominate new generation additions in the West.
- Shale gas lowers gas and electricity price forecasts from the previous IRP.
- A growing Northwest wind fleet reduces springtime market prices below zero in some hours.
- Federal greenhouse gas policy is uncertain; the IRP quantifies this uncertainty by modeling four different mitigation regimes.
- The Expected Case reduces Western Interconnect greenhouse gas emissions by 28 percent (18 percent from current levels) relative to a case without a carbon mitigation regime.
- Carbon mitigation policy increases Western Interconnect costs by $3.5 billion annually.

Marketplace
AURORAxmp is a fundamentals-based modeling tool used by Avista to simulate the Western Interconnect electricity market. The Western Interconnect includes the states west of the Rocky Mountains, the Canadian provinces of British Columbia and Alberta, and the Baja region of Mexico as shown in Figure 7.1. The modeled area has an installed resource base of approximately 240,000 MW.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 130 of 1069

Figure 7.1: NERC Interconnection Map



The Western Interconnect is separated from interconnects to the east and ERCOT except by eight inverter stations. The Western Interconnect follows operation and reliability guidelines administered by the Western Electricity Coordinating Council (WECC).

The Western Interconnect electric system is divided into 16 AURORAxmp modeling zones based on load concentrations and transmission constraints. After extensive study in the 2009 IRP, Avista models the Northwest region as a single zone because this configuration dispatches resources in a manner most reflective of historical operations. Table 7.1 describes the specific zones modeled in this IRP.

Table 7.1: AURORA^{XMP} Zones

Northwest- OR/WA/ID/MT	Southern Idaho
Eastern Montana	Wyoming
Northern California	Southern California
Central California	Arizona
Colorado	New Mexico
British Columbia	Alberta
North Nevada	South Nevada
Utah	Baja, Mexico

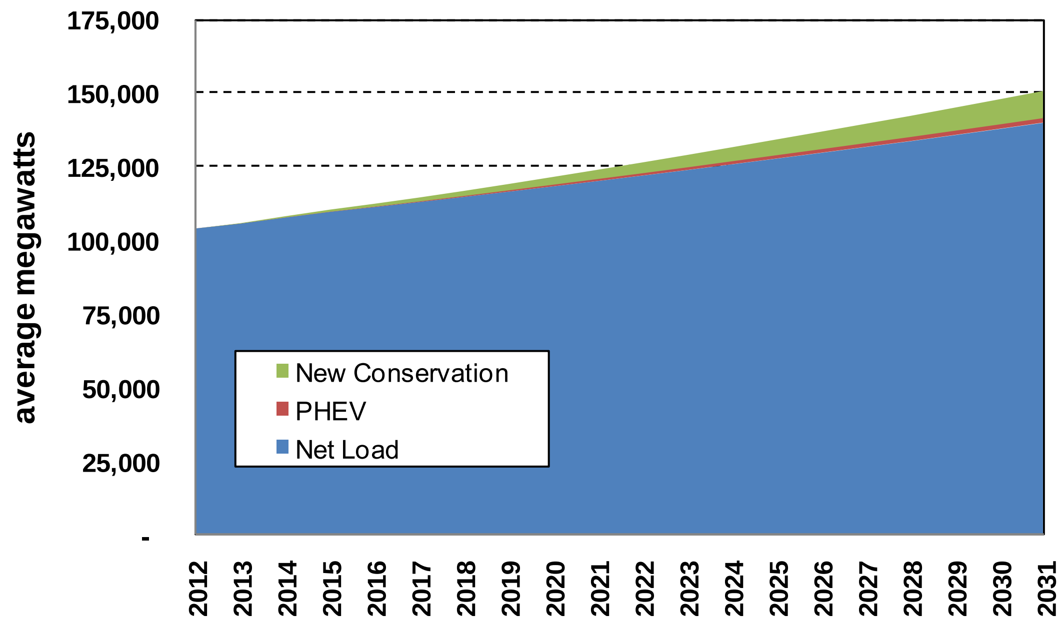
Fundamentals-based electricity models range in their abilities to emulate power system operations accurately. Some models account for every bus and transmission line, while other models utilize regions or zones. An IRP requires regional price and plant dispatch information but does not require detailed modeling at the bus level.

Western Interconnect Loads

The 2011 IRP relies on a load forecast for each zone of the Western Interconnect. Avista uses external sources to quantify load growth estimates across the west. These load estimates include impacts of increasing energy efficiency and demand destruction caused by potential emissions legislation and the associated price increases expected to reduce loads over time from their present trajectory.

Specific regional load growth levels are in Table 7.2. Avista projects that overall Western Interconnect loads rise 1.65 percent annually over the next 20 years, from 103,840 aMW in 2012 to 141,654 aMW in 2031. Included in this forecast are rising plug-in electric vehicle (PHEV) loads. Load growth rates without PHEV would be 1.57 percent. Absent conservation efforts, Western Interconnect loads are 9,000 aMW higher in 2031. Figure 7.2 illustrates the load forecast and the impacts of new conservation and PHEVs. The Northwest grows more slowly than the Western Interconnect at large. Loads rise one percent per year over the IRP timeframe.

Figure 7.2: 20-Year Annual Average Western Interconnect Energy



Transmission

The IRP reflects various regional transmission projects announced over the past several years. Many of these projects move distant renewable resources to load centers in support of state-level renewable portfolio standards (RPS). Transmission upgrades included in the IRP are in Table 7.2. Transmission upgrades within AURORAxmp zones were not included explicitly in the model, as they do not affect power transactions between zones.

Table 7.2: Western Interconnect Transmission Upgrades Included in Analysis

Project	From	To	Year Available	Capacity MW
Canada – PNW Project	British Columbia	Northwest	2018	3,000
PNW – California Project	Northwest	California	2018	3,000
Eastern Nevada Intertie	North Nevada	South Nevada	2015	1,600
Gateway South	Wyoming	Utah	2015	3,000
Gateway Central	Idaho	Utah	2015	1,320
Gateway West	Wyoming	Idaho	2016	1,500
SunZia/Navajo Transmission	Arizona	New Mexico	2016	3,000
Wyoming – Colorado Intertie	Wyoming	Colorado	2013	900
Hemingway to Boardman	Idaho	Northwest	2019	1,500

New Resource Additions

An estimate for new resource capacity in the Western Interconnect is forecasted as part of the long-term electric market price forecast. It accounts for load growth and various other mandates. These additions meet capacity, energy, ancillary services, and renewable portfolio mandates. To meet capacity requirements, gas-fired CCCT or SCCT, solar, wind, coal IGCC, coal IGCC with sequestration, and nuclear were options were considered.[1] For the first time, Avista assumes that no new pulverized coal additions in the Western Interconnect over the forecast horizon.

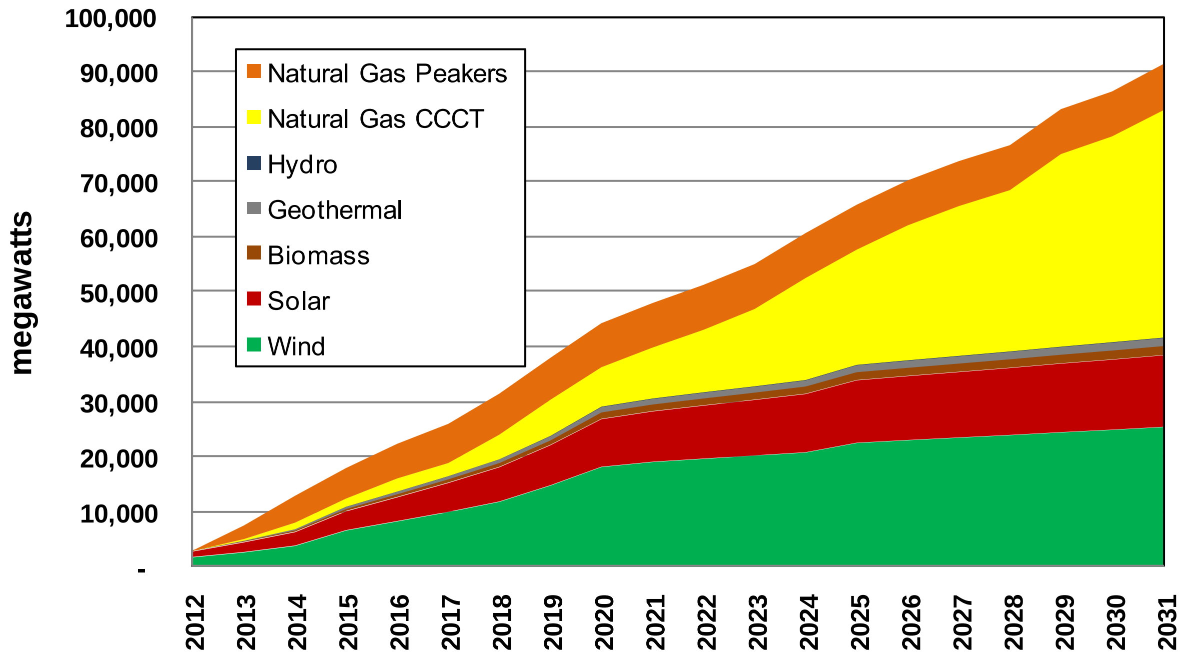
Many states have created RPS requirements promoting renewable generation to curb greenhouse gas emissions, provide jobs, and to diversify the energy mix of the United States. RPS legislation generally requires utilities to meet a portion of their load with qualified renewable resources. No federal RPS mandate exists presently; therefore, each state defines their RPS obligations differently. AURORAxmp cannot model RPS levels explicitly. Instead, Avista input RPS requirements into the model at levels satisfying state laws. Renewable resource portfolios adequate to meet Western Interconnect RPS obligations were input using work by the Northwest Power and Conservation Council (NPCC); these percentages formed the basis for RPS shortfalls in each state. Beyond the manually input RPS resources, the model selected no additional renewables.

Figure 7.3 illustrates new capacity and RPS additions made in the modeling process. Wind and solar facilities meet most renewable energy requirements.. Geothermal, biomass, and hydroelectric resources provide a more limited contribution to RPS needs. Renewable resource choices are modeled to differ by state depending on the requirements of state laws and the availability of renewable resources in a region. For example, the Southwest will meet RPS requirements with solar and wind given policy choices by those states. The Northwest will use a combination of wind and hydroelectric upgrades because the economic costs of these resources are the lowest. Rocky

[1] Wind receives a five percent capacity credit on a regional basis; it receives no capacity credit where selected to meet Avista requirements.

Mountain states will predominately use wind to meet RPS requirements, again due to the fact that wind is the least-cost renewable resource modeled in the IRP.

Figure 7.3: New Resource Added (Nameplate Capacity)



Fuel Prices and Conditions

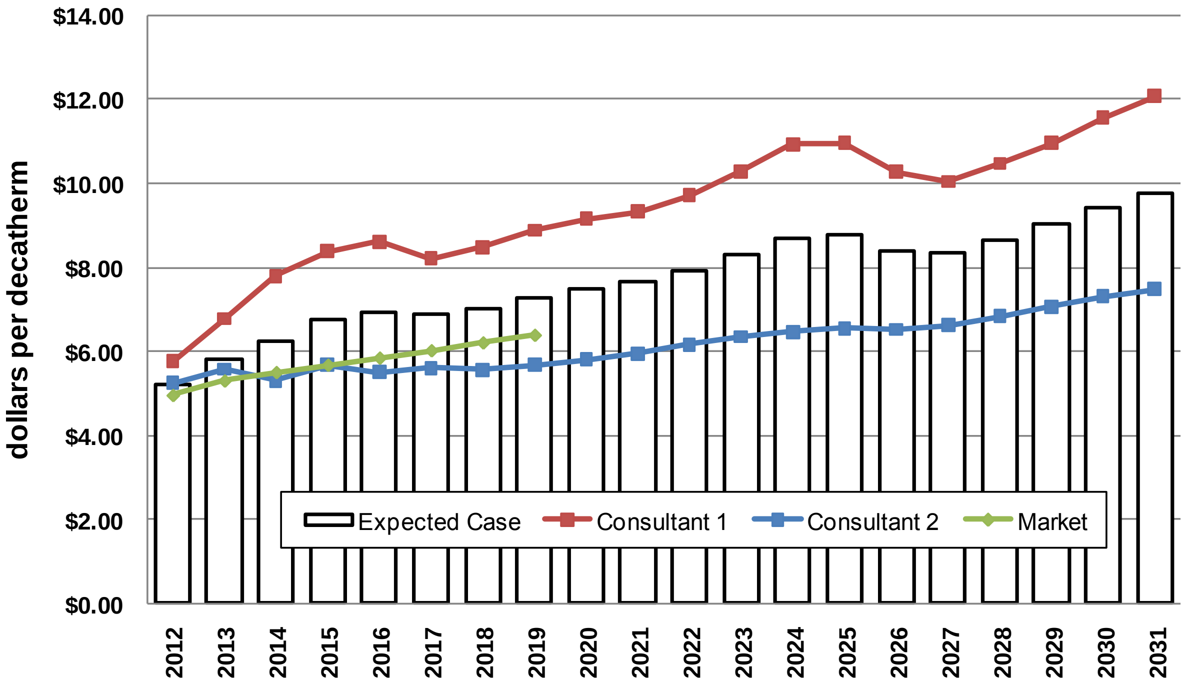
Fuel cost and availability are some of the most important drivers of resource values. Some resources, including geothermal and biomass, have limited fuel options or sources, while coal and natural gas have more fuel sources. Hydro and wind use free fuel sources, but are highly dependent on weather.

Natural Gas

The fuel of choice for new base load and peaking capability continues to be natural gas. Natural gas is subject to price volatility, though increasing unconventional sources may reduce future volatility. Avista uses forward market prices and a combination of two forecasts from prominent energy industry consultant to develop its natural gas price forecast for this IRP.[2] The forecast uses an equal weighting of the consultant forecasts and forward prices in 2012.[3] After 2012, the weighting of forward prices fell by 10 percent each year through 2016. After 2016, the forecast includes a 50/50 weighting of the two consultant forecasts. For example, in 2015 the price forecast is a weighted average of the market (20 percent), Consultant 1 (40 percent) and Consultant 2 (40 percent). The long-term forecasts include impacts of potential national carbon legislation. Carbon legislation will increase demand for natural gas as generation shifts away from coal. Figure 7.4 shows the price forecast for Henry Hub; the levelized nominal price is $7.30 per Dth. The forecast without carbon legislation is $6.78 per Dth.

[2] Consultant forecasts as of December 2010.
[3] The 50 percent weighting applies to the average of the two consultant forecasts.

Figure 7.4: Henry Hub Natural Gas Price Forecast



The forecast from Consultant 1 assumes a timely and moderate economic recovery and aggressive long term demand growth from the power sector in part due to an improved competitive position relative to coal. The forecast includes a modest federal carbon price of $14 per metric ton beginning 2016 and rising to $25/metric ton by 2025. This in turn results in accelerated coal retirements pressuring prices early in the forecast. A brief price respite occurs following carbon legislation but prices resume their build as competition for capital, equipment and labor from strong recovery in oil demand drive up gas drilling costs and supply growth from shale gas moderates. An Alaskan gas pipeline around 2026 produces a brief gas glut but is quickly absorbed and the uptrend in prices resumes.

The forecast from Consultant 2 assumes a more gradual and modest economic recovery including a more moderate rebound in power demand early in the forecast. Their outlook reflects an expectation of significant low cost supplies from shale gas resources that quickly respond to rising demand. The improved predictability of shale gas volumes and costs prompt active hedging by producers when prices escalate counteracting the trend and resulting in more stable pricing. This forecast does not include carbon legislation or an Alaskan natural gas pipeline.

Price differences across North America depend on demand at the trading hubs and the pipeline constraints between them. Many pipeline projects are in the works in the Northwest and the west to access historically cheaper gas supplies located in the Rocky Mountains. Table 7.3 presents western gas basin differentials from Henry Hub prices. Prices converge over the course of the study as new pipelines and new sources of gas come online. To illustrate the seasonality of natural gas prices, monthly Stanfield price shapes in Table 7.4 show various forecast years.

Table 7.3: Natural Gas Price Basin Differentials from Henry Hub

Basin	2012	2015	2020	2025	2030
Stanfield	93.4%	94.4%	90.3%	92.6%	90.6%
Malin	94.7%	95.7%	92.5%	94.9%	92.9%
Sumas	93.7%	94.6%	88.5%	90.5%	88.3%
AECO	89.1%	90.6%	86.3%	88.1%	85.8%
Rockies	93.6%	94.9%	90.6%	89.4%	87.2%
Southern CA	97.5%	99.3%	99.3%	100.0%	102.7%
Stanfield	93.4%	94.4%	90.3%	92.6%	90.6%

Table 7.4: Monthly Price Differentials for Stanfield

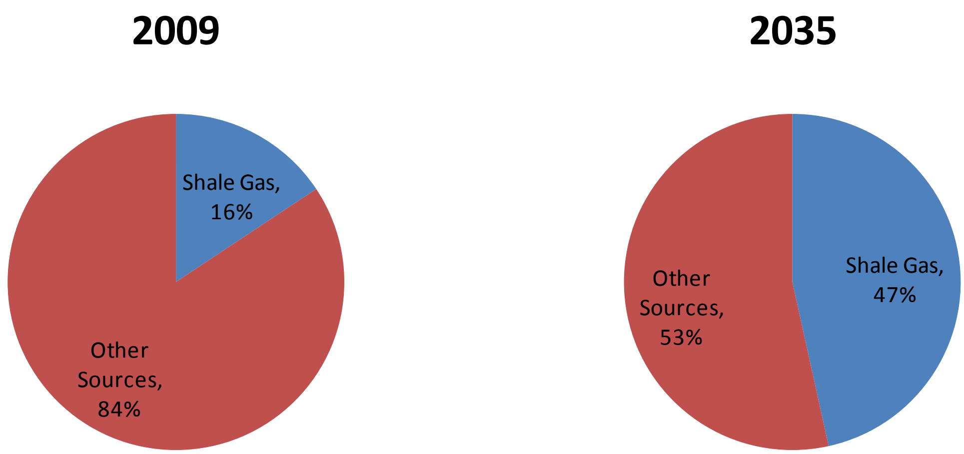
Month	2012	2015	2020	2025	2030
Jan	94.4%	95.9%	92.2%	94.7%	92.5%
Feb	94.4%	96.1%	92.0%	94.7%	92.5%
Mar	94.0%	95.6%	92.0%	94.3%	93.9%
Apr	92.6%	94.1%	89.4%	91.3%	90.0%
May	92.2%	93.1%	88.2%	90.4%	88.8%
Jun	92.3%	93.1%	88.2%	90.5%	88.5%
Jul	92.6%	92.9%	87.8%	90.0%	88.0%
Aug	92.7%	93.1%	88.0%	90.0%	88.3%
Sep	93.0%	93.9%	89.7%	92.1%	89.2%
Oct	93.3%	94.8%	90.6%	93.6%	90.4%
Nov	94.4%	95.0%	92.5%	95.3%	92.7%
Dec	94.9%	95.0%	92.7%	94.9%	92.5%

Unconventional Natural Gas Supplies

Shale natural gas production has game-changing impacts on the natural gas industry, dramatically revising the amount of economical natural gas production. Shale gas often is lower in cost than conventional natural gas production because of economies of scale, near elimination of exploration risks and standardized, sophisticated production techniques that streamline costs and minimize the time from drilling to market delivery. Shale gas could continue to greatly alter the natural gas marketplace, holding down both price and volatility over the long run as production quickly responds to changing market conditions. This in turn leads to numerous ripple effects, including longer-term bilateral hedging transactions, new financing structures including cost index pricing, and/or vertical integration by utilities choosing to limit their exposure to natural gas price increases and volatility through the acquisition of shale-gas reserves as illustrated by the recent purchase of reserves by Northwest Natural Gas Company. See Figure 7.5 for the projected change in contribution of shale to other sources of natural gas between 2009 and 2035.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 136 of 1069

Figure 7.5: Shale Gas Production Forecast[4]



Shale gas is not free of controversy. Concerns include water, air, noise, and seismic environmental impacts arising from unconventional extraction techniques. Water issues include availability, chemical mixing, groundwater contamination, and disposal. Air quality concerns stem from methane leaks during production and processing. Mitigating excessive noise in urban drilling and elevated seismic activity near drilling sites are also fomenting apprehension. State and federal agencies are reviewing the environmental impacts of this new production method. As a result, unconventional natural gas production in some areas has stopped. Increased environmental protections might increase costs and environmental uncertainty could precipitate increased price volatility.

Shale gas production influences the U.S. liquid natural gas (LNG) market. It has broken the link between North American natural gas global LNG prices. Numerous planned re-gasification terminals are on hold or cancelled. Some facilities now seek approvals to become LNG exporters rather than importers. These changes appear to affect gas storage and transportation infrastructure. For example, the Kitimat LNG export terminal in northern British Columbia, if built, will export significant LNG quantities to Asian markets. These exports will affect overall market conditions for natural gas in the United States and the Pacific Northwest.

Coal

As discussed earlier in this chapter, there are no new coal plants built for the Western Interconnect. Therefore, the coal price forecasts affect only existing coal facilities. Each plant's historical fuel costs escalate by rates contained in a consultant's study. The average annual price increase over the IRP timeframe is 1.4 percent. For the Colstrip facility, where Avista has access to project-specific information, Avista did not rely on the consultant study. Instead, it used an escalation rate based on existing contracts.

Woody Biomass

The future price and availability of woody biomass (or hog fuel) is critical to understanding the viability of new wood-fired facilities. Hog fuel availability is highly

[4] Source: Energy Information Administration (EIA)

dependent on overall lumber demand. Avista has operated its Kettle Falls wood-fired generator since 1983. When it was constructed, hog fuel was a waste product from area sawmills that procured at a near-zero cost. The plant had surplus fuel even into the mid-2000s, but has struggled since then to procure enough reasonably priced fuel because of the impacts of a recession on the housing market, and the resultant decrease in lumber demand. The IRP projects biomass prices in the west to extend from historical levels at a rate of three percent per year to reflect ongoing tight market conditions.

Hydroelectric

The Northwest and British Columbia have substantial hydroelectric generation capacity. A favorable characteristic of hydroelectric power is its ability to provide near-instantaneous generation up to and potentially beyond its nameplate rating. This characteristic is particularly valuable for meeting peak load demands, following general intra-day load trends, shaping energy for sale during higher-valued peak hours, and integrating variable generation resources. The key drawback to hydroelectricity is its output variability a month-to-month and year-to-year.

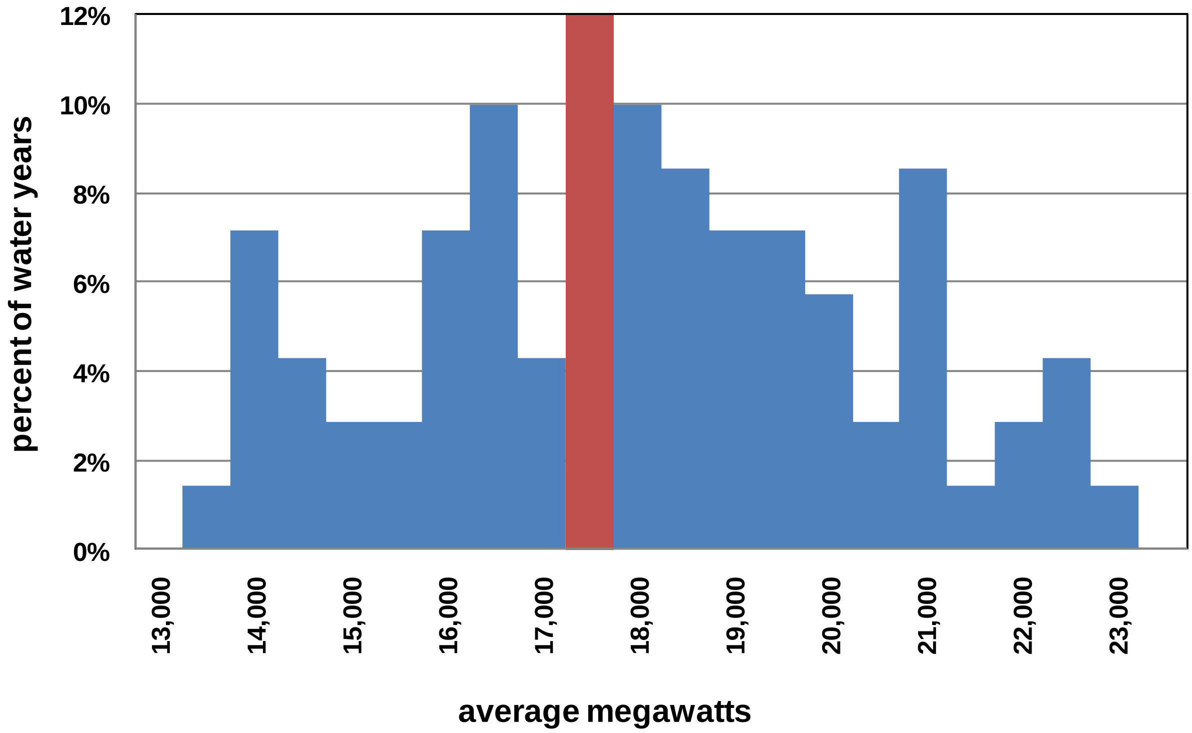
This IRP uses the results of the Northwest Power Pool's (NWPP) 2009-10 Headwater Benefits Study to model regional hydro availability. The NWPP study provides energy levels for each hydroelectric facility by month over a 70-year hydrological record spanning the years 1928 to 1999. British Columbia's hydroelectric plants are modeled using data from the Canadian government[5].

Many of the analyses in the IRP use an average of the 70-year hydroelectric record; whereas stochastic studies randomly draw from the 70-year record (see Risk Analysis later in this section), as the historical distribution of hydroelectric generation is not normally distributed. AURORAxmp maps each hydroelectric plant to a load zone.

For Avista hydroelectric plants, proprietary software provides a more detailed representation of operating characteristics and capabilities. Figure 7.6 shows average hydroelectric energy (in red) of 18,172 aMW in Washington, Oregon, Idaho, Western Montana, and British Columbia. The chart also show the range in potential energy used in the stochastic study, with a 10th percentile water year of 14,395 aMW (-21 percent), and a 90th percentile water year of 21,629 aMW (+40 percent).

[5] Statistics Canada, www.statcan.gc.ca

Figure 7.6: Northwest Expected Energy

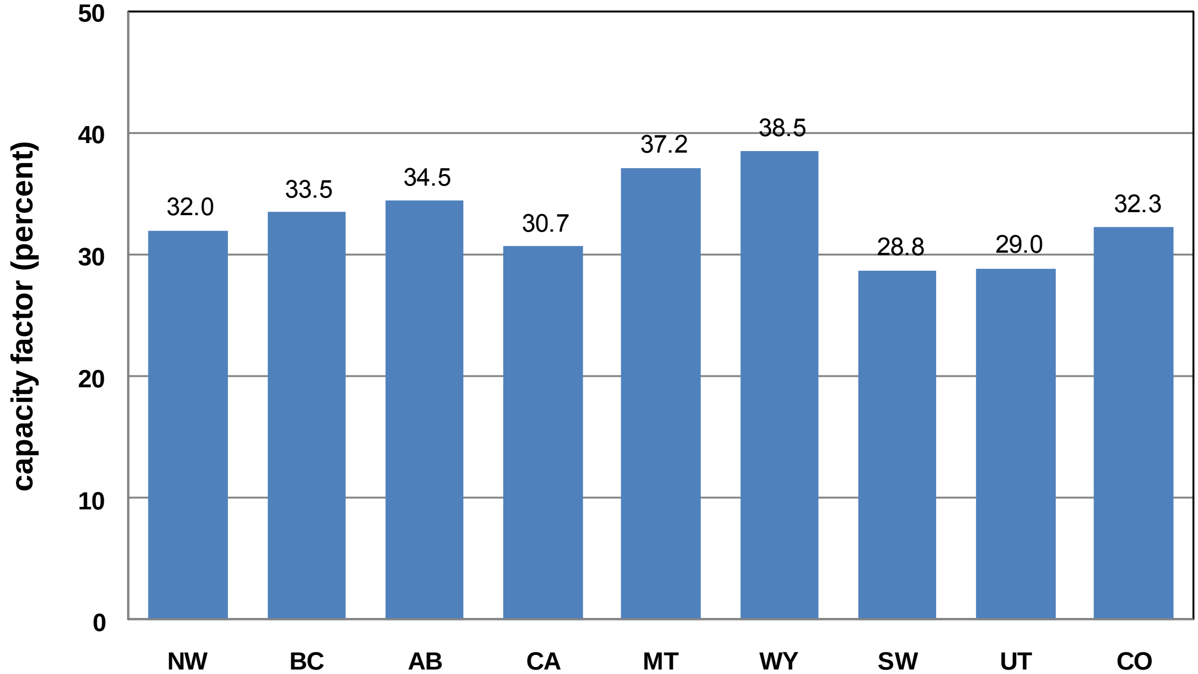


AURORAxmp represents hydroelectric plants using annual and monthly capacity factors, minimum and maximum generation levels, and sustained peaking generation capabilities. The model's objective, subject to constraints, is to move hydroelectric generation into peak hours to follow daily load changes; this maximizes the value of the system consistent with actual operations.

Wind

Additional wind resources are necessary to satisfy renewable portfolio standards. These additions mean significant competition for the remaining higher-quality wind sites. The capacity factors in Figure 7.7 present average generation for the entire area, not for specific projects. The IRP uses capacity factors from a review of the Bonneville Power Administration (BPA) and the National Renewable Energy Laboratory (NREL) data.

Figure 7.7: Regional Wind Expected Capacity Factors



Greenhouse Gas Emissions

Greenhouse gas regulation is one the greatest fundamental risks facing the electricity marketplace today because of the industry's heavy reliance on carbon-emitting thermal power generation plants. Reducing carbon emissions at existing power plants, and the construction of low- and non-carbon-emitting technologies, changes the resource mix over time. No federal regulations presently constrain greenhouse emissions, but federal legislation is still expected. In the interim, several western states and Canadian provinces are promoting the Western Climate Initiative as an alternative to federal legislation. The goal is to develop a multi-jurisdictional greenhouse gas policy.

To simulate greenhouse gas regulation, Avista developed four policy models and their assumed financial impact on the energy marketplace. Each policy represents a potential path governments could take over the next several years. The policies received weighting factors, with the weighted average price of the policies forming the Expected Case. The four greenhouse gas policies used in this IRP are in Table 7.5:

Table 7.5: Monthly Price Differentials for Stanfield

Strategy	Weight (%)	Details
Regional Greenhouse Gas Policies	30	– Greenhouse gas reductions in California, Oregon, Washington, and New Mexico between 2014 and 2019. – About a 10 percent reduction below 2005 levels by 2020. – Beginning in 2020, shift to National Climate Policy with 15 percent below 2005 levels by 2030.
National Climate Policy	30	– Federal legislation only applies beginning in 2015 – About 15 percent below 2005 levels by 2020 and about 35 percent below 2005 levels by 2030.
National Carbon Tax	30	– Federal legislation only applies. – $33 per short ton, then 5 percent per year escalation for the remainder of the study. – Begins in 2015.
No Greenhouse Gas Reductions	10	– No carbon reduction program. – State-level emission performance standards apply and no new coal-plants added in the Western United States.

Figure 7.8 shows the expected price of greenhouse gas emission for each policy described in Table 7.5 and the weighted average price comprising of the Expected Case. The carbon policy in each stochastic study comes from the distribution of the four cases described above.

Figure 7.8: Price of Greenhouse Gas Credits in each Carbon Policy

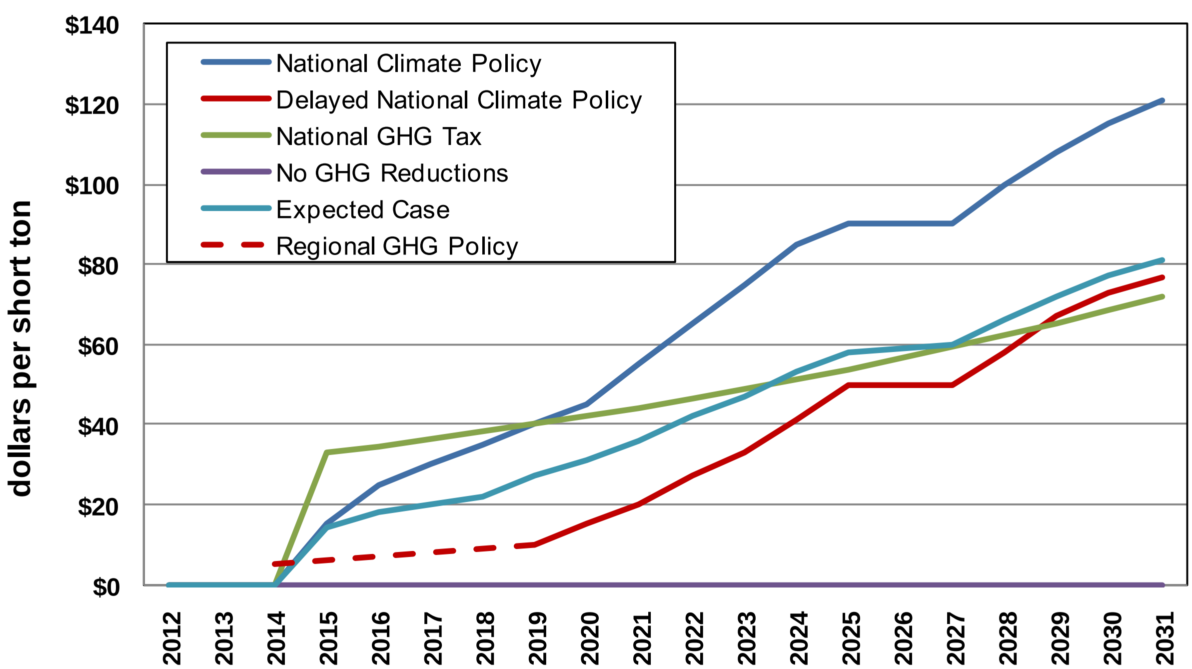


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 141 of 1069

Risk Analysis

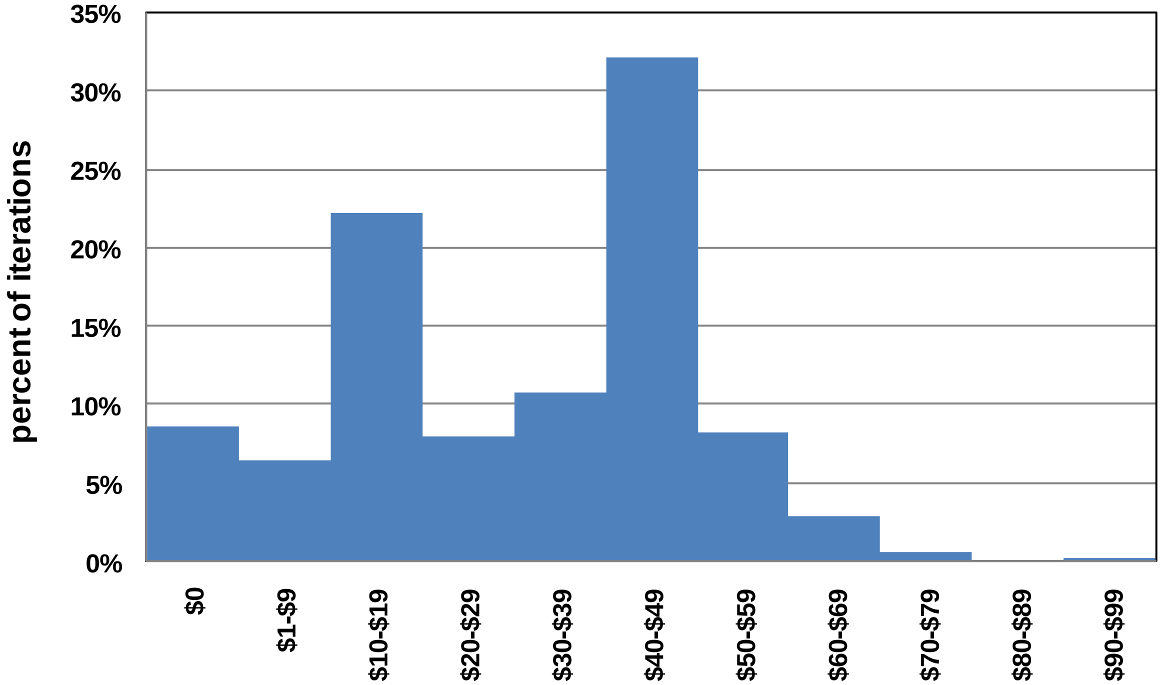
To account for the uncertainty of future electric prices, a stochastic study is preformed using the variables discussed earlier in this chapter. It is better to represent the electricity price forecast as a range rather than a point estimate. Point estimates are unlikely to forecast any of the underlying assumptions perfectly, whereas stochastic price forecasts develop a more robust resource strategy. For example, fuel price volatility and carbon risk directly affect natural gas-fired resources but not wind resources. Wind resources, on the other hand, are subject to varying output on an hourly, daily, monthly, and annual basis. In prior IRP's Avista modeled 250 to 300 stochastic iterations or scenarios. This IRP developed 500 iterations to provide a more robust results distribution to better illustrate potential tail outcomes. The increased number of studies will affect the overall results of the IRP, but should assist in explaining the results better, especially at the tails. The next several pages discuss input variables driving market prices, and describe the methodology and the range in inputs used in the modeling process.

Greenhouse Gas Prices

Without established federal legislation and no formal rules for western carbon markets, the expected price of carbon emission is difficult to determine without resorting to a macroeconomic model. Even with carbon rules in place, prices in a cap and trade program reflect the tradeoff and interaction between natural gas and coal prices and the ultimate maximum emissions level allowed by the program. Further, it is likely that certain states might stop pursuing cap and trade programs because of recent successes in shutting down northwest coal-fired facilitates. As discussed earlier, four possible legislative outcomes reflect the uncertainty surrounding future legislation. Each was included in the stochastic analysis based on its weighting.

The price of carbon mitigation will vary over time, as the natural gas price affects the cost efficiency of displacing coal-fired generation. When natural gas prices rise, so too must carbon prices. To account for this relationship, once the carbon policy is randomly selected based for each scenario the resultant carbon price is adjusted up or down to reflect the natural gas price forecast in a manner to attain the required carbon mitigation goal. An example of this adjustment is in Figure 7.9 for the year 2020. The predominant market prices are between $40 and $49 per short ton of carbon. The distribution reflected the Carbon Tax policy strategy by approximately 100 of these iterations has a price of $42.12 per short ton of carbon.

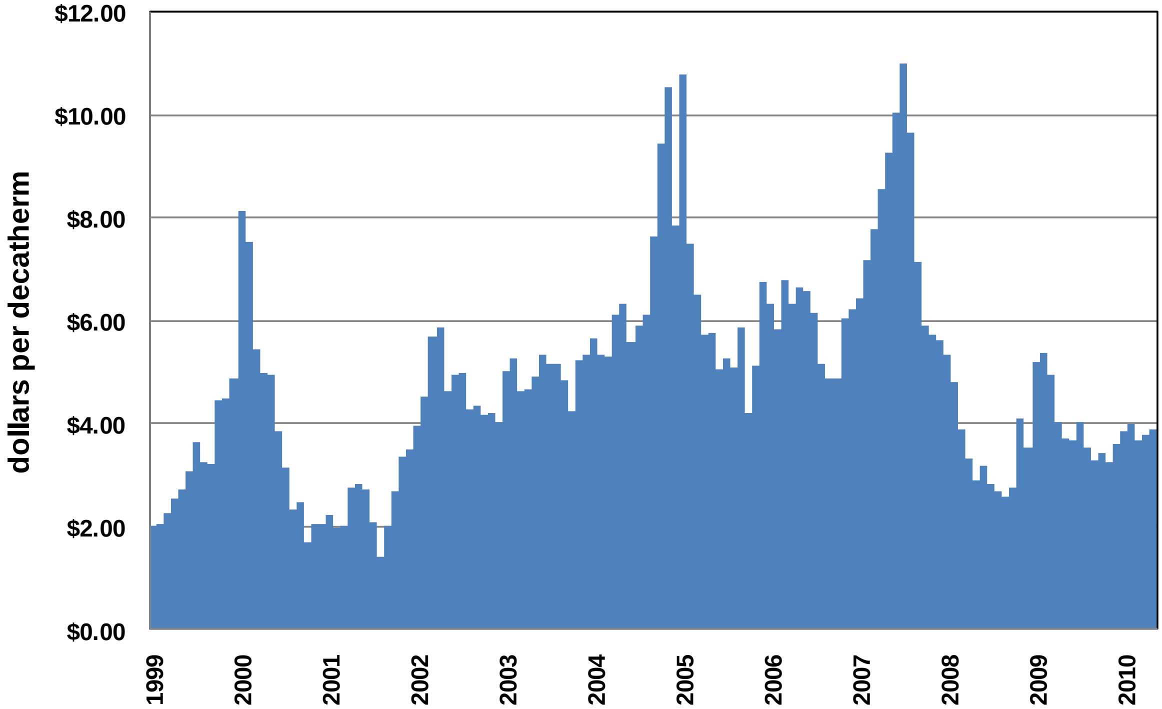
Figure 7.9: Distribution of Annual Average Carbon Prices for 2020



Natural Gas

Natural gas prices are among the most highly volatile of any traded commodity. Daily AECO prices ranged between $0.78 and $12.92 per Dth between 2002 and 2010. Average AECO monthly prices since December 1999 are in Figure 7.10. Prices retreated from their 2008 highs to a low of $2.69 per Dth in July 2009, but prices have stabilized in the $3 to $4 range over the past year. This stabilization likely is a result of both waning demand due to the U.S. recession and shale gas discoveries.

Figure 7.10: Historical AECO Natural Gas Prices



There are several valid methods to stochastically model natural gas prices. For this IRP, Avista uses a new method to represent the price history our industry has witnessed. The mean prices discussed above are the starting point. Prices then vary using historical month-to-month volatility using a lognormal distribution. The lognormal distribution's standard deviation differs monthly depending on historical month-to-month changes.

The Stanfield hub natural gas price distribution is in Figure 7.11 for 2012, 2020, and 2030. Mean prices in 2012 are $4.89 per Dth and the median level is $4.80 per Dth. The 90th percentile is $5.49 per Dth and the TailVar90, or average of the highest 10 percent of the iterations, is $5.92 per Dth. Figure 7.12 illustrates the range of gas prices for each year of the price forecast. Stanfield prices are black bars; white bars represent the range between the 10th and 90th percentiles; triangles represent TailVar90.

Figure 7.11: Stanfield Annual Average Natural Gas Price Distribution

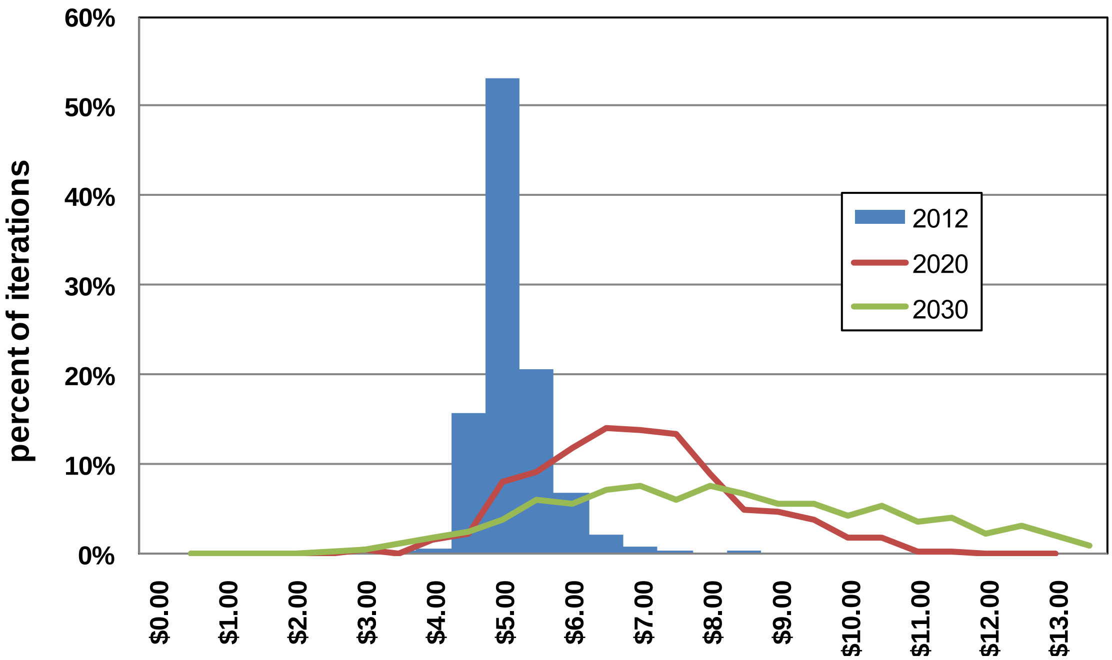
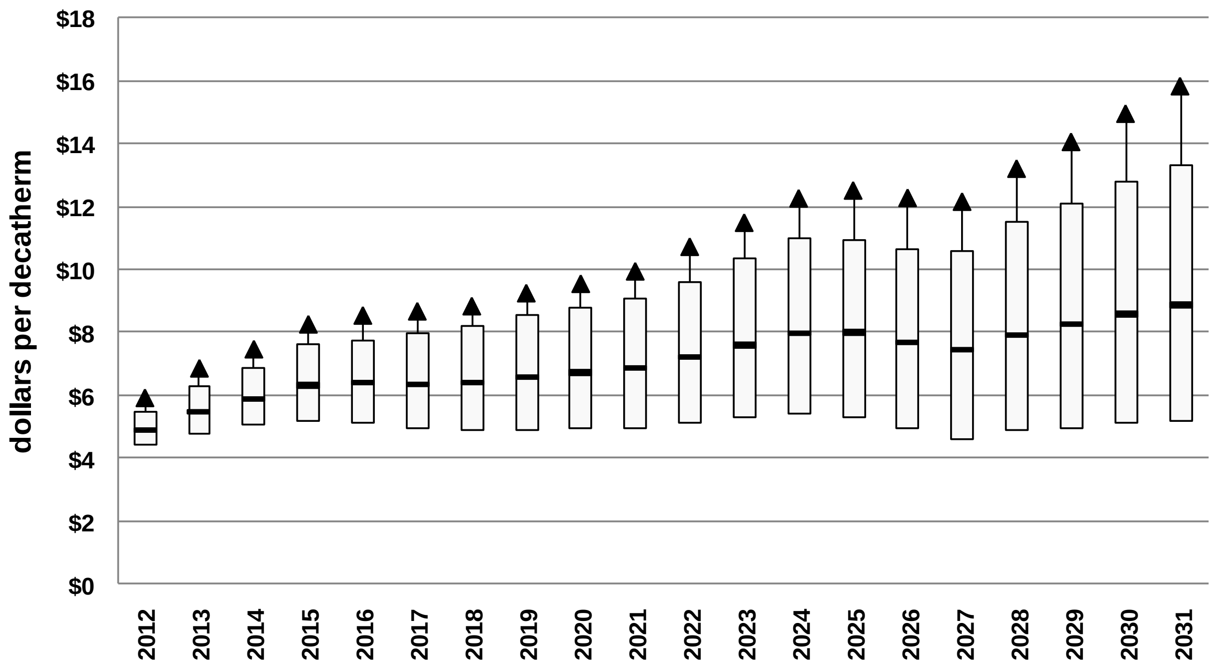


Figure 7.12: Stanfield Natural Gas Distributions



Load

Several factors drive load uncertainty. The largest short-run driver run is weather. Over the long-run economic conditions, such as the recent economic downturn, tend to have a more significant effect on the load forecast. Underlying IRP loads increase at the levels discussed earlier in this chapter, but risk analyses emulate the varying of weather conditions and resultant load impacts.

To model weather variation, Avista continues to use a method it adopted for its 2003 IRP. FERC Form 714 data for the years 2005 through 2009 for the Western Interconnect form the basis for the analysis. Correlations between the Northwest and other Western Interconnect load areas represent how loads move across the larger system. This method avoids oversimplifying the Western Interconnect load picture. Absent the use of correlation, stochastic models merely offset changes in one variable with changes in another, thereby virtually eliminating the possibility of modeling correlated excursions. Given the high degree of interdependency across the Western Interconnect created by significant intertie connections, the additional accuracy in modeling loads in this matter is crucial for understanding variation in wholesale electricity market prices. It is also crucial for understanding the value of resources used to meet variation (i.e., peaking generation).

Tables 7.6 and 7.7 present the load correlations. Statistics are relative to the Northwest load area (Oregon, Washington, and North Idaho). “NotSig” in the table indicates that no statistically valid correlation exists in the evaluated load data. “Mix” indicates the relationship was not consistent across the 2005 to 2009 period. For regions and periods with NotSig and Mix results, no correlation exists. Tables 7.8 and 7.9 provide the coefficient of determination (standard deviation divided by the average) values for each zone. The weather adjustments are consistent for each area, except for shoulder months where loads tend to diverge from one another.

Table 7.6: January through June Area Correlations

	Jan	Feb	Mar	Apr	May	Jun
Alberta	74%	29%	70%	64%	18%	65%
Arizona	73%	75%	74%	8%	Not Sig	8%
Avista	90%	87%	82%	80%	60%	42%
British Columbia	84%	84%	75%	46%	Not Sig	Mix
Colorado	Mix	Mix	Mix	Mix	Not Sig	Not Sig
Montana	82%	76%	69%	55%	33%	28%
New Mexico	8%	Not Sig	Not Sig	Not Sig	16%	Not Sig
North California	34%	36%	8%	Not Sig	34%	8%
North Nevada	73%	65%	Not Sig	8%	25%	27%
South California	74%	45%	69%	31%	10%	44%
South Idaho	87%	86%	65%	40%	66%	28%
South Nevada	67%	83%	37%	Not Sig	Mix	16%
Utah	25%	Not Sig	8%	Not Sig	17%	Not Sig
Wyoming	67%	54%	72%	36%	41%	18%

Table 7.7: July through December Area Correlations

	Jul	Aug	Sep	Oct	Nov	Dec
Alberta	39%	45%	68%	55%	66%	66%
Arizona	9%	26%	9%	Mix	Mix	55%
Avista	60%	54%	19%	78%	88%	89%
British Columbia	8%	Mix	Mix	9%	72%	77%
Colorado	Mix	Mix	Mix	54%	71%	49%
Montana	Mix	Not Sig	27%	53%	81%	86%
New Mexico	25%	27%	43%	17%	35%	Not Sig
North California	Not Sig	Mix	63%	Not Sig	26%	25%
North Nevada	29%	48%	Not Sig	8%	74%	67%
South California	26%	27%	18%	Not Sig	Mix	54%
South Idaho	44%	47%	Not Sig	46%	84%	83%
South Nevada	16%	18%	Not Sig	Mix	Mix	64%
Utah	Not Sig	16%	42%	27%	53%	17%
Wyoming	8%	9%	9%	8%	Not Sig	53%

Table 7.8: Area Load Coefficient of Determination (Std Dev/Mean)

	Jan	Feb	Mar	Apr	May	Jun
Alberta	2.7%	2.4%	2.8%	2.6%	2.9%	3.2%
Arizona	5.5%	4.2%	3.4%	6.1%	10.2%	9.5%
Avista	6.7%	5.3%	6.3%	5.6%	5.3%	6.4%
Baja Mexico	9.5%	7.9%	8.5%	9.2%	10.5%	7.6%
British Columbia	5.0%	3.9%	4.5%	5.2%	4.6%	4.0%
North California	5.1%	5.1%	5.0%	5.6%	8.7%	9.5%
Colorado	4.5%	4.2%	4.6%	4.0%	5.4%	8.4%
South Idaho	5.4%	5.7%	5.4%	6.0%	10.2%	13.9%
Montana	5.3%	4.1%	4.0%	4.4%	4.0%	5.9%
Northern Nevada	2.6%	3.0%	2.9%	2.8%	4.8%	5.7%
Southern Nevada	4.8%	3.6%	3.3%	6.6%	13.0%	11.2%
New Mexico	4.5%	4.1%	4.3%	4.5%	7.4%	6.9%
Pacific Northwest	6.6%	5.9%	5.9%	5.7%	4.9%	4.9%
South California	6.0%	5.6%	6.0%	7.0%	8.6%	8.8%
Utah	4.1%	4.3%	4.5%	4.4%	6.3%	9.0%
Wyoming	7.0%	6.7%	6.5%	5.9%	5.0%	8.3%

Table 7.9: Area Load Coefficient of Determination (Std Dev/Mean)

	Jul	Aug	Sep	Oct	Nov	Dec
Alberta	3.1%	3.2%	2.8%	2.7%	2.6%	3.3%
Arizona	7.0%	6.5%	8.4%	10.0%	4.7%	5.3%
Avista	6.9%	7.2%	5.8%	5.4%	6.6%	7.6%
Baja Mexico	6.4%	6.3%	11.6%	9.9%	7.6%	10.2%
British Columbia	4.7%	4.1%	4.4%	5.0%	6.2%	6.2%
North California	9.6%	7.9%	8.4%	5.3%	5.6%	5.6%
Colorado	7.2%	6.8%	5.8%	4.0%	5.1%	5.0%
South Idaho	5.9%	6.9%	10.5%	4.7%	6.8%	7.1%
Montana	5.1%	5.6%	3.7%	4.0%	5.0%	5.7%
Northern Nevada	5.1%	4.2%	4.9%	2.7%	3.6%	3.5%
Southern Nevada	6.9%	6.3%	12.0%	7.8%	3.8%	4.4%
New Mexico	6.0%	5.7%	5.8%	5.3%	5.0%	4.9%
Pacific Northwest	6.5%	5.2%	4.6%	5.3%	7.0%	8.6%
South California	7.7%	7.8%	10.3%	7.4%	6.8%	6.4%
Utah	5.1%	6.2%	6.7%	4.1%	4.9%	4.4%
Wyoming	8.3%	9.1%	6.1%	5.3%	7.1%	7.6%

Hydroelectric

Hydroelectric generation is historically the most commonly modeled stochastic variable in the Northwest because it has a large impact on regional electricity prices. The IRP uses a 70-year hydro record starting with the 1928-29 water year. A randomly drawn water year is selected from the record using a “bootstrapping” method, meaning that each water year is used approximately 143 times in the study (500 scenarios x 20 years / 70 water year records). There is some debate in the Northwest over whether the hydroelectric record has year-to-year correlation. Avista’s preliminary work in this area has not found significant year-over-year correlation; the 70-year water record shows a modest 41 percent correlation. Low correlation does not necessarily mean that the correlation is zero. Further study of year-to-year correlation is an action item coming out of this planning cycle.

Wind

Wind has the most volatile short-term generation profile of any resource presently available to utilities. Storage, apart from some integration with hydroelectric projects, is not a financially viable. This makes it necessary to capture wind volatility in the power supply model to determine its value and impacts on the wholesale power markets. Accurately modeling wind resources requires hourly and intra-hour generation shapes. For regional market modeling, the representation is similar to how AURORAxmp models hydroelectric resources. A single wind generation shape represents all wind resources in each load area. This shape is smoother than it would be for individual wind plant, but it closely represents the diversity that a large number of wind farms located across a zone would create.

This simplified wind methodology works well for forecasting electricity prices across a large market, but it does not accurately represent the volatility of specific wind resources

Avista might select as part of its Preferred Resource Strategy. Therefore individual wind farm shapes form the basis of resource options for Avista.

Ten potential 8,760-hour wind shapes represent each geographic region or facility. Each year contains a wind shape drawn from the ten representations, as is done with the hydro record. The IRP relies on two data sources for the wind shapes. The first is BPA balancing area wind data. The second is NREL-modeled data between 2004 and 2006.

Avista believes that an accurate representation of a wind shape across the West requires meeting several conditions:

1. The data is correlated between areas and reflective of history.
2. Data within load areas needs to be auto-correlated (each hour correlated to each other).
3. The average and standard deviation of each load area's wind capacity factor needs to be consistent with the expected amount of energy for a particular area in the year and in each month.
4. The relationship between on- and off-peak wind energy needs to be consistent with historic wind conditions. For example, more energy in off-peak hours than on-peak hours where this has been experience historically.
5. Capacity factors for a diversified wind region should never be greater than about 90 percent due to turbine outages and wind diversity within-area.

Absent meeting these conditions, it is unlikely that any wind study provides an adequate level of accuracy for planning efforts. The methodology developed for this IRP attempts to keep the five requirements by first using a regression model of the historic data for each region. The independent variables used in the analysis were month, hour type (night or day), and generation levels from the prior two hours. To reflect correlation between regions, a capacity factor adjustment reflects historic regional correlation using an assumed normal distribution with the historic correlation as the mean. After this adjustment, a capacity factor adjustment takes account of those hours with generation levels exceeding a 90 percent capacity factor. The resulting capacity factors for each region are in Table 7.10. A Northwest region example of an 8,760-hour wind generation profile is in Figure 7.13. This example, shown in blue, has a 33 percent capacity factor. Figure 7.14 shows actual 2010 generation recorded by BPA Transmission; in 2010, the average wind fleet in BPA's balancing authority had a 27.5 percent capacity factor.

Table 7.10: Expected Capacity factor by Region

Region	Capacity Factor	Region	Capacity Factor
Northwest	32.0%	Southwest	28.9%
California	30.9%	Utah	28.8%
Montana	37.2%	Colorado	32.2%
Wyoming	38.5%	British Columbia	33.4%
Eastern Washington	30.7%	Alberta	34.5%

Figure 7.13: Wind Model Output for the Northwest Region

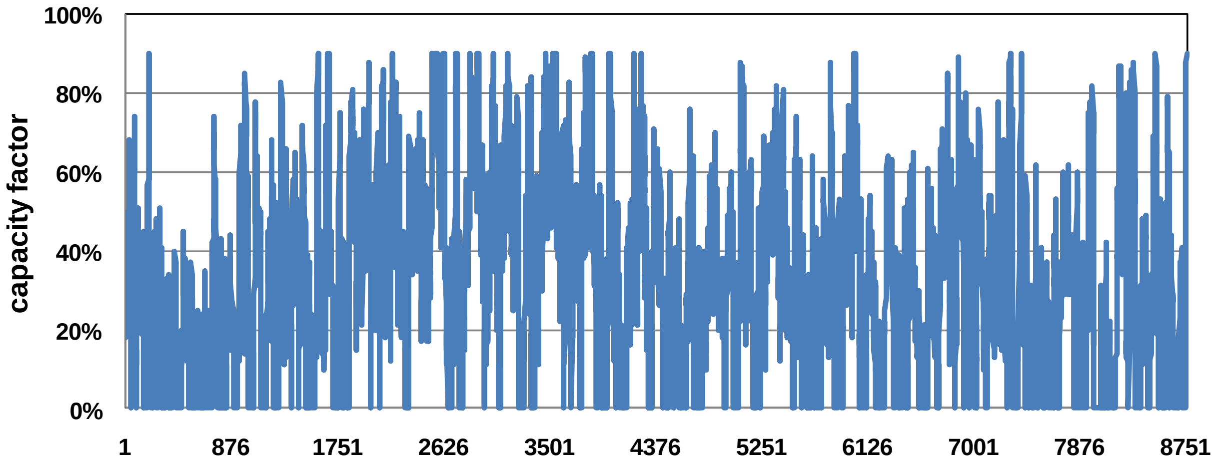
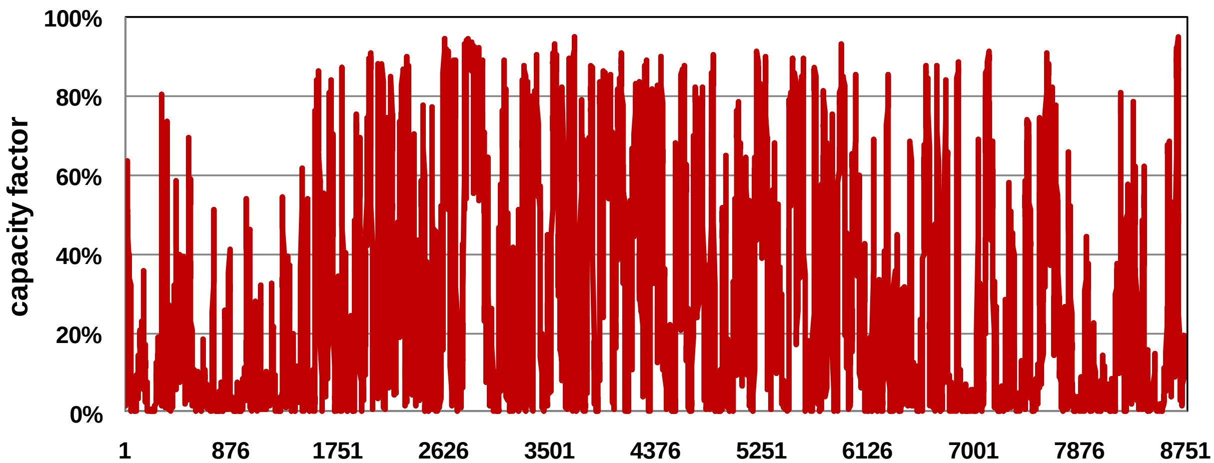


Figure 7.14: 2010 Actual Wind Output BPA Balancing Authority[6]



There is speculation that a correlation exists between wind and hydro, especially outside of the winter months where storm events bring both rain to the river system and wind to the wind farms. This IRP does not correlate wind and hydro due to a lack of historical data to test this hypothesis. Where correlation exists, it would be optimal to run the model 70 historical wind years with matching historical water years. A continual study of this relationship is an action item for this plan.

Forced Outages

In most deterministic market modeling studies, plant forced outages are represented by a simple average reduction to maximum capability. This over simplification generally represents expected values well; however, in stochastic modeling, it is better to represent the system more accurately by randomly placing non-hydro units out of service based on a mean time to repair and an average forced outage rate. Internal

[6] Chart data is from the BPA at: http://transmission.bpa.gov/Business/Operations/Wind/default.aspx.

studies show that this level of modeling detail is necessary only for large natural gas-fired (greater than 100 MW), coal, and nuclear plants. Forced outage rates and the mean time to repair data come from analyzing the North American Electric Reliability Corporation's Generating Availability Data System (GADS) database.

Other Variables

Coal, hog fuel, fuel oil, and variable O&M variables are modeled stochastically. These included either normal or lognormal distributions in the study. Due to their moderate affects on market prices, their details are not discussed here but are in Appendix A.

Market Price Forecast

An optimal resource portfolio cannot ignore the extrinsic value inherent in its resource choices. The 2011 IRP simulation compares each resource's expected hourly output using forecasted Mid-Columbia hourly prices over 500 iterations of Monte Carlo-style scenario analysis.

Hourly electricity prices are either the operating cost of the marginal unit in the Northwest or the economic cost to move power into or out of the Northwest. A forecast of available future resources helps create an electricity market price projection. The IRP uses regional planning margins to set minimum capacity requirements, rather than a summation of the capacity needs of individual utilities in the region. Western regions can have resource surpluses even where some utilities may be in deficit. This imbalance can be due in part to ownership of regional generation by independent power producers, and possible differences in planning methodologies used by utilities in the region.

AURORAxmp assigns market values to each resource alternative available to the PRS, but the AURORAxmp model does not itself select PRS resources. Several market price forecasts determine the value and volatility of a resource portfolio. As Avista does not know what will happen in the future, it relies on risk analysis to help determine an optimal resource strategy. Risk analysis uses several market price forecasts with different assumptions than the expected case or changes the underlying statistics of a study. The modeling splits alternate cases are into stochastic and deterministic studies.

A stochastic study uses Monte Carlo analysis to quantify the variability in future market prices. These analyses include 500 iterations of varying natural gas prices, loads, hydroelectric generation, thermal outages, wind generation shapes, and greenhouse gas emissions prices. Four stochastic studies—an Expected Case, one case without greenhouse gas limitations, a high natural gas volatility case, and an early coal plant retirement case are used. The remaining studies were deterministic scenario analyses.

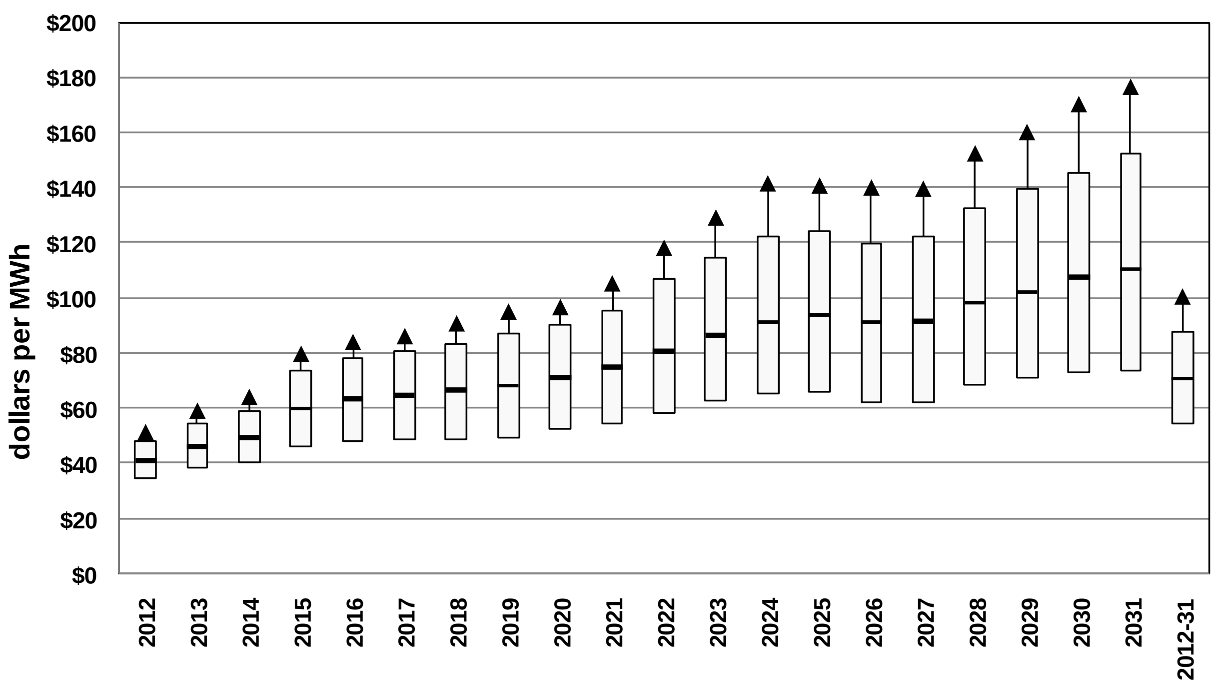
Mid-Columbia Price Forecast

The Mid-Columbia is Avista's primary electricity trading hub. The Western Interconnect also has trading hubs on the California/Oregon Border (COB), Four Corners, Palo Verde, SP15 (southern California), NP15 (northern California) and Mead. The Mid-Columbia market is usually least cost because of low cost hydroelectric generation, though other markets can at times be less expensive when Rocky Mountain area natural gas prices are low and gas-fired generation is setting marginal power prices.

Fundamentals-based market analysis is critical to understanding the market environment. The Expected Case includes two studies. The first is a deterministic market view using expected levels for the key assumptions discussed in the first part of this chapter. The second is a risk or stochastic study with 500 unique scenarios based on different underlining assumptions for gas prices, load, greenhouse gas emissions prices, wind generation, hydroelectric generation, forced outages, and others. Each study simulates the entire Western Interconnect hourly between 2012 and 2031. The analysis used 18 central processing units (CPUs) linked to a SQL server to simulate the studies, creating over 45 GB of data requiring 2,000 hours of computing time.

The resultant average market prices developed from the stochastic model are similar to the results from the deterministic model. Figure 7.15 shows the stochastic market price results as the horizontal bar and the vertical bars represent the 10^{th} and 90^{th} percentile for annual average prices. The triangle represents the Tail Var 90. The nominal levelized price for the 20-year expected prices is \$70.50 per MWh. The deterministic prices are \$0.87 per MWh lower than the stochastic prices presented in Figure 7.15.

Figure 7.15: Mid-Columbia Electric Price Forecast Range



The annual averages of the stochastic case on-peak, off-peak and levelized prices are in Table 7.10. The Mid-Columbia market price averages \$70.50 per MWh over the next 20 years. The 2009 IRP annual average nominal price was \$93.74 per MWh. Spreads between on- and off-peak prices are \$11.48 per MWh over 20 years.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 152 of 1069

Table 7.11: Annual Average Mid-Columbia Electric Prices ($/MWh)

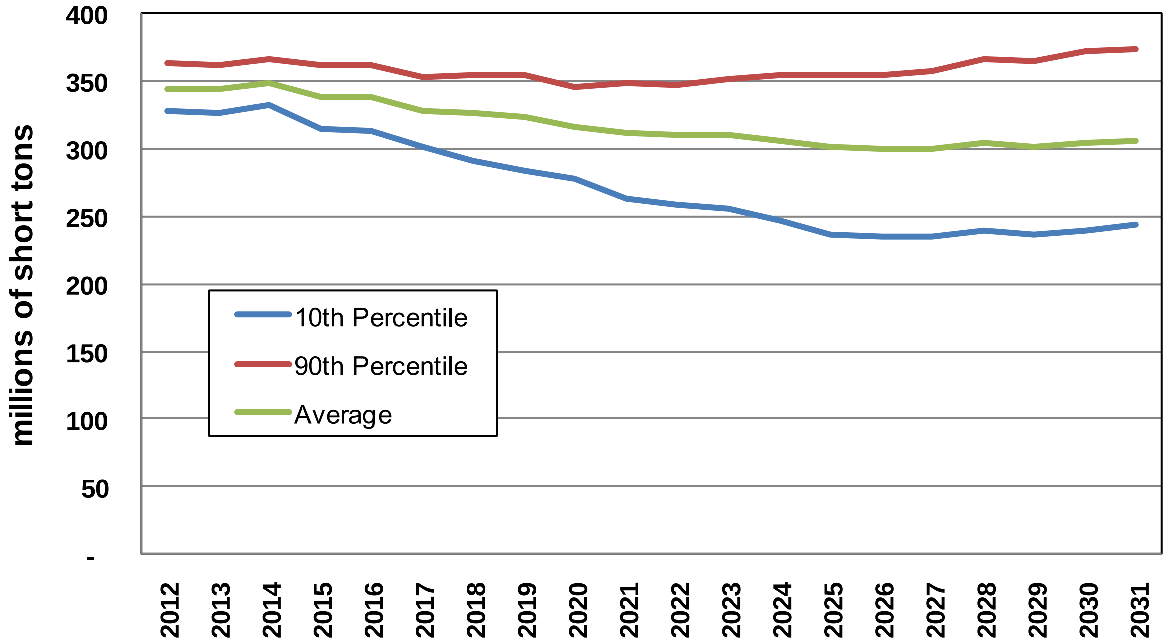
Year	On Peak	Off Peak	Flat
2012	40.87	36.51	44.16
2013	46.13	41.19	49.84
2014	49.11	43.62	53.23
2015	59.86	54.08	64.19
2016	63.25	57.12	67.84
2017	64.53	58.65	68.96
2018	66.55	60.33	71.21
2019	68.26	62.03	72.92
2020	71.05	64.56	75.91
2021	74.88	68.30	79.81
2022	80.49	73.65	85.62
2023	86.28	79.24	91.59
2024	91.26	83.55	97.04
2025	93.71	85.18	100.10
2026	91.35	83.08	97.54
2027	91.37	83.17	97.52
2028	98.30	89.92	104.63
2029	102.25	93.52	108.80
2030	107.56	97.77	114.89
2031	110.55	99.90	118.53
Nominal Levelized	**70.50**	**63.94**	**75.42**

Greenhouse Gas Emission Levels

Greenhouse gas levels increase over the study period absent social policies intended to reverse the trend. The compliance costs of meeting potential greenhouse gas mitigation discussed earlier in this chapter provide price signals to encourage reductions in greenhouse gas emissions. Figure 7.16 shows the expected greenhouse gas emissions from the 500 market forecast simulations. The average level of greenhouse gas emissions from electric generation decrease by 11.2 percent over the 20-year study. The figure also includes the 10th and 90th percentile statistics of the dataset. As discussed earlier, ten percent of the cases assume no future carbon mitigation policies; in these cases the incremental emissions are partly offset by now-expected coal plant retirements[7], low natural gas prices, and increased in wind generation that make coal resources uncompetitive in some months of the forecast.

[7] Recently announced retirements included in the 2011 IRP are 1,561 MW in Colorado, 585 MW in Oregon, and 172 MW in Utah. The 2011 IRP analyses occurred prior to the announcement of the future closure of the 1,376 MW Centralia Coal Plant in Washington State. Its closure should further carbon emission reductions beyond those projected in this plan.

Figure 7.16: Western States Greenhouse Gas Emissions

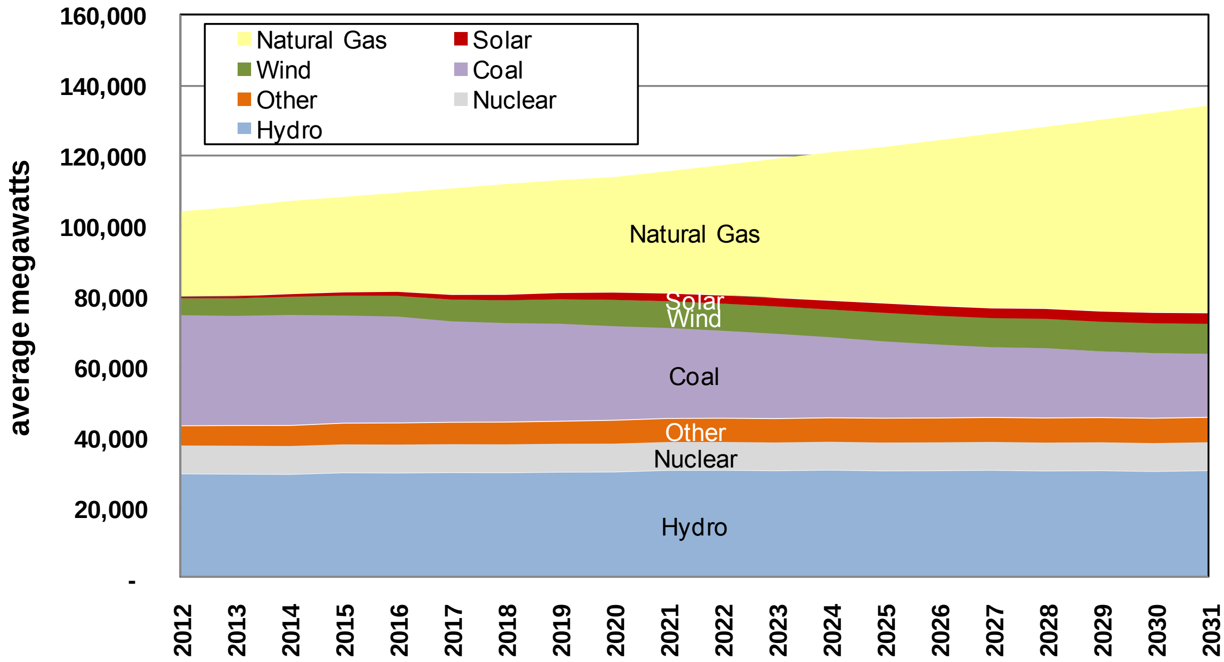


Resource Dispatch

State-level RPS goals and greenhouse gas legislation will change resource dispatch decisions and affect future power prices. The Northwest already is witnessing the market-changing effects of a 5,000+ MW wind fleet. Figure 7.17 illustrates that natural gas fuels 23 percent of total generation in 2012, and 41 percent in 2031. Coal generation decreases from 30 percent of Western Interconnect generation in 2012 to 13 percent in 2031. Solar and wind increase from 5 percent in 2012 to 13 percent in 2031. New renewable generation sources offset coal generation reductions, but natural gas-fired resources meet load growth.

Public policy changes to encourage renewable energy development and reduce greenhouse gas emissions have the potential to change the electricity marketplace. On its present trajectory, policy changes are likely to move the generation fleet toward its potentially most volatile contributor—natural gas. These policies will displace low-cost coal-fired generation with higher-cost renewables and gas-fired generation having lower capacity factors (wind) and higher marginal costs (natural gas). If history is our guide, regulated utilities will recover their costs from stranded coal plants, requiring customers to pay even more. Further, wholesale prices likely will increase with the effects of the changing resource dispatch driven by carbon emission limitations. New environmental policy driven investment, combined with higher market prices, will necessarily lead to retail rates that are higher than they would be absent greenhouse reduction policies.

Figure 7.17: Base Case Western Interconnect Resource Mix



Scenario Analysis

Scenario analysis evaluates the impact of specific changes in underlying assumptions on the market. Four stochastic studies were performed to help understand potential market price changes and to examine the potential risk to Avista's PRS if certain assumptions were changed. The scenarios studied used 500 iterations to model the effects of unconstrained carbon emissions, doubling of natural gas price volatility, and the early retirement of coal plants. In addition to the stochastic market scenarios, deterministic scenarios explained the impacts of low natural gas prices, high natural gas prices, and high wind penetration. Prior IPRs used market scenarios to stress test the PRS. Since the PRS accounts for a range of possible outcomes in its risk analysis, the market scenario section is more limited in this IRP. Additional scenarios illustrate the impacts potential policies might have on the industry, and how Avista could respond.

Unconstrained Carbon Emissions

The Unconstrained Carbon Emissions scenario is necessary to quantify projected greenhouse gas policy costs. The first study is a deterministic scenario. A second stochastic study models 500 individual iterations of varying natural gas prices, loads, wind generation, forced outages, and hydroelectric conditions. The assumptions are similar to the Expected Case with a few notable exceptions. First, natural gas prices are lower because of less demand for natural gas caused by the continued use of coal-fired generation. Without carbon legislation, natural gas prices are $0.52 per Dth lower levelized over 20 years, a 7.1 percent decrease.

Without projected greenhouse gas mitigation, Mid-Columbia market prices are lower and the total cost to serve customers is lower. The average of the 500 simulations finds wholesale market prices $17.64 per MWh lower, on a nominal levelized basis, compared to the Expected Case; this represents a 33.4 percent market price increase for greenhouse gas emissions mitigation (Figure 7.18). The total cost of fuel in the Western Interconnect with greenhouse gas mitigation is 7.65 percent higher than without the greenhouse gas mitigation.

Figure 7.18: Mid-Columbia Prices Comparison with and without Carbon Legislation

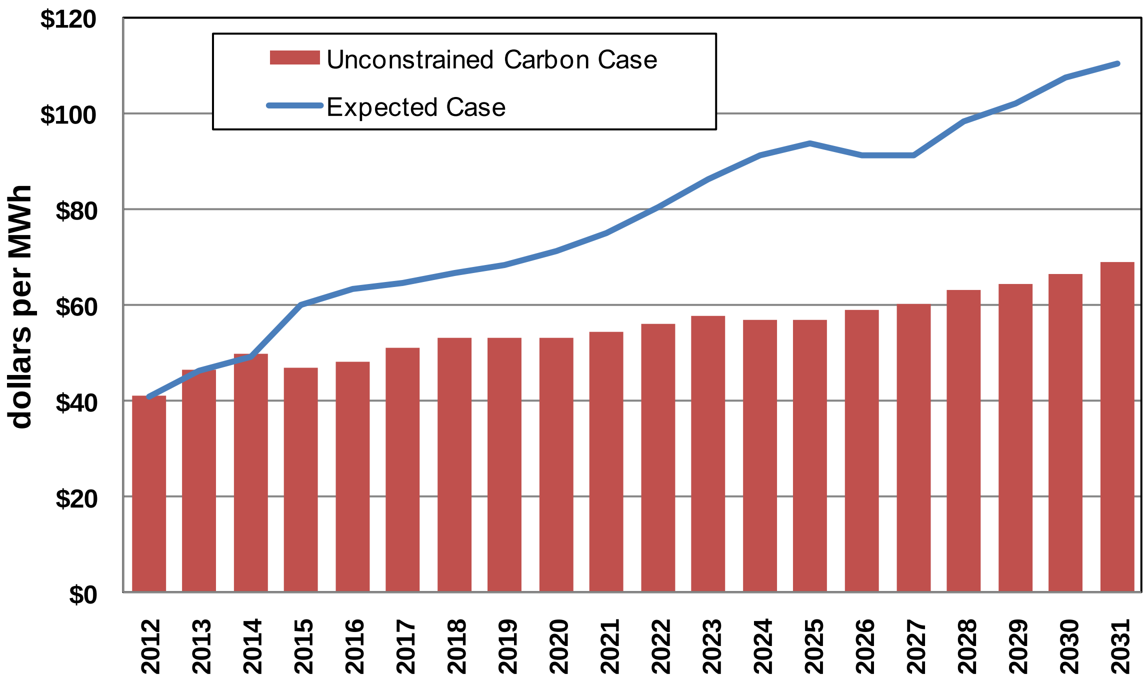


Figure 7.19 illustrates the difference between greenhouse gas emissions with and without the emissions costs included in the Expected Case. Based on the model results and assumptions, emissions would be 8.5 percent higher in 2020 and 21.5 percent higher in 2031 without the assumed greenhouse gas penalty. Increased greenhouse gas emissions from higher coal-fired dispatch levels are the cause (see Figure 7.20). The Expected Case, which includes greenhouse gas costs, reduces coal dispatch by 36 percent compared to the unconstrained greenhouse gas scenario, while natural gas generation production increases by 19 percent.

Figure 7.19: Western U.S. Carbon Emissions Comparison

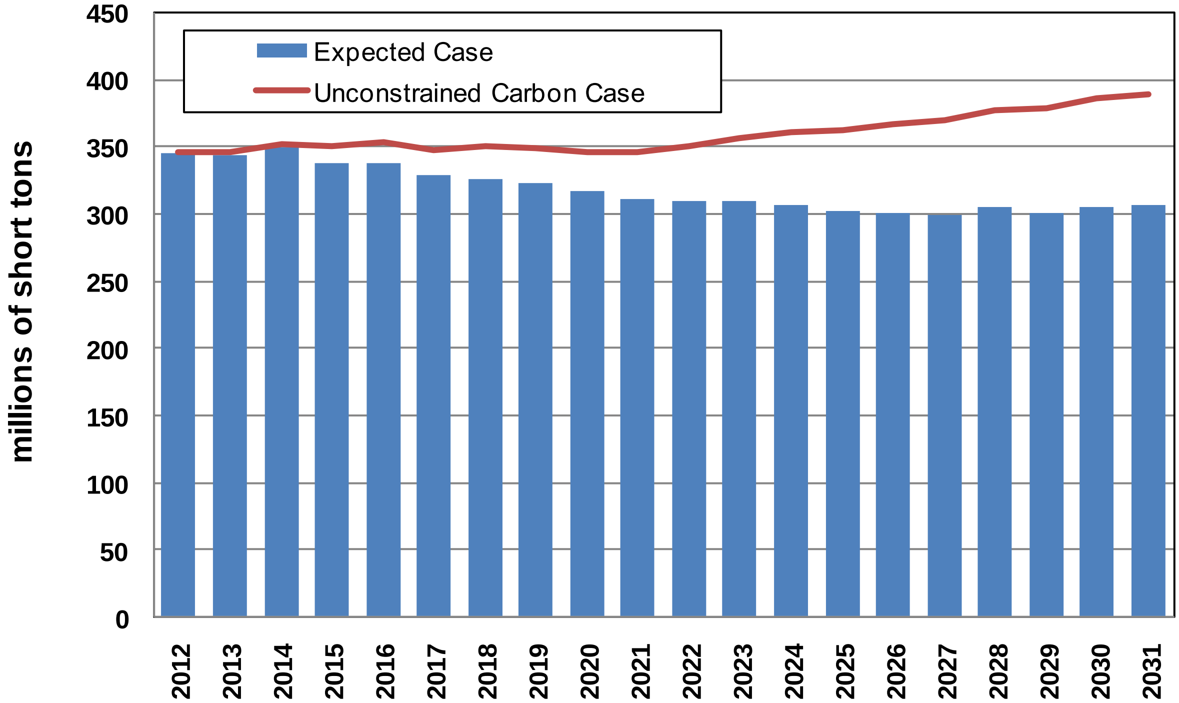
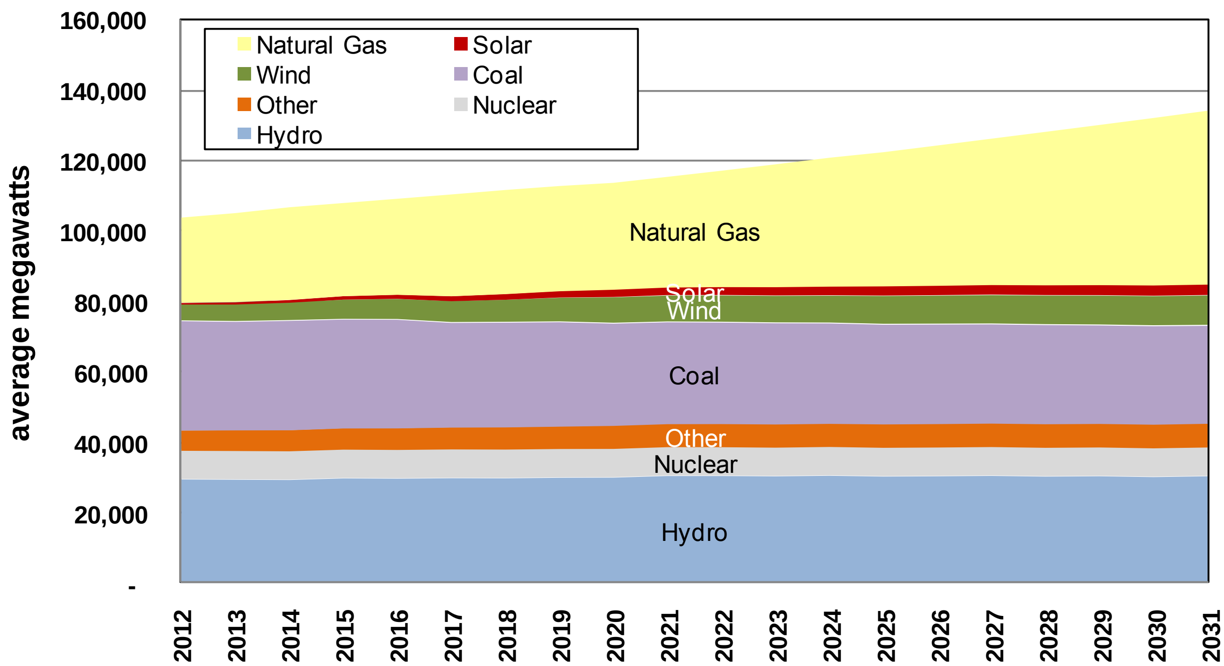


Figure 7.20: Unconstrained Carbon Scenario Resource Dispatch



Alternative Greenhouse Gas Mitigation Methods

As part of the development of the Expected Case's four greenhouse gas policies, market simulations were conducted to calculate the price of greenhouse gas required to meet the reduction goal. Figure 7.8, shown earlier, illustrates the prices required to meet the goals. Figure 7.21 illustrates the corresponding forecasted electric market prices at Mid-Columbia on an average annual basis. The Expected Case line is the average of the 500 simulations and the other lines represent the deterministic study results for each greenhouse gas policy modeled. The values shown in Figure 7.22 are discounted and levelized over the 20-year study period to represent the average price of power.

Figure 7.21: Average Annual Mid-Columbia Electric Prices for Alternative Greenhouse Gas Policies

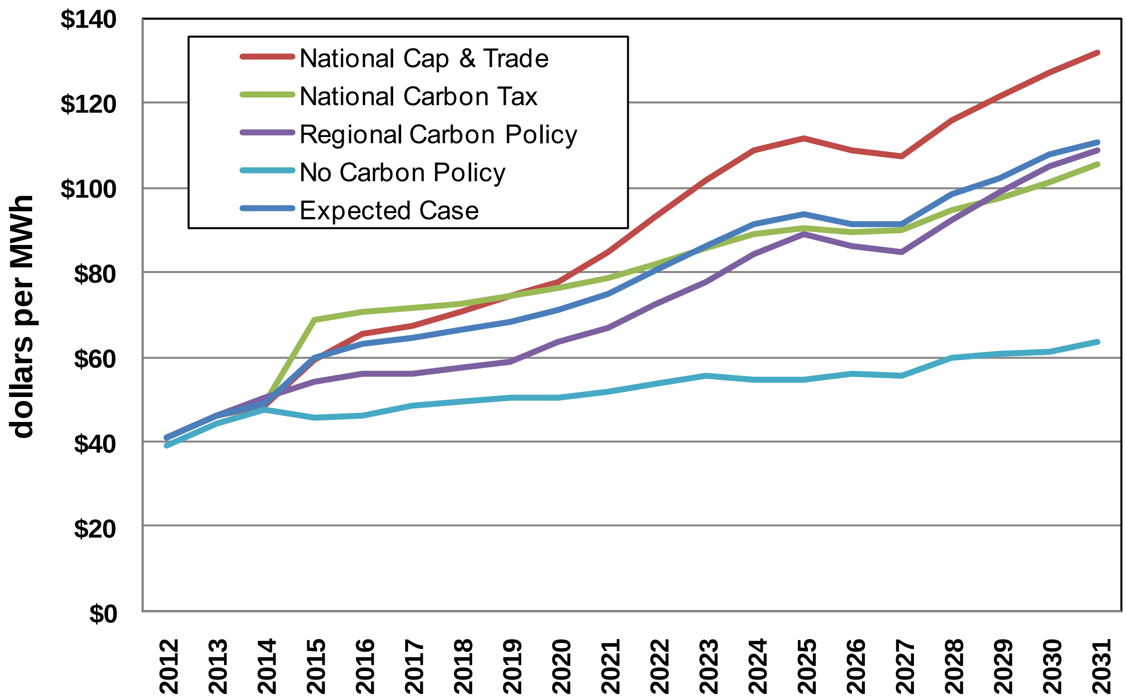


Figure 7.22: Nominal Levelized Mid-Columbia Electric Prices for Alternative Greenhouse Gas Policies

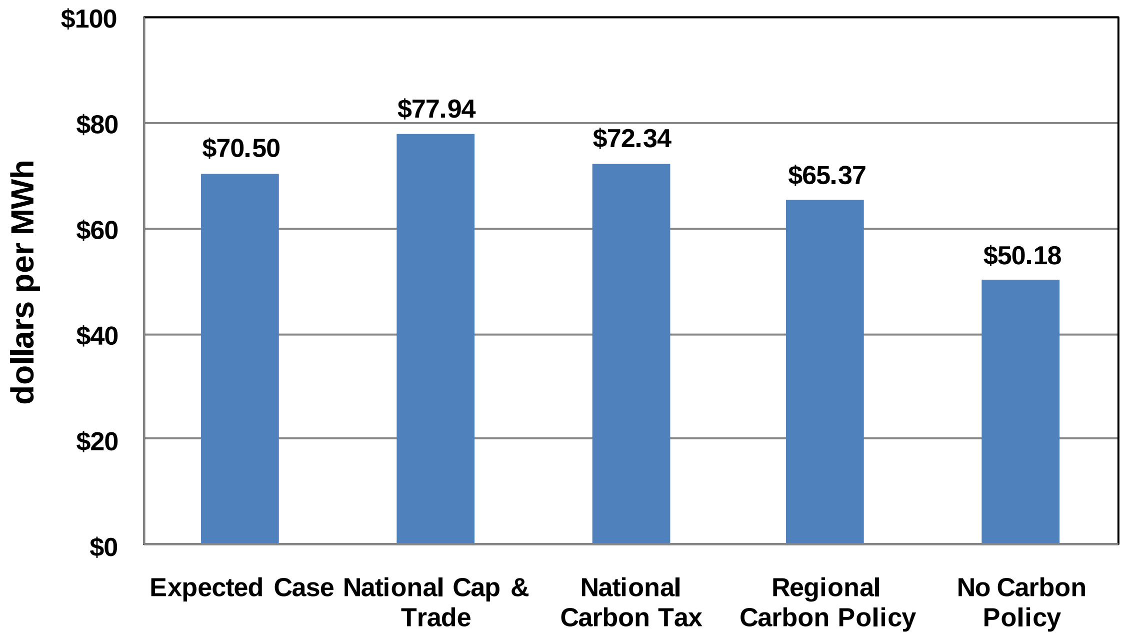
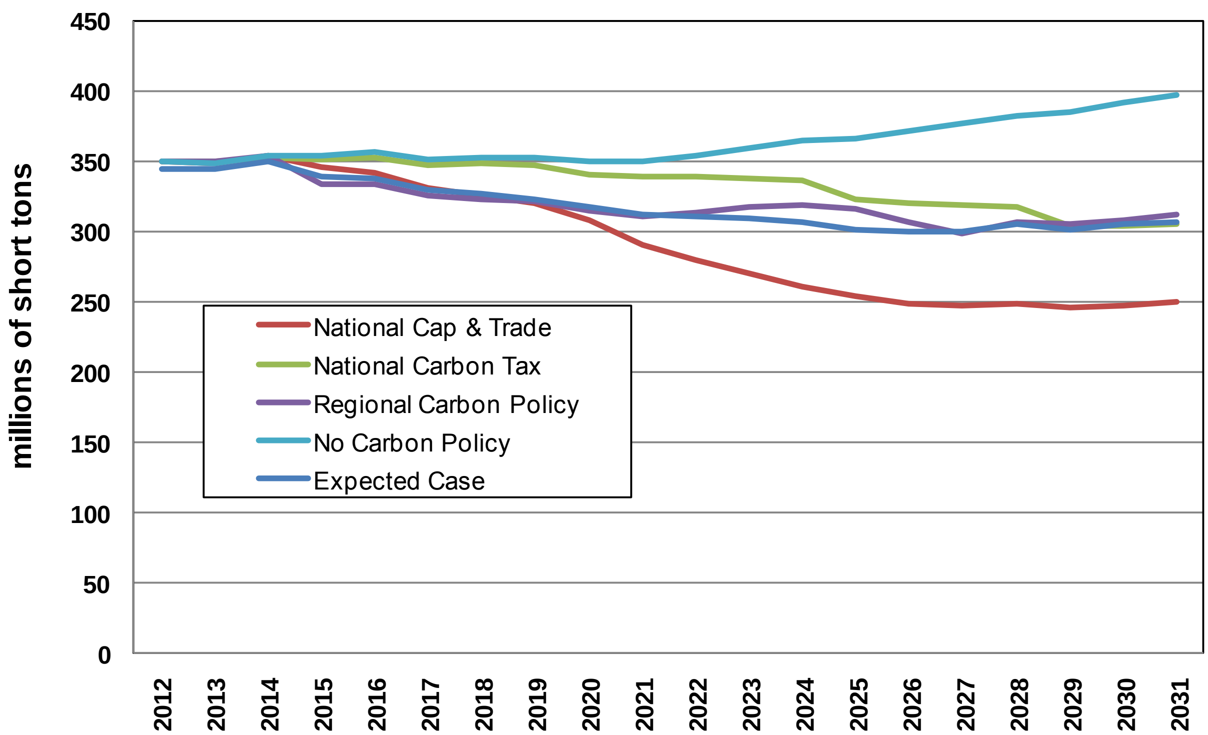


Figure 7.23 shows the annual expected greenhouse gas emissions levels for each of the policies in. The four potential outcomes represent a range of futures under different forms of greenhouse gas emissions legislation.

Figure 7.23: Annual Greenhouse Gas Emissions for Alternative Greenhouse Gas Policies



Mandatory Coal Retirement

Proposed federal greenhouse gas cap and trade legislation is not law. The Environmental Protection Agency and other organizations have pursued alternative methods to reduce greenhouse gases from electric generation through regulatory means. More details surrounding these policy alternatives are in the Planning Environment chapter. The goal of this scenario is to illustrate the affect on electricity market prices and system fuel costs where a policy is put in place requiring all coal plants to retire at the end of 40 years of life, or to be phased out by 2020 if the plant is already over 40 years old. The study uses 500 iterations as conducted on other studies.

In Figure 7.24 the average annual prices for this scenario are compared to the Expected Case. The resulting prices levelized are $57.01 per MWh, 19 percent lower than the Expected Case and 27 percent lower than the National Cap and Trade Strategy. The surprising fact about this greenhouse gas policy is that Mid-Columbia prices are only 7.3 percent higher than the no carbon penalty case and the policy still achieves substantial greenhouse gas reductions as shown in Figure 7.25. The driver of these results is that natural gas-fired units face no carbon costs. Without the emissions adder to natural gas, the marginal price of power remains as a natural gas-fired plant, and the increase in power cost is more driven by the increased demand driving natural gas prices higher and the inclusion of less low cost base load capacity in shoulder months. Although lower market prices make this greenhouse gas strategy appealing, it does have a negative consequence.

In Table 7.12 annual incremental costs of each potential strategy are compared and the Early Coal Plant Retirement strategy is $3.2 billion more costly for the Western Interconnect as compared to the National Cap and Trade strategy. This increase results from the forced addition of new resources to replace coal plants rather than letting coal plants remain on line, but instead dispatching them much less frequently, thus avoiding new capital investment. One thing to keep in mind, is this a 20 year study of the western interconnect. A longer-term national model may illustrate different results. Taking into account national economics may also change opinions on the results as well. In the end, any greenhouse reduction strategy needs to be a low cost solution that does not affect the electricity marketplace in a negative manner.

Figure 7.24: Average Annual Mid-Columbia Price Comparison of Greenhouse Gas Policies

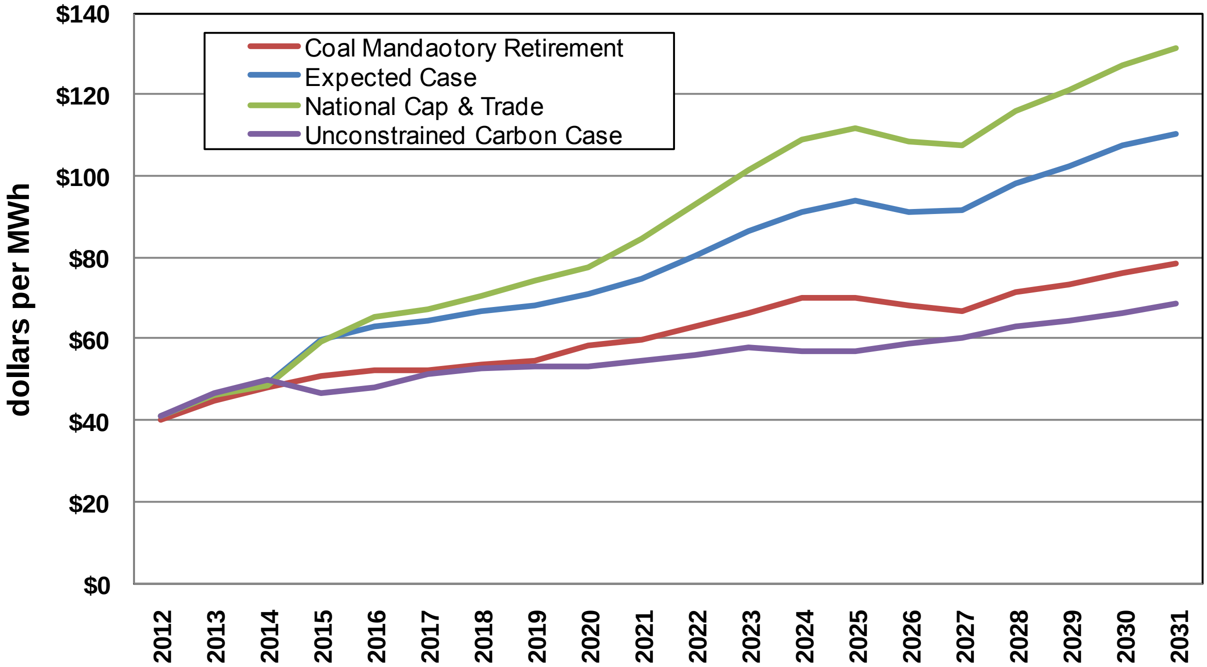


Figure 7.25: Expected Greenhouse Gas Emissions Comparison

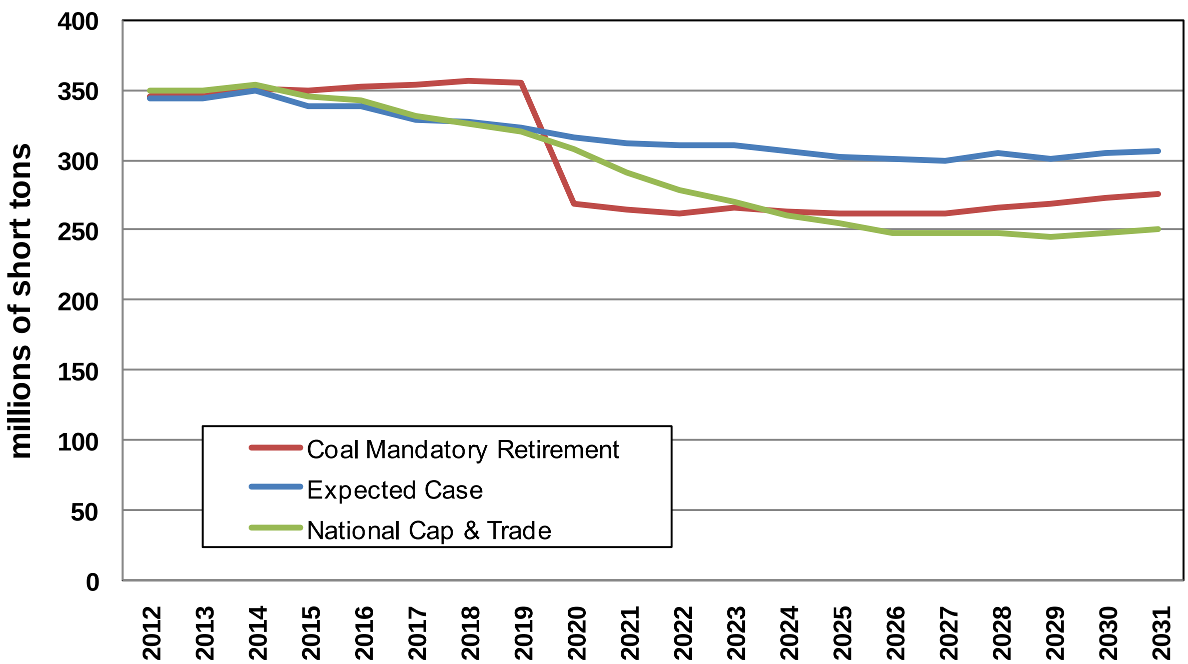


Table 7.12: Impacts of Greenhouse Gas Mitigation Policies in the West

Market Scenario	Change to GHG Emissions by 2031	Added Levelized Cost per Year (Billions)
Unconstrained Greenhouse Gas Case	14%	0.0
Expected Case	-18%	3.5
Coal Mandatory Retirement	-22%	8.1
National Cap & Trade	-29%	4.9

High and Low Natural Gas Price Scenarios

The High and Low Natural Gas Price scenarios illustrate Mid-Columbia electric prices for differing natural gas prices. These scenarios maintain carbon emissions at the same level as the Expected Case to determine carbon prices at lower natural gas prices. Figure 7.4, located earlier in the chapter, shows the low and high natural gas price forecasts used in this scenario as Consultant 1 and Consultant 2 prices. Using these prices, the resulting greenhouse gas price forecast assuming a cap and trade mechanism that achieves the same reductions as the Expected Case is in Figure 7.26. The natural gas prices in this scenario are approximately plus or minus 20 percent compared to the Expected Case, but greenhouse gas prices must increase or decrease, respectively, by approximately 31 percent to achieve the same greenhouse gas levels as the Expected Case. The Mid-Columbia market price forecasts for the high and low natural gas price cases are in Figure 7.27. The nominal levelized electric price for the low gas price case is $57.00 per MWh and $82.17 per MWh for the high gas price case.

Figure 7.26: Natural Gas Price Scenario's Greenhouse Gas Emission Prices

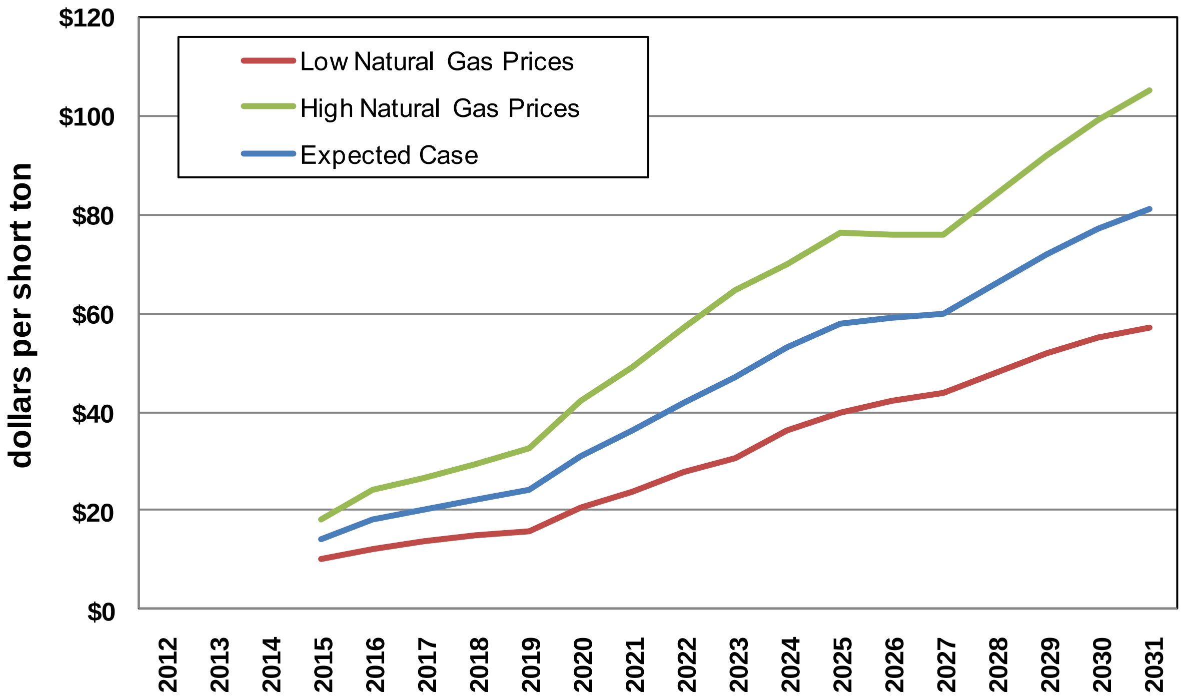
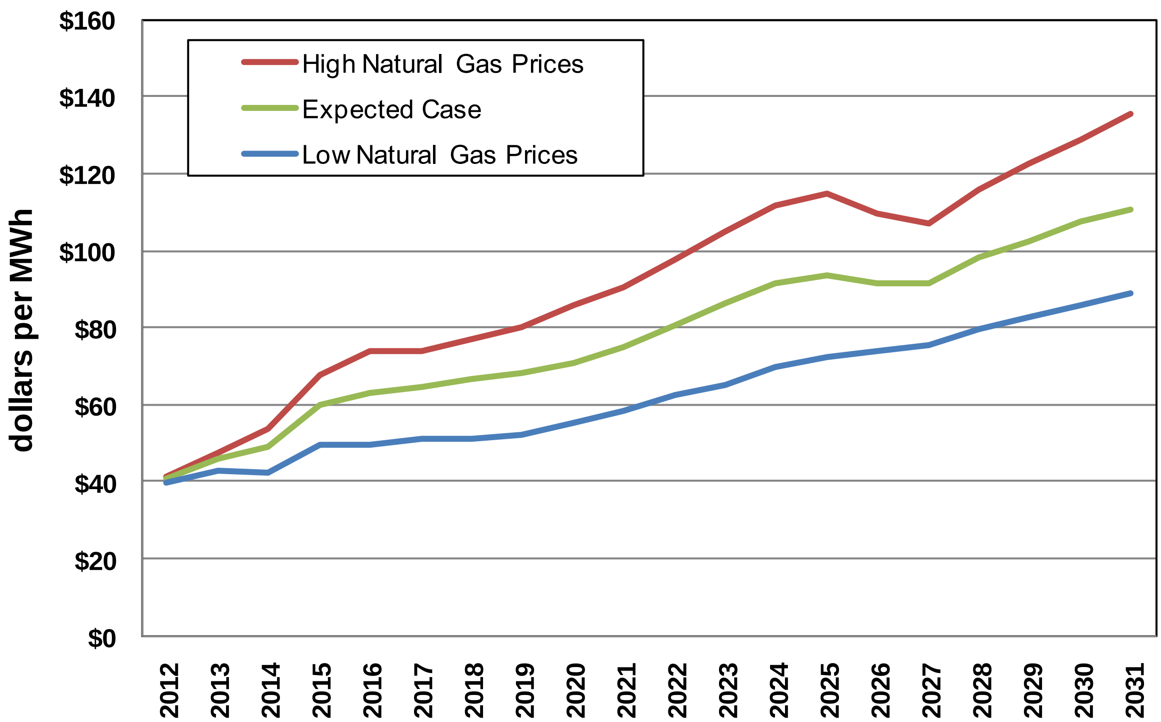


Figure 7.27: Natural Gas Price Scenario's Mid-Columbia Price Forecasts



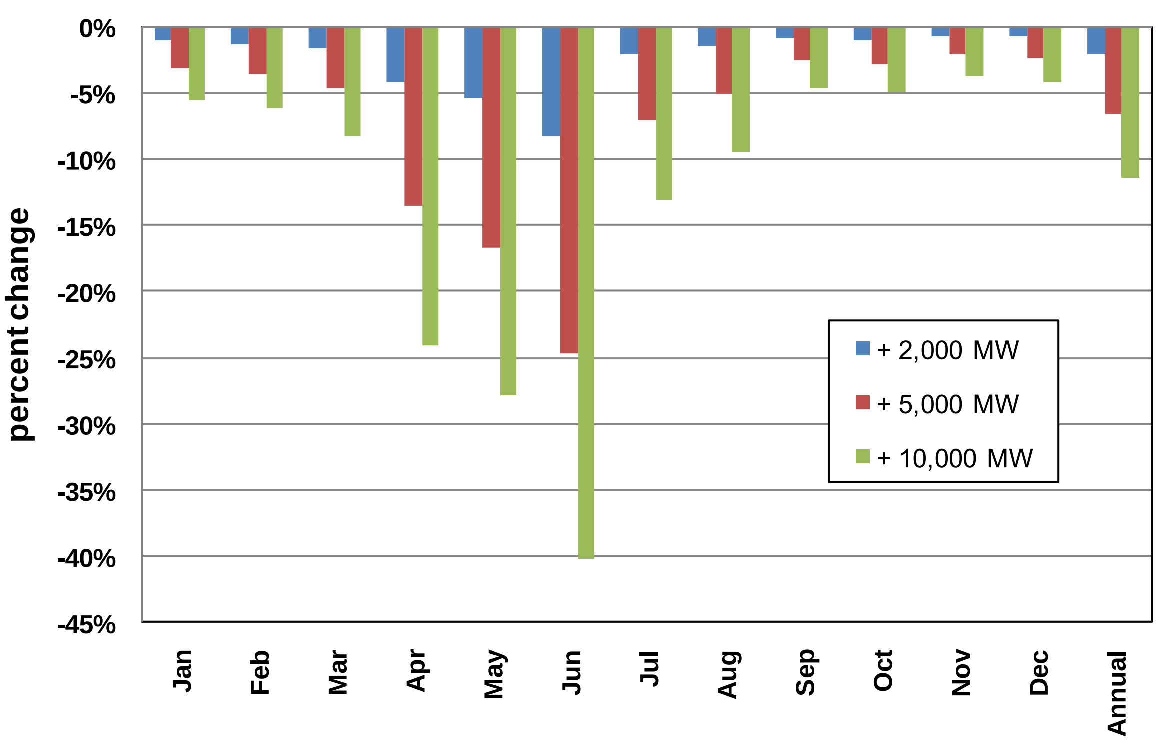
Wind Proliferation and Negative Pricing

Avista uses the IRP process to identify and understand the impacts of potential market changes, rather than only focusing on Avista's PRS. In past IRPs, Avista has studied the market impacts of electric cars and the addition of large amounts of solar generation to the grid. For this IRP, the non-PRS study focuses on the growing penetration of wind generation in the Northwest. 2015 was chosen as the period for this study and includes four sensitivities; the sensitivity included 100 iterations of potential outcomes.

The sensitivities in this case range from 7,000 MW to 17,000 MW (additions of between zero MW and 10,000 MW to the Expected Case wind penetration forecast) of total wind capacity in the Northwest. Currently, there is approximately 5,000 MW in the four northwest states and the Expected Case includes approximately 7,000 MW of wind by 2015. The key results of this study include the change in market prices, the amount of negative price episodes, and the overall effect of additional wind generation on the margins of existing Avista facilities.

The first major change to the power market by high wind penetration is the change to wholesale market prices. Based on the average of the 100 iterations of each case, Figure 7.28 illustrates the percent change to Mid-Columbia average monthly prices in cases that increase wind capacity by 2,000, 5,000, and 10,000 MW above the Expected Case forecast. The major price changes occur in the second quarter of the year. On average, market price changes are 2 percent lower than the Expected Case with 2,000 MW of additional wind by 2015, 7 percent lower with 5,000 MW, and 11 percent lower with 10,000 MW.

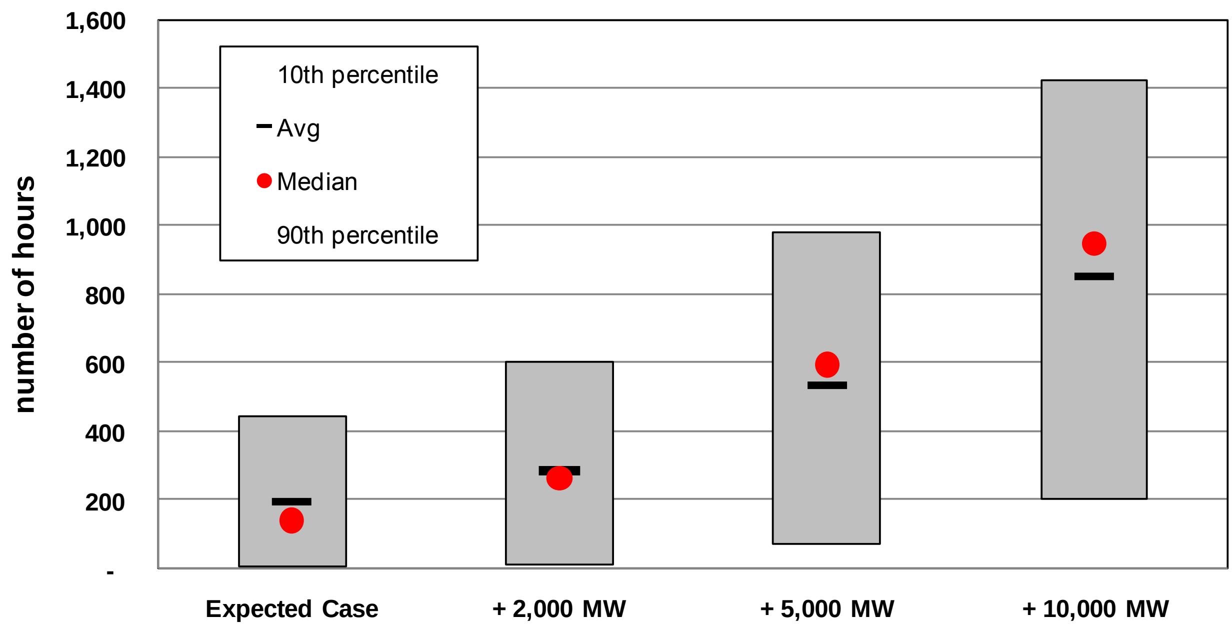
Figure 7.28: Wind Sensitivity Mid-Columbia Price Changes



The reduction in overall wholesale prices comes substantially from negative prices. Negative pricing can occur when resources must operate irrespective of the price offered in the wholesale marketplace, and when a resource receives economic benefit for generation beyond market prices (tax credits and RECs). In some markets negative prices occur when certain base-load generation resources (e.g., nuclear plants) in total exceed nighttime loads but must be operated to ensure their availability during the next day's peak demand periods. Negative pricing is an issue today in the Northwest when the region's hydroelectric system is experiencing high flow condition (generally during spring runoff) and when there is no wind generation curtailment.

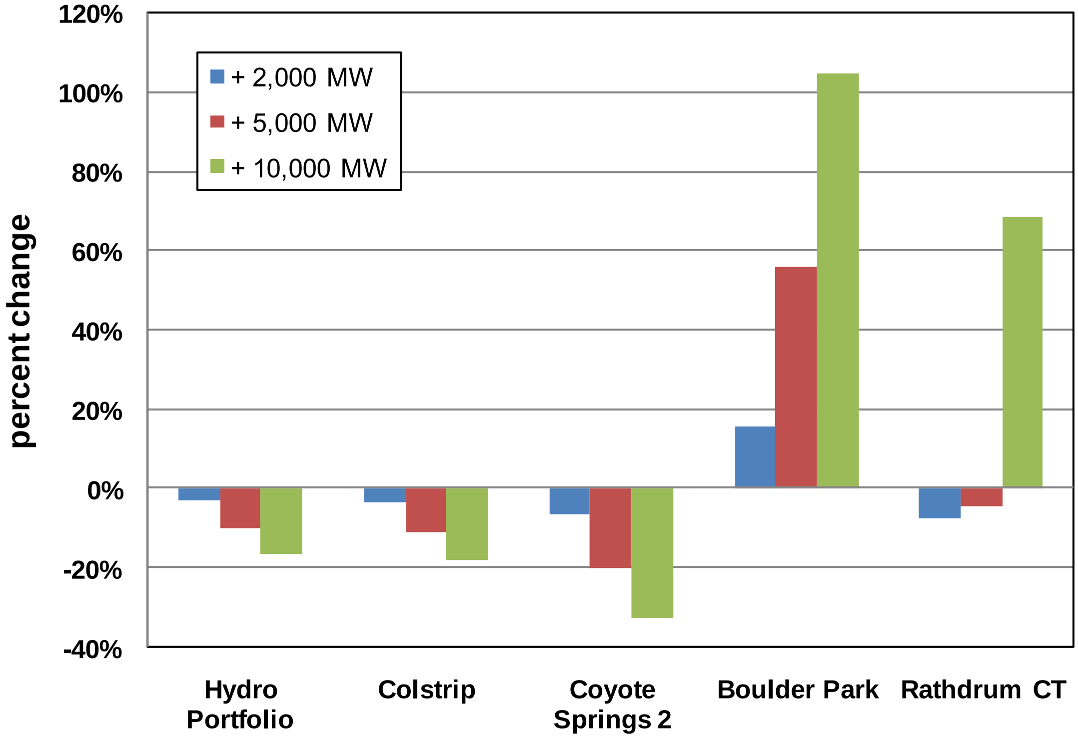
Many hydroelectric facilities must generate electricity and not spill water under varying licensing requirements. This situation compounds when generation resources, such as wind, receive federal production tax and renewable energy credits. Wind facilities in the Expected Case contribute to 193 hours of negative prices, or 2.2 percent of the hours, as shown in Figure 7.29. With 2,000 MW of additional wind capacity, the frequency of negative pricing increases to 3.2 percent. With 5,000 MW, prices fall by 6.1 percent. And with 10,000 MW, prices fall by 9.7 percent.

Figure 7.29: Wind Sensitivity Negative Pricing



The final item reviewed as part of this high wind penetration study is the effect to the profitability of non-wind and hydro resources and total power supply costs. Figure 7.30 shows that Avista's coal-fired, combined cycle natural gas-fired, and hydroelectric revenues decline, but that the value of gas-fired peaking resources will increase. The estimated impact of increased wind penetration to Avista net power supply cost is a net increase between 0.03 percent and 0.37 percent.

Figure 7.30: Change to Resource Revenues



Market Analysis Summary

Market analysis is a key component of the IRP. The market is where Avista trades its electricity surpluses and deficits. It is difficult to examine all potential resources evaluated by Avista for possible inclusion in the PRS without a firm understanding of the marketplace and how public policy and changes to resource and cost assumptions affect the market. As prices have declined since the 2009 IRP, and have the potential to fall farther, the market price forecasts could have an effect on the cost to bring new resources on to the Avista system and their potential rate effects.

New legislation and regulations affecting the electric system are on the horizon. Regardless of policies to decrease greenhouse gas emissions, make generation greener, promote energy independence or affect reliability—power costs will increase because new capacity and transmission resources are needed to replace aging infrastructure and serve new load growth. Greenhouse gas emissions and RPS legislation will diversify fuel supplies, but will also increase demand for natural gas-fired resources. Policymakers and the public will need to determine if the ultimate benefits of these types of legislation outweigh the increased costs.

8. Preferred Resource Strategy

Introduction

The Preferred Resource Strategy (PRS) chapter describes potential costs and financial risks of the Company's resource acquisition strategy. It details the planning and resource decision methodologies, describes strategy, considers climate change policy, and shows how the strategy may evolve if certain expected future conditions change.

The 2011 PRS describes a reasonable low-cost plan along the efficient frontier of potential resource portfolios accounting for fuel supply risk, price risk, and greenhouse gas mitigation. Major changes from the 2009 plan include reduced amounts of wind generation and the introduction of natural gas-fired peaking resources. The plan includes less wind because of lower expected retail loads resulting from the present economic downturn and increased conservation acquisition. Expected wind generation needs are lower due to a modest change in the modeling method used to represent annual variability from RPS-qualifying resources. The selection of gas-fired peaking resources resulted from a lower natural gas price forecast, lower retail loads, and the need for more flexible generation resources to manage the variability associated with renewable generation.

Section Highlights

- A newly signed contract for the Palouse Wind project located near Spokane, Washington will fulfill Avista's RPS obligations through 2019.
- Avista's first load-driven acquisition is a gas-fired peaking plant in 2019; total gas-fired acquisition is 756 MW over the IRP timeframe.
- The 2011 plan splits natural gas-fired generation between simple- and combined-cycle plants in anticipation of a growing need for system flexibility to integrate variable resources.
- Efficiency improvements, both on the customer and utility sides of the meter, are at the highest expected level in our planning history.
- Total capital needs for generation resources in the PRS are $1.7 billion.
- Conservation and system efficiency spending will increase over time; a total of $1.4 billion will acquire 310 aMW over 20 years.

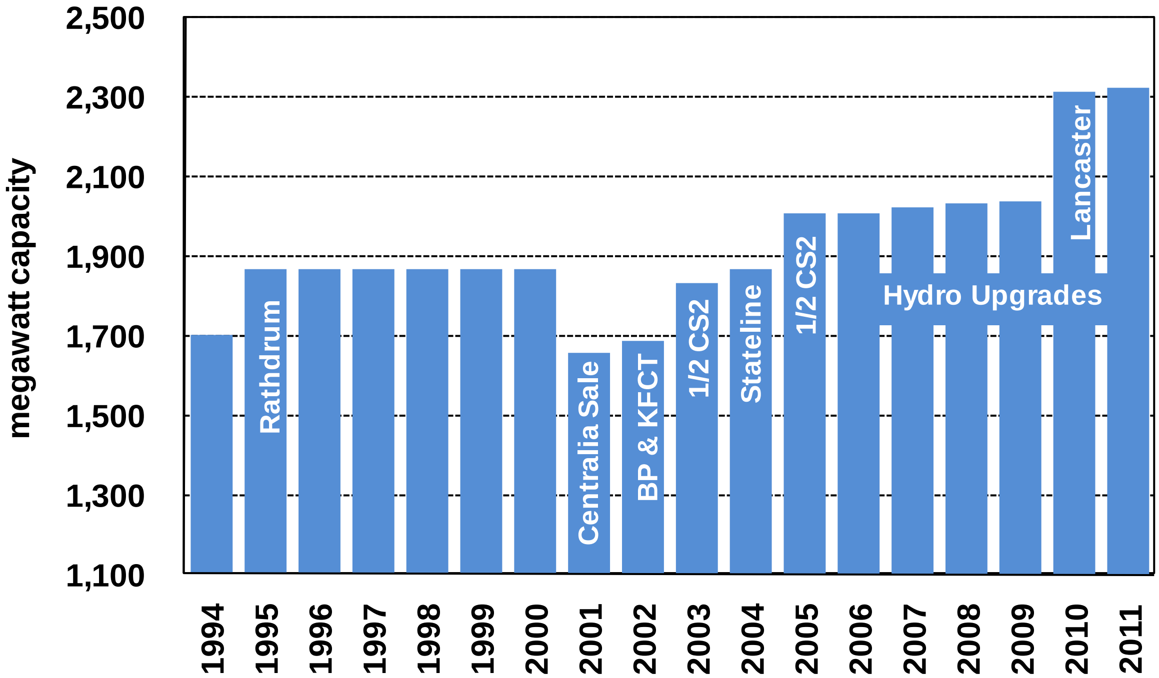
Supply-Side Resource Acquisitions

Avista began its shift away from coal-fired resources with the sale of its 210 MW share of the Centralia coal plant in 2001 and its replacement with natural gas-fired projects (see Figure 8.1). After the Centralia sale, Avista acquired 32 MW of gas-fired peaking capacity and 287 MW of intermediate load gas-fired capacity. In addition, Avista contracted for 35 MW of wind capacity from the Stateline Wind Project and added 42 MW of new capacity to its hydroelectric fleet through project upgrades. Avista gained control of the output for the 270 MW Lancaster Generating Facility through a long-term

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 168 of 1069

tolling arrangement on January 1, 2010. The Company plans to upgrade its Nine Mile Falls project. The upgrade could involve replacement with in-kind equipment or a new powerhouse. Avista plans to complete the last turbine runner upgrade at Noxon Rapids in 2012, adding seven MW (1 aMW) to the project's capability.

Figure 8.1: Resource Acquisition History



Resource Selection Process

Avista uses several decision support systems to develop its resource strategy. The PRS relies on results from the PRiSM model whose objective function is to meet resource deficits while accounting for overall cost, risk, renewable energy requirements, and other constraints. The AURORAxmp model, discussed in detail in the Market Analysis chapter, calculates the operating margin (value) of every resource option considered in each of 500 potential future outcomes. PRiSM evaluates resource values by combining operating margins with capital and fixed operating costs. From an efficient frontier, Avista selects a resource mix meeting all capacity, energy, RPS, and other requirements.

PRiSM

Avista staff developed the PRiSM model in 2002 to support PRS selection. PRiSM uses a linear programming routine to support complex decision making with multiple objectives. Linear programming tools provide optimal values for variables, given system constraints.

Overview of the PRiSM Model

The PRiSM model requires a number of inputs:

1. Expected Future Deficiencies
    - Summer 18-hour capacity
    - Winter 18-hour capacity
    - Annual energy
    - I-937 RPS Requirements
2. Costs to Serve Future Retail Loads
3. Existing Resource Contributions
    - Operating margins
    - Carbon emission levels
4. Resource Options
    - Fixed operating costs
    - Return on capital
    - Interest expense
    - Taxes
    - Generation levels
    - Emission levels
5. Limitations
    - Market reliance (surplus/deficit limits on energy, capacity and RPS)
    - Resources available to meet future deficits
    - Resource retirement limits (function disabled for 2011 IRP)
    - Capital expenditure limits (function disabled for 2011 IRP)
    - Emission levels (function disabled for 2011 IRP)

PRiSM uses these inputs to develop an optimal resource mix over time at varying levels of cost and resultant risk levels. It weights the first decade more heavily than the later years to highlight the importance of near-term decisions. A simplified view of the PRiSM linear programming objective function is below.

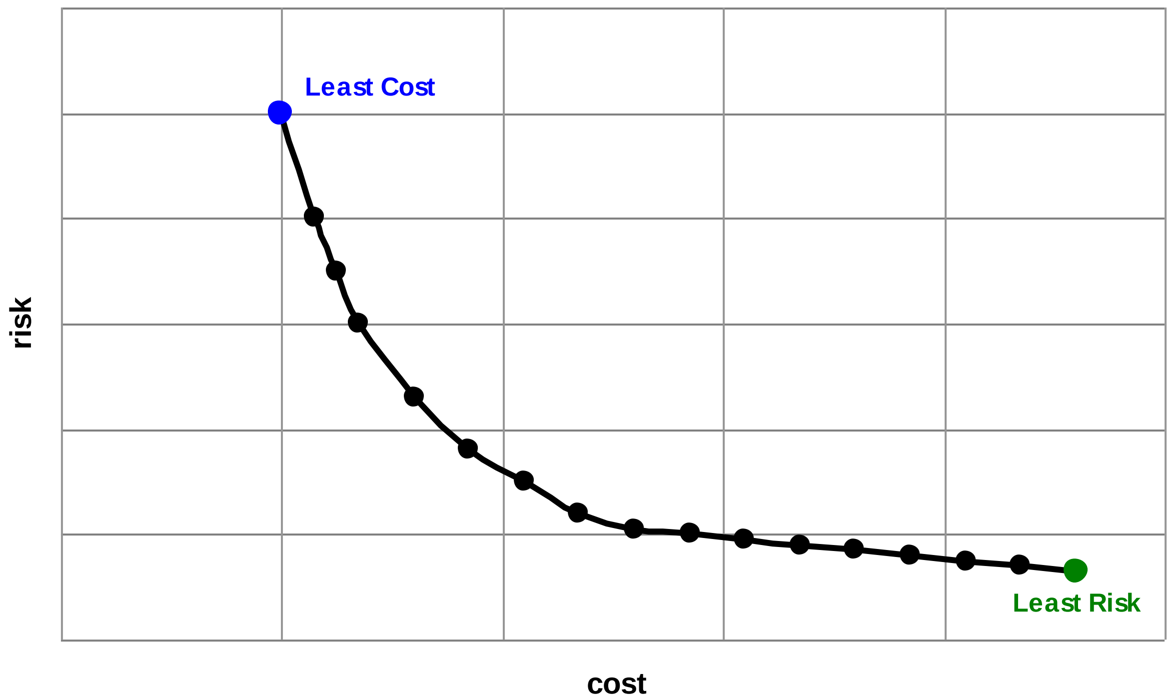
PRiSM Objective Function

Minimize: $(X_1 * NPV_{2012\text{-}2022}) + (X_2 * NPV_{2012\text{-}2031}) + (X_3 * NPV_{2012\text{-}2061})$

Where: X_1 = Weight of net costs over the first 10 years (75 percent)
X_2 = Weight of net costs over 20 years of the plan (20 percent)
X_3 = Weight of net costs over the next 50 years (5 percent)
NPV is the net present value of total cost (existing resource marginal costs, all future resource fixed and variable costs, and all future conservation costs and the net short-term market sales/purchases).

An efficient frontier captures the optimal mix of resources, given varying levels of cost and risk. Figure 8.2 illustrates the efficient frontier concept. The optimal point on the efficient frontier curve depends on the level of risk Avista and its customers are willing to accept. Environmental legislation, cost, regulation, and the availability of commercially ready technologies greatly limit utility-scale resource options. The model does not meet deficits with market purchases, or allow the construction of resources in any increment needed.[1] Instead, the model uses market purchases to fill short-term gaps and constructs resources in block sizes equal to the actual project capacities.

Figure 8.2: Conceptual Efficient Frontier Curve



Constraints

As discussed earlier in this chapter, reflecting real-world constraints in the model is necessary to create a realistic representation of the future. Some constraints are physical and others are societal. The major resource constraints are capacity and energy needs, Washington's RPS, and the greenhouse gas emissions performance standard.

The PRiSM model is limited to choosing resources by type and by size. It can select from combined- and simple-cycle natural gas-fired combustion turbines, wind, and upgrades to existing thermal resources, and conservation. Sequestered and non-sequestered coal plants are not an option in this IRP because of Washington's emissions performance standard. Detailed hydroelectric upgrade potentials were not available during PRS development and are not included as resource options.

Washington's RPS fundamentally changed how the Company meets future loads. Before the addition of an RPS obligation, the efficient frontier contained a least-cost strategy on one axis and the least-risk strategy on the other axis, and all of the points in between. Next, management used the efficient frontier to determine where they wanted to be on the cost-risk continuum. The least cost strategy typically consisted of gas-fired

[1] Market reliance, as identified in Section 2, is determined prior to PRiSM's optimization.

peaking resources. Portfolios with less risk generally replaced some of the gas-fired peaking resources with wind generation, other renewables, combined cycle gas-fired plants, or coal-fired resources. Past IRPs identified resource strategies that included all of these risk-reducing resources.

Added environmental and legislative constraints greatly reduce the ability to reduce future costs and/or risks and require the procurement of renewable generation resources that previously were included for risk-mitigation. Because significant levels of renewable generation are required under Washington law, the 2011 IRP strategy simply complies with environmental and legislative constraints.

Resource Deficiencies

Avista no longer uses a one-hour peak planning methodology, instead using the peak planning methodology recommended by the Northwest Power and Conservation Council – three-day, 18-hour (6 hours each day) peak events occurring both in the summer and winter. This method better emulates the Northwest and Avista's actual ability to meet short-term peak events with hydroelectric facilities. Avista accounts for the regional view of surplus power and includes a pro-rata share of regional surpluses when available. Finally, the peak planning methodology includes other operating reserves and a planning margin.

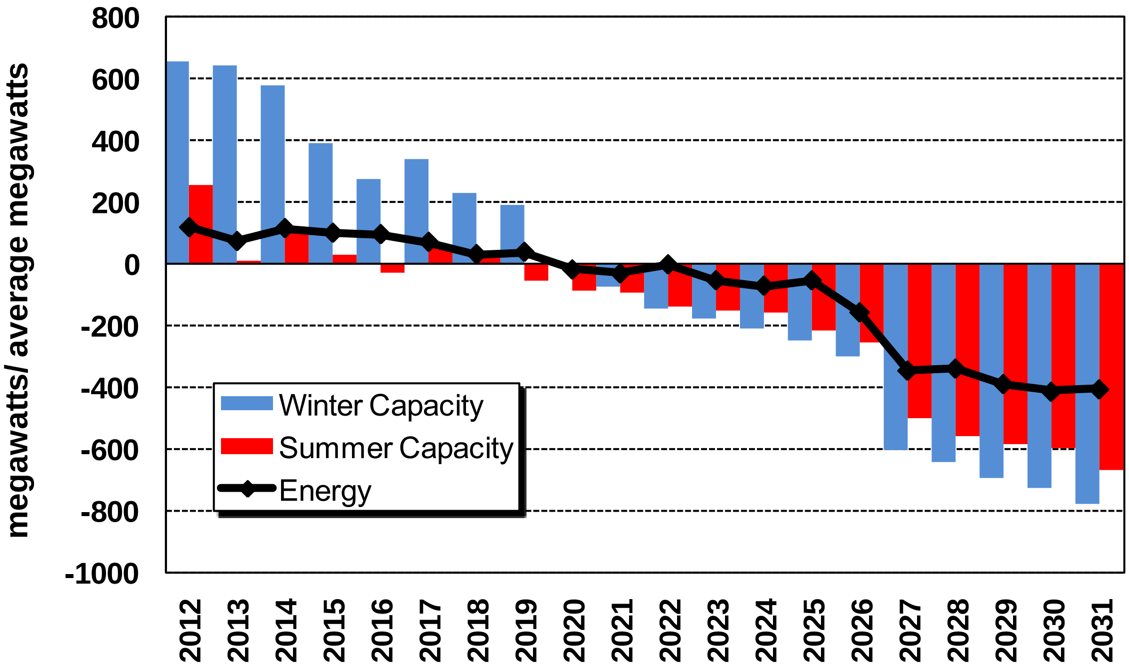
Even with the new peak planning methodology, Avista currently projects having adequate resources between owned and contractually controlled generation to meet annual physical energy and capacity needs until 2016.[2] See Figure 8.3 for Avista's physical resource positions for annual energy, summer capacity, and winter capacity. This figure accounts for the effects of new energy efficiency programs on the load forecast. Absent energy efficiency, our resource position would be deficient earlier. The first capacity deficit is short-lived because a 150 MW capacity sale contract ends in 2016. Avista likely will address the 2016 capacity deficit with market purchases as 2016 approaches; therefore, the first long-term capacity deficit begins in the summer of 2019.

Avista's resource portfolio has 281 MW of natural gas-fired peaking plants available to serve winter loads and 201 MW available in the summer. For long-term planning, these resources are available to generate energy at their full capabilities. Operationally, less expensive wholesale marketplace purchases may displace Avista's available resources. On an annual average basis, our loads and resources fall out of balance in 2020 for energy; the first quarterly energy deficit is in the first quarter of 2013.

PRiSM selects new resources to fill capacity and energy deficits, although the model may over- or under-build where economics support it. Because of acquisitions driven by capacity RPS compliance, large energy surpluses result. See Figure 8.3.

[2] See Chapter 2 for further details on this peak planning methodology.

Figure 8.3: Physical Resource Positions (Includes Conservation)



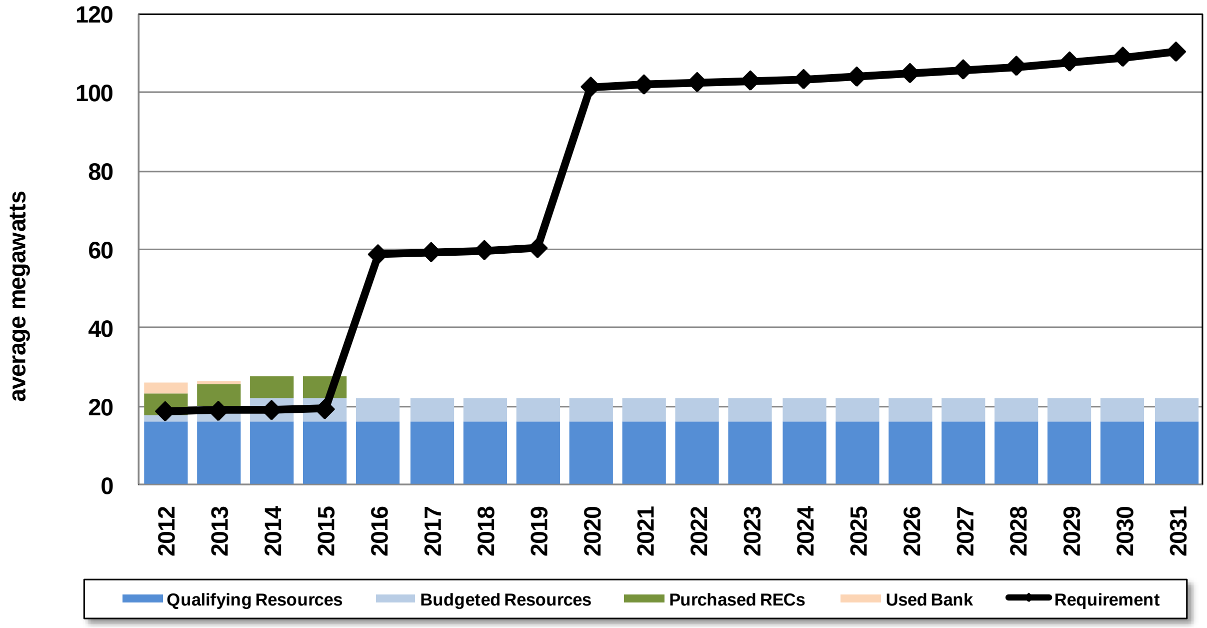
Renewable Portfolio Standards

Washington voters approved the Energy Independence Act through Initiative 937 (I-937) in the November 2006 general election. I-937 requires utilities with over 25,000 customers to meet three percent of retail load from qualified renewable resources by 2012, nine percent by 2016, and 15 percent by 2020. The initiative also requires utilities to acquire all cost-effective conservation and energy efficiency measures. The Company has been participating in the UTC's Renewable Portfolio Standard Workgroup at the Washington Commission.

Avista expects to meet or exceed its renewable energy requirements between 2012 and 2015 through a combination of qualifying hydroelectric upgrades, the Palouse Wind project, and a REC purchase. Projected REC positions are in Figure 8.4[3]. I-937 includes the flexibility to use RECs from the current year, from the previous year, or from the following year for compliance. REC contingency reserves will be "banked" each year to account for compliance variability driven by loads and hydroelectric and wind generation variation. Projected requirements and new resources used to meet future RPS obligations are in Table 8.31.

[3] Figure 8.4 does not show the expected RECs from the Palouse Wind contract, which was signed after the modeling for the 2011 was completed.

Figure 8.4: REC Requirements vs. Qualifying RECs for Washington State RPS



Preferred Resource Strategy

The 2011 PRS consists of existing thermal resource upgrades, wind, conservation, and natural gas-fired simple and combined cycle gas turbines. The first resource acquisition is approximately 42 aMW of wind by the end of 2012 to take advantage of federal tax incentives.[4]

Avista will rebuild distribution feeders over the next twenty years. The PRS includes 27 MW of peak capacity savings and 13 aMW of energy savings from smart grid and distribution feeder initiatives. More discussion on this topic is included in the distribution upgrades section of the Transmission and Distribution chapter.

The PRiSM model selected an 83 MW simple cycle combustion turbine as its first large capacity addition by the end of 2018. Another 83 MW simple cycle combustion turbine follows by the end of 2020. Also in the 2018 to 20 period, existing thermal unit upgrades add 4 MW of capacity. The PRS adds 43 aMW of additional wind by the end of 2019-20 to meet the 15 percent renewable energy goal.

The PRS includes a 270 MW natural gas-fired combined-cycle combustion turbine (CCCT) in 2023, and another 270 MW CCCT in 2026, to meet projected capacity deficits created by the expiration of the Lancaster tolling agreement. Following this need is a 46 MW simple cycle turbine. In total, the PRS adds 1,024 MW of new generation capacity by the end of the IRP forecast. Table 8.1 presents the 2011 PRS resource types, timing and sizes.

[4] Avista met this requirement through a 2011 RFP process that selected the Palouse Wind Project.

Table 8.1: 2011 Preferred Resource Strategy

Resource	By the End of Year	Nameplate (MW)	Energy (aMW)
NW Wind	2012	120	35
SCCT	2018	83	75
Existing Thermal Resource Upgrades	2019	4	3
NW Wind	2019-2020	120	35
SCCT	2020	83	75
CCCT	2023	270	237
CCCT	2026	270	237
SCCT	2029	46	42
Total		**996**	**739**
Efficiency Improvements	**By the End of Year**	**Peak Reduction (MW)**	**Energy (aMW)**
Distribution Efficiencies	2012-2031	28	13
Energy Efficiency	2012-2031	419	310
Total		**447**	**323**

Table 8.2 shows the 2009 Preferred Resource Strategy. The major differences in the 2011 plan are a reduction in the quantity of wind resources and a switch to a combination of simple and combined cycle resources from only combined cycle gas-fired resources.

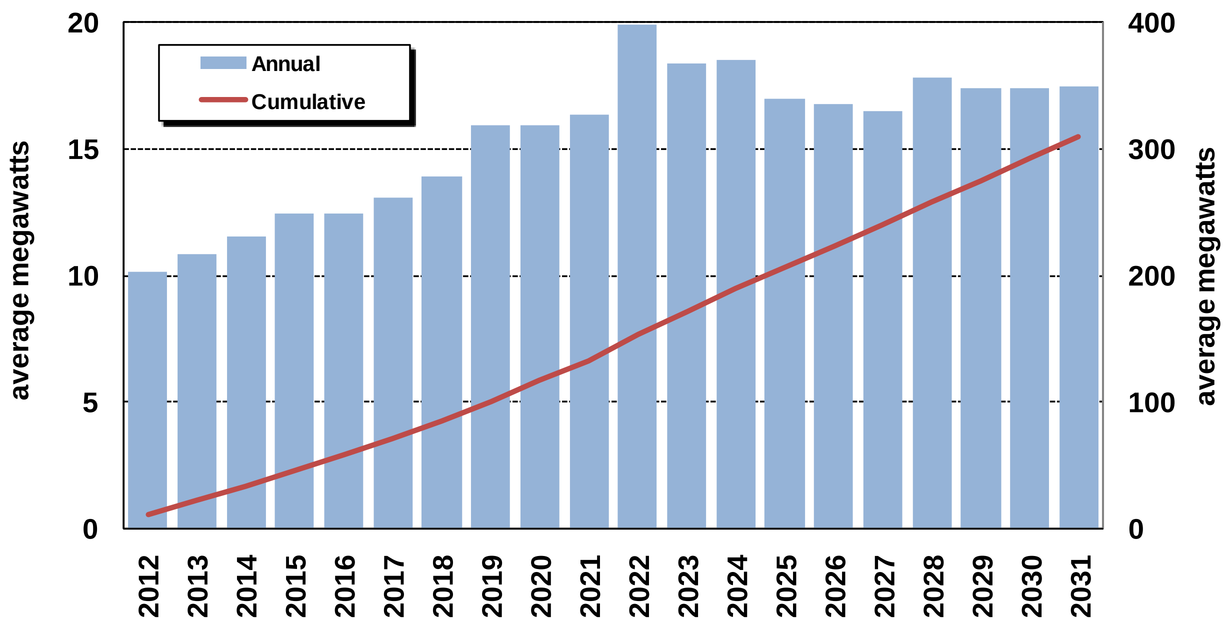
Table 8.2: 2009 Preferred Resource Strategy

Resource	By the End of Year	Nameplate (MW)	Energy (aMW)
Northwest Wind	2012	150	48
Little Falls Unit Upgrades	2013-2016	3	1
Northwest Wind	2019	150	50
Combined-Cycle Combustion Turbine	2019	250	225
Upper Falls	2020	2	1
Northwest Wind	2022	50	17
Combined-Cycle Combustion Turbine	2024	250	225
Combined-Cycle Combustion Turbine	2027	250	225
Total		**1,105**	**792**
Efficiency Improvements	**By the End of Year**	**Peak Reduction (MW)**	**Energy (aMW)**
Distribution Efficiencies	2010-2015	5	3
Energy Efficiency	2010-2029	339	226
Total		**344**	**229**

Energy Efficiency

Energy efficiency is an integral part of the PRS analytical process. Energy efficiency is also a critical component of I-937, where utilities are required to obtain all cost effective conservation. Avista developed avoided energy costs and compared those figures against a conservation supply curve developed by Global Energy Partners. The 20-year forecast of energy efficiency acquisitions is in Figure 8.5. Avista plans to acquire 133 aMW of energy efficiency over the next 10 years and 310 aMW over 20 years. These acquisitions will reduce system peak, shaving 207 MW from by 2022, and 419 MW in 2031. Please refer to Chapter 3 for a more detailed discussion of energy efficiency resources.

Figure 8.5: Energy Efficiency Annual Expected Acquisition



Palouse Wind

On February 22, 2011, Avista issued a request for proposals (RFP) for I-937-qualifying renewable energy. Following the RFP, Avista selected the Palouse Wind project located between Rosalia and Oakesdale, Washington. The project will have a maximum capability of approximately 100 MW and an expected annual average energy output of 40 aMW. The contract is a 30-year power purchase agreement with a purchase option after year 10. The project should be on-line in the second half of 2012. This new resource is not included in the PRS as it was under contract negotiation during the development of this plan, this resource meets the PRS Northwest Wind resource need in 2012.

Reardan Wind Project

Avista purchased development rights for a wind site located in its service territory near Reardan, Washington, from Energy Northwest in 2008. The fully permitted site has several years of meteorological data and is ready for construction. This wind site is competitive to higher capacity factor sites, as the project does not require any third-party transmission and is located near Avista work crews.[5] This site could supply between 50 MW and 100 MW of wind generation. With the acquisition of the Palouse Wind project, development at Reardan is not likely prior to 2018-19.

Little Falls Hydro Upgrades

The 2009 PRS included 0.9 aMW of incremental energy from upgrades to the Little Falls project between 2013 and 2016. When preparing this plan, Avista expected in-kind turbine replacements and no incremental energy. Additional study and modeling identified up to three aMW of incremental energy that will qualify for Washington's Energy Independence Act. Final decisions about the upgrades are still pending. Analysis around this option continues and an update will be in the 2013 IRP.

Distribution Feeder Upgrades

Distribution feeder upgrades were in the PRS for the first time in the 2009 IRP. The feeder upgrade process began with an upgrade to the Ninth & Central Streets feeder in Spokane. The decision to rebuild a feeder considers energy savings, operation and maintenance savings, the age of existing equipment, reliability indexes, and the number of customers on the feeder. Based on analyses performed for this IRP, Avista likely will rebuild many of its distribution feeders, limited to five or six per year due to financial and staffing limitations. Feeder rebuild projects will begin in 2012 or 2013 and the Company will allocate resources after prioritizing the projects. Savings are subject to change after further detailed cost analyses and rebuild schedules are completed and more information is provided in Chapter 5.

Simple Cycle Combustion Turbines

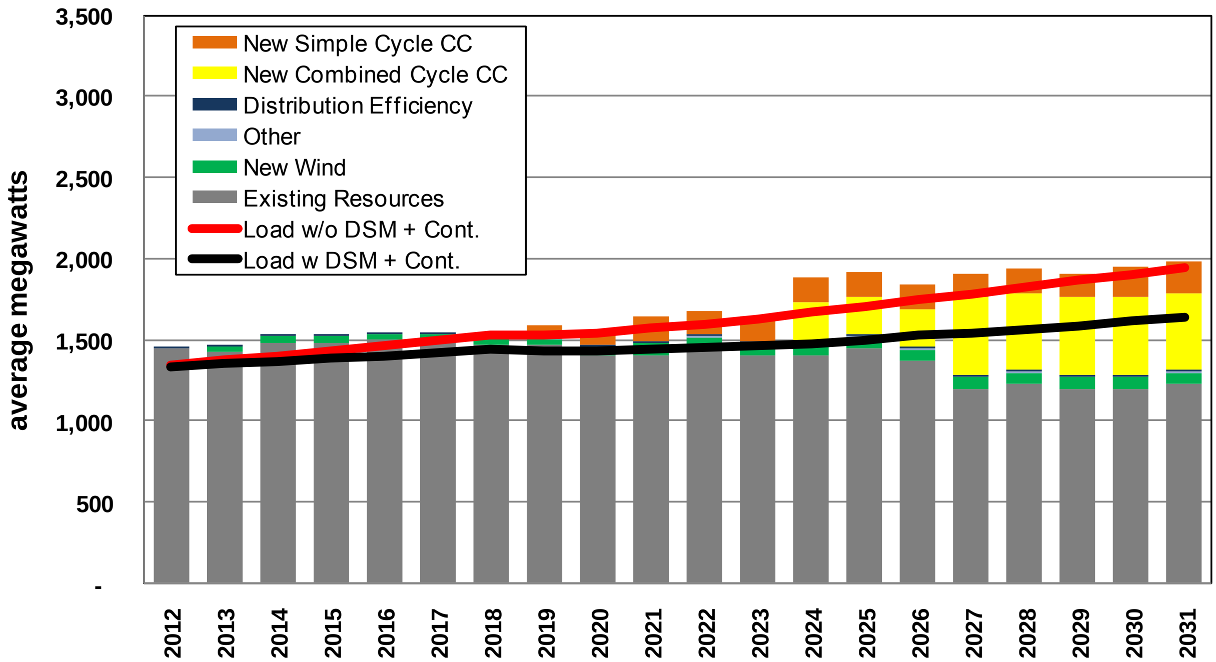
Avista plans to identify potential sites for new gas-fired generation capacity within its service territory ahead of an anticipated 2019 need. Avista's service territory has areas with different combinations of benefits and costs. Locations in Washington would have higher generation costs because of natural gas fuel taxes and carbon mitigation fees. However, the potential benefits of a Washington location, including proximity to natural gas pipelines and Avista's transmission system; lower project elevations that provide higher on-peak capacity contributions per investment dollar; and water to cool the facility, might outweigh the costs. In Idaho, lower taxes and fees decrease the cost of a potential facility, but there are fewer locations to site a facility near natural gas pipelines, fewer low cost transmission interconnections, and fewer sites with adequate cooling water. The identification and procurement of a natural gas project site option is an Action Item for this IRP.

Loads and Resources Positions

Conservation acquisitions identified in this IRP reduce the load forecast, as shown in Figure 8.6. The red line illustrates the Company's load obligation absent energy efficiency programs. Absent conservation, Avista would need new resources in 2018 rather than 2020.

[5] Higher capacity factor wind sites are generally located outside of Avista's service territory.

Figure 8.6: Annual Average Load and Resource Balance



The first winter peak deficit without the conservation resource would occur in 2020, but the deficit does not occur until 2022 with the acquisition of new energy efficiency measures (see Figure 8.7). Avista expects to have modest short-term resource deficits prior to 2022 and intends to meet these deficiencies with market purchases rather than acquiring a resource prior to a sustained need. An analysis of regional loads and resources support the Company's position that existing regional capacity should be available to support a robust short-term wholesale market in the timeframe required. A capacity resource could replace market purchases, without a significant impact on the long-term portfolio cost, if conditions change and the Company determines that it cannot depend on the regional market surplus during this period.

The summer peak load and resource position shows a capacity need prior to the first winter need. Avista's peak loads are lower in summer than in the winter, but the impacts on hydroelectric and thermal generation capacity in the summer, due to lower flow conditions and high temperatures, are greater than the load differences. As shown in Figure 8.8, summer resource deficits occur in 2013 without conservation and in 2016 (short-term) and 2019 (long-term) with conservation measures. The Company plans to fill the short-term summer capacity deficit in 2016 with market purchases. Beginning in 2022, summer deficits no longer drive Avista's capacity needs due to the expiration of the WNP-3 contract in 2019.

Figure 8.7: Winter Peak Load and Resource Balance

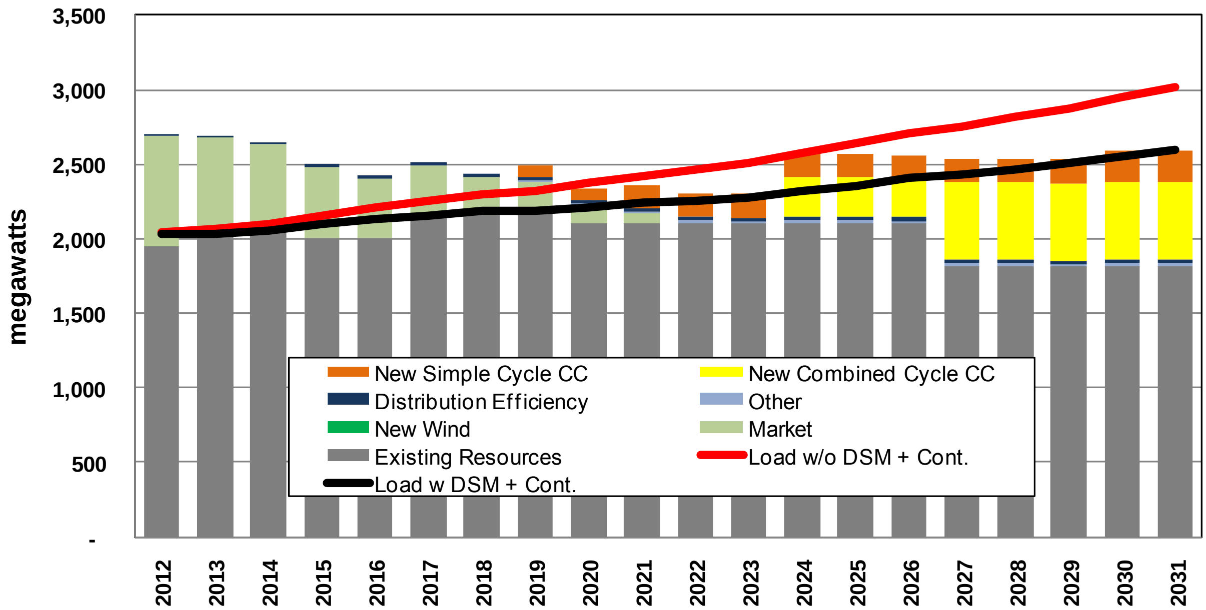
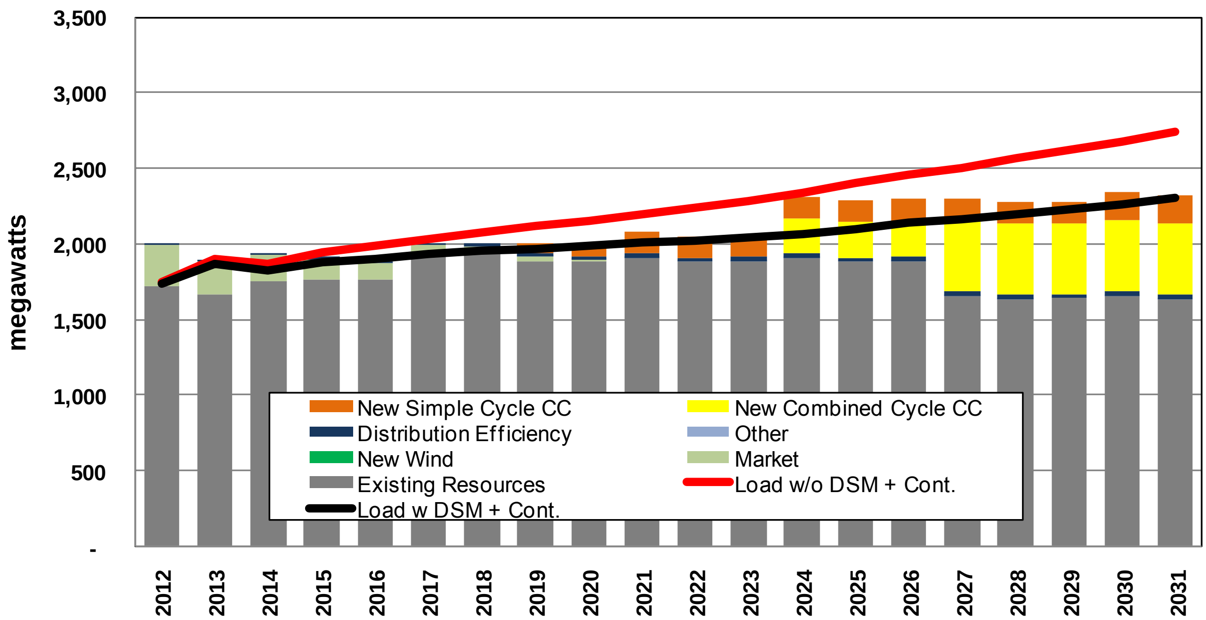


Figure 8.8: Summer Peak Load and Resource Balance



Under Washington regulation (WAC 480-107-15), utilities having generation capacity deficits within three years of an IRP filing must also file a proposed Request for Proposals (RFP) with the Washington Utilities and Transportation Commission (UTC). The RFP is due to the UTC no later than 135 days after the IRP filing. After UTC approval, bids to meet the anticipated capacity shortfall must be solicited within 30 days.

Tables 8.28 and 8.29, shown later in this section, detail Avista's capacity position over the IRP timeframe. With a portion of loads met by Avista's share of the regional capacity surplus, Avista does not require winter capacity until 2022. A summer capacity deficiency does not occur until 2016. Simplified summaries are below in Tables 8.3 and 8.4. They show Avista does not require capacity in the next three years; therefore an RFP is not required under WAC 480-107-15.

Table 8.3: Avista Medium-Term Winter Capacity Tabulation

	2012	2013	2014
Load Obligations	1,890	1,912	1,892
Reserves Planning	371	356	358
Total Obligations	**2,261**	**2,268**	**2,250**
Utility Resources	2,192	2,267	2,277
NW Market Share	737	656	565
Total Resources	**2,929**	**2,923**	**2,842**
Net Position	**668**	**655**	**592**

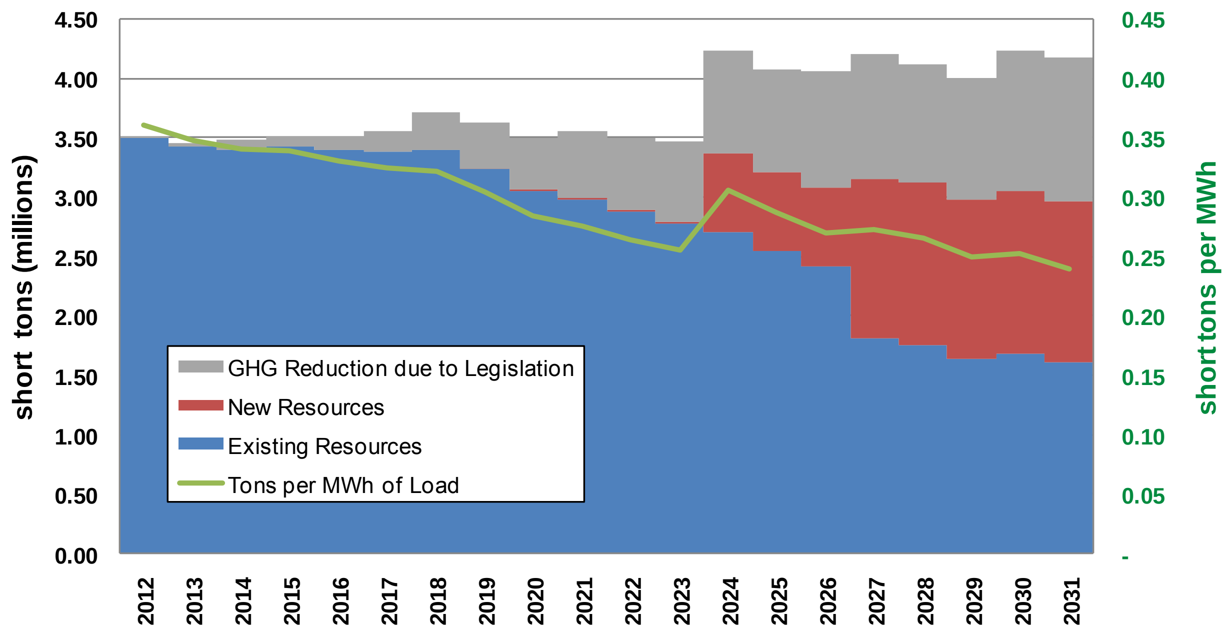
Table 8.4: Avista Medium-Term Summer Capacity Tabulation

	2012	2013	2014
Load Obligations	1,743	1,756	1,785
Reserves Planning	227	322	238
Total Obligations	**1,970**	**2,078**	**2,023**
Utility Resources	1,960	1,880	1,962
NW Market Availability	275	221	178
Total Resources	**2,235**	**2,101**	**2,140**
Net Position	**265**	**23**	**117**

Greenhouse Gas Emissions

The Market Analysis chapter discusses how greenhouse gas emissions from electric generation in the Western Interconnect decrease due to the addition of carbon emission penalties. Avista's greenhouse gas emissions should fall because of anticipated carbon reduction policies. Greenhouse gas policies will affect higher-cost coal facilities before affecting low operating cost facilities, such as Colstrip. New or underutilized natural gas-fired resources located closer to west coast load centers will replace the coal-fired facilities. Figure 8.9 presents expected greenhouse gas emissions with the addition of PRS resources. Overall Company greenhouse gas emissions should fall starting in 2020 as Colstrip output decreases and natural gas-fired generation increases. The 2024 increase in emissions shown in Figure 8.9 comes from a new CCCT resource. These emission estimates do not include emissions produced from purchased power or include a reduction in emissions for off-system sales. The Company expects its greenhouse gas emissions intensity from owned and controlled generation to fall from 0.36 short tons per MWh to 0.24 short tons per MWh with the current resource mix and the generation identified in the PRS[6].

Figure 8.9: Avista Owned and Controlled Resource's Greenhouse Gas Emissions



Greenhouse gas policy has a clear impact on Avista's future resource mix. Absent carbon policy, cumulative greenhouse gas emissions over the 20-year IRP timeframe would be 18 percent higher, with the difference growing each year of the forecast. By 2031, annual emissions would be 29 percent higher without carbon mitigation. The gray area illustrates these differences in Figure 8.9.

Efficient Frontier Analysis

Efficient frontier analysis is the backbone of the Preferred Resource Strategy. PRiSM helps develop the efficient frontier by simulating the costs and risks of several different resource portfolios. The analysis illustrates the relative performance of potential portfolios to each other on a cost and risk basis. Thought of a different way, the curve represents the least-cost strategy at each risk level. The PRS analyses examined the following portfolios, as detailed here and in Figure 8.10:

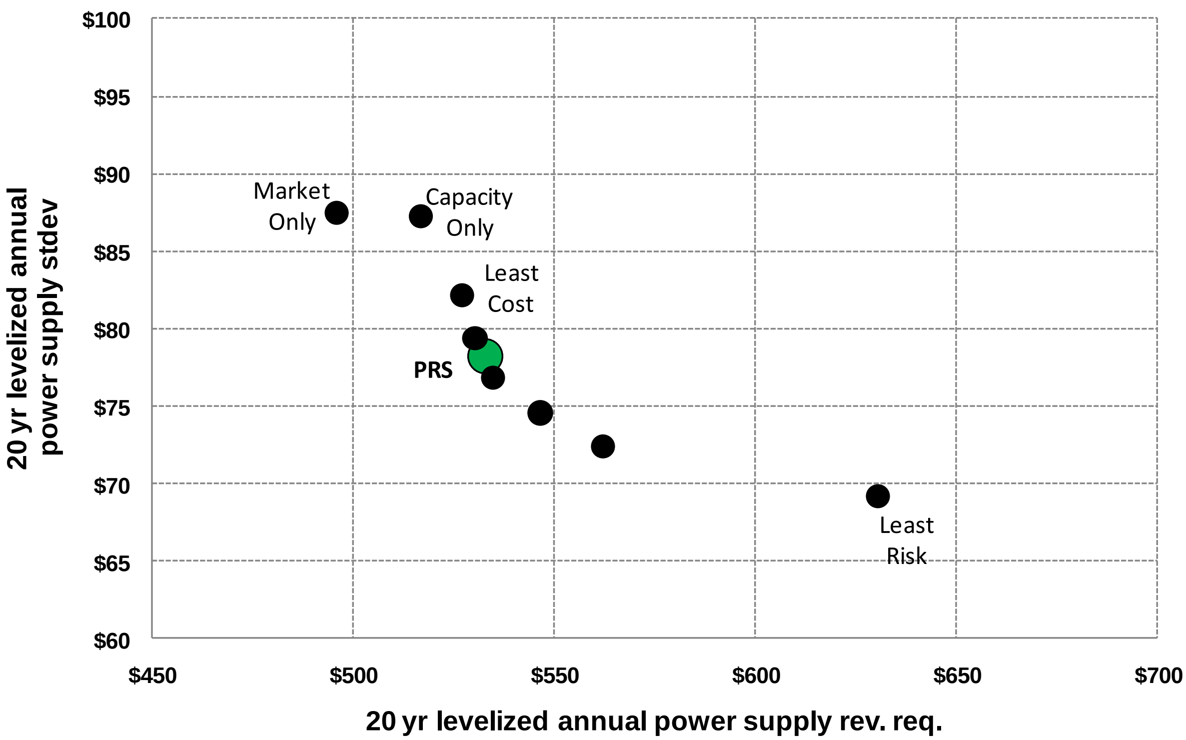
- **Market Only**: All resource deficits met with spot market purchases.
- **Capacity Only**: Only capacity deficits met with new resources. Energy and RPS requirements ignored.

[6] Greenhouse gas emissions are not included for the Kettle Falls plant because biomass is a carbon neutral resource.

- **Least Cost**: All capacity, energy and RPS requirements met with new least-cost resources. This portfolio ignores power supply expense volatility in favor of lowest cost resources.
- **Least Risk**: All capacity, energy and RPS requirements met with least-risk resources. This portfolio ignores the overall cost of the selected portfolio in favor of minimizing risk.
- **Efficient Frontier:** All capacity, energy and RPS requirements met with sets of intermediate portfolios between the least risk and least cost options.
- **Preferred Resource Strategy**: All capacity, energy and RPS requirements met while recognizing both the overall cost and risk inherent in the portfolio.

Figure 8.10 presents the Efficient Frontier. The x-axis is the levelized nominal cost per year for power supply costs and the y-axis is the levelized standard deviation of power supply costs.

Figure 8.10: Expected Case Efficient Frontier



The Market Only portfolio is least cost from a long-term financial perspective, but it has the highest level of risk. The strategy fails to meet capacity, energy, and RPS requirements with Company-controlled assets.

The Capacity Only strategy meets capacity requirements by adding gas-fired peaking plants, but wholesale market purchases displace them in most hours. This strategy does not meet RPS requirements and does not decrease power supply cost volatility, except at the tail of the distribution. The Least Cost strategy meets capacity, energy and RPS requirements at the lowest possible cost by adding gas-fired peaking plants and minimum levels of wind generation to meet Washington State RPS requirements. The Least Risk strategy substantially replaces gas-fired peaking plants with gas-fired combined-cycle combustion turbines, increases the quantity of wind resources, and adds solar resources to the mix.

All portfolios along the efficient frontier are the least cost portfolio for a given level of risk and portfolio constraints. The decision to select a particular portfolio along the efficient frontier curve focuses on volatility reductions gained by spending more capital. Avista management determines the ultimate selection of the PRS over other potential resource strategies in an effort to balance overall long-term customer costs with the risks of year-over-year expense variability. The PRS includes 1.2 percent more costs on average and 4.5 percent less volatility compared to the Least Cost portfolio.

Avoided Costs

The efficient frontier methodology can determine the avoided cost of new resource additions. There are two avoided cost calculations for this IRP; one for energy efficiency and one for new generation resources.

Avoided Cost of Conservation

Three portfolios are required to estimate the supply-side cost components necessary to estimate the avoided cost for conservation. The differences between each portfolio sum to the avoided cost of conservation:

- **Market Only:** This resource portfolio includes no new resource additions and the incremental cost of new power supply is the cost to buy power from the short-term market. The price difference between the Expected Case and the Unconstrained Carbon scenario is the greenhouse gas policy cost.
- **Capacity Only:** This resource portfolio builds new resource capacity to meet resource deficits to meet peak load. The difference between the Market Only and Capacity Only strategies equals the capacity value of the new resources. This estimate typically shows the incremental cost divided by the incremental kilowatts of installed capacity. For this example the $/kW adder is translated to $/MWh assuming a flat energy delivery.
- **Pre-Preferred Resource Strategy:** This resource portfolio is similar to the PRS resource mix assuming the Company does not pursue the conservation resource.

Table 8.5 shows the 20-year levelized avoided cost of conservation. The avoided cost for conservation includes value only for those periods realizing avoided costs. For example, the avoided costs of conservation programs only include a capacity value in the years where the Company is short capacity. Further, the market component (Energy Forecast) applies to each conservation program depending upon the timing of energy delivery. For example, an air conditioning program receives an energy value depending upon prices in the summer months when actual energy savings occur.

Table 8.5: Nominal Levelized Avoided Costs ($/MWh)

	2012-2031
Energy Forecast	52.86
Carbon Adder Forecast	17.64
Capacity Value	10.51
Risk Premium	7.38
Total	**88.39**

I-937 requires that the avoided costs used for conservation include additional items beyond the actual cost of avoided energy and capacity. Avoided costs increase by 10 percent to bias the IRP toward a preference for conservation. Additionally, reduced transmission and distribution losses, and operations and maintenance are also included. The following formula identifies the costs included in the avoided cost for energy efficiency measures.

$$\{(E + PC + R) * (1 + P)\} * (1 + L) + DC * (1 + L)$$

Where:

E = Market energy price. The price calculated with AURORAxmp is $70.50 per MWh and includes projected greenhouse gas costs.

PC = New resource capacity savings. This value is calculated using PRiSM and is estimated to be $10.51 per MWh.

R = Risk premium to account for RPS and rate volatility reductions. This PRiSM-calculated value is $7.38 per MWh.

P = Power Act preference premium. This is the additional 10 percent premium given as a preference towards energy efficiency measures.

L = Transmission and distribution losses. This component is 6.1 percent based on Avista's estimated system average losses.

DC = Distribution capacity savings. This value is approximately $10/kW-year or $1.14 per MWh.

The following calculation shows the estimated levelized avoided cost for a theoretical conservation program that reduces load by one megawatt each hour of the year:

$$\{[(52.86 + 17.64 + 10.51 + 7.38) * (1 + 10\%)] * (1 + 6.1\%) + [1.14 * (1 + 6.1\%)]\}$$
$$= \$104.37 \text{ per MWh}$$

Preferred Resource Strategy Avoided Costs

An avoided cost calculation for supply-side resources is developed using conservation avoided cost estimates and methods, and final PRS data. However, the avoided cost values for generation resources represent a portfolio including conservation measures and excluding greenhouse gas emission adders.[7] The risk component of the avoided cost includes renewable energy credits and the difference in cost between combined and simple cycle CTs to reduce Avista's market risk. See Table 8.6 for the prices per MWh. The 20-year levelized cost equates to $84.64 per MWh.

Table 8.6: Preferred Resource Strategy Avoided Cost ($/MWh)

Year	Energy	Capacity	Risk	Total
2012	41.19	0.00	0.00	41.19
2013	46.58	0.00	15.20	61.78
2014	49.73	0.00	16.21	65.93
2015	46.76	0.00	17.28	64.04
2016	48.20	0.00	18.42	66.62
2017	51.15	0.00	19.64	70.79
2018	52.91	0.00	20.94	73.85
2019	52.97	16.16	22.33	91.46
2020	53.25	17.52	23.81	94.58
2021	54.45	17.00	25.39	96.83
2022	56.15	16.71	27.07	99.93
2023	57.82	17.18	28.86	103.86
2024	56.89	17.24	30.77	104.90
2025	56.80	17.16	32.81	106.77
2026	58.82	17.42	34.98	111.23
2027	60.36	17.72	37.30	115.38
2028	63.08	18.86	39.77	121.71
2029	64.51	18.54	42.41	125.45
2030	66.29	18.21	45.21	129.71
2031	68.89	17.70	48.21	134.79

New Resource Avoided Costs

Avoided costs are updated as new information becomes available, including changes to market prices, loads and resources. As such, Table 8.7 represents avoided costs after the acquisition of the Palouse Wind project. The updated avoided cost schedule is significantly lower than the preliminary value due substantially to the elimination of the risk premium. The risk premium is not included in the updated avoided cost table for three reasons. First, the largest component of the risk premium is the value of meeting environmental mandates. The risk premium reflects those resources meeting Washington state renewable performance standard, but there is no guarantee that a new resource will meet the requirements. Further, Avista's regulatory commissions have

[7] No further greenhouse gas mitigation policies beyond current state and federal regulations are included. As such, the resource avoided cost calculation does not include this adder. Only when state or federally imposed greenhouse gas costs are assessed on electric generation will the carbon adder be included in avoided costs.

not ruled that environmental benefits (i.e., renewable energy credits) from Public Utility Regulatory Policy Act of 1978 (PURPA) resources are owned by the purchasing utility. Similarly, the remaining portion of reduced risk is from the benefits of a combined-cycle combustion turbine relative to a simple-cycle combustion turbine. As with environmental attributes, there is no guarantee that a PURPA or other resource will include this benefit. Quantifying the risk benefits requires resource-specific evaluations through Avista's IRP models is part of a negotiated PURPA contract. The updated 20-year levelized avoided cost is $61.46 per MWh.

Table 8.7: Updated Annual Avoided Costs ($/MWh)

Year	Energy	Capacity	Total
2012	41.19	0.00	41.19
2013	46.58	0.00	46.58
2014	49.73	0.00	49.73
2015	46.76	0.00	46.76
2016	48.20	0.00	48.20
2017	51.15	0.00	51.15
2018	52.91	0.00	52.91
2019	52.97	16.16	69.13
2020	53.25	17.52	70.77
2021	54.45	17.00	71.44
2022	56.15	16.71	72.86
2023	57.82	17.18	75.00
2024	56.89	17.24	74.12
2025	56.80	17.16	73.96
2026	58.82	17.42	76.24
2027	60.36	17.72	78.08
2028	63.08	18.86	81.94
2029	64.51	18.54	83.05
2030	66.29	18.21	84.50
2031	68.89	17.70	86.59

Preferred Resource Strategy

Earlier in this chapter, the PRS and summary levelized costs and risk were illustrated and compared to portfolios along the efficient frontier. This section provides more detail about the PRS, the associated financial risks of the PRS, the cost of its resultant emissions, and an index of resultant power supply expenses.

Capital Spending Requirements

One of the major assumptions in this IRP is that Avista finances and owns all new resources. Using this assumption, and the resources identified in the PRS, the first capital addition to rate base is in 2013 for distribution feeder upgrades, followed by additional capital needs for PRS wind development[8]. Wind or other generation

[8] Avista acquired the Palouse Wind Project through a Purchase Power Agreement and this capital addition is no longer needed.

resources acquired via a power purchase agreement may reduce expected PRS capital spending. Distribution feeder upgrades may begin in 2012 depending upon operational availability of resources needed for the work, but 2013 will be the first full year of commercial operations.

The capital cash flows in Table 8.8 include allowance for funds used during construction (AFUDC) and account for tax incentives and sales taxes. Costs in Table 8.7 are shown when capital would be placed in rate base, rather than when capital is actually spent. The present value of the required investment is just over $0.84 billion and the nominal total capital expense is $1.7 billion over the IRP timeframe.

Table 8.8: PRS Rate Base Additions from Capital Expenditures (Millions of Dollars)[9]

Year	Investment	Year	Investment
2012	0	2022	6
2013	243	2023	6
2014	6	2024	448
2015	6	2025	0
2016	6	2026	0
2017	4	2027	461
2018	7	2028	0
2019	77	2029	0
2020	90	2030	74
2021	251	2031	0
2012-21 Total	**690**	**2022-31 Totals**	**994**

Annual Power Supply Expenses and Volatility

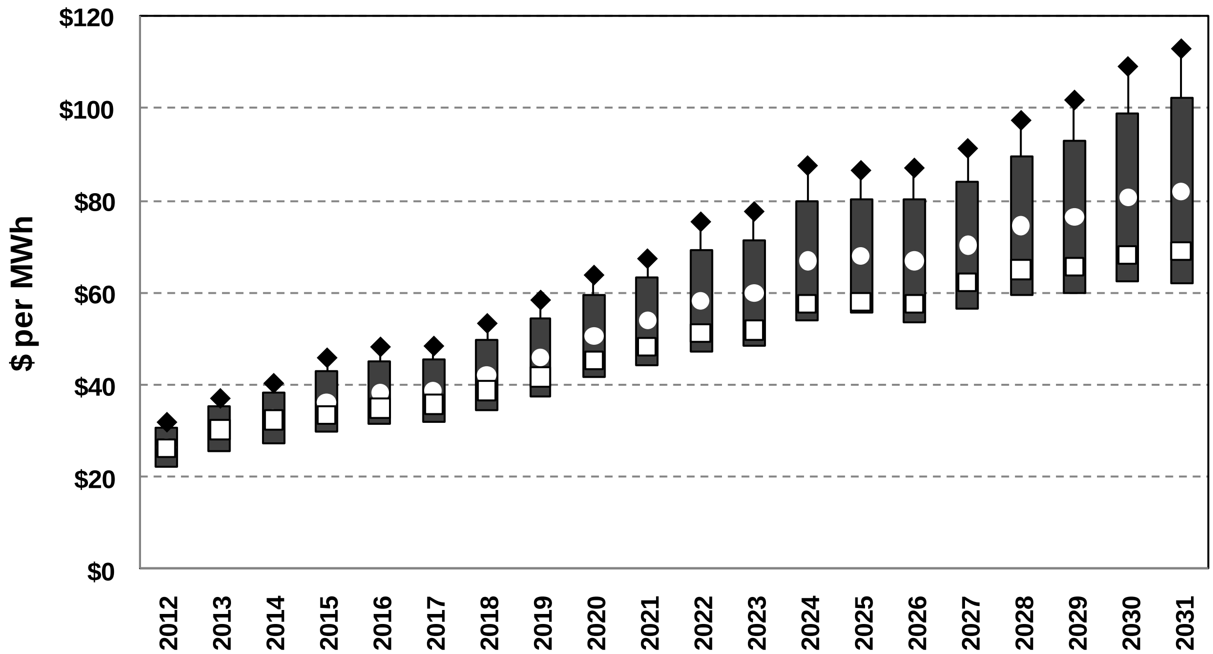
The PRS variance analysis tracks fuel, variable O&M, emissions, and market transaction costs for the existing resource portfolio. These costs are captured for each of the 500 iterations of the Expected Case risk analysis. In addition to existing portfolio costs, new resource capital, fuel, O&M, emissions, and other costs are tracked to provide a range of potential costs to serve future loads. Figure 8.11 shows expected PRS costs modeled through 2031 as the white circle (Nominal). In 2012, costs are expected to be $26 per MWh. The 80 percent confidence interval, represented as the black bar, ranges between $22 and $31 per MWh. The black diamonds in the figure represent the TailVar 90 risk level, or the average of the top 10 percent of the worst outcomes; the 2010 TailVar cost is $32 per MWh, or $6 per MWh above the expected value.

Power supply costs increase with natural gas and greenhouse gas price increases. Uncertainty increases over time and the confidence interval band expands. The white boxes in Figure 8.11 represent the cost per MWh without greenhouse gas costs. For example, in 2020 the average system costs would be 8.8 percent lower without carbon

[9] By acquiring a PPA for the Palouse Wind project, the Company forgoes the large capital investment shown in 2013.

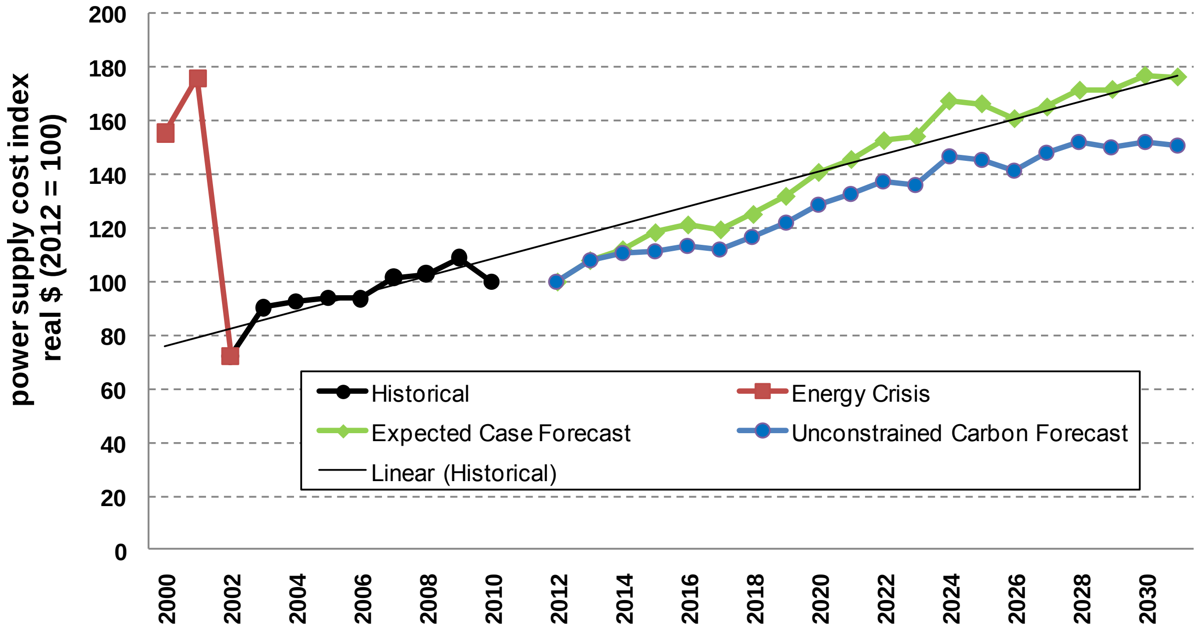
mitigation. The expected levelized cost for the expected case is $48.59 per MWh and $43.73 per MWh (10 percent lower) without greenhouse gas costs.

Figure 8.11: Power Supply Expense Range



A common question regarding IRPs is what will be the change to power supply costs over the time horizon of the plan. Figure 8.12 illustrates expected power supply cost changes compared to historical power supply costs under the Preferred Resource Strategy. It shows that power supply costs, on a per-MWh basis have increased 4.1 percent per year over inflation between 2002 and 2010. This 4.1 percent annual growth rate increase is in Figure 8.12 as a linear black line. By 2021, absent greenhouse gas emissions costs, power supply costs are expected to be 32 percent higher than 2010, but up to 41 percent higher with the addition of greenhouse gas emissions costs for an annual growth rate of 2.6 percent and 3.8 percent respectively.

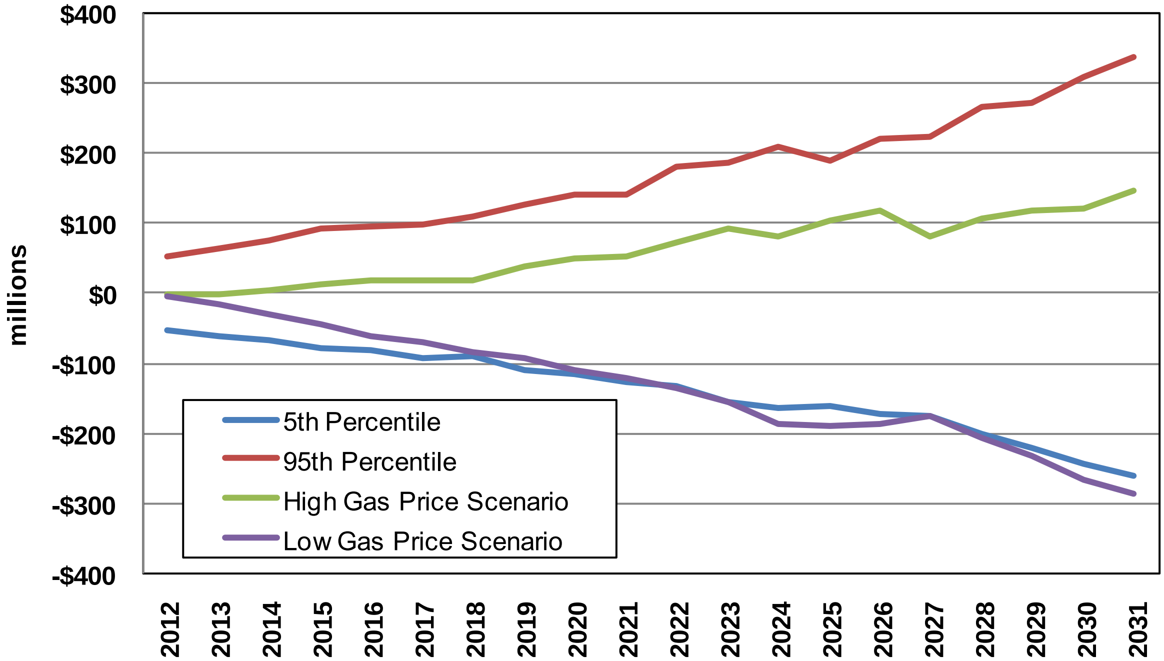
Figure 8.12: Real Power Supply Expected Rate Growth Index $/MWh (2012 = 100)



Natural Gas Price Risk

The Market Analysis chapter showed the results of high and low natural gas price forecasts. The PRS includes 752 MW of natural gas-fired resources and exposes Avista's customers to increasing levels of natural gas price risk. This section uses natural gas price forecast scenarios, including changes to expected greenhouse gas prices, to explain the range of costs resulting from the PRS. Figure 8.13 shows the total portfolio cost range using different natural gas scenarios compared to the expected cost of the PRS. The low natural gas price scenario reduces expected costs by 19.5 percent and the high gas price scenario increases costs by 8.7 percent on a present value basis. Lower natural gas prices have greater effect on prices than higher prices as the Using stochastic model results, rather than the deterministic scenarios, illustrates risk exposure to the wholesale market. The 5th and 95th percentiles reflect variability from natural gas and other variables. The low natural gas price scenario is reflective of a low cost future, but the high natural gas price scenario does not reflect the potential cost excursions that could affect the PRS that is not natural gas price related.

Figure 8.13: Power Supply Cost Sensitivities

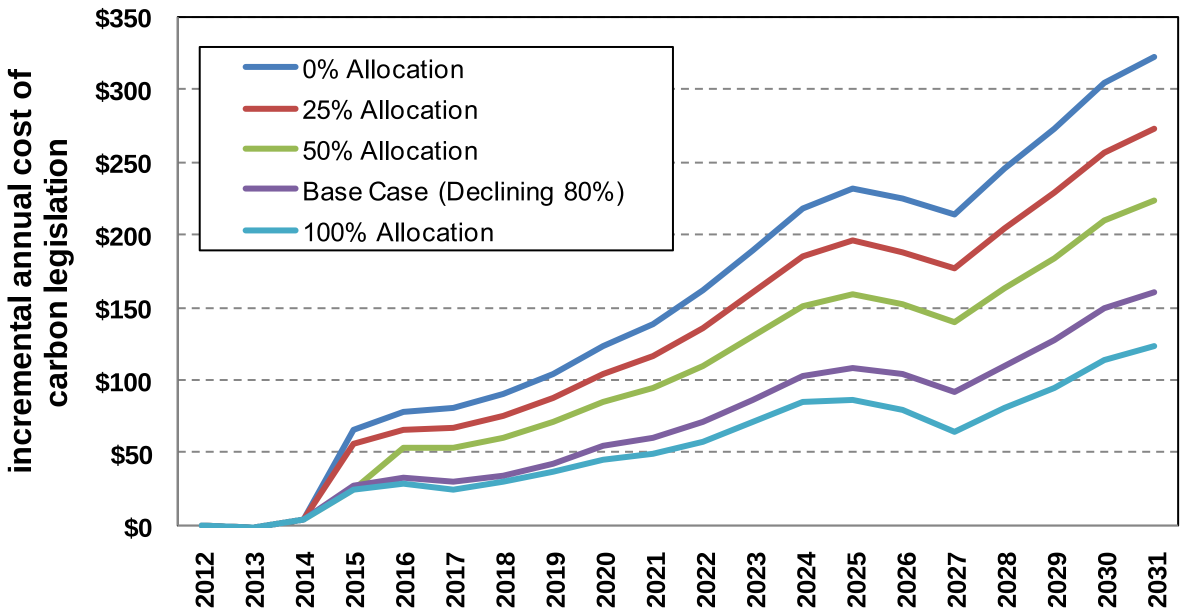


Greenhouse Gas Costs

Avista anticipates some form of federal greenhouse gas policy, although the exact nature, timing and scope are unknown. As described in the Market Analysis chapter, four potential greenhouse gas policies are modeled to estimate marginal electricity costs. The estimate of greenhouse gas emission costs depends on the number of free allowances provided by the government. Figure 8.14 illustrates the range of total annual greenhouse gas costs as the percent of free credits allocated to Avista are changed. For example, if no credits are allocated to Avista in 2022, Avista's cost to serve customers will be $91 million ($162 million in total) higher than the Expected Case where 80 percent of the credits are free and mitigation costs $71 million.

A reduction in output from the Colstrip generators, increased natural gas prices and increased wholesale electricity prices drive most of the greenhouse gas policy cost increases. In the marketplace, low marginal cost coal-fired plants dispatch less, or even turn off, and higher marginal cost natural gas-fired resources replaces their output. The cost of natural gas resources is higher than it would be absent greenhouse gas costs because of increased demand for gas-fired resources. These additional costs represent up to 11 percent of total power supply expenses in the Expected Case.

Figure 8.14: Greenhouse Gas Related Power Supply Expense



Efficient Frontier Comparison of Greenhouse Gas Policies

Three stochastic market studies studied the cost of different greenhouse gas policies: 1) the Expected Case, 2) Unconstrained Carbon, and 3) Mandatory Coal Retirement. These three stochastic market forecasts were than assumed to be potential markets in PRiSM and an efficient frontier for each market future was created, as shown in Figure 8.15. Table 8.9 provides more details about the study results. The PRS portfolio is the same in the Expected Case and the Unconstrained Carbon Case, but the Mandatory Coal Retirement Case retires Colstrip Unit 3 in 2023 and Unit 4 in 2026, replacing them with a CCCT. Colstrip decommissioning costs is not included in figures.

Figure 8.15: Efficient Frontier Comparison

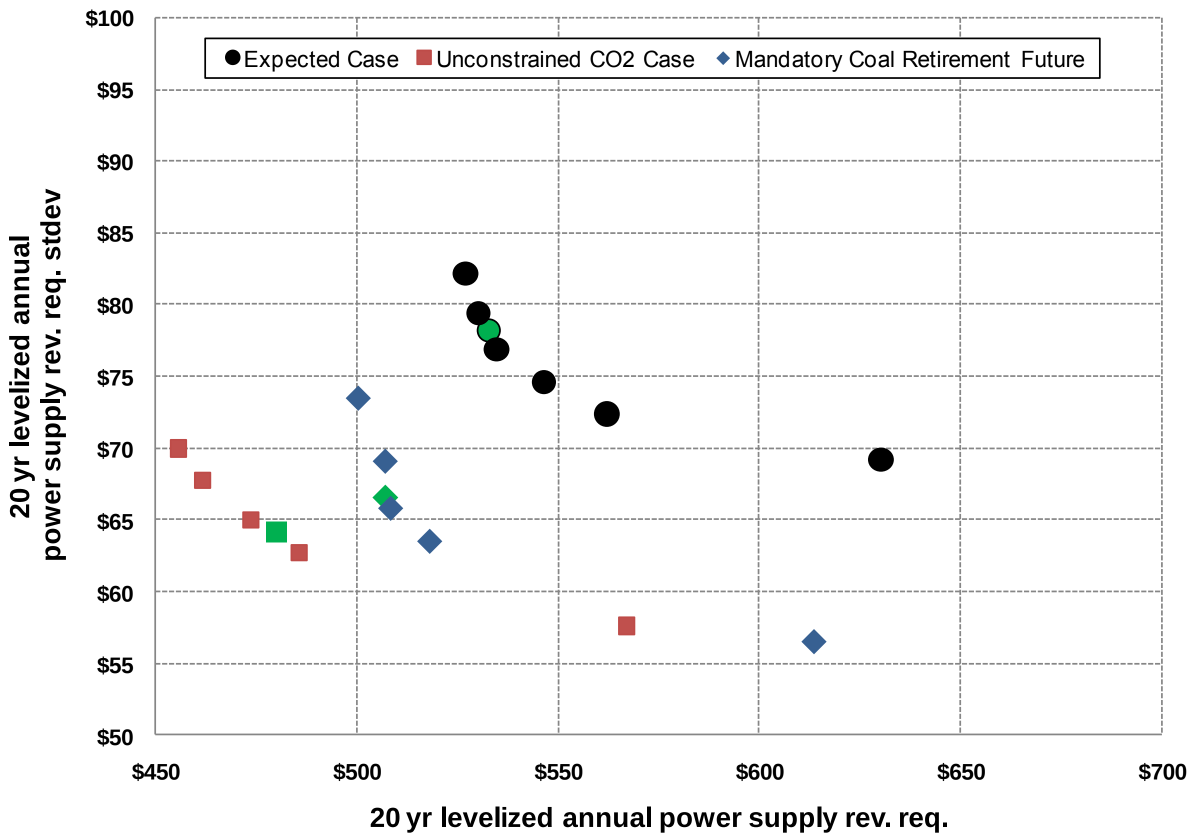


Table 8.9: Preferred Portfolio Cost and Risk Comparison (Millions $)

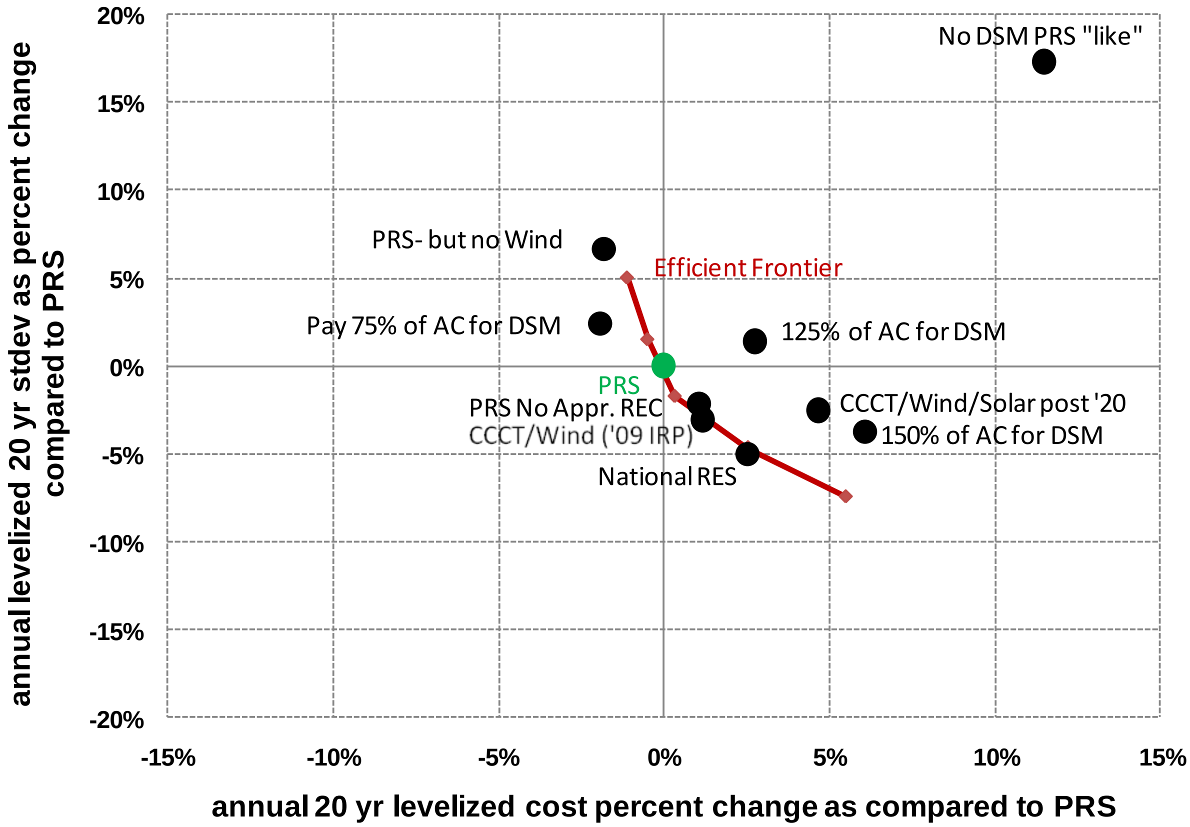
	Expected Case	Unconstrained Carbon	Coal Retirement
2012-2022 Cost NPV	3,094	2,886	2,937
2012-2031 Cost NPV	5,735	5,168	5,458
2022 Expected Cost	636	564	576
2022 Stdev	91	68	71
2022 Stdev/Cost	14%	12%	0
2022 CO_2 Emissions (000's)	2,894	3,498	3,752
2031 CO_2 Emissions (000's)	2,972	4,177	3,560

Portfolio Scenarios

The efficient frontier analysis creates resource portfolios for alternative levels of risk and cost. Avista's management selected the PRS to balance costs and risk inherent in our resource portfolio. The following list of portfolios shows details of alternatives to the PRS, either along the efficient frontier or "hand-picked" so that the costs of these choices could be considered. Figure 8.16 illustrates the levelized cost percent change and the levelized annual standard deviation percent change for each of the portfolios in comparison to the PRS.

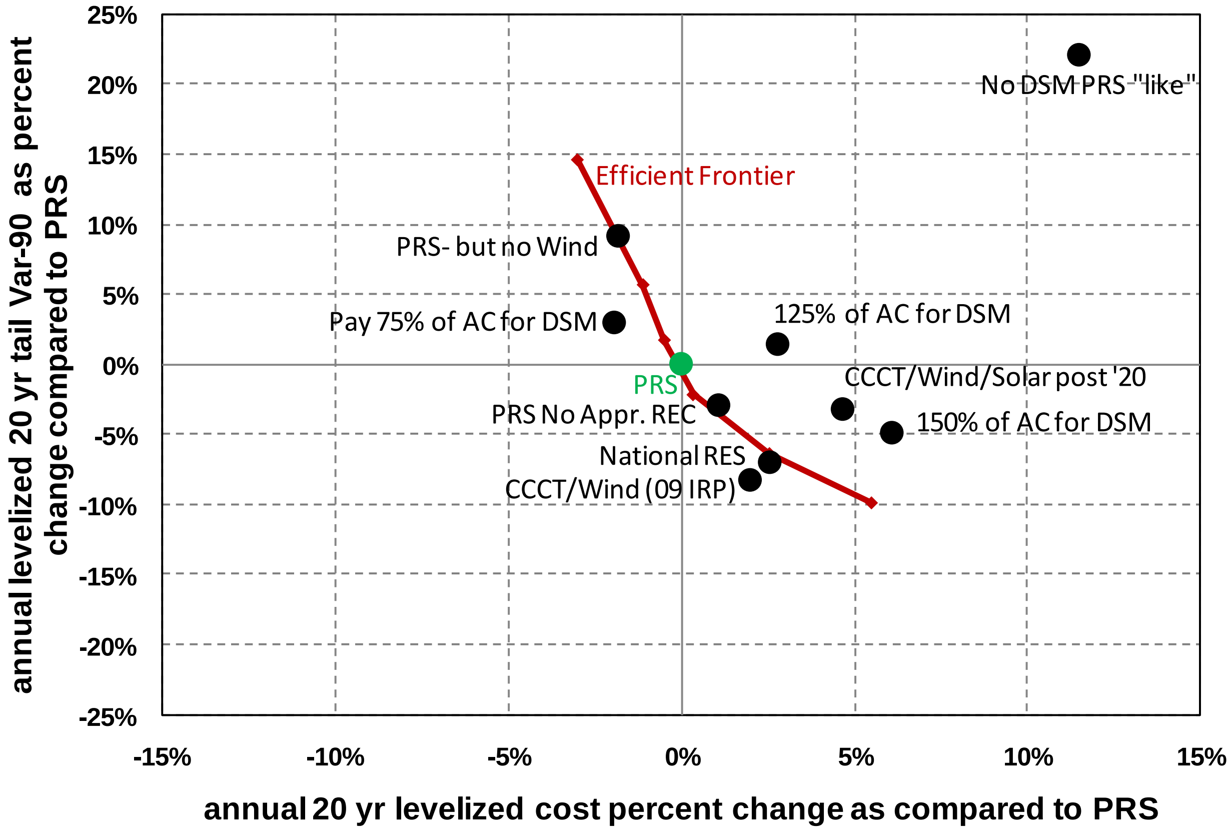
Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 192 of 1069

Figure 8.16: Efficient Frontier Comparison



The Technical Advisory Committee requested Avista to show the efficient frontier and other portfolios using Tail Var 90 rather than standard deviation as a measure of risk (Figure 8.17). The TAC wanted to know if we measured risk differently would the Company draw a different conclusion on its resource choice. The result of this study shows using Tail Var 90 changes the magnitude of risk as compared to the standard deviation, but the PRS remains the Company's best choice. Using Tail Var 90 magnifies the risk savings of moving from Simple Cycle CTs to Combined Cycle CTs, as the standard deviation method shows a 5 percent reduction in risk for 2 percent more in cost, while the Tail Var 90 method shows a 15 percent risk reduction for the same cost increase.

Figure 8.17: Efficient Frontier Comparison with Tail Var90



The following section describes the resources selected in each of the portfolios designated in Figure 8.16. Table 8.10 summarizes the PRS.

Table 8.10: Preferred Resource Strategy

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	166	0	46	**166**	**212**
CCCT (Nameplate)	0	0	270	270	**0**	**540**
Thermal Upgrades	0	4	0	0	**4**	**4**
Wind (Energy)	35	36	0	0	**71**	**71**
Solar (Energy)	0	0	0	0	**0**	**0**
Conservation (Energy)	57	75	91	87	**133**	**310**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 194 of 1069

Least Cost Portfolio

The Least Cost portfolio is the PRiSM model's resulting portfolio that meets capacity, energy and RPS needs at the least expected cost. This portfolio is a combination of wind and natural gas-fired SCCT generation. Table 8.11 illustrates the generation resources added in the Least Cost portfolio.

Table 8.11: Least Cost Portfolio

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	83	249	415	**83**	**747**
CCCT (Nameplate)	0	0	0	0	**0**	**0**
Thermal Upgrades	0	0	0	0	**0**	**0**
Wind (Energy)	35	24	12	0	**59**	**71**
Solar (Energy)	0	0	0	0	**0**	**0**
Conservation (Energy)	57	75	91	87	**133**	**310**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

Least Risk Portfolio

The Least Risk portfolio is the portfolio selected by the PRiSM model meeting all capacity, energy and RPS needs at the least expected risk. PRiSM measures risk using levelized annual power supply cost variance. This portfolio is a combination of wind, solar, natural gas-fired SCCT and CCCT generation resources. Table 8.12 illustrates the resources added in the Least Risk portfolio.

Table 8.12: Least Risk Portfolio

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	0	3	184	**0**	**187**
CCCT (Nameplate)	0	270	270	0	**270**	**540**
Thermal Upgrades	0	3	14	0	**3**	**17**
Wind (Energy)	61	37	0	0	**98**	**98**
Solar (Energy)	25	27	6	6	**52**	**64**
Conservation (Energy)	57	75	91	87	**133**	**310**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

50/50Cost and Risk Midpoint Portfolio

The 50/50 Cost and Risk Midpoint portfolio is the PRiSM model's portfolio selection that meets capacity, energy and RPS needs at the midpoint between the least risk and least cost resource portfolios. This resource portfolio is a combination of wind, solar and natural gas-fired SCCT and CCCT generation. Table 8.13 illustrates the resources added in this portfolio.

Table 8.13: 50/50 Cost and Risk Midpoint Portfolio

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	83	0	94	**83**	**177**
CCCT (Nameplate)	0	0	270	270	**0**	**540**
Thermal Upgrades	0	0	4	0	**0**	**4**
Wind (Energy)	35	23	23	12	**58**	**93**
Solar (Energy)	0	0	0	9	**0**	**9**
Conservation (Energy)	57	75	91	87	**133**	**310**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

75/25 Cost and Risk Portfolio
The 75/25 Cost and Risk portfolio is the PRiSM model's portfolio selection that meets capacity, energy and RPS needs at the midpoint between the least cost portfolio and the 50/50 portfolio. This portfolio is similar to the PRS with a combination of wind and natural gas-fired SCCT generation. Table 8.14 illustrates the resources added under the 75/25 Cost and Risk portfolio.

Table 8.14: 75/25 Cost Risk Portfolio

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	83	249	0	**83**	**332**
CCCT (Nameplate)	0	0	0	540	**0**	**540**
Thermal Upgrades	0	0	0	0	**0**	**0**
Wind (Energy)	35	23	12	12	**58**	**82**
Solar (Energy)	0	0	0	0	**0**	**0**
Conservation (Energy)	57	75	91	87	**133**	**310**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

25/75 Cost and Risk Portfolio
The 25/75 Cost Risk portfolio is the PRiSM model's portfolio selection meeting capacity, energy and RPS needs at the midpoint between the Least Risk portfolio and the 50/50 Cost and Risk portfolio. The 25/75 Cost and Risk portfolio includes a combination of wind, solar, and natural gas-fired SCCT and CCCT generation. Table 8.15 illustrates the resources added in the 25/75 Cost and Risk portfolio.

Table 8.15: 25/75 Cost Risk Portfolio

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	83	0	0	**83**	**83**
CCCT (Nameplate)	0	0	540	270	**0**	**810**
Thermal Upgrades	0	0	4	0	**0**	**4**
Wind (Energy)	35	23	37	0	**58**	**95**
Solar (Energy)	0	0	0	5	**0**	**5**
Conservation (Energy)	57	75	91	87	**133**	**310**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

PRS without Apprentice Credits

The PRS without Apprentice Credits portfolio represents a resource strategy that assumes the Company is unable to contract for apprentice labor for new wind resources and therefore the acquisitions do not qualify for the 20 percent REC credit adder in I-937. This portfolio is a similar to the PRS, but includes 25 aMW of additional wind energy. Where wind resources have an average capacity factor of 31 percent, Avista would need to procure an additional 80 MW of nameplate wind capacity. Table 8.16 illustrates the PRS without Apprenticeship Credits portfolio resource additions.

Table 8.16: PRS without Apprentice Credits

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	166	0	46	**166**	**212**
CCCT (Nameplate)	0	0	270	270	**0**	**540**
Thermal Upgrades	0	4	0	0	**4**	**4**
Wind (Energy)	35	49	12	0	**84**	**96**
Solar (Energy)	0	0	0	0	**0**	**0**
Conservation (Energy)	57	75	91	87	**133**	**310**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

2009 IRP Portfolio

The PRS from the 2009 IRP included 350 MW of wind generation and 750 MW of gas-fired CCCT generation. The 2009 IRP Portfolio emulates the 2009 PRS with 2011 IRP adjustments for lower load projections and lower natural gas and market electricity prices. Table 8.17 illustrates the resource additions under the 2009 IRP Portfolio.

Table 8.17: 2009 IRP Portfolio

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	0	0	0	**0**	**0**
CCCT (Nameplate)	0	270	270	270	**270**	**810**
Thermal Upgrades	0	0	0	0	**0**	**0**
Wind (Energy)	44	44	15	0	**87**	**102**
Solar (Energy)	0	0	0	0	**0**	**0**
Conservation (Energy)	57	75	91	87	**133**	**310**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

PRS without Wind Portfolio
The PRS without Wind Portfolio illustrates the cost of wind additions to the PRS. This portfolio is the same as the 2011 PRS, but excludes the qualified renewable generation required by the Energy Independence Act. Table 8.18 illustrates the resources added under the PRS without Wind Portfolio.

Table 8.18: PRS without Wind Portfolio

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	166	0	46	**166**	**212**
CCCT (Nameplate)	0	0	270	270	**0**	**540**
Thermal Upgrades	0	4	0	0	**4**	**4**
Wind (Energy)	0	0	0	0	**0**	**0**
Solar (Energy)	0	0	0	0	**0**	**0**
Conservation (Energy)	57	75	91	87	**133**	**310**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

CCCT with Solar after 2015 Portfolio
The CCCT with Solar after 2015 Portfolio illustrates the additional cost of using solar, rather than wind, to meet Washington's I-937 requirements. Table 8.19 shows the resources added under the CCCT with Solar after 2015 Portfolio.

Table 8.19: CCCT with Solar after 2015 Portfolio

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	0	0	0	**0**	**0**
CCCT (Nameplate)	0	0	270	540	**0**	**810**
Thermal Upgrades	0	7	3	0	**10**	**10**
Wind (Energy)	36	0	0	0	**36**	**36**
Solar (Energy)	0	26	7	0	**26**	**33**
Conservation (Energy)	57	75	91	87	**133**	**310**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

National Renewable Energy Standard Portfolio

There have been several attempts to implement a federal renewable energy standard. The National Renewable Energy Standard Portfolio illustrates changes to the PRS needed to meet renewable requirements at the national level. Depending on the legislation, Avista may be required to secure an additional 106 aMW[10] to cover the Company's retail loads in the Idaho service territory. The actual level of wind required under a federal renewable energy standard would depend upon how the legislation treats our existing renewable resources and how it considers hydroelectric generation.[11] The portfolio assumes that hydroelectric netting would be included and that the federal law would not supersede state law. We did not model a national energy standard, as proposed by President Obama, because the PRS most likely would meet the standard because Avista is already subject to Washington's emission performance standards. Table 8.20 illustrates the resources added under the National Renewable Energy Standard portfolio.

Table 8.20: National Renewable Energy Standard

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	166	0	46	**166**	**212**
CCCT (Nameplate)	0	0	270	270	**0**	**540**
Thermal Upgrades	0	4	0	0	**4**	**4**
Wind (Energy)	47	47	35	49	**93**	**177**
Solar (Energy)	0	0	0	1	**0**	**1**
Conservation (Energy)	57	75	91	87	**133**	**310**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

[10] 106 aMW is equal to 341 MW of nameplate capacity wind generation at a 31 percent capacity factor.
[11] Proposed federal legislation has allowed utilities to "net" hydroelectric generation against retail loads prior to calculating RPS obligations.

PRS without Conservation Portfolio

The PRS without Conservation Portfolio illustrates the benefits of conservation. This portfolio meets capacity, energy and RPS needs in a similar manner as the PRS. Table 8.21 illustrates the resources added under the PRS without Conservation Portfolio.

Table 8.21: PRS without Conservation

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	83	212	83	97	**295**	**475**
CCCT (Nameplate)	0	0	270	545	**0**	**815**
Thermal Upgrades	7	0	0	3	**7**	**10**
Wind (Energy)	35	36	23	0	**71**	**94**
Solar (Energy)	0	0	0	0	**0**	**0**
Conservation (Energy)	0	0	0	0	**0**	**0**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

PRS Conservation Avoided Costs 25% Lower Portfolio

The PRS Conservation Avoided Costs 25% Lower Portfolio illustrates resulting changes to cost and risk if avoided costs for conservation was set at the avoided cost of generation resources, or if natural gas prices included in this IRP are too high. This portfolio represents conservation estimates without discretionary adders. Table 8.22 illustrates the resources added under this portfolio.

Table 8.22: PRS Conservation Avoided Costs 25% Lower

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	166	83	0	**166**	**249**
CCCT (Nameplate)	0	0	270	270	**0**	**540**
Thermal Upgrades	0	0	4	0	**0**	**4**
Wind (Energy)	35	24	23	0	**59**	**82**
Solar (Energy)	0	0	0	0	**0**	**0**
Conservation (Energy)	54	61	75	76	**115**	**266**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

PRS Conservation Avoided Costs 25% Higher Portfolio

The PRS Conservation Avoided Costs 25% Higher Portfolio illustrates the resource changes that would occur if Avista spent additional dollars toward the acquisition of additional conservation. This portfolio represents the added conservation at a spending level of an additional 25 percent and the resulting offset in supply-side resources. Table 8.23 illustrates the resources added under this portfolio.

Table 8.23: PRS Conservation Avoided Costs 25% Higher

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	166	83	0	**166**	**415**
CCCT (Nameplate)	0	0	0	270	**0**	**270**
Thermal Upgrades	0	4	4	0	**4**	**7**
Wind (Energy)	35	23	12	0	**58**	**70**
Solar (Energy)	0	0	0	0	**0**	**0**
Conservation (Energy)	61	83	95	94	**144**	**334**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

PRS Conservation Avoided Costs 50% Higher Portfolio

The PRS Conservation Avoided Costs 50% Higher Portfolio illustrates the resource changes that would occur if Avista spent an additional 50 percent on the acquisition of conservation resources. Table 8.24 illustrates the resources obtained in this portfolio.

Table 8.24: PRS Conservation Avoided Costs 50% Higher

Resource	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	46	0	83	**46**	**129**
CCCT (Nameplate)	0	0	270	270	**0**	**540**
Thermal Upgrades	0	0	4	0	**0**	**4**
Wind (Energy)	35	23	12	0	**58**	**70**
Solar (Energy)	0	0	0	0	**0**	**0**
Conservation (Energy)	62	91	103	94	**153**	**350**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

Resource Tipping Point Analysis

In many resource plans, a PRS is presented with a comparison to other portfolios to help illustrate cost and risk trade-offs. This IRP extends the portfolio analysis beyond this simple exercise by focusing on how the portfolio might change if key assumptions were changed. This provides an array of strategies in reaction to fundamentally different futures instead of a single strategy. This section identifies assumptions that could alter the PRS, such as changes to load growth, varying resource capital costs, hydroelectric upgrade opportunities, the emergence of other non-wind and non-solar renewable options, or an expansion of the region’s nuclear generation fleet.

Solar Capital Costs Sensitivity

The capital costs of photovoltaic solar generation significantly decreased since the 2009 IRP and the 30 percent Investment Tax Credit for solar generation was extended through the end of 2015. Solar generation still is not competitive with wind in the Northwest, even with lower capital costs and tax credits. A sensitivity analysis determined the price reduction that would be necessary to make photovoltaic solar generation competitive with wind generation. The analysis reduced solar capital costs in the year 2020 until the PRiSM model selected solar over wind. This analysis also assumed the double solar REC credit for I-937. The results of the study were that the capital costs for solar would need to decrease 53 percent, to $2,020/kW (2020 nominal dollars including AFUDC), in order to make solar competitive with wind generation.

CCCT Capital Cost Sensitivity

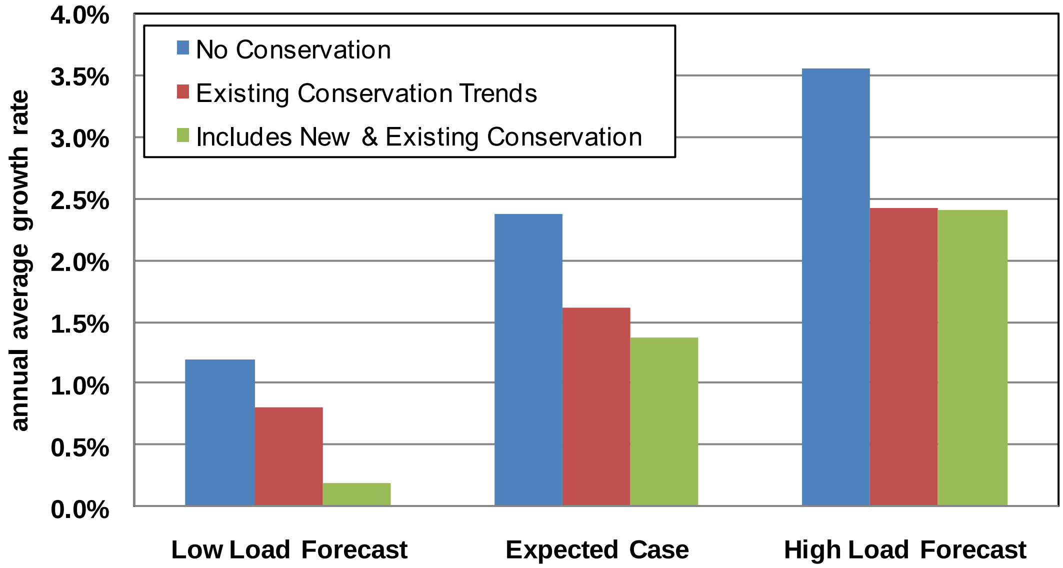
CCCTs were the lowest cost resource option in the 2009 IRP. SCCTs are again the lowest cost resource option, similar to all Avista IRPs prior to its 2009 IRP. A sensitivity analysis determined why CCCTs were more cost-effective than SCCTs in the 2009 IRP. The first test involved an analysis of capital costs. The model found that CCCT capital costs had to be 22 percent lower than forecasted in this IRP to be selected over SCCTs. Another indication of the change is that O&M cost estimates were lower in the 2009 IRP ($11/kW-year) as compared to the 2011 IRP ($16/kW-year). The 2009 IRP also assumed that a lower-cost water-cooled plant rather than an air-cooled plant would be developed. This IRP assumes an air-cooled CCCT due to the increasing difficulty in obtaining water rights near customer loads. Additional analysis could indicate that changes in the spark spread, fuel transportation costs, heat rates, or greenhouse gas policies could affect the selection of CCCTs over SCCTs more than changes in capital costs. Further, natural gas prices could affect this choice, such as lower or higher prices could affect this decision, to fully study this theory would require two additional stochastic studies and this scope of work would extend the timeline for this IRP's completion.

Load Forecast Alternatives

An important test in an IRP is its performance across varying load growth sensitivities. Avista's loads could grow faster with future development activity after the economy recovers, or could stagnate in a continued recession. This sensitivity analysis studies the impact to the PRS if loads grows faster or slower than the Expected Case estimate. Faster load growth will increase the need for capital and slower load growth will decrease the need for capital spending on new generation. This analysis focuses on understanding the changes in the timing of resource decisions based on changes in load growth.

Loads are expected to grow, net of conservation, at a rate of 1.37 percent over the IRP timeframe. The Low Load Growth scenario cuts the underlying load growth rate by 50 percent and the High Load Growth case increases expected load growth rate by 50 percent. The sensitivity analysis indicated that, net of conservation, the Low Load case's growth rate is 0.19% and the High Load Growth case is 2.4 percent. See Figure 8.18 for load forecast estimates in each case. The load forecast change is not linear since conservation will make up a greater amount of new load growth in the low case as conservation programs target existing load (85 percent of load growth). However, in a high case conservation only makes up 40 percent of load growth that is assumed to be code requirement driven energy efficiency. As a comparison, the Expected Case forecast assumes conservation meets 48 percent of new load.

Figure 8.18: Load Growth Scenario's Cost/Risk Comparison



The lower load growth case's resource strategy would not change near-term resource acquisitions (see Table 8.25), but would eliminate the need for some wind and gas-fired resources later in the IRP time horizon.

Table 8.25: Low Load Growth Resource Strategy

Resources	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	0	0	0	212	**0**	**212**
CCCT (Nameplate)	0	0	0	0	**0**	**0**
Thermal Upgrades	0	0	0	4	**0**	**4**
Wind (Energy)	35	12	24	0	**47**	**71**
Solar (Energy)	0	0	0	0	**0**	**0**
Conservation (Energy)	49	60	69	70	**108**	**247**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

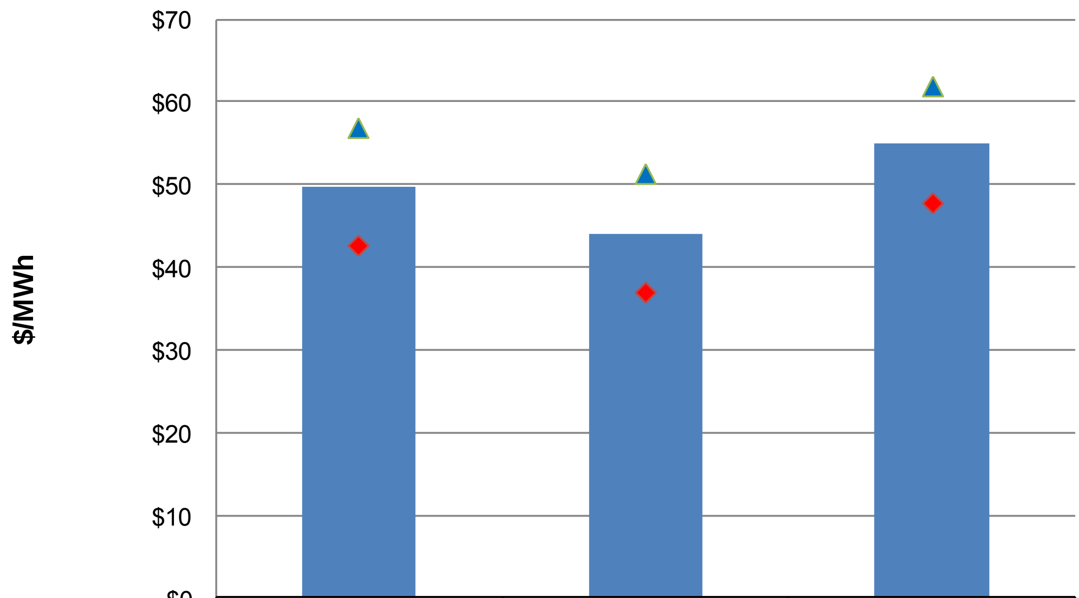
Table 8.26 shows the resource strategy with higher growth rates. The amount of wind acquisitions would increase by 22 aMW and additional peaking resources would be required to compensate for higher growth rates. In the later years of the study, additional gas-fired and wind generation resources would be needed to meet peak load growth and RPS requirements.

Table 8.26: High Load Growth Resource Strategy

Resources	2012-16	2017-21	2022-26	2027-31	First 10 Years	All 20 Years
SCCT (Nameplate)	83	298	83	46	**381**	**510**
CCCT (Nameplate)	0	0	270	540	**0**	**810**
Thermal Upgrades	4	6	0	0	**10**	**10**
Wind (Energy)	35	23	35	0	**58**	**93**
Solar (Energy)	0	0	0	1	**0**	**1**
Conservation (Energy)	71	94	122	156	**165**	**443**
Dist. Feeders (Energy)	8	3	2	1	**11**	**13**

Figure 8.19 shows the cost, and cost range, for each load growth scenario from a dollar per megawatt-hour perspective. The chart explains a positive correlation between load growth and the average cost to serve customers.

Figure 8.19: Load Growth Scenario's Cost/Risk Comparison



	Base Case	Low Load Growth	High Load Growth
Levelized Cost $/MWh	49.75	44.11	54.86
1 Sigma Lower	42.67	36.99	47.80
1 Sigma Higher	56.83	51.23	61.92

Summary

The Preferred Resource Strategy is the roadmap for a resource acquisition plan that which balances the tradeoff between cost and risk while preparing the Company to provide reliable electricity service to its customers. Table 8.27 provides a summary of the total resources selected for each of the portfolios discussed in this chapter. Distribution Feeder upgrades are included at the same level (13 aMW) in all portfolios but are not included in the table.

Table 8.27: Summary of Resource Portfolios

Portfolio	SCCT (Nameplate)	CCCT (Nameplate)	Thermal Upgrades	Wind (Energy)	Solar (Energy)	Conservation (Energy)
Preferred Resource Strategy	212	540	4	71	0	310
Least Cost	747	0	0	71	0	310
Least Risk	187	540	17	98	64	310
50/50 Cost Risk	177	540	4	93	9	310
75/25 Cost Risk	332	540	0	82	0	310
25/75 Cost Risk	83	810	4	95	5	310
PRS without Apprentice Credits	212	540	4	96	0	310
2009 PRS	0	810	0	102	0	310
PRS Without Wind	212	540	4	0	0	310
CCCT with Solar	0	810	10	36	33	310
National Renewable Energy Standard	212	540	4	177	1	310
PRS without Conservation	475	815	10	94	0	0
PRS Conservation A/C 25% Lower	249	540	4	82	0	266
PRS Conservation A/C 25% Higher	415	270	7	70	0	334
PRS Conservation A/C 50% Higher	129	540	4	70	0	350
Low Load Growth	212	0	4	71	0	247
High Load Growth	510	810	10	93	1	443

The IRP is a continual effort to select cost- and risk-minimizing resources complementing the Company's existing resource mix. Its results and insights help management and policy-makers formulate good decisions on behalf of ratepayers. The PRS includes a combination of conservation, efficiency improvements including feeder upgrades, hydroelectric upgrades, wind, and gas-fired simple and combined-cycle combustion turbines. The resource strategy identified in this report will change in response to new information, but Avista focuses decision making on near-term resource acquisitions where substantial changes concerning the data needed to make decisions are less likely to occur.

Table 8.28: Winter 18-Hour Capacity Position (MW) Net of Conservation with New Resources[12]

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
TOTAL LOAD OBLIGATIONS																				
Native Load (Net of Efficiency Programs)	-1,648	-1,670	-1,681	-1,688	-1,717	-1,744	-1,768	-1,785	-1,804	-1,823	-1,837	-1,856	-1,884	-1,918	-1,955	-1,985	-2,018	-2,053	-2,091	-2,132
Firm Power Sales	-242	-242	-211	-158	-158	-8	-8	-7	-7	-7	-7	-7	-6	-6	-6	-6	-6	-6	-6	-6
Total Requirements	**-1,890**	**-1,912**	**-1,892**	**-1,846**	**-1,875**	**-1,752**	**-1,776**	**-1,791**	**-1,811**	**-1,829**	**-1,844**	**-1,862**	**-1,890**	**-1,924**	**-1,962**	**-1,991**	**-2,024**	**-2,059**	**-2,097**	**-2,138**
RESOURCES																				
Firm Power Purchases	175	175	175	175	175	175	174	173	173	173	90	90	90	90	90	90	90	90	90	90
Hydro Resources	880	955	965	854	854	865	861	889	881	889	889	881	889	889	881	889	889	881	889	889
Base Load Thermals	895	895	895	895	895	895	895	895	895	895	895	895	895	895	895	606	606	606	606	606
Wind Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peaking Units	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242
Total Resources	**2,192**	**2,267**	**2,277**	**2,166**	**2,166**	**2,177**	**2,172**	**2,199**	**2,191**	**2,199**	**2,116**	**2,108**	**2,116**	**2,116**	**2,108**	**1,826**	**1,826**	**1,818**	**1,826**	**1,826**
Peak Position Before Reserves Planning	**302**	**355**	**385**	**319**	**291**	**425**	**396**	**407**	**380**	**369**	**272**	**245**	**225**	**191**	**146**	**-165**	**-198**	**-240**	**-271**	**-312**
RESERVES PLANNING																				
Required Operating Reserves	-162	-164	-163	-161	-164	-156	-159	-160	-162	-163	-169	-171	-173	-176	-180	-168	-169	-169	-170	-171
Available Operating Reserves	23	42	42	8	8	8	8	34	34	34	34	34	34	34	34	34	34	34	34	34
Planning Margin	-232	-235	-237	-239	-243	-247	-250	-253	-256	-258	-261	-263	-267	-272	-277	-282	-286	-291	-297	-302
Total Reserves Planning	**-371**	**-356**	**-358**	**-392**	**-398**	**-395**	**-401**	**-379**	**-384**	**-387**	**-396**	**-400**	**-406**	**-414**	**-423**	**-416**	**-421**	**-426**	**-433**	**-439**
Peak Position With Reserves Planning	**-69**	**-1**	**27**	**-72**	**-107**	**30**	**-5**	**28**	**-4**	**-18**	**-123**	**-155**	**-181**	**-223**	**-277**	**-581**	**-620**	**-667**	**-703**	**-751**
Planning Margin Before NW Market	**17%**	**21%**	**23%**	**18%**	**16%**	**25%**	**23%**	**25%**	**23%**	**22%**	**17%**	**15%**	**14%**	**12%**	**9%**	**-7%**	**-8%**	**-10%**	**-11%**	**-13%**
Avista Share of Excess NW Market	737	656	565	477	400	326	255	186	115	56	0	0	0	0	0	0	0	0	0	0
Peak Position Witn NW Market	**668**	**655**	**592**	**405**	**293**	**356**	**250**	**214**	**111**	**38**	**-123**	**-155**	**-181**	**-223**	**-277**	**-581**	**-620**	**-667**	**-703**	**-751**
Planning Margin With NW Market	**56%**	**55%**	**52%**	**44%**	**37%**	**43%**	**37%**	**35%**	**29%**	**25%**	**17%**	**15%**	**14%**	**12%**	**9%**	**-7%**	**-8%**	**-10%**	**-11%**	**-13%**
NEW RESOURCES																				
New Simple Cycle CC	0	0	0	0	0	0	0	80	80	160	160	160	160	160	160	160	160	160	204	204
New Combined Cycle CC	0	0	0	0	0	0	0	0	0	0	0	0	260	260	260	520	520	520	520	520
New Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thermal Resource Upgrades	0	0	0	0	0	0	0	16	16	16	16	16	16	16	16	16	16	16	16	16
Total New Resources	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**96**	**96**	**176**	**176**	**176**	**435**	**435**	**435**	**695**	**695**	**695**	**740**	**740**
Peak Position with New Resources	**668**	**655**	**592**	**405**	**293**	**356**	**250**	**310**	**207**	**213**	**52**	**21**	**254**	**213**	**158**	**114**	**76**	**29**	**36**	**-11**
Planning Margin With New Resources	**56%**	**55%**	**52%**	**44%**	**37%**	**43%**	**37%**	**40%**	**34%**	**35%**	**26%**	**24%**	**37%**	**34%**	**31%**	**28%**	**26%**	**24%**	**24%**	**22%**

12 Native load includes forecasted savings from conservation and distribution efficiencies programs.

Table 8.29: Summer 18-Hour Capacity Position (MW) Net of Conservation with New Resources[13]

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
TOTAL LOAD OBLIGATIONS																				
Native Load (Net of Efficiency Programs)	-1,500	-1,538	-1,573	-1,614	-1,637	-1,660	-1,679	-1,692	-1,707	-1,721	-1,731	-1,745	-1,767	-1,795	-1,827	-1,852	-1,879	-1,907	-1,939	-1,973
Firm Power Sales	-243	-218	-212	-159	-159	-9	-9	-8	-8	-8	-8	-8	-8	-7	-7	-7	-7	-7	-7	-7
Total Requirements	**-1,743**	**-1,756**	**-1,785**	**-1,774**	**-1,797**	**-1,669**	**-1,688**	**-1,700**	**-1,715**	**-1,729**	**-1,739**	**-1,753**	**-1,775**	**-1,802**	**-1,834**	**-1,859**	**-1,886**	**-1,915**	**-1,946**	**-1,981**
RESOURCES																				
Firm Power Purchases	85	85	85	85	85	85	85	83	83	82	82	82	82	82	82	82	82	82	82	82
Hydro Resources	900	819	902	859	866	864	885	833	840	859	833	840	859	833	840	859	833	840	859	833
Base Load Thermals	799	799	799	799	799	799	799	799	799	799	799	799	799	799	799	551	551	551	551	551
Wind Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peaking Units	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176
Total Resources	**1,960**	**1,880**	**1,962**	**1,919**	**1,926**	**1,924**	**1,945**	**1,891**	**1,897**	**1,916**	**1,891**	**1,896**	**1,916**	**1,890**	**1,896**	**1,668**	**1,642**	**1,648**	**1,668**	**1,642**
Peak Position Before Reserves Planning	**217**	**124**	**176**	**146**	**130**	**255**	**257**	**191**	**183**	**187**	**152**	**144**	**141**	**88**	**62**	**-191**	**-244**	**-267**	**-279**	**-339**
RESERVES PLANNING																				
Required Operating Reserves	-153	-156	-158	-159	-161	-154	-155	-156	-158	-159	-160	-161	-163	-165	-168	-155	-154	-155	-157	-156
Available Operating Reserves	155	66	171	159	159	159	161	158	158	161	158	158	161	158	158	161	158	158	161	158
Planning Margin	-227	-232	-238	-244	-248	-252	-255	-257	-259	-262	-263	-266	-269	-273	-278	-282	-286	-290	-295	-300
Total Reserves Planning	**-227**	**-322**	**-238**	**-244**	**-251**	**-252**	**-255**	**-257**	**-259**	**-262**	**-265**	**-269**	**-271**	**-280**	**-288**	**-282**	**-286**	**-290**	**-295**	**-300**
Peak Position With Reserves Planning	**-10**	**-199**	**-62**	**-99**	**-122**	**3**	**2**	**-66**	**-77**	**-74**	**-114**	**-125**	**-130**	**-192**	**-226**	**-473**	**-530**	**-557**	**-574**	**-639**
Planning Margin Before NW Market	**21%**	**11%**	**19%**	**17%**	**16%**	**25%**	**25%**	**21%**	**20%**	**20%**	**18%**	**17%**	**17%**	**14%**	**12%**	**-2%**	**-5%**	**-6%**	**-6%**	**-9%**
Avista Share of Excess NW Market	275	221	178	141	107	78	52	31	10	3	0	0	0	0	0	0	0	0	0	0
Peak Position With NW Market	**265**	**22**	**117**	**42**	**-15**	**81**	**54**	**-35**	**-67**	**-71**	**-114**	**-125**	**-130**	**-192**	**-226**	**-473**	**-530**	**-557**	**-574**	**-639**
Planning Margin With NW Market	**37%**	**23%**	**29%**	**25%**	**22%**	**29%**	**28%**	**22%**	**20%**	**20%**	**18%**	**17%**	**17%**	**14%**	**12%**	**-2%**	**-5%**	**-6%**	**-6%**	**-9%**
NEW RESOURCES																				
New Simple Cycle CC	0	0	0	0	0	0	0	72	72	144	144	144	144	144	144	144	144	144	184	184
New Combined Cycle CC	0	0	0	0	0	0	0	0	0	0	0	0	235	235	235	470	470	470	470	470
New Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thermal Resource Upgrades	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
Total New Resources	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**73**	**73**	**145**	**145**	**145**	**380**	**380**	**380**	**615**	**615**	**615**	**655**	**655**
Peak Position with New Resources	**265**	**22**	**117**	**42**	**-15**	**81**	**54**	**38**	**6**	**74**	**32**	**20**	**250**	**188**	**154**	**142**	**85**	**58**	**81**	**16**
Planning Margin With New Resources	**37%**	**23%**	**29%**	**25%**	**22%**	**29%**	**28%**	**27%**	**25%**	**29%**	**26%**	**26%**	**38%**	**35%**	**33%**	**31%**	**28%**	**26%**	**28%**	**24%**

[13] Ibid

Table 8.30: Average Annual Energy Position (aMW) With New Resources[14]

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
TOTAL LOAD OBLIGATIONS																				
Native Load (Net of Efficiency Programs)	-1,102	-1,121	-1,135	-1,147	-1,165	-1,184	-1,199	-1,208	-1,220	-1,231	-1,239	-1,249	-1,266	-1,286	-1,312	-1,331	-1,351	-1,372	-1,396	-1,421
Firm Power Sales	-140	-127	-109	-58	-58	-6	-6	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
Total Requirements	**-1,242**	**-1,248**	**-1,244**	**-1,205**	**-1,222**	**-1,190**	**-1,204**	**-1,214**	**-1,225**	**-1,236**	**-1,244**	**-1,254**	**-1,271**	**-1,291**	**-1,318**	**-1,336**	**-1,356**	**-1,377**	**-1,401**	**-1,426**
RESOURCES																				
Firm Power Purchases	163	164	163	165	163	112	111	91	66	66	65	65	65	65	65	65	65	65	65	65
Hydro Resources	522	525	527	495	495	495	490	481	481	481	481	481	481	481	481	481	481	481	481	481
Base Load Thermals	755	714	751	744	746	741	724	758	721	721	758	721	721	758	684	515	541	515	515	541
Wind Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Resources	**1,441**	**1,403**	**1,442**	**1,405**	**1,404**	**1,348**	**1,325**	**1,330**	**1,268**	**1,268**	**1,304**	**1,266**	**1,267**	**1,304**	**1,229**	**1,060**	**1,087**	**1,060**	**1,060**	**1,087**
Energy Position Before Contingency Planning	**198**	**155**	**198**	**200**	**182**	**158**	**121**	**117**	**43**	**32**	**61**	**12**	**-4**	**12**	**-88**	**-275**	**-269**	**-317**	**-340**	**-339**
CONTINGENCY PLANNING																				
Peaking Resources	153	153	153	138	153	154	153	147	146	145	147	146	145	147	146	145	147	146	145	147
Contingency	-228	-229	-230	-231	-232	-233	-233	-216	-197	-198	-198	-199	-200	-201	-202	-203	-204	-205	-206	-200
Energy Position With Contingency Planning	**123**	**79**	**121**	**107**	**103**	**79**	**40**	**48**	**-9**	**-21**	**9**	**-42**	**-59**	**-42**	**-145**	**-333**	**-326**	**-376**	**-401**	**-393**
NEW RESOURCES																				
New Simple Cycle CC	0	0	0	0	0	0	0	75	75	151	151	151	151	151	151	151	151	151	192	192
New Combined Cycle CC	0	0	0	0	0	0	0	0	0	0	0	0	237	237	237	474	474	474	474	474
New Wind	0	35	35	35	35	35	35	35	47	71	71	71	71	71	71	71	71	71	71	71
Thermal Resource Upgrades	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3
Total New Resources	**0**	**35**	**35**	**35**	**35**	**35**	**35**	**114**	**126**	**225**	**225**	**225**	**462**	**462**	**462**	**699**	**699**	**699**	**741**	**741**
Peak Position with New Resources	**123**	**114**	**156**	**142**	**138**	**114**	**75**	**161**	**117**	**204**	**234**	**183**	**403**	**420**	**317**	**366**	**373**	**323**	**340**	**348**

[14] Ibid

Table 8.31: Washington State RPS Detail with New Resources (aMW)[15]

	On-line Year	Apprentice Labor Credit	Upgrade Energy	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
WA State Retail Sales Forecast				628	630	634	644	650	656	663	667	674	678	682	686	687	690	696	702	708	715	723	731	740	750
RPS %					0%	3%	3%	3%	3%	9%	9%	9%	9%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
REQUIRED RENEWABLE ENERGY						**19**	**19**	**19**	**19**	**59**	**59**	**60**	**60**	**101**	**102**	**103**	**103**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**
Renewable Resources																									
Purchased RECs					0	6	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long Lake	1999	1.0	2.2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Little Falls	2001	1.0	0.6		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cabinet 2	2004	1.0	2.9		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Cabinet 3	2001	1.0	4.5		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Cabinet 4	2007	1.0	2.0		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Noxon 1	2009	1.0	2.3		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Noxon 3	2010	1.0	1.9		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Noxon 2	2011	1.0	1.0		0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Noxon 4	2012	1.0	0.9		0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Nine Mile	2012	1.0	3.7		0	0	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
New Wind	2013+	1.2			0	0	42	42	42	42	42	42	42	57	85	85	85	85	85	85	85	85	85	85	85
Total Qualifying Resources					*17*	*23*	*68*	*70*	*70*	*64*	*64*	*64*	*64*	*79*	*107*	*107*	*107*	*107*	*107*	*107*	*107*	*107*	*107*	*107*	*107*
NET REC POSITION					**17**	**5**	**49**	**50**	**50**	**5**	**5**	**4**	**4**	**(23)**	**5**	**5**	**4**	**4**	**3**	**2**	**1**	**1**	**(1)**	**(2)**	**(3)**
REC Bank																									
Previous Year Balance					0	17	21	68	70	70	64	64	64	64	41	46	51	56	60	63	65	67	67	67	65
REC's Required					0	(19)	(19)	(19)	(19)	(59)	(59)	(60)	(60)	(101)	(102)	(103)	(103)	(103)	(104)	(105)	(106)	(107)	(108)	(109)	(110)
REC's Generated/Purchased					17	23	68	70	70	64	64	64	64	79	107	107	107	107	107	107	107	107	107	107	107
Expired/Sold RECs						0	(2)	(49)	(50)	(11)	(5)	(4)	(4)	0	0	0	0	0	0	0	0	0	0	0	0
NET REC BANK					**17**	**21**	**68**	**70**	**70**	**64**	**64**	**64**	**64**	**41**	**46**	**51**	**56**	**60**	**63**	**65**	**67**	**67**	**67**	**65**	**62**
REC Reserve Requirement (95th PERCENTILE)																									
Load					0	1	1	1	1	3	3	3	3	5	5	5	5	5	5	5	5	5	5	6	6
Existing Hydro Upgrades					0	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Total REC Reserve Requirement					**0**	**7**	**8**	**8**	**8**	**10**	**10**	**10**	**10**	**12**	**12**	**12**	**12**	**12**	**12**	**13**	**13**	**13**	**13**	**13**	**13**
NET REC POSITION					**17**	**14**	**63**	**110**	**112**	**65**	**59**	**58**	**57**	**29**	**34**	**39**	**43**	**47**	**50**	**53**	**54**	**55**	**54**	**52**	**49**

[15] Retail sales forecast includes new conservation programs.

9. Action Items

The Integrated Resource Plan (IRP) is an ongoing and iterative process balancing regular publication timelines with pursuing the best 20-year resource strategies. The biennial publication date provides opportunities for ongoing improvements to the modeling and forecasting procedures and tools, as well as the opportunity to enhance the process with new research as the planning environment changes. This section provides an overview of the progress made on the 2009 IRP Action Plan and provides the 2011 Action Plan.

Summary of the 2009 IRP Action Plan

The 2009 Action Plan included five separate categories: resource additions and analysis, energy efficiency, environmental policies, modeling and forecasting enhancements, and transmission planning.

2009 Action Plan – Resource Additions and Analysis

- Continue to explore the potential for wind and non-renewable resources.
- Issue an RFP for turbines at Reardan and up to 100 MW of wind or other renewables in 2009.
- Finish studies on the costs and environmental benefits of hydro upgrades at Cabinet Gorge, Long Lake, Post Falls, and Monroe Street.
- Study potential locations for the natural gas-fired resource identified to be online between 2015 and 2020.
- Continue participation in regional IRP processes and where agreeable find resource opportunities to meet resource requirements on a collaborative basis.

Progress Report – Resource Additions and Analysis

After filing the 2009 IRP, the Company issued two RFPs: (1) a 35 aMW Renewable RFP and (2) a wind turbine RFP for the Reardan development. The 2009 RFP showed that the anticipated benefits of early construction of Reardan, or a third party acquisition, identified in the 2009 IRP were not available. The Company retains the Reardan Wind Project site as an option to meet future RPS goals. Site control provides a hedge against escalating costs and the limited number of viable Pacific Northwest wind sites. Additional studies on non-wind renewable energy sources continued throughout this planning cycle. More details about non-wind renewables are included in the Generation Resource Options and Preferred Resource Strategy chapters.

Following the 2009 RFP, several wind development firms asked when another RFP would be issued, indicating that wind turbine prices had fallen greatly since the 2009 RFP and that prices in a new RFP issuance would be competitive to the wholesale market prices (when including REC sales) when including federal and state tax subsidies. In response, the Company issued an RFP for approximately 35 aMW of Washington renewable portfolio standard-qualified renewable energy contracts. The Company did not include its Reardan Wind Project, as it could not be completed in time to take advantage of the expiring Federal tax subsidies.[1] The Company's February 2011

[1] Federal tax incentives for wind expire at the end of calendar year 2012.

RFP received bids for 774 MW of qualifying projects (769 MW of wind and 5 MW of landfill gas). The Company selected the 105 MW Palouse Wind Project, located near Oakesdale, Washington. The proposal is a 30-year power purchase agreement with a buyout option after year 10. Further details regarding this acquisition are contained in the Preferred Resource Strategy Chapter.

The Company is continuing to research system hydroelectric upgrade options. The results of these studies are not yet complete, and we therefore were unable to include the results of these studies in this IRP. Some preliminary results are in the Generation Resource Options Chapter, and in presentations to the third Technical Advisory Committee on December 2, 2010. The slides from that presentation are contained in Appendix A.

Preliminary work on identifying potential locations for future natural gas-fired resources identified in the 2009 IRP is complete, but a final site selection is not complete. The 2011 PRS pushes the need for the next gas-fired plant until 2019 and changes the technology from combined to simple cycle. This work will continue and an update given as an Action Item in the 2013 IRP.

The Company continues to participate in regional IRP processes, attending peer-utility meetings. Regional utilities participated in our Technical Advisory Committee meetings to share the latest concepts in resource planning.

2009 Action Plan – Energy Efficiency

- Pursue American Reinvestment and Recovery Act of 2009 (ARRA) funding for low income weatherization.
- Analyze and report on the results of the July 2007 through December 2009 demand response pilot in Moscow and Sandpoint.
- Have an external party perform a study on technical, economic, and achievable potential for energy efficiency in Avista's entire service territory.
- Study and quantify transmission and distribution efficiency concepts as they apply to meeting Washington's RPS goals.
- Update processes and protocols for conservation measurement, evaluation and verification.
- Determine the potential impacts and costs of load management options.

Progress Report – Energy Efficiency

Avista's Community Action Agencies received significant increases for low-income weatherization through ARRA funds. The Idaho Load Management Pilot Final Report, issued on March 1, 2010, provides details on the Moscow and Sandpoint demand response project. The pilot included ten successful trial events, including the cycling of heating and air conditioning units and the short-term interruption of water heaters. Five percent of the eligible participants agreed to participate in the volunteer program; two percent of customers participating in the study opted-out of the program during events. Even though the program successfully showed the capability of a load interruption program as a reliable capacity resource, the regional power market does not support the present costs of such a program at this time. The Company will continue to monitor the marketplace to determine if this type of load management program will become cost effective in the future.

Global Energy Partners (Global) completed a 20-year conservation potential assessment for our residential, commercial and industrial customers in Idaho and Washington. Global presented the assessment results at the fifth Technical Advisory Committee meeting on April 12, 2011. A copy of the presentation is included in Appendix D, and more details are in the Energy Efficiency chapter.

The study and quantification of transmission and distribution efficiency concepts, as they apply to meeting Washington's renewable portfolio standard goals is part of an ongoing process. It will be refined as the Company prepares its initial Washington Energy Independence Act compliance report to the Washington Utility and Transportation Commission. Additional details are in the Energy Efficiency and Transmission and Distribution chapters of this IRP.

The Company continues to update the processes and protocols for conservation measurement, evaluation and verification (EM&V). The Company participated in an EM&V Collaborative in 2010 resulting in an EM&V framework, annual EM&V plans and development of individual program EM&V plans. This continual EM&V loop will feed improved processes and protocols for conservation measurement, evaluation and verification. As part of the conservation potential study, Global Energy Partners looked at demand response potential and costs. More details about this work are in the Energy Efficiency chapter.

2009 Action Plan – Environmental Policy

- Continue to study the potential impact of state and federal climate change legislation.
- Continue and report on the work of Avista's Climate Change Council.

Progress Report – Environmental Policy

Avista's Climate Change Council and the Resource Planning team actively analyze state and federal greenhouse gas legislation. This work will continue until final rules are established and laws passed. The focus will then shift to mitigating the costs of meeting these laws and regulations. Avista has quantified its greenhouse gas emissions using the World Resources Initiative–World Business Council for Sustainable Development (WRI-WBCSD) inventory protocol in anticipation of state and federal greenhouse gas reporting mandates. Details about Climate Change Council efforts are in the Policy Considerations chapter.

2009 Action Plan – Modeling and Forecasting Enhancements

- Refine cost driver relationships in the stochastic model.
- Continue to refine PRiSM by developing a resource retirement capability to solve for other risk measurements and by adding more resource options.
- Continue developing Loss of Load Probability and Sustained Peaking analysis for inclusion in the IRP process, and confirm appropriateness of the 15 percent capacity planning margin assumed for this IRP.
- Continue studying the impacts of climate change on the load forecast.
- Study load growth trends and their correlation to weather patterns.

Progress Report – Modeling and Forecasting Enhancements

Improvements have continued on stochastic modeling for the IRP. This plan relies on new methods for modeling natural gas and wind. Work continues on developing a method to correlate temperature, wind and hydro in the stochastic model. This work will continue and results reported in the 2013 IRP.

The 2011 IRP includes several refinements to the PRiSM model. A resource retirement capability was developed, but not utilized for this IRP. We developed a method to evaluate the true standard deviation of power supply costs for the 2011 IRP, but long solution times prevented its adoption. This plan also includes more resource options, and modeling of generators by state and by location on the regional transmission system.

Loss of Load Probability (LOLP) and Sustained Peaking analysis models were developed and used for the 2011 IRP. This IRP uses an 18-hour sustained peak over three days to estimate the need for new resources. Avista developed an LOLP model for this IRP and presented it to the TAC on September 9, 2010; however, subsequent testing of the model found that the LOLP study was driven primarily by regional market availability assumptions that were beyond the scope of the study. The Company will continue to work with the Northwest Power and Conservation Council to determine the best methods for identifying regional market availability. More details are in the Loads & Resources and Preferred Resource Strategy chapters.

The IRP load forecast continues to estimate the impacts of climate change on customer load growth. More details are included in the Load and Resource chapter of this IRP. Any changes will be in the 2013 IRP.

Transmission Planning

- Work to maintain/retain existing transmission rights on the Company's transmission system, under applicable FERC policies, for transmission service to bundled retail native load.
- Continue to participate in BPA transmission practice processes and rate proceedings to minimize the costs of integrating existing resources outside of the Company's service area.

- Continue to participate in regional and sub-regional efforts to establish new regional transmission structures (ColumbiaGrid and other forums) to facilitate long-term expansion of the regional transmission system.
- Evaluate costs to integrate new resources across Avista's service territory and from regions outside of the Northwest.
- Study and implement distribution feeder rebuilds to reduce system losses.
- Study transmission reconfigurations that economically reduce system losses.

Progress Report – Transmission Planning

The 2009 IRP transmission planning action item studies continue and are included in the 2013 Action Plan. Details about progress made toward the maintenance of existing transmission rights, involvement in BPA processes, participation in regional transmission processes, and the evaluation of integrating different resources in the IRP are in the Transmission and Distribution chapter.

Avista has completed a feeder rebuild pilot project at its 9th and Central 12F4 feeder. The Company received federal stimulus dollars for several "Smart Grid" initiatives that include projects contained in the 2009 IRP. The Company is developing a program to rebuild additional feeders as outlined in this plan. Additional details on these projects are included in the Transmission and Distribution Chapter.

2011 IRP Action Plan

The Company's 2011 Preferred Resource Strategy provides direction and guidance for the type, timing and size of future resource acquisitions. The 2011 IRP Action Plan highlights the activities planned for possible inclusion in the 2013 IRP. Progress and results for each of the 2011 Action Plan items will be reported to the Technical Advisory Committee and the results will be included in Avista's 2013 IRP. The 2011 Action Plan includes input from Commission Staff, the Company's management team, and the Technical Advisory Committee.

Resource Additions and Analysis

- Continue to explore and follow potential new resources opportunities.
- Continue studies on the costs, energy, capacity and environmental benefits of hydro upgrades at both Spokane and Clark Fork River projects.
- Study potential locations for the natural gas-fired resource identified to be online by the end of 2018.
- Continue participation in regional IRP processes and, where agreeable, find opportunities to meet resource requirements on a collaborative basis with other utilities.
- Provide an update on the Little Falls and Nine Mile hydroelectric project upgrades.
- Study potential for demand response projects with industrial customers.
- Continue to monitor regional surplus capacity and Avista's reliance on this surplus for near- and medium-term needs.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 214 of 1069

Energy Efficiency

- Study and quantify transmission and distribution efficiency projects as they apply to Washington RPS goals.
- Update processes and protocols for conservation measurement, evaluation and verification.
- Continue to determine the potential impacts and costs of load management options.

Environmental Policy

- Continue studies of state and federal climate change policies.
- Continue and report on the work of Avista's Climate Change Council.

Modeling and Forecasting Enhancements

- Continue following regional reliability processes and develop Avista-centric modeling for possible inclusion in the 2013 IRP.
- Continue studying the impacts of climate change on retail loads.
- Refine the stochastic model for cost driver relationships, including further analyzing year-to-year hydro correlation and the correlation between wind, load, and hydro.

Transmission and Distribution Planning

- Work to maintain the Company's existing transmission rights, under applicable FERC policies, for transmission service to bundled retail native load.
- Continue to participate in BPA transmission processes and rate proceedings to minimize costs of integrating existing resources outside of Avista's service area.
- Continue to participate in regional and sub-regional efforts to establish new regional transmission structures to facilitate long-term expansion of the regional transmission system.
- Evaluate the costs to integrate new resources across Avista's service territory and from regions outside of the Northwest.
- Study and implement distribution feeder rebuilds to reduce system losses.
- Continue to study other potential areas to implement Smart Grid projects to other areas of the service territory.
- Study transmission reconfigurations that economically reduce system losses.

Production Credits

Primary Avista 2011 Electric IRP Team

Individual	Title	Contribution
Clint Kalich	Manager of Resource Planning & Analysis	Project Manager
James Gall	Senior Power Supply Analyst	Analysis/Author
John Lyons	Power Supply Analyst	Research/Author/Editor
Randy Barcus	Economic Analyst	Load Forecast
Lori Hermanson	Utility Resource Analyst	Energy Efficiency
Scott Waples	Director System Planning	Transmission & Distribution

Other Contributors

Name	Title
Reuben Arts	System Planning Engineer
Thomas Dempsey	Manager, Generation Joint Projects
Mike Gonnella	Manager of Engineering - Thermal
Jason Graham	Mechanical Engineer
Curt Kirkeby	Senior Engineer II
Mike Magruder	Substation Engineering Manger
Jon Powell	Partnership Solutions Manager
Greg Rahn	Manager of Natural Gas Planning
Xin Shane	Power Supply Analyst
Ken Sweigart	Transmission Design Manager
Steve Wenke	Chief Generation Engineer
Jessie Wuerst	Communications Manager

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Exhibit No. 4
Case Nos. AVU-E-12-08
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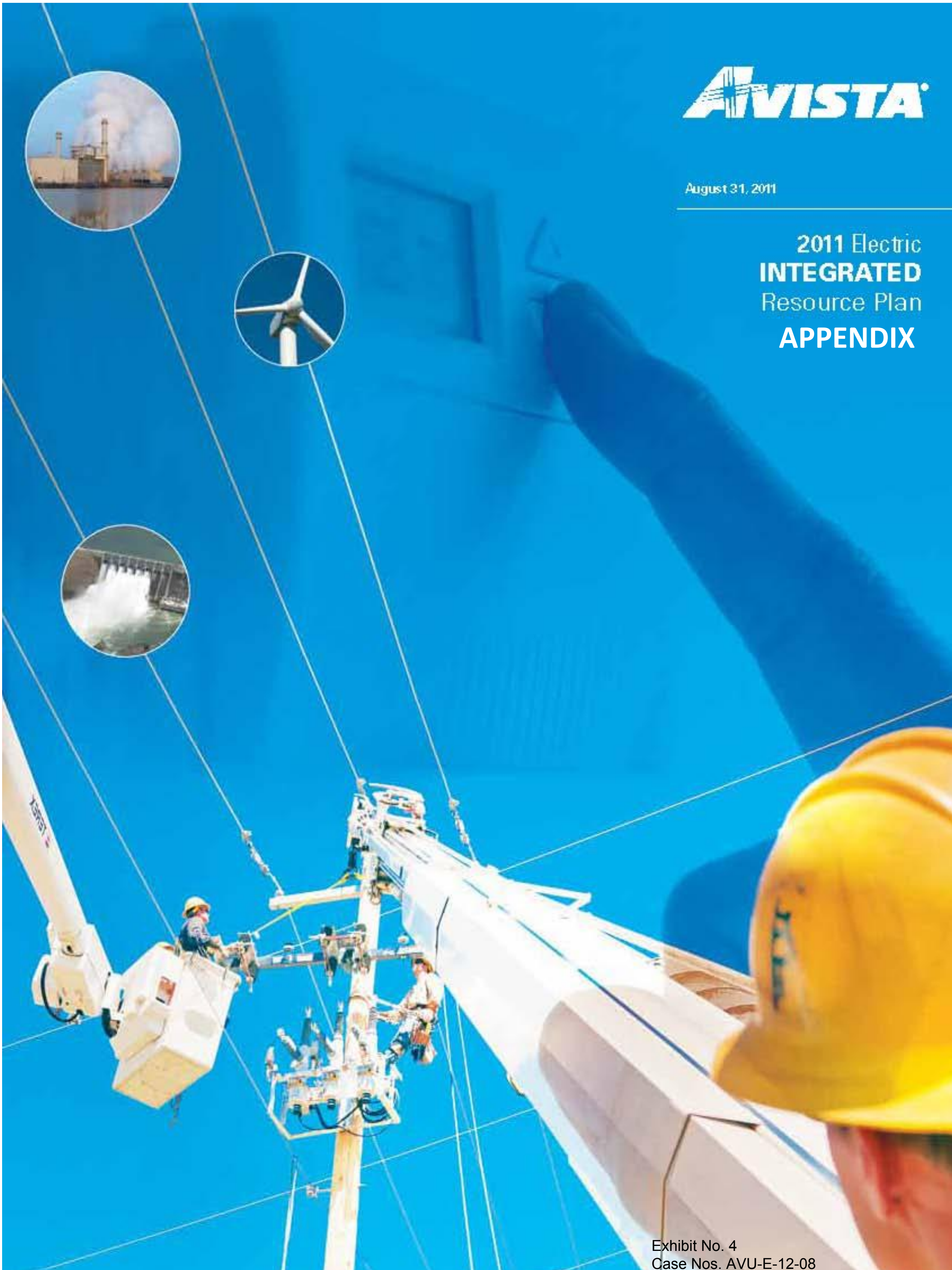
Schedule 1, Page 216 of 1069



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August 31, 2011

2011 Electric INTEGRATED Resource Plan

APPENDIX

Appendix Table of Contents

2011 Electric Integrated Resource Plan

Appendix A – Technical Advisory Committee Presentations

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Avista's 2011 Electric Integrated Resource Plan

Technical Advisory Committee Meeting No. 1 Agenda

Thursday, May 27, 2010

Conference Room 130

Topic	Time	Staff
1. Introduction	10:30	Lafferty
2. Work Plan	10:35	Lyons
3. Load & Resource Balance Update	11:00	Shane
4. Resource Planning Environment	11:35	Lyons
5. Lunch	12:00	
6. 2011 IRP Topic Discussions	1:15	
• Analytical Process Changes		Gall
• Hydro Modeling		Shane
• Resource Adequacy		Kalich
• Loss of Load Probability		Gall
• Energy Efficiency		Hermanson
• Scoping the 2011 Plan		Kalich
7. Adjourn	3:30	

Work Plan

John Lyons

Technical Advisory Committee Meeting #1

2011 Electric Integrated Resource Plan

May 27, 2010

Technical Advisory Committee Meetings

May 27, 2010: Work plan, load & resource balance, resource planning environment, and 2011 IRP topic discussions (analytical process changes, hydro modeling, resource adequacy, loss of load probability, energy efficiency, and scoping the 2011 plan)

August 2010: Risk and resource assumptions, loss of load probability analysis, scenarios and futures, and energy efficiency

October 2010: Load forecast, preliminary electric and gas price forecasts, updated load & resource forecast balance, and transmission cost studies

February 2011: Review of modeling and assumptions, and draft PRS

March 2011: Review of scenarios and futures, and portfolio analysis

April 2011: Review of final PRS and action items

June 2011: Review of the 2011 IRP

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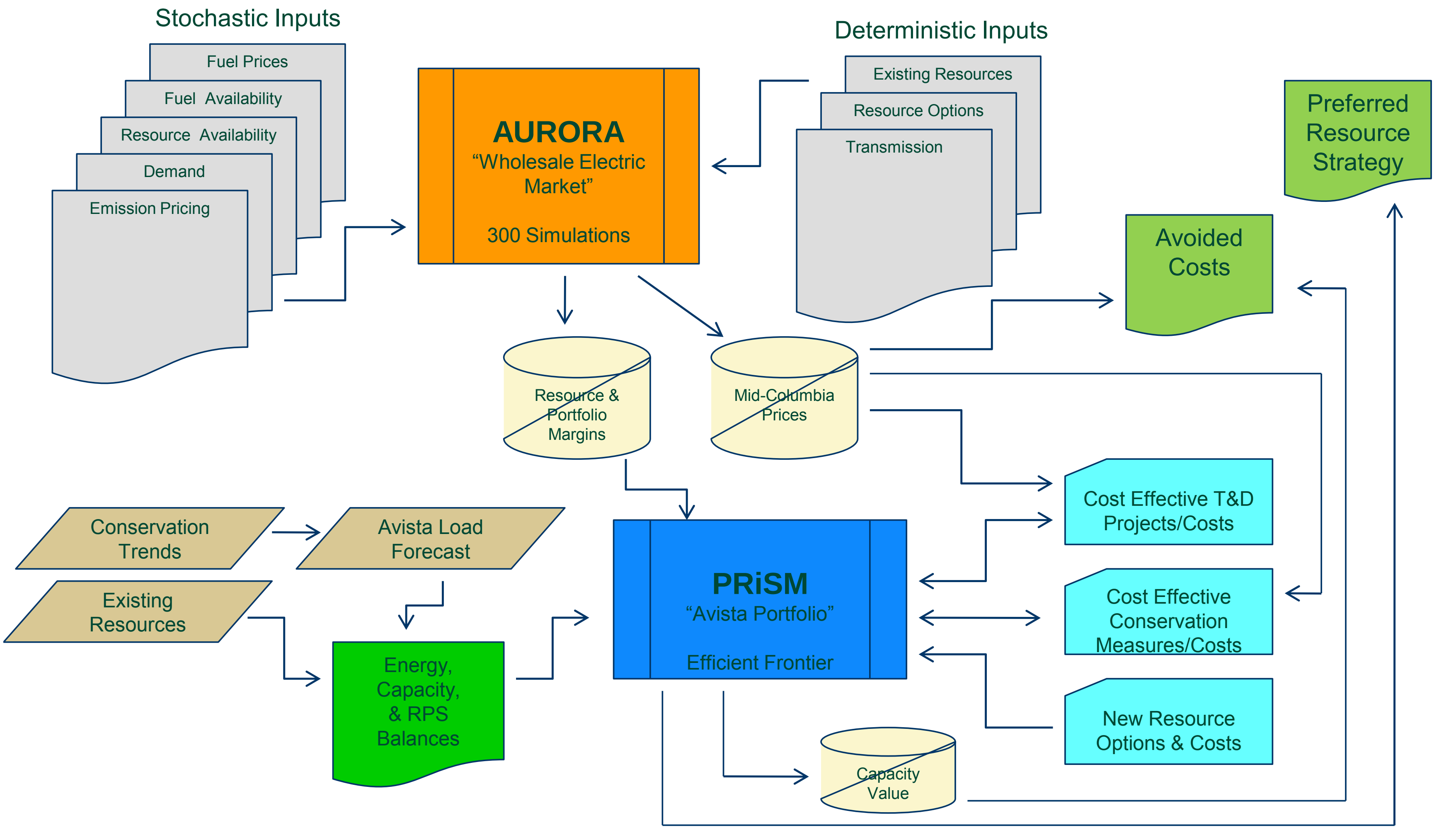
2011 Integrated Resource Plan Modeling Process



2011 Electric IRP Draft Outline

1. Executive Summary
2. Introduction and Stakeholder Involvement
3. Loads and Resources
    a) Load forecast and scenarios
    b) Existing resources
    c) Resource adequacy
4. Energy Efficiency and Demand Response
    a) Energy and capacity savings projections and methodology
    b) Two year energy savings target (I-937) & business planning process
    c) Demand response options and study results
    d) Risk and externalities
5. Environmental Issues
    a) Carbon emissions
    b) Other
6. Transmission Planning
    a) Resource integration
    b) Smart grid
    c) Other T&D efficiencies

2011 Electric IRP Draft Outline (cont)

7. Generation Resource Options
    a) New resource alternatives
    b) Thermal and hydro upgrades
8. Market Analysis
    a) Regional loads, transmission, resources
    b) Fuel price forecasts
    c) Risk modeling
    d) Market price forecasts
    e) Market scenario analysis
9. Preferred Resource Strategy
    a) The PRiSM Model and efficient frontier analysis
    b) Preferred Resource Strategy results and I-937 compliance
    c) Portfolio scenario analysis
10. Action Items

Load and Resource Balance Forecast

Xin Shane

Technical Advisory Committee Meeting #1

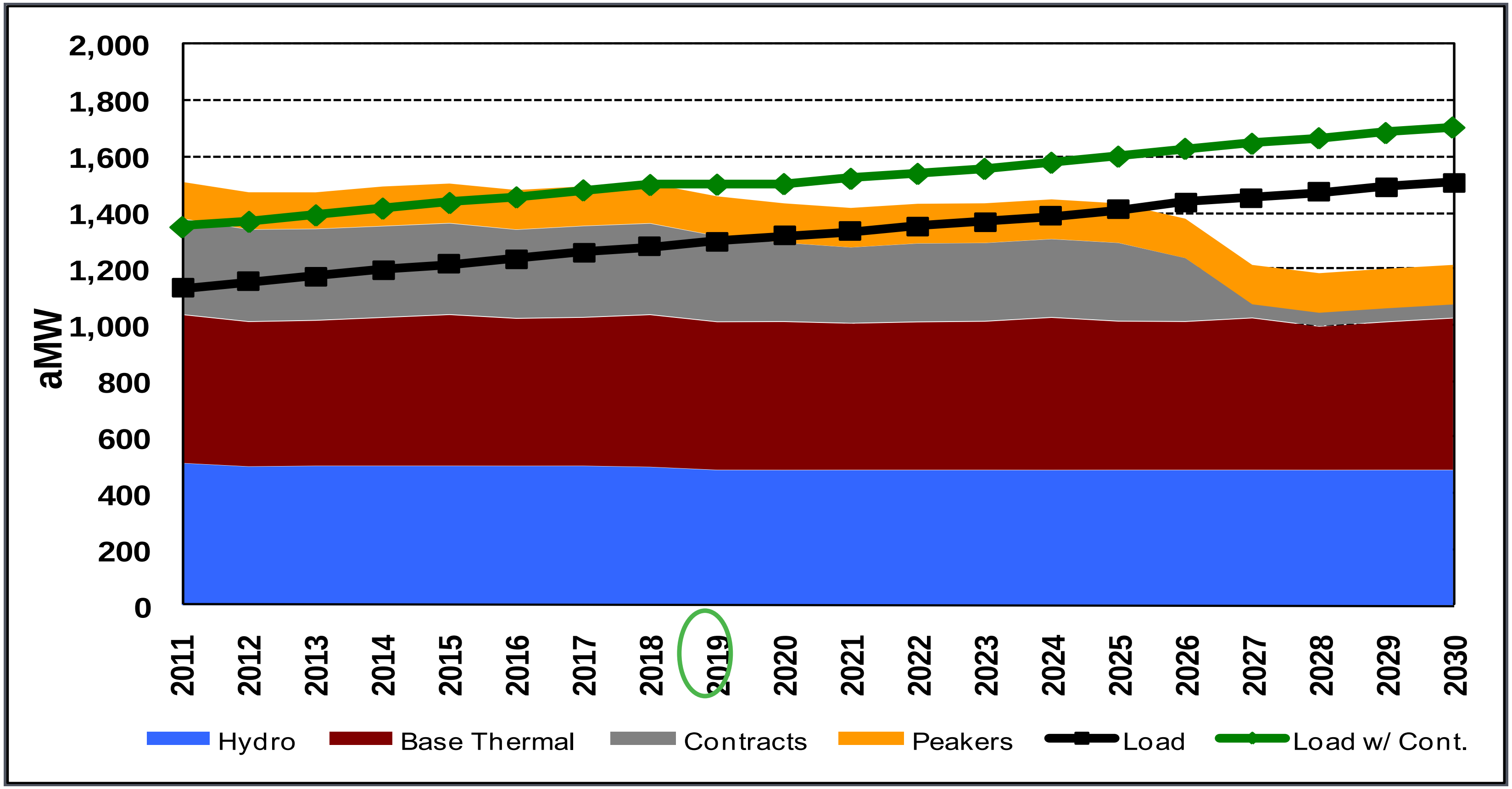
2011 Electric Integrated Resource Plan

May 27, 2010

L&R Changes From 2009 IRP

- **Load**- 10 year growth rate 1.8%, 20 year growth rate 1.6% for Peak and Energy. The forecast for year 2011 is 42 aMW lower than previous forecast or 3.6% lower
- **Hydro**- Uses Clark Fork Optimization Package Results
- **Thermal**- CS2 duct burner capacity is upgraded to 28 MW from 23 MW

Annual Average Energy Position
Base Case



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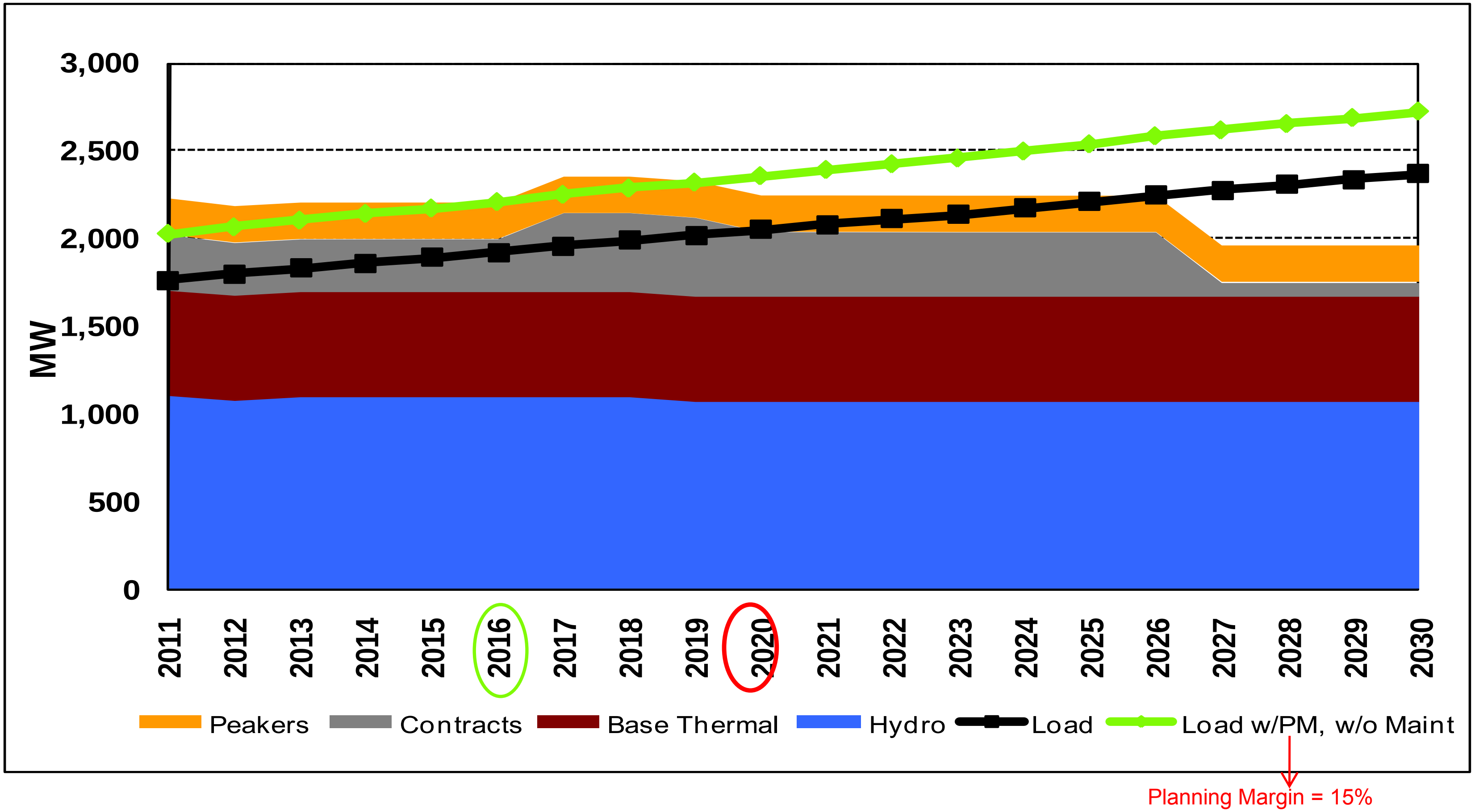
Winter Capacity Position

Base Case



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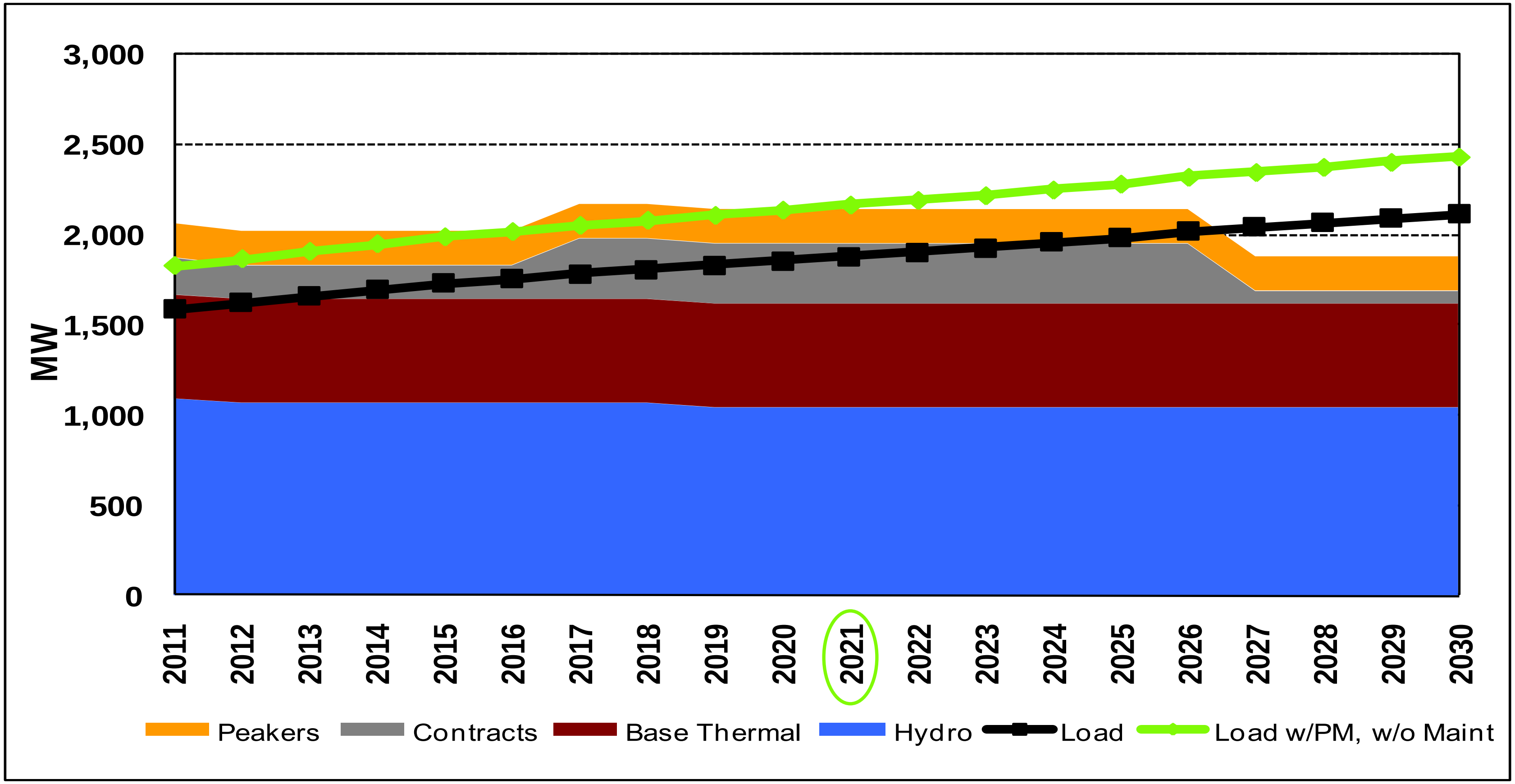
August Capacity Position

Base Case



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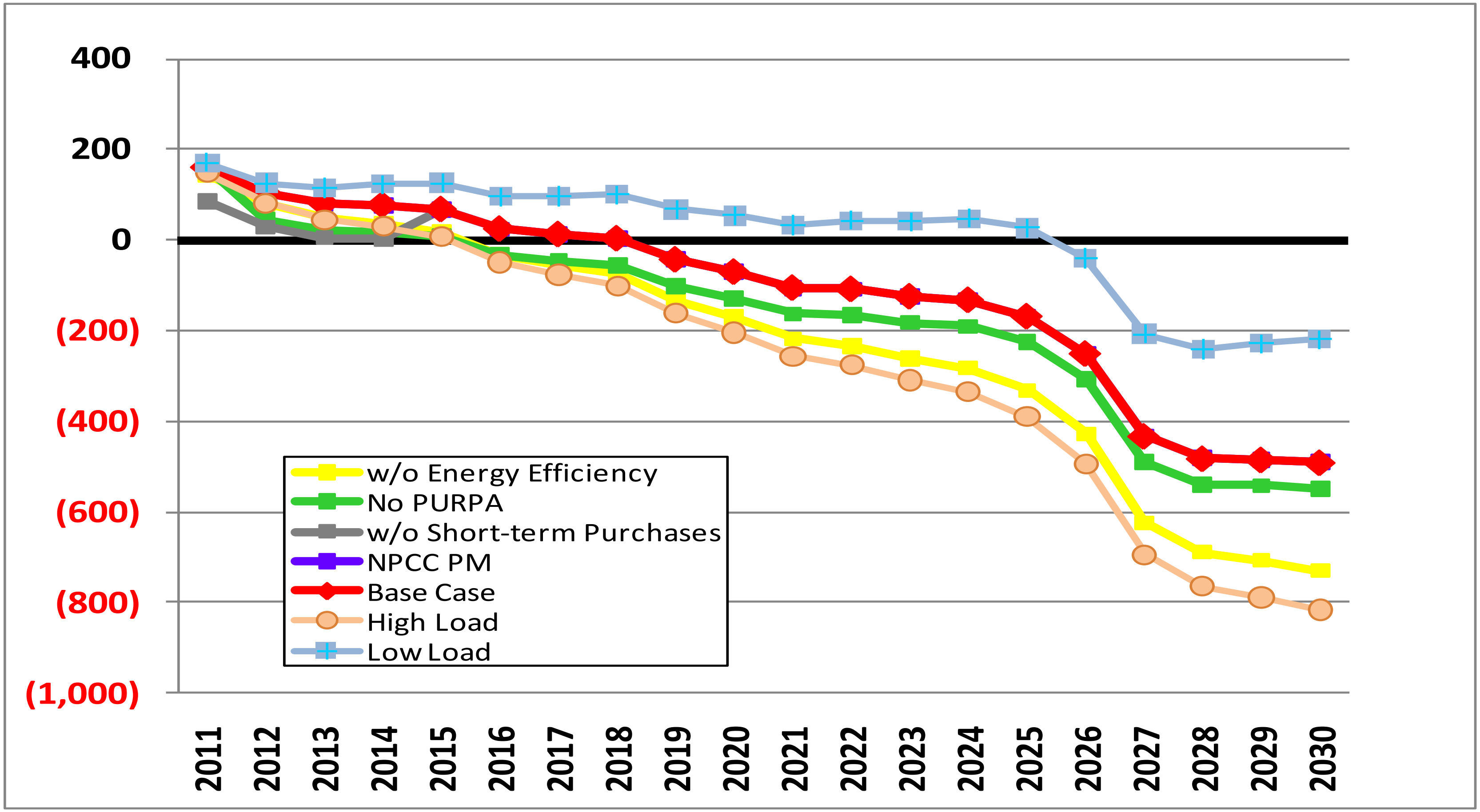
Energy Positions – 7 Scenarios

(aMW)



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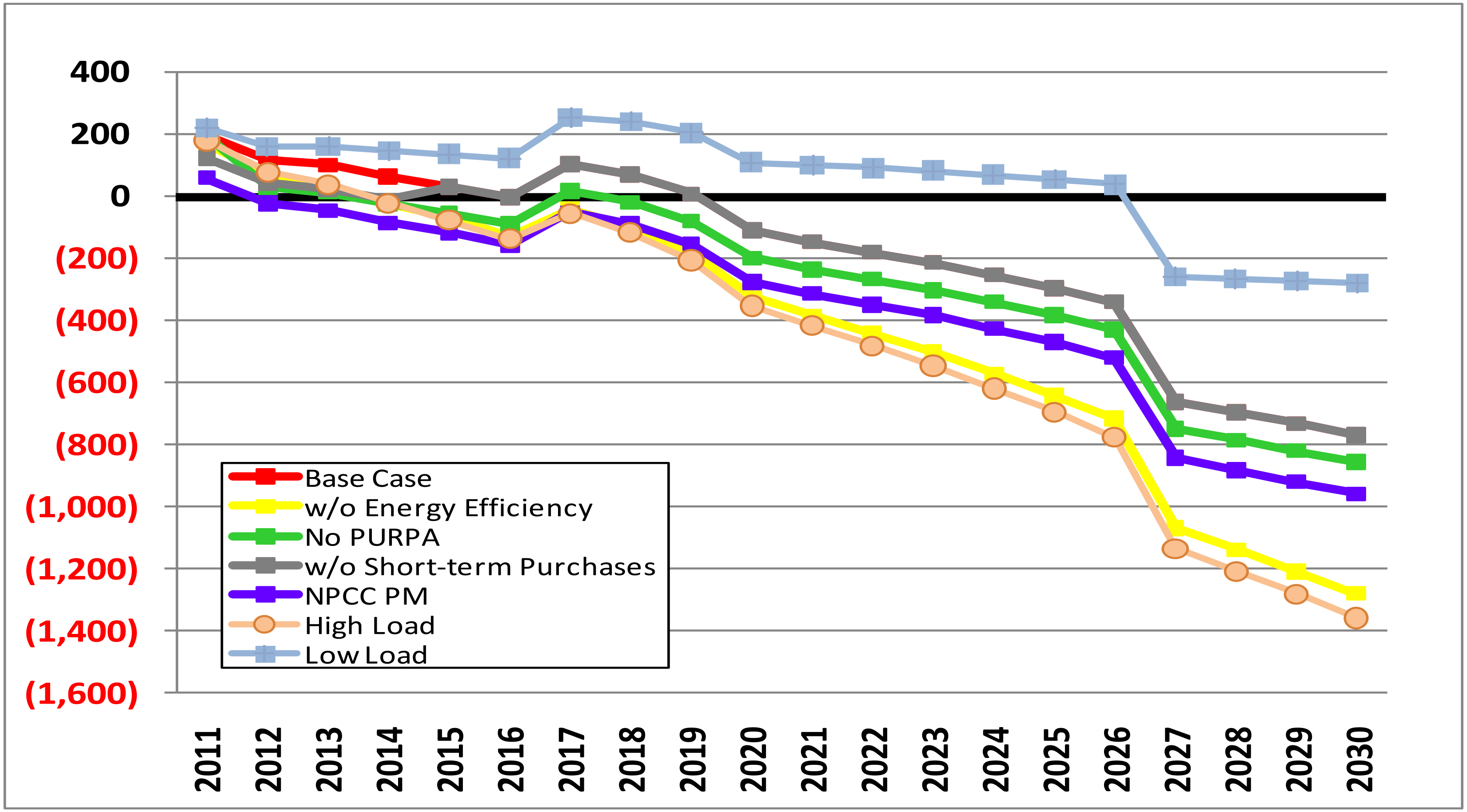
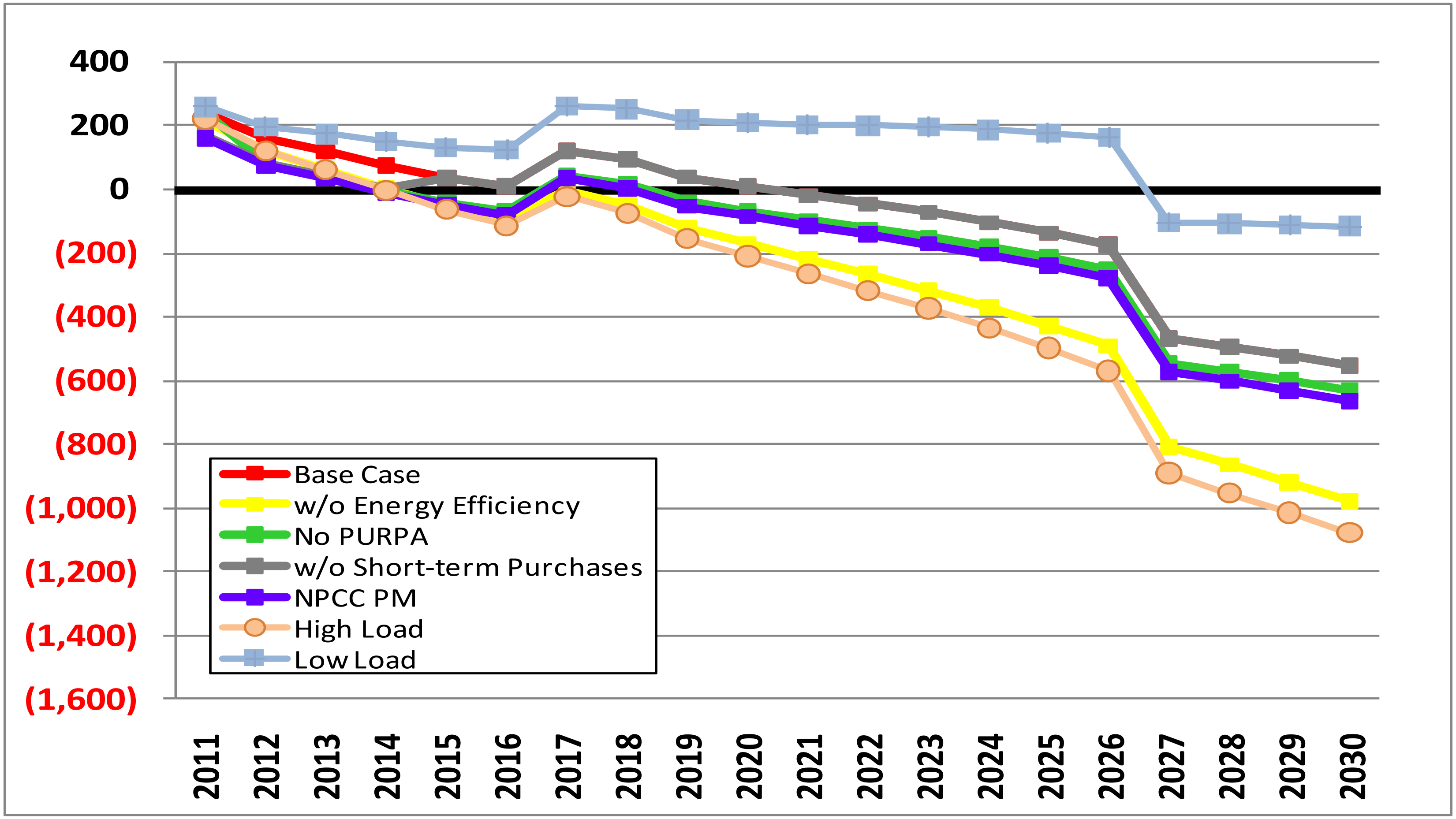
Winter Capacity Positions – 7 Scenarios

(MW)



August Capacity Positions – 7 Scenarios

(MW)



Washington State RPS (aMW)

	On-line Year	Apprentice Labor	Upgrade Energy	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
WA State Retail Sales Forecast				656	668	681	693	702	712	721	730	740	751
Load 10% Chance of Exceedance				29	30	30	31	31	32	32	33	33	34
Planning RPS Load				685	698	711	724	733	744	753	763	773	785
RPS %				0%	3%	3%	3%	3%	9%	9%	9%	9%	15%
Required Renewable Energy				**0.0**	**20.3**	**20.8**	**21.1**	**21.5**	**65.6**	**66.5**	**67.4**	**68.2**	**115.2**
Renewable Resources													
Purchased RECs				0.0	5.7	5.7	5.7	5.7	0.0	0.0	0.0	0.0	0.0
Kettle Falls	1983			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stateline	1999			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long Lake 3	1999			2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Little Falls 4	2001			0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cabinet 2	2004			2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Cabinet 3	2001			4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Cabinet 4	2007	1.0	1.99	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Noxon 1	2009	1.0	2.90	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Reardan				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hydro 10% Chance of Exceedance				(4.2)	(4.2)	(4.2)	(4.2)	(4.2)	(4.2)	(4.2)	(4.2)	(4.2)	(4.2)
Total Qualifying Resources				***10.9***	***16.5***	***16.6***	***16.6***	***16.6***	***10.9***	***10.9***	***10.9***	***10.9***	***10.9***
Net REC Position (Completed)				**10.9**	**(3.8)**	**(4.2)**	**(4.6)**	**(5.0)**	**(54.7)**	**(55.6)**	**(56.5)**	**(57.4)**	**(104.4)**
Budgeted Hydro Upgrades													
Noxon 2	2011	1.0	1.00	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Noxon 3	2010	1.0	1.30	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Noxon 4	2012	1.0	1.20	0.0	0.6	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Nine Mile	2012	1.2	3.80	0.0	2.3	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Hydro 10% Chance of Exceedance				(0.5)	(1.3)	(2.0)	(2.0)	(2.0)	(2.0)	(2.0)	(2.0)	(2.0)	(2.0)
Total Budgeted Hydro Upgrades				***1.3***	***3.8***	***6.1***	***6.1***	***6.1***	***6.1***	***6.1***	***6.1***	***6.1***	***6.1***
Rollover Credits				0.0	12.1	12.2	14.1	15.6	16.7	0.0	0.0	0.0	0.0
Net REC Postion (Budgeted Upgrades)	**with Rollover**			**12.1**	**12.2**	**14.1**	**15.6**	**16.7**	**(31.9)**	**(49.5)**	**(50.4)**	**(51.3)**	**(98.3)**
Net REC Postion (Budgeted Upgrades)	**w/o Rollover**			**12.1**	**0.1**	**1.9**	**1.5**	**1.1**	**(48.6)**	**(49.5)**	**(50.4)**	**(51.3)**	**(98.3)**

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Planning Environment

John Lyons

Technical Advisory Committee Meeting #1

2011 Electric Integrated Resource Plan

May 27, 2010

Major Planning Issues

1. Renewable Portfolio Standards
   – State and federal
2. Greenhouse Gas Regulations
   – State, regional, and federal
   – Emissions performance standards and reporting
3. Energy Efficiency Requirements
4. Reliability Planning
5. Variable Resource Integration
6. Electric Vehicles
7. Smart Grid
8. PURPA

State & Federal Greenhouse Gas Reduction Goals

Percentage goals below 2005 greenhouse gas emissions

	Kerry-Lieberman	Waxman-Markey
2013	4.75%	3% (2012)
2020	17%	17%
2030	42%	42%
2050	83%	83%

	Washington Goals
2020	1990 emissions
2035	25% below 1990
2050	50% below 1990

Key Components Kerry-Lieberman (American Power Act)

- Allowances:
  - 75% emissions based and 25% load based
  - Prohibition from receiving excess allocations
  - Electricity sector begins in 2013, natural gas in 2016
  - Increased levels of free allocations
- Preemption of state cap-and-trade programs
- Preempt EPA regulation through Clean Air Act
- Carbon fees for petroleum
- Emissions credit limitations
- Emissions credit banking and borrowing

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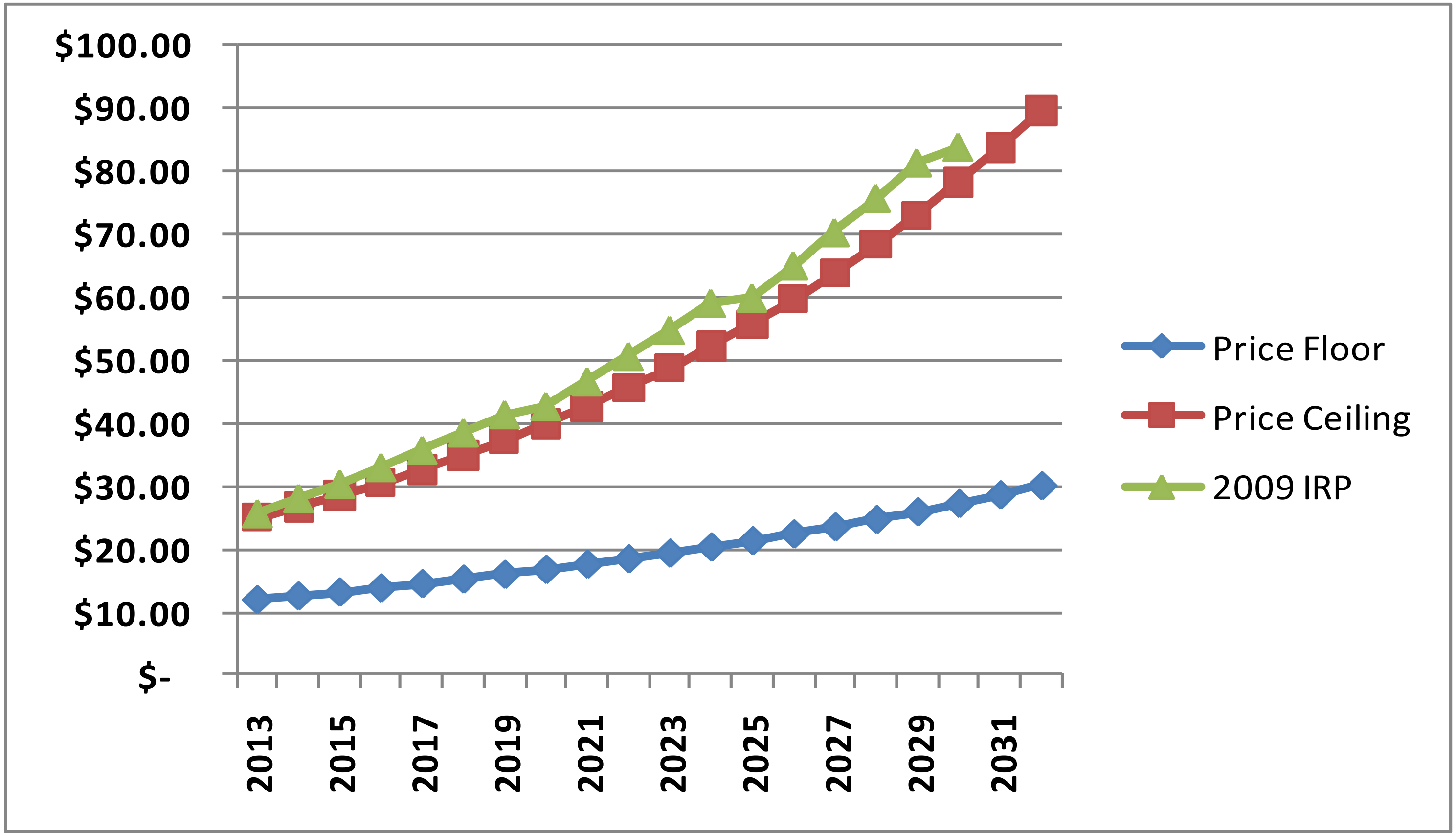
American Power Act – Price Collars



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EPA Tailoring Rule

- Clean Air Act permitting requirements for greenhouse gas (GHG) emissions from large stationary sources
- January 2, 2011: Prevention of Significant Deterioration (PSD) requirements for GHG emissions for new and modified facilities needing non-GHG PSD permits and increasing GHG emissions 75,000 tons CO_2-e or more per year
- July 1, 2011: PSD requirements on new facilities emitting 100,000 tons CO_2-e and modifications increasing GHG emissions 75,000 tons
- Rulemaking in 2011 setting emission thresholds and permitting requirements for 2013

Analytical Process Changes

James Gall

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2011 Electric Integrated Resource Plan

May 27, 2010

2011 Integrated Resource Plan Modeling Process

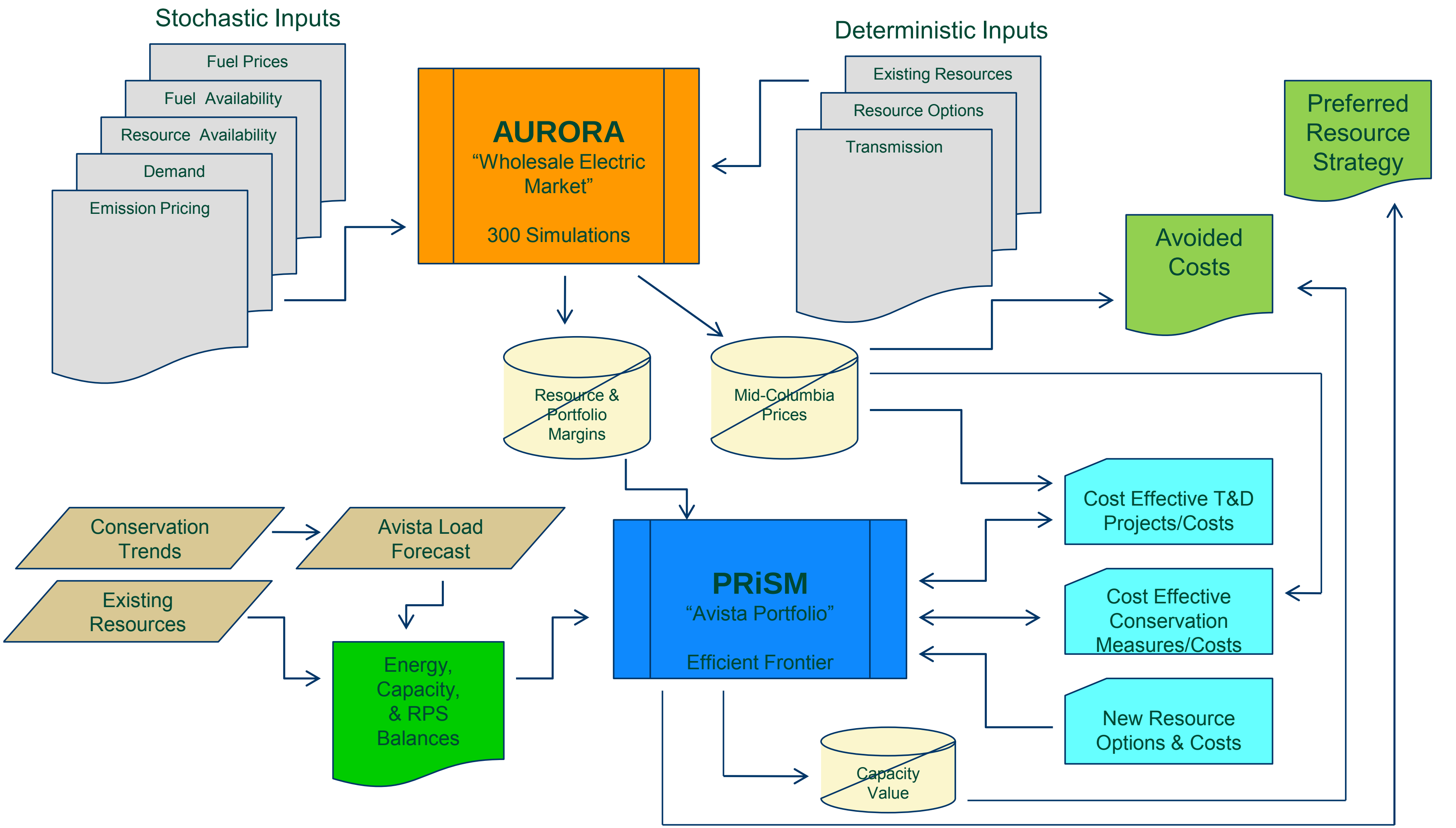

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 243 of 1069

Modeling Enhancements and Questions/Feedback

Modeling Enhancements

- Study period 2012 – 2031
- Use Loss of Load Probability/Expectation to target planning margins
- Resource retirements as an option in PRiSM
- Add other matrices to evaluate portfolio risk (i.e. Tail Var, CoVar, CO_2)
- Increased number of resource upgrades as options (thermal and hydro)
- Increased number of distribution efficiency programs
- Evaluate demand response programs
- Further enhance relationships of regional market variables (i.e. correlations)

Questions/Feedback

- Real versus nominal costs/prices reporting
- Market analysis (more, less, same- stochastic or scenario focused)
- Portfolio analysis (more, less, or same)
- Other requests

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Hydro System Optimization Modeling

Xin Shane

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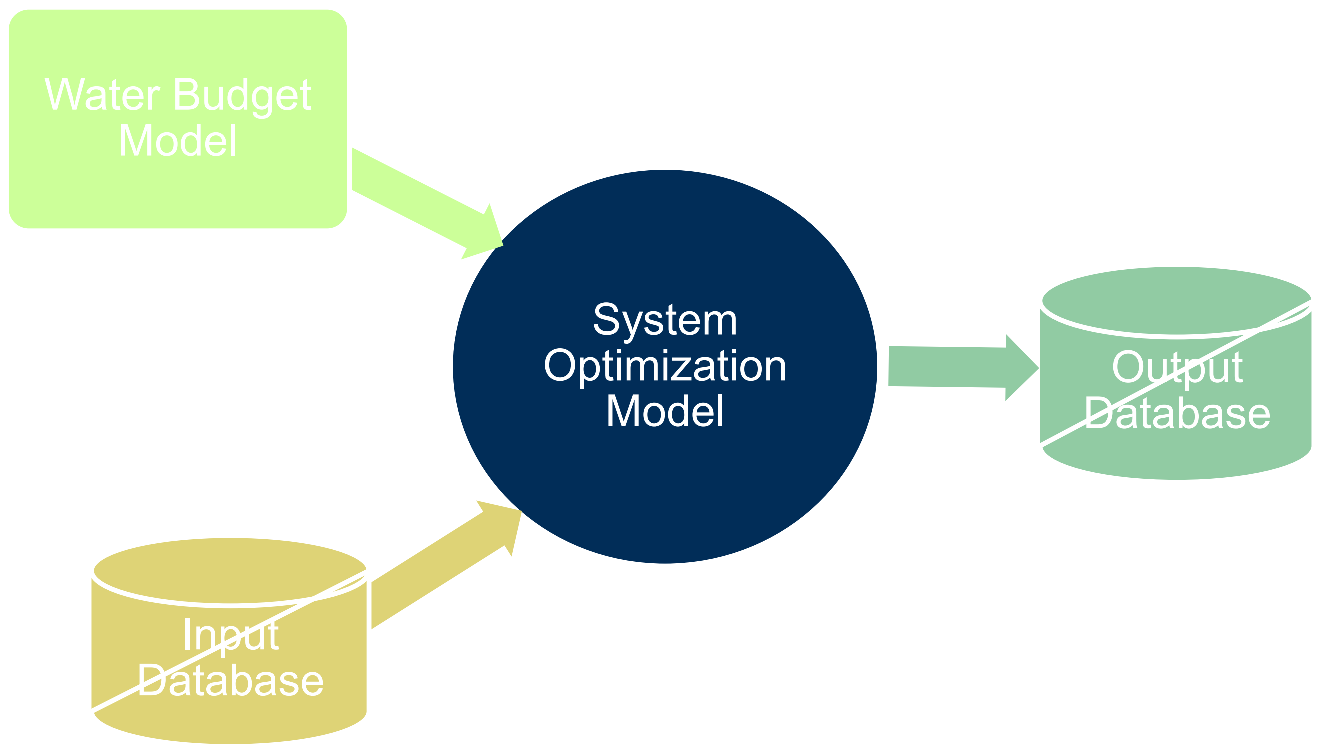
2011 Electric Integrated Resource Plan

May 27, 2010

Structure of Hydro System Optimization Package



Water Budget Model Overview

The Water Budget Model's primary goal is to recognize the storage capabilities inherent in system reservoirs, optimizing water releases to maximize generation values while enforcing project constraints.

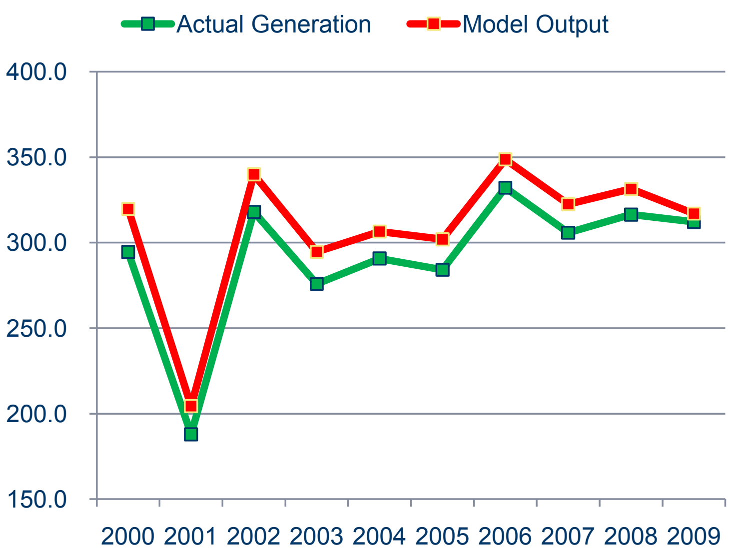
- Today's computers cannot optimize at an adequate detail level to extend the hourly Optimization Model to annual or multi-year timeframes
- Water Budget Model simplifies certain aspects, allowing optimization across many weeks to years
- Approach is a best practice, "industry standard"

System Optimization Model Overview

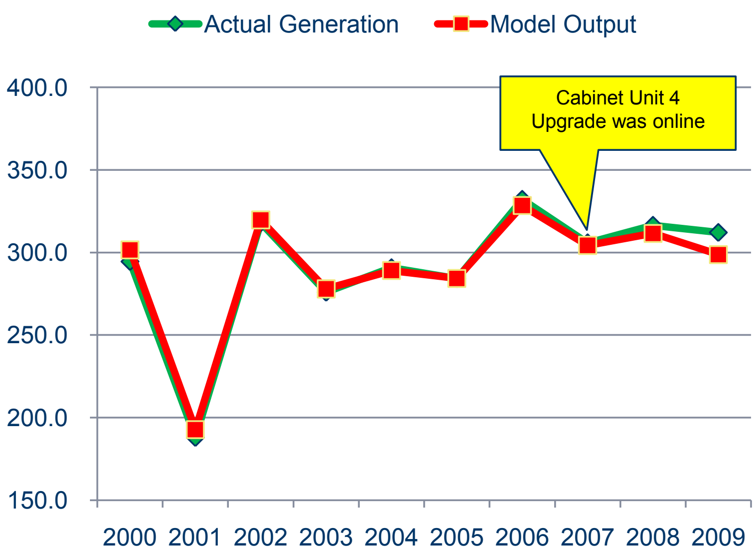
- Hourly model, with potential for more granularity (i.e., intra-hour analyses)
- Each project is represented in detail, including:
  - Accurate (piece-wise) reflection of individual turbine efficiency curves;
  - Physical and license-constrained reservoir elevations;
  - Tailrace elevations;
  - Minimum and maximum flow constraints; and
  - Other regulation constraints
- Shapes generation into the most beneficial (i.e., most economic) time periods using storage reservoirs
- Maximizes generation by flowing water through the most efficient points on each turbine's power curve

Model vs Actual Generation- Clark Fork Example (aMW)

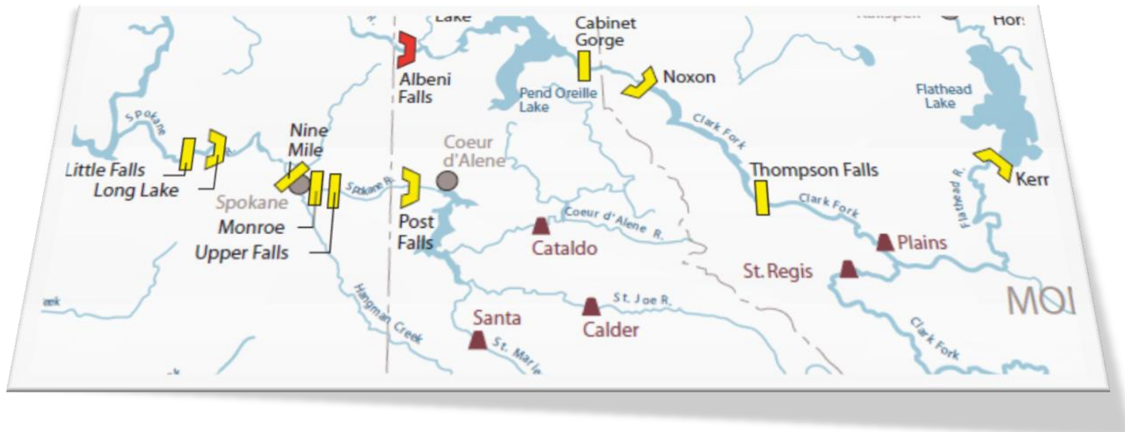
Before Benchmarking



After Benchmarking



Next Steps



- **Complete Spokane River Model**
- **Complete Upgrade Analyses for the Following Projects**
  - Long Lake–new power house with 1 or 2 new units (30-120 MW, pumped storage)
  - Post Falls–replace powerhouse with between 1 and 3 new units (25-40 MW)
  - Monroe Street–one additional unit (~45 MW capacity)
  - Cabinet Gorge–one or 2 new units (60-120 MW, help with total dissolved gas mitigation)

Resource Adequacy

Clint Kalich

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2011 Electric Integrated Resource Plan

May 27, 2010

Concepts

- Generator Capacity Services
  - Energy
  - Reserve for forced outages and extended load (i.e., hot and cold weather) excursions
  - Regulating
  - Load following
  - Energy imbalance (mismatches between scheduled and actual generation)

- Traditional Resource Planning Methodologies
  - Energy L&R
    - Average forecast
    - Plus contingency energy
  - Capacity L&R
    - Average peak load
    - Plus planning margin

Capacity Services Definitions

- Energy
  - Average capability to do work over a given time horizon
  - Conversion of fuel (water, wind, coal, gas, wood, etc.) to electricity

- Planning Reserves
  - Operating Reserve – capacity held back to cover forced outages and non-firm imports
    - 5%-7%-5% of online capacity for hydro-thermal-wind
    - at minimum half must be “spinning;” the remaining can be “non-spinning”
    - first hour of system contingency met through NWPP Reserve Sharing Group
  - Regulating Reserve – spinning reserve immediately responsive to AGC
    - generally a seconds-to-5-minute product

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Capacity Services Definitions, Cont.

- Planning Reserves, Cont.
  - Load Following
    - Reserve-like product to follow variations in load and resources across the trading hour
      - beyond 5 minutes
      - can be spinning or non-spinning (traditionally spinning in the NW)
  - Energy Imbalance
    - "Make-up energy"
    - Covers variations between hourly scheduled and actual generation levels

Potential Changes to L&R Planning Margin

- Operating Reserve
  - 5% hydro and wind
  - 7% thermal
- Regulating Reserve: ~25 MW
- Load Following: TBD
- Energy Imbalance
  - Wind and solar ~10-15%
  - Load ~2%
- Weather Variation: TBD

Key Considerations by Resource

- All Resources
  - Abilities to provide individual capacity services discussed above
  - Potential maintenance schedules
  - Forced outage characteristics

- Hydro
  - Sustained peaking capabilities
  - Run-of-river vs. reservoir storage vs. pumped storage
  - Upstream inflows during critical events

- Gas-Fired Thermals
  - Weather impacts
  - Resource type (peaking versus base-load, etc.)
  - Fuel availability over peak events

Key Considerations by Resource, Cont.

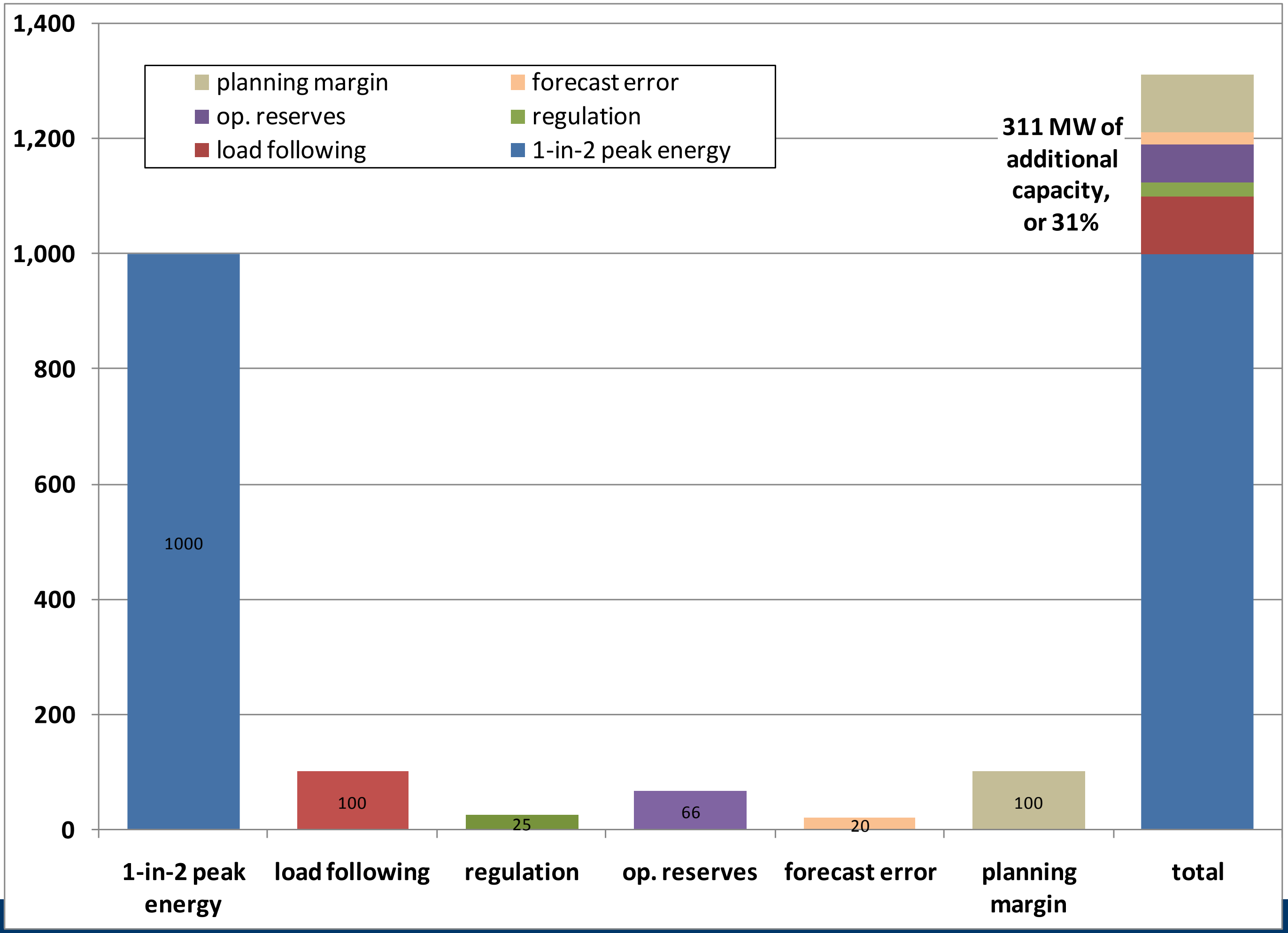
- Coal
  - Ramp rates

- Load Interruption (aka demand-side management)
  - Coincidence of measure with system peaking periods
  - Frequency of interruption rights
  - Duration of interruption rights
  - Sustainability of interruption savings
    - Especially when looking outside of industrial/large commercial classes

Key Considerations by Resource, Cont.

- Market Purchases
  - How much is available during critical events
    - Transmission constraints
    - Surpluses on 3rd party systems
  - “Firmness” of anticipated deliveries
    - Is 3rd party “firming” the sale?
    - In other words, will purchases be cut during critical events to serve 3rd-party system?

Illustration of Capacity Obligation



Metrics to Measure Resource Adequacy

- Loss of Load Probability (LOLP)
  - Percent of iterations that have at least one loss of load event

- Loss of Load Expectation (LOLE)
  - Days with an event; units are the number of days per year

- Loss of Load Hours (LOLH)
  - Hours with an event; units are the number of hours per year

- Expected or Equivalent Unserved Energy (EUE)
  - Average quantity of energy not served in each iteration (MWh)

Planning Margin Perspectives

- Avista Margin History
  - 10% of peak load, plus 90 MW (1980s-2008)
  - 15% of peak load (2009)

- FERC Standard Market Design: 12-18%

- Northwest Power and Conservation Council: 23% winter (January) , 24% summer (July)

- Avista 2011 IRP Margin
  - Based on probabilistic reliability study
    - LOLP, LOLE, LOLH, EUE metrics
      - 5% LOLP (proposed)
      - 1 day in 10 years LOLE (proposed)
      - LOLH and EUE (TBD)

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Loss of Load Probability

James Gall

Technical Advisory Committee Meeting #1

2011 Electric Integrated Resource Plan

May 27, 2010

Overview

Why

Avista's capacity planning margin is 15% of peak load. Without conducting a statistical analysis regarding probability of no serving all customer load due to lack of generation, the 15% should be questioned- especially as additional variable generation is added.

Modeling

- 8,760 hours for ~1,000 potential outcomes (draws, games, iterations, etc)
- Study 2012, '16, '20, '24, and '28
- Randomizes: forced outages, temperature, loads, wind generation, and hydro conditions
- Takes into account hydro constraints, market purchases, and reserves including: within hour load variation, variable resource reserves, and operating reserves
- Can illustrate benefits using demand response and federal emergency hydro

For the Next TAC meeting

- Detailed presentation on how model works
- Finalize 2012 study (final load & wind modules)
- Market reliance scenarios
- Test 2009 IRP's Preferred Resource Strategy for later years

Energy Efficiency & Demand Response

Lori Hermanson

Technical Advisory Committee Meeting #1

2011 Electric Integrated Resource Plan

May 27, 2010

Energy Efficiency Progress Since Last IRP

- **Targets and Year-to-Date Achievement**
- **I-937 Plan for Washington accepted with conditions**
  - Target for Washington electric only
  - Year-to-date results toward I-937 targets
- **Demand Response Pilot**
  - Tested and improved equipment capability on Avista's system
  - Initiated 10 successful events of either cycling heating or AC or shutting off water heaters for 2-4 hrs
  - Proved customers' strong willingness to participate with few opt-outs
  - Low northwest on/off-peak price differentials makes these programs not cost effective

Next Steps for 2011 IRP

Conservation Potential Assessment (all states, gas/electric)

- Issue RFP in June
- Complete RFP by October
- Evaluate TRC cost-effectiveness with draft IRP electric price forecast in November
- Establish energy efficiency placeholder levels in early January
- Update with finalized IRP electric price forecast in late January
- Finalize energy efficiency levels in early February
- Draft energy efficiency and demand response section of IRP document

Avista's 2011 Electric Integrated Resource Plan

Technical Advisory Committee Meeting No. 2 Agenda

September 8th and 9th, 2010
Avista Headquarters – Spokane, Washington

Wednesday, September 8th

Leave from Avista	**8:30 am**
Lancaster Tour	**9:30 am**
Rathdrum CT & Boulder Park Stops	
Lunch – Sawtooth Grill	**12:30 pm**
Upper Falls & Monroe Street	**1:45 pm**
Return to Avista	**4:00 pm**

Thursday, September 9, 2010
Avista Conference Room 130

Topic	Time	Staff
1. Introduction	10:00	Storro
2. Resource Assumptions	10:05	Lyons
3. Reliability Planning	10:35	Gall
4. Lunch	11:30	
5. Sustainability Report	12:30	Wuerst
6. Combined Heat and Power Generation	1:30	Dempsey
7. Energy Efficiency	2:30	Hermanson
8. Adjourn	3:30	

Resource Assumptions

John Lyons

Technical Advisory Committee Meeting #2

2011 Electric Integrated Resource Plan

September 9, 2010

Supply Side Resource Data Sources

- Power Council – 6th Power Plan
- Resource lists developed internally from:
  - Trade journals
  - Press releases from other companies
  - Engineering studies and models
  - State commission announcements
  - Proposals from developers
- Consulting firms/reports
- State and federal resource studies
- Data sources are used to check and refine generic resource assumptions

Resource Updates from 2009 IRP

- Focusing on resource options identified in the 6th Power Plan
- Lancaster PPA began serving Avista Utilities load on January 1, 2010
- 150 MW of Northwest based wind in the 2009 Preferred Resource Strategy has been postponed
- Noxon Rapids Unit #3 upgrade completed in April 2010; Unit #2 and #4 upgrades scheduled for April 2011 and April 2012
- Started work on the Nine Mile upgrade

Natural Gas-Fired Resources

Resource Type	First Year	Size (MW)	Levelized Overnight Costs (2012 $/MWh) *	Capital Cost Excludes AFUDC (Nominal 2012)
SCCT (aero)	2014	46	$106	$1,033/kW
SCCT (frame)	2014	83	$114	$591/kW
Hybrid SCCT	2014	94	$103	$1,107/kW
CCCT (air)	2016	270	$88	$1,105/kW
CCCT (water)	2016	275	$85	$1,053/kW
Small Cogeneration	2015	5	$112	$3,472/kW
Reciprocating Engine	2014	99	$111	$1,139 /kW

* Prices are based on a preliminary gas price forecast

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Other Thermal Resources

Resource Type	First Year	Size (MW)	Levelized Overnight Costs (2012 $/MWh)	Capital Cost Excludes AFUDC (Nominal 2012)
Coal (Ultra-critical)	2018	300	$123	$3,250/kW
Coal (IGCC)	2014	300	$138	$3,252/kW
Coal (IGCC w/sequestration)	2018	250	$156	$4,722/kW
Nuclear	2021	500	$150	$5,802/kW

Renewable Resources

Resource Type	First Year	Size (MW)	Levelized Overnight Costs (2012 $/MWh)	Capital Cost Excludes AFUDC (Nominal 2012)
Wind	2016	50	$106	$1,951/kW
Geothermal	2017	15	$110	$4,463/kW
Wood Biomass	2015	25	$166	$3,710/kW
Landfill Gas	2014	3.2	$60	$2,023/kW
Manure Digester	2013	0.85	$111	$4,304/kW
Waste Water Treatment	2014	0.85	$114	$4,304/kW
Solar Photovoltaic	2014	5	$429	$7,140/kW
Solar Thermal	2016	25	$195	$4,751/kW

Avista Hydro Upgrades

Resource Type	Year	Size (MW)
Little Falls 1 Upgrade	2014	1.0
Little Falls 2 Upgrade	2015	1.0
Little Falls 3 Upgrade	2016	1.0
Little Falls 4 Upgrade	2017	1.0
Post Falls New Powerhouse	TBD	TBD
Upper Falls Upgrade	2019	2.0
Long Lake Second Powerhouse / Pumped Storage	2020	60
Long Lake Second Powerhouse	2020	50 – 60
Cabinet Gorge Unit 5	2015	50
Monroe Street Unit 2	TBD	37.5

Cost estimates for these potential Avista resource upgrades will be presented at a later TAC meeting after the estimates are further developed

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Reliability Planning

James Gall

Technical Advisory Committee Meeting #2

2011 Electric Integrated Resource Plan

September 9, 2010

Overview

Objective

Develop a planning tool to help quantify the amount of resources need above expected peak load

Why

A 15% capacity planning margin is currently added to forecast peak load. Without conducting a statistical analysis regarding the probability of not serving all customer load and reserve requirements, the 15% should be questioned- especially as variable generation is added.

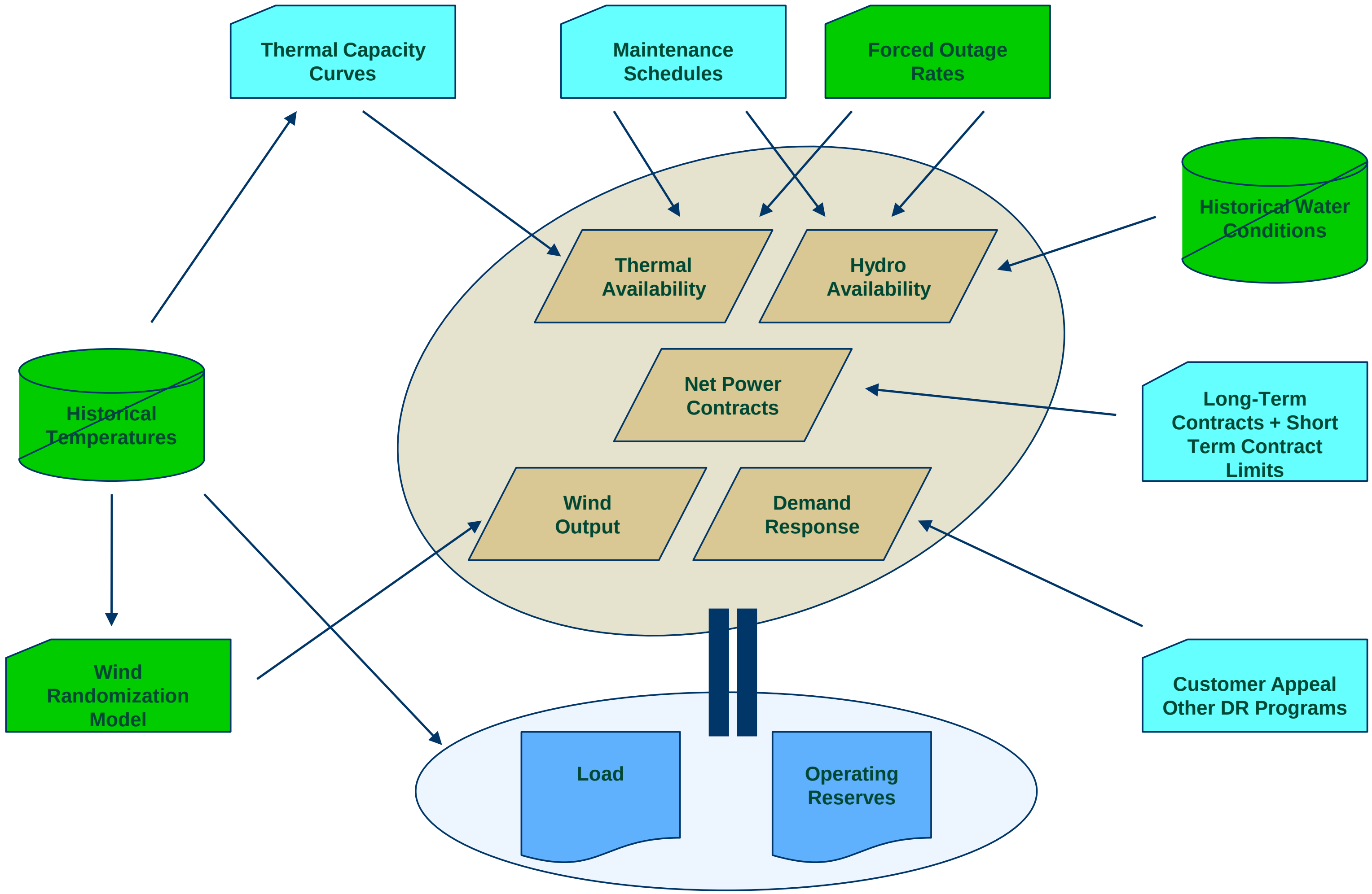
End Result

Determine load variation adder to include in long-term load & resource balance (In addition to regulating reserves and regulating margin)

Modeling

- 8,760 hours for 800 potential outcomes (draws, games, iterations, etc)
- This presentation includes 2012 and 2017
- Other years of interest 2016, 2020, 2025, 2027
- Randomizes: forced outages, temperature, loads, wind generation, and hydro conditions
- Includes hydro constraints, short-term market purchases, and reserves including: within hour load variation, variable resource reserves, and operating reserves
- Can illustrate benefits of using demand response and federal hydro

Reliability Model



Loads

- Load shapes are derived from historic daily high and low temperatures
- Uses 120 years of Spokane temperatures
- The average load of all iterations matches the energy load forecast
- The average of the peak load is within the standard error of the peak load forecast
- Hourly load forecast uses monthly regression model with coefficients:
  - hour, day, temperature, and major weather event triggers

Hydro

- Randomly selects a hydro year between 1928 and 1999
- Each hydro year includes monthly energy averages
- Run-of-river facilities
  - Monthly energy average is used for all hours of the month
  - No shaping or reserves are assumed to be available
- Storage facilities
  - Monthly average generation equals the “drawn” hydro level
  - In case of planned/forced outage, water can be spilled
  - Linear program moves energy into hours needed to meet load
  - Reservoir min and max levels, ramping rates, and daily limits are enforced
  - Unused capacity is held as operating reserves

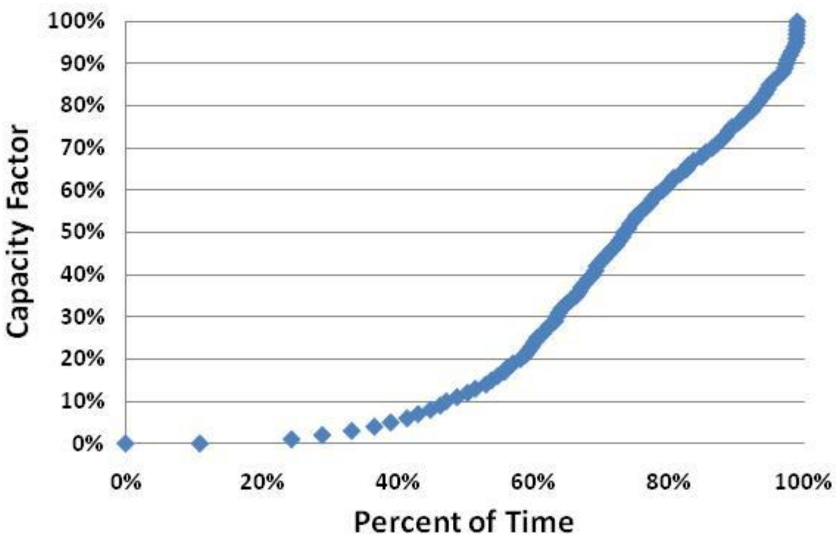
Thermal

- Plants are considered available rather than dispatched
- Temperature dependency
  - Gas-fired facilities use capacity based upon location temperature
  - Temperatures are randomly drawn and are the same as the temperatures used in the load calculation
- Forced outages
  - Input forced outage rate and mean-time-to-repair
  - Outages occur randomly using a frequency and duration method
  - Ramp rates are used following outages
- Maintenance schedules
  - Planned maintenance schedules are assumed
  - Typical outages are in April though June

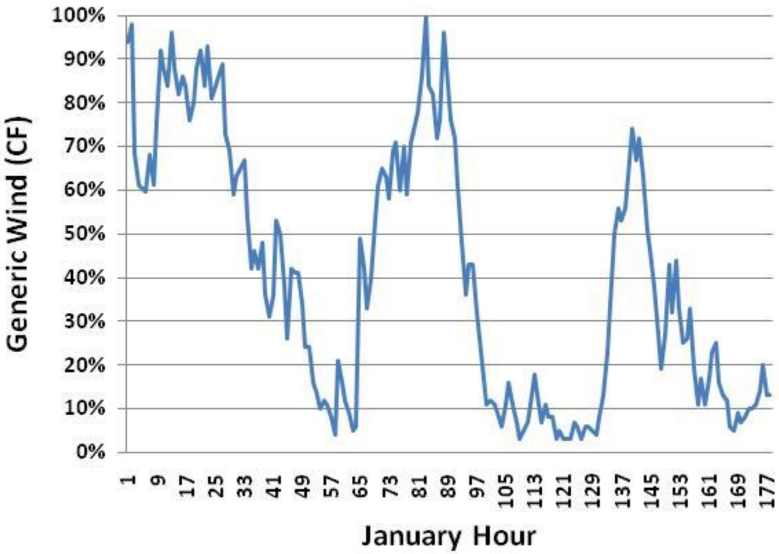
Wind

- Uses monthly on/off peak duration curves *(see chart on left of January on-peak hours)*
- Random number selects position on curve
- Following hour is correlated to previous hour using a correlation factor and variation

January On-Peak Wind Duration Curve



January Hourly Simulated Wind Generation



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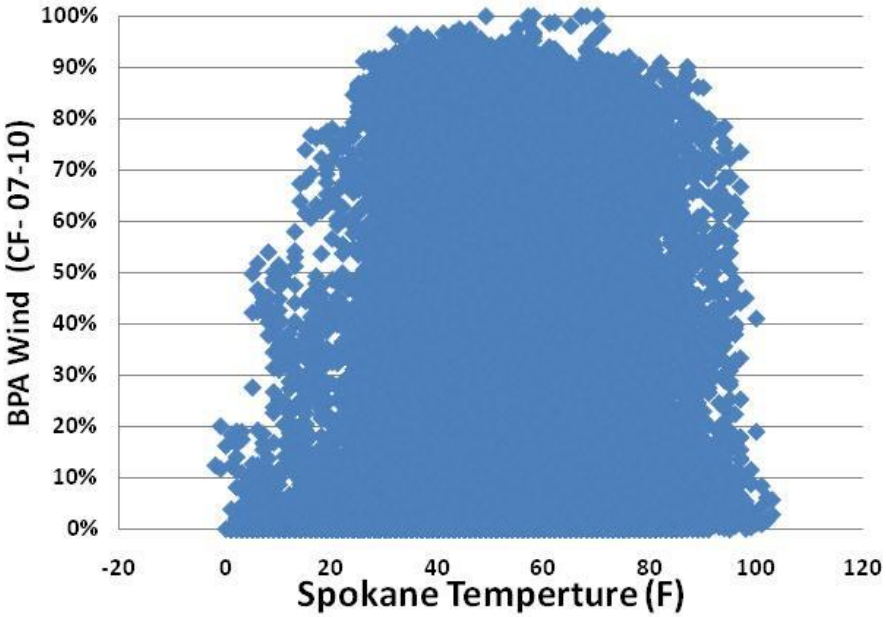
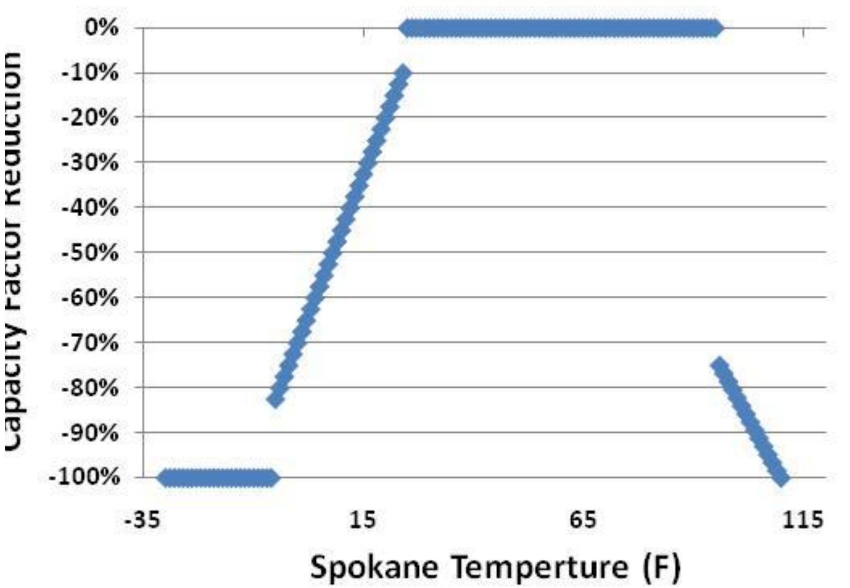
Wind *(continued)*

- Historical data from BPA control area shows generation is mitigated in below 32° F and above 95° F. *(see chart below on left)*
- Capacity factors are reduced at specified temps to model this phenomenon, *(see chart on right)*

BPA Wind CF vs Spokane Temperatures



Capacity Factor Adjustments for Specific Temperatures



Demand Curtailment

- Customer appeal
  - Public appeal to all customers to conserve energy, radio/TV broadcasts
  - Base case includes 25 MW reductions up to two times per year for hours across the peak
- Industrial process
  - Not included in base case
  - Designed to shift load from peak hours
- Sensitivities studies can help determine value of programs

Reserves

- Operating Reserves:
  - 5% hydro and 7% thermal are simplified to 6% of load minus market purchases
  - Simplification allows linearization of the objective function
- Regulating Margin:
  - 1.6% of average hourly load level (based on historical average of max load within hour versus average load)
  - Capacity is for within hour load variations
- Intermediate (Wind) Resource Regulation:
  - Lesser of 10% of nameplate capacity or generation amount
- Reserves are met by excess hydro capacity and thermal generation in excess of load

Third Party Transactions

- Long term firm power agreements are considered in the objective function
- Short-term transactions are treated as available market purchase, no short-term sales are considered
- In tight market conditions (low or high temperatures) market availability is limited to 300 MW on-peak and 500 MW off-peak.
- In other market conditions the market availability is limited to 500 MW on-peak and 750 MW off-peak.
- Scenario analysis will be performed to understand the change in loss of load given these assumptions

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Objective Function

Load Serving

- Load [SM]
+ Available thermal capacity [RM]
+ Dispatched hydro capability [LP]
+ Wind generation [SM/RM]
+/- LT Contracts
+ Federal Hydro (optional)
+ Demand Curtailment (optional) [LP]
+ Market Purchases

>= 0 or event triggered

Operating Reserves

- Operating Reserve Requirement
- Intra-hour load regulation
- Wind regulation
+ Available thermal capacity
+ Unused hydro capacity

>= 0 or event triggered

SM: Stochastic Model
RM: Randomization Model
LP: Linear Program

Metrics

- Monthly and Annual Data
- Loss of Load Probability (LOLP): percent of iterations with a reserve or load loss
  - Calculation: iterations with event / # of iterations
  - Metric: 5% or less
- Loss of Load Hour (LOLH): expected number of hours each year with a load loss
  - Calculation: total hours with event / (# of iterations)
  - Metric: 0.24 (24 hours per 10 years)
- Loss of Load Expectation (LOLE): expected number of days each year with a load loss
  - Calculation: Days with event / # of iterations
  - Metric: 1 day in 10 years or 0.10 or less [or do we want 0.05, 1 in 20?]
- Equivalent Unserved Energy (EUE): average MWh of lost load over a year

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2012 Assumptions

- Noxon Rapids 4 is on maintenance Jan – mid March
- 300 MW on-peak market
- No Federal hydro release

2012 Draft Results

Item	Annual Results	Target
LOLP	4.8%	Below 5%
LOLH	0.255	Not below 0.24
LOLE	0.066	Below 0.10
EUE	38.47	TBD

Results	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Iterations												
Load loss w/o reserves	7	2	3	0	0	0	2	1	0	0	0	1
Load loss w/ reserves	5	2	3	0	0	0	2	1	0	0	0	1
Reserve violatons	16	3	0	0	0	0	7	4	0	0	0	0
Total Load Loss or Reserve Violatons	**20**	**5**	**3**	**0**	**0**	**0**	**7**	**5**	**0**	**0**	**0**	**1**
LOLP	**2.5%**	**0.6%**	**0.4%**	**0.0%**	**0.0%**	**0.0%**	**0.9%**	**0.6%**	**0.0%**	**0.0%**	**0.0%**	**0.1%**
Hours at Loss												
Load loss w/o reserves	79	31	22	0	0	0	7	6	0	0	0	10
Load loss w/ reserves	64	27	20	0	0	0	6	6	0	0	0	8
Reserve violations	37	7	0	0	0	0	29	9	0	0	0	0
Total Load Loss or Reserve Violations	**98**	**34**	**20**	**0**	**0**	**0**	**29**	**15**	**0**	**0**	**0**	**8**
LOLH	**0.12**	**0.04**	**0.03**	**-**	**-**	**-**	**0.04**	**0.02**	**-**	**-**	**-**	**0.01**
Other Data												
Reserves Used (MWh/Iterations)	12	8	5	-	-	-	1	1	-	-	-	2
Unserved Energy (MWh/Iterations)	14	8	6	-	-	-	1	1	-	-	-	3
Reserve Violations (MWh/Iterations)	3	0	-	-	-	-	2	0	-	-	-	-
Unserved Energy (MWh/Iterations)	2	0	1	-	-	-	0	0	-	-	-	0
EUE: Unserved Energy/Reserves (MWh/Iteratons)	**4.7**	**0.7**	**1.2**	**0.0**	**0.0**	**0.0**	**2.2**	**0.3**	**0.0**	**0.0**	**0.0**	**0.1**
Market used (iterations)	286	120	39	6	518	548	349	374	92	56	91	37
Market used (hours)	5,100	1,450	968	19	5,785	6,136	4,072	8,246	1,179	727	2,055	332
Probability of market	35.8%	15.0%	4.9%	0.8%	64.8%	68.5%	43.6%	46.8%	11.5%	7.0%	11.4%	4.6%

2012 Draft Results

(What if Noxon 4 was not on Maintenance?)

Item	Annual Results	Target
LOLP	2.5%	Below 5%
LOLH	0.14	Below 0.24
LOLE	0.035	Below 0.10
EUE	18.99	TBD

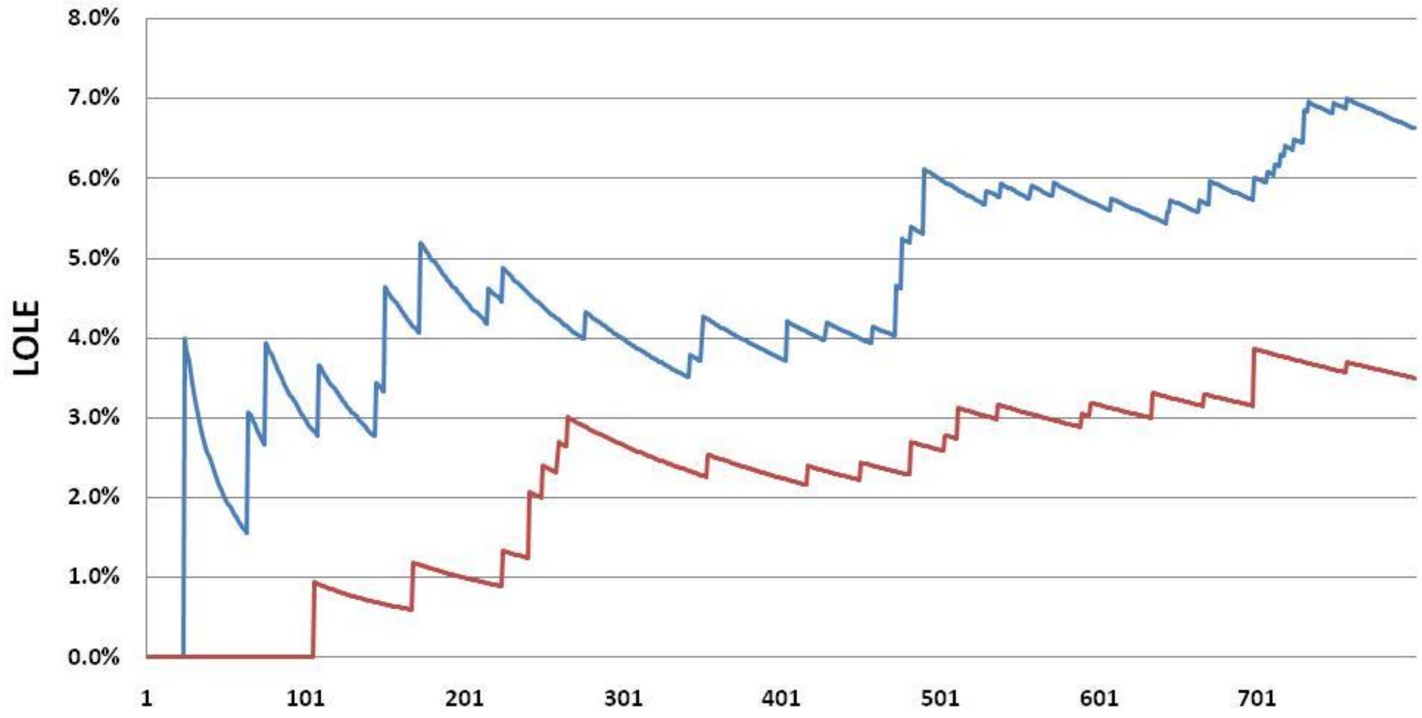
Results

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Iterations												
Load loss w/o reserves	1	1	0	0	0	0	0	0	0	0	2	0
Load loss w/ reserves	1	1	0	0	0	0	0	0	0	0	2	0
Reserve violatons	7	0	0	0	1	0	4	2	1	0	0	2
Total Load Loss or Reserve Violatons	**8**	**1**	**0**	**0**	**1**	**0**	**4**	**2**	**1**	**0**	**2**	**2**
LOLP	**1.0%**	**0.1%**	**0.0%**	**0.0%**	**0.1%**	**0.0%**	**0.5%**	**0.3%**	**0.1%**	**0.0%**	**0.3%**	**0.3%**
Hours at Loss												
Load loss w/o reserves	54	13	0	0	0	0	0	0	0	0	9	0
Load loss w/ reserves	51	12	0	0	0	0	0	0	0	0	6	0
Reserve violations	15	0	0	0	2	0	10	8	2	0	0	6
Total Load Loss or Reserve Violations	**66**	**12**	**0**	**0**	**2**	**0**	**10**	**8**	**2**	**0**	**6**	**6**
LOLH	**0.08**	**0.02**	**-**	**-**	**0.00**	**-**	**0.01**	**0.01**	**0.00**	**-**	**0.01**	**0.01**
Other Data												
Reserves Used (MWh/Iterations)	12	2	-	-	-	-	-	-	-	-	1	-
Unserved Energy (MWh/Iterations)	13	2	-	-	-	-	-	-	-	-	1	-
Reserve Violations (MWh/Iterations)	1	-	-	-	0	-	0	0	0	-	-	0
Unserved Energy (MWh/Iterations)	1	0	-	-	-	-	-	-	-	-	0	-
EUE: Unserved Energy/Reserves (MWh/Iteratons)	**2.1**	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.5**	**0.4**	**0.0**	**0.0**	**0.4**	**0.2**
Market used (iterations)	203	83	49	6	539	560	352	382	82	41	95	34
Market used (hours)	3,954	1,110	985	8	5,712	5,971	3,822	8,183	1,039	485	2,353	267
Probability of market	25.4%	10.4%	6.1%	0.8%	67.4%	70.0%	44.0%	47.8%	10.3%	5.1%	11.9%	4.3%

Results (DRAFT)

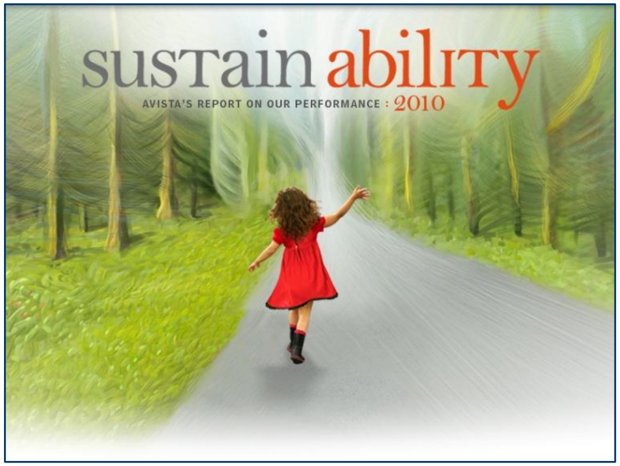
Study	LOLP (% of draws)	LOLH (Avg un-served hours)	LOLE (Avg un-served days)	EUE (Avg Un-served MWh)
2012	4.8%	0.255	0.066	38.47
2012 (Noxon Available all Year)	2.5%	0.140	0.035	18.99
2017 (with 150 MW wind)	1.5%	0.099	0.019	20.75
2017 (No Wind)	1.9%	0.110	0.028	20.17

How Many Iterations Is Enough?



Next Steps For Reliability Planning

- Study additional years
- Re-evaluate number of draws
- Run scenarios for different market availability amounts, demand curtailment, and wind penetration
- Evaluate moving model from Excel/WB to a different platform to increase speed
- Lock down acceptable metrics for load loss
- Develop new planning margin based upon results of the study
- More to come at a future TAC meeting



Avista's 2010 Sustainability Report

TAC Presentation

SEPT. 9, 2010

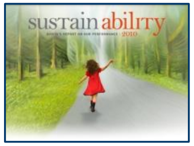
"To be persuasive, we must be believable; to be believable, we must be credible; to be credible, we must be truthful."

Edward R. Murrow

Our commitment to sustainability:

Avista's goal is to provide energy for today's customers while preserving the ability of future generations to do the same.

We strive to engage our stakeholders -- customers, investors, employees, communities and others – in achieving this goal.



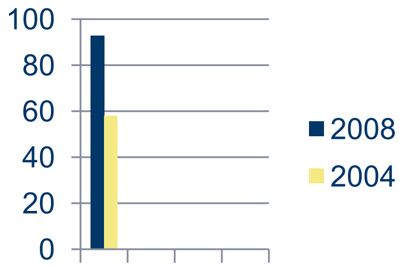
Why do a Corporate Sustainability Report?

"The time has come to usher in a new era…of responsibility."
President Barak Obama

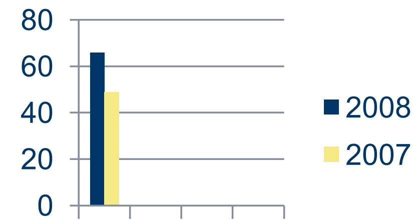
- Trust and transparency have been found to be as important to corporate reputation as service quality.

- CSR is a means to provide enterprise-wide information in a single location about our company's strategies and actions impacting ***people, planet and performance*** – topics key to building trust.

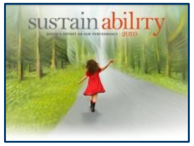
- An increasing number of investors, customers and other stakeholders and prospective employee are looking for this information.



# of S&P 100 companies including web-based sustainability information



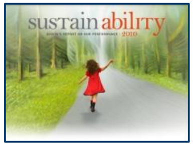
# of S&P 100 companies producing formal sustainability reports



Source: Social Investment Forum, Dec. 2009)

Objectives of Avista's Sustainability Report:

- Be a launch pad for initiating stakeholder conversations and enhancing engagement, internally and externally
- Provide information about Avista's environmental, operations, governance and socially responsible programs and actions and business practices
- Act as a catalyst for internal strategy and goal setting



What goes into a sustainability report?

- Sustainability Action Team – Internal, cross-enterprise

Environmental, Safety, Production & Generation, DSM/Energy Solutions, Power Supply, Facilities, Supply Chain, Human Resources, Finance, Corporate Communications

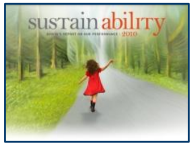
Global Reporting Initiative™

- Prioritizing topics for inclusion
  - Assess stakeholder interest
  - Assess society's interest
  - Determine business position
  - Determine impact on reputation
  - Public or reportable information

113 Performance indicators reported on

- Structure of the report

- Distribution of the report



AVISTA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OUR COMMUNITY
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GO
Scott Morris on Avista's Sustainable Future
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Our Company
Our Employees
Our Customers & Communities
Our Environment
About the Report
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AVISTA'S REPORT ON OUR PERFORMANCE : 2010
B
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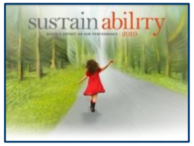
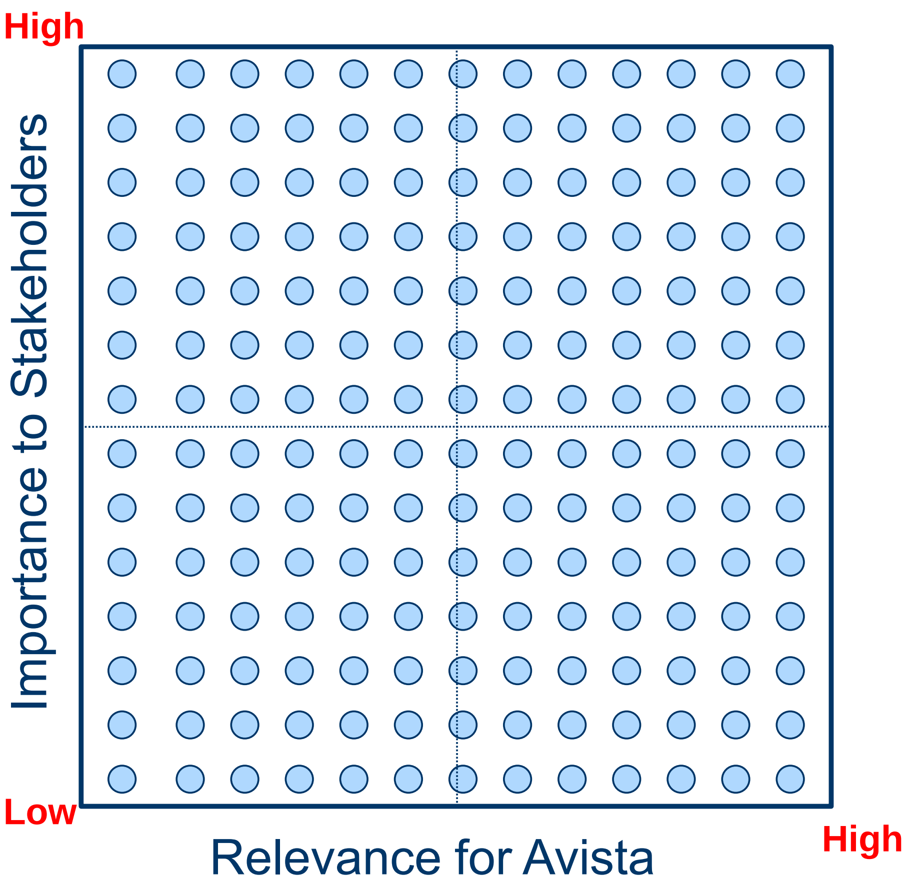
Considerations for Future Sustainability Reporting

- Review of 2010 report by GRI
- Determine project's scope and direction and align these with Avista's strategic direction
- Initiate in-depth conversations with departments across the company to determine additional reporting and data assurance opportunities
- Expand the number of external stakeholders who give feedback on the report
- Increase the visibility of Avista's sustainability report and practices across stakeholders and other audiences without "green washing"



Materiality: Which information to Include?



Topics to Consider

- Avista's Energy Efficiency
- Biodiversity
- Corporate Citizenship
- Customer Satisfaction
- Direct Use of Natural Gas
- DSM Programs
- Employee Satisfaction
- Energy Security
- Environmental Performance
- Ethical Business Practices
- Executive Compensation
- Financial Performance
- GHG Footprint
- Global Climate Change
- Governance
- Human Resources
- NGO Relations
- Public Policy
- Rates
- Resource Planning
- Safety
- Stakeholder Engagement
- System Reliability
- Supply Chain
- Waste Discharge
- Water use
- Work Force Diversity

Others??

Cogeneration Case Study

Thomas C. Dempsey, PE
Manager Generation Joint Projects

Technical Advisory Committee Meeting #2
2011 Electric Integrated Resource Plan
September 9, 2010

Cogeneration

"Cogeneration is the use of a heat engine or a power station to simultaneously generate both electricity and useful heat."- Wikipedia

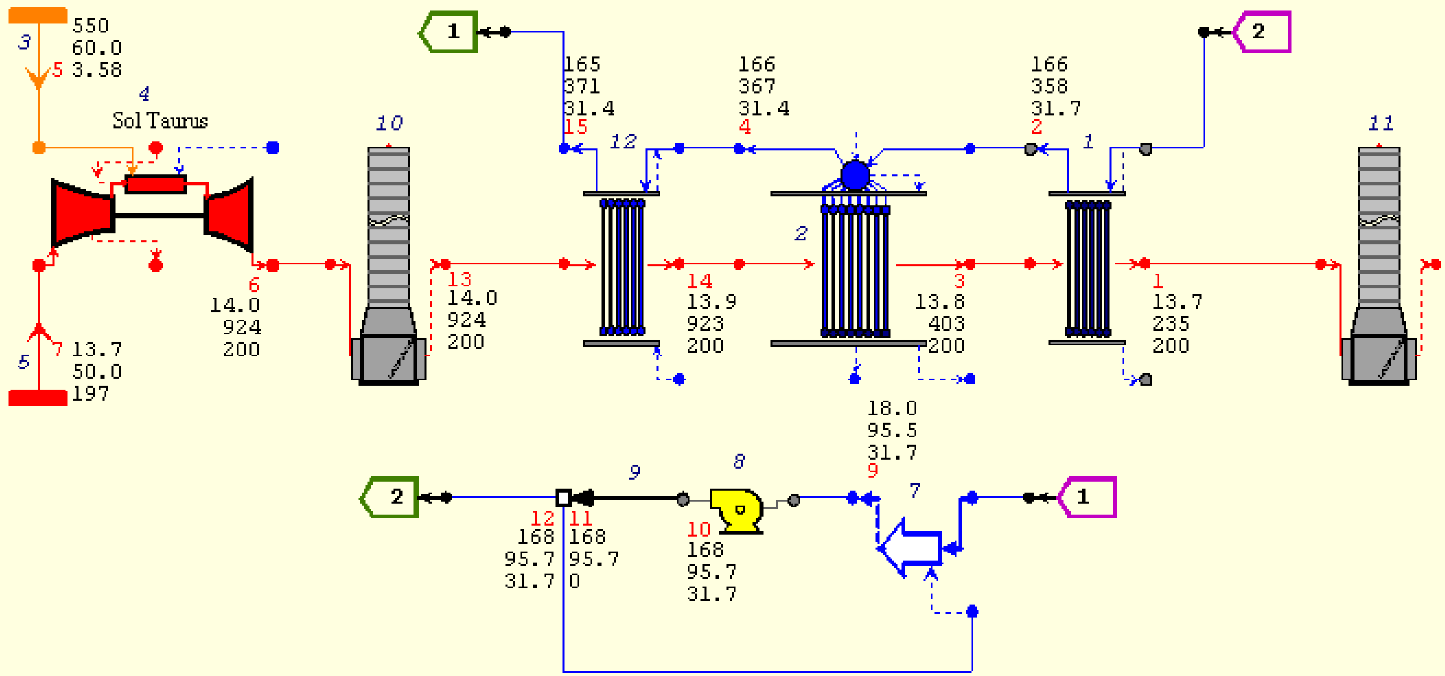
"A combined cycle is characteristic of a power producing engine or plant that employs more than one thermodynamic cycle"- Wikipedia

Cogeneration= Power [kW]+ Heat [Btu/hr]

Combined Cycle = Gas Turbine Power [kW] + Steam Turbine Power [kW]

Cogeneration Design

Solar Taurus 70 Combined Heat and Power



Net power	6801	kW
Net process output	35606	kBTU/h
CHP efficiency	82.62	%
PURPA efficiency	57.61	%
Net heat rate(HHV)	11587	BTU/kWh
Net fuel input(HHV)	78808	kBTU/h
Energy chargeable to power	32897	kBTU/h
Electric efficiency on chargeable energy	70.55	%

Efficiency of a Combined Cycle Plant

Efficiency = What you get/What you pay for
Heat Rate = What you pay for/What you get
Heat Rate = 1/Efficiency

How does the efficiency of a combined cycle plant compare with that of a cogeneration facility? Shown below are numbers typical to advanced combined cycle combustion turbine facilities. What we pay for is the fuel expressed in terms of British Thermal Units [Btu's]. What we "get" is *electrical* energy expressed in terms of kilowatt-hours [kWh's]. **Advanced combined cycle turbines have higher heating value net efficiencies around 50%.**

$$CombinedCycleEfficiency = \frac{1}{NetHeatRate}$$

$$CombinedCycleEfficiency = \frac{1}{6800\,\frac{Btu}{kWh}} \times 3412\,\frac{Btu}{kWh} = 50\%$$

NOTE: Btu's and kWh's are both units of "energy". We multiply by the unit conversion factor of 3412 in order to arrive at a dimensionless number which we can express as percent.

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Efficiency of a Cogeneration Facility

Efficiency = What you get/What you pay for

There are many ways of looking at the efficiency of a cogeneration facility. The calculation below is calculated strictly in terms of useful energy divided by fuel energy. **For the example turbine modeled, the thermal efficiency as calculated below is much higher than the thermal efficiency for my example combined cycle plant.**

$$CogenEfficiency = \frac{Electricity + Heat}{Fuel}$$

$$CogenCycleEfficiency = \frac{6801kW \times \frac{3.412kBtu}{kWh} + 35606\frac{kBtu}{h}}{78808\frac{kBtu}{h}}$$

$$CogenCycleEfficiency = 75\%$$

NOTE: Solar Taurus 70, Spokane Elevation, 150 psig steam, no duct firing

Comparing Combined Cycle with Cogen on Equivalent Terms

3.5 Energy Accounting

In a pure power plant, efficiency is simply defined as:

Electric Efficiency = Power Out/Fuel In

In most cases, this is expressed as a percentage, requiring that the numerator and denominator be quantified in the same units. Distinctions are made as to whether the 'power out' is the gross power (at the generator terminals) or the net power (that available to the grid after deducting plant auxiliary loads and transformer losses). Separate distinctions indicate whether the energy flow rate cited as 'fuel in' is the LHV or HHV fuel energy flow rate.

An alternate comparison of output power with fuel energy consumption is the heat rate, essentially the reciprocal of the efficiency.

Heat Rate = Fuel In/Power Out

Unlike efficiency, heat rate is generally left in a dimensional form, Btu/kWhr or kJ/kWhr.

The efficiency of a cogeneration plant, that produces useful heat as well as electric power, may be expressed as a *Total Efficiency*, also called the *CHP Efficiency* (Combined Heat & Power), or as a *PURPA Efficiency* (Public Utilities Regulatory Policy Act of 1979, a US regulatory measure of efficiency):

Total (CHP) Efficiency = (Power Out + Net Process Heat Out)/Fuel In

PURPA Efficiency = (Power Out + 1/2 Net Process Heat Out)/Fuel In

Comparing Combined Cycle with Cogen on Equivalent Terms

Assumptions

1. The boiler efficiency of the auxiliary boiler is assumed based on typical industry values.
2. Thermoflex 20 model of a Solar Taurus 70, 150 psig steam, Spokane Elevation

Constants:

Cogen simple cycle net heat rate $CGSS_{HR} := 11587 \frac{BTU}{kW \cdot hr}$ $SteamEnergy := 35.606 \cdot \frac{MillionBTU}{hr}$

Auxiliary boiler efficiency $B_{eff} := 82 \cdot \%$ $Power := 6801 \cdot kW$

Case 1 COMBINED CYCLE- In this case we are using a combined cycle unit to generate our electrical needs and a separate auxiliary boiler to generate the steam we need.

Combined cycle net heat rate $CC_{HR} := 6800 \frac{BTU}{kW \cdot hr}$

Combined cycle fuel consumption $CC_{gasin} := CC_{HR} \cdot Power$ $CC_{gasin} = 46.2 \cdot \frac{MillionBTU}{hr}$

AUXILIARY BOILER:

$SteamEnergy = 35.6 \cdot \frac{MillionBTU}{hr}$

$AuxBoiler_{gasin} := \frac{SteamEnergy}{B_{eff}}$ $AuxBoiler_{gasin} = 43.4 \cdot \frac{MillionBTU}{hr}$

$TotalGas := CC_{gasin} + AuxBoiler_{gasin}$ $CCE\% := \frac{1}{CC_{HR}}$

Case 2 COGENERATION- In this case we are using a COGEN unit to meet both power and steam needs.

Cogen turbine fuel consumption $CG_{gasin} := CGSS_{HR} \cdot Power$ Equivalent Electric Heat Rate $EEHR := \frac{CG_{gasin} - AuxBoiler_{gasin}}{Power}$

Cogen Equivalent Electric Efficiency $CGEE\% := \frac{1}{EEHR}$

Comparing Combined Cycle with Cogen on Equivalent Terms

Summary: Although the efficiency of the Cogeneration facility is higher than that of the combined cycle, the equivalent efficiency of the cogen facility is significantly lower than its apparent thermal efficiency. Overall thermal efficiency is not comparable to combined cycle efficiency because steam energy is not equivalent to electric energy.

Combined Cycle Turbine

$$TotalGas = 89.7\ \frac{MillionBTU}{hr}$$

$$CC_{HR} = 6800\ \frac{BTU}{kW \cdot hr}$$

$$CCE\% = 50.2\%$$

Cogen Facility

$$CG_{gasin} = 78.8\ \frac{MillionBTU}{hr}$$

$$EEHR = 5202\ \frac{BTU}{kW \cdot hr}$$

$$CGEE\% = 65.6\%$$

For this example, the cogen facility uses only 87.8% if the gas that would be used by a combined cycle plant in conjunction with an auxiliary boiler to produce steam. At a gas price of $4.00 per Million Btu, the combined cycle would incur an additional $6.40 per MWh in fuel costs. In most cases this magnitude of reduction in costs is not enough to overcome the low economies of scale and other costs associated with cogen.

Cogeneration Fuel Savings in Context

- At $4.00 per MMBtu, this cogen case shows a reduction of $6.40/MWh in fuel costs.

- For an 80% capacity factor, maintaining 5 additional employees to operate the cogen facility around the clock will cost approximately $10.00/MWh (only 1 employee on shift most of the time). Labor costs for the combined cycle facility will be on the order of $2.50 per MWh due to enormous economies of scale effects.

- Maintenance costs for the cogen facility will be on the order of $4-$7 per MWh more than that of the combined cycle facility.

- Capital cost recovery on a per MWh basis is significantly higher for the cogen facility due to economy of scale effects.

- In the Pacific Northwest there are significant periods every year where it is uneconomic to run due to hydro run-off. A cogen facility would either have to run during uneconomic times or the plant would have to have complete redundancy with gas fired boilers.

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Energy Efficiency Approach for the 2011 Electric Integrated Resource Plan

Lori Hermanson

Technical Advisory Committee Meeting #2

2011 Electric Integrated Resource Plan

September 9, 2010

Evolvement of Energy Efficiency

- Growth in annual tariff rider funding and program offerings over the last 10 years
  - Five times more electric funding
  - Nearly 12 times more natural gas funding
- Heightened regulatory requirements and increasing amounts of Evaluation, Measurement & Verification (EM&V)
  - Annual electric (I-937 conditions) and natural gas verification of savings (Washington decoupling)
  - EM&V Collaborative as required by the Washington Utilities and Transportation Commission (WUTC) – final paper filed 9/1/10
  - WUTC required 3-6% of conservation budget on EM&V
- IRP action item and one of the I-937 conditions – potential studies every two years

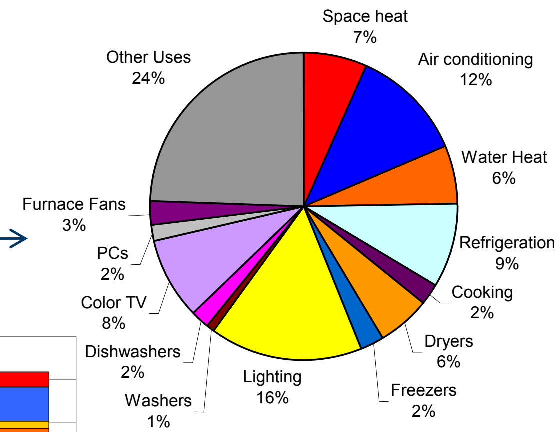
Approach for Estimating Energy Efficiency Potential

Utility data → **Base-year Energy Consumption** by state, fuel and sector

Customer surveys
Utility data
Secondary data

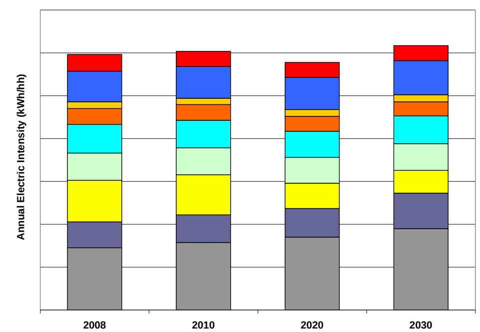
Develop prototypes and perform energy analysis

→ **Energy Market Profiles** by end use, fuel, segment and vintage



Forecast data:
Customer growth
Price forecast
Purchase shares
Codes and standards

→ **Baseline Forecast by End Use**



EE measure list
Measure costs
Energy analysis to estimate savings

→ **EE Potential**

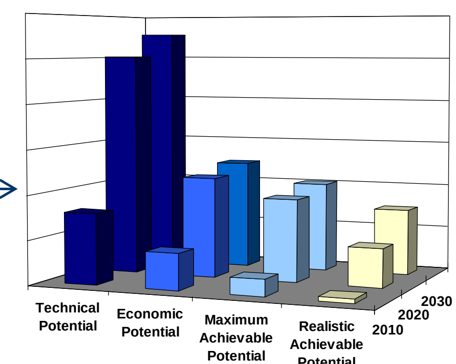


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Exhibit No. 4
Case Nos. AVU-E-12-08
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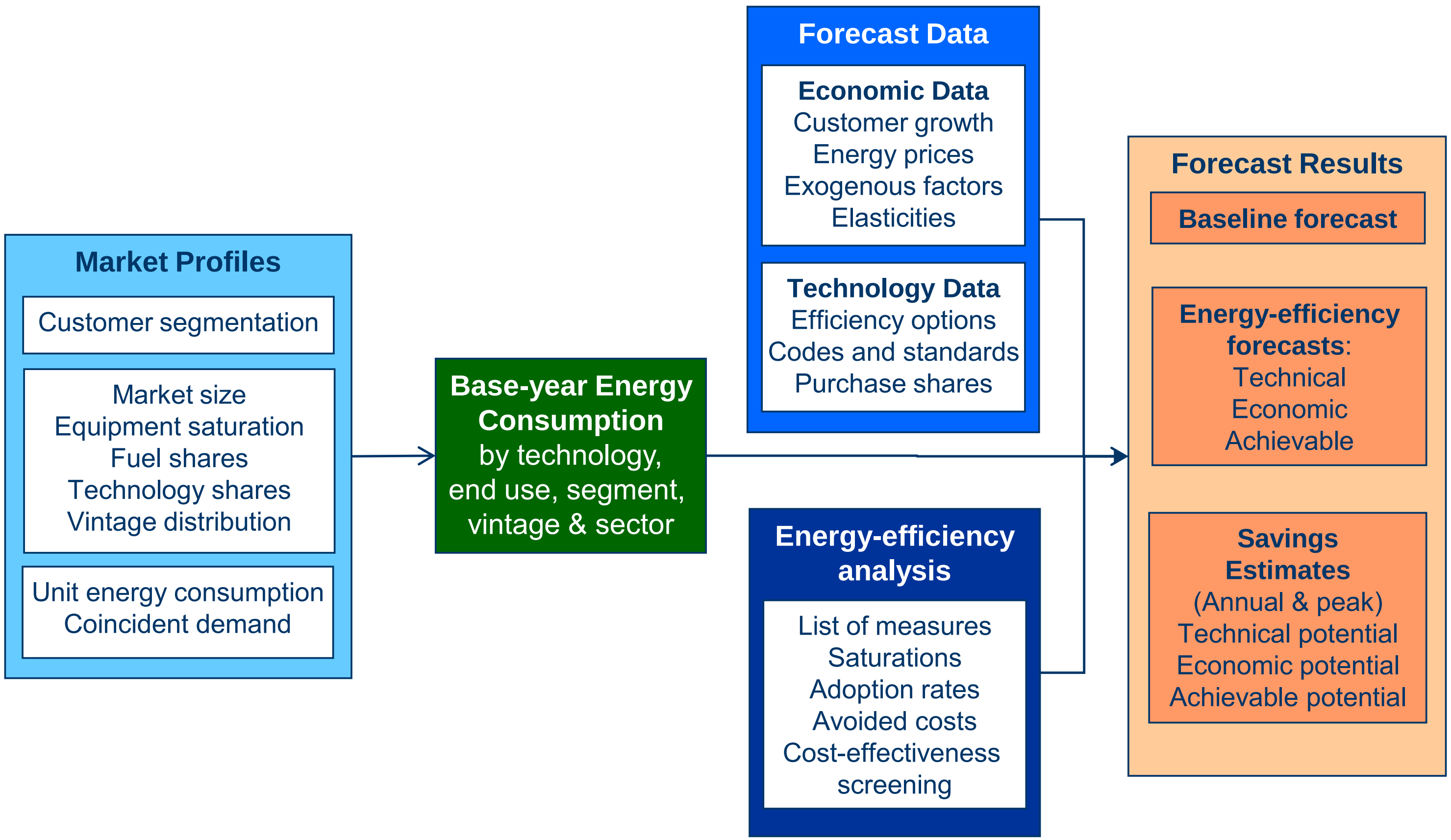
Schedule 1, Page 315 of 1069

Global Energy Partners LoadMAP™ Analysis Framework

(Load Management Analysis and Planning tool)



Market Segmentation for Energy Efficiency

- State and fuels
- By sectors
  - Residential
    - Limited Income
    - Single-family housing
    - Multifamily housing
    - Mobile homes and manufactured housing
  - Commercial and industrial by rate class
  - Pumping
- Vintage (retrofit vs. lost-opportunity)
- Appliances/end uses (space heat, cooling, lighting, water heat, motors) and technologies (lamps, chillers, color TVs, etc)
- Equipment efficiency (old, standard, high efficiency)

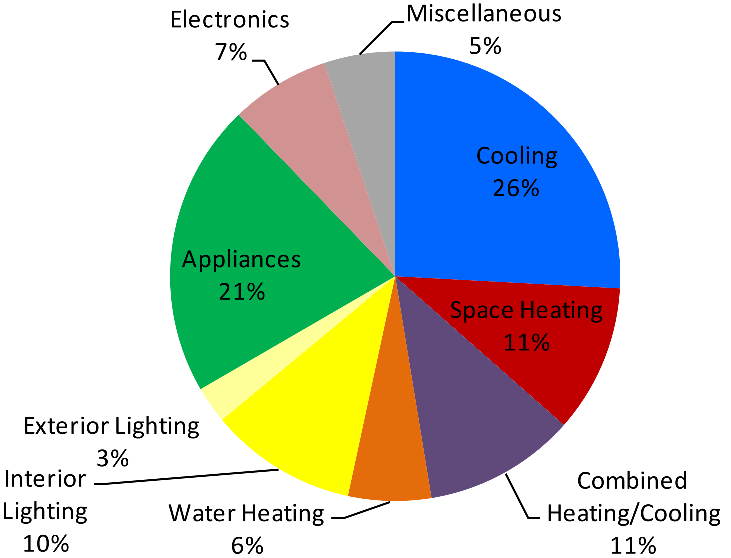
Market Segmentation for Demand Response

- State
- Energy metric (peak demand) for annual, summer and winter
- Sector
  - Residential
  - Commercial and industrial combined
- Appliances/end uses (space heat, cooling, water heat, process, other)
- Enabling technology (with and without enabling technology)

Energy Market Profile Example: Residential

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	86%	3,985	3,433	1,587
Cooling	Room AC	13%	3,188	410	190
Space Heating	Electric Resistance	5%	18,214	910	421
Space Heating	Electric Furnace	0%	18,943	-	-
Combined Heat/Cool	Air Source Heat Pump	13%	14,004	1,820	842
Combined Heat/Cool	Geo-Thermal Heat Pump	0%	9,242	-	-
Water Heating	Water Heater	24%	2,793	663	307
Interior Lighting	Screw-in	100%	1,242	1,242	574
Interior Lighting	Linear Fluorescent	100%	243	243	112
Exterior Lighting	Screw-in	85%	374	318	147
Exterior Lighting	Linear Fluorescent	85%	73	62	29
Appliances	Refrigerator	100%	891	891	412
Appliances	Freezer	42%	376	157	73
Appliances	Second Refrigerator	20%	1,326	265	123
Appliances	Clothes Washer	96%	561	540	250
Appliances	Clothes Dryer	84%	821	693	321
Appliances	Combined Washer/Dryer	0%	786	-	-
Appliances	Dishwasher	61%	173	105	49
Appliances	Cooking	71%	750	533	247
Electronics	Personal Computer	65%	470	306	142
Electronics	Color TV	96%	313	300	139
Electronics	Other Electronics	100%	343	343	159
Miscellaneous	Pool Pump	13%	2,671	339	157
Miscellaneous	Furnace Fan	68%	431	293	136
Miscellaneous	Other Miscellaneous	100%	194	194	90
	Total			**14,069**	**6,505**

End-use shares of total residential sector use



Baseline End-Use Forecast

Definition of **baseline forecast**:

- Comprehensive end-use forecast
- Forecast without future utility programs
- Incorporates appliance standards and building codes already on the books
- Typically includes naturally occurring efficiency (consistent with 6th Plan)

Process for developing the baseline forecast

1. End-use segmentation
2. Energy market profiles – snapshot of current energy use
3. Technologies/efficiency options available today and in the future
4. Forecast data and assumptions
5. Assess and compare with existing forecasts

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End-Use Segmentation Example

Residential	Commercial	Industrial
Cooling	**Cooling**	**Process Heating**
Central AC	*Central Chiller*	*Electric resistance*
Room AC	*Packaged AC*	*Radio frequency*
Space Heating	*PTAC*	**Process Cooling and Refrigeration**
Electric Resistance	**Space Heating**	**Machine Drive**
Electric Furnace	*Electric Resistance*	*1-5 hp motors*
Combined Heating/Cooling	**Combined Heating/Cooling**	*5-20 hp motors*
Air Source Heat Pump	*Air Source Heat Pump*	*20-50 hp motors*
Geothermal Heat Pump	*Geohermal Heat Pump*	*50-100 hp motors*
Water Heating	**Water Heating**	*100-200 hp motors*
Interior Lighting	**Interior Lighting**	*200-500 hp motors*
Screw-in	*Screw-in*	*500-1,000 hp motors*
Linear Fluorescent	*Linear Fluorescent*	*1,000-2,500 hp motors*
Exterior Lighting	**Exterior Lighting**	*>2,500 hp motors*
Screw-in	*Screw-in*	**Facility HVAC**
Linear Fluorescent	*Linear Fluorescent*	**Facility lighting**
Appliances	**Refrigeration**	*Incandescent*
Refrigerator	*Walk-in Refrigeration*	*Fluorescent*
Freezer	*Reach-in Refrigeration*	*HID*
Clothes Washer	**Office Equipment**	
Clothes Dryer	*PC*	
Combined Washer/Dryer	*Server*	
Dishwasher	*Monitor*	
Cooking	*Printer/Copier*	
Electronics	**Food Service**	
Personal Computer	**Ventilation**	
Color TV	**Miscellaneous**	
Other Electronics		
Miscellaneous		
Pool Pump		
Furnace Fan		
Other Miscellaneous		

Energy Market Profiles

Description

Energy market profiles describe how customers use energy in a recent base year

Market profile elements

- Market size
- Fuel shares/saturations by end use
- Unit energy consumption (UECs, EUIs) by end use/tech
- Peak factors

Profile elements are calibrated to match customer segments' use in base year from billing system

Key data sources

Market characterization data

Previous potential studies

Global's previous customer surveys

Prototypes and BEST^{TM} analysis

Forecast Data and Assumptions

Forecast drivers

Customer growth

Other exogenous variables

- Energy prices
- Income

Usage elasticities by end use for each exogenous variable

Technology forecasts

Equipment purchase shares by decision type

- Replace on burnout
- New construction
- Non-owner acquisition

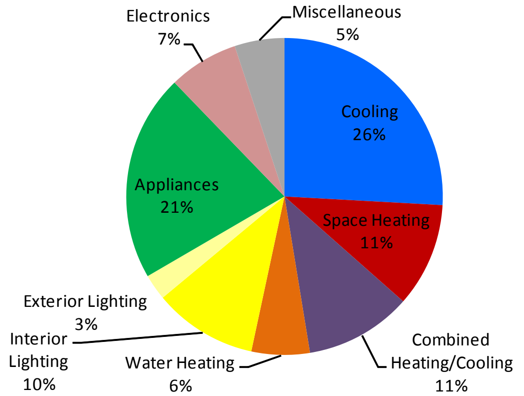
Shares are user defined

- Defaults based on trends in EIA's Annual Energy Outlook
- Incorporate existing appliance/equipment standards
- Will be refined using PNW and Avista data

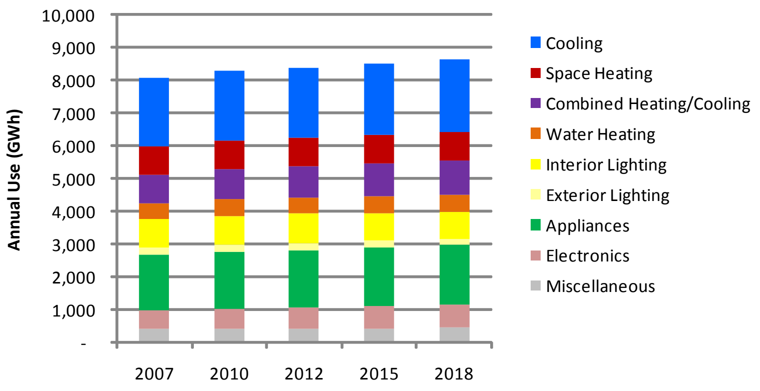
Sample Baseline Forecast for Residential Sector

Residential Use by End Use (GWh)	2007	2010	2012	2015	2018	% Change	Avg. growth rate
Cooling	2,093	2,128	2,151	2,186	2,227	6.4%	0.56%
Space Heating	862	863	864	867	871	1.1%	0.10%
Combined Heating/Cooling	883	923	951	989	1,029	16.5%	1.39%
Water Heating	482	495	503	515	528	9.7%	0.84%
Interior Lighting	858	872	880	840	802	-6.6%	-0.62%
Exterior Lighting	215	215	215	202	189	-11.8%	-1.14%
Appliances	1,711	1,741	1,760	1,787	1,816	6.1%	0.54%
Electronics	578	616	641	679	718	24.2%	1.97%
Miscellaneous	412	423	430	441	453	9.9%	0.86%
Total	**8,093**	**8,274**	**8,395**	**8,506**	**8,633**	**6.7%**	**0.59%**

Residential Use in the Base Year (2007)



Residential Forecast (GWh)



Energy Efficiency Potential

1. Characterize energy efficiency measures

2. Perform economic screen

3. Assemble data for estimating achievable potential

4. Calculate potential

5. Develop supply curves based on levelized costs of each individual measure (low, medium, high-case potential differentiations)

Definitions of Energy Efficiency Potential

Technical Potential – most efficient measures are adopted, regardless of cost or customer acceptance

Economic Potential – only cost-effective measures are adopted by customers

- Apply TRC test
- Avista avoided costs + 10% conservation adder (consistent with 6th Plan)

Achievable Potential

- Council's definition – 85% of economic potential at the end of ten years
- Other definition?

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Estimate Demand Response Potential

- Develop revised peak demand forecast
  – After savings from EE are applied
- Identify capacity-constraint time period
  – Winter peak day (cold weather)
  – Summer peak day (hot weather)
- Identify and characterize relevant DR options (e.g., direct load control, curtailable/interruptible tariffs, demand bidding)
- Estimate potentials

Estimating Demand Response Potential

- Develop baseline forecast by segment
  – Peak by segment
  – Customer by segment
- Program data
  – Participants in base year
  – Forecast of participants
  – Per customer impacts in base year
- Assess cost effectiveness
- Compute peak reduction

Deliverables that Feed IRP Process

- Report documenting entire study and presentation to Avista (electric – October, natural gas 2011)
- LoadMAP, fully populated for future updates
- Updated avoided costs from Aurora available in November as well as updated load and price forecasts
- Updated potentials for energy efficiency and demand response for final input in model

Potential Study Timeline

Month	August				September				October				Nov	Dec	Jan	Feb	March	April
Week	1	2	3	4	1	2	3	4	1	2	3	4						
Kick-off meeting		M																
Final work plan				♦														
Gather data																		
Electricity Analysis																		
Market characterization					♦													
Baseline forecasts						♦												
EE measure list						♦												
Preliminary potential estimates								M										
Final potential estimates									♦									
Draft report w/supply curves										R								
Demand Response Analysis																		
Market characterization						♦												
Baseline forecasts							♦											
Identify DR programs								M										
Preliminary potential estimates									♦									
Draft report										R								
Natural Gas Analysis																		
EE measure analysis													♦					
Baseline forecasts														♦				
EE measure list															♦			
Preliminary potential estimates															♦M			
Final potential estimates																♦		
Draft report																	R	
Final Report (on all analyses)																		R, M

Meetings (in-person or webcast) M
Memos, interim deliverables ♦
Reports R

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Avista's 2011 Electric Integrated Resource Plan

Technical Advisory Committee Meeting No. 3 Agenda

Avista Headquarters – Spokane, Washington

Thursday, December 2, 2010
Avista Conference Room 428

Topic	Time	Staff
1. Introduction	9:00	Storro
2. Transmission (costs & issues)	9:05	Waples
3. Potential Hydro Upgrades	10:00	Wenke
4. Potential Thermal Upgrades	10:45	Graham
5. Lunch	11:30	
6. Load Forecast	12:30	Barcus
7. Stochastic Modeling	1:30	Gall
8. Adjourn	2:30	

To participate by phone:
1. Please join my meeting.
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2. Join the conference call:

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Access Code: 271-248-826
Audio PIN: Shown after joining the meeting

Meeting ID: 271-248-826

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New Resource Integration – Transmission

Executive Level Summary of Avista 2010 Resource Integration Study Work

Scott Waples, Reuben Arts, and the Avista System Planning Group

Technical Advisory Committee Meeting #3

2011 Electric Integrated Resource Plan

December 2nd, 2010

Federal Standards of Conduct

- Mandatory Federal Standards of Conduct Require That:
  - No non-public transmission information be shared with the Avista Merchant Function.
  - Please note that there are Avista Merchant Personnel in attendance at this meeting.

- Meeting Notices:
  - This meeting was Posted on the Avista OASIS website on 11/19/2010.

Federal Standards, Requirements, and Risks

- Mandatory Federal Standards Include:
  - No overloads all lines and equipment in service (N-0).
  - No overloads or loss of load for one element out of service (N-1).
  - Some relaxation of the above for two elements out (N-2).
  - Resource Integration requirements (Avista or 3rd party generation) are the same as those for the general system – all Standards must be met.
- Potential Sanctions:
  - Up to $1M Per Day Per Occurrence.
  - Mitigation Plan must be provided and progress demonstrated.

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Recent Examples of Avista Construction

- Benewah Station:
  - 230 / 115 kV Station with a Single 125 MVA Transformer.
  - 230 kV Connections between the North and South Avista Load Centers.
  - 230 kV Double Breaker / Double Bus Configuration for increased reliability.
- Benewah – Shawnee 230 kV line:
  - Completes transmission required for both load service and the West of Hatwai transfer requirements.
  - Allows for resource integration in the center and south areas of the Avista system.

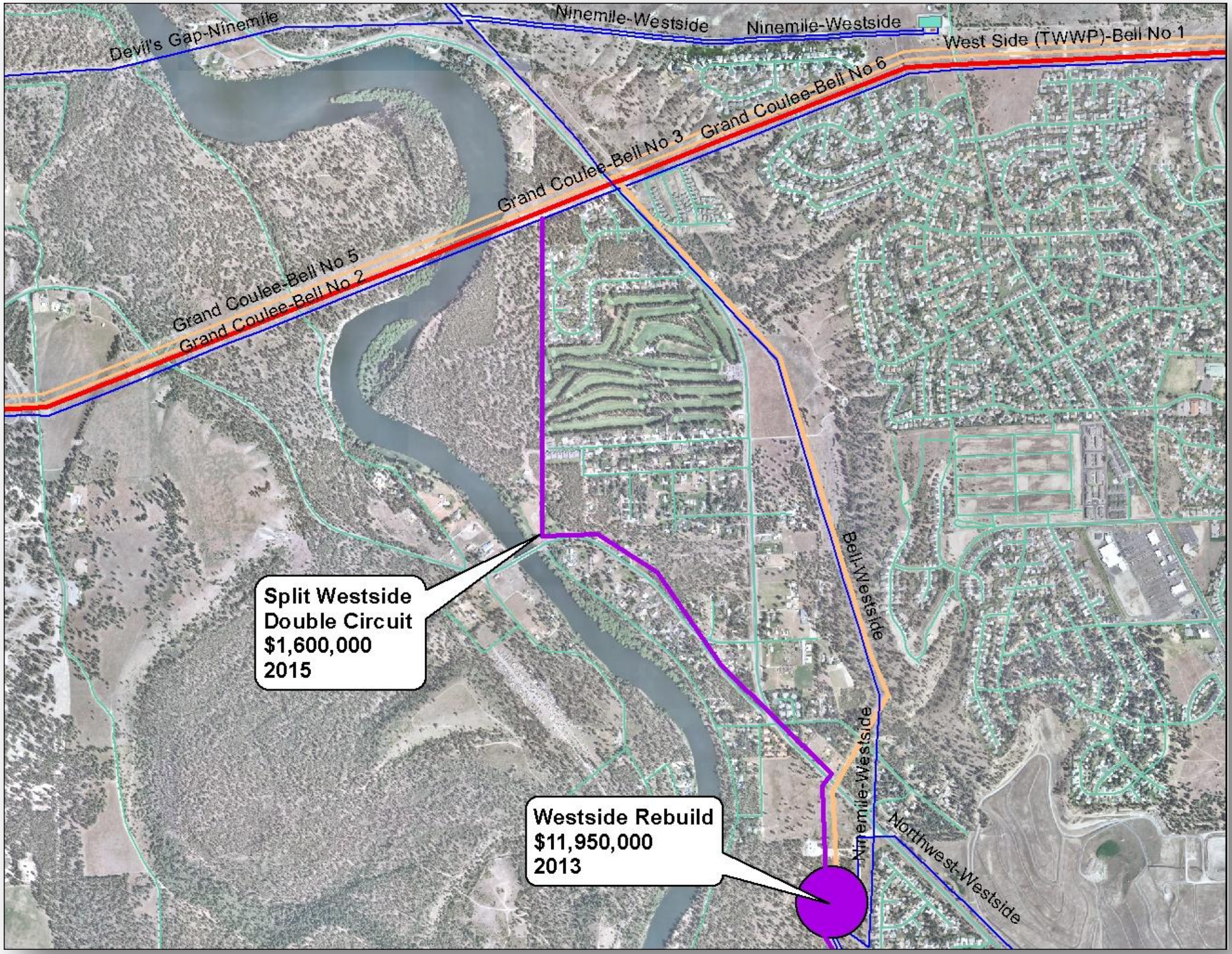
Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 337 of 1069

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 338 of 1069

Examples of Future Construction Required to Meet NERC / WECC Reliability Standards

- Moscow Station:
  - 230 / 115 kV Station, single 250 MVA transformer.
  - Increases capacity to the Moscow / Pullman area and relieves loading on the Shawnee transformer.
- Westside Station:
  - 230 / 115 kV Station, two 250 MVA transformers.
  - Increases capacity and security to the West Plains area of Spokane County, and relieves heavy loading on large transformers in the central Spokane area.
- Irvin 115 kV and Associated 115 kV Reconductoring:
  - 115 kV Switching Station and other upgrades to meet additional load growth in the Spokane Valley.

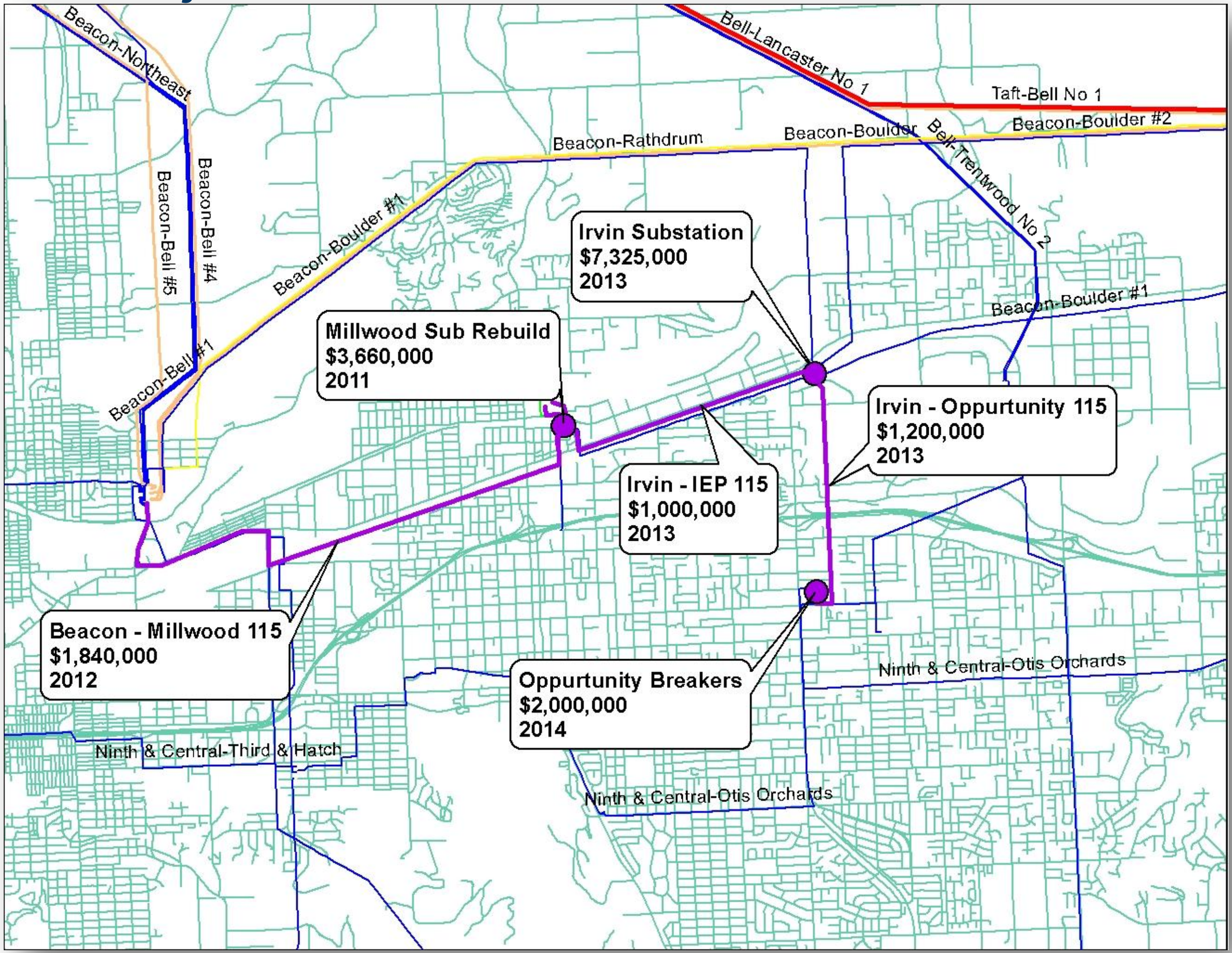
Westside Rebuild – 2 x 250 MVA Transformers



Moscow 230/115 kV Estimate and Schedule

	2010	2011	2012	2013	2014	total
Transmission				$575,000	$575,000	$1,150,000
Substation	$500,000	$1,500,000	$3,000,000	$4,775,000	$2,750,000	$12,525,000
Distribution					$25,000	$25,000
total	$500,000	$1,500,000	$3,000,000	$5,350,000	$3,350,000	$13,700,000

Irvin Project



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Avista Non-IRP Generation Queue

- **Active (see http://www.oatioasis.com/avat/index.html) :**
  - **Project # 08**:
    - 75 MW, in Facility Study Stage.
  - **Project # 14**:
    - 210 MW, in System Impact Study Stage (SIS).
  - **Project #17:**
    - 100 MW, in Facility Study Stage.
  - **Project # 26**:
    - 42MW, in SIS Stage.
  - **Project # 27**:
    - 10 MW, in SIS Stage.
  - **Project # 29**:
    - 6.5 MW, in SIS Stage.

Non-coincident IRP Interconnection Requests

- **Potential West Plains / Devils Gap Integration :**
  - **Reardan**:
    - 90 MW, 2014
    - +60 MW (150 MW total), 2014
  - **Long Lake**:
    - + 30 MW (118 MW total), 2018
    - + 60 MW (148 MW total), 2018
    - + 100 MW (188 MW total), 2018
  - **Little Falls**:
    - + 4MW (40 total), 2014-2017

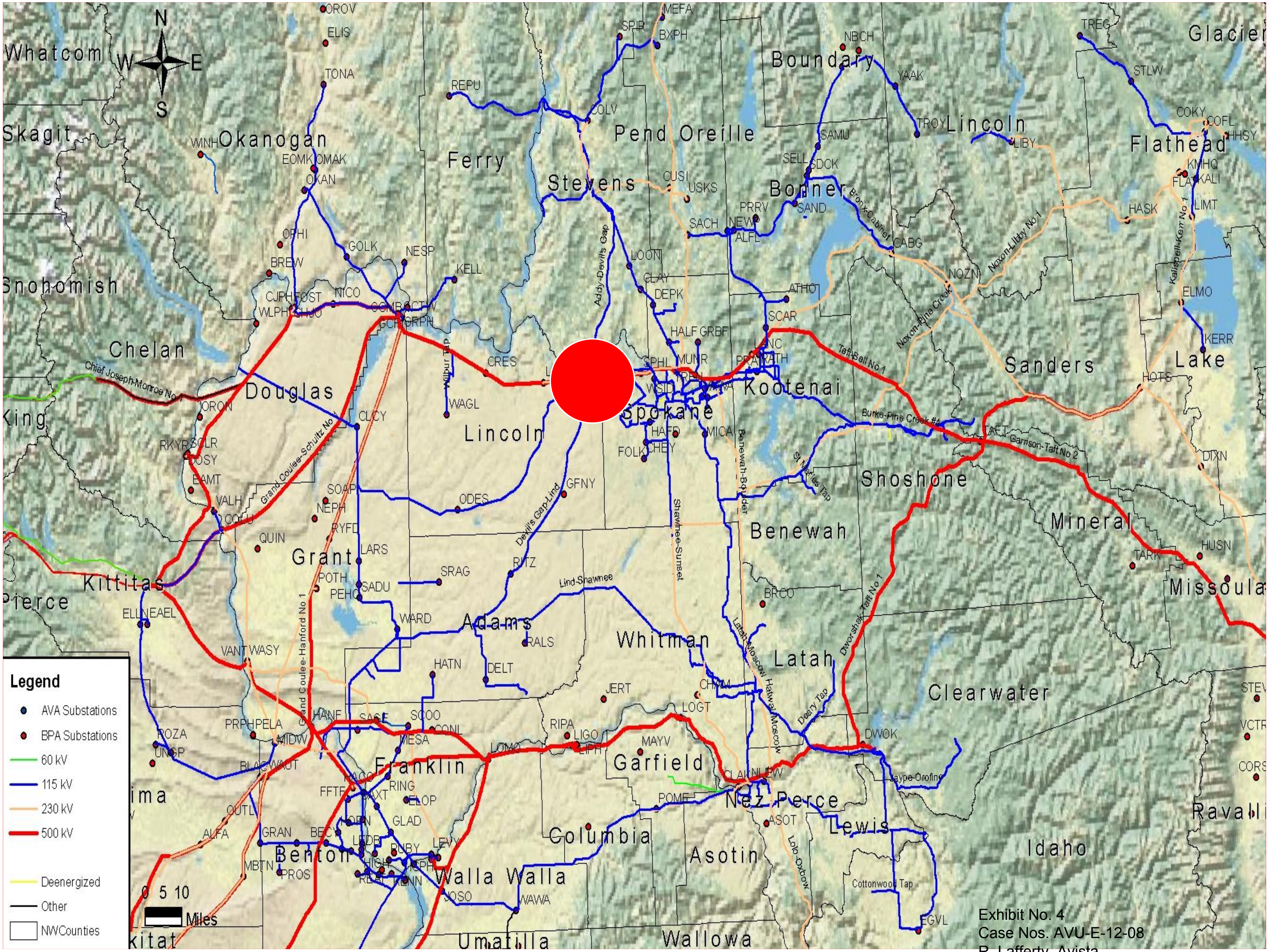

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 345 of 1069

Non-coincident IRP Interconnection Requests

- **Potential "Far West" (Big Bend) Area Integration :**
  - **Othello Area**:
    - Up to 100 MW in 2014, 2015, or 2019 (2015 energization is the most probable)

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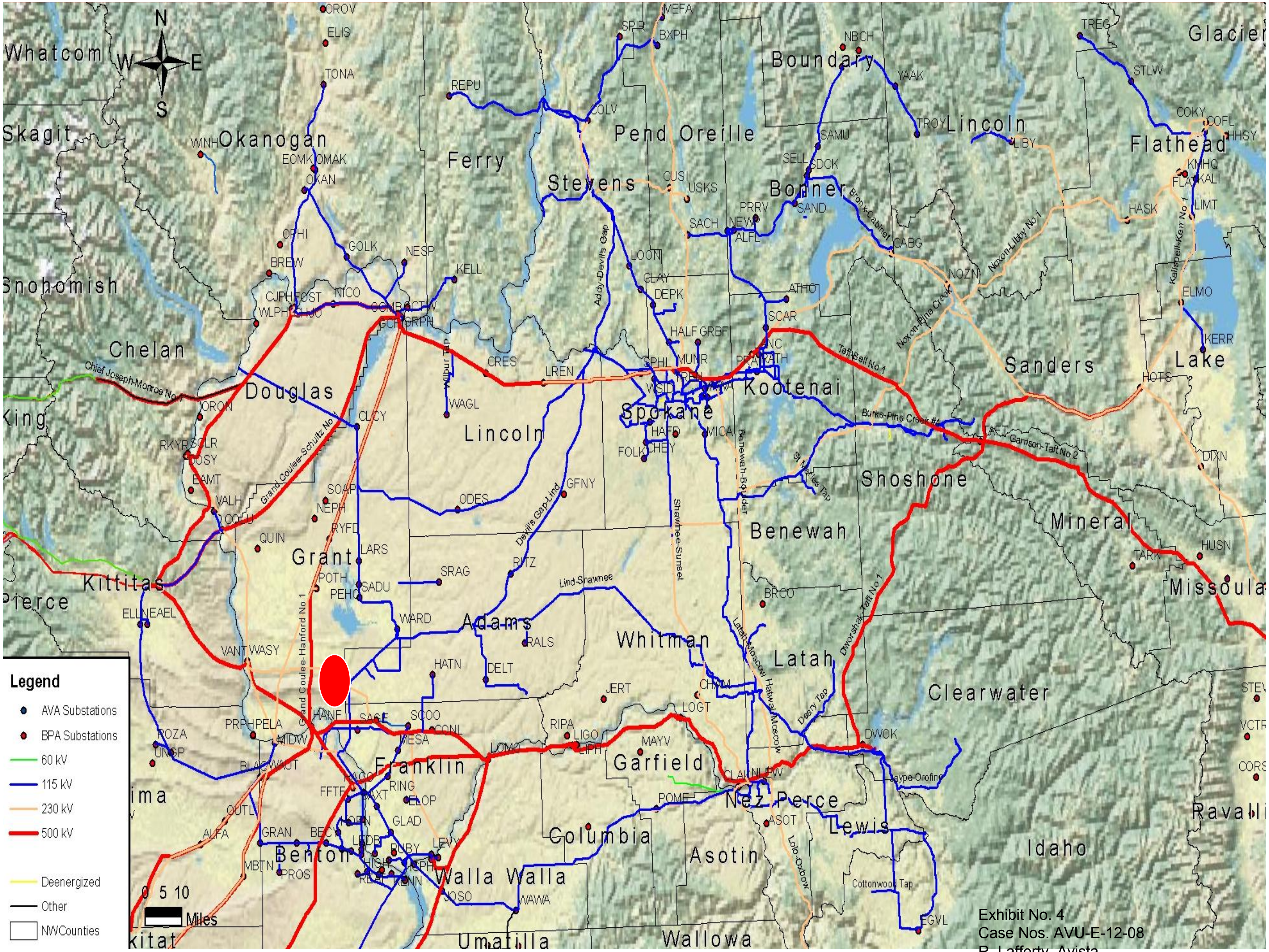

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista

Non-coincident IRP Interconnection Requests

- **Potential "Central Area" Thermal or Wind Integration** :
  - **Benewah**:
    - 300 MW 2018
  - **Rosalia**:
    - 300 MW, 2018
- **Potential "East & North Area" Thermal or Wind Integration** :
  - **Rathdrum**:
    - 300 MW, 2018
    - + 100 MW (400 MW total), 2018
  - **Sandpoint**:
    - 100-300 MW, 2018

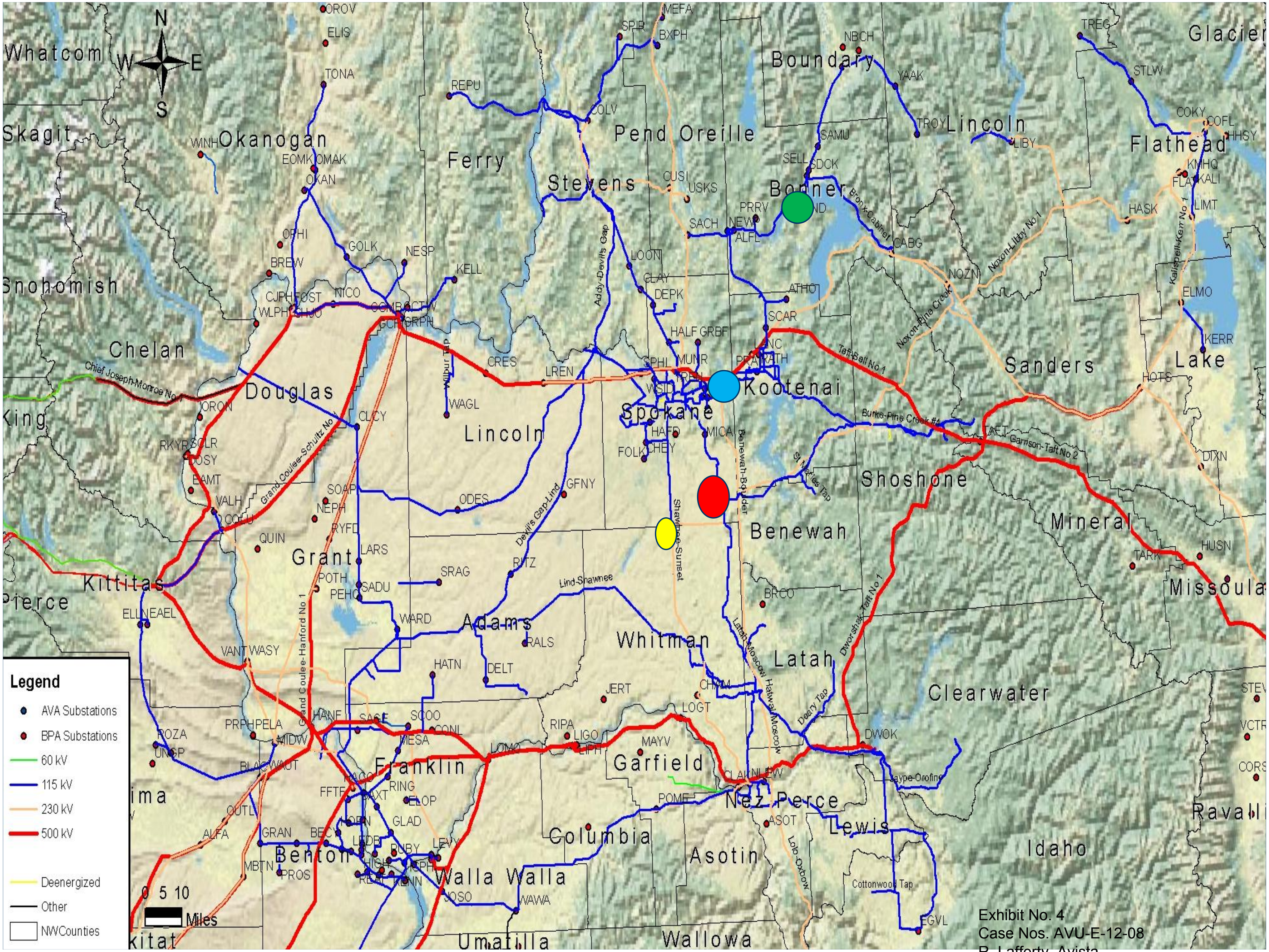

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 349 of 1069

Non-coincident IRP Interconnection Requests

- **<u>Other "Large" Hydro Integration</u>** :
  - Cabinet Gorge ("East"): + 60 MW, 2018
  - Monroe Street (Spokane): + 20MW, 2018 or +60 MW, 2018
  - Post Falls (Coeur d' Alene): + 14 MW, 2018

- **<u>"Small" Hydro Integration</u>** :
  - Upper Falls (Spokane): + 2 MW, 2019

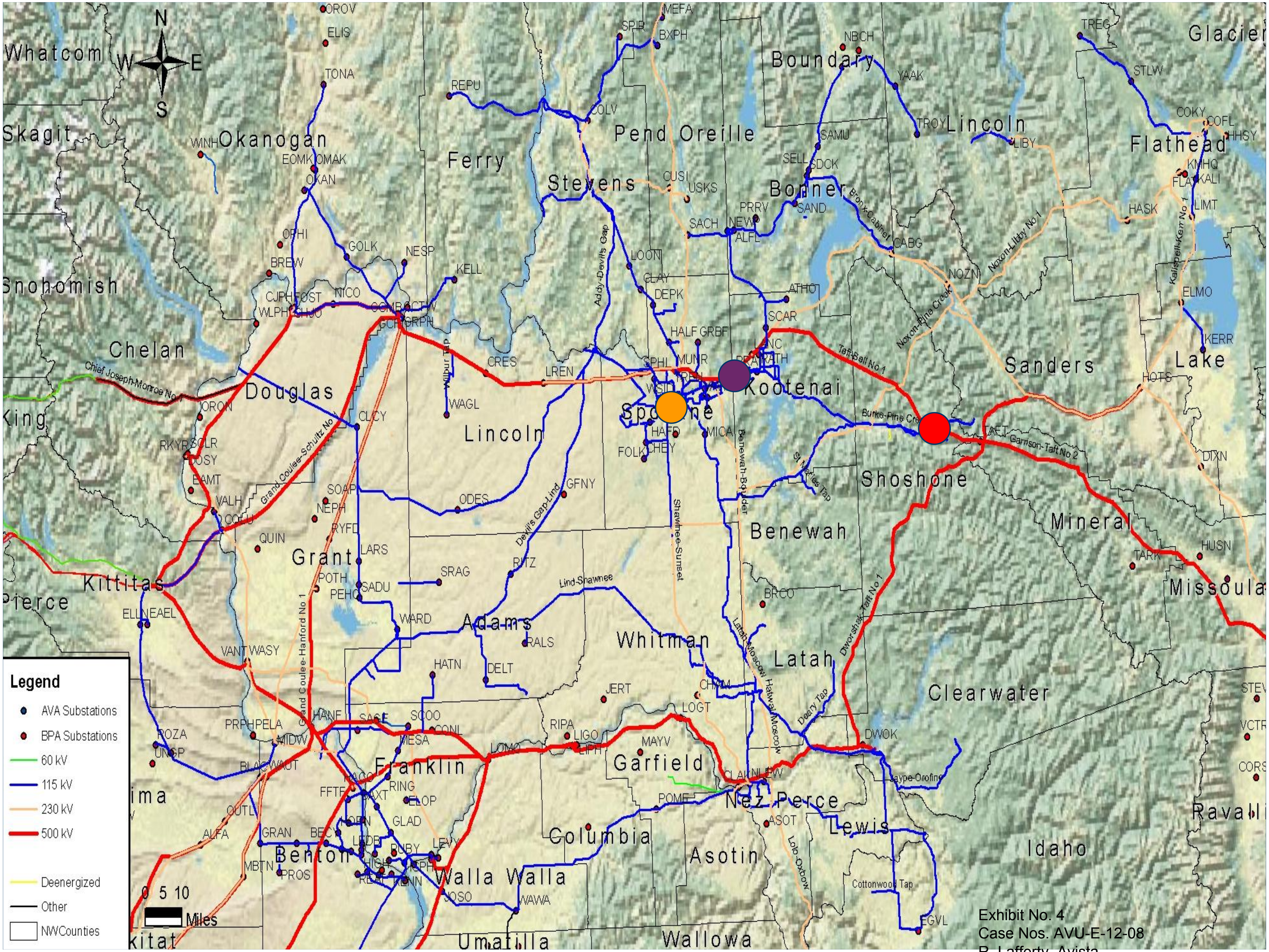

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 351 of 1069

Study Process and Cost Estimates

- **Study Process:**
  - Avista System Planning does transmission system analysis using WECC approved "study cases" (which we modify) for all analyses and uses approved software tools (PTI, GE, PowerWorld) to "do the math" on various alternatives.
- **Pre-Engineering Cost Estimates:**
  - Avista Engineering does pre-engineering cost estimation.
  - Estimates are generally plus or minus 50% accuracy (no rights-of-way, soils analysis, firm quotes for equipment, etc.).
  - Transmission integration is often about 10% of total project costs (but can be much higher depending on where the resource is integrated).

Transmission Study Process With Respect to Resource Type

- **"We (Transmission) Don't Care"!**
  - **Transmission Analysis is "Resource Blind":**
    - Wind
    - Water
    - Gas
    - Pumped Storage
    - Other
  - **Transmission Integration Costs Will be the Same for ANY Resource.**

West Plains / Devils Gap Area

- Necessitates a "Tipping Point" Analysis:
  - Total potential generation is 4 MW to 254 MW – lots of options!
  - Voltage Level Analysis:
    - How much can be integrated at 115 kV:
      - At no cost?
      - At a "max 115 kV development" cost?
    - How much can be integrated at 230 kV:
      - Can it be done with only one 230 kV line?
      - What are the costs for one versus two lines?
  - What are the $/MW costs for the various options?

West Plains / Devils Gap Area

- **<u>115 kV Analysis</u>**:
  - 4 MW requires no transmission additions (one bookend).
  - 75 MW can be integrated for about $15M.
  - Requires new 115 kV line and station upgrades.
- **<u>230 kV Analysis</u>**:
  - 254 MW can be added for about $30-$55M (2-230 kV lines).
  - These costs don't include the planned 230 kV Spokane Loop.
- **<u>"All Things Being Equal" $$/MW Comparison</u>**:
  - 75 MW @ 115 kV @ $15M => $200/kW
  - 254 MW @ 230 kV @ $30-$55M => $118-$217/kW

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“Central” and “East” Areas

- **<u>230 kV Integration</u>**:
  - Benewah: 300 MW @ about $5M
  - Rosalia: 300 MW @ about $8M
  - Rathdrum:
    - 300 MW @ about $5M (Will require Gen Dropping).
    - 400 MW @ about $5M (Will require Gen Dropping).
    - A concern is “too many eggs” on the Rathdrum Prairie:
      - Existing Rathdrum – 160 MW.
      - Existing Lancaster – 270 MW.
      - New Rathdrum – 300-400 MW.
  - All studies are post integration of the Lancaster generation into the Avista 230 kV system.

"Far West" (Big Bend) Area

- **Othello 115 kV Analysis**:
  - 17 MW requires no transmission additions (one bookend).
  - 100 MW can be integrated for between $13-$25M.
  - Requires new 115 kV line, local 115 kV line reconductor, and a new POI 115 kV substation (the lower costs require generator dropping).
- **230 kV Analysis**:
  - 250 MW can be added for about $8M.
  - Requires a new POI 230 kV substation.
  - Does not consider contractual constraints on the Walla Walla – Wanapum 230 kV line

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“North” and Other Hydro

- **Sandpoint, Idaho**:
  - Sandpoint: 50 MW @ about $2-5M (depending on BPA).
  - More than 50 MW is probably cost prohibitive.
- **Other “Large” Hydro**:
  - Cabinet Gorge: 60 MW @ about $2-$10M (Cabinet Gorge – Rathdrum @ 100 Degrees Centigrade & 115 kV reconductor).
  - Monroe Street: 20 MW @ about $3M (does not include Metro).
  - Monroe Street: 60MW @ about $3M (as above).
  - Post Falls: 14 MW @ about $1M
- **Other “Small” Hydro Integration** :
  - Upper Falls: 2 MW @ about $1M

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“Off System” Resources

- **<u>Integration of 100-300 MW:</u>**
  - Potential at Bell, Hatwai, Hot Springs, or Mid Columbia:
  - Wheeling over the BPA system presently costs $4.4M/year plus $2.5M/year for losses (@$50/MW-hr) for 300 MW of BPA transmission service (if it is available). The BPA rate is expected to increase by about 9% in 2013. A BPA “Lines and Loads” Study (funded by AVA) is required to determine capacity in the BPA Grid.
  - A study similar to the FERC “Market Power Study” is used to determine at what cost these resources could be integrated into the Avista Grid. Recent studies have indicated that as much as $50M could be required for 300 MW of integration from BPA into the Avista system.

Future Work?

- **Generic Break Point Studies for IRP / 3rd Party Developers:**
  - "How many MW can we integrate where for about what $$?"
    - Main Grid 230 kV Stations.
    - Select 115 kV Stations.
- **Potential Open Seasons:**
  - "Does anyone want to get to the Mid Columbia?"
  - "Does anyone want to get out of Montana?"
  - "Does anyone want to get to PAC or IPC?"
- **Canada – Northwest – California Transmission Project:**
  - "If this project is built, how should we interconnect?"
  - "What other markets would this project access?"

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Finis

Questions?

Hydro Upgrade Opportunities

Steve Wenke

Technical Advisory Committee Meeting #3

2011 Electric Integrated Resource Plan

December 2, 2010

Presentation Outline

- Background of Avista's Hydro System
- Looking Back on What has Been Done
- Current Upgrade Projects
- Other Opportunities
- Issues

Background

- Aging hydro system
- Advancements in hydro turbine technology
- Hydraulic size of facilities

Avista's Hydro Portfolio

- First project was Monroe Street that came on line in 1891.
- "Newest" Spokane River plant is Upper Falls which came on line in 1920.
- The larger Clark Fork River projects were developed in the mid to late 1950's

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Aging Technology

Modern turbine designs convert the energy of falling water at a rate of about 94% efficiency

- Combined Cycle Gas Plant – 52%
- Wind Turbine 40-50%

1960 and earlier vintage hydro plants have efficiencies of abut 88% or lower

- Estimate 80% at Upper Falls
- Estimate 85% at Little Falls

Plant Hydraulic Designs

The older Spokane River Plants were sized based on the needs of the day

- Base loaded energy
- Ability to swing output to make loads (i.e. regulation)
- Generator island areas (i.e. generator were not networked together)

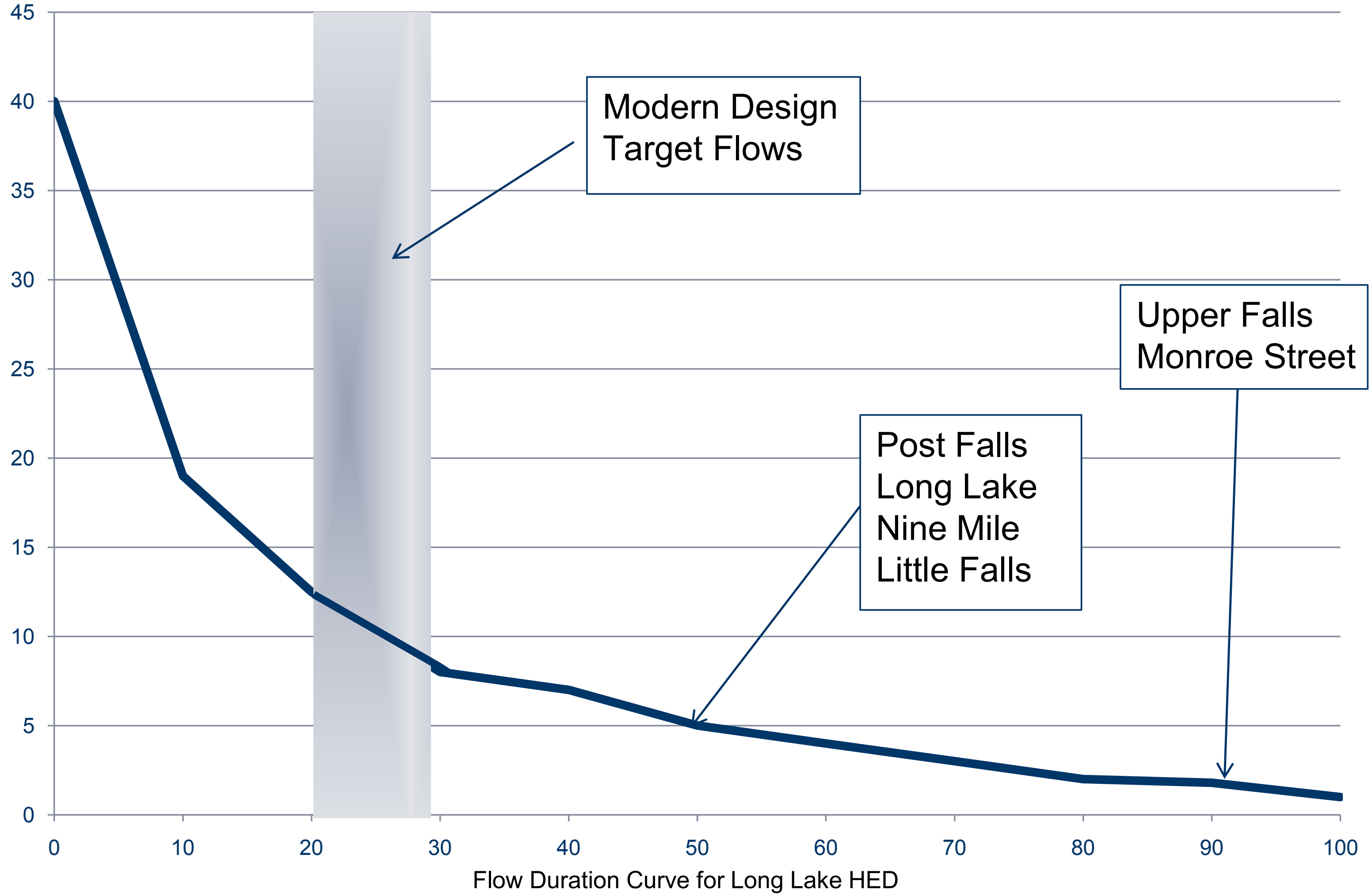
The result are plants that are relatively high on the flow exceedence curves

The Opportunity

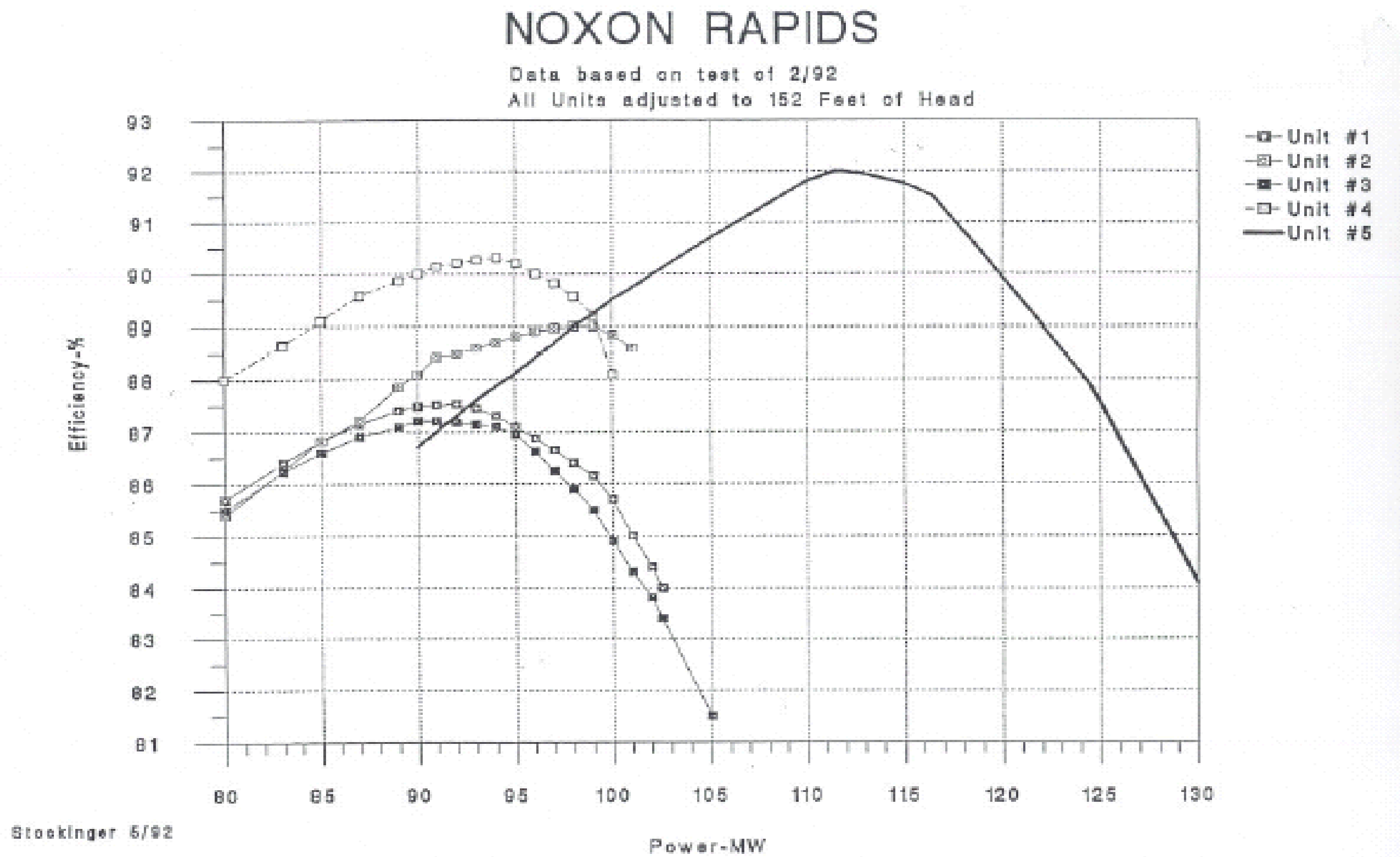
In simple terms, with unit flow capacity (cfs) and plant head (height of dam) the same, we should be able to improve the energy output of an older hydro unit by as much as 6% by replacing the old turbine with a modern designed unit.

- In fact, this does vary for each particular site based on the civil works of the specific dams

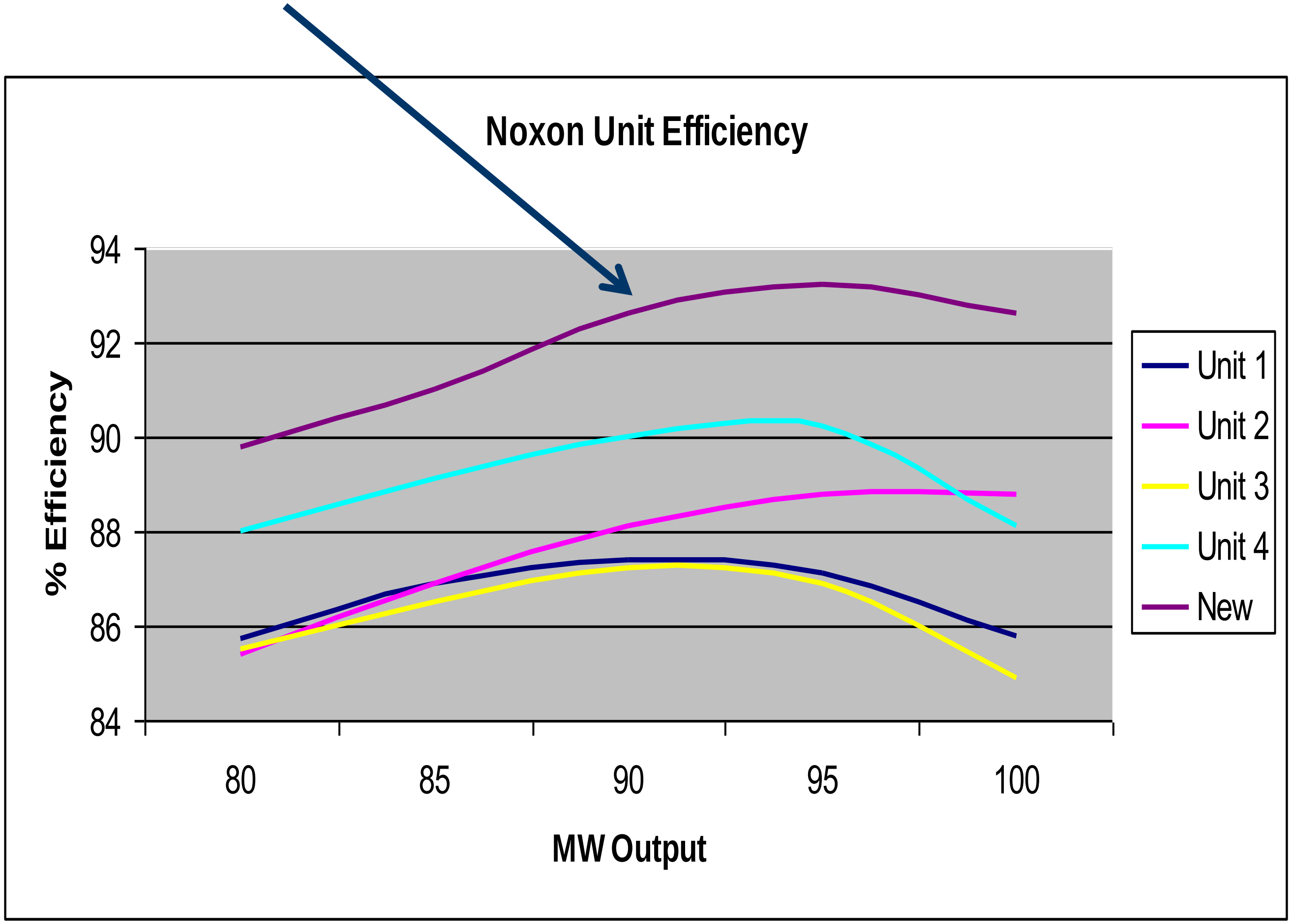
Plant Hydraulic Designs



Noxon Rapids Upgrades
Variable Efficiency Curves



New Runner Comparison



Looking Back

We have been actively pursuing hydro upgrades since 1989

- Monroe Street - 1992
- Nine Mile Units 3 and 4 - 1994
- Cabinet Gorge Unit 1 -1994
- Long Lake Units 1, 2, 3, and 4 – 1994 - 1999
- Little Falls Units 2 and 4 – 1994, 2001
- Cabinet Gorge Units 2, 3, and 4 – 2001 – 2004
- Noxon Rapids Units 1, 3 2009, 2010

Character of the Upgrades

Powerhouse Replacement

Powerhouse Refurbishment and Unit Replacement

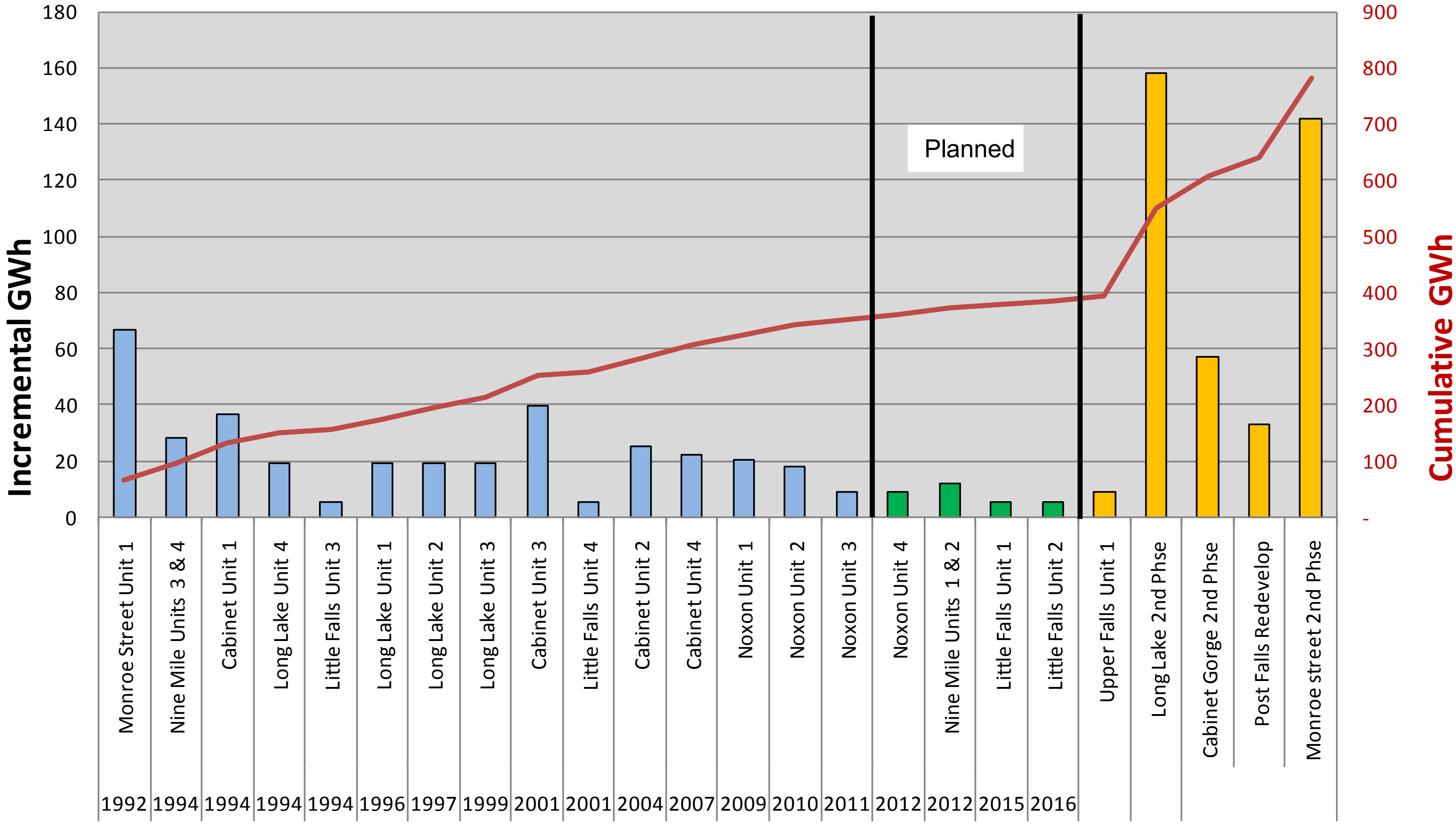
Runner Replacement

Unit Replacement

Powerhouse Additions

- To this point in time, we have not added new powerhouse additions to existing facilities

What we have done to date:
Energy (GWh's)



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What we have done to date: Added Hydro Capacity (MW's)

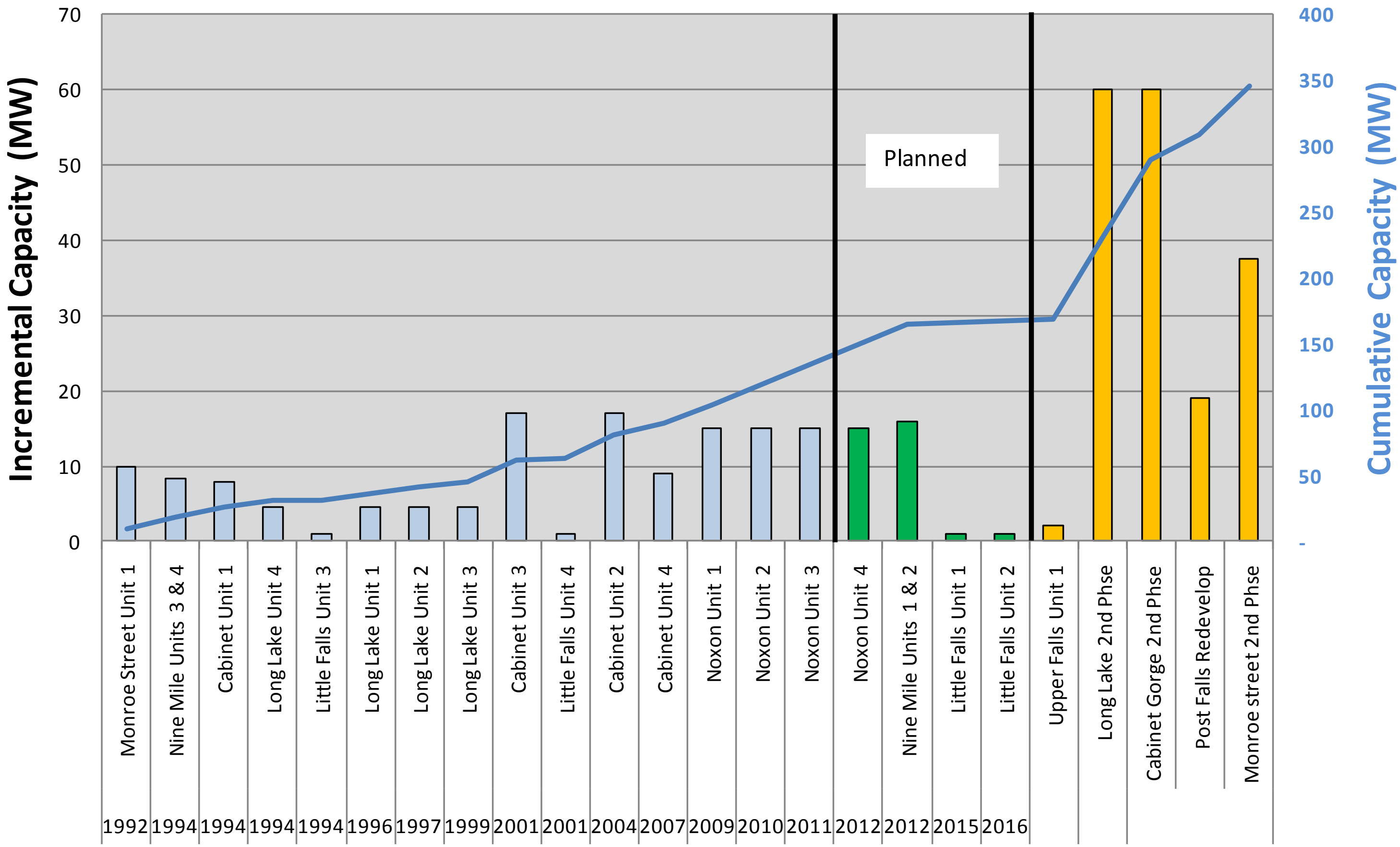

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Exhibit No. 4
Case Nos. AVU-E-12-08
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Schedule 1, Page 375 of 1069

Summary

- Over the past 20 years, we have added 334,000 MWh's and 120 MW's of hydro to our system
- We are currently planning to add an estimated 49,000 MWh's and 48 MW's
- There are considerations for an additional 116,000 MWh's and 176 MW's

Current Projects

- Little Falls Refurbishment
- Nine Mile Redevelopment

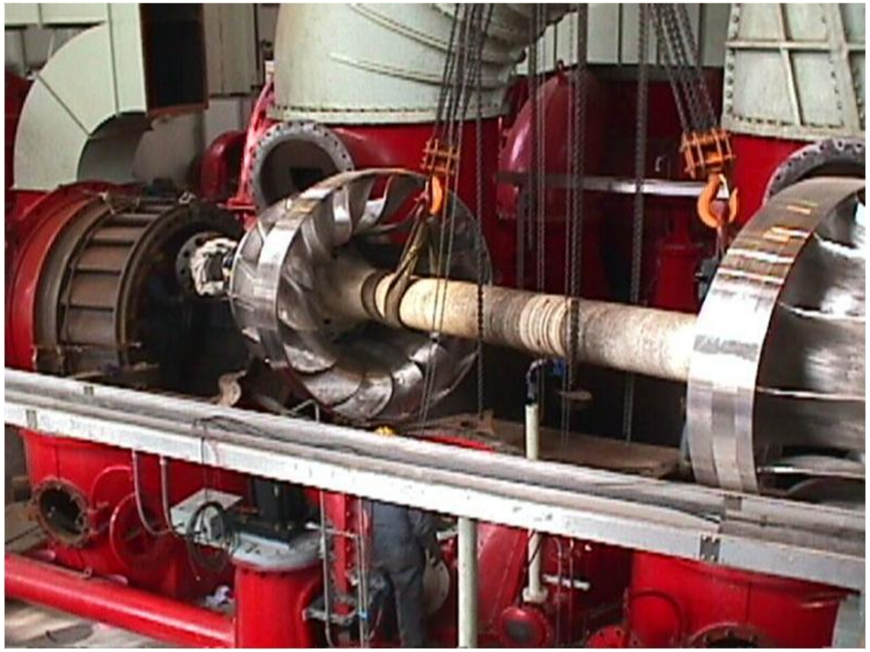
Little Falls Upgrade

- Seeking an increase in turbine efficiency
- Current estimated efficiency is 80%
- Upgraded runners are expected to be 85%
- Approximately 2 MW improvement expected

Little Falls Upgrade

General Scope of work would include replacement of all of the old equipment at the plant – a major undertaking

Photo Showing New Turbine Runners Being installed in Unit 4 in 2001



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Little Falls Upgrade

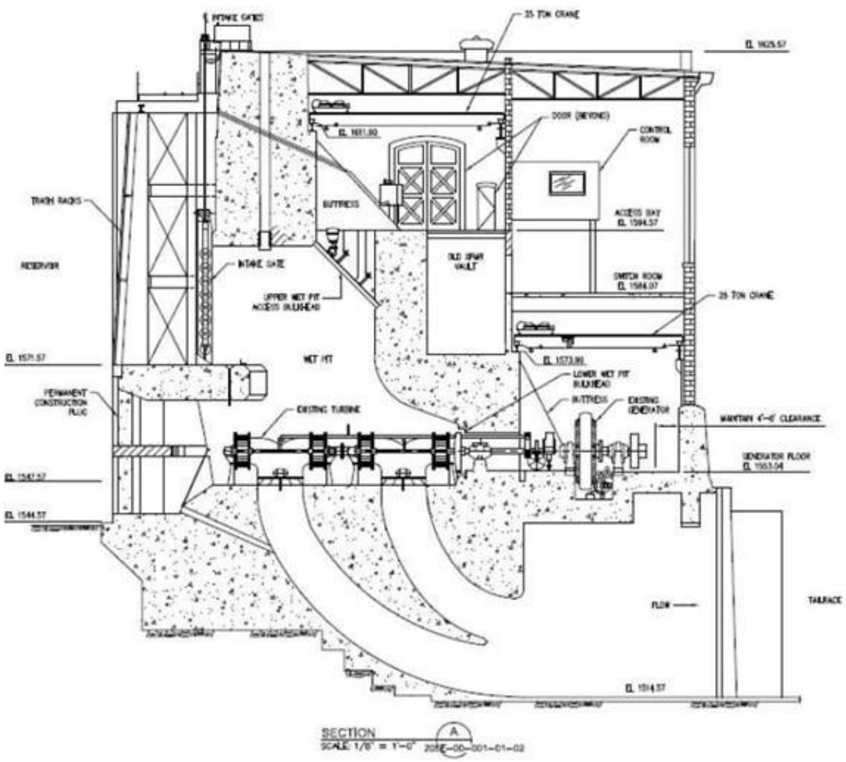
DRAFT

- Expected additional Capacity – 2 MW
- Expected additional Energy – 8,760 MWh
- Estimated Costs - $1.5 million
- Other Considerations:
  – Much of the existing equipment is at the end of its service life and will likely be replaced, significantly increasing the scope of this project work.
  – We have yet to explore expansion plans for this site, and may elect to do so.

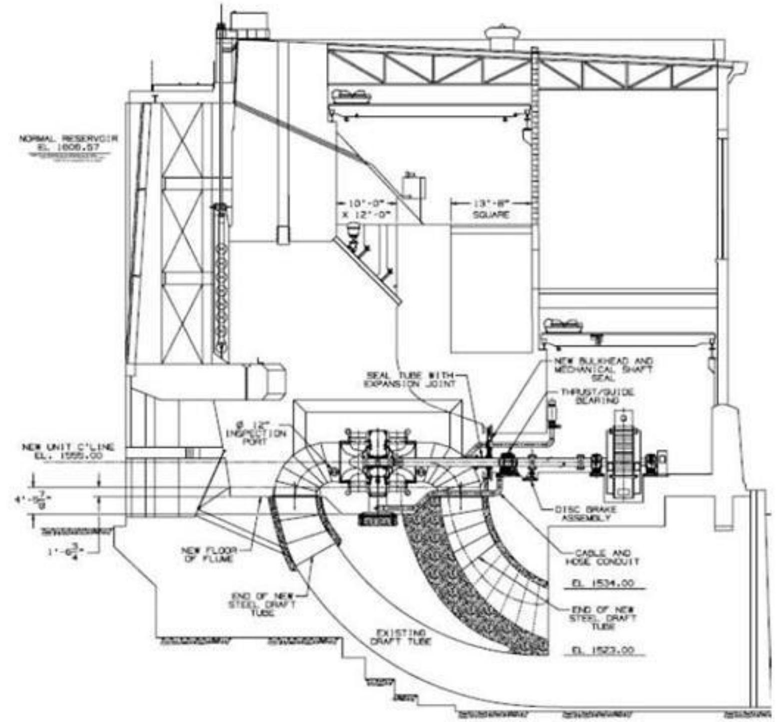
Nine Mile Redevelopment

This project is to replace Units 1 and 2. These are original 1908 machines and are no longer repairable. The basic scope is to remove the old systems and install new turbines, generators, switchgear, and controls to update the plant.

Nine Mile Redevelopment



Existing Units – Horizontal Quad Runner



Proposed American Hydro Seagull Units

Nine Mile Redevelopment

DRAFT

- Expected additional Capacity – 16 MW
- Expected additional Energy – 11,800 MWh
- Estimated Costs - $38 million
- Other Considerations:
  - This addresses Units 1 and 2. Units 3 and 4 were replaced in the 1994.
  - Sediment buildup in the river needs to be addressed.
  - Existing balance of plant equipment is also to be replaced with this project work
  - We just completed a “Obermeyer Gate” installation to eliminate the flashboard system

Nine Mile Sediment Impacts

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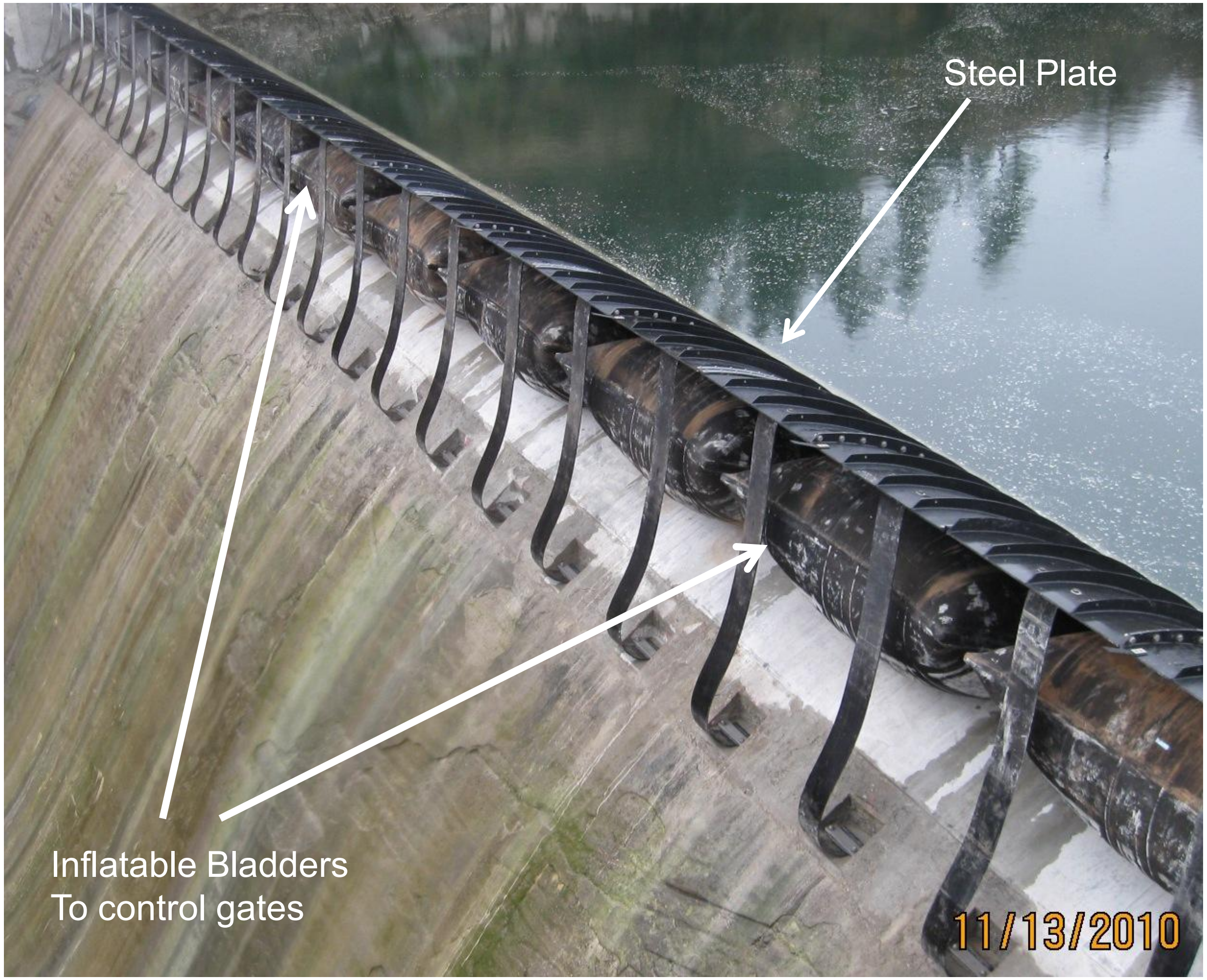
Nine Mile Flashboard Replacement

From the 1940's until last year, we Would install wooden flashboards On the dam to get an additional 10 Feet of head. Each spring these Would be released and have to be Replaced each year.

Nine Mile Obermeyer Gate



Other Opportunities

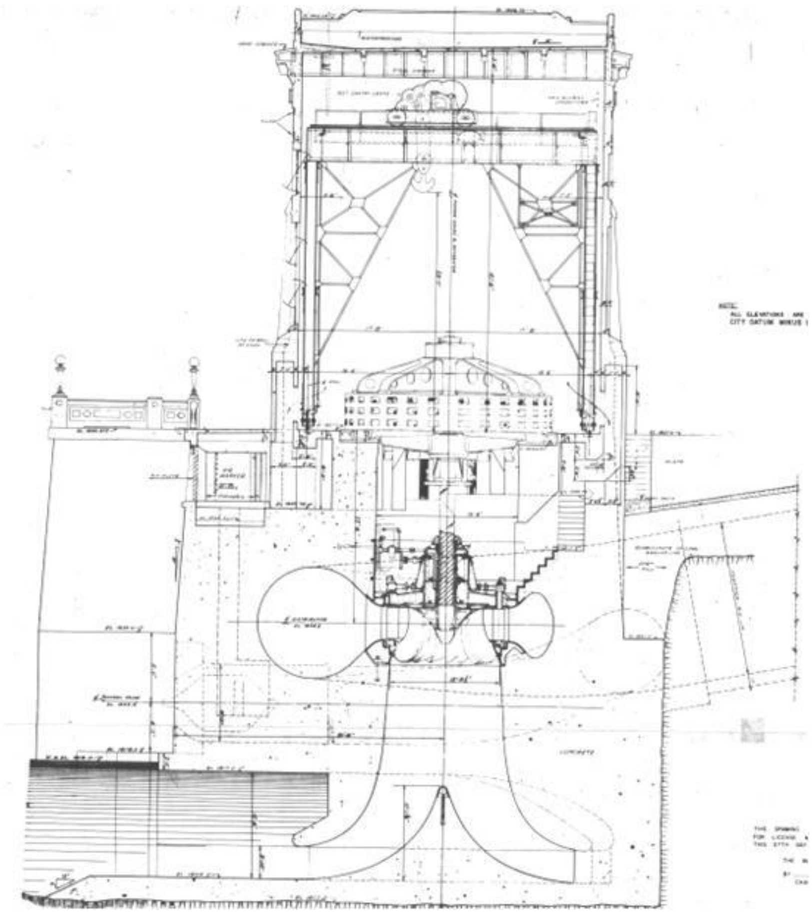
- Upper Falls Runner Replacement
- Long Lake Second Powerhouse Addition
- Cabinet Gorge Second Powerhouse Addition
- Post Falls Refurbishment
- Monroe Street Second Powerhouse Addition

Upper Falls Runner Replacement

Seeking to increase the output of the unit by replacing the turbine runner and modifying the existing draft tube to improve efficiency.

Upper Falls Runner Replacement

General Scope of Work would be to remove the old runner, modify the draft tube, stay vanes, and discharge area, and install a new runner



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Upper Falls Runner Replacement

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- Expected additional Capacity - 2 MW's
- Expected additional Energy 8,600 MWh's
- Estimated Costs - $6.8 million
- Other Considerations:
  - New license conditions have not yet been considered in this options.
  - Would require considerable modification to the existing draft tube system

Long Lake Second Powerhouse

Seek to increase plant capacity by the addition of a second powerhouse and large capacity unit

Long Lake Second Powerhouse

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Long Lake Second Powerhouse

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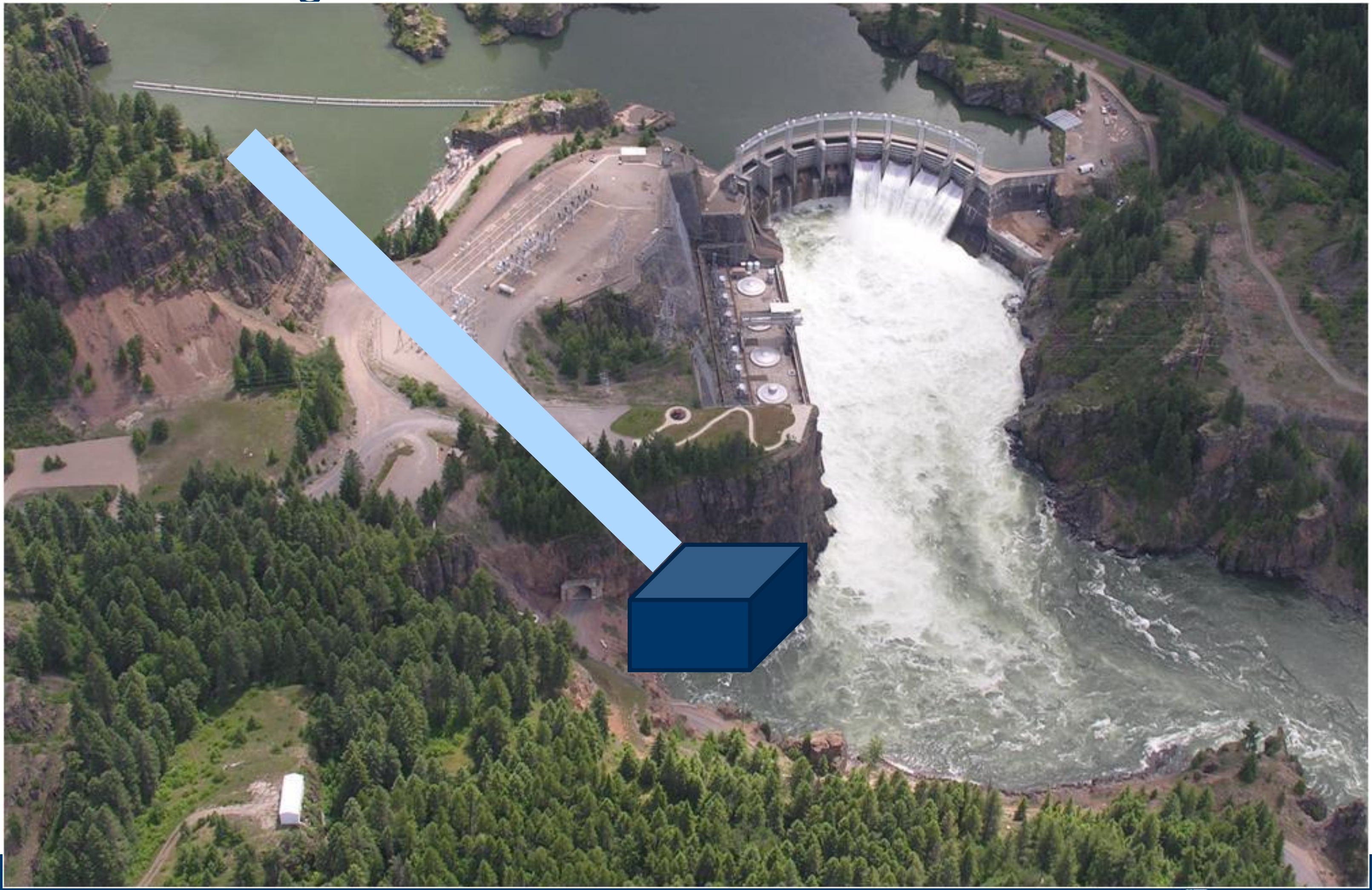
- Expected additional Capacity – 60 - 120 MW
- Expected additional Energy – 158,000 – 178,000 MWh
- Estimated Costs - $120+ million
- Other Considerations:
  - Impacts of construction to the existing plant
  - Condition of small arch dam to be used as a cofferdam

Cabinet Gorge Second Powerhouse

Seek to increase plant capacity by the addition of a second powerhouse and match Noxon Rapids flow capacity

Cabinet Gorge Second Powerhouse



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Cabinet Gorge Second Powerhouse

DRAFT

- Expected additional Capacity – 50 MW
- Expected additional Energy – 57,000 MWh
- Estimated Costs - $115 million
- Other Considerations:
  - This project would favorably impact the Total Dissolved Gas (TDG) issue at Cabinet Gorge and is currently under consideration by the Clark Fork License team.

Post Falls Refurbishment

This would involve removing all of the old station equipment and replacing it with new units. The building exterior would remain intact

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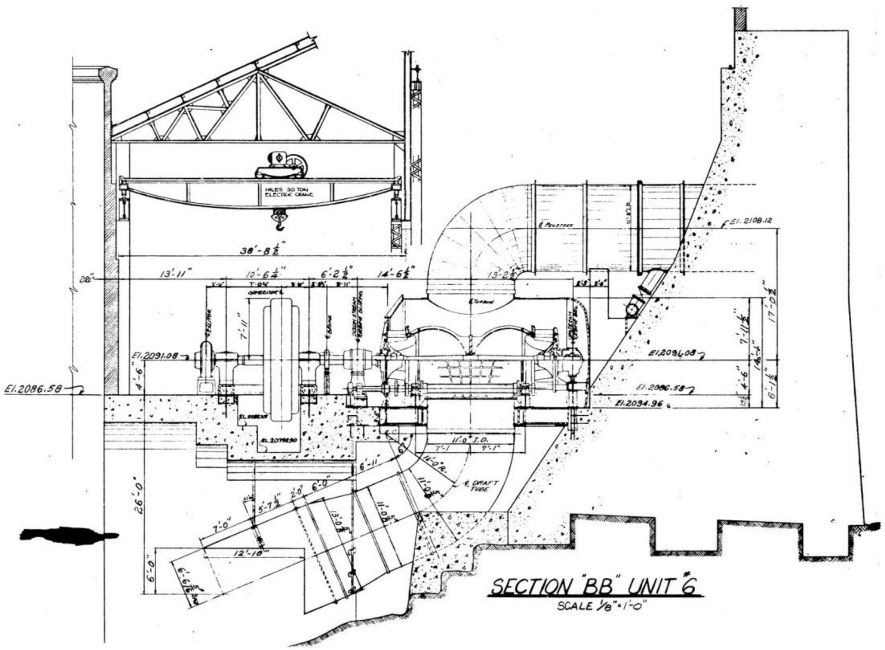
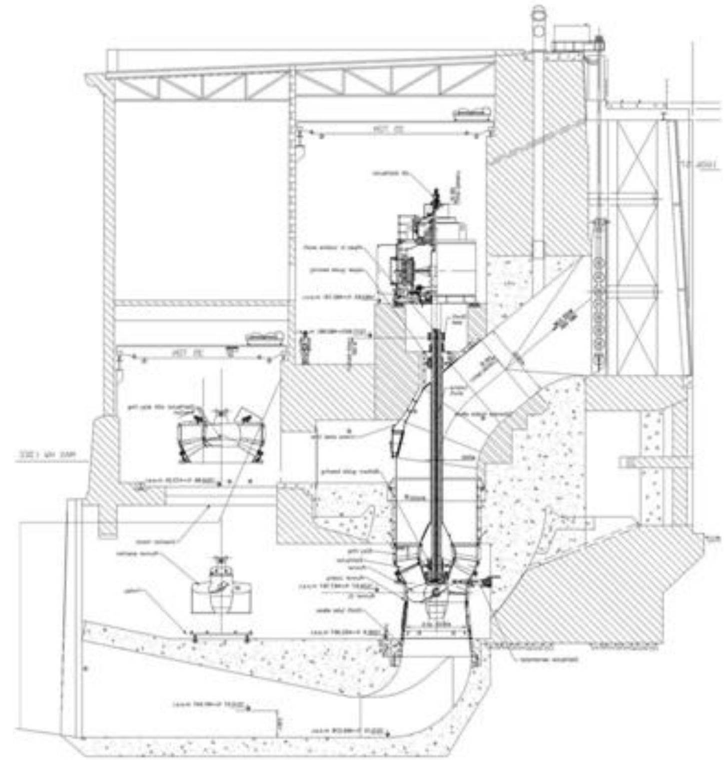
Post Falls Upgrade

The Scope is to remove the old horizontal units and replace them with high efficiency and higher capacity vertical units





Post Falls Upgrade

DRAFT

- Expected Additional Capacity – 19 MW's
- Expected additional Energy – 33,000 MWh's
- Estimated Costs - $75 million
- Other Considerations:
  – Need to evaluate this plan against new license conditions

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Monroe Street Second Powerhouse

The basic project here is to harness the capacity of the 140 waterfall that the Spokane River drops in downtown Spokane

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Monroe Street Second Powerhouse

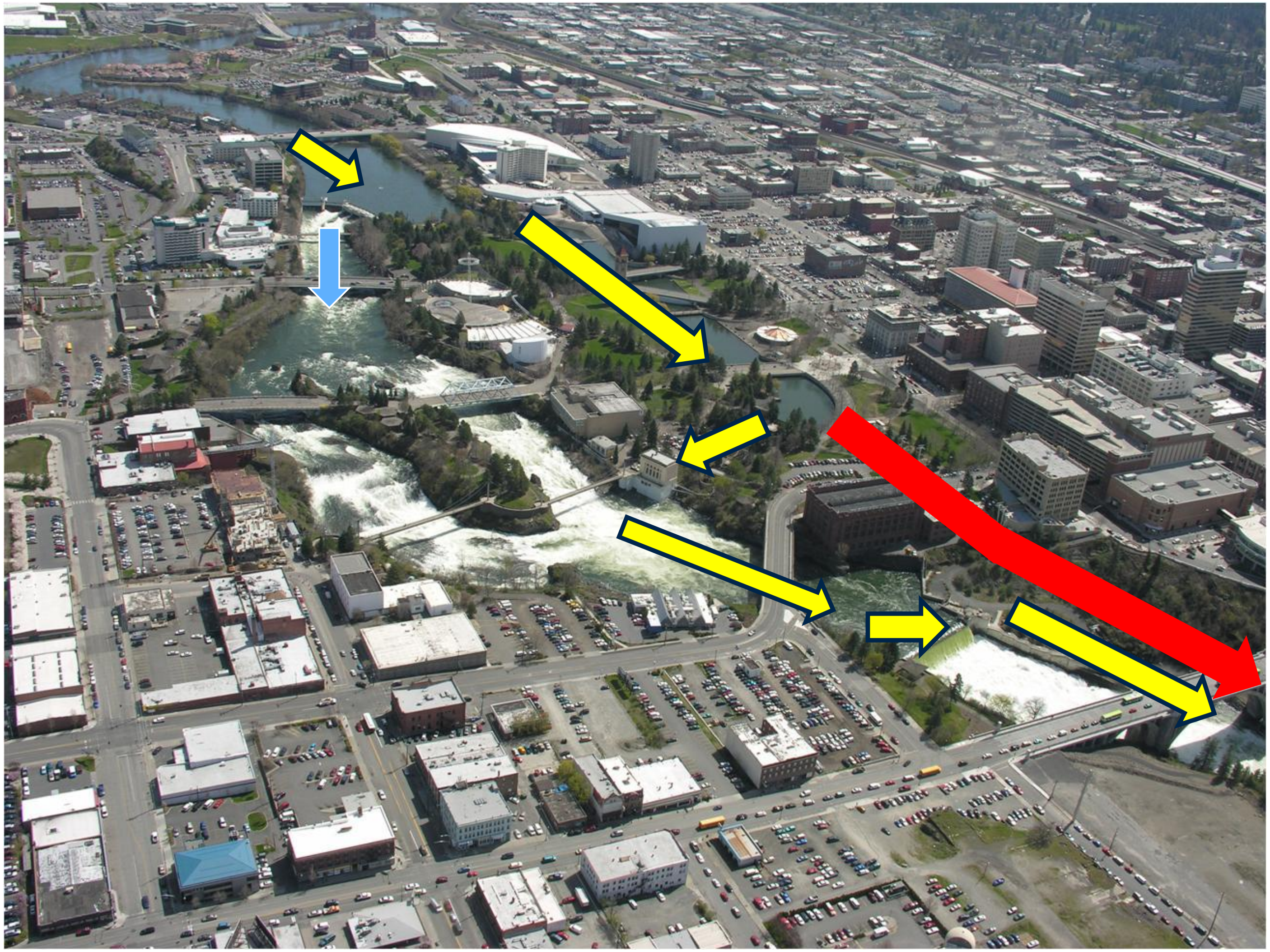

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Exhibit No. 4
Case Nos. AVU-E-12-08
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Schedule 1, Page 401 of 1069

Monroe Street Second Powerhouse

- Expected Additional Capacity – 37.5 MW's
- Expected additional Energy – 142,000 MWh's
- Estimated Costs - $95 million
- Other Considerations:
  – Downtown Spokane and Riverfront Park locations make this a challenging option
  – Would require a significant make over of the western edge of Riverfront Park, and channel dredging

Hydro Upgrades – Other Issues

- Aging equipment is driving much of the work.
- Gaining valuable experience for our work force
- Current incentives for REC's and tax incentives are playing a part
- Needs for future capacity
- Environmental Drivers
  - Total Dissolved Gas – desire to reduce spill at some sites
  - Needs for more modern plants with appropriate systems to avoid possible releases
  - Licenses have provided some certainty around investment opportunities.
  - Significant permit time for second powerhouse projects

Potential Thermal Upgrades

Jason Graham
Generation Engineer

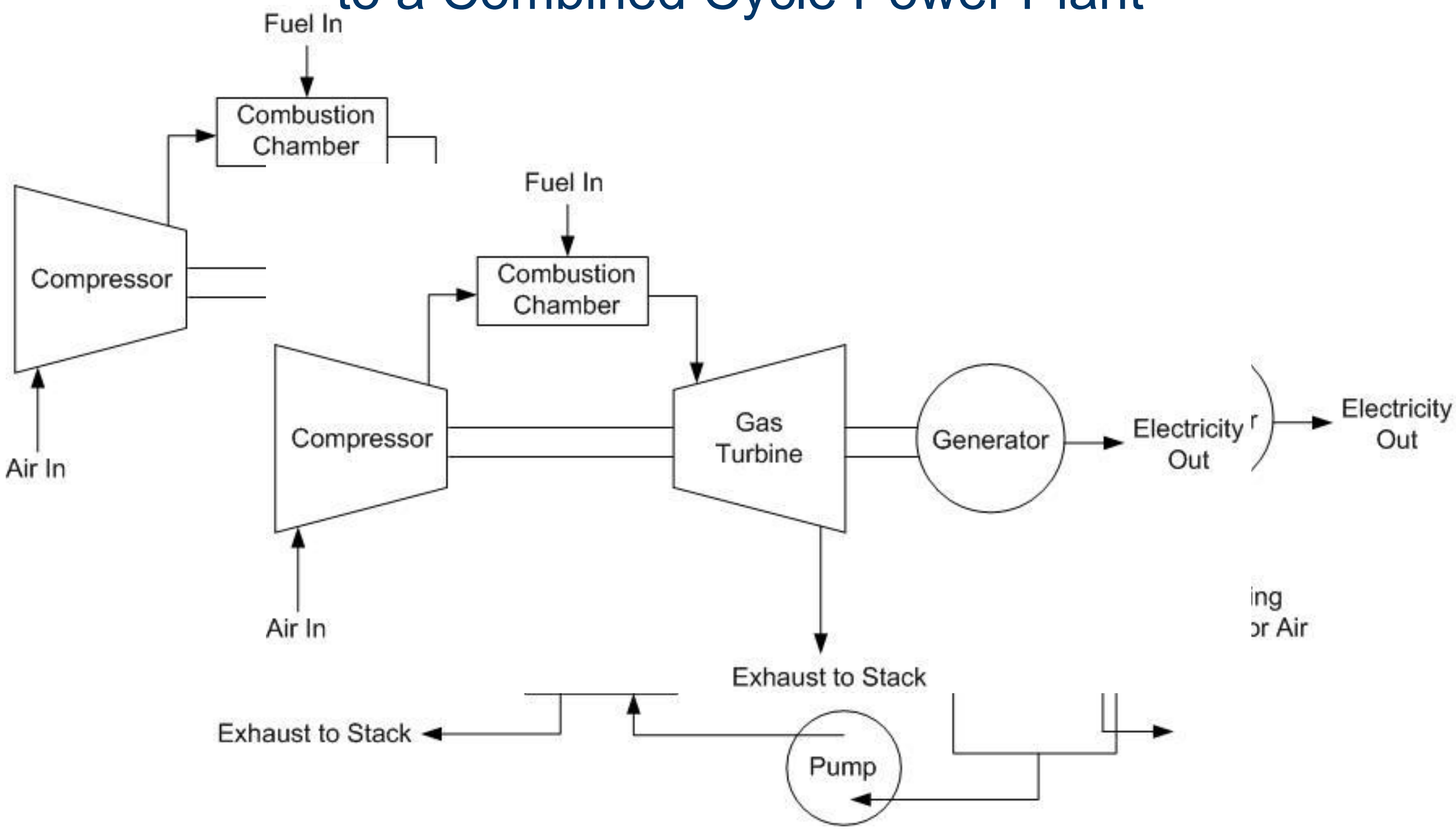
Overview

- Conversion of Rathdrum CT to a Combined Cycle Power Plant
- Water Demineralization System for Inlet Fogging at Rathdrum CT
- Inlet Chiller at Coyote Springs 2
- Cold Day Performance Software Upgrade at Coyote Springs 2
- Advanced Hot Gas Path Hardware Upgrade at Coyote Springs 2
- Cooling Optimization Hardware Upgrade at Coyote Springs 2
- Wood Fuel Gasification at Kettle Falls Generation Site

Rathdrum Combustion Turbine
Rathdrum, Idaho

- Two General Electric 7EA Combustion Turbines
- On Line in 1994
- Simple Cycle Configuration
- Approximately 160 MW Combined Output
- Heat Rate of 11,612 Btu/kWh (HHV)

Conversion of Rathdrum CT to a Combined Cycle Power Plant



Conversion of Rathdrum CT to Combined Cycle Water Cooled Condenser

Incremental Output Increase:	78.4 MW At 5°F
	85.2 MW at 55°F
	91.4 MW at 100°F
Overall Plant Heat Rate Change:	-3782 Btu/kWhr (HHV)
Variable Operating Costs:	$1.50/MWh
Fixed Operating Costs:	$15/kWyr
Capital Cost:	$71M
Plant Unavailable Time:	6 Months

Conversion of Rathdrum CT to Combined Cycle
Air Cooled Condenser

Incremental Output Increase:	77.9 MW At 5°F
	79.9 MW at 55°F
	82.4 MW at 100°F
Overall Plant Heat Rate Change:	-3626 Btu/kWhr (HHV)
Variable Operating Costs:	$1.30/MWh
Fixed Operating Costs:	$15/kWyr
Capital Cost:	$81.5M
Plant Unavailable Time:	6 Months

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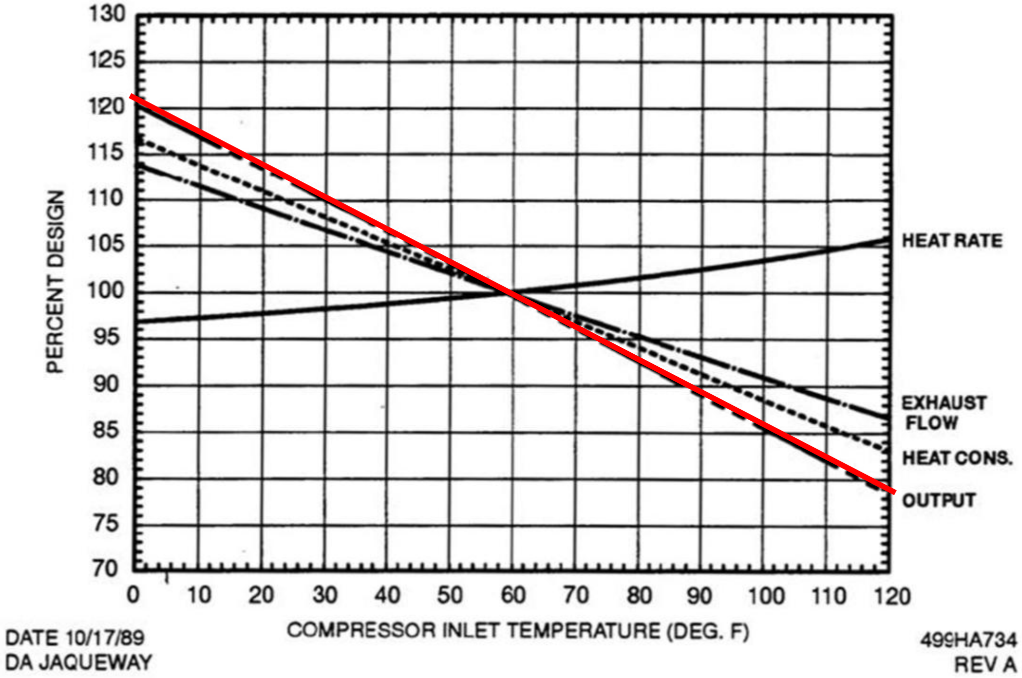
Water Demineralizer at Rathdrum CT for Inlet Fogging



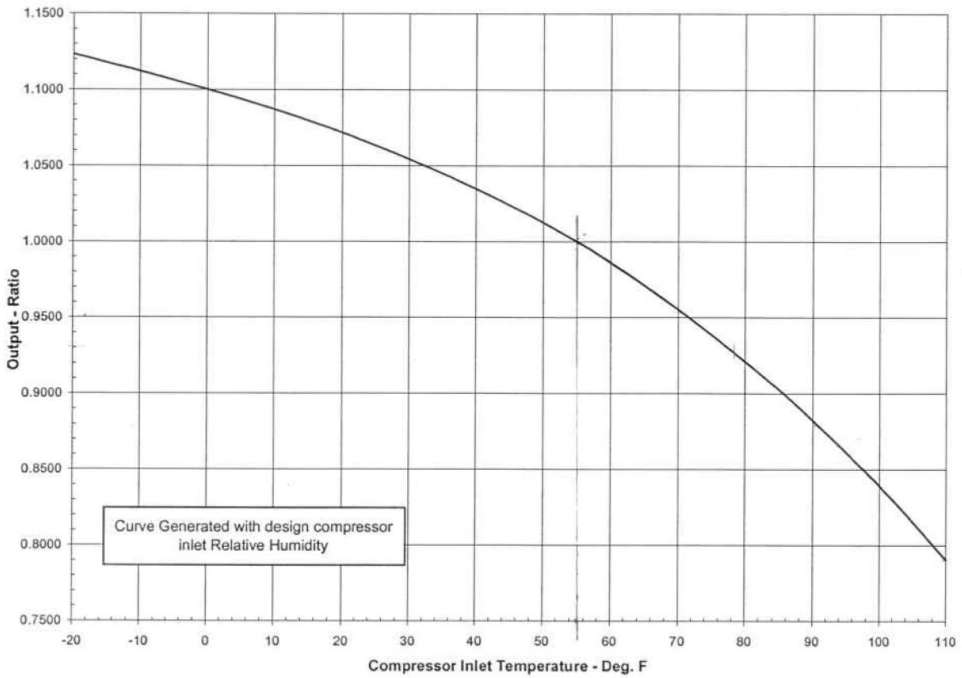
Water Demineralizer at Rathdrum CT for Inlet Fogging

Incremental Output Increase:	N/A At 5°F
	4.4 MW at 55°F
	17.6 MW at 100°F
Overall Plant Heat Rate Change:	-67 Btu/kWhr (HHV)
Variable Operating Costs:	$1.00/MWh
Fixed Operating Costs:	Insignificant
Capital Cost:	$1M
Plant Unavailable Time:	2 Months

Coyote Springs 2
Boardman, Oregon

- One General Electric 7FA Combustion Turbine
- Combined Cycle Configuration
- On Line in 2003
- Approximately 279 MW Combined Output (Duct Fired)
- Heat Rate of 6229 Btu/kWh (HHV)

Inlet Chiller at Coyote Springs 2



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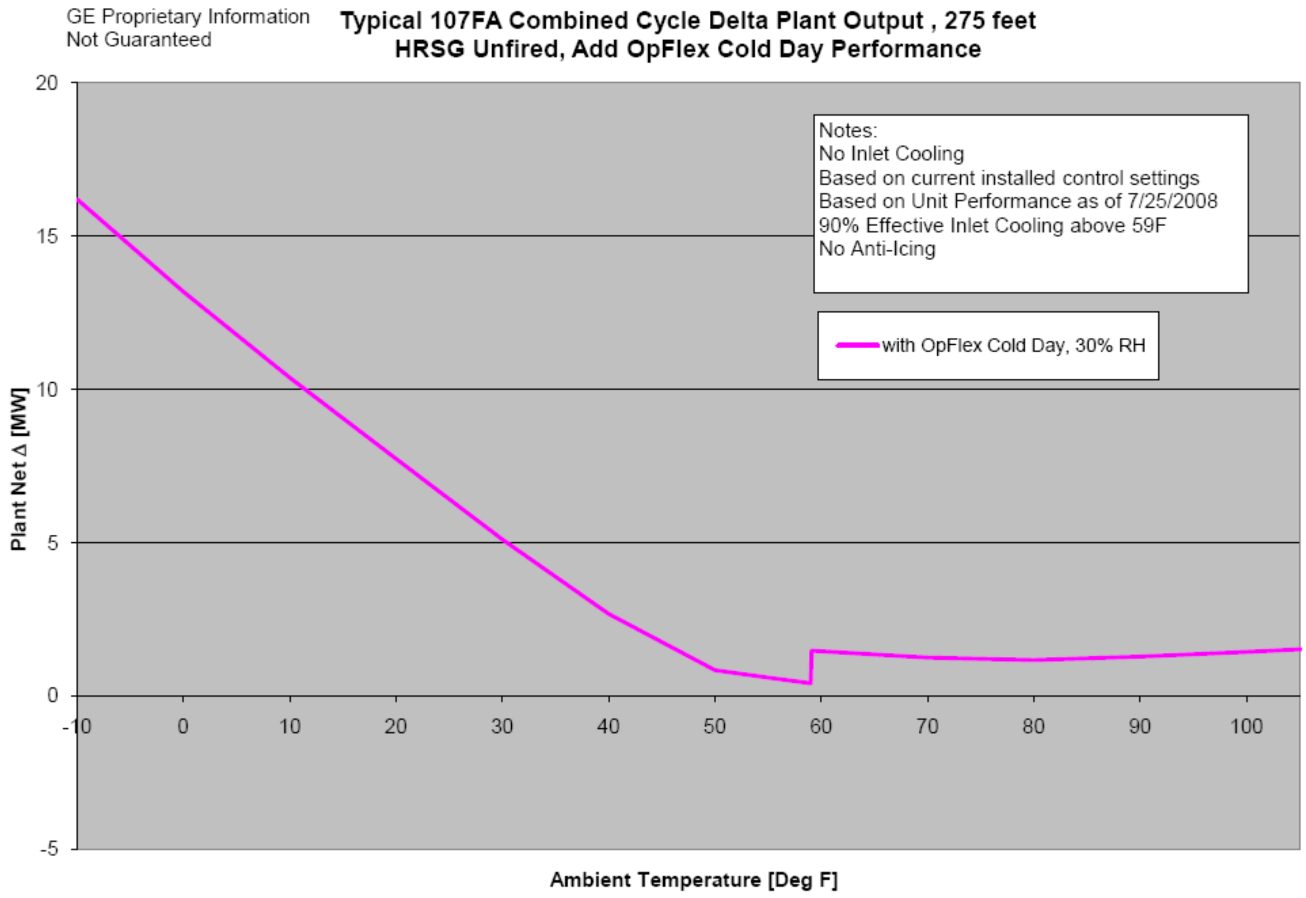
Inlet Chiller at Coyote Springs 2 w/o Thermal Storage

Incremental Output Increase:	N/A At 5°F
	0 MW at 55°F
	29.8 MW at 100°F
Overall Plant Heat Rate Change:	Insignificant
Variable Operating Costs:	Insignificant
Fixed Operating Costs:	Insignificant
Capital Cost:	$10M
Plant Unavailable Time:	3 Months

Inlet Chiller at Coyote Springs 2 With Thermal Storage

Incremental Output Increase:	N/A At 5°F
	0 MW at 55°F
	32.2 MW at 100°F
Overall Plant Heat Rate Change:	Insignificant
Variable Operating Costs:	Insignificant
Fixed Operating Costs:	Insignificant
Capital Cost:	$10M
Plant Unavailable Time:	3 Months

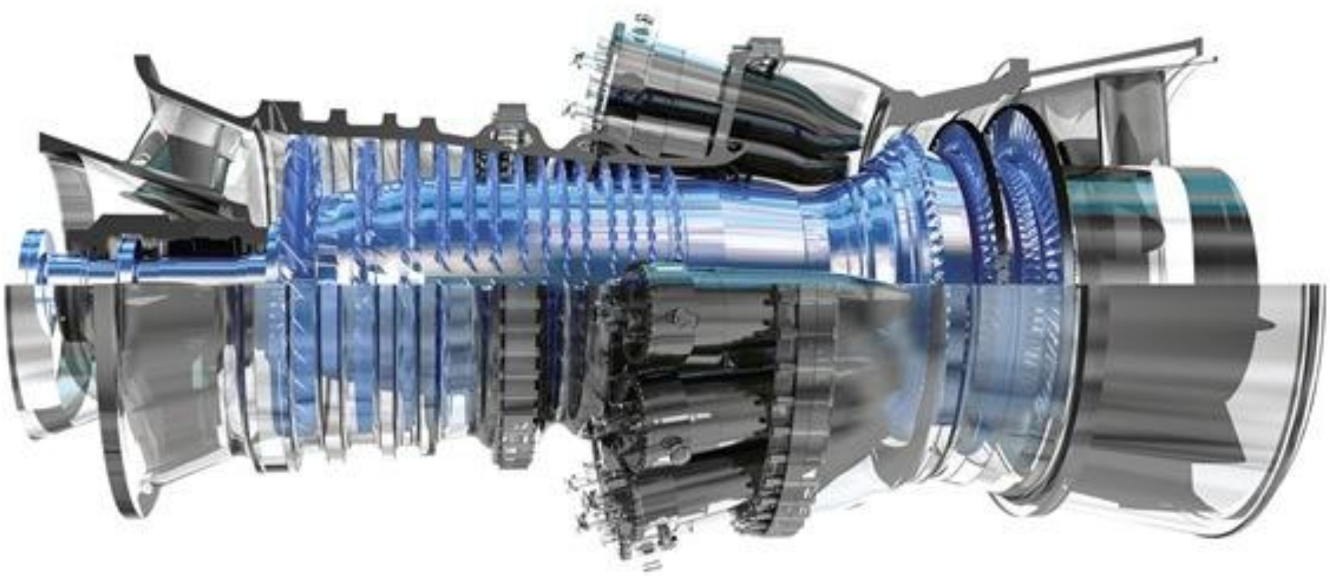
Cold Day Performance Software Upgrade at Coyote Springs 2



Cold Day Performance Software Upgrade at Coyote Springs 2

Incremental Output Increase:	17.6 MW At 5°F
	0.8 MW at 55°F
	1.2 MW at 100°F
Overall Plant Heat Rate Change:	Insignificant
Variable Operating Costs:	None
Fixed Operating Costs:	None
Capital Cost:	$4.5M
Plant Unavailable Time:	2 Months

Advanced Hot Gas Path Hardware Upgrade at Coyote Springs 2



Source: General Electric

Advanced Hot Gas Path Hardware Upgrade at Coyote Springs 2

Incremental Output Increase:	8.6 MW At 5°F
	8.0 MW at 55°F
	7.1 MW at 100°F
Overall Plant Heat Rate Change:	-76 Btu/kWhr
Variable Operating Costs:	None
Fixed Operating Costs:	$3.9M
Capital Cost:	$18M
Plant Unavailable Time:	None

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Cooling Optimization Hardware Upgrade at Coyote Springs 2

7FA Cooling Optimization Package,
Image removed, GE Proprietary

Source: General Electric

Cooling Optimization Hardware Upgrade at Coyote Springs 2

Incremental Output Increase:	2.8 MW At 5°F
	2.6 MW at 55°F
	2.3 MW at 100°F
Overall Plant Heat Rate Change:	-35 Btu/kWhr
Variable Operating Costs:	None
Fixed Operating Costs:	None
Capital Cost:	$7.2M
Plant Unavailable Time:	2 Months

Kettle Falls Generating Station
Kettle Falls, Washington

- Wood Fired Boiler with General Electric Steam Turbine
- On Line in 1983
- Approximately 48 MW Output

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Gasification of Wood Fuel at Kettle Falls Generation Site

Nexterra Gasification System

1. Fuel In-Feed System
2. Gasifier
3. Automatic Ash Removal System
4. Syngas

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Gasification of Wood Fuel at Kettle Falls Generation Site

- Gasification of wood fuel for use in turbines is in it's infancy
- Difficulty with adequately cleaning the syngas for use in a turbine
- No reliable data on expected costs or operational characteristics

Questions?

Load Forecast

Randy Barcus

Technical Advisory Committee Meeting #3

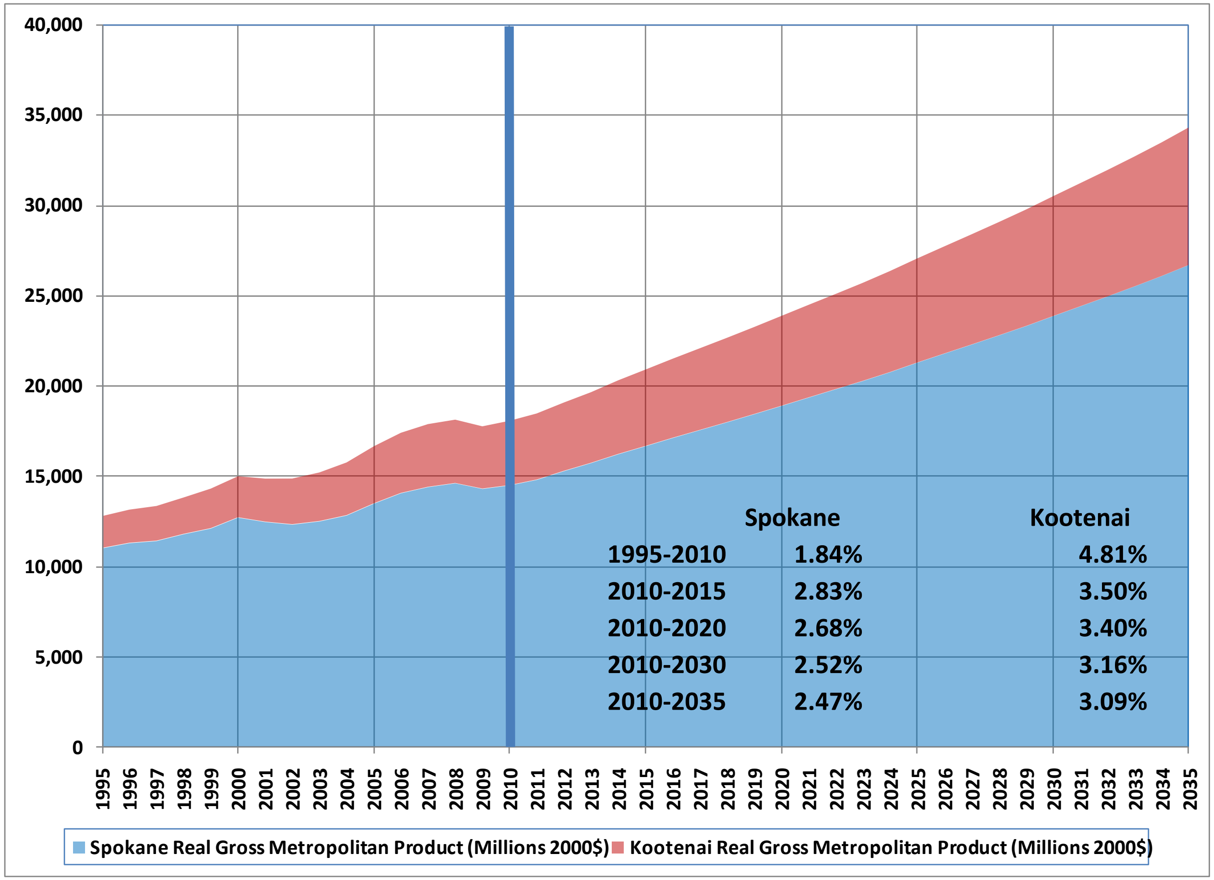
2011 Electric Integrated Resource Plan

December 2, 2010

Load Forecast 2011-2035 Outline

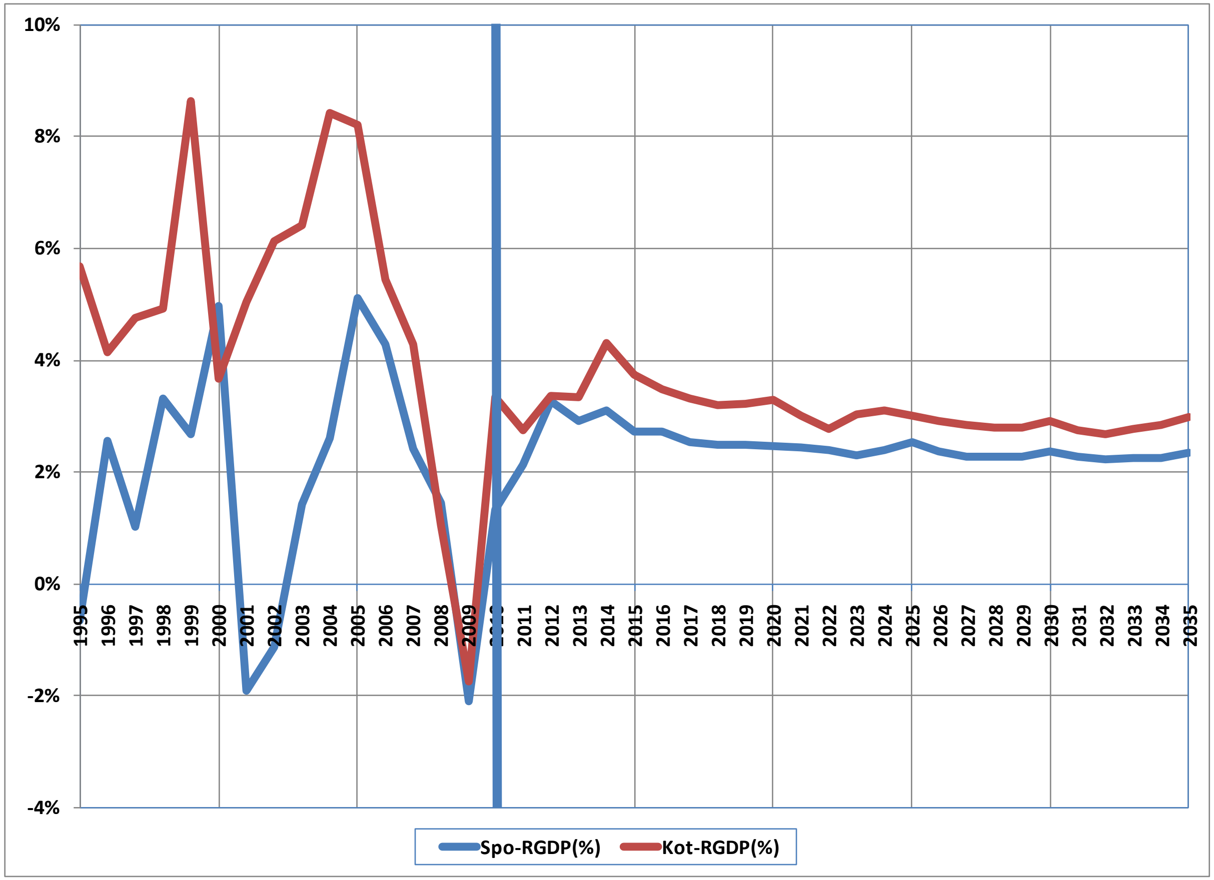
- Economy
- Weather
- Price Elasticity
- Customer Regressions
- Small Sector Forecasts
- Large Customer Forecasts
- Irrigation and Pumping Sales
- Sales Forecast
- Load Forecast
- Expected Peak Forecast
- Load Forecast Scenarios

Real Gross Metropolitan Product ($millions) History 1995-2010, Forecast 2010-2035



	Spokane	Kootenai
1995-2010	1.84%	4.81%
2010-2015	2.83%	3.50%
2010-2020	2.68%	3.40%
2010-2030	2.52%	3.16%
2010-2035	2.47%	3.09%

Real Gross Metropolitan Product
Annual Percent Change



GLOBAL INSIGHT

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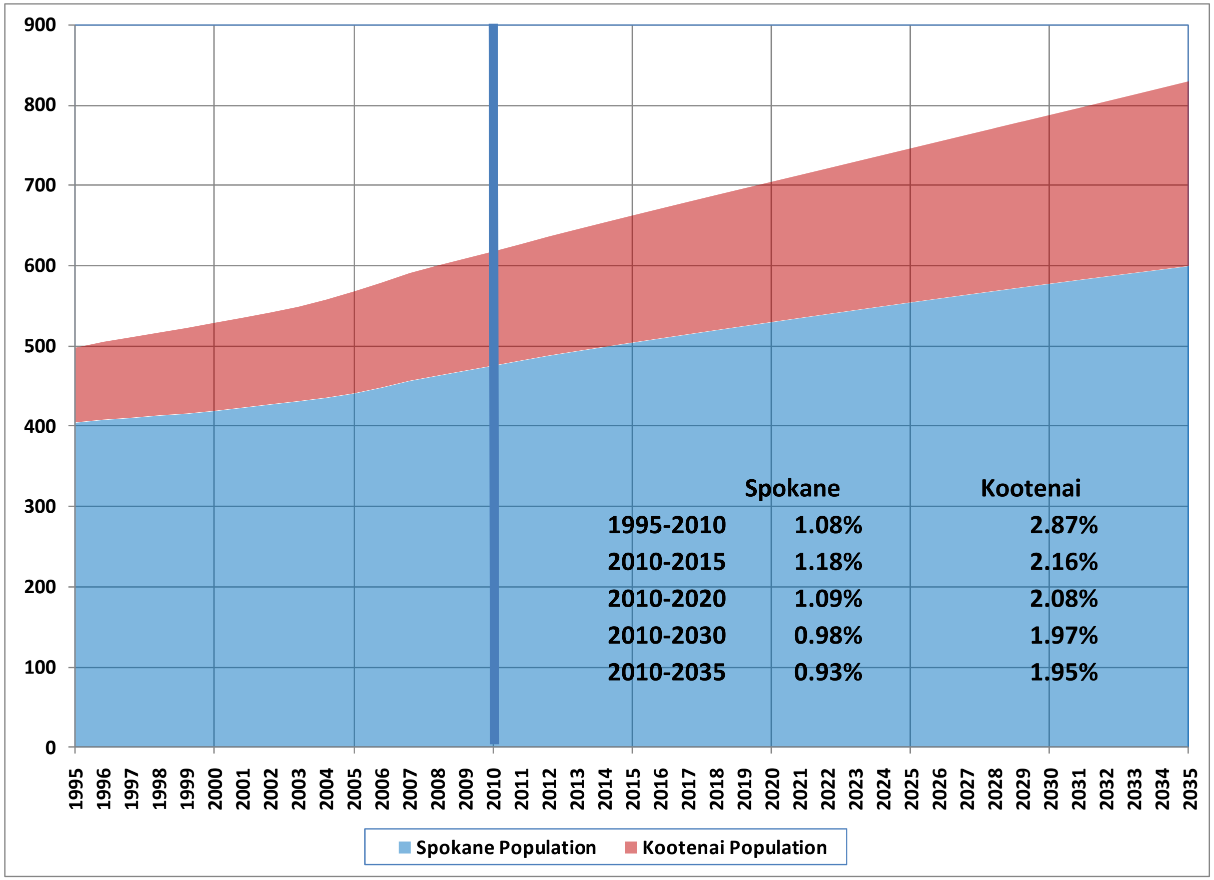
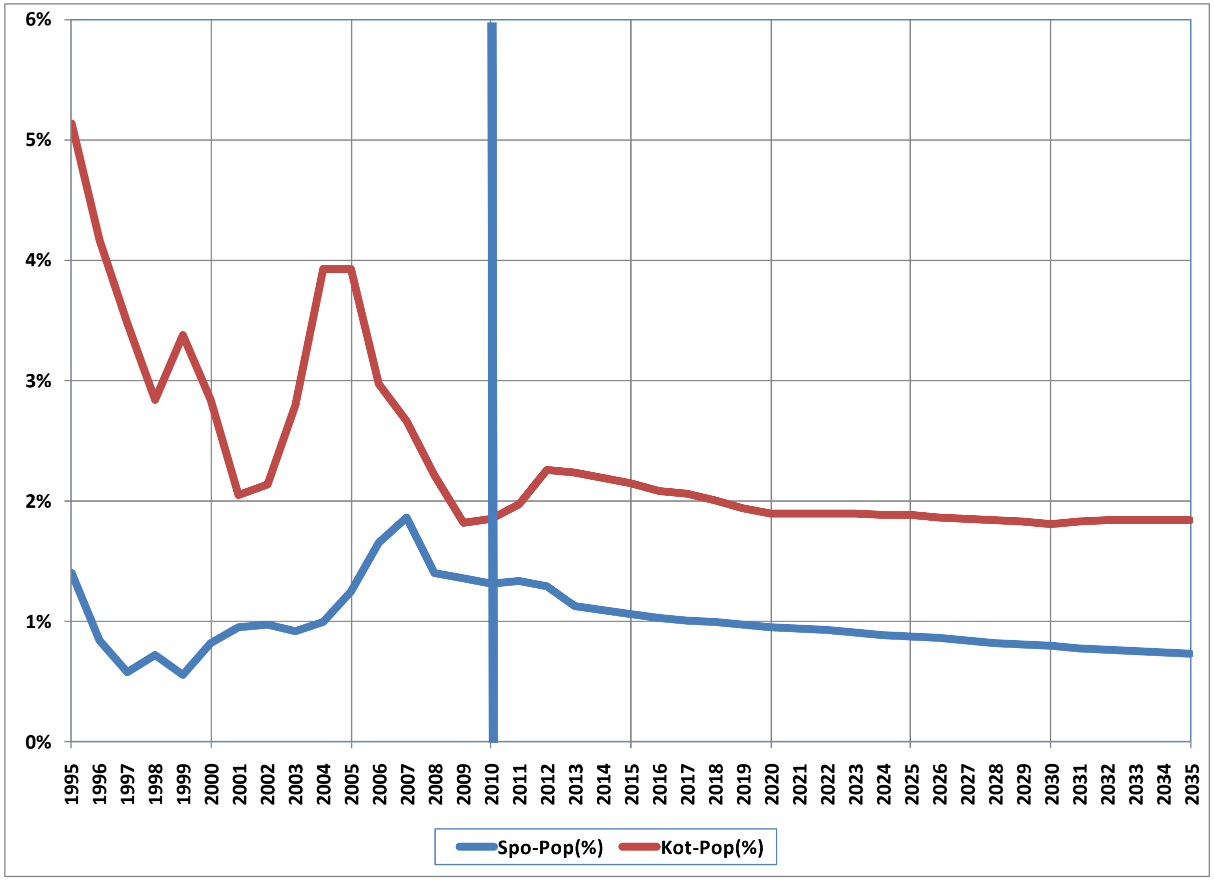
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 429 of 1069

Annual Population—thousands of persons
History 1995-2010, Forecast 2010-2035



Population
Annual Percent Change



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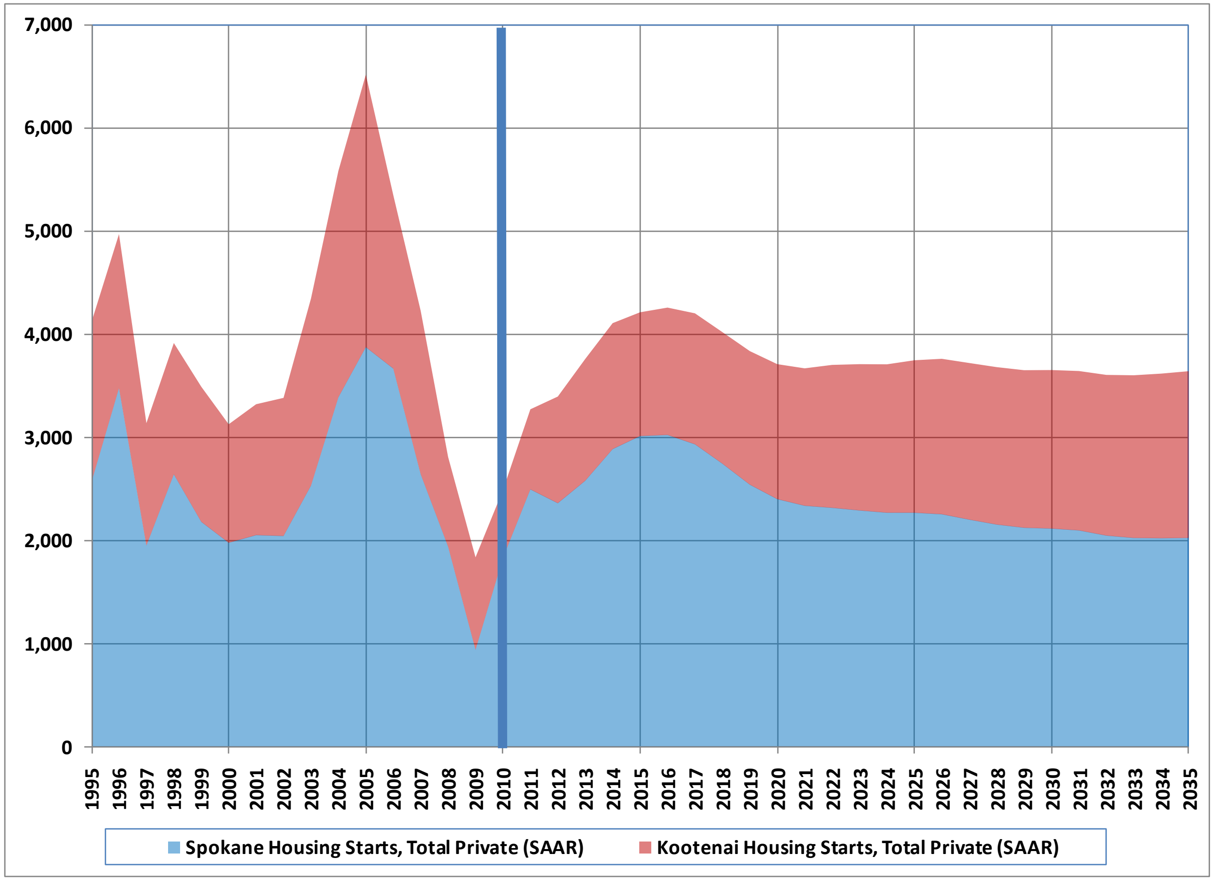
Annual Housing Starts
History 1995-2010, Forecast 2010-2035



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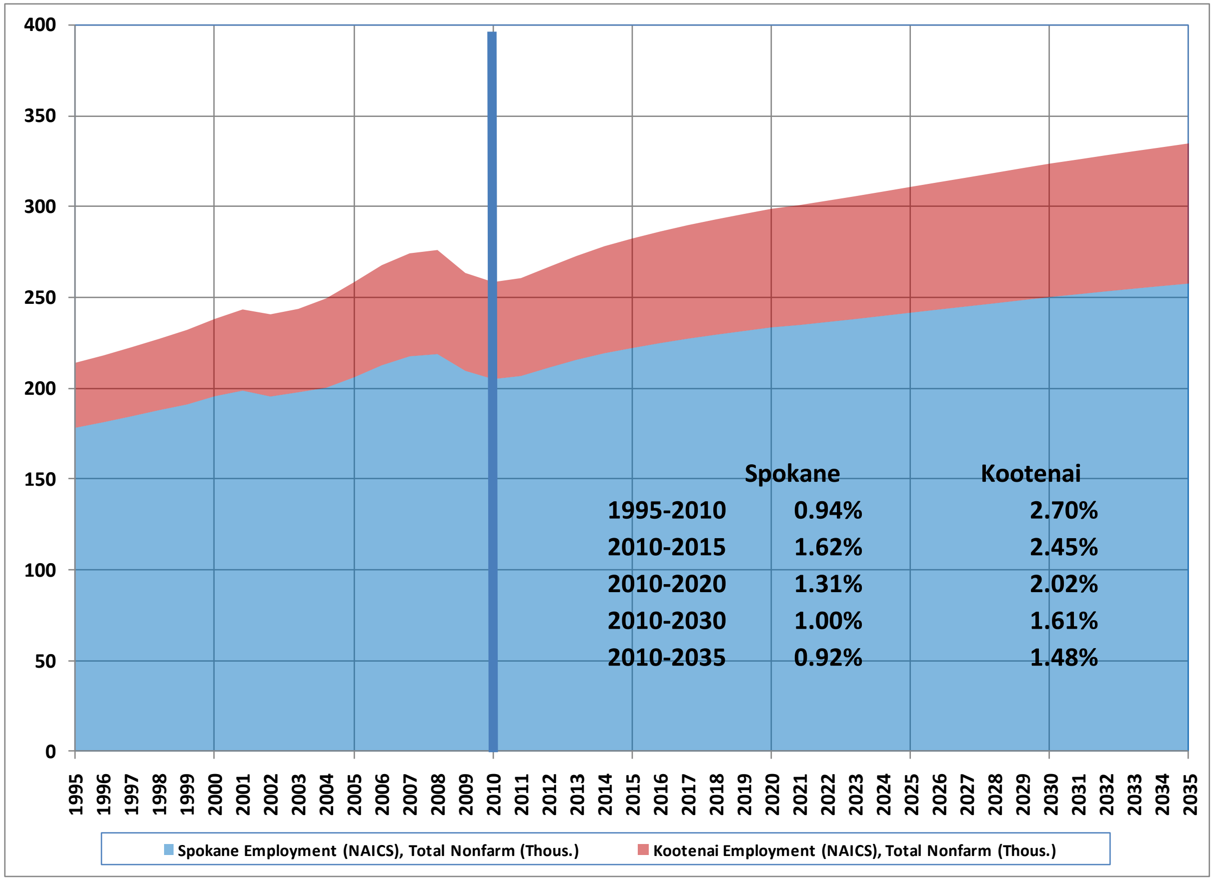
Schedule 1, Page 432 of 1069

Average Annual Non-Ag Employment—thousands History 1995-2010, Forecast 2010-2035



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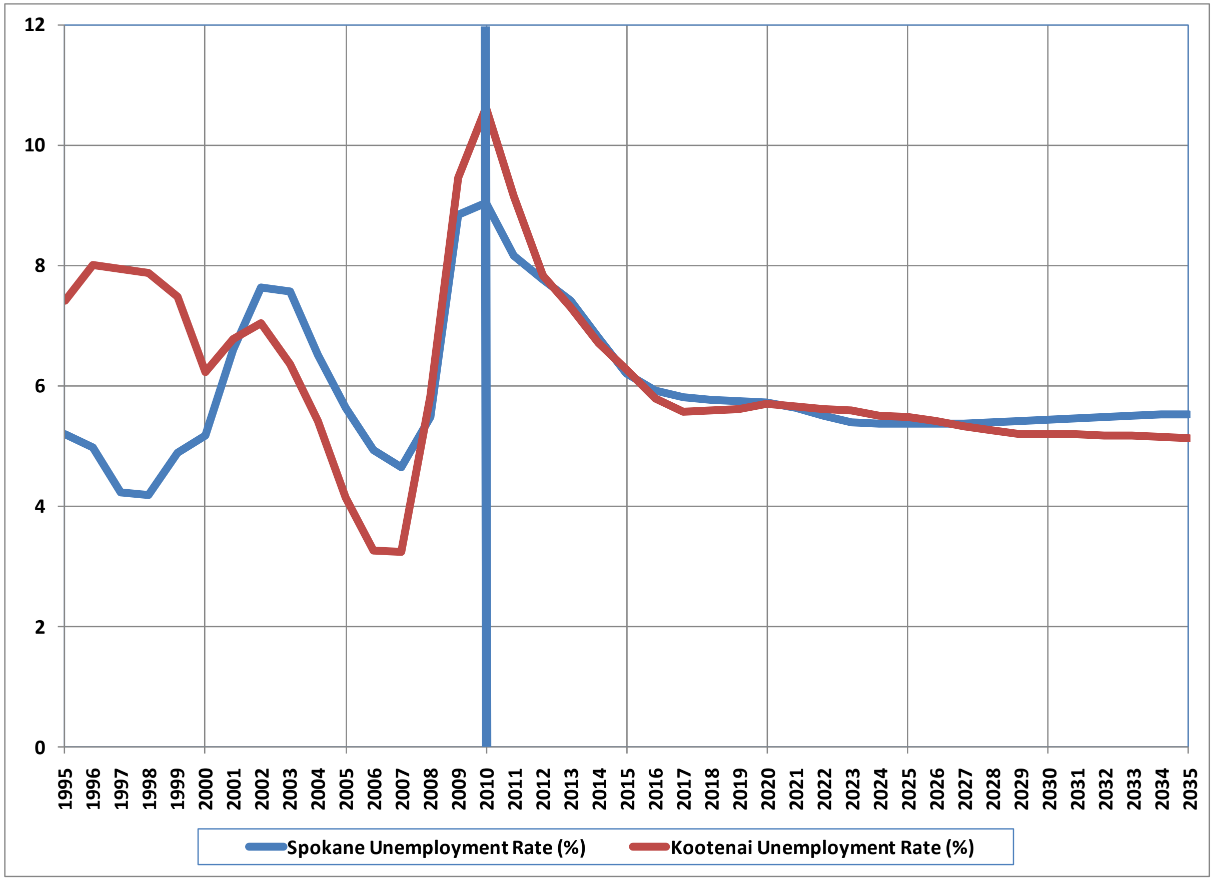
Non-Ag Employment
Annual Percent Change

Average Annual Unemployment Rate--Percent



GLOBAL INSIGHT

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Case Nos. AVU-E-12-08
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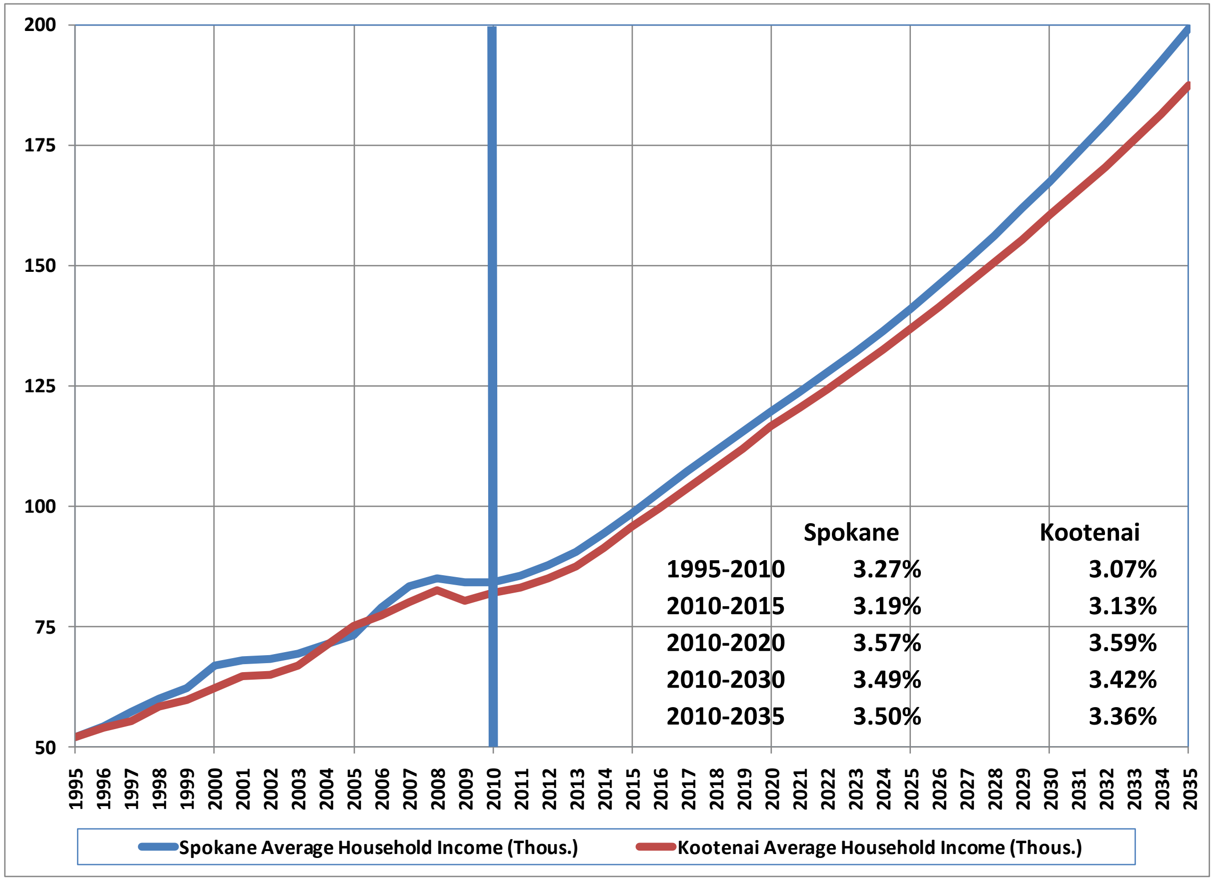
Schedule 1, Page 435 of 1069

Average Annual Household Income—Thousands $



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Schedule 1, Page 436 of 1069

Average Household Income—Percent Change Compared to U.S. Consumer Price Index (CPIU)

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 437 of 1069

Weather Assumptions

- We use degree days (heating and cooling) base 65 degrees
- We define “normal” as the average of the last 30 years of actual data; for this forecast, the period is 1980-2009
- We assume the first year (2011) of the forecast is “normal”
- A gradual warming trend in temperature equal to the University of Washington “Climate Change Scenarios” 2008 study Average case converted by us to heating and cooling degree days
- http://cses.washington.edu/cig/fpt/ccscenarios.shtml

Spokane HDD 1970-1999 Average			6,848	
	Low	1.1	6,547	95.6%
2025 Computation	Average*	2.0	6,300	92.0%
	High	3.3	5,944	86.8%
	Low	1.5	6,437	94.0%
2045 Computation	Average*	3.2	5,971	87.2%
	High	5.2	5,423	79.2%
	Low	2.8	6,081	88.8%
2085 Computation	Average*	5.3	5,396	78.8%
	High	9.7	4,190	61.2%

Spokane CDD 1970-1999 Average			411	
	Low	1.1	511	124.3%
2025 Computation	Average*	2.0	593	144.3%
	High	3.3	711	173.0%
	Low	1.5	548	133.2%
2045 Computation	Average*	3.2	702	170.8%
	High	5.2	884	215.1%
	Low	2.8	666	162.0%
2085 Computation	Average*	5.3	893	217.3%
	High	9.7	1,294	314.7%

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Price Elasticity

- The price elasticity assumptions are unchanged from the prior IRP
  - Residential -0.15
  - Commercial -0.10
  - Cross-price +0.05
  - Income +0.75
- We monitor price elasticity estimates for consistency
  - Energy Information Administration
  - Itron Energy Forecasting Group
  - American Gas Association/Gas Forecasters Forum

Customer Regressions

- We use annual housing starts forecasts from Global Insight, Inc. to forecast residential customers—this method is new
  - The dependent variable is annual residential customer additions, the independent variable is annual housing starts
  - We forecast Idaho and Washington Schedule 1 customers using separate models
- We use annual residential customer additions to forecast commercial customer additions.
  - The dependent variable is annual commercial customer additions, the independent variable is residential customer additions
- For very large commercial customers, we add one in 2017, 2021, and 2028 in Washington and one in Idaho in 2025

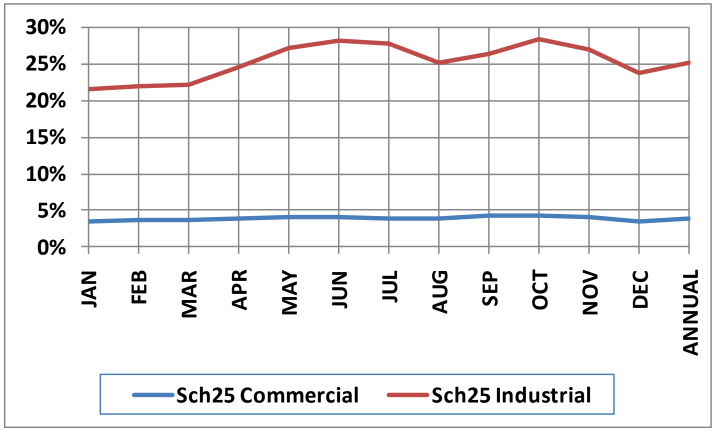
Small Sector Forecasts

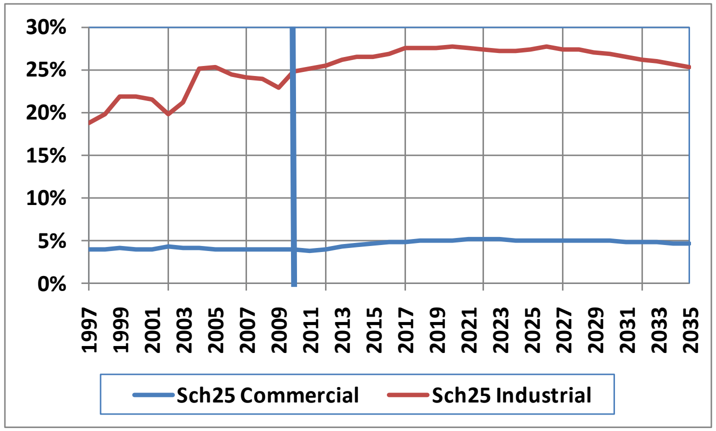
- We forecast electricity sales by state, by rate schedule
- We produce monthly sales forecasts until 2015, annual to 2035
- We define small sector sales in Washington as:
  - Residential schedule 1, 12, 22, 32 and 48
  - Commercial schedule 11, 21, 28, 31 and 47
  - Industrial schedule 11, 21, 31, 32 and 47
  - Street Lighting schedule 41, 42, 44, 45 and 46
- We define small sector sales in Idaho as:
  - Residential schedule 1, 12, 22, 32, 48 and 49
  - Commercial schedule 11, 21, 31, 47 and 49
  - Industrial schedule 11, 21, 31, 32, 47 and 49
  - Street Lighting schedule 41, 42, 43 44, 45 and 46
- *We define large sector sales as schedule 25 commercial and industrial in both states*

Large Customer Forecasts

- We are prohibited from disclosing individual large customer sales
- Sector groupings
  - Paper Manufacturers
  - Potato Processors
  - Lumber and Wood Producers
  - Hospitals
  - Aircraft Parts Manufacturers
  - Universities
  - Wastewater Treatment Facilities
  - Ammunition Manufacturers
  - Cabinetry Manufacturers
  - Foundries
  - Mines
  - Hotels
  - Electronic Equipment Manufacturers
  - Courthouse/Office Building
- All together there are 13 commercial and 18 industrial meter points

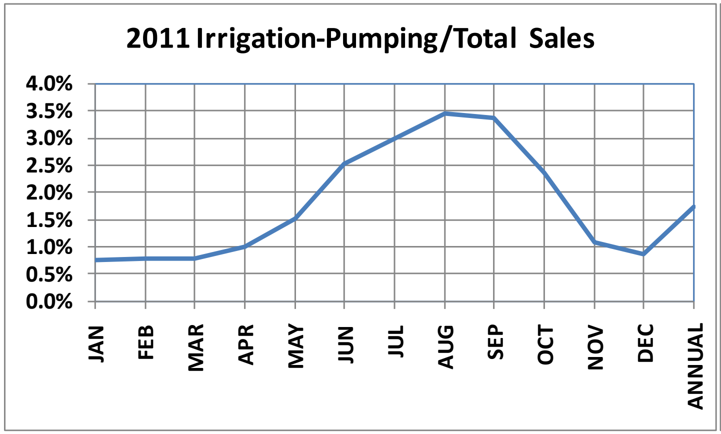
Large Customer Share of Total kWh Sales Commercial and Industrial Schedule 25

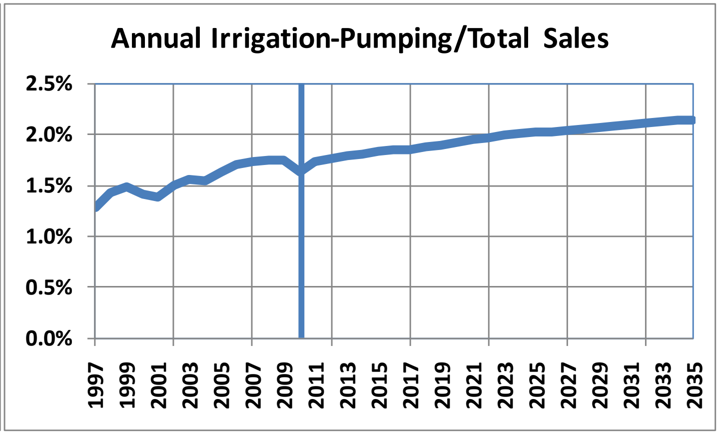




Note—the above charts are stacked line

Irrigation and Pumping Sales
Special Load Analysis





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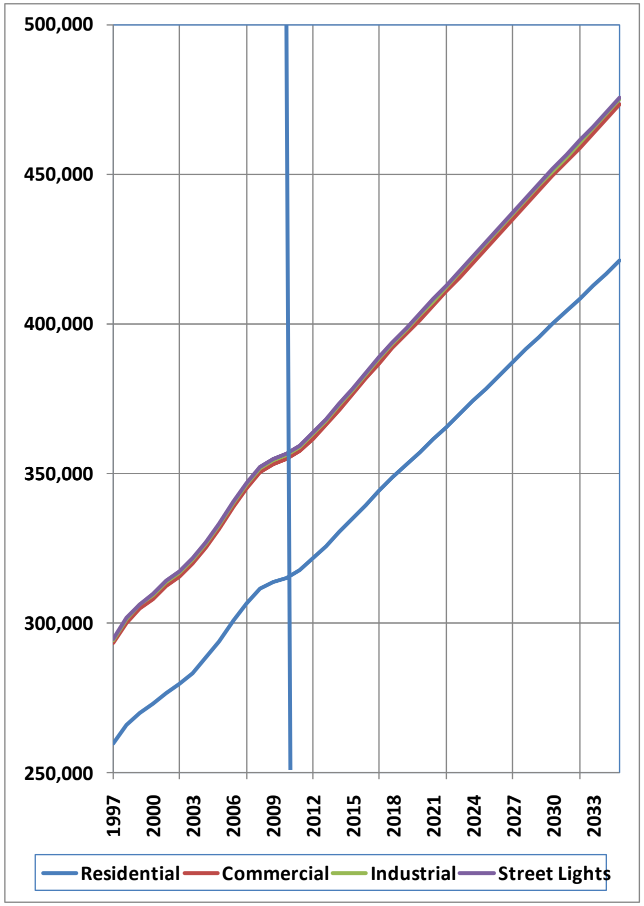
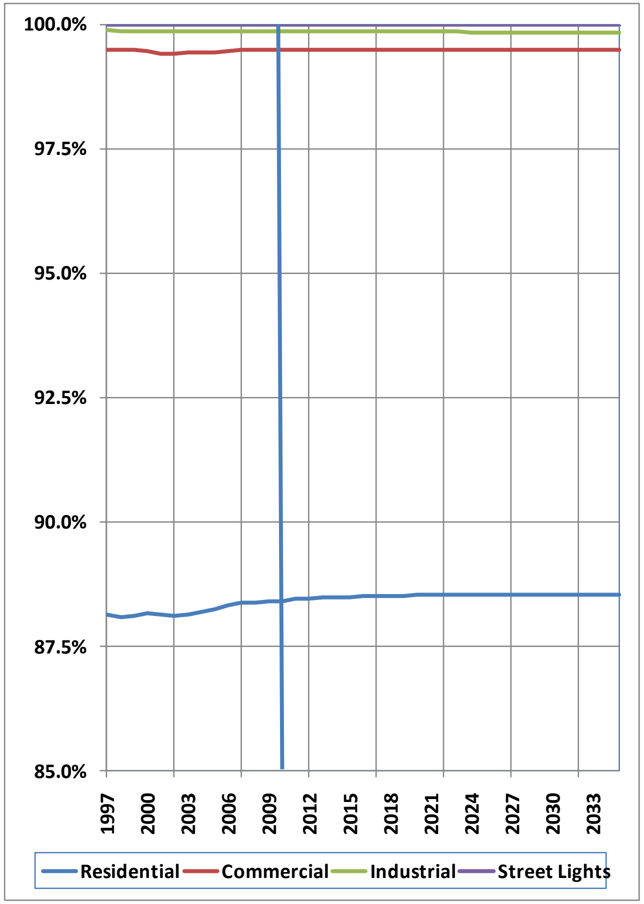
Customer Forecasts

	Residential	Commercial	Industrial	Street Lights	Total Customers
2000-2010	1.44%	1.19%	0.94%	1.37%	1.41%
2010-2015	1.22%	1.06%	0.90%	2.63%	1.20%
2010-2020	1.26%	1.14%	0.85%	2.49%	1.24%
2010-2030	1.20%	1.14%	0.72%	2.27%	1.19%
2010-2035	1.17%	1.12%	0.69%	2.18%	1.16%





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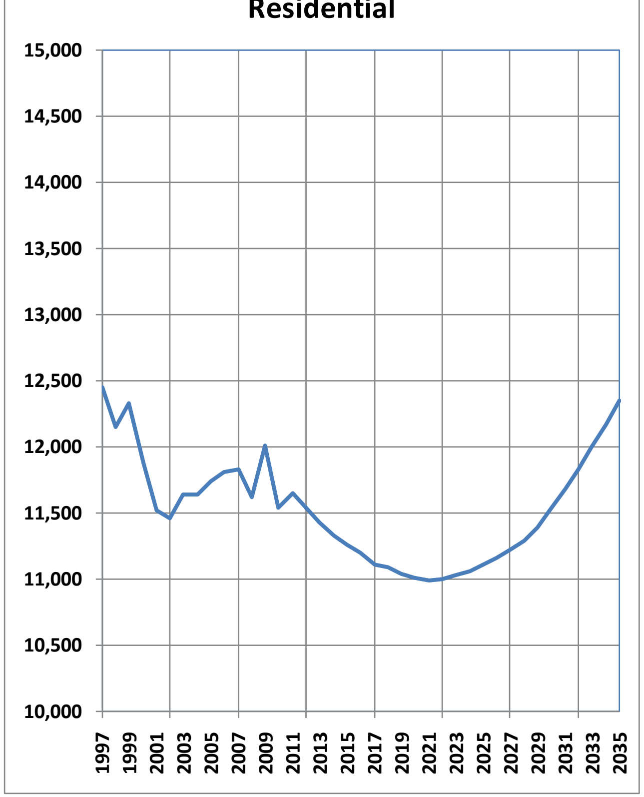
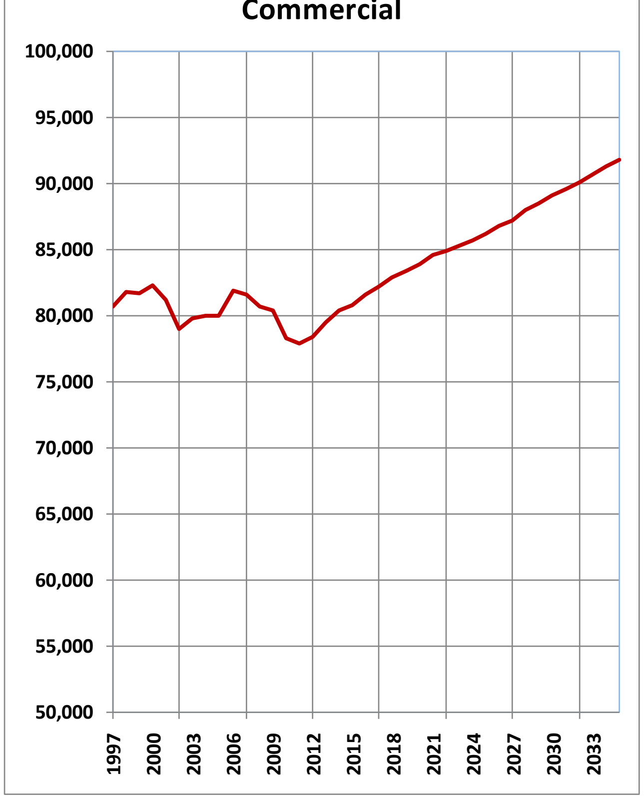
kWh Use per Average Residential Customer

	Residential	Commercial
2000-2010	-0.29%	-0.50%
2010-2015	-0.49%	0.65%
2010-2020	-0.47%	0.70%
2010-2030	0.00%	0.65%
2010-2035	0.27%	0.64%





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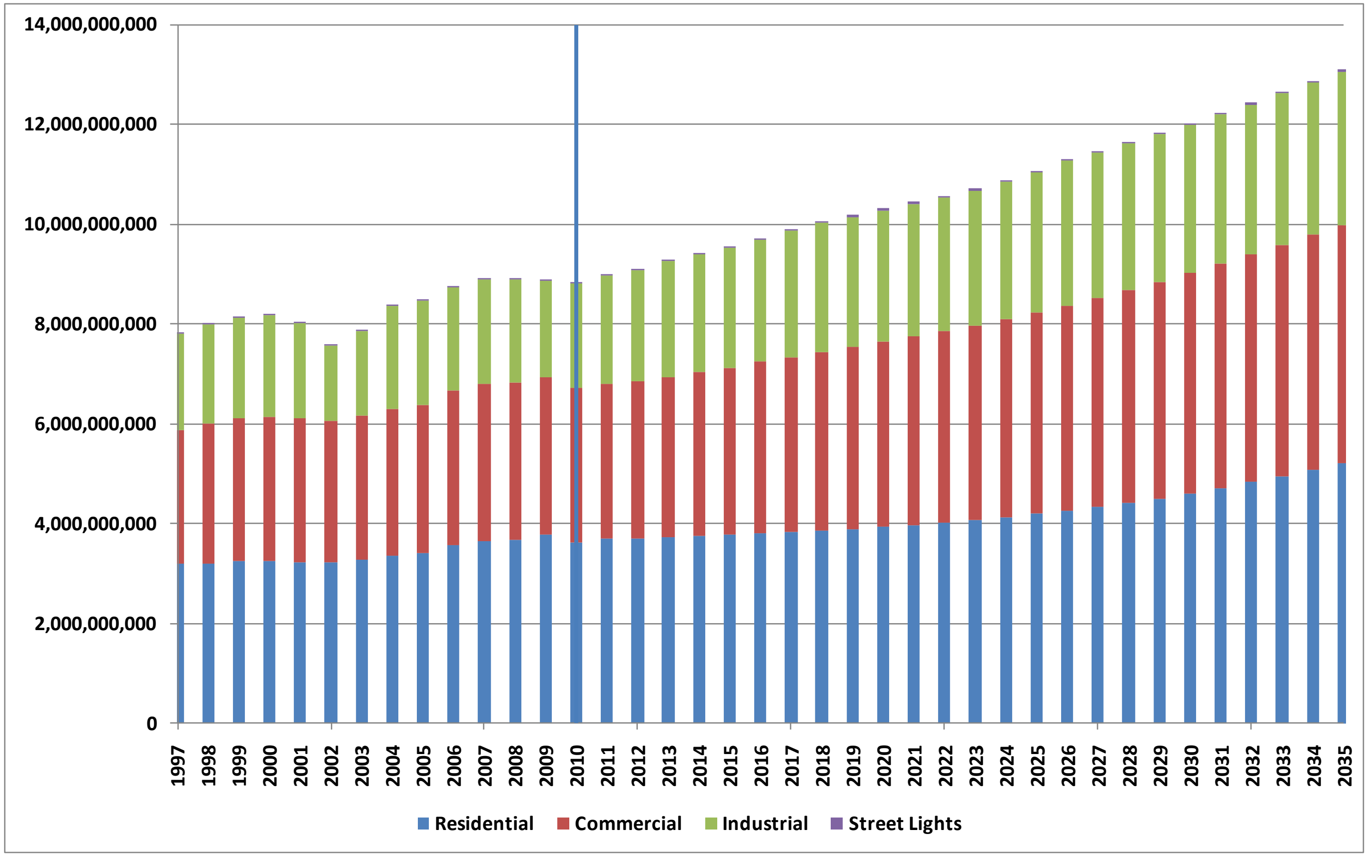
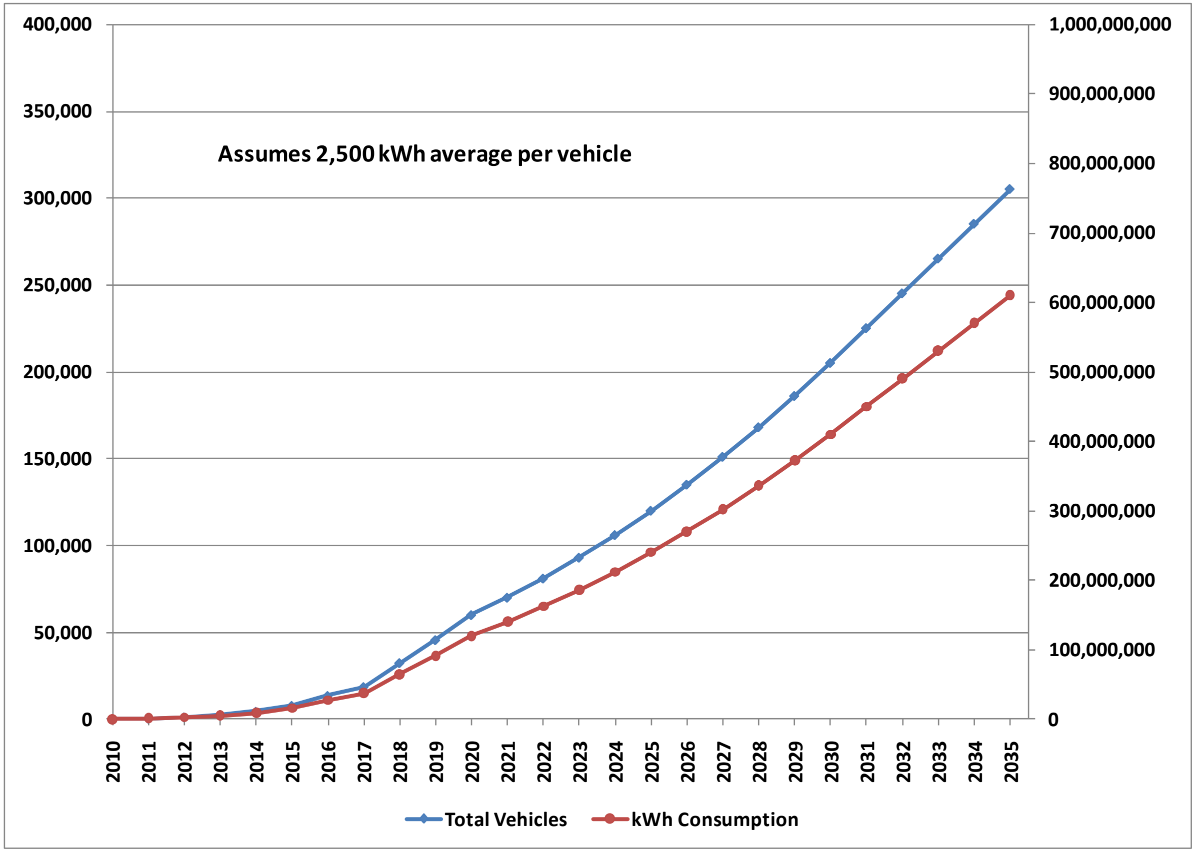
kWh Sales Customer Class

	Residential	Commercial	Industrial	Street Lights	Total Sales
2000-2010	1.11%	0.69%	0.23%	0.53%	0.75%
2010-2015	0.72%	1.71%	2.74%	2.49%	1.56%
2010-2020	0.79%	1.84%	2.38%	2.32%	1.56%
2010-2030	1.19%	1.79%	1.78%	2.03%	1.55%
2010-2035	1.44%	1.77%	1.56%	1.94%	1.59%



Electric Car Forecast (PIH & PEV)



Load Forecast in Average MW

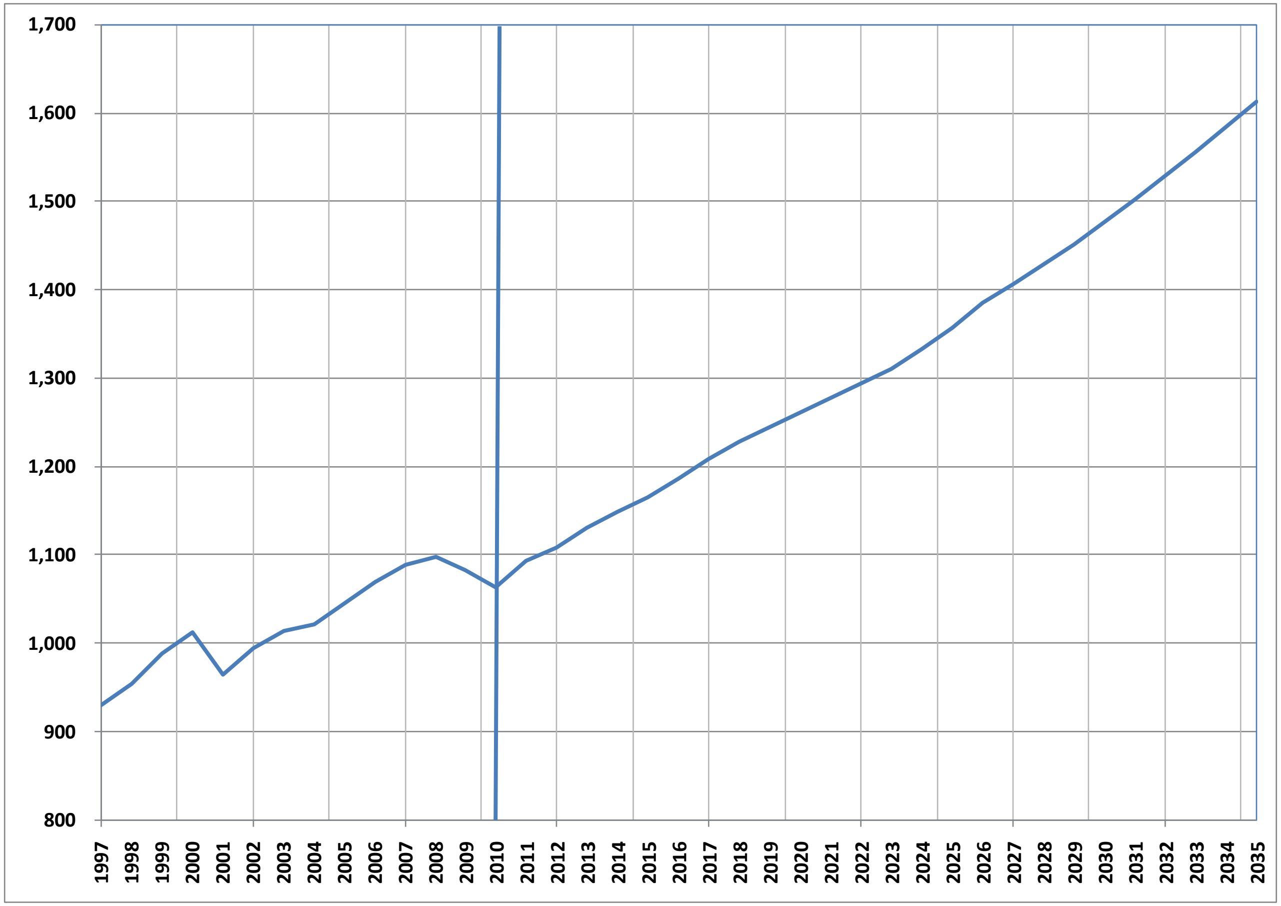


Exhibit No. 4
Case Nos. AVU-E-12-08
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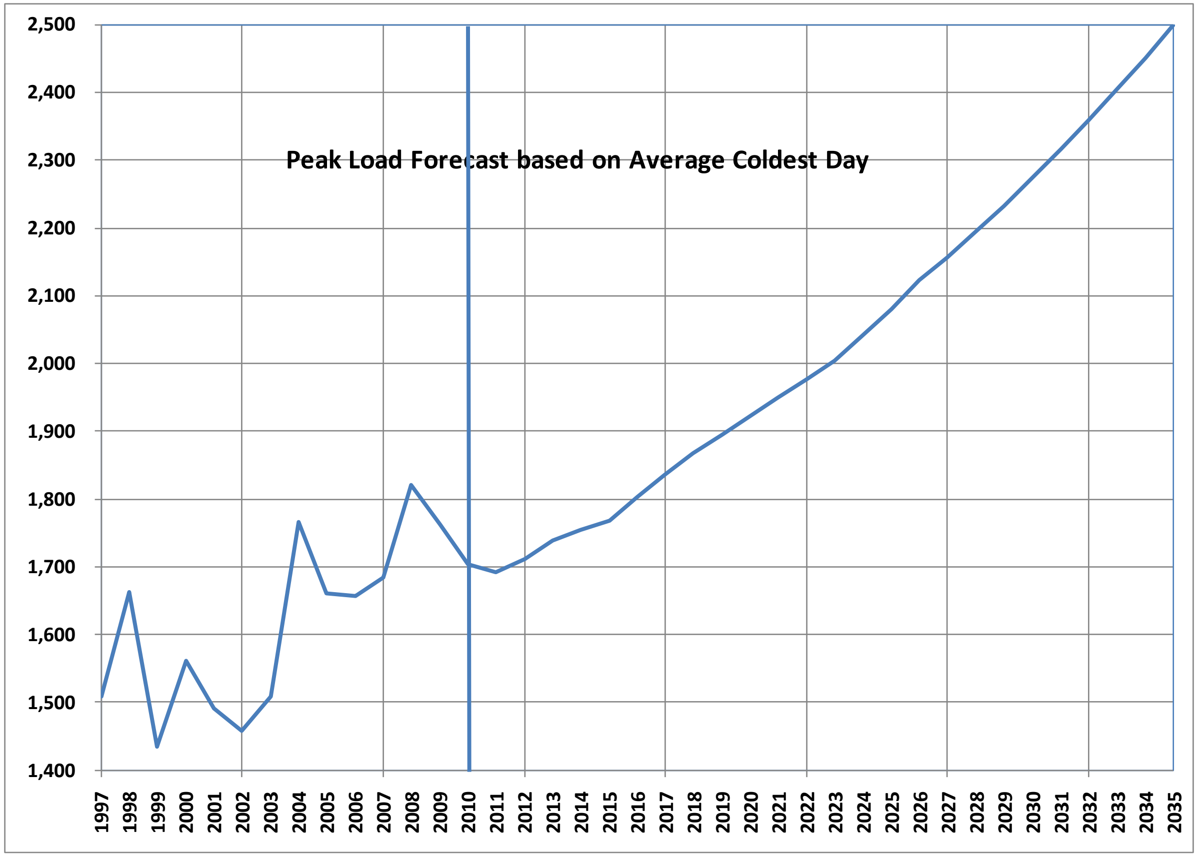
Schedule 1, Page 449 of 1069

Peak Demand in Megawatts



Medium Scenario Growth Rates

	Energy	Peak Demand
2000-2010	0.48%	0.87%
2010-2015	1.85%	0.76%
2010-2020	1.72%	1.22%
2010-2030	1.66%	1.46%
2010-2035	1.68%	1.55%

Exhibit No. 4
Case Nos. AVU-E-12-08
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Schedule 1, Page 451 of 1069

Load Forecast Prepared 10 Years Ago

For		Forecast aMW	Days	Forecast MWH	Actual aMW	Days	Actual MWH	Percent Difference
2009	Jan	1,362	31	1,013,121	1,272	31	946,653	-6.6%
	Feb	1,266	28	850,592	1,186	28	796,895	-6.3%
	Mar	1,145	31	851,634	1,121	31	833,848	-2.1%
	Apr	1,080	30	777,278	980	30	705,751	-9.2%
	May	1,068	31	794,688	952	31	708,039	-10.9%
	Jun	1,089	30	783,858	979	30	704,569	-10.1%
	Jul	1,070	31	796,388	1,057	31	786,248	-1.3%
	Aug	1,074	31	798,938	1,034	31	769,272	-3.7%
	Sep	986	30	709,832	968	30	697,305	-1.8%
	Oct	1,109	31	825,286	1,014	31	754,464	-8.6%
	Nov	1,217	30	875,980	1,106	30	796,630	-9.1%
	Dec	1,335	31	993,573	1,321	31	982,507	-1.1%
				10,071,167			9,482,181	-5.8%

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Case Nos. AVU-E-12-08
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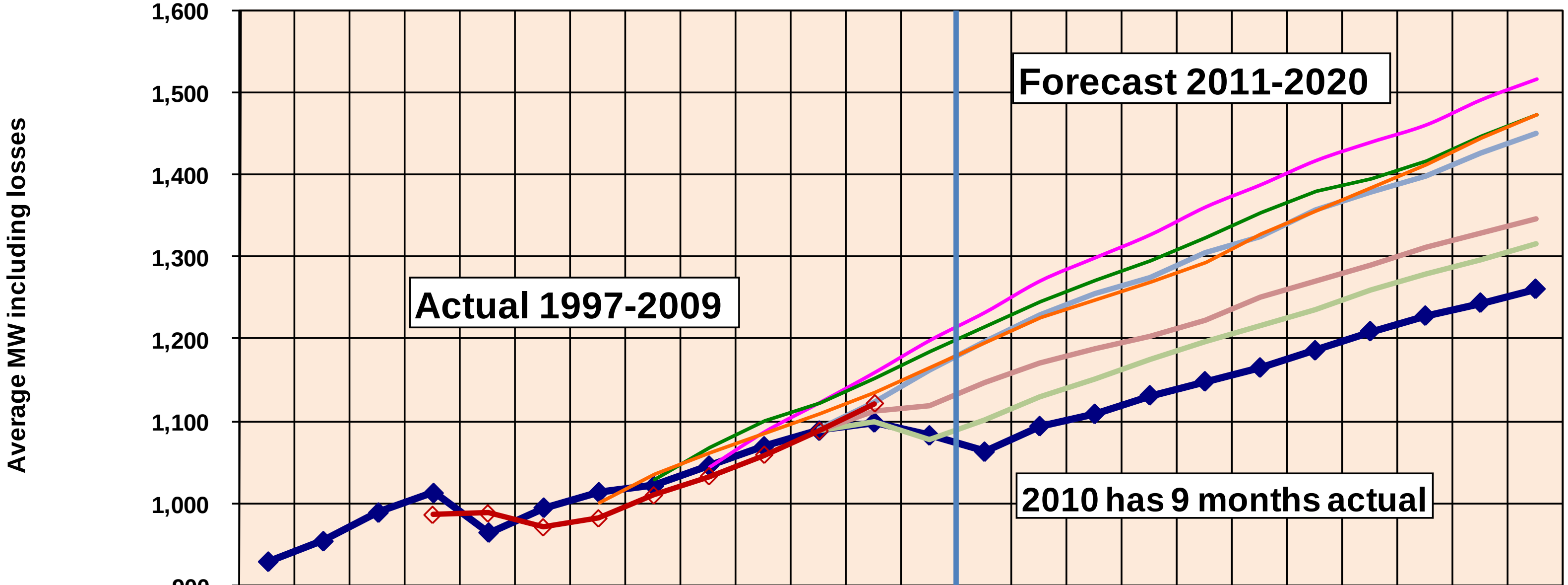
Schedule 1, Page 452 of 1069

Forecast Comparisons

Net Native Load

with Electric Cars

2011 Forecast Growth Rates Base 2011
5 =1.63%, 10 =1.56%, 20 =1.60%, 24 =1.63%



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
F2011	929	954	989	1,013	965	995	1,013	1,021	1,046	1,069	1,088	1,098	1,082	1,063	1,094	1,109	1,131	1,148	1,165	1,186	1,209	1,228	1,244	1,260
F2010											1,088	1,098	1,076	1,101	1,130	1,151	1,174	1,197	1,216	1,235	1,260	1,278	1,296	1,315
F2009											1,088	1,113	1,119	1,148	1,171	1,188	1,202	1,222	1,252	1,270	1,289	1,311	1,329	1,347
F2007IRP											1,091	1,124	1,163	1,196	1,229	1,255	1,274	1,306	1,325	1,358	1,379	1,399	1,426	1,449
F2006									1,043	1,086	1,122	1,159	1,198	1,232	1,270	1,299	1,327	1,360	1,388	1,417	1,440	1,461	1,491	1,516
F2005								1,029	1,067	1,099	1,122	1,152	1,185	1,215	1,246	1,270	1,296	1,323	1,354	1,379	1,395	1,417	1,447	1,472
F2004							1,000	1,035	1,061	1,085	1,109	1,135	1,164	1,196	1,225	1,247	1,270	1,293	1,327	1,356	1,384	1,412	1,444	1,474
F1999				986	988	971	982	1,009	1,033	1,059	1,088	1,121												

F2011 F2010 F2009 F2007IRP F2006 F2005 F2004 F1999

Population Forecasts—Then and Now

		July 1st Estimates						
	Spokane County Census April 1st	OFM 1995	OFM 2007	Avista 2000	Avista 2010	Decade Medium Growth Rate	Decade Low Growth Rate	Decade High Growth Rate
1960	278,333							
1970	287,487					0.32%		
1980	341,835					1.75%		
1990	361,333	361,333		361,333		0.56%		
2000	417,939		417,939			1.47%		
2010*	470,300	476,400	466,724	449,300	475,646	1.19%		
2020			529,451		530,003	1.09%	0.54%	1.63%
2030			589,623		577,829	0.87%	0.43%	1.30%
2035					599,873			

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 454 of 1069

Low, Medium and High Growth Scenarios

- Global Insight provides us with Medium Scenario economic forecasts

- We plan to overlay the 6th Power Plan range for Low and High

- NPPC Low 0.8%, Medium 1.4%, High 1.8% for 2010-2030
  - http://www.nwcouncil.org/energy/powerplan/6/final/SixthPowerPlan_Ch3.pdf page 3-5

- Avista's 2010-2030 growth rate medium scenario 1.66%
- Overlay Low 0.95%, Overlay High 2.13% by ratio method

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Stochastic Modeling Assumption & Methodology Discussion

James Gall

Technical Advisory Committee Meeting #3

2011 Electric Integrated Resource Plan

December 2, 2010

2011 Integrated Resource Plan Modeling Process

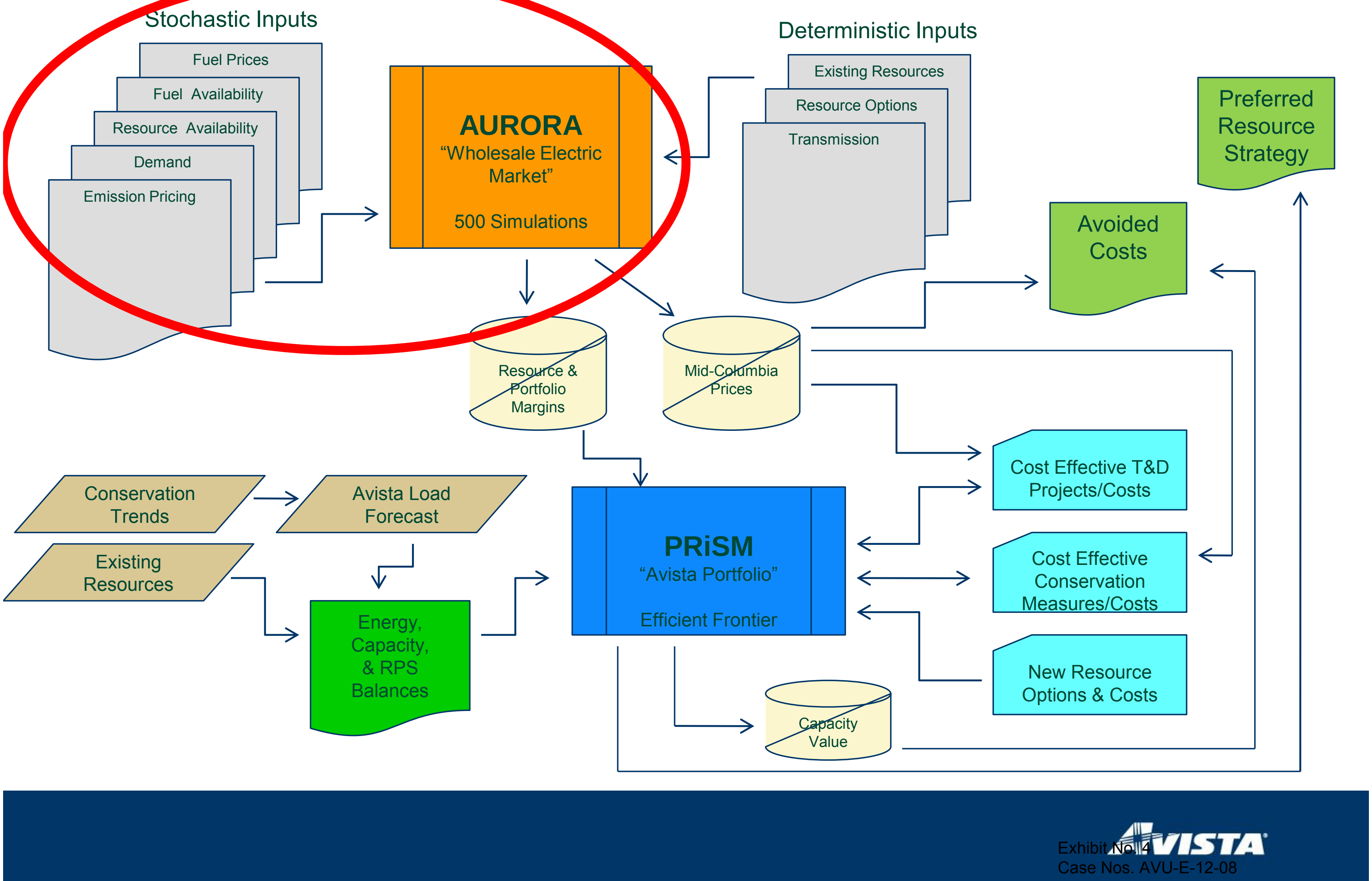

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 457 of 1069

Why Conduct a Stochastic Study

- Quantifies the risk (range in prices/costs) of the wholesale electric market.
- Determines range in potential market value of each resource option.
- Determines the range in potential cost to serve customers over the IRP time period.

IRP's objective is plan on a resource portfolio that is not only least cost but at an acceptable level of risk.

Measurements of Risk

- Standard Deviation
- Mean Absolute Error
- Value at Risk
- Tail Var "90"
- Percentile
- Probability

Market Stochastic Study Variables

- Hydro availability
- Wind availability
- Coal prices
- Wood prices
- Oil prices
- Inflation
- Forced outages
- Natural gas prices
- Weather (load)
- Economic growth (load)
- Conservation (load)
- Carbon legislation
- Resource Capital Costs (?)

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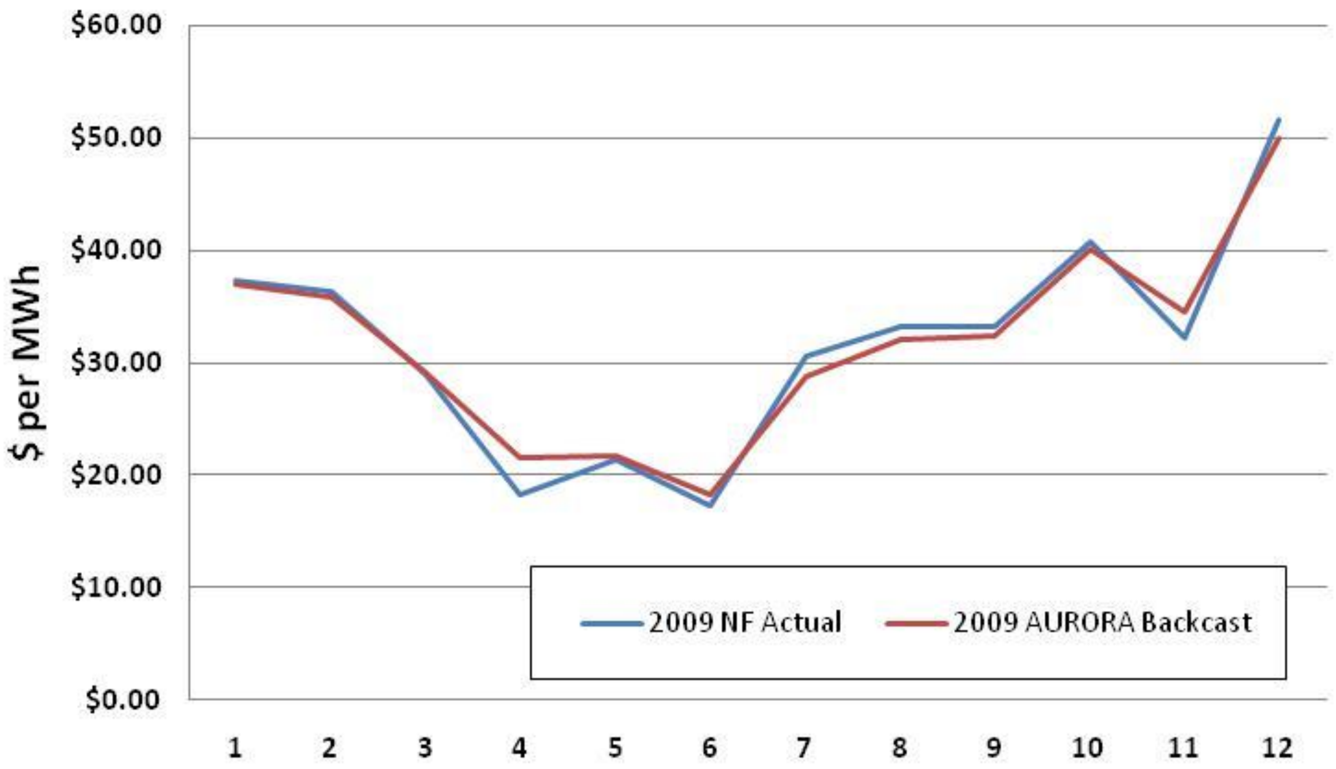
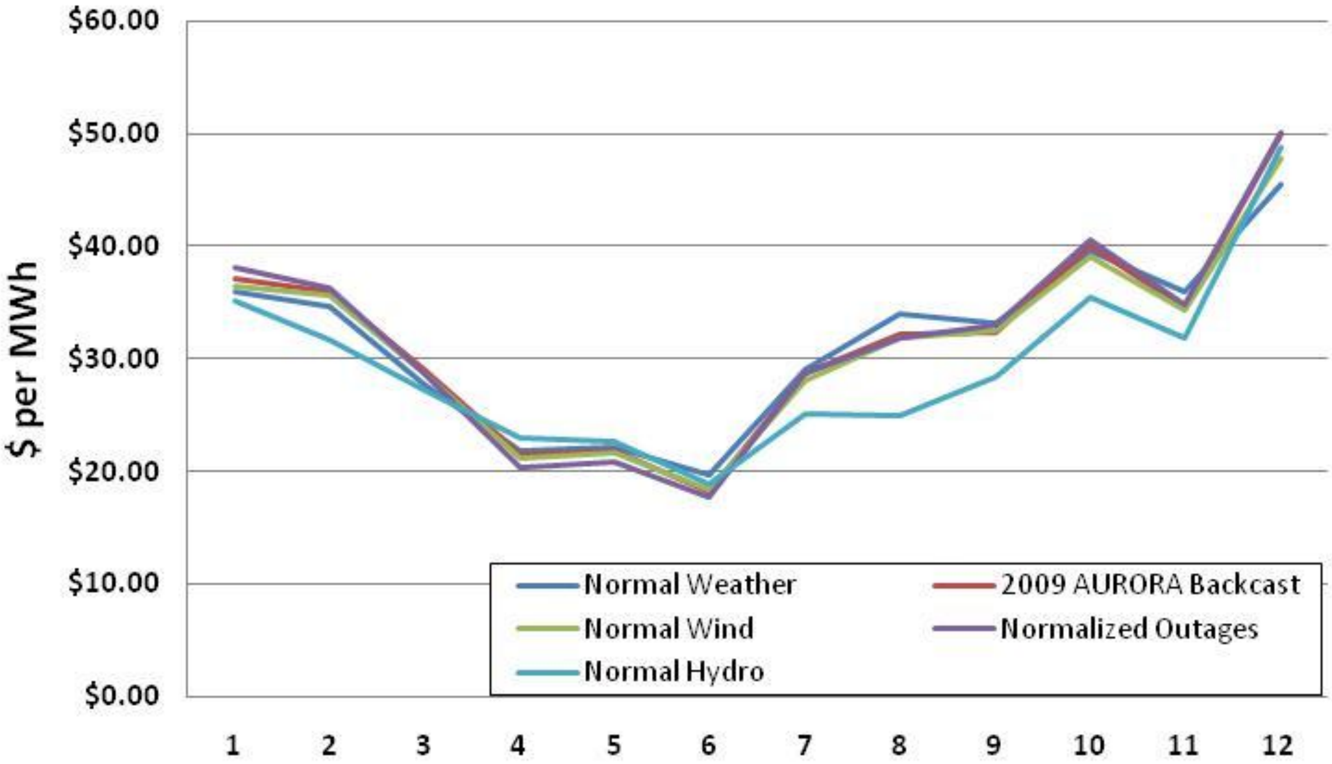
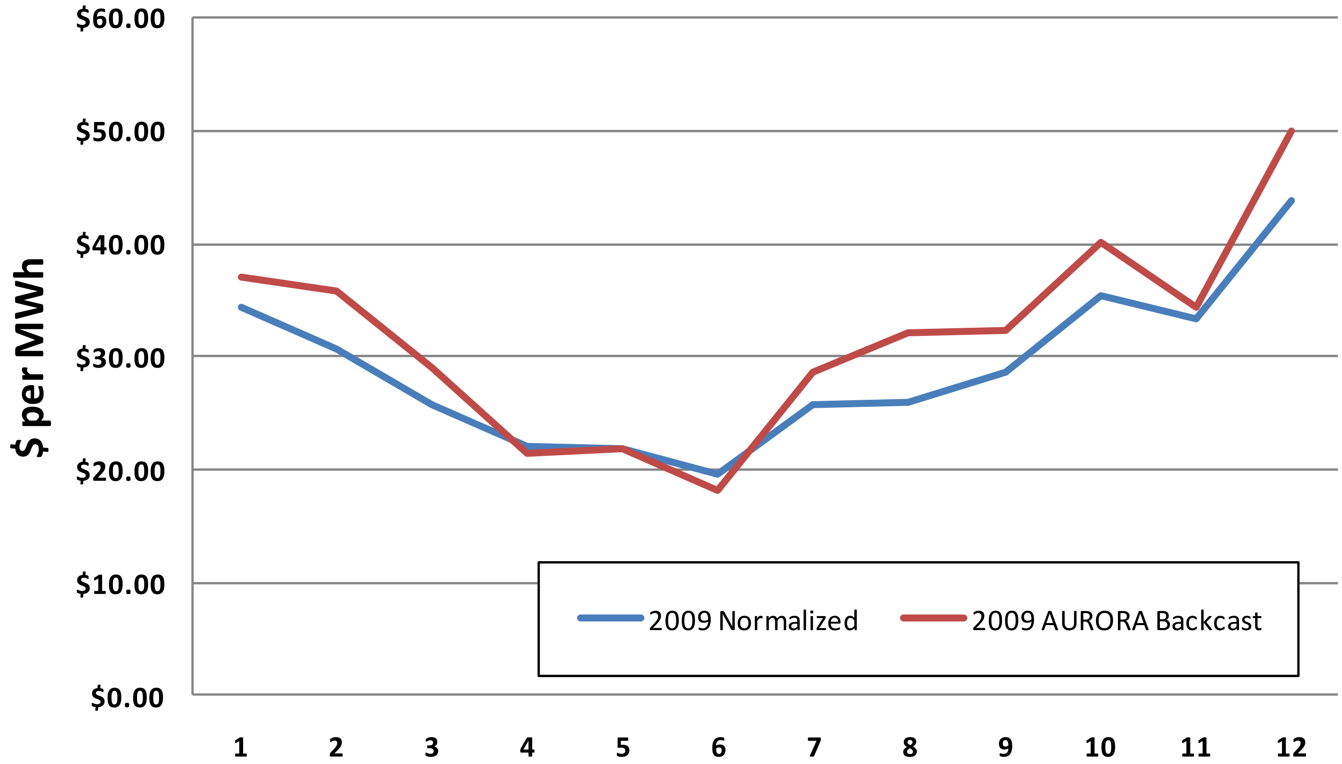
2009 Mid-Columbia Flat Electric Prices



2009 Mid-Columbia Flat Electric Prices with Individual Normalized Inputs

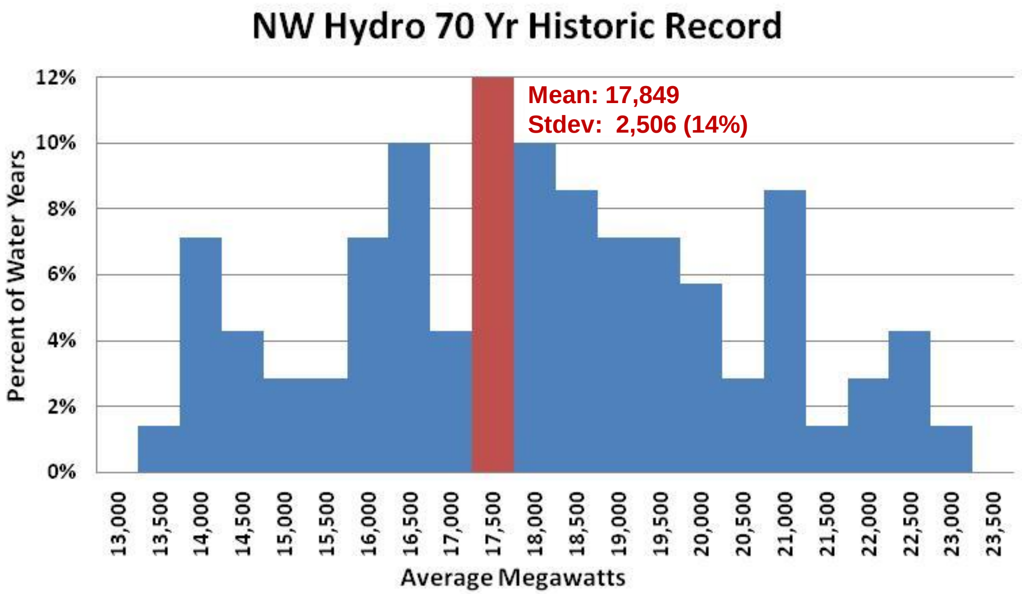


2009 Mid-Columbia Flat Normalized Electric Price

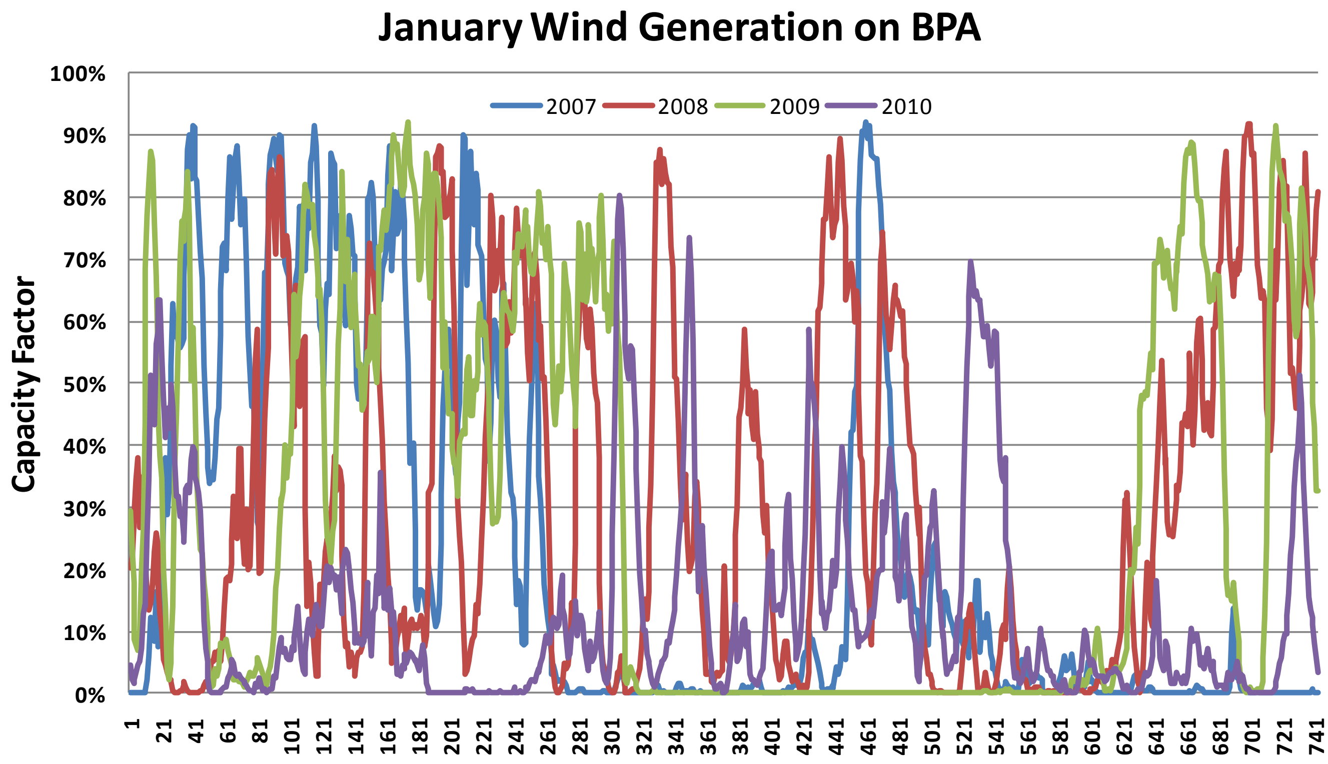


Hydro

- Random draw of 70 historical hydro years.
- Avista projects use results of Avista hydro model
- Regional projects uses Northwest Power Pool model



Historical Wind Generation



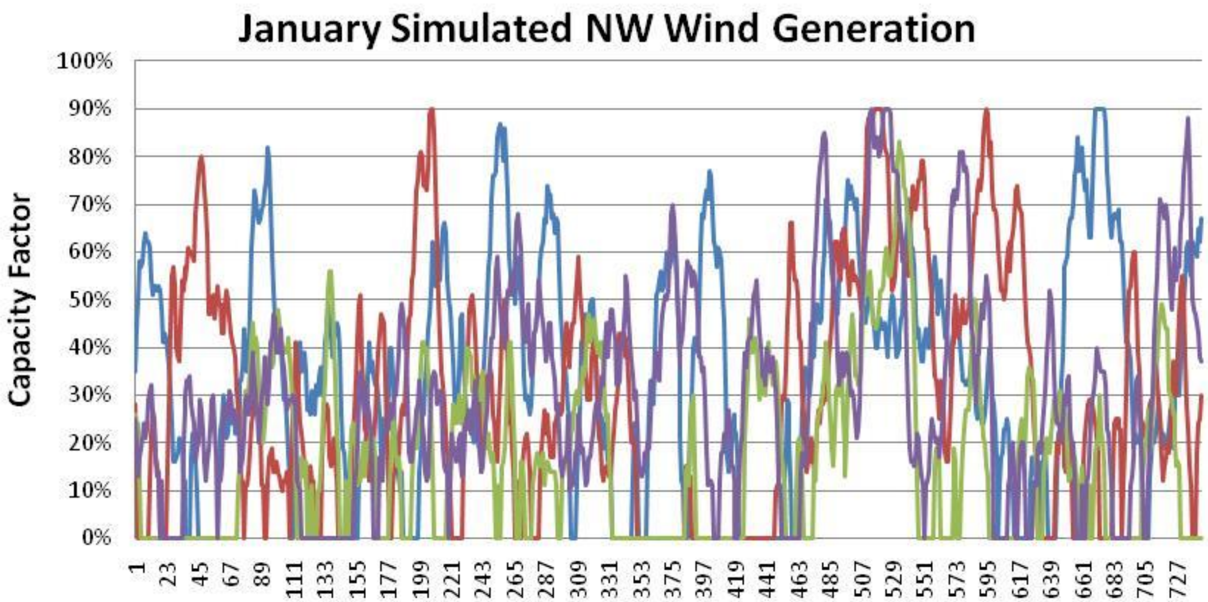
Wind

- Use 50 potential wind draws
- Each draw will be 8,760 hour shape
- Use separate wind shape available for most of the Western states and provinces
- NREL hourly simulated generation data (2004-06) is used to estimate capacity factors and correlations for non-NW areas

Area	CF		Area	CF
Northwest	31.8%		Southwest	28.8%
California	30.6%		Utah	29.0%
Montana	37.2%		Colorado	32.2%
Wyoming	38.2%		British Columbia	33.2%
Eastern WA	30.6%		Alberta	34.3%

Wind (Continued)

- Regression model using BPA/NREL data
  - Uses hour type, month, hour -1, hour -2 for the coefficients
  - Northwest: 97.5% R^2, 4.7% (CF standard error)
  - Random error with normal distribution to create variability



Coal, Oil, and Wood Prices

- Assume normal distribution of annual change in price
- Mean prices are based on Wood Mackenzie for oil and coal
- Standard Deviations:
  - Coal: 10%
  - Oil: 25%
  - Wood: 10%

Inflation

- Based on Global Insights forecast for average and standard deviation
- Average inflation is assumed to be 1.70%, w/ standard deviation of 1% (59% of mean)

Forced Outages

- Historical Outage rates are available from NERC's GAR Report
  - GADS- Generation Availability Report
- Data available for Coal, Nuclear, NG, and Oil by size of plant
  - Both planned and unplanned outages are tracked
  - Data is only available for all plants (no drill down option)
- AURORA's has random forced outage logic
  - Uses mean time to repair and annual forced outage rate
  - Both matrices can be derived from GADS data

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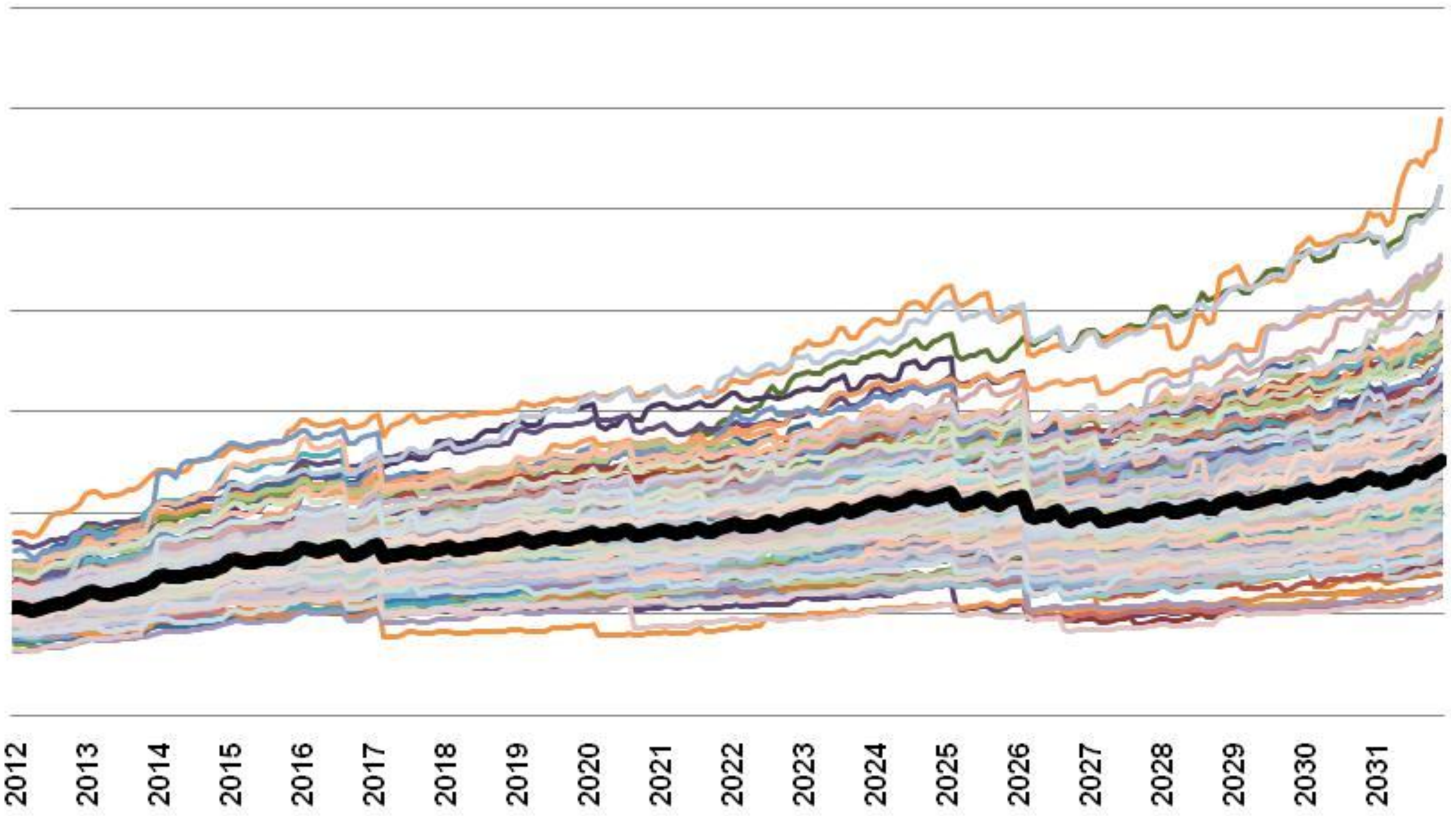
Historical Monthly AECO Natural Gas Prices

- Historical prices have been volatile
- Will volatility continue, or will shale gas flatten volatility?
- Will there still be boom/bust in natural gas prices?

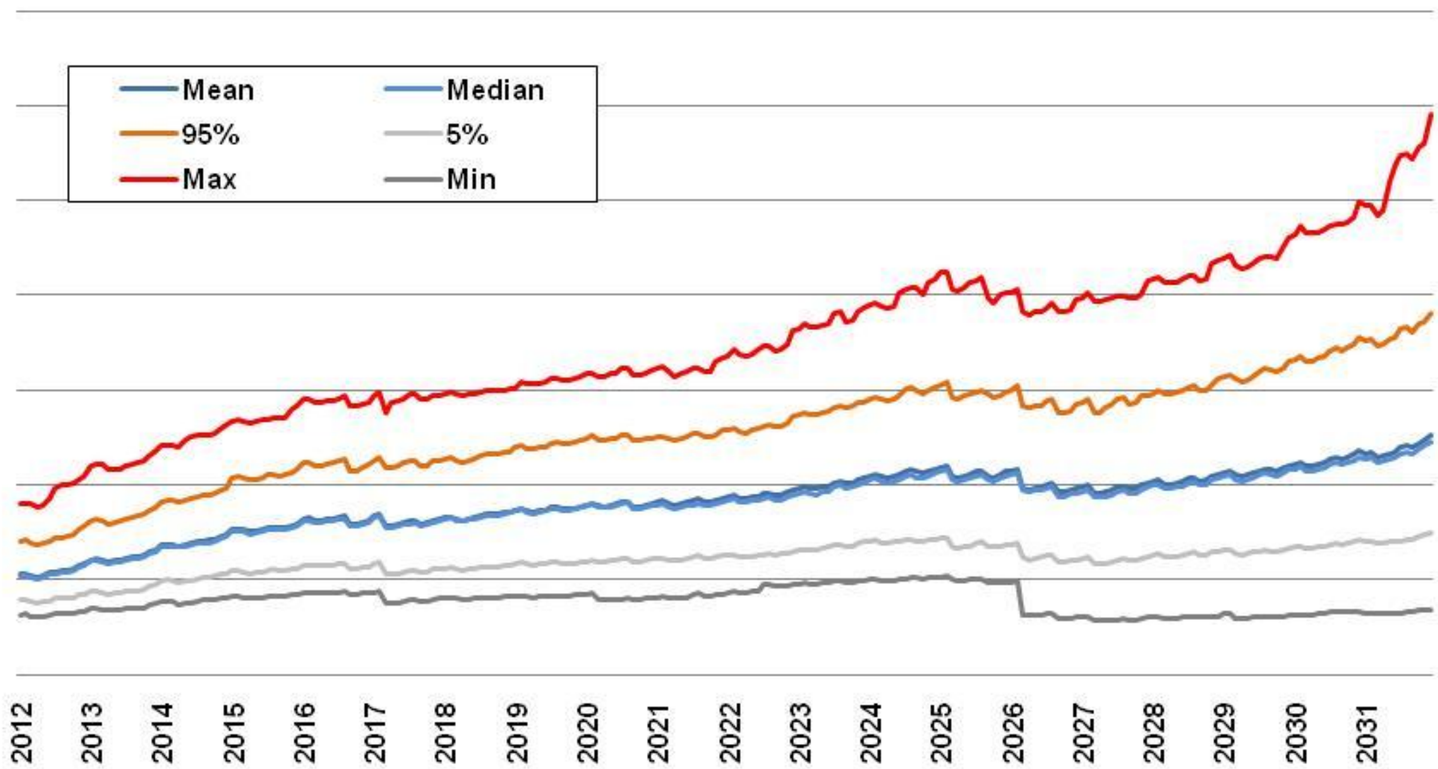
Natural Gas Prices

- Mean natural gas prices are yet to be finalized. Prices will be finalized by end of 2010 to take into account best available information for the plan
- To model the variability of prices will use a new method for this IRP.
  - Randomize the percent change between month to month prices based on a lognormal distribution
  - This method provides high month to month correlations as history demonstrates (90%+)

Natural Gas Forecast (individual draws)



Natural Gas Forecast (Statistics 500 draws)

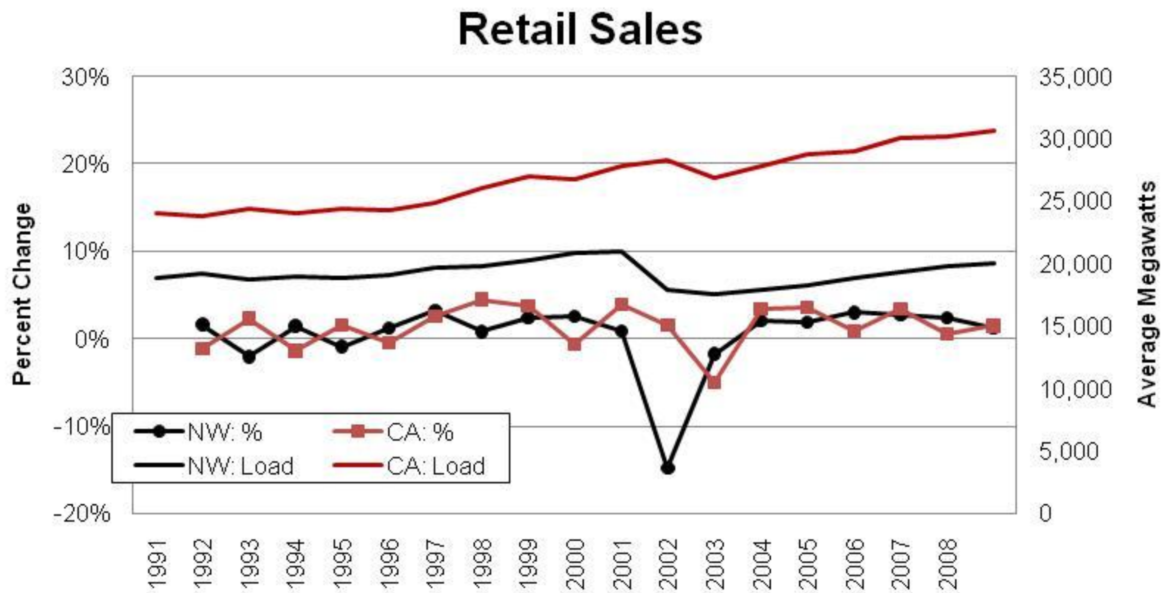


Load (Weather)

- Weather variation will be modeled in AURORA with monthly load variances for 2005 through 2009
- Weather is assumed to be normally distributed with standard deviation for each load area and a correlation to the Northwest area based on FERC Form 714 hourly load profiles
- Further detail on this methodology can be found in prior IRPs

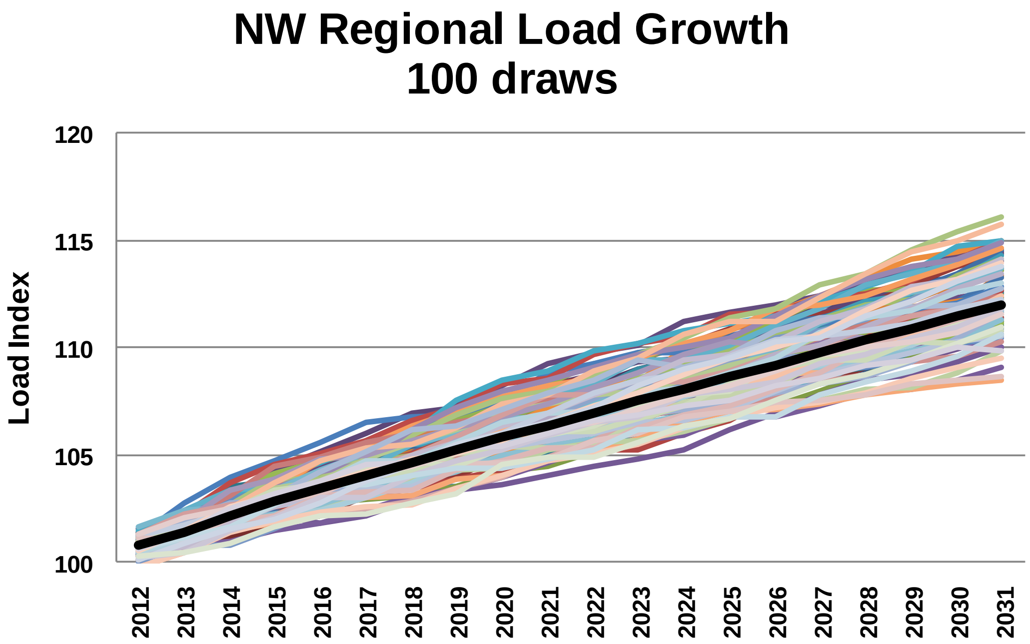
Load (Economic & Conservation)

- Weather is not the only driver in future loads, economic growth, electric cars, and conservation will affect energy demand
- Historical load growth is highly volatile (see chart below)



Load (Economic & Conservation)…. continued

- Expected load growth will assume Wood Mackenzie forecast
- Standard deviation is assumed to be 50% (same as last plan)



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Carbon Legislation

- No national carbon legislation has been passed
- Many western states/provinces have passed some type of carbon reduction scheme
- For this plan..
  - 5 scenarios are developed based on potential outcomes.
  - Each scenario is assigned a weighting
  - The weighted average of the scenarios will be the base forecast
  - Natural gas prices and carbon prices will be correlated for national policy scenarios

Carbon Legislation Scenarios

1. Western Climate Initiative “WCI” (20% probability)
   - No federal legislation, carbon reduction in CA, OR, WA, NM only
   - 15% below 2005 levels by 2020
   - Begins in 2012, regional trading allowed
2. Regional Greenhouse Gas Initiative “RGGI” (20% probability)
   - No federal legislation, carbon reduction in CA, OR, WA, NM only
   - 187 million tons per year through 2014, then 10% reduction by 2018
   - Begins in 2012, within state trading only
3. National Climate Policy (20% probability)
   - Federal legislation only applies
   - 17% below 2005 levels by 2020, 42% below 2005 levels by 2030
   - Begins in 2015, national trading allowed
4. National Carbon Tax (15% probability)
   - Federal legislation only applies
   - $33 per short ton, than 5% per year escalation
   - Begins in 2015
5. No Carbon Reductions (5% probability)
   - No carbon reduction scheme
   - State level emission performance standards apply and no new coal in US West

Next Meeting

1. Finalize mean key driver assumptions
2. Implement stochastic modeling methodologies with AURORA
3. Simulate the market future 500 times between 2012-2031
4. Present results for electric market prices and other key results
5. Evaluate the potential of modeling capital costs stochastically

Avista's 2011 Electric Integrated Resource Plan
Technical Advisory Committee Meeting No. 4 Agenda
Avista Headquarters – Spokane, Washington

Thursday, February 3, 2011
Avista Conference Room 130

Topic	Time	Staff
1. Introduction	9:30	Storro
2. Natural Gas Price Forecast	9:35	Rahn
3. Electric Price Forecast	10:30	Gall
4. Lunch	12:00	
5. Resource Requirement Projections	1:00	Kalich
6. Portfolio and Market Scenario Planning	2:30	Lyons
7. Adjourn	3:00	

Conference Call Instructions:
1. Please join my meeting.
https://www2.gotomeeting.com/join/717354547

2. Join the conference call:

Dial +1 (714) 551-0020
Access Code: 717-354-547
Audio PIN: Shown after joining the meeting

Meeting ID: 717-354-547

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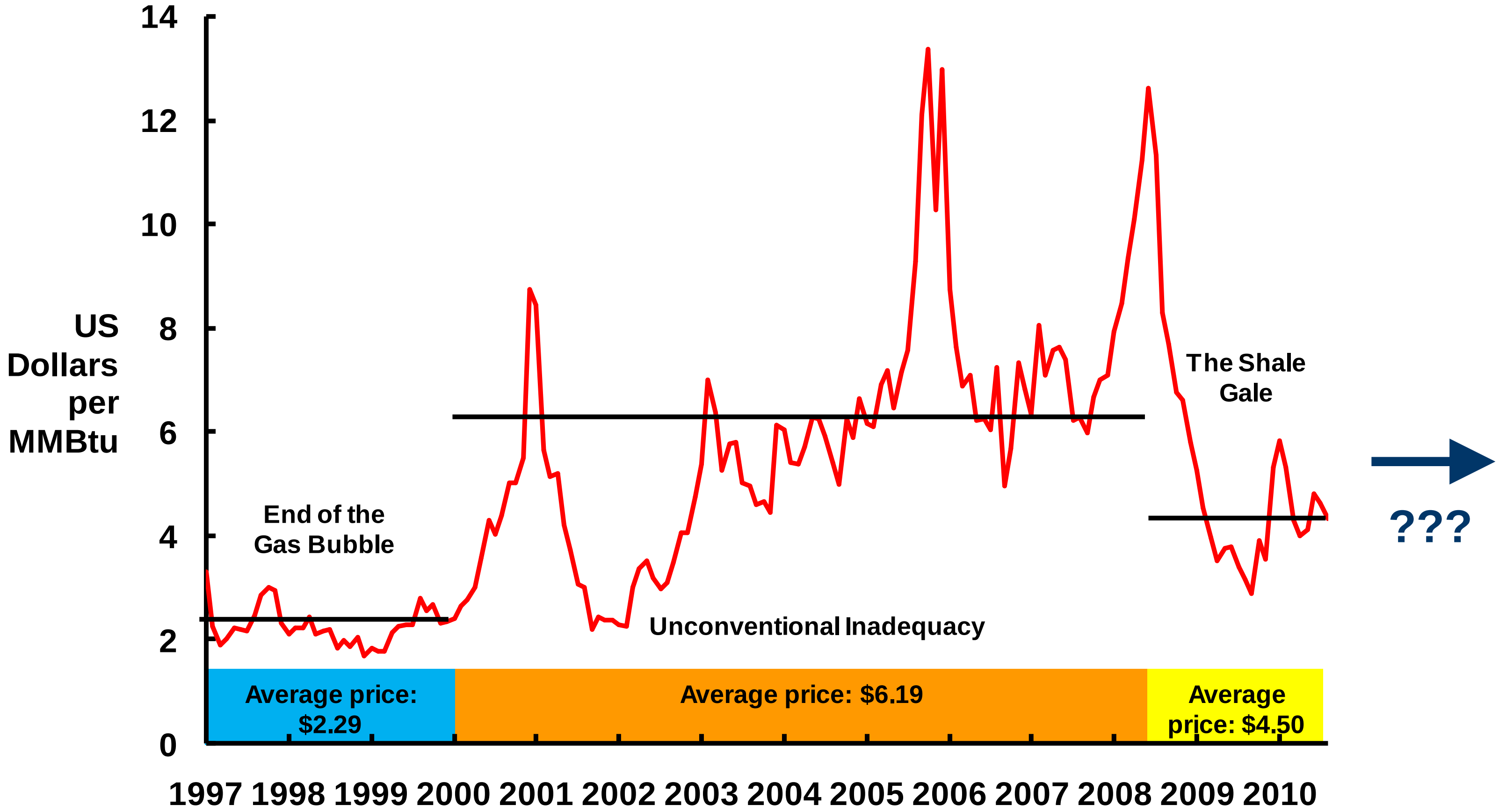
Avista Electric IRP
Natural Gas Price Forecast

Technical Advisory Committee Meeting

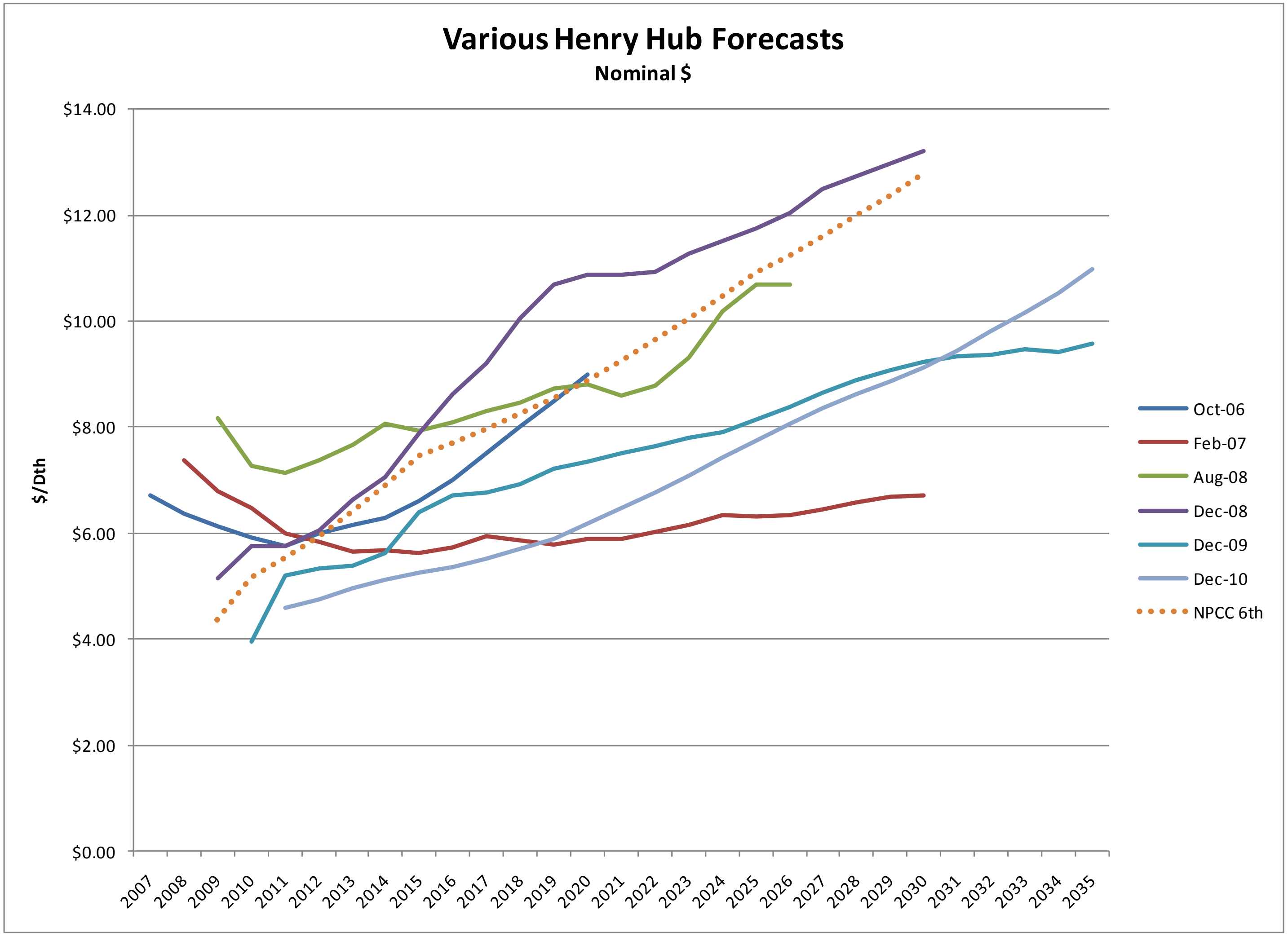
February 4, 2011

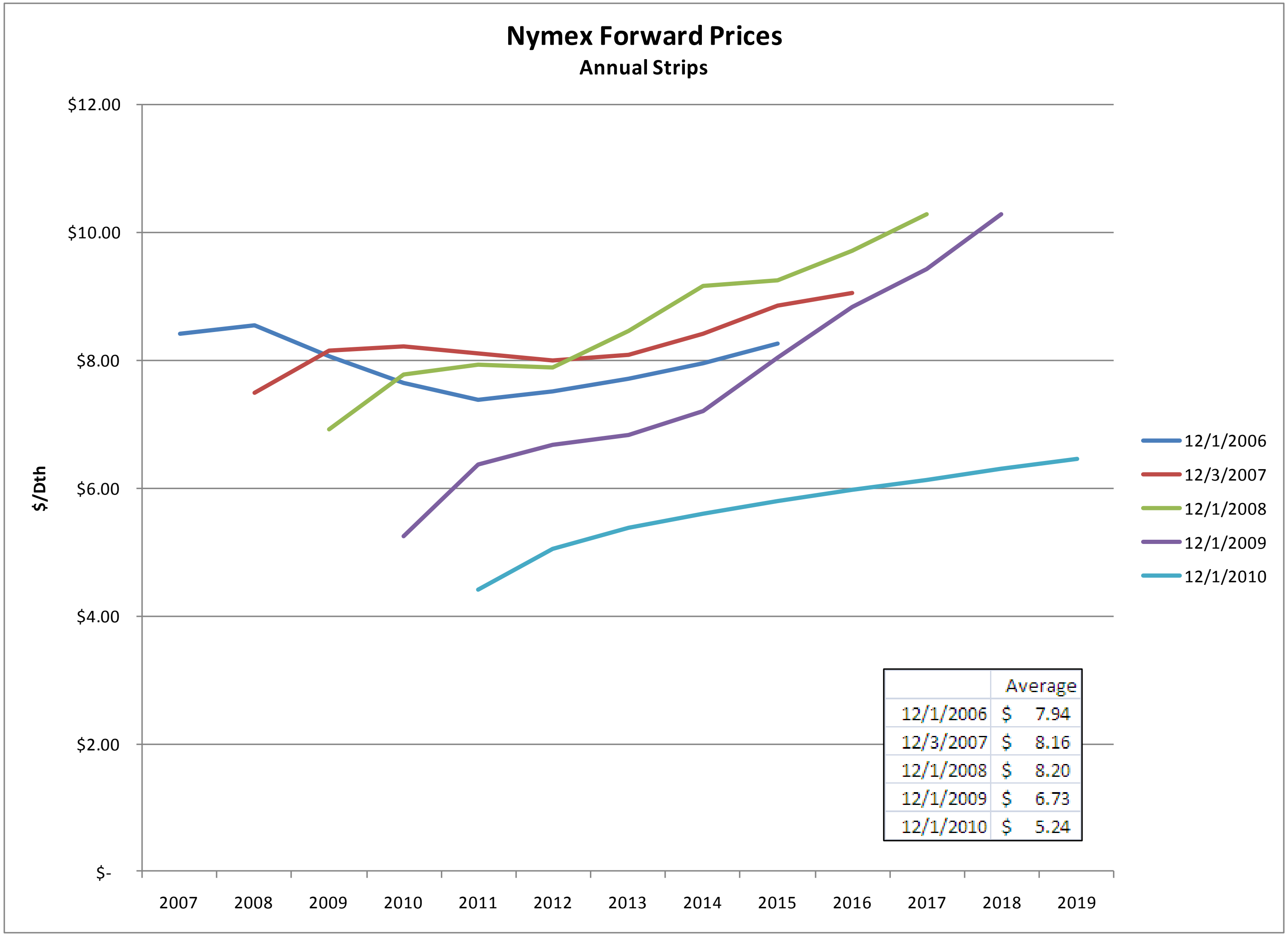
Henry Hub Historical Price Trend



Source: Platts.

Brief History of Forecasts




Nymex Forward Prices
Annual Strips
$12.00
$10.00
$8.00
$6.00
$4.00
$2.00
$-
$/Dth
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
12/1/2006
12/3/2007
12/1/2008
12/1/2009
12/1/2010
Average
12/1/2006 $ 7.94
12/3/2007 $ 8.16
12/1/2008 $ 8.20
12/1/2009 $ 6.73
12/1/2010 $ 5.24

Long Term Natural Gas Price Drivers

DEMAND

- Economy
  - Industrial
  - Power Generation

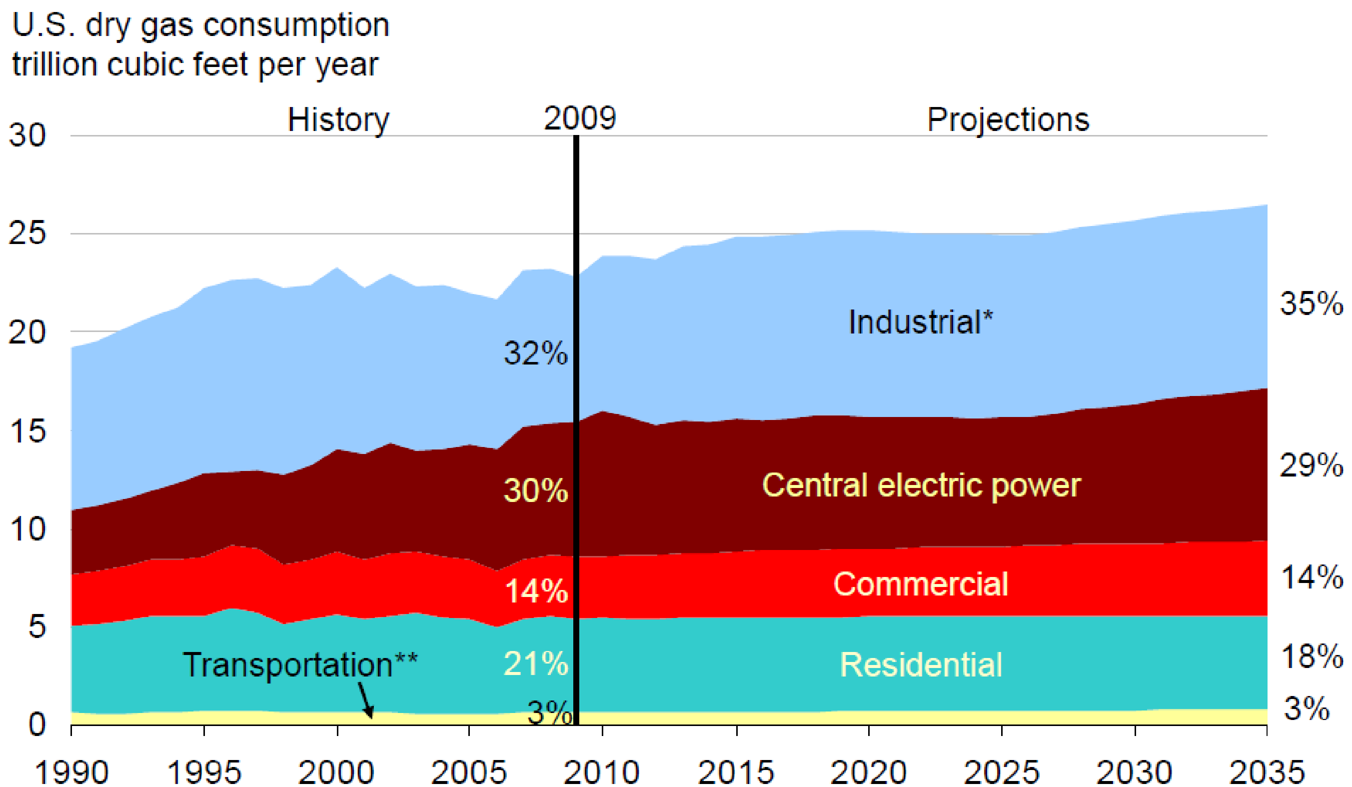
SUPPLY

- US Natural Gas Production
- Imports from Canada

OTHER FACTORS

- Oil and Coal Prices
- Carbon Legislation/Renewable Portfolio Standards
- Global Dynamics; LNG Imports (Exports?)

US Natural Gas Demand Forecast

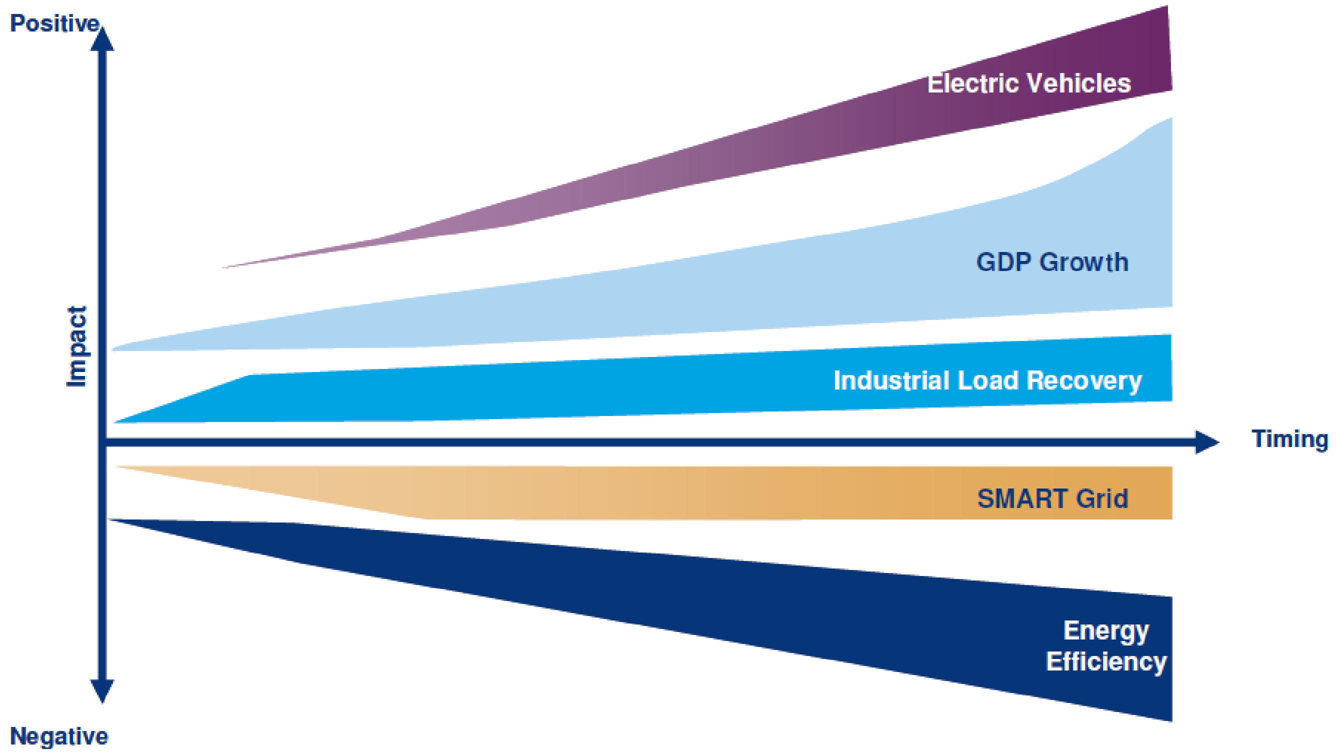


* Includes combined heat-and-power and lease and plant fuel. ** Includes pipeline fuel.

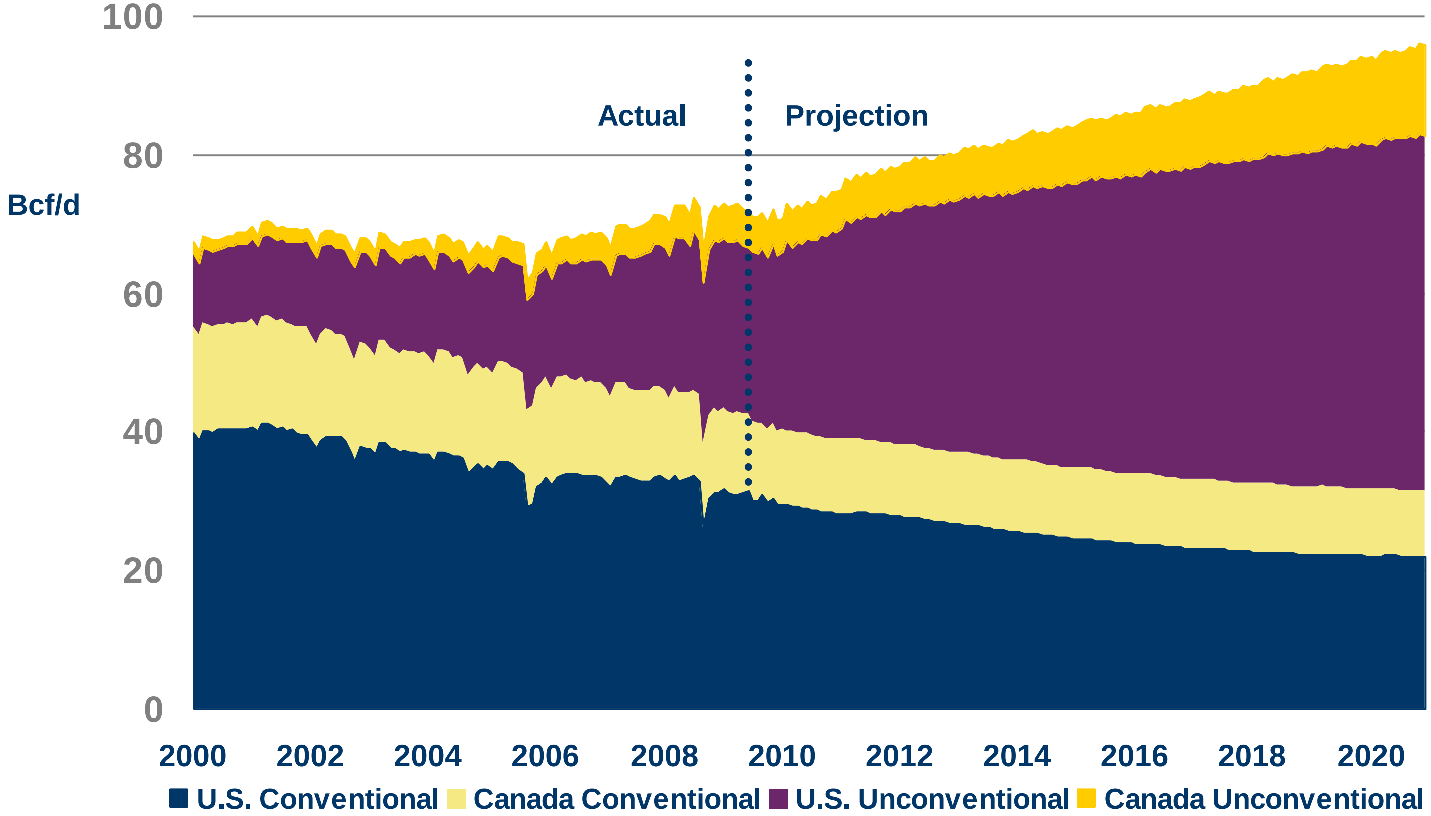
Richard Newell, December 16, 2010

Source: EIA, *Annual Energy Outlook 2011*

Power demand risks: a multitude of uncertainties



North American Natural Gas Production



Source: EIA & NEB historic data; Encana forecasts

Shale Gas Economics 101

Bigger Costs. Bigger Volumes.

Conventional Vertical Drilling

Unconventional Horizontal Drilling and Hydraulic Fracturing

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The Shale Drilling Process

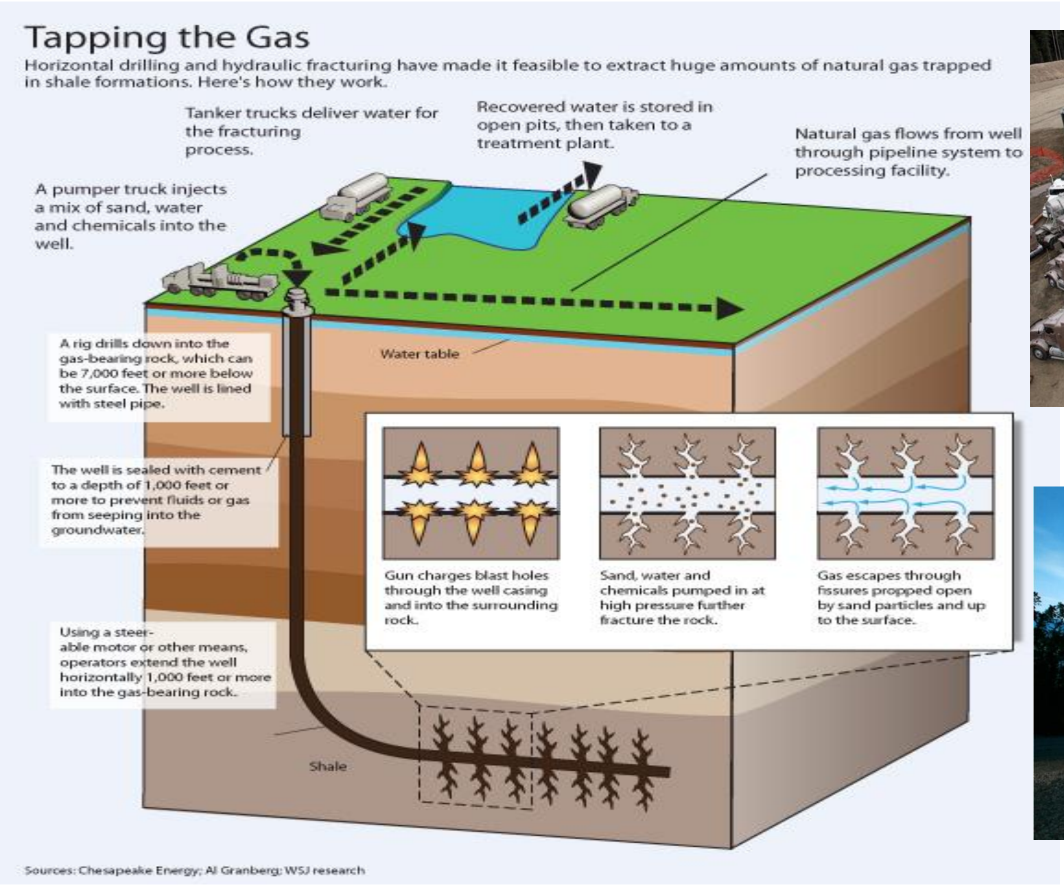

Exhibit No. 4
Case Nos. AVU-E-12-08
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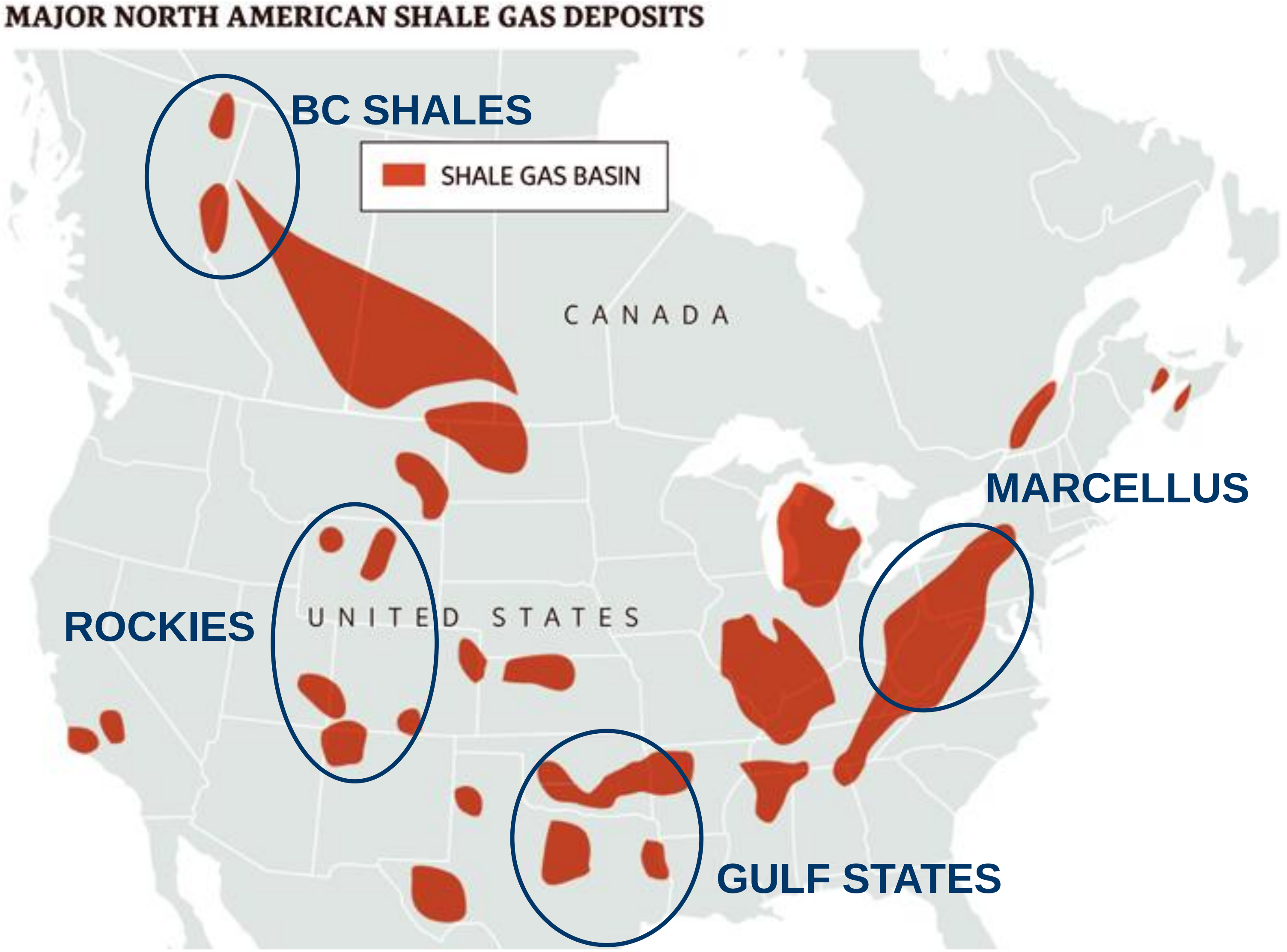
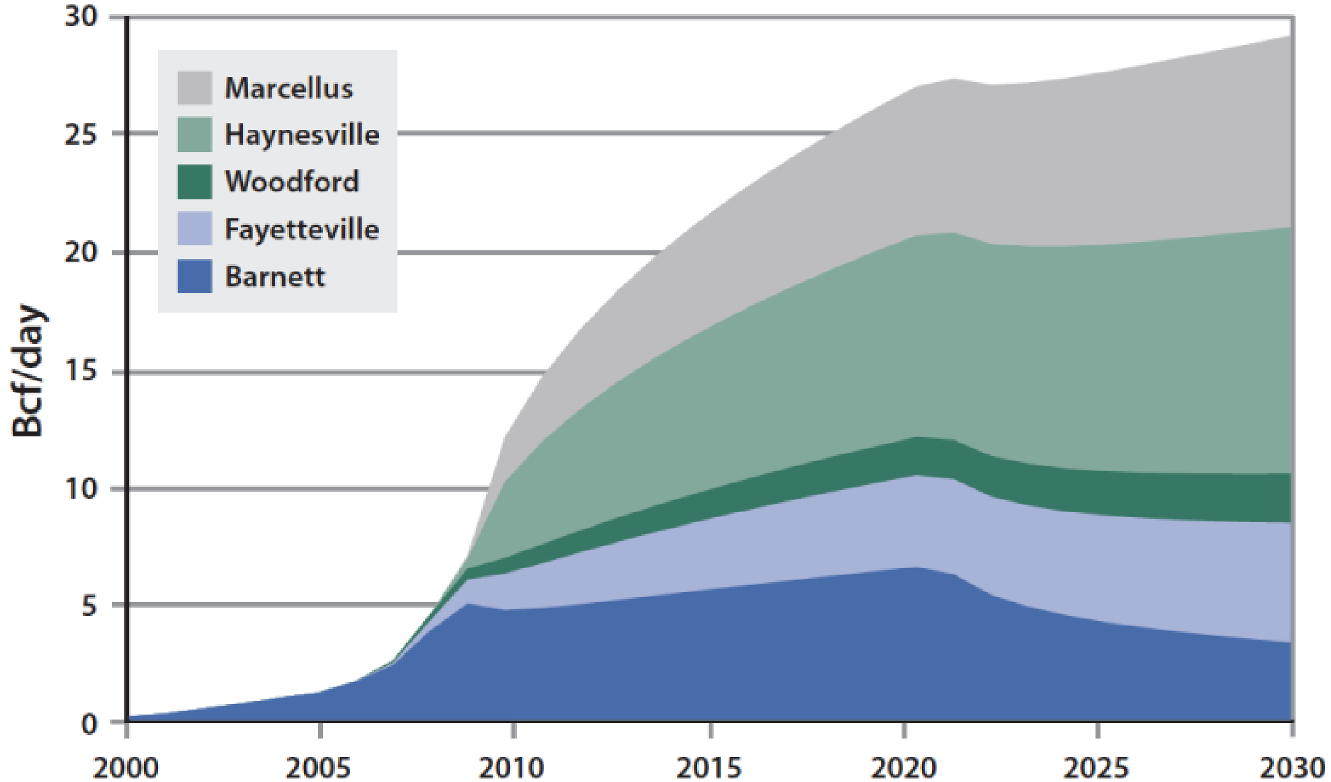
Schedule 1, Page 491 of 1069

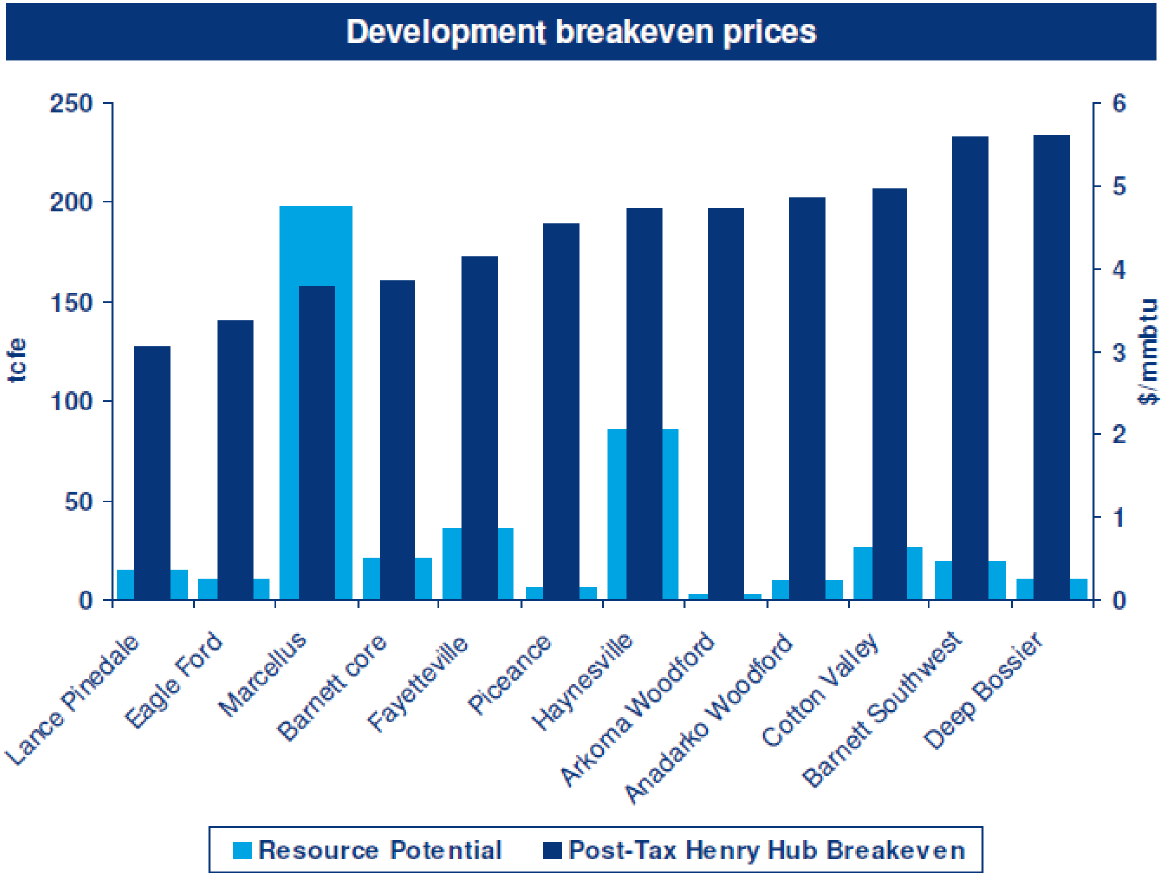

MAJOR NORTH AMERICAN SHALE GAS DEPOSITS
BC SHALES
SHALE GAS BASIN
CANADA
MARCELLUS
ROCKIES
UNITED STATES
GULF STATES

Growth in U.S. Shale Gas Production



Source: MIT Study The Future of Natural Gas

Costs and Volumes – Selected Gas Plays

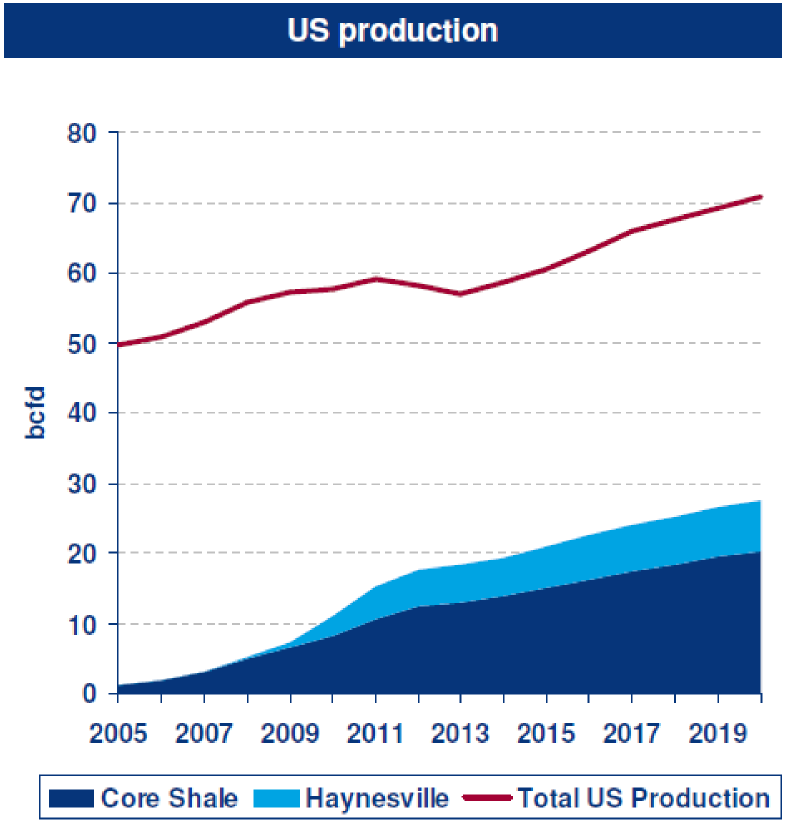


Source: Wood Mackenzie

The Gas Factory
Technology and Efficiency

1. **Drilling Days** - depending on vertical depth and lateral length, a typical 90-100 day turnaround has been reduced down to 18–45 days
2. **Lateral Length** - commonly going to about 4,000+ feet horizontal, pushing beyond 10,000 feet in some wells
3. **Wells per Pad/Simultaneous Operations** - each pad has up to 8 wells; simultaneous well work on multiple wellbores
4. **Number of Fracturing Stages** – 1 or 2 stage jobs in the past; now 8-10 stages or more
5. **Simultaneous Fracturing** – fracturing simultaneous wellbores to achieve acute stresses and more effective fracs

Shale Gas and US Production

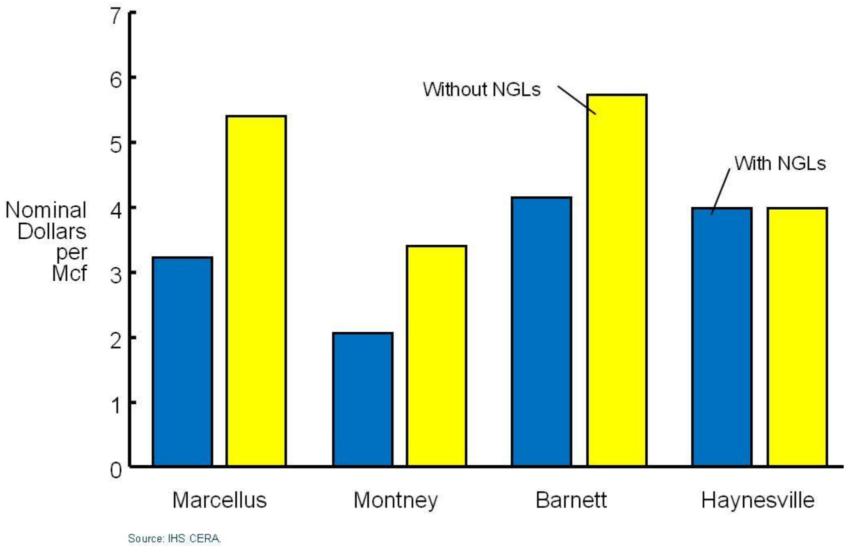


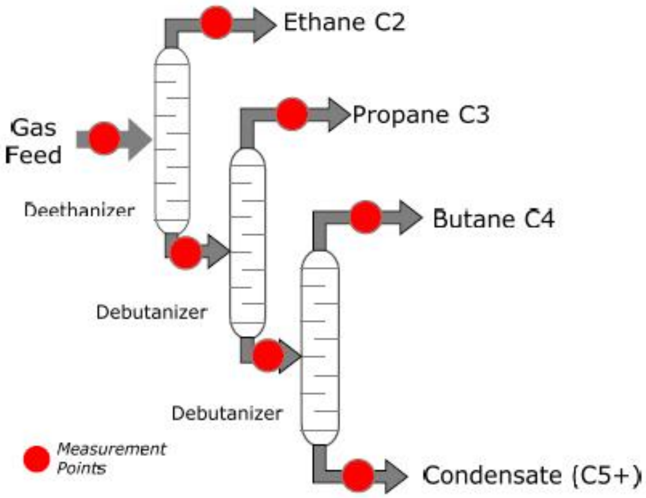
Source: Wood Mackenzie

Natural Gas Liquids (NGLs)

What are they?

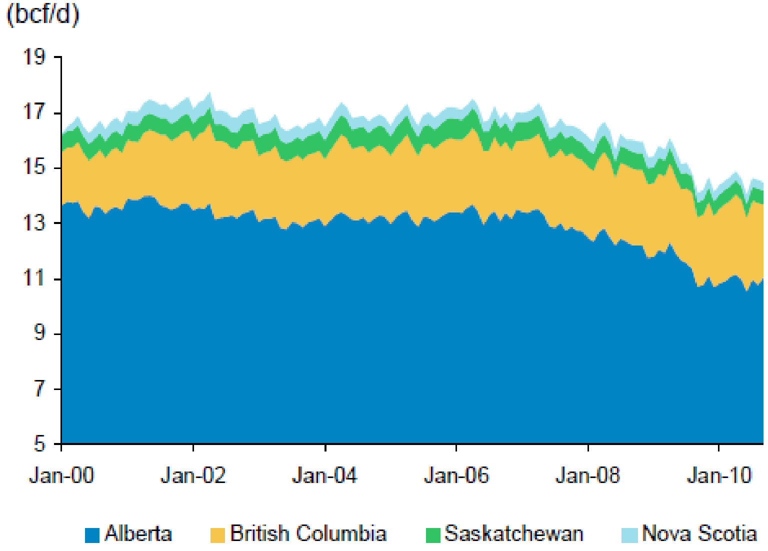
Natural gas liquids (NGLs) are hydrocarbons often found resident with natural gas. They are recovered as liquids through a purification process at processing plants. They include ethane, propane, and butane and condensate (natural gasoline).





Canada Exports

Historical Trend – Declining Exports



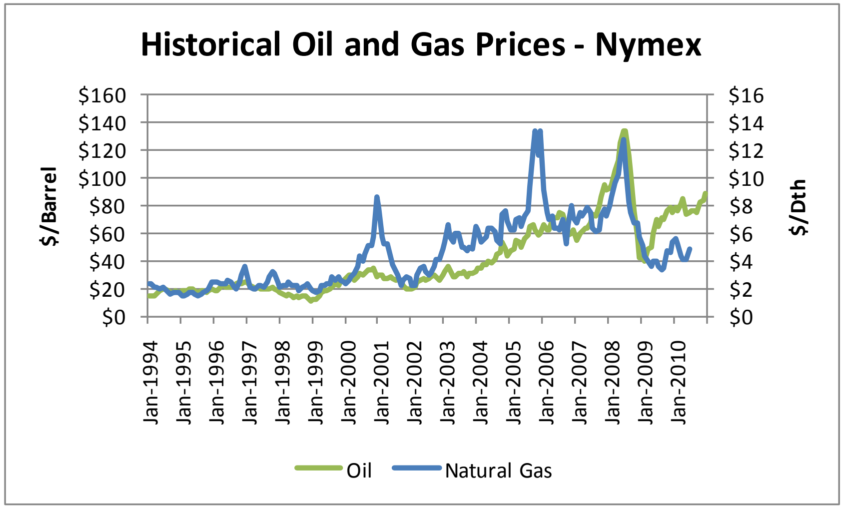
Source: National Energy Board, Morgan Stanley Commodity Research

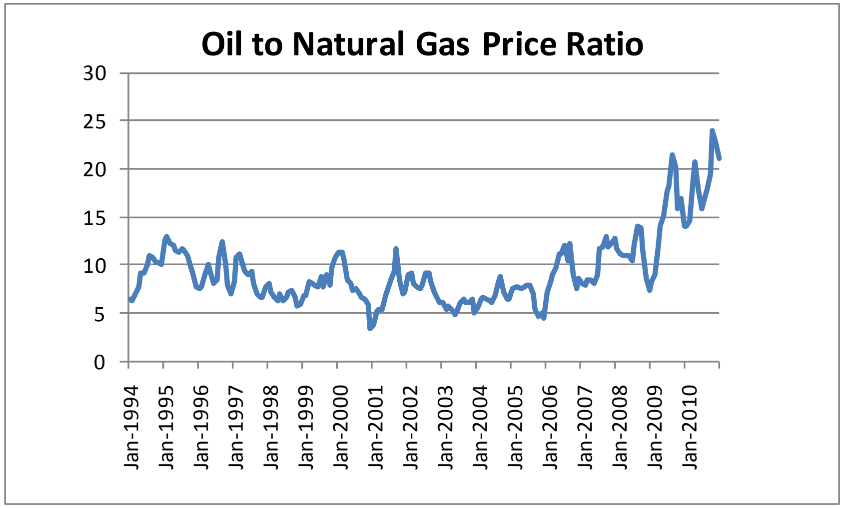
Recent Trends

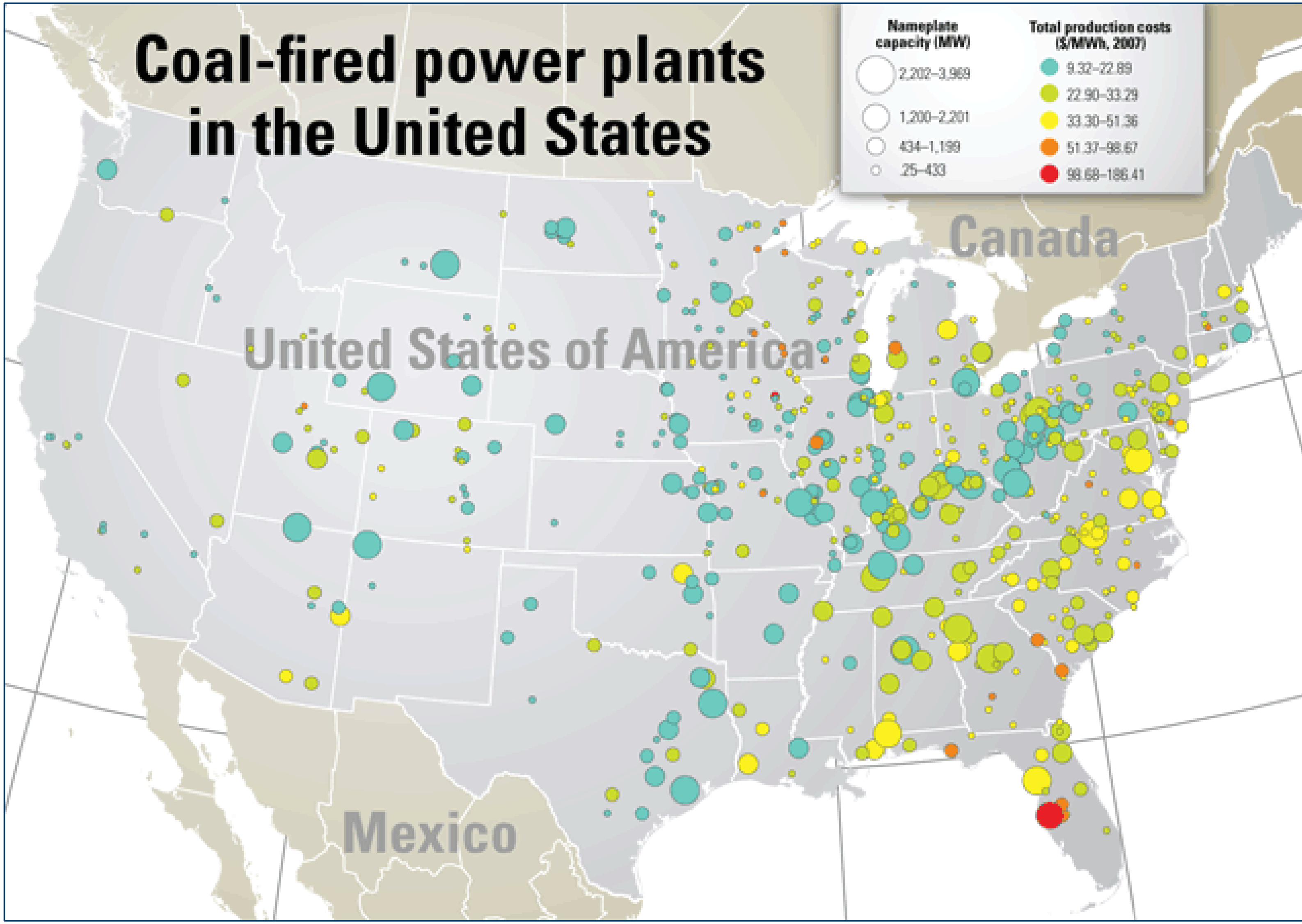
- **Imports declining slower than anticipated**
- **BC Shale larger and faster than anticipated**
- **Alberta royalties renegotiated**
- **Lower oil prices have slowed demand for oil sands production**

Oil vs. Natural Gas Relationship

- Strong long term price correlation historically
- Long term ratio of approx. 8 to 1 (1994-2008)
- Since Jan 2009 ratio has **doubled** to approx 17 to 1
- Shale gas could fundamentally and permanently change historic ratio
- Alternatively, increased demand from low prices could cure low prices






Coal-fired power plants
in the United States
Nameplate capacity (MW)
2,202–3,969
1,200–2,201
434–1,199
.25–433
Total production costs ($/MWh, 2007)
9.32–22.89
22.90–33.29
33.30–51.36
51.37–98.67
98.68–186.41
Canada
United States of America
Mexico

Carbon Policy/Renewable Portfolio Standards

Natural Gas has a critical yet complex role in carbon policy creation and implementation.

- Numerous complex issues and uncertainties
- Need to balance economic challenges with policy objectives
- Complex issues within cap and trade vs. simpler carbon tax
- Long term role or interim bridge?

Natural Gas also has an important backup role for intermittent renewable generation sources

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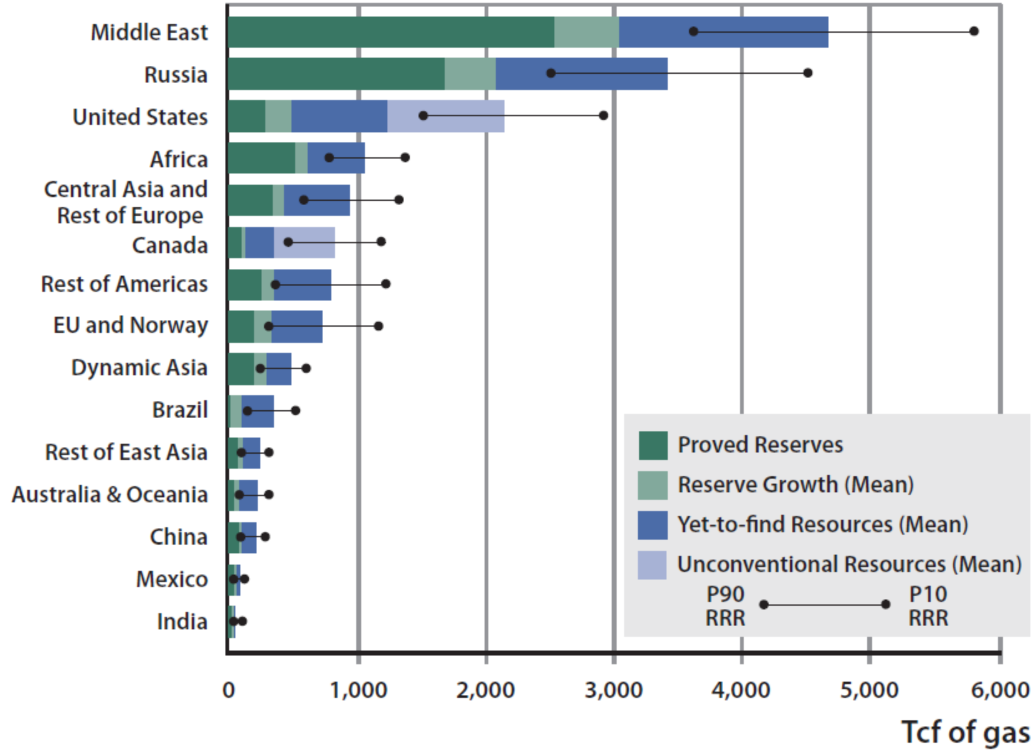
Global Natural Gas Estimates

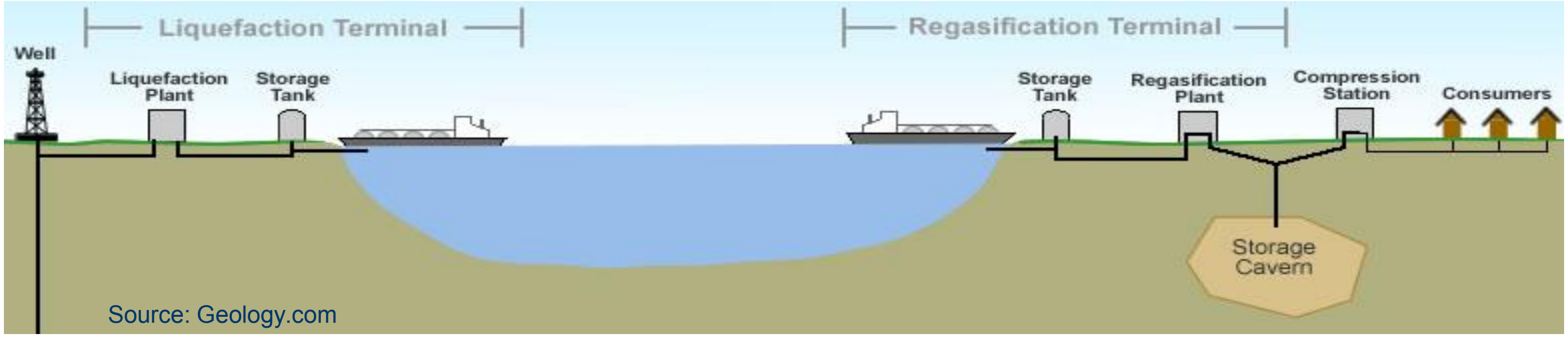
Figure 2.2 Global Remaining Recoverable Gas Resource (RRR) by EPPA Region, with Uncertainty[2] (excludes unconventional gas outside North America)



Source: MIT Study The Future of Natural Gas

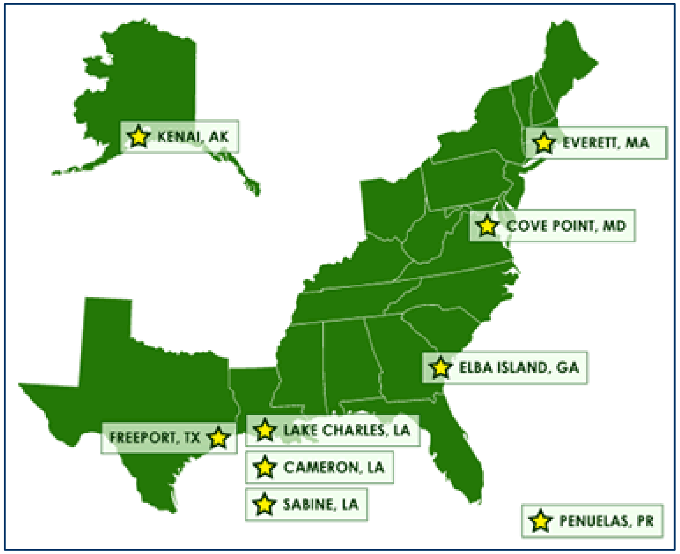
LNG Imports…or Exports?

LNG traditionally flows to North America after other higher-priced markets receive their share



Source: Geology.com

Source: Apache LNG

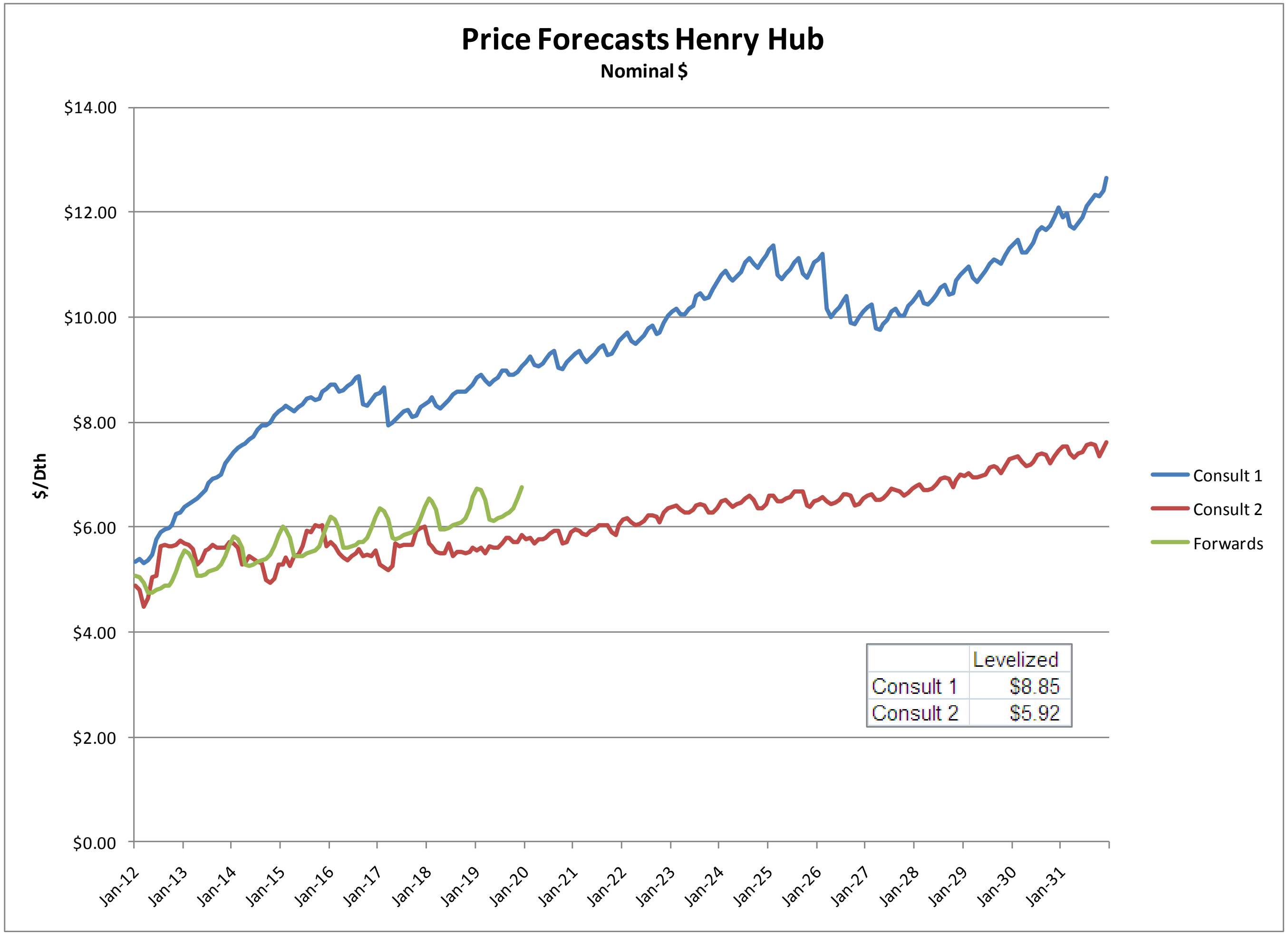


Source: Federal Energy Regulatory Commission

IRP Price Forecast Methodology

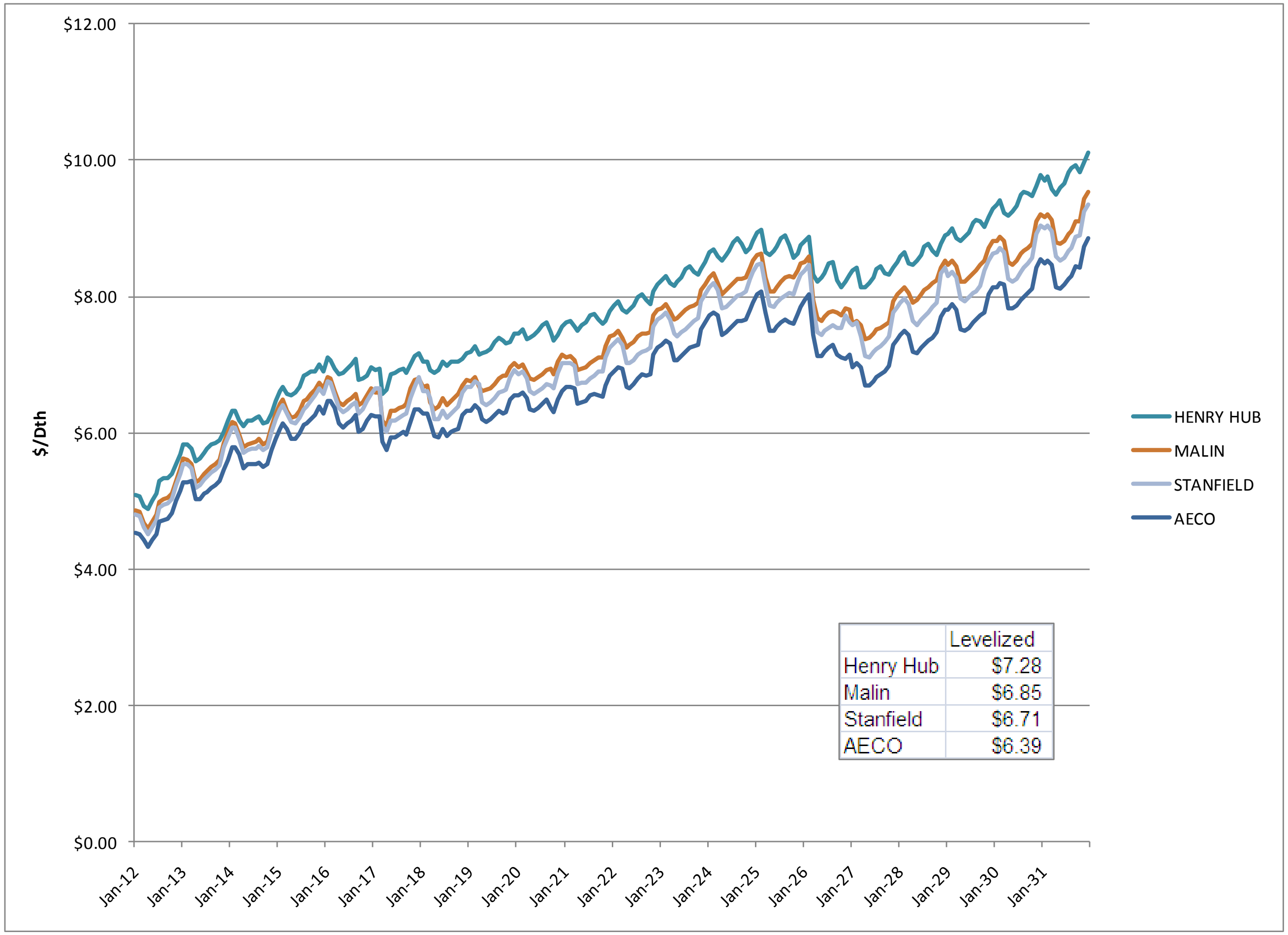
1. Two fundamental forecasts (Consultant #1 & Consultant #2)
2. Forward prices
3. 50/50 weighting fundamental and forwards year 1
4. Reduce forwards weighting 10% each year thereafter
5. By year 6, forecast is 50% Consultant #1, 50% Consultant #2

IRP Price Forecast Components



IRP Price Forecast – Selected Hubs

Nominal $



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Electric Market Forecast

(Preliminary Draft)

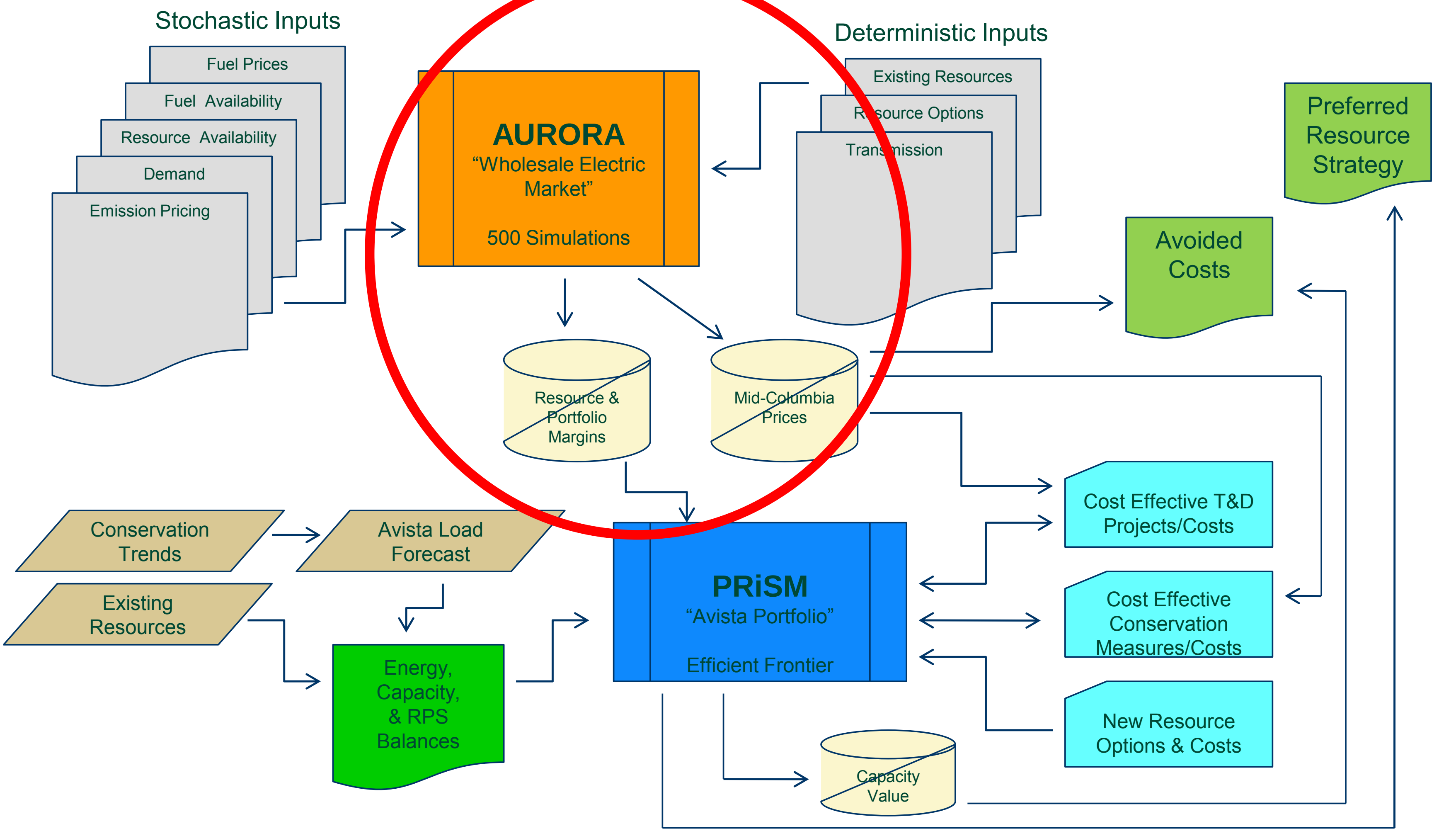
James Gall

Technical Advisory Committee Meeting #4

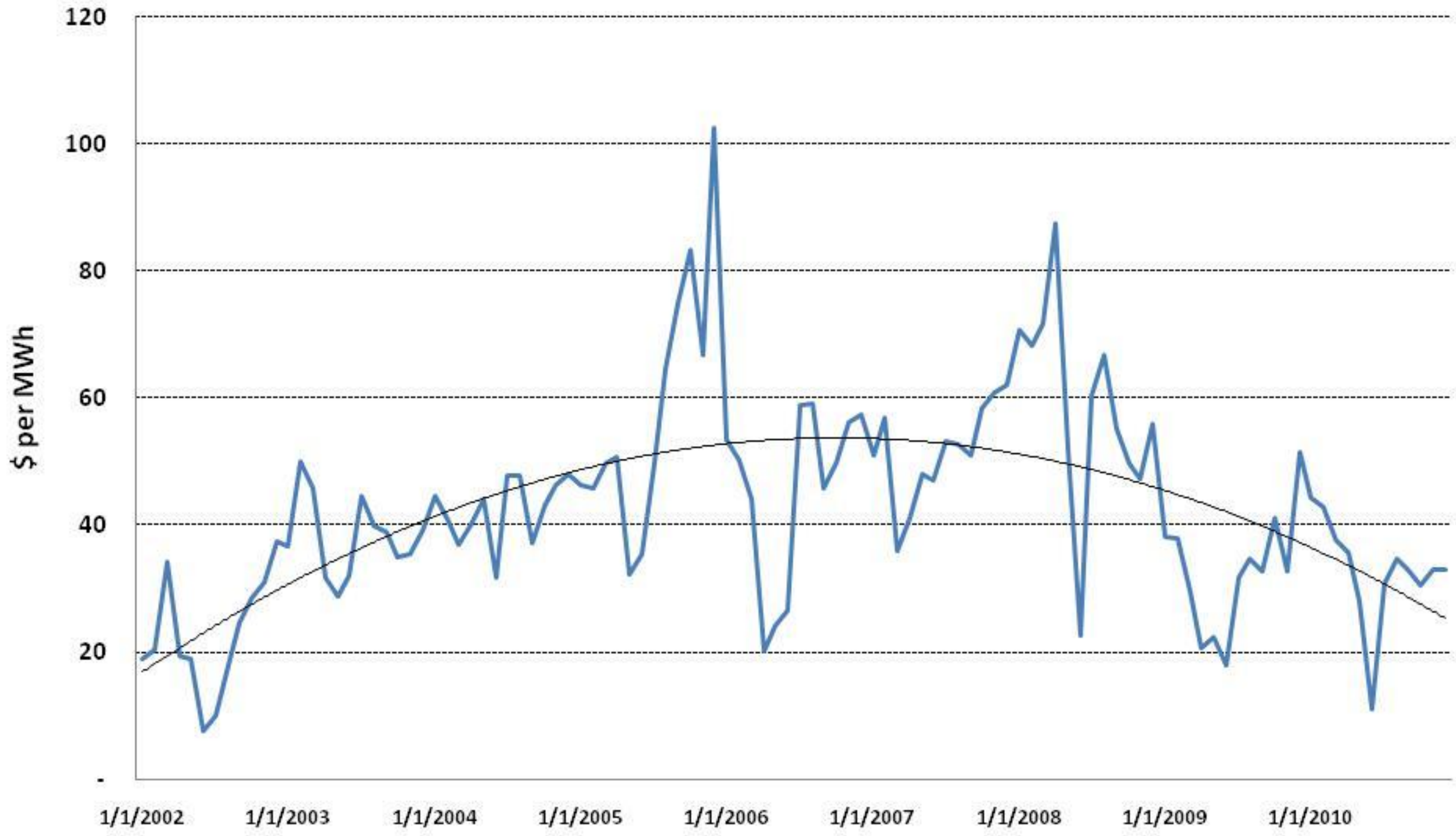
2011 Electric Integrated Resource Plan

February 3, 2011

2011 Integrated Resource Plan Modeling Process



Historical Monthly Flat Mid-Columbia Prices



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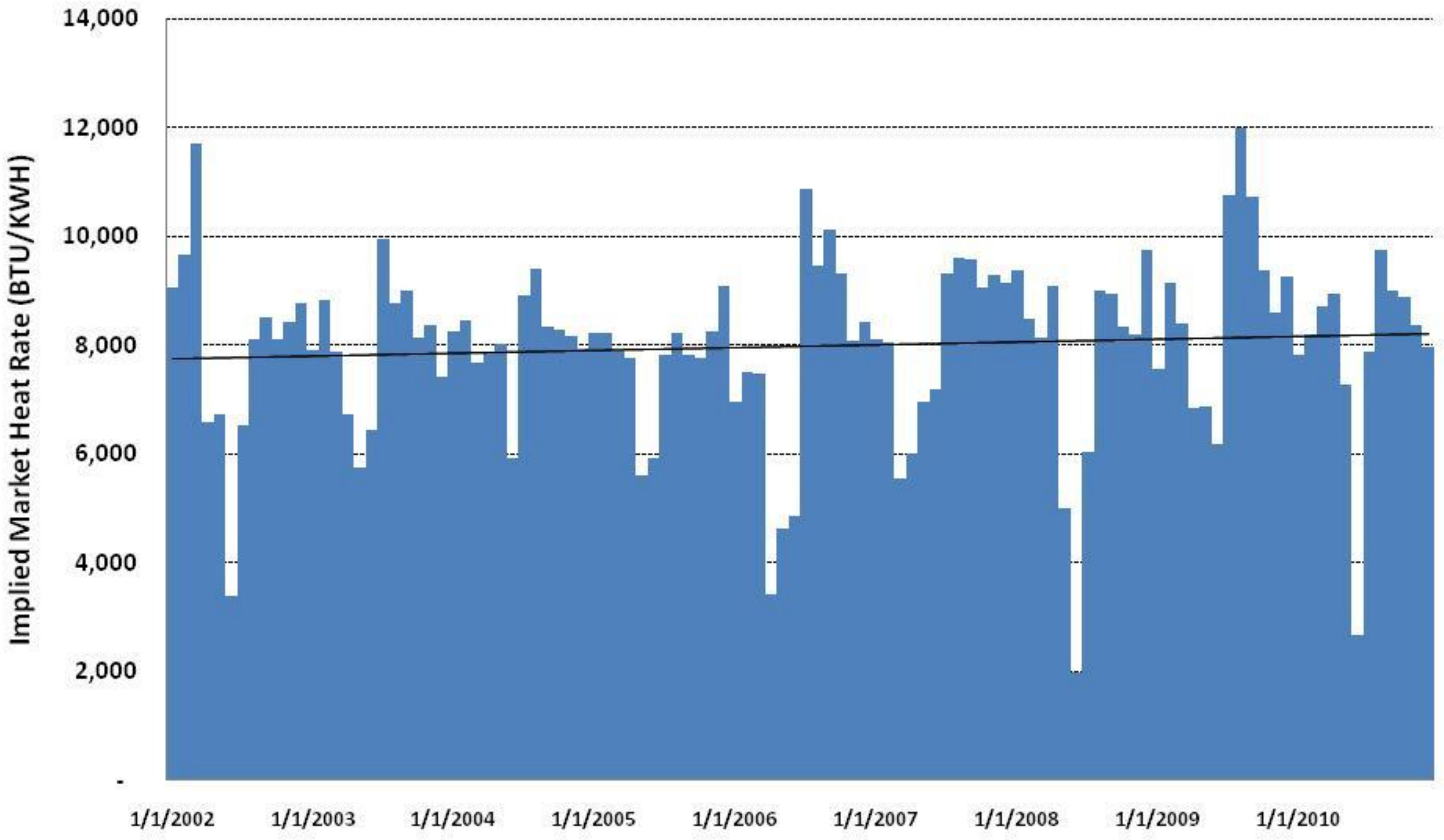
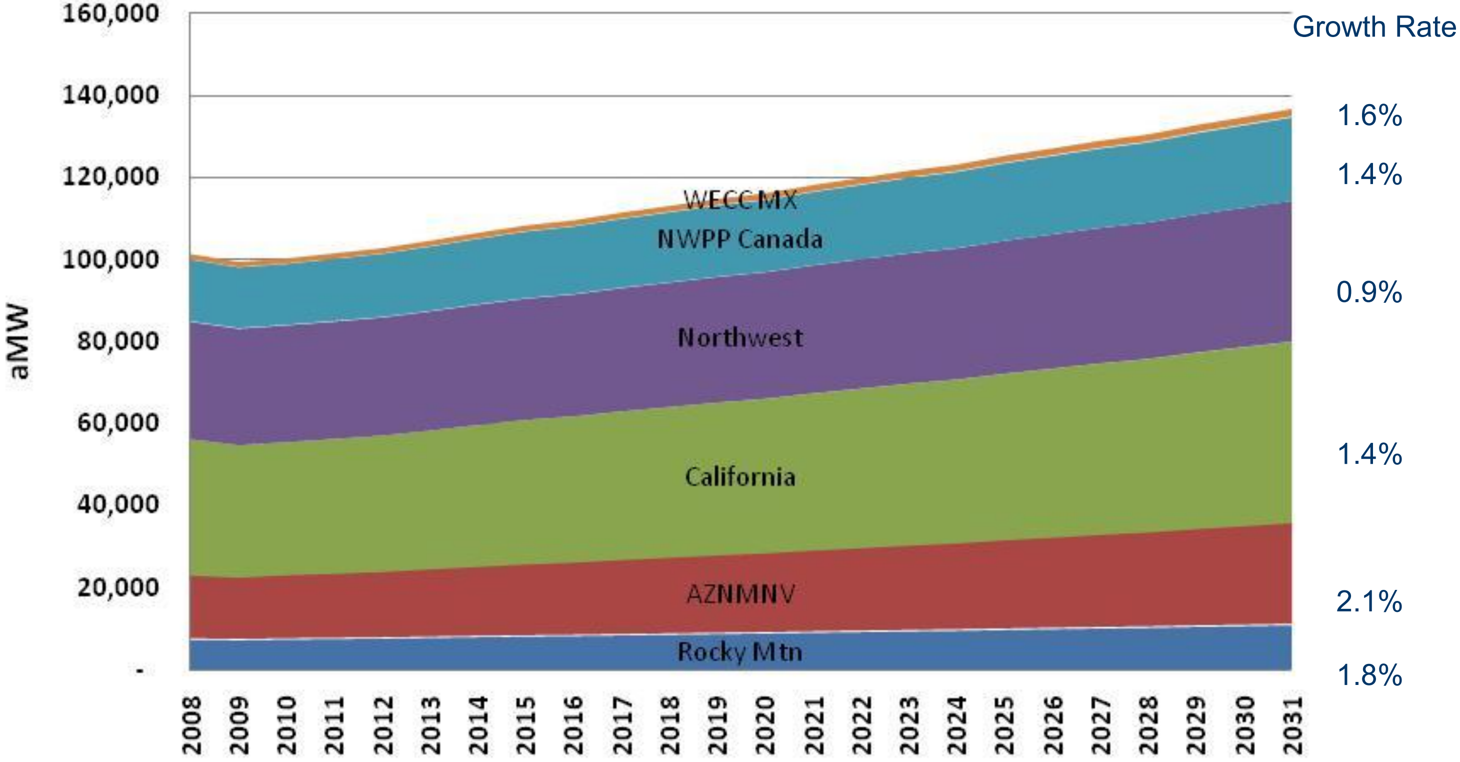
Historical Monthly Implied Market Heat Rates
(Mid-Columbia/Stanfield x 1,000)

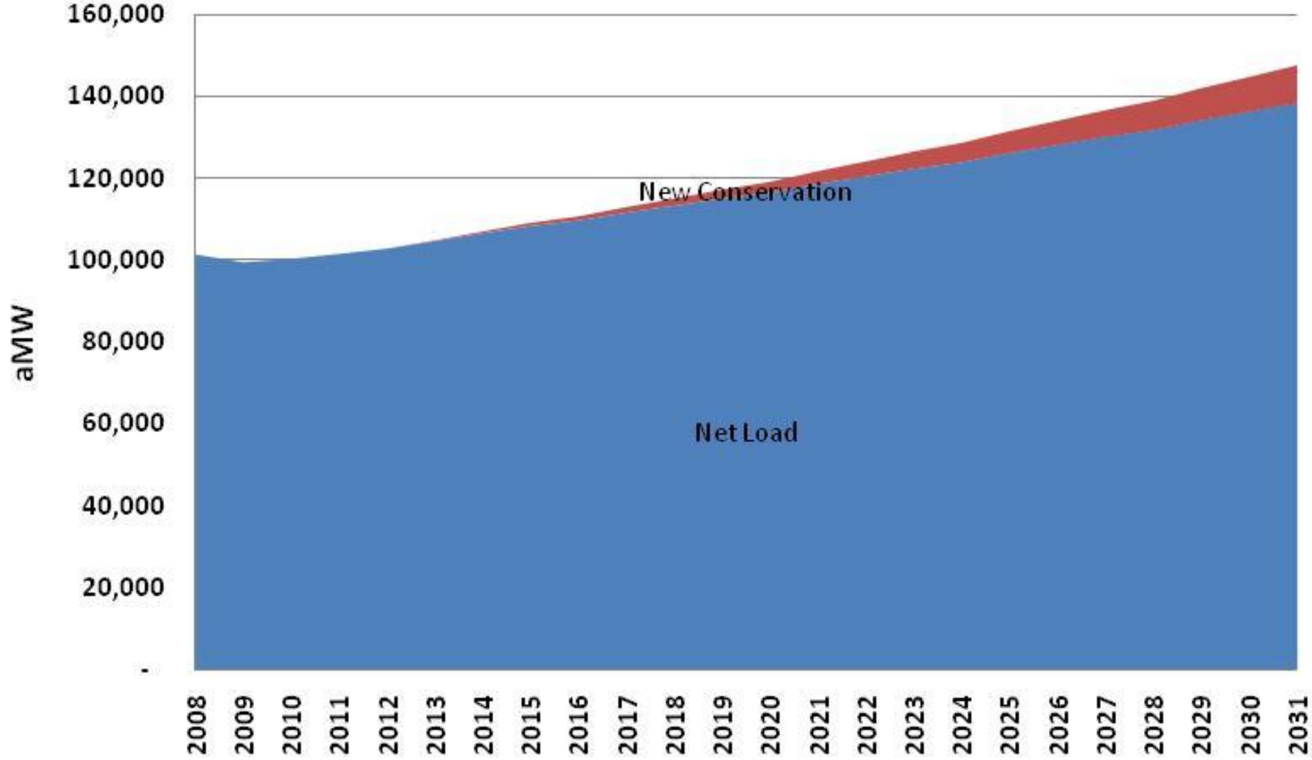


Western Interconnect Load Growth



Regional Load Growth Source: Wood Mackenzie

New Western Interconnect (WECC) Conservation



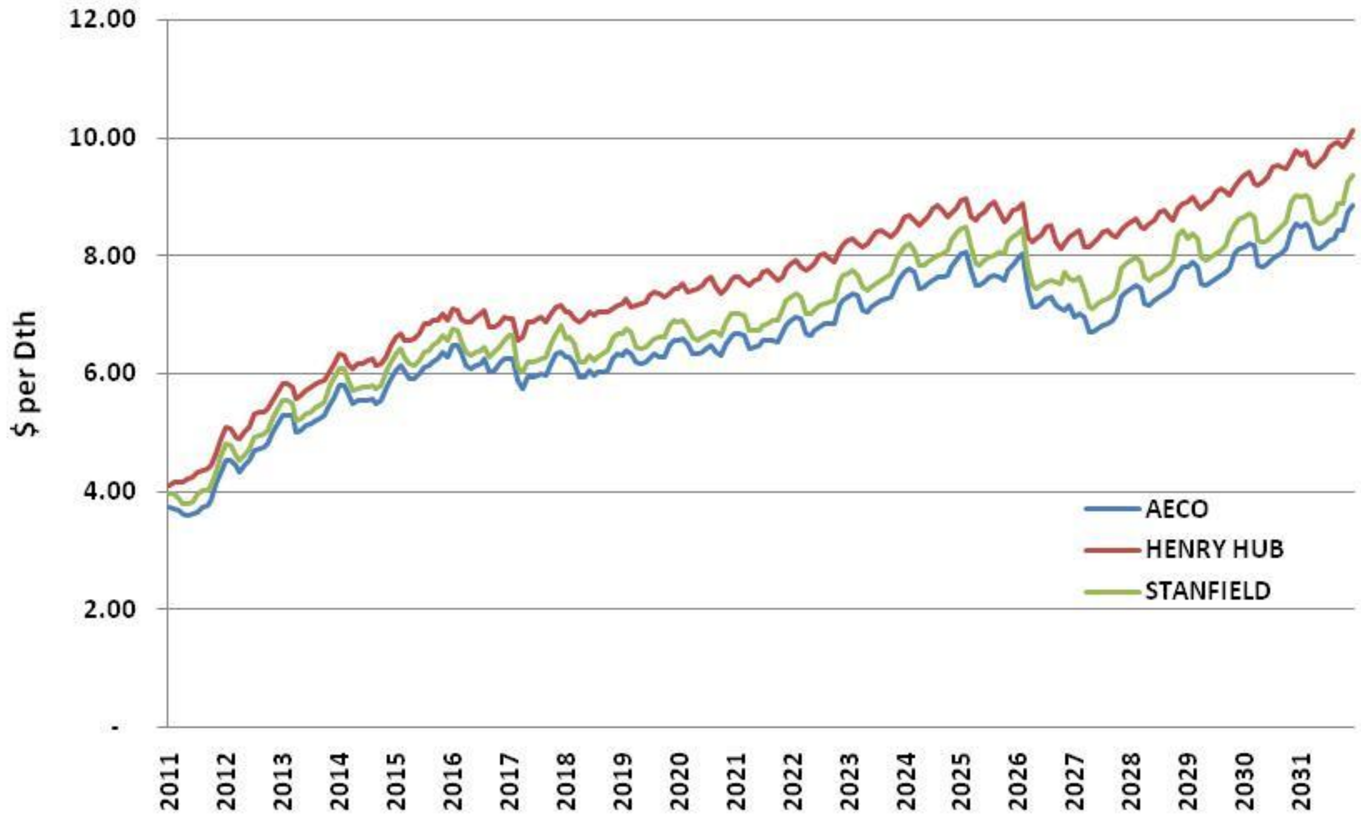
New conservation meets 21% of Load Growth

Regional Load Growth/Conservation Source: Wood Mackenzie

Western Interconnect Plug-in Electric Hybrid Vehicles Assumption

- Electric Cars are assumed to be adopted at the Northwest Power & Conservation Council estimate per the “Case 2” of the 6th Power Plan
  - 18% of cars by 2020 and 28% by 2030
- 95% of cars will charge at night and 5% during on-peak hours
- PHEV are not assumed to meet electric capacity needs

Natural Gas Price Re-Cap



2012-2031
Nominal
Levelized Price

$7.28- Henry Hub

$6.71- Stanfield

$6.39- AECO

Western Interconnect Transmission Additions

- Additional regional transmission additions are assumed to take place in the future, these are the additions assumed in the Base Case market analysis (MW)
  - Idaho - NW: 1,500 (2019)
  - Canada - NW - California: 3,000 (2018)
  - Wyoming - Utah: 3,000 (2015)
  - Wyoming - Idaho: 1,500 (2016)
  - Wyoming - Colorado: 900 (2013)
  - Idaho - Utah: 1,320 (2016)
  - N. Nevada - S. Nevada: 1,600 (2015)
  - New Mexico - Arizona: 3,000 (2016)

New Resource Alternatives

Western Interconnect

Resource alternatives to meet Renewable Portfolio Standards

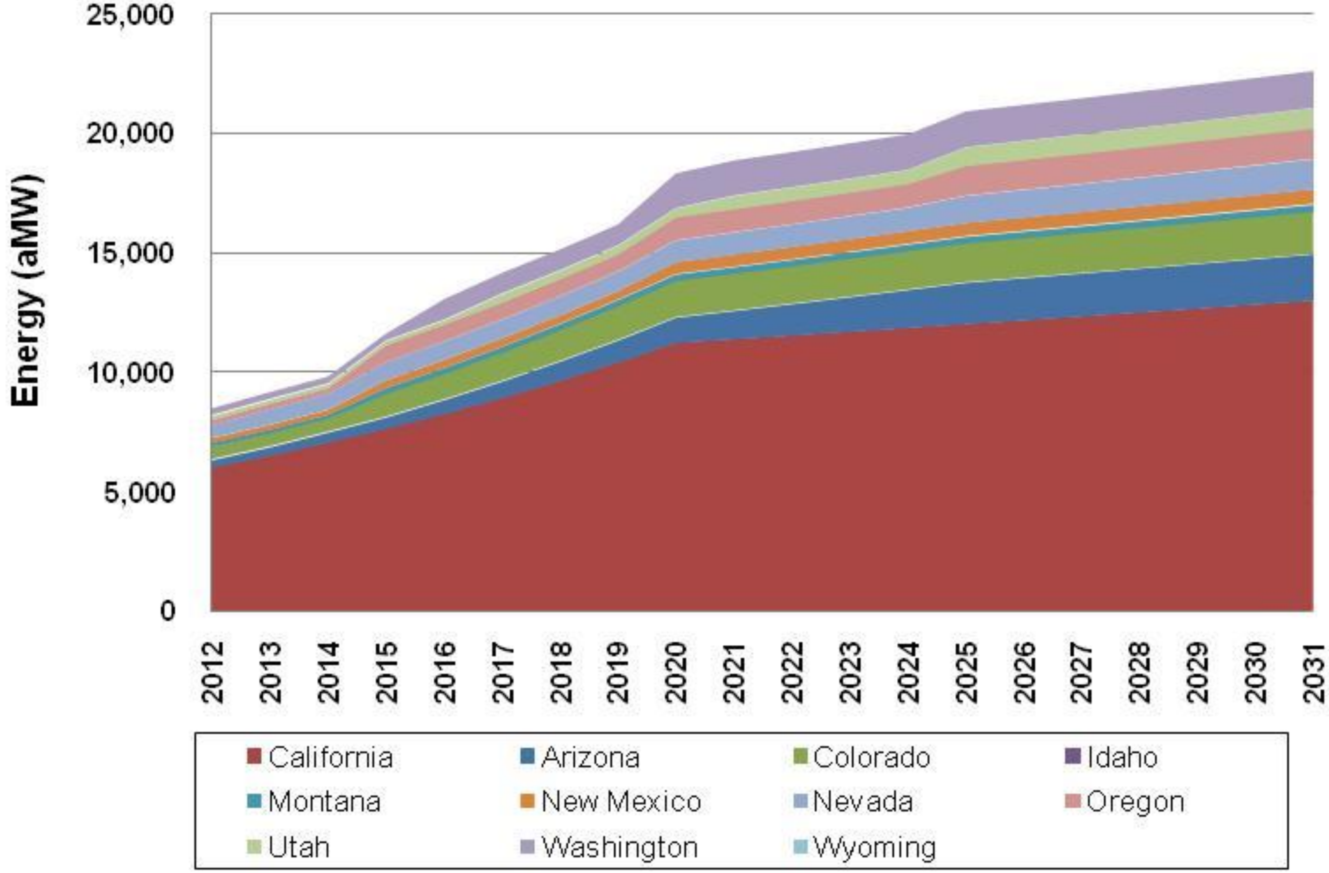
- Wind
- Solar
- Biomass
- Geothermal
- Hydro Upgrades

Resource alternatives to meet regional capacity requirements

- Combined Cycle
- Simple Cycle (Aero, Frame, Hybrid)
- Solar
- Wind (non RPS states)
- Nuclear
- Coal Pulverized
- Coal IGCC
- Coal IGCC with Sequestration

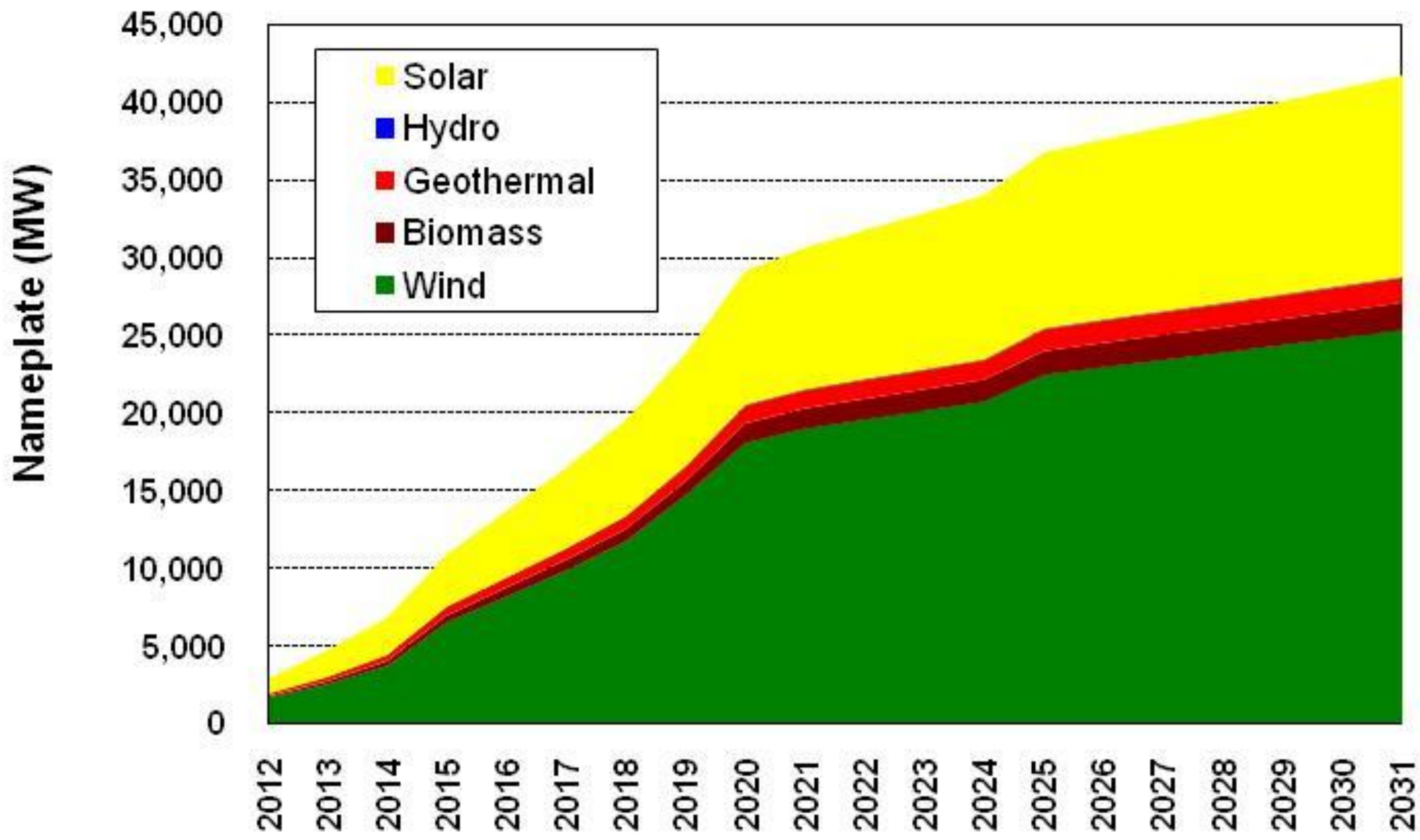
State Renewable Energy Requirements

Western Interconnect



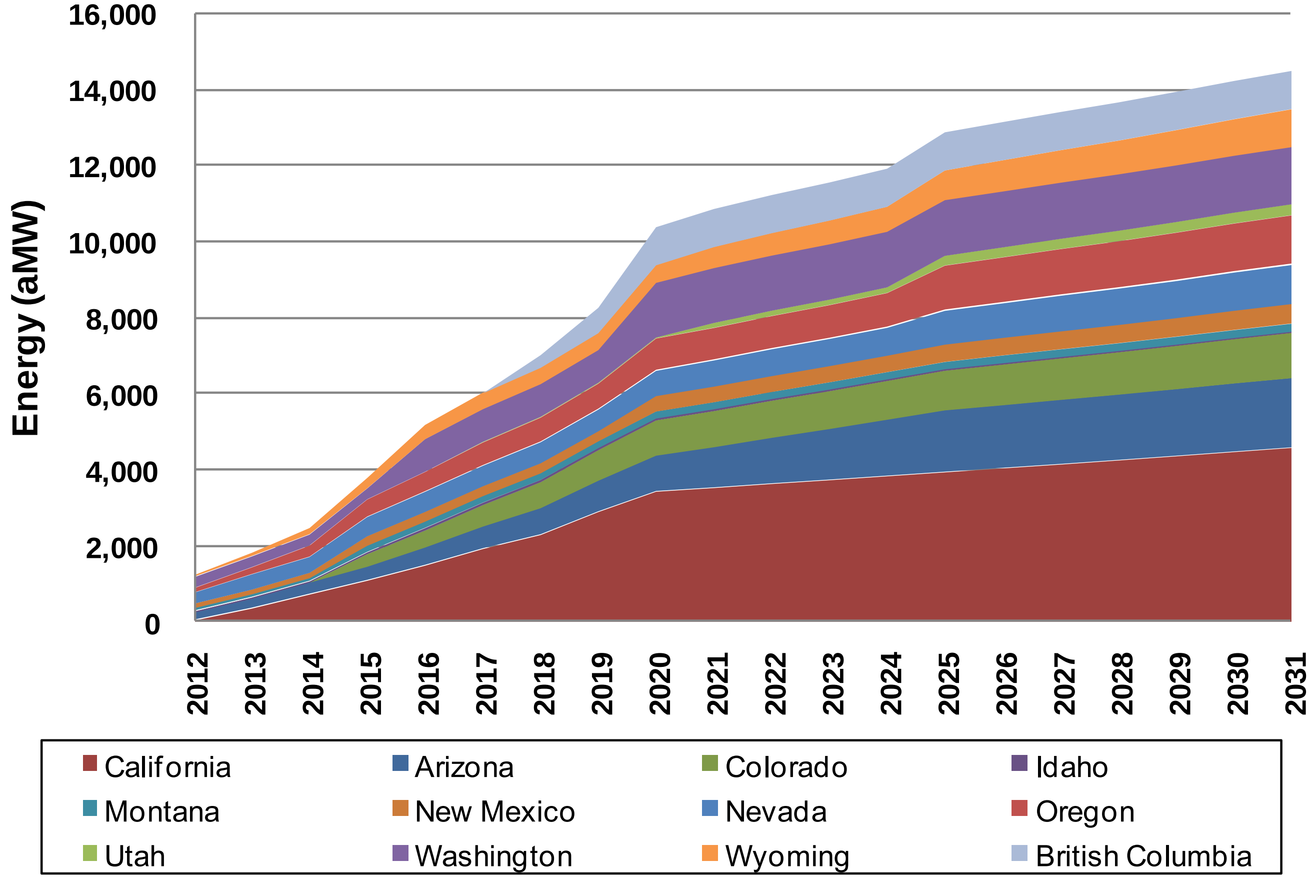
New Renewable Resources Added for RPS by Type

Western Interconnect

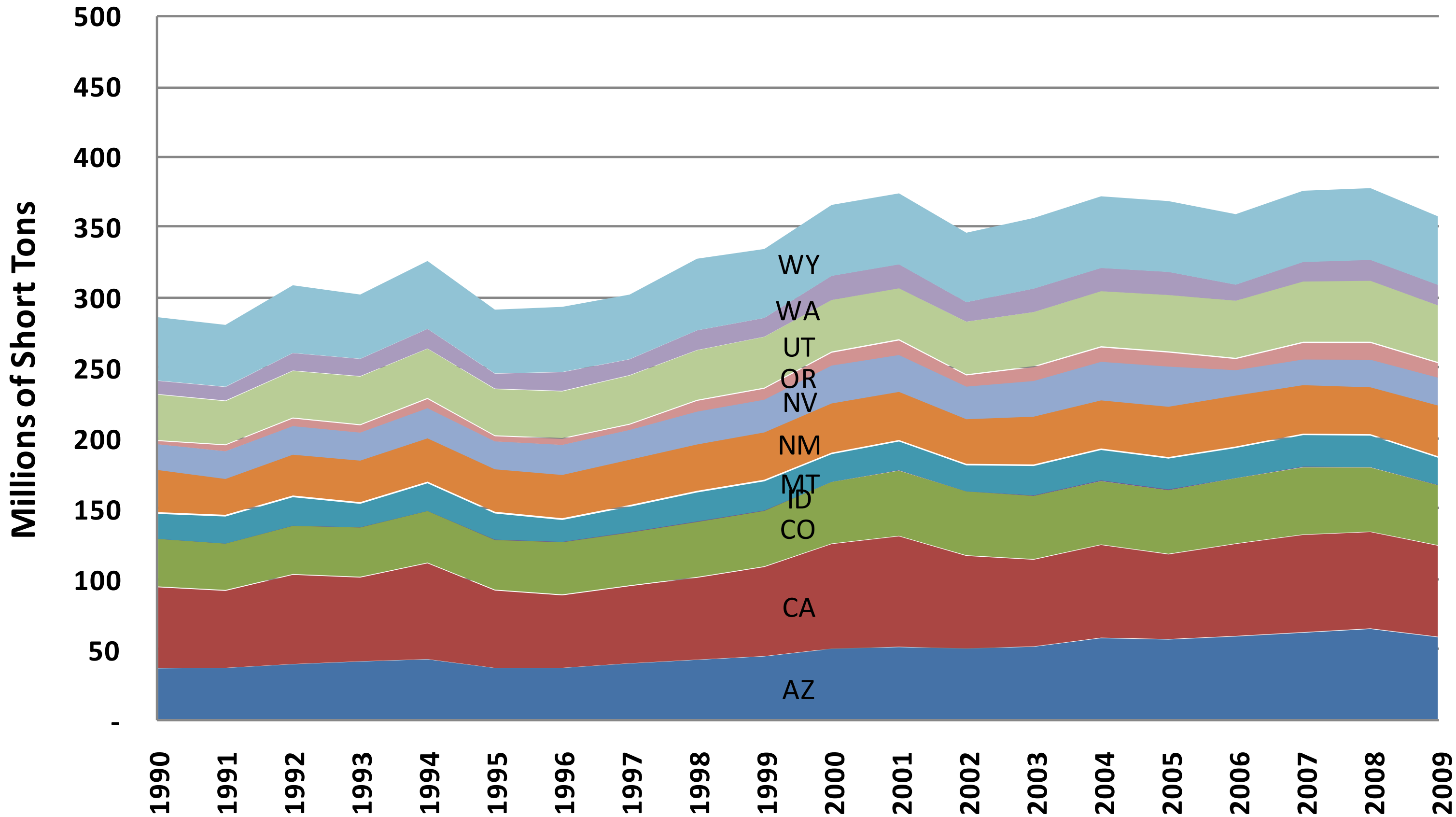


Location of New Renewable Resources

Western Interconnect



Generation Greenhouse (CO_2) Gas Emissions by State in the Western Interconnect



Source: EPA

Greenhouse Gas (CO_2) Reduction Schemes

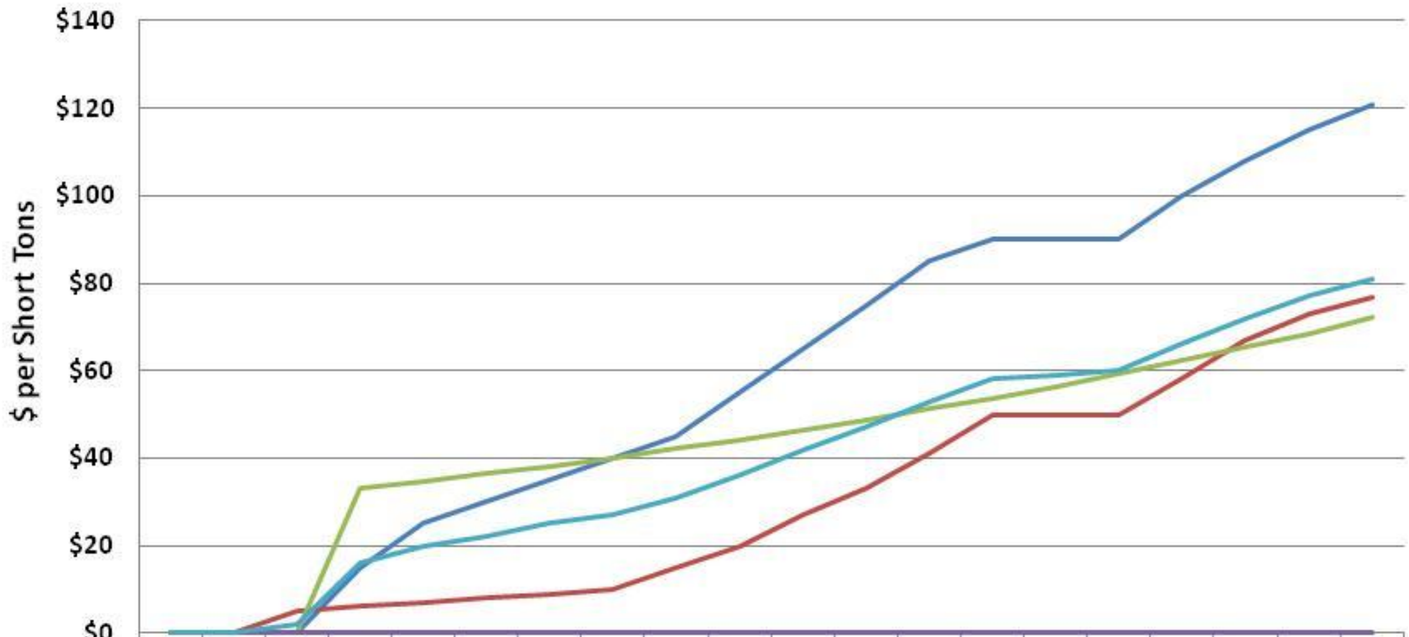
Stochastic Case

1. Regional Greenhouse Gas Policies (30% probability)
   – State carbon reduction in CA, OR, WA, NM between 2014 and 2019
   – ~10% reduction below 2005 levels by 2020
   – Beginning in 2020 shift to National Climate Policy with 15% below 2005 levels by 2030
2. National Climate Policy (30% probability)
   – Federal legislation only applies beginning in 2015
   – ~15% below 2005 levels by 2020, ~35% below 2005 levels by 2030
3. National Carbon Tax (30% probability)
   – Federal legislation only applies
   – $33 per short ton, than 5% per year escalation
   – Begins in 2015
4. No Carbon Reductions (10% probability)
   – No carbon reduction scheme
   – State level emission performance standards apply and no new coal in US West

Deterministic Case

– Emissions reduced to the weighted average of four cases above

Resulting Greenhouse Gas (CO_2) Reduction Prices



2015-2031 Levelized Price per Short Ton		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
$59.36	National Climate Policy	0	0	0	15	25	30	35	40	45	55	65	75	85	90	90	90	100	108	115	121
$28.02	Regional GHG Policies	0	0	5	6	7	8	9	10	15	20	27	33	41	50	50	50	58	67	73	77
$46.48	National Carbon Tax	0	0	0	33	35	36	38	40	42	44	46	49	51	54	56	59	62	65	69	72
$00.00	No GHG Reductions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$40.20	Expected Case	0	0	2	16	20	22	25	27	31	36	42	47	53	58	59	60	66	72	77	81

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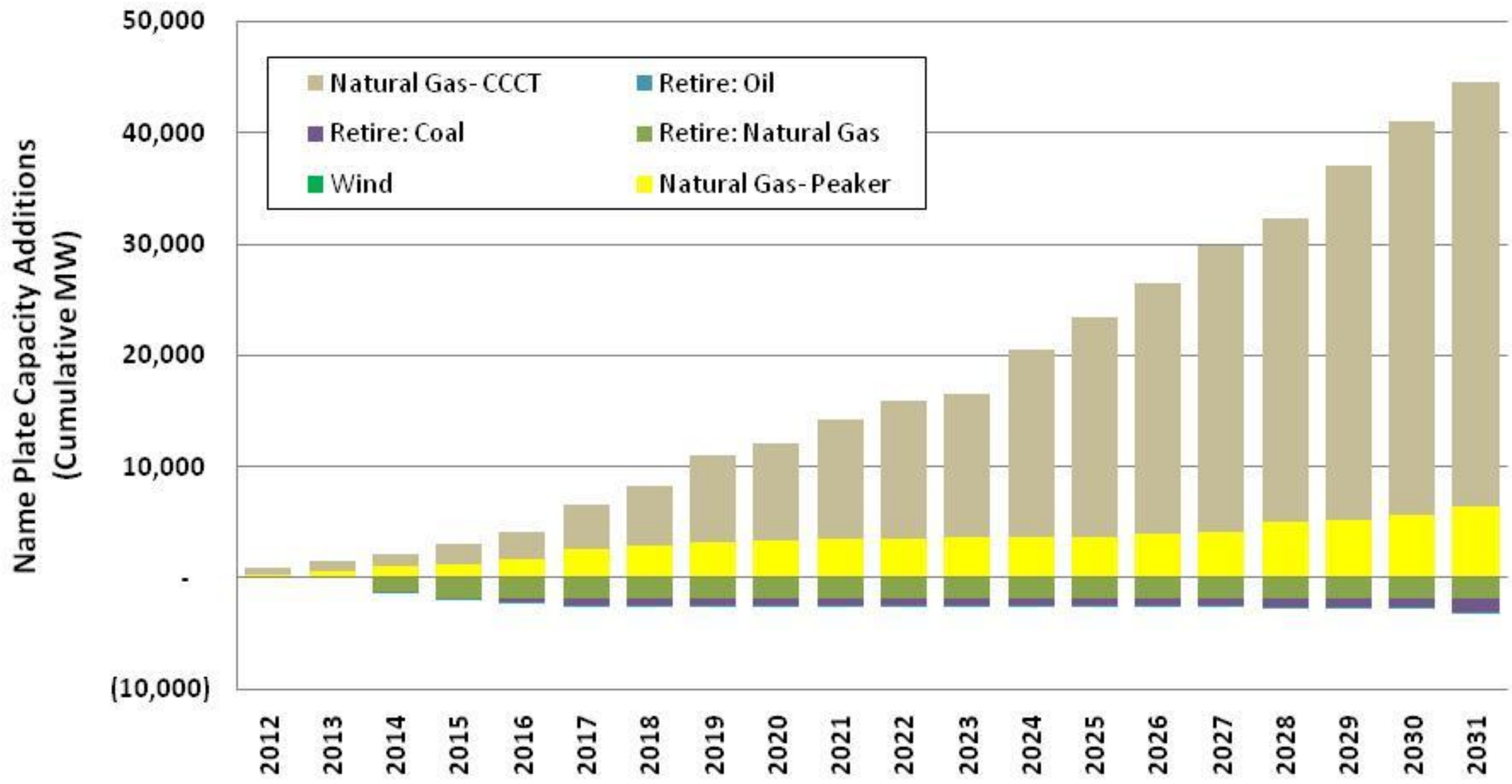
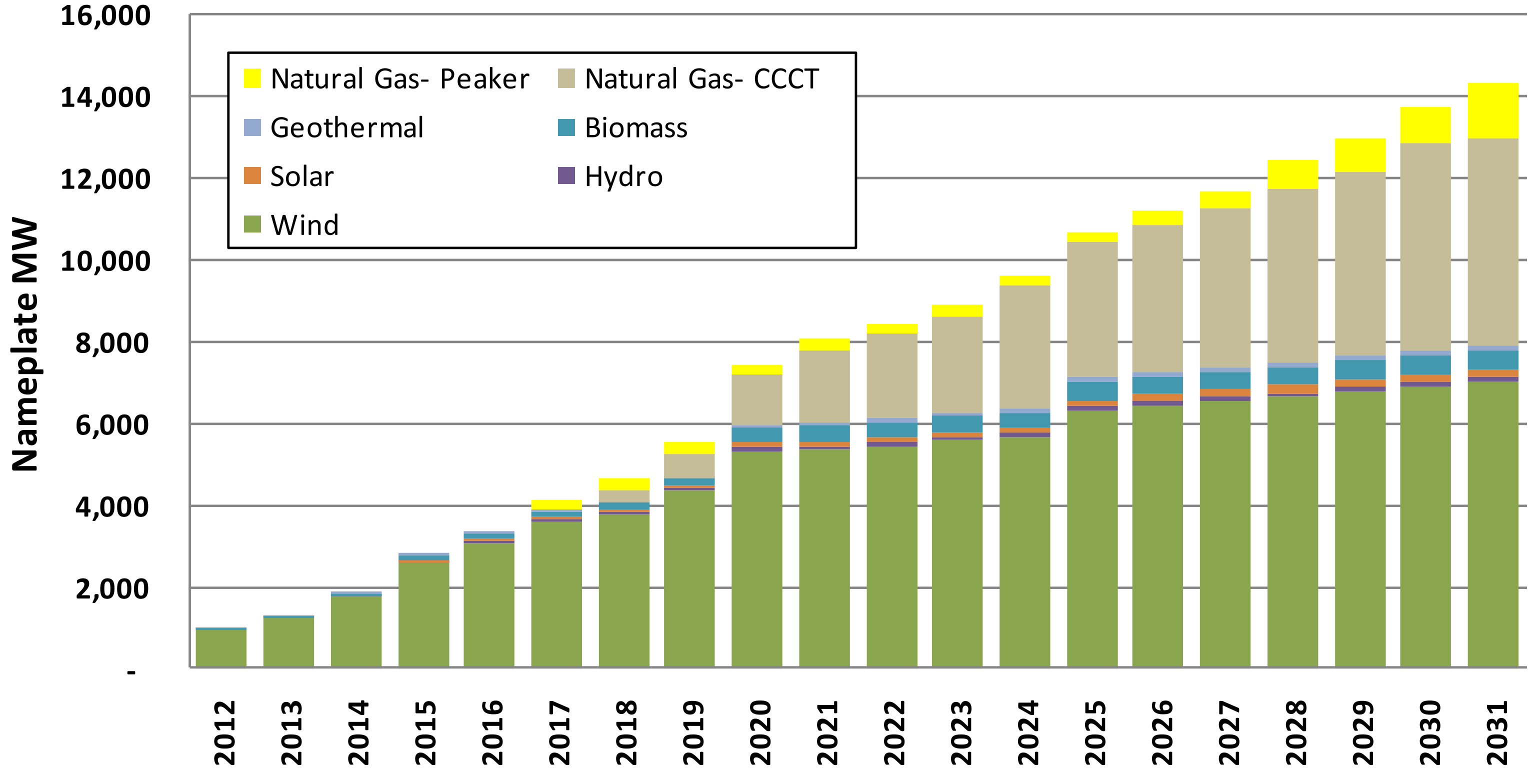
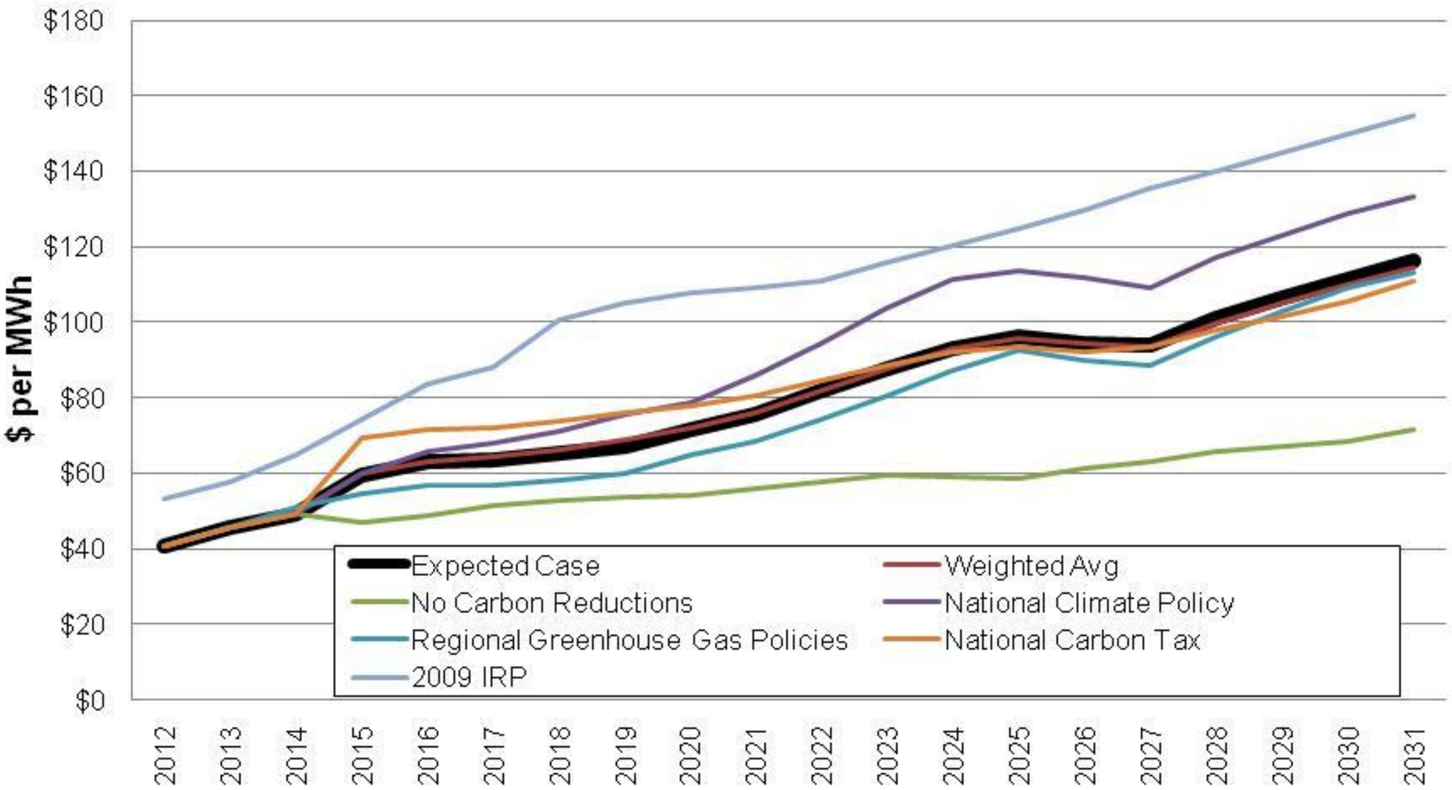
New Resource Selected to Meet Capacity Requirements in Western Interconnect



Northwest New Resources (RPS, Export, & Capacity)



Deterministic Mid-Columbia Annual Average Price Forecast



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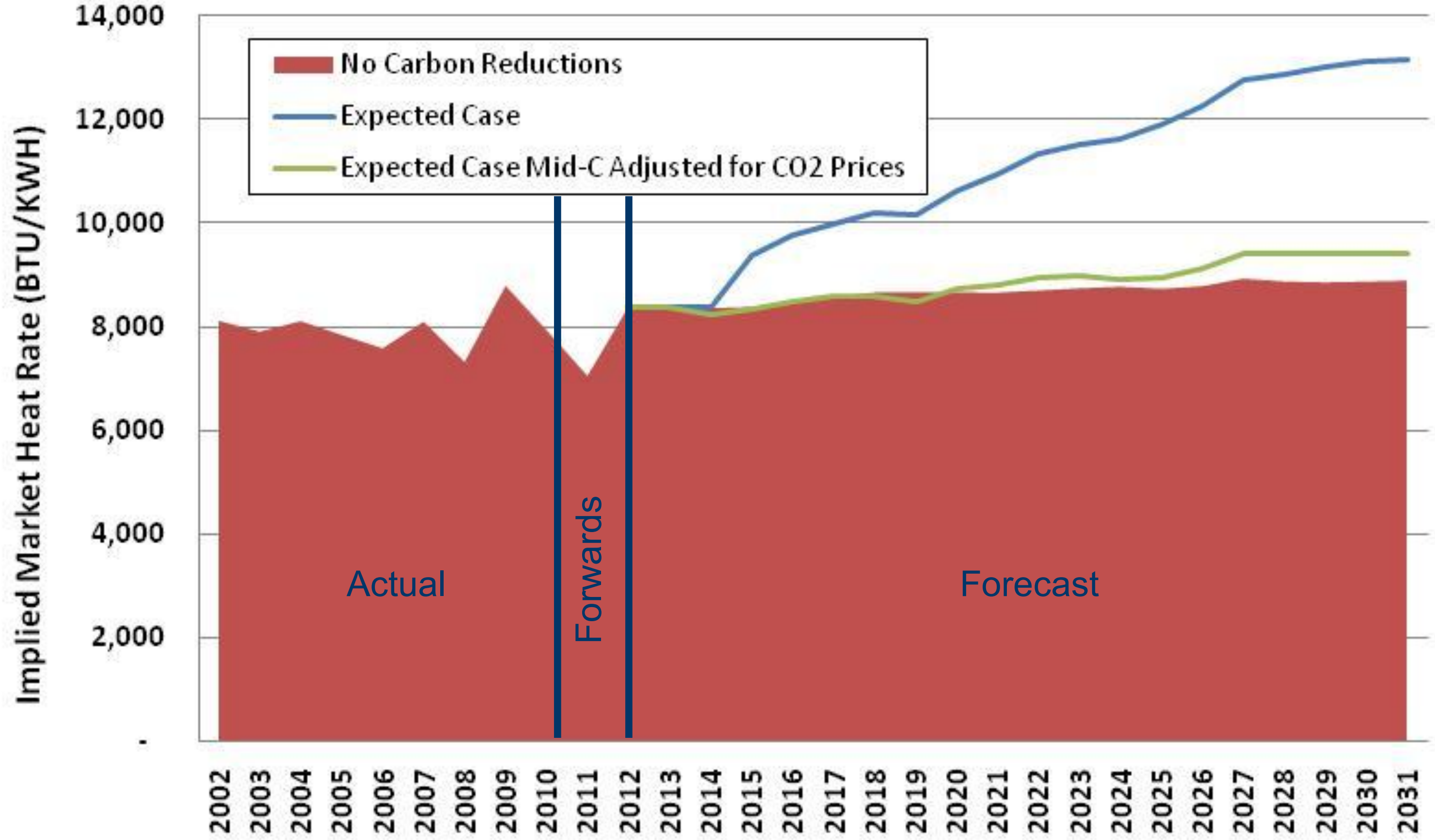
Deterministic Mid-C Annual Avg Price Forecast

Levelized Nominal Prices

Scheme	Levelized Price $/MWh 2012-31
2009 IRP Expected Case (Adjusted)	97.60
2011 IRP Expected Case	71.22
Scenarios	
Regional Greenhouse Gas Policies	66.91
National Climate Policy	78.94
National Carbon Tax	73.98
No Carbon Reductions	53.70
Weighted Average	71.32

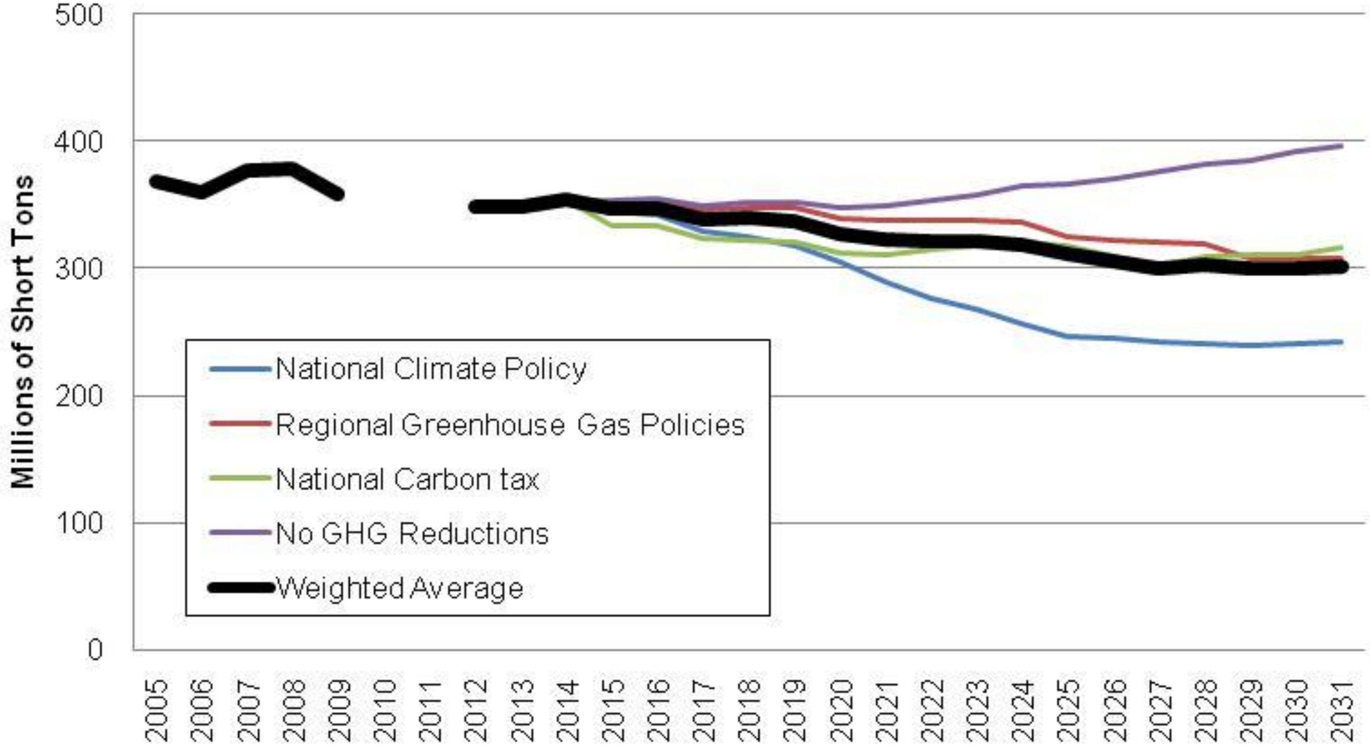
Deterministic Implied Market Heat Rates

(Mid-Columbia / Stanfield x 1,000)



Deterministic Greenhouse Gas (CO_2) Levels

(US Western Interconnect)



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Case Nos. AVU-E-12-08
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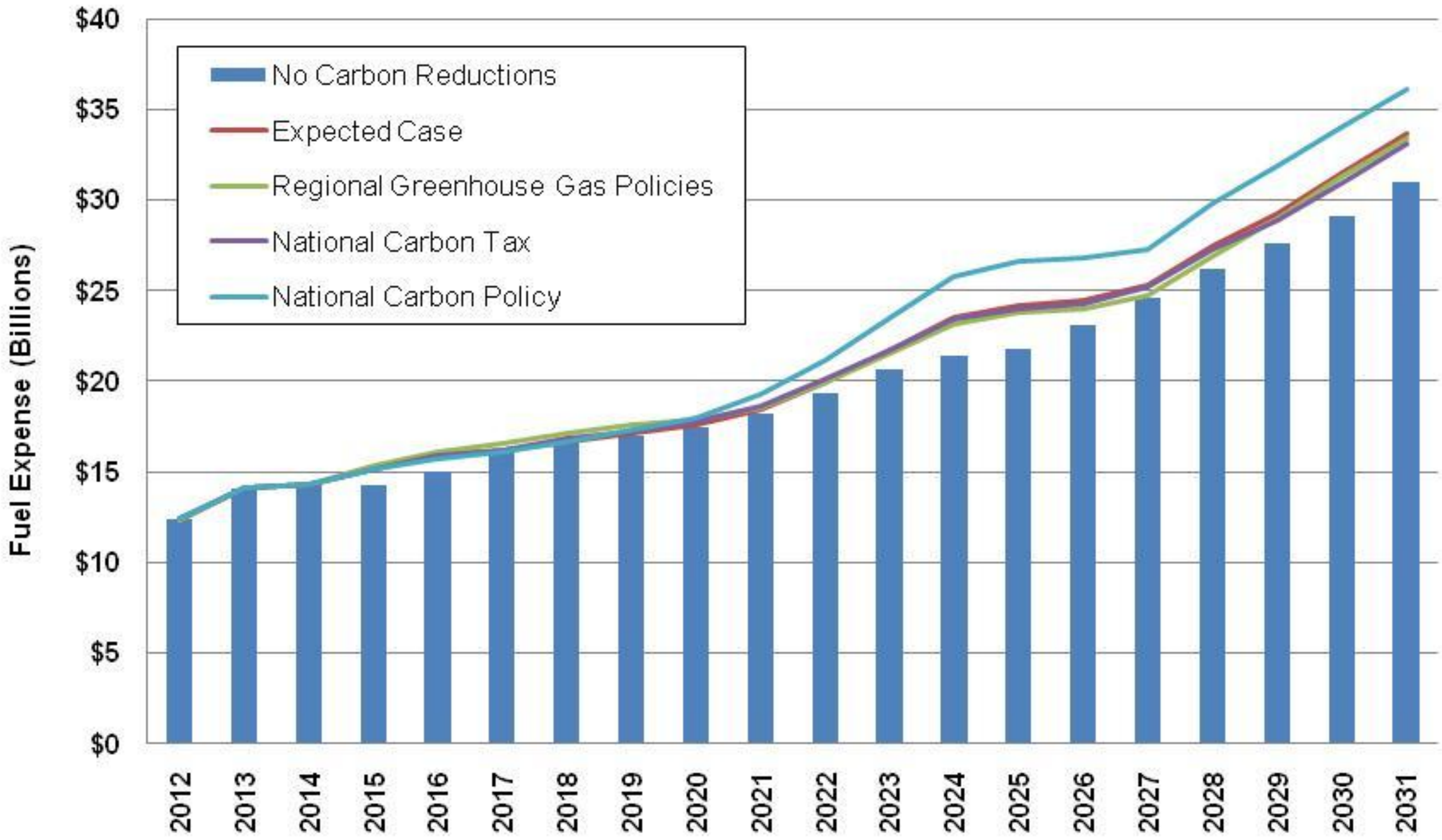
Schedule 1, Page 528 of 1069

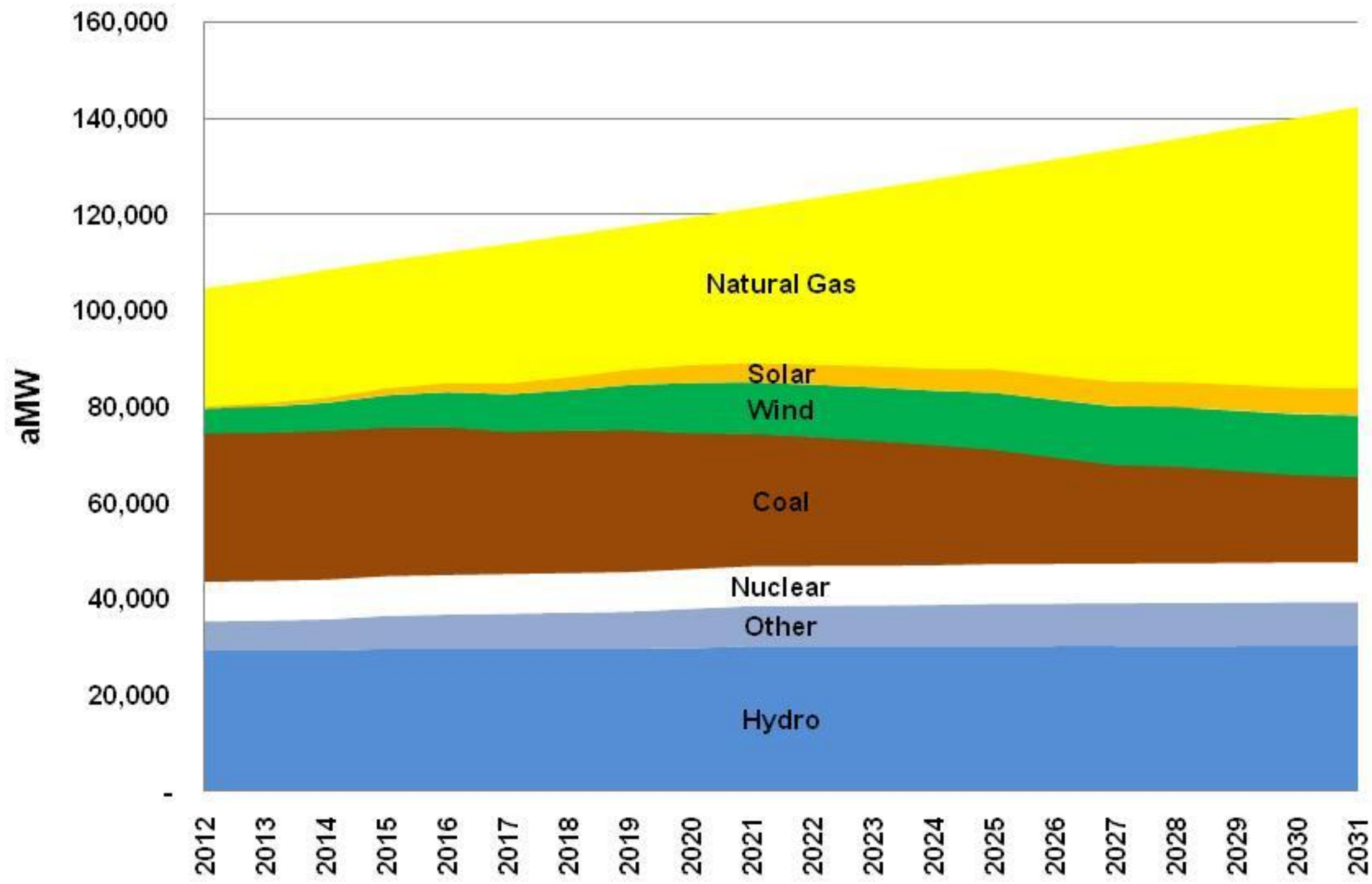
Total Generation Fuel Costs

US Western Interconnect



“Expected Case” Resource Energy Mix

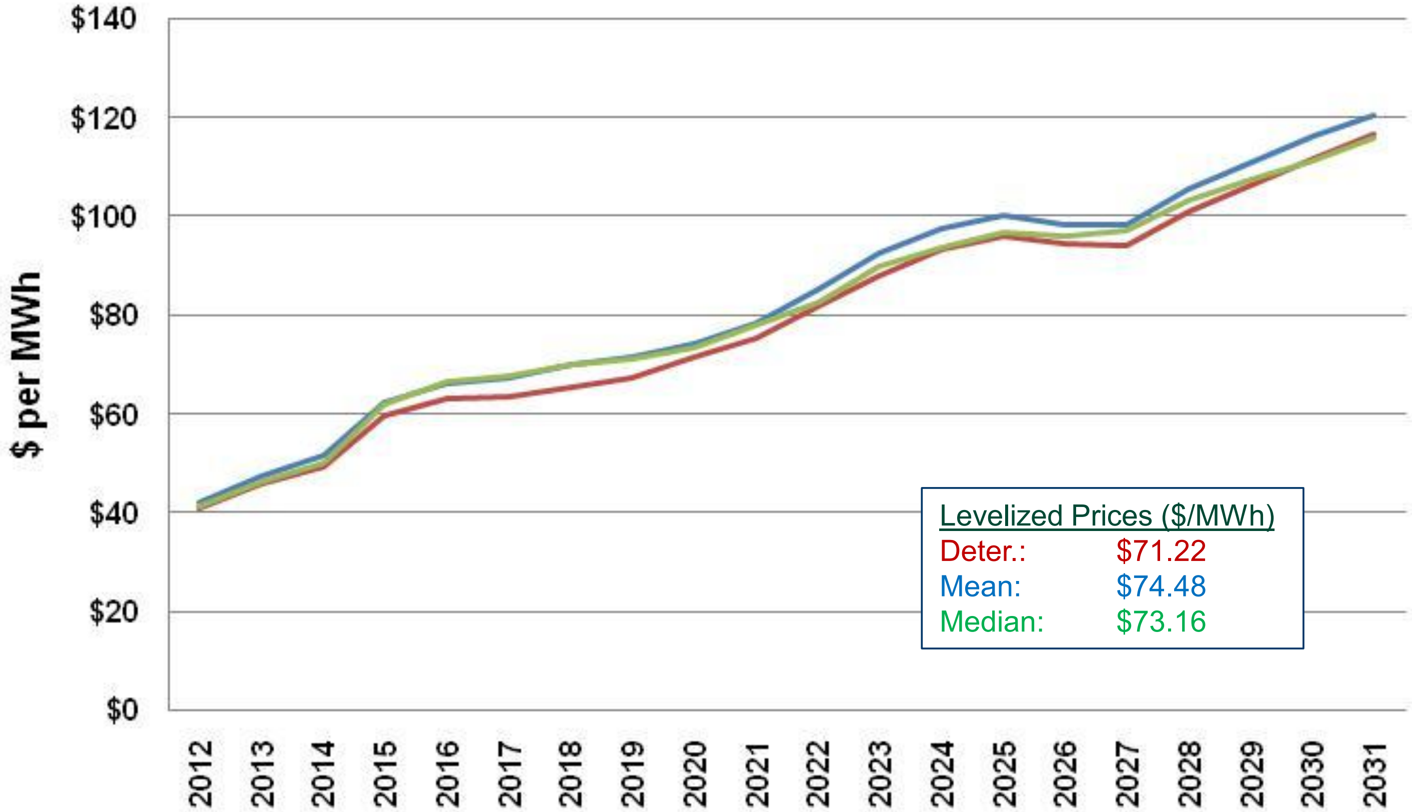
US Western Interconnect



Stochastic Modeling Changes From Last TAC Meeting

- Assumptions based on methodologies discussed in last TAC meeting, with some exceptions.
- Wind model randomly draws from 15 wind years for each study year, previous TAC discussed drawing from 50 wind years for the entire 20 years of each iteration.
- Oil and wood price escalation will use lognormal distributions.
- Natural gas price methodology is the same but will use historical month-to-month standard deviation.
- Adjustment developed for linking carbon prices to natural gas prices, no carbon reduction case will have ~10% reduction to natural gas prices

Stochastic Electric Market Prices Compared to Deterministic



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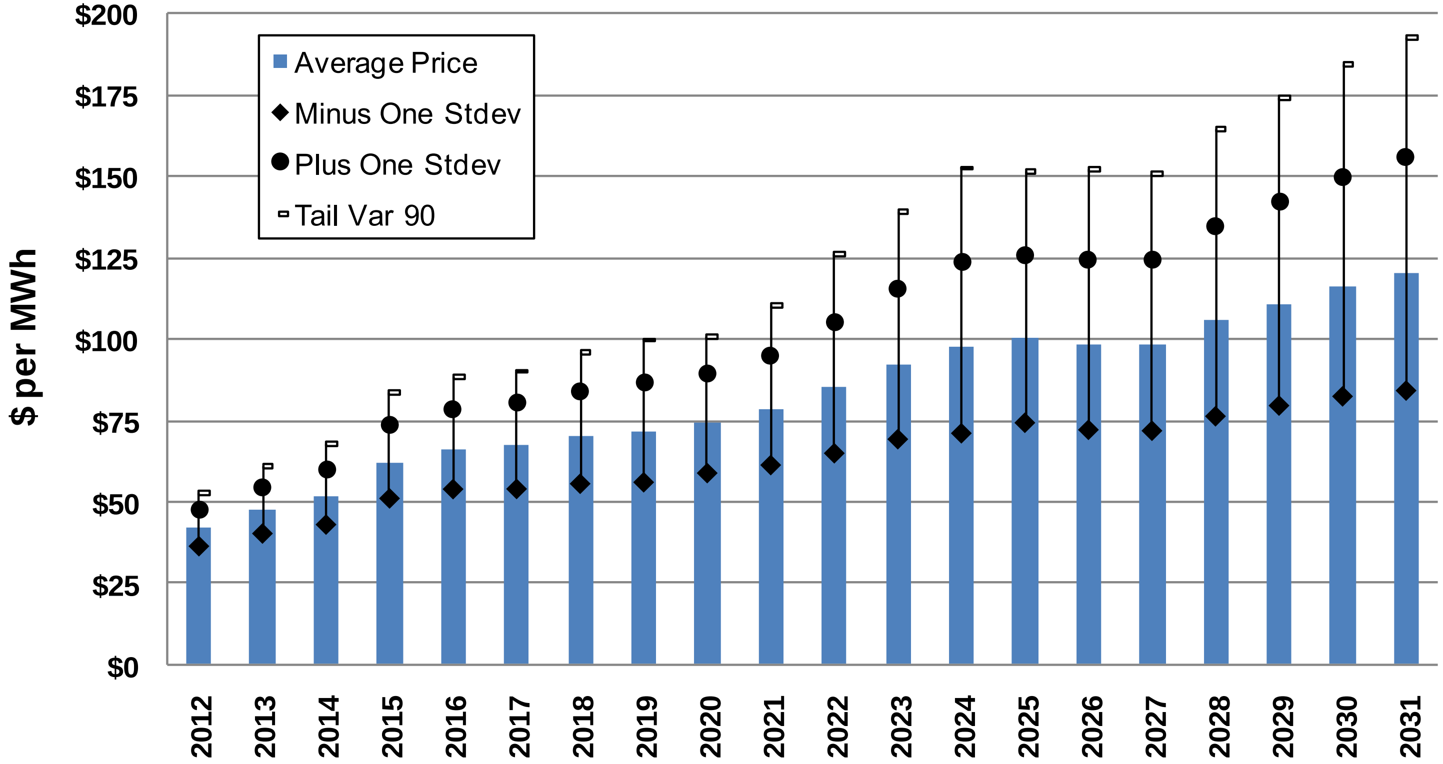
Range in Market Prices

Annual Flat Mid-Columbia



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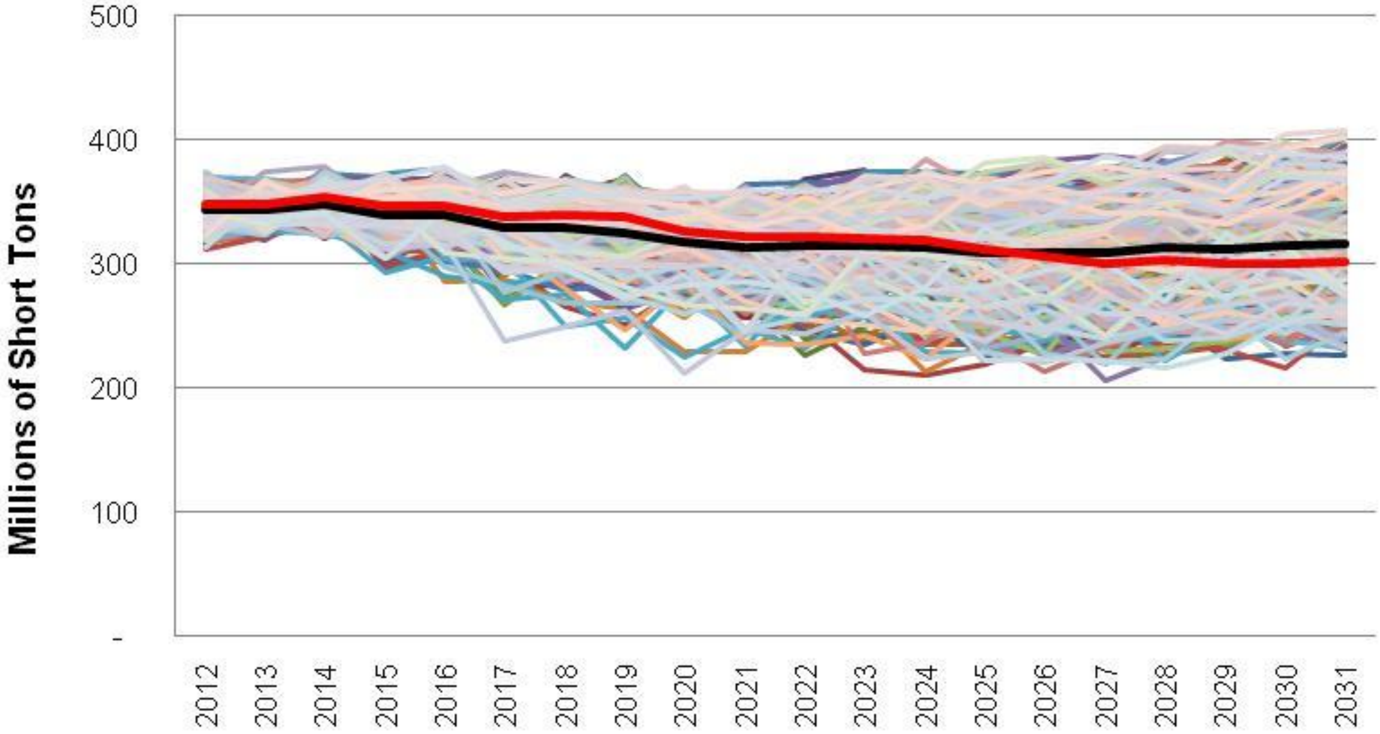
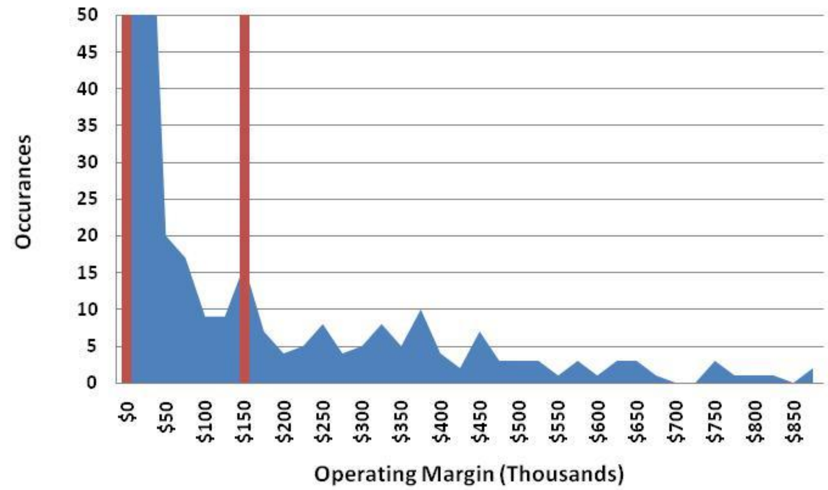
Range in US-Western Interconnect Carbon Emissions



Resource Valuations Deterministic vs Stochastic Example

Combined Cycle 2012 Operating Margin

Simple Cycle 2012 Operating Margin



Next Steps

1. Finalize "Expected Case" study
2. Portfolio Analysis
   - Preferred Resource Strategy
   - Efficient Frontier
   - Resource cost/availability sensitivities
3. Deterministic Market Scenario Studies
   - Resource portfolio scenario analysis
4. Stochastic Market Scenario Studies
   - Alternative "risk" markets; i.e. no carbon case, gas volatility
   - Alternative Efficient Frontier results

Resource Requirement Projections

Clint Kalich

Technical Advisory Committee Meeting #4

2011 Electric Integrated Resource Plan

February 3, 2011

Agenda

- Reliability Modeling Update
- Avista Reliance on Wholesale Marketplace
- Shift from 1-Hour to 18-Hour Peaking Period
- Regional Capacity Position
- Avista Reliance on Wholesale Marketplace
- Avista Resource Positions
- Conclusions

Reliability Modeling Update

- Completed Advanced Model Late 2010
  - Sophisticated hydro logic
  - Weather-dependent thermal logic
  - Robust representation of hourly loads
  - Time-series representation of data
- Numerous Runs of Reliability Model
- Results Indicate Key Assumption is Market Availability
  - More important than hydro, load, thermal resources
- Yet Don't Really Know What The Broader Market Looks Like
- Negates Most Benefits (at least for IRP) of Reliability Model
- Therefore a Simpler Approach Was Followed

One-Hour vs. 18-Hour Sustained Peak

- Historically Region (and Avista) Has Planned on One-Hour Peak Demand Scenarios
- Similar to Other Regions in WECC & NERC
- Works Great for Thermal Systems Without Fuel Limits
- Doesn’t Work As Well for Hydro Systems with a Limited Fuel Source
- Region Has Shifted from a One-Hour Peak to a 3-Day, 6 Hours Per Day Sustained Demand Event
- AKA 18-Hour Sustained Peak Event

One-Hour vs. 18-Hour Sustained Peak

- Affects (Lowers) Hydro Resource and Load Capabilities
- No Assumed Impact on Thermal Operations
  - Except output is affected by assumed peak condition ambient temperatures
- Avista's Method Relies Substantially on Northwest Power and Conservation Council's ("NWPP") Work
  - 24% Winter and 23% Summer Planning Margin
  - Compares to 15% assumption in 2009 IRP
  - Essentially the same as 2009 IRP assumption but operating reserves are added

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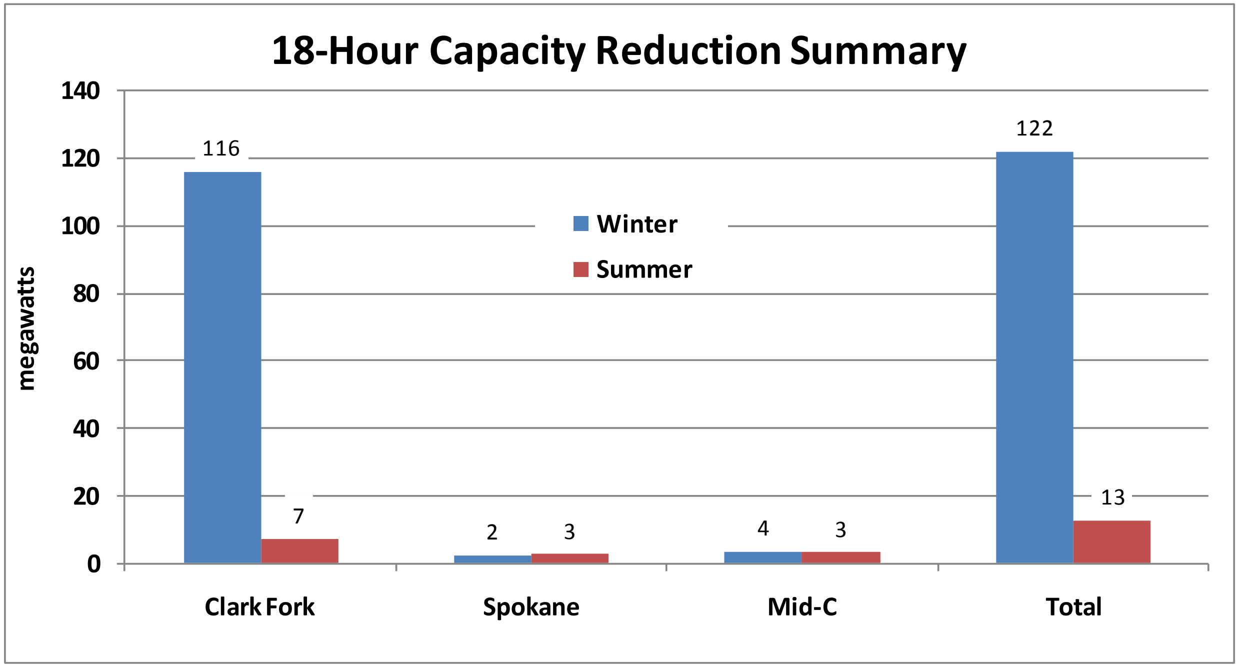
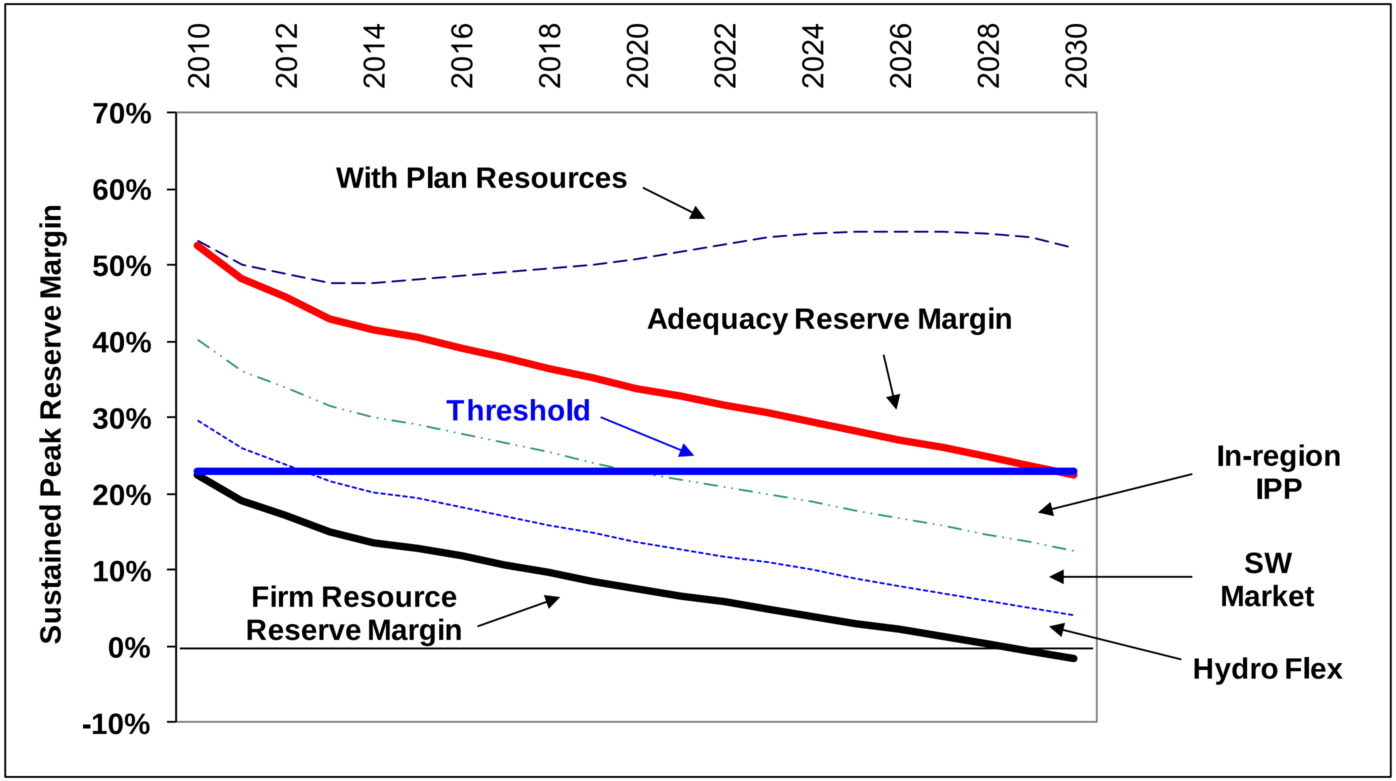
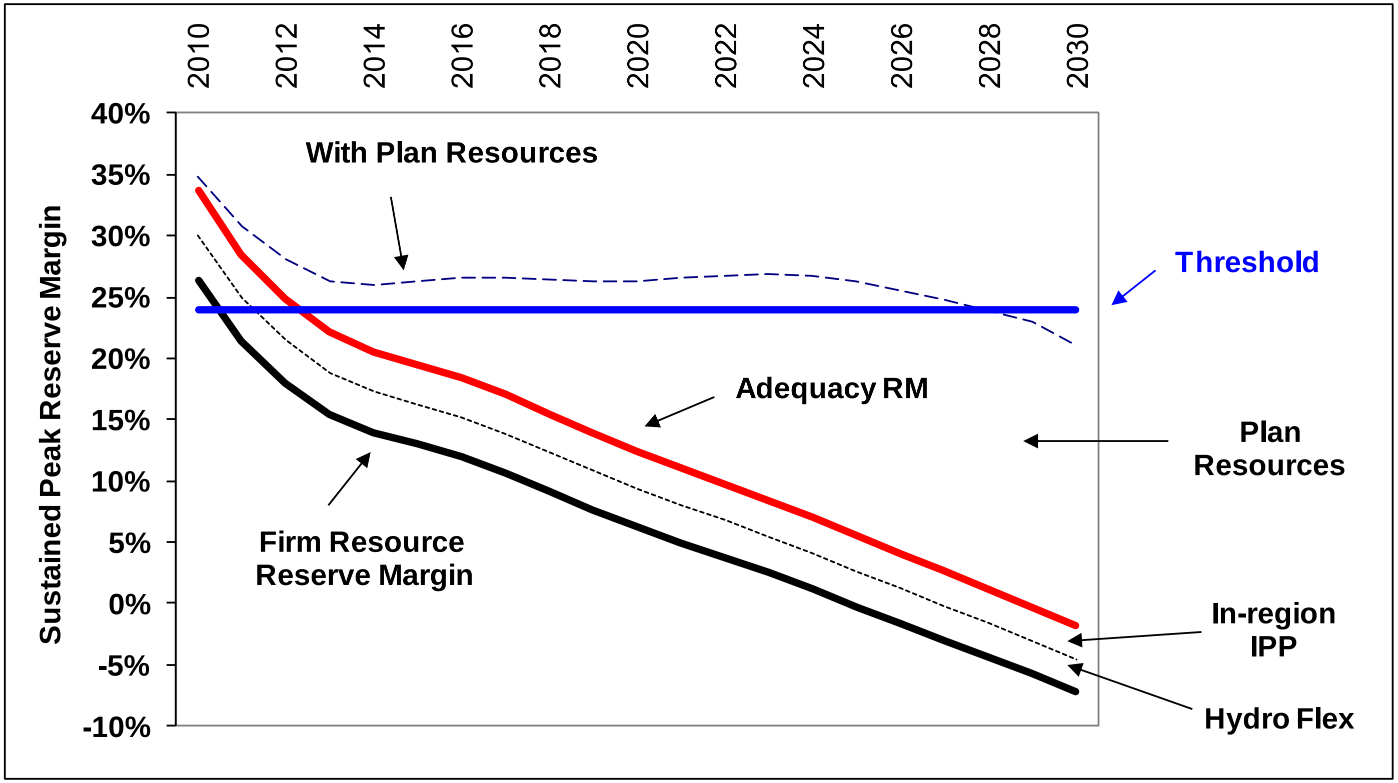
Hydro 18-Hour Sustained Capacity Impacts
Avista's System



Regional Capacity Position
NPCC Winter Assessment



Regional Capacity Position
NPCC Summer Assessment



Avista Reliance On Wholesale Market

- Avista Relies on a “Modified” NWPP Load and Resource Balance
  - Ignore aggressive conservation assumption
    - use Wood-Mac forecast of 0.9% regional load growth
  - No capacity contribution for wind (-250 MW)
  - 10% wind capacity reserves (-500 MW)
    - Do not plan to interrupt wind at peak
- 5.5% of Regional Surplus is Available to Avista
  - Phased out over 10 years
    - 10% reduction per year

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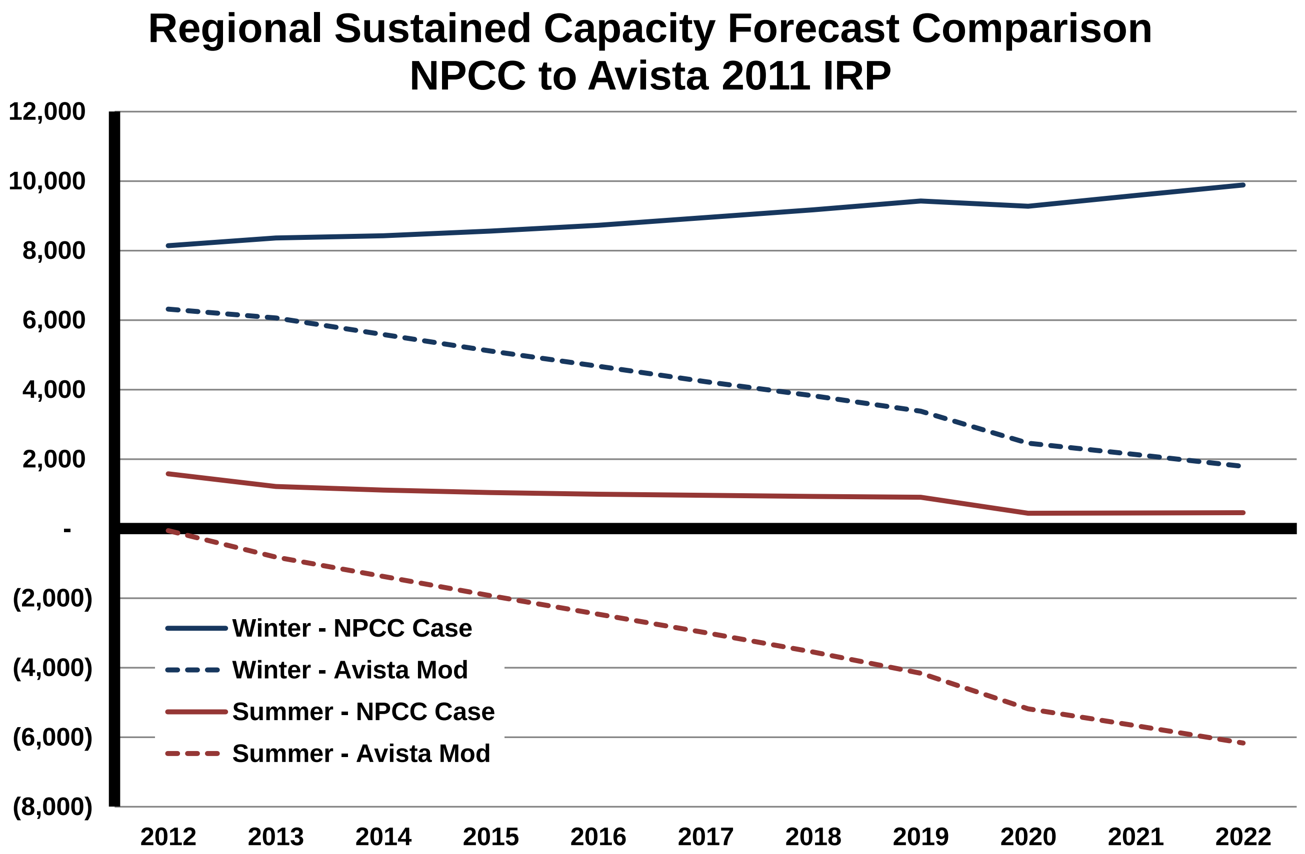
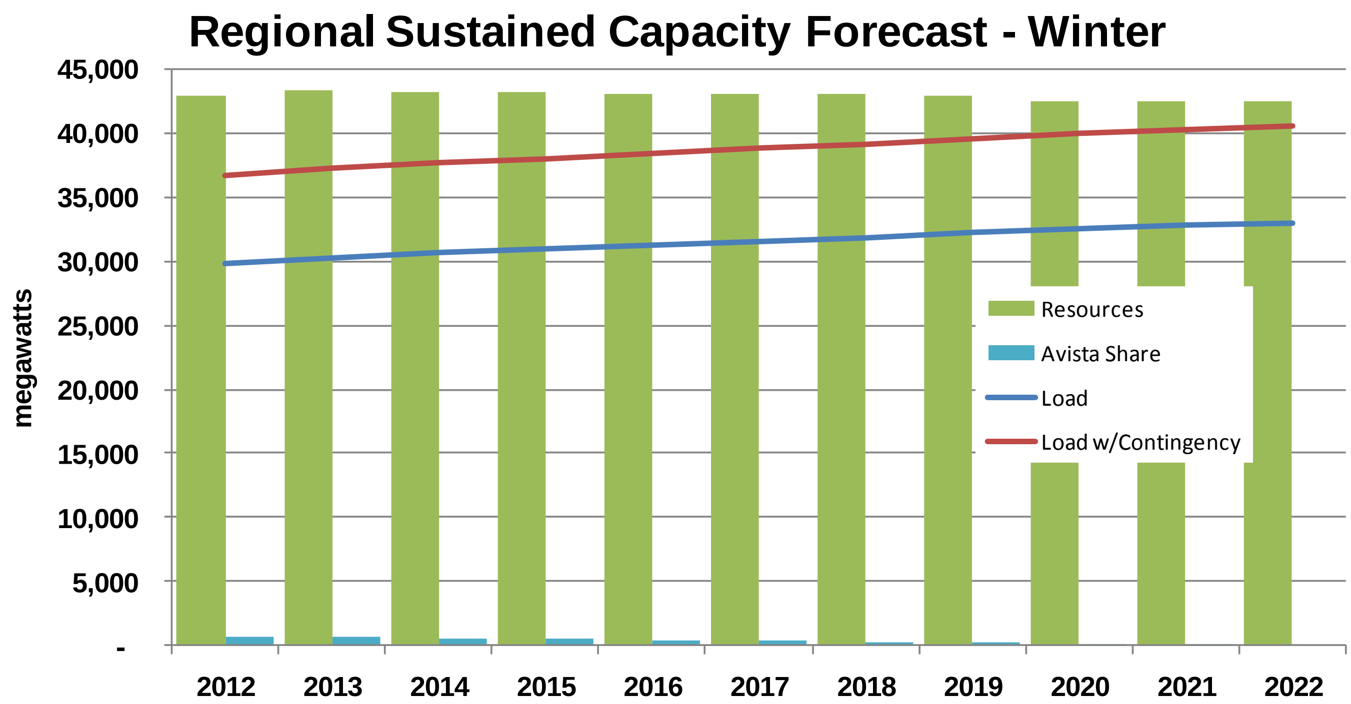
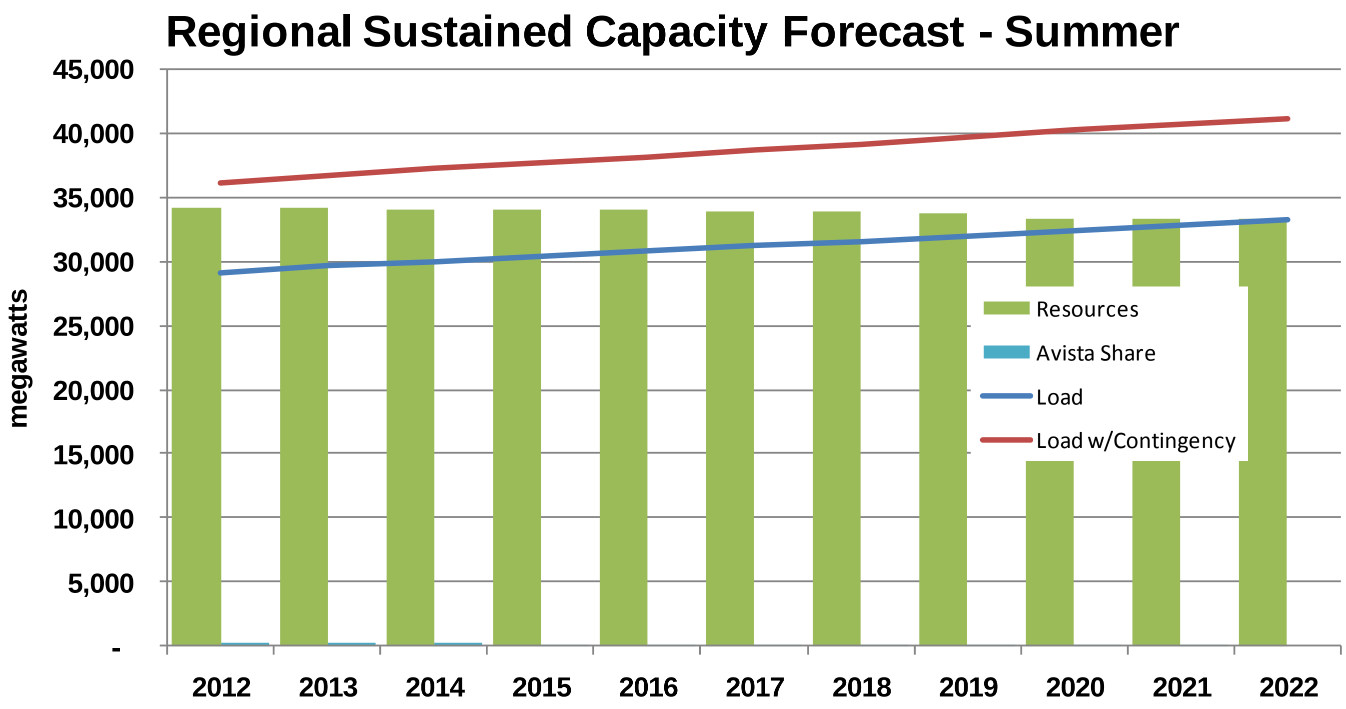
Regional Capacity Position Comparison



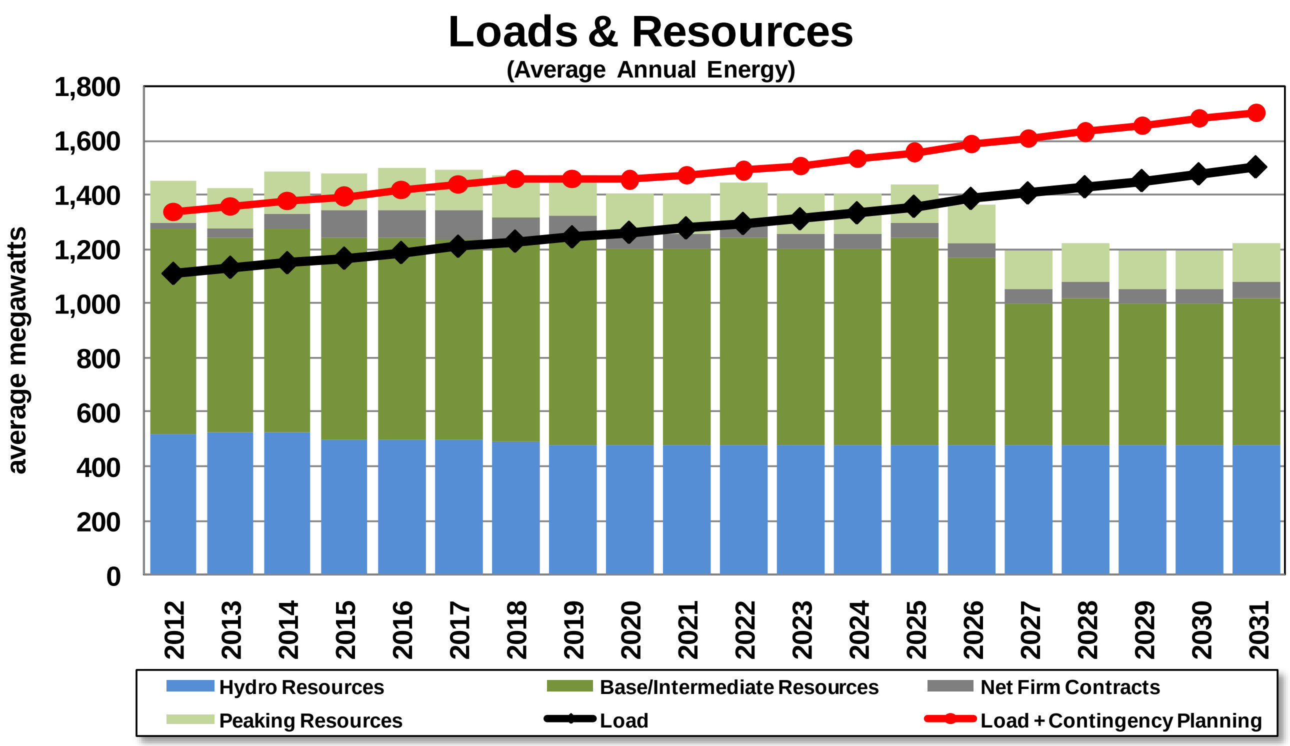
Regional Capacity Position
Winter



Regional Sustained Capacity Position
Summer



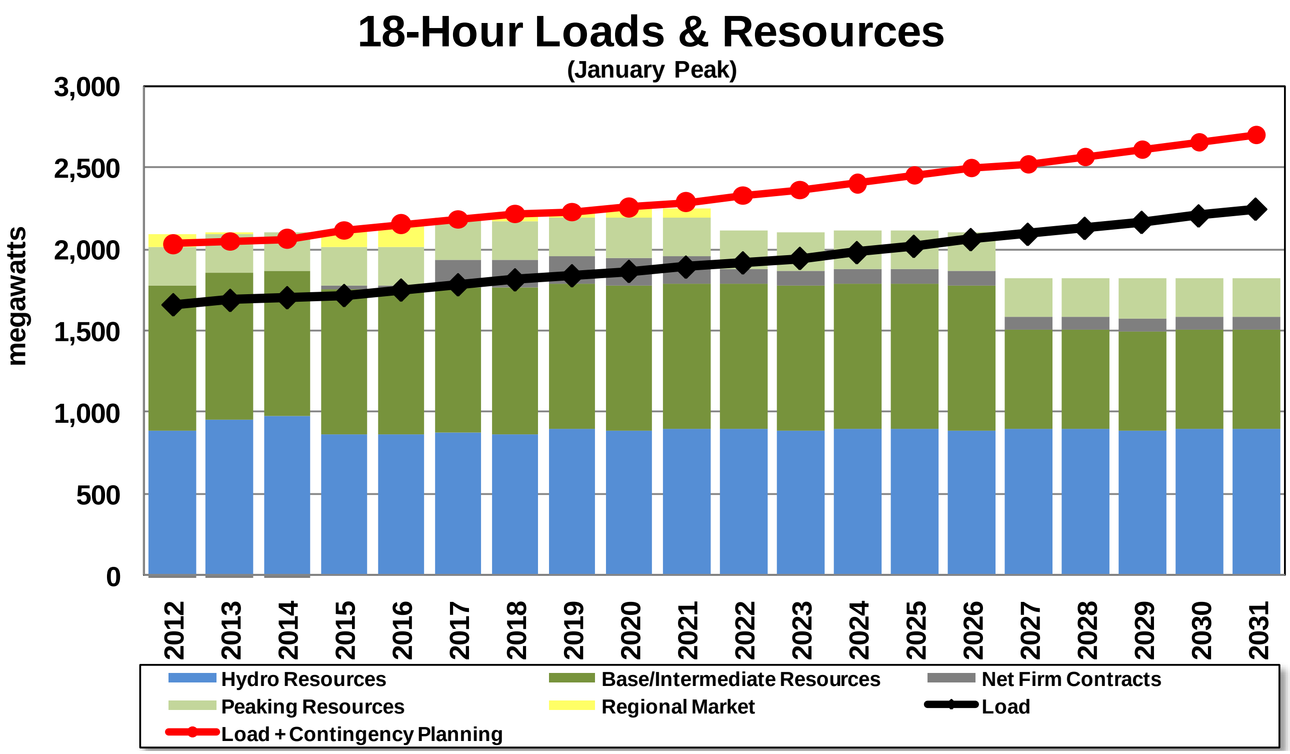
Avista Energy Position



Avista Energy Position

		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
	REQUIREMENTS																				
1	Native Load	-1,109	-1,131	-1,148	-1,165	-1,186	-1,209	-1,228	-1,244	-1,260	-1,277	-1,293	-1,310	-1,333	-1,357	-1,386	-1,406	-1,429	-1,452	-1,477	-1,502
2	Firm Power Sales	-138	-124	-107	-57	-57	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
3	**Total Requirements**	**-1,247**	**-1,256**	**-1,255**	**-1,222**	**-1,243**	**-1,214**	**-1,233**	**-1,249**	**-1,266**	**-1,282**	**-1,298**	**-1,316**	**-1,338**	**-1,362**	**-1,391**	**-1,411**	**-1,434**	**-1,457**	**-1,482**	**-1,508**
	RESOURCES																				
4	Firm Power Purchases	160	160	160	160	160	109	108	88	62	62	61	61	61	61	61	61	61	61	61	61
5	Hydro	519	525	528	496	496	496	492	481	481	481	481	481	481	481	481	481	481	481	481	481
6	Baseload/Intermediate Resources	755	714	751	744	746	741	724	758	721	721	758	721	721	758	684	515	541	515	515	541
7	Wind Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	**Total Resources**	**1,435**	**1,399**	**1,439**	**1,401**	**1,402**	**1,346**	**1,324**	**1,327**	**1,264**	**1,264**	**1,301**	**1,263**	**1,263**	**1,300**	**1,226**	**1,057**	**1,083**	**1,057**	**1,057**	**1,083**
9	**POSITION**	**188**	**144**	**184**	**179**	**159**	**131**	**91**	**78**	**-2**	**-18**	**2**	**-53**	**-75**	**-62**	**-165**	**-354**	**-351**	**-400**	**-425**	**-425**
	CONTINGENCY PLANNING																				
10	Peaking Resources	153	153	153	138	153	154	153	147	146	145	147	146	145	147	146	145	147	146	145	147
11	Contingency	-227	-228	-228	-229	-230	-231	-232	-214	-195	-196	-197	-198	-199	-200	-201	-202	-203	-203	-204	-199
12	**CONTINGENCY NET POSITION**	**113**	**69**	**109**	**88**	**82**	**54**	**12**	**11**	**-51**	**-69**	**-48**	**-105**	**-128**	**-115**	**-221**	**-411**	**-407**	**-458**	**-484**	**-476**
	Energy Margin	**15%**	**11%**	**15%**	**15%**	**13%**	**11%**	**7%**	**6%**	**0%**	**-1%**	**0%**	**-4%**	**-6%**	**-5%**	**-12%**	**-25%**	**-24%**	**-27%**	**-29%**	**-28%**

Avista Winter Capacity Positions



Avista Winter Capacity Positions

		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
	REQUIREMENTS																				
1	Native Load	-1,661	-1,688	-1,704	-1,718	-1,751	-1,784	-1,814	-1,839	-1,866	-1,892	-1,919	-1,946	-1,982	-2,020	-2,062	-2,094	-2,131	-2,168	-2,208	-2,249
2	Firm Power Sales	-238	-237	-207	-157	-157	-7	-7	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
3	**Total Requirements**	**-1,899**	**-1,925**	**-1,911**	**-1,874**	**-1,908**	**-1,790**	**-1,821**	**-1,846**	**-1,873**	**-1,899**	**-1,925**	**-1,953**	**-1,988**	**-2,027**	**-2,068**	**-2,101**	**-2,138**	**-2,174**	**-2,214**	**-2,256**
	RESOURCES																				
4	Firm Power Purchases	175	175	175	175	175	175	175	173	173	173	90	90	90	90	90	90	90	90	90	90
5	Hydro Resources	882	957	973	861	861	872	868	896	887	896	896	887	896	896	887	896	896	887	896	896
6	Base Load Thermals	895	895	895	895	895	895	895	895	895	895	895	895	895	895	895	606	606	606	606	606
7	Wind Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Peaking Units	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242
9	**Total Resources**	**2,194**	**2,269**	**2,285**	**2,173**	**2,173**	**2,185**	**2,180**	**2,206**	**2,197**	**2,206**	**2,124**	**2,114**	**2,123**	**2,123**	**2,114**	**1,833**	**1,833**	**1,825**	**1,833**	**1,833**
10	**PEAK POSITION**	**295**	**344**	**374**	**299**	**266**	**394**	**360**	**360**	**325**	**307**	**199**	**162**	**135**	**96**	**46**	**-267**	**-304**	**-350**	**-381**	**-422**
	RESERVE PLANNING																				
11	Required Operating Reserves	-162	-164	-163	-162	-165	-158	-160	-163	-164	-167	-173	-176	-179	-182	-186	-170	-171	-171	-172	-173
12	Available Operating Reserves	23	42	42	8	8	8	8	34	34	34	34	34	34	34	34	34	34	34	34	34
13	Planning Margin	-233	-236	-239	-240	-245	-250	-254	-258	-261	-265	-269	-272	-277	-283	-289	-293	-298	-304	-309	-315
14	**Total Reserve Planning**	**-372**	**-358**	**-360**	**-394**	**-402**	**-399**	**-406**	**-387**	**-391**	**-398**	**-408**	**-414**	**-422**	**-431**	**-441**	**-429**	**-435**	**-441**	**-447**	**-454**
15	**Peak Position**	**-76**	**-14**	**14**	**-95**	**-136**	**-5**	**-46**	**-26**	**-67**	**-91**	**-209**	**-253**	**-288**	**-335**	**-395**	**-697**	**-739**	**-790**	**-828**	**-876**
16	**Planning Margin**	**16%**	**18%**	**20%**	**16%**	**14%**	**22%**	**20%**	**20%**	**17%**	**16%**	**10%**	**8%**	**7%**	**5%**	**2%**	**-13%**	**-14%**	**-16%**	**-17%**	**-19%**
17	**Avista Share of Excess NW Capacity**	737	656	565	477	400	326	255	186	115	56	0	0	0	0	0	0	0	0	0	0
18	**Peak Position Net Market**	**661**	**642**	**579**	**382**	**264**	**321**	**209**	**159**	**48**	**(35)**	**(209)**	**(253)**	**(288)**	**(335)**	**(395)**	**(697)**	**(739)**	**(790)**	**(828)**	**(876)**

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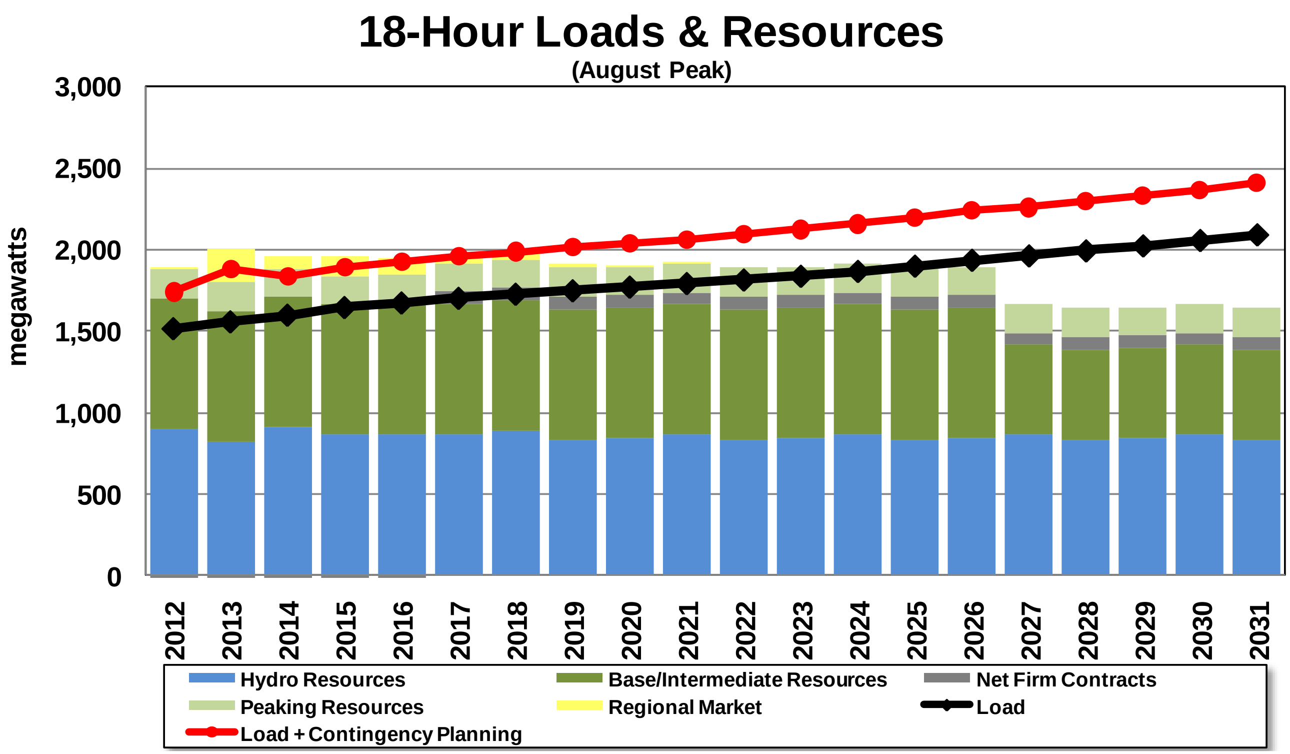
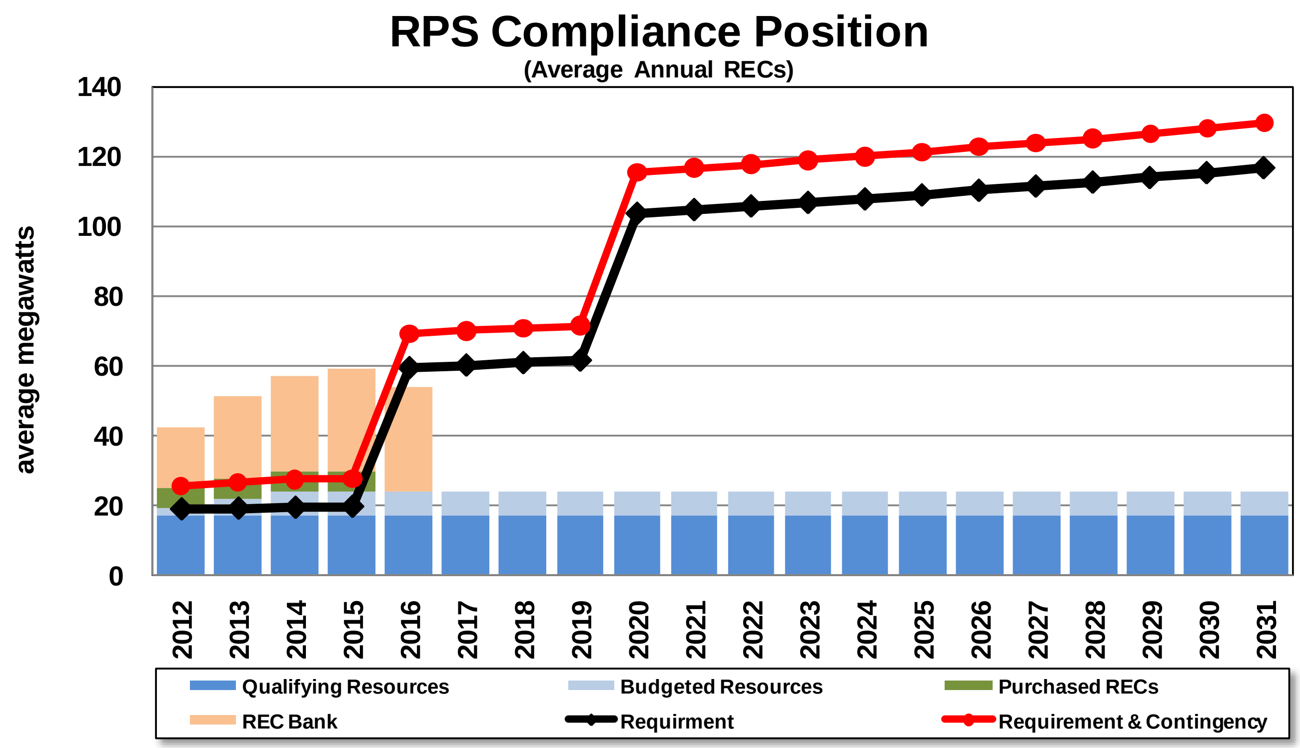
Avista Summer Capacity Positions



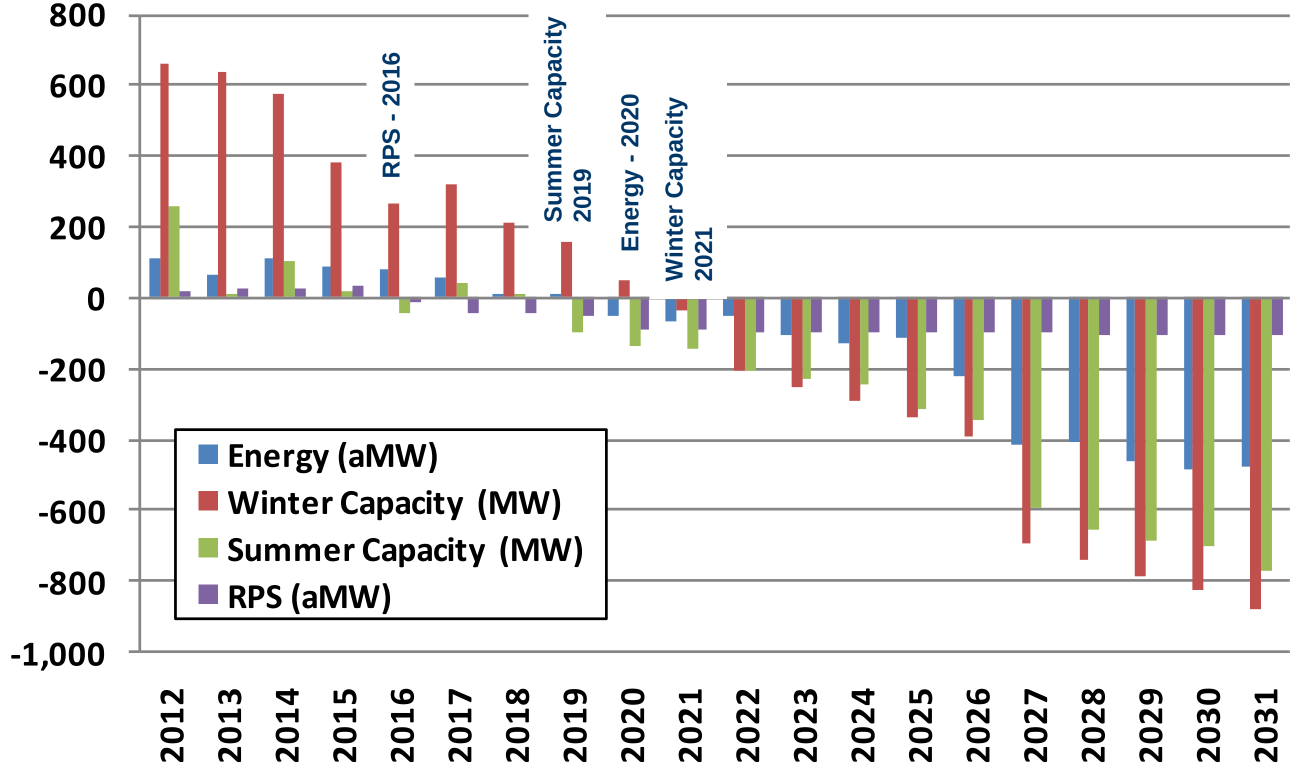
Avista Summer Capacity Positions

		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
	REQUIREMENTS																				
1	Native Load	-1,514	-1,556	-1,597	-1,644	-1,673	-1,701	-1,727	-1,748	-1,771	-1,793	-1,815	-1,838	-1,868	-1,900	-1,937	-1,964	-1,995	-2,026	-2,059	-2,094
2	Contracts Obligations	-239	-214	-208	-158	-158	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
3	**Total Requirements**	**-1,753**	**-1,770**	**-1,805**	**-1,802**	**-1,831**	**-1,709**	**-1,735**	**-1,756**	**-1,778**	**-1,800**	**-1,822**	**-1,846**	**-1,876**	**-1,908**	**-1,944**	**-1,972**	**-2,002**	**-2,033**	**-2,067**	**-2,102**
	RESOURCES																				
4	Contracts Rights	86	86	86	86	86	86	86	82	82	82	82	82	82	82	82	82	82	82	82	82
5	Hydro Resources	904	823	907	864	871	866	887	837	845	864	837	845	864	837	845	864	837	845	864	837
6	Base Load Thermals	799	799	799	799	799	799	799	799	799	799	799	799	799	799	799	551	551	551	551	551
7	Wind Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Peaking Units	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176
9	**Total Resources**	**1,964**	**1,884**	**1,968**	**1,925**	**1,932**	**1,927**	**1,948**	**1,895**	**1,903**	**1,922**	**1,895**	**1,902**	**1,921**	**1,894**	**1,902**	**1,673**	**1,646**	**1,653**	**1,673**	**1,646**
10	**PEAK POSITION**	**212**	**114**	**163**	**123**	**101**	**218**	**213**	**139**	**124**	**121**	**72**	**56**	**46**	**-14**	**-42**	**-299**	**-357**	**-380**	**-394**	**-456**
	RESERVE PLANNING																				
11	Required Operating Reserves	-153	-156	-159	-160	-162	-155	-157	-160	-161	-163	-165	-167	-169	-172	-173	-157	-156	-157	-159	-158
12	Available Operating Reserves	155	66	171	159	159	159	161	158	158	161	158	158	161	158	158	161	158	158	161	158
13	Planning Margin	-227	-233	-240	-247	-251	-255	-259	-262	-266	-269	-272	-276	-280	-285	-290	-295	-299	-304	-309	-314
14	**Total Reserve Planning**	**-227**	**-324**	**-240**	**-248**	**-255**	**-255**	**-259**	**-264**	**-269**	**-271**	**-279**	**-285**	**-289**	**-298**	**-305**	**-295**	**-299**	**-304**	**-309**	**-314**
15	**Peak Position**	**-16**	**-211**	**-77**	**-125**	**-154**	**-38**	**-46**	**-125**	**-144**	**-150**	**-207**	**-228**	**-244**	**-312**	**-348**	**-593**	**-656**	**-684**	**-703**	**-770**
16	**Planning Margin**	**12%**	**6%**	**9%**	**7%**	**6%**	**13%**	**12%**	**8%**	**7%**	**7%**	**4%**	**3%**	**2%**	**-1%**	**-2%**	**-15%**	**-18%**	**-19%**	**-19%**	**-22%**
17	**Avista Share of Excess NW Capacity**	275	221	178	141	107	78	52	31	10	3	0	0	0	0	0	0	0	0	0	0
18	**Peak Position Net Market**	**259**	**10**	**102**	**16**	**(47)**	**40**	**6**	**(94)**	**(134)**	**(147)**	**(207)**	**(228)**	**(244)**	**(312)**	**(348)**	**(593)**	**(656)**	**(684)**	**(703)**	**(770)**

Avista I-937 (Renewable Energy) Position



Deficits Summary



Avista 2011 IRP Positions Summary

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Energy (aMW)	113	69	109	88	82	54	12	11	(51)	(69)
Winter Capacity (MW)	661	642	579	382	264	321	209	159	48	(35)
Summer Capacity (MW)	259	10	102	16	(47)	40	6	(94)	(134)	(147)
RPS (aMW)	17	25	30	32	(16)	(46)	(47)	(47)	(92)	(93)

Impact of Resource Positions

- Positions Determine Future Resource Needs
  - Targets are 2016 RECs and 2019 summer capacity
- PRiSM Model Selects Resources Necessary to Fill Gaps That Meet Various Criteria
- Each New Resource Option Has Unique Capacity and Energy Characteristics
  - e.g., wind “consumes” 10% of nameplate
  - Gas-fired plants generate monthly based on ambient temperatures during peak weather events
- High and Low Cases Indicate Impacts of Varying Load Conditions

Portfolio and Market Scenario Planning

John Lyons

Technical Advisory Committee Meeting #4

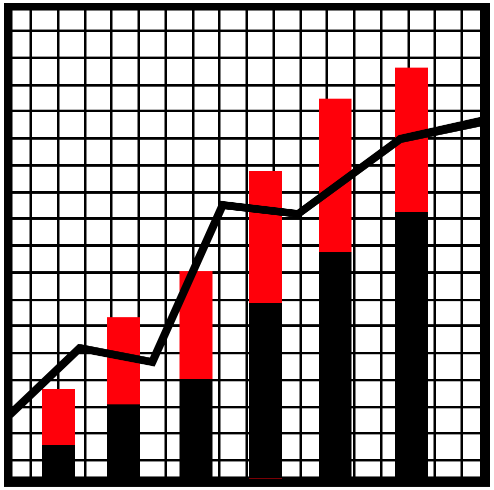
2011 Electric Integrated Resource Plan

February 3, 2011

Use of Scenarios in the IRP

Scenarios provide details about the impacts of different planning assumptions

- Avista's current load and resource portfolio
- Preferred Resource Strategy
- Wholesale electric market
- Different resource options



Scenario Types for the 2011 IRP

1. Deterministic Market Scenarios
2. Stochastic Market Scenarios
3. Portfolio Scenarios

2011 IRP Deterministic Market Scenarios

Deterministic scenarios test the Preferred Resource Strategy (PRS) across several different futures

- Low and High Gas Scenarios
- High Wind Penetration Scenarios
- Carbon Scenarios
- Western Coal Plant Phase Out Scenario

2011 IRP Stochastic Market Scenarios

- Expected Case – assumes average hydro, load, gas prices, wind, emissions prices and forced outages
- Volatile Fuel Scenario – test higher gas price volatility
- Unconstrained Carbon Scenario – determines the cost of different greenhouse gas emissions programs
- Mandatory Coal Retirement Scenario – Western coal plants automatically retired after 40 years of service

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Portfolio Scenarios

- Market Reliance Only
- Capacity Only
- All CCCT and Wind
- All SCCT and Wind
- CO_2 Credit Allocations
- Nuclear Availability (2025)
- 2009 PRS
- National Renewable Energy Standard
- CT& CCCT Tipping Point
- Wind & Solar Tipping Point
- Nuclear Tipping Point Analysis
- Carbon Sequestration
- Colstrip Scenarios:
  - Different O&M charges;
  - Early Retirement;
  - Incremental Pollution Control, (sequestration); and
  - Railed coal
- Others?

Avista's 2011 Electric Integrated Resource Plan

Technical Advisory Committee Meeting No. 5 Agenda

Avista Headquarters – Spokane, Washington

Tuesday, April 12, 2011
Avista Conference Room 130

	Topic	Time	Staff
1.	Introduction	9:30	Storro
2.	Conservation Avoided Cost Methodology	9:35	Gall
3.	Conservation	9:45	Hermanson/ Global Energy Partners
4.	Draft Preferred Resource Strategy Portfolio Alternatives & Scenarios	11:15	Gall
5.	Lunch	12:15	
6.	Draft Preferred Resource Strategy Portfolio Alternatives & Scenarios	1:00	Gall
7.	Smart Grid	2:30	Kirkeby
8.	Adjourn	3:30	

Conservation Avoided Costs

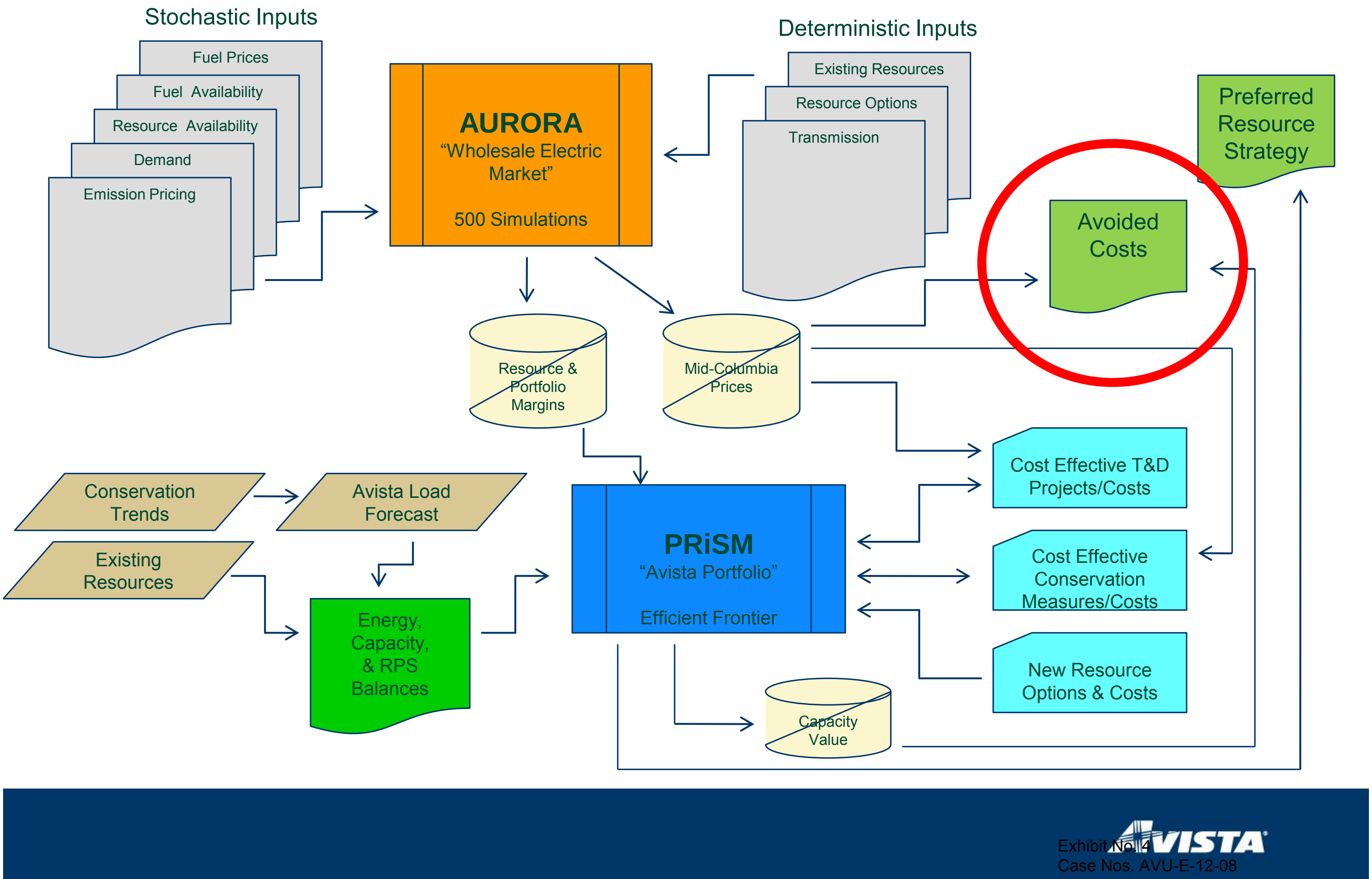
James Gall

Technical Advisory Committee Meeting #5

2011 Electric Integrated Resource Plan

April 12, 2011

2011 Integrated Resource Plan Modeling Process



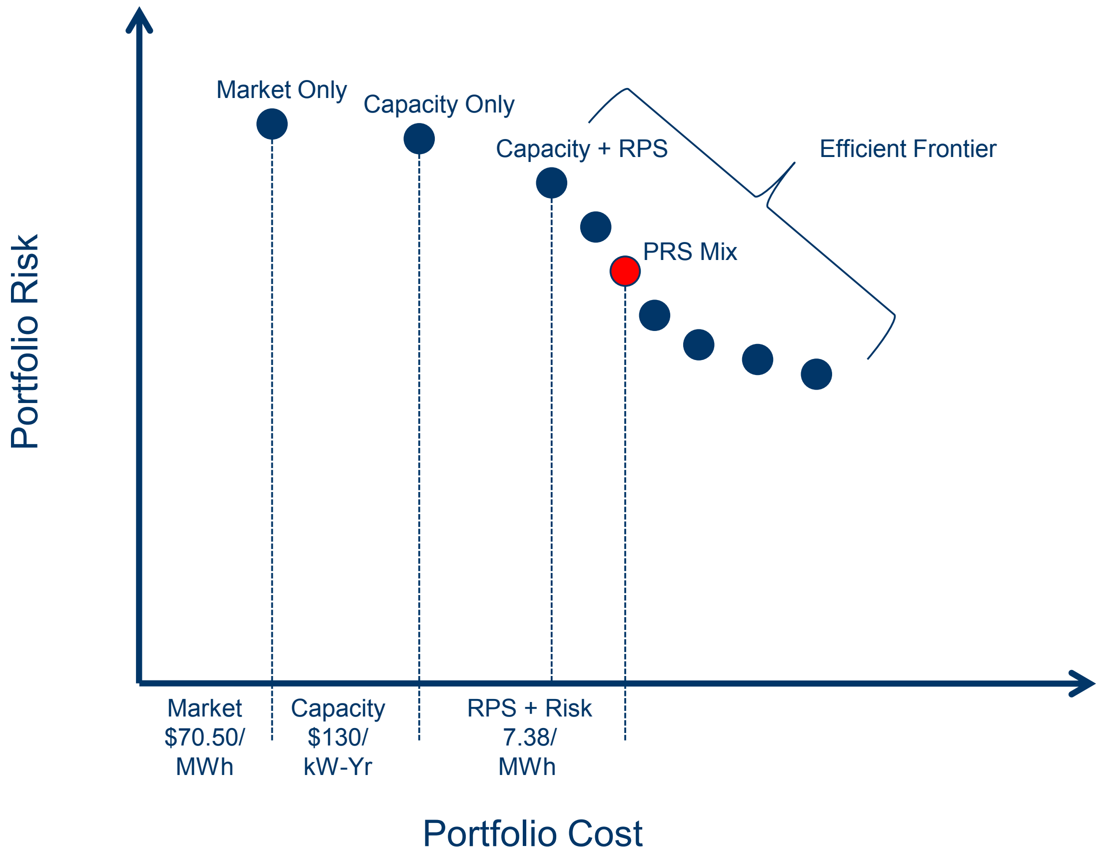
How to Value Conservation

$$\{(E + PC + R) * (1 + P)\} * (1 + L) + DC * (1 + L)$$

Where:
E = market energy price (calculated by Aurora, including forecasted CO2 mitigation)
PC = new resource capacity savings (calculated by PRISM)
R = Risk premium to account for RPS and rate volatility reduction (calculated by PRISM)
P = Power Act preference premium (10% assumption)
DC = distribution capacity savings (~$10/kW-year based on Heritage Project calculation)
L = transmission and distribution losses (6.1% assumption based on Avista's system average losses)

Efficient Frontier Approach

Assumes no additional Conservation Resources



Avoided Cost Calculation

For 1 MW Measure With Flat Delivery

Item	$/MWh
Energy Price	70.50
Capacity Savings	10.51
Risk Premium	7.38
Subtotal	**88.39**

Item	$/MWh
10% Preference	8.84
Distribution Capacity Savings	1.14
T&D losses	6.02
Subtotal	**16.00**

Avoided Cost:
$104.39
per
MWh

Avista Conservation Potential Assessment Electricity

Prepared for
Avista Utilities Technical Advisory Committee
by
Global Energy Partners
April 12, 2011

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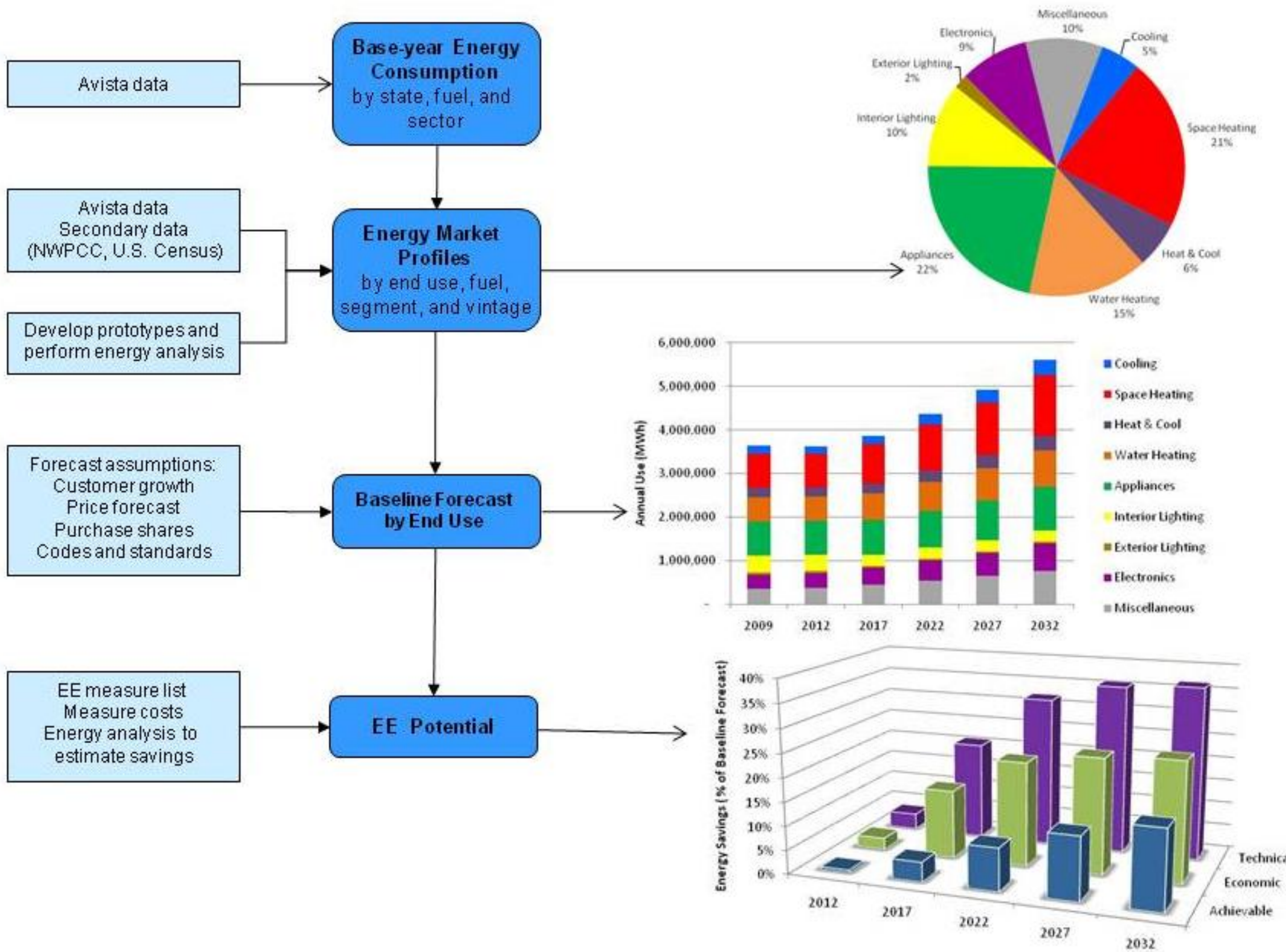
Topics

- Background and objectives
- Study approach
- Energy efficiency analysis results (electricity)
- Demand response analysis

Background and general objectives

- Assess and analyze 20-year cost-effective energy efficiency (EE) potentials
  - Support Avista IRP development
  - Meet Washington I-937 Conservation Potential Assessment requirements
- EE Potential assessment considers
  - Impacts of existing programs
  - Naturally occurring energy savings
  - Impacts of codes and standards
  - Technology developments and innovation
  - The economy and energy prices
- Assess and analyze DR potentials

Overview of EE analysis approach



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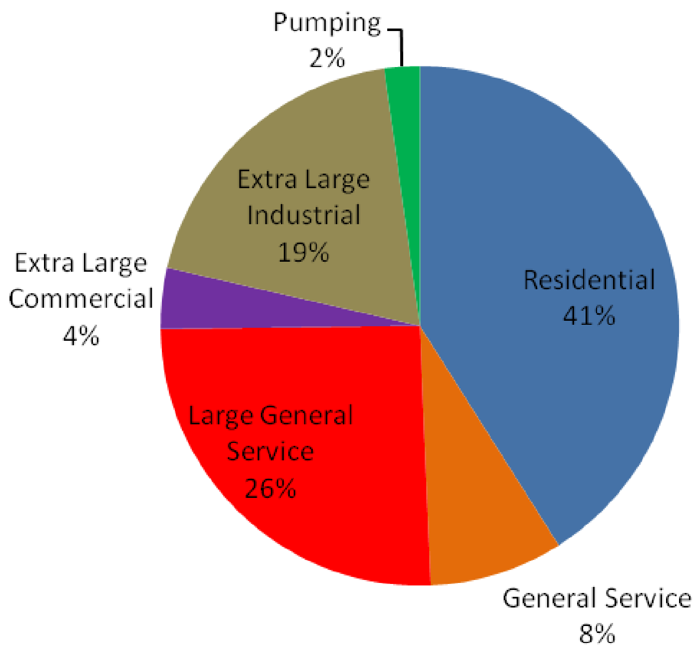
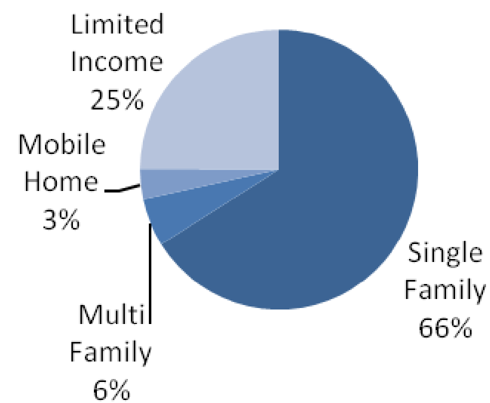
Base-year Energy Consumption

- Base year is 2009
  - Most recent year with complete sales and customer data when study began
  - 2009 also base year for Avista load research study
- Market segmentation, based on rate classes
  - Residential (rate class 001), segmented by housing type and income
    - Single Family
    - Multi Family
    - Mobile Home
    - Limited Income
  - Commercial and Industrial
    - General Service (rate classes 011, 012)
    - Large General Service (rate classes 021, 022)
    - Extra Large Commercial GS (rate class 025C)
    - Extra Large Industrial GS (rate class 025C)
  - Pumping (rate classes 031, 032)

Base-year Energy Consumption 2009 % of sales, Washington and Idaho





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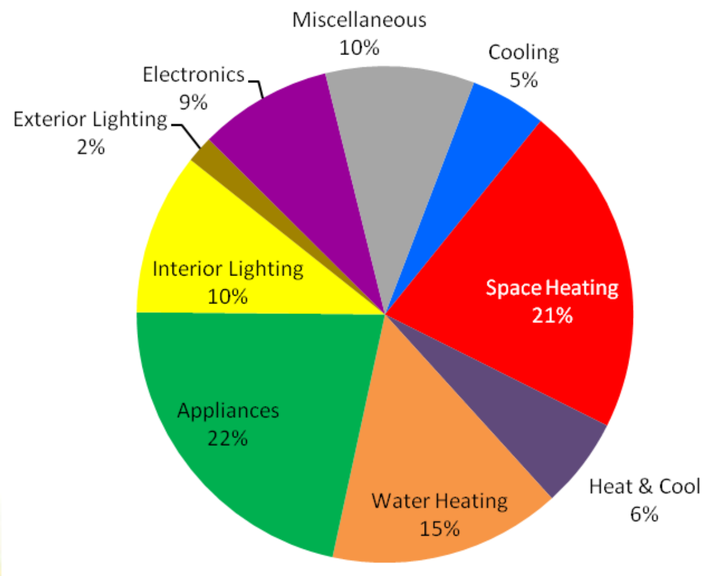
Energy Market Profiles

- Characterize energy use by sector, segment, end use, and technology
- Existing, replacement, and new construction
- Accounts for
  - Naturally occurring conservation
  - Codes and standards
  - Previous DSM results
  - Equipment saturation and fuel shares

Residential Energy Use by End Use, 2009



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Baseline Forecast

- Incorporates
  - Customer / market growth
  - Income growth
  - Avista retail rates forecast
  - Trends in end-use/technology saturations
  - Equipment purchase decisions
  - Elasticities for retail rates, income, persons per household
- Accounts for
  - Naturally occurring conservation
  - Codes and standards
  - Previous DSM

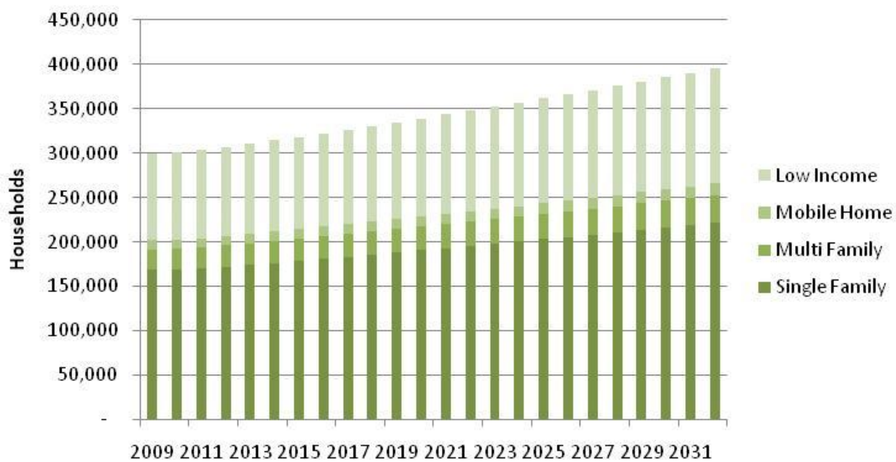

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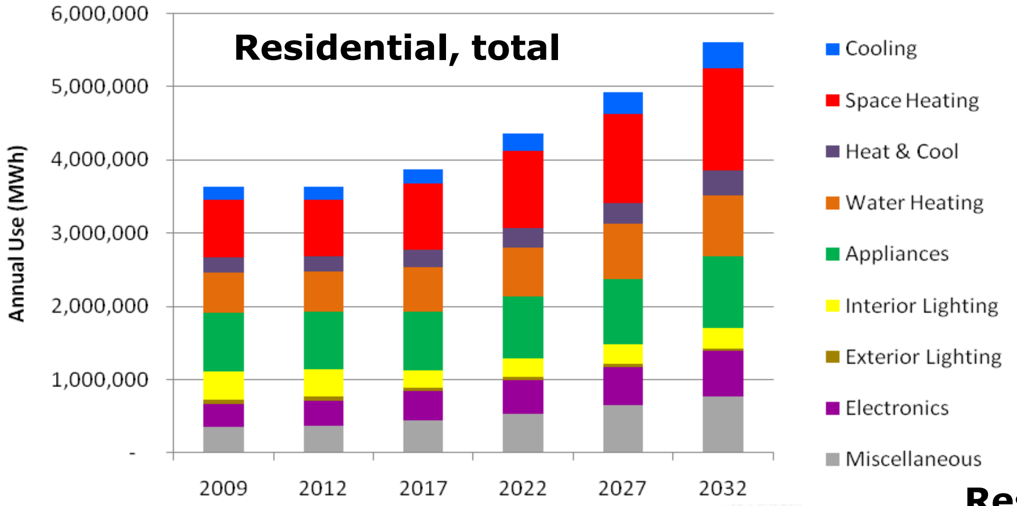
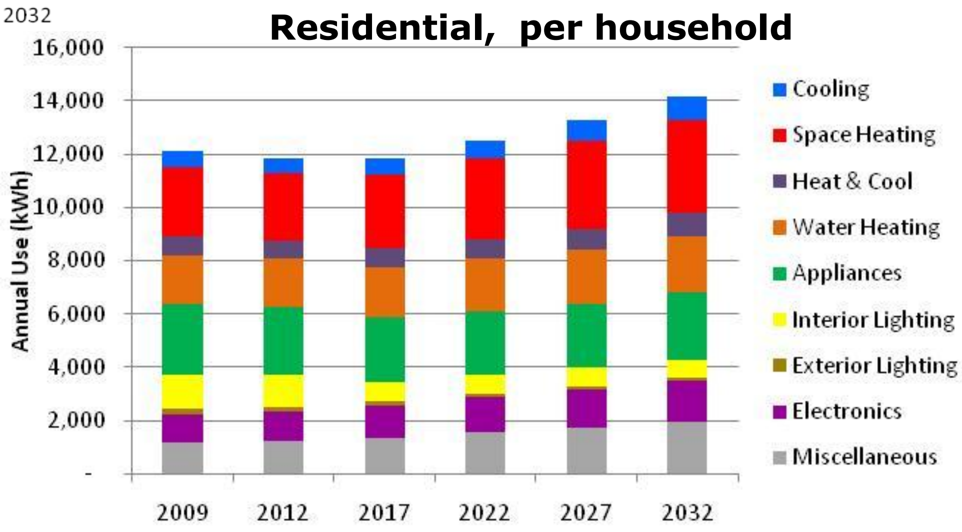
Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 577 of 1069

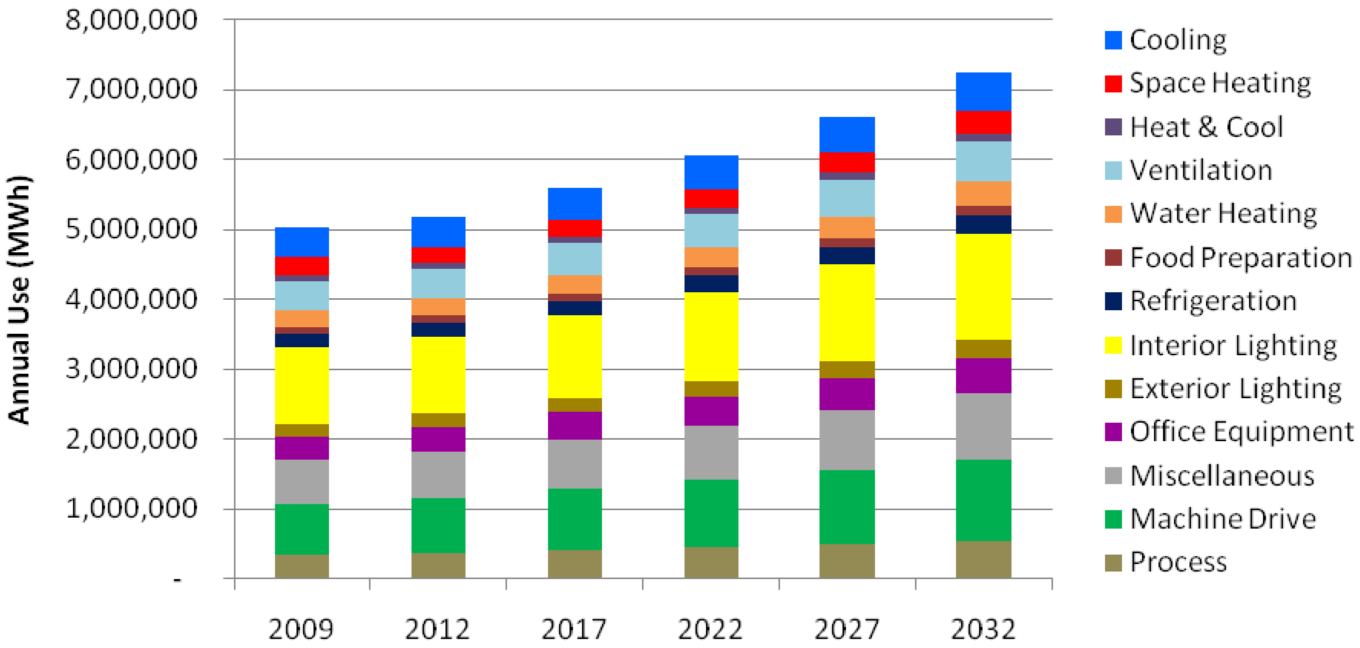
Baseline Forecast





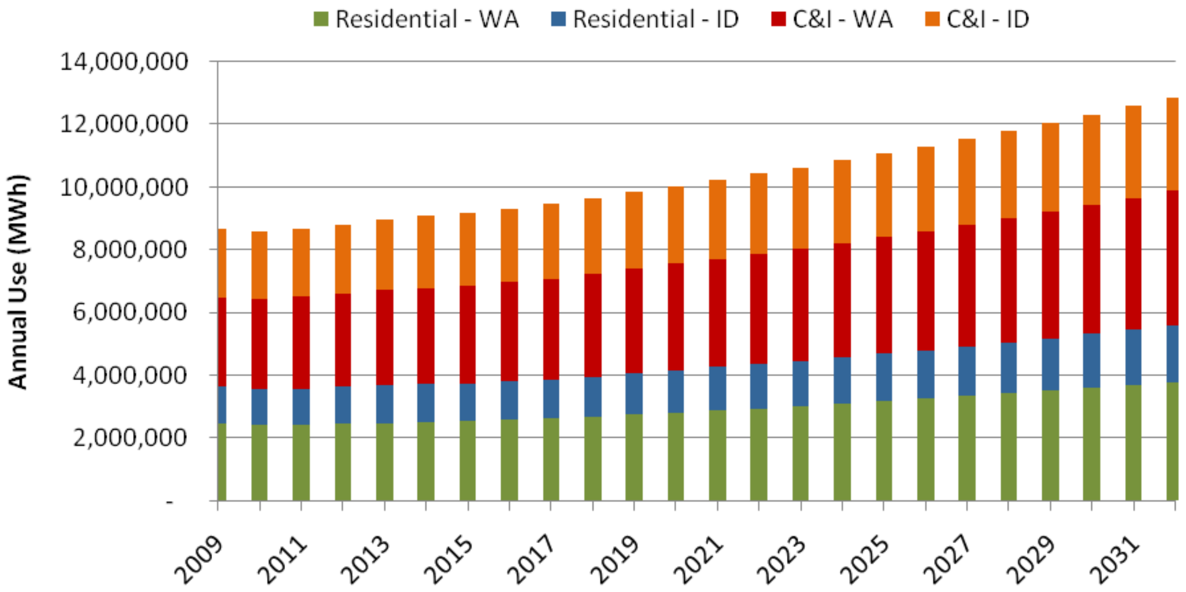
Baseline Forecast

Commercial & Industrial



Baseline Forecast

- Overall 48% growth in electricity use.
- Average annual growth rate of 1.7%
- Comparable with Avista 2009 IRP



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Schedule 1, Page 580 of 1069

Energy Efficiency Potential

- Energy Efficient Equipment and Measures
  - 2,808 equipment options and 1,524 other measures
  - Avista existing DSM programs
  - NEEA RTF
  - Sixth Power Plan database
  - Other utility programs
- Measure characterization
  - Life
  - Energy and demand savings
  - Cost
  - Year off market (Standards)
  - Saturation
  - Applicability / Feasibility

Efficiency Level	Useful Life	Equipment Cost	Energy Usage (kWh/yr)	On Market	Off Market
SEER 13	15	$3,794	$1,619	2009	2014
SEER 14 (ENERGY STAR)	15	$4,072	$1,485	2009	2032
SEER 15 (CEE Tier 2)	15	$4,350	$1,435	2009	2032
SEER 16 (CEE Tier 3)	15	$4,628	$1,393	2009	2032
Ductless Mini-split System	20	$8,193	$1,214	2009	2032

Consistency with Sixth Plan

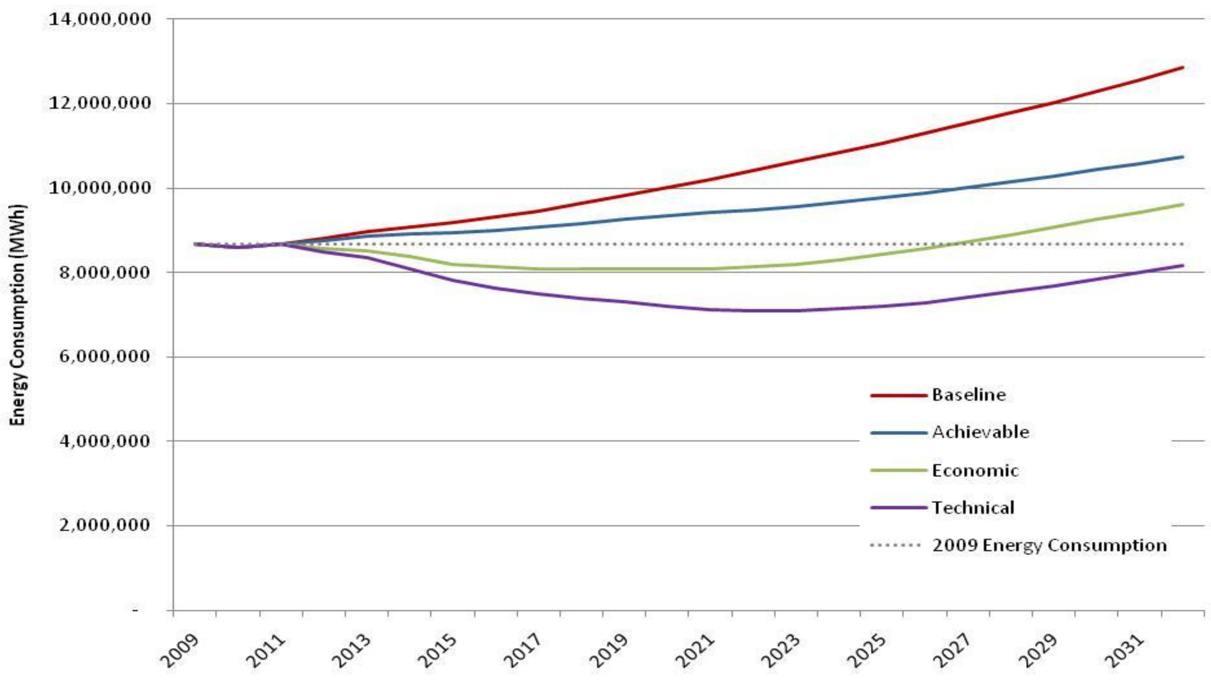
- End-use model — bottom-up approach to understanding savings
  - Measure life
  - Stock accounting
  - Measure saturation and applicability
- Accounts for
  - Naturally occurring conservation
  - Codes and standards
- Measures include those in Sixth Plan (other measures also)
- Considers both lost opportunity and non-lost opportunity
- Economic potential, based on Total Resource Cost (TRC) test
- Achievable potential considers realistic rate at which technologies can be deployed
- Maximum potential in 20 years is 85% of economic potential

Energy Efficiency Potential

- Savings could be acquired through a variety of means
  - Market transformation, including NEEA
  - Utility programs

Summary of EE results

- Baseline forecast — 48% growth (2032 vs. 2009)
- Achievable potential — 24% growth (2032 vs. 2009)
- Energy efficiency offsets 50% of growth



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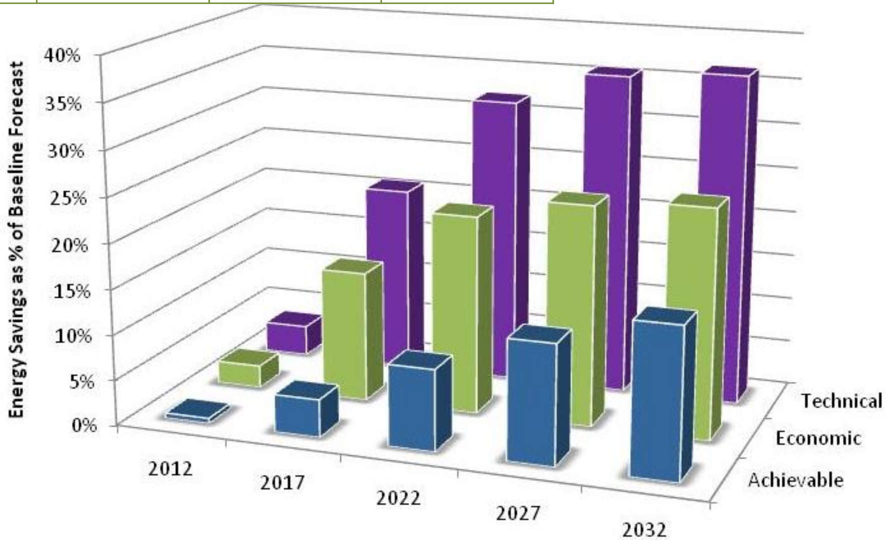
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 584 of 1069

Summary of EE results (continued)

Summary of Energy Savings from Energy Efficiency

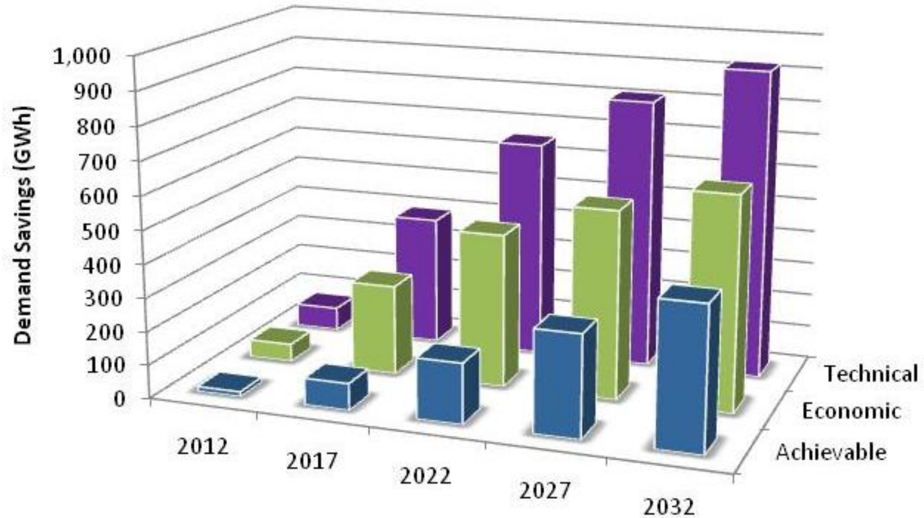
	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	8,799,079	9,464,078	10,417,644	11,537,369	12,852,394
Cumulative Energy Savings (MWh)					
Achievable	49,428	393,796	931,744	1,514,569	2,105,572
Economic	219,482	1,371,691	2,289,256	2,802,046	3,228,731
Technical	301,070	1,967,390	3,327,203	4,116,738	4,697,328
Cumulative Energy Savings (% of Baseline)					
Achievable	0.6%	4.2%	8.9%	13.1%	16.4%
Economic	2.5%	14.5%	22.0%	24.3%	25.1%
Technical	3.4%	20.8%	31.9%	35.7%	36.5%



Summary of EE results (continued)

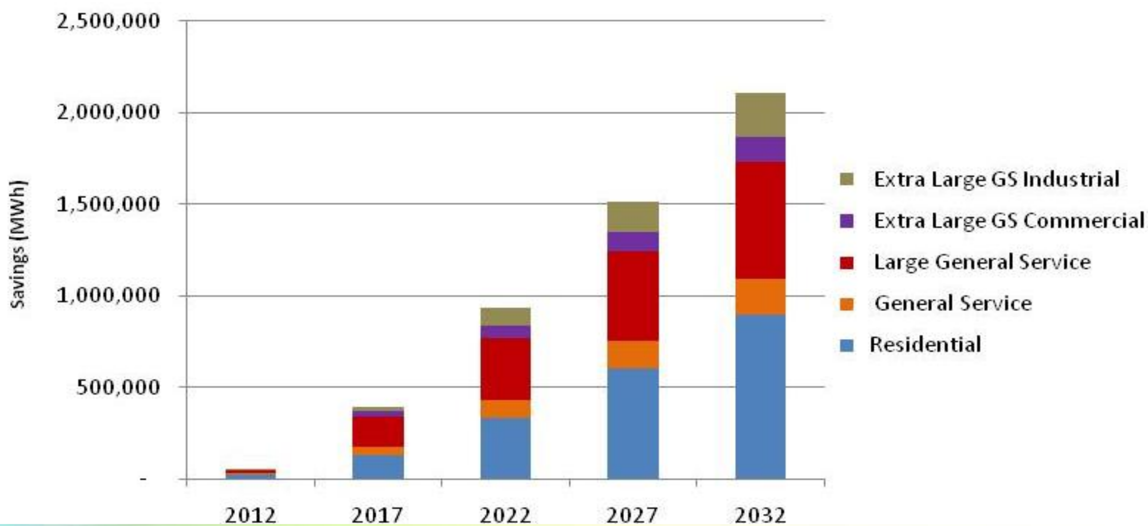
Summary of Peak Demand Savings from Energy Efficiency

	2012	2017	2022	2027	2032
Baseline Forecast (MW)	1,780	1,881	2,080	2,306	2,567
Peak Savings (MWh)					
Achievable	14	80	180	303	424
Economic	53	271	459	563	638
Technical	70	391	654	810	923
Peak Savings (% of Baseline)					
Achievable	0.8%	4.3%	8.7%	13.1%	16.5%
Economic	3.0%	14.4%	22.1%	24.4%	24.8%
Technical	3.9%	20.8%	31.5%	35.1%	35.9%



Savings by Sector

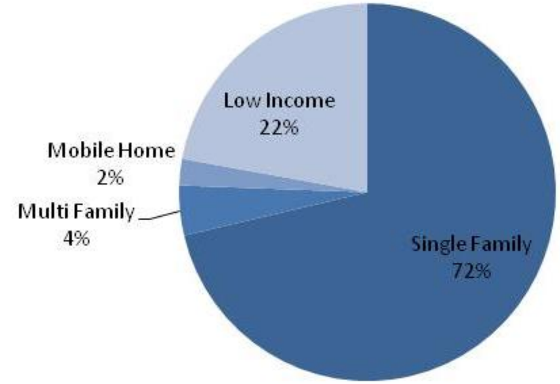
	2012	2017	2022	2027	2032
Cumulative Energy Savings (MWh)					
Residential	25,651	127,984	331,874	606,994	896,296
C&I Total	23,777	265,812	599,870	907,575	1,209,276
Cumulative Energy Savings (% of total)					
Residential	**52%**	**33%**	**36%**	**40%**	**43%**
General Service	9%	12%	10%	10%	9%
Large General Service	30%	42%	36%	32%	30%
Extra Large GS Commercial	7%	8%	8%	7%	7%
Extra Large GS Industrial	3%	5%	10%	11%	11%
C&I Total	**48%**	**67%**	**64%**	**60%**	**57%**



Residential EE Results

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	3,626,735	3,871,491	4,356,537	4,919,347	5,601,421
Cumulative Energy Savings (MWh)					
Achievable	25,651	127,984	331,874	606,994	896,296
Economic	89,611	516,797	955,211	1,193,716	1,373,565
Technical	135,783	857,178	1,468,391	1,831,465	2,114,488
Cumulative Energy Savings (% of Baseline)					
Achievable	0.7%	3.3%	7.6%	12.3%	16.0%
Economic	2.5%	13.3%	21.9%	24.3%	24.5%
Technical	3.7%	22.1%	33.7%	37.2%	37.7%

Savings by housing type, 2022



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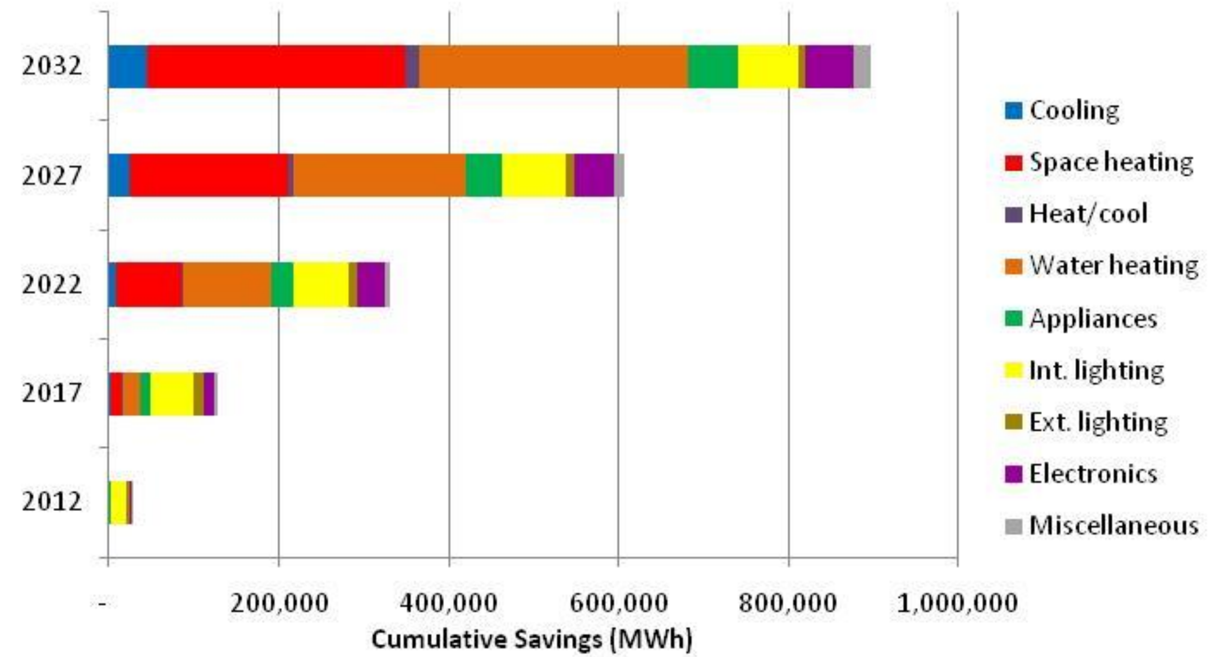
Residential EE Results

Cumulative Energy Savings by End Use (MWh), Selected Years



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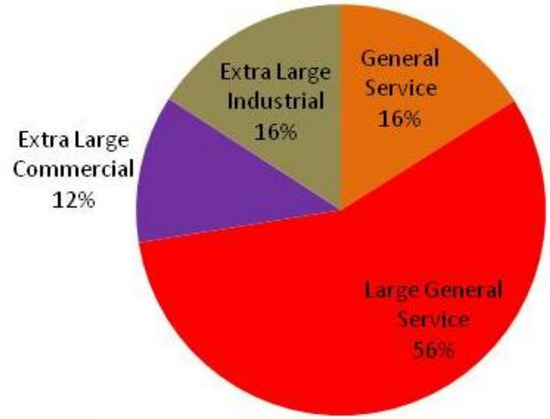
C&I EE Results

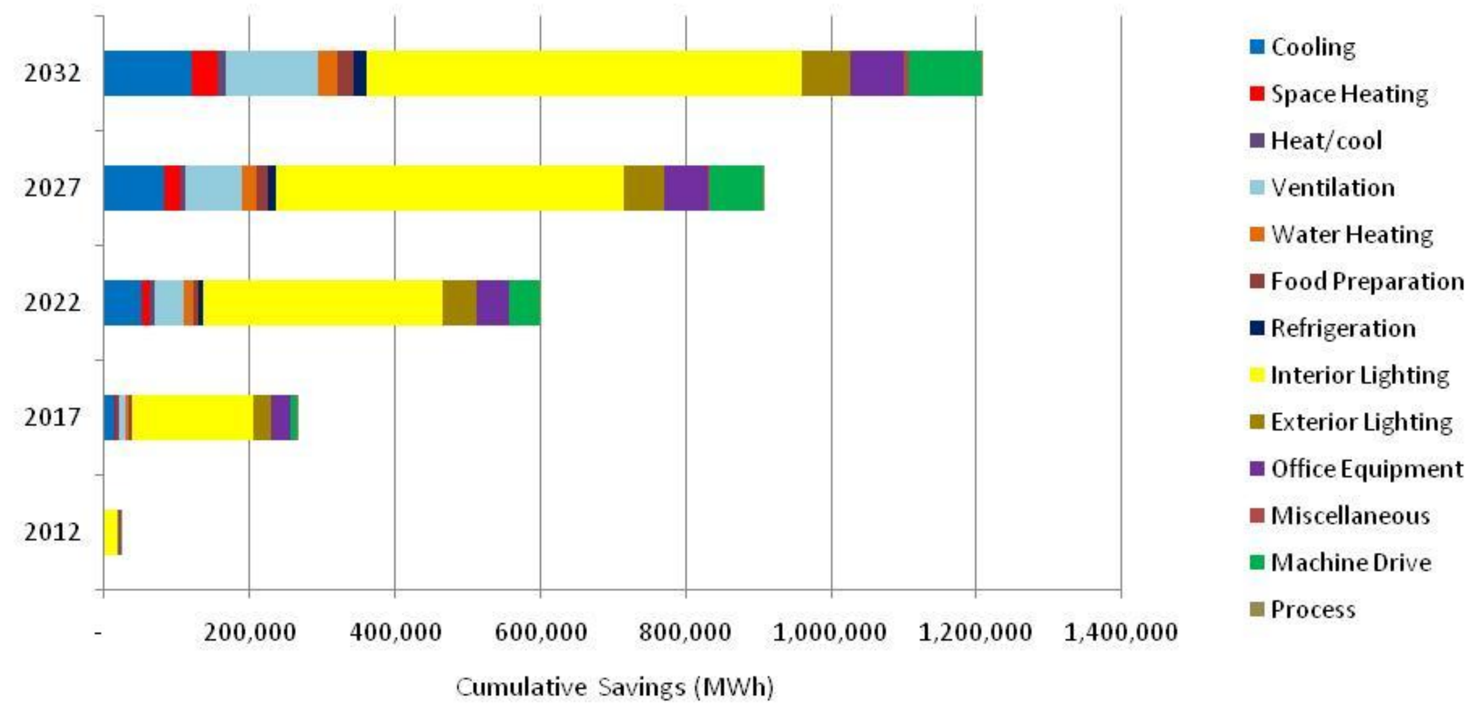
	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	5,172,344	5,592,586	6,061,107	6,618,022	7,250,973
Cumulative Energy Savings (MWh)					
Achievable	23,777	265,812	599,870	907,575	1,209,276
Economic	129,871	854,893	1,334,045	1,608,330	1,855,166
Technical	165,288	1,110,212	1,858,812	2,285,273	2,582,839
Cumulative Energy Savings (% of Baseline)					
Achievable	0.5%	4.8%	9.9%	13.7%	16.7%
Economic	2.5%	15.3%	22.0%	24.3%	25.6%
Technical	3.2%	19.9%	30.7%	34.5%	35.6%

Savings by rate class, 2022



C&I EE Results

Cumulative Energy Savings by End Use (MWh), Selected Years



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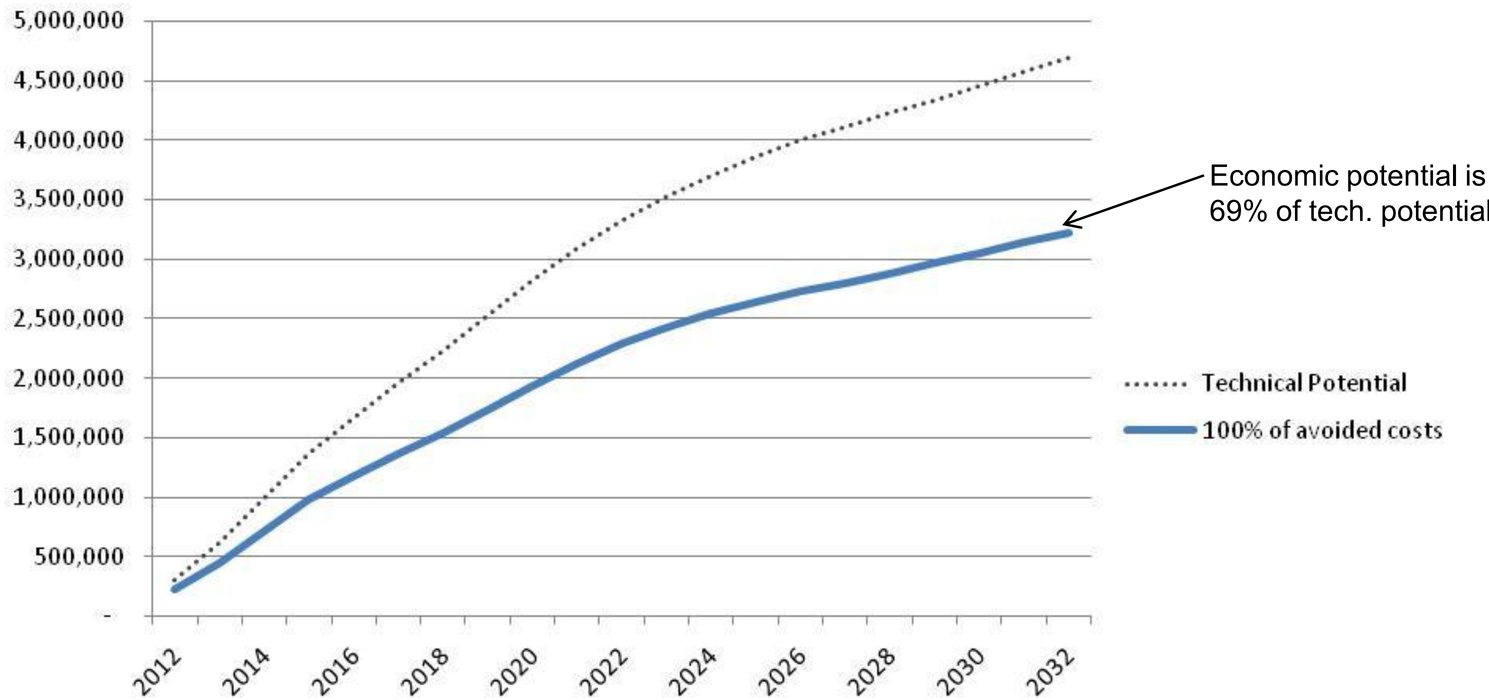
Schedule 1, Page 591 of 1069

Avoided Cost Scenarios

Economic Potential, Cumulative Savings (MWh)



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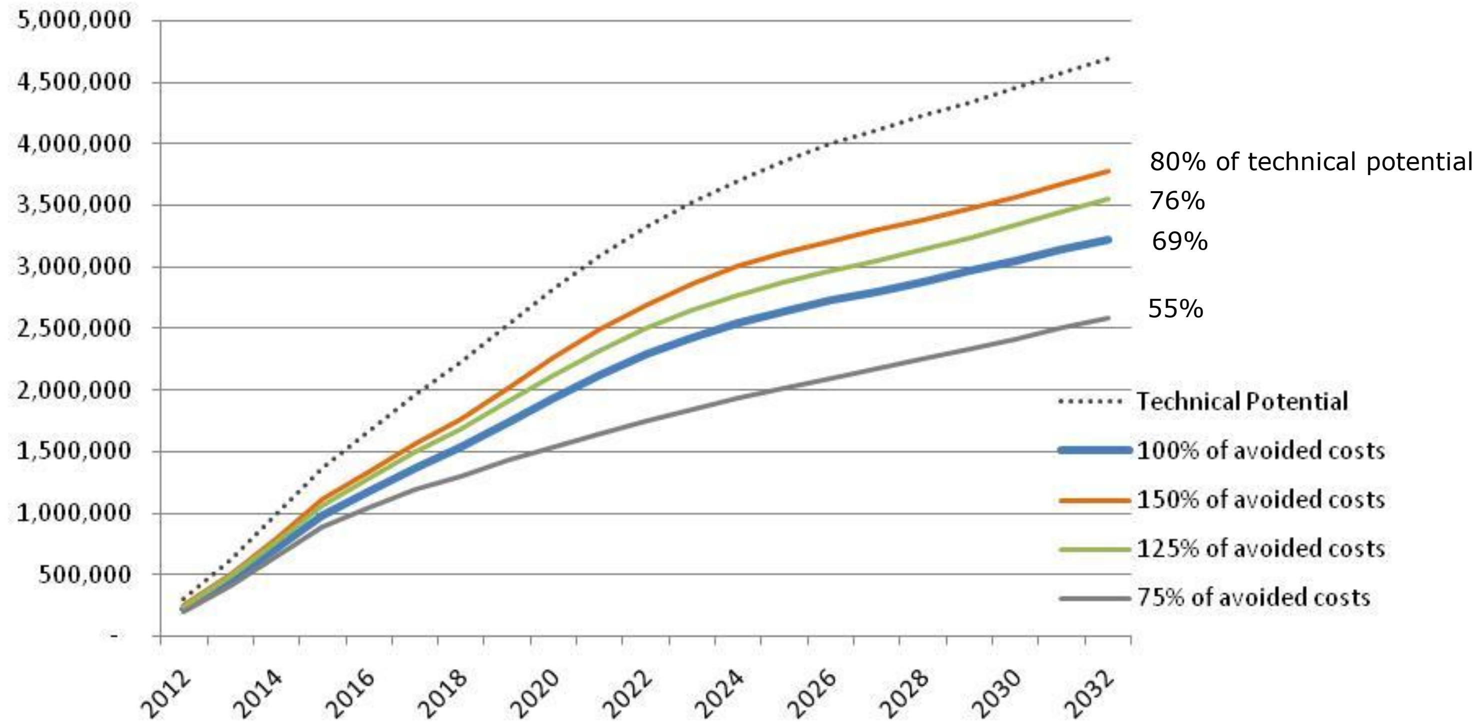
Avoided Cost Scenarios

Economic Potential Case, Cumulative Savings (MWh)



Demand Response Analysis

- Define the types of DR programs most suitable for Avista
- Determine DR potential

Demand Response Program	Residential	General Service	Large General Service	Extra Large General Service	Pumping
Direct Load Control					
Mass Market Direct Load Control	x	x			
Direct Load Control			x	x	x
Other Programs					
Demand Bidding / Buyback			x	x	
Curtailable/Interruptible			x	x	
Auto DR / Fast DR	x	x	x	x	

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Deliverables from CPA analysis

- Final report electricity
  - EE approach and results
  - DR approach and results
  - Appendices
- LoadMAP models
- Gas potential study

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Preferred Resource Strategy & Scenario Analysis

(Preliminary Draft)

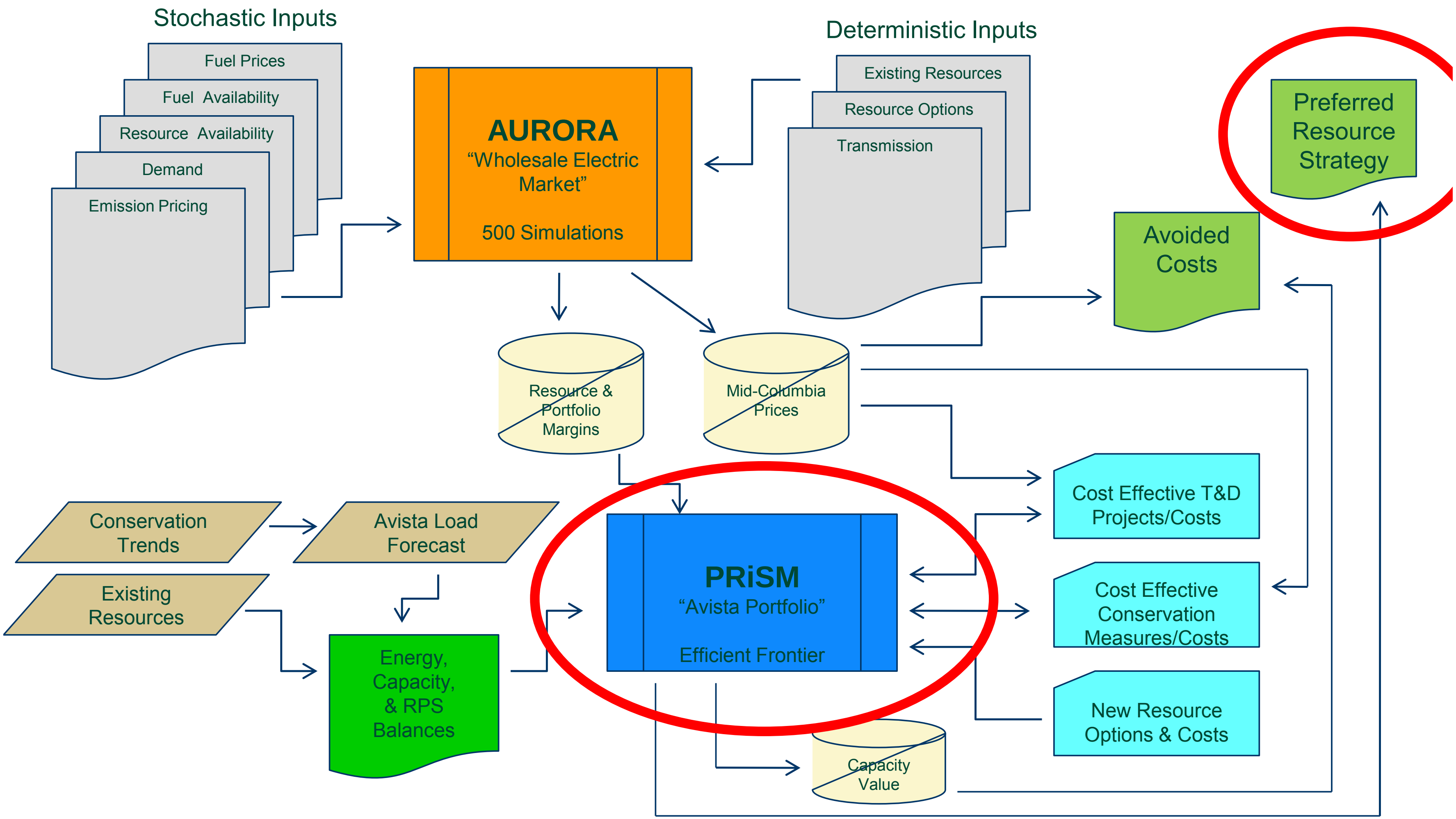
James Gall

Technical Advisory Committee Meeting #5

2011 Electric Integrated Resource Plan

April 12, 2011

2011 Integrated Resource Plan Modeling Process



PRiSM Objective Function

- Linear program solving for the optimal resource strategy to meet resource deficits over planning horizon.
- Model selects its resources to reduce cost, risk, or both.

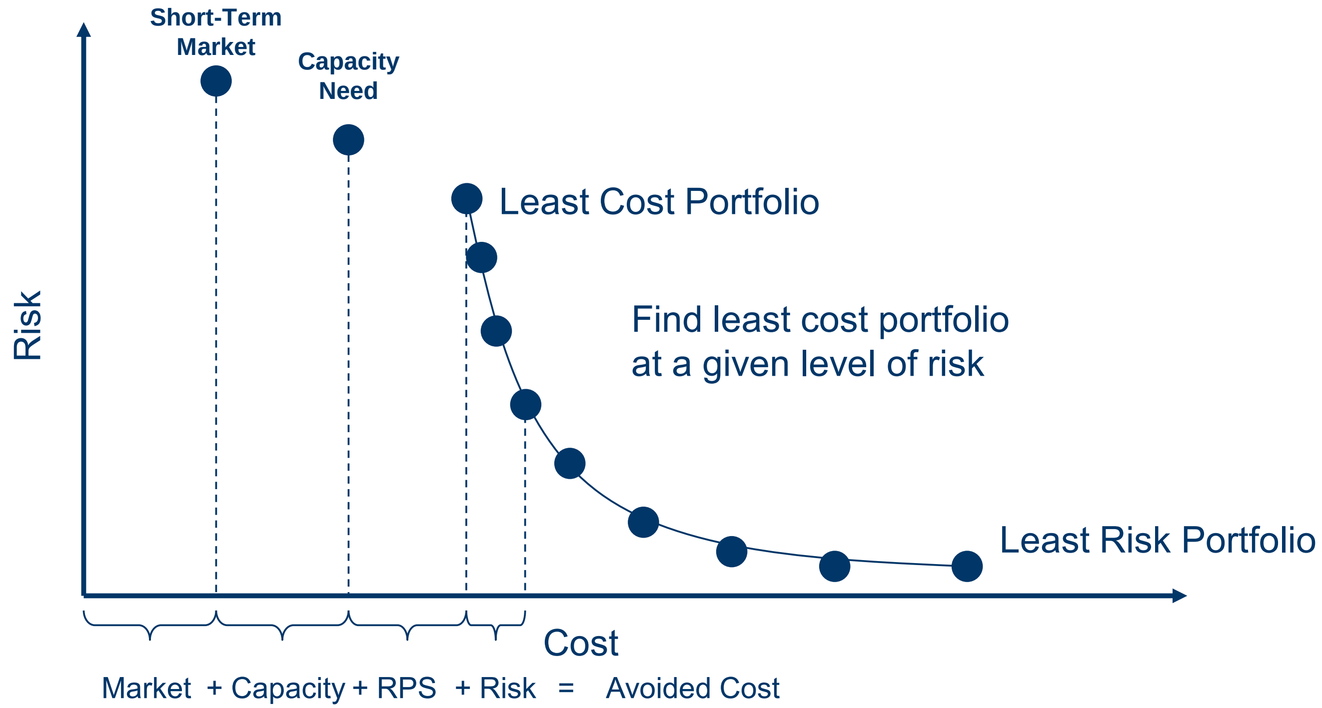
Minimize: Total Power Supply Cost on NPV basis (2012-2052 with emphasis on first 11 years of the plan)

Subject to:

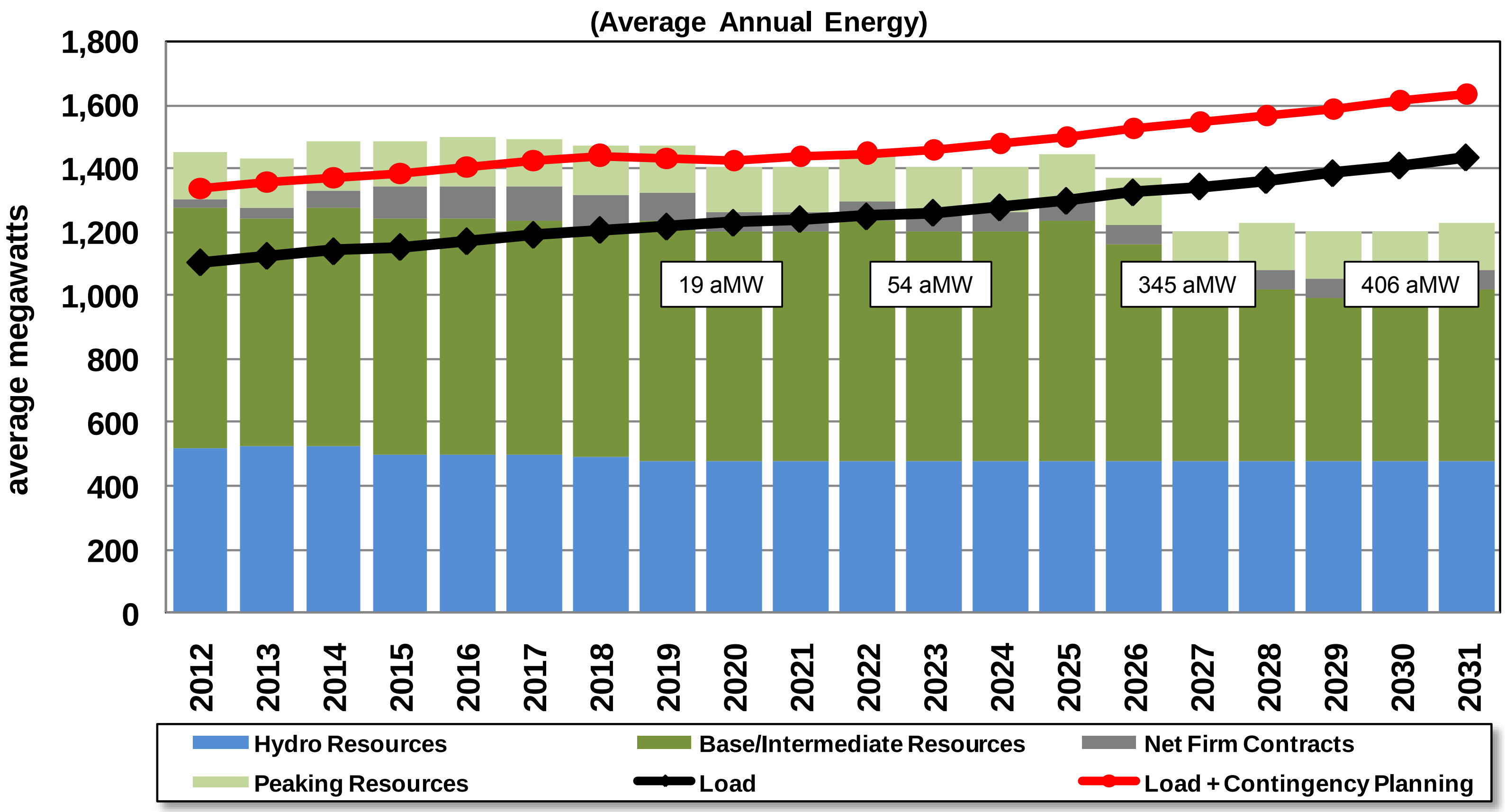
- Risk Level
- Capacity Need +/- deviation
- Energy Need +/- deviation
- Renewable Portfolio Standards
- Resource Limitations and Timing

Efficient Frontier

- Demonstrates the trade off of cost and risk
- Avoided Cost Calculation



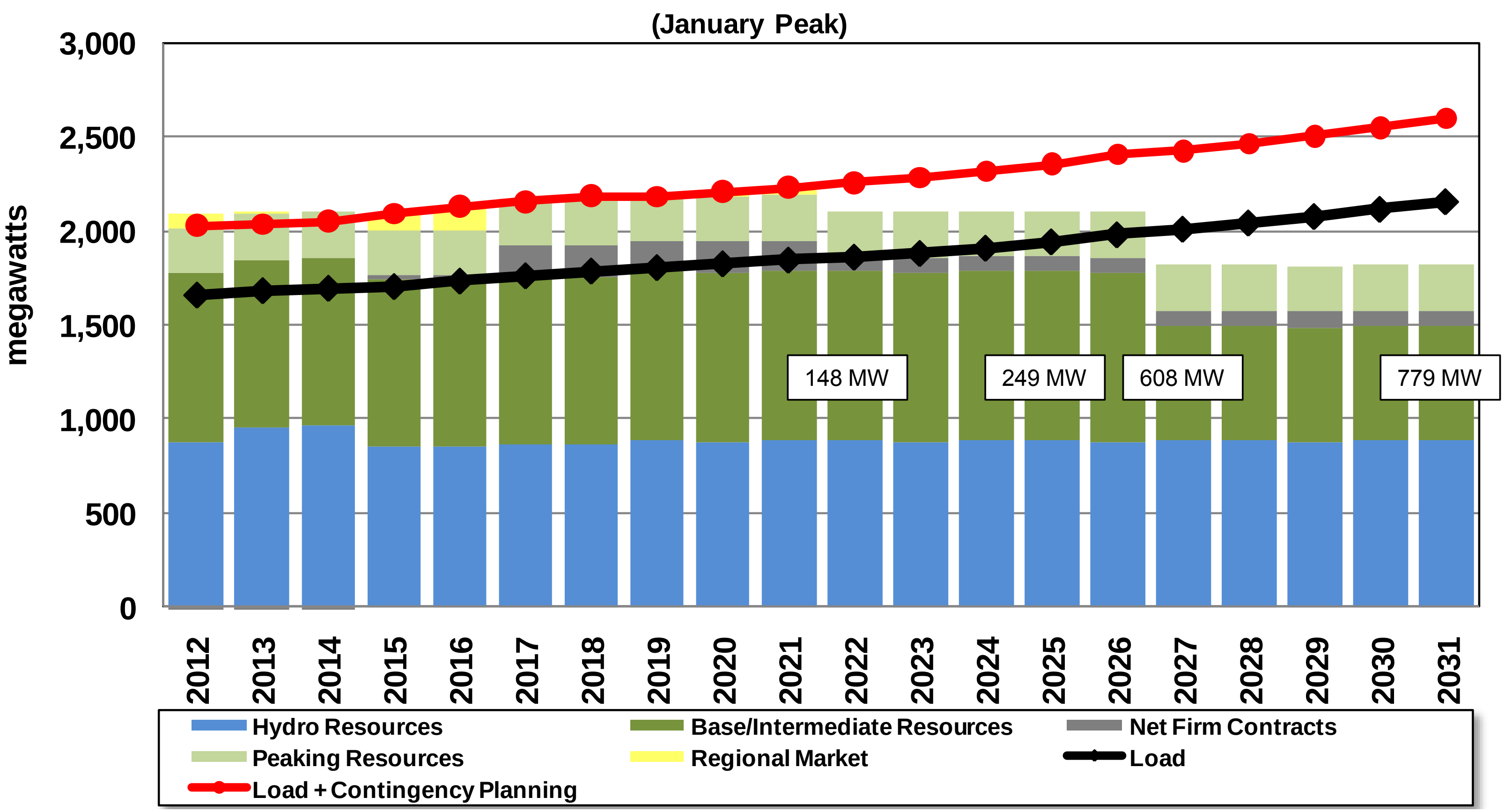
Energy Load & Resource Balance (Includes Conservation)



DRAFT

Winter 18 Hr Peak Load & Resource Balance

(Includes Conservation)



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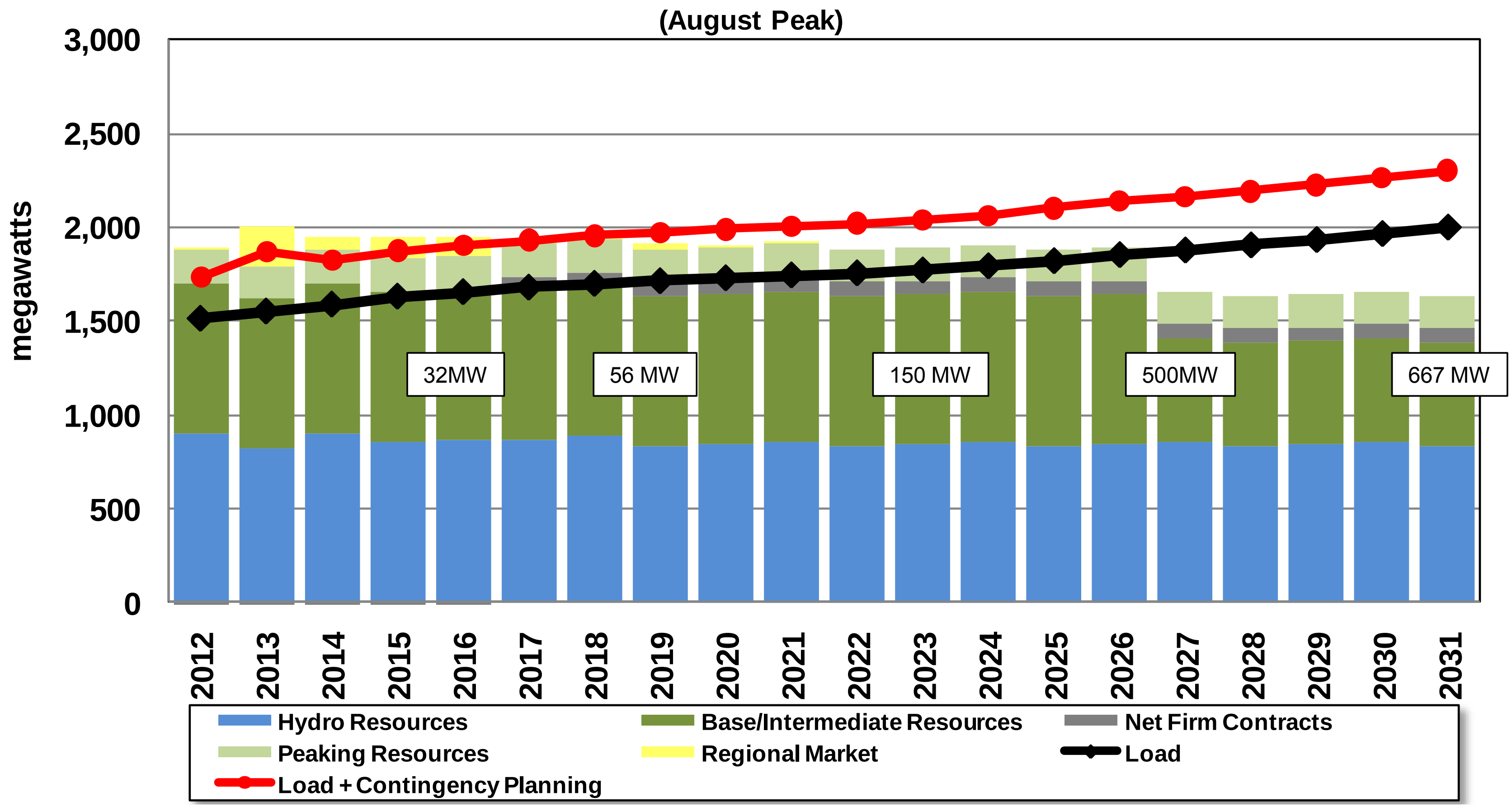
AVISTA

Summer 18 hr Peak Load & Resource Balance

(Includes Conservation)



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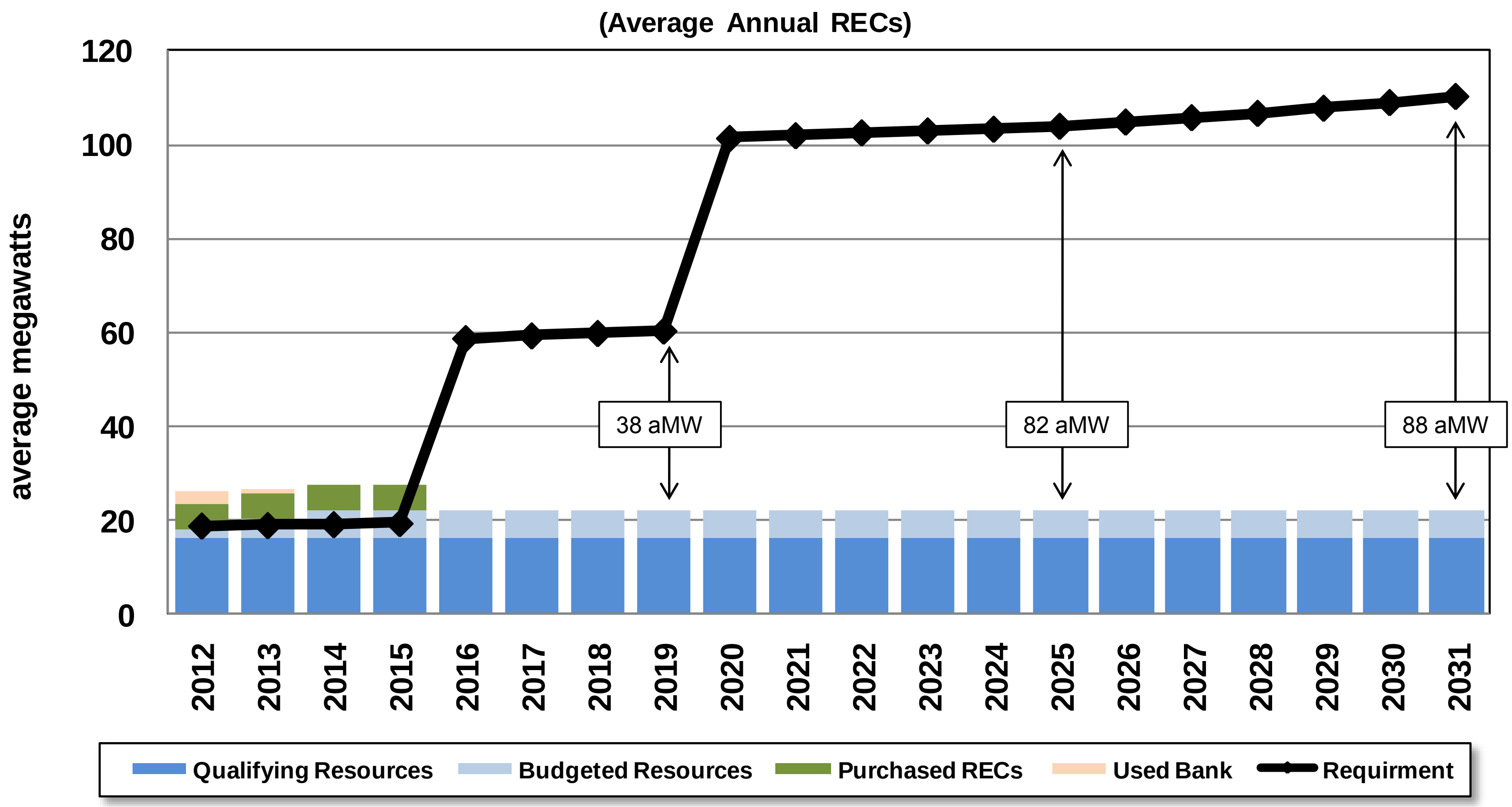
REC Contingency & Banking

- Reserve requirement- Must hold REC reserves in “REC Bank” each year.
  - Sales uncertainty (5%)
  - Hydro uncertainty (26%)
  - Wind uncertainty (30%)
  - Currently 8 aMW
- Roll over rights- RECs can be used for prior year or future year. Plan is to use 2011 REC for 2012, then excess 2012 RECs can be used for 2013.

WA State Renewable Portfolio Standard Compliance

(Does Not Include Contingency)



Actual Efficient Frontier Results

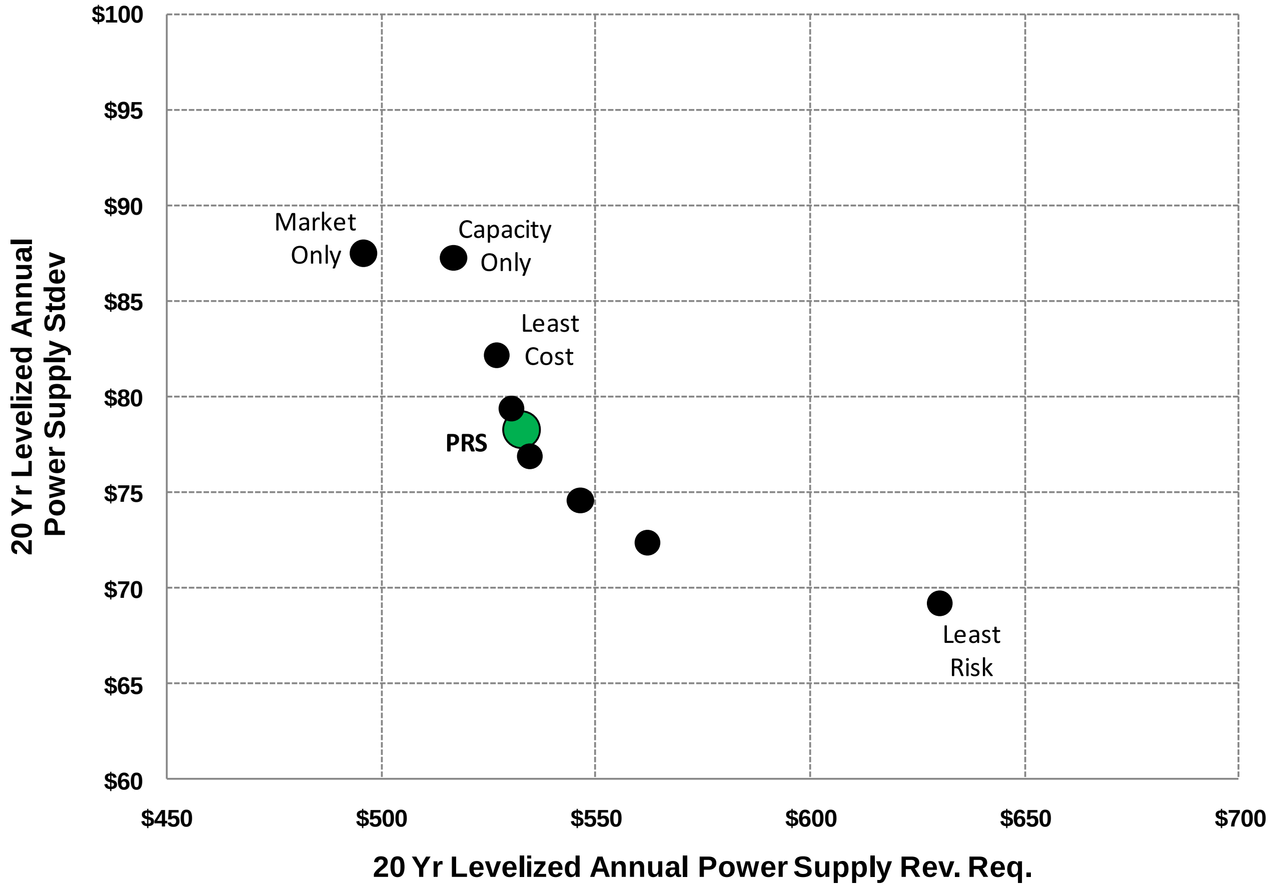


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Exhibit No. 4
Case Nos. AVU-E-12-08
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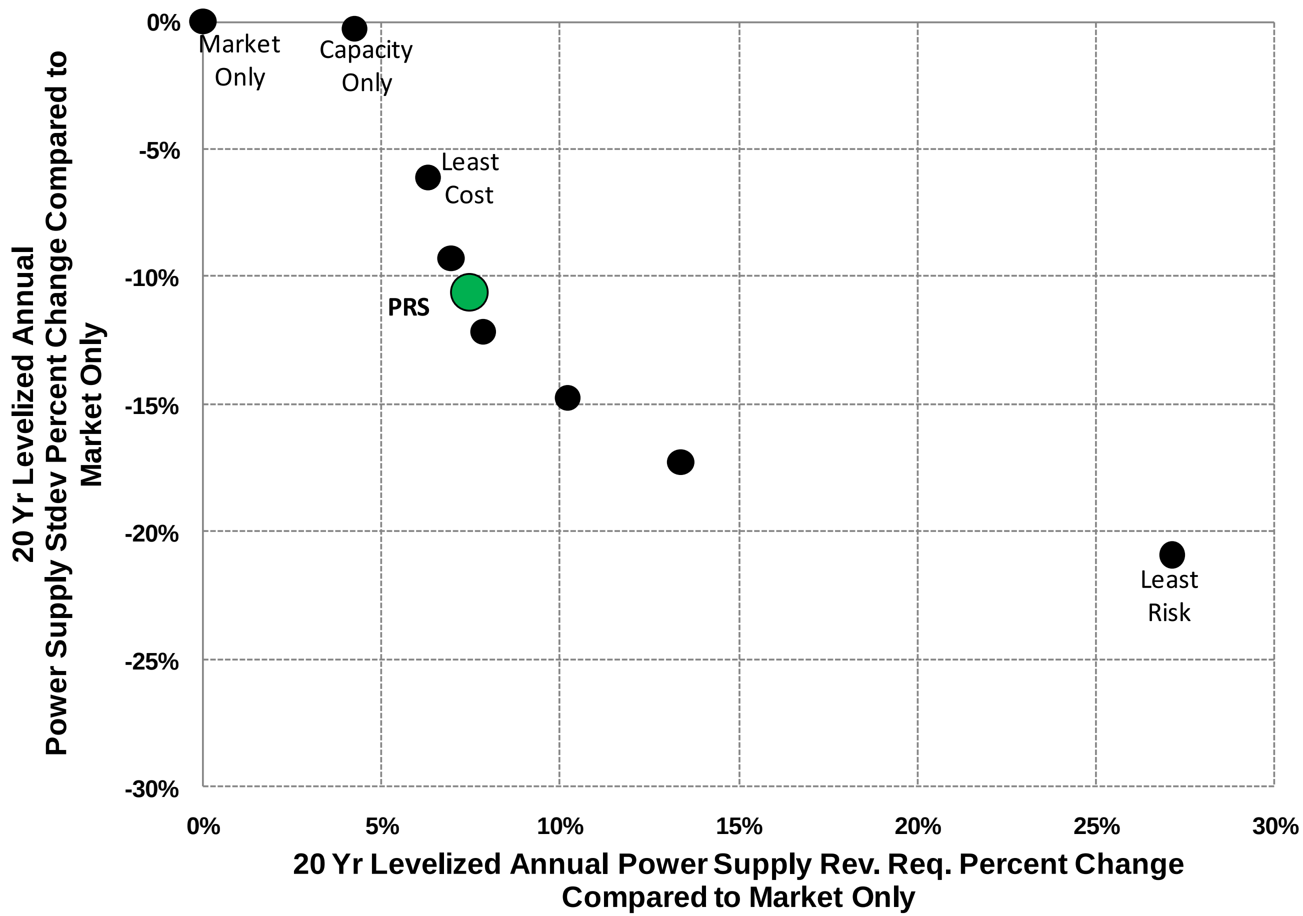
Schedule 1, Page 606 of 1069

Actual Efficient Frontier Results As a Percent of Market Only Portfolio



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Schedule 1, Page 607 of 1069

2009 Draft Preferred Resource Strategy

Year Ending	Resource
2012	150 MW NW Wind (48 aMW)
2013-2015	Little Falls Unit Upgrades (0.9 aMW)
2019	150 MW NW Wind (50 aMW)
2019	Combined Cycle CT (250 MW)
2020	Upper Falls Upgrade (1 aMW)
2022	50 MW NW Wind (17 aMW)
2024	Combined Cycle CT (250 MW)
2026/27	Combined Cycle CT (250 MW)
2010+	Distribution Feeder Upgrades (2.7 aMW by 2029)
2010+	Conservation (226 aMW by 2029)

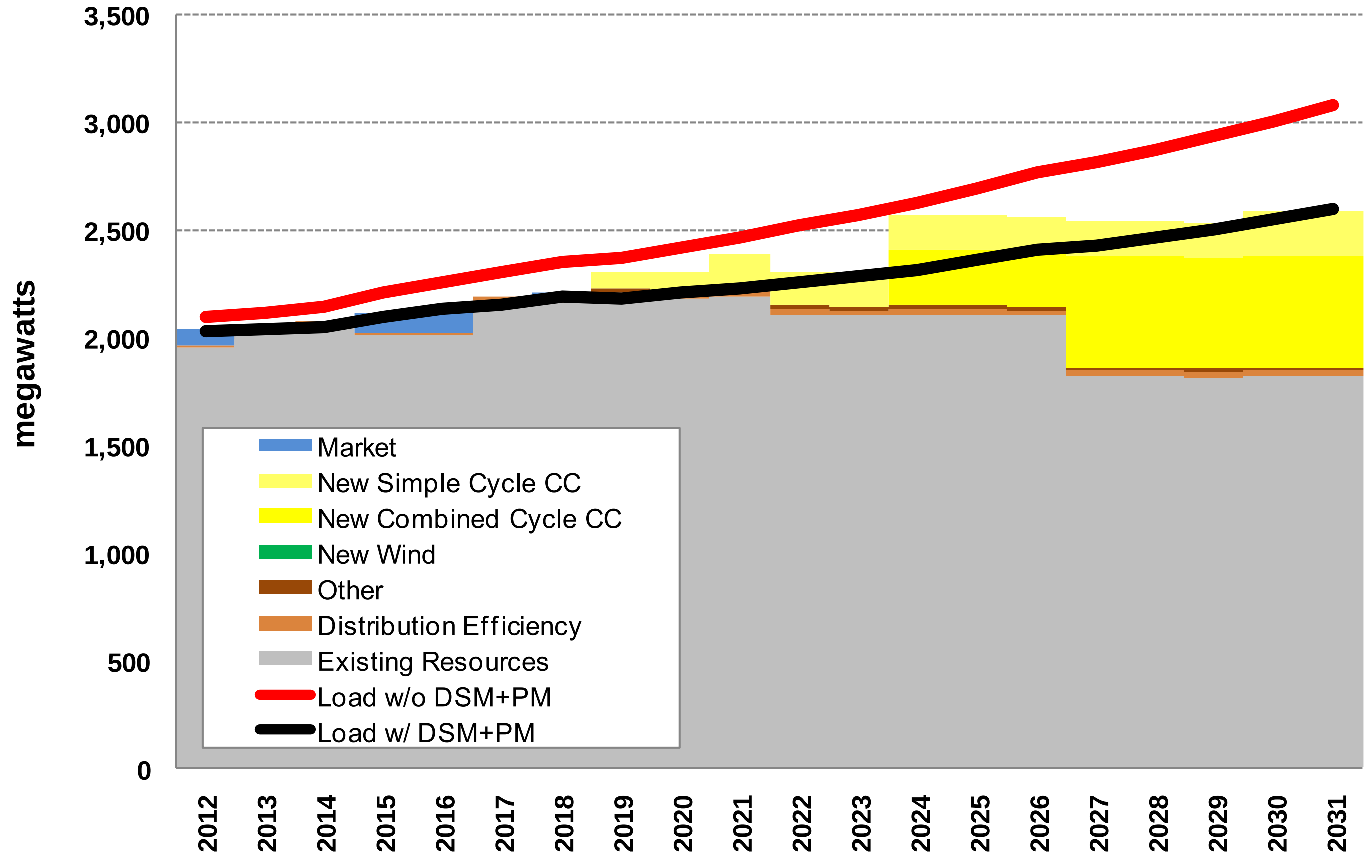
2011 Draft Preferred Resource Strategy

Year Ending	Resource
2012	Wind (~ 42 aMW REC)
2018	Simple Cycle CT(~ 83 MW)
2020	Simple Cycle CT (~ 83 MW)
2018-2019	Thermal Upgrades (~ 7 MW)
2018-2019	Wind (~ 43 aMW REC)
2023	Combined Cycle CT (~ 270 MW)
2026/27	Combined Cycle CT (~ 270 MW)
2029	Simple Cycle CT (~ 46 MW)
2012+	Distribution Feeder Upgrades (13 aMW by 2031)
2012+	Conservation (310 aMW by 2031)

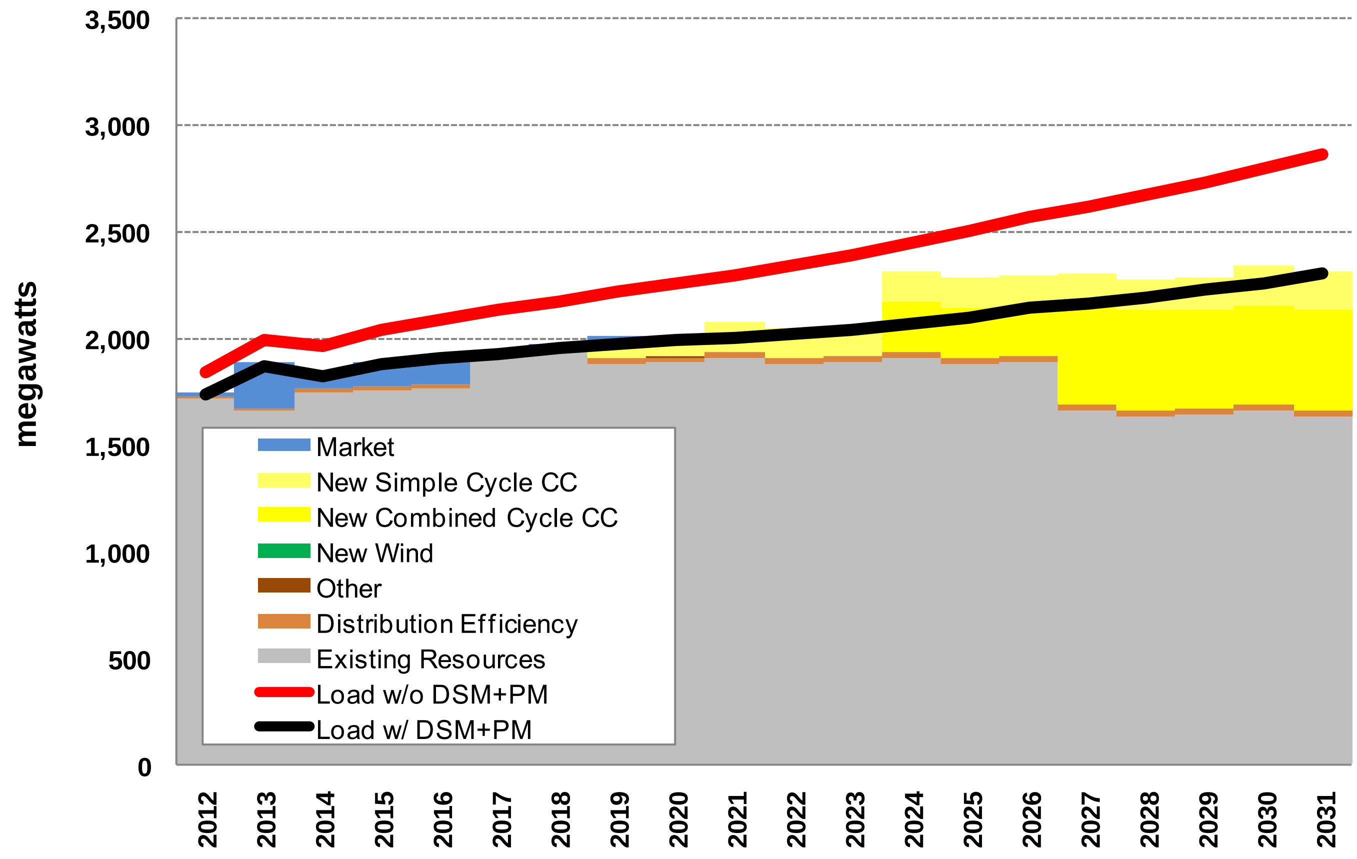
2011 IRP Comparison to 2009 IRP

- 2019: CCCT Replaced With Two CTs Over 3 Years
- 2012: Less Wind (42 aMW vs. 48 aMW)
- 2024/2027: CCCT Need Remains
- 2020: Less Wind (43 aMW vs. 50 aMW)
- 2022: Wind Need Eliminated (-17 aMW)
- 2030: Additional 46 MW CT
- 84 aMW Increased Conservation Over 20 Years
- 10 aMW Increased Distribution Losses Savings over 20 years
- Changes in Hydro Upgrade Assumptions
  - Little Falls in-kind replacement instead of upgrade
  - Upper Falls upgrade removed pending further study

Winter Capacity Load and Resources



Summer Capacity Load and Resources



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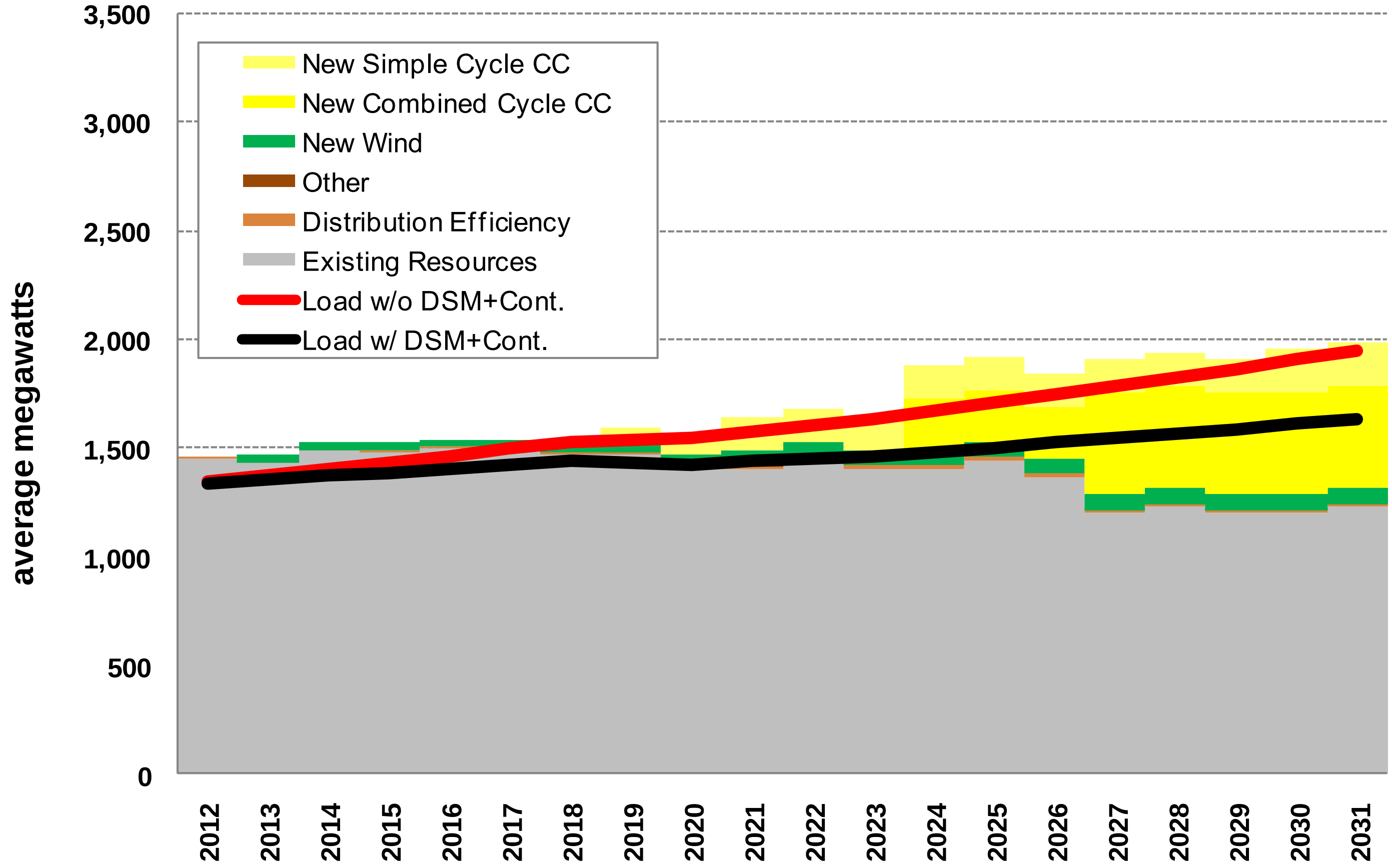
Annual Average Energy Load and Resources



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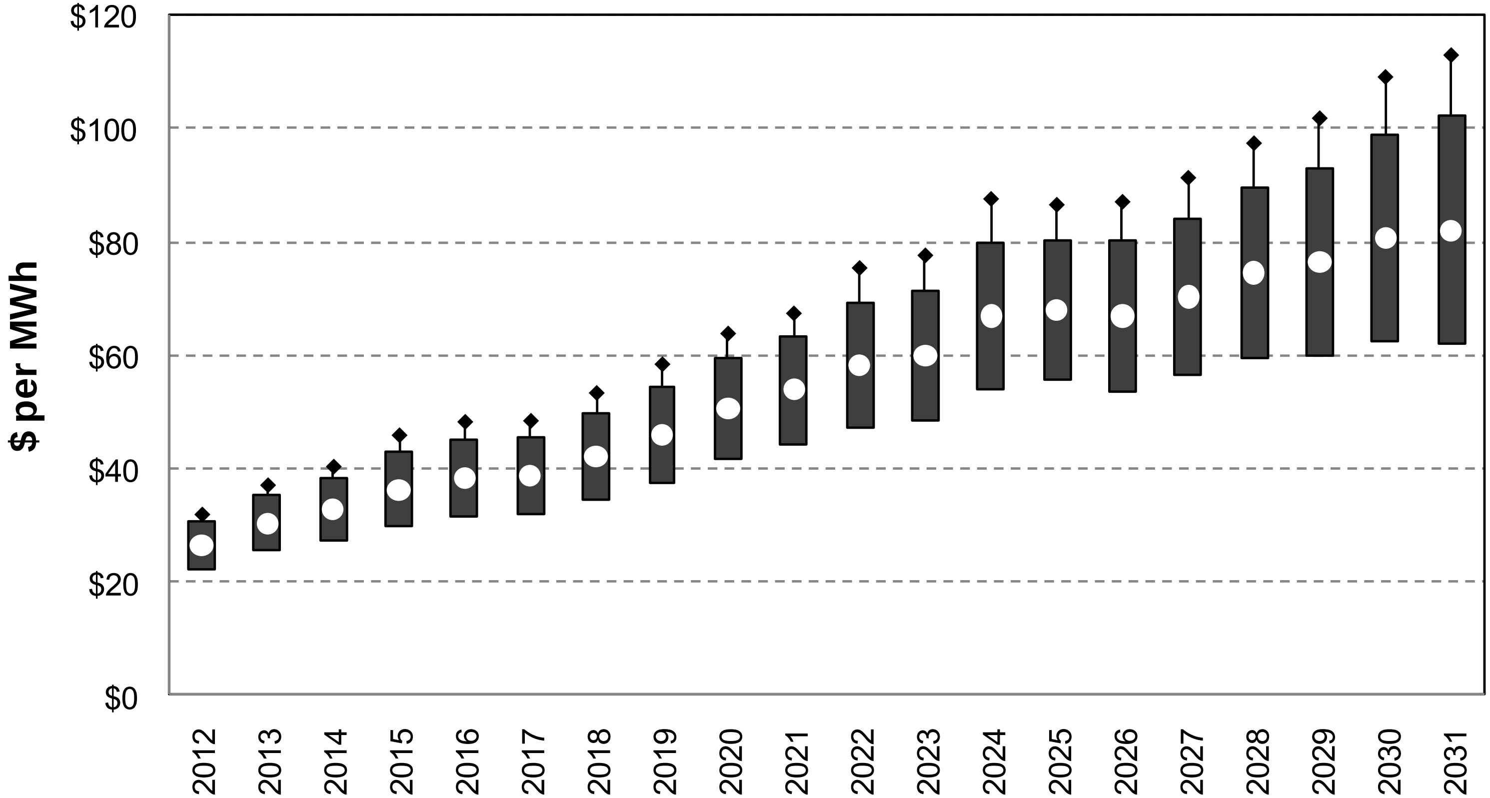
I-937 Table (aMW REC)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Beginning Bank		17	7	19	19	42	47	51	55	59	36
Requirement	**0**	**(19)**	**(19)**	**(19)**	**(19)**	**(59)**	**(59)**	**(60)**	**(60)**	**(101)**	**(102)**
Current Available	17	23	26	28	28	22	22	22	22	22	22
New Qualifying RECs	0	0	42	42	42	42	42	42	42	57	85
Sold Qualifying RECs	0	(14)	(37)	(50)	(28)	0	0	0	0	0	(5)
End Bank	**17**	**7**	**19**	**19**	**42**	**47**	**51**	**55**	**59**	**36**	**36**
Contingency Bank	**0**	**7**	**8**	**8**	**8**	**23**	**23**	**23**	**23**	**36**	**36**

		2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Beginning Bank		36	36	36	36	39	42	43	44	43	42
Requirement		**(103)**	**(103)**	**(103)**	**(104)**	**(105)**	**(106)**	**(107)**	**(108)**	**(109)**	**(110)**
Current Available		22	22	22	22	22	22	22	22	22	22
New Qualifying RECs		85	85	85	85	85	85	85	85	85	85
Sold Qualifying RECs		(5)	(4)	(4)	(0)	0	0	0	0	0	0
End Bank		**36**	**36**	**36**	**39**	**42**	**43**	**44**	**43**	**42**	**39**
Contingency Bank		**36**	**36**	**36**	**36**	**37**	**38**	**38**	**38**	**39**	**39**

Preferred Resource Strategy Annual Costs per MWh Expected Market Conditions (80% Credit Allocation)

(Includes all Power Supply Costs except Capital Plant in Rate Base)



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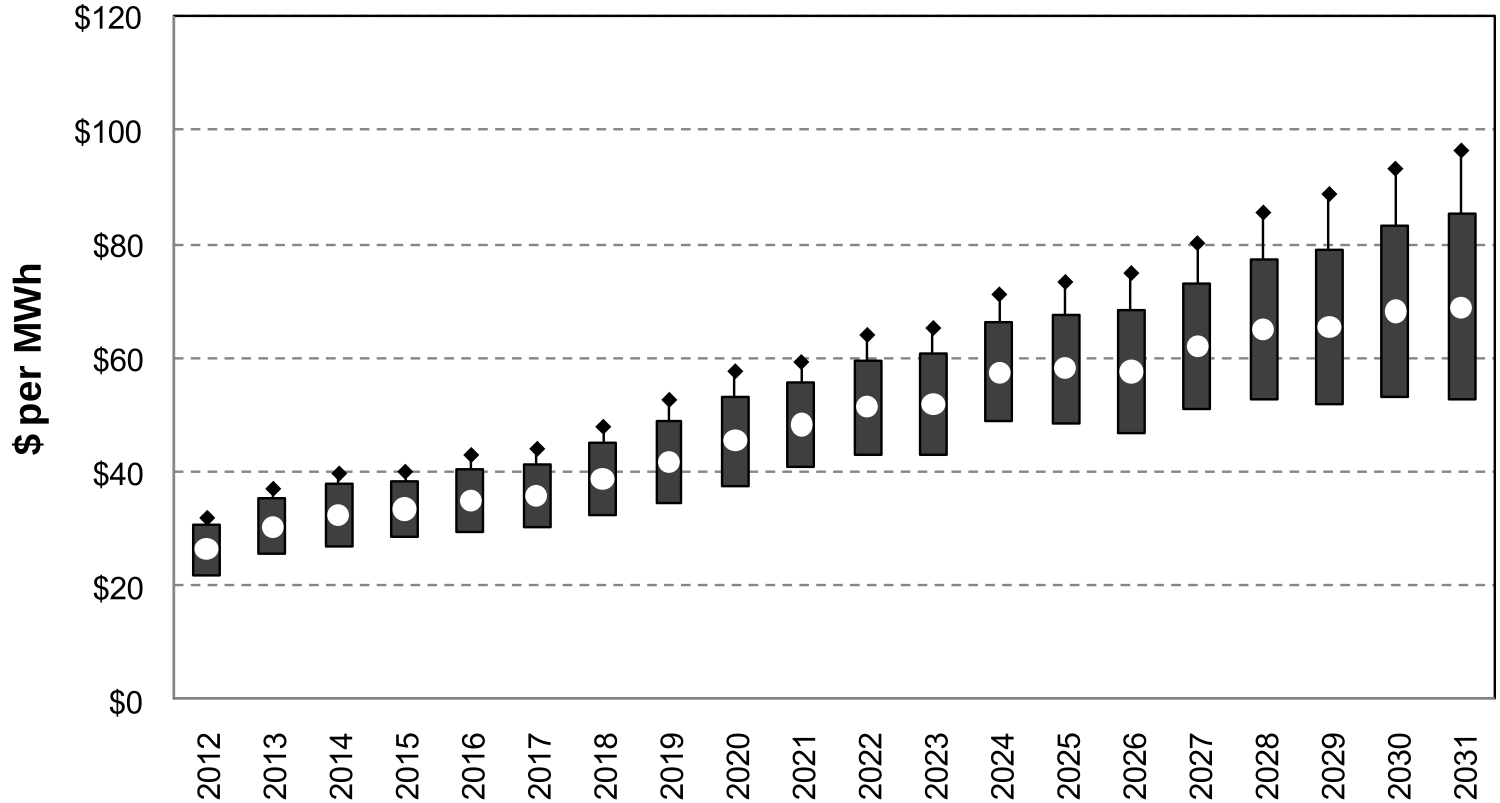
Preferred Resource Strategy Annual Costs per MWh No Carbon Legislation

(Includes Power Supply Costs except Capital Plant in Rate Base)



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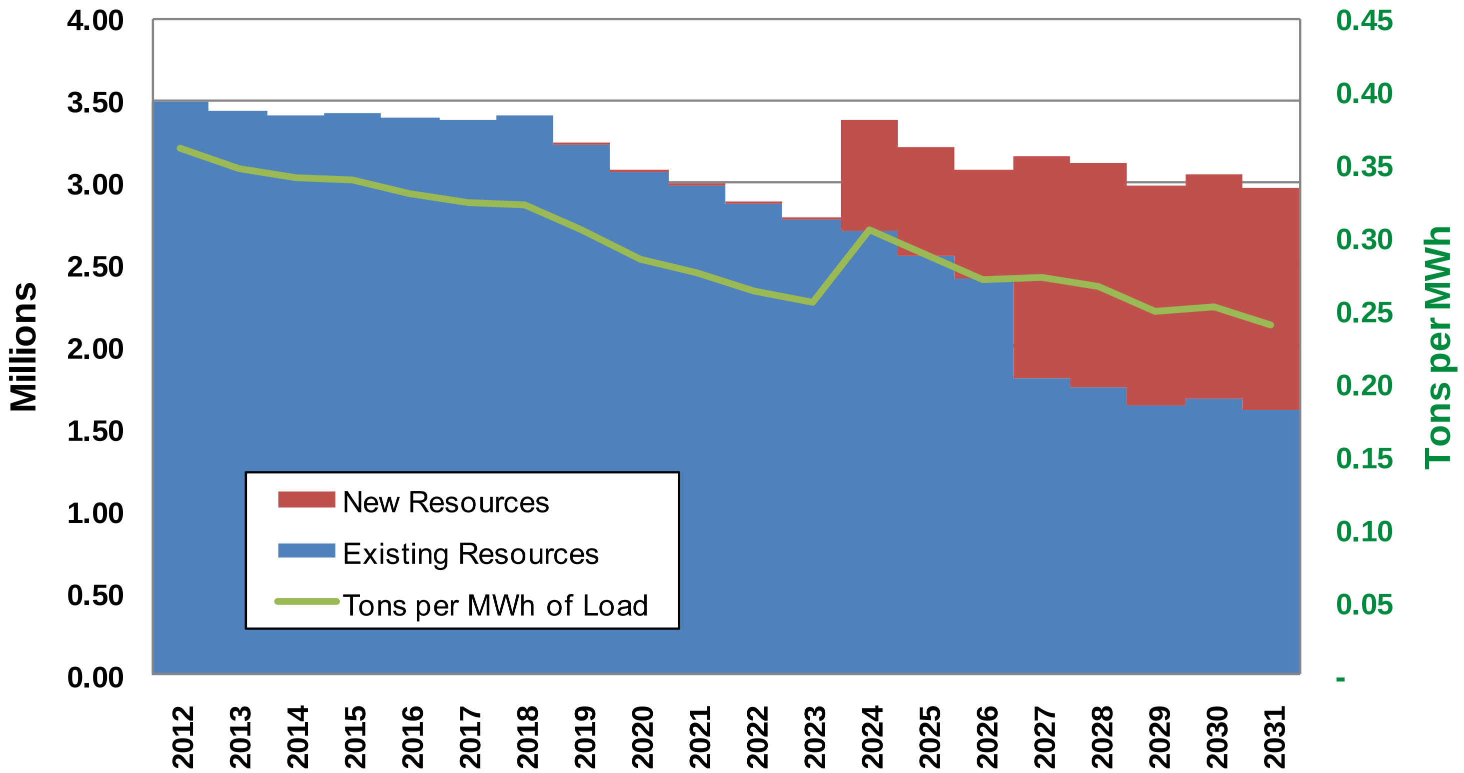
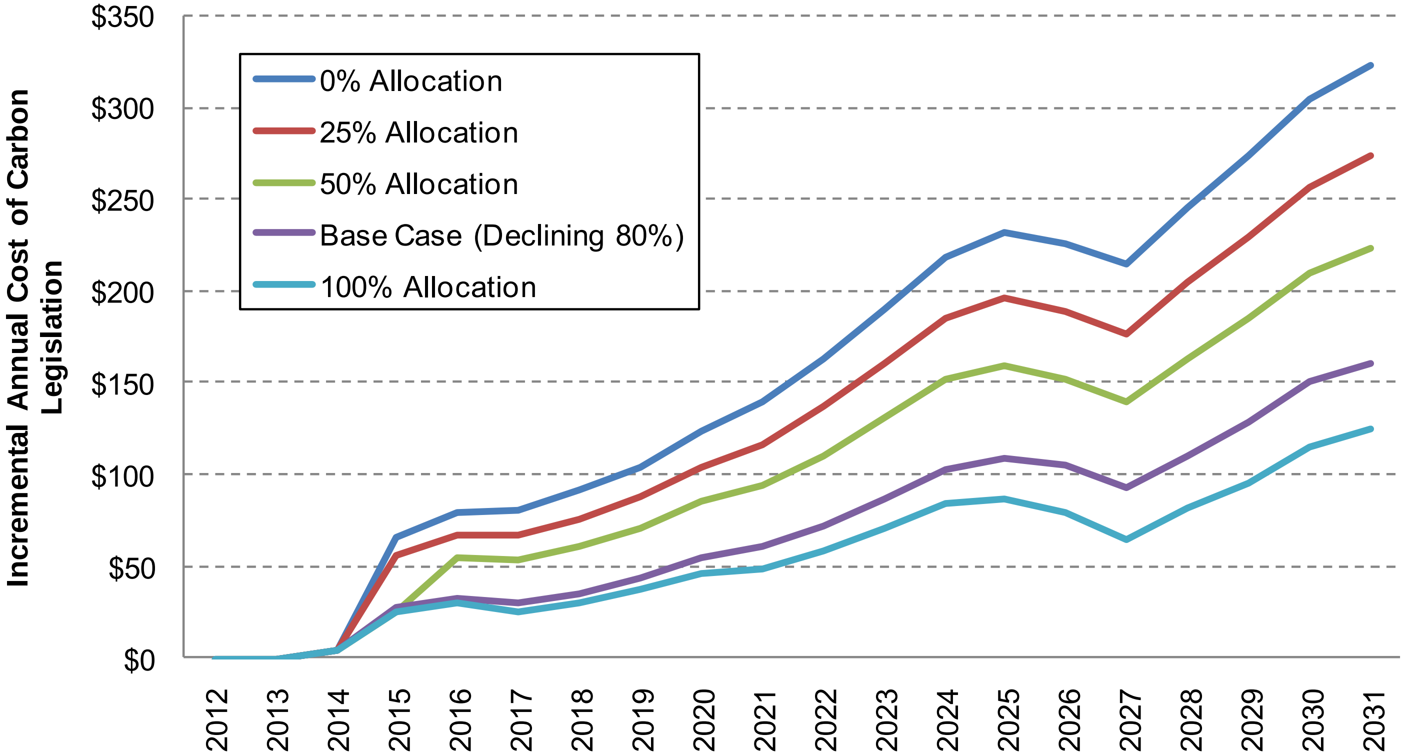
Greenhouse Gas Emissions (millions of short tons)



Greenhouse Gas Cost



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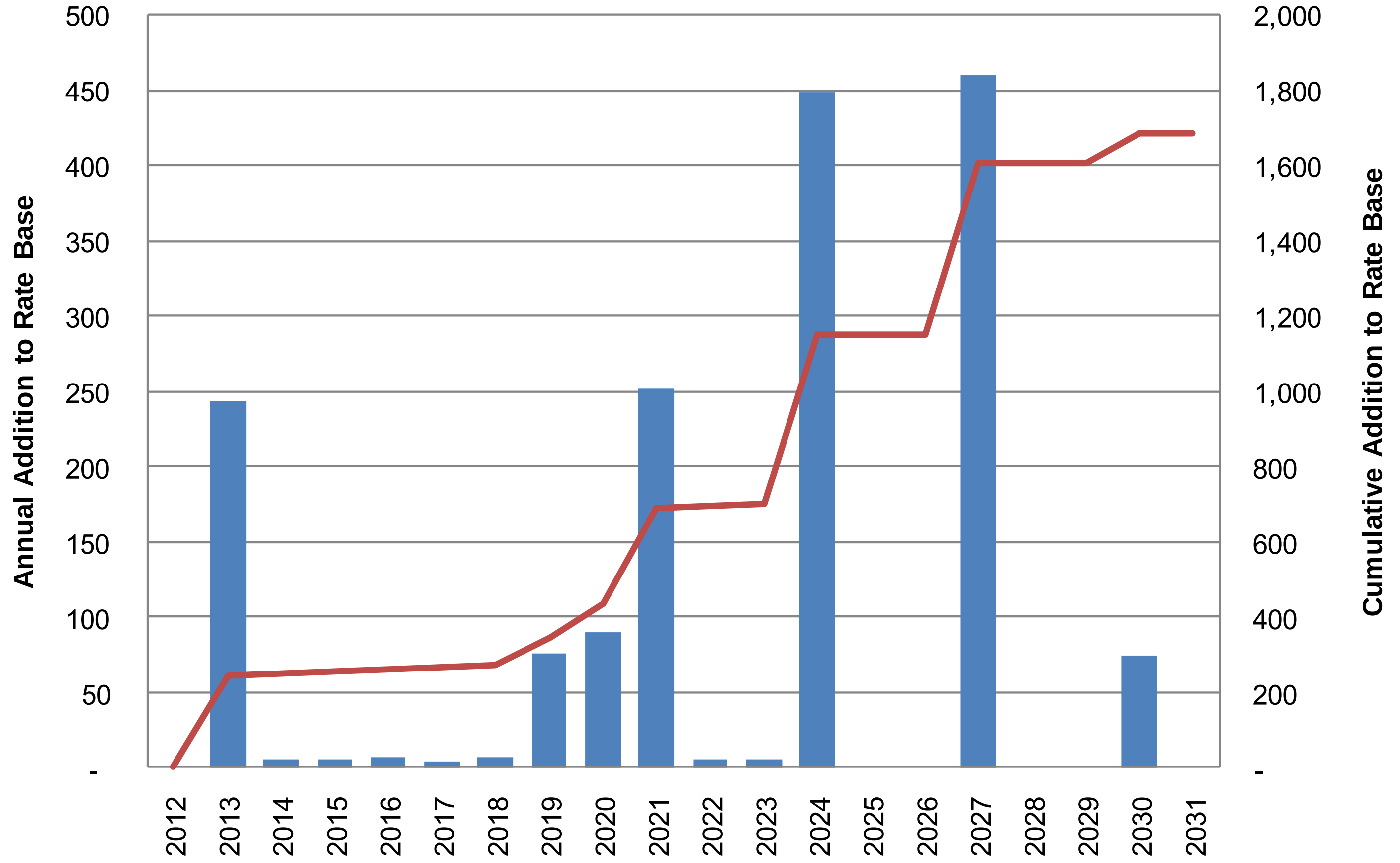
PRS Capital Requirements (millions $)



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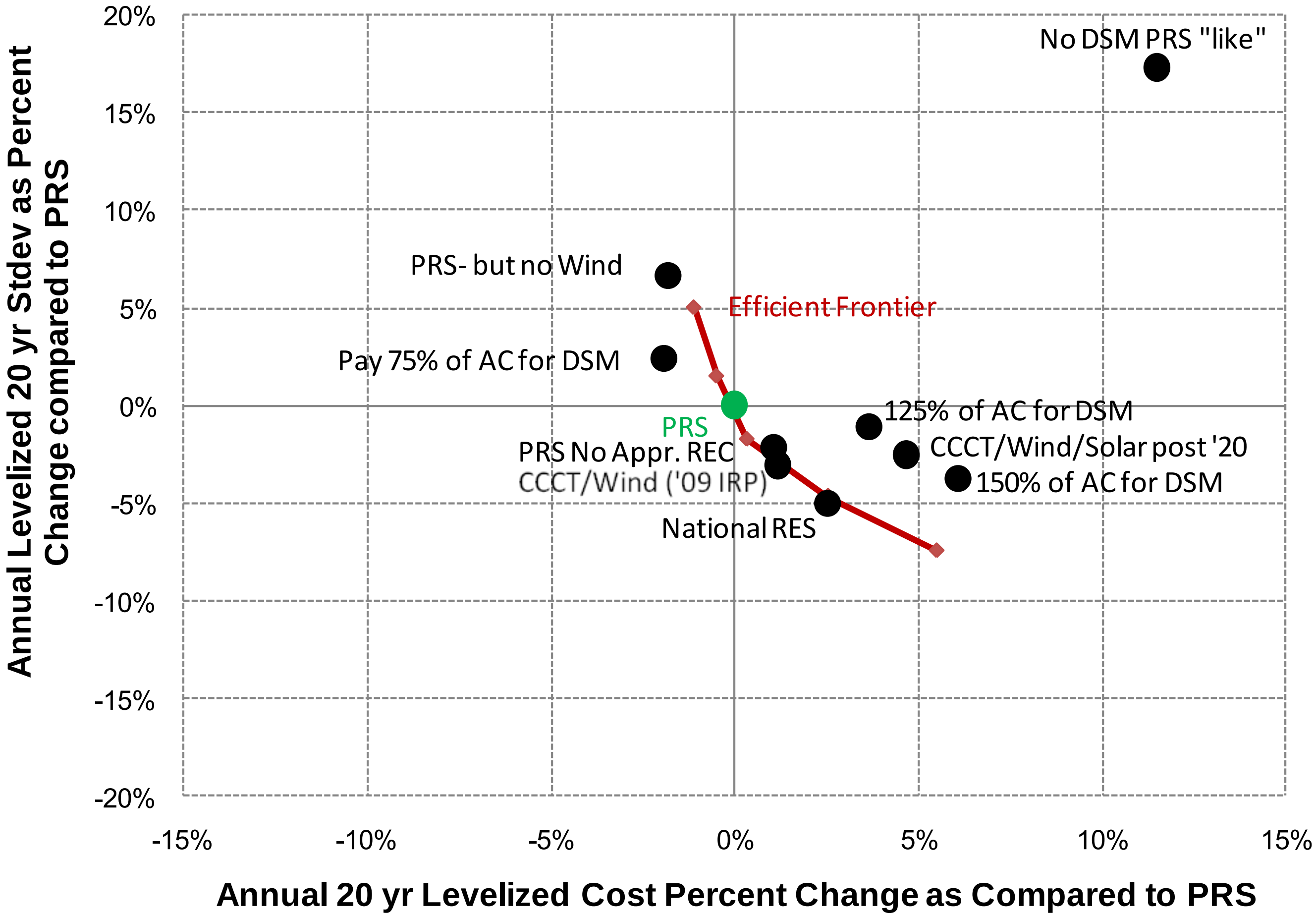
R. Lafferty, Avista
Schedule 1, Page 619 of 1069

Alternative Strategies Comparison



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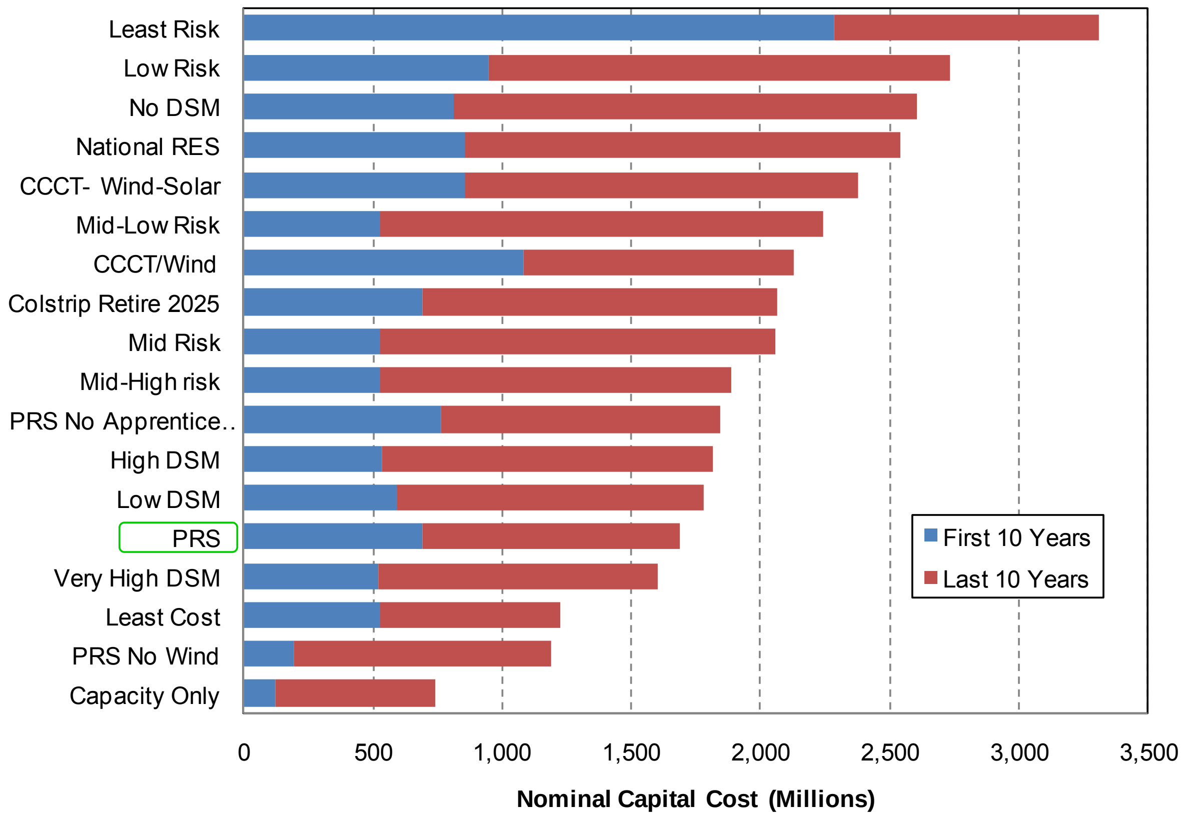
Capital Expenditures (Alternative Portfolios)



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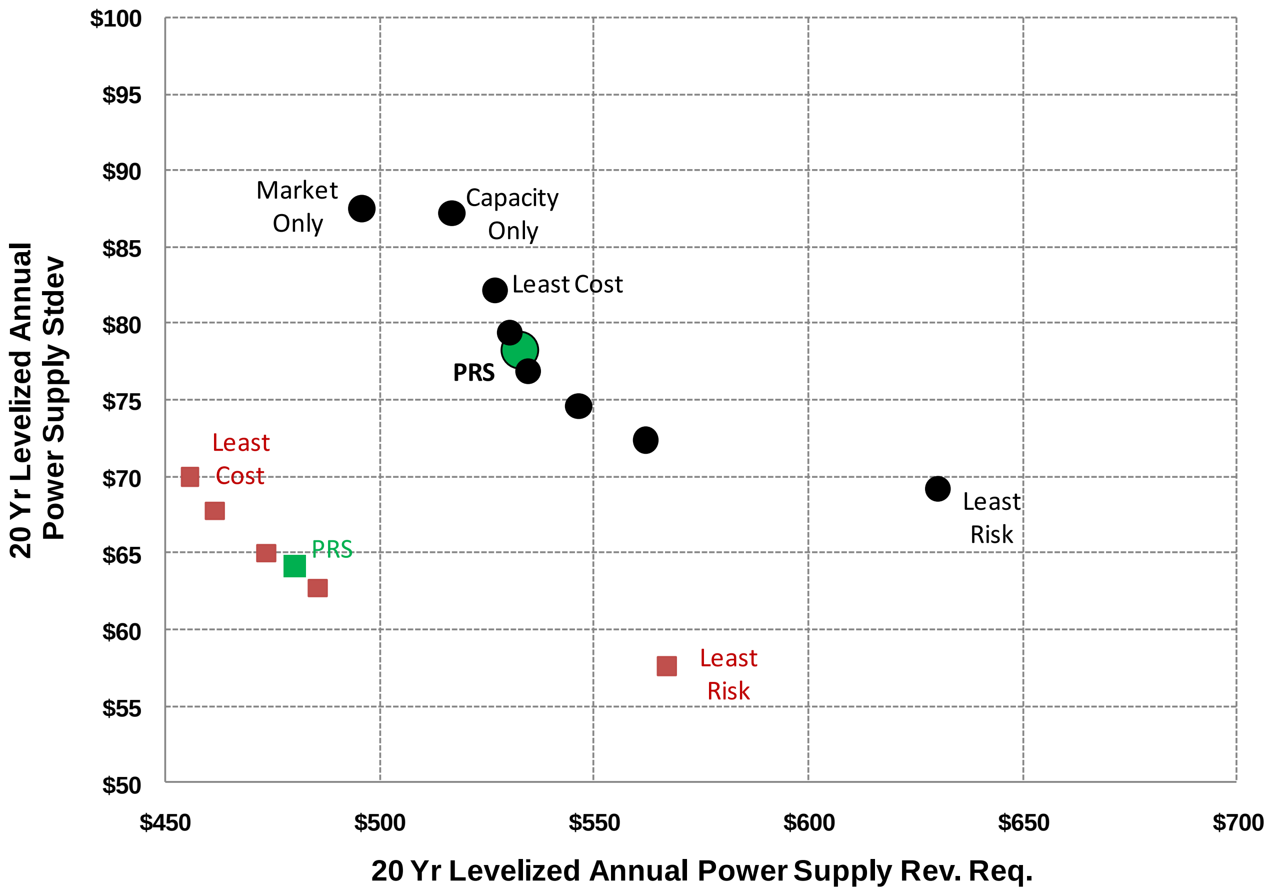
Base Case Efficient Frontier Compared to No Carbon Costs Efficient Frontier



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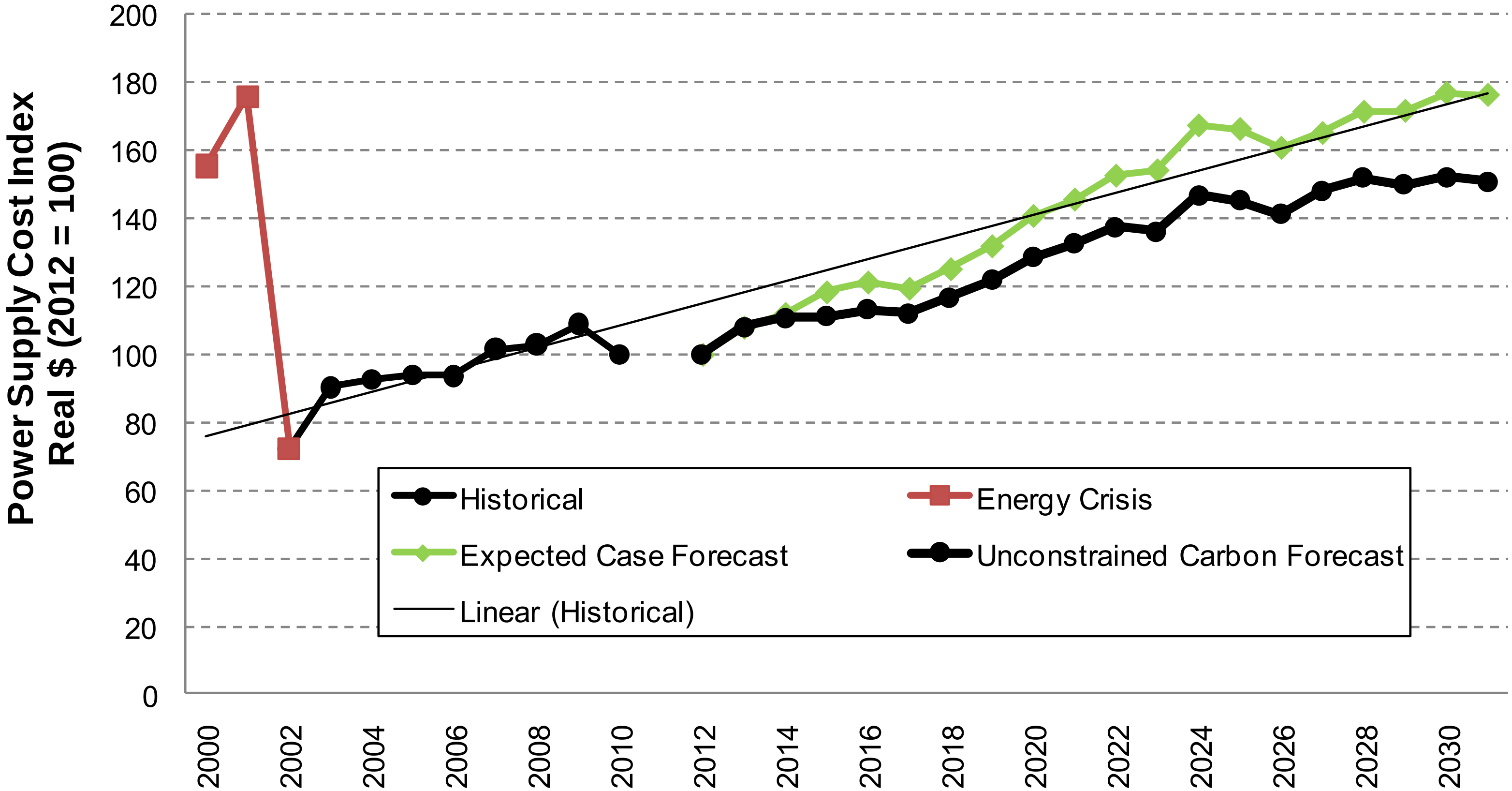
Power Supply Cost Expected and Historical Growth Index



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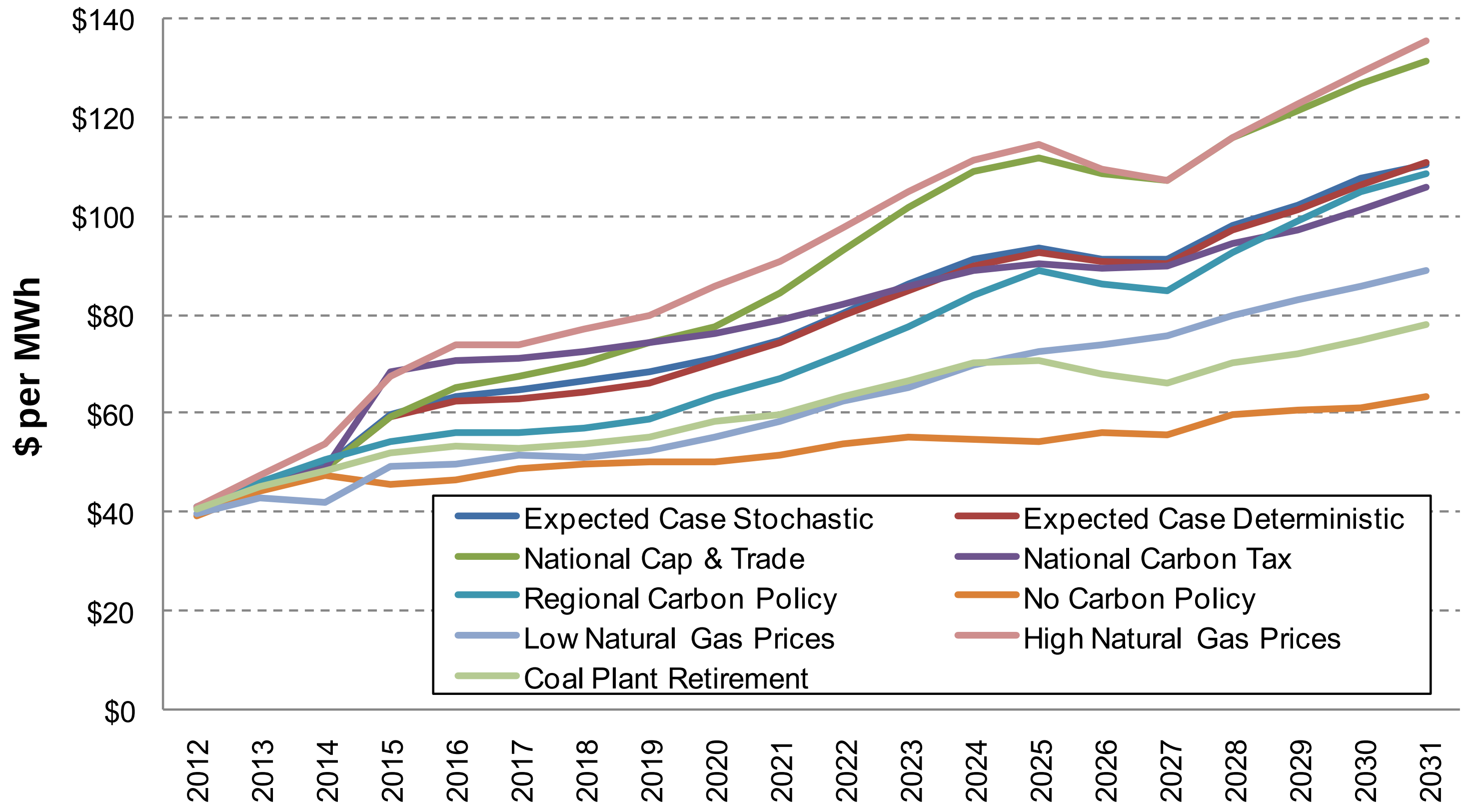
Schedule 1, Page 623 of 1069

Resource Cost Tipping Point Analysis

	Target Resource Capital Cost ($/kW)	Required Cost to be Selected ($/kW)	Percent Reduction
CCCT to replace SCCT to be least cost (2024)	$1,609	$1,255	-22%
Wind shift to Solar (2020) (2x REC included)	$4,371	$2,052	-53%

Market Scenario Analysis Update

Mid-Columbia Electric Price Forecast



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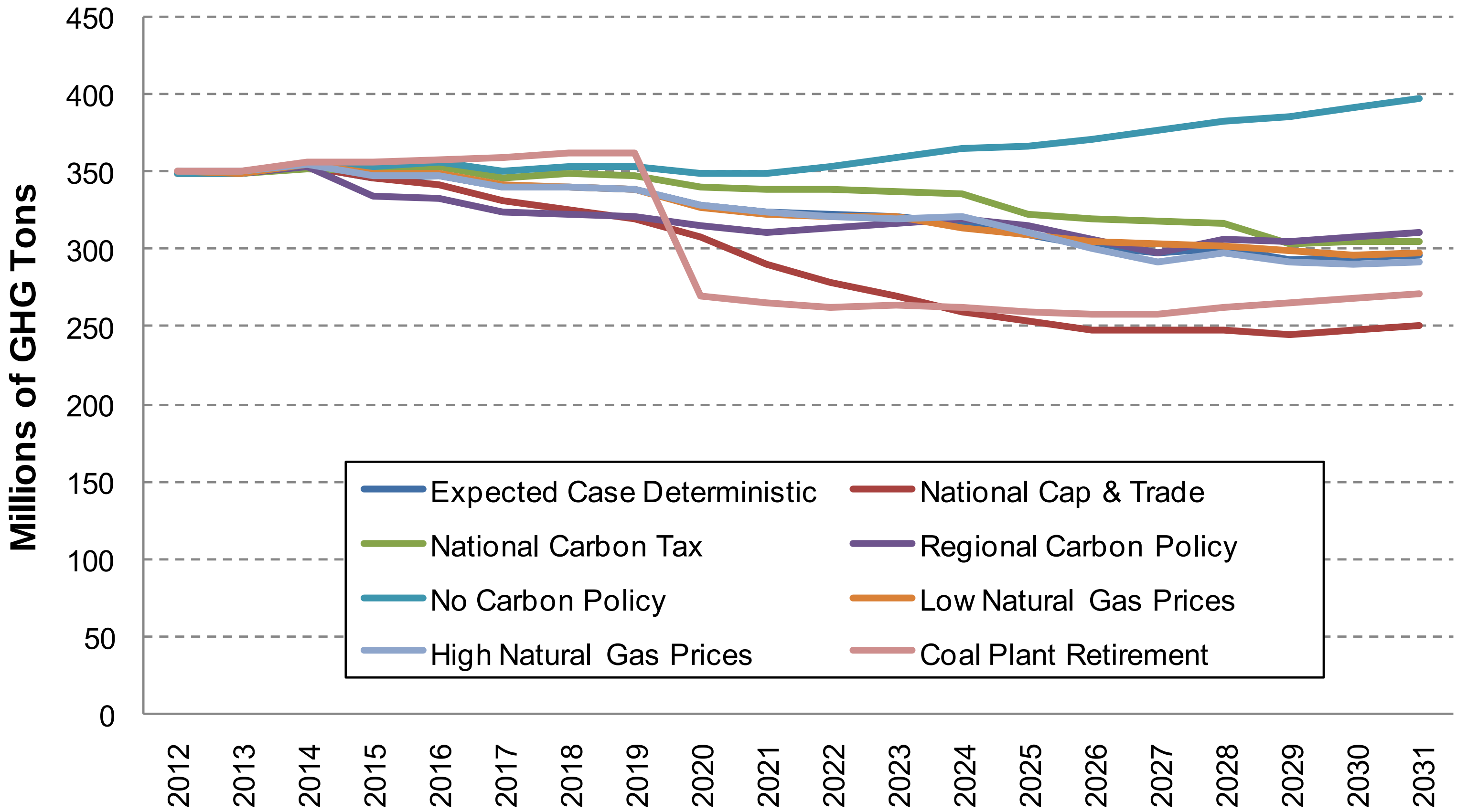
US WECC GHG Emissions



Next Steps

- Obtain internal feedback and approvals of Preferred Resource Strategy
- Compare alternative resource portfolios using alternative market conditions
- Compare efficient frontier analysis with additional stochastic market analysis (i.e. coal plant retirement/Volatile NG)
- Further investigate Demand Response cost/benefits

Smart Grid Project Overview

TAC Meeting – April 12, 2011

Curtis Kirkeby, P.E.

Sr. Electrical Engineer – SGDP Principal Investigator

Avista Smart Grid Grants

Smart Grid Investment Grant (SGIG)

Spokane, WA

Smart Grid Demonstration Project (SGDP)

Pullman, WA

Smart Grid Workforce Training Grant

Jack Stewart Training Center - Spokane, WA

Exhibit No. 4
Case Nos. AVU-E-12-08
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Schedule 1, Page 630 of 1069

Smart Grid Workforce Training Grant

Five state partnership: Industry, Education, Labor

Benefits to Our Region –

- Local facility to train on new technology
- Leverage training needs of other Avista grants; build new curriculum
- Federal dollars to update existing training and facilities to up-skill current and future workers

Award:	$5.0 m over 3 years
Avista portion of award:	$1.3 m over 3 years
Grant Partner match	$6.8 m over 3 years

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Grant Objectives

- Smart Grid Training Delivery
- Smart Grid Training Portal
- Share Best Practices on Smart Grid Training

"Create an effective and efficient electric power workforce proficient in smart grid competencies"

Avista Objectives

- Construct a training substation for training on smart grid technology
- Update training programs to incorporate smart grid technology
- On-line curriculum to be shared by utilities and colleges

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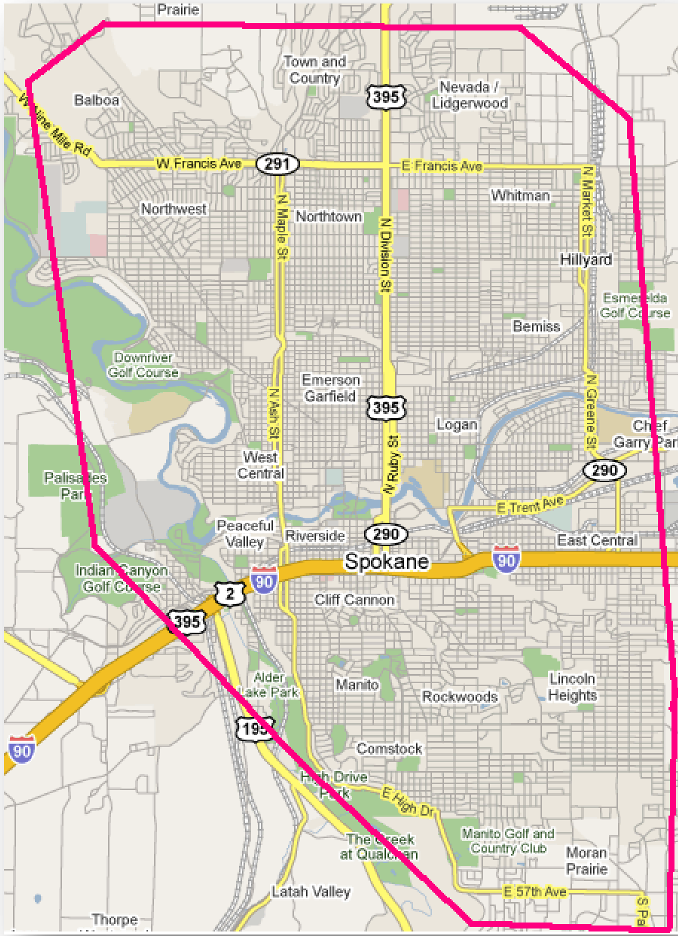
SGIG – Spokane, WA



- Target
- 59 Distribution Circuits
- 110,000 Electric Customers
- 14 Substations

Loss Reduction – 42,000 Mega watt hours/Year

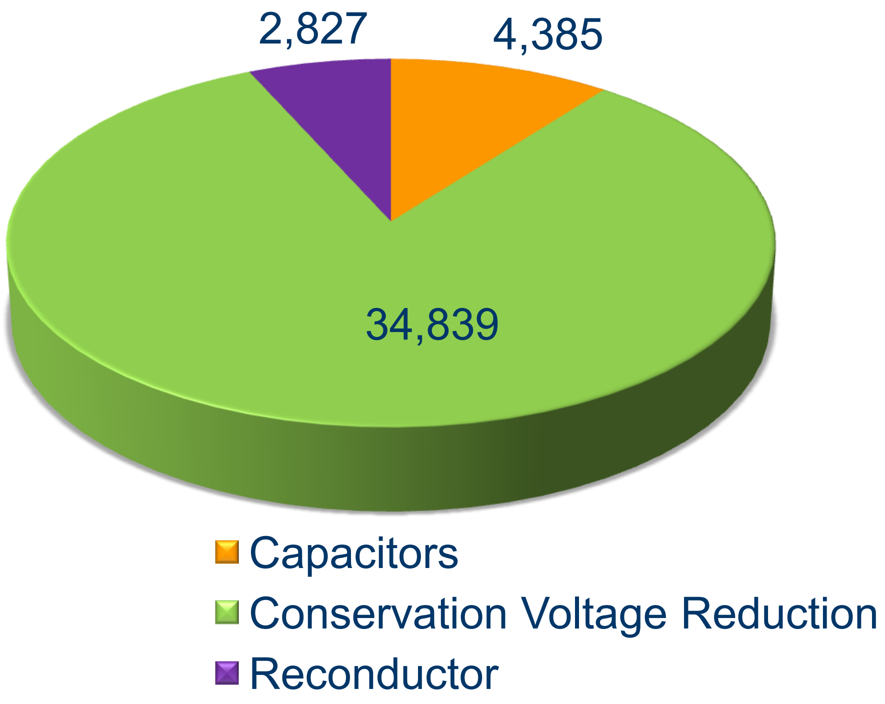
2500 Homes/Year

Green House Gas Reduction: 14,000 Tons

SGIG – Benefits

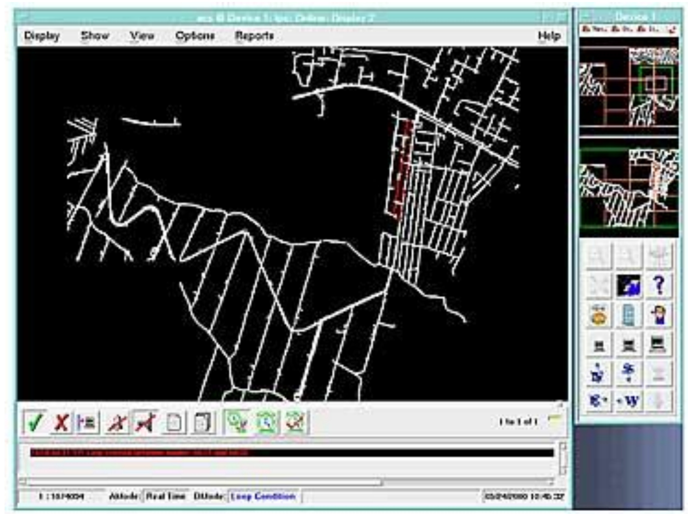
Carbon Reduction: 14,360 Tons a year.
- $50/Ton to Sequester
- $718,000/year.

Savings (MWh)

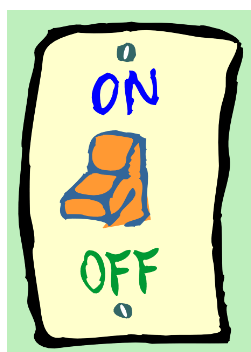


SGIG – Enabling Technologies

Communication:
- Wireless to Field Devices
- Fiber to Substations



Field Equipment
- Switches and Reclosers
- Capacitor Banks
- Voltage Regulators



Distribution Management System (DMS)
- Remotely Control and Operate Distribution Equipment
- Continually Analyzing the System for Optimization
- Automated Fault Detection Isolation and Restoration

SGIG – Construction

Substation

Cap

■ Complete ■ To Be Completed

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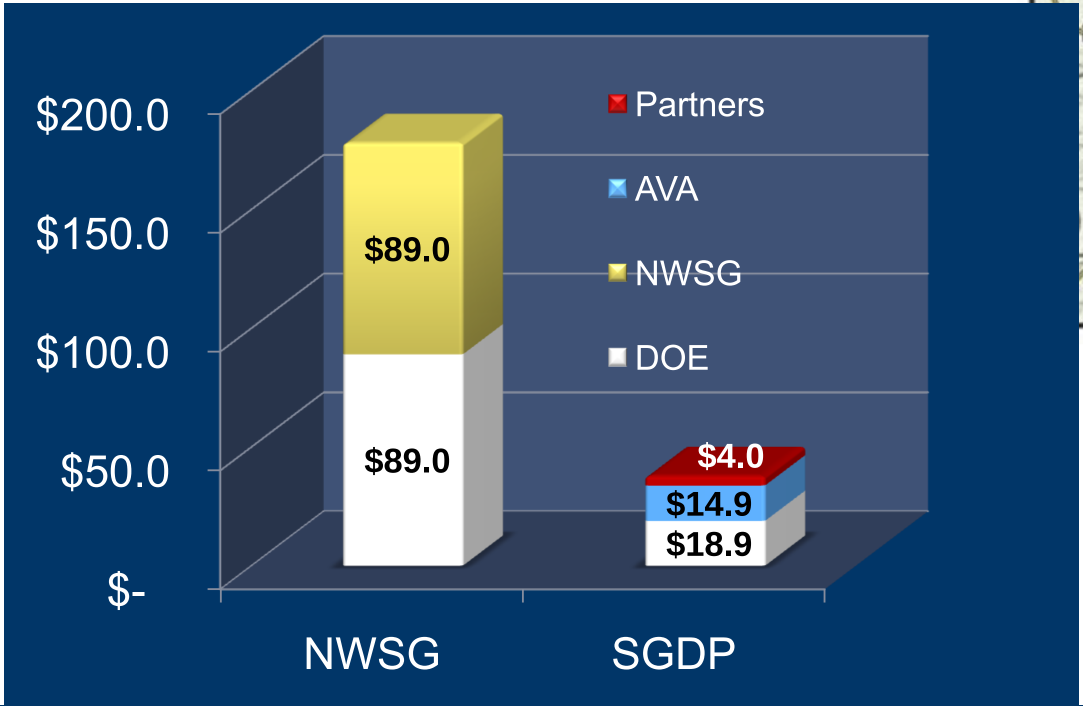
SGDP – Demonstration Project



SGDP – Regional Players

National Energy Technology Laboratory

Bonneville Power Administration

Battelle NW

3 Tier
Areva
IBM
Netezza
Quality Logic

Utility Partners

Avista
Benton PUD
City of Ellensburg
Flathead Electric
Idaho Falls Power
Lower Valley Energy
Milton-Freewater
Northwestern Energy
Peninsula Light
PGE
Seattle City Light (UW)

Pacific Northwest SMART GRID DEMONSTRATION PROJECT

Exhibit No. 4
Case Nos. AVU-E-12-08
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Schedule 1, Page 639 of 1069

SGDP – System Elements

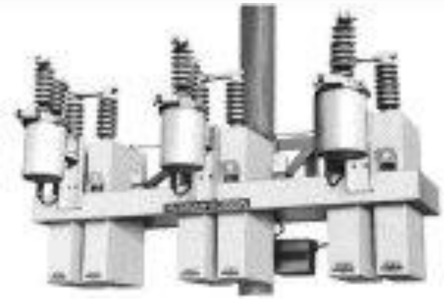
3 substations

- Regulator controls
- Reclosers/relays

13 circuits

- 45 automated line switches & reclosers
- 20 switched and fixed capacitor
- Fault Indicators
- Low loss transformers w/ communications

Wireless & fiber communications



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Schedule 1, Page 640 of 1069

SGDP – Itron Open Way AMI

- ≈ 14,000 Residential / Commercial Electric Meters
- ≈ 6000 Residential / Commercial Gas Meter Registers
- Wireless Communication w/ Fiber Backhaul
- Remote Service Switch
- Back Office Software Systems

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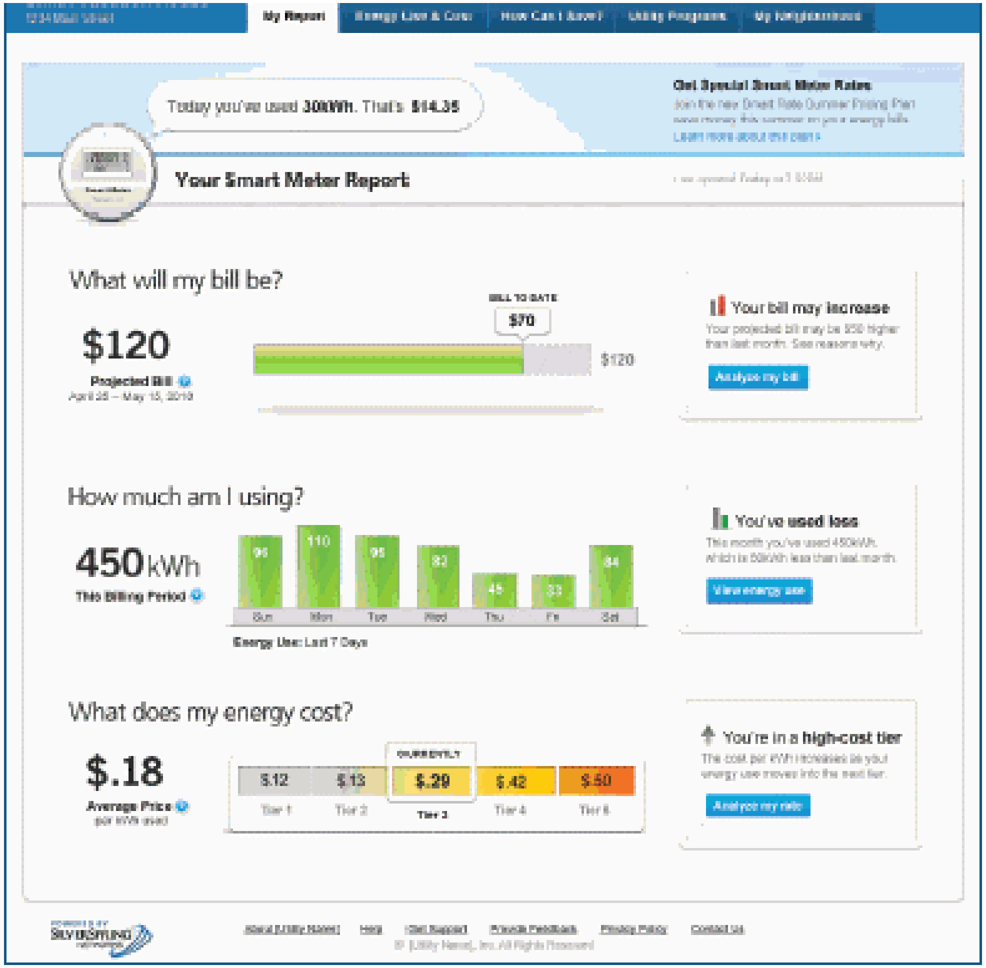
Schedule 1, Page 641 of 1069

Customer Web Portals



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Schedule 1, Page 642 of 1069

In-Home Displays

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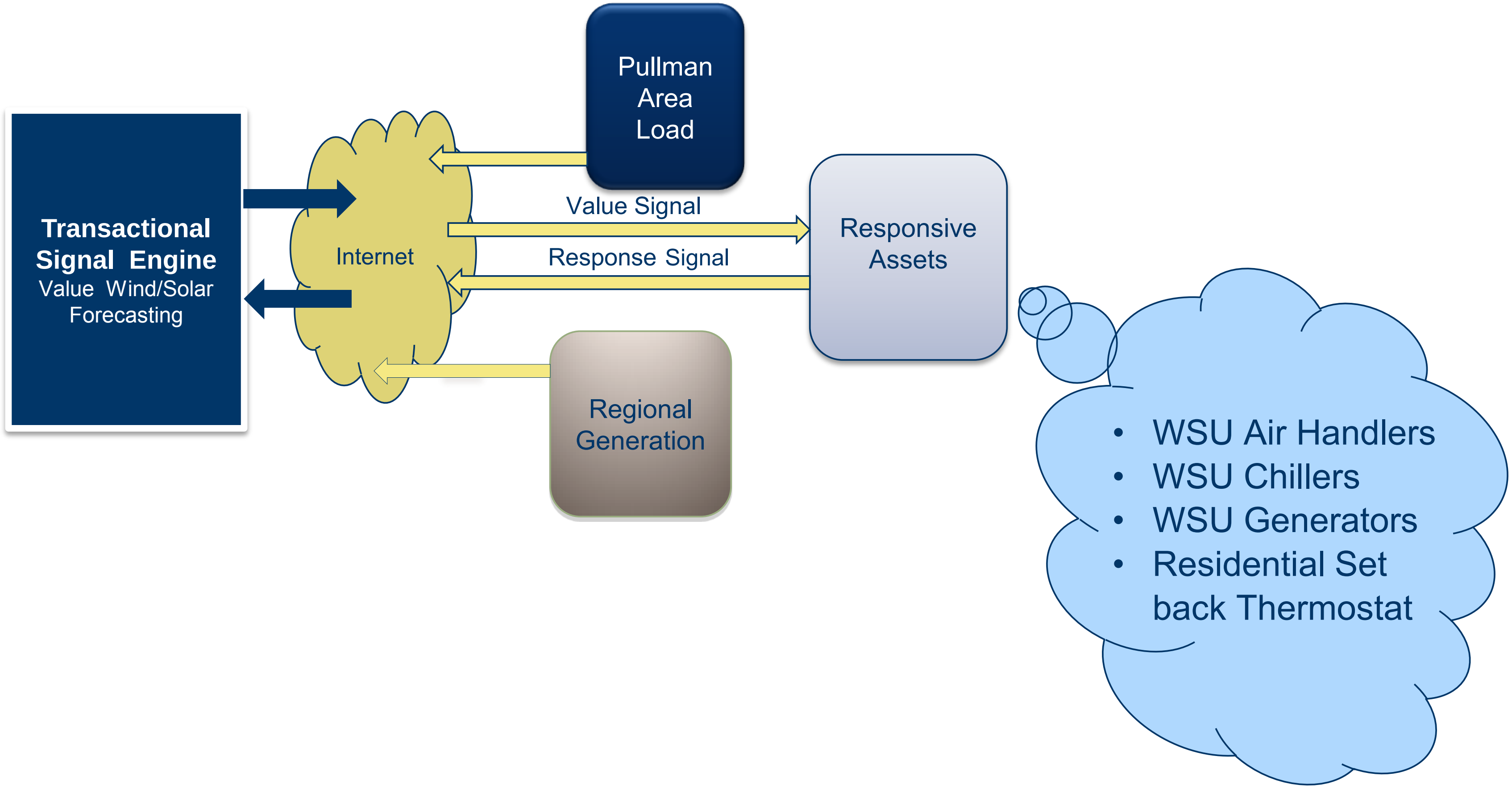
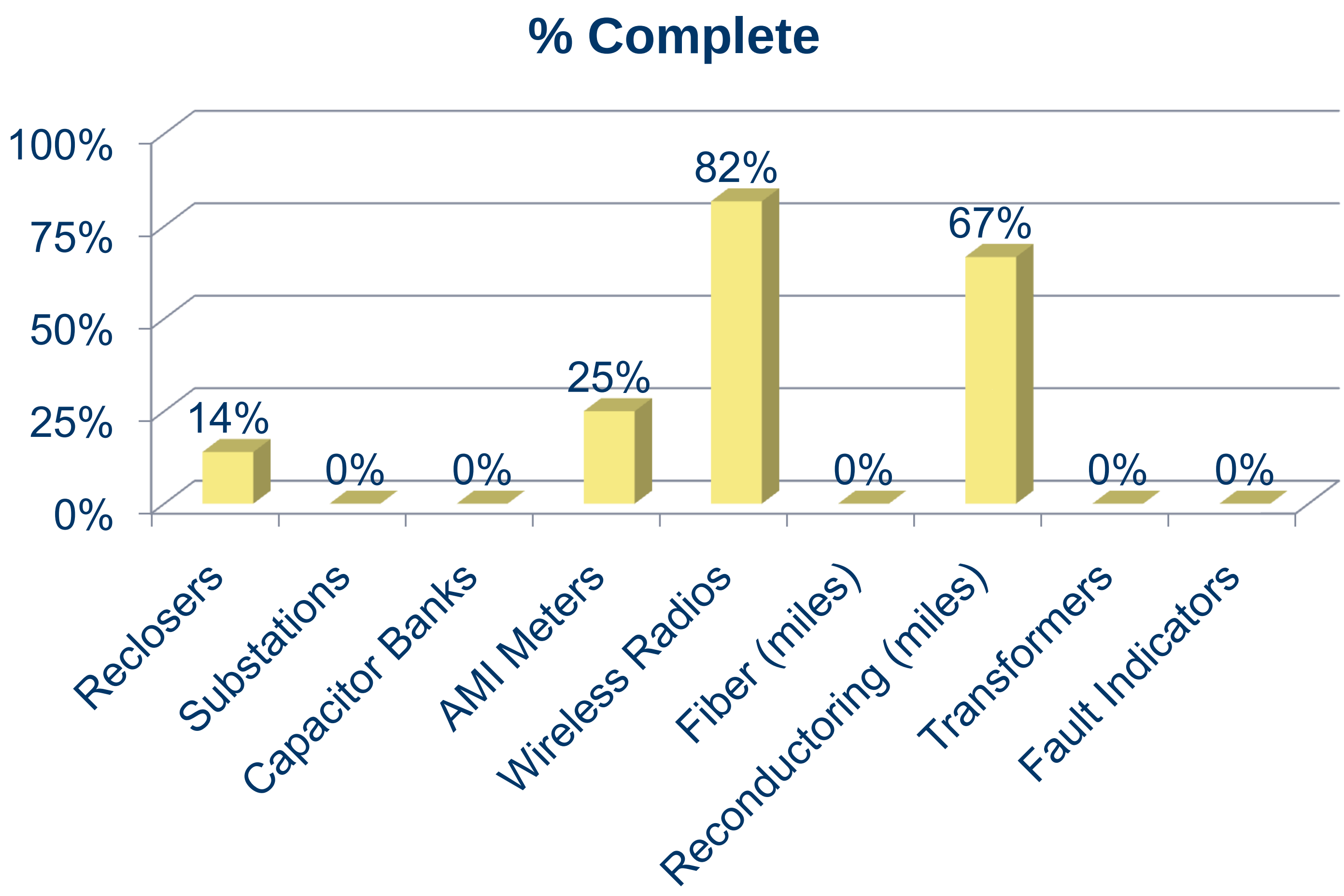
SGDP – Transactional Signal



SGDP – Construction



Smart Grid Energy Impacts

	SGIG (MWh)		SGDP (MWh)	
Year	Cumulative	I-937	Cumulative	I-937
2010	1500	1500	0	0
2011	7212	5712	286	286
2012	42051	34839	286	0
2013	42051	0	6763	6477

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Future Programs

FEEDER REBUILDS

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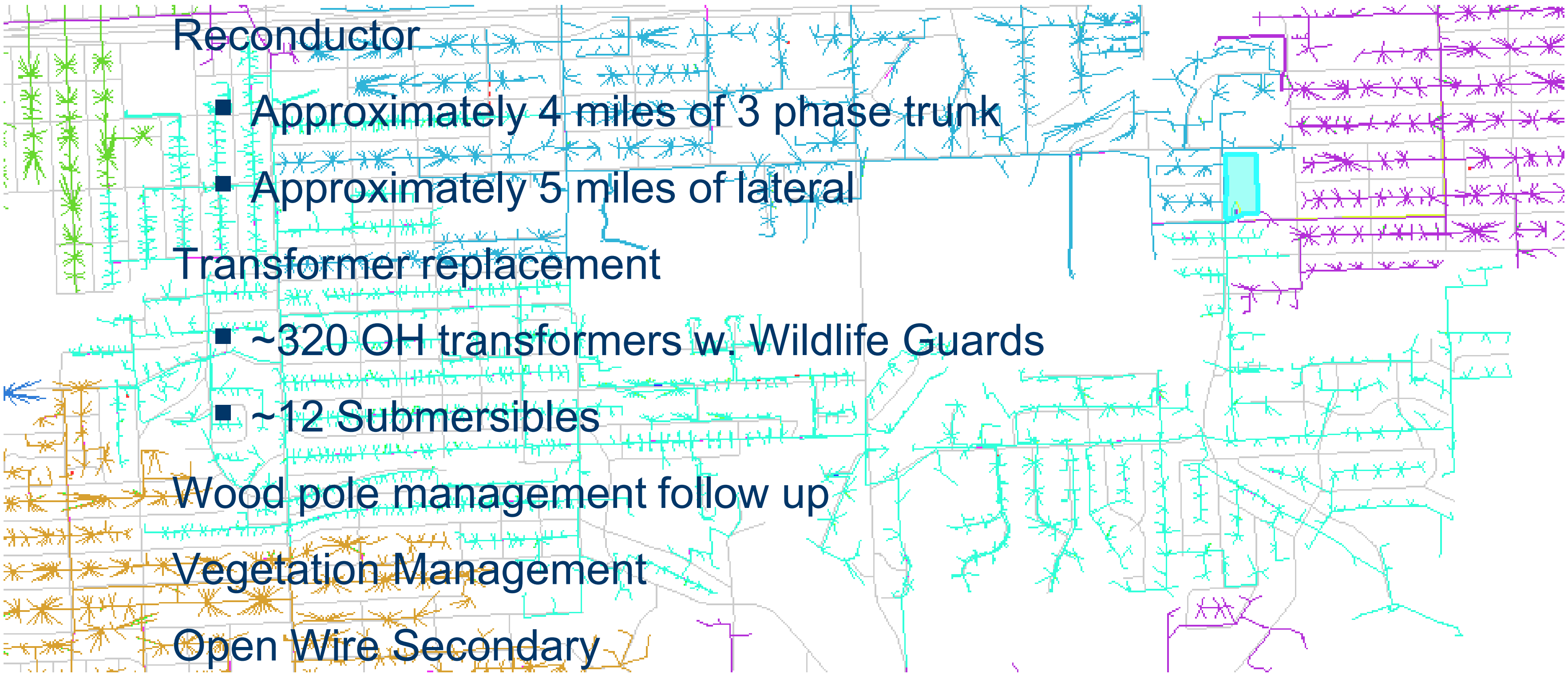
9th and Central 12F4 (9CE12F4) - 2009

Primary Goals



- Reconductor
  - Approximately 4 miles of 3 phase trunk
  - Approximately 5 miles of lateral
- Transformer replacement
  - ~320 OH transformers w. Wildlife Guards
  - ~12 Submersibles
- Wood pole management follow up
- Vegetation Management
- Open Wire Secondary

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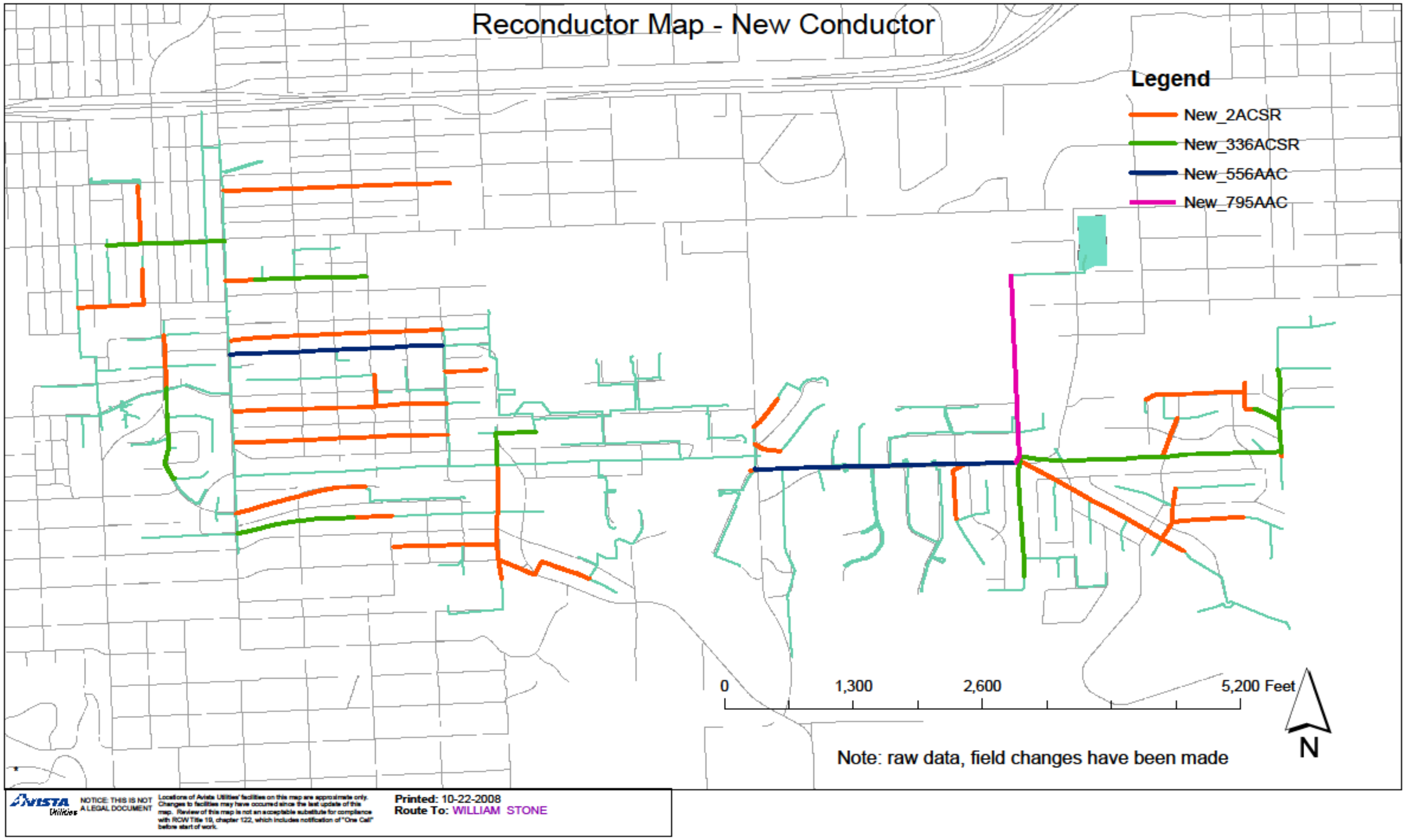
9CE12F4 Reconductor



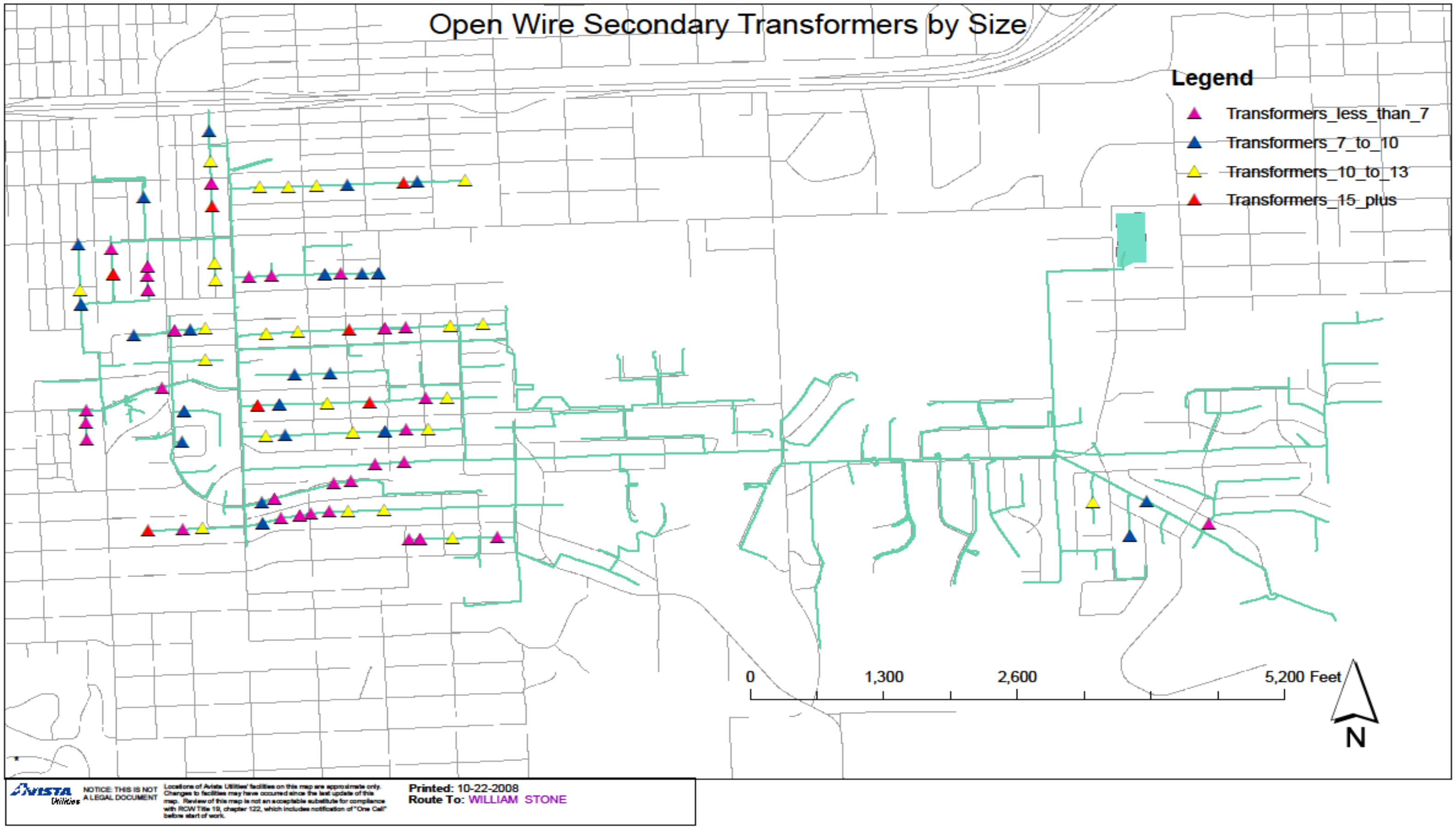
9CE12F4 Realignment

Good opportunity to move facilities where it makes sense for reliability and future maintenance and access

9CE12F4 Transformer Replacement

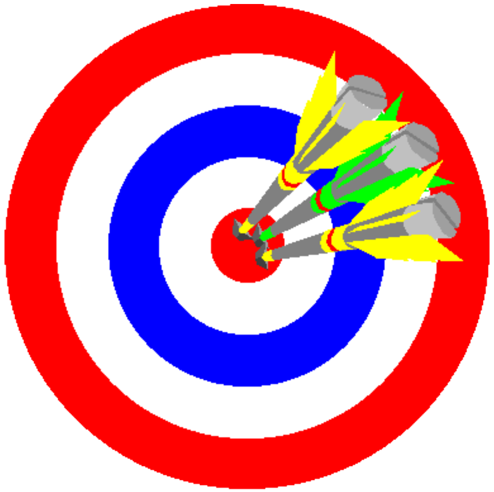
- All pre-2004 OH transformers replaced with new high efficiency units
- Lower core losses account for ~31 ave. kW

9CE12F4 Open Wire Secondary



9CE12F4 Outcome

- Clear understanding of the state of facility
- Understanding of work & resource staging
- Understanding of volt/var and voltage reduction opportunity
- Baseline for savings validation
- Future rebuilds are warranted



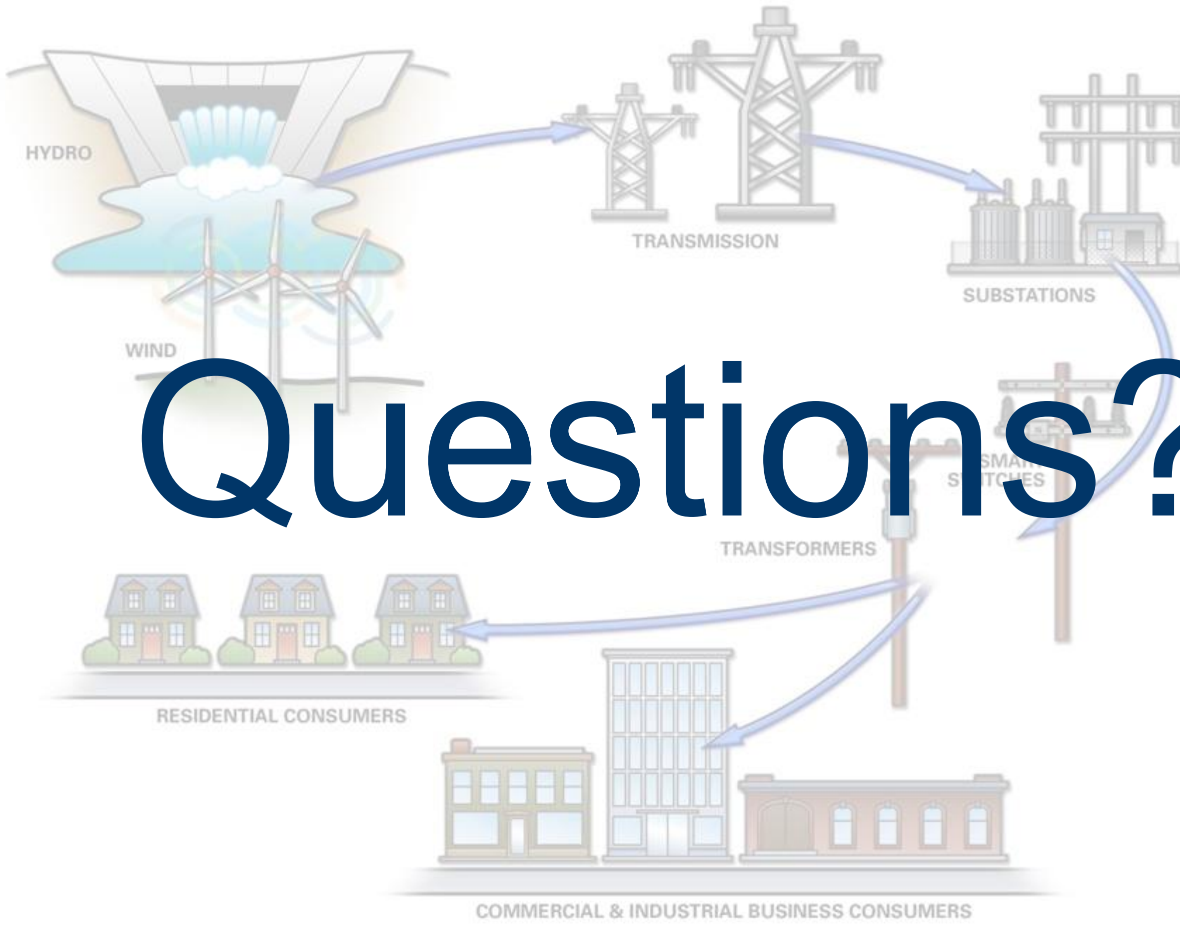
Future Programs

FEEDER REBUILDS

Feeder Rebuilds

- Detailed analysis has been completed for six feeders
- Results extrapolated to the remaining feeders
- The top 60 feeders targeted for energy savings in IRP
- Schedule is being developed based on resource availability
- Rebuilds to begin in 2013

Questions?



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Avista's 2011 Electric Integrated Resource Plan

Technical Advisory Committee Meeting No. 6 Agenda

Avista Headquarters – Spokane, Washington

Thursday, June 23, 2011
Avista Conference Room 130

Topic	Time	Staff
1. Introduction	9:30	Storro
2. High Wind Market Analysis	9:35	Kalich
3. PRS & Scenario Analysis	10:15	Gall
4. IRP Action Items	11:15	Lyons
5. IRP Section Highlights	11:45	Kalich
6. Lunch	12:15	
7. Adjourn		

High Wind Market Analysis

James Gall

Technical Advisory Committee Meeting #6

2011 Electric Integrated Resource Plan

June 23, 2011

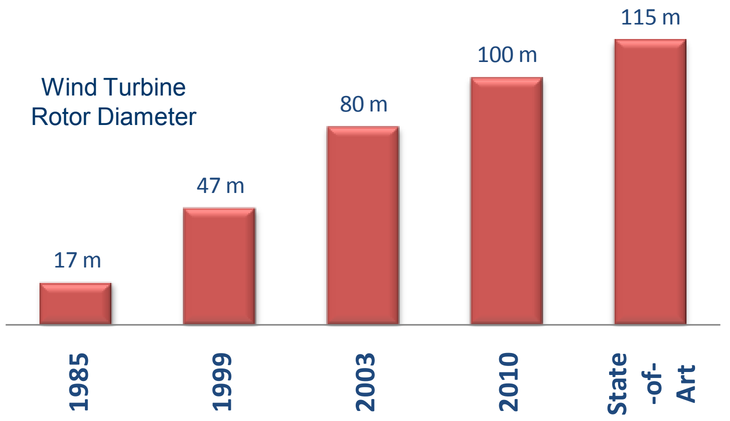
Northwest Wind Facts

- Pacific Northwest wind fleet by balancing authority (~5,200 MW)

Bonneville	~3,500 MW
PacifiCorp	~1,400 MW
Puget Sound Energy *	275 MW
Avista	35 MW

- 2/3 of NW wind fleet is on BPA system
  - 10,500 MW peak load
  - 80% exported to other utilities
  - BPA balance authority forecast
    - 5,250 MW in 2012
    - 8,700 MW in 2020

Wind Turbines Are Getting Bigger



* PSE has 430 MW of wind, 155 MW is in Bonneville's balancing area

Exhibit No. 4
Case Nos. AVU-E-12-08
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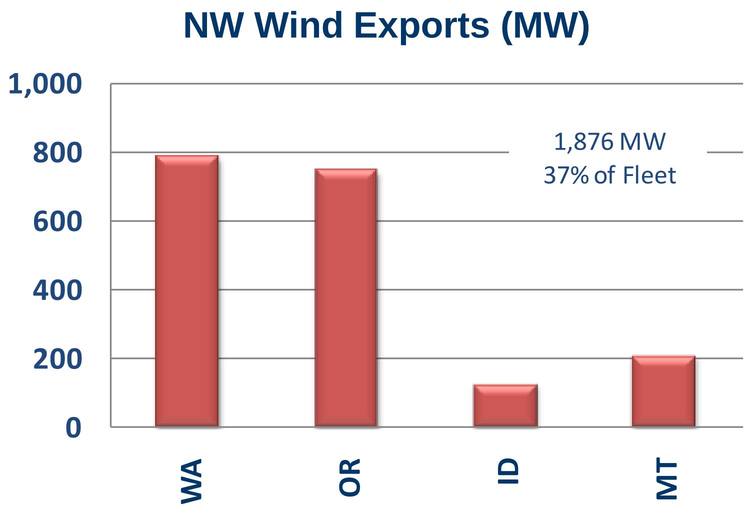
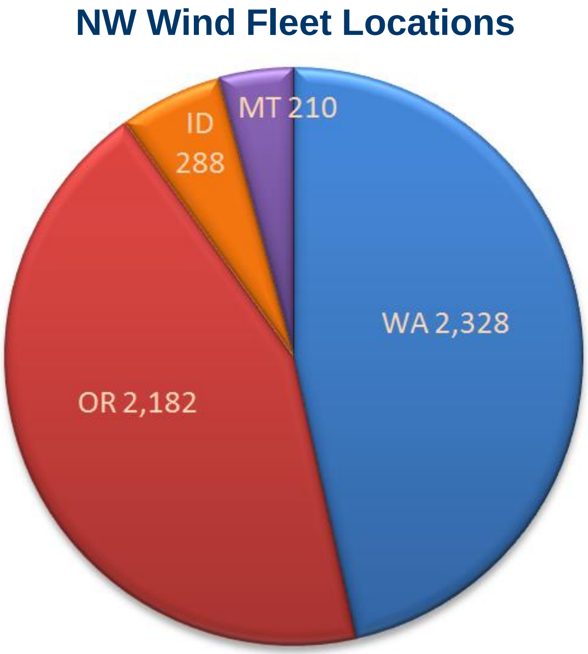
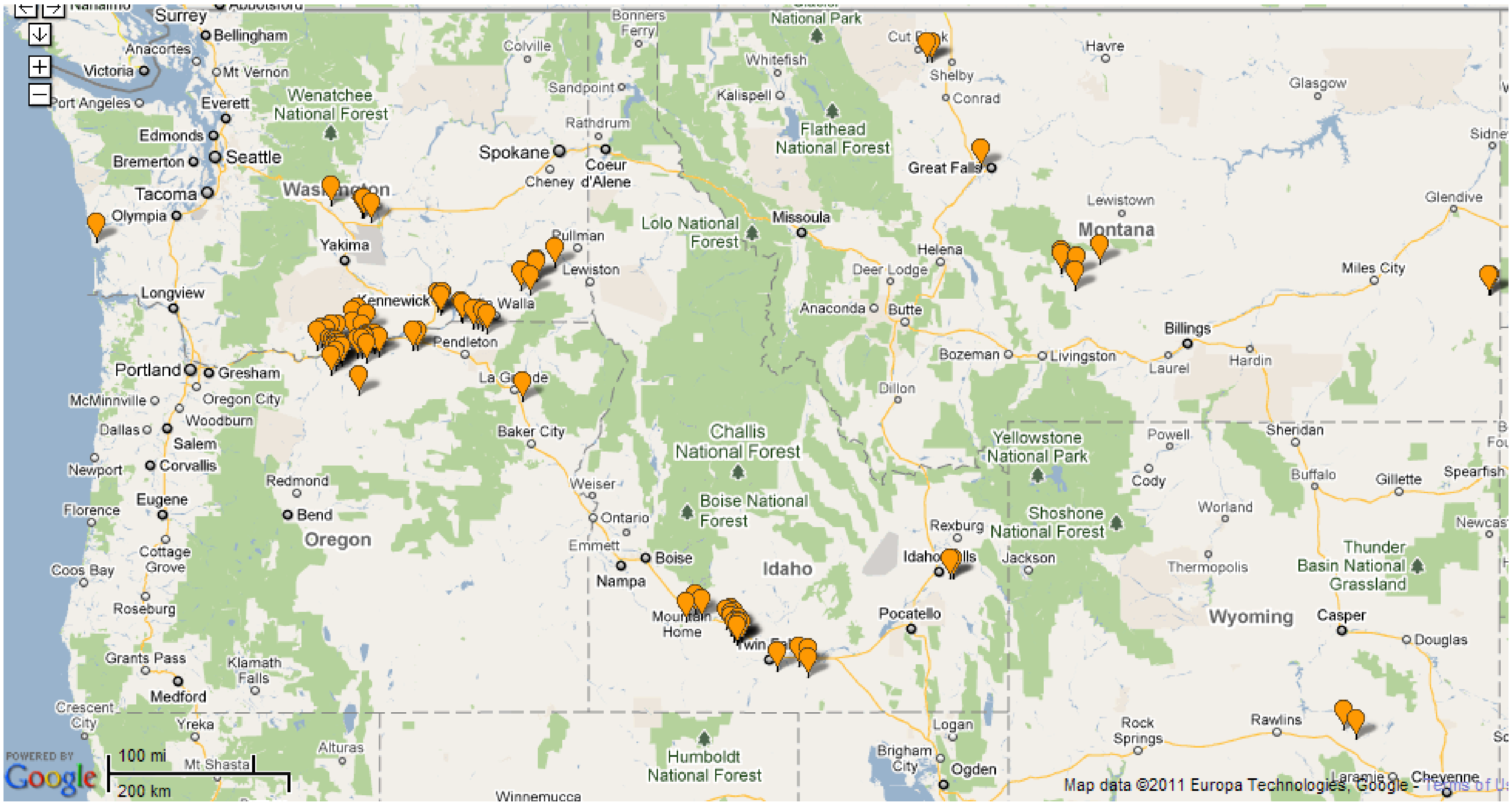
Schedule 1, Page 659 of 1069

Northwest Wind Resource Locations & Exports





Northwest Wind Fleet Locations



Source: RNP.org

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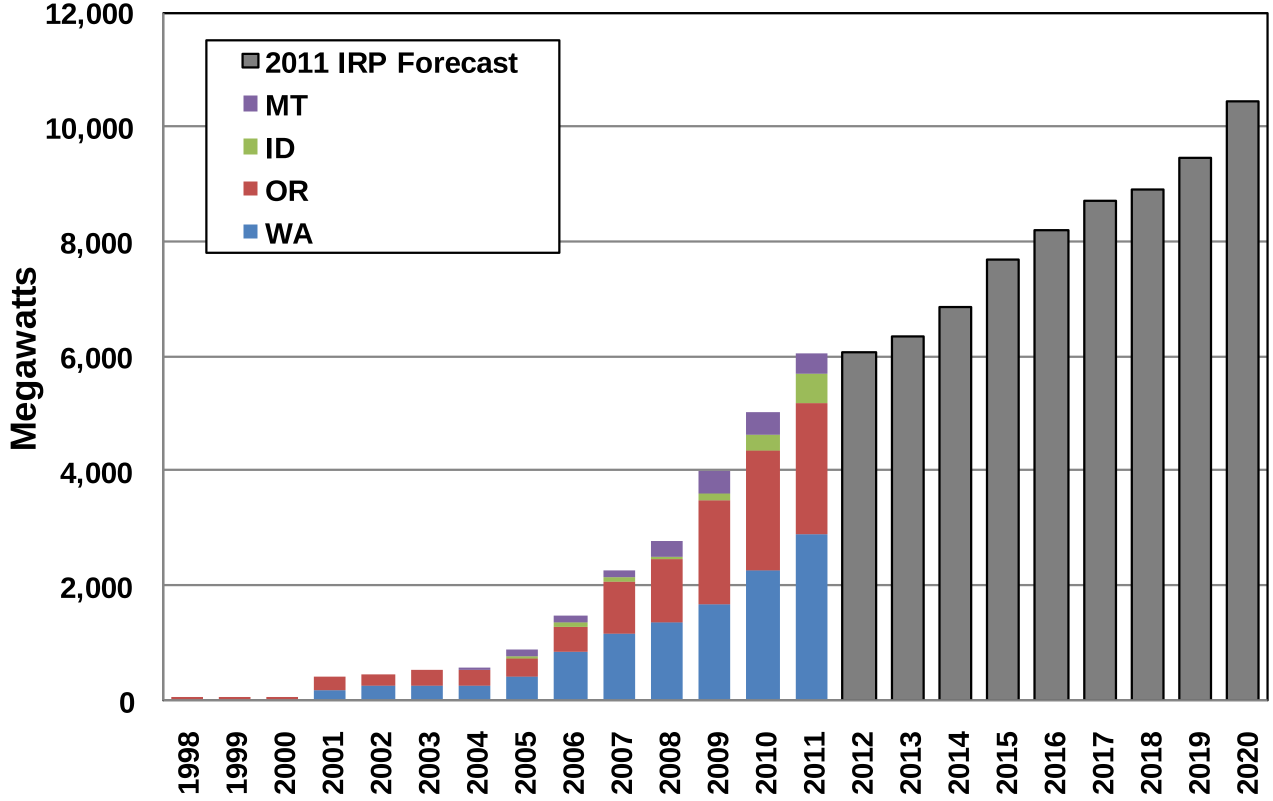
Schedule 1, Page 661 of 1069

Northwest Wind Capacity Past and Future

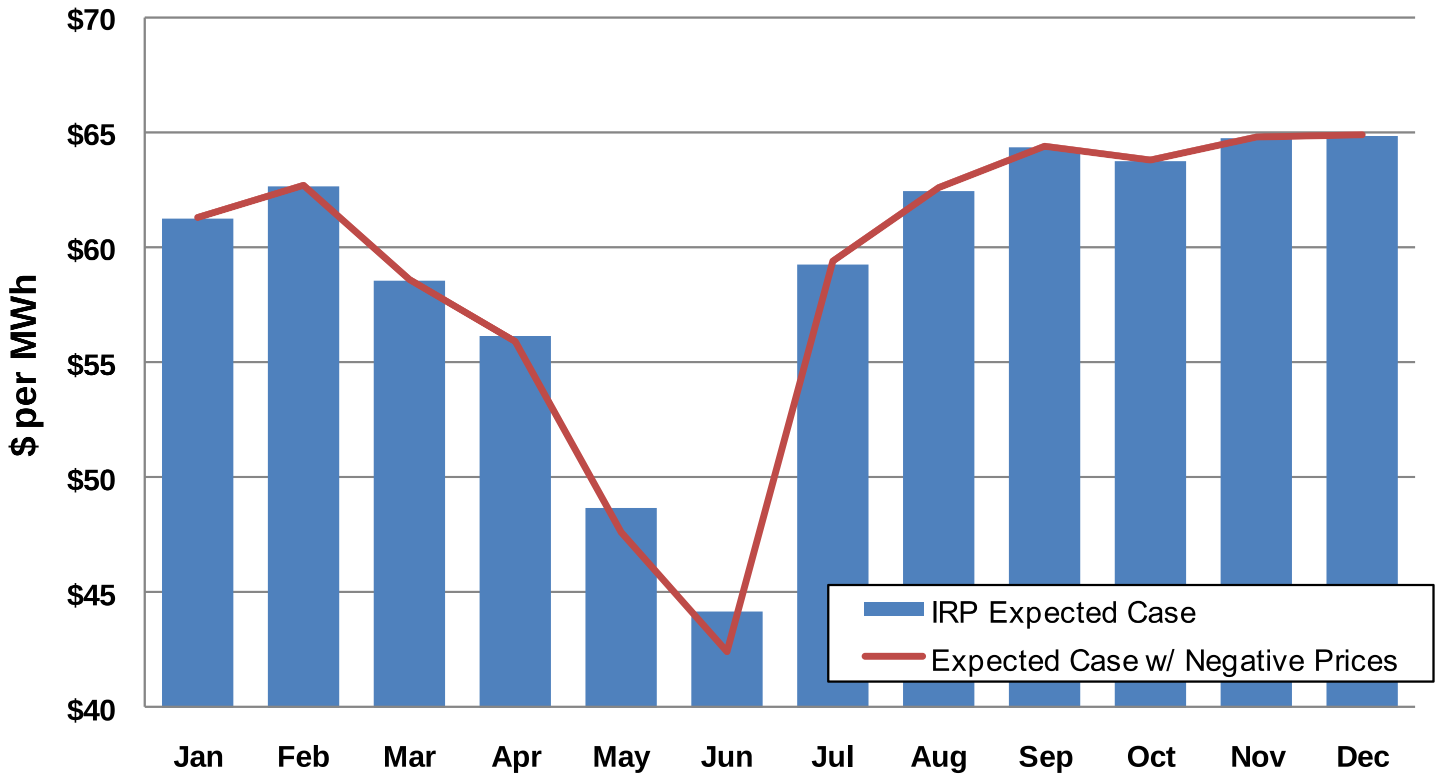


Historical data provided by RNP website

Study Scope

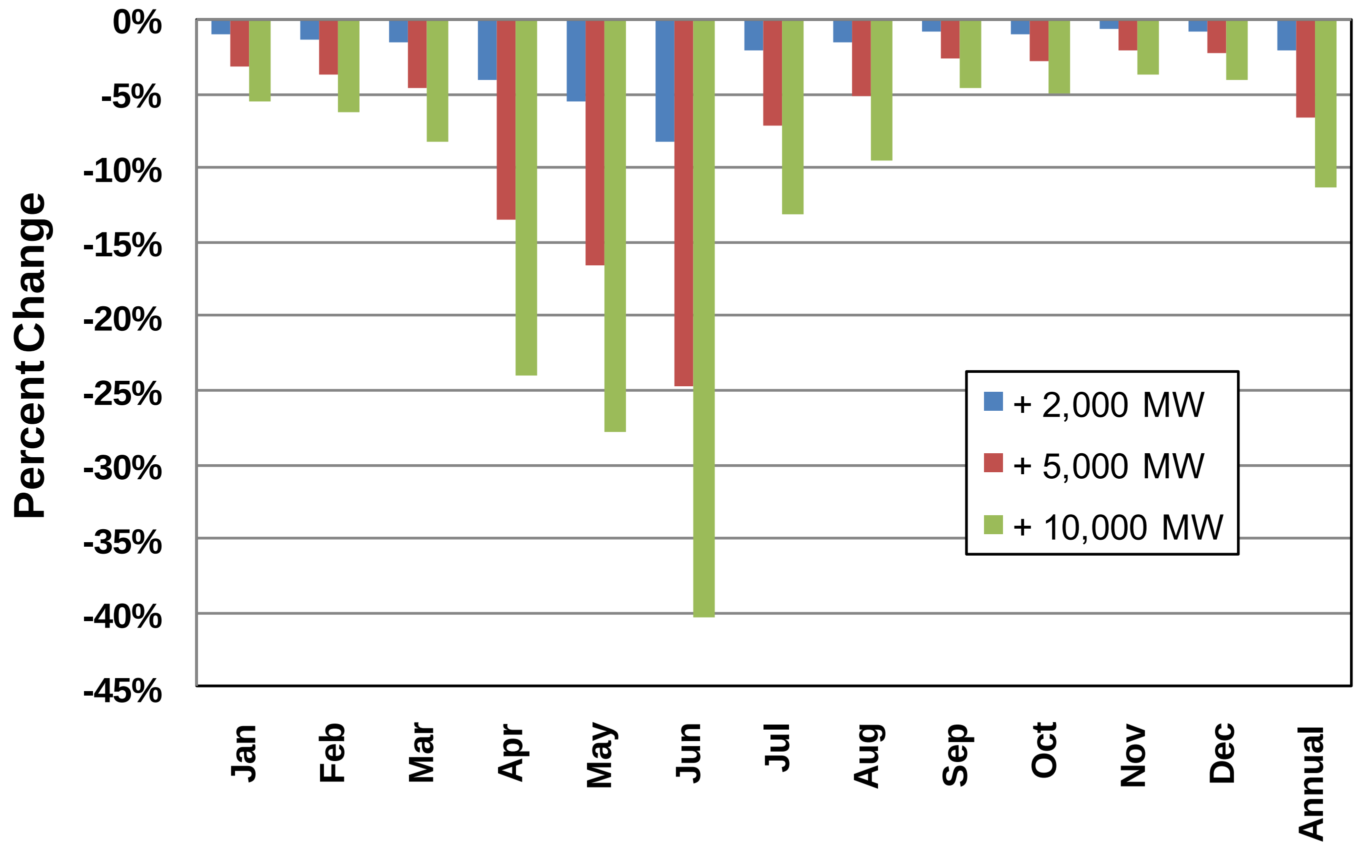
- Understand impact to the power system with more than forecasted amount of wind generation
- Uses IRP Expected Case for 2015
- Adjust model to allow for negative pricing using -$40/MWh for Northwest hydro projects and -$10 to -$30/MWh for wind projects
- Run 100 iterations for each of these scenarios
  - Add 2,000 MW of wind
  - Add 5,000 MW of wind
  - Add 10,000 MW of wind

Negative Price Impact to IRP Expected Case Market Forecast

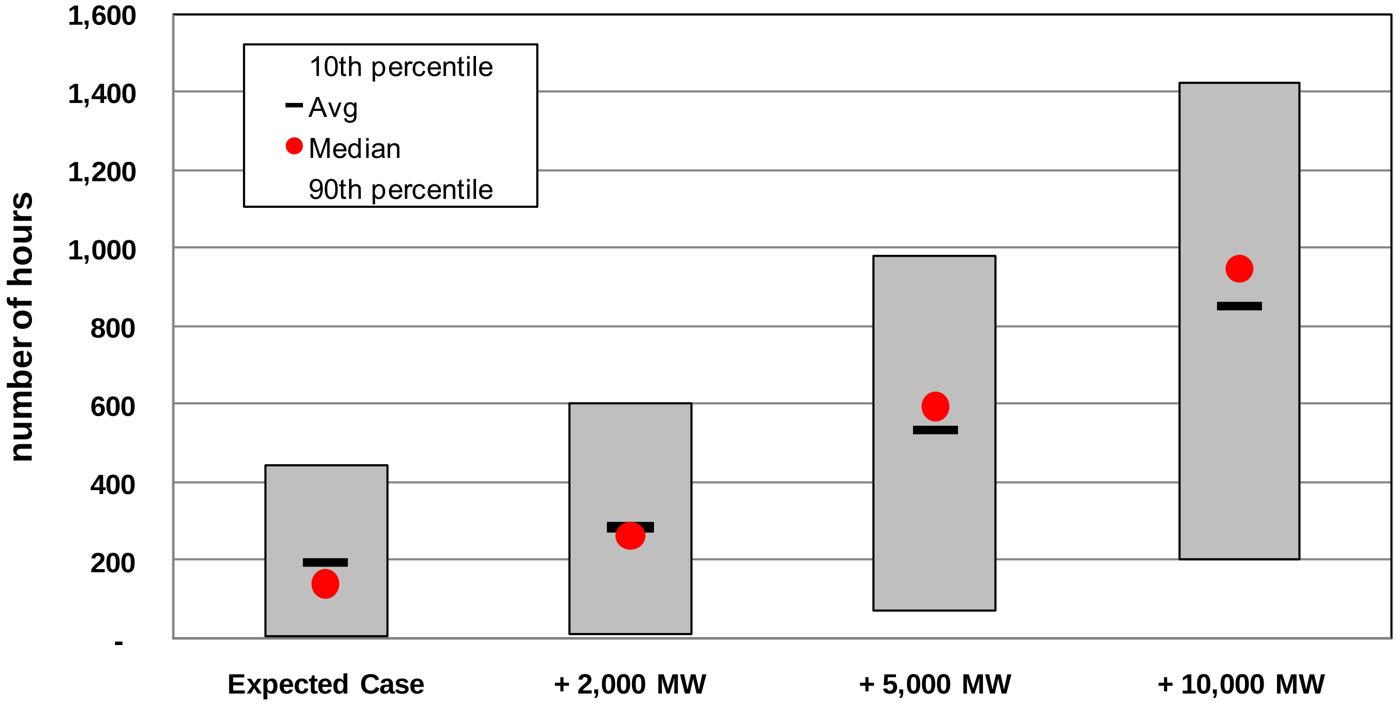


Annual price change is -0.3%, Q2 would be 2.2% lower

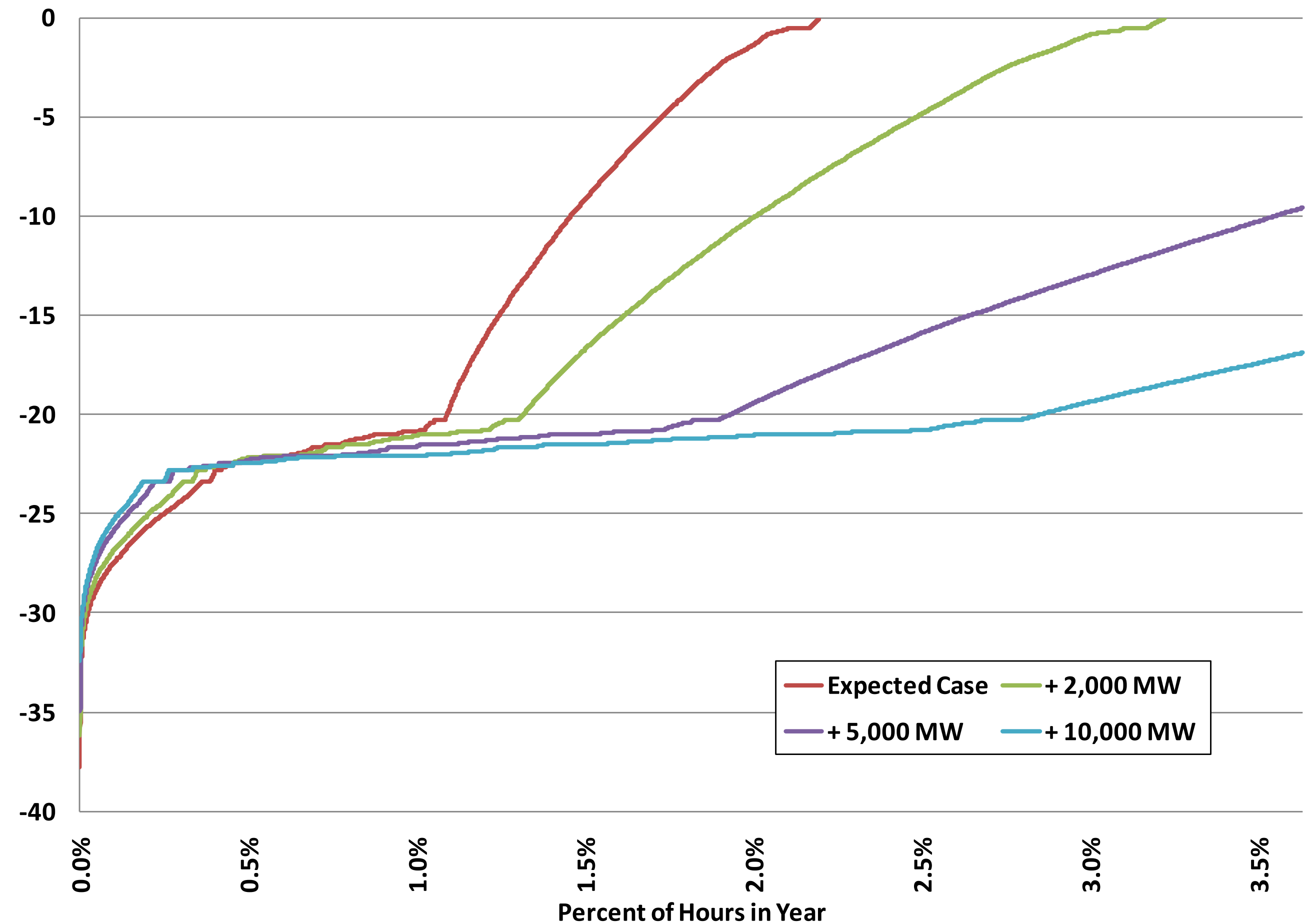
Wind Scenarios: Change to Monthly Average Mid-Columbia Electric Prices



Wind Scenarios: Change to Occurrences of Negative Prices



Wind Scenarios: Negative Price Duration Curve



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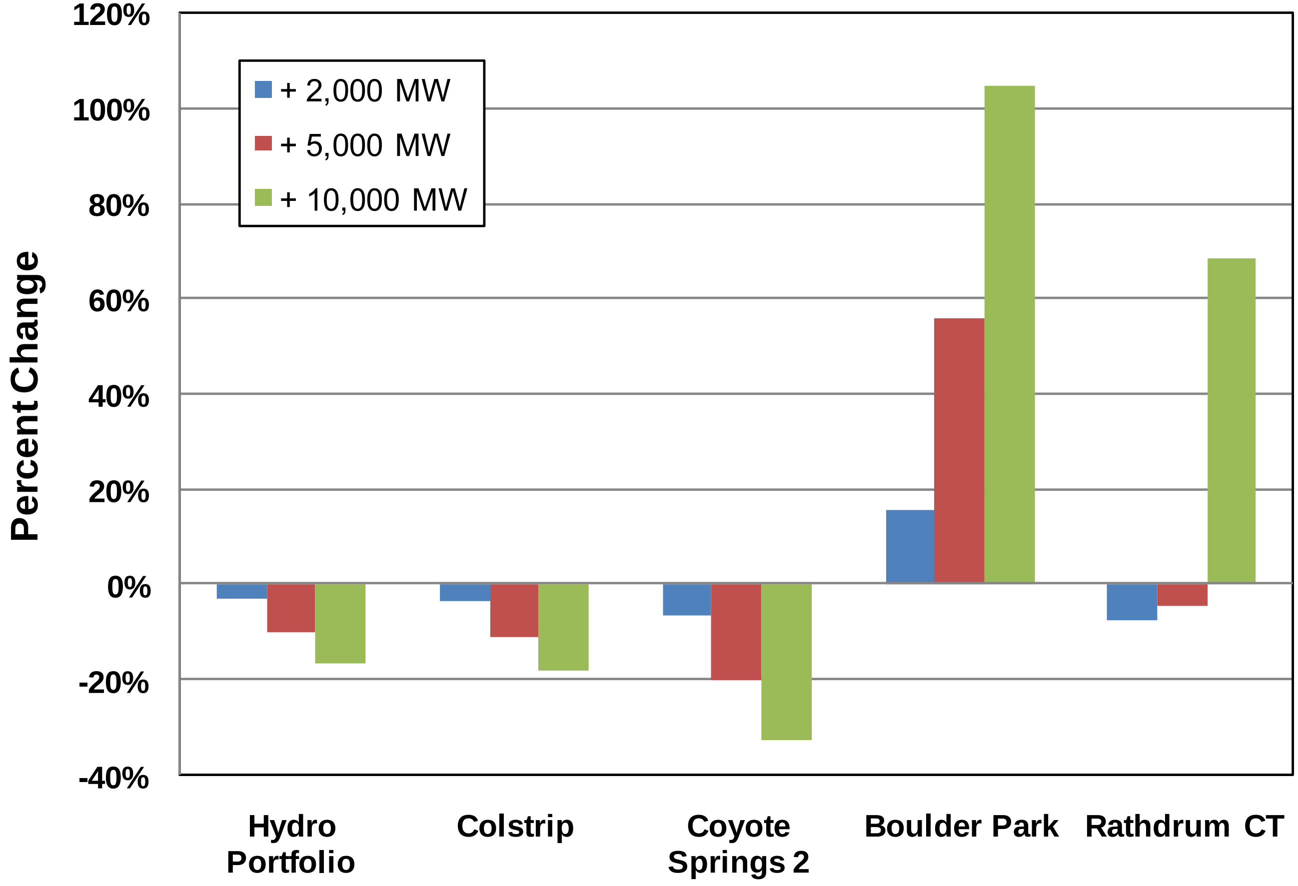
Wind Scenarios: Change to Avista Plant Operating Margins



Preferred Resource Strategy & Scenario Analysis

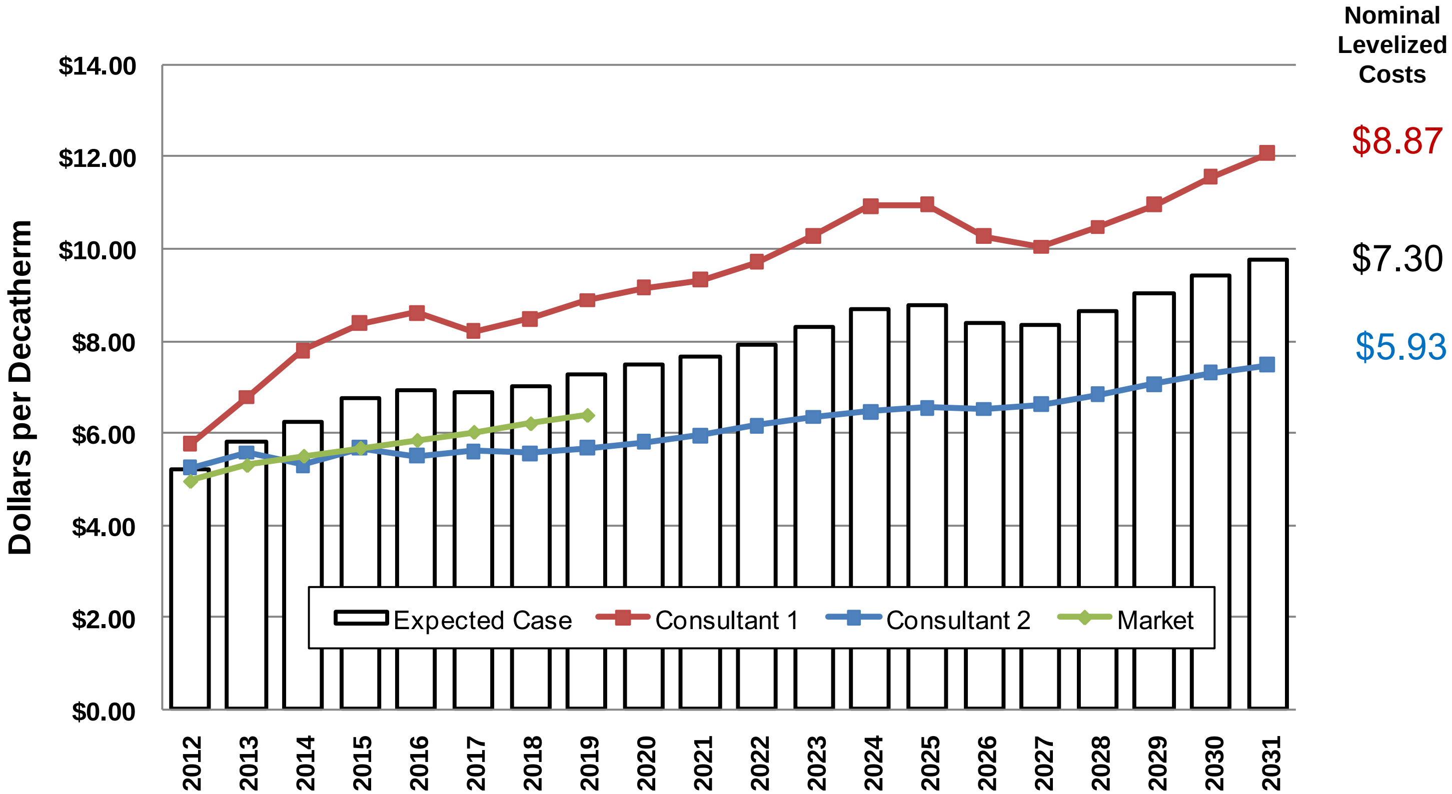
James Gall

Technical Advisory Committee Meeting #6

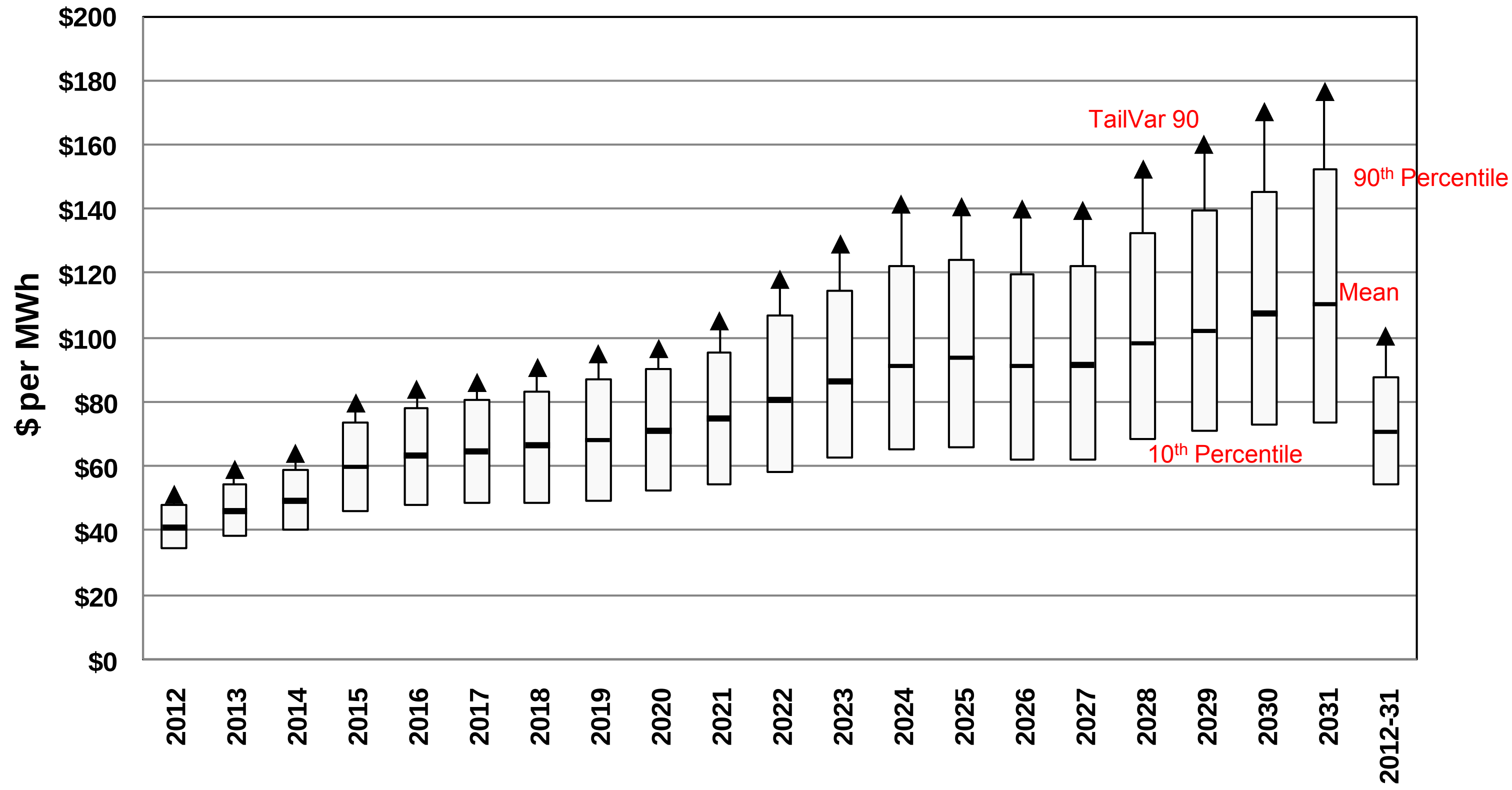
2011 Electric Integrated Resource Plan

June 23, 2011

Natural Gas Price Forecast (Henry Hub)



Expected Case: Mid-Columbia Electric Price Forecast



20 Year Levelized Price of $70.50 ($54 to $87) per MWh

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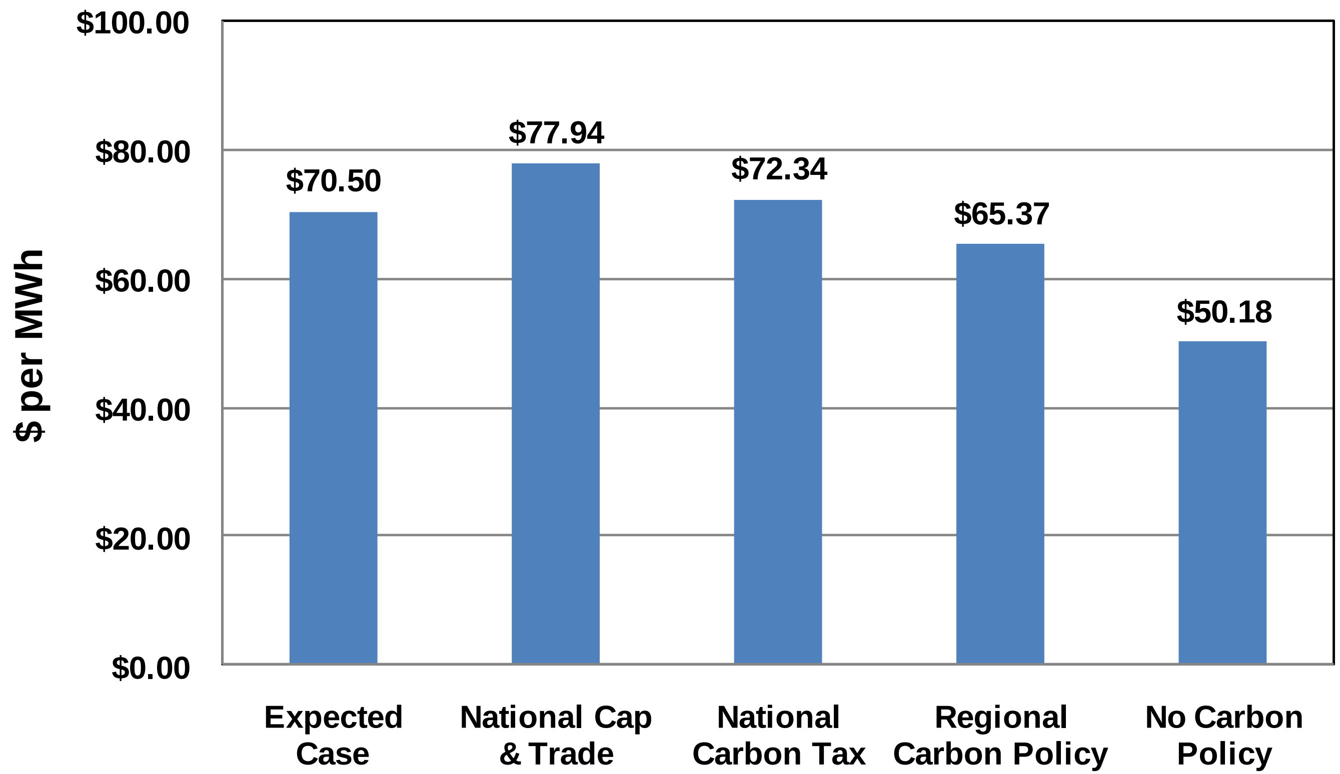
Mid-Columbia Electric Price Forecast
Nominal 20 year Levelized Prices



Scenarios are deterministic study results

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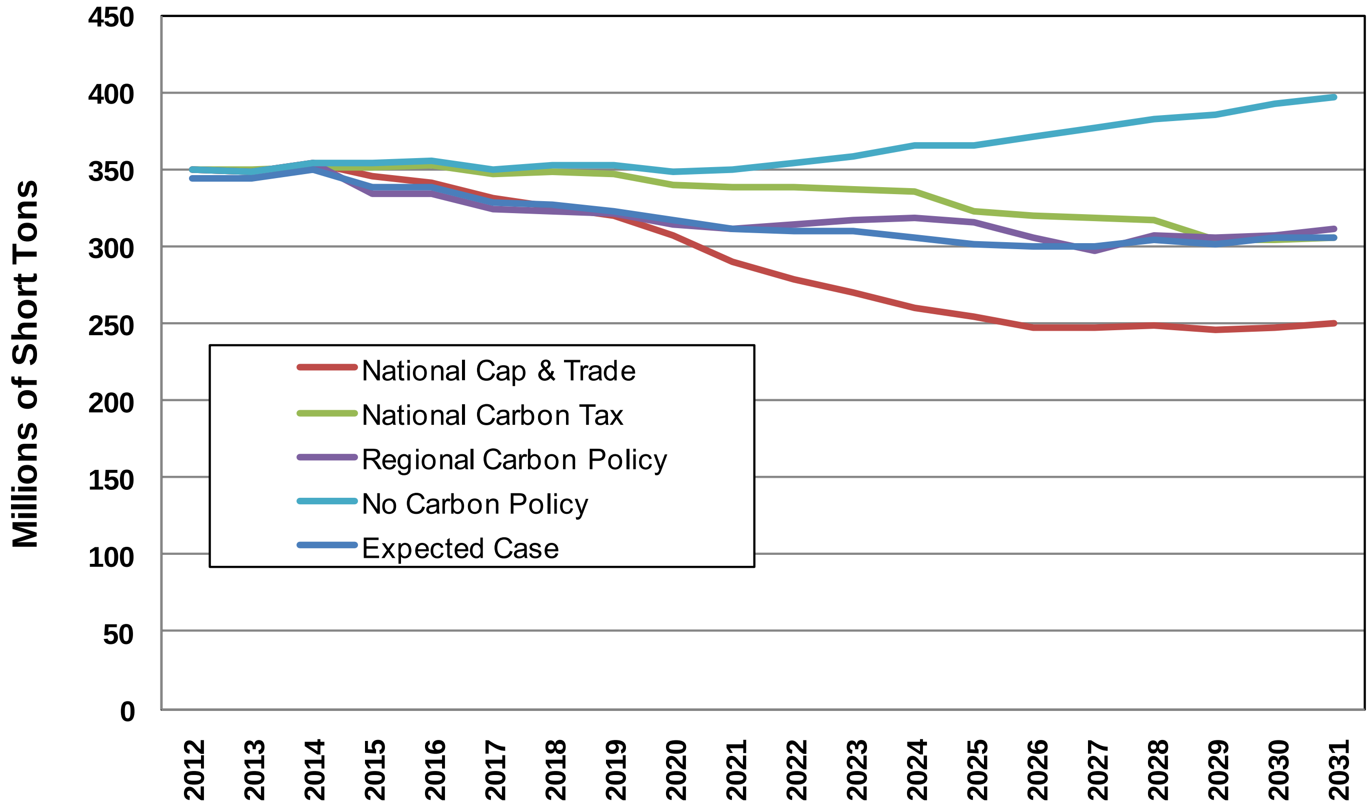
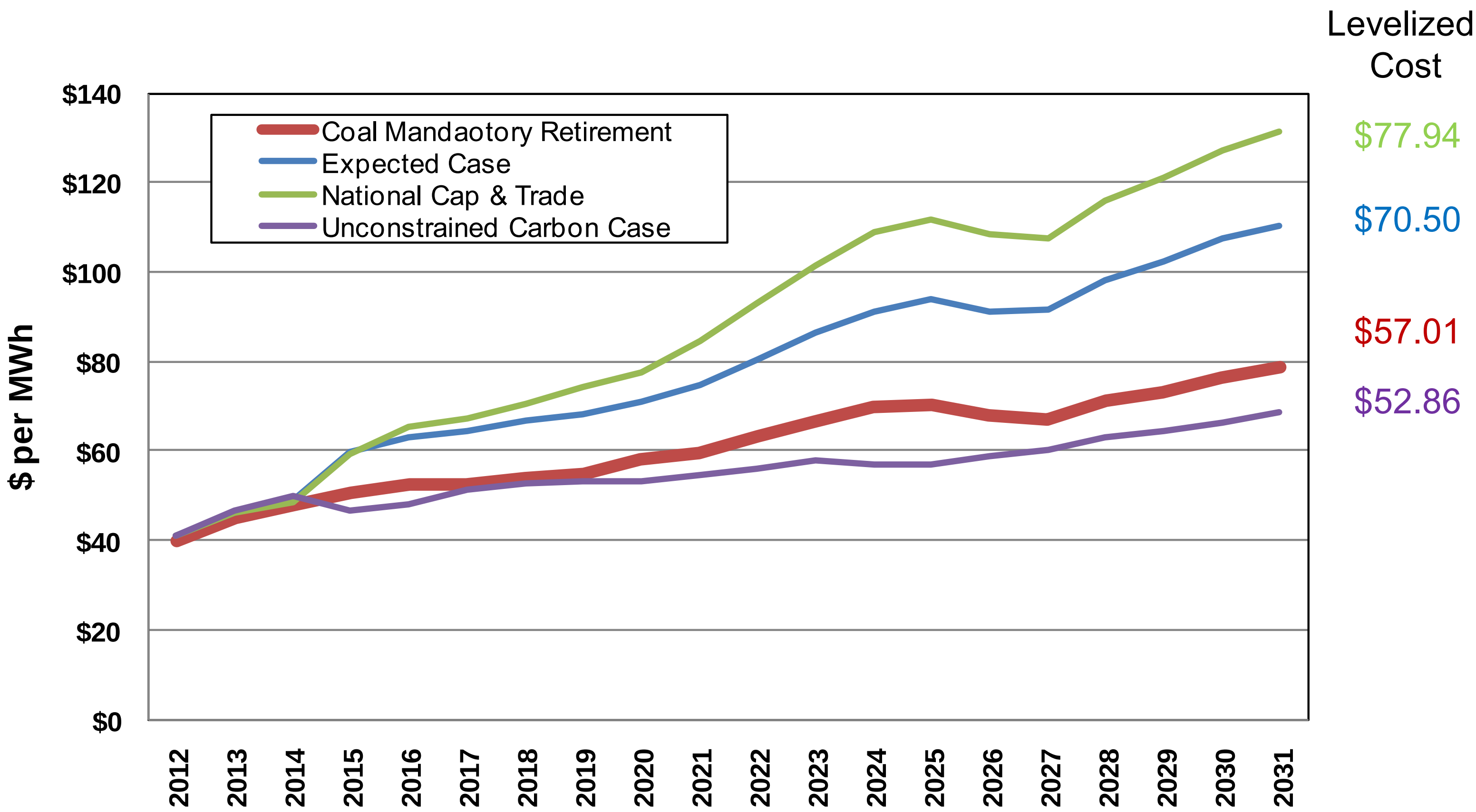
Western Interconnect Greenhouse Gas Forecast



Mandatory Coal Retirement Scenario

- Coal plants are to be phased out after 40 years of life.
- No greenhouse gas penalties
- Uses Expected Case's natural gas forecast
- Modeled stochastically using 500 iterations

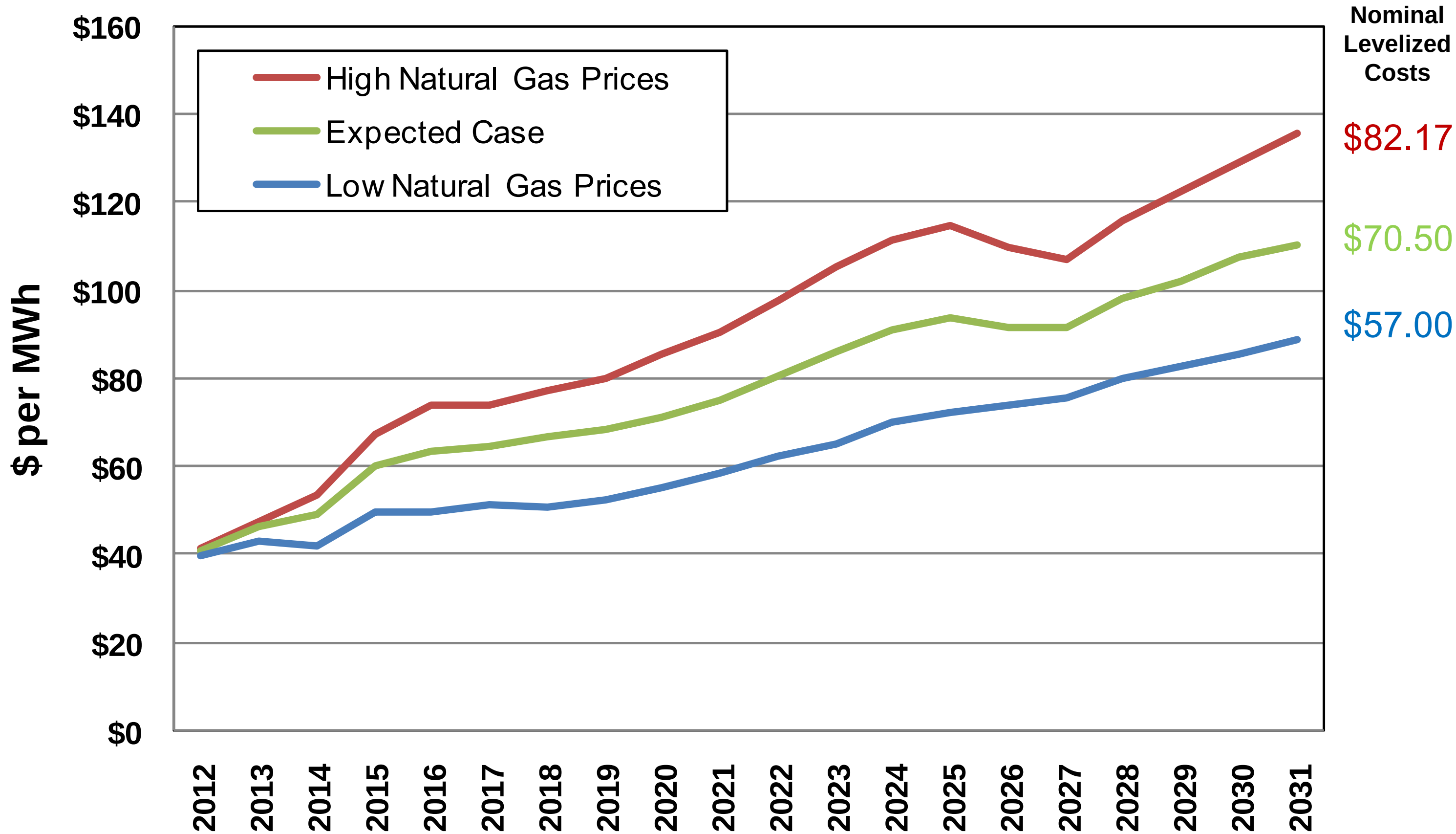
Mid-Columbia Electric Price Forecast



Greenhouse Gas and Costs of Carbon Mitigation Scenarios

Market Scenario	Change to GHG Emissions From 2012 by 2031	Added Levelized Cost per Year (Billions)
Unconstrained GHG Gas Case	14%	0.0
Expected Case	-18%	3.5
Coal Mandatory Retirement	-22%	8.1
National Cap & Trade	-29%	4.9

Mid-Columbia Price Forecast with Natural Gas Price Sensitivities

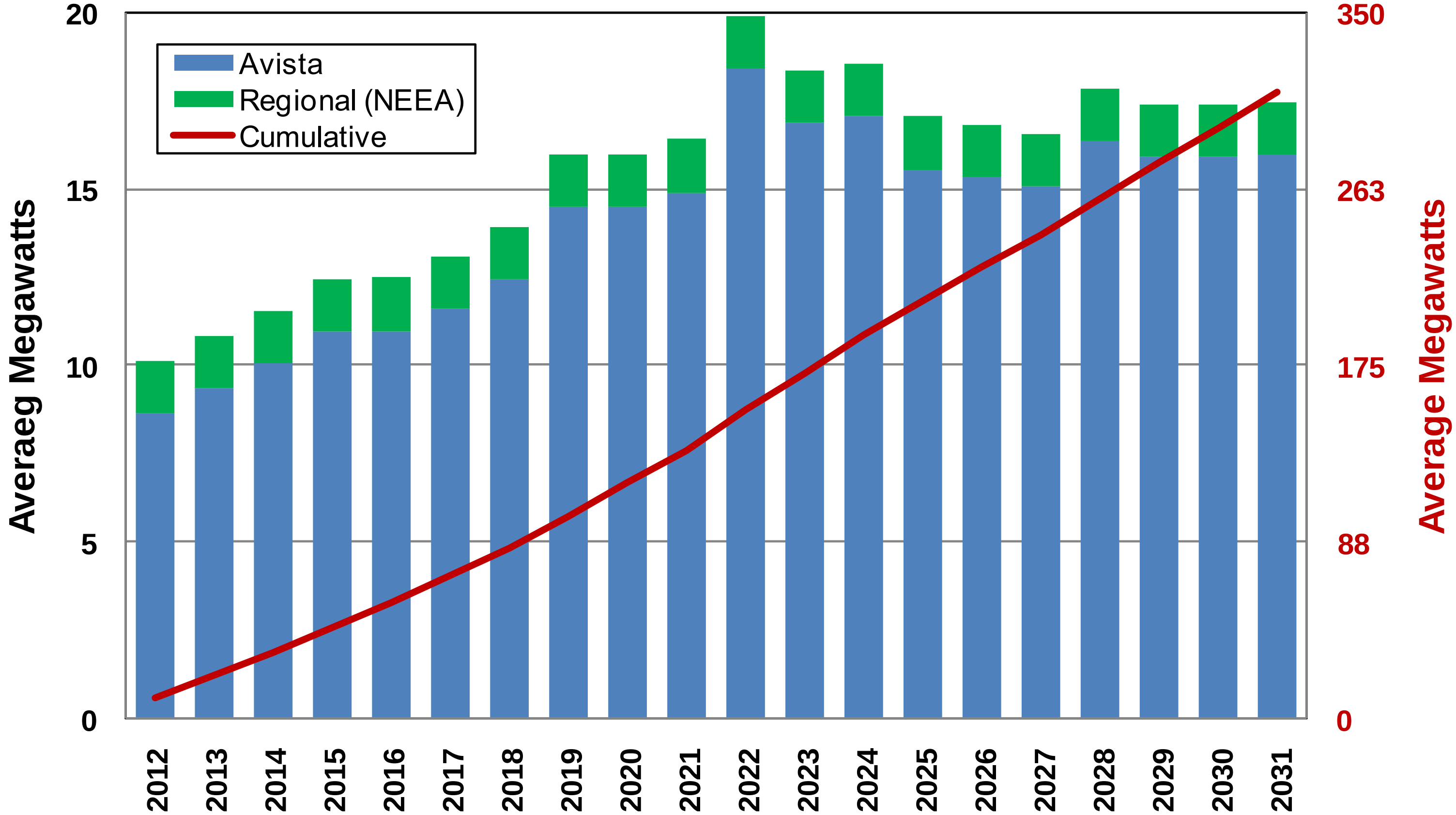


All cases have the same greenhouse reduction goal, but have different prices

2011 Draft Preferred Resource Strategy

Year Ending	Resource
2012	Wind (~ 42 aMW REC)
2018	Simple Cycle CT(~ 83 MW)
2020	Simple Cycle CT (~ 83 MW)
2018-2019	Thermal Upgrades (~ 7 MW)
2018-2019	Wind (~ 43 aMW REC)
2023	Combined Cycle CT (~ 270 MW)
2026/27	Combined Cycle CT (~ 270 MW)
2029	Simple Cycle CT (~ 46 MW)
2012+	Distribution Feeder Upgrades (13 aMW by 2031)
2012+	Conservation (310 aMW by 2031)

Conservation Projection



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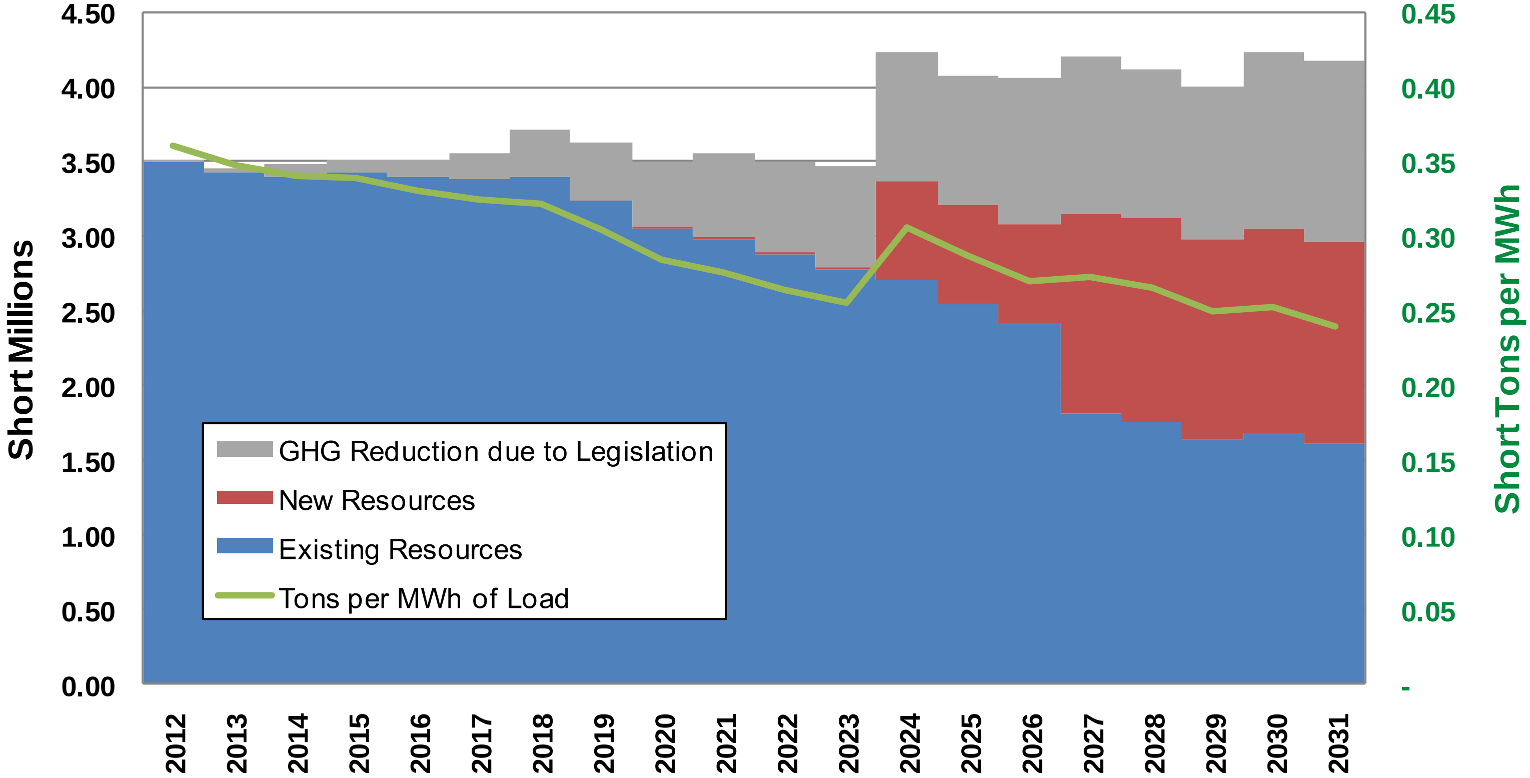
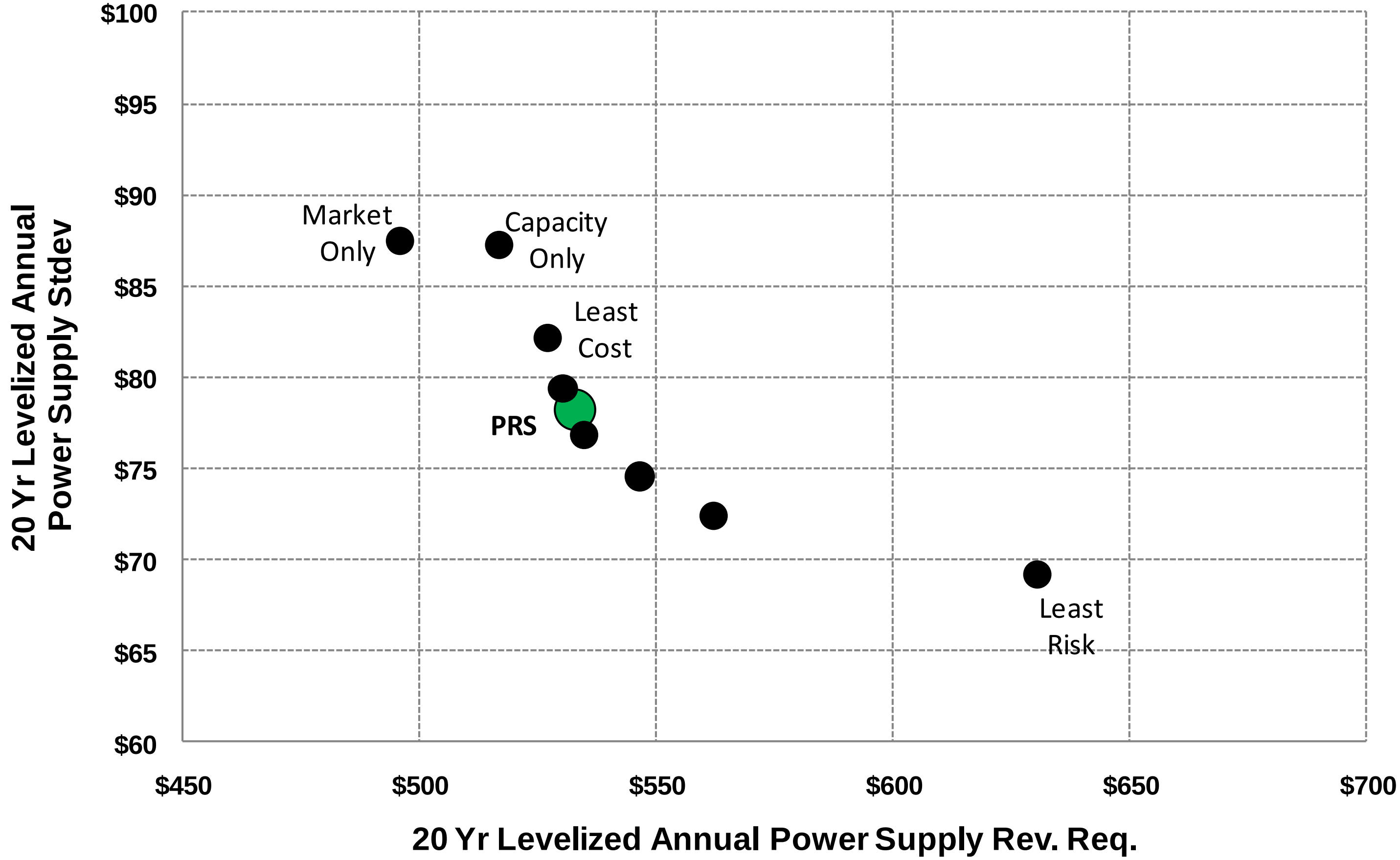
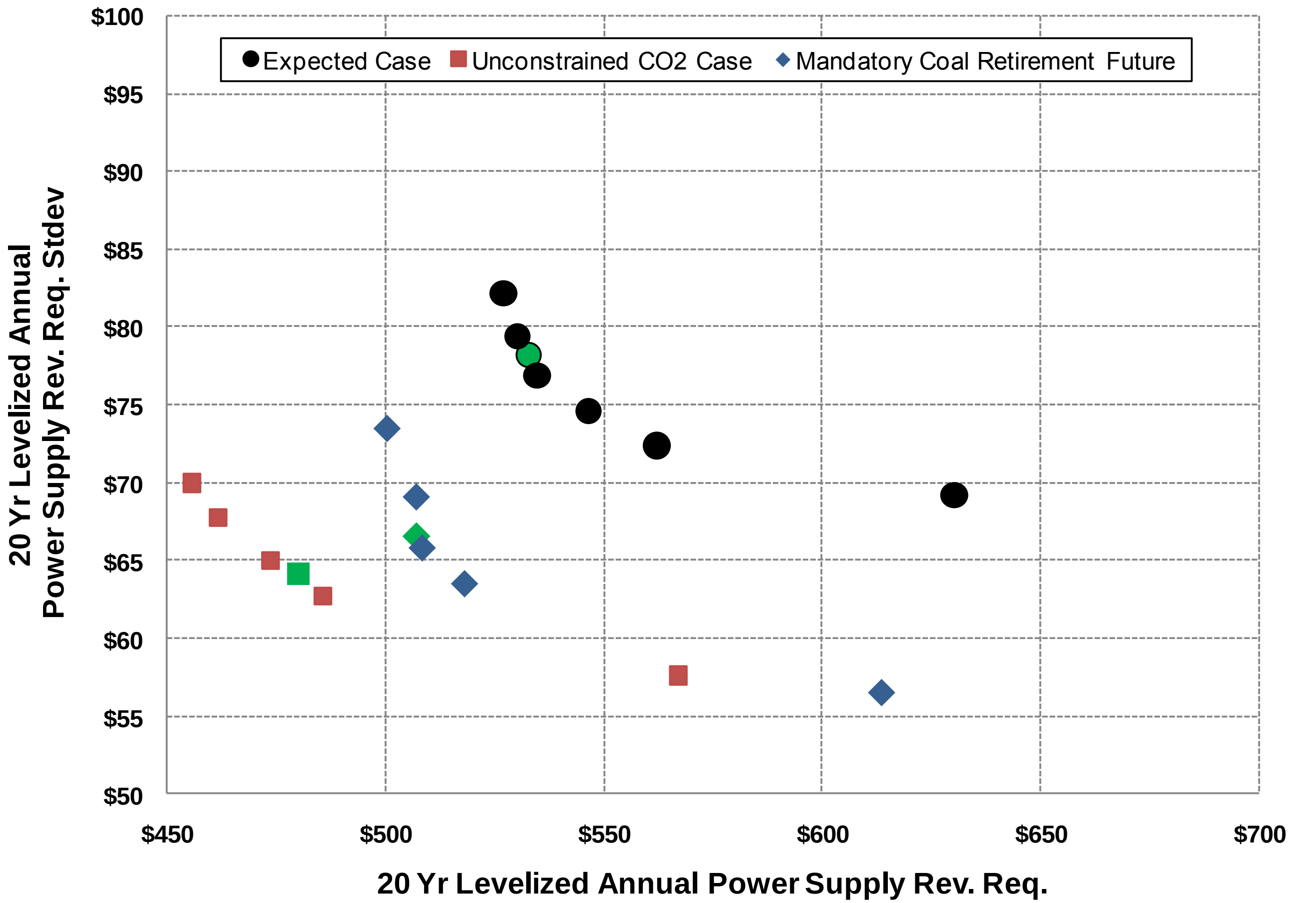
Avista Resource's Greenhouse Gas Emissions



Efficient Frontier



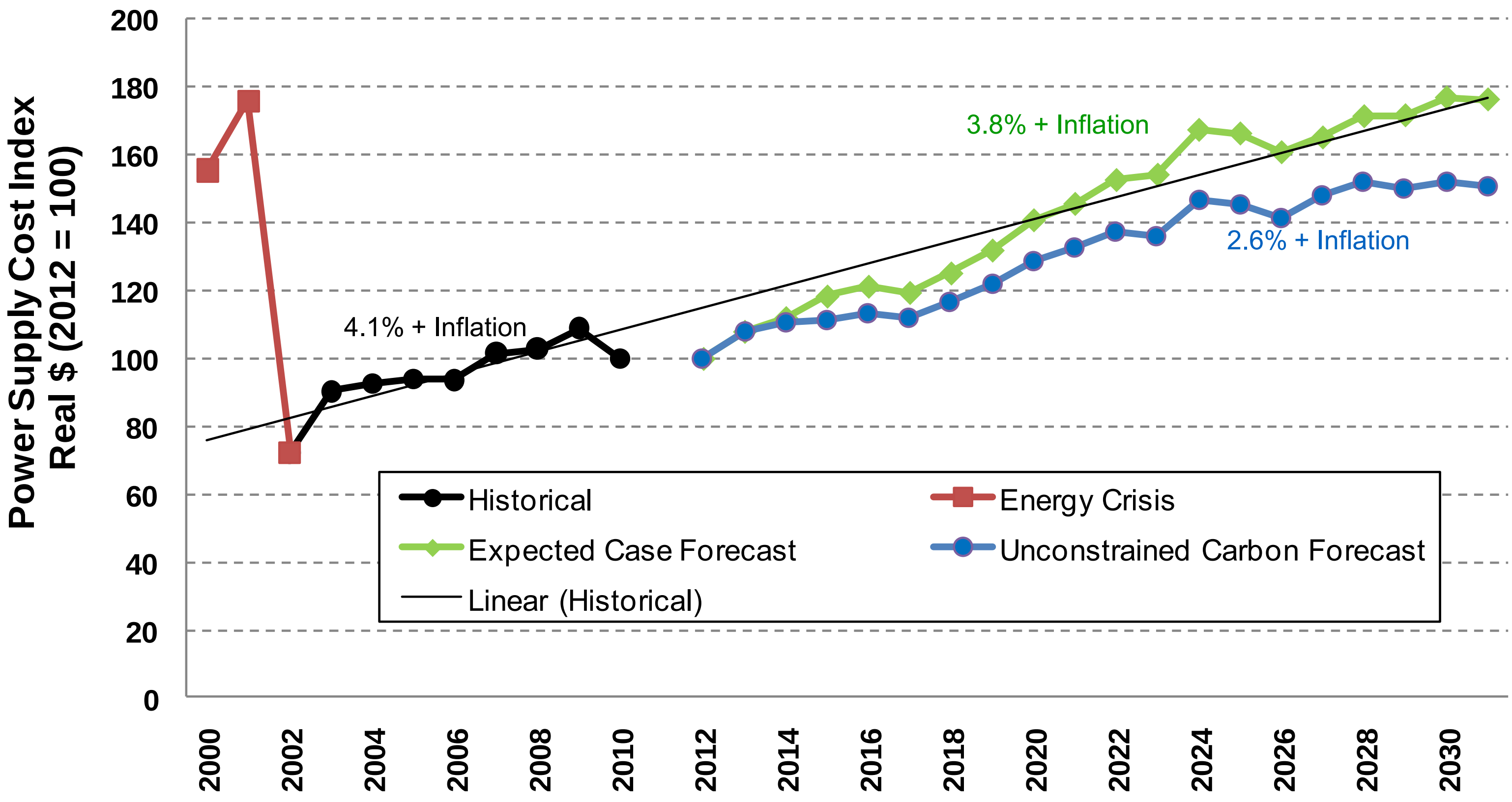
Efficient Frontier with Alternative Greenhouse Gas Methodologies



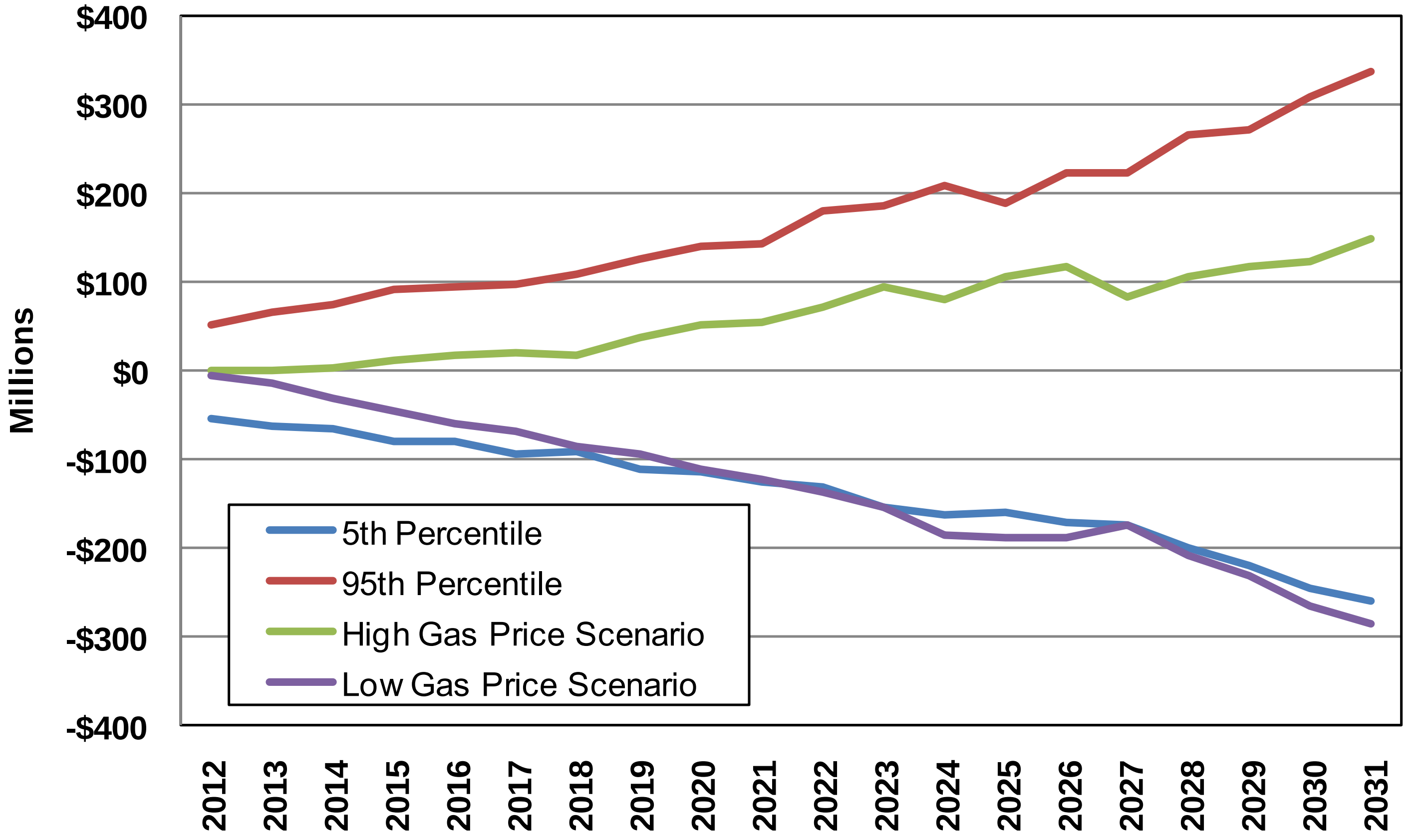
Greenhouse Gas Methodologies Summary

	Expected Case	Unconstrained Carbon	Coal Retirement
2012-2022 Cost NPV	3,094	2,886	2,937
2012-2031 Cost NPV	5,735	5,168	5,458
2022 Expected Cost	636	564	576
2022 Stdev	91	68	71
2022 Stdev/Cost	14%	12%	12%
2022 CO_2 Emissions (000's)	2,894	3,498	3,752
2031 CO_2 Emissions (000's)	2,972	4,177	3,560

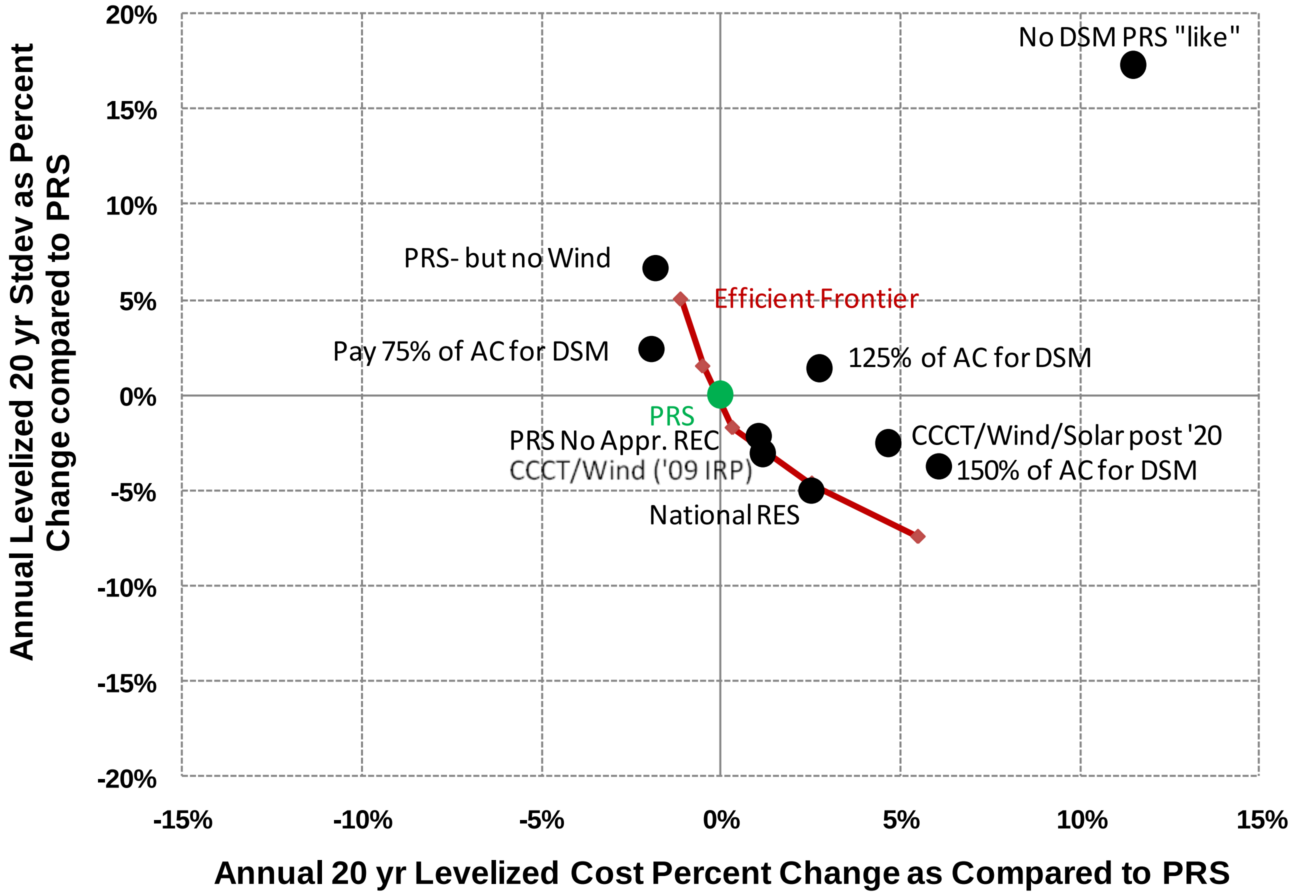
Power Supply Cost/MWh Index



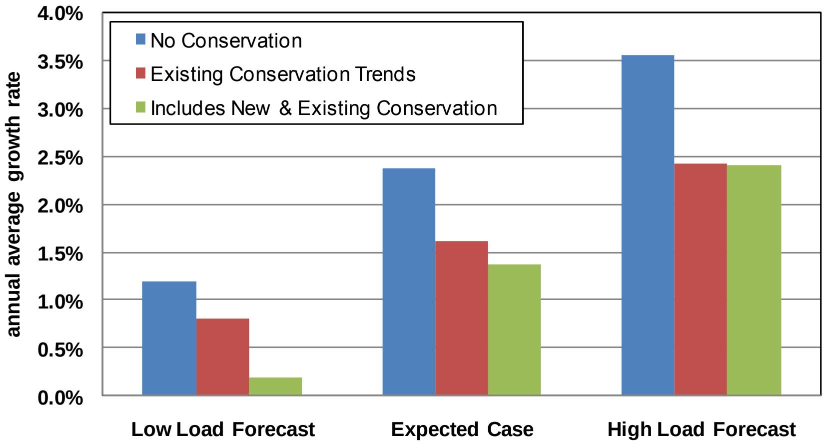
Power Supply Costs with Alternative Natural Gas Prices (Preferred Resource Strategy)

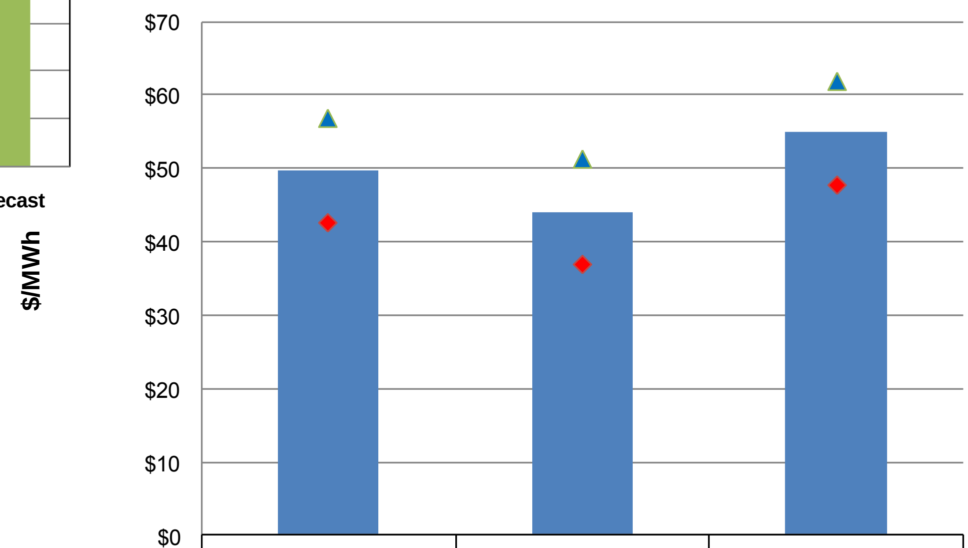


Efficient Frontier vs Alternative Portfolios



Load Growth Sensitivities





	Base Case	Low Load Growth	High Load Growth
Levelized Cost $/MWh	49.75	44.11	54.86
1 Sigma Lower	42.67	36.99	47.80
1 Sigma Higher	56.83	51.23	61.92

Portfolio Resources (MW)

Portfolio	SCCT (Nameplate)	CCCT (Nameplate)	Thermal Upgrades	Wind (Energy)	Solar (Energy)	Conservation (Energy)	Dist. Feeders (Energy)
Preferred Resource Strategy	212	540	4	71	0	310	13
Least Cost	747	0	0	71	0	310	13
Least Risk	187	540	17	98	64	310	13
50% Cost/50% Risk	177	540	4	93	9	310	13
75% Cost/ 25% Risk	332	540	0	82	0	310	13
25% Cost/ 75% Risk	83	810	4	95	5	310	13
PRS without Apprentice Credits	212	540	4	96	0	310	13
2009 IRP "Like"	0	810	0	102	0	310	13
PRS Without Wind	212	540	4	0	0	310	13
CCCT with Solar after 2015	0	810	10	36	33	310	13
PRS + Wind to meet National RES	212	540	4	177	1	310	13
PRS if no Conservation	475	815	10	94	0	0	13
PRS Conservation A/C 25% Lower	249	540	4	82	0	266	13
PRS Conservation A/C 25% Higher	415	270	7	70	0	334	13
PRS Conservation A/C 50% Higher	129	540	4	70	0	350	13
Low Load Growth	212	0	4	71	0	247	13
High Load Growth	510	810	10	93	1	443	13

AVISTA

2011 IRP Action Items

John Lyons

Technical Advisory Committee Meeting #6

2011 Electric Integrated Resource Plan

June 23, 2011

2009 IRP Action Item Review

2009 IRP Action Items

- Resource Additions and Analysis
- Energy Efficiency
- Environmental Policy
- Modeling and Forecasting Enhancements
- Transmission Planning

2009 Action Items – Resource Additions & Analysis

- Continue to explore the potential for wind and non-wind renewable resources.
- Issue an RFP for turbines at Reardan and up to 100 MW of wind or other renewables in 2009.
- Finish studies on the costs and environmental benefits of hydro upgrades at Cabinet Gorge, Long Lake, Post Falls, and Monroe Street.
- Study potential locations for the natural gas-fired resource identified to be online between 2015 and 2020
- Continue participation in the regional IRP processes and where agreeable find resource opportunities to meet resource requirements on a collaborative basis.

2009 Action Items – Energy Efficiency

- Pursue American Reinvestment and Recovery Act of 2009 (ARRA) funding for low income weatherization.
- Analyze and report on the results of the July 2007 through December 2009 demand response pilot in Moscow and Sandpoint.
- Have an external party perform a study on technical, economic, and achievable potential for energy efficiency in Avista's entire service territory.
- Study and quantify transmission and distribution efficiency concepts as they apply to meeting Washington's RPS goals.
- Update processes and protocols for conservation measurement, evaluation and verification.
- Determine the potential impacts and costs of load management options.

2009 Action Items – Environmental Policy

- Continue to study the potential impact of state and federal climate change legislation.
- Continue and report on the work of Avista's Climate Change Council.

2009 Action Items – Modeling & Forecasting

- Refine stochastic model cost driver relationships.
- Continue PRiSM refinements by developing a resource retirement capability to solve for other risk measurements and by adding more resource options.
- Continue developing Loss of Load Probability and Sustained Peaking analysis for inclusion in the IRP process, and confirm appropriateness of the 15% capacity planning margin assumed for this IRP.
- Continue studying the impacts of climate change on the load forecast.
- Study load growth trends and their correlation to weather patterns.

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2009 Action Items – Transmission Planning

- Work to maintain/retain existing transmission rights on the Company's transmission system, under applicable FERC policies, for transmission service to bundled retail native load.
- Continue to participate in BPA transmission practice processes and rate proceedings to minimize the costs of integrating existing resources outside of the Company's service area.
- Continue to participate in regional and sub-regional efforts to establish new regional transmission structures (ColumbiaGrid and other forums) to facilitate long-term expansion of the regional transmission system.
- Evaluate costs to integrate new resources across Avista's service territory and from regions outside of the Northwest.
- Study and implement distribution feeder rebuild projects to reduce system losses.
- Study transmission reconfigurations to economically reduce system losses.

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2011 IRP Action Items

2011 Action Items Resource Additions & Analysis

- Continue to explore and follow potential new resources opportunities.
- Continue studies on the costs, energy, capacity and environmental benefits of hydro upgrades at Cabinet Gorge, Long Lake, Post Falls, and Monroe Street.
- Study potential locations for the natural gas-fired resource identified to be online in 2019.
- Continue participation in regional IRP processes and, where agreeable, find opportunities to meet resource requirements on a collaborative basis with other utilities.
- Provide an update on the Little Falls and Nine Mile hydroelectric project upgrades.

2011 Action Items – Energy Efficiency

- Study and quantify transmission and distribution efficiency projects as they apply to Washington RPS goals.
- Update processes and protocols for conservation measurement, evaluation and verification.
- Continue to determine the potential impacts and costs of load management options.

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2011 Action Items – Environmental Policy

- Continue studies of state and federal climate change policies.
- Continue and report on the work of Avista's Climate Change Council.

2011 Action Items – Modeling & Forecasting

- Continue following regional reliability processes and develop Avista-centric modeling for possible inclusion in the 2013 IRP.
- Continue studying the impacts of climate change on retail loads.
- Refine the stochastic model for cost driver relationships, including further analyzing year-to-year hydro correlation and the correlation between wind, load, and hydro.

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2011 Action Items – Transmission and Distribution Planning

- Work to maintain existing transmission rights, under applicable FERC policies, for transmission service to bundled retail native load.
- Continue to participate in BPA transmission processes and rate proceedings to minimize costs of integrating existing resources outside of Avista's service area.
- Continue to participate in efforts to establish new regional transmission structures to facilitate long-term expansion of the regional transmission system.
- Evaluate the costs to integrate new resources across Avista's service territory and from regions outside of the Northwest.
- Study and implement distribution feeder rebuild projects to reduce system losses.
- Study transmission reconfigurations to economically reduce system losses.

AVISTA

2011 IRP Section Highlights

John Lyons

Technical Advisory Committee Meeting #6

2011 Electric Integrated Resource Plan

June 23, 2011

Loads & Resources Highlights

- Historic conservation acquisitions are included in the load forecast; higher acquisition levels anticipated in the IRP reduce the load forecast further.
- Annual electricity sales growth from 2012 to 2031 averages 1.6%.
- Expected energy deficits begin in 2020, growing to 475 aMW by 2031.
- Expected capacity deficits begin in 2019, growing to 883 MW by 2031.
- Conservation pushes the need for resources out by one year for energy and six years for capacity.
- Renewable portfolio standard deficiencies drive near-term resource needs.

Energy Efficiency Highlights

- Conservation reduces load by 47 percent through the IRP timeframe.
- Avista began offering conservation programs in 1978.
- Company-sponsored conservation reduces retail loads by approximately 10 percent, or 120 aMW.
- More than 2,800 equipment options and over 1,500 measure options covering all major end-use equipment, as well as devices and actions to reduce energy consumption were evaluated for this IRP.
- This IRP includes a Conservation Potential Assessment of the Company's Idaho and Washington service territories.

Policy Considerations Highlights

- Avista supports national greenhouse gas legislation that is workable, cost effective and fair.
- Avista supports national greenhouse gas legislation that protects the economy, supports technological innovation, and addresses emissions from developing nations.
- The Company is a member of the Clean Energy Group
- Avista's Climate Change Council monitors greenhouse gas legislation and environmental regulation issues.

Transmission & Distribution Highlights

- Avista has received a total of 43 requests for non-Avista resource integration.
- Projected costs of transmission upgrades are included in the 2011 Preferred Resource Strategy.
- The Company has received matching federal grants and is investing in three Smart Grid programs projected to reduce load by 5.57 aMW by 2013.
- Sixty distribution feeders were found to be preliminarily economic during the IRP timeframe, reducing system losses by 6.1 aMW.
- The Company participates in various regional transmission planning forums.
- Various upgrades to our transmission system are planned over the next five years.

Generation Resource Options Highlights

- Only resources with well-defined costs and operating histories were considered in the PRS analysis.
- Wind and solar resources were evaluated as the renewable options available to the Company; other technologies will be considered in renewable RFP efforts.
- Renewable resource costs assume present state and federal incentive levels, but no extensions.
- For the first time, thermal generation upgrades were considered as resource options.

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Market Analysis Highlights

- Gas and wind resources are expected to dominate new generation additions in the West for the foreseeable future.
- The massive growth in unconventional natural gas has lowered gas price forecasts and expected future electricity market prices.
- Expansion of the Northwest wind fleet is reducing the value of springtime hydroelectric generation and driving short-term market prices below zero.
- Federal greenhouse gas policy is uncertain; the IRP quantifies this uncertainty by modeling four different mitigation regimes.
- The Expected Case reduces greenhouse gas emissions by 18 percent and increases overall Western Interconnect costs by $3.5 billion per year. Absent mitigation, overall emissions are forecast to increase by 14 percent over the next 20 years.

Preferred Resource Strategy Highlights

- Avista's first load –driven acquisition is a natural gas-fired peaking plant in 2019; total gas-fired acquisition is 752 MW over the IRP timeframe.
- The 2011 plan splits natural gas-fired generation between simple- and combined-cycle plants in anticipation of a growing need for system flexibility to integrate variable resources.
- Efficiency improvements, both on the customer and utility sides of the meter, are at the highest expected level in our planning history.
- Total capital needs for generation resources in the PRS are $1.6 billion.
- Conservation and system efficiency spending will increase over time; a total of $1.5 billion will acquire 323 aMW.

Remaining 2011 IRP Schedule

- July 1, 2011 Management review of Internal Draft 2011 IRP complete
- July 8, 2011 distribution of Draft 2011 IRP to TAC participants
- August 1, 2011: External review by TAC complete
- August 8, 2011: Final 2011 IRP sent to print
- August 30, 2011: 2011 IRP documents sent to the Idaho and Washington Commissions
- August 31, 2011: 2011 IRP available to public, including publication on the Company's web site

2011 Electric Integrated Resource Plan

Appendix B – Work Plan

Work Plan for Avista's 2011 Electric Integrated Resource Plan

For the
Washington Utilities and Transportation Commission

August 31, 2010

2011 Integrated Resource Planning Work Plan

This Work Plan is submitted in compliance with the Washington Utilities and Transportation Commission's Integrated Resource Planning (IRP) rules (WAC 480-100-238). This work plan outlines the process Avista will follow to develop its 2011 Integrated Resource Plan to be filed with Washington and Idaho Commissions by August 31, 2011. Avista uses a public process to obtain technical expertise and guidance throughout the planning period through a series of public Technical Advisory Committee (TAC) meetings. The first of these meetings for the 2011 IRP was held on May 27, 2010.

The 2011 IRP process will be similar to those used to produce the previous three published plans. AURORA^{xmp} will be used for electric market forecasting, resource valuation, and for conducting Monte-Carlo style risk analyses. Results from AURORA^{xmp} will be used to select the Preferred Resource Strategy (PRS) using the proprietary PRiSM 3.0 model. This tool fills future capacity and energy (physical/renewable) deficits using an efficient frontier approach to evaluate quantitative portfolio risk versus portfolio cost while accounting for environmental legislation. Qualitative risk will be evaluated in a separate analysis. The process timeline is shown in Exhibit 1 and the process to identify the PRS is shown in Exhibit 2.

Avista intends to use both detailed site-specific and generic resource assumptions in this plan. These assumptions will be determined by using the 6th Power Plan for generic resources and site-specific assumptions developed by Avista will be used for existing resource upgrades. This plan will study renewable portfolio standards, environmental costs, sustained peaking requirements, and energy efficiency programs. This IRP will develop a strategy that meets or exceeds both the renewable portfolio standards and greenhouse gas emissions regulations.

Avista intends to test the PRS against several scenarios and stochastic futures. The TAC meetings will be an important factor to determine the underlying assumptions used in the scenarios and futures. The IRP process is very technical and data intensive; public comments are welcome and will require input in a timely manner for appropriate inclusion into the process so the plan can be submitted according to the tentative schedule.

Topics and meeting times may be changed depending on the availability of and requests for additional topics from the TAC members. The tentative timeline for public Technical Advisory Committee meetings:

- **May 27, 2010 –** Load & resource balance, climate change, loss of load probability analysis, work plan, and analytical process changes
- **September 8, 2010 –** Plant tours for TAC members
- **September 9, 2010 –** Generic resource assumptions, reliability planning, combined heat & power, sustainability, and energy efficiency
- **November 4, 2010 –** Load forecast, stochastic assumptions, resource upgrade costs, and transmission cost studies

- **January 20, 2011 –** Electric and gas price forecasts, load & resource forecast
- **March 10, 2011 –** Draft PRS, review of scenarios and futures, and portfolio analysis
- **April 28, 2011 –** Review of final PRS and action items
- **June 23, 2011 –** Review of the 2011 IRP

2011 Electric IRP Draft Outline

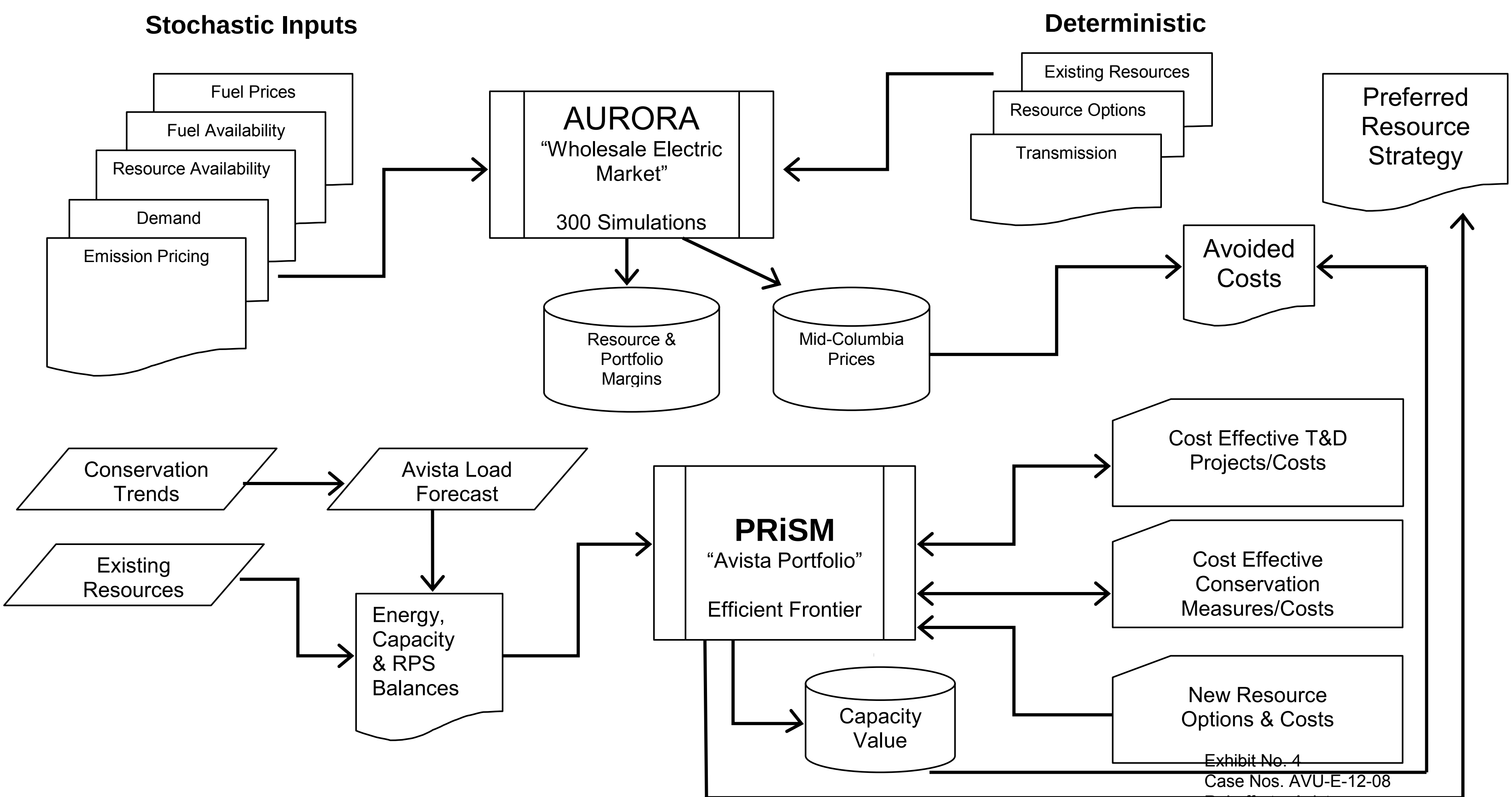
This section provides a draft outline of the major sections in the 2011 Electric IRP. This outline will be updated as IRP studies are completed and input from the Technical Advisory Committee has been received.

1. Executive Summary
2. Introduction and Stakeholder Involvement
3. Loads and Resources
    a. Economic Conditions
    b. Avista Load Forecast
    c. Load Forecast Scenarios
    d. Supply Side Resources
    e. Reserve Margins
    f. Resource Requirements
4. Energy Efficiency and Demand Response
5. Environmental Policy Issues
6. Transmission Planning
7. Modeling Approach
    a. Assumptions and Inputs
    b. Risk Modeling
    c. Resource Alternatives
    d. The PRiSM Model
8. Market Modeling Approach
    a. Futures
    b. Scenarios
    c. Avoided Costs
9. Preferred Resource Strategy & Stress Analysis
10. Action Items

Exhibit 1: 2011 Electric IRP Timeline

Task	Target Date
Preferred Resource Strategy (PRS)	
Finalize load forecast	July 2010
Identify regional resource options for electric market price forecast	September 2010
Identify Avista's supply & conservation resource options	September 2010
Update AURORA^{xmp} database for electric market price forecast	October 2010
Finalize datasets/statistics variables for risk studies	October 2010
Draft transmission study due	October 2010
Energy efficiency load shapes input into AURORA^{xmp}	October 2010
Final transmission study due	November 2010
Select natural gas price forecast	December 2010
Finalize deterministic base case	December 2010
Base case stochastic study complete	January 2011
Finalize PRiSM 3.0 model	January 2011
Develop efficient frontier and PRS	January 2011
Simulation of risk studies "futures" complete	February 2011
Simulate market scenarios in AURORA^{xmp}	February 2011
Evaluate resource strategies against market futures and scenarios	March 2011
Present preliminary study and PRS to TAC	March 2011
Writing Tasks	
File 2011 IRP work plan	August 2010
Prepare report and appendix outline	September 2010
Prepare text drafts	April 2011
Prepare charts and tables	April 2011
Internal draft released at Avista	May 2011
External draft released to the TAC	June 2011
Final editing and printing	August 2011
Final IRP submission to Commissions and distribution to TAC	August 31, 2011

Exhibit 2: 2011 Electric IRP Modeling Process



2011 Electric Integrated Resource Plan

Appendix C – Comprehensive Energy Efficiency Equipment List and Measure Options

RESIDENTIAL ENERGY EFFICIENCY EQUIPMENT AND MEASURE DATA

This appendix presents detailed information for all residential energy efficiency equipment and measures that were evaluated in LoadMAP. Several sets of tables are provided.

Table C-1 provides brief descriptions for all equipment and measures that were assessed for potenital.

Tables C-2 through C-9 list the detailed unit-level data for the equipment measures for each of the housing type segments — single family, multi-family, mobile home, and limited income — and for existing and new construction, respectively. Savings are in kWh/yr/household, and incremental costs are in $/household, unless noted otherwise. The B/C ratio is zero if the measure represents the baseline technology or if the technology is not available in the first year of the forecast (2012). The B/C ratio is calculated within LoadMAP for each year of the forecast and is available once the technology or measure becomes available.

Tables C-10 through C-17 list the detailed unit-level data for the non-equipment energy efficiency measures for each of the housing type segments and for existing and new construction, respectively. Because these measures can produce energy-use savings for multiple end-use loads (e.g., insulation affects heating and cooling energy use) savings are expressed as a percentage of the end-use loads. Base saturation indicates the percentage of homes in which the measure is already installed. Applicability/Feasibility is the product of two factors that account for whether the measure is applicable to the building. Cost is expressed in $/household. The detailed measure-level tables present the results of the benefit/cost (B/C) analysis for the first year of the forecast. The B/C ratio is zero if the measure represents the baseline technology or if the measure is not available in the first year of the forecast (2012). The B/C ratio is calculated within LoadMAP for each year of the forecast and is available once the technology or measure becomes available.

Note that Tables C-2 through C-17 present information for Washington. For Idaho, savings and B/C ratios may be slightly different due to weather-related usage, differences in the states' market profiles, and different retail electricity prices. Although Idaho-specific values are not presented here, they are available within the LoadMAP files.

Table C–1 Residential Energy Efficiency Equipment/Measure Descriptions

End-Use	Equipment/ Measure	Description
Cooling	Air Conditioner — Central (CAC)	Central air conditioners consist of a refrigeration system using a direct expansion cycle. Equipment includes a compressor, an air-cooled condenser (located outdoors), an expansion valve, and an evaporator coil. A supply fan near the evaporator coil distributes supply air through air ducts to the building. Cooling efficiencies vary based on materials used, equipment size, condenser type, and system configuration. CACs may be unitary (all components housed in a factory-built assembly) or split system (an outdoor condenser section and an indoor evaporator section connected by refrigerant lines and with the compressor either indoors or outdoors). Energy efficiency is rated according to the size of the unit using the Seasonal Energy Efficiency Rating (SEER). Systems with Variable Refrigerant Flow further improve the operating efficiency. A high-efficiency option for a ductless mini-split system was also analyzed.
Cooling	Central Air Conditioner, Early Replacement	CAC systems currently on the market are significantly more efficient that older units, due to technology improvement and stricter appliance standards. This measure incents homeowners to replace an aging but still working unit with a new, higher-efficiency one.
Cooling	Central Air Conditioner Maintenance and Tune Up	An air conditioner's filters, coils, and fins require regular cleaning and maintenance for the unit to function effectively and efficiently throughout its life. Neglecting necessary maintenance leads to a steady decline in performance, requiring the AC unit to use more energy for the same cooling load.
Cooling	Air Conditioner - Room, ENERGY STAR or better	Room air conditioners are designed to cool a single room or space. They incorporate a complete air-cooled refrigeration and air-handling system in an individual package. Room air conditioners come in several forms, including window, split-type, and packaged terminal units. Energy efficiency is rated according to the size of the unit using the Energy Efficiency Rating (EER).
Cooling	Room AC — Removal of Second Unit	Homeowners may have a second room AC unit that is extremely inefficient. This measure incents homeowners to recycle the second unit and thus also eliminates associated electricity use.
Cooling	Attic Fan Attic Fan, Photovoltaic	Attic fans can reduce the need for AC by reducing heat transfer from the attic through the ceiling of the house. A well-ventilated attic can be several degrees cooler than a comparable, unventilated attic. An option for an attic fan equipped with a small solar photovoltaic generator was also modeled.
Cooling	Ceiling Fan	Ceiling fans can reduce the need for air conditioning. However, the house occupants must also select a ceiling fan with a high-efficiency motor and either shutoff the AC system or setup the thermostat temperature of the air conditioning system to realize the potential energy savings. Some ceiling fans also come with lamps. In this analysis, it is assumed that there are no lamps, and installing a ceiling fan will allow occupants to increase the thermostat cooling setpoint up by 2°F.
Cooling	Whole-House Fan	Whole-house fans can reduce the need for AC on moderate-weather days or on cool evenings. The fan facilitates a quick air change throughout the entire house. Several windows must be open to achieve the best results. The fan is mounted on the top floor of the house, usually in a hallway ceiling.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 720 of 1069

End-Use	Equipment/ Measure	Description
Space Heating	Convert to Gas	This fuel-switching measure is the replacement of an electric furnace with a gas-fired furnace. This measure will eliminate all electricity consumption and demand due to electric space heating. In this study, it is assumed that this measure can be implemented only in homes within 500 feet of a gas main.
Heat/Cool	Air Source Heat Pump	A central heat pump consists of components similar to a CAC system, but is usually designed to function both as a heat pump and an air conditioner. It consists of a refrigeration system using a direct expansion (DX) cycle. Equipment includes a compressor, an air-cooled condenser (located outdoors), an expansion valve, and an evaporator coil (located in the supply air duct near the supply fan) and a reversing valve to change the DX cycle from cooling to heating when required. The cooling and heating efficiencies vary based on the materials used, equipment size, condenser type, and system configuration. Heat pumps may be unitary (all components housed in a factory-built assembly) or a split system (an outdoor condenser section and an indoor evaporator section connected by refrigerant lines, with either outdoors or indoors. A high-efficiency option for a ductless mini-split system was also analyzed.
Heat / Cool	Geothermal Heat Pump	Geothermal heat pumps are similar to air-source heat pumps, but use the ground or groundwater instead of outside air to provide a heat source/sink. A geothermal heat pump system generally consists of three major subsystems or parts: a geothermal heat pump to move heat between the building and the fluid in the earth connection, an earth connection for transferring heat between the fluid and the earth, and a distribution subsystem for delivering heating or cooling to the building. The system may also have a desuperheater to supplement the building's water heater, or a full-demand water heater to meet all of the building's hot water needs.
Heat / Cool	Air Source Heat Pump Maintenance	A heat pump's filters, coils, and fins require regular cleaning and maintenance for the unit to function effectively and efficiently throughout its life. Neglecting necessary maintenance ensures a steady decline in performance while energy use steadily increases.
HVAC (all)	Insulation – Ducting	Air distribution ducts can be insulated to reduce heating or cooling losses. Best results can be achieved by covering the entire surface area with insulation. Several types of ducts and duct insulation are available, including flexible duct, pre-insulated duct, duct board, duct wrap, tacked, or glued rigid insulation, and waterproof hard shell materials for exterior ducts. This analysis assumes that installing duct insulation can reduce the temperature drop/gain in ducts by 50%.
HVAC (all)	Repair and Sealing – Ducting	An ideal duct system would be free of leaks. Leakage in unsealed ducts varies considerably because of differences in fabricating machinery used, methods for assembly, installation workmanship, and age of the ductwork. Air leaks from the system to the outdoors result in a direct loss proportional to the amount of leakage and the difference in enthalpy between the outdoor air and the conditioned air. This analysis assumes that over time air loss from ducts has doubled, and conducting repair and sealing of the ducts will restore leakage from ducts to the original baseline level.

End-Use	Equipment/ Measure	Description
HVAC (all)	Thermostat — Clock/Programmable	A programmable thermostat can be added to most heating/cooling systems. They are typically used during winter to lower temperatures at night and in summer to increase temperatures during the afternoon. The energy savings from this type of thermostat are identical to those of a "setback" strategy with standard thermostats, but the convenience of a programmable thermostat makes it a much more attractive option. In this analysis, the baseline is assumed to have no thermostat setback.
HVAC (all)	Doors — Storm and Thermal	Like other components of the shell, doors are subject to several types of heat loss: conduction, infiltration, and radiant losses. Similar to a storm window, a storm door creates an insulating air space between the storm and primary doors. A tight fitting storm door can also help reduce air leakage or infiltration. Thermal doors have exceptional thermal insulation properties and also are provided with weather-stripping on the doorframe to reduce air leakage.
HVAC (all)	Insulation — Infiltration Control	Lowering the air infiltration rate by caulking small leaks and weather-stripping around window frames, doorframes, power outlets, plumbing, and wall corners can provide significant energy savings. Weather-stripping doors and windows will create a tight seal and further reduce air infiltration.
HVAC (all)	Insulation —Ceiling	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation above ceilings can conserve energy by reducing the heat loss or gain into attics and/or through roofs. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose, loose-fill (blown) fiberglass, and rigid polystyrene.
HVAC (all)	Insulation — Radiant Barrier	Radiant barriers are materials installed to reduce the heat gain in buildings. Radiant barriers are made from materials that are highly reflective and have low emissivity like aluminum. The closer the emissivity is to 0 the better they will perform. Radiant barriers can be placed above the insulation or on the roof rafters.
HVAC (all)	Insulation — Foundation Insulation — Wall Cavity Insulation — Wall Sheathing	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation can conserve energy by reducing heat loss or gain from a building. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose, loose-fill (blown) fiberglass, and rigid polystyrene. Foundation, insulation, wall cavity insulation, and wall sheathing were modeled for new construction / major retrofits only.
Cooling	Roof — High Reflectivity	The color and material of a building structure surface determine the amount of solar radiation absorbed by that surface and subsequently transferred into a building. This is called solar absorptance. Using a roofing material with low solar absorptance or painting the roof a light color reduces the cooling load. This analysis assumes that implementing high reflectivity roofs will decrease the roof's absorptance of solar radiation by 45%.
Cooling	Windows — Reflective Film	Reflective films applied to the window interior help reduce solar gain into the space and thus lower cooling energy use.

End-Use	Equipment/ Measure	Description
HVAC (all)	Windows — High Efficiency / ENERGY STAR	High-efficiency windows, such as those labeled under the ENERGY STAR Program, are designed to reduce energy use and increase occupant comfort. High-efficiency windows reduce the amount of heat transfer through the glazing surface. For example, some windows have a low-E coating, a thin film of metallic oxide coating on the glass surface that allows passage of short-wave solar energy through glass and prevents long-wave energy from escaping. Another example is double-pane glass that reduces conductive and convective heat transfer. Some double-pane windows are gas-filled (usually argon) to further increase the insulating properties of the window.
Water Heating	Water Heater - Electric, High Efficiency	For electric hot water heating, the most common type is a storage heater, which incorporates an electric heating element, storage tank, outer jacket, insulation, and controls in a single unit. Efficient units are characterized by a high recovery or thermal efficiency and low standby losses (the ratio of heat lost per hour to the content of the stored water). Electric instantaneous water heaters are available, but are excluded from this study due to potentially high instantaneous demand concerns.
Water Heating	Water Heater, Heat Pump	An electric heat pump water heater (HPWH) uses a vapor-compression thermodynamic cycle similar to that found in an air-conditioner or refrigerator. Electrical work input allows a heat pump water heater to extract heat from an available source (e.g., air) and reject that heat to a higher temperature sink, in this case, the water in the water heater. Because a HPWH makes use of available ambient heat, the coefficient of performance is greater than one — typically in the range of 2 to 3. These devices are available as an alternative to conventional tank water heaters of 55 gallons or larger. By utilizing the earth as a thermal reservoir, ground source HPWH systems can reach even higher levels of efficiency. The heat pump can be integrated with a traditional water storage tank or installed remote to the storage tank.
Water Heating	Water Heating, Solar	Solar water heating systems can be used in residential buildings that have an appropriate near-south-facing roof or nearby unshaded grounds for installing a collector. Although system types vary, in general these systems use a solar absorber surface within a solar collector or an actual storage tank. Either a heat-transfer fluid or the actual potable water flows through tubes attached to the absorber and transfers heat from it. (Systems with a separate heat-transfer-fluid loop include a heat exchanger that then heats the potable water.) The heated water is stored in a separate preheat tank or a conventional water heater tank. If additional heat is needed, it is provided by a conventional water-heating system.
Water Heating	Convert to Gas	This fuel-switching measure is the replacement of an electric water heater with a gas-fired water heater. This measure will eliminate all electricity consumption and demand due to electric water heating. In this study, it is assumed that this measure can be implemented only in home within 500 feet of a gas main.
Water Heating	Faucet Aerators	Water faucet aerators are threaded screens that attach to existing faucets. They reduce the volume of water coming out of faucets while introducing air into the water stream. This measure provides energy saving by reducing hot water use, as well as water conservation for both hot and cold water.

End-Use	Equipment/ Measure	Description
Water Heating	Pipe Insulation	Insulating hot water pipes decreases energy losses from piping that distributes hot water throughout the building. I also results in quicker delivery of hot water and may allow lower the hot water set point, which saves energy. The most common insulation materials for this purpose are polyethylene and neoprene.
Water Heating	Low-Flow Showerheads	Similar to faucet aerators, low-flow showerheads reduce the consumption of hot water, which in turn decreases water heating energy use.
Water Heating	Tank Blanket	Insulating hot water tanks decreases standby energy losses from the tank. Pre-fitted insulating blankets are readily available.
Water Heating	Thermostat Setback / Timer	These measures use either a programmable thermostat or a timer to adjust the water heater setpoint at times of low usage, typically when a home is unoccupied.
Water Heating	Hot Water Saver	A hot water saver is a plumbing device that attaches to the showerhead and that pauses the flow of water until the water is hot enough for use. The water is re-started by the flip of a switch.
Interior Lighting / Exterior Lighting	Infrared Halogen Lamps	Infrared halogen lamps are designed to be a replacement for standards incandescent lamps. Also referred to as advanced incandescent lamps, these products meet the Energy Independence and Security Act (EISA) lighting standards and are phased in as the baseline technology screw-in lamp technology to reflect the timeline over which the EISA lighting standards take effect.
Interior Lighting / Exterior Lighting	Compact Fluorescent Lamps	Compact fluorescent lamps are designed to be a replacement for standard incandescent lamps and use about 25% of the energy used by standard incandescent lamps to produce the same lumen output. The can use either electronic or magnetic ballasts. Integral compact fluorescent lamps have the ballast integrated into the base of the lamp and have a standard screw-in base that permits installation into existing incandescent fixtures.
Interior Lighting / Exterior Lighting	Solid State Lighting, LEDs (Screw-in and linear)	Light-emitting diode (LED) lighting has seen recent penetration in specific applications such as traffic lights and exit signs. With the potential for extremely high efficiency, LEDs show promise to provide general-use lighting for interior spaces. Current models commercially available have efficacies comparable to CFLs. However, theoretical efficiencies are significantly higher. LED models under development are expected to provide improved efficacies.
Interior Lighting	Fluorescent, T8, Super T8, and T5 Lamps and Electronic Ballasts	T8 fluorescent lamps are smaller in diameter than standard T12 lamps, resulting in greater light output per watt. T8 lamps also operate at a lower current and wattage, which increases the efficiency of the ballast but requires the lamps to be compatible with the ballast. Fluorescent lamp fixtures can include a reflector that increases the light output from the fixture, and thus make it possible to use a fewer number of lamps in each fixture. T5 lamps further increase efficiency by reducing the lamp diameter to 5/8”.
Exterior Lighting	Metal Halide and High Pressure Sodium	These lamps technologies can provide slightly higher efficiencies than CFLs in exterior applications.
Interior Lighting	Occupancy Sensors	Occupancy sensors turn lights off when a space is unoccupied. They are appropriate for areas with intermittent use, such as bathrooms or storage areas.

End-Use	Equipment/ Measure	Description
Exterior Lighting	Photovoltaic Installation	Solar photovoltaic generation may be used to power exterior lighting and thus eliminate all or part of the electrical energy use.
Exterior Lighting	Photosensor Control	Photosensor controls turn exterior lighting on or off based on ambient lighting levels. Compared with manual operation, this can reduce the operation of exterior lighting during daylight hours.
Exterior Lighting	Timeclock Installation	Lighting timers turn exterior lighting on or off based on a preset schedule. Compared with manual operation, this can reduce the operation of exterior lighting during daylight hours.
Appliances	Refrigerator/Freezer, ENERGY STAR or better	Energy-efficient refrigerators/freezers incorporate features such as improved cabinet insulation, more efficient compressors and evaporator fans, defrost controls, mullion heaters, oversized condenser coils, and improved door seals. Further efficiency increases can be obtained by reducing the volume of refrigerated space, or adding multiple compartments to reduce losses from opening doors.
Appliances	Refrigerator/Freezer — Early Replacement	Refrigerators/freezers currently on the market are significantly more efficient that older units, due to technology improvement and stricter appliance standards. This measure incents homeowners to replace an aging but still working unit with a new, higher-efficiency one.
Appliances	Refrigerator/Freezer — Remove Second Unit	Homeowners may have a second refrigerator or freezer that is not used to full capacity and that, because of its age, is extremely inefficient. This measure incents homeowners to recycle the second unit and thus also eliminates associated electricity use.
Appliances	Dishwasher, ENERGY STAR or better	ENERGY STAR labeled dishwashers save by using both improved technology for the primary wash cycle, and by using less hot water. Construction includes more effective washing action, energy-efficient motors, and other advanced technology such as sensors that determine the length of the wash cycle and the temperature of the water necessary to clean the dishes.
Appliances	Clothes Washer, ENERGY STAR or better	ENERGY STAR labeled clothes washers use superior designs that require less water. Sensors match the hot water needs to the size and soil level of the load, preventing energy waste. Further energy and water savings can be achieved through advanced technologies such as inverter-drive or combination washer-dryer units.
Appliances	Clothes Dryer – Electric, High Efficiency	An energy-efficient clothes dryer has a moisture-sensing device to terminate the drying cycle rather than using a timer, and an energy-efficient motor is used for spinning the dryer tub. Application of a heat pump cycle for extracting the moisture from clothes leads to additional energy savings.
Appliances	Range and Oven – Electric, High Efficiency	These products have additional insulation in the oven compartment and tighter-fitting oven door gaskets and hinges to save energy. Conventional ovens must first heat up about 35 pounds of steel and a large amount of air before they heat up the food. Tests indicate that only 6% of the energy output of a typical oven is actually absorbed by the food.
Electronics	Color TVs and Home Electronics, ENERGY STAR or better	In the average home, electronic products consumed significant energy, even when they are turn off, to maintain features like clocks, remote control, and channel/station memory. ENERGY STAR labeled consumer electronics can drastically reduce consumption during standby mode, in addition to saving energy through advanced power management during normal use.

End-Use	Equipment/ Measure	Description
Electronics	Personal Computers, ENERGY STAR or better	Improved power management can significantly reduce the annual energy consumption of PCs and monitors in both standby and normal operation. ENERGY STAR and Climate Savers labeled products provide increasing level of energy efficiency.
Electronics	Reduce Standby Wattage	Representing a growing portion of home electricity consumption, plug-in electronics such as set-top boxes, DVD players, gaming systems, digital video recorders, and even battery chargers for mobile phones and laptop computers are often designed to supply a set voltage. When the units are not in use, this voltage could be dropped significantly (~1 W) and thereby generate a significant energy savings, assumed for this analysis to be between 4-5% on average. These savings are in excess of the measures already discussed for computers and televisions.
Misc.	Furnace Fans, Electronically Commutating Motor	In homes heated by a furnace, there is still substantial energy use by the fan responsible for moving the hot air throughout the ductwork. Application of an Electronically Commutating Motor (ECM) ensures that motor speed matches the heating requirements of the system and saves energy when compared to a continuously operating standard motor.
Miscellaneous	Pool Pump	High-efficiency motors and two-speed pumps provide improved energy efficiency for this load.
Miscellaneous	Pool Pump Timer	A pool pump timer allows the pump to turn off automatically, eliminating the wasted energy associated with unnecessary pumping.
Miscellaneous	Trees for Shading	Planting of shade trees, suitable to the local climate, can reduce the need for air conditioning and provide non-energy benefits as well.
Cooling / Space Heating / Interior Lighting	Home Energy Management System	A centralized home energy management system can be used to control and schedule cooling, space heating, lighting, and possibly appliances as well. Some designs also allow the homeowner to remotely control loads via the Internet.
Cooling / Space Heating	Solar Photovoltaic	Adding a solar photovoltaic (PV) system to the home can meet a portion of the home's electric load and in some cases nearly the entire load, depending on the PV system size, orientation, solar resource, and other factors. For this analysis, we assume a grid-connected system and apply the electricity savings to the home's cooling and space heating loads.
Cooling / Space Heating / Interior Lighting	Advanced New Construction Designs	Advanced new construction designs use an integrated approach to the design of new buildings to account for the interaction of building systems. Typically, designs specify the building orientation, building shell, building mechanical systems, and controls strategies with the goal of optimizing building energy efficiency and comfort. Options that may be evaluated and incorporated include passive solar strategies, increased thermal mass, natural ventilation, daylighting strategies, and shading strategies, This measure was modeled for new construction only.
Cooling / Space Heating / Interior Lighting	ENERGY STAR Homes	This measure was modeled for new construction only.
Cooling / Space Heating / Interior Lighting	Energy-Efficient Manufactured Homes	This measure was modeled for new construction only.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista

Table C-2 Energy Efficiency Equipment Data — Single Family, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	134	$278	15	0.41
Cooling	Central AC	SEER 15 (CEE Tier 2)	184	$556	15	0.28
Cooling	Central AC	SEER 16 (CEE Tier 3)	226	$834	15	0.23
Cooling	Central AC	Ductless Mini-Split System	405	$4,399	20	0.14
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	62	$104	10	0.33
Cooling	Room AC	EER 11	73	$282	10	0.15
Cooling	Room AC	EER 11.5	99	$626	10	0.09
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	492	$1,000	15	0.43
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	675	$2,318	15	0.26
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	829	$3,505	15	0.21
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	1,486	$5,655	20	0.45
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	516	$1,500	14	0.28
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	173	$41	15	5.79
Water Heating	Water Heater	Geothermal Heat Pump	2,269	$6,586	15	0.47
Water Heating	Water Heater	Solar	2,493	$5,653	15	0.60
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	14.44
Interior Lighting*	Screw-in	LED	40	$80	12	0.90
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.16
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.71
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.14
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.77
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	22.43
Exterior Lighting*	Screw-in	LED	37	$79	12	0.89
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	7.40
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	4.03
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	9.14
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.82
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	45	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	88	$487	10	0.16
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	98	$48	13	2.39
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	41	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	53	$1	9	31.05
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	108	$89	13	1.28
Appliances	Refrigerator	Baseline (2014)	144	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	230	$89	13	-

* Savings and costs are per unit, e.g., per lamp.

Table C-2 Energy Efficiency Equipment Data — Single Family, Existing Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	114	$32	11	3.03
Appliances	Freezer	Baseline (2014)	152	$0	11	-
Appliances	Freezer	Energy Star (2014)	243	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	111	$89	13	1.31
Appliances	Second Refrigerator	Baseline (2014)	148	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	237	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	9	$2	13	7.00
Appliances	Stove	Induction (High Efficiency)	46	$1,432	13	0.05
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	108	$1	5	35.63
Electronics	Personal Computers	Climate Savers	154	$175	5	0.35
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	87	$1	11	133.21
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	138	$85	15	1.96
Miscellaneous	Pool Pump	Two-Speed Pump	551	$579	15	1.15
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	127	$1	18	281.65
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-3 Energy Efficiency Equipment Data — Multi Family, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	67	$93	15	0.62
Cooling	Central AC	SEER 15 (CEE Tier 2)	133	$185	15	0.61
Cooling	Central AC	SEER 16 (CEE Tier 3)	187	$278	15	0.57
Cooling	Central AC	Ductless Mini-Split System	245	$2,012	20	0.19
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	32	$52	10	0.35
Cooling	Room AC	EER 11	38	$141	10	0.15
Cooling	Room AC	EER 11.5	52	$313	10	0.09
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	238	$1,246	15	0.17
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	467	$2,315	15	0.18
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	659	$3,277	15	0.18
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	862	$5,022	20	0.27
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	248	$1,500	14	0.14
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	107	$41	15	3.61
Water Heating	Water Heater	Solar	1,539	$5,653	15	0.38
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	10.47
Interior Lighting*	Screw-in	LED	40	$80	12	0.65
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.16
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.71
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.14
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.77
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	32.52
Exterior Lighting*	Screw-in	LED	37	$79	12	1.29
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	7.40
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	4.03
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	9.14
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.82
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	23	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	44	$487	10	0.08
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	93	$48	13	2.28
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	15	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	19	$1	9	11.14
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	92	$89	13	1.09
Appliances	Refrigerator	Baseline (2014)	123	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	196	$89	13	-

* Savings and costs are per unit, e.g., per lamp.

Table C-3 Energy Efficiency Equipment Data—Multi Family, Existing Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	108	$32	11	2.88
Appliances	Freezer	Baseline (2014)	145	$0	11	-
Appliances	Freezer	Energy Star (2014)	231	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	93	$89	13	1.11
Appliances	Second Refrigerator	Baseline (2014)	124	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	199	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	4	$2	13	2.99
Appliances	Stove	Induction (High Efficiency)	20	$1,432	13	0.02
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	86	$1	5	29.28
Electronics	Personal Computers	Climate Savers	123	$175	5	0.29
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	43	$1	11	67.65
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	-	$85	15	-
Miscellaneous	Pool Pump	Two-Speed Pump	-	$579	15	-
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	10	$1	18	21.87
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-4 Energy Efficiency Equipment Data — Mobile Home, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	80	$278	15	0.24
Cooling	Central AC	SEER 15 (CEE Tier 2)	110	$556	15	0.17
Cooling	Central AC	SEER 16 (CEE Tier 3)	134	$834	15	0.14
Cooling	Central AC	Ductless Mini-Split System	241	$4,399	20	0.08
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	37	$52	10	0.40
Cooling	Room AC	EER 11	44	$141	10	0.17
Cooling	Room AC	EER 11.5	59	$313	10	0.11
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	282	$1,246	15	0.20
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	387	$2,315	15	0.15
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	475	$3,277	15	0.13
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	852	$5,022	20	0.27
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	295	$1,500	14	0.16
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	88	$41	15	2.95
Water Heating	Water Heater	Solar	1,271	$5,653	15	0.31
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	13.00
Interior Lighting*	Screw-in	LED	40	$80	12	0.81
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.04
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.64
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.13
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.70
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	20.19
Exterior Lighting*	Screw-in	LED	37	$79	12	0.80
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	6.66
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	3.63
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	8.23
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.74
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	46	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	89	$487	10	0.16
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	99	$48	13	2.43
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	41	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	54	$1	9	31.57
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	110	$89	13	1.30
Appliances	Refrigerator	Baseline (2014)	146	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	234	$89	13	-

* Savings and costs are per unit, e.g., per lamp

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista

Table C-4 Energy Efficiency Equipment Data — Mobile Home, Existing Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	116	$32	11	3.08
Appliances	Freezer	Baseline (2014)	155	$0	11	-
Appliances	Freezer	Energy Star (2014)	248	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	113	$89	13	1.34
Appliances	Second Refrigerator	Baseline (2014)	150	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	241	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	8	$2	13	6.30
Appliances	Stove	Induction (High Efficiency)	41	$1,432	13	0.04
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	101	$1	5	33.39
Electronics	Personal Computers	Climate Savers	144	$175	5	0.33
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	87	$1	11	133.21
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	138	$85	15	1.96
Miscellaneous	Pool Pump	Two-Speed Pump	551	$579	15	1.15
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	127	$1	18	281.65
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 732 of 1069

Table C-5 Energy Efficiency Equipment Data — Limited Income, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	76	$185	15	0.35
Cooling	Central AC	SEER 15 (CEE Tier 2)	104	$370	15	0.24
Cooling	Central AC	SEER 16 (CEE Tier 3)	127	$556	15	0.19
Cooling	Central AC	Ductless Mini-Split System	229	$2,394	20	0.15
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	65	$104	10	0.35
Cooling	Room AC	EER 11	77	$282	10	0.15
Cooling	Room AC	EER 11.5	104	$626	10	0.09
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	192	$1,246	15	0.13
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	263	$2,315	15	0.10
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	323	$3,277	15	0.09
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	579	$5,022	20	0.18
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	201	$1,500	14	0.11
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	116	$41	15	3.94
Water Heating	Water Heater	Solar	1,679	$5,653	15	0.41
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	13.85
Interior Lighting*	Screw-in	LED	40	$80	12	0.86
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.16
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.71
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.14
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.77
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	32.52
Exterior Lighting*	Screw-in	LED	37	$79	12	1.29
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	7.40
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	4.03
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	9.14
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.82
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	20	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	38	$487	10	0.07
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	104	$48	13	2.56
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	12	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	15	$1	9	9.07
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	92	$89	13	1.09
Appliances	Refrigerator	Baseline (2014)	123	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	196	$89	13	-

* Savings and costs are per unit, e.g., per lamp

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 733 of 1069

Table C-5 Energy Efficiency Equipment Data — Limited Income, Existing Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	108	$32	11	2.88
Appliances	Freezer	Baseline (2014)	145	$0	11	-
Appliances	Freezer	Energy Star (2014)	231	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	93	$89	13	1.11
Appliances	Second Refrigerator	Baseline (2014)	124	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	199	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	5	$2	13	3.59
Appliances	Stove	Induction (High Efficiency)	24	$1,432	13	0.02
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	89	$1	5	30.10
Electronics	Personal Computers	Climate Savers	127	$175	5	0.29
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	49	$1	11	77.80
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	57	$85	15	0.83
Miscellaneous	Pool Pump	Two-Speed Pump	226	$579	15	0.49
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	54	$1	18	123.18
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-6 Energy Efficiency Equipment Data —Single Family, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	180	$278	15	0.55
Cooling	Central AC	SEER 15 (CEE Tier 2)	240	$556	15	0.36
Cooling	Central AC	SEER 16 (CEE Tier 3)	290	$834	15	0.29
Cooling	Central AC	Ductless Mini-Split System	543	$4,399	20	0.19
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	76	$104	10	0.41
Cooling	Room AC	EER 11	90	$282	10	0.18
Cooling	Room AC	EER 11.5	122	$626	10	0.11
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	588	$1,000	15	0.51
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	783	$2,318	15	0.30
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	946	$3,505	15	0.24
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	1,775	$5,655	20	0.54
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	630	$1,500	14	0.35
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	219	$41	15	7.35
Water Heating	Water Heater	Geothermal Heat Pump	2,878	$6,586	15	0.60
Interior Lighting*	Water Heater	Solar	3,163	$5,653	15	0.77
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	14.05
Interior Lighting*	Screw-in	LED	40	$80	12	0.87
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.16
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.71
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.14
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Exterior Lighting*	Pin-based	LED	14	$17	10	0.77
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	21.82
Exterior Lighting*	Screw-in	LED	37	$79	12	0.87
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	7.40
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	4.03
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	9.14
Exterior Lighting	High Intensity/Flood	LED	66	$79	10	0.82
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	58	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	112	$487	10	0.21
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	117	$48	13	2.86
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	47	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	62	$1	9	36.25
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	102	$89	13	1.20
Appliances	Refrigerator	Baseline (2014)	135	$0	13	-

* Savings and costs are per unit, e.g., per lamp

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 735 of 1069

Table C-6 Energy Efficiency Equipment Data —Single Family, New Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Refrigerator	Energy Star (2014)	217	$89	13	-
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	116	$32	11	3.08
Appliances	Freezer	Baseline (2014)	155	$0	11	-
Appliances	Freezer	Energy Star (2014)	248	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	116	$89	13	1.37
Appliances	Second Refrigerator	Baseline (2014)	154	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	247	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	11	$2	13	8.51
Appliances	Stove	Induction (High Efficiency)	56	$1,432	13	0.06
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	111	$1	5	36.63
Electronics	Personal Computers	Climate Savers	158	$175	5	0.36
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	96	$1	11	148.53
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	156	$85	15	2.22
Miscellaneous	Pool Pump	Two-Speed Pump	623	$579	15	1.30
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	155	$1	18	345.87
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-7 Energy Efficiency Equipment Data — Multi Family, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	85	$93	15	0.78
Cooling	Central AC	SEER 15 (CEE Tier 2)	166	$185	15	0.76
Cooling	Central AC	SEER 16 (CEE Tier 3)	234	$278	15	0.71
Cooling	Central AC	Ductless Mini-Split System	308	$2,012	20	0.24
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	37	$52	10	0.39
Cooling	Room AC	EER 11	43	$141	10	0.17
Cooling	Room AC	EER 11.5	59	$313	10	0.10
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	292	$1,246	15	0.21
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	571	$2,315	15	0.22
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	804	$3,277	15	0.21
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	1,058	$5,022	20	0.33
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	282	$1,500	14	0.15
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	124	$41	15	4.19
Water Heating	Water Heater	Solar	1,786	$5,653	15	0.44
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	10.18
Interior Lighting*	Screw-in	LED	40	$80	12	0.63
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.16
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.71
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.14
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.77
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	31.63
Exterior Lighting*	Screw-in	LED	37	$79	12	1.26
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	7.40
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	4.03
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	9.14
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.82
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	26	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	51	$487	10	0.09
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	105	$48	13	2.56
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	16	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	21	$1	9	12.38
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	108	$89	13	1.28
Appliances	Refrigerator	Baseline (2014)	144	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	230	$89	13	-

* Savings and costs are per unit, e.g., per lamp

Table C-7 Energy Efficiency Equipment Data — Multi Family, New Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	115	$32	11	3.06
Appliances	Freezer	Baseline (2014)	154	$0	11	-
Appliances	Freezer	Energy Star (2014)	246	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	103	$89	13	1.21
Appliances	Second Refrigerator	Baseline (2014)	137	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	219	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	4	$2	13	3.31
Appliances	Stove	Induction (High Efficiency)	22	$1,432	13	0.02
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	88	$1	5	29.69
Electronics	Personal Computers	Climate Savers	125	$175	5	0.29
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	45	$1	11	71.54
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	-	$85	15	-
Miscellaneous	Pool Pump	Two-Speed Pump	-	$579	15	-
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	11	$1	18	24.36
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-8 Energy Efficiency Equipment Data — Mobile Home, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	100	$278	15	0.30
Cooling	Central AC	SEER 15 (CEE Tier 2)	133	$556	15	0.20
Cooling	Central AC	SEER 16 (CEE Tier 3)	161	$834	15	0.16
Cooling	Central AC	Ductless Mini-Split System	301	$4,399	20	0.11
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	42	$52	10	0.45
Cooling	Room AC	EER 11	50	$141	10	0.20
Cooling	Room AC	EER 11.5	67	$313	10	0.12
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	313	$1,246	15	0.22
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	417	$2,315	15	0.16
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	505	$3,277	15	0.13
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	946	$5,022	20	0.30
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	336	$1,500	14	0.18
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	102	$41	15	3.42
Water Heating	Water Heater	Solar	1,474	$5,653	15	0.36
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	12.64
Interior Lighting*	Screw-in	LED	40	$80	12	0.79
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.04
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.64
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.13
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.70
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	19.63
Exterior Lighting*	Screw-in	LED	37	$79	12	0.78
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	6.66
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	3.63
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	8.23
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.74
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	54	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	104	$487	10	0.19
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	111	$48	13	2.73
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	46	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	60	$1	9	35.11
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	129	$89	13	1.52
Appliances	Refrigerator	Baseline (2014)	172	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	275	$89	13	-

* Savings and costs are per unit, e.g., per lamp

Table C-8 Energy Efficiency Equipment Data — Mobile Home, New Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	124	$32	11	3.28
Appliances	Freezer	Baseline (2014)	165	$0	11	-
Appliances	Freezer	Energy Star (2014)	263	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	124	$89	13	1.47
Appliances	Second Refrigerator	Baseline (2014)	165	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	264	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	9	$2	13	6.98
Appliances	Stove	Induction (High Efficiency)	46	$1,432	13	0.05
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	103	$1	5	33.86
Electronics	Personal Computers	Climate Savers	146	$175	5	0.33
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	91	$1	11	140.87
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	154	$85	15	2.20
Miscellaneous	Pool Pump	Two-Speed Pump	617	$579	15	1.29
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	141	$1	18	313.76
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-9 Energy Efficiency Equipment Data — Limited Income, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	95	$185	15	0.43
Cooling	Central AC	SEER 15 (CEE Tier 2)	126	$370	15	0.29
Cooling	Central AC	SEER 16 (CEE Tier 3)	152	$556	15	0.23
Cooling	Central AC	Ductless Mini-Split System	286	$2,394	20	0.18
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	74	$104	10	0.40
Cooling	Room AC	EER 11	87	$282	10	0.17
Cooling	Room AC	EER 11.5	118	$626	10	0.11
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	213	$1,246	15	0.15
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	284	$2,315	15	0.11
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	343	$3,277	15	0.09
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	643	$5,022	20	0.20
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	228	$1,500	14	0.13
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	135	$41	15	4.57
Water Heating	Water Heater	Solar	1,949	$5,653	15	0.48
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	13.47
Interior Lighting*	Screw-in	LED	40	$80	12	0.84
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.16
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.71
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.14
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.77
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	31.63
Exterior Lighting*	Screw-in	LED	37	$79	12	1.26
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	7.40
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	4.03
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	9.14
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.82
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	23	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	44	$487	10	0.08
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	117	$48	13	2.87
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	13	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	17	$1	9	10.08
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	108	$89	13	1.28
Appliances	Refrigerator	Baseline (2014)	144	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	230	$89	13	-

* Savings and costs are per unit, e.g., per lamp

Table C-9 Energy Efficiency Equipment Data — Limited Income, New Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	115	$32	11	3.06
Appliances	Freezer	Baseline (2014)	154	$0	11	-
Appliances	Freezer	Energy Star (2014)	246	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	103	$89	13	1.21
Appliances	Second Refrigerator	Baseline (2014)	137	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	219	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	5	$2	13	3.98
Appliances	Stove	Induction (High Efficiency)	26	$1,432	13	0.03
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	90	$1	5	30.52
Electronics	Personal Computers	Climate Savers	129	$175	5	0.30
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	52	$1	11	82.28
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	63	$85	15	0.93
Miscellaneous	Pool Pump	Two-Speed Pump	254	$579	15	0.54
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	60	$1	18	137.23
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-10 Energy-Efficiency Measure Data—Single Family, Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Early Replacement	Cooling	10%	0%	0%	8%	$2,895	15	0.05
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	41%	100%	$125	4	0.70
Room AC - Removal of Second Unit	Cooling	100%	0%	0%	25%	$75	5	2.45
Attic Fan - Installation	Cooling	1%	0%	12%	23%	$116	18	0.08
Attic Fan - Photovoltaic - Installation	Cooling	1%	0%	13%	45%	$350	19	0.06
Ceiling Fan - Installation	Cooling	11%	0%	51%	75%	$160	15	0.81
Whole-House Fan - Installation	Cooling	9%	0%	7%	19%	$200	18	0.62
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$125	4	1.49
Insulation - Ducting	Cooling	3%	0%	15%	75%	$500	18	0.78
Insulation - Ducting	Space Heating	4%	4%	15%	75%	$500	18	0.78
Repair and Sealing - Ducting	Cooling	10%	0%	12%	50%	$500	18	2.08
Repair and Sealing - Ducting	Space Heating	15%	15%	12%	50%	$500	18	2.08
Thermostat - Clock/Programmable	Cooling	8%	0%	55%	56%	$114	11	2.89
Thermostat - Clock/Programmable	Space Heating	9%	5%	55%	56%	$114	11	2.89
Doors - Storm and Thermal	Cooling	1%	0%	38%	75%	$320	12	0.25
Doors - Storm and Thermal	Space Heating	2%	2%	38%	75%	$320	12	0.25
Insulation - Infiltration Control	Cooling	3%	0%	46%	90%	$266	12	1.72
Insulation - Infiltration Control	Space Heating	10%	10%	46%	90%	$266	12	1.72
Insulation - Ceiling	Cooling	3%	0%	68%	72%	$594	20	1.11
Insulation - Ceiling	Space Heating	10%	5%	68%	72%	$594	20	1.11
Insulation - Radiant Barrier	Cooling	5%	0%	5%	90%	$923	12	0.41
Insulation - Radiant Barrier	Space Heating	2%	1%	5%	90%	$923	12	0.41
Roofs - High Reflectivity	Cooling	6%	0%	5%	10%	$1,550	15	0.05
Windows - Reflective Film	Cooling	7%	0%	5%	45%	$267	10	0.21
Windows - High Efficiency/Energy Star	Cooling	12%	0%	83%	90%	$7,500	25	0.38
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	83%	90%	$7,500	25	0.38
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	24%	25%	$750	15	0.10
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	0%	10%	80%	$2,975	15	0.03
Exterior Lighting - Photosensor Control	Exterior Lighting	15%	0%	24%	45%	$90	8	0.21
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	10%	45%	$72	8	0.35
Water Heater - Faucet Aerators	Water Heating	4%	2%	53%	90%	$24	25	8.78
Water Heater - Pipe Insulation	Water Heating	6%	3%	17%	38%	$180	13	1.05
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	75%	80%	$96	10	4.56
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	54%	75%	$15	10	15.53
Water Heater - Thermostat Setback	Water Heating	9%	5%	17%	75%	$40	5	2.99
Water Heater - Timer	Water Heating	8%	4%	17%	40%	$194	10	1.06
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	3.28
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	1.76
Refrigerator - Early Replacement	Appliances	15%	15%	0%	20%	$1,203	13	0.08
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.99
Freezer - Early Replacement	Appliances	15%	15%	0%	20%	$484	11	0.18
Freezer - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.76
Home Energy Management System	Cooling	10%	0%	20%	38%	$300	20	2.46
Home Energy Management System	Space Heating	10%	5%	20%	38%	$300	20	2.46
Home Energy Management System	Interior Lighting	10%	5%	20%	38%	$300	20	2.46
Photovoltaics	Cooling	50%	0%	0%	48%	$17,000	15	0.10
Photovoltaics	Space Heating	25%	25%	0%	48%	$17,000	15	0.10
Pool - Pump Timer	Miscellaneous	60%	0%	59%	90%	$160	15	4.92
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.43
Water Heater - Heat Pump	Water Heating	30%	15%	0%	25%	$1,500	15	0.75
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$3,675	15	1.22
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$13,769	15	0.95

Note: Costs are per household.

Table C-11 Energy-Efficiency Measure Data — Multi Family, Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Early Replacement	Cooling	10%	0%	0%	8%	$2,895	15	0.02
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	33%	100%	$100	4	0.59
Room AC - Removal of Second Unit	Cooling	100%	0%	0%	25%	$75	5	1.28
Ceiling Fan - Installation	Cooling	11%	0%	32%	75%	$80	15	0.49
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$100	4	1.05
Insulation - Ducting	Cooling	3%	0%	13%	75%	$375	18	1.16
Insulation - Ducting	Space Heating	4%	4%	13%	75%	$375	18	1.16
Repair and Sealing - Ducting	Cooling	4%	0%	12%	50%	$500	18	0.95
Repair and Sealing - Ducting	Space Heating	4%	4%	12%	50%	$500	18	0.95
Thermostat - Clock/Programmable	Cooling	8%	0%	27%	68%	$114	11	2.39
Thermostat - Clock/Programmable	Space Heating	6%	3%	27%	68%	$114	11	2.39
Doors - Storm and Thermal	Cooling	1%	0%	17%	75%	$320	12	0.35
Doors - Storm and Thermal	Space Heating	2%	2%	17%	75%	$320	12	0.35
Insulation - Infiltration Control	Cooling	1%	0%	19%	90%	$266	12	2.95
Insulation - Infiltration Control	Space Heating	13%	13%	19%	90%	$266	12	2.95
Insulation - Ceiling	Cooling	13%	0%	27%	30%	$215	20	5.67
Insulation - Ceiling	Space Heating	13%	13%	27%	30%	$215	20	5.67
Insulation - Radiant Barrier	Cooling	4%	0%	5%	90%	$923	12	0.52
Insulation - Radiant Barrier	Space Heating	4%	4%	5%	90%	$923	12	0.52
Roofs - High Reflectivity	Cooling	13%	0%	3%	10%	$1,550	15	0.03
Windows - Reflective Film	Cooling	7%	0%	5%	45%	$167	10	0.10
Windows - High Efficiency/Energy Star	Cooling	13%	0%	70%	90%	$2,500	25	0.56
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	70%	90%	$2,500	25	0.56
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	6%	10%	$256	15	0.14
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	0%	10%	50%	$2,975	15	0.00
Exterior Lighting - Photosensor Control	Exterior Lighting	20%	0%	7%	45%	$90	8	0.04
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	6%	45%	$72	8	0.05
Water Heater - Faucet Aerators	Water Heating	5%	2%	43%	90%	$24	25	6.63
Water Heater - Pipe Insulation	Water Heating	6%	3%	6%	38%	$180	13	0.65
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	71%	75%	$96	10	2.84
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	54%	75%	$15	10	9.66
Water Heater - Thermostat Setback	Water Heating	9%	5%	17%	75%	$40	5	1.86
Water Heater - Timer	Water Heating	8%	4%	5%	40%	$194	10	0.66
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	2.04
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	0.58
Refrigerator - Early Replacement	Appliances	15%	15%	0%	20%	$1,203	13	0.07
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.36
Freezer - Early Replacement	Appliances	15%	15%	0%	20%	$484	11	0.17
Freezer - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.57
Home Energy Management System	Cooling	10%	0%	5%	13%	$300	20	2.46
Home Energy Management System	Space Heating	10%	5%	5%	13%	$300	20	2.46
Home Energy Management System	Interior Lighting	10%	5%	5%	13%	$300	20	2.46
Photovoltaics	Cooling	50%	0%	0%	12%	$8,500	15	0.22
Photovoltaics	Space Heating	25%	25%	0%	12%	$8,500	15	0.22
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.13
Water Heater - Heat Pump	Water Heating	30%	15%	0%	10%	$1,500	15	0.47
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$2,845	15	0.99
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$10,946	15	0.72

Note: Costs are per household.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 744 of 1069

Table C-12 Energy-Efficiency Measure Data — Mobile Home, Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Early Replacement	Cooling	10%	0%	0%	8%	$2,895	15	0.03
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	59%	100%	$100	4	0.63
Room AC - Removal of Second Unit	Cooling	100%	0%	0%	25%	$75	5	1.46
Ceiling Fan - Installation	Cooling	11%	0%	60%	75%	$80	15	0.79
Whole-House Fan - Installation	Cooling	9%	0%	5%	19%	$150	18	0.41
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$125	4	1.02
Insulation - Ducting	Cooling	3%	0%	15%	75%	$375	18	0.94
Insulation - Ducting	Space Heating	4%	4%	15%	75%	$375	18	0.94
Repair and Sealing - Ducting	Cooling	10%	0%	12%	50%	$500	18	2.08
Repair and Sealing - Ducting	Space Heating	15%	15%	12%	50%	$500	18	2.08
Thermostat - Clock/Programmable	Cooling	8%	0%	51%	56%	$114	11	2.78
Thermostat - Clock/Programmable	Space Heating	9%	5%	51%	56%	$114	11	2.78
Doors - Storm and Thermal	Cooling	1%	0%	38%	75%	$320	12	0.25
Doors - Storm and Thermal	Space Heating	2%	2%	38%	75%	$320	12	0.25
Insulation - Infiltration Control	Cooling	3%	0%	46%	90%	$266	12	1.80
Insulation - Infiltration Control	Space Heating	10%	10%	46%	90%	$266	12	1.80
Insulation - Ceiling	Cooling	3%	0%	79%	81%	$707	20	1.00
Insulation - Ceiling	Space Heating	10%	5%	79%	81%	$707	20	1.00
Insulation - Radiant Barrier	Cooling	2%	0%	5%	90%	$923	12	0.35
Insulation - Radiant Barrier	Space Heating	1%	1%	5%	90%	$923	12	0.35
Roofs - High Reflectivity	Cooling	6%	0%	5%	10%	$1,550	15	0.02
Windows - Reflective Film	Cooling	7%	0%	5%	45%	$167	10	0.16
Windows - High Efficiency/Energy Star	Cooling	12%	0%	47%	90%	$7,500	25	0.37
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	47%	90%	$7,500	25	0.37
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	67%	72%	$750	15	0.09
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	0%	10%	80%	$2,975	15	0.03
Exterior Lighting - Photosensor Control	Exterior Lighting	15%	0%	23%	45%	$90	8	0.19
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	10%	45%	$72	8	0.32
Water Heater - Faucet Aerators	Water Heating	4%	2%	79%	90%	$24	25	4.47
Water Heater - Pipe Insulation	Water Heating	6%	3%	17%	38%	$180	13	0.53
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	92%	95%	$96	10	2.32
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	54%	75%	$15	10	7.91
Water Heater - Thermostat Setback	Water Heating	9%	5%	17%	75%	$40	5	1.52
Water Heater - Timer	Water Heating	8%	4%	17%	40%	$194	10	0.54
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	1.67
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	1.65
Refrigerator - Early Replacement	Appliances	15%	15%	0%	20%	$1,203	13	0.08
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	4.06
Freezer - Early Replacement	Appliances	15%	15%	0%	20%	$484	11	0.18
Freezer - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.82
Home Energy Management System	Cooling	10%	0%	20%	38%	$300	20	2.28
Home Energy Management System	Space Heating	10%	5%	20%	38%	$300	20	2.28
Home Energy Management System	Interior Lighting	10%	5%	20%	38%	$300	20	2.28
Photovoltaics	Cooling	50%	0%	0%	48%	$17,000	15	0.09
Photovoltaics	Space Heating	25%	25%	0%	48%	$17,000	15	0.09
Pool - Pump Timer	Miscellaneous	60%	0%	50%	90%	$160	15	4.92
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.21
Water Heater - Heat Pump	Water Heating	30%	15%	0%	10%	$1,500	15	0.38
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$2,616	15	0.88
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$11,135	15	0.62

Note: Costs are per household.

Table C-13 Energy-Efficiency Measure Data — Limited Income, Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Early Replacement	Cooling	10%	0%	0%	8%	$2,895	15	0.03
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	25%	100%	$100	4	0.61
Room AC - Removal of Second Unit	Cooling	100%	0%	0%	25%	$75	5	2.56
Attic Fan - Installation	Cooling	1%	0%	3%	23%	$116	18	0.05
Attic Fan - Photovoltaic - Installation	Cooling	1%	0%	2%	11%	$350	19	0.03
Ceiling Fan - Installation	Cooling	11%	0%	41%	75%	$80	15	0.89
Whole-House Fan - Installation	Cooling	9%	0%	5%	19%	$150	18	0.46
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$125	4	0.82
Insulation - Ducting	Cooling	3%	0%	13%	75%	$395	18	0.90
Insulation - Ducting	Space Heating	4%	4%	13%	75%	$395	18	0.90
Repair and Sealing - Ducting	Cooling	10%	0%	12%	50%	$500	18	2.07
Repair and Sealing - Ducting	Space Heating	15%	15%	12%	50%	$500	18	2.07
Thermostat - Clock/Programmable	Cooling	8%	0%	27%	68%	$114	11	2.63
Thermostat - Clock/Programmable	Space Heating	9%	5%	27%	68%	$114	11	2.63
Doors - Storm and Thermal	Cooling	1%	0%	17%	75%	$320	12	0.25
Doors - Storm and Thermal	Space Heating	2%	2%	17%	75%	$320	12	0.25
Insulation - Infiltration Control	Cooling	3%	0%	19%	90%	$266	12	1.78
Insulation - Infiltration Control	Space Heating	10%	10%	19%	90%	$266	12	1.78
Insulation - Ceiling	Cooling	3%	0%	36%	41%	$215	20	2.44
Insulation - Ceiling	Space Heating	10%	5%	36%	41%	$215	20	2.44
Insulation - Radiant Barrier	Cooling	2%	0%	5%	90%	$923	12	0.35
Insulation - Radiant Barrier	Space Heating	1%	1%	5%	90%	$923	12	0.35
Roofs - High Reflectivity	Cooling	6%	0%	3%	10%	$1,550	15	0.03
Windows - Reflective Film	Cooling	7%	0%	5%	45%	$167	10	0.18
Windows - High Efficiency/Energy Star	Cooling	12%	0%	68%	90%	$2,500	25	0.51
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	68%	90%	$2,500	25	0.51
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	8%	10%	$256	15	0.16
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	50%	10%	50%	$2,975	15	0.01
Exterior Lighting - Photosensor Control	Exterior Lighting	15%	0%	8%	45%	$90	8	0.06
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	6%	45%	$72	8	0.10
Water Heater - Faucet Aerators	Water Heating	4%	2%	46%	90%	$24	25	5.95
Water Heater - Pipe Insulation	Water Heating	6%	3%	6%	38%	$180	13	0.71
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	73%	75%	$96	10	3.09
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	54%	75%	$15	10	10.53
Water Heater - Thermostat Setback	Water Heating	9%	5%	17%	75%	$40	5	2.03
Water Heater - Timer	Water Heating	8%	4%	5%	40%	$194	10	0.72
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	2.23
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	0.77
Refrigerator - Early Replacement	Appliances	15%	15%	0%	20%	$1,203	13	0.07
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.36
Freezer - Early Replacement	Appliances	15%	15%	0%	20%	$484	11	0.17
Freezer - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.57
Home Energy Management System	Cooling	10%	0%	5%	13%	$300	20	2.00
Home Energy Management System	Space Heating	10%	5%	5%	13%	$300	20	2.00
Home Energy Management System	Interior Lighting	10%	5%	5%	13%	$300	20	2.00
Photovoltaics	Cooling	50%	0%	0%	48%	$8,500	15	0.17
Photovoltaics	Space Heating	25%	25%	0%	48%	$8,500	15	0.17
Pool - Pump Timer	Miscellaneous	60%	0%	50%	90%	$160	15	2.02
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.24
Water Heater - Heat Pump	Water Heating	30%	15%	0%	20%	$1,500	15	0.51
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$2,970	15	1.03
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$10,798	15	0.69

Note: Costs are per household.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 746 of 1069

Table C-14 Energy-Efficiency Measure Data — Single Family, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	41%	100%	$125	4	0.78
Attic Fan - Installation	Cooling	1%	0%	13%	23%	$97	18	0.15
Attic Fan - Photovoltaic - Installation	Cooling	1%	0%	4%	11%	$200	19	0.15
Ceiling Fan - Installation	Cooling	10%	0%	53%	75%	$160	15	1.09
Whole-House Fan - Installation	Cooling	9%	0%	4%	19%	$200	18	0.92
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$125	4	1.69
Insulation - Ducting	Cooling	3%	0%	50%	75%	$250	18	1.31
Insulation - Ducting	Space Heating	4%	4%	50%	75%	$250	18	1.31
Thermostat - Clock/Programmable	Cooling	8%	0%	91%	95%	$114	11	2.91
Thermostat - Clock/Programmable	Space Heating	8%	4%	91%	95%	$114	11	2.91
Doors - Storm and Thermal	Cooling	1%	0%	13%	75%	$180	12	0.45
Doors - Storm and Thermal	Space Heating	2%	2%	13%	75%	$180	12	0.45
Insulation - Ceiling	Cooling	3%	0%	68%	71%	$634	20	0.99
Insulation - Ceiling	Space Heating	8%	6%	68%	71%	$634	20	0.99
Insulation - Radiant Barrier	Cooling	2%	0%	25%	90%	$923	12	0.37
Insulation - Radiant Barrier	Space Heating	1%	1%	25%	90%	$923	12	0.37
Insulation - Foundation	Cooling	3%	0%	20%	90%	$358	20	1.35
Insulation - Foundation	Space Heating	6%	6%	20%	90%	$358	20	1.35
Insulation - Wall Cavity	Cooling	2%	0%	20%	90%	$236	20	1.15
Insulation - Wall Cavity	Space Heating	3%	3%	20%	90%	$236	20	1.15
Insulation - Wall Sheathing	Cooling	1%	0%	64%	90%	$300	20	0.89
Insulation - Wall Sheathing	Space Heating	3%	3%	64%	90%	$300	20	0.89
Roofs - High Reflectivity	Cooling	5%	0%	5%	90%	$517	15	0.17
Windows - Reflective Film	Cooling	7%	0%	2%	45%	$267	10	0.31
Windows - High Efficiency/Energy Star	Cooling	12%	0%	100%	100%	$2,200	25	0.62
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	100%	100%	$2,200	25	0.62
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	24%	27%	$500	15	0.16
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	0%	10%	80%	$2,975	15	0.04
Exterior Lighting - Photosensor Control	Exterior Lighting	13%	0%	13%	45%	$90	8	0.19
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	16%	45%	$72	8	0.36
Water Heater - Faucet Aerators	Water Heating	4%	2%	38%	90%	$24	25	11.03
Water Heater - Pipe Insulation	Water Heating	6%	3%	8%	41%	$50	13	4.71
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	90%	95%	$48	10	11.33
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$15	10	19.30
Water Heater - Thermostat Setback	Water Heating	9%	5%	5%	75%	$40	5	3.70
Water Heater - Timer	Water Heating	8%	4%	5%	40%	$194	10	1.31
Water Heater - Drainwater Heat Reocvery	Water Heating	9%	5%	1%	90%	$899	15	0.47
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	4.06
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	1.99
Home Energy Management System	Cooling	10%	0%	20%	68%	$250	20	3.16
Home Energy Management System	Space Heating	10%	5%	20%	68%	$250	20	3.16
Home Energy Management System	Interior Lighting	10%	5%	20%	68%	$250	20	3.16
Photovoltaics	Cooling	50%	0%	1%	48%	$15,800	15	0.12
Photovoltaics	Space Heating	25%	25%	1%	48%	$15,800	15	0.12
Pool - Pump Timer	Miscellaneous	60%	0%	55%	90%	$160	15	5.43
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.64
Advanced New Construction Designs	Cooling	40%	0%	2%	45%	$4,500	18	1.09
Advanced New Construction Designs	Space Heating	40%	40%	2%	45%	$4,500	18	1.09
Advanced New Construction Designs	Interior Lighting	20%	20%	2%	45%	$4,500	18	1.09
Energy Star Homes	Cooling	20%	0%	12%	75%	$5,000	18	0.75
Energy Star Homes	Space Heating	20%	20%	12%	75%	$5,000	18	0.75
Energy Star Homes	Interior Lighting	20%	20%	12%	75%	$5,000	18	0.75
Water Heater - Heat Pump	Water Heating	30%	15%	0%	25%	$1,500	15	0.94
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$3,675	15	1.53
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$13,769	15	1.14

Note: Costs are per household.

Table C-15 Energy-Efficiency Measure Data — Multi Family, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	33%	100%	$100	4	0.62
Ceiling Fan - Installation	Cooling	10%	0%	18%	75%	$80	15	0.77
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$100	4	1.12
Insulation - Ducting	Cooling	2%	0%	50%	75%	$200	18	1.18
Insulation - Ducting	Space Heating	2%	2%	50%	75%	$200	18	1.18
Thermostat - Clock/Programmable	Cooling	8%	0%	77%	80%	$114	11	2.29
Thermostat - Clock/Programmable	Space Heating	5%	3%	77%	80%	$114	11	2.29
Doors - Storm and Thermal	Cooling	1%	0%	19%	75%	$180	12	0.66
Doors - Storm and Thermal	Space Heating	2%	2%	19%	75%	$180	12	0.66
Insulation - Ceiling	Cooling	12%	0%	27%	48%	$152	20	10.12
Insulation - Ceiling	Space Heating	16%	16%	27%	48%	$152	20	10.12
Insulation - Radiant Barrier	Cooling	2%	0%	5%	90%	$923	12	0.50
Insulation - Radiant Barrier	Space Heating	3%	3%	5%	90%	$923	12	0.50
Insulation - Wall Cavity	Cooling	2%	0%	4%	90%	$63	20	6.14
Insulation - Wall Cavity	Space Heating	4%	4%	4%	90%	$63	20	6.14
Insulation - Wall Sheathing	Cooling	1%	0%	55%	90%	$210	20	1.59
Insulation - Wall Sheathing	Space Heating	3%	3%	55%	90%	$210	20	1.59
Roofs - High Reflectivity	Cooling	8%	0%	0%	90%	$517	15	0.10
Windows - Reflective Film	Cooling	7%	0%	2%	45%	$167	10	0.17
Windows - High Efficiency/Energy Star	Cooling	13%	0%	100%	100%	$2,200	25	0.63
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	100%	100%	$2,200	25	0.63
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	6%	9%	$256	15	0.14
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	0%	10%	50%	$2,975	15	0.01
Exterior Lighting - Photosensor Control	Exterior Lighting	20%	0%	1%	45%	$90	8	0.04
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	11%	45%	$72	8	0.05
Water Heater - Faucet Aerators	Water Heating	5%	2%	11%	90%	$24	25	7.63
Water Heater - Pipe Insulation	Water Heating	6%	3%	0%	41%	$50	13	2.68
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	66%	75%	$48	10	6.45
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$15	10	10.99
Water Heater - Thermostat Setback	Water Heating	9%	5%	5%	75%	$40	5	2.11
Water Heater - Timer	Water Heating	8%	4%	5%	40%	$194	10	0.75
Water Heater - Drainwater Heat Reocvery	Water Heating	9%	5%	1%	90%	$899	15	0.27
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	2.31
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	0.63
Home Energy Management System	Cooling	10%	0%	5%	68%	$250	20	3.19
Home Energy Management System	Space Heating	10%	5%	5%	68%	$250	20	3.19
Home Energy Management System	Interior Lighting	10%	5%	5%	68%	$250	20	3.19
Photovoltaics	Cooling	50%	0%	0%	12%	$7,900	15	0.26
Photovoltaics	Space Heating	25%	25%	0%	12%	$7,900	15	0.26
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.23
Advanced New Construction Designs	Cooling	40%	0%	2%	45%	$2,500	18	1.47
Advanced New Construction Designs	Space Heating	40%	40%	2%	45%	$2,500	18	1.47
Advanced New Construction Designs	Interior Lighting	20%	20%	2%	45%	$2,500	18	1.47
Water Heater - Heat Pump	Water Heating	30%	15%	0%	10%	$1,500	15	0.53
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$2,845	15	1.13
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$10,946	15	0.84

Note: Costs are per household.

Table C-16 Energy-Efficiency Measure Data — Mobile Home, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	59%	100%	$100	4	0.66
Ceiling Fan - Installation	Cooling	10%	0%	57%	75%	$80	15	0.95
Whole-House Fan - Installation	Cooling	9%	0%	4%	19%	$150	18	0.53
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$125	4	1.09
Insulation - Ducting	Cooling	3%	0%	50%	75%	$200	18	1.59
Insulation - Ducting	Space Heating	4%	4%	50%	75%	$200	18	1.59
Thermostat - Clock/Programmable	Cooling	8%	0%	57%	75%	$114	11	2.77
Thermostat - Clock/Programmable	Space Heating	8%	4%	57%	75%	$114	11	2.77
Doors - Storm and Thermal	Cooling	1%	0%	13%	75%	$180	12	0.49
Doors - Storm and Thermal	Space Heating	2%	2%	13%	75%	$180	12	0.49
Insulation - Ceiling	Cooling	3%	0%	79%	81%	$176	20	3.02
Insulation - Ceiling	Space Heating	8%	6%	79%	81%	$176	20	3.02
Insulation - Radiant Barrier	Cooling	2%	0%	25%	90%	$923	12	0.36
Insulation - Radiant Barrier	Space Heating	1%	1%	25%	90%	$923	12	0.36
Insulation - Wall Cavity	Cooling	2%	0%	20%	90%	$197	20	1.35
Insulation - Wall Cavity	Space Heating	3%	3%	20%	90%	$197	20	1.35
Insulation - Wall Sheathing	Cooling	1%	0%	64%	90%	$300	20	0.96
Insulation - Wall Sheathing	Space Heating	3%	3%	64%	90%	$300	20	0.96
Roofs - High Reflectivity	Cooling	5%	0%	5%	90%	$517	15	0.07
Windows - Reflective Film	Cooling	7%	0%	2%	45%	$167	10	0.21
Windows - High Efficiency/Energy Star	Cooling	12%	0%	85%	90%	$2,200	25	0.57
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	85%	90%	$2,200	25	0.57
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	67%	72%	$500	15	0.14
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	50%	10%	80%	$2,975	15	0.03
Exterior Lighting - Photosensor Control	Exterior Lighting	13%	0%	13%	45%	$90	8	0.17
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	16%	45%	$72	8	0.32
Water Heater - Faucet Aerators	Water Heating	4%	2%	57%	90%	$24	25	5.14
Water Heater - Pipe Insulation	Water Heating	6%	3%	8%	41%	$50	13	2.20
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	92%	95%	$48	10	5.28
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$15	10	9.00
Water Heater - Thermostat Setback	Water Heating	9%	5%	5%	75%	$40	5	1.72
Water Heater - Timer	Water Heating	8%	4%	5%	40%	$194	10	0.61
Water Heater - Drainwater Heat Reocvery	Water Heating	9%	5%	1%	90%	$899	15	0.22
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	1.89
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	1.79
Home Energy Management System	Cooling	10%	0%	20%	68%	$250	20	2.94
Home Energy Management System	Space Heating	10%	5%	20%	68%	$250	20	2.94
Home Energy Management System	Interior Lighting	10%	5%	20%	68%	$250	20	2.94
Photovoltaics	Cooling	50%	0%	1%	48%	$15,800	15	0.10
Photovoltaics	Space Heating	25%	25%	1%	48%	$15,800	15	0.10
Pool - Pump Timer	Miscellaneous	60%	0%	35%	90%	$160	15	5.38
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.28
Advanced New Construction Designs	Cooling	30%	0%	2%	45%	$4,500	18	0.52
Advanced New Construction Designs	Space Heating	30%	30%	2%	45%	$4,500	18	0.52
Advanced New Construction Designs	Interior Lighting	20%	20%	2%	45%	$4,500	18	0.52
Energy Efficient Manufactured Homes	Cooling	20%	0%	10%	75%	$3,500	18	0.88
Energy Efficient Manufactured Homes	Space Heating	20%	20%	10%	75%	$3,500	18	0.88
Energy Efficient Manufactured Homes	Interior Lighting	20%	20%	10%	75%	$3,500	18	0.88
Water Heater - Heat Pump	Water Heating	30%	15%	0%	10%	$1,500	15	0.44
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$2,616	15	1.00
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$11,738	15	0.69

Note: Costs are per household.

Table C-17 Energy-Efficiency Measure Data — Limited Income, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	25%	100%	$100	4	0.65
Attic Fan - Installation	Cooling	1%	0%	15%	23%	$97	18	0.07
Attic Fan - Photovoltaic - Installation	Cooling	1%	0%	5%	11%	$200	19	0.07
Ceiling Fan - Installation	Cooling	10%	0%	33%	75%	$80	15	1.03
Whole-House Fan - Installation	Cooling	9%	0%	4%	19%	$150	18	0.58
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$125	4	0.87
Insulation - Ducting	Cooling	3%	0%	50%	75%	$210	18	1.47
Insulation - Ducting	Space Heating	4%	4%	50%	75%	$210	18	1.47
Thermostat - Clock/Programmable	Cooling	8%	0%	29%	30%	$114	11	2.54
Thermostat - Clock/Programmable	Space Heating	8%	4%	29%	30%	$114	11	2.54
Doors - Storm and Thermal	Cooling	1%	0%	19%	75%	$180	12	0.46
Doors - Storm and Thermal	Space Heating	2%	2%	19%	75%	$180	12	0.46
Insulation - Ceiling	Cooling	3%	0%	36%	48%	$152	20	3.20
Insulation - Ceiling	Space Heating	8%	6%	36%	48%	$152	20	3.20
Insulation - Radiant Barrier	Cooling	2%	0%	5%	90%	$923	12	0.36
Insulation - Radiant Barrier	Space Heating	1%	1%	5%	90%	$923	12	0.36
Insulation - Foundation	Cooling	3%	0%	4%	90%	$358	20	1.37
Insulation - Foundation	Space Heating	6%	6%	4%	90%	$358	20	1.37
Insulation - Wall Cavity	Cooling	2%	0%	4%	90%	$63	20	3.46
Insulation - Wall Cavity	Space Heating	3%	3%	4%	90%	$63	20	3.46
Insulation - Wall Sheathing	Cooling	1%	0%	59%	90%	$210	20	1.19
Insulation - Wall Sheathing	Space Heating	3%	3%	59%	90%	$210	20	1.19
Roofs - High Reflectivity	Cooling	5%	0%	0%	90%	$517	15	0.08
Windows - Reflective Film	Cooling	7%	0%	2%	45%	$167	10	0.23
Windows - High Efficiency/Energy Star	Cooling	12%	0%	78%	90%	$2,200	25	0.55
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	78%	90%	$2,200	25	0.55
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	8%	9%	$256	15	0.17
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	50%	10%	50%	$2,975	15	0.01
Exterior Lighting - Photosensor Control	Exterior Lighting	13%	0%	0%	45%	$90	8	0.06
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	11%	45%	$72	8	0.10
Water Heater - Faucet Aerators	Water Heating	4%	2%	11%	90%	$24	25	6.84
Water Heater - Pipe Insulation	Water Heating	6%	3%	0%	41%	$50	13	2.92
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	21%	75%	$48	10	7.03
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$15	10	11.97
Water Heater - Thermostat Setback	Water Heating	9%	5%	5%	75%	$40	5	2.29
Water Heater - Timer	Water Heating	8%	4%	5%	40%	$194	10	0.81
Water Heater - Drainwater Heat Reocvery	Water Heating	9%	5%	1%	90%	$899	15	0.29
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	2.52
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	0.83
Home Energy Management System	Cooling	10%	0%	5%	68%	$250	20	2.50
Home Energy Management System	Space Heating	10%	5%	5%	68%	$250	20	2.50
Home Energy Management System	Interior Lighting	10%	5%	5%	68%	$250	20	2.50
Photovoltaics	Cooling	50%	0%	0%	48%	$7,900	15	0.20
Photovoltaics	Space Heating	25%	25%	0%	48%	$7,900	15	0.20
Pool - Pump Timer	Miscellaneous	60%	0%	35%	90%	$160	15	2.21
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.30
Advanced New Construction Designs	Cooling	30%	0%	2%	45%	$2,500	18	1.25
Advanced New Construction Designs	Space Heating	30%	30%	2%	45%	$2,500	18	1.25
Advanced New Construction Designs	Interior Lighting	20%	20%	2%	45%	$2,500	18	1.25
Water Heater - Heat Pump	Water Heating	30%	15%	0%	20%	$1,500	15	0.58
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$2,970	15	1.18
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$10,798	15	0.81

Note: Costs are per household.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 750 of 1069

COMMERCIAL ENERGY EFFICIENCY EQUIPMENT AND MEASURE DATA

This appendix presents detailed information for all commercial and industrial energy efficiency equipment and measures that were evaluated in LoadMAP. Several sets of tables are provided.

Table D-1 provides brief descriptions for all equipment and measures that were assessed for potenital.

Tables D-2 through D-9 list the detailed unit-level data for the equipment measures for each of the C&I segments — small/medium commercial, large commercial, extra-large commercial, and extra-large industial — and for existing and new construction, respectively. Savings are in kWh/yr/sq.ft., and incremental costs are in $/sq.ft. The B/C ratio is zero if the measure represents the baseline technology or if the technology is not available in the first year of the forecast (2012). The B/C ratio is calculated within LoadMAP for each year of the forecast and is available once the technology or measure becomes available.

Tables D-10 through D-17 list the detailed unit-level data for the non-equipment energy efficiency measures for each of the segments and for existing and new construction, respectively. Because these measures can produce energy-use savings for multiple end-use loads (e.g., insulation affects heating and cooling energy use) savings are expressed as a percentage of the end-use loads. Base saturation indicates the percentage of buildings in which the measure is already installed. Applicability/Feasibility is the product of two factors that account for whether the measure is applicable to the building. Cost is expressed in $/sq.ft. The detailed measure-level tables present the results of the benefit/cost (B/C) analysis for the first year of the forecast. The B/C ratio is zero if the measure represents the baseline technology or if the measure is not available in the first year of the forecast (2012). The B/C ratio is calculated within LoadMAP for each year of the forecast and is available once the technology or measure becomes available.

Note that Tables D-2 through D-17 present information for Washington. For Idaho, savings and B/C ratios may be slightly different due to weather-related usage, differences in the states' market profiles, and different retail electricity prices. Although Idaho-specific values are not presented here, they are available within the LoadMAP files.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Cooling	Central Cooling Systems	Commercial buildings are often cooled with a central chiller plant that creates chilled water for distribution throughout the facility. Chillers can be air source or water source, which include heat rejection via a condenser loop and cooling tower. Because of the wide variety of system types and sizes, savings and cost values for efficiency improvements in chiller systems represent an average over air- and water-cooled systems, as well as screw, reciprocating, and centrifugal technologies. Under this simplified approach, each central system is characterized by an aggregate efficiency value (inclusive of chiller, pumps, motors and condenser loop equipment), in kW/ton with a further efficiency upgrade through the application of variable refrigerant flow technology.
Cooling	Chilled Water Variable Flow System	The chilled water variable flow system is essentially a single chilled water loop with variable volume and speed. A single set of pumps operated by a VSD eliminates the need for separate distribution pumps and makes the chilled water flow throughout the entire system be variable. The use of adjustable flow limiting valves is designed to optimize water flow. Such valves provide flow limiting, shut-off and adjustment functions, automatically compensating for changes in system pressure to maximize energy efficiency.
Cooling	Packaged Cooling Systems / Rooftop Units (RTUs) and Heat Pumps	Packaged cooling systems are simple to install and maintain, and are commonly used in small and medium-sized commercial buildings. Applications range from a single supply system with air intake filters, supply fan, and cooling coil, or can become more complex with the addition of a return air duct, return air fan, and various controls to optimize performance. For packaged RTUs, varying Energy Efficiency Ratios (EER) were considered, as well as ductless or "mini-split" systems with variable refrigerant flow. For heat pumps, units with increasing EER and COP levels were evaluated, as well as a ductless mini-split system.
Cooling	Packaged Terminal Air Conditioners (PTAC)	Window (or wall) mounted room air conditioners (and heat pumps) are designed to cool (or heat) a single room or space. This type of unit incorporates a complete air-cooled refrigeration and air-handling system in an individual package. Conditioned air is discharged in response to thermostatic control to meet room requirements. Each unit has a self-contained, air-cooled direct expansion (DX) cooling system, a heat pump or other fuel-based heating system and associated controls. The energy savings increase with each incremental increase in efficiency, measured in terms of EER level.
Space Heating	Convert to Gas	This fuel-switching measure is the replacement of an electric furnace with a gas furnace. This measure eliminates all prior electricity consumption and demand due to electric space heating. In this study, it is assumed this measure can be implemented only in buildings within 500 feet of a gas main.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Cooling, Space Heating, Interior Lighting	Energy Management System	An energy management system (EMS) allows managers/owners to monitor and control the major energy-consuming systems within a commercial building. At the minimum, the EMS can be used to monitor and record energy consumption of the different end-uses in a building, and can control operation schedules of the HVAC and lighting systems. The monitoring function helps building managers/owners to identify systems that are operating inefficiently so that actions can be taken to correct the problem. The EMS can also provide preventive maintenance scheduling that will reduce the cost of operations and maintenance in the long run. The control functionality of the EMS allows the building manager/owner to operate building systems from one central location. The operation schedules set via the EMS help to prevent building systems from operating during unwanted or unoccupied periods. This analysis assumes that this measure is limited to buildings with a central HVAC system.
Cooling, Space Heating	Economizer	Economizers allow outside air (when it is cool and dry enough) to be brought into the building space to meet cooling loads instead of using mechanically cooled interior air. A dual enthalpy economizer consists of indoor and outdoor temperature and humidity sensors, dampers, motors, and motor controls. Economizers are most applicable to temperate climates and savings will be smaller in extremely hot or humid areas.
Cooling	VSD on Water Pumps	The part-load efficiency of chilled water loop pumps can be improved substantially by varying the speed of the motor drive according to the building demand for cooling. There is also a reduction in piping losses associated with this measure that has a major impact on the energy use for a building. However, pump speeds can generally only be reduced to a minimum specified rate, because chillers and the control valves may require a minimum flow rate to operate. There are two major types of variable speed drives: mechanical and electronic. An additional benefit of variable-speed drives is the ability to start and stop the motor gradually, thus extending the life of the motor and associated machinery. This analysis assumes that electronic variable speed drives are installed.
Cooling	Turbocor Compressor	Turbocor compressors use oil-free magnetic bearings to reduce friction losses and couples that with a two-stage centrifugal compressor to reduce central chiller energy consumption.
Cooling	High-Efficiency Cooling Tower Fans	High efficiency cooling tower fans utilize variable frequency drives in the cooling tower design. VFDs improve fan performance by adjusting fan speed and rotation as conditions change.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Cooling	Condenser Water Temperature Reset	Chilled water reset controls save energy by improving chiller performance through increasing the supply chilled water temperature, which allows increased suction pressure during low load periods. Raising the chilled water temperature also reduces chilled water piping losses. However, the primary savings from the chilled water reset measure results from chiller efficiency improvement. This is due partly to the smaller temperature difference between chilled water and ambient air, and partly due to the sensitivity of chiller performance to suction temperature.
Cooling	Maintenance	Filters, coils, and fins require regular cleaning and maintenance for the heat pump or roof top unit to function effectively and efficiently throughout its years of service. Neglecting necessary maintenance leads to a steady decline in performance while energy use increases. Maintenance can increase the efficiency of poorly performing equipment by as much as 10%.
Cooling	Evaporative Precooler	Evaporative precooling can improve the performance of air conditioning systems, most commonly RTUs. These systems typically use indirect evaporative cooling as a first stage to pre-cool outside air. If the evaporative system cannot meet the full cooling load, the air steam is further cooled with conventional refrigerative air conditioning technology.
Cooling	Roof- High Reflectivity (Cool Roof)	The color and material of a building structure surface will determine the amount of solar radiation absorbed by that surface and subsequently transferred into a building. This is called solar absorptance. By using a material or painting the roof with a light color (and a lower solar absorptance), the roof will absorb less solar radiation and consequently reduce the cooling load.
Cooling, Space Heating	Green Roofs	A green roof covers a section or the entire building roof with a waterproof membrane and vegetative material. Like cool roofs, green roofs can reduce solar absorptance and they can also provide insulation. They also provide non-energy benefits by absorbing rainwater and thus reducing storm water run-off, providing wildlife habitat, and reducing so-called urban heat island effects.
Cooling, Space Heating, Ventilation	HVAC Retrocommissioning	Over time, the performance of complex mechanical systems providing heating and cooling to existing commercial spaces degrades as a result of inappropriate changes to or overrides of controls, deteriorating equipment, clogged filters, changing demands and schedules, and pressure imbalances. Retrocommissioning is a comprehensive analysis of an entire system in which an engineer assesses shortcomings in system performance, and then optimizes through a process of tune-up, maintenance, and reprogramming of control or automation software. Energy efficiency programs throughout the country promote retrocommissioning as a means of greatly reducing energy consumption in existing buildings.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Cooling, Space Heating, Ventilation, Interior Lighting	Comprehensive Retrocommissioning	Comprehensive retrocommissioning covers not only HVAC and lighting, but other existing building systems as well. For example, it can improve efficiency of non-HVAC motors, vertical transport systems, and domestic hot water systems.
Cooling, Space Heating, Ventilation, Interior Lighting/Exterior Lighting	HVAC Commissioning Lighting Commissioning Comprehensive Commissioning	For new construction and major renovations, commissioning ensures that building systems are properly designed, specified, and installed to meet the design intent and provide high-efficiency performance. As the names suggests, HVAC Commissioning and Lighting Commissioning focus only on HVAC and lighting equipment and controls. Comprehensive commissioning addresses these systems but usually begins earlier in the design process, and may also address domestic hot water, non-HVAC fans, vertical transport, telecommunications, fire protection, and other building systems.
Cooling, Space Heating, Interior Lighting	Advanced New Construction Designs	Advanced new construction designs use an integrated approach to the design of new buildings to account for the interaction of building systems. Typically, architects and engineers work closely to specify the building orientation, building shell, building mechanical systems, and controls strategies with the goal of optimizing building energy efficiency and comfort. Options that may be evaluated and incorporated include passive solar strategies, increased thermal mass, daylighting strategies, and shading strategies, This measure was modeled for new construction only.
Cooling, Space Heating	Programmable Thermostat	A programmable thermostat can be added to most heating/cooling systems. They are typically used during winter to lower temperatures at night and in summer to increase temperatures during the afternoon. There are two-setting models, and well as models that allow separate programming for each day of the week. The energy savings from this type of thermostat are identical to those of a "setback" strategy with standard thermostats, but the convenience of a programmable thermostat makes it a much more attractive option. In this analysis, the baseline is assumed to have no thermostat setback.
Cooling, Space Heating	Duct Repair and Sealing	An ideal duct system would be free of leaks. Leakage in unsealed ducts varies considerably because of the differences in fabricating machinery used, the methods for assembly, installation workmanship, and age of the ductwork. Air leaks from the system to the outdoors result in a direct loss proportional to the amount of leakage and the difference in enthalpy between the outdoor air and the conditioned air. To seal ducts, a wide variety of sealing methods and products exist. Each has a relatively short shelf life, and no documented research has identified the aging characteristics of sealant applications. This analysis assumes that the baseline air loss from ducts has doubled, and conducting repair and sealing of the ducts will restore leakage from ducts to the original baseline level.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Cooling, Space Heating	Duct Insulation	Air distribution ducts can be insulated to reduce heating or cooling losses. Best results can be achieved by covering the entire surface area with insulation. Insulation material inhibits the transfer of heat through the air-supply duct. Several types of ducts and duct insulation are available, including flexible duct, pre-insulated duct, duct board, duct wrap, tacked, or glued rigid insulation, and waterproof hard shell materials for exterior ducts.
Cooling, Space Heating	Insulation – Radiant Barrier	Radiant barriers inhibit heat transfer by thermal radiation. When a radiant barrier is installed beneath the roofing material much of the heat radiated from a hot roof is reflected back to the roof limiting the amount of heat emitted downwards.
Cooling, Space Heating	High-Efficiency Windows	High-efficiency windows, such as those labeled under the ENERGY STAR Program, are designed to reduce a building's energy bill while increasing comfort for the occupants at the same time. High-efficiency windows have reducing properties that reduce the amount of heat transfer through the glazing surface. For example, some windows have a low-E coating, which is a thin film of metallic oxide coating on the glass surface that allows passage of short-wave solar energy through glass and prevents long-wave energy from escaping. Another example is double-pane glass that reduces conductive and convective heat transfer. There are also double-pane glasses that are gas-filled (usually argon) to further increase the insulating properties of the window.
Cooling, Space Heating	Ceiling and Wall Cavity Insulation	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation can conserve energy by reducing the heat loss or gain of a building. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose; loose-fill (blown) fiberglass; and rigid polystyrene.
Ventilation	Cooking – Exhaust Hoods with Sensor Controls	Improved exhaust hoods involve installing variable-speed controls on commercial kitchen hoods. These controls provide ventilation based on actual cooking loads. When grills, broilers, stoves, fryers or other kitchen appliances are not being used, the controls automatically sense the reduced load and decrease the fan speed accordingly. This results in lower energy consumption because the system is only running as needed rather than at 100% capacity at all times.
Ventilation	Variable Air Volume	A variable air volume ventilation system modulates the air flow rate as needed based on the interior conditions of the building to reduce fan load, improve dehumidification, and reduce energy usage.
Ventilation	Fans – Energy Efficient Motors	High-efficiency motors are essentially interchangeable with standard motors, but differences in construction make them more efficient. Energy-efficient motors achieve their improved efficiency by reducing the losses that occur in the conversion of electrical energy to mechanical energy. This analysis assumes that the efficiency of supply fans is increased by 5% due to installing energy-efficient motors.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Ventilation	Fans – Variable Speed Control (VSD)	The part-load efficiency of ventilation fans can be improved substantially by varying the speed of the motor drive. There are two major types of variable speed controls: mechanical and electronic. An additional benefit of variable-speed controls is the ability to start and stop the motor gradually, thus extending the life of the motor and associated machinery. This analysis assumes that electronic variable speed controls are installed.
Water Heating	High-Efficiency Water Heater Systems	Efficient electric water heaters are characterized by a high recovery or thermal efficiency (percentage of delivered electric energy which is transferred to the water) and low standby losses (the ratio of heat lost per hour to the content of the stored water). Included in the savings associated with high-efficiency electric water heaters are timers that allow temperature setpoints to change with hot water demand patterns. For example, the heating element could be shut off throughout the night, increasing the overall energy factor of the unit. In addition, tank and pipe insulation reduces standby losses and therefore reduces the demands on the water heater. This analysis considers conventional electric water heaters with efficiency greater than 96%, as well as geothermal heat pump water heaters for effective efficiency greater than one. Solar water heating was evaluated as well.
Water Heating	Convert to Gas	This fuel-switching measure is the replacement of an electric water heater with a gas-fired water heater. This measure will eliminate all prior electricity consumption and demand due to electric water heating. In this study, it is assumed that this measure can be implemented only in buildings within 500 feet of a gas main.
Water Heating	Heat Pump Water Heater	Heat pump water heaters use heat pump technology to extract heat from the ambient surroundings and transfer it to a hot water tank. These devices are available as an alternative to conventional tank water heaters of 55 gallons or larger.
Water Heating	Faucet Aerators/Low Flow Nozzles	A faucet aerator or low flow nozzle spreads the stream from a faucet helping to reduce water usage. The amount of water passing through the aerator is measured in gallons per minute (GPM) and the lower the GPM the more water the aerator conserves.
Water Heating	Pipe Insulation	Insulating hot water pipes decreases the amount of energy lost during distribution of hot water throughout the building. Insulating pipes will result in quicker delivery of hot water and allows lowering the water heating set point. There are several different types of insulation, the most common being polyethylene and neoprene.
Water Heating	High-Efficiency Circulation Pump	A high efficiency circulation pump uses an electronically commutated motor (ECM) to improve motor efficiency over a larger range of partial loads. In addition, an ECM allows for improved low RPM performance with greater torque and smaller pump dimensions.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Water Heating	Tank Blanket/Insulation	Insulation levels on domestic hot water heaters can be increased by installing a fiberglass blanket on the outside of the tank. This increase in insulation reduces standby losses and thus saves energy. Water heater insulation is available either by the blanket or by square foot of fiberglass insulation with R-values ranging from 5 to 14.
Water Heating	Thermostat Setback	Installing a setback thermostat on the water heater can lead to significant energy savings during periods when there is no one in the building.
Water Heating	Hot Water Saver	A hot water saver is a plumbing device that attaches to the showerhead and that pauses the flow of water until the water is hot enough for use. The water is re-started by the flip of a switch.
Interior Lighting, Exterior Lighting	Lamp Replacement (Interior Screw-in, HID, and Linear Fluorescent Exterior Screw-in, HID, and Linear Fluorescent)	Commercial lighting differs from the residential sector in that efficiency changes typically require more than the simple purchase and quick installation of a screw-in compact fluorescent lamp. Restrictions regarding ballasts, fixtures, and circuitry limit the potential for direct substitution of one lamp type for another. However, such replacements do exist. For example, screw-in incandescent lamps can readily be replaced with CFLs or LEDs. Also, during the buildout for a leased office space, the management could decide to replace all T12 lamps and magnetic ballasts with T8/electronic ballast configurations. This type of decision-making is modeled on a stock turnover basis because of the time between opportunities for upgrades.
Interior Lighting, Exterior Lighting	Lighting Retrocommissioning	Lighting retrocommissioning projects in existing commercial buildings do not require an event such as a tenant turnover, a major renovation, or an update to electrical circuits to drive its adoption. Rather, a decision-maker can decide at any time to perform a comprehensive audit of a facility's lighting systems, followed by an upgrade of equipment (lamps, ballasts, fixtures, reflectors), controls (occupancy sensors, daylighting controls, and central automation).
Interior Lighting	Delamping and Install Reflectors	While sometimes included in lighting retrofit projects, delamping is often performed as a separate energy efficiency measure in which a lighting engineer analyzes the lighting provided by current systems compared to the requirements of building occupants. This often leads to the removal of unnecessary lamps corresponding to an overall reduction in energy usage. .In addition, installing a reflector in each fixture can improve light distribution from the remaining lamps.
Interior Lighting, Exterior Lighting	Lighting Time Clocks and Timers	While outdoor lighting is typically required only at night, in many cases lighting remains on during daylight hours. A simple timer can set a diurnal schedule for outdoor lighting and thus reduce the operating hours by as much as 50%.
Interior Lighting	Central Lighting Controls	Central lighting control systems provide building-wide control of interior lighting to ensure that lights are properly scheduled based on expected building occupancy. Individual zones or circuits can be controlled.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 758 of 1069

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Interior Lighting	Photocell Controlled T8 Dimming Ballasts	Photocells, in concert with dimming ballasts, can detect when adequate daylighting is available and dim or turn off lights to reduce electricity consumption. Usually one photocell is used to control a group of fixtures, a zone, or a circuit.
Interior Lighting	Bi-Level Fixture with Occupancy Sensor	Bi-level fixtures with occupancy sensors detect when a space is unoccupied and reduce light output to a lower level. These devices
Interior Lighting	High Bay Fixtures	Fluorescent fixtures designed for high-bay applications have several advantages over similar HID fixtures: lower energy consumption, lower lumen depreciation rates, better dimming options, faster start-up and restrike, better color rendition, more pupil lumens, and reduced glare.
Interior Lighting	Occupancy Sensor	The installation of occupancy sensors allows lights to be turned off during periods when a space is unoccupied, virtually eliminating the wasted energy due to lights being left on. There are several types of occupancy sensors in the market.
Interior Lighting	LED Exit Lighting	The lamps inside exit signs represent a significant energy end-use, since they usually operate 24 hours per day. Many old exit signs use incandescent lamps, which consume approximately 40 watts per sign. The incandescent lamps can be replaced with LED lamps that are specially designed for this specific purpose. In comparison, the LED lamps consume approximately 2-5 watts.
Interior Lighting	Task Lighting	In commercial facilities, individual work areas can use task lighting instead of brightly lighting the entire area. Significant energy savings can be realized by focusing light directly where it is needed and lowering the general lighting level. An example of task lighting is the common desk lamp. A 25W desk lamp can be installed in place of a typical lamp in a fixture.
Interior Lighting, Cooling	Hotel Guestroom Controls	Hotel guestrooms can be fitted with occupancy controls that turn off energy-using equipment when the guest is not using the room. The occupancy controls comes in several forms, but this analysis assumes the simplest kind, which is a simple switch near the room's entry where the guest can deposit their room key or card. If the key or card is present, then lights, TV, and air conditioning can receive power and operate. When the guest leaves and takes the key, all equipment shuts off.
Exterior Lighting	Daylighting Controls	Daylighting controls use a photosensor to detect ambient light and turn off exterior lights accordingly.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Exterior Lighting	Photovoltaic Lighting	Outdoor photovoltaic (PV) lighting systems use PV panels (or modules), which convert sunlight to electricity. The electricity is stored in batteries for use at night. They can be cost effective relative to installing power cables and/or step down transformers for relatively small lighting loads. The "nightly run time" listings on most "off-the-shelf" products are based on specific sunlight conditions. Systems located in places that receive less sunlight than the system is designed for will operate for fewer hours per night than expected. Nightly run times may also vary depending on how clear the sky is on any given day. Shading of the PV panel by landscape features (vegetation, buildings, etc.) will also have a large impact on battery charging and performance. Open areas with no shading, such as parking lots, are ideal places where PV lighting systems can be used.
Exterior Lighting	Cold Cathode Lighting	Cold cathode lighting does not use an external heat source to provide thermionic emission of electrons. Cold cathode lighting is typically used for exterior signage or where temperatures are likely to drop below freezing.
Exterior Lighting	Induction Lamps	Induction lamps use a contactless bulb and rely on electromagnetic fields to transfer power. This allows for the lamp to utilize more efficient materials that would otherwise react with metal electrodes. In addition, the lack of an electrode significantly extends lamp life while reducing lumen depreciation.
Office Equipment	Desktop and Laptop Computing Equipment	ENERGY STAR labeled office equipment saves energy by powering down and "going to sleep" when not in use. ENERGY STAR labeled computers automatically power down to 15 watts or less when not in use and may actually last longer than conventional products because they spend a large portion of time in a low-power sleep mode. ENERGY STAR labeled computers also generate less heat than conventional models. The ClimateSavers Initiative, made up of leading computer processor manufacturers, has stated a goal of reducing power consumption in active mode by 50% by integrating innovative power management into the chip design process.
Office Equipment	Monitors	ENERGY STAR labeled office equipment saves energy by powering down and "going to sleep" when not in use. ENERGY STAR labeled monitors automatically power down to 15 watts or less when not in use.
Office Equipment	Servers	In addition to the "sleep" mode a reductions and the efficient processors being designed by members of the ClimateSavers Initiative, servers have additional energy-saving opportunities through "virtualization" and other architecture solutions that involve optimal matching of computation tasks to hardware requirements

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Office Equipment	Printers/Copiers/ Fax/ POS Terminals	ENERGY STAR labeled office equipment saves energy by powering down and "going to sleep" when not in use. ENERGY STAR labeled copiers are equipped with a feature that allows them to automatically turn off after a period of inactivity, reducing a copier's annual electricity costs by over 60%. High-speed copiers that include a duplexing unit that is set to automatically make double-sided copies can reduce paper costs and help to save trees.
Office Equipment	ENERGY STAR Power Supply	Power supplies with an efficient ac-dc or ac-ac conversion process can obtain the ENERGY STAR label. These devices can be used to power computers, phones, and other office equipment.
Refrigeration	Walk-in Refrigeration Systems	Standard compressors typically operate at approximately 65% efficiency. High-efficiency models are available that can improve compressor efficiency by 15%.
Refrigeration	Glass Door and Solid Door Refrigeration Units (Reach-in /Open Display Case/Vending Machine) Door Gasket Replacement High Efficiency Case Lighting	In addition to walk-in, "cold-storage" refrigeration, a significant amount of energy in the commercial sector can be attributed to "reach-in" units. These stand-alone appliances can range from a residential-style refrigerator/freezer unit in an office kitchen or the breakroom of a retail store to the refrigerated display cases in some grocery or convenience stores. As in the case of residential units, these refrigerators can be designed to perform at higher efficiency through a combination of compressor equipment upgrades, default temperature settings, and defrost patterns. Other measures for these units are replacing aging door gaskets that no longer adequately seal the case, and replacing inefficient display lights with CFL or LED systems to reduce internal heat gains in the cases.
Refrigeration	Open Display Case	Glass doors can be used to enclose multi-deck display cases for refrigerated items in supermarkets. In addition, more efficient units are designed to perform at higher efficiency through a combination of compressor equipment upgrades, default temperature settings, and defrost patterns.
Refrigeration	Anti-Sweat Heater/ Auto Door Closer Controls	Anti-sweat heaters are used in virtually all low-temperature display cases and many medium-temperature cases to control humidity and prevent the condensation of water vapor on the sides and doors and on the products contained in the cases. Typically, these heaters stay on all the time, even though they only need to be on about half the time. Anti-sweat heater controls can come in the form of humidity sensors or time clocks.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Refrigeration	Floating Head Pressure Controls	Floating head pressure control allows the pressure in the condenser to "float" with ambient temperatures. This method reduces refrigeration compression ratios, improves system efficiency and extends the compressor life. The greatest savings with a floating head pressure approach occurs when the ambient temperatures are low, such as in the winter season. Floating head pressure control is most practical for new installations. However, retrofits installation can be completed with some existing refrigeration systems. Installing floating head pressure control increases the capacity of the compressor when temperatures are low, which may lead to short cycling.
Refrigeration	Bare Suction Lines	Insulating bare suction lines reduces heat
Refrigeration	Night Covers	Night covers can be used on open refrigeration cases when a facility is closed or few customers are in the store.
Refrigeration	Strip Curtain	Strip curtains at the entrances to large walk-in coolers or freezers, such as those used in supermarkets, reduce air transfer between the refrigerated space and the surrounding space.
Refrigeration	Icemakers	In certain building types (restaurant, hotel), the production of ice is a significant usage of electricity. By optimizing the timing of ice production and the type of output to the specific application, icemakers are assumed to deliver electricity savings.
Refrigeration	Vending Machine - Controller	Cold beverage vending machines usually operate 24 hours a day regardless of whether the surrounding area is occupied or not. The result is that the vending machine consumes energy unnecessarily, because it will operate all night to keep the beverage cold even when there would be no customer until the next morning. A vending machine controller can reduce energy consumption without compromising the temperature of the vended product. The controller uses an infrared sensor to monitor the surrounding area's occupancy and will power down the vending machine when the area is unoccupied. It will also monitor the room's temperature and will re -power the machine at one to three hour intervals independent of occupancy to ensure that the product stays cold.
Food Service	Kitchen Equipment	Commercial cooking and food preparation equipment represent a significant contribution to energy consumption in restaurants and other food service applications. By replacing old units with efficient ones, this energy consumption can be greatly reduced. These measures include fryers, commercial ovens, dishwashers, hot food containers and miscellaneous other food preparation equipment. Savings range between 15 and 65%, depending on the specific unit being replaced.
Cooling, Space Heating, Interior Lighting, Food Preparation, Refrigeration	Custom Measures	Custom measures were included in the CPA analysis to serve as a "catch all" for measures for which costs and savings are not easily quantified and that could be part of a program such as Avista's existing Site-Specific incentive program. Costs and energy savings were assumed such that the measures passed the economic screen.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Miscellaneous	Non-HVAC motor	Because the Small/Medium Commercial and Large Commercial segments include some industrial customers, the CPA analysis included equipment upgrades for non-HVAC motors. This equipment measure also incorporates improvements for vertical transport. Premium efficiency motors reduce the amount of lost energy going into heat rather than power. Since less heat is generated, less energy is needed to cool the motor with a fan. Therefore, the initial cost of energy efficient motors is generally higher than for standard motors. However their life-cycle costs can make them far more economical because of savings they generate in operating expense. Premium efficiency motors can provide savings of 0.5% to 3% over standard motors. The savings results from the fact that energy efficient motors run cooler than their standard counterparts, resulting in an increase in the life of the motor insulation and bearing. In general, an efficient motor is a more reliable motor because there are fewer winding failures, longer periods between needed maintenance, and fewer forced outages. For example, using copper instead of aluminum in the windings, and increasing conductor cross-sectional area, lowers a motor's I2R losses.
Miscellaneous	Pumps – Variable Speed Control	The part-load efficiency of chilled and hot water loop pumps can be improved substantially by varying the speed of the motor drive according to the building demand for heating or cooling. There is also a reduction in piping losses associated with this measure that has a major impact on the heating loads and energy use for a building. However, pump speeds can generally only be reduced to a minimum specified rate, because chillers, boilers, and the control valves may require a minimum flow rate to operate. There are two major types of variable speed controls: mechanical and electronic. An additional benefit of variable-speed drives is the ability to start and stop the motor gradually, thus extending the life of the motor and associated machinery. This analysis assumes that electronic variable speed controls are installed.
Miscellaneous	Laundry – High Efficiency Clothes Washer	High efficiency clothes washers use designs that require less water. These machines use sensors to match the hot water needs to the load, preventing energy waste. There are two designs: top-loading and front-loading. Further energy and water savings can be achieved through advanced technologies such as inverter-drive or combination washer-dryer units.
Miscellaneous	ENERGY STAR Water Cooler	An ENERGY STAR water cooler has more insulation and improved chilling mechanisms, resulting in about half the energy use of a standard cooler.
Miscellaneous	Industrial Process Improvements	Because the Avista C&I sector segmentation was based on Avista's rate classes, the commercial building segments include a small percentage or industrial business types. This measure was included to account for energy efficiency potential that could be achieved through various process improvements at these customers.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Machine Drive.	Motors, Premium Efficiency	Premium efficiency motors reduce the amount of lost energy going into heat rather than power. Since less heat is generated, less energy is needed to cool the motor with a fan. Therefore, the initial cost of energy efficient motors is generally higher than for standard motors. However their life-cycle costs can make them far more economical because of savings they generate in operating expense. Premium efficiency motors can provide savings of 0.5% to 3% over standard motors. The savings results from the fact that energy efficient motors run cooler than their standard counterparts, resulting in an increase in the life of the motor insulation and bearing. In general, an efficient motor is a more reliable motor because there are fewer winding failures, longer periods between needed maintenance, and fewer forced outages. For example, using copper instead of aluminum in the windings, and increasing conductor cross-sectional area, lowers a motor's I2R losses. This analysis assumes 75% loading factor (for peak efficiency) for 1800 rpm motor. Hours of operation vary depending on horsepower size. In addition, improved drives and controls are assumed to be implemented along with the motors, resulting in savings as high as 10% of annual energy consumption
Machine Drive	Motors – Variable Frequency Drive	In addition to energy savings, VFDs increase motor and system life and provide a greater degree of control over the motor system. Especially for motor systems handling fluids, VFDs can efficiently respond to changing operating conditions.
Machine Drive	Magnetic Adjustable Speed Drive	To allow for adjustable speed operation, this technology uses magnetic induction to couple a drive to its load. Varying the magnetic slip within the coupling controls the speed of the output shaft. Magnetic drives perform best at the upper end of the speed range due to the energy consumed by the slip. Unlike traditional ASDs, magnetically coupled ASDs create no power distortion on the electrical system. However, magnetically coupled ASD efficiency is best when power needs are greatest. VFDs may show greater efficiency when the average load speed is below 90% of the motor speed, however this occurs when power demands are reduced.
Machine Drive	Compressed Air – System Controls, Optimization and Improvements, Maintenance	Controls for compressed air systems can shift load from two partially loaded compressors to one compressor in order to maximize compression efficiency and may also involve the addition of VFDs. Improvements include installing high-efficiency motors. Maintenance includes fixing air leaks and replacing air filters.
Machine Drive	Fan Systems – Controls, Optimization and Maintenance	Certain practices require a consistent flow rate, such as indoor air quality and clean room ventilation. To achieve this, fan flow controls can be used to maintain precise volume flow control ensuring a constant air delivery even on fluctuating pressure conditions. This is done through programmable circuitry to electronically control fan motor speed. Motors can be configured to accept a signal from a controller that would vary the flow rate in direct proportion to the signal.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 764 of 1069

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Machine Drive	Pumping Systems – Controls, Optimization and Maintenance	Pumping systems optimization includes installing VFDs, correctly resizing the motors, and installing timers and automated on-off controls. Maintenance includes repairing diaphragms and fixing piping leaks.
Process	Process Cooling/Refrigeration	Because of the customized nature of industrial cooling and refrigeration applications, a variety of opportunities are summarized as a general improvement in cooling and cold storage equipment. Costs and savings were developed using average values for this group of measures from the Sixth Plan industrial supply curve workbooks.
Process	Process Heating	Because of the customized nature of industrial heating applications, a variety of opportunities are summarized as a general improvement in process heating equipment, such as arc furnaces. Costs and savings were developed using average values for this group of measures from the Sixth Plan industrial supply curve workbooks.
Process	Electrochemical Process	Because of the customized nature of industrial electrochemical applications, a variety of opportunities are summarized as a general improvement in equipment and processes. Costs and savings were developed using average values for this group of measures from the Sixth Plan industrial supply curve workbooks.
Process	Refrigeration – System Controls, Maintenance, and Optimization	Because refrigeration equipment performance degrades over time and control settings are frequently overridden, these measures account for savings that can be achieved through system maintenance and controls optimization.

Table D-2 Energy Efficiency Equipment Data — Small/Medium Comm., Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Central Chiller	1.3 kw/ton, COP 2.7	0.29	$0.39	20	-
Cooling	Central Chiller	1.26 kw/ton, COP 2.8	0.35	$0.50	20	0.51
Cooling	Central Chiller	1.0 kw/ton, COP 3.5	0.73	$0.62	20	1.90
Cooling	Central Chiller	0.97 kw/ton, COP 3.6	0.77	$0.74	20	1.39
Cooling	Central Chiller	Variable Refrigerant Flow	1.01	$11.57	20	0.07
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.22	$0.18	16	-
Cooling	RTU	EER 11.2	0.43	$0.35	16	-
Cooling	RTU	EER 12.0	0.57	$0.58	16	0.49
Cooling	RTU	Ductless VRF	0.69	$5.12	16	0.05
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.09	$0.08	14	0.86
Cooling	PTAC	EER 10.8	0.21	$0.16	14	1.00
Cooling	PTAC	EER 11	0.25	$0.43	14	0.43
Cooling	PTAC	EER 11.5	0.33	$0.96	14	0.27
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	0.57	$0.39	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	0.90	$1.18	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	1.20	$1.57	15	0.98
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	1.31	$1.96	15	0.68
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	1.46	$11.50	20	0.10
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	1.30	$1.22	15	1.07
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.23	$0.09	4	-
Interior Lighting	Interior Screw-in	CFL	0.94	$0.03	7	16.50
Interior Lighting	Interior Screw-in	LED	1.04	$1.18	12	0.84
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.30	($0.07)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.30	($0.03)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.91	$0.25	6	1.73
Interior Lighting	Linear Fluorescent	T5	0.95	$0.43	6	1.06
Interior Lighting	Linear Fluorescent	LED	0.99	$3.74	15	0.33
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.14	$0.05	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.60	$0.02	7	17.60
Exterior Lighting	Exterior Screw-in	Metal Halides	0.60	$0.05	4	3.16
Exterior Lighting	Exterior Screw-in	LED	0.66	$0.64	12	0.90
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.22	($0.13)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.24	$0.55	9	0.37
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.01	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.04	$0.02	6	1.12
Exterior Lighting	Linear Fluorescent	T5	0.04	$0.03	6	0.69
Exterior Lighting	Linear Fluorescent	LED	0.05	$0.24	15	0.22
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0.00	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	0.10	$0.02	15	5.23
Water Heating	Water Heater	Geothermal Heat Pump	1.33	$3.53	15	0.43
Water Heating	Water Heater	Solar	1.46	$3.03	15	0.55
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Efficient	0.03	$0.04	12	0.80
Food Preparation	Oven	Standard	-	$0.00	12	-

Note: Costs and savings are per sq. ft.

Table D-2 Energy Efficiency Equipment Data — Small/Med. Comm., Existing Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Food Preparation	Oven	Efficient	0.39	$0.36	12	1.02
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Efficient	0.02	$0.05	12	0.36
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Efficient	0.40	$0.16	12	2.29
Food Preparation	Food Prep	Standard	-	$0.00	12	-
Food Preparation	Food Prep	Efficient	0.00	$0.03	12	0.07
Refrigeration	Walk in Refrigeration	Standard	-	$0.00	18	-
Refrigeration	Walk in Refrigeration	Efficient	-	$0.09	18	-
Refrigeration	Glass Door Display	Standard	-	$0.00	18	-
Refrigeration	Glass Door Display	Efficient	0.16	$0.00	18	56.08
Refrigeration	Solid Door Refrigerator	Standard	-	$0.00	18	-
Refrigeration	Solid Door Refrigerator	Efficient	0.19	$0.02	18	9.87
Refrigeration	Open Display Case	Standard	-	$0.00	18	-
Refrigeration	Open Display Case	Efficient	0.00	$0.00	18	0.24
Refrigeration	Vending Machine	Base	-	$0.00	10	-
Refrigeration	Vending Machine	Base (2012)	0.11	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency	0.13	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency (2012)	0.20	$0.00	10	46.48
Refrigeration	Icemaker	Standard	-	$0.00	12	-
Refrigeration	Icemaker	Efficient	0.05	$0.00	12	12.76
Office Equipment	Desktop Computer	Baseline	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.19	$0.00	4	23.04
Office Equipment	Desktop Computer	Climate Savers	0.27	$0.36	4	0.23
Office Equipment	Laptop Computer	Baseline	-	$0.00	4	-
Office Equipment	Laptop Computer	Energy Star	0.02	$0.00	4	7.34
Office Equipment	Laptop Computer	Climate Savers	0.03	$0.12	4	0.08
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.12	$0.01	3	2.14
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.22	$0.00	4	19.68
Office Equipment	Printer/copier/fax	Standard	-	$0.00	6	-
Office Equipment	Printer/copier/fax	Energy Star	0.09	$0.04	6	0.98
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Energy Star	0.03	$0.00	4	2.96
Miscellaneous	Non-HVAC Motor	Standard	-	$0.00	15	-
Miscellaneous	Non-HVAC Motor	Standard (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motor	High Efficiency	0.05	$0.06	15	0.95
Miscellaneous	Non-HVAC Motor	High Efficiency (2015)	0.06	$0.06	15	-
Miscellaneous	Non-HVAC Motor	Premium	0.07	$0.11	15	0.72
Miscellaneous	Non-HVAC Motor	Premium (2015)	0.08	$0.11	15	-
Miscellaneous	Other Miscellaneous	Miscellaneous	-	$0.00	5	-
Miscellaneous	Other Miscellaneous	Miscellaneous (2013)	0.00	$0.00	5	-

Note: Costs and savings are per sq. ft.

Table D-3 Energy Efficiency Equipment Data — Large Commercial, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Central Chiller	1.3 kw/ton, COP 2.7	0.30	$0.26	20	-
Cooling	Central Chiller	1.26 kw/ton, COP 2.8	0.36	$0.33	20	0.83
Cooling	Central Chiller	1.0 kw/ton, COP 3.5	0.75	$0.41	20	3.11
Cooling	Central Chiller	0.97 kw/ton, COP 3.6	0.79	$0.49	20	2.28
Cooling	Central Chiller	Variable Refrigerant Flow	1.04	$7.63	20	0.11
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.22	$0.13	16	-
Cooling	RTU	EER 11.2	0.45	$0.25	16	-
Cooling	RTU	EER 12.0	0.59	$0.41	16	0.75
Cooling	RTU	Ductless VRF	0.72	$3.67	16	0.07
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.09	$0.09	14	0.86
Cooling	PTAC	EER 10.8	0.21	$0.17	14	1.00
Cooling	PTAC	EER 11	0.25	$0.46	14	0.43
Cooling	PTAC	EER 11.5	0.34	$1.03	14	0.27
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	0.46	$0.18	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	0.73	$0.55	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	0.97	$0.73	15	1.85
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	1.07	$0.91	15	1.28
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	1.19	$5.35	20	0.19
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	1.03	$1.22	15	0.86
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.19	$0.08	4	-
Interior Lighting	Interior Screw-in	CFL	0.78	$0.03	7	14.13
Interior Lighting	Interior Screw-in	LED	0.87	$1.11	12	0.72
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.31	($0.08)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.30	($0.03)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.89	$0.25	6	1.66
Interior Lighting	Linear Fluorescent	T5	0.92	$0.42	6	1.02
Interior Lighting	Linear Fluorescent	LED	0.97	$3.67	15	0.32
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.08	$0.01	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.34	$0.01	7	34.02
Exterior Lighting	Exterior Screw-in	Metal Halides	0.34	$0.02	4	6.10
Exterior Lighting	Exterior Screw-in	LED	0.38	$0.19	12	1.73
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.19	($0.11)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.20	$0.45	9	0.37
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.01	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.04	$0.02	6	1.18
Exterior Lighting	Linear Fluorescent	T5	0.04	$0.03	6	0.72
Exterior Lighting	Linear Fluorescent	LED	0.05	$0.24	15	0.23
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0.00	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	0.12	$0.02	15	5.71
Water Heating	Water Heater	Geothermal Heat Pump	1.54	$3.53	15	0.46
Water Heating	Water Heater	Solar	1.69	$3.03	15	0.60
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Efficient	0.07	$0.02	12	3.52
Food Preparation	Oven	Standard	-	$0.00	12	-

Note: Costs and savings are per sq. ft.

Table D-3 Energy Efficiency Equipment Data — Large Commercial, Existing Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Food Preparation	Oven	Efficient	0.75	$0.46	12	1.43
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Efficient	0.07	$0.10	12	0.58
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Efficient	0.35	$0.30	12	0.99
Food Preparation	Food Prep	Standard	-	$0.00	12	-
Food Preparation	Food Prep	Efficient	0.01	$0.03	12	0.24
Refrigeration	Walk in Refrigeration	Standard	-	$0.00	18	-
Refrigeration	Walk in Refrigeration	Efficient	0.15	$1.26	18	0.13
Refrigeration	Glass Door Display	Standard	-	$0.00	18	-
Refrigeration	Glass Door Display	Efficient	0.13	$0.01	18	24.96
Refrigeration	Solid Door Refrigerator	Standard	-	$0.00	18	-
Refrigeration	Solid Door Refrigerator	Efficient	0.30	$0.08	18	4.39
Refrigeration	Open Display Case	Standard	-	$0.00	18	-
Refrigeration	Open Display Case	Efficient	0.00	$0.04	18	0.16
Refrigeration	Vending Machine	Base	-	$0.00	10	-
Refrigeration	Vending Machine	Base (2012)	0.13	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency	0.15	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency (2012)	0.23	$0.00	10	20.70
Refrigeration	Icemaker	Standard	-	$0.00	12	-
Refrigeration	Icemaker	Efficient	0.11	$0.02	12	5.62
Office Equipment	Desktop Computer	Baseline	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.35	$0.00	4	47.46
Office Equipment	Desktop Computer	Climate Savers	0.50	$0.32	4	0.46
Office Equipment	Laptop Computer	Baseline	-	$0.00	4	-
Office Equipment	Laptop Computer	Energy Star	0.02	$0.00	4	15.12
Office Equipment	Laptop Computer	Climate Savers	0.04	$0.06	4	0.17
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.13	$0.01	3	4.41
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.19	$0.01	4	9.14
Office Equipment	Printer/copier/fax	Standard	-	$0.00	6	-
Office Equipment	Printer/copier/fax	Energy Star	0.08	$0.02	6	2.02
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Energy Star	0.01	$0.00	4	2.94
Miscellaneous	Non-HVAC Motor	Standard	-	$0.00	15	-
Miscellaneous	Non-HVAC Motor	Standard (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motor	High Efficiency	0.06	$0.06	15	0.92
Miscellaneous	Non-HVAC Motor	High Efficiency (2015)	0.06	$0.06	15	-
Miscellaneous	Non-HVAC Motor	Premium	0.08	$0.13	15	0.69
Miscellaneous	Non-HVAC Motor	Premium (2015)	0.09	$0.13	15	-
Miscellaneous	Other Miscellaneous	Miscellaneous	-	$0.00	5	-
Miscellaneous	Other Miscellaneous	Miscellaneous (2013)	0.00	$0.00	5	-

Note: Costs and savings are per sq. ft.

Table D-4 Energy Efficiency Equipment Data — Extra Large Commercial, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Central Chiller	0.60 kw/ton, COP 5.9	0.43	$0.09	20	-
Cooling	Central Chiller	0.58 kw/ton, COP 6.1	0.49	$0.18	20	0.66
Cooling	Central Chiller	0.55 kw/Ton, COP 6.4	0.57	$0.25	20	0.91
Cooling	Central Chiller	0.51 kw/ton, COP 6.9	0.69	$0.44	20	0.78
Cooling	Central Chiller	0.50 kw/Ton, COP 7.0	0.72	$0.53	20	0.69
Cooling	Central Chiller	0.48 kw/ton, COP 7.3	0.77	$0.62	20	0.68
Cooling	Central Chiller	Variable Refrigerant Flow	1.00	$10.92	20	0.05
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.20	$0.24	16	-
Cooling	RTU	EER 11.2	0.41	$0.45	16	-
Cooling	RTU	EER 12.0	0.53	$0.75	16	0.37
Cooling	RTU	Ductless VRF	0.65	$6.64	16	0.03
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.08	$0.06	14	1.09
Cooling	PTAC	EER 10.8	0.19	$0.12	14	1.28
Cooling	PTAC	EER 11	0.22	$0.32	14	0.55
Cooling	PTAC	EER 11.5	0.30	$0.71	14	0.34
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	0.50	$0.24	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	0.79	$0.73	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	1.06	$0.97	15	1.34
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	1.16	$1.21	15	0.93
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	1.29	$7.10	20	0.14
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	1.21	$1.22	15	1.01
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.30	$0.14	4	-
Interior Lighting	Interior Screw-in	CFL	1.25	$0.06	7	13.22
Interior Lighting	Interior Screw-in	LED	1.38	$1.90	12	0.67
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.13	($0.05)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.20	($0.03)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.59	$0.21	6	1.31
Interior Lighting	Linear Fluorescent	T5	0.61	$0.35	6	0.80
Interior Lighting	Linear Fluorescent	LED	0.64	$3.08	15	0.25
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.02	$0.00	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.10	$0.00	7	37.00
Exterior Lighting	Exterior Screw-in	Metal Halides	0.10	$0.00	4	6.64
Exterior Lighting	Exterior Screw-in	LED	0.11	$0.05	12	1.89
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.26	($0.16)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.28	$0.64	9	0.37
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.00	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.01	$0.00	6	1.12
Exterior Lighting	Linear Fluorescent	T5	0.01	$0.01	6	0.69
Exterior Lighting	Linear Fluorescent	LED	0.01	$0.06	15	0.22
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0.00	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	0.19	$0.02	15	9.79
Water Heating	Water Heater	Geothermal Heat Pump	2.47	$3.53	15	0.80
Water Heating	Water Heater	Solar	2.72	$3.03	15	1.02
Food Preparation	Fryer	Standard	-	$0.00	12	-

Note: Costs and savings are per sq. ft.

Table D-4 Energy Efficiency Equipment Data — Extra Large Commercial, Existing Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Food Preparation	Fryer	Efficient	0.03	$0.00	12	6.02
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Efficient	0.85	$0.38	12	2.11
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Efficient	0.03	$0.04	12	0.57
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Efficient	0.17	$0.22	12	0.73
Food Preparation	Food Prep	Standard	-	$0.00	12	-
Food Preparation	Food Prep	Efficient	0.00	$0.03	12	0.15
Refrigeration	Walk in Refrigeration	Standard	-	$0.00	18	-
Refrigeration	Walk in Refrigeration	Efficient	0.06	$0.05	18	1.42
Refrigeration	Glass Door Display	Standard	-	$0.00	18	-
Refrigeration	Glass Door Display	Efficient	0.04	$0.00	18	78.11
Refrigeration	Solid Door Refrigerator	Standard	-	$0.00	18	-
Refrigeration	Solid Door Refrigerator	Efficient	0.27	$0.02	18	12.81
Refrigeration	Open Display Case	Standard	-	$0.00	18	-
Refrigeration	Open Display Case	Efficient	0.01	$0.03	18	0.34
Refrigeration	Vending Machine	Base	-	$0.00	10	-
Refrigeration	Vending Machine	Base (2012)	0.13	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency	0.16	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency (2012)	0.24	$0.00	10	68.21
Refrigeration	Icemaker	Standard	-	$0.00	12	-
Refrigeration	Icemaker	Efficient	0.05	$0.00	12	17.60
Office Equipment	Desktop Computer	Baseline	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.25	$0.00	4	32.37
Office Equipment	Desktop Computer	Climate Savers	0.35	$0.33	4	0.32
Office Equipment	Laptop Computer	Baseline	-	$0.00	4	-
Office Equipment	Laptop Computer	Energy Star	0.02	$0.00	4	10.31
Office Equipment	Laptop Computer	Climate Savers	0.04	$0.10	4	0.12
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.06	$0.00	3	3.01
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.11	$0.01	4	6.80
Office Equipment	Printer/copier/fax	Standard	-	$0.00	6	-
Office Equipment	Printer/copier/fax	Energy Star	0.02	$0.01	6	1.38
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Energy Star	0.00	$0.00	4	2.01
Miscellaneous	Non-HVAC Motor	Standard	-	$0.00	15	-
Miscellaneous	Non-HVAC Motor	Standard (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motor	High Efficiency	0.03	$0.03	15	1.02
Miscellaneous	Non-HVAC Motor	High Efficiency (2015)	0.04	$0.03	15	-
Miscellaneous	Non-HVAC Motor	Premium	0.05	$0.07	15	0.76
Miscellaneous	Non-HVAC Motor	Premium (2015)	0.05	$0.07	15	-
Miscellaneous	Other Miscellaneous	Miscellaneous	-	$0.00	5	-
Miscellaneous	Other Miscellaneous	Miscellaneous (2013)	0.00	$0.00	5	-

Note: Costs and savings are per sq. ft.

Table D-5 Energy Efficiency Equipment Data — Extra Large Industrial, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Central Chiller	0.60 kw/ton, COP 5.9	1.61	$0.33	20	-
Cooling	Central Chiller	0.58 kw/ton, COP 6.1	1.82	$0.66	20	0.68
Cooling	Central Chiller	0.55 kw/Ton, COP 6.4	2.15	$0.93	20	0.94
Cooling	Central Chiller	0.51 kw/ton, COP 6.9	2.58	$1.59	20	0.80
Cooling	Central Chiller	0.50 kw/Ton, COP 7.0	2.68	$1.92	20	0.71
Cooling	Central Chiller	0.48 kw/ton, COP 7.3	2.90	$2.25	20	0.70
Cooling	Central Chiller	Variable Refrigerant Flow	3.74	$39.62	20	0.06
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.56	$0.39	16	-
Cooling	RTU	EER 11.2	1.12	$0.73	16	-
Cooling	RTU	EER 12.0	1.47	$1.22	16	0.62
Cooling	RTU	Ductless VRF	1.79	$10.83	16	0.06
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.20	$0.06	14	2.79
Cooling	PTAC	EER 10.8	0.47	$0.11	14	3.27
Cooling	PTAC	EER 11	0.55	$0.31	14	1.41
Cooling	PTAC	EER 11.5	0.75	$0.69	14	0.87
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	1.07	$0.92	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	1.69	$2.75	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	2.25	$3.66	15	0.75
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	2.47	$4.58	15	0.52
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	2.74	$26.86	20	0.08
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	7.66	$1.22	15	6.38
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.09	$0.04	4	-
Interior Lighting	Interior Screw-in	CFL	0.38	$0.02	7	14.80
Interior Lighting	Interior Screw-in	LED	0.42	$0.52	12	0.75
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.46	($0.14)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.10	($0.01)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.31	$0.08	6	1.73
Interior Lighting	Linear Fluorescent	T5	0.32	$0.14	6	1.06
Interior Lighting	Linear Fluorescent	LED	0.33	$1.21	15	0.33
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.01	$0.00	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.02	$0.00	7	15.02
Exterior Lighting	Exterior Screw-in	Metal Halides	0.02	$0.00	4	2.69
Exterior Lighting	Exterior Screw-in	LED	0.03	$0.03	12	0.77
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.07	($0.04)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.08	$0.18	9	0.37
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.00	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	6	1.16
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	6	0.71
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.01	15	0.22
Process	Process Cooling/Refrigera	Standard	-	$0.00	10	-
Process	Process Cooling/Refrigera	Efficient	18.88	$5.59	10	2.49
Process	Process Heating	Standard	-	$0.00	10	-
Process	Process Heating	Efficient	6.18	$0.57	10	7.97
Process	Electrochemical Process	Standard	-	$0.00	10	-

Note: Costs and savings are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 772 of 1069

Table D-5 Energy Efficiency Equipment Data — Extra Large Industrial, Existing Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Process	Electrochemical Process	Efficient	13.16	$2.64	10	3.67
Machine Drive	Less than 5 HP	Standard	-	$0.00	10	-
Machine Drive	Less than 5 HP	High Efficiency	0.05	$0.02	10	2.08
Machine Drive	Less than 5 HP	Standard (2015)	0.07	$0.00	10	-
Machine Drive	Less than 5 HP	Premium	0.07	$0.03	10	1.66
Machine Drive	Less than 5 HP	High Efficiency (2015)	0.11	$0.02	10	-
Machine Drive	Less than 5 HP	Premium (2015)	0.14	$0.03	10	-
Machine Drive	5-24 HP	Standard	-	$0.00	10	-
Machine Drive	5-24 HP	High	0.11	$0.02	10	5.09
Machine Drive	5-24 HP	Premium	0.18	$0.03	10	4.07
Machine Drive	25-99 HP	Standard	-	$0.00	10	-
Machine Drive	25-99 HP	High	0.31	$0.02	10	13.72
Machine Drive	25-99 HP	Premium	0.49	$0.03	10	10.97
Machine Drive	100-249 HP	Standard	-	$0.00	10	-
Machine Drive	100-249 HP	High	0.12	$0.02	10	5.17
Machine Drive	100-249 HP	Premium	0.15	$0.03	10	3.44
Machine Drive	250-499 HP	Standard	-	$0.00	10	-
Machine Drive	250-499 HP	High	0.35	$0.02	10	15.66
Machine Drive	250-499 HP	Premium	0.47	$0.03	10	10.44
Machine Drive	500 and more HP	Standard	-	$0.00	10	-
Machine Drive	500 and more HP	High	0.59	$0.02	10	26.28
Machine Drive	500 and more HP	Premium	0.78	$0.03	10	17.52
Miscellaneous	Miscellaneous	Miscellaneous	-	$0.00	5	-

Note: Costs and savings are per sq. ft.

Table D-6 Energy Efficiency Equipment Data — Small/Medium Commercial, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Central Chiller	1.3 kw/ton, COP 2.7	0.29	$0.39	20	-
Cooling	Central Chiller	1.26 kw/ton, COP 2.8	0.35	$0.50	20	0.51
Cooling	Central Chiller	1.0 kw/ton, COP 3.5	0.73	$0.62	20	1.90
Cooling	Central Chiller	0.97 kw/ton, COP 3.6	0.77	$0.74	20	1.39
Cooling	Central Chiller	Variable Refrigerant Flow	1.01	$11.57	20	0.07
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.22	$0.18	16	-
Cooling	RTU	EER 11.2	0.43	$0.35	16	-
Cooling	RTU	EER 12.0	0.57	$0.58	16	0.49
Cooling	RTU	Ductless VRF	0.69	$5.12	16	0.05
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.09	$0.08	14	0.86
Cooling	PTAC	EER 10.8	0.21	$0.16	14	1.00
Cooling	PTAC	EER 11	0.25	$0.43	14	0.43
Cooling	PTAC	EER 11.5	0.33	$0.96	14	0.27
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	0.57	$0.39	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	0.90	$1.18	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	1.20	$1.57	15	0.98
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	1.31	$1.96	15	0.68
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	1.46	$11.50	20	0.10
Combined Heating/Cooling	Heat Pump	Geothermal Heat Pump	1.75	$20.69	20	-
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	1.64	$1.22	15	1.35
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.20	$0.09	4	-
Interior Lighting	Interior Screw-in	CFL	0.85	$0.03	7	14.85
Interior Lighting	Interior Screw-in	LED	0.93	$1.18	12	0.76
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.27	($0.07)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.27	($0.03)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.82	$0.25	6	1.56
Interior Lighting	Linear Fluorescent	T5	0.85	$0.43	6	0.95
Interior Lighting	Linear Fluorescent	LED	0.89	$3.74	15	0.30
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.13	$0.05	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.54	$0.02	7	15.84
Exterior Lighting	Exterior Screw-in	Metal Halides	0.54	$0.05	4	2.84
Exterior Lighting	Exterior Screw-in	LED	0.60	$0.64	12	0.81
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.20	($0.13)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.22	$0.55	9	0.33
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.01	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.04	$0.02	6	1.01
Exterior Lighting	Linear Fluorescent	T5	0.04	$0.03	6	0.62
Exterior Lighting	Linear Fluorescent	LED	0.04	$0.24	15	0.20
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0.00	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	0.10	$0.02	15	5.23
Water Heating	Water Heater	Geothermal Heat Pump	1.33	$3.53	15	0.43
Water Heating	Water Heater	Solar	1.46	$3.03	15	0.55
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Efficient	0.03	$0.04	12	0.80

Note: Costs and savings are per sq. ft.

Table D-6 Energy Efficiency Equipment Data — Small/Medium Commercial, New Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Efficient	0.39	$0.36	12	1.02
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Efficient	0.02	$0.05	12	0.36
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Efficient	0.40	$0.16	12	2.29
Food Preparation	Food Prep	Standard	-	$0.00	12	-
Food Preparation	Food Prep	Efficient	0.00	$0.03	12	0.07
Refrigeration	Walk in Refrigeration	Standard	-	$0.00	18	-
Refrigeration	Walk in Refrigeration	Efficient	-	$0.09	18	-
Refrigeration	Glass Door Display	Standard	-	$0.00	18	-
Refrigeration	Glass Door Display	Efficient	0.16	$0.00	18	56.08
Refrigeration	Solid Door Refrigerator	Standard	-	$0.00	18	-
Refrigeration	Solid Door Refrigerator	Efficient	0.19	$0.02	18	9.87
Refrigeration	Open Display Case	Standard	-	$0.00	18	-
Refrigeration	Open Display Case	Efficient	0.00	$0.00	18	0.24
Refrigeration	Vending Machine	Base	-	$0.00	10	-
Refrigeration	Vending Machine	Base (2012)	0.11	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency	0.13	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency (2012)	0.20	$0.00	10	46.48
Refrigeration	Icemaker	Standard	-	$0.00	12	-
Refrigeration	Icemaker	Efficient	0.05	$0.00	12	12.76
Office Equipment	Desktop Computer	Baseline	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.19	$0.00	4	23.04
Office Equipment	Desktop Computer	Climate Savers	0.27	$0.36	4	0.23
Office Equipment	Laptop Computer	Baseline	-	$0.00	4	-
Office Equipment	Laptop Computer	Energy Star	0.02	$0.00	4	7.34
Office Equipment	Laptop Computer	Climate Savers	0.03	$0.12	4	0.08
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.12	$0.01	3	2.14
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.22	$0.00	4	19.68
Office Equipment	Printer/copier/fax	Standard	-	$0.00	6	-
Office Equipment	Printer/copier/fax	Energy Star	0.09	$0.04	6	0.98
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Energy Star	0.03	$0.00	4	2.96
Miscellaneous	Non-HVAC Motor	Standard	-	$0.00	15	-
Miscellaneous	Non-HVAC Motor	Standard (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motor	High Efficiency	0.05	$0.06	15	0.95
Miscellaneous	Non-HVAC Motor	High Efficiency (2015)	0.06	$0.06	15	-
Miscellaneous	Non-HVAC Motor	Premium	0.07	$0.11	15	0.72
Miscellaneous	Non-HVAC Motor	Premium (2015)	0.08	$0.11	15	-
Miscellaneous	Other Miscellaneous	Miscellaneous	-	$0.00	5	-
Miscellaneous	Other Miscellaneous	Miscellaneous (2013)	0.00	$0.00	5	-

Note: Costs and savings are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista

Table D-7 Energy Efficiency Equipment Data — Large Commercial, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Central Chiller	1.3 kw/ton, COP 2.7	0.32	$0.24	20	-
Cooling	Central Chiller	1.26 kw/ton, COP 2.8	0.39	$0.31	20	0.97
Cooling	Central Chiller	1.0 kw/ton, COP 3.5	0.80	$0.38	20	3.62
Cooling	Central Chiller	0.97 kw/ton, COP 3.6	0.85	$0.45	20	2.66
Cooling	Central Chiller	Variable Refrigerant Flow	1.12	$7.06	20	0.12
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.22	$0.13	16	-
Cooling	RTU	EER 11.2	0.45	$0.25	16	-
Cooling	RTU	EER 12.0	0.59	$0.41	16	0.75
Cooling	RTU	Ductless VRF	0.72	$3.67	16	0.07
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.09	$0.09	14	0.86
Cooling	PTAC	EER 10.8	0.21	$0.17	14	1.00
Cooling	PTAC	EER 11	0.25	$0.46	14	0.43
Cooling	PTAC	EER 11.5	0.34	$1.03	14	0.27
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	0.46	$0.18	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	0.73	$0.55	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	0.97	$0.73	15	1.85
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	1.07	$0.91	15	1.28
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	1.19	$5.35	20	0.19
Combined Heating/Cooling	Heat Pump	Geothermal Heat Pump	1.42	$9.62	20	-
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	1.30	$1.22	15	1.09
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.17	$0.08	4	-
Interior Lighting	Interior Screw-in	CFL	0.71	$0.03	7	12.72
Interior Lighting	Interior Screw-in	LED	0.78	$1.11	12	0.65
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.28	($0.08)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.27	($0.03)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.80	$0.25	6	1.49
Interior Lighting	Linear Fluorescent	T5	0.83	$0.42	6	0.92
Interior Lighting	Linear Fluorescent	LED	0.87	$3.67	15	0.29
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.07	$0.01	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.31	$0.01	7	30.62
Exterior Lighting	Exterior Screw-in	Metal Halides	0.31	$0.02	4	5.49
Exterior Lighting	Exterior Screw-in	LED	0.34	$0.19	12	1.56
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.17	($0.11)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.18	$0.45	9	0.34
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.01	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.04	$0.02	6	1.06
Exterior Lighting	Linear Fluorescent	T5	0.04	$0.03	6	0.65
Exterior Lighting	Linear Fluorescent	LED	0.04	$0.24	15	0.20
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0.00	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	0.12	$0.02	15	5.71
Water Heating	Water Heater	Geothermal Heat Pump	1.54	$3.53	15	0.46
Water Heating	Water Heater	Solar	1.69	$3.03	15	0.60
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Efficient	0.07	$0.02	12	3.52

Note: Costs and savings are per sq. ft.

Table D-7 Energy Efficiency Equipment Data — Large Commercial, New Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Efficient	0.75	$0.46	12	1.43
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Efficient	0.07	$0.10	12	0.58
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Efficient	0.35	$0.30	12	0.99
Food Preparation	Food Prep	Standard	-	$0.00	12	-
Food Preparation	Food Prep	Efficient	0.01	$0.03	12	0.24
Refrigeration	Walk in Refrigeration	Standard	-	$0.00	18	-
Refrigeration	Walk in Refrigeration	Efficient	0.15	$1.26	18	0.13
Refrigeration	Glass Door Display	Standard	-	$0.00	18	-
Refrigeration	Glass Door Display	Efficient	0.13	$0.01	18	24.96
Refrigeration	Solid Door Refrigerator	Standard	-	$0.00	18	-
Refrigeration	Solid Door Refrigerator	Efficient	0.30	$0.08	18	4.39
Refrigeration	Open Display Case	Standard	-	$0.00	18	-
Refrigeration	Open Display Case	Efficient	0.00	$0.04	18	0.16
Refrigeration	Vending Machine	Base	-	$0.00	10	-
Refrigeration	Vending Machine	Base (2012)	0.13	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency	0.15	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency (2012)	0.23	$0.00	10	20.70
Refrigeration	Icemaker	Standard	-	$0.00	12	-
Refrigeration	Icemaker	Efficient	0.11	$0.02	12	5.62
Office Equipment	Desktop Computer	Baseline	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.35	$0.00	4	47.46
Office Equipment	Desktop Computer	Climate Savers	0.50	$0.32	4	0.46
Office Equipment	Laptop Computer	Baseline	-	$0.00	4	-
Office Equipment	Laptop Computer	Energy Star	0.02	$0.00	4	15.12
Office Equipment	Laptop Computer	Climate Savers	0.04	$0.06	4	0.17
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.13	$0.01	3	4.41
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.19	$0.01	4	9.14
Office Equipment	Printer/copier/fax	Standard	-	$0.00	6	-
Office Equipment	Printer/copier/fax	Energy Star	0.08	$0.02	6	2.02
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Energy Star	0.01	$0.00	4	2.94
Miscellaneous	Non-HVAC Motor	Standard	-	$0.00	15	-
Miscellaneous	Non-HVAC Motor	Standard (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motor	High Efficiency	0.06	$0.06	15	0.92
Miscellaneous	Non-HVAC Motor	High Efficiency (2015)	0.06	$0.06	15	-
Miscellaneous	Non-HVAC Motor	Premium	0.08	$0.13	15	0.69
Miscellaneous	Non-HVAC Motor	Premium (2015)	0.09	$0.13	15	-
Miscellaneous	Other Miscellaneous	Miscellaneous	-	$0.00	5	-
Miscellaneous	Other Miscellaneous	Miscellaneous (2013)	0.00	$0.00	5	-

Note: Costs and savings are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 777 of 1069

Table D-8 Energy Efficiency Equipment Data — Extra Large Commercial, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Central Chiller	0.60 kw/ton, COP 5.9	0.43	$0.09	20	-
Cooling	Central Chiller	0.58 kw/ton, COP 6.1	0.49	$0.18	20	0.66
Cooling	Central Chiller	0.55 kw/Ton, COP 6.4	0.57	$0.25	20	0.91
Cooling	Central Chiller	0.51 kw/ton, COP 6.9	0.69	$0.44	20	0.78
Cooling	Central Chiller	0.50 kw/Ton, COP 7.0	0.72	$0.53	20	0.69
Cooling	Central Chiller	0.48 kw/ton, COP 7.3	0.77	$0.62	20	0.68
Cooling	Central Chiller	Variable Refrigerant Flow	1.00	$10.92	20	0.05
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.20	$0.24	16	-
Cooling	RTU	EER 11.2	0.41	$0.44	16	-
Cooling	RTU	EER 12.0	0.53	$0.73	16	0.37
Cooling	RTU	Ductless VRF	0.65	$6.51	16	0.04
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.08	$0.06	14	1.09
Cooling	PTAC	EER 10.8	0.19	$0.12	14	1.28
Cooling	PTAC	EER 11	0.22	$0.32	14	0.55
Cooling	PTAC	EER 11.5	0.30	$0.71	14	0.34
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	0.50	$0.24	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	0.79	$0.73	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	1.06	$0.97	15	1.34
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	1.16	$1.21	15	0.93
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	1.29	$7.10	20	0.14
Combined Heating/Cooling	Heat Pump	Geothermal Heat Pump	1.55	$12.77	20	-
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	1.52	$1.22	15	1.27
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.27	$0.14	4	-
Interior Lighting	Interior Screw-in	CFL	1.13	$0.06	7	11.90
Interior Lighting	Interior Screw-in	LED	1.24	$1.90	12	0.61
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.11	($0.05)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.18	($0.03)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.53	$0.21	6	1.18
Interior Lighting	Linear Fluorescent	T5	0.55	$0.35	6	0.72
Interior Lighting	Linear Fluorescent	LED	0.58	$3.08	15	0.23
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.02	$0.00	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.09	$0.00	7	33.30
Exterior Lighting	Exterior Screw-in	Metal Halides	0.09	$0.00	4	5.97
Exterior Lighting	Exterior Screw-in	LED	0.10	$0.05	12	1.70
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.24	($0.16)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.25	$0.64	9	0.33
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.00	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.01	$0.00	6	1.01
Exterior Lighting	Linear Fluorescent	T5	0.01	$0.01	6	0.62
Exterior Lighting	Linear Fluorescent	LED	0.01	$0.06	15	0.19
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0.00	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	0.19	$0.02	15	9.79
Water Heating	Water Heater	Geothermal Heat Pump	2.47	$3.53	15	0.80
Water Heating	Water Heater	Solar	2.72	$3.03	15	1.02

Note: Costs and savings are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 778 of 1069

Table D-9 Energy Efficiency Equipment Data — Extra Large Commercial, New Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Efficient	0.03	$0.00	12	6.02
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Efficient	0.85	$0.38	12	2.11
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Efficient	0.03	$0.04	12	0.57
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Efficient	0.17	$0.22	12	0.73
Food Preparation	Food Prep	Standard	-	$0.00	12	-
Food Preparation	Food Prep	Efficient	0.00	$0.03	12	0.15
Refrigeration	Walk in Refrigeration	Standard	-	$0.00	18	-
Refrigeration	Walk in Refrigeration	Efficient	0.06	$0.05	18	1.42
Refrigeration	Glass Door Display	Standard	-	$0.00	18	-
Refrigeration	Glass Door Display	Efficient	0.04	$0.00	18	78.11
Refrigeration	Solid Door Refrigerator	Standard	-	$0.00	18	-
Refrigeration	Solid Door Refrigerator	Efficient	0.27	$0.02	18	13.75
Refrigeration	Open Display Case	Standard	-	$0.00	18	-
Refrigeration	Open Display Case	Efficient	0.01	$0.03	18	0.34
Refrigeration	Vending Machine	Base	-	$0.00	10	-
Refrigeration	Vending Machine	Base (2012)	0.13	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency	0.16	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency (2012)	0.24	$0.00	10	68.21
Refrigeration	Icemaker	Standard	-	$0.00	12	-
Refrigeration	Icemaker	Efficient	0.05	$0.00	12	17.60
Office Equipment	Desktop Computer	Baseline	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.25	$0.00	4	32.37
Office Equipment	Desktop Computer	Climate Savers	0.35	$0.33	4	0.32
Office Equipment	Laptop Computer	Baseline	-	$0.00	4	-
Office Equipment	Laptop Computer	Energy Star	0.02	$0.00	4	10.31
Office Equipment	Laptop Computer	Climate Savers	0.04	$0.10	4	0.12
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.06	$0.00	3	3.01
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.11	$0.01	4	6.80
Office Equipment	Printer/copier/fax	Standard	-	$0.00	6	-
Office Equipment	Printer/copier/fax	Energy Star	0.02	$0.01	6	1.38
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Energy Star	0.00	$0.00	4	2.01
Miscellaneous	Non-HVAC Motor	Standard	-	$0.00	15	-
Miscellaneous	Non-HVAC Motor	Standard (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motor	High Efficiency	0.03	$0.03	15	1.02
Miscellaneous	Non-HVAC Motor	High Efficiency (2015)	0.04	$0.03	15	-
Miscellaneous	Non-HVAC Motor	Premium	0.05	$0.07	15	0.76
Miscellaneous	Non-HVAC Motor	Premium (2015)	0.05	$0.07	15	-
Miscellaneous	Other Miscellaneous	Miscellaneous	-	$0.00	5	-
Miscellaneous	Other Miscellaneous	Miscellaneous (2013)	0.00	$0.00	5	-

Note: Costs and savings are per sq. ft.

Table D-9 Energy Efficiency Equipment Data — Extra Large Industrial, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Central Chiller	0.60 kw/ton, COP 5.9	1.61	$0.33	20	-
Cooling	Central Chiller	0.58 kw/ton, COP 6.1	1.82	$0.66	20	0.68
Cooling	Central Chiller	0.55 kw/Ton, COP 6.4	2.15	$0.93	20	0.94
Cooling	Central Chiller	0.51 kw/ton, COP 6.9	2.58	$1.59	20	0.80
Cooling	Central Chiller	0.50 kw/Ton, COP 7.0	2.68	$1.92	20	0.71
Cooling	Central Chiller	0.48 kw/ton, COP 7.3	2.90	$2.25	20	0.70
Cooling	Central Chiller	Variable Refrigerant Flow	3.74	$39.62	20	0.06
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.56	$0.39	16	-
Cooling	RTU	EER 11.2	1.12	$0.74	16	-
Cooling	RTU	EER 12.0	1.47	$1.23	16	0.62
Cooling	RTU	Ductless VRF	1.79	$10.88	16	0.06
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.20	$0.06	14	2.79
Cooling	PTAC	EER 10.8	0.47	$0.11	14	3.27
Cooling	PTAC	EER 11	0.55	$0.31	14	1.41
Cooling	PTAC	EER 11.5	0.75	$0.69	14	0.87
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	1.07	$0.92	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	1.69	$2.75	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	2.25	$3.66	15	0.75
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	2.47	$4.58	15	0.52
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	2.74	$26.86	20	0.08
Combined Heating/Cooling	Heat Pump	Geothermal Heat Pump	3.29	$48.32	20	-
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	9.66	$1.22	15	8.05
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.08	$0.04	4	-
Interior Lighting	Interior Screw-in	CFL	0.34	$0.02	7	13.32
Interior Lighting	Interior Screw-in	LED	0.38	$0.52	12	0.68
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.41	($0.14)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.09	($0.01)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.28	$0.08	6	1.56
Interior Lighting	Linear Fluorescent	T5	0.29	$0.14	6	0.96
Interior Lighting	Linear Fluorescent	LED	0.30	$1.21	15	0.30
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.01	$0.00	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.02	$0.00	7	13.52
Exterior Lighting	Exterior Screw-in	Metal Halides	0.02	$0.00	4	2.42
Exterior Lighting	Exterior Screw-in	LED	0.02	$0.03	12	0.69
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.07	($0.04)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.07	$0.18	9	0.33
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.00	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	6	1.05
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	6	0.64
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.01	15	0.20
Process	Process Cooling/Refrigera	Standard	-	$0.00	10	-
Process	Process Cooling/Refrigera	Efficient	18.88	$5.59	10	2.49
Process	Process Heating	Standard	-	$0.00	10	-
Process	Process Heating	Efficient	6.18	$0.57	10	7.97

Note: Costs and savings are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 780 of 1069

Table D-9 Energy Efficiency Equipment Data — Extra Large Industrial, New Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Process	Electrochemical Process	Standard	-	$0.00	10	-
Process	Electrochemical Process	Efficient	13.16	$2.64	10	3.67
Machine Drive	Less than 5 HP	Standard	-	$0.00	10	-
Machine Drive	Less than 5 HP	High Efficiency	0.05	$0.02	10	2.08
Machine Drive	Less than 5 HP	Standard (2015)	0.07	$0.00	10	-
Machine Drive	Less than 5 HP	Premium	0.07	$0.03	10	1.66
Machine Drive	Less than 5 HP	High Efficiency (2015)	0.11	$0.02	10	-
Machine Drive	Less than 5 HP	Premium (2015)	0.14	$0.03	10	-
Machine Drive	5-24 HP	Standard	-	$0.00	10	-
Machine Drive	5-24 HP	High	0.11	$0.02	10	5.09
Machine Drive	5-24 HP	Premium	0.18	$0.03	10	4.07
Machine Drive	25-99 HP	Standard	-	$0.00	10	-
Machine Drive	25-99 HP	High	0.31	$0.02	10	13.72
Machine Drive	25-99 HP	Premium	0.49	$0.03	10	10.97
Machine Drive	100-249 HP	Standard	-	$0.00	10	-
Machine Drive	100-249 HP	High	0.12	$0.02	10	5.17
Machine Drive	100-249 HP	Premium	0.15	$0.03	10	3.44
Machine Drive	250-499 HP	Standard	-	$0.00	10	-
Machine Drive	250-499 HP	High	0.35	$0.02	10	15.66
Machine Drive	250-499 HP	Premium	0.47	$0.03	10	10.44
Machine Drive	500 and more HP	Standard	-	$0.00	10	-
Machine Drive	500 and more HP	High	0.59	$0.02	10	26.28
Machine Drive	500 and more HP	Premium	0.78	$0.03	10	17.52
Miscellaneous	Miscellaneous	Miscellaneous	-	$0.00	5	-

Note: Costs and savings are per sq. ft.

Table D-10 Energy Efficiency Measure Data — Small/Med. Comm., Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
RTU - Maintenance	Cooling	14%	0%	14%	90%	$0.08	4	0.75
RTU - Evaporative Precooler	Cooling	10%	0%	0%	0%	$0.88	15	0.20
Chiller - Chilled Water Reset	Cooling	14%	0%	0%	0%	$0.86	4	0.08
Chiller - Chilled Water Variable-Flow System	Cooling	5%	0%	0%	0%	$0.86	10	0.07
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	0%	$0.90	20	0.70
Chiller - VSD	Cooling	27%	0%	0%	0%	$1.17	20	0.48
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.01
Chiller - Condenser Water Temprature Reset	Cooling	10%	0%	0%	0%	$0.87	14	0.18
Cooling - Economizer Installation	Cooling	6%	0%	45%	49%	$0.15	15	0.71
Heat Pump - Maintenance	Combined Heating/Cooling	7%	7%	10%	95%	$0.03	4	5.00
Insulation - Ducting	Cooling	6%	0%	9%	50%	$0.41	20	0.71
Insulation - Ducting	Space Heating	3%	1%	9%	50%	$0.41	20	0.71
Repair and Sealing - Ducting	Cooling	2%	0%	5%	25%	$0.38	15	0.45
Repair and Sealing - Ducting	Space Heating	2%	1%	5%	25%	$0.38	15	0.45
Energy Management System	Cooling	6%	0%	24%	75%	$0.35	14	0.72
Energy Management System	Space Heating	5%	3%	24%	75%	$0.35	14	0.72
Energy Management System	Interior Lighting	2%	1%	24%	75%	$0.35	14	0.72
Cooking - Exhaust Hoods with Sensor Control	Ventilation	25%	13%	1%	15%	$0.04	10	7.36
Fans - Energy Efficient Motors	Ventilation	5%	5%	11%	90%	$0.05	10	1.38
Fans - Variable Speed Control	Ventilation	15%	5%	8%	90%	$0.20	10	0.89
Retrocommissioning - HVAC	Cooling	9%	0%	15%	90%	$0.60	4	0.50
Retrocommissioning - HVAC	Space Heating	9%	6%	15%	90%	$0.60	4	0.50
Retrocommissioning - HVAC	Ventilation	9%	6%	15%	90%	$0.60	4	0.50
Pumps - Variable Speed Control	Miscellaneous	1%	0%	0%	34%	$0.44	10	1.01
Thermostat - Clock/Programmable	Cooling	5%	0%	34%	50%	$0.13	11	1.12
Thermostat - Clock/Programmable	Space Heating	5%	1%	34%	50%	$0.13	11	1.12
Insulation - Ceiling	Cooling	2%	0%	10%	18%	$0.64	20	0.70
Insulation - Ceiling	Space Heating	17%	4%	10%	18%	$0.64	20	0.70
Insulation - Radiant Barrier	Cooling	3%	0%	7%	13%	$0.26	20	0.81
Insulation - Radiant Barrier	Space Heating	5%	2%	7%	13%	$0.26	20	0.81
Roofs - High Reflectivity	Cooling	15%	0%	2%	95%	$0.18	15	1.47
Windows - High Efficiency	Cooling	5%	0%	61%	75%	$0.44	20	0.63
Windows - High Efficiency	Space Heating	3%	2%	61%	75%	$0.44	20	0.63
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	81%	90%	$0.65	8	0.34
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	Interior Lighting	25%	13%	1%	45%	$0.50	8	0.90
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	2%	50%	$0.11	8	1.36
Interior Fluorescent - Delamp and Install Reflectors	Interior Lighting	20%	10%	18%	25%	$0.50	11	0.97
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$0.50	8	0.36
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	23%	$0.70	11	1.73
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	7%	45%	$0.20	8	1.11
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.26
Interior Screw-in - Task Lighting	Interior Lighting	7%	4%	25%	75%	$0.24	5	0.09
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	9%	56%	$0.20	8	0.56
Water Heater - Faucet Aerators/Low Flow Nozzles	Water Heating	4%	1%	8%	90%	$0.01	9	4.28
Water Heater - Pipe Insulation	Water Heating	6%	3%	46%	50%	$0.28	15	0.37
Water Heater - High Efficiency Circulation Pump	Water Heating	5%	4%	0%	0%	$0.11	10	0.64
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	40%	50%	$0.02	10	5.87
Water Heater - Thermostat Setback	Water Heating	4%	2%	5%	75%	$0.11	10	0.47
Water Heater - Hot Water Saver	Water Heating	5%	1%	0%	0%	$0.02	5	1.56
Refrigeration - Anti-Sweat Heater/Auto Door Closer	Refrigeration	5%	3%	0%	75%	$0.20	16	1.10
Refrigeration - Floating Head Pressure	Refrigeration	7%	4%	18%	38%	$0.35	16	1.25
Refrigeration - Door Gasket Replacement	Refrigeration	4%	2%	5%	75%	$0.10	8	0.10
Insulation - Bare Suction Lines	Refrigeration	3%	2%	5%	75%	$0.10	8	0.21
Refrigeration - Night Covers	Refrigeration	6%	3%	5%	75%	$0.05	8	1.02
Refrigeration - Strip Curtain	Refrigeration	4%	2%	5%	56%	$0.02	8	0.00
Retrocommissioning - Comprehensive	Cooling	12%	0%	40%	90%	$0.70	4	0.71
Retrocommissioning - Comprehensive	Space Heating	12%	9%	40%	90%	$0.70	4	0.71
Retrocommissioning - Comprehensive	Interior Lighting	12%	9%	40%	90%	$0.70	4	0.71
Office Equipment - Energy Star Power Supply	Office Equipment	1%	1%	10%	95%	$0.00	7	61.20
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	10	1.09
LED Exit Lighting	Interior Lighting	2%	2%	9%	86%	$0.00	10	12.75
Retrocommissioning - Lighting	Interior Lighting	9%	6%	5%	90%	$0.10	5	1.59
Retrocommissioning - Lighting	Exterior Lighting	9%	6%	5%	90%	$0.10	5	1.59
Refrigeration - High Efficiency Case Lighting	Refrigeration	4%	2%	5%	75%	$0.20	8	0.00
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	1.37
Exterior Lighting - Induction Lamps	Exterior Lighting	3%	3%	5%	56%	$0.00	5	8.10
Laundry - High Efficiency Clothes Washer	Miscellaneous	0%	0%	5%	10%	$0.00	10	36.95
Interior Lighting - Hotel Guestroom Controls	Interior Lighting	10%	5%	0%	0%	$0.14	8	0.33
Miscellaneous - Energy Star Water Cooler	Miscellaneous	0%	0%	5%	95%	$0.00	8	1.95
Industrial Process Improvements	Miscellaneous	10%	8%	0%	23%	$0.52	10	1.16
Custom Measures	Cooling	10%	0%	10%	45%	$1.50	15	0.59
Custom Measures	Space Heating	10%	8%	10%	45%	$1.50	15	0.59
Custom Measures	Interior Lighting	10%	6%	10%	45%	$1.50	15	0.59
Custom Measures	Food Preparation	10%	7%	10%	45%	$1.50	15	0.59
Custom Measures	Refrigeration	10%	5%	10%	45%	$1.50	15	0.59
Water Heater - Heat Pump	Water Heating	30%	15%	0%	19%	$0.80	15	0.69
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$4.00	15	0.54
Furnace - Convert to Gas	Space Heating	100%	100%	0%	47%	$8.04	15	1.08

Note: Costs are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 782 of 1069

Table D-11 Energy Efficiency Measure Data — Large Commercial, Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
RTU - Maintenance	Cooling	14%	0%	27%	90%	$0.06	4	1.30
RTU - Evaporative Precooler	Cooling	10%	0%	0%	0%	$0.88	15	0.21
Chiller - Chilled Water Reset	Cooling	19%	0%	15%	75%	$0.18	4	0.50
Chiller - Chilled Water Variable-Flow System	Cooling	5%	0%	30%	34%	$0.18	10	0.31
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	66%	$0.90	20	0.64
Chiller - VSD	Cooling	32%	0%	15%	66%	$1.17	20	0.52
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	15%	41%	$0.04	10	0.01
Chiller - Condenser Water Temprature Reset	Cooling	9%	0%	5%	75%	$0.18	14	0.76
Cooling - Economizer Installation	Cooling	11%	0%	44%	49%	$0.15	15	1.29
Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	10%	95%	$0.06	4	3.04
Insulation - Ducting	Cooling	3%	0%	8%	50%	$0.41	20	0.52
Insulation - Ducting	Space Heating	3%	1%	8%	50%	$0.41	20	0.52
Repair and Sealing - Ducting	Cooling	2%	0%	5%	25%	$0.38	15	0.43
Repair and Sealing - Ducting	Space Heating	2%	1%	5%	25%	$0.38	15	0.43
Energy Management System	Cooling	23%	0%	37%	90%	$0.35	14	2.63
Energy Management System	Space Heating	18%	12%	37%	90%	$0.35	14	2.63
Energy Management System	Interior Lighting	9%	6%	37%	90%	$0.35	14	2.63
Cooking - Exhaust Hoods with Sensor Control	Ventilation	13%	7%	1%	11%	$0.04	10	2.97
Fans - Energy Efficient Motors	Ventilation	5%	5%	11%	90%	$0.05	10	1.11
Fans - Variable Speed Control	Ventilation	15%	5%	2%	90%	$0.20	10	0.71
Retrocommissioning - HVAC	Cooling	12%	0%	15%	90%	$0.30	4	0.72
Retrocommissioning - HVAC	Space Heating	12%	9%	15%	90%	$0.30	4	0.72
Retrocommissioning - HVAC	Ventilation	9%	6%	15%	90%	$0.30	4	0.72
Pumps - Variable Speed Control	Miscellaneous	1%	0%	0%	34%	$0.13	10	1.05
Thermostat - Clock/Programmable	Cooling	5%	0%	33%	50%	$0.13	11	1.02
Thermostat - Clock/Programmable	Space Heating	5%	1%	33%	50%	$0.13	11	1.02
Insulation - Ceiling	Cooling	1%	0%	9%	30%	$0.85	20	0.45
Insulation - Ceiling	Space Heating	12%	3%	9%	30%	$0.85	20	0.45
Insulation - Radiant Barrier	Cooling	2%	0%	7%	13%	$0.26	20	0.64
Insulation - Radiant Barrier	Space Heating	5%	2%	7%	13%	$0.26	20	0.64
Roofs - High Reflectivity	Cooling	5%	0%	2%	75%	$0.08	15	1.08
Windows - High Efficiency	Cooling	12%	0%	72%	75%	$0.88	20	0.74
Windows - High Efficiency	Space Heating	11%	8%	72%	75%	$0.88	20	0.74
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	86%	90%	$0.65	8	0.34
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	Interior Lighting	25%	13%	1%	45%	$0.45	8	0.96
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	2%	13%	$0.29	8	0.42
Interior Fluorescent - Delamp and Install Reflectors	Interior Lighting	30%	15%	17%	38%	$0.50	11	1.40
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$0.40	8	0.43
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	23%	$0.63	11	1.85
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	13%	45%	$0.20	8	1.10
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.21
Interior Screw-in - Task Lighting	Interior Lighting	10%	5%	10%	75%	$0.24	5	0.13
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	9%	56%	$0.20	8	0.55
Water Heater - Faucet Aerators/Low Flow Nozzles	Water Heating	4%	1%	3%	90%	$0.03	9	1.62
Water Heater - Pipe Insulation	Water Heating	6%	3%	0%	0%	$0.28	15	0.42
Water Heater - High Efficiency Circulation Pump	Water Heating	5%	4%	0%	23%	$0.11	10	0.70
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$0.04	10	3.28
Water Heater - Thermostat Setback	Water Heating	4%	2%	0%	0%	$0.11	10	0.52
Water Heater - Hot Water Saver	Water Heating	5%	1%	0%	3%	$0.04	5	0.88
Refrigeration - Anti-Sweat Heater/Auto Door Closer	Refrigeration	5%	3%	0%	75%	$0.20	16	0.58
Refrigeration - Floating Head Pressure	Refrigeration	7%	4%	38%	45%	$0.35	16	0.95
Refrigeration - Door Gasket Replacement	Refrigeration	4%	2%	5%	75%	$0.10	8	0.65
Insulation - Bare Suction Lines	Refrigeration	3%	2%	5%	75%	$0.10	8	0.37
Refrigeration - Night Covers	Refrigeration	6%	3%	5%	75%	$0.05	8	0.65
Refrigeration - Strip Curtain	Refrigeration	4%	2%	5%	56%	$0.02	8	0.96
Retrocommissioning - Comprehensive	Cooling	12%	0%	40%	90%	$0.35	4	1.06
Retrocommissioning - Comprehensive	Space Heating	12%	9%	40%	90%	$0.35	4	1.06
Retrocommissioning - Comprehensive	Interior Lighting	12%	9%	40%	90%	$0.35	4	1.06
Office Equipment - Energy Star Power Supply	Office Equipment	1%	1%	10%	95%	$0.00	7	68.11
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	10	1.11
LED Exit Lighting	Interior Lighting	2%	2%	9%	86%	$0.00	10	12.29
Retrocommissioning - Lighting	Interior Lighting	9%	6%	5%	90%	$0.05	5	3.07
Retrocommissioning - Lighting	Exterior Lighting	9%	6%	5%	90%	$0.05	5	3.07
Refrigeration - High Efficiency Case Lighting	Refrigeration	4%	2%	5%	75%	$0.20	8	0.52
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	1.14
Exterior Lighting - Induction Lamps	Exterior Lighting	3%	3%	5%	56%	$0.00	5	6.50
Laundry - High Efficiency Clothes Washer	Miscellaneous	0%	0%	5%	10%	$0.00	10	33.94
Interior Lighting - Hotel Guestroom Controls	Interior Lighting	10%	5%	1%	2%	$0.14	8	0.32
Miscellaneous - Energy Star Water Cooler	Miscellaneous	0%	0%	5%	95%	$0.00	8	1.78
Industrial Process Improvements	Miscellaneous	10%	8%	0%	5%	$0.52	10	1.18
Custom Measures	Cooling	10%	0%	10%	45%	$0.90	15	0.99
Custom Measures	Space Heating	10%	8%	10%	45%	$0.90	15	0.99
Custom Measures	Interior Lighting	10%	8%	10%	45%	$0.90	15	0.99
Custom Measures	Food Preparation	10%	8%	10%	45%	$0.90	15	0.99
Custom Measures	Refrigeration	10%	8%	10%	45%	$0.90	15	0.99
Water Heater - Heat Pump	Water Heating	30%	15%	0%	28%	$0.80	15	0.77
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	0%	$4.00	15	0.59
Furnace - Convert to Gas	Space Heating	100%	100%	0%	0%	$6.00	15	1.04

Note: Costs are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista

Table D-12 Energy Efficiency Measure Data — Extra Large Comm., Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
RTU - Maintenance	Cooling	14%	0%	47%	90%	$0.06	4	1.15
RTU - Evaporative Precooler	Cooling	10%	0%	0%	0%	$0.88	15	0.19
Chiller - Chilled Water Reset	Cooling	15%	0%	30%	75%	$0.09	4	0.79
Chiller - Chilled Water Variable-Flow System	Cooling	8%	0%	30%	34%	$0.09	10	1.00
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	75%	$0.90	20	0.66
Chiller - VSD	Cooling	28%	0%	3%	75%	$1.17	20	0.47
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	25%	37%	$0.04	10	0.01
Chiller - Condenser Water Temprature Reset	Cooling	9%	0%	0%	75%	$0.09	14	1.49
Cooling - Economizer Installation	Cooling	11%	0%	73%	81%	$0.15	15	1.20
Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	5%	95%	$0.06	4	2.91
Insulation - Ducting	Cooling	8%	0%	2%	50%	$0.41	20	0.77
Insulation - Ducting	Space Heating	3%	1%	2%	50%	$0.41	20	0.77
Repair and Sealing - Ducting	Cooling	5%	0%	5%	25%	$0.38	15	0.65
Repair and Sealing - Ducting	Space Heating	5%	3%	5%	25%	$0.38	15	0.65
Energy Management System	Cooling	12%	0%	80%	90%	$0.35	14	1.21
Energy Management System	Space Heating	9%	6%	80%	90%	$0.35	14	1.21
Energy Management System	Interior Lighting	5%	3%	80%	90%	$0.35	14	1.21
Cooking - Exhaust Hoods with Sensor Control	Ventilation	13%	7%	1%	8%	$0.04	10	3.46
Fans - Energy Efficient Motors	Ventilation	5%	5%	11%	90%	$0.05	10	1.30
Fans - Variable Speed Control	Ventilation	15%	5%	2%	90%	$0.20	10	0.83
Retrocommissioning - HVAC	Cooling	12%	0%	15%	90%	$0.20	4	1.00
Retrocommissioning - HVAC	Space Heating	12%	9%	15%	90%	$0.20	4	1.00
Retrocommissioning - HVAC	Ventilation	9%	6%	15%	90%	$0.20	4	1.00
Pumps - Variable Speed Control	Miscellaneous	1%	0%	1%	34%	$0.44	10	1.01
Thermostat - Clock/Programmable	Cooling	3%	0%	25%	50%	$0.13	11	0.69
Thermostat - Clock/Programmable	Space Heating	3%	1%	25%	50%	$0.13	11	0.69
Insulation - Ceiling	Cooling	1%	0%	2%	9%	$0.85	20	0.48
Insulation - Ceiling	Space Heating	12%	3%	2%	9%	$0.85	20	0.48
Insulation - Radiant Barrier	Cooling	1%	0%	2%	13%	$0.26	20	0.57
Insulation - Radiant Barrier	Space Heating	4%	2%	2%	13%	$0.26	20	0.57
Roofs - High Reflectivity	Cooling	10%	0%	0%	95%	$0.18	15	0.90
Windows - High Efficiency	Cooling	6%	0%	95%	100%	$2.10	20	0.37
Windows - High Efficiency	Space Heating	2%	2%	95%	100%	$2.10	20	0.37
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	78%	90%	$0.65	8	0.26
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	Interior Lighting	25%	13%	3%	45%	$0.40	8	0.72
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	2%	10%	$0.29	8	0.45
Interior Fluorescent - Delamp and Install Reflectors	Interior Lighting	30%	15%	3%	25%	$0.50	11	0.93
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$0.20	8	0.57
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	23%	$0.56	11	1.38
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	42%	45%	$0.20	8	0.84
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.23
Interior Screw-in - Task Lighting	Interior Lighting	10%	5%	5%	75%	$0.24	5	0.18
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	12%	56%	$0.20	8	0.42
Water Heater - Faucet Aerators/Low Flow Nozzles	Water Heating	4%	1%	2%	90%	$0.03	9	2.66
Water Heater - Pipe Insulation	Water Heating	6%	3%	0%	0%	$0.28	15	0.70
Water Heater - High Efficiency Circulation Pump	Water Heating	5%	4%	0%	23%	$0.11	10	1.19
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$0.04	10	5.48
Water Heater - Thermostat Setback	Water Heating	4%	0%	0%	0%	$0.11	10	0.72
Water Heater - Hot Water Saver	Water Heating	5%	1%	0%	0%	$0.04	5	1.45
Refrigeration - Anti-Sweat Heater/Auto Door Closer	Refrigeration	5%	3%	10%	75%	$0.20	16	0.02
Refrigeration - Floating Head Pressure	Refrigeration	7%	4%	10%	38%	$0.35	16	0.34
Refrigeration - Door Gasket Replacement	Refrigeration	4%	2%	5%	75%	$0.10	8	0.13
Insulation - Bare Suction Lines	Refrigeration	3%	2%	5%	75%	$0.10	8	0.28
Refrigeration - Night Covers	Refrigeration	6%	3%	5%	75%	$0.05	8	0.29
Refrigeration - Strip Curtain	Refrigeration	4%	2%	5%	56%	$0.02	8	0.18
Retrocommissioning - Comprehensive	Cooling	12%	0%	40%	90%	$0.25	4	1.21
Retrocommissioning - Comprehensive	Space Heating	12%	9%	40%	90%	$0.25	4	1.21
Retrocommissioning - Comprehensive	Interior Lighting	12%	9%	40%	90%	$0.25	4	1.21
Office Equipment - Energy Star Power Supply	Office Equipment	1%	1%	10%	95%	$0.00	7	39.11
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	10	1.12
LED Exit Lighting	Interior Lighting	2%	2%	9%	86%	$0.00	10	18.34
Retrocommissioning - Lighting	Interior Lighting	9%	6%	5%	90%	$0.05	5	2.54
Retrocommissioning - Lighting	Exterior Lighting	9%	6%	5%	90%	$0.05	5	2.54
Refrigeration - High Efficiency Case Lighting	Refrigeration	4%	2%	5%	75%	$0.20	8	0.04
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	1.61
Exterior Lighting - Induction Lamps	Exterior Lighting	3%	3%	5%	56%	$0.00	5	6.95
Laundry - High Efficiency Clothes Washer	Miscellaneous	0%	0%	5%	10%	$0.00	10	20.31
Interior Lighting - Hotel Guestroom Controls	Interior Lighting	10%	5%	0%	0%	$0.14	8	0.47
Miscellaneous - Energy Star Water Cooler	Miscellaneous	0%	0%	5%	95%	$0.00	8	1.07
Industrial Process Improvements	Miscellaneous	10%	8%	0%	0%	$0.52	10	1.11
Custom Measures	Cooling	10%	0%	10%	45%	$0.67	15	1.09
Custom Measures	Space Heating	10%	8%	10%	45%	$0.67	15	1.09
Custom Measures	Interior Lighting	10%	8%	10%	45%	$0.67	15	1.09
Custom Measures	Food Preparation	10%	8%	10%	45%	$0.67	15	1.09
Custom Measures	Refrigeration	10%	8%	10%	45%	$0.67	15	1.09
Water Heater - Heat Pump	Water Heating	30%	15%	0%	41%	$0.80	15	1.28
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	0%	$4.00	15	1.00
Furnace - Convert to Gas	Space Heating	100%	100%	0%	0%	$4.00	15	1.66

Note: Costs are per sq. ft.

Table D-13 Energy Efficiency Measure Data — Extra Large Industrial, Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Refrigeration - System Controls	Process	11%	8%	5%	34%	$0.40	10	18.09
Refrigeration - System Maintenance	Process	3%	2%	5%	34%	$0.00	10	2,067.93
Refrigeration - System Optimization	Process	15%	11%	5%	34%	$0.80	10	12.92
Motors - Variable Frequency Drive	Machine Drive	13%	9%	25%	38%	$0.10	10	3.38
Motors - Magnetic Adjustable Speed Drives	Machine Drive	13%	9%	25%	38%	$0.10	10	3.38
Compressed Air - System Controls	Machine Drive	9%	7%	5%	34%	$0.40	10	0.59
Compressed Air - System Optimization and Improvements	Machine Drive	13%	9%	5%	34%	$0.80	10	0.42
Compressed Air - System Maintenance	Machine Drive	3%	2%	5%	34%	$0.20	10	0.34
Compressed Air - Compressor Replacement	Machine Drive	5%	4%	5%	34%	$0.20	10	0.68
Fan System - Controls	Machine Drive	4%	3%	10%	38%	$0.35	10	0.11
Fan System - Controls	Machine Drive	4%	3%	10%	38%	$0.35	10	0.11
Fan System - Optimization	Machine Drive	6%	5%	10%	38%	$0.70	10	0.08
Fan System - Optimization	Machine Drive	6%	5%	10%	38%	$0.70	10	0.08
Fan System - Maintenance	Machine Drive	1%	1%	10%	38%	$0.15	10	0.07
Fan System - Maintenance	Machine Drive	1%	1%	10%	38%	$0.15	10	0.07
Pumping System - Controls	Machine Drive	5%	4%	5%	34%	$0.38	12	0.43
Pumping System - Optimization	Machine Drive	13%	9%	5%	34%	$0.75	12	0.54
Pumping System - Maintenance	Machine Drive	2%	1%	5%	34%	$0.19	10	0.27
RTU - Maintenance	Cooling	14%	0%	22%	90%	$0.06	4	3.18
Chiller - Chilled Water Reset	Cooling	14%	0%	30%	75%	$0.09	4	2.69
Chiller - Chilled Water Variable-Flow System	Cooling	5%	0%	30%	34%	$0.20	10	1.05
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	67%	$0.90	20	2.48
Chiller - VSD	Cooling	26%	0%	15%	67%	$1.17	20	1.68
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	25%	50%	$0.04	10	0.03
Chiller - Condenser Water Temprature Reset	Cooling	10%	0%	0%	75%	$0.20	14	2.72
Cooling - Economizer Installation	Cooling	6%	0%	29%	34%	$0.15	15	2.02
Heat Pump - Maintenance	Combined Heating/Cooling	7%	7%	2%	95%	$0.03	4	8.67
Insulation - Ducting	Space Heating	6%	6%	12%	50%	$0.41	20	1.01
Insulation - Ducting	Cooling	3%	0%	12%	50%	$0.41	20	1.01
Repair and Sealing - Ducting	Cooling	2%	0%	5%	25%	$0.38	15	0.63
Repair and Sealing - Ducting	Space Heating	2%	1%	5%	25%	$0.38	15	0.63
Energy Management System	Cooling	6%	0%	11%	90%	$0.35	14	1.09
Energy Management System	Space Heating	5%	3%	11%	90%	$0.35	14	1.09
Energy Management System	Interior Lighting	2%	1%	11%	90%	$0.35	14	1.09
Fans - Energy Efficient Motors	Ventilation	5%	5%	2%	90%	$0.14	10	2.94
Fans - Variable Speed Control	Ventilation	15%	5%	3%	90%	$0.20	10	5.29
Retrocommissioning - HVAC	Cooling	12%	0%	1%	70%	$0.25	4	1.54
Retrocommissioning - HVAC	Space Heating	12%	9%	1%	70%	$0.25	4	1.54
Retrocommissioning - HVAC	Ventilation	9%	6%	1%	70%	$0.25	4	1.54
Pumps - Variable Speed Control	Machine Drive	5%	4%	0%	34%	$0.44	10	0.31
Thermostat - Clock/Programmable	Cooling	5%	0%	59%	70%	$0.13	11	2.11
Thermostat - Clock/Programmable	Space Heating	5%	1%	59%	70%	$0.13	11	2.11
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	84%	90%	$0.65	8	0.17
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	2%	27%	$0.08	8	0.46
Interior Fluorescent - Delamp and Install Reflectors	Interior Lighting	20%	10%	17%	38%	$0.50	11	0.31
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	38%	$0.20	11	1.95
LED Exit Lighting	Interior Lighting	2%	2%	9%	86%	$0.00	10	4.00
Retrocommissioning - Lighting	Interior Lighting	9%	6%	9%	70%	$0.05	5	1.44
Retrocommissioning - Lighting	Exterior Lighting	9%	6%	9%	70%	$0.05	5	1.44
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	15%	45%	$0.20	8	0.55
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.07
Interior Screw-in - Task Lighting	Interior Lighting	7%	4%	10%	75%	$0.24	5	0.03
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	2%	56%	$0.20	8	0.27
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	0.46
Custom Measures	Cooling	10%	0%	10%	45%	$1.60	15	1.63
Custom Measures	Space Heating	10%	8%	10%	45%	$1.60	15	1.63
Custom Measures	Interior Lighting	10%	8%	10%	45%	$1.60	15	1.63
Custom Measures	Machine Drive	10%	8%	10%	45%	$1.60	15	1.63
Furnace - Convert to Gas	Space Heating	100%	100%	0%	0%	$4.00	15	2.67

Note: Costs are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista

Table D-14 Energy Efficiency Measure Data — Small/Medium Comm., New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
RTU - Maintenance	Cooling	14%	0%	14%	90%	$0.08	4	0.82
RTU - Evaporative Precooler	Cooling	10%	0%	0%	0%	$0.88	15	0.18
Chiller - Chilled Water Reset	Cooling	11%	0%	0%	0%	$0.86	4	0.06
Chiller - Chilled Water Variable-Flow System	Cooling	4%	0%	0%	0%	$0.86	10	0.05
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	0%	$0.90	20	0.63
Chiller - VSD	Cooling	26%	0%	0%	0%	$1.17	20	0.42
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.01
Chiller - Condenser Water Temprature Reset	Cooling	8%	0%	0%	0%	$0.87	14	0.13
Cooling - Economizer Installation	Cooling	6%	0%	45%	49%	$0.15	15	0.65
Heat Pump - Maintenance	Combined Heating/Cooling	7%	7%	10%	95%	$0.03	4	4.32
Insulation - Ducting	Cooling	5%	0%	9%	50%	$0.41	20	0.64
Insulation - Ducting	Space Heating	3%	1%	9%	50%	$0.41	20	0.64
Energy Management System	Cooling	5%	0%	24%	75%	$0.35	14	0.55
Energy Management System	Space Heating	2%	1%	24%	75%	$0.35	14	0.55
Energy Management System	Interior Lighting	2%	1%	24%	75%	$0.35	14	0.55
Cooking - Exhaust Hoods with Sensor Control	Ventilation	25%	13%	1%	15%	$0.04	10	7.04
Fans - Energy Efficient Motors	Ventilation	5%	5%	11%	90%	$0.05	10	1.32
Fans - Variable Speed Control	Ventilation	15%	5%	8%	90%	$0.20	10	0.85
Commissioning - HVAC	Cooling	5%	0%	40%	75%	$0.90	25	0.33
Commissioning - HVAC	Space Heating	5%	4%	40%	75%	$0.90	25	0.33
Commissioning - HVAC	Ventilation	5%	4%	40%	75%	$0.90	25	0.33
Pumps - Variable Speed Control	Miscellaneous	1%	0%	5%	34%	$0.44	10	1.01
Thermostat - Clock/Programmable	Cooling	5%	0%	34%	50%	$0.13	11	1.06
Thermostat - Clock/Programmable	Space Heating	5%	1%	34%	50%	$0.13	11	1.06
Insulation - Ceiling	Cooling	1%	0%	10%	81%	$0.16	20	1.60
Insulation - Ceiling	Space Heating	15%	4%	10%	81%	$0.16	20	1.60
Insulation - Radiant Barrier	Cooling	2%	0%	7%	13%	$0.26	20	0.76
Insulation - Radiant Barrier	Space Heating	6%	2%	7%	13%	$0.26	20	0.76
Roofs - High Reflectivity	Cooling	7%	0%	5%	95%	$0.09	15	1.25
Windows - High Efficiency	Cooling	5%	0%	61%	75%	$0.35	20	0.69
Windows - High Efficiency	Space Heating	3%	2%	61%	75%	$0.35	20	0.69
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	81%	90%	$0.65	8	0.31
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	Interior Lighting	25%	13%	1%	45%	$0.38	8	1.07
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	10%	75%	$0.09	8	1.50
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$0.50	8	0.32
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	23%	$0.70	11	1.56
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	7%	45%	$0.20	8	1.00
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.24
Interior Screw-in - Task Lighting	Interior Lighting	7%	4%	25%	75%	$0.24	5	0.08
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	9%	56%	$0.20	8	0.50
Water Heater - Faucet Aerators/Low Flow Nozzles	Water Heating	4%	1%	8%	90%	$0.01	9	4.22
Water Heater - Pipe Insulation	Water Heating	4%	2%	46%	50%	$0.28	15	0.24
Water Heater - High Efficiency Circulation Pump	Water Heating	5%	4%	0%	0%	$0.11	10	0.63
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	40%	50%	$0.02	10	5.80
Water Heater - Thermostat Setback	Water Heating	4%	0%	10%	75%	$0.11	10	0.38
Water Heater - Hot Water Saver	Water Heating	5%	1%	0%	0%	$0.02	5	1.53
Refrigeration - Anti-Sweat Heater/Auto Door Closer	Refrigeration	5%	3%	0%	75%	$0.20	16	1.09
Refrigeration - Floating Head Pressure	Refrigeration	7%	4%	18%	38%	$0.35	16	1.24
Refrigeration - Door Gasket Replacement	Refrigeration	4%	2%	5%	75%	$0.10	8	0.09
Insulation - Bare Suction Lines	Refrigeration	3%	2%	5%	75%	$0.10	8	0.20
Refrigeration - Night Covers	Refrigeration	6%	3%	5%	75%	$0.05	8	1.02
Refrigeration - Strip Curtain	Refrigeration	4%	2%	5%	56%	$0.02	8	0.00
Commissioning - Comprehensive	Cooling	10%	0%	40%	75%	$1.25	25	0.83
Commissioning - Comprehensive	Space Heating	10%	7%	40%	75%	$1.25	25	0.83
Commissioning - Comprehensive	Interior Lighting	10%	7%	40%	75%	$1.25	25	0.83
Office Equipment - Energy Star Power Supply	Office Equipment	1%	1%	10%	95%	$0.00	7	61.07
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	10	1.08
LED Exit Lighting	Interior Lighting	2%	2%	85%	86%	$0.00	10	11.83
Commissioning - Lighting	Interior Lighting	5%	4%	30%	75%	$0.20	25	1.54
Commissioning - Lighting	Exterior Lighting	5%	4%	30%	75%	$0.20	25	1.54
Refrigeration - High Efficiency Case Lighting	Refrigeration	4%	2%	5%	75%	$0.20	8	0.00
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	1.23
Exterior Lighting - Induction Lamps	Exterior Lighting	3%	3%	5%	56%	$0.00	5	7.30
Laundry - High Efficiency Clothes Washer	Miscellaneous	0%	0%	5%	10%	$0.00	10	36.95
Interior Lighting - Hotel Guestroom Controls	Interior Lighting	10%	5%	0%	0%	$0.14	8	0.30
Miscellaneous - Energy Star Water Cooler	Miscellaneous	0%	0%	5%	95%	$0.00	8	1.95
Advanced New Construction Designs	Cooling	40%	0%	5%	75%	$2.00	35	2.01
Advanced New Construction Designs	Space Heating	40%	30%	5%	75%	$2.00	35	2.01
Advanced New Construction Designs	Interior Lighting	25%	19%	5%	75%	$2.00	35	2.01
Insulation - Wall Cavity	Cooling	1%	0%	10%	68%	$0.34	20	0.72
Insulation - Wall Cavity	Space Heating	10%	2%	10%	68%	$0.34	20	0.72
Roofs - Green	Cooling	7%	0%	2%	11%	$1.00	30	0.26
Roofs - Green	Space Heating	4%	3%	2%	11%	$1.00	30	0.26
Industrial Process Improvements	Miscellaneous	10%	8%	0%	23%	$0.52	10	1.16
Custom Measures	Cooling	8%	0%	10%	45%	$1.50	15	0.45
Custom Measures	Space Heating	8%	6%	10%	45%	$1.50	15	0.45
Custom Measures	Interior Lighting	8%	6%	10%	45%	$1.50	15	0.45
Custom Measures	Food Preparation	8%	6%	10%	45%	$1.50	15	0.45
Custom Measures	Refrigeration	8%	6%	10%	45%	$1.50	15	0.45
Water Heater - Heat Pump	Water Heating	30%	15%	0%	19%	$0.80	15	0.68
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$4.00	15	0.53
Furnace - Convert to Gas	Space Heating	100%	100%	0%	47%	$8.04	15	1.01

Note: Costs are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 786 of 1069

Table D-15 Energy Efficiency Measure Data — Large Commercial, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
RTU - Maintenance	Cooling	14%	0%	27%	90%	$0.06	4	1.13
RTU - Evaporative Precooler	Cooling	10%	0%	0%	0%	$0.88	15	0.19
Chiller - Chilled Water Reset	Cooling	18%	0%	30%	75%	$0.18	4	0.42
Chiller - Chilled Water Variable-Flow System	Cooling	5%	0%	30%	34%	$0.18	10	0.28
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	66%	$0.90	20	0.61
Chiller - VSD	Cooling	32%	0%	15%	66%	$1.17	20	0.50
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	15%	41%	$0.04	10	0.01
Chiller - Condenser Water Temprature Reset	Cooling	8%	0%	25%	75%	$0.18	14	0.63
Cooling - Economizer Installation	Cooling	11%	0%	44%	49%	$0.15	15	1.19
Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	10%	95%	$0.06	4	2.72
Insulation - Ducting	Cooling	4%	0%	8%	50%	$0.41	20	0.56
Insulation - Ducting	Space Heating	3%	1%	8%	50%	$0.41	20	0.56
Energy Management System	Cooling	21%	0%	48%	90%	$0.35	14	2.10
Energy Management System	Space Heating	8%	5%	48%	90%	$0.35	14	2.10
Energy Management System	Interior Lighting	9%	6%	48%	90%	$0.35	14	2.10
Cooking - Exhaust Hoods with Sensor Control	Ventilation	13%	7%	1%	11%	$0.04	10	2.84
Fans - Energy Efficient Motors	Ventilation	5%	5%	11%	90%	$0.05	10	1.07
Fans - Variable Speed Control	Ventilation	15%	5%	2%	90%	$0.20	10	0.68
Commissioning - HVAC	Cooling	5%	0%	50%	75%	$0.85	25	0.30
Commissioning - HVAC	Space Heating	5%	4%	50%	75%	$0.85	25	0.30
Commissioning - HVAC	Ventilation	5%	4%	50%	75%	$0.85	25	0.30
Pumps - Variable Speed Control	Miscellaneous	1%	0%	5%	34%	$0.13	10	1.05
Thermostat - Clock/Programmable	Cooling	5%	0%	33%	50%	$0.13	11	0.97
Thermostat - Clock/Programmable	Space Heating	5%	1%	33%	50%	$0.13	11	0.97
Insulation - Ceiling	Cooling	1%	0%	75%	81%	$0.35	20	0.60
Insulation - Ceiling	Space Heating	10%	3%	75%	81%	$0.35	20	0.60
Insulation - Radiant Barrier	Cooling	1%	0%	7%	13%	$0.26	20	0.56
Insulation - Radiant Barrier	Space Heating	5%	2%	7%	13%	$0.26	20	0.56
Roofs - High Reflectivity	Cooling	4%	0%	5%	95%	$0.05	15	1.28
Windows - High Efficiency	Cooling	12%	0%	72%	75%	$0.88	20	0.72
Windows - High Efficiency	Space Heating	11%	8%	72%	75%	$0.88	20	0.72
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	86%	90%	$0.65	8	0.30
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	Interior Lighting	25%	13%	1%	45%	$0.34	8	1.14
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	10%	19%	$0.19	8	0.57
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$0.40	8	0.39
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	23%	$0.63	11	1.66
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	13%	45%	$0.20	8	0.99
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.19
Interior Screw-in - Task Lighting	Interior Lighting	10%	5%	10%	75%	$0.24	5	0.11
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	9%	56%	$0.20	8	0.49
Water Heater - Faucet Aerators/Low Flow Nozzles	Water Heating	4%	1%	3%	90%	$0.03	9	1.60
Water Heater - Pipe Insulation	Water Heating	4%	2%	0%	0%	$0.28	15	0.27
Water Heater - High Efficiency Circulation Pump	Water Heating	5%	4%	0%	23%	$0.11	10	0.69
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$0.04	10	3.23
Water Heater - Thermostat Setback	Water Heating	4%	0%	0%	0%	$0.11	10	0.44
Water Heater - Hot Water Saver	Water Heating	5%	1%	0%	3%	$0.04	5	0.87
Refrigeration - Anti-Sweat Heater/Auto Door Closer	Refrigeration	5%	3%	0%	75%	$0.20	16	0.58
Refrigeration - Floating Head Pressure	Refrigeration	7%	4%	38%	45%	$0.35	16	0.94
Refrigeration - Door Gasket Replacement	Refrigeration	4%	2%	5%	75%	$0.10	8	0.63
Insulation - Bare Suction Lines	Refrigeration	3%	2%	5%	75%	$0.10	8	0.35
Refrigeration - Night Covers	Refrigeration	6%	3%	5%	75%	$0.05	8	0.65
Refrigeration - Strip Curtain	Refrigeration	4%	2%	5%	56%	$0.02	8	0.94
Commissioning - Comprehensive	Cooling	10%	0%	40%	75%	$1.00	25	0.96
Commissioning - Comprehensive	Space Heating	10%	7%	40%	75%	$1.00	25	0.96
Commissioning - Comprehensive	Interior Lighting	10%	7%	40%	75%	$1.00	25	0.96
Office Equipment - Energy Star Power Supply	Office Equipment	1%	1%	10%	95%	$0.00	7	67.83
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	10	1.09
LED Exit Lighting	Interior Lighting	2%	2%	85%	86%	$0.00	10	11.13
Commissioning - Lighting	Interior Lighting	5%	4%	60%	75%	$0.15	25	1.99
Commissioning - Lighting	Exterior Lighting	5%	4%	60%	75%	$0.15	25	1.99
Refrigeration - High Efficiency Case Lighting	Refrigeration	4%	2%	5%	75%	$0.20	8	0.52
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	1.03
Exterior Lighting - Induction Lamps	Exterior Lighting	3%	3%	5%	56%	$0.00	5	5.86
Laundry - High Efficiency Clothes Washer	Miscellaneous	0%	0%	5%	10%	$0.00	10	33.94
Interior Lighting - Hotel Guestroom Controls	Interior Lighting	10%	5%	1%	2%	$0.14	8	0.29
Miscellaneous - Energy Star Water Cooler	Miscellaneous	0%	0%	5%	95%	$0.00	8	1.78
Advanced New Construction Designs	Cooling	40%	0%	5%	75%	$2.00	35	1.84
Advanced New Construction Designs	Space Heating	40%	30%	5%	75%	$2.00	35	1.84
Advanced New Construction Designs	Interior Lighting	25%	19%	5%	75%	$2.00	35	1.84
Insulation - Wall Cavity	Cooling	1%	0%	9%	68%	$0.78	20	0.43
Insulation - Wall Cavity	Space Heating	10%	2%	9%	68%	$0.78	20	0.43
Roofs - Green	Cooling	4%	0%	2%	13%	$1.00	15	0.08
Roofs - Green	Space Heating	2%	2%	2%	13%	$1.00	15	0.08
Industrial Process Improvements	Miscellaneous	10%	8%	0%	5%	$0.52	10	1.18
Custom Measures	Cooling	8%	0%	10%	45%	$0.90	15	0.73
Custom Measures	Space Heating	8%	6%	10%	45%	$0.90	15	0.73
Custom Measures	Interior Lighting	8%	6%	10%	45%	$0.90	15	0.73
Custom Measures	Food Preparation	8%	6%	10%	45%	$0.90	15	0.73
Custom Measures	Refrigeration	8%	6%	10%	45%	$0.90	15	0.73
Water Heater - Heat Pump	Water Heating	30%	15%	0%	28%	$0.80	15	0.76
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	0%	$4.00	15	0.58
Furnace - Convert to Gas	Space Heating	100%	100%	0%	0%	$6.00	15	0.98

Note: Costs are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 787 of 1069

Table D-16 Energy Efficiency Measure Data — Extra Large Commercial, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
RTU - Maintenance	Cooling	14%	0%	47%	90%	$0.06	4	1.02
RTU - Evaporative Precooler	Cooling	10%	0%	0%	0%	$0.88	15	0.17
Chiller - Chilled Water Reset	Cooling	12%	0%	60%	75%	$0.09	4	0.61
Chiller - Chilled Water Variable-Flow System	Cooling	8%	0%	30%	34%	$0.09	10	0.95
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	75%	$0.90	20	0.64
Chiller - VSD	Cooling	28%	0%	3%	75%	$1.17	20	0.45
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	25%	37%	$0.04	10	0.01
Chiller - Condenser Water Temprature Reset	Cooling	8%	0%	25%	75%	$0.09	14	1.28
Cooling - Economizer Installation	Cooling	11%	0%	73%	81%	$0.15	15	1.14
Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	5%	95%	$0.06	4	2.61
Insulation - Ducting	Cooling	7%	0%	2%	50%	$0.41	20	0.71
Insulation - Ducting	Space Heating	3%	1%	2%	50%	$0.41	20	0.71
Energy Management System	Cooling	11%	0%	80%	90%	$0.35	14	0.94
Energy Management System	Space Heating	4%	2%	80%	90%	$0.35	14	0.94
Energy Management System	Interior Lighting	5%	3%	80%	90%	$0.35	14	0.94
Cooking - Exhaust Hoods with Sensor Control	Ventilation	13%	7%	1%	8%	$0.04	10	3.31
Fans - Energy Efficient Motors	Ventilation	5%	5%	11%	90%	$0.05	10	1.24
Fans - Variable Speed Control	Ventilation	15%	5%	2%	90%	$0.20	10	0.80
Commissioning - HVAC	Cooling	5%	0%	50%	75%	$0.70	25	0.42
Commissioning - HVAC	Space Heating	5%	4%	50%	75%	$0.70	25	0.42
Commissioning - HVAC	Ventilation	5%	4%	50%	75%	$0.70	25	0.42
Pumps - Variable Speed Control	Miscellaneous	1%	0%	1%	34%	$0.44	10	1.01
Thermostat - Clock/Programmable	Cooling	3%	0%	25%	50%	$0.13	11	0.67
Thermostat - Clock/Programmable	Space Heating	3%	1%	25%	50%	$0.13	11	0.67
Insulation - Ceiling	Cooling	1%	0%	2%	81%	$0.35	20	0.68
Insulation - Ceiling	Space Heating	10%	3%	2%	81%	$0.35	20	0.68
Insulation - Radiant Barrier	Cooling	1%	0%	2%	13%	$0.26	20	0.47
Insulation - Radiant Barrier	Space Heating	2%	1%	2%	13%	$0.26	20	0.47
Roofs - High Reflectivity	Cooling	10%	0%	5%	95%	$0.18	15	0.85
Windows - High Efficiency	Cooling	6%	0%	95%	100%	$1.69	20	0.38
Windows - High Efficiency	Space Heating	2%	2%	95%	100%	$1.69	20	0.38
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	78%	90%	$0.65	8	0.23
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	Interior Lighting	25%	13%	3%	45%	$0.30	8	0.86
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	10%	15%	$0.19	8	0.61
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$0.20	8	0.52
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	23%	$0.56	11	1.24
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	42%	45%	$0.20	8	0.76
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.20
Interior Screw-in - Task Lighting	Interior Lighting	10%	5%	25%	75%	$0.24	5	0.16
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	12%	56%	$0.20	8	0.38
Water Heater - Faucet Aerators/Low Flow Nozzles	Water Heating	4%	1%	2%	90%	$0.03	9	2.63
Water Heater - Pipe Insulation	Water Heating	6%	3%	0%	0%	$0.28	15	0.69
Water Heater - High Efficiency Circulation Pump	Water Heating	5%	4%	0%	23%	$0.11	10	1.18
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$0.04	10	5.43
Water Heater - Thermostat Setback	Water Heating	4%	0%	0%	0%	$0.11	10	0.71
Water Heater - Hot Water Saver	Water Heating	5%	1%	0%	0%	$0.04	5	1.43
Refrigeration - Anti-Sweat Heater/Auto Door Closer	Refrigeration	5%	3%	10%	75%	$0.20	16	0.02
Refrigeration - Floating Head Pressure	Refrigeration	7%	4%	10%	38%	$0.35	16	0.32
Refrigeration - Door Gasket Replacement	Refrigeration	4%	2%	5%	75%	$0.10	8	0.12
Insulation - Bare Suction Lines	Refrigeration	3%	2%	5%	75%	$0.10	8	0.26
Refrigeration - Night Covers	Refrigeration	6%	3%	5%	75%	$0.05	8	0.27
Refrigeration - Strip Curtain	Refrigeration	4%	2%	5%	56%	$0.02	8	0.17
Commissioning - Comprehensive	Cooling	10%	0%	40%	75%	$0.80	25	1.05
Commissioning - Comprehensive	Space Heating	10%	7%	40%	75%	$0.80	25	1.05
Commissioning - Comprehensive	Interior Lighting	10%	7%	40%	75%	$0.80	25	1.05
Office Equipment - Energy Star Power Supply	Office Equipment	1%	1%	10%	95%	$0.00	7	38.86
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	10	1.10
LED Exit Lighting	Interior Lighting	2%	2%	85%	86%	$0.00	10	16.52
Commissioning - Lighting	Interior Lighting	5%	4%	60%	75%	$0.10	25	2.47
Commissioning - Lighting	Exterior Lighting	5%	4%	60%	75%	$0.10	25	2.47
Refrigeration - High Efficiency Case Lighting	Refrigeration	4%	2%	5%	75%	$0.20	8	0.04
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	1.45
Exterior Lighting - Induction Lamps	Exterior Lighting	3%	3%	5%	56%	$0.00	5	6.26
Laundry - High Efficiency Clothes Washer	Miscellaneous	0%	0%	5%	10%	$0.00	10	20.31
Interior Lighting - Hotel Guestroom Controls	Interior Lighting	10%	5%	0%	0%	$0.14	8	0.42
Miscellaneous - Energy Star Water Cooler	Miscellaneous	0%	0%	5%	95%	$0.00	8	1.07
Advanced New Construction Designs	Cooling	40%	0%	5%	75%	$2.00	35	1.67
Advanced New Construction Designs	Space Heating	40%	30%	5%	75%	$2.00	35	1.67
Advanced New Construction Designs	Interior Lighting	25%	19%	5%	75%	$2.00	35	1.67
Insulation - Wall Cavity	Cooling	1%	0%	2%	68%	$0.09	20	1.73
Insulation - Wall Cavity	Space Heating	10%	2%	2%	68%	$0.09	20	1.73
Roofs - Green	Cooling	10%	0%	2%	13%	$1.00	15	0.20
Roofs - Green	Space Heating	5%	3%	2%	13%	$1.00	15	0.20
Industrial Process Improvements	Miscellaneous	10%	8%	0%	0%	$0.52	10	1.11
Custom Measures	Cooling	8%	0%	10%	45%	$0.67	15	0.81
Custom Measures	Space Heating	8%	6%	10%	45%	$0.67	15	0.81
Custom Measures	Interior Lighting	8%	6%	10%	45%	$0.67	15	0.81
Custom Measures	Food Preparation	8%	6%	10%	45%	$0.67	15	0.81
Custom Measures	Refrigeration	8%	6%	10%	45%	$0.67	15	0.81
Water Heater - Heat Pump	Water Heating	30%	15%	0%	41%	$0.80	15	1.27
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	0%	$4.00	15	1.00
Furnace - Convert to Gas	Space Heating	100%	100%	0%	0%	$4.00	15	1.57

Note: Costs are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 788 of 1069

Table D-17 Energy Efficiency Measure Data — Extra Large Industrial, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Refrigeration - System Controls	Process	11%	8%	5%	34%	$0.40	10	18.09
Refrigeration - System Maintenance	Process	3%	2%	5%	34%	$0.00	10	2,067.93
Refrigeration - System Optimization	Process	15%	11%	5%	34%	$0.80	10	12.92
Motors - Variable Frequency Drive	Machine Drive	13%	9%	25%	38%	$0.10	10	3.38
Motors - Magnetic Adjustable Speed Drives	Machine Drive	13%	9%	25%	38%	$0.10	10	3.38
Compressed Air - System Controls	Machine Drive	9%	7%	5%	34%	$0.40	10	0.59
Compressed Air - System Optimization and Improvements	Machine Drive	13%	9%	5%	34%	$0.80	10	0.42
Compressed Air - System Maintenance	Machine Drive	3%	2%	5%	34%	$0.20	10	0.34
Compressed Air - Compressor Replacement	Machine Drive	5%	4%	5%	34%	$0.20	10	0.68
Fan System - Controls	Machine Drive	4%	3%	10%	38%	$0.35	10	0.11
Fan System - Controls	Machine Drive	4%	3%	10%	38%	$0.35	10	0.11
Fan System - Optimization	Machine Drive	6%	5%	10%	38%	$0.70	10	0.08
Fan System - Optimization	Machine Drive	6%	5%	10%	38%	$0.70	10	0.08
Fan System - Maintenance	Machine Drive	1%	1%	10%	38%	$0.15	10	0.07
Fan System - Maintenance	Machine Drive	1%	1%	10%	38%	$0.15	10	0.07
Pumping System - Controls	Machine Drive	5%	4%	5%	34%	$0.38	12	0.42
Pumping System - Optimization	Machine Drive	13%	9%	5%	34%	$0.75	12	0.54
Pumping System - Maintenance	Machine Drive	2%	1%	5%	34%	$0.19	10	0.27
RTU - Maintenance	Cooling	14%	0%	22%	90%	$0.06	4	2.82
Chiller - Chilled Water Reset	Cooling	14%	0%	60%	75%	$0.09	4	2.53
Chiller - Chilled Water Variable-Flow System	Cooling	4%	0%	30%	34%	$0.20	10	0.80
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	67%	$0.90	20	2.40
Chiller - VSD	Cooling	27%	0%	25%	67%	$1.17	20	1.63
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	25%	50%	$0.04	10	0.04
Chiller - Condenser Water Temprature Reset	Cooling	10%	0%	5%	75%	$0.20	14	2.60
Cooling - Economizer Installation	Cooling	6%	0%	29%	34%	$0.15	15	1.92
Heat Pump - Maintenance	Combined Heating/Cooling	7%	7%	2%	95%	$0.03	4	7.76
Insulation - Ducting	Space Heating	5%	5%	12%	50%	$0.41	20	0.95
Insulation - Ducting	Cooling	3%	0%	12%	50%	$0.41	20	0.95
Energy Management System	Cooling	5%	0%	11%	90%	$0.35	14	0.88
Energy Management System	Space Heating	2%	1%	11%	90%	$0.35	14	0.88
Energy Management System	Interior Lighting	2%	1%	11%	90%	$0.35	14	0.88
Fans - Energy Efficient Motors	Ventilation	5%	5%	2%	90%	$0.14	10	2.81
Fans - Variable Speed Control	Ventilation	15%	5%	3%	90%	$0.34	10	2.97
Commissioning - HVAC	Cooling	5%	0%	60%	75%	$0.70	25	0.92
Commissioning - HVAC	Space Heating	5%	4%	60%	75%	$0.70	25	0.92
Commissioning - HVAC	Ventilation	5%	4%	60%	75%	$0.70	25	0.92
Pumps - Variable Speed Control	Machine Drive	5%	4%	0%	34%	$0.44	10	0.31
Thermostat - Clock/Programmable	Cooling	5%	0%	59%	70%	$0.13	11	2.02
Thermostat - Clock/Programmable	Space Heating	5%	1%	59%	70%	$0.13	11	2.02
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	84%	90%	$0.65	8	0.15
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	10%	40%	$0.08	8	0.42
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	38%	$0.20	11	1.76
LED Exit Lighting	Interior Lighting	2%	2%	85%	86%	$0.00	10	3.72
Commissioning - Lighting	Interior Lighting	5%	4%	60%	75%	$0.10	25	1.41
Commissioning - Lighting	Exterior Lighting	5%	4%	60%	75%	$0.10	25	1.41
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	15%	45%	$0.20	8	0.50
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.06
Interior Screw-in - Task Lighting	Interior Lighting	7%	4%	10%	75%	$0.24	5	0.03
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	2%	56%	$0.20	8	0.25
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	0.41
Advanced New Construction Designs	Cooling	40%	0%	5%	75%	$2.00	35	2.67
Advanced New Construction Designs	Space Heating	40%	30%	5%	75%	$2.00	35	2.67
Advanced New Construction Designs	Interior Lighting	25%	19%	5%	75%	$2.00	35	2.67
Custom Measures	Cooling	8%	0%	10%	45%	$1.60	15	1.28
Custom Measures	Space Heating	8%	6%	10%	45%	$1.60	15	1.28
Custom Measures	Interior Lighting	8%	6%	10%	45%	$1.60	15	1.28
Custom Measures	Machine Drive	8%	6%	10%	45%	$1.60	15	1.28
Furnace - Convert to Gas	Space Heating	100%	100%	0%	0%	$4.00	15	2.51

Note: Costs are per sq. ft.

2011 Electric Integrated Resource Plan

Appendix D – Avista Electric Conservation Potential Assessment Study

AVISTA

AVISTA ELECTRIC CONSERVATION POTENTIAL ASSESSMENT STUDY

Final Report — Electricity Potentials

August 19, 2011

J. Borstein, Project Manager
I. Rohmund, Director

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EXECUTIVE SUMMARY

Avista Corporation (Avista) engaged Global Energy Partners (Global) to conduct a Conservation Potential Assessment (CPA) Study. The CPA is a 20-year potentials study for energy efficiency (EE) and demand response (DR) to provide data on demand-side resources for developing Avista's 2011 Integrated Resource Plan (IRP), and in accordance with Washington I-937. The study used 2009, the first year for which complete billing data was available, as the baseline year and then developed potential estimates for the period 2012–2032. This report provides results of the electricity energy efficiency potential study only, and subsequent documents will address natural gas and DR potential.

Study Objectives

The study objectives included:

- Conduct a conservation potential study for electricity for Washington and Idaho, and natural gas for Washington, Idaho, and Oregon. The study will account for:
    - Impacts of existing Avista conservation programs
    - Avista's load forecasts and load shapes
    - Impacts of codes and standards
    - Technology developments and innovation
    - The economy and energy prices
    - Naturally occurring energy savings
- Assess and analyze cost-effective EE and DR potentials in accordance with the Northwest Power and Conservation Council's (NWPPC) 6th Power Plan and Washington I-937 requirements.
- Obtain supply curves showing the incremental costs associated with achieving higher levels of EE and stacking EE resources by cost of conserved energy.
- Analyze various market penetration rates associated with technical, economic, achievable, and naturally occurring potential estimates.

Study Approach

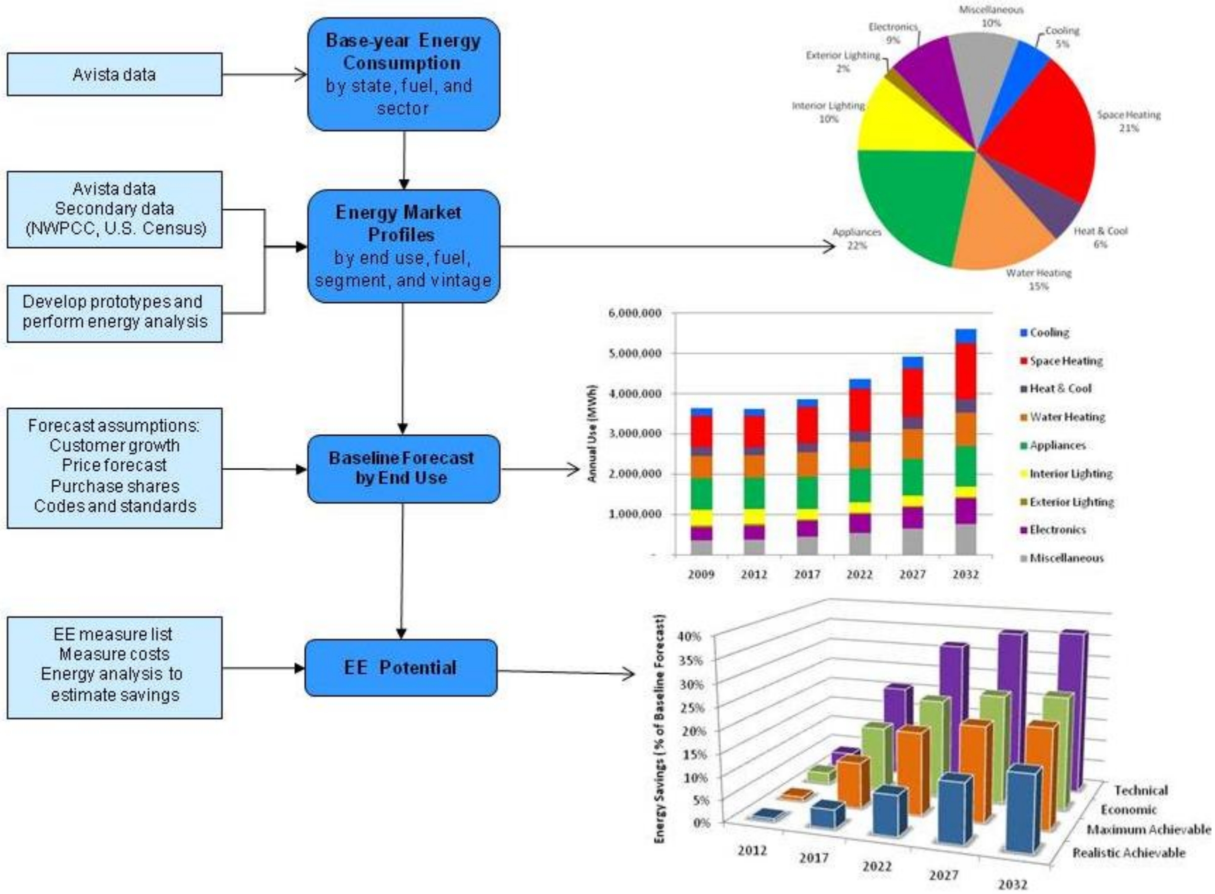
To execute this project, Global took the following steps, which are also shown in Figure ES-1.

1. Performed a market assessment to describe base year energy consumption for the residential and C&I sectors. This included using utility data and secondary data to understand customers in Avista's service territory and how these customers currently use electricity. Based on the market assessment, we developed energy market profiles for the study's base year, 2009.
2. Developed a baseline energy forecast by sector and end use for the twenty-year study period.
3. Identified and analyzed energy-efficiency measures appropriate for the Avista service area.
4. Estimated four levels of energy-efficiency potential, *technical, economic, maximum achievable,* and *realistic achievable*.

The steps are described in further detail in Chapter 2.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 796 of 1069

Figure ES-1 Analysis Approach Overview



The study segmented Avista customers by state and rate class (Residential, Commercial & Industrial (C&I) General Service, C&I Large General Service, Extra Large Commercial, and Extra Large Industrial). In addition, the residential class was segmented by housing type and income (single family, multi-family, mobile home, and low income). The low-income threshold for purposes of this study was defined as 200% of the Federal poverty level. For the pumping rate classes, representing 2% of load, the Northwest Power and Conservation Council (NWPCC) Sixth Plan calculator was used to determine future EE potential. Within each segment, energy use was characterized by end-use (e.g., space heating, cooling, lighting, water heat, motors, etc.) and by technology (e.g., heat pump, resistance heating, furnace for space heating). This market characterization is detailed in Chapter 3.

The baseline forecast is the "business as usual" metric, without new utility conservation programs, against which energy savings from energy efficiency measures are compared. The baseline forecast includes the projected impacts of known codes and standards, as of 2010 when the study was conducted. These include the Energy Independence and Security Act (EISA), which mandates higher efficacies for lighting technologies starting in 2012, and a series of recent appliance standards agreed upon in 2010. These recent codes and standards have direct bearing on the amount of utility program potential over and above the effects of codes and standards and naturally occurring conservation. This process incorporates the changes in market conditions such as customer and market growth, income growth, Avista's retail rates forecast, trends in end-use and technology saturations, equipment purchase decisions, consumer price elasticity, and income and persons per household. The baseline forecast enables understanding customer potential estimates in the context of total energy use in the future.

For each customer sector, a robust list of electrical energy efficiency measures was compiled, drawing upon the Sixth Power Plan database, the Regional Technical Forum (RTF), and other

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 797 of 1069

measures considered applicable to Avista. This list of energy efficiency equipment and measures included 2,808 equipment options and 1,524 measure options and represented a wide variety of major types of end-use equipment, as well as devices and actions to reduce energy consumption. Considered against current avoided costs, many of these measures do not pass the economic screens, but may ultimately be part of Avista's energy efficiency program portfolio during this 20-year planning horizon. Measure cost, savings, estimated useful life, and other performance factors were characterized for the list of measures. Cost-effectiveness screening was performed, using the total resource cost (TRC) test, for each measure and each year of the study to develop economic potential. The measure analysis is discussed in Chapter 5.

Market Characterization and Baseline Forecast

During 2009, Avista served 354,615 residential, commercial, industrial, and pumping customers with a combined electricity use of approximately 8,862 GWh.

Residential Sector

The total number of 2009 residential customers was 200,134 in Washington and 99,579 in Idaho. Table ES-1 shows their distribution by housing type and income level. The limited income category, which is composed of single-family, multi-family, and mobile homes, represents households with income below $35,000 annually.

Table ES-1 Residential Electricity Usage and Intensity by Segment and State, 2009

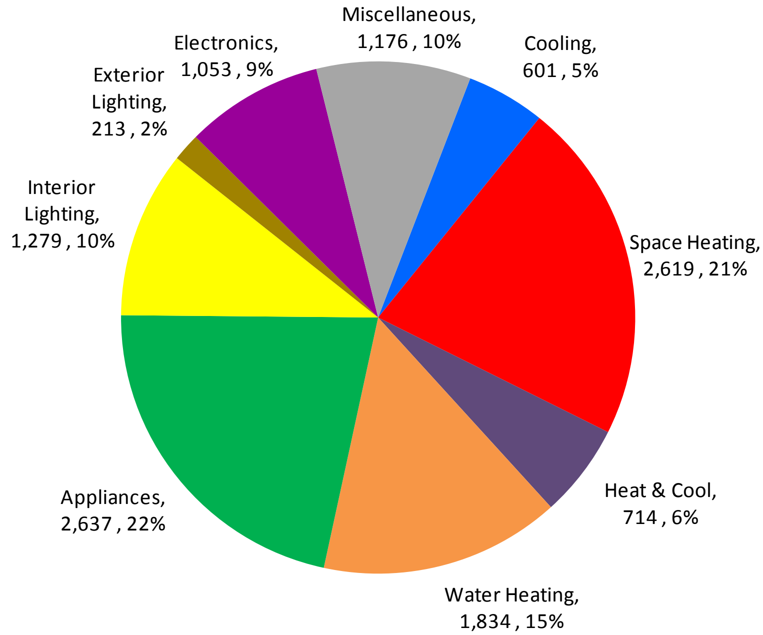
Washington Segment	Intensity (kWh/Household)	Number of Customers	% of Customers	2009 Electricity Sales (MWh)	% of Sales
Single Family	14,547	109,134	54%	1,587,572	65%
Multi-Family	8,728	18,219	9%	159,019	6%
Mobile Home	13,092	5,248	3%	68,708	3%
Limited Income	9,424	67,533	34%	636,407	26%
Total	**12,250**	**200,134**	**100%**	**2,451,707**	**100%**

Idaho Segment	Intensity (kWh/Household)	Number of Customers	% of Customers	2009 Electricity Sales (MWh)	% of Sales
Single Family	13,703	59,205	59%	811,302	69%
Multi-Family	8,213	5,237	5%	43,013	4%
Mobile Home	12,320	4,774	5%	58,815	5%
Limited Income	8,868	30,363	31%	269,249	23%
Total	**11,874**	**99,580**	**100%**	**1,182,379**	**100%**

For each residential segment, a snapshot of electricity use by end use and technology was developed. Figure ES-2 presents the end-use breakout by household for the residential sector as a whole. The appliance end use accounts for the largest share of the usage, closely followed by space heating, with water heating the third largest end use. The miscellaneous end use includes such devices as furnace fans, pool pumps, and other "plug" loads (hair dryers, power tools, coffee makers, etc.). Interior and exterior lighting combined account for 12% of electricity use in 2009. The electronics end use, which includes personal computers, televisions, home audio, video game consoles, etc., also contributes significantly to household electricity usage. Cooling and combined heating and cooling through heat pumps make up the remainder.

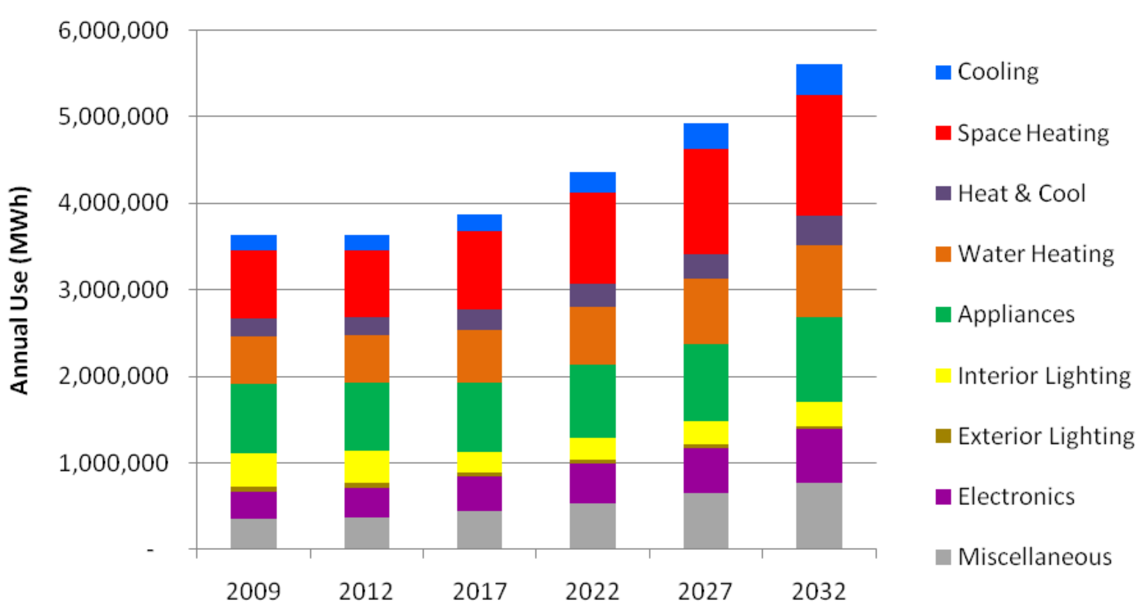
Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 798 of 1069

Figure ES-2 Residential Electricity Use by End Use per Household, 2009 (kWh and %)



The residential baseline forecast incorporates the effects of future customer growth, trends in appliance ownership, building codes, federal appliance standards and customer usage response to changes in electricity prices and household income. As such, it includes naturally-occurring energy efficiency. Overall, residential use in both states and for all segments increases from 3,634,054 MWh in 2009 to 5,600,870 MWh in 2032, an average annual growth rate of 1.9%. This reflects projected growth in the number of households, home size, and income levels, as well as relatively low electricity prices. Figure ES-3 shows the residential baseline forecast by end use.

Figure ES-3 Residential Baseline Forecast by End Use



Commercial & Industrial Sector

Table ES-2 and Table ES-3 present the segmentation of C&I customers in Washington and Idaho respectively. Although the General Service 011 and Large General Service 021 rate classes include a small percentage of industrial customers, we treated them as primarily commercial building types. For the General Service segment, we assumed facilities were small to medium buildings, dominated by retail facilities. For the Large General Service segment, we assumed the typical facility was an office building.

Table ES-2 Commercial Sector Market Characterization Results, Washington 2009

Avista Rate Schedule		LoadMAP Segment and Typical Building	Electricity sales (MWh)	Intensity (kWh/sq.ft.)
General Service	011, 012	Small and Medium Commercial — Retail	415,935	17.5
Large General Service	021, 022	Large Commercial — Office	1,556,929	16.7
Extra Large General Service Commercial	025C	Extra Large Commercial — University	265,686	13.9
Extra Large General Service Industrial	025I	Extra Large Industrial	613,615	40.0
Total			**2,852,165**	

Table ES-3 Commercial Sector Market Characterization Results, Idaho 2009

Avista Rate Schedule		LoadMAP Segment and Typical Building	Electricity sales (MWh)	Intensity (kWh/sq.ft.)
General Service	011, 012	Small and Medium Commercial — Retail	322,570	17.5
Large General Service	021, 022	Large Commercial — Office	699,953	16.7
Extra Large General Service Commercial	025C	Extra Large Commercial — University	70,361	13.9
Extra Large General Service Industrial	025I, 025P	Extra Large Industrial	1,087,974	40.0
Total			**2,180,858**	

Figure ES-4 shows the breakdown of annual electricity usage by end use for the C&I sector as a whole. Lighting is the largest single end use in the sector, accounting for one fifth of total usage.

Figure ES-4 Commercial and Industrial Electricity Consumption by End Use, 2009

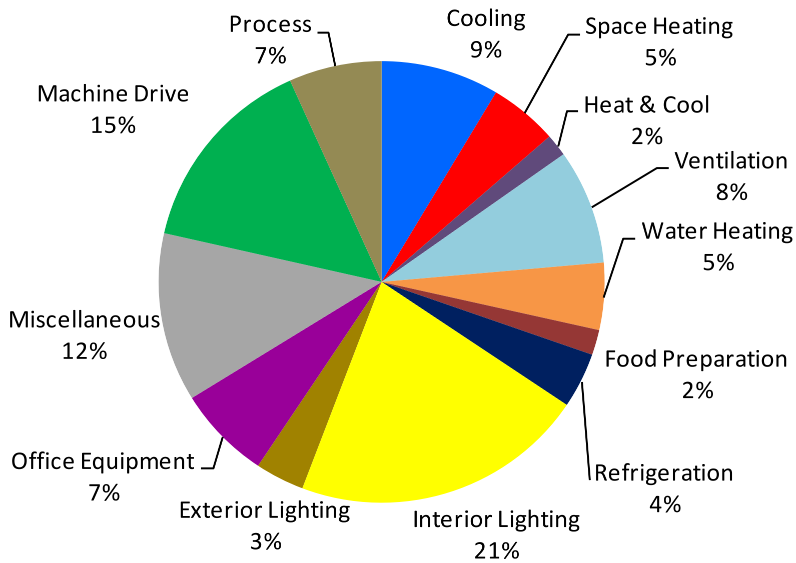
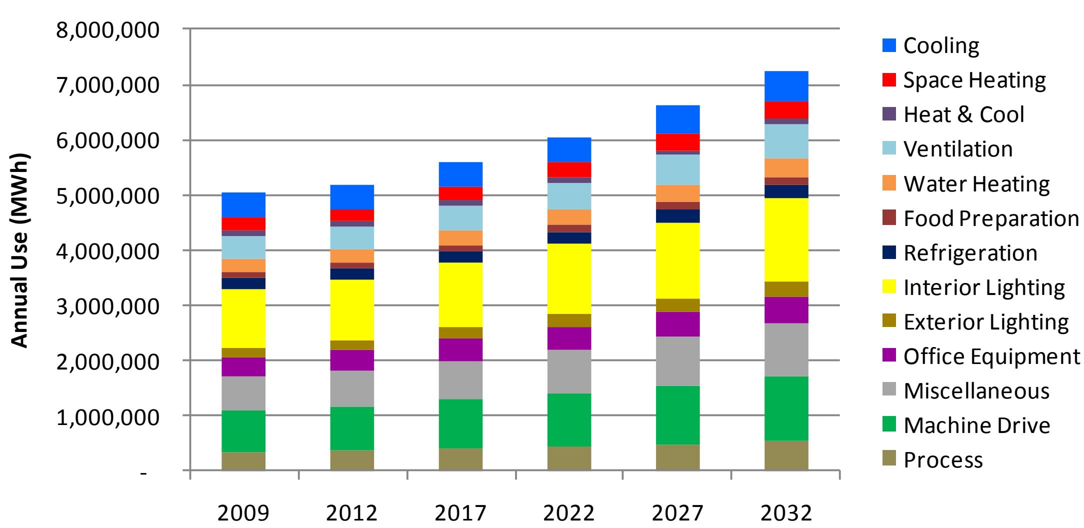


Figure ES-5 presents the baseline forecast at the end-use level for the C&I sector as a whole. Overall, C&I annual energy use increases from 5,033,023 MWh in 2009 to 7,239,694 MWh in 2032, a 43.8% increase. This reflects growth in floor space across all sectors. Interior screw-in lighting increases over the forecast period, but at a slower rate than other technologies as a result of the EISA lighting standard.

Figure ES-5 C&I Baseline Electricity Forecast by End Use



System-wide Baseline Forecast Summary

Table ES-4 and Figure ES-6 provide an overall summary of the baseline forecast by sector and for the Avista system as a whole. Overall, the forecast for the next 20 years shows substantial growth, reflecting projected increases in customers and income. This forecast is the metric against which the energy-efficiency savings potential is compared.

Table ES-4 Baseline Forecast Summary by Sector and State

End Use	2009	2012	2022	2032	% Change ('09–'32)	Avg. Growth Rate ('09–'32)
Res. WA	2,451,707	2,448,104	2,947,427	3,792,486	54.7%	1.9%
Res. ID	1,182,379	1,178,591	1,408,812	1,808,300	52.9%	1.8%
C&I WA	2,852,165	2,955,156	3,509,816	4,280,649	50.1%	1.8%
C&I ID	2,180,858	2,217,188	2,551,291	2,970,324	36.2%	1.3%
Total	**8,667,109**	**8,799,039**	**10,417,347**	**12,851,760**	**48.3%**	**1.7%**

Figure ES-6 Baseline Forecast Summary by Sector and State

The baseline forecast, prior to the consideration of potentials, projects overall growth of 48% in electric consumption. This compounded average annual growth rate of 1.7% during this 20 year period is consistent with Avista's current and previous Integrated Resource Plans. Chapter 4 provides details of the baseline forecast.

Definitions of Potential

In this study, we estimated four types of potential: *technical; economic;* and achievable potential, which is further divided into *maximum achievable,* and *realistic achievable*. Technical and economic potential are both theoretical limits to efficiency savings. Achievable potential embodies a set of assumptions about the decisions consumers make regarding the efficiency of the equipment they purchase, the maintenance activities they undertake, the controls they use for energy-consuming equipment, and the elements of building construction.

Technical potential is defined as the theoretical upper limit of energy efficiency potential. It assumes that customers adopt all feasible measures regardless of their cost. At the time of equipment failure, customers replace their equipment with the most efficient option available. In new construction, customers and developers also choose the most efficient equipment option. Examples of measures that make up technical potential in the residential sector include:

- Ductless mini-split air conditioners with variable refrigerant flow
- Ground source (or geothermal) heat pumps
- LED lighting for general service and linear applications

Technical potential also assumes the adoption of every available other measure, where applicable. For example, it includes installation of high-efficiency windows in all new construction opportunities and air conditioner maintenance in all existing buildings with central and room air conditioning.

Economic potential represents the adoption of all ***cost-effective*** energy efficiency measures. As described earlier, LoadMAP performs an economic screen to determine which measures are economically viable. LoadMAP incorporates the result of the screen into the purchase shares to reflect the most efficient measure that passes the screen. For our analysis, we apply the total resource cost (TRC) test, which compares lifetime energy and capacity benefits to the incremental cost, including the administrative costs associated with any energy-efficiency program. The benefits include non-energy benefits.

Achievable potential refines the economic potential by taking into account penetration rates of efficient technologies, expected program participation, and customer preferences and likely behavior. Two types of achievable potential were evaluated for this study:

- ***Maximum achievable potential (MAP)*** establishes an upper boundary of potential savings a utility could achieve through its energy efficiency programs. MAP presumes incentives that are sufficient to ensure customer adoption. It also considers a maximum participation rate by customers for the various energy efficiency programs that are designed to deliver the various measures. For this study, we developed market acceptance rate (MAR) factors, based on the ramp rate curves used in the Sixth Power Plan.1 These MAR factors were then applied to this study's estimates of economic potential to estimate MAP.
- ***Realistic achievable potential (RAP)*** represents a lower boundary forecast of potentials resulting from likely customer behavior and penetration rates of efficient technologies. It uses a set of program implementation factors (PIFs) to take into account existing barriers that are likely to limit the amount of savings that might be achieved through energy efficiency programs. The RAP also takes into account recent utility experience and reported savings from past and present programs.

[1] The Sixth Power Plan Conservation Supply Curve workbooks are available at http://www.nwcouncil.org/energy/powerplan/6/supplycurves/default.htm, with separate workbooks for specific sectors and end uses.

Potential Savings from Electric Energy Efficiency

Maximum achievable potential across all sectors is 88,760 MWh (10.1 aMW) in 2012 and increases to a cumulative value of 2,905,702 MWh (331.7 aMW) by 2032. These savings represents 1.0% of the baseline forecast in 2012 and 22.6% in 2032. Realistic achievable potential in 2012 is 50,261 MWh (5.7 aMW) and reaches a cumulative value of 2,155,133 MWh (246.0 aMW) by 2032, for savings that are 0.6% and 16.8% of the baseline in 2012 and 2032 respectively. Between 2012 and 2032, the baseline forecast shows overall electricity consumption growth of 46%, but the realistic achievable potential forecast reduces growth by half to 23%. Technical potential by 2032 is 37.8% of the baseline and economic potential savings are 26.4% of the baseline, or roughly 70% of technical potential savings. MAP and RAP savings in 2012 are 86% and 64% respectively of the economic potential savings.

Figure ES-7 displays the energy use forecast for the four potential levels versus the baseline forecast. Figure ES-8 summarizes the energy-efficiency savings for the four potential levels relative to the baseline forecast for selected years. Table ES-5 presents the energy consumption and peak demand for the potential levels across sectors.

Figure ES-7 Energy Efficiency Potential Forecasts, All Sectors

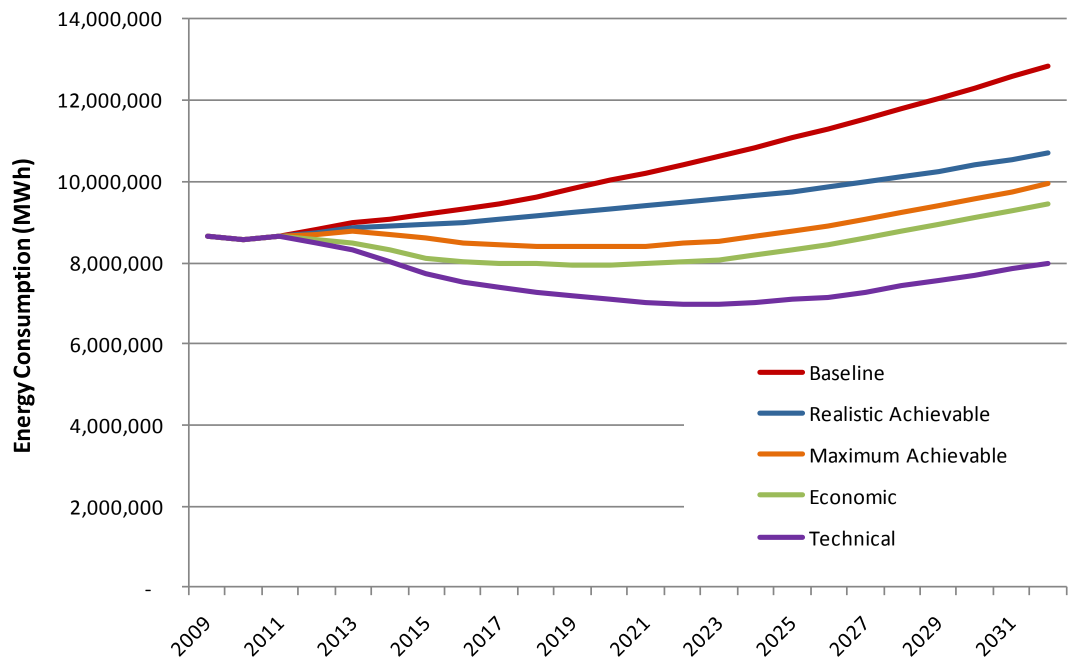


Figure ES-8 Summary of Energy Efficiency Potential Savings, All Sectors

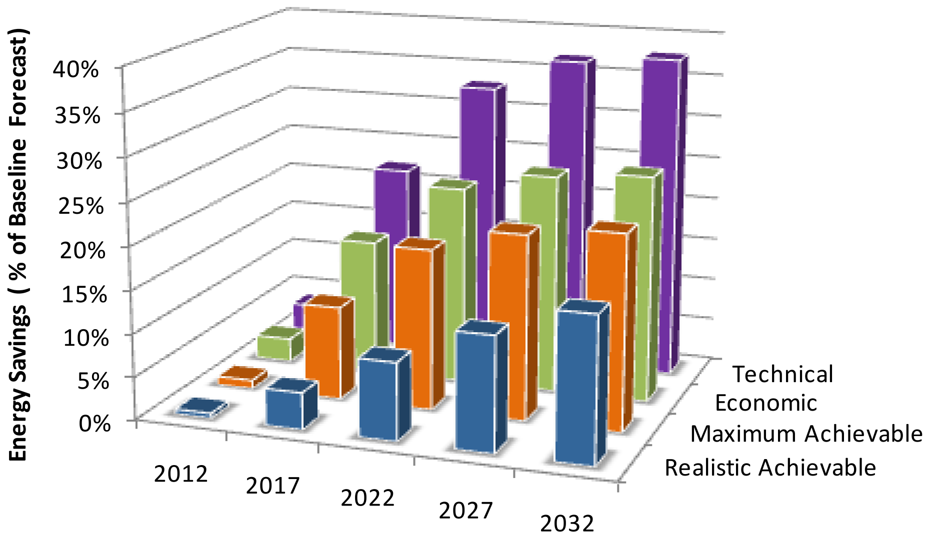


Table ES-5 Summary of Energy Efficiency Potential, All Sectors

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	8,799,039	9,463,880	10,417,347	11,536,869	12,851,760
Baseline Peak Demand (MW)	1,780	1,880	2,080	2,306	2,566
Cumulative Energy Savings (MWh)					
Realistic Achievable	50,261	405,985	945,183	1,536,357	2,155,133
Maximum Achievable	88,760	1,035,470	1,952,473	2,476,694	2,905,702
Economic	244,292	1,493,608	2,411,399	2,937,775	3,387,203
Technical	329,513	2,087,061	3,435,475	4,250,217	4,852,362
Cumulative Energy Savings (% of Baseline)					
Realistic Achievable	0.6%	4.3%	9.1%	13.3%	16.8%
Maximum Achievable	1.0%	10.9%	18.7%	21.5%	22.6%
Economic	2.8%	15.8%	23.1%	25.5%	26.4%
Technical	3.7%	22.1%	33.0%	36.8%	37.8%
Peak Savings (MW)					
Realistic Achievable	14	84	183	306	431
Maximum Achievable	22	207	386	492	566
Economic	60	302	479	580	659
Technical	78	422	669	826	943
Peak Savings (% of Baseline)					
Realistic Achievable	0.8%	4.5%	8.8%	13.3%	16.8%
Maximum Achievable	1.2%	11.0%	18.6%	21.3%	22.1%
Economic	3.4%	16.0%	23.0%	25.2%	25.7%
Technical	4.4%	22.4%	32.2%	35.8%	36.8%

Table ES-6 and Figure ES-9 summarize cumulative realistic achievable potential by sector. Initially, the residential sector accounts for about 52% of the savings, but by the end of the study, the C&I sector becomes the source of 58% of the savings.

Table ES-6 Realistic Achievable Cumulative Energy-efficiency Potential by Sector, MWh

Segment	2012	2017	2022	2027	2032
Residential, WA	17,413	94,529	238,739	431,973	637,029
Residential, ID	8,692	43,922	97,705	172,179	260,003
C&I, WA	15,733	173,433	378,252	575,328	774,619
C&I, ID	8,423	94,102	230,487	356,878	483,482
Total	**50,261**	**405,985**	**945,183**	**1,536,357**	**2,155,133**

Figure ES-9 Realistic Achievable Cumulative Potential by Sector

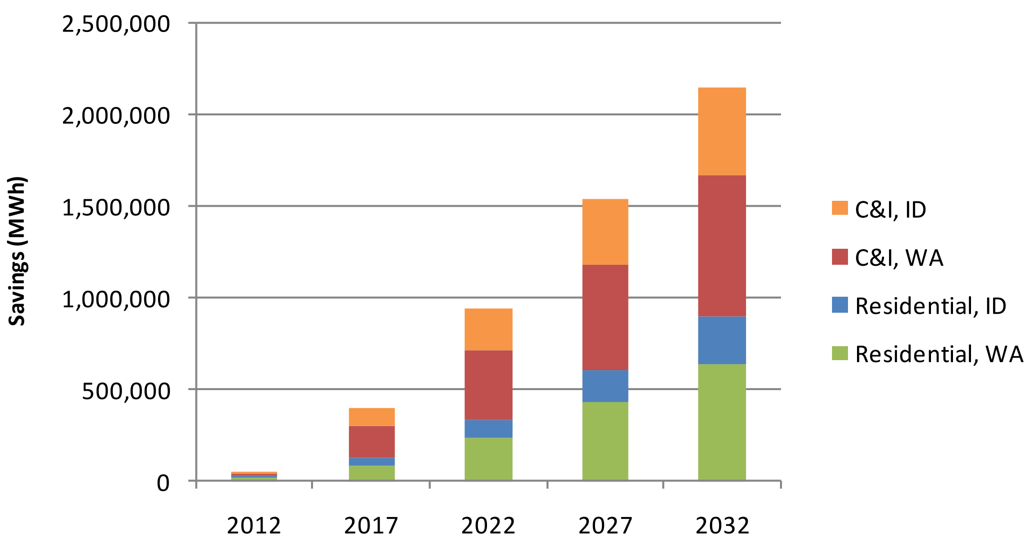


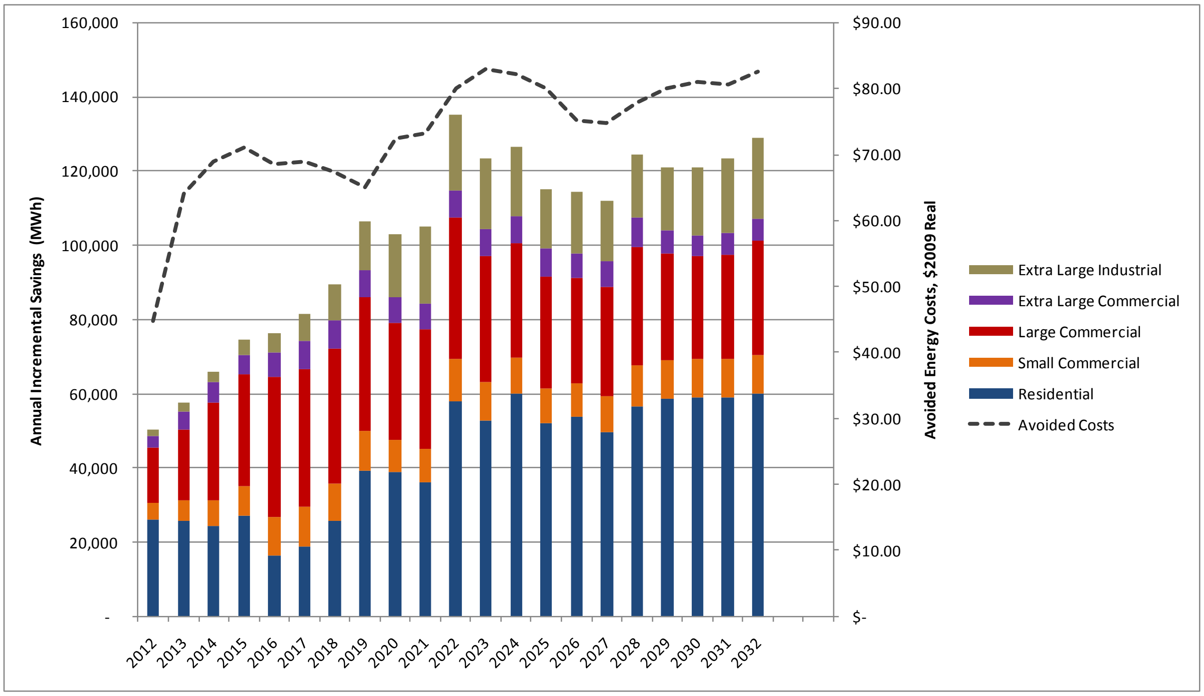
Table ES-7 shows the incremental annual realistic achievable potential by sector for 2012 through 2015. During this period, lighting and appliance standards slow the rate of growth in the residential baseline energy consumption, thus reducing the amount of incremental annual potential savings from residential conservation programs. On the other hand, C&I potential continues to grow. Complete annual incremental savings for Washington and Idaho appear in Appendices A and B respectively.

Table ES-7 Incremental Annual Realistic Achievable Energy-efficiency Potential by Sector, MWh

Segment	2012	2013	2014	2015
Residential, WA	17,413	17,161	16,488	18,514
Residential, ID	8,692	8,451	7,943	8,569
C&I, WA	15,733	21,165	26,869	30,393
C&I, ID	8,423	10,734	14,543	16,956
Total	**50,261**	**57,511**	**65,843**	**74,432**

Figure ES-10 illustrates how the annual incremental realistic achievable potential throughout the study tracks the avoided energy costs, with annual potential generally increasing or decreasing along with avoided costs. Note however that other factors also influence potential, particularly the rates at which programs can ramp up over time, which is particularly relevant to how potential changes from year to year in the early years of the study.

Figure ES-10 Incremental Annual Realistic Achievable Energy-efficiency (MWh) vs. Avoided Energy Cost



Note: Avoided costs are 2009 real dollars and include energy costs, risk, and the 10% Power Act premium.

Residential Sector Potential

Realistic achievable potential savings for the residential sector in both states is 26,105 MWh in 2012, or 0.7% of the sector's baseline forecast. It reaches 897,032 MWh, or 16.0% of the baseline forecast by 2032. Technical and economic potential savings are 37.7% and 24.5% respectively. Table ES-8 presents estimates for energy and peak demand under the four types of potential.

Table ES-8 Energy Efficiency Potential, Residential Sector

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	3,626,696	3,871,294	4,356,240	4,918,847	5,600,787
Baseline Peak Demand (MW)	991	1,026	1,150	1,288	1,449
Cumulative Energy Savings (MWh)					
Realistic Achievable	26,105	138,450	336,444	604,152	897,032
Maximum Achievable	36,300	429,065	798,829	1,024,671	1,192,794
Economic	104,111	583,427	967,788	1,188,497	1,373,869
Technical	153,100	918,965	1,468,041	1,825,587	2,112,855
Cumulative Energy Savings (% of Baseline)					
Realistic Achievable	0.7%	3.6%	7.7%	12.3%	16.0%
Maximum Achievable	1.0%	11.1%	18.3%	20.8%	21.3%
Economic	2.9%	15.1%	22.2%	24.2%	24.5%
Technical	4.2%	23.7%	33.7%	37.1%	37.7%
Peak Savings (MW)					
Realistic Achievable	10	44	100	179	262
Maximum Achievable	14	120	232	301	343
Economic	38	171	286	349	396
Technical	51	256	407	503	579
Peak Savings (% of Baseline)					
Realistic Achievable	1.1%	4.3%	8.7%	13.9%	18.1%
Maximum Achievable	1.4%	11.7%	20.2%	23.3%	23.7%
Economic	3.8%	16.7%	24.9%	27.1%	27.3%
Technical	5.1%	24.9%	35.4%	39.0%	40.0%

In terms of how residential potential is divided among the various end uses, we note the following:

- ***Water Heating*** offers the highest cumulative technical potential over the 20-year period, which reflects the high potential for conversion to natural gas in homes where gas is available (see discussion below) and use of heat pump water heaters where gas is not available, as well as a wide range of other water heating measures. Conversion to natural gas passes the TRC test throughout the study period for most Washington housing types and for single family homes in Idaho. In contrast, based on the study's assumptions of equipment cost and avoided cost, heat pump water heaters are cost-effective in new single family homes by 2014, but do not become cost-effective for existing homes until 2024 in Idaho and 2028 in Washington. Water heating also has the highest cumulative realistic achievable potential.

- ***Space Heating*** offers the second-highest cumulative technical potential over the study and its economic potential is slightly higher than water heating, again due to the potential for conversion to natural gas (see discussion below), but also due to shell measures, controls, and advanced new construction designs. Based on realistic achievable savings, space heating also ranks second.
- ***Interior lighting*** offers the fourth-largest technical potential savings, but the third-largest economic and realistic achievable potential. The lighting standard begins its phase-in starting in 2012, which coincides with the availability in the market place of advanced incandescent lamps that meet the minimum efficacy standard. The baseline forecast assumes that people will install both advanced incandescent and CFLs in screw-in lighting applications. For technical potential, LED lamps are the most efficient option, starting in 2012. However, LED lamps do not pass the economic screen until 2022, when they begin to become cost-effective for pin-based fixtures. Nonetheless, there is significant economic and realistic achievable lighting potential due to conversion from advanced incandescents to CFLs.
- ***Appliances*** rank sixth based on technical potential, but fourth in terms of realistic achievable potential. This reflects the cost-effectiveness of the highest-efficiency white-goods appliances for both new construction and for replacing failed units, as well as the market acceptance of high-efficiency appliances. Removal of second refrigerators and freezers also contributes to economic and realistic achievable potential within this end use.
- ***Cooling*** offers the third-highest technical potential, but is sixth based on realistic achievable potential. Initially technical potential is low but ramps up due to the assumption of increased saturation of air conditioning over time. Economic potential for cooling in 2031 is about 40% of technical potential because the higher SEER units do not pass the economic screen based on based on the study's assumptions of equipment cost and avoided cost.
- ***Home electronics*** also offer substantial savings opportunities. Technical potential reflects the purchase of ENERGY STAR units for all technologies, except PCs and laptops for which a super-efficient "climate saver" option is available in the marketplace. However, the climate saver options are not cost-effective during the forecast horizon, so economic potential reflects the purchase of ENERGY STAR units across all technologies in this end use.

Commercial and Industrial Sector Potential

Realistic achievable potential savings for the C&I sector in both states is 24,155 MWh in 2012, or 0.5% of the sector's baseline forecast. It reaches 1,258,101 MWh, or 17.4% of the baseline forecast by 2032. Technical and economic potential savings are 37.8% and 27.8% of the baseline forecast respectively. Table ES-9 presents estimates for the sector's energy and peak demand under the four types of potential.

In terms of how potential is divided among the various end uses, we note the following:

- ***Interior lighting*** offers the largest technical, economic, and achievable potential. The high technical potential of 892,840 MWh in 2032 is a result of LED lighting that is now commercially available in screw-in and linear lighting applications, as well as numerous fixture improvement and control options. However, LED lighting is not cost effective given the study's avoided cost assumptions, so economic potential reflects installation of CFL, T5, and Super T8 lamps throughout most of the commercial sector. Still, this results in realistic achievable potential of 598,564 MWh by 2032.
- ***Cooling*** has the third highest savings for technical potential at 302,301 MWh in 2032, and many of the cooling measures are cost effective, including installation of high-efficiency equipment, thermal shell measures, HVAC control strategies, and retrocommissioning. Because the market for cooling technologies is mature, these savings are relatively easy to capture, as reflected in the ramp rates for these measures. Thus realistic achievable potential for cooling, at 119,700 MWh, is the second highest among C&I end uses.

- ***Ventilation*** is second in terms of technical and economic potential due to conversion to variable air volume systems, high-efficiency and variable speed control fans, and retrocommissioning. Realistic achievable potential in 2032 of 117,020 MWh ranks this end use third, just behind cooling.
- ***Machine drive*** ranks fourth in realistic achievable potential at 101,018 MWh in 2032. Even though the National Electrical Manufacturer's Association (NEMA) standards make premium efficiency motors the baseline efficiency level, savings remain available from upgrading to still more efficient levels.
- ***Office equipment, exterior lighting, and industrial process improvements*** offer smaller but still significant realistic achievable potential by 2032 at 73,152 MWh, 68,467 MWh, and 60,759 MWh respectively.
- Savings from ***commercial refrigeration, food preparation, and water heating*** are relatively small across the C&I sector as a whole, though these end uses can offer significant savings in supermarkets, restaurants, hospitals, and other buildings where these end use constitute a larger portion of overall energy use.

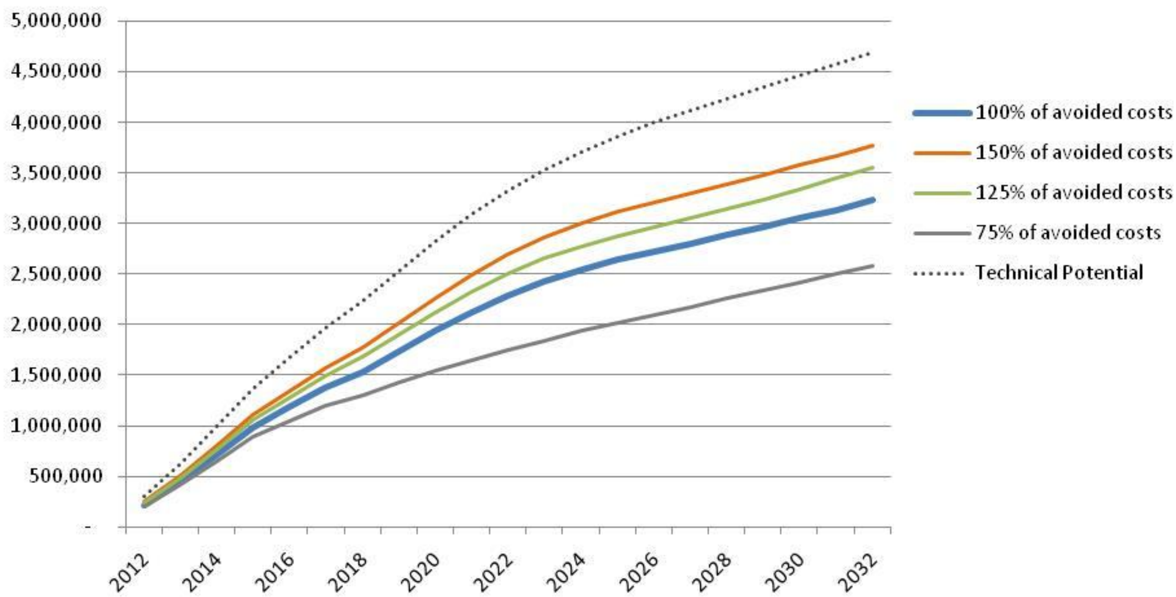
Table ES-9 Energy Efficiency Potential, Commercial and Industrial Sector

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	5,172,344	5,592,586	6,061,107	6,618,022	7,250,973
Cumulative Energy Savings (MWh)					
Realistic Achievable	24,155	267,535	608,739	932,205	1,258,101
Maximum Achievable	52,460	606,406	1,153,644	1,452,022	1,712,907
Economic	140,180	910,181	1,443,612	1,749,278	2,013,333
Technical	176,414	1,168,096	1,967,434	2,424,630	2,739,507
Cumulative Energy Savings (% of Baseline)					
Realistic Achievable	0.5%	4.8%	10.0%	14.1%	17.4%
Maximum Achievable	1.0%	10.8%	19.0%	21.9%	23.6%
Economic	2.7%	16.3%	23.8%	26.4%	27.8%
Technical	3.4%	20.9%	32.5%	36.6%	37.8%
Peak Savings (MW)					
Realistic Achievable	4	40	84	127	169
Maximum Achievable	8	88	154	191	223
Economic	22	130	193	231	263
Technical	27	166	262	324	364
Peak Savings (% of Baseline)					
Realistic Achievable	0.5%	4.7%	9.0%	12.4%	15.1%
Maximum Achievable	1.0%	10.3%	16.6%	18.8%	20.0%
Economic	2.7%	15.3%	20.8%	22.7%	23.6%
Technical	3.4%	19.4%	28.2%	31.8%	32.6%

Sensitivity of Potential to Avoided Costs

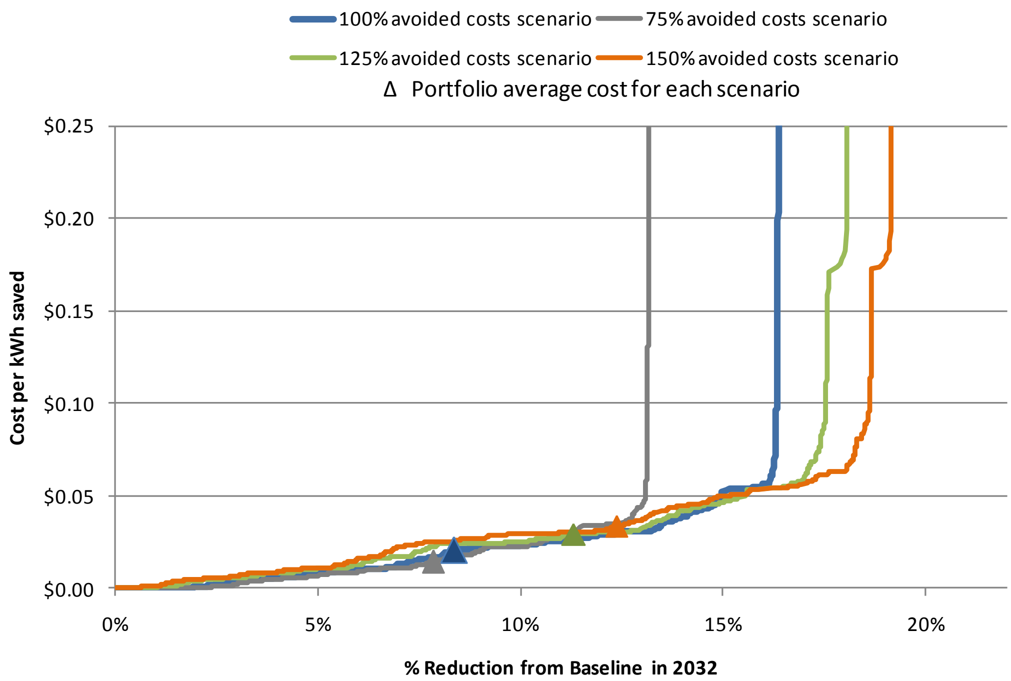
Global modeled several scenarios with varying levels of avoided costs in addition to the base case. The other scenarios included 150%, 125%, and 75% of the avoided costs used in the base case. Figure ES -11 shows how realistic achievable potential varies under the four scenarios. The base case realistic achievable potential is approximately 16.4% of the baseline forecast by 2032. With the 150% avoided cost case, realistic achievable potential increased to 19.2% of the baseline forecast, while the 125% avoided cost case and the 75% avoided cost case yielded realistic achievable potential equal to 18.1% and 13.2% of the baseline forecast respectively. While the changes are significant, the relationship between avoided cost and realistic achievable potential is not linear and increases in avoided costs do not provide equivalent percentage increases in realistic achievable potential. Technical potential imposes a limit on the amount of additional conservation and each incremental unit of conservation becomes increasingly expensive.

Figure ES -11 Energy Savings, Economic Potential Case by Avoided Costs Scenario (MWh)



The project developed a series of supply curves based on the four avoided cost scenarios, shown in Figure ES -12. Each supply curve is created by stacking measures and equipment over the 20-year planning horizon in ascending order of cost. As expected, this stacking of conservation resources produces a traditional upward-sloping supply curve. The 75% of avoided cost scenario provides roughly a 13% reduction in energy use compared with the baseline forecast in 2032, at a cost of $0.05/kWh or less. The other three scenarios track one another closely, providing just over 15% savings in 2032 at costs below $0.05/kWh.

Figure ES -12 Supply Curves for Evaluated EE Measures and Avoided Cost Scenarios



Sensitivity of Potential to Customer and Economic Growth

This conservation potential assessment shows that conservation offsets roughly 50% of growth in electrical energy use for the Avista system, whereas the Sixth Plan projects that conservation can offset 80% of growth. Of course, Avista's service territory differs from the region overall in many ways, including its climate. Another significant factor may be the CPA study's assumptions regarding customer and economic growth. To better understand how growth affects the study's results, the project team evaluated scenarios with lower customer and economic growth, as indicated in Table ES-10.

Table ES-10 Varying Growth Scenario Descriptions

	Reference Scenario	Low Growth Scenario 1	Low Growth Scenario 2
Home size	~ 1% per year growth	Capped at 110% of existing home size	Capped at 110% of existing home size
Per capita income growth	1.6% 2011–2015; 2.2% 2016–2020; 2.1% thereafter	1.6% after 2016	1.6% after 2016
Residential sector market growth	1.30% after 2015 (WA) 1.25% after 2015 (ID)	no change	1.0% after 2015 (WA & ID)
Commercial sector market growth, WA & ID	~ 2.0% (varies by segment)	no change	1.0% all segments

Table ES -11 shows that as economic and customer growth decreases, the ability of conservation to offset growth increases. In the reference scenario, energy efficiency offsets 52% of growth in consumption, while in the lower growth scenarios, EE offsets 54% and 76% of growth respectively. This is the case because with reduced new construction, load growth and achievable potential drop, but savings due to the retrofit of existing buildings constitute a greater proportion of load growth.

Table ES -11 Varying Growth Scenario Results

	Reference Scenario	Low Growth Scenario 1	Low Growth Scenario 2
Baseline forecast 2012 (MWh)	8,799,039	8,799,039	8,799,033
Baseline forecast 2032 (MWh)	12,851,760	12,523,843	11,178,008
Load growth 2012-2032 (MWh)	4,052,720	3,724,803	2,378,975
Realistic achievable potential forecast 2032 (MWh)	10,745,176	10,500,088	9,366,471
Realistic achievable potential savings 2032 (MWh)	2,106,584	2,023,754	1,811,538
Percentage of growth offset	52%	54%	76%

Note: Value of 2,106,548 MWh for 2032 realistic achievable potential was based on interim results and thus is different from the value shown elsewhere in this report.

Pumping Potential

As displayed in Table ES -12, pumping accounts represent 2.2% of Avista's total electricity sales and 0.8% of peak demand. Because pumping represents a relatively small percentage of Avista's total sales, the project team decided to use the NWPCC Sixth Plan calculator to estimate pumping energy efficiency potential.

Table ES -12 Pumping Rate Classes, Electricity Sales and Peak Demand 2009

Sector	Rate Schedule(s)	Number of meters (customers)	2009 Electricity sales (MWh)	Peak demand (MW)
Pumping, Washington	031, 032	2,361	135,999	10
Pumping, Idaho	031, 032	1,312	58,885	4
Pumping, Total		3,673	194,884	14
Percentage of System Total			**2.2%**	**0.8%**

The Sixth Plan Calculator estimates agricultural conservation targets through 2019, based on 2007 sales. We trended the data through 2022 to provide annual savings estimates for the ten-year period 2012–2022, with the results provided in Table ES -13 and Table ES -14.

Table ES -13 Sixth Plan Calculator Agriculture Incremental Annual Potential, Selected Years (MWh)

Segment	2012	2013	2014	2015
Pumping, Washington	1,567	1,484	1,402	1,835
Pumping, Idaho	690	654	618	809
Pumping, Total	**2,257**	**2,138**	**2,020**	**2,643**

Table ES -14 Sixth Plan Calculator Agriculture Cumulative Potential, Selected Years (MWh)

Measure	2012	2017	2022
Pumping, Washington	1,567	9,979	18,892
Pumping, Idaho	690	4,397	8,324
Pumping, Total	**2,257**	**14,375**	**27,217**

Report Organization

The body of the report is organized as follows:

- Chapter 1, Introduction
- Chapter 2, Study Approach for Energy Efficiency Analysis
- Chapter 3, Market Assessment and Market Profiles
- Chapter 4, Baseline Forecast
- Chapter 5, Energy Efficiency Measure Analysis
- Chapter 6, Energy Efficiency Potential Results
- Appendix A, Washington Results
- Appendix B, Idaho Results
- Appendix C, Residential Energy Efficiency Equipment and Measure Data
- Appendix D, Commercial Energy Efficiency Equipment and Measure Data
- Appendix E, Study References

Results of the demand response analysis and the natural gas potential assessment will be presented in separate forthcoming documents.

CONTENTS

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 816 of 1069

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 817 of 1069

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

1.1 BACKGROUND

Avista Corporation (Avista) engaged Global Energy Partners (Global) to conduct a Conservation Potential Assessment (CPA) Study. The CPA is a 20-year potentials study for energy efficiency (EE) and demand response (DR) to provide data on demand-side resources for developing Avista's 2011 Integrated Resource Plan (IRP), and in accordance with Washington I-937. The study used 2009, the first year for which complete billing data was available, as the baseline year and then developed potential estimates for the period 2012-2032. Although the final report will address electricity and natural gas, this interim report provides results of the electricity potential study only.

1.2 OBJECTIVES

Key objectives for the study include:

- Conduct a conservation potential study for electricity for Washington and Idaho, and natural gas for Washington, Idaho, and Oregon. The study will account for:
  - Impacts of existing Avista conservation programs
  - Avista's load forecasts and load shapes
  - Impacts of codes and standards
  - Technology developments and innovation
  - The economy and energy prices
  - Naturally occurring energy savings
- Assess and analyze cost-effective EE and DR potentials in accordance with the Northwest Power and Conservation Council's (NWPPC) 6th Power Plan and Washington I-937 requirements.
- Obtain supply curves showing the incremental costs associated with achieving higher levels of EE and DR and stacking EE and DR resources by cost of conserved energy.
- Analyze various market penetration rates associated with technical, economic, achievable, and naturally occurring potential estimates.

1.3 REPORT ORGANIZATION

The remainder of this report presents the results of the electricity conservation potential assessment for Avista's Washington and Oregon service territory. In most cases, results for Avista's overall electric system are presented in the body of the report, and Washington- and Oregon-specific results are presented in Appendices A and B respectively. The report is organized as follows:

- Chapter 2, Study Approach for Energy Efficiency Analysis
- Chapter 3, Market Assessment and Market Profiles
- Chapter 4, Baseline Forecast
- Chapter 5, Energy Efficiency Measure Analysis
- Chapter 6, Energy Efficiency Potential Results
- Appendix A, Washington Results
- Appendix B, Idaho Results
- Appendix C, Residential Energy Efficiency Equipment and Measure Data
- Appendix D, Commercial Energy Efficiency Equipment and Measure Data
- Appendix E, Study References

Results of the demand response analysis and the natural gas potential assessment will be presented in separate forthcoming documents.

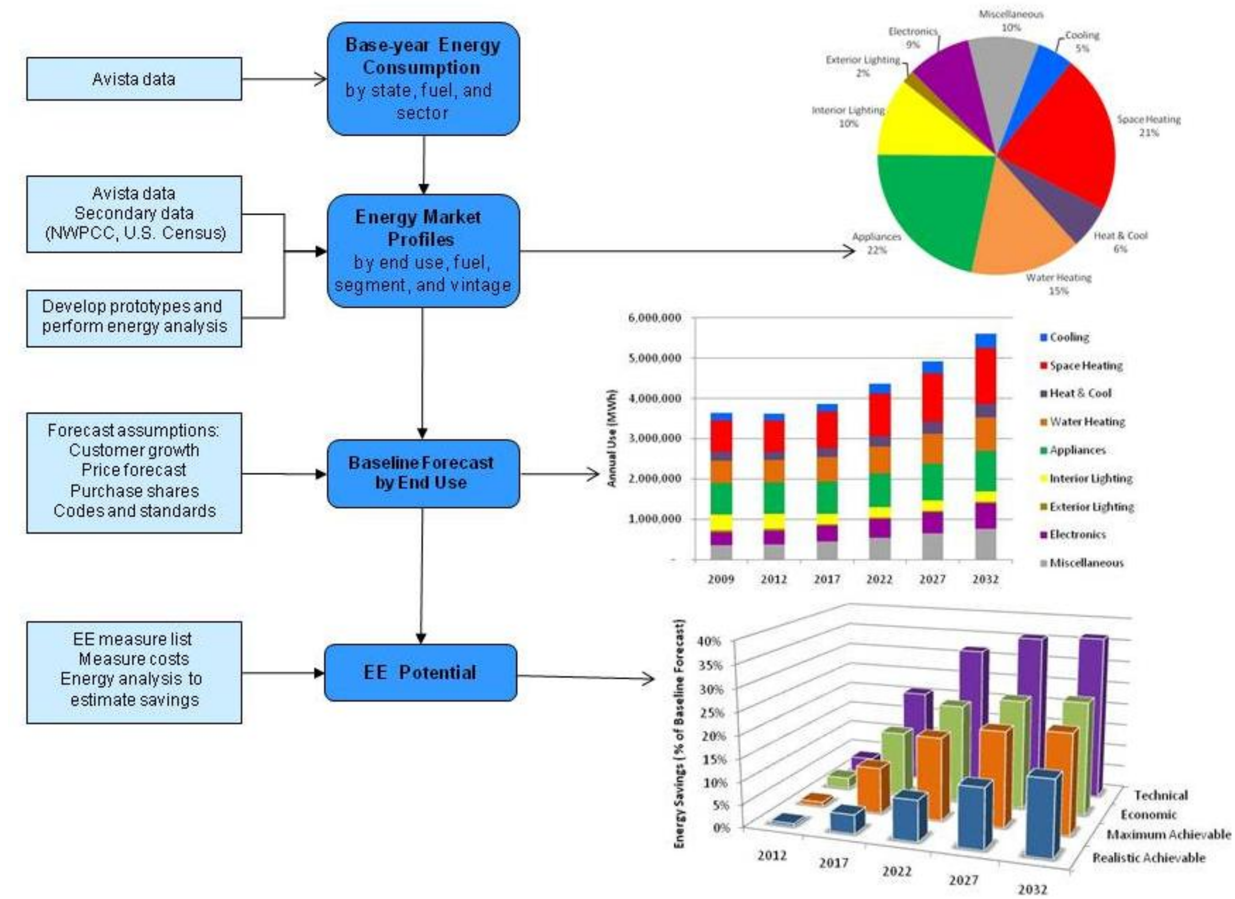
STUDY APPROACH FOR ENERGY EFFICIENCY ANALYSIS

To execute this project, Global took the following steps, which are also shown in Figure 2-1.

1. Performed a market assessment to describe base year energy consumption for the residential and C&I sectors. This included using utility data and secondary data to understand customers in Avista's service territory and how these customers currently use electricity. Based on the market assessment, we developed energy market profiles for the study's base year, 2009.
2. Developed a baseline energy forecast by sector and end use for the twenty-year study period.
3. Identified and analyzed energy-efficiency measures appropriate for the Avista service area.
4. Estimated four levels of energy-efficiency potential, *Technical, Economic, Maximum Achievable,* and *Realistic Achievable*.

The steps are described in further detail throughout the remainder of this section.

Figure 2-1 Analysis Approach Overview



2.1 MARKET ASSESSMENT AND MARKET PROFILES

It is absolutely critical to develop a good understanding of where Avista is today in terms of energy use and customer behavior before developing projections of potential EE savings. The purpose of the market assessment is to develop market profiles that describe current electricity use in terms of sector, customer segment, and end use. The base year for this study is 2009, the most recent year for which complete billing data was available at the start of the study.

We began the market assessment by defining the market segments (building types, end uses and other dimensions) that are relevant in the Avista service territory. The segmentation scheme employed for this project, as presented in Table 2-1, is based on Avista rate schedules. For the pumping rate classes, we determined to use the Northwest Power and Conservation Council (NWPCC) Sixth Plan calculator to determine future EE potential.

Table 2-1 Segmentation Framework for Electricity

Market Dimension	Segmentation Design	Dimension Examples
Dimension 1	Geographic Region	Washington, Idaho
Dimension 2	Sector / Rate Class	Residential — Rate Class 001 C&I General Service — Rate Class 011, 012 C&I Large General Service — Rate Classes 021, 022 Comm. Extra Large General Service — Rate Class 025 Ind. Extra Large General Service — Rate Classes 025, 025P Pumping — Rate Classes 030, 031, 032
Dimension 3	Building Type	Residential: single-family, multi-family, mobile home, limited income No further segmentation of C&I and pumping, except for XLarge General Service, which was divided into commercial and industrial segments
Dimension 4	Vintage	Existing and new construction (as appropriate for residential and commercial sectors)
Dimension 5	End Uses	Cooling, lighting, water heat, motors, etc. (as appropriate by sector)
Dimension 6	Appliances/End Uses and Technologies	Cooling, lighting, water heat, motors, etc. (as appropriate by sector); Technologies such as types of lamps, chillers, color TVs, etc.
Dimension 7	Equipment Efficiency Levels	Old, Standard (minimum standard), Maximum Efficiency

With the segmentation scheme defined, we set out to populate the market profiles. The first step was to identify the electricity sales in the base year for each segment using Avista's 2009 historical customer billing data by rate class. In order to further divide the residential sector, we relied upon regional demographic and economic data from secondary sources (see below).

Then, we developed the data for the remaining market profile elements, which include market size, annual electricity use, electric appliance and equipment saturations, technology shares, and end-use consumption estimates (unit energy consumption or UEC for residential customers and energy use index or EUI for C&I customers). We calibrated the elements of the market profile for each segment to match the segment and sector-level sales we developed in the previous step. We developed market profiles for the entire existing market, as well as new construction in each segment.

While this study did not involve any primary market research, a wealth of primary data is available for the Pacific Northwest region from NEEA and a recent customer saturation survey from Inland Power and Light, a neighboring utility. In addition, data were available from a residential survey conducted as part of Inland Power's December 2009 CPA. We used these sources together with other secondary data, including the Energy Information Agency's Residential Energy Consumption Survey (RECS), the Annual Energy Outlook (AEO), the California's Residential Appliance Saturation Survey (RASS), and the California Commercial End Use Survey (CEUS), to develop the market profiles.

In addition to information about annual electricity use, we also needed estimates of peak demand by segment and end use in order to calculate peak-demand savings from EE measures. We developed a set of peak factors, factors that represent the fraction of annual energy use that occurs during the peak hour, and apply them to annual electricity use to calculate peak demand by end use. Peak factors for this study were developed for each sector, customer segment and end use using Global's EnergyShape™ database and information from Avista regarding its load shapes and peak demand.[2]

Table 2-2 summarizes the data required for the market profiles. This information is required for each segment within each sector, as well as for new construction and existing dwellings/buildings. Additional details regarding sources appear in Appendix E.

Table 2-2 Data Needs for the Market Profiles

Model Inputs	Description	Key Sources
Base-year data		
Market size	Base-year residential dwellings and C&I floor space	Avista billing data, NEEA Reports
Appliance/equipment saturations	Fraction of dwellings with an appliance/technology; Percentage of C&I floor space with equipment/technology	NEAA reports, Inland Power & Light residential saturation survey, RECS, and other secondary data
UEC/EUI for each end-use technology	UEC: Annual electricity use for a technology in dwelling that have the technology; EUI: Annual electricity use per square foot for a technology in floor space that has the technology	NEAA reports, RASS, CEUS, engineering analysis, prototype simulations, engineering analysis
Appliance/equipment vintage distribution	Age distribution for each technology	NEEA reports, RASS, CEUS, secondary data (DEEM, EIA, EPRI, DEER, etc.)
Efficiency options for each technology	List of available efficiency options and annual energy use for each technology	Prototype simulations, engineering analysis, appliance/equipment standards, secondary data (DEEM, EIA, EPRI, DEER, etc.)
Peak factors	Share of technology energy use that occurs during the peak hour	Avista data; Global's EnergyShape database

The quality of data inputs is critical. To ensure the best results, we pursued the following course during the data-development process.

[2] The peak factors were used to compute peak demand savings only and they were not used to develop a stand-alone peak-demand forecast.

1. Used NEEA reports, the Inland Power & Light survey of its residential customers, and RECS to provide information about market size for customer segments, appliance and equipment saturations, appliance and equipment characteristics, UECs, building characteristics, customer behavior, operating characteristics, and energy-efficiency actions already taken.
2. Incorporated secondary data sources to supplement and corroborate the research in items 1 and 2 above.
3. Compared and cross-checked with data obtained as part of other northwest utility studies, the EPRI National Potential Study, and other regional sources.
4. Ensured calibration to control totals such as total usage values by segment, available through the billing data.
5. Worked with the Avista staff and the extended project team to vet the data against their knowledge and experience.

The market assessment, market segmentation, and resulting market profiles are presented in Chapter 3.

2.2 BASELINE FORECAST

The next step of the energy efficiency potential study was to develop the baseline forecast which is the metric against which savings from energy-efficiency measures are compared. The baseline case forecasts annual electricity use and peak demand by customer segment and end use under a "business as usual" (without new utility programs) scenario for the 20-year planning horizon starting in 2012. This process is crucial as it allows for projections to be determined in the absence of future conservation programs. This puts the changes in market conditions and customer potentials estimates in context of total energy use in the future and also allows us to project where the energy-efficiency savings will come from. The end-use forecast also includes the expected impacts of codes and standards, which affect what is possible through utility programs. Given the recent extensive attention to energy efficiency at the national level through Smart Grid and American Reinvestment and Recovery Act (ARRA) stimulus efforts and promulgated through the implementation of more stringent codes and standards both nationally and in local jurisdictions, we have taken steps in our modeling framework to capture the effects of market influences in our baseline forecast assessments. This is an important issue for this study, as the adoption of future codes and standards will have a direct bearing on how much utility program EE potential there can be over and above the effects of those efforts. This study includes standards in effect as of late 2010, which were not taken into account during the development of the Sixth Plan.

Inputs to the baseline forecast include:

- Current economic growth forecasts
- New construction forecasts
- Appliance and equipment standards
- Existing and approved changes to building codes and standards
- Forecasted changes in fuel share and equipment saturation
- The (future) effects of utility programs offered prior to 2010
- Avista's electricity price and sales forecasts

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 827 of 1069

2.2.1 Modeling Approach

We used the Load Management Analysis and Planning tool (LoadMAP™) to develop the baseline forecast, as well as forecasts of energy-efficiency potential. Global developed LoadMAP in 2007 and has used it for the EPRI National Potential Study and numerous utility-specific forecasting and potential studies. Built in Excel, the LoadMAP framework is both accessible and transparent and has the following key features.

- Embodies the basic principles of rigorous end-use models (such as EPRI's REEPS and COMMEND) but in a more simplified, accessible form.
- Includes stock-accounting algorithms that treat older, less efficient appliance/equipment stock separately from newer, more efficient equipment. Equipment is replaced according to the measure life defined by the user.
- Balances the competing needs of simplicity and robustness by incorporating important modeling details related to equipment saturations, efficiencies, vintage, and the like, where market data are available, and treats end uses separately to account for varying importance and availability of data resources.
- Isolates new construction from existing equipment and buildings and treats purchase decisions for new construction, replacement upon failure, early replacement, and non-owner acquisition separately.
- Uses a simple logic for appliance and equipment decisions. Other models available for this purpose embody complex decision choice algorithms or diffusion assumptions, and the model parameters tend to be difficult to estimate or observe and sometimes produce anomalous results that require calibration or even overriding. The LoadMAP approach allows the user to drive the appliance and equipment choices year by year directly in the model. This flexible approach allows users to import the results from diffusion models or to input individual assumptions. The framework also facilitates sensitivity analysis.
- Includes appliance and equipment models customized by end use. For example, the logic for lighting equipment is distinct from refrigerators and freezers.
- Can accommodate various levels of segmentation. Analysis can be performed at the sector level (e.g., total residential) or for customized segments within sectors (e.g., housing type or income level).

Consistent with the segmentation scheme and the market profiles we describe above, the LoadMAP model provides forecasts of baseline energy use by sector, segment, end use and technology for existing and new buildings. It provides forecasts of total energy use and energy-efficiency savings associated with the four types of potential. It also provides forecasts of peak-demand savings for each type of potential.[3]

Table 2-3 summarizes the LoadMAP model inputs required for the baseline forecast. These inputs are required for each segment within each sector, as well as for new construction and existing dwellings/buildings.

[3] The model computes a peak-demand forecast for each type of potential for each end use as an intermediate calculation. Peak-demand savings are calculated as the difference between the peak-demand value in the potential forecast (e.g., technical potential) and the peak-demand value in the baseline forecast.

Table 2-3 Data Needs for the Baseline Forecast and Potentials Estimation in LoadMAP

Model Inputs	Description	Key Sources
Customer growth forecasts	Forecasts of new construction in residential and C&I sectors	Avista 2009 IRP, Sixth Power Plan, Regional census data
Equipment purchase shares for baseline forecast	For each equipment/technology, purchase shares for each efficiency level; specified separately for equipment replacement (replace-on-burnout), non-owner acquisition, and new construction	Shipments data, AEO forecast assumptions, appliance/efficiency standards analysis
Electricity prices	Forecast of average electricity prices	Avista price forecast data
Utilization model parameters	Price elasticities, elasticities for other variables (income, weather)	EPRI's REEPS and COMMEND models; Avista forecasting data

We present the results of the baseline forecast development in Chapter 4. As with the development of the market profiles, we reviewed the baseline forecast results with the Avista staff.

2.3 ENERGY EFFICIENCY MEASURES ANALYSIS

The framework for assessing savings, costs, and other attributes of energy-efficiency measures involves identifying the list of measures to include in the analysis, determining their applicability to each market sector and segment, fully characterizing each measure, and performing cost-effectiveness screening. Potential measures include the replacement of a unit that has failed or is at the end of its useful life with an efficient unit, retrofit/early replacement of equipment, improvements to the building envelope and other actions resulting in improved energy efficiency, and the application of controls to optimize energy use.

We compiled a robust listing of energy efficiency measures for each customer sector, drawing upon a variety of secondary sources:

- The Sixth Power Plan database of EE measure costs and savings
- NEEA's Regional Technical Forum
- Database for Energy Efficient Resources (DEER). The California Energy Commission and California Public Utilities Commission (CPUC) sponsor this database, which is designed to provide well-documented estimates of energy and peak demand savings values, measure costs, and effective useful life (EUL) all with one data source for the state of California.
- Global's Database of Energy Efficiency Measures (DEEM). In 2004, Global prepared a database of energy efficiency measures for residential and commercial segments across the U.S. This is analogous to the DEER database developed for California. Global updates the database on a regular basis as it conducts new energy efficiency potential studies.
- EPRI National Potential Study (2009). In 2009, Global conducted an assessment of the national potential for energy efficiency, with estimates derived for the four DOE regions (including the Pacific region that includes California).

Based on this compilation of information, Global assembled a broad and inclusive universal list of EE measures, covering all major types of end-use equipment, as well as devices and actions to reduce energy consumption. If considered today, many of these measures would not pass the economic screens, but may ultimately be part of Avista's EE program portfolios.

Once we assembled the list of EE measures, the project team assessed their energy-saving characteristics. For energy-saving measures not already specified in the databases above, we used Global's Building Energy Simulation Tool (BEST), a derivative of the DOE 2.2 building simulation model, to estimate measure savings. We used building prototypes for the Northwest region to estimate energy savings.

For each measure we also characterized incremental cost, service life, and other performance factors. Following the measure characterization, we performed an economic screening of each measure, which serves as the basis for developing the economic potential.

We provide further descriptions of EE measures analysis and the economic screening process in Chapter 5.

2.4 ASSESSMENT OF ENERGY-EFFICIENCY POTENTIAL

A key objective of this study is to estimate the potential for energy savings through energy efficiency activities in the Avista electric service territory. The potential impact of EE activities is the cumulative total of all energy-related projects.

The approach we used for this study adheres to the approaches and conventions outlined in the National Action Plan for Energy-Efficiency (NAPEE) Guide for Conducting Potential Studies (November 2007).[4] The NAPEE Guide represents the most credible and comprehensive industry practice for specifying energy-efficiency potential. Specifically, four types of potentials were developed as part of this study.

Technical potential is calculated by applying the most efficient option commercially available to each purchase decision, regardless of cost. It is a theoretical case that provides the broadest and highest definition of savings potential since it quantifies the savings that would result if all current equipment, processes, and practices in all sectors of the market were replaced by the most efficient feasible type. Technical potential does not take into account the cost-effectiveness of the measures. Further, technical potential is specifically defined as "phase-in technical potential," which assumes that only the portion of the current stock of equipment that has reached the end of its useful life and is due for turnover is changed out by the most efficient measures available (i.e., replacement). Non-equipment measures, such as controls and other devices (e.g., programmable thermostats) are not adopted all at once but are phased-in over time, just like the equipment measures. Lighting retrofits, which are in effect early replacements of existing lighting systems, are considered a non-equipment measure.

Economic potential results from the purchase of the most efficient *cost-effective* option available for a given equipment or non-equipment measure. Cost effectiveness is determined by applying an economic test. In this report, the total resource cost (TRC) test[5] was used to assess the cost-effectiveness of individual measures. Measures that passed the economic screen were then represented in the aggregate for economic potential. As with technical potential, economic potential is a phased-in approach. Economic potential is still a hypothetical upper-boundary of savings potential as it represents only measures that are economic but does not yet consider customer acceptance and other factors.

Achievable potential refines the economic potential by taking into account penetration rates of efficient technologies, expected program participation, and customer preferences and likely behavior. Two types of achievable potential were evaluated for this study:

- ***Maximum achievable potential (MAP)*** establishes an upper boundary of potential savings a utility could achieve through its energy efficiency programs. MAP presumes incentives that are sufficient to ensure customer adoption. It also considers a maximum

[4] National Action Plan for Energy Efficiency (2007). *National Action Plan for Energy Efficiency Vision for 2025:* Developing a Framework for Change. www.epa.gov/eeactionplan.

[5] While there are other tests that can be used to represent the economic potential (e.g., Participant or Utility Cost), the TRC is generally seen as the most appropriate representation of economic potential since it tends to be most representative of the net benefits of energy efficiency to society as a whole. The TRC is used in the economic screen as a proxy for moving forward and representing achievable energy efficiency savings potential for those measures that are most widely cost-effective.

participation rate by customers for the various energy efficiency programs that are designed to deliver the various measures. For this study, we developed market acceptance rate (MAR) factors, based on the ramp rate curves used in the Sixth Power Plan. These MAR factors were then applied to this study's estimates of economic potential to estimate MAP.

- ***Realistic achievable potential (RAP)*** represents a lower boundary forecast of potentials resulting from likely customer behavior and penetration rates of efficient technologies. It uses a set of program implementation factors (PIFs) to take into account existing barriers that are likely to limit the amount of savings that might be achieved through energy efficiency programs. The RAP also takes into account recent utility experience and reported savings from past and present programs.

2.4.1 Modeling Approach

We used LoadMAP to develop the estimates of technical, economic, and achievable potential. LoadMAP calculates results in terms of annual energy saved (kWh) and peak demand reduction (MW) for each level of potential by market segment, end use, and measure type. Figure 2-2 illustrates the LoadMAP process for developing both the baseline forecast the potentials forecasts.

For the ***technical potential***, LoadMAP "chooses" the most efficient option for each purchase decision involving major end-use equipment (refrigerators, air conditioners) during the forecast period. It also phases in all non-equipment measures during the forecast period.

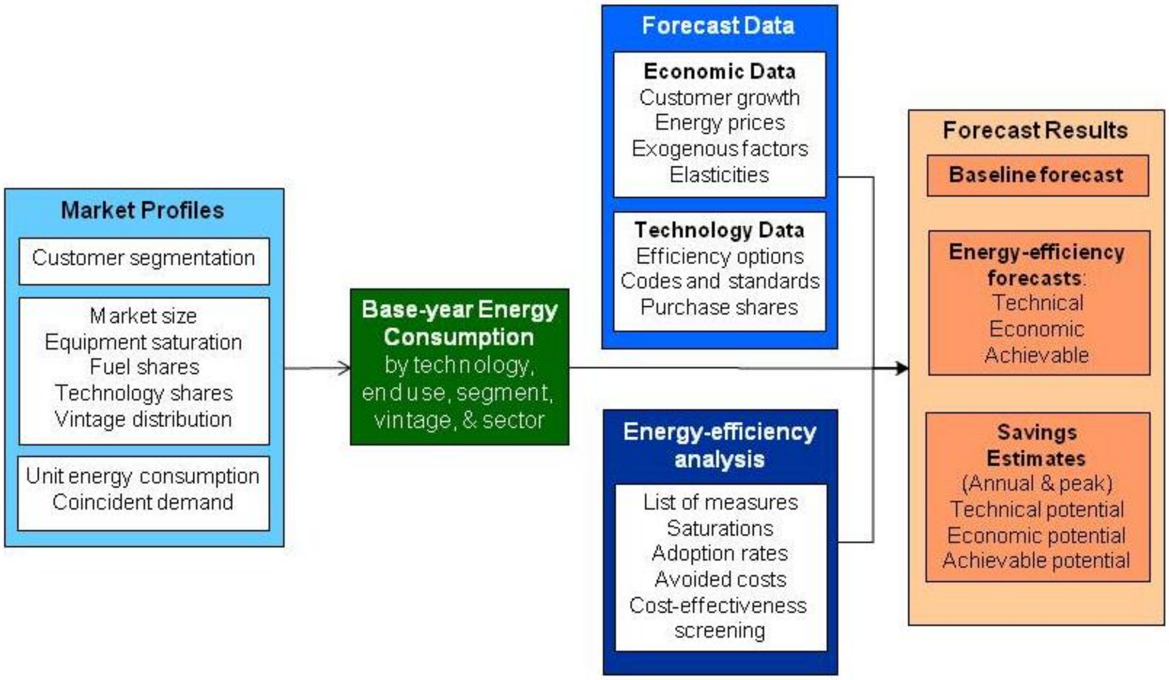
For the ***economic potential***, LoadMAP applies the TRC, which tests each measure in terms of its lifetime benefits (i.e., energy savings multiplied by the avoided cost) relative to the initial capital cost required to install the measure. If the benefit/cost ratio is greater than or equal to 1.0, then the measure passes the screen and it is included in the calculation of economic potential. If the B/C ratio is less than 1.0, the measure is screened out of economic potential. To allow for the changing characteristics of individual, new measures, we perform the economic screen during each year of the forecast period. Therefore, a measure than may not pass the screen in 2010 may pass in some future year. If more than one efficiency option passes the economic screen, for example if SEER 15 and SEER 16 both pass, then the most efficient option, SEER 16, is included in the calculation of economic potential.

Economic potential still does not take into account the acceptance of those measures by customers, so it is still a hypothetical upper-boundary of EE potential. But again, this exercise is important as it provides useful insights as to how much potential is economic and oftentimes can be compared with other studies of economic potential.

To develop estimates for ***maximum and realistic achievable potential***, we specify market adoption rates and program implementation factors for each measure as described above. For this study, we based these factors on the Sixth Power Plan's conservation curve ramp rates, and the past experience at Avista and at other utility EE programs. We also tapped into our recently completed market research for two EE potential studies in which we assessed customer acceptance rates taking into account some degree of financial intervention on the part of the utility to bring down customer paybacks to a level that motivates their participation in various EE programs. While there is a significant degree of uncertainty associated with these adoption rates, we believe that the approach is reasonable and is bounded by the experience gained from other utility EE efforts. Because the adoption rates are model inputs, they can be modified as new information becomes available.

The LoadMAP model provides a forecast of annual electricity use and peak demand under the four types of potential. The energy and peak-demand savings from energy efficiency measures are calculated as the difference between the values for the baseline forecast and the potential forecast.

Figure 2-2 LoadMAP Baseline and Potential Modeling



Results of the potentials assessment are presented in Chapter 6.

MARKET ASSESSMENT AND MARKET PROFILES

Avista Utilities, headquartered in Spokane, Washington is an investor-owned utility with annual revenues of more than $1.3 billion. Avista provides electric and natural gas service to about 481,000 customers in a service territory of more than 30,000 square miles. Avista uses a mix of hydro, natural gas, coal and biomass generation delivered over 2,100 miles of transmission line, 17,000 miles of distribution line, and 6,100 miles of natural gas distribution mains. Avista currently operates a portfolio of electric and natural gas conservation programs in Washington, Idaho, and Oregon for residential, low-income, and non-residential customers that is funded by a non-bypassable systems benefits charge.

The base year for this study is 2009, the most recent year for which complete billing data were available at the beginning of the study. Table 3-1 and Table 3-2 show the breakdown, for Washington and Idaho respectively, of 2009 electricity sales among the major sectors and rate classes, drawn from billing data provided by Avista. Peak demand data was taken from the 2009 *System Load Research Project* report.[6] Figure 3-1and Figure 3-2 show similar data, but with the Extra Large General Service customers (rate class 025) further divided into commercial and industrial. In Figure 3-2 for Idaho, Extra Large General Service also includes Potlatch, rate class 25P.

Table 3-1 Electricity Sales and Peak Demand by Rate Class, Washington 2009

Sector	Rate Schedule(s)	Number of meters (customers)	2009 Electricity sales (MWh)	Peak demand (MW)
Residential	001	200,134	2,451,687	710
General Service	011, 012	27,142	415,935	64
Large General Service	021, 022	3,352	1,556,929	232
Extra Large General Service	025	22	879,233	134
Pumping	031, 032	2,361	135,999	10
Total		**233,011**	**5,439,850**	**1,150**

Table 3-2 Electricity Use and Peak Demand by Rate Class, Idaho 2009

Sector	Rate Schedule(s)	Number of meters (customers)	2009 Electricity sales (MWh)	Peak demand (MW)
Residential	001	99,580	1,182,368	283
General Service	011, 012	19,245	322,570	61
Large General Service	021, 022	1,456	699,953	115
Extra Large General Service	025, 025P	10	266,044	40
Extra Large GS Potlatch	025P	1	892	101
Pumping	031, 032	1,312	58,885	4
Total		**121,604**	**3,422,111**	**603**

[6] Avista Corp. *System Load Research Project* report, March 2010, prepared by KEMA.

Figure 3-1 Electricity Sales by Rate Class, Washington 2009

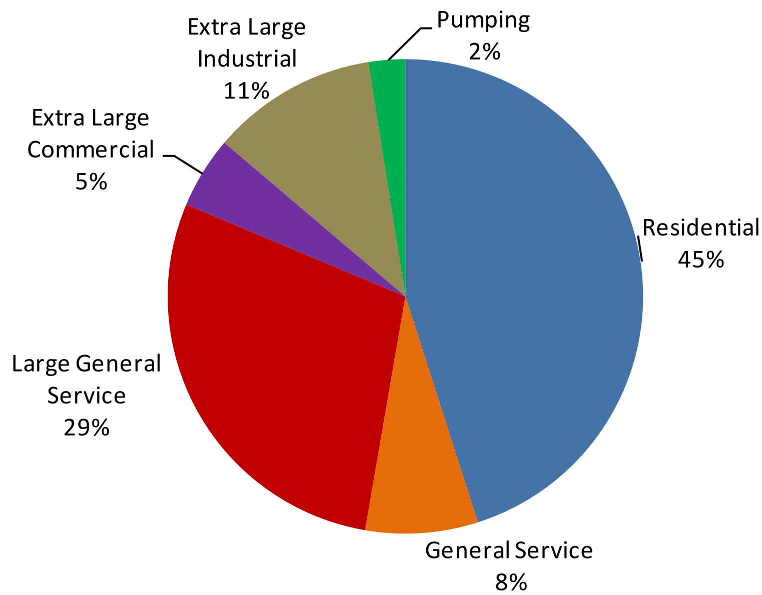
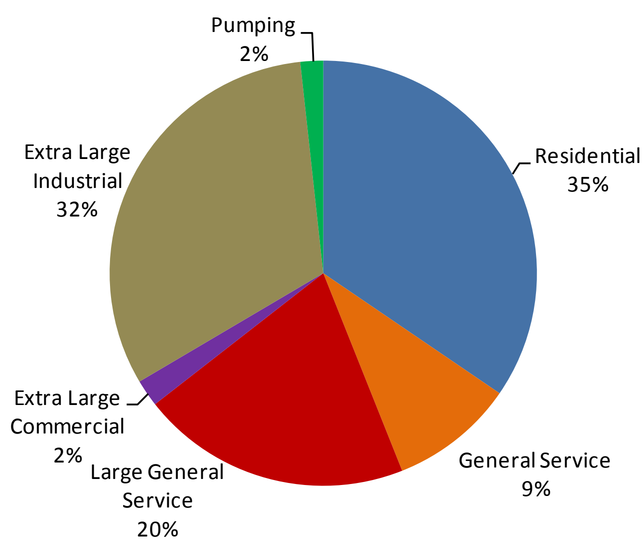


Figure 3-2 Electricity Sales by Rate Class, Idaho 2009



For this study, the project team decided not to explicitly model the EE potential for pumping customers but instead to use the Northwest Power and Conservation Council (NPCC) standard calculator to estimate EE potential. Results of that calculation appear in Chapter 6.

Below we discuss the market characterization and development of market profiles for the Residential and C&I sectors.

3.1 RESIDENTIAL SECTOR

This section characterizes the residential market at a high level, and then provides a profile of how customers in each residential segment use electricity by end use.

3.1.1 Market Characterization

The total number of residential customers was 200,134 in Washington and 99,579 in Idaho, based on the average number of rate class 001 monthly customers for 2009 provided by Avista.[7] We segmented these customers into four groups based on housing type and level of income: single family, multi family, mobile home, and limited income. The single family segment includes single-family detached homes, townhouses, and duplexes or row houses. The multi family segment includes apartments or condos in buildings with more than two units. The limited income segment is composed of all three housing types: single-family homes, multi-family homes, and mobile homes.

Because Avista does not maintain information on housing type or income level, we relied on a variety of survey and demographic sources for segmenting the residential market, including the U.S. Census American Community Survey 2006-2008, a 2009 Inland Power customer survey, and other sources (see Appendix E). Avista defines the limited-income category as those customers with annual income less than or equal to two times the poverty level. For an average household size of 2.5 persons, two times the poverty level is $32,880. For the purpose of our analysis, we used a slightly higher income level cutoff of $35,000 to define this segment, which allowed us to take advantage of the data sources listed above.

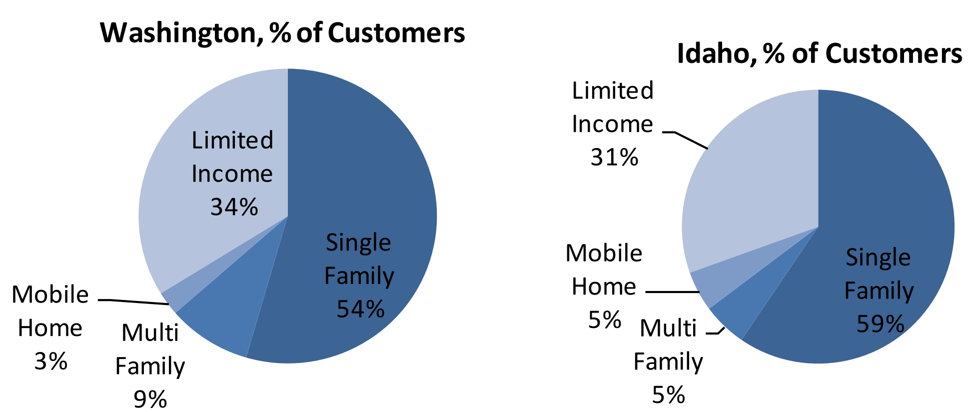
The resulting residential customer allocation by segment appears in Table 3-3 and in Figure 3-3.

Table 3-3 Residential Sector Allocation by Segments

	Washington		Idaho	
Segment	**Allocation of Customers**	**% of Total**	**Allocation of Customers**	**% of Total**
Single Family	109,134	54%	59,205	59%
Multi Family	18,219	9%	5,237	5%
Mobile Home	5,248	3%	4,774	5%
Limited Income	67,533	34%	30,363	31%
Total	**200,134**	100%	**99,579**	**100%**

Note: Minor difference with Idaho residential customer total 99,580 Table 3-2 due to calibration.

Figure 3-3 Residential Sector Allocation by Segments, Percentage of Customers



[7] Rate classes 12 and 22, although they include homes, are included with rates classes 11 and 21 respectively, which corresponds with how customer classes were combined for Avista's *System Load Research Project* report.

Next, to determine the residential whole building energy intensity (kWh/household) by segment, we drew upon data from the Energy Information Agency, a NEEA residential billing analysis report, and the Inland Power & Light 2009 Conservation Potential Assessment. Based on these sources, we developed the segment level energy intensities shown in Table 3-4. The selected energy intensity values multiplied by the number of households equal the annual sales for each segment. These values sum to the total annual energy use for the residential sector in each state. Figure 3-4 presents the resulting energy sales by segment. The single-family segment used just over half the total residential sector electricity in 2009.

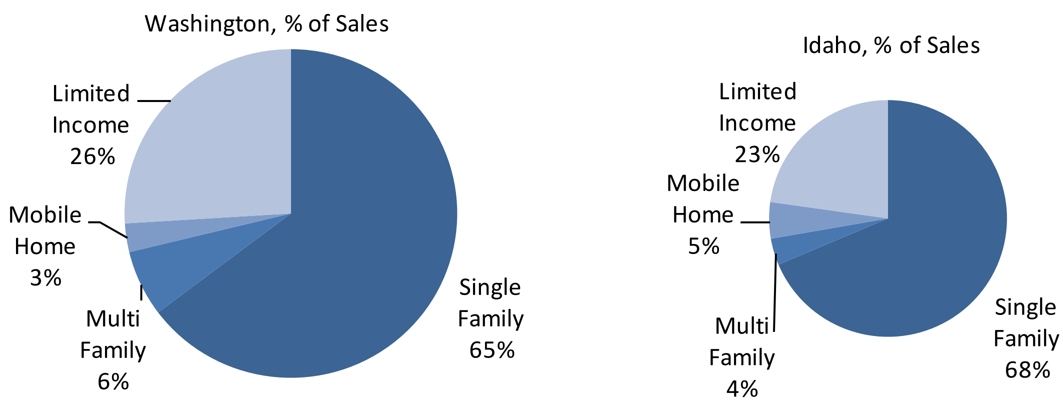
Table 3-4 Residential Electricity Usage and Intensity by Segment and State, 2009

Washington Segment	Intensity (kWh/Household)	Number of Customers	% of Customers	2009 Electricity Sales (MWh)	% of Sales
Single Family	14,547	109,134	54%	1,587,572	65%
Multi-Family	8,728	18,219	9%	159,019	6%
Mobile Home	13,092	5,248	3%	68,708	3%
Limited Income	9,424	67,533	34%	636,407	26%
Total	**12,250**	**200,134**	**100%**	**2,451,707**	**100%**

Idaho Segment	Intensity (kWh/Household)	Number of Customers	% of Customers	2009 Electricity Sales (MWh)	% of Sales
Single Family	13,703	59,205	59%	811,302	69%
Multi-Family	8,213	5,237	5%	43,013	4%
Mobile Home	12,320	4,774	5%	58,815	5%
Limited Income	8,868	30,363	31%	269,249	23%
Total	**11,874**	**99,580**	**100%**	**1,182,379**	**100%**

Note: Minor differences with totals in Table 3-1 and Table 3-2 due to calibration.

Figure 3-4 Residential Electricity Use by Customer Segment, Percentage of Sales 2009



3.1.2 Residential Market Profiles

As we describe in the previous chapter, the market profiles provide the foundation upon which we develop the baseline forecast. For each segment, we created a market profile, which includes the following elements:

- ***Market size*** represents the number of customers in the segment
- ***Saturations*** embody the fraction of homes with the electric technologies. (e.g., homes with electric space heating). We developed these using a combination of survey data from sources including Inland Power & Light, NEEA, and Puget Sound Energy (PSE). The results were cross-checked and validated against various other secondary sources.
- ***UEC (unit energy consumption)*** describes the amount of electricity consumed in 2009 by a specific technology in homes that have the technology (in kWh/household). As above, we used data from Inland Power & Light, NEEA, and PSE. We also used data from various utility potential studies that Global has recently completed. As needed, some minor adjustments were made to calibrate to whole-building intensities.
- ***Intensity*** represents the average use for the technology across all homes in 2009. It is computed as the product of the saturation and the UEC and is defined as kWh/household.
- ***Usage*** is the annual electricity use by a technology/end use in the segment. It is the product of the number of households and intensity and is quantified in GWh.

Table 3-5 presents the average existing home market profile for the entire Avista residential sector. The table shows data captured directly from LoadMAP. Values in red are inputs to LoadMAP. The existing-home profile represents all the housing stock in the Avista service area in 2009. Market profiles for each of the residential segments in Washington and Idaho respectively appear in Appendix A and B.

Figure 3-5 presents the end-use breakout for the residential sector as a whole. The appliance end use accounts for the largest share of the usage, closely followed by space heating, with water heating the third largest end use. The miscellaneous end use includes such devices as furnace fans, pool pumps, and other "plug" loads (hair dryers, power tools, coffee makers, etc.). Interior and exterior lighting combined account for 12% of electricity use in 2009. The electronics end use, which includes personal computers, televisions, home audio, video game consoles, etc., also contributes significantly to household electricity usage. Cooling and combined heating and cooling through heat pumps make up the remainder.

Figure 3-5 Residential Electricity Use by End Use per Household, 2009 (kWh and %)

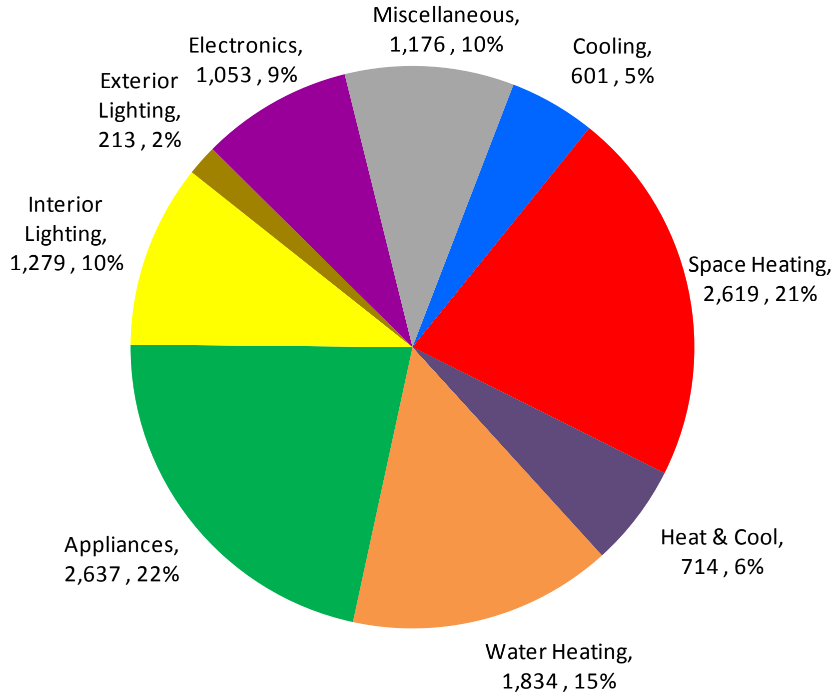


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 839 of 1069

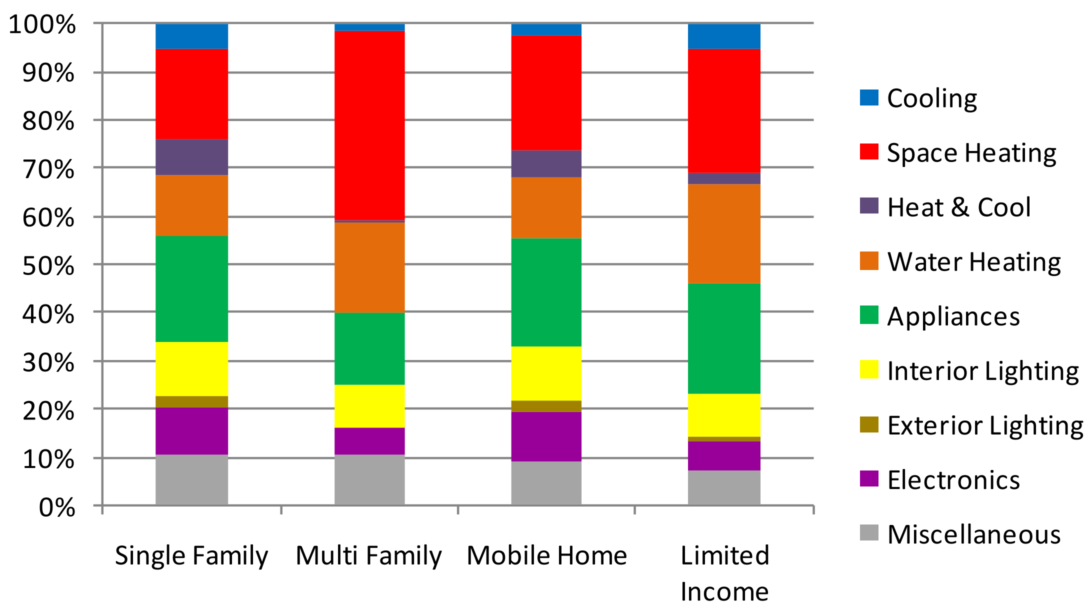
Table 3-5 Average Residential Sector Market Profile

Average Market Profile - Residential Sector

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	29%	1,613	470	141
Cooling	Room AC	20%	643	131	39
Combined Heating/Cooling	Air Source Heat Pump	14%	5,051	699	209
Combined Heating/Cooling	Geothermal Heat Pump	0%	3,715	15	4
Space Heating	Electric Resistance	18%	6,114	1,119	335
Space Heating	Electric Furnace	22%	6,779	1,492	447
Space Heating	Supplemental	9%	83	8	2
Water Heating	Water Heater	66%	2,796	1,834	550
Interior Lighting	Screw-in	100%	1,144	1,144	343
Interior Lighting	Linear Fluorescent	66%	121	80	24
Interior Lighting	Pin-based	92%	59	55	16
Exterior Lighting	Screw-in	70%	301	211	63
Exterior Lighting	High Intensity/Flood	2%	116	2	1
Appliances	Clothes Washer	84%	105	88	26
Appliances	Clothes Dryer	80%	621	498	149
Appliances	Dishwasher	86%	185	160	48
Appliances	Refrigerator	100%	746	746	224
Appliances	Freezer	62%	760	474	142
Appliances	Second Refrigerator	35%	787	277	83
Appliances	Stove	86%	299	257	77
Appliances	Microwave	95%	144	137	41
Electronics	Personal Computers	121%	263	317	95
Electronics	TVs	222%	311	688	206
Electronics	Devices and Gadgets	100%	48	48	14
Miscellaneous	Pool Pump	10%	1,328	130	39
Miscellaneous	Furnace Fan	26%	404	107	32
Miscellaneous	Miscellaneous	100%	940	940	282
Total				**12,125**	**3,634**

Figure 3-6 presents the end-use shares of total electricity use for each housing type. Space heating is the largest single use in all housing types except single family homes where it is lower relative to other uses. Appliances are the largest energy consumer in the single family segment and are a significant energy use in the other segments as well.

Figure 3-6 End-Use Shares of Total Electricity Use by Housing Type, 2009



3.2 COMMERCIAL AND INDUSTRIAL SECTORS

The approach we used for the C&I sectors is analogous to the residential sector. It begins with segmentation, then defines market size and annual electricity use, and concludes with market profiles.

3.2.1 C&I Market Characterization

We developed the non-residential energy use by segment using Avista 2009 billing data by rate class. Table 3-6 and Table 3-7 present the results for the market characterization for Washington and Idaho respectively. Although the General Service 011 and Large General Service 021 rate classes include a small percentage of industrial customers, we chose to model these as primarily commercial building types. For the General Service segment, we assumed facilities were small to medium buildings, dominated by retail facilities. For the Large General Service segment, we assumed the typical facility was an office building. When developing the market profiles, as further described below, we began with these assumed prototypical building types, but adjusted them to account for the diversity in each segment. For the Extra Large General Service rate class 025, we divided customers into separate commercial and industrial segments and included the Potlatch facility, Idaho rate class 025P, with the other Idaho Extra Large industrial customers. This grouping enabled better modeling of the industrial customers.

We then used data from NEEA, the California Commercial End Use Study (CEUS), and other recently completed studies to develop estimates of floor space and annual intensities (in kWh/square foot) for each segment. Because of the heterogeneous nature of the C&I sectors and the wide variation in customer size (compared to residential homes), floor space is used as the unit of measure to quantify energy use and equipment inventories on a per-square-foot basis. Note that we are not concerned with absolute square footage, as the purpose of this study is not to estimate C&I floor space, but with the relative size of each segment and its growth over time.

Table 3-6 Commercial Sector Market Characterization Results, Washington 2009

Avista Rate Schedule		LoadMAP Segment and Typical Building	Electricity sales (MWh)	Intensity (kWh/sq.ft.)
General Service	011, 012	Small and Medium Commercial — Retail	415,935	17.5
Large General Service	021, 022	Large Commercial — Office	1,556,929	16.7
Extra Large General Service Commercial	025C	Extra Large Commercial — University	265,686	13.9
Extra Large General Service Industrial	025I	Extra Large Industrial	613,615	40.0
Total			**2,852,165**	

Table 3-7 Commercial Sector Market Characterization Results, Idaho 2009

Avista Rate Schedule		LoadMAP Segment and Typical Building	Electricity sales (MWh)	Intensity (kWh/sq.ft.)
General Service	011, 012	Small and Medium Commercial — Retail	322,570	17.5
Large General Service	021, 022	Large Commercial — Office	699,953	16.7
Extra Large General Service Commercial	025C	Extra Large Commercial — University	70,361	13.9
Extra Large General Service Industrial	025I, 025P	Extra Large Industrial	1,087,974	40.0
Total			**2,180,858**	

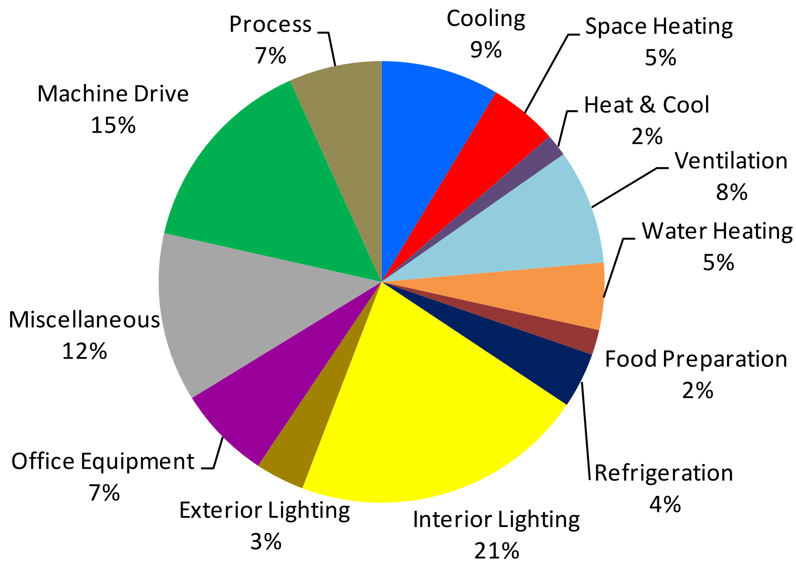
3.2.2 C&I Market Profiles

For the C&I sector, the approach we used to develop market profiles is similar to what we described above for residential.

- ***Saturations*** are the percentage of floor space with each electric end use. For space heating, cooling and water heating, this embodies the electric fuel share. For space heating and cooling, it also embodies the fraction of conditioned space. The saturation values for each end use are from NEEA reports, supplemented with other secondary sources to develop the technology-level saturations. For the industrial segments, we drew upon U.S. Industrial Electric Motor Systems Market Opportunities Assessment from the US Department of Energy (US DOE) and the EIA Annual Energy Outlook.
- ***EUIs (end-use indices)*** represent the amount of electricity used per square foot of floor space in buildings where the equipment is present. Data from NEEA. US DOE, EIA, and other secondary sources provided EUIs by end use. We developed the technology-level EUIs using our engineering model BEST and other secondary sources. Finally, we adjusted the EUIs to calibrate to Avista's overall building type intensity.
- ***Intensity*** is the average use across all floor space (computed as the product of saturation and EUI). For the industrial sector, we calibrate
- ***Annual use*** is the total consumption in 2009 for each end use (computed as the product of the intensity and the floor space for the segment.

Figure 3-7 shows the breakdown of annual electricity usage by end use for the C&I sector as a whole. Lighting is the largest single end use in the sector, accounting for one fifth of total usage.

Figure 3-7 Commercial and Industrial Electricity Consumption by End Use, 2009



This information is further detailed in Figure 3-8, which shows the end-use breakdown for the composite of the three commercial segments — Small/Medium, Large, and Extra Large — and Figure 3-9, which shows similar information for the Extra Large Industrial segment.

Observations include the following:

- Commercial buildings
  - Lighting is the largest single energy use across all of the commercial buildings, accounting for 29% of energy use.
  - Space conditioning, including heating, cooling, and ventilation, is close behind with 27% of energy use.
  - Miscellaneous and office equipment are the next largest energy uses.
  - Water heating, refrigeration, and food preparation are only a small portion of energy use in the commercial sector overall, though they are more significant in specific building types (supermarkets, restaurants, hospitals, lodging).
- Extra Large Industrial facilities
  - Machine drive and process loads dominate in this segment, together accounting for 65% of energy use.
  - HVAC and interior lighting consume 17% and 6% of energy respectively.

Figure 3-8 Commercial End Use Consumption, 2009

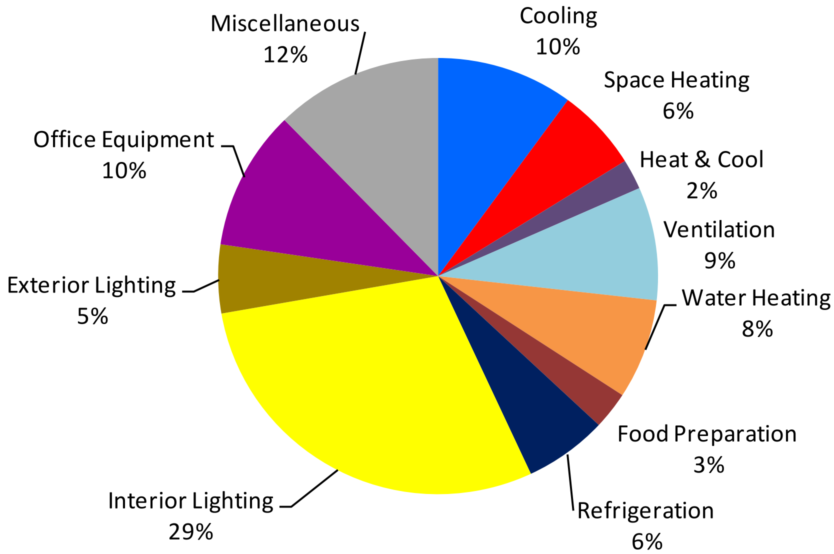


Figure 3-9 Extra Large Industrial End Use Consumption, 2009

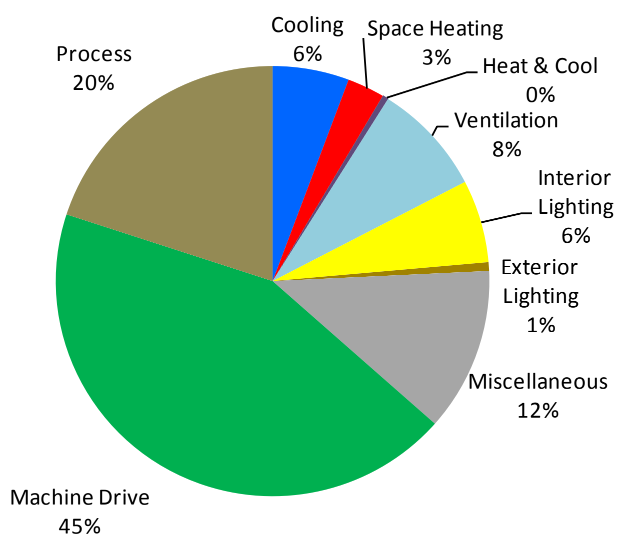


Table 3-8 shows an example commercial average base year market profile, in this case for the Washington Small/Medium Commercial Segment. The table show data captured from LoadMAP, where values shown in red are inputs to the model. The market profiles for each of the Washington and Idaho C&I segments are shown in Appendices A and B respectively.

Table 3-8 Small/Medium Commercial Segment Market Profile, Washington, 2009

Average Market Profiles

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)
Cooling	Central Chiller	13.8%	2.39	0.33	8
Cooling	RTU	63.1%	2.46	1.55	37
Cooling	PTAC	3.3%	2.44	0.08	2
Combined Heating/Cooling	Heat Pump	3.6%	6.19	0.22	5
Space Heating	Electric Resistance	5.9%	6.72	0.39	9
Space Heating	Furnace	17.7%	7.05	1.25	30
Ventilation	Ventilation	76.9%	2.09	1.61	38
Interior Lighting	Interior Screw-in	100.0%	1.00	1.00	24
Interior Lighting	HID	100.0%	0.68	0.68	16
Interior Lighting	Linear Fluorescent	100.0%	3.37	3.37	80
Exterior Lighting	Exterior Screw-in	82.6%	0.20	0.16	4
Exterior Lighting	HID	82.6%	0.76	0.63	15
Exterior Lighting	Linear Fluorescent	82.6%	0.16	0.13	3
Water Heating	Water Heater	63.0%	2.00	1.26	30
Food Preparation	Fryer	25.8%	0.16	0.04	1
Food Preparation	Oven	25.8%	0.98	0.25	6
Food Preparation	Dishwasher	25.8%	0.06	0.01	0
Food Preparation	Hot Food Container	25.8%	0.31	0.08	2
Food Preparation	Food Prep	25.8%	0.01	0.00	0
Refrigeration	Walk in Refrigeration	0.0%	-	-	-
Refrigeration	Glass Door Display	52.4%	0.45	0.23	6
Refrigeration	Solid Door Refrigerator	52.4%	0.50	0.26	6
Refrigeration	Open Display Case	52.4%	0.04	0.02	1
Refrigeration	Vending Machine	52.4%	0.30	0.16	4
Refrigeration	Icemaker	52.4%	0.34	0.18	4
Office Equipment	Desktop Computer	99.9%	0.48	0.48	11
Office Equipment	Laptop Computer	99.9%	0.06	0.06	1
Office Equipment	Server	99.9%	0.36	0.36	9
Office Equipment	Monitor	99.9%	0.25	0.25	6
Office Equipment	Printer/copier/fax	99.9%	0.24	0.24	6
Office Equipment	POS Terminal	99.9%	0.27	0.27	7
Miscellaneous	Non-HVAC Motor	40.2%	1.22	0.49	12
Miscellaneous	Other Miscellaneous	100.0%	1.43	1.43	34
Total				**17.50**	**416**

BASELINE FORECAST

Prior to developing estimates of energy-efficiency potential, a baseline end-use forecast was prepared to quantify how electricity is used by end use in the base year and what electricity is likely to be in the future in absence of new utility programs. The baseline forecast serves as the metric against which energy-efficiency potentials — technical, economic, and achievable — are compared.

4.1 RESIDENTIAL SECTOR

4.1.1 Residential Baseline Forecast Drivers

In general, the baseline forecast incorporates assumptions about economic growth, electricity prices, appliance/equipment standards and building codes already mandated, and naturally occurring conservation. The key inputs we used to develop the forecast for Avista include:

- Customer growth: provided by Avista through 2015, and rate of growth assumed constant thereafter
- Forecasts of electricity prices: provided by Avista through 2015, with rate of increases thereafter based on the Annual Energy Outlook (AEO)
- Forecasts of household size: from Census data and the 6th Plan
- Forecast of income: from Washington state data
- Trends in end-use/technology saturations: developed from the AEO
- Equipment purchase decisions: developed from AEO

Table 4-1 presents the assumptions used in the forecast regarding market size growth, household size, median household income, and electricity prices. The market size growth rate was applied equally to each of the four segments.

Table 4-1 Residential Market Size Forecast (number of households)

Driver	2009	2012	2017	2022	2027	2032	Average Growth (%/yr)
Market Size WA (number of households)	200,134	204,530	217,921	232,414	247,871	264,356	1.21%
Market Size ID (number of households)	99,579	102,077	108,592	115,553	122,960	130,842	1.19%
Persons per household	2.50	2.50	2.50	2.50	2.50	2.50	–
Electricity price WA (cents per kWh)	$0.0721	$0.0796	$0.0804	$0.0825	$0.0845	$0.0867	0.80%
Electricity price ID (cents per kWh)	$0.0742	$0.0855	$0.0876	$0.0898	$0.0921	$0.0944	1.05%
Per capita income ($ real, 2000)	$34,506	$35,787	$39,202	$43,623	$48,400	$53,700	1.92%

In addition to forecasts for household size, electricity price, and median household income, the model also requires elasticities for these variables. The elasticities for prices and persons per household are based on the REEPS model developed by the Electric Power Research Institute (EPRI). The income elasticity was provided by Avista. The values are as follows:

- –0.151 for electricity prices
- 0.75 for income for all end uses except for appliances, where we use 0.375
- 0.20 for persons per household

In addition, we implemented the following assumptions for the residential sector[8]:

- In 2006, a Federal standard for central air conditioners and heat pumps went into effect, requiring all newly manufactured air conditioners and heat pumps to meet SEER 13 or better. This standard applies to replace-upon-burnout in existing construction and new construction. In 2016, the standard becomes SEER 14[9].
- In April 2010, DOE released updated water heater standards that go into effect April 16, 2015. The new standard for water heaters with volume at or below 55 gallons requires an energy factor (EF) equal to 0.96 minus 0.0003 times the rated storage volume in gallons.
- DOE is scheduled to make a final ruling on refrigerator and freezer standards on December 31, 2010. We incorporated this anticipated ruling into the forecast and assumed that refrigeration and freezer consumption will decrease by 20% in 2014[10]. This forecast does not include anticipated standards for room air conditioners, clothes washers, clothes dryers and dishwashers because DOE rulings on the standards have not yet been set.
- Residential lighting is affected by the passage of the Energy Independence and Security Act (EISA) in 2007, which mandates higher efficacies for lighting technologies starting in 2012. Several lighting technologies are anticipated to meet this standard when it goes into effect, including compact fluorescent lamps (CFL) and white light-emitting diodes (LED). As a result, the share of incandescent lamps decreases while CFL and LED purchases increase. CFLs dominate over the forecast period, but LEDs account for about 20% of purchases by 2020.
- In November 2008, ENERGY STAR 3.0 for color televisions went into effect. This standard sets the rules for becoming ENERGY STAR qualified. One such criterion is that TVs must not exceed 1 watt of power in standby mode.

4.1.2 Residential Baseline Forecast Results

Overall, residential use in both states and for all segments increases from 3,634,054 MWh in 2009 to 5,600,870 MWh in 2032, an average annual growth rate of 1.9%. This is slightly higher than the 1.5% annual growth rate in Avista's 2009 IRP for the period 2009 through 2030. Because the IRP forecast includes future conservation activities and LoadMAP's baseline forecast does not, we would generally expect LoadMAP's baseline forecast to be somewhat higher. This increase is also more than double the AEO forecast of 0.8% average growth.

[8] These assumptions reflect standards in effect as of late 2010 or scheduled to take effect over the course of the 20-year study period. Because some of these standards were not yet announced when the NWPCC Sixth Plan was developed, this study's baseline incorporates reduced baseline energy usage compared with the Sixth Plan.

[9] This assumption was included in the 2010 Annual Energy Outlook (AEO) forecast. The SEER 14 standard level used in the AEO forecast was established in a 2009 consensus agreement made between equipment manufacturers and energy efficiency advocacy organizations. DOE is required to publish the final rule on central air conditioners and heat pump standards in 2011.

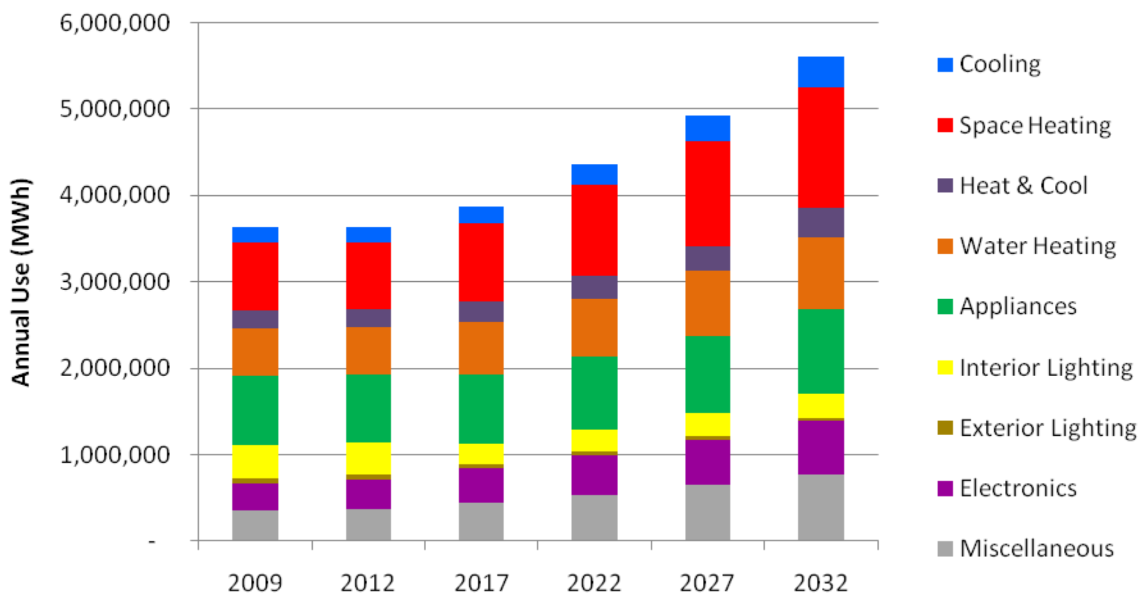
[10] This level is consistent with the standard recently agreed upon in a joint proposal by home appliance manufacturers and energy efficiency advocates which states that refrigeration and freezer consumption must decrease by 20-30% effective in 2014.

General observations about this forecast include the following:

- Overall, household growth is robust, with a nearly 32% increase between 2009 and 2032. The AEO forecast is somewhat lower, with a 26% increase in the number of households.
- The factors that impact usage — relatively low electricity prices and strong income growth — result in strong residential consumption growth over the forecast period.
- New homes are larger than existing homes, based on data from the AEO and other studies. However, equipment and appliances are more efficient, so the combined effect is slightly positive.

Figure 4-1 presents the baseline forecast at the end-use level for the residential sector as a whole, in both Washington and Idaho.

Figure 4-1 Residential Baseline Forecast by End Use



End-use specific observations include:

- The drop in all space conditioning loads from 2009 to 2012 is due to the transition from actual weather in 2009 (589 cooling degree days and 6,976 heating degree days) to the normal weather forecast (434 cooling degree days and 6,657 heating degree days) thereafter.
- Cooling grows due to increasing saturation of central air conditioning in new homes and larger home sizes, as well as the addition of central air conditioning to existing homes.
- Space heating, combined heating and cooling, and water heating grow, but at a slightly moderate rate compared to cooling, again due to the growth in households and to larger home sizes.
- Beginning in 2012, the federal lighting standards cause a decline in electricity for interior lighting use of 29% and exterior lighting use by 41% over the forecast period. The AEO 2010 forecast projects a 26% decline in lighting energy use over the same period. The AEO reduction is less than that shown here, again due to increasing home size.
- Appliances decrease, reflecting efficiency gains, particularly in the refrigeration appliances due to standards that offset the small increases in saturations of dishwashers, clothes washers, and clothes dryers.

- Growth in electricity use in electronics is strong and reflects an increase in the saturation of electronics and the trend toward higher-powered computers and larger televisions.
- Growth in miscellaneous use is also substantial. This has been a long-term trend and we incorporate growth assumptions that are consistent with the AEO.

Figure 4-2 presents the forecast of use per household. Most noticeable is that lighting use decreases significantly after 2010, as the lighting standard from EISA comes into effect and as LED lamps begin to gain traction in the later years of the forecast. Appliance use also decreases over the forecast period due to appliance standards. Use in electronics and miscellaneous increase over the forecast period, reflecting the trend that households continue to add various electronics to the home.

Figure 4-2 Residential Baseline Electricity Use per Household by End Use

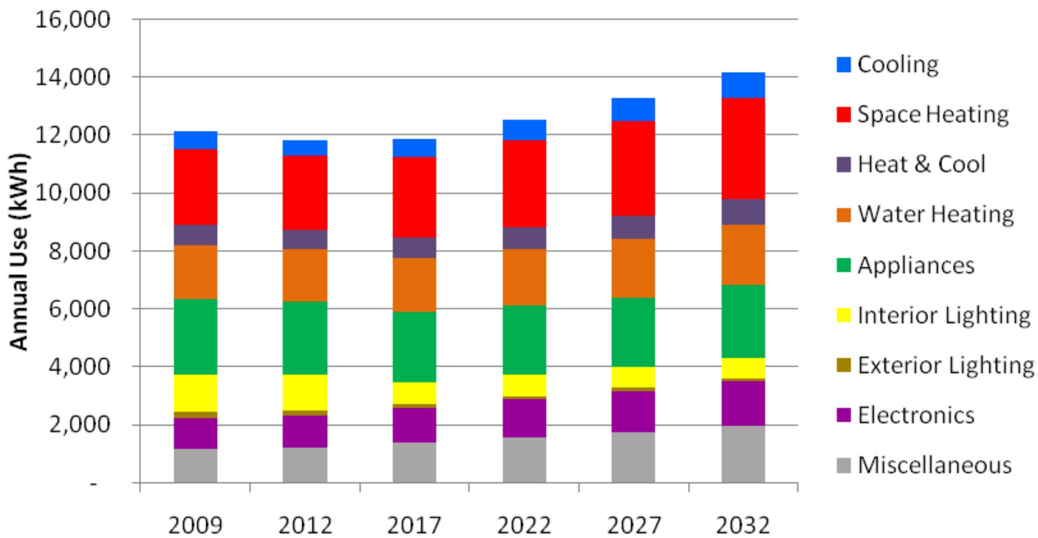


Table 4-2 shows the forecast by end use, while Table 4-3 provides additional detail by technology within each end use. Central AC increases during the forecast as more households add air conditioning. Screw-in lighting decreases as a result of the EISA lighting standard. Over the forecast period there is strong growth in usage from electronics due to the increase in saturation.

Table 4-2 Residential Baseline Forecast Electricity Consumption by End Use (MWh)

End Use	2009	2012	2017	2022	2027	2032	% Change ('09–'32)	Avg. growth rate
Cooling	180,022	164,865	197,394	239,439	292,044	355,171	97%	3.0%
Space Heating	784,854	783,258	906,261	1,051,822	1,210,093	1,383,665	76%	2.5%
Heat & Cool	213,860	201,410	229,160	258,676	295,177	341,644	60%	2.0%
Water Heating	549,606	557,022	611,950	675,037	748,494	830,988	51%	1.8%
Interior Lighting	790,377	776,482	795,594	835,023	894,245	989,025	25%	1.0%
Exterior Lighting	383,305	371,610	246,575	256,864	262,823	271,374	-29%	-1.5%
Appliances	63,864	61,321	41,763	39,795	38,430	37,735	-41%	-2.3%
Electronics	315,599	336,152	394,727	459,538	529,485	616,688	95%	2.9%
Miscellaneous	352,599	374,575	447,870	540,047	648,055	774,496	120%	3.4%
Total	**180,022**	**164,865**	**197,394**	**239,439**	**292,044**	**355,171**	**54%**	**1.9%**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 850 of 1069

Table 4-3 Residential Baseline Electricity Forecast by End Use and Technology (MWh)

End Use	Technology	2009	2012	2017	2022	2027	2032	% Change ('09–'32)	Avg. Growth Rate
Cooling	Central AC	140,731	130,669	161,085	199,996	249,120	308,429	119%	3.4%
	Room AC	39,291	34,196	36,310	39,443	42,924	46,742	19%	0.8%
Space Heating	Electric Furnace	447,317	447,255	520,409	606,695	700,178	801,899	79%	2.5%
	Electric Resistance	335,280	333,732	383,172	441,947	506,164	577,358	72%	2.4%
	Supplemental	2,257	2,272	2,680	3,180	3,750	4,409	95%	2.9%
Heat & Cool	Air Source Heat Pump	209,371	197,111	224,050	252,476	287,663	332,619	59%	2.0%
	Geothermal Heat Pump	4,489	4,299	5,109	6,200	7,514	9,025	101%	3.0%
Water Heating	Water Heater	549,606	557,022	611,950	675,037	748,494	830,988	51%	1.8%
Appliances	Refrigerator	223,654	213,517	204,566	204,184	209,933	231,329	3%	0.1%
	Freezer	141,950	137,910	137,084	136,274	143,528	158,560	12%	0.5%
	Second Refrigerator	83,117	77,296	72,374	70,707	69,137	73,789	-11%	-0.5%
	Clothes Washer	26,332	26,102	27,746	30,875	34,868	39,019	48%	1.7%
	Clothes Dryer	149,267	150,677	163,829	180,582	199,465	221,428	48%	1.7%
	Dishwasher	47,886	48,894	54,242	60,691	68,105	76,321	59%	2.0%
	Stove	77,079	79,792	89,107	99,966	111,884	125,081	62%	2.1%
	Microwave	41,092	42,294	46,647	51,744	57,325	63,498	55%	1.9%
Interior Lighting	Screw-in	342,923	329,329	198,253	200,264	196,856	194,811	-43%	-2.5%
	Linear Fluorescent	24,025	25,171	29,266	34,273	39,944	46,451	93%	2.9%
	Pin-based	16,358	17,110	19,056	22,326	26,023	30,112	84%	2.7%
Exterior Lighting	Screw-in	63,165	60,629	41,255	39,254	37,834	37,069	-41%	-2.3%
	High Intensity/Flood	698	692	508	540	596	666	-5%	-0.2%
Electronics	Personal Computers	94,922	101,516	120,451	143,627	170,677	202,632	113%	3.3%
	TVs	206,326	219,527	256,515	294,816	333,825	384,485	86%	2.7%
	Devices and Gadgets	14,351	15,110	17,761	21,095	24,983	29,572	106%	3.1%
Miscellaneous	Furnace Fan	32,029	33,795	39,817	47,004	54,841	63,046	97%	2.9%
	Pool Pump	38,852	39,438	44,334	51,331	59,964	69,728	79%	2.5%
	Miscellaneous	281,718	301,342	363,719	441,712	533,250	641,722	128%	3.6%
Grand Total		**3,634,086**	**3,626,696**	**3,871,294**	**4,356,240**	**4,918,847**	**5,600,787**	**54%**	**1.9%**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 851 of 1069

4.2 COMMERCIAL AND INDUSTRIAL SECTOR

4.2.1 C&I Baseline Forecast Drivers

As is the case with the residential sector, the C&I baseline forecast incorporates assumptions about economic growth, electricity prices, equipment standards and building codes already mandated, and naturally occurring conservation. The key inputs we used to develop the forecast for Avista include:

- Floor space growth for Commercial segments derived from Avista customer and load growth projections through 2015 and from Avista IRP projections regarding expansion of existing Extra Large Customer facilities; after 2015 assumed constant growth rate of 2% based on Avista IRP[11]
- Floor space growth for Extra Large Industrial segment derived from Avista customer and load growth projections through 2015; thereafter based on based on employment growth of 2.8% in Washington and 1.4% in Idaho[12]
- Forecasts of electricity prices provided by Avista through 2015, with rate of increases thereafter based on the Annual Energy Outlook (AEO)
- Trends in end-use/technology saturations developed from the AEO
- Equipment purchase decisions developed from AEO[13]

Table 4-4 presents the growth and electricity price assumptions used in the C&I forecast. Market size growth is shown as an indexed value where 2009 equals 1.0

Table 4-4 Commercial Market Size Growth and Electricity Price Forecast

Indexed Market Size 2009 = 1.0	2009	2012	2017	2022	2027	2032	Avg. Growth (%/yr)
Small/Med. Comm., WA	1.00	1.04	1.14	1.26	1.39	1.53	1.85%
Large Comm., WA	1.00	1.01	1.10	1.22	1.34	1.48	1.72%
Extra Large Comm., WA	1.00	1.05	1.34	1.48	1.63	1.80	2.57%
Extra Large Industrial, WA	1.00	1.16	1.31	1.51	1.73	1.99	2.99%
Small/Med. Comm., ID	1.00	1.03	1.13	1.25	1.38	1.53	1.84%
Large Comm., ID	1.00	1.03	1.15	1.27	1.40	1.54	1.88%
Extra Large Comm., ID	1.00	1.04	1.25	1.38	1.52	1.68	2.26%
Extra Large Industrial, ID	1.00	1.04	1.13	1.21	1.30	1.39	1.44%

Electricity Price	2009	2012	2017	2022	2027	2032	Avg. Growth (%/yr)
Electricity price, WA (cents per kWh)	$0.0700	$0.0698	$0.0703	$0.0727	$0.0752	$0.0778	0.46%
Electricity price, ID (cents per kWh)	$0.0566	$0.0586	$0.0600	$0.0621	$0.0642	$0.0664	0.69%

[11] Avista 2009 IRP, p. 2-10: Commercial usage per customer is forecast to increase for several years due to additional buildings either built or anticipated to be built by existing very large customers, such as Washington State University and Sacred Heart Hospital. Expected additions for very large customers are included in the forecast through 2015, and no additions are included in the forecast after 2015.

[12] Avista 2009 IRP p. 2-6.

[13] We developed baseline purchase decisions using the Energy Information Agency's *Annual Energy Outlook* report (2010), which utilizes the National Energy Modeling System (NEMS) to produce a self-consistent supply and demand economic model. We calibrated equipment purchase options to match manufacturer shipment data for recent years and trended forward.

4.2.2 C&I Baseline Forecast Results

Figure 4-3 and Table 4-5 present the baseline forecast at the end-use level for the C&I sector as a whole. Overall, C&I annual energy use increases from 5,033,023 MWh in 2009 to 7,239,694 MWh in 2032, a 43.8% increase. This reflects growth in floor space across all sectors. Table 4-6 presents the C&I forecast by technology. Interior screw-in lighting increases over the forecast period, but at a slower rate than other technologies as a result of the lighting standard.

Figure 4-3 C&I Baseline Electricity Forecast by End Use

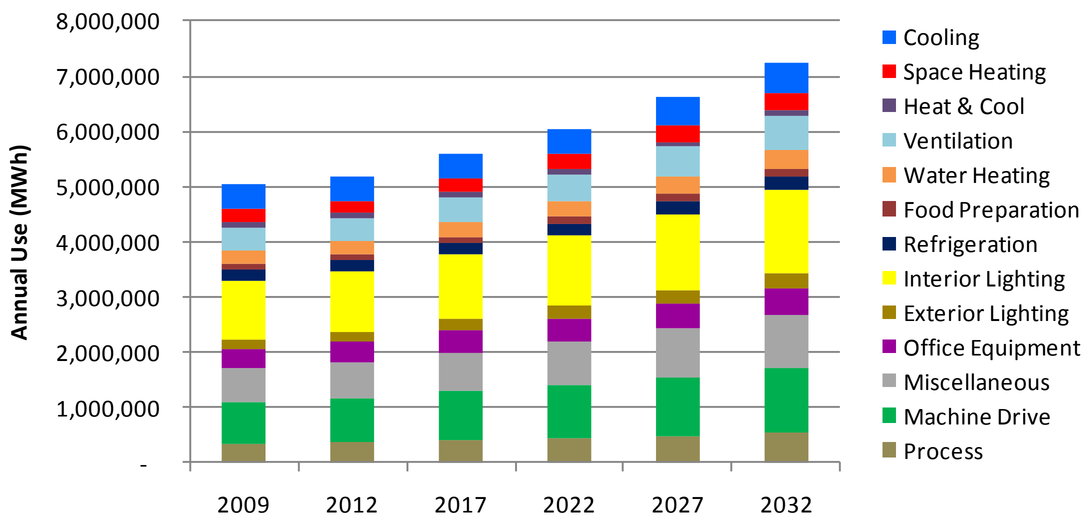


Table 4-5 C&I Electricity Consumption by End Use (MWh)

End Use	2009	2012	2017	2022	2027	2032	% Change ('09–'32)	Avg. growth rate
Cooling	433,257	429,715	453,330	473,311	504,446	550,621	27.1%	1.04%
Space Heating	250,919	224,970	249,918	273,638	300,093	330,065	31.5%	1.19%
Heat & Cool	81,984	80,104	82,263	86,559	94,007	103,167	25.8%	1.00%
Ventilation	421,805	426,987	457,118	487,582	534,845	588,427	39.5%	1.45%
Water Heating	246,022	244,232	266,435	289,253	315,002	344,844	40.2%	1.47%
Food Preparation	92,263	94,294	104,419	114,396	125,186	136,992	48.5%	1.72%
Refrigeration	203,660	204,139	213,050	224,372	242,222	264,431	29.8%	1.14%
Interior Lighting	1,079,050	1,106,035	1,175,567	1,274,090	1,388,871	1,513,165	40.2%	1.47%
Exterior Lighting	179,595	183,933	202,023	219,529	239,546	261,703	45.7%	1.64%
Office Equipment	344,351	363,758	387,164	421,052	458,189	498,560	44.8%	1.61%
Miscellaneous	619,607	645,918	714,601	785,490	863,772	950,463	53.4%	1.86%
Machine Drive	740,191	800,303	881,202	966,387	1,061,952	1,169,146	58.0%	1.99%
Process	340,318	367,955	405,497	445,447	489,890	539,389	58.5%	2.00%
Total	**433,257**	**429,715**	**453,330**	**473,311**	**504,446**	**550,621**	**27.1%**	**1.04%**

Table 4-6 C&I Baseline Electricity Forecast by End Use and Technology (MWh)

End Use	Technology	2009	2012	2017	2022	2027	2032	% Change ('09–'32)	Avg. Growth Rate
Cooling	Central Chiller	161,468	161,651	175,544	184,829	194,228	210,874	30.6%	1.16%
	PTAC	18,631	18,428	18,862	19,691	21,069	23,036	23.6%	0.92%
	RTU	253,158	249,637	258,925	268,791	289,149	316,711	25.1%	0.97%
Space Heating	Electric Resistance	102,223	191,387	212,950	234,235	257,713	283,617	177.5%	4.44%
	Furnace	148,697	33,583	36,969	39,403	42,380	46,447	-68.8%	-5.06%
Heat & Cool	Heat Pump	81,984	80,104	82,263	86,559	94,007	103,167	25.8%	1.00%
Ventilation	Ventilation	421,805	426,987	457,118	487,582	534,845	588,427	39.5%	1.45%
Water Heating	Water Heater	246,022	244,232	266,435	289,253	315,002	344,844	40.2%	1.47%
Food Preparation	Dishwasher	5,561	5,675	6,260	6,889	7,580	8,341	50.0%	1.76%
	Fryer	10,938	11,160	12,267	13,442	14,715	16,107	47.3%	1.68%
	Oven	64,439	65,882	73,158	80,123	87,640	95,864	48.8%	1.73%
	Hot Food Container	10,600	10,838	11,915	13,043	14,260	15,590	47.1%	1.68%
	Food Prep	724	739	818	900	991	1,090	50.5%	1.78%
Refrigeration	Walk in Refrigeration	26,545	26,356	27,877	29,977	32,721	35,993	35.6%	1.32%
	Glass Door Display	29,998	29,887	31,549	33,927	37,032	40,736	35.8%	1.33%
	Solid Door Refrigerator	56,389	55,997	58,578	61,819	66,199	71,682	27.1%	1.04%
	Open Display Case	18,136	18,080	19,502	20,983	22,909	25,201	39.0%	1.43%
	Vending Machine	28,068	28,373	25,594	23,005	23,392	24,849	-11.5%	-0.53%
	Icemaker	44,524	45,447	49,951	54,661	59,969	65,969	48.2%	1.71%
Interior Lighting	HID	175,721	181,398	198,158	215,929	235,578	257,305	46.4%	1.66%
	Linear Fluorescent	686,924	702,882	771,014	840,371	916,893	1,001,311	45.8%	1.64%
	Interior Screw-in	216,406	221,755	206,395	217,790	236,400	254,549	17.6%	0.71%

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 855 of 1069

Table 4-6 C&I Baseline Electricity Forecast by End Use and Technology (MWh) (continued)

End Use	Technology	2009	2012	2017	2022	2027	2032	% Change ('09–'32)	Avg. Growth Rate
Exterior Lighting	HID	132,407	135,795	150,576	164,140	179,105	195,616	47.7%	1.70%
	Linear Fluorescent	25,393	25,871	28,196	30,732	33,529	36,611	44.2%	1.59%
	Exterior Screw-in	21,795	22,266	23,250	24,657	26,912	29,475	35.2%	1.31%
Office Equipment	Monitor	41,029	53,265	46,532	50,891	55,743	61,060	48.8%	1.73%
	Server	74,853	76,495	84,537	93,022	102,358	112,632	50.5%	1.78%
	Desktop Computer	154,994	158,861	173,772	187,271	201,951	217,747	40.5%	1.48%
	Laptop Computer	13,081	13,425	14,794	15,996	17,306	18,722	43.1%	1.56%
	Printer/copier/fax	39,520	40,314	44,034	48,018	52,383	57,096	44.5%	1.60%
	POS Terminal	20,873	21,398	23,495	25,853	28,448	31,304	50.0%	1.76%
Miscellaneous	Other Miscellaneous	263,934	269,935	298,454	328,409	361,370	397,639	50.7%	1.78%
	Miscellaneous	208,493	225,425	248,425	272,900	300,128	330,453	58.5%	2.00%
	Non-HVAC Motor	147,180	150,558	167,722	184,182	202,275	222,371	51.1%	1.79%
Machine Drive	Less than 5 HP	35,529	38,415	41,579	44,045	47,585	52,286	47.2%	1.68%
	5-24 HP	76,980	83,231	91,723	100,760	110,813	122,010	58.5%	2.00%
	25-99 HP	188,009	203,277	224,017	246,087	270,640	297,986	58.5%	2.00%
	100-249 HP	106,588	115,244	127,002	139,514	153,434	168,937	58.5%	2.00%
	250-499 HP	116,950	126,448	139,349	153,078	168,351	185,361	58.5%	2.00%
	500 and more HP	216,136	233,688	257,531	282,903	311,129	342,566	58.5%	2.00%
Process	Process Cooling/Refrigeration	102,095	110,387	121,649	133,634	146,967	161,817	58.5%	2.00%
	Process Heating	153,143	165,580	182,474	200,451	220,451	242,725	58.5%	2.00%
	Electrochemical Process	85,079	91,989	101,374	111,362	122,473	134,847	58.5%	2.00%
Grand Total		**5,033,023**	**5,172,344**	**5,592,586**	**6,061,107**	**6,618,022**	**7,250,973**	**44.1%**	**1.59%**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 856 of 1069

4.3 BASELINE FORECAST SUMMARY

Table 4-7 and Figure 4-4 provide an overall summary of the baseline forecast by sector and for the Avista system as a whole. Overall, the forecast for the next 20 years shows substantial growth, reflecting projected increases in customers and income. This forecast is the metric against which the energy-efficiency savings potential is compared.

Table 4-7 Baseline Forecast Summary by Sector and State

End Use	2009	2012	2017	2022	2027	2032	% Change ('09–'32)	Avg. Growth Rate ('09–'32)
Res. WA	2,451,707	2,448,104	2,617,630	2,947,427	3,329,882	3,792,486	54.7%	1.9%
Res. ID	1,182,379	1,178,591	1,253,664	1,408,812	1,588,965	1,808,300	52.9%	1.8%
C&I WA	2,852,165	2,955,156	3,209,083	3,509,816	3,869,176	4,280,649	50.1%	1.8%
C&I ID	2,180,858	2,217,188	2,383,504	2,551,291	2,748,846	2,970,324	36.2%	1.3%
Total	8,667,109	8,799,039	9,463,880	10,417,347	11,536,869	12,851,760	48.3%	1.7%

Figure 4-4 Baseline Forecast Summary by Sector and State

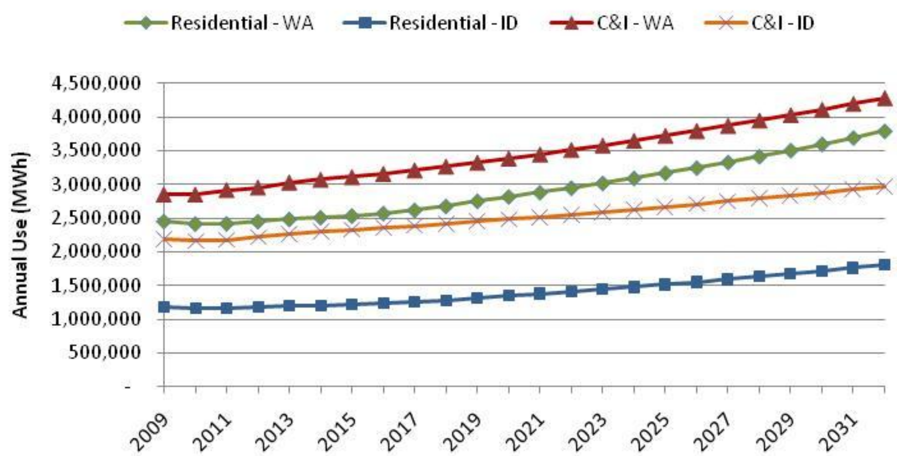


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 857 of 1069

4.3.1 Comparison of Baseline Forecast with Avista 2009 IRP

Table 4-8 compares the Avista 2009 IRP forecast, the LoadMAP baseline forecast for Washington and Idaho combined, and the regional forecast from the Sixth Plan. For the LoadMAP baseline and Avista forecast, the table shows data for the period 2009 through 2030, the last year of the IRP forecast. The Sixth Plan forecast is the medium case scenario for 2010 through 2030.

Table 4-8 Comparison of LoadMAP Baseline, Avista IRP, and Sixth Plan Energy Forecasts (MWh)

	LoadMAP Baseline			Avista IRP[14]			Sixth Plan[15]
Sector	**2009**	**2030**	**Avg. Growth ('09-'30)**	**2009**	**2030**	**Avg. Growth ('09-'30)**	**Avg. Growth ('10-'30)**
Residential	3,634,086	5,314,970	1.8%	3,700,000	5,048,000	1.5%	1.4%
Commercial	3,331,433	4,457,968	1.4%	3,400,000	4,773,000	1.6%	1.6%
Industrial	1,701,589	2,530,353	1.9%	1,900,000	3,029,000	2.2%	0.8%
Total	**8,667,109**	**12,303,291**	**1.7%**	**9,002,009**	**12,852,030**	**1.7%**	**1.4%**

The LoadMAP and IRP forecasts do not match exactly for the base year, likely due to the slightly different ways in which the study team selected rate classes to include and how we grouped them. Also, the IRP was prepared in September 2009, before final results for 2009 were available.

Overall growth in energy usage agrees well between LoadMAP and the IRP, at approximately 1.7% annual average growth. However, Global's forecast for the Residential sector produces greater growth than the IRP's projections, while the opposite is true for Commercial and Industrial sectors. Because the LoadMAP baseline excludes future additional conservation activities, we would generally expect it to be somewhat higher than the IRP forecast, as is the case with the Residential sector. In general, the Sixth Plan forecast, which also excludes additional conservation, is lower than both the LoadMAP and Avista IRP forecasts, with the exception of the Commercial sector, where the Sixth Plan and the Avista IRP agree.

Retail Electricity Prices

Table 4-9 compares retail electricity prices used in the LoadMAP model and those projected in the IRP.

Table 4-9 Comparison of Retail Electricity Prices

Sector	LoadMAP						Avista IRP[16]	
	2009 ($/kWh)	**2018 ($/kWh)**	**Avg. Growth ('09-'18)**	**2019 ($/kWh)**	**2032 ($/kWh)**	**Avg. Growth ('19-'32)**	**Avg. Growth ('19-'32)**	**Avg. Growth ('19-'30)**
Res. WA	$0.072	$0.080	1.2%	$0.0818	$0.087	0.5%	10.0%	Inflation
Res. ID	$0.074	$0.088	1.8%	$0.089	$0.094	0.5%	10.0%	Inflation
C&I WA	$0.0700	$0.0703	0.1%	$0.0713	$0.0778	0.7%	10.0%	Inflation
C&I ID	$0.0566	$0.0600	0.6%	$0.0608	$0.0664	0.7%	10.0%	inflation

[14] Avista forecast from 2009 IRP, Figure 2.10 and p. 2-12.
[15] NPCC Sixth Northwest Conservation and Electric Power Plan, p. C-6, table C-3.
[16] Avista 2009 IRP, p. 2-9.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista

Avista's IRP forecast "is based on retail prices increasing an average of 10 percent annually from 2010 to 2018, followed by increases at the rate of inflation thereafter." However, Avista's most recent load forecast for 2011–2015 shows lower annual rate increases. For this study, Global used the rates from the 2011–2015 load forecast and thereafter, based on data from the AEO, increased rates by 0.50% and 0.68% respectively for residential and C/I customers.

Residential Energy Use per Household

As mentioned above, the LoadMAP residential baseline energy use forecast is higher than the IRP residential forecast. Furthermore, the baseline forecast of energy use per household is notably different, with average growth of 0.6% compared with Avista IRP showing that energy use per household decreases over time.[17]

Long-Term Weather

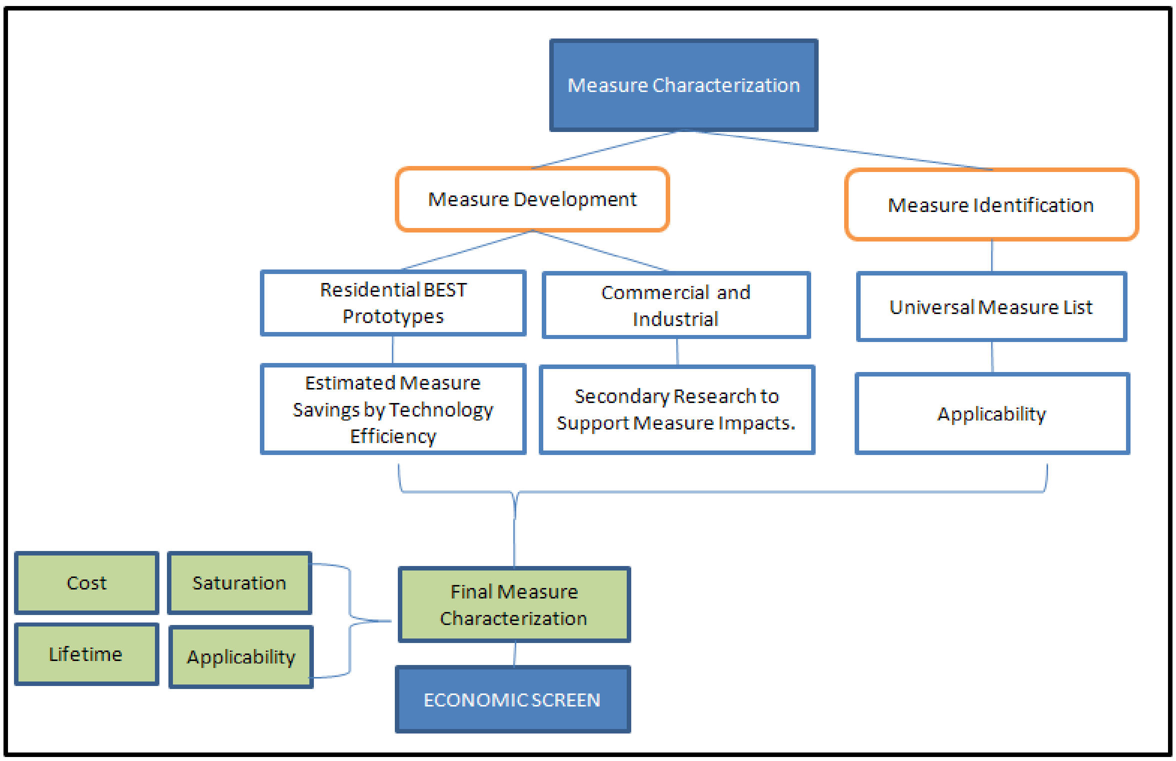
This study used the 30-year normal weather data. In contrast, the IRP mentions warming trends in recent weather. Although the model does not directly account for climate changes, the residential market profiles show an increase in air conditioning saturation over time, which indirectly reflects weather trends.

[17] Avista 2009 IRP Figure 2.9, p. 2-11.

ENERGY-EFFICIENCY MEASURE ANALYSIS

This section describes the framework used to assess the savings, costs, and other attributes of energy-efficiency measures. These characteristics form the basis for measure-level cost-effectiveness analyses as well as for determining measure-level savings. For all measures, Global assembled information to reflect equipment performance, incremental costs, and equipment lifetimes. We used this information, along with the avoided costs, in the economic screen to determine economically feasible measures. Figure 5-1 outlines the framework for measure analysis.

Figure 5-1 Approach for Measure Assessment



5.1 SELECTION OF ENERGY EFFICIENCY MEASURES

The first step of the energy efficiency measure analysis was to identify the list of all relevant energy efficiency measures that should be considered for the Avista CPA. Sources consulted to develop the list for this study included:

- Avista's existing conservation programs
- The Sixth Power Plan database of EE measure costs and savings
- NEEA's Regional Technical Forum
- Database for Energy Efficient Resources (DEER): The California Energy Commission and California Public Utilities Commission (CPUC) sponsor this database, which is designed to provide well-documented estimates of energy and peak demand savings values, measure costs, and effective useful life (EUL) all with one data source for the state of California.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 860 of 1069

- Global's Database of Energy Efficiency Measures (DEEM). In 2004, Global prepared a database of energy efficiency measures for residential and commercial segments across the U.S., analogous to the DEER database developed for California. Global updates the database on a regular basis as it conducts new energy efficiency potential studies.
- EPRI National Potential Study (2009). Global's assessment of the national potential for energy efficiency derived for the four DOE regions (including the Pacific region.
- Other recent Global potential studies

Measures can be categorized into one of two types, equipment measures and non-equipment measures, according to the LoadMAP taxonomy:

Equipment measures, or efficient energy-consuming equipment, save energy by providing the same service with a lower energy requirement. An example is the replacement of a standard efficiency refrigerator with an ENERGY STAR model. For equipment measures, many efficiency levels are available for a specific technology that range from the baseline unit (often determined by code or standard) up to the most efficient product commercially available. For instance, in the case of central air conditioners, this list begins with the federal standard SEER 13 unit and spans a broad spectrum of efficiency, with the highest efficiency level represented by a ductless mini-split system with variable refrigerant flow (at SEER levels of 18 or greater).

Non-equipment measures save energy by reducing the need for delivered energy but do not involve replacement or purchase of major end-use equipment (such as a refrigerator or air conditioner). An example would be a programmable thermostat that is pre-set, for example, to run the air conditioner only when people are home. Non-equipment measures fall into one of the following categories:

- Building shell (windows, insulation, roofing material)
- Equipment controls (thermostat, occupancy sensors)
- Equipment maintenance (cleaning filters, changing setpoints)
- Whole-building design (natural ventilation, passive solar lighting)
- Lighting retrofits (included as a non-equipment measure because retrofits are performed prior to the equipment's normal end of life)
- Displacement measures (ceiling fan instead of central air conditioner)

Non-equipment measures can apply to more than one end use. For example, insulation levels will affect both cooling and space heating energy consumption.

Global prepared a preliminary list of measures for Avista's review and revised the list based on Avista's input.

5.1.1 Residential Measures

Table 5-1 and Table 5-2 show the residential equipment and non-equipment measure options respectively and the segments for which they were modeled. Residential measures are described in Appendix C.

5.1.2 Commercial and Industrial Measures

Table 5-3and Table 5-4 list the C&I equipment and non-equipment measures, respectively. Measures were modeled for nearly all C&I building types, both new and existing, with only a few exceptions as shown. For all C&I segments, a custom measure category was included to serve as a "catch all" for measures for which costs and savings are not easily quantified and that could be part of a program such as Avista's existing Site-Specific incentive program. In addition, because the Small/Medium Commercial and Large Commercial segments also include some industrial customers, we included a non-equipment measure called Industrial Process Improvements to capture potential savings from these customers. C&I Measures are described in Appendix D.

Table 5-1   Summary of Residential Equipment Measures

End Use	Technology	Efficiency Option	Efficiency	Lifetime	On Market	Off Market	Single Family (existing & new)	Multi Family (existing & new)	Mobile Home (existing & new)	Low Income (existing & new)
Cooling	Central AC	SEER 13	100%	15	2009	2014	●	●	●	●
	Central AC	SEER 14 (ENERGY STAR)	92%	15	2009	2032	●	●	●	●
	Central AC	SEER 15 (CEE Tier 2)	89%	15	2009	2032	●	●	●	●
	Central AC	SEER 16 (CEE Tier 3)	86%	15	2009	2032	●	●	●	●
	Central AC	Ductless Mini-Split System	75%	20	2009	2032	●	●	●	●
	Room AC	EER 9.8	100%	10	2009	2032	●	●	●	●
	Room AC	EER 10.8 (ENERGY STAR)	91%	10	2009	2032	●	●	●	●
	Room AC	EER 11	89%	10	2009	2032	●	●	●	●
	Room AC	EER 11.5	85%	10	2009	2032	●	●	●	●
Heat & Cool	Air Source Heat Pump	SEER 13	100%	15	2009	2014	●	●	●	●
	Air Source Heat Pump	SEER 14 (ENERGY STAR)	92%	15	2009	2032	●	●	●	●
	Air Source Heat Pump	SEER 15 (CEE Tier 2)	89%	15	2009	2032	●	●	●	●
	Air Source Heat Pump	SEER 16 (CEE Tier 3)	86%	15	2009	2032	●	●	●	●
	Air Source Heat Pump	Ductless Mini-Split System	75%	20	2009	2032	●	●	●	●
	Geothermal Heat Pump	Standard	100%	14	2009	2032	●	●	●	●
	Geothermal Heat Pump	High Efficiency	86%	14	2009	2032	●	●	●	●
Space Heating	Electric Resistance	Electric Resistance	100%	20	2009	2032	●	●	●	●
	Electric Furnace	3400 BTU/KW	100%	15	2009	2032	●	●	●	●
	Supplemental	Supplemental	100%	5	2009	2032	●	●	●	●
Water Heating	Water Heater	Baseline (EF=0.90)	100%	15	2009	2015	●	●	●	●
	Water Heater	High Efficiency (EF=0.95)	95%	15	2009	2032	●	●	●	●
	Water Heater	Geothermal Heat Pump	32%	15	2009	2032	●			
	Water Heater	Solar	25%	15	2009	2032	●	●	●	●
Interior Lighting	Screw-in	Incandescent	100%	4	2009	2014	●	●	●	●
	Screw-in	Infrared Halogen	81%	5	2015	2020	●	●	●	●
	Screw-in	CFL	22%	6	2009	2032	●	●	●	●
	Screw-in	LED	14%	12	2009	2032	●	●	●	●
	Linear Fluorescent	T12	100%	6	2009	2032	●	●	●	●
	Linear Fluorescent	T8	91%	6	2009	2032	●	●	●	●
	Linear Fluorescent	Super T8	74%	6	2009	2032	●	●	●	●
	Linear Fluorescent	T5	73%	6	2009	2032	●	●	●	●
	Linear Fluorescent	LED	72%	10	2009	2032	●	●	●	●
	Pin-based	Halogen	100%	4	2009	2032	●	●	●	●
	Pin-based	CFL	23%	6	2009	2032	●	●	●	●
	Pin-based	LED	16%	10	2009	2032	●	●	●	●
Exterior Lighting	Screw-in	Incandescent	100%	4	2009	2014	●	●	●	●
	Screw-in	Infrared Halogen	79%	5	2015	2020	●	●	●	●
	Screw-in	CFL	20%	6	2009	2032	●	●	●	●
	Screw-in	LED	14%	12	2009	2032	●	●	●	●
	High Intensity/Flood	Incandescent	100%	4	2009	2014	●	●	●	●
	High Intensity/Flood	Infrared Halogen	88%	4	2015	2020	●	●	●	●
	High Intensity/Flood	CFL	29%	5	2009	2032	●	●	●	●
	High Intensity/Flood	Metal Halide	27%	5	2009	2032	●	●	●	●
	High Intensity/Flood	High Pressure Sodium	19%	5	2009	2032	●	●	●	●
	High Intensity/Flood	LED	18%	10	2009	2032	●	●	●	●

Table 5-1 Summary of Residential Equipment Measures (continued)

End Use	Technology	Efficiency Option	Efficiency	Lifetime	On Market	Off Market	Single Family (existing & new)	Multi Family (existing & new)	Mobile Home (existing & new)	Low Income (existing & new)
Appliances	Clothes Washer	Baseline	100%	10	2009	2032	●	●	●	●
	Clothes Washer	ENERGY STAR (MEF > 1.8)	70%	10	2009	2032	●	●	●	●
	Clothes Washer	Horizontal Axis	42%	10	2009	2032	●	●	●	●
	Clothes Dryer	Baseline	100%	13	2009	2032	●	●	●	●
	Clothes Dryer	Moisture Detection	85%	13	2009	2032	●	●	●	●
	Dishwasher	Baseline	100%	9	2009	2032	●	●	●	●
	Dishwasher	ENERGY STAR	85%	9	2009	2010	●	●	●	●
	Dishwasher	ENERGY STAR (2011)	81%	9	2011	2032	●	●	●	●
	Refrigerator	Baseline	100%	13	2009	2013	●	●	●	●
	Refrigerator	ENERGY STAR	85%	13	2009	2013	●	●	●	●
	Refrigerator	Baseline (2014)	80%	13	2014	2032	●	●	●	●
	Refrigerator	ENERGY STAR (2014)	68%	13	2014	2032	●	●	●	●
	Freezer	Baseline	100%	11	2009	2013	●	●	●	●
	Freezer	ENERGY STAR	85%	11	2009	2013	●	●	●	●
	Freezer	Baseline (2014)	80%	11	2014	2032	●	●	●	●
	Freezer	ENERGY STAR (2014)	68%	11	2014	2032	●	●	●	●
	Second Refrigerator	Baseline	100%	13	2009	2013	●	●	●	●
	Second Refrigerator	ENERGY STAR	85%	13	2009	2013	●	●	●	●
	Second Refrigerator	Baseline (2014)	80%	13	2014	2032	●	●	●	●
	Second Refrigerator	ENERGY STAR (2014)	68%	13	2014	2032	●	●	●	●
	Stove	Baseline	100%	13	2009	2032	●	●	●	●
	Stove	Convection Oven	98%	13	2009	2032	●	●	●	●
	Stove	Induction (High Efficiency)	88%	13	2009	2032	●	●	●	●
	Microwave	Microwave	100%	9	2009	2032	●	●	●	●
Electronics	Personal Computers	Baseline	100%	5	2009	2032	●	●	●	●
	Personal Computers	ENERGY STAR	65%	5	2009	2032	●	●	●	●
	Personal Computers	Climate Savers	50%	5	2009	2032	●	●	●	●
	TVs	Baseline	100%	11	2009	2032	●	●	●	●
	TVs	ENERGY STAR	80%	11	2009	2032	●	●	●	●
	Devices and Gadgets	Devices and Gadgets	100%	5	2009	2032	●	●	●	●
Miscellaneous	Pool Pump	Baseline Pump	100%	15	2009	2032	●		●	●
	Pool Pump	High Efficiency Pump	90%	15	2009	2032	●		●	●
	Pool Pump	Two-Speed Pump	60%	15	2009	2032	●		●	●
	Furnace Fan	Baseline	100%	18	2009	2032	●	●	●	●
	Furnace Fan	Furnace Fan with ECM	75%	18	2009	2032	●	●	●	●
	Miscellaneous	Miscellaneous	100%	5	2009	2032	●	●	●	●

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 863 of 1069

Table 5-2 Summary of Residential Non-equipment Measures

End Use	Measure	Single Family Existing	Single Family New Construction	Multi Family Existing	Multi Family New Construction	Mobile Home Existing	Mobile Home New Construction	Low Income Existing	Low Income New Construction
HVAC	Central AC - Early Replacement	●		●		●	●	●	
	Central AC - Maintenance and Tune-Up	●	●	●	●	●	●	●	●
	Room AC - Removal of Second Unit	●		●		●	●	●	
	Air Source Heat Pump - Maintenance	●	●	●	●	●	●	●	●
	Furnace - Convert to Gas	●	●	●	●	●	●	●	●
	Attic Fan - Installation	●	●					●	●
	Attic Fan - Photovoltaic - Installation	●	●					●	●
	Ceiling Fan - Installation	●	●	●	●	●	●	●	●
	Whole-House Fan - Installation	●	●			●	●	●	●
	Thermostat - Clock/Programmable	●	●	●	●	●	●	●	●
	Insulation - Ceiling / Attic	●	●	●	●	●	●	●	●
	Insulation - Radiant Barrier	●	●	●	●	●	●	●	●
	Insulation - Infiltration Control	●		●		●		●	●
	Insulation - Ducting	●	●	●	●	●	●	●	●
	Repair and Sealing - Ducting	●		●		●		●	
	Insulation - Foundation		●						●
	Insulation - Wall Cavity		●		●		●		●
	Insulation - Wall Sheathing		●		●		●		●
	Doors - Storm and Thermal	●	●	●	●	●	●	●	●
	Windows - Reflective Film	●	●	●	●	●	●	●	●
	Windows - High Efficiency/ENERGY STAR	●	●	●	●	●	●	●	●
	Roofs - High Reflectivity	●	●	●	●	●	●	●	●
	Trees for Shading	●	●	●	●	●	●	●	●
Int. Lighting	Interior Lighting - Occupancy Sensors	●	●	●	●	●	●	●	●
Exterior Lighting	Exterior Lighting - Photovoltaic Installation	●	●	●	●	●	●	●	●
	Exterior Lighting - Photosensor Control	●	●	●	●	●	●	●	●
	Exterior Lighting - Timeclock Installation	●	●	●	●	●	●	●	●
Water Heating	Water Heater - Faucet Aerators	●	●	●	●	●	●	●	●
	Water Heater - Pipe Insulation	●	●	●	●	●	●	●	●
	Water Heater - Low Flow Showerheads	●	●	●	●	●	●	●	●
	Water Heater - Tank Blanket/Insulation	●	●	●	●	●	●	●	●
	Water Heater - Thermostat Setback	●	●	●	●	●	●	●	●
	Water Heater - Timer	●	●	●	●	●	●	●	●
	Water Heater - Hot Water Saver	●	●	●	●	●	●	●	●
	Water Heater - Drainwater Heat Recovery		●		●		●		●
	Water Heater - Convert to Gas	●	●	●	●	●	●	●	●
	Water Heater - Heat Pump Water Heater	●	●	●	●	●	●	●	●
Appliances	Refrigerator - Early Replacement	●		●		●		●	
	Refrigerator - Remove Second Unit	●		●		●		●	
	Freezer - Early Replacement	●		●		●		●	
	Freezer - Remove Second Unit	●		●		●		●	
Electronics	Electronics - Reduce Standby Wattage	●	●	●	●	●	●	●	●
Misc.	Pool - Pump Timer	●	●			●	●	●	●
Multiple End Uses	Home Energy Management System	●	●	●	●	●	●	●	●
	Advanced New Construction Designs		●		●		●		●
	Energy Efficient Manufactured Homes						●		
	ENERGY STAR Homes		●						
	Photovoltaic System	●	●	●	●	●	●	●	●

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 864 of 1069

Table 5-3 Summary of Commercial and Industrial Equipment Measures

End Use	Technology	Efficiency Option	Small/Med. Comm. (existing & new)	Large Comm. (existing & new)	Extra Large Comm. (existing & new)	Extra Large Ind. (existing & new)
Cooling	Central Chiller	1.5 kW/ton, COP 2.3	●	●		
	Central Chiller	1.3 kW/ton, COP 2.7	●	●		
	Central Chiller	1.26 kW/ton, COP 2.8	●	●		
	Central Chiller	1.0 kW/ton, COP 3.5	●	●		
	Central Chiller	0.97 kW/ton, COP 3.6	●	●		
	Central Chiller	0.75 kw/ton, COP 4.7			●	●
	Central Chiller	0.60 kw/ton, COP 5.9			●	●
	Central Chiller	0.58 kw/ton, COP 6.1			●	●
	Central Chiller	0.55 kw/Ton, COP 6.4			●	●
	Central Chiller	0.51 kw/ton, COP 6.9			●	●
	Central Chiller	0.50 kw/Ton, COP 7.0			●	●
	Central Chiller	0.48 kw/ton, COP 7.3			●	●
	Central Chiller	Variable Refrigerant Flow	●	●	●	●
	RTU	EER 9.2	●	●	●	●
	RTU	EER 10.1	●	●	●	●
	RTU	EER 11.2	●	●	●	●
	RTU	EER 12.0	●	●	●	●
	RTU	Ductless VRF	●	●	●	●
Heat & Cool	PTAC	EER 9.8	●	●	●	●
	PTAC	EER 10.2	●	●	●	●
	PTAC	EER 10.8	●	●	●	●
	PTAC	EER 11	●	●	●	●
	PTAC	EER 11.5	●	●	●	●
	Heat Pump	EER 9.3, COP 3.1	●	●	●	●
	Heat Pump	EER 10.3, COP 3.2	●	●	●	●
	Heat Pump	EER 11.0, COP 3.3	●	●	●	●
	Heat Pump	EER 11.7, COP 3.4	●	●	●	●
	Heat Pump	EER 12, COP 3.4	●	●	●	●
	Heat Pump	Ductless Mini-Split System	●	●	●	●
	Heat Pump	Geothermal*	●	●	●	●
Space Heating	Electric Resistance	Standard	●	●	●	●
	Furnace	Standard	●	●	●	●
Ventilation	Ventilation	Constant Volume	●	●	●	●
	Ventilation	Variable Air Volume	●	●	●	●

*** New construction only**

Table 5-3 Summary of Commercial and Industrial Equipment Measures (continued)

End Use	Technology	Efficiency Option	Small/Med. Comm. (existing & new)	Large Comm. (existing & new)	Extra Large Comm. (existing & new)	Extra Large Ind. (existing & new)
Interior Lighting	Interior Screw-in	Incandescents	●	●	●	●
	Interior Screw-in	Infrared Halogen	●	●	●	●
	Interior Screw-in	CFL	●	●	●	●
	Interior Screw-in	LED	●	●	●	●
	HID	Metal Halides	●	●	●	●
	HID	High Pressure Sodium	●	●	●	●
	Linear Fluorescent	T12	●	●	●	●
	Linear Fluorescent	T8	●	●	●	●
	Linear Fluorescent	Super T8	●	●	●	●
	Linear Fluorescent	T5	●	●	●	●
	Linear Fluorescent	LED	●	●	●	●
Exterior Lighting	Exterior Screw-in	Incandescents	●	●	●	●
	Exterior Screw-in	Infrared Halogen	●	●	●	●
	Exterior Screw-in	CFL	●	●	●	●
	Exterior Screw-in	Metal Halides	●	●	●	●
	Exterior Screw-in	LED	●	●	●	●
	HID	Metal Halides	●	●	●	●
	HID	High Pressure Sodium	●	●	●	●
	HID	Low Pressure Sodium	●	●	●	●
	Linear Fluorescent	T12	●	●	●	●
	Linear Fluorescent	T8	●	●	●	●
	Linear Fluorescent	Super T8	●	●	●	●
	Linear Fluorescent	T5	●	●	●	●
	Linear Fluorescent	LED	●	●	●	●
Water Heating	Water Heater	Baseline (EF=0.90)	●	●	●	
	Water Heater	High Efficiency (EF=0.95)	●	●	●	
	Water Heater	Geothermal Heat Pump	●	●	●	
	Water Heater	Solar	●	●	●	
Food Preparation	Fryer	Standard	●	●	●	
	Fryer	Efficient	●	●	●	
	Oven	Standard	●	●	●	
	Oven	Efficient	●	●	●	
	Dishwasher	Standard	●	●	●	
	Dishwasher	Efficient	●	●	●	
	Hot Food Container	Standard	●	●	●	
	Hot Food Container	Efficient	●	●	●	
	Food Prep Misc.	Standard	●	●	●	
	Food Prep Misc.	Efficient	●	●	●	

Table 5-3 Summary of Commercial and Industrial Equipment Measures (continued)

End Use	Technology	Efficiency Option	Small/Med. Comm. (existing & new)	Large Comm. (existing & new)	Extra Large Comm. (existing & new)	Extra Large Ind. (existing & new)
Refrigeration	Walk in Refrigeration	Standard	●	●	●	
	Walk in Refrigeration	Efficient	●	●	●	
	Glass Door Display	Standard	●	●	●	
	Glass Door Display	Efficient	●	●	●	
	Solid Door Refrigerator	Standard	●	●	●	
	Solid Door Refrigerator	Efficient	●	●	●	
	Open Display Case	Standard	●	●	●	
	Open Display Case	Efficient	●	●	●	
	Vending Machine	Base	●	●	●	
	Vending Machine	Base (2012)	●	●	●	
	Vending Machine	High Efficiency	●	●	●	
	Vending Machine	High Efficiency (2012)	●	●	●	
	Icemaker	Standard	●	●	●	
	Icemaker	Efficient	●	●	●	
Office Equipment	Desktop Computer	Baseline	●	●	●	
	Desktop Computer	ENERGY STAR	●	●	●	
	Desktop Computer	Climate Savers	●	●	●	
	Laptop Computer	Baseline	●	●	●	
	Laptop Computer	ENERGY STAR	●	●	●	
	Laptop Computer	Climate Savers	●	●	●	
	Server	Standard	●	●	●	
	Server	ENERGY STAR	●	●	●	
	Monitor	Standard	●	●	●	
	Monitor	ENERGY STAR	●	●	●	
	Printer/copier/fax	Standard	●	●	●	
	Printer/copier/fax	ENERGY STAR	●	●	●	
	POS Terminal	Standard	●	●	●	
	POS Terminal	ENERGY STAR	●	●	●	
Miscellaneous	Non-HVAC Motor	Standard	●	●	●	
	Non-HVAC Motor	Standard (2015)	●	●	●	
	Non-HVAC Motor	High Efficiency	●	●	●	
	Non-HVAC Motor	High Efficiency (2015)	●	●	●	
	Non-HVAC Motor	Premium	●	●	●	
	Non-HVAC Motor	Premium (2015)	●	●	●	
	Other Miscellaneous	Miscellaneous	●	●	●	●
	Other Miscellaneous	Miscellaneous (2013)	●	●	●	

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 867 of 1069

Table 5-3 Summary of Commercial and Industrial Equipment Measures (continued)

End Use	Technology	Efficiency Option	Small/Med. Comm. (existing & new)	Large Comm. (existing & new)	Extra Large Comm. (existing & new)	Extra Large Ind. (existing & new)
Machine Drive	Less than 5 HP	Standard				●
	Less than 5 HP	High Efficiency				●
	Less than 5 HP	Standard (2015)				●
	Less than 5 HP	Premium				●
	Less than 5 HP	High Efficiency (2015)				●
	Less than 5 HP	Premium (2015)				●
	5-24 HP	Standard				●
	5-24 HP	High				●
	5-24 HP	Premium				●
	25-99 HP	Standard				●
	25-99 HP	High				●
	25-99 HP	Premium				●
	100-249 HP	Standard				●
	100-249 HP	High				●
	100-249 HP	Premium				●
	250-499 HP	Standard				●
	250-499 HP	High				●
	250-499 HP	Premium				●
	500 and more HP	Standard				●
	500 and more HP	High				●
	500 and more HP	Premium				●
Process	Process Cooling/Refrig.	Standard				●
	Process Cooling/Refrig.	Efficient				●
	Process Heating	Standard				●
	Process Heating	Efficient				●
	Electrochemical Process	Standard				●
	Electrochemical Process	Efficient				●

Table 5-4 Summary of Commercial and Industrial Non-equipment Measures

End Use	Measure	Commercial Existing Buildings	Commercial New Construction	Industrial Existing Buildings	Industrial New Construction
HVAC	RTU - Maintenance	●	●	●	●
	RTU - Evaporative Precooler	●	●		
	Chiller - Chilled Water Reset	●	●	●	●
	Chiller - Chilled Water Variable-Flow System	●	●	●	●
	Chiller - Condenser Water Temprature Reset	●	●	●	●
	Chiller - High Efficiency Cooling Tower Fans	●	●	●	●
	Chiller - Turbocor Compressor	●	●	●	●
	Chiller - VSD	●	●	●	●
	Cooling - Economizer Installation	●	●	●	●
	Heat Pump - Maintenance	●	●	●	●
	Insulation - Ducting	●	●	●	●
	Repair and Sealing - Ducting	●		●	
	Insulation - Ceiling	●	●		
	Insulation - Radiant Barrier	●	●		
	Insulation - Wall Cavity		●		
	Cooking - Exhaust Hoods with Sensor Control	●	●		
	Fans - Energy Efficient Motors	●	●	●	●
	Fans - Variable Speed Control	●	●	●	●
	Pumps - Variable Speed Control	●	●		
	Thermostat - Clock/Programmable	●	●	●	●
	Roofs - High Reflectivity	●	●		
	Roofs - Green		●		
	Windows - High Efficiency	●	●		
	Retrocommissioning - HVAC	●		●	
	Commissioning - HVAC		●		●
	Furnace - Convert to Gas	●	●	●	●
Interior Lighting	Interior Fluorescent - Photocell Controlled T8 Dimming	●	●		
	Interior Fluorescent - Delamp and Install Reflectors	●		●	
	Interior Fluorescent - Bi-Level Fixture w/Occupancy Sen	●	●		
	Interior Fluorescent - High Bay Fixtures	●	●	●	●
	Interior Screw-in - Task Lighting	●	●	●	●
	Central Lighting Controls	●	●	●	●
	Occupancy Sensors	●	●	●	●
	Time Clocks and Timers	●	●	●	●
	LED Exit Lighting	●	●	●	●
	Hotel Guestroom Controls	●	●		
	Retrocommissioning - Lighting	●		●	
	Commissioning - Lighting		●		●
Exterior Lighting	Daylighting Controls	●	●	●	●
	Photovoltaic Installation	●	●	●	●
	Cold Cathode Lighting	●	●	●	●
	Induction Lamps	●	●		

Note: Conversion of electric furnaces to gas was only modeled for Small/Medium Commercial segment.

Table 5-4 Summary of Commercial and Industrial Non-equipment Measures (continued)

End Use	Measure	Commercial Existing Buildings	Commercial New Construction	Industrial Existing Buildings	Industrial New Construction
Water Heating	Faucet Aerators/Low Flow Nozzles	●	●		
	Hot Water Saver	●	●		
	Pipe Insulation	●	●		
	Tank Blanket/Insulation	●	●		
	Thermostat Setback	●	●		
	Convert to Gas	●	●		
	Heat Pump Water Heater	●	●		
Refrigeration	Floating Head Pressure	●	●		
	Insulation - Bare Suction Lines	●	●		
	Demand Defrost	●	●		
	High Efficiency Case Lighting	●	●		
	Evaporator Fan Controls	●	●		
	Anti-Sweat Heater/Auto Door Closer	●	●		
	Door Gasket Replacement	●	●		
	Night Covers	●	●		
	Strip Curtain	●	●		
	Vending Machine - Controller	●	●		
Office Equipment	ENERGY STAR Power Supply	●	●		
Miscellaneous	Laundry - High Efficiency Clothes Washer	●	●		
	Miscellaneous - Energy Star Water Cooler	●	●		
Machine Drive	Motors - Variable Frequency Drive			●	●
	Motors - Magnetic Adjustable Speed Drives			●	●
	Compressed Air - System Controls			●	●
	Compressed Air - System Optimization & Improvements			●	●
	Compressed Air - System Maintenance			●	●
	Compressed Air - Compressor Replacement			●	●
	Fan System - Controls			●	●
	Fan System - Optimization			●	●
	Fan System - Maintenance			●	●
	Pumping System - Controls			●	●
	Pumping System - Optimization			●	●
	Pumping System - Maintenance			●	●
	Pumps - Variable Speed Control	●	●	●	●
Industrial Process	Industrial Process Improvements	●	●		
	Refrigeration - System Controls			●	●
	Refrigeration - System Maintenance			●	●
	Refrigeration - System Optimization			●	●
Multiple End Uses	Energy Management System	●	●	●	●
	Retrocommissioning - Comprehensive	●			
	Advanced New Construction Designs		●		●
	Commissioning - Comprehensive		●		
	Pumps - Variable Speed Control	●	●	●	●
	Custom Measures	●	●	●	●

Note: Conversion of electric water heaters to gas only modeled for Small/Medium Commercial segment.

5.2 MEASURE CHARACTERISTICS

For each measure considered, the Global team developed the following data for input to the LoadMAP model:

- ***Energy Impacts:*** The energy-savings impacts represent the annual reduction in consumption attributable to each specific measure. Savings were developed as a percentage of the energy end use that the measure affects. This approach takes into account the efficiency of the equipment that is providing that end use. For example, savings due to increased insulation will be greater if heating is provided by electric resistance, and lower if heating is provided by a heat pump. For the residential and commercial sectors, the BEST simulation model was used to determine the savings impacts. The key advantage of utilizing BEST is that interactive effects between HVAC measures and other measures such as lighting and building construction are captured and quantified. In addition, the prototype modeling combines the primary market data with Spokane-specific Typical Meteorological Year (TMY) weather data to derive savings. For the industrial sector, secondary data resources such as the EPRI National Potential Study and DEEM were used to develop assessments of savings at the end-use level.
- ***Peak Demand Impacts:*** Savings during the peak demand periods are specified for each measure. These impacts relate to the energy savings and depend on each measure's "coincidence" with the system peak. To accurately express the peak impacts of the energy efficiency measures considered, the project used a combined approach of prototype simulation (BEST model) and Global's proprietary end-use load shape database, EnergyShape.
- ***Costs:*** For equipment measures, the measure characterization includes the full cost of purchasing and installing the equipment on a per-unit or per-square-foot basis for the residential and C&I sectors, respectively. For non-equipment measures in existing buildings, the cost likewise represents the full installed cost. For non-equipment measures in new construction, the approach is slightly different; the costs may be either the full cost of the measure, for example a programmable thermostat, or as appropriate, it may be the incremental cost of upgrading from a standard level to a higher efficiency level, such as upgrading from R13 to R26 insulation. These costs were developed specifically for the Spokane area and drew upon sources including the Sixth Plan databases.
- ***Measure Lifetimes:*** These estimates were derived from the technical data and secondary data sources that support the measure demand and energy savings analysis. Values were obtained from the Sixth Plan database, DEER database, DEEM, and other secondary sources.
- ***Applicability:*** This factor is an estimate of the percentage of either dwellings in the residential sector or square feet in the C&I sectors where it is technically feasible for the specific measure to be implemented. These figures are based on secondary data sources such as NEEA reports, California's DEER database, DEEM, and others.
- ***On Market and Off Market Availability:*** To account for the fact that some equipment will no longer be available for sale due to changes in appliance standards, or that some high-efficiency equipment is expected to enter the market during the study period, the project also developed on market and off market inputs, expressed as years, for the equipment measures.

5.2.1 Measure Cost Data Development

Costs for equipment and non-equipment measures include both material and labor costs associated with the measure's installation. These costs draw upon national construction cost averages.

The following references were used to develop the equipment and measure costs:

- Sixth Northwest Conservation and Electric Power Plan Conservation Supply Curves workbooks
- DEER – California Database for Energy Efficient Resources
- RS Means Facilities Maintenance and Repair Cost Data
- RS Means Mechanical Construction Costs
- RS Means Building Construction Cost Data
- USGBC — LEED New Construction & Major Renovation (2008)
- RS Means Green Buildings Project Planning & Cost Estimating Second Edition (2008)
- Grainger Catalog Volume 398, (2007-2008)

5.2.2 Representative Measure Data Inputs

To provide an example of the measure data, Table 5-5 and Table 5-6 present samples of the detailed data inputs behind equipment and non-equipment measures, respectively, for the case of residential central air conditioning in single-family homes. Table 5-5 displays the various efficiency levels available as equipment measures, as well as the corresponding useful life, usage, and cost estimates. These values all contribute to the outcome of the stock accounting model, in which the purchase of an above-standard unit is first analyzed for cost-effectiveness (comparing incremental cost to lifetime benefits) and then, for the levels that pass the screen, incorporated into the new units purchased.

Table 5-5 Sample Equipment Measures for Central Air Conditioning — Single Family Home Segment

Efficiency Level	Useful Life	Equipment Cost	Energy Usage(kWh/yr)	On Market	Off Market
SEER 13	15	$3,794	1,619	2009	2014
SEER 14 (ENERGY STAR)	15	$4,072	1,485	2009	2032
SEER 15 (CEE Tier 2)	15	$4,350	1,435	2009	2032
SEER 16 (CEE Tier 3)	15	$4,628	1,393	2009	2032
Ductless Mini-split System	20	$8,193	1,214	2009	2032

Table 5-6 lists the non-equipment measures affecting an existing single-family home's central air conditioning electricity use. These measures are also evaluated for cost-effectiveness based on the lifetime benefits relative to the cost of the measure. The total savings are calculated for each year of the model and depend on the base year saturation of the measure, the overall applicability of the measure, and the savings as a percentage of the relevant energy end uses. Residential central air conditioning provides energy savings, but no demand savings due to Avista's existing heating season peak. In addition to the Applicability factor, a Feasibility factor is applied to account for the feasibility of installing the measure.

Table 5-6 Sample Non-Equipment Measures – Single Family Homes, Existing

End Use	Measure	Saturation in 2009[18]	Applicability	Feasibility	Lifetime (years)	Measure Installed Cost	Energy Savings (%)	Demand Savings (%)
Cooling	Central AC — Early Replacement	0%	80%	10%	15	$2,895	10.0%	0%
Cooling	Central AC — Maintenance and Tune-Up	41%	100%	100%	4	$125	10.0%	0%
Cooling	Attic Fan — Installation	11%	50%	45%	18	$116	0.7%	0%
Cooling	Attic Fan — Photovoltaic	13%	100%	45%	19	$350	1.4%	0%
Cooling	Ceiling Fan	52%	100%	75%	15	$160	11.0%	0%
Cooling	Whole-House Fan	7%	25%	75%	18	$200	9.0%	0%
Cooling	Insulation — Ducting	15%	100%	75%	18	$500	3.0%	0%
Cooling	Repair and Sealing — Ducting	12%	100%	50%	18	$500	10.0%	0%
Cooling	Doors — Storm and Thermal	38%	100%	75%	11	$320	1.0%	0%
Cooling	Insulation — Infiltration Control	46%	100%	90%	12	$266	3.0%	0%
Cooling	Insulation — Ceiling	68%	90%	80%	20	$594	3.0%	0%
Cooling	Insulation — Radiant Barrier	5%	100%	90%	12	$923	5.0%	0%
Cooling	Roofs — High Reflectivity	5%	100%	10%	15	$1,550	6.1%	0%
Cooling	Windows — Reflective Film	5%	50%	90%	10	$267	7.0%	0%
Cooling	Windows — High Efficiency/ENERGY STAR	83%	100%	90%	25	$7,500	12.0%	0%
Cooling	Thermostat — Clock/Programmable	55%	75%	75%	11	$114	8.0%	0%
Cooling	Home Energy Management System	20%	50%	75%	20	$300	10.0%	0%
Cooling	Photovoltaics	0%	80%	60%	15	$17,000	50.0%	0%
Cooling	Trees for Shading	10%	90%	75%	20	$40	1.1%	0%

5.2.3 Conversion to Natural Gas

Conversion to natural gas (fuel switching) for both space heating and water heating was evaluated as a special case. These options were evaluated as non-equipment measures, though of course, they are in fact equipment changes. Modeling conversion to gas as a non-equipment measure allowed using the applicability and feasibility factors to better account for customers' real ability to implement these technologies.

For conversion of water heaters to natural gas, an applicability factor was developed based on Avista GIS data combined with the market profiles to indicate that approximately 63% of Washington homes and 57% of Idaho homes with electric water heating are within 500 feet of a gas main. The feasibility factor of 80% assumes that other factors, such as inability to accommodate venting, would prevent 20% of customers from making the switch to gas water heating. For heat pump water heaters, we assumed the technology is applicable to the remaining customers (100% – (63% * 80%) = 50% in Washington and 54% using a similar calculation for

[18] Note that saturation levels reflected for 2009 change over time as more measures are adopted.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 873 of 1069

Idaho). However, the feasibility factor is 50% for single family homes because only about half of these customers have water heating systems with tanks larger than 55 gallons that are suitable for heat pump water heaters. For the other housing types, the feasibility factors were lower due to the still lower saturation of larger than 55 gallon water heating systems. Conversion of electric furnaces to gas was modeled using similar assumptions.

Table 5-7 shows assumptions for water heating non-equipment measures in Washington single-family homes, including the conversion to gas and heat pump measures discussed above.

Table 5-7 Sample Non-Equipment Water Heating Measures – Single Family Homes, Existing, Washington

End Use	Measure	Saturation in 2009[19]	Applicability	Feasibility	Lifetime (years)	Measure Installed Cost	Energy Savings (%)	Demand Savings (%)
Water Heating	Faucet Aerators	53%	100%	90%	25	$24	3.7%	1.9%
Water Heating	Pipe Insulation	17%	100%	38%	13	$180	5.7%	2.9%
Water Heating	Low Flow Showerheads	75%	100%	80%	10	$96	17.1%	8.6%
Water Heating	Tank Blanket/Insulation	17%	100%	75%	10	$15	9.1%	4.6%
Water Heating	Thermostat Setback	17%	100%	75%	5	$40	9.1%	4.6%
Water Heating	Timer	17%	100%	40%	10	$194	8.0%	4.0%
Water Heating	Hot Water Saver	5%	100%	50%	5	$35	8.8%	4.4%
Water Heating	Convert to Gas	0%	63%	80%	15	$3,675	100.0%	100.0%
Water Heating	Heat Pump	0%	50%	50%	15	$1,500	30.0%	15.0%

The equipment measure data tables for all energy efficiency measures assessed in this study are presented in Appendix C for the residential sector and Appendix C for the C&I sectors.

5.3 APPLICATION OF MEASURES FOR TECHNICAL POTENTIAL

Technical potential, as we defined it in Chapter 2, is a theoretical construct that assumes the highest efficiency measures that are technically feasible to install are adopted by customers, regardless of cost or customer preferences. Thus, determining the technical potential is relatively straightforward; LoadMAP uses the energy use associated with the most efficient equipment options for each end use and technology, as well as the energy savings for all defined non-equipment measures that apply to that end use and technology, to calculate energy use at the technical potential level. For example, for residential central air conditioning, as shown in Table 5-5, the most efficient option is a ductless mini-split system. The multiple non-equipment measures shown in Table 5-7 are then applied to the energy used by the ductless mini-split system to further reduce CAC energy use. LoadMAP applies the savings due to the non-equipment measures one-by-one to avoid double counting of savings. The measures are evaluated in order of their B/C ratio, with the measure with the highest B/C ratio applied first. Each time a measure is applied, the baseline energy use for the end use is reduced and the percentage savings for the next measure is applied to the revised (lower) usage.

5.4 APPLICATION OF MEASURES FOR ECONOMIC POTENTIAL

Next, to determine the economic level of efficiency potential, it is necessary to perform an economic screen on each individual measure. The economic screen applied in this study for non-

[19] Note that saturation levels reflected for 2009 change over time as more measures are adopted.

equipment measures is a total resource cost (TRC) test that compares the lifetime benefits (both energy and peak demand) of each applicable measure with installed cost (including material, labor, and administration of a delivery mechanism, such as an energy efficiency program).[20] The lifetime benefits are obtained by multiplying the annual energy and demand savings for each measure by all appropriate avoided costs for each year, and discounting the dollar savings to the present value equivalent. Global assigns each measure values for savings, costs, and lifetimes as part of our measure characterization process. For economic screening of measures, incentives are not included because they represent a simple transfer from one party to another but have no effect on the overall measure cost.

The lifetime benefits of each energy efficiency measure depend on the forecast of Avista avoided costs. Avista provided projected avoided costs for energy and capacity over the study period. Figure 5-2 shows the avoided energy costs for the residential and C&I segments, which are 2009 real $/MWh and include Avista's adjustments for risk and the 10% Power Act premium. The avoided energy costs differ by segment due to the segments' differing load shapes. Figure 5-2 also shows the avoided capacity costs for Avista's overall system in 2009 real $/kW.

The LoadMAP model performs the economic screening dynamically, taking into account changing savings and cost data over time. Thus, some measures pass the economic screen for some — but not all — of the years in the forecast.

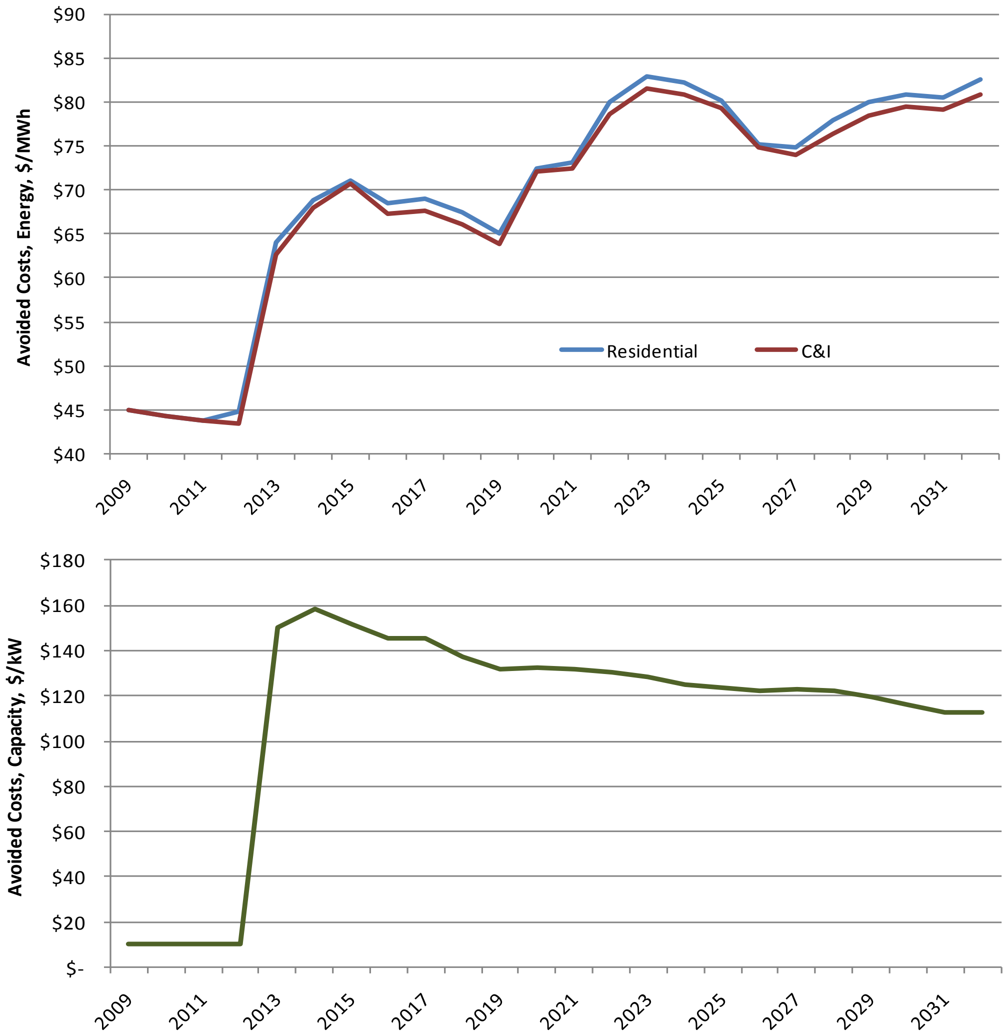
It is important to note the following about the economic screen:

- The economic evaluation of every measure in the screen is conducted relative to a baseline condition. For instance, in order to determine the kilowatt-hour (kWh) savings potential of a measure, kWh consumption with the measure applied must be compared to the kWh consumption of a baseline condition.
- The economic screening was conducted only for measures that are applicable to each building type and vintage; thus if a measure is deemed to be irrelevant to a particular building type and vintage, it is excluded from the respective economic screen table.

[20] Note that the TRC test is typically the industry standard for evaluating measure-level cost-effectiveness. There are other test perspectives that are often considered in energy efficiency potential studies. The Participant test measures the benefits and costs from the perspective of program participants as a whole. The Ratepayer Impact Measure (RIM) test measures the difference between the change in total revenues paid to a utility and the change in total costs to a utility resulting from the energy efficiency and demand response programs. The Utility Cost (UC) test measures the costs and benefits from the perspective of the utility administering the program. Neither the RIM nor UC tests are typically applied in the context of measure-level economic screens, but rather in the broader context of energy efficiency programs and initiatives put into place to deliver the energy efficiency measures.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 875 of 1069

Figure 5-2 Avoided Costs for Energy and Capacity



5.4.1 Equipment Measures Economic Screening

For equipment measures, LoadMAP evaluates the cost-effectiveness of each measure option, compared to the efficiency option that immediately precedes it. Continuing with the example of residential central air conditioning, as shown in Table 5-5, the standard efficiency option in 2010 is SEER 13. LoadMAP calculates the lifetime benefits and costs associated with each of the higher efficiency options to select the option with the highest net present value.

Table 5-8 shows the results of the economic screen for CAC for selected years, as well as results for two interior lighting technologies. In 2010, the most cost-effective option is SEER 14, while in 2012, due to rising energy costs, it changes to SEER 15. However, in 2015, due to federal energy efficiency standards, the SEER 13 unit goes off the market and SEER 14 becomes the standard efficiency unit. In 2015 and beyond, the economic screen selects the SEER 14 option because the marginal savings between the standard efficiency SEER 14 unit and the higher-efficiency options are not sufficient to make the higher-efficiency units economical. The table also shows how the economic choice for two of the lighting technology options varies over the study period.

Table 5-8 Economic Screen Results for Selected Residential Equipment Measures

Technology	2012	2017	2022	2027	2032
Central AC	SEER 13	SEER 14	SEER 14	SEER 14	SEER 14
Interior Lighting Screw-in	CFL	CFL	CFL	LED	LED
Interior Lighting Linear Fluorescent	T8	T8	T8	Super T8	Super T8

5.4.2 Non-equipment Measures Economic Screening

For non-equipment measures, LoadMAP evaluates the cost-effectiveness of each measure. The kWh savings are computed as the percent savings from the measure applied to the relevant end-use energy. If the measure passes the screen (has a B/C ratio greater than or equal to 1.0), the measure is included in economic potential. Otherwise, it is screened out for that year.

5.5 TOTAL MEASURES EVALUATED

Table 5-9 summarizes the number of equipment and non-equipment measures evaluated for each sector. In total, the project evaluated 4,332 energy efficiency measures.

Table 5-9 Number of Measures Evaluated

	Residential	C&I	Total Number of Measures
Equipment Measures Evaluated	1,284	608	1,892
Non-Equipment Measures Evaluated	1,524	916	2,440
Total Measures Evaluated	**2,808**	**1,524**	**4,332**

Appendix C shows the results of the economic screening process by segment, vintage, end use and measure for the residential sector. Appendix D shows the equivalent information for the commercial and industrial sectors.

ENERGY EFFICIENCY POTENTIAL RESULTS

This chapter presents the results of the energy-efficiency analysis. Before we provide the overall and sector-level results, we review the four levels of potential developed for this study.

6.1 DEFINITIONS OF POTENTIAL

In this study, we estimated four types of potential: *technical; economic;* and achievable potential, which is further divided into *maximum achievable,* and *realistic achievable*. Technical and economic potential are both theoretical limits to efficiency savings. Achievable potential embodies a set of assumptions about the decisions consumers make regarding the efficiency of the equipment they purchase, the maintenance activities they undertake, the controls they use for energy-consuming equipment, and the elements of building construction. Two types of achievable potential were developed for this study, maximum achievable and realistic achievable, to bound the range of achievable potential. For details on the types of potentials, see Chapter 2.

As with the baseline forecast, we developed the estimates of energy-efficiency potential using the LoadMAP model. We present high-level results in the rest of this chapter for the overall Avista electricity system. Separate results for Washington and Idaho are presented in Appendices A and B.

6.2 OVERALL ENERGY EFFICIENCY POTENTIAL

Maximum achievable potential across all sectors is 88,760 MWh (10.1 aMW) in 2012 and increases to a cumulative value of 2,905,702 MWh (331.7 aMW) by 2032. These savings represents 1.0% of the baseline forecast in 2012 and 22.6% in 2032. Realistic achievable potential in 2012 is 50,261 MWh (5.7 aMW) and reaches a cumulative value of 2,155,133 MWh (246.0 aMW) by 2032, for savings that are 0.6% and 16.8% of the baseline in 2012 and 2032 respectively. Between 2012 and 2032, the baseline forecast shows overall electricity consumption growth of 46%, but the realistic achievable potential forecast reduces growth by half to 23%. Technical potential by 2032 is 37.8% of the baseline and economic potential savings are 26.4% of the baseline, or roughly 70% of technical potential savings. MAP and RAP savings in 2012 are 86% and 64% respectively of the economic potential savings.

Figure 6-1 summarizes the energy-efficiency savings for the four potential levels relative to the baseline forecast for selected years. Figure 6-2 displays the energy use forecast for the four potential levels versus the baseline forecast. Table 6-1 presents the energy consumption and peak demand for the potential levels across sectors.

Figure 6-1 Summary of Energy Efficiency Potential Savings, All Sectors

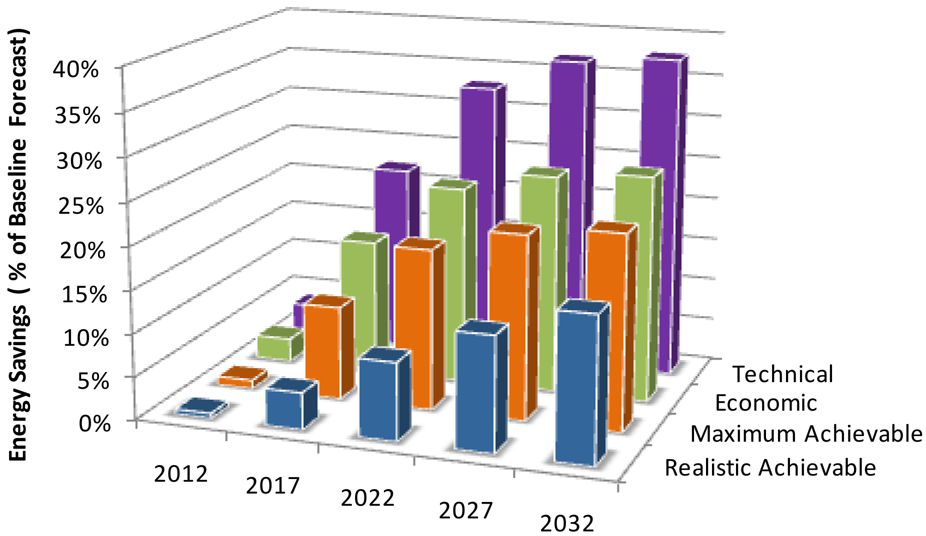


Figure 6-2 Energy Efficiency Potential Forecasts, All Sectors

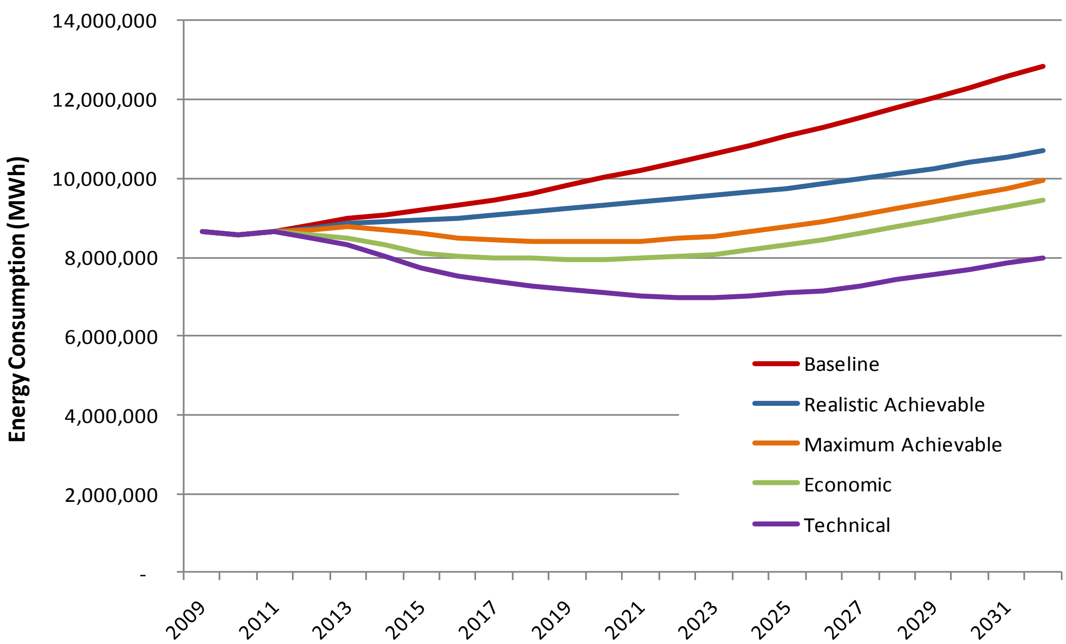


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 879 of 1069

Table 6-1 Summary of Energy Efficiency Potential, All Sectors

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	8,799,039	9,463,880	10,417,347	11,536,869	12,851,760
Baseline Peak Demand (MW)	1,780	1,880	2,080	2,306	2,566
Cumulative Energy Savings (MWh)					
Realistic Achievable	50,261	405,985	945,183	1,536,357	2,155,133
Maximum Achievable	88,760	1,035,470	1,952,473	2,476,694	2,905,702
Economic	244,292	1,493,608	2,411,399	2,937,775	3,387,203
Technical	329,513	2,087,061	3,435,475	4,250,217	4,852,362
Cumulative Energy Savings (% of Baseline)					
Realistic Achievable	0.6%	4.3%	9.1%	13.3%	16.8%
Maximum Achievable	1.0%	10.9%	18.7%	21.5%	22.6%
Economic	2.8%	15.8%	23.1%	25.5%	26.4%
Technical	3.7%	22.1%	33.0%	36.8%	37.8%
Peak Savings (MW)					
Realistic Achievable	14	84	183	306	431
Maximum Achievable	22	207	386	492	566
Economic	60	302	479	580	659
Technical	78	422	669	826	943
Peak Savings (% of Baseline)					
Realistic Achievable	0.8%	4.5%	8.8%	13.3%	16.8%
Maximum Achievable	1.2%	11.0%	18.6%	21.3%	22.1%
Economic	3.4%	16.0%	23.0%	25.2%	25.7%
Technical	4.4%	22.4%	32.2%	35.8%	36.8%

Table 6-2 and Figure 6-3 summarize cumulative realistic achievable potential by sector. Initially, the residential sector accounts for about 52% of the savings, but by the end of the study, the C&I sector becomes the source of 58% of the savings.

Table 6-2 Realistic Achievable Cumulative Energy-efficiency Potential by Sector, MWh

Segment	2012	2017	2022	2027	2032
Residential, WA	17,413	94,529	238,739	431,973	637,029
Residential, ID	8,692	43,922	97,705	172,179	260,003
C&I, WA	15,733	173,433	378,252	575,328	774,619
C&I, ID	8,423	94,102	230,487	356,878	483,482
Total	50,261	405,985	945,183	1,536,357	2,155,133

Figure 6-3 Realistic Achievable Cumulative Potential by Sector

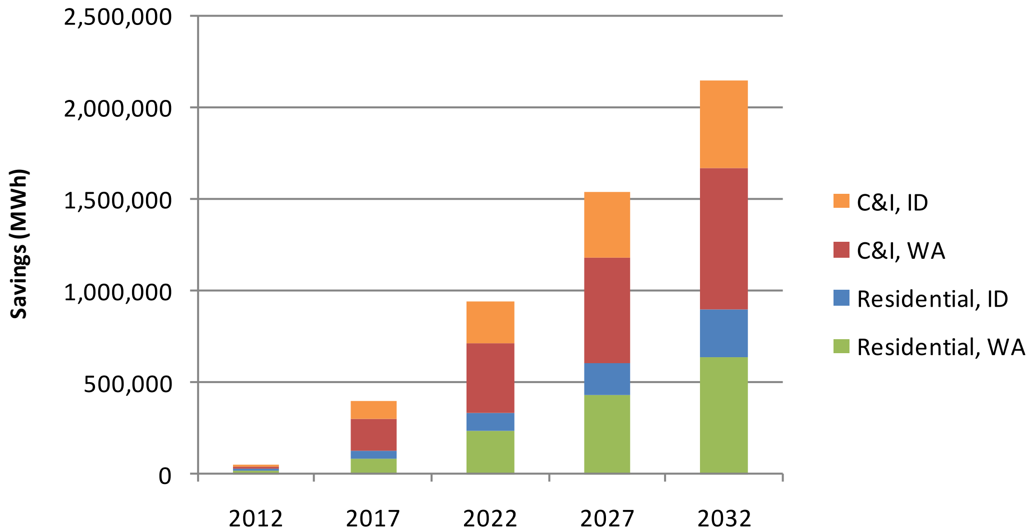


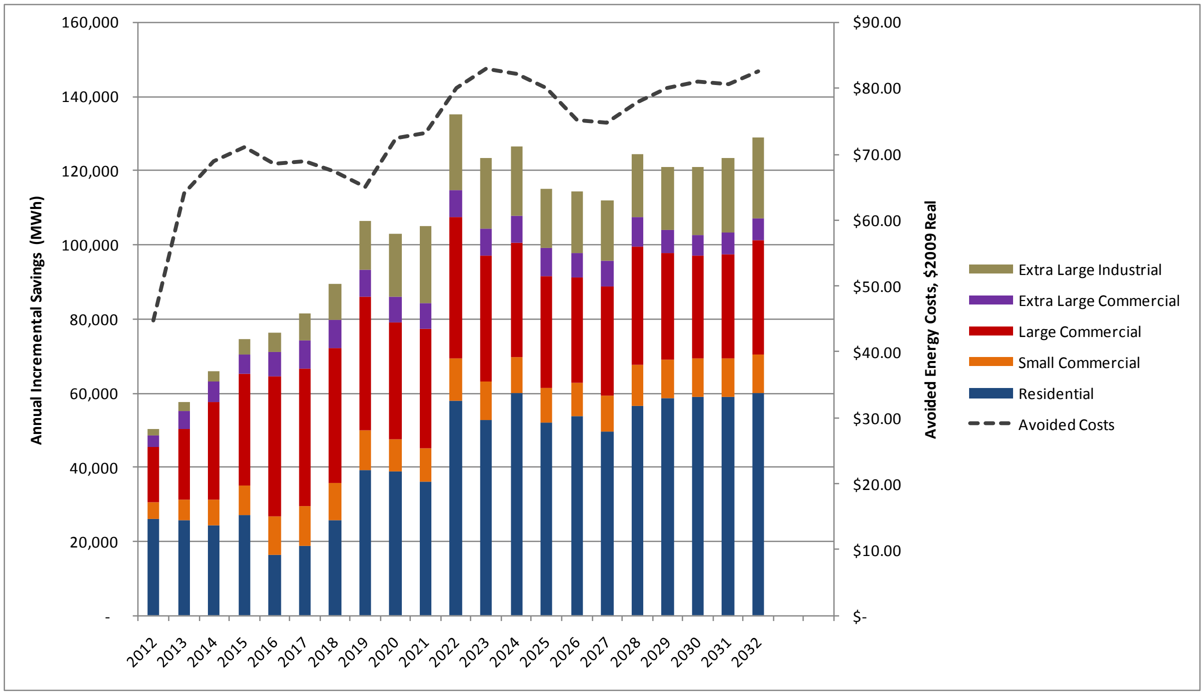
Table 6-3 shows the incremental annual realistic achievable potential by sector for 2012 through 2015. During this period, lighting and appliance standards slow the rate of growth in the residential baseline energy consumption, thus reducing the amount of incremental annual potential savings from residential conservation programs. On the other hand, C&I potential continues to grow. Complete annual incremental savings for Washington and Idaho appear in Appendices A and B respectively.

Table 6-3 Incremental Annual Realistic Achievable Energy-efficiency Potential by Sector, MWh

Segment	2012	2013	2014	2015
Residential, WA	17,413	17,161	16,488	18,514
Residential, ID	8,692	8,451	7,943	8,569
C&I, WA	15,733	21,165	26,869	30,393
C&I, ID	8,423	10,734	14,543	16,956
Total	**50,261**	**57,511**	**65,843**	**74,432**

In Figure 6-4, we can see how the annual incremental realistic achievable potential throughout the study tracks the avoided energy costs, with annual potential generally increasing or decreasing along with avoided costs. Note however that other factors also influence potential, particularly the rates at which programs can ramp up over time, which is particularly relevant to how potential changes from year to year in the early years of the study.

Figure 6-4 Incremental Annual Realistic Achievable Energy-efficiency (MWh) vs. Avoided Energy Cost



Note: Avoided costs are 2009 real dollars and include energy costs, risk, and the 10% Power Act premium.

6.3 RESIDENTIAL SECTOR

Realistic achievable potential savings for the residential sector in both states is 26,105 MWh in 2012, or 0.7% of the sector's baseline forecast. It reaches 897,032 MWh, or 16.0% of the baseline forecast by 2032. Technical and economic potential savings are 37.7% and 24.5% respectively. Figure 6-5 depicts the potential savings estimates graphically. Figure 6-6 shows the energy use forecasts under the four types of potential versus the baseline forecast. Table 6-3 presents estimates for energy and peak demand under the four types of potential.

Figure 6-5 Energy Efficiency Potential Savings, Residential Sector

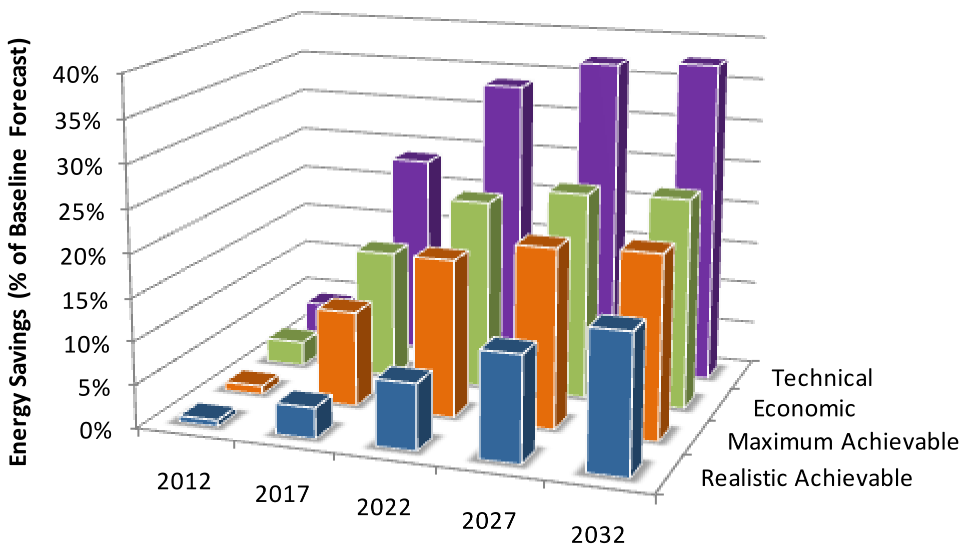


Figure 6-6 Energy Efficiency Potential Forecast, Residential Sector

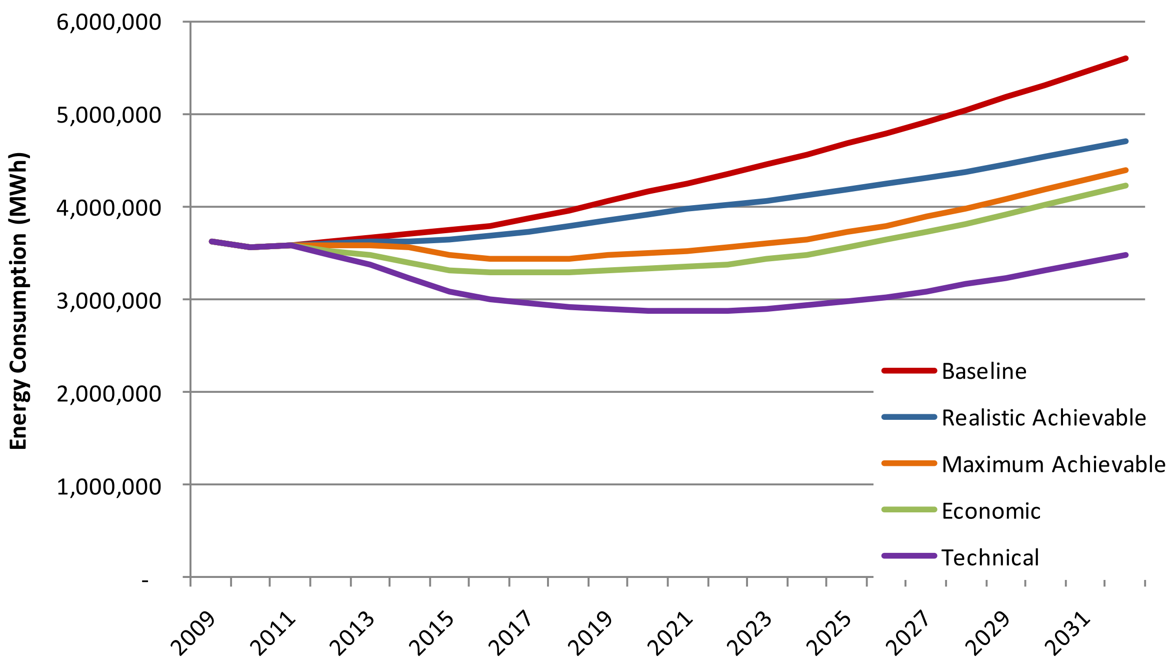


Table 6-4 Energy Efficiency Potential, Residential Sector

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	3,626,696	3,871,294	4,356,240	4,918,847	5,600,787
Baseline Peak Demand (MW)	991	1,026	1,150	1,288	1,449
Cumulative Energy Savings (MWh)					
Realistic Achievable	26,105	138,450	336,444	604,152	897,032
Maximum Achievable	36,300	429,065	798,829	1,024,671	1,192,794
Economic	104,111	583,427	967,788	1,188,497	1,373,869
Technical	153,100	918,965	1,468,041	1,825,587	2,112,855
Cumulative Energy Savings (% of Baseline)					
Realistic Achievable	0.7%	3.6%	7.7%	12.3%	16.0%
Maximum Achievable	1.0%	11.1%	18.3%	20.8%	21.3%
Economic	2.9%	15.1%	22.2%	24.2%	24.5%
Technical	4.2%	23.7%	33.7%	37.1%	37.7%
Peak Savings (MW)					
Realistic Achievable	10	44	100	179	262
Maximum Achievable	14	120	232	301	343
Economic	38	171	286	349	396
Technical	51	256	407	503	579
Peak Savings (% of Baseline)					
Realistic Achievable	1.1%	4.3%	8.7%	13.9%	18.1%
Maximum Achievable	1.4%	11.7%	20.2%	23.3%	23.7%
Economic	3.8%	16.7%	24.9%	27.1%	27.3%
Technical	5.1%	24.9%	35.4%	39.0%	40.0%

6.3.1 Residential Potential by Market Segment

Table 6-5 shows the baseline forecast and realistic achievable potential energy savings for the four residential segments in selected years. Single-family homes in Washington and Idaho account for 65% and 68% of each state's residential sector total sales during the base year and throughout the forecast. Thus, as one would expect, single-family homes account for the largest share of potential savings. Table 6-6 takes a closer look at savings by segment and potential level in 2022, the mid-point of the 20-year period.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 884 of 1069

Table 6-5 Residential Sector, Baseline and Realistic Achievable Potential by Segment

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)					
Single Family	2,394,930	2,551,956	2,876,301	3,252,564	3,709,958
Multi Family	203,544	222,114	253,265	288,585	330,209
Mobile Home	126,939	133,923	149,975	168,639	191,313
Limited Income	901,283	963,301	1,076,699	1,209,059	1,369,306
Total	3,626,696	3,871,294	4,356,240	4,918,847	5,600,787
Cumulative Energy Savings, Realistic Achievable Potential (MWh)					
Single Family	18,783	96,418	240,911	426,483	630,128
Multi Family	1,066	5,833	14,343	28,236	42,801
Mobile Home	985	4,280	7,677	13,381	20,040
Limited Income	5,272	31,920	73,512	136,051	204,063
Total	26,105	138,450	336,444	604,152	897,032
% of Total Residential Cumulative Energy Savings					
Single Family	72.0%	69.6%	71.6%	70.6%	70.2%
Multi Family	4.1%	4.2%	4.3%	4.7%	4.8%
Mobile Home	3.8%	3.1%	2.3%	2.2%	2.2%
Limited Income	20.2%	23.1%	21.8%	22.5%	22.7%

Table 6-6 Residential Realistic Achievable Potential by Housing Type, 2022

Forecast	Single Family	Multi Family	Mobile Home	Limited Income	Total
Baseline Forecast (MWh)	2,876,301	253,265	149,975	1,076,699	4,356,240
Cumulative Energy Savings (MWh)					
Realistic Achievable	240,911	14,343	7,677	73,512	336,444
Economic Potential	679,288	46,859	21,400	220,241	967,788
Technical Potential	950,449	77,463	52,154	387,975	1,468,041
Cumulative Energy Savings % of Baseline					
Realistic Achievable	8.4%	5.7%	5.1%	6.8%	7.7%
Economic Potential	23.6%	18.5%	14.3%	20.5%	22.2%
Technical Potential	33.0%	30.6%	34.8%	36.0%	33.7%

6.3.2 Residential Potential by End Use, Technology, and Measure Type

Table 6-7 provides estimates of savings for each end use and type of potential.

- ***Water Heating*** offers the highest cumulative technical potential over the 20-year period, which reflects the high potential for conversion to natural gas in homes where gas is available (see discussion below) and use of heat pump water heaters where gas is not available, as well as a wide range of other water heating measures. Conversion to natural gas passes the TRC test throughout the study period for most Washington housing types and for single family homes in Idaho. In contrast, based on the study's assumptions of equipment cost and avoided cost, heat pump water heaters are cost-effective in new single family homes by 2014, but do not become cost-effective for existing homes until 2024 in Idaho and 2028 in Washington. Water heating also has the highest cumulative realistic achievable potential.
- ***Space Heating*** offers the second-highest cumulative technical potential over the study and its economic potential is slightly higher than water heating, again due to the potential for conversion to natural gas (see discussion below), but also due to shell measures, controls, and advanced new construction designs. Based on realistic achievable savings, space heating also ranks second.
- ***Interior lighting*** offers the fourth-largest technical potential savings, but the third-largest economic and realistic achievable potential. The lighting standard begins its phase-in starting in 2012, which coincides with the availability in the market place of advanced incandescent lamps that meet the minimum efficacy standard. The baseline forecast assumes that people will install both advanced incandescent and CFLs in screw-in lighting applications. For technical potential, LED lamps are the most efficient option, starting in 2012. However, LED lamps do not pass the economic screen until 2022, when they begin to become cost-effective for pin-based fixtures. Nonetheless, there is significant economic and realistic achievable lighting potential due to conversion from advanced incandescents to CFLs.
- ***Appliances*** rank sixth based on technical potential, but fourth in terms of realistic achievable potential. This reflects the cost-effectiveness of the highest-efficiency white-goods appliances for both new construction and for replacing failed units, as well as the market acceptance of high-efficiency appliances. Removal of second refrigerators and freezers also contributes to economic and realistic achievable potential within this end use.
- ***Cooling*** offers the third-highest technical potential, but is sixth based on realistic achievable potential. Initially technical potential is low but ramps up due to the assumption of increased saturation of air conditioning over time. Economic potential for cooling in 2031 is about 40% of technical potential because the higher SEER units do not pass the economic screen based on based on the study's assumptions of equipment cost and avoided cost.
- ***Home electronics*** also offer substantial savings opportunities. Technical potential reflects the purchase of ENERGY STAR units for all technologies, except PCs and laptops for which a super-efficient "climate saver" option is available in the marketplace. However, the climate saver options are not cost-effective during the forecast horizon, so economic potential reflects the purchase of ENERGY STAR units across all technologies in this end use.

Table 6-7 Residential Cumulative Savings by End Use and Potential Type (MWh)

End Use	Case	2012	2017	2022	2027	2032
Cooling	Realistic Achievable	14	2,443	8,588	23,412	44,892
	Economic	364	22,925	41,690	60,482	82,185
	Technical	4,155	63,885	102,963	147,309	200,588
Space Heating	Realistic Achievable	306	17,366	81,141	187,511	304,466
	Economic	9,645	157,044	303,749	401,120	480,554
	Technical	13,047	206,921	390,626	523,886	650,322
Heat/Cool	Realistic Achievable	12	872	2,353	6,048	15,539
	Economic	447	12,872	15,291	18,697	27,916
	Technical	3,334	27,773	47,801	66,829	76,389
Water Heating	Realistic Achievable	636	25,578	102,451	201,179	317,521
	Economic	12,121	135,781	297,102	388,156	462,418
	Technical	35,027	281,264	527,056	667,224	745,280
Appliances	Realistic Achievable	1,282	12,411	26,859	42,554	59,056
	Economic	5,548	61,277	80,081	85,195	91,618
	Technical	7,229	78,554	105,335	113,831	120,932
Interior Lighting	Realistic Achievable	18,569	52,269	64,439	74,958	71,445
	Economic	55,377	107,842	116,225	106,057	86,182
	Technical	64,748	148,015	146,127	136,520	126,690
Exterior Lighting	Realistic Achievable	3,281	10,532	10,777	10,042	8,058
	Economic	9,770	21,965	17,611	13,313	9,494
	Technical	11,200	28,680	24,906	22,638	22,320
Electronics	Realistic Achievable	1,780	13,544	32,080	45,568	57,382
	Economic	8,967	45,853	67,702	76,036	87,323
	Technical	12,390	65,526	93,981	106,595	122,734
Miscellaneous	Realistic Achievable	225	3,435	7,756	12,880	18,673
	Economic	1,871	17,869	28,336	39,442	46,180
	Technical	1,970	18,348	29,247	40,754	47,600
Total	Realistic Achievable	26,105	138,450	336,444	604,152	897,032
	Economic	104,111	583,427	967,788	1,188,497	1,373,869
	Technical	153,100	918,965	1,468,041	1,825,587	2,112,855

Figure 6-7 focuses on realistic achievable potential by end use in selected years. As discussed above, by the end of the study period, water heating and space heating are the largest contributors to realistic achievable potential. In the early years of the study period, lighting maintains its historic role as the largest contributor to residential sector savings, due to remaining opportunities for conversion from incandescent lighting (both today's standard lamps and the new advanced incandescents) to CFLs. By 2022, however, the percentage of savings due to lighting is projected to drop off as advanced incandescents become the new baseline.

Figure 6-7 Residential Realistic Achievable Potential by End Use, Selected Years

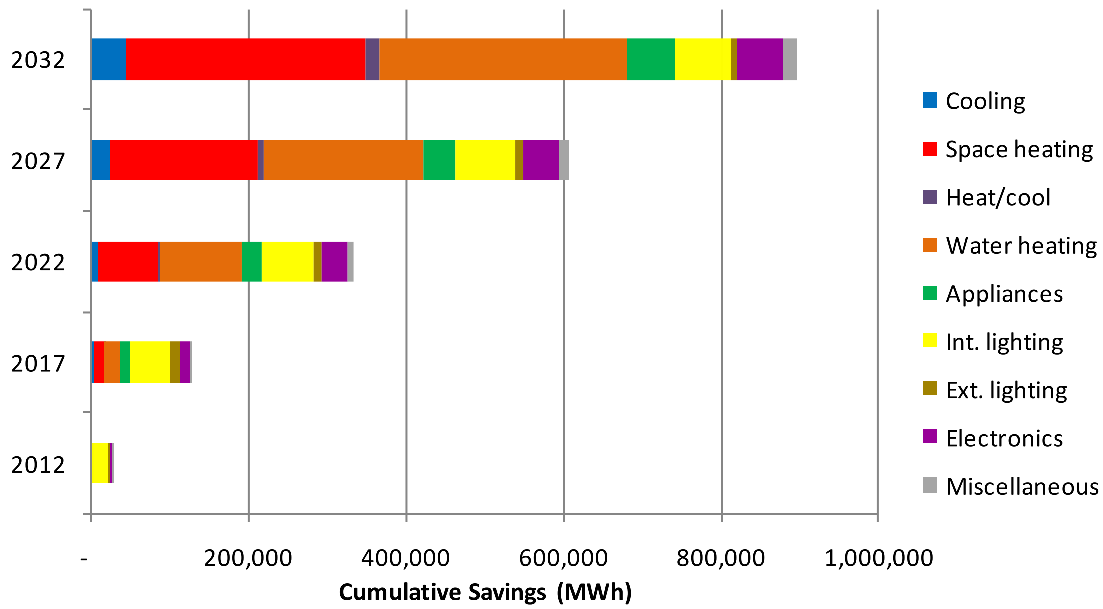


Table 6-8 shows the savings by end use and market segment in 2022. The segments are similar in terms of the savings opportunities by end use, but there are a few notable differences. Single-family homes have more exterior lighting and so have more savings potential for this end use. Similarly, single-family homes have swimming pools and therefore have more potential for savings in pool pumps, which are included in miscellaneous loads. Water heating is a higher proportion of potential savings in multi-family homes, mobile homes, and limited income homes, reflecting the smaller home sizes and thus diminished savings potential for space conditioning and appliances, compared to single family homes.

Table 6-8 Residential Potential by End Use and Market Segment, 2022 (MWh)

	Single Family	Multi Family	Mobile Home	Limited Income	Total
Cooling	4,975	258	129	3,226	8,588
Space heating	63,291	3,985	908	12,957	81,141
Heat/cool	2,138	12	88	114	2,353
Water heating	65,162	6,257	1,293	29,739	102,451
Appliances	19,090	529	950	6,290	26,859
Interior lighting	45,467	2,415	2,203	14,354	64,439
Exterior lighting	8,875	127	480	1,295	10,777
Electronics	25,054	754	1,302	4,970	32,080
Miscellaneous	6,860	6	324	566	7,756
Total	**240,911**	**14,343**	**7,677**	**73,512**	**336,444**

As described in Chapter 5, using our LoadMAP model, we develop separate estimates of potential for equipment and non-equipment measures. Table 6-9 presents results for equipment at the technology level, for which realistic chievable potential is greater than zero.

Table 6-9 Residential Cumulative Realistic Achievable Potential by End Use and Equipment Measures, Selected Years (MWh)

End Use	Technology	2012	2017	2022
Cooling	Central AC	-	152	167
Heat/Cool	Air Source Ht. Pump	-	-	-
Water Heating	Water Heater	140	1,047	1,096
Appliances	Clothes Washer	83	1,014	2,552
	Clothes Dryer	103	708	1,299
	Dishwasher	115	1,074	2,621
	Refrigerator	438	1,999	4,064
	Freezer	333	1,651	3,592
	Second Refrigerator	154	747	1,424
	Stove	22	165	371
Interior Lighting	Screw-in	17,292	42,771	48,939
	Linear Fluorescent	173	1,906	3,576
	Pin-based	1,102	7,398	11,079
Exterior Lighting	Screw-in	3,256	10,404	10,606
	High Intensity/Flood	25	128	171
Electronics	Personal Computers	1,148	9,279	15,975
	TVs	620	3,260	6,039
Miscellaneous	Pool Pump	171	1,581	3,896
	Furnace Fan	45	560	1,668
Total		**25,220**	**85,845**	**119,135**

Conversion of electric water heaters and electric furnaces to natural gas was modeled as a special case within the measure analysis to allow consideration of feasibility (e.g., homes too far from a natural gas line), as well as to allow the option of a heat pump water heater for homes where conversion to gas is not feasible. Table 6-10 shows the residential sector achievable savings from converting electric furnaces and water heaters to natural gas. Conversion ramps up slowly, but because it completely removes use of electricity from two of the largest ends uses, it accounts for a substantial portion of savings by 2032: For water heating, about one-fourth of the savings from conversion to gas occurs in new construction. For furnaces, the fraction due to new construction is roughly one-third.

Table 6-10 Residential Realistic Achievable Savings from Conversion to Natural Gas (MWh)

	2012	2017	2022	2027	2032
Water heater —convert to gas Realistic achievable potential (MWh)	267	10,214	69,745	145,049	216,351
Water heater –convert to gas (% of Res. Achievable potential)	0.5%	2.5%	7.4%	9.4%	10.0%
Furnace — convert to gas Realistic achievable potential (MWh)	244	7,803	49,719	106,607	171,095
Furnace — convert to gas (% of Res. Achievable potential)	0.5%	1.9%	5.3%	6.9%	7.9%

Table 6-11 presents savings results for non-equipment measures for which realistic achievable potential is greater than zero, sorted by cumulative potential in 2032. Note that because a measure such as insulation provides both space cooling and space heating savings, Table 6-11 does not break down savings by end use.

Table 6-11 Residential Realistic Achievable Savings for Non-equipment Measures (MWh), Selected Years

Measure	2012	2017	2022
Water Heater - Convert to Gas	267	10,214	69,745
Furnace - Convert to Gas	244	7,803	49,719
Advanced New Construction Designs	1	180	4,206
Repair and Sealing - Ducting	20	2,713	7,763
Insulation - Infiltration Control	20	2,731	7,696
Water Heater - Thermostat Setback	142	8,150	13,721
Home Energy Management System	7	1,175	4,146
Water Heater - Hot Water Saver	6	426	5,447
Freezer - Remove Second Unit	22	3,246	6,959
Electronics - Reduce Standby Wattage	13	1,004	10,066
Thermostat - Clock/Programmable	21	2,859	7,907
Insulation - Foundation	1	438	1,979
Air Source Heat Pump - Maintenance	12	872	2,353
Refrigerator - Remove Second Unit	13	1,807	3,977
Water Heater - Faucet Aerators	12	978	2,341
Insulation - Ducting	1	195	1,024
Insulation - Wall Cavity	1	275	1,234
Water Heater - Tank Blanket/Insulation	49	2,596	4,051
Ceiling Fan - Installation	0	87	743
Room AC - Removal of Second Unit	6	919	2,280
Water Heater - Heat Pump	-	23	793
Water Heater - Timer	8	1,152	2,477
Insulation - Ceiling	2	400	1,201
Water Heater - Low Flow Showerheads	9	887	1,762
Central AC - Maintenance and Tune-Up	-	-	-
Pool - Pump Timer	8	1,294	2,192
Insulation - Wall Sheathing	0	50	230
Water Heater - Pipe Insulation	2	105	1,018
Whole-House Fan - Installation	0	27	278
Total	**885**	**52,605**	**217,309**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 890 of 1069

Looking at both the equipment (Table 6-9) and non-equipment measure results (Table 6-11), we see that initially nearly all of the savings come from the equipment measures, particularly lighting, but over time an increasing proportion of the savings come from conversion of water heating and space heating to natural gas. At the study mid-point in 2022, the four measures with the greatest realistic achievable poential are:

- Water heater conversion to gas (69,745 MWh)
- Furnace conversion to gas (49,719 MWh)
- Replacement of interior screw in lamps (48,939 MWh)
- Replacement of personal computers with ENERGY STAR units (15,975 MWh)

These four measures provide realistic achievable potential of 184,378 MWh in 2022, which is approximately 55% of the total 2022 potential for the residential sector.

6.4 COMMERCIAL AND INDUSTRIAL SECTOR POTENTIAL

Realistic achievable potential savings for the C&I sector in both states is 24,155 MWh in 2012, or 0.5% of the sector's baseline forecast. It reaches 1,258,101 MWh, or 17.4% of the baseline forecast by 2032. Technical and economic potential savings are 37.8% and 27.8% of the baseline forecast respectively. Figure 6-8 depicts the potential savings estimates graphically. Figure 6-9 shows the energy use forecasts under the four types of potential versus the baseline forecast. Table 6-12 presents estimates for the sector's energy and peak demand under the four types of potential.

Figure 6-8 Energy Efficiency Potential Savings, Commercial and Industrial Sector

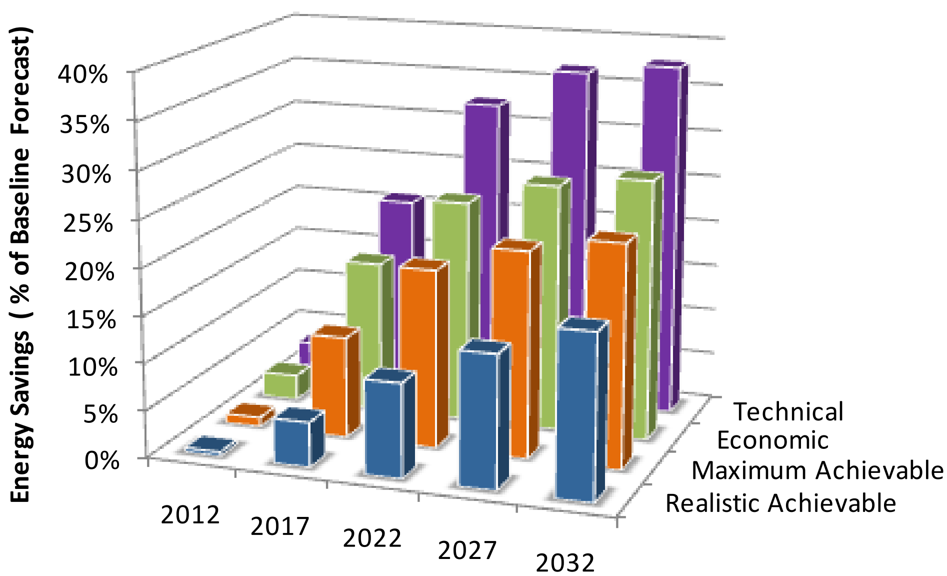


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 891 of 1069

Figure 6-9 Energy Efficiency Potential Forecast, Commercial and Industrial Sector

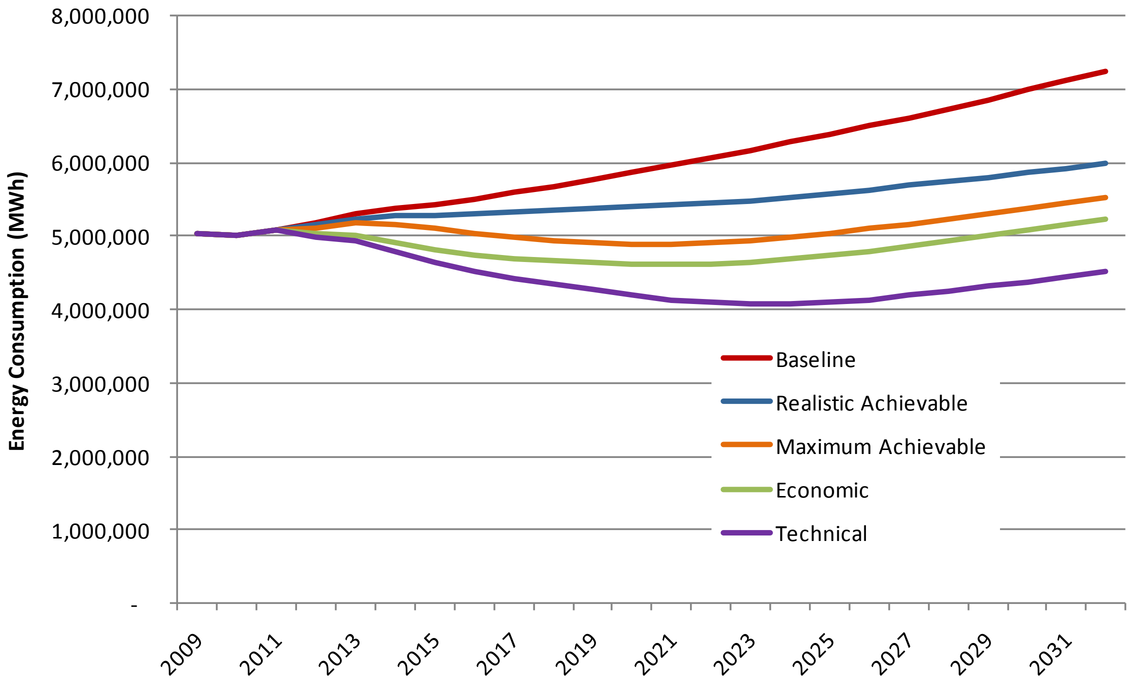


Table 6-12 Energy Efficiency Potential, Commercial and Industrial Sector

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	5,172,344	5,592,586	6,061,107	6,618,022	7,250,973
Cumulative Energy Savings (MWh)					
Realistic Achievable	24,155	267,535	608,739	932,205	1,258,101
Maximum Achievable	52,460	606,406	1,153,644	1,452,022	1,712,907
Economic	140,180	910,181	1,443,612	1,749,278	2,013,333
Technical	176,414	1,168,096	1,967,434	2,424,630	2,739,507
Cumulative Energy Savings (% of Baseline)					
Realistic Achievable	0.5%	4.8%	10.0%	14.1%	17.4%
Maximum Achievable	1.0%	10.8%	19.0%	21.9%	23.6%
Economic	2.7%	16.3%	23.8%	26.4%	27.8%
Technical	3.4%	20.9%	32.5%	36.6%	37.8%
Peak Savings (MW)					
Realistic Achievable	4	40	84	127	169
Maximum Achievable	8	88	154	191	223
Economic	22	130	193	231	263
Technical	27	166	262	324	364
Peak Savings (% of Baseline)					
Realistic Achievable	0.5%	4.7%	9.0%	12.4%	15.1%
Maximum Achievable	1.0%	10.3%	16.6%	18.8%	20.0%
Economic	2.7%	15.3%	20.8%	22.7%	23.6%
Technical	3.4%	19.4%	28.2%	31.8%	32.6%

6.4.1 Commercial Potential by Market Segment and State

Table 6-13 shows the baseline forecast and realistic achievable potential energy savings for the four C&I segments. Large Commercial customers account for the largest portion of the baseline forecast and thus also have the largest realistic achievable potential. In 2012 the Large Commercial segment's realistic achievable potential is 14,754 MWh or 61.1% of C&I total realistic achievable potential. By 2032 its share of C&I potential has dropped slightly to 50.8%. In contrast, the Extra Large Industrial customers increase their role in savings over the study period, beginning with only 1,673 MWh of realistic achievable potential or 6.9% of total C&I potential in 2012, but growing by 2032 to cumulative realistic achievable savings of 285,178 MWh or 22.7% of the C&I sector savings. Table 6-14 takes a closer look at savings by segment and potential level in 2022, the mid-point of the 20-year period.

Table 6-13 C&I Sector, Baseline and Realistic Achievable Potential by Segment

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)					
Small/Med. Commercial	730,499	772,442	832,324	906,807	992,374
Large Commercial	2,266,380	2,403,446	2,592,110	2,822,788	3,088,354
Extra Large Commercial	347,860	421,489	457,725	497,943	541,389
Extra Large Industrial	1,827,605	1,995,209	2,178,948	2,390,485	2,628,857
Total	5,172,344	5,592,586	6,061,107	6,618,022	7,250,973
Cumulative Energy Savings, Realistic Achievable Potential (MWh)					
Small/Med. Commercial	4,513	46,375	96,231	144,812	197,619
Large Commercial	14,754	164,668	338,450	491,020	638,562
Extra Large Commercial	3,216	33,198	69,605	105,163	136,743
Extra Large Industrial	1,673	23,294	104,453	191,210	285,178
Total	24,155	267,535	608,739	932,205	1,258,101
% of Total C&I Cumulative Energy Savings					
Small/Med. Commercial	18.7%	17.3%	15.8%	15.5%	15.7%
Large Commercial	61.1%	61.6%	55.6%	52.7%	50.8%
Extra Large Commercial	13.3%	12.4%	11.4%	11.3%	10.9%
Extra Large Industrial	6.9%	8.7%	17.2%	20.5%	22.7%

Table 6-14 C&I Realistic Achievable Potential by Segment, 2022

Forecast	Small/Med. Commercial	Large Commercial	Extra Large Commercial	Extra Large Industrial	Total
Baseline Forecast (MWh)	832,324	2,592,110	457,725	2,178,948	6,061,107
Cumulative Energy Savings (MWh)					
Realistic achievable	96,231	338,450	69,605	104,453	608,739
Economic Potential	193,950	646,644	144,275	458,743	1,443,612
Technical Potential	308,119	951,283	184,560	523,472	1,967,434
Cumulative Energy Savings % of Baseline					
Realistic achievable	12%	13%	15%	5%	10%
Economic Potential	23%	25%	32%	21%	24%
Technical Potential	37%	37%	40%	24%	32%

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 893 of 1069

6.4.2 C&I Potential by End Use, Technology, and Measure Type

Table 6-15 presents the C&I sector savings by end use and potential type. Recall that the Small/Medium Commercial and Large Commercial Segments include a small percentage of industrial-type customers. Hence, we included a non-equipment measure called Industrial Process Improvements to capture potential savings from these customers. In addition, the miscellaneous category includes non-HVAC motors to capture motor use within small industrial facilities. For all C&I customers, a custom measure category was included to serve as a "catch all" for measures for which costs and savings are not easily quantified and that could be part of a program such as Avista's existing Site-Specific incentive program. In terms of how potential is divided among the various end uses, we note the following:

- ***Interior lighting*** offers the largest technical, economic, and achievable potential. The high technical potential of 892,840 MWh in 2032 is a result of LED lighting that is now commercially available in screw-in and linear lighting applications, as well as numerous fixture improvement and control options. However, LED lighting is not cost effective given the study's avoided cost assumptions, so economic potential reflects installation of CFL, T5, and Super T8 lamps throughout most of the commercial sector. Still, this results in realistic achievable potential of 598,564 MWh by 2032.
- ***Cooling*** has the third highest savings for technical potential at 302,301 MWh in 2032, and many of the cooling measures are cost effective, including installation of high-efficiency equipment, thermal shell measures, HVAC control strategies, and retrocommissioning. Because the market for cooling technologies is mature, these savings are relatively easy to capture, as reflected in the ramp rates for these measures. Thus realistic achievable potential for cooling, at 119,700 MWh, is the second highest among C&I end uses.
- ***Ventilation*** is second in terms of technical and economic potential due to conversion to variable air volume systems, high-efficiency and variable speed control fans, and retrocommissioning. Realistic achievable potential in 2032 of 117,020 MWh ranks this end use third, just behind cooling.
- ***Machine drive*** ranks fourth in realistic achievable potential at 101,018 MWh in 2032. Even though the National Electrical Manufacturer's Association (NEMA) standards make premium efficiency motors the baseline efficiency level, savings remain available from upgrading to still more efficient levels.
- ***Office equipment, exterior lighting, and industrial process improvements*** offer smaller but still significant realistic achievable potential by 2032 at 73,152 MWh, 68,467 MWh, and 60,759 MWh respectively.
- ***Commercial refrigeration, food preparation, and water heating*** savings are relatively small across the C&I sector as a whole, though these end uses can offer significant savings in supermarkets, restaurants, hospitals, and other buildings where these end use constitute a larger portion of overall energy use.

Table 6-15 C&I Cumulative Savings by End Use and Potential Type, Selected Years, (MWh)

End Use	Case	2012	2017	2022	2027	2032
Cooling	RAP	205	14,595	50,416	82,103	119,700
	Economic	2,848	51,234	108,395	146,209	191,484
	Technical	7,425	96,886	200,488	252,951	302,301
Space Heating	RAP	17	2,185	11,476	22,223	36,932
	Economic	346	11,546	31,407	45,917	66,710
	Technical	571	18,000	51,975	71,620	94,893
Heat/Cool	RAP	47	3,765	6,874	8,352	10,413
	Economic	541	8,928	11,319	13,415	15,092
	Technical	743	10,317	13,864	16,814	18,949
Ventilation	RAP	457	7,102	35,467	69,845	117,020
	Economic	7,544	56,221	144,530	201,459	237,313
	Technical	10,719	82,071	220,464	294,789	323,008
Water Heating	RAP	205	6,315	13,969	20,663	27,581
	Economic	1,907	19,044	27,780	34,762	36,791
	Technical	13,251	96,031	174,865	249,540	274,478
Food Preparation	RAP	213	2,665	7,608	14,695	22,009
	Economic	2,824	17,789	32,528	39,188	42,755
	Technical	3,215	19,520	35,976	43,195	47,322
Refrigeration	RAP	185	1,877	6,192	11,901	17,567
	Economic	2,768	13,518	25,844	33,360	37,422
	Technical	3,273	17,982	40,008	51,933	58,855
Interior Lighting	RAP	17,619	166,503	328,877	477,040	598,564
	Economic	78,200	461,679	609,517	700,595	803,195
	Technical	85,734	504,965	681,379	784,870	892,840
Exterior Lighting	Achievable	1,634	23,519	46,019	57,477	68,467
	Economic	7,096	67,172	78,193	81,864	86,650
	Technical	7,893	73,413	87,263	98,652	110,984
Office Equipment	RAP	2,642	27,112	44,602	58,637	73,152
	Economic	19,053	86,895	91,341	95,389	99,348
	Technical	25,452	119,267	126,773	134,377	142,248
Machine Drive	RAP	581	9,104	42,030	72,656	101,018
	Economic	6,560	57,477	158,387	196,285	214,864
	Technical	6,994	67,404	204,459	258,683	286,647
Process	RAP	345	2,590	14,014	33,699	60,759
	Economic	10,390	57,275	120,473	154,151	172,559
	Technical	10,390	57,275	120,473	154,151	172,559
Miscellaneous	RAP	7	204	1,194	2,914	4,921
	Economic	103	1,403	3,897	6,684	9,150
	Technical	753	4,964	9,446	13,056	14,423
Total	RAP	24,154	267,494	608,739	932,221	1,258,104
	Economic	140,121	909,897	1,443,612	1,749,309	2,013,338
	Technical	175,565	1,165,177	1,967,434	2,424,763	2,739,528

Figure 6-10 focuses on achievable potential by end use in selected years. Interior lighting remains the largest source of potential in the C&I sector throughout the study. Cooling, ventilation, and machine drive are the next largest contributors as discussed above.

Figure 6-10 C&I Realistic Achievable Potential by End Use, Selected Years

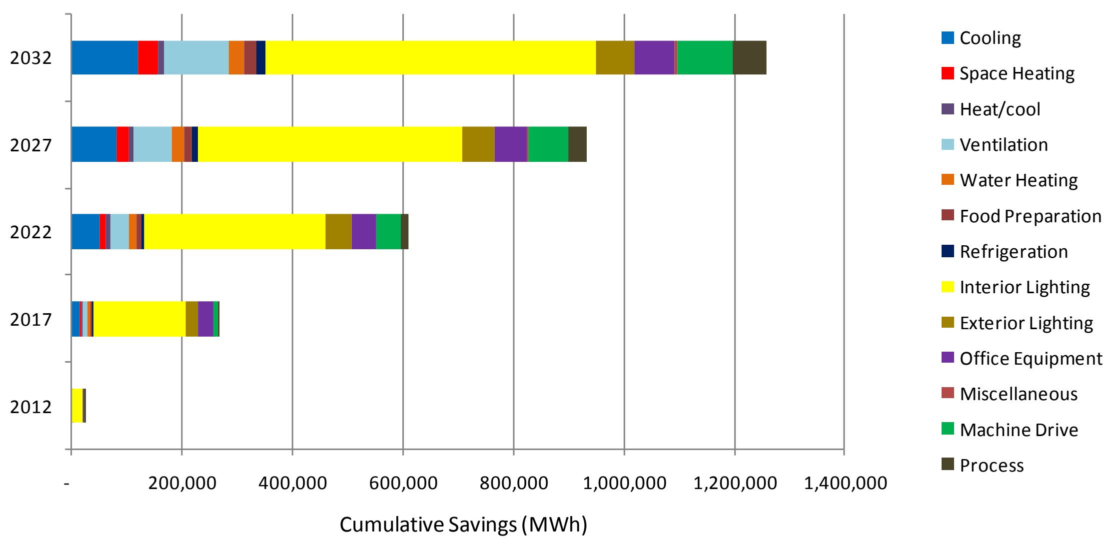


Table 6-16 shows the savings by end use and C&I market segment in 2022. As one would expect, the Extra Large Industrial segment differs significantly from the other segments. Machine drive and process improvements constitute 40% and 13% of realistic achievable potential for this segment. Note that the three commercial building segments, which are based on Avista's rate structure, do include a small percentage of industrial businesses. For these customers, the miscellaneous savings end-use includes non-HVAC motors.

Table 6-16 C&I Realistic Achievable Potential by End Use and Market Segment, 2022 (MWh)

	Small/Med. Commercial	Large Commercial	Extra Large Commercial	Extra Large Industrial	Total
Cooling	3,823	26,225	5,151	15,217	50,416
Space Heating	778	6,727	1,521	2,450	11,476
Combined Heating/Cooling	572	5,264	583	455	6,874
Ventilation	8,757	5,663	5,627	15,420	35,467
Water Heating	2,190	5,825	5,954	-	13,969
Food Preparation	1,238	5,563	807	-	7,608
Refrigeration	1,313	4,383	496	-	6,192
Interior Lighting	58,481	218,078	38,555	13,764	328,877
Exterior Lighting	10,719	27,639	6,557	1,103	46,019
Office Equipment	8,011	32,404	4,187	-	44,602
Machine Drive	-	-	-	42,030	42,030
Process	-	-	-	14,014	14,014
Miscellaneous	349	678	168	-	1,194
Total	**96,231**	**338,450**	**69,605**	**104,453**	**608,739**

Table 6-17 presents realistic achievable potential savings for equipment measures for which realistic achievable potential is greater than zero. These results provide additional detail at the technology level. For example, within interior lighting, screw-in lamps initial provide the greatest share of savings, but the EISA standards move the baseline in that category to a higher efficiency level. Consequently, in the long run, fluorescent lamps offer the greatest savings potential.

Table 6-17 C&I Cumulative Realistic Achievable Potential by End Use and Equipment Measures, Selected Years (MWh)

End Use	Technology	2012	2017	2022
Cooling	Central Chiller	81	855	3,288
	PTAC	6	6	6
Heat/Cool	Heat Pump	21	391	1,172
Ventilation	Ventilation	140	1,047	1,096
Water Heater	Water Heater	174	2,019	4,463
Food Preparation	Fryer	13	147	392
	Hot Food Container	13	275	763
	Oven	187	2,203	5,881
Refrigeration	Glass Door Display	32	434	1,248
	Icemaker	25	324	961
	Solid Door Refrigerator	43	497	1,331
	Vending Machine	83	455	1,111
	Walk in Refrigeration	2	26	63
Interior Lighting	Interior Screw-in	10,283	66,690	101,556
	HID	2,837	25,587	50,762
	Linear Fluorescent	4,319	53,111	104,450
Exterior Lighting	Screw-in	230	3,155	5,265
	HID	1,267	16,135	31,807
	Linear Fluorescent	124	2,230	3,784
Office Equipment	Desktop Computer	1,546	14,363	22,986
	Laptop Computer	111	1,031	1,649
	Monitor	317	1,139	1,970
	POS Terminal	37	514	939
	Printer/copier/fax	110	1,626	2,988
	Server	511	7,235	11,670
Machine Drive	Less than 5 HP	34	236	663
	5-24 HP	73	532	1,536
	25-99 HP	183	1,325	3,825
	100-249 HP	51	373	1,077
	250-499 HP	55	397	1,145
	500 and more HP	103	748	2,160
Process	Electrochem. Process	49	358	1,869
	Process Cooling/Refrig.	65	479	2,500
	Process Heating	231	1,707	8,907
Miscellaneous	Non-HVAC Motor	6	95	520
Total		**23,654**	**212,346**	**405,630**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 897 of 1069

Table 6-18 presents savings results for non-equipment measures for which realistic achievable potential is greater than zero, sorted by cumulative potential in 2032. Note that, because a measure such as insulation provides both space cooling and space heating savings, Table 6-18 does not break down savings by end use.

Table 6-18 C&I Cumulative Realistic Achievable Savings for Non-equipment Measures, Selected Years (MWh)

Measure	2012	2017	2022
Energy Management System	39	2,372	25,108
Advanced New Construction Designs	1	106	1,626
Retrocommissioning - Lighting	57	11,775	21,760
Interior Fluorescent - High Bay Fixtures	21	1,262	13,307
Custom Measures	4	829	11,321
Retrocommissioning - Comprehensive	41	8,649	15,523
Fans - Variable Speed Control	12	553	5,368
RTU - Maintenance	63	7,964	14,458
Fans - Energy Efficient Motors	10	651	6,782
Photocell Controlled T8 Dimming Ballasts	0	61	535
Retrocommissioning - HVAC	5	580	5,758
Pumping System - Optimization	11	507	4,907
Compressed Air - System Optimization and Improvements	11	506	4,837
Interior Lighting - Occupancy Sensors	19	726	5,616
Motors - Variable Frequency Drive	18	2,220	4,618
Motors - Magnetic Adjustable Speed Drives	8	367	3,707
Water Heater - Faucet Aerators/Low Flow Nozzles	27	3,964	8,101
Interior Fluorescent - Delamp and Install Reflectors	18	728	5,429
Commissioning - Comprehensive	0	368	2,614
Compressed Air - System Controls	7	355	3,457
Chiller - Turbocor Compressor	4	276	3,008
Heat Pump - Maintenance	26	3,374	5,702
Roofs - High Reflectivity	2	54	426
Pumps - Variable Speed Control	5	250	2,395
Chiller - Condenser Water Temperature Reset	7	419	3,987
Chiller - VSD	3	208	2,116
Compressed Air - Compressor Replacement	4	203	1,982
Pumping System - Controls	4	202	1,942
Thermostat - Clock/Programmable	5	762	1,499
Exterior Lighting - Daylighting Controls	4	161	1,309
Commissioning - Lighting	0	248	842
Office Equipment - Energy Star Power Supply	9	1,205	2,400
Compressed Air - System Maintenance	13	717	1,198
Insulation - Ducting	1	145	1,221
Chiller - Chilled Water Reset	4	645	1,142

Measure	2012	2017	2022
Water Heater - Heat Pump	1	69	870
Cooking - Exhaust Hoods with Sensor Control	1	14	127
Pumping System - Maintenance	-	43	606
Furnace - Convert to Gas	2	80	527
Cooling - Economizer Installation	3	125	1,138
Exterior Lighting - Induction Lamps	0	29	430
Refrigeration - System Optimization	0	24	388
Insulation - Ceiling	0	2	29
Refrigeration - System Controls	0	17	272
Industrial Process Improvements	0	28	332
LED Exit Lighting	25	932	1,028
Insulation - Wall Cavity	0	12	177
Commissioning - HVAC	-	-	20
Water Heater - Tank Blanket/Insulation	4	255	449
Miscellaneous - Energy Star Water Cooler	0	59	173
Refrigeration - Floating Head Pressure	0	10	105
Refrigeration - Strip Curtain	-	1	34
Refrigeration - System Maintenance	0	5	78
Refrigeration - Anti-Sweat Heater/Auto Door Closer	0	8	81
Water Heater - Hot Water Saver	-	-	4
Water Heater - High Efficiency Circulation Pump	0	8	83
Vending Machine - Controller	0	39	66
Chiller - Chilled Water Variable-Flow System	0	6	51
Exterior Lighting - Cold Cathode Lighting	0	2	24
Laundry - High Efficiency Clothes Washer	0	9	16
Refrigeration - Night Covers	0	1	9
Total	501	55,189	203,109

By the mid-point of the study period, 2022, the greatest savings come from:

- Replacement of interior lamps (linear fluorescent, screw in, and HID systems: 42,202 MWh)
- Replacement of office equipment with more efficient units (101,556 MWh)
- Replacement of exterior lamps (40,855 GWh)
- Installation of Energy Management Systems (25,108 MWh)
- Retrocommissioning of lighting systems (21,760 MWh)

Together, these five measures account for 285,137 MWh or 47% of the realistic achievable potential savings in the commercial sector in 2022.

6.5 SENSITIVITY ANALYSIS

Global conducted two sets of sensitivity analyses to better understand the effects of changing assumptions on conservation potential. The first looked at changes in avoided costs, and the second considered lower rates of customer and economic growth in Avista's service territory. Because these sensitivity analyses were conducted using an interim, earlier set of potential results, the potential levels in the discussion below are slightly lower than the potential levels presented elsewhere in this chapter. For example, the 2032 realistic achievable cumulative potential in 2032 shown above is 2,155,133 MWh, but the value in the sensitivity analyses is 2,106,548 MWh or 2% less. However, the project team agreed that the general results of the sensitivity analyses would be essentially unchanged, and therefore the sensitivity analyses based on interim results are presented here.

6.5.1 Sensitivity of Potential to Avoided Cost

Global modeled several scenarios with varying levels of avoided costs in addition to the base case. The other scenarios included 150%, 125%, and 75% of the avoided costs used in the base case. Figure 6-11 illustrates how realistic achievable potential varies under the four scenarios. The dotted line in Figure 6-11 indicates the technical potential, which is not affected by avoided costs. The four other lines illustrate how economic potential changes over time with avoided costs. While the changes are significant, the relationship between avoided cost and achievable potential is not linear and increases in avoided costs do not provide equivalent percentage increases in economic potential, and therefore in achievable potential also. Technical potential imposes a limit on the amount of additional conservation and each incremental unit of conservation becomes increasingly expensive.

Figure 6-11 Energy Savings, Economic Potential Case by Avoided Costs Scenario (MWh)

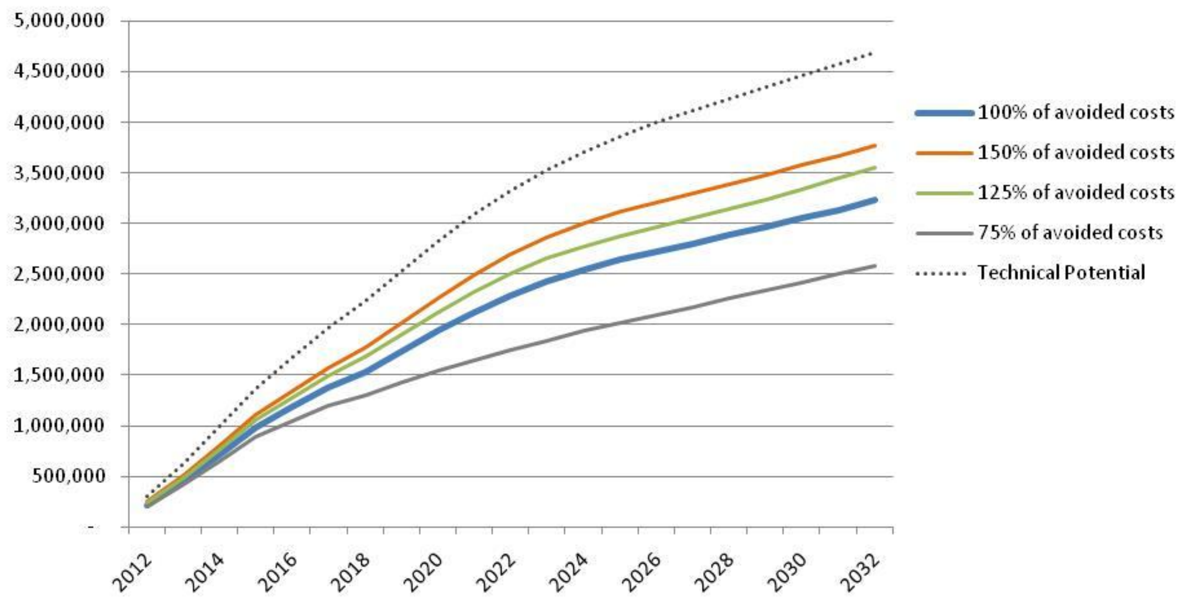


Table 6-19 provides additional information on how avoided cost changes affect realistic achievable potential. In the reference case, realistic achievable potential is approximately 16.4% of the baseline forecast by 2032. With the 150% avoided cost case, realistic achievable potential increased to 19.2% of the baseline forecast, while the 125% avoided cost case and the 75% avoided cost case yielded realistic achievable potential equal to 18.1% and 13.2% of the baseline forecast respectively.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 900 of 1069

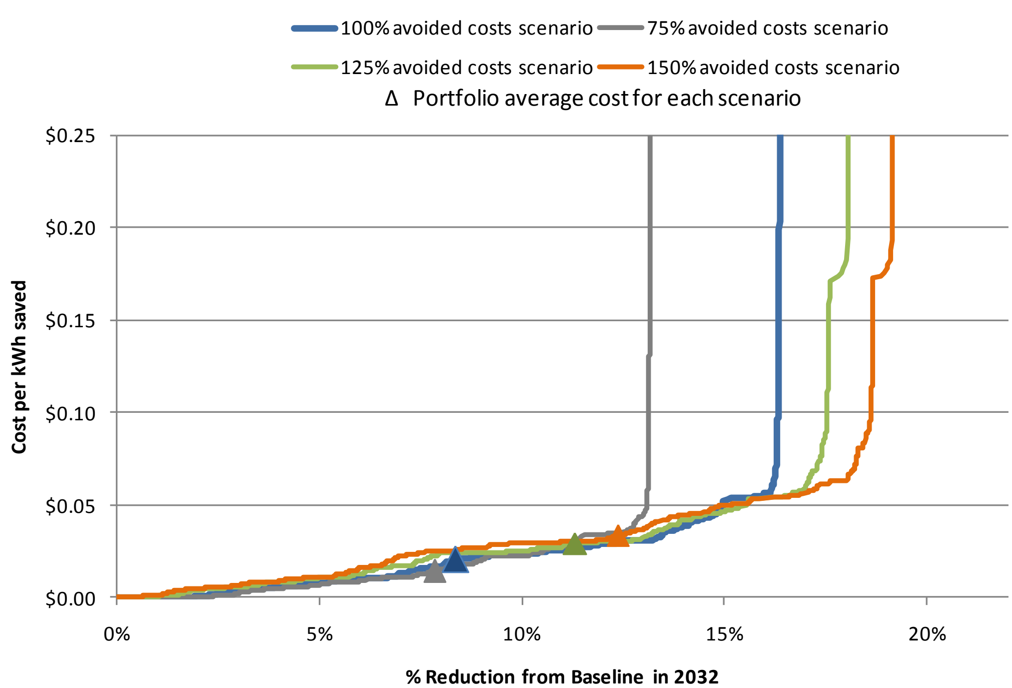
Table 6-19 Realistic Achievable Potential with Varying Avoided Costs

	Reference Scenario	75% of avoided costs	125% of avoided costs	150% of avoided costs
Realistic achievable potential savings 2032 (MWh)	2,106,584	1,690,671	2,320,926	2,464,465
Realistic achievable potential, percentage of baseline forecast, 2032	16.4%	13.2%	18.1%	19.2%
Percentage change in savings vs. 100% avoided cost scenario		-20%	10%	17%

Note: Value of 2,106,548 MWh for 2032 realistic achievable potential was based on interim results and thus is different from the value shown elsewhere in this report.

The project developed a series of supply curves based on the four avoided cost scenarios, shown in Figure 6-12. Each supply curve is created by stacking measures and equipment over the 20-year planning horizon in ascending order of cost. As expected, this stacking of conservation resources produces a traditional upward-sloping supply curve. Because there is a gap in the cost of the energy efficiency measures as you move up the supply curve, the measures with a very high cost cause a rapid sloping of the supply curve. The 75% of avoided cost scenario provides roughly a 13% reduction in energy use compared with the baseline forecast in 2032, at a cost of $0.05/kWh or less. The other three scenarios track one another closely, providing just over 15% savings in 2032 at costs below $0.05/kWh. Results do not differ greatly until the curves begin to reach the increasingly high-cost measures.

Figure 6-12 Supply Curves for Evaluated EE Measures and Avoided Cost Scenarios



6.5.2 Sensitivity of Potential to Customer and Economic Growth

This conservation potential assessment shows that conservation offsets roughly half of growth in electrical energy use for the Avista system, whereas the Sixth Plan projects that conservation can offset 80% of growth. Of course, Avista's service territory differs from the region overall in many ways, including its climate. Another significant factor may be the CPA study's assumptions regarding customer and economic growth. To better understand how growth affects the study's results, we used the LoadMAP model to evaluate several scenarios with lower customer and economic growth, as indicated in Table 6-20. Low Growth Scenario 1 assumes that home size (in square footage) grows 1% per year but is then capped at 110% of home size in the base year. This scenario also assumes lower rates of income growth, as shown in Table 6-20. The Low Growth Scenario 2 uses the same assumptions but in addition assumes lower customer growth in terms of total households for the residential sector and total square footage for the C&I sector.

Table 6-20 Varying Growth Scenario Descriptions

	Reference Scenario	Low Growth Scenario 1	Low Growth Scenario 2
Home size	~ 1% per year growth	Capped at 110% of existing home size	Capped at 110% of existing home size
Per capita income growth	1.6% 2011–2015; 2.2% 2016–2020; 2.1% thereafter	1.6% after 2016	1.6% after 2016
Residential sector market growth	1.30% after 2015 (WA) 1.25% after 2015 (ID)	no change	1.0% after 2015 (WA & ID)
Commercial sector market growth, WA & ID	~ 2.0% (varies by segment)	no change	1.0% all segments

Table 6-21 shows that as economic and customer growth decreases, the ability of conservation to offset growth increases. In the reference scenario, energy efficiency offsets 52% of growth in consumption, while in the lower growth scenarios, EE offsets 54% and 76% of growth respectively. This is the case because with reduced new construction, load growth and realistic achievable potential drop, but savings due to the retrofit of existing buildings constitute a greater proportion of load growth.

Table 6-21 Varying Growth Scenario Results

	Reference Scenario	Low Growth Scenario 1	Low Growth Scenario 2
Baseline forecast 2012 (MWh)	8,799,039	8,799,039	8,799,033
Baseline forecast 2032 (MWh)	12,851,760	12,523,843	11,178,008
Load growth 2012-2032 (MWh)	4,052,720	3,724,803	2,378,975
Realistic achievable potential forecast 2032 (MWh)	10,745,176	10,500,088	9,366,471
Realistic achievable potential savings 2032 (MWh)	2,106,584	2,023,754	1,811,538
Percentage of growth offset	52%	54%	76%

Note: Value of 2,106,548 MWh for 2032 realistic achievable potential was based on an interim results reference case and thus is different from the value shown elsewhere in this report. The general effects would be the same with the revised reference case.

6.6 PUMPING POTENTIAL

Table 6-22 displays the 2009 electricity sales and peak demand of Avista's pumping customers. These customers include mostly municipal water systems and some irrigation customers. The pumping accounts represent 2.2% of total electricity sales and 0.8% of peak demand. (Total in this case refers to the rate classes listed in Table 3-1 and Table 3-2: residential, commercial, industrial, and pumping). Because pumping represents a relatively small percentage of Avista's total sales, the project team decided to use the NWPCC Sixth Plan calculator to estimate pumping energy efficiency potential.

Table 6-22 Pumping Rate Classes, Electricity Sales and Peak Demand 2009

Sector	Rate Schedule(s)	Number of meters (customers)	2009 Electricity sales (MWh)	Peak demand (MW)
Pumping, Washington	031, 032	2,361	135,999	10
Pumping, Idaho	031, 032	1,312	58,885	4
Pumping, Total		3,673	194,884	14
Percentage of System Total			**2.2%**	**0.8%**

The Sixth Plan Calculator estimates agricultural conservation targets based on 2007 sales. It provides annual conservation targets through 2019. Therefore, we trended the data through 2022 to provide annual savings estimates for the ten-year period 2012–2022, with the results shown in Figure 6-13. Table 6-23 displays incremental annual savings potential for 2012–2015, while Table 6-24 provides cumulative potential for selected years.

Figure 6-13 Sixth Plan Calculator Agriculture Incremental Annual Potential

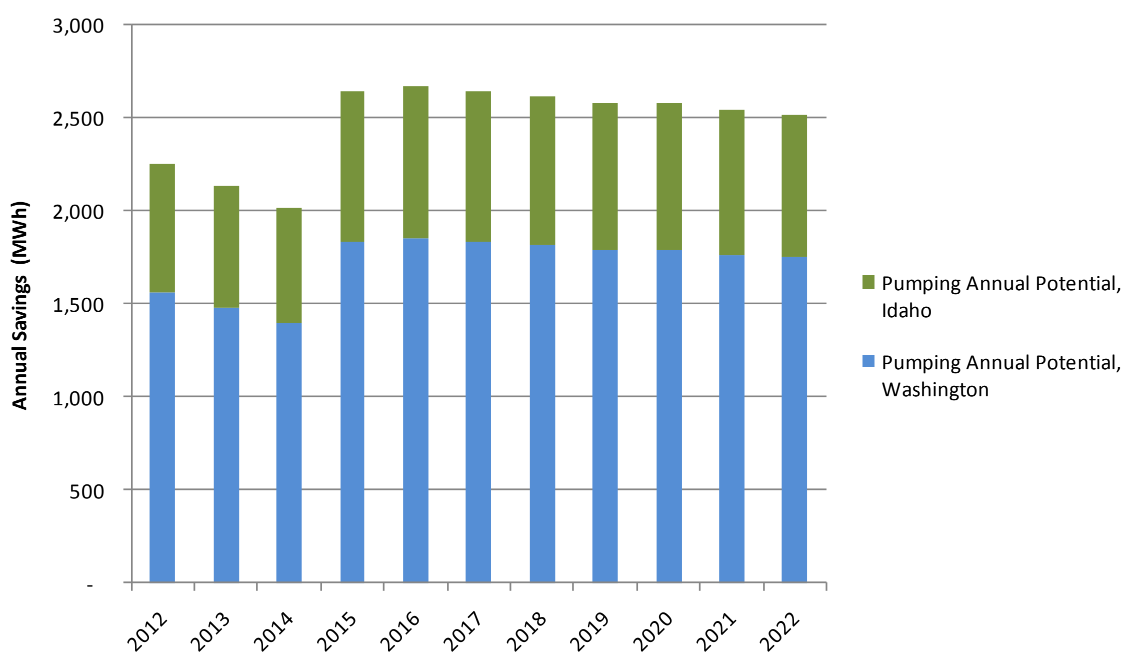


Table 6-23 Sixth Plan Calculator Agriculture Incremental Annual Potential, Selected Years (MWh)

Segment	2012	2013	2014	2015
Pumping, Washington	1,567	1,484	1,402	1,835
Pumping, Idaho	690	654	618	809
Pumping, Total	**2,257**	**2,138**	**2,020**	**2,643**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 903 of 1069

Table 6-24 Sixth Plan Calculator Agriculture Cumulative Potential, Selected Years (MWh)

Measure	2012	2017	2022
Pumping, Washington	1,567	9,979	18,892
Pumping, Idaho	690	4,397	8,324
Pumping, Total	2,257	14,375	27,217

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AVISTA CONSERVATION POTENTIAL ASSESSMENT APPENDICES

Final Report — Electricity Potentials

August 19, 2011

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

WASHINGTON MARKET PROFILES, BASELINE FORECAST, AND POTENTIAL RESULTS

This appendix contains Washington-specific tables that summarize the study assumptions, inputs, and results for Avista's Washington service territory only. These tables either repeat Washington-specific information provided previously within the body of the report, or provide Washington-specific information that corresponds to Avista system-level information in the report.

Table A–1 Electricity Sales and Peak Demand by Rate Class, Washington 2009

Sector	Rate Schedule(s)	Number of meters (customers)	2009 Electricity sales (MWh)	Peak demand (MW)
Residential	001	200,134	2,451,687	710
General Service	011, 012	27,142	415,935	64
Large General Service	021, 022	3,352	1,556,929	232
Extra Large General Service	025	22	879,233	134
Pumping	031, 032	2,361	135,999	10
Total		**233,011**	**5,439,850**	**1,150**

Table A-2 Residential Electricity Usage and Intensity by Segment, Washington 2009

Washington Segment	Intensity (kWh/Household)	Number of Customers	% of Customers	2009 Electricity Sales (MWh)	% of Sales
Single Family	14,547	109,134	54%	1,587,572	65%
Multi-Family	8,728	18,219	9%	159,019	6%
Mobile Home	13,092	5,248	3%	68,708	3%
Limited Income	9,424	67,533	34%	636,407	26%
Total	**12,250**	**200,134**	**100%**	**2,451,707**	**100%**

Note: Minor differences with totals in Table A-1 due to calibration.

Table A-3 Single Family Market Profile, 2009, Washington

		Average Market Profiles				New Units			
End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)	Saturation	UEC (kWh)	Intensity (kWh/HH)	Compared to Average
Cooling	Central AC	36.8%	1,857	684	75	73.4%	2,154	1,581	16%
Cooling	Room AC	10.8%	683	74	8	1.4%	793	11	16%
Combined Heating/Cooling	Air Source Heat Pump	18.4%	6,091	1,122	122	15.0%	7,066	1,063	16%
Combined Heating/Cooling	Geothermal Heat Pump	0.7%	3,655	26	3	0.8%	4,239	32	16%
Space Heating	Electric Resistance	6.2%	10,449	647	71	3.0%	12,539	373	20%
Space Heating	Electric Furnace	25.0%	8,360	2,088	228	25.0%	10,031	2,505	20%
Space Heating	Supplemental	6.1%	117	7	1	6.1%	140	9	20%
Water Heating	Water Heater	55.3%	3,466	1,918	209	43.7%	4,177	1,827	21%
Interior Lighting	Screw-in	100.0%	1,452	1,452	158	100.0%	1,452	1,452	0%
Interior Lighting	Linear Fluorescent	69.2%	152	105	11	69.2%	152	105	0%
Interior Lighting	Pin-based	100.0%	60	60	7	100.0%	60	60	0%
Exterior Lighting	Screw-in	86.7%	381	330	36	86.7%	381	330	0%
Exterior Lighting	High Intensity/Flood	1.9%	146	3	0	1.9%	146	3	0%
Appliances	Clothes Washer	98.0%	126	124	13	99.8%	154	154	22%
Appliances	Clothes Dryer	92.8%	609	565	62	89.0%	692	616	14%
Appliances	Dishwasher	93.9%	246	231	25	99.9%	271	271	11%
Appliances	Refrigerator	100.0%	793	793	87	100.0%	625	625	-21%
Appliances	Freezer	69.4%	773	536	58	69.4%	708	491	-8%
Appliances	Second Refrigerator	47.3%	816	386	42	20.5%	711	146	-13%
Appliances	Stove	82.1%	383	314	34	82.1%	465	382	22%
Appliances	Microwave	98.5%	168	166	18	98.5%	173	171	3%
Electronics	Personal Computers	140.0%	279	391	43	147.0%	287	422	3%
Electronics	TVs	260.0%	359	933	102	260.0%	400	1,041	12%
Electronics	Devices and Gadgets	100.0%	60	60	7	100.0%	67	67	10%
Miscellaneous	Pool Pump	13.3%	1,500	200	22	14.0%	1,526	214	2%
Miscellaneous	Furnace Fan	30.1%	500	151	16	30.1%	614	185	23%
Miscellaneous	Miscellaneous	100.0%	1,180	1,180	129	100.0%	1,416	1,416	20%
	Total			**14,547**	**1,588**			**15,549**	

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 921 of 1069

Table A-4 Multi-family Market Profile, 2009, Washington

		Average Market Profiles				New Units			
End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)	Saturation	UEC (kWh)	Intensity (kWh/HH)	Compared to Average
Cooling	Central AC	5.0%	928	46	1	24.1%	1,003	241	8%
Cooling	Room AC	25.0%	355	89	2	18.9%	384	73	8%
Combined Heating/Cooling	Air Source Heat Pump	1.0%	2,928	29	1	3.4%	3,163	108	8%
Combined Heating/Cooling	Geothermal Heat Pump	0.0%	1,757	-	-	0.5%	1,898	9	8%
Space Heating	Electric Resistance	59.0%	5,476	3,231	59	59.0%	6,023	3,554	10%
Space Heating	Electric Furnace	5.0%	4,381	219	4	5.0%	4,819	241	10%
Space Heating	Supplemental	18.0%	61	11	0	18.9%	67	13	10%
Water Heating	Water Heater	77.0%	2,142	1,650	30	71.3%	2,362	1,684	10%
Interior Lighting	Screw-in	100.0%	750	750	14	100.0%	750	750	0%
Interior Lighting	Linear Fluorescent	32.0%	76	24	0	32.0%	76	24	0%
Interior Lighting	Pin-based	3.0%	75	2	0	3.0%	75	2	0%
Exterior Lighting	Screw-in	38.5%	55	21	0	38.5%	55	21	0%
Exterior Lighting	High Intensity/Flood	0.2%	73	0	0	0.2%	73	0	0%
Appliances	Clothes Washer	32.0%	63	20	0	32.0%	70	22	11%
Appliances	Clothes Dryer	30.7%	582	179	3	30.7%	621	191	7%
Appliances	Dishwasher	64.0%	88	56	1	64.0%	93	59	5%
Appliances	Refrigerator	100.0%	677	677	12	100.0%	665	665	-2%
Appliances	Freezer	8.4%	734	62	1	8.4%	703	59	-4%
Appliances	Second Refrigerator	5.0%	687	34	1	5.0%	631	32	-8%
Appliances	Stove	96.4%	163	158	3	96.4%	181	175	11%
Appliances	Microwave	90.0%	99	89	2	90.0%	101	91	1%
Electronics	Personal Computers	63.0%	223	141	3	66.2%	226	150	1%
Electronics	TVs	165.0%	178	293	5	165.0%	188	310	6%
Electronics	Devices and Gadgets	100.0%	25	25	0	100.0%	26	26	5%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Furnace Fan	13.0%	38	5	0	13.0%	42	5	11%
Miscellaneous	Miscellaneous	100.0%	917	917	17	100.0%	963	963	5%
Total				**8,728**	**159**			**9,468**	

Table A-5 Mobile Home Market Profile, 2009, Washington

		Average Market Profiles				New Units			
End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)	Saturation	UEC (kWh)	Intensity (kWh/HH)	Compared to Average
Cooling	Central AC	23.2%	1,106	256	1	35.9%	1,194	428	8%
Cooling	Room AC	23.2%	407	94	0	22.0%	439	97	8%
Combined Heating/Cooling	Air Source Heat Pump	21.7%	3,488	759	4	22.8%	3,767	860	8%
Combined Heating/Cooling	Geothermal Heat Pump	0.0%	2,093	-	-	0.0%	2,260	-	8%
Space Heating	Electric Resistance	0.0%	5,888	-	-	0.0%	6,476	-	10%
Space Heating	Electric Furnace	68.1%	4,710	3,209	17	68.1%	5,181	3,530	10%
Space Heating	Supplemental	1.4%	34	0	0	1.5%	37	1	10%
Water Heating	Water Heater	96.3%	1,766	1,702	9	91.0%	1,947	1,771	10%
Interior Lighting	Screw-in	100.0%	1,307	1,307	7	100.0%	1,307	1,307	0%
Interior Lighting	Linear Fluorescent	69.2%	137	95	0	69.2%	137	95	0%
Interior Lighting	Pin-based	100.0%	54	54	0	100.0%	54	54	0%
Exterior Lighting	Screw-in	86.7%	343	297	2	86.7%	343	297	0%
Exterior Lighting	High Intensity/Flood	1.9%	131	2	0	1.9%	131	2	0%
Appliances	Clothes Washer	96.3%	128	124	1	96.3%	142	137	11%
Appliances	Clothes Dryer	98.8%	620	612	3	98.8%	662	653	7%
Appliances	Dishwasher	89.0%	250	222	1	89.0%	263	234	5%
Appliances	Refrigerator	100.0%	806	806	4	100.0%	792	792	-2%
Appliances	Freezer	59.3%	786	466	2	59.3%	753	446	-4%
Appliances	Second Refrigerator	19.5%	830	162	1	19.5%	762	149	-8%
Appliances	Stove	93.9%	344	323	2	93.9%	381	358	11%
Appliances	Microwave	82.0%	151	124	1	82.0%	154	126	2%
Electronics	Personal Computers	116.5%	262	305	2	122.3%	265	324	1%
Electronics	TVs	260.0%	359	933	5	260.0%	380	987	6%
Electronics	Devices and Gadgets	100.0%	60	60	0	100.0%	64	64	5%
Miscellaneous	Pool Pump	11.1%	1,500	167	1	11.7%	1,513	177	1%
Miscellaneous	Furnace Fan	8.3%	500	42	0	8.3%	557	47	11%
Miscellaneous	Miscellaneous	100.0%	971	971	5	100.0%	1,020	1,020	5%
Total				**13,092**	**69**			**13,955**	

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 923 of 1069

Table A-6 Limited Income Market Profile, 2009, Washington

		Average Market Profiles				New Units			
End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)	Saturation	UEC (kWh)	Intensity (kWh/HH)	Compared to Average
Cooling	Central AC	22.2%	1,049	233	16	28.7%	1,133	325	8%
Cooling	Room AC	35.4%	712	252	17	18.0%	769	138	8%
Combined Heating/Cooling	Air Source Heat Pump	10.4%	2,372	247	17	10.4%	2,561	267	8%
Combined Heating/Cooling	Geothermal Heat Pump	0.0%	1,423	-	-	0.5%	1,537	8	8%
Space Heating	Electric Resistance	32.0%	5,164	1,651	112	28.8%	5,680	1,635	10%
Space Heating	Electric Furnace	19.3%	4,123	796	54	21.2%	4,536	963	10%
Space Heating	Supplemental	12.7%	63	8	1	13.4%	69	9	10%
Water Heating	Water Heater	83.9%	2,334	1,958	132	67.0%	2,574	1,725	10%
Interior Lighting	Screw-in	100.0%	728	728	49	100.0%	728	728	0%
Interior Lighting	Linear Fluorescent	69.2%	75	52	3	69.2%	75	52	0%
Interior Lighting	Pin-based	100.0%	59	59	4	100.0%	59	59	0%
Exterior Lighting	Screw-in	47.1%	106	50	3	47.1%	106	50	0%
Exterior Lighting	High Intensity/Flood	2.7%	84	2	0	2.7%	84	2	0%
Appliances	Clothes Washer	71.3%	55	39	3	71.3%	61	43	11%
Appliances	Clothes Dryer	68.6%	652	447	30	68.6%	696	477	7%
Appliances	Dishwasher	78.5%	72	56	4	78.5%	75	59	5%
Appliances	Refrigerator	100.0%	677	677	46	100.0%	665	665	-2%
Appliances	Freezer	63.4%	734	466	31	63.4%	703	446	-4%
Appliances	Second Refrigerator	23.4%	687	161	11	23.4%	631	148	-8%
Appliances	Stove	89.7%	196	176	12	89.7%	217	195	11%
Appliances	Microwave	92.6%	109	101	7	92.6%	111	102	1%
Electronics	Personal Computers	101.4%	230	233	16	106.5%	233	248	1%
Electronics	TVs	165.0%	204	337	23	165.0%	216	356	6%
Electronics	Devices and Gadgets	100.0%	30	30	2	105.0%	32	33	5%
Miscellaneous	Pool Pump	5.8%	617	36	2	5.8%	622	36	1%
Miscellaneous	Furnace Fan	25.2%	213	54	4	25.2%	238	60	11%
Miscellaneous	Miscellaneous	100.0%	575	575	39	100.0%	604	604	5%
Total				**9,424**	**636**			**9,434**	

Table A-7 Commercial Sector Market Characterization Results, Washington 2009

Avista Rate Schedule		LoadMAP Segment and Typical Building	Electricity sales (MWh)	Intensity (kWh/sq.ft.)
General Service	011, 012	Small and Medium Commercial — Retail	415,935	17.5
Large General Service	021, 022	Large Commercial — Office	1,556,929	16.7
Extra Large General Service Commercial	025C	Extra Large Commercial — University	265,686	13.9
Extra Large General Service Industrial	025I	Extra Large Industrial	613,615	40.0
Total			**2,852,165**	

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 925 of 1069

Table A-8 Small/Medium Commercial Segment Market Profile, Washington, 2009

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Central Chiller	13.8%	2.39	0.33	8	13.8%	2.15	0.30	-10%
Cooling	RTU	63.1%	2.46	1.55	37	63.1%	2.22	1.40	-10%
Cooling	PTAC	3.3%	2.44	0.08	2	3.3%	2.20	0.07	-10%
Combined Heating/Cooling	Heat Pump	3.6%	6.19	0.22	5	3.6%	5.57	0.20	-10%
Space Heating	Electric Resistance	5.9%	6.72	0.39	9	5.9%	6.72	0.39	0%
Space Heating	Furnace	17.7%	7.05	1.25	30	17.7%	6.34	1.13	-10%
Ventilation	Ventilation	76.9%	2.09	1.61	38	76.9%	1.88	1.45	-10%
Interior Lighting	Interior Screw-in	100.0%	1.00	1.00	24	100.0%	0.90	0.90	-10%
Interior Lighting	HID	100.0%	0.68	0.68	16	100.0%	0.61	0.61	-10%
Interior Lighting	Linear Fluorescent	100.0%	3.37	3.37	80	100.0%	3.03	3.03	-10%
Exterior Lighting	Exterior Screw-in	82.6%	0.20	0.16	4	82.6%	0.18	0.15	-10%
Exterior Lighting	HID	82.6%	0.76	0.63	15	82.6%	0.68	0.56	-10%
Exterior Lighting	Linear Fluorescent	82.6%	0.16	0.13	3	82.6%	0.14	0.12	-10%
Water Heating	Water Heater	63.0%	2.00	1.26	30	63.0%	1.90	1.19	-5%
Food Preparation	Fryer	25.8%	0.16	0.04	1	25.8%	0.16	0.04	0%
Food Preparation	Oven	25.8%	0.98	0.25	6	25.8%	0.98	0.25	0%
Food Preparation	Dishwasher	25.8%	0.06	0.01	0	25.8%	0.06	0.01	0%
Food Preparation	Hot Food Container	25.8%	0.31	0.08	2	25.8%	0.31	0.08	0%
Food Preparation	Food Prep	25.8%	0.01	0.00	0	25.8%	0.01	0.00	0%
Refrigeration	Walk in Refrigeration	0.0%	-	-	-	0.0%	-	-	
Refrigeration	Glass Door Display	52.4%	0.45	0.23	6	52.4%	0.40	0.21	-10%
Refrigeration	Solid Door Refrigerator	52.4%	0.50	0.26	6	52.4%	0.45	0.24	-10%
Refrigeration	Open Display Case	52.4%	0.04	0.02	1	52.4%	0.04	0.02	-10%
Refrigeration	Vending Machine	52.4%	0.30	0.16	4	52.4%	0.30	0.16	0%
Refrigeration	Icemaker	52.4%	0.34	0.18	4	52.4%	0.34	0.18	0%
Office Equipment	Desktop Computer	99.9%	0.48	0.48	11	99.9%	0.48	0.48	0%
Office Equipment	Laptop Computer	99.9%	0.06	0.06	1	99.9%	0.06	0.06	0%
Office Equipment	Server	99.9%	0.36	0.36	9	99.9%	0.36	0.36	0%
Office Equipment	Monitor	99.9%	0.25	0.25	6	99.9%	0.25	0.25	0%
Office Equipment	Printer/copier/fax	99.9%	0.24	0.24	6	99.9%	0.24	0.24	0%
Office Equipment	POS Terminal	99.9%	0.27	0.27	7	99.9%	0.27	0.27	0%
Miscellaneous	Non-HVAC Motor	40.2%	1.22	0.49	12	40.2%	1.22	0.49	0%
Miscellaneous	Other Miscellaneous	100.0%	1.43	1.43	34	100.0%	1.43	1.43	0%
Total				**17.50**	**416**			**16.3**	

Table A-9 Large Commercial Segment Market Profile, Washington, 2009

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Central Chiller	24.7%	2.15	0.53	49	24.7%	1.93	0.48	-10%
Cooling	RTU	37.8%	2.52	0.95	89	37.8%	2.26	0.86	-10%
Cooling	PTAC	3.8%	2.49	0.09	9	3.8%	2.24	0.08	-10%
Combined Heating/Cooling	Heat Pump	9.1%	4.81	0.44	41	9.1%	4.33	0.40	-10%
Space Heating	Electric Resistance	5.9%	3.62	0.21	20	5.9%	3.62	0.21	0%
Space Heating	Furnace	12.7%	4.68	0.60	55	12.7%	4.21	0.54	-10%
Ventilation	Ventilation	75.1%	1.66	1.24	116	75.1%	1.49	1.12	-10%
Interior Lighting	Interior Screw-in	100.0%	0.94	0.94	88	100.0%	0.85	0.85	-10%
Interior Lighting	HID	100.0%	0.71	0.71	66	100.0%	0.64	0.64	-10%
Interior Lighting	Linear Fluorescent	100.0%	3.29	3.29	307	100.0%	2.96	2.96	-10%
Exterior Lighting	Exterior Screw-in	89.6%	0.11	0.10	9	89.6%	0.10	0.09	-10%
Exterior Lighting	HID	89.6%	0.62	0.56	52	89.6%	0.56	0.50	-10%
Exterior Lighting	Linear Fluorescent	89.6%	0.16	0.14	13	89.6%	0.14	0.13	-10%
Water Heating	Water Heater	54.2%	2.31	1.25	117	54.2%	2.20	1.19	-5%
Food Preparation	Fryer	18.4%	0.35	0.06	6	18.4%	0.35	0.06	0%
Food Preparation	Oven	18.4%	1.88	0.35	32	18.4%	1.88	0.35	0%
Food Preparation	Dishwasher	18.4%	0.19	0.03	3	18.4%	0.19	0.03	0%
Food Preparation	Hot Food Container	18.4%	0.27	0.05	5	18.4%	0.27	0.05	0%
Food Preparation	Food Prep	18.4%	0.02	0.00	0	18.4%	0.02	0.00	0%
Refrigeration	Walk in Refrigeration	39.1%	0.48	0.19	17	39.1%	0.43	0.17	-10%
Refrigeration	Glass Door Display	39.1%	0.37	0.14	13	39.1%	0.33	0.13	-10%
Refrigeration	Solid Door Refrigerator	39.1%	0.77	0.30	28	39.1%	0.69	0.27	-10%
Refrigeration	Open Display Case	39.1%	0.27	0.10	10	39.1%	0.24	0.09	-10%
Refrigeration	Vending Machine	39.1%	0.36	0.14	13	39.1%	0.36	0.14	0%
Refrigeration	Icemaker	39.1%	0.66	0.26	24	39.1%	0.66	0.26	0%
Office Equipment	Desktop Computer	98.4%	0.90	0.88	82	98.4%	0.90	0.88	0%
Office Equipment	Laptop Computer	98.4%	0.07	0.07	6	98.4%	0.07	0.07	0%
Office Equipment	Server	98.4%	0.42	0.41	38	98.4%	0.42	0.41	0%
Office Equipment	Monitor	98.4%	0.21	0.20	19	98.4%	0.21	0.20	0%
Office Equipment	Printer/copier/fax	98.4%	0.21	0.21	19	98.4%	0.21	0.21	0%
Office Equipment	POS Terminal	98.4%	0.07	0.07	6	98.4%	0.07	0.07	0%
Miscellaneous	Non-HVAC Motor	57.7%	1.40	0.81	75	57.7%	1.40	0.81	0%
Miscellaneous	Other Miscellaneous	100.0%	1.36	1.36	127	100.0%	1.36	1.36	0%
	Total			**16.70**	**1,557**			**15.6**	

Table A-10 Extra Large Commercial Segment Market Profile, Washington, 2009

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Central Chiller	52.2%	2.13	1.11	21	52.2%	1.92	1.00	-10%
Cooling	RTU	24.7%	2.22	0.55	10	24.7%	2.00	0.49	-10%
Cooling	PTAC	0.0%	2.22	-	-	0.0%	2.00	-	-10%
Combined Heating/Cooling	Heat Pump	4.4%	5.23	0.23	4	4.4%	4.70	0.21	-10%
Space Heating	Electric Resistance	15.8%	4.39	0.69	13	15.8%	4.39	0.69	0%
Space Heating	Furnace	5.6%	5.67	0.32	6	5.6%	5.11	0.29	-10%
Ventilation	Ventilation	90.2%	1.94	1.75	33	90.2%	1.74	1.57	-10%
Interior Lighting	Interior Screw-in	100.0%	1.37	1.37	26	100.0%	1.23	1.23	-10%
Interior Lighting	HID	100.0%	0.29	0.29	6	100.0%	0.26	0.26	-10%
Interior Lighting	Linear Fluorescent	100.0%	2.19	2.19	42	100.0%	1.97	1.97	-10%
Exterior Lighting	Exterior Screw-in	96.3%	0.03	0.03	1	96.3%	0.03	0.03	-10%
Exterior Lighting	HID	96.3%	0.88	0.85	16	96.3%	0.79	0.76	-10%
Exterior Lighting	Linear Fluorescent	96.3%	0.04	0.03	1	96.3%	0.03	0.03	-10%
Water Heating	Water Heater	26.3%	3.72	0.98	19	26.3%	3.53	0.93	-5%
Food Preparation	Fryer	13.8%	0.13	0.02	0	13.8%	0.13	0.02	0%
Food Preparation	Oven	13.8%	2.12	0.29	6	13.8%	2.12	0.29	0%
Food Preparation	Dishwasher	13.8%	0.08	0.01	0	13.8%	0.08	0.01	0%
Food Preparation	Hot Food Container	13.8%	0.13	0.02	0	13.8%	0.13	0.02	0%
Food Preparation	Food Prep	13.8%	0.01	0.00	0	13.8%	0.01	0.00	0%
Refrigeration	Walk in Refrigeration	26.6%	0.19	0.05	1	26.6%	0.17	0.04	-10%
Refrigeration	Glass Door Display	26.6%	0.11	0.03	1	26.6%	0.10	0.03	-10%
Refrigeration	Solid Door Refrigerator	26.6%	0.71	0.19	4	26.6%	0.64	0.17	-10%
Refrigeration	Open Display Case	26.6%	0.50	0.13	3	26.6%	0.45	0.12	-10%
Refrigeration	Vending Machine	26.6%	0.38	0.10	2	26.6%	0.38	0.10	0%
Refrigeration	Icemaker	26.6%	0.31	0.08	2	26.6%	0.31	0.08	0%
Office Equipment	Desktop Computer	100.0%	0.64	0.64	12	100.0%	0.64	0.64	0%
Office Equipment	Laptop Computer	100.0%	0.07	0.07	1	100.0%	0.07	0.07	0%
Office Equipment	Server	100.0%	0.17	0.17	3	100.0%	0.17	0.17	0%
Office Equipment	Monitor	100.0%	0.13	0.13	2	100.0%	0.13	0.13	0%
Office Equipment	Printer/copier/fax	100.0%	0.05	0.05	1	100.0%	0.05	0.05	0%
Office Equipment	POS Terminal	100.0%	0.01	0.01	0	100.0%	0.01	0.01	0%
Miscellaneous	Non-HVAC Motor	88.8%	0.82	0.73	14	88.8%	0.82	0.73	0%
Miscellaneous	Other Miscellaneous	100.0%	0.80	0.80	15	100.0%	0.80	0.80	0%
Total				**13.90**	**266**			**12.9**	

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 928 of 1069

Table A-11 Extra Large Industrial Segment Market Profile, Washington, 2009

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Central Chiller	14.4%	7.98	1.15	18	14.4%	7.18	1.04	-10%
Cooling	RTU	17.1%	6.32	1.08	17	17.1%	5.68	0.97	-10%
Cooling	PTAC	1.1%	5.50	0.06	1	1.1%	4.95	0.05	-10%
Combined Heating/Cooling	Heat Pump	1.6%	11.13	0.18	3	1.6%	10.01	0.16	-10%
Space Heating	Electric Resistance	10.8%	8.67	0.93	14	10.8%	8.67	0.93	0%
Space Heating	Furnace	2.0%	9.10	0.18	3	2.0%	8.19	0.17	-10%
Ventilation	Ventilation	27.4%	12.31	3.37	52	27.4%	11.08	3.04	-10%
Interior Lighting	Interior Screw-in	100.0%	0.33	0.33	5	100.0%	0.30	0.30	-10%
Interior Lighting	HID	100.0%	1.05	1.05	16	100.0%	0.94	0.94	-10%
Interior Lighting	Linear Fluorescent	100.0%	1.10	1.10	17	100.0%	0.99	0.99	-10%
Exterior Lighting	Exterior Screw-in	92.5%	0.02	0.02	0	92.5%	0.02	0.02	-10%
Exterior Lighting	HID	92.5%	0.25	0.23	4	92.5%	0.23	0.21	-10%
Exterior Lighting	Linear Fluorescent	92.5%	0.01	0.01	0	92.5%	0.01	0.01	-10%
Process	Process Cooling/Refrigeration	2.4%	99.67	2.40	37	2.4%	99.67	2.40	0%
Process	Process Heating	26.2%	13.74	3.60	55	26.2%	13.74	3.60	0%
Process	Electrochemical Process	2.6%	77.43	2.00	31	2.6%	77.43	2.00	0%
Machine Drive	Less than 5 HP	90.5%	0.92	0.84	13	90.5%	0.92	0.84	0%
Machine Drive	5-24 HP	80.1%	2.26	1.81	28	80.1%	2.26	1.81	0%
Machine Drive	25-99 HP	72.4%	6.10	4.42	68	72.4%	6.10	4.42	0%
Machine Drive	100-249 HP	65.3%	3.84	2.51	38	65.3%	3.84	2.51	0%
Machine Drive	250-499 HP	23.7%	11.61	2.75	42	23.7%	11.61	2.75	0%
Machine Drive	500 and more HP	26.1%	19.50	5.08	78	26.1%	19.50	5.08	0%
Miscellaneous	Miscellaneous	100.0%	4.90	4.90	75	100.0%	4.90	4.90	0%
	Total			**40.00**	**614**			**39.1**	

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 929 of 1069

Figure A–1 Residential Baseline Forecast by End Use, Washington

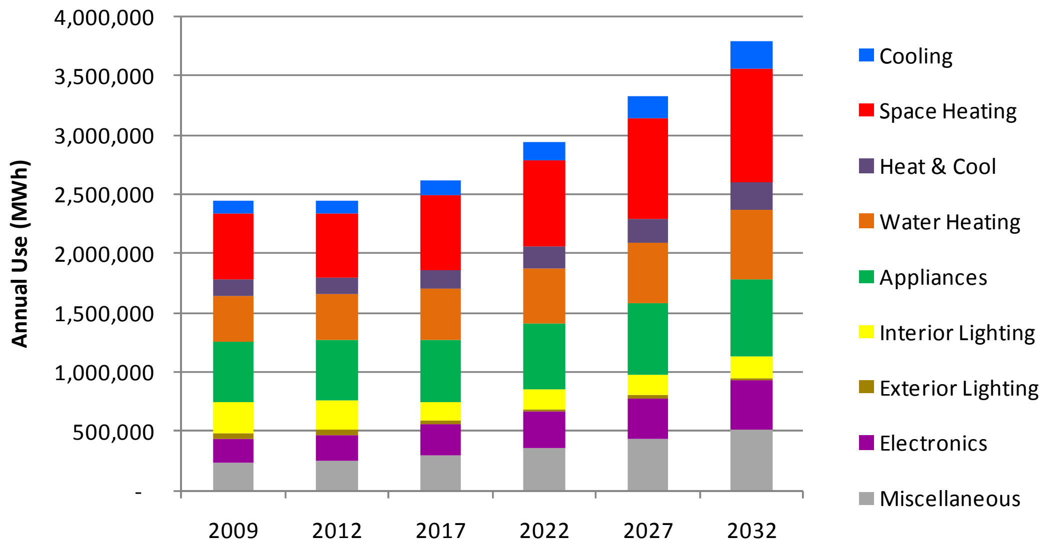

Figure A-2 C&I Baseline Electricity Forecast by End Use, Washington

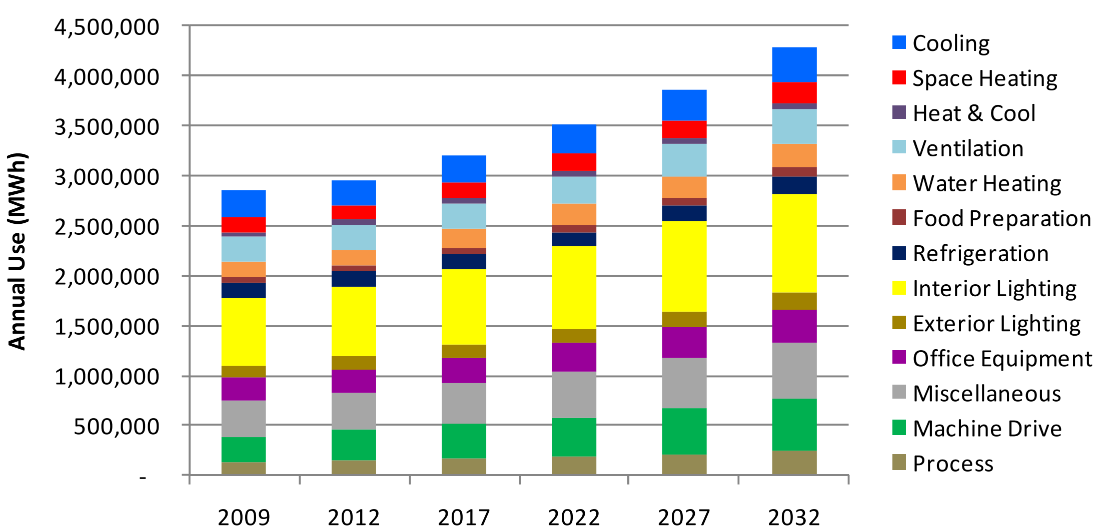

Table A-12 Baseline Forecast Summary by Sector, Washington

End Use	2009	2012	2017	2022	2027	2032	% Change ('09–'32)	Avg. Growth Rate ('09–'32)
Res. WA	2,451,707	2,448,104	2,617,630	2,947,427	3,329,882	3,792,486	54.7%	1.9%
C&I WA	2,852,165	2,955,156	3,209,083	3,509,816	3,869,176	4,280,649	50.1%	1.8%
Total	5,303,872	5,403,260	5,826,712	6,457,243	7,199,059	8,073,136	52.2%	1.8%

Figure A-3 Baseline Forecast Summary by Sector, Washington

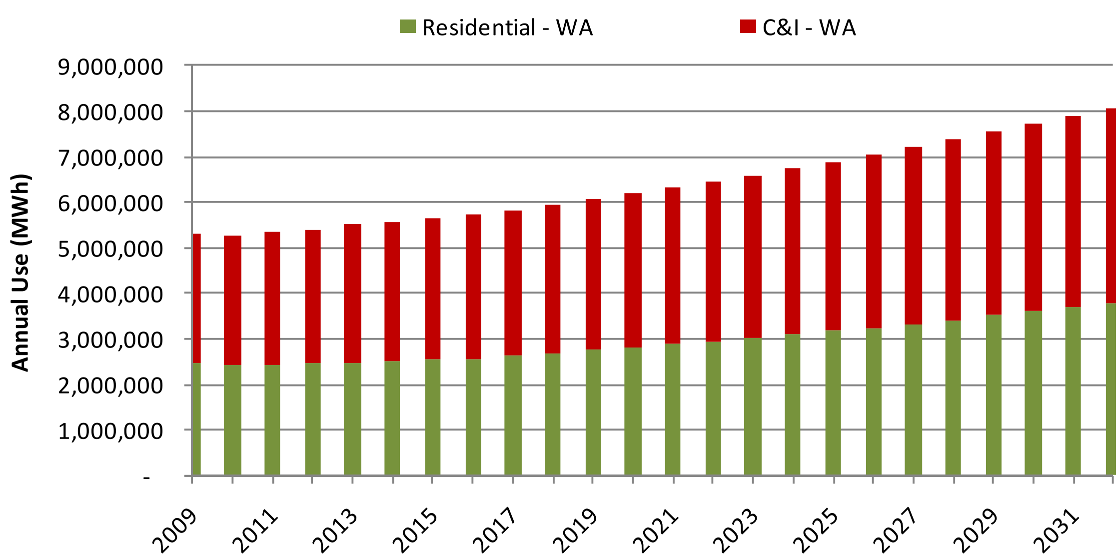

Exhibit No. 4
Case Nos. AVU-E-12-08
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Schedule 1, Page 931 of 1069

Figure A-4 Summary of Energy Efficiency Potential Savings, Washington, All Sectors

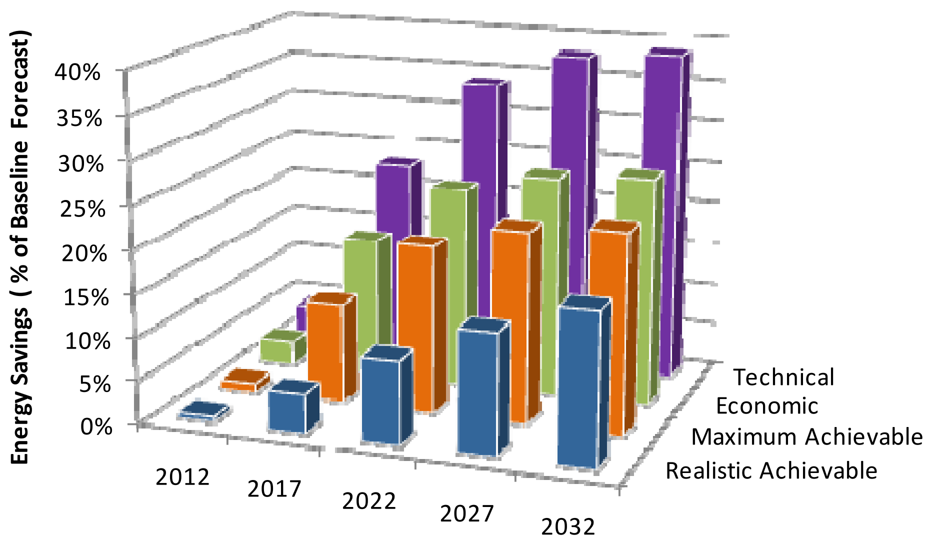

Figure A-5 Energy Efficiency Potential Forecasts, Washington, All Sectors

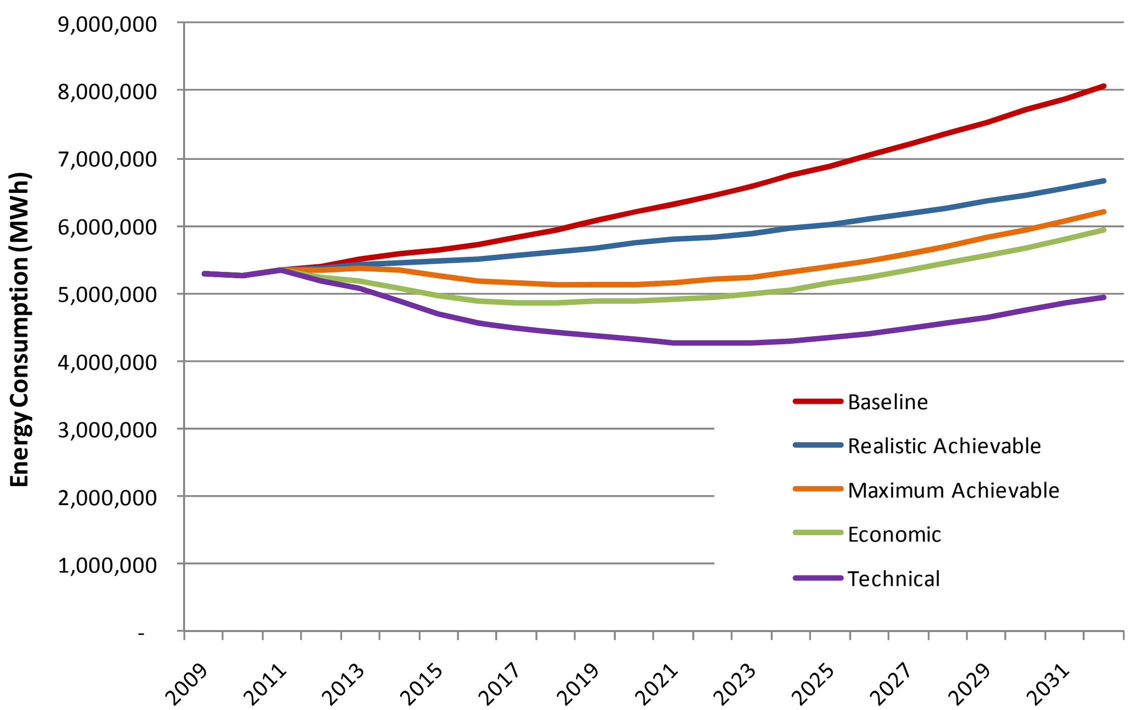

Table A-13 Summary of Energy Efficiency Potential, Washington, All Sectors

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	5,403,260	5,826,712	6,457,243	7,199,059	8,073,136
Baseline Peak Demand(MW)	1,170	1,236	1,374	1,531	1,713
Cumulative Energy Savings (MWh)					
Realistic Achievable	33,146	267,962	616,991	1,007,301	1,411,648
Maximum Achievable	57,434	679,603	1,258,467	1,598,673	1,869,605
Economic	156,759	956,924	1,517,670	1,853,199	2,143,779
Technical	212,980	1,349,814	2,191,746	2,718,118	3,118,733
Cumulative Energy Savings (% of Baseline)					
Realistic Achievable	0.6%	4.6%	9.6%	14.0%	17.5%
Maximum Achievable	1.1%	11.7%	19.5%	22.2%	23.2%
Economic	2.9%	16.4%	23.5%	25.7%	26.6%
Technical	3.9%	23.2%	33.9%	37.8%	38.6%
Peak Savings (MW)					
Realistic Achievable	10	57	126	212	298
Maximum Achievable	15	142	266	339	388
Economic	41	204	325	394	447
Technical	53	289	457	565	645
Peak Savings (% of Baseline)					
Realistic Achievable	0.8%	4.6%	9.2%	13.8%	17.4%
Maximum Achievable	1.3%	11.5%	19.3%	22.1%	22.6%
Economic	3.5%	16.5%	23.7%	25.8%	26.1%
Technical	4.6%	23.4%	33.3%	36.9%	37.6%

Table A-14 Achievable Cumulative EE Potential by Sector, Washington (MWh)

Segment	2012	2017	2022	2027	2032
Residential, WA	17,413	94,529	238,739	431,973	637,029
C&I, WA	15,733	173,433	378,252	575,328	774,619
Total	**33,146**	**267,962**	**616,991**	**1,007,301**	**1,411,648**

Figure A-6 Achievable Cumulative Potential by Sector, Washington

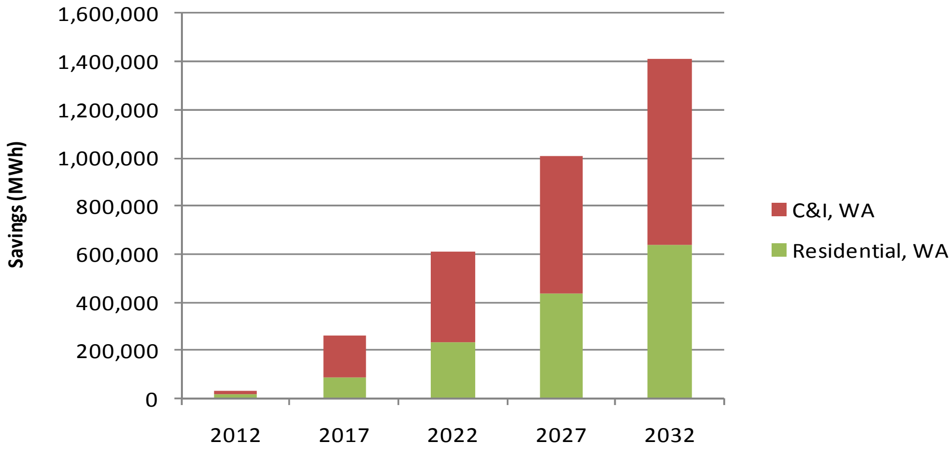

Figure A-7 Residential Energy Efficiency Potential Savings, Washington

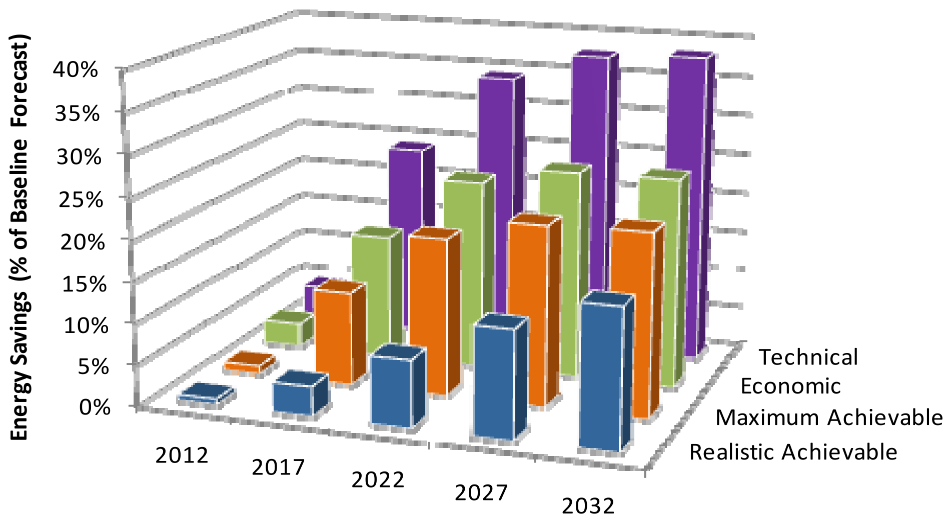

Figure A-8 Residential Energy Efficiency Potential Forecast, Washington

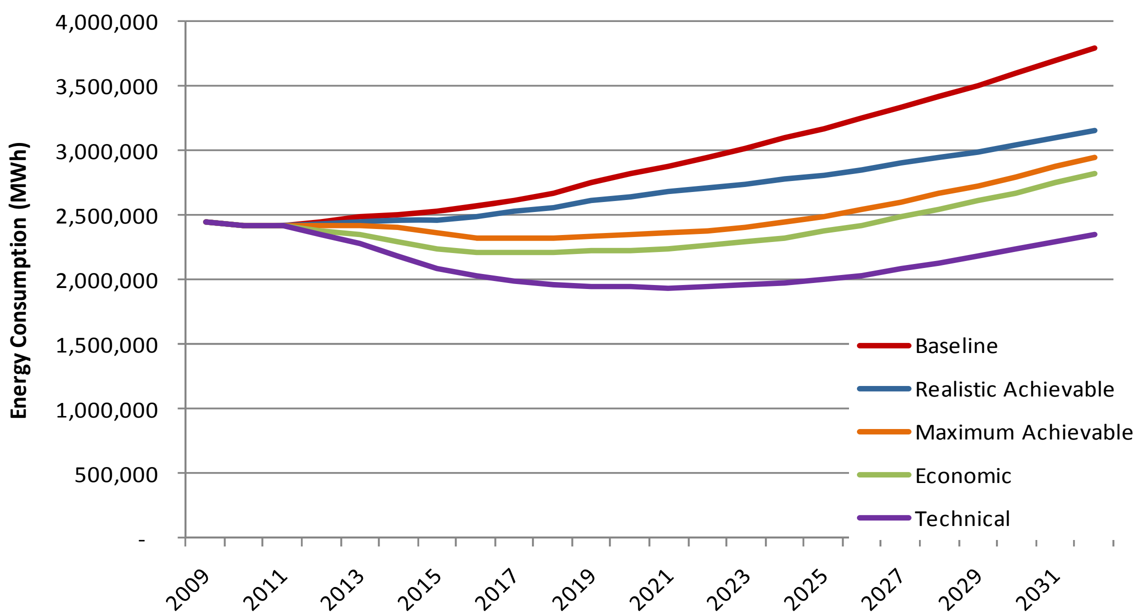

Table A-15 Energy Efficiency Potential for the Residential Sector, Washington

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	2,448,104	2,617,630	2,947,427	3,329,882	3,792,486
Baseline Peak Demand (MW)	710	736	825	925	1,041
Cumulative Energy Savings (MWh)					
Realistic achievable	17,413	94,529	238,739	431,973	637,029
Maximum achievable	24,459	298,135	567,960	730,774	843,186
Economic	70,743	404,323	687,451	847,003	970,769
Technical	103,446	626,769	1,005,455	1,250,538	1,446,982
Cumulative Energy Savings (% of Baseline)					
Realistic Achievable	0.7%	3.6%	8.1%	13.0%	16.8%
Maximum achievable	1.0%	11.4%	19.3%	21.9%	22.2%
Economic	2.9%	15.4%	23.3%	25.4%	25.6%
Technical	4.2%	23.9%	34.1%	37.6%	38.2%
Peak Savings (MW)					
Realistic Achievable	7	32	74	133	193
Maximum achievable	10	87	171	222	251
Economic	27	124	211	258	290
Technical	37	187	298	368	422
Peak Savings (% of Baseline)					
Realistic Achievable	1.0%	4.3%	9.0%	14.4%	18.5%
Maximum achievable	1.4%	11.9%	20.7%	24.0%	24.1%
Economic	3.9%	16.8%	25.5%	27.9%	27.8%
Technical	5.2%	25.4%	36.1%	39.8%	40.5%

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 935 of 1069

Table A-16 Residential Baseline & Realistic Achievable Potential by Segment, WA

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)					
Single Family	1,585,536	1,691,161	1,906,692	2,156,609	2,459,834
Multi Family	160,305	175,186	199,898	227,929	260,943
Mobile Home	68,448	72,476	81,311	91,591	104,051
Limited Income	633,816	678,807	759,527	853,753	967,658
Total	2,448,104	2,617,630	2,947,427	3,329,882	3,792,486
Energy Savings, Realistic Achievable Potential (MWh)					
Single Family	12,388	64,350	164,414	291,057	426,412
Multi Family	830	4,691	12,243	24,346	36,864
Mobile Home	520	2,283	4,274	7,827	11,714
Limited Income	3,674	23,204	57,808	108,744	162,039
Total	17,413	94,529	238,739	431,973	637,029
% of Total Residential Energy Savings					
Single Family	71.1%	68.1%	68.9%	67.4%	66.9%
Multi Family	4.8%	5.0%	5.1%	5.6%	5.8%
Mobile Home	3.0%	2.4%	1.8%	1.8%	1.8%
Limited Income	21.1%	24.5%	24.2%	25.2%	25.4%

Table A-17 Residential Potential by Housing Type, 2022, Washington

Forecast	Single Family	Multi Family	Mobile Home	Limited Income	Total
Baseline Forecast (MWh)	1,906,692	199,898	81,311	759,527	2,947,427
Cumulative Energy Savings (MWh)					
Realistic Achievable	164,414	12,243	4,274	57,808	238,739
Maximum Achievable	386,645	31,832	9,576	139,906	567,960
Economic Potential	463,459	39,746	11,955	172,291	687,451
Technical Potential	639,003	61,512	28,913	276,028	1,005,455
Energy Savings % of Baseline					
Realistic Achievable	8.6%	6.1%	5.3%	7.6%	8.1%
Maximum Achievable	20.3%	15.9%	11.8%	18.4%	19.3%
Economic Potential	24.3%	19.9%	14.7%	22.7%	23.3%
Technical Potential	33.5%	30.8%	35.6%	36.3%	34.1%

Table A-18 Residential Cumulative Savings by End Use and Potential Type, Washington (MWh)

End Use	Case	2012	2017	2022	2027	2032
Cooling	Realistic Achievable	9	1,659	5,876	15,615	29,687
	Economic	246	15,452	28,210	40,243	54,276
	Technical	2,766	42,662	68,576	97,845	132,886
Space Heating	Realistic Achievable	216	12,242	57,209	132,448	215,198
	Economic	6,791	110,158	213,315	282,271	338,227
	Technical	9,175	144,853	273,139	365,838	453,464
Heat/Cool	Realistic Achievable	9	595	1,581	4,130	10,179
	Economic	311	8,778	10,272	12,770	18,457
	Technical	2,278	18,977	32,657	45,591	52,056
Water Heating	Realistic Achievable	469	18,949	78,476	154,418	239,950
	Economic	9,253	101,513	227,153	297,020	348,485
	Technical	24,475	195,999	366,992	463,545	517,698
Appliances	Realistic Achievable	848	8,195	17,794	28,160	39,054
	Economic	3,663	40,418	53,006	56,444	60,723
	Technical	4,768	51,790	69,442	75,057	79,777
Interior Lighting	Realistic Achievable	12,389	34,835	44,682	52,336	47,795
	Economic	36,945	71,839	81,146	74,030	56,992
	Technical	43,188	98,598	97,421	91,087	84,570
Exterior Lighting	Realistic Achievable	2,156	6,922	7,102	6,615	5,305
	Economic	6,420	14,434	11,588	8,760	6,252
	Technical	7,353	18,822	16,360	14,884	14,685
Electronics	Realistic Achievable	1,173	8,913	21,007	29,939	37,810
	Economic	5,909	30,195	44,462	50,005	57,525
	Technical	8,171	43,205	61,954	70,337	81,054
Miscellaneous	Realistic Achievable	145	2,218	5,012	8,312	12,051
	Economic	1,205	11,535	18,300	25,461	29,833
	Technical	1,273	11,864	18,916	26,354	30,793
Total	Realistic Achievable	17,413	94,529	238,739	431,973	637,029
	Economic	70,743	404,323	687,451	847,003	970,769
	Technical	103,446	626,769	1,005,455	1,250,538	1,446,982

Figure A–9 Residential Achievable Potential by End Use, Selected Years, Washington

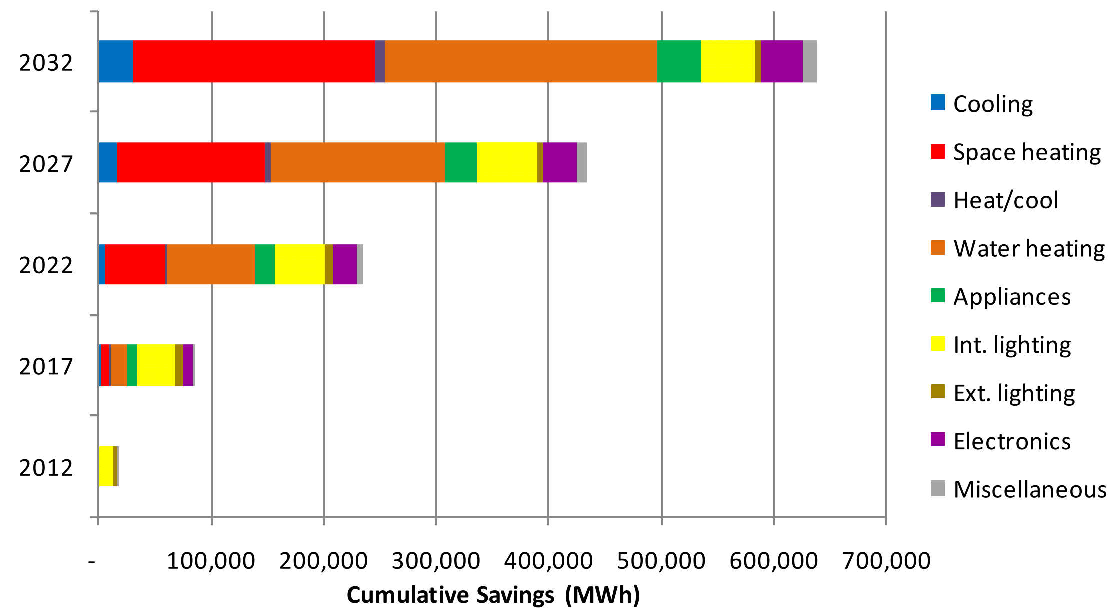

Table A-19 Residential Realistic Achievable Potential by End Use and Market Segment, 2022, WA (MWh)

	Single Family	Multi Family	Mobile Home	Limited Income	Total
Cooling	3,239	206	70	2,360	5,876
Space heating	44,225	3,196	506	9,282	57,209
Heat/cool	1,464	10	49	58	1,581
Water heating	44,891	5,834	886	26,864	78,476
Appliances	12,433	426	499	4,436	17,794
Interior lighting	31,573	1,880	1,155	10,074	44,682
Exterior lighting	5,854	99	252	896	7,102
Electronics	16,296	587	685	3,438	21,007
Miscellaneous	4,438	5	171	399	5,012
Total	**164,414**	**12,243**	**4,274**	**57,808**	**238,739**

Table A-20 Residential Cumulative Realistic Achievable Potential by End Use and Equipment Measures, Washington, Selected Years (MWh)

End Use	Technology	2012	2017	2022
Cooling	Central AC	-	100	112
Heat/Cool	Air Source Ht. Pump	-	-	-
Water Heating	Water Heater	97	726	760
Appliances	Clothes Washer	54	661	1,664
	Clothes Dryer	68	468	858
	Dishwasher	75	701	1,709
	Refrigerator	293	1,347	2,798
	Freezer	220	1,091	2,371
	Second Refrigerator	101	490	949
	Stove	14	109	245
Interior Lighting	Screw-in	11,536	28,508	34,316
	Linear Fluorescent	117	1,267	2,373
	Pin-based	735	4,932	7,438
Exterior Lighting	Screw-in	2,139	6,837	6,987
	High Intensity/Flood	17	85	115
Electronics	Personal Computers	758	6,128	10,557
	TVs	407	2,139	3,960
Miscellaneous	Pool Pump	110	1,022	2,525
	Furnace Fan	29	358	1,066
Total		16,770	56,971	80,803

Table A-21 Residential Realistic Achievable Savings for Non-equipment Measures, Washington (MWh)

Measure	2012	2017	2022
Water Heater - Convert to Gas	211	8,173	55,933
Furnace - Convert to Gas	172	5,504	35,051
Advanced New Construction Designs	1	119	2,781
Repair and Sealing - Ducting	13	1,860	5,347
Insulation - Infiltration Control	14	1,927	5,432
Water Heater - Thermostat Setback	98	5,644	9,489
Home Energy Management System	5	798	2,822
Water Heater - Hot Water Saver	4	296	3,785
Freezer - Remove Second Unit	15	2,142	4,592
Thermostat - Clock/Programmable	15	2,060	5,686
Electronics - Reduce Standby Wattage	8	646	6,490
Insulation - Foundation	1	298	1,351
Air Source Heat Pump - Maintenance	9	595	1,581
Refrigerator - Remove Second Unit	8	1,185	2,608
Water Heater - Faucet Aerators	9	685	1,639
Insulation - Ducting	1	146	836
Insulation - Wall Cavity	0	190	865
Water Heater - Tank Blanket/Insulation	34	1,803	2,812
Room AC - Removal of Second Unit	4	638	1,582
Ceiling Fan - Installation	0	63	576
Water Heater - Timer	8	934	1,676
Insulation - Ceiling	2	285	862
Water Heater - Low Flow Showerheads	6	617	1,233
Water Heater - Heat Pump	-	11	458
Central AC - Maintenance and Tune-Up	-	-	-
Insulation - Wall Sheathing	0	36	172
Pool - Pump Timer	5	838	1,421
Water Heater - Pipe Insulation	1	72	692
Whole-House Fan - Installation	-	6	166
Total	643	37,558	157,936

Figure A-10 Energy Efficiency Potential Savings, C&I Sector, Washington

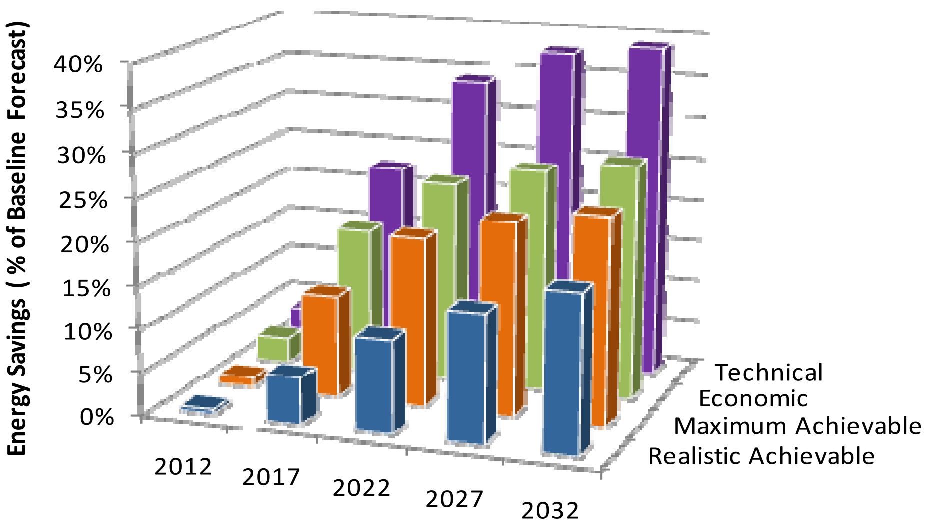

Figure A-11 Energy Efficiency Potential Forecast, C&I Sector, Washington

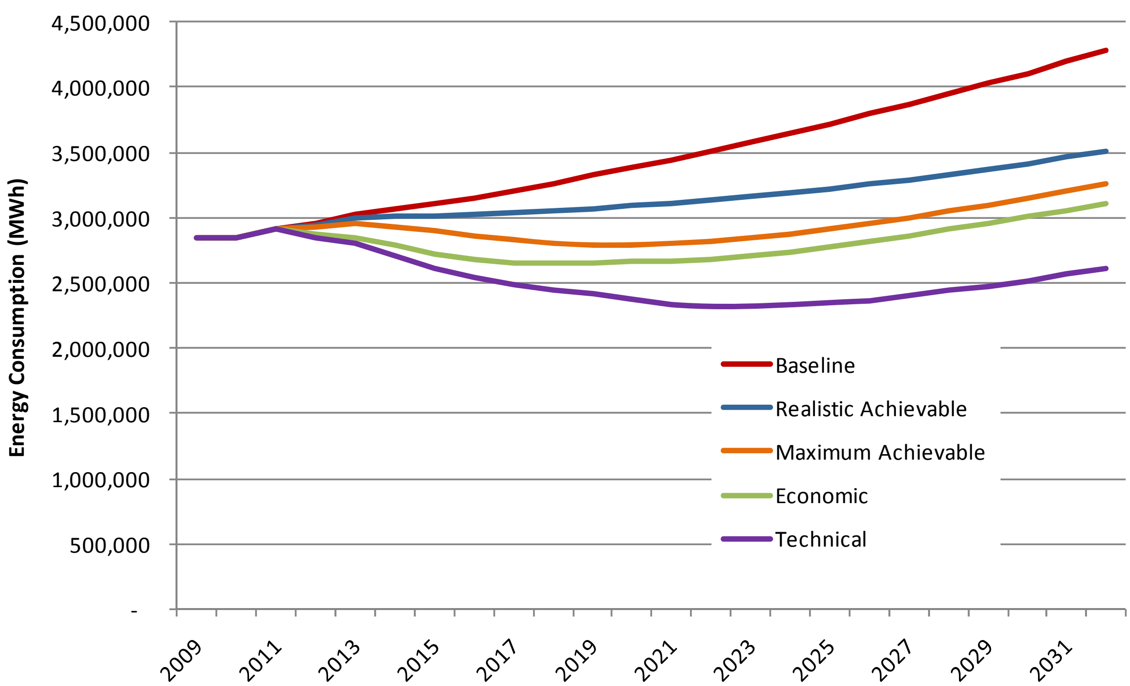

Table A-22 Energy Efficiency Potential, C&I Sector, Washington

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	2,955,156	3,209,083	3,509,816	3,869,176	4,280,649
Baseline Peak Demand(MW)	460	500	549	607	671
Cumulative Energy Savings (MWh)					
Realistic Achievable	15,733	173,433	378,252	575,328	774,619
Maximum Achievable	32,975	381,468	690,507	867,899	1,026,419
Economic	86,016	552,602	830,218	1,006,195	1,173,010
Technical	109,533	723,045	1,186,290	1,467,580	1,671,750
Cumulative Energy Savings (% of Baseline)					
Realistic Achievable	0.5%	5.4%	10.8%	14.9%	18.1%
Maximum Achievable	1.1%	11.9%	19.7%	22.4%	24.0%
Economic	2.9%	17.2%	23.7%	26.0%	27.4%
Technical	3.7%	22.5%	33.8%	37.9%	39.1%
Peak Savings (MW)					
Realistic Achievable	2	25	52	79	105
Maximum Achievable	5	55	95	117	137
Economic	13	80	114	137	157
Technical	17	102	159	197	223
Peak Savings (% of Baseline)					
Realistic Achievable	0.5%	5.1%	9.5%	13.0%	15.7%
Maximum Achievable	1.1%	11.0%	17.2%	19.4%	20.4%
Economic	2.9%	15.9%	20.8%	22.6%	23.4%
Technical	3.6%	20.4%	28.9%	32.5%	33.2%

Table A-23 C&I Sector, Baseline and Realistic Achievable Potential by Segment, Washington

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)					
Small/Med. Commercial	413,131	436,628	470,488	512,594	560,964
Large Commercial	1,558,848	1,641,938	1,770,523	1,927,937	2,109,236
Extra Large Commercial	275,848	338,184	367,338	399,653	434,542
Extra Large Industrial	707,328	792,332	901,468	1,028,993	1,175,907
Total	2,955,156	3,209,083	3,509,816	3,869,176	4,280,649
Cumulative Energy Savings, Achievable Potential (MWh)					
Small/Med. Commercial	2,551	25,567	52,366	79,356	108,891
Large Commercial	10,092	112,528	231,487	335,497	435,628
Extra Large Commercial	2,607	27,021	56,555	85,997	112,469
Extra Large Industrial	483	8,317	37,844	74,477	117,630
Total	15,733	173,433	378,252	575,328	774,619
% of Total C&I Cumulative Energy Savings					
Small/Med. Commercial	16.2%	14.7%	13.8%	13.8%	14.1%
Large Commercial	64.1%	64.9%	61.2%	58.3%	56.2%
Extra Large Commercial	16.6%	15.6%	15.0%	14.9%	14.5%
Extra Large Industrial	3.1%	4.8%	10.0%	12.9%	15.2%

Table A-24 C&I Potential by Segment, Washington, 2022

Forecast	Small/Med. Commercial	Large Commercial	Extra Large Commercial	Extra Large Industrial	Total
Baseline Forecast (MWh)	470,488	1,770,523	367,338	901,468	3,509,816
Cumulative Energy Savings (MWh)					
Realistic Achievable	52,366	231,487	56,555	37,844	378,252
Economic Potential	106,676	441,853	118,311	163,378	830,218
Technical Potential	172,714	650,066	148,095	215,416	1,186,290
Cumulative Energy Savings % of Baseline					
Realistic Achievable	11%	13%	15%	4%	11%
Economic Potential	23%	25%	32%	18%	24%
Technical Potential	37%	37%	40%	24%	34%

Table A-25 C&I Cumulative Savings by End Use and Potential Type, Washington (MWh)

End Use	Case	2012	2017	2022	2027	2032
Cooling	Realistic Achievable	127	8,672	29,166	48,498	72,425
	Economic	1,709	30,259	62,983	86,699	116,136
	Technical	4,457	60,126	124,114	157,093	189,090
Space Heating	Realistic Achievable	10	1,427	7,180	14,045	23,624
	Economic	212	7,563	19,650	28,833	42,274
	Technical	356	11,555	32,534	45,033	60,186
Heat/Cool	Realistic Achievable	31	2,494	4,572	5,575	6,982
	Economic	357	5,927	7,558	8,984	10,138
	Technical	483	6,778	9,118	11,073	12,505
Ventilation	Realistic Achievable	246	4,256	20,112	40,397	69,089
	Economic	4,017	29,775	75,187	107,501	130,189
	Technical	6,107	47,417	127,261	172,058	190,303
Water Heating	Realistic Achievable	181	4,769	10,742	16,921	23,513
	Economic	1,709	15,526	22,956	29,467	31,482
	Technical	8,806	63,741	116,091	166,541	183,186
Food Preparation	Realistic Achievable	140	1,796	5,159	9,950	14,898
	Economic	1,863	11,976	21,990	26,511	28,922
	Technical	2,173	13,179	24,316	29,162	31,947
Refrigeration	Realistic Achievable	123	1,246	4,138	7,959	11,717
	Economic	1,843	8,978	17,215	22,233	24,920
	Technical	2,183	11,986	26,785	34,794	39,418
Interior Lighting	Realistic Achievable	11,768	111,221	218,748	316,260	394,891
	Economic	50,511	299,598	396,845	456,682	523,557
	Technical	55,416	327,215	442,057	510,066	581,362
Exterior Lighting	Realistic Achievable	1,108	15,661	30,450	38,068	45,433
	Economic	4,693	44,035	50,942	53,236	56,711
	Technical	5,191	48,166	57,089	64,537	72,708
Office Equipment	Realistic Achievable	1,779	18,258	30,020	39,448	49,199
	Economic	12,800	58,446	61,458	64,159	66,791
	Technical	17,214	80,539	85,590	90,712	96,009
Machine Drive	Realistic Achievable	199	2,492	8,718	15,739	23,806
	Economic	2,252	17,069	40,392	50,946	58,527
	Technical	2,653	26,498	84,466	111,180	128,005
Process	Realistic Achievable	17	999	8,473	20,545	35,763
	Economic	3,980	22,472	50,483	66,505	77,283
	Technical	3,980	22,472	50,483	66,505	77,283
Miscellaneous	Realistic Achievable	5	142	775	1,924	3,280
	Economic	70	977	2,561	4,439	6,080
	Technical	514	3,373	6,388	8,826	9,749
Total	Realistic Achievable	15,733	173,433	378,252	575,328	774,619
	Economic	86,016	552,602	830,218	1,006,195	1,173,010
	Technical	109,533	723,045	1,186,290	1,467,580	1,671,750

Figure A-12 C&I Achievable Potential by End Use, Selected Years, Washington

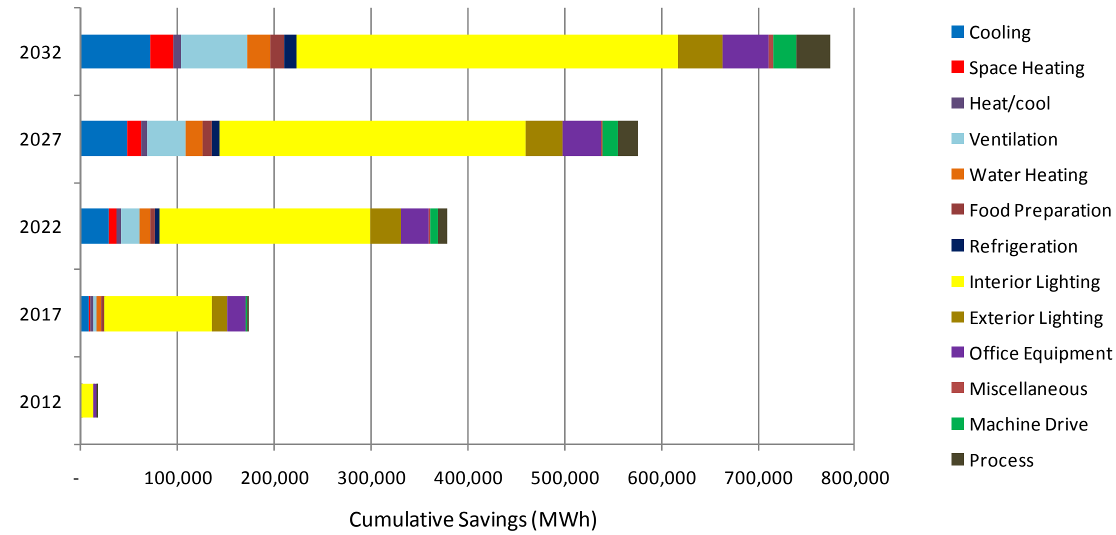

Table A-26 C&I Realistic Achievable Potential by End Use and Market Segment, 2022, Washington (MWh)

	Small/Med. Commercial	Large Commercial	Extra Large Commercial	Extra Large Industrial	Total
Cooling	1,017	17,942	4,119	6,087	29,166
Space Heating	440	4,617	1,216	906	7,180
Combined Heating/Cooling	323	3,597	464	188	4,572
Ventilation	4,268	3,818	4,496	7,530	20,112
Water Heating	1,238	3,974	5,530	-	10,742
Food Preparation	700	3,815	644	-	5,159
Refrigeration	741	3,001	396	-	4,138
Interior Lighting	33,054	149,244	30,943	5,507	218,748
Exterior Lighting	5,854	18,916	5,246	434	30,450
Office Equipment	4,529	22,130	3,362	-	30,020
Machine Drive	-	-	-	8,718	8,718
Process	-	-	-	8,473	8,473
Miscellaneous	202	432	141	-	775
Total	**52,366**	**231,487**	**56,555**	**37,844**	**378,252**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 945 of 1069

Table A-27 C&I Cumulative Achievable Potential by End Use and Equipment Measures, Washington (MWh)

End Use	Technology	2012	2017	2022
Cooling	Central Chiller	53	551	2,062
	PTAC	4	4	4
Heat/Cool	Heat Pump	14	263	795
Ventilation	Ventilation	235	3,625	13,529
Water Heater	Water Heater	160	1,908	4,354
Food Preparation	Fryer	9	101	271
	Hot Food Container	5	172	488
	Oven	127	1,495	3,996
Refrigeration	Glass Door Display	21	279	808
	Icemaker	16	216	644
	Solid Door Refrigerator	29	332	893
	Vending Machine	55	303	740
	Walk in Refrigeration	21	279	808
Interior Lighting	Interior Screw-in	6,957	45,558	69,399
	HID	1,823	16,436	32,323
	Linear Fluorescent	2,869	35,193	69,229
Exterior Lighting	Screw-in	154	2,018	3,288
	HID	864	10,866	21,367
	Linear Fluorescent	82	1,472	2,497
Office Equipment	Desktop Computer	1,056	9,794	15,665
	Laptop Computer	75	700	1,119
	Monitor	211	757	1,307
	POS Terminal	23	318	580
	Printer/copier/fax	66	1,061	1,963
	Server	342	4,823	7,781
Machine Drive	Less than 5 HP	13	92	280
	5-24 HP	28	208	649
	25-99 HP	69	518	1,616
	100-249 HP	19	146	455
	250-499 HP	21	155	484
	500 and more HP	39	292	913
Process	Electrochem. Process	2	138	1,150
	Process Cooling/Refrig.	3	185	1,538
	Process Heating	11	658	5,482
Miscellaneous	Non-HVAC Motor	4	70	339
Total		**15,460**	**140,725**	**268,060**

Table A-28 C&I Cumulative Achievable Savings for Non-equipment Measures, Washington (MWh)

Measure	2012	2017	2022
Energy Management System	25	1,553	16,501
Advanced New Construction Designs	1	70	1,070
Retrocommissioning - Lighting	37	7,653	14,120
Interior Fluorescent - High Bay Fixtures	13	787	8,430
Retrocommissioning - Comprehensive	29	6,096	10,951
Custom Measures	2	533	7,173
RTU - Maintenance	39	4,686	8,093
Fans - Variable Speed Control	5	218	2,179
Fans - Energy Efficient Motors	5	304	3,318
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	0	39	342
Interior Lighting - Occupancy Sensors	13	477	3,666
Interior Fluorescent - Delamp and Install Reflectors	12	506	3,807
Water Heater - Faucet Aerators/Low Flow Nozzles	18	2,657	5,409
Commissioning - Comprehensive	0	245	1,809
Retrocommissioning - HVAC	2	258	2,720
Heat Pump - Maintenance	17	2,231	3,777
Motors - Variable Frequency Drive	7	883	1,911
Motors - Magnetic Adjustable Speed Drives	3	146	1,535
Roofs - High Reflectivity	1	33	262
Chiller - Turbocor Compressor	2	109	1,244
Chiller - Condenser Water Temperature Reset	4	222	2,148
Chiller - VSD	1	81	859
Commissioning - Lighting	0	155	528
Thermostat - Clock/Programmable	3	458	904
Office Equipment - ENERGY STAR Power Supply	6	806	1,605
Exterior Lighting - Daylighting Controls	2	92	747
Water Heater - Heat Pump	0	54	659
Cooking - Exhaust Hoods with Sensor Control	0	8	71
Cooling - Economizer Installation	2	83	760
Insulation - Ducting	1	53	443
Exterior Lighting - Induction Lamps	0	20	290
Furnace - Convert to Gas	1	45	297
Chiller - Chilled Water Reset	1	242	437
Insulation - Wall Cavity	0	10	146
Insulation - Ceiling	0	1	17
Refrigeration - System Optimization	0	10	159
LED Exit Lighting	17	613	670
Industrial Process Improvements	0	17	205

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 947 of 1069

Measure	2012	2017	2022
Refrigeration - System Controls	0	7	112
Commissioning - HVAC	-	-	16
Water Heater - Tank Blanket/Insulation	2	144	254
Pumps - Variable Speed Control	0	9	106
Miscellaneous - ENERGY STAR Water Cooler	0	40	115
Refrigeration - Strip Curtain	-	1	20
Refrigeration - Floating Head Pressure	0	6	59
Water Heater - Hot Water Saver	-	-	2
Refrigeration - Anti-Sweat Heater/Auto Door Closer	0	4	46
Refrigeration - System Maintenance	0	2	32
Water Heater - High Efficiency Circulation Pump	0	6	64
Vending Machine - Controller	0	26	44
Chiller - Chilled Water Variable-Flow System	0	4	32
Exterior Lighting - Cold Cathode Lighting	0	1	16
Laundry - High Efficiency Clothes Washer	0	6	10
Refrigeration - Night Covers	0	0	5
Total	**273**	**32,708**	**110,192**

IDAHO MARKET PROFILES, BASELINE FORECAST, AND POTENTIAL RESULTS

This appendix contains Idaho-specific tables that summarize the study assumptions, inputs, and results for Avista's Idaho service territory only. These tables either repeat Idaho-specific information provided previously within the body of the report, or provide Idaho-specific information that corresponds to Avista system-level information in the report.

Table B–1 Electricity Use and Peak Demand by Rate Class, Idaho 2009

Sector	Rate Schedule(s)	Number of meters (customers)	2009 Electricity sales (MWh)	Peak demand (MW)
Residential	001	99,580	1,182,368	283
General Service	011, 012	19,245	322,570	61
Large General Service	021, 022	1,456	699,953	115
Extra Large General Service	025, 025P	10	266,044	40
Extra Large GS Potlatch	025P	1	892	101
Pumping	031, 032	1,312	58,885	4
Total		**121,604**	**3,422,111**	**603**

Table B–2 Residential Electricity Usage and Intensity by Segment, Idaho 2009

Idaho Segment	Intensity (kWh/Household)	Number of Customers	% of Customers	2009 Electricity Sales (MWh)	% of Sales
Single Family	13,703	59,205	59%	811,302	69%
Multi-Family	8,213	5,237	5%	43,013	4%
Mobile Home	12,320	4,774	5%	58,815	5%
Limited Income	8,868	30,363	31%	269,249	23%
Total	**11,874**	**99,580**	**100%**	**1,182,379**	**100%**

Note: Minor differences with totals in Table B–1 due to calibration.

Table B–3 Single Family Market Profile, 2009, Idaho

		Average Market Profiles				New Units			
End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)	Saturation	UEC (kWh)	Intensity (kWh/HH)	Compared to Average
Cooling	Central AC	36.8%	1,857	684	41	73.4%	2,154	1,581	16%
Cooling	Room AC	10.8%	683	74	4	1.4%	793	11	16%
Combined Heating/Cooling	Air Source Heat Pump	14.7%	6,377	940	56	13.6%	7,398	1,004	16%
Combined Heating/Cooling	Geothermal Heat Pump	0.7%	3,826	27	2	0.8%	4,439	33	16%
Space Heating	Electric Resistance	5.0%	11,494	570	34	2.5%	13,793	342	20%
Space Heating	Electric Furnace	20.0%	9,195	1,837	109	21.0%	11,035	2,315	20%
Space Heating	Supplemental	6.1%	128	8	0	6.1%	154	9	20%
Water Heating	Water Heater	44.4%	3,813	1,694	100	37.8%	4,595	1,736	21%
Interior Lighting	Screw-in	100.0%	1,394	1,394	83	100.0%	1,394	1,394	0%
Interior Lighting	Linear Fluorescent	69.2%	146	101	6	69.2%	146	101	0%
Interior Lighting	Pin-based	100.0%	58	58	3	100.0%	58	58	0%
Exterior Lighting	Screw-in	86.7%	366	317	19	86.7%	366	317	0%
Exterior Lighting	High Intensity/Flood	1.9%	140	3	0	1.9%	140	3	0%
Appliances	Clothes Washer	98.0%	126	124	7	99.8%	154	154	22%
Appliances	Clothes Dryer	92.8%	609	565	33	89.0%	692	616	14%
Appliances	Dishwasher	93.9%	246	231	14	99.9%	271	271	11%
Appliances	Refrigerator	100.0%	793	793	47	100.0%	625	625	-21%
Appliances	Freezer	69.4%	773	536	32	69.4%	708	491	-8%
Appliances	Second Refrigerator	47.3%	816	386	23	20.5%	711	146	-13%
Appliances	Stove	82.1%	383	314	19	82.1%	465	382	22%
Appliances	Microwave	98.5%	168	166	10	98.5%	173	171	3%
Electronics	Personal Computers	140.0%	279	391	23	147.0%	287	422	3%
Electronics	TVs	260.0%	359	933	55	260.0%	400	1,041	12%
Electronics	Devices and Gadgets	100.0%	60	60	4	100.0%	67	67	10%
Miscellaneous	Pool Pump	13.3%	1,500	200	12	14.0%	1,526	214	2%
Miscellaneous	Furnace Fan	30.1%	550	166	10	30.1%	675	203	23%
Miscellaneous	Miscellaneous	100.0%	1,132	1,132	67	100.0%	1,359	1,359	20%
Total				**13,703**	**811**			**15,063**	

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 951 of 1069

Table B–4 Multi-family Market Profile, 2009, Idaho

		Average Market Profiles				New Units			
End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)	Saturation	UEC (kWh)	Intensity (kWh/HH)	Compared to Average
Cooling	Central AC	5.0%	845	42	0	24.1%	912	220	8%
Cooling	Room AC	25.0%	324	81	0	18.9%	350	66	8%
Combined Heating/Cooling	Air Source Heat Pump	1.0%	2,665	27	0	3.4%	2,878	98	8%
Combined Heating/Cooling	Geothermal Heat Pump	0.0%	1,599	-	-	0.5%	1,727	9	8%
Space Heating	Electric Resistance	59.0%	4,983	2,940	15	59.0%	5,481	3,234	10%
Space Heating	Electric Furnace	5.0%	3,986	199	1	5.0%	4,385	219	10%
Space Heating	Supplemental	18.0%	56	10	0	18.9%	61	12	10%
Water Heating	Water Heater	77.0%	1,936	1,491	8	71.3%	2,134	1,522	10%
Interior Lighting	Screw-in	100.0%	750	750	4	100.0%	750	750	0%
Interior Lighting	Linear Fluorescent	32.0%	76	24	0	32.0%	76	24	0%
Interior Lighting	Pin-based	3.0%	75	2	0	3.0%	75	2	0%
Exterior Lighting	Screw-in	38.5%	55	21	0	38.5%	55	21	0%
Exterior Lighting	High Intensity/Flood	0.2%	73	0	0	0.2%	73	0	0%
Appliances	Clothes Washer	32.0%	63	20	0	32.0%	70	22	11%
Appliances	Clothes Dryer	30.7%	582	179	1	30.7%	621	191	7%
Appliances	Dishwasher	64.0%	88	56	0	64.0%	93	59	5%
Appliances	Refrigerator	100.0%	677	677	4	100.0%	665	665	-2%
Appliances	Freezer	8.4%	734	62	0	8.4%	703	59	-4%
Appliances	Second Refrigerator	5.0%	687	34	0	5.0%	631	32	-8%
Appliances	Stove	96.4%	163	158	1	96.4%	181	175	11%
Appliances	Microwave	90.0%	99	89	0	90.0%	101	91	1%
Electronics	Personal Computers	63.0%	223	141	1	66.2%	226	150	1%
Electronics	TVs	165.0%	178	293	2	165.0%	188	310	6%
Electronics	Devices and Gadgets	100.0%	25	25	0	100.0%	26	26	5%
Miscellaneous	Pool Pump	0.0%	-	-	-	0.0%	-	-	0%
Miscellaneous	Furnace Fan	13.0%	38	5	0	13.0%	42	5	11%
Miscellaneous	Miscellaneous	100.0%	888	888	5	100.0%	932	932	5%
Total				**8,213**	**43**			**8,893**	

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 952 of 1069

Table B–5 Mobile Home Market Profile, 2009, Idaho

		Average Market Profiles				New Units			
End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)	Saturation	UEC (kWh)	Intensity (kWh/HH)	Compared to Average
Cooling	Central AC	23.2%	962	223	1	35.9%	1,039	373	8%
Cooling	Room AC	23.2%	354	82	0	22.0%	382	84	8%
Combined Heating/Cooling	Air Source Heat Pump	21.7%	3,035	660	3	22.8%	3,277	748	8%
Combined Heating/Cooling	Geothermal Heat Pump	0.0%	1,821	-	-	0.0%	1,966	-	8%
Space Heating	Electric Resistance	0.0%	5,122	-	-	0.0%	5,634	-	10%
Space Heating	Electric Furnace	68.1%	4,098	2,792	13	68.1%	4,508	3,071	10%
Space Heating	Supplemental	1.4%	30	0	0	1.5%	33	0	10%
Water Heating	Water Heater	96.3%	1,607	1,549	7	91.0%	1,772	1,612	10%
Interior Lighting	Screw-in	100.0%	1,307	1,307	6	100.0%	1,307	1,307	0%
Interior Lighting	Linear Fluorescent	69.2%	137	95	0	69.2%	137	95	0%
Interior Lighting	Pin-based	100.0%	54	54	0	100.0%	54	54	0%
Exterior Lighting	Screw-in	86.7%	343	297	1	86.7%	343	297	0%
Exterior Lighting	High Intensity/Flood	1.9%	131	2	0	1.9%	131	2	0%
Appliances	Clothes Washer	96.3%	128	124	1	96.3%	142	137	11%
Appliances	Clothes Dryer	98.8%	620	612	3	98.8%	662	653	7%
Appliances	Dishwasher	89.0%	250	222	1	89.0%	263	234	5%
Appliances	Refrigerator	100.0%	806	806	4	100.0%	792	792	-2%
Appliances	Freezer	59.3%	786	466	2	59.3%	753	446	-4%
Appliances	Second Refrigerator	19.5%	830	162	1	19.5%	762	149	-8%
Appliances	Stove	93.9%	344	323	2	93.9%	381	358	11%
Appliances	Microwave	82.0%	151	124	1	82.0%	154	126	2%
Electronics	Personal Computers	116.5%	262	305	1	122.3%	265	324	1%
Electronics	TVs	260.0%	359	933	4	260.0%	380	987	6%
Electronics	Devices and Gadgets	100.0%	60	60	0	100.0%	64	64	5%
Miscellaneous	Pool Pump	11.1%	1,500	167	1	11.7%	1,513	177	1%
Miscellaneous	Furnace Fan	8.3%	500	42	0	8.3%	557	47	11%
Miscellaneous	Miscellaneous	100.0%	913	913	4	100.0%	959	959	5%
Total				**12,320**	**59**			**13,096**	

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 953 of 1069

Table B–6 Limited Income Market Profile, 2009, Idaho

		Average Market Profiles				New Units			
End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)	Saturation	UEC (kWh)	Intensity (kWh/HH)	Compared to Average
Cooling	Central AC	22.2%	944	210	6	28.7%	1,019	293	8%
Cooling	Room AC	35.4%	641	227	7	18.0%	692	124	8%
Combined Heating/Cooling	Air Source Heat Pump	10.4%	2,134	222	7	10.4%	2,305	240	8%
Combined Heating/Cooling	Geothermal Heat Pump	0.0%	1,281	-	-	0.5%	1,383	7	8%
Space Heating	Electric Resistance	32.0%	4,647	1,486	45	28.8%	5,112	1,471	10%
Space Heating	Electric Furnace	19.3%	3,711	716	22	21.2%	4,082	867	10%
Space Heating	Supplemental	12.7%	57	7	0	13.4%	62	8	10%
Water Heating	Water Heater	83.9%	2,101	1,762	54	67.0%	2,316	1,552	10%
Interior Lighting	Screw-in	100.0%	728	728	22	100.0%	728	728	0%
Interior Lighting	Linear Fluorescent	69.2%	75	52	2	69.2%	75	52	0%
Interior Lighting	Pin-based	100.0%	59	59	2	100.0%	59	59	0%
Exterior Lighting	Screw-in	47.1%	106	50	2	47.1%	106	50	0%
Exterior Lighting	High Intensity/Flood	2.7%	84	2	0	2.7%	84	2	0%
Appliances	Clothes Washer	71.3%	55	39	1	71.3%	61	43	11%
Appliances	Clothes Dryer	68.6%	652	447	14	68.6%	696	477	7%
Appliances	Dishwasher	78.5%	72	56	2	78.5%	75	59	5%
Appliances	Refrigerator	100.0%	677	677	21	100.0%	665	665	-2%
Appliances	Freezer	63.4%	734	466	14	63.4%	703	446	-4%
Appliances	Second Refrigerator	23.4%	687	161	5	23.4%	631	148	-8%
Appliances	Stove	89.7%	196	176	5	89.7%	217	195	11%
Appliances	Microwave	92.6%	109	101	3	92.6%	111	102	1%
Electronics	Personal Computers	101.4%	230	233	7	106.5%	233	248	1%
Electronics	TVs	165.0%	204	337	10	165.0%	216	356	6%
Electronics	Devices and Gadgets	100.0%	30	30	1	105.0%	32	33	5%
Miscellaneous	Pool Pump	5.8%	617	36	1	5.8%	622	36	1%
Miscellaneous	Furnace Fan	25.2%	213	54	2	25.2%	238	60	11%
Miscellaneous	Miscellaneous	100.0%	534	534	16	100.0%	561	561	5%
Total				**8,868**	**269**			**8,884**	

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 954 of 1069

Table B–7 Commercial Sector Market Characterization Results, Idaho 2009

Avista Rate Schedule		**LoadMAP Segment and Typical Building**	**Electricity sales (MWh)**	**Intensity (kWh/sq.ft.)**
General Service	011, 012	Small and Medium Commercial — Retail	322,570	17.5
Large General Service	021, 022	Large Commercial — Office	699,953	16.7
Extra Large General Service Commercial	025C	Extra Large Commercial — University	70,361	13.9
Extra Large General Service Industrial	025I, 025P	Extra Large Industrial	1,087,974	40.0
Total			**2,180,858**	

Table B-8 Small/Medium Commercial Segment Market Profile, Idaho, 2009

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Central Chiller	13.8%	2.39	0.33	6	13.8%	2.15	0.30	-10%
Cooling	RTU	63.1%	2.46	1.55	29	63.1%	2.22	1.40	-10%
Cooling	PTAC	3.3%	2.44	0.08	1	3.3%	2.20	0.07	-10%
Combined Heating/Cooling	Heat Pump	3.6%	6.19	0.22	4	3.6%	5.57	0.20	-10%
Space Heating	Electric Resistance	5.9%	6.72	0.39	7	5.9%	6.72	0.39	0%
Space Heating	Furnace	17.7%	7.05	1.25	23	17.7%	6.34	1.13	-10%
Ventilation	Ventilation	76.9%	2.09	1.61	30	76.9%	1.88	1.45	-10%
Interior Lighting	Interior Screw-in	100.0%	1.00	1.00	18	100.0%	0.90	0.90	-10%
Interior Lighting	HID	100.0%	0.68	0.68	13	100.0%	0.61	0.61	-10%
Interior Lighting	Linear Fluorescent	100.0%	3.37	3.37	62	100.0%	3.03	3.03	-10%
Exterior Lighting	Exterior Screw-in	82.6%	0.20	0.16	3	82.6%	0.18	0.15	-10%
Exterior Lighting	HID	82.6%	0.76	0.63	12	82.6%	0.68	0.56	-10%
Exterior Lighting	Linear Fluorescent	82.6%	0.16	0.13	2	82.6%	0.14	0.12	-10%
Water Heating	Water Heater	63.0%	2.00	1.26	23	63.0%	1.90	1.19	-5%
Food Preparation	Fryer	25.8%	0.16	0.04	1	25.8%	0.16	0.04	0%
Food Preparation	Oven	25.8%	0.98	0.25	5	25.8%	0.98	0.25	0%
Food Preparation	Dishwasher	25.8%	0.06	0.01	0	25.8%	0.06	0.01	0%
Food Preparation	Hot Food Container	25.8%	0.31	0.08	1	25.8%	0.31	0.08	0%
Food Preparation	Food Prep	25.8%	0.01	0.00	0	25.8%	0.01	0.00	0%
Refrigeration	Walk in Refrigeration	52.4%	-	-	-	52.4%	-	-	0%
Refrigeration	Glass Door Display	52.4%	0.45	0.23	4	52.4%	0.40	0.21	-10%
Refrigeration	Solid Door Refrigerator	52.4%	0.50	0.26	5	52.4%	0.45	0.24	-10%
Refrigeration	Open Display Case	52.4%	0.04	0.02	0	52.4%	0.04	0.02	-10%
Refrigeration	Vending Machine	52.4%	0.30	0.16	3	52.4%	0.30	0.16	0%
Refrigeration	Icemaker	52.4%	0.34	0.18	3	52.4%	0.34	0.18	0%
Office Equipment	Desktop Computer	99.9%	0.48	0.48	9	99.9%	0.48	0.48	0%
Office Equipment	Laptop Computer	99.9%	0.06	0.06	1	99.9%	0.06	0.06	0%
Office Equipment	Server	99.9%	0.36	0.36	7	99.9%	0.36	0.36	0%
Office Equipment	Monitor	99.9%	0.25	0.25	5	99.9%	0.25	0.25	0%
Office Equipment	Printer/copier/fax	99.9%	0.24	0.24	4	99.9%	0.24	0.24	0%
Office Equipment	POS Terminal	99.9%	0.27	0.27	5	99.9%	0.27	0.27	0%
Miscellaneous	Non-HVAC Motor	40.2%	1.22	0.49	9	40.2%	1.22	0.49	0%
Miscellaneous	Other Miscellaneous	100.0%	1.43	1.43	26	100.0%	1.43	1.43	0%
Total				**17.50**	**323**			**16.3**	

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 956 of 1069

Table B–9 Large Commercial Segment Market Profile, Idaho, 2009

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Central Chiller	24.7%	2.15	0.53	22	24.7%	1.93	0.48	-10%
Cooling	RTU	37.8%	2.52	0.95	40	37.8%	2.26	0.86	-10%
Cooling	PTAC	3.8%	2.49	0.09	4	3.8%	2.24	0.08	-10%
Combined Heating/Cooling	Heat Pump	9.1%	4.81	0.44	18	9.1%	4.33	0.40	-10%
Space Heating	Electric Resistance	5.9%	3.62	0.21	9	5.9%	3.62	0.21	0%
Space Heating	Furnace	12.7%	4.68	0.60	25	12.7%	4.21	0.54	-10%
Ventilation	Ventilation	75.1%	1.66	1.24	52	75.1%	1.49	1.12	-10%
Interior Lighting	Interior Screw-in	100.0%	0.94	0.94	39	100.0%	0.85	0.85	-10%
Interior Lighting	HID	100.0%	0.71	0.71	30	100.0%	0.64	0.64	-10%
Interior Lighting	Linear Fluorescent	100.0%	3.29	3.29	138	100.0%	2.96	2.96	-10%
Exterior Lighting	Exterior Screw-in	89.6%	0.11	0.10	4	89.6%	0.10	0.09	-10%
Exterior Lighting	HID	89.6%	0.62	0.56	23	89.6%	0.56	0.50	-10%
Exterior Lighting	Linear Fluorescent	89.6%	0.16	0.14	6	89.6%	0.14	0.13	-10%
Water Heating	Water Heater	54.2%	2.31	1.25	53	54.2%	2.20	1.19	-5%
Food Preparation	Fryer	18.4%	0.35	0.06	3	18.4%	0.35	0.06	0%
Food Preparation	Oven	18.4%	1.88	0.35	14	18.4%	1.88	0.35	0%
Food Preparation	Dishwasher	18.4%	0.19	0.03	1	18.4%	0.19	0.03	0%
Food Preparation	Hot Food Container	18.4%	0.27	0.05	2	18.4%	0.27	0.05	0%
Food Preparation	Food Prep	18.4%	0.02	0.00	0	18.4%	0.02	0.00	0%
Refrigeration	Walk in Refrigeration	39.1%	0.48	0.19	8	39.1%	0.43	0.17	-10%
Refrigeration	Glass Door Display	39.1%	0.37	0.14	6	39.1%	0.33	0.13	-10%
Refrigeration	Solid Door Refrigerator	39.1%	0.77	0.30	13	39.1%	0.69	0.27	-10%
Refrigeration	Open Display Case	39.1%	0.27	0.10	4	39.1%	0.24	0.09	-10%
Refrigeration	Vending Machine	39.1%	0.36	0.14	6	39.1%	0.36	0.14	0%
Refrigeration	Icemaker	39.1%	0.66	0.26	11	39.1%	0.66	0.26	0%
Office Equipment	Desktop Computer	98.4%	0.90	0.88	37	98.4%	0.90	0.88	0%
Office Equipment	Laptop Computer	98.4%	0.07	0.07	3	98.4%	0.07	0.07	0%
Office Equipment	Server	98.4%	0.42	0.41	17	98.4%	0.42	0.41	0%
Office Equipment	Monitor	98.4%	0.21	0.20	9	98.4%	0.21	0.20	0%
Office Equipment	Printer/copier/fax	98.4%	0.21	0.21	9	98.4%	0.21	0.21	0%
Office Equipment	POS Terminal	98.4%	0.07	0.07	3	98.4%	0.07	0.07	0%
Miscellaneous	Non-HVAC Motor	57.7%	1.40	0.81	34	57.7%	1.40	0.81	0%
Miscellaneous	Other Miscellaneous	100.0%	1.36	1.36	57	100.0%	1.36	1.36	0%
Total				**16.70**	**700**			**15.6**	

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 957 of 1069

Table B–10 Extra Large Commercial Segment Market Profile, Idaho, 2009

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Central Chiller	52.2%	2.13	1.11	6	52.2%	1.92	1.00	-10%
Cooling	RTU	24.7%	2.22	0.55	3	24.7%	2.00	0.49	-10%
Cooling	PTAC	0.0%	2.22	-	-	0.0%	2.00	-	-10%
Combined Heating/Cooling	Heat Pump	4.4%	5.23	0.23	1	4.4%	4.70	0.21	-10%
Space Heating	Electric Resistance	15.8%	4.39	0.69	4	15.8%	4.39	0.69	0%
Space Heating	Furnace	5.6%	5.67	0.32	2	5.6%	5.11	0.29	-10%
Ventilation	Ventilation	90.2%	1.94	1.75	9	90.2%	1.74	1.57	-10%
Interior Lighting	Interior Screw-in	100.0%	1.37	1.37	7	100.0%	1.23	1.23	-10%
Interior Lighting	HID	100.0%	0.29	0.29	1	100.0%	0.26	0.26	-10%
Interior Lighting	Linear Fluorescent	100.0%	2.19	2.19	11	100.0%	1.97	1.97	-10%
Exterior Lighting	Exterior Screw-in	96.3%	0.03	0.03	0	96.3%	0.03	0.03	-10%
Exterior Lighting	HID	96.3%	0.88	0.85	4	96.3%	0.79	0.76	-10%
Exterior Lighting	Linear Fluorescent	96.3%	0.04	0.03	0	96.3%	0.03	0.03	-10%
Water Heating	Water Heater	26.3%	3.72	0.98	5	26.3%	3.53	0.93	-5%
Food Preparation	Fryer	13.8%	0.13	0.02	0	13.8%	0.13	0.02	0%
Food Preparation	Oven	13.8%	2.12	0.29	1	13.8%	2.12	0.29	0%
Food Preparation	Dishwasher	13.8%	0.08	0.01	0	13.8%	0.08	0.01	0%
Food Preparation	Hot Food Container	13.8%	0.13	0.02	0	13.8%	0.13	0.02	0%
Food Preparation	Food Prep	13.8%	0.01	0.00	0	13.8%	0.01	0.00	0%
Refrigeration	Walk in Refrigeration	26.6%	0.19	0.05	0	26.6%	0.17	0.04	-10%
Refrigeration	Glass Door Display	26.6%	0.11	0.03	0	26.6%	0.10	0.03	-10%
Refrigeration	Solid Door Refrigerator	26.6%	0.71	0.19	1	26.6%	0.64	0.17	-10%
Refrigeration	Open Display Case	26.6%	0.50	0.13	1	26.6%	0.45	0.12	-10%
Refrigeration	Vending Machine	26.6%	0.38	0.10	1	26.6%	0.38	0.10	0%
Refrigeration	Icemaker	26.6%	0.31	0.08	0	26.6%	0.31	0.08	0%
Office Equipment	Desktop Computer	100.0%	0.64	0.64	3	100.0%	0.64	0.64	0%
Office Equipment	Laptop Computer	100.0%	0.07	0.07	0	100.0%	0.07	0.07	0%
Office Equipment	Server	100.0%	0.17	0.17	1	100.0%	0.17	0.17	0%
Office Equipment	Monitor	100.0%	0.13	0.13	1	100.0%	0.13	0.13	0%
Office Equipment	Printer/copier/fax	100.0%	0.05	0.05	0	100.0%	0.05	0.05	0%
Office Equipment	POS Terminal	100.0%	0.01	0.01	0	100.0%	0.01	0.01	0%
Miscellaneous	Non-HVAC Motor	88.8%	0.82	0.73	4	88.8%	0.82	0.73	0%
Miscellaneous	Other Miscellaneous	100.0%	0.80	0.80	4	100.0%	0.80	0.80	0%
Total				**13.90**	**70**			**12.9**	

Table B–11 Extra Large Industrial Segment Market Profile, Idaho, 2009

		Average Market Profiles				New Units			
End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Usage (GWh)	Saturation	EUI (kWh)	Intensity (kWh/Sqft.)	Compared to Average
Cooling	Central Chiller	14.4%	7.98	1.15	31	14.4%	7.18	1.04	-10%
Cooling	RTU	17.1%	6.32	1.08	29	17.1%	5.68	0.97	-10%
Cooling	PTAC	1.1%	5.50	0.06	2	1.1%	4.95	0.05	-10%
Combined Heating/Cooling	Heat Pump	1.6%	11.13	0.18	5	1.6%	10.01	0.16	-10%
Space Heating	Electric Resistance	10.8%	8.67	0.93	25	10.8%	8.67	0.93	0%
Space Heating	Furnace	2.0%	9.10	0.18	5	2.0%	8.19	0.17	-10%
Ventilation	Ventilation	27.4%	12.31	3.37	92	27.4%	11.08	3.04	-10%
Interior Lighting	Interior Screw-in	100.0%	0.33	0.33	9	100.0%	0.30	0.30	-10%
Interior Lighting	HID	100.0%	1.05	1.05	28	100.0%	0.94	0.94	-10%
Interior Lighting	Linear Fluorescent	100.0%	1.10	1.10	30	100.0%	0.99	0.99	-10%
Exterior Lighting	Exterior Screw-in	92.5%	0.02	0.02	1	92.5%	0.02	0.02	-10%
Exterior Lighting	HID	92.5%	0.25	0.23	6	92.5%	0.23	0.21	-10%
Exterior Lighting	Linear Fluorescent	92.5%	0.01	0.01	0	92.5%	0.01	0.01	-10%
Process	Process Cooling/Refrigeration	2.4%	99.67	2.40	65	2.4%	99.67	2.40	0%
Process	Process Heating	26.2%	13.74	3.60	98	26.2%	13.74	3.60	0%
Process	Electrochemical Process	2.6%	77.43	2.00	54	2.6%	77.43	2.00	0%
Machine Drive	Less than 5 HP	90.5%	0.92	0.84	23	90.5%	0.92	0.84	0%
Machine Drive	5-24 HP	80.1%	2.26	1.81	49	80.1%	2.26	1.81	0%
Machine Drive	25-99 HP	72.4%	6.10	4.42	120	72.4%	6.10	4.42	0%
Machine Drive	100-249 HP	65.3%	3.84	2.51	68	65.3%	3.84	2.51	0%
Machine Drive	250-499 HP	23.7%	11.61	2.75	75	23.7%	11.61	2.75	0%
Machine Drive	500 and more HP	26.1%	19.50	5.08	138	26.1%	19.50	5.08	0%
Miscellaneous	Miscellaneous	100.0%	4.90	4.90	133	100.0%	4.90	4.90	0%
	Total			**40.00**	**1,088**			**39.1**	

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 959 of 1069

Figure B–1 Residential Baseline Forecast by End Use, Idaho

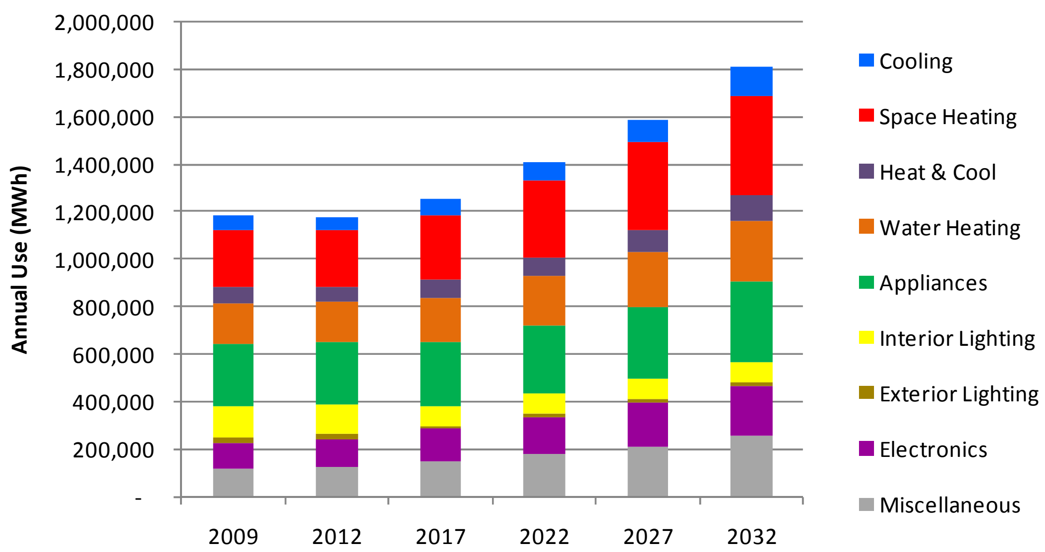

Figure B–2 C&I Baseline Electricity Forecast by End Use, Idaho

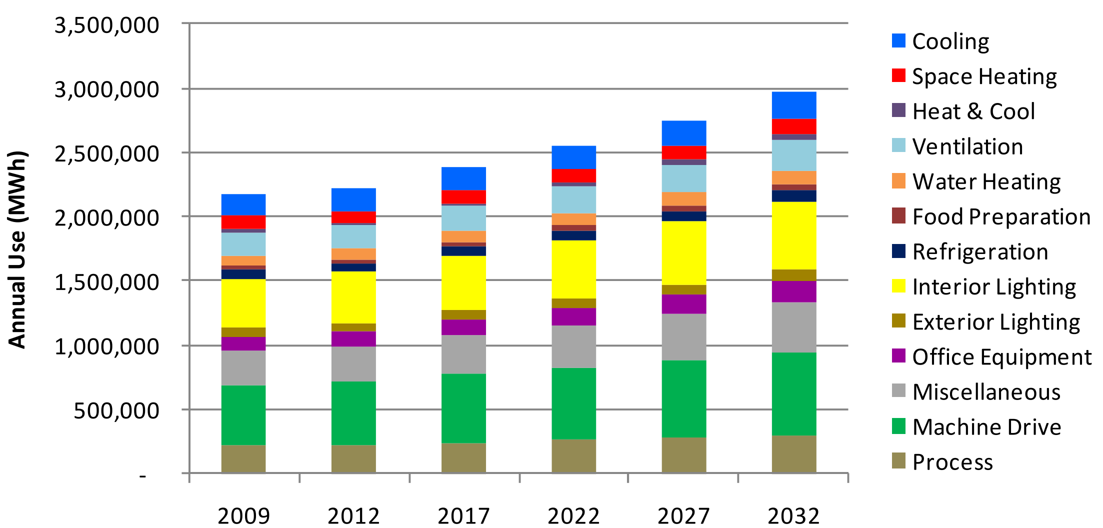

Table B-12 Baseline Forecast Summary by Sector, Idaho

End Use	2009	2012	2017	2022	2027	2032	% Change ('09–'32)	Avg. Growth Rate ('09–'32)
Res. ID	1,182,379	1,178,591	1,253,664	1,408,812	1,588,965	1,808,300	52.9%	1.8%
C&I ID	2,180,858	2,217,188	2,383,504	2,551,291	2,748,846	2,970,324	36.2%	1.3%
Total	3,363,237	3,395,780	3,637,168	3,960,104	4,337,811	4,778,624	42.1%	1.5%

Figure B–3 Baseline Forecast Summary by Sector, Idaho

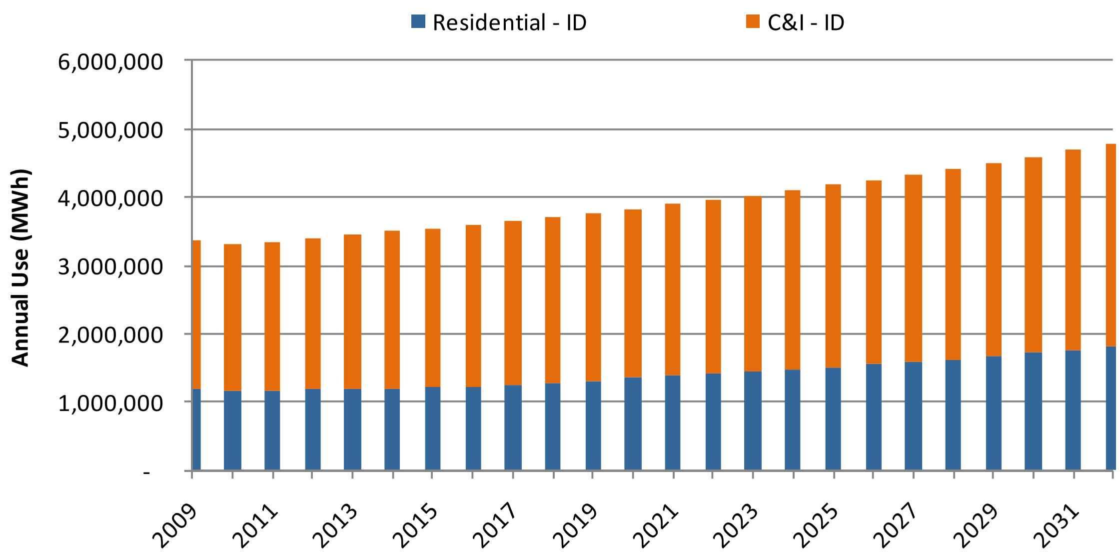

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 961 of 1069

Figure B-4 Summary of Energy Efficiency Potential Savings, Idaho, All Sectors

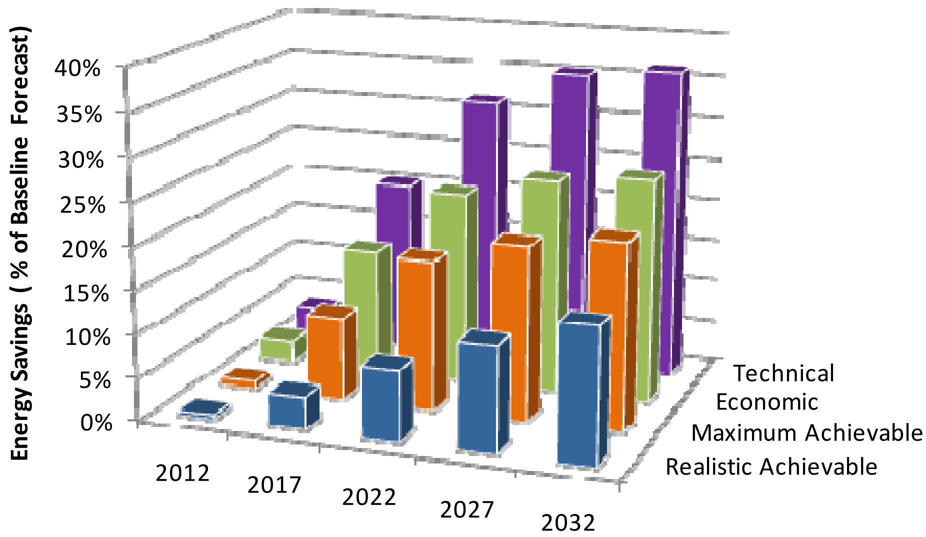

Figure B-5 Energy Efficiency Potential Forecasts, Idaho, All Sectors

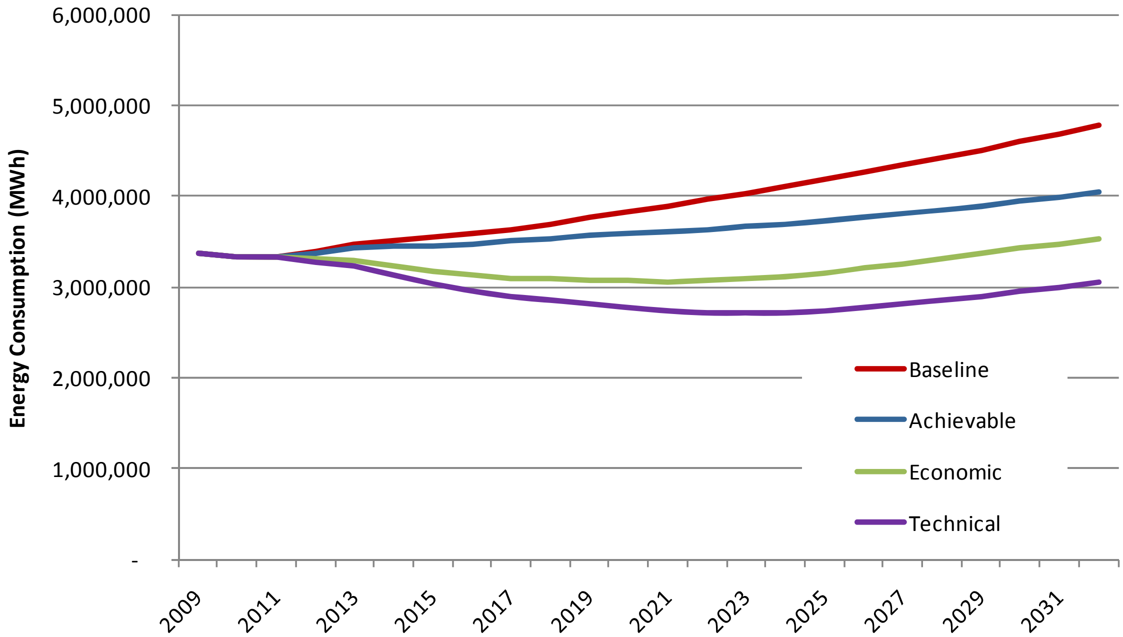

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 962 of 1069

Table B–13 Summary of Energy Efficiency Potential, Idaho, All Sectors

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	3,395,780	3,637,168	3,960,104	4,337,811	4,778,624
Baseline Peak Demand(MW)	610	644	705	775	854
Cumulative Energy Savings (MWh)					
Realistic Achievable	17,115	138,024	328,192	529,056	743,485
Maximum Achievable	31,326	355,867	694,006	878,021	1,036,097
Economic	87,533	536,684	893,730	1,084,577	1,243,423
Technical	116,533	737,247	1,243,729	1,532,099	1,733,629
Cumulative Energy Savings (% of Baseline)					
Realistic Achievable	0.5%	3.8%	8.3%	12.2%	15.6%
Maximum Achievable	0.9%	9.8%	17.5%	20.2%	21.7%
Economic	2.6%	14.8%	22.6%	25.0%	26.0%
Technical	3.4%	20.3%	31.4%	35.3%	36.3%
Peak Savings (MW)					
Realistic Achievable	4	27	57	94	133
Maximum Achievable	7	65	120	153	178
Economic	19	98	154	186	213
Technical	24	133	212	262	299
Peak Savings (% of Baseline)					
Realistic Achievable	0.7%	4.1%	8.1%	12.1%	15.6%
Maximum Achievable	1.1%	10.1%	17.1%	19.7%	20.9%
Economic	3.1%	15.2%	21.9%	24.0%	24.9%
Technical	4.0%	20.6%	30.1%	33.8%	35.0%

Table B–14 Achievable Cumulative EE Potential by Sector, Idaho (MWh)

Segment	2012	2017	2022	2027	2032
Residential, Idaho	8,692	43,922	97,705	172,179	260,003
C&I, Idaho	8,423	94,102	230,487	356,878	483,482
Total	17,115	138,024	328,192	529,056	743,485

Figure B-6 Achievable Cumulative Potential by Sector, Idaho

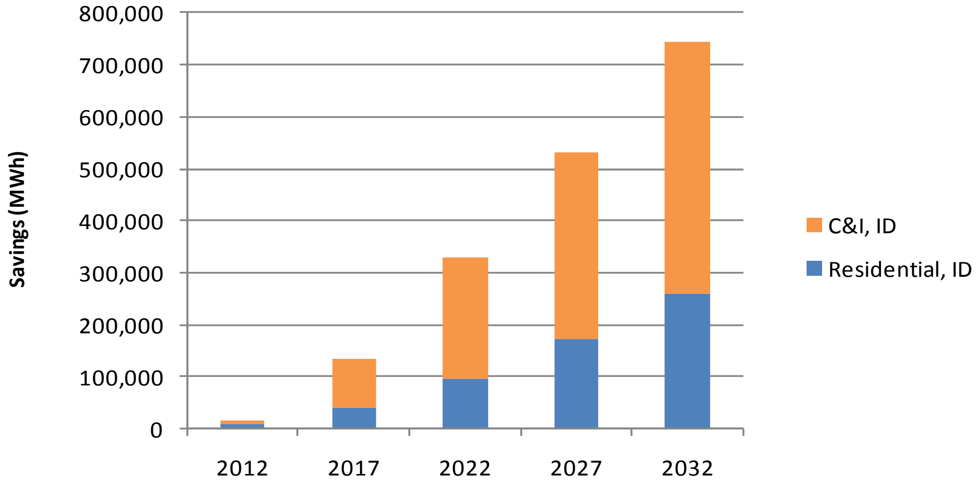

Figure B-7 Residential Energy Efficiency Potential Savings, Idaho

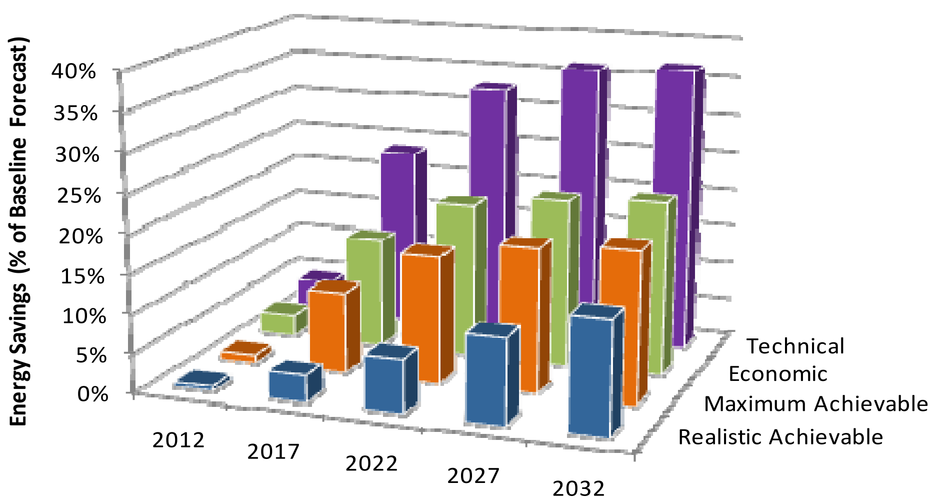

Figure B-8 Residential Energy Efficiency Potential Forecast, Idaho

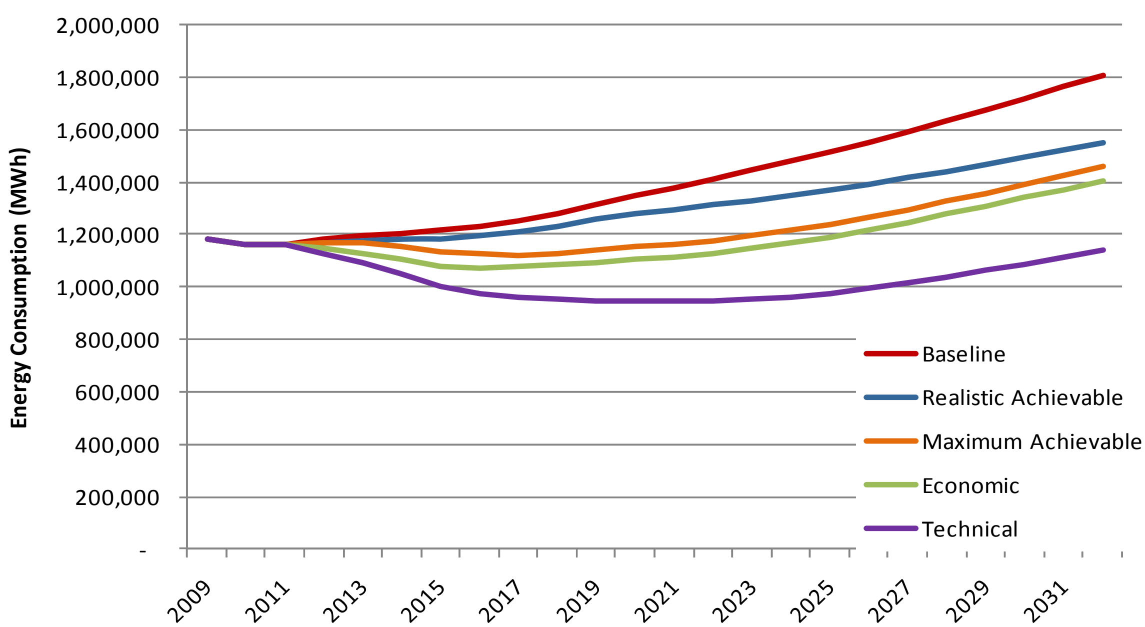

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 964 of 1069

Table B–15 Energy Efficiency Potential for the Residential Sector, Idaho

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	1,178,591	1,253,664	1,408,812	1,588,965	1,808,300
Baseline Peak Demand(MW)	281	290	325	363	408
Cumulative Energy Savings (MWh)					
Realistic achievable	8,692	43,922	97,705	172,179	260,003
Maximum achievable	11,841	130,930	230,870	293,897	349,609
Economic	33,369	179,104	280,336	341,494	403,100
Technical	49,653	292,196	462,586	575,049	665,872
Cumulative Energy Savings (% of Baseline)					
Realistic achievable	0.7%	3.5%	6.9%	10.8%	14.4%
Maximum achievable	1.0%	10.4%	16.4%	18.5%	19.3%
Economic	2.8%	14.3%	19.9%	21.5%	22.3%
Technical	4.2%	23.3%	32.8%	36.2%	36.8%
Peak Savings (MW)					
Realistic achievable	3	12	26	47	70
Maximum achievable	4	32	61	79	92
Economic	11	47	75	92	106
Technical	14	69	109	135	157
Peak Savings (% of Baseline)					
Realistic achievable	1.1%	4.2%	7.9%	12.8%	17.0%
Maximum achievable	1.4%	11.2%	18.7%	21.7%	22.5%
Economic	3.8%	16.3%	23.2%	25.3%	26.1%
Technical	4.9%	23.8%	33.5%	37.2%	38.6%

Table B-16 Residential Baseline & Realistic Achievable Potential by Segment, Idaho

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)					
Single Family	809,394	860,796	969,610	1,095,955	1,250,124
Multi Family	43,239	46,927	53,367	60,656	69,266
Mobile Home	58,491	61,447	68,664	77,048	87,262
Limited Income	267,467	284,494	317,172	355,306	401,648
Total	1,178,591	1,253,664	1,408,812	1,588,965	1,808,300
Energy Savings, Realistic Achievable Potential (MWh)					
Single Family	6,394	32,068	76,498	135,426	203,716
Multi Family	236	1,141	2,100	3,891	5,937
Mobile Home	465	1,997	3,403	5,554	8,326
Limited Income	1,597	8,715	15,705	27,307	42,024
Total	8,692	43,922	97,705	172,179	260,003
% of Total Residential Energy Savings					
Single Family	73.6%	73.0%	78.3%	78.7%	78.4%
Multi Family	2.7%	2.6%	2.1%	2.3%	2.3%
Mobile Home	5.3%	4.5%	3.5%	3.2%	3.2%
Limited Income	18.4%	19.8%	16.1%	15.9%	16.2%

Table B-17 Residential Potential by Housing Type, 2022, Idaho

Forecast	Single Family	Multi Family	Mobile Home	Limited Income	Total
Baseline Forecast (MWh)	969,610	53,367	68,664	317,172	1,408,812
Cumulative Energy Savings (MWh)					
Realistic Achievable	76,498	2,100	3,403	15,705	97,705
Maximum Achievable	180,146	5,514	7,612	37,597	230,870
Economic Potential	215,829	7,112	9,445	47,950	280,336
Technical Potential	311,446	15,951	23,241	111,948	462,586
Energy Savings % of Baseline					
Realistic Achievable	7.9%	3.9%	5.0%	5.0%	6.9%
Maximum Achievable	18.6%	10.3%	11.1%	11.9%	16.4%
Economic Potential	22.3%	13.3%	13.8%	15.1%	19.9%
Technical Potential	32.1%	29.9%	33.8%	35.3%	32.8%

Table A-18 Residential Cumulative Savings by End Use and Potential Type, Oregon (MWh)

End Use	Case	2012	2017	2022	2027	2032
Cooling	Realistic Achievable	4	784	2,713	7,797	15,205
	Economic	118	7,473	13,481	20,239	27,909
	Technical	1,389	21,223	34,387	49,464	67,702
Space Heating	Realistic Achievable	90	5,124	23,932	55,063	89,268
	Economic	2,854	46,886	90,434	118,849	142,327
	Technical	3,872	62,068	117,487	158,049	196,858
Heat/Cool	Realistic Achievable	4	277	772	1,917	5,360
	Economic	136	4,094	5,019	5,928	9,460
	Technical	1,056	8,796	15,144	21,238	24,333
Water Heating	Realistic Achievable	167	6,629	23,974	46,762	77,570
	Economic	2,868	34,268	69,949	91,136	113,933
	Technical	10,553	85,265	160,064	203,679	227,582
Appliances	Realistic Achievable	434	4,216	9,065	14,393	20,002
	Economic	1,885	20,859	27,076	28,751	30,895
	Technical	2,461	26,764	35,893	38,774	41,155
Interior Lighting	Realistic Achievable	6,180	17,434	19,757	22,622	23,650
	Economic	18,432	36,002	35,080	32,028	29,190
	Technical	21,560	49,417	48,706	45,433	42,120
Exterior Lighting	Realistic Achievable	1,125	3,610	3,675	3,426	2,753
	Economic	3,350	7,531	6,023	4,553	3,242
	Technical	3,846	9,858	8,546	7,753	7,635
Electronics	Realistic Achievable	607	4,630	11,073	15,629	19,572
	Economic	3,058	15,658	23,240	26,031	29,797
	Technical	4,219	22,321	32,027	36,258	41,681
Miscellaneous	Realistic Achievable	80	1,217	2,744	4,568	6,622
	Economic	667	6,334	10,036	13,980	16,348
	Technical	697	6,484	10,331	14,400	16,807
Total	Realistic Achievable	8,692	43,922	97,705	172,179	260,003
	Economic	33,369	179,104	280,336	341,494	403,100
	Technical	49,653	292,196	462,586	575,049	665,872

Figure B–9 Residential Realistic Achievable Potential by End Use, Selected Years, Idaho

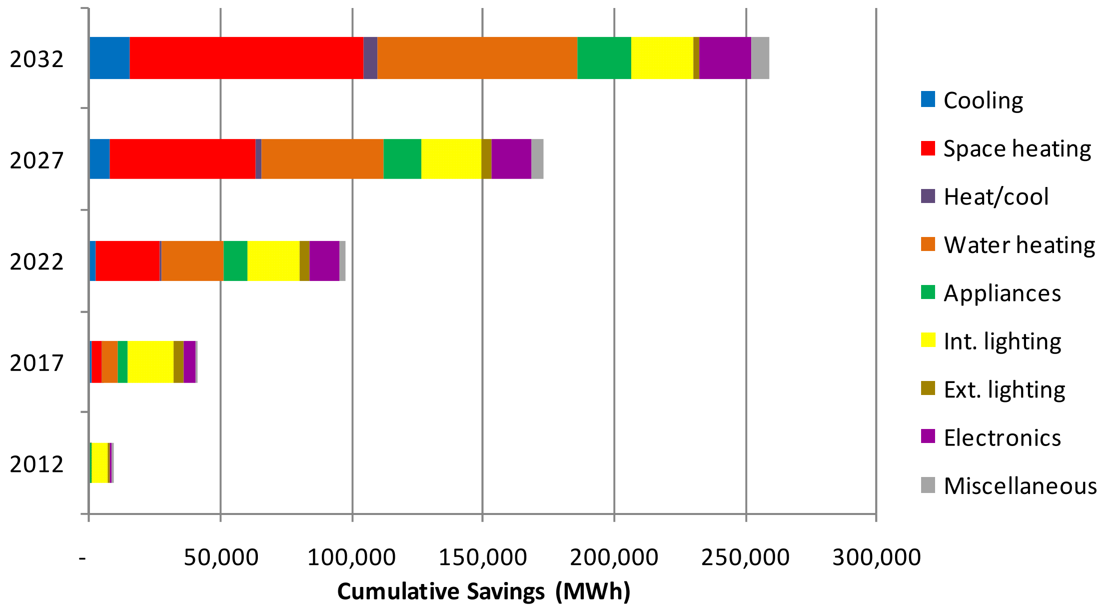

Table B-19 Residential Realistic Achievable Potential by End Use and Market Segment, 2022, Idaho (MWh)

	Single Family	Multi Family	Mobile Home	Limited Income	Total
Cooling	1,736	51	59	866	2,713
Space heating	19,066	789	402	3,676	23,932
Heat/cool	675	3	39	56	772
Water heating	20,270	422	407	2,875	23,974
Appliances	6,657	103	451	1,854	9,065
Interior lighting	13,894	535	1,047	4,281	19,757
Exterior lighting	3,020	28	227	399	3,675
Electronics	8,757	167	617	1,531	11,073
Miscellaneous	2,422	1	153	168	2,744
Total	**76,498**	**2,100**	**3,403**	**15,705**	**97,705**

Table B–20 Residential Cumulative Realistic Achievable Potential by End Use and Equipment Measures, Idaho, Selected Years (MWh)

End Use	Technology	2012	2017	2022
Cooling	Central AC	-	51	55
Heat/Cool	Air Source Ht. Pump	-	-	-
Water Heating	Water Heater	43	321	336
Appliances	Clothes Washer	29	352	888
	Clothes Dryer	35	240	440
	Dishwasher	40	373	912
	Refrigerator	146	652	1,266
	Freezer	113	560	1,221
	Second Refrigerator	53	257	475
	Stove	7	56	126
Interior Lighting	Screw-in	5,757	14,262	14,623
	Linear Fluorescent	56	639	1,202
	Pin-based	367	2,466	3,641
Exterior Lighting	Screw-in	1,117	3,567	3,619
	High Intensity/Flood	8	43	56
Electronics	Personal Computers	389	3,151	5,418
	TVs	213	1,121	2,079
Miscellaneous	Pool Pump	61	559	1,372
	Furnace Fan	16	202	602
Total		**8,450**	**28,875**	**38,332**

Table B–21 Residential Realistic Achievable Savings for Non-equipment Measures, Idaho (MWh)

Measure	2012	2017	2022
Furnace - Convert to Gas	72	2,299	14,668
Water Heater - Convert to Gas	56	2,041	13,812
Advanced New Construction Designs	0	62	1,426
Repair and Sealing - Ducting	6	853	2,417
Insulation - Infiltration Control	6	804	2,265
Water Heater - Thermostat Setback	44	2,506	4,232
Home Energy Management System	2	377	1,323
Freezer - Remove Second Unit	8	1,104	2,367
Water Heater - Hot Water Saver	2	130	1,663
Electronics - Reduce Standby Wattage	4	358	3,576
Thermostat - Clock/Programmable	6	799	2,222
Insulation - Foundation	0	141	628
Air Source Heat Pump - Maintenance	4	277	772
Refrigerator - Remove Second Unit	4	622	1,369
Water Heater - Heat Pump	-	12	334
Water Heater - Faucet Aerators	4	293	702
Insulation - Ducting	0	49	188
Water Heater - Tank Blanket/Insulation	15	794	1,238
Insulation - Wall Cavity	0	85	369
Ceiling Fan - Installation	0	24	167
Room AC - Removal of Second Unit	2	281	698
Insulation - Ceiling	1	115	339
Water Heater - Timer	0	231	801
Water Heater - Low Flow Showerheads	3	270	529
Central AC - Maintenance and Tune-Up	-	-	-
Whole-House Fan - Installation	0	21	112
Pool - Pump Timer	3	456	771
Water Heater - Pipe Insulation	0	34	326
Insulation - Wall Sheathing	0	13	58
Total	242	15,047	59,373

Figure B–10 Energy Efficiency Potential Savings, C&I Sector, Idaho

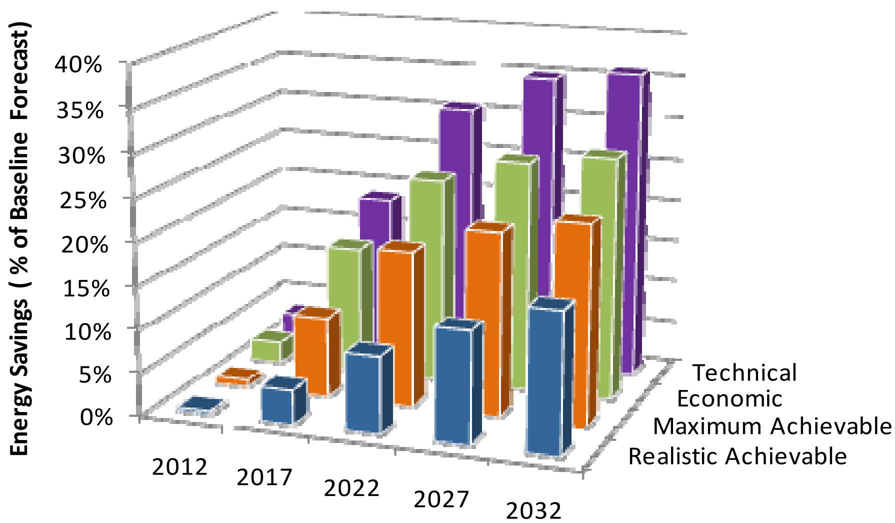

Figure B–11 Energy Efficiency Potential Forecast, C&I Sector, Idaho

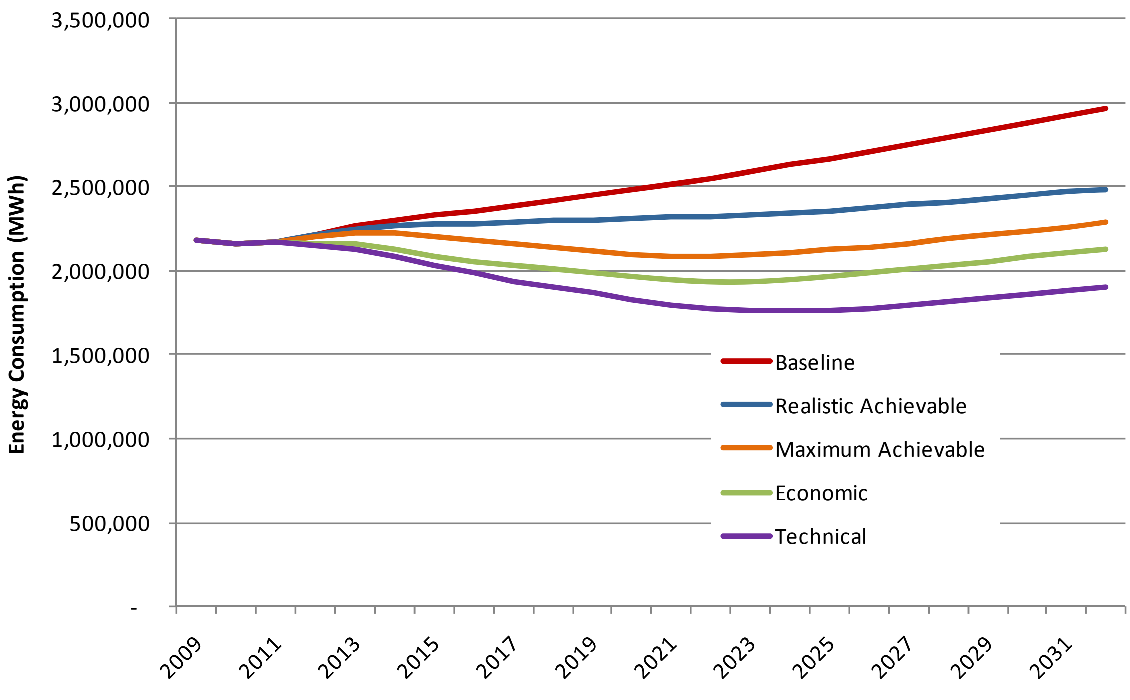

Table B–22 Energy Efficiency Potential, C&I Sector, Idaho

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)	2,217,188	2,383,504	2,551,291	2,748,846	2,970,324
Baseline Peak Demand(MW)	329	354	380	411	446
Cumulative Energy Savings (MWh)					
Realistic Achievable	8,423	94,102	230,487	356,878	483,482
Maximum Achievable	19,485	224,938	463,136	584,124	686,488
Economic	54,164	357,579	613,394	743,082	840,323
Technical	66,880	445,051	781,143	957,050	1,067,757
Cumulative Energy Savings (% of Baseline)					
Realistic Achievable	0.4%	3.9%	9.0%	13.0%	16.3%
Maximum Achievable	0.9%	9.4%	18.2%	21.2%	23.1%
Economic	2.4%	15.0%	24.0%	27.0%	28.3%
Technical	3.0%	18.7%	30.6%	34.8%	35.9%
Peak Savings (MW)					
Realistic Achievable	1	14	31	48	64
Maximum Achievable	3	33	60	74	86
Economic	8	51	79	94	106
Technical	10	64	103	127	141
Peak Savings (% of Baseline)					
Realistic Achievable	0.4%	4.1%	8.3%	11.6%	14.3%
Maximum Achievable	0.9%	9.2%	15.7%	17.9%	19.4%
Economic	2.5%	14.3%	20.7%	22.9%	23.8%
Technical	3.1%	18.1%	27.2%	30.8%	31.7%

Table B–23 C&I Sector, Baseline and Realistic Achievable Potential by Segment, Idaho

	2012	2017	2022	2027	2032
Baseline Forecast (MWh)					
Small/Med. Commercial	317,367	335,813	361,837	394,213	431,409
Large Commercial	707,532	761,508	821,587	894,850	979,118
Extra Large Commercial	72,013	83,305	90,387	98,291	106,847
Extra Large Industrial	1,120,277	1,202,878	1,277,480	1,361,492	1,452,949
Total	2,217,188	2,383,504	2,551,291	2,748,846	2,970,324
Cumulative Energy Savings, Achievable Potential (MWh)					
Small/Med. Commercial	1,962	20,807	43,865	65,456	88,728
Large Commercial	4,662	52,140	106,963	155,523	202,933
Extra Large Commercial	609	6,178	13,050	19,166	24,274
Extra Large Industrial	1,190	14,977	66,609	116,733	167,548
Total	8,423	94,102	230,487	356,878	483,482
% of Total C&I Cumulative Energy Savings					
Small/Med. Commercial	23.3%	22.1%	19.0%	18.3%	18.4%
Large Commercial	55.4%	55.4%	46.4%	43.6%	42.0%
Extra Large Commercial	7.2%	6.6%	5.7%	5.4%	5.0%
Extra Large Industrial	14.1%	15.9%	28.9%	32.7%	34.7%

Table B–24 C&I Potential by Segment, Idaho, 2022

Forecast	Small/Med. Commercial	Large Commercial	Extra Large Commercial	Extra Large Industrial	Total
Baseline Forecast (MWh)	361,837	821,587	90,387	1,277,480	2,551,291
Cumulative Energy Savings (MWh)					
Realistic Achievable	43,865	106,963	13,050	66,609	230,487
Economic Potential	87,274	204,790	25,964	295,365	613,394
Technical Potential	135,405	301,217	36,465	308,056	781,143
Cumulative Energy Savings % of Baseline					
Realistic Achievable	12%	13%	14%	5%	9%
Economic Potential	24%	25%	29%	23%	24%
Technical Potential	37%	37%	40%	24%	31%

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 973 of 1069

Table B-25 C&I Cumulative Savings by End Use and Potential Type, Idaho (MWh)

End Use	Case	2012	2017	2022	2027	2032
Cooling	Realistic Achievable	78	5,923	21,250	33,605	47,275
	Economic	1,138	20,975	45,413	59,510	75,348
	Technical	2,968	36,760	76,374	95,858	113,212
Space Heating	Realistic Achievable	6	758	4,296	8,178	13,308
	Economic	133	3,983	11,757	17,084	24,436
	Technical	215	6,445	19,442	26,587	34,707
Heat/Cool	Realistic Achievable	16	1,271	2,302	2,778	3,432
	Economic	185	3,001	3,761	4,432	4,954
	Technical	260	3,540	4,747	5,741	6,445
Ventilation	Realistic Achievable	211	2,846	15,356	29,448	47,931
	Economic	3,528	26,446	69,343	93,958	107,124
	Technical	4,612	34,655	93,204	122,731	132,705
Water Heating	Realistic Achievable	25	1,545	3,227	3,742	4,068
	Economic	198	3,518	4,823	5,295	5,309
	Technical	4,444	32,290	58,774	82,998	91,291
Food Preparation	Realistic Achievable	72	868	2,449	4,745	7,111
	Economic	962	5,813	10,539	12,677	13,834
	Technical	1,043	6,341	11,660	14,033	15,375
Refrigeration	Realistic Achievable	62	631	2,054	3,943	5,850
	Economic	925	4,540	8,629	11,127	12,502
	Technical	1,091	5,996	13,223	17,139	19,437
Interior Lighting	Realistic Achievable	5,851	55,282	110,129	160,780	203,673
	Economic	27,689	162,081	212,672	243,913	279,638
	Technical	30,318	177,750	239,322	274,804	311,478
Exterior Lighting	Realistic Achievable	526	7,858	15,569	19,409	23,034
	Economic	2,403	23,137	27,251	28,628	29,938
	Technical	2,701	25,247	30,174	34,115	38,276
Office Equipment	Realistic Achievable	862	8,854	14,582	19,189	23,952
	Economic	6,253	28,449	29,883	31,230	32,556
	Technical	8,238	38,728	41,183	43,665	46,239
Machine Drive	Realistic Achievable	382	6,612	33,312	56,917	77,212
	Economic	4,308	40,409	117,995	145,338	156,337
	Technical	4,341	40,906	119,993	147,502	158,642
Process	Realistic Achievable	328	1,590	5,541	13,154	24,996
	Economic	6,410	34,803	69,990	87,646	95,276
	Technical	6,410	34,803	69,990	87,646	95,276
Miscellaneous	Realistic Achievable	2	62	419	989	1,641
	Economic	33	426	1,336	2,245	3,070
	Technical	239	1,591	3,058	4,230	4,673
Total	Realistic Achievable	8,423	94,102	230,487	356,878	483,482
	Economic	54,164	357,579	613,394	743,082	840,323
	Technical	66,880	445,051	781,143	957,050	1,067,757

Figure B-12 C&I Achievable Potential by End Use, Selected Years, Idaho

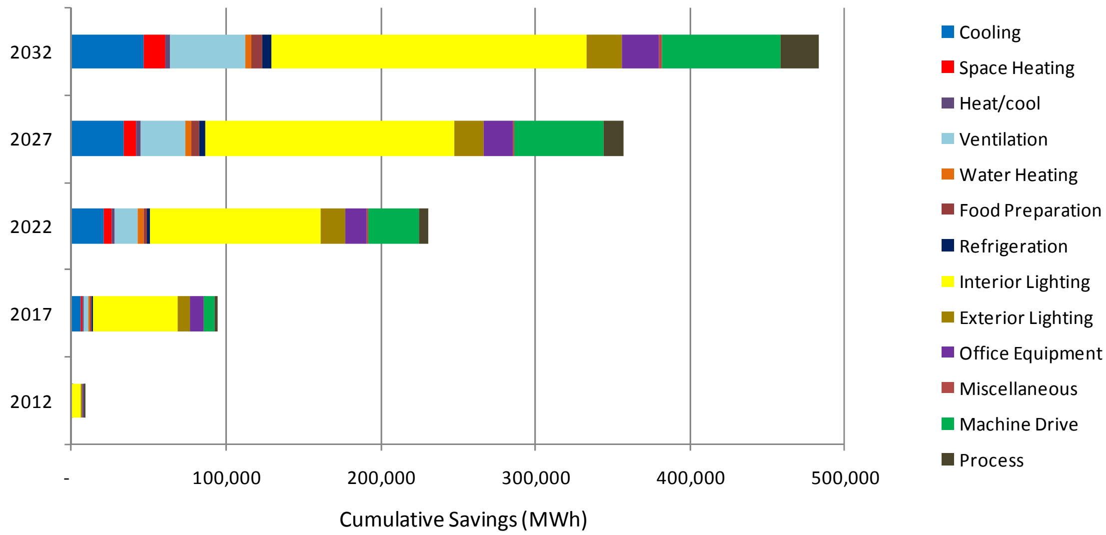

Table B-26 C&I Realistic Achievable Potential by End Use Market Segment, 2022, Idaho (MWh)

	Small/Med. Commercial	Large Commercial	Extra Large Commercial	Extra Large Industrial	Total
Cooling	2,805	8,283	1,032	9,129	21,250
Space Heating	338	2,110	305	1,544	4,296
Combined Heating/Cooling	249	1,666	119	267	2,302
Ventilation	4,489	1,846	1,131	7,890	15,356
Water Heating	952	1,851	424	-	3,227
Food Preparation	538	1,748	163	-	2,449
Refrigeration	572	1,382	100	-	2,054
Interior Lighting	25,426	68,834	7,612	8,256	110,129
Exterior Lighting	4,866	8,723	1,312	669	15,569
Office Equipment	3,482	10,274	825	-	14,582
Machine Drive	-	-	-	33,312	33,312
Process	-	-	-	5,541	5,541
Miscellaneous	146	246	26	-	419
Total	**43,865**	**106,963**	**13,050**	**66,609**	**230,487**

Table B-27 C&I Cumulative Achievable Potential by End Use and Equipment Measures, Washington (MWh)

End Use	Technology	2012	2017	2022
Cooling	Central Chiller	29	304	1,225
	PTAC	2	2	2
Heat/Cool	Heat Pump	7	128	376
Ventilation	Ventilation	196	2,023	7,393
Water Heater	Water Heater	14	111	109
Food Preparation	Fryer	4	46	121
	Hot Food Container	9	102	274
	Oven	60	708	1,884
Refrigeration	Glass Door Display	11	155	440
	Icemaker	8	108	317
	Solid Door Refrigerator	14	165	438
	Vending Machine	27	152	371
	Walk in Refriger'n	0	5	13
Interior Lighting	Interior Screw-in	3,326	21,132	32,157
	HID	1,014	9,151	18,439
	Linear Fluorescent	1,450	17,918	35,222
Exterior Lighting	Screw-in	76	1,138	1,977
	HID	403	5,269	10,440
	Linear Fluorescent	42	758	1,287
Office Equipment	Desktop Computer	490	4,569	7,322
	Laptop Computer	35	331	530
	Monitor	106	383	662
	POS Terminal	14	196	359
	Printer/copier/fax	44	564	1,025
	Server	169	2,412	3,889
Machine Drive	Less than 5 HP	21	144	383
	5-24 HP	46	324	887
	25-99 HP	114	808	2,209
	100-249 HP	32	227	622
	250-499 HP	34	242	661
	500 and more HP	64	456	1,247
Process	Electrochem. Process	46	220	719
	Process Cooling/Refrig.	62	294	961
	Process Heating	220	1,048	3,426
Miscellaneous	Non-HVAC Motor	2	25	181
Total		8,194	71,620	137,570

Table B-28 C&I Cumulative Achievable Savings for Non-equipment Measures, Idaho (MWh)

Measure	2012	2017	2022
Energy Management System	13	819	8,607
Advanced New Construction Designs	0	36	557
Retrocommissioning - Lighting	20	4,122	7,640
Interior Fluorescent - High Bay Fixtures	8	475	4,877
Pumping System - Optimization	11	507	4,907
Compressed Air - System Optimization and Improvements	11	506	4,837
Custom Measures	2	296	4,148
Fans - Variable Speed Control	7	335	3,189
Compressed Air - System Controls	7	355	3,457
RTU - Maintenance	24	3,277	6,364
Fans - Energy Efficient Motors	6	346	3,463
Retrocommissioning - Comprehensive	12	2,552	4,572
Retrocommissioning - HVAC	3	323	3,038
Motors - Variable Frequency Drive	11	1,338	2,707
Pumps - Variable Speed Control	5	241	2,289
Motors - Magnetic Adjustable Speed Drives	5	221	2,171
Compressed Air - Compressor Replacement	4	203	1,982
Pumping System - Controls	4	202	1,942
Chiller - Turbocor Compressor	3	167	1,764
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	0	22	193
Interior Lighting - Occupancy Sensors	7	249	1,949
Water Heater - Faucet Aerators/Low Flow Nozzles	9	1,306	2,692
Chiller - VSD	2	127	1,257
Interior Fluorescent - Delamp and Install Reflectors	6	222	1,622
Roofs - High Reflectivity	1	21	165
Commissioning - Comprehensive	0	123	805
Chiller - Condenser Water Temperature Reset	3	196	1,839
Heat Pump - Maintenance	9	1,143	1,925
Compressed Air - System Maintenance	13	717	1,198
Pumping System - Maintenance	-	43	606
Exterior Lighting - Daylighting Controls	2	70	562
Insulation - Ducting	1	93	778
Chiller - Chilled Water Reset	2	403	705
Thermostat - Clock/Programmable	2	304	595
Commissioning - Lighting	0	94	314
Office Equipment - ENERGY STAR Power Supply	3	399	795
Cooking - Exhaust Hoods with Sensor Control	0	6	56
Refrigeration - System Optimization	0	15	229

Measure	2012	2017	2022
Furnace - Convert to Gas	1	35	229
Water Heater - Heat Pump	0	16	211
Refrigeration - System Controls	0	10	160
Cooling - Economizer Installation	1	42	378
Exterior Lighting - Induction Lamps	0	10	140
Insulation - Ceiling	0	1	13
Industrial Process Improvements	0	11	127
LED Exit Lighting	9	319	358
Commissioning - HVAC	-	-	4
Water Heater - Tank Blanket/Insulation	2	111	195
Miscellaneous - ENERGY STAR Water Cooler	0	20	58
Refrigeration - System Maintenance	0	3	46
Refrigeration - Floating Head Pressure	0	4	46
Insulation - Wall Cavity	0	2	31
Refrigeration - Strip Curtain	-	0	14
Refrigeration - Anti-Sweat Heater/Auto Door Closer	0	3	35
Water Heater - Hot Water Saver	-	-	1
Water Heater - High Efficiency Circulation Pump	0	2	19
Vending Machine - Controller	0	13	22
Chiller - Chilled Water Variable-Flow System	0	2	19
Exterior Lighting - Cold Cathode Lighting	0	1	8
Refrigeration - Night Covers	0	0	4
Laundry - High Efficiency Clothes Washer	0	3	5
Total	**228**	**22,482**	**92,917**

RESIDENTIAL ENERGY EFFICIENCY EQUIPMENT AND MEASURE DATA

This appendix presents detailed information for all residential energy efficiency equipment and measures that were evaluated in LoadMAP. Several sets of tables are provided.

Table C-1 provides brief descriptions for all equipment and measures that were assessed for potenital.

Tables C-2 through C-9 list the detailed unit-level data for the equipment measures for each of the housing type segments — single family, multi-family, mobile home, and limited income — and for existing and new construction, respectively. Savings are in kWh/yr/household, and incremental costs are in $/household, unless noted otherwise. The B/C ratio is zero if the measure represents the baseline technology or if the technology is not available in the first year of the forecast (2012). The B/C ratio is calculated within LoadMAP for each year of the forecast and is available once the technology or measure becomes available.

Tables C-10 through C-17 list the detailed unit-level data for the non-equipment energy efficiency measures for each of the housing type segments and for existing and new construction, respectively. Because these measures can produce energy-use savings for multiple end-use loads (e.g., insulation affects heating and cooling energy use) savings are expressed as a percentage of the end-use loads. Base saturation indicates the percentage of homes in which the measure is already installed. Applicability/Feasibility is the product of two factors that account for whether the measure is applicable to the building. Cost is expressed in $/household. The detailed measure-level tables present the results of the benefit/cost (B/C) analysis for the first year of the forecast. The B/C ratio is zero if the measure represents the baseline technology or if the measure is not available in the first year of the forecast (2012). The B/C ratio is calculated within LoadMAP for each year of the forecast and is available once the technology or measure becomes available.

Note that Tables C-2 through C-17 present information for Washington. For Idaho, savings and B/C ratios may be slightly different due to weather-related usage, differences in the states' market profiles, and different retail electricity prices. Although Idaho-specific values are not presented here, they are available within the LoadMAP files.

Table C–1 Residential Energy Efficiency Equipment/Measure Descriptions

End-Use	Equipment/ Measure	Description
Cooling	Air Conditioner — Central (CAC)	Central air conditioners consist of a refrigeration system using a direct expansion cycle. Equipment includes a compressor, an air-cooled condenser (located outdoors), an expansion valve, and an evaporator coil. A supply fan near the evaporator coil distributes supply air through air ducts to the building. Cooling efficiencies vary based on materials used, equipment size, condenser type, and system configuration. CACs may be unitary (all components housed in a factory-built assembly) or split system (an outdoor condenser section and an indoor evaporator section connected by refrigerant lines and with the compressor either indoors or outdoors). Energy efficiency is rated according to the size of the unit using the Seasonal Energy Efficiency Rating (SEER). Systems with Variable Refrigerant Flow further improve the operating efficiency. A high-efficiency option for a ductless mini-split system was also analyzed.
Cooling	Central Air Conditioner, Early Replacement	CAC systems currently on the market are significantly more efficient that older units, due to technology improvement and stricter appliance standards. This measure incents homeowners to replace an aging but still working unit with a new, higher-efficiency one.
Cooling	Central Air Conditioner Maintenance and Tune Up	An air conditioner's filters, coils, and fins require regular cleaning and maintenance for the unit to function effectively and efficiently throughout its life. Neglecting necessary maintenance leads to a steady decline in performance, requiring the AC unit to use more energy for the same cooling load.
Cooling	Air Conditioner - Room, ENERGY STAR or better	Room air conditioners are designed to cool a single room or space. They incorporate a complete air-cooled refrigeration and air-handling system in an individual package. Room air conditioners come in several forms, including window, split-type, and packaged terminal units. Energy efficiency is rated according to the size of the unit using the Energy Efficiency Rating (EER).
Cooling	Room AC — Removal of Second Unit	Homeowners may have a second room AC unit that is extremely inefficient. This measure incents homeowners to recycle the second unit and thus also eliminates associated electricity use.
Cooling	Attic Fan Attic Fan, Photovoltaic	Attic fans can reduce the need for AC by reducing heat transfer from the attic through the ceiling of the house. A well-ventilated attic can be several degrees cooler than a comparable, unventilated attic. An option for an attic fan equipped with a small solar photovoltaic generator was also modeled.
Cooling	Ceiling Fan	Ceiling fans can reduce the need for air conditioning. However, the house occupants must also select a ceiling fan with a high-efficiency motor and either shutoff the AC system or setup the thermostat temperature of the air conditioning system to realize the potential energy savings. Some ceiling fans also come with lamps. In this analysis, it is assumed that there are no lamps, and installing a ceiling fan will allow occupants to increase the thermostat cooling setpoint up by 2°F.
Cooling	Whole-House Fan	Whole-house fans can reduce the need for AC on moderate-weather days or on cool evenings. The fan facilitates a quick air change throughout the entire house. Several windows must be open to achieve the best results. The fan is mounted on the top floor of the house, usually in a hallway ceiling.

End-Use	Equipment/ Measure	Description
Space Heating	Convert to Gas	This fuel-switching measure is the replacement of an electric furnace with a gas-fired furnace. This measure will eliminate all electricity consumption and demand due to electric space heating. In this study, it is assumed that this measure can be implemented only in homes within 500 feet of a gas main.
Heat/Cool	Air Source Heat Pump	A central heat pump consists of components similar to a CAC system, but is usually designed to function both as a heat pump and an air conditioner. It consists of a refrigeration system using a direct expansion (DX) cycle. Equipment includes a compressor, an air-cooled condenser (located outdoors), an expansion valve, and an evaporator coil (located in the supply air duct near the supply fan) and a reversing valve to change the DX cycle from cooling to heating when required. The cooling and heating efficiencies vary based on the materials used, equipment size, condenser type, and system configuration. Heat pumps may be unitary (all components housed in a factory-built assembly) or a split system (an outdoor condenser section and an indoor evaporator section connected by refrigerant lines, with either outdoors or indoors. A high-efficiency option for a ductless mini-split system was also analyzed.
Heat / Cool	Geothermal Heat Pump	Geothermal heat pumps are similar to air-source heat pumps, but use the ground or groundwater instead of outside air to provide a heat source/sink. A geothermal heat pump system generally consists of three major subsystems or parts: a geothermal heat pump to move heat between the building and the fluid in the earth connection, an earth connection for transferring heat between the fluid and the earth, and a distribution subsystem for delivering heating or cooling to the building. The system may also have a desuperheater to supplement the building's water heater, or a full-demand water heater to meet all of the building's hot water needs.
Heat / Cool	Air Source Heat Pump Maintenance	A heat pump's filters, coils, and fins require regular cleaning and maintenance for the unit to function effectively and efficiently throughout its life. Neglecting necessary maintenance ensures a steady decline in performance while energy use steadily increases.
HVAC (all)	Insulation – Ducting	Air distribution ducts can be insulated to reduce heating or cooling losses. Best results can be achieved by covering the entire surface area with insulation. Several types of ducts and duct insulation are available, including flexible duct, pre-insulated duct, duct board, duct wrap, tacked, or glued rigid insulation, and waterproof hard shell materials for exterior ducts. This analysis assumes that installing duct insulation can reduce the temperature drop/gain in ducts by 50%.
HVAC (all)	Repair and Sealing – Ducting	An ideal duct system would be free of leaks. Leakage in unsealed ducts varies considerably because of differences in fabricating machinery used, methods for assembly, installation workmanship, and age of the ductwork. Air leaks from the system to the outdoors result in a direct loss proportional to the amount of leakage and the difference in enthalpy between the outdoor air and the conditioned air. This analysis assumes that over time air loss from ducts has doubled, and conducting repair and sealing of the ducts will restore leakage from ducts to the original baseline level.

End-Use	Equipment/ Measure	Description
HVAC (all)	Thermostat — Clock/Programmable	A programmable thermostat can be added to most heating/cooling systems. They are typically used during winter to lower temperatures at night and in summer to increase temperatures during the afternoon. The energy savings from this type of thermostat are identical to those of a "setback" strategy with standard thermostats, but the convenience of a programmable thermostat makes it a much more attractive option. In this analysis, the baseline is assumed to have no thermostat setback.
HVAC (all)	Doors — Storm and Thermal	Like other components of the shell, doors are subject to several types of heat loss: conduction, infiltration, and radiant losses. Similar to a storm window, a storm door creates an insulating air space between the storm and primary doors. A tight fitting storm door can also help reduce air leakage or infiltration. Thermal doors have exceptional thermal insulation properties and also are provided with weather-stripping on the doorframe to reduce air leakage.
HVAC (all)	Insulation — Infiltration Control	Lowering the air infiltration rate by caulking small leaks and weather-stripping around window frames, doorframes, power outlets, plumbing, and wall corners can provide significant energy savings. Weather-stripping doors and windows will create a tight seal and further reduce air infiltration.
HVAC (all)	Insulation —Ceiling	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation above ceilings can conserve energy by reducing the heat loss or gain into attics and/or through roofs. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose, loose-fill (blown) fiberglass, and rigid polystyrene.
HVAC (all)	Insulation — Radiant Barrier	Radiant barriers are materials installed to reduce the heat gain in buildings. Radiant barriers are made from materials that are highly reflective and have low emissivity like aluminum. The closer the emissivity is to 0 the better they will perform. Radiant barriers can be placed above the insulation or on the roof rafters.
HVAC (all)	Insulation — Foundation Insulation — Wall Cavity Insulation — Wall Sheathing	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation can conserve energy by reducing heat loss or gain from a building. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose, loose-fill (blown) fiberglass, and rigid polystyrene. Foundation, insulation, wall cavity insulation, and wall sheathing were modeled for new construction / major retrofits only.
Cooling	Roof — High Reflectivity	The color and material of a building structure surface determine the amount of solar radiation absorbed by that surface and subsequently transferred into a building. This is called solar absorptance. Using a roofing material with low solar absorptance or painting the roof a light color reduces the cooling load. This analysis assumes that implementing high reflectivity roofs will decrease the roof's absorptance of solar radiation by 45%.
Cooling	Windows — Reflective Film	Reflective films applied to the window interior help reduce solar gain into the space and thus lower cooling energy use.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 983 of 1069

End-Use	Equipment/ Measure	Description
HVAC (all)	Windows — High Efficiency / ENERGY STAR	High-efficiency windows, such as those labeled under the ENERGY STAR Program, are designed to reduce energy use and increase occupant comfort. High-efficiency windows reduce the amount of heat transfer through the glazing surface. For example, some windows have a low-E coating, a thin film of metallic oxide coating on the glass surface that allows passage of short-wave solar energy through glass and prevents long-wave energy from escaping. Another example is double-pane glass that reduces conductive and convective heat transfer. Some double-pane windows are gas-filled (usually argon) to further increase the insulating properties of the window.
Water Heating	Water Heater - Electric, High Efficiency	For electric hot water heating, the most common type is a storage heater, which incorporates an electric heating element, storage tank, outer jacket, insulation, and controls in a single unit. Efficient units are characterized by a high recovery or thermal efficiency and low standby losses (the ratio of heat lost per hour to the content of the stored water). Electric instantaneous water heaters are available, but are excluded from this study due to potentially high instantaneous demand concerns.
Water Heating	Water Heater, Heat Pump	An electric heat pump water heater (HPWH) uses a vapor-compression thermodynamic cycle similar to that found in an air-conditioner or refrigerator. Electrical work input allows a heat pump water heater to extract heat from an available source (e.g., air) and reject that heat to a higher temperature sink, in this case, the water in the water heater. Because a HPWH makes use of available ambient heat, the coefficient of performance is greater than one — typically in the range of 2 to 3. These devices are available as an alternative to conventional tank water heaters of 55 gallons or larger. By utilizing the earth as a thermal reservoir, ground source HPWH systems can reach even higher levels of efficiency. The heat pump can be integrated with a traditional water storage tank or installed remote to the storage tank.
Water Heating	Water Heating, Solar	Solar water heating systems can be used in residential buildings that have an appropriate near-south-facing roof or nearby unshaded grounds for installing a collector. Although system types vary, in general these systems use a solar absorber surface within a solar collector or an actual storage tank. Either a heat-transfer fluid or the actual potable water flows through tubes attached to the absorber and transfers heat from it. (Systems with a separate heat-transfer-fluid loop include a heat exchanger that then heats the potable water.) The heated water is stored in a separate preheat tank or a conventional water heater tank. If additional heat is needed, it is provided by a conventional water-heating system.
Water Heating	Convert to Gas	This fuel-switching measure is the replacement of an electric water heater with a gas-fired water heater. This measure will eliminate all electricity consumption and demand due to electric water heating. In this study, it is assumed that this measure can be implemented only in home within 500 feet of a gas main.
Water Heating	Faucet Aerators	Water faucet aerators are threaded screens that attach to existing faucets. They reduce the volume of water coming out of faucets while introducing air into the water stream. This measure provides energy saving by reducing hot water use, as well as water conservation for both hot and cold water.

End-Use	Equipment/ Measure	Description
Water Heating	Pipe Insulation	Insulating hot water pipes decreases energy losses from piping that distributes hot water throughout the building. I also results in quicker delivery of hot water and may allow lower the hot water set point, which saves energy. The most common insulation materials for this purpose are polyethylene and neoprene.
Water Heating	Low-Flow Showerheads	Similar to faucet aerators, low-flow showerheads reduce the consumption of hot water, which in turn decreases water heating energy use.
Water Heating	Tank Blanket	Insulating hot water tanks decreases standby energy losses from the tank. Pre-fitted insulating blankets are readily available.
Water Heating	Thermostat Setback / Timer	These measures use either a programmable thermostat or a timer to adjust the water heater setpoint at times of low usage, typically when a home is unoccupied.
Water Heating	Hot Water Saver	A hot water saver is a plumbing device that attaches to the showerhead and that pauses the flow of water until the water is hot enough for use. The water is re-started by the flip of a switch.
Interior Lighting / Exterior Lighting	Infrared Halogen Lamps	Infrared halogen lamps are designed to be a replacement for standards incandescent lamps. Also referred to as advanced incandescent lamps, these products meet the Energy Independence and Security Act (EISA) lighting standards and are phased in as the baseline technology screw-in lamp technology to reflect the timeline over which the EISA lighting standards take effect.
Interior Lighting / Exterior Lighting	Compact Fluorescent Lamps	Compact fluorescent lamps are designed to be a replacement for standard incandescent lamps and use about 25% of the energy used by standard incandescent lamps to produce the same lumen output. The can use either electronic or magnetic ballasts. Integral compact fluorescent lamps have the ballast integrated into the base of the lamp and have a standard screw-in base that permits installation into existing incandescent fixtures.
Interior Lighting / Exterior Lighting	Solid State Lighting, LEDs (Screw-in and linear)	Light-emitting diode (LED) lighting has seen recent penetration in specific applications such as traffic lights and exit signs. With the potential for extremely high efficiency, LEDs show promise to provide general-use lighting for interior spaces. Current models commercially available have efficacies comparable to CFLs. However, theoretical efficiencies are significantly higher. LED models under development are expected to provide improved efficacies.
Interior Lighting	Fluorescent, T8, Super T8, and T5 Lamps and Electronic Ballasts	T8 fluorescent lamps are smaller in diameter than standard T12 lamps, resulting in greater light output per watt. T8 lamps also operate at a lower current and wattage, which increases the efficiency of the ballast but requires the lamps to be compatible with the ballast. Fluorescent lamp fixtures can include a reflector that increases the light output from the fixture, and thus make it possible to use a fewer number of lamps in each fixture. T5 lamps further increase efficiency by reducing the lamp diameter to 5/8".
Exterior Lighting	Metal Halide and High Pressure Sodium	These lamps technologies can provide slightly higher efficiencies than CFLs in exterior applications.
Interior Lighting	Occupancy Sensors	Occupancy sensors turn lights off when a space is unoccupied. They are appropriate for areas with intermittent use, such as bathrooms or storage areas.

End-Use	Equipment/ Measure	Description
Exterior Lighting	Photovoltaic Installation	Solar photovoltaic generation may be used to power exterior lighting and thus eliminate all or part of the electrical energy use.
Exterior Lighting	Photosensor Control	Photosensor controls turn exterior lighting on or off based on ambient lighting levels. Compared with manual operation, this can reduce the operation of exterior lighting during daylight hours.
Exterior Lighting	Timeclock Installation	Lighting timers turn exterior lighting on or off based on a preset schedule. Compared with manual operation, this can reduce the operation of exterior lighting during daylight hours.
Appliances	Refrigerator/Freezer, ENERGY STAR or better	Energy-efficient refrigerators/freezers incorporate features such as improved cabinet insulation, more efficient compressors and evaporator fans, defrost controls, mullion heaters, oversized condenser coils, and improved door seals. Further efficiency increases can be obtained by reducing the volume of refrigerated space, or adding multiple compartments to reduce losses from opening doors.
Appliances	Refrigerator/Freezer — Early Replacement	Refrigerators/freezers currently on the market are significantly more efficient that older units, due to technology improvement and stricter appliance standards. This measure incents homeowners to replace an aging but still working unit with a new, higher-efficiency one.
Appliances	Refrigerator/Freezer — Remove Second Unit	Homeowners may have a second refrigerator or freezer that is not used to full capacity and that, because of its age, is extremely inefficient. This measure incents homeowners to recycle the second unit and thus also eliminates associated electricity use.
Appliances	Dishwasher, ENERGY STAR or better	ENERGY STAR labeled dishwashers save by using both improved technology for the primary wash cycle, and by using less hot water. Construction includes more effective washing action, energy-efficient motors, and other advanced technology such as sensors that determine the length of the wash cycle and the temperature of the water necessary to clean the dishes.
Appliances	Clothes Washer, ENERGY STAR or better	ENERGY STAR labeled clothes washers use superior designs that require less water. Sensors match the hot water needs to the size and soil level of the load, preventing energy waste. Further energy and water savings can be achieved through advanced technologies such as inverter-drive or combination washer-dryer units.
Appliances	Clothes Dryer – Electric, High Efficiency	An energy-efficient clothes dryer has a moisture-sensing device to terminate the drying cycle rather than using a timer, and an energy-efficient motor is used for spinning the dryer tub. Application of a heat pump cycle for extracting the moisture from clothes leads to additional energy savings.
Appliances	Range and Oven – Electric, High Efficiency	These products have additional insulation in the oven compartment and tighter-fitting oven door gaskets and hinges to save energy. Conventional ovens must first heat up about 35 pounds of steel and a large amount of air before they heat up the food. Tests indicate that only 6% of the energy output of a typical oven is actually absorbed by the food.
Electronics	Color TVs and Home Electronics, ENERGY STAR or better	In the average home, electronic products consumed significant energy, even when they are turn off, to maintain features like clocks, remote control, and channel/station memory. ENERGY STAR labeled consumer electronics can drastically reduce consumption during standby mode, in addition to saving energy through advanced power management during normal use.

End-Use	Equipment/ Measure	Description
Electronics	Personal Computers, ENERGY STAR or better	Improved power management can significantly reduce the annual energy consumption of PCs and monitors in both standby and normal operation. ENERGY STAR and Climate Savers labeled products provide increasing level of energy efficiency.
Electronics	Reduce Standby Wattage	Representing a growing portion of home electricity consumption, plug-in electronics such as set-top boxes, DVD players, gaming systems, digital video recorders, and even battery chargers for mobile phones and laptop computers are often designed to supply a set voltage. When the units are not in use, this voltage could be dropped significantly (~1 W) and thereby generate a significant energy savings, assumed for this analysis to be between 4-5% on average. These savings are in excess of the measures already discussed for computers and televisions.
Misc.	Furnace Fans, Electronically Commutating Motor	In homes heated by a furnace, there is still substantial energy use by the fan responsible for moving the hot air throughout the ductwork. Application of an Electronically Commutating Motor (ECM) ensures that motor speed matches the heating requirements of the system and saves energy when compared to a continuously operating standard motor.
Miscellaneous	Pool Pump	High-efficiency motors and two-speed pumps provide improved energy efficiency for this load.
Miscellaneous	Pool Pump Timer	A pool pump timer allows the pump to turn off automatically, eliminating the wasted energy associated with unnecessary pumping.
Miscellaneous	Trees for Shading	Planting of shade trees, suitable to the local climate, can reduce the need for air conditioning and provide non-energy benefits as well.
Cooling / Space Heating / Interior Lighting	Home Energy Management System	A centralized home energy management system can be used to control and schedule cooling, space heating, lighting, and possibly appliances as well. Some designs also allow the homeowner to remotely control loads via the Internet.
Cooling / Space Heating	Solar Photovoltaic	Adding a solar photovoltaic (PV) system to the home can meet a portion of the home's electric load and in some cases nearly the entire load, depending on the PV system size, orientation, solar resource, and other factors. For this analysis, we assume a grid-connected system and apply the electricity savings to the home's cooling and space heating loads.
Cooling / Space Heating / Interior Lighting	Advanced New Construction Designs	Advanced new construction designs use an integrated approach to the design of new buildings to account for the interaction of building systems. Typically, designs specify the building orientation, building shell, building mechanical systems, and controls strategies with the goal of optimizing building energy efficiency and comfort. Options that may be evaluated and incorporated include passive solar strategies, increased thermal mass, natural ventilation, daylighting strategies, and shading strategies, This measure was modeled for new construction only.
Cooling / Space Heating / Interior Lighting	ENERGY STAR Homes	This measure was modeled for new construction only.
Cooling / Space Heating / Interior Lighting	Energy-Efficient Manufactured Homes	This measure was modeled for new construction only.

Table C-2 Energy Efficiency Equipment Data — Single Family, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	134	$278	15	0.41
Cooling	Central AC	SEER 15 (CEE Tier 2)	184	$556	15	0.28
Cooling	Central AC	SEER 16 (CEE Tier 3)	226	$834	15	0.23
Cooling	Central AC	Ductless Mini-Split System	405	$4,399	20	0.14
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	62	$104	10	0.33
Cooling	Room AC	EER 11	73	$282	10	0.15
Cooling	Room AC	EER 11.5	99	$626	10	0.09
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	492	$1,000	15	0.43
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	675	$2,318	15	0.26
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	829	$3,505	15	0.21
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	1,486	$5,655	20	0.45
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	516	$1,500	14	0.28
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	173	$41	15	5.79
Water Heating	Water Heater	Geothermal Heat Pump	2,269	$6,586	15	0.47
Water Heating	Water Heater	Solar	2,493	$5,653	15	0.60
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	14.44
Interior Lighting*	Screw-in	LED	40	$80	12	0.90
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.16
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.71
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.14
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.77
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	22.43
Exterior Lighting*	Screw-in	LED	37	$79	12	0.89
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	7.40
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	4.03
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	9.14
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.82
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	45	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	88	$487	10	0.16
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	98	$48	13	2.39
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	41	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	53	$1	9	31.05
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	108	$89	13	1.28
Appliances	Refrigerator	Baseline (2014)	144	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	230	$89	13	-

* Savings and costs are per unit, e.g., per lamp.

Table C-2 Energy Efficiency Equipment Data — Single Family, Existing Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	114	$32	11	3.03
Appliances	Freezer	Baseline (2014)	152	$0	11	-
Appliances	Freezer	Energy Star (2014)	243	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	111	$89	13	1.31
Appliances	Second Refrigerator	Baseline (2014)	148	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	237	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	9	$2	13	7.00
Appliances	Stove	Induction (High Efficiency)	46	$1,432	13	0.05
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	108	$1	5	35.63
Electronics	Personal Computers	Climate Savers	154	$175	5	0.35
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	87	$1	11	133.21
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	138	$85	15	1.96
Miscellaneous	Pool Pump	Two-Speed Pump	551	$579	15	1.15
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	127	$1	18	281.65
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-3 Energy Efficiency Equipment Data — Multi Family, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	67	$93	15	0.62
Cooling	Central AC	SEER 15 (CEE Tier 2)	133	$185	15	0.61
Cooling	Central AC	SEER 16 (CEE Tier 3)	187	$278	15	0.57
Cooling	Central AC	Ductless Mini-Split System	245	$2,012	20	0.19
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	32	$52	10	0.35
Cooling	Room AC	EER 11	38	$141	10	0.15
Cooling	Room AC	EER 11.5	52	$313	10	0.09
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	238	$1,246	15	0.17
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	467	$2,315	15	0.18
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	659	$3,277	15	0.18
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	862	$5,022	20	0.27
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	248	$1,500	14	0.14
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	107	$41	15	3.61
Water Heating	Water Heater	Solar	1,539	$5,653	15	0.38
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	10.47
Interior Lighting*	Screw-in	LED	40	$80	12	0.65
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.16
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.71
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.14
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.77
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	32.52
Exterior Lighting*	Screw-in	LED	37	$79	12	1.29
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	7.40
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	4.03
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	9.14
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.82
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	23	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	44	$487	10	0.08
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	93	$48	13	2.28
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	15	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	19	$1	9	11.14
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	92	$89	13	1.09
Appliances	Refrigerator	Baseline (2014)	123	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	196	$89	13	-

* Savings and costs are per unit, e.g., per lamp.

Table C-3 Energy Efficiency Equipment Data—Multi Family, Existing Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	108	$32	11	2.88
Appliances	Freezer	Baseline (2014)	145	$0	11	-
Appliances	Freezer	Energy Star (2014)	231	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	93	$89	13	1.11
Appliances	Second Refrigerator	Baseline (2014)	124	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	199	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	4	$2	13	2.99
Appliances	Stove	Induction (High Efficiency)	20	$1,432	13	0.02
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	86	$1	5	29.28
Electronics	Personal Computers	Climate Savers	123	$175	5	0.29
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	43	$1	11	67.65
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	-	$85	15	-
Miscellaneous	Pool Pump	Two-Speed Pump	-	$579	15	-
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	10	$1	18	21.87
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-4 Energy Efficiency Equipment Data — Mobile Home, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	80	$278	15	0.24
Cooling	Central AC	SEER 15 (CEE Tier 2)	110	$556	15	0.17
Cooling	Central AC	SEER 16 (CEE Tier 3)	134	$834	15	0.14
Cooling	Central AC	Ductless Mini-Split System	241	$4,399	20	0.08
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	37	$52	10	0.40
Cooling	Room AC	EER 11	44	$141	10	0.17
Cooling	Room AC	EER 11.5	59	$313	10	0.11
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	282	$1,246	15	0.20
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	387	$2,315	15	0.15
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	475	$3,277	15	0.13
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	852	$5,022	20	0.27
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	295	$1,500	14	0.16
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	88	$41	15	2.95
Water Heating	Water Heater	Solar	1,271	$5,653	15	0.31
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	13.00
Interior Lighting*	Screw-in	LED	40	$80	12	0.81
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.04
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.64
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.13
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.70
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	20.19
Exterior Lighting*	Screw-in	LED	37	$79	12	0.80
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	6.66
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	3.63
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	8.23
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.74
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	46	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	89	$487	10	0.16
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	99	$48	13	2.43
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	41	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	54	$1	9	31.57
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	110	$89	13	1.30
Appliances	Refrigerator	Baseline (2014)	146	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	234	$89	13	-

* Savings and costs are per unit, e.g., per lamp

Table C-4 Energy Efficiency Equipment Data — Mobile Home, Existing Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	116	$32	11	3.08
Appliances	Freezer	Baseline (2014)	155	$0	11	-
Appliances	Freezer	Energy Star (2014)	248	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	113	$89	13	1.34
Appliances	Second Refrigerator	Baseline (2014)	150	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	241	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	8	$2	13	6.30
Appliances	Stove	Induction (High Efficiency)	41	$1,432	13	0.04
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	101	$1	5	33.39
Electronics	Personal Computers	Climate Savers	144	$175	5	0.33
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	87	$1	11	133.21
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	138	$85	15	1.96
Miscellaneous	Pool Pump	Two-Speed Pump	551	$579	15	1.15
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	127	$1	18	281.65
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-5 Energy Efficiency Equipment Data — Limited Income, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	76	$185	15	0.35
Cooling	Central AC	SEER 15 (CEE Tier 2)	104	$370	15	0.24
Cooling	Central AC	SEER 16 (CEE Tier 3)	127	$556	15	0.19
Cooling	Central AC	Ductless Mini-Split System	229	$2,394	20	0.15
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	65	$104	10	0.35
Cooling	Room AC	EER 11	77	$282	10	0.15
Cooling	Room AC	EER 11.5	104	$626	10	0.09
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	192	$1,246	15	0.13
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	263	$2,315	15	0.10
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	323	$3,277	15	0.09
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	579	$5,022	20	0.18
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	201	$1,500	14	0.11
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	116	$41	15	3.94
Water Heating	Water Heater	Solar	1,679	$5,653	15	0.41
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	13.85
Interior Lighting*	Screw-in	LED	40	$80	12	0.86
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.16
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.71
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.14
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.77
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	32.52
Exterior Lighting*	Screw-in	LED	37	$79	12	1.29
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	7.40
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	4.03
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	9.14
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.82
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	20	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	38	$487	10	0.07
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	104	$48	13	2.56
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	12	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	15	$1	9	9.07
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	92	$89	13	1.09
Appliances	Refrigerator	Baseline (2014)	123	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	196	$89	13	-

* Savings and costs are per unit, e.g., per lamp

Table C-5 Energy Efficiency Equipment Data — Limited Income, Existing Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	108	$32	11	2.88
Appliances	Freezer	Baseline (2014)	145	$0	11	-
Appliances	Freezer	Energy Star (2014)	231	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	93	$89	13	1.11
Appliances	Second Refrigerator	Baseline (2014)	124	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	199	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	5	$2	13	3.59
Appliances	Stove	Induction (High Efficiency)	24	$1,432	13	0.02
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	89	$1	5	30.10
Electronics	Personal Computers	Climate Savers	127	$175	5	0.29
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	49	$1	11	77.80
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	57	$85	15	0.83
Miscellaneous	Pool Pump	Two-Speed Pump	226	$579	15	0.49
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	54	$1	18	123.18
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-6 Energy Efficiency Equipment Data —Single Family, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	180	$278	15	0.55
Cooling	Central AC	SEER 15 (CEE Tier 2)	240	$556	15	0.36
Cooling	Central AC	SEER 16 (CEE Tier 3)	290	$834	15	0.29
Cooling	Central AC	Ductless Mini-Split System	543	$4,399	20	0.19
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	76	$104	10	0.41
Cooling	Room AC	EER 11	90	$282	10	0.18
Cooling	Room AC	EER 11.5	122	$626	10	0.11
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	588	$1,000	15	0.51
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	783	$2,318	15	0.30
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	946	$3,505	15	0.24
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	1,775	$5,655	20	0.54
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	630	$1,500	14	0.35
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	219	$41	15	7.35
Water Heating	Water Heater	Geothermal Heat Pump	2,878	$6,586	15	0.60
Interior Lighting*	Water Heater	Solar	3,163	$5,653	15	0.77
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	14.05
Interior Lighting*	Screw-in	LED	40	$80	12	0.87
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.16
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.71
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.14
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Exterior Lighting*	Pin-based	LED	14	$17	10	0.77
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	21.82
Exterior Lighting*	Screw-in	LED	37	$79	12	0.87
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	7.40
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	4.03
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	9.14
Exterior Lighting	High Intensity/Flood	LED	66	$79	10	0.82
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	58	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	112	$487	10	0.21
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	117	$48	13	2.86
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	47	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	62	$1	9	36.25
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	102	$89	13	1.20
Appliances	Refrigerator	Baseline (2014)	135	$0	13	-

* Savings and costs are per unit, e.g., per lamp

Table C-6 Energy Efficiency Equipment Data —Single Family, New Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Refrigerator	Energy Star (2014)	217	$89	13	-
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	116	$32	11	3.08
Appliances	Freezer	Baseline (2014)	155	$0	11	-
Appliances	Freezer	Energy Star (2014)	248	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	116	$89	13	1.37
Appliances	Second Refrigerator	Baseline (2014)	154	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	247	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	11	$2	13	8.51
Appliances	Stove	Induction (High Efficiency)	56	$1,432	13	0.06
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	111	$1	5	36.63
Electronics	Personal Computers	Climate Savers	158	$175	5	0.36
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	96	$1	11	148.53
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	156	$85	15	2.22
Miscellaneous	Pool Pump	Two-Speed Pump	623	$579	15	1.30
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	155	$1	18	345.87
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-7 Energy Efficiency Equipment Data — Multi Family, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	85	$93	15	0.78
Cooling	Central AC	SEER 15 (CEE Tier 2)	166	$185	15	0.76
Cooling	Central AC	SEER 16 (CEE Tier 3)	234	$278	15	0.71
Cooling	Central AC	Ductless Mini-Split System	308	$2,012	20	0.24
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	37	$52	10	0.39
Cooling	Room AC	EER 11	43	$141	10	0.17
Cooling	Room AC	EER 11.5	59	$313	10	0.10
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	292	$1,246	15	0.21
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	571	$2,315	15	0.22
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	804	$3,277	15	0.21
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	1,058	$5,022	20	0.33
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	282	$1,500	14	0.15
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	124	$41	15	4.19
Water Heating	Water Heater	Solar	1,786	$5,653	15	0.44
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	10.18
Interior Lighting*	Screw-in	LED	40	$80	12	0.63
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.16
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.71
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.14
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.77
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	31.63
Exterior Lighting*	Screw-in	LED	37	$79	12	1.26
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	7.40
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	4.03
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	9.14
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.82
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	26	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	51	$487	10	0.09
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	105	$48	13	2.56
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	16	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	21	$1	9	12.38
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	108	$89	13	1.28
Appliances	Refrigerator	Baseline (2014)	144	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	230	$89	13	-

* Savings and costs are per unit, e.g., per lamp

Table C-7 Energy Efficiency Equipment Data — Multi Family, New Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	115	$32	11	3.06
Appliances	Freezer	Baseline (2014)	154	$0	11	-
Appliances	Freezer	Energy Star (2014)	246	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	103	$89	13	1.21
Appliances	Second Refrigerator	Baseline (2014)	137	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	219	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	4	$2	13	3.31
Appliances	Stove	Induction (High Efficiency)	22	$1,432	13	0.02
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	88	$1	5	29.69
Electronics	Personal Computers	Climate Savers	125	$175	5	0.29
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	45	$1	11	71.54
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	-	$85	15	-
Miscellaneous	Pool Pump	Two-Speed Pump	-	$579	15	-
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	11	$1	18	24.36
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-8 Energy Efficiency Equipment Data — Mobile Home, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	100	$278	15	0.30
Cooling	Central AC	SEER 15 (CEE Tier 2)	133	$556	15	0.20
Cooling	Central AC	SEER 16 (CEE Tier 3)	161	$834	15	0.16
Cooling	Central AC	Ductless Mini-Split System	301	$4,399	20	0.11
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	42	$52	10	0.45
Cooling	Room AC	EER 11	50	$141	10	0.20
Cooling	Room AC	EER 11.5	67	$313	10	0.12
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	313	$1,246	15	0.22
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	417	$2,315	15	0.16
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	505	$3,277	15	0.13
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	946	$5,022	20	0.30
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	336	$1,500	14	0.18
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	102	$41	15	3.42
Water Heating	Water Heater	Solar	1,474	$5,653	15	0.36
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	12.64
Interior Lighting*	Screw-in	LED	40	$80	12	0.79
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.04
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.64
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.13
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.70
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	19.63
Exterior Lighting*	Screw-in	LED	37	$79	12	0.78
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	6.66
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	3.63
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	8.23
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.74
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	54	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	104	$487	10	0.19
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	111	$48	13	2.73
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	46	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	60	$1	9	35.11
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	129	$89	13	1.52
Appliances	Refrigerator	Baseline (2014)	172	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	275	$89	13	-

* Savings and costs are per unit, e.g., per lamp

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1000 of 1069

Table C-8 Energy Efficiency Equipment Data — Mobile Home, New Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	124	$32	11	3.28
Appliances	Freezer	Baseline (2014)	165	$0	11	-
Appliances	Freezer	Energy Star (2014)	263	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	124	$89	13	1.47
Appliances	Second Refrigerator	Baseline (2014)	165	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	264	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	9	$2	13	6.98
Appliances	Stove	Induction (High Efficiency)	46	$1,432	13	0.05
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	103	$1	5	33.86
Electronics	Personal Computers	Climate Savers	146	$175	5	0.33
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	91	$1	11	140.87
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	154	$85	15	2.20
Miscellaneous	Pool Pump	Two-Speed Pump	617	$579	15	1.29
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	141	$1	18	313.76
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Table C-9 Energy Efficiency Equipment Data — Limited Income, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost (/HH)	Lifetime (yrs)	BC Ratio
Cooling	Central AC	SEER 13	-	$0	15	-
Cooling	Central AC	SEER 14 (Energy Star)	95	$185	15	0.43
Cooling	Central AC	SEER 15 (CEE Tier 2)	126	$370	15	0.29
Cooling	Central AC	SEER 16 (CEE Tier 3)	152	$556	15	0.23
Cooling	Central AC	Ductless Mini-Split System	286	$2,394	20	0.18
Cooling	Room AC	EER 9.8	-	$0	10	-
Cooling	Room AC	EER 10.8 (Energy Star)	74	$104	10	0.40
Cooling	Room AC	EER 11	87	$282	10	0.17
Cooling	Room AC	EER 11.5	118	$626	10	0.11
Combined Heating/Cooling	Air Source Heat Pump	SEER 13	-	$0	15	-
Combined Heating/Cooling	Air Source Heat Pump	SEER 14 (Energy Star)	213	$1,246	15	0.15
Combined Heating/Cooling	Air Source Heat Pump	SEER 15 (CEE Tier 2)	284	$2,315	15	0.11
Combined Heating/Cooling	Air Source Heat Pump	SEER 16 (CEE Tier 3)	343	$3,277	15	0.09
Combined Heating/Cooling	Air Source Heat Pump	Ductless Mini-Split System	643	$5,022	20	0.20
Combined Heating/Cooling	Geothermal Heat Pump	Standard	-	$0	14	-
Combined Heating/Cooling	Geothermal Heat Pump	High Efficiency	228	$1,500	14	0.13
Space Heating	Electric Resistance	Electric Resistance	-	$0	20	-
Space Heating	Electric Furnace	3400 BTU/KW	-	$0	15	-
Space Heating	Supplemental	Supplemental	-	$0	5	-
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	135	$41	15	4.57
Water Heating	Water Heater	Solar	1,949	$5,653	15	0.48
Interior Lighting*	Screw-in	Incandescent	-	$0	4	-
Interior Lighting*	Screw-in	Infrared Halogen	14	$4	5	-
Interior Lighting*	Screw-in	CFL	38	$2	6	13.47
Interior Lighting*	Screw-in	LED	40	$80	12	0.84
Interior Lighting*	Linear Fluorescent	T12	-	$0	6	-
Interior Lighting*	Linear Fluorescent	T8	6	($1)	6	1.00
Interior Lighting*	Linear Fluorescent	Super T8	6	$7	6	1.16
Interior Lighting*	Linear Fluorescent	T5	10	$10	6	0.71
Interior Lighting*	Linear Fluorescent	LED	18	$55	10	0.14
Interior Lighting*	Pin-based	Halogen	-	$0	4	-
Interior Lighting*	Pin-based	CFL	13	$4	6	1.00
Interior Lighting*	Pin-based	LED	14	$17	10	0.77
Exterior Lighting*	Screw-in	Incandescent	-	$0	4	-
Exterior Lighting*	Screw-in	Infrared Halogen	12	$4	5	-
Exterior Lighting*	Screw-in	CFL	27	$3	6	31.63
Exterior Lighting*	Screw-in	LED	37	$79	12	1.26
Exterior Lighting*	High Intensity/Flood	Incandescent	-	$0	4	-
Exterior Lighting*	High Intensity/Flood	Infrared Halogen	34	$4	4	-
Exterior Lighting*	High Intensity/Flood	CFL	60	$4	5	7.40
Exterior Lighting*	High Intensity/Flood	Metal Halide	22	$31	5	4.03
Exterior Lighting*	High Intensity/Flood	High Pressure Sodium	22	$23	5	9.14
Exterior Lighting*	High Intensity/Flood	LED	66	$79	10	0.82
Appliances	Clothes Washer	Baseline	-	$0	10	-
Appliances	Clothes Washer	Energy Star (MEF > 1.8)	23	$0	10	1.00
Appliances	Clothes Washer	Horizontal Axis	44	$487	10	0.08
Appliances	Clothes Dryer	Baseline	-	$0	13	-
Appliances	Clothes Dryer	Moisture Detection	117	$48	13	2.87
Appliances	Dishwasher	Baseline	-	$0	9	-
Appliances	Dishwasher	Energy Star	13	$1	9	-
Appliances	Dishwasher	Energy Star (2011)	17	$1	9	10.08
Appliances	Refrigerator	Baseline	-	$0	13	-
Appliances	Refrigerator	Energy Star	108	$89	13	1.28
Appliances	Refrigerator	Baseline (2014)	144	$0	13	-
Appliances	Refrigerator	Energy Star (2014)	230	$89	13	-

* Savings and costs are per unit, e.g., per lamp

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1002 of 1069

Table C-9 Energy Efficiency Equipment Data — Limited Income, New Vintage (cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr/HH)	Incremental Cost ($/HH)	Lifetime (yrs)	BC Ratio
Appliances	Freezer	Baseline	-	$0	11	-
Appliances	Freezer	Energy Star	115	$32	11	3.06
Appliances	Freezer	Baseline (2014)	154	$0	11	-
Appliances	Freezer	Energy Star (2014)	246	$32	11	-
Appliances	Second Refrigerator	Baseline	-	$0	13	-
Appliances	Second Refrigerator	Energy Star	103	$89	13	1.21
Appliances	Second Refrigerator	Baseline (2014)	137	$0	13	-
Appliances	Second Refrigerator	Energy Star (2014)	219	$89	13	-
Appliances	Stove	Baseline	-	$0	13	-
Appliances	Stove	Convection Oven	5	$2	13	3.98
Appliances	Stove	Induction (High Efficiency)	26	$1,432	13	0.03
Appliances	Microwave	Baseline	-	$0	9	-
Electronics	Personal Computers	Baseline	-	$0	5	-
Electronics	Personal Computers	Energy Star	90	$1	5	30.52
Electronics	Personal Computers	Climate Savers	129	$175	5	0.30
Electronics	TVs	Baseline	-	$0	11	-
Electronics	TVs	Energy Star	52	$1	11	82.28
Electronics	Devices and Gadgets	Devices and Gadgets	-	$0	5	-
Miscellaneous	Pool Pump	Baseline Pump	-	$0	15	-
Miscellaneous	Pool Pump	High Efficiency Pump	63	$85	15	0.93
Miscellaneous	Pool Pump	Two-Speed Pump	254	$579	15	0.54
Miscellaneous	Furnace Fan	Baseline	-	$0	18	-
Miscellaneous	Furnace Fan	Furnace Fan with ECM	60	$1	18	137.23
Miscellaneous	Miscellaneous	Miscellaneous	-	$0	5	-

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1003 of 1069

Table C-10 Energy-Efficiency Measure Data—Single Family, Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Early Replacement	Cooling	10%	0%	0%	8%	$2,895	15	0.05
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	41%	100%	$125	4	0.70
Room AC - Removal of Second Unit	Cooling	100%	0%	0%	25%	$75	5	2.45
Attic Fan - Installation	Cooling	1%	0%	12%	23%	$116	18	0.08
Attic Fan - Photovoltaic - Installation	Cooling	1%	0%	13%	45%	$350	19	0.06
Ceiling Fan - Installation	Cooling	11%	0%	51%	75%	$160	15	0.81
Whole-House Fan - Installation	Cooling	9%	0%	7%	19%	$200	18	0.62
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$125	4	1.49
Insulation - Ducting	Cooling	3%	0%	15%	75%	$500	18	0.78
Insulation - Ducting	Space Heating	4%	4%	15%	75%	$500	18	0.78
Repair and Sealing - Ducting	Cooling	10%	0%	12%	50%	$500	18	2.08
Repair and Sealing - Ducting	Space Heating	15%	15%	12%	50%	$500	18	2.08
Thermostat - Clock/Programmable	Cooling	8%	0%	55%	56%	$114	11	2.89
Thermostat - Clock/Programmable	Space Heating	9%	5%	55%	56%	$114	11	2.89
Doors - Storm and Thermal	Cooling	1%	0%	38%	75%	$320	12	0.25
Doors - Storm and Thermal	Space Heating	2%	2%	38%	75%	$320	12	0.25
Insulation - Infiltration Control	Cooling	3%	0%	46%	90%	$266	12	1.72
Insulation - Infiltration Control	Space Heating	10%	10%	46%	90%	$266	12	1.72
Insulation - Ceiling	Cooling	3%	0%	68%	72%	$594	20	1.11
Insulation - Ceiling	Space Heating	10%	5%	68%	72%	$594	20	1.11
Insulation - Radiant Barrier	Cooling	5%	0%	5%	90%	$923	12	0.41
Insulation - Radiant Barrier	Space Heating	2%	1%	5%	90%	$923	12	0.41
Roofs - High Reflectivity	Cooling	6%	0%	5%	10%	$1,550	15	0.05
Windows - Reflective Film	Cooling	7%	0%	5%	45%	$267	10	0.21
Windows - High Efficiency/Energy Star	Cooling	12%	0%	83%	90%	$7,500	25	0.38
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	83%	90%	$7,500	25	0.38
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	24%	25%	$750	15	0.10
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	0%	10%	80%	$2,975	15	0.03
Exterior Lighting - Photosensor Control	Exterior Lighting	15%	0%	24%	45%	$90	8	0.21
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	10%	45%	$72	8	0.35
Water Heater - Faucet Aerators	Water Heating	4%	2%	53%	90%	$24	25	8.78
Water Heater - Pipe Insulation	Water Heating	6%	3%	17%	38%	$180	13	1.05
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	75%	80%	$96	10	4.56
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	54%	75%	$15	10	15.53
Water Heater - Thermostat Setback	Water Heating	9%	5%	17%	75%	$40	5	2.99
Water Heater - Timer	Water Heating	8%	4%	17%	40%	$194	10	1.06
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	3.28
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	1.76
Refrigerator - Early Replacement	Appliances	15%	15%	0%	20%	$1,203	13	0.08
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.99
Freezer - Early Replacement	Appliances	15%	15%	0%	20%	$484	11	0.18
Freezer - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.76
Home Energy Management System	Cooling	10%	0%	20%	38%	$300	20	2.46
Home Energy Management System	Space Heating	10%	5%	20%	38%	$300	20	2.46
Home Energy Management System	Interior Lighting	10%	5%	20%	38%	$300	20	2.46
Photovoltaics	Cooling	50%	0%	0%	48%	$17,000	15	0.10
Photovoltaics	Space Heating	25%	25%	0%	48%	$17,000	15	0.10
Pool - Pump Timer	Miscellaneous	60%	0%	59%	90%	$160	15	4.92
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.43
Water Heater - Heat Pump	Water Heating	30%	15%	0%	25%	$1,500	15	0.75
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$3,675	15	1.22
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$13,769	15	0.95

Note: Costs are per household.

Table C-11 Energy-Efficiency Measure Data — Multi Family, Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Early Replacement	Cooling	10%	0%	0%	8%	$2,895	15	0.02
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	33%	100%	$100	4	0.59
Room AC - Removal of Second Unit	Cooling	100%	0%	0%	25%	$75	5	1.28
Ceiling Fan - Installation	Cooling	11%	0%	32%	75%	$80	15	0.49
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$100	4	1.05
Insulation - Ducting	Cooling	3%	0%	13%	75%	$375	18	1.16
Insulation - Ducting	Space Heating	4%	4%	13%	75%	$375	18	1.16
Repair and Sealing - Ducting	Cooling	4%	0%	12%	50%	$500	18	0.95
Repair and Sealing - Ducting	Space Heating	4%	4%	12%	50%	$500	18	0.95
Thermostat - Clock/Programmable	Cooling	8%	0%	27%	68%	$114	11	2.39
Thermostat - Clock/Programmable	Space Heating	6%	3%	27%	68%	$114	11	2.39
Doors - Storm and Thermal	Cooling	1%	0%	17%	75%	$320	12	0.35
Doors - Storm and Thermal	Space Heating	2%	2%	17%	75%	$320	12	0.35
Insulation - Infiltration Control	Cooling	1%	0%	19%	90%	$266	12	2.95
Insulation - Infiltration Control	Space Heating	13%	13%	19%	90%	$266	12	2.95
Insulation - Ceiling	Cooling	13%	0%	27%	30%	$215	20	5.67
Insulation - Ceiling	Space Heating	13%	13%	27%	30%	$215	20	5.67
Insulation - Radiant Barrier	Cooling	4%	0%	5%	90%	$923	12	0.52
Insulation - Radiant Barrier	Space Heating	4%	4%	5%	90%	$923	12	0.52
Roofs - High Reflectivity	Cooling	13%	0%	3%	10%	$1,550	15	0.03
Windows - Reflective Film	Cooling	7%	0%	5%	45%	$167	10	0.10
Windows - High Efficiency/Energy Star	Cooling	13%	0%	70%	90%	$2,500	25	0.56
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	70%	90%	$2,500	25	0.56
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	6%	10%	$256	15	0.14
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	0%	10%	50%	$2,975	15	0.00
Exterior Lighting - Photosensor Control	Exterior Lighting	20%	0%	7%	45%	$90	8	0.04
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	6%	45%	$72	8	0.05
Water Heater - Faucet Aerators	Water Heating	5%	2%	43%	90%	$24	25	6.63
Water Heater - Pipe Insulation	Water Heating	6%	3%	6%	38%	$180	13	0.65
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	71%	75%	$96	10	2.84
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	54%	75%	$15	10	9.66
Water Heater - Thermostat Setback	Water Heating	9%	5%	17%	75%	$40	5	1.86
Water Heater - Timer	Water Heating	8%	4%	5%	40%	$194	10	0.66
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	2.04
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	0.58
Refrigerator - Early Replacement	Appliances	15%	15%	0%	20%	$1,203	13	0.07
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.36
Freezer - Early Replacement	Appliances	15%	15%	0%	20%	$484	11	0.17
Freezer - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.57
Home Energy Management System	Cooling	10%	0%	5%	13%	$300	20	2.46
Home Energy Management System	Space Heating	10%	5%	5%	13%	$300	20	2.46
Home Energy Management System	Interior Lighting	10%	5%	5%	13%	$300	20	2.46
Photovoltaics	Cooling	50%	0%	0%	12%	$8,500	15	0.22
Photovoltaics	Space Heating	25%	25%	0%	12%	$8,500	15	0.22
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.13
Water Heater - Heat Pump	Water Heating	30%	15%	0%	10%	$1,500	15	0.47
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$2,845	15	0.99
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$10,946	15	0.72

Note: Costs are per household.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1005 of 1069

Table C-12 Energy-Efficiency Measure Data — Mobile Home, Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Early Replacement	Cooling	10%	0%	0%	8%	$2,895	15	0.03
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	59%	100%	$100	4	0.63
Room AC - Removal of Second Unit	Cooling	100%	0%	0%	25%	$75	5	1.46
Ceiling Fan - Installation	Cooling	11%	0%	60%	75%	$80	15	0.79
Whole-House Fan - Installation	Cooling	9%	0%	5%	19%	$150	18	0.41
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$125	4	1.02
Insulation - Ducting	Cooling	3%	0%	15%	75%	$375	18	0.94
Insulation - Ducting	Space Heating	4%	4%	15%	75%	$375	18	0.94
Repair and Sealing - Ducting	Cooling	10%	0%	12%	50%	$500	18	2.08
Repair and Sealing - Ducting	Space Heating	15%	15%	12%	50%	$500	18	2.08
Thermostat - Clock/Programmable	Cooling	8%	0%	51%	56%	$114	11	2.78
Thermostat - Clock/Programmable	Space Heating	9%	5%	51%	56%	$114	11	2.78
Doors - Storm and Thermal	Cooling	1%	0%	38%	75%	$320	12	0.25
Doors - Storm and Thermal	Space Heating	2%	2%	38%	75%	$320	12	0.25
Insulation - Infiltration Control	Cooling	3%	0%	46%	90%	$266	12	1.80
Insulation - Infiltration Control	Space Heating	10%	10%	46%	90%	$266	12	1.80
Insulation - Ceiling	Cooling	3%	0%	79%	81%	$707	20	1.00
Insulation - Ceiling	Space Heating	10%	5%	79%	81%	$707	20	1.00
Insulation - Radiant Barrier	Cooling	2%	0%	5%	90%	$923	12	0.35
Insulation - Radiant Barrier	Space Heating	1%	1%	5%	90%	$923	12	0.35
Roofs - High Reflectivity	Cooling	6%	0%	5%	10%	$1,550	15	0.02
Windows - Reflective Film	Cooling	7%	0%	5%	45%	$167	10	0.16
Windows - High Efficiency/Energy Star	Cooling	12%	0%	47%	90%	$7,500	25	0.37
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	47%	90%	$7,500	25	0.37
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	67%	72%	$750	15	0.09
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	0%	10%	80%	$2,975	15	0.03
Exterior Lighting - Photosensor Control	Exterior Lighting	15%	0%	23%	45%	$90	8	0.19
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	10%	45%	$72	8	0.32
Water Heater - Faucet Aerators	Water Heating	4%	2%	79%	90%	$24	25	4.47
Water Heater - Pipe Insulation	Water Heating	6%	3%	17%	38%	$180	13	0.53
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	92%	95%	$96	10	2.32
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	54%	75%	$15	10	7.91
Water Heater - Thermostat Setback	Water Heating	9%	5%	17%	75%	$40	5	1.52
Water Heater - Timer	Water Heating	8%	4%	17%	40%	$194	10	0.54
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	1.67
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	1.65
Refrigerator - Early Replacement	Appliances	15%	15%	0%	20%	$1,203	13	0.08
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	4.06
Freezer - Early Replacement	Appliances	15%	15%	0%	20%	$484	11	0.18
Freezer - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.82
Home Energy Management System	Cooling	10%	0%	20%	38%	$300	20	2.28
Home Energy Management System	Space Heating	10%	5%	20%	38%	$300	20	2.28
Home Energy Management System	Interior Lighting	10%	5%	20%	38%	$300	20	2.28
Photovoltaics	Cooling	50%	0%	0%	48%	$17,000	15	0.09
Photovoltaics	Space Heating	25%	25%	0%	48%	$17,000	15	0.09
Pool - Pump Timer	Miscellaneous	60%	0%	50%	90%	$160	15	4.92
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.21
Water Heater - Heat Pump	Water Heating	30%	15%	0%	10%	$1,500	15	0.38
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$2,616	15	0.88
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$11,135	15	0.62

Note: Costs are per household.

Table C-13 Energy-Efficiency Measure Data — Limited Income, Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Early Replacement	Cooling	10%	0%	0%	8%	$2,895	15	0.03
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	25%	100%	$100	4	0.61
Room AC - Removal of Second Unit	Cooling	100%	0%	0%	25%	$75	5	2.56
Attic Fan - Installation	Cooling	1%	0%	3%	23%	$116	18	0.05
Attic Fan - Photovoltaic - Installation	Cooling	1%	0%	2%	11%	$350	19	0.03
Ceiling Fan - Installation	Cooling	11%	0%	41%	75%	$80	15	0.89
Whole-House Fan - Installation	Cooling	9%	0%	5%	19%	$150	18	0.46
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$125	4	0.82
Insulation - Ducting	Cooling	3%	0%	13%	75%	$395	18	0.90
Insulation - Ducting	Space Heating	4%	4%	13%	75%	$395	18	0.90
Repair and Sealing - Ducting	Cooling	10%	0%	12%	50%	$500	18	2.07
Repair and Sealing - Ducting	Space Heating	15%	15%	12%	50%	$500	18	2.07
Thermostat - Clock/Programmable	Cooling	8%	0%	27%	68%	$114	11	2.63
Thermostat - Clock/Programmable	Space Heating	9%	5%	27%	68%	$114	11	2.63
Doors - Storm and Thermal	Cooling	1%	0%	17%	75%	$320	12	0.25
Doors - Storm and Thermal	Space Heating	2%	2%	17%	75%	$320	12	0.25
Insulation - Infiltration Control	Cooling	3%	0%	19%	90%	$266	12	1.78
Insulation - Infiltration Control	Space Heating	10%	10%	19%	90%	$266	12	1.78
Insulation - Ceiling	Cooling	3%	0%	36%	41%	$215	20	2.44
Insulation - Ceiling	Space Heating	10%	5%	36%	41%	$215	20	2.44
Insulation - Radiant Barrier	Cooling	2%	0%	5%	90%	$923	12	0.35
Insulation - Radiant Barrier	Space Heating	1%	1%	5%	90%	$923	12	0.35
Roofs - High Reflectivity	Cooling	6%	0%	3%	10%	$1,550	15	0.03
Windows - Reflective Film	Cooling	7%	0%	5%	45%	$167	10	0.18
Windows - High Efficiency/Energy Star	Cooling	12%	0%	68%	90%	$2,500	25	0.51
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	68%	90%	$2,500	25	0.51
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	8%	10%	$256	15	0.16
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	50%	10%	50%	$2,975	15	0.01
Exterior Lighting - Photosensor Control	Exterior Lighting	15%	0%	8%	45%	$90	8	0.06
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	6%	45%	$72	8	0.10
Water Heater - Faucet Aerators	Water Heating	4%	2%	46%	90%	$24	25	5.95
Water Heater - Pipe Insulation	Water Heating	6%	3%	6%	38%	$180	13	0.71
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	73%	75%	$96	10	3.09
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	54%	75%	$15	10	10.53
Water Heater - Thermostat Setback	Water Heating	9%	5%	17%	75%	$40	5	2.03
Water Heater - Timer	Water Heating	8%	4%	5%	40%	$194	10	0.72
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	2.23
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	0.77
Refrigerator - Early Replacement	Appliances	15%	15%	0%	20%	$1,203	13	0.07
Refrigerator - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.36
Freezer - Early Replacement	Appliances	15%	15%	0%	20%	$484	11	0.17
Freezer - Remove Second Unit	Appliances	100%	100%	0%	25%	$75	5	3.57
Home Energy Management System	Cooling	10%	0%	5%	13%	$300	20	2.00
Home Energy Management System	Space Heating	10%	5%	5%	13%	$300	20	2.00
Home Energy Management System	Interior Lighting	10%	5%	5%	13%	$300	20	2.00
Photovoltaics	Cooling	50%	0%	0%	48%	$8,500	15	0.17
Photovoltaics	Space Heating	25%	25%	0%	48%	$8,500	15	0.17
Pool - Pump Timer	Miscellaneous	60%	0%	50%	90%	$160	15	2.02
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.24
Water Heater - Heat Pump	Water Heating	30%	15%	0%	20%	$1,500	15	0.51
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$2,970	15	1.03
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$10,798	15	0.69

Note: Costs are per household.

Table C-14 Energy-Efficiency Measure Data — Single Family, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	41%	100%	$125	4	0.78
Attic Fan - Installation	Cooling	1%	0%	13%	23%	$97	18	0.15
Attic Fan - Photovoltaic - Installation	Cooling	1%	0%	4%	11%	$200	19	0.15
Ceiling Fan - Installation	Cooling	10%	0%	53%	75%	$160	15	1.09
Whole-House Fan - Installation	Cooling	9%	0%	4%	19%	$200	18	0.92
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$125	4	1.69
Insulation - Ducting	Cooling	3%	0%	50%	75%	$250	18	1.31
Insulation - Ducting	Space Heating	4%	4%	50%	75%	$250	18	1.31
Thermostat - Clock/Programmable	Cooling	8%	0%	91%	95%	$114	11	2.91
Thermostat - Clock/Programmable	Space Heating	8%	4%	91%	95%	$114	11	2.91
Doors - Storm and Thermal	Cooling	1%	0%	13%	75%	$180	12	0.45
Doors - Storm and Thermal	Space Heating	2%	2%	13%	75%	$180	12	0.45
Insulation - Ceiling	Cooling	3%	0%	68%	71%	$634	20	0.99
Insulation - Ceiling	Space Heating	8%	6%	68%	71%	$634	20	0.99
Insulation - Radiant Barrier	Cooling	2%	0%	25%	90%	$923	12	0.37
Insulation - Radiant Barrier	Space Heating	1%	1%	25%	90%	$923	12	0.37
Insulation - Foundation	Cooling	3%	0%	20%	90%	$358	20	1.35
Insulation - Foundation	Space Heating	6%	6%	20%	90%	$358	20	1.35
Insulation - Wall Cavity	Cooling	2%	0%	20%	90%	$236	20	1.15
Insulation - Wall Cavity	Space Heating	3%	3%	20%	90%	$236	20	1.15
Insulation - Wall Sheathing	Cooling	1%	0%	64%	90%	$300	20	0.89
Insulation - Wall Sheathing	Space Heating	3%	3%	64%	90%	$300	20	0.89
Roofs - High Reflectivity	Cooling	5%	0%	5%	90%	$517	15	0.17
Windows - Reflective Film	Cooling	7%	0%	2%	45%	$267	10	0.31
Windows - High Efficiency/Energy Star	Cooling	12%	0%	100%	100%	$2,200	25	0.62
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	100%	100%	$2,200	25	0.62
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	24%	27%	$500	15	0.16
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	0%	10%	80%	$2,975	15	0.04
Exterior Lighting - Photosensor Control	Exterior Lighting	13%	0%	13%	45%	$90	8	0.19
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	16%	45%	$72	8	0.36
Water Heater - Faucet Aerators	Water Heating	4%	2%	38%	90%	$24	25	11.03
Water Heater - Pipe Insulation	Water Heating	6%	3%	8%	41%	$50	13	4.71
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	90%	95%	$48	10	11.33
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$15	10	19.30
Water Heater - Thermostat Setback	Water Heating	9%	5%	5%	75%	$40	5	3.70
Water Heater - Timer	Water Heating	8%	4%	5%	40%	$194	10	1.31
Water Heater - Drainwater Heat Reocvery	Water Heating	9%	5%	1%	90%	$899	15	0.47
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	4.06
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	1.99
Home Energy Management System	Cooling	10%	0%	20%	68%	$250	20	3.16
Home Energy Management System	Space Heating	10%	5%	20%	68%	$250	20	3.16
Home Energy Management System	Interior Lighting	10%	5%	20%	68%	$250	20	3.16
Photovoltaics	Cooling	50%	0%	1%	48%	$15,800	15	0.12
Photovoltaics	Space Heating	25%	25%	1%	48%	$15,800	15	0.12
Pool - Pump Timer	Miscellaneous	60%	0%	55%	90%	$160	15	5.43
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.64
Advanced New Construction Designs	Cooling	40%	0%	2%	45%	$4,500	18	1.09
Advanced New Construction Designs	Space Heating	40%	40%	2%	45%	$4,500	18	1.09
Advanced New Construction Designs	Interior Lighting	20%	20%	2%	45%	$4,500	18	1.09
Energy Star Homes	Cooling	20%	0%	12%	75%	$5,000	18	0.75
Energy Star Homes	Space Heating	20%	20%	12%	75%	$5,000	18	0.75
Energy Star Homes	Interior Lighting	20%	20%	12%	75%	$5,000	18	0.75
Water Heater - Heat Pump	Water Heating	30%	15%	0%	25%	$1,500	15	0.94
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$3,675	15	1.53
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$13,769	15	1.14

Note: Costs are per household.

Table C-15 Energy-Efficiency Measure Data — Multi Family, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	33%	100%	$100	4	0.62
Ceiling Fan - Installation	Cooling	10%	0%	18%	75%	$80	15	0.77
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$100	4	1.12
Insulation - Ducting	Cooling	2%	0%	50%	75%	$200	18	1.18
Insulation - Ducting	Space Heating	2%	2%	50%	75%	$200	18	1.18
Thermostat - Clock/Programmable	Cooling	8%	0%	77%	80%	$114	11	2.29
Thermostat - Clock/Programmable	Space Heating	5%	3%	77%	80%	$114	11	2.29
Doors - Storm and Thermal	Cooling	1%	0%	19%	75%	$180	12	0.66
Doors - Storm and Thermal	Space Heating	2%	2%	19%	75%	$180	12	0.66
Insulation - Ceiling	Cooling	12%	0%	27%	48%	$152	20	10.12
Insulation - Ceiling	Space Heating	16%	16%	27%	48%	$152	20	10.12
Insulation - Radiant Barrier	Cooling	2%	0%	5%	90%	$923	12	0.50
Insulation - Radiant Barrier	Space Heating	3%	3%	5%	90%	$923	12	0.50
Insulation - Wall Cavity	Cooling	2%	0%	4%	90%	$63	20	6.14
Insulation - Wall Cavity	Space Heating	4%	4%	4%	90%	$63	20	6.14
Insulation - Wall Sheathing	Cooling	1%	0%	55%	90%	$210	20	1.59
Insulation - Wall Sheathing	Space Heating	3%	3%	55%	90%	$210	20	1.59
Roofs - High Reflectivity	Cooling	8%	0%	0%	90%	$517	15	0.10
Windows - Reflective Film	Cooling	7%	0%	2%	45%	$167	10	0.17
Windows - High Efficiency/Energy Star	Cooling	13%	0%	100%	100%	$2,200	25	0.63
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	100%	100%	$2,200	25	0.63
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	6%	9%	$256	15	0.14
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	0%	10%	50%	$2,975	15	0.01
Exterior Lighting - Photosensor Control	Exterior Lighting	20%	0%	1%	45%	$90	8	0.04
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	11%	45%	$72	8	0.05
Water Heater - Faucet Aerators	Water Heating	5%	2%	11%	90%	$24	25	7.63
Water Heater - Pipe Insulation	Water Heating	6%	3%	0%	41%	$50	13	2.68
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	66%	75%	$48	10	6.45
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$15	10	10.99
Water Heater - Thermostat Setback	Water Heating	9%	5%	5%	75%	$40	5	2.11
Water Heater - Timer	Water Heating	8%	4%	5%	40%	$194	10	0.75
Water Heater - Drainwater Heat Reocvery	Water Heating	9%	5%	1%	90%	$899	15	0.27
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	2.31
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	0.63
Home Energy Management System	Cooling	10%	0%	5%	68%	$250	20	3.19
Home Energy Management System	Space Heating	10%	5%	5%	68%	$250	20	3.19
Home Energy Management System	Interior Lighting	10%	5%	5%	68%	$250	20	3.19
Photovoltaics	Cooling	50%	0%	0%	12%	$7,900	15	0.26
Photovoltaics	Space Heating	25%	25%	0%	12%	$7,900	15	0.26
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.23
Advanced New Construction Designs	Cooling	40%	0%	2%	45%	$2,500	18	1.47
Advanced New Construction Designs	Space Heating	40%	40%	2%	45%	$2,500	18	1.47
Advanced New Construction Designs	Interior Lighting	20%	20%	2%	45%	$2,500	18	1.47
Water Heater - Heat Pump	Water Heating	30%	15%	0%	10%	$1,500	15	0.53
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$2,845	15	1.13
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$10,946	15	0.84

Note: Costs are per household.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1009 of 1069

Table C-16 Energy-Efficiency Measure Data — Mobile Home, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	59%	100%	$100	4	0.66
Ceiling Fan - Installation	Cooling	10%	0%	57%	75%	$80	15	0.95
Whole-House Fan - Installation	Cooling	9%	0%	4%	19%	$150	18	0.53
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$125	4	1.09
Insulation - Ducting	Cooling	3%	0%	50%	75%	$200	18	1.59
Insulation - Ducting	Space Heating	4%	4%	50%	75%	$200	18	1.59
Thermostat - Clock/Programmable	Cooling	8%	0%	57%	75%	$114	11	2.77
Thermostat - Clock/Programmable	Space Heating	8%	4%	57%	75%	$114	11	2.77
Doors - Storm and Thermal	Cooling	1%	0%	13%	75%	$180	12	0.49
Doors - Storm and Thermal	Space Heating	2%	2%	13%	75%	$180	12	0.49
Insulation - Ceiling	Cooling	3%	0%	79%	81%	$176	20	3.02
Insulation - Ceiling	Space Heating	8%	6%	79%	81%	$176	20	3.02
Insulation - Radiant Barrier	Cooling	2%	0%	25%	90%	$923	12	0.36
Insulation - Radiant Barrier	Space Heating	1%	1%	25%	90%	$923	12	0.36
Insulation - Wall Cavity	Cooling	2%	0%	20%	90%	$197	20	1.35
Insulation - Wall Cavity	Space Heating	3%	3%	20%	90%	$197	20	1.35
Insulation - Wall Sheathing	Cooling	1%	0%	64%	90%	$300	20	0.96
Insulation - Wall Sheathing	Space Heating	3%	3%	64%	90%	$300	20	0.96
Roofs - High Reflectivity	Cooling	5%	0%	5%	90%	$517	15	0.07
Windows - Reflective Film	Cooling	7%	0%	2%	45%	$167	10	0.21
Windows - High Efficiency/Energy Star	Cooling	12%	0%	85%	90%	$2,200	25	0.57
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	85%	90%	$2,200	25	0.57
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	67%	72%	$500	15	0.14
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	50%	10%	80%	$2,975	15	0.03
Exterior Lighting - Photosensor Control	Exterior Lighting	13%	0%	13%	45%	$90	8	0.17
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	16%	45%	$72	8	0.32
Water Heater - Faucet Aerators	Water Heating	4%	2%	57%	90%	$24	25	5.14
Water Heater - Pipe Insulation	Water Heating	6%	3%	8%	41%	$50	13	2.20
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	92%	95%	$48	10	5.28
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$15	10	9.00
Water Heater - Thermostat Setback	Water Heating	9%	5%	5%	75%	$40	5	1.72
Water Heater - Timer	Water Heating	8%	4%	5%	40%	$194	10	0.61
Water Heater - Drainwater Heat Reocvery	Water Heating	9%	5%	1%	90%	$899	15	0.22
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	1.89
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	1.79
Home Energy Management System	Cooling	10%	0%	20%	68%	$250	20	2.94
Home Energy Management System	Space Heating	10%	5%	20%	68%	$250	20	2.94
Home Energy Management System	Interior Lighting	10%	5%	20%	68%	$250	20	2.94
Photovoltaics	Cooling	50%	0%	1%	48%	$15,800	15	0.10
Photovoltaics	Space Heating	25%	25%	1%	48%	$15,800	15	0.10
Pool - Pump Timer	Miscellaneous	60%	0%	35%	90%	$160	15	5.38
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.28
Advanced New Construction Designs	Cooling	30%	0%	2%	45%	$4,500	18	0.52
Advanced New Construction Designs	Space Heating	30%	30%	2%	45%	$4,500	18	0.52
Advanced New Construction Designs	Interior Lighting	20%	20%	2%	45%	$4,500	18	0.52
Energy Efficient Manufactured Homes	Cooling	20%	0%	10%	75%	$3,500	18	0.88
Energy Efficient Manufactured Homes	Space Heating	20%	20%	10%	75%	$3,500	18	0.88
Energy Efficient Manufactured Homes	Interior Lighting	20%	20%	10%	75%	$3,500	18	0.88
Water Heater - Heat Pump	Water Heating	30%	15%	0%	10%	$1,500	15	0.44
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$2,616	15	1.00
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$11,738	15	0.69

Note: Costs are per household.

Table C-17 Energy-Efficiency Measure Data — Limited Income, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Central AC - Maintenance and Tune-Up	Cooling	10%	0%	25%	100%	$100	4	0.65
Attic Fan - Installation	Cooling	1%	0%	15%	23%	$97	18	0.07
Attic Fan - Photovoltaic - Installation	Cooling	1%	0%	5%	11%	$200	19	0.07
Ceiling Fan - Installation	Cooling	10%	0%	33%	75%	$80	15	1.03
Whole-House Fan - Installation	Cooling	9%	0%	4%	19%	$150	18	0.58
Air Source Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	25%	90%	$125	4	0.87
Insulation - Ducting	Cooling	3%	0%	50%	75%	$210	18	1.47
Insulation - Ducting	Space Heating	4%	4%	50%	75%	$210	18	1.47
Thermostat - Clock/Programmable	Cooling	8%	0%	29%	30%	$114	11	2.54
Thermostat - Clock/Programmable	Space Heating	8%	4%	29%	30%	$114	11	2.54
Doors - Storm and Thermal	Cooling	1%	0%	19%	75%	$180	12	0.46
Doors - Storm and Thermal	Space Heating	2%	2%	19%	75%	$180	12	0.46
Insulation - Ceiling	Cooling	3%	0%	36%	48%	$152	20	3.20
Insulation - Ceiling	Space Heating	8%	6%	36%	48%	$152	20	3.20
Insulation - Radiant Barrier	Cooling	2%	0%	5%	90%	$923	12	0.36
Insulation - Radiant Barrier	Space Heating	1%	1%	5%	90%	$923	12	0.36
Insulation - Foundation	Cooling	3%	0%	4%	90%	$358	20	1.37
Insulation - Foundation	Space Heating	6%	6%	4%	90%	$358	20	1.37
Insulation - Wall Cavity	Cooling	2%	0%	4%	90%	$63	20	3.46
Insulation - Wall Cavity	Space Heating	3%	3%	4%	90%	$63	20	3.46
Insulation - Wall Sheathing	Cooling	1%	0%	59%	90%	$210	20	1.19
Insulation - Wall Sheathing	Space Heating	3%	3%	59%	90%	$210	20	1.19
Roofs - High Reflectivity	Cooling	5%	0%	0%	90%	$517	15	0.08
Windows - Reflective Film	Cooling	7%	0%	2%	45%	$167	10	0.23
Windows - High Efficiency/Energy Star	Cooling	12%	0%	78%	90%	$2,200	25	0.55
Windows - High Efficiency/Energy Star	Space Heating	7%	5%	78%	90%	$2,200	25	0.55
Interior Lighting - Occupancy Sensor	Interior Lighting	9%	5%	8%	9%	$256	15	0.17
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	50%	50%	10%	50%	$2,975	15	0.01
Exterior Lighting - Photosensor Control	Exterior Lighting	13%	0%	0%	45%	$90	8	0.06
Exterior Lighting - Timeclock Installation	Exterior Lighting	20%	0%	11%	45%	$72	8	0.10
Water Heater - Faucet Aerators	Water Heating	4%	2%	11%	90%	$24	25	6.84
Water Heater - Pipe Insulation	Water Heating	6%	3%	0%	41%	$50	13	2.92
Water Heater - Low Flow Showerheads	Water Heating	17%	9%	21%	75%	$48	10	7.03
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$15	10	11.97
Water Heater - Thermostat Setback	Water Heating	9%	5%	5%	75%	$40	5	2.29
Water Heater - Timer	Water Heating	8%	4%	5%	40%	$194	10	0.81
Water Heater - Drainwater Heat Reocvery	Water Heating	9%	5%	1%	90%	$899	15	0.29
Water Heater - Hot Water Saver	Water Heating	9%	4%	5%	50%	$35	5	2.52
Electronics - Reduce Standby Wattage	Electronics	5%	5%	5%	90%	$20	8	0.83
Home Energy Management System	Cooling	10%	0%	5%	68%	$250	20	2.50
Home Energy Management System	Space Heating	10%	5%	5%	68%	$250	20	2.50
Home Energy Management System	Interior Lighting	10%	5%	5%	68%	$250	20	2.50
Photovoltaics	Cooling	50%	0%	0%	48%	$7,900	15	0.20
Photovoltaics	Space Heating	25%	25%	0%	48%	$7,900	15	0.20
Pool - Pump Timer	Miscellaneous	60%	0%	35%	90%	$160	15	2.21
Trees for Shading	Cooling	1%	0%	10%	68%	$40	20	0.30
Advanced New Construction Designs	Cooling	30%	0%	2%	45%	$2,500	18	1.25
Advanced New Construction Designs	Space Heating	30%	30%	2%	45%	$2,500	18	1.25
Advanced New Construction Designs	Interior Lighting	20%	20%	2%	45%	$2,500	18	1.25
Water Heater - Heat Pump	Water Heating	30%	15%	0%	20%	$1,500	15	0.58
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$2,970	15	1.18
Furnace - Convert to Gas	Space Heating	100%	100%	0%	45%	$10,798	15	0.81

Note: Costs are per household.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1011 of 1069

COMMERCIAL ENERGY EFFICIENCY EQUIPMENT AND MEASURE DATA

This appendix presents detailed information for all commercial and industrial energy efficiency equipment and measures that were evaluated in LoadMAP. Several sets of tables are provided.

Table D-1 provides brief descriptions for all equipment and measures that were assessed for potenital.

Tables D-2 through D-9 list the detailed unit-level data for the equipment measures for each of the C&I segments — small/medium commercial, large commercial, extra-large commercial, and extra-large industial — and for existing and new construction, respectively. Savings are in kWh/yr/sq.ft., and incremental costs are in $/sq.ft. The B/C ratio is zero if the measure represents the baseline technology or if the technology is not available in the first year of the forecast (2012). The B/C ratio is calculated within LoadMAP for each year of the forecast and is available once the technology or measure becomes available.

Tables D-10 through D-17 list the detailed unit-level data for the non-equipment energy efficiency measures for each of the segments and for existing and new construction, respectively. Because these measures can produce energy-use savings for multiple end-use loads (e.g., insulation affects heating and cooling energy use) savings are expressed as a percentage of the end-use loads. Base saturation indicates the percentage of buildings in which the measure is already installed. Applicability/Feasibility is the product of two factors that account for whether the measure is applicable to the building. Cost is expressed in $/sq.ft. The detailed measure-level tables present the results of the benefit/cost (B/C) analysis for the first year of the forecast. The B/C ratio is zero if the measure represents the baseline technology or if the measure is not available in the first year of the forecast (2012). The B/C ratio is calculated within LoadMAP for each year of the forecast and is available once the technology or measure becomes available.

Note that Tables D-2 through D-17 present information for Washington. For Idaho, savings and B/C ratios may be slightly different due to weather-related usage, differences in the states' market profiles, and different retail electricity prices. Although Idaho-specific values are not presented here, they are available within the LoadMAP files.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1012 of 1069

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Cooling	Central Cooling Systems	Commercial buildings are often cooled with a central chiller plant that creates chilled water for distribution throughout the facility. Chillers can be air source or water source, which include heat rejection via a condenser loop and cooling tower. Because of the wide variety of system types and sizes, savings and cost values for efficiency improvements in chiller systems represent an average over air- and water-cooled systems, as well as screw, reciprocating, and centrifugal technologies. Under this simplified approach, each central system is characterized by an aggregate efficiency value (inclusive of chiller, pumps, motors and condenser loop equipment), in kW/ton with a further efficiency upgrade through the application of variable refrigerant flow technology.
Cooling	Chilled Water Variable Flow System	The chilled water variable flow system is essentially a single chilled water loop with variable volume and speed. A single set of pumps operated by a VSD eliminates the need for separate distribution pumps and makes the chilled water flow throughout the entire system be variable. The use of adjustable flow limiting valves is designed to optimize water flow. Such valves provide flow limiting, shut-off and adjustment functions, automatically compensating for changes in system pressure to maximize energy efficiency.
Cooling	Packaged Cooling Systems / Rooftop Units (RTUs) and Heat Pumps	Packaged cooling systems are simple to install and maintain, and are commonly used in small and medium-sized commercial buildings. Applications range from a single supply system with air intake filters, supply fan, and cooling coil, or can become more complex with the addition of a return air duct, return air fan, and various controls to optimize performance. For packaged RTUs, varying Energy Efficiency Ratios (EER) were considered, as well as ductless or “mini-split” systems with variable refrigerant flow. For heat pumps, units with increasing EER and COP levels were evaluated, as well as a ductless mini-split system.
Cooling	Packaged Terminal Air Conditioners (PTAC)	Window (or wall) mounted room air conditioners (and heat pumps) are designed to cool (or heat) a single room or space. This type of unit incorporates a complete air-cooled refrigeration and air-handling system in an individual package. Conditioned air is discharged in response to thermostatic control to meet room requirements. Each unit has a self-contained, air-cooled direct expansion (DX) cooling system, a heat pump or other fuel-based heating system and associated controls. The energy savings increase with each incremental increase in efficiency, measured in terms of EER level.
Space Heating	Convert to Gas	This fuel-switching measure is the replacement of an electric furnace with a gas furnace. This measure eliminates all prior electricity consumption and demand due to electric space heating. In this study, it is assumed this measure can be implemented only in buildings within 500 feet of a gas main.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1013 of 1069

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Cooling, Space Heating, Interior Lighting	Energy Management System	An energy management system (EMS) allows managers/owners to monitor and control the major energy-consuming systems within a commercial building. At the minimum, the EMS can be used to monitor and record energy consumption of the different end-uses in a building, and can control operation schedules of the HVAC and lighting systems. The monitoring function helps building managers/owners to identify systems that are operating inefficiently so that actions can be taken to correct the problem. The EMS can also provide preventive maintenance scheduling that will reduce the cost of operations and maintenance in the long run. The control functionality of the EMS allows the building manager/owner to operate building systems from one central location. The operation schedules set via the EMS help to prevent building systems from operating during unwanted or unoccupied periods. This analysis assumes that this measure is limited to buildings with a central HVAC system.
Cooling, Space Heating	Economizer	Economizers allow outside air (when it is cool and dry enough) to be brought into the building space to meet cooling loads instead of using mechanically cooled interior air. A dual enthalpy economizer consists of indoor and outdoor temperature and humidity sensors, dampers, motors, and motor controls. Economizers are most applicable to temperate climates and savings will be smaller in extremely hot or humid areas.
Cooling	VSD on Water Pumps	The part-load efficiency of chilled water loop pumps can be improved substantially by varying the speed of the motor drive according to the building demand for cooling. There is also a reduction in piping losses associated with this measure that has a major impact on the energy use for a building. However, pump speeds can generally only be reduced to a minimum specified rate, because chillers and the control valves may require a minimum flow rate to operate. There are two major types of variable speed drives: mechanical and electronic. An additional benefit of variable-speed drives is the ability to start and stop the motor gradually, thus extending the life of the motor and associated machinery. This analysis assumes that electronic variable speed drives are installed.
Cooling	Turbocor Compressor	Turbocor compressors use oil-free magnetic bearings to reduce friction losses and couples that with a two-stage centrifugal compressor to reduce central chiller energy consumption.
Cooling	High-Efficiency Cooling Tower Fans	High efficiency cooling tower fans utilize variable frequency drives in the cooling tower design. VFDs improve fan performance by adjusting fan speed and rotation as conditions change.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1014 of 1069

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Cooling	Condenser Water Temperature Reset	Chilled water reset controls save energy by improving chiller performance through increasing the supply chilled water temperature, which allows increased suction pressure during low load periods. Raising the chilled water temperature also reduces chilled water piping losses. However, the primary savings from the chilled water reset measure results from chiller efficiency improvement. This is due partly to the smaller temperature difference between chilled water and ambient air, and partly due to the sensitivity of chiller performance to suction temperature.
Cooling	Maintenance	Filters, coils, and fins require regular cleaning and maintenance for the heat pump or roof top unit to function effectively and efficiently throughout its years of service. Neglecting necessary maintenance leads to a steady decline in performance while energy use increases. Maintenance can increase the efficiency of poorly performing equipment by as much as 10%.
Cooling	Evaporative Precooler	Evaporative precooling can improve the performance of air conditioning systems, most commonly RTUs. These systems typically use indirect evaporative cooling as a first stage to pre-cool outside air. If the evaporative system cannot meet the full cooling load, the air steam is further cooled with conventional refrigerative air conditioning technology.
Cooling	Roof- High Reflectivity (Cool Roof)	The color and material of a building structure surface will determine the amount of solar radiation absorbed by that surface and subsequently transferred into a building. This is called solar absorptance. By using a material or painting the roof with a light color (and a lower solar absorptance), the roof will absorb less solar radiation and consequently reduce the cooling load.
Cooling, Space Heating	Green Roofs	A green roof covers a section or the entire building roof with a waterproof membrane and vegetative material. Like cool roofs, green roofs can reduce solar absorptance and they can also provide insulation. They also provide non-energy benefits by absorbing rainwater and thus reducing storm water run-off, providing wildlife habitat, and reducing so-called urban heat island effects.
Cooling, Space Heating, Ventilation	HVAC Retrocommissioning	Over time, the performance of complex mechanical systems providing heating and cooling to existing commercial spaces degrades as a result of inappropriate changes to or overrides of controls, deteriorating equipment, clogged filters, changing demands and schedules, and pressure imbalances. Retrocommissioning is a comprehensive analysis of an entire system in which an engineer assesses shortcomings in system performance, and then optimizes through a process of tune-up, maintenance, and reprogramming of control or automation software. Energy efficiency programs throughout the country promote retrocommissioning as a means of greatly reducing energy consumption in existing buildings.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Cooling, Space Heating, Ventilation, Interior Lighting	Comprehensive Retrocommissioning	Comprehensive retrocommissioning covers not only HVAC and lighting, but other existing building systems as well. For example, it can improve efficiency of non-HVAC motors, vertical transport systems, and domestic hot water systems.
Cooling, Space Heating, Ventilation, Interior Lighting/Exterior Lighting	HVAC Commissioning Lighting Commissioning Comprehensive Commissioning	For new construction and major renovations, commissioning ensures that building systems are properly designed, specified, and installed to meet the design intent and provide high-efficiency performance. As the names suggests, HVAC Commissioning and Lighting Commissioning focus only on HVAC and lighting equipment and controls. Comprehensive commissioning addresses these systems but usually begins earlier in the design process, and may also address domestic hot water, non-HVAC fans, vertical transport, telecommunications, fire protection, and other building systems.
Cooling, Space Heating, Interior Lighting	Advanced New Construction Designs	Advanced new construction designs use an integrated approach to the design of new buildings to account for the interaction of building systems. Typically, architects and engineers work closely to specify the building orientation, building shell, building mechanical systems, and controls strategies with the goal of optimizing building energy efficiency and comfort. Options that may be evaluated and incorporated include passive solar strategies, increased thermal mass, daylighting strategies, and shading strategies, This measure was modeled for new construction only.
Cooling, Space Heating	Programmable Thermostat	A programmable thermostat can be added to most heating/cooling systems. They are typically used during winter to lower temperatures at night and in summer to increase temperatures during the afternoon. There are two-setting models, and well as models that allow separate programming for each day of the week. The energy savings from this type of thermostat are identical to those of a "setback" strategy with standard thermostats, but the convenience of a programmable thermostat makes it a much more attractive option. In this analysis, the baseline is assumed to have no thermostat setback.
Cooling, Space Heating	Duct Repair and Sealing	An ideal duct system would be free of leaks. Leakage in unsealed ducts varies considerably because of the differences in fabricating machinery used, the methods for assembly, installation workmanship, and age of the ductwork. Air leaks from the system to the outdoors result in a direct loss proportional to the amount of leakage and the difference in enthalpy between the outdoor air and the conditioned air. To seal ducts, a wide variety of sealing methods and products exist. Each has a relatively short shelf life, and no documented research has identified the aging characteristics of sealant applications. This analysis assumes that the baseline air loss from ducts has doubled, and conducting repair and sealing of the ducts will restore leakage from ducts to the original baseline level.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Cooling, Space Heating	Duct Insulation	Air distribution ducts can be insulated to reduce heating or cooling losses. Best results can be achieved by covering the entire surface area with insulation. Insulation material inhibits the transfer of heat through the air-supply duct. Several types of ducts and duct insulation are available, including flexible duct, pre-insulated duct, duct board, duct wrap, tacked, or glued rigid insulation, and waterproof hard shell materials for exterior ducts.
Cooling, Space Heating	Insulation – Radiant Barrier	Radiant barriers inhibit heat transfer by thermal radiation. When a radiant barrier is installed beneath the roofing material much of the heat radiated from a hot roof is reflected back to the roof limiting the amount of heat emitted downwards.
Cooling, Space Heating	High-Efficiency Windows	High-efficiency windows, such as those labeled under the ENERGY STAR Program, are designed to reduce a building's energy bill while increasing comfort for the occupants at the same time. High-efficiency windows have reducing properties that reduce the amount of heat transfer through the glazing surface. For example, some windows have a low-E coating, which is a thin film of metallic oxide coating on the glass surface that allows passage of short-wave solar energy through glass and prevents long-wave energy from escaping. Another example is double-pane glass that reduces conductive and convective heat transfer. There are also double-pane glasses that are gas-filled (usually argon) to further increase the insulating properties of the window.
Cooling, Space Heating	Ceiling and Wall Cavity Insulation	Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. Thus, thermal insulation can conserve energy by reducing the heat loss or gain of a building. The type of building construction defines insulating possibilities. Typical insulating materials include: loose-fill (blown) cellulose; loose-fill (blown) fiberglass; and rigid polystyrene.
Ventilation	Cooking – Exhaust Hoods with Sensor Controls	Improved exhaust hoods involve installing variable-speed controls on commercial kitchen hoods. These controls provide ventilation based on actual cooking loads. When grills, broilers, stoves, fryers or other kitchen appliances are not being used, the controls automatically sense the reduced load and decrease the fan speed accordingly. This results in lower energy consumption because the system is only running as needed rather than at 100% capacity at all times.
Ventilation	Variable Air Volume	A variable air volume ventilation system modulates the air flow rate as needed based on the interior conditions of the building to reduce fan load, improve dehumidification, and reduce energy usage.
Ventilation	Fans – Energy Efficient Motors	High-efficiency motors are essentially interchangeable with standard motors, but differences in construction make them more efficient. Energy-efficient motors achieve their improved efficiency by reducing the losses that occur in the conversion of electrical energy to mechanical energy. This analysis assumes that the efficiency of supply fans is increased by 5% due to installing energy-efficient motors.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Ventilation	Fans – Variable Speed Control (VSD)	The part-load efficiency of ventilation fans can be improved substantially by varying the speed of the motor drive. There are two major types of variable speed controls: mechanical and electronic. An additional benefit of variable-speed controls is the ability to start and stop the motor gradually, thus extending the life of the motor and associated machinery. This analysis assumes that electronic variable speed controls are installed.
Water Heating	High-Efficiency Water Heater Systems	Efficient electric water heaters are characterized by a high recovery or thermal efficiency (percentage of delivered electric energy which is transferred to the water) and low standby losses (the ratio of heat lost per hour to the content of the stored water). Included in the savings associated with high-efficiency electric water heaters are timers that allow temperature setpoints to change with hot water demand patterns. For example, the heating element could be shut off throughout the night, increasing the overall energy factor of the unit. In addition, tank and pipe insulation reduces standby losses and therefore reduces the demands on the water heater. This analysis considers conventional electric water heaters with efficiency greater than 96%, as well as geothermal heat pump water heaters for effective efficiency greater than one. Solar water heating was evaluated as well.
Water Heating	Convert to Gas	This fuel-switching measure is the replacement of an electric water heater with a gas-fired water heater. This measure will eliminate all prior electricity consumption and demand due to electric water heating. In this study, it is assumed that this measure can be implemented only in buildings within 500 feet of a gas main.
Water Heating	Heat Pump Water Heater	Heat pump water heaters use heat pump technology to extract heat from the ambient surroundings and transfer it to a hot water tank. These devices are available as an alternative to conventional tank water heaters of 55 gallons or larger.
Water Heating	Faucet Aerators/Low Flow Nozzles	A faucet aerator or low flow nozzle spreads the stream from a faucet helping to reduce water usage. The amount of water passing through the aerator is measured in gallons per minute (GPM) and the lower the GPM the more water the aerator conserves.
Water Heating	Pipe Insulation	Insulating hot water pipes decreases the amount of energy lost during distribution of hot water throughout the building. Insulating pipes will result in quicker delivery of hot water and allows lowering the water heating set point. There are several different types of insulation, the most common being polyethylene and neoprene.
Water Heating	High-Efficiency Circulation Pump	A high efficiency circulation pump uses an electronically commutated motor (ECM) to improve motor efficiency over a larger range of partial loads. In addition, an ECM allows for improved low RPM performance with greater torque and smaller pump dimensions.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Water Heating	Tank Blanket/Insulation	Insulation levels on domestic hot water heaters can be increased by installing a fiberglass blanket on the outside of the tank. This increase in insulation reduces standby losses and thus saves energy. Water heater insulation is available either by the blanket or by square foot of fiberglass insulation with R-values ranging from 5 to 14.
Water Heating	Thermostat Setback	Installing a setback thermostat on the water heater can lead to significant energy savings during periods when there is no one in the building.
Water Heating	Hot Water Saver	A hot water saver is a plumbing device that attaches to the showerhead and that pauses the flow of water until the water is hot enough for use. The water is re-started by the flip of a switch.
Interior Lighting, Exterior Lighting	Lamp Replacement (Interior Screw-in, HID, and Linear Fluorescent Exterior Screw-in, HID, and Linear Fluorescent)	Commercial lighting differs from the residential sector in that efficiency changes typically require more than the simple purchase and quick installation of a screw-in compact fluorescent lamp. Restrictions regarding ballasts, fixtures, and circuitry limit the potential for direct substitution of one lamp type for another. However, such replacements do exist. For example, screw-in incandescent lamps can readily be replaced with CFLs or LEDs. Also, during the buildout for a leased office space, the management could decide to replace all T12 lamps and magnetic ballasts with T8/electronic ballast configurations. This type of decision-making is modeled on a stock turnover basis because of the time between opportunities for upgrades.
Interior Lighting, Exterior Lighting	Lighting Retrocommissioning	Lighting retrocommissioning projects in existing commercial buildings do not require an event such as a tenant turnover, a major renovation, or an update to electrical circuits to drive its adoption. Rather, a decision-maker can decide at any time to perform a comprehensive audit of a facility's lighting systems, followed by an upgrade of equipment (lamps, ballasts, fixtures, reflectors), controls (occupancy sensors, daylighting controls, and central automation).
Interior Lighting	Delamping and Install Reflectors	While sometimes included in lighting retrofit projects, delamping is often performed as a separate energy efficiency measure in which a lighting engineer analyzes the lighting provided by current systems compared to the requirements of building occupants. This often leads to the removal of unnecessary lamps corresponding to an overall reduction in energy usage. .In addition, installing a reflector in each fixture can improve light distribution from the remaining lamps.
Interior Lighting, Exterior Lighting	Lighting Time Clocks and Timers	While outdoor lighting is typically required only at night, in many cases lighting remains on during daylight hours. A simple timer can set a diurnal schedule for outdoor lighting and thus reduce the operating hours by as much as 50%.
Interior Lighting	Central Lighting Controls	Central lighting control systems provide building-wide control of interior lighting to ensure that lights are properly scheduled based on expected building occupancy. Individual zones or circuits can be controlled.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Interior Lighting	Photocell Controlled T8 Dimming Ballasts	Photocells, in concert with dimming ballasts, can detect when adequate daylighting is available and dim or turn off lights to reduce electricity consumption. Usually one photocell is used to control a group of fixtures, a zone, or a circuit.
Interior Lighting	Bi-Level Fixture with Occupancy Sensor	Bi-level fixtures with occupancy sensors detect when a space is unoccupied and reduce light output to a lower level. These devices
Interior Lighting	High Bay Fixtures	Fluorescent fixtures designed for high-bay applications have several advantages over similar HID fixtures: lower energy consumption, lower lumen depreciation rates, better dimming options, faster start-up and restrike, better color rendition, more pupil lumens, and reduced glare.
Interior Lighting	Occupancy Sensor	The installation of occupancy sensors allows lights to be turned off during periods when a space is unoccupied, virtually eliminating the wasted energy due to lights being left on. There are several types of occupancy sensors in the market.
Interior Lighting	LED Exit Lighting	The lamps inside exit signs represent a significant energy end-use, since they usually operate 24 hours per day. Many old exit signs use incandescent lamps, which consume approximately 40 watts per sign. The incandescent lamps can be replaced with LED lamps that are specially designed for this specific purpose. In comparison, the LED lamps consume approximately 2-5 watts.
Interior Lighting	Task Lighting	In commercial facilities, individual work areas can use task lighting instead of brightly lighting the entire area. Significant energy savings can be realized by focusing light directly where it is needed and lowering the general lighting level. An example of task lighting is the common desk lamp. A 25W desk lamp can be installed in place of a typical lamp in a fixture.
Interior Lighting, Cooling	Hotel Guestroom Controls	Hotel guestrooms can be fitted with occupancy controls that turn off energy-using equipment when the guest is not using the room. The occupancy controls comes in several forms, but this analysis assumes the simplest kind, which is a simple switch near the room's entry where the guest can deposit their room key or card. If the key or card is present, then lights, TV, and air conditioning can receive power and operate. When the guest leaves and takes the key, all equipment shuts off.
Exterior Lighting	Daylighting Controls	Daylighting controls use a photosensor to detect ambient light and turn off exterior lights accordingly.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Exterior Lighting	Photovoltaic Lighting	Outdoor photovoltaic (PV) lighting systems use PV panels (or modules), which convert sunlight to electricity. The electricity is stored in batteries for use at night. They can be cost effective relative to installing power cables and/or step down transformers for relatively small lighting loads. The "nightly run time" listings on most "off-the-shelf" products are based on specific sunlight conditions. Systems located in places that receive less sunlight than the system is designed for will operate for fewer hours per night than expected. Nightly run times may also vary depending on how clear the sky is on any given day. Shading of the PV panel by landscape features (vegetation, buildings, etc.) will also have a large impact on battery charging and performance. Open areas with no shading, such as parking lots, are ideal places where PV lighting systems can be used.
Exterior Lighting	Cold Cathode Lighting	Cold cathode lighting does not use an external heat source to provide thermionic emission of electrons. Cold cathode lighting is typically used for exterior signage or where temperatures are likely to drop below freezing.
Exterior Lighting	Induction Lamps	Induction lamps use a contactless bulb and rely on electromagnetic fields to transfer power. This allows for the lamp to utilize more efficient materials that would otherwise react with metal electrodes. In addition, the lack of an electrode significantly extends lamp life while reducing lumen depreciation.
Office Equipment	Desktop and Laptop Computing Equipment	ENERGY STAR labeled office equipment saves energy by powering down and "going to sleep" when not in use. ENERGY STAR labeled computers automatically power down to 15 watts or less when not in use and may actually last longer than conventional products because they spend a large portion of time in a low-power sleep mode. ENERGY STAR labeled computers also generate less heat than conventional models. The ClimateSavers Initiative, made up of leading computer processor manufacturers, has stated a goal of reducing power consumption in active mode by 50% by integrating innovative power management into the chip design process.
Office Equipment	Monitors	ENERGY STAR labeled office equipment saves energy by powering down and "going to sleep" when not in use. ENERGY STAR labeled monitors automatically power down to 15 watts or less when not in use.
Office Equipment	Servers	In addition to the "sleep" mode a reductions and the efficient processors being designed by members of the ClimateSavers Initiative, servers have additional energy-saving opportunities through "virtualization" and other architecture solutions that involve optimal matching of computation tasks to hardware requirements

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Office Equipment	Printers/Copiers/ Fax/ POS Terminals	ENERGY STAR labeled office equipment saves energy by powering down and "going to sleep" when not in use. ENERGY STAR labeled copiers are equipped with a feature that allows them to automatically turn off after a period of inactivity, reducing a copier's annual electricity costs by over 60%. High-speed copiers that include a duplexing unit that is set to automatically make double-sided copies can reduce paper costs and help to save trees.
Office Equipment	ENERGY STAR Power Supply	Power supplies with an efficient ac-dc or ac-ac conversion process can obtain the ENERGY STAR label. These devices can be used to power computers, phones, and other office equipment.
Refrigeration	Walk-in Refrigeration Systems	Standard compressors typically operate at approximately 65% efficiency. High-efficiency models are available that can improve compressor efficiency by 15%.
Refrigeration	Glass Door and Solid Door Refrigeration Units (Reach-in /Open Display Case/Vending Machine) Door Gasket Replacement High Efficiency Case Lighting	In addition to walk-in, "cold-storage" refrigeration, a significant amount of energy in the commercial sector can be attributed to "reach-in" units. These stand-alone appliances can range from a residential-style refrigerator/freezer unit in an office kitchen or the breakroom of a retail store to the refrigerated display cases in some grocery or convenience stores. As in the case of residential units, these refrigerators can be designed to perform at higher efficiency through a combination of compressor equipment upgrades, default temperature settings, and defrost patterns. Other measures for these units are replacing aging door gaskets that no longer adequately seal the case, and replacing inefficient display lights with CFL or LED systems to reduce internal heat gains in the cases.
Refrigeration	Open Display Case	Glass doors can be used to enclose multi-deck display cases for refrigerated items in supermarkets. In addition, more efficient units are designed to perform at higher efficiency through a combination of compressor equipment upgrades, default temperature settings, and defrost patterns.
Refrigeration	Anti-Sweat Heater/ Auto Door Closer Controls	Anti-sweat heaters are used in virtually all low-temperature display cases and many medium-temperature cases to control humidity and prevent the condensation of water vapor on the sides and doors and on the products contained in the cases. Typically, these heaters stay on all the time, even though they only need to be on about half the time. Anti-sweat heater controls can come in the form of humidity sensors or time clocks.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Refrigeration	Floating Head Pressure Controls	Floating head pressure control allows the pressure in the condenser to "float" with ambient temperatures. This method reduces refrigeration compression ratios, improves system efficiency and extends the compressor life. The greatest savings with a floating head pressure approach occurs when the ambient temperatures are low, such as in the winter season. Floating head pressure control is most practical for new installations. However, retrofits installation can be completed with some existing refrigeration systems. Installing floating head pressure control increases the capacity of the compressor when temperatures are low, which may lead to short cycling.
Refrigeration	Bare Suction Lines	Insulating bare suction lines reduces heat
Refrigeration	Night Covers	Night covers can be used on open refrigeration cases when a facility is closed or few customers are in the store.
Refrigeration	Strip Curtain	Strip curtains at the entrances to large walk-in coolers or freezers, such as those used in supermarkets, reduce air transfer between the refrigerated space and the surrounding space.
Refrigeration	Icemakers	In certain building types (restaurant, hotel), the production of ice is a significant usage of electricity. By optimizing the timing of ice production and the type of output to the specific application, icemakers are assumed to deliver electricity savings.
Refrigeration	Vending Machine - Controller	Cold beverage vending machines usually operate 24 hours a day regardless of whether the surrounding area is occupied or not. The result is that the vending machine consumes energy unnecessarily, because it will operate all night to keep the beverage cold even when there would be no customer until the next morning. A vending machine controller can reduce energy consumption without compromising the temperature of the vended product. The controller uses an infrared sensor to monitor the surrounding area's occupancy and will power down the vending machine when the area is unoccupied. It will also monitor the room's temperature and will re -power the machine at one to three hour intervals independent of occupancy to ensure that the product stays cold.
Food Service	Kitchen Equipment	Commercial cooking and food preparation equipment represent a significant contribution to energy consumption in restaurants and other food service applications. By replacing old units with efficient ones, this energy consumption can be greatly reduced. These measures include fryers, commercial ovens, dishwashers, hot food containers and miscellaneous other food preparation equipment. Savings range between 15 and 65%, depending on the specific unit being replaced.
Cooling, Space Heating, Interior Lighting, Food Preparation, Refrigeration	Custom Measures	Custom measures were included in the CPA analysis to serve as a "catch all" for measures for which costs and savings are not easily quantified and that could be part of a program such as Avista's existing Site-Specific incentive program. Costs and energy savings were assumed such that the measures passed the economic screen.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Miscellaneous	Non-HVAC motor	Because the Small/Medium Commercial and Large Commercial segments include some industrial customers, the CPA analysis included equipment upgrades for non-HVAC motors. This equipment measure also incorporates improvements for vertical transport. Premium efficiency motors reduce the amount of lost energy going into heat rather than power. Since less heat is generated, less energy is needed to cool the motor with a fan. Therefore, the initial cost of energy efficient motors is generally higher than for standard motors. However their life-cycle costs can make them far more economical because of savings they generate in operating expense. Premium efficiency motors can provide savings of 0.5% to 3% over standard motors. The savings results from the fact that energy efficient motors run cooler than their standard counterparts, resulting in an increase in the life of the motor insulation and bearing. In general, an efficient motor is a more reliable motor because there are fewer winding failures, longer periods between needed maintenance, and fewer forced outages. For example, using copper instead of aluminum in the windings, and increasing conductor cross-sectional area, lowers a motor's I2R losses.
Miscellaneous	Pumps – Variable Speed Control	The part-load efficiency of chilled and hot water loop pumps can be improved substantially by varying the speed of the motor drive according to the building demand for heating or cooling. There is also a reduction in piping losses associated with this measure that has a major impact on the heating loads and energy use for a building. However, pump speeds can generally only be reduced to a minimum specified rate, because chillers, boilers, and the control valves may require a minimum flow rate to operate. There are two major types of variable speed controls: mechanical and electronic. An additional benefit of variable-speed drives is the ability to start and stop the motor gradually, thus extending the life of the motor and associated machinery. This analysis assumes that electronic variable speed controls are installed.
Miscellaneous	Laundry – High Efficiency Clothes Washer	High efficiency clothes washers use designs that require less water. These machines use sensors to match the hot water needs to the load, preventing energy waste. There are two designs: top-loading and front-loading. Further energy and water savings can be achieved through advanced technologies such as inverter-drive or combination washer-dryer units.
Miscellaneous	ENERGY STAR Water Cooler	An ENERGY STAR water cooler has more insulation and improved chilling mechanisms, resulting in about half the energy use of a standard cooler.
Miscellaneous	Industrial Process Improvements	Because the Avista C&I sector segmentation was based on Avista's rate classes, the commercial building segments include a small percentage or industrial business types. This measure was included to account for energy efficiency potential that could be achieved through various process improvements at these customers.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Machine Drive.	Motors, Premium Efficiency	Premium efficiency motors reduce the amount of lost energy going into heat rather than power. Since less heat is generated, less energy is needed to cool the motor with a fan. Therefore, the initial cost of energy efficient motors is generally higher than for standard motors. However their life-cycle costs can make them far more economical because of savings they generate in operating expense. Premium efficiency motors can provide savings of 0.5% to 3% over standard motors. The savings results from the fact that energy efficient motors run cooler than their standard counterparts, resulting in an increase in the life of the motor insulation and bearing. In general, an efficient motor is a more reliable motor because there are fewer winding failures, longer periods between needed maintenance, and fewer forced outages. For example, using copper instead of aluminum in the windings, and increasing conductor cross-sectional area, lowers a motor's I2R losses. This analysis assumes 75% loading factor (for peak efficiency) for 1800 rpm motor. Hours of operation vary depending on horsepower size. In addition, improved drives and controls are assumed to be implemented along with the motors, resulting in savings as high as 10% of annual energy consumption
Machine Drive	Motors – Variable Frequency Drive	In addition to energy savings, VFDs increase motor and system life and provide a greater degree of control over the motor system. Especially for motor systems handling fluids, VFDs can efficiently respond to changing operating conditions.
Machine Drive	Magnetic Adjustable Speed Drive	To allow for adjustable speed operation, this technology uses magnetic induction to couple a drive to its load. Varying the magnetic slip within the coupling controls the speed of the output shaft. Magnetic drives perform best at the upper end of the speed range due to the energy consumed by the slip. Unlike traditional ASDs, magnetically coupled ASDs create no power distortion on the electrical system. However, magnetically coupled ASD efficiency is best when power needs are greatest. VFDs may show greater efficiency when the average load speed is below 90% of the motor speed, however this occurs when power demands are reduced.
Machine Drive	Compressed Air – System Controls, Optimization and Improvements, Maintenance	Controls for compressed air systems can shift load from two partially loaded compressors to one compressor in order to maximize compression efficiency and may also involve the addition of VFDs. Improvements include installing high-efficiency motors. Maintenance includes fixing air leaks and replacing air filters.
Machine Drive	Fan Systems – Controls, Optimization and Maintenance	Certain practices require a consistent flow rate, such as indoor air quality and clean room ventilation. To achieve this, fan flow controls can be used to maintain precise volume flow control ensuring a constant air delivery even on fluctuating pressure conditions. This is done through programmable circuitry to electronically control fan motor speed. Motors can be configured to accept a signal from a controller that would vary the flow rate in direct proportion to the signal.

Table D-1 Commercial and Industrial Energy-Efficiency Equipment/Measure Descriptions

End-Use	Energy Efficiency Measure	Description
Machine Drive	Pumping Systems – Controls, Optimization and Maintenance	Pumping systems optimization includes installing VFDs, correctly resizing the motors, and installing timers and automated on-off controls. Maintenance includes repairing diaphragms and fixing piping leaks.
Process	Process Cooling/Refrigeration	Because of the customized nature of industrial cooling and refrigeration applications, a variety of opportunities are summarized as a general improvement in cooling and cold storage equipment. Costs and savings were developed using average values for this group of measures from the Sixth Plan industrial supply curve workbooks.
Process	Process Heating	Because of the customized nature of industrial heating applications, a variety of opportunities are summarized as a general improvement in process heating equipment, such as arc furnaces. Costs and savings were developed using average values for this group of measures from the Sixth Plan industrial supply curve workbooks.
Process	Electrochemical Process	Because of the customized nature of industrial electrochemical applications, a variety of opportunities are summarized as a general improvement in equipment and processes. Costs and savings were developed using average values for this group of measures from the Sixth Plan industrial supply curve workbooks.
Process	Refrigeration – System Controls, Maintenance, and Optimization	Because refrigeration equipment performance degrades over time and control settings are frequently overridden, these measures account for savings that can be achieved through system maintenance and controls optimization.

Table D-2 Energy Efficiency Equipment Data — Small/Medium Comm., Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Central Chiller	1.3 kw/ton, COP 2.7	0.29	$0.39	20	-
Cooling	Central Chiller	1.26 kw/ton, COP 2.8	0.35	$0.50	20	0.51
Cooling	Central Chiller	1.0 kw/ton, COP 3.5	0.73	$0.62	20	1.90
Cooling	Central Chiller	0.97 kw/ton, COP 3.6	0.77	$0.74	20	1.39
Cooling	Central Chiller	Variable Refrigerant Flow	1.01	$11.57	20	0.07
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.22	$0.18	16	-
Cooling	RTU	EER 11.2	0.43	$0.35	16	-
Cooling	RTU	EER 12.0	0.57	$0.58	16	0.49
Cooling	RTU	Ductless VRF	0.69	$5.12	16	0.05
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.09	$0.08	14	0.86
Cooling	PTAC	EER 10.8	0.21	$0.16	14	1.00
Cooling	PTAC	EER 11	0.25	$0.43	14	0.43
Cooling	PTAC	EER 11.5	0.33	$0.96	14	0.27
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	0.57	$0.39	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	0.90	$1.18	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	1.20	$1.57	15	0.98
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	1.31	$1.96	15	0.68
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	1.46	$11.50	20	0.10
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	1.30	$1.22	15	1.07
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.23	$0.09	4	-
Interior Lighting	Interior Screw-in	CFL	0.94	$0.03	7	16.50
Interior Lighting	Interior Screw-in	LED	1.04	$1.18	12	0.84
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.30	($0.07)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.30	($0.03)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.91	$0.25	6	1.73
Interior Lighting	Linear Fluorescent	T5	0.95	$0.43	6	1.06
Interior Lighting	Linear Fluorescent	LED	0.99	$3.74	15	0.33
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.14	$0.05	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.60	$0.02	7	17.60
Exterior Lighting	Exterior Screw-in	Metal Halides	0.60	$0.05	4	3.16
Exterior Lighting	Exterior Screw-in	LED	0.66	$0.64	12	0.90
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.22	($0.13)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.24	$0.55	9	0.37
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.01	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.04	$0.02	6	1.12
Exterior Lighting	Linear Fluorescent	T5	0.04	$0.03	6	0.69
Exterior Lighting	Linear Fluorescent	LED	0.05	$0.24	15	0.22
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0.00	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	0.10	$0.02	15	5.23
Water Heating	Water Heater	Geothermal Heat Pump	1.33	$3.53	15	0.43
Water Heating	Water Heater	Solar	1.46	$3.03	15	0.55
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Efficient	0.03	$0.04	12	0.80
Food Preparation	Oven	Standard	-	$0.00	12	-

Note: Costs and savings are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1027 of 1069

Table D-2 Energy Efficiency Equipment Data — Small/Med. Comm., Existing Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Food Preparation	Oven	Efficient	0.39	$0.36	12	1.02
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Efficient	0.02	$0.05	12	0.36
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Efficient	0.40	$0.16	12	2.29
Food Preparation	Food Prep	Standard	-	$0.00	12	-
Food Preparation	Food Prep	Efficient	0.00	$0.03	12	0.07
Refrigeration	Walk in Refrigeration	Standard	-	$0.00	18	-
Refrigeration	Walk in Refrigeration	Efficient	-	$0.09	18	-
Refrigeration	Glass Door Display	Standard	-	$0.00	18	-
Refrigeration	Glass Door Display	Efficient	0.16	$0.00	18	56.08
Refrigeration	Solid Door Refrigerator	Standard	-	$0.00	18	-
Refrigeration	Solid Door Refrigerator	Efficient	0.19	$0.02	18	9.87
Refrigeration	Open Display Case	Standard	-	$0.00	18	-
Refrigeration	Open Display Case	Efficient	0.00	$0.00	18	0.24
Refrigeration	Vending Machine	Base	-	$0.00	10	-
Refrigeration	Vending Machine	Base (2012)	0.11	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency	0.13	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency (2012)	0.20	$0.00	10	46.48
Refrigeration	Icemaker	Standard	-	$0.00	12	-
Refrigeration	Icemaker	Efficient	0.05	$0.00	12	12.76
Office Equipment	Desktop Computer	Baseline	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.19	$0.00	4	23.04
Office Equipment	Desktop Computer	Climate Savers	0.27	$0.36	4	0.23
Office Equipment	Laptop Computer	Baseline	-	$0.00	4	-
Office Equipment	Laptop Computer	Energy Star	0.02	$0.00	4	7.34
Office Equipment	Laptop Computer	Climate Savers	0.03	$0.12	4	0.08
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.12	$0.01	3	2.14
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.22	$0.00	4	19.68
Office Equipment	Printer/copier/fax	Standard	-	$0.00	6	-
Office Equipment	Printer/copier/fax	Energy Star	0.09	$0.04	6	0.98
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Energy Star	0.03	$0.00	4	2.96
Miscellaneous	Non-HVAC Motor	Standard	-	$0.00	15	-
Miscellaneous	Non-HVAC Motor	Standard (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motor	High Efficiency	0.05	$0.06	15	0.95
Miscellaneous	Non-HVAC Motor	High Efficiency (2015)	0.06	$0.06	15	-
Miscellaneous	Non-HVAC Motor	Premium	0.07	$0.11	15	0.72
Miscellaneous	Non-HVAC Motor	Premium (2015)	0.08	$0.11	15	-
Miscellaneous	Other Miscellaneous	Miscellaneous	-	$0.00	5	-
Miscellaneous	Other Miscellaneous	Miscellaneous (2013)	0.00	$0.00	5	-

Note: Costs and savings are per sq. ft.

Table D-3 Energy Efficiency Equipment Data — Large Commercial, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Central Chiller	1.3 kw/ton, COP 2.7	0.30	$0.26	20	-
Cooling	Central Chiller	1.26 kw/ton, COP 2.8	0.36	$0.33	20	0.83
Cooling	Central Chiller	1.0 kw/ton, COP 3.5	0.75	$0.41	20	3.11
Cooling	Central Chiller	0.97 kw/ton, COP 3.6	0.79	$0.49	20	2.28
Cooling	Central Chiller	Variable Refrigerant Flow	1.04	$7.63	20	0.11
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.22	$0.13	16	-
Cooling	RTU	EER 11.2	0.45	$0.25	16	-
Cooling	RTU	EER 12.0	0.59	$0.41	16	0.75
Cooling	RTU	Ductless VRF	0.72	$3.67	16	0.07
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.09	$0.09	14	0.86
Cooling	PTAC	EER 10.8	0.21	$0.17	14	1.00
Cooling	PTAC	EER 11	0.25	$0.46	14	0.43
Cooling	PTAC	EER 11.5	0.34	$1.03	14	0.27
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	0.46	$0.18	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	0.73	$0.55	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	0.97	$0.73	15	1.85
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	1.07	$0.91	15	1.28
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	1.19	$5.35	20	0.19
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	1.03	$1.22	15	0.86
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.19	$0.08	4	-
Interior Lighting	Interior Screw-in	CFL	0.78	$0.03	7	14.13
Interior Lighting	Interior Screw-in	LED	0.87	$1.11	12	0.72
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.31	($0.08)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.30	($0.03)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.89	$0.25	6	1.66
Interior Lighting	Linear Fluorescent	T5	0.92	$0.42	6	1.02
Interior Lighting	Linear Fluorescent	LED	0.97	$3.67	15	0.32
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.08	$0.01	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.34	$0.01	7	34.02
Exterior Lighting	Exterior Screw-in	Metal Halides	0.34	$0.02	4	6.10
Exterior Lighting	Exterior Screw-in	LED	0.38	$0.19	12	1.73
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.19	($0.11)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.20	$0.45	9	0.37
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.01	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.04	$0.02	6	1.18
Exterior Lighting	Linear Fluorescent	T5	0.04	$0.03	6	0.72
Exterior Lighting	Linear Fluorescent	LED	0.05	$0.24	15	0.23
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0.00	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	0.12	$0.02	15	5.71
Water Heating	Water Heater	Geothermal Heat Pump	1.54	$3.53	15	0.46
Water Heating	Water Heater	Solar	1.69	$3.03	15	0.60
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Efficient	0.07	$0.02	12	3.52
Food Preparation	Oven	Standard	-	$0.00	12	-

Note: Costs and savings are per sq. ft.

Table D-3 Energy Efficiency Equipment Data — Large Commercial, Existing Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Food Preparation	Oven	Efficient	0.75	$0.46	12	1.43
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Efficient	0.07	$0.10	12	0.58
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Efficient	0.35	$0.30	12	0.99
Food Preparation	Food Prep	Standard	-	$0.00	12	-
Food Preparation	Food Prep	Efficient	0.01	$0.03	12	0.24
Refrigeration	Walk in Refrigeration	Standard	-	$0.00	18	-
Refrigeration	Walk in Refrigeration	Efficient	0.15	$1.26	18	0.13
Refrigeration	Glass Door Display	Standard	-	$0.00	18	-
Refrigeration	Glass Door Display	Efficient	0.13	$0.01	18	24.96
Refrigeration	Solid Door Refrigerator	Standard	-	$0.00	18	-
Refrigeration	Solid Door Refrigerator	Efficient	0.30	$0.08	18	4.39
Refrigeration	Open Display Case	Standard	-	$0.00	18	-
Refrigeration	Open Display Case	Efficient	0.00	$0.04	18	0.16
Refrigeration	Vending Machine	Base	-	$0.00	10	-
Refrigeration	Vending Machine	Base (2012)	0.13	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency	0.15	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency (2012)	0.23	$0.00	10	20.70
Refrigeration	Icemaker	Standard	-	$0.00	12	-
Refrigeration	Icemaker	Efficient	0.11	$0.02	12	5.62
Office Equipment	Desktop Computer	Baseline	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.35	$0.00	4	47.46
Office Equipment	Desktop Computer	Climate Savers	0.50	$0.32	4	0.46
Office Equipment	Laptop Computer	Baseline	-	$0.00	4	-
Office Equipment	Laptop Computer	Energy Star	0.02	$0.00	4	15.12
Office Equipment	Laptop Computer	Climate Savers	0.04	$0.06	4	0.17
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.13	$0.01	3	4.41
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.19	$0.01	4	9.14
Office Equipment	Printer/copier/fax	Standard	-	$0.00	6	-
Office Equipment	Printer/copier/fax	Energy Star	0.08	$0.02	6	2.02
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Energy Star	0.01	$0.00	4	2.94
Miscellaneous	Non-HVAC Motor	Standard	-	$0.00	15	-
Miscellaneous	Non-HVAC Motor	Standard (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motor	High Efficiency	0.06	$0.06	15	0.92
Miscellaneous	Non-HVAC Motor	High Efficiency (2015)	0.06	$0.06	15	-
Miscellaneous	Non-HVAC Motor	Premium	0.08	$0.13	15	0.69
Miscellaneous	Non-HVAC Motor	Premium (2015)	0.09	$0.13	15	-
Miscellaneous	Other Miscellaneous	Miscellaneous	-	$0.00	5	-
Miscellaneous	Other Miscellaneous	Miscellaneous (2013)	0.00	$0.00	5	-

Note: Costs and savings are per sq. ft.

Table D-4 Energy Efficiency Equipment Data — Extra Large Commercial, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Central Chiller	0.60 kw/ton, COP 5.9	0.43	$0.09	20	-
Cooling	Central Chiller	0.58 kw/ton, COP 6.1	0.49	$0.18	20	0.66
Cooling	Central Chiller	0.55 kw/Ton, COP 6.4	0.57	$0.25	20	0.91
Cooling	Central Chiller	0.51 kw/ton, COP 6.9	0.69	$0.44	20	0.78
Cooling	Central Chiller	0.50 kw/Ton, COP 7.0	0.72	$0.53	20	0.69
Cooling	Central Chiller	0.48 kw/ton, COP 7.3	0.77	$0.62	20	0.68
Cooling	Central Chiller	Variable Refrigerant Flow	1.00	$10.92	20	0.05
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.20	$0.24	16	-
Cooling	RTU	EER 11.2	0.41	$0.45	16	-
Cooling	RTU	EER 12.0	0.53	$0.75	16	0.37
Cooling	RTU	Ductless VRF	0.65	$6.64	16	0.03
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.08	$0.06	14	1.09
Cooling	PTAC	EER 10.8	0.19	$0.12	14	1.28
Cooling	PTAC	EER 11	0.22	$0.32	14	0.55
Cooling	PTAC	EER 11.5	0.30	$0.71	14	0.34
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	0.50	$0.24	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	0.79	$0.73	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	1.06	$0.97	15	1.34
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	1.16	$1.21	15	0.93
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	1.29	$7.10	20	0.14
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	1.21	$1.22	15	1.01
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.30	$0.14	4	-
Interior Lighting	Interior Screw-in	CFL	1.25	$0.06	7	13.22
Interior Lighting	Interior Screw-in	LED	1.38	$1.90	12	0.67
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.13	($0.05)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.20	($0.03)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.59	$0.21	6	1.31
Interior Lighting	Linear Fluorescent	T5	0.61	$0.35	6	0.80
Interior Lighting	Linear Fluorescent	LED	0.64	$3.08	15	0.25
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.02	$0.00	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.10	$0.00	7	37.00
Exterior Lighting	Exterior Screw-in	Metal Halides	0.10	$0.00	4	6.64
Exterior Lighting	Exterior Screw-in	LED	0.11	$0.05	12	1.89
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.26	($0.16)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.28	$0.64	9	0.37
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.00	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.01	$0.00	6	1.12
Exterior Lighting	Linear Fluorescent	T5	0.01	$0.01	6	0.69
Exterior Lighting	Linear Fluorescent	LED	0.01	$0.06	15	0.22
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0.00	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	0.19	$0.02	15	9.79
Water Heating	Water Heater	Geothermal Heat Pump	2.47	$3.53	15	0.80
Water Heating	Water Heater	Solar	2.72	$3.03	15	1.02
Food Preparation	Fryer	Standard	-	$0.00	12	-

Note: Costs and savings are per sq. ft.

Table D-4 Energy Efficiency Equipment Data — Extra Large Commercial, Existing Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Food Preparation	Fryer	Efficient	0.03	$0.00	12	6.02
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Efficient	0.85	$0.38	12	2.11
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Efficient	0.03	$0.04	12	0.57
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Efficient	0.17	$0.22	12	0.73
Food Preparation	Food Prep	Standard	-	$0.00	12	-
Food Preparation	Food Prep	Efficient	0.00	$0.03	12	0.15
Refrigeration	Walk in Refrigeration	Standard	-	$0.00	18	-
Refrigeration	Walk in Refrigeration	Efficient	0.06	$0.05	18	1.42
Refrigeration	Glass Door Display	Standard	-	$0.00	18	-
Refrigeration	Glass Door Display	Efficient	0.04	$0.00	18	78.11
Refrigeration	Solid Door Refrigerator	Standard	-	$0.00	18	-
Refrigeration	Solid Door Refrigerator	Efficient	0.27	$0.02	18	12.81
Refrigeration	Open Display Case	Standard	-	$0.00	18	-
Refrigeration	Open Display Case	Efficient	0.01	$0.03	18	0.34
Refrigeration	Vending Machine	Base	-	$0.00	10	-
Refrigeration	Vending Machine	Base (2012)	0.13	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency	0.16	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency (2012)	0.24	$0.00	10	68.21
Refrigeration	Icemaker	Standard	-	$0.00	12	-
Refrigeration	Icemaker	Efficient	0.05	$0.00	12	17.60
Office Equipment	Desktop Computer	Baseline	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.25	$0.00	4	32.37
Office Equipment	Desktop Computer	Climate Savers	0.35	$0.33	4	0.32
Office Equipment	Laptop Computer	Baseline	-	$0.00	4	-
Office Equipment	Laptop Computer	Energy Star	0.02	$0.00	4	10.31
Office Equipment	Laptop Computer	Climate Savers	0.04	$0.10	4	0.12
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.06	$0.00	3	3.01
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.11	$0.01	4	6.80
Office Equipment	Printer/copier/fax	Standard	-	$0.00	6	-
Office Equipment	Printer/copier/fax	Energy Star	0.02	$0.01	6	1.38
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Energy Star	0.00	$0.00	4	2.01
Miscellaneous	Non-HVAC Motor	Standard	-	$0.00	15	-
Miscellaneous	Non-HVAC Motor	Standard (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motor	High Efficiency	0.03	$0.03	15	1.02
Miscellaneous	Non-HVAC Motor	High Efficiency (2015)	0.04	$0.03	15	-
Miscellaneous	Non-HVAC Motor	Premium	0.05	$0.07	15	0.76
Miscellaneous	Non-HVAC Motor	Premium (2015)	0.05	$0.07	15	-
Miscellaneous	Other Miscellaneous	Miscellaneous	-	$0.00	5	-
Miscellaneous	Other Miscellaneous	Miscellaneous (2013)	0.00	$0.00	5	-

Note: Costs and savings are per sq. ft.

Table D-5 Energy Efficiency Equipment Data — Extra Large Industrial, Existing Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Central Chiller	0.60 kw/ton, COP 5.9	1.61	$0.33	20	-
Cooling	Central Chiller	0.58 kw/ton, COP 6.1	1.82	$0.66	20	0.68
Cooling	Central Chiller	0.55 kw/Ton, COP 6.4	2.15	$0.93	20	0.94
Cooling	Central Chiller	0.51 kw/ton, COP 6.9	2.58	$1.59	20	0.80
Cooling	Central Chiller	0.50 kw/Ton, COP 7.0	2.68	$1.92	20	0.71
Cooling	Central Chiller	0.48 kw/ton, COP 7.3	2.90	$2.25	20	0.70
Cooling	Central Chiller	Variable Refrigerant Flow	3.74	$39.62	20	0.06
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.56	$0.39	16	-
Cooling	RTU	EER 11.2	1.12	$0.73	16	-
Cooling	RTU	EER 12.0	1.47	$1.22	16	0.62
Cooling	RTU	Ductless VRF	1.79	$10.83	16	0.06
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.20	$0.06	14	2.79
Cooling	PTAC	EER 10.8	0.47	$0.11	14	3.27
Cooling	PTAC	EER 11	0.55	$0.31	14	1.41
Cooling	PTAC	EER 11.5	0.75	$0.69	14	0.87
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	1.07	$0.92	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	1.69	$2.75	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	2.25	$3.66	15	0.75
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	2.47	$4.58	15	0.52
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	2.74	$26.86	20	0.08
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	7.66	$1.22	15	6.38
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.09	$0.04	4	-
Interior Lighting	Interior Screw-in	CFL	0.38	$0.02	7	14.80
Interior Lighting	Interior Screw-in	LED	0.42	$0.52	12	0.75
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.46	($0.14)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.10	($0.01)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.31	$0.08	6	1.73
Interior Lighting	Linear Fluorescent	T5	0.32	$0.14	6	1.06
Interior Lighting	Linear Fluorescent	LED	0.33	$1.21	15	0.33
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.01	$0.00	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.02	$0.00	7	15.02
Exterior Lighting	Exterior Screw-in	Metal Halides	0.02	$0.00	4	2.69
Exterior Lighting	Exterior Screw-in	LED	0.03	$0.03	12	0.77
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.07	($0.04)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.08	$0.18	9	0.37
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.00	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	6	1.16
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	6	0.71
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.01	15	0.22
Process	Process Cooling/Refrigera	Standard	-	$0.00	10	-
Process	Process Cooling/Refrigera	Efficient	18.88	$5.59	10	2.49
Process	Process Heating	Standard	-	$0.00	10	-
Process	Process Heating	Efficient	6.18	$0.57	10	7.97
Process	Electrochemical Process	Standard	-	$0.00	10	-

Note: Costs and savings are per sq. ft.

Table D-5 Energy Efficiency Equipment Data — Extra Large Industrial, Existing Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Process	Electrochemical Process	Efficient	13.16	$2.64	10	3.67
Machine Drive	Less than 5 HP	Standard	-	$0.00	10	-
Machine Drive	Less than 5 HP	High Efficiency	0.05	$0.02	10	2.08
Machine Drive	Less than 5 HP	Standard (2015)	0.07	$0.00	10	-
Machine Drive	Less than 5 HP	Premium	0.07	$0.03	10	1.66
Machine Drive	Less than 5 HP	High Efficiency (2015)	0.11	$0.02	10	-
Machine Drive	Less than 5 HP	Premium (2015)	0.14	$0.03	10	-
Machine Drive	5-24 HP	Standard	-	$0.00	10	-
Machine Drive	5-24 HP	High	0.11	$0.02	10	5.09
Machine Drive	5-24 HP	Premium	0.18	$0.03	10	4.07
Machine Drive	25-99 HP	Standard	-	$0.00	10	-
Machine Drive	25-99 HP	High	0.31	$0.02	10	13.72
Machine Drive	25-99 HP	Premium	0.49	$0.03	10	10.97
Machine Drive	100-249 HP	Standard	-	$0.00	10	-
Machine Drive	100-249 HP	High	0.12	$0.02	10	5.17
Machine Drive	100-249 HP	Premium	0.15	$0.03	10	3.44
Machine Drive	250-499 HP	Standard	-	$0.00	10	-
Machine Drive	250-499 HP	High	0.35	$0.02	10	15.66
Machine Drive	250-499 HP	Premium	0.47	$0.03	10	10.44
Machine Drive	500 and more HP	Standard	-	$0.00	10	-
Machine Drive	500 and more HP	High	0.59	$0.02	10	26.28
Machine Drive	500 and more HP	Premium	0.78	$0.03	10	17.52
Miscellaneous	Miscellaneous	Miscellaneous	-	$0.00	5	-

Note: Costs and savings are per sq. ft.

Table D-6 Energy Efficiency Equipment Data — Small/Medium Commercial, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Central Chiller	1.3 kw/ton, COP 2.7	0.29	$0.39	20	-
Cooling	Central Chiller	1.26 kw/ton, COP 2.8	0.35	$0.50	20	0.51
Cooling	Central Chiller	1.0 kw/ton, COP 3.5	0.73	$0.62	20	1.90
Cooling	Central Chiller	0.97 kw/ton, COP 3.6	0.77	$0.74	20	1.39
Cooling	Central Chiller	Variable Refrigerant Flow	1.01	$11.57	20	0.07
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.22	$0.18	16	-
Cooling	RTU	EER 11.2	0.43	$0.35	16	-
Cooling	RTU	EER 12.0	0.57	$0.58	16	0.49
Cooling	RTU	Ductless VRF	0.69	$5.12	16	0.05
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.09	$0.08	14	0.86
Cooling	PTAC	EER 10.8	0.21	$0.16	14	1.00
Cooling	PTAC	EER 11	0.25	$0.43	14	0.43
Cooling	PTAC	EER 11.5	0.33	$0.96	14	0.27
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	0.57	$0.39	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	0.90	$1.18	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	1.20	$1.57	15	0.98
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	1.31	$1.96	15	0.68
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	1.46	$11.50	20	0.10
Combined Heating/Cooling	Heat Pump	Geothermal Heat Pump	1.75	$20.69	20	-
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	1.64	$1.22	15	1.35
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.20	$0.09	4	-
Interior Lighting	Interior Screw-in	CFL	0.85	$0.03	7	14.85
Interior Lighting	Interior Screw-in	LED	0.93	$1.18	12	0.76
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.27	($0.07)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.27	($0.03)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.82	$0.25	6	1.56
Interior Lighting	Linear Fluorescent	T5	0.85	$0.43	6	0.95
Interior Lighting	Linear Fluorescent	LED	0.89	$3.74	15	0.30
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.13	$0.05	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.54	$0.02	7	15.84
Exterior Lighting	Exterior Screw-in	Metal Halides	0.54	$0.05	4	2.84
Exterior Lighting	Exterior Screw-in	LED	0.60	$0.64	12	0.81
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.20	($0.13)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.22	$0.55	9	0.33
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.01	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.04	$0.02	6	1.01
Exterior Lighting	Linear Fluorescent	T5	0.04	$0.03	6	0.62
Exterior Lighting	Linear Fluorescent	LED	0.04	$0.24	15	0.20
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0.00	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	0.10	$0.02	15	5.23
Water Heating	Water Heater	Geothermal Heat Pump	1.33	$3.53	15	0.43
Water Heating	Water Heater	Solar	1.46	$3.03	15	0.55
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Efficient	0.03	$0.04	12	0.80

Note: Costs and savings are per sq. ft.

Table D-6 Energy Efficiency Equipment Data — Small/Medium Commercial, New Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Efficient	0.39	$0.36	12	1.02
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Efficient	0.02	$0.05	12	0.36
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Efficient	0.40	$0.16	12	2.29
Food Preparation	Food Prep	Standard	-	$0.00	12	-
Food Preparation	Food Prep	Efficient	0.00	$0.03	12	0.07
Refrigeration	Walk in Refrigeration	Standard	-	$0.00	18	-
Refrigeration	Walk in Refrigeration	Efficient	-	$0.09	18	-
Refrigeration	Glass Door Display	Standard	-	$0.00	18	-
Refrigeration	Glass Door Display	Efficient	0.16	$0.00	18	56.08
Refrigeration	Solid Door Refrigerator	Standard	-	$0.00	18	-
Refrigeration	Solid Door Refrigerator	Efficient	0.19	$0.02	18	9.87
Refrigeration	Open Display Case	Standard	-	$0.00	18	-
Refrigeration	Open Display Case	Efficient	0.00	$0.00	18	0.24
Refrigeration	Vending Machine	Base	-	$0.00	10	-
Refrigeration	Vending Machine	Base (2012)	0.11	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency	0.13	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency (2012)	0.20	$0.00	10	46.48
Refrigeration	Icemaker	Standard	-	$0.00	12	-
Refrigeration	Icemaker	Efficient	0.05	$0.00	12	12.76
Office Equipment	Desktop Computer	Baseline	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.19	$0.00	4	23.04
Office Equipment	Desktop Computer	Climate Savers	0.27	$0.36	4	0.23
Office Equipment	Laptop Computer	Baseline	-	$0.00	4	-
Office Equipment	Laptop Computer	Energy Star	0.02	$0.00	4	7.34
Office Equipment	Laptop Computer	Climate Savers	0.03	$0.12	4	0.08
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.12	$0.01	3	2.14
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.22	$0.00	4	19.68
Office Equipment	Printer/copier/fax	Standard	-	$0.00	6	-
Office Equipment	Printer/copier/fax	Energy Star	0.09	$0.04	6	0.98
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Energy Star	0.03	$0.00	4	2.96
Miscellaneous	Non-HVAC Motor	Standard	-	$0.00	15	-
Miscellaneous	Non-HVAC Motor	Standard (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motor	High Efficiency	0.05	$0.06	15	0.95
Miscellaneous	Non-HVAC Motor	High Efficiency (2015)	0.06	$0.06	15	-
Miscellaneous	Non-HVAC Motor	Premium	0.07	$0.11	15	0.72
Miscellaneous	Non-HVAC Motor	Premium (2015)	0.08	$0.11	15	-
Miscellaneous	Other Miscellaneous	Miscellaneous	-	$0.00	5	-
Miscellaneous	Other Miscellaneous	Miscellaneous (2013)	0.00	$0.00	5	-

Note: Costs and savings are per sq. ft.

Table D-7 Energy Efficiency Equipment Data — Large Commercial, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	1.5 kw/ton, COP 2.3	-	$0.00	20	-
Cooling	Central Chiller	1.3 kw/ton, COP 2.7	0.32	$0.24	20	-
Cooling	Central Chiller	1.26 kw/ton, COP 2.8	0.39	$0.31	20	0.97
Cooling	Central Chiller	1.0 kw/ton, COP 3.5	0.80	$0.38	20	3.62
Cooling	Central Chiller	0.97 kw/ton, COP 3.6	0.85	$0.45	20	2.66
Cooling	Central Chiller	Variable Refrigerant Flow	1.12	$7.06	20	0.12
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.22	$0.13	16	-
Cooling	RTU	EER 11.2	0.45	$0.25	16	-
Cooling	RTU	EER 12.0	0.59	$0.41	16	0.75
Cooling	RTU	Ductless VRF	0.72	$3.67	16	0.07
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.09	$0.09	14	0.86
Cooling	PTAC	EER 10.8	0.21	$0.17	14	1.00
Cooling	PTAC	EER 11	0.25	$0.46	14	0.43
Cooling	PTAC	EER 11.5	0.34	$1.03	14	0.27
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	0.46	$0.18	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	0.73	$0.55	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	0.97	$0.73	15	1.85
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	1.07	$0.91	15	1.28
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	1.19	$5.35	20	0.19
Combined Heating/Cooling	Heat Pump	Geothermal Heat Pump	1.42	$9.62	20	-
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	1.30	$1.22	15	1.09
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.17	$0.08	4	-
Interior Lighting	Interior Screw-in	CFL	0.71	$0.03	7	12.72
Interior Lighting	Interior Screw-in	LED	0.78	$1.11	12	0.65
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.28	($0.08)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.27	($0.03)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.80	$0.25	6	1.49
Interior Lighting	Linear Fluorescent	T5	0.83	$0.42	6	0.92
Interior Lighting	Linear Fluorescent	LED	0.87	$3.67	15	0.29
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.07	$0.01	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.31	$0.01	7	30.62
Exterior Lighting	Exterior Screw-in	Metal Halides	0.31	$0.02	4	5.49
Exterior Lighting	Exterior Screw-in	LED	0.34	$0.19	12	1.56
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.17	($0.11)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.18	$0.45	9	0.34
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.01	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.04	$0.02	6	1.06
Exterior Lighting	Linear Fluorescent	T5	0.04	$0.03	6	0.65
Exterior Lighting	Linear Fluorescent	LED	0.04	$0.24	15	0.20
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0.00	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	0.12	$0.02	15	5.71
Water Heating	Water Heater	Geothermal Heat Pump	1.54	$3.53	15	0.46
Water Heating	Water Heater	Solar	1.69	$3.03	15	0.60
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Efficient	0.07	$0.02	12	3.52

Note: Costs and savings are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1037 of 1069

Table D-7 Energy Efficiency Equipment Data — Large Commercial, New Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Efficient	0.75	$0.46	12	1.43
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Efficient	0.07	$0.10	12	0.58
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Efficient	0.35	$0.30	12	0.99
Food Preparation	Food Prep	Standard	-	$0.00	12	-
Food Preparation	Food Prep	Efficient	0.01	$0.03	12	0.24
Refrigeration	Walk in Refrigeration	Standard	-	$0.00	18	-
Refrigeration	Walk in Refrigeration	Efficient	0.15	$1.26	18	0.13
Refrigeration	Glass Door Display	Standard	-	$0.00	18	-
Refrigeration	Glass Door Display	Efficient	0.13	$0.01	18	24.96
Refrigeration	Solid Door Refrigerator	Standard	-	$0.00	18	-
Refrigeration	Solid Door Refrigerator	Efficient	0.30	$0.08	18	4.39
Refrigeration	Open Display Case	Standard	-	$0.00	18	-
Refrigeration	Open Display Case	Efficient	0.00	$0.04	18	0.16
Refrigeration	Vending Machine	Base	-	$0.00	10	-
Refrigeration	Vending Machine	Base (2012)	0.13	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency	0.15	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency (2012)	0.23	$0.00	10	20.70
Refrigeration	Icemaker	Standard	-	$0.00	12	-
Refrigeration	Icemaker	Efficient	0.11	$0.02	12	5.62
Office Equipment	Desktop Computer	Baseline	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.35	$0.00	4	47.46
Office Equipment	Desktop Computer	Climate Savers	0.50	$0.32	4	0.46
Office Equipment	Laptop Computer	Baseline	-	$0.00	4	-
Office Equipment	Laptop Computer	Energy Star	0.02	$0.00	4	15.12
Office Equipment	Laptop Computer	Climate Savers	0.04	$0.06	4	0.17
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.13	$0.01	3	4.41
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.19	$0.01	4	9.14
Office Equipment	Printer/copier/fax	Standard	-	$0.00	6	-
Office Equipment	Printer/copier/fax	Energy Star	0.08	$0.02	6	2.02
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Energy Star	0.01	$0.00	4	2.94
Miscellaneous	Non-HVAC Motor	Standard	-	$0.00	15	-
Miscellaneous	Non-HVAC Motor	Standard (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motor	High Efficiency	0.06	$0.06	15	0.92
Miscellaneous	Non-HVAC Motor	High Efficiency (2015)	0.06	$0.06	15	-
Miscellaneous	Non-HVAC Motor	Premium	0.08	$0.13	15	0.69
Miscellaneous	Non-HVAC Motor	Premium (2015)	0.09	$0.13	15	-
Miscellaneous	Other Miscellaneous	Miscellaneous	-	$0.00	5	-
Miscellaneous	Other Miscellaneous	Miscellaneous (2013)	0.00	$0.00	5	-

Note: Costs and savings are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1038 of 1069

Table D-8 Energy Efficiency Equipment Data — Extra Large Commercial, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Central Chiller	0.60 kw/ton, COP 5.9	0.43	$0.09	20	-
Cooling	Central Chiller	0.58 kw/ton, COP 6.1	0.49	$0.18	20	0.66
Cooling	Central Chiller	0.55 kw/Ton, COP 6.4	0.57	$0.25	20	0.91
Cooling	Central Chiller	0.51 kw/ton, COP 6.9	0.69	$0.44	20	0.78
Cooling	Central Chiller	0.50 kw/Ton, COP 7.0	0.72	$0.53	20	0.69
Cooling	Central Chiller	0.48 kw/ton, COP 7.3	0.77	$0.62	20	0.68
Cooling	Central Chiller	Variable Refrigerant Flow	1.00	$10.92	20	0.05
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.20	$0.24	16	-
Cooling	RTU	EER 11.2	0.41	$0.44	16	-
Cooling	RTU	EER 12.0	0.53	$0.73	16	0.37
Cooling	RTU	Ductless VRF	0.65	$6.51	16	0.04
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.08	$0.06	14	1.09
Cooling	PTAC	EER 10.8	0.19	$0.12	14	1.28
Cooling	PTAC	EER 11	0.22	$0.32	14	0.55
Cooling	PTAC	EER 11.5	0.30	$0.71	14	0.34
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	0.50	$0.24	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	0.79	$0.73	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	1.06	$0.97	15	1.34
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	1.16	$1.21	15	0.93
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	1.29	$7.10	20	0.14
Combined Heating/Cooling	Heat Pump	Geothermal Heat Pump	1.55	$12.77	20	-
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	1.52	$1.22	15	1.27
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.27	$0.14	4	-
Interior Lighting	Interior Screw-in	CFL	1.13	$0.06	7	11.90
Interior Lighting	Interior Screw-in	LED	1.24	$1.90	12	0.61
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.11	($0.05)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.18	($0.03)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.53	$0.21	6	1.18
Interior Lighting	Linear Fluorescent	T5	0.55	$0.35	6	0.72
Interior Lighting	Linear Fluorescent	LED	0.58	$3.08	15	0.23
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.02	$0.00	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.09	$0.00	7	33.30
Exterior Lighting	Exterior Screw-in	Metal Halides	0.09	$0.00	4	5.97
Exterior Lighting	Exterior Screw-in	LED	0.10	$0.05	12	1.70
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.24	($0.16)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.25	$0.64	9	0.33
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.00	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.01	$0.00	6	1.01
Exterior Lighting	Linear Fluorescent	T5	0.01	$0.01	6	0.62
Exterior Lighting	Linear Fluorescent	LED	0.01	$0.06	15	0.19
Water Heating	Water Heater	Baseline (EF=0.90)	-	$0.00	15	-
Water Heating	Water Heater	High Efficiency (EF=0.95)	0.19	$0.02	15	9.79
Water Heating	Water Heater	Geothermal Heat Pump	2.47	$3.53	15	0.80
Water Heating	Water Heater	Solar	2.72	$3.03	15	1.02

Note: Costs and savings are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1039 of 1069

Table D-9 Energy Efficiency Equipment Data — Extra Large Commercial, New Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Food Preparation	Fryer	Standard	-	$0.00	12	-
Food Preparation	Fryer	Efficient	0.03	$0.00	12	6.02
Food Preparation	Oven	Standard	-	$0.00	12	-
Food Preparation	Oven	Efficient	0.85	$0.38	12	2.11
Food Preparation	Dishwasher	Standard	-	$0.00	12	-
Food Preparation	Dishwasher	Efficient	0.03	$0.04	12	0.57
Food Preparation	Hot Food Container	Standard	-	$0.00	12	-
Food Preparation	Hot Food Container	Efficient	0.17	$0.22	12	0.73
Food Preparation	Food Prep	Standard	-	$0.00	12	-
Food Preparation	Food Prep	Efficient	0.00	$0.03	12	0.15
Refrigeration	Walk in Refrigeration	Standard	-	$0.00	18	-
Refrigeration	Walk in Refrigeration	Efficient	0.06	$0.05	18	1.42
Refrigeration	Glass Door Display	Standard	-	$0.00	18	-
Refrigeration	Glass Door Display	Efficient	0.04	$0.00	18	78.11
Refrigeration	Solid Door Refrigerator	Standard	-	$0.00	18	-
Refrigeration	Solid Door Refrigerator	Efficient	0.27	$0.02	18	13.75
Refrigeration	Open Display Case	Standard	-	$0.00	18	-
Refrigeration	Open Display Case	Efficient	0.01	$0.03	18	0.34
Refrigeration	Vending Machine	Base	-	$0.00	10	-
Refrigeration	Vending Machine	Base (2012)	0.13	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency	0.16	$0.00	10	-
Refrigeration	Vending Machine	High Efficiency (2012)	0.24	$0.00	10	68.21
Refrigeration	Icemaker	Standard	-	$0.00	12	-
Refrigeration	Icemaker	Efficient	0.05	$0.00	12	17.60
Office Equipment	Desktop Computer	Baseline	-	$0.00	4	-
Office Equipment	Desktop Computer	Energy Star	0.25	$0.00	4	32.37
Office Equipment	Desktop Computer	Climate Savers	0.35	$0.33	4	0.32
Office Equipment	Laptop Computer	Baseline	-	$0.00	4	-
Office Equipment	Laptop Computer	Energy Star	0.02	$0.00	4	10.31
Office Equipment	Laptop Computer	Climate Savers	0.04	$0.10	4	0.12
Office Equipment	Server	Standard	-	$0.00	3	-
Office Equipment	Server	Energy Star	0.06	$0.00	3	3.01
Office Equipment	Monitor	Standard	-	$0.00	4	-
Office Equipment	Monitor	Energy Star	0.11	$0.01	4	6.80
Office Equipment	Printer/copier/fax	Standard	-	$0.00	6	-
Office Equipment	Printer/copier/fax	Energy Star	0.02	$0.01	6	1.38
Office Equipment	POS Terminal	Standard	-	$0.00	4	-
Office Equipment	POS Terminal	Energy Star	0.00	$0.00	4	2.01
Miscellaneous	Non-HVAC Motor	Standard	-	$0.00	15	-
Miscellaneous	Non-HVAC Motor	Standard (2015)	0.01	$0.00	15	-
Miscellaneous	Non-HVAC Motor	High Efficiency	0.03	$0.03	15	1.02
Miscellaneous	Non-HVAC Motor	High Efficiency (2015)	0.04	$0.03	15	-
Miscellaneous	Non-HVAC Motor	Premium	0.05	$0.07	15	0.76
Miscellaneous	Non-HVAC Motor	Premium (2015)	0.05	$0.07	15	-
Miscellaneous	Other Miscellaneous	Miscellaneous	-	$0.00	5	-
Miscellaneous	Other Miscellaneous	Miscellaneous (2013)	0.00	$0.00	5	-

Note: Costs and savings are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1040 of 1069

Table D-9 Energy Efficiency Equipment Data — Extra Large Industrial, New Vintage

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Cooling	Central Chiller	0.75 kw/ton, COP 4.7	-	$0.00	20	-
Cooling	Central Chiller	0.60 kw/ton, COP 5.9	1.61	$0.33	20	-
Cooling	Central Chiller	0.58 kw/ton, COP 6.1	1.82	$0.66	20	0.68
Cooling	Central Chiller	0.55 kw/Ton, COP 6.4	2.15	$0.93	20	0.94
Cooling	Central Chiller	0.51 kw/ton, COP 6.9	2.58	$1.59	20	0.80
Cooling	Central Chiller	0.50 kw/Ton, COP 7.0	2.68	$1.92	20	0.71
Cooling	Central Chiller	0.48 kw/ton, COP 7.3	2.90	$2.25	20	0.70
Cooling	Central Chiller	Variable Refrigerant Flow	3.74	$39.62	20	0.06
Cooling	RTU	EER 9.2	-	$0.00	16	-
Cooling	RTU	EER 10.1	0.56	$0.39	16	-
Cooling	RTU	EER 11.2	1.12	$0.74	16	-
Cooling	RTU	EER 12.0	1.47	$1.23	16	0.62
Cooling	RTU	Ductless VRF	1.79	$10.88	16	0.06
Cooling	PTAC	EER 9.8	-	$0.00	14	-
Cooling	PTAC	EER 10.2	0.20	$0.06	14	2.79
Cooling	PTAC	EER 10.8	0.47	$0.11	14	3.27
Cooling	PTAC	EER 11	0.55	$0.31	14	1.41
Cooling	PTAC	EER 11.5	0.75	$0.69	14	0.87
Combined Heating/Cooling	Heat Pump	EER 9.3, COP 3.1	-	$0.00	15	-
Combined Heating/Cooling	Heat Pump	EER 10.3, COP 3.2	1.07	$0.92	15	-
Combined Heating/Cooling	Heat Pump	EER 11.0, COP 3.3	1.69	$2.75	15	-
Combined Heating/Cooling	Heat Pump	EER 11.7, COP 3.4	2.25	$3.66	15	0.75
Combined Heating/Cooling	Heat Pump	EER 12, COP 3.4	2.47	$4.58	15	0.52
Combined Heating/Cooling	Heat Pump	Ductless Mini-Split System	2.74	$26.86	20	0.08
Combined Heating/Cooling	Heat Pump	Geothermal Heat Pump	3.29	$48.32	20	-
Space Heating	Electric Resistance	Standard	-	$0.00	25	-
Space Heating	Furnace	Standard	-	$0.00	18	-
Ventilation	Ventilation	Constant Volume	-	$0.00	15	-
Ventilation	Ventilation	Variable Air Volume	9.66	$1.22	15	8.05
Interior Lighting	Interior Screw-in	Incandescents	-	$0.00	4	-
Interior Lighting	Interior Screw-in	Infrared Halogen	0.08	$0.04	4	-
Interior Lighting	Interior Screw-in	CFL	0.34	$0.02	7	13.32
Interior Lighting	Interior Screw-in	LED	0.38	$0.52	12	0.68
Interior Lighting	HID	Metal Halides	-	$0.00	6	-
Interior Lighting	HID	High Pressure Sodium	0.41	($0.14)	9	1.00
Interior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Interior Lighting	Linear Fluorescent	T8	0.09	($0.01)	6	1.00
Interior Lighting	Linear Fluorescent	Super T8	0.28	$0.08	6	1.56
Interior Lighting	Linear Fluorescent	T5	0.29	$0.14	6	0.96
Interior Lighting	Linear Fluorescent	LED	0.30	$1.21	15	0.30
Exterior Lighting	Exterior Screw-in	Incandescent	-	$0.00	4	-
Exterior Lighting	Exterior Screw-in	Infrared Halogen	0.01	$0.00	4	-
Exterior Lighting	Exterior Screw-in	CFL	0.02	$0.00	7	13.52
Exterior Lighting	Exterior Screw-in	Metal Halides	0.02	$0.00	4	2.42
Exterior Lighting	Exterior Screw-in	LED	0.02	$0.03	12	0.69
Exterior Lighting	HID	Metal Halides	-	$0.00	6	-
Exterior Lighting	HID	High Pressure Sodium	0.07	($0.04)	9	1.00
Exterior Lighting	HID	Low Pressure Sodium	0.07	$0.18	9	0.33
Exterior Lighting	Linear Fluorescent	T12	-	$0.00	6	-
Exterior Lighting	Linear Fluorescent	T8	0.00	($0.00)	6	1.00
Exterior Lighting	Linear Fluorescent	Super T8	0.00	$0.00	6	1.05
Exterior Lighting	Linear Fluorescent	T5	0.00	$0.00	6	0.64
Exterior Lighting	Linear Fluorescent	LED	0.00	$0.01	15	0.20
Process	Process Cooling/Refrigera	Standard	-	$0.00	10	-
Process	Process Cooling/Refrigera	Efficient	18.88	$5.59	10	2.49
Process	Process Heating	Standard	-	$0.00	10	-
Process	Process Heating	Efficient	6.18	$0.57	10	7.97

Note: Costs and savings are per sq. ft.

Table D-9 Energy Efficiency Equipment Data — Extra Large Industrial, New Vintage (Cont.)

End Use	Technology	Efficiency Definition	Savings (kWh/yr)	Incremental Cost	Lifetime (yrs)	BC Ratio
Process	Electrochemical Process	Standard	-	$0.00	10	-
Process	Electrochemical Process	Efficient	13.16	$2.64	10	3.67
Machine Drive	Less than 5 HP	Standard	-	$0.00	10	-
Machine Drive	Less than 5 HP	High Efficiency	0.05	$0.02	10	2.08
Machine Drive	Less than 5 HP	Standard (2015)	0.07	$0.00	10	-
Machine Drive	Less than 5 HP	Premium	0.07	$0.03	10	1.66
Machine Drive	Less than 5 HP	High Efficiency (2015)	0.11	$0.02	10	-
Machine Drive	Less than 5 HP	Premium (2015)	0.14	$0.03	10	-
Machine Drive	5-24 HP	Standard	-	$0.00	10	-
Machine Drive	5-24 HP	High	0.11	$0.02	10	5.09
Machine Drive	5-24 HP	Premium	0.18	$0.03	10	4.07
Machine Drive	25-99 HP	Standard	-	$0.00	10	-
Machine Drive	25-99 HP	High	0.31	$0.02	10	13.72
Machine Drive	25-99 HP	Premium	0.49	$0.03	10	10.97
Machine Drive	100-249 HP	Standard	-	$0.00	10	-
Machine Drive	100-249 HP	High	0.12	$0.02	10	5.17
Machine Drive	100-249 HP	Premium	0.15	$0.03	10	3.44
Machine Drive	250-499 HP	Standard	-	$0.00	10	-
Machine Drive	250-499 HP	High	0.35	$0.02	10	15.66
Machine Drive	250-499 HP	Premium	0.47	$0.03	10	10.44
Machine Drive	500 and more HP	Standard	-	$0.00	10	-
Machine Drive	500 and more HP	High	0.59	$0.02	10	26.28
Machine Drive	500 and more HP	Premium	0.78	$0.03	10	17.52
Miscellaneous	Miscellaneous	Miscellaneous	-	$0.00	5	-

Note: Costs and savings are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1042 of 1069

Table D-10 Energy Efficiency Measure Data — Small/Med. Comm., Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
RTU - Maintenance	Cooling	14%	0%	14%	90%	$0.08	4	0.75
RTU - Evaporative Precooler	Cooling	10%	0%	0%	0%	$0.88	15	0.20
Chiller - Chilled Water Reset	Cooling	14%	0%	0%	0%	$0.86	4	0.08
Chiller - Chilled Water Variable-Flow System	Cooling	5%	0%	0%	0%	$0.86	10	0.07
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	0%	$0.90	20	0.70
Chiller - VSD	Cooling	27%	0%	0%	0%	$1.17	20	0.48
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.01
Chiller - Condenser Water Temprature Reset	Cooling	10%	0%	0%	0%	$0.87	14	0.18
Cooling - Economizer Installation	Cooling	6%	0%	45%	49%	$0.15	15	0.71
Heat Pump - Maintenance	Combined Heating/Cooling	7%	7%	10%	95%	$0.03	4	5.00
Insulation - Ducting	Cooling	6%	0%	9%	50%	$0.41	20	0.71
Insulation - Ducting	Space Heating	3%	1%	9%	50%	$0.41	20	0.71
Repair and Sealing - Ducting	Cooling	2%	0%	5%	25%	$0.38	15	0.45
Repair and Sealing - Ducting	Space Heating	2%	1%	5%	25%	$0.38	15	0.45
Energy Management System	Cooling	6%	0%	24%	75%	$0.35	14	0.72
Energy Management System	Space Heating	5%	3%	24%	75%	$0.35	14	0.72
Energy Management System	Interior Lighting	2%	1%	24%	75%	$0.35	14	0.72
Cooking - Exhaust Hoods with Sensor Control	Ventilation	25%	13%	1%	15%	$0.04	10	7.36
Fans - Energy Efficient Motors	Ventilation	5%	5%	11%	90%	$0.05	10	1.38
Fans - Variable Speed Control	Ventilation	15%	5%	8%	90%	$0.20	10	0.89
Retrocommissioning - HVAC	Cooling	9%	0%	15%	90%	$0.60	4	0.50
Retrocommissioning - HVAC	Space Heating	9%	6%	15%	90%	$0.60	4	0.50
Retrocommissioning - HVAC	Ventilation	9%	6%	15%	90%	$0.60	4	0.50
Pumps - Variable Speed Control	Miscellaneous	1%	0%	0%	34%	$0.44	10	1.01
Thermostat - Clock/Programmable	Cooling	5%	0%	34%	50%	$0.13	11	1.12
Thermostat - Clock/Programmable	Space Heating	5%	1%	34%	50%	$0.13	11	1.12
Insulation - Ceiling	Cooling	2%	0%	10%	18%	$0.64	20	0.70
Insulation - Ceiling	Space Heating	17%	4%	10%	18%	$0.64	20	0.70
Insulation - Radiant Barrier	Cooling	3%	0%	7%	13%	$0.26	20	0.81
Insulation - Radiant Barrier	Space Heating	5%	2%	7%	13%	$0.26	20	0.81
Roofs - High Reflectivity	Cooling	15%	0%	2%	95%	$0.18	15	1.47
Windows - High Efficiency	Cooling	5%	0%	61%	75%	$0.44	20	0.63
Windows - High Efficiency	Space Heating	3%	2%	61%	75%	$0.44	20	0.63
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	81%	90%	$0.65	8	0.34
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	Interior Lighting	25%	13%	1%	45%	$0.50	8	0.90
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	2%	50%	$0.11	8	1.36
Interior Fluorescent - Delamp and Install Reflectors	Interior Lighting	20%	10%	18%	25%	$0.50	11	0.97
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$0.50	8	0.36
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	23%	$0.70	11	1.73
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	7%	45%	$0.20	8	1.11
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.26
Interior Screw-in - Task Lighting	Interior Lighting	7%	4%	25%	75%	$0.24	5	0.09
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	9%	56%	$0.20	8	0.56
Water Heater - Faucet Aerators/Low Flow Nozzles	Water Heating	4%	1%	8%	90%	$0.01	9	4.28
Water Heater - Pipe Insulation	Water Heating	6%	3%	46%	50%	$0.28	15	0.37
Water Heater - High Efficiency Circulation Pump	Water Heating	5%	4%	0%	0%	$0.11	10	0.64
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	40%	50%	$0.02	10	5.87
Water Heater - Thermostat Setback	Water Heating	4%	2%	5%	75%	$0.11	10	0.47
Water Heater - Hot Water Saver	Water Heating	5%	1%	0%	0%	$0.02	5	1.56
Refrigeration - Anti-Sweat Heater/Auto Door Closer	Refrigeration	5%	3%	0%	75%	$0.20	16	1.10
Refrigeration - Floating Head Pressure	Refrigeration	7%	4%	18%	38%	$0.35	16	1.25
Refrigeration - Door Gasket Replacement	Refrigeration	4%	2%	5%	75%	$0.10	8	0.10
Insulation - Bare Suction Lines	Refrigeration	3%	2%	5%	75%	$0.10	8	0.21
Refrigeration - Night Covers	Refrigeration	6%	3%	5%	75%	$0.05	8	1.02
Refrigeration - Strip Curtain	Refrigeration	4%	2%	5%	56%	$0.02	8	0.00
Retrocommissioning - Comprehensive	Cooling	12%	0%	40%	90%	$0.70	4	0.71
Retrocommissioning - Comprehensive	Space Heating	12%	9%	40%	90%	$0.70	4	0.71
Retrocommissioning - Comprehensive	Interior Lighting	12%	9%	40%	90%	$0.70	4	0.71
Office Equipment - Energy Star Power Supply	Office Equipment	1%	1%	10%	95%	$0.00	7	61.20
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	10	1.09
LED Exit Lighting	Interior Lighting	2%	2%	9%	86%	$0.00	10	12.75
Retrocommissioning - Lighting	Interior Lighting	9%	6%	5%	90%	$0.10	5	1.59
Retrocommissioning - Lighting	Exterior Lighting	9%	6%	5%	90%	$0.10	5	1.59
Refrigeration - High Efficiency Case Lighting	Refrigeration	4%	2%	5%	75%	$0.20	8	0.00
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	1.37
Exterior Lighting - Induction Lamps	Exterior Lighting	3%	3%	5%	56%	$0.00	5	8.10
Laundry - High Efficiency Clothes Washer	Miscellaneous	0%	0%	5%	10%	$0.00	10	36.95
Interior Lighting - Hotel Guestroom Controls	Interior Lighting	10%	5%	0%	0%	$0.14	8	0.33
Miscellaneous - Energy Star Water Cooler	Miscellaneous	0%	0%	5%	95%	$0.00	8	1.95
Industrial Process Improvements	Miscellaneous	10%	8%	0%	23%	$0.52	10	1.16
Custom Measures	Cooling	10%	0%	10%	45%	$1.50	15	0.59
Custom Measures	Space Heating	10%	8%	10%	45%	$1.50	15	0.59
Custom Measures	Interior Lighting	10%	6%	10%	45%	$1.50	15	0.59
Custom Measures	Food Preparation	10%	7%	10%	45%	$1.50	15	0.59
Custom Measures	Refrigeration	10%	5%	10%	45%	$1.50	15	0.59
Water Heater - Heat Pump	Water Heating	30%	15%	0%	19%	$0.80	15	0.69
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$4.00	15	0.54
Furnace - Convert to Gas	Space Heating	100%	100%	0%	47%	$8.04	15	1.08

Note: Costs are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1043 of 1069

Table D-11 Energy Efficiency Measure Data — Large Commercial, Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
RTU - Maintenance	Cooling	14%	0%	27%	90%	$0.06	4	1.30
RTU - Evaporative Precooler	Cooling	10%	0%	0%	0%	$0.88	15	0.21
Chiller - Chilled Water Reset	Cooling	19%	0%	15%	75%	$0.18	4	0.50
Chiller - Chilled Water Variable-Flow System	Cooling	5%	0%	30%	34%	$0.18	10	0.31
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	66%	$0.90	20	0.64
Chiller - VSD	Cooling	32%	0%	15%	66%	$1.17	20	0.52
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	15%	41%	$0.04	10	0.01
Chiller - Condenser Water Temprature Reset	Cooling	9%	0%	5%	75%	$0.18	14	0.76
Cooling - Economizer Installation	Cooling	11%	0%	44%	49%	$0.15	15	1.29
Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	10%	95%	$0.06	4	3.04
Insulation - Ducting	Cooling	3%	0%	8%	50%	$0.41	20	0.52
Insulation - Ducting	Space Heating	3%	1%	8%	50%	$0.41	20	0.52
Repair and Sealing - Ducting	Cooling	2%	0%	5%	25%	$0.38	15	0.43
Repair and Sealing - Ducting	Space Heating	2%	1%	5%	25%	$0.38	15	0.43
Energy Management System	Cooling	23%	0%	37%	90%	$0.35	14	2.63
Energy Management System	Space Heating	18%	12%	37%	90%	$0.35	14	2.63
Energy Management System	Interior Lighting	9%	6%	37%	90%	$0.35	14	2.63
Cooking - Exhaust Hoods with Sensor Control	Ventilation	13%	7%	1%	11%	$0.04	10	2.97
Fans - Energy Efficient Motors	Ventilation	5%	5%	11%	90%	$0.05	10	1.11
Fans - Variable Speed Control	Ventilation	15%	5%	2%	90%	$0.20	10	0.71
Retrocommissioning - HVAC	Cooling	12%	0%	15%	90%	$0.30	4	0.72
Retrocommissioning - HVAC	Space Heating	12%	9%	15%	90%	$0.30	4	0.72
Retrocommissioning - HVAC	Ventilation	9%	6%	15%	90%	$0.30	4	0.72
Pumps - Variable Speed Control	Miscellaneous	1%	0%	0%	34%	$0.13	10	1.05
Thermostat - Clock/Programmable	Cooling	5%	0%	33%	50%	$0.13	11	1.02
Thermostat - Clock/Programmable	Space Heating	5%	1%	33%	50%	$0.13	11	1.02
Insulation - Ceiling	Cooling	1%	0%	9%	30%	$0.85	20	0.45
Insulation - Ceiling	Space Heating	12%	3%	9%	30%	$0.85	20	0.45
Insulation - Radiant Barrier	Cooling	2%	0%	7%	13%	$0.26	20	0.64
Insulation - Radiant Barrier	Space Heating	5%	2%	7%	13%	$0.26	20	0.64
Roofs - High Reflectivity	Cooling	5%	0%	2%	75%	$0.08	15	1.08
Windows - High Efficiency	Cooling	12%	0%	72%	75%	$0.88	20	0.74
Windows - High Efficiency	Space Heating	11%	8%	72%	75%	$0.88	20	0.74
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	86%	90%	$0.65	8	0.34
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	Interior Lighting	25%	13%	1%	45%	$0.45	8	0.96
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	2%	13%	$0.29	8	0.42
Interior Fluorescent - Delamp and Install Reflectors	Interior Lighting	30%	15%	17%	38%	$0.50	11	1.40
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$0.40	8	0.43
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	23%	$0.63	11	1.85
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	13%	45%	$0.20	8	1.10
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.21
Interior Screw-in - Task Lighting	Interior Lighting	10%	5%	10%	75%	$0.24	5	0.13
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	9%	56%	$0.20	8	0.55
Water Heater - Faucet Aerators/Low Flow Nozzles	Water Heating	4%	1%	3%	90%	$0.03	9	1.62
Water Heater - Pipe Insulation	Water Heating	6%	3%	0%	0%	$0.28	15	0.42
Water Heater - High Efficiency Circulation Pump	Water Heating	5%	4%	0%	23%	$0.11	10	0.70
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$0.04	10	3.28
Water Heater - Thermostat Setback	Water Heating	4%	2%	0%	0%	$0.11	10	0.52
Water Heater - Hot Water Saver	Water Heating	5%	1%	0%	3%	$0.04	5	0.88
Refrigeration - Anti-Sweat Heater/Auto Door Closer	Refrigeration	5%	3%	0%	75%	$0.20	16	0.58
Refrigeration - Floating Head Pressure	Refrigeration	7%	4%	38%	45%	$0.35	16	0.95
Refrigeration - Door Gasket Replacement	Refrigeration	4%	2%	5%	75%	$0.10	8	0.65
Insulation - Bare Suction Lines	Refrigeration	3%	2%	5%	75%	$0.10	8	0.37
Refrigeration - Night Covers	Refrigeration	6%	3%	5%	75%	$0.05	8	0.65
Refrigeration - Strip Curtain	Refrigeration	4%	2%	5%	56%	$0.02	8	0.96
Retrocommissioning - Comprehensive	Cooling	12%	0%	40%	90%	$0.35	4	1.06
Retrocommissioning - Comprehensive	Space Heating	12%	9%	40%	90%	$0.35	4	1.06
Retrocommissioning - Comprehensive	Interior Lighting	12%	9%	40%	90%	$0.35	4	1.06
Office Equipment - Energy Star Power Supply	Office Equipment	1%	1%	10%	95%	$0.00	7	68.11
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	10	1.11
LED Exit Lighting	Interior Lighting	2%	2%	9%	86%	$0.00	10	12.29
Retrocommissioning - Lighting	Interior Lighting	9%	6%	5%	90%	$0.05	5	3.07
Retrocommissioning - Lighting	Exterior Lighting	9%	6%	5%	90%	$0.05	5	3.07
Refrigeration - High Efficiency Case Lighting	Refrigeration	4%	2%	5%	75%	$0.20	8	0.52
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	1.14
Exterior Lighting - Induction Lamps	Exterior Lighting	3%	3%	5%	56%	$0.00	5	6.50
Laundry - High Efficiency Clothes Washer	Miscellaneous	0%	0%	5%	10%	$0.00	10	33.94
Interior Lighting - Hotel Guestroom Controls	Interior Lighting	10%	5%	1%	2%	$0.14	8	0.32
Miscellaneous - Energy Star Water Cooler	Miscellaneous	0%	0%	5%	95%	$0.00	8	1.78
Industrial Process Improvements	Miscellaneous	10%	8%	0%	5%	$0.52	10	1.18
Custom Measures	Cooling	10%	0%	10%	45%	$0.90	15	0.99
Custom Measures	Space Heating	10%	8%	10%	45%	$0.90	15	0.99
Custom Measures	Interior Lighting	10%	8%	10%	45%	$0.90	15	0.99
Custom Measures	Food Preparation	10%	8%	10%	45%	$0.90	15	0.99
Custom Measures	Refrigeration	10%	8%	10%	45%	$0.90	15	0.99
Water Heater - Heat Pump	Water Heating	30%	15%	0%	28%	$0.80	15	0.77
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	0%	$4.00	15	0.59
Furnace - Convert to Gas	Space Heating	100%	100%	0%	0%	$6.00	15	1.04

Note: Costs are per sq. ft.

Table D-12 Energy Efficiency Measure Data — Extra Large Comm., Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
RTU - Maintenance	Cooling	14%	0%	47%	90%	$0.06	4	1.15
RTU - Evaporative Precooler	Cooling	10%	0%	0%	0%	$0.88	15	0.19
Chiller - Chilled Water Reset	Cooling	15%	0%	30%	75%	$0.09	4	0.79
Chiller - Chilled Water Variable-Flow System	Cooling	8%	0%	30%	34%	$0.09	10	1.00
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	75%	$0.90	20	0.66
Chiller - VSD	Cooling	28%	0%	3%	75%	$1.17	20	0.47
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	25%	37%	$0.04	10	0.01
Chiller - Condenser Water Temprature Reset	Cooling	9%	0%	0%	75%	$0.09	14	1.49
Cooling - Economizer Installation	Cooling	11%	0%	73%	81%	$0.15	15	1.20
Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	5%	95%	$0.06	4	2.91
Insulation - Ducting	Cooling	8%	0%	2%	50%	$0.41	20	0.77
Insulation - Ducting	Space Heating	3%	1%	2%	50%	$0.41	20	0.77
Repair and Sealing - Ducting	Cooling	5%	0%	5%	25%	$0.38	15	0.65
Repair and Sealing - Ducting	Space Heating	5%	3%	5%	25%	$0.38	15	0.65
Energy Management System	Cooling	12%	0%	80%	90%	$0.35	14	1.21
Energy Management System	Space Heating	9%	6%	80%	90%	$0.35	14	1.21
Energy Management System	Interior Lighting	5%	3%	80%	90%	$0.35	14	1.21
Cooking - Exhaust Hoods with Sensor Control	Ventilation	13%	7%	1%	8%	$0.04	10	3.46
Fans - Energy Efficient Motors	Ventilation	5%	5%	11%	90%	$0.05	10	1.30
Fans - Variable Speed Control	Ventilation	15%	5%	2%	90%	$0.20	10	0.83
Retrocommissioning - HVAC	Cooling	12%	0%	15%	90%	$0.20	4	1.00
Retrocommissioning - HVAC	Space Heating	12%	9%	15%	90%	$0.20	4	1.00
Retrocommissioning - HVAC	Ventilation	9%	6%	15%	90%	$0.20	4	1.00
Pumps - Variable Speed Control	Miscellaneous	1%	0%	1%	34%	$0.44	10	1.01
Thermostat - Clock/Programmable	Cooling	3%	0%	25%	50%	$0.13	11	0.69
Thermostat - Clock/Programmable	Space Heating	3%	1%	25%	50%	$0.13	11	0.69
Insulation - Ceiling	Cooling	1%	0%	2%	9%	$0.85	20	0.48
Insulation - Ceiling	Space Heating	12%	3%	2%	9%	$0.85	20	0.48
Insulation - Radiant Barrier	Cooling	1%	0%	2%	13%	$0.26	20	0.57
Insulation - Radiant Barrier	Space Heating	4%	2%	2%	13%	$0.26	20	0.57
Roofs - High Reflectivity	Cooling	10%	0%	0%	95%	$0.18	15	0.90
Windows - High Efficiency	Cooling	6%	0%	95%	100%	$2.10	20	0.37
Windows - High Efficiency	Space Heating	2%	2%	95%	100%	$2.10	20	0.37
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	78%	90%	$0.65	8	0.26
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	Interior Lighting	25%	13%	3%	45%	$0.40	8	0.72
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	2%	10%	$0.29	8	0.45
Interior Fluorescent - Delamp and Install Reflectors	Interior Lighting	30%	15%	3%	25%	$0.50	11	0.93
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$0.20	8	0.57
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	23%	$0.56	11	1.38
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	42%	45%	$0.20	8	0.84
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.23
Interior Screw-in - Task Lighting	Interior Lighting	10%	5%	5%	75%	$0.24	5	0.18
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	12%	56%	$0.20	8	0.42
Water Heater - Faucet Aerators/Low Flow Nozzles	Water Heating	4%	1%	2%	90%	$0.03	9	2.66
Water Heater - Pipe Insulation	Water Heating	6%	3%	0%	0%	$0.28	15	0.70
Water Heater - High Efficiency Circulation Pump	Water Heating	5%	4%	0%	23%	$0.11	10	1.19
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$0.04	10	5.48
Water Heater - Thermostat Setback	Water Heating	4%	0%	0%	0%	$0.11	10	0.72
Water Heater - Hot Water Saver	Water Heating	5%	1%	0%	0%	$0.04	5	1.45
Refrigeration - Anti-Sweat Heater/Auto Door Closer	Refrigeration	5%	3%	10%	75%	$0.20	16	0.02
Refrigeration - Floating Head Pressure	Refrigeration	7%	4%	10%	38%	$0.35	16	0.34
Refrigeration - Door Gasket Replacement	Refrigeration	4%	2%	5%	75%	$0.10	8	0.13
Insulation - Bare Suction Lines	Refrigeration	3%	2%	5%	75%	$0.10	8	0.28
Refrigeration - Night Covers	Refrigeration	6%	3%	5%	75%	$0.05	8	0.29
Refrigeration - Strip Curtain	Refrigeration	4%	2%	5%	56%	$0.02	8	0.18
Retrocommissioning - Comprehensive	Cooling	12%	0%	40%	90%	$0.25	4	1.21
Retrocommissioning - Comprehensive	Space Heating	12%	9%	40%	90%	$0.25	4	1.21
Retrocommissioning - Comprehensive	Interior Lighting	12%	9%	40%	90%	$0.25	4	1.21
Office Equipment - Energy Star Power Supply	Office Equipment	1%	1%	10%	95%	$0.00	7	39.11
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	10	1.12
LED Exit Lighting	Interior Lighting	2%	2%	9%	86%	$0.00	10	18.34
Retrocommissioning - Lighting	Interior Lighting	9%	6%	5%	90%	$0.05	5	2.54
Retrocommissioning - Lighting	Exterior Lighting	9%	6%	5%	90%	$0.05	5	2.54
Refrigeration - High Efficiency Case Lighting	Refrigeration	4%	2%	5%	75%	$0.20	8	0.04
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	1.61
Exterior Lighting - Induction Lamps	Exterior Lighting	3%	3%	5%	56%	$0.00	5	6.95
Laundry - High Efficiency Clothes Washer	Miscellaneous	0%	0%	5%	10%	$0.00	10	20.31
Interior Lighting - Hotel Guestroom Controls	Interior Lighting	10%	5%	0%	0%	$0.14	8	0.47
Miscellaneous - Energy Star Water Cooler	Miscellaneous	0%	0%	5%	95%	$0.00	8	1.07
Industrial Process Improvements	Miscellaneous	10%	8%	0%	0%	$0.52	10	1.11
Custom Measures	Cooling	10%	0%	10%	45%	$0.67	15	1.09
Custom Measures	Space Heating	10%	8%	10%	45%	$0.67	15	1.09
Custom Measures	Interior Lighting	10%	8%	10%	45%	$0.67	15	1.09
Custom Measures	Food Preparation	10%	8%	10%	45%	$0.67	15	1.09
Custom Measures	Refrigeration	10%	8%	10%	45%	$0.67	15	1.09
Water Heater - Heat Pump	Water Heating	30%	15%	0%	41%	$0.80	15	1.28
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	0%	$4.00	15	1.00
Furnace - Convert to Gas	Space Heating	100%	100%	0%	0%	$4.00	15	1.66

Note: Costs are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1045 of 1069

Table D-13 Energy Efficiency Measure Data — Extra Large Industrial, Existing Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Refrigeration - System Controls	Process	11%	8%	5%	34%	$0.40	10	18.09
Refrigeration - System Maintenance	Process	3%	2%	5%	34%	$0.00	10	2,067.93
Refrigeration - System Optimization	Process	15%	11%	5%	34%	$0.80	10	12.92
Motors - Variable Frequency Drive	Machine Drive	13%	9%	25%	38%	$0.10	10	3.38
Motors - Magnetic Adjustable Speed Drives	Machine Drive	13%	9%	25%	38%	$0.10	10	3.38
Compressed Air - System Controls	Machine Drive	9%	7%	5%	34%	$0.40	10	0.59
Compressed Air - System Optimization and Improvements	Machine Drive	13%	9%	5%	34%	$0.80	10	0.42
Compressed Air - System Maintenance	Machine Drive	3%	2%	5%	34%	$0.20	10	0.34
Compressed Air - Compressor Replacement	Machine Drive	5%	4%	5%	34%	$0.20	10	0.68
Fan System - Controls	Machine Drive	4%	3%	10%	38%	$0.35	10	0.11
Fan System - Controls	Machine Drive	4%	3%	10%	38%	$0.35	10	0.11
Fan System - Optimization	Machine Drive	6%	5%	10%	38%	$0.70	10	0.08
Fan System - Optimization	Machine Drive	6%	5%	10%	38%	$0.70	10	0.08
Fan System - Maintenance	Machine Drive	1%	1%	10%	38%	$0.15	10	0.07
Fan System - Maintenance	Machine Drive	1%	1%	10%	38%	$0.15	10	0.07
Pumping System - Controls	Machine Drive	5%	4%	5%	34%	$0.38	12	0.43
Pumping System - Optimization	Machine Drive	13%	9%	5%	34%	$0.75	12	0.54
Pumping System - Maintenance	Machine Drive	2%	1%	5%	34%	$0.19	10	0.27
RTU - Maintenance	Cooling	14%	0%	22%	90%	$0.06	4	3.18
Chiller - Chilled Water Reset	Cooling	14%	0%	30%	75%	$0.09	4	2.69
Chiller - Chilled Water Variable-Flow System	Cooling	5%	0%	30%	34%	$0.20	10	1.05
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	67%	$0.90	20	2.48
Chiller - VSD	Cooling	26%	0%	15%	67%	$1.17	20	1.68
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	25%	50%	$0.04	10	0.03
Chiller - Condenser Water Temprature Reset	Cooling	10%	0%	0%	75%	$0.20	14	2.72
Cooling - Economizer Installation	Cooling	6%	0%	29%	34%	$0.15	15	2.02
Heat Pump - Maintenance	Combined Heating/Cooling	7%	7%	2%	95%	$0.03	4	8.67
Insulation - Ducting	Space Heating	6%	6%	12%	50%	$0.41	20	1.01
Insulation - Ducting	Cooling	3%	0%	12%	50%	$0.41	20	1.01
Repair and Sealing - Ducting	Cooling	2%	0%	5%	25%	$0.38	15	0.63
Repair and Sealing - Ducting	Space Heating	2%	1%	5%	25%	$0.38	15	0.63
Energy Management System	Cooling	6%	0%	11%	90%	$0.35	14	1.09
Energy Management System	Space Heating	5%	3%	11%	90%	$0.35	14	1.09
Energy Management System	Interior Lighting	2%	1%	11%	90%	$0.35	14	1.09
Fans - Energy Efficient Motors	Ventilation	5%	5%	2%	90%	$0.14	10	2.94
Fans - Variable Speed Control	Ventilation	15%	5%	3%	90%	$0.20	10	5.29
Retrocommissioning - HVAC	Cooling	12%	0%	1%	70%	$0.25	4	1.54
Retrocommissioning - HVAC	Space Heating	12%	9%	1%	70%	$0.25	4	1.54
Retrocommissioning - HVAC	Ventilation	9%	6%	1%	70%	$0.25	4	1.54
Pumps - Variable Speed Control	Machine Drive	5%	4%	0%	34%	$0.44	10	0.31
Thermostat - Clock/Programmable	Cooling	5%	0%	59%	70%	$0.13	11	2.11
Thermostat - Clock/Programmable	Space Heating	5%	1%	59%	70%	$0.13	11	2.11
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	84%	90%	$0.65	8	0.17
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	2%	27%	$0.08	8	0.46
Interior Fluorescent - Delamp and Install Reflectors	Interior Lighting	20%	10%	17%	38%	$0.50	11	0.31
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	38%	$0.20	11	1.95
LED Exit Lighting	Interior Lighting	2%	2%	9%	86%	$0.00	10	4.00
Retrocommissioning - Lighting	Interior Lighting	9%	6%	9%	70%	$0.05	5	1.44
Retrocommissioning - Lighting	Exterior Lighting	9%	6%	9%	70%	$0.05	5	1.44
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	15%	45%	$0.20	8	0.55
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.07
Interior Screw-in - Task Lighting	Interior Lighting	7%	4%	10%	75%	$0.24	5	0.03
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	2%	56%	$0.20	8	0.27
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	0.46
Custom Measures	Cooling	10%	0%	10%	45%	$1.60	15	1.63
Custom Measures	Space Heating	10%	8%	10%	45%	$1.60	15	1.63
Custom Measures	Interior Lighting	10%	8%	10%	45%	$1.60	15	1.63
Custom Measures	Machine Drive	10%	8%	10%	45%	$1.60	15	1.63
Furnace - Convert to Gas	Space Heating	100%	100%	0%	0%	$4.00	15	2.67

Note: Costs are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista

Table D-14 Energy Efficiency Measure Data — Small/Medium Comm., New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
RTU - Maintenance	Cooling	14%	0%	14%	90%	$0.08	4	0.82
RTU - Evaporative Precooler	Cooling	10%	0%	0%	0%	$0.88	15	0.18
Chiller - Chilled Water Reset	Cooling	11%	0%	0%	0%	$0.86	4	0.06
Chiller - Chilled Water Variable-Flow System	Cooling	4%	0%	0%	0%	$0.86	10	0.05
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	0%	$0.90	20	0.63
Chiller - VSD	Cooling	26%	0%	0%	0%	$1.17	20	0.42
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	0%	0%	$0.04	10	0.01
Chiller - Condenser Water Temprature Reset	Cooling	8%	0%	0%	0%	$0.87	14	0.13
Cooling - Economizer Installation	Cooling	6%	0%	45%	49%	$0.15	15	0.65
Heat Pump - Maintenance	Combined Heating/Cooling	7%	7%	10%	95%	$0.03	4	4.32
Insulation - Ducting	Cooling	5%	0%	9%	50%	$0.41	20	0.64
Insulation - Ducting	Space Heating	3%	1%	9%	50%	$0.41	20	0.64
Energy Management System	Cooling	5%	0%	24%	75%	$0.35	14	0.55
Energy Management System	Space Heating	2%	1%	24%	75%	$0.35	14	0.55
Energy Management System	Interior Lighting	2%	1%	24%	75%	$0.35	14	0.55
Cooking - Exhaust Hoods with Sensor Control	Ventilation	25%	13%	1%	15%	$0.04	10	7.04
Fans - Energy Efficient Motors	Ventilation	5%	5%	11%	90%	$0.05	10	1.32
Fans - Variable Speed Control	Ventilation	15%	5%	8%	90%	$0.20	10	0.85
Commissioning - HVAC	Cooling	5%	0%	40%	75%	$0.90	25	0.33
Commissioning - HVAC	Space Heating	5%	4%	40%	75%	$0.90	25	0.33
Commissioning - HVAC	Ventilation	5%	4%	40%	75%	$0.90	25	0.33
Pumps - Variable Speed Control	Miscellaneous	1%	0%	5%	34%	$0.44	10	1.01
Thermostat - Clock/Programmable	Cooling	5%	0%	34%	50%	$0.13	11	1.06
Thermostat - Clock/Programmable	Space Heating	5%	1%	34%	50%	$0.13	11	1.06
Insulation - Ceiling	Cooling	1%	0%	10%	81%	$0.16	20	1.60
Insulation - Ceiling	Space Heating	15%	4%	10%	81%	$0.16	20	1.60
Insulation - Radiant Barrier	Cooling	2%	0%	7%	13%	$0.26	20	0.76
Insulation - Radiant Barrier	Space Heating	6%	2%	7%	13%	$0.26	20	0.76
Roofs - High Reflectivity	Cooling	7%	0%	5%	95%	$0.09	15	1.25
Windows - High Efficiency	Cooling	5%	0%	61%	75%	$0.35	20	0.69
Windows - High Efficiency	Space Heating	3%	2%	61%	75%	$0.35	20	0.69
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	81%	90%	$0.65	8	0.31
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	Interior Lighting	25%	13%	1%	45%	$0.38	8	1.07
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	10%	75%	$0.09	8	1.50
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$0.50	8	0.32
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	23%	$0.70	11	1.56
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	7%	45%	$0.20	8	1.00
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.24
Interior Screw-in - Task Lighting	Interior Lighting	7%	4%	25%	75%	$0.24	5	0.08
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	9%	56%	$0.20	8	0.50
Water Heater - Faucet Aerators/Low Flow Nozzles	Water Heating	4%	1%	8%	90%	$0.01	9	4.22
Water Heater - Pipe Insulation	Water Heating	4%	2%	46%	50%	$0.28	15	0.24
Water Heater - High Efficiency Circulation Pump	Water Heating	5%	4%	0%	0%	$0.11	10	0.63
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	40%	50%	$0.02	10	5.80
Water Heater - Thermostat Setback	Water Heating	4%	0%	10%	75%	$0.11	10	0.38
Water Heater - Hot Water Saver	Water Heating	5%	1%	0%	0%	$0.02	5	1.53
Refrigeration - Anti-Sweat Heater/Auto Door Closer	Refrigeration	5%	3%	0%	75%	$0.20	16	1.09
Refrigeration - Floating Head Pressure	Refrigeration	7%	4%	18%	38%	$0.35	16	1.24
Refrigeration - Door Gasket Replacement	Refrigeration	4%	2%	5%	75%	$0.10	8	0.09
Insulation - Bare Suction Lines	Refrigeration	3%	2%	5%	75%	$0.10	8	0.20
Refrigeration - Night Covers	Refrigeration	6%	3%	5%	75%	$0.05	8	1.02
Refrigeration - Strip Curtain	Refrigeration	4%	2%	5%	56%	$0.02	8	0.00
Commissioning - Comprehensive	Cooling	10%	0%	40%	75%	$1.25	25	0.83
Commissioning - Comprehensive	Space Heating	10%	7%	40%	75%	$1.25	25	0.83
Commissioning - Comprehensive	Interior Lighting	10%	7%	40%	75%	$1.25	25	0.83
Office Equipment - Energy Star Power Supply	Office Equipment	1%	1%	10%	95%	$0.00	7	61.07
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	10	1.08
LED Exit Lighting	Interior Lighting	2%	2%	85%	86%	$0.00	10	11.83
Commissioning - Lighting	Interior Lighting	5%	4%	30%	75%	$0.20	25	1.54
Commissioning - Lighting	Exterior Lighting	5%	4%	30%	75%	$0.20	25	1.54
Refrigeration - High Efficiency Case Lighting	Refrigeration	4%	2%	5%	75%	$0.20	8	0.00
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	1.23
Exterior Lighting - Induction Lamps	Exterior Lighting	3%	3%	5%	56%	$0.00	5	7.30
Laundry - High Efficiency Clothes Washer	Miscellaneous	0%	0%	5%	10%	$0.00	10	36.95
Interior Lighting - Hotel Guestroom Controls	Interior Lighting	10%	5%	0%	0%	$0.14	8	0.30
Miscellaneous - Energy Star Water Cooler	Miscellaneous	0%	0%	5%	95%	$0.00	8	1.95
Advanced New Construction Designs	Cooling	40%	0%	5%	75%	$2.00	35	2.01
Advanced New Construction Designs	Space Heating	40%	30%	5%	75%	$2.00	35	2.01
Advanced New Construction Designs	Interior Lighting	25%	19%	5%	75%	$2.00	35	2.01
Insulation - Wall Cavity	Cooling	1%	0%	10%	68%	$0.34	20	0.72
Insulation - Wall Cavity	Space Heating	10%	2%	10%	68%	$0.34	20	0.72
Roofs - Green	Cooling	7%	0%	2%	11%	$1.00	30	0.26
Roofs - Green	Space Heating	4%	3%	2%	11%	$1.00	30	0.26
Industrial Process Improvements	Miscellaneous	10%	8%	0%	23%	$0.52	10	1.16
Custom Measures	Cooling	8%	0%	10%	45%	$1.50	15	0.45
Custom Measures	Space Heating	8%	6%	10%	45%	$1.50	15	0.45
Custom Measures	Interior Lighting	8%	6%	10%	45%	$1.50	15	0.45
Custom Measures	Food Preparation	8%	6%	10%	45%	$1.50	15	0.45
Custom Measures	Refrigeration	8%	6%	10%	45%	$1.50	15	0.45
Water Heater - Heat Pump	Water Heating	30%	15%	0%	19%	$0.80	15	0.68
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	50%	$4.00	15	0.53
Furnace - Convert to Gas	Space Heating	100%	100%	0%	47%	$8.04	15	1.01

Note: Costs are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1047 of 1069

Table D-15 Energy Efficiency Measure Data — Large Commercial, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
RTU - Maintenance	Cooling	14%	0%	27%	90%	$0.06	4	1.13
RTU - Evaporative Precooler	Cooling	10%	0%	0%	0%	$0.88	15	0.19
Chiller - Chilled Water Reset	Cooling	18%	0%	30%	75%	$0.18	4	0.42
Chiller - Chilled Water Variable-Flow System	Cooling	5%	0%	30%	34%	$0.18	10	0.28
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	66%	$0.90	20	0.61
Chiller - VSD	Cooling	32%	0%	15%	66%	$1.17	20	0.50
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	15%	41%	$0.04	10	0.01
Chiller - Condenser Water Temprature Reset	Cooling	8%	0%	25%	75%	$0.18	14	0.63
Cooling - Economizer Installation	Cooling	11%	0%	44%	49%	$0.15	15	1.19
Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	10%	95%	$0.06	4	2.72
Insulation - Ducting	Cooling	4%	0%	8%	50%	$0.41	20	0.56
Insulation - Ducting	Space Heating	3%	1%	8%	50%	$0.41	20	0.56
Energy Management System	Cooling	21%	0%	48%	90%	$0.35	14	2.10
Energy Management System	Space Heating	8%	5%	48%	90%	$0.35	14	2.10
Energy Management System	Interior Lighting	9%	6%	48%	90%	$0.35	14	2.10
Cooking - Exhaust Hoods with Sensor Control	Ventilation	13%	7%	1%	11%	$0.04	10	2.84
Fans - Energy Efficient Motors	Ventilation	5%	5%	11%	90%	$0.05	10	1.07
Fans - Variable Speed Control	Ventilation	15%	5%	2%	90%	$0.20	10	0.68
Commissioning - HVAC	Cooling	5%	0%	50%	75%	$0.85	25	0.30
Commissioning - HVAC	Space Heating	5%	4%	50%	75%	$0.85	25	0.30
Commissioning - HVAC	Ventilation	5%	4%	50%	75%	$0.85	25	0.30
Pumps - Variable Speed Control	Miscellaneous	1%	0%	5%	34%	$0.13	10	1.05
Thermostat - Clock/Programmable	Cooling	5%	0%	33%	50%	$0.13	11	0.97
Thermostat - Clock/Programmable	Space Heating	5%	1%	33%	50%	$0.13	11	0.97
Insulation - Ceiling	Cooling	1%	0%	75%	81%	$0.35	20	0.60
Insulation - Ceiling	Space Heating	10%	3%	75%	81%	$0.35	20	0.60
Insulation - Radiant Barrier	Cooling	1%	0%	7%	13%	$0.26	20	0.56
Insulation - Radiant Barrier	Space Heating	5%	2%	7%	13%	$0.26	20	0.56
Roofs - High Reflectivity	Cooling	4%	0%	5%	95%	$0.05	15	1.28
Windows - High Efficiency	Cooling	12%	0%	72%	75%	$0.88	20	0.72
Windows - High Efficiency	Space Heating	11%	8%	72%	75%	$0.88	20	0.72
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	86%	90%	$0.65	8	0.30
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	Interior Lighting	25%	13%	1%	45%	$0.34	8	1.14
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	10%	19%	$0.19	8	0.57
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$0.40	8	0.39
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	23%	$0.63	11	1.66
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	13%	45%	$0.20	8	0.99
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.19
Interior Screw-in - Task Lighting	Interior Lighting	10%	5%	10%	75%	$0.24	5	0.11
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	9%	56%	$0.20	8	0.49
Water Heater - Faucet Aerators/Low Flow Nozzles	Water Heating	4%	1%	3%	90%	$0.03	9	1.60
Water Heater - Pipe Insulation	Water Heating	4%	2%	0%	0%	$0.28	15	0.27
Water Heater - High Efficiency Circulation Pump	Water Heating	5%	4%	0%	23%	$0.11	10	0.69
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$0.04	10	3.23
Water Heater - Thermostat Setback	Water Heating	4%	0%	0%	0%	$0.11	10	0.44
Water Heater - Hot Water Saver	Water Heating	5%	1%	0%	3%	$0.04	5	0.87
Refrigeration - Anti-Sweat Heater/Auto Door Closer	Refrigeration	5%	3%	0%	75%	$0.20	16	0.58
Refrigeration - Floating Head Pressure	Refrigeration	7%	4%	38%	45%	$0.35	16	0.94
Refrigeration - Door Gasket Replacement	Refrigeration	4%	2%	5%	75%	$0.10	8	0.63
Insulation - Bare Suction Lines	Refrigeration	3%	2%	5%	75%	$0.10	8	0.35
Refrigeration - Night Covers	Refrigeration	6%	3%	5%	75%	$0.05	8	0.65
Refrigeration - Strip Curtain	Refrigeration	4%	2%	5%	56%	$0.02	8	0.94
Commissioning - Comprehensive	Cooling	10%	0%	40%	75%	$1.00	25	0.96
Commissioning - Comprehensive	Space Heating	10%	7%	40%	75%	$1.00	25	0.96
Commissioning - Comprehensive	Interior Lighting	10%	7%	40%	75%	$1.00	25	0.96
Office Equipment - Energy Star Power Supply	Office Equipment	1%	1%	10%	95%	$0.00	7	67.83
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	10	1.09
LED Exit Lighting	Interior Lighting	2%	2%	85%	86%	$0.00	10	11.13
Commissioning - Lighting	Interior Lighting	5%	4%	60%	75%	$0.15	25	1.99
Commissioning - Lighting	Exterior Lighting	5%	4%	60%	75%	$0.15	25	1.99
Refrigeration - High Efficiency Case Lighting	Refrigeration	4%	2%	5%	75%	$0.20	8	0.52
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	1.03
Exterior Lighting - Induction Lamps	Exterior Lighting	3%	3%	5%	56%	$0.00	5	5.86
Laundry - High Efficiency Clothes Washer	Miscellaneous	0%	0%	5%	10%	$0.00	10	33.94
Interior Lighting - Hotel Guestroom Controls	Interior Lighting	10%	5%	1%	2%	$0.14	8	0.29
Miscellaneous - Energy Star Water Cooler	Miscellaneous	0%	0%	5%	95%	$0.00	8	1.78
Advanced New Construction Designs	Cooling	40%	0%	5%	75%	$2.00	35	1.84
Advanced New Construction Designs	Space Heating	40%	30%	5%	75%	$2.00	35	1.84
Advanced New Construction Designs	Interior Lighting	25%	19%	5%	75%	$2.00	35	1.84
Insulation - Wall Cavity	Cooling	1%	0%	9%	68%	$0.78	20	0.43
Insulation - Wall Cavity	Space Heating	10%	2%	9%	68%	$0.78	20	0.43
Roofs - Green	Cooling	4%	0%	2%	13%	$1.00	15	0.08
Roofs - Green	Space Heating	2%	2%	2%	13%	$1.00	15	0.08
Industrial Process Improvements	Miscellaneous	10%	8%	0%	5%	$0.52	10	1.18
Custom Measures	Cooling	8%	0%	10%	45%	$0.90	15	0.73
Custom Measures	Space Heating	8%	6%	10%	45%	$0.90	15	0.73
Custom Measures	Interior Lighting	8%	6%	10%	45%	$0.90	15	0.73
Custom Measures	Food Preparation	8%	6%	10%	45%	$0.90	15	0.73
Custom Measures	Refrigeration	8%	6%	10%	45%	$0.90	15	0.73
Water Heater - Heat Pump	Water Heating	30%	15%	0%	28%	$0.80	15	0.76
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	0%	$4.00	15	0.58
Furnace - Convert to Gas	Space Heating	100%	100%	0%	0%	$6.00	15	0.98

Note: Costs are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1048 of 1069

Table D-16 Energy Efficiency Measure Data — Extra Large Commercial, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
RTU - Maintenance	Cooling	14%	0%	47%	90%	$0.06	4	1.02
RTU - Evaporative Precooler	Cooling	10%	0%	0%	0%	$0.88	15	0.17
Chiller - Chilled Water Reset	Cooling	12%	0%	60%	75%	$0.09	4	0.61
Chiller - Chilled Water Variable-Flow System	Cooling	8%	0%	30%	34%	$0.09	10	0.95
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	75%	$0.90	20	0.64
Chiller - VSD	Cooling	28%	0%	3%	75%	$1.17	20	0.45
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	25%	37%	$0.04	10	0.01
Chiller - Condenser Water Temprature Reset	Cooling	8%	0%	25%	75%	$0.09	14	1.28
Cooling - Economizer Installation	Cooling	11%	0%	73%	81%	$0.15	15	1.14
Heat Pump - Maintenance	Combined Heating/Cooling	10%	10%	5%	95%	$0.06	4	2.61
Insulation - Ducting	Cooling	7%	0%	2%	50%	$0.41	20	0.71
Insulation - Ducting	Space Heating	3%	1%	2%	50%	$0.41	20	0.71
Energy Management System	Cooling	11%	0%	80%	90%	$0.35	14	0.94
Energy Management System	Space Heating	4%	2%	80%	90%	$0.35	14	0.94
Energy Management System	Interior Lighting	5%	3%	80%	90%	$0.35	14	0.94
Cooking - Exhaust Hoods with Sensor Control	Ventilation	13%	7%	1%	8%	$0.04	10	3.31
Fans - Energy Efficient Motors	Ventilation	5%	5%	11%	90%	$0.05	10	1.24
Fans - Variable Speed Control	Ventilation	15%	5%	2%	90%	$0.20	10	0.80
Commissioning - HVAC	Cooling	5%	0%	50%	75%	$0.70	25	0.42
Commissioning - HVAC	Space Heating	5%	4%	50%	75%	$0.70	25	0.42
Commissioning - HVAC	Ventilation	5%	4%	50%	75%	$0.70	25	0.42
Pumps - Variable Speed Control	Miscellaneous	1%	0%	1%	34%	$0.44	10	1.01
Thermostat - Clock/Programmable	Cooling	3%	0%	25%	50%	$0.13	11	0.67
Thermostat - Clock/Programmable	Space Heating	3%	1%	25%	50%	$0.13	11	0.67
Insulation - Ceiling	Cooling	1%	0%	2%	81%	$0.35	20	0.68
Insulation - Ceiling	Space Heating	10%	3%	2%	81%	$0.35	20	0.68
Insulation - Radiant Barrier	Cooling	1%	0%	2%	13%	$0.26	20	0.47
Insulation - Radiant Barrier	Space Heating	2%	1%	2%	13%	$0.26	20	0.47
Roofs - High Reflectivity	Cooling	10%	0%	5%	95%	$0.18	15	0.85
Windows - High Efficiency	Cooling	6%	0%	95%	100%	$1.69	20	0.38
Windows - High Efficiency	Space Heating	2%	2%	95%	100%	$1.69	20	0.38
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	78%	90%	$0.65	8	0.23
Interior Lighting - Photocell Controlled T8 Dimming Ballasts	Interior Lighting	25%	13%	3%	45%	$0.30	8	0.86
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	10%	15%	$0.19	8	0.61
Interior Fluorescent - Bi-Level Fixture w/Occupancy Sensor	Interior Lighting	10%	5%	10%	23%	$0.20	8	0.52
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	23%	$0.56	11	1.24
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	42%	45%	$0.20	8	0.76
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.20
Interior Screw-in - Task Lighting	Interior Lighting	10%	5%	25%	75%	$0.24	5	0.16
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	12%	56%	$0.20	8	0.38
Water Heater - Faucet Aerators/Low Flow Nozzles	Water Heating	4%	1%	2%	90%	$0.03	9	2.63
Water Heater - Pipe Insulation	Water Heating	6%	3%	0%	0%	$0.28	15	0.69
Water Heater - High Efficiency Circulation Pump	Water Heating	5%	4%	0%	23%	$0.11	10	1.18
Water Heater - Tank Blanket/Insulation	Water Heating	9%	5%	0%	0%	$0.04	10	5.43
Water Heater - Thermostat Setback	Water Heating	4%	0%	0%	0%	$0.11	10	0.71
Water Heater - Hot Water Saver	Water Heating	5%	1%	0%	0%	$0.04	5	1.43
Refrigeration - Anti-Sweat Heater/Auto Door Closer	Refrigeration	5%	3%	10%	75%	$0.20	16	0.02
Refrigeration - Floating Head Pressure	Refrigeration	7%	4%	10%	38%	$0.35	16	0.32
Refrigeration - Door Gasket Replacement	Refrigeration	4%	2%	5%	75%	$0.10	8	0.12
Insulation - Bare Suction Lines	Refrigeration	3%	2%	5%	75%	$0.10	8	0.26
Refrigeration - Night Covers	Refrigeration	6%	3%	5%	75%	$0.05	8	0.27
Refrigeration - Strip Curtain	Refrigeration	4%	2%	5%	56%	$0.02	8	0.17
Commissioning - Comprehensive	Cooling	10%	0%	40%	75%	$0.80	25	1.05
Commissioning - Comprehensive	Space Heating	10%	7%	40%	75%	$0.80	25	1.05
Commissioning - Comprehensive	Interior Lighting	10%	7%	40%	75%	$0.80	25	1.05
Office Equipment - Energy Star Power Supply	Office Equipment	1%	1%	10%	95%	$0.00	7	38.86
Vending Machine - Controller	Refrigeration	15%	11%	2%	10%	$0.27	10	1.10
LED Exit Lighting	Interior Lighting	2%	2%	85%	86%	$0.00	10	16.52
Commissioning - Lighting	Interior Lighting	5%	4%	60%	75%	$0.10	25	2.47
Commissioning - Lighting	Exterior Lighting	5%	4%	60%	75%	$0.10	25	2.47
Refrigeration - High Efficiency Case Lighting	Refrigeration	4%	2%	5%	75%	$0.20	8	0.04
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	1.45
Exterior Lighting - Induction Lamps	Exterior Lighting	3%	3%	5%	56%	$0.00	5	6.26
Laundry - High Efficiency Clothes Washer	Miscellaneous	0%	0%	5%	10%	$0.00	10	20.31
Interior Lighting - Hotel Guestroom Controls	Interior Lighting	10%	5%	0%	0%	$0.14	8	0.42
Miscellaneous - Energy Star Water Cooler	Miscellaneous	0%	0%	5%	95%	$0.00	8	1.07
Advanced New Construction Designs	Cooling	40%	0%	5%	75%	$2.00	35	1.67
Advanced New Construction Designs	Space Heating	40%	30%	5%	75%	$2.00	35	1.67
Advanced New Construction Designs	Interior Lighting	25%	19%	5%	75%	$2.00	35	1.67
Insulation - Wall Cavity	Cooling	1%	0%	2%	68%	$0.09	20	1.73
Insulation - Wall Cavity	Space Heating	10%	2%	2%	68%	$0.09	20	1.73
Roofs - Green	Cooling	10%	0%	2%	13%	$1.00	15	0.20
Roofs - Green	Space Heating	5%	3%	2%	13%	$1.00	15	0.20
Industrial Process Improvements	Miscellaneous	10%	8%	0%	0%	$0.52	10	1.11
Custom Measures	Cooling	8%	0%	10%	45%	$0.67	15	0.81
Custom Measures	Space Heating	8%	6%	10%	45%	$0.67	15	0.81
Custom Measures	Interior Lighting	8%	6%	10%	45%	$0.67	15	0.81
Custom Measures	Food Preparation	8%	6%	10%	45%	$0.67	15	0.81
Custom Measures	Refrigeration	8%	6%	10%	45%	$0.67	15	0.81
Water Heater - Heat Pump	Water Heating	30%	15%	0%	41%	$0.80	15	1.27
Water Heater - Convert to Gas	Water Heating	100%	100%	0%	0%	$4.00	15	1.00
Furnace - Convert to Gas	Space Heating	100%	100%	0%	0%	$4.00	15	1.57

Note: Costs are per sq. ft.

Table D-17 Energy Efficiency Measure Data — Extra Large Industrial, New Vintage

Measure	Enduse	Energy Savings	Demand Savings	Base Saturation	Appl./ Feas.	Cost	Lifetime	BC Ratio
Refrigeration - System Controls	Process	11%	8%	5%	34%	$0.40	10	18.09
Refrigeration - System Maintenance	Process	3%	2%	5%	34%	$0.00	10	2,067.93
Refrigeration - System Optimization	Process	15%	11%	5%	34%	$0.80	10	12.92
Motors - Variable Frequency Drive	Machine Drive	13%	9%	25%	38%	$0.10	10	3.38
Motors - Magnetic Adjustable Speed Drives	Machine Drive	13%	9%	25%	38%	$0.10	10	3.38
Compressed Air - System Controls	Machine Drive	9%	7%	5%	34%	$0.40	10	0.59
Compressed Air - System Optimization and Improvements	Machine Drive	13%	9%	5%	34%	$0.80	10	0.42
Compressed Air - System Maintenance	Machine Drive	3%	2%	5%	34%	$0.20	10	0.34
Compressed Air - Compressor Replacement	Machine Drive	5%	4%	5%	34%	$0.20	10	0.68
Fan System - Controls	Machine Drive	4%	3%	10%	38%	$0.35	10	0.11
Fan System - Controls	Machine Drive	4%	3%	10%	38%	$0.35	10	0.11
Fan System - Optimization	Machine Drive	6%	5%	10%	38%	$0.70	10	0.08
Fan System - Optimization	Machine Drive	6%	5%	10%	38%	$0.70	10	0.08
Fan System - Maintenance	Machine Drive	1%	1%	10%	38%	$0.15	10	0.07
Fan System - Maintenance	Machine Drive	1%	1%	10%	38%	$0.15	10	0.07
Pumping System - Controls	Machine Drive	5%	4%	5%	34%	$0.38	12	0.42
Pumping System - Optimization	Machine Drive	13%	9%	5%	34%	$0.75	12	0.54
Pumping System - Maintenance	Machine Drive	2%	1%	5%	34%	$0.19	10	0.27
RTU - Maintenance	Cooling	14%	0%	22%	90%	$0.06	4	2.82
Chiller - Chilled Water Reset	Cooling	14%	0%	60%	75%	$0.09	4	2.53
Chiller - Chilled Water Variable-Flow System	Cooling	4%	0%	30%	34%	$0.20	10	0.80
Chiller - Turbocor Compressor	Cooling	30%	0%	0%	67%	$0.90	20	2.40
Chiller - VSD	Cooling	27%	0%	25%	67%	$1.17	20	1.63
Chiller - High Efficiency Cooling Tower Fans	Cooling	0%	0%	25%	50%	$0.04	10	0.04
Chiller - Condenser Water Temprature Reset	Cooling	10%	0%	5%	75%	$0.20	14	2.60
Cooling - Economizer Installation	Cooling	6%	0%	29%	34%	$0.15	15	1.92
Heat Pump - Maintenance	Combined Heating/Cooling	7%	7%	2%	95%	$0.03	4	7.76
Insulation - Ducting	Space Heating	5%	5%	12%	50%	$0.41	20	0.95
Insulation - Ducting	Cooling	3%	0%	12%	50%	$0.41	20	0.95
Energy Management System	Cooling	5%	0%	11%	90%	$0.35	14	0.88
Energy Management System	Space Heating	2%	1%	11%	90%	$0.35	14	0.88
Energy Management System	Interior Lighting	2%	1%	11%	90%	$0.35	14	0.88
Fans - Energy Efficient Motors	Ventilation	5%	5%	2%	90%	$0.14	10	2.81
Fans - Variable Speed Control	Ventilation	15%	5%	3%	90%	$0.34	10	2.97
Commissioning - HVAC	Cooling	5%	0%	60%	75%	$0.70	25	0.92
Commissioning - HVAC	Space Heating	5%	4%	60%	75%	$0.70	25	0.92
Commissioning - HVAC	Ventilation	5%	4%	60%	75%	$0.70	25	0.92
Pumps - Variable Speed Control	Machine Drive	5%	4%	0%	34%	$0.44	10	0.31
Thermostat - Clock/Programmable	Cooling	5%	0%	59%	70%	$0.13	11	2.02
Thermostat - Clock/Programmable	Space Heating	5%	1%	59%	70%	$0.13	11	2.02
Interior Lighting - Central Lighting Controls	Interior Lighting	10%	5%	84%	90%	$0.65	8	0.15
Exterior Lighting - Daylighting Controls	Exterior Lighting	30%	0%	10%	40%	$0.08	8	0.42
Interior Fluorescent - High Bay Fixtures	Interior Lighting	50%	25%	10%	38%	$0.20	11	1.76
LED Exit Lighting	Interior Lighting	2%	2%	85%	86%	$0.00	10	3.72
Commissioning - Lighting	Interior Lighting	5%	4%	60%	75%	$0.10	25	1.41
Commissioning - Lighting	Exterior Lighting	5%	4%	60%	75%	$0.10	25	1.41
Interior Lighting - Occupancy Sensors	Interior Lighting	10%	5%	15%	45%	$0.20	8	0.50
Exterior Lighting - Photovoltaic Installation	Exterior Lighting	75%	75%	5%	13%	$0.92	5	0.06
Interior Screw-in - Task Lighting	Interior Lighting	7%	4%	10%	75%	$0.24	5	0.03
Interior Lighting - Time Clocks and Timers	Interior Lighting	5%	3%	2%	56%	$0.20	8	0.25
Exterior Lighting - Cold Cathode Lighting	Exterior Lighting	1%	1%	5%	25%	$0.00	5	0.41
Advanced New Construction Designs	Cooling	40%	0%	5%	75%	$2.00	35	2.67
Advanced New Construction Designs	Space Heating	40%	30%	5%	75%	$2.00	35	2.67
Advanced New Construction Designs	Interior Lighting	25%	19%	5%	75%	$2.00	35	2.67
Custom Measures	Cooling	8%	0%	10%	45%	$1.60	15	1.28
Custom Measures	Space Heating	8%	6%	10%	45%	$1.60	15	1.28
Custom Measures	Interior Lighting	8%	6%	10%	45%	$1.60	15	1.28
Custom Measures	Machine Drive	8%	6%	10%	45%	$1.60	15	1.28
Furnace - Convert to Gas	Space Heating	100%	100%	0%	0%	$4.00	15	2.51

Note: Costs are per sq. ft.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 1, Page 1050 of 1069

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2011 Electric Integrated Resource Plan

Appendix E – North Idaho Transmission Study

Interoffice Memorandum
System Planning

MEMO: **SP-2011-08 Rev A**
DATE: **August 11, 2011**
TO: **James Gall, IRP Group**
FROM: **Reuben Arts**
SUBJECT: **500 MW of New Generation in the Rathdrum Area**

Introduction

Based on initial 2011 IRP analysis 200 MW of new capacity is required in 2019-2020 and an additional 300 MW of capacity in the 2022-2024 time period. North Idaho is one of several potential locations this capacity could be added, but requires further detail to understand its potential.

Problem Statement

The IRP group is specifically interested in the cost for both the point of integration (POI) station and associated system upgrades, to integrate the new generation with the following options:

1. Cabinet-Rathdrum 230 kV transmission line (assume 5 miles from Rathdrum)
2. Rathdrum-Boulder 230 kV transmission line (assume Lancaster looped in, and assume the generation is half way between Lancaster and Rathdrum)
3. Rathdrum-Beacon 230 kV transmission line (assume 1-2 miles from Rathdrum)
4. Double Tap, Rathdrum-Boulder and Rathdrum-Beacon 230 kV transmission lines (again assume Lancaster is looped in and that the new generation will tap between Lancaster and Rathdrum)
5. Mixed location. 300 MW at the least cost option (between 1 and 4) and an additional 200 MW on the Cabinet-Rathdrum 230 kV transmission line.
6. Other Transmission Alternatives

Power Flow Analysis

The case that was used to highlight the impacts of an additional 500 MW in the Rathdrum area was the WECC approved and Avista modified light summer high flow case (AVA-11ls1ae-12BA1251-WOH4277). The West of Hatwai path typically experiences high flows during light Avista load hours. High West of Hatwai flows tend to coincide with high Western Montana Hydro generation, high Boundary generation, high flows on Montana to Northwest, and light loads in Eastern Washington, North Idaho, and Montana. Existing Clark Fork RAS is in place, and assumed armed, since the Western Montana Hydro (WMH) complex is greater than 1450 MW. Since the New Project would require significant Avista system transmission changes, and RAS changes, the results are listed as though RAS were not armed. This does affect the results of some contingencies, but ultimately does not change the conclusions of this memo.

Option 1

Perhaps one of the worst performing arrangements is option 1.This option immediately requires another line, or a line reconductor, from the 500 MW project back to Rathdrum. In order to stay within N-0 thermal limits the project can only be 175 MW without any system upgrades. In a high flow, N-0 scenario, the line segment from the project back to Rathdrum loads to around 163%, which is roughly 272 MW overloaded. There are a handful of N-1 and N-2 contingencies that cause significant thermal violations, the worst N-1 being the loss of the 230 kV transmission line from the new project to Rathdrum. See Figure 1

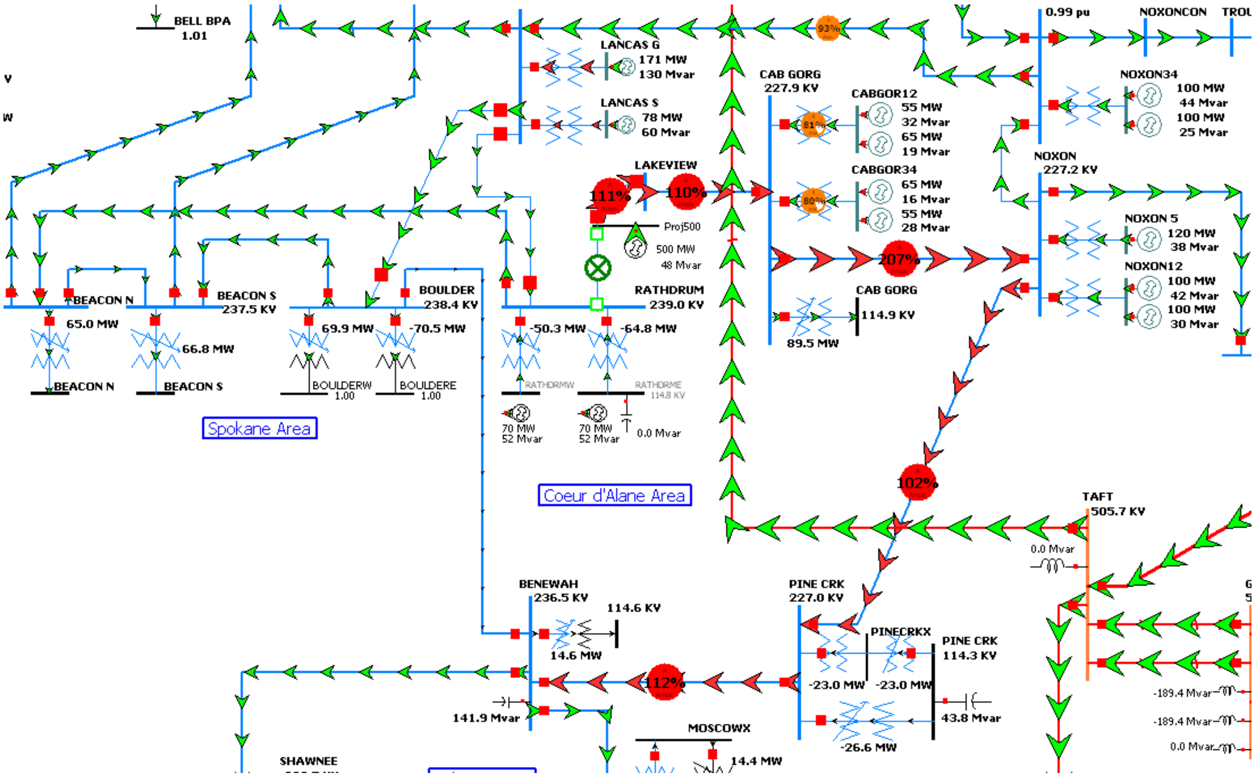

Figure 1 – N-1 Contingency

In addition to this worst case outage there are two N-2 scenarios that cause fairly significant problems as well. The Beacon-Rathdrum and Boulder-Lancaster-Rathdrum 230 kV transmission lines share a common structure for the majority of the line lengths. Losing both lines to the west of Lancaster causes the Bell S3-Lancaster 230 kV transmission line to overload. Losing both lines to the east of Lancaster, causes nearly the same scenario as shown in Figure 1.

To alleviate these overloads three new 230 kV transmission lines, would need to be built. First the Rathdrum-New Project 230 kV transmission line must be reconductored at a cost of roughly $2.25M. Second, A 230 kV transmission line, with new right-of-way, must be built from the New Project to Lancaster. The estimated distance for this line is roughly 5 miles. The estimated loaded cost for this line, including a new line position at Lancaster and at the New Project, is roughly $9M. Finally, another 230 kV transmission line, again with new right-of-way, is required from Lancaster to Boulder. This line length is estimate at roughly 15 miles. The estimated loaded cost of the new line, including new line positions, is roughly $17M. New right-of-way in this area will be difficult to obtain, which would have the potential of more than doubling costs.

RAS may be a viable solution. If at all possible RAS should be a last resort. Unlike improving our transmission system, RAS does not provide operational flexibility and in some cases can compound the impacts of future generation needs. However, it does represent the cheapest solution and is therefore listed as solution 1.

Option 1	N-0 Max. Output	Facility Requirement[1]	Total[2] ($000)
Solution 1	500 MW	Reconductor 230 kV transmission line from new station to Rathdrum, New 230 kV DB-DB Station and RAS[3]	13,250
Solution 2	500 MW	Reconductor from Rathdrum-New Project. New line from Lancaster to New Project. New line from Lancaster to Boulder, New 230 kV DB-DB Station	36,250

Option 2

This option would tap the Rathdrum-Boulder, or what soon will be the Rathdrum-Lancaster-Boulder, 230 kV transmission line. This options has no N-0 issues at the full requested 500 MW. There are a handful of N-1 and N-2 contingencies that cause significant thermal violations, the worst being the loss of the Lancaster-Boulder & Rathdrum-Beacon 230 kV transmission lines. These lines share a common structure and therefore represent a credible N-2 scenario. This outage causes the Lancaster-Bell S3 230 kV transmission line to load to 189%, or roughly 450 MW above its thermal limit. See Figure 2.

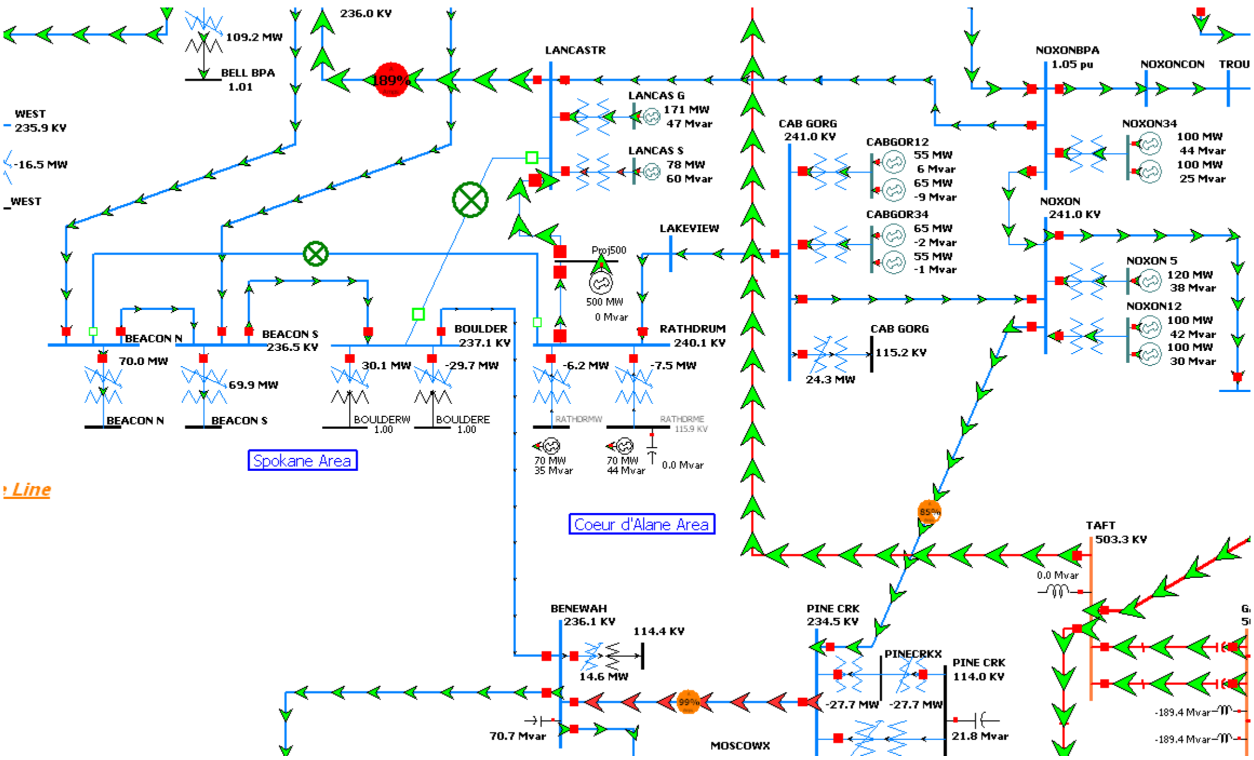

Figure 2 - N-2 Contingency

To alleviate these overloads two new 230 kV transmission lines, would need to be built. A 230 kV transmission line, with new right-of-way, must be built from the New Project to Lancaster. The estimated distance for this line is roughly 3 miles. The estimated loaded cost for this line, including a new line position at Lancaster and at the New Project, is roughly $8M. Another 230 kV transmission line, again with new right-of-way, is required from Lancaster to Boulder. This line length is estimate at roughly 15 miles. The estimated loaded cost of the new line, including new line positions, is roughly $17M. New right-of-way in this area will be difficult to obtain, which would have the potential of more than doubling costs.

[1] Cost estimates do not include costs of the radial line to the POI, the generator or generator station if applicable.
[2] Total is for network and direct assigned costs, are in 2011 dollars, and is +/- 50%.
[3] The RAS portion is a worst case scenario where another fiber loop is required. $3M allocated for RAS.

RAS may be a viable solution. If at all possible RAS should be a last resort. Unlike improving our transmission system, RAS does not provide operational flexibility and in some cases can compound the impacts of future generation needs. However, it does represent the cheapest solution and is therefore listed as solution 1.

Option 2	N-0 Max. Output	Facility Requirement[4]	Total[5] ($000)
Solution 1	500 MW	New 230 kV DB-DB Station and RAS[6]	11,000
Solution 2	500 MW	New line from Lancaster to New Project. New line from Lancaster to Boulder, New 230 kV DB-DB Station	33,000

Option 3

This option taps the Rathdrum-Beacon 230 kV transmission line. Again, this options has no N-0 issues at the full requested 500 MW. There are a handful of N-1 and N-2 contingencies that cause significant thermal violations, the worst being the loss of the Beacon-New Project & Rathdrum-Lancaster 230 kV transmission lines. These lines share a common structure and therefore represent a credible N-2 scenario. This outage forces the entire proposed 500 MW toward Cabinet and Noxon. This causes overloads on the Cabinet-Noxon and Pine Creek-Benewah 230 kV transmission lines. See Figure 3.

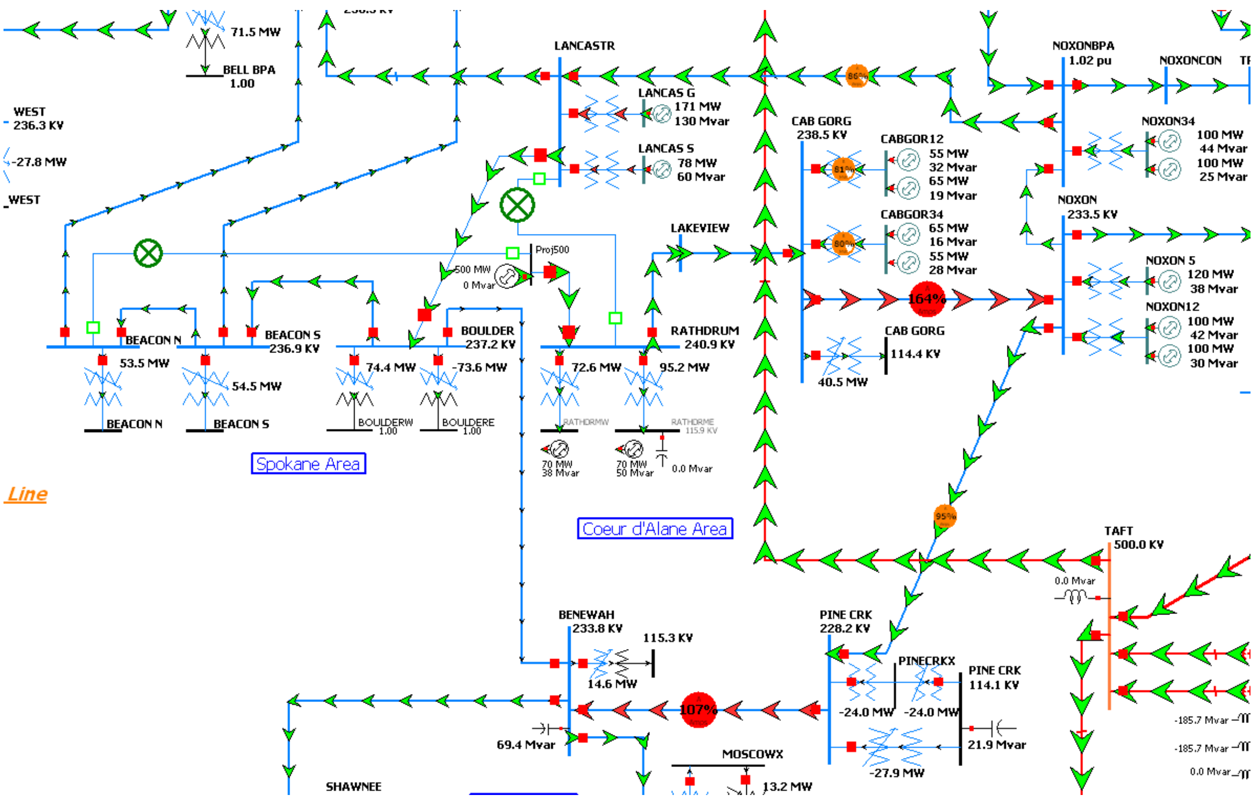

Figure 3 - N-2 Contingency

[4] Cost estimates do not include costs of the radial line to the POI, the generator or generator station if applicable.
[5] Total is for network and direct assigned costs, are in 2011 dollars, and is +/- 50%.
[6] The RAS portion is a worst case scenario where another fiber loop is required. $3M allocated for RAS.

To alleviate these overloads two new 230 kV transmission lines, would need to be built. A 230 kV transmission line, with new right-of-way, must be built from the New Project to Lancaster. The estimated distance for this line is roughly 3 miles. The estimated loaded cost for this line, including a new line position at Lancaster and at the New Project, is roughly $8M. Another 230 kV transmission line, again with new right-of-way, is required from Lancaster to Boulder. This line length is estimate at roughly 15 miles. The estimated loaded cost of the new line, including new line positions, is roughly $17M. New right-of-way in this area will be difficult to obtain, which would have the potential of more than doubling costs.

RAS may be a viable solution. If at all possible RAS should be a last resort. Unlike improving our transmission system, RAS does not provide operational flexibility and in some cases can compound the impacts of future generation needs. However, it does represent the cheapest solution and is therefore listed as solution 1.

Option 3	N-0 Max. Output	Facility Requirement[7]	Total[8] ($000)
Solution 1	500 MW	New 230 kV DB-DB Station and RAS[9]	11,000
Solution 2	500 MW	New line from Lancaster to New Project. New line from Lancaster to Boulder, New 230 kV DB-DB Station	33,000

Option 4

This option taps the Rathdrum-Beacon & Rathdrum-Lancaster 230 kV transmission lines. This options has no N-0 issues at the full requested 500 MW. There are a handful of N-1 and N-2 contingencies that cause significant thermal violations, the worst being the loss of the Beacon-New Project & Lancaster-New Project 230 kV transmission lines. These lines share a common structure and therefore represent a credible N-2 scenario. This outage forces the entire proposed 500 MW toward Cabinet and Noxon. This causes overloads on the Cabinet-Noxon and Pine Creek-Benewah 230 kV transmission lines. (Very similar to Figure 3 on the previous page).

To alleviate these overloads two new 230 kV transmission lines, would need to be built. A 230 kV transmission line, with new right-of-way, must be built from the New Project to Lancaster. The estimated distance for this line is roughly 3 miles. The estimated loaded cost for this line, including a new line position at Lancaster and at the New Project, is roughly $8M. Another 230 kV transmission line, again with new right-of-way, is required from Lancaster to Boulder. This line length is estimate at roughly 15 miles. The estimated loaded cost of the new line, including new line positions, is roughly $17M. New right-of-way in this area will be difficult to obtain, which would have the potential of more than doubling costs.

RAS may be a viable solution. If at all possible RAS should be a last resort. Unlike improving our transmission system, RAS does not provide operational flexibility and in some cases can compound the impacts of future generation needs. However, it does represent the cheapest solution and is therefore listed as solution 1.

Option 4	N-0 Max. Output	Facility Requirement	Total ($000)
Solution 1	500 MW	New 230 kV DB-DB Station and RAS	15,000
Solution 2	500 MW	New line from Lancaster to New Project. New line from Lancaster to Boulder, New 230 kV DB-DB Station	37,000

[7] Cost estimates do not include costs of the radial line to the POI, the generator or generator station if applicable.
[8] Total is for network and direct assigned costs, are in 2011 dollars, and is +/- 50%.
[9] The RAS portion is a worst case scenario where another fiber loop is required. $3M allocated for RAS.

Option 5

This option taps the Rathdrum-Beacon & Rathdrum-Cabinet 230 kV transmission lines. A new switching station is required for each tap. A 300 MW generating station would be on the Beacon-Rathdrum 230 kV transmission line and 200 MW would be on the Rathdrum-Cabinet 230 kV transmission line. This option has no N-0 issues at the full requested 500 MW. There are a handful of N-1 and N-2 contingencies that cause significant thermal violations, the worst being the loss of the Beacon-New Project & Lancaster-Rathdrum 230 kV transmission lines. These lines share a common structure and therefore represent a credible N-2 scenario. This outage forces the entire proposed 500 MW toward Cabinet and Noxon. This causes overloads on the Cabinet-Noxon and Pine Creek-Benewah 230 kV transmission lines. (Very similar to what was shown in Figure 3).

To alleviate these overloads three new 230 kV transmission lines, would need to be built. A 230 kV transmission line, with new right-of-way, must be built from the New Project (300MW piece) to Lancaster. The estimated distance for this line is roughly 5 miles. The estimated loaded cost for this line, including a new line position at Lancaster and at the New Project, is roughly $9M. Another 230 kV transmission line, again with new right-of-way, is required from Lancaster to Boulder. This line length is estimate at roughly 15 miles. The estimated loaded cost of the new line, including new line positions, is roughly $17M. Finally, for the loss of the Rathdrum-New Project (200MW piece) 230 kV transmission line, causes the Cabinet-Noxon 230 kV transmission line to load to 117%. To alleviate this overload a new line, with new right-of-way must be built back to Rathdrum. The estimated loaded cost of this 5 mile line, along with associated line positions, is $9M. New right-of-way in this area will be difficult to obtain, which would have the potential of more than doubling costs.

RAS may be a viable solution. If at all possible RAS should be a last resort. Unlike improving our transmission system, RAS does not provide operational flexibility and in some cases can compound the impacts of future generation needs. However, it does represent the cheapest solution and is therefore listed as solution 1.

Option 5	N-0 Max. Output	Facility Requirement[10]	Total[11] ($000)
Solution 1	500 MW	Two New 230 kV DB-DB Stations and RAS[12]	22,000
Solution 2	500 MW	Two New 230 kV DB-DB Stations, New line from Lancaster to New Project (300MW). New line from Lancaster to Boulder, New line from New Project (200MW) to Rathdrum	51,000

Option 6 – Other Transmission Alternatives

In addition to the five options listed, there are a few more options that may seem to be intuitive interconnection points. These integration options are:

a. Lancaster 230 kV (BPA) switching station
b. Rathdrum 230/115/13.2 kV substation
c. Cabinet-Rathdrum & Noxon-Lancaster 230 kV transmission lines
d. Bell-Taft 500 kV transmission line

Option 6a - Connecting to the Lancaster 230 kV switching station would save Avista the cost of a new switching station. It would also negate the need for a new transmission line, with associated right-of-way, from the new project to Lancaster. The estimated savings, adding the previously quoted loaded costs, less

[10] Cost estimates do not include costs of the radial line to the POI, the generator or generator station if applicable.
[11] Total is for network and direct assigned costs, are in 2011 dollars, and is +/- 50%.
[12] The RAS portion is a worst case scenario where another fiber loop is required. $3M allocated for RAS.

the added cost of connecting to Lancaster, is $13M[13]. This does not take into account any fees associated with connecting to BPA. This option assumes there is room in the Lancaster substation to accept the new line position. If Lancaster substation cannot accommodate the new line position, the cost savings to interconnect at Lancaster may be negligible or non-existent.

This option would still have all the contingency issues and associated upgrades similar to Option 2.

Option 6b - Connecting to the Rathdrum substation saves the cost of building another switching station. All contingency results are nearly identical to connecting the project to option 2 or option 3. The estimated savings of this option is $4M[14]. This option assumes there is room in the Rathdrum substation to accept the new line position. If Rathdrum substation cannot accommodate the new line position, the cost savings to interconnect at Rathdrum may be negligible or non-existent.

Option 6c – Tapping the Cabinet-Rathdrum & Noxon-Lancaster 230 kV transmission lines does improve the network performance, in comparison to tapping only the Cabinet-Rathdrum 230 kV transmission line. However, this option still requires all the same network upgrades that option 1 requires since it is still possible to have an N-2 situation where the generation of the New Project, Noxon and Cabinet is separated from the Coeur d'Alene/Spokane load. (See Figure 1). This option is listed for completeness.

Option 6d - Connecting solely to the Bell-Taft 500 kV transmission line cannot be done without RAS and possibly some network upgrades on BPA's system. In addition to the network upgrades that would likely be required on BPA's system, Avista would also be financially liable to pay wheeling fees from the new project across BPA's lines to Avista's load. If the project is connected to both BPA's Bell-Taft 500 kV transmission line and Avista's Rathdrum area 230 kV system, effectively avoiding wheeling charges, both RAS and significant network upgrades will be required. Due to the cost of a new 500 kV substation, associated RAS and the potentially large cost of network upgrades on BPA's 500 kV system, this option is not recommended.

Conclusion

Of the formally identified options, options 2 and 3 represent the least cost and best performing options. Of the other transmission alternatives, the Lancaster switching station, followed by the Rathdrum substation, interconnection options represent the least cost and best performing alternative options. The following favorable options are:

- Option 2: $11-33M (RAS only vs System Upgrades)[15]
- Option 3: $11-33M (RAS only vs System Upgrades)[15]
- Lancaster Alternative Option: $7-20M (RAS only vs System Upgrades)
- Rathdrum Alternative Option: $7-33M (RAS only vs System Upgrades)

[13] Assumes a network upgrade solution would be pursued, instead of a RAS only solution.
[14] This $4M savings would be for either a RAS only or a network upgrade solution.
[15] If the new project is interconnected to the west of Lancaster, the Lancaster-New Project 230 kV transmission line is not needed. Hence the network upgrade cost would be reduced by $8M.

2011 Electric Integrated Resource Plan

Appendix F – 2011 Electric IRP New Resource Table for Transmission

2011 Avista IRP

New Resource Table For Transmission

Resource	Resource Location	POR or Local Area	POD	Start	Stop	Capacity MW	Year Total
Noxon 4 (incremental)	Noxon, MT	Noxon, MT	AVA System	4/1/2012	Indefinite	14.0	
Wind	Oaksdale, WA	Thorton	AVA System	8/1/2012	Indefinite	102.0	116.0
Lancaster CCCT	Rathdrum, ID	Bell/Westside	AVA System	1/1/2013	10/31/2026	125.0	
Lancaster CCCT	Rathdrum, ID	Mid-C	AVA System	1/1/2013	10/31/2026	150.0	275.0
Coyote Springs 2	Boardman, OR	Coyote Springs 2	AVA System	5/1/2018	Indefinite	16.0	16.0
SCCT	TBD	TBD	AVA System	1/1/2019	Indefinite	86.3	86.3
Wind	Reardan, WA	Reardan	AVA System	1/1/2020	Indefinite	60.0	60.0
Wind	Reardan, WA	Reardan	AVA System	1/1/2021	Indefinite	60.0	
SCCT	TBD	TBD	AVA System	1/1/2021	Indefinite	86.3	146.3
CCCT	TBD	TBD	AVA System	1/1/2024	Indefinite	280.8	280.8
CCCT	TBD	TBD	AVA System	11/1/2026	Indefinite	280.8	280.8
SCCT	TBD	TBD	AVA System	1/1/2030	Indefinite	47.8	47.8
					Total	1309	1309

August 18, 2011

Energy Position

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
	REQUIREMENTS																				
1	Native Load	-1,134	-1,150	-1,165	-1,183	-1,207	-1,222	-1,235	-1,251	-1,266	-1,281	-1,296	-1,315	-1,334	-1,360	-1,375	-1,393	-1,411	-1,430	-1,450	-1,471
2	Firm Power Sales	-127	-109	-58	-58	-6	-6	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
3	**Total Requirements**	**-1,260**	**-1,259**	**-1,223**	**-1,241**	**-1,213**	**-1,227**	**-1,240**	**-1,256**	**-1,271**	**-1,286**	**-1,301**	**-1,320**	**-1,339**	**-1,365**	**-1,380**	**-1,398**	**-1,416**	**-1,435**	**-1,455**	**-1,476**
	RESOURCES																				
4	Firm Power Purchases	179	179	181	179	127	127	107	82	81	81	80	80	80	80	80	80	80	80	80	80
5	Hydro	525	527	495	495	495	490	481	481	481	481	481	481	481	481	481	481	481	481	481	481
6	Baseload/Intermediate Resources	715	718	723	711	716	726	707	720	731	707	720	731	707	679	518	495	508	518	495	508
7	Wind Resources	49	42	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
8	**Total Resources**	**1,420**	**1,425**	**1,399**	**1,386**	**1,339**	**1,343**	**1,294**	**1,283**	**1,293**	**1,268**	**1,282**	**1,292**	**1,268**	**1,241**	**1,080**	**1,056**	**1,069**	**1,080**	**1,056**	**1,069**
9	**POSITION**	**159**	**166**	**176**	**145**	**126**	**116**	**54**	**27**	**22**	**-17**	**-19**	**-27**	**-72**	**-124**	**-301**	**-342**	**-347**	**-356**	**-399**	**-406**
	CONTINGENCY PLANNING																				
10	Peaking Resources	153	153	139	154	153	153	153	147	151	153	147	151	153	147	151	153	147	151	153	147
11	Contingency	-229	-230	-231	-232	-233	-233	-216	-197	-198	-198	-199	-200	-201	-202	-203	-204	-205	-206	-207	-208
12	**CONTINGENCY NET POSITION**	**83**	**88**	**84**	**67**	**46**	**35**	**-9**	**-23**	**-24**	**-63**	**-71**	**-76**	**-120**	**-179**	**-352**	**-393**	**-404**	**-410**	**-453**	**-467**

January Peak Position (18 Hour)

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
	REQUIREMENTS																				
1	Native Load	-1,682	-1,701	-1,717	-1,745	-1,778	-1,802	-1,824	-1,849	-1,873	-1,896	-1,921	-1,951	-1,982	-2,017	-2,043	-2,071	-2,100	-2,130	-2,162	-2,196
2	Firm Power Sales	-242	-211	-158	-158	-8	-8	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
3	**Total Requirements**	**-1,924**	**-1,912**	**-1,875**	**-1,903**	**-1,786**	**-1,810**	**-1,830**	**-1,855**	**-1,880**	**-1,903**	**-1,927**	**-1,957**	**-1,989**	**-2,024**	**-2,049**	**-2,078**	**-2,106**	**-2,137**	**-2,168**	**-2,202**
	RESOURCES																				
4	Firm Power Purchases	176	176	176	176	176	176	174	92	92	92	91	91	91	91	91	91	91	91	91	91
5	Hydro Resources	955	965	854	854	865	861	889	881	889	889	881	889	889	881	889	889	881	889	889	881
6	Base Load Thermals	884	884	884	884	884	884	884	884	884	884	884	884	884	884	606	606	606	606	606	606
7	Wind Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Peaking Units	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242
9	**Total Resources**	**2,258**	**2,268**	**2,156**	**2,156**	**2,168**	**2,163**	**2,189**	**2,100**	**2,107**	**2,107**	**2,099**	**2,107**	**2,107**	**2,099**	**1,828**	**1,828**	**1,820**	**1,828**	**1,828**	**1,820**
10	**PEAK POSITION**	**334**	**356**	**282**	**253**	**381**	**353**	**359**	**245**	**228**	**204**	**172**	**150**	**118**	**75**	**-221**	**-250**	**-286**	**-309**	**-341**	**-382**
	RESERVE PLANNING																				
11	Required Operating Reserves	-182	-183	-177	-179	-172	-175	-177	-183	-186	-188	-190	-193	-196	-199	-186	-187	-187	-188	-189	-190
12	Available Operating Reserves	183	183	137	137	137	137	175	175	175	175	175	175	175	175	175	175	175	175	175	175
13	Planning Margin	-209	-210	-212	-215	-218	-220	-222	-225	-227	-229	-232	-235	-238	-241	-244	-247	-249	-252	-255	-259
14	**Total Reserve Planning**	**-209**	**-210**	**-252**	**-257**	**-253**	**-258**	**-224**	**-234**	**-238**	**-242**	**-248**	**-253**	**-259**	**-265**	**-255**	**-259**	**-261**	**-265**	**-269**	**-274**
15	**Peak Position**	**125**	**146**	**30**	**-4**	**128**	**95**	**135**	**11**	**-10**	**-38**	**-76**	**-103**	**-141**	**-190**	**-476**	**-508**	**-547**	**-574**	**-610**	**-655**
16	**Planning Margin**	**17%**	**19%**	**15%**	**13%**	**21%**	**20%**	**20%**	**13%**	**12%**	**11%**	**9%**	**8%**	**6%**	**4%**	**-11%**	**-12%**	**-14%**	**-14%**	**-16%**	**-17%**
17	**Avista Share of Excess NW Capacity**	737	656	565	477	400	326	255	186	115	56	0	0	0	0	0	0	0	0	0	0
18	**Peak Position Net Market**	**862**	**802**	**595**	**474**	**528**	**421**	**390**	**197**	**104**	**18**	**(76)**	**(103)**	**(141)**	**(190)**	**(476)**	**(508)**	**(547)**	**(574)**	**(610)**	**(655)**

August Peak Position (18 Hour)

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
	REQUIREMENTS																				
1	Native Load	-1,545	-1,577	-1,614	-1,638	-1,667	-1,686	-1,704	-1,725	-1,745	-1,764	-1,784	-1,809	-1,835	-1,866	-1,887	-1,910	-1,934	-1,959	-1,985	-2,013
2	Contracts Obligations	-218	-212	-159	-159	-9	-9	-8	-8	-8	-8	-8	-8	-7	-7	-7	-7	-7	-7	-7	-7
3	**Total Requirements**	**-1,763**	**-1,789**	**-1,773**	**-1,797**	**-1,676**	**-1,695**	**-1,712**	**-1,732**	**-1,753**	**-1,772**	**-1,792**	**-1,816**	**-1,843**	**-1,873**	**-1,894**	**-1,918**	**-1,941**	**-1,966**	**-1,993**	**-2,020**
	RESOURCES																				
4	Contracts Rights	87	87	87	87	87	87	85	85	84	84	84	84	84	84	84	84	84	84	84	84
5	Hydro Resources	819	902	859	866	864	885	833	840	859	833	840	859	833	840	859	833	840	859	833	840
6	Base Load Thermals	780	780	780	780	780	780	780	780	780	780	780	780	780	780	551	551	551	551	551	551
7	Wind Resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Peaking Units	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176
9	**Total Resources**	**1,863**	**1,945**	**1,903**	**1,910**	**1,908**	**1,929**	**1,874**	**1,881**	**1,900**	**1,874**	**1,880**	**1,899**	**1,874**	**1,880**	**1,669**	**1,644**	**1,650**	**1,669**	**1,644**	**1,650**
10	**PEAK POSITION**	**100**	**156**	**130**	**113**	**232**	**234**	**163**	**148**	**147**	**102**	**88**	**83**	**31**	**7**	**-224**	**-274**	**-291**	**-297**	**-349**	**-370**
	RESERVE PLANNING																				
11	Required Operating Reserves	-174	-171	-171	-173	-166	-168	-170	-172	-173	-176	-177	-179	-182	-185	-171	-170	-171	-173	-172	-174
12	Available Operating Reserves	73	178	166	166	166	171	165	166	170	165	166	170	165	166	170	165	166	170	165	166
13	Planning Margin	-232	-236	-241	-244	-247	-250	-252	-255	-257	-259	-262	-265	-268	-272	-275	-278	-281	-284	-287	-291
14	**Total Reserve Planning**	**-334**	**-236**	**-246**	**-251**	**-247**	**-250**	**-257**	**-261**	**-260**	**-270**	**-273**	**-274**	**-285**	**-291**	**-276**	**-283**	**-286**	**-287**	**-294**	**-298**
15	**Peak Position**	**-234**	**-80**	**-116**	**-138**	**-15**	**-16**	**-94**	**-112**	**-113**	**-168**	**-185**	**-191**	**-254**	**-284**	**-500**	**-557**	**-577**	**-584**	**-643**	**-668**
16	**Planning Margin**	**6%**	**9%**	**7%**	**6%**	**14%**	**14%**	**10%**	**9%**	**8%**	**6%**	**5%**	**5%**	**2%**	**0%**	**-12%**	**-14%**	**-15%**	**-15%**	**-18%**	**-18%**
17	**Avista Share of Excess NW Capacity**	275	221	178	141	107	78	52	31	10	3	0	0	0	0	0	0	0	0	0	0
18	**Peak Position Net Market**	**41**	**141**	**62**	**3**	**92**	**61**	**(42)**	**(82)**	**(103)**	**(165)**	**(185)**	**(191)**	**(254)**	**(284)**	**(500)**	**(557)**	**(577)**	**(584)**	**(643)**	**(668)**

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Avista Utilities Energy Resources Risk Policy

Pages 1 through 28

Map of the Palouse Wind Project

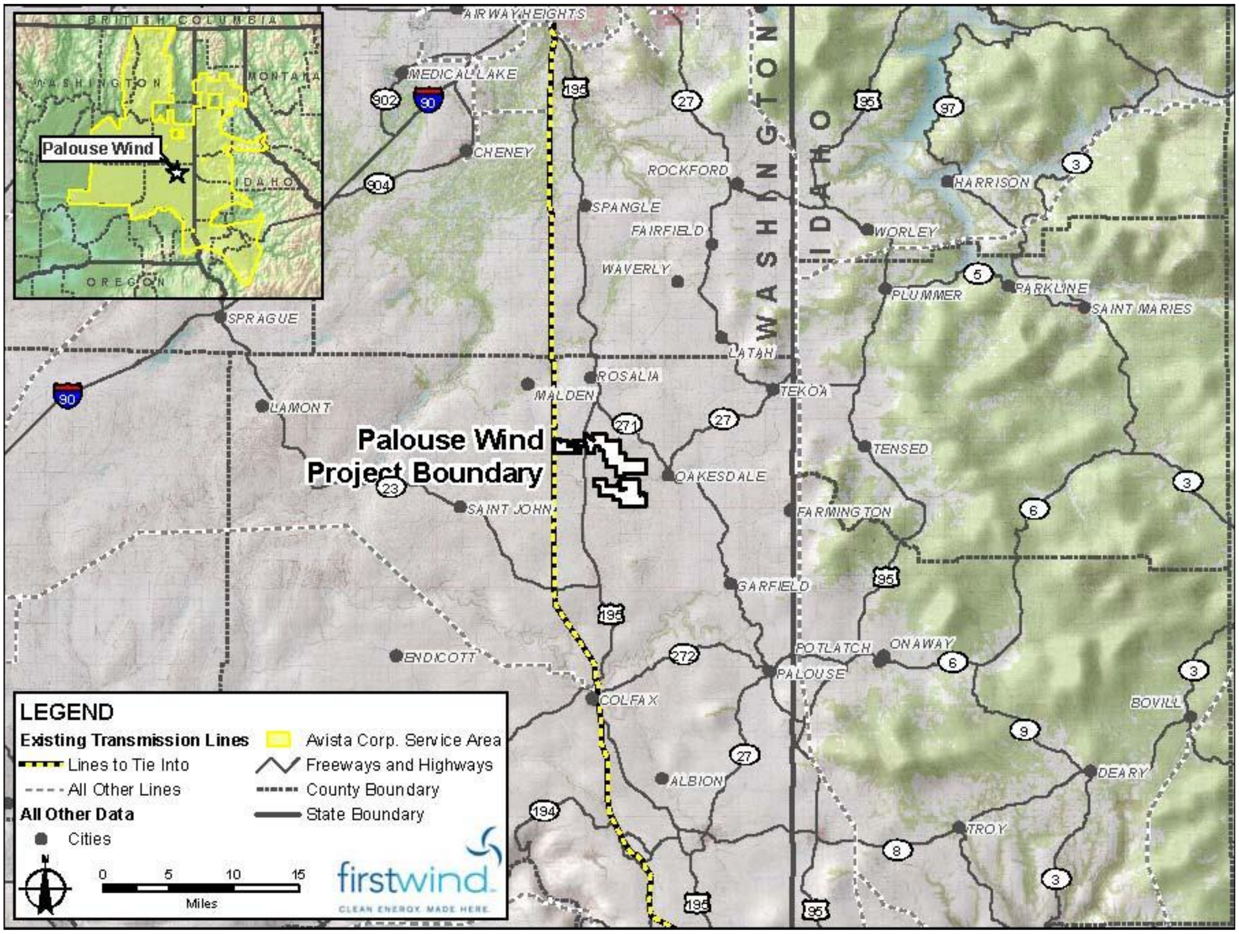

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 4, Page 1 of 1

2009 Electric Integrated Resource Plan

August 31, 2009

AVISTA®

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Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 1 of 729

SPECIAL THANKS TO OUR TALENTED VENDORS FROM THE SPOKANE AREA WHO PRODUCED THIS IRP:

Ross Printing Company

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TABLE OF CONTENTS

SAFE HARBOR STATEMENT

This document contains forward-looking statements. Such statements are subject to a variety of risks, uncertainties and other factors, most of which are beyond the company's control, and many of which could have a significant impact on the company's operations, results of operations and financial condition, and could cause actual results to differ materially from those anticipated.

For a further discussion of these factors and other important factors, please refer to our reports filed with the Securities and Exchange Commission which are available on our website at www.avistacorp.com. The company undertakes no obligation to update any forward-looking statement or statements to reflect events or circumstances that occur after the date on which such statement is made or to reflect the occurrence of unanticipated events.

TABLE OF TABLES

TABLE OF TABLES (continued)

TABLE OF FIGURES

TABLE OF FIGURES (continued)

TABLE OF FIGURES (continued)

LIST OF ACRONYMS AND KEY TERMS

AARG	Annual Average Rate of Growth
AVA	Avista
aMW	Average Megawatts
BPA	Bonneville Power Administration
CCCT	Combined-Cycle Combustion
Turbine	
CFL	Compact Fluorescent Lamp
CO_2	Carbon Dioxide
CSA	Climate Stewardship Act (also
known as	
	the McCain-Lieberman Bill)
CVR	Controlled Voltage Reduction
Dth	decatherm
EF	Efficiency
EIA	Energy Information Administration
FERC	Federal Energy Regulatory Commission
GE	The General Electric Company
GHG	Greenhouse Gas
GWh	Gigawatt-hour
HRSG	Heat Recovery Steam Generator
HVAC	Heating, Ventilation and Air Conditioning (HVAC)
IDP	Idaho Power Company
IGCC	Integrated Gasification Combined Cycle
IRP	Integrated Resource Plan
IS	Information Systems
kV	kilo-volt
kW	kilowatt
kWh	kilowatt-hour
LIRAP	Low Income Rate Assistance
Program	
LP	Linear Programming
Mmbtu	Million British Thermal Units, 1 mmbtu = 1 dth of Natural Gas
MW	megawatt
MWh	megawatt-hour
NCEP	National Commission for Energy Policy
NEB	Non-Energy Benefits
Nominal	Discounting Method that Includes Inflation
NPCC	Northwest Power and Conservation Council (formerly Northwest Power Planning Council)
NPV	Net Present Value
NWPP	Northwest Power Pool
O&M	Operations and Maintenance
OASIS	Open Access Same-Time
Information	
	System
OSU	Oregon State University
PC	Personal Computer
PGE	Portland General Electric
PRS	Preferred Resource Strategy
PRiSM	Preferred Resource Strategy Line Programming Model
psig	Pounds Per Square Inch Gauge
PTC	Production Tax Credit
PUD	Public Utility District
PURPA	Public Utility Regulatory Policies Act of 1978
Real	Discounting Method that Excludes Inflation
RPS	Renewable Portfolio Standards
RTO	Regional Transmission
Organization	
SCCT	Simple-Cycle Combustion Turbine
TAC	Technical Advisory Committee
TIG	Transmission Improvements Group
TRC	Total Resource Cost
Triple E	External Energy Efficiency Board
VFD	Variable Frequency Drive
WECC	Western Electricity Coordinating Council
WNP-3	Washington Public Power Supply System (WPPSS, now Energy Northwest) – Washington Nuclear Plant No. 3

2009 IRP INTRODUCTION

Avista has a long tradition of innovation as a provider of clean, renewable energy. The 2009 Integrated Resource Plan (IRP) continues that tradition as it looks into the future needs of our customers. The IRP analyzes and outlines a strategy to meet projected demand through energy efficiency and a careful mix of new renewables and traditional resources.

The plan includes economic growth forecasts for the Avista service territory. Electricity sales growth is expected to occur at a rate of 1.7 percent over the next two decades. Avista projects that it will have sufficient resources to meet growth until 2018 when new energy supplies will need to be brought online.

Avista expects to add increasing amounts of new renewables to its generation portfolio in the coming years. This is partly due to active and pending state and federal regulations. Regardless of legislation, Avista believes that renewables represent viable energy sources that reduce the need for fossil fuels and diversify our resource mix.

New renewable energy sources like wind and solar power currently are more expensive to build than traditional energy resources. An added challenge is they are intermittent resources, meaning that the wind doesn't always blow and the sun doesn't always shine. Customers except high reliability so utilities will still need energy resources like natural gas and hydropower to keep the lights on. This presents a challenge to resource planners who must consider realiabilty as well as rate and environmental impacts.

The IRP is updated every two years and looks 20 years into the future. This plan is developed by Avista's professional energy analysts using sophisticated modeling tools and input from interested community stakeholders.

Each IRP is a thoroughly researched and data driven document to guide responsible resource planning for the company. The plan's Preferred Resource Strategy (PRS) section covers our projected resource acquisitions over the next 20 years.

Some highlights of the PRS include:

- 150 MW of wind power by 2012 to take advantage of renewable energy tax incentives, diversify our fuel mix, and meet renewable portfolio standards.
- An additional 200 MW of wind power over the IRP timeframe.
- 26 percent of future load growth is met by new conservation.
- Construction of 750 MW of clean-burning natural gas-fired generation facilities.
- Avista does not plan to add any coal-fired generation to its resource mix.
- Aggressive energy efficiency measures are expected to save 226 aMW of cumulative energy over the next 20 years.
- 5 MW of hydro upgrades are planned for the Little Falls and Upper Falls hydro projects.
- Large hydro upgrades will be studied as alternative new renewable resources for the 2011 IRP.
- Transmission upgrades will be needed to add new generation and Avista will continue to participate in regional efforts to expand the region's transmission system.

This document is mostly technical in nature. The IRP has an Executive Summary and chapter highlights at the beginning of each section to help guide the reader.

Avista expects to begin developing the 2011 IRP in early 2010. Stakeholder involvement is encouraged and interested parties may contact John Lyons at 509-495-8515 or john.lyons@avistacorp.com for more information on participating in the IRP process.

Executive Summary

Avista's 2009 Integrated Resource Plan (IRP) guides the utility's resource acquisition strategy over the next two years and the overall direction of resource procurements for the remainder of the 20-year planning horizon. The IRP provides a snapshot of the Company's resources and loads, and provides guidance regarding resource needs and acquisitions. The Preferred Resource Strategy (PRS) is a mix of renewable resources, conservation, upgrades at existing facilities, and new gas-fired generation.

The PRS balances low cost, reliable service, reasonable future rate volatility, and renewable resource requirements. Avista's management and stakeholders from the Technical Advisory Committee (TAC) play a key role in guiding the development of the IRP. TAC members include customers, commission staff, consumer advocates, academics, utility peers, government agencies, and other interested parties. The TAC provides significant input on modeling, resource assumptions, and the general direction of the planning process.

Noxon Rapids Upgrade Crew

Resource Needs

Plant upgrades and conservation measures are integral to Avista's resource strategy, but are ultimately inadequate to meet all future load growth. Annual energy deficits begin in 2018, with loads plus a planning margin exceeding resource capability by 27 aMW. Energy deficits rise to 126 aMW in 2022 and 527 aMW in 2029. The Company will be short 45 MW of capacity in 2015. In 2022 and 2029, capacity deficits rise to 139 MW and 667 MW, respectively. Table 1 presents Avista's net load position for the first 10 years of the study.

Table 1: Net Position Forecast

Net Position	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Energy (aMW)	309	185	123	110	93	59	38	31	-27	-35
Capacity (MW)	293	124	53	31	0	-45	-74	45	11	-46

Increasing deficits are a result of forecasted 1.7 percent energy and capacity load growth through 2029. Expirations of long-term contracts also increase deficiencies. Figures 1 and 2 provide graphical representations of the Company's load and resource balance. The forecasted load in each year includes the one-in-two peak forecast plus planning and operating reserve obligations. The forecast would be higher without past conservation acquisitions.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 13 of 729

Figure 1: Load Resource Balance—Winter Capacity

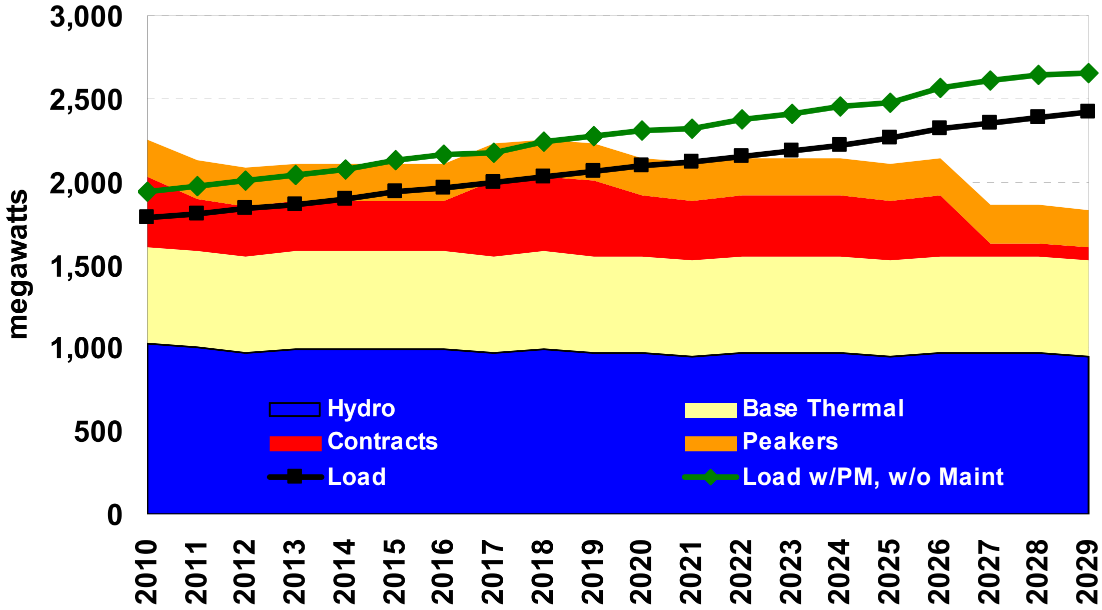


Figure 2: Load Resource Balance—Energy

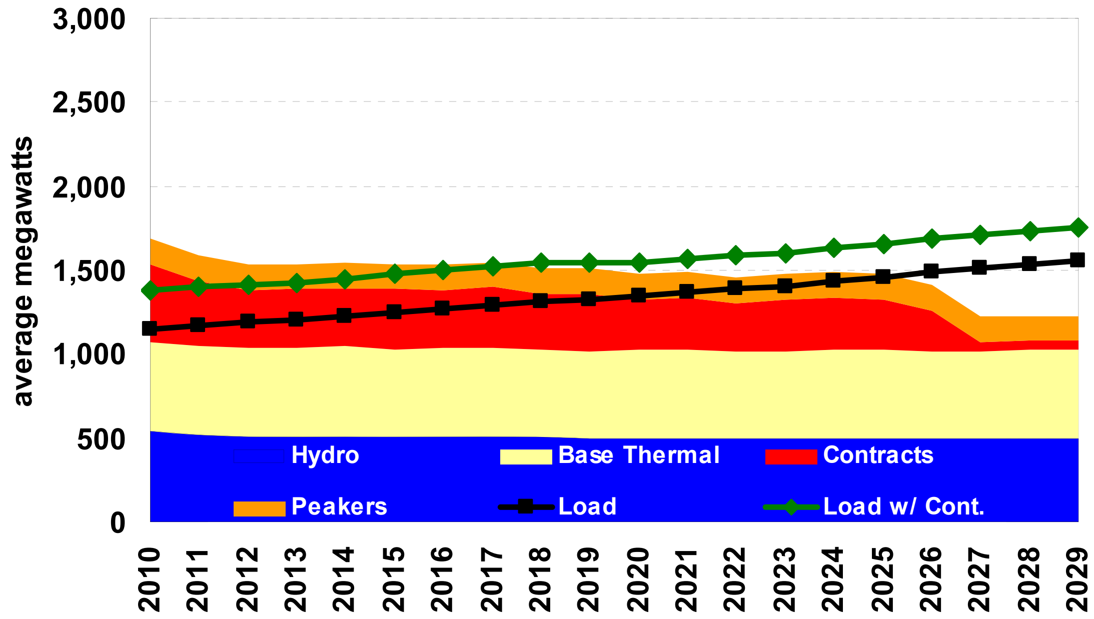


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 14 of 729

Modeling and Results

Avista used a multi-step approach to develop its PRS. The process began with the identification and quantification of potential new resources to serve future demand across the West. A Western Interconnect-wide study was performed to understand the impact of regional markets on the Northwest electricity marketplace. Avista's existing resource stack was combined with the present transmission grid to simulate hourly operations for the Western Interconnect from 2010 to 2029.

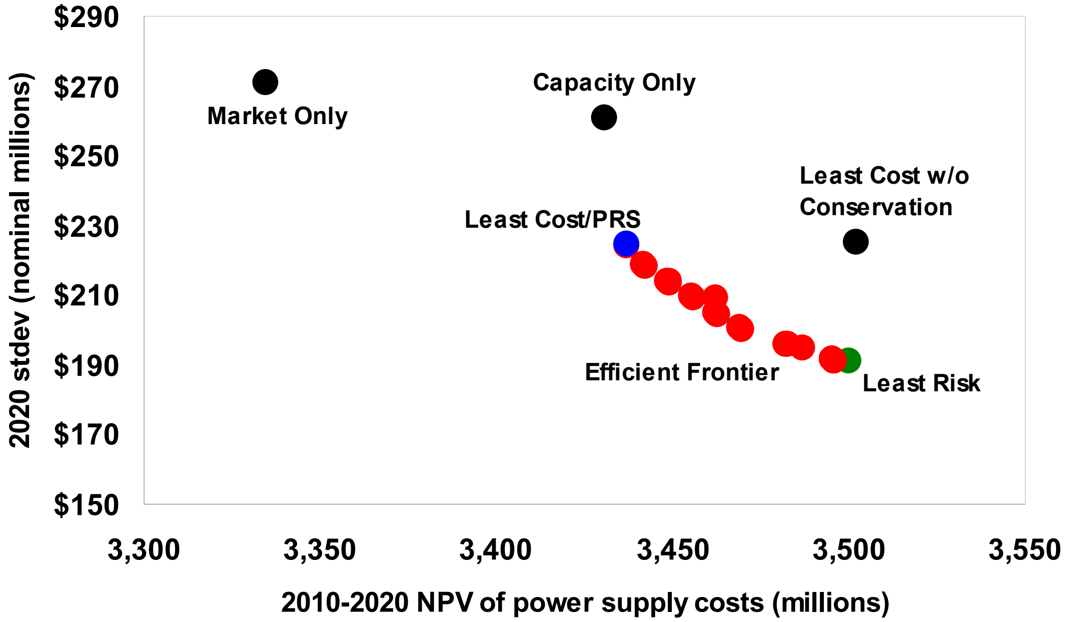
Cost-effective new resources and transmission were added as necessary to meet growing loads. Monte Carlo-style analysis varied hydro, wind, load, forced outages, greenhouse gas emissions, and gas price data over 250 iterations of potential future conditions. The simulation results were used to estimate the Mid-Columbia electric market, and the iterations collectively formed the Base Case for this IRP.

Estimated market prices were used to analyze potential conservation initiatives and available supply-side resources to meet forecasted resource requirements. Each new resource option was valued against the Mid-Columbia market to identify the future value of each asset to the Company, as well as its inherent risk measured in year-to-year power supply cost volatility. Future market values and risk were compared with the capital and fixed operation and maintenance costs that would be incurred. Avista's Preferred Resource Strategy Linear Programming Model (PRiSM) assisted in selecting the PRS for serving future load. The PRS selection was based on forecasted energy and capacity needs, resource values, state mandated renewable portfolio standards, and limiting power supply expense variability.

Portfolio scenarios were used to identify tipping points that would change the PRS under alternative conditions beyond the Base Case. The scenarios identified changes to underlying assumptions that could alter the PRS, such as changes to load growth, capital costs, hydro upgrades, the emergence of other small renewable projects and nuclear revival.

The preferred resource portfolio must address two key challenges that include the mitigation of future costs and risk given a set of environmental constraints. An efficient frontier helps determine trade offs between risk and cost. This approach is similar to finding the optimal mix of risk and return when developing a personal investment portfolio. As expected returns increase, so do risks; whereas reducing risk reduces overall returns. Finding the PRS is similar to the investor's dilemma, but the trade-off is future costs against power supply cost variation. Figure 3 presents the change in cost and risk from the PRS on the Efficient Frontier.

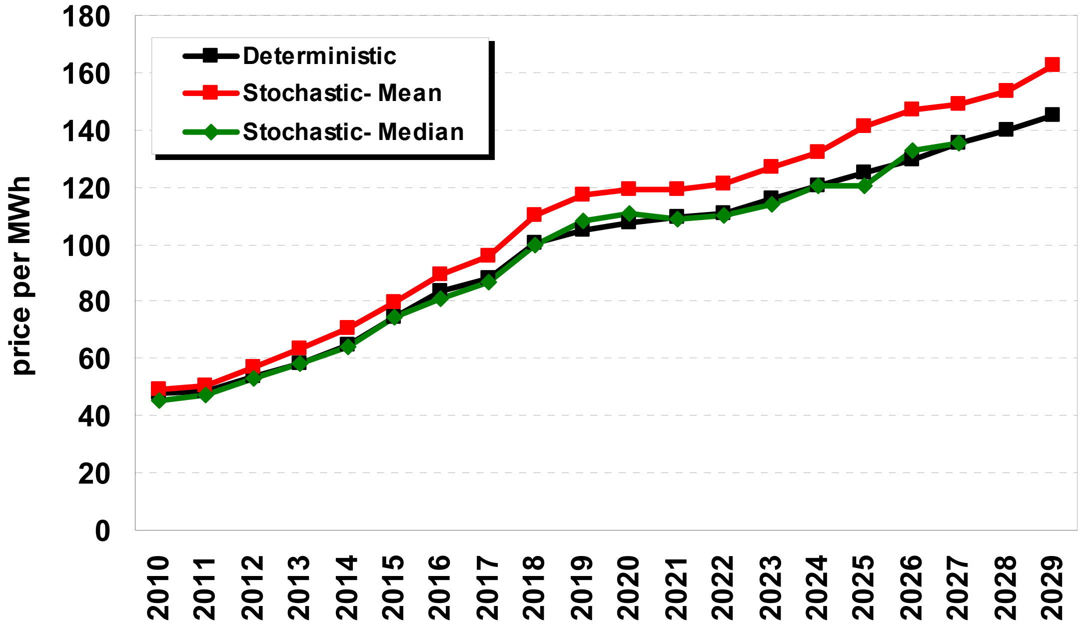
Figure 3: Efficient Frontier



Electricity and Natural Gas Market Price Forecasts

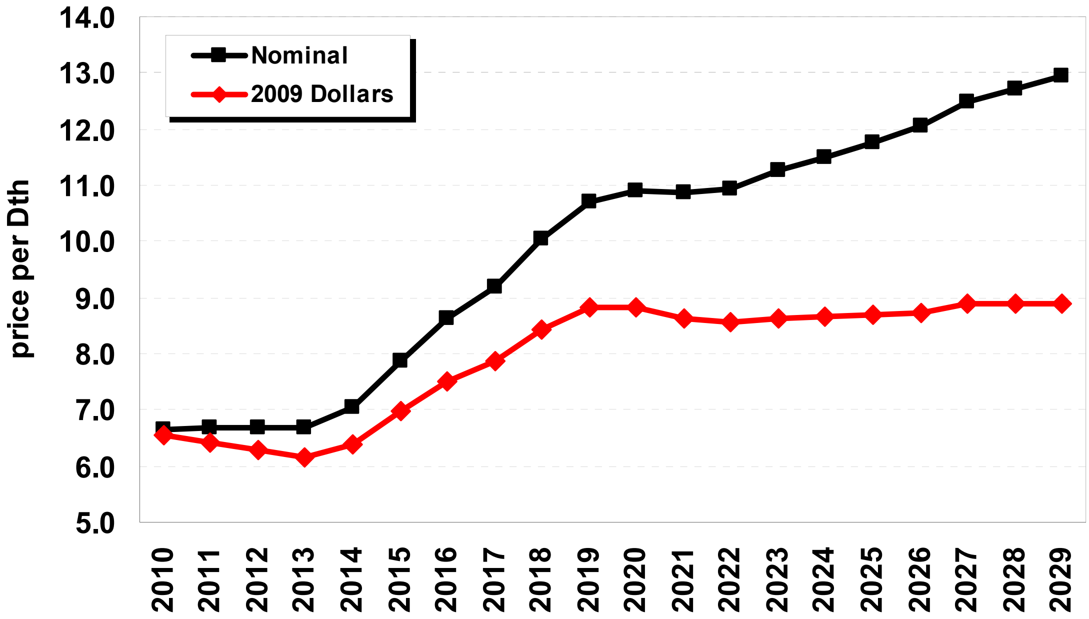
Figure 4 shows the Company's electricity price forecast developed for the 2009 IRP. The Mid-Columbia market price is expected to average $79.56 per MWh in 2009 dollars over the next 20 years; the average nominal price is $93.74 per MWh. Spreads between on- and off-peak prices are $14.34 per MWh in 2010 and $32.71 per MWh in 2029. Stochastic prices are higher than deterministic prices, as the stochastic model accounts for carbon, hydro, natural gas, forced outage and wind energy risks.

Figure 4: Annual Flat Mid-Columbia Prices



Electricity prices are highly correlated with natural gas prices because natural gas-fired generation is the marginal resource in the Western Interconnect. Base Case natural gas prices at Henry Hub are shown in Figure 5. The levelized Henry Hub nominal price is expected to be $9.05 per Dth over the next 20 years and the real 2009 dollar levelized cost is $7.67. The natural gas forecast is derived from a combination of sources in the near term including the New York Mercantile Exchange, the Energy Information Administration, Wood Mackenzie and other consultants. Longer term prices rely on the forecast from Wood Mackenzie. The forecast includes a price adder of $0.50 per Dth in 2013 and $1.00 per Dth after 2018 (2009 dollars) to account for the increase in demand of natural gas due to a shift from coal to natural gas-fired generation.

Figure 5: Annual Average Henry Hub Natural Gas Price

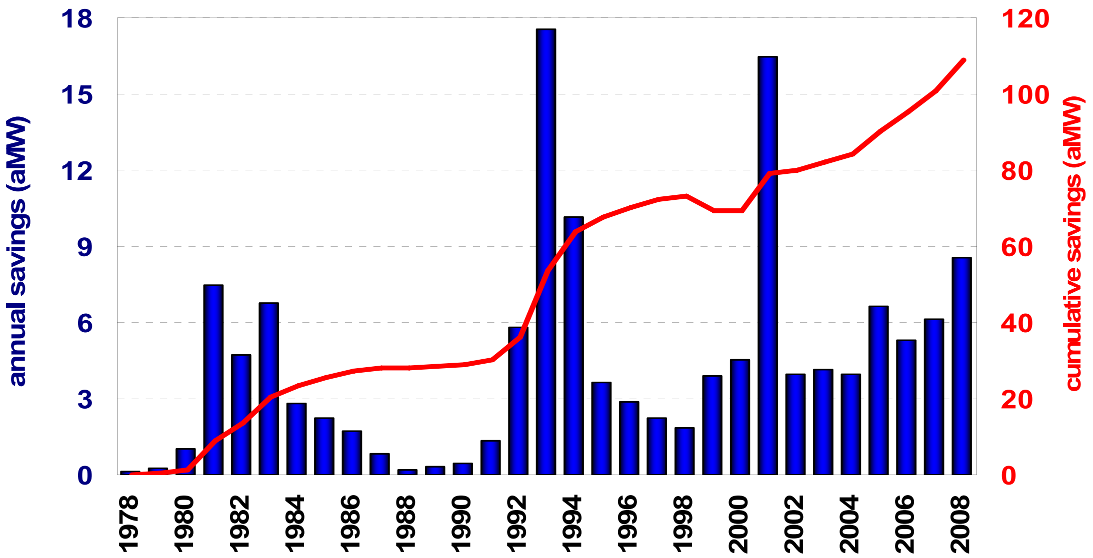


Energy Efficiency

Avista's energy efficiency efforts provide conservation programs and education for residential, commercial, industrial and low income customers. Programs fall into prescriptive and site-specific classifications. Prescriptive programs offer cash incentives for standardized products, such as compact fluorescent light bulbs. These programs are directed towards residential and small commercial customers. Site-specific programs provide cash incentives for any cost-effective energy savings measure with a payback greater than one year. Site-specific programs require customized services for commercial and industrial customers because many applications need to be tailored to each customer's premises and processes.

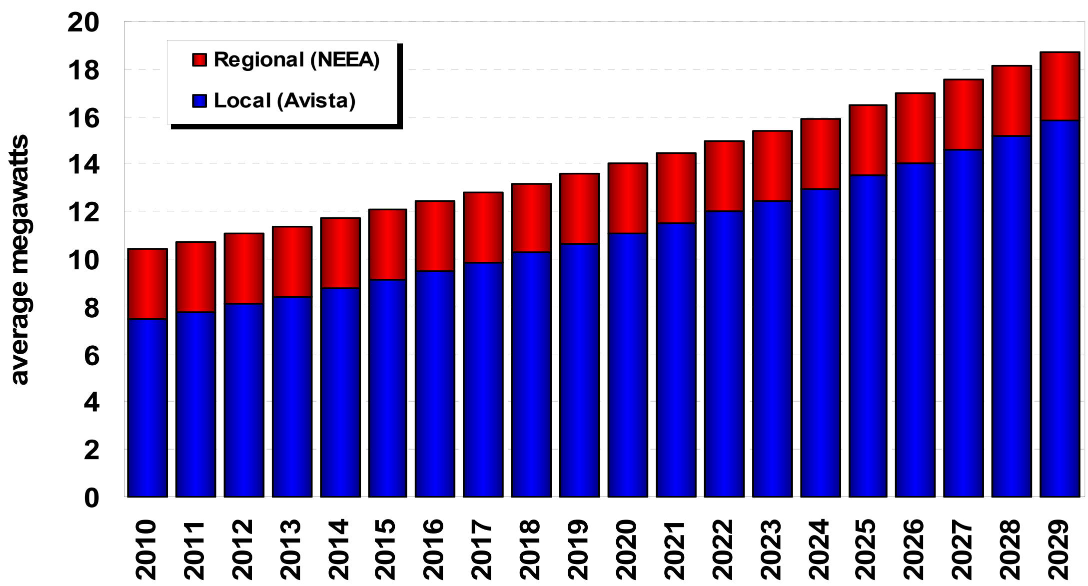
Figure 6 shows how conservation has decreased the Company's energy requirements by 138.5 aMW since programs began in the late 1970s. 109 aMW of efficiency projects acquired over the past 18 years are still online.

Figure 6: Cumulative Conservation Acquisitions



Approximately 3,000 efficiency measures were evaluated for the 2009 IRP. The PRS includes 10.4 aMW (7.5 aMW local and 2.9 aMW regional) of conservation are expected to be obtained in 2010. Figure 7 shows the projected levels of local and regional conservation over the next 20 years.

Figure 7: Forecast of Conservation Acquisition



Preferred Resource Strategy

The PRS is developed after careful consideration of information gathered over the IRP process. The PRS is reviewed and critiqued by management and the TAC. The 2009 plan relies on a combination of conservation, distribution system upgrades, wind, hydro upgrades, and gas-fired combined-cycle combustion turbines. It also identifies transmission projects to improve system reliability and to access generation resources necessary to comply with renewable portfolio standards. Figure 8 illustrates the Company's PRS.

Figure 8: Preferred Resource Strategy

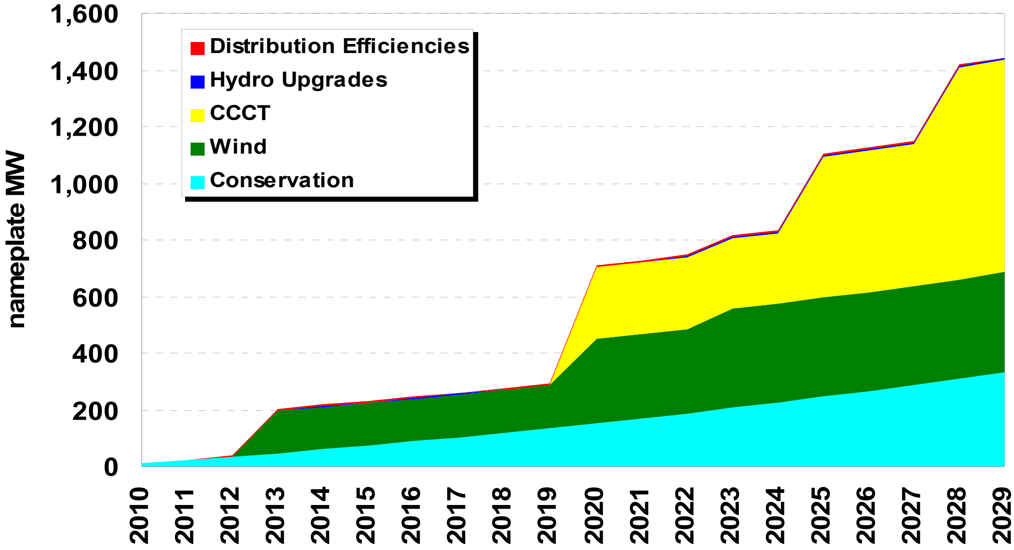


Table 2: 2009 Preferred Resource Strategy

Resource	By the End of Year	Nameplate (MW)	Energy (aMW)
NW Wind	2012	150.0	48.0
Distribution Efficiencies	2010-2015	5.0	2.7
Little Falls Unit Upgrades	2013-2016	3.0	0.9
NW Wind	2019	150.0	50.0
CCCT	2019	250.0	225.0
Upper Falls	2020	2.0	1.0
NW Wind	2022	50.0	17.0
CCCT	2024	250.0	225.0
CCCT	2027	250.0	225.0
Conservation	All Years	339.0	226.0
Total		**1,449.0**	**1,020.6**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 20 of 729

The PRS resources, shown in nameplate capability, are shown in tabular format in Table 2 for the 2009 PRS and Table 3 for the 2007 PRS.

Table 3: 2007 Preferred Resource Strategy

Resource	By the End of Year	Nameplate (MW)	Energy (aMW)
Non-Wind Renewable	2011	20.0	18.0
Non-Wind Renewable	2012	10.0	9.0
NW Wind	2013	100.0	33.0
Non-Wind Renewable	2013	5.0	4.5
Share of CCCT	2014	75.0	67.5
NW Wind	2015	100.0	33.0
NW Wind	2016	100.0	33.0
Non-Wind Renewable	2019	10.0	9.0
Non-Wind Renewable	2020	10.0	9.0
Non-Wind Renewable	2021	5.0	4.5
Share of CCCT[1]	2019	297.0	267.3
Share of CCCT	2027	305.0	274.5
Conservation	All Years	331.5	221.0
Total		**1,368.5**	**983.3**

The 2009 IRP requires just over $1.0 billion in net present value of new capital investments over the next 20 years.

Carbon Emissions

Carbon emission costs have been included in the Base Case since the 2007 IRP. Carbon, or CO_2, cost estimates are from a national market study by Wood Mackenzie. Figure 8 shows projected CO_2 emissions prices. Figure 9 shows the projected carbon emissions for existing and new generation assets. These estimates do not include emissions from market and contract purchases, and CO_2 emissions are not reduced for wholesale sales. The white area of Figure 10 indicates estimated emission levels without legislative action.

Figure 9: Estimated Price of CO_2 Credits for 2009 IRP

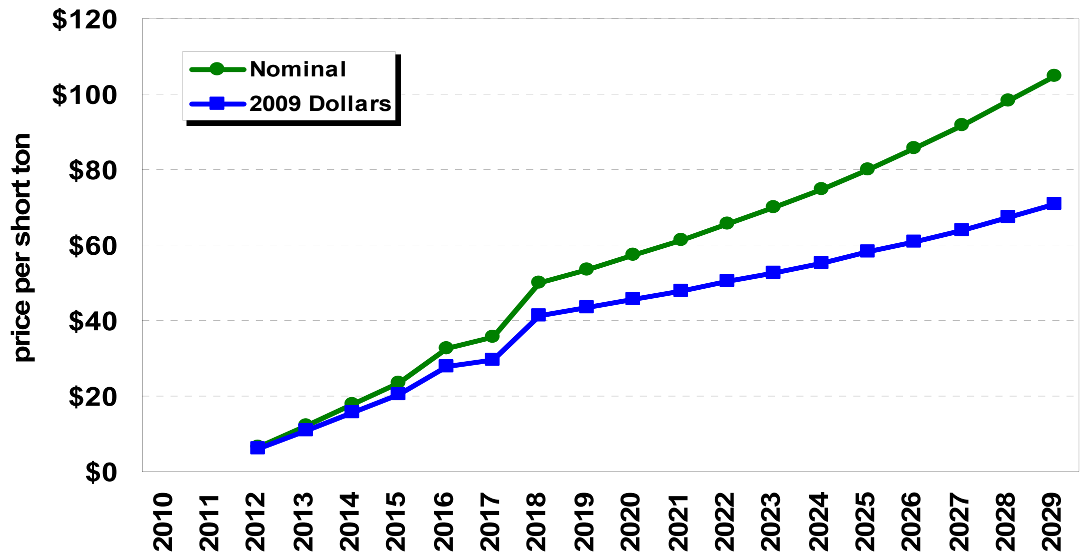
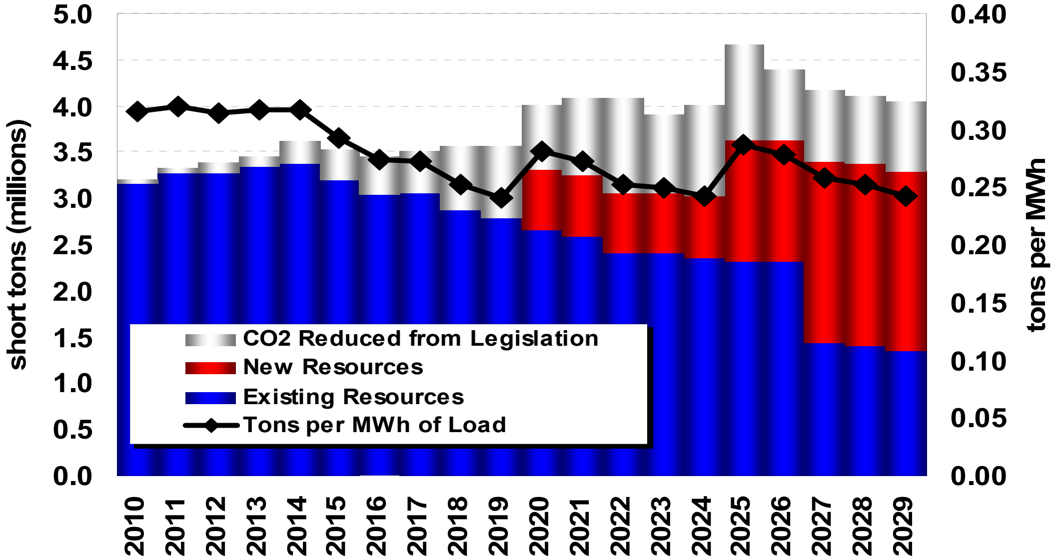


Figure 10: Avista Owned and Controlled Resource's Greenhouse Gas Emissions



Action Items

The Company's 2009 Action Plan outlines activities and studies to be developed and presented in the 2011 Integrated Resource Plan. The Action Plan was developed using input from the Company's management team and the TAC. Action Item categories include resource additions and analysis, demand side management, environmental policy, modeling and forecasting enhancements, and transmission planning.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 22 of 729

1. Introduction and Stakeholder Involvement

Avista Utilities submits a biennial Integrated Resource Plan (IRP) to the Idaho and Washington public utility commissions.[1] The 2009 IRP is Avista's eleventh plan identifying and describing its Preferred Resource Strategy (PRS) for meeting customer's future requirements while balancing cost and risk measures.

The Company is statutorily obligated to provide reliable electric service to customers at rates, terms, and conditions that are "just, fair, reasonable and sufficient." We assess resource acquisition strategies and business plans to acquire resources to meet resource adequacy requirements and optimize the value of our current resource portfolio. Avista uses the IRP as a resource evaluation tool, rather than a plan for acquiring a particular asset. The 2009 IRP refines our process for the evaluation of resource decisions, requests for proposals and other acquisition efforts.

IRP Process

Avista actively sought input from a variety of constituents through the Technical Advisory Committee (TAC). The TAC included Commission Staff, customers, academics, government agencies, consultants, utilities and other interested parties. The Company sponsored six TAC meetings for the 2009 IRP. The TAC process began on May 14, 2008 and the final meeting to present the results of the 2009 IRP occurred on June 24, 2009. Over 70 people were invited to each meeting. Each TAC meeting covered different aspects of the 2009 IRP planning activities and solicited contributions and assessments regarding modeling assumptions, modeling processes, and results. Agendas and presentations are in Appendix A and on Avista's web site located at www.avistautilities.com/inside/resources/irp/electric.

Stakeholder Participation

The IRP process provides substantial opportunities for stakeholders to participate in Avista's resource planning activities. The Company utilizes three main stakeholder groups for the public involvement component of the IRP. The main group involves stakeholders with expertise in various aspects of utility planning to provide input concerning the studies, resource data, modeling efforts and critical review of the modeling results. This group includes Commission Staff, planners from other utilities, academics, and consultants. The second group includes parties involved with a specific aspect of the IRP. Examples of this group include environmental groups such as the Northwest Energy Coalition and government agencies. The third area of public involvement includes delegates from and participation in regional planning efforts, such as the Northwest Power and Conservation Council and the Western Electricity Coordinating Council.

[1] Washington IRP requirements are contained in WAC 480-100-251 Least Cost Planning. Idaho IRP requirements are outlined in Case No. U-1500-165 Order No. 22299, Case No. GNR-E-93-1, Order No. 24729, and Case No. GNR-E-93-3, Order No. 25260.

Public Process

The 2009 IRP is developed and written with the aid of a public process. All of the 2009 TAC presentations are available for review at the Company's website. The entire 2009 IRP, its appendices, and previous IRPs are available at Avista's web site.

Technical Advisory Committee

Avista's IRP is developed with significant amounts of public input and involvement. The Company had six TAC meetings supplemented with phone and email contact to develop this plan. Some of the topics included in the 2009 TAC series were: resource options, conservation, modeling, fuel price forecasts, load forecasts, market drivers and environmental issues.

The TAC mailing list includes over 70 individuals from 46 different organizations. The Company greatly appreciates all of the time and effort expended by the participants in the TAC process and looks forward to their continued involvement in the 2011 IRP. Avista wishes to acknowledge the contributions of the TAC participants in Table 1.1.

Table 1.1: TAC Participants

Participant	Organization
Andy Ford	Washington State University
Robin Toth	Greater Spokane Inc.
Dave Van Hersett	Resource Development Associates
Mike Connelly	Idaho Forest Group
John Daquisto	Gonzaga University
Lea Daeschel	Washington Attorney General's Office
Deborah Reynolds	Washington Utility and Transportation Commission
Steve Johnson	Washington Utility and Transportation Commission
David Nightingale	Washington Utility and Transportation Commission
Vanda Novak	Washington Utility and Transportation Commission
Carrie Dolwick	Northwest Energy Coalition
Kirsten Wilson	Washington State General Administration
Rick Sterling	Idaho Public Utilities Commission
Chuck Murray	Community Trade and Economic Development
Tom Noll	Idaho Power
Maury Galbraith	Northwest Power and Conservation Council
Villamour Gamponia	Puget Sound Energy
Mike Kersh	Inland Empire Paper

Table 1.2 provides a list of TAC meeting dates and agenda items covered in each meeting.

Table 1.2: TAC Meeting Dates and Agenda Items

Meeting Date	Agenda Items
TAC 1 – May 14, 2008	• Load and Resource Balance Update • Climate Change Update • Renewable Acquisitions • Loss of Load Probability Analysis • 2009 IRP Topic Discussions – Work Plan and Analytical Process Changes
TAC 2 – August 27, 2008	• Risk Assumptions/PRiSM • Resource Assumptions • Scenarios and Futures • Demand Side Management
TAC 3 – October 22, 2008	• Load Forecast • Natural Gas Price Forecast • Electric Price Forecast • Legislative Update
TAC 4 – January 28, 2009	• 2008 Peak Load Event • Natural Gas and Electric Price Update • Resource Assumptions • Transmission • Draft Preferred Resource Strategy
TAC 5 – March 25, 2009	• Conservation • Preferred Resource Strategy • Scenarios and Futures • 2009 IRP Topics
TAC 6 – June 24, 2009	• Presentation of the 2009 PRS • 2009 IRP Action Items

Issue Specific Public Involvement Activities

Besides TAC meetings, Avista also sponsors and participates in several other collaborative processes involving a range of public interests.

External Energy Efficiency ("Triple E") Board

The Triple E Board began in 1995 for stakeholders and public groups to gather and discus conservation efforts. The Triple E Group grew out of the DSM Issues group, which was influential in developing the country's first distribution surcharge for conservation acquisition for Avista.

FERC Hydro Relicensing – Clark Fork River Projects

Over 50 stakeholder groups participated in the Clark Fork hydro-relicensing process beginning in 1993. This led to the first all-party settlement filed with a Federal Energy Regulatory Commission (FERC) relicensing application, and eventual issuance of a 45-year FERC operating license effective March 1, 2001. The nationally recognized Living License concept was a result of this process. This collaborative process continues in the implementation phase of the Living License with stakeholders participating in various protection, mitigation and enhancement measures.

FERC Hydro Relicensing – Spokane River Projects

The Company has utilized a hydro relicensing process for the Spokane River Projects similar to the process used for relicensing the Clark Fork Projects. Avista was issued a 50-year license for the Spokane River Projects by FERC in June 2009. Approximately 100 stakeholder groups participated in this collaborative effort.

Low Income Rate Assistance Program (LIRAP)

LIRAP progress is shared with several community action agencies in the Company's Washington service territory through regular meetings. The program began in 2001 and has quarterly meetings to review administrative issues and needs.

Regional Planning

The Pacific Northwest's generation and transmission system is operated in a coordinated fashion. Avista participates in many organization's planning processes. Information from this participation is used to supplement the Company's IRP process. Some organizations Avista participates in are:

- Western Electricity Coordinating Council
- Northwest Power and Conservation Council
- Northwest Power Pool
- Pacific Northwest Utilities Conference Committee
- ColumbiaGrid
- Northwest Transmission Assessment Committee
- Seams Steering Group – Western Interconnection
- North American Electric Reliability Council

Future Public Involvement

Avista actively solicits input from interested parties to enhance the integrated resource planning process. Advice will be requested from members of the Technical Advisory Committee on a wide variety of resource planning issues. We will continue to work on expanding the diversity of the members on the TAC, and will strive to maintain the TAC meetings as an open public process.

2009 IRP Outline

The 2009 IRP consists of nine chapters plus an executive summary. A series of technical appendices supplement this report.

Executive Summary

This chapter summarizes results and highlights of the 2009 IRP.

Chapter 1: Introduction and Stakeholder Involvement

This chapter introduces the IRP and provides details concerning public participation and involvement in the integrated resource planning process.

Chapter 2: Loads and Resources

The first half of this chapter covers Avista's load forecast and relevant local economic forecasts. The last half describes Company-owned generating resources, major contractual rights and obligations, capacity and energy tabulations and reserve issues.

Chapter 3: Energy Efficiency

This chapter discusses Avista's energy efficiency programs. It provides an overview of the programs, descriptions of conservation measures, analysis of conservation measures for the IRP and the conservation results for the 2009 IRP.

Chapter 4: Environmental Policy

This chapter focuses on modeling efforts and issues surrounding greenhouse gas emissions and state and federal environmental regulations.

Chapter 5: Transmission and Distribution Planning

This chapter discusses Avista's distribution and transmission systems, as well as regional transmission planning issues. Transmission cost studies used in IRP modeling efforts are also covered.

Chapter 6: Generation Resource Options

This chapter covers costs and operating characteristics of generation resource types modeled for the 2009 IRP.

Chapter 7: Market Analysis

This chapter covers the analysis of wholesale markets for the 2009 IRP.

Chapter 8: Preferred Resource Strategy

This chapter provides details about Avista's 2009 PRS. It compares the PRS to a variety of theoretical portfolios under stochastic and scenario-based analyses.

Chapter 9: Action Items

This chapter provides an overview of progress made on Action Items from the 2007 IRP and presents details about Action Items for the 2009 IRP.

Regulatory Requirements

The IRP process for Washington has several requirements that must be met and documented under Washington Administrative Code (WAC). Table 1.3 provides the applicable WACs and indicates the chapter where each rule or requirement is met.

Table 1.3 Washington IRP Rules and Requirements

Rule and Requirement	Plan Citation
WAC 480-100-238(4) – Work plan filed no later than 12 months before next IRP due date. Work plan outlines content of IRP. Work plan outlines method for assessing potential resources.	Work plan submitted to the WUTC on August 29, 2008, See Appendix B
WAC 480-100-238(5) – Work plan outlines timing and extent of public participation.	Appendix B
WAC 480-100-238(2)(a) – Plan describes mix of energy supply resources.	Chapter 6- Generation Resource Options
WAC 480-100-238(2)(a) – Plan describes conservation supply.	Chapter 3- Energy Efficiency
WAC 480-100-238(2)(a) – Plan addresses supply in terms of current and future needs of utility ratepayers.	Chapter 2- Loads & Resources
WAC 480-100-238(2)(b) – Plan uses lowest reasonable cost (LRC) analysis to select mix of resources.	Chapter 8- Preferred Resource Strategy
WAC 480-100-238(2)(b) – LRC analysis considers resource costs.	Chapter 8- Preferred Resource Strategy
WAC 480-100-238(2)(b) – LRC analysis considers market-volatility risks.	Chapter 4- Environmental Policy Chapter 7- Market Analysis Chapter 8- Preferred Resource Strategy
WAC 480-100-238 (2)(b) – LRC analysis considers demand side uncertainties.	Chapter 3- Energy Efficiency
WAC 480-100-238(2)(b) – LRC analysis considers resource dispatchability.	Chapter 6- Generation Resource Options Chapter 7- Market Analysis
WAC 480-100-238(2)(b) – LRC analysis considers resource effect on system operation.	Chapter 7- Market Analysis Chapter 8- Preferred Resource Strategy

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 28 of 729

WAC 480-100-238(2)(b) – LRC analysis considers risks imposed on ratepayers.	Chapter 4- Environmental Policy Chapter 6- Generation Resource Options Chapter 7- Market Analysis Chapter 8- Preferred Resource Strategy
WAC 480-100-238(2)(b) – LRC analysis considers public policies regarding resource preference adopted by Washington state or federal government.	Chapter 2- Loads & Resources Chapter 4- Environmental Policy Chapter 8- Preferred Resource Strategy
WAC 480-100-238(2)(b) – LRC analysis considers cost of risks associated with environmental effects including emissions of carbon dioxide.	Chapter 4- Environmental Policy Chapter 8- Preferred Resource Strategy
WAC 480-100-238(2)(c) – Plan defines conservation as any reduction in electric power consumption that results from increases in the efficiency of energy use, production, or distribution.	Chapter 3- Energy Efficiency Chapter 8- Preferred Resource Strategy
WAC 480-100-238(3)(a) – Plan includes a range of forecasts of future demand.	Chapter 2- Loads and Resources Chapter 8- Preferred Resource Strategy
WAC 480-100-238(3)(a) – Plan develops forecasts using methods that examine the effect of economic forces on the consumption of electricity.	Chapter 2- Loads and Resources Chapter 5- Transmission & Distribution Chapter 8- Preferred Resource Strategy
WAC 480-100-238-(3)(a) – Plan develops forecasts using methods that address changes in the number, type and efficiency of end-uses.	Chapter 2- Loads and Resources Chapter 3- Energy Efficiency Chapter 5- Transmission & Distribution
WAC 480-100-238(3)(b) – Plan includes an assessment of commercially available conservation, including load management.	Chapter 3- Energy Efficiency Chapter 5- Transmission & Distribution
WAC 480-100-238(3)(b) – Plan includes an assessment of currently employed and new policies and programs needed to obtain the conservation improvements.	Chapter 3- Energy Efficiency Chapter 5- Transmission & Distribution

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 29 of 729

WAC 480-100-238(3)(c) – Plan includes an assessment of a wide range of conventional and commercially available nonconventional generating technologies.	Chapter 6- Generator Resource Options Chapter 8- Preferred Resource Strategy
WAC 480-100-238(3)(d) – Plan includes an assessment of transmission system capability and reliability (as allowed by current law).	Chapter 5- Transmission & Distribution
WAC 480-100-238(3)(e) – Plan includes a comparative evaluation of energy supply resources (including transmission and distribution) and improvements in conservation using LRC.	Chapter 3- Energy Efficiency Chapter 5- Transmission & Distribution
WAC-480-100-238(3)(f) – Demand forecasts and resource evaluations are integrated into the long range plan for resource acquisition.	Chapter 3- Energy Efficiency Chapter 5- Transmission & Distribution Chapter 6- Generator Resource Options Chapter 8- Preferred Resource Strategy
WAC 480-100-238(3)(g) – Plan includes a two-year action plan that implements the long range plan.	Chapter 9- Action Items
WAC 480-100-238(3)(h) – Plan includes a progress report on the implementation of the previously filed plan.	Chapter 9- Action Items
WAC 480-100-238(5) – Plan includes description of consultation with commission staff. (Description not required)	Chapter 1- Introduction and Stakeholder Involvement
WAC 480-100-238(5) – Plan includes description of work plan. (Description not required)	Appendix B

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 30 of 729

2. Loads and Resources

Introduction and Highlights

Loads and resources represent two key components of the Integrated Resource Plan (IRP). The first half of this chapter summarizes customer and load forecasts for our service territory. This includes forecast ranges, load scenarios and an overview of recent enhancements to our forecasting models and processes. The second half of the chapter covers resource requirements, including descriptions of Company-owned and operated resources, as well as long-term contracts.

Section Highlights

- Weak economic growth is expected through 2011 in Avista's service territory.
- Historic conservation acquisitions are included in the load forecast; higher acquisition levels anticipated in this IRP reduce the load forecast further.
- Annual electricity sales growth from 2010-2020 averages 1.7 percent over the next decade (199 aMW) and 1.7 percent over the entire 20-year forecast.
- Peak loads are expected to grow at a 1.7 percent annual rate over the next 10 years (312 MW) and 1.7 percent over the 20-year forecast.
- Energy deficits begin in 2018; absent conservation deficits would begin in 2016.
- Renewable portfolio standard deficiencies are the driver of near-term resource need.

Economic Conditions in the Electric Service Territory

Avista's Plug-In Hybrid Sun Car

Avista serves a wide area of eastern Washington and northern Idaho. This area is geographically and economically diverse. Avista serves most of the urbanized and suburban areas in 24 counties. Figure 2.1 is a map of the Company's electric and natural gas service territories. The orange areas are electric and yellow areas are natural gas service territories.

The economy of the Inland Northwest has transformed over the past 20 years, from a natural resource-based manufacturing to diversified light manufacturing and services. Much of the mountainous area of the region is owned by the Federal government and managed by the United States Forest Service. Timber harvest reductions on public lands have closed many local sawmills. Two pulp and paper plants served by Avista have access to large forest land holdings; but they continue to face stiff domestic and international competition for their products.

Figure 2.1: Avista's Service Territory

Employment grows during periods of economic expansion and contracts during recessions. Our service territory experienced large scale unemployment during two national recessions in the 1980s. Avista's service territory was mostly bypassed by the 1991/92 national recession, but was not as fortunate during the 2001 recession. The current recession is expected to end by 2011. Effects of recessions and economic growth are best illustrated by employment for the three principal counties in Avista's electric service territory: Bonner, Kootenai and Spokane. Regional employment data is provided later in this chapter.

Population often is more stable than employment during times of economic change; however, population contracts during severe economic downturns as people leave in search of employment opportunities. Over the past 25 years, 1987 was the only year the region experienced a net loss in population. Figure 2.2 details actual and projected annual population changes in Bonner, Kootenai, and Spokane counties from 1990 to 2030. Figure 2.3 shows total population in these three counties for the same period.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 32 of 729

Figure 2.2: Population Change for Spokane, Kootenai and Bonner Counties

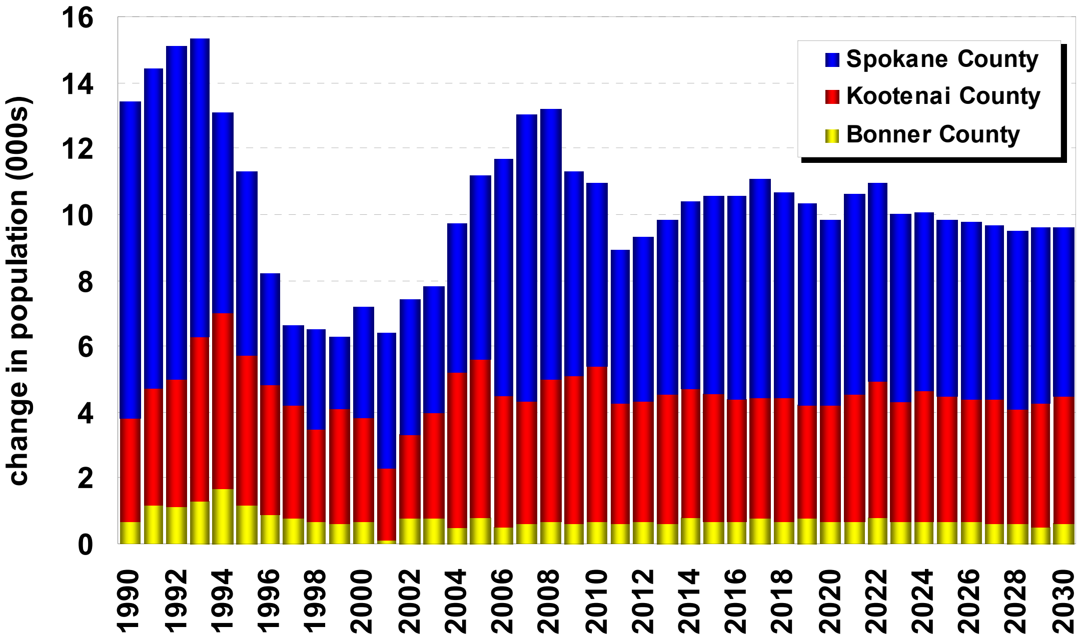
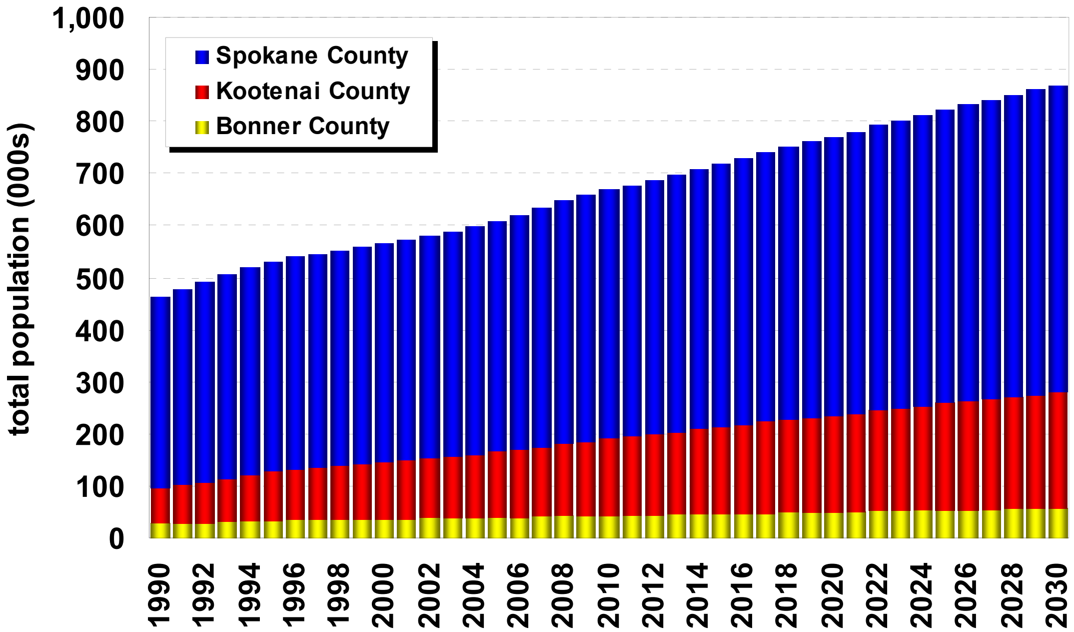


Figure 2.3: Total Population for Spokane, Kootenai and Bonner Counties



People, Jobs and Customers

Avista acquires national and county-level employment and population forecasts from Global Insight, Inc. Global Insight is an internationally recognized economic forecasting consulting firm used by various agencies in Washington and Idaho. The data encompasses the three principal counties which comprise over 80 percent of our service area economy, namely, Spokane County in Washington; and Kootenai and Bonner counties in Idaho. The national forecast for this IRP was prepared in March 2008; county-level estimates were completed in June 2008 and the load forecast was completed in July 2008.

The forecast and underlying assumptions used in this IRP were presented at the Third Technical Advisory Committee (TAC) meeting for Avista's 2009 Integrated Resource Plan on October 22, 2009. Key forecasts assumptions are shown in Table 2.1.

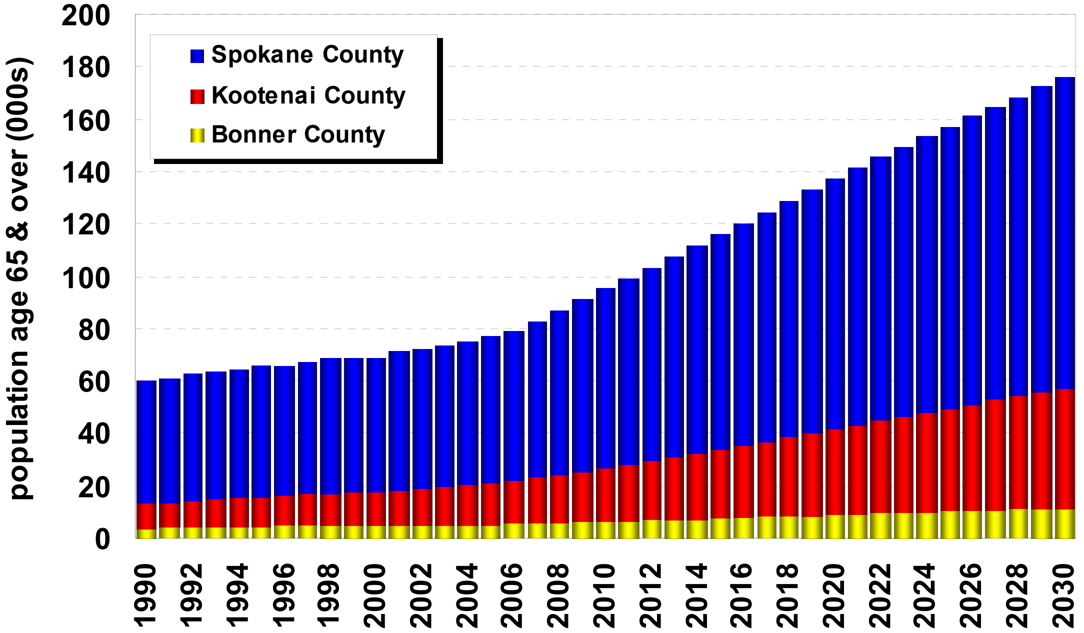
Table 2.1: Global Insight National Long Range Forecast Assumptions

Assumption	Range	Assumption	Range
Gross Domestic Product	1.9%-3.2%	Housing Starts (mil.)	1.5-1.8/year
Consumer Price Index	3.5%-1.7%	Job Growth	0.9%/year
West Texas Crude 2000$	$30-$50	Worker Productivity	2%
Fed Funds Rate	4%-8%	Consumer Sentiment	90
Unemployment Rate	4.3%-4.9%		

Looking forward, the national economy slows after recovering from the present recession, setting the stage for regional economic performance in Avista's electric service area. As shown in the charts above, population growth rebounds after slow growth from 1997 to 2002. Population growth is expected to resume its recent trend after 2010.

Regional population growth is supported by retiree immigration, representing between 10 and 20 percent of overall population growth. Figure 2.4 presents the population history and forecast for individuals 65 years and over in the three-county area. Between 1990 and 2010 this segment averages a compound growth rate of 2.6 percent in Bonner County, 4.1 percent in Kootenai County and 1.0 percent in Spokane County. The age group represents 14.2 percent of the overall population in 2010. The forecast predicts growth of 3.1 percent, 4.0 percent, and 2.8 percent, respectively, pushing the overall contribution of this age group to 20.2 percent in 2030.

Figure 2.4: Three-County Population Age 65 and Over



Employment growth often drives population growth. Figure 2.5 shows historical employment trends from 1990 and anticipated growth through 2030.

Figure 2.5: Three-County Job Change

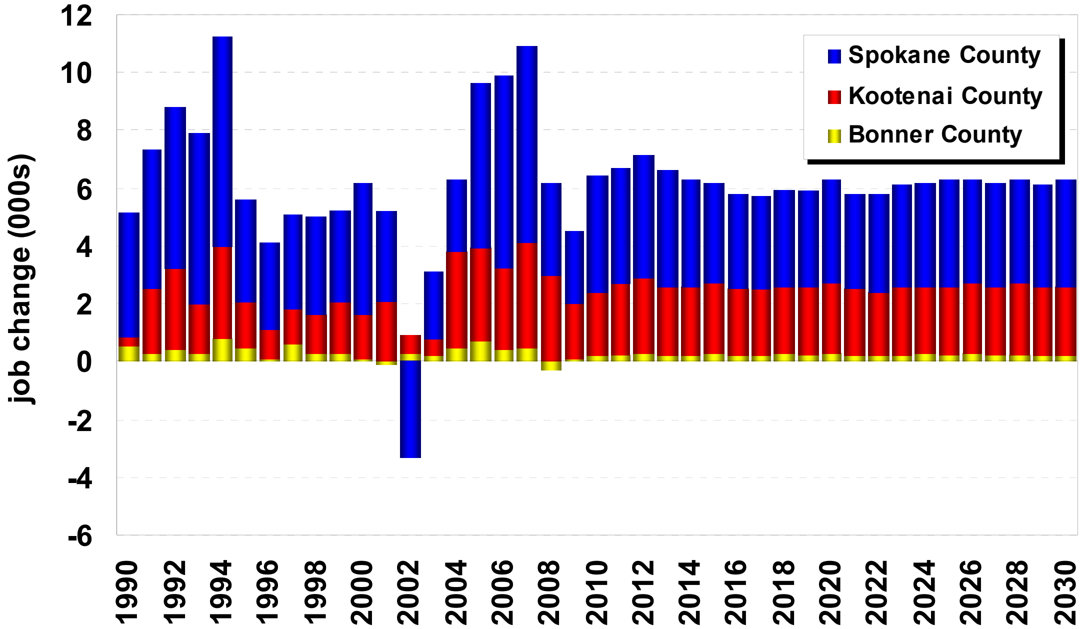
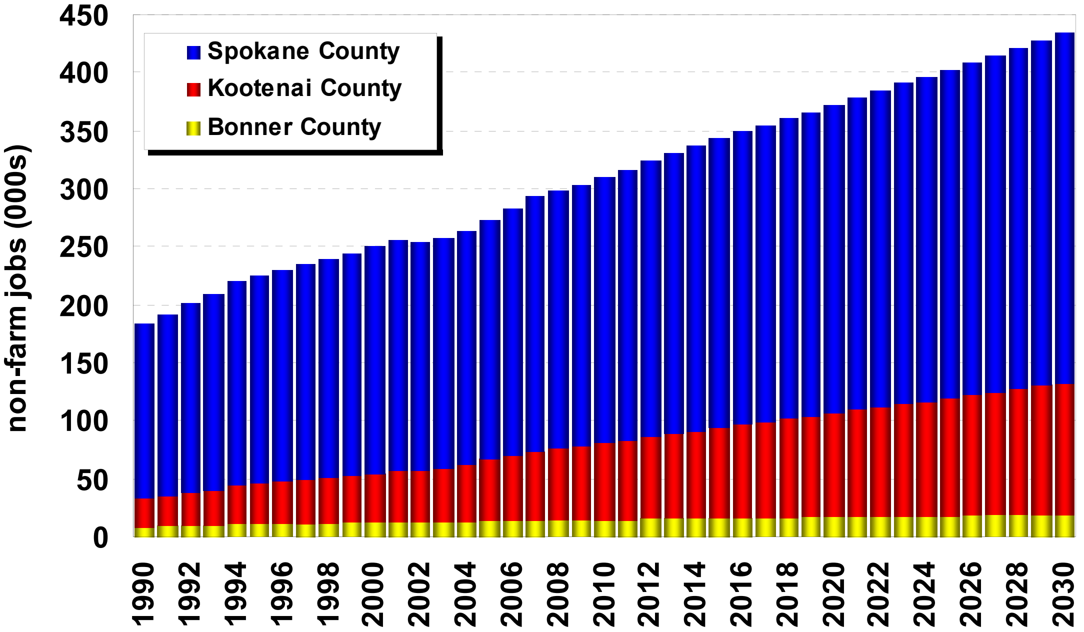


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 35 of 729

Overall non-farm wage and salary employment over the past 20 years averaged 2.8 percent for Bonner County, 5.1 percent for Kootenai County and 2.1 percent for Spokane County. Figure 2.6 provides additional non-farm employment data. Over the forecast horizon growth rates are predicted at 1.4 percent, 2.8 percent, and 1.4 percent, respectively. As indicated in the following chart, annual employment growth is expected to be approximately 6,200 new jobs.

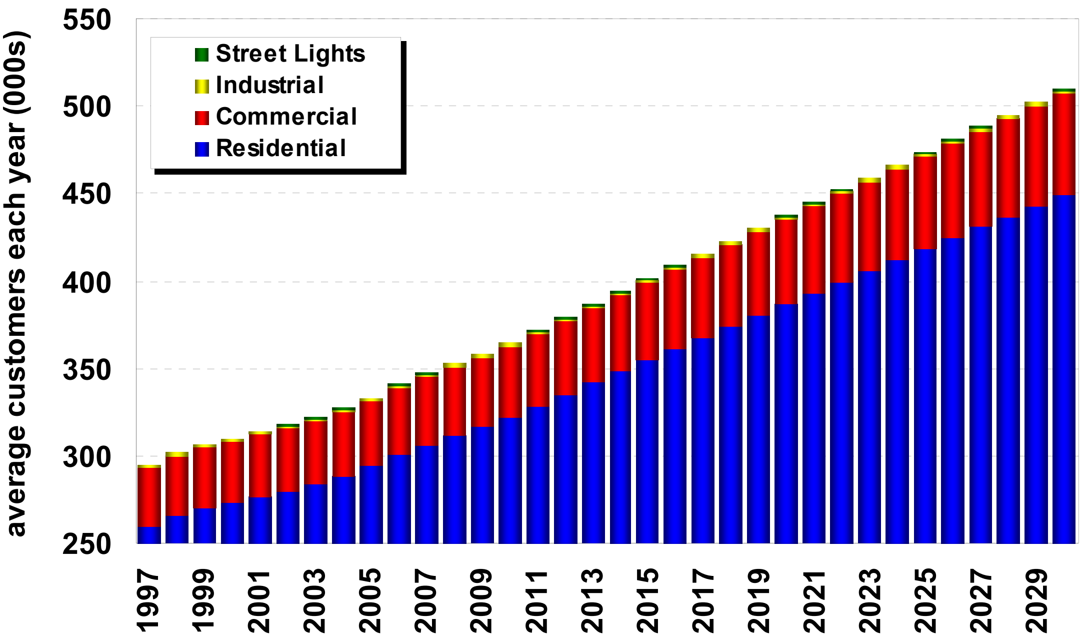
Figure 2.6: Three-County Non-Farm Jobs



Customer growth projections follow from baseline economic forecasts. The Company tracks four key customer classes—residential, commercial, industrial and street lighting. Residential customer forecasts are driven by population. Commercial forecasts rely heavily on employment and lagged residential growth trends. Industrial customer growth is correlated with employment growth. Employment statistics have the greatest probability of near term changes as we emerge from the present recession. Street lighting trends with population growth.

Avista forecasts sales by rate schedule. The overall customer forecast is a compilation of the various rate schedules of our served states. For example, the residential class forecast is comprised of separate forecasts prepared for rate schedules 1, 12, 22 and 32 for Washington and Idaho. See Figure 2.7 for Avista's annual average customer forecast levels.

Figure 2.7: Avista Annual Average Customer Forecast



Avista served 311,807 residential customers, 39,154 commercial customers, 1,393 industrial customers and 433 street lighting customers for a total of 352,786 retail customers in 2008. This is an increase from 340,652 retail customers in 2006. The 2029 forecast predicts 443,278 residential, 56,849 commercial, 1,654 industrial and 644 street lighting customers for a grand total of 502,425 retail customers. The 20-year compound growth rate averages 1.7 percent.

Weather Forecasts

The baseline electricity sales forecast is based on 30-year normal temperatures recorded at the Spokane International Airport weather station, as tabulated by the National Weather Service from 1971 through 2000. Daily values go back as far as 1890. There are several other weather stations with historical records in the Company's electric service area; however data is available for a much shorter duration. Sales forecasts are prepared using monthly data because more granular load information is not available. The Company finds high correlations between the Spokane International Airport and other weather stations in its service territory. It uses heating degree days to measure cold weather and cooling degree days to measure hot weather in its retail sales forecast.

In response to questions from the TAC, the Company has implemented estimates of the impacts of climate change in its retail load forecast. Ample evidence of cooling and warming trends exists in the 115-year record. The recent trend has been a warming climate compared to the 30-year normal. Trends in heating and cooling degree days for Spokane are roughly equal to the scientific community's predictions for this geographic area, implying a one degree warming every 25 years. Incorporating the warming trend finds that in 20 years summer load would be approximately 26 aMW higher than the 30 year average weather case. In the winter, loads would be approximately 40 aMW lower in 2029, for a net impact of a 14 aMW load decrease. The Company will continue to study these data trends in its two year Action Plan and report findings in the 2011 IRP.

Price Elasticity

Price elasticity is a central economic concept for projecting electricity demand. Price elasticity of demand is the ratio of the percentage change in the quantity demanded of a good or service to a percentage change in its price. Elasticity measures the responsiveness of buyers to changes in electricity prices. A consumer who is sensitive to price changes has a relatively elastic demand profile. A customer who is unresponsive to price changes has a relatively inelastic demand profile. During the 2000-01 energy crisis, customers showed increased sensitivity, or price elasticity of demand, by reducing their overall electricity usage in response to price increases.

Cross-price elasticity, is the ratio of the percentage change in the quantity demanded of one good to a percentage change in the price of another good. A positive coefficient indicates that the two products are substitutes; a negative coefficient indicates they are complementary goods. Substitute goods are replacements for one another. As the price of the first good increases relative to the price of the second good, consumers shift their consumption to the second good. Complementary goods are used together; increases in the price of one good result in a decrease in demand for the second good along with the first. The principal cross price elasticity impact on electricity demand is the substitutability of natural gas in some applications, including water and space heating.

Income elasticity of demand is the ratio of the percentage change in the quantity demanded of one good to a percentage change in consumer income. Income elasticity measures the responsiveness of consumer purchases to income changes. Two impacts affect electricity demand. The first is affordability. As incomes rise, a consumer's ability to pay for goods and services increases. The second income-related impact is the amount and number of customers using equipment within their homes and businesses. As incomes rise, consumers are more likely to purchase more electricity-consuming equipment, live in larger dwellings and use electrical equipment more often.

The correlation between retail electricity prices and the commodity cost of natural gas has increased in recent years. We estimate customer class price elasticity in our computation of electricity and natural gas demand. Residential customer price elasticity is estimated at negative 0.15. Commercial customer price elasticity is estimated at negative 0.10. The cross-price elasticity of natural gas and electricity is estimated to be positive 0.05. Income elasticity is estimated at positive 0.75, meaning electricity is more affordable as incomes rise.

Retail Price Forecast

The retail sales forecast is based on retail prices increasing an average of 10 percent annually from 2010 to 2018, followed by increases at the rate of inflation thereafter. Approximately one third of the rate rise is assumed to be driven by carbon-related legislation, assuming that future federal carbon legislation does not provide for any rate mitigation. The remaining two-thirds of rate rise is for capital additions and higher fuel costs.

Conservation

It is difficult to separate the interrelated impacts of rising electricity and natural gas prices, rising incomes and conservation programs. Avista collects data on total demand and must derive the impacts associated with consumption changes. The Company has offered conservation programs since 1978. The impact of conservation on electricity usage is fully embedded in the historical data; therefore, we concluded that existing conservation levels (7.5 aMW) are embedded in the forecast. Where conservation acquisition decreases from this level, retail load obligations would increase. As this IRP forecasts growing conservation acquisition, this growth reduces retail load obligations from the forecast.

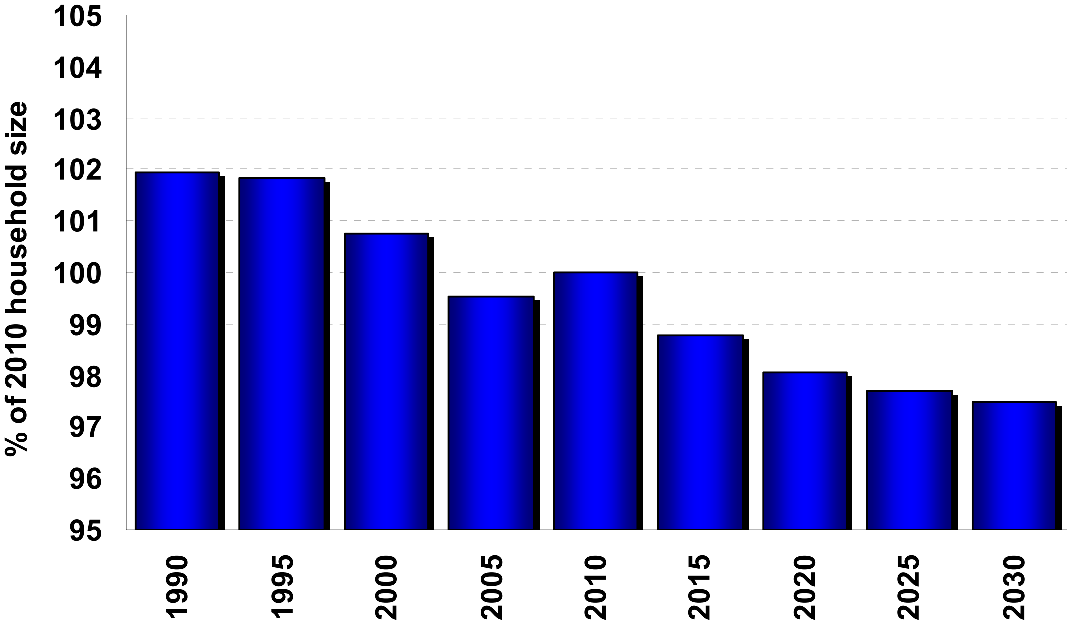
Use Per Customer Projections

The database used to project usage per customer uses monthly electricity sales and the number of customers by rate schedule, customer class, and state from 1997 to 2008. Historical data is weather-normalized to remove the impact of heating and cooling degree day deviations from expected normal values, as discussed above. Retail electric price increase assumptions are applied to price elasticity estimates to estimate price-induced reductions in electrical use per customer.

The Company included a forecast of personal residential electric vehicles in the Base Case. These vehicles are a combination of plug-in hybrids and electric-only and represent a proportional share from the Northwest Power and Conservation Council's estimates available in mid-2008. Avista's share by 2030 is expected to be 85,000 plug-in hybrid cars, increasing residential load about 1.3% from 2010 to 2030.

The residential use per customer trend over the long term is flat, consistent with embedded conservation, warming temperatures and price elasticity offset by electric vehicles. The number of occupants per household is also decreasing over time. Figure 2.8 shows the number of persons per household over the next 20 years.

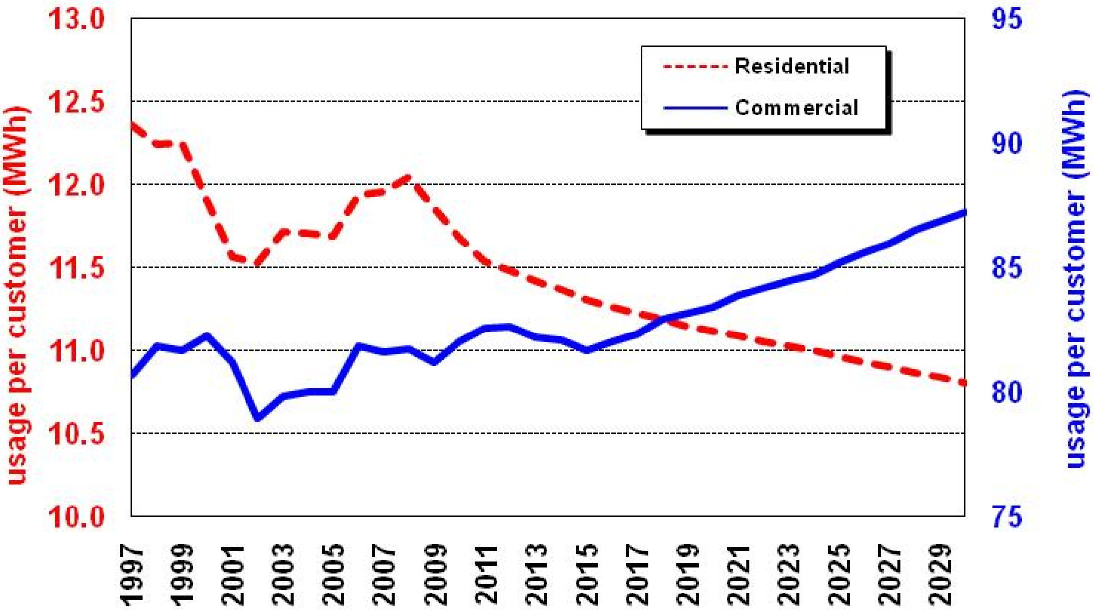
Figure 2.8: Household Size Index



Residential customers tend to be homogeneous relative to dwelling size. Commercial customers are heterogeneous, ranging from small customers with varying electricity intensity per square foot of floor space to big box retailers with generally higher intensities. The addition of new large commercial customers, specifically universities and hospitals, can greatly skew average use per average customer statistics. Customer usage is illustrated in Figure 2.9.

Estimates for residential use per customer across all schedules are relatively smooth. Commercial usage per customer is forecast to increase for several years due to additional buildings either built or anticipated to be built by existing very large customers, such as Washington State University and Sacred Heart Hospital. Expected additions for very large customers are included in the forecast through 2015, and no additions are included in the forecast after 2015. We will include publicly-announced long lead time buildings in the load forecast in future IRPs.

Figure 2.9: Annual Use per Customer



Retail Electricity Sales Forecast

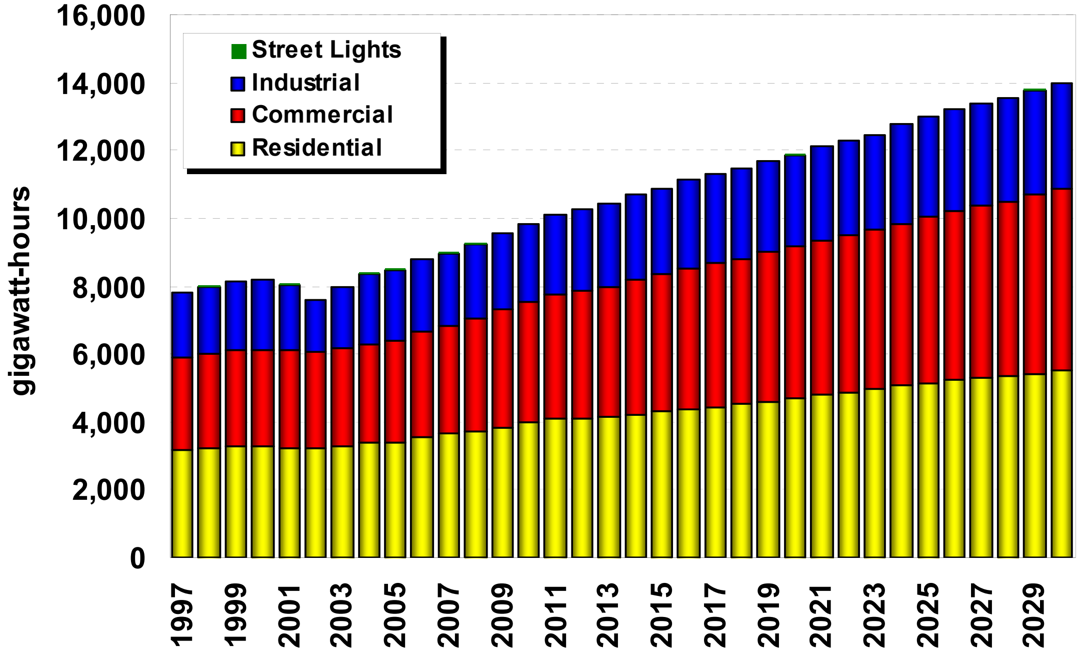
Between 1997 and 2008 the region was affected by major economic changes, not the least of which was a marked increase in wholesale and retail electricity prices. The energy crisis of 2000-01 included the implementation of widespread, permanent conservation efforts by our customers. In 2004, rising retail electricity rates further reinforced conservation efforts. Several large industrial facilities served by the Company closed permanently during the 2001-02 economic recession. Recently the economy has entered a significant recession.

Retail electricity consumption rose from 8.2 billion kWh in 1999 to over 8.9 billion kWh in 2008. This increase was in spite of the combined impacts of higher prices and decreased electricity demand during the energy crisis. The forecasted average annual increase in retail sales over the 2009 to 2029 period is 1.8 percent.

The sales forecast takes a “bottom up” approach, summing forecasts of the number of customers and usage per customer to produce a retail sales forecast. Individual forecasts for our largest industrial customers (Schedule 25) include planned or announced production increases or decreases. Lumber and wood products industries have slowed down from very high production levels, which is consistent with the decline in housing starts at the national level and the current recession. The load forecasts for these sectors were reduced to account for decreased production levels. Anticipated sales to aerospace and aeronautical equipment suppliers have increased and local plants have announced plans to hire more workers and increase their output.

Actual, not weather corrected, retail electricity sales to Avista customers in 2008 were 8.93 billion kWh. Heating degree days in 2008 were 103 percent of normal, almost completely offset in terms of energy use by 121 percent of normal cooling degree days. The forecast for 2030 is 12.85 billion kWh, representing a 1.7 percent compounded increase in retail sales. See Figure 2.10. Degree days in 2030 are forecast to be 87 percent of the 1971-2000 thirty year normal for heating and 149 percent for cooling.

Figure 2.10: Avista's Retail Sales Forecast



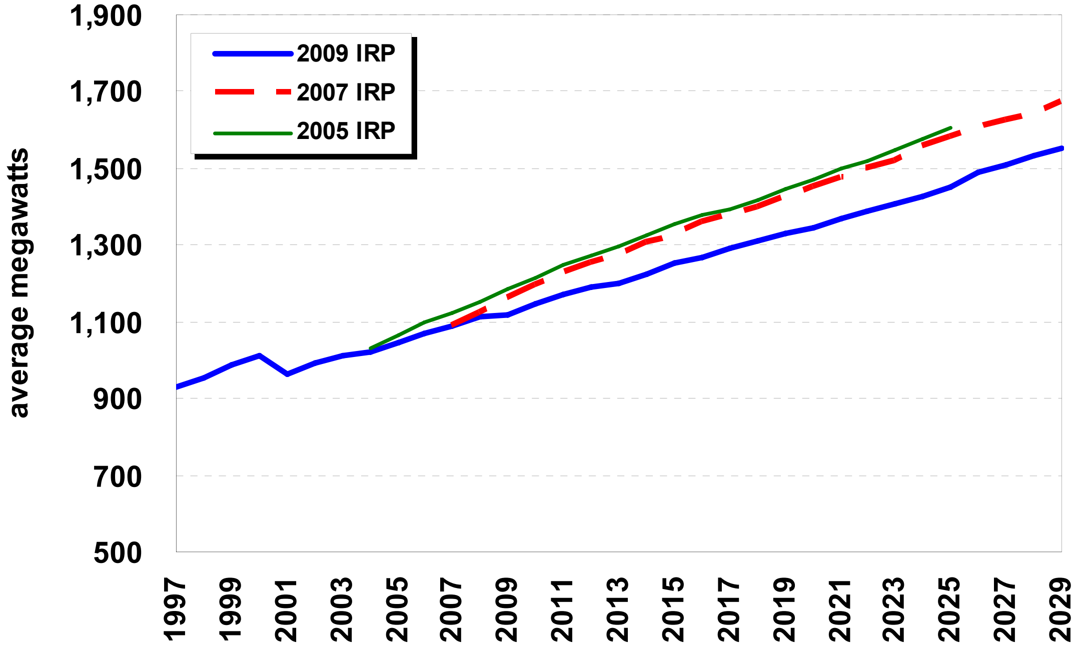
Load Forecast

Load forecasts are derived from retail sales. Retail sales in kilowatt hours are converted into average megawatt hours using a regression model to ensure monthly load shapes conform to history. The Company's load forecast is termed its native load. Native load is net of line losses across the Avista transmission system.

Native load growth is shown in Figure 2.11. Note the significant drop in 2001 during the energy crisis. Loads from 1997 to 2008 are not weather normalized. Annual growth is expected to be 1.7 percent over the next twenty years. The 2005 and 2007 IRP load forecasts are presented for comparison purposes. Loads are moderately lower in the 2009 IRP compared with the 2007 IRP due to the cumulative impact of additional conservation measures from the 2007 IRP being incorporated in this forecast.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 42 of 729

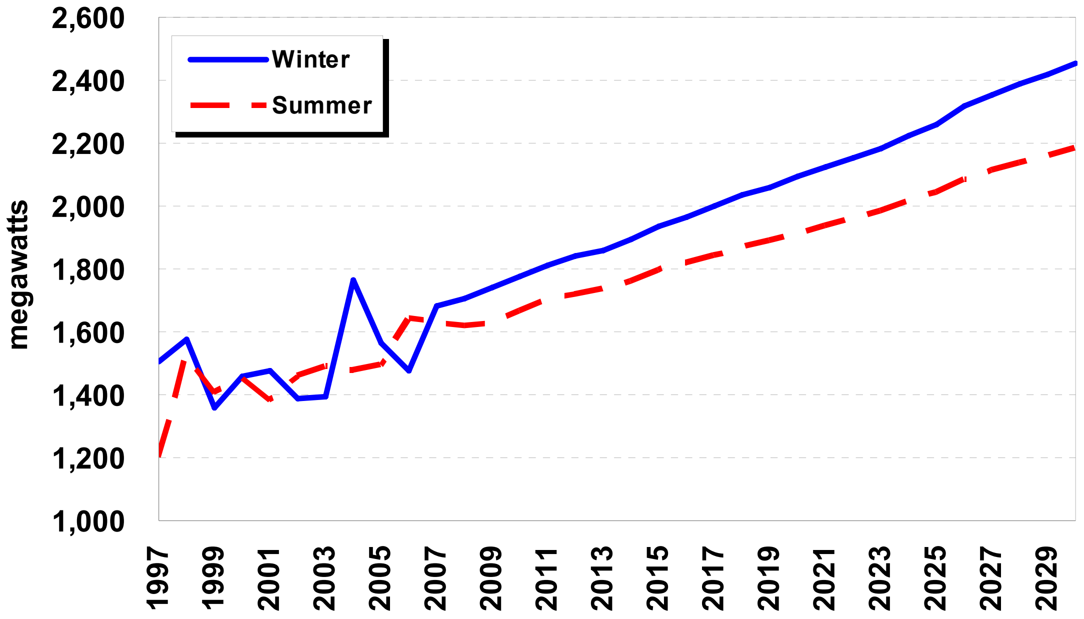
Figure 2.11: Annual Net Native Load



Peak Demand Forecast

The peak demand forecast in each year represents the most likely value for that year. It does not represent the extreme peak demand. The most likely peak demand has a 50 percent chance of being exceeded in any year. The peak forecast is produced by running a regression between actual peak demand and net native load. The peak demand forecast is in Figure 2.12. Peak loads are expected to grow at 1.7 percent between 2009 and 2019 (223 MW) and 1.7 percent over the entire 20-year forecast.

Figure 2.12: Calendar Year Peak Demand

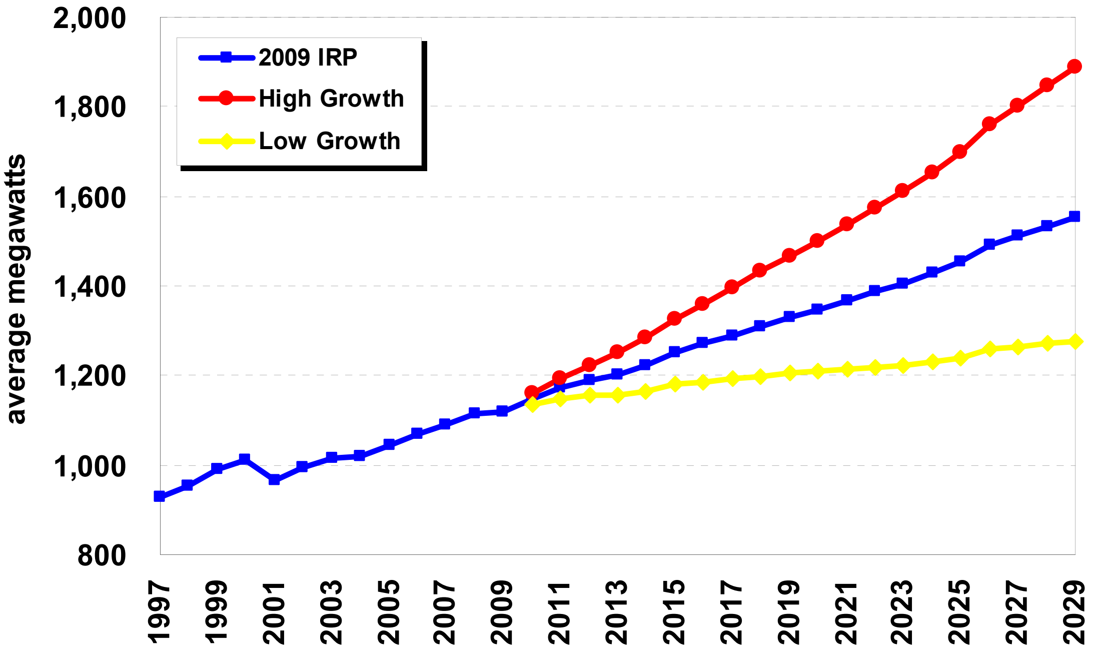


Historical data are influenced by extreme weather events. The comparatively low 1999 peak demand figure was the result of a warmer-than-average winter peak day; the peak in 2006 was the result of a below-average winter peak day. The 1999 and 2006 peak demand values illustrate why relying on compound growth rates for the peak demand forecast is an oversimplification and why the Company plans to own or control enough generation assets and contracts to meet peak demand during weather events.

Avista has witnessed significant summer load growth as air conditioning penetration has risen in its service territory. That said, Avista expects to remain a winter-peaking utility in the foreseeable future. It is possible that very mild winter weather and extremely hot summertime temperatures could result in our summer peak load exceeding our wintertime demand level in a given year. This will be an anomaly. The 2007 IRP provided an illustration of this trend into the future.

Figure 2.13 shows the high and low load growth scenarios compared to the base load forecast. The high load growth scenario projects 2.6 percent load growth over the 20 year forecast. The low load forecast assumes 0.6 percent load growth over the next 20 years.

Figure 2.13: Electric Load Forecast Scenarios



Avista Resources and Contracts

The Company relies on a diversified portfolio of generating assets to meet customer loads. Avista owns and operates eight hydroelectric projects located on the Spokane and Clark Fork Rivers. Its thermal assets include partial ownership of two coal-fired units in Montana, four natural gas-fired projects within its service territory, another natural gas-fired project in Oregon and a biomass plant near Kettle Falls, Washington.

Spokane River Hydroelectric Projects

Avista owns and operates six hydroelectric projects on the Spokane River. These projects received a new 50-year FERC operating license in June 2009. The following section includes a short description of the Spokane River projects with the maximum capacity and nameplate ratings for each plant. The maximum capacity of a generating unit is the total amount of electricity a plant can safely generate. This is often higher than the nameplate rating. The nameplate, or installed capacity is the plant's capacity as rated by the manufacturer.

Post Falls

The upper most hydro facility on the Spokane River is Post Falls, located at its Idaho namesake near the Washington/Idaho border. The project began operation in 1906 and maintains lake elevation during the summer for Lake Coeur d'Alene. The project has six units, with the last added in 1980. The project is capable of producing 18.0 MW and has a 14.75 MW nameplate rating. Avista is studying the potential to replace the powerhouse with two larger units to increase energy production at the plant, and another option to increase generation by upgrading Unit 6.

Upper Falls
The Upper Falls project began generating in 1922 in downtown Spokane and is within the city's Riverfront Park. This project is comprised of a single 10.0 MW unit with a 10.26 MW maximum capacity rating. Rewinding the generator and replacing the runner is evaluated in this IRP; the upgrade would increase generation by approximately 2.0 MW.

Monroe Street
The Monroe Street facility was the Company's first generating unit. It started service in 1890 near what is now Riverfront Park. Rebuilt in 1992, the single generating unit has a 15.0 MW maximum capacity and a 14.8 MW nameplate rating. In year's past a second powerhouse at Monroe Street was evaluated. As part of the Company's efforts to increase renewable generation, this option will be studied further.

Nine Mile
The Nine Mile project was built by a private developer in 1908 near Nine Mile Falls, Washington, nine miles northwest of Spokane. The Company purchased it in 1925 from the Spokane & Eastern Railway. Its four units have a 17.6 MW maximum capacity[1] and a 26.4 MW nameplate rating. Currently Unit 1 provides no generation and Unit 2 is limited to half load. These units will be replaced and are expected to be online by 2012 and 2013. A rubber dam will be added to the facility, replacing flashboards, to take advantage of high flows. The total incremental capacity is 8.8 MW and an additional 4.4 aMW of renewable energy from its former operational capability.

Long Lake
The Long Lake project is located northwest of Spokane and maintains Lake Spokane, also known as Long Lake. The facility was the highest spillway dam with the largest turbines in the world when it was completed in 1915. The plant was upgraded with new runners in the 1990s, adding 2.2 aMW of renewable energy. The project's four units provide 88.0 MW of combined capacity and have an 81.6 MW nameplate rating. This IRP evaluates two additional upgrades at the project, either an additional 24 MW unit in the existing powerhouse or the development of a second powerhouse with a 60 MW generator.

Little Falls
The Little Falls project was completed in 1910 near Ford, Washington, and is Avista's furthest downstream hydro facility on the Spokane River. The facility was recently upgraded to generate an additional 0.6 aMW of renewable energy with a runner replacement on Unit 4. The facility's four units generate 35.2 MW of maximum capacity and have a 32.0 MW nameplate rating. Generator rewinds at each of these units were included at as resource options in this IRP for a total potential of 4.0 MW of additional capacity and 1.3 aMW of energy.

[1] This is the de-rated capacity considering the outage of unit 1 and de-rate of unit 2

Clark Fork River Hydroelectric Project

The Clark Fork River Project includes hydroelectric projects near Clark Fork, Idaho, and Noxon, Montana, 70 miles south of the Canadian border. The plants are operated under a FERC license through 2046.

Cabinet Gorge

The Cabinet Gorge plant started generating power in 1952 with two units. The plant was expanded with two additional generators in the following year. The current maximum capacity of the plant is 270.5 MW; it has a nameplate rating of 265.2 MW. Upgrades at this project began with the replacement of Unit 1 in 1994. Unit 3 was upgraded in 2001 and Unit 2 was upgraded in 2004. Unit 4, received a $6 million turbine upgrade in 2007, increasing its generating capacity from 55 MW to 64 MW, and adding 2.1 aMW of renewable energy. The Company is evaluating the addition of a fifth unit at the project. This addition would add 50 to 60 MW of capacity and up to 10.2 aMW of renewable energy.

Noxon Rapids

The Noxon Rapids project includes four generators installed between 1959 and 1960, and a fifth unit added in 1977. The current plant configuration has a maximum capacity of 541.0 MW and a generator nameplate rating of 480.6 MW. The project's units are currently being upgraded. The Unit 1 upgrade was completed in April 2009 and the remaining units will be replaced over the next three years. The upgrades are expected to add 30 MW of capacity and 6 aMW of qualified renewable energy to the Company's resource portfolio.

Total Hydroelectric Generation

In total, our hydroelectric plants are capable of generating as much as 986 MW. Table 2.2 summarizes the Company's hydro projects. This table also includes the average annual energy output of each facility based on the 70-year hydrologic record.

Table 2.2: Company-Owned Hydro Resources

Project Name	River System	Location	Start Date	Nameplate Capacity (MW)	Maximum Capability (MW)	Expected Energy (aMW)
Monroe Street	Spokane	Spokane, WA	1890	14.8	15.0	11.6
Post Falls	Spokane	Post Falls, ID	1906	14.7	18.0	9.8
Nine Mile	Spokane	Nine Mile Falls, WA	1925	26.4	17.6	13.3
Little Falls	Spokane	Ford, WA	1910	32.0	35.2	23.7
Long Lake	Spokane	Ford, WA	1915	81.6	88.0	58.4
Upper Falls	Spokane	Spokane, WA	1922	10.3	10.0	8.6
Cabinet Gorge	Clark Fork	Clark Fork, ID	1952	265.2	270.5	123.8
Noxon Rapids	Clark Fork	Noxon, MT	1959	541.0	480.6	197.1
Total				**986.0**	**934.9**	**446.3**

Thermal Resources

Avista owns seven thermal assets located across the Northwest. Each thermal plant is expected to continue to be available through the 20-year duration of the 2009 IRP. The Company's thermal resources provide dependable low-cost energy to serve base loads and provide peak load serving capabilities. A summary of Avista's thermal resources is shown in Table 2.3.

Colstrip

The Colstrip plant, located in Eastern Montana, consists of four coal-fired steam plants owned by a group of utilities. PPL Montana operates the facilities. Avista owns 15 percent of Units 3 and 4. Unit 3 was completed in 1984 and Unit 4 was finished in 1986. The Company's share of each Colstrip unit has a maximum net capacity of 111.0 MW and a nameplate rating of 123.5 MW. Capital improvements to both units were completed in 2006 and 2007 to improve efficiency, reliability and generation capacity. The upgrades included new high-pressure steam turbine rotors and a conversion from analog to digital control systems. These capital improvements increased the Company's share of generation by 4.2 MW at each unit without any additional fuel consumption.

Rathdrum

Rathdrum is a two-unit simple-cycle combustion turbine. The gas-fired plant is located near Rathdrum, Idaho. It entered service in 1995 and has a maximum capacity of 180.0 MW in the winter and 126.0 MW in the summer. The nameplate rating is 166.5 MW.

Northeast

The Northeast plant, located in northeast Spokane, is a two-unit aero-derivative simple-cycle plant completed in 1978. The plant is capable of burning natural gas or fuel oil, but current air permits prevent the use of fuel oil. The combined maximum capacity of the units is 68.0 MW in the winter and 42.0 MW in the summer, with a nameplate rating of 61.2 MW. Northeast is primarily used for reserve capacity to protect against reliability concerns and market aberrations.

Boulder Park

The Boulder Park project was completed in Spokane Valley in 2002. The site uses six natural gas-fired internal combustion engines to produce a combined maximum capacity and nameplate rating of 24.6 MW.

Coyote Springs 2

Coyote Springs 2 is a natural gas-fired combined cycle combustion turbine located near Boardman, Oregon. The plant began service in 2003. The maximum capacity is 280.6 MW in the winter and 226.5 MW in the summer and the duct burner provides the unit with an additional capability of up to 20.4 MW. The nameplate rating for this plant is 287.3 MW.

Kettle Falls and Kettle Falls CT

The Kettle Falls biomass facility was completed in 1983 near Kettle Falls, Washington and is one of the largest biomass plants in North America. The open-loop biomass steam plant is fueled by waste wood products from area mills and forest slash, but can


Kettle Falls Generation Station

also run on natural gas. A gas-fired CT was added to the facility in 2002. The CT burns natural gas and sends exhaust heat to the wood facilities boiler to increase wood fuel efficiency.

The wood portion of the plant has a maximum capacity of 50.0 MW and a nameplate rating is 50.7 MW; typically the plant operates between 45 and 47 MW due to fuel quality issues. The plant's capacity increases to 56.0 MW when operated in combined-cycle mode with the CT. The CT produces 5.2 MW of peaking capability in the summer and 7.8 MW in the winter. The CT resource has limited operations in winter when the gas pipeline is constrained. Avista is evaluating upgrading the capacity of the pipeline, This IRP also evaluates the addition of a wood gasifier to the project so that the CT can use less natural gas and generate more renewable energy.

Table 2.3: Company-Owned Thermal Resources

Project Name	Location	Fuel Type	Start Date	Winter Maximum Capacity (MW)	Summer Maximum Capacity (MW)	Nameplate Capacity (MW)
Colstrip 3 (15%)	Colstrip, MT	Coal	1984	111.0	111.0	123.5
Colstrip 4 (15%)	Colstrip, MT	Coal	1986	111.0	111.0	123.5
Rathdrum	Rathdrum, ID	Gas	1995	180.0	126.0	166.5
Northeast	Spokane, WA	Gas	1978	68.0	42.0	61.2
Boulder Park	Spokane, WA	Gas	2002	24.6	24.6	24.6
Coyote Springs 2	Boardman, OR	Gas	2003	301.0	246.9	287.3
Kettle Falls[2]	Kettle Falls, WA	Wood/Gas	1983	50.0	50.0	50.7
Kettle Falls CT	Kettle Falls, WA	Gas	2002	7.8	5.2	7.2
Total				**853.4**	**716.7**	**844.5**

Power Purchase and Sale Contracts

The Company utilizes several power supply purchase and sale arrangements to meet some load requirements. This chapter describes some of the larger contracts in effect during the scope of the 2009 IRP. Contracts can provide many benefits including environmentally low-impact and low-cost hydro and wind power. A 2010 annual summary of Avista's large contracts is in Table 2.4.

[2] Assumes combined cycle mode; when not in this mode the operational capacity is between 45-47 MW depending upon fuel quality.

Bonneville Power Administration – WNP-3 Settlement

Avista (then Washington Water Power) signed settlement agreements with Bonneville Power Administration (BPA) and Energy Northwest (formerly the Washington Public Power Supply System or WPPSS) on September 17, 1985, ending construction delay claims against both parties. The settlement provides an energy exchange through June 30, 2019, with an agreement to reimburse the Company for certain WPPSS – Washington Nuclear Plant No. 3 (WNP-3) preservation costs and an irrevocable offer of WNP-3 capability for acquisition under the Regional Power Act.

The energy exchange portion of the settlement contains two basic provisions. The first provision provides approximately 42 aMW of energy to the Company from BPA through 2019, subject to a contract minimum of 5.8 million megawatt-hours. Avista is obligated to pay BPA operating and maintenance costs associated with the energy exchange as determined by a formula that ranges from $16 to $29 per megawatt-hour in 1987 year constant dollars.

The second provision provides BPA approximately 32 aMW of return energy at a cost equal to the actual operating cost of the Company's highest-cost resource. A further discussion of this obligation, and how Avista plans to account for it, is covered under the Planning Margin heading of this chapter.

Mid-Columbia Hydroelectric Contracts

During the 1950s and 1960s, public utility districts (PUDs) in central Washington developed hydroelectric projects on the Columbia River. Each plant was oversized compared to the loads then served by the PUDs. Long-term contracts were signed with public, municipal and investor-owned utilities throughout the Northwest to assist with project financing and to ensure a market for the surplus power.

The Company entered into long-term contracts for the output of four of these projects "at cost." The contracts provide energy, capacity and reserve capabilities; in 2010 contracts will provide approximately 164 MW of capacity and 85 aMW of energy. Over the next 20 years, the Wells (2018) and Rocky Reach (2011) contracts will expire. Avista may be able to extend these contracts; however, it has no assurance today that extensions will be offered. Due to this uncertainty, the IRP does not include these contracts beyond their expiration dates.

Avista renewed its contract with Grant PUD in 2005 for power from the Priest Rapids project. The contract term will equal the term in the forthcoming Priest Rapids and Wanapum dam FERC licenses in 2052.

Lancaster

Avista acquired the output rights to the Lancaster combined-cycle generating station as part of the sale of Avista Energy to Shell in 2007. Lancaster is also known as the Rathdrum Generating Station, but the plant is referred to as Lancaster in this IRP to remove confusion with the Rathdrum CT. The project is under a tolling Power Purchase Agreement (PPA) with Energy Investors Funds (80 percent owner) and Goldman Sachs (20 percent owner) through October 2026. Avista has the right to dispatch the plant and is responsible for providing fuel, energy, and capacity payments. The 2007 IRP showed that the Lancaster project was a lower cost acquisition than a greenfield site and was also lower in cost than recent CCCT transactions in the Northwest.

Table 2.4: Large Contractual Rights and Obligations

Contract	Type	End Date	Winter Capacity (MW)	Summer Capacity (MW)	2010 Annual Energy (aMW)
Canadian Entitlement	Sale	n/a	6.3	6.3	3.6
Douglas Settlement	Purchase	Sep-2018	2.5	3.9	3.7
Forward Market	Purchase	Dec-2010	100.0	100.0	100.0
Grant Displacement	Purchase	Sep-2011	17.4	19.6	22.0
Lancaster	Purchase	Oct-2026	281.0	264.0	237.8
Nichols Pumping	Sale	n/a	6.8	6.8	6.8
PGE Capacity	Exchange	Dec-2016	150.0	150.0	0.0
Potlatch	PURPA	Dec-2011	75.0	75.0	47.6
Rocky Reach	Purchase	Oct-2011	34.5	34.0	20.3
Stateline	Purchase	Dec-2011	0.0	0.0	8.3
Stimson Lumber	PURPA	Sep-2011	4.2	4.4	4.2
Upriver (net load)	PURPA	Dec-2011	8.2	-1.3	6.1
Wanapum/Priest Rapids	Purchase	Mar-2052	67.6	66.6	34.8
Wells	Purchase	Aug-2018	26.1	25.9	14.7
WNP-3	Purchase/Sale	Jun-2019	89.3	0.0	42.3

Reserve Margins

Planning reserves accommodate situations when loads exceed and/or resources are below expectations due to adverse weather, forced outages, poor water conditions or other contingencies. There are disagreements within the industry on adequate reserve margin levels. Many stem from system differences, such as resource mix, system size, and transmission interconnections. For example, a hydro-based utility generally has a higher capacity to energy ratio than a thermal-based utility.

Reserve margins, on average, increase customer rates when compared to resource portfolios without reserves, due to carrying additional cost of generation. Reserve resources have the physical capability to generate electricity, but high operating costs limit economic dispatch and the potential to create revenues to offset capital investments.

Avista Planning Margin

Avista retains two types of planning margins—capacity and energy. Capacity planning is a traditional planning metric for many utilities to ensure they can meet peak loads at times of system strain. Energy planning is used for utilities with resources that have an unpredictable fuel source, such as wind and hydro, but also to cover load variance. For capacity planning, Avista reserves are not directly based on unit size or resource type.

Planning reserves are set at a level equal to 15 percent planning reserve margin during the Company's peak load hour.

For energy planning, resources must be adequate to meet customer requirements. Extreme weather conditions can change monthly energy obligations by up to 30 percent. If generation capability does not meet high load variations, customers and the utility are exposed to increased short term market volatility. In addition to load variance, Avista also uses a planning margin for its hydro generation. Unlike weather, hydro is not normally distributed due to river regulation by the hydroelectric projects.

There is a difference of regional opinion concerning the proper method for establishing a resource planning margin. Many utilities in the Northwest base their capacity planning on critical water using the 1936/37 hydro year as the critical time period. The critical water year of 1936/37 is poor on an annual basis, but it is not necessarily critical month-to-month. The utility could build resources to reach the 99 percent confidence level, and could significantly decrease the frequency of market purchases, but this strategy requires approximately 200 MW of additional generation capability. Additional capital expenditures to support this level of reliability would put upward pressure on retail rates. Analysis of historical data indicates that an optimal criterion is the use of a 90 percent confidence interval based on the monthly variability of load and the 10th percentile of monthly historical hydro energy. This results in a 10 percent chance of load exceeding the planning criteria for each month. In other words, there is a 10 percent chance that the Company would need to purchase energy from the market in any given month.

Additional variability is inherent in Avista's WNP-3 contract with BPA. The contract includes a return energy provision that can equal 32 aMW annually. The contract would be exercised under adverse conditions, such as low hydroelectric generation or high loads. The contract was last exercised in 2001. Energy planning margin is increased by 32 aMW to account for the WNP-3 obligation through its expiration in 2019. The total capacity planning margin and energy margin adds 267 MW of required capacity and 227 aMW of energy in 2010.

Other Planning Methods

Parallel to planning margins is a gray area between energy and capacity planning. Sustained peaking and Loss of Load Probability (LOLP) metrics can be used to further evaluate system constraints. Avista has actively participated in the Northwest Power and Conservation Council's Resource Adequacy committees over the past few years. This effort has used LOLP and sustained capacity analyses to evaluate the Northwest's resource position over extended timeframes. Preliminary work indicates that the Northwest should carry approximately a 25 percent planning margin in the wintertime and a 17 percent planning margin in the summertime. These levels are much higher than the 12 to 15 percent levels recommended in other markets, primarily due to the Northwest's heavier reliance on hydroelectric generation. Given the uncertainties surrounding higher planning margins, Avista will not adopt the NPCC metrics in this planning cycle. The Company will continue to participate in the regional process and will use the results for future resource planning.

Sustained peaking capacity is a tabulation of loads and resources over a period exceeding the traditional one-hour definition. It is also a measure of reliability and recognizes that peak loads do not stress the system for just one hour. The difference from traditional one hour peak analysis is a look at multiple days versus one hour. The analysis also considers hydro system impacts by freezing temperatures and hydro reservoir depletion.

LOLP has only recently gained attention in the Northwest. The industry standard is a 5.0 percent acceptable loss of load. Avista has created a tool to evaluate LOLP, but there is still significant uncertainty surrounding how much energy from the wholesale market would be available to Avista at a time of regional peak loads. At the first TAC meeting, an early analysis was shown for 2009 and included many scenarios. The results of this study indicated for the 2009 planning year the LOLP is 2.1 percent in the winter and 3.8 percent in the summer, but this includes a market availability of 300 MW. If only 200 MW of on-peak market is available, the LOLP increases to 7.4 percent in the winter and 12.1 percent in the summer. Additional studies are required for this analysis. The goal for the LOLP tool is to ensure the Preferred Resource Strategy adds resources adequate to meet reliability criteria, but the critical assumption is the amount of energy available from the market. The Northwest Power and Conservation Council is studying this problem, and Avista will use the results from that process.

Washington State Renewable Portfolio Standard

In the November 2006 general election, Washington State voters approved Citizens Initiative 937. The initiative requires utilities with more than 25,000 customers to source 3 percent of their energy from qualified renewables by 2012, 9 percent by 2016, and 15 percent by 2020. Utilities also must acquire all cost effective conservation and energy efficiency measures. Even though Avista does not require new resources to meet forecasted loads through 2017, this new law requires Avista to acquire qualified renewable generation or Renewable Energy Certificates (REC) resources it otherwise would not need to meet the initiative's renewable goals.

Avista will meet or exceed its renewable requirement goals between 2012 and 2015 with a recent REC purchase and qualified hydroelectric upgrades. The Company plans to acquire resources to ensure that it is not forced to make REC purchases in a strained market in nine of 10 years due to lower-than-expected wind and hydro generation levels. See Table 2.5.

Resource Requirements

The differences between loads and resources illustrate potential needs the Company must address through future resource acquisitions. Avista regularly develops a 20-year forecast of peak capacity loads and resources. Peak load is the maximum one-hour obligation, including operating reserves, on the expected average coldest day in January and the average hottest day in August. Peak resource capability is the maximum one hour generation capability of Company resources, including net contract contribution, at the time of the one-hour system peak, and excludes resource that are on maintenance during peak load periods.

Avista is surplus capacity through 2014. It then carries a modest deficit until the Portland General Exchange contract expires in 2016. Avista is then capacity surplus in 2019. Deficits grow after 2018 as peaking requirements increase with load growth, and as the Company's resource base declines with the expiration of market purchases and Mid-Columbia hydroelectric project contracts. Winter and summer capacity positions are shown in Figures 2.15 and 2.16, respectively. Tabular views of this data are in Table 2.6 and Table 2.7.

In addition to balancing capacity, Avista procures enough resources to meet its energy obligations. The energy position includes resources at their full capability during normal weather conditions in each month. It includes generation maintenance schedules and loads based on expected normal temperatures. The first deficit year for energy (including the planning margin) is 2018. Quarterly deficits begin in the fourth quarter of 2014. A graphical representation of Avista's positions is shown in Figure 2.17; a tabular version of the data is shown Table 2.8. Each of these charts includes conservation levels per the 2007 IRP. In Chapter 8, conservation levels are updated to reflect 2009 IRP levels.

Figure 2.15: Winter Capacity Position

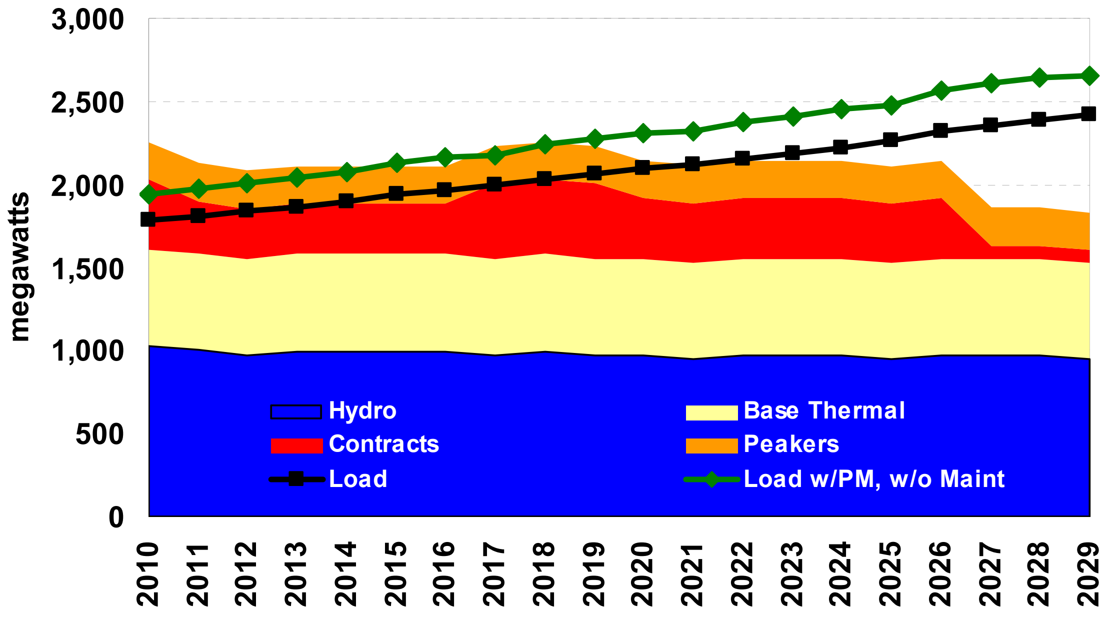


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 54 of 729

Figure 2.16: Summer Capacity Position

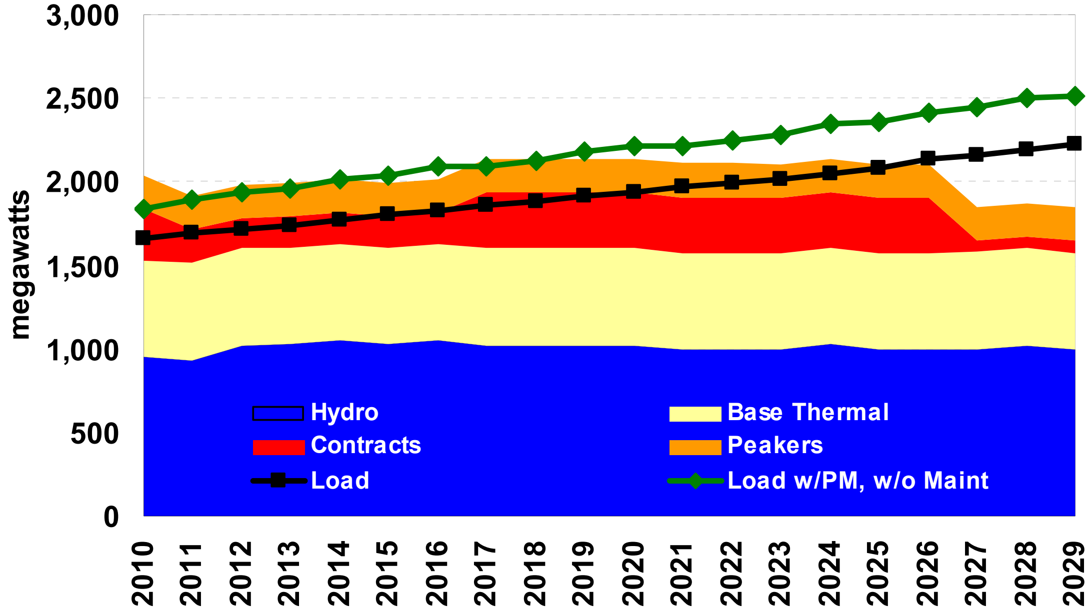


Figure 2.17: Annual Average Position

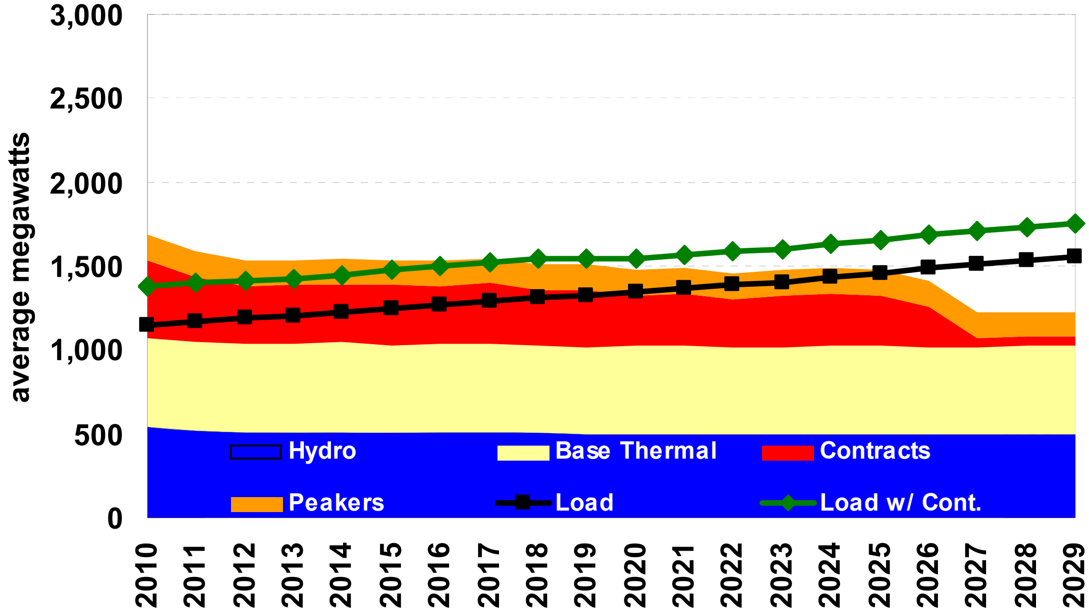


Table 2.5: Washington State RPS Detail (aMW)

	On-line Year	Upgrade Energy	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
WA State Retail Sales Forecast			653	668	678	686	695	703	716	729	744	756	768	782	795	808	823	837	851
Load 10% Change of Exceedance			29	29	30	30	31	31	32	32	33	33	34	34	35	35	36	37	37
Planning RPS Load			681	697	708	716	725	734	748	762	776	789	802	817	830	843	859	874	888
RPS %			0%	0%	3%	3%	3%	3%	9%	9%	9%	9%	15%	15%	15%	15%	15%	15%	15%
Required Renewable Energy			**0.0**	**0.0**	**20.7**	**21.1**	**21.4**	**21.6**	**65.7**	**66.7**	**67.9**	**69.2**	**117.4**	**119.3**	**121.4**	**123.5**	**125.5**	**127.6**	**129.9**
Renewable Resources																			
Purchased RECs			0.0	0.0	5.7	5.7	5.7	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kettle Falls	1983		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stateline	1999		7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long Lake 3	1999		2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Little Falls 4	2001		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cabinet 2	2004		2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Cabinet 3	2001		4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Cabinet 4	2007		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Apprentice Credits			0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Hydro 10% Chance of Exceedance			(3.5)	(3.5)	(3.5)	(3.5)	(3.5)	(3.5)	(3.5)	(3.5)	(3.5)	(3.5)	(3.5)	(3.5)	(3.5)	(3.5)	(3.5)	(3.5)	(3.5)
Total Qualifying Resources			***16.6***	***16.6***	***14.8***	***14.8***	***14.8***	***14.8***	***9.1***	***9.1***	***9.1***	***9.1***	***9.1***	***9.1***	***9.1***	***9.1***	***9.1***	***9.1***	***9.1***
Net REC Position (Completed)			**16.6**	**16.6**	**(5.9)**	**(6.3)**	**(6.6)**	**(6.8)**	**(56.6)**	**(57.6)**	**(58.8)**	**(60.1)**	**(108.3)**	**(110.2)**	**(112.3)**	**(114.4)**	**(116.4)**	**(118.5)**	**(120.8)**
Budgeted Hydro Upgrades																			
Noxon 1	2009	2.30	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Noxon 2	2010	1.00	0.6	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Noxon 3	2011	1.30	0.0	0.8	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Noxon 4	2012	1.20	0.0	0.0	0.7	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Nine Mile	2012	3.80	0.0	0.0	2.3	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Hydro 10% Chance of Exceedance			(1.0)	(1.4)	(2.3)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)
Total Budgeted Hydro Upgrades			***2.4***	***3.3***	***6.2***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***
Net REC Postion (Budgeted Upgrades)			**19.0**	**19.9**	**0.3**	**2.2**	**2.0**	**1.7**	**(48.1)**	**(49.1)**	**(50.3)**	**(51.6)**	**(99.8)**	**(101.7)**	**(103.8)**	**(105.9)**	**(107.9)**	**(110.0)**	**(112.3)**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 56 of 729

Table 2.6: Winter Capacity Position (MW) - Plan for Position Excluding Maintenance

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
REQUIREMENTS																				
Native Load	-1,779	-1,812	-1,839	-1,862	-1,893	-1,937	-1,967	-1,998	-2,033	-2,062	-2,091	-2,124	-2,154	-2,185	-2,222	-2,261	-2,320	-2,352	-2,387	-2,419
Contracts Obligations	-240	-239	-239	-239	-239	-164	-164	-14	-14	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12
Total Requirements	**-2,019**	**-2,051**	**-2,078**	**-2,101**	**-2,132**	**-2,101**	**-2,131**	**-2,012**	**-2,046**	**-2,074**	**-2,103**	**-2,136**	**-2,166**	**-2,197**	**-2,234**	**-2,273**	**-2,331**	**-2,364**	**-2,398**	**-2,431**
RESOURCES																				
Contracts Rights	657	557	539	539	539	464	464	464	464	462	372	372	372	371	371	371	371	90	90	90
Hydro Resources	1,030	1,000	972	997	997	997	997	970	997	971	971	944	971	971	971	944	971	971	971	944
Base Load Thermals	580	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584
Peaking Units	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226
Total Resources	**2,493**	**2,366**	**2,321**	**2,346**	**2,346**	**2,271**	**2,271**	**2,244**	**2,271**	**2,242**	**2,153**	**2,126**	**2,153**	**2,152**	**2,152**	**2,125**	**2,152**	**1,871**	**1,871**	**1,844**
PEAK POSITION	**474**	**315**	**242**	**246**	**214**	**170**	**141**	**232**	**225**	**169**	**50**	**-10**	**-14**	**-45**	**-82**	**-148**	**-180**	**-493**	**-528**	**-587**
RESERVE PLANNING																				
Planning Reserve Margin	-267	-272	-276	-279	-284	-291	-295	-300	-305	-309	-314	-319	-323	-328	-333	-339	-348	-353	-358	-363
Peak Position With Maint.	207	43	-33	-34	-70	-120	-154	-67	-80	-140	-264	-328	-337	-373	-416	-487	-528	-846	-886	-950
POSITION EXCLUDING MAINT.	**313**	**148**	**71**	**66**	**30**	**-20**	**-54**	**60**	**20**	**-40**	**-164**	**-201**	**-237**	**-273**	**-316**	**-360**	**-428**	**-746**	**-786**	**-823**

Table 2.7: Summer Capacity Position (MW) - Plan for Position Excluding Maintenance

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
REQUIREMENTS																				
Native Load	-1,659	-1,695	-1,720	-1,739	-1,766	-1,805	-1,830	-1,858	-1,887	-1,912	-1,938	-1,966	-1,993	-2,019	-2,051	-2,085	-2,136	-2,164	-2,194	-2,222
Contracts Obligations	-241	-240	-240	-240	-240	-165	-165	-15	-15	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13
Total Requirements	**-1,900**	**-1,936**	**-1,960**	**-1,979**	**-2,006**	**-1,970**	**-1,995**	**-1,872**	**-1,902**	**-1,925**	**-1,951**	**-1,979**	**-2,006**	**-2,032**	**-2,064**	**-2,098**	**-2,149**	**-2,177**	**-2,207**	**-2,235**
RESOURCES																				
Contracts Rights	545	445	425	425	425	350	350	350	350	346	346	346	346	346	346	346	346	82	82	82
Hydro Resources	953	932	1,020	1,028	1,051	1,028	1,049	1,022	1,022	1,021	1,023	996	996	993	1,028	996	996	1,002	1,023	996
Base Load Thermals	577	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Peaking Units	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Total Resources	**2,274**	**2,158**	**2,225**	**2,234**	**2,257**	**2,159**	**2,180**	**2,152**	**2,152**	**2,147**	**2,150**	**2,122**	**2,122**	**2,119**	**2,155**	**2,122**	**2,122**	**1,864**	**1,885**	**1,858**
PEAK POSITION	**374**	**222**	**266**	**255**	**251**	**189**	**184**	**280**	**250**	**222**	**198**	**143**	**116**	**87**	**90**	**24**	**-27**	**-313**	**-322**	**-377**
RESERVE PLANNING																				
Planning Reserve Margin	-249	-254	-258	-261	-265	-271	-275	-279	-283	-287	-291	-295	-299	-303	-308	-313	-320	-325	-329	-333
Peak Position with Maint.	125	-33	8	-6	-14	-82	-90	1	-33	-65	-92	-152	-182	-216	-217	-289	-348	-637	-651	-711
POSITION EXCLUDING MAINT.	**293**	**124**	**53**	**31**	**0**	**-45**	**-74**	**45**	**11**	**-46**	**-76**	**-108**	**-139**	**-169**	**-206**	**-245**	**-304**	**-600**	**-634**	**-667**

Table 2.8: Annual Energy Position (aMW) - Plan for Contingency Net Position

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
REQUIREMENTS																				
Native Load	-1,148	-1,171	-1,189	-1,202	-1,222	-1,252	-1,270	-1,289	-1,311	-1,329	-1,348	-1,367	-1,386	-1,405	-1,429	-1,452	-1,491	-1,511	-1,533	-1,553
Contract Obligations	-139	-139	-139	-139	-139	-64	-64	-12	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11
Total Requirements	**-1,287**	**-1,310**	**-1,328**	**-1,341**	**-1,361**	**-1,315**	**-1,334**	**-1,301**	**-1,322**	**-1,339**	**-1,358**	**-1,378**	**-1,397**	**-1,416**	**-1,439**	**-1,463**	**-1,502**	**-1,522**	**-1,544**	**-1,564**
RESOURCES																				
Contract Rights	604	521	487	495	473	420	410	368	346	347	311	322	299	321	321	310	254	61	61	61
Hydro	538	520	509	511	511	511	511	511	507	496	496	496	496	496	496	496	496	496	496	496
Thermal Resources	528	528	527	526	542	517	526	528	519	520	530	530	519	520	529	531	519	523	529	530
Total Resources	**1,670**	**1,569**	**1,522**	**1,532**	**1,526**	**1,448**	**1,446**	**1,407**	**1,371**	**1,363**	**1,337**	**1,348**	**1,314**	**1,337**	**1,346**	**1,336**	**1,270**	**1,080**	**1,086**	**1,087**
POSITION	**382**	**259**	**194**	**191**	**165**	**133**	**112**	**106**	**49**	**24**	**-21**	**-30**	**-83**	**-79**	**-94**	**-127**	**-232**	**-442**	**-458**	**-477**
CONTINGENCY PLANNING																				
Contingency Total	-227	-228	-224	-225	-226	-227	-227	-228	-229	-212	-195	-196	-197	-198	-199	-200	-201	-202	-202	-203
Peaking Resources	153	153	153	144	153	153	153	153	153	153	153	153	153	153	153	153	153	153	153	153
CONTINGENCY NET POSITION	**309**	**185**	**123**	**110**	**93**	**59**	**38**	**31**	**-27**	**-35**	**-63**	**-73**	**-126**	**-124**	**-139**	**-173**	**-280**	**-490**	**-507**	**-527**

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 58 of 729

3. Energy Efficiency

Introduction

Avista's energy efficiency programs provide a wide range of conservation options and education for residential, commercial, industrial and low income customers. Programs fall into prescriptive and site-specific classifications. Prescriptive programs offer cash incentives for standardized products, such as compact fluorescent light bulbs and high efficiency appliances. These programs are primarily directed towards residential and small commercial customers. Site-specific programs provide cash incentives for any cost-effective energy savings measure with a payback greater than one year. These site-specific programs require customized services for commercial and industrial customers because many applications need to be tailored to the unique characteristics of customer's premises and processes.

Energy efficient window replacement at Avista's headquarters in Spokane, Washington

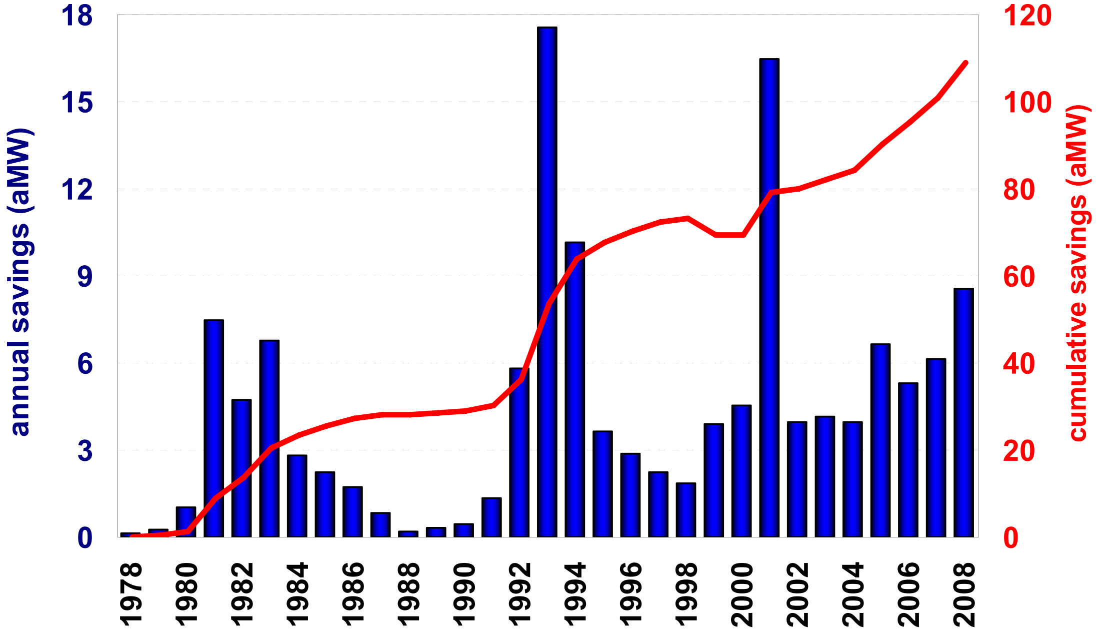
Chapter Highlights

- Conservation additions provide 26 percent of new supplies through 2020.
- 2009 IRP includes 0.3 aMW (3.3 percent) more conservation than the 2007 IRP.
- Avista has offered conservation programs for over 30 years.
- The Company has acquired 138.5 aMW of electric efficiency in the past three decades; an estimated 109 aMW continue to reduce customer loads.
- The Company is prepared to quickly respond to another energy crisis with efficiency measures.
- Approximately 3,000 efficiency measures were evaluated for the 2009 IRP.
- 7.5 aMW of local and 2.9 aMW of regional conservation are expected in 2010.

Avista has continuously offered electric efficiency programs since 1978. Some of Avista's most notable efficiency achievements include the Energy Exchanger programs, which converted over 20,000 homes from electric to natural gas space or water heating from 1992 to 1994; pioneering the country's first system benefit charge for energy efficiency in 1995; and the immediate conservation response during the 2001 Western energy crisis which tripled annual energy savings at only twice the cost in half the time during a period of high wholesale market prices. The Company's conservation programs provide savings that regularly meet or exceed its regional share of energy efficiency savings as outlined by the Northwest Power and Conservation Council (NPCC). Figure 3.1 illustrates Avista's historical electricity conservation acquisitions.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 59 of 729

Figure 3.1: Historical Conservation Acquisition



Avista has acquired 138.5 aMW of cumulative electricity efficiency resources over the last 30-years; of the 138.5 aMW total, 109 aMW acquired during the last 18 years is assumed to still be online and providing resource value today. Northwest Energy Efficiency Alliance's (NEEA's) cumulative conservation estimates are based on an 18-year average weighted measure life.

All conservation measures and programs have been examined based on surrogate generation costs in this IRP. New savings targets have been established and the Company is planning a significant ramp-up of energy efficiency activity in the coming years.

Avista is also expanding the breadth of its energy efficiency activities to include demand response initiatives and is analyzing the potential for transmission and distribution efficiency measures. More details about transmission and distribution efficiency projects can be found in the Transmission and Distribution chapter of this IRP. Our demand response pilot is still in process, so there is not enough data to currently determine if Avista will continue demand response initiatives, and they were not included in this IRP. The results of the demand response pilot will be addressed in detail in the 2011 IRP.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 60 of 729

Cooperative Regional Market Transformation Programs

Avista is a funding and fully participating member of NEEA, www.nwalliance.org. NEEA is funded by regional investor-owned and public utilities to acquire electric efficiency measures that are best achieved through broad market transformation efforts. These programs reach beyond individual service territories and consequently require regional cooperation to succeed.

Past NEEA funding has been $20 million shared throughout the region. Avista's four percent annual portion of NEEA funding has been $800,000. The Northwest funding utilities have been discussing increasing this amount by 50 percent or more and reapportioning member shares to reflect current retail load. Avista's share would be increased from 4.0 percent to 5.41 percent. This increase in our regional funding share would increase our savings acquisition by 30% or more. NEEA has proven to be a cost-effective component of regional resource acquisition. Avista has and continues to leverage NEEA ventures when cost-effective enhancements can be achieved.

Attributing regionally acquired conservation savings to individual utilities is difficult. To ensure that resources are not double-counted at regional and local levels, NEEA has excluded all energy for which local utility rebates have been granted. This allows the summation of local and regional acquisitions to determine the total impact in a market. Avista has typically applied our funding share of slightly less than four percent to NEEA's annual claim of energy savings. It was assumed that historic acquisitions would remain flat at the most recent level because there are no reliable 20-year estimates of regional program acquisitions. This assumption is speculative and dependent on the opportunities for regional market transformation during this period. It is consistent with the recent history of NEEA funding.

Program Funding

Avista changed its approach to conservation cost-recovery in 1995 from the traditional capitalization of the investments to cost-recovery through a non-bypassable public benefits surcharge (the tariff rider). Avista currently manages four separate tariff riders for Washington electric, Idaho electric, Washington natural gas and Idaho natural gas investments. Based upon the demand for funds and incoming tariff rider revenues, this balance can be positive or negative at any particular point in time.

The aggregate tariff rider balances were returned to a zero balance in 2005 from a $12.4 million deficit in the aftermath of the 2001 Western energy crisis. Recent demand for conservation services has exceeded tariff rider revenues. The most recent projection forecasts a $3.6 million negative balance in the Washington electric DSM tariff rider by the end of 2009. The Idaho electric tariff balance is projected to be just below $4.0 million with schedule 91 increases effective August 1, 2009.

Energy Independence Act

Washington's Energy Indpendence Act, established under Initiative 937 (I-937), and codified under RCW 19.285, requires utilities with over 25,000 customers to obtain a fixed percentage of their electricity from qualifying renewable resources. The mandates are three percent of retail load in Washington by 2012, nine percent by 2016 and 15 percent by 2020. As experience has shown in other jurisdictions, these requirements

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 61 of 729

could be changed by the state legislature in the future. In addition to its RPS, I-937 also requires utilities with over 25,000 customers to acquire all cost-effective and achievable energy conservation. The methodology for identifying the conservation target must be consistent with the methods used by the Northwest Power and Conservation Council (NPCC) in its power plans. Avista's methodology for identifying its conservation target is consistent with the NPCC Sixth Power Plan methodology to the extent possible given the timing of the two processes (this IRP was completed prior to the completion of the Sixth Power Plan). The conservation inputs for this IRP process leveraged the NPCC work. To the extent that significant changes are incorporated into the Sixth Power Plan after the completion of this IRP, it is Avista's intent to reserve the opportunity to substitute our share of the regional conservation potential ultimately defined by the Sixth Power Plan, on a year-by-year basis, for the conservation targets identified in this IRP.

The first performance period for the Washington energy efficiency target will be 2010-2011. Washington regulations require the Company to file its biennial conservation target on or before January 31, 2010. Avista's report, as required by WAC 480-109 (3)(c), will "describe the technologies, data collection, processes, procedures and assumptions the utility used to develop these figures. This report must describe and support any changes in assumptions or methodologies used in the Utility's most recent IRP or the Conservation Council's [NPCC] Power Plan." WAC 480-109 requires approval, approval with modifications or rejection by the WUTC of the Company's targets. Avista's filing will follow, and this IRP will be consistent with, the NPCC's Sixth Power Plan. The Company's report will include traditional conservation efforts (possibly exclusive of electric to natural gas conversions), non-programmatic adoption of energy efficiency measures consistent with the Sixth Power Plan and distribution efficiency measures which would include savings on the utility and customer sides of the meter. Since distribution efficiencies count toward our goal, meeting plan requirements with the least net cost to ratepayers will involve interdepartmental coordination of efforts and development of new processes.

American Recovery and Reinvestment Act of 2009

Portions of the American Recovery and Reinvestment Act of 2009 (ARRA) provide economic stimulus funding for energy conservation, including residential audits, weatherization and smart grid development. Avista is working with local governments to field residential audits funded by a combination of our energy efficiency tariff rider, local government Energy Efficiency Conservation Block Grant (EECBG) funds, State Energy Program funds and the customer. The most recent iteration of these analyses calls for a "mid-level" audit that includes the installation of low-cost measures such as CFL's, door sweeps, water tank blankets, low-flow showerheads, furnace filter replacements, refrigerator and coil cleaning and several infiltration reduction measures. The audit is a $325 direct investment including about $160 in low-cost direct-install measures and $165 in auditor labor cost. The Company anticipates some program administrative labor needs on the back-end and estimates this to be the equivalent of about 2.9 full-time employees.

The Company currently estimates that customers will pay $150, with the remainder of the $325 incremental audit cost being split between the tariff rider and local government EECBG funds. The full cost of back office labor will also be funded by the tariff rider. If a local government chooses to not provide EECBG funds, customers will be responsible for paying the total cost of the audit. This enables Avista to offer this service throughout our Washington and Idaho jurisdictions, regardless of how different local governments choose to use their EECBG funds.

The ARRA economic stimulus funding low income weatherization will be allocated directly to regional community action agencies, as they already have the infrastructure necessary to distribute these funds to low income customers. Therefore, Avista will not be involved in administering programs funded under this portion of the ARRA. Low income populations served by the economic stimulus funding will not be counted towards our conservation goals since the Company is not contributing to the acquisition process.

Avista may participate in a regional smart grid demonstration project. The project scope would include distribution automation, distributed generation, energy storage, advanced metering infrastructure (AMI), software and support and demand response. The application deadline for this project is August 26, 2009.

Electricity Efficiency in the 2009 IRP

Avista has reviewed its efficiency options to ensure it is evaluating all alternatives in an effort to delay building additional generation industry infrastructure. The Heritage Project began during the 2007 IRP evaluation and "roadmaps" for several key areas were developed and followed. The roadmaps included: energy efficiency, demand response, transmission and distribution, and analytics.

Energy Efficiency

The Company has completed a comprehensive assessment of industry best practices in energy efficiency and enhanced its program offerings. As a result of this process, the Company launched rebate programs for residential fireplace dampers, non-residential prescriptive side-stream filtration, prescriptive energy/heat recovery ventilation, prescriptive demand control ventilation, prescriptive steam trap maintenance, retro-commissioning, as well as offering CFL coupons and community outreach and education on low cost and no cost ways to save energy. In addition, the Company has an on-going Facilities Model Program focusing on energy efficiency while maintaining and upgrading our facilities. Several projects at Avista's facilities, such as HVAC control upgrades, variable frequency drives (VFDs) on fan motors, and upgrades to the economizer cooling were estimated to save the Company 270,000 kWh and nearly 20,000 therms per year. The Company continues to assess the implementation of cost-effective energy efficiency upgrades where appropriate.

Load Management

While Avista faces higher market prices during peak demand periods, our costs are very different from other parts of the country. Technology costs continue to decline while technological improvements continue to develop making integration with our system a possibility. Since the Load Management Roadmap was developed, a program manager was added to evaluate load management. As part of this effort, a two year pilot of end-use control technology as well as customer acceptance was launched. This pilot will be completed on December 31, 2009. The Company will report on the pilot results in the 2011 IRP.

Analytics

Identification of cost-effective energy efficiency through traditional conservation or distribution efficiencies, as well as demand response, is dependent upon a technically sound and transparent analytical approach. Representatives from several departments developed concepts for resource evaluation of six resource value categories. Four of these values are part of a total avoided cost of energy usage while the remaining two values represent reductions in system coincident peak. Components included in the avoided cost of energy are commodity cost of energy, avoidance of carbon emissions, reducing retail rate volatility, and transmission and distribution system loss reduction. The value of system coincident peak capacity includes deferring future investments in generation capacity and transmission and distribution.

Transmission and Distribution

Avista completed a comprehensive assessment of the available cost-effective electric efficiency opportunities. This is always a factor in the completion of all IRP efforts given, but it is significantly increased. Further evaluation of these efficiency opportunities continue past the IRP processes. Avista evaluates energy-efficiency potential for the IRP in a manner that can augment the conservation business planning process and ultimately lead to appropriate revisions in efficiency acquisition operations.

Consistency between the IRP Evaluation and Conservation Operations

Avista evaluates energy-efficiency potential for the IRP in a manner that can augment the conservation business planning process and ultimately lead to appropriate revisions in conservation acquisition operations.

Avista utilizes the IRP process to comprehensively reevaluate the conservation market. This assessment evaluates individual technologies (generally prescriptive programs) where possible as well as program potential when a technology approach is infeasible. The evaluation assesses resource characteristics and constructs a conservation supply curve using the levelized total resource cost (TRC) and acquirable resource potential for each technology. Cost-effective technologies, compared to the defined avoided cost, are incorporated into the IRP acquisition target.

Further detailed program evaluation is applied when technologies in the program cannot be defined to permit their individual evaluation. This is the case in the Company's comprehensive limited income program, a portion of the non-residential site specific programs and the cooperative regional programs. The target acquisition for these programs is based on the modification of the historical baseline for known or likely changes in the market. This includes but is not necessarily limited to modifying the baseline for price elasticity and load growth.

Evaluation of Efficiency Technology Opportunities

The Regional Technical Forum (RTF) periodically surveys Pacific Northwest utilities and evaluates the amount of remaining conservation potential in the region. The Company used the results of these efforts as the starting point for evaluating different types of conservation technologies. Approximately 3,000 efficiency concepts were evaluated by Avista's staff using a six-stage review process. The process began with concepts using easily obtained data and moved toward more technically rigorous analyses. Measures that ranked poorly on the initial review did not receive further consideration. The individual phases of the analytical process are as follows.

Defining: Refinement and redefinition of the concept list to eliminate duplicative concepts and develop common definitions.

Qualitative ranking: The refined concepts were ranked based on a qualitative feasibility assessment. Concepts determined to not be acquirable through utility intervention were eliminated from further consideration.

Defining cost characteristics: Concepts with a reasonable potential for incorporation in the conservation portfolio were evaluated based on preliminary assessments of cost-effectiveness. This step required estimates of incremental customer cost, non-energy benefits, energy savings and measure life to develop a TRC levelized cost. Concepts were sorted based upon these cost characteristics.

Defining resource potential: Acquirable potentials for concepts specific to Avista's customers were estimated for the remaining concepts. These acquirable potentials came from an evaluation of technical and economic potential adjusted for utility intervention limitations to address barriers to customer adoption regardless of the economics.

Identifying load profiles: The value of capacity contribution (transmission, distribution and generation) is also included for evaluation of the total avoided cost. The Company based the avoided cost of energy on a 20-year, 8,760-hour avoided cost matrix. A 70-year avoided cost projection was also developed to account for the longevity of some measures. This avoided cost structure made it necessary to develop an 8,760-hour load profile for each evaluated measure. Avista uses thirty-three residential and non-residential load profiles in this part of the exercise. Appendix C contains a list of the load profiles used in this analysis.

Calculating TRC cost-effectiveness: A full TRC cost-effectiveness evaluation was performed on the remaining 706 residential and 2,484 non-residential concepts. The following section provides a more detailed explanation of the review of these concepts. A summary list of concepts reaching the evaluation stage is included in Appendix D.

Evaluation of TRC Cost-Effectiveness for Finalist Concepts

The construction of the TRC cost for each measure was based on the incremental customer cost. Non-energy benefits were considered, but none of the evaluated measures had a large enough non-energy benefit to materially change the final cost-effectiveness evaluation.

Estimating the TRC values is an intrinsically quantitative process. This required a present value calculation of the avoided energy and capacity cost over the measure life for each concept. The avoided cost of energy was based upon an application of the measure's 8,760-hour load profile to the 8,760-hour avoided cost structure.

For purposes of measure evaluation, it was appropriate to focus upon deferring a summer space-cooling-driven load. The 3,190 evaluated concepts had significant differences in their impact upon system coincident load and these differences were not always apparent based upon the general pattern of the measure load shape. To determine the expected impact upon the deemed space cooling-driven system peak load the 3,190 concepts and 33 load shapes (including a flat load option) were categorized into three groups.

Zero impact: Measures that would not have any impact on a summer space-cooling-driven peak received a zero valuation regardless of their load profile. This includes measures such as residential space-heating efficiencies.

Non-Drivers: Measures that were not related to space cooling but would potentially contribute to system load during a space cooling-driven peak received a capacity valuation based upon the average demand of their specific load profile during eight hour summer peak load period. The eight peak hours were 1 pm to 8 pm, weekdays only, between June 15 and September 15. These measures include commercial lighting and residential appliances.

Drivers: Measures that would drive a space cooling peak received a capacity valuation based on the maximum hourly demand identified in their 8,760-hour load profile. This includes measures such as residential and non-residential air conditioning efficiency.

A TRC ratio was developed after the TRC cost and benefit calculations were completed. Even though this analysis limits the identification of future DSM acquisition to measures that fully pass the TRC cost-effectiveness test, the Company plans on evaluating all measures with a benefit-to-cost ratio of 0.75 or higher in order to provide a fair evaluation of the marginally failing measures.

Having identified TRC cost-effective measures, the next step determined the annual acquisition of the identified potential. This completed the evaluation of those concepts that were suitable for review by groups of technology types within the IRP. These results are revisited following the explanation of the programmatically reviewed elements of the DSM portfolio.

Evaluation of Comprehensive Program Elements

The all-inclusive nature of Avista's non-residential site specific and limited income portfolios make it infeasible to generically evaluate the entire spectrum of possible efficiency measures. Nevertheless, it is necessary to develop estimates for the potential of these markets in order to establish a meaningful business planning process. Unique efficiency measures could not be generically evaluated as individual technologies. In place of this approach, the Company established a historical baseline level of acquisition and modified it to incorporate the impact of known or likely changes in the market.

The Company's limited income portfolio is all-inclusive for qualifying efficiency measures. The portfolio is implemented in cooperation with community action agencies that are given wide latitude in their approach to distributing program funds. No changes were expected in the ability of agency infrastructure to deliver these programs, and there were not any known market or technology changes that would cause a significant change in the ability to obtain efficiency resources from this segment. It was determined that a historical baseline would be the most appropriate starting point for estimating future throughput. The economic stimulus funding from the ARRA for low income weatherization was unknown at the time this analysis was completed. There may be material increases in the low income population served by the economic stimulus funding. Analysis funding impacts will be treated as an Action Item for reporting in the 2011 IRP. This historical baseline was modified for load growth and retail price elasticity based upon assumptions consistent with the forecasts available at the time. This resulted in a forecast of limited income acquisition for incorporation into the final conservation forecast.

Although some of the measures incorporated into the site-specific program were specifically evaluated, a large portion of non-residential acquisition comes from measures which could not be generically evaluated. As with the limited income program, the historical baseline was modified for anticipated load growth and retail price elasticity to develop a forecast. Unlike the limited income program, it was necessary to separate the specifically evaluated measures from the historical baseline, and then combine the two again as part of the final expected conservation acquisition. This process is illustrated in a flowchart in Appendix E.

Technical Potential

Every five years, the NPCC develops a regional Power Plan that evaluates technically available conservation potential. This amount is reduced to reflect the fraction of measures that can never be practically achieved, even if the measures were free and cost-effective. The Council believes this practically achievable conservation potential can reach penetration levels of 85 percent over the next twenty years.

The Sixth Power Plan is currently being drafted and will not be completed until after submission of the 2009 IRP, however, the Council's most recent draft plan estimates Avista's portion of the regional target to be 329 aMW for the twenty year period. This is an early estimate but should be within 10 to 15 percent of the final regional technical potential per the Council's Sixth Power Plan.

The Company's last external study on our energy savings potential was done in 2005. As an action item, Avista is committing to updating our estimates through another third-party savings potential study. We anticipate this study will cover all states and fuels intended to be used in the preparation of the 2011 IRP.

The Council only provides targets at a higher, utility level. Our measures along with their acquirable potential are illustrated in Appendix F.

Compilation of the Final DSM Resource Estimates

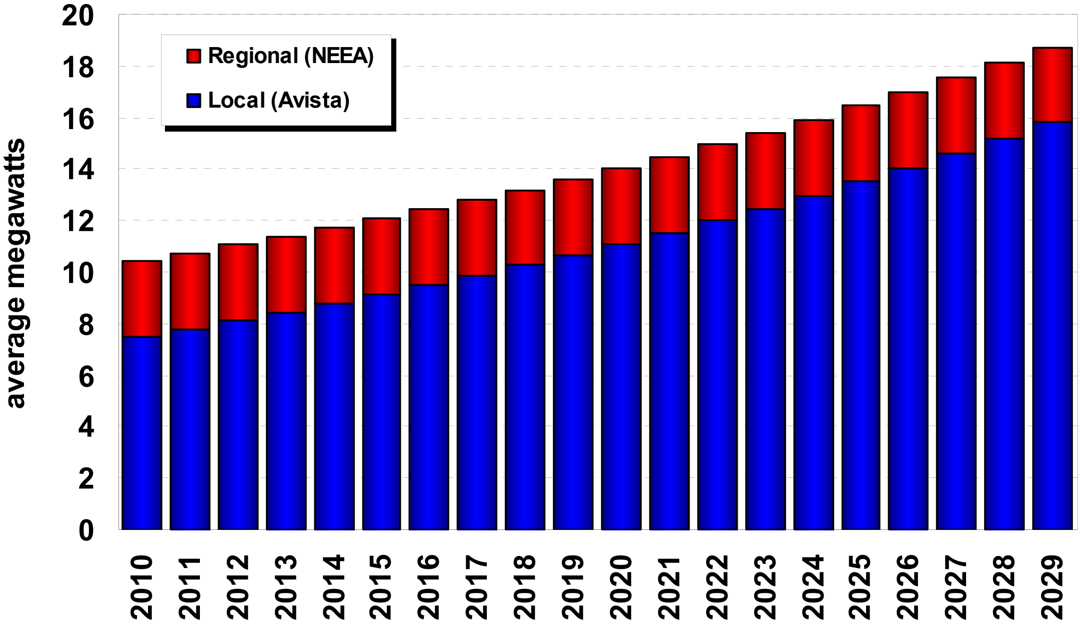
The following conservation targets were developed by summing individually evaluated concepts and the evaluated programs over a 20-year period. The first two years of the targets are detailed in Table 3.1. Transmission and Distribution efficiency improvements are covered in Chapter 5.

Table 3.1: Current Avista Energy Efficiency Programs

Portfolio	2010 Target	2011 Target
Limited Income Residential	1,977,099	2,056,183
Residential	20,518,584	21,339,327
Prescriptive Non-Residential	18,211,396	18,939,852
Site-Specific Non-Residential	24,936,765	25,934,236
Total Local Acquisition (kWh)	**65,643,844**	**68,269,598**
Local	7.5	7.8
Regional	2.9	2.9
Total before Distribution Efficiencies (aMW)	**10.4**	**10.7**
Estimated NPCC Sixth Plan Goal (aMW)	**11.2**	**12.4**

A graphical representation of the annual conservation targets for the full 20-year horizon is illustrated in Figure 3.3. A flat annual 2.94 aMW estimate of Avista's share of regional resource acquisition (Avista's pro-rated share of NEEA's annual savings) is included in the estimate. In the absence of reliable 20-year estimates of regional program acquisition, it was assumed that historic acquisition levels would remain flat at their most recent anticipated level. This assumption is speculative and dependent on the opportunities for regional market transformation during this period, but is consistent with the recent history of flat NEAA funding.

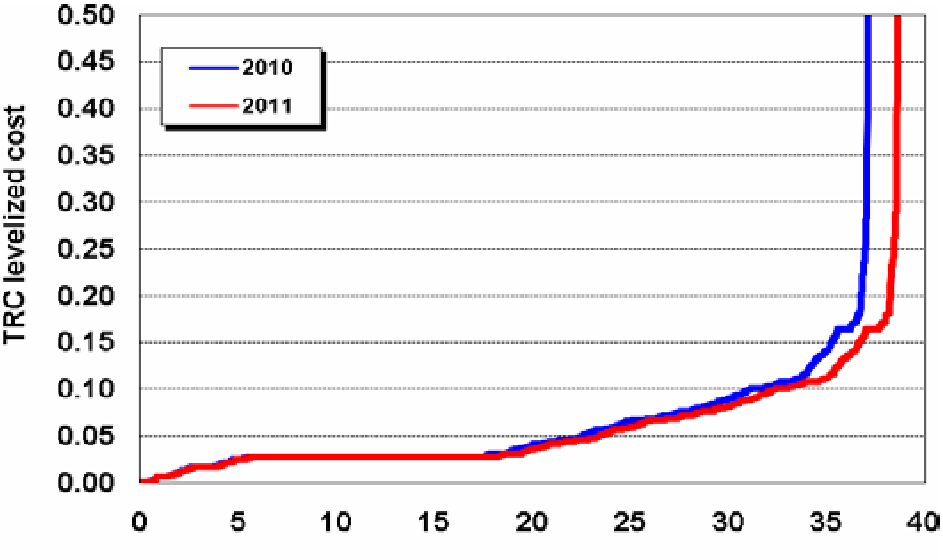
Figure 3.2: Forecast of Conservation Acquisition



A measure-by-measure stacking of the 845 evaluated concepts, in ascending order of levelized TRC, leads to a traditional upward-sloping supply curve for this component of the conservation target, as illustrated in Figure 3.3. Supply curves for 2010 and 2011 have been shown to represent the two years before the next IRP. The rightward shift of the supply curve over time is a consequence of the assumption that lower cost measures will be less available in subsequent years due to early adoption thereby causing movement up the supply curve.

Since there is a gap in the cost of energy efficiency measures, the measures with a very high total resource cost cause a rapid sloping of the supply curve. Therefore, measures with a total resource cost in excess of $0.50 per kwh have not been included in Figure 3.3

Figure 3.3: Supply of Evaluated Conservation Measures (Levelized TRC Cost)



annual GWH acquisition

Integrating IRP Results into the Business Planning Process

The IRP evaluation process provides a high-level estimate of cost-effective conservation acquisition. Avista uses the results of the IRP evaluation to establish a budget for conservation measures, determine the size and skill sets necessary for future conservation operations, and identify general target markets for programs. However, the results are not detailed enough to become an operational conservation business plan. The results of the IRP analysis establish baseline goals for continued development and enhancement of Avista's conservation programs. The near-term conservation business planning is summarized by portfolio in the following sections.

Residential Portfolio

A review of residential program concepts and sensitivity to key assumptions indicate that more detailed assumptions based on actual program plans and target markets may improve the cost-effectiveness of many of the residential concepts that marginally failed in this analysis. To account for this marginal failure rate, all concepts with TRC benefit-to-cost ratios of 0.75 or better are evaluated as part of the business planning process. Over 62 percent (443 out of 706) of the evaluated residential concepts met the criteria. Measures unavailable for the IRP evaluation will be inserted into a reevaluation process for possible inclusion in the Business Plan.

Limited Income Residential Portfolio

Avista is committed to maintaining stable funding and maintaining program flexibility for limited income conservation programs. There are six local community action partner (CAP) agencies the Company funds to deliver limited income weatherization and energy efficiency programs. Five of the funded agencies offer electric efficiency measures. CAP agency funding is currently set at $1,972,000 million per year ($490,000 to Idaho and

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 70 of 729

$1,482,000 to Washington). Limited income programs include infiltration, insulation, Energy Star approved windows, doors and refrigerators, space and water heating upgrades, and electric to natural gas space and water heating conversions. CAP agencies can offer other cost-effective programs with Avista's approval. These programs require periodic updates because of changes in fuel focus and target measures. The Company is quantifying potential impacts of the three-year Northwest Sustainable Energy for Economic Development project.

Non-Residential Portfolio

There is sufficient uncertainty and potential for improvement in evaluated non-residential program concepts to warrant regular reevaluations to ensure they retain a minimum TRC cost-to-benefit ratio of 0.75 based on refined program planning assumptions. Ninety four percent (2,337) of the 2,484 non-residential concepts evaluated for the IRP meet the TRC criteria. The programs will be reviewed for target marketing, the creation of a prescriptive program, or for targeting under a site-specific program.

All electric-efficiency measures with a simple payback exceeding one year automatically qualify for the non-residential portfolio. The IRP provides account executives, program managers and end-use engineers with valuable information regarding potentially cost-effective target markets. However, the unique and specific characteristics of a customer's facility override any high-level program prioritization.

Demand Response

The Idaho Public Utilities Commission approved a residential demand response pilot launched in July 2007. Smart thermostats and direct control unit (DCU) switches for water heaters, as well as compressors for heat pumps or air conditioners, were selected for this pilot. Seventy-two customers participated in the Sandpoint and Moscow area projects. Two demand response events were called during 2008 and three demand response events were called during the winter of 2008-2009. This pilot is scheduled to continue through December 31, 2009. The Company anticipates calling two to three additional summer events and two to three more winter events before the end of this pilot. Test results were not available in time for the 2009 IRP.

Summary

The IRP evaluation process assists the Company in developing a conservation business plan and meeting regulatory requirements. Avista uses this opportunity for comprehensive evaluation as an integral part of the ongoing management of Avista's conservation portfolio. The acquisition targets provide valuable information for future budgetary, staffing and resource planning needs. However, numerical targets do not displace the Company's fundamental obligation to pursue a resource strategy that best meets customer needs under a continually changing environment. The efficiency targets established in this IRP planning process may be modified as necessary to meet these evolving obligations.

4. Environmental Policy

Environmental policy often means different things to different stakeholders. The 2007 IRP included a chapter on emissions that focused on legislation and regulations concerning sulfur dioxide, nitrogen oxide, mercury, and carbon dioxide (CO_2); including modeling assumptions used for each emission type. With the exception of CO_2, current regulatory environment diminishes the need for a specific discussion of other emissions in this chapter. Current Washington laws, specifically an emissions performance standard, effectively forbid the addition of new coal plants in the Preferred Resource Strategy, and mercury controls have been added to the Company's coal projects located in Colstrip, Montana. This chapter is dedicated to a discussion of the two most important areas of environmentally related legislation: renewable portfolio standards and the regulation of greenhouse gases.

Environmental Concerns

Greenhouse gas emissions present a resource planning challenge because of continuously evolving legislative developments resulting in ever-changing projections of the scope and costs of a carbon allocation market. If environmental concerns were the only issue faced by utilities, resource planning would be reduced to choosing the required amount and type of renewable generating technology to use. However, utility planning is compounded by the need to maintain system reliability, acquire least cost resources, mitigate price volatility, meet renewable generation requirements and satisfy future greenhouse gas emissions constraints. Each generating resource also has distinctive operating characteristics, cost structures and environmental challenges. Traditional generation technologies are financially and operationally well understood. For example, coal-fired units have high capital costs, long lead times, and relatively low and stable fuel costs. They are difficult to site because of state laws, local opposition and environmental issues ranging from mercury to greenhouse gas emissions. There are also problems with the remote locations of coal mines or the high cost of transporting coal. Natural gas-fired plants have relatively low capital costs, can be located closer to load centers than coal plants, can be constructed in a relatively short time frame, and have much lower emission levels than traditional coal-fired technologies, but they are affected by high fuel price volatility.

Chapter Highlights

- Avista supports national greenhouse gas legislation that is workable, cost effective, fair, protects the economy, supports technological innovation, and addresses emissions from developing nations.
- The Company is a member of the Clean Energy Group.
- The Company is gaining experience in trading carbon credits through its membership in the Chicago Climate Exchange.
- Avista's Climate Change Committee monitors emissions legislation and issues.
- Avista participates in the annual Carbon Disclosure Project.

Newly installed solar panels at Avista's headquarters in Spokane, Washington

Renewable energy technologies such as wind, biomass, and solar have different challenges. Renewable resources are attractive because they have low or no fuel costs and low or no emissions. But, they provide limited on-peak capacity, present integration challenges and have high upfront capital costs. Similar to coal plants, renewable resource projects are usually located where their fuel source is most abundant. Remote locations may require significant investment in transmission interconnection and capacity expansion, as well as resolution of possible wildlife and aesthetic concerns. Unlike coal or natural gas-fired plants, the fuel for non-biomass renewable resources cannot be transported from one location to another to better utilize existing transmission facilities or minimize opposition to project development. Biomass facilities can be particularly challenged because of their dependence on the health of the forest products industry and access to biomass materials located in publicly-owned forests.

Furthermore, the long-term economic viability of renewable resources is uncertain for at least two important reasons. First, federal investment and production tax credits are scheduled to expire within the planning horizon of this IRP and their continuation cannot be relied upon in light of the impact such subsidies have on the finances of the federal government and the relative maturity of wind technology development. Second, the cost of renewable technologies is affected by many relatively unpredictable factors, including renewable portfolio standard mandates, material prices and currency exchange rates.

There is still a great deal of uncertainty regarding greenhouse gas emissions regulation. There continues to be strong regional and national support for addressing climate change. Since the publication of the 2007 IRP, many changes in the approach and potential for actual greenhouse gas emissions regulation have occurred, including:

- Different and changing federal legislative proposals: Lieberman-Warner, Dingell-Boucher, and now Waxman-Markey;
- Leadership changes at the federal level leading to a determination to address climate change. The election of President Obama and the commitment of Congressional leaders to enact climate change legislation in the near-term.
- Passage of H.R. 2454, the American Clean Energy and Security Act;
- Joining RPS and greenhouse gas issues under the Waxman-Markey legislation; and
- Developments in climate change legislation in jurisdictions such as Washington and Oregon.

Climate Change Policy Efforts

Avista's Climate Change Committee (CCC) was chartered as an internal clearinghouse for all matters related to climate change. In regards to climate change, the CCC:

- Anticipates and evaluates strategic needs and opportunities relating to climate change;
- Analyzes the company-wide implications of various trends and proposals;
- Develops recommendations on positions and action plans; and
- Facilitates internal and external communications regarding climate change issues.

The core team of the CCC includes members from Environmental Affairs, Government Relations, Corporate Communications, Engineering, Energy Solutions, and Resource Planning. Other areas of the Company are invited as needed. The monthly meetings for this group include work divided into immediate and long term concerns. The immediate concerns include reviewing and analyzing state and federal legislation, reviewing corporate climate change policy, and responding to internal and external data requests. Longer term issues involve emissions tracking and certification, providing recommendations for greenhouse gas reduction goals and activities, evaluating the merits of different reduction programs, actively participating in the development of legislation, and benchmarking climate change policies and activities against other organizations.

Avista has maintained its membership in the Clean Energy Group which includes Calpine, Entergy, Exelon, Florida Power and Light, Pacific Gas & Electric and Public Service Energy Group. This group collectively evaluates and supports different greenhouse gas legislation such as H.R. 2454, the American Clean Energy and Security Act of 2009, submitted by Congressmen Henry A. Waxman and Edward J. Markey and narrowly passed in June 2009. This legislation aims to combine RPS, greenhouse gas and energy efficiency issues under a single bill. Avista also participates in hydro and biomass issues through its membership in national hydroelectric and biomass associations.

Avista's Position on Climate Change Legislation

Avista expects comprehensive federal greenhouse gas legislation to be enacted within the next two to three years. This is slightly longer than projected in the 2007 IRP, primarily because of issues involving the current recession taking up legislative time. The current lack of definitive legislation makes for an uncertain environment as Avista plans to meet future customer loads. Avista does not have a preferred form of greenhouse gas legislation at this time, but supports federal legislation that is:

- Workable and cost effective;
- Fair;
- Protective of the economy and consumers;
- Supportive of technological innovation; and
- Includes emissions from developing nations.

Workable and cost effective legislation would be carefully crafted to produce actual greenhouse gas reductions through a single system, as opposed to competing, if not conflicting, state, regional and federal systems. The legislation also needs to be fair in that its impacts must be equitably distributed across all sectors of the economy based on relative contribution to greenhouse gas emissions. Protecting the economy and consumers is of utmost importance. The legislation cannot be so onerous that it stalls the economy or fails to have any sort of adjustment mechanism in case the market solution fails causing allowance or offset prices to escalate at unmanageable rates. Supporting a wide variety of technological innovations should be a key component of any greenhouse gas reduction legislation because innovation can help contain costs, as well as provide a potential boost to the economy through an increased manufacturing base. Climate change legislation must involve developing nations with increasing greenhouse gas emissions; legislation should include strategies for working with other nations directly or through international bodies to control global emissions.

Greenhouse Gas Concerns for Resource Planning

Resource planning, in the context of greenhouse gas emissions regulation, raises concerns about the balance between the Company's obligations for environmental stewardship and cost implications for our customers. Consideration must be given to the cost effectiveness of resource decisions as well as the need to mitigate the financial impact of emissions risks.

Complying with greenhouse gas emission regulations, particularly in the form of a cap and trade mechanism, involves two actions: ensuring the Company maintains sufficient allowances and/or offsets to correspond with its emissions during a compliance period, and undertaking measures to reduce the Company's future emissions. Effectuating emission reductions on a utility-wide basis can entail any and all of the following:

- Increasing efficiency of existing fossil-fueled generation resources;
- Reducing emissions from existing fossil-fueled generation through fuel displacement including co-firing with biomass or biofuels;
- Permanently decreasing output from existing fossil-fueled resources and substituting them with lower emitting resources;
- Decommissioning or divesting fossil-fueled generation and substituting lower emitting resources;
- Reducing exposure to market purchases of fossil-fueled generation, particularly during periods of diminished hydropower production, by establishing larger reserves based on lower emitting technologies; and
- Increasing investments in energy efficiency measures.

With the exception of increasing Avista's commitment to energy efficiency, the cost and risks of the other actions listed above cannot be adequately, let alone fully, evaluated until uncertainty about the nature of greenhouse gas emission regulations is resolved; that is, after a regulatory regime has been implemented and the economic effects of its interacting components can be modeled. A specific reduction strategy as part of an IRP may be forthcoming when greater regulatory clarity and more precise modeling parameters exist. In the meantime, the model for this IRP internalizes a carbon price proxy based on the Wood Mackenzie forecast based on the November 2008 discussion draft legislation sponsored by Representatives John Dingell and Rick Boucher. The 2009 IRP focuses on the costs and mitigation of carbon dioxide since it is the most prevalent and primary greenhouse gas emitted from fossil-fueled generation sources.

Emissions Legislation

Several themes have emerged from various climate change legislative proposals that have been considered since publication of the 2007 IRP. These include:

- Settling of scientific questions about human contributions to climate change; it is viewed as a largely anthropogenic or human-developed phenomenon.
- A consensus view that regulation should be applied on an economy-wide basis, rather than one or two sectors at a time.
- Technology will be a key component to reducing overall greenhouse gas emissions, particularly in the electric sector. Significant investment in carbon capture and sequestration technology will be needed since coal will continue to be an important part of the U.S. generation fleet into the foreseeable future.
- Developing countries must be involved in reducing global emissions as greenhouse gas emissions generally increase with economic growth.
- The longer federal legislation takes to enact, the higher the probability of that inconsistent state and regional regulatory schemes may be implemented. A patchwork of regulation may obstruct the operation of businesses serving multiple jurisdictions by causing market disruptions and increasing the uncertainty of how federal and disparate state and regional regulatory systems might interact.

These themes all point towards a need to develop national greenhouse gas legislation in a timely manner to ensure the best environmental and economic outcomes. The current version of the Waxman-Markey bill importantly acknowledges these multi-jurisdiction problems by temporarily superseding state and regional cap and trade regulation over emissions covered under federal law between 2012 and 2017.

Federal Emissions and Renewables Legislation

The U.S. House of Representatives passed H.R. 2454, the American Clean Energy and Security Act by Waxman and Markey on June 26, 2009. Among its many components, this bill establishes greenhouse gas reduction goals, creates a national cap-and-trade program, and outlines a national RPS. Some of the bill's details include:

- RPS goals start at six percent in 2012 and increase to 20 percent by 2020.
- Recognizes hydroelectric efficiency upgrades and additions effectuated since January 1, 1992 as qualifying against the renewable energy standard.

- Removes existing hydroelectric power generation, excluding upgrades made after January 1, 1992, from the load base against which the renewable energy standard is applied.
- Allows electric utilities to make $25 per MWh alternative compliance payments, adjusted for inflation starting in 2010, in lieu of acquiring new renewable resources or renewable energy certificates (REC).
- Permits REC trading, and banking of RECs for three years.
- Greenhouse gas reduction goals of 3 percent below 2005 levels by 2012, 17 percent by 2020, 42 percent by 2030 and 83 percent by 2005.
- Proposes to administratively allocate allowances to electric utilities from 2011 through 2028, with 50 percent of them being allocated on the basis of a utility's share of emissions associated with retail sales and 50 percent being allocated based on a utility's annual average electricity deliveries.
- Calculates a utility's average annual emissions based upon data from 2006 through 2008, or any three consecutive calendar years between 1999 and 2008, as may be selected by the utility.
- Allows banking and borrowing of emission allowances.
- Allows for some forms of carbon offsets.
- Establishes mechanisms for containing costs and for regulating allowance and derivative markets.

Jeff Bingaman is also developing a federal RPS bill that is working its way through the Senate. The Bingaman bill sets a 15 percent renewable energy goal by 2021 and allows electric utilities to meet up to four percent of their RPS goals with energy efficiency. The bill also creates an off ramp provision exempting a utility from the RPS if their retail rates would increase by four or more percent in any given year for complying with the law.

Avista's main concerns with the potential federal climate change legislation concerns the compliance costs, which centers primarily, though not exclusively, on the method of allocating allowances and the amount of allowances the Company may be required to purchase through auction. Avista favors the adoption of a compromise advocated by the Edison Electric Institute, which allows for half of the allowances allocated to electric utilities to be load based and half of the allowances to be emissions based. This is a more equitable compromise than allocation based solely on historic emissions, which could provide a windfall for non-utility generators for their past greenhouse gas emissions and effectively penalizes past use of renewable energy. Administrative or direct allocation, at least in the beginning of the program, is also favored because it will mitigate compliance cost impacts on customers while the allowance markets and emissions reductions technologies are developed.

State Level Emissions Legislation

The failure of the federal government to enact greenhouse gas emission regulations during the current decade has encouraged many states to develop their own climate change laws and regulations. Climate change legislation can take many forms, including comprehensive regulation in the form of a cap and trade system, and complementary policies, such as renewable portfolio standards, energy efficiency standards, and emission performance standards. All of these standards are included for Washington, but not necessarily in other jurisdictions where Avista operates. Individual state actions can produce a patchwork of competing rules and regulations for utilities to follow, which may be particularly problematic for multi-jurisdictional utilities such as Avista. There are currently 23 states plus the District of Columbia with active renewable portfolio standards.

One of the more notable state level greenhouse gas initiatives outside of the Pacific Northwest is the Regional Greenhouse Gas Initiative (RGGI) agreement between ten northeastern and mid-Atlantic states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont) to implement a cap and trade program for carbon dioxide emissions from power plants. The District of Columbia, Pennsylvania, and some Canadian Provinces are also participating as RGGI observers. RGGI's cap and trade regulations have been effective since January, 2009.

The Western Regional Climate Action Initiative, otherwise known as the Western Climate Initiative (WCI), began with a February 26, 2007 agreement to reduce greenhouse gas emissions through a regional reduction goal and market-based trading system. This group includes Arizona, British Columbia, California, Manitoba, Montana, New Mexico, Oregon, Utah, Quebec and Washington. In September 2008, the WCI released a set of Final Design recommendations for a regional cap and trade regulatory system to cover 90 percent of the societal greenhouse gas emissions within the region by 2015. The WCI is presently proceeding to finish its Work Plan, which completes details necessary to implement its proposed cap and trade system. The WCI has also recently initiated a process to identify and evaluate complementary policies that can be adopted region-wide to further ensure that greenhouse gas reduction goals are met. In addition, the WCI has formally submitted comments to Congress regarding the content of the Waxman-Markey bill. There have also been a number of regional municipalities participating in the U.S. Mayors Climate Protection Agreement to reduce GHG emissions to seven percent below 1990 levels by 2012.

It is important to acknowledge that a federal cap and trade program, such as that envisioned by the Waxman-Markey legislation, will not operate in isolation. Members of the Western Climate Initiative, such as Washington, Oregon, and Montana, are likely to – as some of them have already – pursue complementary policies to regulate emission sources that are covered under cap and trade regulation, as well as those that will not be regulated under a cap and trade program. The Waxman-Markey bill in its current form illustrates this potentiality. Even though the federal legislation would preclude states from implementing their own cap and trade regulations between 2012 and 2017, it would not prevent states from imposing any different form of regulations on the covered sources before, during or after that time frame, or from administering and augmenting federal cap and trade regulations after 2017.

The adoption of greenhouse gas emission reduction goals, and any associated regulations by Washington, could directly impact the Company's generation assets in the state, which are largely comprised of the Kettle Falls Generating Station, the Northeast Combustion turbines and the Boulder Park peaking facilities. Oregon's greenhouse gas reduction goals and potential future regulations can be applied to the Coyote Springs 2 project.

Idaho Emissions Legislation

Idaho is not a member of WCI and does not regulate greenhouse gases or have an RPS. However, the state is actively trying to promote the development of local renewable energy.

Montana Emissions Legislation

The Montana Global Warming Solutions Act (House Bill 753) was submitted in late 2006 to establish greenhouse gas reductions goals to be achieved by 2020. This legislation did not leave committee. Montana now has a non-statutory goal of reducing greenhouse gas emissions to 1990 levels by 2020. In 2007, the Legislature passed House Bill 25, requiring new coal-fired facilities built in the state to sequester 50 percent of their emissions. Montana's renewable portfolio standard law, which was enacted through Senate Bill 415 in 2005, does not apply to Avista because the Company does not serve retail load in Montana. While involved in the Western Climate Initiative, Montana did not consider any legislation during the 2009 Legislative Session to authorize its participation in and implementation of the regional cap and trade system designed by the WCI.

Oregon Emissions Legislation

The State of Oregon has been actively developing legislation concerning greenhouse gases and renewable portfolio standards. Oregon's climate change legislation began in December 2004 when the Oregon Strategy for Greenhouse Gas Reduction called for the development of a detailed GHG report by the end of 2007. That year, the Legislature enacted House Bill 3543 calling for reductions of greenhouse gas emissions to 10 percent below 1990 levels by 2020 and 75 percent below 1990 levels by 2050. These reduction goals are in addition to a 1997 regulation requiring fossil-fueled generation developers to offset the project's CO_2 emissions exceeding 83 percent of the emissions of a state-of-the-art gas-fired CCCT by paying into the Climate Trust of Oregon. Senate Bill 838 requires large electric utilities to generate 25 percent of annual electricity sales with qualified renewable resources by 2025. Shorter term goals include five percent by 2011, 15 percent by 2015 and 20 percent by 2020. Governor Ted Kulongoski introduced Senate Bill 80 during the 2009 Legislative Session to authorize the state's implementation of cap and trade regulations either in isolation or as part of a regional program. This legislation failed. Oregon continues to be an active member of WCI.

Washington Emissions Legislation

The State of Washington has enacted several measures affecting fossil-fueled generation and the diversification of generation resources. A law was enacted in 2004 that requires new fossil-fueled thermal electric generating facilities of more that 25 MW generation capacity to mitigate CO_2 emissions through a plan including: third party mitigation, purchased carbon credits or cogeneration. Washington's Energy Independence Act (I-937), passed in the November 2006 election, established a requirement for utilities with over 25,000 customers to use qualified renewable energy or renewable energy certificates to serve three percent of retail load by 2012, nine percent by 2016 and 15 percent by 2020. Failure to meet the RPS requirements results in a fine. The initiative also requires utilities to acquire all cost effective conservation and energy efficiency measures.

Senate Bill 5840 was brought forward in 2009 to update I-937, qualify existing biomass generation (e.g., Kettle Falls) as an eligible renewable resource, and adjust the renewable energy standards, but it failed to obtain the needed votes after emerging from Conference Committee in the closing days of the Legislative Session. The renewable requirement begins in 2012.

Avista is projected to meet or exceed its renewable requirements between 2012 and 2015 through a combination of hydro upgrades and REC purchases. The Company could bank RECs acquired from the Stateline Wind contract in 2011 for 2012, but these RECs are allocated for its Buck-a-Block program. The 2009 IRP has been developed so that the I-937 RPS goals will be achieved by the Company.

In 2007 the Legislature passed Senate Bill 6001. It prohibits electric utilities from entering into financial commitments beyond five years for fossil-fueled generation where CO_2 emissions exceed 1,100 pounds per MWh. In 2013 the emissions performance standard will be lowered every five years to reflect the emissions profile of the latest commercially available CCCT. The emissions performance standard effectively prevents utilities from developing new coal-fired generation or expanding the generation capacity of existing coal-fired generation, unless they can sequester emissions from the facility. The Legislature amended Senate Bill 6001 in 2009 to prohibit contractual commitments where more than 12 percent of the total power supplied under the contract comes from unspecified sources.

Governor Christine Gregoire signed Executive Order 07-02 in February 2007 which established the following GHG emissions goals:

- 1990 levels by 2020;
- 25 percent below 1990 levels by 2035;
- 50 percent below 1990 levels by 2050 or 75 percent below expected emissions in 2050;
- Increase clean energy jobs to 25,000 by 2020; and
- Reduce statewide fuel imports by 20 percent.

The goals of this Executive Order were later codified into law when the Legislature enacted Senate Bill 6001 in 2007. Taking the next step to achieve the State's greenhouse gas reduction goals, the governor introduced legislation (Senate Bill 5735 and House Bill 1819) during the 2009 Legislative Session to authorize the Department of Ecology to adopt rules, consistent from recommendations from the Western Climate Initiative, enabling the state to administer and enforce a regional cap and trade program. When that legislation failed, Governor Gregoire signed Executive Order 09-05 directing the Department of Ecology to develop emission reduction “strategies and actions”, including complementary policies, to meet Washington’s 2020 emission reduction target by October 1, 2010. This directive will require the agency to provide “each facility that the Department of Ecology believes is responsible for the emission of 25,000 metric tons or more of carbon dioxide equivalent each year in Washington with” an estimate of each facility’s baseline emissions and to designate “each facility’s proportionate share of greenhouse gas emission” reductions necessary to achieve the state’s 2020 emission reduction goal. The department is also asked, by December 1, 2009, to develop emission benchmarks by industry sector for facilities the Department of Ecology believes will be covered by a federal or regional cap and trade program; the state may advocate the use of these emission benchmarks in any federal or regional cap and trade program as an appropriate basis for the distribution of emission allowances. The department must submit recommendations regarding its industry benchmarks and their appropriate use to the Governor by July 1, 2011.

Washington Renewable Portfolio Standard (I-937)

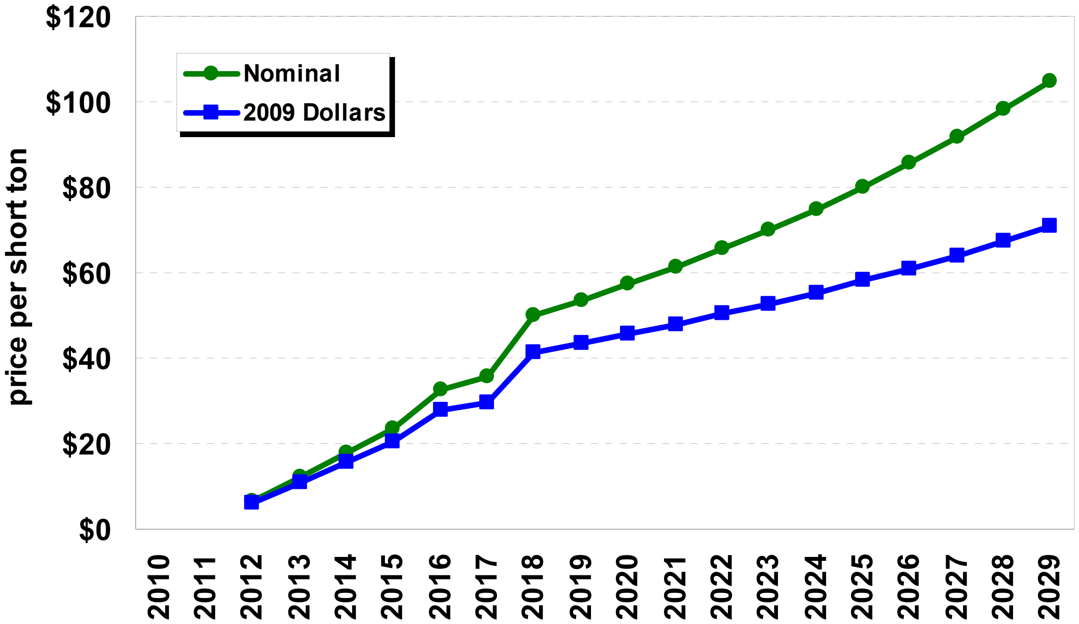
National RPS legislation is being developed through Waxman and Markey’s American Clean Energy Security Act of 2009 (HR 2454) and Senator Bingaman’s draft RPS bill. The proposed federal RPS level ranges between 10 and 25 percent with several target years. Federal legislation is expected to include a hydro netting provision, which excludes loads served by hydropower energy from the RPS requirement. Federal legislation conceptually – and significantly -- differs from I-937, in particular with respect to hydro-netting. The absence of hydro-netting makes the Washington RPS more stringent than proposed federal requirements. National legislation may count existing biomass resources, including Kettle Falls, against the renewable energy standard, as well as power from upgrades to hydropower facilities that were effectuated before 1999 (the date established in I-937 to determine resource eligibility). Treatment of renewable resources in federal legislation would not allow the Company to use RECs from federally-eligible resources to comply with I-937, but Avista would be able to make REC sales from certain facilities into a national market and perhaps individual state markets governed by their own RPS requirements.

Emissions Measurement and Modeling

Greenhouse gas tracking is an important part of the IRP modeling process because emissions legislation is one of the greatest fundamental risks facing the electricity marketplace today. Reducing CO_2 emissions from power plants will fundamentally alter the resource mix as society moves towards a carbon constrained future. Though there are no federal laws regulating carbon emissions presently, carbon costs still need to be projected for planning purposes because expectations for carbon regulation can change resource decisions.

This IRP uses a Wood Mackenzie carbon price forecast. Wood Mackenzie based its carbon price forecast on November 2008 legislation sponsored by Representatives Dingell and Boucher. Even though the Dingell-Boucher bill is no longer being considered for federal greenhouse gas legislation, it does provide a reasonable proxy for the current Waxman-Markey bill. Wood Mackenzie balanced its macro-economic models by identifying a carbon price forecast to meet national greenhouse gas reduction goals. Figure 4.1 shows the carbon price forecast for this IRP. The 2009 IRP assumes carbon will have a cost starting in 2012. The levelized cost of carbon is $46.14 (nominal) and $33.37 (2009 dollars). Natural gas prices greatly affect carbon offset values. Therefore, when natural gas prices rise or fall, the IRP assumes carbon costs will change to balance the relative competitiveness of gas and coal.

Figure 4.1: Price of Carbon Dioxide Credits



5. Transmission and Distribution

Introduction

This section of the Integrated Resource Plan (IRP) provides an overview of Avista's transmission system, recently completed and planned upgrades, transmission planning issues, and estimated costs and issues involved with integrating potential resources into the transmission system.

Coordinating transmission system operations and planning activities among regional transmission providers is necessary to maintain reliable and economic service for Avista's customers. Transmission providers and interested stakeholders continue to implement changes in the region's approach to planning, constructing and operating the transmission system under new rules promulgated by the Federal Energy Regulatory Commission (FERC) and under state and local siting agencies. This section was developed in full compliance with Avista's FERC Standards of Conduct governing communications between Avista merchant and transmission functions.

Transmission upgrade work

Chapter Highlights

- Avista recently completed a $130 million transmission improvement project.
- The Company has over 2,200 miles of high voltage transmission.
- Avista is actively involved in regional transmission planning efforts.
- The costs of transmission upgrades are included in the 2009 Preferred Resource Strategy.

Avista's Transmission System

Avista owns and operates approximately 685 miles of 230 kilovolt (kV) and 1,527 miles of 115 kV transmission lines. Avista also owns an 11 percent interest in 495 miles of the 500 kV line between Colstrip and Townsend, Montana. The transmission system includes switching stations and high-voltage substations with transformers, monitoring and metering devices, and other system operation-related equipment. The system transfers power from Avista's generation resources to its retail load centers. The Company also has network interconnections with the following utilities:

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 85 of 729

- Bonneville Power Administration (BPA)
- Chelan County PUD
- Grant County PUD
- Idaho Power Company
- NorthWestern Energy
- PacifiCorp
- Pend Oreille County PUD

Figure 5.1: Avista transmission system

In addition to providing enhanced transmission system reliability, network interconnections serve as points of receipt for power from generating facilities outside Avista's service area. These interconnections also provide for the interchange of power with entities within and outside of the Pacific Northwest, including the integration of long and short-term contract resources. Avista also has interconnections with several government-owned and cooperative utilities at transmission and distribution voltage levels, representing non-network radial points of delivery for service to wholesale loads.

Transmission Changes since the 2007 IRP

Avista has completed a multi-year $130 million transmission upgrade project. Much of this construction was completed prior to 2007 and was documented in the 2007 IRP. Since the 2007 IRP the Company completed 60 miles of new 230 kV transmission between its Benewah and Shawnee substations to increase capacity between the north and south portions of its system. The project provides a second 230 kV transmission line between Avista's northern and southern load service areas, significantly improving reliability. Energized in December, 2007, Avista installed a new 200 megavolt- ampere-reactive (MVAR) 230 kV capacitor bank at the Benewah station in October of 2008, and installed a new 125 MVA 230/115 kV transformer in November of 2008. This work, known as the West of Hatwai reinforcement, was part of a joint transmission project between Avista and BPA.

Future Upgrades and Interconnections

Station Upgrades

Several station upgrades are planned for the next 10 years. The final scope of station upgrades has not yet been determined, but four of the Company's 230 kV station upgrades (Noxon, Moscow, Westside and Pine Creek) are slotted for completion within the next five to 10 years. A number of 115 kV capacitor banks will also be installed at various substations throughout the Avista transmission system.

South Spokane 230 kV Reinforcement

Recent transmission studies indicate the need for an additional 230 kV line to the south and west of Spokane. Avista currently has no 230 kV source southwest of the Spokane area and relies on its 115 kV system for load service as well as bulk power flow through the area. The project scope is currently being defined; however, preliminary studies indicate the need for the following projects:

- New 230/115 kV station near Garden Springs;
- Tap the Benewah-Boulder 230 kV line southwest of the Liberty Lake area and construct a new 230 kV switching station (for later development of a 230/115 kV substation);
- Connection of the Liberty Lake 230 kV station with the Garden Springs 230 kV station;
- New 230 kV line from Garden Springs to Westside; and
- Origination and termination of the 115 kV lines from the Spokane 230/115 kV line.

The final scope for the South Spokane 230 kV Reinforcement project is scheduled for completion by the end of 2009. Its energization date is expected to be 2018, with staged in-service dates beginning in 2014.

Canada to California Transmission Project and Devils Gap Interconnection

One of the primary projects under review at the Transmission Coordination Work Group (TCWG, see below) is a new transmission line involving four major projects.

- 500 kV HVAC facilities from Selkirk in southeast British Columbia to the proposed Northeast Oregon (NEO) Station, with an intermediate interconnection with Avista at a new Devils Gap Substation near Spokane;
- 500 kV HVDC facilities from NEO Station to Collinsville Substation in the San Francisco Bay Area, with a possible third terminal at Cottonwood Area Substation in northern California (DC Segment);
- Voltage support at the interconnecting substations; and
- Remedial actions for project outages.

The proposed north-to-south rating for the two-segment project is 3,000 MW. It will improve system reliability in the Western Interconnection, as well as provide access to significant renewable resources. Its target operating date is December 2015. Avista joins Pacific Gas and Electric, PacifiCorp and the British Columbia Transmission Corporation in this project.

The Avista Devils Gap Interconnection project is comprised of a 500 MW bi-directional 500/230 kV interconnection and 230 kV transmission into the Spokane area 230 kV grid. It (plus additional transmission in the area around the proposed NEO substation) would provide additional transmission Avista could use to integrate Coyote Springs 2 generation. The Project will allow Avista to enhance its access to incremental renewable resources in the Pacific Northwest, Canada and, at times, the southwestern U.S. Immediate and future environmental and resource needs of Avista and other Western Interconnected utilities will be aided by this Project.

Avista's goal is to also provide market participants with beneficial opportunities to use its facilities. Through its participation in TCWG meetings Avista makes all project information available to group members, including resource developers, load serving entities, energy marketers and independent transmission owners.

Regional Transmission System

BPA operates over 15,000 miles of transmission facilities throughout the Pacific Northwest. BPA's system represents a large portion of the region's high voltage (230 kV or higher) transmission grid. Avista uses the BPA transmission system to transfer output from its remote generation sources to Avista's transmission system, including its Colstrip units, Coyote Springs 2 and its Washington Public Power Supply System Washington Nuclear Plant No. 3 settlement contract. Avista also contracts with BPA for Network Integration Transmission Service to transfer power to 10 delivery points on the BPA system to serve portions of the Company's retail load.

Avista participates in regional and BPA-specific forums to coordinate system reliability issues and manage BPA transmission costs. We participate in BPA transmission and power rate case processes, and in BPA's Business Practices Technical Forum, to ensure charges remain reasonable and support system reliability and access. Avista also works with BPA and other regional utilities to coordinate major transmission facility outages.

Future generation resource development will require construction of new transmission assets. BPA recently received $3.5 billion in additional borrowing authority through the American Recovery and Reinvestment Act of 2009. Increased borrowing capability enhances BPA's ability to construct new transmission projects. One recent example is the 79-mile long 500 kV McNary-John Day upgrade. This $200 million project had been on hold since 2002 because of BPA's inability to finance the project.

FERC Planning Requirements and Processes

FERC provides guidance to regional and local area transmission planning. The following section describes several requirements and processes important to Avista's transmission planning function.

Attachment K

On December 7, 2007, Avista submitted a revised Attachment K to its Open Access Transmission Tariff (OATT). The revisions to the prior Attachment K met nine transmission planning principles proposed in FERC Order 890. The principles made the planning process more open to interested stakeholders and formalized coordination between interconnected utilities. In its Attachment K process, Avista established three levels of planning on the local, sub-regional and regional levels.

At the local level, Avista develops a two-year Local Planning Process culminating with the production of a Local Planning Report (in coordination with Avista's five- and ten-year Transmission Plans). Avista encourages participation of interconnected neighbors, transmission customers and other stakeholders in the local planning process. The Company uses ColumbiaGrid to coordinate planning with sub-regional groups. Regionally, Avista participates in several WECC processes and groups, including various Regional Review processes, Transmission Expansion Planning Policy Committee, Planning Coordination Committee and the newly formed Transmission Coordination Work Group (TCWG). Participation in these efforts supports regional coordination of Avista's transmission projects.

Avista submitted a modified Attachment K to FERC on October 15, 2008 to correct deficiencies in its 2007 filing. The Attachment K revisions included clarifications that did not change the substance of the original filing.

Western Electricity Coordinating Council

The Western Electricity Coordinating Council (WECC) coordinates and promotes electric system reliability in the Western Interconnection. WECC also supports efficient and competitive power markets, assures open and non-discriminatory transmission access among members, provides a forum for resolving transmission access or capacity ownership disputes, and provides an environment for coordinating operating and planning activities as set forth in WECC Bylaws. Avista participates in WECC's Planning, Operations, and Market Interface committees, as well as various sub groups and other processes such as the TCWG.

Northwest Power Pool

The Pacific Northwest has a long history of coordinated transmission planning through Northwest Power Pool (NWPP) workgroups. The NWPP was formed in 1942 when the federal government directed utilities to coordinate operations in support of wartime production. NWPP activities are determined by committees including the Operating Committee, the PNCA Coordinating Group and the Transmission Planning Committee (TPC). The TPC, formed in 1990, provides a forum for addressing northwest electric planning issues and concerns, including a structured interface with outside stakeholders.

The NWPP serves as a Northwest electricity industry reliability forum. It helps coordinate present and future industry restructuring. NWPP promotes member cooperation to achieve reliable system operation, coordinate power system planning and assist transmission planning in the Northwest Interconnected area. NWPP membership is voluntary and includes major generating utilities serving the Northwestern U.S., British Columbia and Alberta. Smaller, principally non-generating utilities, participate indirectly through their member systems.

ColumbiaGrid

ColumbiaGrid was formed on March 31, 2006 to develop sub-regional transmission plans, assess transmission alternatives (including non-wires alternatives), provide a decision-making forum, and a cost-allocation methodology for new transmission projects. This group was formed in response to a number of FERC initiatives. Avista joined ColumbiaGrid in early 2007. Other members include BPA, Chelan County PUD, Grant County PUD, Puget Sound Energy, Seattle City Light and Tacoma Power. Though not a member, Snohomish PUD participates in a number of functional agreements. These agreements are used to help different organizations and groups determine areas of transmission work and establish agreements to carry out the plans.

Transmission Coordination Work Group

The TCWG is a joint effort of Avista, BPA, Idaho Power, Pacific Gas and Electric, PacifiCorp, Portland General Electric, Sea Breeze Pacific-RTS and TransCanada to coordinate transmission project developments expected to interconnect at or near the proposed NEO station near Boardman, Oregon. These projects are following the WECC Regional Planning and Project Rating Guidelines. Detailed information on NEO and the projects that could be integrated at NEO may be found at www.nwpp.org/tcwg .

Avista Transmission Reliability and Operations

Avista plans and operates its transmission system pursuant to applicable criteria established by the North American Electric Reliability Corporation (NERC), WECC and the NWPP. Through involvement in WECC and NWPP standing committees and sub-committees, Avista participates in the development of new and revised criteria, and coordinates planning and operation of its transmission system with neighboring systems. Mandatory reliability standards promulgated through FERC and NERC, subject Avista to periodic performance audits through these regional organizations. Portions of Avista's transmission system are fully subscribed for transferring power output of Company generation resources to its retail load centers. Transmission capacity that is not reserved and scheduled to move power to satisfy long-term (greater than one year) obligations is marketed on a short-term basis and may be used by Avista for short-term resource optimization or third parties seeking short-term transmission service pursuant to FERC requirements under Orders 888, 889 and 890.

Transmission Construction Costs

An essential part of the IRP is estimating transmission costs to integrate new generation resources. Construction-quality estimates were only made for three projects proposed in the IRP. The other options identified in this IRP are based on engineering judgment.

There is an inverse relationship between transmission project size and the certainty of the estimates. A 50 MW resource can be integrated in many places on the Company's system for a moderate cost compared to its overall installation cost. There are fewer options available for locating a 500 MW plant on Avista's system. Larger (750 and 1,000 MW) plants have even fewer location options. Each would require participation in FERC's Generation Interconnection Process as well as coordination through the regional processes described above. These processes would be completed to determine impacts on Avista and other systems' transmission grid before a final plant placement decision.

Estimating Transmission and Integration Costs

The following sections provide an overview of Avista's estimated resource integration costs for the 2009 IRP. Integration points were roughly divided into locations where interconnection study work has been completed and additional points where new resources might be interconnected. Rigorous analyses have not been completed for off-system alternatives because of the breadth of study needed for those estimates. Limited study work has been completed except for projects with existing generation interconnection requests to Avista's transmission group. Completing transmission studies without detailed project parameters is nearly impossible. Approximate worst-case estimates have been assigned based on engineering judgment for neighboring system impacts. Generation interconnection costs are listed for locations within Avista's transmission system. Internal cost estimates are in 2009 dollars and are based on engineering judgment with a 50 percent margin for error. Construction timelines are defined from the beginning of the permitting process to line energization.

Integration of Resources External to the Avista System

Avista's load serving entity function (Avista-LSE) is required to submit generation interconnection and transmission service requests on third party transmission systems. The third party determines transmission system integration and wheeling service costs for delivering new resource power to Avista's system. Construction cost estimates are based on $2 million per mile of new 500 kV lines, $700,000 per mile of 230 kV lines and $350,000 per mile of 115 kV lines.

Eastern Montana Resources

A regional study sponsored by the NWPP and Northwest Transmission Assessment Committee (NTAC) found that enhancement of existing 500 kV and 230 kV facilities would be required to integrate additional generation from Montana. Power transfer from eastern Montana to the Northwest is affected by several constraints. A more detailed study effort focusing on relieving constraints from central and eastern Montana is underway as a joint effort by Avista, BPA, NorthWestern Energy, PacifiCorp and Puget Sound Energy. The study is scheduled for completion in 2010 to identify transmission constraints and engineering-level construction cost estimates to fix the constraints.

Integration of Resources on the Avista Transmission System

Avista-LSE has requested three generator interconnection studies: one near Reardan, Washington, a second near Grangeville, Idaho, and a third in Garfield County, Washington. Each interconnection study request is discussed below.

Reardan, Washington

Avista-LSE submitted a generator interconnection request to Avista Transmission for a 65 MW wind project located south of Reardan, Washington, and has requested a study of interconnection to Avista's 115 kV Devil's Gap – Lind line. The point of interconnection is located approximately six miles south of the Reardan Substation on the Gaffney – Reardan segment of the line. Initial studies indicate that construction of a new 115 kV transmission line into the Spokane area will be required to accommodate the full project output. Preliminary cost estimates of interconnecting a wind project at Reardan are under $15 million; however, not all costs associated with the upgrade will be directly assigned to the project because some upgrades are needed whether or nor the project is completed.

Avista-LSE will submit a transmission service request to determine any required system reinforcements necessary to enable the proposed project to be a designated network resource serving native load under FERC OATT requirements.

Grangeville, Idaho

Avista-LSE submitted a generator interconnection request to Avista Transmission in 2008 for a proposed 120 MW wind project located near Grangeville, Idaho. The transmission line from the project to the point of interconnection is approximately 10 miles. Studies indicate the project is feasible based on the preliminary analysis; however the work also identified thermal violations under certain contingency conditions. The total estimated cost of interconnecting this project at the Grangeville Substation, without mitigating the reactive power consumption of the transmission system, is estimated to be $12.9 million including reconductoring the local transmission lines. The cost estimate does not include constructing a radial 115 kV interconnection transmission line from the project to the point of interconnection at the Grangeville substation.

Garfield County, Washington

Avista-LSE submitted a generator interconnection request for a 200 MW wind project located approximately three miles east of the Columbia/Garfield (Washington) county line in Garfield County. The project, located near Pomeroy, Washington, would interconnect to the existing Dry Creek-Talbot 230 kV line via a double-bus, double-breaker (six breaker station) configured station. The approximate interconnection cost is $4 million.

Lancaster Integration

Avista is evaluating various alternatives for a new transmission interconnection with BPA in the Spokane Valley. One interconnection is at BPA's Lancaster Substation. This interconnection might allow Avista to eliminate or offset some BPA wheeling charges for moving the Lancaster combustion turbine project to Avista's system. Avista is working

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 92 of 729

with BPA to determine what form the interconnection should take. Preliminary studies indicate that Avista could expand existing BPA facilities, construct an interconnection to BPA facilities, and build a loop-in to the Avista Boulder-Rathdrum 230 kV line.

This project could benefit Avista and BPA by increasing system reliability, decreasing losses and delaying the need for additional transformation at the BPA Bell Substation. The proposed plan of service might represent the best option for service from Avista's sole perspective. Additional studies indicate that looping the Boulder-Rathdrum 230 kV line into the Lancaster Substation may allow more transfer capability across the combined transmission infrastructure of Avista and BPA. The preliminary study results are expected by the end of the third quarter of 2009. Construction could be completed by the end of 2010.

Other Potential Resources

2009 IRP resources could be located on Avista's or another organizations transmission grid. The following section provides details concerning generic potential resources. Generator interconnection and transmission service requests would be required to integrate any new generation resource.

CCCT with Duct Burner

A 150 to 250 MW CCCT could be integrated into Avista's 230 kV grid at several locations. The best locations from a transmission siting perspective are near the existing Rathdrum and Lancaster units near Rathdrum, Idaho or near the Benewah 230/115 kV station near Benewah, Idaho

Small Cogeneration (<5 MW)

Small cogeneration plants are likely to be near large industrial loads. Because of the unique nature of these installations, detailed studies must be run to determine integration costs. These costs cannot be estimated until a generator interconnection request is made.

Hybrid SCCT (LMS 100)

As with the CCCT, a 100 MW SCCT could be integrated into the Avista 230 kV grid in several locations. The best locations from a transmission siting perspective are near the existing Rathdrum and Lancaster units near Rathdrum, Idaho, or near the Benewah 230/115 kV station near Benewah, Idaho.

Coal

It is unlikely that a coal-fired facility (traditional or gasification) would be built in Avista's service territory, especially with Washington's emissions performance standards. If a coal plant is developed, it would probably be integrated on a third party transmission system.

Geothermal

There are no known geothermal resources in Avista's service territory, so this resource type would require an interconnection request on another system. The most likely areas for this type of generation for Avista are located in Nevada or Oregon. Significant transmission constraints exist between these states and Avista's system, increasing the cost of integrating a geothermal resource.

Nuclear

Direct integration of nuclear power into Avista's transmission system is unlikely because of the significant cost, siting and waste issues associated with this resource. If this type of resource were constructed, regional studies as well as generator interconnection and transmission service requests on the transmission provider would be required.

Hydro Upgrades

Spokane River Upgrades

The transmission system serving the Spokane River projects plant is robust so small upgrades could be integrated with minimal system impacts. Larger upgrade options, including a second powerhouse at Monroe Street or a Post Falls rebuild, could require significant upgrades. Generator interconnection and transmission service requests would be necessary prior to work being initiated.

Clark Fork Hydro Upgrades

The Clark Fork area transmission system consists of Avista and BPA 230 kV lines integrating Western Montana hydro projects. These include the federally-operated Libby and Hungry Horse projects and Avista's Clark Fork Projects (Cabinet Gorge and Noxon Rapids). Avista coordinates operation of the Clark Fork projects with BPA to maintain system reliability in the Western Montana area. Additional transmission upgrades are not anticipated to integrate the planned Clark Fork upgrades. However, the addition of new units to the Clark Fork project may require transmission upgrades.

Distribution Efficiencies

Avista delivers electrical energy from generators to the customer's meter through a network of conductors (links) and stations (nodes). The network system is operated at various voltages to reduce current losses across the system dependent upon the distance the energy must travel. A common rule to determine efficient energy delivery is one kV per mile. For example, 115 kV power systems commonly transfer energy over a distance of up to 115 miles while 13 kV power systems generally limit delivery of energy to 13 miles.

Avista's energy delivery systems are categorized into two classes: transmission and distribution. Avista's transmission system operates at nominal voltages of 230 kV and 115 kV. Distribution is operated at a range of voltages between 4.16 kV and 34.5 kV. Avista's distribution system is typically operated at a nominal voltage of 13.2 kV in its urban service centers. In addition to voltages, the transmission system is designed and operated distinctly from the distribution system. For example, the transmission system is a network linking multiple sources with multiple loads while the distribution system is configured in radial feeders which link a single source to multiple loads.

System Efficiencies Team

Avista's System Efficiencies Team of operational, engineering and planning staff developed a plan to evaluate potential energy savings from transmission and distribution (T&D) system upgrades. The first phase summarized energy savings from distribution feeder upgrades. The second phase, beginning in the summer of 2009, combines transmission system topologies with "right sizing" distribution feeders to reduce system losses, improve system reliability and meet future load growth.

Distribution Feeders

The System Efficiencies Team evaluated energy losses across Avista's distribution system. Avista's distribution system consists of approximately 330 feeders covering 30,000 square miles. The distribution feeders range in length from 3 to 73 miles.

The System Efficiencies Team evaluated several efficiency programs across urban and rural distribution feeders. The programs consisted of the following system enhancements:

- Conductor losses;
- Distribution Transformers;
- Secondary Districts; and
- VAR compensation.

The energy loss, capital investment and O&M cost reductions resulting from individual efficiency programs were combined on a per-feeder basis. This approach provided a means to rank and compare energy savings and net resource cost for each feeder.

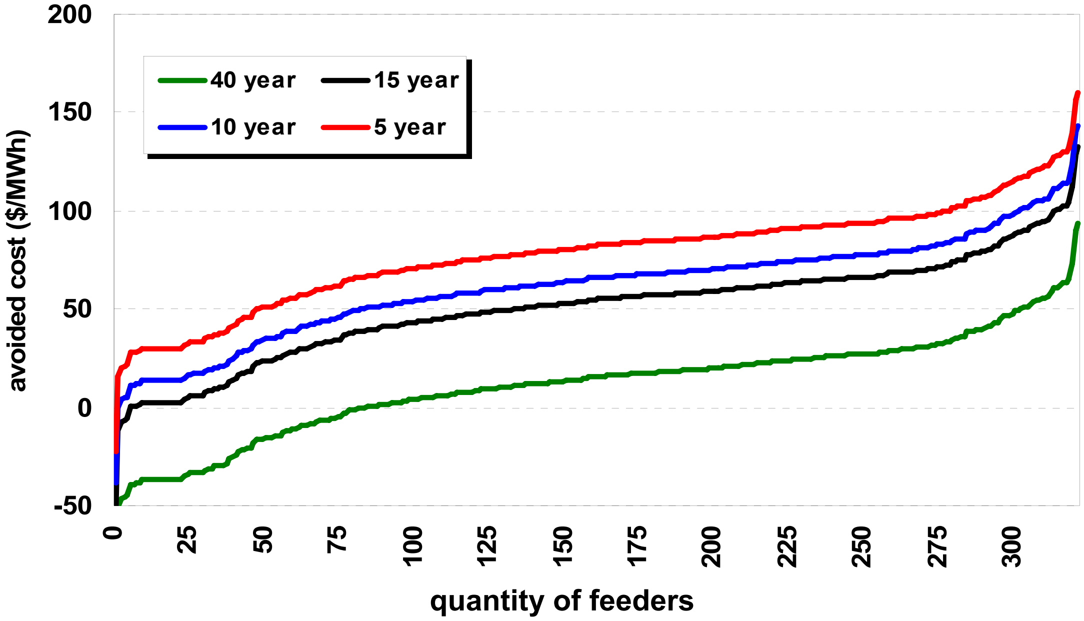
Economic Analysis

Economic analysis determined the net resource costs to upgrade each feeder for the four program areas listed above. The net resource cost determines the avoided cost of a new energy resource levelized over the asset's life-cycle expressed in dollars per megawatt (MW). This economic value is calculated by estimating the capital investment, energy savings, and avoidance of O&M and interim capital investments resulting from feeder upgrades. The economic analysis methodology and assumptions are more fully described in the Avista Distribution System Efficiencies Program document in Appendix G.

The O&M avoided costs for upgrades were determined by modeling existing feeders in the Availability Workbench Program. This program is an expected value model combining a weighted average time and material cost of equipment failure with the probability of failure. The distribution feeder's conductor, transformers and ancillary equipment were used to determine the failure model for each feeder. Customer, material and labor costs incurred by outages from equipment failure are the economic parameters used to measure the economic risk of a failure. The results were calibrated to the expected value model using industry indexes and Avista's actual outage history.

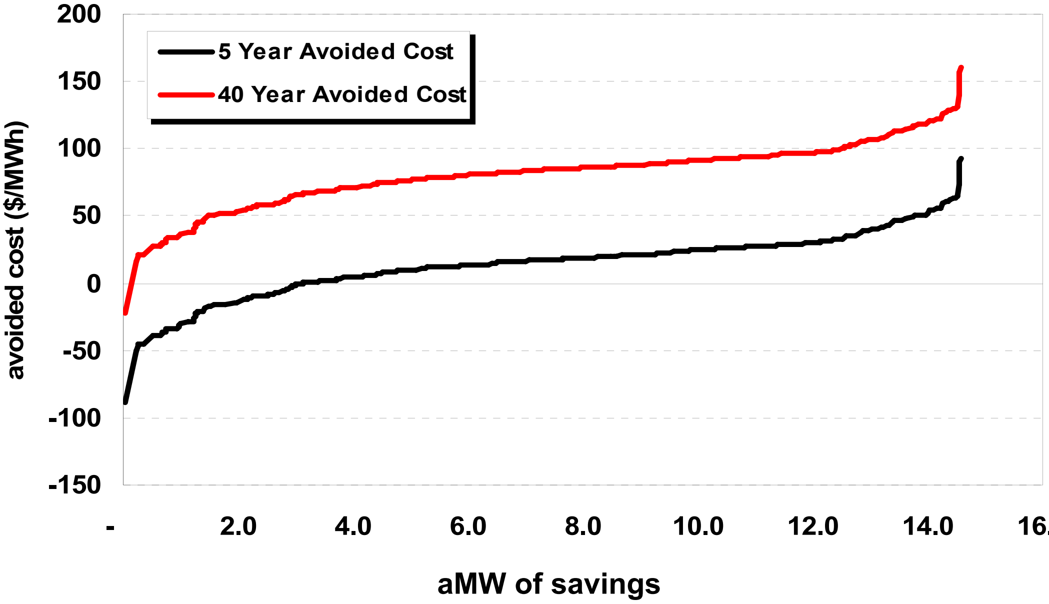
A sensitivity analysis determined the variability of net resource values of different projected O&M time horizons, since O&M avoided costs are based on expected outcomes. Figure 5.2 illustrates the levelized cost of feeder upgrades.

Figure 5.2: Levelized Cost of Feeder Upgrades



Distribution feeders with the highest potential for efficiency gains were included in the IRP analysis. The five selected feeders are estimated to reduce system losses by 2.7 aMW. Figure 5.3 shows the projected feeder upgrade supply curve of potential for loss reduction. If all feeders under $100 per MWh using the 40 year levelized cost method were upgraded, nearly 13 aMW could be saved and between 20 and 25 MW of peak savings could be realized.

Figure 5.3: Estimated Feeder Supply Curve



Operational Considerations

By implementing feeder efficiency programs, voltage drop across feeders will decrease and will provide an opportunity to deploy a Conservation Voltage Reduction (CVR) program. Although CVR was not evaluated in the system efficiencies program, previous studies suggest additional energy savings can be achieved by lowering the voltage. Also, with the implementation of “smart grid” technology, voltage can be regulated to follow the time-varying load profile along the feeder more accurately. The energy savings associated with CVR can be challenging to forecast since it is dependent upon system configuration and varying load characteristics. However, a study conducted by the Northwest Energy Efficiency Alliance in January 2008 determined a general guideline of 0.7 percent reduction in energy consumption with a 1 percent change in voltage.

Transmission Topologies and Distribution Feeder Sizing

After completion of the distribution analysis, a second-phase analysis will incorporate transmission topology, station locations and load growth. Avista’s power grid was designed and built to adhere to reliability and capacity guidelines for the least first cost. This approach was reasonable considering the low cost of electrical energy at the time the system was constructed. With the increasing cost of energy, a life cycle economic analysis is warranted to evaluate power system losses corresponding to various power grid configurations.

The comprehensive analysis will review several transmission topologies to determine the most efficient configuration to move bulk power through and by Avista’s balancing area. The transmission topologies will consider the efficiency between star network, hub and loop, southern loop and southern source. Avista’s load service will be incorporated in this analysis by determining ideal substation placement and feeder sizes as well as forecasted load growth. The comprehensive analysis will evaluate many of the items listed below.

- Develop performance criteria to determine system measures;
- Develop base case to measure existing system performance;
- Develop methodology to determine a full build out load case;
- Identify transmission topologies to be evaluated;
- Identify guidelines for placing substations;
- Identify guidelines for distribution feeder sizes; and
- Bound the analysis to ensure the system remains reliable, compliant and operationally flexible.

Summary

Avista's transmission system consists of over 2,200 miles of high voltage transmission lines. Transmission system planning utilizes various local, sub-region and regional processes providing opportunities for stakeholder input into system expansions and upgrades. The system can integrate small amounts of generation in many areas for moderate integration costs; these costs tend to escalate rapidly as generation project size increases. Planning and initial cost estimates have been developed for three wind projects on the Avista system. Integration costs for the interconnection of customer-owned generation will be developed after a complete generation interconnection request has been submitted and accepted by Avista's Transmission Department.

6. Generation Resource Options

Introduction

There are many generating options to meet future resource deficits. Avista can upgrade existing resources, build new facilities or contract with other energy companies for future delivery. This section describes the resources considered to meet future resource needs. Most of the new resources described in this chapter are generic. Actual size, cost and operating characteristics may differ due to siting or engineering requirements. This chapter also includes some resource options specific to Avista, including the Reardan wind site and hydro upgrades to our Spokane and Clark Fork River Projects. The costs and characteristics of these resources are based on preliminary studies.

Chapter Highlights

- Only resources with well-defined costs and characteristics were considered in the PRS analysis; other resources were studied in sensitivities.
- Renewable resource economics include federal tax incentives.
- Small hydro upgrades and wood-fired upgrades were considered in this IRP..

Assumptions

For the Preferred Resource Strategy (PRS) analysis, Avista only considers commercially-available resources with well-known cost, availability and generation profiles. These resources include gas-fired combined cycle combustion turbines (CCCT) and simple cycle combustion turbines (SCCT), large scale wind, and small hydro upgrades to the Spokane River Projects. Several other resource options described later in the chapter were not included the PRS analysis, but were modeled as sensitivities to understand potential impacts to the PRS.

Levelized costs referred to throughout this section are assumed to be at the generation busbar. The nominal discount rate used in the analyses is 7.08 percent; the real discount rate is 5.09 percent. Nominal levelized costs were computed by discounting nominal cash flows at the nominal interest rate. Real levelized costs were computed by discounting real 2009 dollar cash flows at the real discount rate.

Renewable resources eligible for either the federal investment tax credit[1] (ITC) or production tax credit (PTC) are assumed to use the highest-value credit. The levelized costs shown in this chapter are based on maximum available energy for each year instead of expected generation. For example, wind generation assumes 33 percent availability, CCCT generation assumes 90 percent availability and SCCT generation

[1] Avista may not be able to take advantage of the full 30 percent tax credit in a single year. The utility may need to find a tax investor or spread the tax credit over multiple years. The Company may be eligible for treasury credits for projects with construction dates beginning before January 1, 2011.

assumes 92 percent availability. The following are definitions of the levelized cost items used in this chapter:

- *Capital Recovery and Taxes*: includes depreciation, return on capital, income taxes, property taxes, insurance, and miscellaneous charges such as uncollectible accounts and state taxes for each of these items pertaining to generation asset investment.
- *Interconnection Capital Recovery*: includes depreciation, return on capital, income taxes, property taxes, insurance, and miscellaneous charges such as uncollectible accounts and state taxes for each of these items pertaining to transmission asset investments needed to interconnect the generator.
- *Allowance for Funds Used During Construction (AFUDC):* the cost of money for construction payments before the utility is allowed to recover prudently invested costs.
- *Variable Operations and Maintenance (O&M):* Costs per MWh related to incremental generation.
- *Fixed O&M:* Costs related to plant operation such as labor, parts, and other maintenance services (pipeline capacity costs are included for CCCT resources) that are not based on generation levels.
- *CO_2 Emissions Adder:* Cost of carbon dioxide (greenhouse gas) emissions based on Wood Mackenzie forecast.
- *NOx and SO_2:* Cost of nitrous oxide and sulfur dioxide emissions based on the Wood Mackenzie forecast.
- *Fuel Costs*: The cost of fuels such as natural gas, coal or wood per the efficiency of the generator. Further details on fuel prices are included in the Market Analysis chapter.
- *Excise Taxes and Other Overheads:* Includes miscellaneous charges for non-capital expenses.

Noxon Rapids turbine upgrade

Tables at the end of this chapter (Table 6.28 and Table 6.29) show incremental capacity, heat rates, generation and transmission capital cost estimates before AFUDC, fixed O&M, variable costs, peak credit[2] and levelized costs. All costs shown in this section are in 2009 dollars unless otherwise noted.

[2] Peak credit is the amount of capacity a resource contributes at system peak.

Gas-Fired Combined Cycle Combustion Turbine (CCCT)

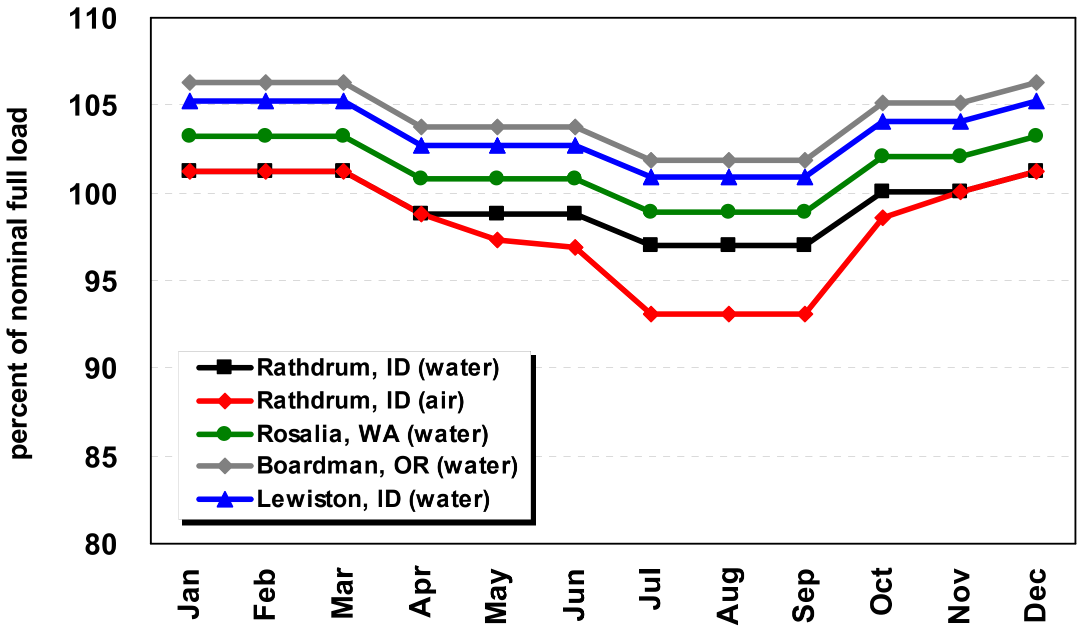
The gas-fired CCCT plants were the Northwest resource of choice earlier this decade. The technology provides a reliable source of both capacity and energy for a relatively inexpensive upfront investment. The main disadvantage is generation cost volatility due to reliance on natural gas. The Company's 2007 IRP discussed the potential for buying long-term fixed price contracts or supplies to reduce the price volatility and risk associated with this technology.

CCCTs were modeled using one-on-one (1x1) configurations with both water- and air-cooling technologies. This configuration consists of a single gas turbine, a single heat recovery steam generator (HRSG) and a duct burner to gain generation from the HRSG. These plants are 250 MW to 300 MW each. Plants can be constructed with two gas turbines and one HRSG (2x1 configuration) up to 600 MW. For modeling purposes, 250 MW and 400 MW plant sizes were included as resource options. Capital cost estimates were based on General Electric (GE) 7FA machine technology. O&M costs were based on engineering estimates from the Company's experience with Coyote Spring 2.

The heat rate modeled for a water-cooled CCCT resource is 6,750 Btu/kWh in 2009. The CCCT heat rate falls by 0.5 percent annually to reflect anticipated technological improvements. The plants include seven percent of rated capacity as duct firing at a heat rate of 8,500 Btu/kWh. Forced outage rates are estimated at 5.0 percent per year and 18 days of maintenance are assumed. Cold startup costs are $35/MWh plus 6.6 Dth per MW per start.

CCCT plants are modeled to back down to 55 percent of nameplate capacity and ramp from zero to full load in five hours. Carbon emissions are 117 pounds per Dth of fuel. The maximum capability of each plant is highly dependent on ambient temperature and plant elevation. Figure 6.1 illustrates the average capacity by month for a water-cooled CCCT located in Rathdrum, Idaho, compared to the same technology at other locations. The air-cooled technology is shown for illustrative purposes and would be an alternative configuration if an adequate water supply is unavailable. Air-cooled technologies provide less capacity during warmer periods of the year. The figure illustrates how combined cycle capacity is greatly affected by site elevation. (Rosalia-2,238 feet, Rathdrum-2,211 feet, Lewiston-745 feet and Boardman-298 feet).

Figure 6.1: CCCT Output Per 100 MW of Nameplate Capacity



The capital cost for a CCCT with AFUDC is estimated to be $1,553 per kW. Fixed O&M costs are expected to be $11 per kW-year. Table 6.1 is the levelized cost for a CCCT resource in both nominal and 2009 dollars.

Table 6.1: CCCT (Water Cooled) Levelized Costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	20.91	15.49
Interconnection capital recovery	0.76	0.64
AFUDC	2.60	2.21
Variable O&M	3.88	3.29
Fixed O&M	4.00	3.39
CO_2 emissions adder	15.25	12.94
NOx and SO_2 emission adder	0.15	0.13
Fuel costs	59.29	50.28
Excise taxes and other overheads	3.57	3.04
Total Cost	**110.41**	**91.40**

It is possible to sequester 90 percent of the carbon emissions from a gas-fired resource. A cost adder of $1,374 per kW was added for sequestration, for a total cost of $2,907 per kW including AFUDC. The fixed O&M is expected to increase to $18.70 per kW-year. The levelized cost for this resource option is shown in Table 6.2.

Table 6.2: CCCT with Carbon Sequestration Levelized Costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	43.70	32.38
Interconnection capital recovery	0.57	0.48
AFUDC	7.51	6.37
Variable O&M	5.69	4.83
Fixed O&M	5.86	4.97
CO_2 emissions adder	1.98	1.68
NOx & SO_2 emission adder	0.00	0.00
Fuel costs	75.51	64.20
Excise taxes and other overheads	3.86	3.28
Total Cost	**144.68**	**118.18**

Gas-Fired Simple Cycle Combustion Turbine (SCCT)

Gas-fired combustion turbines provide low-cost capacity and are capable of providing energy as needed. Technology advances allow some SCCTs the ability to start and ramp quickly, enabling them to provide regulation services and reserves for varying loads and intermittent resources such as wind.

Two SCCT options were modeled in the IRP: Frame (GE 7EA) and hybrid aero-derivative (GE LMS 100). The LMS 100 ramps up quickly and has a lower heat rate and lower start-up costs than the 7EA model, but its capital costs are significantly higher. O&M costs are based on engineering and NPCC estimates. The frame machine is modeled in 60 MW increments and the LMS 100 in 100 MW increments.

Heat rates for SCCT plants are 8,400 Btu/kWh (LMS100) and 10,200 Btu/kWh (7EA) in 2009, decreasing by 0.5 percent per year (real) to reflect anticipated technological improvements. Forced outage rates are estimated at five percent per year, with no maintenance outages (approximately 10 days per year) because it is assumed to occur in months when these plants do not typically operate. Cold startup costs are $15 per MW per start for the frame machine and one Dth per MW for the LMS 100. The maximum capabilities of these plants are highly dependent on ambient temperature, and use the same monthly capacity shape as CCCT plants.

The capital cost for a 2009 SCCT with AFUDC is estimated to be $676 per kW for the frame and $1,342 per kW for the LMS 100. Fixed O&M costs are modeled at $4 per kW-year for each resource. Tables 6.3 and 6.4 show the levelized cost per MWh for each resource. The LMS 100 can provide regulation for load and wind; reserves were valued at $84 per kW-year in the PRS analysis.

Table 6.3: Frame SCCT Levelized Costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	9.27	6.87
Interconnection capital recovery	0.74	0.63
AFUDC	0.43	0.36
Variable O&M	5.90	5.00
Fixed O&M	0.58	0.49
CO_2 emissions adder	23.04	19.55
NOx & SO_2 emission adder	0.23	0.19
Fuel costs	90.09	76.40
Excise taxes and other overheads	5.19	4.40
Total Cost	**135.47**	**113.90**

Table 6.4: LMS 100 Levelized Costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	19.31	14.31
Interconnection capital recovery	0.74	0.63
AFUDC	0.89	0.75
Variable O&M	6.49	5.50
Fixed O&M	0.58	0.49
CO_2 emissions adder	18.97	16.10
NOx & SO_2 emission adder	0.19	0.16
Fuel costs	74.19	62.92
Excise taxes and other overheads	4.35	3.69
Total Cost	**125.71**	**104.55**

Wind

Concerns over the environmental impact of carbon-based generation technologies have increased demand for wind generation. Governments are promoting wind generation through tax credits, renewable portfolio standards and climate change legislation. The 2009 American Recovery and Reinvestment Act extended the PTC for wind through January 1, 2013 and provided an option for owners to select a 30 percent ITC instead.

Several wind resource locations were studied for this IRP:

- Reardan (up to 50 MW);
- Columbia Basin (50 MW increments);
- Montana (25 MW increments);
- Small scale (less than 1 MW); and
- Offshore (75 MW increments).

Reardan and Columbia Basin locations were the only wind resources considered for the PRS analysis. Other resource locations will be considered if projects are submitted in response to competitive solicitations.

Transmission is an issue for many wind projects. Projects often are not close to transmission, or when they are the existing lines are fully subscribed. New transmission must often be constructed. For IRP analyses, transmission costs are assumed to be:

- ***Reardan***: Avista transmission system requiring $15 million in network and project transmission improvements.
- ***Columbia Basin (Tier 1 and Tier 2)***: BPA wheel[3] and $100 per kW for local interconnection.
- ***Montana***: Northwestern wheel[4] and $50 per kW for local interconnection.
- ***Small Scale***: Avista distribution system and $100 per kW for distribution interconnection and a 10 percent adder for saved transmission and distribution losses.
- ***Offshore***: BPA wheel and $36 per kW for local interconnection (assumes economies of scale).

Wind resources benefit from having no emissions and no fuel costs, but are disadvantaged by not being dispatchable, and being capital and labor intensive. The costs for capital and fixed O&M, and capacity factors are shown in Table 6.5. Capacity factors are expected (P50) values for each location. A statistical method, based on regional wind studies, was used to derive a range of capacity factors depending on the wind regime in each year (see stochastic modeling assumptions for more details). Using these expected capacity factors and the capital and operating costs, levelized costs are illustrated in Tables 6.6, 6.7 and 6.8. The cost of integrating wind generation is not shown, but is expected to change over time depending upon the amount of wind resources on the Avista system. The PRS analysis used a cost of $3.50 per MWh for integration services.

Table 6.5: Wind Capital and Fixed O&M Costs

Location	**Capital 2009$** (includes AFUDC)	**Fixed O&M** ($ per kW-year)	**Capacity Factor**
Reardan[5]	2,183	45	30.0%
Columbia Basin (Tier 1)	2,262	50	33.0%
Columbia Basin (Tier 2)	2,262	50	26.4%
Montana	2,262	50	37.0%
Small Scale	3,343	50	20.0%
Off Shore	5,573	95	45.0%

[3] $18 per kW-year and losses are 1.9 percent. Tier 2 wind has a 20 percent lower capacity factor than Tier 1 wind.
[4] $40.80 per kW-year and losses are 4.0 percent
[5] Costs for the Reardan Wind Project are generic based on prices at the time of modeling. Actual costs will vary depending on turbine and balance of plant costs at time of construction. Reardan is assumed to be slightly less expensive than Columbia Basin projects, due to the lack of significant transmission upgrade costs, no third party development fees and the proximity of the project to Avista's operations center.

Table 6.6: Columbia Basin Wind Project Levelized Costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	56.63	48.01
Interconnection capital recovery	4.40	3.73
AFUDC	4.60	3.90
Variable O&M	3.54	3.00
Fixed O&M	20.79	17.63
CO_2 emissions adder	0.00	0.00
NO_x & SO_2 emissions adder	0.00	0.00
Fuel costs	0.00	0.00
Integration	4.05	3.50
Excise taxes and other overheads	1.05	0.89
Total Cost	**95.06**	**80.66**

Table 6.7: Small Scale Project Levelized Costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	125.01	105.97
Interconnection capital recovery	0.00	0.00
AFUDC	10.14	8.60
Variable O&M	3.54	3.00
Fixed O&M	30.60	25.94
CO_2 emissions adder	0.00	0.00
NOx and SO_2 emission adder	0.00	0.00
Fuel costs	0.00	0.00
Integration	4.05	3.50
Excise taxes and other overheads	1.48	1.25
Total Cost	**174.82**	**148.27**

Table 6.8: Offshore Wind Project Levelized Costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	103.83	88.02
Interconnection capital recovery	1.16	0.99
AFUDC	11.16	9.46
Variable O&M	5.90	5.00
Fixed O&M	28.97	24.57
CO_2 emissions adder	0.00	0.00
NO_x and SO_2 emissions adder	0.00	0.00
Fuel costs	0.00	0.00
Integration	4.05	3.50
Excise taxes and other overheads	1.51	1.28
Total Cost	**156.58**	**132.81**

Coal

Pulverized and integrated gasification combined cycle (IGCC) coal plants were included as resource options for the IRP. Pulverized coal options included sub-critical, super-critical, ultra-critical and circulating fluidized bed (CFB) technologies. These different technologies have different boiler temperatures and pressures, resulting in different capital cost and operating efficiencies. The ultra-critical plant was modeled for sensitivity analysis.

IGCC plants gasify coal, thereby lowering carbon emissions and removing toxic substances before combustion. This technology has the potential to sequester 90 percent of carbon emissions, effectively reducing CO_2 emissions from 205 pounds per MMBtu to 20.5 pounds per MMBtu.

The Washington State legislature passed Senate Bill 6001 in 2007, effectively prohibiting local electric utilities from developing coal-fired facilities that do not sequester emissions. A coal facility could legally be constructed to serve Idaho loads, where no emissions performance standard exists, but Avista is not considering a pulverized coal facility for the 2009 IRP and believes such a facility is unlikely to be approved. IGCC facilities were modeled in 200 MW increments in the PRS analysis beginning in 2022 for IGCC plants without sequestration and 2025 for an IGCC plants with sequestration.

Capital and fixed O&M costs, and heat rates, are shown in Table 6.9. Levelized costs per MWh are shown in Tables 6.10, 6.11 and 6.12. IGCC resources currently may qualify for the federal PTC; but the levelized costs in the tables below do not reflect the incentive as it is expected to expire before an IGCC resource could be built in 2022. IGCC coal plants are assumed to be located in Montana with transmission provided by upgrades to Northwestern's system.

Table 6.9: Coal Capital Costs (2009$)

Technology	Capital Cost ($/kW includes AFUDC)	Fixed O&M ($/kW/Yr)	Heat Rate (btu/kWh)
Ultra Critical Pulverized Coal	$3,594	$38	8,825
IGCC	$4,305	$41	8,130
IGCC with Sequestration	$6,013	$50	9,595

Table 6.10: Ultra Critical Pulverized Coal Project Levelized Cost per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	49.96	37.02
Interconnection capital recovery	0.60	0.57
AFUDC	9.29	7.87
Variable O&M	1.53	1.30
Fixed O&M	5.98	5.07
CO_2 emissions adder	34.92	29.63
NOx and SO_2 emission adder	1.30	1.26
Fuel costs	11.37	9.64
Excise taxes and other overheads	2.39	2.03
Total Cost	**117.34**	**94.32**

Table 6.11: IGCC Coal Project Levelized Cost per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	59.95	44.42
Interconnection capital recovery	0.60	0.51
AFUDC	11.14	9.45
Variable O&M	4.72	4.00
Fixed O&M	6.45	5.47
CO_2 emissions adder	32.17	27.30
NOx and SO_2 emission adder	0.59	0.54
Fuel costs	10.47	8.88
Excise taxes and other overheads	2.36	2.00
Total Cost	**128.45**	**102.56**

Table 6.12: IGCC with Carbon Sequestration Coal Project Levelized Cost ($/MWh)

Item	Nominal $	Real 2009$
Capital recovery and taxes	84.71	62.77
Interconnection capital recovery	0.61	0.51
AFUDC	15.75	13.35
Variable O&M	5.19	4.40
Fixed O&M	7.94	6.73
CO_2 emissions adder	3.80	3.22
NOx and SO_2 emission adder	0.18	0.15
Fuel costs	12.36	10.48
Excise taxes and other overheads	1.28	1.08
Total Cost	**131.82**	**102.70**

Hydroelectric Project Upgrades

Avista has a long history of owning, maintaining and operating hydroelectric projects. We continue to programmatically upgrade many of our hydroelectric facilities. Our latest hydro upgrades add 7 MW at Noxon Rapids Unit 1 and 17 MW at Cabinet Gorge Unit 4. The Company is planning to upgrade units 2, 3 and 4 at Noxon Rapids (2010, 2011 and 2012 respectively), and units 1 and 2 at Nine Mile in 2012.

Avista designed and studied other larger potential upgrades at Long Lake and Cabinet Gorge. These upgrades were too costly in previous studies, but increasing market prices, growing capacity needs, renewable energy incentives and carbon emission costs may make these resources financially more attractive now. Upgrade options include a second powerhouse at Long Lake, a fifth unit at Long Lake and Cabinet Gorge Unit 5. These upgrades are not included as PRS options, but they were evaluated for sensitivity analysis. See Table 6.13 for more information on these hydro upgrades.

Avista engineers also developed preliminary plans to replace the powerhouse at Post Falls, doubling its capacity. These large hydro upgrade options have attracted attention during this IRP cycle and will be further studied between now and the 2011 IRP. The estimated levelized costs of hydro upgrades are included in Table 6.14 and Table 6.15.

Table 6.13: Hydro Upgrade Project Characteristics

Project	Capital Cost (2009$) (includes AFUDC)	Year Available	Capacity (MW)	Capacity Factor
Little Falls Unit 1	2,787	2014	1.0	32%
Little Falls Unit 2	1,929	2015	1.0	32%
Little Falls Unit 3	3,430	2016	1.0	32%
Little Falls Unit 4	1,393	2017	1.0	32%
Post Falls Unit 6	5,359	2018	0.2	32%
Upper Falls	3,870	2019	2.0	49%
Long Lake Unit 5	2,882	2020	24.0	34%
Long Lake 2nd Powerhouse	2,454	2020	60.0	30%
Cabinet Gorge Unit 5	1,660	2015	60.0	17%

Table 6.14: Hydro Upgrade Nominal Levelized Costs per MWh

Project	Generation Capital Recovery & Taxes	Transmission Capital Recovery & Taxes	AFUDC	Fixed O&M	Total Cost
Little Falls Unit 1	81.07	0.00	5.82	0.00	**86.89**
Little Falls Unit 2	56.13	0.00	4.03	0.00	**60.16**
Little Falls Unit 3	99.78	0.00	7.16	0.00	**106.94**
Little Falls Unit 4	40.54	0.00	2.91	0.00	**43.45**
Post Falls Unit 6	155.91	0.00	11.19	0.00	**167.10**
Upper Falls	71.27	0.00	7.54	0.00	**78.81**
Long Lake Unit 5	63.58	14.38	10.93	0.40	**89.29**
Long Lake 2nd Powerhouse	66.52	6.51	10.56	0.90	**84.49**
Cabinet Gorge Unit 5	83.15	0.00	14.29	1.58	**99.02**

Table 6.15: Hydro Upgrade 2009$ Levelized Costs per MWh

Project	Generation Capital Recovery & Taxes	Transmission Capital Recovery & Taxes	AFUDC	Fixed O&M	Total Cost
Little Falls Unit 1	68.72	0.00	4.93	0.00	**73.66**
Little Falls Unit 2	47.58	0.00	3.42	0.00	**50.99**
Little Falls Unit 3	84.58	0.00	6.07	0.00	**90.66**
Little Falls Unit 4	34.36	0.00	2.47	0.00	**36.83**
Post Falls Unit 6	132.16	0.00	9.49	0.00	**141.65**
Upper Falls	60.42	0.00	6.39	0.00	**66.80**
Long Lake Unit 5	53.90	12.19	9.26	0.34	**75.71**
Long Lake 2nd PH	56.39	5.52	8.95	0.76	**71.65**
Cabinet Gorge Unit 5	70.49	0.00	12.12	1.34	**84.00**

Other Resource Options

A thorough IRP considers resources that may not be commercially or economically ready for utility-scale development. This is particularly true for some emerging technologies that are attractive from an environmental perspective. These resources are analyzed to ensure that the Company does not overlook resource options with changing economic characteristics. Avista analyzed solar, tidal (wave), biomass, geothermal, co-generation, nuclear, pumped storage, hydrokinetics and large scale hydro.

Solar

Solar technology has advanced in the last several years with help from renewable portfolio standards, the federal ITC and state incentives. Solar still struggles economically against other resources because of its low capacity factor and high capital cost. To its credit, solar provides predictable on-peak generation that complements the loads of summer-peaking utilities.

The Northwest is not a prime location for photovoltaic solar relative to the Southwest. A well placed utility scale photovoltaic system located in the Pacific Northwest would achieve a capacity factor of less than 20 percent. Three solar technologies were studied for this IRP: utility scale photovoltaic, solar-thermal, and roof-top photovoltaic. Each option has certain advantages. Utility scale photovoltaic can be optimally located for the best solar radiation, solar thermal has the ability to produce a higher capacity factor (up to 30 percent) and store energy for several hours, and roof-top solar is located at the source of the load reducing system losses. Capital costs, including AFUDC, for these technologies are expected to be:

- Utility Scale Photovoltaic: $7,900 per kW;
- Solar or Concentrating Thermal: $4,541 per kW; and
- Roof Top Solar: $8,283 per kW.

The levelized costs of these resources, including federal incentives,[6] are shown in Tables 6.16 and 6.17.

Table 6.16: Solar Nominal Levelized Cost ($/MWh)

Item	Utility Scale Photovoltaic	Solar Thermal	Roof-Top Solar
Capital recovery and taxes	312.51	130.82	444.46
Interconnection capital recovery	0.00	4.86	0.00
AFUDC	11.06	12.84	15.73
Variable O&M	0.00	0.00	0.00
Fixed O&M	19.58	29.73	24.48
CO_2 emissions adder	0.00	0.00	0.00
NO_x and SO_2 emissions adder	0.00	0.00	0.00
Fuel costs	0.00	0.00	0.00
Excise taxes and other overheads	0.85	1.29	1.06
Total Cost	**344.00**	**179.54**	**485.73**

[6] Washington has small renewable energy incentives for up to $2,000 per year, depending upon location of manufacturing, through June of 2014. These incentives are not included in this analysis.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 111 of 729

Table 6.17: Solar 2009$ Levelized Cost ($/MWh)

Item	Utility Scale Photovoltaic	Solar Thermal	Roof-Top Solar
Capital recovery and taxes	264.93	110.90	376.79
Interconnection capital recovery	0.00	4.11	0.00
AFUDC	9.38	10.88	13.34
Variable O&M	0.00	0.00	0.00
Fixed O&M	16.60	25.21	20.76
CO_2 emissions adder	0.00	0.00	0.00
NO_x and SO_2 emissions adder	0.00	0.00	0.00
Fuel costs	0.00	0.00	0.00
Excise taxes and other overheads	0.72	1.09	0.90
Total Cost	**291.63**	**152.20**	**411.78**

Biomass and Wood Generation

Avista is an industry leader in biomass generation. In 1983, the Company built one of the largest biomass generation facilities in North America, the 50 MW Kettle Falls Generating Station. Eastern Washington and Northern Idaho have the potential for new biomass facilities. As part of the 2007 IRP Action Plan to study biomass potential, the Company targeted its biomass focus on wood generation. Several unique options were evaluated for this IRP.

The first option is to use the utility's existing steam turbine capacity at Coyote Spring 2 by augmenting with wood; this option is the CCCT Wood Boiler and would require new facilities at Coyote Springs 2 for wood handling. It would also require fuel deliveries from locations remote from the plant, increasing its fuel costs. This option could add 10 MW of capacity to Coyote Springs 2 when the gas-fired portion of the plant is online.

A second option is to add a wood gasifier to the Kettle Falls Combustion Turbine. It would utilize existing facilities and infrastructure, and increase winter peak generating capacity[7] by 7.8 MW. The IRP analysis also includes generic biomass resources, including a new large biomass generation facility using wood gasification technology and generic biomass resources fueled with manure, landfill gas, wood, and other bio-waste fuels, including open- and closed-loop technologies. Assumed capital and operating costs are shown in Table 6.18. The levelized costs are shown in Table 6.19 and Table 6.20. The costs include production tax credits that were extended through January 1, 2014; closed loop technologies receive double the federal credits. No fuel costs were included for non-wood biomass resources because the fuel cost will depend on the type of fuel source. For example, a digester resource located at a dairy will have free fuel.

[7] The Kettle Falls CT is currently unavailable for winter peak generation due to limited fuel transportation. Increasing fuel capacity to the northern service area is currently being examined.

Table 6.18: Biomass Capital Costs

Project	Capital Cost (2009$) (includes AFUDC)	Fixed O&M ($/kW/Yr)
CCCT Wood Boiler	2,745	121
KFCT Wood Gasifier	4,645	85
Wood Gasifer Combined Cycle	3,476	85
Biomass Open-Loop	5,406	85
Biomass Closed-Loop	8,649	150

Table 6.19: Biomass Nominal Levelized Costs per MWh

Item	CCCT Wood Boiler	KFCT Wood Gasifier	Wood Gasifier CC	Biomass Open-Loop	Biomass Closed-Loop
Capital recovery and taxes	24.67	43.03	32.49	48.16	77.07
Interconnection capital recovery	0.00	0.00	0.28	0.28	0.28
AFUDC	2.42	2.30	1.73	3.91	6.25
Variable O&M	7.08	9.08	9.08	3.54	11.79
Fixed O&M	18.09	12.68	12.68	12.40	21.89
CO_2 emissions adder	0.00	0.00	0.00	0.00	0.00
NOx and SO_2 emission adder	2.12	0.00	0.00	0.00	0.00
Fuel costs	82.50	40.46	40.46	0.00	0.00
Excise taxes and other overheads	4.75	2.69	2.69	0.69	1.46
Total Cost	**141.63**	**110.24**	**99.41**	**68.98**	**118.74**

Table 6.20: Biomass 2009 Dollar Levelized Cost per MWh

Item	CCCT Wood Boiler	KFCT Wood Gasifier	Wood Gasifier CC	Biomass Open-Loop	Biomass Closed-Loop
Capital recovery and taxes	20.91	36.48	27.55	40.83	65.33
Interconnection capital recovery	0.00	0.00	0.24	0.24	0.24
AFUDC	2.05	1.95	1.47	3.31	5.30
Variable O&M	6.00	7.70	7.70	3.00	10.00
Fixed O&M	15.34	10.75	10.75	10.52	18.56
CO_2 emissions adder	0.00	0.00	0.00	0.00	0.00
NOx and SO_2 emission adder	1.83	0.00	0.00	0.00	0.00
Fuel costs	69.95	34.31	34.31	0.00	0.00
Excise taxes and other overheads	4.03	2.28	2.28	0.59	1.24
Total Cost	**120.12**	**93.47**	**84.30**	**58.48**	**100.66**

Geothermal

Northwest utilities have developed increased interest in geothermal energy over the past two years. Geothermal energy provides a stable renewable source that can provide capacity and energy with minimal carbon dioxide emissions (zero to 200 pounds per MWh). The federal government has also extended production tax credits to this technology through January 1, 2014. Geothermal energy is disadvantaged by a risky development process involving drilling several thousand feet below the earth's crust; each hole can cost over $3 million. Capital costs are assumed to be $5,698 per kW, including AFUDC, with fixed operating costs of $75 per kW-year. Table 6.21 presents the levelized cost for geothermal generation. Geothermal costs appear attractive once a viable location has been found, but the risk capital required to find a viable site is significant and cannot be underestimated. The values below do not account for dry-hole costs.

Table 6.21: Geothermal Levelized Costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	49.05	41.58
Interconnection capital recovery	0.28	0.24
AFUDC	6.85	5.81
Variable O&M	5.90	5.00
Fixed O&M	11.14	9.45
CO_2 emissions adder	1.93	1.64
NOx and SO_2 emission adder	0.00	0.00
Fuel costs	0.00	0.00
Excise taxes and other overheads	0.82	0.70
Total Cost	**75.97**	**64.41**

Tidal and Wave

Tidal and wave power are in the early stages of development. It has varying generation, but is more predictable than wind. Questions remain surrounding corrosion, bio-fouling by barnacles and other marine organisms, environmental issues and siting concerns. Depending upon its application, tidal power can generate in two time periods daily, but the generation pattern follows the lunar cycle. A 30 percent capacity factor was assumed for the IRP analysis.

Given its early development stage, tidal power was not considered for the PRS. The costs of tidal power are uncertain at this time and were estimated using a variety of sources and engineering estimates. Capital costs including AFUDC are expected to be $10,389 per kW. Costs presented in Table 6.22 are estimated costs for an experimental project.

Table 6.22: Tidal/Wave Levelized Costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	305.57	259.04
Interconnection capital recovery	0.00	0.00
AFUDC	11.90	10.09
Variable O&M	0.00	0.00
Fixed O&M	448.74	379.52
CO_2 emissions adder	0.00	0.00
NO_x & SO_2 emission adder	0.00	0.00
Fuel costs	0.00	0.00
Excise taxes and other overheads	19.42	16.47
Total	**785.63**	**665.12**

Small Cogeneration

Avista has few industrial customers capable of developing a cogeneration project. If an interested customer was inclined to proceed, it could provide benefits including reduced transmission and distribution losses, shared fuel/capital/emissions costs, and credit towards Washington's I-937 targets. This resource was excluded from the PRS, because Avista is not aware of any cogeneration plans by its customers. If a customer wanted to pursue this resource, Avista would consider it along with other generation options. The expected levelized costs for cogeneration are shown in Table 6.23.

Table 6.23: Small Cogeneration Levelized Costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	28.09	20.81
Interconnection capital recovery	0.00	0.00
AFUDC	1.29	1.10
Variable O&M	5.90	5.00
Fixed O&M	2.43	2.06
CO_2 emissions adder	12.87	10.92
NO_x and SO_2 emission adder	0.13	0.11
Fuel costs	49.18	41.70
Excise taxes and other overheads	3.05	2.59
Total	**102.94**	**84.29**

Nuclear

Nuclear plants are not currently considered a viable resource option for Avista given the uncertainty of their economics, the apparent lack of political support for the technology in the region. Like coal plants, nuclear resources need to be studied because other utilities in the Western Interconnect may be able to incorporate nuclear power into their resource mixes. The viability of nuclear power could change as national policy priorities focus attention on de-carbonizing the nation's energy supply. Nuclear capital costs are difficult to forecast, as no new nuclear facility has been built in the United States since the 1980s, so costs were obtained from industry studies and plant license proposals. Capital cost sensitivity analyses were performed to compensate for the difficulties obtaining reliable capital costs for nuclear plants. The starting point for capital costs was $7,168 per kW, including AFUDC. Levelized costs are shown in Table 6.24.

Table 6.24: Nuclear Levelized costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	91.79	77.81
Interconnection capital recovery	0.60	0.51
AFUDC	27.23	23.09
Variable O&M	0.65	0.55
Fixed O&M	15.29	12.96
CO_2 emissions adder	0.00	0.00
NOx and SO_2 emission adder	0.00	0.00
Fuel costs	12.06	10.22
Excise taxes and other overheads	0.55	0.47
Total	**148.17**	**125.61**

Hydrokinetics

Hydrokinetics projects consist of small turbines placed in rivers that generate based on the amount of water flow in the system. Avista has identified potential locations for this technology and has developed preliminary cost estimates shown in Table 6.25. Capital costs for this low-impact hydro resource is expected to be $4,212 per kW including AFUDC and fixed O&M is $3 per kW-year.

Table 6.25: Hydrokinetics Levelized costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	138.89	117.75
Interconnection capital recovery	0.00	0.00
AFUDC	7.38	6.25
Variable O&M	0.00	0.00
Fixed O&M	1.53	1.30
CO_2 emissions adder	0.00	0.00
NOx and SO_2 emission adder	0.00	0.00
Fuel costs	0.00	0.00
Excise taxes and other overheads	0.07	0.06
Total Cost	**147.87**	**125.35**

Pumped Storage

Increasing wind generation levels in the Northwest has renewed interest in pumped storage. Few studies have been conducted for the Northwest market. The most likely storage options are water or battery technologies. Either option faces significant re-charging penalties illustrated by the high variable O&M charge. The expected capital cost is $4,151 per kW, including AFUDC, with $5 per kW-year for fixed O&M. Levelized costs estimates are shown in Table 6.26. The reserve value, estimated to be $84 per kW-year is not shown in the table.

Table 6.26: Pumped Storage Levelized costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	90.71	88.61
Interconnection capital recovery	2.59	2.20
AFUDC	16.86	14.29
Variable O&M	92.86	78.76
Fixed O&M	1.22	1.04
CO_2 emissions adder	0.00	0.00
NO_x and SO_2 emissions adder	0.00	0.00
Fuel costs	0.00	0.00
Excise taxes and other overheads	4.07	3.45
Total	**208.31**	**188.35**

Large Scale Hydro

New large hydro projects are not likely to be built in the Pacific Northwest because of environmental and cost hurdles. British Columbia has projects in the design phases. Avista may be able to contract with a Canadian firm for delivery of this energy. However, the resource was not considered for the PRS analyses because of the uncertainty surrounding large hydro, and the lack of transmission from British Columbia to Avista's service territory. The expected capital costs, including AFUDC, are estimated at $5,273 per kW; fixed O&M is estimated at $2 per kW-year. The levelized cost analysis shown in Table 6.27 includes BPA and British Columbia Transmission Corporation transmission wheels.

Table 6.27: Large Scale Hydro Levelized costs per MWh

Item	Nominal $	Real 2009$
Capital recovery and taxes	232.41	197.01
Interconnection capital recovery	1.86	1.58
AFUDC	39.95	39.09
Variable O&M	0.00	0.00
Fixed O&M	0.98	0.83
CO_2 emissions adder	0.00	0.00
NO_x and SO_2 emission adder	0.00	0.00
Fuel costs	0.00	0.00
Excise taxes and other overheads	0.04	0.04
Total	**275.24**	**238.54**

Summary

Avista has several resource alternatives to select from for this IRP. Each provides different benefits, costs and risks. This IRP identifies relevant characteristics and chooses a set of resources that are actionable, meet customer's energy and capacity needs, balances renewable requirements and keeps customer costs minimized. Table 6.28 is a summary of resource costs and plant characteristics used in the PRS analyses. All other resources are shown in Table 6.29. The PRS chapter discusses resource choices and provides "tipping-point" analyses to explain how resource costs would need to change to be included in the PRS. [Note: capital costs do not include AFUDC.]

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 118 of 729

Table 6.28: Resource Analysis Summary for Preferred Resource Strategy Analysis

Resource	Resource Size (MW)	Heat Rate (btu/ kWh)	Gen. Capital Cost ($2009/kW)	Trans. Capital Cost ($2009/kW)	Fixed O&M ($2009/ kW/yr)	Variable O&M ($2009/ MWh)	Peak Credit (Winter/ Summer) (%)	Nominal Levelized Costs ($MWh)	Real Levelized Costs (2009$/ MWh)
Little Falls 4	1	n/a	1,300	0	0	0	100/90	43.45	36.83
Little Falls 2	1	n/a	1,800	0	0	0	100/90	60.16	50.99
Upper Falls	2	n/a	3,500	0	0	0	100/90	78.81	66.80
Little Falls 1	1	n/a	2,600	0	0	0	100/90	86.89	73.66
Wind (Generic)	50	n/a	2,000	100	50	3	0/0	95.06	80.66
Little Falls 3	1	n/a	3,200	0	0	0	100/90	106.94	90.66
CCCT (1x1) Water Cooled	250/400	6,750	1,321	48	11	3.29	105/95	110.41	91.40
IGCC	200	8,130	3,600	36	41	4	105/95	128.45	102.56
IGCC with Sequestration	200	9,595	5,040	36	50	4.4	100/100	131.82	102.70
SCCT LMS 100	100	8,400	1,247	48	4	5.5	105/95	125.71	104.55
SCCT Frame	60	10,200	600	48	4	5	105/95	135.47	113.90
CCCT (2x1) w/ Seq	125	8,775	2,240	48	18.7	4.83	105/95	144.68	118.18

Table 6.29: Resource Analysis Summary for Other Resources Options

Resource	Increment Resource Size (MW)	Heat Rate (btu /kWh)	Capital Cost ($2009/ kW)	Trans. Capital Cost ($2009/kW)	Fixed O&M ($2009/kW/yr)	Variable O&M ($2009/ MWh)	Peak Credit (Winter/ Summer)	Nominal Levelized Costs ($MWh)	Real Levelized Costs (2009$/ MWh)
Biomass Open-Loop	5	10,500	5,000	18	85	3	100/100	68.91	58.48
Geothermal	5	n/a	5,000	18	75	5	110/90	75.97	64.41
Long Lake 2nd Powerhouse	60	n/a	2,000	0	2	0	100/90	84.49	71.65
Long Lake Unit 5	24	n/a	2,167	0	1	0	100/90	89.29	75.71
Cabinet Gorge Unit 5	60	n/a	1,417	0	2	0	100/100	99.02	84.00
Small Co-Gen	2.5	5,700	2,000	0	5	5	105/95	102.94	84.29
Wood Gasifer Combined Cycle	5	10,300	3,300	18	85	7.7	110/90	99.41	84.30
KFCT Wood Gasifier	7	10,300	4,370	0	85	7.7	100/0	110.24	93.47
Ultra Critical Pulverized Coal	200	8,825	3,000	36	38	1.3	100/100	117.34	94.32
Biomass Closed-Loop	5	10,500	8,000	18	150	10	100/100	118.74	100.66
CCCT Wood Boiler	10	10,500	2,500	0	121	6	100/100	141.63	120.12
Hydrokinetics	0.1	n/a	4,000	0	3	0	100/100	147.87	125.35
Nuclear	250	10,400	5,500	36	97	0.55	100/100	148.17	125.61
Wind: Off Shore	75	n/a	5,000	36	95	5	0/0	156.58	132.81
Post Falls Unit 6	0.2	n/a	5,000	0	0	0	100/90	167.10	141.65
Wind: Small Scale	0.1	n/a	3,000	100	50	3	0/0	174.82	148.27
Solar Thermal	2	n/a	4,200	100	3	0	5/100	179.54	152.20
Pumped Storage	5	n/a	3,500	100	5	0	100/100	208.31	188.35
Large Scale Hydro	100	n/a	4,500	36	2	0	100/100	275.24	238.54
Utility Scale Photovoltaic	0.5	n/a	7,500	0	1	0	5/60	344.00	291.63
Roof-Top Solar	0.5	n/a	8,000	0	0.5	0	5/60	485.73	411.78
Tidal (wave)	0.1	n/a	10,000	0	1000	0	0/0	785.63	666.12

7. Market Analysis

Introduction

This section discusses the market environment that Avista expects to face in the future. The analytical foundation for the 2009 IRP is a fundamentals-based electricity model of the entire Western Interconnect. The market analysis compares potential resource options on their value in the wholesale marketplace, rather than on overall costs. Resource net market values are used in the Preferred Resource Strategy (PRS) analyses. Understanding market conditions in the different geographic areas of the Western Interconnect is important, because regional markets are highly correlated because of large transmission linkages between load centers. This IRP builds on prior analytical work by maintaining the relationships between the various sub-markets within the Western Interconnect and the changing value of company-owned and contracted-for resources. The backbone of the analysis is AURORAxmp, an electric market model that dispatches resources to loads across the Western Interconnect with given fuel prices, hydro conditions, and transmission and resource constraints. The model's primary outputs are electricity prices at key market hubs (e.g., Mid-Columbia), resource dispatch costs and values and greenhouse gas emissions.

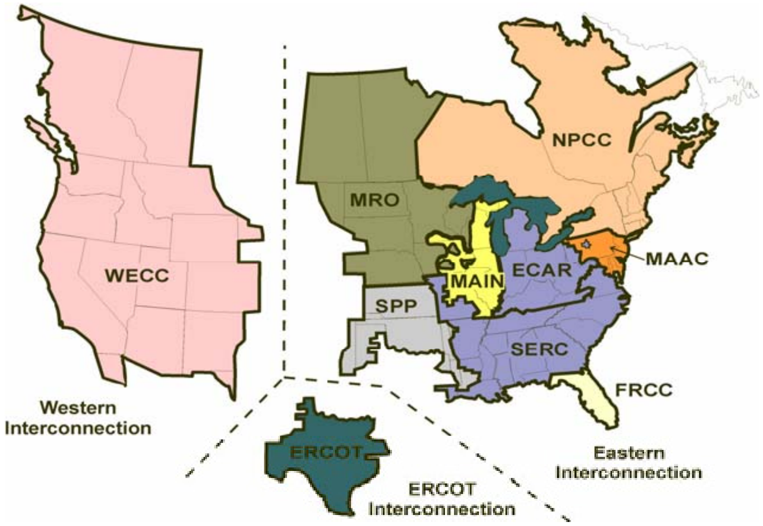
Chapter Highlights

- Mid-Columbia electricity and Malin natural gas prices are 27 and 20 percent higher than the 2007 IRP, primarily due to carbon legislation impacts.
- Mid-Columbia electricity prices are expected to average $79.56 per megawatt-hour (levelized) over the next 20 years.
- Mid-Columbia electricity prices are forecast to be one-third higher, than they otherwise would be, due to projected carbon legislation.
- Average Malin natural gas prices are expected to be $7.36 per decatherm (levelized) over the next 20 years.
- Gas-fired resources continue to serve most new loads and take the place of coal generation to reduce greenhouse gas emissions
- Society's mandates to acquire new renewable resources help reduce carbon emmisions, but force utilities to invest in twice as much generation infrastructure.
- New environment-driven investment, combined with higher market prices will lead to higher retail rates, absent federal initiatives to limit rate increases.
- Carbon legislation is expected to increase 20-year cost (NPV, 2009 dollars) for electricity generation by $25.7 billion (10 percent) in the Western Interconnect.

Marketplace

AURORAxmp is a modeling tool used to simulate the Western Interconnect. The Western Interconnect includes the states west of the Rocky Mountains, the Canadian provinces of British Columbia and Alberta and the Baja region of Mexico as shown in Figure 7.1. The modeled area has an installed resource base of approximately 200,000 MW, and an average load of approximately half that level.

Figure 7.1: NERC Interconnection Map



The Western Interconnect is separated from the Eastern Interconnect and ERCOT systems except by eight inverter stations. The Western Interconnect follows operation and reliability guidelines administered by the Western Electricity Coordinating Council (WECC).

The Western Interconnect electric system is divided into 16 AURORAxmp modeling zones based on load concentrations and transmission constraints. After extensive study, Avista found that the Northwest is best modeled as a single zone. The single zone more accurately dispatches resources relative to splitting the Northwest into multiple areas. The regional topology in this IRP differs from the previous plan by reverting to a single zone.

Fundamentals-based electricity models range in their abilities to emulate power system operations. Some account for every bus and transmission line while others utilize regions or zones. An IRP requires regional price and plant dispatch information. The specific zones modeled are described in Table 7.1.

Table 7.1: AURORA^{XMP} Zones

Northwest- OR/WA/ID/MT	Southern Idaho
Eastern Montana	Wyoming
Northern California	Southern California
Central California	Arizona
Colorado	New Mexico
British Columbia	Alberta
North Nevada	South Nevada
Utah	Baja, Mexico

Western Interconnect Loads

A load forecast was developed for each area of the Western Interconnect. Avista relied on external sources to quantify load growth across the west. These sources included the integrated resource plans for Northwest utilities and Wood Mackenzie for the remaining areas. Carbon legislation and associated price increases are expected to reduce loads over time from their present trajectory. Wood Mackenzie forecasts loads to be one percent lower in 2020 and 4.6 percent lower in 2026 compared to projected loads without carbon legislation.

Specific regional load growth levels are presented in Table 7.2. Overall Western Interconnect loads are forecast to rise by an average level of 1.6 percent over the next 20 years, from 106,727 aMW in 2010 to 146,579 aMW in 2029. A planning margin was added to the load forecast to account for unplanned events. Regional planning margins are assumed to be 25 percent in the winter in the Northwest, 17 percent for California, and 15 percent for all other zones. Higher Northwest planning margins are needed to account for hydroelectric variability. Additional details about planning margins are in the Loads and Resources chapter.

Table 7.2: 20-Year Annual Average Peak & Energy Load Growth Rates

Northwest Areas	Growth Rate	Other Areas	Growth Rate
Eastern Oregon	0.01%	California	1.51%
Eastern WA/North Idaho	1.39%	Baja, Mexico	1.51%
Northwest Washington	1.69%	Arizona	1.97%
Seattle Metro Area	1.69%	South Nevada	1.97%
Portland Metro Area	1.74%	North Nevada	2.18%
SW Washington	1.69%	New Mexico	1.83%
Western Oregon	0.01%	Colorado	1.48%
Central Washington	2.53%	Wyoming	3.59%
South Idaho	1.31%	Utah	1.91%
Western Montana	0.61%	Alberta	2.00%
British Columbia	1.26%	Eastern Montana	0.61%

Transmission

Several regional transmission projects have been announced in the last two years. Many of these projects will move renewable resources to load centers for renewable portfolio standards (RPS) obligations. The AURORAxmp model was updated to reflect the 26,600 MW of transmission upgrades shown in Table 7.3. The transmission expansion represents the most likely upgrades at the time the price forecast was developed (Dec 2008). Transmission upgrades within AURORAxmp zones were not included in the model, as they do not impact power transactions between zones.

Table 7.3: Western Interconnect Transmission Upgrades Included in Analysis

Project	From	To	Year Available	Capacity MW
Canada – PNW Project	British Columbia	Northwest	2018	3,000
PNW – California Project	Northwest	California	2018	3,500
Eastern Nevada Intertie	North Nevada	South Nevada	2015	1,600
Colstrip Transmission	Montana	Northwest	2012	500
Gateway South	Utah	Nevada	2014	600
Gateway South	Wyoming	Utah	2015	3,000
Gateway Central	Idaho	Utah	2016	1,500
Sunzia/Navajo Transmission	Arizona	New Mexico	2013	3,000
Wyoming- Colorado Intertie	Wyoming	Colorado	2013	900
Gateway South	Wyoming	Utah	2015	3,000
Gateway West	Wyoming	Idaho	2016	3,000
Hemingway to Boardman	Idaho	Northwest	2015	1,500
Hemingway to Captain Jack	Idaho	Southern Oregon	2015	1,500
Total				**26,600**

Regional Renewable Portfolio Standards

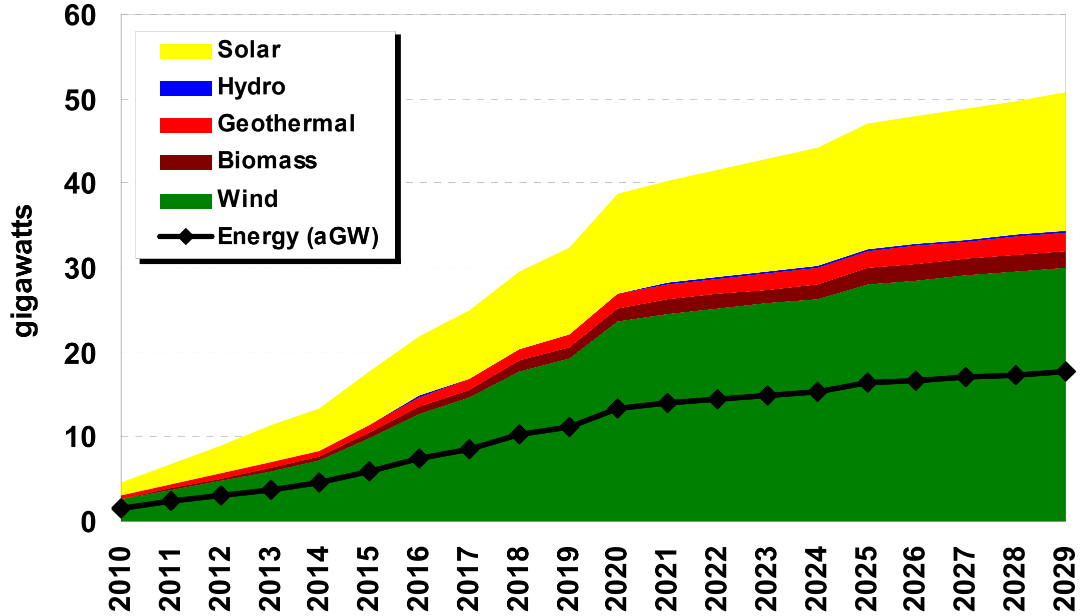
In an effort to curb greenhouse gas emissions and diversify energy sources, many states have created RPS requirements. RPS legislation requires utilities to meet a portion of their load with qualified renewable resources. Each state defines RPS obligations differently. AURORAxmp does not have the ability to target RPS levels, so RPS requirements were input into the model to ensure that renewable resource levels satisfy state laws.

Wind, the predominant renewable resource, does not add capacity to the electric system. Wind plants are not likely to be able to recover all of their life-cycle costs from the wholesale electricity marketplace. Renewable resource portfolios to meet Western Interconnect RPS obligations were developed by the Northwest Power and Conservation Council (NPCC); these percentages were applied to estimated RPS shortfalls in each state. California has the most aggressive RPS goal (33 percent by 2020). The 2009 IRP adopts the NPCC resource mix assumptions. Figure 7.2 illustrates projected renewable resource additions to the Western Interconnect. Renewable resources were manually added only to meet RPS requirements, not exceed it.

AURORAxmp could have added additional renewable resources where they were found to be economical as part of its optimization routine, but it did not.

Figure 7.2 illustrates the difference between nameplate capacity and the delivered energy of the RPS additions. Most renewable energy requirements are met by wind, with a smaller contribution from solar. Geothermal, biomass and hydro resources fill remaining RPS needs. The renewable resource choices differ by state consistent with their respective laws. The Southwest will meet requirements with solar and wind; the Northwest will use wind and hydro; and the Rocky Mountain states will predominately use wind to meet RPS needs.

Figure 7.2: Renewable Resource Additions to Meet RPS

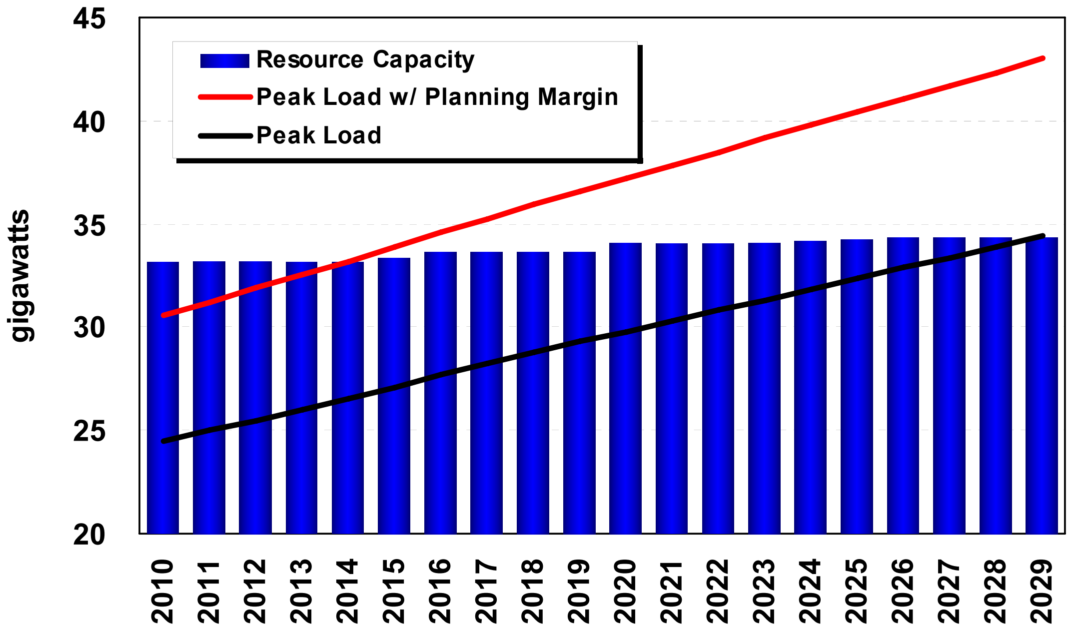


Resource Deficits

Assumptions are made on when, where and how many of each new resource type will be added to meet peak demand in order to forecast electricity market prices. New renewable resources meet energy needs, but add a much smaller level of capacity to the system so that each megawatt of additional wind requires an additional resource to provide dependable capacity. In line with the NPCC assumptions, wind is assumed to provide five percent of its nameplate capacity to meet regional peak demand periods in the IRP price forecast analysis.

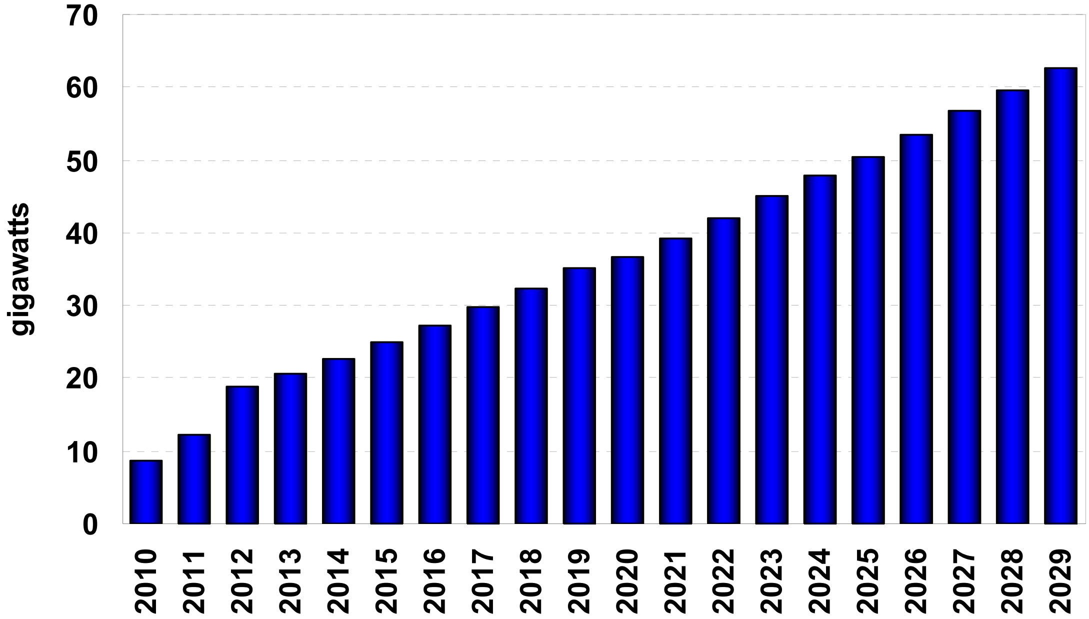
The Northwest historically has depended on hydro system flexibility to meet peak demand, but new wind regulation obligations and increased fisheries obligations have constrained the system. The hydro system can flex for a few hours during a cold day, but may not have the energy to meet a cold or hot weather event lasting several days. AURORAxmp adds resources to meet one hour system peaks. To simulate a sustained peaking event exceeding one hour, the amount of hydro available to meet system peaks was decreased by approximately one-third. Figure 7.3 illustrates the Northwest resource shortfall. Blue bars represent the capacity contributions of hydro, thermal and other resources. The black line represents forecasted winter peak load plus net firm transfers from outside the region (net load). The red line is the net load with a 25 percent planning margin. Based on these assumptions, the Northwest region is deficit beginning in 2015; individual utility needs may differ. Avista's resource position was described in Chapter Two.

Figure 7.3: Northwest Peak Load/Resource Balance



Outside the Northwest, resources and loads are more closely aligned with deficits in some areas beginning in 2010. Figure 7.4 sums capacity deficits for the entire Western Interconnect; nearly 10 gigawatts (GW) of capacity are needed in 2010, 38 GW are needed in 2020 and 62 GW are needed in 2029.

Figure 7.4: Total Western Interconnect Capacity Deficits



New Resource Options

The resource deficits shown in Figure 7.4 must be met by resources with dependable capacity, including gas-fired CCCT or SCCT, coal IGCC, coal with carbon sequestration, solar, nuclear and traditional pulverized coal plants. Table 7.4 shows resource options available to fill deficits in different regions.

Table 7.4: New Resources Available to Meet Resource Deficits

Region	CCCT/ SCCT	Wind	Solar	Nuclear	Pulv. Coal	IGCC Coal	IGCC Coal w/ CO_2 Seq.
Northwest	Unlimited	Tier 2	Unlimited	2022	n/a	n/a	2025
California	Unlimited	Tier 2	Unlimited	n/a	n/a	n/a	2025
Desert SW	Unlimited	Tier 2	Unlimited	2022	n/a	n/a	2025
Rocky Mountains	Unlimited	Tier 1	Unlimited	2022	n/a	2015	2025
Canada	Unlimited	Tier 1	Unlimited	2022	2015	2015	2025

Fuel Prices and Conditions

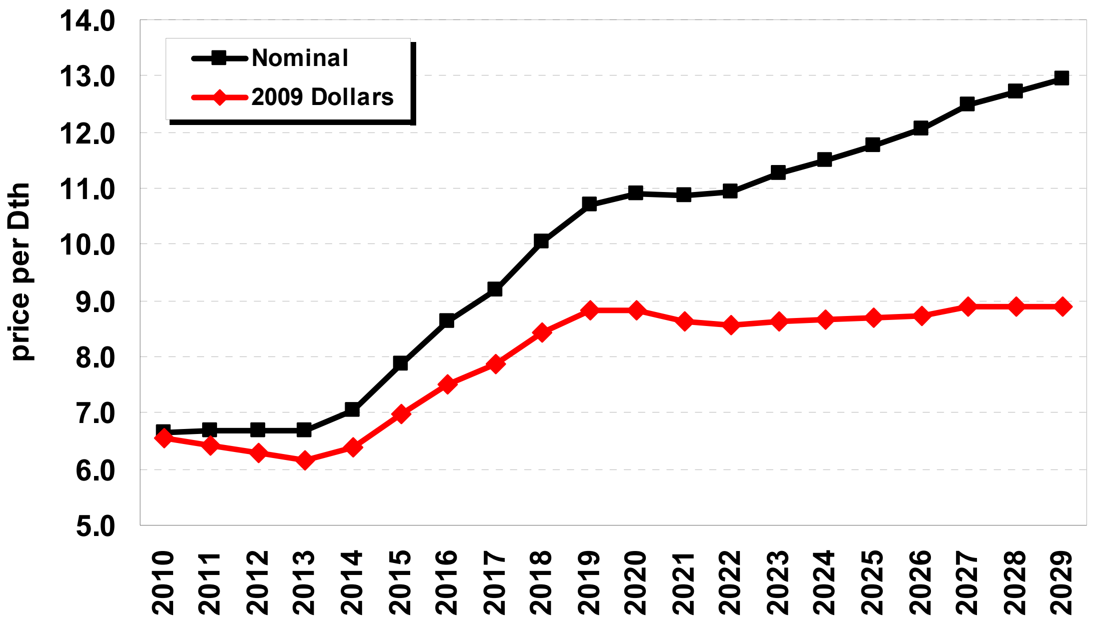
Some of the most important drivers of resource costs and values are fuel and availability. Some resources, including geothermal and biomass, have limited fuel options or sources, while coal and natural gas have more fuel sources. Hydro and wind use free fuel sources, but are highly dependent on weather.

Natural Gas
The fuel of choice for new base load and peaking resources continues to be natural gas. The largest drawback to natural gas is its high price volatility. Avista used forward market prices and a combination of independent sources including the Energy Information Administration (EIA), the New York Mercantile Exchange and Wood Mackenzie through 2011. Wood Mackenzie prices were used from 2013 through 2029. 2012 prices used the average of 2011 and 2013.

The natural gas price forecast was completed in December 2008. It was adjusted for the expected impacts of carbon legislation. Such legislation will cause the demand for natural gas to increase as generation shifts from coal. The increase is estimated to be $0.50 per Dth in 2013 and $1.00 per Dth after 2018 (2009 dollars).

Economic recovery should absorb excess productive capacity for natural gas and increase overall demand growth by 2014. Carbon legislation also will spur incremental demand for a multi-year cycle of gas-fired generation construction. This increased demand, combined with low investments in drilling in prior years, should push prices higher. The Frontier Gas Pipeline (1 bcfd) from Alberta to Chicago should also be operational by the end of the next decade. Figure 7.5 shows the price forecast for Henry Hub; the levelized nominal price is $9.05 per Dth and the real levelized cost is $7.67 per Dth.

Figure 7.5: Henry Hub Natural Gas Price Forecast



Prices differences across North America depend on demand at various trading hubs and the pipeline constraints between trading hubs. Many pipeline projects have been

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 128 of 729

announced to access cheaper gas supplies located in the Rocky Mountains. Table 7.5 presents western gas basin differentials from Henry Hub and the levelized price of gas at each basin. Prices converge as new pipelines are built and new sources of gas come online. To illustrate the seasonality of natural gas prices, the monthly Malin price shape is provided in Table 7.6 for select years.

Table 7.5: Natural Gas Price Basin Differentials from Henry Hub (Nominal Dollars)

Basin	2010	2015	2020	2025	Nominal Levelized Cost	2009$ Levelized Costs
Henry Hub					$9.05	$7.67
Opal	-2.46	-0.61	-0.68	-0.58	$8.11	$6.88
San Juan	-0.26	-0.10	-0.08	0.39	$9.08	$7.70
Southern CA	-0.32	-0.15	-0.19	1.42	$9.11	$7.73
Malin	-0.51	-0.24	-0.32	-0.49	$8.64	$7.33
Sumas	-0.51	-0.20	-0.26	-0.36	$8.70	$7.38
AECO	-0.61	-0.31	-0.42	-0.67	$8.54	$7.24

Table 7.6: Monthly Price Differentials for Malin

Month	2010	2015	2020	2025
Jan	103.7%	99.8%	105.0%	106.9%
Feb	104.7%	104.9%	109.4%	107.6%
Mar	100.7%	103.7%	104.6%	101.8%
Apr	92.3%	90.6%	94.7%	93.4%
May	92.5%	94.2%	95.4%	94.1%
Jun	94.1%	93.6%	96.0%	94.8%
Jul	95.0%	96.4%	97.8%	95.9%
Aug	95.9%	97.1%	97.8%	96.4%
Sep	97.5%	97.7%	95.2%	97.4%
Oct	98.1%	98.8%	95.3%	97.6%
Nov	112.6%	111.0%	104.1%	106.7%
Dec	113.0%	112.0%	104.7%	107.4%

Coal

Coal transportation prices for existing facilities are based on estimates contained in the AURORAxmp database. For new projects, coal mine costs are based on data provided by the EIA for Wyoming mine-mouth coal. Transportation costs were added based on assumed transportation rates and each existing or proposed plant's distance from the coal supply source. The IRP includes three representative coal plant delivery distances for all new plants: mine mouth, short haul (250 miles) and long haul (1,000 miles). Coal details are in Table 7.7.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 129 of 729

Table 7.7: Western Interconnect Coal Prices (2009$)

Coal type	$/MMBtu	$/short ton
Mine mouth	$0.73	$12.41
Short haul	$1.26	$21.34
Long haul	$2.83	$48.11

Wood/Hog Fuel

Avista has operated the Kettle Falls wood-fired generator for 25 years. When Kettle Falls was constructed, hog fuel was a waste product from area sawmills at low or no cost. The future price and availability of hog fuel are critical to understanding the viability of new wood-fired facilities. Hog fuel costs for new plants are forecasted for two locations. The first is fuel in Avista's service territory, forecast at $30 per ton or $3.30 per MMBtu in real 2009 dollars. The second fuel forecast is for the Boardman, Oregon area for a Coyote Spring 2 wood addition, where the price is estimated to be $60 per ton or $6.60 per MMBtu (2009$). Hog fuel availability is highly dependent on lumber demand. The Kettle Falls plant had surplus fuel in the mid-2000s, but the plant has struggled to find enough economically priced fuel over the past two years.

Hydro

The Northwest and British Columbia have substantial hydroelectric generation capacity. A favorable characteristic of hydro power is its ability to provide short periods of near-instantaneous generation. This characteristic is particularly valuable for meeting peak load demands, following general intra-day load trends, shaping energy for sale during higher-valued peak hours and integrating wind generation. The key drawback to hydro is its lack of predictable energy on a year-to-year or seasonal basis. Hydro is constrained by weather patterns and subsequent stream flows. The amount of energy available at a particular plant depends on river system characteristics.

The IRP uses the Northwest Power Pool's (NWPP) 2007-08 Headwater Benefit Study to model regional hydro availability. The NWPP study provides energy levels for each hydroelectric plant by month from 1928 to 1999. British Columbia plants are modeled using data from the Canadian government.

Many of the analyses in this IRP use an average of the 70-year hydroelectric record; whereas stochastic studies randomly draw from the 70-year record (see Risk Analysis later in this chapter). Hydroelectric plants are divided into geographic regions and represented as a single plant in each zone. The Company models its own projects individually to provide greater detail about its resources. Table 7.8 shows average assumed hydro capacity factors for the Northwest hydroelectric plants.

Table 7.8: Northwest Hydro Capacity Factors

Area	Annual Average Capacity Factor
Eastern Oregon	42%
Eastern WA/North Idaho	43%
Northwest Washington	40%
Portland Metro Area	41%
SW Washington	38%
Western Oregon	31%
Central Washington	46%
South Idaho	44%
Western Montana	42%
British Columbia	64%

AURORAxmp represents hydroelectric plants using annual and monthly capacity factors, minimum and maximum generation levels, and sustained peaking generation capabilities. The model's objective, subject to constraints, is to move hydroelectric generation into peak hours to follow daily load changes. This objective maximizes the value of the system consistent with actual operations.

Wind and Solar

As additional wind and solar capacity is added to the electric system to satisfy renewable portfolio standards, there will be significant competition for higher quality wind and solar sites. The capacity factors in Table 7.9 present average generation for the entire area, not specific projects. The Rocky Mountain area is the best location for wind generation and the desert Southwest is best for solar generation.

Table 7.9: Western Interconnect Wind Capacity Factors

Area	Wind CF (%)	Solar CF (%)	Area	Wind CF (%)	Solar CF (%)
Montana	37.36	19.63	Colorado	34.32	25.23
Canada	36.29	16.82	New Mexico	33.09	25.23
Wyoming	36.13	19.63	South Nevada	33.05	28.04
South Idaho	34.91	22.43	Northwest	32.77	19.63
Utah	34.85	22.43	South California	31.20	25.23
Arizona	32.39	25.23	North California	28.97	19.63
North Nevada	34.56	22.43	Baja, Mexico	31.20	28.04

Greenhouse Gas Emissions

Greenhouse gas or CO_2 legislation is one the greatest fundamental risks facing the electricity marketplace today. Reducing CO_2 emissions from power plants will change the resource mix over time as society moves away from traditional resources and shifts to an increased reliance on renewable resources. There is currently no federal regulation of carbon emissions, but national legislation is expected to pass in the next few years. In the interim, several western states and provinces are promoting the Western Climate Initiative to develop a multi-jurisdictional greenhouse gas reduction program. Whether or not a federal system will ultimately supersede these efforts is not known.

The Wood Mackenzie carbon price forecast was used in this IRP. Wood Mackenzie considered this forecast as it developed its other commodity price forecasts. Carbon prices ultimately will depend on greenhouse gas reduction goals, the supply and cost of allowances and offsets, and the price of natural gas. The only way to greatly reduce power plant carbon emissions is to price carbon at a level high enough to greatly reduce the dispatch of coal-fired plants.

Wood Mackenzie based its carbon price forecast on November 2008 legislation sponsored by Representatives Dingell and Boucher. Their macro-economic models were balanced by identifying a carbon price forecast adequate to meet federal emission goals. The analysis included new nuclear and carbon sequestration resources to meet future load growth in the 2020's. Figure 7.6 shows the carbon price forecast. The IRP assumes carbon will have a cost starting in 2012. The price trajectory increases greatly in 2018 as the next major step in carbon reduction goals begins. The 20-year levelized cost of carbon is $46.14 (nominal) and $33.37 (2009 dollars). When natural gas prices rise or fall, the cost of carbon is expected to change to balance the relative competitiveness of gas and coal.

The only way to reduce carbon emissions from electric generation below existing levels under a cap-and-trade model is to increase carbon prices to a level making the marginal cost of a coal plant higher than a natural gas-fired resource. For example, a natural gas plant facing a $7.50 per Dth natural gas price will require a carbon price of approximately $60 per short ton to make its dispatch attractive relative to a coal plant with $1.00 per MMBtu fuel. Figure 7.7 illustrates carbon price levels that would be necessary at various natural gas and coal prices to allow natural gas generation to displace coal. The crossover points between the "dashed" coal and "solid" natural gas marginal cost estimates represent the price of carbon that makes the two resources equal in dispatch cost.

Figure 7.6: Price of Carbon Credits

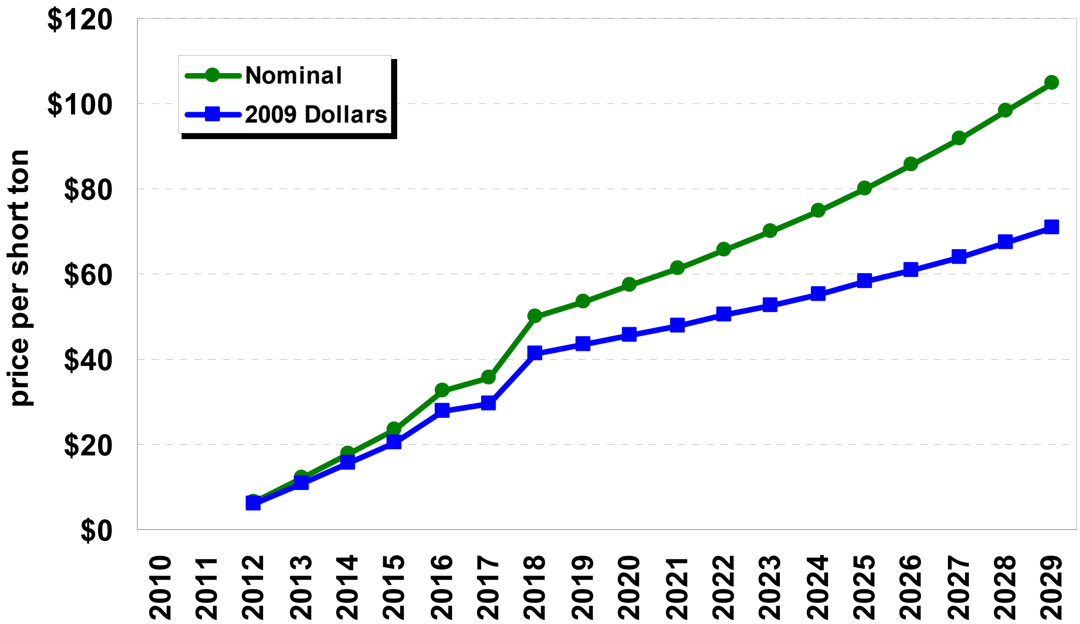
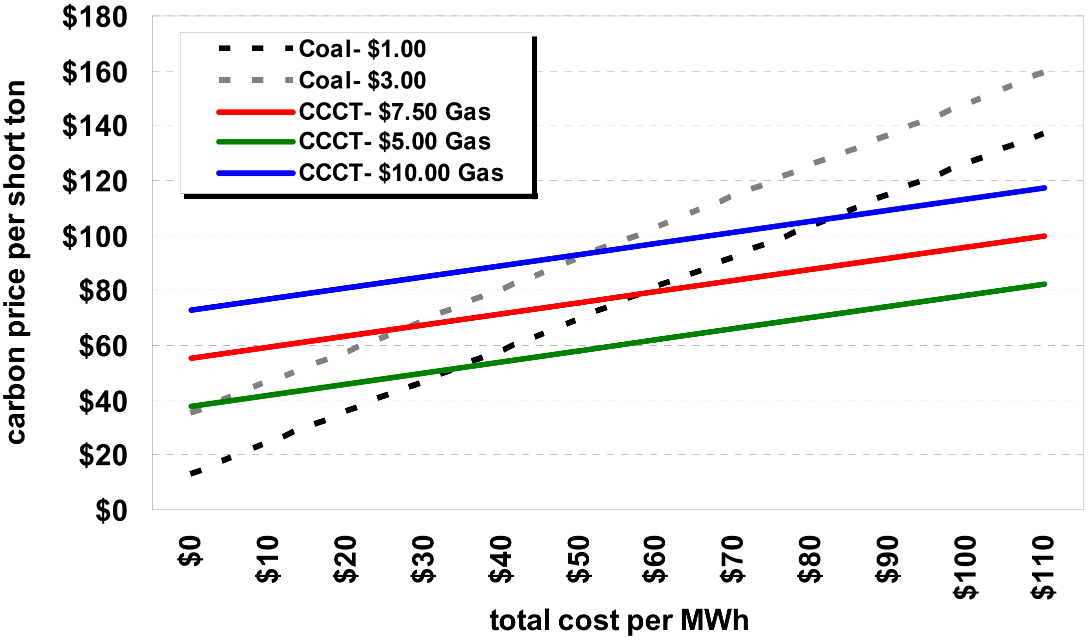


Figure 7.7: Cost of Carbon Credits



Risk Analysis

Base assumptions in this chapter were modeled stochastically to reflect that we do not know what future conditions will actually be. All Base Case assumptions discussed earlier in this chapter represent expected values, not their expected ranges over time. Some market drivers are correlated. For example, higher natural gas prices will likely require higher carbon prices to ensure that carbon reduction goals are met. The increased costs will cause a subsequent load decrease and affect other fuel prices (e.g., hog fuel price might increase as generators chose to burn more of this fuel to avoid higher carbon prices). Table 7.10 illustrates correlations between variables in the IRP. The relationships between variables were developed to show expected levels of cause and effect, not on the results of statistical analysis. Market data does not exist for many of these relationships, so Avista made the assumptions shown in Table 7.10.

Table 7.10: Stochastic Study Correlation Matrix

	Natural Gas Prices	GHG Prices	New Coal Prices	Hog Fuel Prices	Load Growth
Gas Prices	1				
GHG Prices	0.50	1			
New Coal Prices		-0.25	1		
Hog Fuel Prices	0.50	0.50		1	
Load Growth	-0.25	-0.25		-0.5	1

Wind, hydro and forced outages are not necessarily correlated to other market drivers. The stochastic study portion of the IRP includes 250 combinations of these variables; 500 combinations were studied, but no difference in the mean and standard deviation of the results was found.

Greenhouse (GHG) Prices

Without established federal legislation, and no formal rules for western carbon markets, the expected price of GHG emissions is difficult to determine without macroeconomic models capable of determining financial impacts outside of the electric industry. Even with rules in place, carbon prices will be determined based on the tradeoff and interaction between natural gas and coal prices. The lack of certainty means that a range of potential prices needs to be modeled. This IRP utilized ten EPA scenarios as possible legislative outcomes. The EPA scenarios were developed for the Lieberman-Warner bill, the leading federal greenhouse gas legislation at the time the modeling for this IRP was developed. Each scenario was given a weighting (see Table 7.11) by members of Avista's Climate Change Committee. For the scholastic price forecast, the assigned weight will be the probability of a certain base price level.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 134 of 729

Table 7.11: EPA Carbon Study (Nominal Price per Short/Ton)

Study	Weight	2012	2020	2025
ADAGE	10%	28.60	50.89	72.40
IGEM	3%	40.50	70.15	98.04
ADAGE - Low Intl Action	15%	26.20	48.14	66.36
IGEM Unlimited Offsets	10%	8.70	20.63	28.66
IGEM with No Offsets	2%	80.80	134.79	190.04
ADAGE Scenario 6	3%	39.70	67.39	95.02
ADAGE Scenario 7	2%	57.20	94.90	132.73
Alt. Ref. ADAGE	35%	21.00	38.51	54.30
Alt. Ref. IGEM	5%	35.00	61.89	85.97
1766 ADAGE	15%	10.20	20.63	28.66
Weighted Average	**100%**	**23.46**	**42.76**	**59.91**

The EPA and Wood Mackenzie studies differ in many aspects, but the major difference between the two is their assumed natural gas price forecast. To adjust for these differences, 10 price scenarios were developed for the stochastic portion of the IRP. See Table 7.12 for the 10 base carbon scenarios modeled for this IRP.

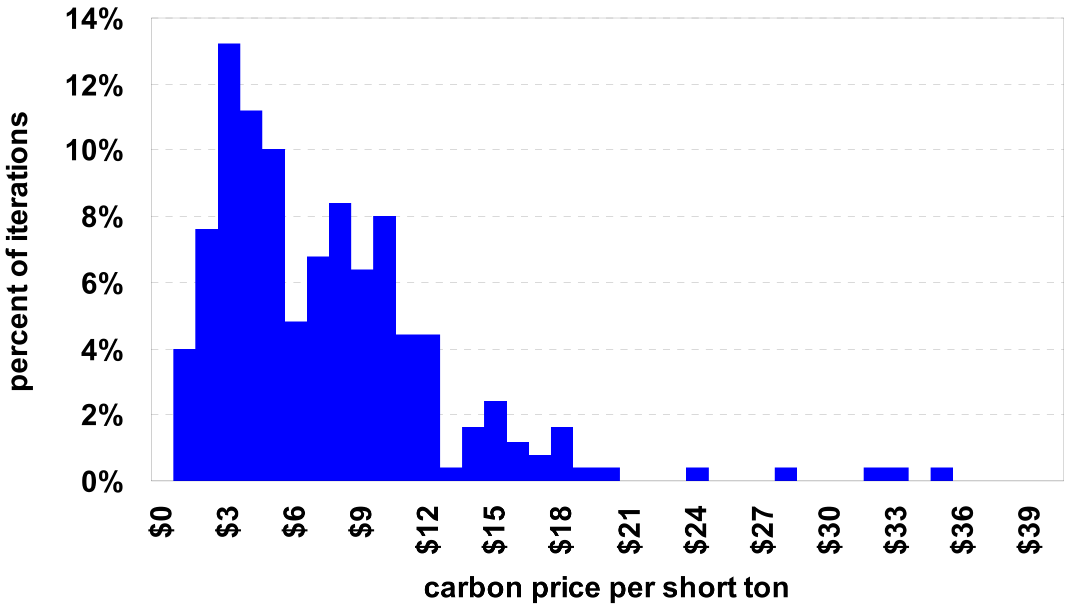
Table 7.12: Ten Cost Scenarios Based on Wood Mackenzie and EPA Studies (Nominal Price per Short Ton)

Scenario	Weight	2012	2020	2025
1	10%	8.01	68.28	96.89
2	3%	11.31	94.12	131.21
3	15%	7.32	64.59	88.82
4	10%	2.42	27.68	38.35
5	2%	22.56	180.86	254.34
6	3%	11.09	90.43	127.17
7	2%	15.97	127.34	177.63
8	35%	5.86	51.67	72.67
9	5%	9.77	83.05	115.06
10	15%	2.85	27.68	38.35
Weighted Average	100%	6.55	57.37	80.18

The carbon price is determined in a two-step process. The first step draws the carbon price regime; the second step adjusts natural gas prices and other variables. The adjustment keeps prices correlated so the market effect is consistent. See Figure 7.8 for the carbon price distribution for the 250 iterations in 2012. Carbon prices range from $1 to $35 per short ton, with an average of $6.55 per short ton. The standard deviations of carbon prices in 2012, 2014, 2016 and beyond are 50 percent, 25 percent and ten percent respectively.

The correlation between carbon and natural gas is likely to be high because gas-fired resources set the marginal price of electricity in most markets. A 50-percent correlation between carbon and natural gas is used for this IRP. A 90-percent correlation scenario found no material impact on the results. The method for obtaining carbon prices and their correlation to other market drivers will be an ongoing IRP process task.

Figure 7.8: Distribution of Annual Average Carbon Prices for 2012



Natural Gas

Natural gas prices are highly volatile. Daily prices at AECO were as high as $12.92 and as low as $0.78 per Dth between 2002 and 2009. To represent future natural gas price uncertainty, volatility is modeled to increase over the study horizon. The standard deviation is set to 35 percent in 2012, 40 percent in 2015, 45 percent in 2020 and 50 percent in 2025 in a lognormal distribution. Prices will be determined by the development and timing of new gas supplies and changes in demand. The IRP risk analysis is an attempt to capture the range of potential outcomes in this uncertain future. The 2012 distribution for average prices is in Figure 7.9. Mean prices in 2012 are expected to be $6.76 per Dth and the median level is $6.24 per Dth. The lognormal distribution skews prices upward. The 95 percent confidence level is $11.56 per Dth and the TailVar90, or average of the highest 10 percent of the iterations, is $12.37 per Dth.

Figure 7.10 illustrates the range of gas prices. The gas prices discussed earlier in this section are shown as white diamonds. The red lines represent median values from the stochastic draws and bars represent the 80 percent confidence interval band. The triangles are the 95 percent confidence level prices. The range of prices increase as time goes on, consistent with the standard deviation assumptions discussed above.

Figure 7.9: Distribution of Annual Average Natural Gas Prices for 2012

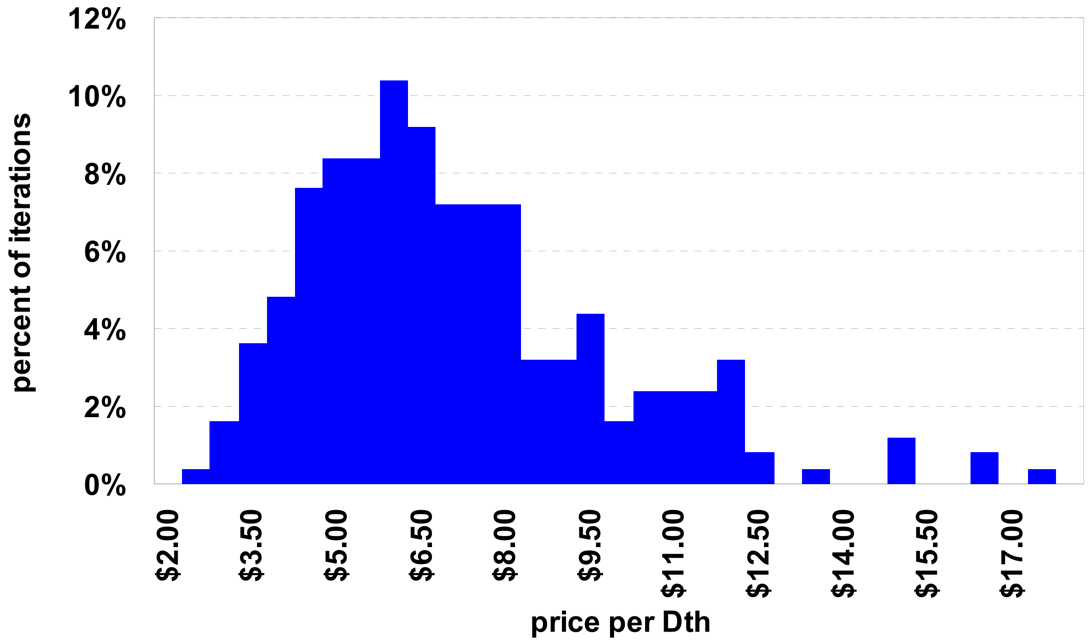
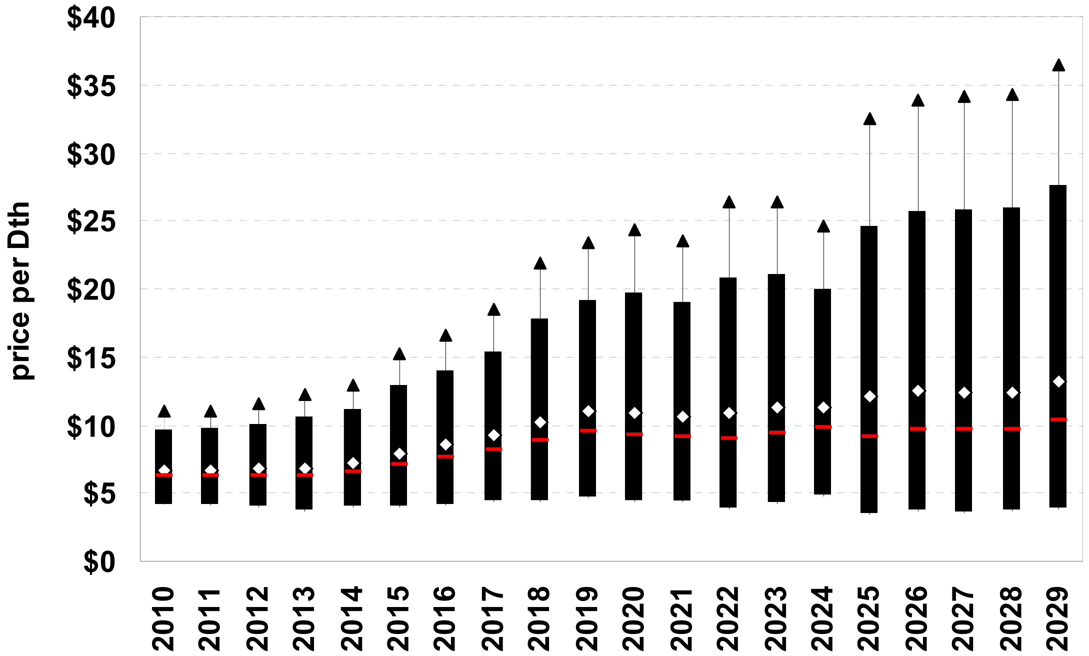
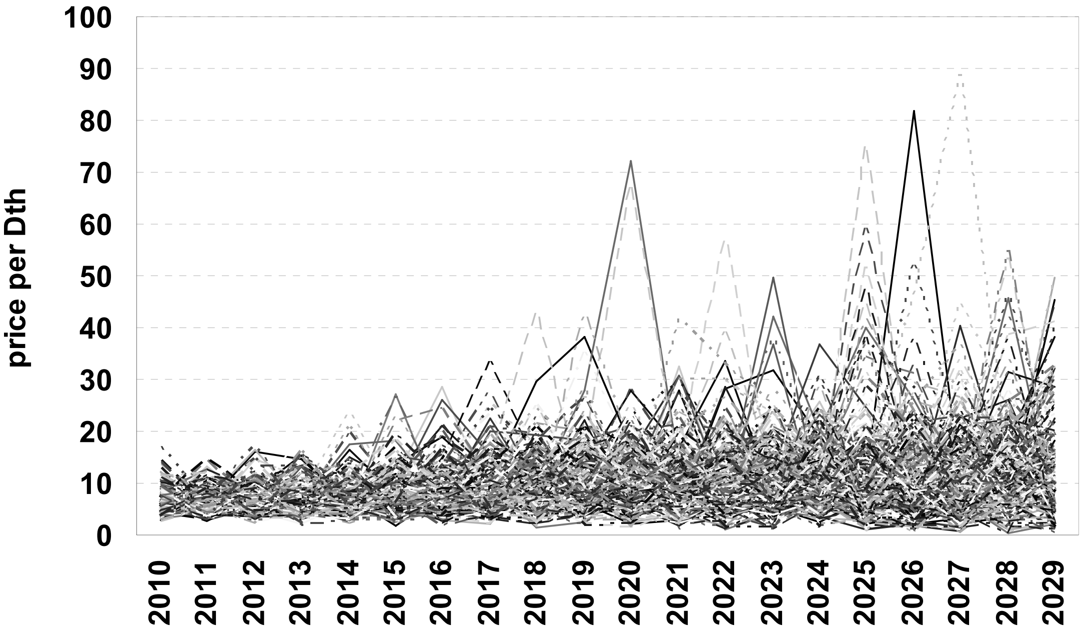


Figure 7.10: Henry Hub Natural Gas Distributions



High carbon prices generally lead to higher natural gas prices due to the 50 percent assumed correlation between the two variables. In the later half of the study horizon, extremely high carbon and natural gas prices are possible due to the vast uncertainty of future price levels. In past IRPs, the year-to-year prices of a draw were correlated, but Avista no longer believes there is enough statistical evidence to support this assumption. Figure 7.11 shows the randomness of annual prices from one year to the next.

Figure 7.11: Random Draws from the Henry Hub Price Distribution



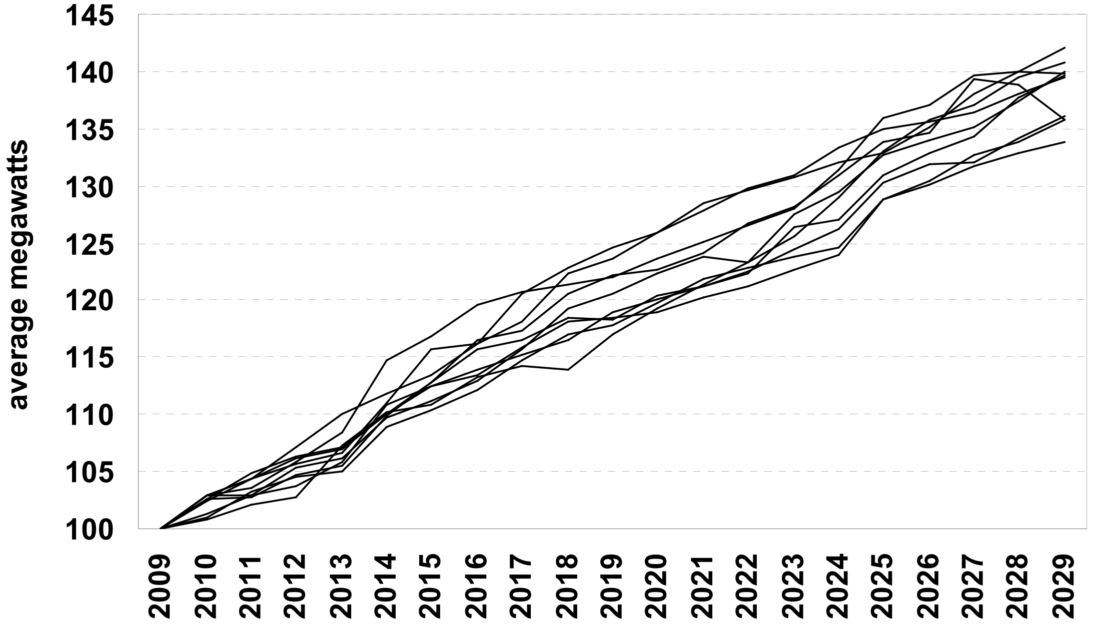
Load

Load variability is driven by several factors. The largest driver is weather because extreme weather variations can move loads up or down compared to overall expected levels. The recent economic downturn has decreased electric demand relative to the long-term average, while earlier economic expansions increased loads. Loads are modeled to increase at the levels discussed earlier in the chapter, but the risk analysis varied economic and weather conditions. The economic adjustments are inversely correlated to natural gas and carbon prices using a lag function. This means that if carbon prices were high in the previous year, then the probability of lower loads is likely the following year (25 percent probability) due to price elasticity responses.

The standard deviation for load growth is estimated at 50 percent. If a load area was forecast to have a 2 percent average annual load growth rate, the load in any given year would be between one and three percent at one standard deviation; two-thirds of all random draws should fall within this range. Figure 7.12 illustrates the annual load growth trajectory for the Western Interconnect in 10 selected iterations.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 138 of 729

Figure 7.12: Random Draws Load Forecast with Year 2009 at 100



The Western Interconnect has many diverse areas and economies. The long-term load-growth correlation between each area is assumed to be 20 percent. Low correlation means each area within the Western Interconnect acts in a relatively independent manner. As with many risk assumptions, the Company will continue to assess the correlations and variation for major drivers of the electricity market. A study of historical weather-adjusted load growth will be examined for Western Interconnect areas for the next IRP.

The method Avista adopted for its 2003 IRP continues to be used to reflect weather patterns across the Western Interconnect. FERC Form 714 data was collected for 2002 to 2007. Correlations between Northwest and other Western Interconnect load areas were calculated and represented as stochastic weather adjustments to the load model. Correlating area loads avoids oversimplifying the Western Interconnect load picture. Absent correlations, stochastic models would offset load changes in one zone with load changes in another, thereby virtually eliminating the possibility of modeling the West-wide load excursions we witness in today's marketplace. Given the high degree of interdependency across the Western Interconnect (e.g., the Northwest and California), this additional accuracy is crucial for understanding variation in wholesale electricity market prices and the value of resources used to meet such variation (i.e., peaking generation). For example, without regional correlation the volatility would be measured, but would not adequately represent heat waves and cold snaps occurring across the Western Interconnect.

Tables 7.13 and 7.14 illustrate the correlations used in the IRP. The correlation statistics are relative to the Northwest load area (Oregon, Washington, and North Idaho).

"NotSig" indicates no statistically valid correlation was found in the evaluated data. "Mix" indicates the relationship was not consistent across time and was not used in this analysis. Tables 7.15 and 7.16 provide the coefficient of determination (standard deviation divided by the average) values for each zone. The weather adjustments are fairly consistent for each area, except for shoulder months where loads diverge from one another.

Table 7.13: January through June Area Correlations

	Jan	Feb	Mar	Apr	May	Jun
Alberta	0.674	0.631	0.494	0.679	0.593	0.771
Avista	0.934	0.886	0.848	0.706	0.819	0.691
Arizona	0.236	0.162	0.077	Mix	Not Sig	0.312
Baja	0.530	0.584	Mix	0.076	Mix	0.692
British Columbia	0.753	0.765	0.763	0.693	0.552	0.552
Colorado	0.653	0.425	Not Sig	0.402	0.493	0.503
Idaho South	0.847	0.743	0.797	0.075	0.237	0.585
Montana	0.831	0.836	0.655	0.338	0.533	0.726
New Mexico	0.570	0.413	0.349	0.469	0.737	0.622
Nevada North	0.690	0.725	0.658	0.683	0.685	0.830
Nevada South	0.785	0.779	0.075	Mix	0.242	0.726
California South	0.499	0.334	Mix	Mix	Not Sig	0.164
Utah	0.482	Not Sig	0.259	Mix	0.077	0.425
Wyoming	0.486	Not Sig	0.167	Mix	Not Sig	0.386
California North	0.750	0.728	0.603	Mix	0.327	0.543

Table 7.14: July through December Area Correlations

	Jul	Aug	Sep	Oct	Nov	Dec
Alberta	0.767	0.777	0.821	0.733	0.673	0.786
Avista	0.909	0.776	0.594	0.873	0.909	0.878
Arizona	0.368	Not Sig	Mix	Mix	Not Sig	Not Sig
Baja	0.689	0.757	Mix	Mix	0.072	0.456
British Columbia	0.677	Mix	0.247	0.666	0.743	0.732
Colorado	0.505	0.686	0.663	0.672	0.694	0.774
Idaho South	0.747	0.760	Mix	0.426	0.873	0.870
Montana	0.782	0.673	0.635	0.775	0.882	0.833
New Mexico	0.596	Mix	0.664	0.525	0.420	0.689
Nevada North	0.780	0.818	0.626	0.447	0.756	0.793
Nevada South	0.689	0.608	0.418	Mix	0.543	0.821
California South	0.487	0.249	Mix	Mix	Not Sig	Mix
Utah	0.400	Mix	0.243	0.161	0.076	Not Sig
Wyoming	0.240	Mix	Mix	Mix	0.072	Not Sig
California North	0.707	0.503	Mix	Mix	0.560	0.764

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 140 of 729

Table 7.15: Area Load Coefficient of Determination (Std Dev/Mean)

	Jan	Feb	Mar	Apr	May	Jun
Alberta	2.8%	2.4%	3.0%	2.9%	2.7%	3.6%
Arizona	5.8%	4.7%	4.3%	6.4%	11.0%	7.6%
Avista	6.7%	5.8%	6.3%	5.4%	5.5%	6.9%
Baja	9.5%	7.9%	8.5%	9.2%	10.5%	7.6%
British Columbia	5.4%	3.8%	5.0%	4.9%	4.3%	4.1%
California North	5.3%	5.5%	5.4%	6.0%	8.6%	9.4%
Colorado	5.2%	5.4%	5.5%	5.2%	6.6%	7.6%
Idaho South	5.2%	5.9%	6.8%	6.0%	10.3%	10.9%
Montana	5.0%	4.7%	4.7%	4.5%	4.7%	5.8%
Nevada North	2.8%	2.8%	3.2%	3.3%	4.9%	5.0%
Nevada South	4.2%	3.7%	3.8%	6.6%	13.8%	9.2%
New Mexico	4.6%	4.4%	4.3%	4.6%	6.8%	5.9%
Oregon Washington Idaho	7.0%	5.6%	6.3%	5.4%	5.0%	5.1%
Southern California	6.7%	6.4%	6.6%	7.4%	9.0%	8.1%
Utah	4.9%	5.3%	5.3%	5.0%	6.7%	8.1%
Wyoming	5.0%	5.4%	5.3%	5.0%	6.5%	8.2%

Table 7.16: Area Load Coefficient of Determination (Std Dev/Mean)

	Jul	Aug	Sep	Oct	Nov	Dec
Alberta	3.5%	3.2%	2.7%	2.9%	2.5%	3.0%
Arizona	7.3%	7.1%	10.5%	10.4%	4.9%	6.1%
Avista	7.8%	6.8%	5.7%	5.9%	6.7%	5.7%
Baja	6.4%	6.3%	11.6%	9.9%	7.6%	10.2%
British Columbia	4.8%	4.4%	4.4%	5.2%	5.9%	4.6%
California North	9.5%	8.0%	9.0%	6.0%	5.9%	5.8%
Colorado	7.2%	7.3%	7.3%	5.2%	5.5%	5.6%
Idaho South	6.2%	6.9%	9.8%	4.5%	6.6%	6.1%
Montana	5.9%	5.4%	4.2%	4.5%	5.4%	4.4%
Nevada North	5.0%	4.4%	5.0%	2.9%	3.4%	3.5%
Nevada South	7.1%	7.2%	12.7%	8.5%	4.0%	4.3%
New Mexico	5.9%	5.4%	5.8%	5.3%	5.0%	5.2%
Oregon Washington Idaho	6.3%	5.1%	4.8%	5.7%	7.0%	5.8%
Southern California	8.8%	8.0%	10.4%	7.6%	7.4%	6.8%
Utah	5.7%	5.6%	7.2%	4.5%	5.4%	5.4%
Wyoming	5.8%	5.6%	7.0%	4.5%	5.4%	5.5%

Coal Prices

Coal prices are not modeled stochastically for existing plants. Coal prices are typically contractually based for long time periods. As coal project contracts expire and plants begin to rely on new fuel sources, prices change with coal supply and demand and transportation. Coal prices were modeled stochastically using a 10 percent standard deviation for new coal projects options considered in Avista's PRS Analysis. Prices are inversely correlated to carbon, as higher carbon prices are expected to decrease coal demand. It is possible that increased international demand for U.S. domestic coal will cause prices to increase. Lower coal demand could reduce the number of suppliers and cause prices to increase. Transportation cost increases arising from factors besides carbon reduction also could raise the cost of coal.

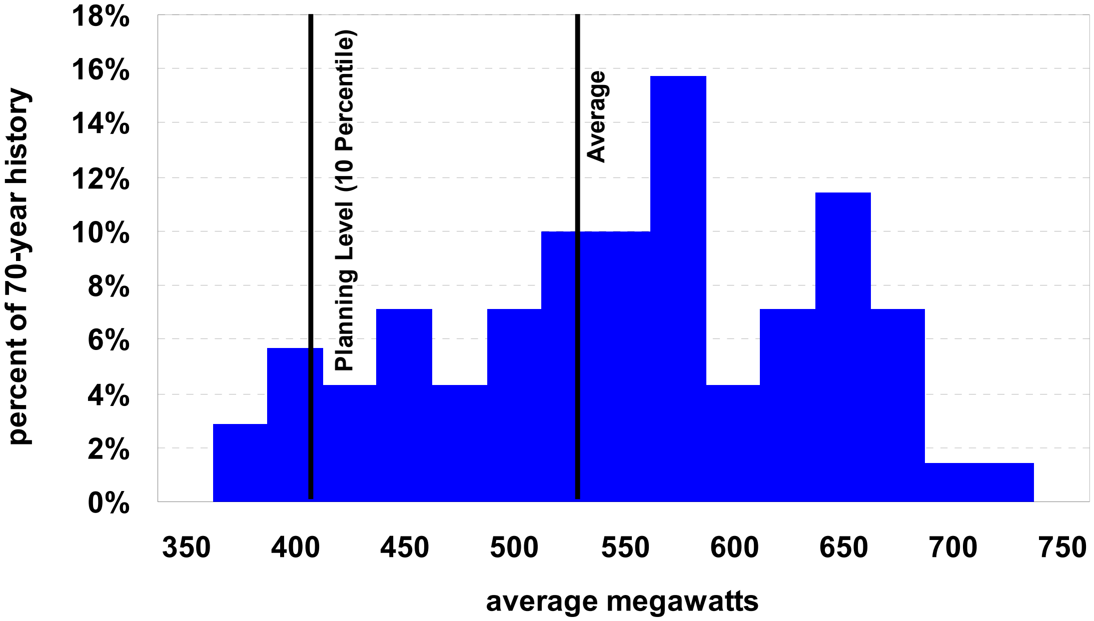
Wood/Hog Fuel

The price of wood, or hog fuel, is modeled stochastically for new resource options available to the PRS. Avista's experience with woody biomass generation indicates consistent price increases for a fuel that used to be free. The price and availability of hog fuel varies with the economy. The IRP stochastic analysis assumes a standard deviation of 10 percent. Further demand for wood residues will increase with aggressive greenhouse gas and renewable portfolio standard legislation. These environmental concerns will encourage more woody-biomass generation or the co-firing of existing coal and other boiler-fired plants with wood pellets. The correlation between wood and carbon prices is therefore assumed to be 50 percent. Hog fuel is also correlated 50 percent to natural gas prices because most commercial wood residue is displacing natural gas.

Hydro

The hydro risk analysis uses the 70-year record (1928 to 1999) from the 2008-09 Headwater Benefits Study completed by the Northwest Power Pool. Each water year is drawn randomly for each iteration of the stochastic analysis. Hydro is not correlated to any other variable in this study. Some preliminary studies indicate that there might be modest correlation between hydroelectric and wind generation over a calendar year or certain seasons. However, Avista is not aware of any comprehensive study of correlation between the two resources. This relationship will be studied as more wind data becomes available. Figure 7.13 shows the distribution of annual hydro capacity factors for Avista's hydro fleet over the 70-year record. Expected hydro output is 538 aMW and median output is 543 aMW.

Figure 7.13: Distribution of Avista's Hydro Generation



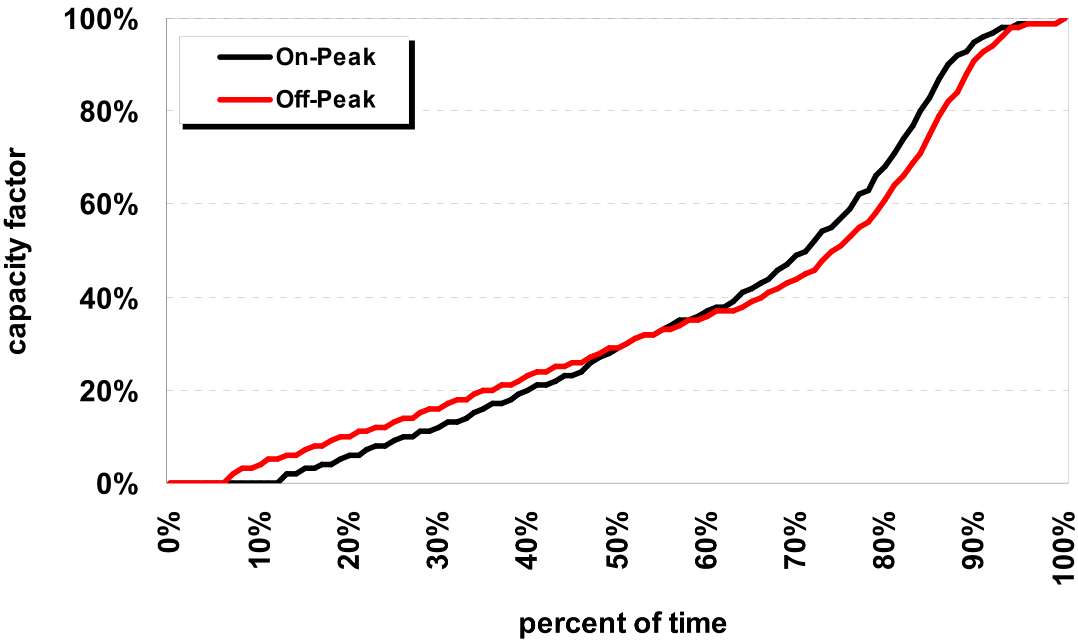
Wind

Wind is one of the most volatile generating resources available to utilities. Storage, apart from some integration with hydro, is not a financially viable option based on current technologies. This makes it necessary to capture wind volatility in the power supply model to determine its impacts on the overall market, as well as the value of any wind project acquisition. Accurately modeling wind resources requires hourly generation shapes. Variability is modeled similar to how AURORAxmp models hydroelectric resources for regional analyses. A single wind generation shape is developed for each area. This generation shape is smoother than individual plant characteristics, but closely represents how a large number of wind farms across a geographical area would operate together.

This simplified wind methodology works well for forecasting electricity prices across a large market, but does not represent well the volatility of specific wind resources the Company might select. A different wind shape was used for each Avista resource option in each of the 250 stochastic iterations. This analysis used historical wind speed data for potential wind sites at Reardan, Washington, the Columbia Basin and Montana.

The first step in developing the wind randomization model was to create a distribution of hourly output. Figure 7.14 shows the distribution for a Northwest wind site. In this example, generation is zero for 13 percent of the on-peak hours and zero for 6 percent of the off-peak hours. The resource is near full output only 5 percent of the time. The second step links next-hour generation to present generation levels. The next hour has a 95 percent probability of being within two percent of the last hour's generation level. The model also correlates wind locations: Reardan is 75 percent correlated to Northwest resources and Montana is 25 percent correlated to Northwest wind resources.

Figure 7.14: Wind Output Distribution



Forced Outages

Forced outages at CCCT, coal and nuclear plants were included in the risk analysis. The forced outage logic in the AURORAxmp algorithm is based on a mean time to repair and a forced outage rate. The model randomly forces a unit out of service and brings it back online at different intervals throughout the year based on its mean time to repair. Operating performance varies from iteration to iteration.

Market Forecast

An optimal resource portfolio must account for the extrinsic value inherent in the resource choices. The 2009 IRP simulation was conducted by comparing each resource's expected hourly output at a forecasted Mid-Columbia hourly price. This exercise was repeated for 250 iterations of Monte Carlo-style stochastic analysis. Resources generating during on-peak hours generally contribute higher margins to Avista's resource portfolio than resources with intermediate and unpredictable output.

Assumptions used to develop the electricity price forecast were discussed earlier in this chapter. In general, hourly electricity price is set by the operating cost of the marginal unit in the Northwest or the economic cost to move power into or out of the Northwest. To create an electricity market price projection, a forecast of available future resources must be determined. The IRP uses regional planning margins to set minimum capacity

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 144 of 729

requirements, instead of using the summation of capacity needs of each utility in the region. Western regions can have resource surpluses even where some individual utilities may be in a deficit situation. This imbalance can be due to ownership of regional generation by independent power producers or differences in planning methodologies used by the deficit utilities.

AURORAxmp assigns market values to each resource alternative available to the Preferred Resource Strategy (PRS), but it does not select PRS resources. Several market price forecasts are used to determine the value and volatility of a resource portfolio. As Avista does not know what will happen in the future with any degree of certainty, it relies on risk analysis to help determine an optimal resource strategy. Risk analysis uses several market price forecasts with different assumptions than the Base Case or changes the underlying statistics of a study. These alternate cases are split into stochastic and deterministic studies.

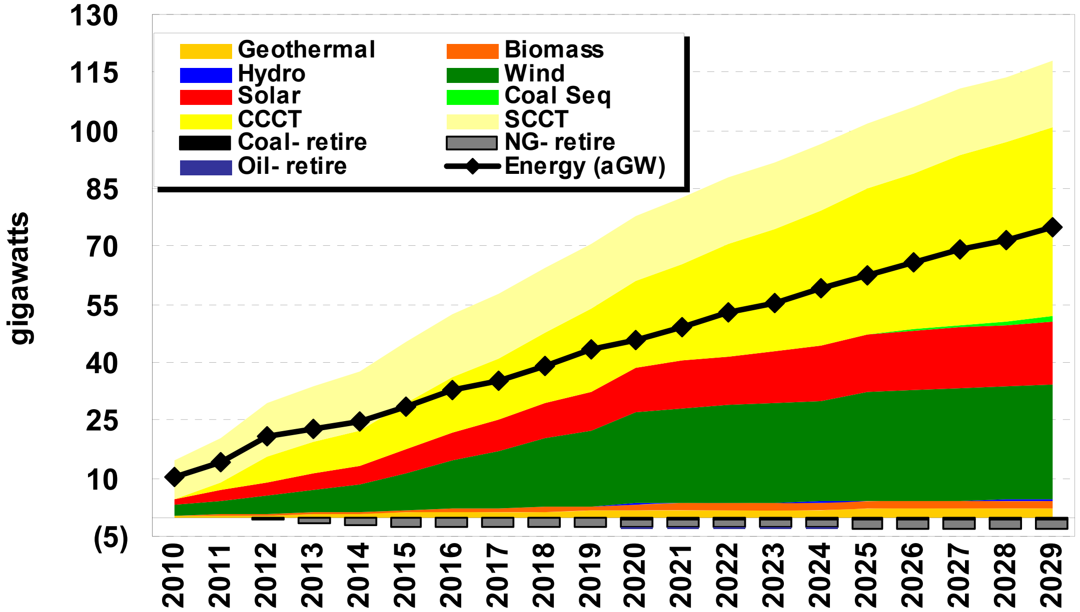
A stochastic study uses Monte Carlo analysis to quantify variability in future market prices. These analyses include 250 iterations of varying gas prices, loads, hydro, thermal outages, wind shapes and emissions prices. Two stochastic studies were developed for this IRP, one with and one without carbon legislation. The remaining studies were deterministic scenario analyses.

Resource Selection

New resource options were discussed earlier in this chapter, along with the amount of capacity necessary to meet capacity targets. New resources for the Western Interconnect will primarily be natural gas-fired. Renewable resources added to meet renewable portfolio standards help fill system energy needs, but fail to provide equivalent capacity for system reliability. Figure 7.15 shows the new resources selected to meet capacity needs and RPS requirements for the Western Interconnect. The model retires a number of coal and high heat rate natural gas plants for economic reasons. Using the same scale, the amount of potential energy is shown in the black line with diamonds. In 2020, 78 GW of nameplate capacity is added, but only 48 GW of energy is available from these resources. Mandates to acquire new renewable resources help reduce carbon emissions, but force utilities to invest in more infrastructure.

The Northwest is expected to need new capacity in 2015, as described earlier in this chapter. The predominant resource selected after renewables to meet Northwest loads is combined cycle combustion turbines. 8,100 MW of CCCT are forecast to be added in the Northwest between 2015 and 2029.

Figure 7.15: Base Case New Resource Selection



Mid-Columbia Price Forecast

The Mid-Columbia electricity trading hub is Avista's primary trading hub. The Western Interconnect also has trading hubs on the California/Oregon Border (COB), Four Corners, Palo Verde, SP15 (southern California), NP15 (northern California) and Mead. The Mid-Columbia market is usually the least cost market because of low-cost hydro generation, though other markets can be less expensive when Rocky Mountain area gas prices are low.

Two studies were conducted for the Base Case. The first is a deterministic market view using expected levels for key assumptions discussed in the first part of this chapter. The second is a risk or stochastic study with 250 unique scenarios based on different underlining assumptions for gas prices, load, carbon prices, wind, hydro, forced outages and others. Each of these studies simulates the entire Western Interconnect between 2010 and 2029 for each hour. The analysis used 25 CPUs linked to a SQL server to simulate the market, creating over 26.5 GB of data requiring 1,500 hours of computing time.

Average prices from the stochastic study do not match deterministic or median prices. Lognormal natural gas prices with carbon penalties affect prices in a lognormal way, with more up-side than down-side price variability. Figure 7.16 compares stochastic market price results to the deterministic Base Case scenario. The price distributions are shown in Figure 7.17 for selected years: the horizontal axis is the percent of time, indicating 10 percent of the iteration's annual flat prices were above $75 per MWh in 2010 and 50 percent of the time prices were over $48 per MWh.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 146 of 729

Figure 7.16: Annual Flat Mid-Columbia Electric Prices

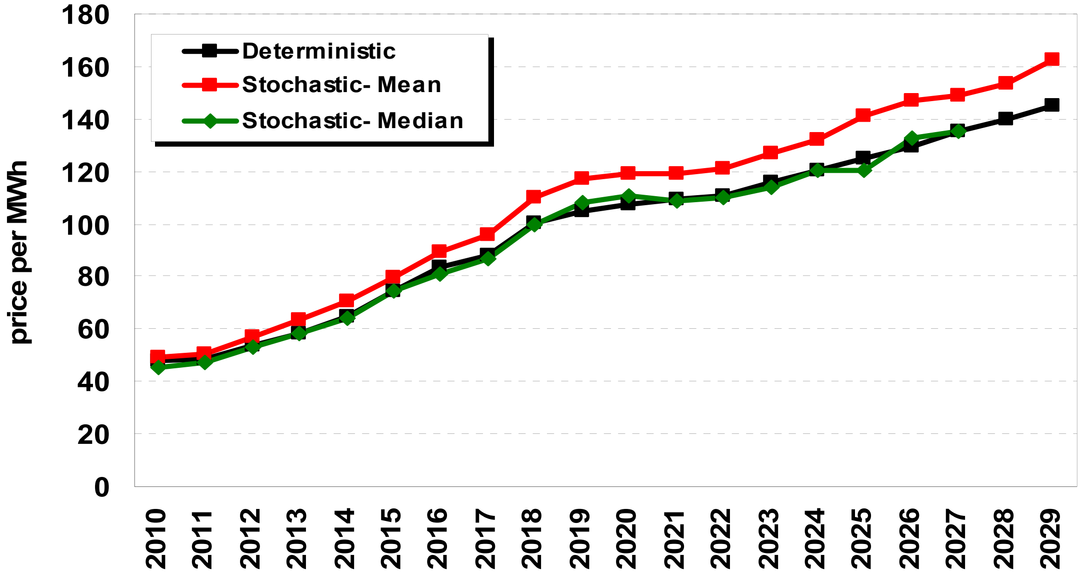
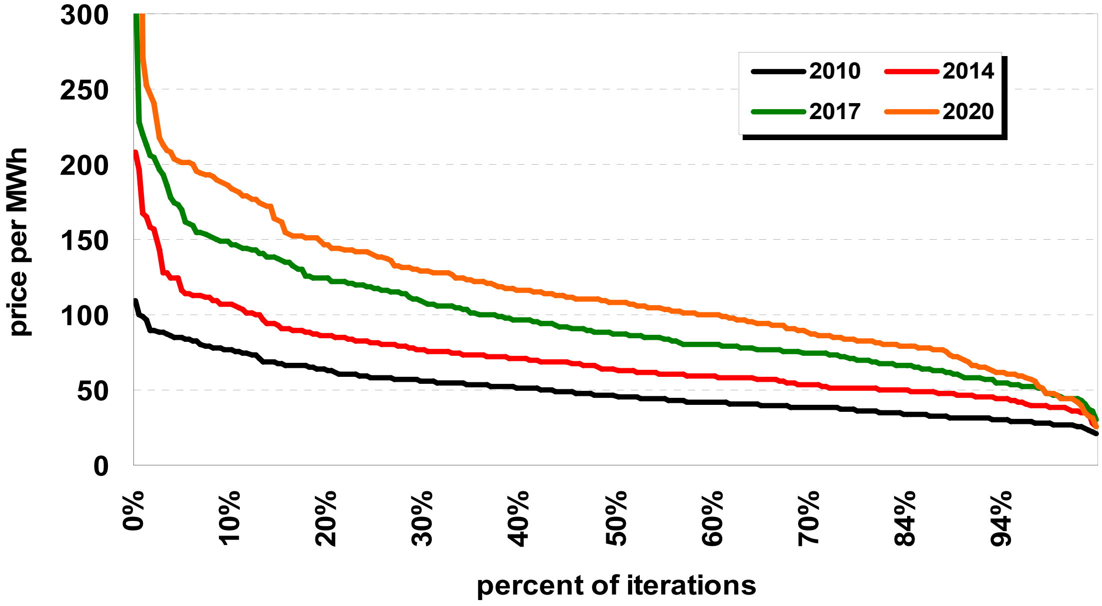


Figure 7.17: Selected Mid-Columbia Annual Flat Price Duration Curves



Annual on- and off-peak prices are presented in Table 7.17, along with levelized costs for deterministic and stochastic analyses. The Mid-Columbia market price is expected to average $79.56 per MWh in 2009 dollars over the next 20 years and the average nominal price is $93.74 per MWh. Spreads between on- and off-peak prices are $14.34 per MWh in 2010 and $32.71 per MWh in 2029.

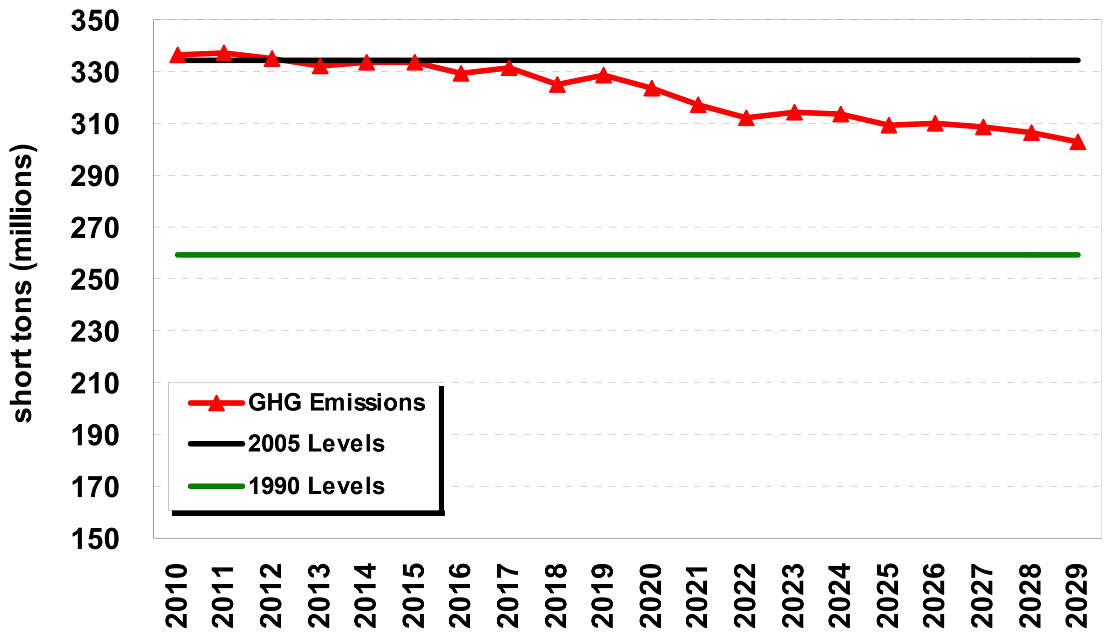
Table 7.17: Annual Mid-Columbia Electric Prices ($/MWh)

Year	Deterministic On Peak	Deterministic Off Peak	Deterministic Flat		Stochastic Mean On Peak	Stochastic Mean Off Peak	Stochastic Mean Flat
2010	53.86	40.08	47.96		55.44	41.10	49.29
2011	54.40	40.35	48.38		56.70	42.10	50.44
2012	59.09	45.83	53.39		62.56	48.49	56.51
2013	63.62	50.37	57.95		68.92	54.34	62.68
2014	71.19	56.95	65.09		76.76	60.98	70.00
2015	80.72	65.87	74.36		86.94	70.07	79.71
2016	90.50	74.69	83.73		97.00	78.71	89.17
2017	95.46	78.86	88.32		103.78	84.00	95.27
2018	107.32	91.28	100.45		119.24	97.01	109.72
2019	112.00	95.68	105.01		126.03	102.86	116.10
2020	114.88	98.22	107.75		128.40	104.45	118.15
2021	116.16	99.70	109.11		129.17	105.09	118.86
2022	117.84	101.50	110.84		131.07	106.60	120.59
2023	123.03	106.01	115.71		138.34	112.73	127.33
2024	128.07	110.46	120.53		142.84	116.61	131.61
2025	132.85	114.43	124.97		152.13	123.83	140.01
2026	137.71	119.03	129.71		158.82	129.10	146.09
2027	143.78	124.25	135.42		161.94	131.58	148.94
2028	148.88	128.60	140.16		166.20	135.23	152.89
2029	153.78	133.09	144.92		175.56	142.85	161.55
Nominal Levelized	**93.10**	**77.39**	**86.36**		**102.41**	**82.17**	**93.74**
2009$ Levelized	**79.01**	**65.68**	**73.30**		**86.92**	**69.75**	**79.56**

Greenhouse Gas Emissions Levels

Greenhouse gas levels are expected to increase over the study period where no carbon legislation is enacted that would affect the Western Interconnect. The carbon costs discussed earlier in this chapter provide price signals to encourage greenhouse gas emission reductions following proposed legislation at the end of 2008. The prices were based on a Wood Mackenzie study including the entire U.S. electrical system. Figure 7.18 shows emissions across the Western Interconnect. Emissions are expected to quickly fall to 2005 levels, and then more toward 1990 levels by the end of the study. The Wood Mackenzie study assumed carbon offsets would help meet Western Interconnect carbon reduction goals. Carbon prices would need to be significantly higher to reduce the Western Interconnect to 1990 emissions levels without the offset assumptions. The Wood Mackenzie study found that the Eastern Interconnect will lower emissions at twice the level as the West, but that the West would reduce it emissions by a higher percentage.

Figure 7.18: Western States Greenhouse Gas Emissions

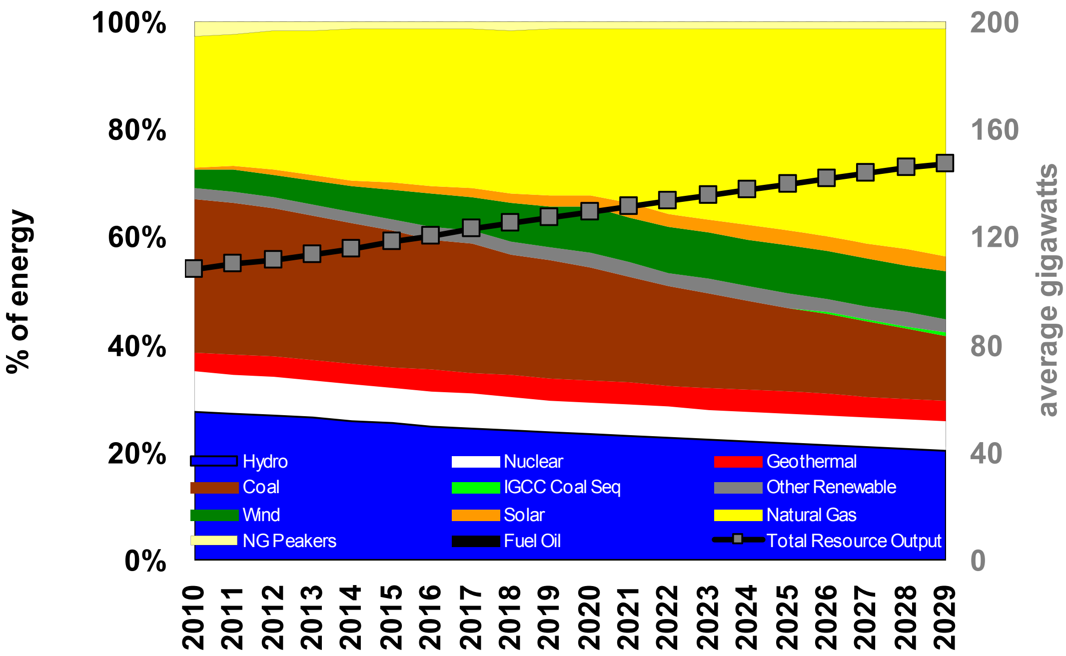


Resource Dispatch

State-level RPS and carbon legislation will change resource dispatch decisions and affect future power supply expenses. Figure 7.19 illustrates that natural gas is expected to be 27 percent of power generation in 2010, 32 percent in 2020 and 44 percent in 2029. Coal decreases from 29 percent of Western Interconnect generation in 2010 to 16 percent in 2029. Non-hydro based renewables increase from 10 percent in 2010 to 25 percent in 2029. The reduction in coal generation is offset by new renewable generation, but load growth will primarily be met by natural gas-fired resources.

Public policy changes to encourage renewable energy development and reduce greenhouse gas emissions will change the electric marketplace. Policy changes are likely to move the electric generation fleet toward its most volatile contributor—natural gas. These policies will displace low-cost and dependable coal-fired generation with higher cost renewables and gas-fired generation having lower capacity factors (wind) and higher marginal costs (natural gas). Regulated utilities are expected to recover stranded coal costs, requiring society to pay for duplicative resources as renewable and natural gas resources are built to satisfy RPS and emissions performance standards. Wholesale prices will increase with the effects of the changing resource dispatch driven by carbon emission limitations. New environment-driven investment, combined with higher market prices, will lead to higher retail rates absent federal action.

Figure 7.19: Base Case Western Interconnect Resource Energy



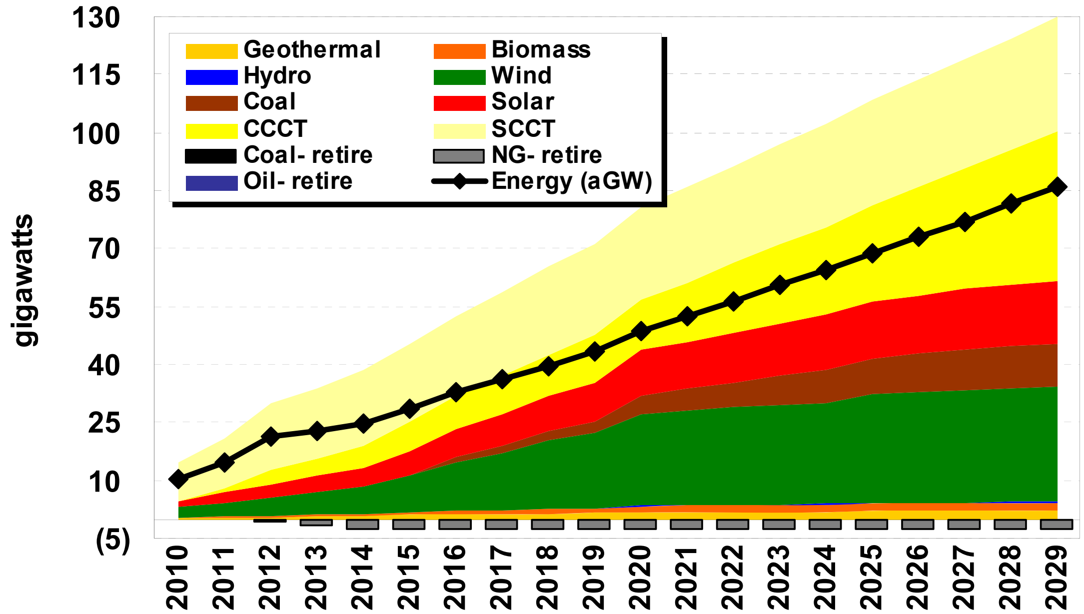
Scenario Analysis

This section evaluates the market with specific changes in individual assumptions. The unconstrained carbon emissions scenario is modeled stochastically and deterministically. It is modeled stochastically because it is used in the PRS analysis to determine the total cost of carbon legislation. The high gas price, low gas price and solar saturation scenarios are provided to show the impact of significant market changes on electricity and carbon prices. Market scenarios were used in prior IRPs to stress test the PRS against different market scenarios. Since the PRS accounts for a range of possible outcomes in its risk analysis, the market scenario analysis section has been limited in this IRP.

Unconstrained Carbon Emissions

The unconstrained carbon emissions scenario quantifies the projected cost of greenhouse gas legislation. The scenario is first studied deterministically, then stochastically, with 250 iterations of varying natural gas prices, loads, wind, forced outages and hydro conditions. The assumptions are similar to the Base Case with a few notable exceptions. First, the natural gas price forecast is lower because of less demand for natural gas caused by the continued use of coal-fired generation. Without carbon legislation, gas prices are expected to be $0.80 per Dth lower, an 8.6 percent decrease. The resources selected for this scenario are shown in Figure 7.20. The primary difference between this scenario's resource selection and the Base Case is the reduction in new natural gas resources and an increase in new coal resources. New coal resources totaled 11,000 MW over the 20-year study; an equivalent amount of CCCTs were removed from the portfolio. A few additional peaking resources were developed in this scenario.

Figure 7.20: Unconstrained Carbon Emissions Resource Selection



Mid-Columbia market prices would be lower absent carbon legislation. The deterministic analysis found prices would be $22.43 per MWh lower on a nominal levelized basis over the forecast horizon; the stochastic analysis found prices would be $25.52 per MWh (32 percent) lower. Prices are lower without carbon penalties because fuel and dispatch costs for natural gas-fired plants are lower. A comparison of the two forecasts is shown in Figure 7.21.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 151 of 729

Figure 7.21: Mid-Columbia Prices Comparison with and without Carbon Legislation

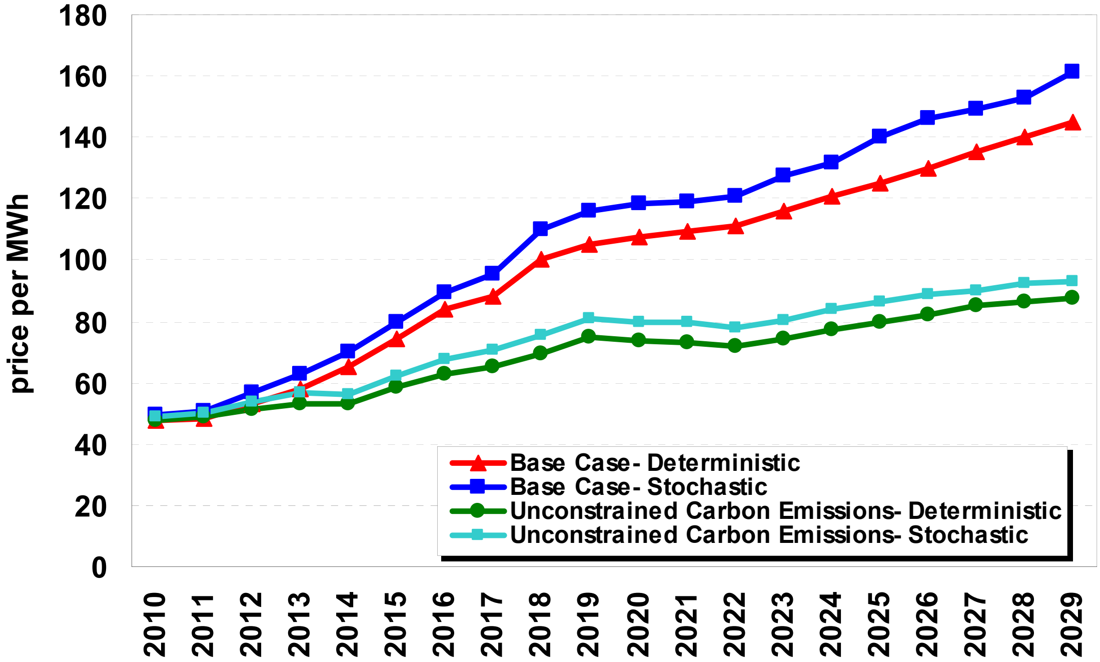


Figure 7.22 illustrates the difference between carbon emissions with and without the carbon adder included in the Base Case. Carbon emissions would be 11 percent higher in 2020 and 40 percent higher in 2029 without the Base Case carbon adder. The increased emissions are caused by higher dispatch levels for coal-fired resources (Figure 7.23) relative to the Base Case. Carbon emission impacts on coal plants could increase overall fuel costs across the Western Interconnect by 16.3 percent or $42.5 billion in present value terms (2009 dollars). Annual cost increases are shown in Figure 7.24. Carbon legislation adds $328 million in present value term (2009 dollars) over the study period for operations, but reduces capital and other non-O&M costs by $17.1 billion. In total, carbon legislation on a 20 year net present value calculation will increase costs by $25.7 billion (10 percent).

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 152 of 729

Figure 7.22: Western U.S. Carbon Emissions Comparison

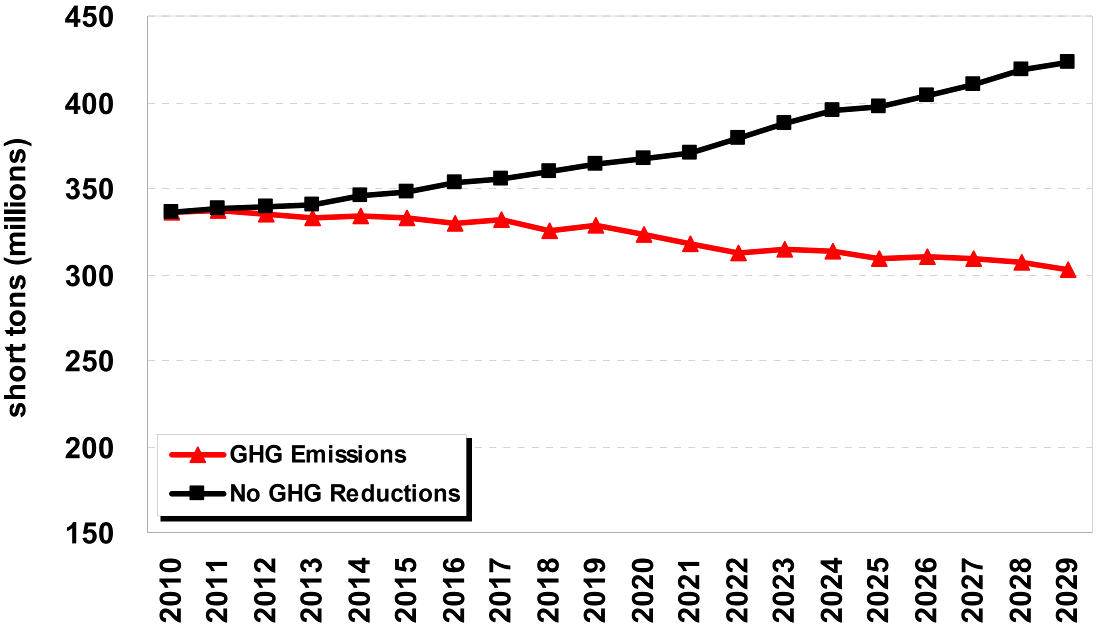


Figure 7.23: Unconstrained Carbon Scenrio Resource Dispatch

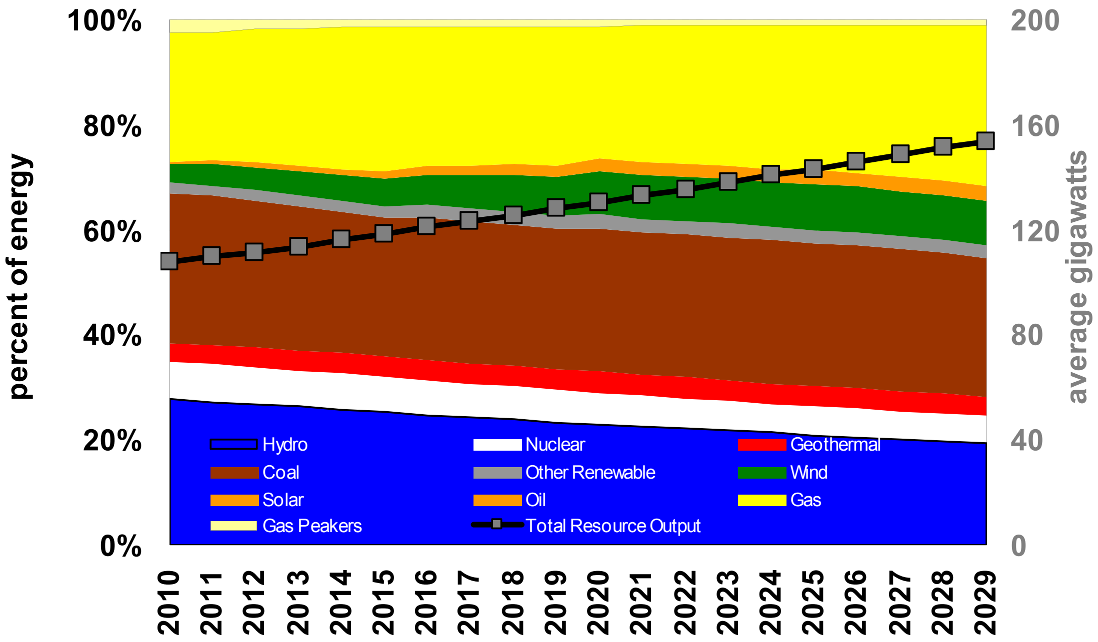
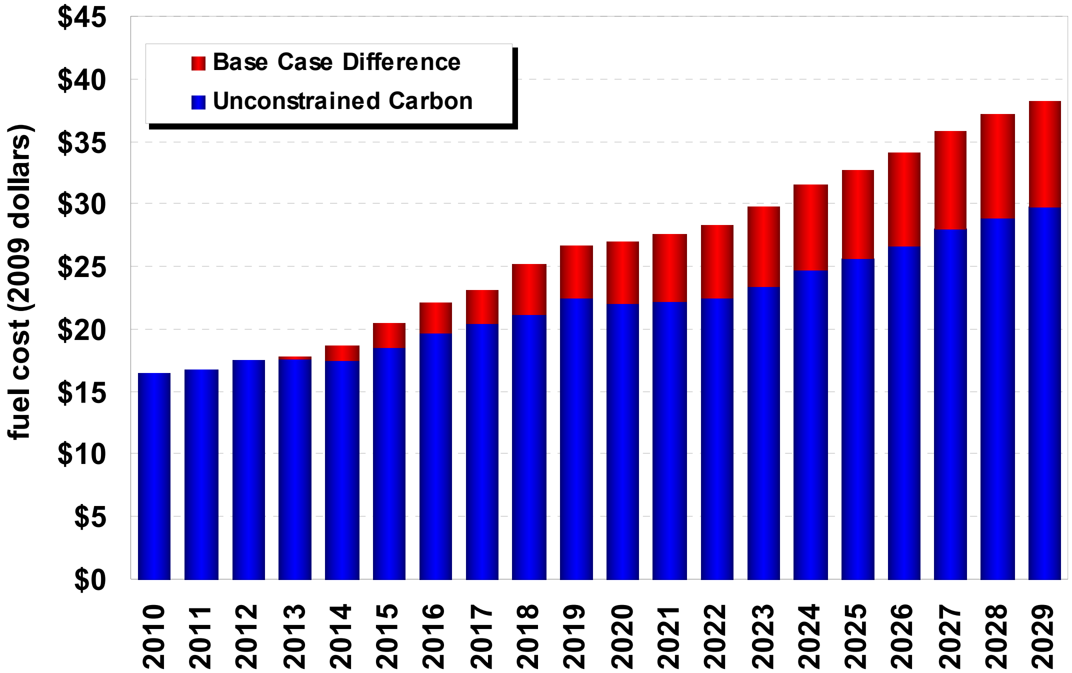


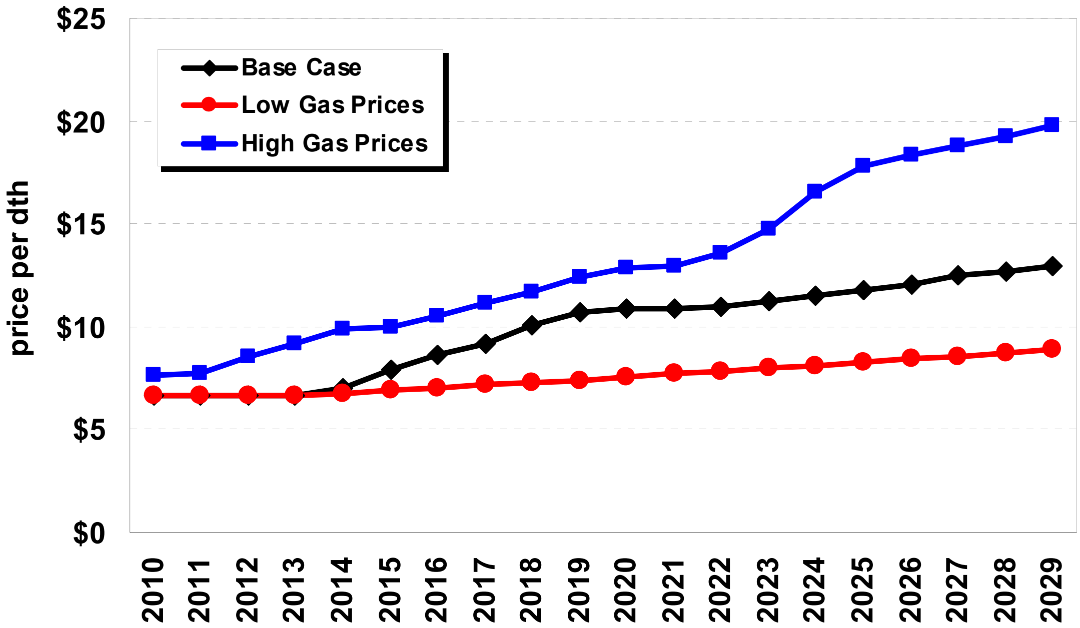
Figure 7.24: Western Interconnect Fuel Cost Comparison



High and Low Natural Gas Prices

The High and Low Natural Gas Price scenarios illustrate the range in Mid-Columbia electricity prices for different ranges of natural gas prices. These scenarios also keep carbon emissions at the same level as the Base Case; therefore, a carbon price can be derived if gas prices change from the Base Case assumptions. Figure 7.25 shows natural gas prices used for these analyses at the Henry Hub. The monthly and basin differential prices remain the same as the Base Case. The objective of the Low Natural Gas Price scenario is to maintain the real price level at the 2010 level throughout the study and only allow nominal prices to increase with inflation. The levelized price is $7.50 per Dth (nominal) and $6.36 per Dth (2009 dollars) in this scenario. The High Natural Gas Price scenario uses a Wood Mackenzie price forecast from the summer of 2008. Prices in this scenario did not include the current recession and subsequent market effects as well as including lower levels of unconventional gas supplies. The levelized price is $12.17 per Dth (nominal) and $10.33 per Dth (2009 dollars) for the High Natural Gas Price scenario.

Figure 7.25: Henry Hub Prices for High and Low Natural Gas Price Scenarios



As discussed throughout this chapter, carbon prices are dependent on natural gas prices. The objective of the High and Low Gas Price scenarios is to keep carbon emissions at the same level as in the Base Case. To achieve these levels, the carbon emission prices shown in Figure 7.26 were used. The nominal levelized greenhouse gas price was $47.12 per short ton for the High Gas Price scenario. It was $24.12 for the Low Gas Price scenario compared to the Base Case of $38.61 per short ton. The real carbon prices in 2009 dollars are $40.06 (Base Case), $20.49 (Low Gas) and $32.83 (High Gas) per short ton respectively.

The new resources selected by AURORAxmp in the High and Low Natural Gas Price scenarios do not differ greatly from the Base Case. This is mostly due to RPS assumptions remaining the same between all cases and because traditional coal is not an option for most U.S. utilities in the Western Interconnect; therefore, the model uses a mix of gas, nuclear, sequestered coal, and low capacity factor wind or solar resources. The High Gas Price scenario is displayed in Figure 7.27. The model in this case selected more carbon sequestration than in the Base Case and added nuclear generation to the resource mix. The model also retired three gigawatts of natural gas and one gigawatt of coal-fired generation.

New resources for the Low Gas Price scenario are shown in Figure 7.28. In the Low Gas Price environment, the model selected only new gas-fired resources in addition to the RPS resources. The model retired four gigawatts of older natural gas and two gigawatts of coal-fired plants.

Figure 7.26: Greenhouse Gas Prices for High and Low Natural Gas Price Scenarios

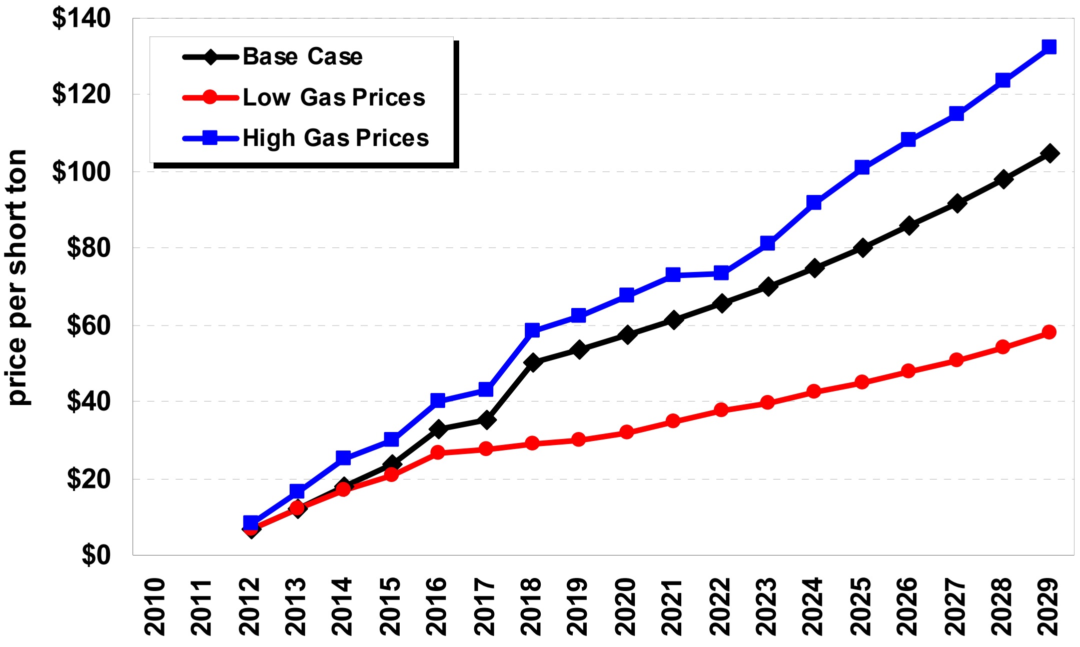


Figure 7.27: High Natural Gas Prices Scenario Resource Selection

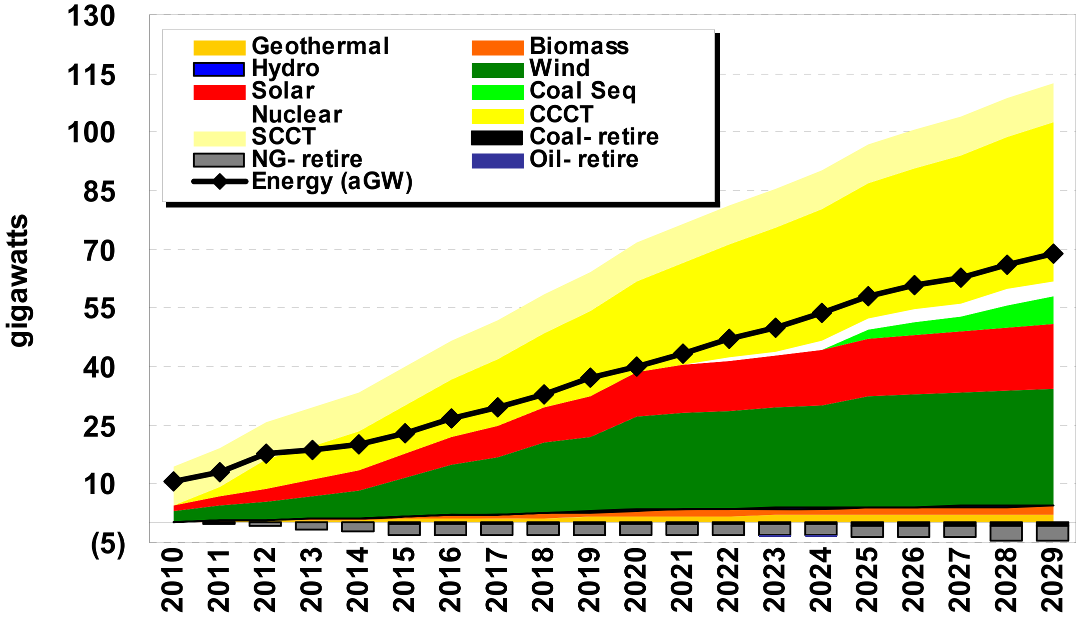
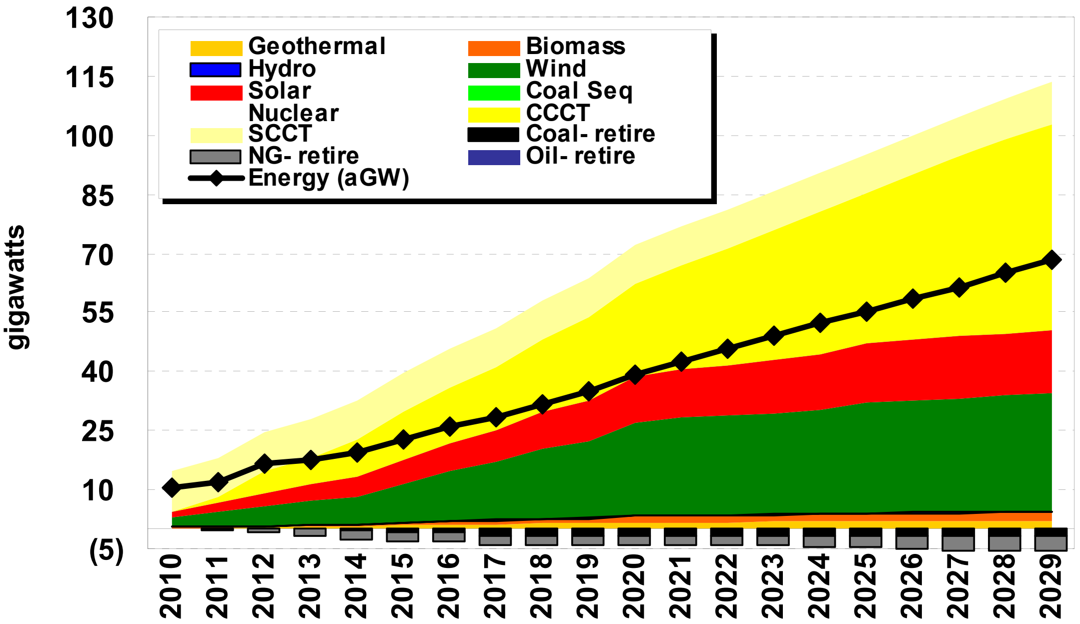


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 156 of 729

Figure 7.28: Low Natural Gas Prices Scenario Resource Selection



As expected, Mid-Columbia electricity prices are higher in the High Gas Price scenario than in the Base Case or the Low Gas Price scenarios. The nominal levelized price for the High Gas Price scenario is $102.61 per MWh. The Low Gas Price scenario is $67.48 per MWh, compared to $86.36 per MWh in the Base Case. Prices are $87.10, $57.24 and $73.30 per MWh in 2009 dollars, respectively. These prices are graphically presented in Figure 7.29. Market prices follow natural gas prices because of the high correlation between these two variables.

The High Gas Price scenario lowers the contribution of natural gas in the Western Interconnect fuel mix and adds coal sequestration and nuclear projects beginning in 2020 (see Figure 7.30). The Low Gas Price scenario has a similar dispatch as the Base Case; it includes an increase in natural gas-fired resources (see Figure 7.31). The contribution from traditional coal-fired resources shrinks to lower carbon emissions in both scenarios.

Figure 7.29: Mid-Columbia Electric Price Forecast

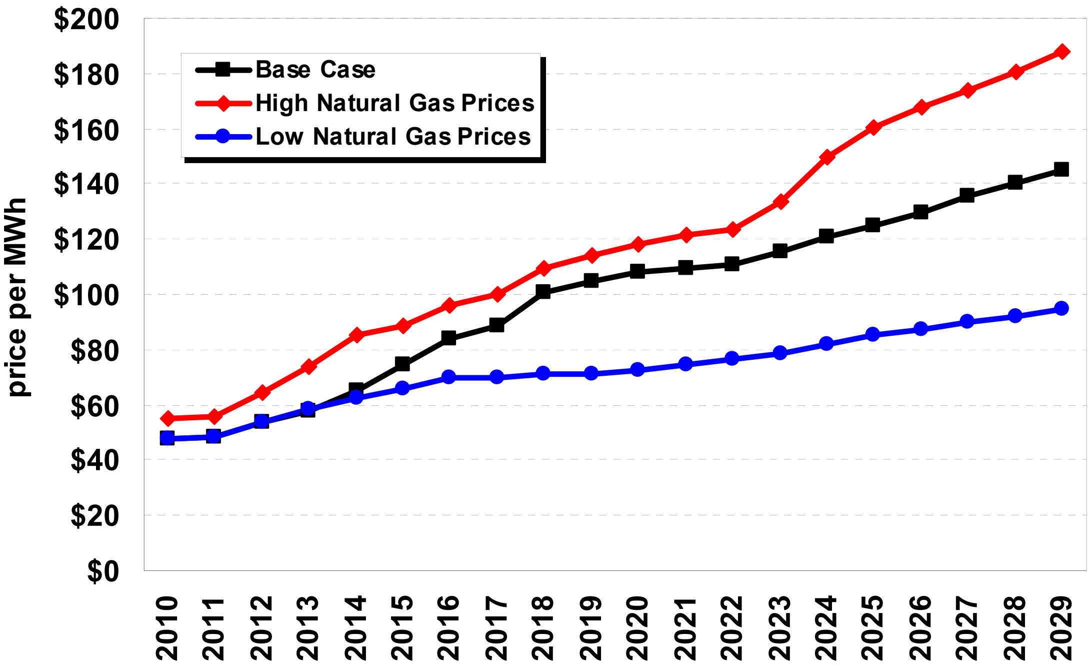


Figure 7.30: Resource Dispatch- High Gas Price Scenario

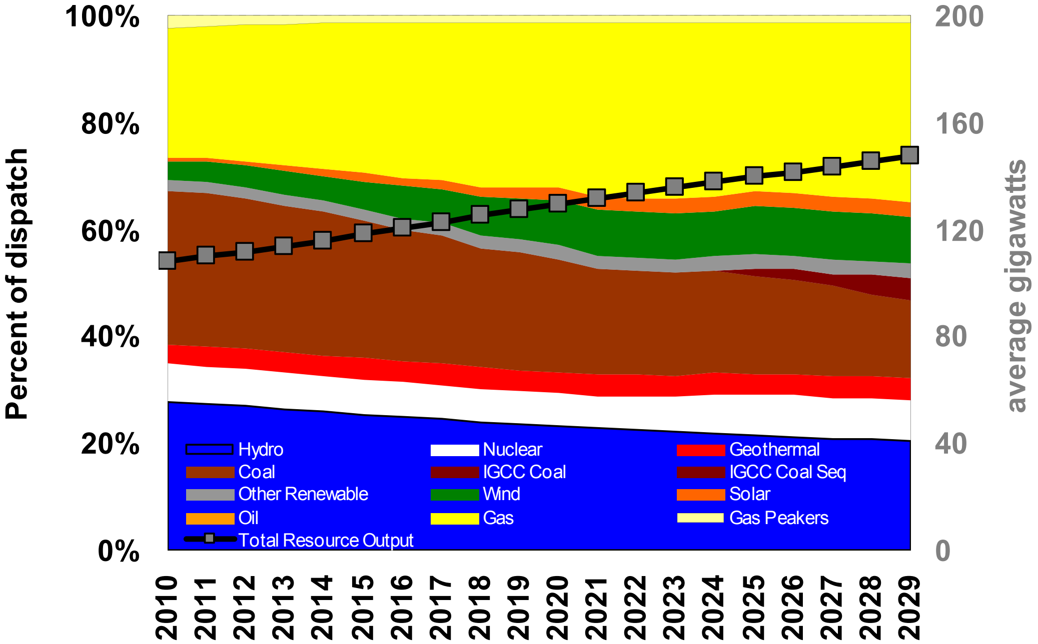
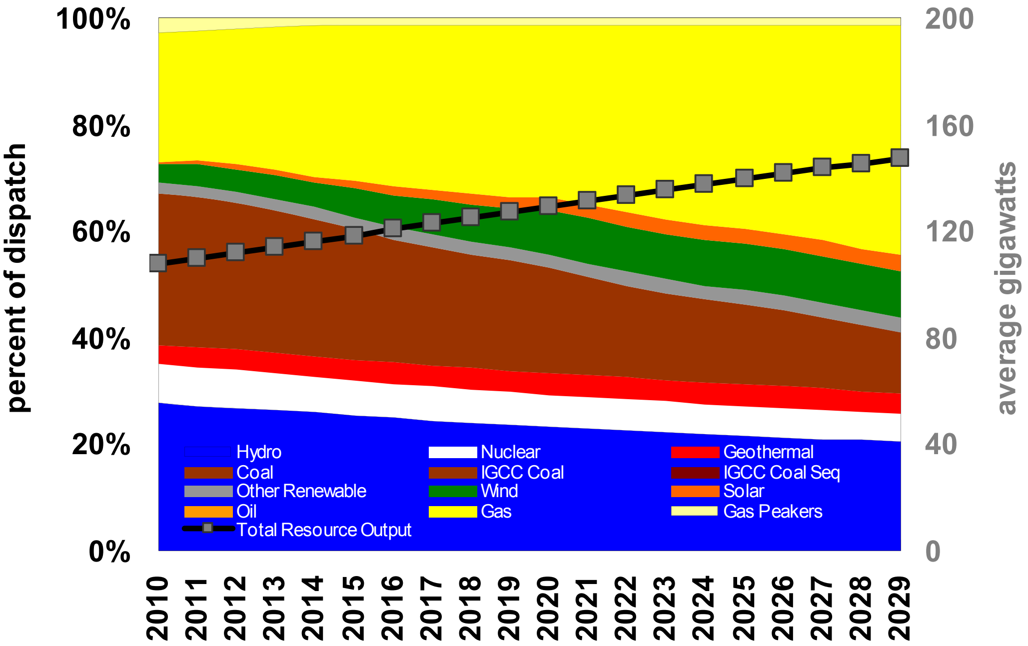


Figure 7.31: Resource Dispatch- Low Gas Price Scenario

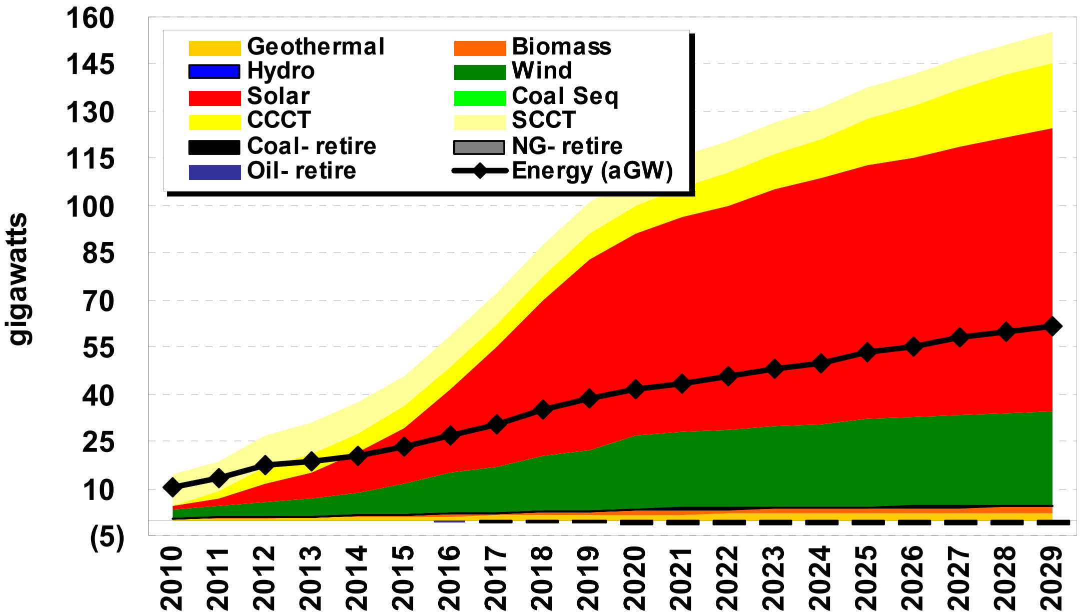


Solar Saturation

It is helpful to use the IRP process to identify and understand potential market changes, rather than only focus on what is or is not included in the Company's PRS. Solar has caught the attention of many utility planners, government officials and customers because of positive environmental characteristics, potential line loss reductions through distributed energy, free fuel and high correlations with on-peak load. Solar has many upside potentials, but is still financially prohibitive because of its high capital costs and limited generation. The Solar Saturation scenario was developed to understand the market reaction to a significant decrease in the price of photovoltaic solar. Natural gas, carbon prices and load remain the same in this scenario. The only change is an 80-percent reduction in installed photovoltaic solar costs. The scenario is not used for the PRS, but is included to identify how market prices and greenhouse gas emissions would be impacted by a significant decrease in photovoltaic solar costs.

If photovoltaic solar became 80 percent less expensive, the amount of solar added above and beyond the RPS levels is 75 GW, for a total of 90 GW of solar capacity by 2029 (Figure 7.32). Even with the added solar, it only contributes 23,000 aMW of energy due to the low capacity factor. Solar is not an ideal fit to meet winter peak in northern areas (5 percent winter capacity contribution in northern states) so another technology must be used or additional solar must be added to compensate for the lower winter capacity.

Figure 7.32: Solar Saturation Scenario Resource Selection



Adding 75 GW of solar did not have a significant impact on Mid-Columbia market prices. There was only a reduction of $3.50 per MWh (4 percent) levelized (nominal), though second and third quarters (high solar months in the Northwest) had lower on-peak power prices than in the Base Case. Prices did not change because the marginal cost of power was still set by gas-fired resources and because solar does not produce power at night. More solar would need to be added and a low-cost storage technology identified to effectively lower market prices. Greenhouse gas emissions were reduced by 10 percent from the Base Case (see Figure 7.33) in this scenario.

More solar generation reduces the Western Interconnect's carbon footprint. Carbon reduction is primary driven by a decrease in natural gas-fired generation. Coal energy increased by 1,000 aMW over the Base Case while natural gas-fired production fell by 18,000 aMW in this scenario (see Figure 7.34). The increase in coal generation was from existing plants operating in off peak hours to compensate for the lack of night time solar generation, while the reduction in natural gas-fired generation is a result of decreased need due to the influx of solar resources to serve on-peak load. This study illustrates that market prices in the Northwest will not radically change in spite of a large amount of new solar generation being added to the system, but greenhouse gas emissions will fall along with natural gas prices.

Figure 7.33: Western Interconnect Carbon Emissions Comparison

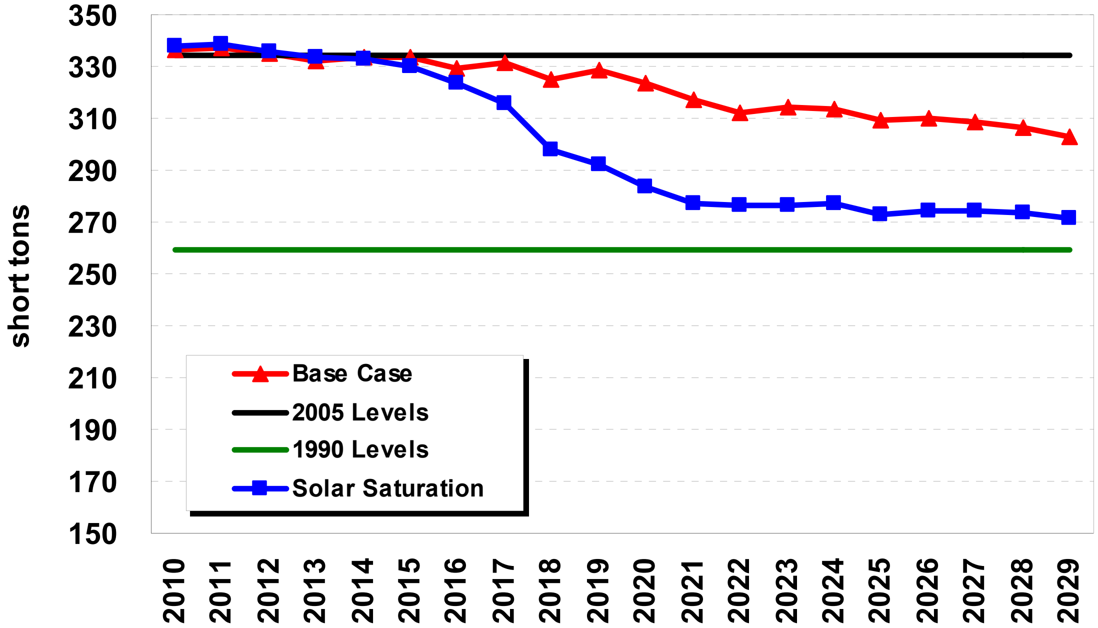


Figure 7.34: Resource Dispatch- Solar Saturation Scenario

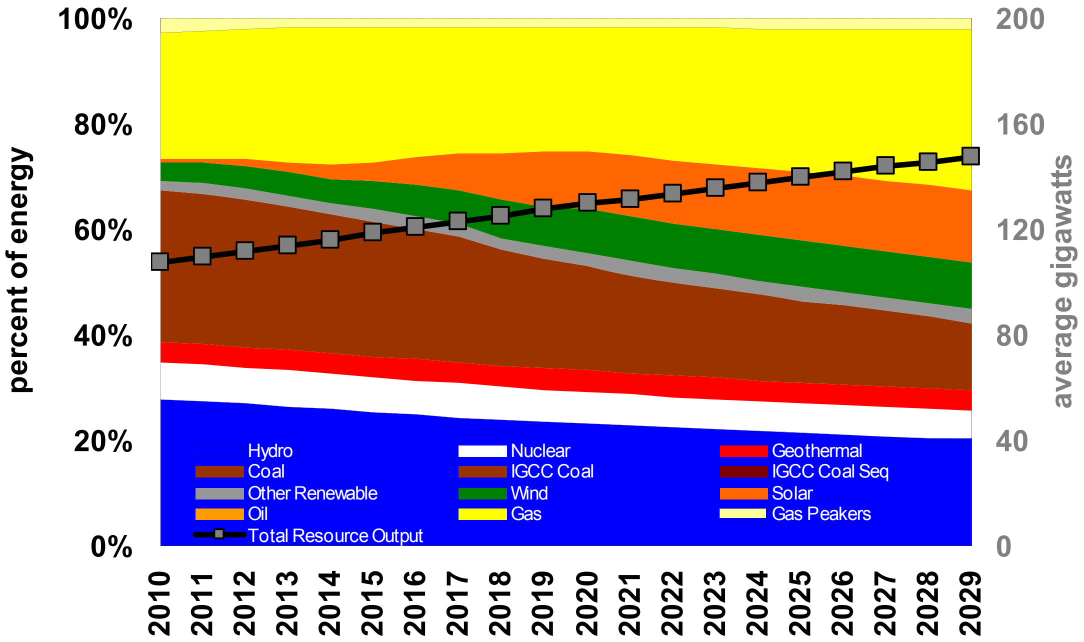


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 161 of 729

Market Analysis Summary

Market analysis is a key component of the IRP. The market is where the Company balances its load and resource positions. Without a firm understanding of the marketplace and how it is affected by public policy, it is difficult to provide a comprehensive examination of potential resource being evaluated by Avista and the utility industry. A summary of key drivers for the 2009 IRP market forecast are presented in Table 7.18 and Table 7.19. These tables present 10- and 20-year levelized costs in nominal and 2009 dollars. The 2007 IRP forecasts are included for comparison. Price expectations have increased since the 2007 IRP. The 10-year Malin natural gas price forecast increased 20 percent, and the Mid-Columbia electric price forecast increased 27 percent from the 2007 IRP. Large increases are the result of carbon mitigation costs. Without greenhouse gas legislation, Malin natural gas and Mid-Columbia electric prices would only have increased seven percent from the previous IRP forecasts.

New legislation and regulations impacting the electric system are on the horizon. It does not matter if the intent is to decrease greenhouse gas emissions, make generation greener, promote energy independence or affect reliability—power costs will increase because new capacity and transmission resources are needed to replace aging resources and meet new load growth. Carbon and RPS legislation will diversify fuel supplies, but will also increase demand for cleaner burning natural gas.

Table 7.18: Malin and Mid-Columbia Forecast Results (Nominal Levelized)

		Stochastic		Deterministic					
		Base Case	Unconst-rained Carbon Emissions	Base Case	Unconst-rained Carbon Emissions	Low Gas Prices	High Gas Prices	Solar	2007 IRP Base Case
10 Year	Malin Natural Gas Prices	$7.43	$6.90	$7.37	$6.90	$6.49	$8.71	$7.37	$6.11
	Mid-Columbia Electric Price	$73.53	$60.18	$68.64	$56.84	$60.24	$80.28	$64.92	$53.76
	Mid-Columbia/Malin x 1000	9,898	8,719	9,311	8,238	9,279	9,212	8,807	8,792
20 Year	Malin Natural Gas Prices	$8.67	$7.87	$8.64	$7.86	$6.88	$10.52	$8.63	$7.15
	Mid-Columbia Electric Price	$93.74	$68.22	$86.36	$63.93	$67.48	$102.61	$82.87	$62.16
	Mid-Columbia/Malin x 1000	10,806	8,671	10,008	8,132	9,809	9,754	9,603	8,694

Table 7.19: Malin and Mid-Columbia Forecast Results (2009 Dollars Levelized)

		Stochastic		Deterministic					
		Base Case	Unconst-rained Carbon Emissions	Base Case	Unconst-rained Carbon Emissions	Low Gas Prices	High Gas Prices	Solar	2007 IRP Base Case
10 Year	Malin Natural Gas Prices	$6.73	$6.25	$6.68	$6.25	$5.88	$8.93	$6.68	$5.54
	Mid-Columbia Electric Price	$66.61	$54.51	$62.18	$51.49	$54.56	$72.72	$58.81	$48.70
	Mid-Columbia/Malin x 1000	9,898	8,718	9,311	8,238	9,279	8,146	8,807	8,792
20 Year	Malin Natural Gas Prices	$7.36	$6.67	$7.33	$6.67	$5.83	$8.93	$7.32	$5.76
	Mid-Columbia Electric Price	$79.56	$57.87	$73.30	$54.23	$57.24	$87.10	$70.33	$50.07
	Mid-Columbia/Malin x 1000	10,811	8,670	10,012	8,132	9,812	9,757	9,607	8,693

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 163 of 729

8. Preferred Resource Strategy

Introduction


Site of the Proposed Reardan Wind Project

This chapter summarizes the 2009 Integrated Resources Plan's (IRP) Preferred Resource Strategy (PRS), along with its potential cost and risks. It details the planning and resource decision methodologies; describes the strategy, climate change ramifications and how the PRS might evolve if base forecasts of future conditions are incorrect.

The 2009 PRS is the least-cost achievable plan accounting for climate change and fuel supply and cost risks. The major change from the 2007 PRS is a greater reliance on wind to meet renewable portfolio standards (RPS), rather than a combination of wind and other renewables. More wind was selected because it is the only renewable resource available in quantities large enough to affect utility planning. It also is more actionable and controllable by the utility, allowing for less reliance on third-party developers that might or might not respond to utility request for proposal (RFP) efforts. It is likely that the 2009 PRS will change as new information becomes available on cost, resource options and legislative actions. However, the strategy contained in this chapter is based on the best information available at this time.

Chapter Highlights

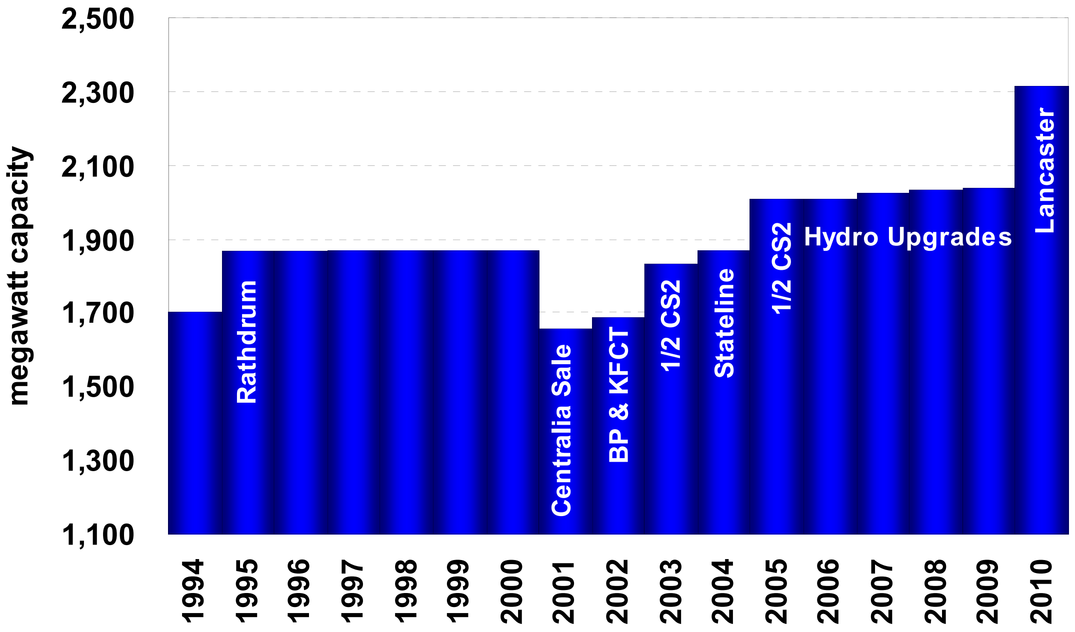
- Avista's physical energy needs begin in 2018 and capacity needs begin in 2015.
- The first supply-side acquisition is 150 MW of wind by the end of 2012.
- Conservation additions provide 26 percent of new supplies through 2020.
- A 250 MW natural gas-fired combined cycle project is required by 2020, but could be required as soon as 2015.
- Large hydro upgrades could change the PRS if further study determines them to be economically viable.

Supply-Side Resource Acquisition History

Avista sold its 210 MW share of the Centralia coal plant in 2001 and replaced its generation with natural gas-fired projects (see Figure 8.1). After the Centralia sale, Avista acquired 32 MW of gas-fired peaking capacity and 287 MW of intermediate load gas-fired capacity. In addition to gas, Avista contracted for 35 MW of wind capacity from Stateline and added 35.5 MW of new capacity through upgrades to its hydro fleet. Avista will gain control of the output for the 270 MW Lancaster Generating Facility (Rathdrum GS) on January 1, 2010. Avista also expects to upgrade its Nine Mile Falls and Noxon Rapids hydro facilities over the next five years.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 165 of 729

Figure 8.1: Resource Acquisition History



Resource Selection Process

Avista uses several decision support systems to develop its resource strategy. The PRS is based on results from the PRiSM model. The model's objective function is to meet resource deficits while accounting for overall cost, risk and other constraints. This method replaces the traditional hand-picked portfolio comparison approach. The AURORAxmp model, discussed in the Market Analysis chapter, calculates the operating margin (value) of Avista's existing resource portfolio and each resource option in each of the 250 potential future outcomes. Then the PRiSM model uses these values combined with capital and fixed operating costs to select the best resource mix to meet capacity, energy, RPS and other requirements.

PRiSM

Avista staff developed the PRiSM model in 2002 to help select the PRS. The PRiSM model uses a linear programming routine to support complex decision making with single or multiple objectives. Linear programs provide optimal values for variables using given system constraints.

Overview of the PRiSM Model

PRiSM has six basic inputs:

1. Load deficits (energy and capacity);
2. RPS standards;
3. Avista's existing portfolio's costs (load and resources) and operating margins (resources);
4. Fixed operating costs, return on capital, interest and taxes for each resource option;
5. Generation levels for existing resources and new resource options; and
6. Carbon emission levels for existing resources and new resource options.

PRiSM uses these inputs to develop an optimal resource mix over time at varying levels of cost and consummate risk level. It weights the first 10 years more heavily than the outer years to recognize the importance of near-term decisions on today's utility interests (i.e., customers and shareholders). A simplified view of the linear programming objective function formula is provided below.

PRiSM Objective Function

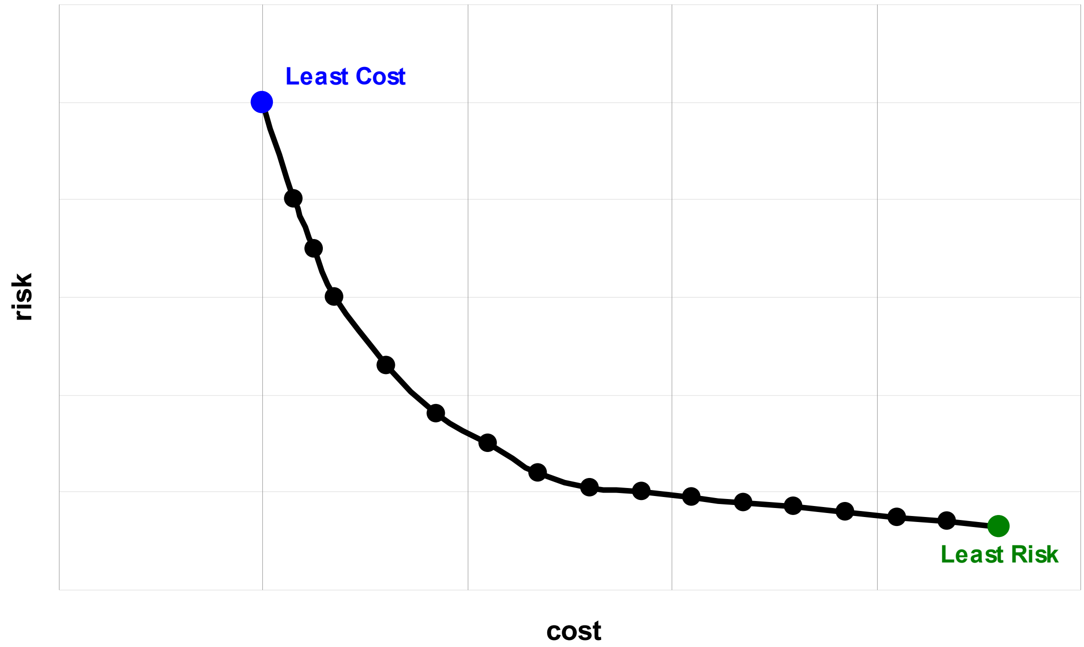
Minimize: $(X_1 * NPV_{2010\text{-}2019}) + (X_2 * NPV_{2010\text{-}2029}) + (X_3 * NPV_{2010\text{-}2059})$

Where: X_1 = Weight of net costs over the first 10 years;
X_2 = Weight of net costs over 20 years of the plan;
X_3 = Weight of net costs over the next 50 years; and
NPV is the net present value of total cost (existing resource marginal costs, all future resource fixed and variable costs, and all future conservation costs and the net short-term market sales/purchases).

Subject to: Capacity needs;
Energy needs;
Washington RPS;
Resource limitations;
Resource availability; and
Risk tolerance

The hypothetical resource set is used to develop an Efficient Frontier. The 2009 IRP Efficient Frontier captures the optimal resource selection, given constraints at each level of cost and risk. Figure 8.2 illustrates the Efficient Frontier. The optimal point on the curve depends on the level of risk Avista and its customers can accept. As discussed in the 2007 IRP, utility-scale resource options are limited because of environmental legislation. Two portfolio planning assumptions from the 2007 IRP are not continued for this plan: RPS requirements can no longer be met entirely with utility purchases of renewable energy certificates (RECs), and long-term fixed-price natural gas is not available to the portfolio. The loss of these options further limits resource choices compared with the 2007 IRP. Avista does not expect it will be able to acquire sufficient RECs at a reasonable price to meet the RPS, and REC purchases expose the Company to potential volatility that asset ownership would not. For resource planning purposes, REC purchases are an option, but not in excess of 45,000 per year. Work since the 2007 IRP have found that long-term fixed-price natural gas contracts consume inordinate amounts of Company capital.

Figure 8.2: Efficient Frontier Curve



Constraints

As discussed earlier in this chapter, constraints are necessary to solve for the optimal resource strategy. Some constraints are physical and others are societal. The major resource constraints are: capacity and energy needs, and Washington's RPS and emissions performance standard (SB 6001).

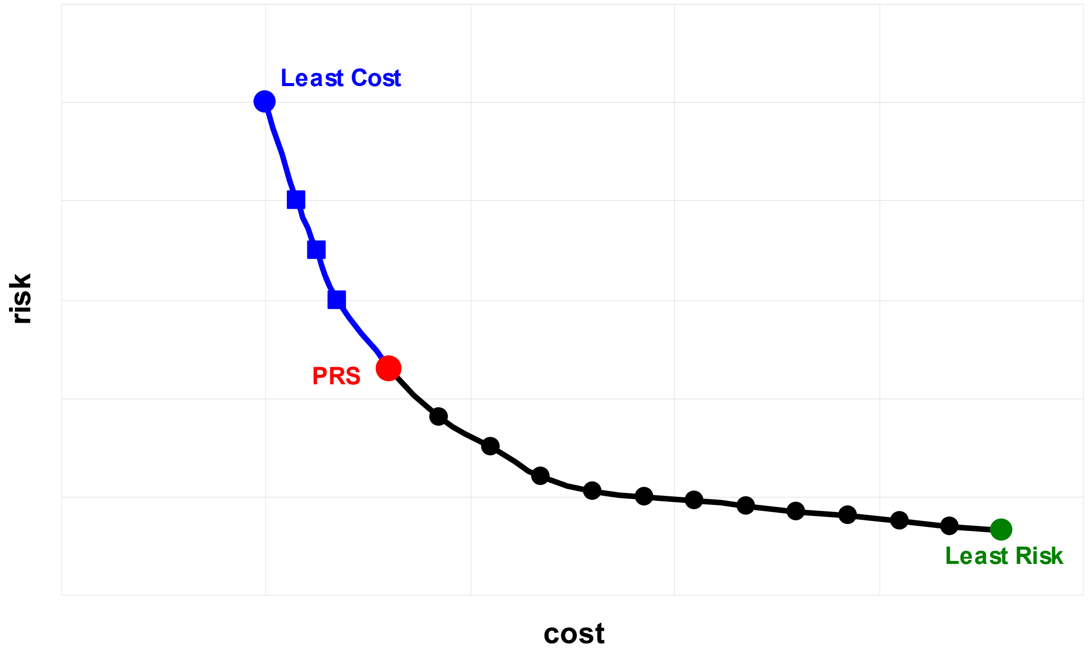
The PRiSM model is limited by resource type and size. It can select from combined- and simple-cycle natural gas-fired combustion turbines, wind and small hydro upgrades. Sequestered coal plants are available beginning in 2023. A new enhancement to PRiSM for the 2009 IRP cycle ensures it selects resources in minimum block sizes rather than mathematically optimal increments. This change better reflects how Avista actually acquires resources. It also emulates how the Company manages lumpy resource additions and that resource positions are not perfectly balanced with load each year. PRiSM is allowed to model Avista's portfolio to be as much as 50 MW short or 200 MW long in any given planning year.

Washington's RPS fundamentally changed how Avista plans to meet future loads. Historically an Efficient Frontier was created with the least-cost strategy on one end and the least-risk strategy on the other. Next, management decided where they wanted to be on the continuums, based on risk appetite. Recent least-cost strategies typically

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 168 of 729

consisted of gas-fired resources. Portfolios with less risk replaced some of the gas-fired resources with wind, other renewables and coal. Past IRPs identified strategies that included these risk-reduction resources. For illustration, these strategies are represented on the Efficient Frontier as a red dot in Figure 8.3. Washington laws requiring the acquisition of renewable generation, or RECs, and the near-ban on new coal-fired facilities, removes the lowest-cost portion of the efficient frontier, illustrated in blue in Figure 8.3. The added constraints greatly reduce the Company's ability to reduce future costs. The 2009 IRP is therefore based on the least-cost strategy that still complies with state laws, rather than a portfolio selected on a full vetting of cost and risk.

Figure 8.3: Efficient Frontier in a Constrained Environment



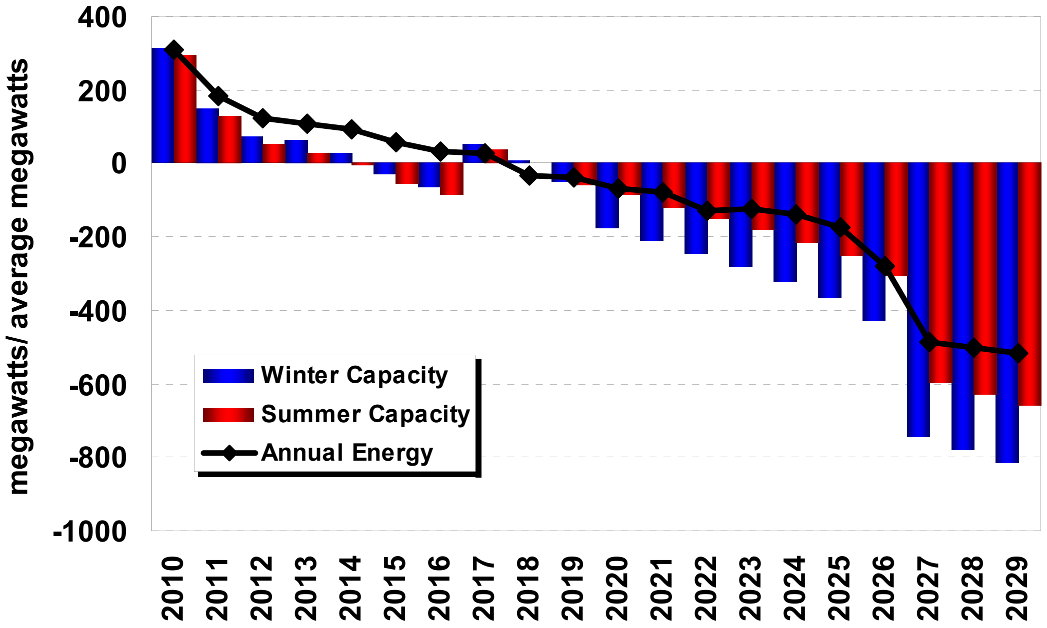
Resource Shortages

Avista has adequate resources to meet annual physical energy and capacity needs until 2015. See Figure 8.4. The graphic accounts for energy efficiency and conservation program impacts on the portfolio. Absent these efficiency gains, our position would be deficit sooner. The first capacity deficit is short-lived because a 150 MW exchange contract ends in 2016. Avista plans to address the 2015-2016 capacity deficit with market purchases as 2015 approaches.

The Company's resource portfolio has 226 MW of natural gas-fired peaking plants available to serve winter loads. For long-term planning these resources are assumed to generate energy at their full capabilities. Operationally, the resources often will be displaced with less expensive purchases from the wholesale marketplace. On an annual average basis our loads and resources fall out of balance in 2018 for energy; the first quarterly energy deficit is in the fourth quarter of 2014.

PRiSM selects new resources to fill capacity and energy deficits, although the model might over- or under-build for economic reasons. Because of its greater capacity need, and the fact that wind acquisitions do not provide capacity commensurate with their energy production, Avista will retain large energy surpluses.

Figure 8.4: Physical Resource Positions



Planning Criteria

Avista uses several risk mitigation methods to manage energy and capacity positions. For capacity, peak load is reflected at the higher of the median coldest or hottest daily temperature on record in the Spokane area. Resources are netted against peak load at their expected capacities at the time of system peak; long-term contracts are also netted in the calculation. A 15 percent planning margin is added to load to represent extreme weather and resource forced outages. The NPCC suggests Northwest planning margin levels of 25 percent for winter and 17 percent for summer. Avista staff has evaluated several methods to determine whether it has adequate reserves, including a sustained peak analysis and loss of load probability calculations. Its evaluations indicated that a 15 percent planning margin is adequate for planning purposes.

Avista uses a similar method for energy planning. Load levels use historic temperatures and include an adjustment for extreme weather, set at a 90 percent confidence level (single-tail). Thermal resources include forced outage rates and planning maintenance downtimes. The largest adjustment is to hydro energy, where water levels are set on a monthly basis to a level exceeded in nine out of 10 years.

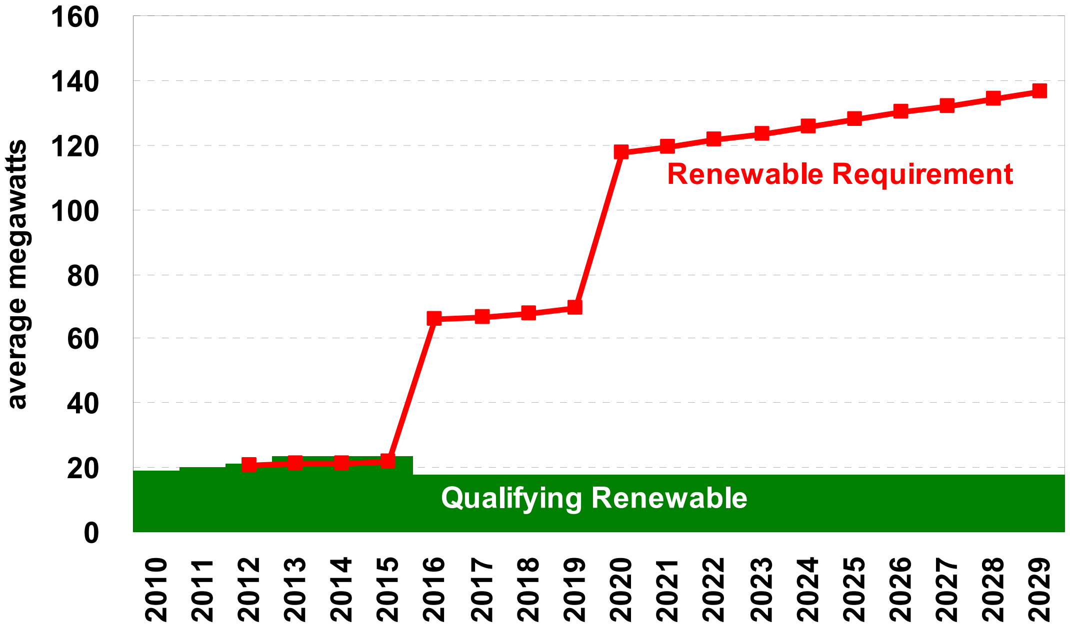
Renewable Portfolio Standards (I-937)

Washington voters approved Initiative 937, the Energy Independence Act, in the November 2006 general election. The initiative requires utilities with over 25,000 customers to meet three percent of load from qualified renewables by 2012, nine percent by 2016 and 15 percent by 2020. The initiative also requires utilities to acquire all cost effective conservation and energy efficiency measures.

Avista projects it will meet or exceed its renewable requirements between 2012 and 2015 through hydro upgrades and a REC purchase made in 2009, as shown in green in Figure 8.5. Avista has the ability to bank RECs acquired from the Stateline Wind contract in 2011 for 2012, but these RECs are sold to customers as part of the Buck-a-Block program. As part of the REC analysis, Avista included a 10 percent margin so Avista is not forced to make REC purchases in a strained market when hydroelectric generation or load varies from its expectation and the Company would potentially be required to pay a penalty.

The Company will need its next block of qualifying resources prior to 2016 and another block will be required prior to 2020. Assuming Avista meets RPS requirements with wind, as illustrated later in this section, it will require 150 MW of nameplate capacity by 2016 and a similar amount by 2020. After 2020, Avista will continue to acquire renewable resources to meet load growth as specified in I-937.

Figure 8.5: REC Requirement vs. Qualifying RECs for Washington State RPS



Preferred Resource Strategy

The 2009 PRS consists of hydro upgrades, wind, conservation, distribution efficiency programs and natural gas-combined cycle gas turbines. The first generation resource acquisition is 150 MW of wind by the end of 2012 to take advantage of federal tax incentives. Based on expected capital cost growth rates and the likelihood of the tax credits not being extended beyond 2012, Avista will develop wind projects prior to its 2016 need.

Avista will begin rebuilding distribution feeders over the next five years. The PRS includes five MW of capacity savings and 2.7 aMW of energy savings. More discussion on this topic is included in the distribution upgrades section of the Transmission and Distribution chapter.

Avista has committed to upgrades at its Noxon Rapids and Nine Mile Falls projects. The PRS identified additional cost-effective upgrade opportunities at Little Falls and Upper Falls. These upgrades provide 5 MW of capacity and 2 aMW of energy qualifying for the Washington RPS.

The PRiSM model selected its first large capacity addition in 2019, a 250 MW combined cycle combustion turbine. Another 150 MW of wind capacity is also needed by the end of 2019 for the 15 percent RPS goal, followed by a 50 MW wind resource in 2022 to meet additional RPS obligations created by load growth. In 2024 and 2027, another 250 MW natural gas combined-cycle plant is needed to meet a capacity deficit created by the expiration of the Lancaster tolling agreement. Table 8.1 presents PRS resources.

Table 8.1: 2009 Preferred Resource Strategy

Resource	By the End of Year	Nameplate (MW)	Energy (aMW)
NW Wind	2012	150.0	48.0
Distribution Efficiencies	2010-2015	5.0	2.7
Little Falls Unit Upgrades	2013-2016	3.0	0.9
NW Wind	2019	150.0	50.0
CCCT	2019	250.0	225.0
Upper Falls	2020	2.0	1.0
NW Wind	2022	50.0	17.0
CCCT	2024	250.0	225.0
CCCT	2027	250.0	225.0
Conservation	All Years	339.0	226.0
Total		**1,449.0**	**1,020.6**

The 2007 PRS is shown in Table 8.2 for comparison. The major difference between the 2009 and 2007 IRPs is the absence of non-wind renewables and an earlier acquisition of wind resources in the 2009 plan. The 2014 share of a CCCT plant was removed, due to a lower load forecast and the decision to fill a temporary capacity shortfall with market purchases. The 2009 plan includes 750 MW of natural gas and 350 MW of wind. The 2007 plan included 677 MW of natural gas-fired generation and 300 MW of wind.

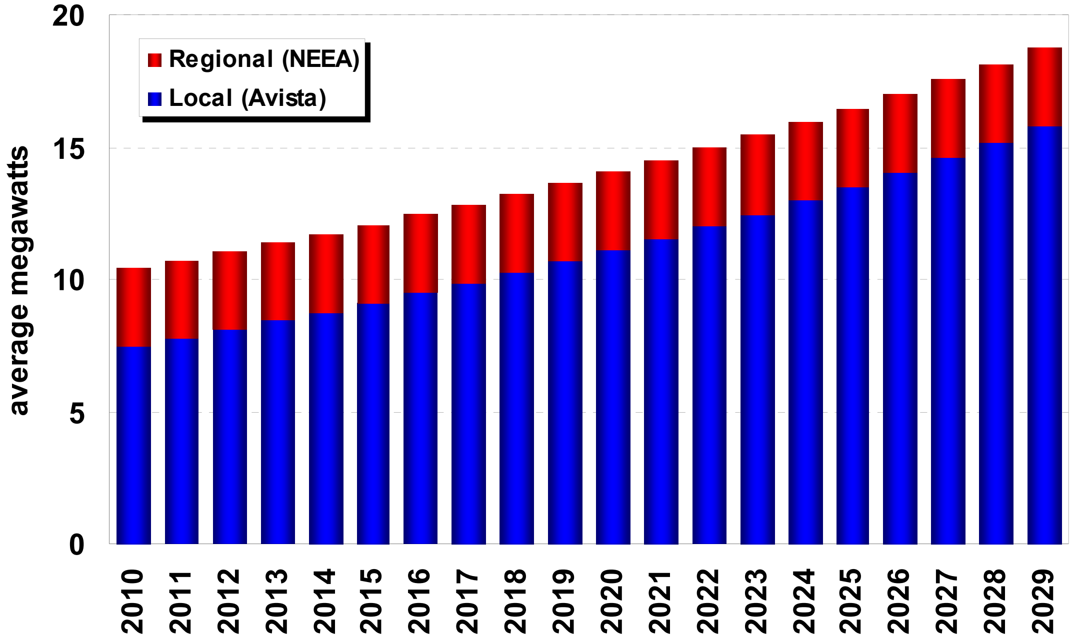
Table 8.2: 2007 Preferred Resource Strategy

Resource	By the End of Year	Nameplate (MW)	Energy (aMW)
Non-Wind Renewable	2011	20.0	18.0
Non-Wind Renewable	2012	10.0	9.0
NW Wind	2013	100.0	33.0
Non-Wind Renewable	2013	5.0	4.5
Share of CCCT	2014	75.0	67.5
NW Wind	2015	100.0	33.0
NW Wind	2016	100.0	33.0
Non-Wind Renewable	2019	10.0	9.0
Non-Wind Renewable	2020	10.0	9.0
Non-Wind Renewable	2021	5.0	4.5
Share of CCCT[1]	2019	297.0	267.3
Share of CCCT	2027	305.0	274.5
Conservation	All Years	331.5	221.0
Total		**1,368.5**	**983.3**

Energy Efficiency and Conservation

Energy efficiency is an integral part of the PRS analytical process. Energy efficiency is also a critical part of the Washington RPS, where utilities are required to obtain all cost effective conservation. Avista uses internal analysis to develop its avoided energy costs and compares these figures against an acquirable supply curve of conservation. The 20-year forecast of acquired energy efficiency is shown in Figure 8.6. Avista will acquire 102 aMW of energy efficiency over the next 10 years and 226 aMW over 20 years. These acquisitions will also reduce the system peak. Efficiency gains are expected to shave 153 MW from the 2020 peak, and 339 MW from the 2029 peak.

Figure 8.6: Energy Efficiency Annual Expected Acquisition



Reardan

Avista purchased the development rights for the Reardan wind site from Energy Northwest in 2008. The site is fully permitted for development and has several years of meteorological data. Reardan is an attractive wind site for Avista because of its close proximately to Spokane—the site is 23 miles west of downtown Spokane. The site is expected to deliver a 28 to 32 percent capacity factor depending on the final project configuration. This wind site is competitive to higher capacity factor sites since the project does not require any third-party transmission and its proximity to Avista. The site has the potential to supply 50 to 100 MW of wind generation.

Additional Northwest Wind

Avista anticipates issuing an all-renewables request for proposals (RFP) in 2009. The RFP will be for wind projects and other renewable generating facilities with expected generation up to 50 aMW. If Reardan is found to be cost-effective relative to the RFP, the total amount of generation acquired from the competitive bidding process will be reduced.

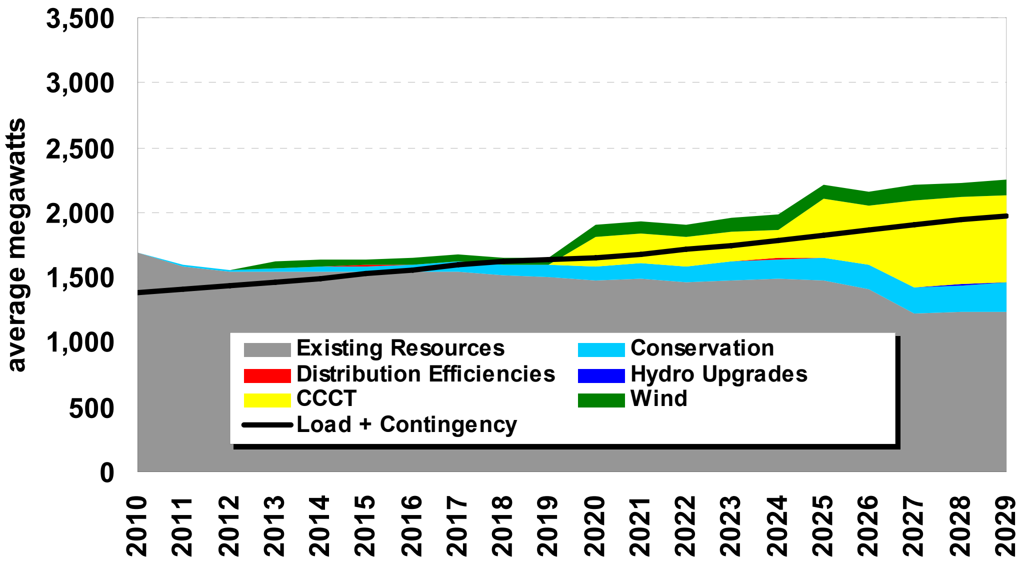
Hydro Upgrades

This IRP has analyzed the potential for upgrades on Avista's hydro system. Small upgrades are included in the PRS analysis, while larger projects are considered as scenarios since they will require further engineering work to determine the ultimate cost of each project. The PRS analysis found four hydro upgrades should be pursued. Little Falls Units 1, 2 and 4 require generator rewinds and generator shaft replacements. Two of the units will also require new runners. The upgrades will provide 1.0 MW of additional capacity and 0.32 aMW of energy for each unit. The Upper Falls upgrade will include a generator rewind and runner replacement. The upgrade will add 2.0 MW of capacity and 1.0 aMW of energy. These hydro upgrades add system capacity and provide qualified renewable energy.

Loads and Resource Balances

The load forecasts shown in the following charts decrement conservation from the load forecast by assumed conservation levels identified in the 2007 IRP to show conservation as a resource. Peak load forecasts are reduced by 1.5 times the average conservation acquisition level. The energy load and resource balance (L&R) forecast (Figure 8.7) reaches its first deficit in 2016 absent conservation; conservation efforts delay the deficit two years, until 2018. The PRS additions remove all negative positions from the L&R position. The CCCT resource included in January 2020 could be brought online as early as 2015 without any significant impact on the PRS where loads differ from the present forecast or other factors make the resource attractive prior to that year (see the end of this chapter for detailed L&R tables).

Figure 8.7: Annual Average Load and Resource Balance



The first winter peak deficit without conservation occurs in 2014 and the deficit is delayed to 2015 with conservation (see Figure 8.8). The resource portfolio shows deficits for 2015 and 2016, but returns to a surplus position in 2017 with the expiration of a 150 MW capacity exchange contract. Avista intends to meet this short-term deficiency with market purchases rather than acquiring a resource prior to a sustained long-term need. However, if the Company determines that it cannot depend on the market during this time period, a capacity resource could be added without a significant impact on the long-term portfolio cost. PRiSM added the first CCCT resource in 2020, leaving a small short position in 2019 that would be filled with market purchases.

The summer peak L&R is similar to the winter peak L&R. While peak loads are lower in summer than winter, hydro and thermal generation capacity is also lower during the summer. As shown in Figure 8.9, summer resource deficits occur in 2013 without conservation and in 2014 with conservation measures. The Company plans to fill the short-term deficit position between 2014 and 2016 with market purchases.

Figure 8.8: Winter Peak Load and Resource Balance

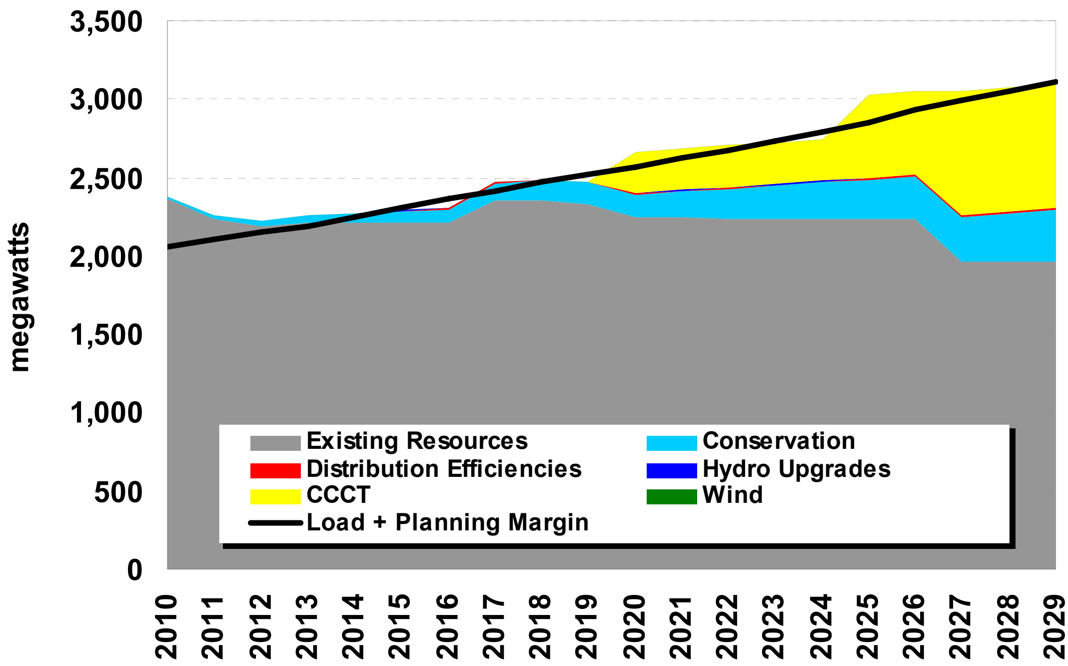
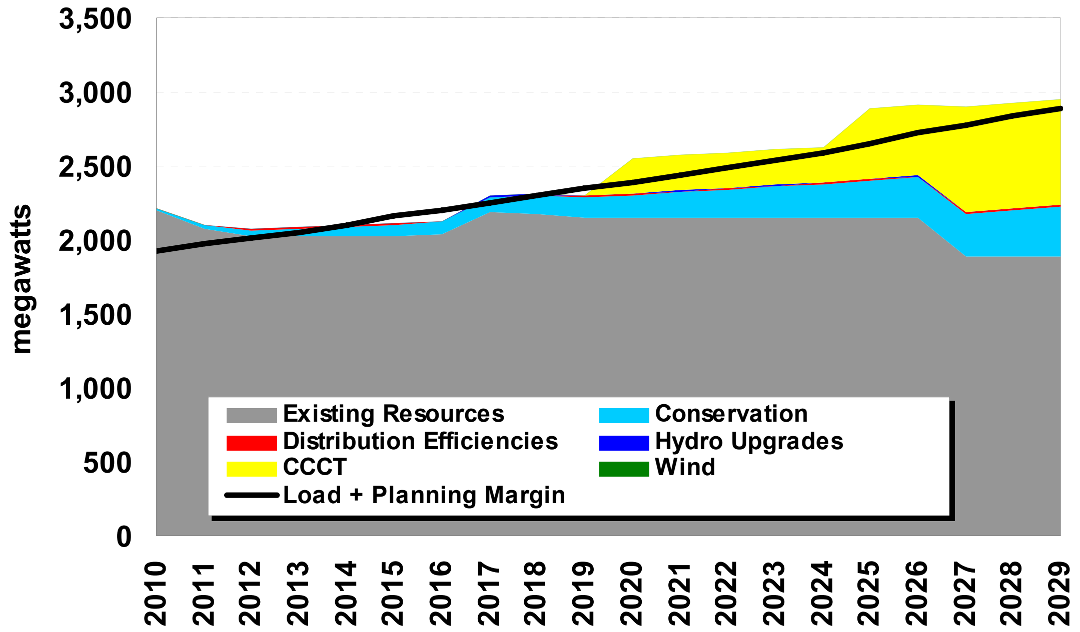


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 176 of 729

Figure 8.9: Summer Peak Load and Resource Balance

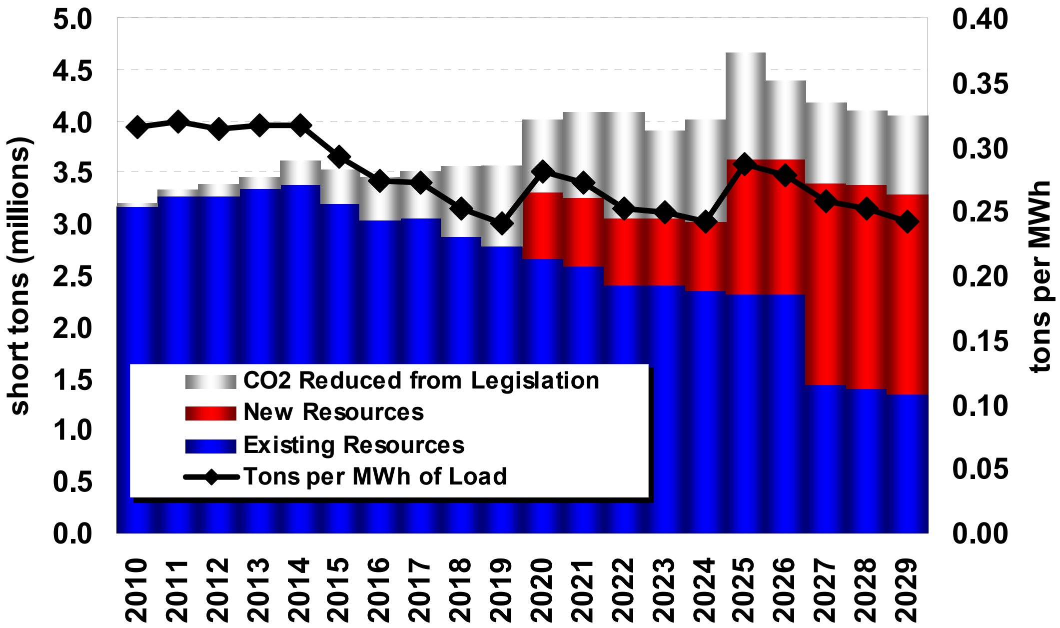


Greenhouse Gas Emissions

The Market Analysis chapter discusses how greenhouse gas emissions in the Western Interconnect will decrease. Avista's greenhouse gas emissions might not fall due to the cap and trade market. The projected cap and trade market interaction will first impact less efficient carbon emitting facilities before affecting the emissions from more efficient facilities. This will affect existing coal resources with high fuel and incremental operation costs as they will be replaced with new or underutilized natural gas-fired resources located closer to west coast load centers. Figure 8.10 shows Avista's expected PRS greenhouse gas emissions. Emissions will be near 2010 levels on an annual basis, but not lower than 2010 levels by the end of 2029. Emissions from current resource portfolio will be reduced as Colstrip's output decreases and natural gas facilities increase generation. The addition of new gas facilities necessary to meet growing loads will ultimately contribute to the Company's emission totals. Emissions by 2029 would be 23 percent higher where no carbon legislation is implemented. Avista's carbon intensity is projected to fall from 0.32 short tons per MWh to 0.24 short tons per MWh by 2029.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 177 of 729

Figure 8.10: Avista Owned and Controlled Resource's Greenhouse Gas Emissions



Efficient Frontier Analysis

The backbone of the PRS is the Efficient Frontier analysis. This analysis illustrates the relative performance of potential portfolios to each other on a cost and risk basis. The curve created in the analysis represents the least-cost strategy at each level of risk. The PRS analyses examined the following portfolios, as detailed here and in Figure 8.11:

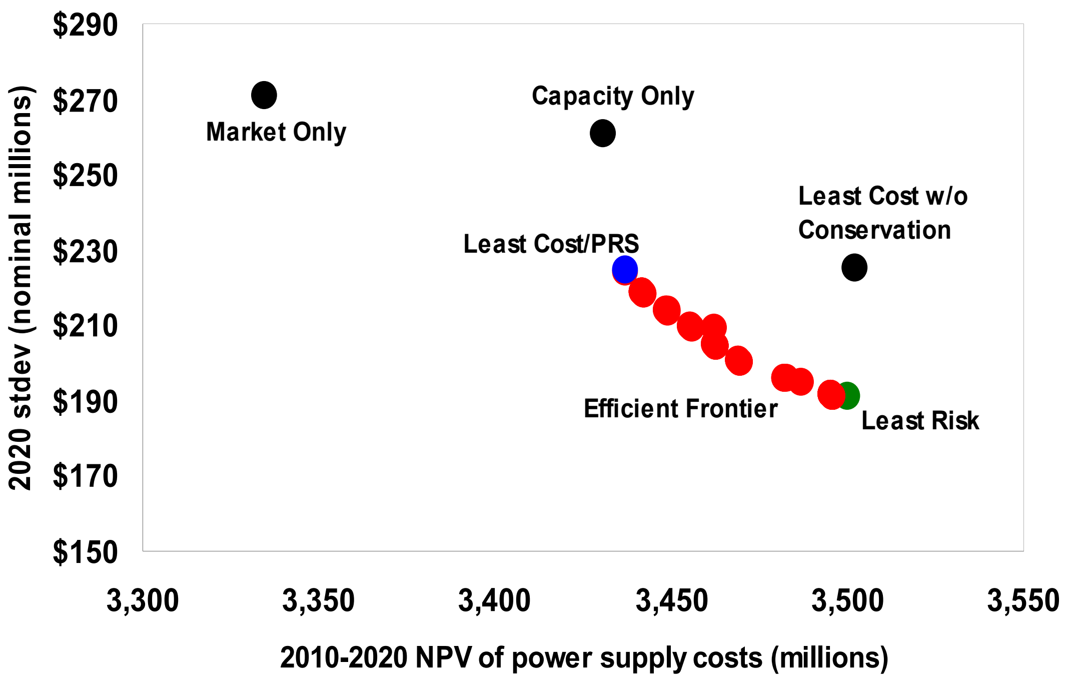
- **Market Only**: No conservation measures, deficits are met with spot market purchases, and capacity and RPS constraints are not met with new resources.
- **Capacity Only**: No conservation measures or resources are added to meet capacity needs and RPS requirements are ignored.
- **Least Cost without Conservation**: Least cost strategy (excluding conservation measures) meeting capacity and RPS requirements.
- **Least Cost**: Least cost strategy that includes conservation measures meeting all capacity and RPS requirements.
- **Least Risk**: Meets capacity and RPS requirements with the lowest risk.
- **Efficient Frontier:** A set of intermediate portfolios between the least risk and least cost options.

The Market Only strategy is the least cost strategy from a long-term financial perspective, but it has a high risk level. This strategy fails to meet RPS requirements unless REC purchases are made and does not acquire capacity resources for reliability.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 178 of 729

The Capacity Only strategy meets reliability needs with CT plant additions, that are mostly displaced by wholesale market purchases. This strategy does not meet RPS requirements or relieve volatility, except for tail risk. The Least Cost without Conservation strategy reduces risks with wind resource additions and selects CCCT resources rather than CTs; this portfolio meets RPS and capacity requirements.

Figure 8.11: Base Case Efficient Frontier



The cost differentials between each portfolio quantifies the avoided costs of the following items:

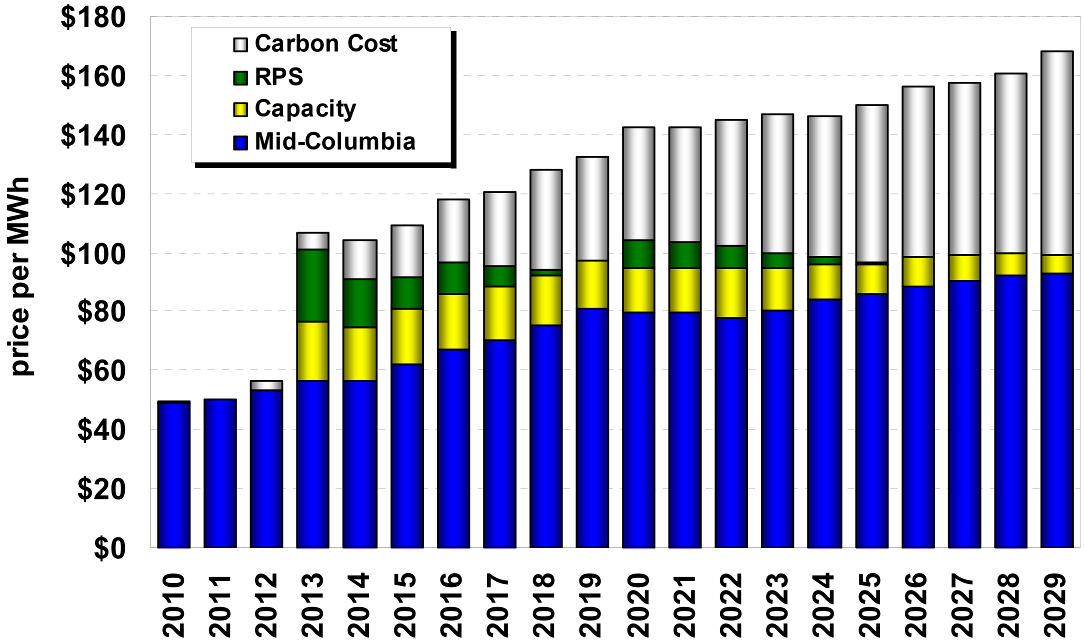
- Market costs: Market Only portfolio.
- Capacity costs: difference between the Market Only and Capacity Only strategies.
- RPS and risk reduction costs: difference between the Capacity Only and Least Cost without Conservation strategies.
- Carbon costs: difference between market prices in the Base Case and the Unconstrained Carbon scenario.

The levelized avoided costs for each item are shown in Table 8.3. The annual avoided conservation costs are shown in Figure 8.12. Avoided costs are determined by resource need and Mid-Columbia market prices. The first adder to Mid-Columbia prices is the carbon adder in 2012, and then capacity and RPS adders are included. The RPS cost-adder disappears in 2019 and 2025, as a result of the selected resources recovering their costs from the market rather than rate payers.

Table 8.3: Levelized Avoided Costs ($/MWh)

	Nominal	2009 Dollars
Mid-Columbia	68.22	54.37
Carbon	25.52	19.83
Capacity	11.66	9.29
Risk	5.76	4.68
Total	**111.15**	**88.18**

Figure 8.12: Avoided Costs for Conservation

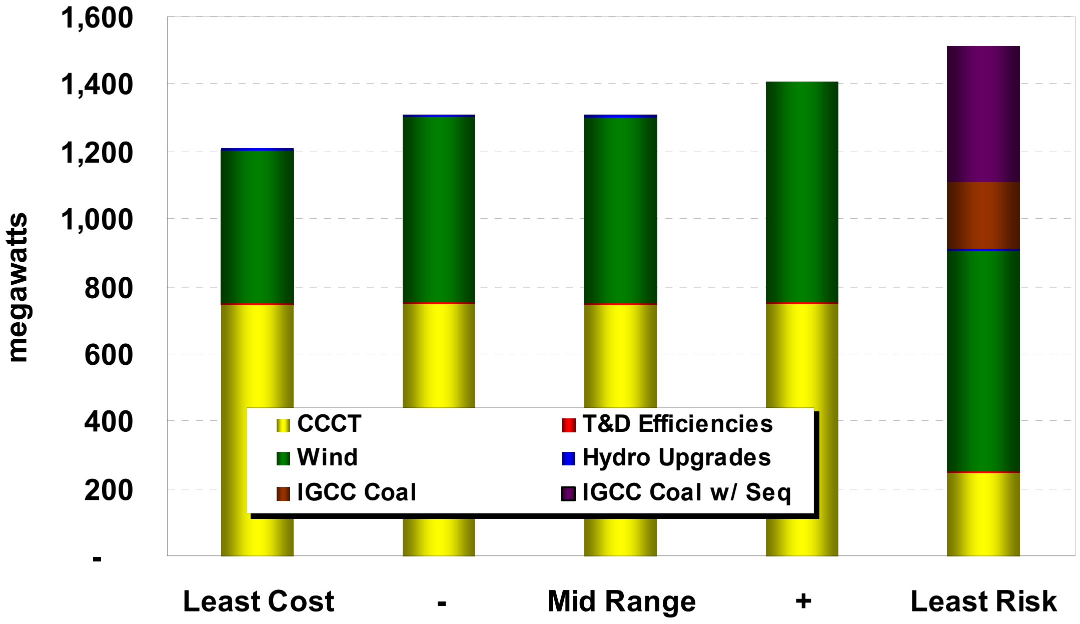


A $111.15 per MWh levelized avoided cost added enough conservation to lower costs by $65 million from the least-cost strategy absent this resource; risk is reduced by 14 percent. The Efficient Frontier portfolios decrease risk but increase costs. These portfolios add wind resources beyond RPS levels and exchange CCCT plants at the end of the study for sequestered coal resources. Avista historically selected resources on the Efficient Frontier, but Washington law requires portfolios to include a certain percentage of qualified renewables, effectively causing utilities to accept less market risk. The least-cost portfolio, with capacity and RPS constraints, was selected over alternative portfolios.

Efficient Frontier Portfolios

The Efficient Frontier analysis creates resource portfolios for given levels of risk and cost. Avista's management selected the least cost portfolio because of the significant risk reductions already present with the inclusion of RPS obligations. Figure 8.13 shows a range of resource portfolios from the Efficient Frontier. Resource portfolios are similar, but differ in the amount and timing of wind acquisitions.

Figure 8.13: Efficient Frontier Portfolios 2029 New Resources



Expected Costs

The stochastic market analysis illustrates a potential range of costs using different market outcomes. The final discussion covers the range of carbon costs that might be added to power supply costs, given carbon legislation's potential impact on the natural gas market, reductions in coal-fired generation dispatch and increases in the dispatch of natural gas-fired resources.

Capital

The PRS first requires capital in 2010 for distribution feeder upgrades, followed by needs for wind development. The capital cash flows in Table 8.4 include AFUDC costs and account for various tax incentives including federal investment tax credits. Costs are shown for years where capital would be placed in rate base, rather than when capital is actually expended. The present value of the $2.2 billion required investment is just over $1 billion. Avista may not have to supply all of the capital that has been identified where it chooses to procure resources through power purchase agreements.

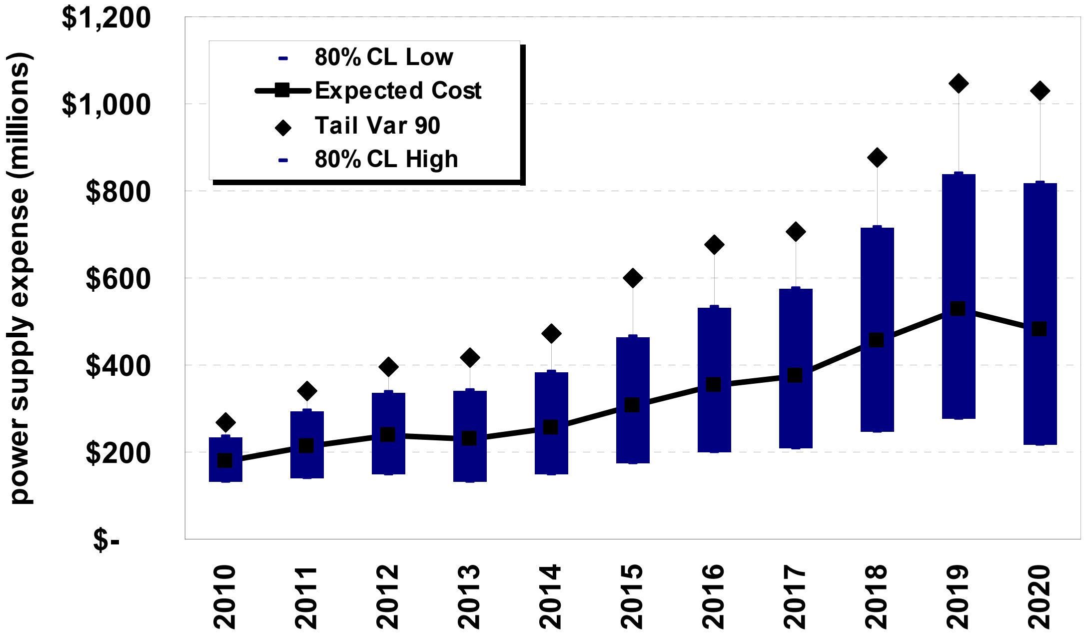
Table 8.4: PRS Rate Base Additions for Capital Expenditures (Millions of Dollars)

Year	Investment	Year	Investment
2010	4.9	2020	942.1
2011	5.0	2021	10.6
2012	5.1	2022	0.0
2013	278.1	2023	163.3
2014	7.7	2024	0.0
2015	2.3	2025	542.0
2016	0.0	2026	0.0
2017	1.7	2027	571.6
2018	0.0	2028	0.0
2019	0.0	2029	0.0
2010-2019 Total	304.8	2020-2029 Totals	2,229.6

Annual Power Supply Expenses and Volatility

The PRS analyses track fuel, variable O&M, emissions and market transaction costs for the existing resource portfolio. These costs are captured for each of the 250 iterations of the Base Case risk analysis. In addition to existing portfolio costs, new resource capital, fuel, O&M, emissions and other costs are tracked to provide a range in potential costs to serve future loads. Figure 8.14 shows expected PRS costs modeled through 2020 as the black line. Costs are expected to be $180 million in 2010. The 80 percent confidence interval, shown in blue, ranges between $130 and $233 million. The black diamonds represent the TailVar 90 risk level, or the top 10 percent of the worst outcomes; this 2010 cost is $270 million, 50 percent higher than the expected value. As natural gas and greenhouse gas prices increase, power supply costs also increase. Price uncertainty increases with time and the confidence interval band expands. The 2020 reduction in variability is created by the addition of wind and CCCT resources to Avista's portfolio.

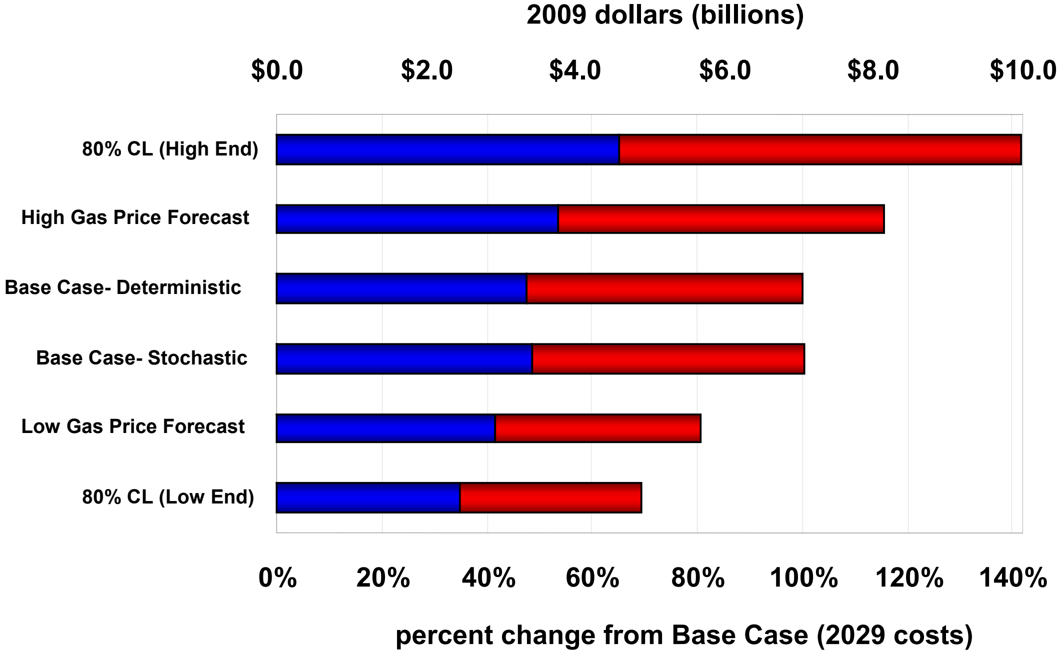
Figure 8.14: Power Supply Expense



Natural Gas Price Risk

The Market Analysis chapter showed the high and low natural gas price forecasts. The 750 MW of PRS gas-fired resources exposes Avista to natural gas price risk. This section uses natural gas price forecast scenarios to calculate the range in expected costs resulting from the PRS. Figure 8.15 shows the total portfolio cost range using different natural gas points in comparison to the deterministic and stochastic Base Cases. The low gas price scenario reduces expected costs 20 percent and the high gas price scenario increases costs 15 percent. Using stochastic model results, rather than deterministic scenarios, illustrates risk exposure to the wholesale market. The 80 percent confidence interval in Figure 8.15 shows variability due to drivers besides natural gas. The range in costs is logarithmic, meaning there is the potential for extremely high costs but that there is not a commensurate cost reduction where gas prices are low. For example, at the 80 percent confidence level, costs range between 30 percent lower and 40 percent higher than the mean values.

Figure 8.15: Power Supply Cost Sensitivities

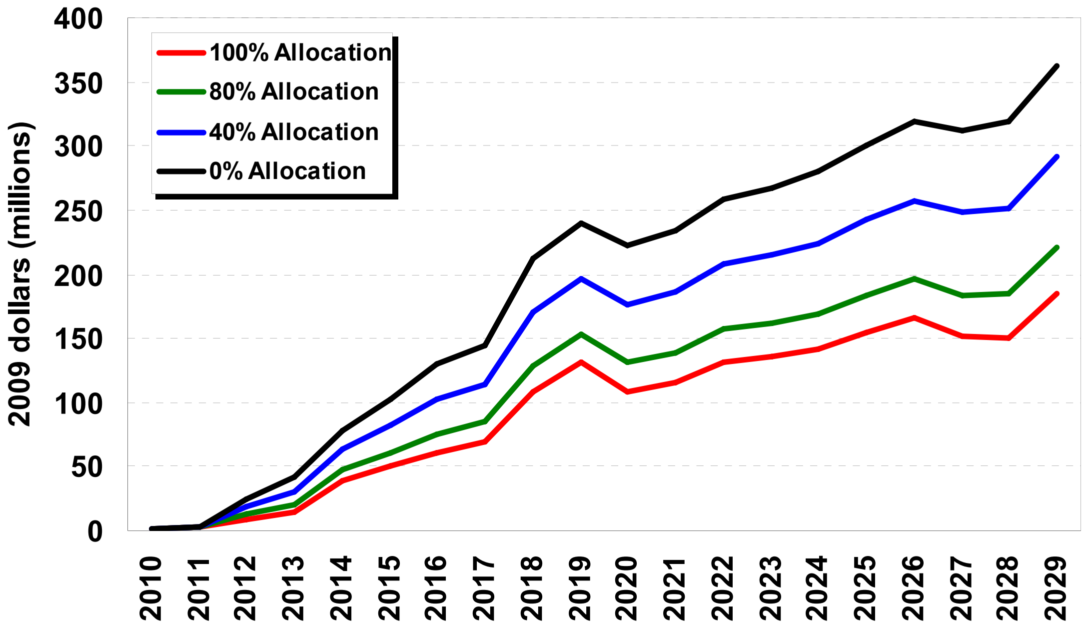


Greenhouse Gas Costs

Avista anticipates federal greenhouse gas laws within the next three years; therefore carbon cost estimates are included in the IRP Base Case. Carbon cost estimates rely on Wood Mackenzie's forecast from the end of 2008. These prices illustrate possible market and opportunity costs of carbon legislation, but ignore the potential for any free carbon allocations. The PRS analysis assumes all carbon credits are auctioned, rather than administratively allocated to utilities. This assumption does not affect the resource strategy because it analyzes the opportunity costs of trading credits for resource decision making. The ultimate number of credits granted versus auctioned to utilities is unknown at this time, and will affect Avista's system costs and rates. The costs shown in Figure 8.16 illustrate the range of potential annual carbon costs associated with future portfolio operations.

Most of the overall carbon costs are a result of decreased Colstrip generation and increased natural gas and electricity market prices. Low cost coal-fired plants are traded for higher-cost natural gas-fired resources. The cost of gas resources is higher than it would be absent carbon legislation because of increased demand for gas-fired resources. These additional costs represent up to 30 percent of total power supply expenses in the Base Case. The costs were calculated by taking the difference in cost between the Base Case against the same resource portfolio in a market without carbon legislation.

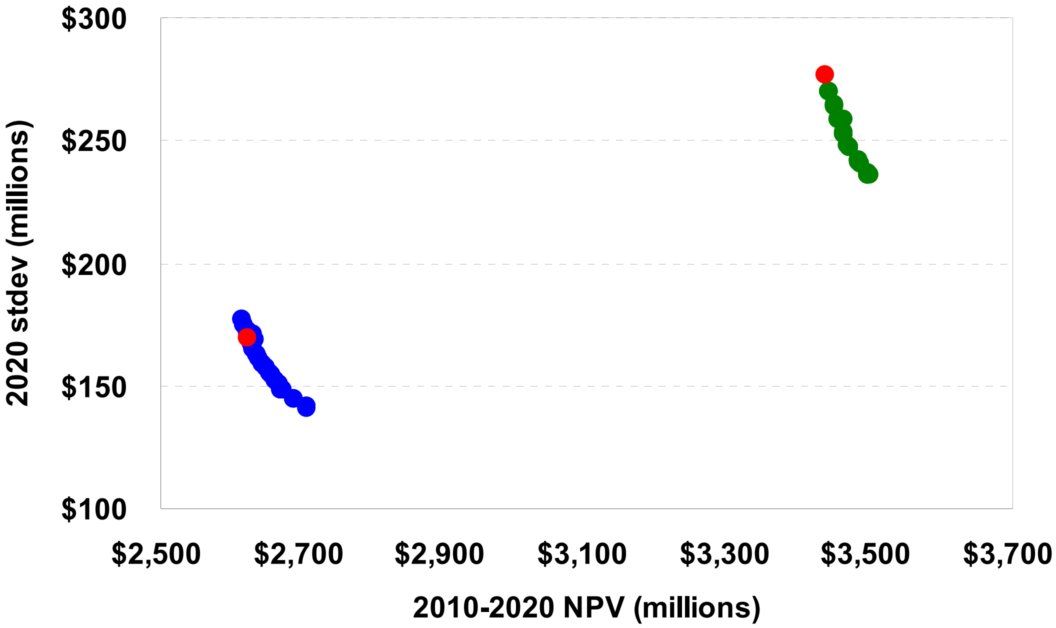
Figure 8.16: Carbon Related Power Supply Expense



Carbon Legislation Impact

The PRS would not differ substantially absent carbon legislation because of Washington's RPS and emissions performance standards on new base load resources. Avista's carbon emissions would be higher, as Colstrip generation would remain at current levels, and the cost and risk to Avista's customers would be lower. This is illustrated by the Efficient Frontier analysis in Figure 8.17. The green curve on the upper right of the chart is the Base Case Efficient Frontier with the red dot representing the PRS. The blue curve in the lower left corner of Figure 8.17 represents the Efficient Frontier without carbon legislation; the curve is less risky and less costly than the Base Case. The red dot on this curve illustrates the non-carbon constrained PRS. A major difference between the resource selections in this scenario is that the least-cost portfolio includes gas-fired peaking plants, rather than combined cycle resources.

Figure 8.17: Efficient Frontier Comparison



The least cost portfolio in this scenario is very similar to the PRS, except 750 MW of combined cycle projects is exchanged for 800 MW of LMS100 simple-cycle generators and one of the Little Falls hydro upgrades is dropped (see Table 8.5). The CCCT is the least cost resource in a carbon constrained world because of its low heat rate and the need for additional base load generation to replace coal. But without carbon constraints, the strategy relies instead on gas peaking plants that ultimately are displaced by market purchases.

The PRS in an unconstrained carbon market would decrease expected costs 24 percent, to $807 million present value, as well as decrease annual power supply cost variation by 30 percent. Table 8.6 summarizes the cost and risk comparison among the PRS and the least cost scenario in an Unconstrained Carbon market. The least cost portfolio in the Unconstrained Carbon scenario decreases cost and increases risk. The strategy has lower carbon emissions from Avista's resources because the strategy uses peaking plants to meet capacity and buys energy from the market, meaning Avista will not directly emit as much greenhouse gas.

Table 8.5: Unconstrained Carbon Scenario- Least Cost Portfolio

Resource	By the End of Year	Nameplate (MW)	Energy (aMW)
NW Wind	2012	100.0	48.0
Distribution Efficiencies	2010-2015	5.0	2.7
Little Falls 4	2016	1.0	0.3
NW Wind	2019	150.0	50.0
SCCT	2019	200.0	180.0
Little Falls 2	2021	1.0	0.3
Little Falls 1	2022	1.0	0.3
NW Wind	2022	50.0	17.0
SCCT	2022	100.0	90.0
SCCT	2025	100.0	90.0
SCCT	2026	300.0	270.0
SCCT	2028	100.0	90.0
Total		**1,159.0**	**838.6**

Table 8.6: Portfolio Cost and Risk Comparison

	Base Case PRS	UC PRS	UC Least Cost Strategy
2010-2020 Cost NPV	$3,430	$2,623	$2,610
2020 Expected Cost	$909	$634	$609
2020 Stdev	$277	$169	$179
2020 Stdev/Cost	30.5%	26.7%	29.4%
2010-2020 Capital	$1,247	$1,247	$1,101
2020 CO_2 Emissions (000's)	3,311	4,016	3,575
2029 CO_2 Emissions (000's)	3,286	4,041	2,928

Portfolio Scenarios

In many resource plans, a PRS is presented with a comparison to other portfolios to illustrate cost and risk trade-offs. Avista wants to extend the portfolio analysis beyond simple portfolio comparisons for this IRP by focusing on how the portfolio would change if assumptions changed. This provides an array of strategies for fundamentally different futures instead of a single strategy. This section identifies assumptions that could alter the PRS, such as changes to load growth, capital costs, hydro upgrades, the emergence of other small renewable projects and a nuclear revival.

The 2007 IRP pushed wind resources out to 2013 due to the federal production tax credit and other renewable resource expectations. Due to the lack of sizeable non-wind renewables and extension of federal tax credits the 2009 IRP suggests that these resources be developed sooner to take advantage of tax savings. Exact online dates will depend on results from a competitive bidding process for wind and other renewables, expected to be released in 2009. The timing of these resources could change depending on capital costs determined in the RFP.

Wind Capital Costs Sensitivity
Avista owns the rights and permits to build the Reardan wind project, but has not secured turbines or completed engineering for the site. Most wind projects in this position today could be completed by the end of 2010 or 2011. The PRiSM model selects this resource to be online by the end of 2012 with an estimated cost of $2,183 per kW (2009 dollars with AFUDC). There are certain tax advantages for beginning project development in 2010, such as taking advantage of the investment tax credit. This analysis determines the tipping point where lower capital costs would allow earlier wind development. The PRiSM model was re-run while lowering the capital cost of wind projects until the model changed resource timing. The Reardan project was selected to be online by the end of 2010 with an all-in capital cost as high as $1,832 per kW (2009 dollars).

CCCT Capital Cost Sensitivity
The Unconstrained Carbon Market future would lead Avista to consider adding simple cycle CTs to the PRS mix to lower costs, but in the carbon constrained world, CCCT resources have lower net costs. Since CCCT acquisition in the PRS does not occur until the end of the next decade, the cost of this resource may change and the cost relationship to a simple cycle CT might also change. This sensitivity analysis determines the maximum CCCT cost that would allow the least cost strategy to select a SCCT over a CCCT. The Base Case CCCT cost is $1,533 per kW (2009 dollars with AFUDC), but if the cost were to increase five percent to $1,611 per kW (2009 dollars), the least cost strategy would change to a SCCT.

CCCT in 2015
The PRS does not meet temporary resource deficits in 2015 or 2016 and will require market purchases to maintain a 15 percent planning margin. The return of capacity from the expiration of the Portland General Exchange contract corrects this deficit. If Avista acquired a combined cycle resource by 2015, costs to meet the earlier obligations would increase 10-year present value costs by $102 million or 2.3 percent and reduce power supply risk between 2015 and 2019 by 5.7 percent. The decision to acquire this resource earlier will depend on the Company’s expectation that the market has the capacity to meet regional peak load. Other scenarios that could impact this decision are dramatic changes in the load forecast, the availability of a sufficient amount of economically viable renewable resources with on-peak capacity contributions, or attractive pricing on a new CCCT.

Load Forecast Alternatives
Loads will probably differ from the current forecast because of the recession and the greater Spokane area could grow faster with future development activity after the economy recovers. This sensitivity analysis studies the impact to the PRS if loads grow faster or slower than the Base Case estimate. Faster load growth will increase the need for capital and slower load growth will slow the need for increased capital. This analysis focuses on understanding the changes in timing of resource decisions. The Base Case forecast is for a 1.7 percent growth rate. The Low Load scenario cuts the growth rate by one percentage point to 0.7 percent and the High Growth case increases by one

percentage point to 2.7 percent. Table 8.7 shows the resource strategy adjusted for lower growth rates. The lower load growth projection would not change near-term resource acquisitions, but would eliminate the need for some wind and gas-fired resources, as shown in the Modification to Strategy column. Table 8.8 shows the resource strategy with higher growth rates. The amount of near-term wind would increase by 50 MW and additional peaking resources would be acquired by 2011 to compensate for higher growth rates. In later years of the study, additional gas-fired and wind resources would be needed to meet peak load growth and RPS requirements. This analysis indicates that lower load growth would not change near-term resource decisions.

Table 8.7: Low Load Growth Resource Strategy Changes to PRS

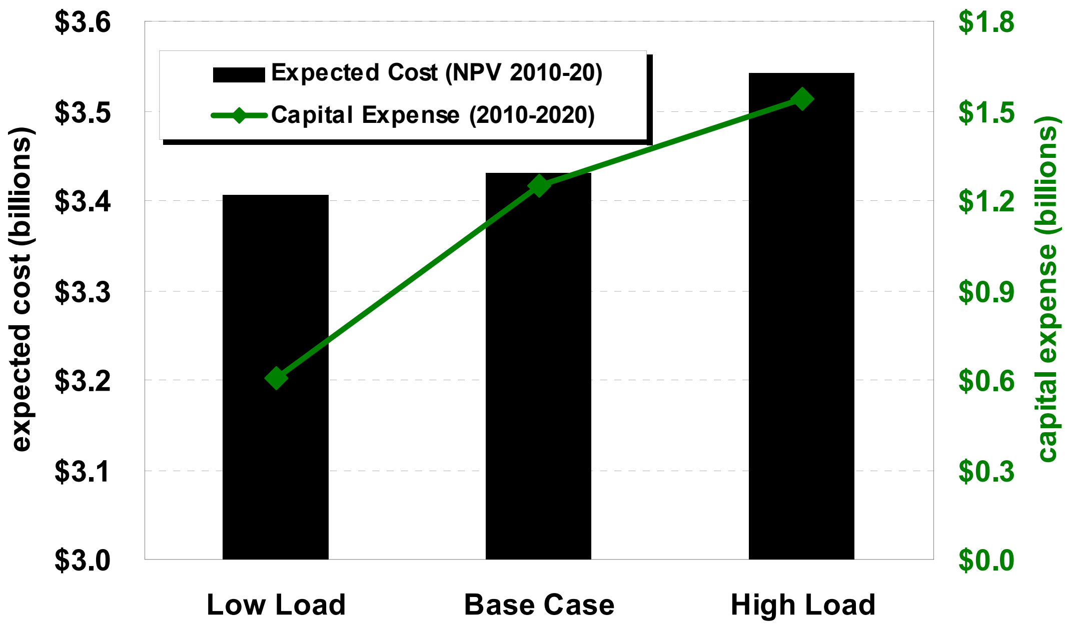
Resource	By the End of Year	Nameplate (MW)	Energy (aMW)	Modification to Strategy
NW Wind	2012	100.0	48.0	No Change
Distribution Efficiencies	2010-2015	5.0	2.7	No Change
Little Falls Unit Upgrades	2013-2016	3.0	0.9	No Change
NW Wind	2019	100.0	33.0	Reduced from 150 MW
CCCT				Removed 250 MW
Upper Falls	2020	2.0	1.0	Delayed to 2028
NW Wind				Removed 50 MW
CCCT	2024	250.0	225.0	Delayed to 2025
CCCT				Removed 250 MW
SCCT	2027	100.0	92.3	Added 100 MW
Total		**560.0**	**402.9**	

Table 8.8: High Load Growth Resource Strategy Changes to PRS

Resource	By the End of Year	Nameplate (MW)	Energy (aMW)	Modification to Strategy
NW Wind	2012	200.0	64.5	Increased from 150 MW
Simple Cycle	2011	60.0	92.3	60 MW Added
Distribution Efficiencies	2010-2015	5.0	2.7	No Change
Little Falls Unit Upgrades	2013-2016	3.0	0.9	No Change
Simple Cycle	2013	100.0	92.3	100 MW Added
Simple Cycle	2017	100.0	92.2	100 MW Added
NW Wind	2019	200.0	66.0	Increased from 150 MW
CCCT	2020	250.0	225.0	Delayed from 2019
Simple Cycle	2019	100.0	92.2	100 MW Added
Upper Falls	2020	2.0	1.0	No Change
NW Wind	2022	50.0	17.0	No Change
CCCT	2024	250.0	225.0	No Change
CCCT	2027	250.0	225.0	No Change
Total		**1,570.0**	**1,196.1**	

The estimated cost for these portfolios is shown in Figure 8.18. The bars show the net present value of costs between 2010 and 2020 (left axis), and the yellow line represents the nominal capital expenditure for these resources (right axis).

Figure 8.18: High & Low Load Growth Cost Comparison



Large Hydro Facility Scenarios

Renewable portfolio standards, capacity needs, and higher electricity market prices are drawing attention to upgrades at Avista's larger hydroelectric developments. Several projects were studied over 20 years ago, but they were not financially feasible at this time. Avista is reevaluating these projects to determine if there are market and environmental benefits making them cost effective today. The large hydro upgrades analyzed for this IRP are Cabinet Gorge Unit 5 (60 MW), Long Lake Unit 5 (24 MW) and Long Lake second power house (60 MW). Other possible hydro upgrades include a new powerhouse at Post Falls and a second powerhouse at Monroe Street. If studies determine these resources are economically viable, then the resource strategy will change because these resources add peak capacity as well as qualified renewable energy. Table 8.9 illustrates potential changes to the PRS under the large hydro upgrade scenario. These upgrades cannot be completed prior to the middle of the next decade, so they will not change near-term resource acquisition plans.

Table 8.9: Large Hydro Upgrade Resource Strategy Modifications

Resource	By the End of Year	Nameplate (MW)	Energy (aMW)	Modification to Strategy
NW Wind	2012	100.0	48.0	No Change
Distribution Efficiencies	2010-2015	5.0	2.7	No Change
Little Falls Unit Upgrades	2013-2016	3.0	0.9	No Change
Cabinet Gorge 5	2014	60.0	10.2	60 MW Added
Long Lake 2 Powerhouse	2019	60.0	18.0	60 MW Added
NW Wind	2019	100.0	33.0	Reduced from 150 MW
CCCT	2019	250.0	225.0	No Change
NW Wind	2022	50.0	17.0	No Change
CCCT	2026	400.0	360.0	Delayed from 2024 and upgraded from 250 MW
CCCT				Removed 250 MW
Upper Falls	2029	2.0	1.0	Delayed from 2020
Totals		**1,030.0**	**715.8**	

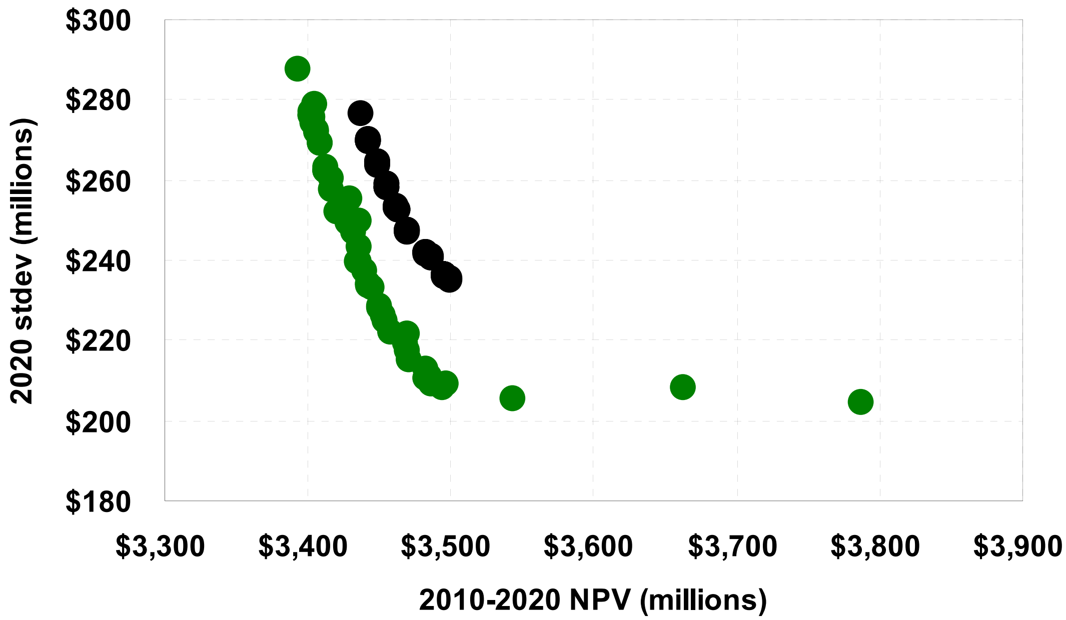
Capital cost sensitivities were performed to determine capital cost limits needed to select large hydro upgrades for the PRS. The analysis found that although higher in cost, a second power house at Long Lake is more favorable than a new Unit 5 at the plant because of the higher capacity value of that option. Both projects could be built at Long Lake to provide system capacity.

An initial review found that costs would need to be under $2,628 per kW, including transmission upgrades and AFUDC, for the Long Lake second powerhouse to be selected in the least cost resource strategy. The Cabinet Gorge Unit 5 upgrade would need to be under $1,289 per kW, including AFUDC. Avista might pursue these upgrades at higher capital cost levels, depending on the value placed on reducing total dissolved gas and reduced market exposure.

Small Renewable Resources Scenario

The PRS in the 2005 and 2007 IRPs included small renewable resources. None were included for the 2009 IRP. Small renewable resources often have unique project characteristics that will affect project costs. This scenario illustrates changes in the PRS if these resources were included in the Efficient Frontier analysis. As Avista solicits 150 MW of wind, it will include requests for other renewable resources in the RFP and give resources with dependable capacity more economic benefit in subsequent bidding analysis. Figure 8.19 presents the Efficient Frontier with the addition of small renewable resources. If non-wind renewables are available to Avista at the prices shown in the resource options chapter, these resources could modestly reduce Avista's costs and risks. Costs are lower because of a reduction in the quantity of resources needed because non-wind renewable resources provide capacity. For example, a 25 MW wind project is not credited with any reliable capacity in this analysis, so it must be backed up with a resource that provides capacity. A 25 MW renewable resource with capacity does not require another resource to provide back-up capacity. But these small renewable resources are not risk free. The owner might cease production at some point in the contract term. Biomass facilities often require an industrial waste product as fuel, so a downturn in the industry reduces fuel availability. Geothermal resources are interesting to Avista because of the potential for low cost and stable base load power, but availability has been questioned recently by the NPCC and only one geothermal resource has been built in the Northwest in recent years.

Figure 8.19: Efficient Frontier Base Case vs. Other Renewables Available



Where Avista is able to acquire non-wind renewables, its resource portfolio strategy will emit fewer greenhouse gases (see Table 8.10). The PRS changes under the small renewable resource scenario are shown in Table 8.11. The strategy reduces wind capacity by 100 MW and trades 100 MW of CCCT for SCCT (the cause for increased risk).

Table 8.10: Portfolio Cost and Risk Comparison

	Base Case PRS	Non-Wind Renewable Least Cost
2010-2020 Cost NPV	$3,430	$3,393
2020 Expected Cost	$909	$875
2020 Standard Deviation	$277	$288
2020 Standard Deviation/Cost	30.5%	30.9%
2010-2020 Capital	$1,247	$840
2020 CO_2 Emissions ('000s)	3,311	2,771
2029 CO_2 Emissions ('000s)	3,286	3,145

Table 8.11: Other Renewables Available- Changes to PRS

Resource	By the End of Year	Nameplate (MW)	Energy (aMW)	Modification to Strategy
Biomass/Geothermal	2011	10.0	9.1	10 MW Added
Reardan Wind	2012	50.0	15.0	No Change
NW Wind	2012	50.0	17.0	Reduced from 100 MW
Biomass/Geothermal	2012	5.0	4.5	5 MW Added
Biomass/Geothermal	2013	5.0	4.5	5 MW Added
Distribution Efficiencies	2010-2015	5.0	2.7	No Change
Little Falls Unit Upgrades	2013-2016	3.0	0.9	No Change
Wood Biomass	2017	5.0	4.5	5 MW Added
KFCT Wood Conversion	2019	7.0	0.0	Capacity/Energy Neutral RECs Added
NW Wind	2019	100.0	33.0	Reduced by 50 MW
Simple Cycle CT	2019	100.0	92.3	100 MW Added
CCCT	2020	250.0	225.0	Delayed from 2019
Upper Falls	2020	2.0	1.0	No Change
NW Wind	2023	50.0	17.0	Delayed from 2022
CCCT	2026	400.0	360.0	Delayed from 2024 and changed to 400 MW
CCCT				250 MW in 2027 Removed
Total		**1,042.0**	**786.5**	

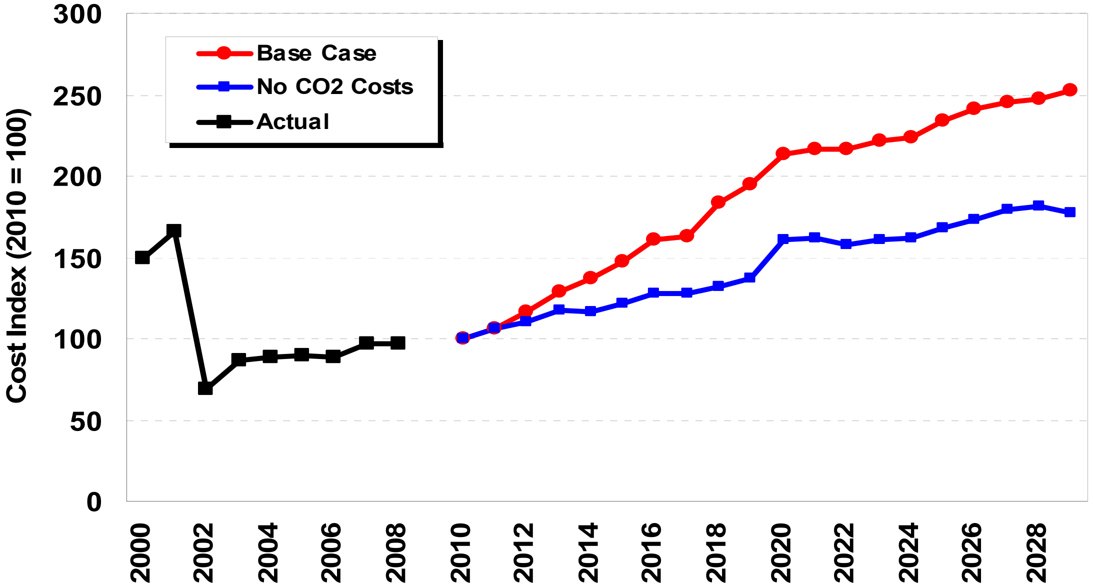
Nuclear

Nuclear resources were not included as a PRS option, but were studied as a resource scenario. This resource intrigues planners because of stable operating costs, base-load capability, and a lack of greenhouse gas emissions. However, nuclear power has high capital costs, and projected capital and operating costs are speculative since no U.S. project has been completed in over 20 years. Long lead times require significant capital to be at risk during construction, forcing higher AFDUC costs. If nuclear was an option in the PRS analysis after 2020 at $5,500 per kW (2009 dollars before AFUDC), the project would not be selected as least cost, but would lower power supply cost variation. At $3,800 per kW, a 250 MW nuclear project would be selected as a least cost resource after 2020. Avista will continue to monitor and investigate nuclear development as projects are announced and developed.

Summary

The IRP is a continual effort to select cost- and risk-minimizing resources that complement existing resources and to help management and policy-makers make informed decisions for ratepayers. The PRS includes a combination of conservation, distribution efficiency, hydro upgrades, wind and combined-cycle combustion turbines. The resource strategy identified in this report will change as new information becomes available, but Avista focuses on near-term acquisitions where changes are less likely. Avista will study large hydro upgrades on the Clark Fork and Spokane rivers to add system capacity and help meet renewable RPS requirements. Figure 8.20 shows power supply costs in 2019 are 38 percent higher in real terms absent carbon legislation, but up to 95 percent higher with carbon legislation. Power supply costs grow 2.9 percent in real terms absent carbon legislation and 4.7 percent with carbon legislation.

Figure 8.20: Real Power Supply Expected Cost Growth Index (2010 = 100)



The black line includes historical plant operations, maintenance, depreciation, return on capital, taxes, fuel costs, and net market purchases and sales. It does not include conservation spending, transmission, distribution, or other A&G costs. The red and blue forecasts include historical costs escalating at the average historical rate and future fuel costs for existing resources and all costs for new resources such as operations and maintenance, taxes, depreciation and return. The lines also include incremental conservation amounts, net market purchases and sales, and carbon costs assuming 100 percent auction.

Table 8.12: Annual Load & Resources (aMW)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Retail Load	1,155	1,186	1,212	1,235	1,265	1,305	1,334	1,364	1,396	1,424	1,454	1,485	1,516	1,547	1,582	1,618	1,669	1,701	1,736	1,769
Existing Resources																				
Hydro	538	520	509	511	511	511	511	511	507	496	496	496	496	496	496	496	496	496	496	496
Net Contracts	464	382	348	356	335	356	346	357	334	336	301	311	289	310	310	299	244	50	50	50
Thermal Resources	528	528	527	526	542	517	526	528	519	520	530	530	519	520	529	531	519	523	529	530
Peaking Resources	153	153	153	144	153	153	153	153	153	153	153	153	153	153	153	153	153	153	153	153
Existing Resources	**1,683**	**1,583**	**1,536**	**1,537**	**1,540**	**1,537**	**1,536**	**1,549**	**1,513**	**1,506**	**1,480**	**1,490**	**1,457**	**1,479**	**1,488**	**1,479**	**1,412**	**1,222**	**1,228**	**1,229**
Contingency	(227)	(228)	(224)	(225)	(226)	(227)	(227)	(228)	(229)	(212)	(195)	(196)	(197)	(198)	(199)	(200)	(201)	(202)	(202)	(203)
Net Position	**301**	**170**	**100**	**76**	**49**	**6**	**(26)**	**(43)**	**(112)**	**(131)**	**(170)**	**(191)**	**(256)**	**(265)**	**(292)**	**(339)**	**(458)**	**(681)**	**(710)**	**(743)**
Conservation	8	16	24	32	41	50	60	70	80	91	102	114	126	139	152	166	180	195	210	226
Net Position w/ Cons.	**309**	**186**	**124**	**108**	**90**	**56**	**34**	**27**	**(32)**	**(40)**	**(68)**	**(77)**	**(130)**	**(126)**	**(140)**	**(173)**	**(278)**	**(486)**	**(500)**	**(517)**
PRS Resources																				
Wind	-	-	-	47	47	47	47	47	47	47	96	96	96	112	112	112	112	112	112	112
CCCT	-	-	-	-	-	-	-	-	-	-	225	225	225	225	225	451	451	676	676	676
Distribution Efficiencies	1	1	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Hydro Upgrades	-	-	-	-	0	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
Total PRS	**1**	**1**	**2**	**50**	**50**	**51**	**51**	**51**	**51**	**51**	**325**	**326**	**326**	**342**	**342**	**567**	**567**	**793**	**793**	**793**
Net Position w/ PRS	**310**	**187**	**125**	**158**	**141**	**107**	**85**	**78**	**19**	**11**	**257**	**249**	**196**	**216**	**202**	**395**	**290**	**307**	**292**	**276**

Table 8.13: Load & Resources at Winter Peak (MW)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Peak Demand	1,789	1,831	1,871	1,906	1,951	2,008	2,052	2,097	2,146	2,189	2,233	2,281	2,327	2,373	2,426	2,481	2,555	2,604	2,656	2,706
Planning Margin	268	275	281	286	293	301	308	315	322	328	335	342	349	356	364	372	383	391	398	406
Total Obligations	**2,057**	**2,106**	**2,152**	**2,192**	**2,244**	**2,309**	**2,360**	**2,412**	**2,468**	**2,517**	**2,568**	**2,623**	**2,676**	**2,729**	**2,790**	**2,853**	**2,938**	**2,995**	**3,054**	**3,112**
Existing Resources																				
Hydro	1,030	1,000	972	997	997	997	997	970	997	971	971	944	971	971	971	944	971	971	971	944
Net Contracts	417	318	300	300	300	301	301	451	451	450	361	361	360	359	359	359	359	78	78	78
Thermal Resources	580	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584
Peaking Resources	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226
Capacity on Maintenance	106	105	105	100	100	100	100	127	100	100	100	127	100	100	100	127	100	100	100	127
Existing Resources	**2,359**	**2,231**	**2,187**	**2,207**	**2,207**	**2,207**	**2,208**	**2,358**	**2,358**	**2,330**	**2,241**	**2,241**	**2,241**	**2,240**	**2,240**	**2,240**	**2,240**	**1,959**	**1,959**	**1,959**
Net Position	**302**	**126**	**35**	**15**	**(36)**	**(102)**	**(152)**	**(54)**	**(110)**	**(187)**	**(327)**	**(382)**	**(435)**	**(489)**	**(550)**	**(613)**	**(698)**	**(1,036)**	**(1,095)**	**(1,153)**
Conservation	12	24	36	48	62	75	90	105	120	137	153	171	189	209	228	249	270	293	315	339
Net Position w/ Cons.	**314**	**150**	**71**	**63**	**25**	**(27)**	**(62)**	**51**	**10**	**(50)**	**(174)**	**(211)**	**(246)**	**(280)**	**(322)**	**(364)**	**(428)**	**(743)**	**(780)**	**(814)**
PRS Resources																				
Wind	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CCCT	-	-	-	-	-	-	-	-	-	-	263	263	263	263	263	525	525	788	788	788
Distribution Efficiencies	1	2	3	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Hydro Upgrades	-	-	-	-	1	2	2	3	3	3	3	5	5	5	5	5	5	5	5	5
Total PRS	**1**	**2**	**3**	**4**	**6**	**7**	**7**	**8**	**8**	**8**	**271**	**273**	**273**	**273**	**273**	**535**	**535**	**798**	**798**	**798**
Net Position w/ PRS	**315**	**152**	**74**	**67**	**31**	**(20)**	**(55)**	**59**	**18**	**(42)**	**97**	**62**	**26**	**(8)**	**(49)**	**171**	**107**	**54**	**17**	**(16)**
Planning Margin	33%	24%	19%	19%	17%	15%	13%	19%	17%	14%	21%	19%	18%	16%	14%	24%	21%	19%	18%	16%

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 196 of 729

Table 8.14: Load & Resources at Summer Peak (MW)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Peak Demand	1,669	1,715	1,751	1,783	1,823	1,876	1,915	1,956	2,000	2,040	2,080	2,123	2,165	2,207	2,255	2,304	2,372	2,416	2,463	2,509
Planning Margin	250	257	263	267	273	281	287	293	300	306	312	318	325	331	338	346	356	362	369	376
Total Obligations	**1,919**	**1,972**	**2,014**	**2,050**	**2,096**	**2,157**	**2,202**	**2,249**	**2,300**	**2,346**	**2,392**	**2,441**	**2,490**	**2,538**	**2,593**	**2,650**	**2,728**	**2,778**	**2,832**	**2,885**
Existing Resources																				
Hydro	953	932	1,020	1,028	1,051	1,028	1,049	1,022	1,022	1,021	1,023	996	996	993	1,028	996	996	1,002	1,023	996
Net Contracts	304	204	185	185	185	185	185	335	335	333	333	333	333	332	332	332	332	68	68	68
Thermal Resources	577	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Peaking Resources	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Maintenance at Peak	168	157	46	37	14	38	17	44	44	19	17	44	44	47	11	44	44	38	17	44
Existing Resources	**2,201**	**2,074**	**2,031**	**2,031**	**2,031**	**2,031**	**2,031**	**2,181**	**2,181**	**2,153**	**2,153**	**2,153**	**2,153**	**2,153**	**2,153**	**2,153**	**2,153**	**1,889**	**1,889**	**1,889**
Net Position	**282**	**102**	**17**	**(20)**	**(66)**	**(126)**	**(171)**	**(68)**	**(119)**	**(193)**	**(239)**	**(289)**	**(337)**	**(385)**	**(441)**	**(497)**	**(575)**	**(890)**	**(944)**	**(997)**
Conservation	12	24	36	48	62	75	90	105	120	137	153	171	189	209	228	249	270	293	315	339
Net Position w/ Cons.	**294**	**126**	**53**	**28**	**(4)**	**(51)**	**(81)**	**37**	**1**	**(56)**	**(86)**	**(118)**	**(148)**	**(177)**	**(213)**	**(248)**	**(305)**	**(597)**	**(629)**	**(658)**
PRS Resources																				
Wind	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CCCT	-	-	-	-	-	-	-	-	-	-	238	238	238	238	238	475	475	713	713	713
Distribution Efficiencies	1	2	3	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Hydro Upgrades	-	-	-	-	1	2	2	3	3	3	3	5	5	5	5	5	5	5	5	5
Total PRS	**1**	**2**	**3**	**4**	**6**	**7**	**7**	**8**	**8**	**8**	**245**	**247**	**247**	**247**	**247**	**485**	**485**	**722**	**722**	**722**
Net Position	**295**	**128**	**56**	**32**	**2**	**(45)**	**(74)**	**45**	**9**	**(49)**	**159**	**129**	**99**	**70**	**34**	**236**	**179**	**125**	**93**	**64**
Planning Margin	33%	23%	19%	17%	16%	13%	12%	18%	16%	14%	24%	23%	21%	20%	18%	28%	25%	23%	22%	20%

9. Action Items

The Integrated Resource Plan (IRP) is an ongoing and iterative process balancing regular publication with pursuing the best long-term resource strategy. The biennial publication date provides opportunities for ongoing improvements to modeling and forecasting procedures and tools, as well as additional research into changing market variables and technologies. This section provides an overview of the progress made on the 2007 IRP Action Plan, while the 2009 Action Plan provides details about issues and improvements developed or raised during this planning cycle, but deferred for treatment in the 2011 IRP.

Summary of the 2007 IRP Action Plan

The 2007 IRP Action Items were separated into five categories: renewable energy, demand side management, emissions, modeling and forecasting enhancements, and transmission planning.

Renewable Energy

- Continue studying wind potential in the Company's service territory, possibly including the placement of anemometers at the most promising wind sites.
- Commission a study of Montana wind resources strategically located near existing Company transmission assets
- Learn more about non-wind renewable resources to satisfy renewable portfolio standards and decrease the Company's carbon footprint.

Avista has actively studied wind development since the publication of the 2007 IRP. The Company purchased the rights to develop a large wind project located at Reardan, Washington in May 2008. The site is being developed as described in the PRS chapter. Met towers were placed at several areas in our service territory to measure wind potential. This wind development work is an ongoing project.

Preliminary work concerning a Montana wind study was done. Transmission limitations for power coming west and the potential for such projects to not qualify toward the Washington RPS made continued work on Montana wind projects less attractive than previously thought. Montana wind will be reevaluated as RPS laws change, and as transmission upgrades are made.

Additional studies regarding non-wind renewable energy sources continued throughout this planning cycle. More details about non-wind renewables are included in the Generation Resource Options and Preferred Resource Strategy chapters. Avista's upcoming request for proposals (RFP) for wind and other renewables will provide further details for the availability and cost of non-renewable resources.

Demand Side Management

- Update processes and protocols for integrating energy efficiency programs into the IRP to improve and streamline the process.
- Study and quantify transmission and distribution efficiency concepts.
- Determine potential impacts and costs of load management options reviewed as part of the Heritage Project.
- Develop and quantify the long-term impacts of the newly signed contractual relationship with the Northwest Sustainable Energy for Economic Development organization.

The integration of DSM resources into the IRP is an ongoing process. Progress made on updating the processes and protocols for integrating energy efficiency programs into the IRP process can be found in the Energy Efficiency chapter. Transmission and distribution efficiency improvements have also been studied for this IRP. Details about the results of these studies can be found in the Transmission and Distribution chapter. Five megawatts of distribution feeder peak savings are included in the PRS for the 2009 IRP. Updates on the results of the Heritage Project and the Northwest Sustainable Energy for Economic Development organization are also included in the Energy Efficiency chapter.

Emissions

- Continue to evaluate the implications of new rules and regulations affecting power plant operations, most notably greenhouse gases.
- Continue to evaluate the merits of various carbon quantification methods and emissions markets.

Avista's Climate Change Committee and the Resource Planning team have been actively analyzing state and federal greenhouse gas legislation since the publication of the 2007 IRP. This work will continue until final rules are established for the Washington legislation and federal laws are passed. Then the focus will shift towards mitigating the cost of climate change to minimize the impact on our customers. Carbon quantification has been done based on the World Resources Initiative - World Business Council for Sustainable Development (WRI-WBCSD) greenhouse gas (GHG) inventory protocol as part of the push to get ready for state and federal GHG reporting mandates. These inventories have also been used for Avista's participation in the Chicago Climate Exchange and the Carbon Disclosure Project. Details about the work done since the 2007 IRP may be found in the Environmental Policy chapter.

Modeling and Forecasting Enhancements

- Study the potential for fixing natural gas prices through financial instruments, coal gasification, investments in gas fields or other means.
- Continue studying the efficient frontier modeling approach to identify more and better uses for its information.
- Further enhance and refine the PRiSM model.

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 200 of 729

- Continue to study the impact of climate change on the load forecast.
- Monitor the following conditions relevant to the load forecast: large commercial load additions, Shoshone county mining developments and market penetration of electric cars.

As explained earlier in the IRP, more studies were done regarding several fixed natural gas opportunities including coal gasification, investment in gas fields or through financial instruments. The common theme from all of the studies was that the capital or credit costs would be too high for Avista to effectively participate in any projects or long-term contracts.

There have been several improvements to the Efficient Frontier and PRiSM modeling approaches, including solving for minimum acquirable resource sizes, and including emissions accounting. Projected impacts from climate change and electric car market penetration have been included in the Company's load forecast, as discussed in the Loads and Resources chapter. Details about changes to relevant load conditions are also included in the Loads and Resources chapter.

Transmission Planning

- Work to maintain/retain existing transmission rights on the Company's transmission system, under applicable FERC policies, for transmission service to bundled retail native load.
- Continue involvement in BPA transmission practice processes and rate proceedings to minimize costs of integrating existing resources outside of the Company's service area.
- Continue participation in regional and sub-regional efforts to establish new regional transmission structures (ColumbiaGrid and other forums) to facilitate long-term expansion of the regional transmission system.
- Evaluate costs to integrate new resources across Avista's service territory and from regions outside of the Northwest.

Transmission planning Action Items are ongoing issues that will be revisited as items in the 2009 Action Plan. Details about progress made towards the maintenance of existing transmission rights, involvement in BPA processes, participation in regional transmission processes, and the evaluation of integrating different resources in the IRP can be found in the Transmission and Distribution chapter.

2009 IRP Action Plan

The Company's 2009 Preferred Resource Strategy provides direction and guidance for the type, timing and size of future resource acquisitions. The 2009 IRP Action Plan provides an overview of activities planned for inclusion in the 2011 IRP. Progress and results for each of the Action Plan items will be monitored and reported to the Technical Advisory Committee and in Avista's 2011 IRP. The Action Plan was developed using input from Commission Staff, the Company's management team and the Technical Advisory Committee.

Resource Additions and Analysis

- Continue to explore the potential for wind and non-renewable resources.
- Issue an RFP for the Reardan wind site, and up to 100 MW of wind or other renewables in 2009.
- Finish studies regarding costs and environmental benefits of the large hydro upgrades at Cabinet Gorge, Long Lake, Post Falls and Monroe Street.
- Study potential locations for the natural gas-fired resource identified to be online between 2015 and 2020.
- Continue participation in regional IRP processes, and where agreeable find resource opportunities to meet resource requirements on a collaborative basis.

Energy Efficiency

- Pursue American Reinvestment and Recovery Act of 2009 funding for income weatherization.
- Analyze and report on results of the July 2007 through December 2009 demand response pilot in Moscow and Sandpoint.
- Have an external party do an updated study on technical, economic, achievable potential for energy efficiency in Avista's service territory.
- Study and quantify transmission and distribution efficiency concepts as they apply toward meeting Washington RPS goals.
- Update processes and protocols for conservation measurement, evaluation and verification.
- Determine potential impacts and costs of load management options.

Environmental Policy

- Continue to study the potential impact of state and federal climate change legislation.
- Continue and report on the work of Avista's Climate Change Committee.

Modeling and Forecasting Enhancements

- Refine cost driver relationships in the stochastic model.
- Continue to refine PRiSM by developing a resource retirement capability, adding the ability to solve for other risk measurements and by adding more resource options.
- Continue developing Loss of Load Probability and Sustained Peaking analysis for inclusion in the IRP process, and confirm appropriateness of the 15 percent capacity planning margin assumed for this IRP.
- Continue studying the impacts of climate change on the load forecast.
- Stay load growth trends and their correlation to weather patterns.

Transmission Planning

- Work to maintain/retain existing transmission rights on the Company's transmission system, under applicable FERC policies, for transmission service to bundled retail native load.
- Continue involvement in BPA transmission practice processes and rate proceedings to minimize costs of integrating existing resources outside of the Company's service area.
- Continue participation in regional and sub-regional efforts to establish new regional transmission structures (ColumbiaGrid and other forums) to facilitate long-term expansion of the regional transmission system.
- Evaluate costs to integrate new resources across Avista's service territory and from regions outside of the Northwest.
- Study and implement distribution feeder rebuild projects to reduce system losses.
- Study transmission reconfigurations to economically reduce system losses.

Production Credits

Primary 2009 IRP Team

Individual	Contribution	Contact
Clint Kalich, Manager of Resource Planning & Analysis	Project Manager	clint.kalich@avistacorp.com
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Appendix

2009

Electric
Integrated Resource Plan

Appendix A – Technical Advisory Committee Meeting Presentations

August 31, 2009

2009 Integrated Resource Plan

Technical Advisory Committee Meeting No. 1 Agenda
May 14, 2008

	Topic	Time	Staff
1.	Introduction	10:30	Vermillion
2.	Load & Resource Balance Update	10:35	Gall
3.	Climate Change Update	11:15	Lyons
4.	Lunch	12:15	
	Special Guest - Steve Silkworth- update on renewable acquisitions		
5.	Loss of Load Probability Analysis	1:15	Gall
6.	2009 IRP Topic Discussions • Work Plan • Analytical Process Changes • Other	2:00	Kalich
7.	Adjourn	3:30	

Load and Resource Balance Forecast

James Gall

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 210 of 729

2007 IRP L&R Review

- Capacity & Energy short beginning 2011
- Load is expected to grow at 2.3% over the next 10 years, and 2.0% over the next twenty years
- Lancaster will be added to the utility's portfolio beginning in 2010, pushing our deficit out to 2015 for capacity and 2017 for energy

AVISTA

Current L&R

What's Changed:

- **Lancaster**- 270 MW CCCT in Rathdrum, ID will be available Jan 1, 2010
- **Load**- 10 year growth rate 1.9%, 20 year growth rate 1.8% for Peak and Energy. The 2010 forecast is 52 aMW lower than previous forecast or 4.4% lower, due to slow down in growth and implementation of conservation programs.
- **Hydro**- Uses 2006/07 Northwest Power Pool Headwater benefits study, mean energy is used versus median energy [-8 aMW]
- **Misc**- Updates to contracts, most from WNP-3 expected availability [+22 aMW]

AVISTA

Annual Average Energy Position

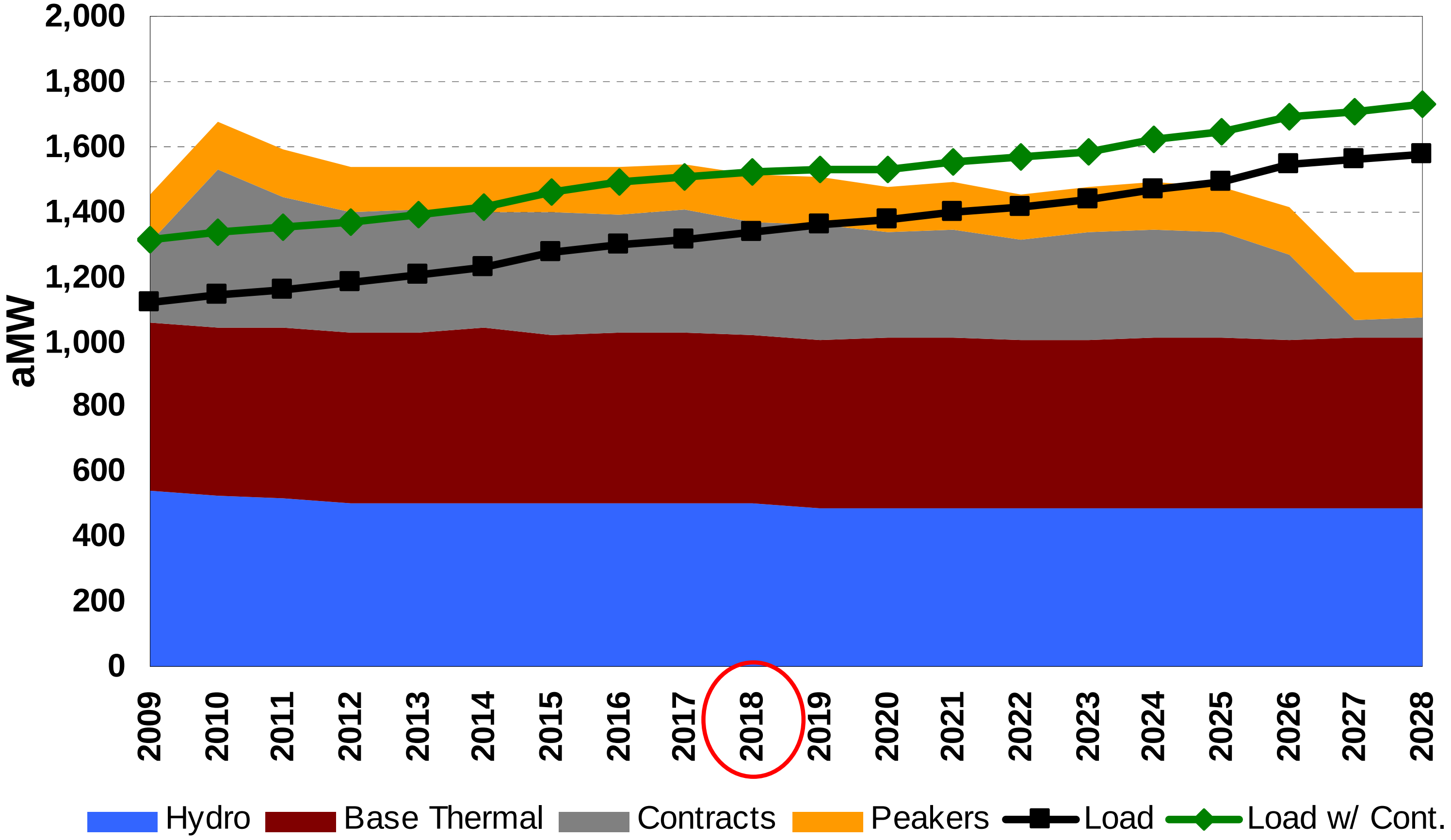
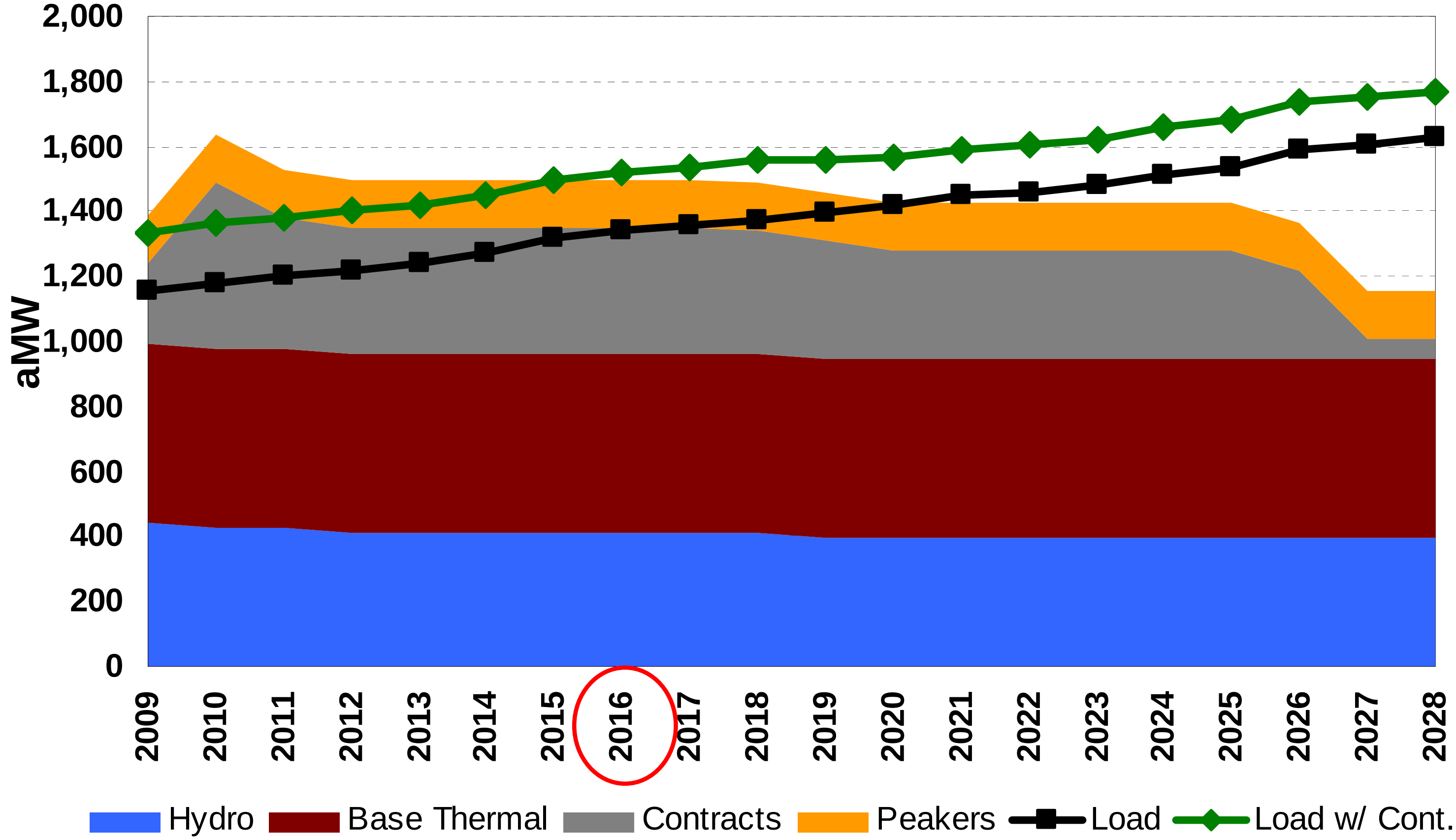


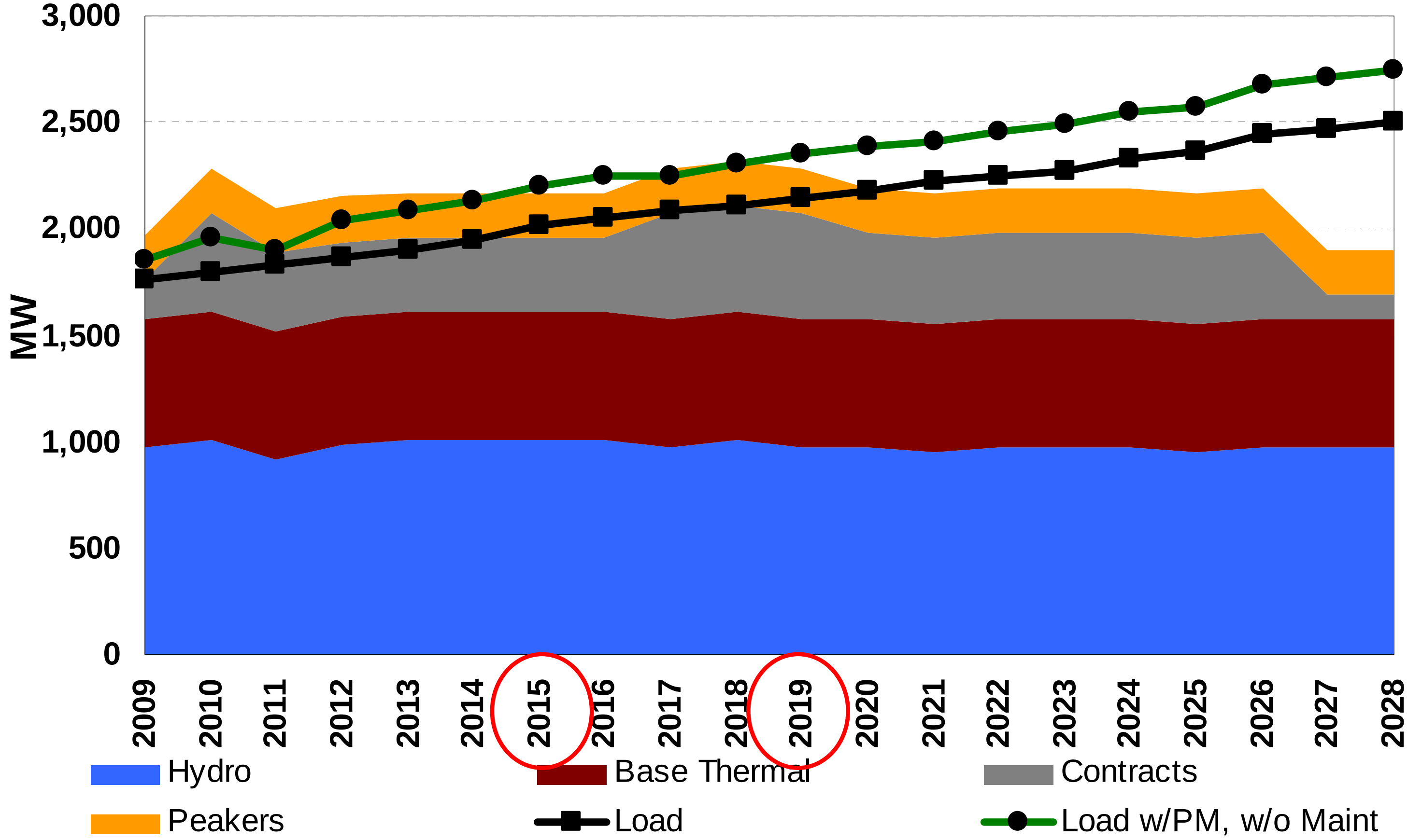
Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 213 of 729

Annual Average Energy Position (exclude Q2)



AVISTA

Annual Position at System Peak



Washington State RPS (aMW)

On-line Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Native Load (Excludes Potlatch)	1,012	1,034	1,053	1,074	1,094	1,121	1,153	1,177	1,194	1,211	1,233	1,253
WA State Load	659	674	686	700	713	730	751	767	778	789	803	816
Load 10% Change of Exceedance	28	29	29	30	30	31	32	33	33	34	34	35
Planning RPS Load	687	702	715	729	743	761	783	799	811	822	837	851
RPS %	0%	0%	0%	3%	3%	3%	3%	9%	9%	9%	9%	15%
Required Renewable Energy	**0.0**	**0.0**	**0.0**	**21.3**	**21.7**	**22.1**	**22.6**	**69.5**	**71.2**	**72.5**	**73.5**	**124.5**
Current Qualifying Resources												
Stateline 1999	7.6	7.6	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long Lake 3 1999	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Little Falls 4 2001	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cabinet 2 2004	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Cabinet 3 2001	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Cabinet 4 2007	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Apprentice Credits	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Hydro 10% Chance of Exceedance	(4.1)	(4.1)	(4.1)	(4.1)	(4.1)	(4.1)	(4.1)	(4.1)	(4.1)	(4.1)	(4.1)	(4.1)
Total Qualifying Resources	***16.1***	***16.1***	***16.1***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***	***8.5***
Net Requirement Need (Completed)	**0.0**	**0.0**	**0.0**	**12.8**	**13.2**	**13.6**	**14.1**	**61.0**	**62.7**	**64.0**	**65.0**	**116.0**
Budgeted Hydro Upgrades												
Noxon 1 2009	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Noxon 2 2010	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Noxon 3 2011	0.0	0.0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Noxon 4 2012	0.0	0.0	0.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Little Falls 1 2015	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.6
Little Falls 2 2016	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.6
Apprentice Credits	0.5	0.7	0.9	1.2	1.2	1.2	1.3	1.4	1.4	1.4	1.4	1.4
Hydro 10% Chance of Exceedance	(1.0)	(1.4)	(1.9)	(2.4)	(2.4)	(2.4)	(2.6)	(2.8)	(2.8)	(2.8)	(2.8)	(2.8)
Total Budgeted Hydro Upgrades	***1.8***	***2.6***	***3.6***	***4.5***	***4.5***	***4.5***	***5.1***	***5.6***	***5.6***	***5.6***	***5.6***	***5.6***
Net Requirement Need (Budgeted)	**0.0**	**0.0**	**0.0**	**8.2**	**8.6**	**9.1**	**9.0**	**55.3**	**57.1**	**58.3**	**59.4**	**110.4**

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Climate Change Update

John Lyons, Ph.D.

Climate Change Update

- Federal GHG legislation – Overview of Lieberman-Warner Bill
- EPA Analysis of Lieberman-Warner
- EIA Analysis of Lieberman-Warner
- Washington Greenhouse Gas Legislation
- Regional Greenhouse Gas Initiative

Lieberman-Warner Climate Security Act of 2007

- Covers emissions of 10,000 mtco2 or greater
- GHG Emissions Reduction Goals:

  2012 – 2005 levels (5,775 mmtco2)

  2020 – 15% below 2005 levels (4,924 mmtco2)

  2030 – 35% below 2005 levels (3,860 mmtco2)

  2040 – 50% below 2005 levels (2,796 mmtco2)

  2050 – 70% below 2005 levels (1,732 mmtco2)

  2007 total U.S. GHG emissions were about 6,000 mmtco2

Lieberman-Warner Climate Security Act of 2007

- 73.5% of allowances distributed for free in 2012 to 14 different groups, free allocations decrease over time
- Allows unlimited banking and trading of allowance
- Borrowing is from EPA is allowed with interest for up to 15% of obligations
- 30% of reductions can be offsets (15% domestic and 15% international)
- Establishes a Carbon Market Efficiency Board to monitor and intervene in the carbon market

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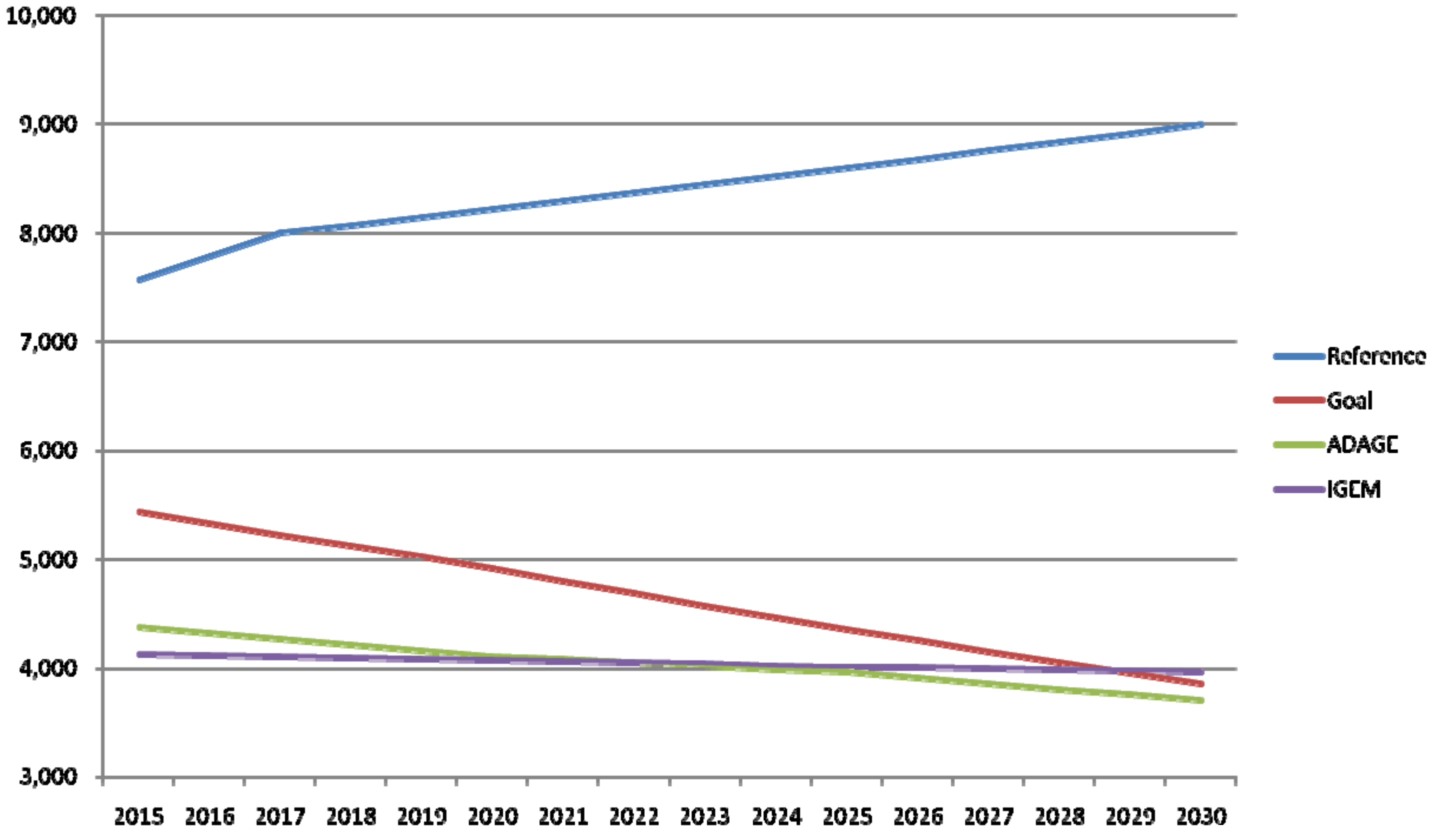
EPA Analysis of Lieberman-Warner

- Reference Case
- S. 2191 Scenario
- S. 2191 Scenario with Low International Actions
- S. 2191 Scenario Allowing Unlimited Offsets
- S. 2191 Scenario with No Offsets
- S. 2191 Constrained Nuclear and Biomass
- S. 2191 Constrained Nuclear, Biomass, and CCS
- S. 2191 Constrained Nuclear, Biomass, and CCS + Beyond Kyoto + Natural Gas Cartel
- Alternative Reference Scenario
- S. 2191 Alternative Reference Scenario

U.S. Carbon Footprint Projections 2015 – 2030



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Case Nos. AVU-E-12-08
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Schedule 5, Page 222 of 729

Federal Spending of Auctioned Credits

Category	ADAGE 2015	ADAGE 2030	IGEM 2015	IGEM 2030
Administration of S. 2191 (assumed to be 1% of auction revenues)	1.6	2.3	2.2	3.2
Zero or Low-Carbon Energy Technologies Deployment	7.8	23.7	10.9	32.7
Advanced Coal and Sequestration Technologies Program	6.1	18.5	8.5	25.6
Fuel from Cellulosic Biomass Program	1.5	4.4	2.0	6.1
Advanced Technology Vehicles Manufacturing Program	2.9	8.9	4.1	12.3
Sustainable Energy Program	6.1	18.5	8.5	25.6
Energy Consumers	8.5	25.6	11.7	35.4
Climate Change Worker Training Program	2.4	7.1	3.3	9.8
Adaptation for Natural Resources in the U.S. and Territories	8.5	25.6	11.7	35.4
International Climate Change Adaptation and National Security Program	2.4	7.1	3.3	9.8
Emergency Firefighting Program	1.2	1.2	1.2	1.2
Energy Independence Acceleration Fund	0.9	2.8	1.3	3.9
Total	**49.9**	**145.7**	**68.7**	**201.0**

ADAGE (Applied Dynamic Analysis of the Global Economy - Ross 2007)

IGEM (Intertemporal General Equilibrium Model - Jorgenson 2007)

Value of Auctioned & Allocated Allowances

Category	ADAGE 2015	ADAGE 2030	IGEM 2015	IGEM 2030
Subtitile A - Auctions (pre-spent by Feds)	47.0	147.0	64.0	201.0
Subtitle B - Early Action	3.0	0.0	4.0	0.0
Subtitle C - States	18.0	26.0	24.0	35.0
Subtitle D - Electricity Consumers	14.0	21.0	20.0	29.0
Subtitle E - Natural Gas Consumers	3.0	5.0	4.0	6.0
Subtitle F - Bonus Allowances for CCS	6.0	9.0	9.0	13.0
Subtitle G - Domestic Ag/Forestry	8.0	12.0	11.0	16.0
Subtitle H - International Forest Protection	4.0	6.0	5.0	8.0
Subtitle I - Transition Assistance	54.0	6.0	74.0	9.0
Subtitle J - Landfill / Coal Mine CH4 Allowance Set - Asides	2.0	2.0	2.0	3.0
Total	**159.0**	**234.0**	**217.0**	**320.0**
net of customer "refunds"	142.0	208.0	193.0	285.0
customer refund %	11%	11%	11%	11%

ADAGE (Applied Dynamic Analysis of the Global Economy - Ross 2007)

IGEM (Intertemporal General Equilibrium Model - Jorgenson 2007)

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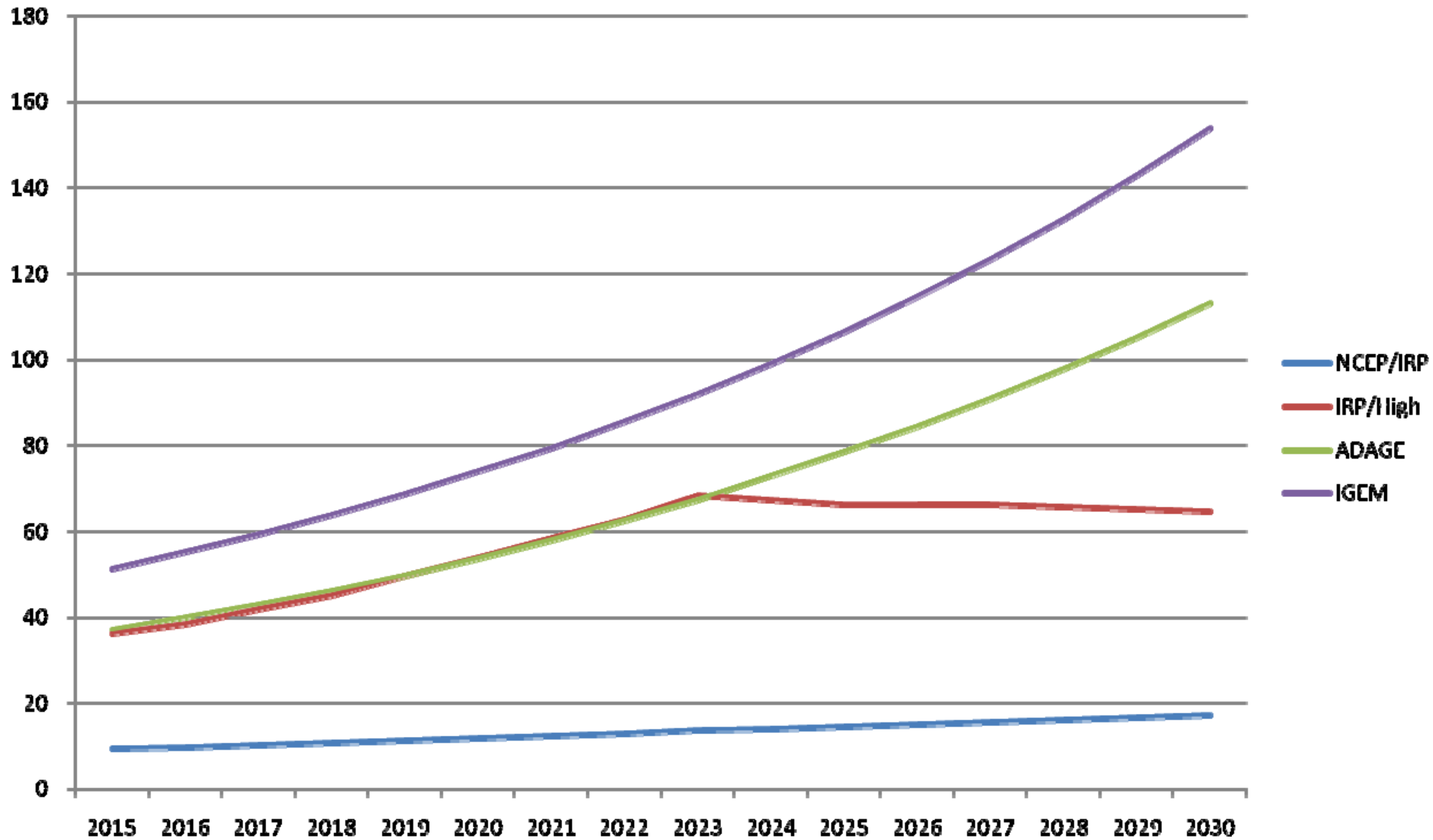
EPA Analysis of U.S. Carbon Emission Cost
($/Metric Ton)



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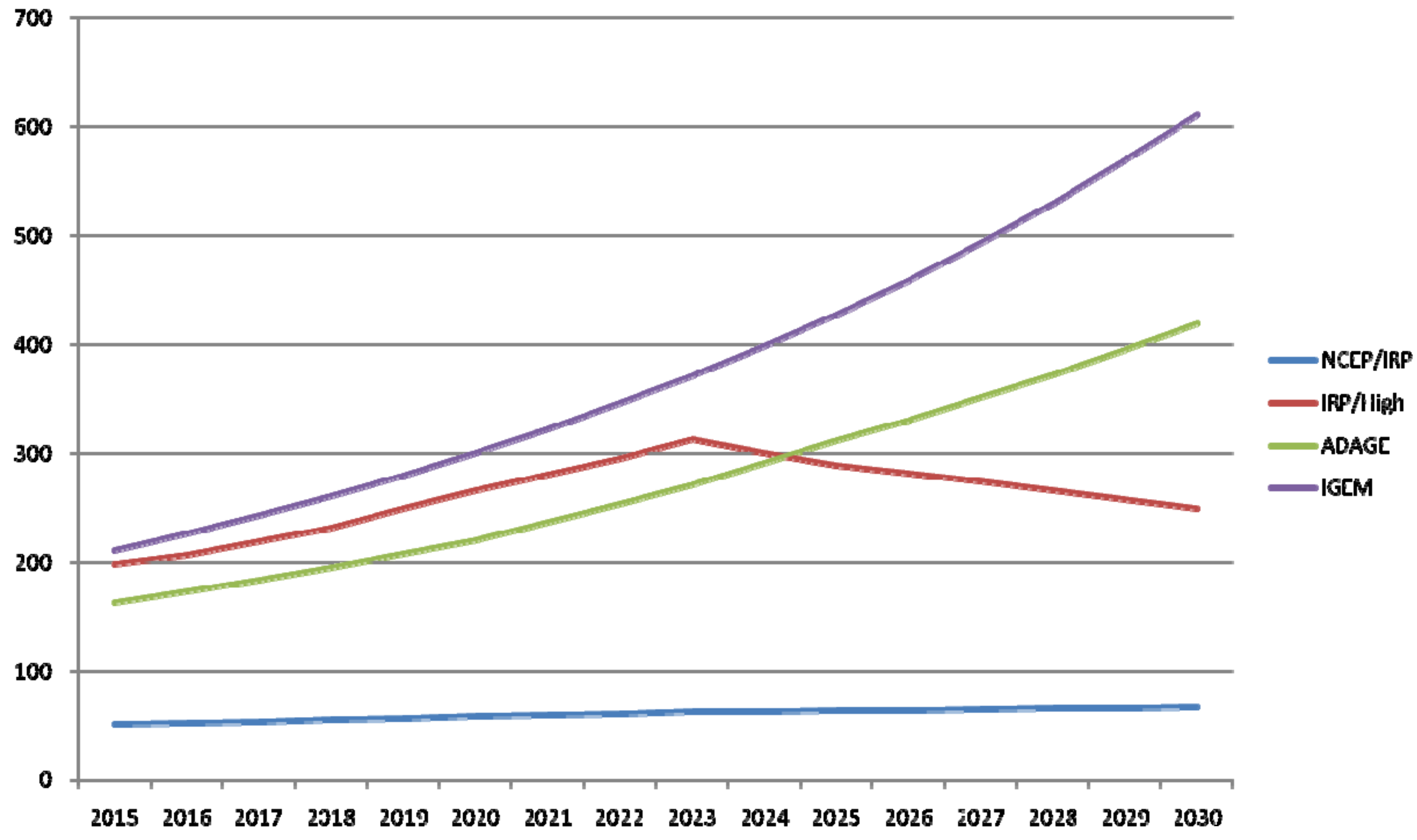
Schedule 5, Page 225 of 729

EPA Analysis Total U.S. Carbon Emission Cost
($billions)



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Schedule 5, Page 226 of 729

EIA Analysis of Lieberman-Warner

- Analysis included 7 cases
- Reference Case
- S. 2191 Core
- No International Offsets Case
- S. 2191 High Cost (CCS, Nuclear and biomass costs 50% higher than in the base case)
- S. 2191 Limited Alternatives
- S. 2191 Limited Alternatives / No International Offsets
- S. 1766 Update (Low Carbon Economy Act of 2007)

EIA Analysis Results

- As expected, impacts directly related to the availability and cost of low-carbon technologies such as CCS and nuclear, as well as the availability of international offsets
- Results are also dependent upon the assessment of the current high commodity prices being permanent or temporary
- Most reductions before 2030 are electricity-related
- GDP reductions in the S. 2191 cases
  - 2020: 0.3% to 0.9%
  - 2030: 0.3% to 0.8%
  - Higher manufacturing impacts

EIA Analysis Results

- Significant increases in new capacity because of early retirement of coal plants through 2030
- There are limited opportunities in the electric power industry after 2030 because the most GHG-intensive plants will have been retired, but population growth will require new generation
- Delivered coal prices increase 405% to 804% in 2030 (2006$)
- Natural gas prices increase 34% to 107% in 2030 (2006$)
- Retail gasoline prices increase $0.41 to $1.01 in 2030

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Washington State GHG legislation

Washington state has three different laws that directly impact GHG emissions and electric resource planning:

- Washington Energy Independence Act (I-937): 15% of new generation must be renewable by 2020
- SB 6001: Limits new base load generation to 1,100 pounds of CO_2 per MWh
- HB 2815: Sets GHG reductions goals for the state as part of the Western Climate Initiative

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Washington HB 2815

Goals are set to meet Washington's share of the Western Climate Initiative

- 2020 – Below 1990 levels
- 2035 – 25% below 1990 levels
- 2050 – 50% below 1990 levels

- May 2008: Guidelines are expected to be released by Department of Ecology

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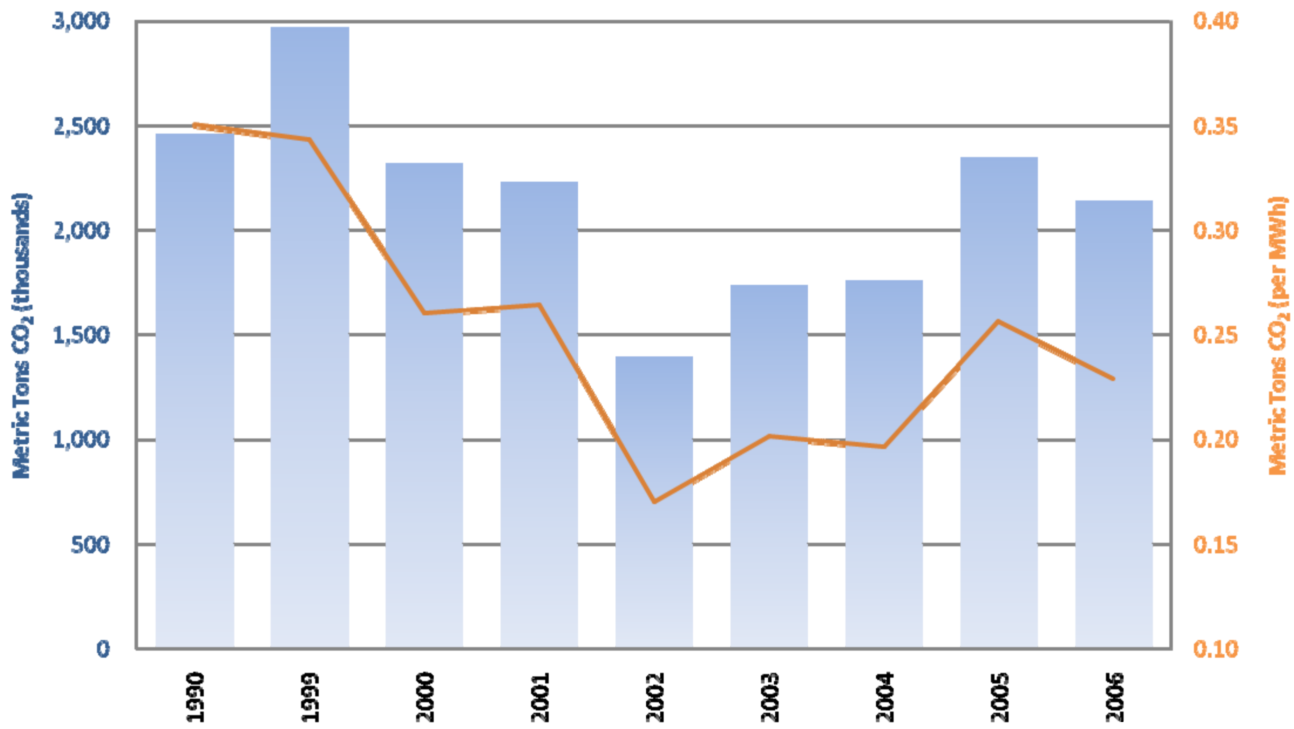
Avista Generation Carbon Footprint
(WRI-WBCSD Protocols, Selected Years 1990-2006)



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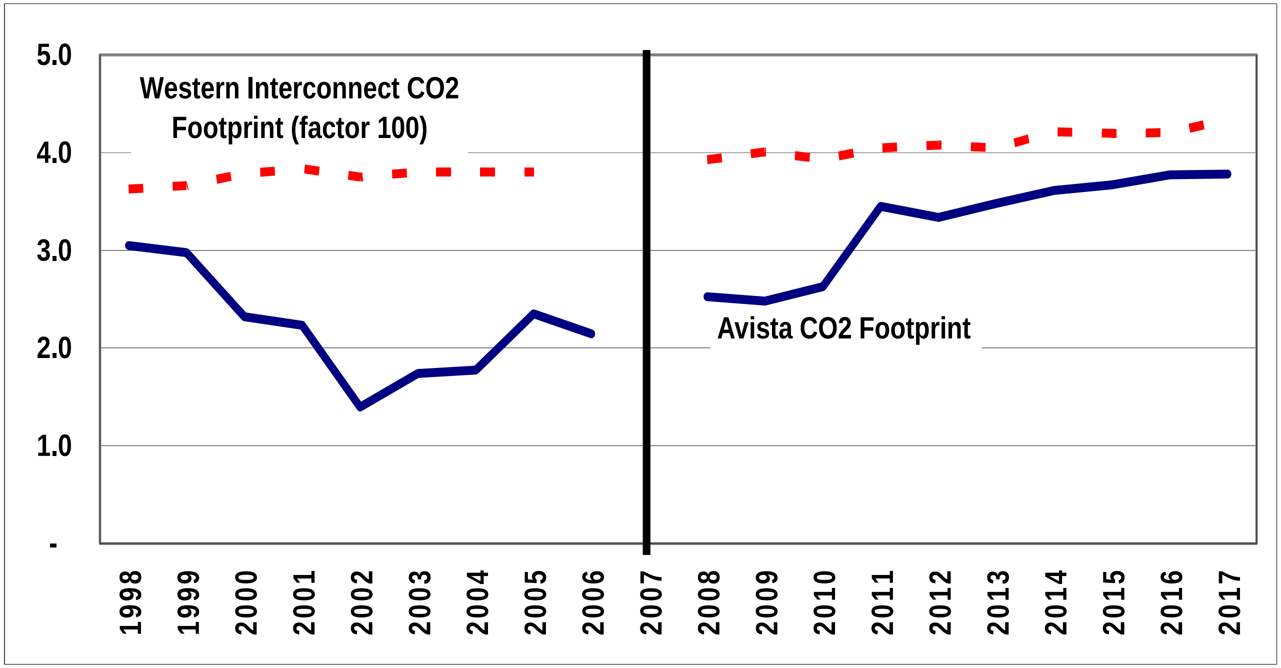
Schedule 5, Page 232 of 729

Avista/WI Generation Carbon Footprint
(millions of tons)



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Schedule 5, Page 233 of 729

Regional Greenhouse Gas Initiative (RGGI)

- Begins January 1, 2009
- Memorandum of understanding signed in 2005 and includes 10 northeastern states
- Caps CO_2 emissions from all power plants greater than 25 MW
- Emissions capped at 121 million short tons per year from 2009 through 2014
- 2015 – 2019 emissions cap reduced by 10%
- 25% of allowances must be strategic or customer oriented in nature
- Some offsets allowed – amount tied to allowance price
- Quarterly auctions beginning in September 2008 with most states having 100% auctions

Loss of Load Probability

James Gall

What is Loss of Load Probability?

A measure of the probability that a system demand will exceed capacity during a given period; often expressed as the estimated number of days over a long period, frequently 10 years or the life of the system.

- *U.S. Department of Energy*

Our study is measured as # of draws where there was a loss of load, for example 1 in 20 draws, is 5%.

LOLP Model Overview

What is it?

- Estimates the probability that not all of load will be served in a given simulation
- Uses available capacity for a given week in January and August
- Simulates major random events, such as wind, hydro, load, and forced outages
- Used to validate planning margin in IRP forecast period

What it is <u>not</u>?

- Energy dispatch model
- Financial costs are not considered
- No estimates for localized transmission/distribution outages
- Does not take into account natural disaster/terrorism related outages

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How It Works

Runs for 168 continuous hours (7 days) in January & August

1) Load is estimated (-)
2) Available capacity from thermal resources (+)
3) Run of river hydro (+)
4) Wind shape calculated (+)
5) Contracts are netted (+/-)
6) Available storage hydro is shaped to high load hours (+) [LP]
7) Market energy purchased up to an assumed limit (+) [LP]
8) Federal hydro release from upstream storage (+) [LP]
9) If load is not served in one or more hours, loss of load occurs

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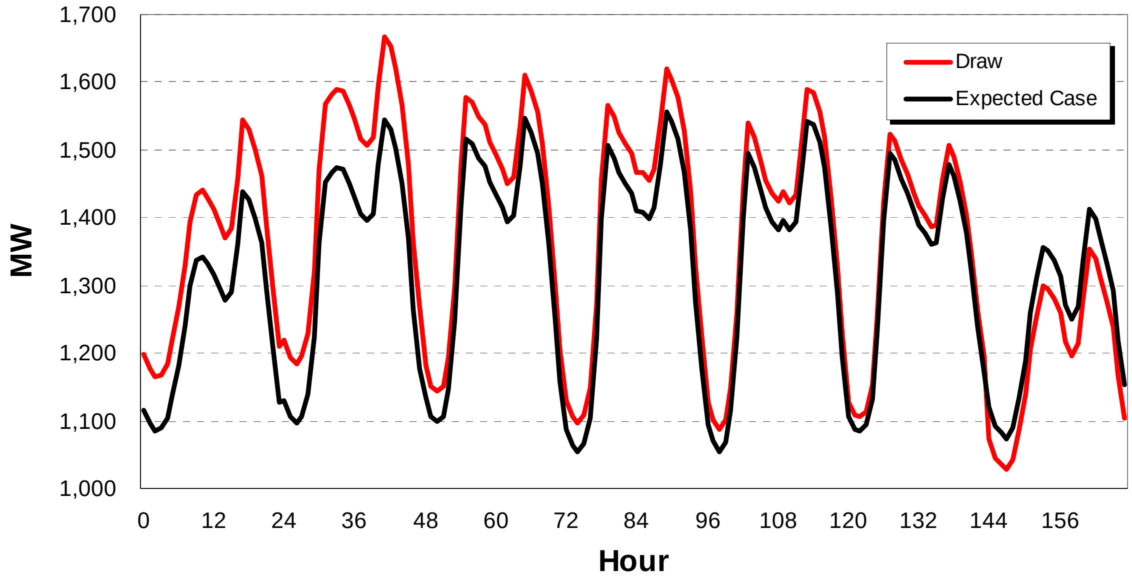
Load

- Uses actual 2007 hourly load shapes for January and August
- Each day an amount of energy is drawn,
  - Correlated to previous day to simulate cold and hot snaps,
  - Based on historic weekly energy shape, and
  - Normal distributions are assumed



Hydro

- Available energy is a random draw from 70 year historical record from the Northwest Power Pool
- Run-of-River projects use this energy shaped to historical flow
- Storage projects use a Linear Program (LP) to move hydro energy to more valuable hours subject to storage constraints and minimum and maximum capacity.
- Plants can spill energy, and draft reservoirs to minimum level
- Scenarios can be studied with/without federal hydro release from upstream storage to prevent load loss

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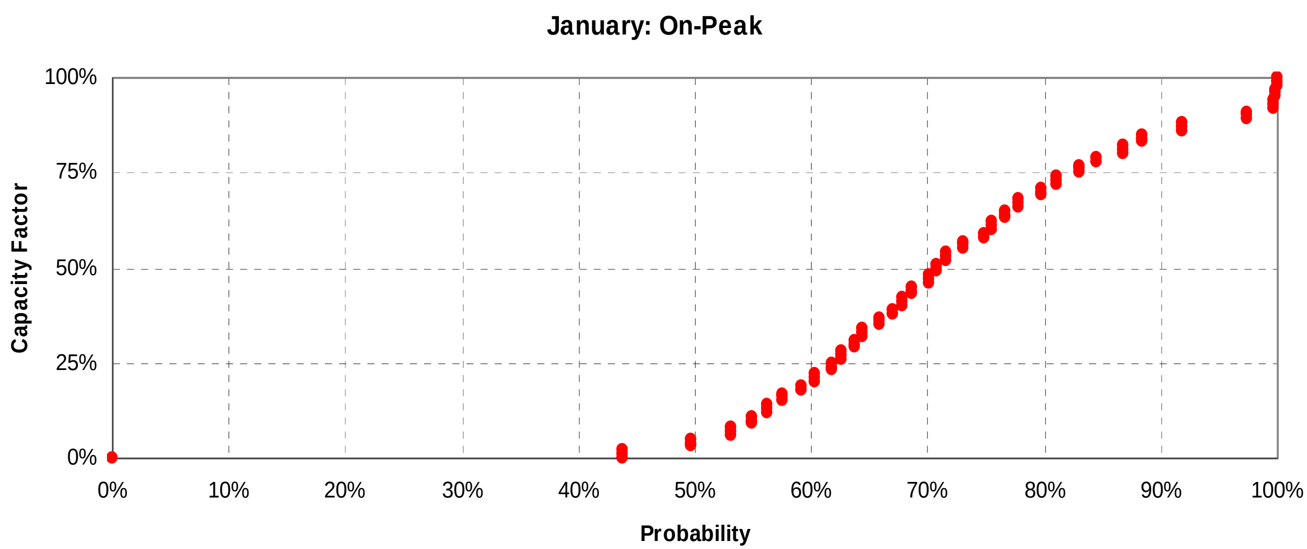
Wind

- Hourly shape based on expected mean energy and frequency distribution for on/off peak hours by month
- Hour to hour correlation
- Future enhancement will have projects correlated



Forced Outages

- For each plant:
  - *Forced Outage Rate (FOR)*
  - *Mean Time To Repair (MTTR)*
  - *Ramp Rate*
- For each hour a unit has a probability of an outage, calculated as:

  Outage Probability = FOR x 8760 / MTTR / 52

  e.g. 0.10 x 8760 / 24 / 52 = 70% chance of outage in the week or 0.42% in a given hour

- If an outage is drawn, another probability is calculated if the unit is to return to service, calculated as:

  Return to Service if: Rnd# > 1 / MTTR, than "on", otherwise "off"

- If a unit has a ramp rate, such as 10 hours, the units available generation will increase linearly over 10 hours until it reaches maximum capability

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2009 Results- Base Case

	January	August
Loss of Load	2.1%	3.8%
Market Reliance	47.6%	55.6%
Peak Load	2,023	2,005
Average Peak Load	1,656	1,492
Average Load	1,319	1,081
Available Market (MW)	300	300
Federal Hydro	0	0

How Many Iterations Do You Need?

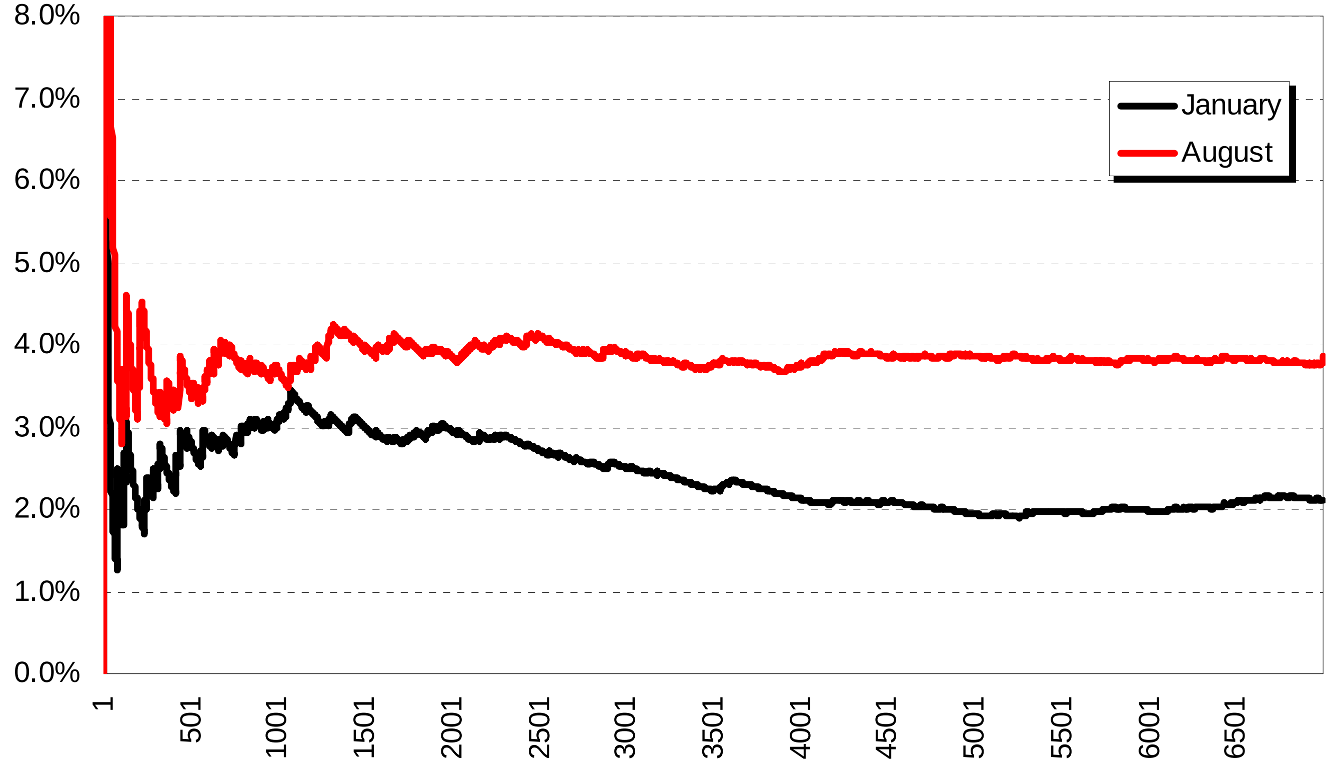

Exhibit No. 4
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Schedule 5, Page 244 of 729

2009 Results- Scenario 1, Less Market Opportunity
200 MW (on-peak), 300 MW (off-peak)

	January	August
Loss of Load	7.4%	12.1%
Market Reliance	47.3%	56.1%
Peak Load	2,053	1,841
Average Peak Load	1,656	1,494
Average Load	1,319	1,081
Available Market (MW)	200	200
Federal Hydro	0	0

2009 Results- Scenario 2, Increase Market Opportunity
400 MW of Market

	January	August
Loss of Load	0.4%	0.9%
Market Reliance	47.3%	56.1%
Peak Load	2,026	1,762
Average Peak Load	1,656	1,494
Average Load	1,319	1,081
Available Market (MW)	400	400
Federal Hydro	0	0

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2020 Results- Scenario 3, Potential Future

	January	August
Loss of Load	3.3%	0.8%
Market Reliance	41.7%	19.6%
Peak Load	2,494	2,279
Average Peak Load	2,048	1,849
Average Load	1,631	1,338
Available Market (MW)	300	300
Federal Hydro	0	0

Adds: Lancaster (270 MW), Reardan (50 MW), CCCT (200 MW), Wind (200 MW)

2020 Results- Scenario 4, All Wind Future

	January	August
Loss of Load	9.8%	3.2%
Market Reliance	73.5%	51.8%
Peak Load	2,515	2,198
Average Peak Load	2,048	1,848
Average Load	1,629	1,138
Available Market (MW)	300	300
Federal Hydro	0	0

Adds: Lancaster (270 MW), Reardan (50 MW), CCCT (0 MW), Wind (400 MW)

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2020 Results- Scenario 5, Flat Wind Future

	January	August
Loss of Load	6.0%	1.8%
Market Reliance	65.7%	39.0%
Peak Load	2,662	2,238
Average Peak Load	2,047	1,851
Average Load	1,630	1,339
Available Market (MW)	300	300
Federal Hydro	0	0

Adds: Lancaster (270 MW), Reardan (50 MW), CCCT (0 MW), Wind (400 MW)

2009 Results- Scenario 6, 5% LOLP Case

	January	August
Loss of Load	4.9%	5.1%
Market Reliance	47.5%	54.8%
Peak Load	1,992	1,780
Average Peak Load	1,657	1,493
Average Load	1,319	1,080
Available Market (MW)	235	270
Federal Hydro	0	0

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What it takes to stay at 5% LOLP for 2009 if remove 100MW of market availability

- Remove 100MW of Market: 15.1%/15.9%
- Add 100MW of CCCT: 5.0%/5.4%
- Add 300MW of Wind: 7.9%/11.1%
- Add 600MW of Wind: 6.0%/8.3%

2009 Results- Scenario 7, Federal Hydro 16 hrs

	January	August
Loss of Load	0.1%	0.0%
Market Reliance	47.6%	55.8%
Peak Load	2,025	1,785
Average Peak Load	1,657	1,493
Average Load	1,320	1,080
Available Market (MW)	300	300
Federal Hydro	16 hrs	16 hrs

2009 IRP Topic Discussions

Clint Kalich

Work Plan – Proposed TAC Meeting Schedule

May 14, 2008 – Kickoff Meeting

August 2008 – TBD

October 2008 – TBD

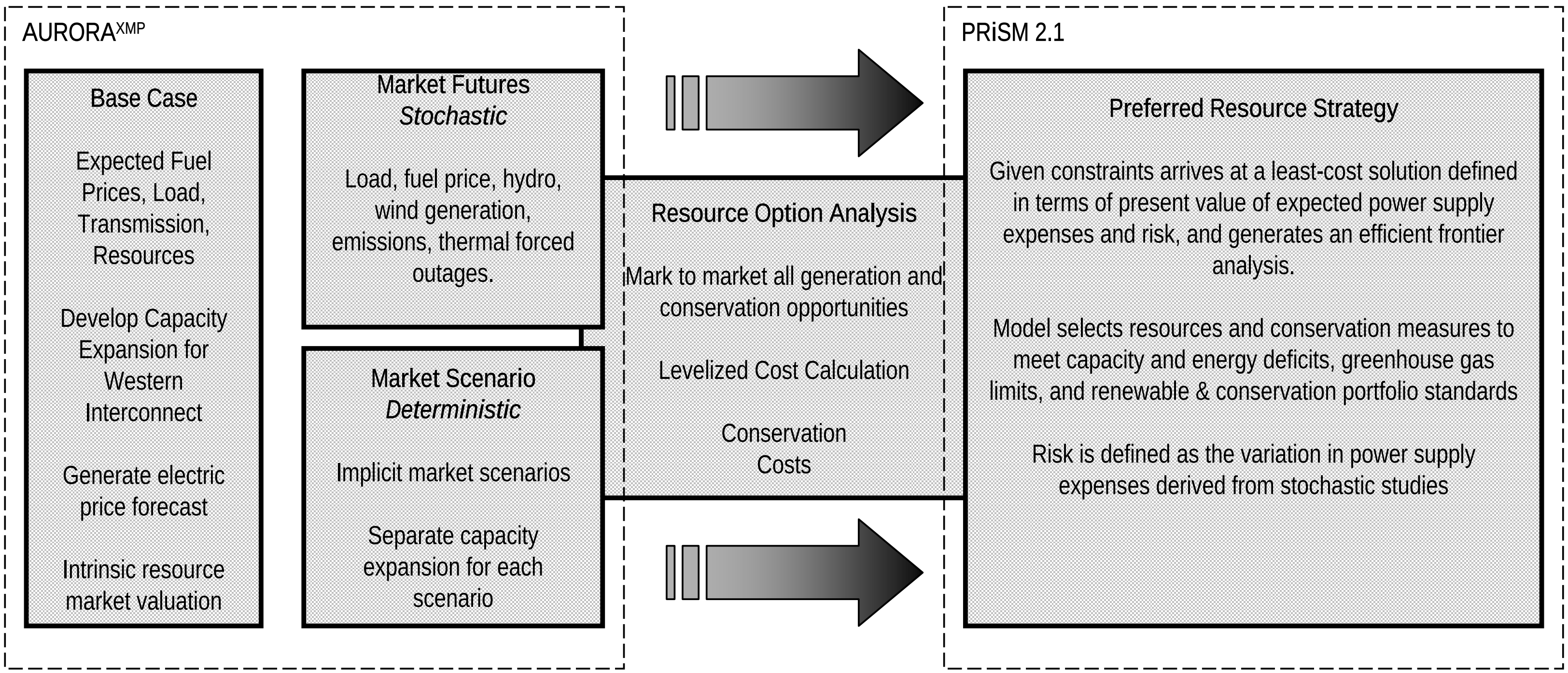
January 2009 – Review of final modeling and assumptions

March 2009 – Review of scenarios and futures, resource, and transmission costs

April 2009 – Review of final PRS

June 2009 – Review of report

Work Plan – Flow Diagram



Work Plan – Timeline on IRP Development

Preferred Resource Strategy

Identify Regional resource options for electric market price forecast	8/15/2008
Identify Avista's resource options	8/31/2008
Develop PRiSM 2.1 model & implement	9/15/2008
Update AURORA^{xmp} database for electric market price forecast	9/30/2008
Select natural gas price forecast	10/10/2008
Finalize deterministic Base Case	10/17/2008
Create datasets/statistics variables for risk studies	10/31/2008
Base case risk study complete	11/30/2008
Develop Efficient Frontier & PRS	1/30/2009
Simulation of risk studies "futures" complete	1/30/2009
Simulate market scenarios in AURORA^{xmp}	2/27/2009
Evaluate resource strategies against market futures & scenarios	3/20/2009
Present to TAC preliminary study and PRS	3/31/2009

Work Plan – Timeline on IRP Development

Writing Tasks

File 2009 Integrated Resource Planning Work Plan	8/30/2008
Prepare Report and Appendix Outline	9/15/2008
Prepare text drafts	4/15/2009
Prepare charts and tables	4/15/2009
Internal draft released	5/1/2009
External draft released	6/15/2009
Final editing and printing	8/1/2009
Report distribution	8/30/2009

Analytical Process Changes

DSM Fully Integrated Into PRiSM

- Valuation, risk, selection

PRiSM Improvements

- “Lumpiness” added
- Portfolio carbon limits
- Additional resource options
- Plant retirement
- New efficient frontier method (balancing risk and cost)
- End effects more accurately modeled
- Added AFUDC
- Market and green tag purchases risk

Resource dispatch & valuation

- Evaluating options to AURORA (e.g., LP Model)

Planning Futures/Scenarios

- More carbon looks
- Solar cost collapse
- Sustained high gas prices
- Lots of nuclear (government support/promotion)
- 25% RPS nationwide
- Back to the Future
  - Determine cost of renewable energy & carbon legislation
- Other Ideas from TAC??

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2009 Integrated Resource Plan
Technical Advisory Committee Meeting No. 2 Agenda
August 27, 2008

	Topic	Time	Staff
1.	Introduction	10:30	Vermillion
2.	Risk Assumptions/PRiSM	10:35	Gall
3.	Resource Assumptions	11:30	Lyons
4.	Lunch	12:15	
5.	Scenarios and Futures	1:15	Lyons
6.	Demand Side Management	2:00	Powell
7.	Adjourn	3:30	

Stochastic Analysis & Resource Portfolio Selection Modeling

James Gall

Presentation Overview

Risk

- Discuss methods and risk assumptions, expected (mean) values will be discussed at later TAC meetings
- Variable correlations are difficult to quantify, recommendations are placeholders until better information is available or the TAC agrees the assumption is acceptable for modeling purposes
- Risk analysis is modeled in AURORA- impacts electric markets prices and the cost of new resource options
- Feedback and suggestions are needed

PRiSM

- Overview of the model and enhancements
- Feedback and suggestions are welcome

Stochastic Analysis Methods & Assumptions

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Long-Term Correlation Matrix

	Gas Prices	CO_2 Prices	NO_X Prices	SO_2 Prices	New Coal Prices	Hog Fuel Prices	Load Growth
Gas Prices	1.00						
CO_2 Prices	0.50	1.00					
NO_X Prices		0.75	1.00				
SO_2 Prices		0.75	1.00	1.00			
New Coal Prices		-0.25	-0.25	-0.25	1.00		
Hog Fuel Prices		0.50				1.00	
Load Growth	-0.25	-0.25					1.00

Carbon Dioxide Credit Prices (CO_2, GHG)

- Similar method to 2007 IRP
- For each iteration, a potential carbon cost scenario is selected, based on a weighting of 10 EPA studies.
- After the scenario is selected, the cost is treated as an expected value and a lognormal distribution is applied to each year.
- Further, natural gas and other market price drivers are correlated to the CO_2 prices
- The intent of this method is model the unknown nature of climate change legislation, it potential for year-to-year price volatility, and its affect on other major market price drivers.

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Carbon Dioxide Credit Prices (nominal)

%	Nominal $/ Short Ton	2010	2011	2012	2016	2020	2025	2029
10%	EPA S. 2191 ADAGE	-	-	28.60	39.08	50.89	72.40	94.74
3%	EPA S. 2191 IGEM	-	-	40.50	53.13	70.15	98.04	122.32
15%	EPA S. 2191 ADAGE - Low Intl Action	-	-	26.20	36.53	48.14	66.36	88.25
10%	EPA S. 2191 IGEM Unlimited Offsets	-	-	8.70	16.09	20.63	28.66	47.69
2%	EPA S. 2191 IGEM with No Offsets	-	-	80.80	100.39	134.79	190.04	221.27
3%	EPA S. 2191 ADAGE Scenario 6	-	-	39.70	51.85	67.39	95.02	119.07
2%	EPA S. 2191 ADAGE Scenario 7	-	-	57.20	72.29	94.90	132.73	159.63
35%	EPA S. 2191 Alt. Ref. ADAGE	-	-	21.00	30.14	38.51	54.30	75.27
5%	EPA S. 2191 Alt. Ref. IGEM	-	-	35.00	46.75	61.89	85.97	109.34
15%	EPA S. 1766 ADAGE	-	-	10.20	17.37	20.63	28.66	47.69
100%	**Expected Value**	**-**	**-**	**23.46**	**33.09**	**42.76**	**59.91**	**81.31**

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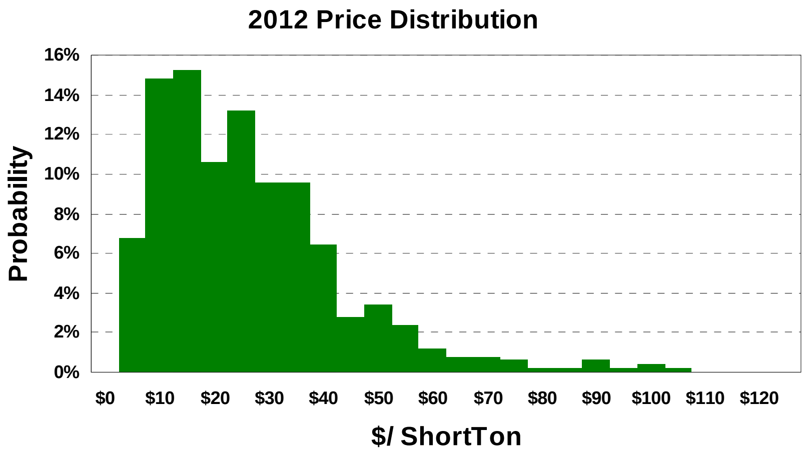
Carbon Dioxide Credit Prices (Cont.)

- Randomly draws price strips for each AURORA iteration
- Each year has lognormal distribution (draw is the mean), market become less volatile over time as market matures
  - 2012-2014 prices use 50% sigma
  - 2015-2016 prices use 25% sigma
  - 2017-2029 prices use 10% sigma



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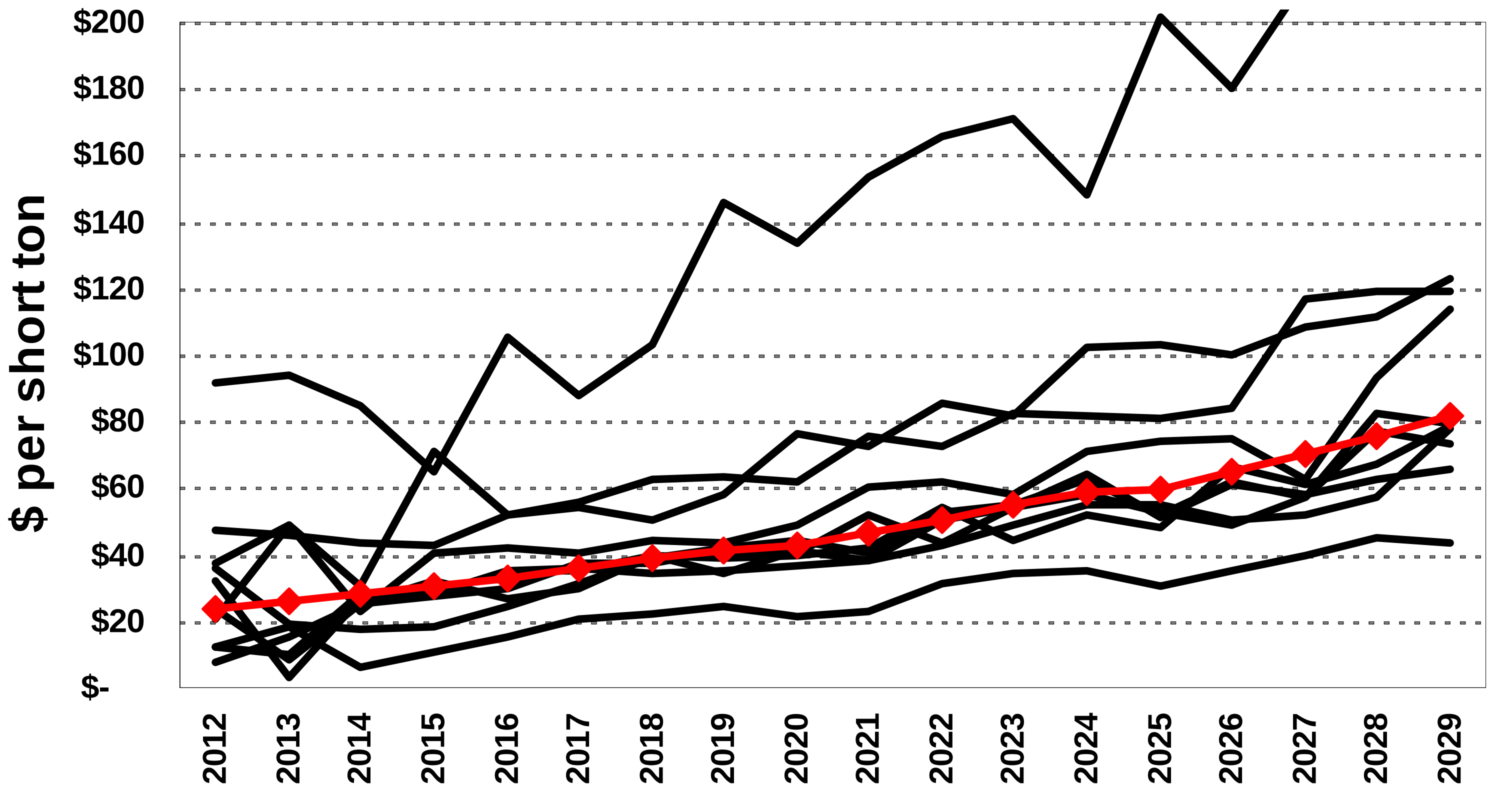
CO_2 Price Trends (10 Simulations)



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Case Nos. AVU-E-12-08
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Schedule 5, Page 268 of 729

Natural Gas Prices

- Lognormal distribution
- Correlated to CO_2 credit prices (50% as placeholder),
  - *Wood Mackenzie will help identify this assumption by studies that model gas prices by changes in gas demand from CO_2 legislation*
- Assumes 35% sigma before CO_2 volatility is applied, than ~58-70%
- Monthly prices may be correlated to load in the winter
- No direct annual serial correlation
- Load growth is negatively correlated at 25%

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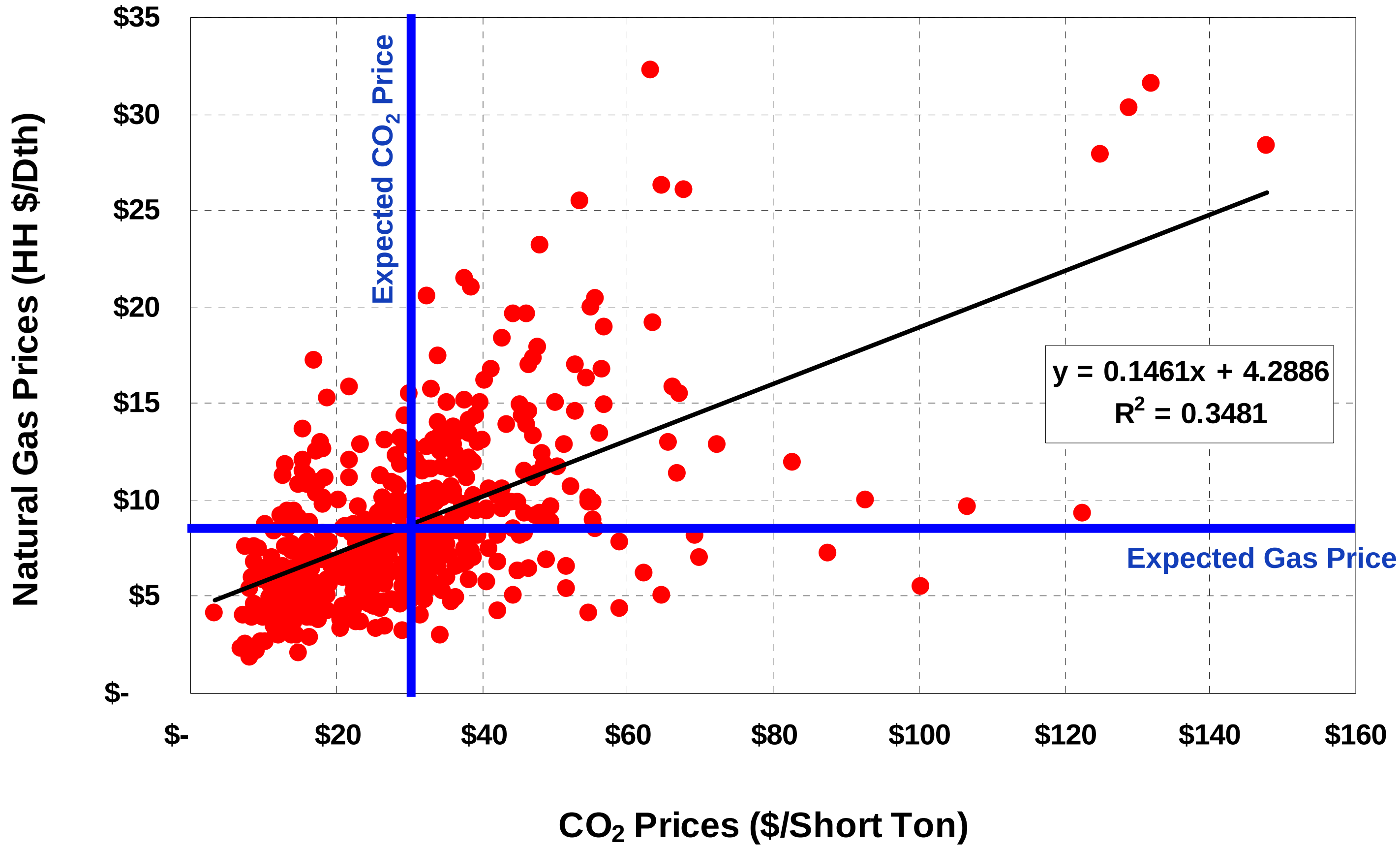
Modeled Natural Gas & CO_2 Price Relationship

Year 2015, Correlation 59%, 500 draws



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Load Growth

- Normal distribution
- Standard deviation is equal to expected value, represents potential volatility due economic activity *(perhaps too volatile)*
- Energy load growth negatively correlated to gas (-25%), CO_2 (-25%),
- Peak load variance modeled as weather variance
- Western Interconnect regional correlation between zones, similar to the 2007 IRP
- Potential correlation between natural gas prices in winter

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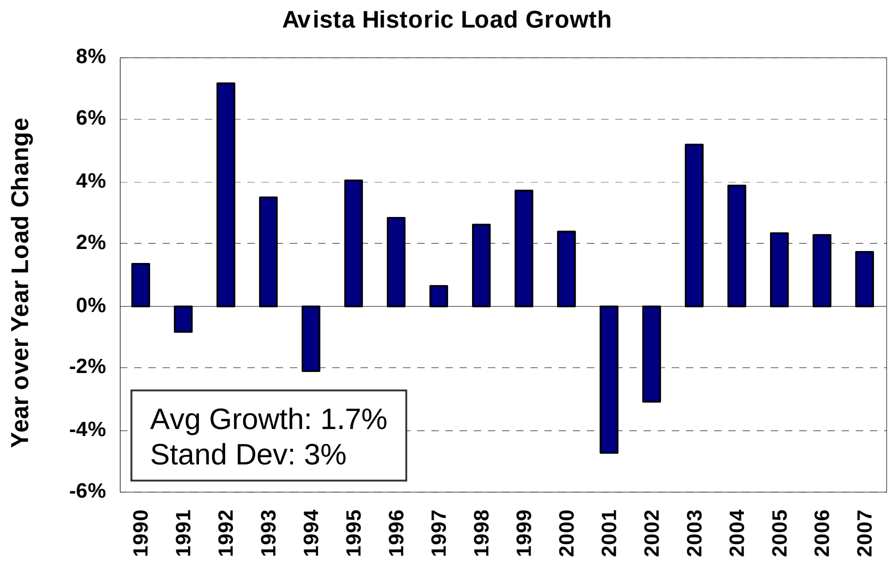
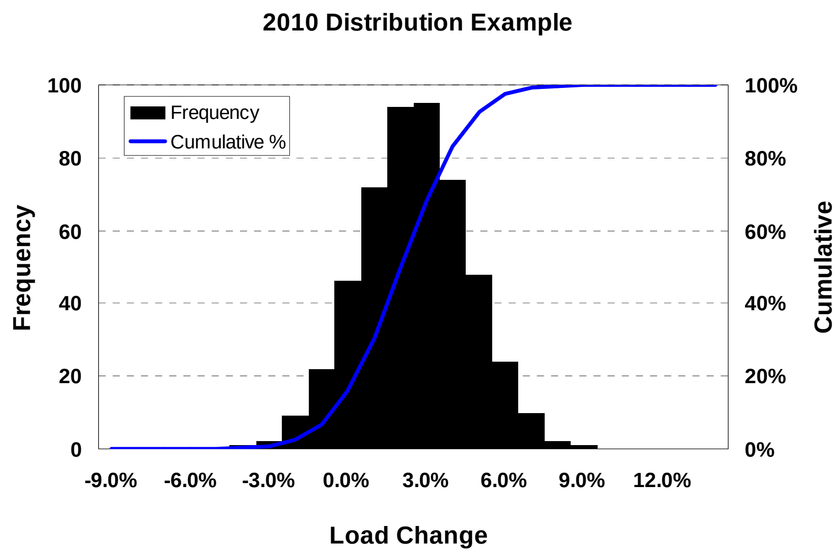
Avista Load Growth Example





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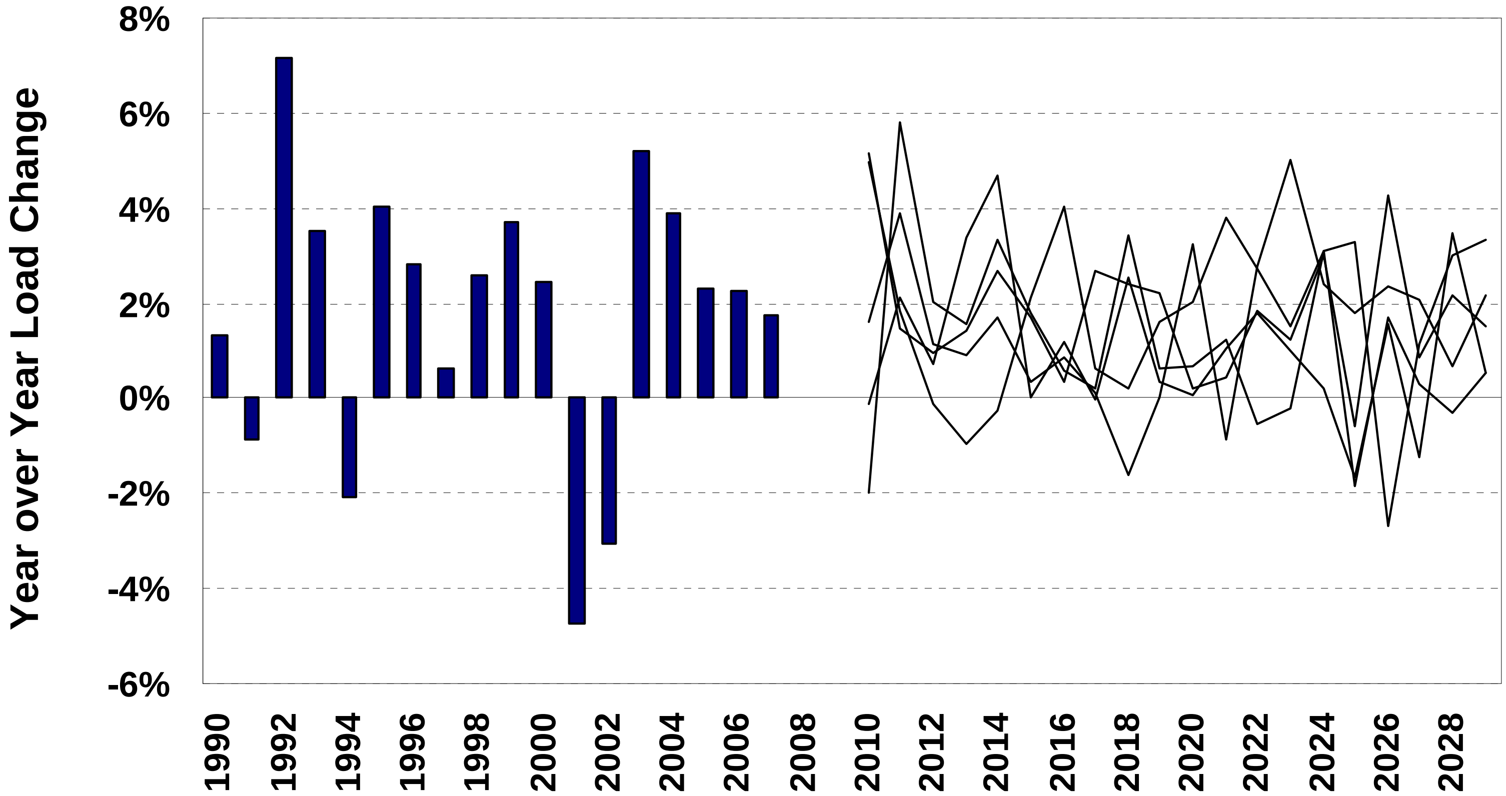
Schedule 5, Page 272 of 729

Load Growth Example (Forecast- 5 draws)



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Schedule 5, Page 273 of 729

Hog Fuel (Wood Waste) Prices

- Normal distribution
- Standard deviation: 10% of expected value
- Positively correlated CO_2 (50%) prices,
  - *A higher CO_2 price could add demand to Wood Prices to offset CO_2*
- Potential correlation to load growth, but more likely correlated to on economic growth, while loads tend to have additional drivers
- What about correlating to natural gas prices

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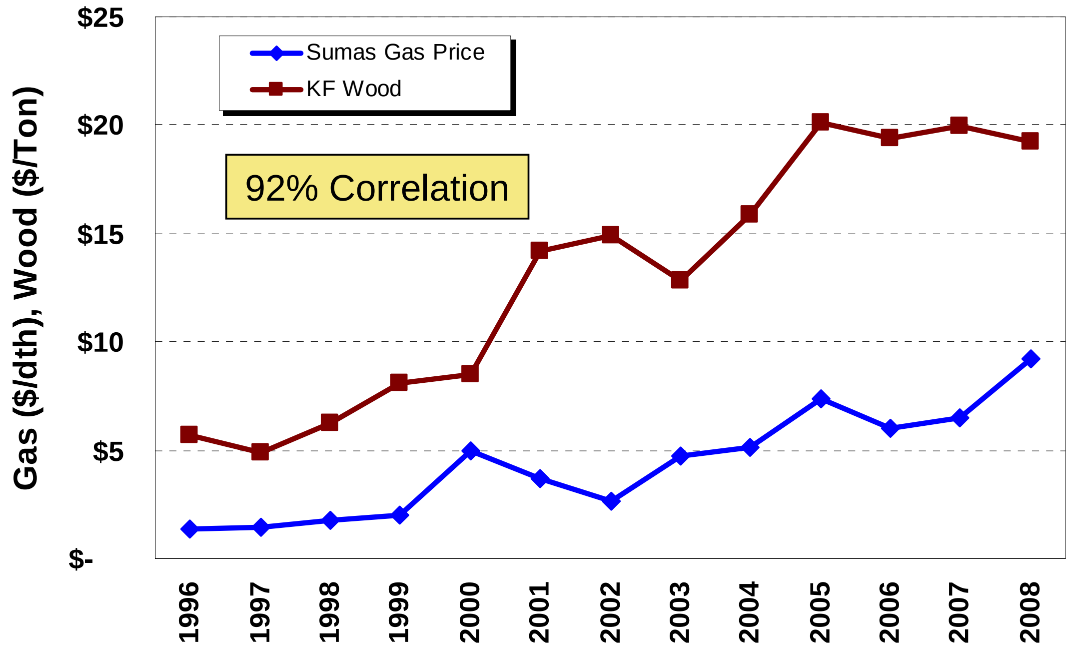
Kettle Falls Prices Compared to Sumas Gas Prices



A multiple regression including inflation & natural gas prices were tested to see if inflation was actually the cause for the correlation.

The results indicated that Sumas gas prices was not a significant predictor of wood prices. **Therefore natural gas will not be correlated to wood prices for this IRP.**

Mine Mouth Coal Price

- Normal distribution
- Standard deviation: 10% of expected value
- Negatively correlated to CO_2 (-25%), and other emissions (-25%)
  - *As policy changes decreasing domestic coal demand, prices could potentially lower as coal mines remain open for international demand*
- Basis for short and long-haul coal prices for new coal options- *this should not affect market prices to any extent*
- No change to existing coal prices for existing plants

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NO_X and SO_2 Credit Prices

- Lognormal distribution
- Standard Deviation: 10% of expected values
- Expected values will be based on July 2008 Wood-Mackenzie study
- Positively correlated to CO_2 prices (75%)
  - *Stricter CO_2 policy will likely lead to stricter air emissions policy and additional gas fired generation- requiring the needs for credits*
- Negatively correlated to new coal prices (-25%)
- No mercury prices will be modeled in this IRP, rather controls will be assumed to be installed on required plants.

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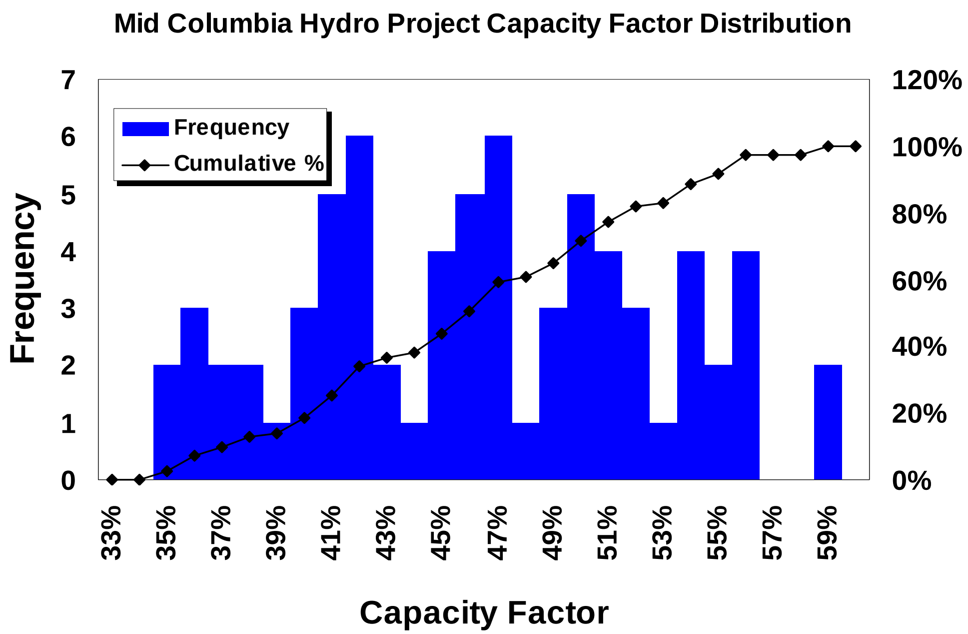
Hydro

- Each year of each iteration will randomly draw of historical 70 year history (1929-1998)
- No historical evidence of normality



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Schedule 5, Page 278 of 729

Wind

- Generic wind for existing projects will use fixed shape with distribution of energy- this is only used for market analysis.
- For potential Avista wind resources, each hour will be randomly drawn based on its probability of occurrence in a given month and time of day with correlation to previous hour.
  - Statistics are available for potential projects on the Columbia River, Reardan, and Montana.
- Similar method was used in the 2007 IRP.
- Potential correlation to winter hydro conditions and will be evaluated

Forced Outages

- Use AURORA logic for random forced outages
- Only Coal, Nuclear, and CCCT plants will be modeled with F/O logic
- Mean Repair Times:
  - Nuclear: 84 hours
  - Coal: 72 hours
  - CCCT: 24 hours

PRiSM

Preferred Resource Strategy Model

Overview & Enhancements

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What is PRiSM?

- Preferred Resource Strategy Model
  - *Selects resource & conservation opportunities on an optimal cost and risk basis using a linear program (What's Best!)*
  - *What's Best is a linear programming tool added to MS Excel*
- Objective function is to either select resource strategies to meet our energy/capacity/market/RPS/CO_2 requirements on a least cost or least risk basis
- Cost is measured by the present value of incremental fuel & O&M expenses and new capital investment
- Risk is measured by the variation in fuel & variable O&M expenses in years 2019 & 2029 (possible PV of 20 years)

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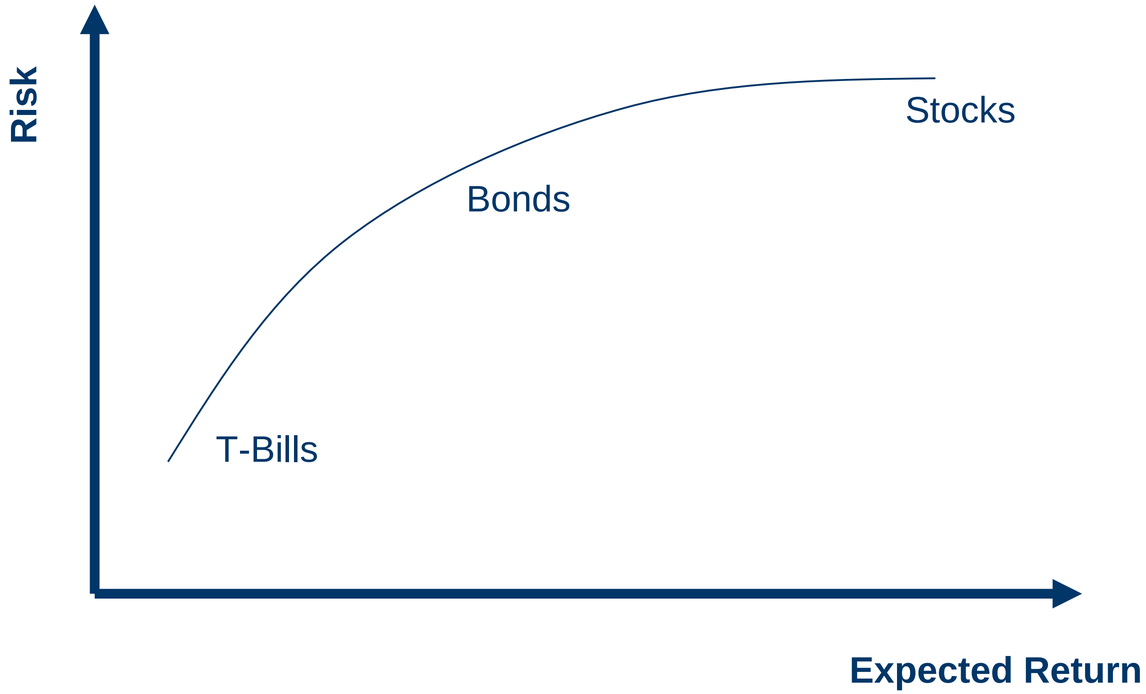
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 282 of 729

Efficient Frontier- Introduction



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Case Nos. AVU-E-12-08
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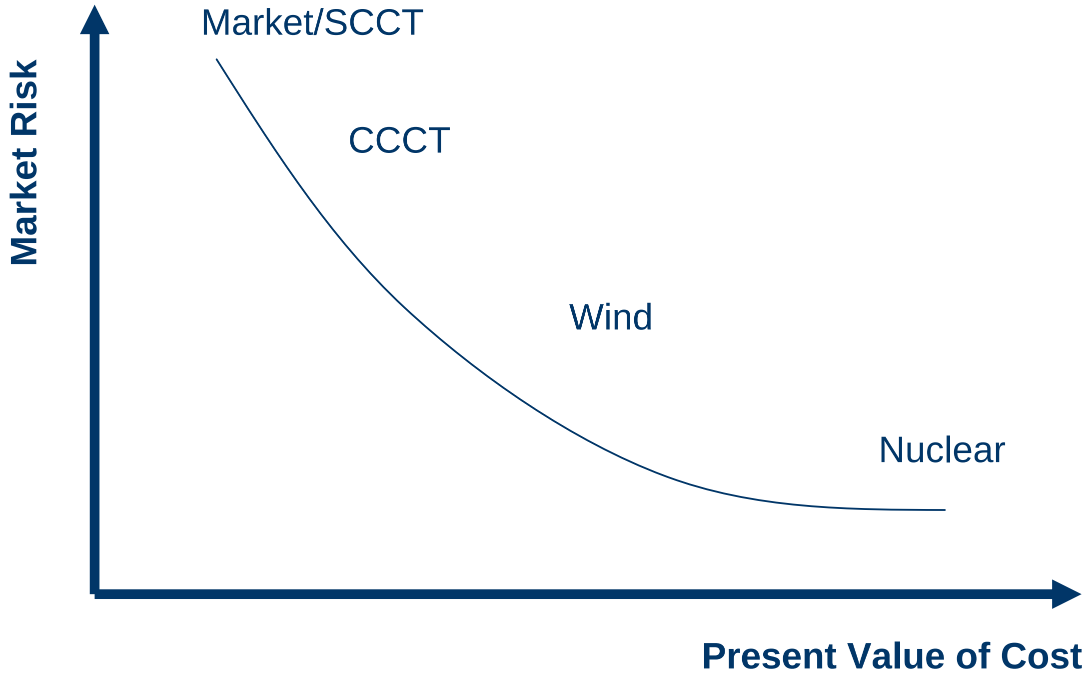
Schedule 5, Page 283 of 729

Efficient Frontier- Introduction



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Schedule 5, Page 284 of 729

New Enhancements

- Conservation measures are selected in model rather than an input (only measures that are between $xx/MWh & $xxx/MWh)
- Resources are now added in increments rather than any amount
- Use more precise method to estimate frontier curve
- Meets both summer & winter capacity requirements
- Ability to retire resources
- Ability to account for greenhouse gas caps
- More accurate ability to take into account post IRP time period

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2009 IRP Resource Assumptions

John Lyons

AVISTA®

Supply Side Resource Data Sources

- Resource lists developed internally
  - Trade journals
  - Press releases
  - Engineering studies and models (ThermoFlow)
  - Announcements from state commissions
  - International projects
  - Proposals from developers
- Power Council
- Consulting firms/reports: Wood Mackenzie, Goldman Sachs, Black & Veatch
- State and federal resource studies
- These data sources are used to develop generic resource types

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Resource Differences from 2007 IRP

- Fewer types of coal resources are included – only ultra critical and IGCC plants are being modeled
- Alberta oil sands are not included as a resource option
- Solar and hydro are being included as resource options for the preferred resource strategy
- Adding more specifics for the Other Renewable Resources category – geothermal, biomass, and solar resources are being modeled separately

Non-Renewable Supply Side Resources

- Natural Gas Combined Cycle (CCCT)
  - 2 x 1 and 1 x 1 with duct burner water cooled (1x1 for PRS)
  - 2 x 1 and 1 x 1 with duct burner air cooled
  - 600 MW with sequestration
- Natural Gas-Fired Simple Cycle – Aero, Frame, and Hybrid
- Small co-generation (< 5 MW)
- Pipeline co-generation
- Coal – ultra critical, IGCC, and IGCC with sequestration
- Nuclear

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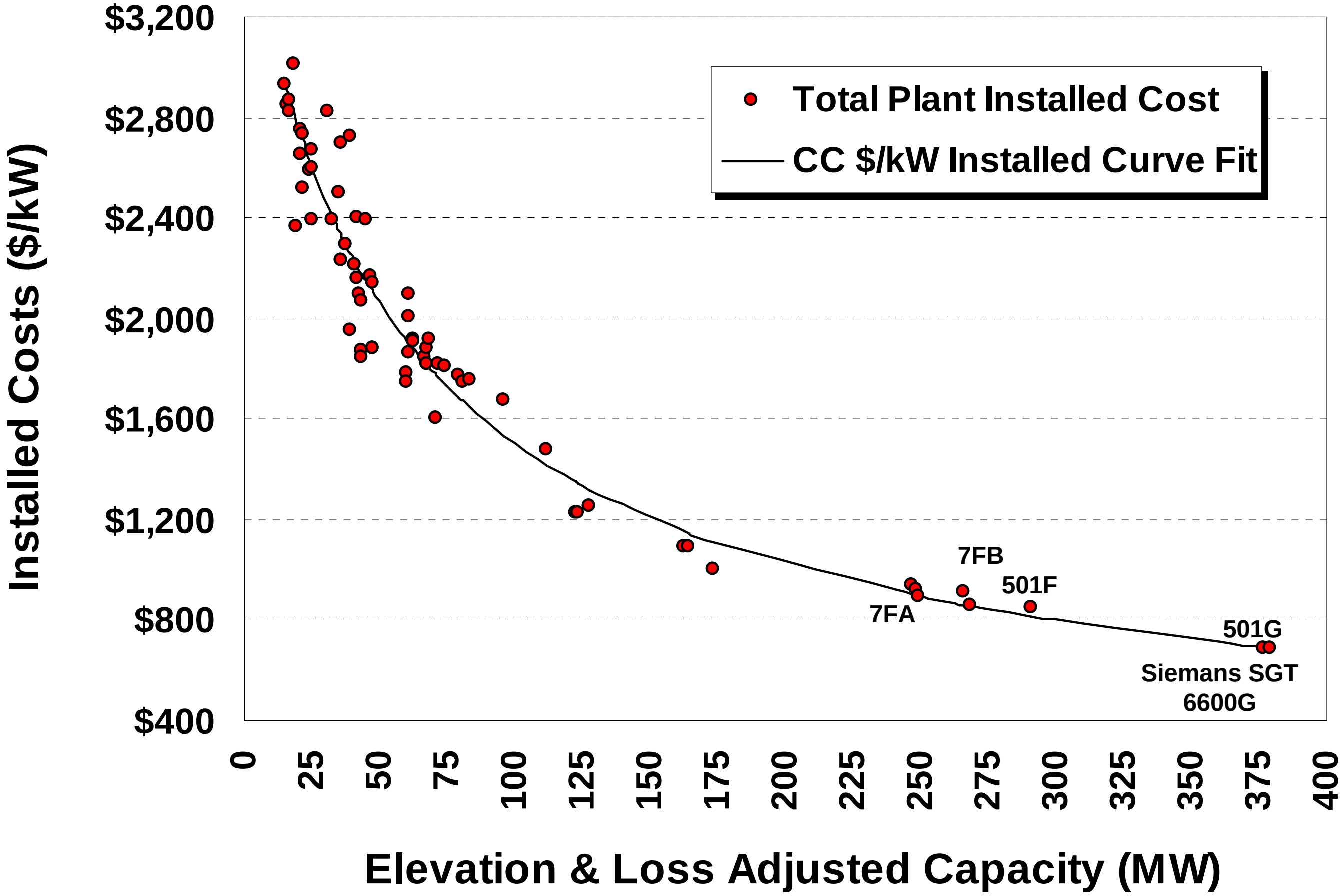
2008 Combined Cycle Total Installed Cost Estimate

2,000 Feet Elevation



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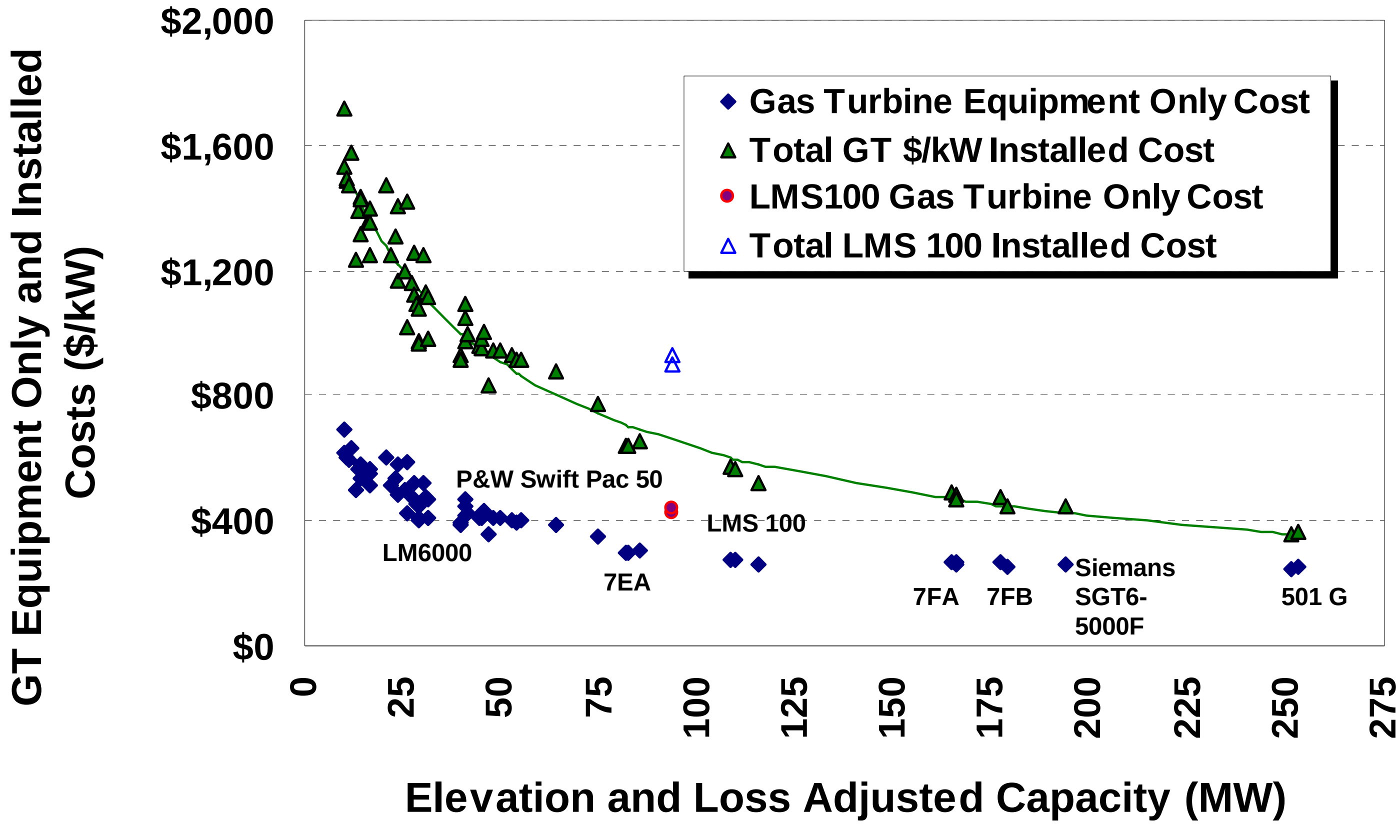
Schedule 5, Page 290 of 729

2008 Simple Cycle Total Installed Cost Estimate

2,000 Feet Elevation



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Case Nos. AVU-E-12-08
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Schedule 5, Page 291 of 729

Renewable Supply Side Resources

- Geothermal
- Wind – 100 MW, < 5 MW, and offshore
- CCCT Wood Boiler
- Wood Gasification Conversion
- Open Loop Biomass – landfill gas, wood, waste, etc.
- Closed Loop Biomass
- Solar Photovoltaic
- Solar Thermal
- Roof Top Solar
- Tidal Power
- Hydrokinetics
- Run of River Hydro
- Pumped Storage

Avista Resource Upgrades

- Little Falls Unit #1 – 4 Upgrades
- Post Falls Unit #6 Upgrade
- Upper Falls Upgrade
- Long Lake new unit and new powerhouse
- Cabinet Gorge #5
- Scheduled upgrades and acquisitions are included in the L&R
  - Noxon Rapids Units #1 – 4 scheduled for 2009 – 2012
  - Lancaster Generation Facility – 2010
  - Reardan – preliminarily scheduled for 2011

Avista 2009 IRP Resource Assumptions

Draft as of 8/27/08
2009 Dollars

Resource (not locational specific)	First Year Available	Availability (MW)	Capital Cost-Exclude AFUDC (2009$/kW)	Transmission Interconnect ($/kW)	Construction (Yrs)	Fixed O&M ($/kW/Yr)	Net HHV Heat Rate(s) (Btu/kWh)	Variable Costs ($/MWh)	Gas Transport ($/Dth/Mn)	Fuel Charge (%)	Winter Capacity Credit (%)	Summer Capacity Credit (%)	Availability (%)	Forced Outage (%)	Annual Avg Maintenance (days)	Min Dispatch (%)	Start up Cost ($/MW/Start)	Start up Fuel (Dth/MW/Start)	Ramp Rate (%/hr)	CO2 (lbs/mmbtu)	SO2 (lbs/mmbtu	NOX (lbs/mmbtu)	Federal Incentives	Sources/Notes
CCCT (2x1) w/ duct burner (wet)	2011	N/A			3		6,750/ 8,500	3.29	0.27	1.0	105	95	90.1	5	18	55	35	6.6	20	117	0.0006	0.02	No	
CCCT (2x1) w/ duct burner (dry)	2011	N/A			3		6,900/ 8,700	3.29	0.27	1.0	105	95	90.1	5	18	55	35	6.6	20	117	0.0006	0.02	No	
CCCT (1x1) w/ duct burner (wet)	2011	N/A	900		3	11.0	6,750/ 8,500	3.29	0.27	1.0	105	95	90.1	5	18	55	35	6.6	20	117	0.0006	0.02	No	O&M: '08 CS2 Budget (LTSA/Major Maint is in VOM calculation), emissions based on CS2, Eng. Est.
CCCT (1x1) w/ duct burner (dry)	2011	N/A	928		3	11.0	6,900/ 8,700	3.29	0.27	1.0	105	95	90.1	5	18	55	35	6.6	20	117	0.0006	0.02	No	Capital Cost Est from Thermoflex and HR based on
CCCT (600MW, w/ Seq)	2025	N/A							0.27	1.0	105	95	90.1	5	18					11.7	0	0	No	
Small Co-Gen (<5MW)	2011	15	2,000		1.5	5.0	5,700	5.00	0.27	1.0	105	95	92.3	5	10	n/a	n/a	n/a	n/a	117	0.0006	0.02	No	
Pipeline Co-Gen	2010								n/a	n/a						n/a	n/a	n/a	n/a	n/a	n/a	n/a	No	
Frame SCCT	2010	N/A	480		1.5		10,200	5.00	0	3.4	105	95	92.3	5	10		15	3.7	100	117	0.0006	0.02	No	Thermoflex, NPCC
Hybrid SCCT (LMS 100)	2010	N/A	900		1.5		8,400	5.00	0	3.4	105	95	92.3	5	10				100	117	0.0006	0.02	No	Thermoflex, NPCC
Wind (100MW)	2010	500	2,400		2	50.0	n/a	3.00	n/a	n/a	TBD	TBD	28-33	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	FULL PTC- 10 Yrs (end 2011)	Recent press, O&M from Uwe's latest O & M Presentation
Wind (<5MW)	2010	10	3,000		2		n/a	3.00	n/a	n/a	TBD	TBD	20.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	FULL PTC- 10 Yrs (end 2011)	
Wind (Offshore)	2018	100	5,000			95.0	n/a		n/a	n/a	TBD	TBD	45.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	FULL PTC- 10 Yrs (end 2011)	PSE Assumption from Wind Developer
Coal (Ultra Critical)	2019	N/A	3,000		8	38.0	8,825	1.30	n/a	n/a	100	100	89.2	7	14	50	n/a	n/a	8	205	0.12	0.07	No	Black & Veatch (O&M), VOM Goldman Sachs, maint based on Colstrip
Coal (IGCC)	2022	N/A	3,600		8	41.0	8,130	4.00	n/a	n/a	105	95	89.2	7	14	75	n/a	n/a	4	205	0.03	0.15	No	Black & Veatch (O&M), VOM Goldman Sachs, assumes extra gasifier
Coal (IGCC w/ Seq)	2025	N/A	5,040		8	50.0	9,595	4.40	n/a	n/a	100	100	88.3	7	17	75	n/a	n/a	4	20.5	0.003	0.015	No	Escalated rates from IGCC based on NPCC for O&M, capital 40% higher than IGCC
Geothermal	2012		4,250		3	75.0		5.00	n/a	n/a	110	90	93.4	5	6	n/a	n/a	n/a	n/a	10	n/a	n/a	FULL PTC- 5 Yrs (End 2011)	Capital Costs per Avg of Kitz & Public Renewable Partners, O&M per GS Study
CCCT Wood Boiler	2012	20	2,500		3	121.0	10,500	6.00	n/a	n/a	100	100	90.1	5	18	0	n/a	n/a	n/a	202	0.025	0.17	HALF PTC- 5 Yrs (End 2011)	Emissions data per Kettle Falls & TD analysis
Wood Gasification Conv. for CCCT DB		25							n/a	n/a			100.0				n/a	n/a	n/a	202			HALF PTC- 5 Yrs (End 2011)	
Wood Gasification Conversion (KFCT)		7							n/a	n/a			100.0				n/a	n/a	n/a	202			HALF PTC- 5 Yrs (End 2011)	
Biomass Open Loop (landfill,wood,waste,etc)	2011		5,000		2				n/a	n/a	100	100	92.3	5	10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	HALF PTC- 5 Yrs (End 2011)	Black & Veatch (Capital)
Biomass Closed Loop	2017				2				n/a	n/a	100	100	92.3	5	10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	FULL PTC- 10 Yrs (end 2011)	
Solar Photovoltaic	2010	50	7,500		1	32.0	n/a	0.00	n/a	n/a		100	20.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30% ITC (End 2011)	Black & Veatch (Capital), O&M per Goldman Sachs Study
Solar Thermal	2010	50	4,200		3	65.0	n/a	0.00	n/a	n/a		100	30.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30% ITC (End 2011)	Black & Veatch (Capital) O&M per Goldman Sachs Study
Roof Top Solar	2010	50	8,000		0.5	30.0	n/a	0.00	n/a	n/a		100	15.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30% ITC (End 2011)	Kyocera Website, O&M per Goldman Sachs Study
Nuclear	2022	500	5,500		10	97.0	10,400	0.55	n/a	n/a	100	100	87.1	8	18		n/a	n/a		n/a	n/a	n/a	FULL PTC- 10 Yrs (end 2011)	Reports/Huron Consulting (Capex), Black & Veatch (O&M)
Tidal Power	2018	2	10,000		1.5	1000.0	n/a	0.00	n/a	n/a	0	0	30.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	FULL PTC- 10 Yrs (end 2011)	Tidal Power Conference and CC fabricated based on range from conference
Little Falls 1 Upgrade	2014	1.0	2,600		2	0.0	n/a	0.00	n/a	n/a	100	100	61.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	HALF PTC- 10 Yrs (end 2011)	Avista Engineering Preliminary Estimate
Little Falls 2 Upgrade	2015	1.0	1,800		2	0.0	n/a	0.00	n/a	n/a	100	100	61.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	HALF PTC- 10 Yrs (end 2011)	Avista Engineering Preliminary Estimate
Little Falls 3 Upgrade	2016	1.0	3,200		2	0.0	n/a	0.00	n/a	n/a	100	100	61.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	HALF PTC- 10 Yrs (end 2011)	Avista Engineering Preliminary Estimate
Little Falls 4 Upgrade	2017	1.0	1,300		2	0.0	n/a	0.00	n/a	n/a	100	100	61.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	HALF PTC- 10 Yrs (end 2011)	Avista Engineering Preliminary Estimate
Post Falls 6 Upgrade	2018	0.2	5,000		2	0.0	n/a	0.00	n/a	n/a	100	100	50.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	HALF PTC- 10 Yrs (end 2011)	Avista Engineering Preliminary Estimate
Upper Falls Upgrade	2019	2.0	3,500		3	0.0	n/a	0.00	n/a	n/a	100	100	90.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	HALF PTC- 10 Yrs (end 2011)	Avista Engineering Preliminary Estimate
Long Lake 5 Addition	2020	24.0	2,167		5	1.0	n/a	0.00	n/a	n/a	100	100	30.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	HALF PTC- 10 Yrs (end 2011)	Avista Engineering Preliminary Estimate
Long Lake 2nd Powerhouse	2020	60.0	2,000		6	2.0	n/a	0.00	n/a	n/a	100	100	2.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	HALF PTC- 10 Yrs (end 2011)	Avista Engineering Preliminary Estimate
Cabinet Gorge Unit 5	2016	60.0	1,417		5	2.0	n/a	0.00	n/a	n/a	100	100	12.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	HALF PTC- 10 Yrs (end 2011)	Avista Engineering Preliminary Estimate
Pumped Storage	2020	25	5,000		8	5.0	n/a	Off-Peak Market	n/a	n/a	100	100	50.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No	Avista Engineering Preliminary Estimate
Hydrokinetics	2014	5	4,000		3	3.0	n/a	0.00	n/a	n/a			75.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	HALF PTC- 10 Yrs (end 2011)	Avista Engineering Preliminary Estimate
Run of River Hydro	2020	N/A	4,500		5	2.0	n/a	0.00	n/a	n/a	100	100	30.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	HALF PTC- 10 Yrs (end 2011)	Avista Engineering Preliminary Estimate

Scenarios and Futures

John Lyons

Uses of Scenarios and Futures

Provide details about impacts and size of impacts of different assumptions

- Avista's current load and resource portfolio
- Preferred Resource Strategy
- Wholesale electric market
- Different resource options

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Market Scenarios

- Starts with the Base Case assuming expected conditions
  - Hydro
  - Load
  - Gas prices
  - Wind
  - Emissions prices
  - Forced outages
- Scenarios study the effects of fundamental changes to a driving force in the forecast
- Scenarios have quicker solution times and provide more understandable results due to the limited change in variables
- Used to test portfolio sensitivities

Market Futures

- A future is a stochastic or random study using Monte Carlo style analysis for risk quantification
- Multiple iterations provide a shape and boundaries to potential costs
- Avista's modeling process looks 21 years into the future with several hundred draws of hydro, load, wind, fuel prices, emissions costs, and thermal forced outage values
- Futures can quantitatively assess market risk
- Use a large amount of computational power for each future
- Results are sometimes difficult to understand because of the sheer number of variables

2009 IRP Market Futures

- **Base Case:** uses expected hydro, wind, load, fuel costs, and emissions costs
- **Unconstrained Carbon:** quantifies CO_2 emissions costs
- **High CO_2 Costs:** higher expected value of CO_2 emissions costs
- **Volatile Fuel:** increase natural gas price volatility

2009 IRP Market Scenarios

- **High and Low Gas Prices:** 50% higher and 50% lower prices
- **CO_2 and Natural Gas:** different levels of linkage between CO_2 and natural gas prices
- **High and Low Load Growth**
- **Electric Car:** high penetration of electric cars
- **Constant Gas Growth:** No downward trend in near term gas prices
- **Unconstrained Carbon Costs:** zero carbon costs
- **High Carbon Costs:** significantly higher than the Base Case
- **Nuclear:** significant new nuclear in the Western Interconnect
- **Buck-a-Watt Solar:** drastic decrease in photovoltaic solar costs

2009 IRP Portfolio Options

- **Efficient frontier**
- **No Resource Additions –** market reliance
- **All CT –** with and without green tags
- **All CCCT –** with and without green tags
- **Fixed Gas –** with and without
- **All Renewables**
- **Wind and CT**
- **Nuclear –** available in 2020
- **Coal –** available in 2018
- **2007 IRP**
- **Others?**

New Scenario Approach

- Previous slides show Avista's past approach to scenarios and futures
- This approach is difficult to use to adjust our resource strategy
- Moving towards a smaller number of scenarios, where each scenario represents a fundamentally different future with its own assumptions
- Scenario matrix with the economy and environmental concerns

1. **Base Case –** center of the matrix
2. **Quadrant 1 –** Economic Boom and Weak Environmental
3. **Quadrant 2 –** Economic Boom and Strong Environmental
4. **Quadrant 3 –** Economic Bust and Weak Environmental
5. **Quadrant 4 –** Economic Bust and Strong Environmental

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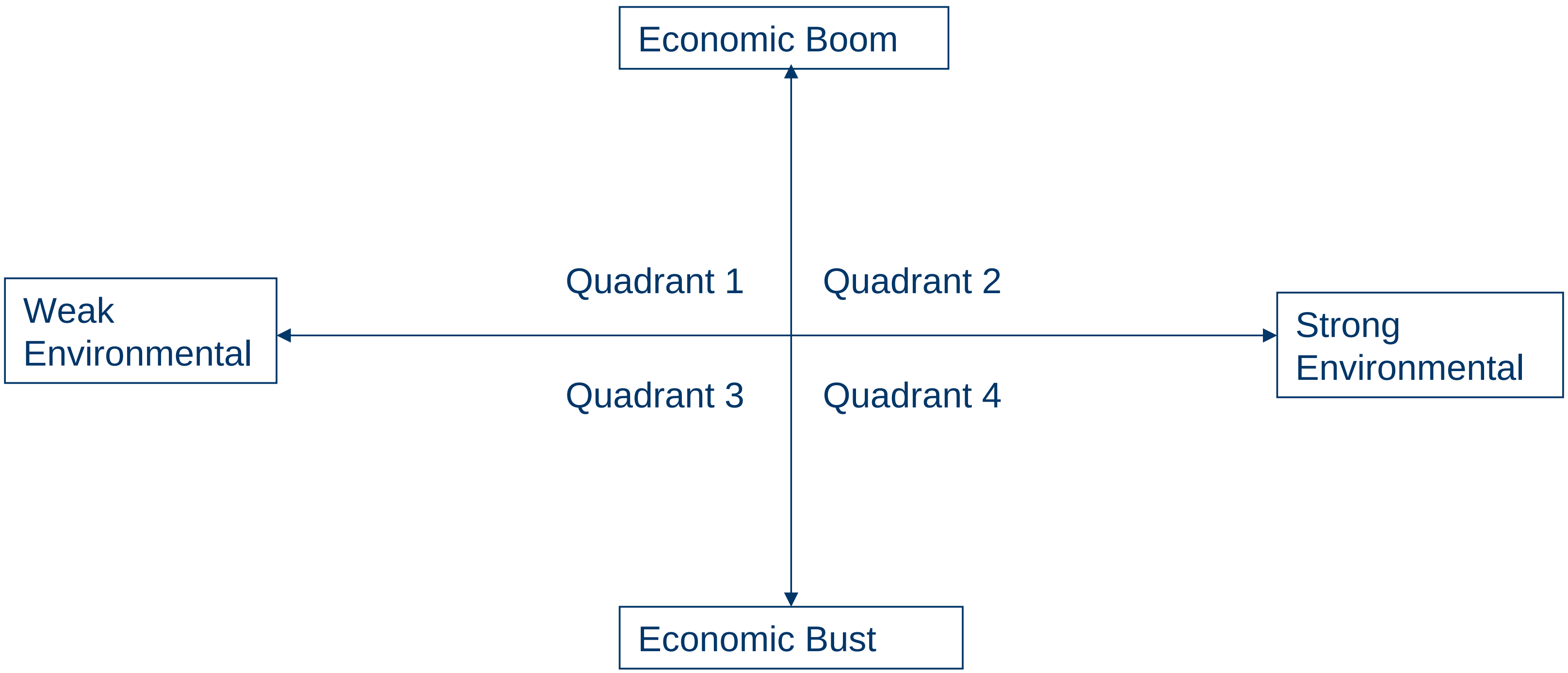
Scenario Matrix – Environmental Regulation and Economics



Potential Scenario Drivers

- **Economic –** inflation, load, commodities, and market developments
- **Environmental –** carbon costs, RPS, and competition for renewables
- **Political –** structure of carbon market
- **Social –** views of environmental issues and response of customers to rate pressure
- **Technological –** help or hindrance, new technologies, and electric cars
- **Organizational –** business as usual, new ways of doing things

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Demand-Side Management in the 2009 Electric IRP

Jon Powell

DSM / IRP Objectives

Opportunity to perform a comprehensive overview of electric resource opportunities and strategy on a level playing field

DSM Challenges in the IRP

- IRP results must be actionable to be meaningful
- The IRP must provide the basis for continual evaluation of DSM opportunities between IRP cycles
- “Normal” technical challenges of assessing DSM resources within the IRP

How Avista Addresses Challenges

- The biennial high-level IRP process is augmented with an annual detailed DSM business plan
- Our tariffs are reasonably flexible in the short-term; even more flexible in the long-term
- The IRP avoided cost stream forms the basis for intra-IRP DSM resource analysis and cost-effectiveness

Annual DSM Business Plan

- Establishes a corporate budget
- Allows for the detailed review of DSM opportunities
- Considers the packaging of measures
- Establishes a high-level program plan for promising measures:
  - Infrastructure requirements (labor and non-labor)
  - Outreach requirements (brochures, paid and free media, etc)
  - Establishes critical trade allies relationships (including potential regional cooperative efforts)
- Program trigger points are established
- Plan for the M&E necessary for program management and external reporting
- Calculate prospective cost-effectiveness (program and portfolio)

DSM Tariffs and Operations

- Tariffs can, and have, changed to meet resource acquisition needs
- DSM operations governed by Schedule 90 and funded by Schedule 91
- Tariffs allow for the inclusion of any measure into the DSM portfolio
- Four basic portfolio's within Avista's DSM operations

1. Non-Residential – mix of "site-specific" and prescriptive programs
2. Residential – exclusively prescriptive programs
3. Residential Limited Income – any measure cooperating with CAP agencies
4. Regional – NEEA's market transformation portfolio

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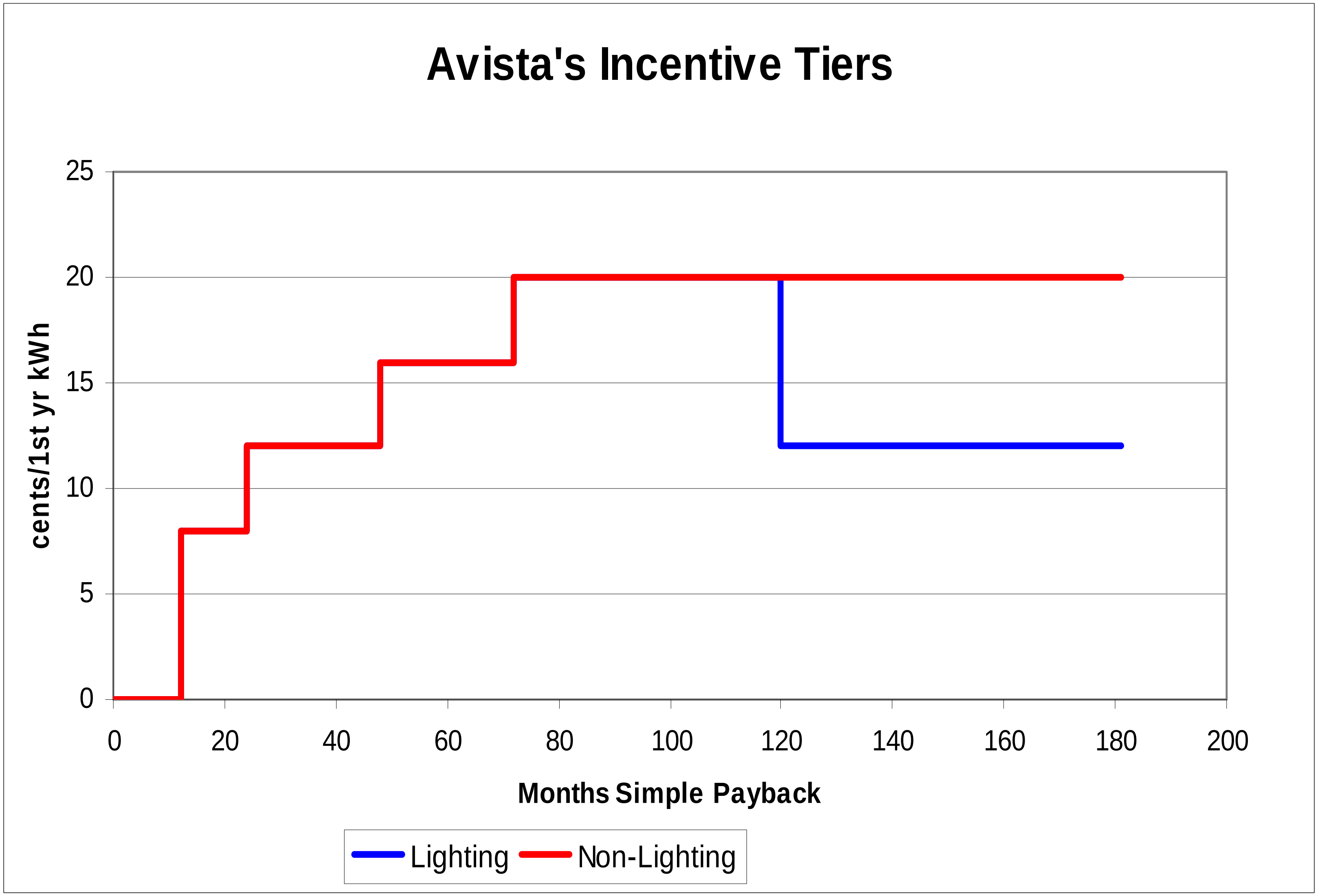

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Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 311 of 729

Electric Avoided Costs

- Price is an efficient means of signaling resource scarcity
- Avoided cost composed of:
  – Commodity avoided cost ($/kWh)
  – Distribution losses ($/kWh)
  – Carbon cost ($/kWh)
  – Value of risk reduction ($/kWh)
  – Generation capacity ($/kW)
  – T&D capacity ($/kW)

Demand-Side Management in the 2009 Electric IRP

Lori Hermanson

Integration of DSM into the 2009 IRP

Interactive process that meets regulatory requirements and produces results for the business planning process.

- Identify commercially available non-residential technologies and applications
  - "Acceptance" or "rejection" within the IRP will not remove any technology or application from potentially being included in our non-residential portfolio
  - Almost 2,500 measures being evaluated for the 2009 IRP
- Re-evaluate existing residential measures and evaluate the inclusion of additional measures
  - May change the menu of qualifying residential measures.
  - Nearly 800 measures being evaluated for 2009

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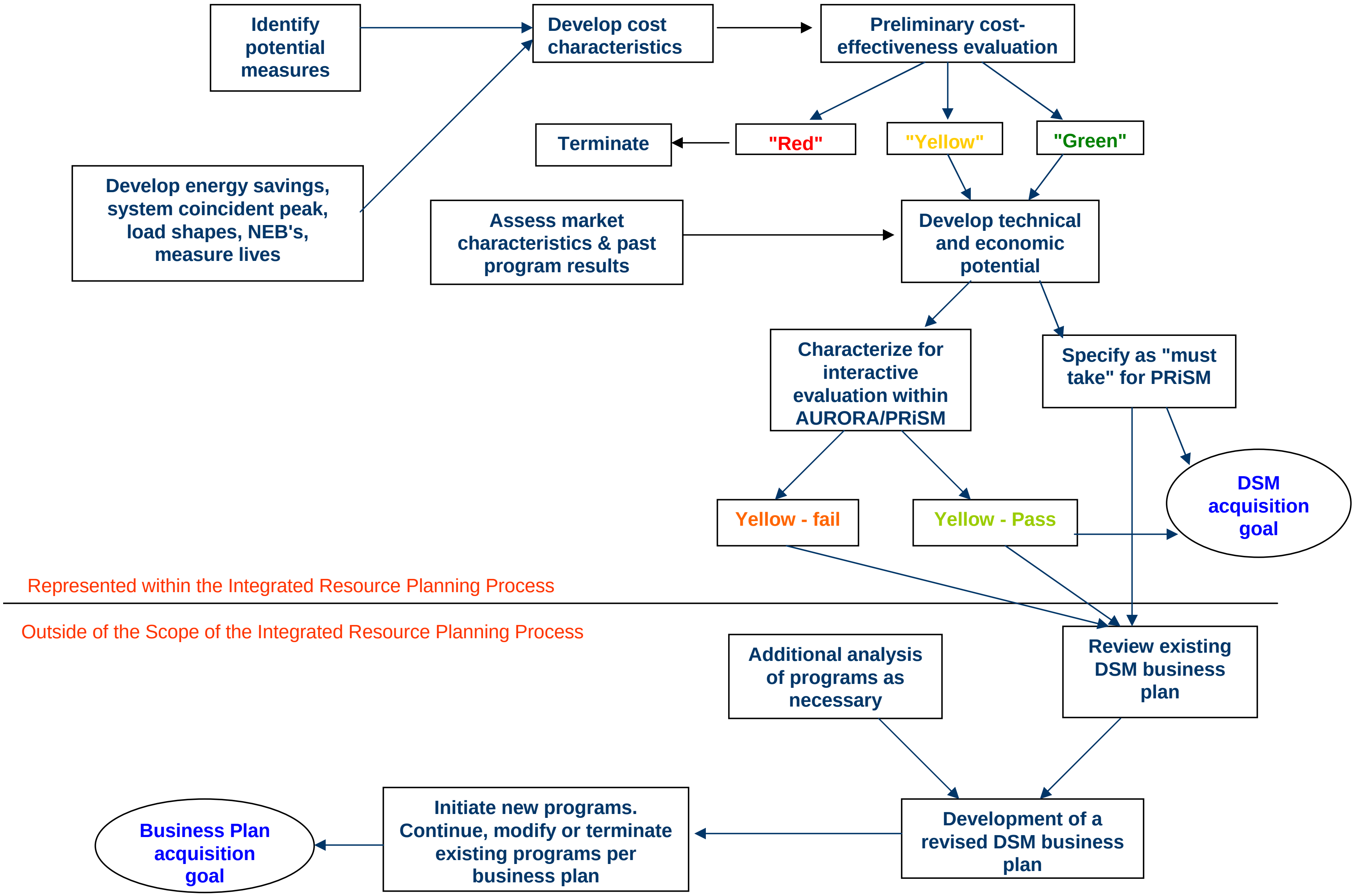
Integration of DSM into the 2009 IRP

- Inclusion of Limited Income and Non-Residential Site Specific programs are done by modifying the historical baseline
  - Not necessarily limited to modifying baseline for price elasticity and load growth
- Improvements in estimating Site Specific programs
  - Identified the largest portion of Site Specific programs and are trying to make them more generic in nature
  - Can process more Non-Residential programs through the entire IRP process as opposed to modifying a historical base


Identify potential measures
Develop cost characteristics
Preliminary cost-effectiveness evaluation
Terminate
"Red"
"Yellow"
"Green"
Develop energy savings, system coincident peak, load shapes, NEB's, measure lives
Assess market characteristics & past program results
Develop technical and economic potential
Characterize for interactive evaluation within AURORA/PRiSM
Specify as "must take" for PRiSM
DSM acquisition goal
Yellow - fail
Yellow - Pass
Represented within the Integrated Resource Planning Process
Outside of the Scope of the Integrated Resource Planning Process
Additional analysis of programs as necessary
Review existing DSM business plan
Business Plan acquisition goal
Initiate new programs. Continue, modify or terminate existing programs per business plan
Development of a revised DSM business plan

Categories of Savings and Benefits

- Obtain savings, system coincident peak savings, incremental customer cost, non-energy benefits and life of each measure
  - Used to calculate a levelized sub-TRC cost
  - Sorted based on results into “reds,” “yellows” and “greens”
  - Band of “yellow” energy only measures to be tested in AURORA is projected to be $70-150/MWh
  - PRiSM automatically selects “greens”
  - Remainder of need is selected from passing “yellows”
  - Establishes the 2009 DSM acquisition goal

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Integration of DSM into the 2009 IRP

- Last year was the first focus on deferring summer space cooling-driven load
  - Load profiles were assigned to each measure
  - Measures categorized by impact to cooling load
    - Zero impact – measures received no additional value regardless of their load profile
    - Non-Drivers – measures unrelated to space cooling but contribute to system load during a cooling-driven peak receive a capacity value based upon the average demand of their specific load profile during peak periods

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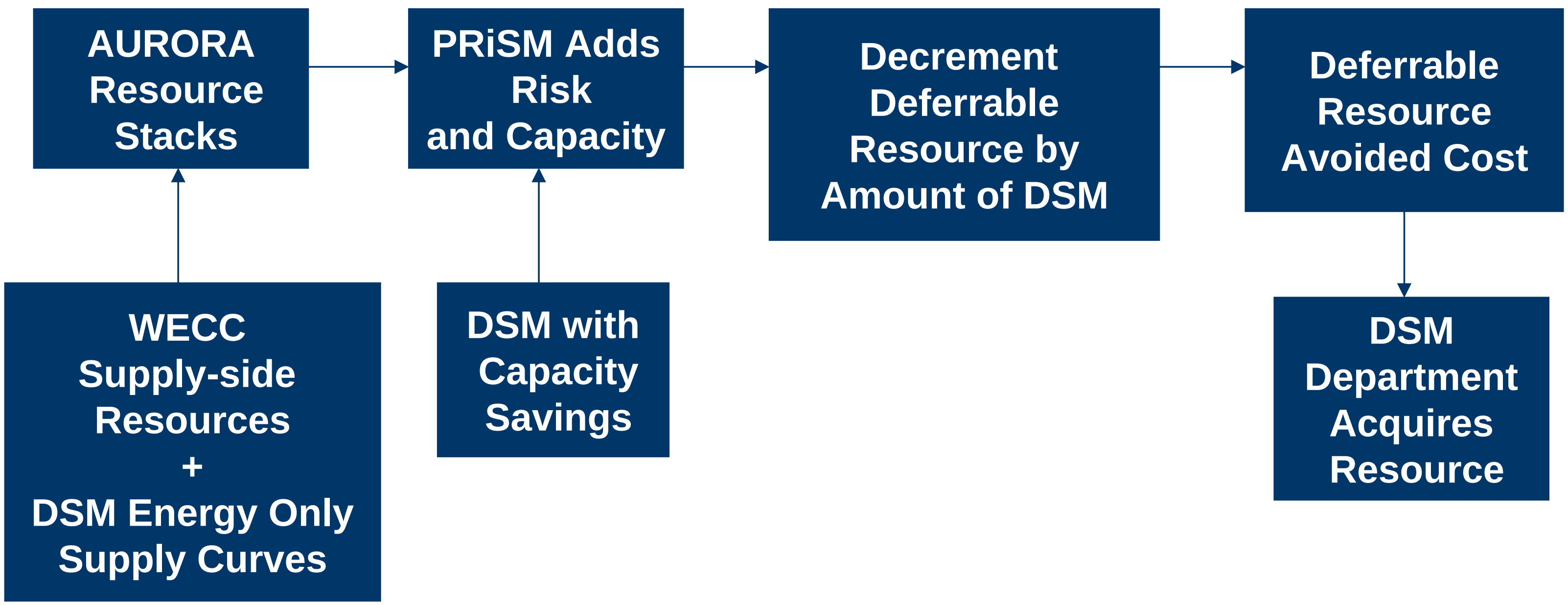
Space Cooling

- Drivers – measures that drive a space cooling peak received a capacity valuation based upon the maximum hourly demand for that load profile
- Improving method of addressing the space cooling driven peak
  - Using the Council's system coincident peak estimates
  - Measures with capacity savings will be tested in PRiSM against the avoided costs inclusive of risk and capacity
  - PRiSM will select measures and they will be incorporated into the final DSM acquisition goal

Incorporating DSM in the 2009 IRP

Integration by Price Signal



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Case Nos. AVU-E-12-08
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Schedule 5, Page 320 of 729

What Works – What Doesn't

- DSM is acquired in small annual amounts relative to the overall load requirement
  - "Snowballing" effect over time
- Historically Avista's DSM has been non-dispatchable
  - Demand Response pilot
  - When enough data is available, modifications to this existing process may need to be made to accommodate demand response technologies and applications
- Allows continuous modification and testing of new opportunities between IRPs in a consistent manner

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Avista's 2009 Electric Integrated Resource Plan

Technical Advisory Committee Meeting No. 3 Agenda
October 22, 2008

	Topic	Time	Staff
1.	Introduction	10:30	Vermillion
2.	Load Forecast	10:35	Barcus
3.	Lunch	11:45	
4.	Natural Gas Price Forecast	12:30	Rahn
5.	Electric Price Forecast	1:30	Gall
6.	Legislative Update	2:30	Sprague
7.	Adjourn	3:30	

F2009 Sales and Load Forecast

July 21, 2008 Operations Council Meeting

Randy Barcus

Edited for 2009 Electric Integrated Resource Plan

Third Technical Advisory Committee Meeting

October 22, 2008

Summary of Results

Electricity Sales Forecast

- 2009 Forecast 9,138 million kWh
- 2009 in F2008 9,134 million kWh
- 5 Year Growth Rate 2009-2014 +1.8%
- 10 Year Growth Rate 2009-2019 +1.7%
- 20 Year Growth Rate 2009-2029 +1.7%
- Last Year 20 Yr. GR 2009-2029 +1.8%

Natural Gas Firm Sales Forecast

- 2009 Firm Forecast 338.5 million therms
- 2009 in F2008 352.0 million therms
- 5 Year Growth Rate 2009-2014
  - Washington -0.2%
  - Idaho +1.0%
  - Oregon +0.8%
  - System +0.3%
- 10 Year GR System +0.9%
- 20 Year GR System +1.3%
- 20 Year Customer GR +2.5%

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Significant Assumptions

Economy—slower growth in near term, returns to trend

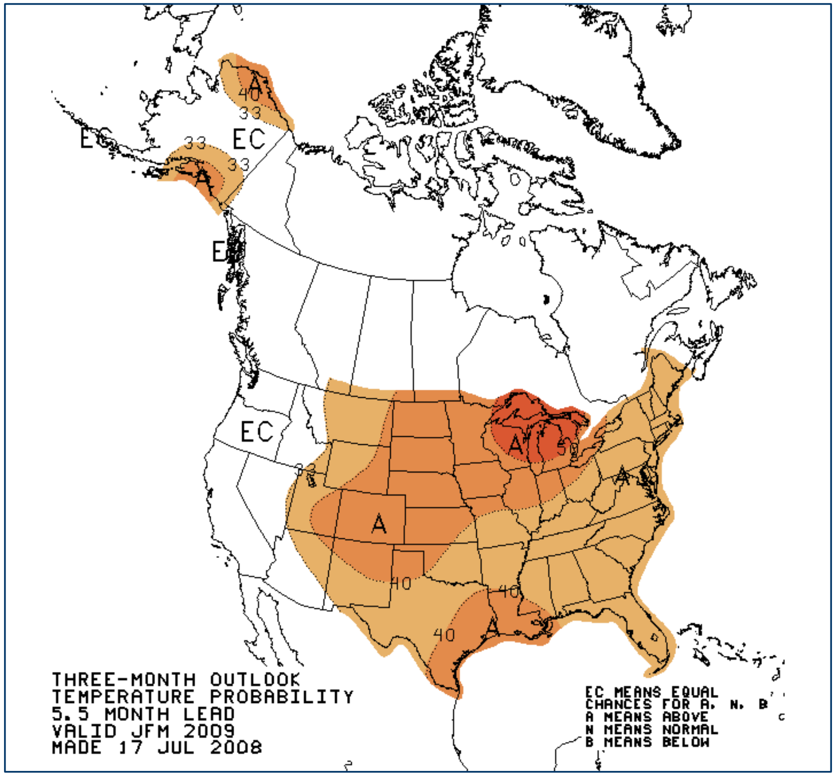
- Tight credit, housing bubble, but strong commodity prices for agriculture and metals
- Regional economy returns to long term trend in 2012

Avista Retail Prices

- Electric prices increase 10% in 2009 and thereafter until 2015, and at inflation plus real income growth thereafter
- Natural gas prices increase 20% in 2009 and 10% thereafter until 2015, and at inflation plus real income growth thereafter
- Carbon taxes are included in the 2012-2015 price increases

Global Warming Degree Days

- 2009 Heating and Cooling at NOAA Normal (1971-2000 avg.)
- 2010-2019 ramps to trend, 2020-2029 on trend



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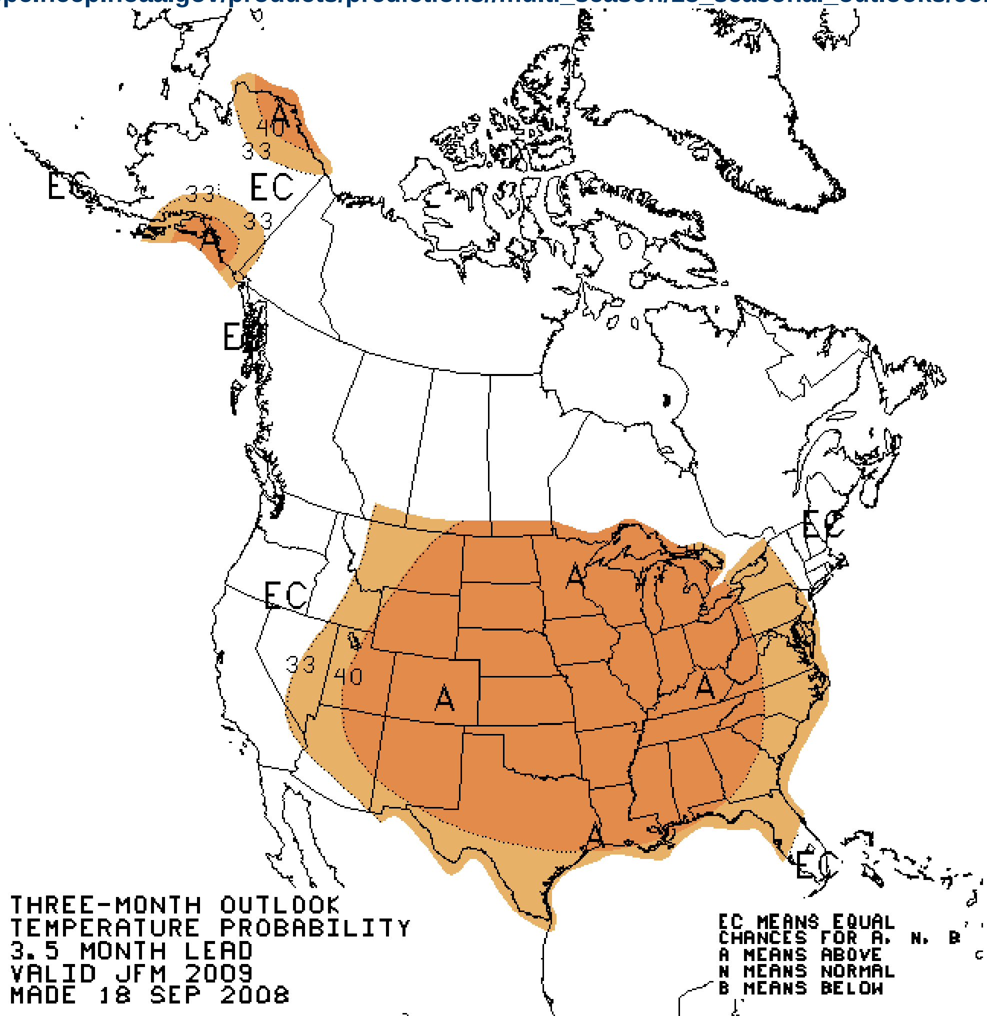
Schedule 5, Page 325 of 729

http://www.cpc.ncep.noaa.gov/products/predictions//multi_season/13_seasonal_outlooks/color/churchill.php



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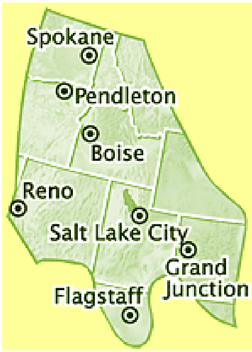


Intermountain
Annual Weather Summary
November 2008 to October 2009

Winter will be much colder and drier than normal, on average, with snowfall above normal in the north and below normal in the south. The coldest temperatures will occur in late December; early, mid-, and late January; and early February. The snowiest periods will be in mid-November, early and mid-December, mid- and late January, and late February.

April and May will be cooler than normal, with slightly above-normal precipitation.

Summer will be cooler than normal, with slightly above-normal rainfall. The hottest periods will be in mid- and late June and early and mid- to late July.

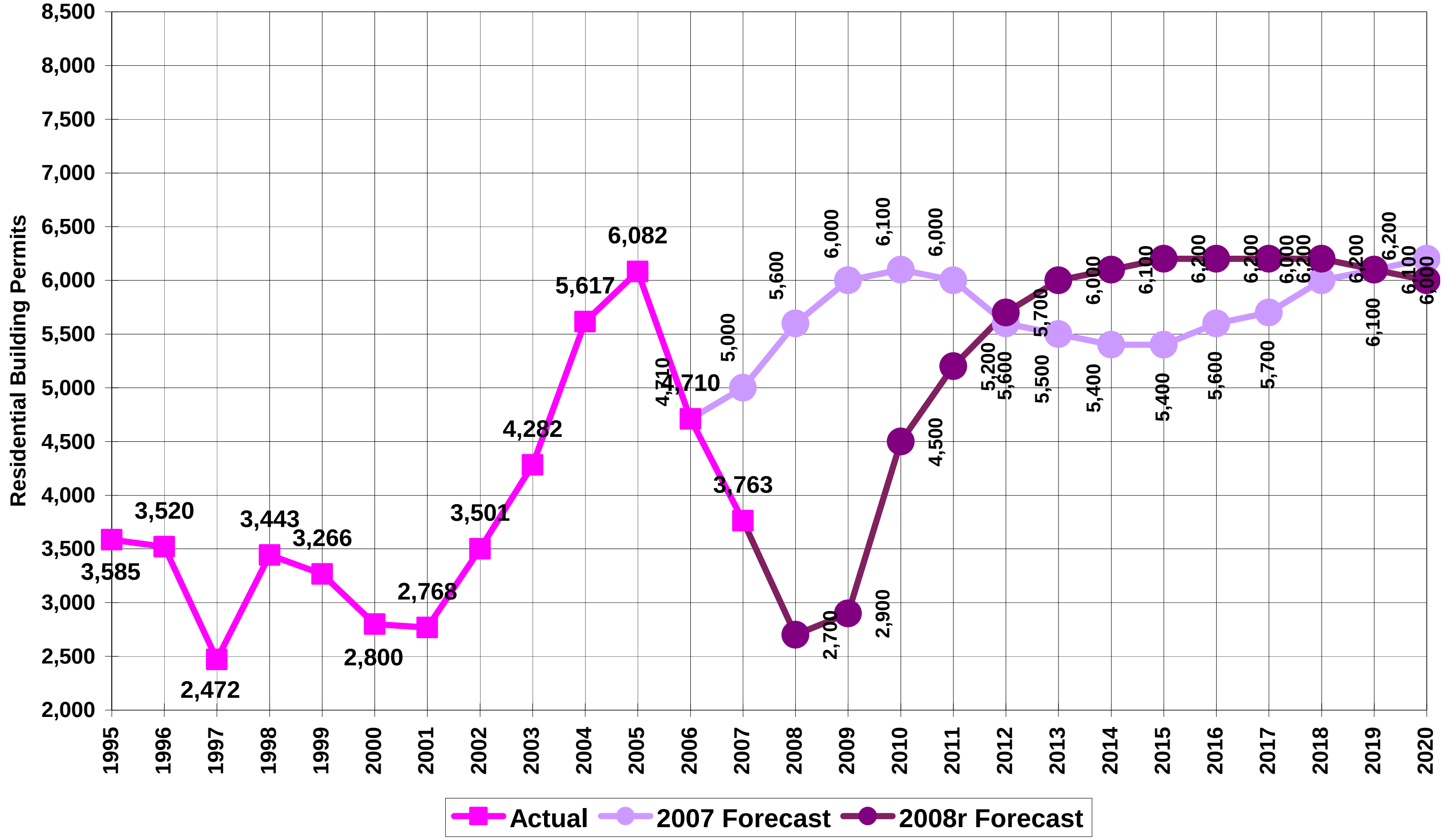
September and October will be warmer and drier than normal.

http://www.almanac.com/weatherforecast/us/13

Other Assumptions

- **DSM and Conservation—included in forecast at new levels**
- **Multi-Family Natural Gas—assuming successful penetration**
- **Inland Empire Paper—12 average MW added load in 2010**
- **Mining Loads—continued high silver prices lead to modest growth**
- **Lumber Loads—low levels through 2009, some bounce in 2010**
- **Plug-In Hybrid Cars—included in forecast**
- **Other implicit assumptions**
  - Housing mix 40% single family, 30% condo/townhome, 30% multifamily rental
  - Average new construction size is 30% larger than present average
  - Growing plug loads (largely digital TV's) offset Energy Star savings
  - The Energy Independence and Security Act of 2007 contains provisions that significantly impact electricity use, particularly residential lighting usage, over the next 5 to 10 years. The key lighting-related provisions that related to energy forecasters are:
    - Incandescent Light Bulb Standard. Requires roughly 25 percent greater efficiency for light bulbs, phased in from 2012 through 2014. This effectively bans the sale of most current incandescent light bulbs. The initial targets will be met by advanced incandescent lamps, which the major manufacturers are just introducing to the market, using halogen capsules with infrared reflective coatings. The longer-term targets will likely be met by compact fluorescent lamps and other advanced technologies, such as light emitting diodes and very advanced incandescent lamps now in development.
    - Lighting Efficiency Standard. Requires a minimum 45 lumens/watt efficiency standard for general service lamps by 2020.
    - Federal Building Lighting Standard. Requires that all lighting in Federal buildings use Energy Star products.
  - The Energy Information Administration's 2008 Annual Energy Outlook (AEO) forecast provides insight into the impact that these provisions will have on residential lighting use. The 2008 Residential AEO forecast projects that lighting's share of total residential electricity usage will drop from 14.4% in 2011, the year before the incandescent light bulb standard takes place, to 10.7% in 2016. Over this five year period, lighting's share of electricity usage is projected to drop by approximately 25%.
  - The long-run effect of the lighting standards on residential electricity usage is to decrease residential lighting share of usage to 8.3% by 2030, a reduction of over 40% from its 2011 level of 14.4%.

2008 Forecast Residential New Construction
Kootenai & Spokane County Combined



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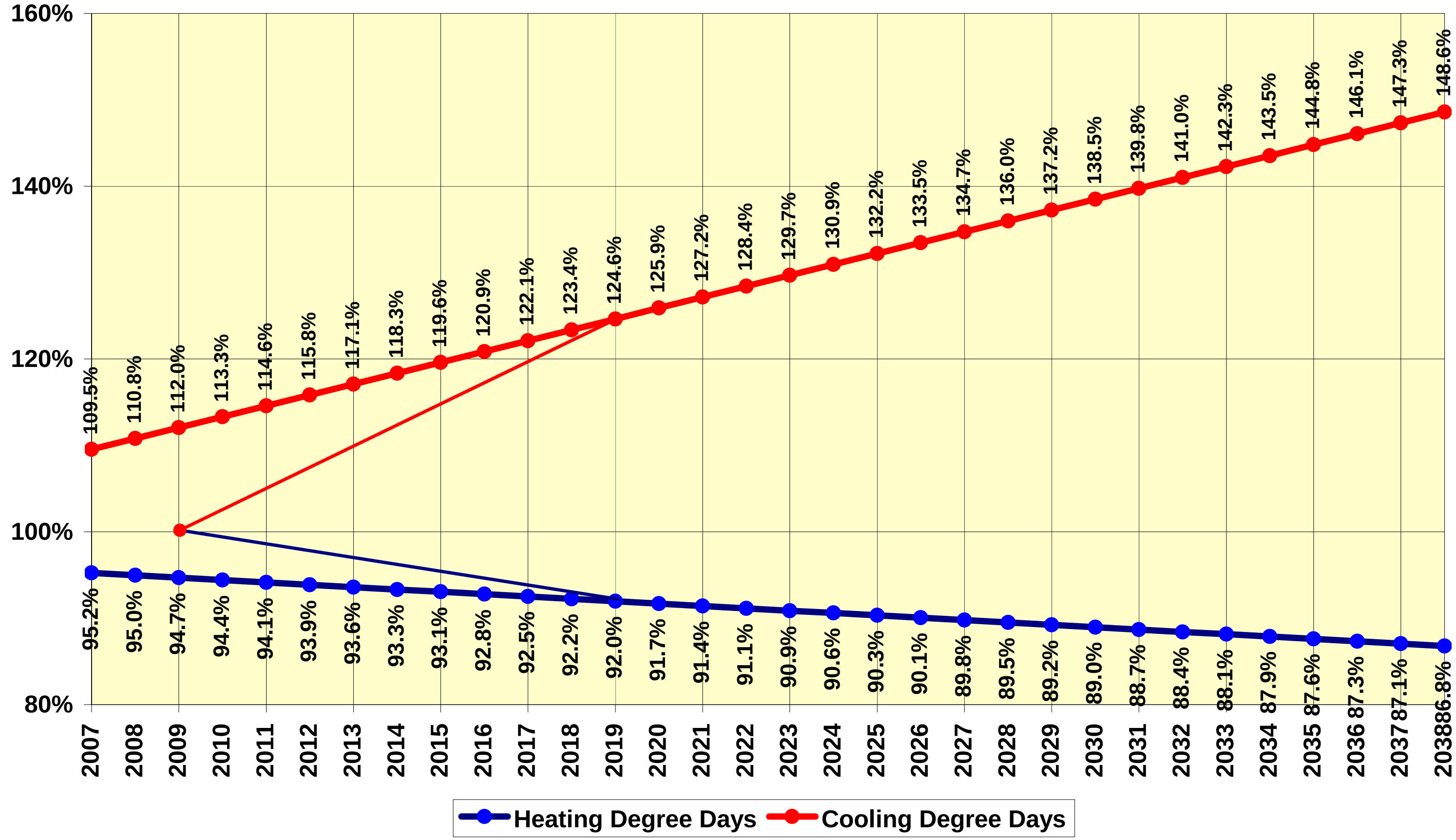
Schedule 5, Page 329 of 729

Spokane NWS Global Warming Degree Day Trends 2007-2038



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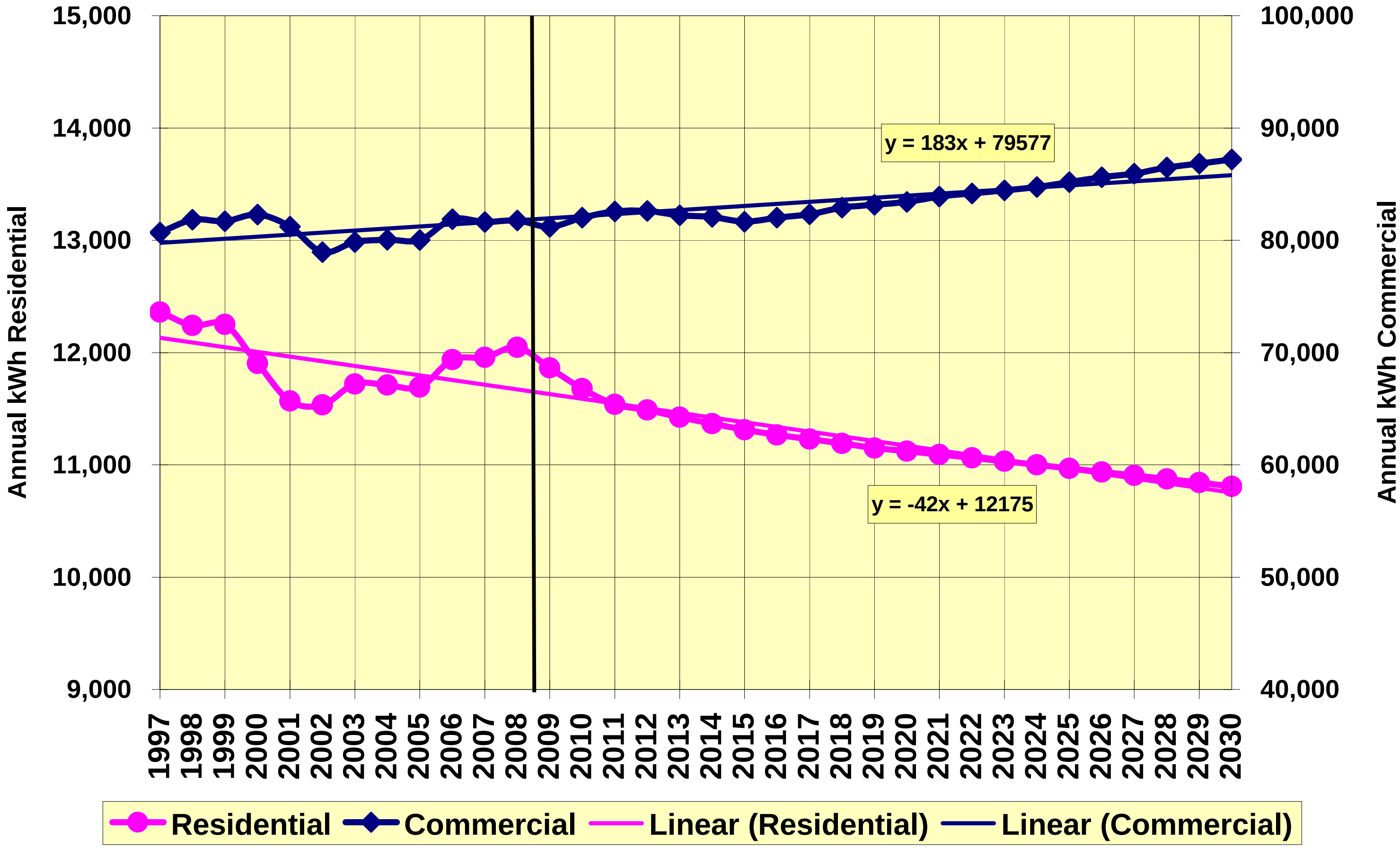
Schedule 5, Page 330 of 729

Electric Average Use per Average Customer



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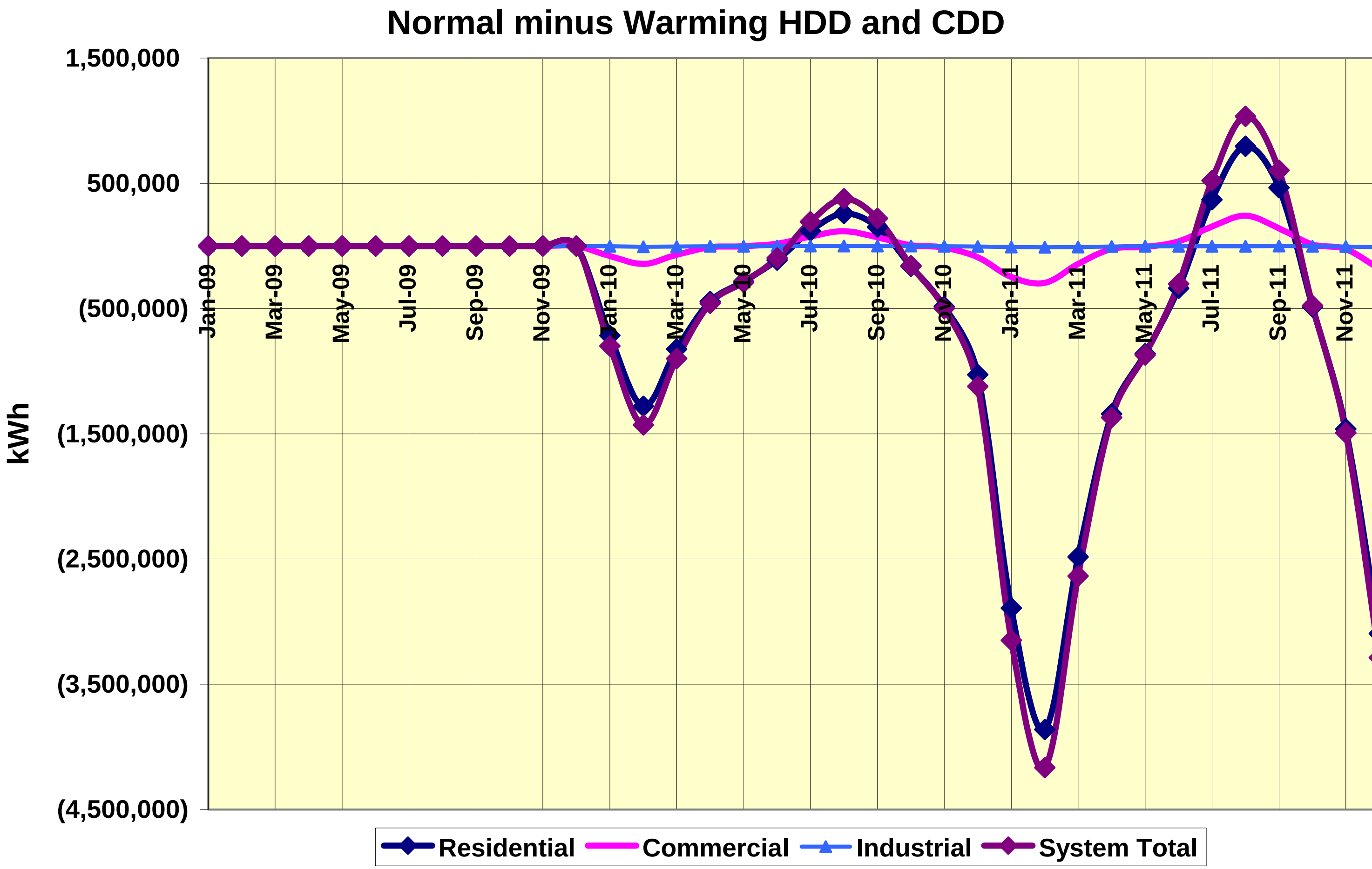
Global Warming Impact



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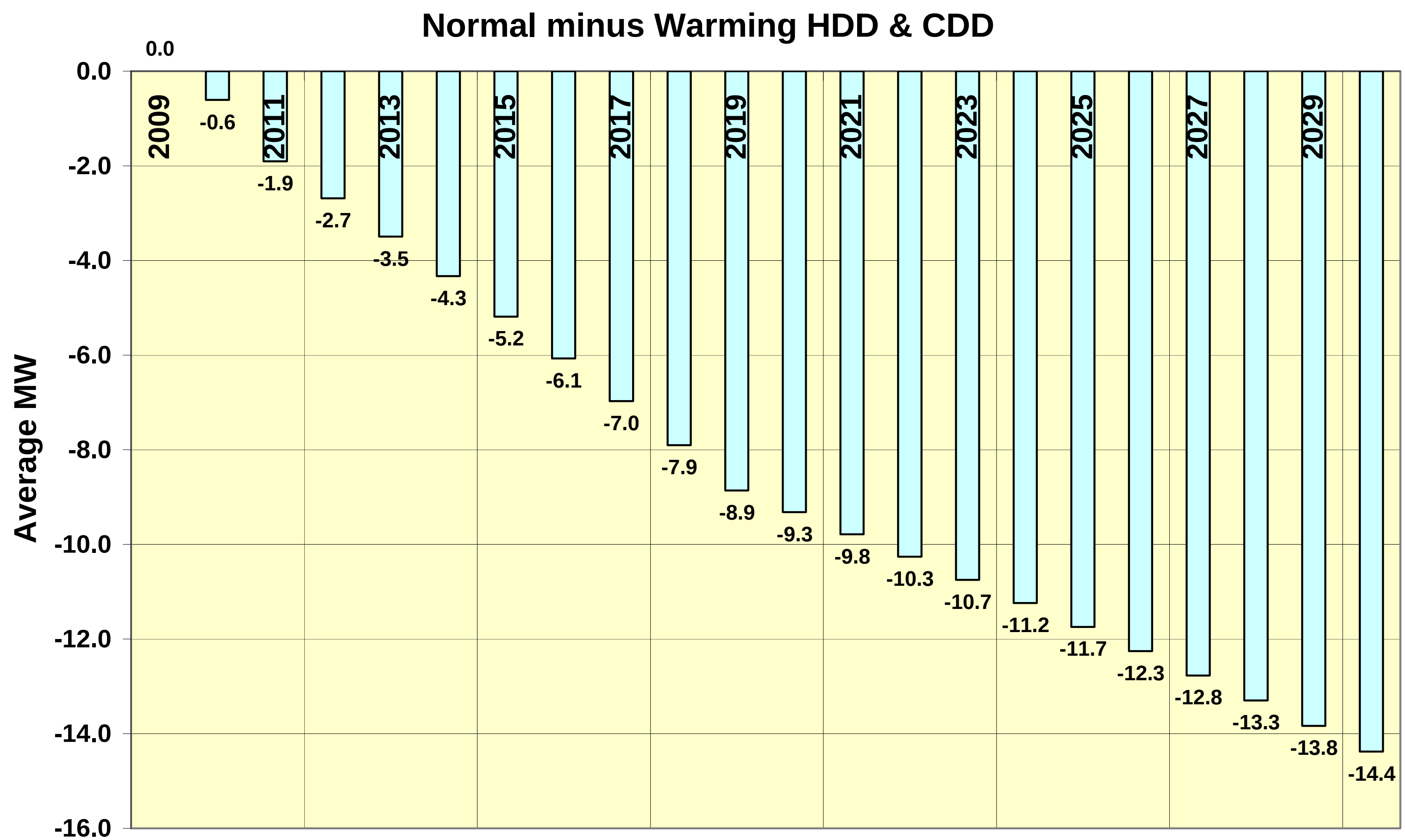
Schedule 5, Page 332 of 729

MW Difference



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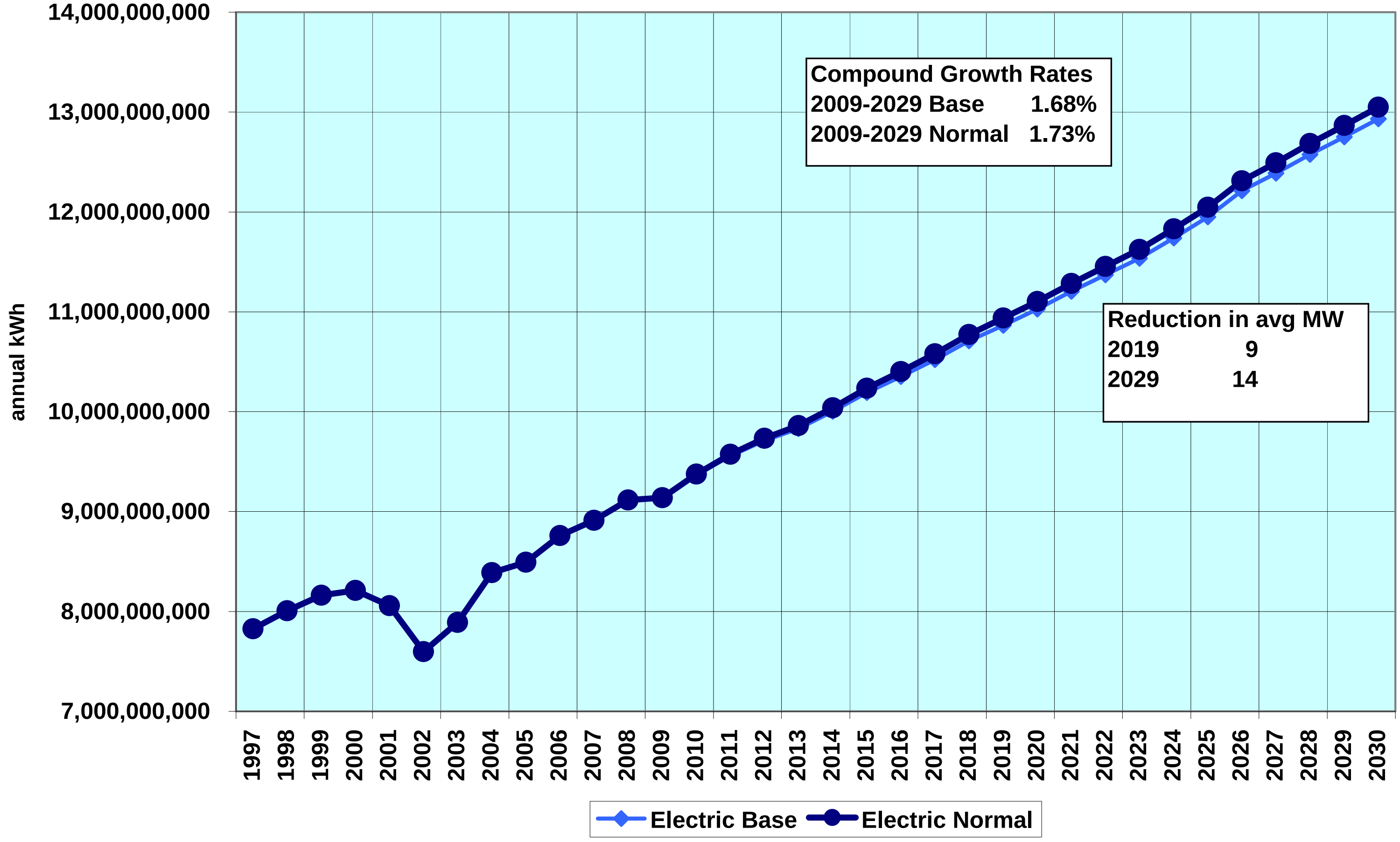
Schedule 5, Page 333 of 729

Electric Sales Forecast Base w/ GW vs. Normal Weather



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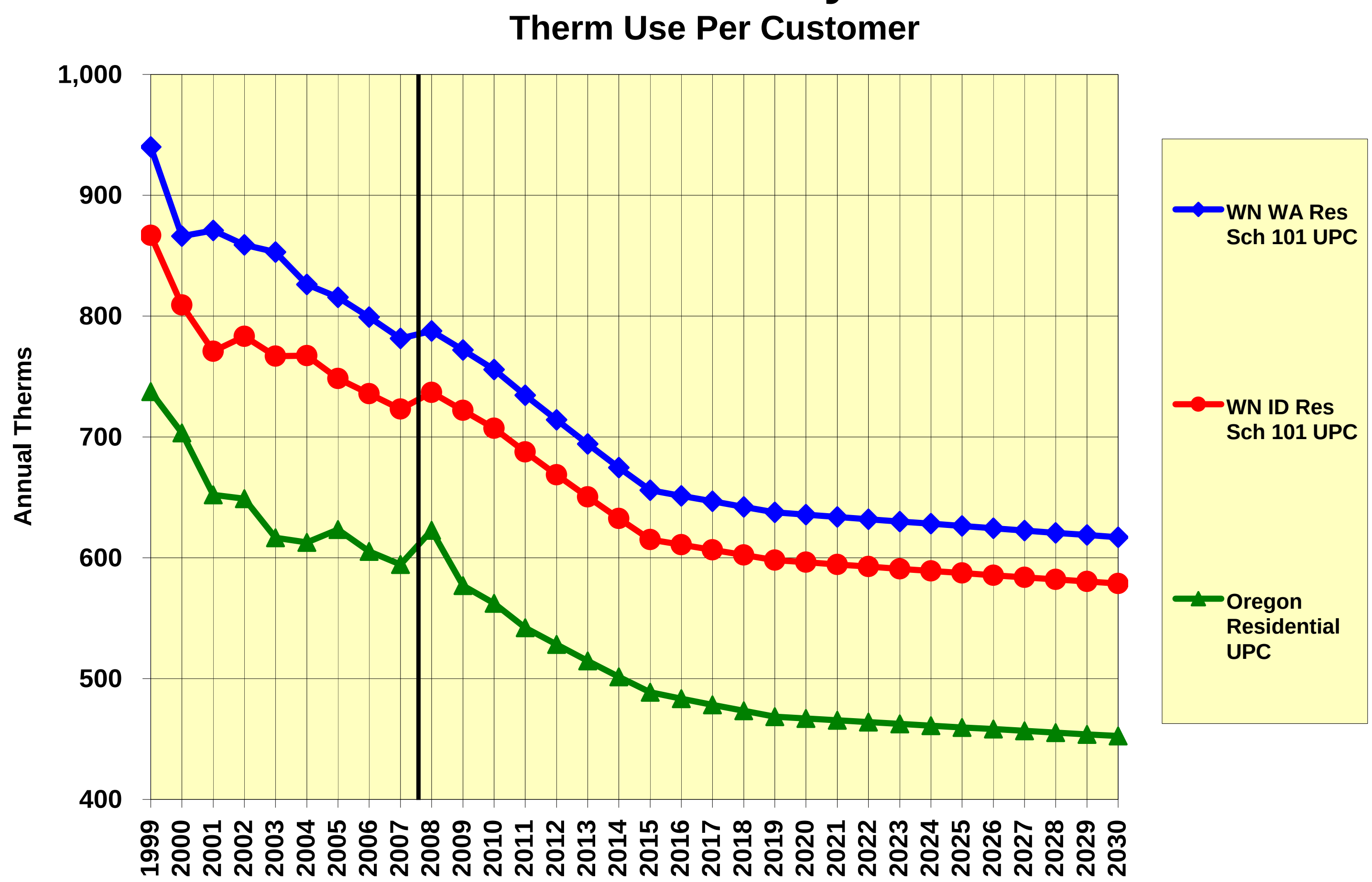
Schedule 5, Page 334 of 729

Avista Residential by Schedule



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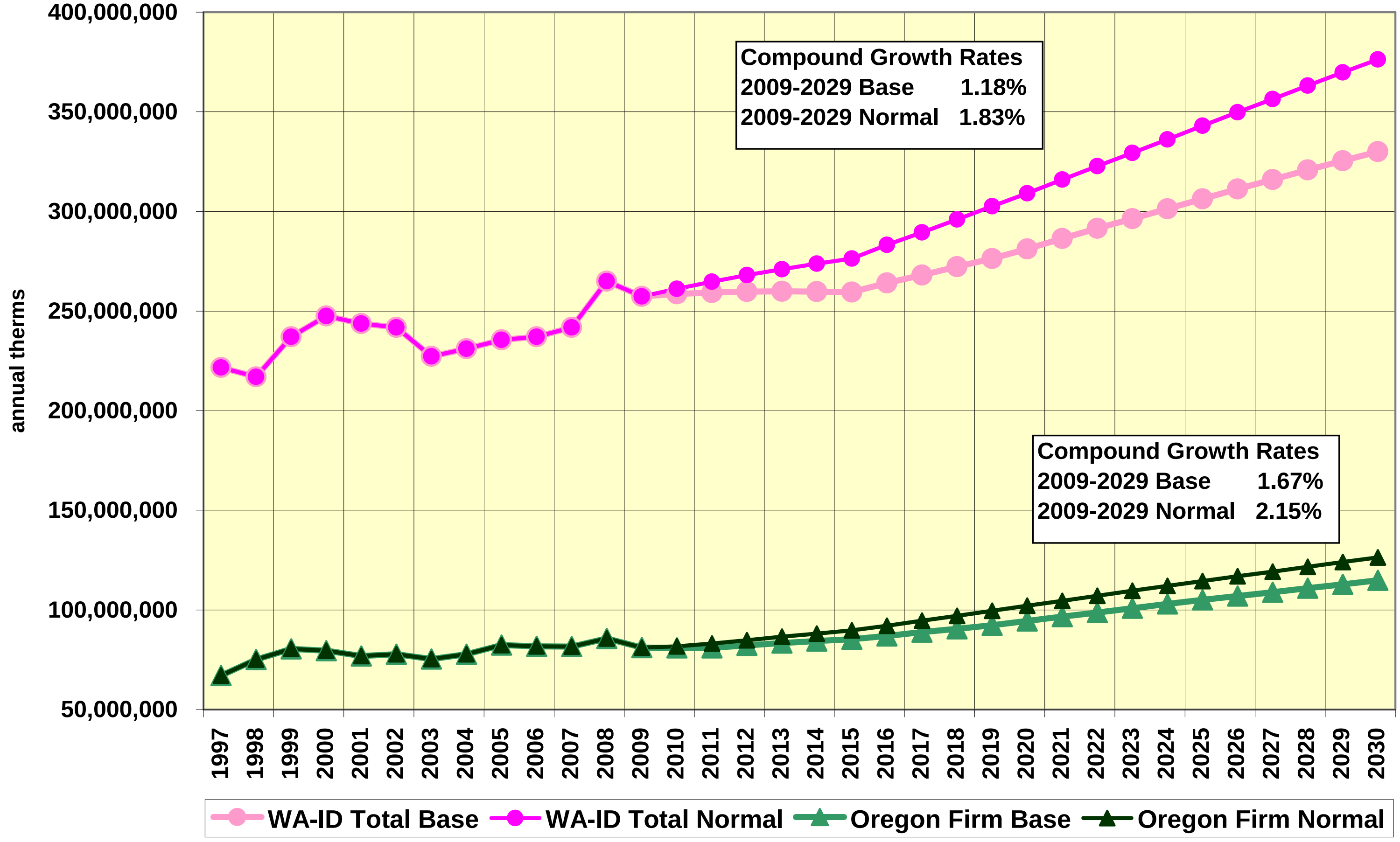
Schedule 5, Page 335 of 729

WA-ID & Oregon Natural Gas Base w/GW vs. Normal Weather



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Schedule 5, Page 336 of 729

Avista Electric Service Area Plug-In Hybrid Car Sales Forecast

	Market Share	Hybrid Vehicles Served	Incremental Sales of Hybrid Vehicles	kWh Energy Consumption	Average MW	Base Case Residential Sales Forecast	Cumulative Percent Boost to Residential	Residential Sales with Hybrid Vehicles
2010	3.5%	1,000	1,000	2,500,000	0.3	3,761,638,997	0.1%	3,764,138,997
2011	6.0%	2,000	1,000	5,000,000	0.6	3,788,118,462	0.1%	3,793,118,462
2012	8.5%	3,500	1,500	8,750,000	1.0	3,842,900,187	0.2%	3,851,650,187
2013	11.0%	5,500	2,000	13,750,000	1.6	3,893,034,524	0.4%	3,906,784,524
2014	14.0%	8,000	2,500	20,000,000	2.3	3,941,757,508	0.5%	3,961,757,508
2015	18.0%	11,000	3,000	27,500,000	3.1	3,988,061,420	0.7%	4,015,561,420
2016	24.0%	15,000	4,000	37,500,000	4.3	4,034,409,825	0.9%	4,071,909,825
2017	26.0%	20,000	5,000	50,000,000	5.7	4,079,468,146	1.2%	4,129,468,146
2018	26.0%	25,000	5,000	62,500,000	7.1	4,123,323,408	1.5%	4,185,823,408
2019	26.0%	30,000	5,000	75,000,000	8.6	4,167,601,524	1.8%	4,242,601,524
2020	26.0%	35,000	5,000	87,500,000	10.0	4,215,588,573	2.1%	4,303,088,573
2021	26.0%	40,000	5,000	100,000,000	11.4	4,261,378,267	2.3%	4,361,378,267
2022	26.0%	45,000	5,000	112,500,000	12.8	4,306,622,849	2.6%	4,419,122,849
2023	26.0%	50,000	5,000	125,000,000	14.3	4,351,888,063	2.9%	4,476,888,063
2024	26.0%	55,000	5,000	137,500,000	15.7	4,396,064,205	3.1%	4,533,564,205
2025	26.0%	60,000	5,000	150,000,000	17.1	4,439,711,711	3.4%	4,589,711,711
2026	26.0%	65,000	5,000	162,500,000	18.6	4,481,771,729	3.6%	4,644,271,729
2027	26.0%	70,000	5,000	175,000,000	20.0	4,523,907,789	3.9%	4,698,907,789
2028	26.0%	75,000	5,000	187,500,000	21.4	4,564,967,067	4.1%	4,752,467,067
2029	26.0%	80,000	5,000	200,000,000	22.8	4,605,531,184	4.3%	4,805,531,184
2030	26.0%	85,000	5,000	212,500,000	24.3	4,645,605,390	4.6%	4,858,105,390
2,500 kWh per car	80% WA		20% ID	2010-2030 CGR		1.06%		1.28%

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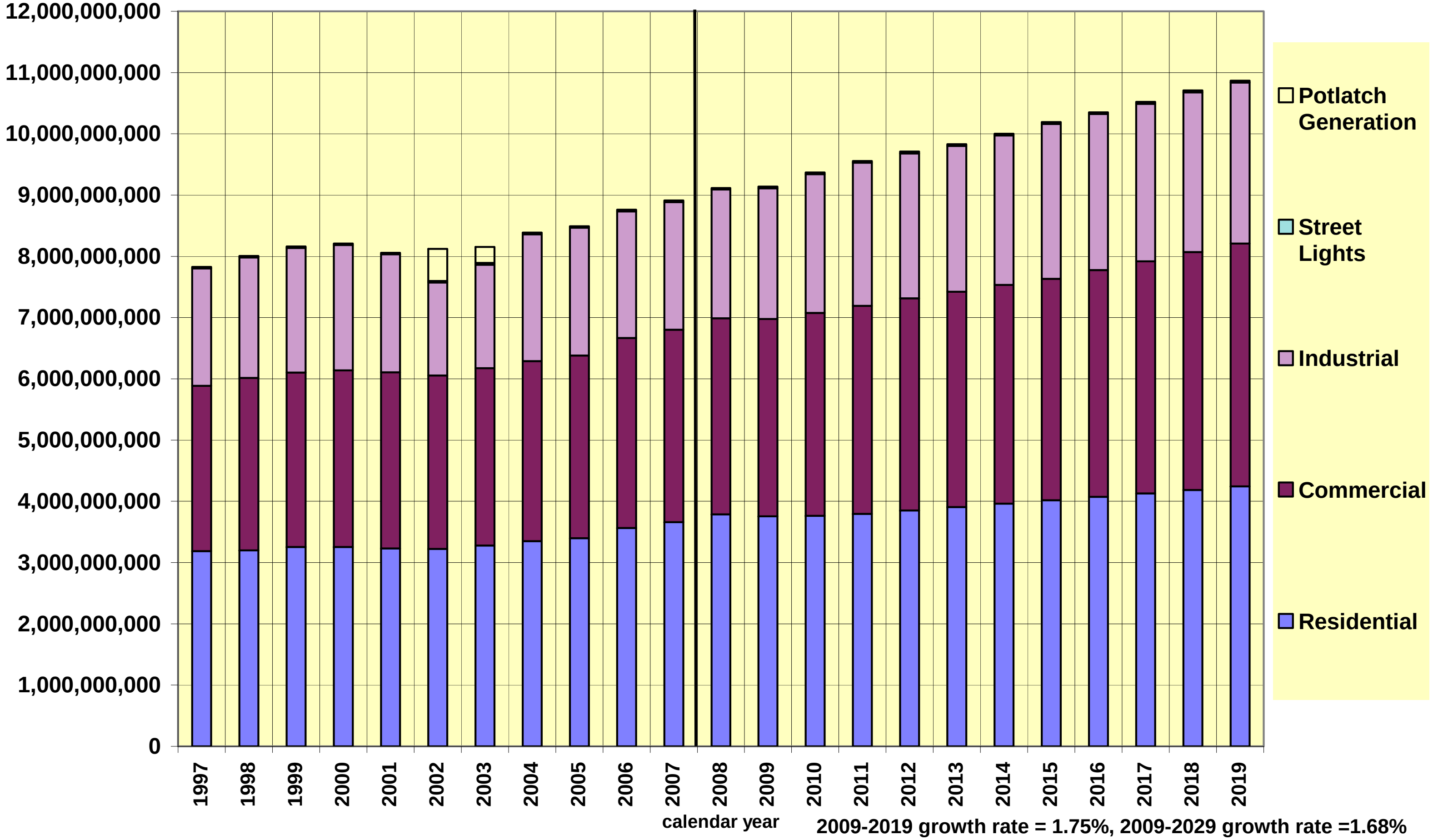
Schedule 5, Page 337 of 729

2009 ELECTRIC RETAIL SALES FORECAST



2009-2019 growth rate = 1.75%, 2009-2029 growth rate =1.68%

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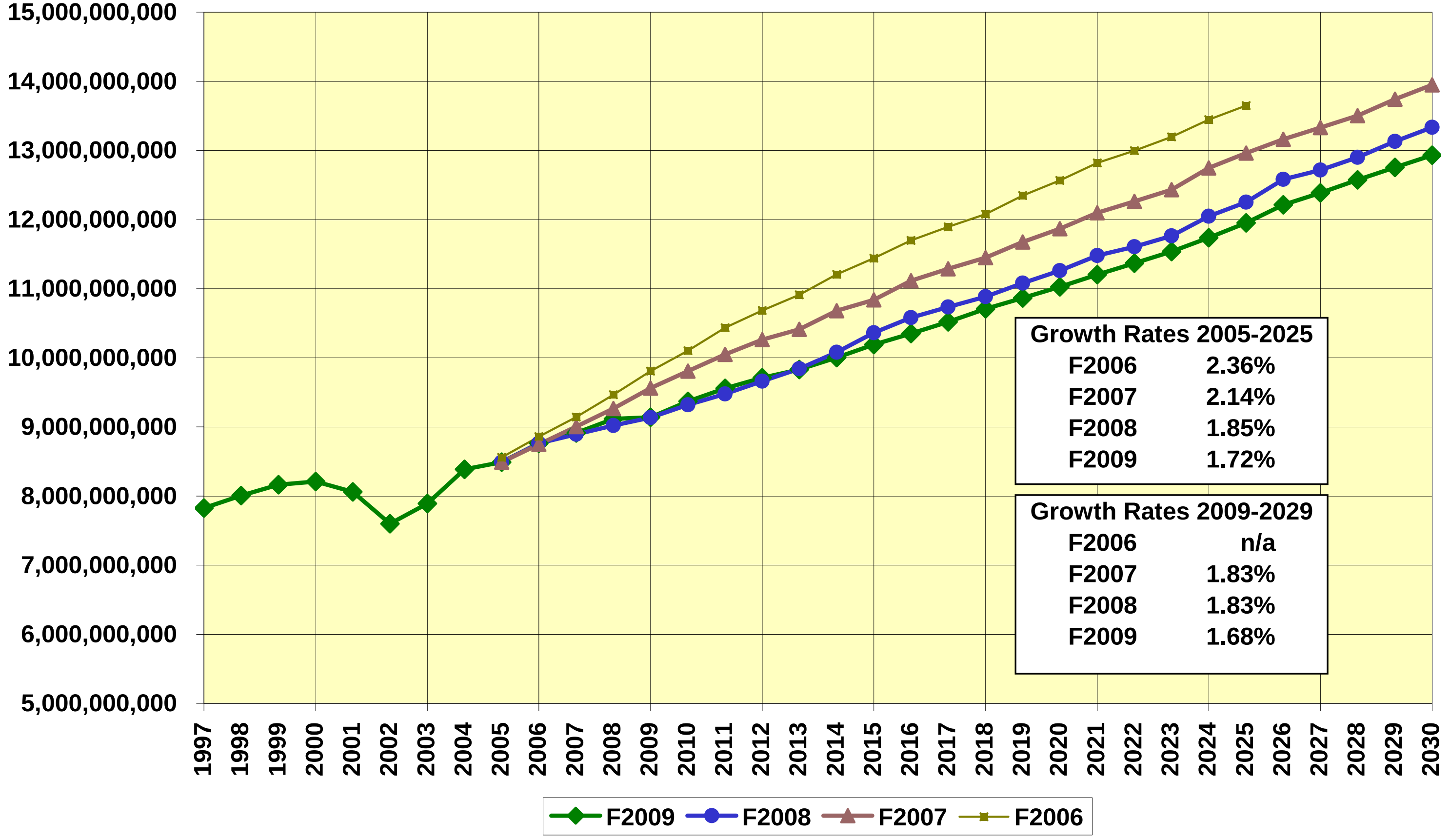
Schedule 5, Page 338 of 729

Load Growth Comparisons

(plug-in hybrid car consumption is included)



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Case Nos. AVU-E-12-08
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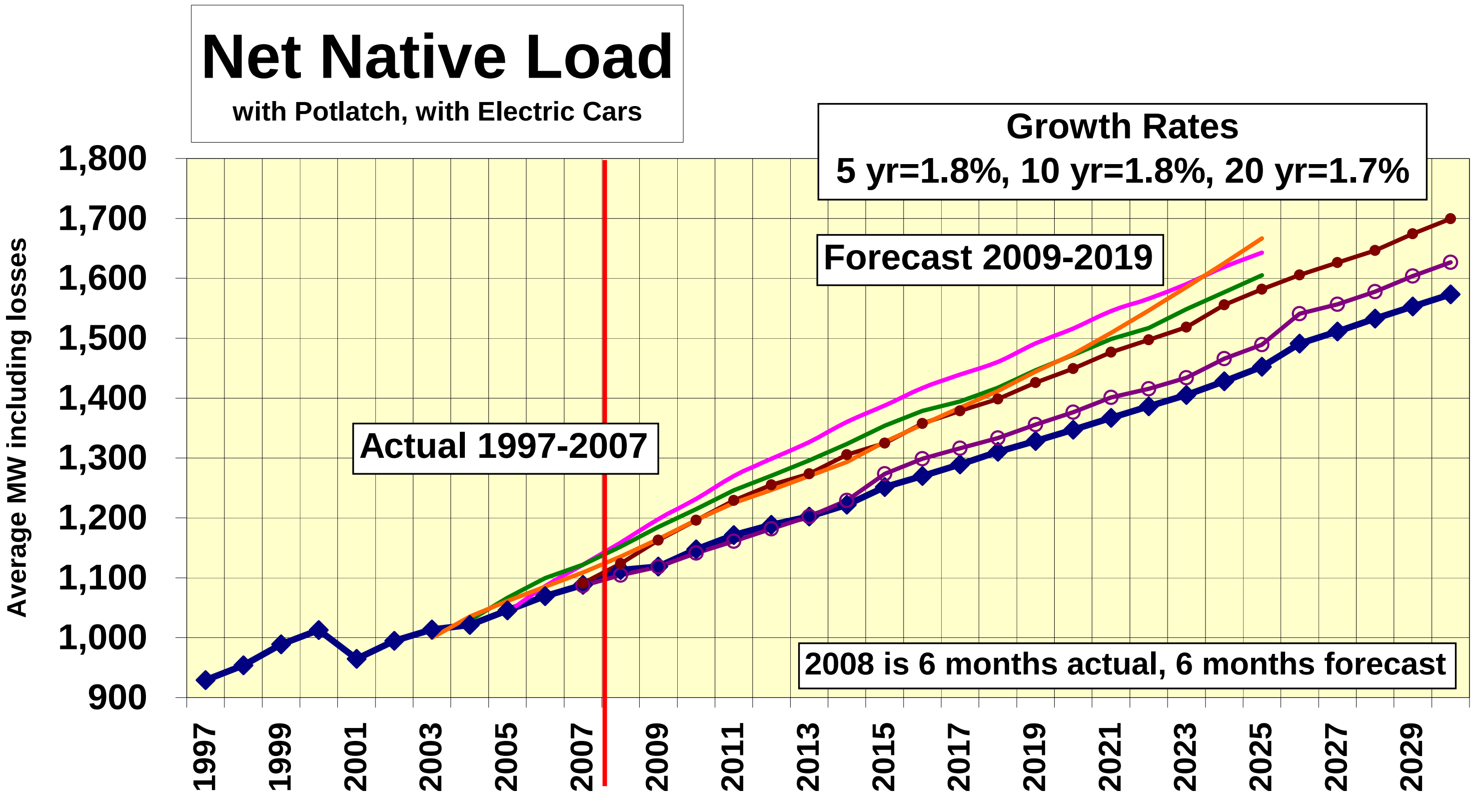
Schedule 5, Page 339 of 729



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
F2009	929	954	989	1,013	965	995	1,013	1,021	1,046	1,069	1,088	1,113	1,119	1,148
F2008											1,087	1,104	1,118	1,141
F2007IRP											1,091	1,124	1,163	1,196
F2006									1,043	1,086	1,122	1,159	1,198	1,232
F2005								1,029	1,067	1,099	1,122	1,152	1,185	1,215
F2004							1,000	1,035	1,061	1,085	1,109	1,135	1,164	1,196

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
F2009	1,171	1,188	1,202	1,222	1,252	1,270	1,289	1,311	1,329	1,347	1,367	1,386	1,405	1,428	1,452	1,491	1,511	1,533	1,553	1,573
F2008	1,161	1,182	1,202	1,229	1,274	1,299	1,316	1,333	1,356	1,376	1,401	1,416	1,434	1,466	1,489	1,541	1,556	1,577	1,604	1,627
F2007IRP	1,229	1,255	1,274	1,306	1,325	1,358	1,379	1,399	1,426	1,449	1,477	1,497	1,518	1,556	1,582	1,606	1,626	1,646	1,674	1,699
F2006	1,270	1,299	1,327	1,360	1,388	1,417	1,440	1,461	1,491	1,516	1,545	1,566	1,590	1,619	1,643					
F2005	1,246	1,270	1,296	1,323	1,354	1,379	1,395	1,417	1,447	1,472	1,499	1,517	1,549	1,577	1,605					
F2004	1,225	1,247	1,270	1,293	1,327	1,356	1,384	1,412	1,444	1,474	1,509	1,546	1,585	1,625	1,667					

F2009 F2008 F2007IRP F2006 F2005 F2004

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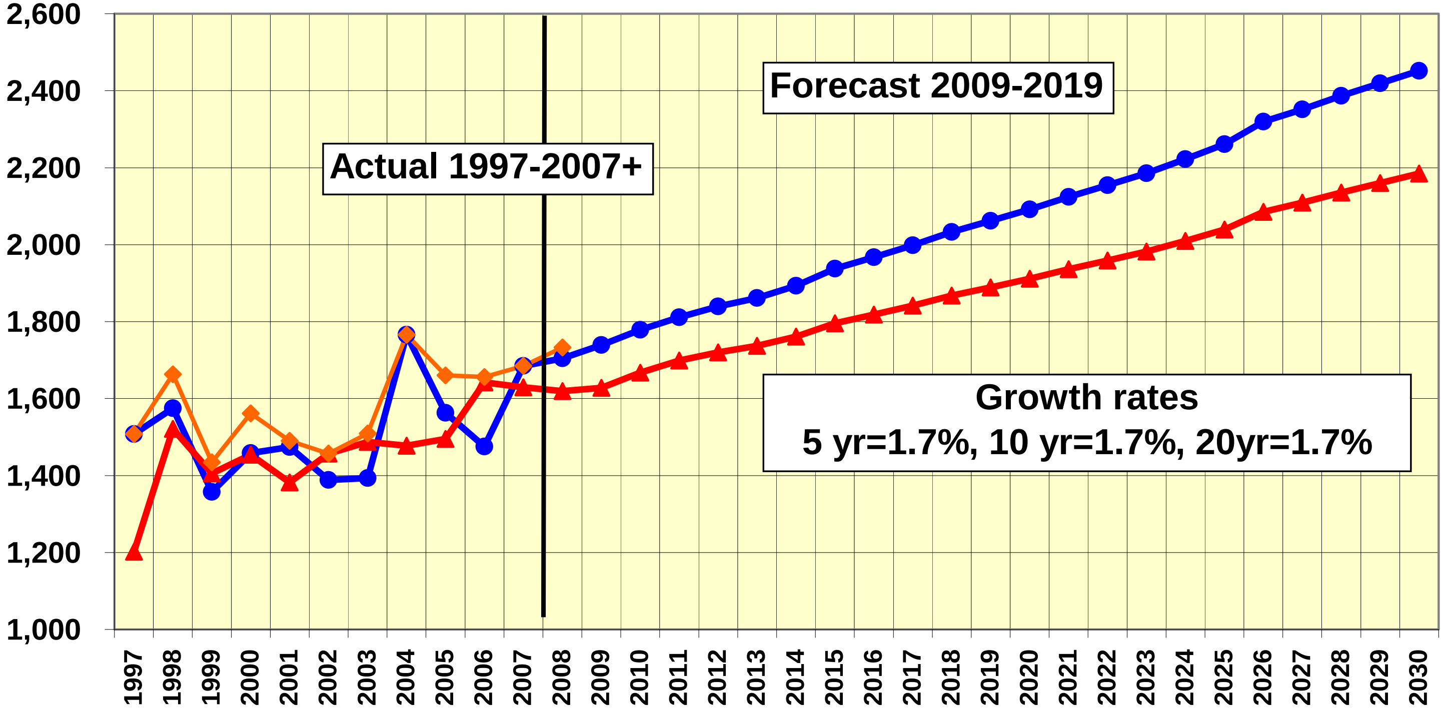
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 340 of 729

Calendar Year, January & July Peak Demands

Megawatts



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Jan	1,508	1,575	1,357	1,458	1,474	1,388	1,393	1,766	1,563	1,475	1,685	1,705	1,739	1,779	1,812	1,839	1,862
Jul	1,202	1,521	1,405	1,454	1,382	1,457	1,487	1,477	1,495	1,642	1,629	1,619	1,628	1,667	1,699	1,720	1,737
Calendar	1,508	1,663	1,434	1,561	1,490	1,457	1,509	1,766	1,660	1,656	1,685	1,733					

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Jan	1,893	1,937	1,967	1,998	2,033	2,062	2,091	2,124	2,154	2,185	2,222	2,261	2,320	2,352	2,387	2,419	2,452
Jul	1,761	1,796	1,818	1,842	1,867	1,889	1,912	1,936	1,959	1,982	2,010	2,039	2,085	2,109	2,135	2,160	2,185
Calendar																	

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Peak Load Planning

•Winter based on average coldest day

Data from 1890 to 2007			Temp	HDD
Average Coldest Day (December & January)			11.7	53.3
Standard Deviation		10.2		
5% chance of exceedance	1.645	16.779	-5.1	70.1
1% chance of exceedance	2.330	23.766	-12.1	77.1
0.25% chance of exceedance	2.814	28.7	-17.0	82.0

•Summer based on average hottest day

Data from 1890 to 2007			Temp	CDD
Average Hottest Day (July & August)			80.0	15.0
Standard Deviation		3.405		
5% chance of exceedance	1.645	5.601	85.6	20.6
1% chance of exceedance	2.330	7.933	87.9	22.9
0.16% chance of exceedance	2.950	10.0	90.0	25.0

Peak Demand Trends

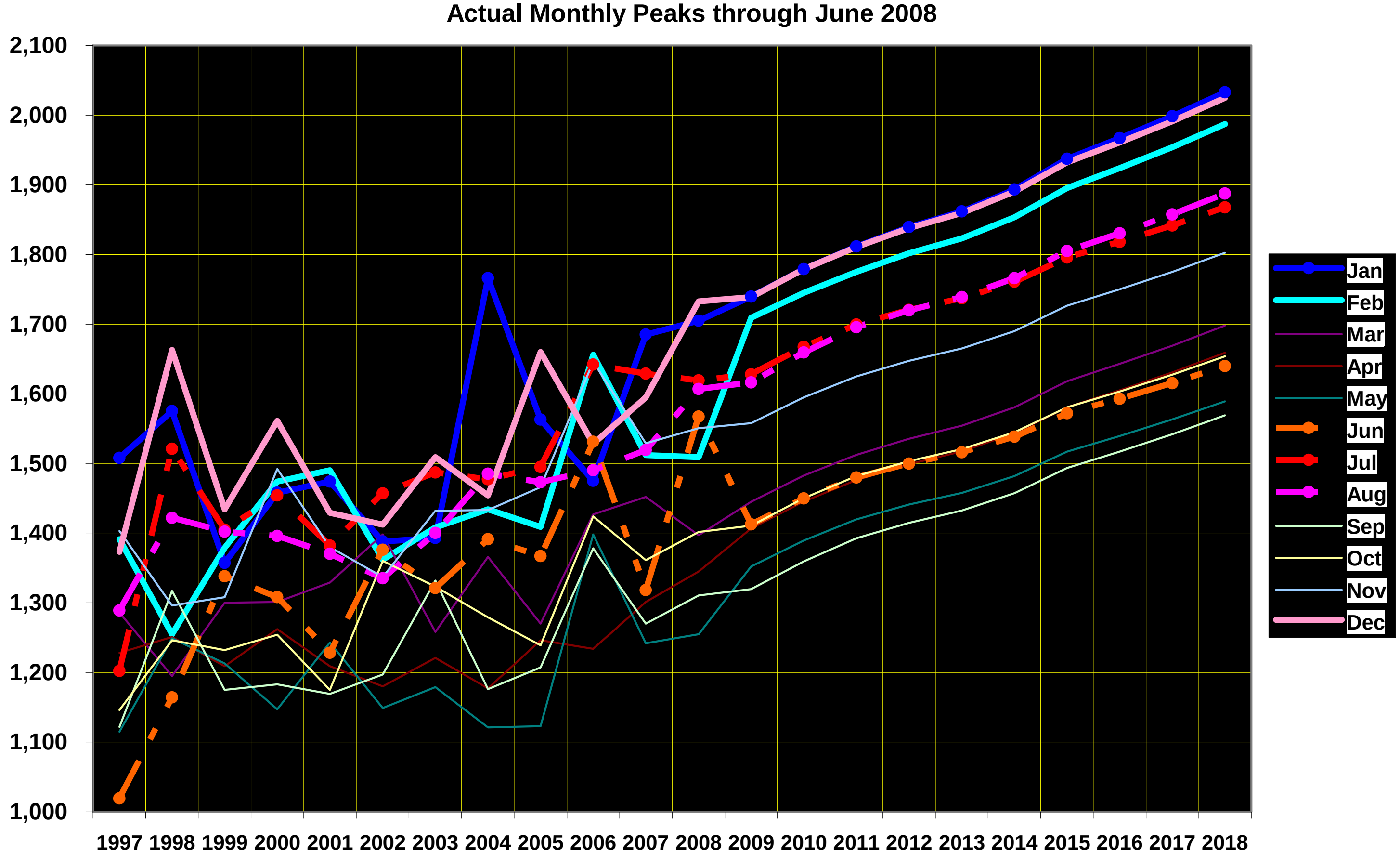

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Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 343 of 729

Questions & Answers

Natural Gas Price Forecast

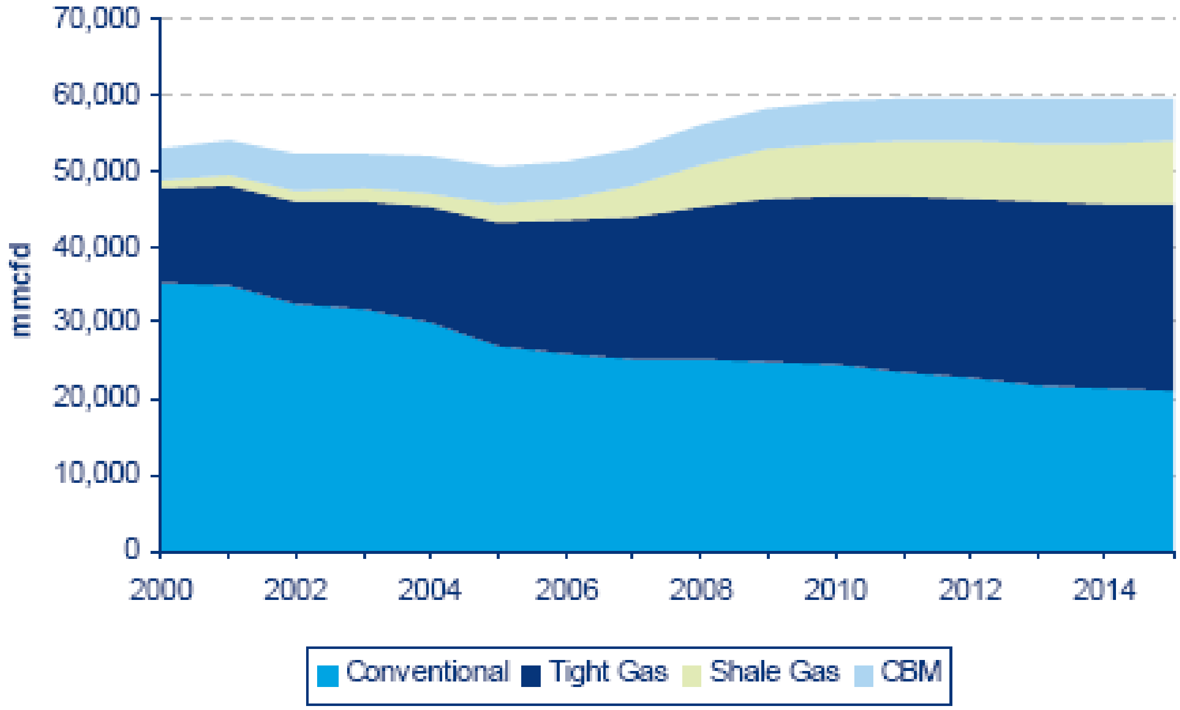
Greg Rahn, Manager Natural Gas Planning
James Gall, Senior Power Supply Analyst

2009 Electric Integrated Resource Plan

Third Technical Advisory Committee Meeting

October 22, 2008

US Supply Growth Forecast through 2015



Source: Wood Mackenzie

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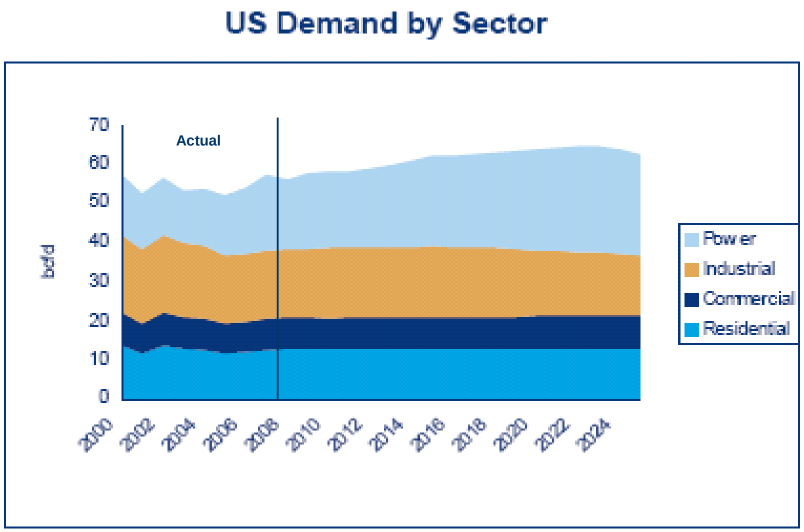
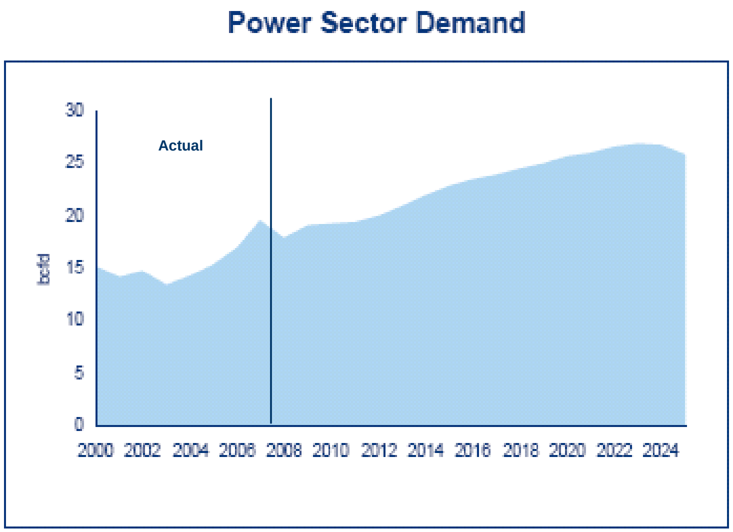
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 346 of 729

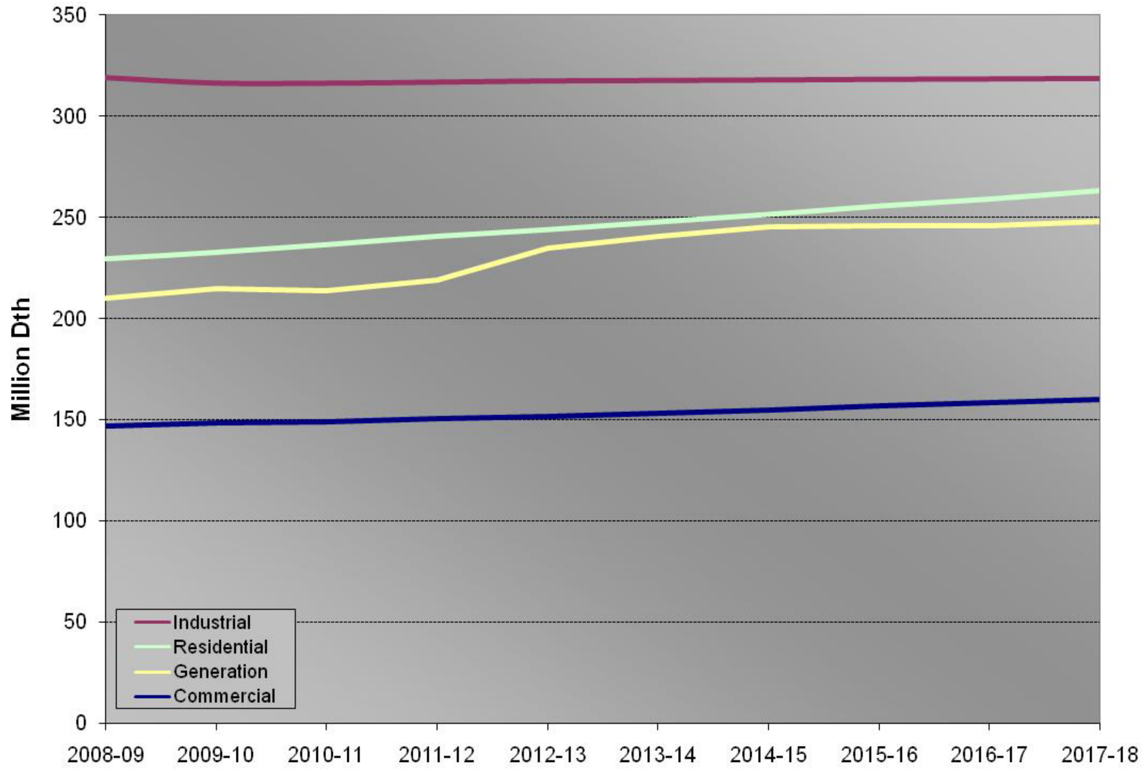
Generation Forecasted to Lead National Demand for Natural Gas





Source: Wood Mackenzie

Regional Natural Gas Demand Forecast



Source: Northwest Gas Association

Interstate Pipeline Flow

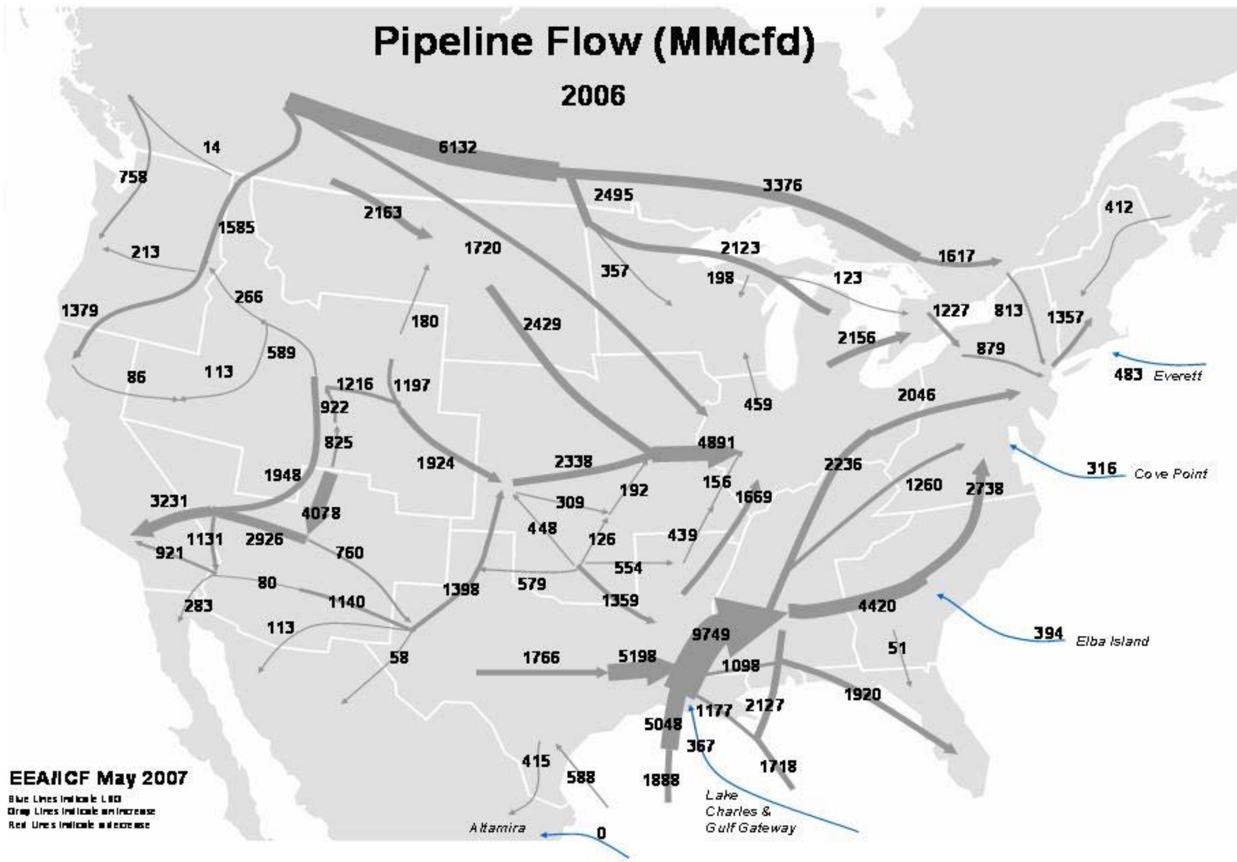
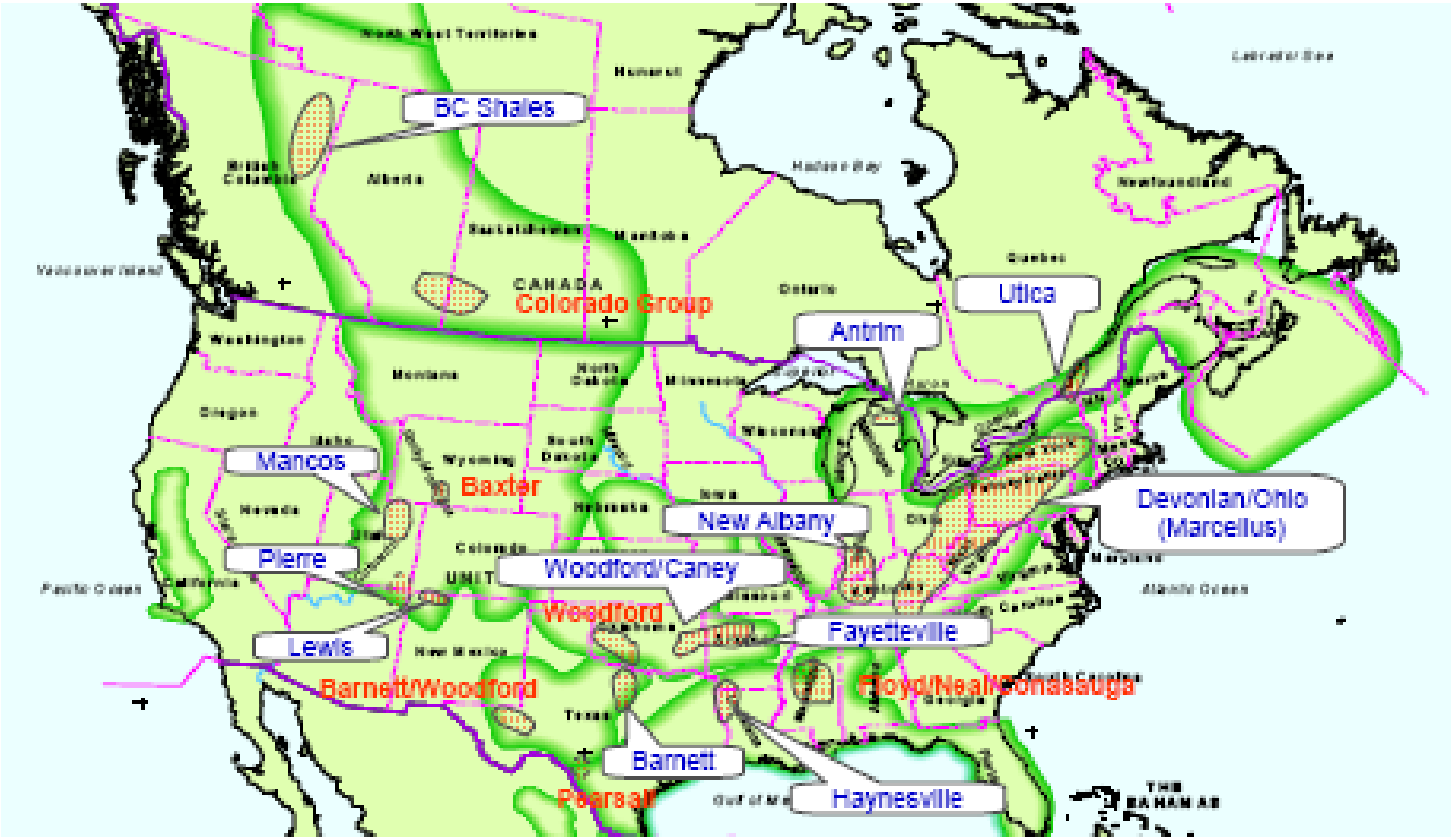


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 349 of 729

Shale Gas Plays



Source: Wood Mackenzie

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Case Nos. AVU-E-12-08
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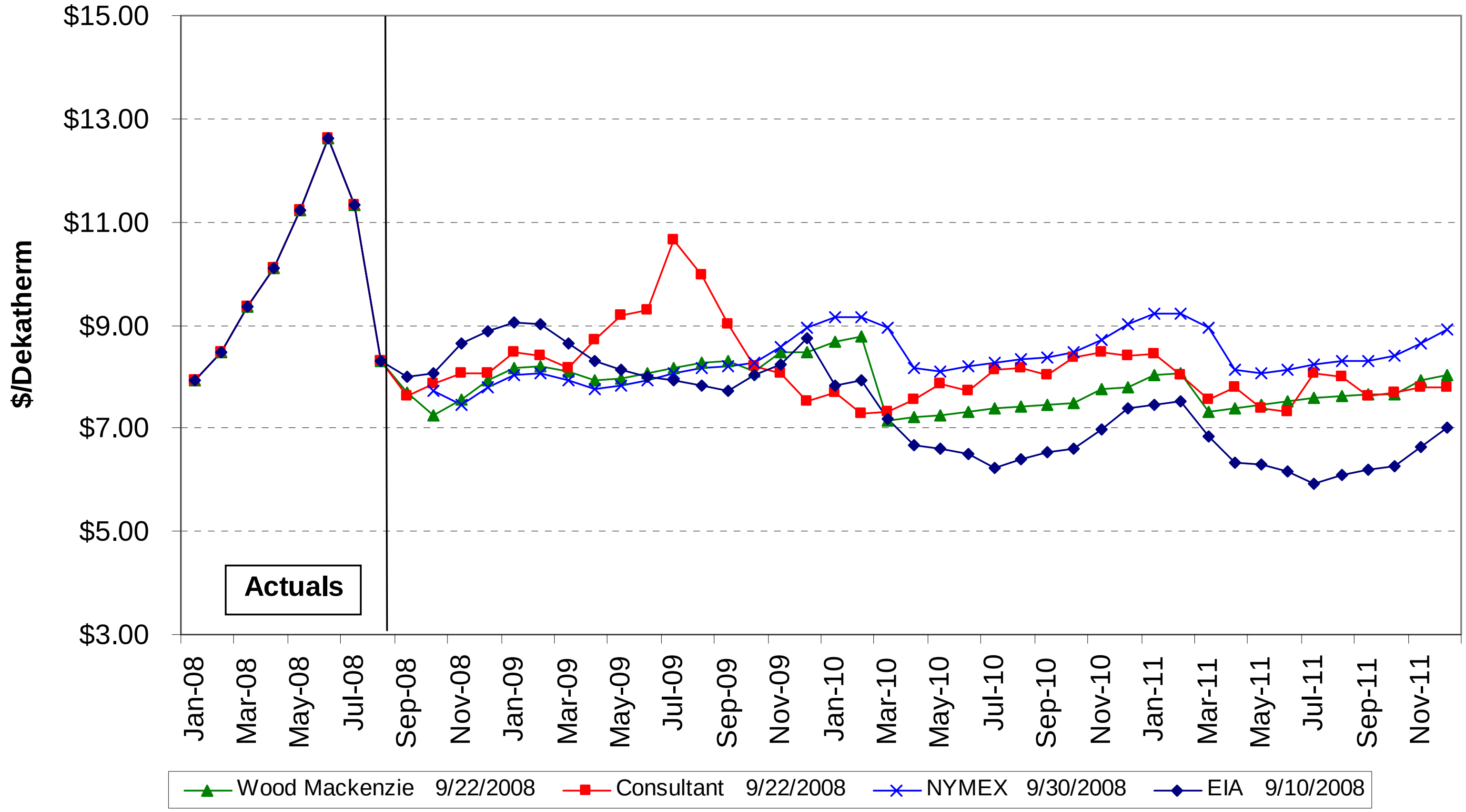
Schedule 5, Page 350 of 729

Henry Hub Short Term Price Forecasts



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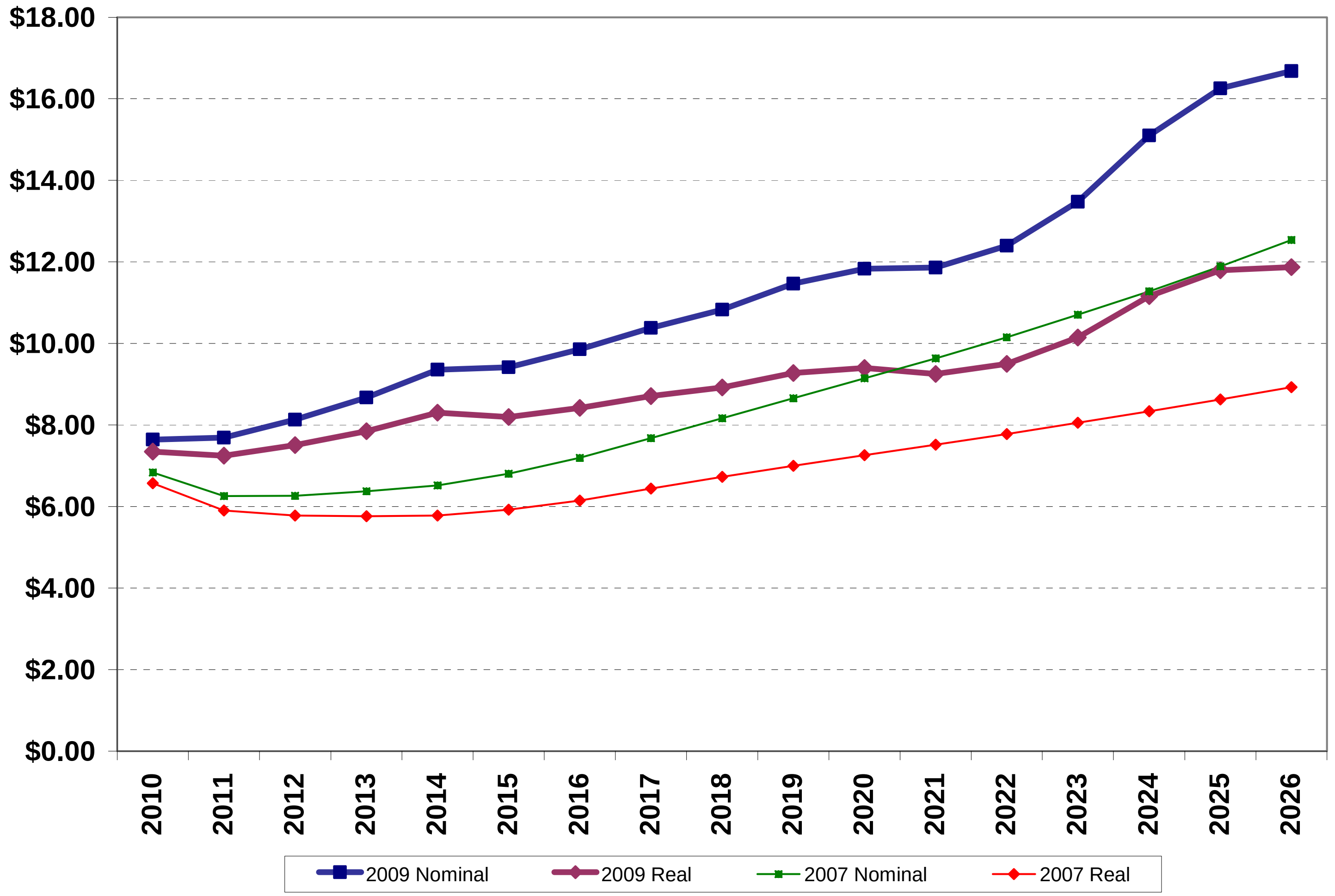
Schedule 5, Page 351 of 729

Forecast Assumptions

	2009	2015	2020
US Economic Growth (% GDP)	2.55%	2.84%	2.73%
US Gas Demand (bcf/d)	64.85	68.44	70.67
EG Demand (bcf\d)	19.33	22.88	26.41
WTI Oil Price (2008$)	$ 72.25	$ 60.40	$ 68.17
US Gas Prod. (bcf\d)	56.82	57.36	55.21
LNG Imports (bcf\d)	1.28	8.40	12.20
Alaska Pipeline			2021

Source: Wood Mackenzie

Annual Gas Price Forecast (Henry Hub)



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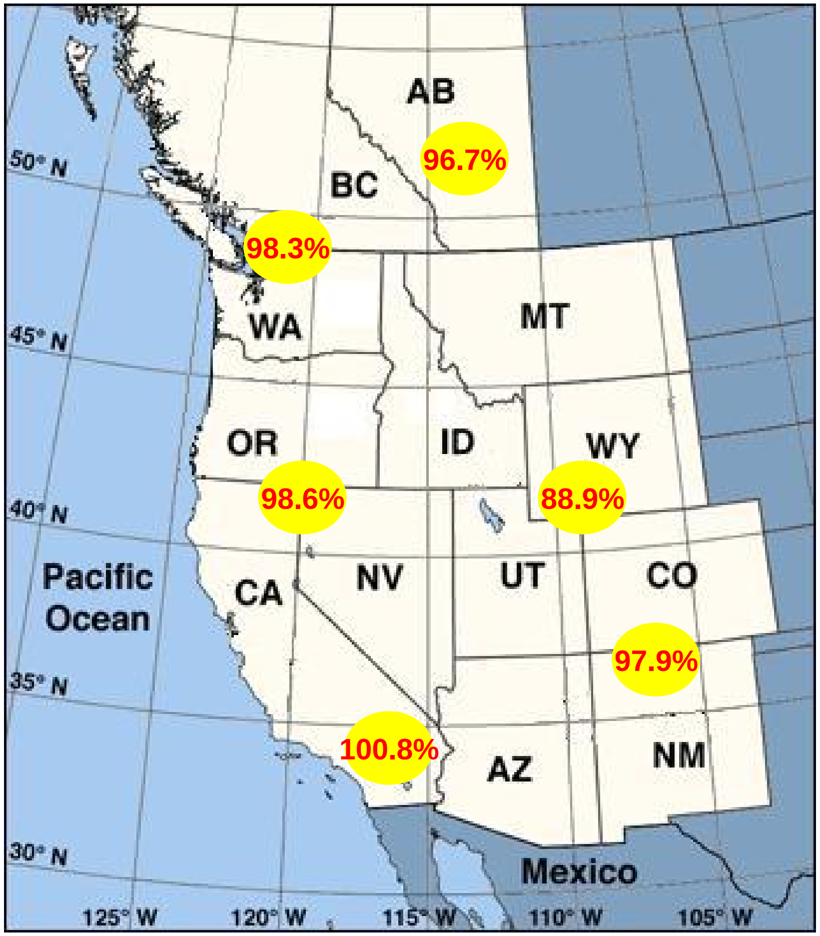
Basin Differentials as a % of Henry Hub*



Location	%
Henry Hub	100.0%
AECO	96.7%
Sumas	98.3%
Malin	98.6%
Opal	88.9%
San Juan	97.9%
So Cal	100.8%

* Based on forecasted 20 year levelized nominal prices

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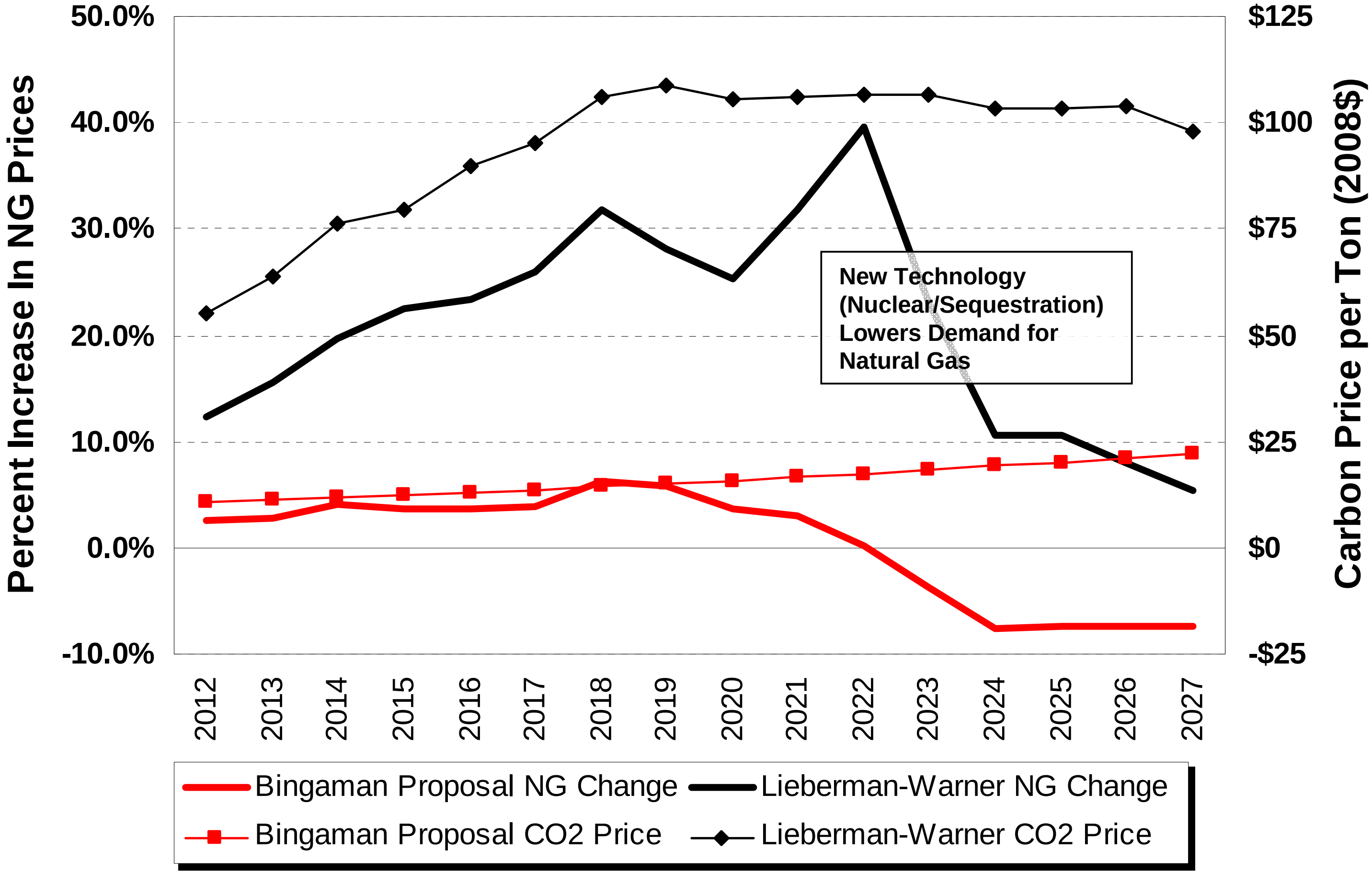
Schedule 5, Page 354 of 729

Monthly Gas Shape*

Month	% of Annual	Month	% of Annual
Jan	103%	Jul	98%
Feb	104%	Aug	99%
Mar	97%	Sep	99%
Apr	96%	Oct	100%
May	97%	Nov	104%
Jun	98%	Dec	105%

* Based on 5 year average of monthly differentials to annual average (AECO)

Wood Mackenzie Green House Gas Scenarios



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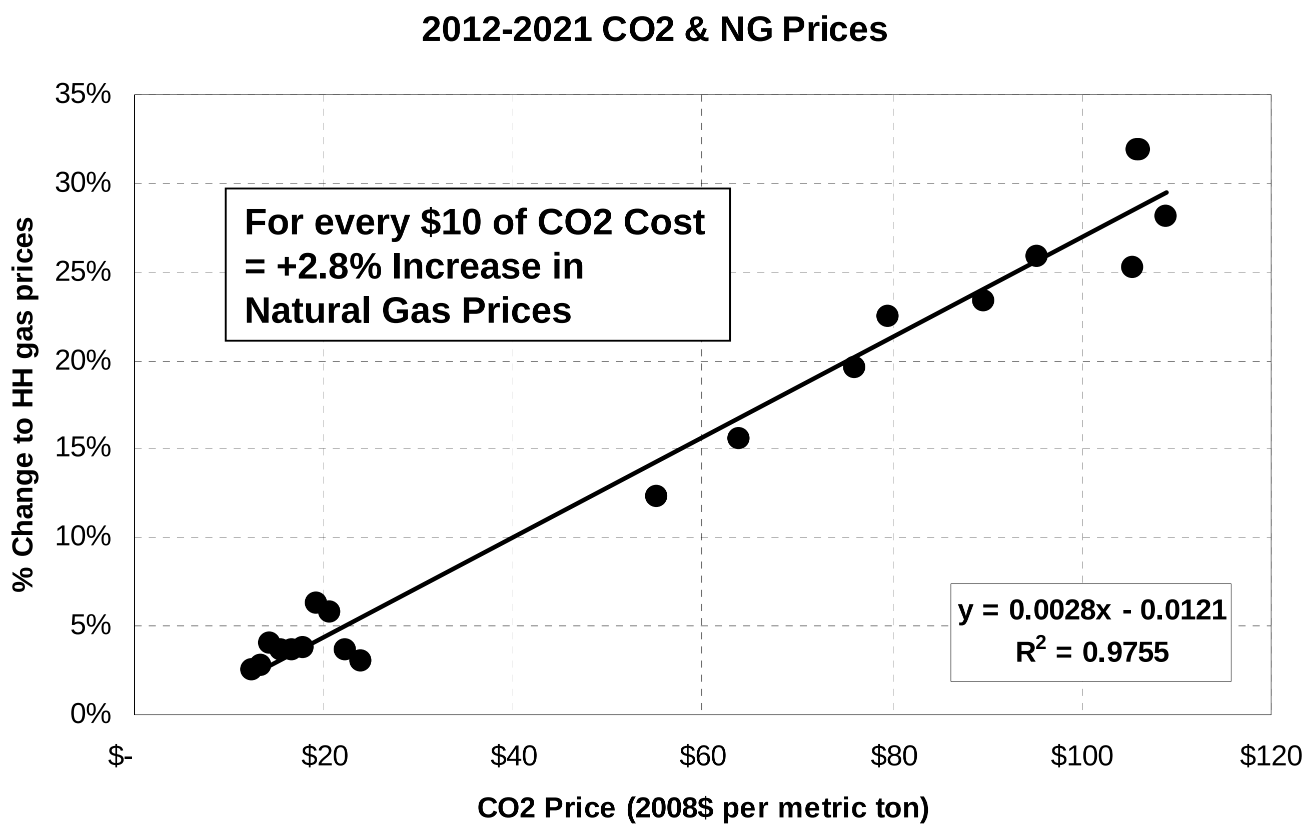
Schedule 5, Page 356 of 729

Carbon Cost & LT Natural Gas Prices Relationship



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Schedule 5, Page 357 of 729

Carbon Impact to Natural Gas Conclusion

- Carbon Legislation will increase natural gas demand and price.
- To meet a national 1990 Carbon Emissions levels; gas prices could be 30% higher than without Carbon Legislation, unless new technology (Nuclear or Carbon Sequestration) is available in high supply.
- ’09 IRP will use the discussed relationship to develop the Base Case natural gas price forecast, until 2025 (first year sequestration is available to the market), post 2025 prices differentials will flatten.
- Increases to natural gas prices will allow existing coal resources to compete with natural gas at higher Carbon cost levels (see Price Forecast Presentation)

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Levelized Natural Gas Costs ($/Dth)*

Location	Nominal		Real (2008$)	
	WM	w/CO_2	WM	w/CO_2
Henry Hub	$10.94	$11.71	$9.11	$9.75
AECO	$10.58	$11.35	$8.81	$9.45
Sumas	$10.76	$11.53	$8.96	$9.60
Malin	$10.79	$11.56	$8.98	$9.62
Opal	$9.72	$10.49	$8.10	$8.74
San Juan	$10.71	$11.48	$8.92	$9.56
Southern Cal	$11.02	$11.80	$9.18	$9.82

* Levelized 20 Years (2010-2029)

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Mid-Columbia Electric Market Forecast

James Gall

2009 Electric Integrated Resource Plan
Third Technical Advisory Committee Meeting
October 22, 2008

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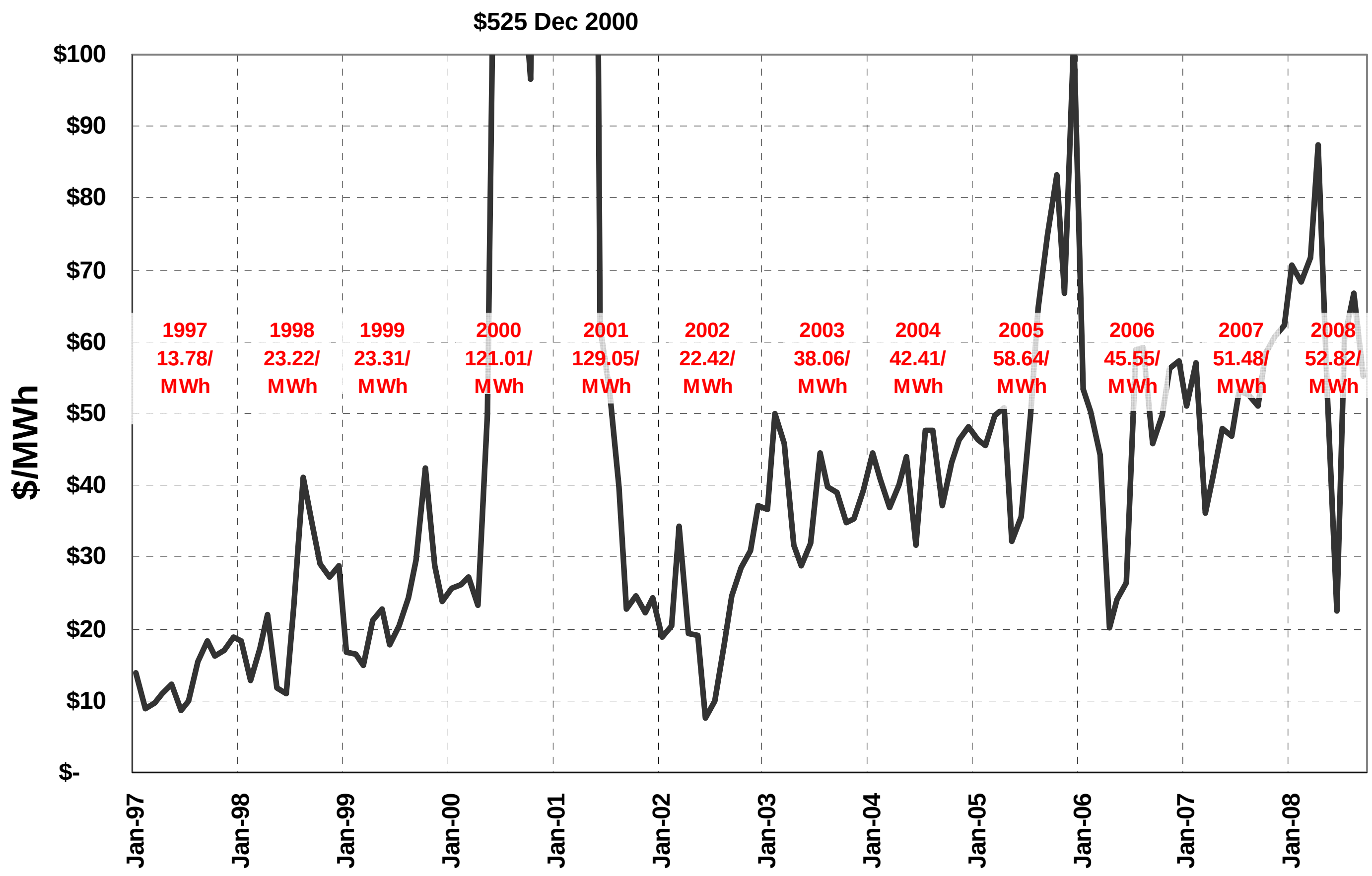
Why Is This Forecast Relevant?

- Used to value future energy costs
- Used to determine resources financial value given different market conditions
- Forecasts when and under what conditions a resource is likely to dispatch
- Test regional market conditions and policies
- Time for changes- recommendations are welcome!

Historical Mid-Columbia Market Prices



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Case Nos. AVU-E-12-08
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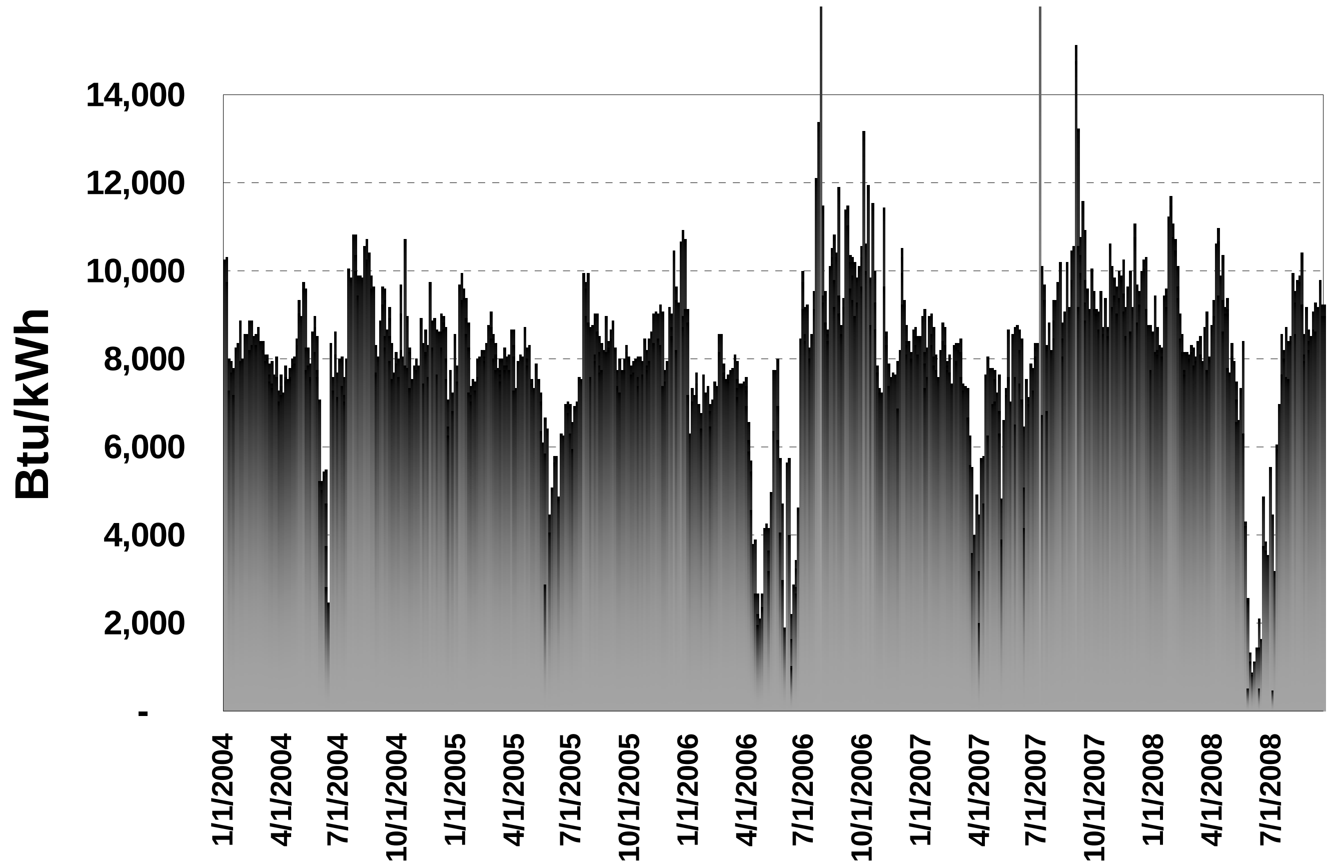
Schedule 5, Page 362 of 729

Historical Market Implied Heat Rate



Mid C Daily Firm/Stanfield Prices x 1000

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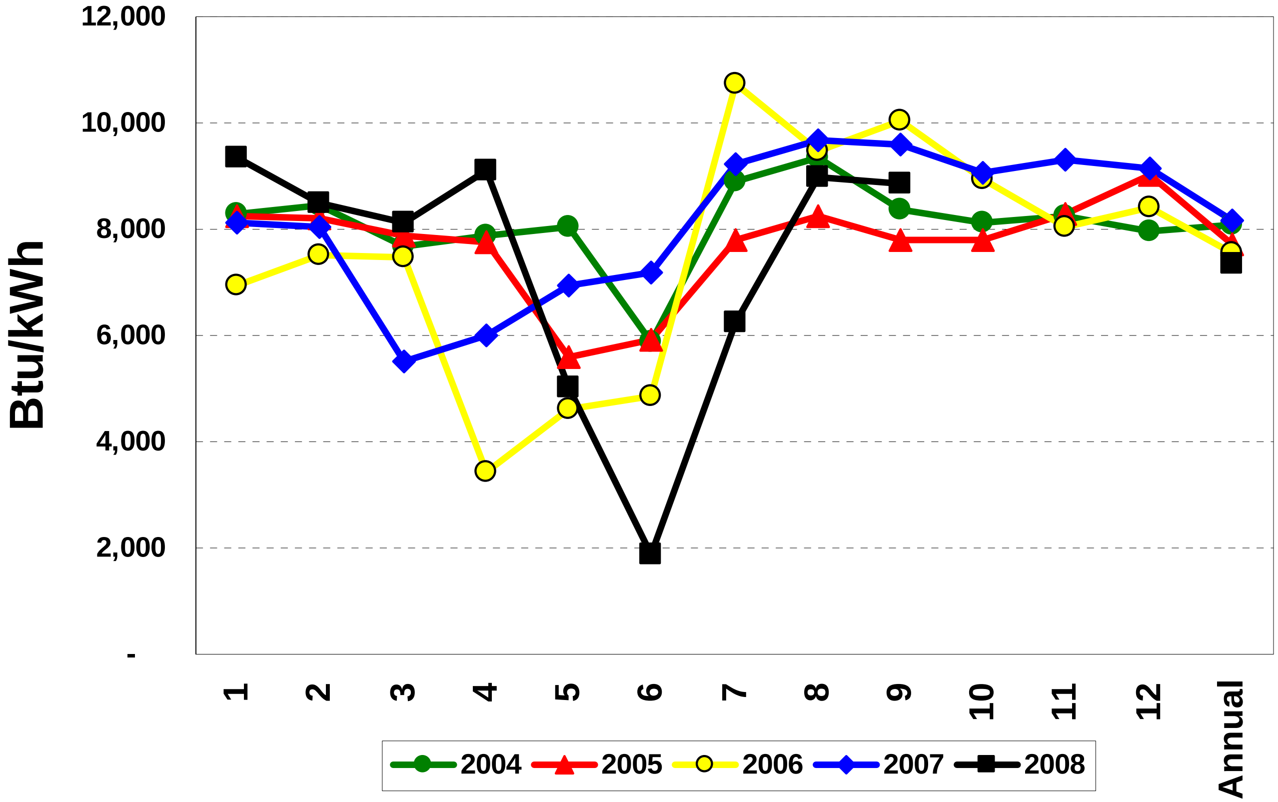
Schedule 5, Page 363 of 729

Historical Market Implied Heat Rate



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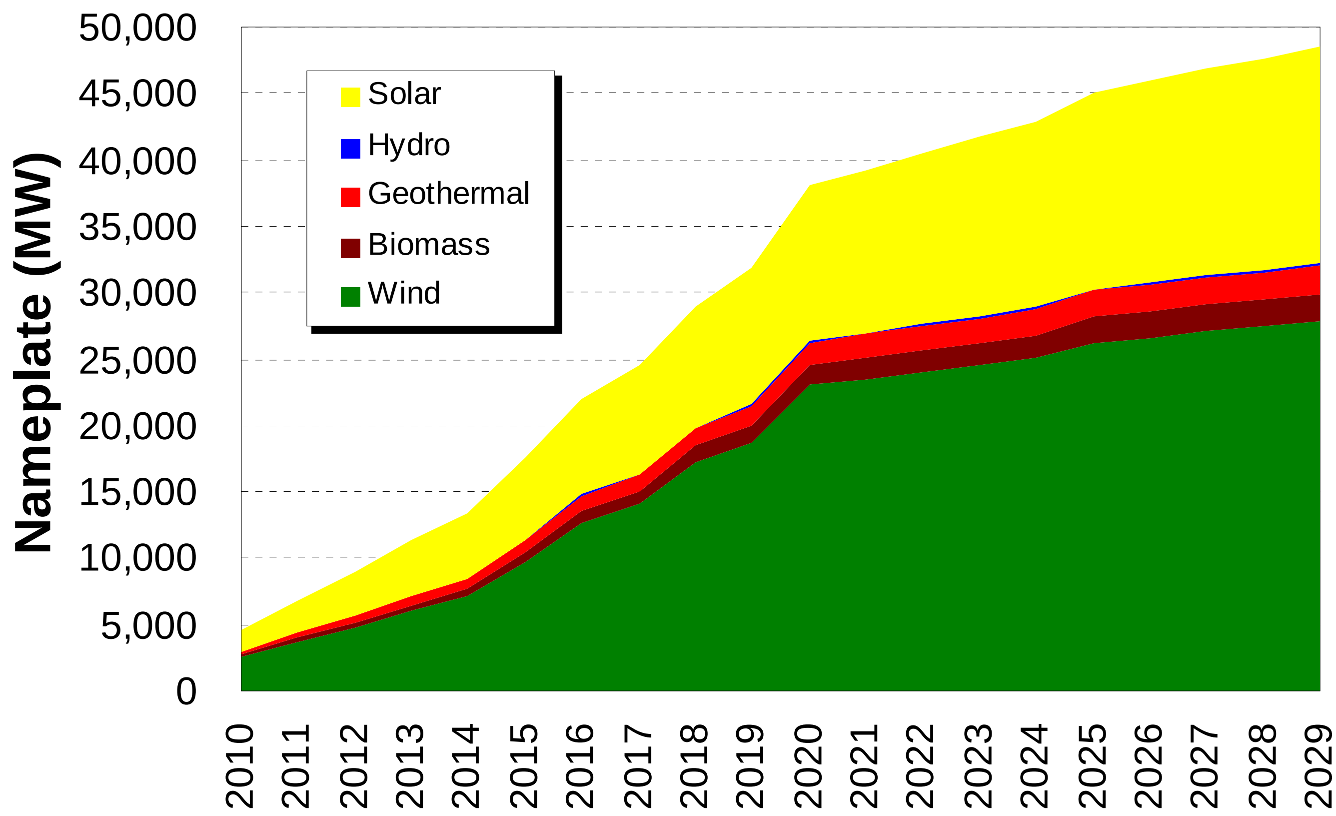
Schedule 5, Page 364 of 729

Regional Demand (20 Year AAGR)

- Source: Wood Mackenzie
  - NW- 0.84%
  - DSW- 2.09%
  - CA- 1.61%
  - RM- 1.78%
  - UT- 2.19% (PAC IRP)
- Will evaluate using NPCC after GRAC meeting
- Evaluate NW IRP Forecasts

RPS Assumptions (Nameplate Capacity)



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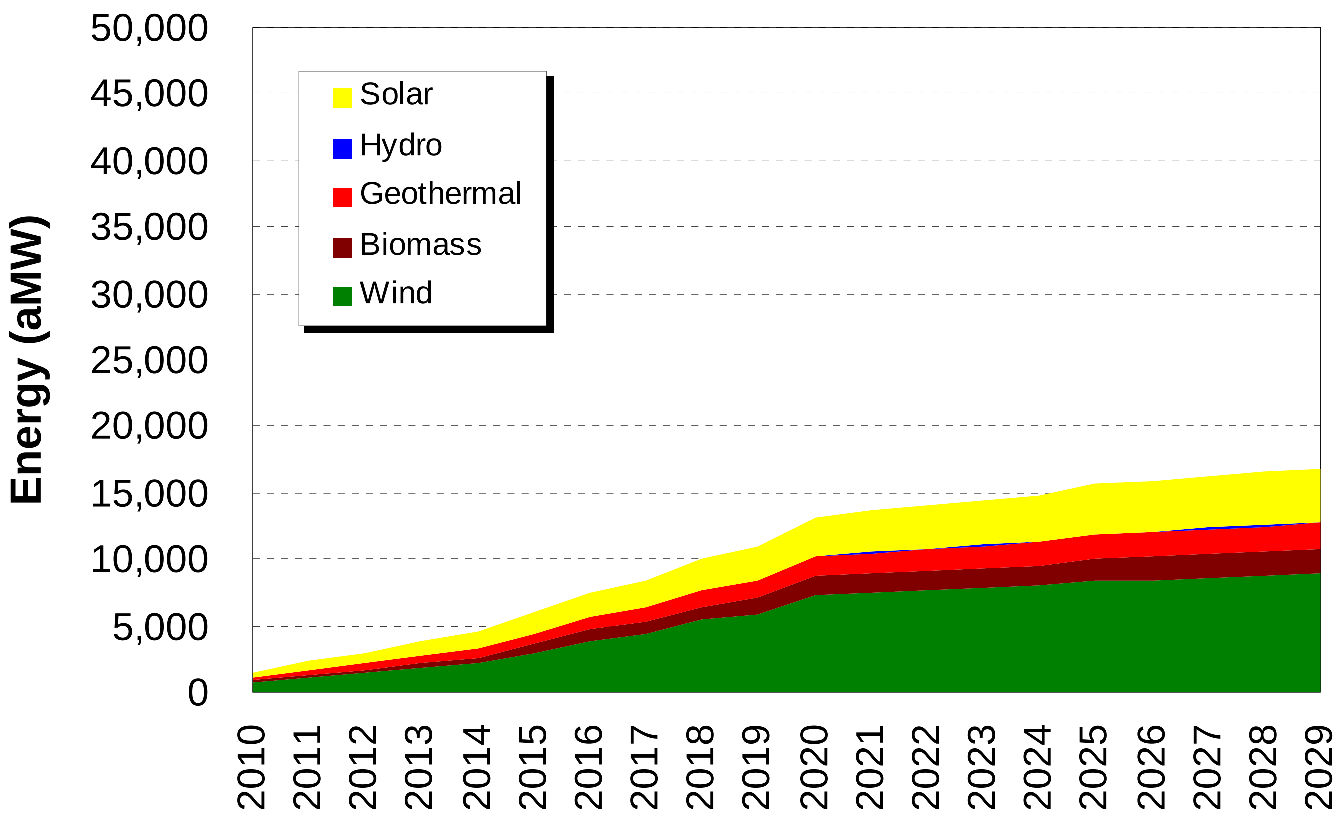
Schedule 5, Page 366 of 729

RPS Assumptions (Energy)



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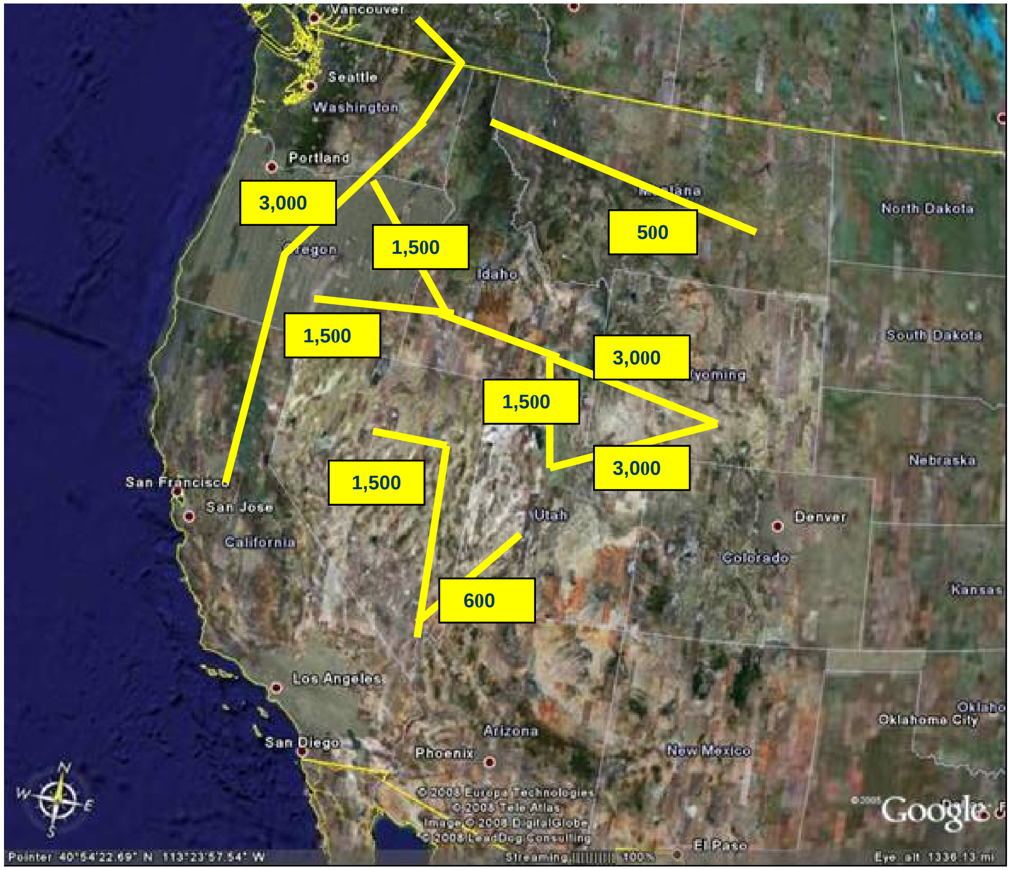
New Transmission Assumptions



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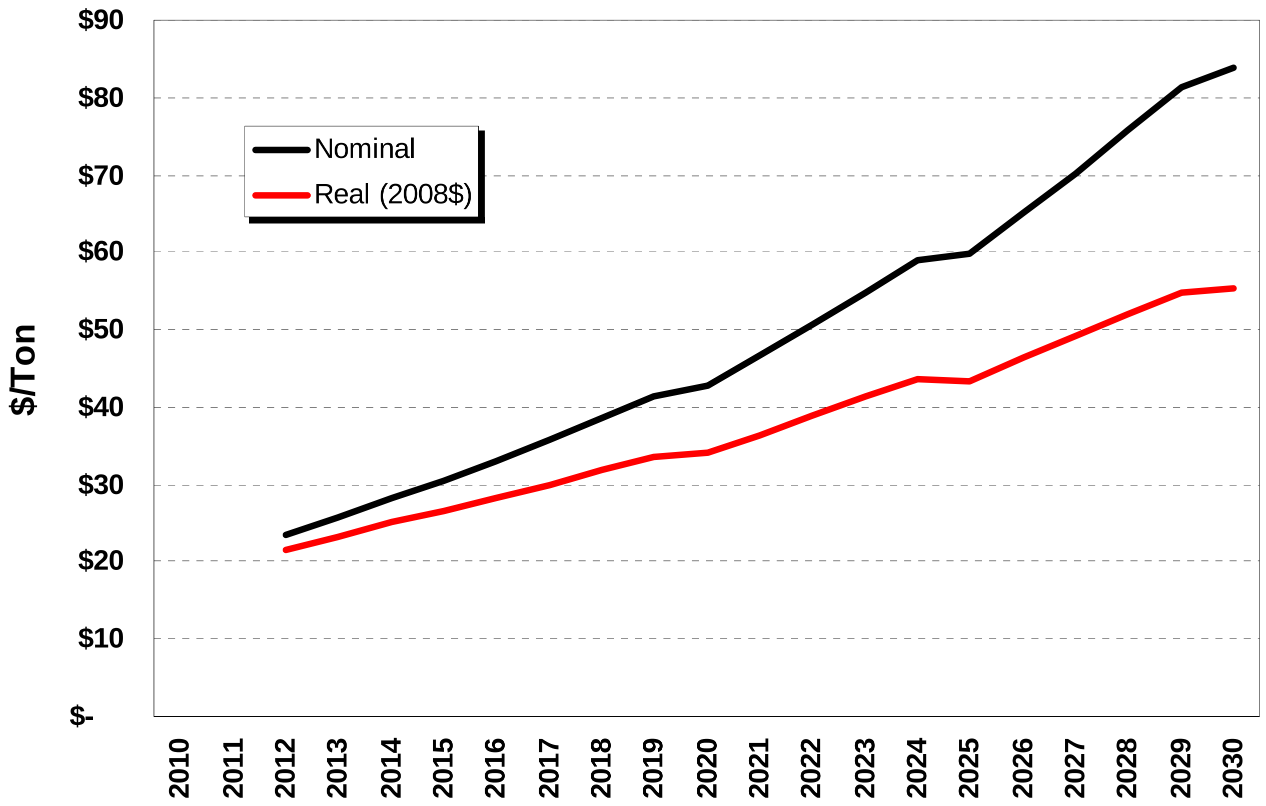
Schedule 5, Page 368 of 729

Regional Resource Options

(First Year Available)

- Combined Cycle Combustion Turbine (2011)
- Single Cycle Combustion Turbine (2010)
- Wind (2010)
- Solar (2010)
- Pulverized Coal (2015)
- IGCC Coal (2015)
- IGCC Coal w/ Sequestration (2025)
- Combine Cycle Combustion Turbine w/ Sequestration (2025)
- Nuclear (2022)

Carbon Adder



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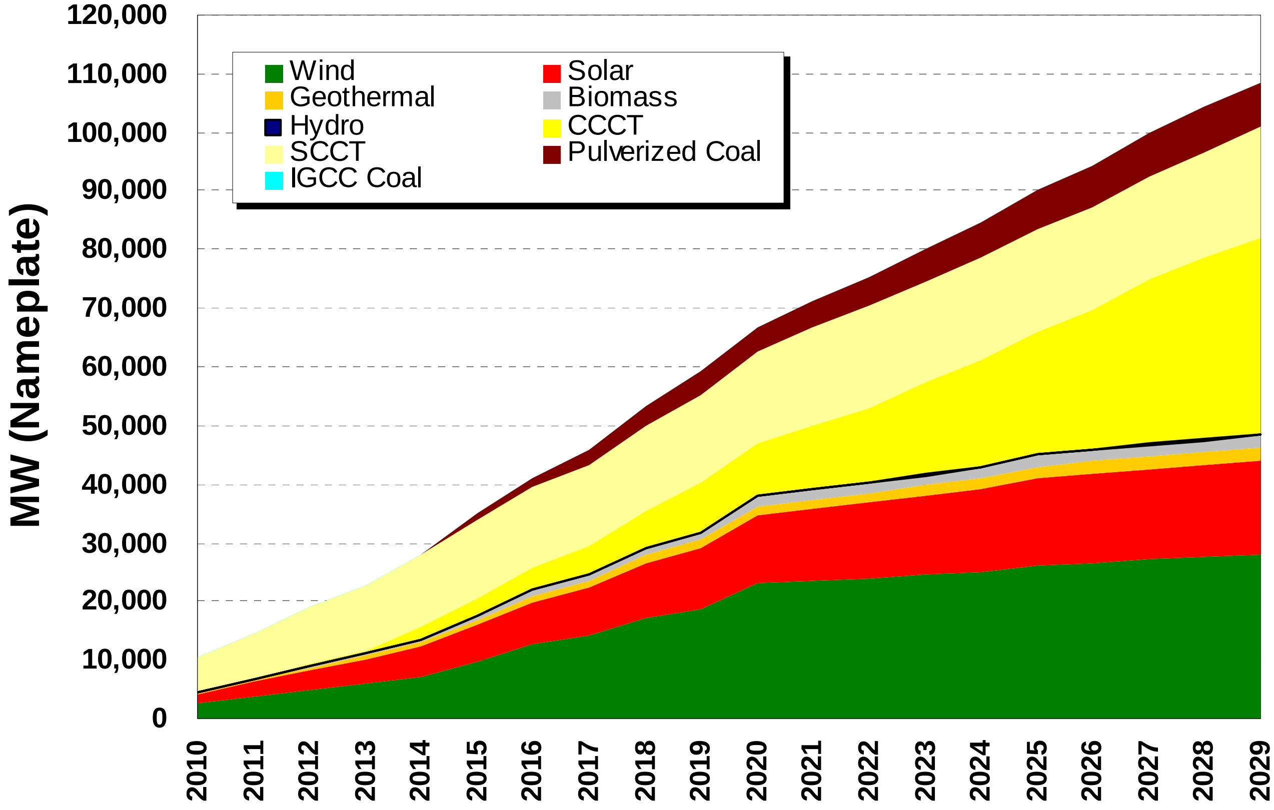
New Resources by Type in the WECC



Retired 1,300 MW of High Heat Rate Natural Gas Plants between 2011-2013

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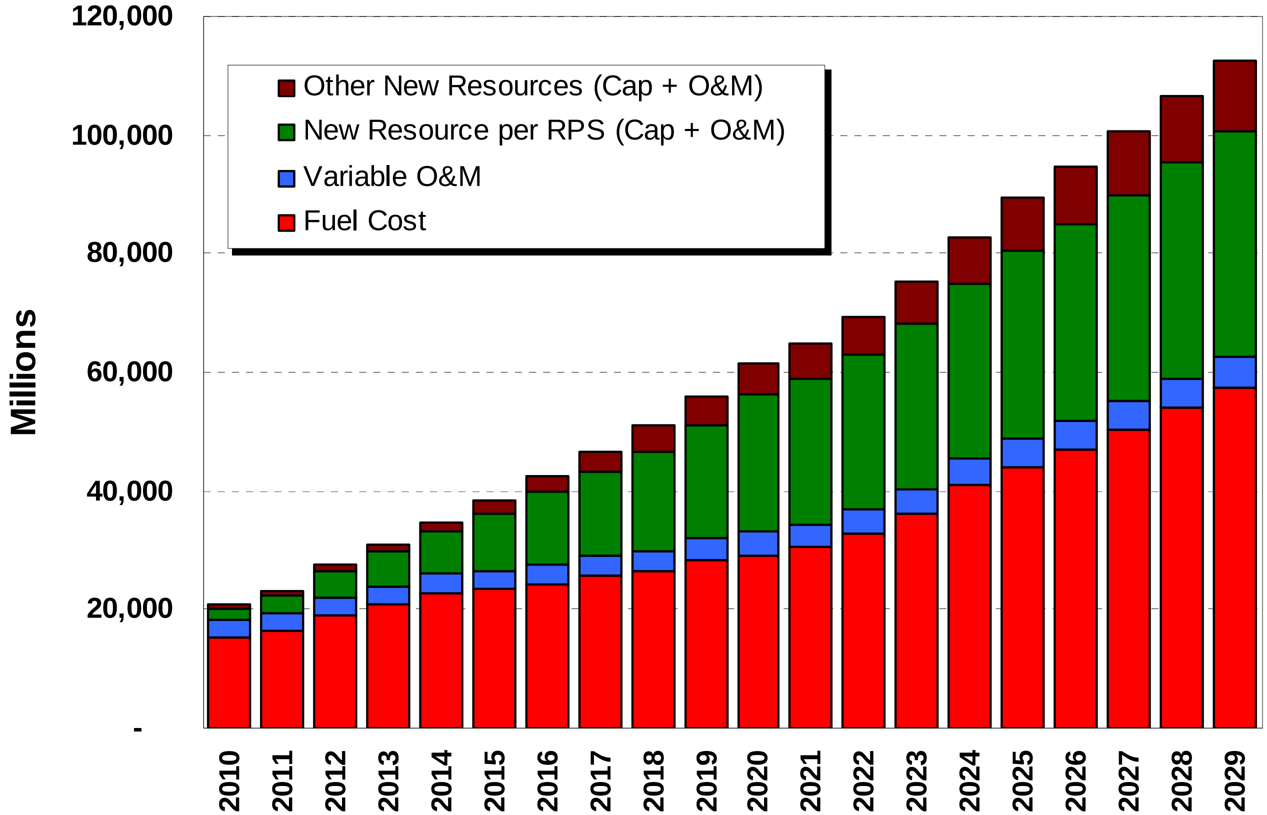
Western Interconnect System Costs
(Nominal - *Excludes Carbon Trading Costs)*



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Case Nos. AVU-E-12-08
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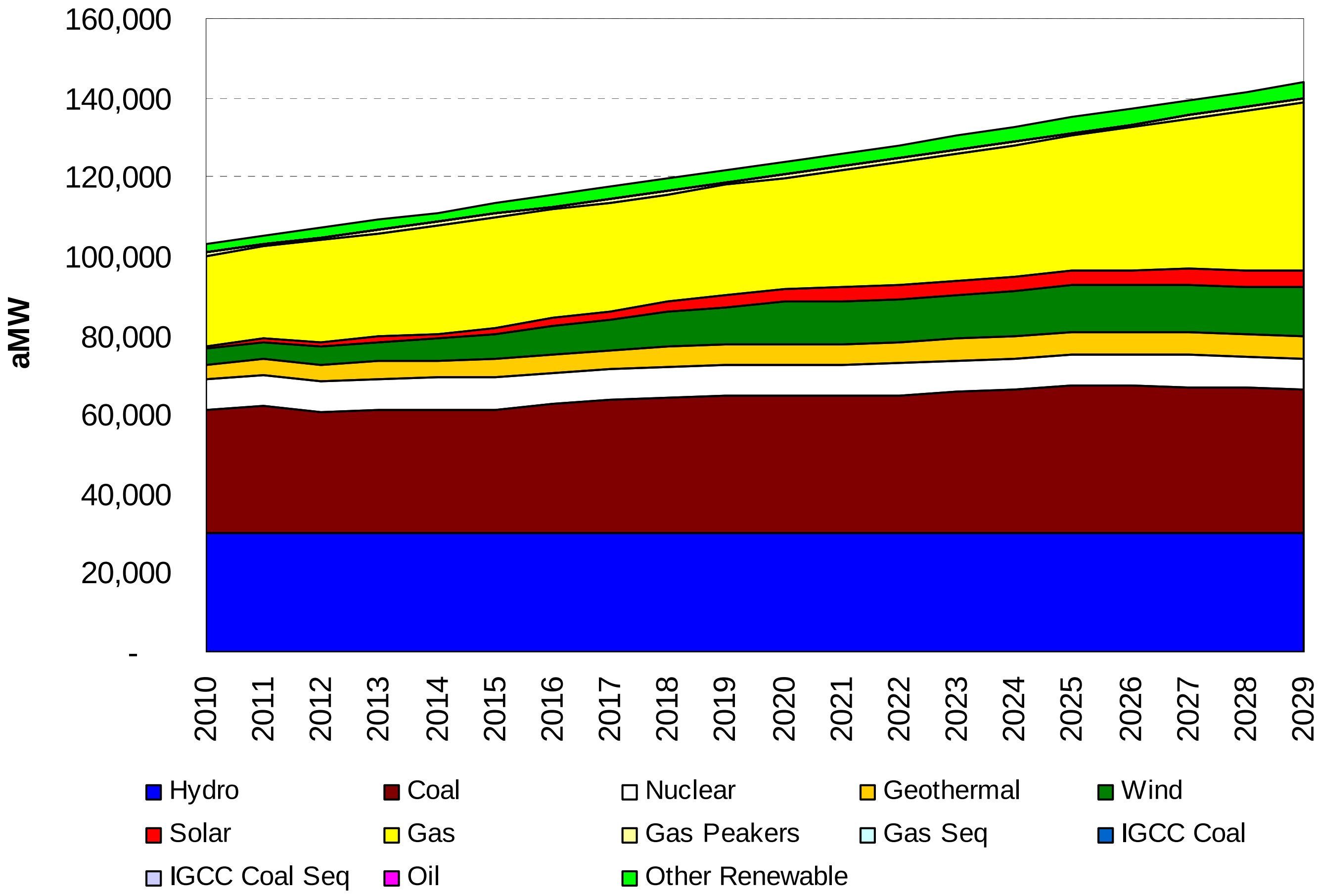
Schedule 5, Page 372 of 729

Resource Dispatch Contribution



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Case Nos. AVU-E-12-08
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Schedule 5, Page 373 of 729

Greenhouse Gas Forecast- US Western Interconnect

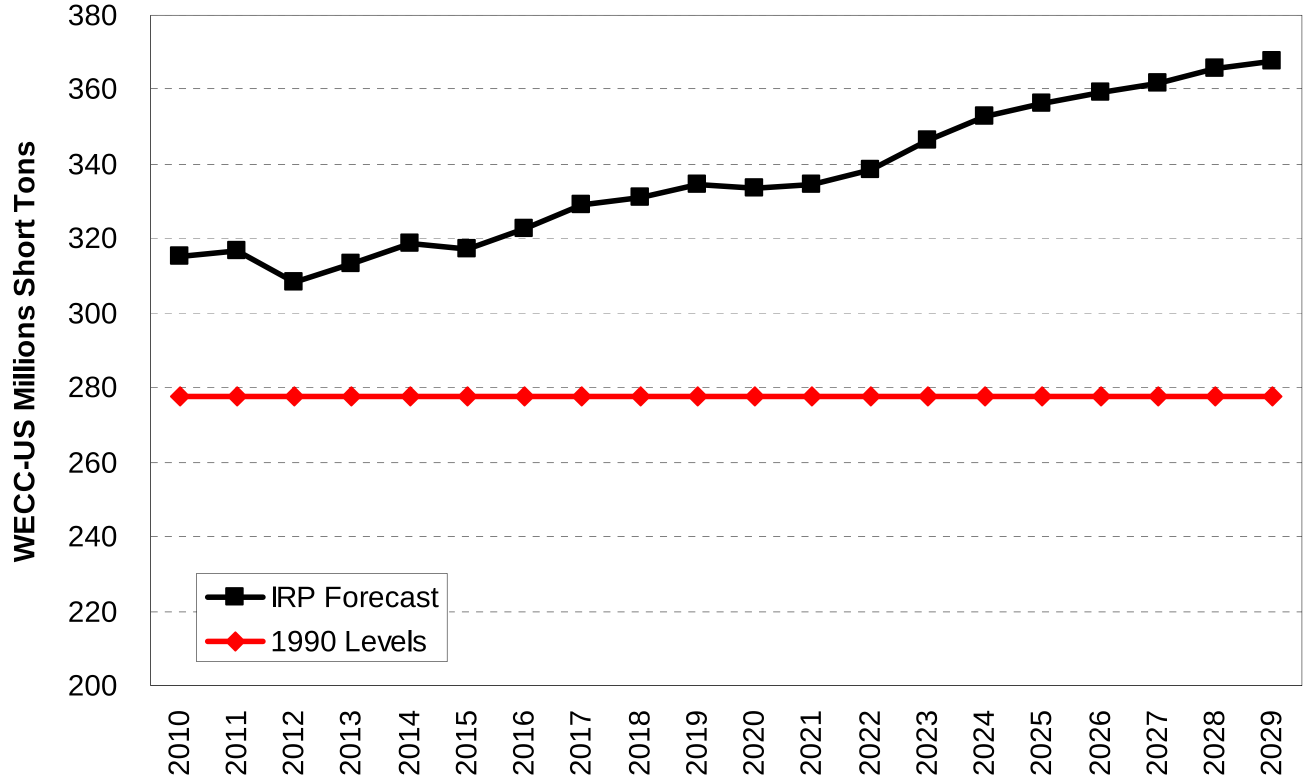

Exhibit No. 4
Case Nos. AVU-E-12-08
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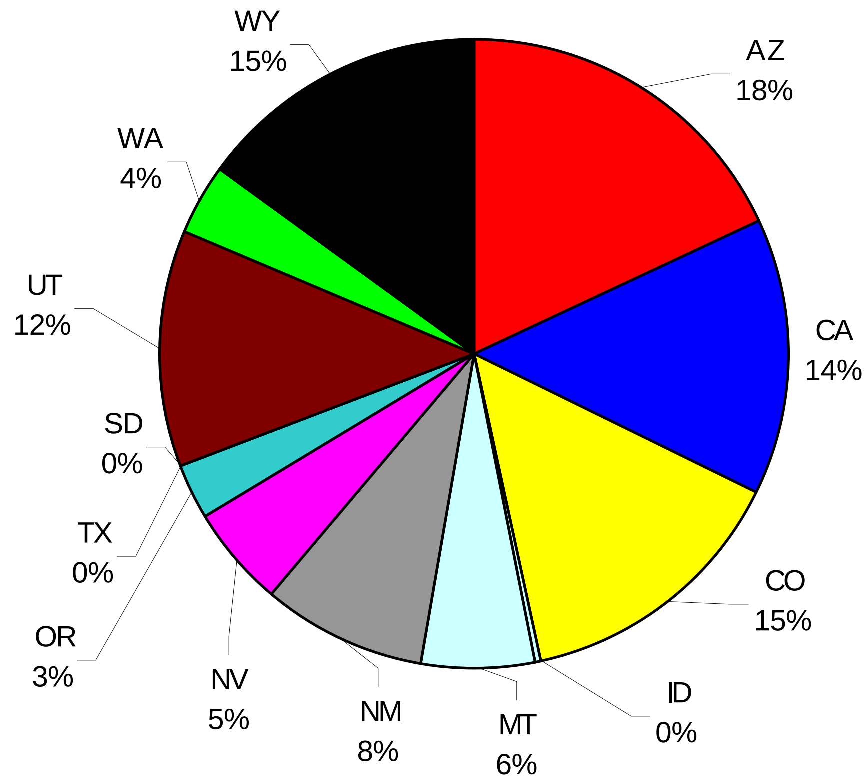
Schedule 5, Page 374 of 729

Greenhouse Gas Forecast

U.S. Western Interconnect



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Case Nos. AVU-E-12-08
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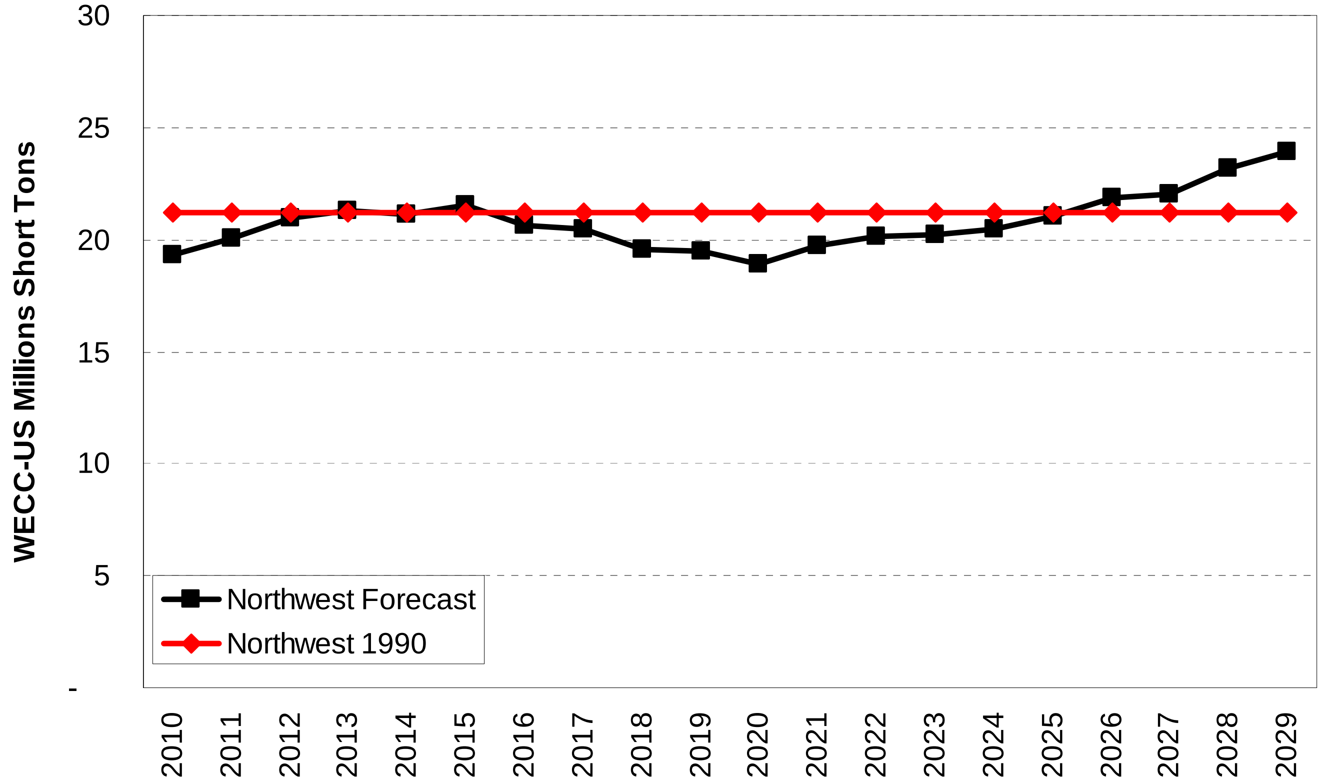
Greenhouse Gas Forecast- WA/OR/ID



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Case Nos. AVU-E-12-08
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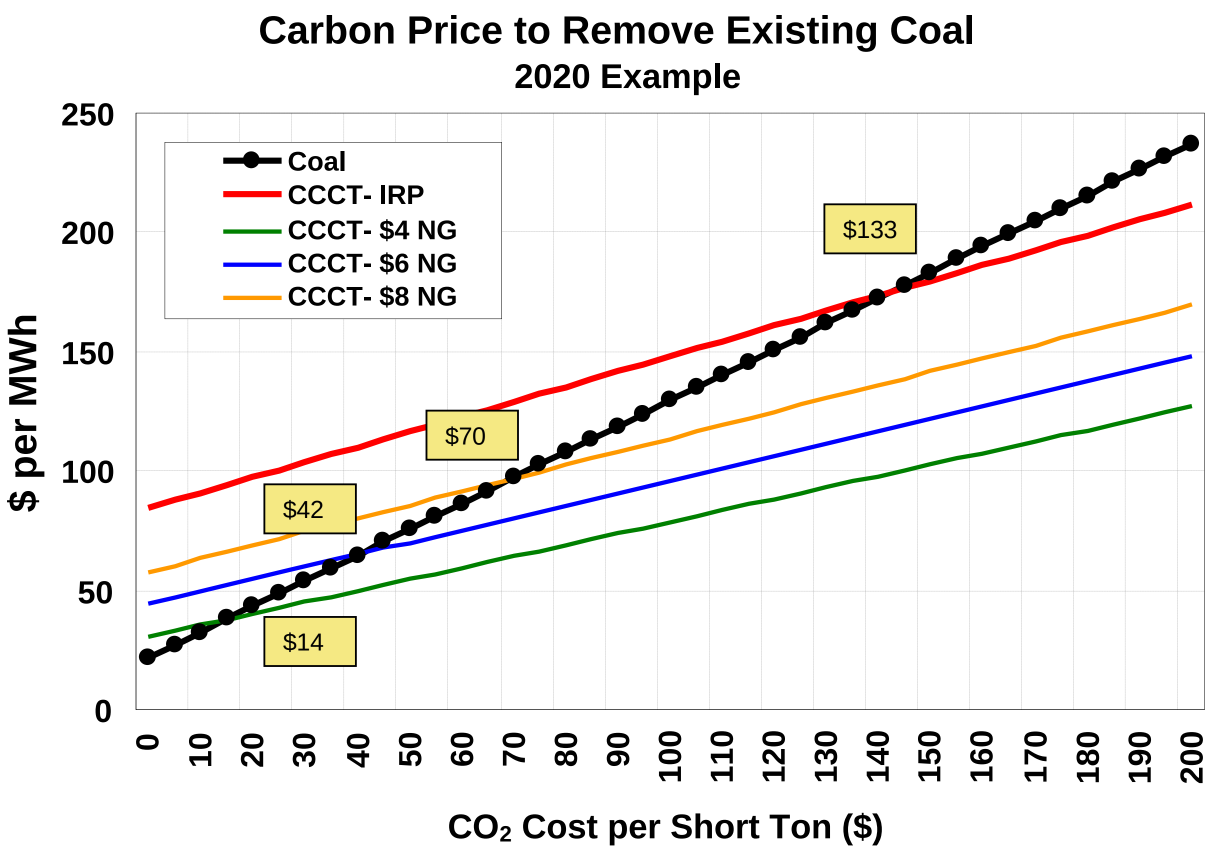
Schedule 5, Page 376 of 729

Carbon Adder High Enough, 2020 Example?



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Schedule 5, Page 377 of 729

How about a Coal Carbon "adder" Instead

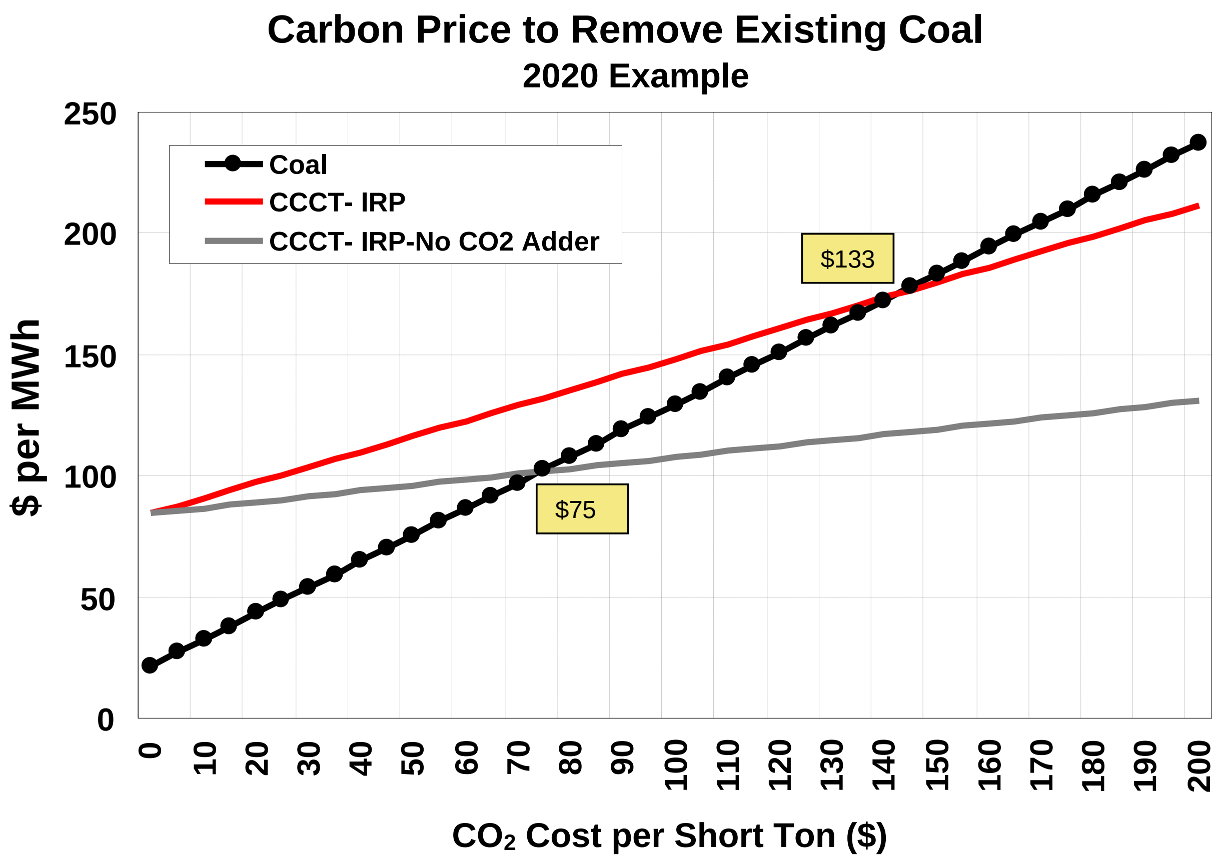

Exhibit No. 4
Case Nos. AVU-E-12-08
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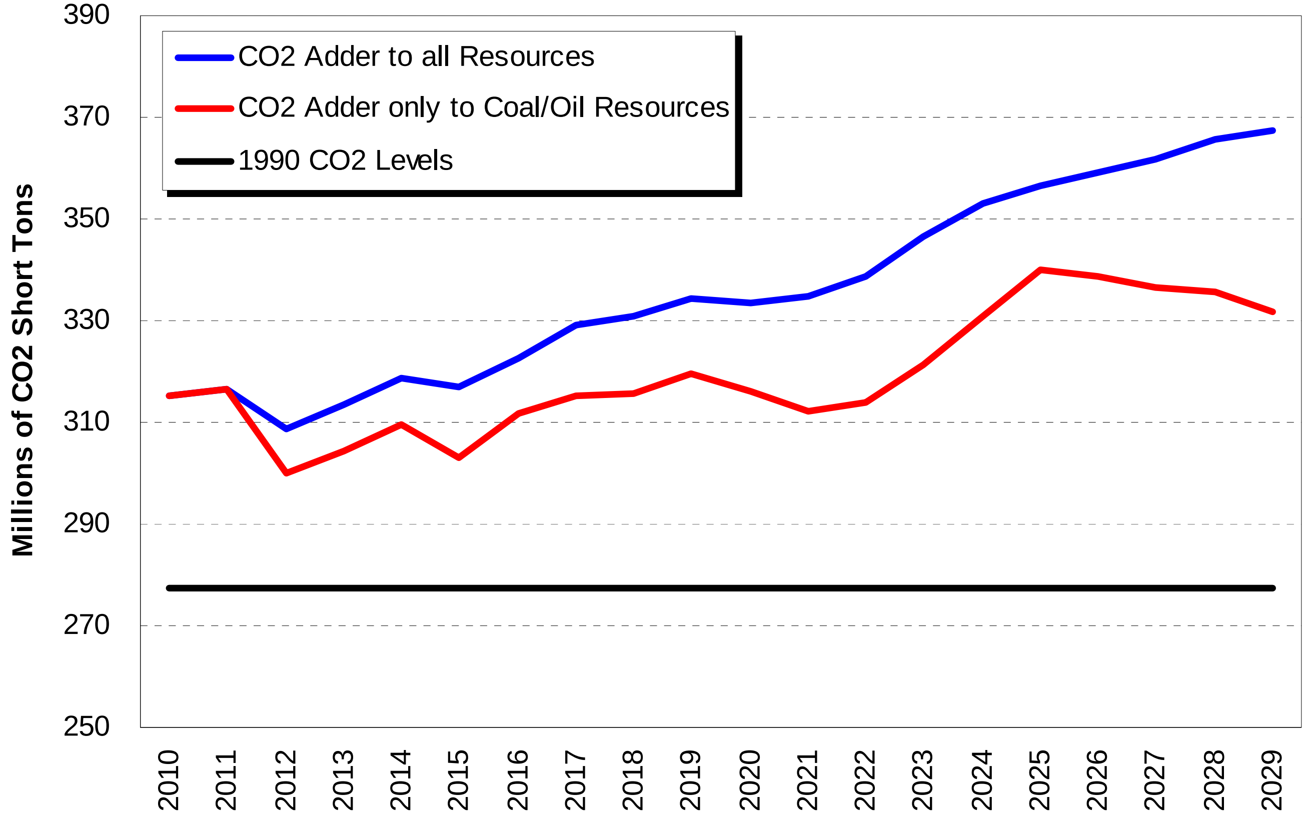
Schedule 5, Page 378 of 729

Greenhouse Gas Forecast- US Western Interconnect



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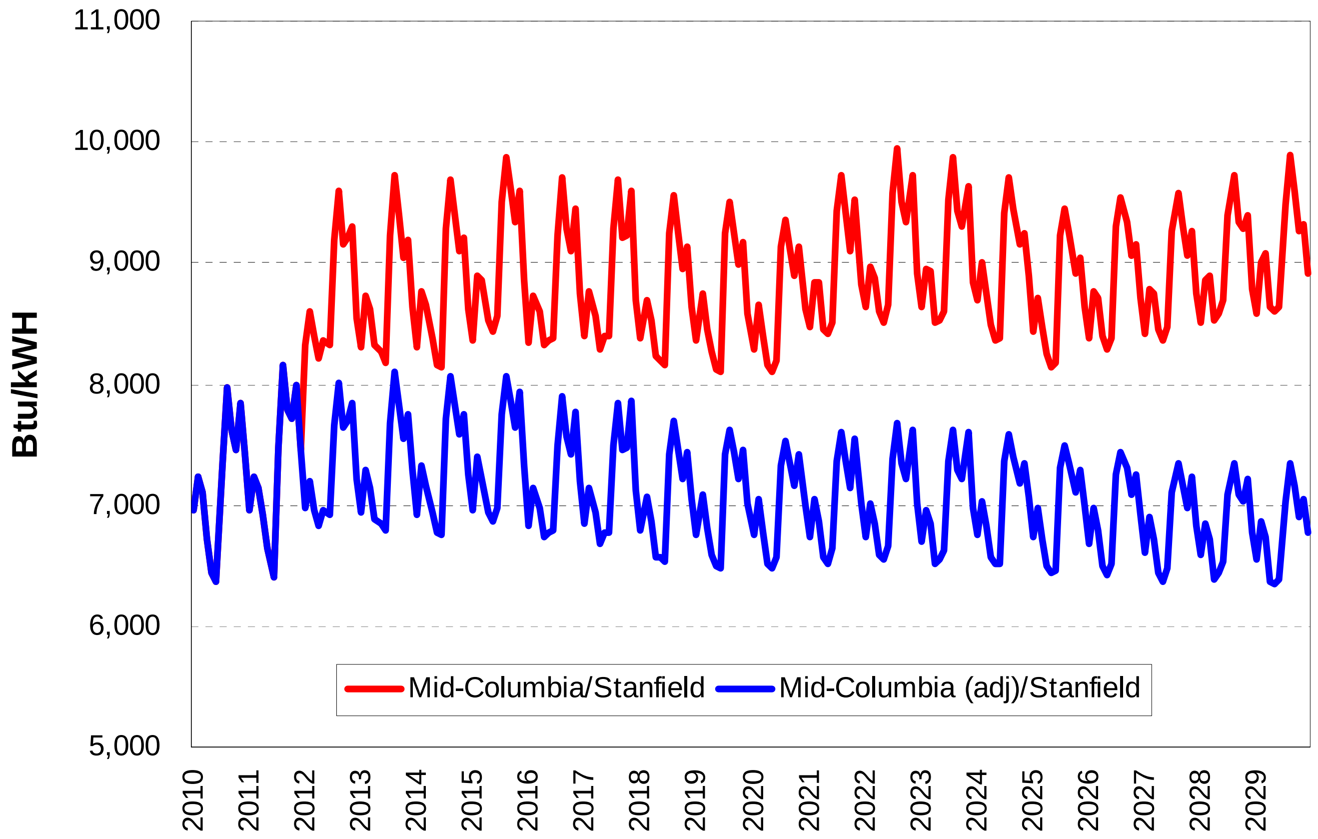
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 379 of 729

Market Implied Heat Rates
(Mid-C/Stanfield)



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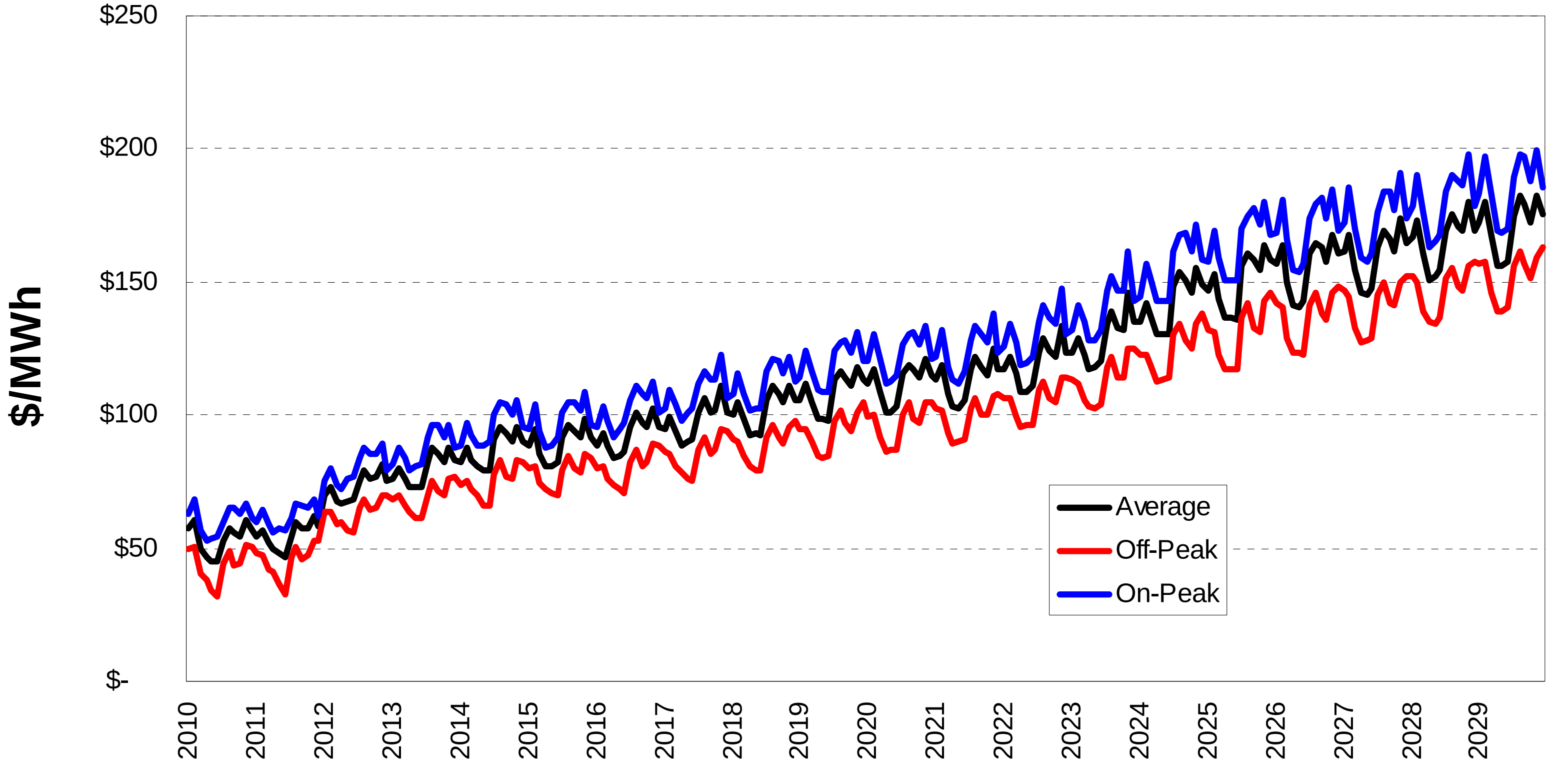
Schedule 5, Page 380 of 729

Annual On-Off Peak Mid-Columbia Prices



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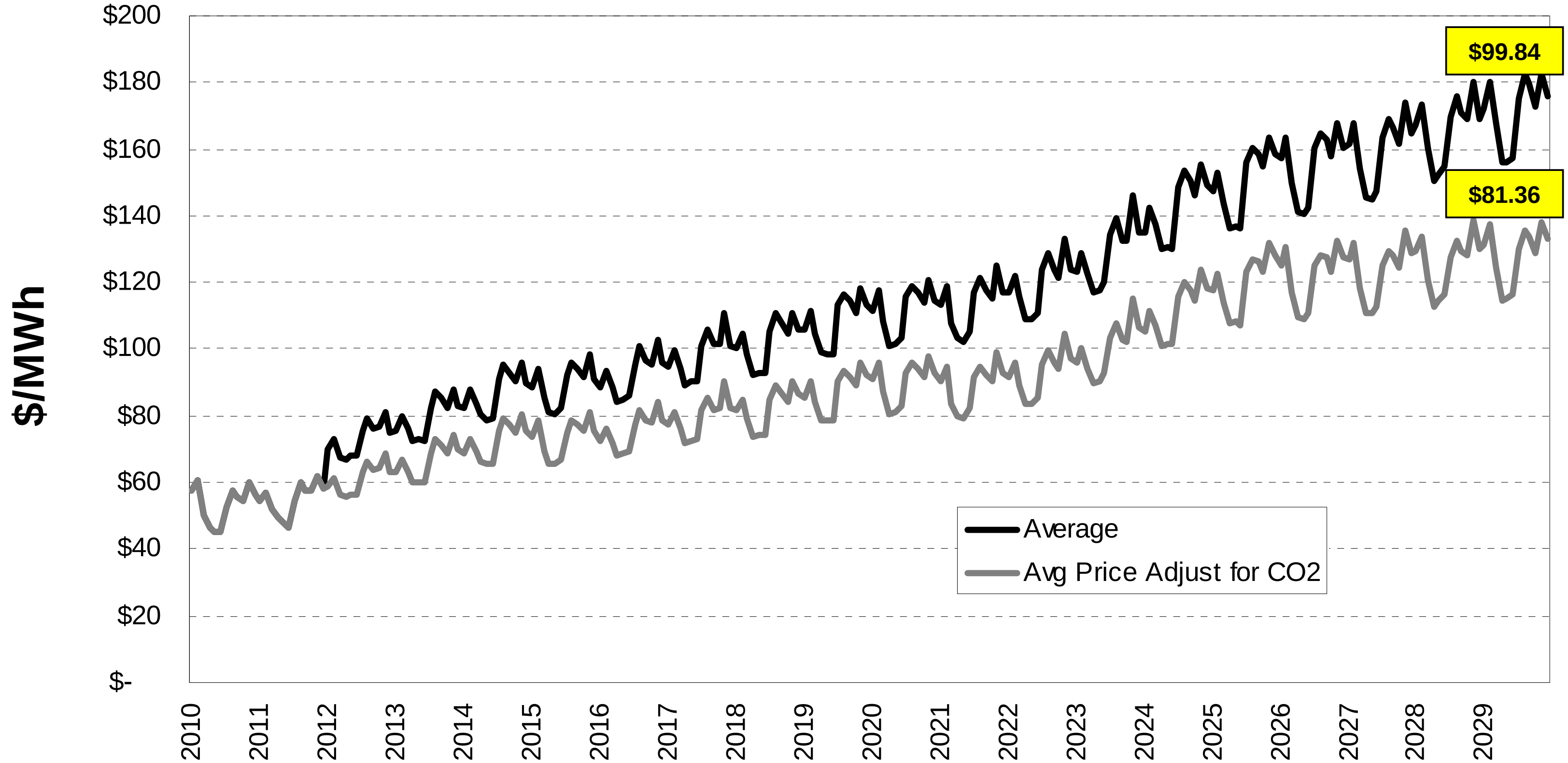
Schedule 5, Page 381 of 729

Mid-Columbia Prices would be lower if not for Carbon Costs



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Case Nos. AVU-E-12-08
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Schedule 5, Page 382 of 729

Mid-Columbia Levelized Prices ($/MWh)

2010-2029

	Average	On-Peak	Off-Peak
20-Year (Nominal)	99.84	109.77	86.60
20-Year (2008$)	83.15	91.41	72.13

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Legislative Update

Collins Sprague

2009 Electric Integrated Resource Plan
Third Technical Advisory Committee Meeting
October 22, 2007

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Western Climate Initiative

- Regional cap and trade implementation
- Electricity sector obligations
- Cost containment mechanisms
- Allowances
- Market regulation and enforcement

Feed-In Tariff

- Solar – Renewable Rate Recovery and Control Act
- Anaerobic Digester ($0.12/kWh), landfill gas ($0.08/kWh), and "organic" combined heat and power ($0.09/kWh)
  - Will not qualify for utility compliance with I-937
- Renewable energy credit (public utility tax) for solar expanded to include other technologies
- Wheeling requirement for output from digesters
  - Transmission cost capped at 5%

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Energy Efficiency

- Existing, new and renovated buildings
- Update Energy Code to achieve 30% reduction from current edition
- "State Building Efficiency and Carbon Reduction Strategy" – targets for building energy use intensity
- Energy benchmark disclosure requirement at time of structure sale
- Partial public utility credit for non-residential energy performance
- Expansion of Local Improvement Districts to finance energy efficiency and district heating/cooling

Other Topics

- Tax incentives
  - Broad tax incentives for combined heat and power, distributed generation, and water systems
  - Renewable energy tax incentives for large-scale generation

- "Product Stewardship" – collection and recycling of incandescent lighting by manufacturers

- Vegetation Management

- Emissions Performance standard revisions

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Avista's 2009 Electric Integrated Resource Plan
Technical Advisory Committee Meeting No. 4 Agenda
January 28, 2009

	Topic	**Time**	**Staff**
1.	Introduction	9:30	Storro
2.	2008 Peak Load Event	9:35	Heath
3.	Natural Gas & Electric Price Update	10:00	Rahn / Gall
4.	Lunch	11:30	
5.	Resource Assumptions	12:30	Lyons
6.	Transmission	1:00	Gibson
7.	Draft Preferred Resource Strategy	2:00	Gall
8.	Adjourn	3:00	

2008 Peak Load Event

Heidi Heath

2009 Electric Integrated Resource Plan

Fourth Technical Advisory Committee Meeting

January 28, 2009

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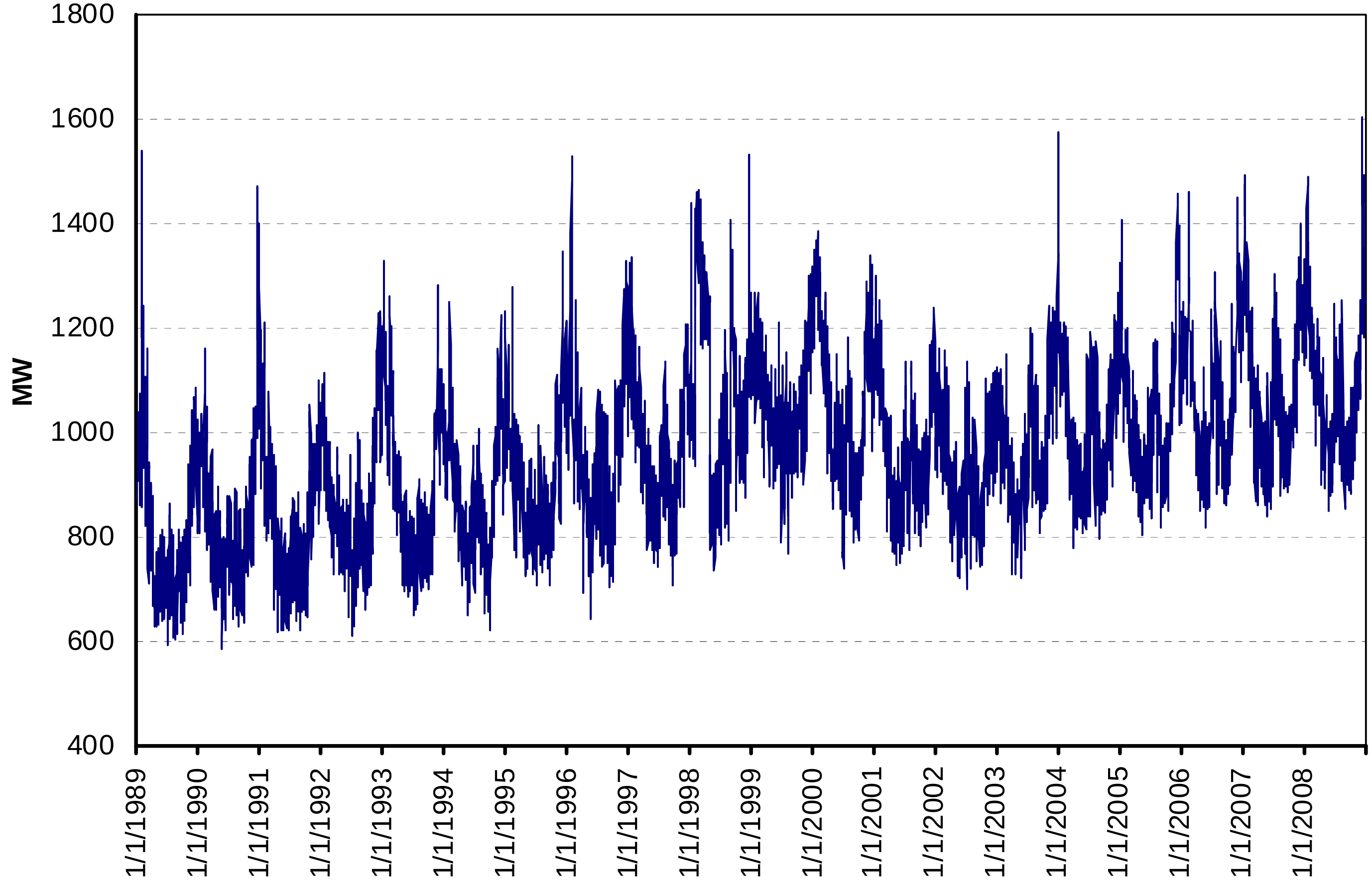
Top Ten Highest Hourly Loads

	Date	Load
1	***12/16/2008***	***1821***
2	***12/16/2008***	***1809***
3	***12/16/2008***	***1791***
4	2/1/1996	1796
5	***12/15/2008***	***1781***
6	***12/15/2008***	***1776***
7	2/2/1996	1770
8	1/5/2004	1766
9	***12/16/2008***	***1759***
10	***12/14/2008***	***1752***

Daily Average Loads
1989-2008



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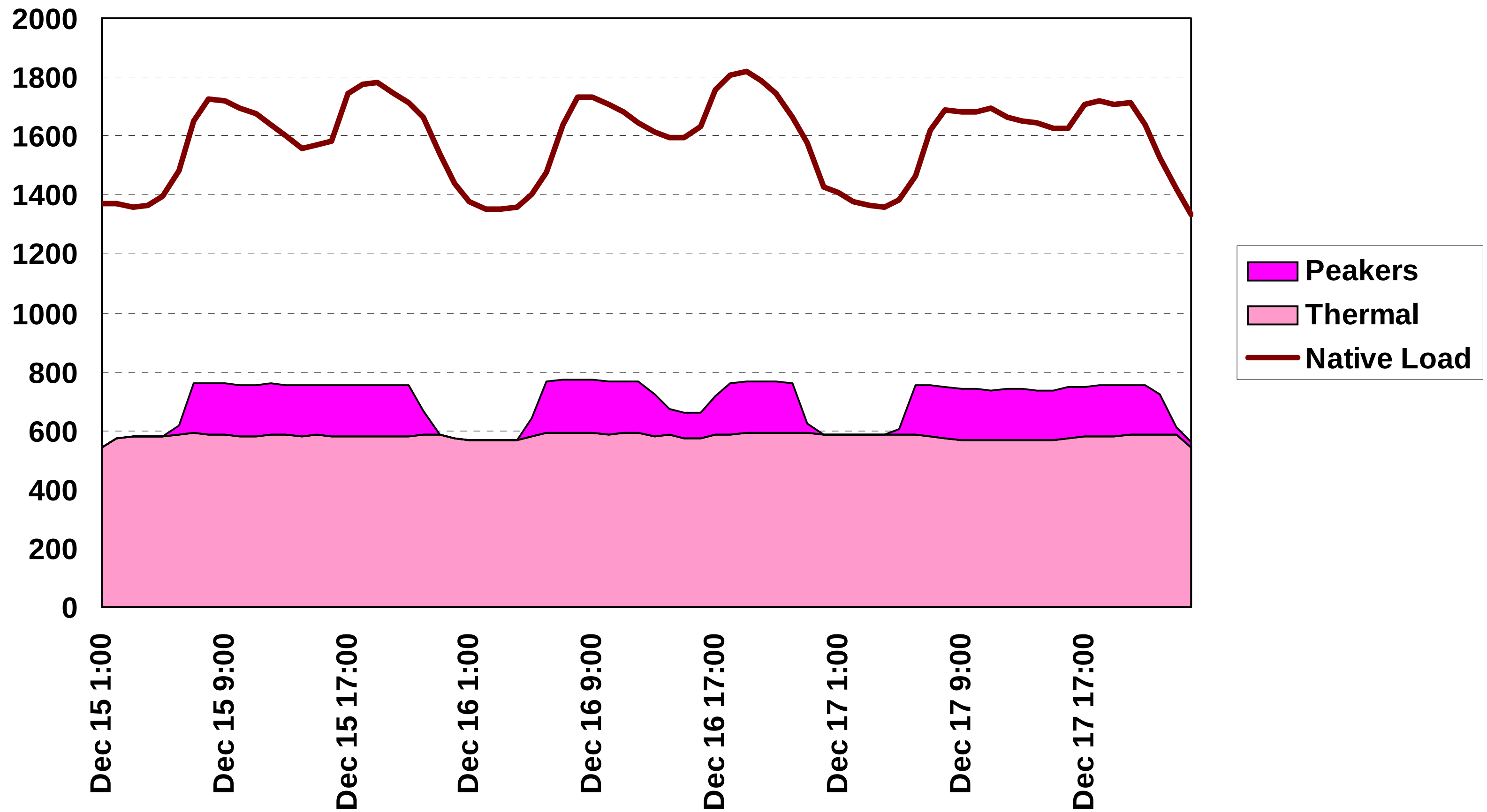
Thermal Generation



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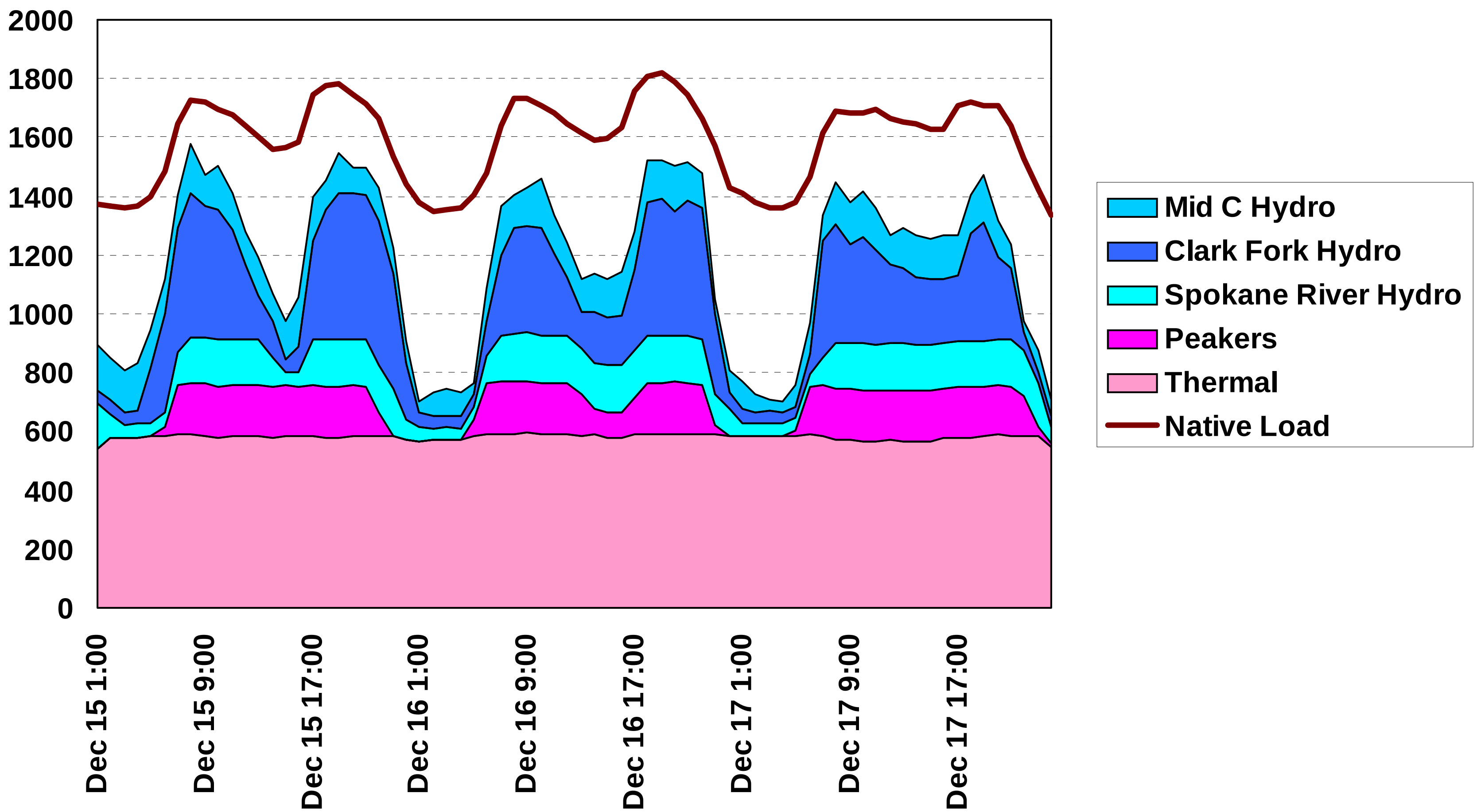
Schedule 5, Page 393 of 729

Hydro Generation



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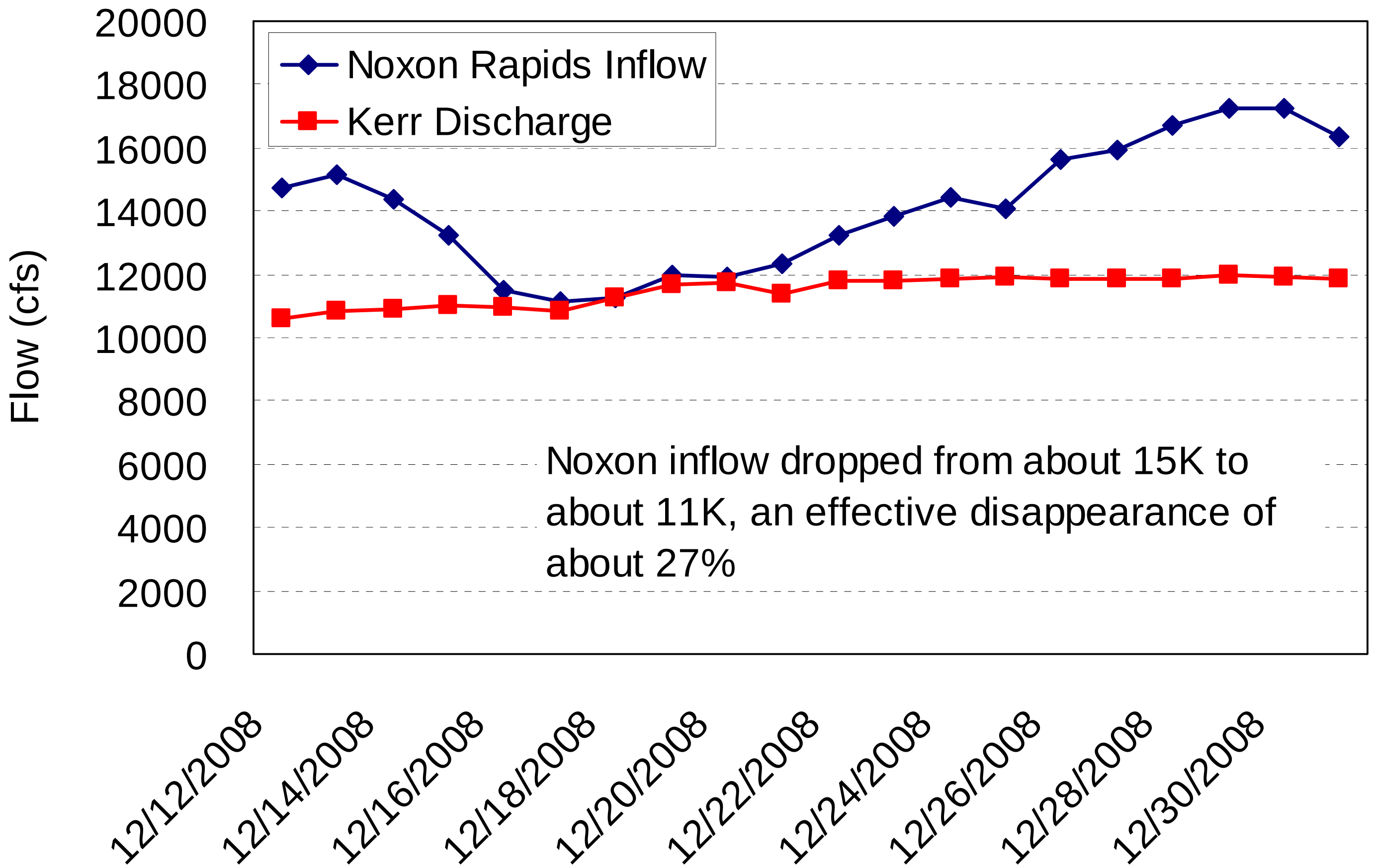
Schedule 5, Page 394 of 729

River icing was a problem!



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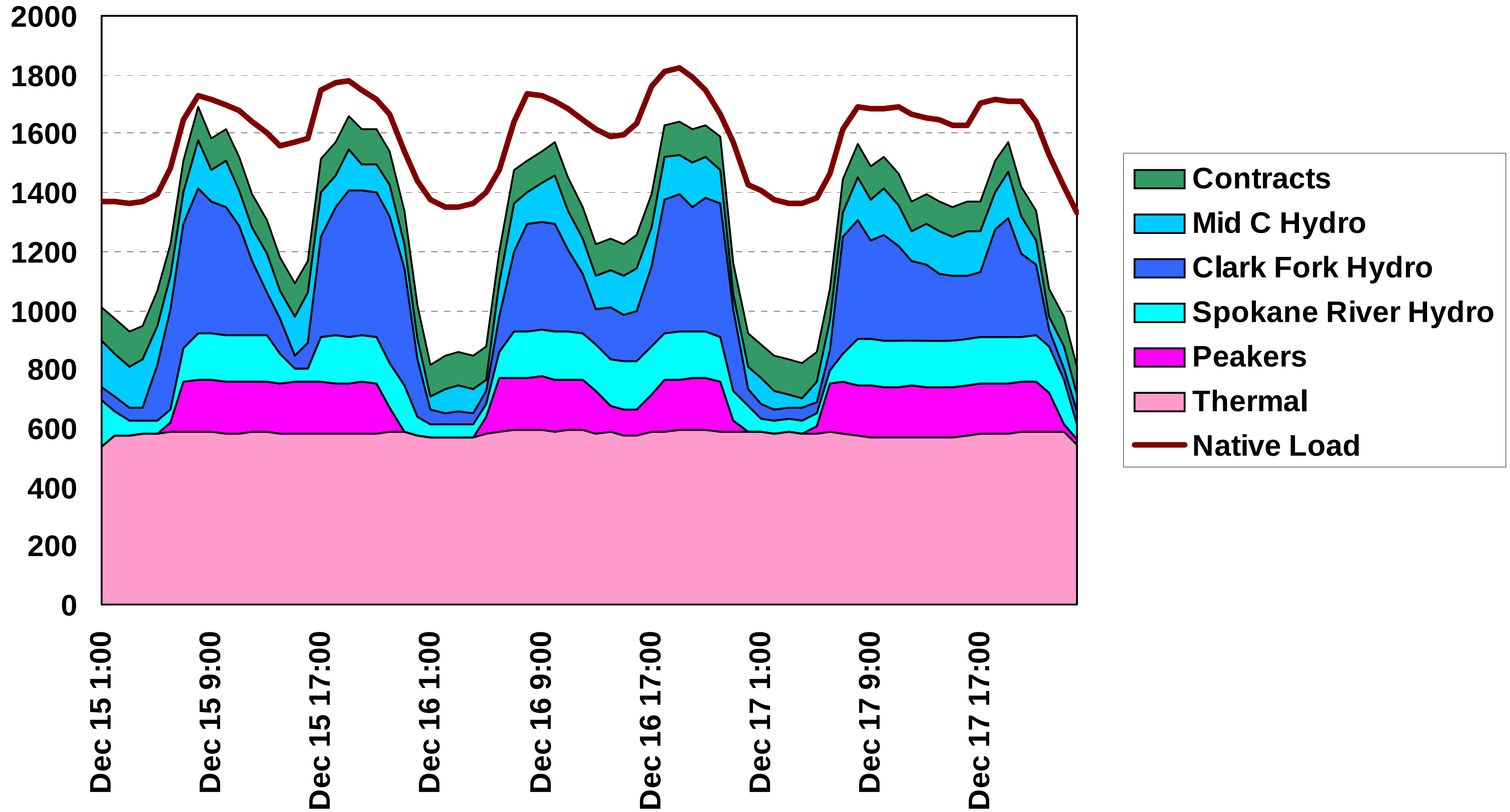
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 395 of 729

Contracts



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Case Nos. AVU-E-12-08
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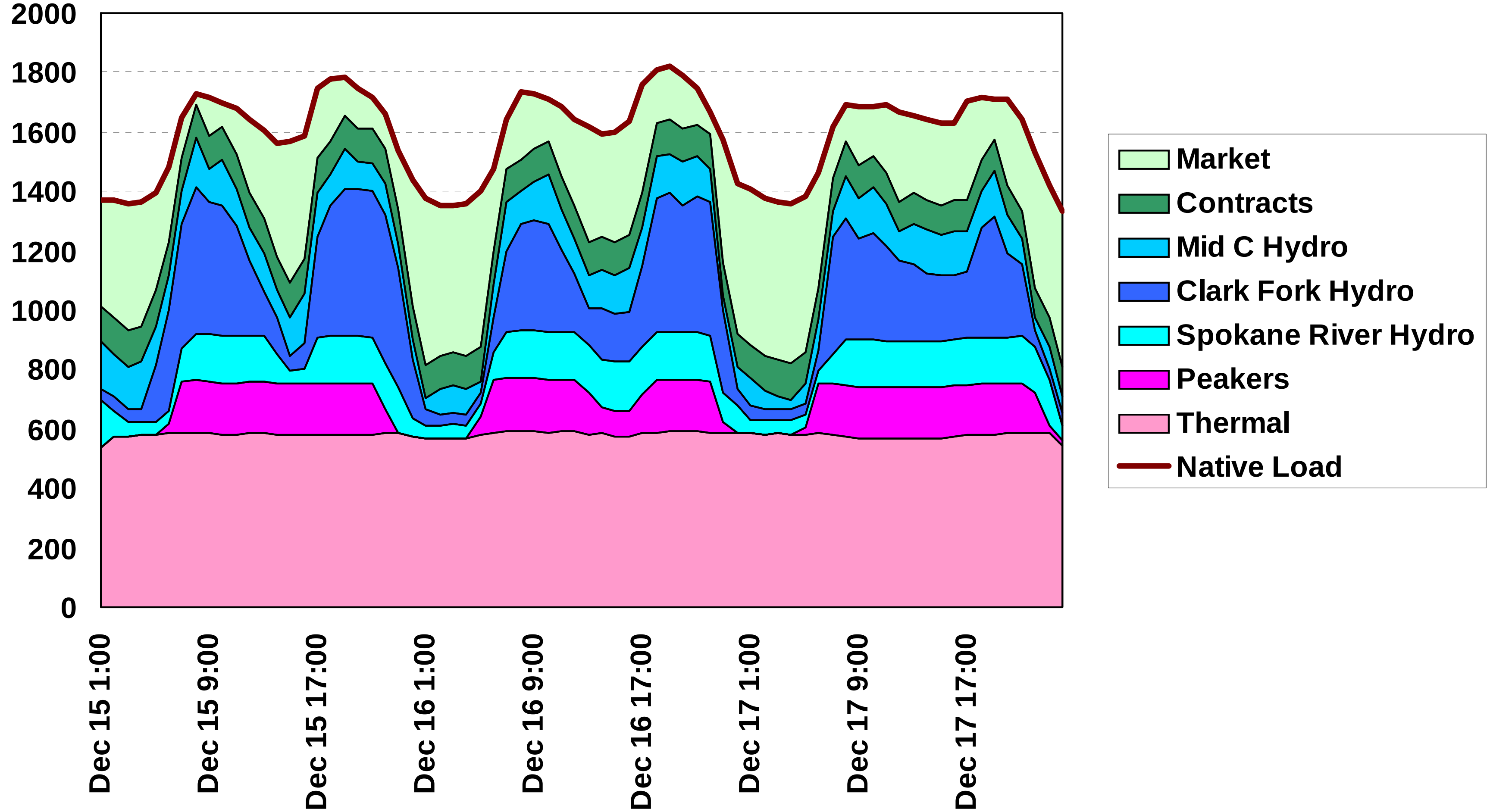
Schedule 5, Page 396 of 729

Market Purchases



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Case Nos. AVU-E-12-08
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Schedule 5, Page 397 of 729

Natural Gas & Electric Price Forecast- Update

Greg Rahn & James Gall

2009 Electric Integrated Resource Plan

Fourth Technical Advisory Committee Meeting

January 28, 2009

Study Changes Since Last TAC

- Wood Mackenzie released its “Carbon Case #3”
  - Mid-range greenhouse gas mitigation scenario
  - Natural gas price impact from greenhouse legislation
  - Demand reductions due to greenhouse gas legislation
- Updated Natural Gas Price Forecast
  - Integrates near term economy
  - Short-term price collapse
  - Credit markets

Natural Gas Price Forecast Update

Supply Increase to Soften Price of Natural Gas

- Edinburgh, Scotland-based energy consultancy Wood Mackenzie said it expects spot prices for natural gas between $5 and $6 per million British thermal units for the next few years, with periods when prices will slip even lower.
- "We are now in a position of significant potential oversupply brought about by the huge success experienced in the development of shale gas plays," says Jen Snyder, head of North American gas research at Wood Mackenzie.

- Russell Gold, The Wall Street Journal

November 25, 2008

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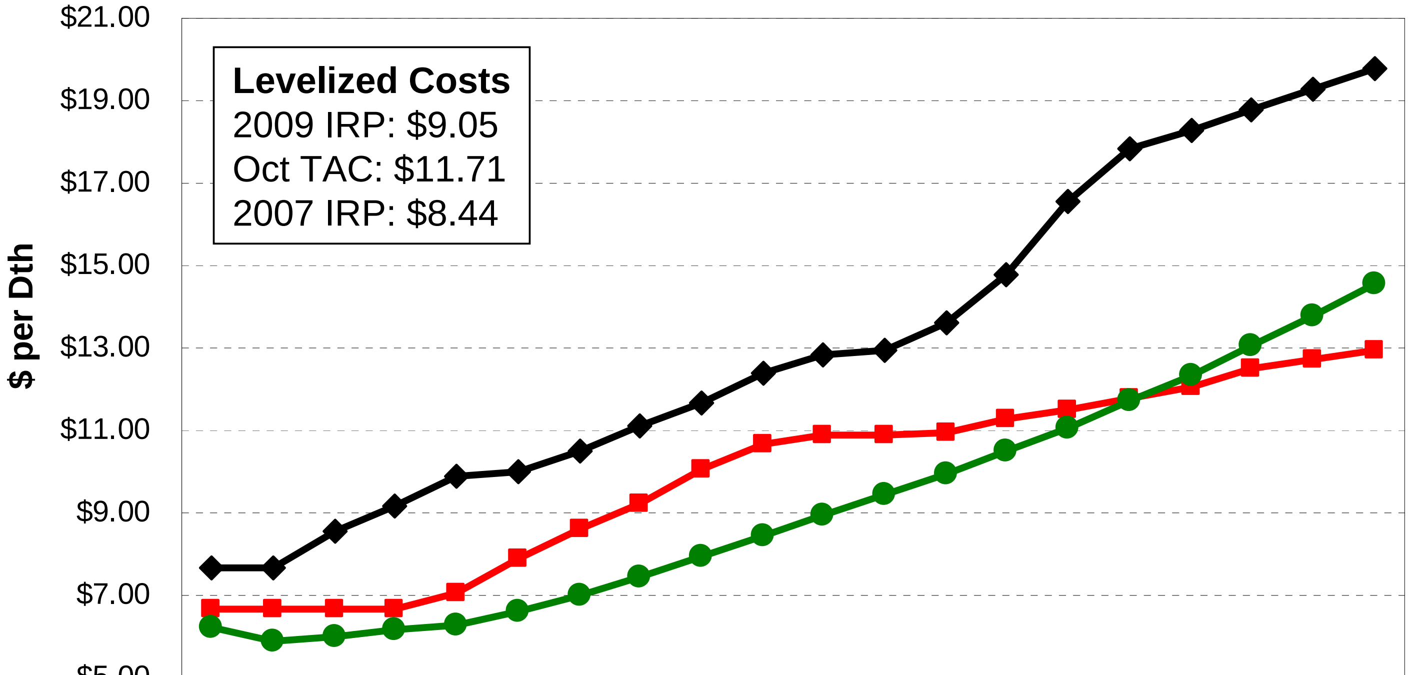
Annual Natural Gas Price Comparison

Henry Hub Nominal $



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
2009 IRP	6.66	6.69	6.69	6.69	7.05	7.87	8.63	9.20	10.05	10.69	10.89	10.86	10.94	11.26	11.50	11.76	12.04	12.49	12.72	12.96
Oct TAC	7.64	7.69	8.53	9.14	9.90	10.00	10.52	11.13	11.67	12.41	12.82	12.94	13.60	14.79	16.57	17.84	18.30	18.77	19.26	19.75
2007 IRP	6.23	5.91	6.00	6.15	6.30	6.59	6.98	7.47	7.95	8.44	8.94	9.43	9.95	10.50	11.08	11.70	12.35	13.04	13.77	14.55

2009 IRP: 2010-2013 Average Price of Consultants, EIA, and Forward Prices

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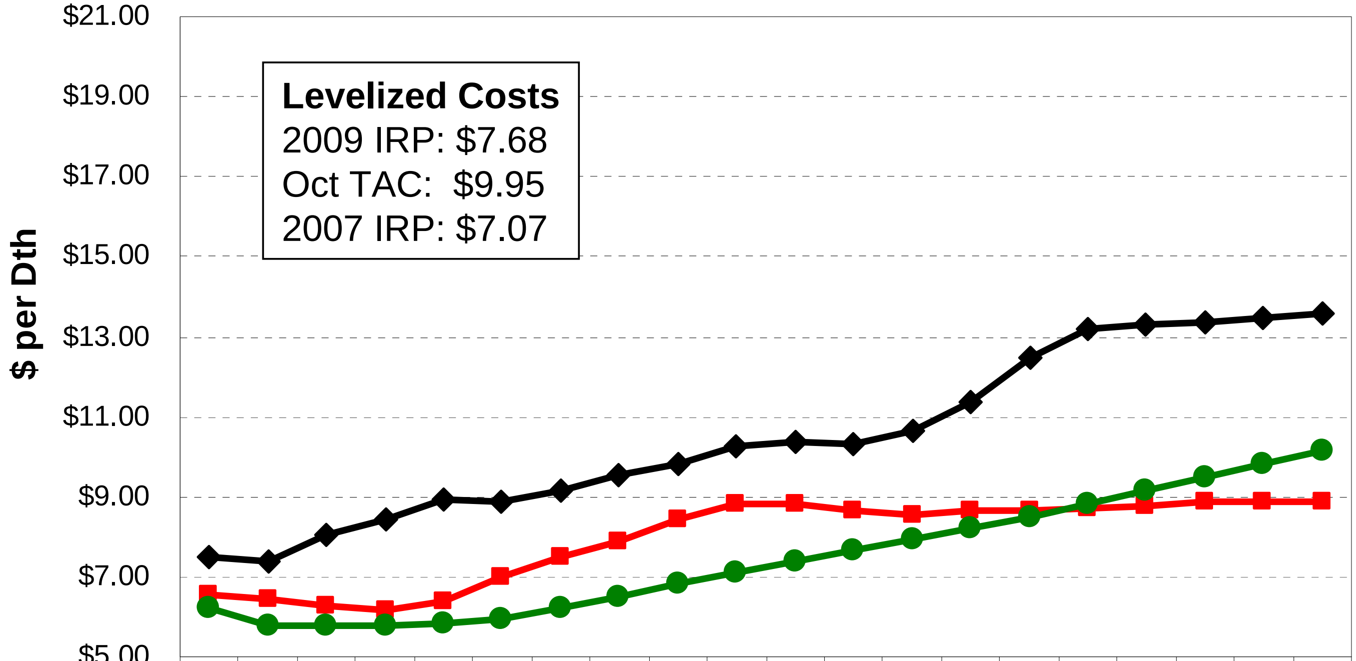
Annual Natural Gas Price Comparison

Henry Hub 2009 $



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
2009 IRP	6.53	6.43	6.29	6.17	6.37	6.98	7.52	7.87	8.44	8.81	8.82	8.64	8.55	8.64	8.66	8.70	8.74	8.90	8.90	8.90
Oct TAC	7.49	7.39	8.03	8.43	8.96	8.88	9.17	9.52	9.80	10.23	10.38	10.29	10.63	11.35	12.48	13.20	13.29	13.37	13.47	13.56
2007 IRP	6.23	5.80	5.77	5.79	5.81	5.96	6.19	6.50	6.80	7.09	7.37	7.63	7.91	8.20	8.50	8.81	9.14	9.47	9.81	10.17

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Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 402 of 729

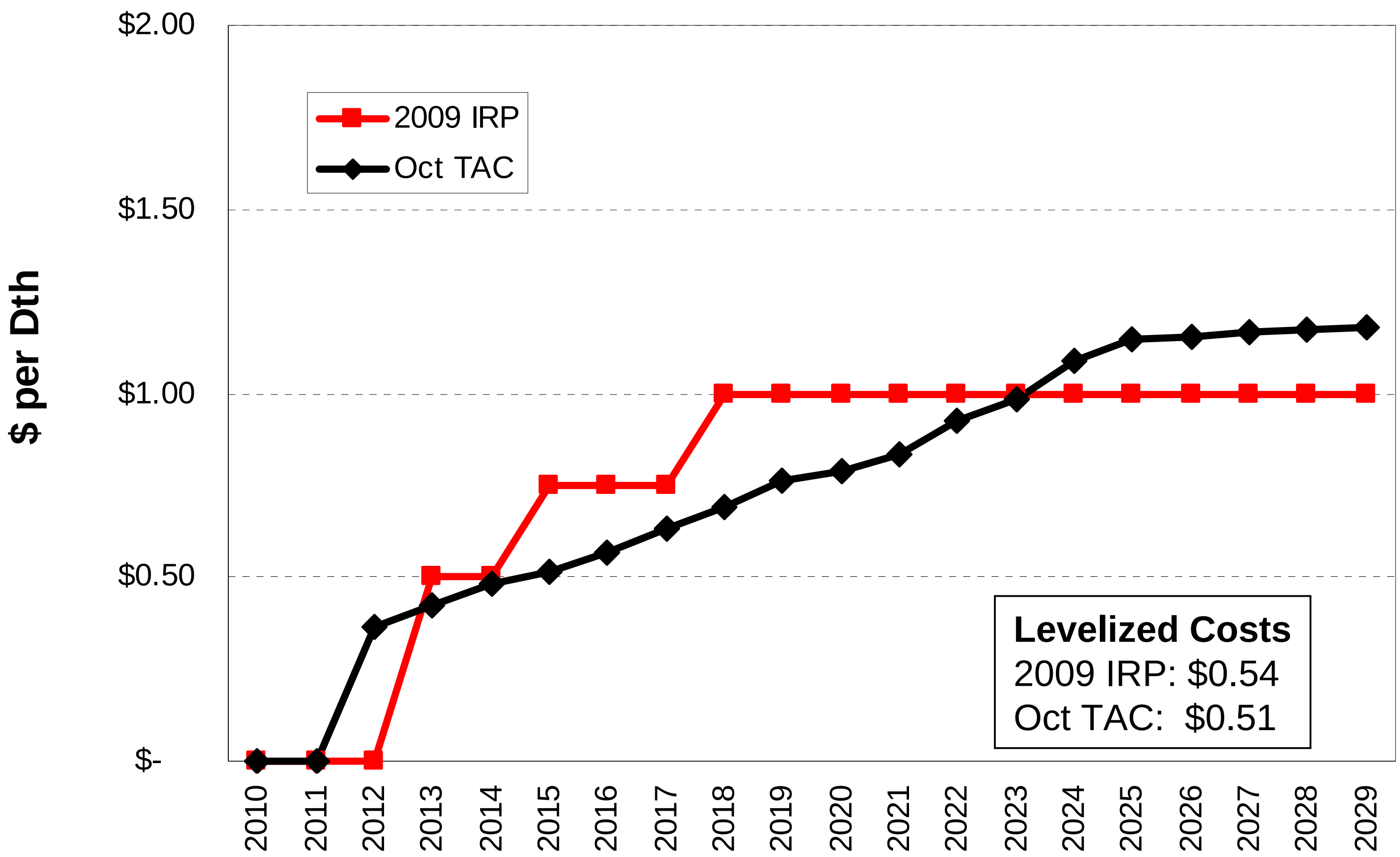
Greenhouse Gas Price Assumptions

- Based on the most recent 'discussion draft' proposal by Reps. Dingell and Boucher of the House Energy and Commerce Committee
- Wood Mackenzie made assumptions on the key components of the analysis such as caps on carbon prices, the allocation of carbon credits, the use of carbon offsets, and, nuclear and CCS technology availability.
- Wood Mackenzie's proprietary upstream oil, gas, and coal data and analysis are the cost and availability of fuel supplies, particularly to support an assumption to increase reliance on natural gas to meet near term emission reduction requirements.
- Carbon offsets/other industry represent difference between forecasted emissions and legislative goals

Source: Wood Mackenzie Carbon Case 3

Annual GHG Adder to Natural Gas Prices

2008 $



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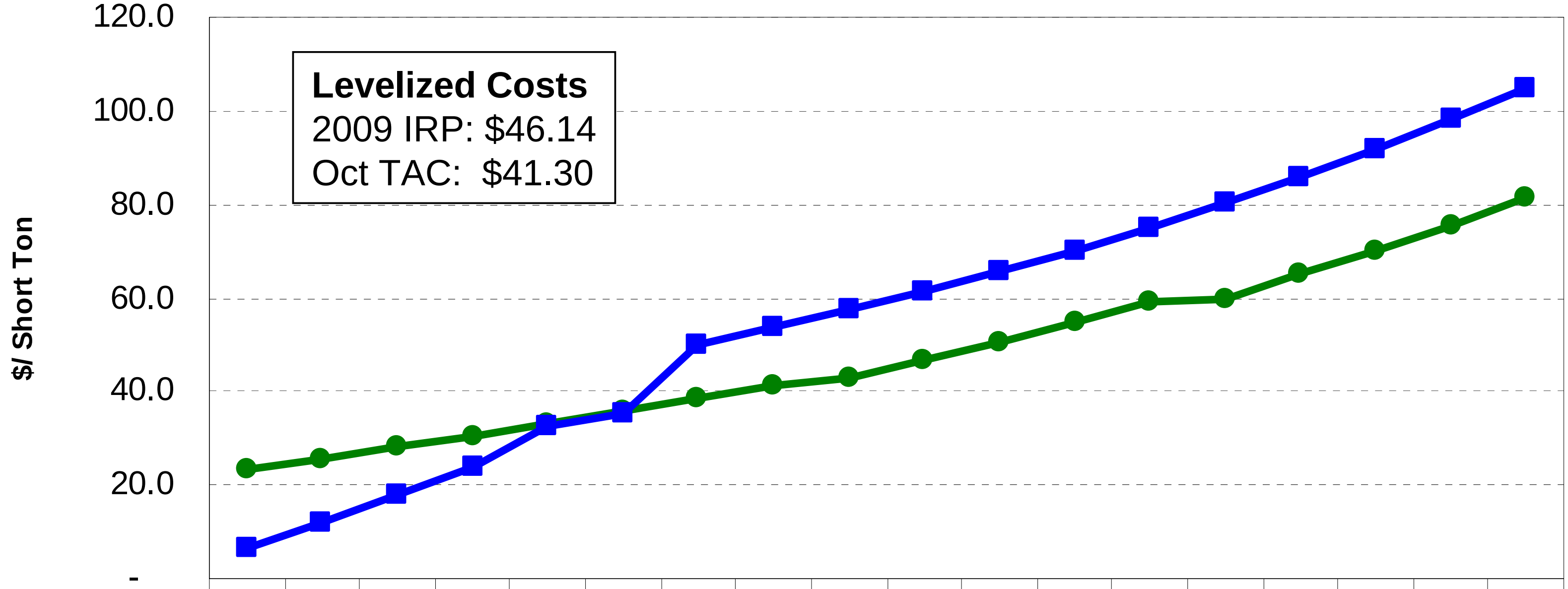
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 404 of 729

Annual GHG Adder per Ton of CO_2

Nominal $



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Oct TAC	23	26	28	30	33	36	39	41	43	47	51	55	59	60	65	70	76	81
2009 IRP	7	12	18	24	33	35	50	54	57	61	66	70	75	80	86	92	98	105

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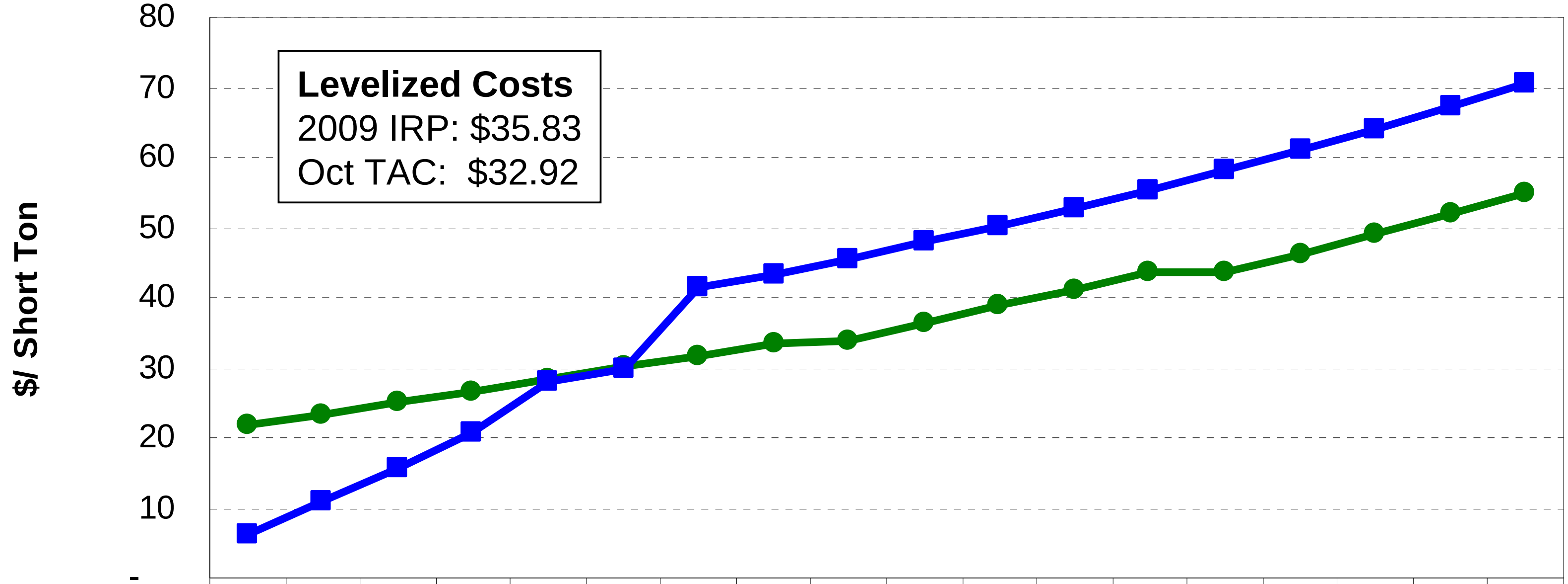
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 405 of 729

Annual GHG Adder per Ton of CO_2

2009 $



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Oct TAC	22	23	25	27	28	30	32	34	34	36	39	41	44	43	46	49	52	55
2009 IRP	6	11	16	21	28	30	41	43	46	48	50	53	55	58	61	64	67	71

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Case Nos. AVU-E-12-08
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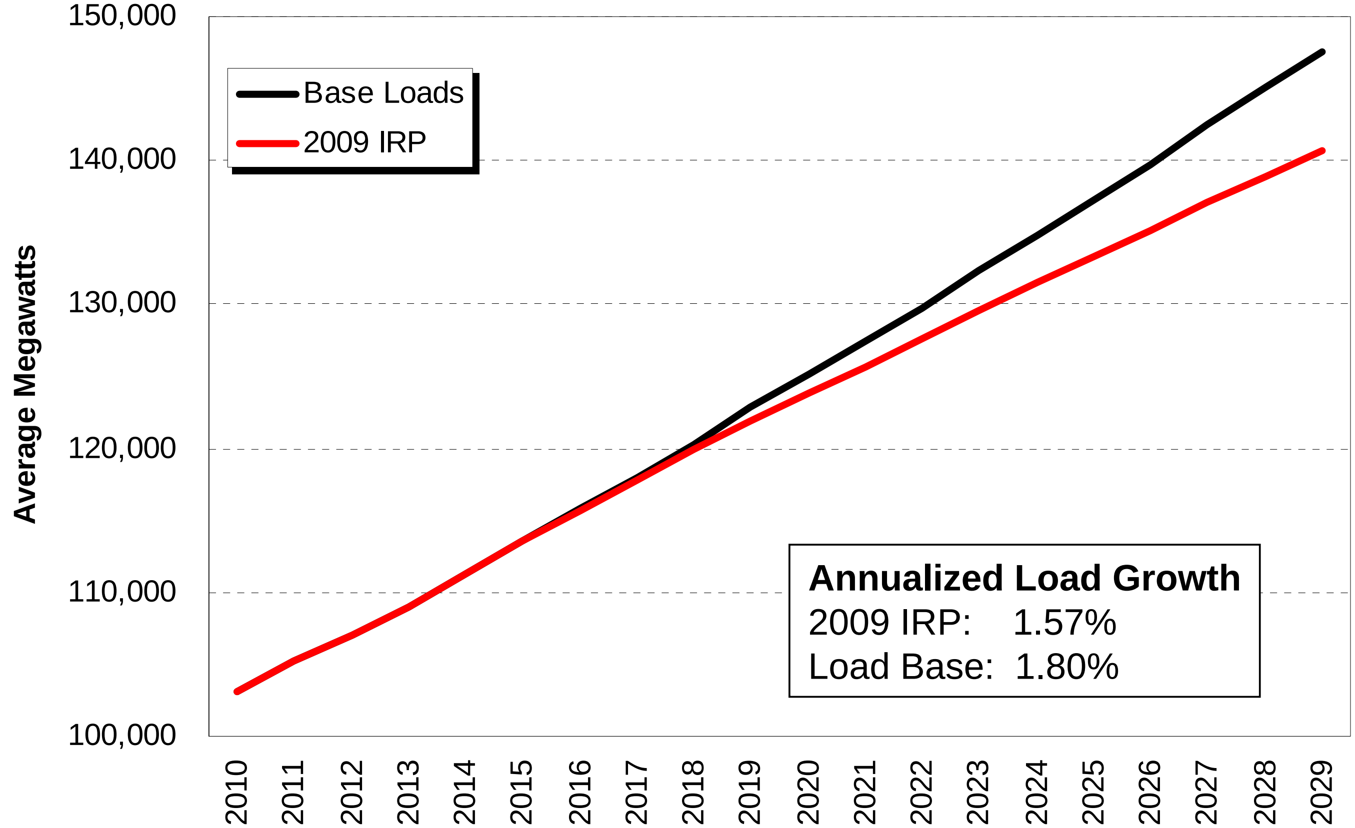
Schedule 5, Page 406 of 729

Western Interconnect Load Growth

Change with Greenhouse Gas Legislation



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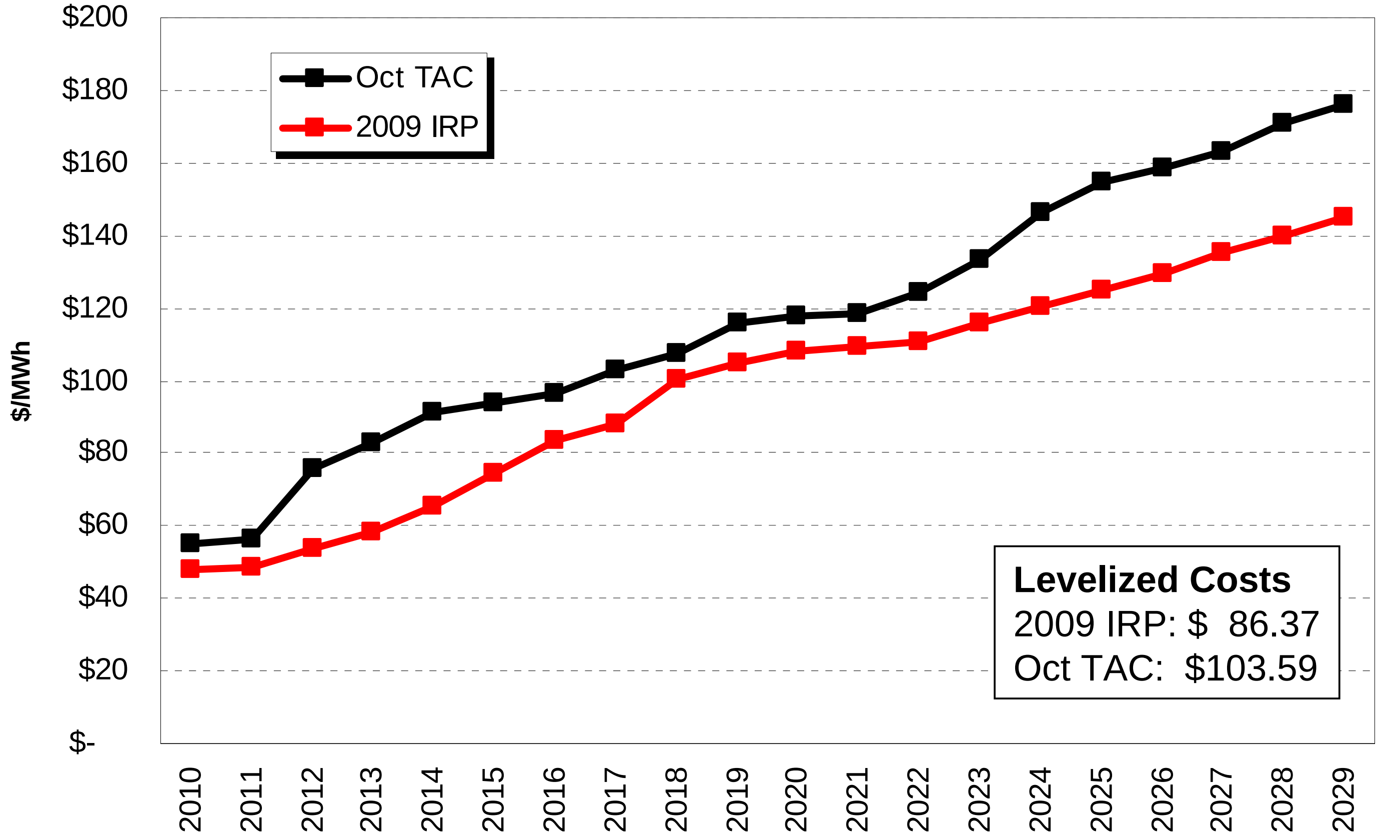
Last TAC Price Forecast vs 2009 IRP



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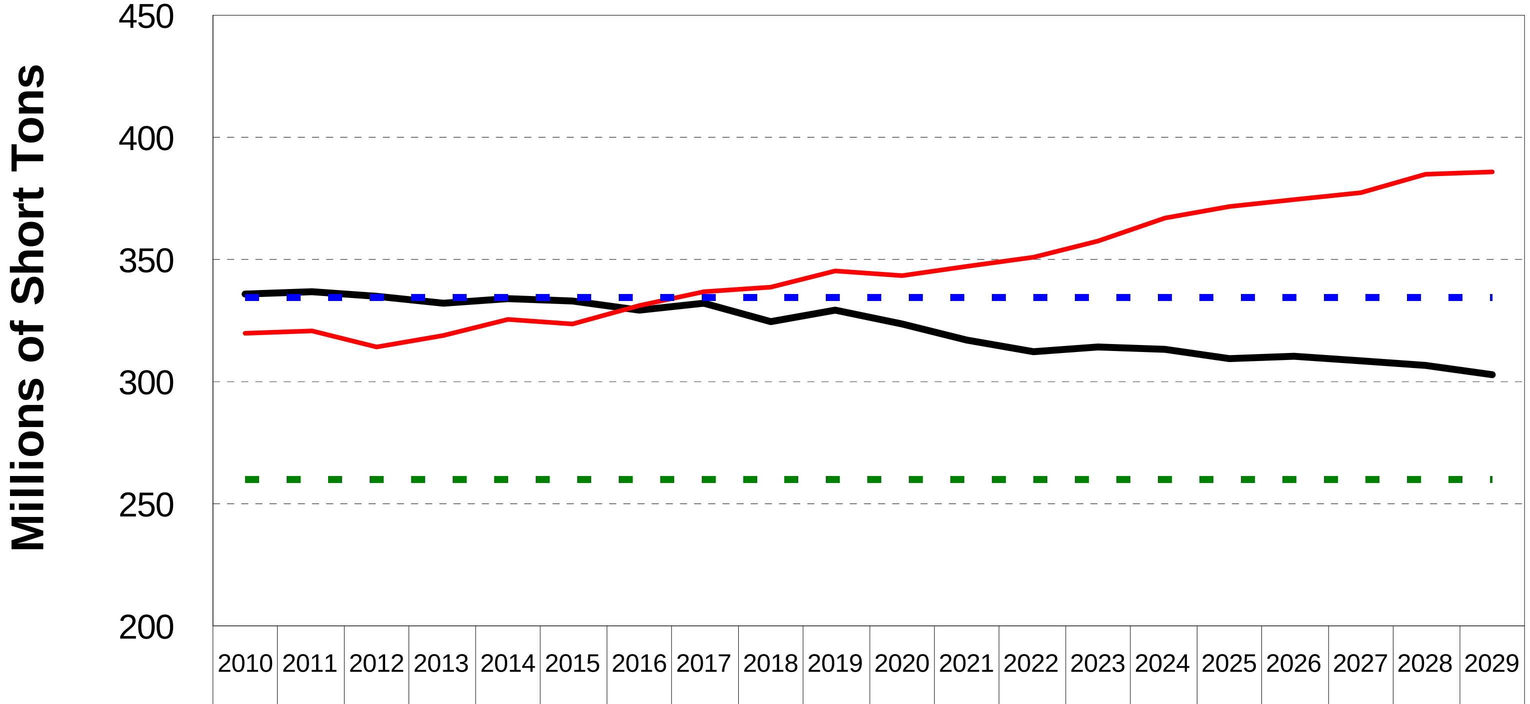
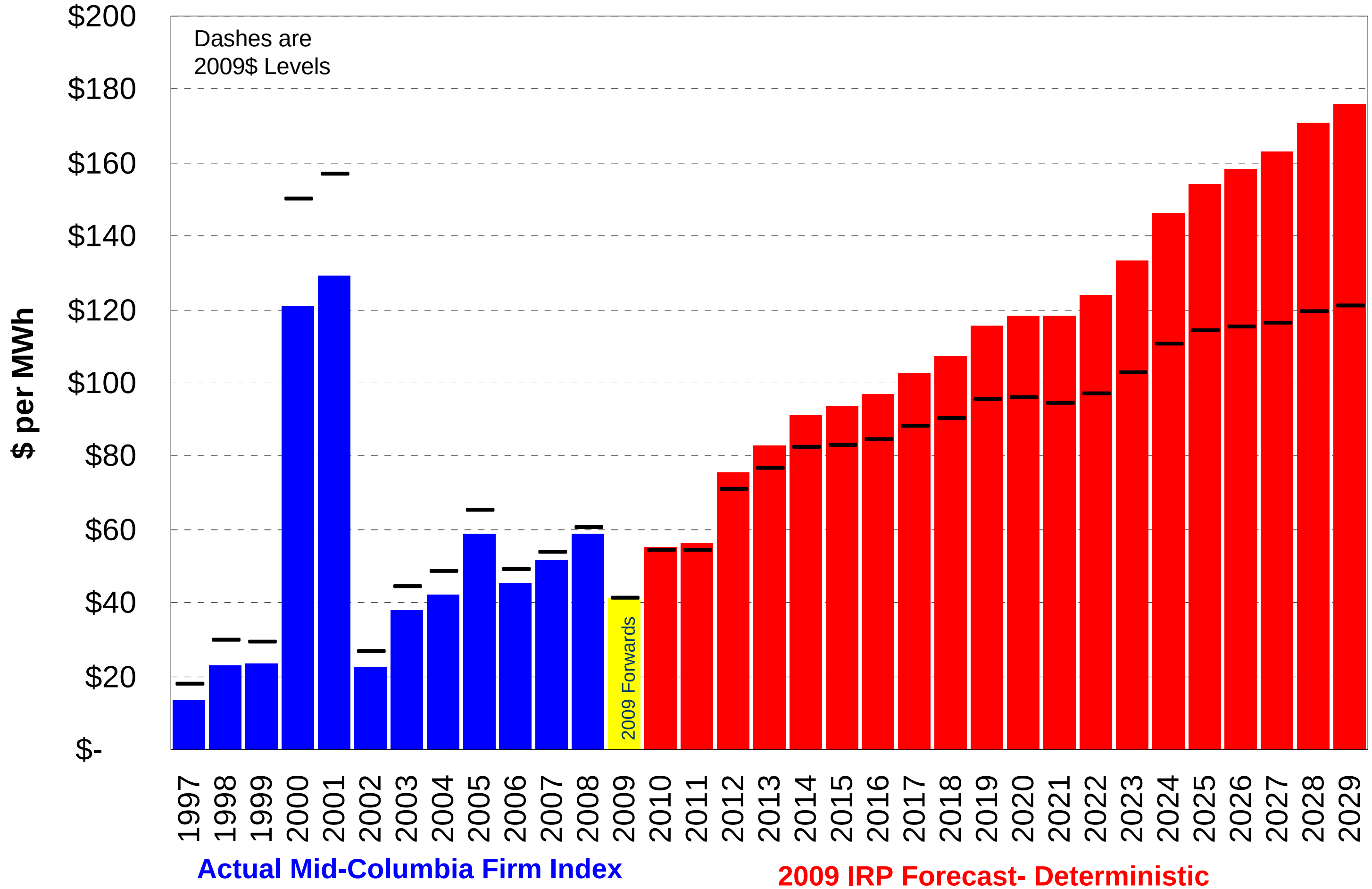
Schedule 5, Page 408 of 729

US Western Interconnect Greenhouse Gas Comparison



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
2009 IRP	336	337	335	332	334	333	330	332	325	329	323	317	312	314	314	309	310	309	307	303
Oct TAC	319	321	314	319	325	324	331	337	338	345	343	347	351	357	367	371	375	377	385	385
2005 Levels	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334
1990 Levels	259	259	259	259	259	259	259	259	259	259	259	259	259	259	259	259	259	259	259	259

Mid-Columbia Actual & Forecast



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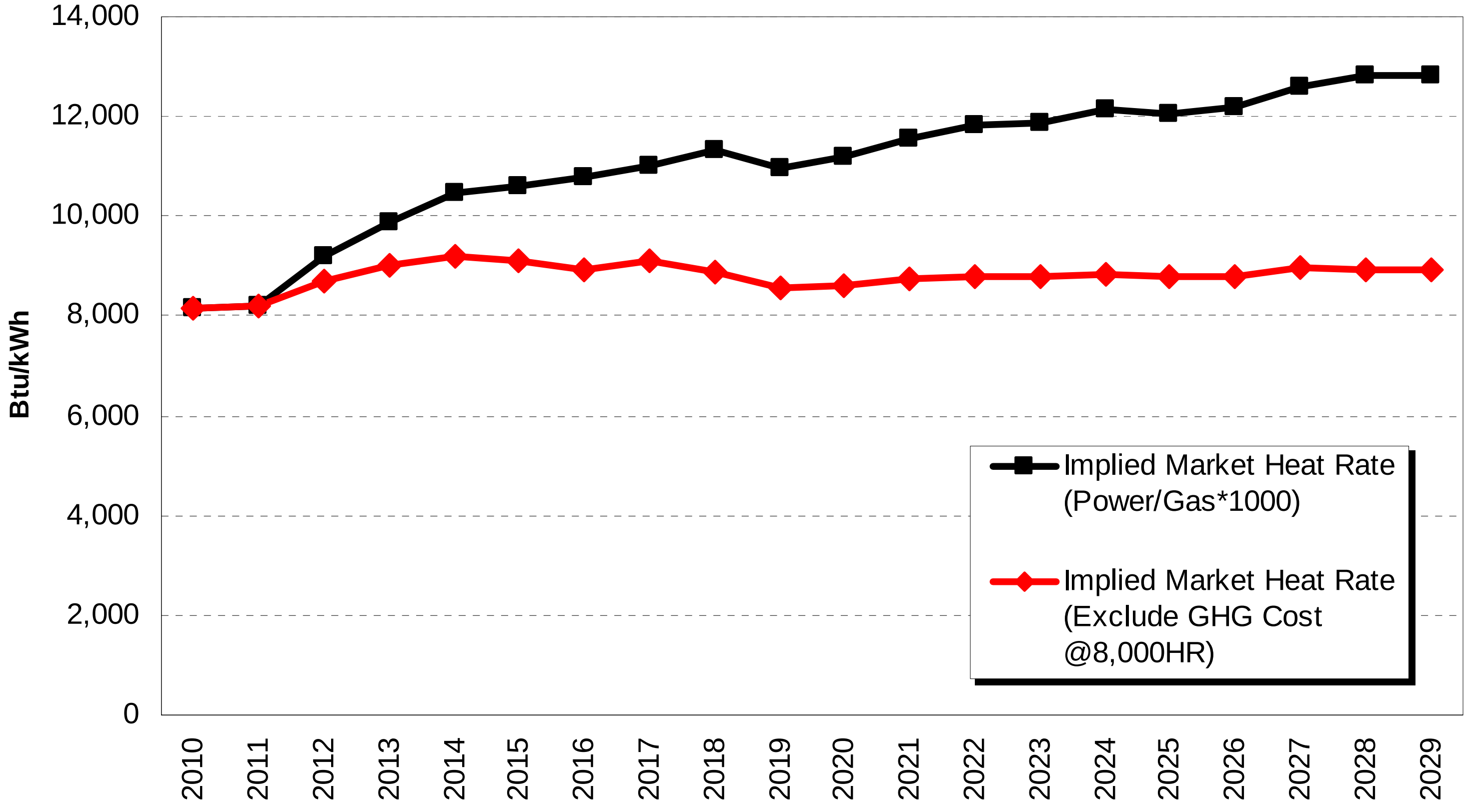
Schedule 5, Page 410 of 729

Implied Market Heat Rate

(Mid-Columbia/Stanfield*1000)



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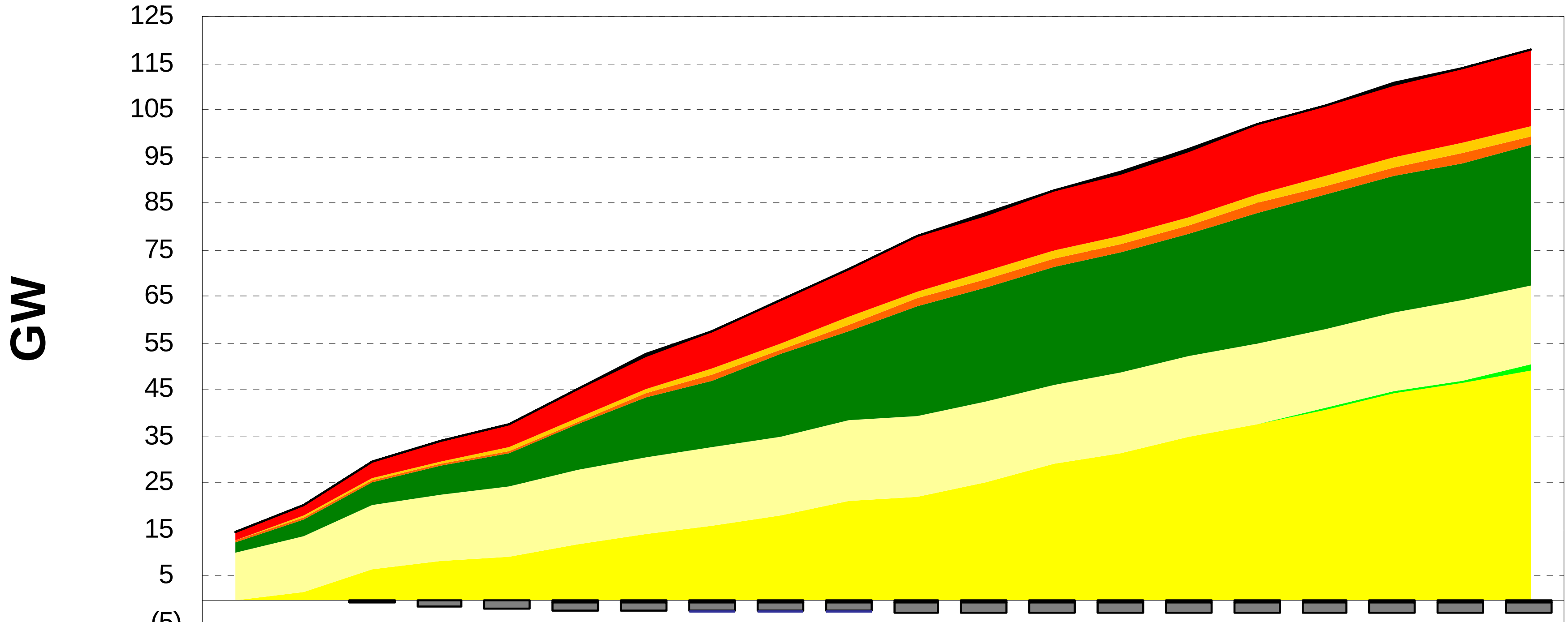
Western Interconnect New Resources



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Hydro	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solar	2	3	3	4	5	6	7	8	9	10	12	12	13	13	14	15	15	16	16	16
Geothermal	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
Biomass	0	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
Wind	3	4	5	6	7	10	13	15	18	19	24	25	25	26	26	28	29	29	29	30
SCCT	10	12	14	15	15	16	16	17	17	17	17	17	17	17	17	17	17	17	17	17
Coal Seq	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1
CCCT	-	2	7	8	9	12	14	16	18	21	22	25	29	32	35	38	41	44	47	49
Oil- retire	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NG- retire	(0)	(0)	(1)	(1)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Coal- retire	-	-	-	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)

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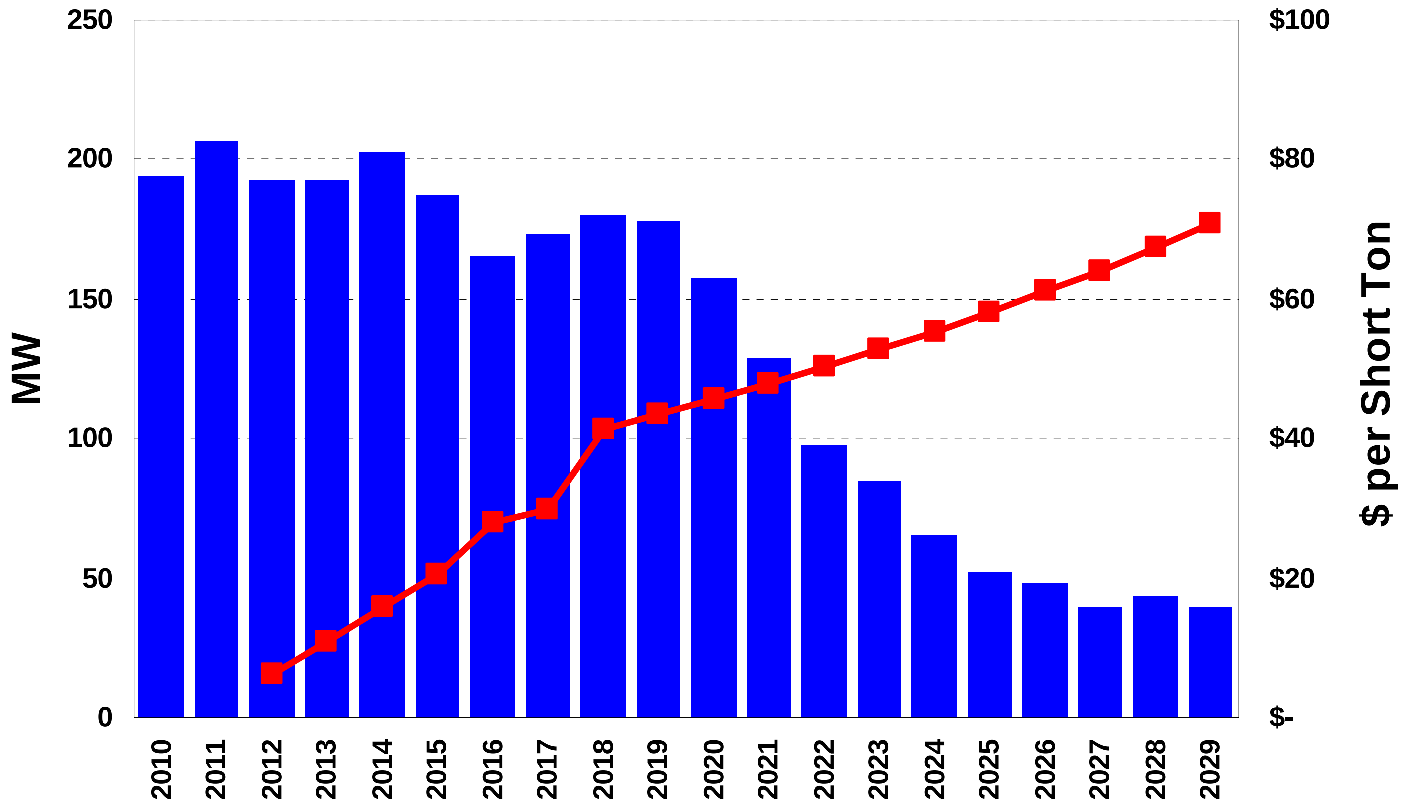
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 412 of 729

Colstrip Generation & CO_2 Legislation



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Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 413 of 729

Stochastic Analysis

Stochastic Study CPU Requirements

- 20-year hourly simulations, 250 times (tested as high as 500)
- Uses 25 CPU and 1 data server
- 26.5 GB output database per study
- 6 hours per simulation, 1,500 hours of computing time
- 2.5 days to complete a study

Long-Term Correlation Matrix

	Gas Prices	GHG Prices	NO_X Prices	SO_2 Prices	New Coal Prices	Hog Fuel Prices	Load Growth
Gas Prices	1.00						
GHG Prices	0.50	1.00					
Hg Prices		-0.50	1.00				
NO_X Prices		0.75	1.00	1.00			
SO_2 Prices		0.75	1.00	1.00	1.00		
New Coal Prices		-0.25	-0.25	-0.25	1.00	1.00	
Hog Fuel Prices	0.50	0.50				1.00	1.00

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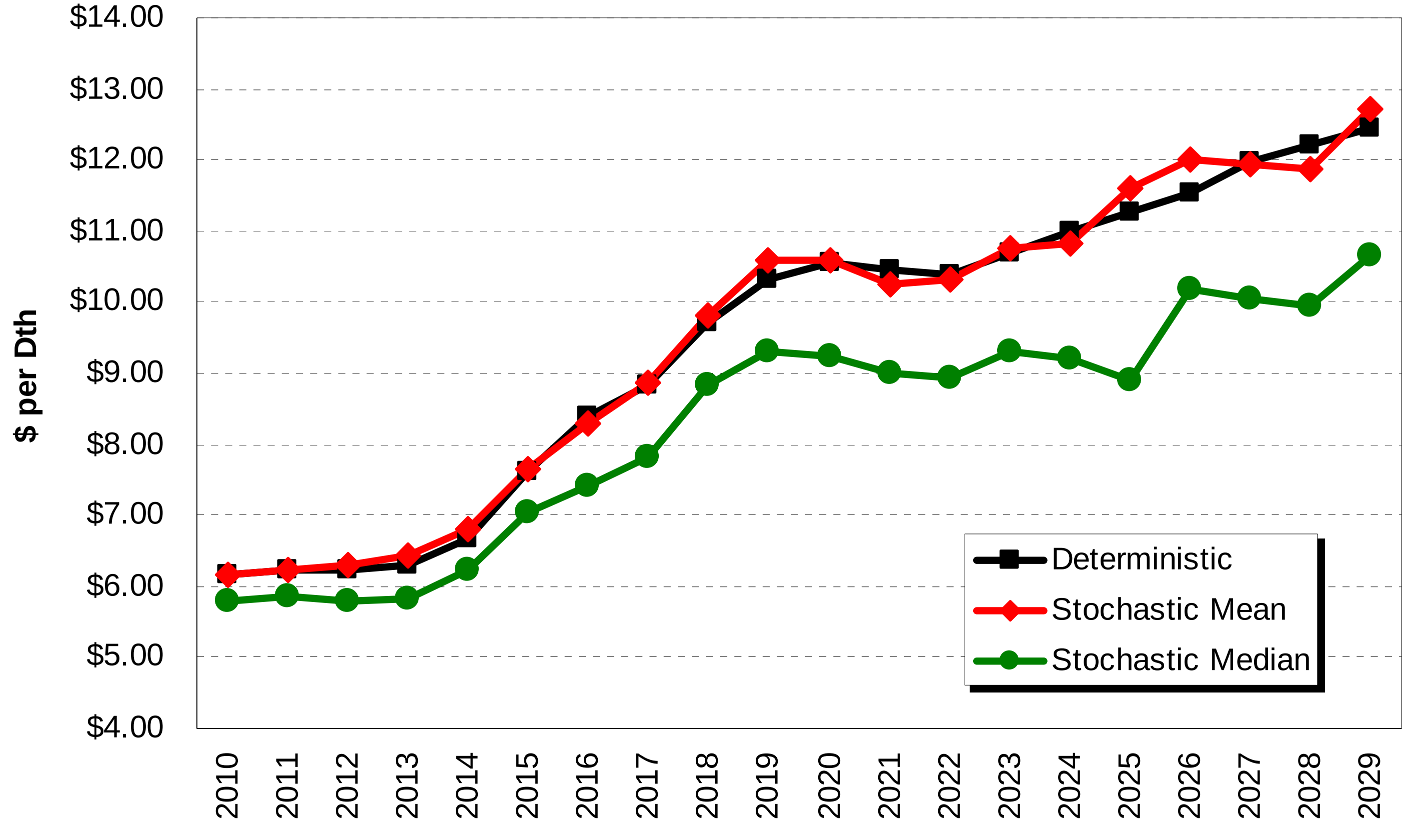
Annual Henry Hub Prices



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Case Nos. AVU-E-12-08
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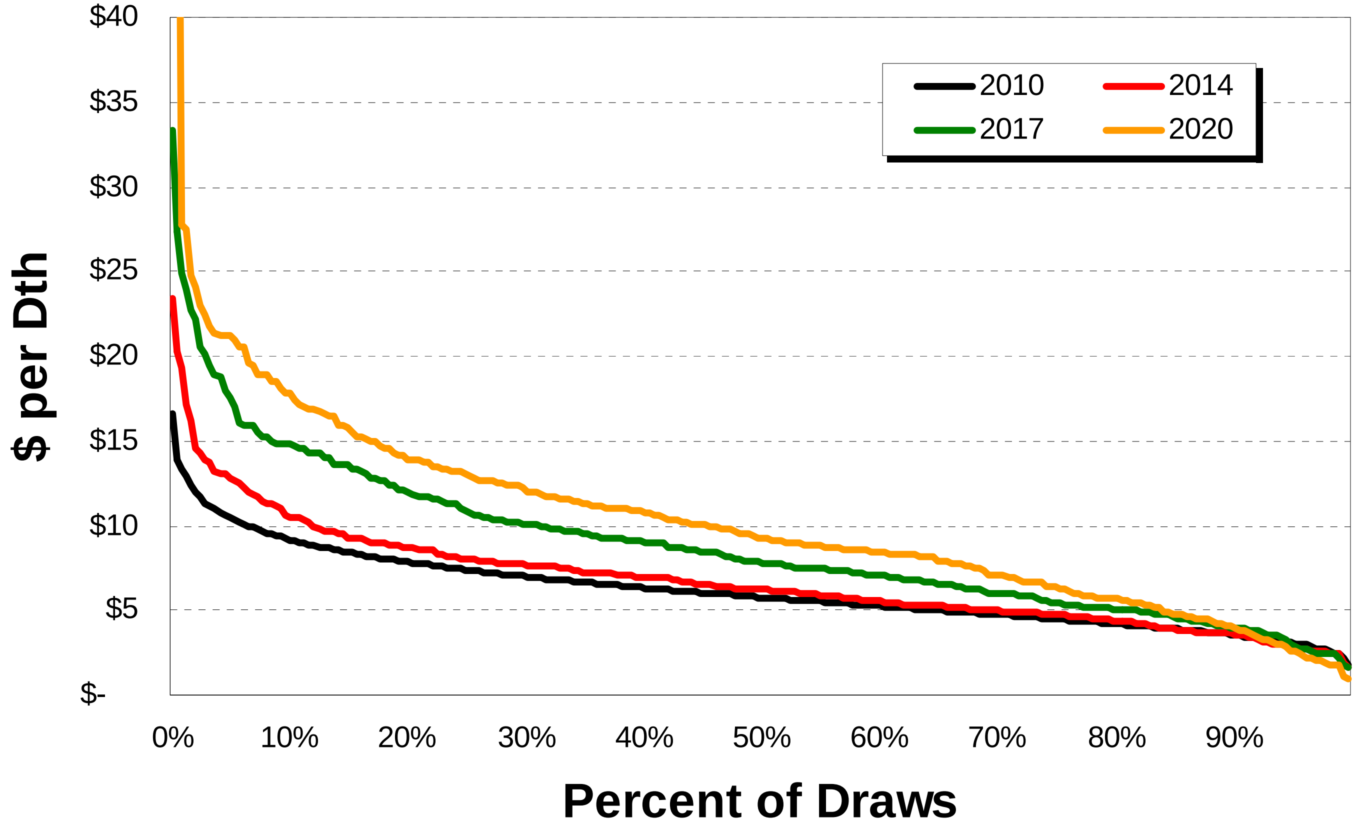
Schedule 5, Page 417 of 729

Annual Henry Hub Prices

Select Years



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Case Nos. AVU-E-12-08
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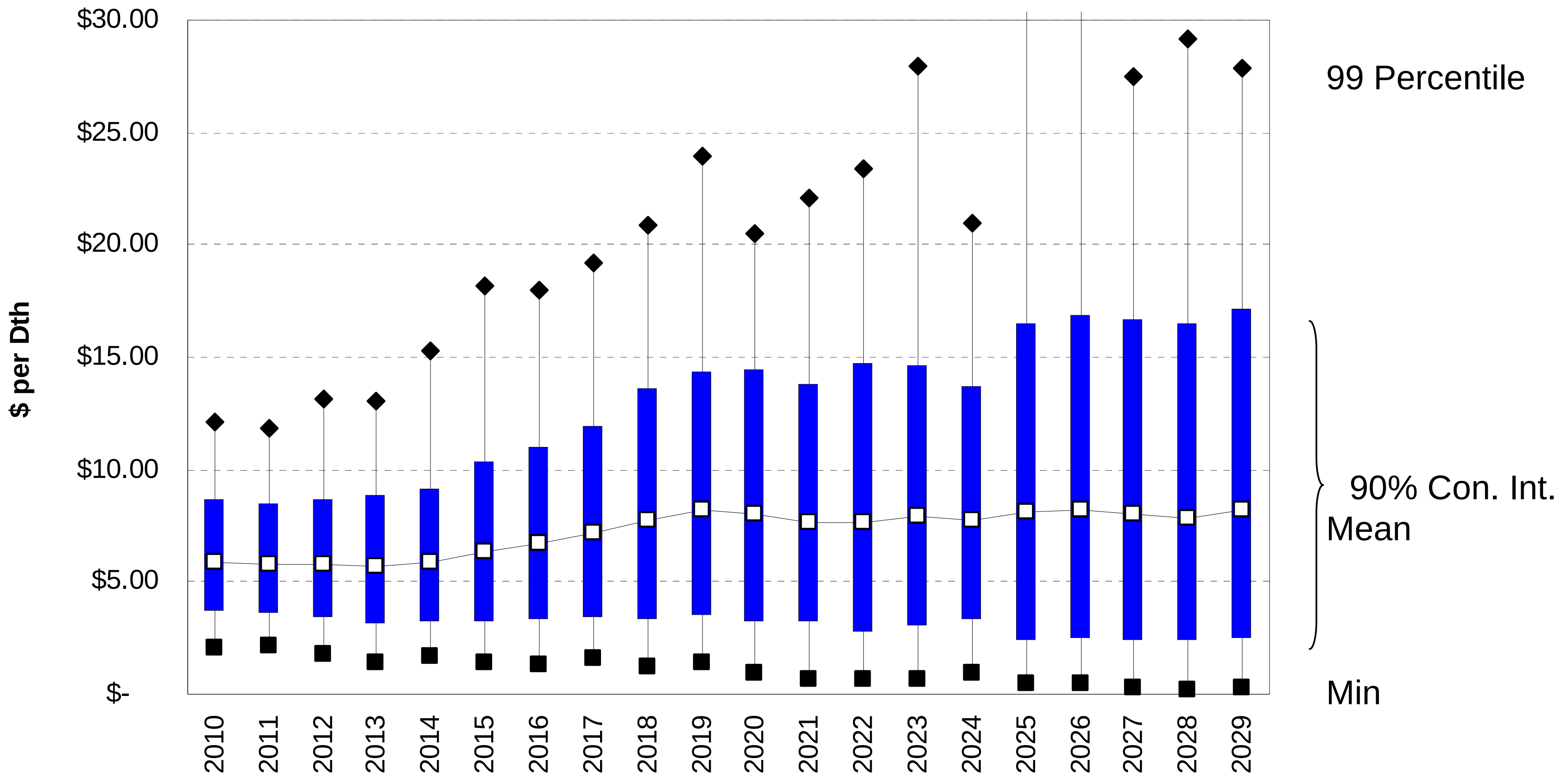
Schedule 5, Page 418 of 729

Annual Henry Hub Stochastic Price Ranges



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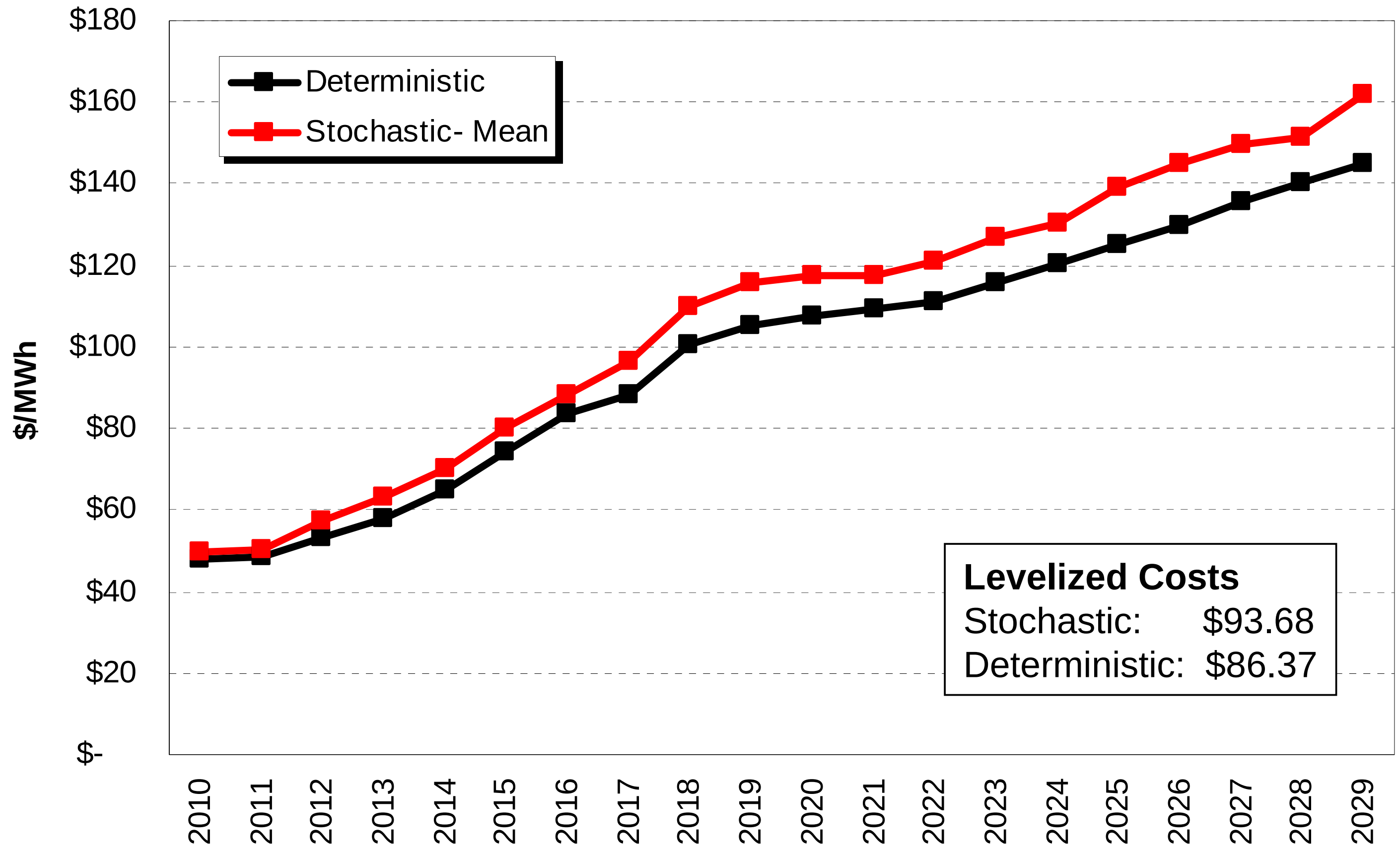
Schedule 5, Page 419 of 729

Annual Mid-Columbia Electric Prices

Deterministic vs. Stochastic Prices



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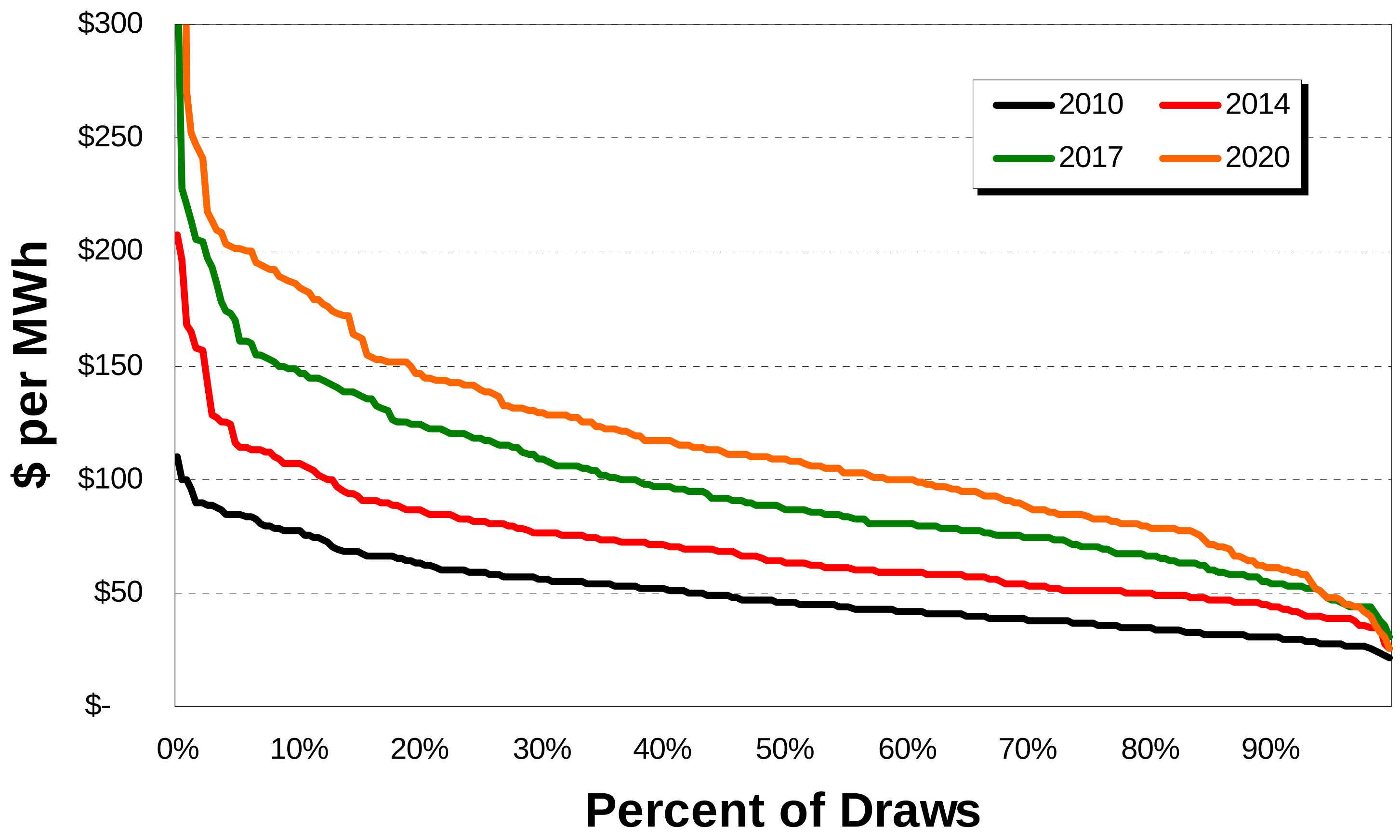
Schedule 5, Page 420 of 729

Annual Avg Mid-Columbia Prices

Select Years



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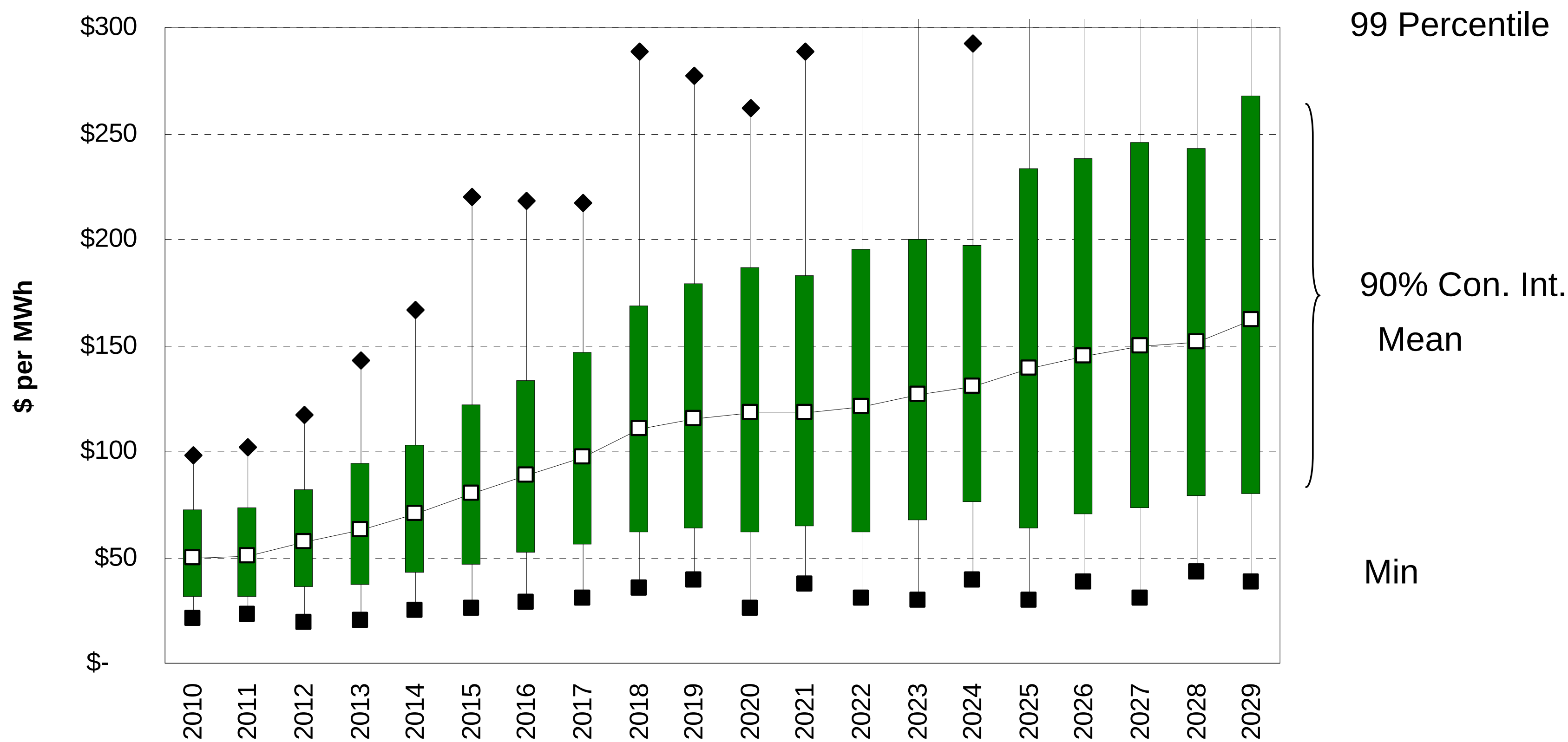
Schedule 5, Page 421 of 729

Annual Mid-Columbia Stochastic Price Results



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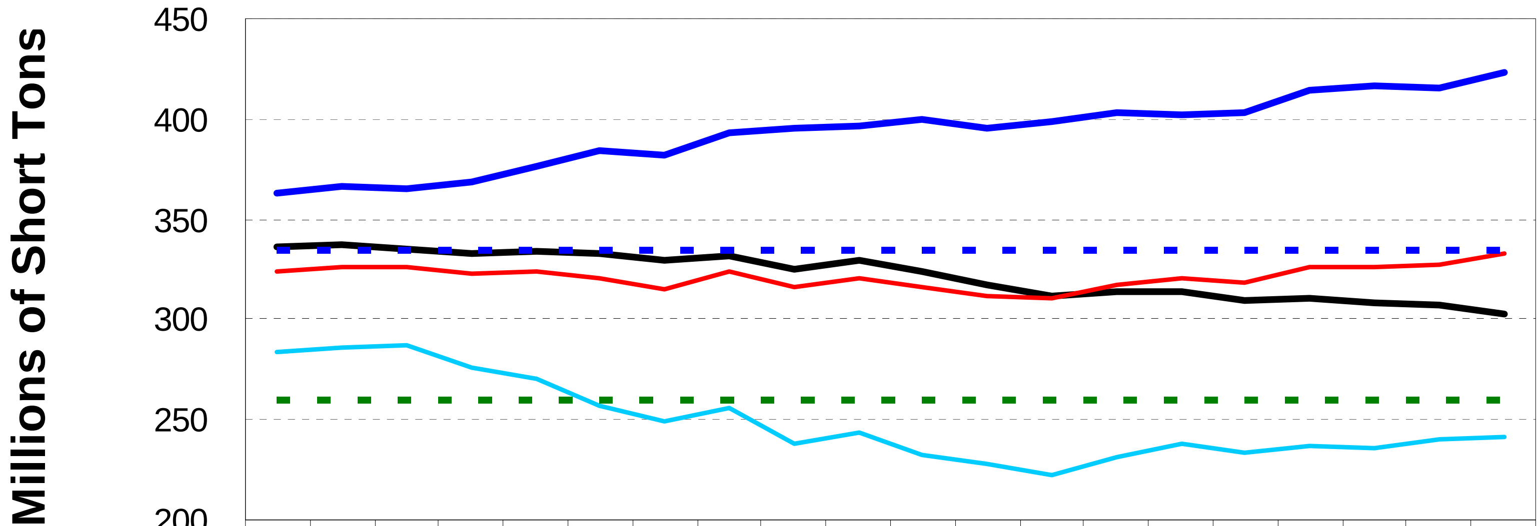
Schedule 5, Page 422 of 729

US- Western Interconnect Greenhouse Gas Emissions By Year



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Deterministic	336	337	335	332	334	333	330	332	325	329	323	317	312	314	314	309	310	309	307	303
Mean	323	326	326	322	323	321	315	324	316	320	316	312	311	317	320	319	326	326	328	333
Upper End Int 80%	363	366	365	369	376	385	382	393	395	397	400	395	398	403	402	403	415	417	415	424
Low er End Int 80%	284	286	287	276	270	257	249	256	238	243	233	228	223	232	238	234	237	236	240	241
2005 Levels	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334	334
1990 Levels	259	259	259	259	259	259	259	259	259	259	259	259	259	259	259	259	259	259	259	259

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2009 IRP Resource Assumptions

John Lyons, Ph.D.

2009 Electric Integrated Resource Plan
Fourth Technical Advisory Committee Meeting
January 28, 2009

Supply Side Resources

- Resource lists and data are developed from a variety of sources including: internal research, Power Council, consulting firms, published reports, and government studies
- Data is used to develop generic resource costs
- Fewer types of coal resources are included – only ultra critical and IGCC plants are being modeled for the 2009 IRP
- Alberta oil sands are not included as a resource option
- Adding more specifics for the Other Renewable Resources category – various geothermal, biomass, and solar resource technologies are being modeled separately for the 2009 IRP
- Pipeline cogeneration has been dropped due to lack of sufficient data

Non-Renewable Supply Side Resources

- Natural Gas Combined Cycle (CCCT)
  - 2 x 1 and 1 x 1 with duct burner water cooled (1x1 for PRS)
  - 2 x 1 and 1 x 1 with duct burner air cooled
  - 600 MW with sequestration
- Natural Gas-Fired Simple Cycle – Aero, Frame, and Hybrid
- Small cogeneration (< 5 MW)
- Coal: ultra critical, IGCC, and IGCC with sequestration
- Nuclear: only alllowed in scenario studies

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Renewable Supply Side Resources

- Geothermal
- Wind – 100 MW, < 5 MW, and offshore
- CCCT Wood Boiler
- Wood Gasification Conversion
- Open Loop Biomass – landfill gas, wood, waste, etc.
- Closed Loop Biomass
- Solar Photovoltaic
- Solar Thermal
- Roof Top Solar
- Tidal Power
- Hydrokinetics
- Run of River Hydro
- Pumped Storage

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Avista Resources and Upgrades

Hydro resources included as resource options

- Little Falls Unit #1 – 4 Upgrades
- Post Falls Unit #6 Upgrade
- Upper Falls Upgrade

Hydro resources considered for further study

- Long Lake new unit and new powerhouse
- Cabinet Gorge #5

Scheduled upgrades and resources presently included in the L&R

- Noxon Rapids Units #1 – 4 Upgrades (2009 – 2012)
- Lancaster Generation Facility Tolling Agreement (2010)

Transmission & Distribution Efficiencies

John Gibson

2009 Electric Integrated Resource Plan

Fourth Technical Advisory Committee Meeting

January 28, 2009

Introduction – System Efficiencies

- Distribution System
  - Analysis Methodology
  - Analysis Criteria
  - Prioritization Tabulation
  - Pilot Project: 9CE12F4
- Transmission System
  - Load Density
  - Grid Topology

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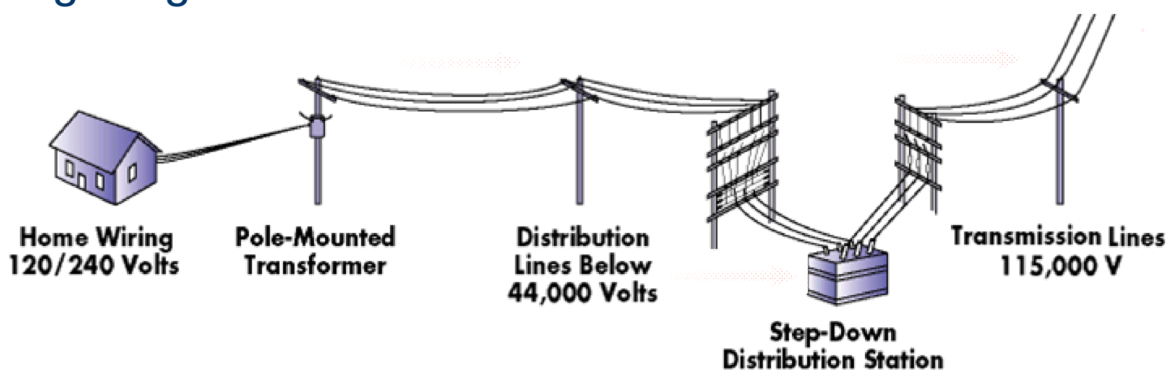
Distribution Efficiency Programs

- Split feeders
- Distribution transformers efficiency – no load loss
- Secondary districts
- Reconductoring
- Reactive loading
- Voltage regulation



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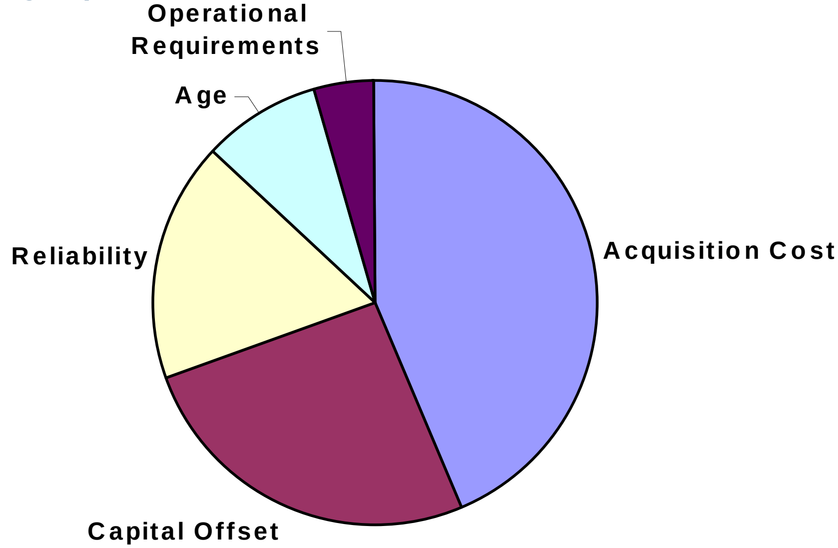
Schedule 5, Page 431 of 729

Distribution Analysis Criteria

- Energy efficiency upgrades (acquisition cost)
- Capital offset (5year capital budget)
- Reliability Index
- Equipment age profile
- Operational requirements



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Schedule 5, Page 432 of 729

Distribution Prioritization Tabulation

Feeder Project	Age	Reliability	Avoided Cost	Capital Offset	Operational Requirements	Overall Score
KET12F2	25.32	328	$85.07	$400,000	Low	0.596
ORI12F3	27.44	285	$73.30	$0	Low	0.591
SPI12F1	27.57	310	$90.76	$220,000	Low	0.558
PRV4S40	23.34	331	$94.10	$0	Low	0.544
ORO1281	30.33	197	$78.97	$0	Low	0.533
SUN12F3	25.20	312	$112.78	$0	High	0.522
COB12F2	27.32	283	$94.81	$0	Low	0.519
LAT421	27.39	309	$102.59	$0	Low	0.508
COB12F1	30.44	303	$108.77	$250,000	Low	0.502
CLV12F4	30.43	323	$108.47	$28,333	Low	0.502
LF34F1	21.71	299	$102.91	$0	Low	0.499
STM631	23.29	317	$109.19	$0	Low	0.490
SUN12F1	31.73	291	$125.03	$0	High	0.483
CLV12F2	30.06	298	$125.81	$780,833	Low	0.481

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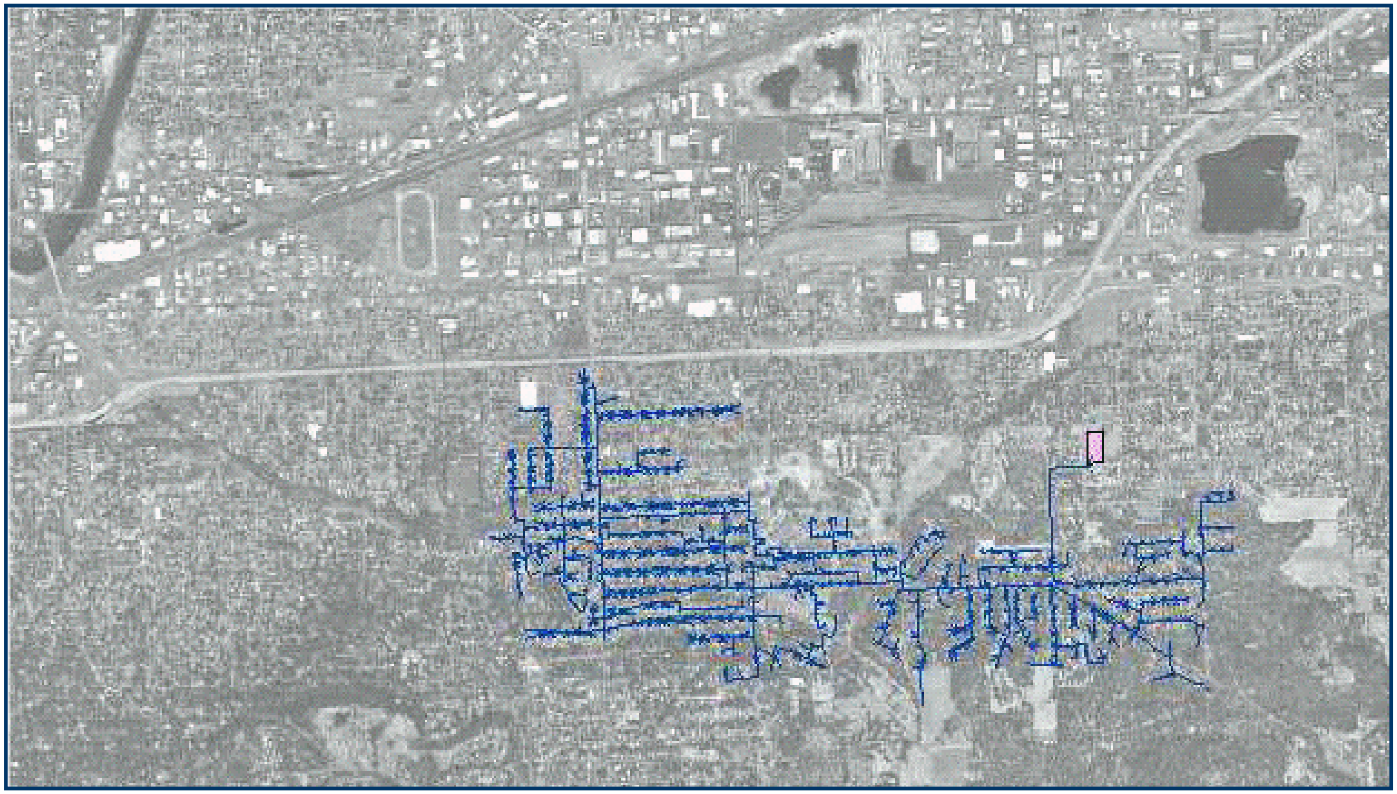
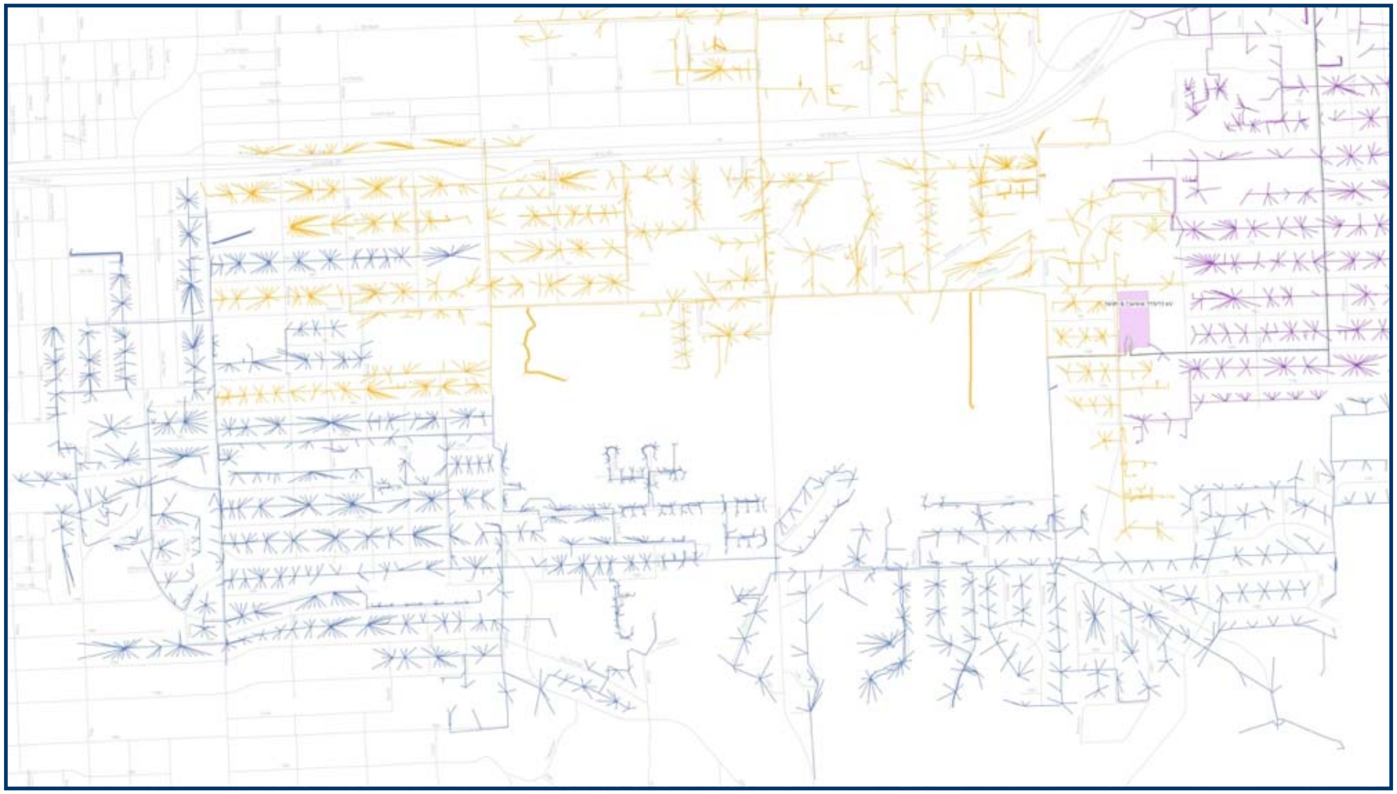
Feed Efficiency Upgrade – Pilot Project



Feed Efficiency Upgrade – Pilot Project



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Case Nos. AVU-E-12-08
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Schedule 5, Page 435 of 729

Feed Efficiency Upgrade – Pilot Project

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Feed Efficiency Upgrade – Pilot Project

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Case Nos. AVU-E-12-08
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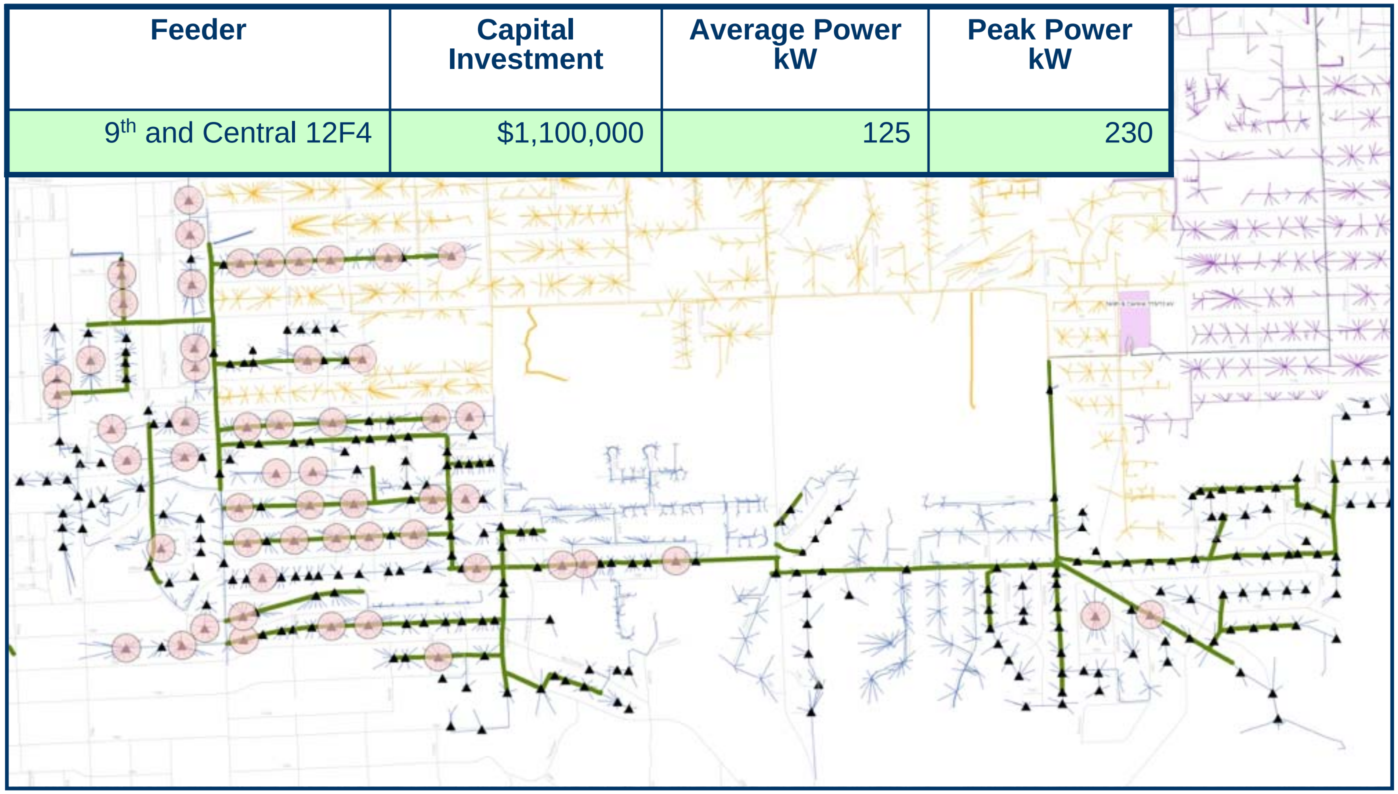
Schedule 5, Page 437 of 729

Feed Efficiency Upgrade – Pilot Project

Feeder	Capital Investment	Average Power kW	Peak Power kW
9th and Central 12F4	$1,100,000	125	230



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Case Nos. AVU-E-12-08
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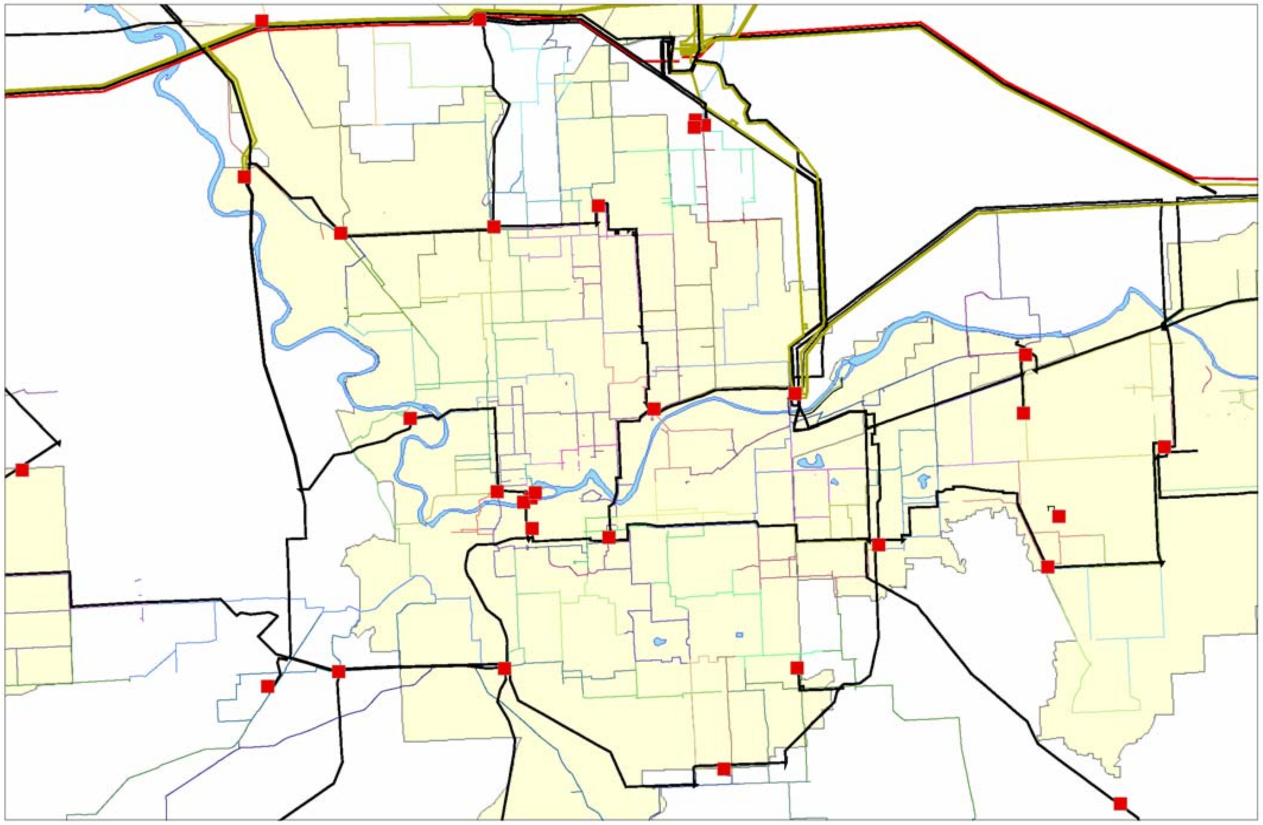
Schedule 5, Page 438 of 729

Transmission Efficiency Initiatives

- Load density and forecasted load growth



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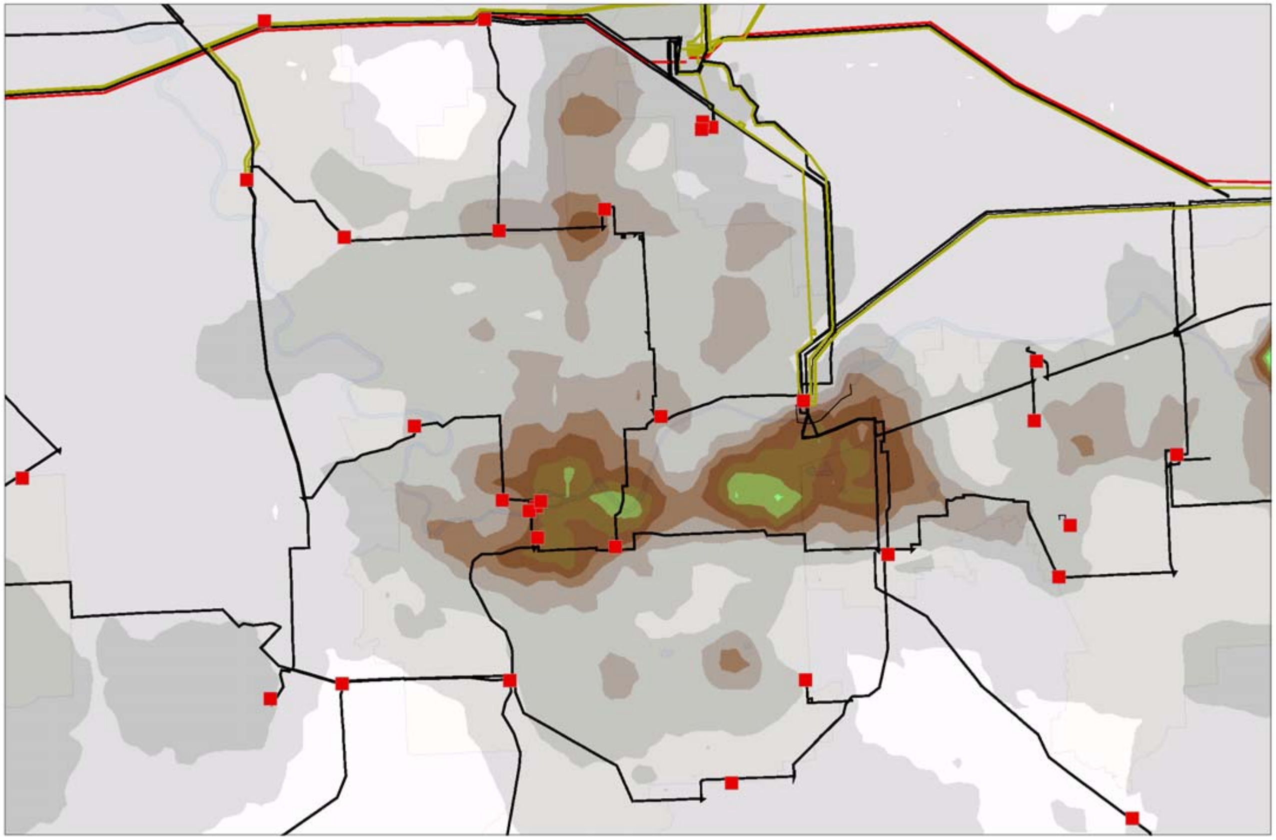
Schedule 5, Page 439 of 729

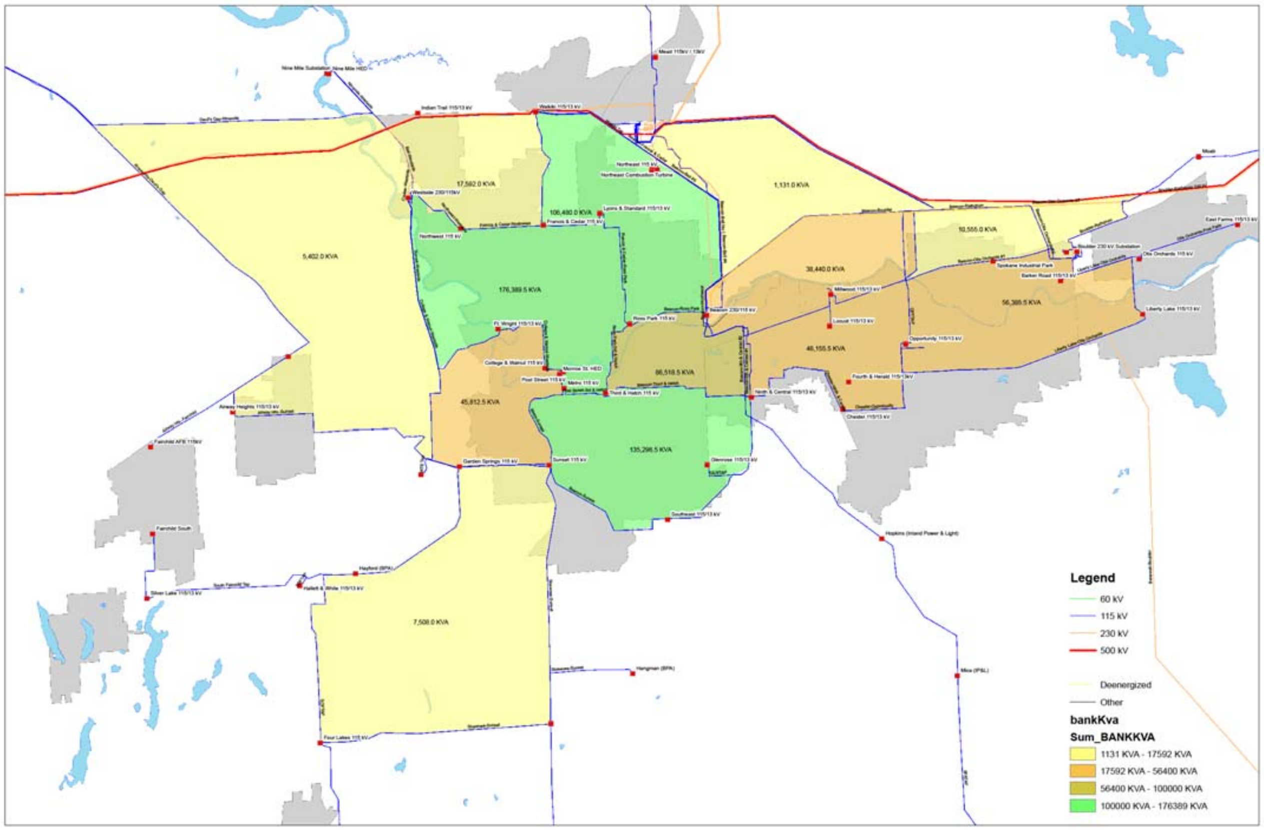
Transmission Efficiency Initiatives

- Load density and forecasted load growth



Transmission Efficiency Initiatives

- Load density and forecasted load growth



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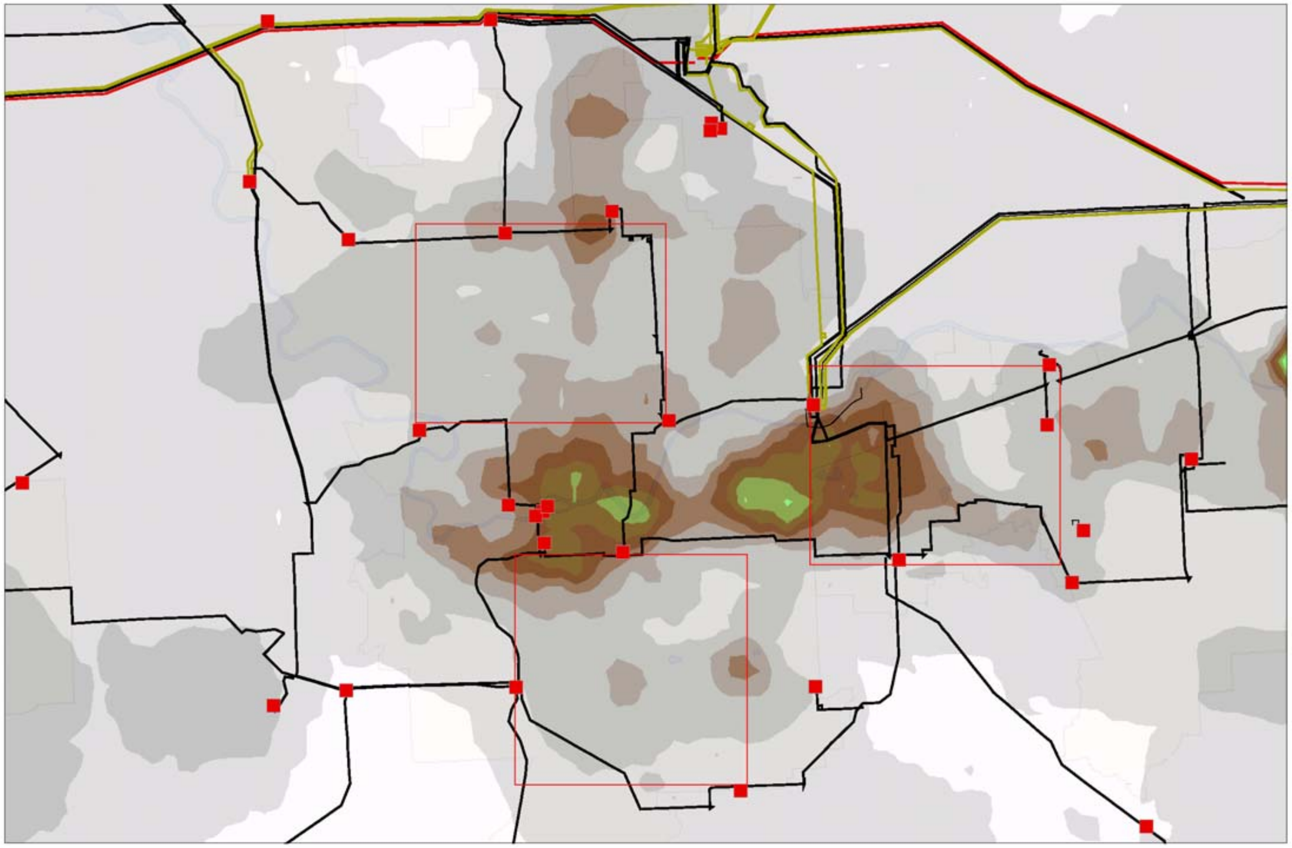
Schedule 5, Page 441 of 729

Transmission Efficiency Initiatives

- Transmission topology
- Transmission archetypes



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Case Nos. AVU-E-12-08
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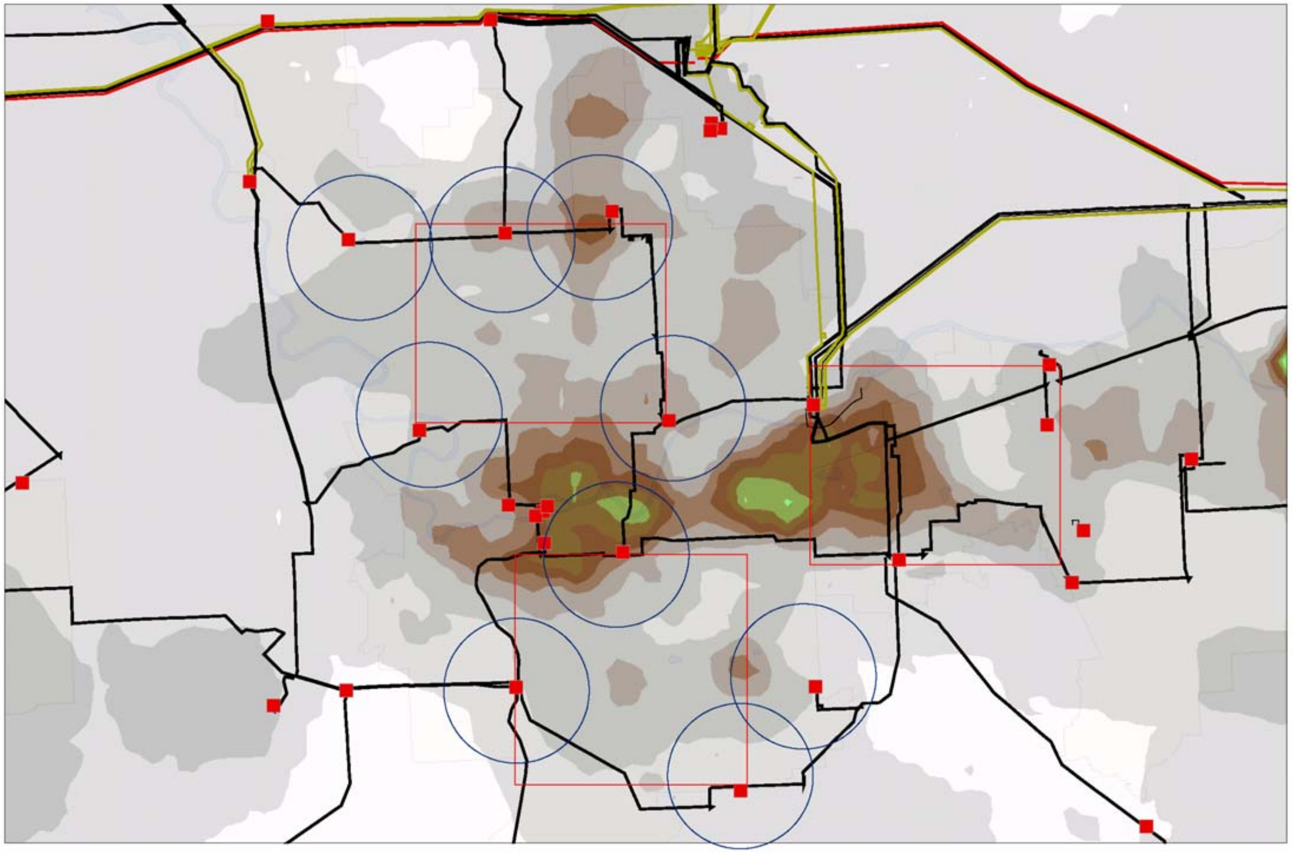
Schedule 5, Page 442 of 729

Transmission Efficiency Initiatives

- Transmission topology
- Transmission archetypes



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Case Nos. AVU-E-12-08
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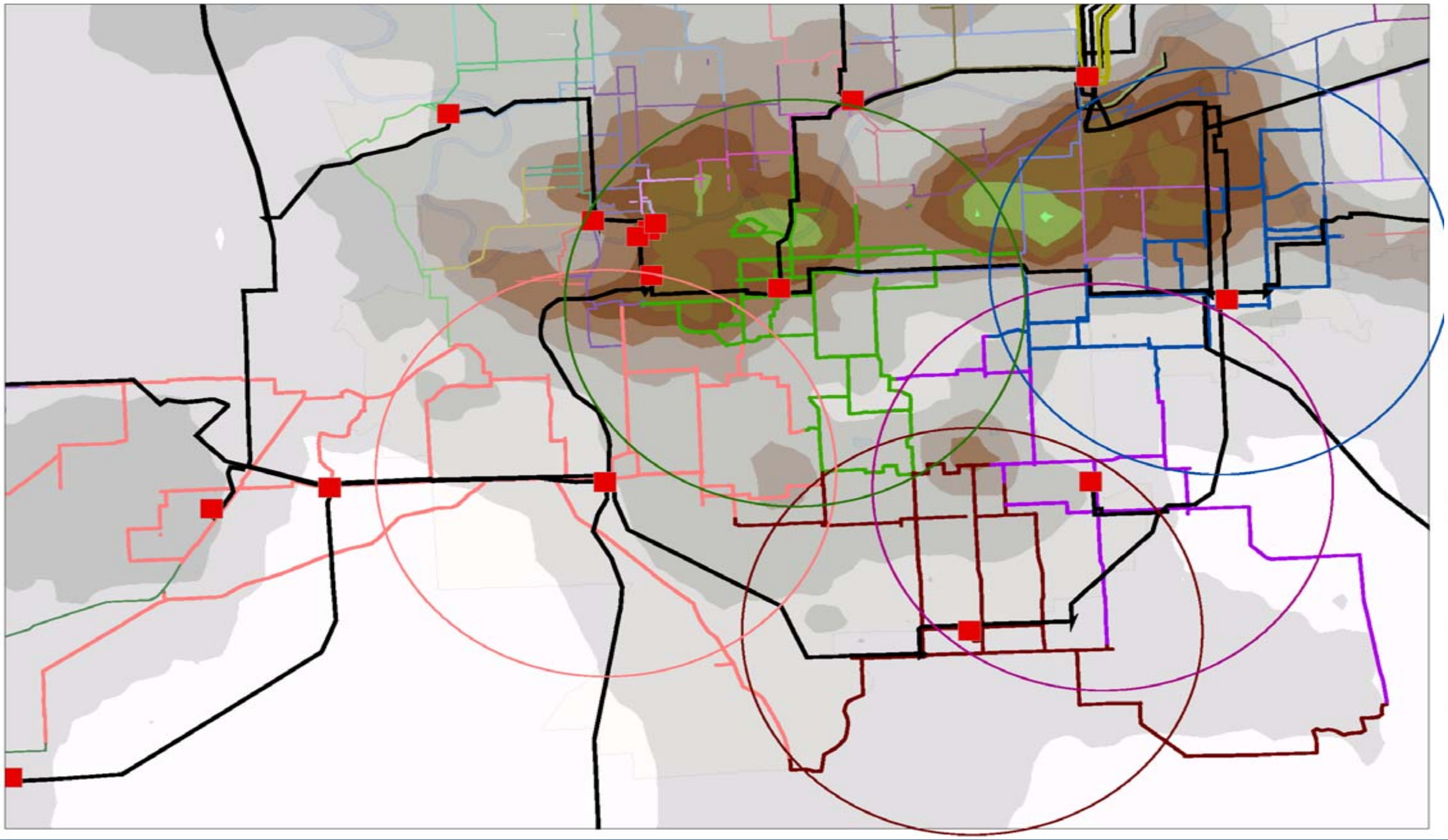
Schedule 5, Page 443 of 729

Transmission Efficiency Initiatives

- Transmission topology
- Transmission archetypes



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Preferred Resource Strategy- DRAFT

James Gall

2009 Electric Integrated Resource Plan

Fourth Technical Advisory Committee Meeting

January 28, 2009

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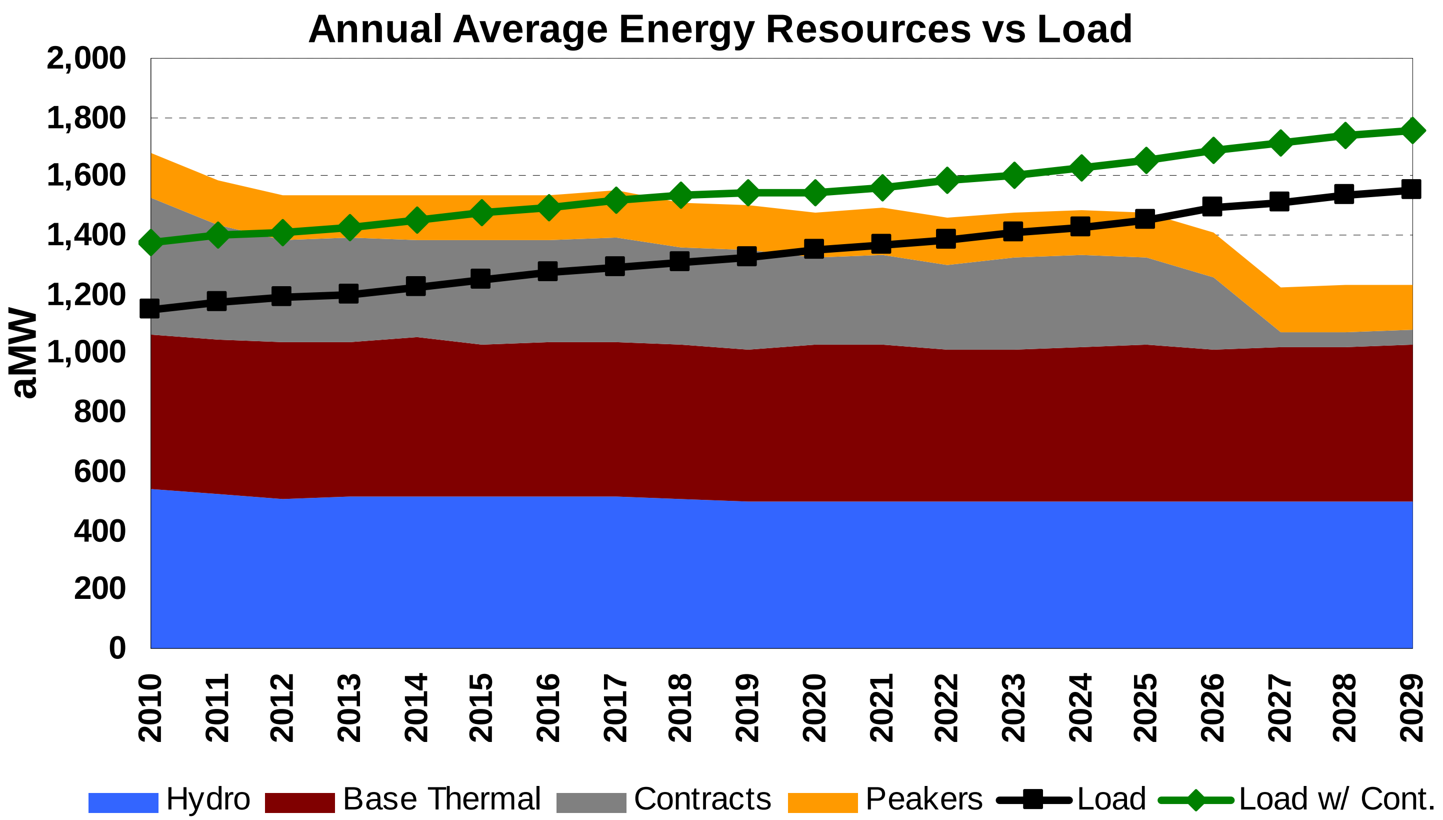
Resource Needs (Energy)

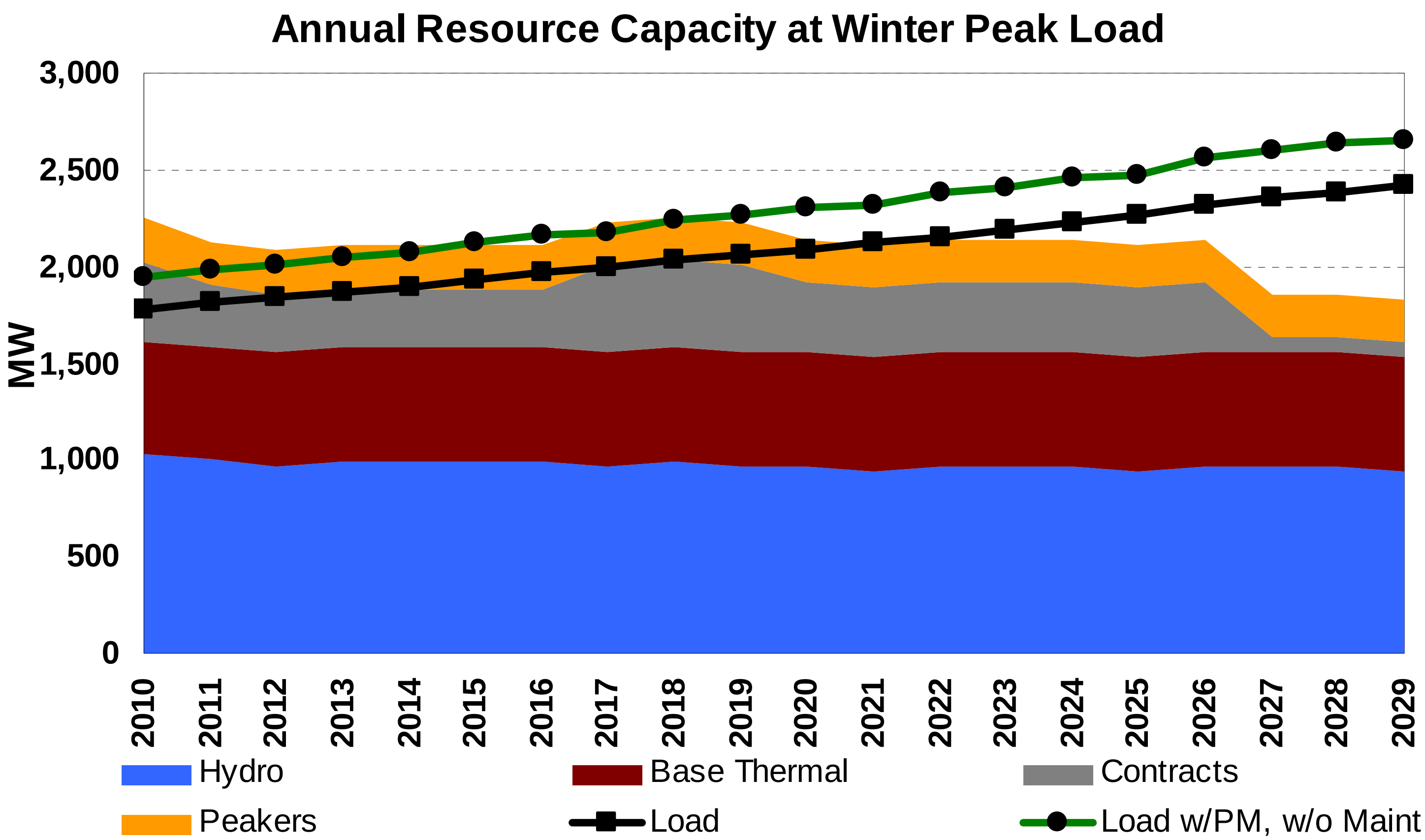


Load is net 2007 Conservation Levels

AVISTA

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 446 of 729

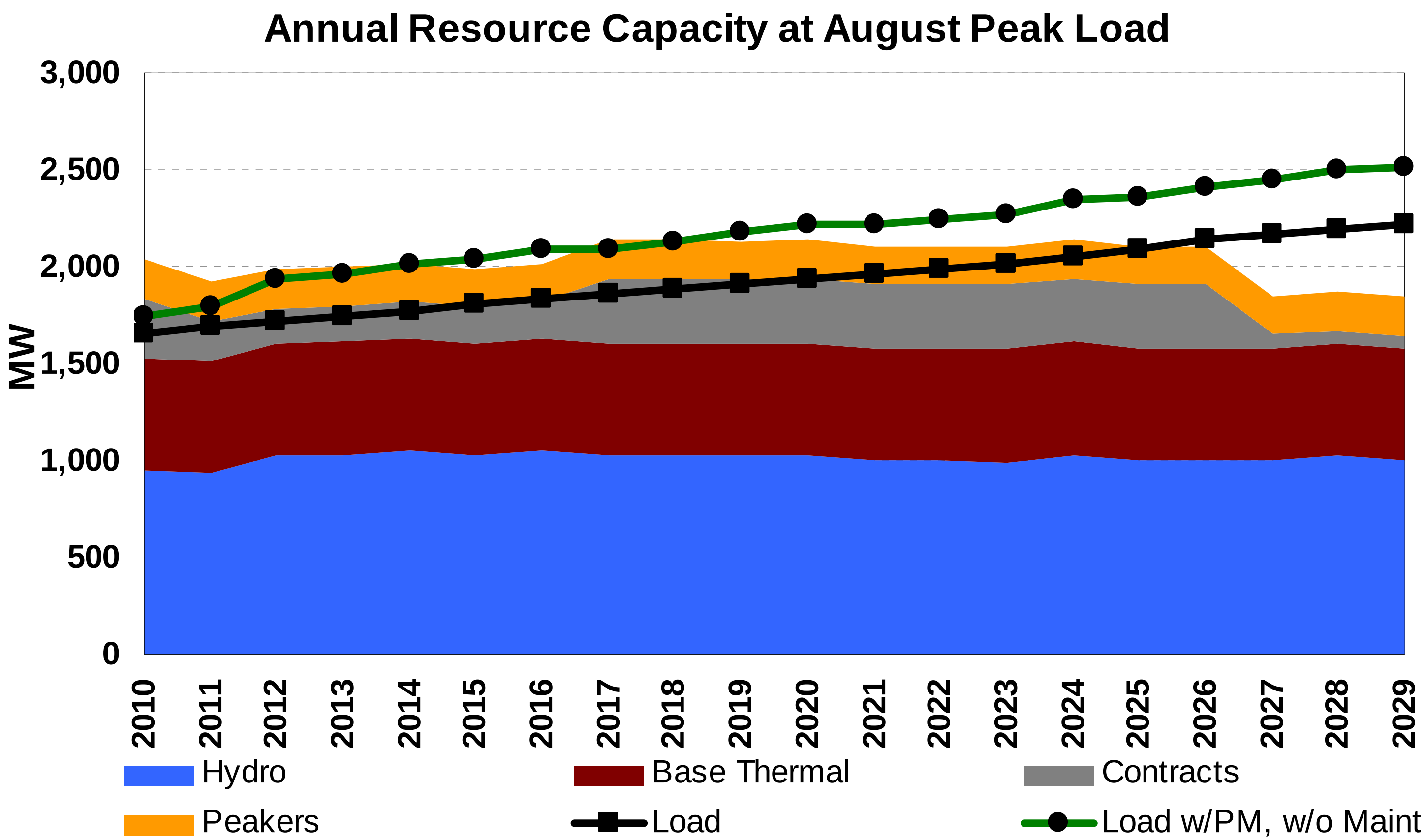
Resource Needs (Winter Capacity)



Load is net 2007 Conservation Levels

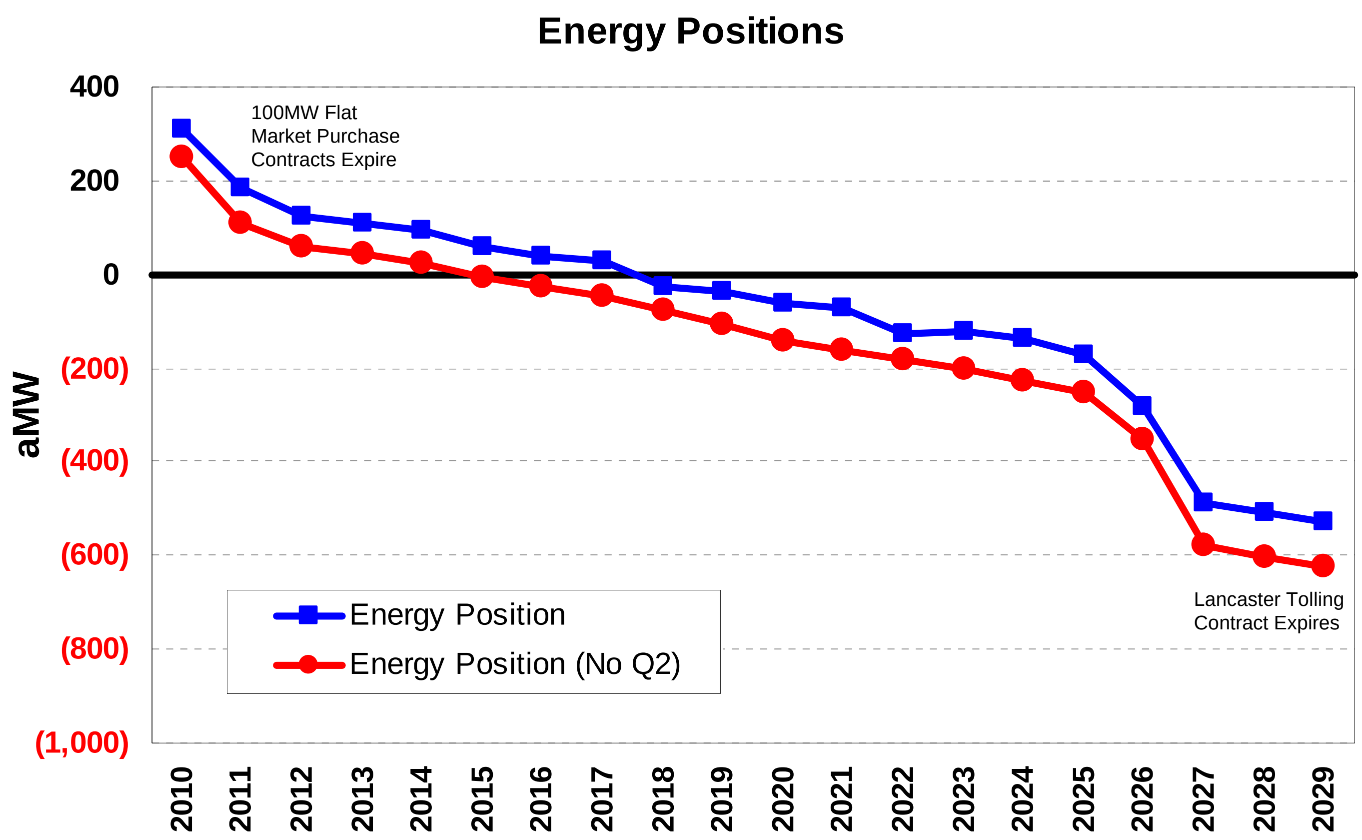
AVISTA

Resource Needs (Summer Capacity)



Load is net 2007 Conservation Levels

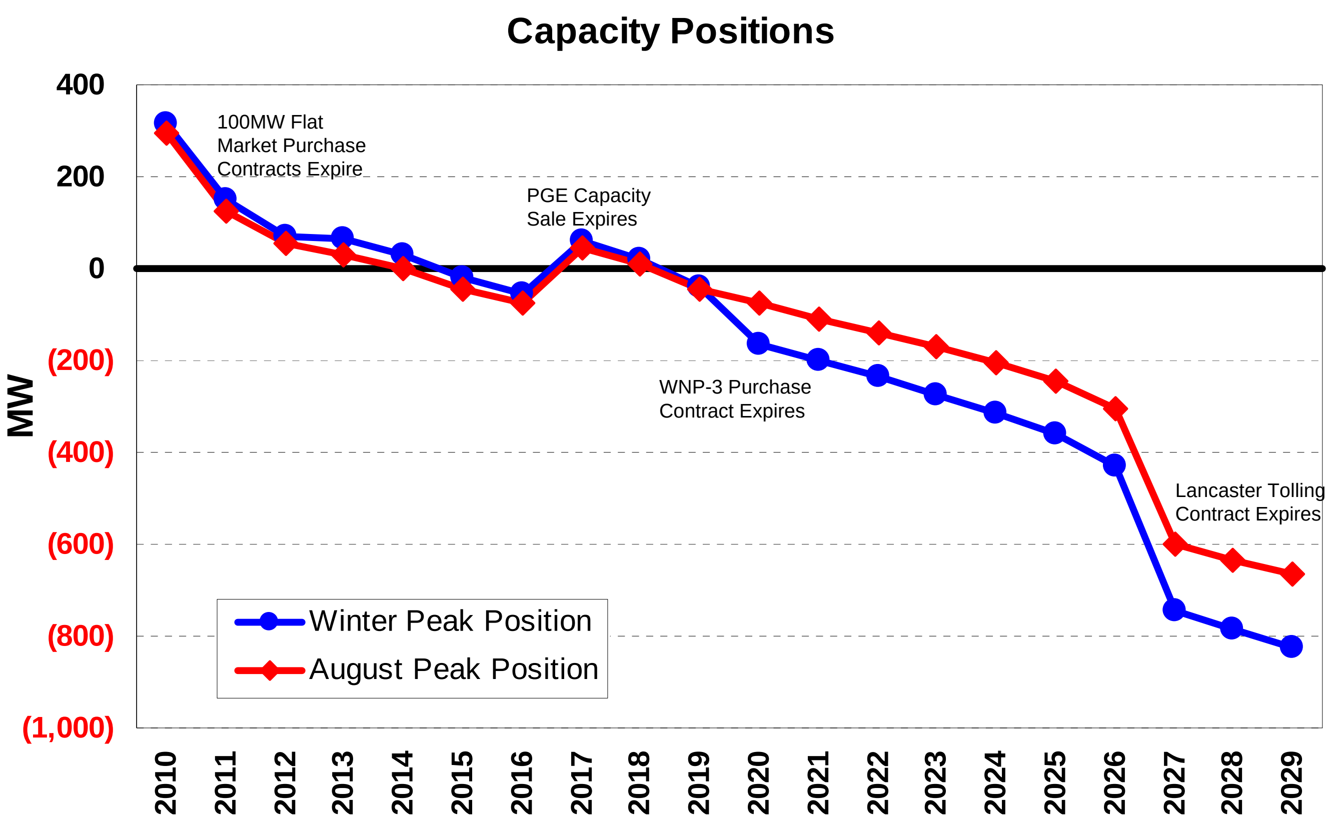
Resource Needs (Energy)



Net 2007 Conservation Levels

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista

Resource Needs (Capacity)



Net 2007 Conservation Levels

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Case Nos. AVU-E-12-08
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Schedule 5, Page 450 of 729

PRiSM Objective Function

- Linear program solving for the optimal resource strategy to meet resource deficits over planning horizon.
- Model selects its resources to reduce cost, risk, or both.

Minimize: Total Power Supply Cost on NPV basis (2010-2050 with emphasis on first 11 years of the plan

Subject to:

- Risk Level
- Capacity Need +/- deviation
- Energy Need +/- deviation
- Renewable Portfolio Standards
- Resource Limitations and Timing
- Greenhouse Gas Limits

AVISTA

PRiSM Data Requirements

- Expected load & resource balance for next 20 years
- 20 year by 250 iteration matrix of resource values
  - Avista's current resource portfolio cost
  - Each new resource alternatives market value (electric price less fuel costs, variable O&M, and emissions costs)
  - Existing resource market value
- Conservation estimates
- Generation capital costs, fixed operating costs, transmission costs, revenue requirements
- Availability assumptions (size, when, where)

PRiSM New Enhancements

- Resources selections must be blocks of resources such as 50 MW wind, 75 MW SCCT, 125 MW CCCT (half unit)
- Use more precise method to estimate frontier curve
- Meets both summer & winter capacity requirements
- Ability to account for greenhouse gas levels
- More accurate ability to take into account post IRP time period
- Ability to retire resources *(used for sensitivity analysis only)*
- Higher cost conservation measures can be selected by the model *(available for final draft)*

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Efficient Frontier

- Demonstrates the trade off of cost and risk
- Avoided Cost Method

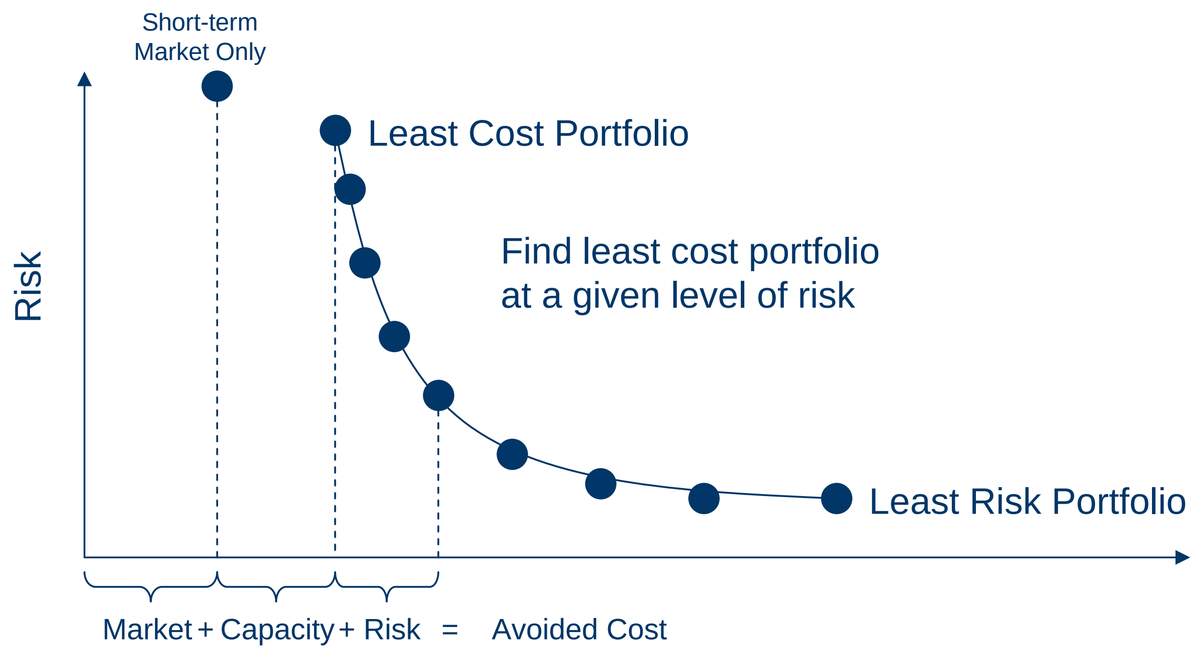

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Exhibit No. 4
Case Nos. AVU-E-12-08
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Schedule 5, Page 454 of 729

Portfolio Scenarios

1) Base Case
2) Case 1 + Small Renewable as Options
3) Case 2 + Large Hydro Upgrades as Options

AVISTA

Efficient Frontier (millions)

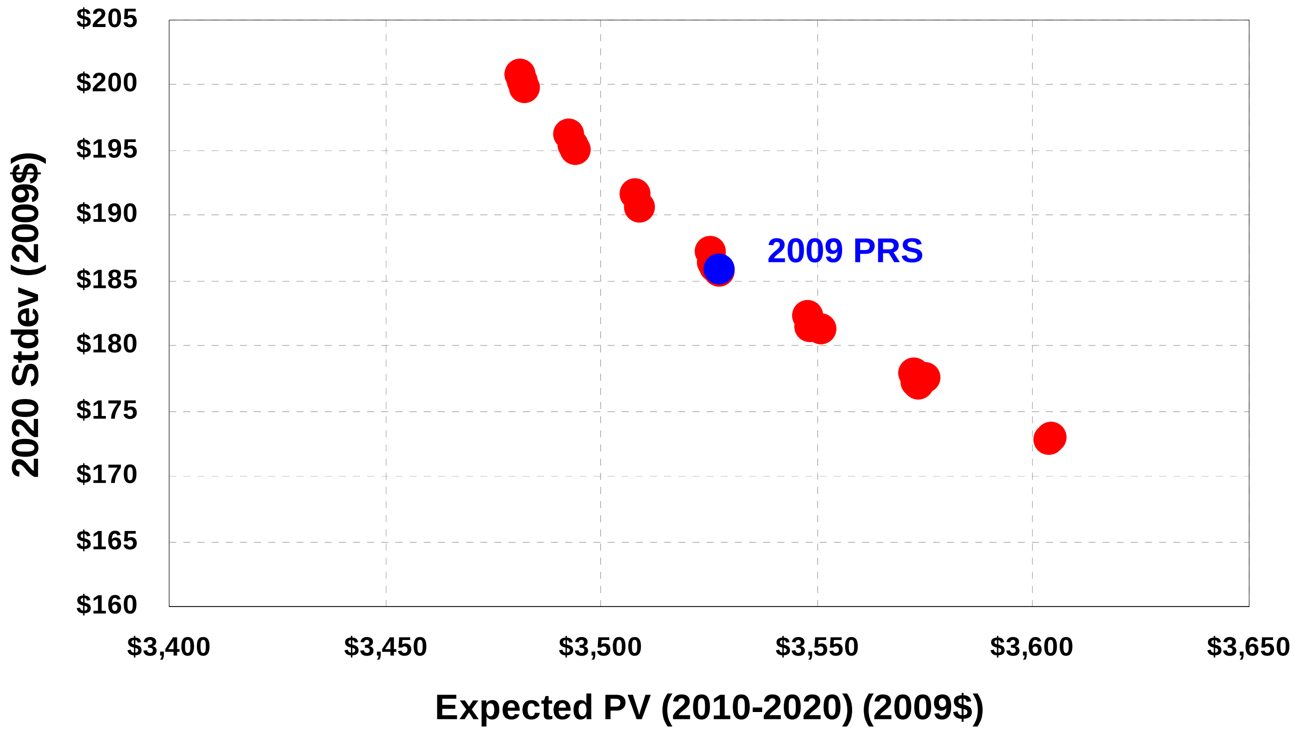

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Exhibit No. 4
Case Nos. AVU-E-12-08
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Schedule 5, Page 456 of 729

Change From Least Cost Portfolio

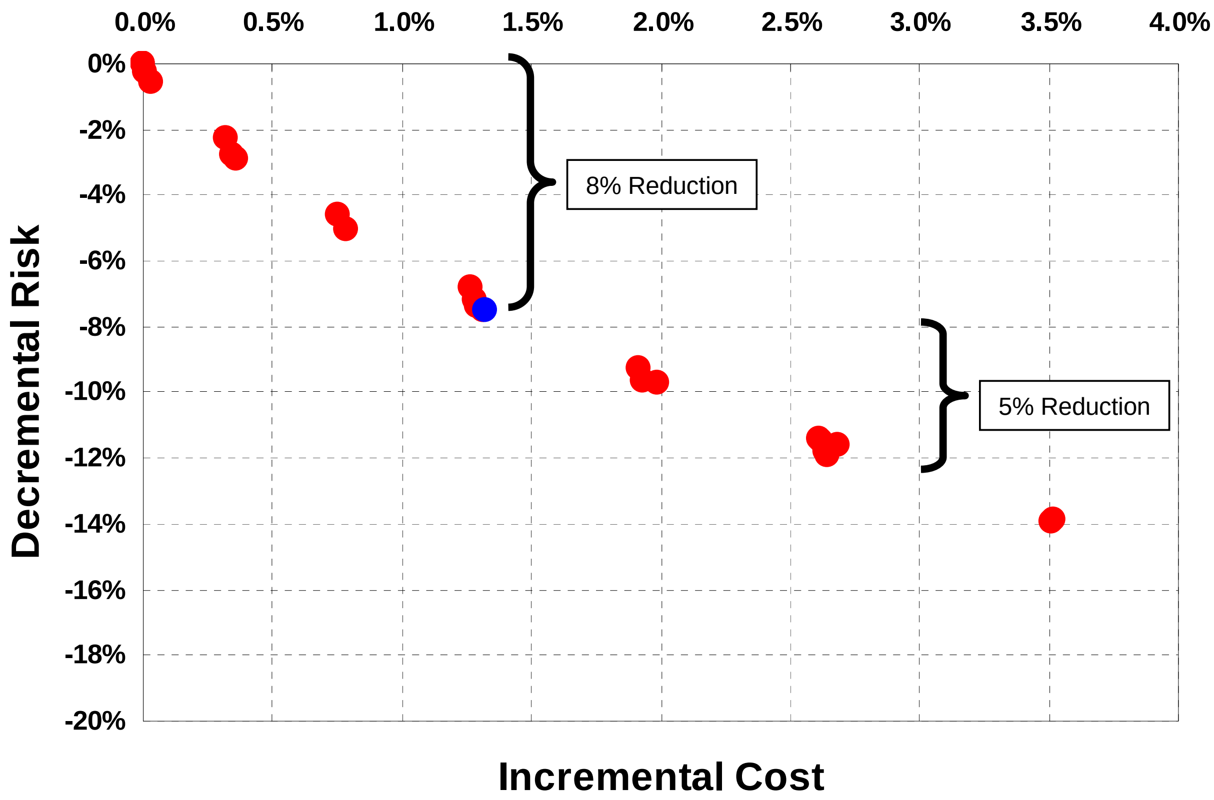

Exhibit No. 4
Case Nos. AVU-E-12-08
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Schedule 5, Page 457 of 729

Preferred Resource Strategy (2020-2029

DRAFT- Base Case

Year	CCCT	SCCT	Reardan	Wind	Other Renew	Solar	Hydro Upgrades	Coal	IGCC w/ Seq	Co-Gen	DSM	T&D	Total	Cumulative
2010											7.8	1.0	8.8	8.8
2011											7.9	1.0	8.9	17.6
2012			50.0								8.0	1.0	59.0	76.6
2013				100.0							8.2	1.0	109.2	185.8
2014											8.3	1.0	9.3	195.1
2015	125.0						1.0				8.4	1.0	135.4	330.5
2016											8.6		8.6	339.1
2017							1.0				8.7		9.7	348.8
2018				100.0							8.9		108.9	457.7
2019				100.0						2.5	9.0		111.5	569.2
2020	250.0			100.0			4.0			5.0	9.2		368.2	937.3
2021											9.3		9.3	946.7
2022											9.5		9.5	956.1
2023											9.6		9.6	965.8
2024											9.8		9.8	975.6
2025	125.0										10.0		135.0	1,110.6
2026	125.0										10.1		135.1	1,245.7
2027	250.0										10.3		260.3	1,506.0
2028				50.0							10.5		60.5	1,566.5
2029				100.0	7.0						10.7		117.7	1,684.2
2010-2019	125.0	-	50.0	300.0	-	-	2.0	-	-	2.5	83.7	6.0	569.2	
2010-2029	875.0	-	50.0	550.0	7.0	-	6.0	-	-	7.5	182.7	6.0	1,684.2	

“Yellow Light” conservation not modeled yet

AVISTA

PRS: Winter Capacity

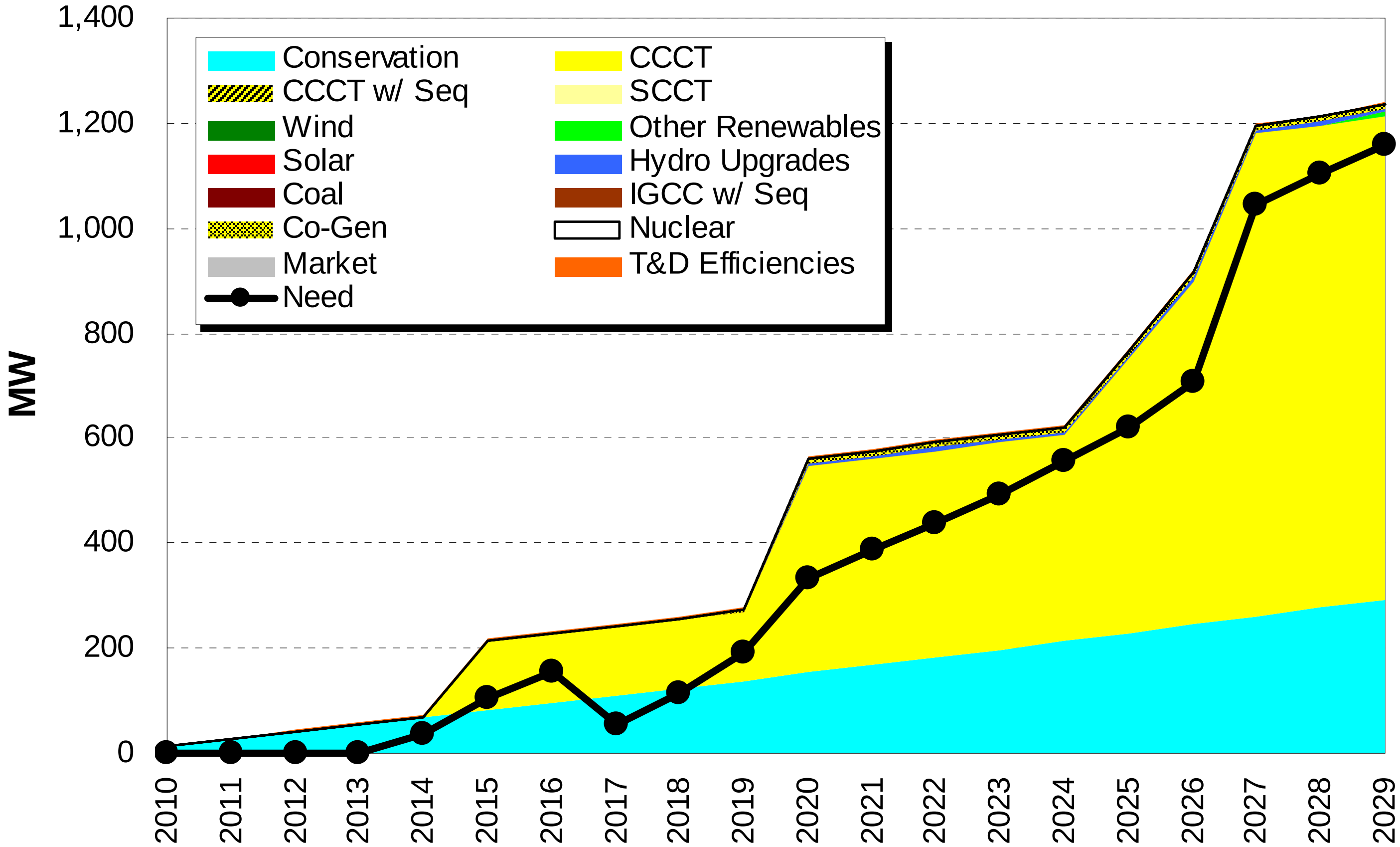
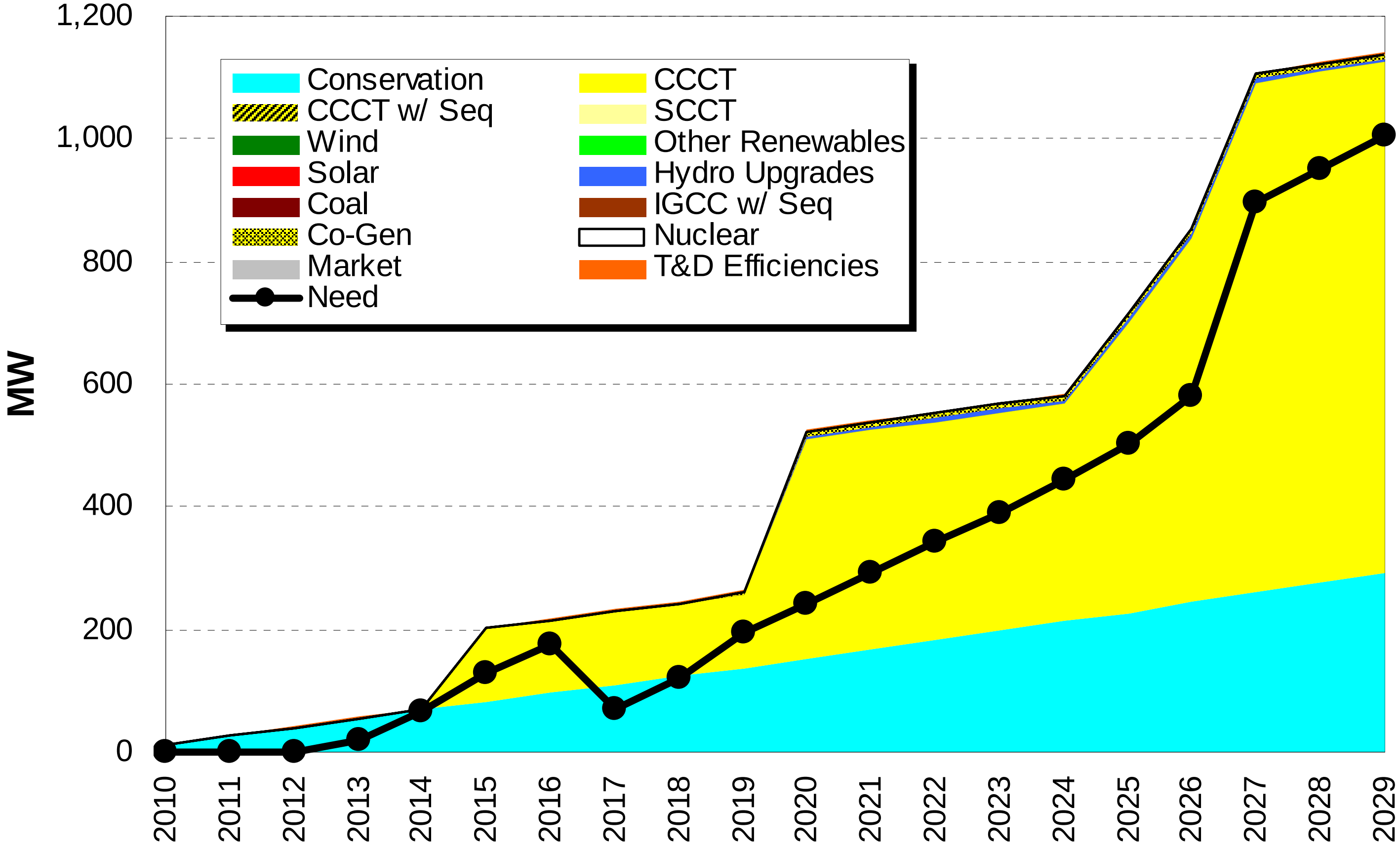


Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 459 of 729

PRS: Summer Capacity



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PRS: Annual Average Energy

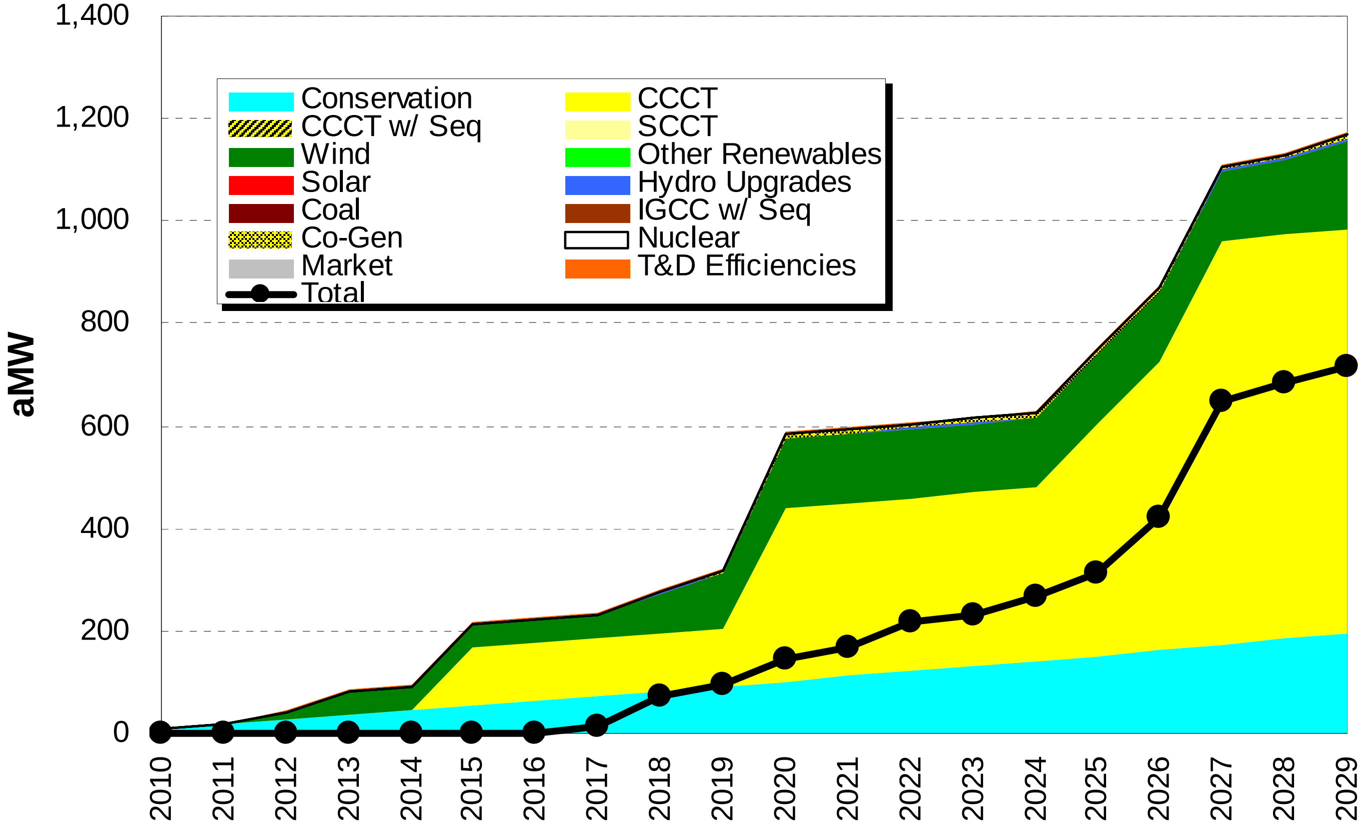

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 461 of 729

PRS: WA RPS Requirement

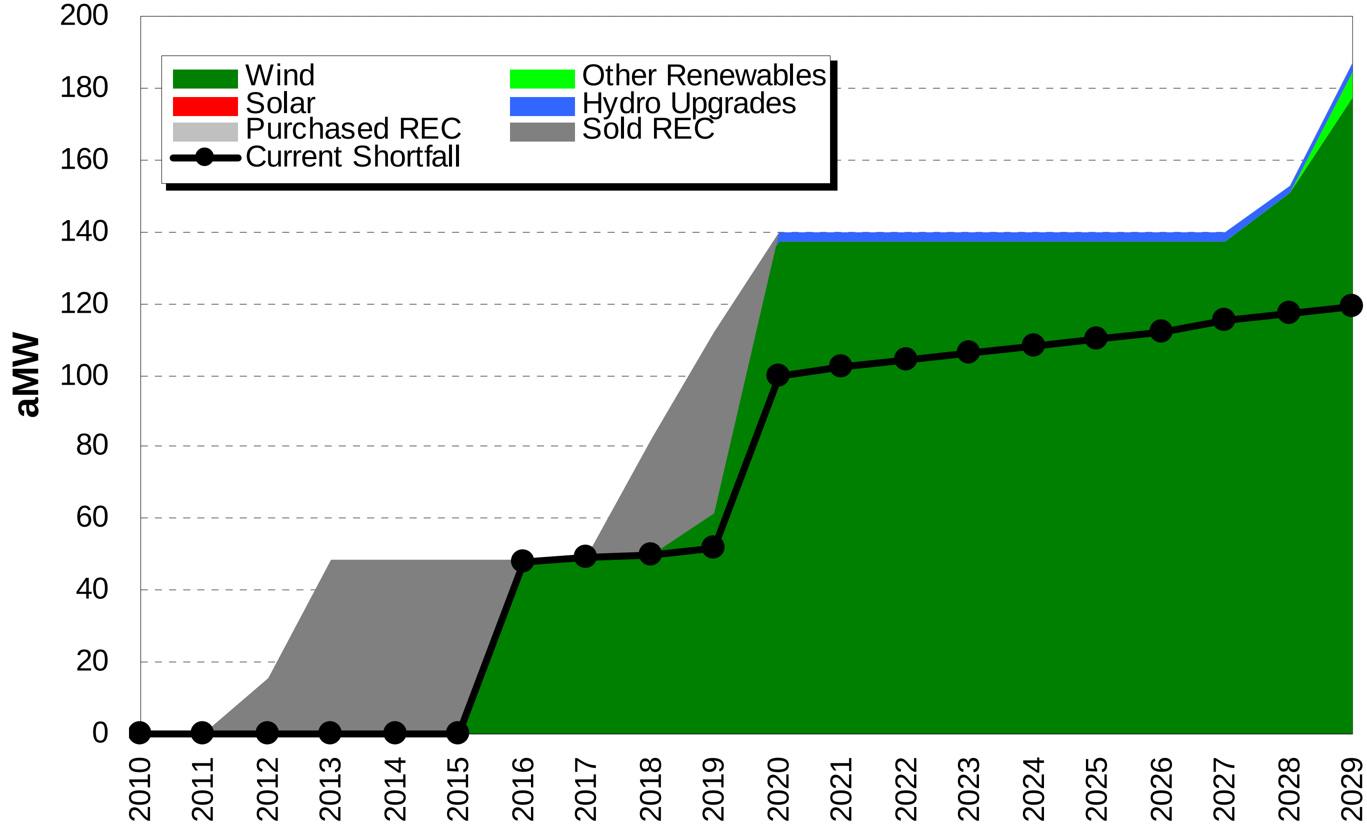

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Exhibit No. 4
Case Nos. AVU-E-12-08
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Schedule 5, Page 462 of 729

PRS: Greenhouse Gas Emissions

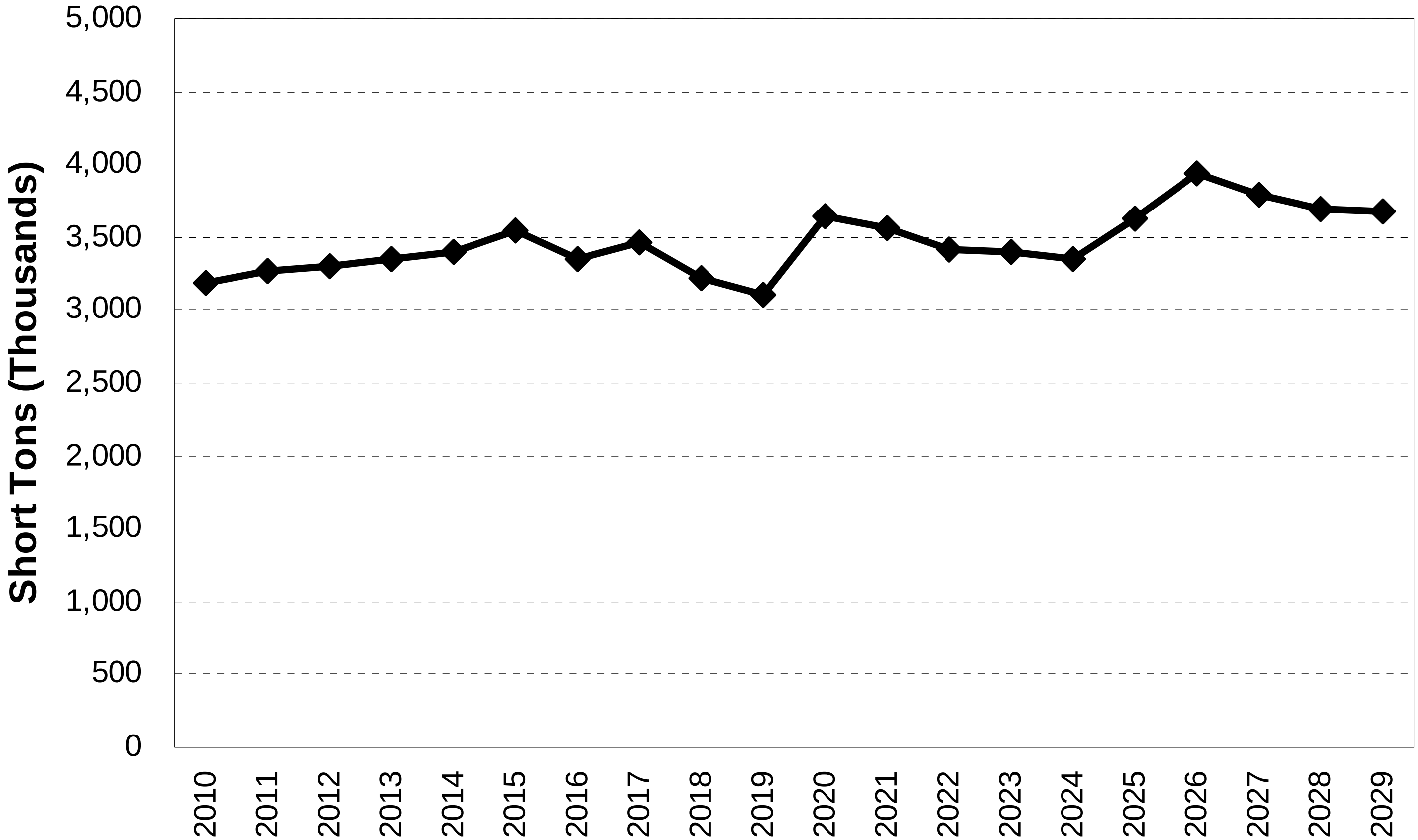

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Exhibit No. 4
Case Nos. AVU-E-12-08
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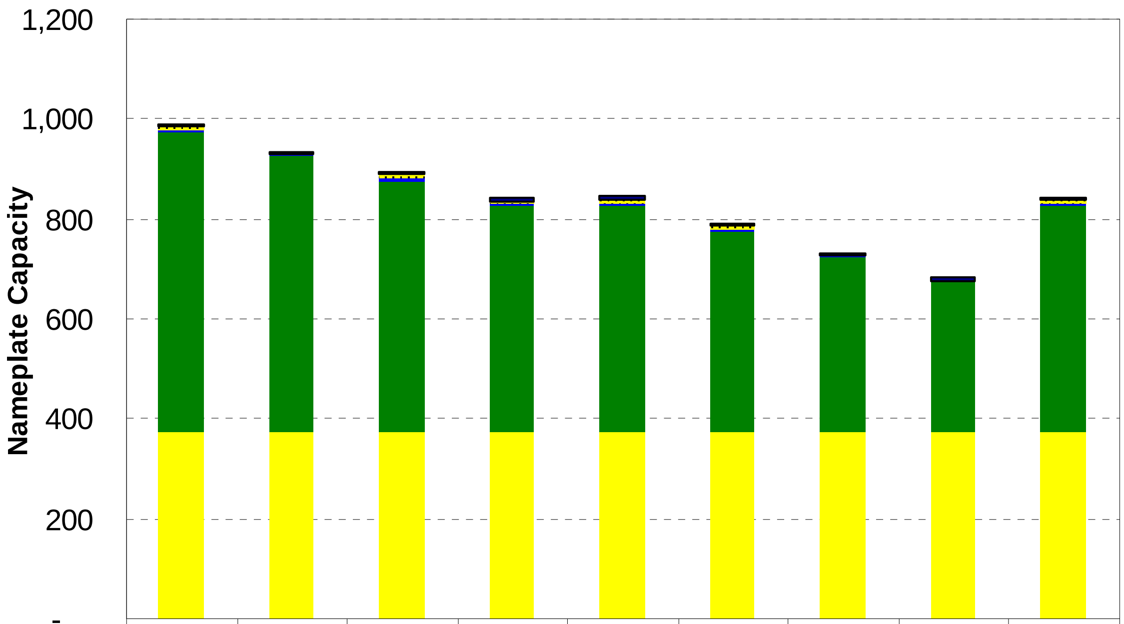
Schedule 5, Page 463 of 729

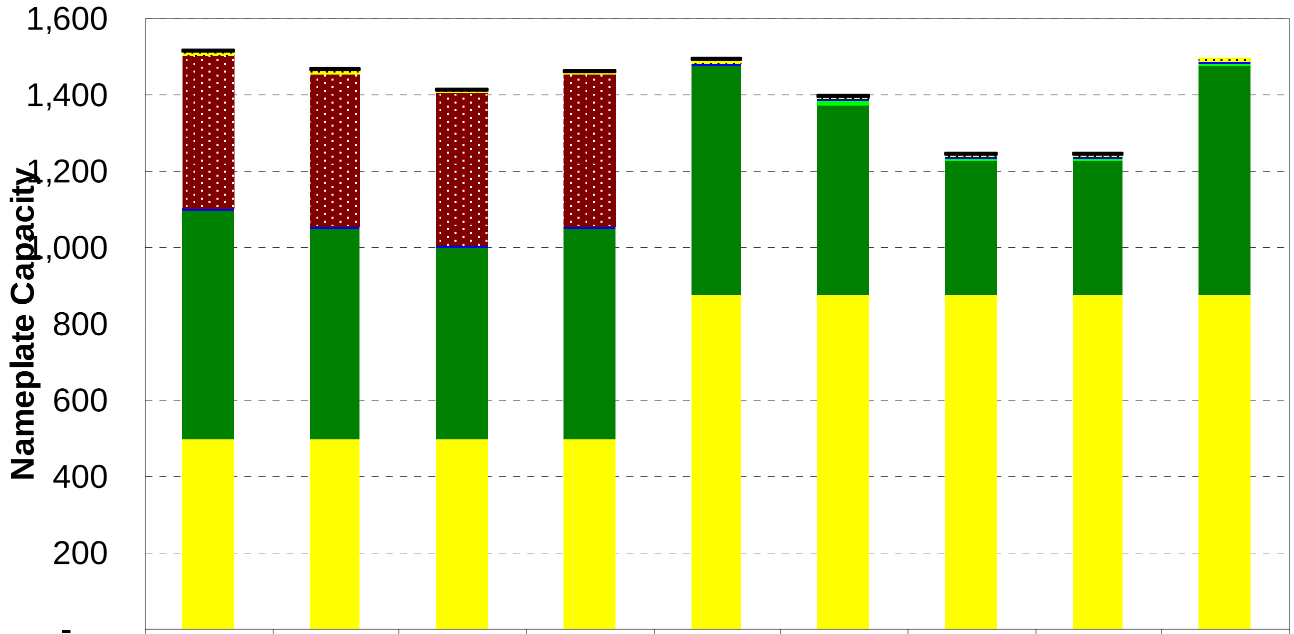
2020: Portfolios on the Efficient Frontier



	Least Risk	---	--	-	+	++	+	Least Cost	PRS
T&D Efficiencies	5	5	5	5	5	5	5	5	4
Co-Gen	5	-	8	5	8	8	-	-	8
IGCC w/ Seq	-	-	-	-	-	-	-	-	-
Coal	-	-	-	-	-	-	-	-	-
Hydro Upgrades	4	4	6	6	6	4	2	2	6
Solar	-	-	-	-	-	-	-	-	-
Other Renewables	-	-	-	-	1	-	-	-	-
Wind	600	550	500	450	450	400	350	300	450
SCCT	-	-	-	-	-	-	-	-	-
CCCT	375	375	375	375	375	375	375	375	375

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 464 of 729

2029: Portfolios on the Efficient Frontier



	Least Risk	---	--	-	+	++	+	Least Cost	PRS
T&D Efficiencies	5	5	5	5	5	5	5	5	4
Co-Gen	10	8	8	5	10	8	8	8	8
IGCC w/ Seq	400	400	400	400	-	-	-	-	-
Coal	-	-	-	-	-	-	-	-	-
Hydro Upgrades	4	6	6	6	6	5	5	5	6
Solar	-	-	-	-	-	-	-	-	-
Other Renewables	-	-	-	-	1	7	7	7	7
Wind	600	550	500	550	600	500	350	350	600
SCCT	-	-	-	-	-	-	-	-	-
CCCT	500	500	500	500	875	875	875	875	875

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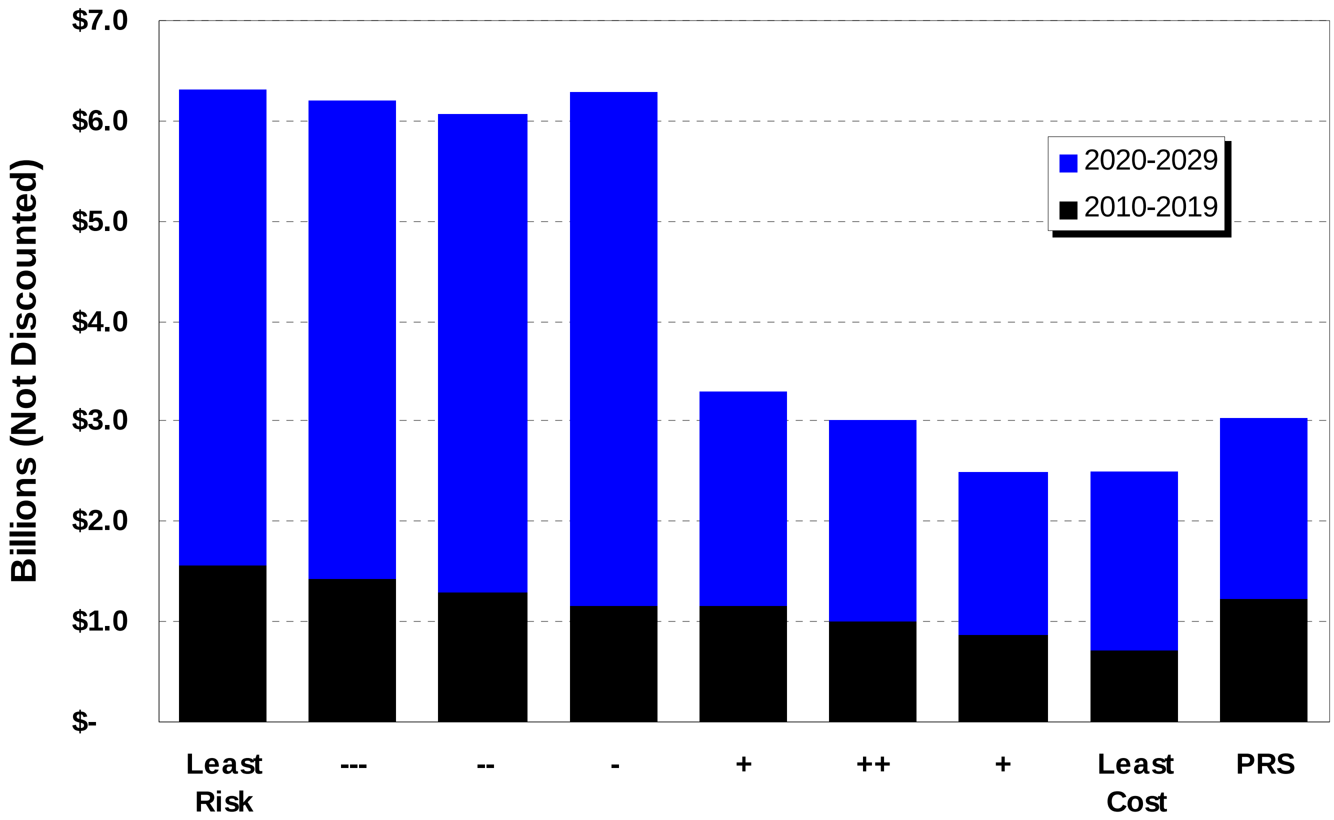
Efficient Frontier: Capital Requirements



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Efficient Frontier Scenario Analysis

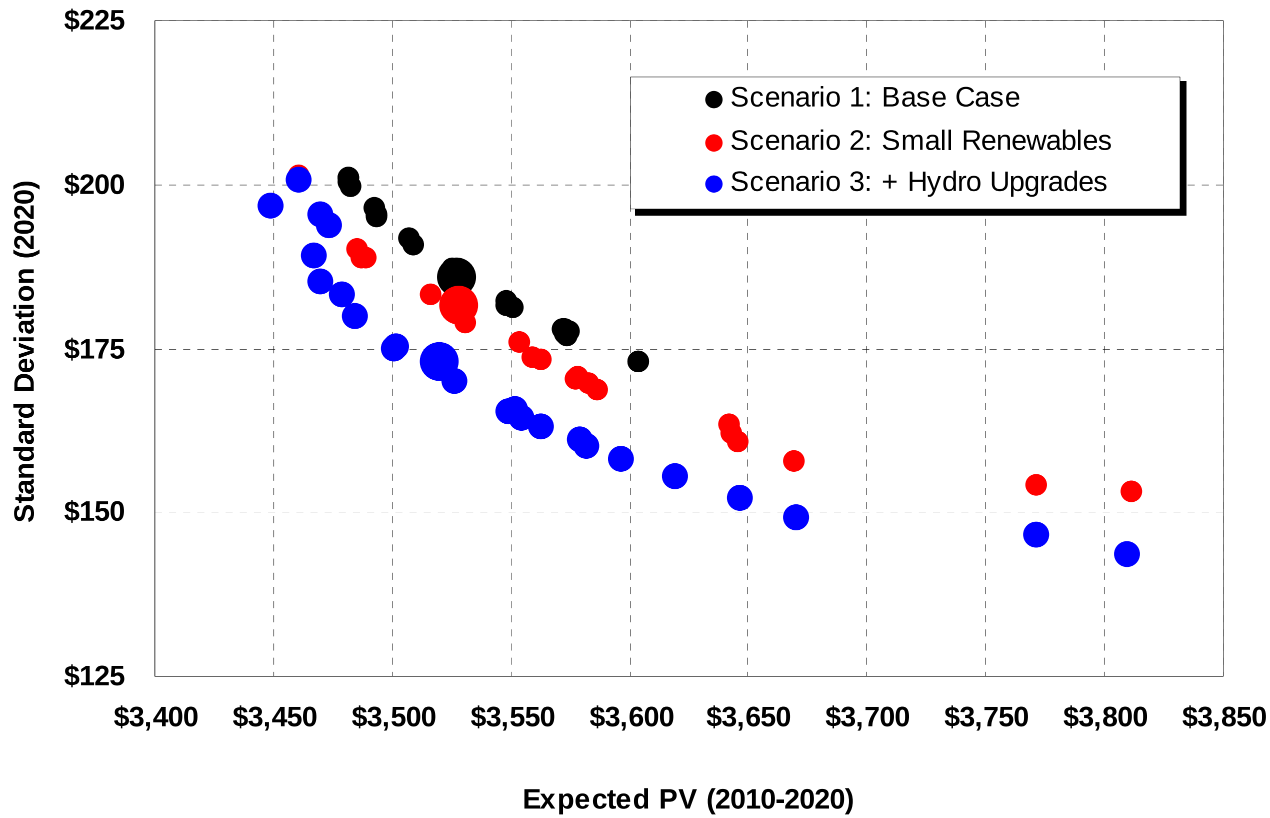

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Exhibit No. 4
Case Nos. AVU-E-12-08
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Schedule 5, Page 467 of 729

Scenario 2- Resource Selection

Small Renewables an Option

Year	CCCT	SCCT	Reardan	Wind	Other Renew	Solar	Hydro Upgrades	Coal	IGCC w/ Seq	Co-Gen	DSM	T&D	Total	Cumulative
2010											7.8	1.0	8.8	8.8
2011											7.9	1.0	8.9	17.6
2012					10.0						8.0	1.0	19.0	36.6
2013			50.0	50.0	5.0						8.2	1.0	114.2	150.8
2014											8.3	1.0	9.3	160.1
2015	125.0						1.0				8.4	1.0	135.4	295.5
2016					10.0						8.6		18.6	314.1
2017											8.7		8.7	322.8
2018				100.0	5.0						8.9		113.9	436.7
2019				100.0							9.0		109.0	545.7
2020	250.0			100.0		4.0	1.0				9.2		364.2	909.8
2021										5.0	9.3		14.3	924.2
2022							1.0			5.0	9.5		15.5	939.6
2023											9.6		9.6	949.3
2024											9.8		9.8	959.1
2025	125.0										10.0		135.0	1,094.1
2026	125.0										10.1		135.1	1,229.2
2027	125.0										10.3		135.3	1,364.5
2028											10.5		10.5	1,375.0
2029		100.0		100.0							10.7		210.7	1,585.7
2010-2019	125.0	-	50.0	250.0	30.0	-	1.0	-	-	-	83.7	6.0	545.7	
2010-2029	750.0	100.0	50.0	450.0	30.0	4.0	3.0	-	-	10.0	182.7	6.0	1,585.7	
2010-2019 (Delta)	-	-	-	(50.0)	30.0	-	(1.0)	-	-	(2.5)	-	-	(23.5)	
2010-2029 (Delta)	(125.0)	100.0	-	(100.0)	23.0	4.0	(3.0)	-	-	2.5	-	-	(98.5)	

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Exhibit No. 4
Case Nos. AVU-E-12-08
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Schedule 5, Page 468 of 729

Scenario 3- Resource Selection

Scenario 2 + Hydro Upgrades an Option

Year	CCCT	SCCT	Reardan	Wind	Other Renew	Solar	Hydro Upgrades	Coal	IGCC w/ Seq	Co-Gen	DSM	T&D	Total	Cumulative
2010											7.8	1.0	8.8	8.8
2011											7.9	1.0	8.9	17.6
2012					10.0						8.0	1.0	19.0	36.6
2013			50.0	50.0		4.0					8.2	1.0	113.2	149.8
2014						4.0					8.3	1.0	13.3	163.1
2015						4.0	60.0				8.4	1.0	73.4	236.5
2016					5.0		1.0				8.6		14.6	251.1
2017							1.0				8.7		9.7	260.8
2018				100.0							8.9		108.9	369.7
2019				100.0		4.0					9.0		113.0	482.7
2020	250.0			100.0		4.0	64.0			5.0	9.2		432.2	914.8
2021											9.3		9.3	924.2
2022											9.5		9.5	933.6
2023											9.6		9.6	943.3
2024											9.8		9.8	953.1
2025	125.0										10.0		135.0	1,088.1
2026	125.0										10.1		135.1	1,223.2
2027	250.0				5.0						10.3		265.3	1,488.5
2028				100.0							10.5		110.5	1,599.0
2029				100.0							10.7		110.7	1,709.7
2010-2019	-	-	50.0	250.0	15.0	16.0	126.0	-	-	-	83.7	6.0	482.7	
2010-2029	750.0	-	50.0	550.0	20.0	20.0	126.0	-	-	5.0	182.7	6.0	1,709.7	
2010-2019 (Delta)	(125.0)	-	-	(50.0)	15.0	16.0	124.0	-	-	(2.5)	-	-	(86.5)	
2010-2029 (Delta)	(125.0)	-	-	-	13.0	20.0	120.0	-	-	(2.5)	-	-	25.5	

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Greenhouse Gas Scenario Comparison

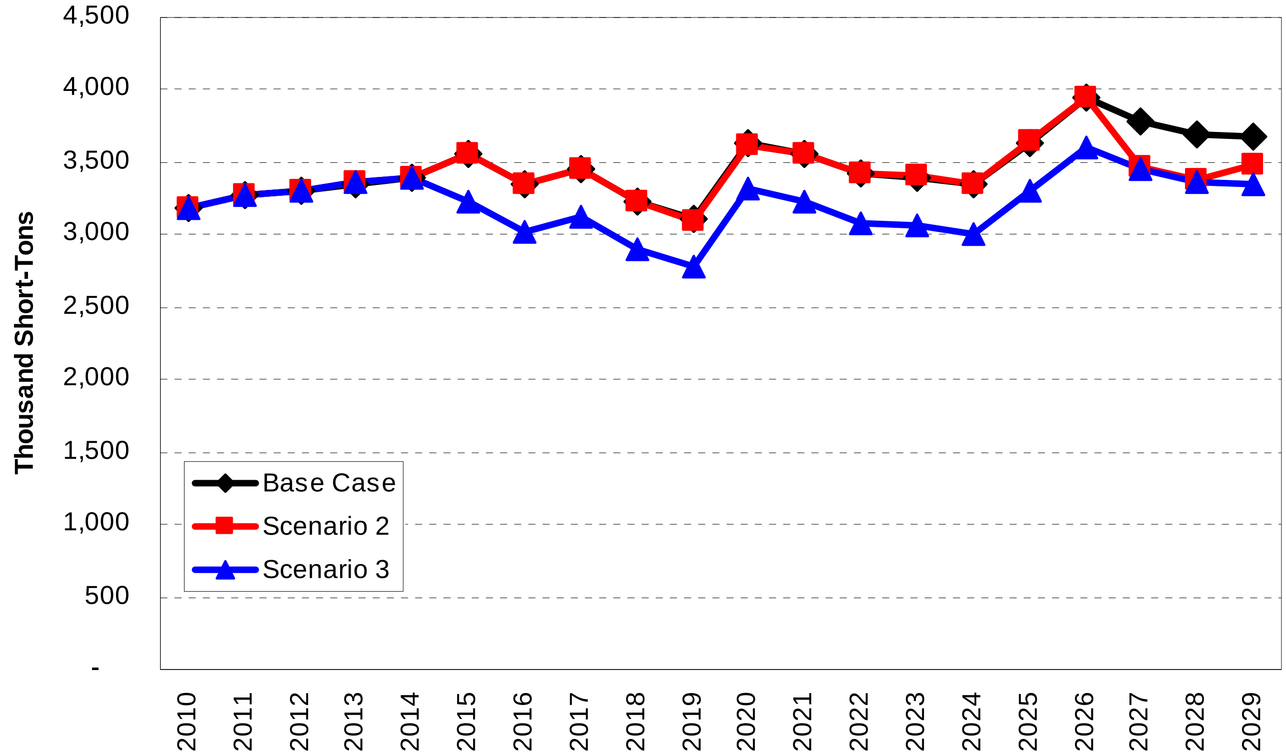

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Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 470 of 729

Next Steps

- Add “Yellow Light” conservation projects as resource options
- Perform capital cost sensitivity analysis
- Study portfolios with renewable requirement changes
  - Resource Availability
  - National RPS
  - Higher WA state RPS target
- Study portfolio options with alternative market futures
- Test “Preferred Resource Strategies” against market scenarios
- Further evaluate large hydro upgrades

AVISTA

Avista's 2009 Electric Integrated Resource Plan

Technical Advisory Committee Meeting No. 5 Agenda

March 25, 2009

	Topic	Time	Staff
1.	Introduction	9:30	Storro
2.	Conservation	9:35	Hermanson
3.	Lunch	11:30	
4.	Preferred Resource Strategy	12:30	Gall
5.	Scenarios and Futures	1:30	Gall/Lyons
6.	2009 IRP Topics	2:30	Lyons
7.	Adjourn	3:00	

DSM in the 2009 Electric IRP

Technical Advisory Committee Meeting

Lori Hermanson

March 25, 2009

Presentation Highlights

- DSM History
- Overview of DSM
  - What, why, how and who of DSM
- Customer segments reached and offerings
- Messaging and outreach through EveryLittleBit and Website
- Tariff Rider Funding
- Metrics
- Stakeholders
- 2008 Results and 2009 Focus
- Integration of DSM into IRP
- Business planning to program development

Brief DSM History

- Offered DSM since 1978
  - Energy exchanger – converted over 20,000 homes from electric to natural gas for space and water
  - Pioneered the country's first system benefit charge for energy efficiency in 1995
  - Immediate conservation response to 2001 Western energy crisis through expanded programs and enhanced incentives
    - – Tripled annual savings at twice the cost
  - During the past 30 years, we acquired 138.5 aMW of energy savings
    - – 109 aMW still online

AVISTA

What We Do

Deep and broad energy efficiency programs with strong messaging for all customers.

We provide financial rebates for all commercial and industrial electric and natural gas savings measures with a payback over one year and we offer rebates for weatherization and efficient appliances as well as low-cost/no-cost tips.

We provide renewable options and are testing end-use demand response pilots.

AVISTA

Why We Do It

Acquire lower cost resources to benefit all customers (IRP implementation)

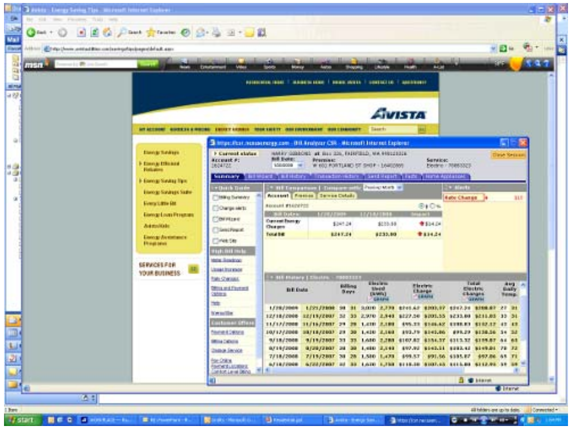
Customer assistance

- Reduction in customers' bills
- Gives customers some control in a higher energy cost environment

Regulatory obligation **<u>and</u>** sensibility

Reduced pressure on, or alternatives for, the capital budget

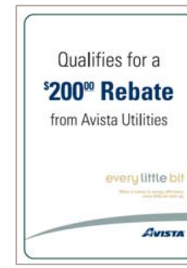
Carbon reduction and environmental focus



How We Do It

Pursue the Best Delivery Mechanisms for the Targeted Market

- Standard Offers ("Prescriptive") for residential & small commercial customers through mass marketing
- Custom ("Site Specific") for C&I customers with one point of contact through our Account Executive Team
- Low Income through community action agencies
- Regional through the NW Energy Efficiency Alliance
- Special projects—RFPs, Pilot Programs, etc.
- Promotion of Codes and Standards



SNAP
Spokane Neighborhood Action Programs

NORTHWEST
ENERGY EFFICIENCY
ALLIANCE

AVISTA

Who Does It

Program Managers and Coordinators

- Catherine Bryan
- Renee Coelho
- Leona Doege
- Chris Drake
- Camille Martin
- Lisa McGarity
- Debby Reid
- Kerry Shroy
- Greta Zink

Analytical Group

- Jon Powell
- Lori Hermanson

Engineering Team

- Tom Lienhard
- Mike Dillon
- Damon Fisher
- Carlos Limon
- Ron Welch

Administration

- Pat Lynch
- Bruce Folsom
- Rachelle McGrath

Students

- Virginia Luka
- Rachael Roig
- Nate Thompson
- Kayla Trabun

Who Does It (cont.)

<<<Site Specific: **Account Executive Team**

Prescriptive: **Marketing Team**>>>

Contact Center assists customers with energy efficiency information

Corporate Communications provides earned media expertise

Community Relations partners with education and community involvement

State and Federal Regulation Department assists with PUC filings and communications

AVISTA

C/I Energy Efficiency Site Specific

Avista Customer
Summary of Proposed
Energy Efficiency Measures
Listed in order of Simple Payback

- Custom Projects
- Technical Assistance
- Free Energy Audits and Analysis
- Design Review
- Cash Incentives

Option No.	Brief EEM Description	EEM Cost	Electric kWh Savings	Demand kW Savings	Nat. Gas Therm Savings	Energy Cost Savings	Simple Payback before incentive	Potential Incentive	Simple Payback After Incentive
1	Site Lighting Retrofit	$179,335	519,441	76	(4,014)	$33,206	5.4 yrs	$ 62,333	3.5 Years
2	Warehouse Heater replacement	$53,395	-	-	2,665	$2,804	19.0 yrs	$ 7,995	16.2 yrs
3	Roof insulation	$180,000	-	-	7,742	$8,146	22.1 yrs	$ 23,226	19.2 yrs
4	Office HVAC retrofits	$404,240	93,842	-	6,069	$11,893	34.0 yrs	$ 21,961	32.1 yrs

Scope of Work:

- The above incentives are based on information provided by vendor. The costs for the insulation were based on $1.50 per square foot. Any higher costs will need verification, but may increase the incentive.
- The warehouse HVAC system change is based on a building model using a warehouse setting and the insulation having already been complete.
- The office HVAC changes are based on the complete sq.ft. of the office space increasing SEER/EER values to new construction standards and a slight increase in AFUE for heating.
- All reports are attached.

AVISTA

C/I Energy Efficiency Prescriptive

Standard Offer Programs

- Measures that have relatively uniform savings
- Pre-determined amount
- Streamlined approach
- Marketability
- Ease of understanding for customers and contractors

Avista Utilities Commercial Lighting Table

Please complete this Lighting Table and submit with Incentive Agreement and copies of invoices. The incentive will be applied to the installed fixture count unless the initial (prior) fixture count is less. In that case, the prior fixture count will be the basis for calculating the eligible incentive.

Existing Equipment	Existing Quantity	New Equipment Installed	Installed Quantity (units)	Per Unit Incentive	Total Incentive
2-Foot Fluorescent Fixtures					
2-Lamp T12 U-Lamp	____ fixtures	T8 U-Lamp or 2-Lamp F17 T8 Fixture/Retrofit	____ fixtures	$15	$____
4-Foot Fluorescent Fixtures					
4-Lamp T12 Fixture	____ fixtures	4-Lamp T8 Fixture/Retrofit	____ fixtures	$25	$____
4-Lamp T12 Fixture	____ fixtures	3-Lamp T8 Fixture*/Retrofit	____ fixtures	$40	$____
4-Lamp T12 Fixture	____ fixtures	2-Lamp T8 Fixture*/Retrofit	____ fixtures	$35	$____
3-Lamp T12 Fixture	____ fixtures	3-Lamp T8 Fixture/Retrofit	____ fixtures	$25	$____
3-Lamp T12 Fixture	____ fixtures	2-Lamp T8 Fixture*/Retrofit	____ fixtures	$30	$____
2-Lamp T12 Fixture	____ fixtures	2-Lamp T8 Fixture/Retrofit	____ fixtures	$15	$____
2-Lamp T12 Fixture	____ fixtures	1-Lamp T8 Fixture*/Retrofit	____ fixtures	$20	$____
1-Lamp T12 Fixture	____ fixtures	1-Lamp T8 Fixture/Retrofit	____ fixtures	$15	$____
8-Foot Fluorescent Fixtures					
4-Lamp T12 (or 2-Lamp HO) Fixture	____ fixtures	4-Lamp (or 2-Lamp HO) T8 Fixture/Retrofit	____ fixtures	$50	$____
2-Lamp T12 Fixture	____ fixtures	2-Lamp T8 Fixture/Retrofit (8' or 4' Lamps)	____ fixtures	$30	$____
1-Lamp T12 Fixture	____ fixtures	1-Lamp T8 Fixture/Retrofit (8' or 4' Lamps)	____ fixtures	$20	$____
2-Lamp T12 HO or VHO Fixture	____ fixtures	4-Lamp T5 High-Output Fixture/Retrofit	____ fixtures	$85	$____
HID Lighting (Metal Halide, High Pressure Sodium, Mercury Vapor)					
400 watt HID Fixture	____ fixtures	4-Lamp T5 High-Output Fixture	____ fixtures	$125	$____
400 watt HID Fixture	____ fixtures	6-Lamp T5 High-Output Fixture	____ fixtures	$90	$____
400 watt HID Fixture	____ fixtures	6-Lamp T8 Fixture (4-Foot Lamps)	____ fixtures	$125	$____
400 watt HID Fixture	____ fixtures	8-Lamp T8 Fixture (4-Foot Lamps)	____ fixtures	$110	$____
400 watt HID Fixture	____ fixtures	200 Watt Induction Fluorescent Fixture	____ fixtures	$220	$____
1000 watt HID Fixture	____ fixtures	(2) 6-Lamp T-5 High-Output Fixtures	____ fixtures	$320	$____
1000 watt HID Fixture	____ fixtures	400 Watt Induction Fluorescent Fixture	____ fixtures	$400	$____
Incandescents					
100 watt or less Incandescent	____ lamps	Compact Fluorescent Lamp (23 watt or Less Screw-In)	____ lamps	$3	$____
Over 100 watt to 200 watt Incandescent	____ lamps	Compact Fluorescent Lamp or Fixture (45 watt)	____ lamps	$15	$____
Over 200 watt Incandescent	____ lamps	Compact Fluorescent Lamp or Fixture (55-65 watt)	____ lamps	$25	$____
60 watt or greater Incandescent	____ lamps	Dimmable Compact Fluorescent or Cold Cathode**	____ lamps	$15	$____
100 watt or greater Incandescent flood	____ fixtures	Ceramic Metal Halide (25 watt)	____ fixtures/lamps	$35	$____
150 watt or greater Incandescent	____ fixtures	New Linear T8 Fluorescent Fixture	____ fixtures	$35	$____
Sign Lighting or Low Wattage Applications (Minimum Runtime Greater than 12 Hours Per Day)					
20-30 watt Incandescent	____ lamps***	LED or Low Wattage Equivalent	____ lamps***	$15	$____
20-60 watt Incandescent	____ lamps	Cold Cathode	____ lamps/fixtures	$10	$____
Exit Signs					
Incandescent Exit Sign	____ exit sign	New LED Exit Sign	____ exit sign	$25	$____
Occupancy Sensors					
Manual Light Switch	____ sensors	Occupancy Sensor Controlling Less than 200-watts	____ sensors	$25	$____
Manual Light Switch	____ sensors	Occupancy Sensor Controlling Greater than 200-watts	____ sensors	$50	$____
Daylight Dimming (Applicable for lights that are no more than 20 feet from a window or skylight)					
No prior dimming control	____ fixtures	Individually Controlled Fixtures	____ fixtures	$25	$____
				Total Incentive	$____

*Reducing the number of lamps in a fixture may reduce light output. In order to achieve adequate light levels a specular reflector may be needed. Testing is encouraged prior to a comprehensive lighting retrofit. **Cold cathodes are only good for replacement of incandescents up to 65 watts.
***Incentive is per incandescent in original sign configuration. 3/08

Page 3 of 4

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C/I Prescriptive (Standard Offer) Programs

- Lighting
- Food Service Equipment
- PC Network Controls
- Premium Efficiency Motors
- Steam Trap Repair/ Replacement
- Demand Controlled Ventilation
- Side Stream Filtration
- Retro-Commissioning
- LEED Certification
- Vending Machine Controllers
- Refrigerated Warehouse
- Electric to Gas Water Heater Conversions
- Variable Frequency Drives
- Commercial Clothes Washers
- Energy Smart Grocer

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Residential Prescriptive Offerings

- High efficiency equipment
- CFL lighting
- Refrigerator recycling
- Conversions from Straight Resistance
- Weatherization
- Rooftop dampers
- Ductless heat pump pilot
- UCONS Multi-family direct install
- www.everylittlebit.com (visit our house of rebates)

every little bit

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Limited Income Offerings

- Weatherization
- Windows/Doors
- Conversions
- Equipment Upgrades
- Health & Human Safety

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Regional Programs (NEEA)

- Acquisition of electric efficiency through market transformation
- Funded by 5 IOUs, ETO, generating publics and BPA
  - Avista's portion – 3.94%
- Regional leaders are discussing expansion of efforts
  - Avista's portion will increase to 5.6%
  - Savings acquisition increase from 1.5 aMW to 2.94 aMW
- Historically been a cost-effective option to acquire resources
  - Levelized TRC cost of about 10 mills
  - Not necessarily representative of future costs

Messaging and Outreach: Every Little Bit

Market research done in 2007 found that Avista’s customers believed they “were already efficiency, that energy efficiency is too expensive, and it doesn’t make much difference.”

In response, the EveryLittleBit campaign was launched with a website, broadcast and print media, and collateral materials in a multi-channel, multi-year approach.

every little bit

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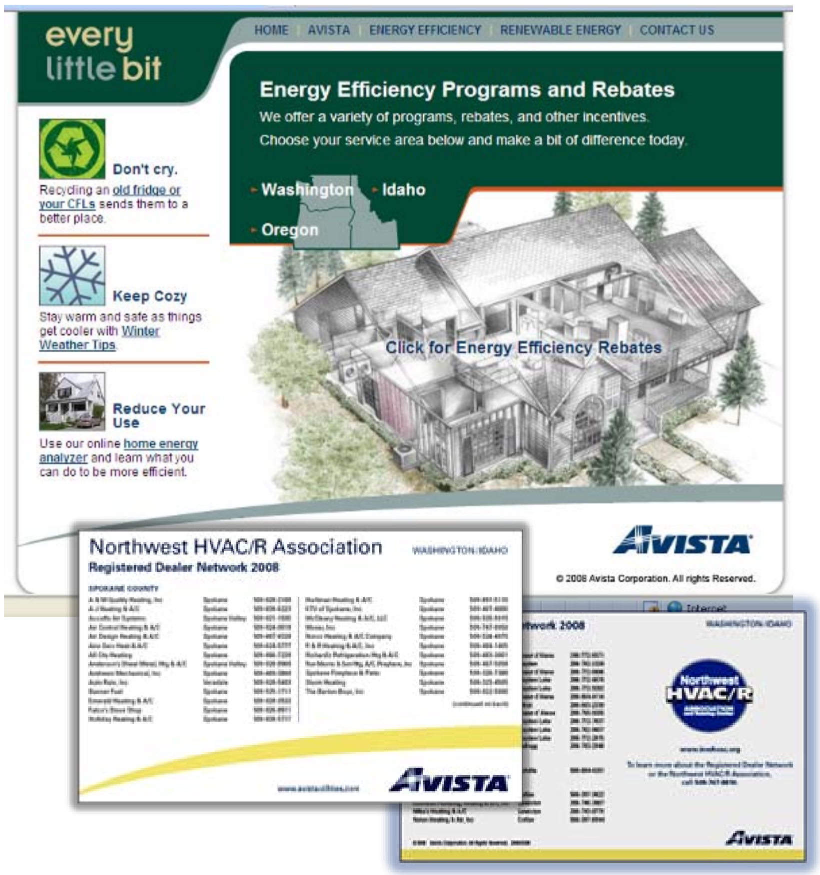
Messaging and Outreach: Online Resources



- www.everylittlebit.com
- www.avistautilities.com
- Energy Saving Tips
- House of Rebates
- Downloadable Forms
- Energy Audit
- Bill Analyzer
- RDN Dealer List
- Efficiency Ave for Business – in process

Funding of Energy Efficiency Programs

- DSM Tariff Rider
  - A percentage of every dollar paid goes to energy efficiency
  - Has multiple regulatory requirements for implementation
- Provides for $23 million annual budget
- Moving towards an annual “true-up”
- First “System Benefit Charge” in North America in 1995
- Continue to evaluate its efficacy and options

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Potential Stimulus Funding

- Funding available for energy conservation and smart grid development
- Avista is currently evaluating possible programs that could be offered with additional funding from the stimulus bill
  - One possible project – regional smart grid pilot
    - Utility and non-utility sponsors
    - Scope includes everything from Advanced Metering Infrastructure (AMI), software and support, to demand response
    - Avista still considering participation but still has not committed to participation

Resource Portfolio Standards (RPS)

- Previously I-937, requires large utilities to obtain a fixed percentage of their electricity from qualifying renewable resources in addition to all cost-effective and acquirable energy conservation
  - 3% by 2012
  - 9% by 2016
  - 15% by 2020
- Avista is working with others to change this legislation to allow utilities to use energy conservation acquisition above the cost-effective levels in lieu of renewables
  - Benefits the customer
  - Truly lower cost resource

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Metrics

Cost-Effectiveness, Measurement and Evaluation, Post-Verification, Triple E Reports, Prudence Findings in General Rate Cases

Table 15EG — **Calculation of Energy Savings vs. Utility Expenditure Proportionality**

	Adjusted Proportionality Calculation		Unadjusted Proportionality Calculation	
	Electric	**Gas**	**Electric**	**Gas**
Actual 1/1/08 to 12/31/08 cash expenditures	$ 14,553,058	$ 6,288,949	$ 14,553,058	$ 6,288,949
Less cash incentives	$ (9,918,978)	$ (5,085,264)	$ -	$ -
Add in derated incentives	$ 9,395,623	$ 5,404,090	$ -	$ -
Adjusted (for incentives) utility expenditures	$ 14,029,702	$ 6,607,775	$ 14,553,058	$ 6,288,949
Normalize NEEA expenditures	$ 61,379	$ -	$ -	$ -
Total adjusted utility expenditures	$ 14,091,081	$ 6,607,775	$ 14,553,058	$ 6,288,949
DSM revenues 1/1/08 to 12/31/08	$ 11,558,429	$ 4,433,213	$ 11,558,429	$ 4,433,213
Adjusted utility expenditures divided by actual revenues	122%	149%	126%	142%
Energy savings from Triple-E Report	74,861,160	1,888,061	74,861,160	1,888,061
IRP Goal	52,966,689	1,425,070	52,966,689	1,425,070
% of goal achieved	141%	132%	141%	132%
Proportionality (kWh and therm)	**116%**	**89%**	**112%**	**93%**
Proportionality (mmbtu)	**103%**		**103%**	

NOTES:

(1) Adjustments for the difference between cash incentives and those accrued as projects move through the "pipeline" (contracted to construction to completed) remove the effect of scheduling cash payment of incentives to future dates.
(2) NEEA revenues have been adjusted to equal our annual maximum contractual obligation. Regional energy savings are not reflected in this calculation.

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Stakeholder Involvement

External Energy Efficiency Board (Triple E)

Non-binding oversight, technical advisory committee

Meets twice a year

Regular reporting

Periodic Newsletters

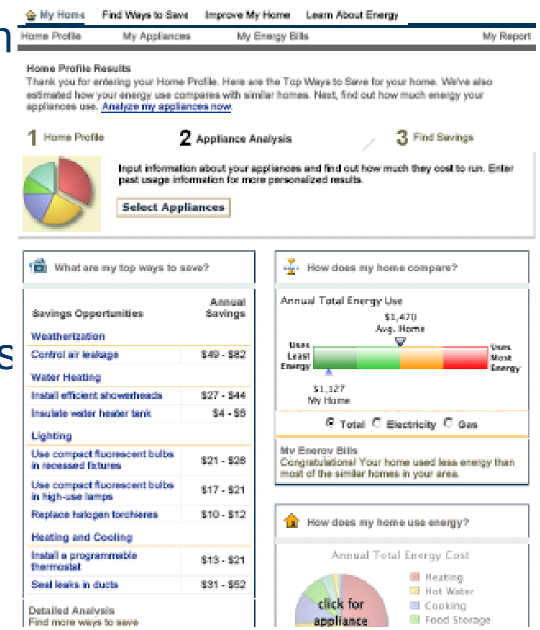
Avista External Energy Efficiency Board
Lynn Anderson – Idaho Public Utilities Commission
Nick Beamer –Aging and Long-Term Care of Eastern Washington
Sheryl Carter – Natural Resource Defense Council
Chris Davis – Spokane Neighborhood Action Programs
Carrie Dolwick – Northwest Energy Coalition
Michael Early – Industrial Customers of Northwest Utilities
Chuck Eberdt – The Energy Project
Tom Eckman – Northwest Power Planning Council
Donn English – Idaho Public Utilities Commission
Claire Fulenwider – Northwest Energy Efficiency Alliance
Stefanie Johnson – Washington Public Counsel
Steven Johnson – Washington Utilities and Transportation Commission
Lisa LaBolle – Idaho Office of Energy Resources
John Kaufman – Oregon Department of Energy
Mary Kimball – Washington Public Council
Lynn Kittilson – Oregon Public Utility Commission
Phil Kercher – Sacred Heart Medical Center
Ron Oscarson - Spokane County
Paula Pyron – Northwest Industrial Gas Users
Deborah Reynolds – Washington Utilities and Transportation Commission
Michael Shepard – E-Source

Incentives/Rebates Paid in 2008

- Slightly over $15 million paid to Avista customers.
  - $7.65 million to commercial/industrial customers
    - – 768 projects received an incentive
  - $6.1 million to residential customers
    - – 12,890 residential customers received incentives
  - $1.2 million to limited income customers
    - – More than 450 households assisted

Avista's 2008 Energy Efficiency Results

- Exceeded electric IRP goal by 41% and natural gas IRP goal by 32%
- Total electric savings over 74.8 million kilowatt h
  - Commercial/Industrial over 41.8 million kwh
  - Residential over 31.1 million kwh
  - Limited Income over 1.8 million kwh
- Total natural gas savings over 1.8 million therms
  - Commercial/Industrial over 1.0 million therms
  - Residential – 749,199 therms
  - Limited Income – 102,438 therms



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2009 Focus

Increasing electric and natural gas savings targets

Continued personalization, presence, and participation for and by customers

New Programs Under Consideration: Small Commercial Initiative, Energy Champion, Energy Coaching, Behavioral Programs, Bundling

Potential changes in Resource Portfolio Standards in Washington, Energy Trust of Oregon, Decoupling in all states

Earnings opportunities and potential for expansion

"Didn't ya hear? To save energy we have to keep the thermostat at 1,100 degrees instead of 1,200 degrees!"

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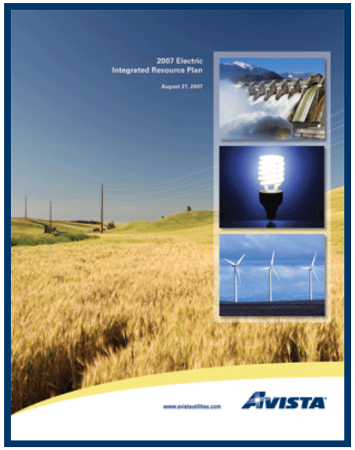
From Planning to Customer Programs



2009 Washington / Idaho DSM Business Plan

A Working Document to Plan and Guide our 2009 Strategy and Operations

Avista Washington / Idaho DSM staff
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Renee Coelho
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Michael Shepard – E-Source

Total Company Planning with >3000 DSM measures considered

From Planning to Tariffs and Programs

>30 Programs and >300 measures offered

Integration of DSM into the 2009 Electric IRP

- Interactive process that meets regulatory requirements and produces results for the business planning process
  - Identify all commercially available technologies or measures
    - “Acceptance” or “rejection” within the IRP will not remove any technology or application from potentially being included
    - Nearly 2,500 measures were evaluated for this IRP
  - Re-evaluate existing residential measures and evaluate the inclusion of addition measures
    - May change the menu of residential offerings
    - Nearly 800 measures were evaluated for this IRP

Integration of DSM into the 2009 Electric IRP (cont.)

- Inclusion of limited income and non-residential site specific programs are done by modifying the historical baseline
  - Not necessarily limited to modifying baseline for price elasticity and load growth
  - Site specific measures that fit into the 3,000+ measures evaluated are evaluated through the normal IRP process outside of this modified historical baseline approach

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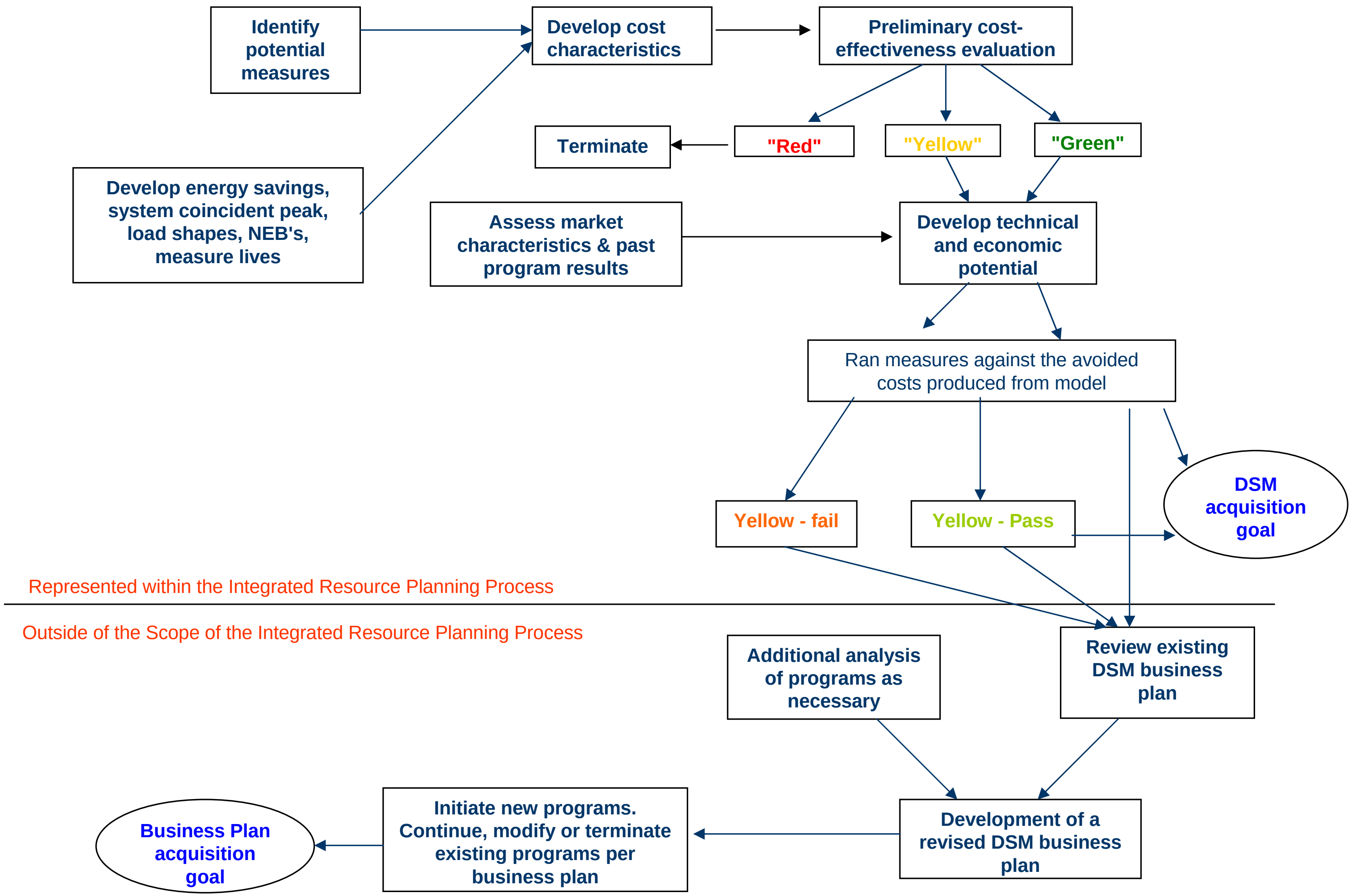
Identify potential measures
Develop cost characteristics
Preliminary cost-effectiveness evaluation
Develop energy savings, system coincident peak, load shapes, NEB's, measure lives
Terminate
"Red"
"Yellow"
"Green"
Assess market characteristics & past program results
Develop technical and economic potential
Ran measures against the avoided costs produced from model
Yellow - fail
Yellow - Pass
DSM acquisition goal
Represented within the Integrated Resource Planning Process
Outside of the Scope of the Integrated Resource Planning Process
Additional analysis of programs as necessary
Review existing DSM business plan
Development of a revised DSM business plan
Initiate new programs. Continue, modify or terminate existing programs per business plan
Business Plan acquisition goal

Evaluation of Measures

- Based on levelized TRC, measures are categorized into "greens", "yellows" and "reds"
  - "Greens" automatically selected and entered into model
  - "Yellows" are tested - range ended up being $90-$140/MWh
  - "Reds" – no further testing
- IRP process results in DSM goal and updated avoided costs
  - 63,119,081 kWh for 2010
  - 65,643,844 kWh for 2011
  - Avoided costs are used to evaluate new measures or technologies that may arise between IRPs

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Business Planning Process

- Selected measures are further evaluated by program managers
  - Market research
  - Program bundling
  - Program development
- Budgets is prepared for individual programs
  - Update economic potential savings acquisition
  - Projection of FTE
  - Estimate of participation levels, incentives, and other expenses
- Business plan goal
  - Historically, has been at or above IRP goal

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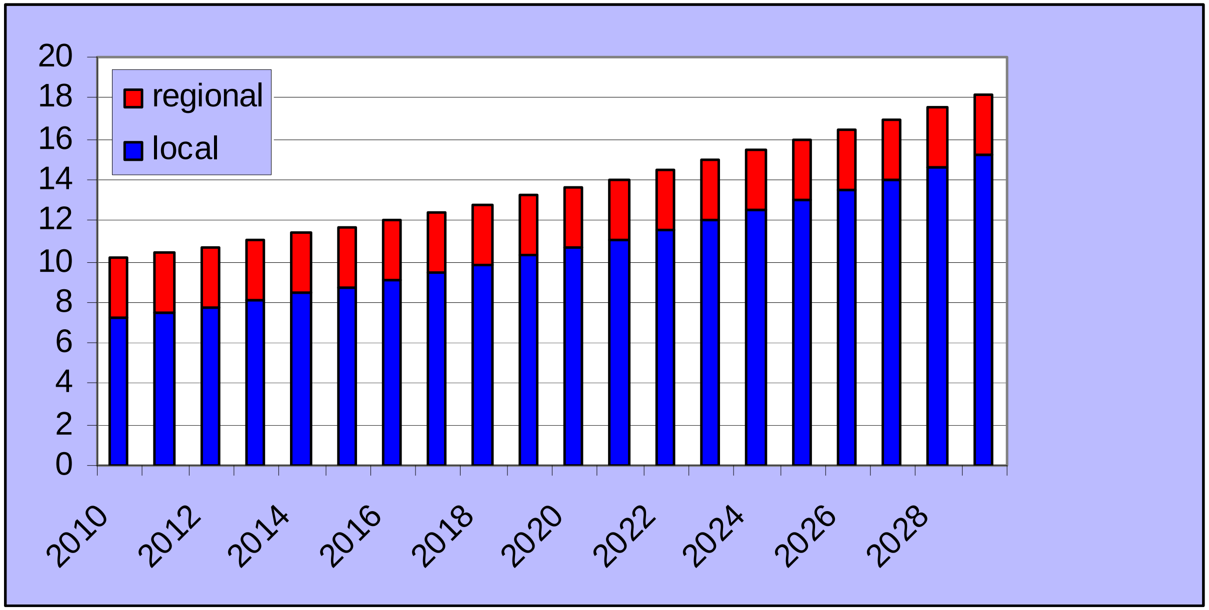
Where Are We At in the IRP Process?

- Goals complete for 2010/2011
- Projection of 20 year DSM acquisition complete



Where Are We At in the IRP Process? (cont.)

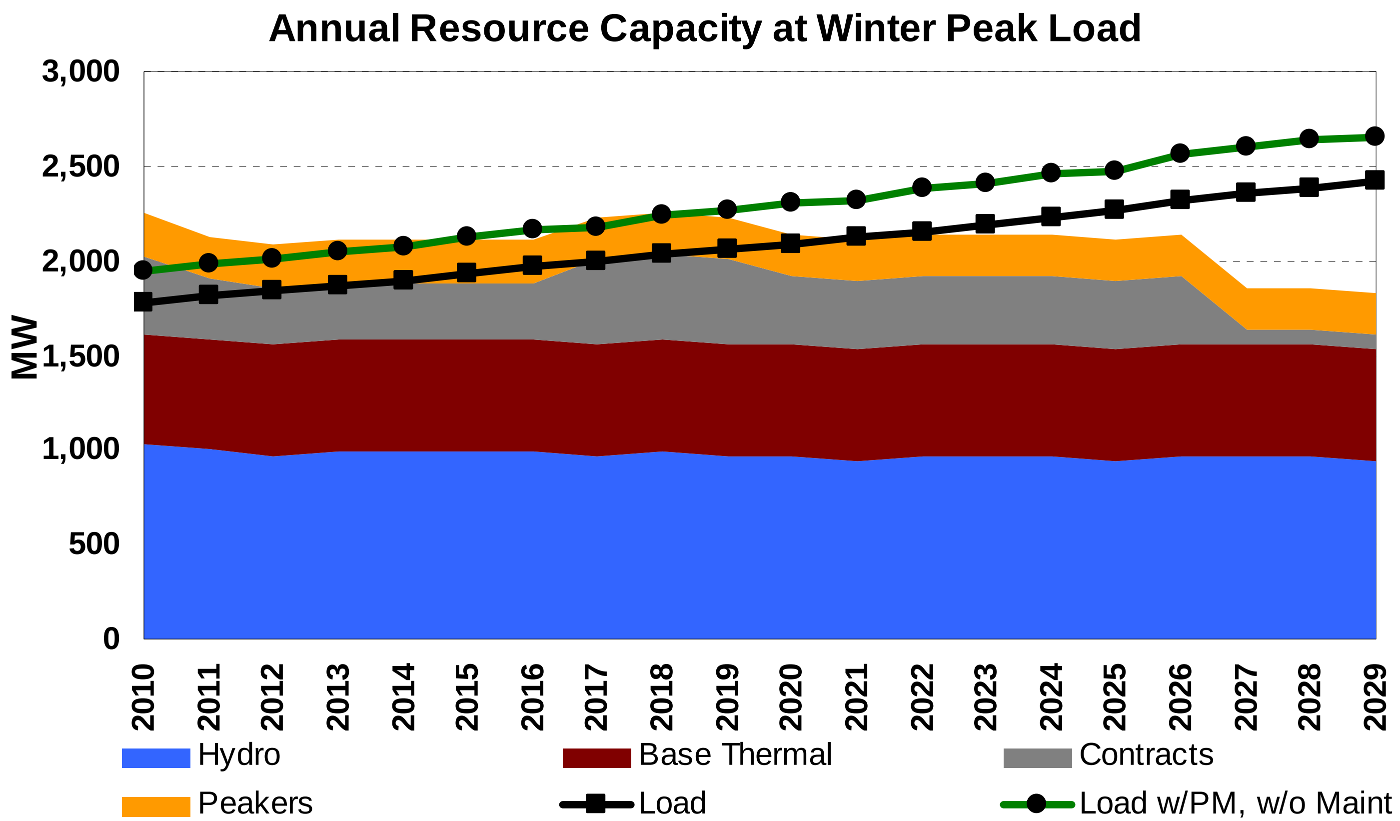
- Written contribution for the IRP document
  - Drafts to J. Powell and B. Folsom for review and edits
  - Insert final numbers and changes
  - Final document due end of March

2009 Preferred Resource Strategy

James Gall

2009 Electric Integrated Resource Plan
Fifth Technical Advisory Committee Meeting
March 25, 2009

January Capacity L&R Balance



Load is net 2007 Conservation Levels

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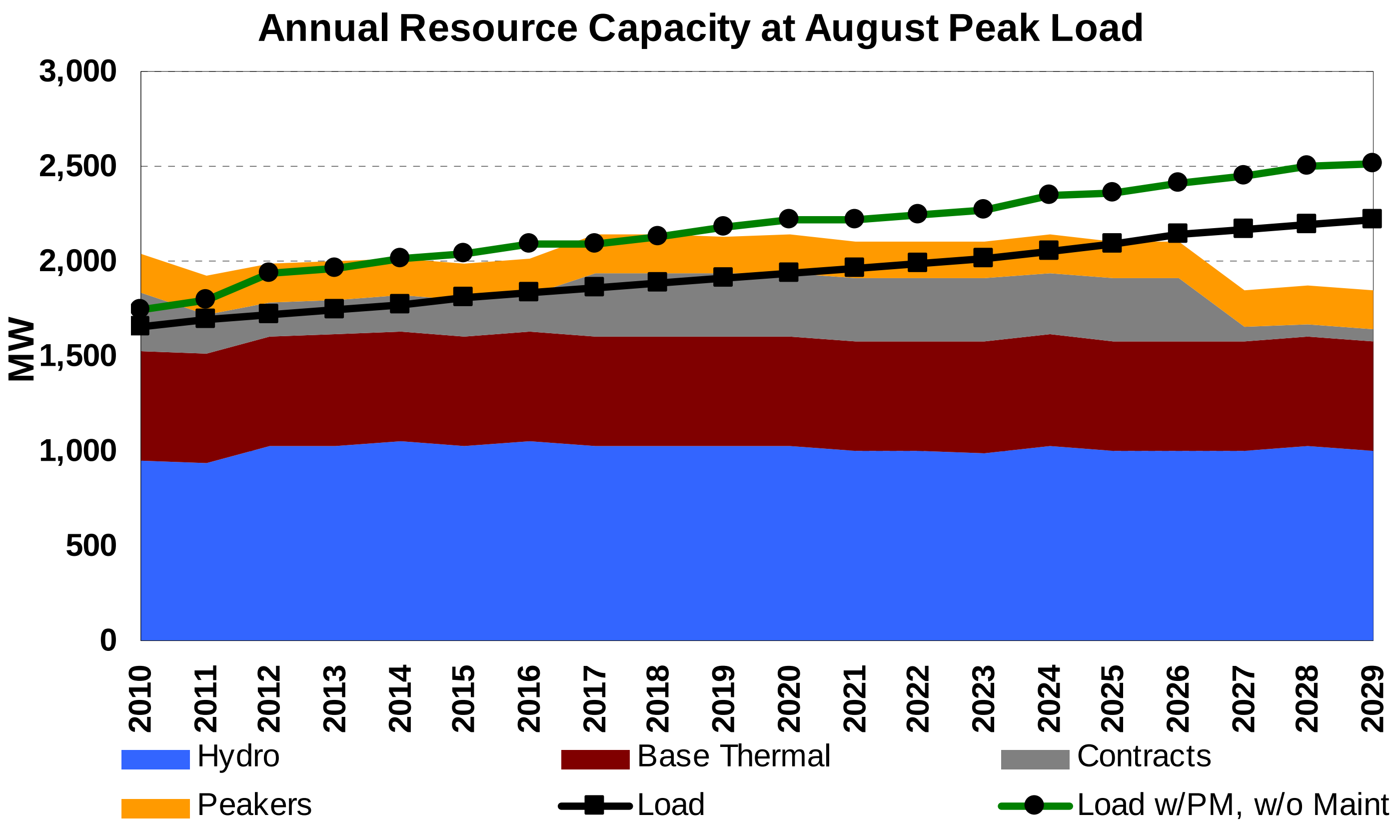
August Capacity L&R Balance



Load is net 2007 Conservation Levels

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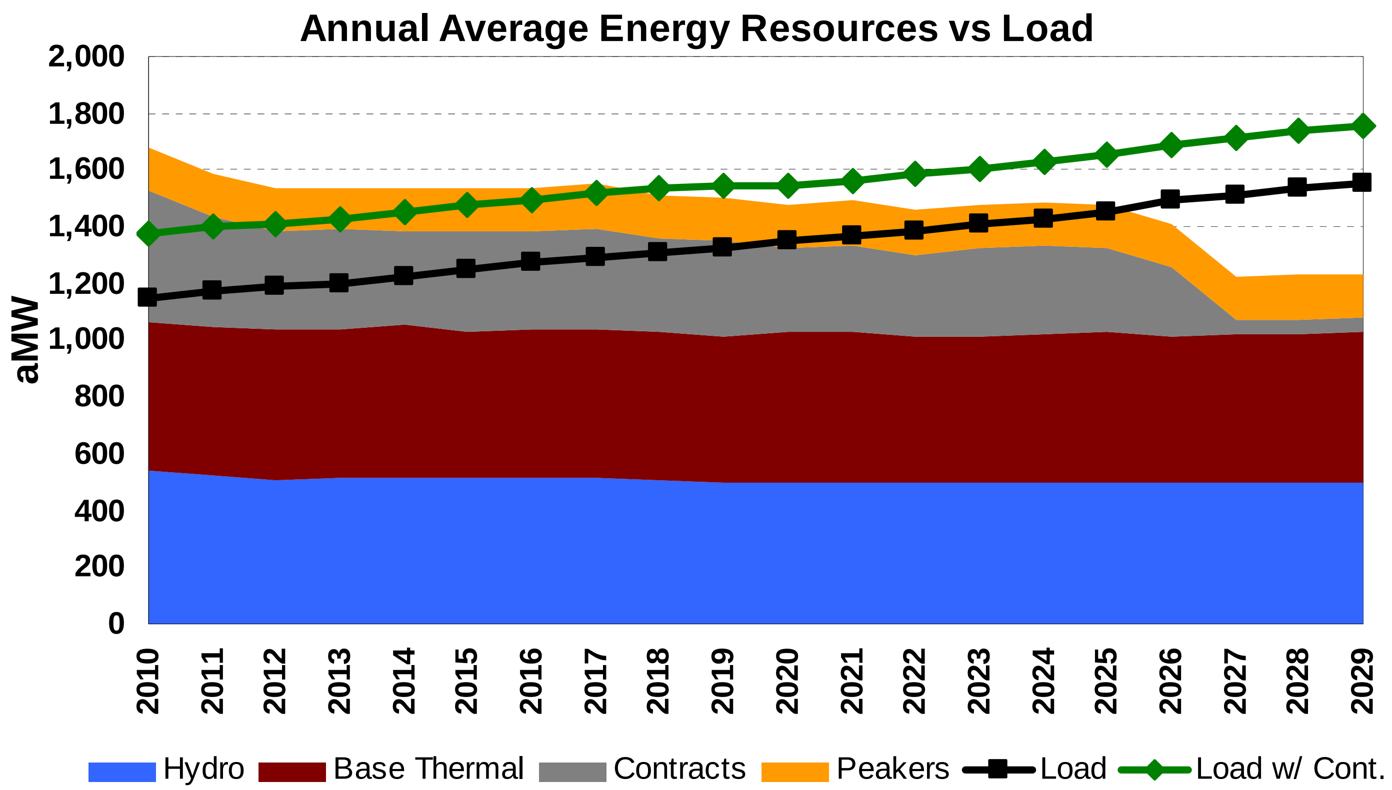
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 507 of 729

Annual Energy L&R Balance



Load is net 2007 Conservation Levels

Exhibit No. 4
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Schedule 5, Page 508 of 729

PRiSM Objective Function

- Linear program solving for the optimal resource strategy to meet resource deficits over planning horizon.
- Model selects its resources to reduce cost, risk, or both.

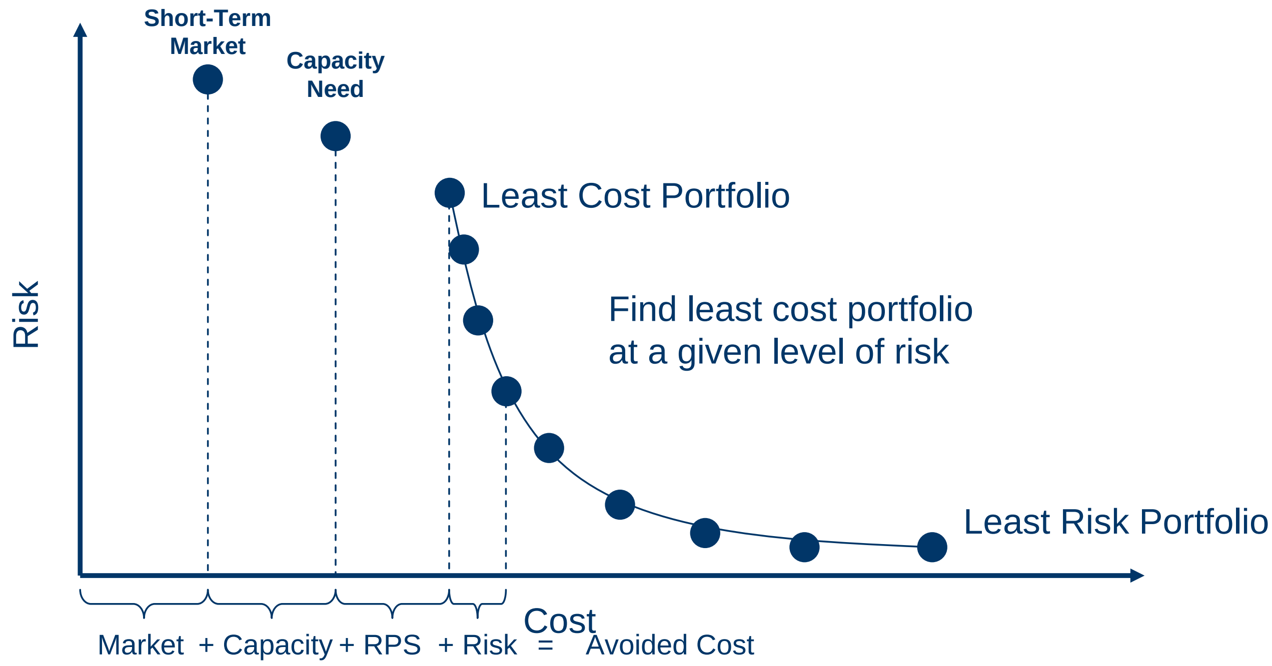
Minimize: Total Power Supply Cost on NPV basis (2010-2050 with emphasis on first 11 years of the plan)

Subject to:

- Risk Level
- Capacity Need +/- deviation
- Energy Need +/- deviation
- Renewable Portfolio Standards
- Resource Limitations and Timing
- Greenhouse Gas Limits

Efficient Frontier

- Demonstrates the trade off of cost and risk
- Avoided Cost Calculation



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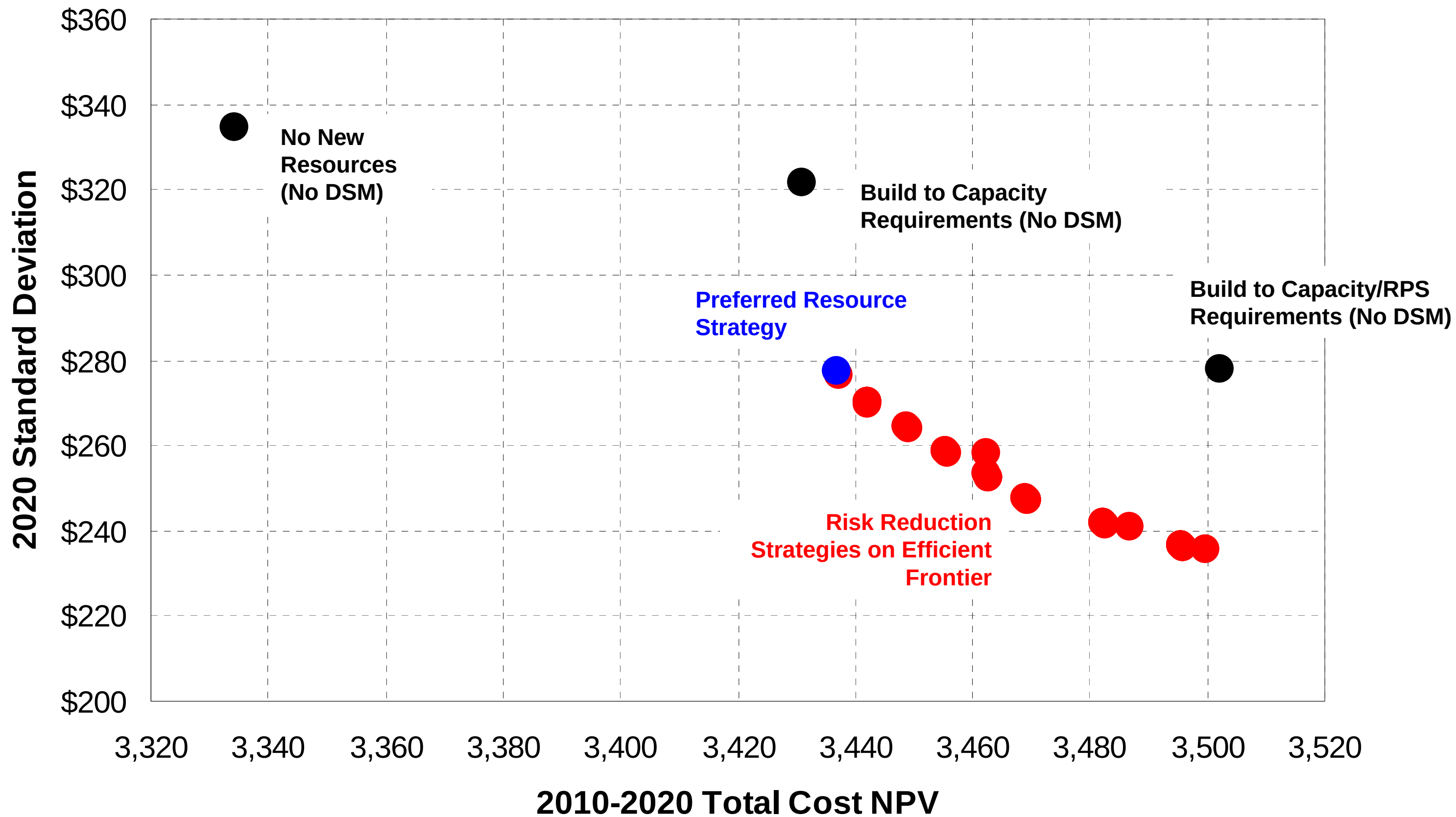
Schedule 5, Page 510 of 729

Efficient Frontier



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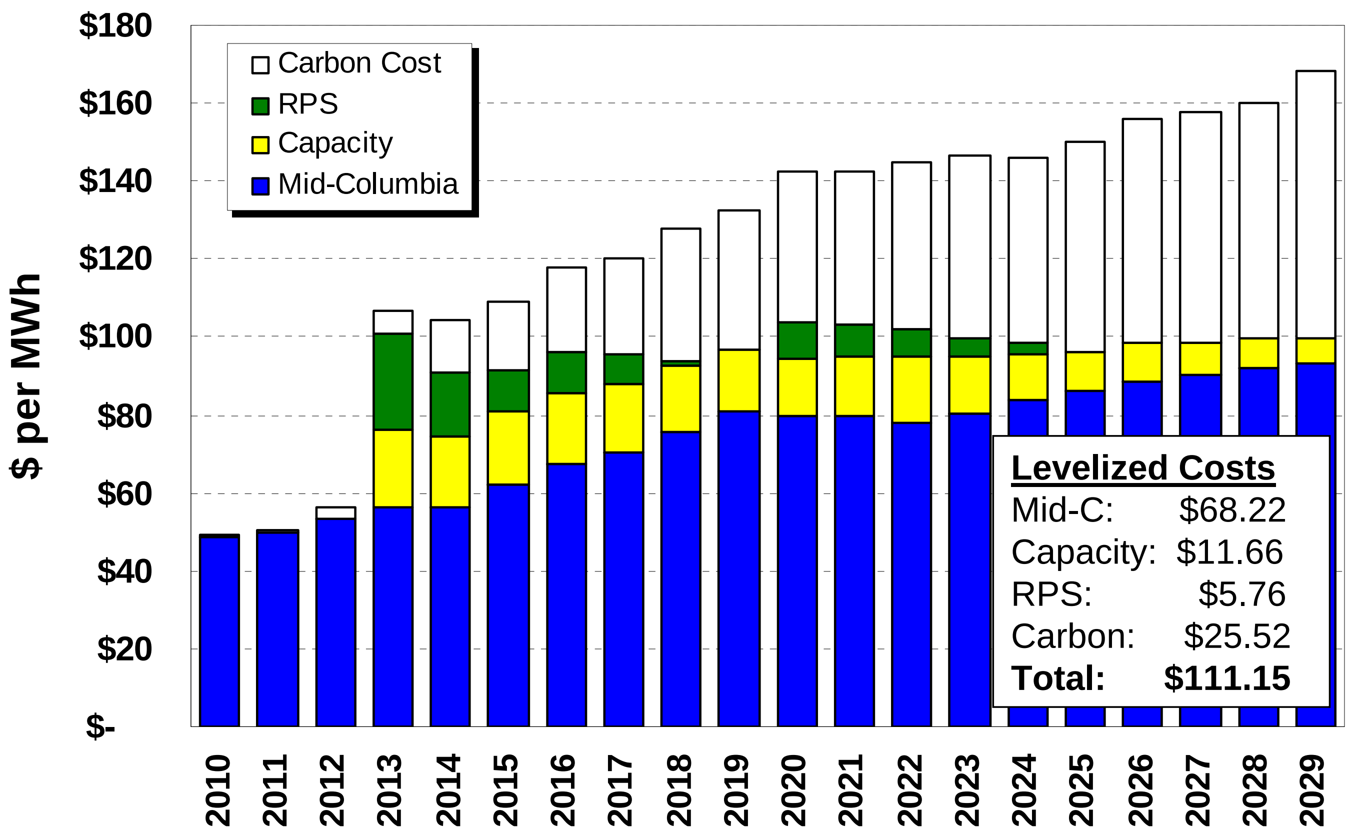
Schedule 5, Page 511 of 729

Avoided Resource Cost



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Schedule 5, Page 512 of 729

2007 Preferred Resource Strategy

(Capacity MW)

Year	CCCT	SCCT	Wind	Hydro Upgrades	Non-Wind Renewables	Low Carbon Baseload	DSM	T&D Efficiency
2008	-	-	-	-	-	-	9	-
2009	-	-	-	-	-	-	10	-
2010	275	-	-	-	-	-	11	-
2011	-	-	-	-	20	-	12	-
2012	-	-	-	-	10	-	13	-
2013	-	-	-	-	-	-	14	-
2014	-	-	100	-	5	-	15	-
2015	-	-	-	-	-	-	15	-
2016	-	-	100	-	-	-	16	-
2017	-	-	100	-	-	-	16	-
2018	-	-	-	-	-	-	16	-
2019	-	-	-	-	-	-	16	-
2020	81	-	-	-	10	-	17	-
2021	32	-	-	-	10	-	17	-
2022	38	-	-	-	5	-	17	-
2023	15	-	-	-	-	-	18	-
2024	58	-	-	-	-	-	18	-
2025	38	-	-	-	-	-	18	-
2026	35	-	-	-	-	-	19	-
2027	305	-	-	-	-	-	19	-
2008-2017	275	-	300	-	35	-	130	-
2008-2027	877	-	300	-	60	-	304	-

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Exhibit No. 4
Case Nos. AVU-E-12-08
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Schedule 5, Page 513 of 729

Preferred Resource Strategy

(Capacity MW)

Year	CCCT	SCCT	Wind	Hydro Upgrades	Low Carbon Baseload	DSM	T&D Effic.
2010	-	-	-	-	-	12	1
2011	-	-	-	-	-	12	1
2012	-	-	-	-	-	12	1
2013	-	-	150	-	-	12	1
2014	-	-	-	1	-	14	1
2015	-	-	-	1	-	14	-
2016	-	-	-	-	-	15	-
2017	-	-	-	1	-	15	-
2018	-	-	-	-	-	15	-
2019	-	-	-	-	-	17	-
2020	250	-	150	-	-	17	-
2021	-	-	-	2	-	18	-
2022	-	-	-	-	-	18	-
2023	-	-	50	-	-	20	-
2024	-	-	-	-	-	20	-
2025	250	-	-	-	-	21	-
2026	-	-	-	-	-	21	-
2027	250	-	-	-	-	23	-
2028	-	-	-	-	-	23	-
2029	-	-	-	-	-	24	-
2010-2019	-	-	150	3	-	137	5
2010-2029	750	-	350	5	-	339	5

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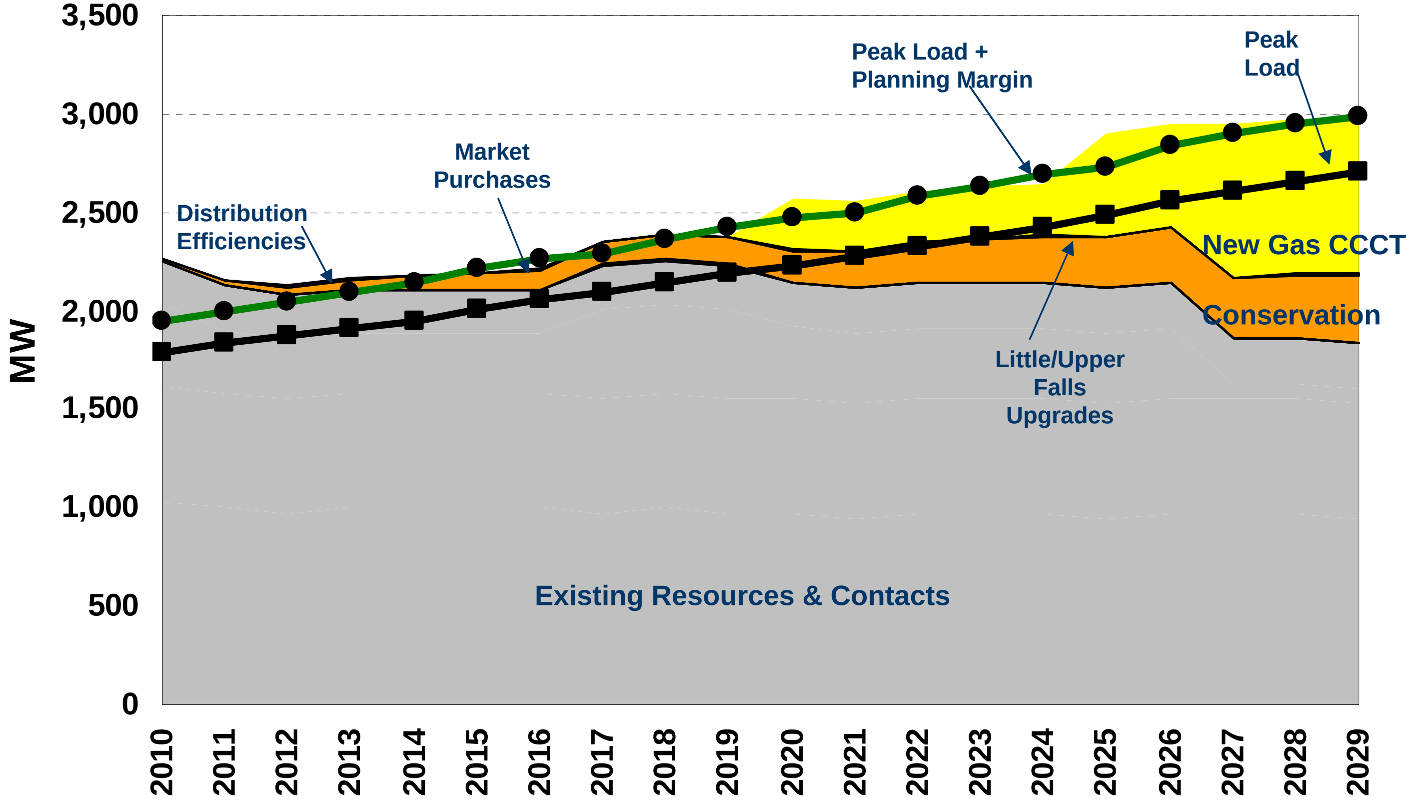
Schedule 5, Page 514 of 729

January Capacity L&R w/ New Resources



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August Capacity L&R w/ New Resources

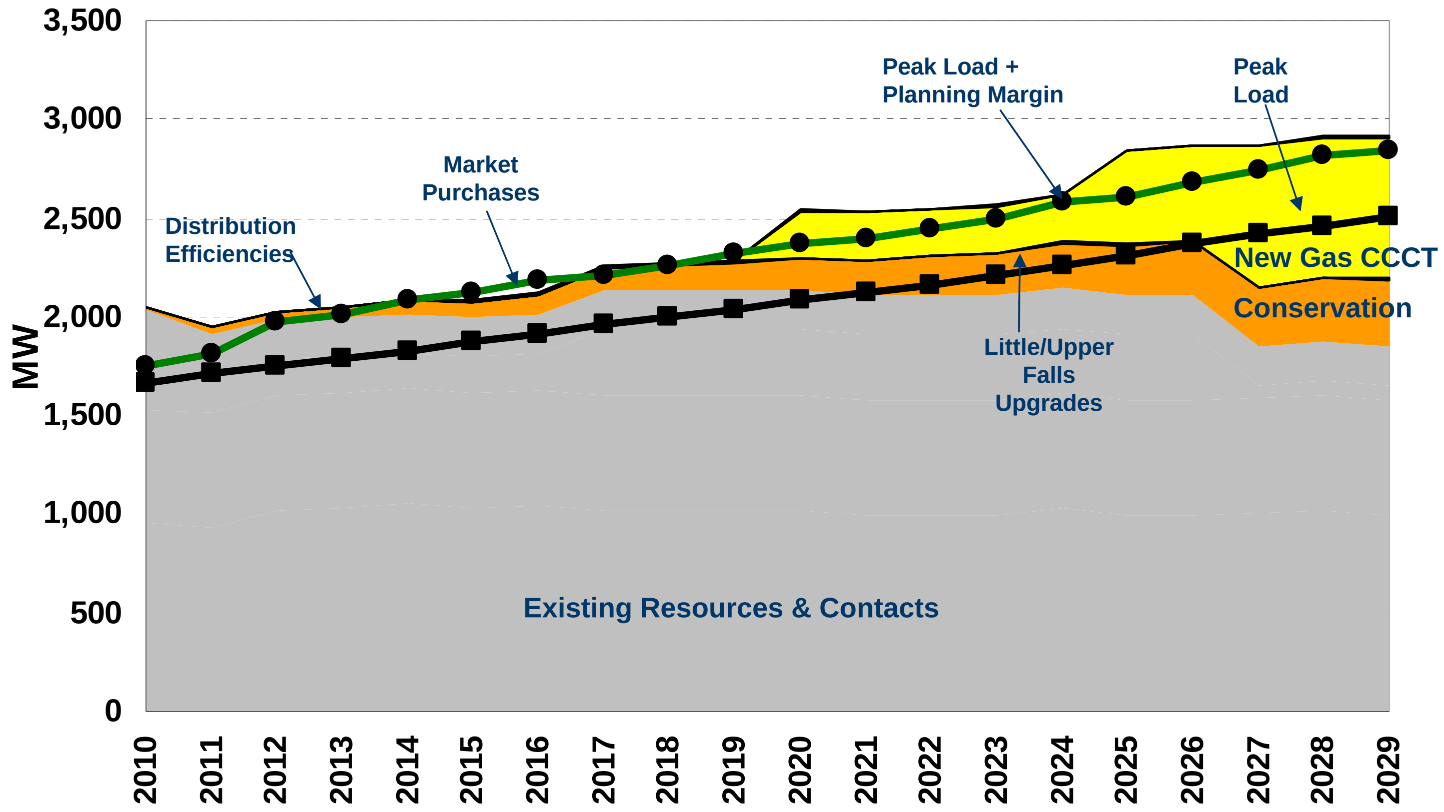

Exhibit No. 4
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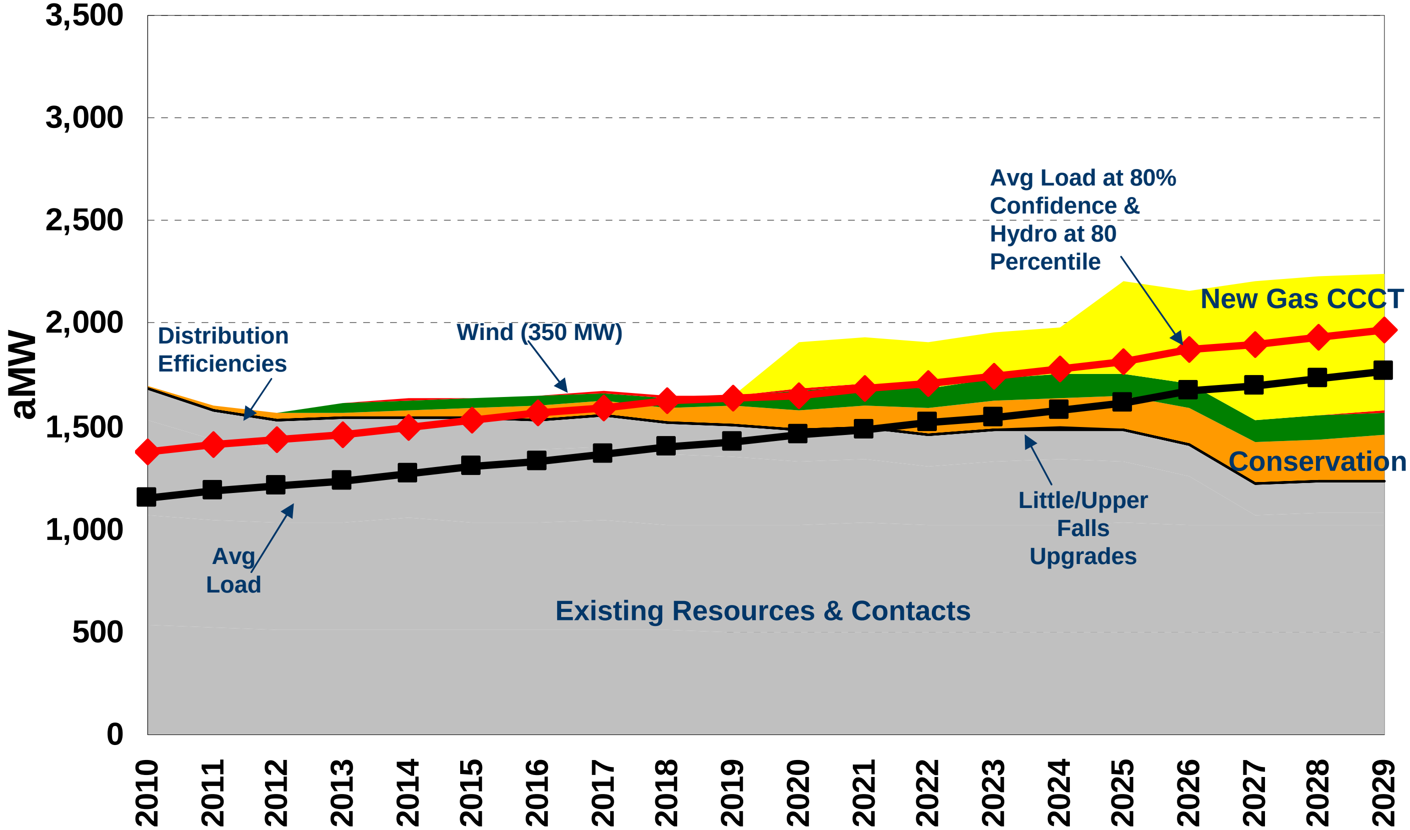
Schedule 5, Page 516 of 729

Annual Energy L&R w/ New Resources



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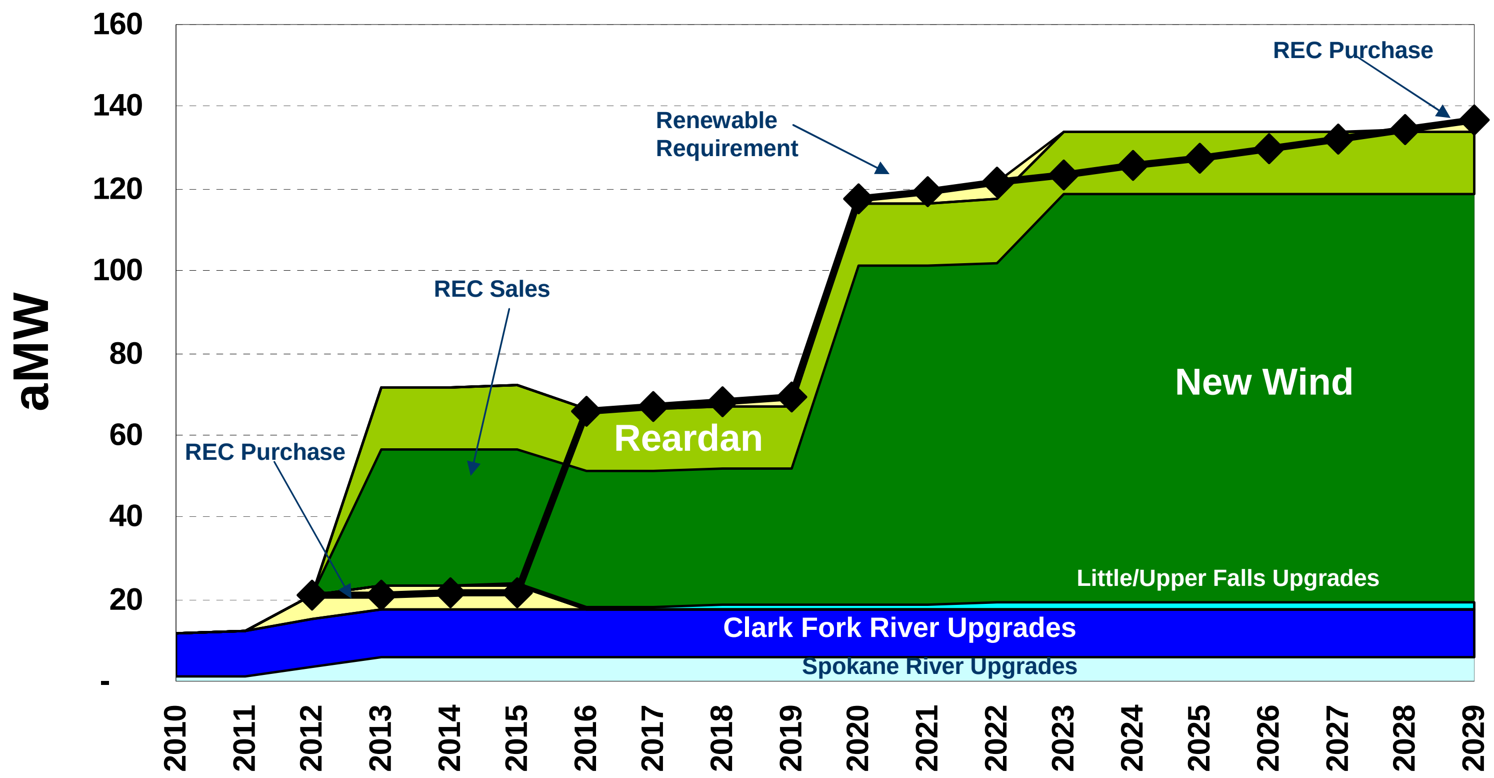
Schedule 5, Page 517 of 729

Washington State RPS Compliance



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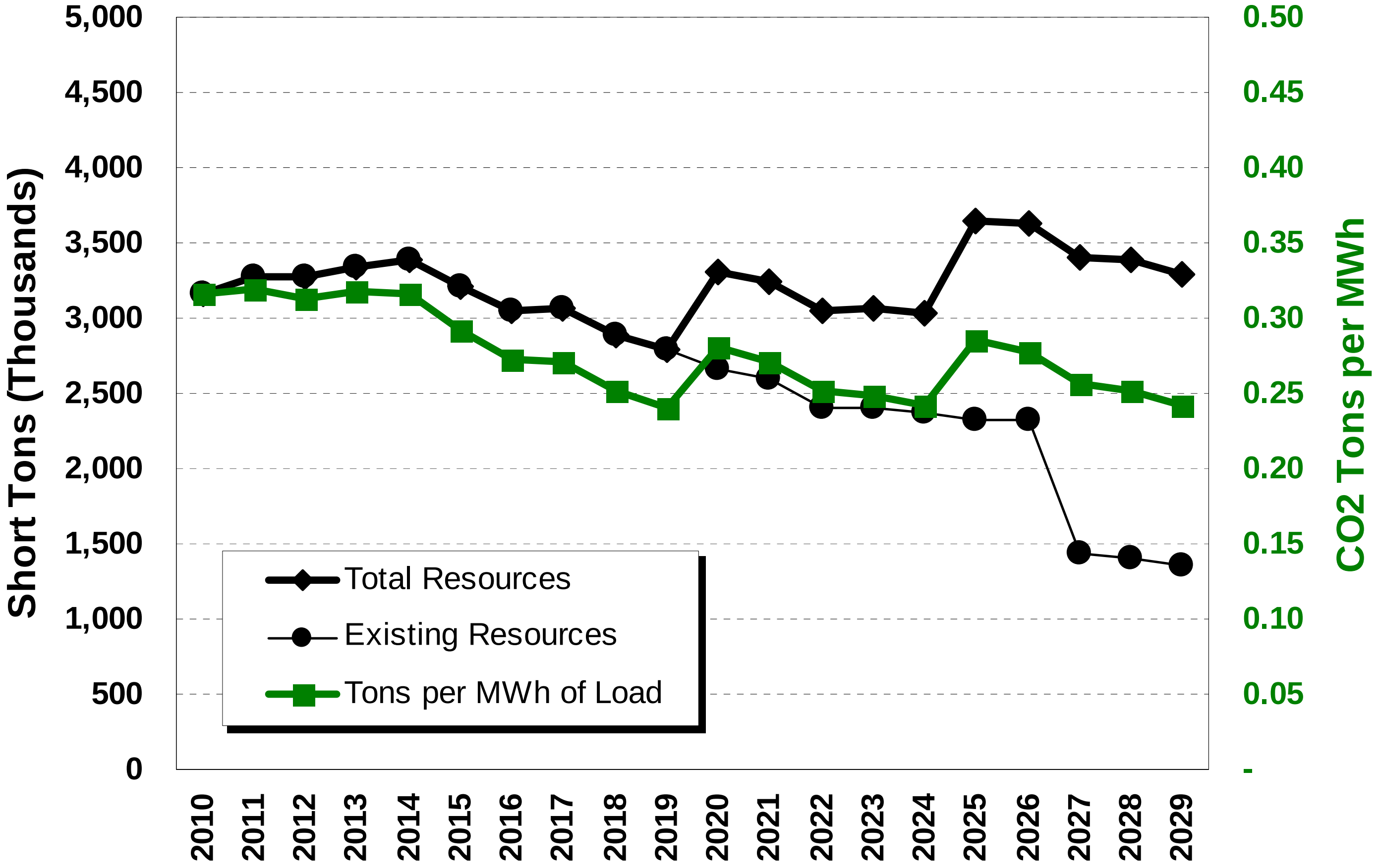
Greenhouse Gas Emissions



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Total Cost of Carbon Legislation

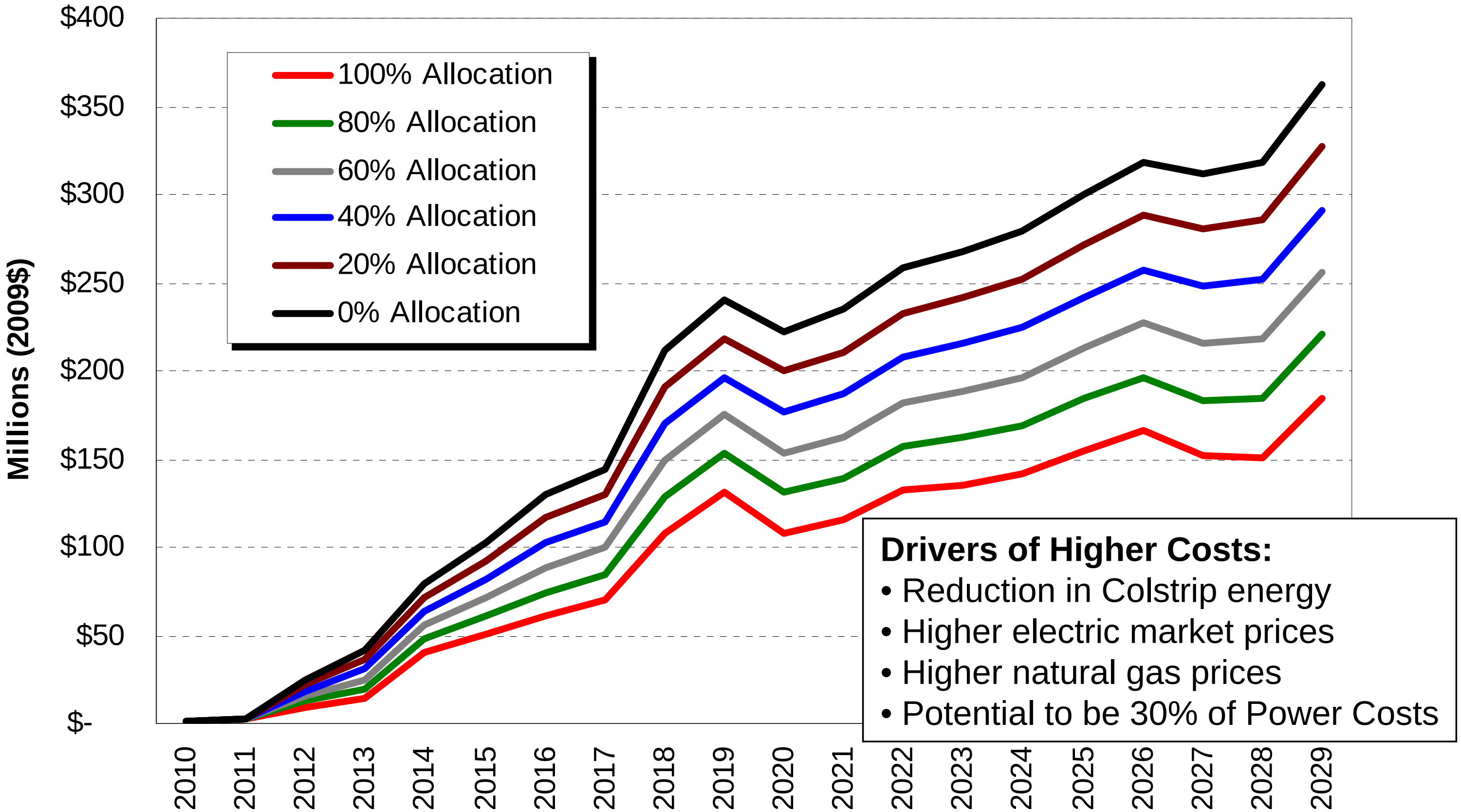

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Exhibit No. 4
Case Nos. AVU-E-12-08
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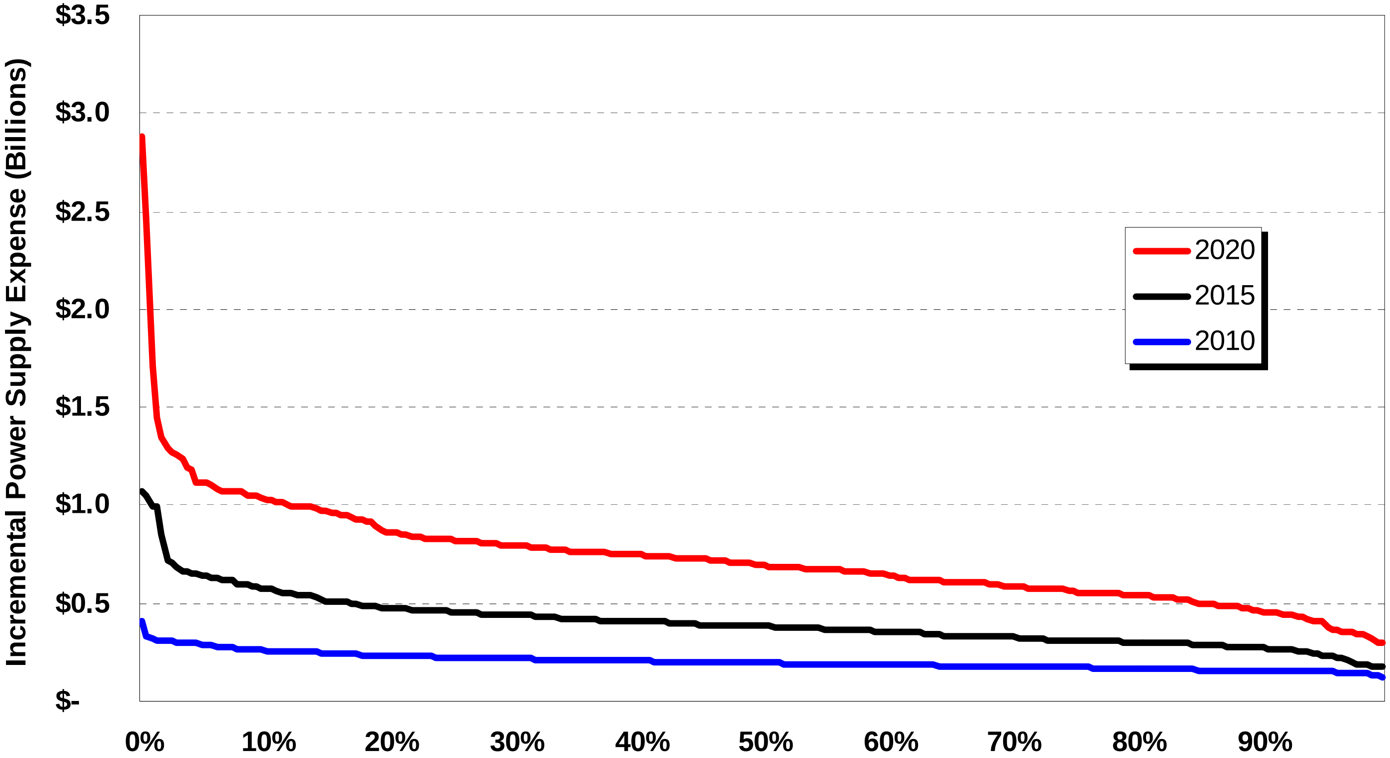
Portfolio Cost Duration Curve (2009$)



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Schedule 5, Page 521 of 729

Scenarios

James Gall & John Lyons

2009 Electric Integrated Resource Plan

Fifth Technical Advisory Committee Meeting

March 25, 2009

Market Scenarios

Market Futures (Stochastic)

- Base Case
- No Carbon Costs

Market Scenarios (Deterministic)

- High Natural Gas Prices
- Low Natural Gas Prices
- Solar Saturation (“Buck-a-Watt”)

No Carbon Cost Scenario

Avista Portfolio Cost versus Risk Analysis

Portfolios:

- Market reliance
- Build to capacity requirements
- Least cost strategy
- Efficient frontier

Avista Portfolio Scenarios

Fundamental Changes

- No State RPS
- Alternative load forecasts (High/Low)
- Least carbon emissions

Capital Cost Sensitivities

- Required capital cost to build wind in 2010
- Required capital cost to move from CCCT to SCCT

Resource Availability

- Large hydro upgrades, with capital cost sensitivities
- Other renewables (Biomass/Geothermal/Hydro Upgrades)
- Nuclear

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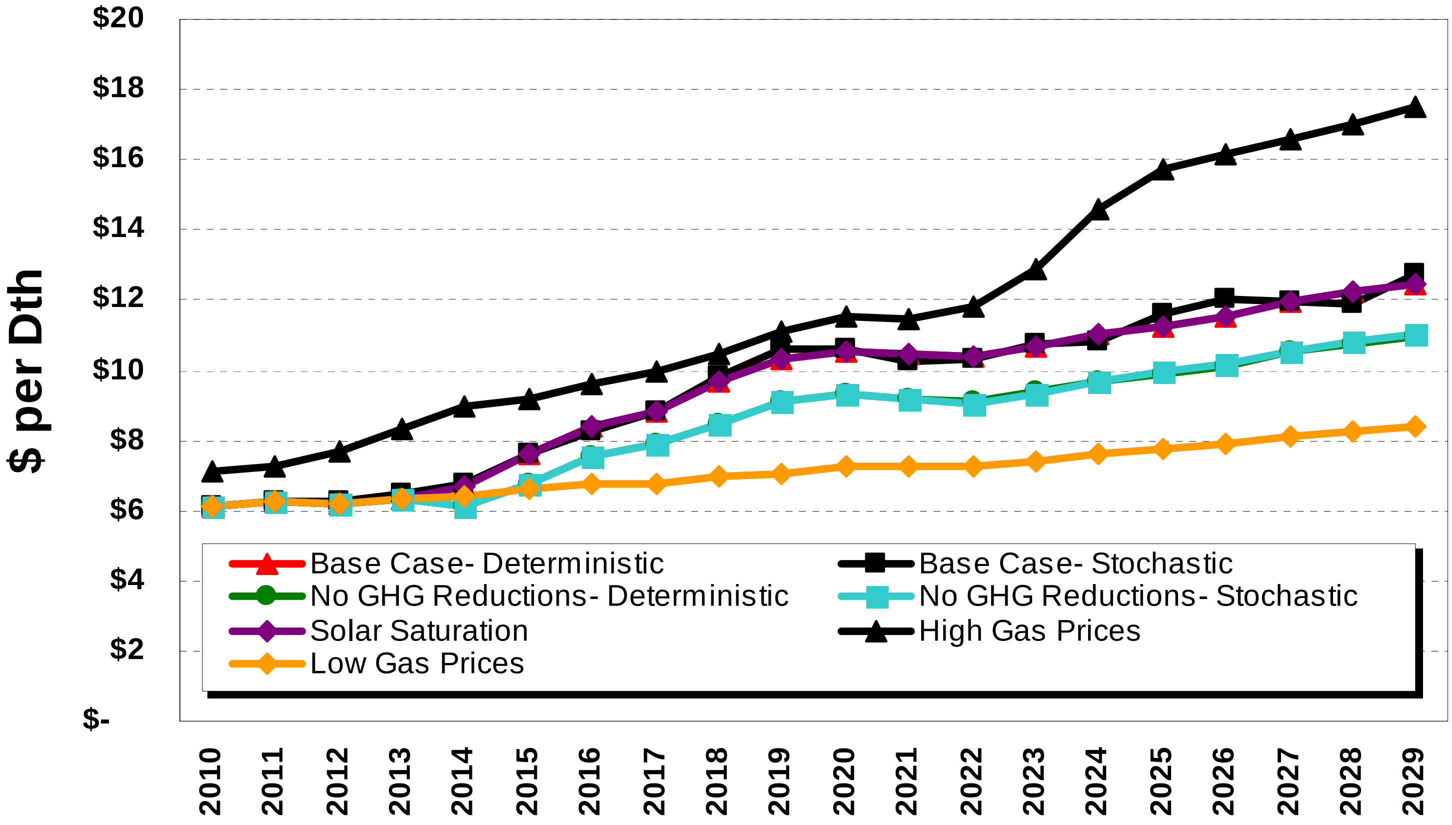
Market Scenarios

Malin Natural Gas Prices (Nominal $)



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Case Nos. AVU-E-12-08
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Schedule 5, Page 527 of 729

Malin Nominal Levelized Price Forecast (2010-2029)

Scenario	$/Dth
Base Case- Deterministic	$8.63
Base Case- Stochastic	$8.67
No GHG Reductions- Deterministic	$7.86
No GHG Reductions- Stochastic	$7.87
Solar Saturation	$8.63
High Gas Prices	$10.52
Low Gas Prices	$6.88
2007 IRP Base Case	$7.15
2007 Climate Stewardship Act Future	$7.15

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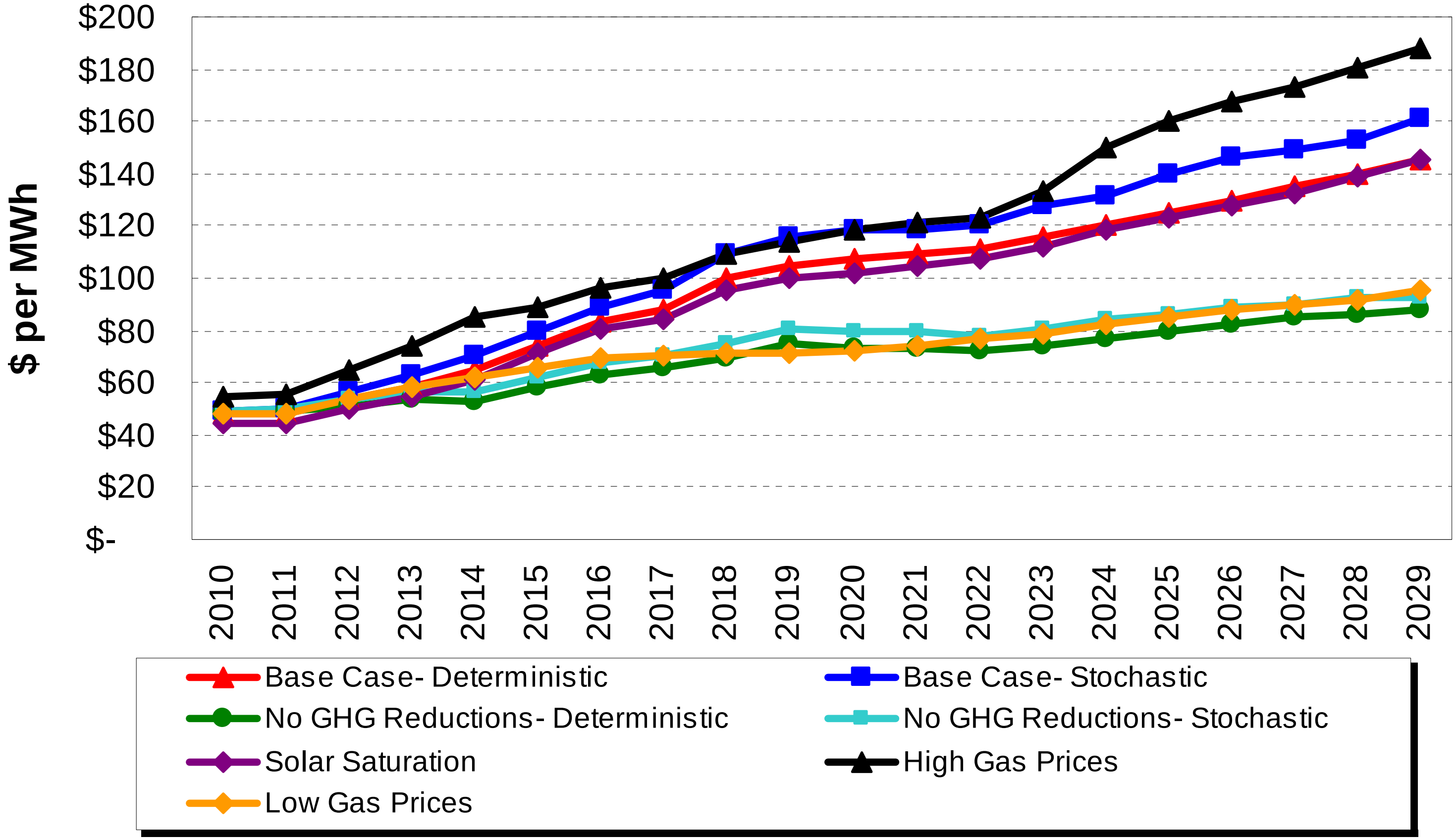
Mid-Columbia Electric Price Forecasts (2010-2029, Nominal $)



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Mid-Columbia Nominal Levelized Price Forecast

Scenario	$/MWh
Base Case- Deterministic	$86.36
Base Case- Stochastic	$93.74
No GHG Reductions- Deterministic	$63.93
No GHG Reductions- Stochastic	$68.22
Solar Saturation	$82.87
High Gas Prices	$102.61
Low Gas Prices	$67.48
2007 IRP Base Case	$62.16
2007 Climate Stewardship Act Future	$73.50

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More on Solar Saturation Scenario

- Reduce capital cost by 80%
- Increased solar energy in 2029 from 4,243 aMW to 20,486 aMW or 75 GW of capacity
- Reduced Western Interconnect fuel costs by 18% or $10 billion in 2029 or $36.4 billion (PV 2009$)
- Reduced 2029 power generation greenhouse gas emissions by 10%
- Small reduction in Q2 and Q3 on-peak power prices, although higher solar saturation rates could further reduce on-peak power prices

Implied Market Heat Rates

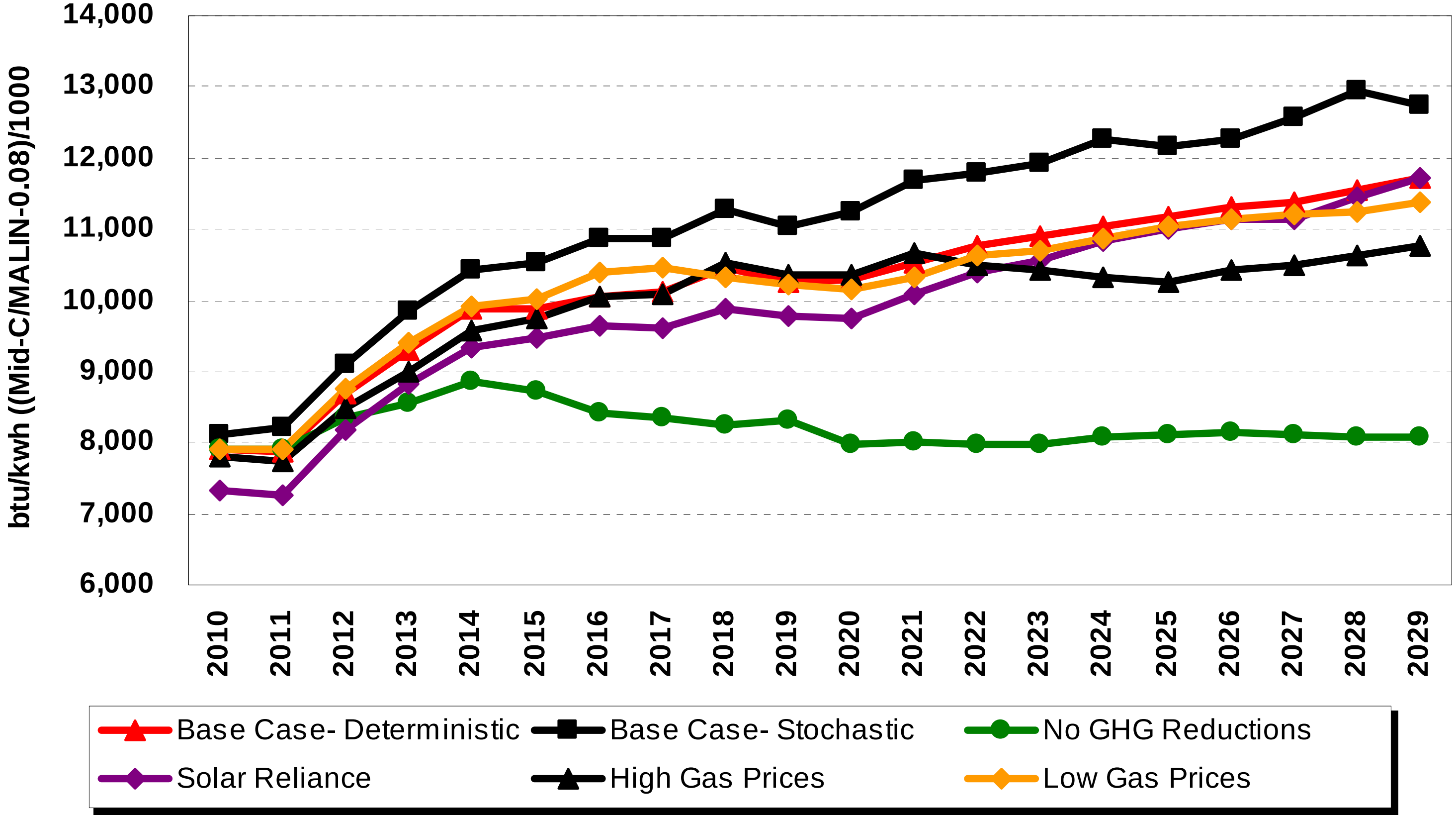

Exhibit No. 4
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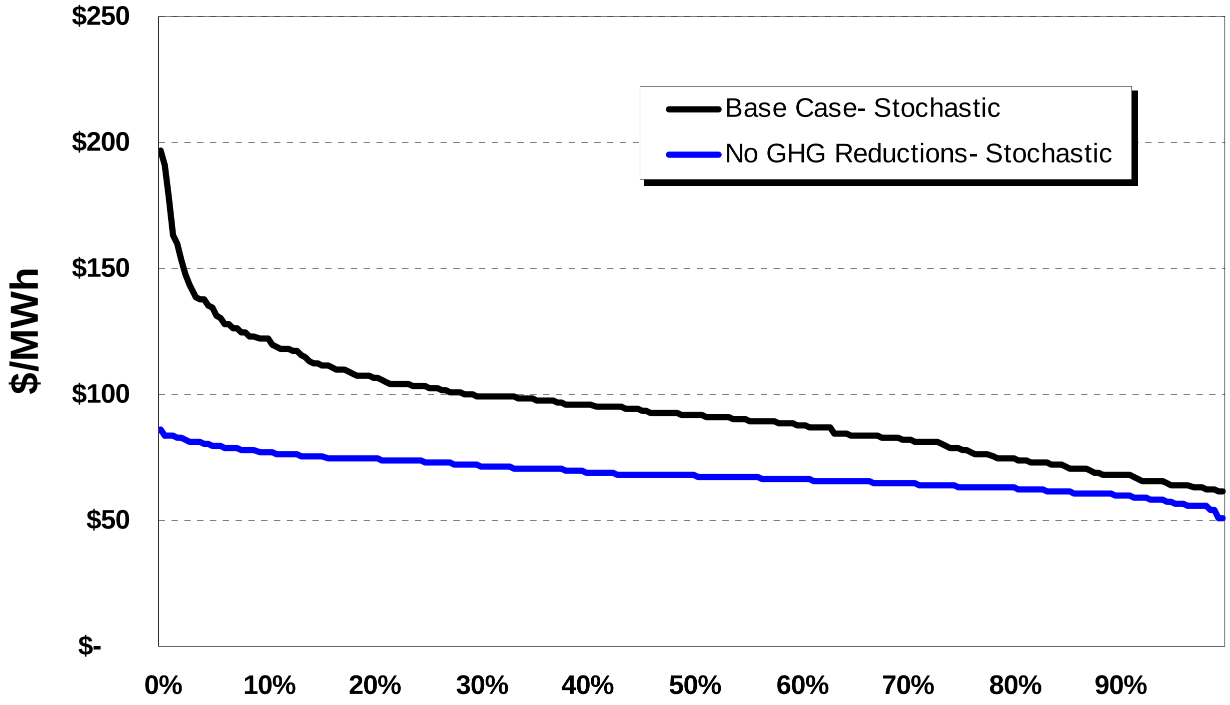
Schedule 5, Page 532 of 729

Mid-Columbia Levelized Price (2010-2029) Duration Curve



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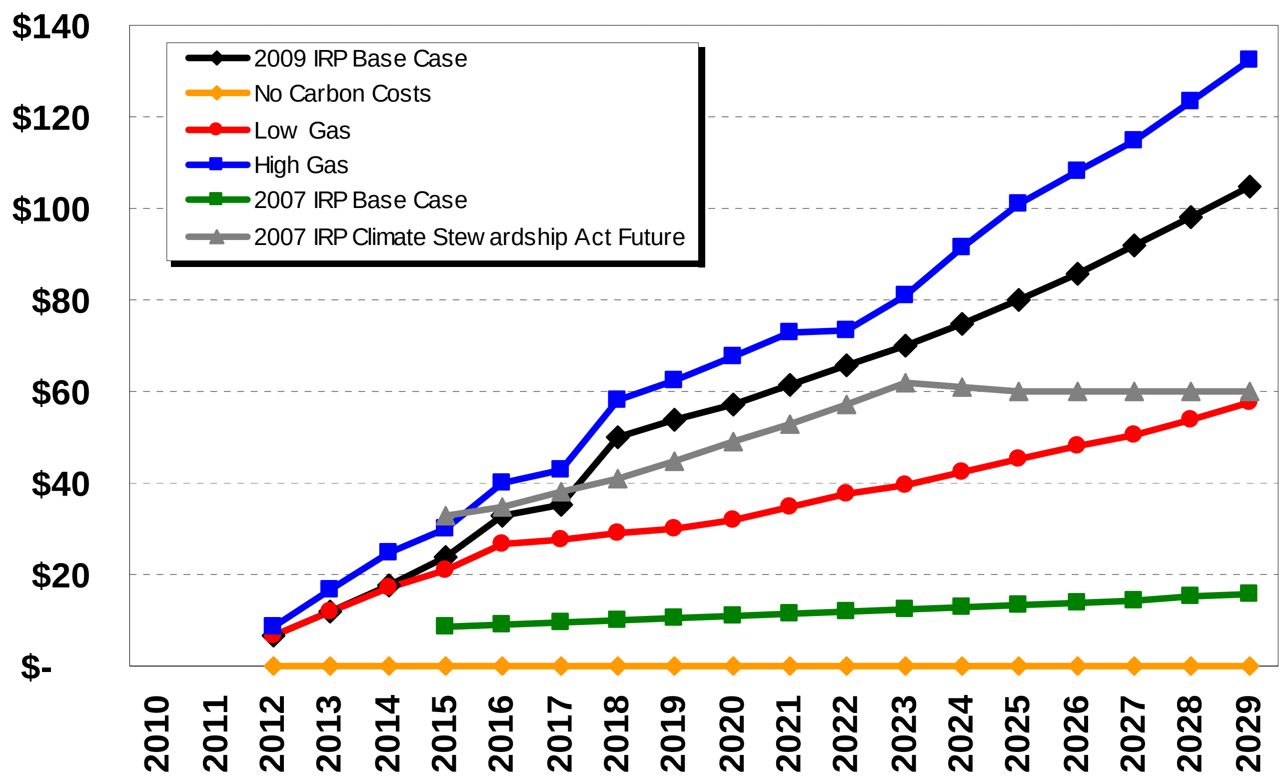
Schedule 5, Page 533 of 729

Greenhouse Gas Prices ($/Ton)



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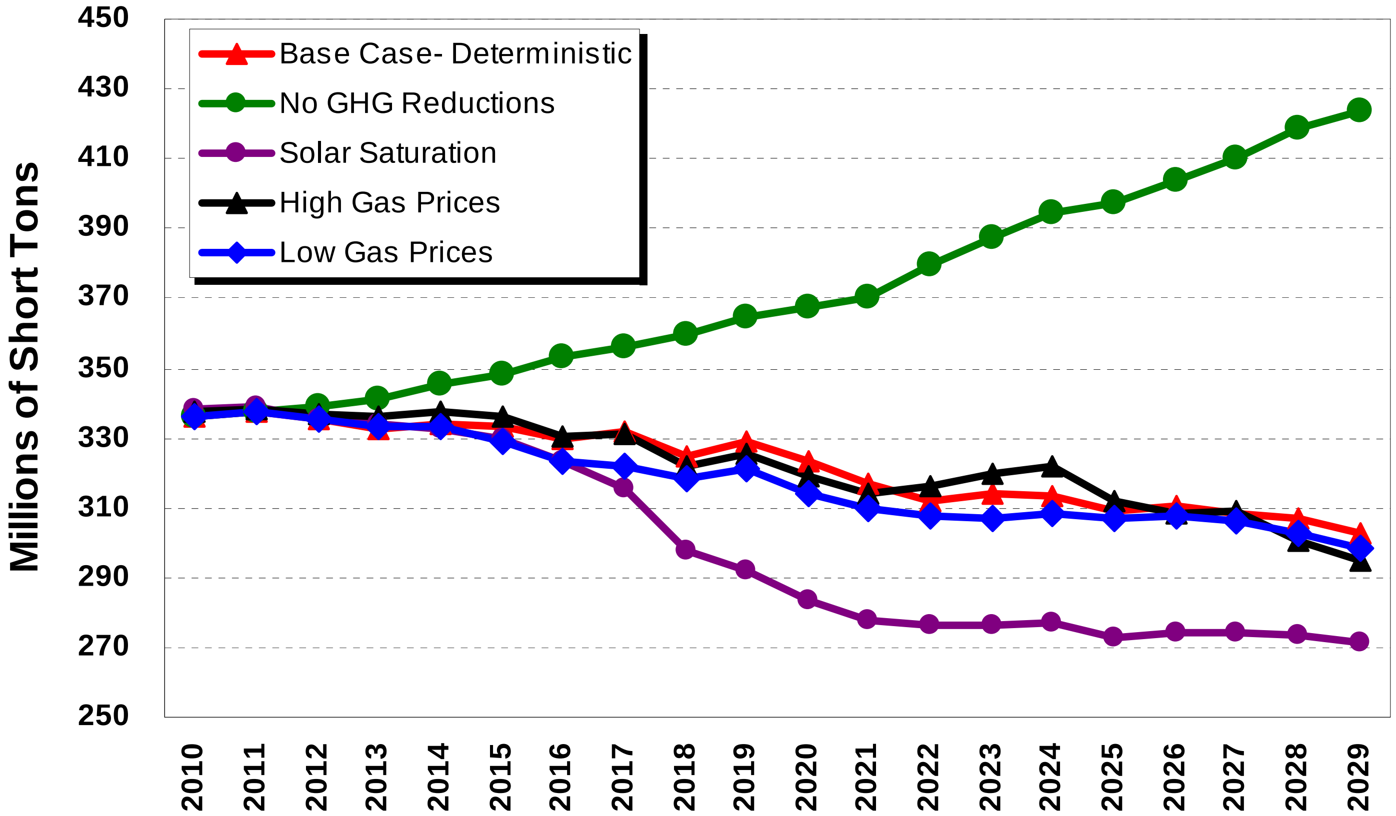
Schedule 5, Page 534 of 729

US WECC Greenhouse Gas Levels



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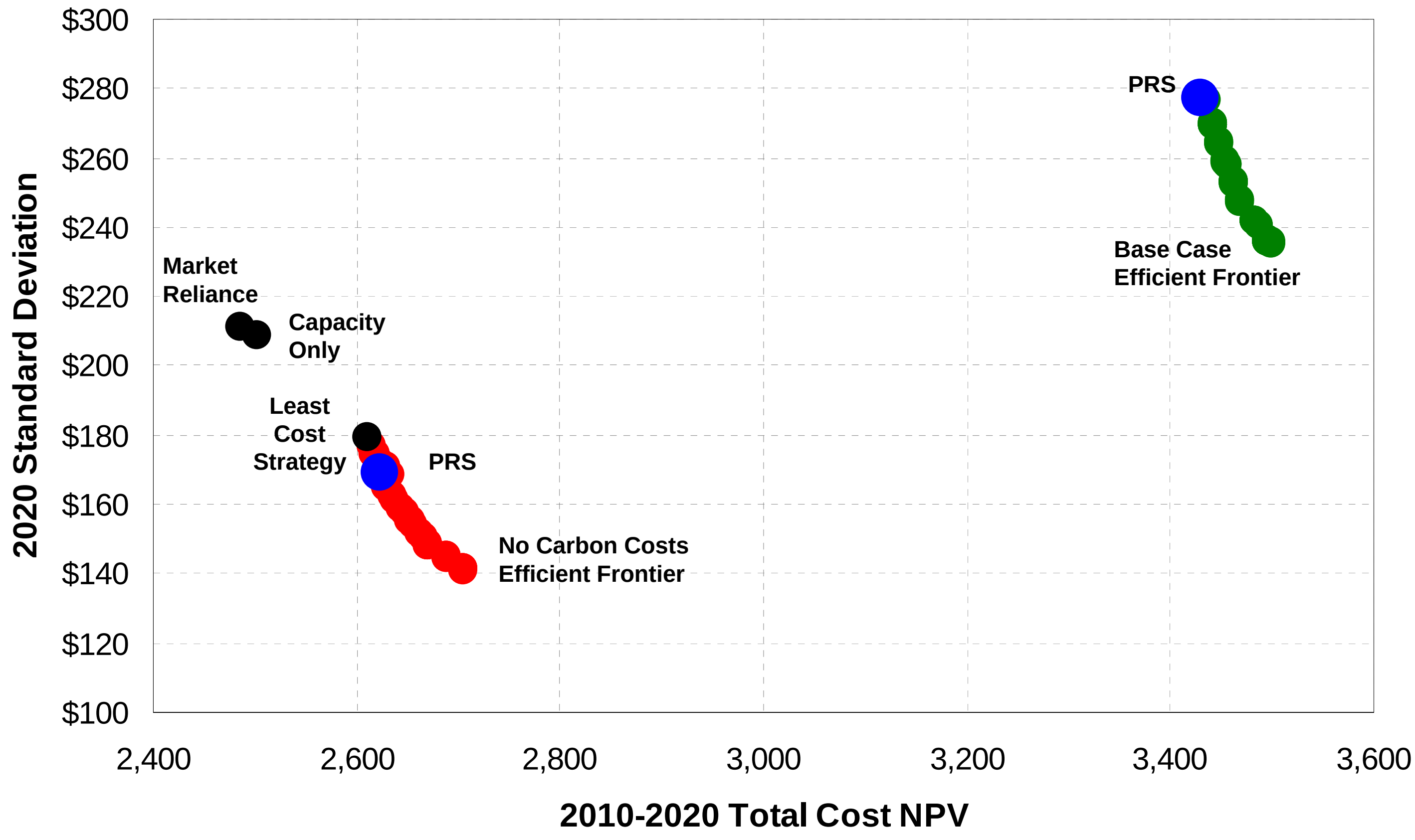
Schedule 5, Page 535 of 729

No Carbon Costs Scenario

No Carbon Costs Scenario



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Case Nos. AVU-E-12-08
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Schedule 5, Page 537 of 729

No CO_2 Costs: Least Cost Strategy (MW)

Year	CCCT	SCCT	Wind	Hydro Upgrades	Low Carbon Baseload	DSM	T&D Effic.
2010	-	-	-	-	-	12	1
2011	-	-	-	-	-	12	1
2012	-	-	-	-	-	12	1
2013	-	-	150	-	-	12	1
2014	-	-	-	-	-	14	1
2015	-	-	-	-	-	14	-
2016	-	-	-	-	-	15	-
2017	-	-	-	1	-	15	-
2018	-	-	-	-	-	15	-
2019	-	-	-	1	-	17	-
2020	-	200	150	-	-	17	-
2021	-	-	-	-	-	18	-
2022	-	-	-	2	-	18	-
2023	-	100	50	-	-	20	-
2024	-	-	-	-	-	20	-
2025	-	-	-	-	-	21	-
2026	-	100	-	-	-	21	-
2027	-	300	-	-	-	23	-
2028	-	-	-	-	-	23	-
2029	-	100	-	-	-	24	-
2010-2019	-	-	150	2	-	137	5
2010-2029	-	800	350	4	-	339	5

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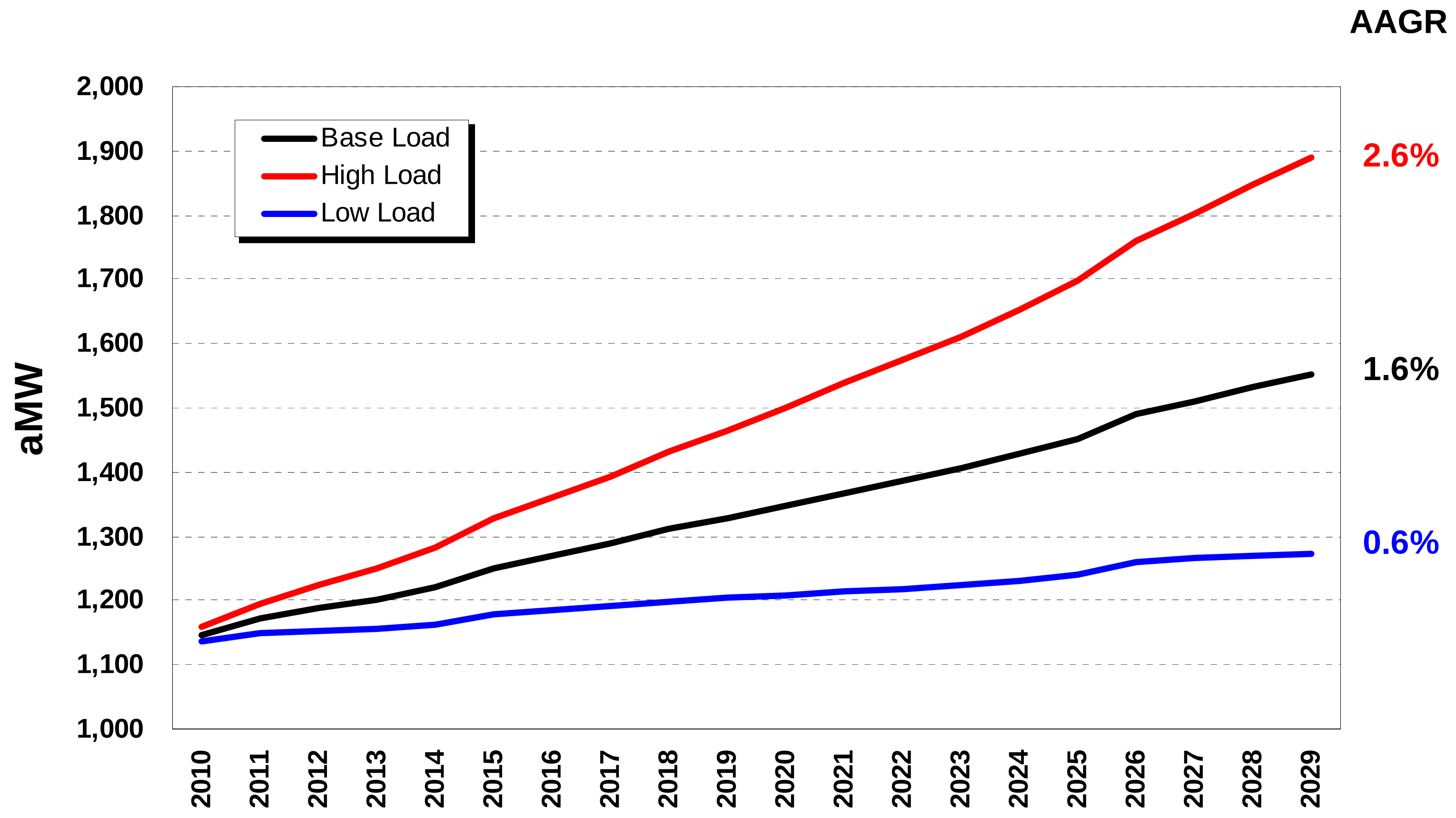
Schedule 5, Page 538 of 729

Fundamental Portfolio Changes

Alternative Load Forecasts (Energy)



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Schedule 5, Page 540 of 729

High Load Least Cost Strategy (MW)

Year	CCCT	SCCT	Wind	Hydro Upgrades	Low Carbon Baseload	DSM	T&D Effic.
2010	-	-	-	-	-	12	1
2011	-	-	-	-	-	12	1
2012	-	60	-	-	-	14	1
2013	-	-	200	-	-	14	1
2014	-	100	-	1	-	15	1
2015	-	-	-	1	-	15	-
2016	-	-	-	-	-	17	-
2017	-	-	-	1	-	17	-
2018	-	100	-	-	-	18	-
2019	-	-	-	-	-	18	-
2020	-	100	200	-	-	20	-
2021	250	-	-	2	-	20	-
2022	-	-	-	-	-	21	-
2023	-	-	50	-	-	23	-
2024	-	-	-	-	-	23	-
2025	250	-	50	-	-	24	-
2026	-	-	-	-	-	26	-
2027	500	-	-	-	-	27	-
2028	-	-	50	-	-	29	-
2029	-	-	-	-	-	29	-
2010-2019	-	260	200	3	-	150	5
2010-2029	1,000	360	550	5	-	389	5

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Low Load Least Cost Strategy (MW)

Year	CCCT	SCCT	Wind	Hydro Upgrades	Low Carbon Baseload	DSM	T&D Effic.
2010	-	-	-	-	-	12	1
2011	-	-	-	-	-	12	1
2012	-	-	-	-	-	12	1
2013	-	-	150	-	-	12	1
2014	-	-	-	1	-	14	1
2015	-	-	-	1	-	14	-
2016	-	-	-	-	-	15	-
2017	-	-	-	1	-	15	-
2018	-	-	-	-	-	15	-
2019	-	-	-	-	-	17	-
2020	-	-	100	-	-	17	-
2021	-	-	-	-	-	18	-
2022	-	-	-	-	-	18	-
2023	-	-	-	-	-	20	-
2024	-	-	-	-	-	20	-
2025	-	-	-	-	-	21	-
2026	250	-	-	-	-	21	-
2027	-	-	-	-	-	23	-
2028	-	100	-	-	-	23	-
2029	-	-	-	2	-	24	-
2010-2019	-	-	150	3	-	137	5
2010-2029	250	100	250	5	-	339	5

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Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 542 of 729

Least Avista Greenhouse Gas Emissions Scenario

- Model selected small renewable and hydro upgrades, simple cycle gas turbines and low carbon emitting resource (nuclear/carbon sequestration)
- Wind resources reduce Western Interconnect emissions, but likely would not significantly reduce Avista's greenhouse gas emissions
- Carbon reductions could be from retiring resources such as Colstrip and Coyote Springs 2

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Capital Cost Sensitivities

Wind Capital Cost Sensitivity

Starting Point: 150 MW Wind by December 31, 2012

- 50 MW Reardan ($2,423 per kW) [2009$: $2,262]
- 100 MW Generic Wind ($2,513 kW) [2009$: $2,183]
  - Assumes Avista can only take advantage of 90% of tax credit beginning in 2011, due to not enough tax liability

Scenario: At what capital cost does PRiSM select Reardan earlier?

- Model selected Reardan in 2010, if capital costs are less than $1,877 per kW [2009$: $1,832]

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CCCT Capital Cost Sensitivity

Starting Point: 250 MW CCCT beginning January 1, 2020

- Generic CCCT ($1,949 per kW) [2009$: $1,461]

Scenario: At what price is CCCT no longer preferred on a least cost basis, if SCCT cost remain equal.

- If cost are above ($2,051 per kW) [2009$: $1,535] the least cost strategy includes 300MW of LMS 100 in 2020-21
- Although, the 2020 standard deviation of power supply expense increases by 3.5%

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Resource Availability Scenarios

Large Hydro Upgrades

- Base Case does not include Cabinet Gorge Unit 5 or Long Lake 2nd PH/Unit 5 as options.
- These units were not considered options at this time, due to cost uncertainty.
- Assumption (2009$):
  - Cabinet Gorge 5: $1,478 kW
  - Long Lake U5: $2,168 kW
  - Long Lake 2nd PH: $2,000 kW

This analysis first allows these units to be available at estimated costs, then studies how cost change impacts the PRS.

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Least Cost Strategy:
With Large Hydro Options (MW)

Year	CCCT	SCCT	Wind	Hydro Upgrades	Low Carbon Baseload	DSM	T&D Effic.
2010	-	-	-	-	-	12	1
2011	-	-	-	-	-	12	1
2012	-	-	-	-	-	12	1
2013	-	-	150	-	-	12	1
2014	-	-	-	1	-	14	1
2015	-	-	-	1	-	14	-
2016	-	-	-	-	-	15	-
2017	-	-	-	1	-	15	-
2018	-	-	-	-	-	15	-
2019	-	-	-	-	-	17	-
2020	-	100	100	60	-	17	-
2021	250	-	-	-	-	18	-
2022	-	-	-	-	-	18	-
2023	-	-	50	-	-	20	-
2024	-	-	-	-	-	20	-
2025	-	-	-	-	-	21	-
2026	-	-	-	-	-	21	-
2027	400	-	-	-	-	23	-
2028	-	-	-	-	-	23	-
2029	-	-	-	2	-	24	-
2010-2019	-	-	150	3	-	137	5
2010-2029	650	100	300	65	-	339	5

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Least Cost Strategy With *Cabinet 4 and Long Lake 2nd PH (MW)*

Year	CCCT	SCCT	Wind	Hydro Upgrades	Low Carbon Baseload	DSM	T&D Effic.
2010	-	-	-	-	-	12	1
2011	-	-	-	-	-	12	1
2012	-	-	-	-	-	12	1
2013	-	-	150	-	-	12	1
2014	-	-	-	1	-	14	1
2015	-	-	-	61	-	14	-
2016	-	-	-	-	-	15	-
2017	-	-	-	1	-	15	-
2018	-	-	-	-	-	15	-
2019	-	-	-	-	-	17	-
2020	-	-	100	60	-	17	-
2021	250	-	-	-	-	18	-
2022	-	-	-	-	-	18	-
2023	-	-	50	-	-	20	-
2024	-	-	-	-	-	20	-
2025	-	-	-	-	-	21	-
2026	-	-	-	-	-	21	-
2027	400	-	-	-	-	23	-
2028	-	-	-	-	-	23	-
2029	-	-	-	2	-	24	-
2010-2019	-	-	150	63	-	137	5
2010-2029	650	-	300	125	-	339	5

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Large Hydro Upgrade Capital Cost Analysis

Long Lake 2nd Powerhouse is favored by PRiSM, due to larger capacity size and similar cost per MWh

- The plant is selected as least cost resource until the cost reaches $2,150 kW

Cabinet Gorge U5 is not selected as a least cost resource, due to low capacity factor, if costs were less than $1,100 per kW, the plant would be selected

While these resources have capital cost uncertainty, they are a viable alternative to reduce carbon emissions

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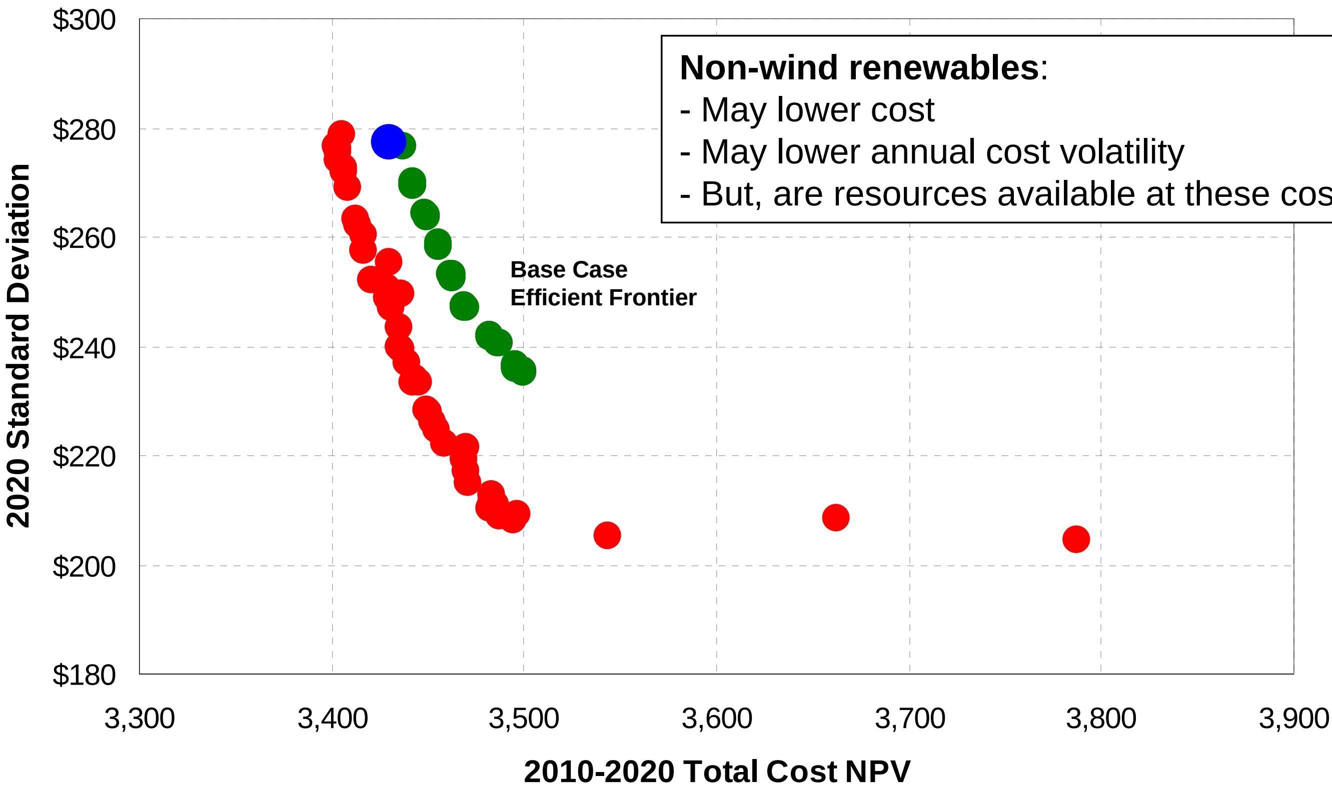
Non-Wind Renewable Resources Available



Non-wind renewables:
- May lower cost
- May lower annual cost volatility
- But, are resources available at these costs?

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Least Cost Strategy- Small Renewables Available (MW)

Year	CCCT	SCCT	Wind	Non-Wind Renewable	Hydro Upgrades	Low Carbon Baseload	DSM	T&D Effic.
2010	-	-	-	-	-	-	12	1
2011	-	-	-	-	-	-	12	1
2012	-	-	-	10	-	-	12	1
2013	-	-	100	5	-	-	12	1
2014	-	-	-	5	1	-	14	1
2015	-	-	-	-	-	-	14	-
2016	-	-	-	-	1	-	15	-
2017	-	-	-	-	1	-	15	-
2018	-	-	-	5	-	-	15	-
2019	-	-	-	-	-	-	17	-
2020	-	100	100	7	2	-	17	-
2021	250	-	-	-	-	-	18	-
2022	-	-	-	-	-	-	18	-
2023	-	-	-	-	-	-	20	-
2024	-	-	50	-	-	-	20	-
2025	-	-	-	-	-	-	21	-
2026	-	-	-	-	-	-	21	-
2027	400	-	-	-	-	-	23	-
2028	-	-	-	-	-	-	23	-
2029	-	-	-	-	-	-	24	-
2010-2019	-	-	100	25	3	-	137	5
2010-2029	650	100	250	32	5	-	339	5

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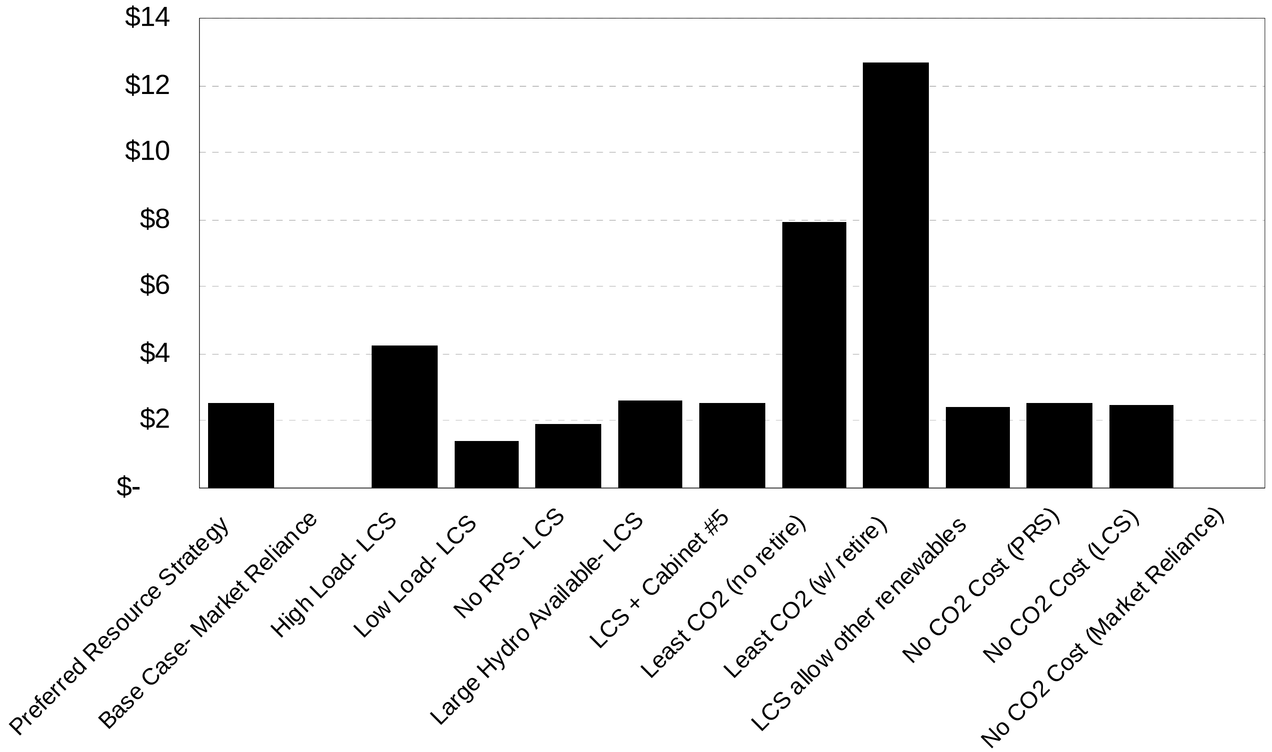
Nuclear

If Nuclear was allowed as a resource beginning in 2020 at a 2009$ capital cost of $5,500 per kW in 250 MW sizes.

- At this cost it would not be selected in the Least Cost Strategy.
- Although, if costs were $3,800 per kW the resource would be selected
- If Avista were to acquire the plant in 100MW quantities it would be least cost at $4,000 per kW.

Capital Expense in Billions Dollars
(Nominal 2010-29)



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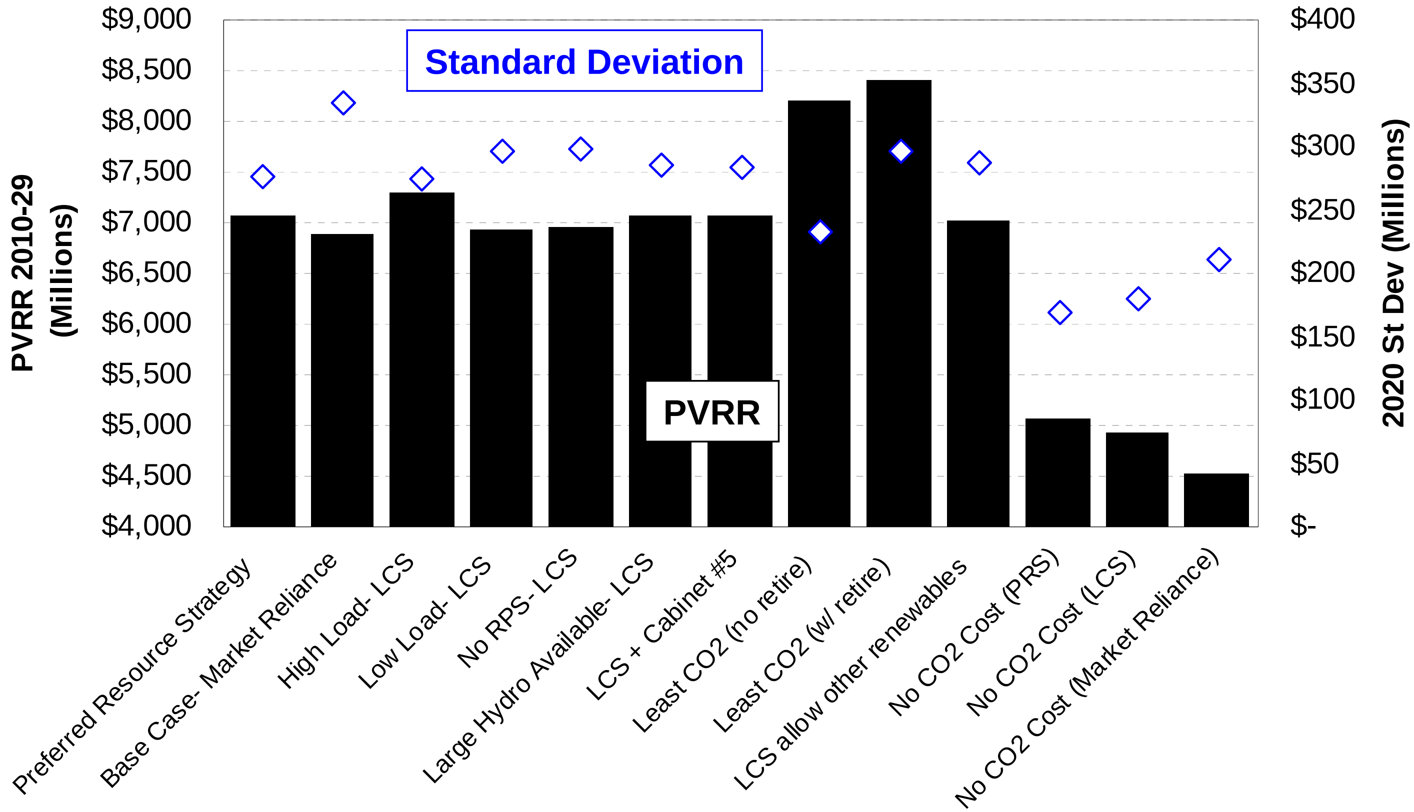
Schedule 5, Page 555 of 729

Portfolio Cost/Risk Comparison



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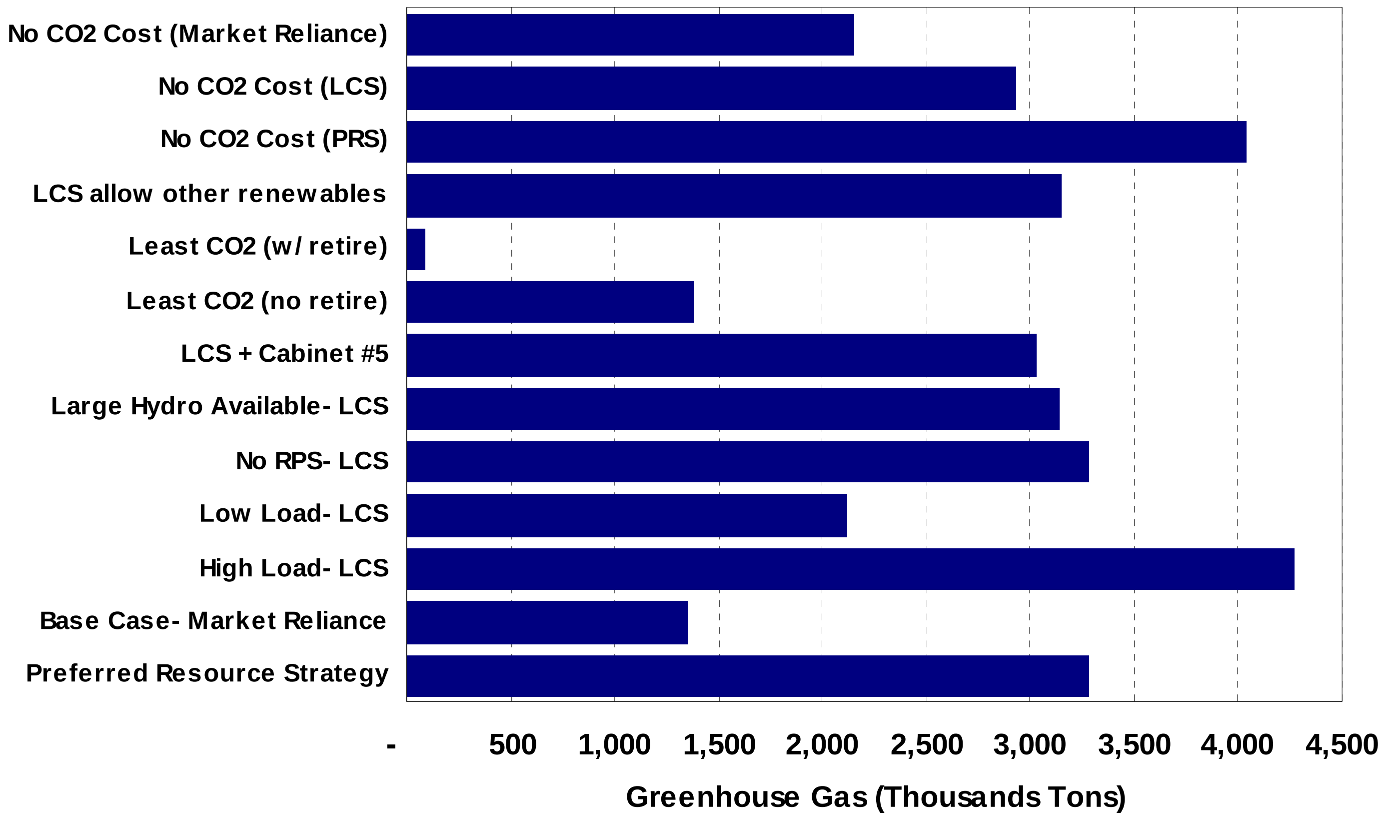
Schedule 5, Page 556 of 729

Avista Greenhouse Gas Emissions (2029)



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Schedule 5, Page 557 of 729

2009 IRP Topics

John Lyons

2009 Electric Integrated Resource Plan
Fifth Technical Advisory Committee Meeting
March 25, 2009

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Executive Summary

- Resource needs
- Modeling and results
- Electricity and natural gas market price forecasts
- Demand side management
- Preferred Resource Strategy
- Environmental issues
- Action items

Introduction & Stakeholder Involvement

- IRP process
- Public involvement
- 2009 IRP chapter overview

Loads and Resources

- Economic forecast
- Load forecast
- Forecast scenarios
- Overview of current resources
- Planning margins and resource requirements

Demand Side Management

- Overview of DSM programs
  - Historical
  - Residential
  - Commercial and Industrial
- DSM programs for 2009 IRP
  - Programs considered
  - Analytics
  - DSM business plan and future commitments

Environmental Issues

- Environmental initiatives and policies
- Avista's Climate Change Committee
- State and federal renewable portfolio standards issues
- State and federal greenhouse gas legislation

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Transmission & Distribution Planning

- Overview of Avista's transmission system
- Regional transmission issues
- Transmission cost estimates
- Distribution efficiency projects
- Transmission efficiency projects

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Modeling Approach

- Market modeling
- Key assumptions and inputs
  - Hydro
  - Fuel prices: coal and natural gas
  - Emissions: SO_2, NO_x and greenhouse gases
  - Risk modeling
  - Resource alternatives
- PRiSM model

Market Modeling Results

- Base Case
- Market Scenarios
- Portfolio Scenarios
  – Fundamental changes
  – Capital cost sensitivities
  – Resource availability

Preferred Resource Strategy

- 2009 Preferred Resource Strategy
- Comparisons with prior plans
- Portfolio strategies and performance across scenarios

2009 IRP Action Items

- Progress on 2007 IRP Action Items
- 2009 Action Items
  - Renewables
  - DSM
  - Greenhouse gas issues
  - Modeling and forecasting enhancements
  - Transmission planning

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Avista's 2009 Electric Integrated Resource Plan

Technical Advisory Committee Meeting No. 6 Agenda

June 24, 2009

	Topic	Time	Staff
1.	Introductions	10:00	Storro
2.	IRP Section Highlights	10:05	Kalich
3.	Preferred Resource Strategy	10:30	Gall
4.	Lunch	11:30	
5.	Preferred Resource Strategy	12:30	Kalich/Gall
6.	IRP Action Items	1:30	Lyons
7.	Adjourn	2:00	

Draft Chapter Highlights

Loads & Resources

- Weak economic growth is expected until 2011 in the service territory.
- Historic conservation acquisitions are included in the load forecast; higher acquisition levels anticipated in this IRP reduce the load forecast further.
- Annual electricity sales growth from 2010-2020 averages 1.6 percent over the next decade (199 aMW) and 1.8 percent over the entire 20-year forecast.
- Peak loads are expected to grow at 1.6 percent annual rate over the next 10 years (312 MW) and also 1.6 percent over the entire 20-year forecast.
- Avista's resource deficits begin 2018; without conservation resources deficits would begin in 2016.
- Capacity deficiencies now are the predominate driver of resource need.

Energy Efficiency

- Avista has offered conservation programs for over 30 years.
- The Company has acquired 138.5 aMW of electric-efficiency in the past three decades; an estimated 109 aMW is still in service, reducing overall load by approximately 10 percent.
- 20,000 additional customers heat their homes with natural gas today because of Avista's first fuel-switching program.
- The Company has developed and maintains the infrastructure necessary to respond quickly to an energy efficiency ramp-up if another energy crisis or opportunity occurs.
- Approximately 3,000 concepts were evaluated by Avista's demand-side management analysts for the 2009 IRP.
- 7 aMW of local and 2.9 aMW of regional conservation is expected in 2010
- Conservation additions provide 26 percent of new supplies through 2020.
- 2009 IRP includes 0.3 aMW (3.3%) more annual conservation acquisition than 2007 plan, building on a 50% increase in the 2005 and another 25% in the 2007 IRP.

Transmission & Distribution

- Avista has completed a $130 million transmission improvement project.
- Avista has over 2,200 miles of high voltage transmission.
- Avista remains actively involved in regional transmission planning efforts.
- The cost of selected new transmission lines and upgrades are included in the 2009 Preferred Resource Strategy.
- 2.7 aMW of distribution efficiencies are included in this IRP.

Generation Resource Options

- Only resources with well known costs were considered in the PRS analysis, other resources were studied in sensitivities.
- Federal tax credits were extended to 1/1/2013 for wind and 1/1/2014 for non-wind renewables with a choice of the PTC ($20/mwh or 30% ITC)
- Large hydro upgrades at Long Lake and Cabinet Gorge are not considered as new resources, but will be further studied for inclusion in the 2011 IRP analysis.
- Small hydro upgrades and wood fired upgrades were considered in this IRP.
- Solar is included as resource option for this first time.

Market Analysis

- Mid-Columbia electric and Malin natural gas prices are 27 and 20 percent higher than the 2007 IRP, primarily due to carbon legislation impacts
- Mid-Columbia electric prices are expected to be $79.56 per megawatt-hour over the next 20 years
- Malin natural gas prices are expected to be $7.36 per decatherm over the next 20 years
- Gas-fired resources continue to serve most new loads and take the place of coal generation to reduce greenhouse gas emissions
- Future carbon credit prices will depend on reduction goals and the differential between natural gas and coal prices
- Carbon legislation increases total fuel expenses in the Western Interconnect by over 16 percent

Preferred Resource Strategy

- Avista's physical energy needs begin in 2018; capacity needs begin in 2016.
- Near-term resource acquisitions are driven by pending environmental regulation and risk reduction.
- The first supply-side resource acquisitions are 150 MW of wind by 2012.
- Conservation additions provide 26 percent of new supplies through 2020.
- A 250 MW natural gas-fired combined cycle project is required by 2020.
- Large hydro upgrades have the potential to change the preferred resource mix.
- The 2020 CCCT acquisition could be moved forward to as soon as 2015 without a significant impact on the preferred resource strategy.

Draft Action Items Highlights

Resource Additions & Analysis

- Continue to explore the potential for wind and non-renewable resources.
- Issue an RFP for turbines at Reardan and up to 100 MW of wind or other renewables in 2009.
- Finish studies regarding the costs and environmental benefits of the large hydro upgrades at Cabinet Gorge, Long Lake, Post Falls, and Monroe Street.
- Study potential locations for the natural gas fired resource identified to be on-line between 2015 and 2020.

Demand Side Management

- Pursue American Reinvestment and Recovery Act funding and its affect on the amount of low income weatherization.
- Analyze and report on the results of the July 2007 through December 2009 demand response pilot in Moscow and Sandpoint.

Environmental Policy

- Continue to study the potential impact of state and federal climate change legislation.
- Continue and report on the work of Avista's Climate Change Committee.

Modeling and Forecasting Enhancements

- Refine the stochastic model for cost driver relationships.
- Continue to refine the PRiSM model.
- Continue developing Loss of Load Probability and Sustained Peaking analysis for inclusion in the IRP process

Transmission Planning

- Work to maintain/retain existing transmission rights on the Company's transmission system, under applicable FERC policies, for transmission service to bundled retail native load.
- Continue involvement in BPA transmission practice processes and rate proceedings to minimize costs of integrating existing resources outside of the company's service area.
- Continue participation in regional and sub-regional efforts to establish new regional transmission structures (ColumbiaGrid and other forums) to facilitate long-term expansion of the regional transmission system.
- Evaluate costs to integrate new resources across Avista's service territory and from regions outside of the Northwest.
- Further study and implement distribution feeder rebuild projects to reduce system losses.
- Study transmission re-configurations to economical reduce system losses.

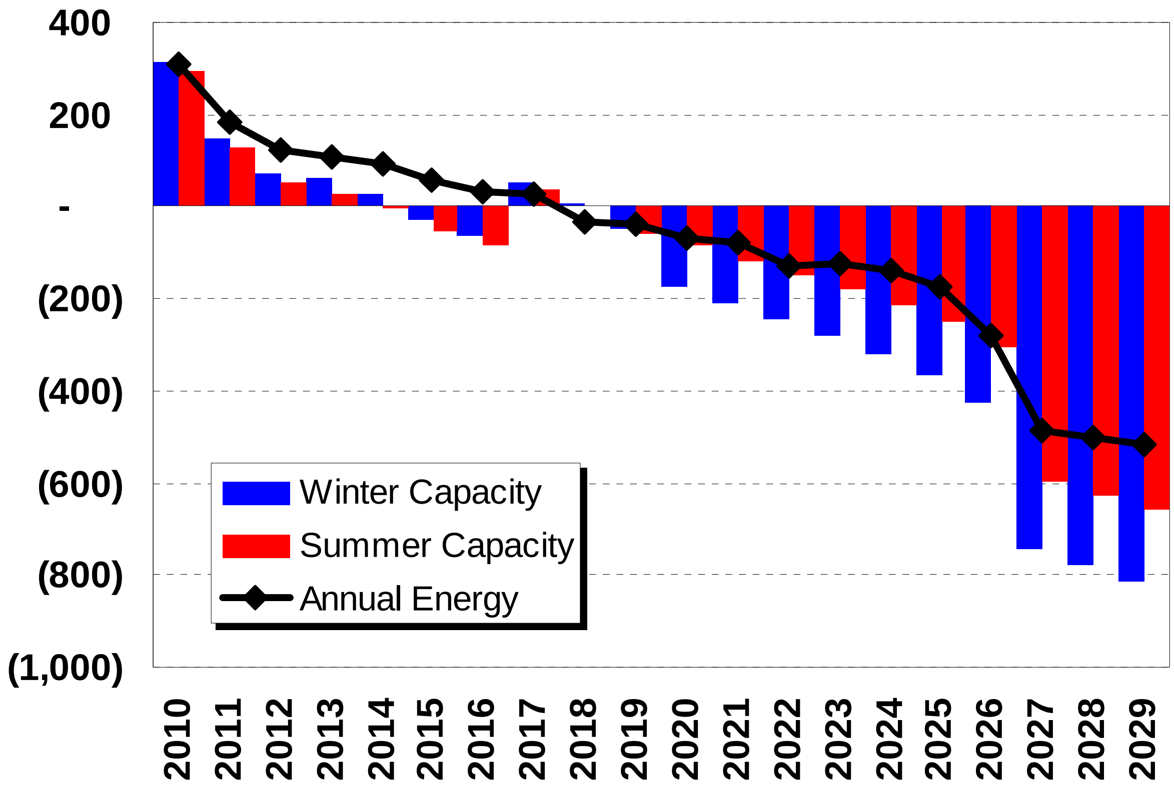
2009 IRP
Preferred Resource Strategy

2009 Electric Integrated Resource Plan

Sixth Technical Advisory Committee Meeting

June 24, 2009

L&R Balances



Load is net 2007 Conservation Levels

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Preferred Resource Strategy Approach

Least Cost Strategy that meets

1. Capacity Needs
2. Energy Needs
3. RPS Requirements
4. Conservation Requirements
5. Emissions Regulation
6. Actionable

Flexible Strategy

Preferred Resource Strategy

But, what if?

- Capital Costs Change
- Load Growth Rate Changes
- Large Hydro Upgrades Are Cost Effective
- Non-Wind Renewables Become Abundant
- Is Nuclear a Solution

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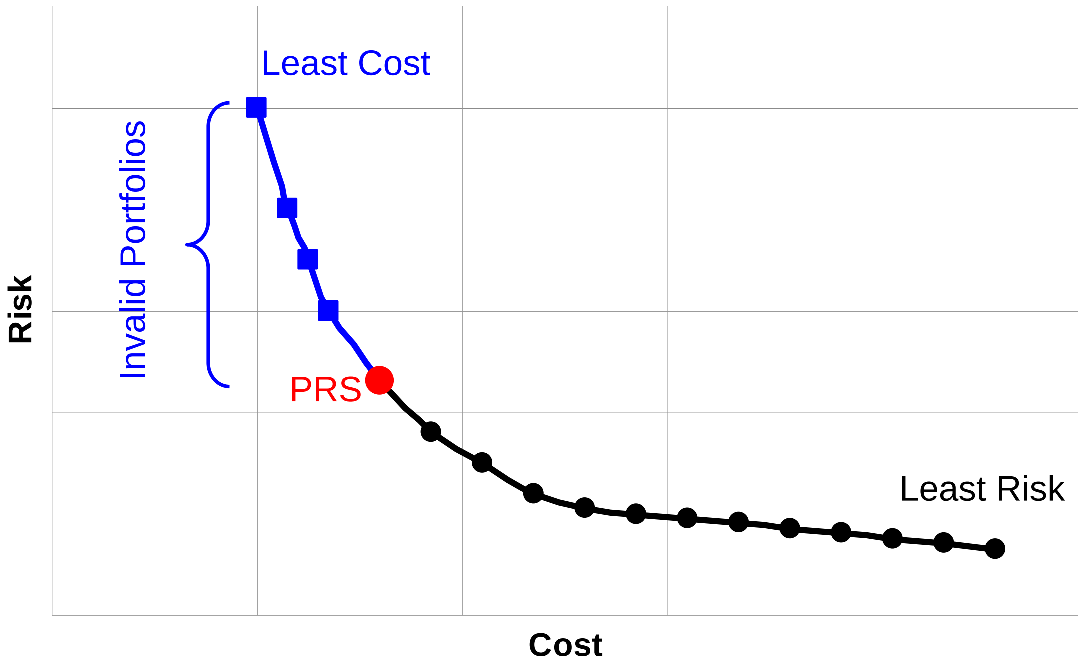
Conceptual Efficient Frontier



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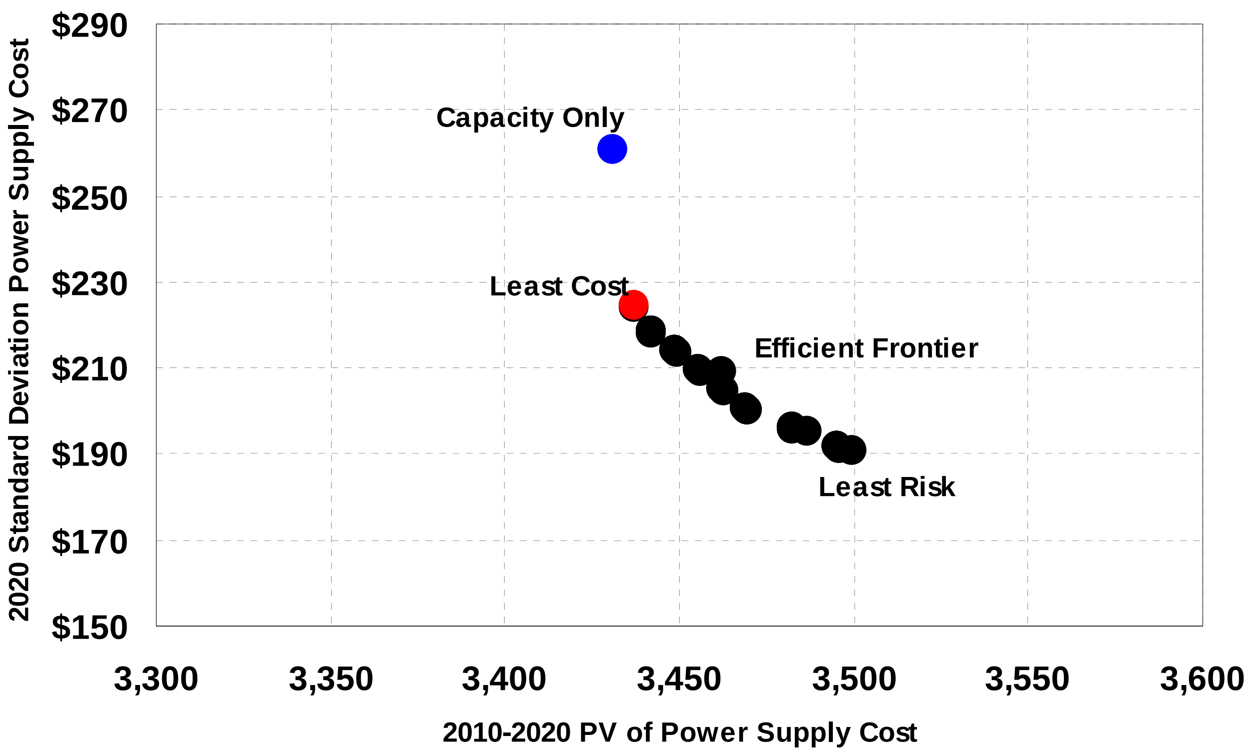
Schedule 5, Page 577 of 729

Efficient Frontier



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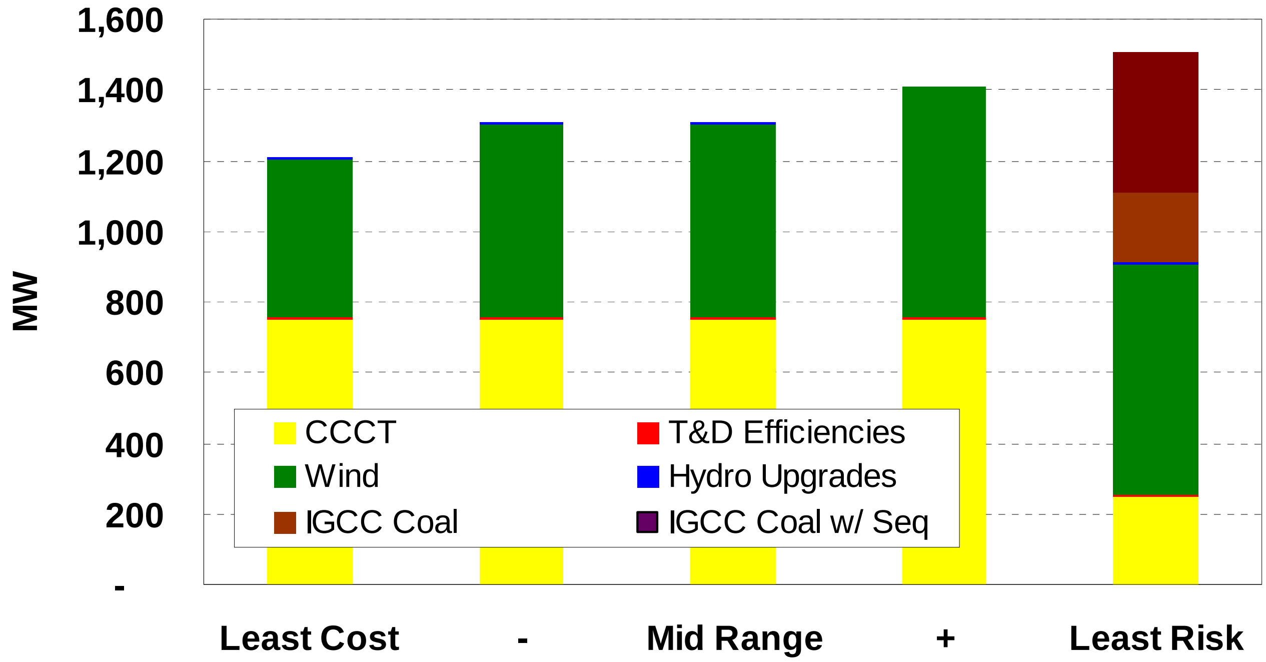
Efficient Frontier Portfolios



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2009 Preferred Resource Strategy

Resource	By the End of Year	Nameplate (MW)	Energy (aMW)
NW Wind	2012	150.0	50.0
Distribution Efficiencies	2010-2015	5.0	2.0
Little Falls 1	2013	1.0	0.3
Little Falls 2	2014	1.0	0.3
Little Falls 4	2016	1.0	0.3
NW Wind	2019	150.0	50.0
CCCT	2019	250.0	225.0
Upper Falls	2020	2.0	1.0
NW Wind	2022	50.0	17.0
CCCT	2024	250.0	225.0
CCCT	2027	250.0	225.0
Conservation	All Years	339.0	226.0
Total		**1,449.0**	**1,019.9**

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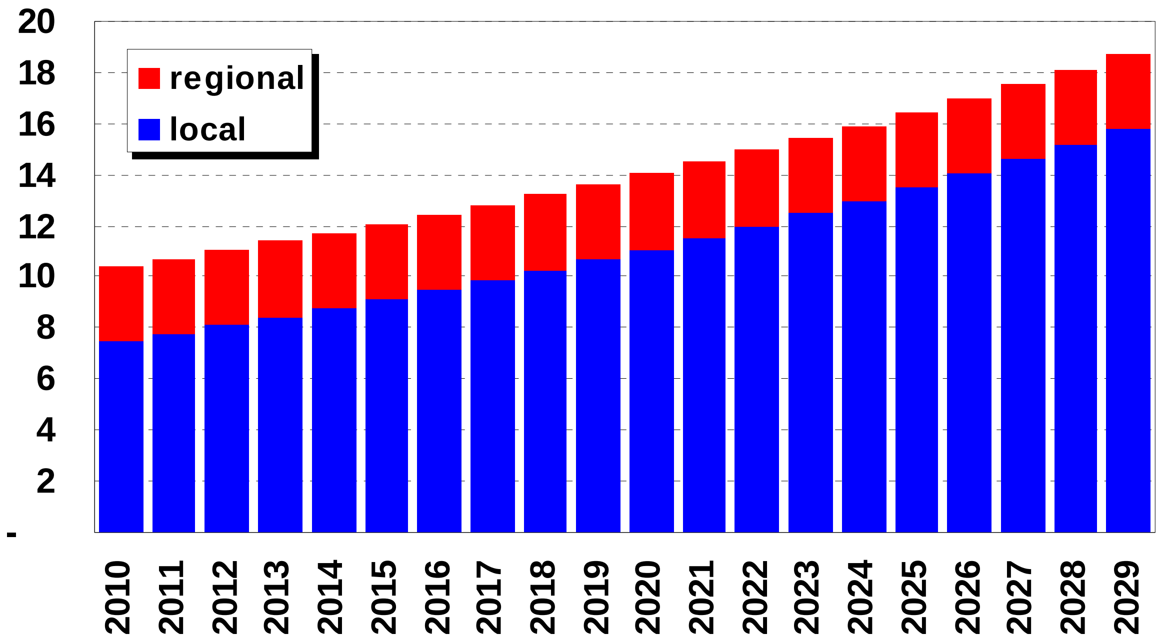
Annual Conservation Acquisition



Local
90 aMW over first 10 years
226 aMW over 20 years

Regional
29 aMW over first 10 years
59 aMW over 20 years

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Local Energy Efficiency Targets

Portfolio	2010 Target	2011 Target
Limited Income Residential	1,977,099	2,056,183
Residential	20,518,584	21,339,327
Prescriptive Non-Residential	18,211,396	18,939,852
Site-Specific Non-Residential	24,936,765	25,934,236
Total Local Acquisition (kWh)	**65,643,844**	**68,269,598**
Local	7.5	7.8
Regional	2.9	2.9
Total Acquisition (aMW)	**10.4**	**10.7**
Draft NPCC 6th Plan Goal	11.2	12.4

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Rate Base Additions for Capital Expenditures (Millions)

Year	Investment	Year	Investment
2010	4.9	2020	942.1
2011	5.0	2021	10.6
2012	5.1	2022	0.0
2013	278.1	2023	163.3
2014	7.7	2024	0.0
2015	2.3	2025	542.0
2016	0.0	2026	0.0
2017	1.7	2027	0.0
2018	0.0	2028	571.6
2019	0.0	2029	0.0

Totals *
$0.3 billion thru 2019
$2.5 billion thru 2029 **

* Excludes conservation funding
** $1.0 billion NPV @ 8% discount rate

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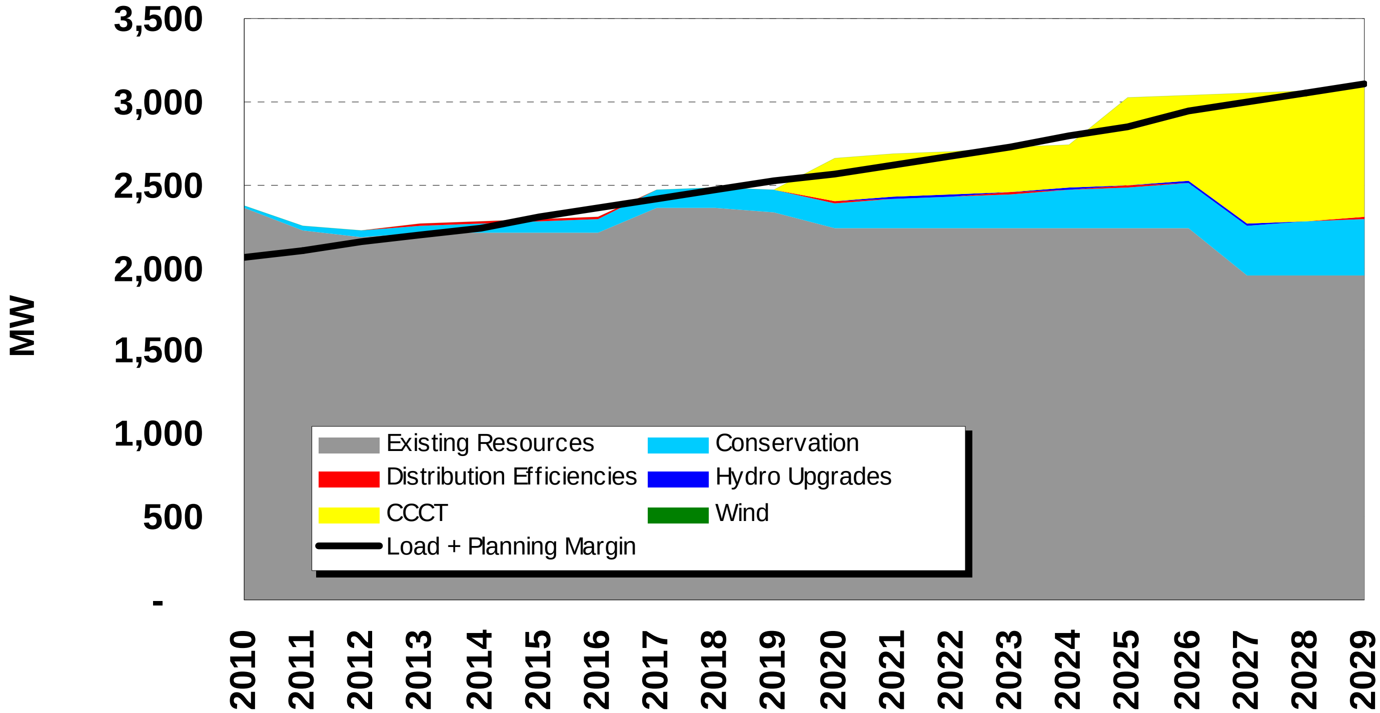
January Capacity L&R w/ New Resources



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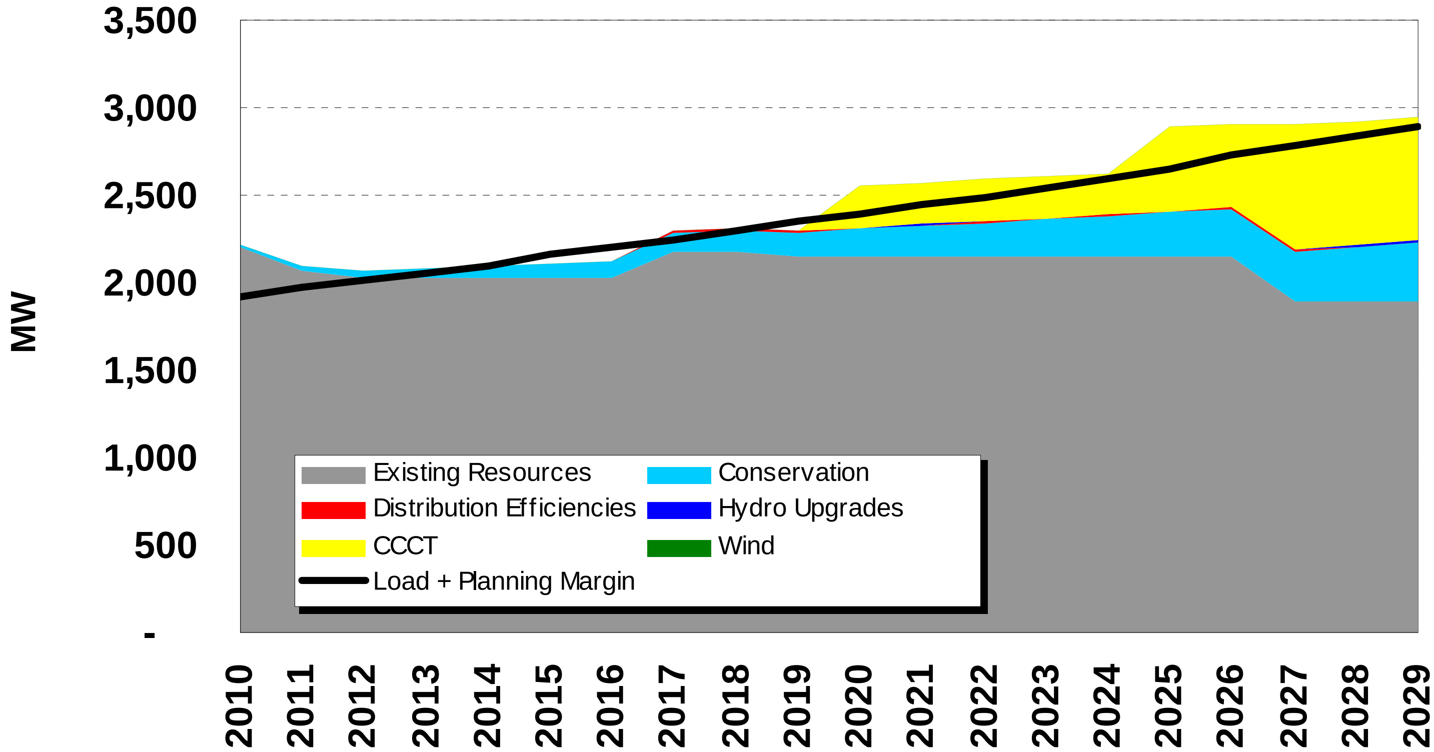
August Capacity L&R w/ New Resources



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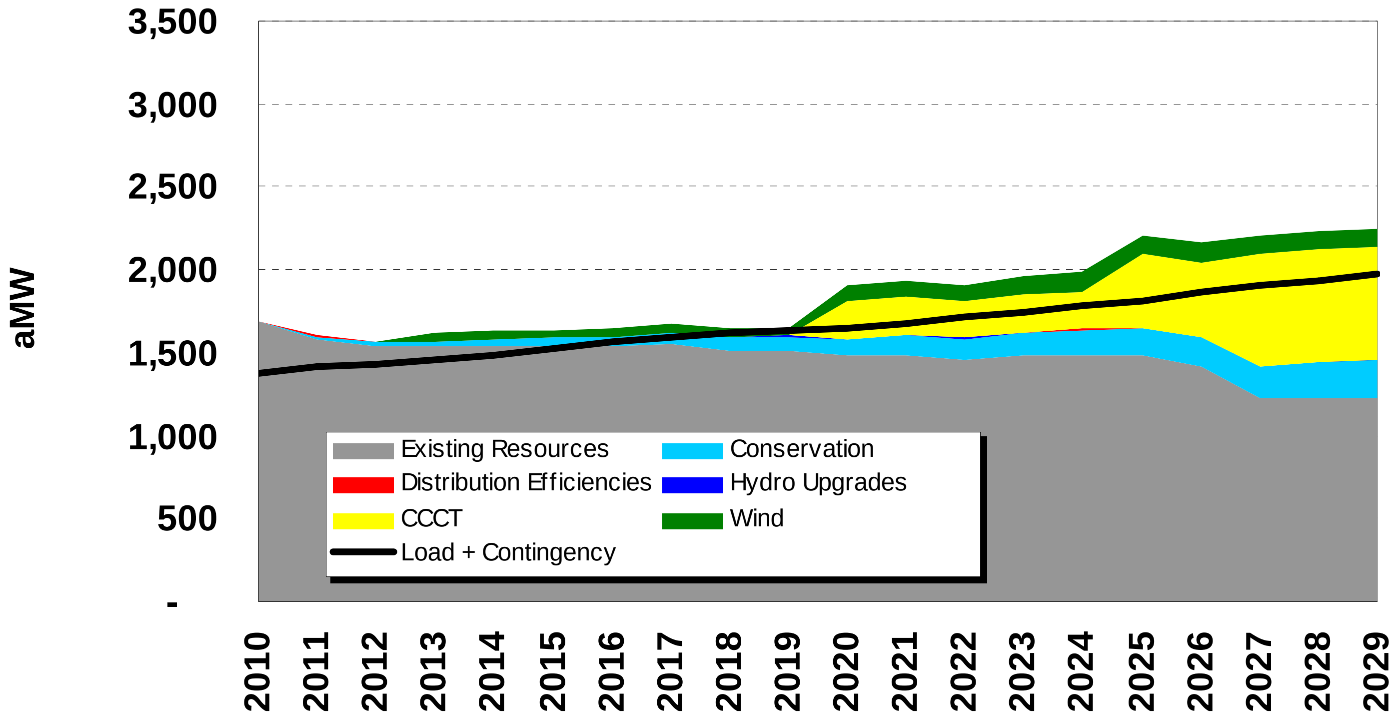
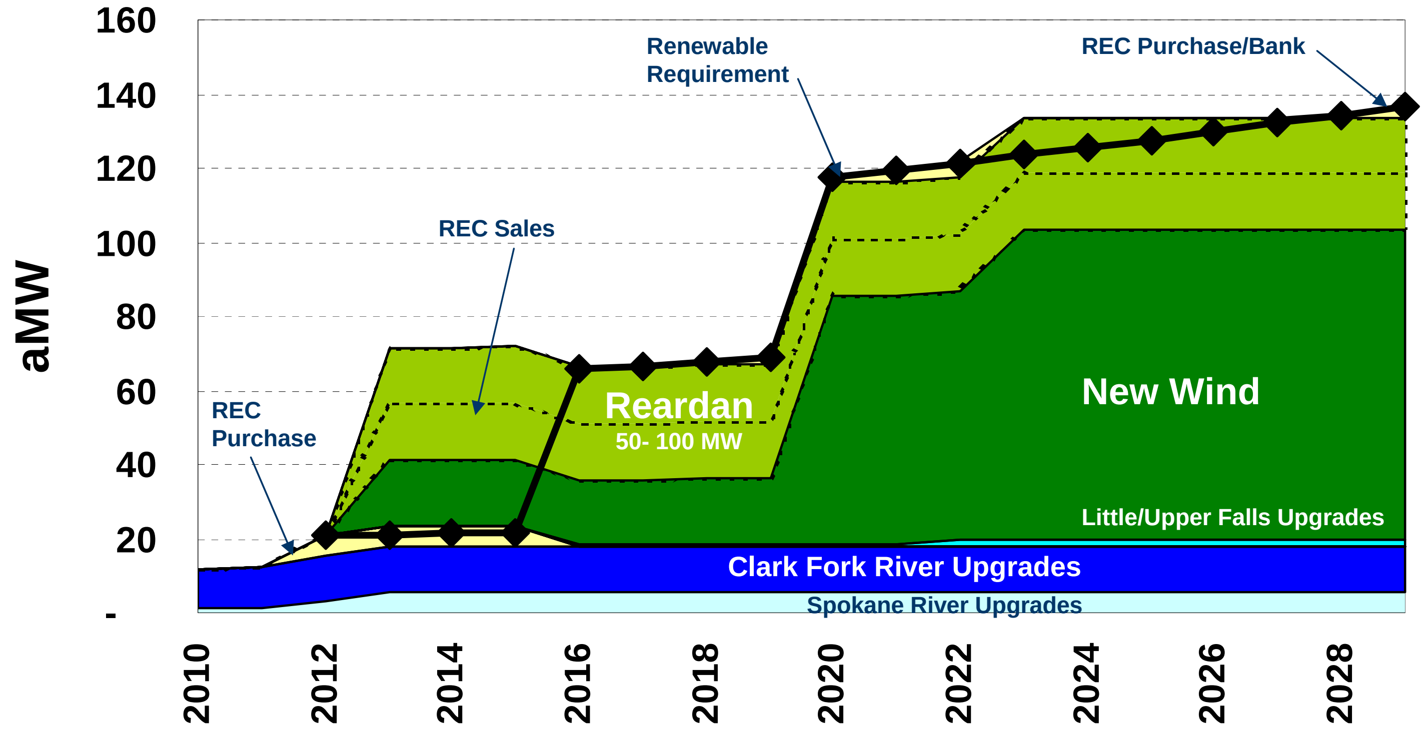
Schedule 5, Page 585 of 729

Annual Energy L&R w/ New Resources



Washington State RPS Compliance



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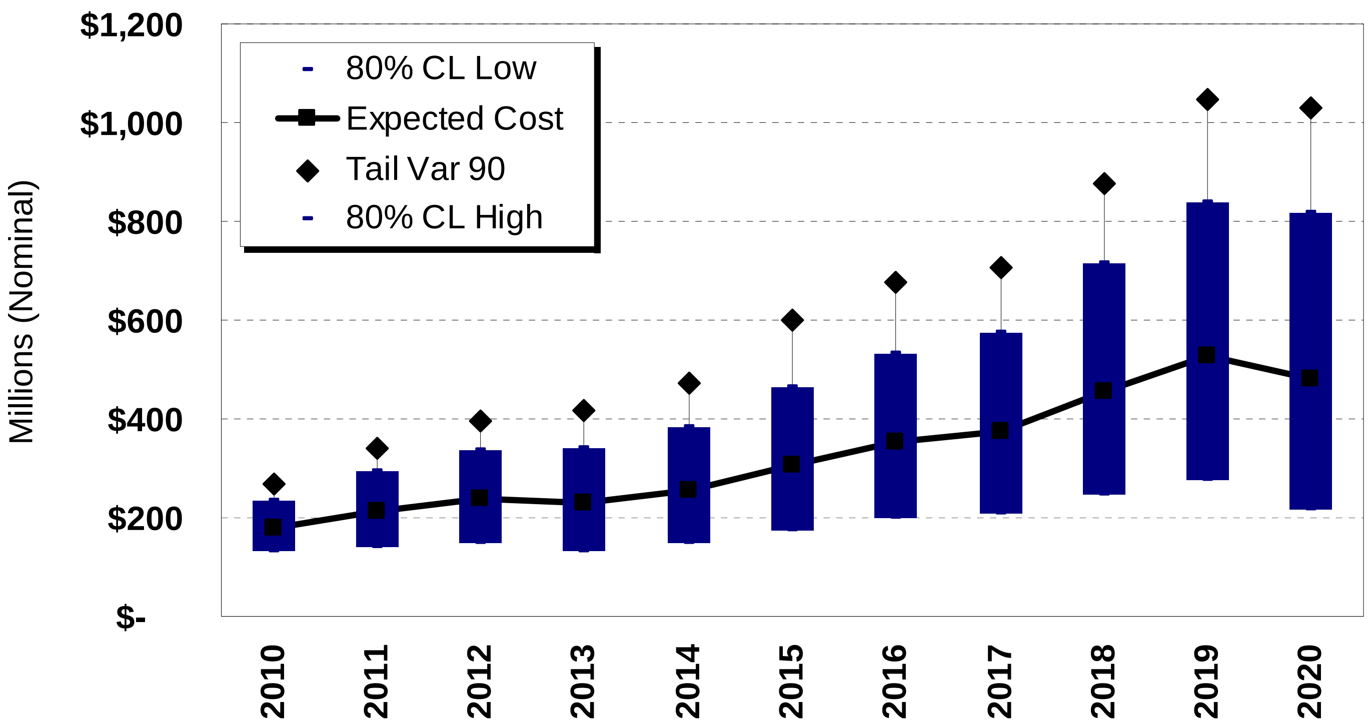
Schedule 5, Page 587 of 729

Power Supply Cost Variation



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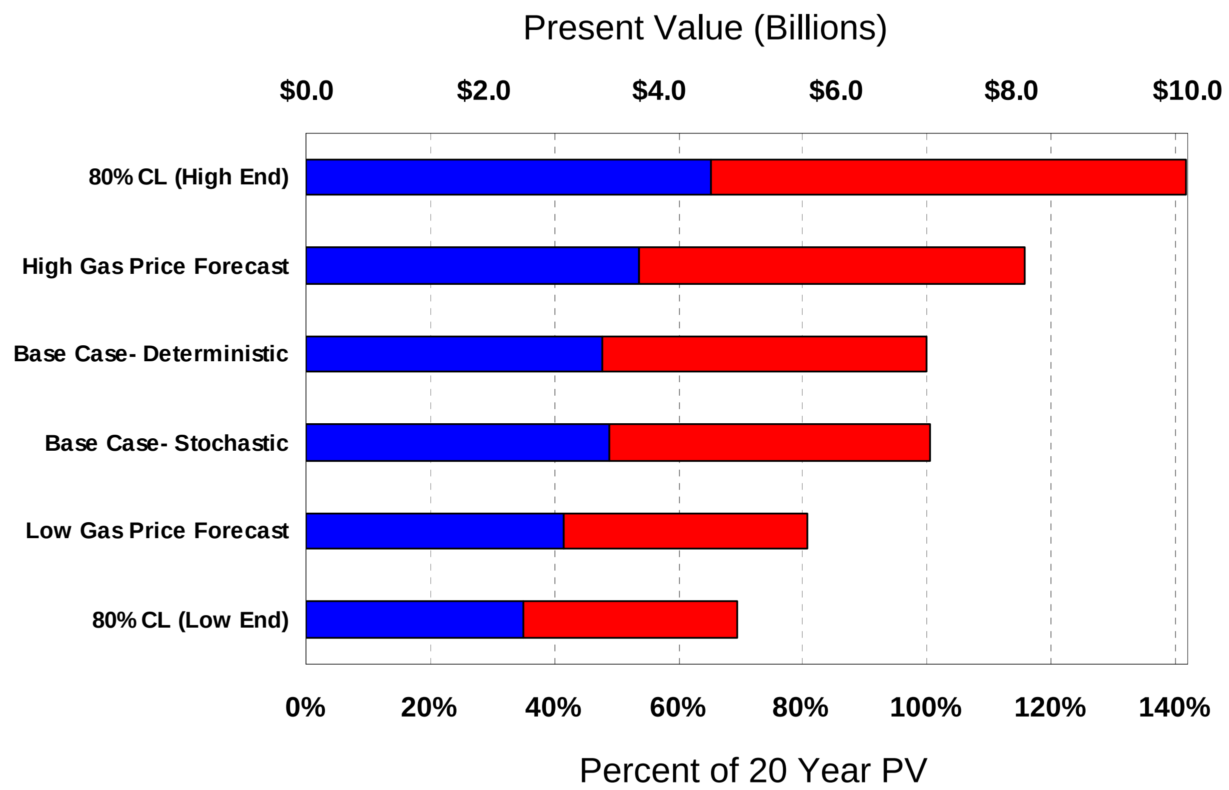
Power Supply Cost Ranges



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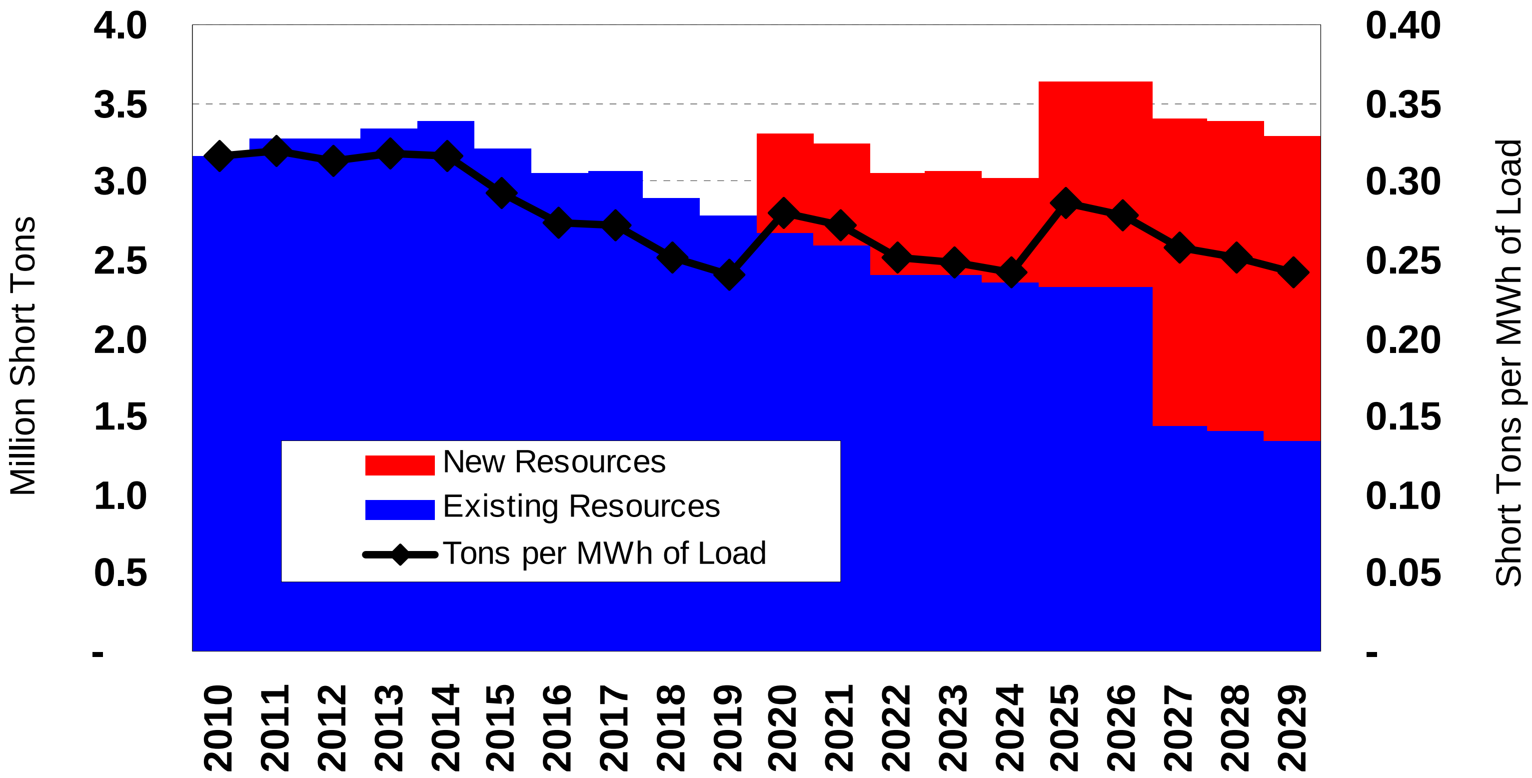
Schedule 5, Page 589 of 729

Avista Generator GHG Emissions



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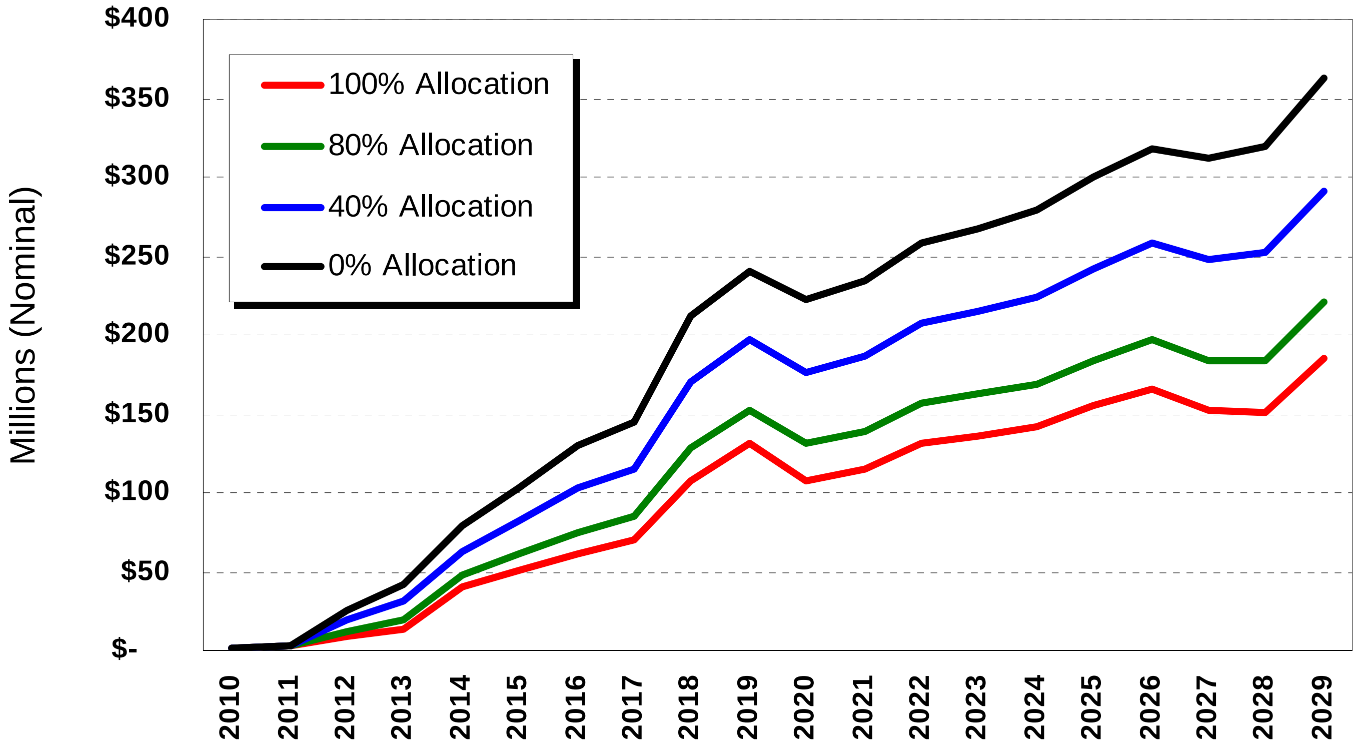
Schedule 5, Page 590 of 729

Total Cost GHG Legislation



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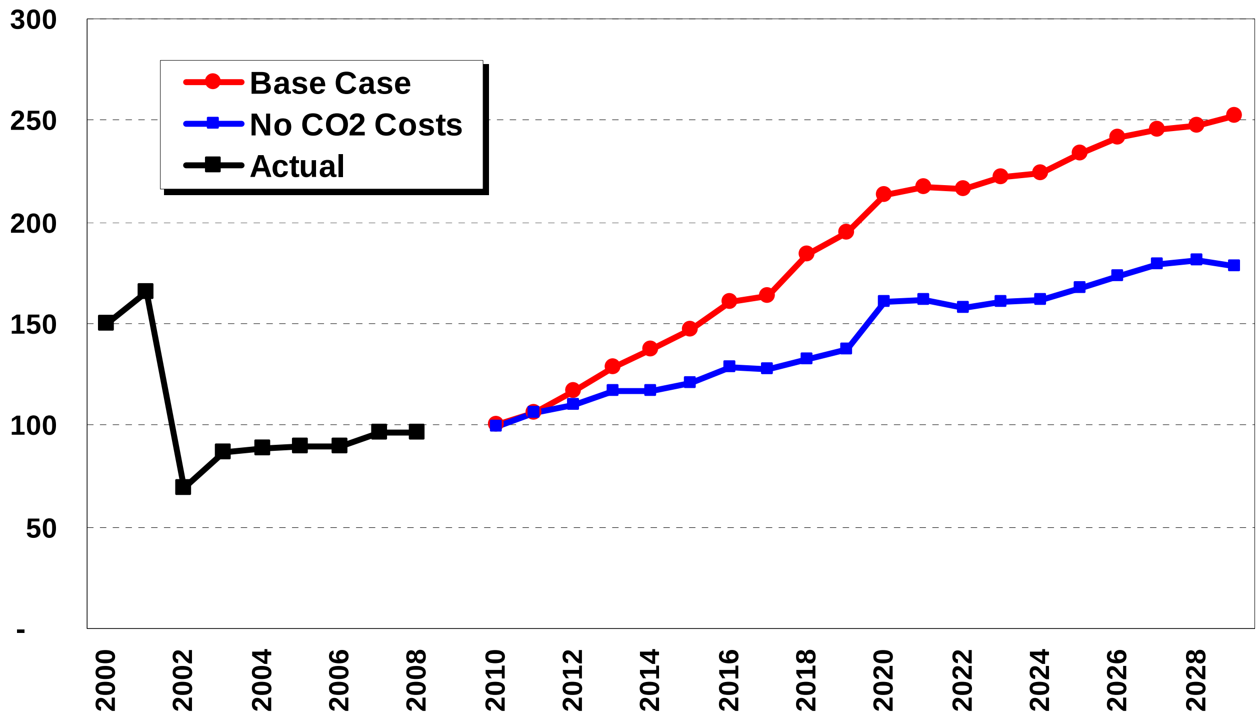
Schedule 5, Page 591 of 729

Future Power Supply Costs

(Index: 2010= 100)



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Schedule 5, Page 592 of 729

Flexible Strategy

What are the tipping points for key capital costs?	**wind capital cost <$1,830/kW, build early** **CCCT cost >$1,610/kW, consider SCCT**
What are the impacts of load growth changes?	**High: 260/100 MW more gas/wind next 10 years** **Low: 250/50 MW less gas/wind in next 10 years**
What if large hydro upgrades are viable?	**eliminate 50/100 MW of wind/gas over 20 years?**
What if non-wind renewables are abundant?	**non-wind renewables replace some wind; could reduce gas by 100 MW**
Is Nuclear a solution?	**least-cost if <=$4,000/kW (current range $5-$10k)**

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Schedule

June 22:	Internal draft released
June 24:	Final Technical Advisory Committee meeting
July 1:	“Big Picture” internal comments
July 6:	External draft released
July 20:	Comment deadline
Aug 31:	IRP Filed with Commissions
~April 2010:	Begin 2011 IRP Process

2009 IRP Action Items

John Lyons

2009 Electric Integrated Resource Plan
Sixth Technical Advisory Committee Meeting
June 24, 2009

2007 IRP Action Items

- Renewable Energy
- Demand Side Management
- Emissions
- Modeling and Forecasting Enhancements
- Transmission Planning

Renewable Energy

- Continue studying wind potential in the Company's service territory, possibly including the placement of anemometers at the most promising wind sites.
- Commission a study of Montana wind resources that are strategically located near existing Company transmission assets
- Learn more about non-wind renewable resources to satisfy renewable portfolio standard requirements and decrease the Company's carbon footprint.

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Demand Side Management

- Update processes and protocols for integrating energy efficiency programs into the IRP to improve and streamline the process.
- Study and quantify transmission and distribution efficiency concepts.
- Determine the potential impacts and costs of load management options currently being reviewed as part of the Heritage Project.
- Develop and quantify the long-term impacts of the newly signed contractual relationship with the Northwest Sustainable Energy for Economic Development organization.

Emissions

- Continue to evaluate the implications of new rules and regulations affecting power plant operations, most notably greenhouse gases.
- Continue to evaluate the merits of various carbon quantification methods and emissions markets.

Modeling and Forecasting Enhancements

- Study the potential for fixing natural gas prices through financial instruments, coal gasification, investments in gas fields, or other means.
- Continue studying the efficient frontier modeling approach to identify more and better uses for its information.
- Further enhance and refine the PRiSM LP model
- Continue to study the impact of climate on the load forecast.
- Monitor the following conditions relevant to the load forecast: large commercial load additions, Shoshone county mining developments, and the market penetration of electric cars.

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Transmission Planning

- Work to maintain/retain existing transmission rights on the Company's transmission system, under applicable FERC policies, for transmission service to bundled retail native load.
- Continue involvement in BPA transmission practice processes and rate proceedings to minimize costs of integrating existing resources outside of the company's service area.
- Continue participation in regional and sub-regional efforts to establish new regional transmission structures (ColumbiaGrid and other forums) to facilitate long-term expansion of the regional transmission system.
- Evaluate costs to integrate new resources across Avista's service territory and from regions outside of the Northwest.

2009 IRP Action Items

- Resource Additions and Analysis
- Demand Side Management
- Environmental Policies
- Modeling and Forecasting Enhancements
- Transmission and Distribution Planning

Resource Additions and Analysis

- Continue to explore the potential for wind and non-renewable resources.
- Issue an RFP for turbines at Reardan and up to 100 MW of wind or other renewables in 2009.
- Finish studies regarding the costs and environmental benefits of the large hydro upgrades at Cabinet Gorge, Long Lake, Post Falls, and Monroe Street.
- Study potential locations for the natural gas fired resource identified to be on-line between 2015 and 2020.

Demand Side Management

- Pursue American Reinvestment and Recovery Act funding
- Analyze and report on the results of the demand response pilot in Moscow and Sandpoint
- Processing and implementing I-937 requirements

Environmental Policies

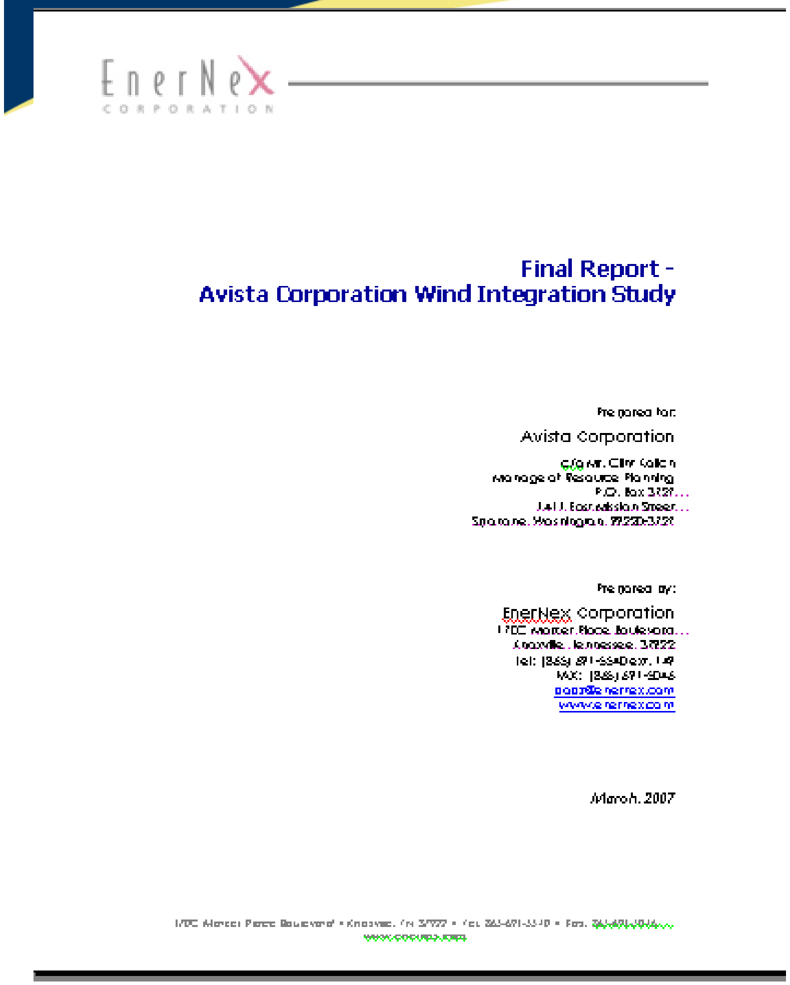
- Continue to study the potential impact of state and federal climate change and renewable portfolio legislation
  - Western Climate Initiative
  - Waxman-Markey – American Clean Energy and Security Act of 2009
- Continue to report on Avista's Climate Change Committee

Modeling and Forecasting Enhancements

- Refine the stochastic model for cost driver relationships
- Continue to refine the PRiSM model
- Continue developing Loss of Load Probability and Sustained Peaking analysis for inclusion in the IRP process
- Study cooling degree day trend coefficient for inclusion in the load forecast

Transmission and Distribution Planning

- Work to maintain and retain existing transmission rights on Avista's transmission system
- Continued involvement in BPA transmission processes and rate proceedings
- Continued participation in regional and sub-regional efforts to establish new regional transmission structures and to facilitate long-term expansion of the regional transmission system
- Evaluate costs to integrate new resources across Avista's service territory and from regions outside of the Northwest
- Study and implement distribution feeder rebuild projects
- Study transmission re-configurations to reduce system losses


EnerNex
CORPORATION

Final Report -
Avista Corporation Wind Integration Study

Prepared for:
Avista Corporation

Prepared by:
EnerNex Corporation

March, 2007

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Defining Wind Integration & Overview of Avista Study

Clint Kalich
Manager of Resource Planning & Power Supply Analyses
clint.kalich@avistacorp.com

October 21, 2008

Outline of Presentation

- Defining Wind Integration
- Overview of Avista's System
- Evaluating Overall Cost of Wind
- Methodology Overview
- Wind Integration Cost Components
- Impact of Shorter Market Time Step
- Benefit of Wind Feathering
- Hydro Re-Dispatch Costs
- Next Steps/Modeling Enhancements
- Other Wind Integration Study Results

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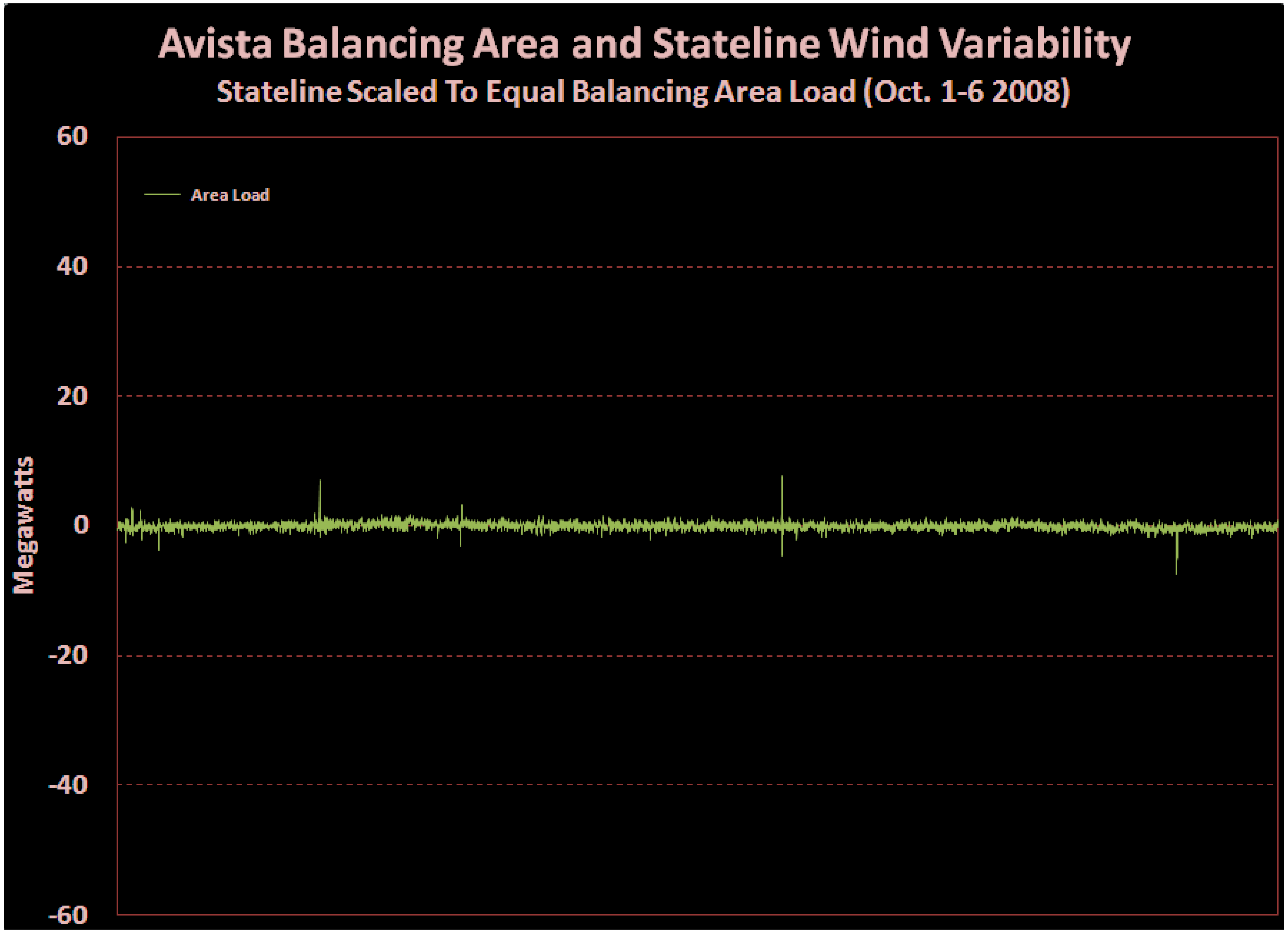
Defining Wind Integration

- **Incremental Reserves (Avista Study Method)**
  - Regulation (<1 minute)
  - Load following
    - covers timeframe from end of regulation up to next ramp (1 hour in WECC)
  - Forecast error
    - difference between forecast and actual generation
- **Other Things Sometimes Called Wind Integration**
  - Shape of delivered energy
  - Fuel savings from wind operations
  - Capital costs
  - Environmental attributes

Bottom Line: Be Careful When Assuming 2 Studies are "Apples-to-Apples"

Defining Wind Integration — A Graphical View



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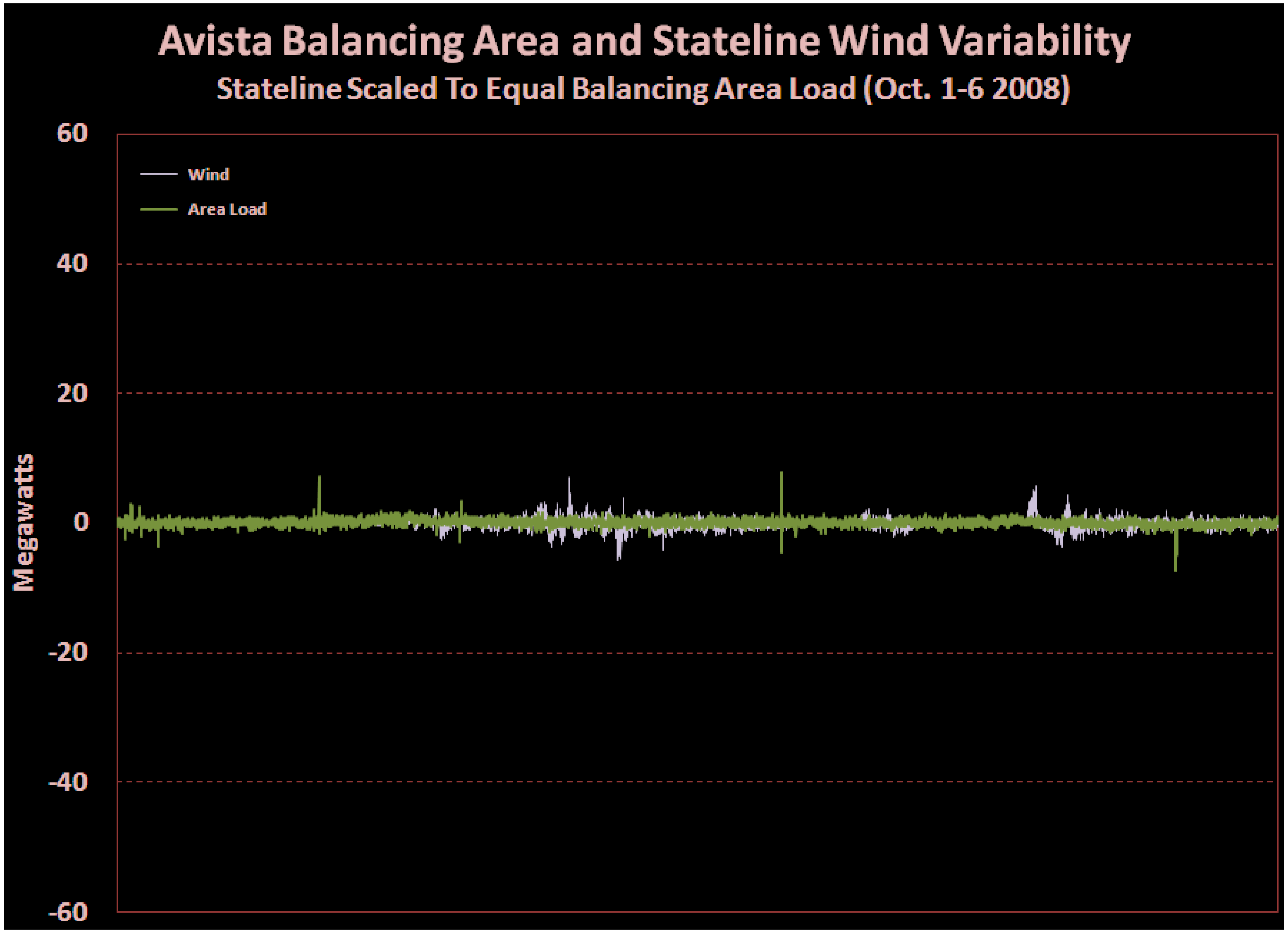
Schedule 5, Page 611 of 729

Defining Wind Integration — A Graphical View



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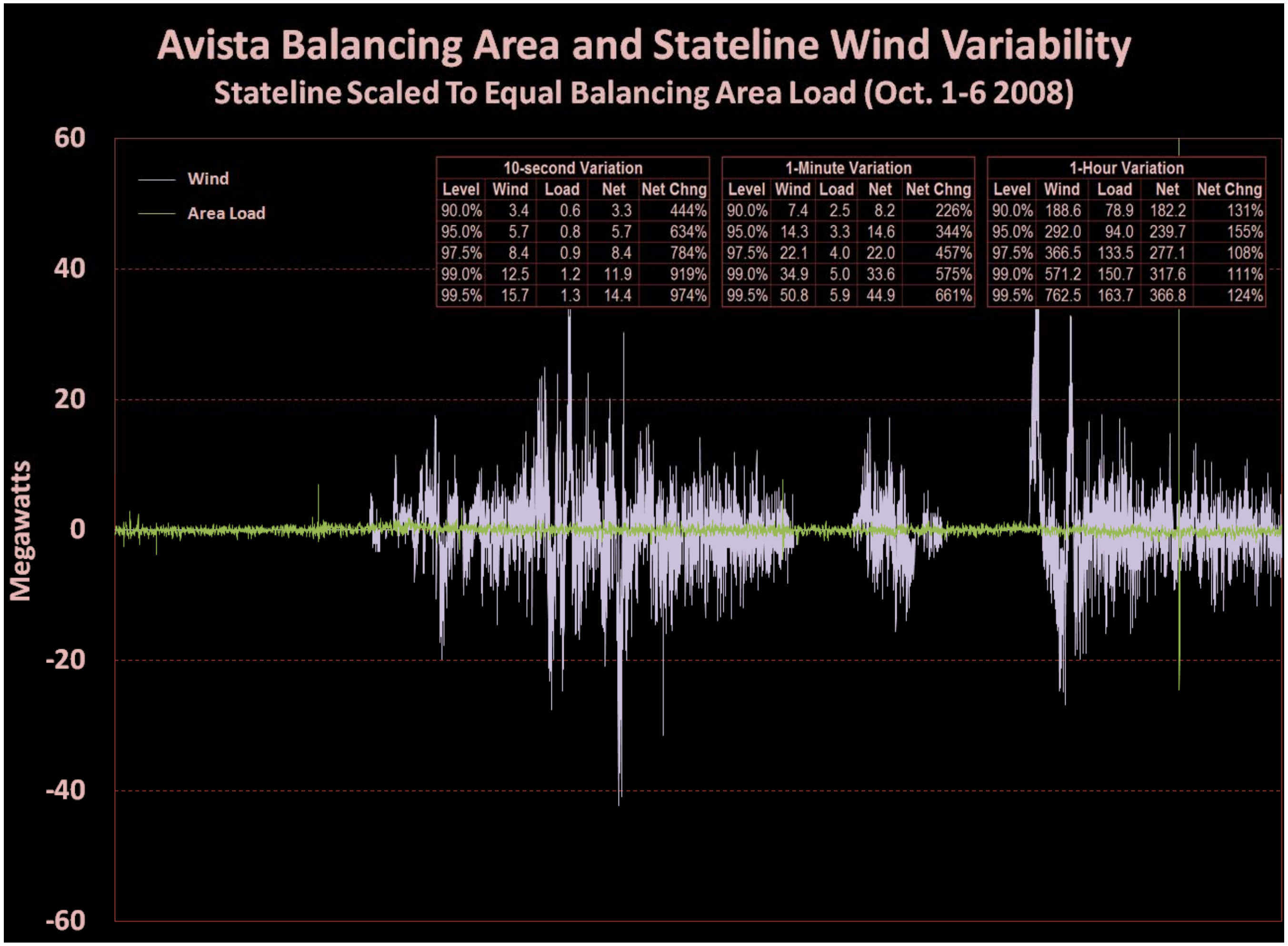
Defining Wind Integration — A Graphical View



10-second Variation				
Level	Wind	Load	Net	Net Chng
90.0%	3.4	0.6	3.3	444%
95.0%	5.7	0.8	5.7	634%
97.5%	8.4	0.9	8.4	784%
99.0%	12.5	1.2	11.9	919%
99.5%	15.7	1.3	14.4	974%

1-Minute Variation				
Level	Wind	Load	Net	Net Chng
90.0%	7.4	2.5	8.2	226%
95.0%	14.3	3.3	14.6	344%
97.5%	22.1	4.0	22.0	457%
99.0%	34.9	5.0	33.6	575%
99.5%	50.8	5.9	44.9	661%

1-Hour Variation				
Level	Wind	Load	Net	Net Chng
90.0%	188.6	78.9	182.2	131%
95.0%	292.0	94.0	239.7	155%
97.5%	366.5	133.5	277.1	108%
99.0%	571.2	150.7	317.6	111%
99.5%	762.5	163.7	366.8	124%

Overview of Avista's System (2010)

- **2,200 MW Control Area Peak**
- **875 MW Minimum Load**
- **1,200 MW Hydro**
  - Very flexible with generous short-term storage
  - Provides majority of reserves for wind
    - – regulation, spinning, supplemental
- **785 MW Gas Turbines**
  - 550 MW CCCT with 100 MW of spinning & supplemental reserves
  - 210 MW (4 units) provide only supplemental reserves
  - Remaining 7 (small) units cannot provide reserves

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Overview of Avista's System, Cont

- **230 MW Coal & 50 MW Biomass**
  - Do not provide reserves
- **35 MW of Stateline Wind**
- **~750 MW Contracts Rights**
  - 350 MW for "native load"
  - 400 MW 3rd party resources to serve 3rd party loads in control area
  - No reserve capabilities
- **~200 MW Capacity Contract Obligations**
  - Sales of AGC and spinning reserves for 3rd party load and wind

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Evaluating Overall Cost of Wind

- **Commodity Value of Energy**
  - Consider hourly pattern
  - Wind doesn't generate flat or at the operator's control
- **Transmission Cost ~ 3 Times Traditional Resources**
- **Impact on Operation of Other Owned Resources**
  - Fuel savings and/or impact on market sales & purchases
- **Incremental Reserve Obligations**
  - Avista definition of wind integration
  - Regulation, load following, forecast error
    - load following and forecast error are greatly affected by spot market timeframe
- **Capital Recovery and Operation Costs**
- **Environmental Attribute Values (green tags, reduced CO_2)**
- **Capacity Contribution (or lack thereof)**

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Methodology Overview

- **Develop Hourly LP Model Of Avista System**
  - Model of both Real-Time and Pre-Schedule timeframes
    - pre-schedule commitment and market transactions “honored” in Real-Time
  - Represent inherent flexibility and constraints
    - hydro storage and minimum flow
    - minimum up/down requirements
    - reserve capabilities and ramping rates
    - transmission paths
    - hydro spill and wind “feathering”
  - Access to energy market for balancing and optimization
    - pre-schedule and real-time markets

Methodology Overview (Cont.)

- **Run Model With and Without Wind Variability**
  - Over same historical timeframe (2002-04)
    - using actual loads
    - wind is priced in each hour at market
    - eliminates potential for wind shape to bias result
    - carry additional reserves in "With Wind" case
- **Compare System Values**
  - Change is spread over wind deliveries to arrive at an integration cost
    - per MWh (absolute or % of market price)
    - per kW-month (absolute or % of market price)

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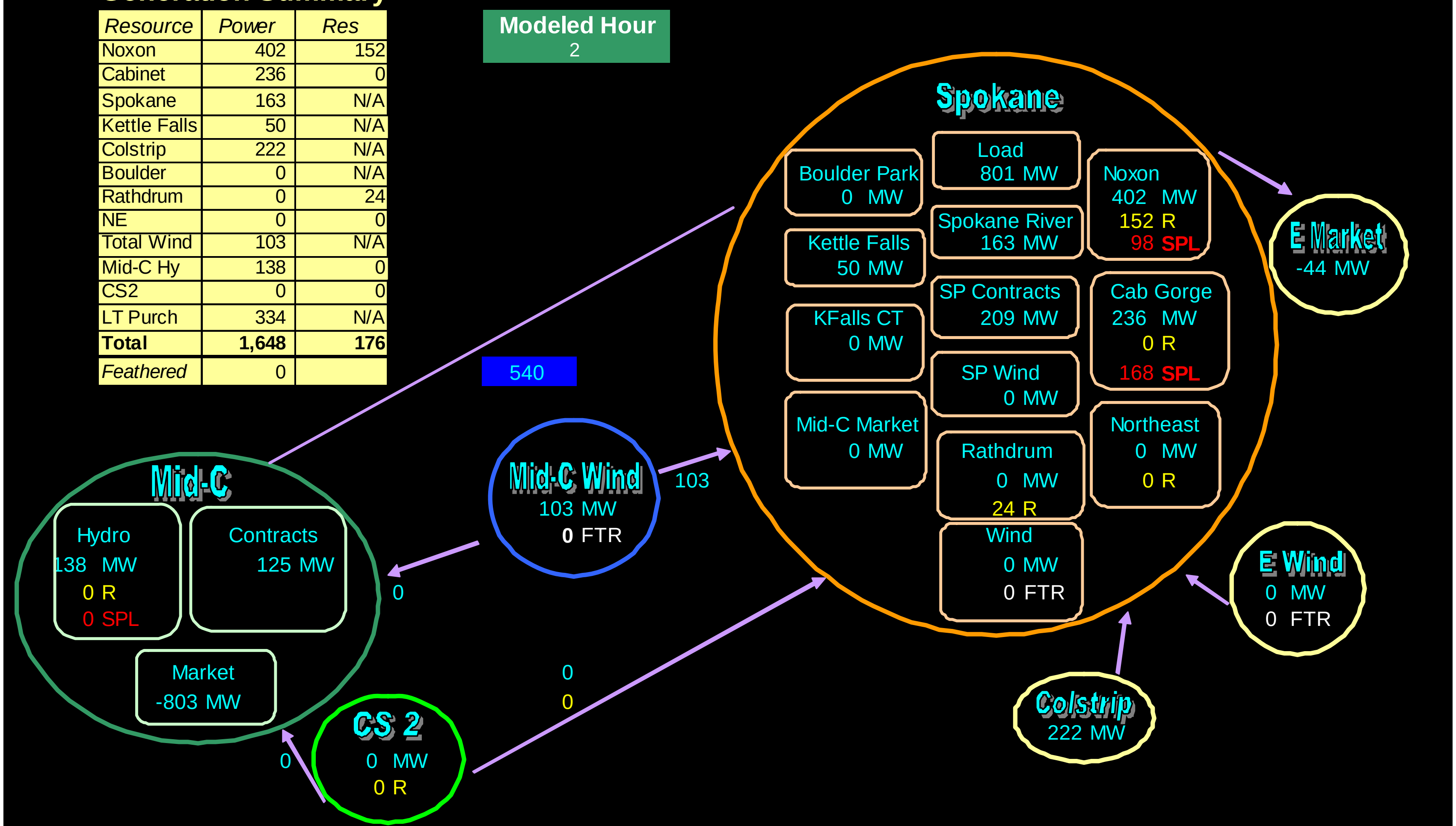
Pre-Schedule Wind Model Delivery Schematic

Generation Summary

Resource	*Power*	*Res*
Noxon	402	152
Cabinet	236	0
Spokane	163	N/A
Kettle Falls	50	N/A
Colstrip	222	N/A
Boulder	0	N/A
Rathdrum	0	24
NE	0	0
Total Wind	103	N/A
Mid-C Hy	138	0
CS2	0	0
LT Purch	334	N/A
Total	**1,648**	**176**
Feathered	0	



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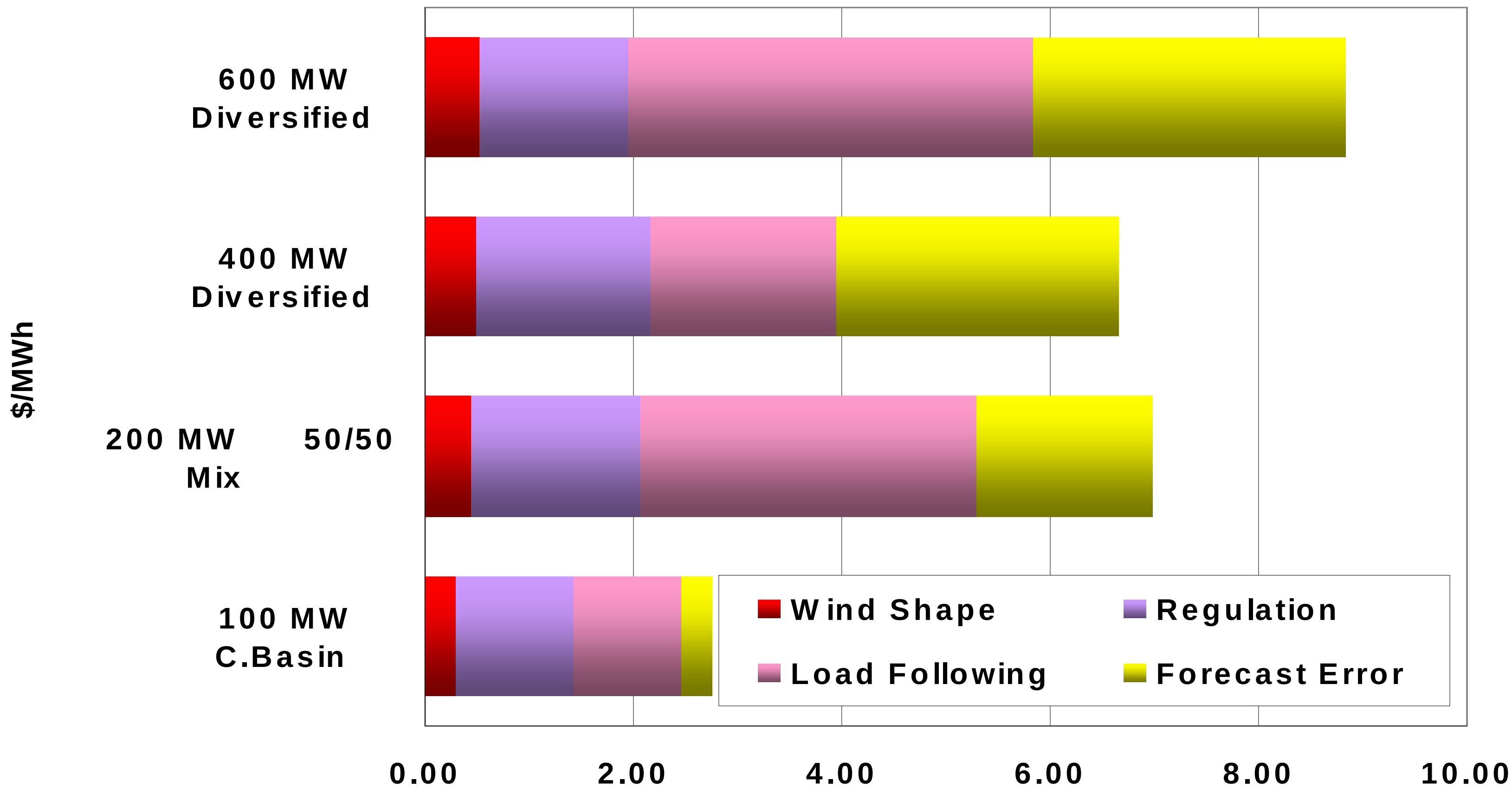
Schedule 5, Page 619 of 729

Wind Integration Cost Components



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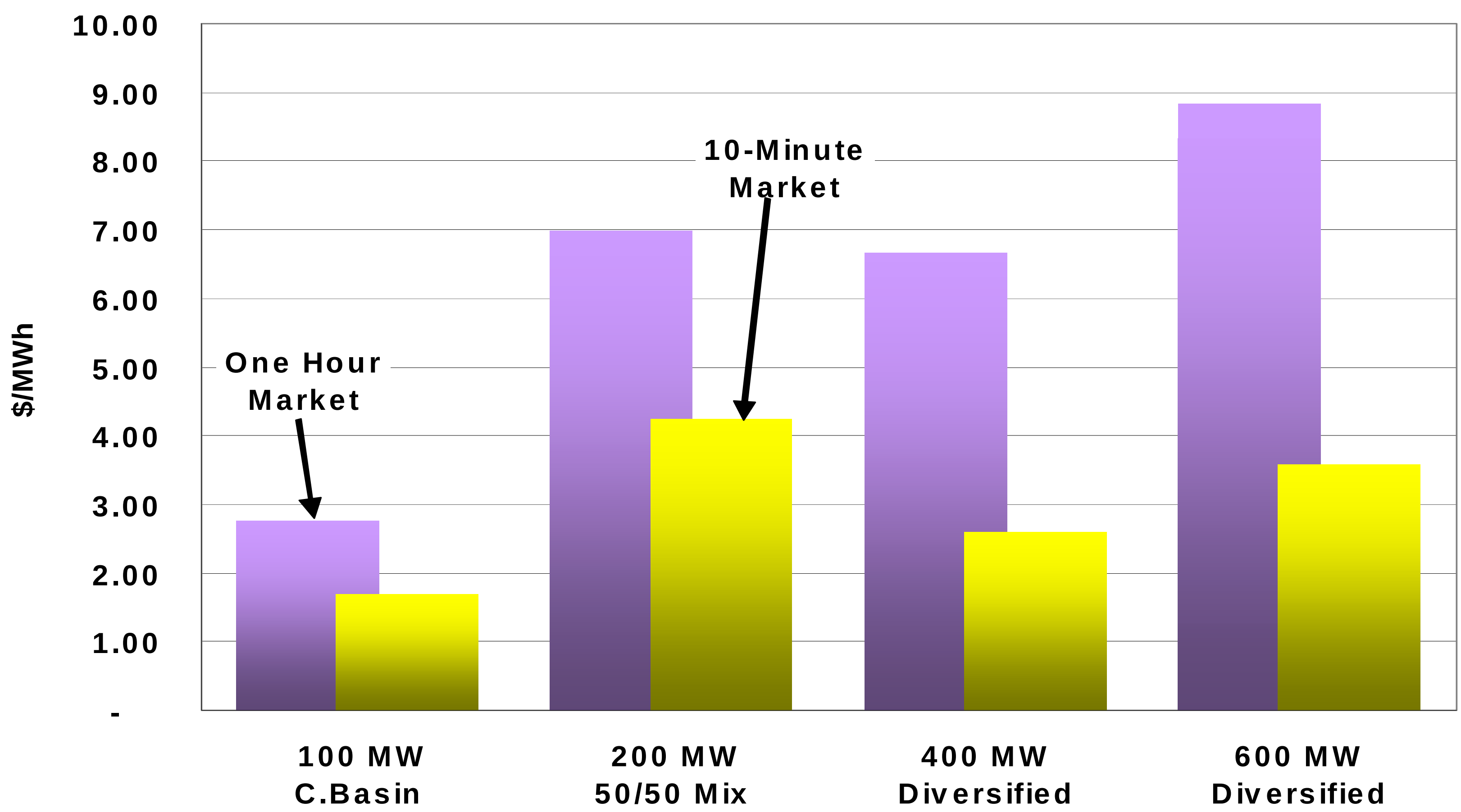
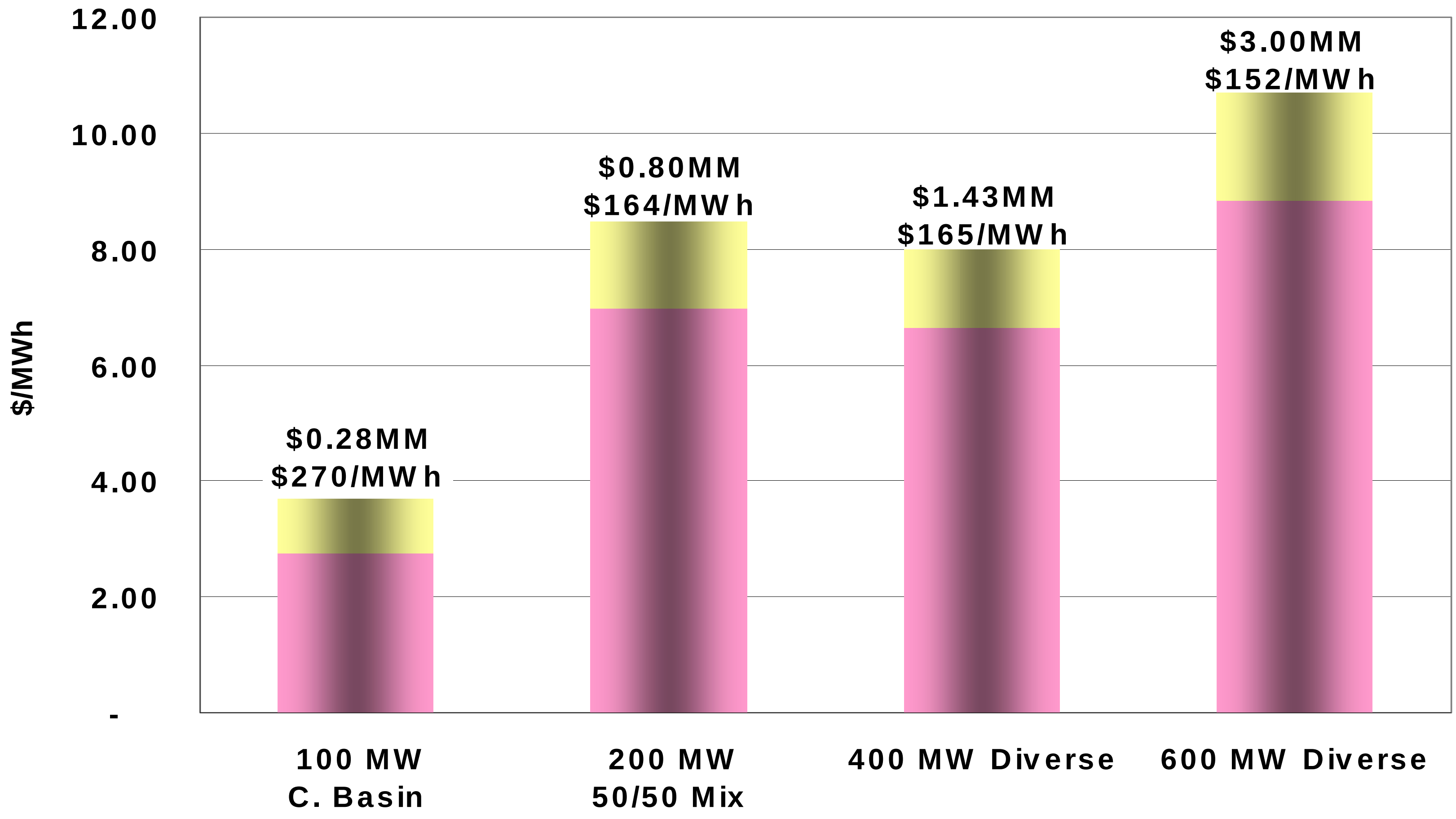
Schedule 5, Page 620 of 729

Impact of Shorter Market Time Step



Benefit of Wind Feathering



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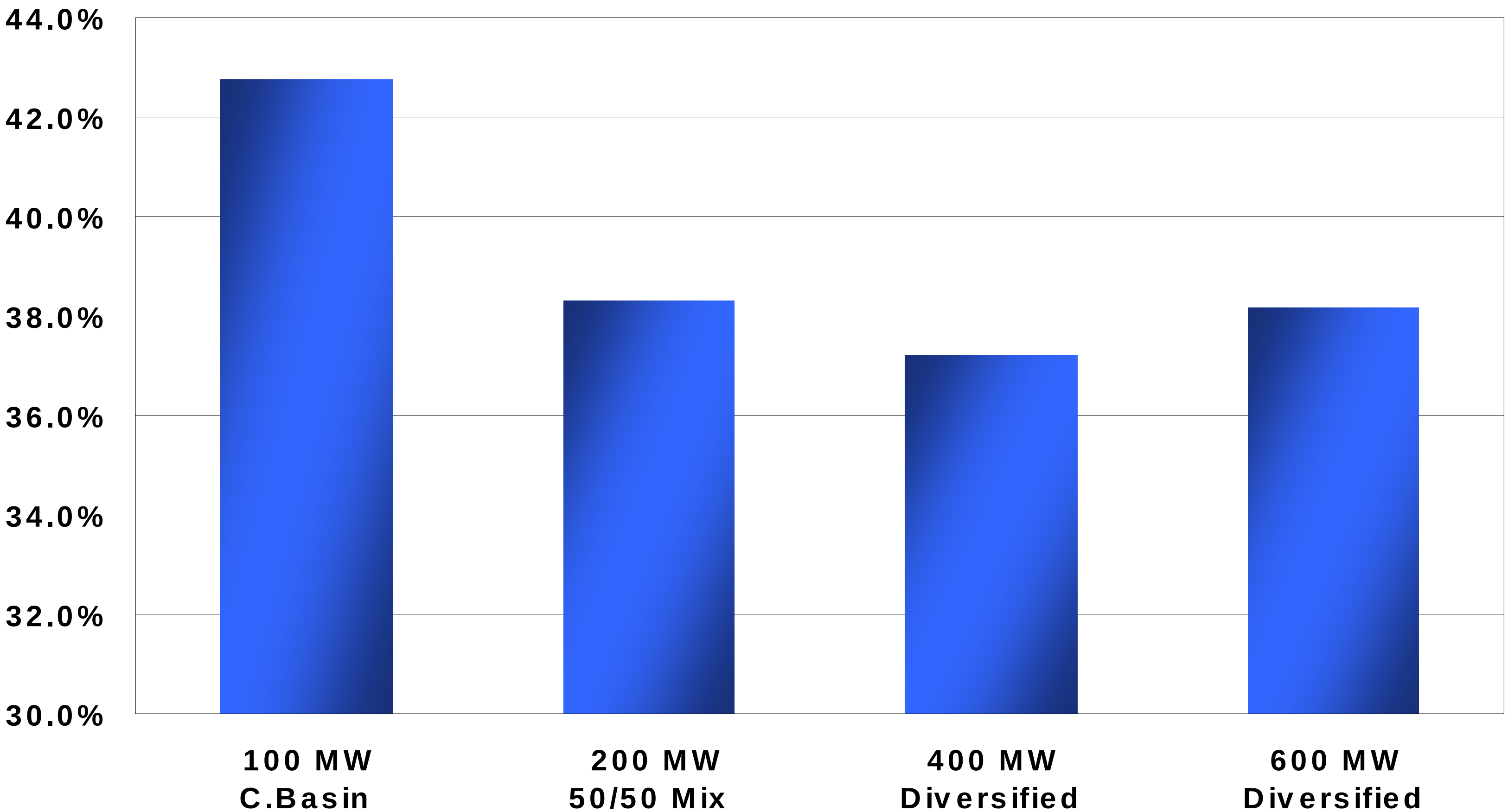
Hydro Re-Dispatch Costs



Next Steps/Modeling Enhancements

- **Update With Latest Data**
  - Augment limited NW data sets with data from outside the NW
  - Update to data through 2006
  - Use NPCC/BPA 3-Tier meso-scale wind data when available
- **Evaluate Regulation, Load Following, Forecast Errors Using Root-Mean-Squares Method**
- **Search For Better Wind Forecasting Algorithms**
- **Enhance Start-Up Cost Logic For Thermal Plants**
- **Model Reserve Capabilities of Coal-Fired Plants**
- **Evaluate Real-Time to Pre-Schedule Relationships**

Other Integration Study Results

Wind Integration Study Costs ($US/MWh)					
Entity	Low	High	Entity	Low	High
APS 2007	0.91	4.08	Maritimes (E. Canada) 2007	3.66	6.13
Avista 2007	2.75	9.00	Minnesota 2004	2.25	5.25
BPA 2007	1.90	4.60	Minnesota 2006	3.45	5.10
BPA 2008			Nordic 2004	1.50	3.15
California	0.45		Norway (Greennet)	0.30	0.68
Colorado 2007	4.00	8.00	PacifiCorp 2006	1.86	5.94
Denmark (Greennet)	0.60		Puget Sound Energy	3.73	4.06
Finland (Greennet)	0.30	2.10	Sweden (Greennet)	0.38	0.90
Finland 2004	3.00	4.50	UK 2002	5.10	6.08
Germany (Greennet)	3.23		UK 2007	2.10	5.10
Idaho Power 2007	6.00	9.00	WeEnergies 2003	1.90	2.90
Ireland	0.38	0.75			

The End

Defining Wind Integration in the 2009 Integrated Resource Plan

Clint Kalich
Manager of Resource Planning & Power Supply Analyses
clint.kalich@avistacorp.com
May 22, 2009

Agenda

10:00 Introductions

10:15 Wind Integration and the 2009 IRP

11:15 Questions/Suggestions for Further Work

12:00 Adjourn

Defining Wind Integration and Its Costs

2009 Integrated Resource Plan

Outline of Presentation

- **Defining Wind Integration**
- **Wind Integration Cost Components**
- **Preferred Resource Strategy Model (PRiSM)**
  - What is PRiSM?
  - The Efficient Frontier
    - covers timeframe from end of regulation up to next ramp (1 hour in WECC)
  - Wind modeling in 2009 IRP
  - Recent enhancements to PRiSM
- **Questions**

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Defining Wind Integration

- **Incremental Reserves (Avista Study Method)**
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Bottom Line: Be Careful When Assuming 2 Studies are "Apples-to-Apples"

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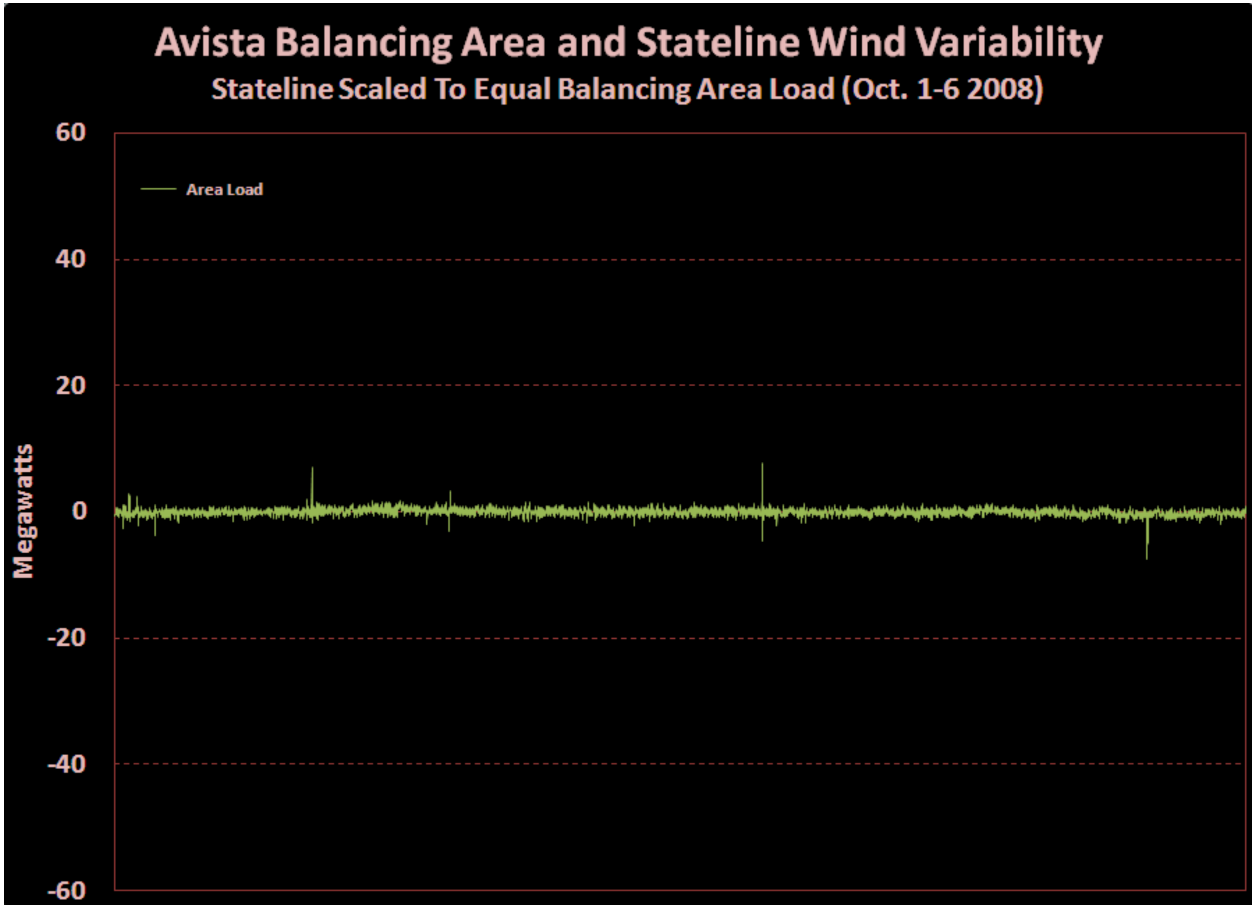
Defining Wind Integration — A Graphical View



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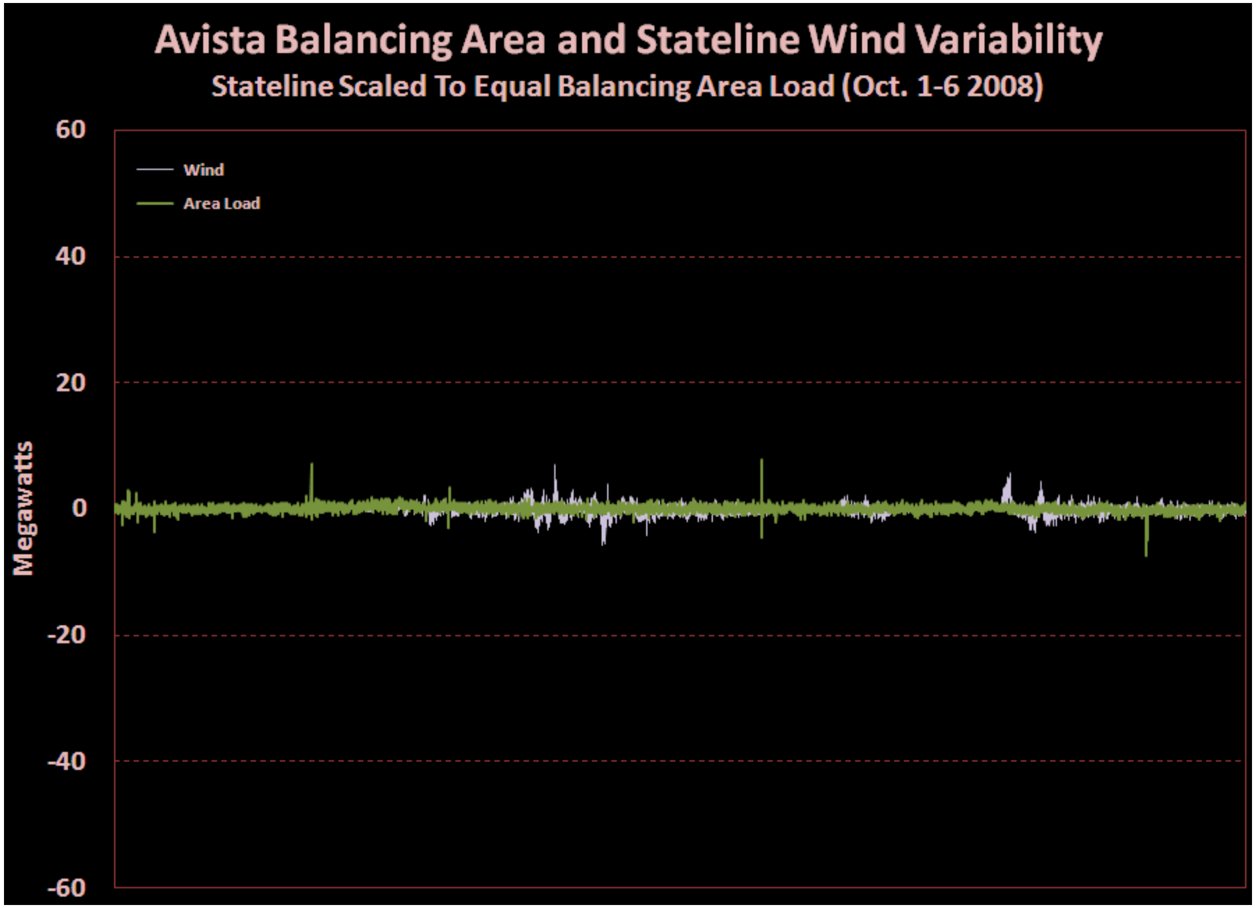
Schedule 5, Page 632 of 729

Defining Wind Integration — A Graphical View



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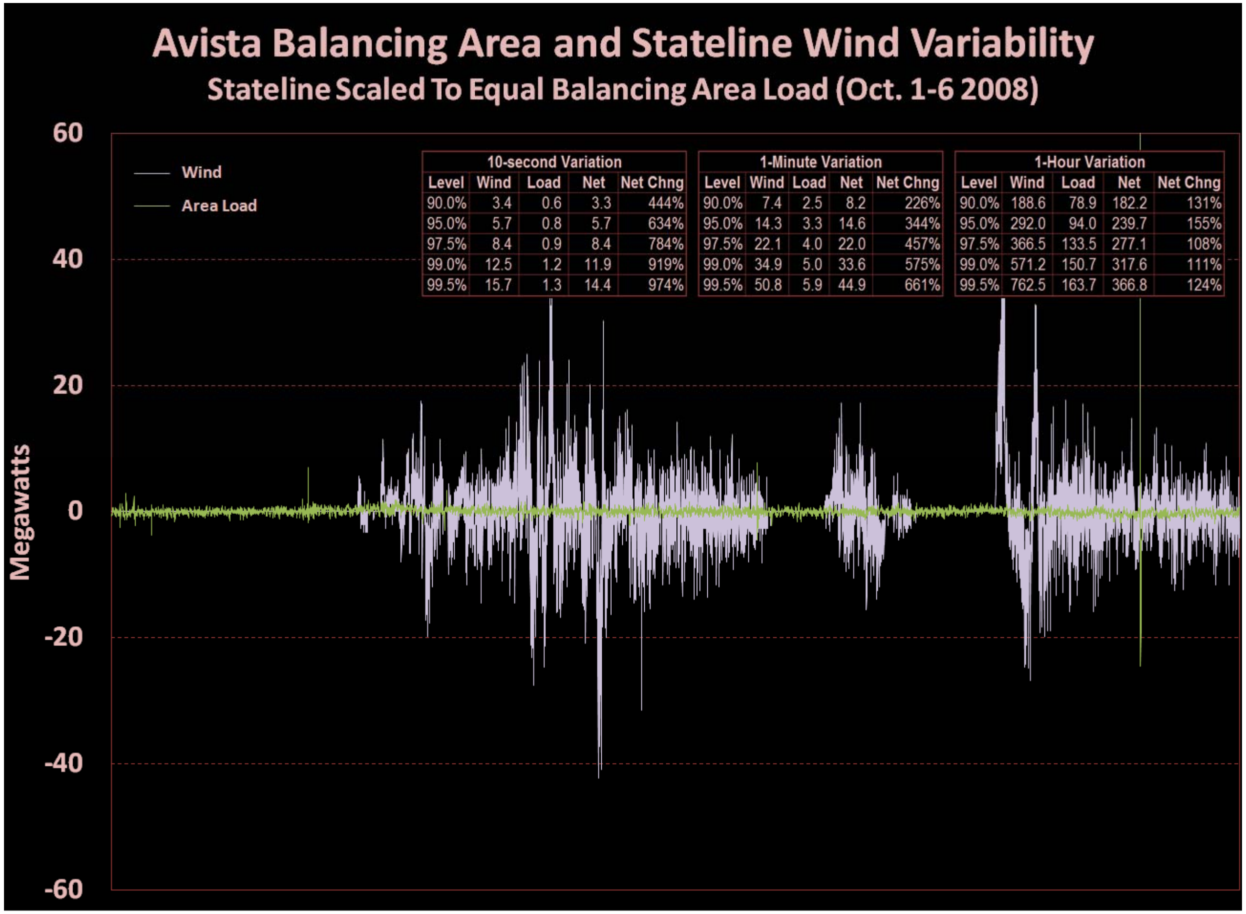

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95.0%	14.3	3.3	14.6	344%
97.5%	22.1	4.0	22.0	457%
99.0%	34.9	5.0	33.6	575%
99.5%	50.8	5.9	44.9	661%

1-Hour Variation				
Level	Wind	Load	Net	Net Chng
90.0%	188.6	78.9	182.2	131%
95.0%	292.0	94.0	239.7	155%
97.5%	366.5	133.5	277.1	108%
99.0%	571.2	150.7	317.6	111%
99.5%	762.5	163.7	366.8	124%

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Wind Integration Cost Components

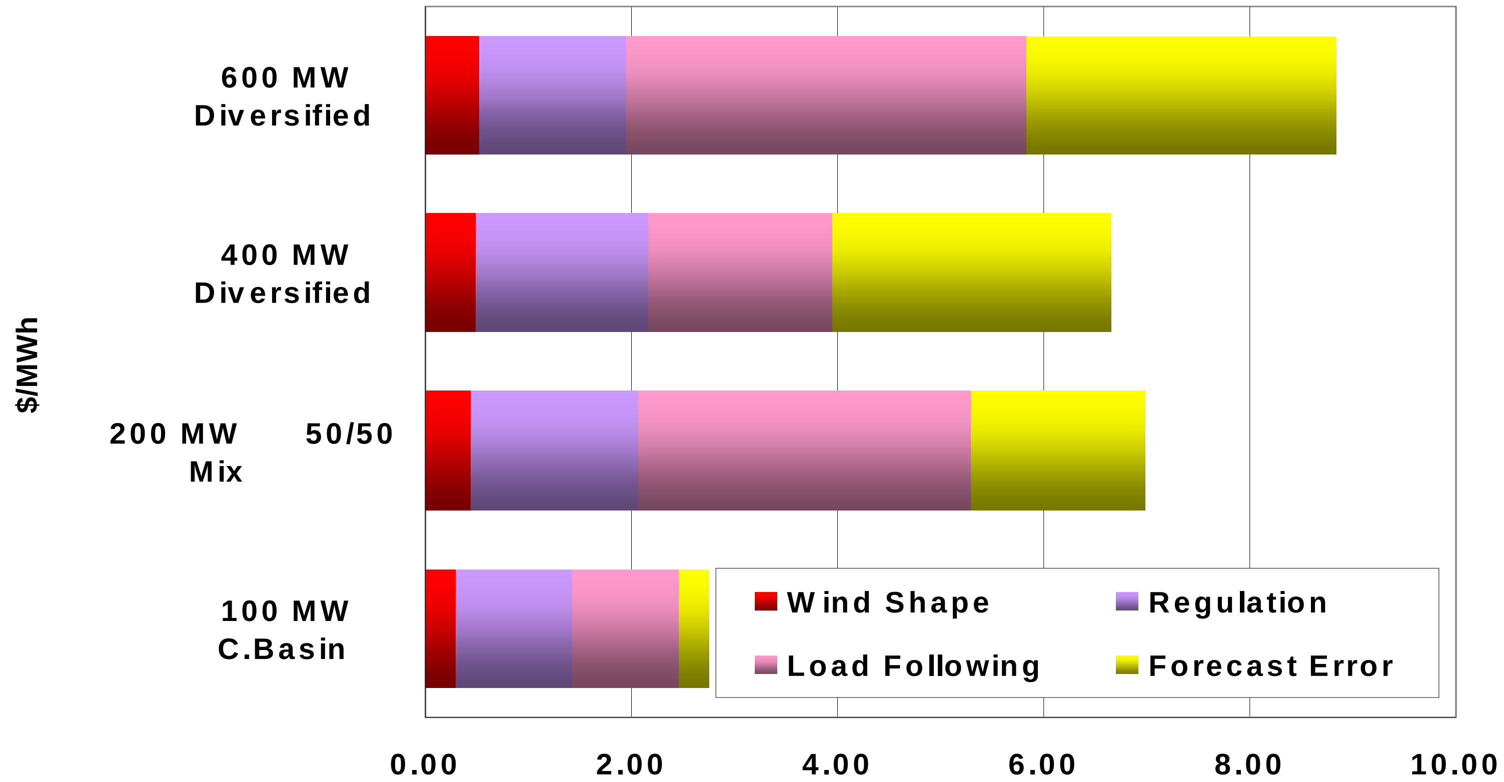

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Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 635 of 729

PRiSM

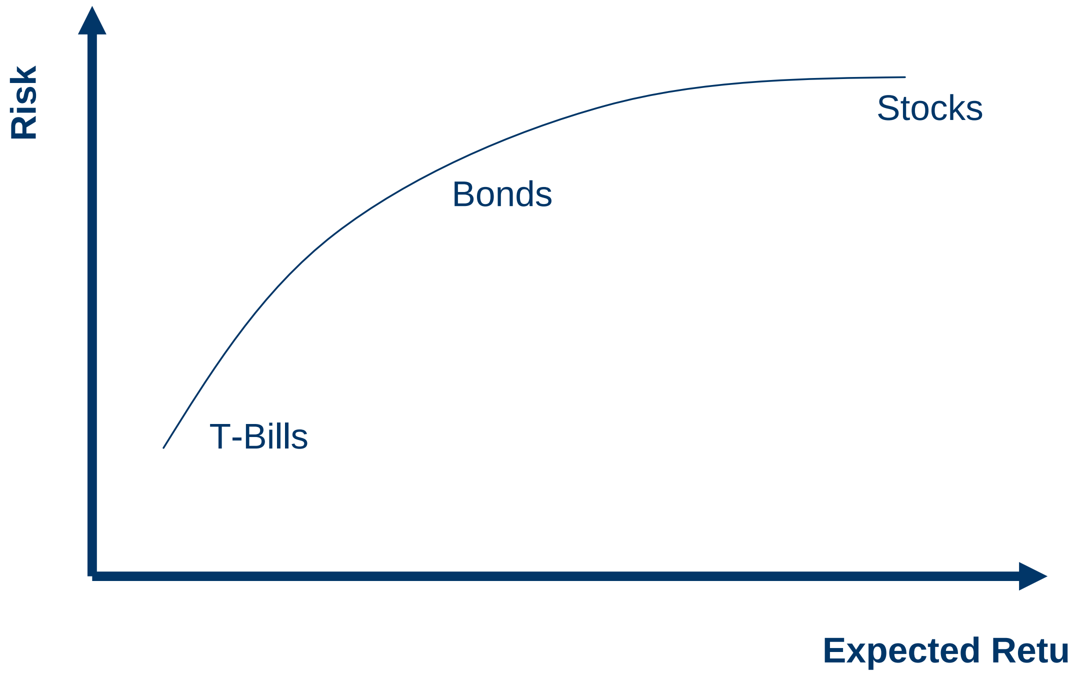
(*Preferred Resource Strategy Model*)

2009 Integrated Resource Plan

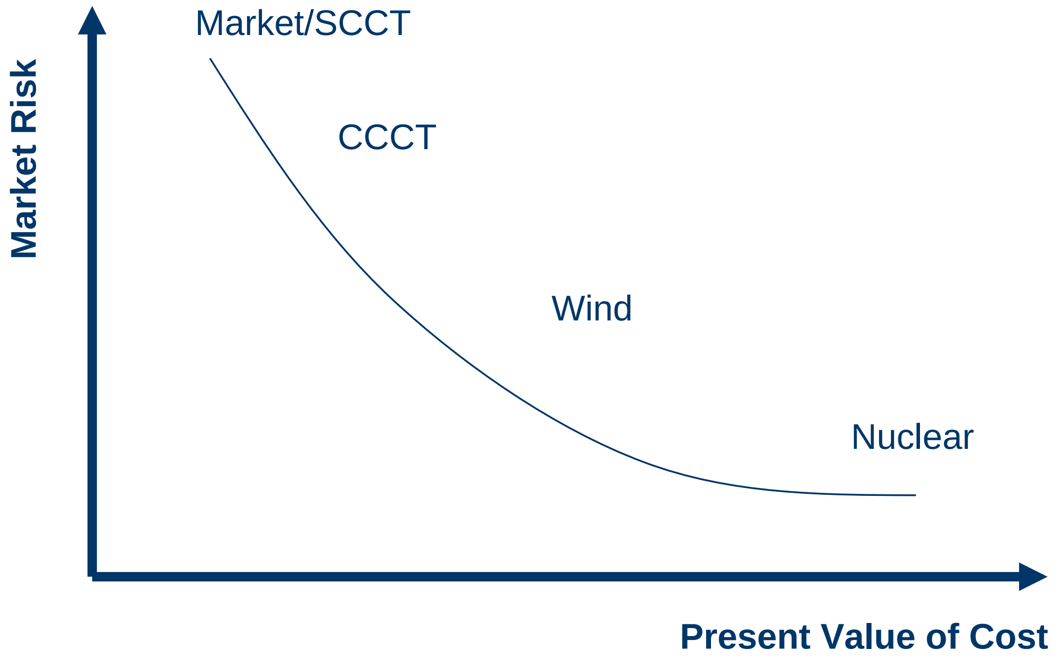
What is PRiSM?

- Preferred Resource Strategy Model
  - *Selects resource & conservation opportunities on an optimal cost and risk basis using a linear program (What's Best!)*
- Objective function is to either select resource strategies to meet our energy/capacity/market/RPS/CO_2 requirements on a least cost and/or least risk basis
- Cost is measured by the present value of incremental fuel & O&M expenses and new capital investment
- Risk is measured by the variation in fuel, emissions, load, wind, forced outages, and variable O&M expenses in years 2019/29

Efficient Frontier- An Introduction 1 (stock portfolios)



Efficient Frontier- An Introduction (Avista IRP)



Wind Modeling in 2009 IRP

- Various Wind Resource Options
  - *Small wind (DG)*
  - *Northwest Wind (Tier 1 and Tier 2)*
  - *Montana Wind*
  - *Reardan Wind Project*

Location	Capital 2009$ (includes AFUDC)	Fixed O&M ($ per kW/Yr)	Capacity Factor
Reardan	2,183	45	30.0%
Columbia Basin (tier 1)	2,262	50	33.0%
Columbia Basin (tier 2)	2,262	50	26.4%
Montana	2,262	50	37.0%
Small Scale	3,343	50	20.0%
Off Shore	5,573	95	45.0%

- Wind Integration Cost of $3.50 per MWh (2009$)
  - *Reflective of low penetration rate presently on system*
  - *Rates will rise as penetration increases*

New Enhancements

- Conservation measures are selected in model rather than an input (only measures that are between $xx/MWh & $xxx/MWh)
- Resources are now added in increments rather than any amount
- Use more precise method to estimate frontier curve
- Meets both summer & winter capacity requirements
- Ability to retire resources
- Ability to account for greenhouse gas caps
- More accurate ability to take into account post IRP time period

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Questions/Open Discussion

2009

Electric
Integrated Resource Plan

Appendix B – 2009 Integrated Resource Planning Work Plan

August 31, 2009

2009 Integrated Resource Planning Work Plan

This Work Plan is provided in response to the WUTC's Integrated Resource Planning (IRP) rules (WAC 480-100-238). It outlines the process Avista will follow to develop its 2009 Integrated Resource Plan to be filed with Washington and Idaho Commissions by August 31, 2009. Avista uses a public process to obtain technical expertise and guidance throughout the planning period through a series of public Technical Advisory Committee (TAC) meetings. The first of these meetings was held on May 14, 2008.

The 2009 Integrated Resource Plan process will be similar to those used to produce the previous three published plans. Avista will be using AURORA^{xmp} for electric market forecasting, resource valuation, and for conducting Monte-Carlo style risk analyses. Results from AURORA^{xmp} will be used to select the Preferred Resource Strategy using the proprietary PRiSM 2.0 model. This tool fills future capacity and energy deficits using an efficient frontier approach to evaluate quantitative portfolio risk versus portfolio cost while accounting for environmental legislation. Qualitative risk will be evaluated in a separate analysis. The process to identify the Preferred Resource Strategy is shown in Exhibit 1 and the process time line is shown in Exhibit 2.

For this plan, Avista intends to use more detailed and site-specific resource assumptions to be determined by an ongoing process to evaluate renewable, gas, and other supply-side resources. This plan will also study environmental costs, sustained peaking requirements, and detailed analyses of demand-side management programs. This IRP will develop a strategy that meets or exceeds renewable portfolio standards and greenhouse gas emissions legislation.

It is Avista's intention to "stress" or test the Preferred Resource Strategy against a variety of scenarios and stochastic futures. The TAC will be an important factor to determine the underlying assumptions used in the scenarios and futures. The IRP process is a very technical and data intensive process; public comments are welcome and will require input in a timely manner for appropriate inclusion into the process so the plan can be submitted according to the contemplated schedule.

Tentative timeline for public Technical Advisory Committee meetings:

- **May 14, 2008 –** Load & resource balance, climate change, loss of load probability analysis, work plan, and analytical process changes
- **August 27, 2008 –** Risk and resource assumptions, scenarios and futures, and demand side management
- **October 22, 2008 –** Load forecast, electric and gas price forecasts, load & resource forecast balance, and transmission cost studies
- **January 28, 2009 –** Review of final modeling and assumptions, and draft PRS
- **March 25, 2009 –** Review of scenarios and futures, and portfolio analysis
- **April 22, 2009 –** Review of final PRS and action items
- **June 24, 2009 –** Review of the 2009 IRP

2009 Electric IRP Draft Outline

This section provides a draft outline of the major sections in the 2009 Electric IRP. This outline will be updated as IRP studies are completed and input from the Technical Advisory Committee has been received.

1. Executive Summary
2. Introduction and Stakeholder Involvement
3. Loads and Resources
    a. Economic Conditions
    b. Load Forecast
    c. Forecast Scenarios
    d. Supply Side Resources
    e. Reserve Margins
    f. Resource Requirements
4. Demand Side Management
5. Environmental Issues
6. Transmission Planning
7. Modeling Approach
    a. Assumptions and Inputs
    b. Risk Modeling
    c. Resource Alternatives
    d. The PRiSM Model
8. Market Modeling Approach
    a. Futures
    b. Scenarios
    c. Avoided Costs
9. Preferred Resource Strategy & Stress Analysis
10. Action Items

Exhibit 1: Avista's 2009 IRP Modeling Process

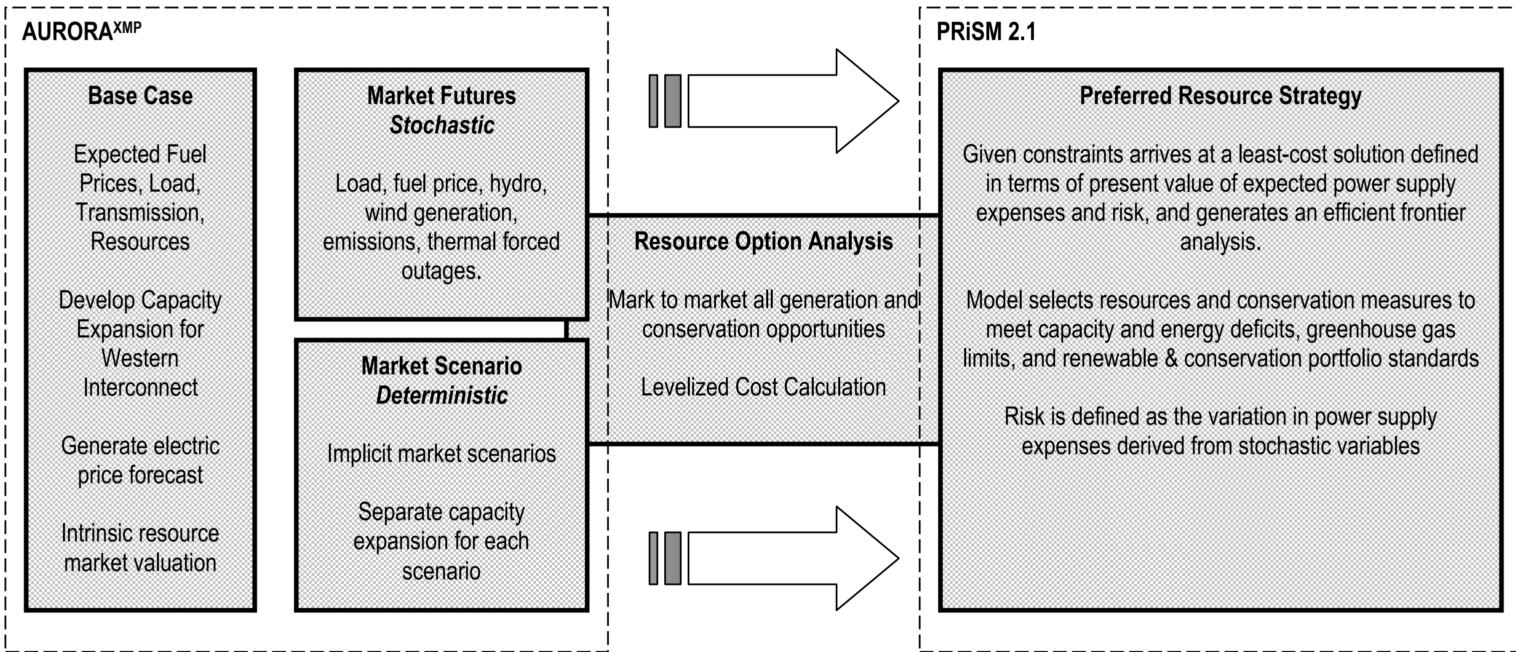

Exhibit 2: Avista's 2009 IRP Timeline

Task	Target Date
Preferred Resource Strategy (PRS)	
Finalize load forecast	7/31/2008
Identify regional resource options for electric market price forecast	8/15/2008
Identify Avista's supply & conservation resource options	8/31/2008
Update AURORA^{xmp} database for electric market price forecast	9/29/2008
Select natural gas price forecast	9/29/2008
Finalize deterministic base case	10/17/2008
Finalize datasets/statistics variables for risk studies	10/31/2008
Draft transmission study due	10/31/2008
Demand-side management load shapes input into AURORA	10/31/2008
Base case stochastic study complete	11/30/2008
Finalize PRiSM 2.1 model	12/19/2008
Final transmission study due	12/31/2008
Develop efficient frontier & PRS	1/30/2009
Simulation of risk studies "futures" complete	2/10/2009
Simulate market scenarios in AURORA^{xmp}	2/27/2009
Evaluate resource strategies against market futures & scenarios	3/20/2009
Present to TAC preliminary study and PRS	3/31/2009
Writing Tasks	
File 2009 integrated resource planning work plan	8/30/2008
Prepare report and appendix outline	9/15/2008
Prepare text drafts	4/15/2009
Prepare charts and tables	4/15/2009
Internal draft released	5/1/2009
External draft released	6/15/2009
Final editing and printing	8/1/2009
Final report distribution	8/30/2009

2009

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Appendix C – Residential and Non-residential Load Profiles

August 31, 2009

Load Shape	Description
1	Res Space Heat
2	Res AC
3	Res Lighting
4	Res Refrigeration
5	Res Water Heating
6	Res Dishwasher
7	Res Washer Dryer
8	Res Misc
9	Res Furnace Fan
10	NonRes Comp Air
11	NonRes Cooking
12	NonRes Space Cooling
13	NonRes Ext Lighting
14	NonRes Space Heating
15	NonRes Water Heating
16	NonRes Int Lighting
17	NonRes Misc
18	NonRes Motors
19	NonRes Office Equipment
20	NonRes Process
21	NonRes Refrigeration
22	NonRes Ventillation
23	Flat
24	NonRes Space Heat/Cool
25	NonRes Space Heat/Cool/Vent
26	NonRes LEED
27	NonRes Refrigerated Warehouses
28	Traffic Signal Red
29	Traffic Signal Green
30	Renewables
31	Multifamily Market Transformation
32	Res Heat/Cool
33	Res Energy Star Homes

2009

Electric
Integrated Resource Plan

Appendix D – DSM Concepts Reaching the Evaluation Stage

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August 31, 2009

Segment	Measure
Non-Res	Anti-Sweat Heat Controls
Non-Res	Auto-Closers for Coolers and Freezers
Non-Res	Built-Up HVAC Controls Optimization-Anchor-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Anchor-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Anchor-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Big Box-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Big Box-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Big Box-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-High End-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-High End-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-High End-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Hospital-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Hospital-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Hospital-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-K-12-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-K-12-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-K-12-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Large Off-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Large Off-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Large Off-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Lodging-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Lodging-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Lodging-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Medium Off-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Medium Off-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Medium Off-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-MIniMart-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-MIniMart-GasHt-Retro

Non-Res	Built-Up HVAC Controls Optimization-Other-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Other-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-OtherHealth-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-OtherHealth-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-OtherHealth-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Other-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Restaurant-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Restaurant-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Restaurant-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Small Box-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Small Box-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Small Box-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Small Off-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Small Off-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Small Off-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Supermarket-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Supermarket-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Supermarket-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-University-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-University-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-University-HtPmpHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Warehouse-ElecHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Warehouse-GasHt-Retro
Non-Res	Built-Up HVAC Controls Optimization-Warehouse-HtPmpHt-Retro
Non-Res	Controls Commission-New
Non-Res	EE Ice Maker from FEMP Baseline
Non-Res	EE Reach-In Freezer from E-Star Baseline
Non-Res	EE Reach-In Refrigerator from E-Star Baseline
Non-Res	EE Vending Machine from Average Baseline
Non-Res	EE Vending Machine from E-Star Baseline
Non-Res	Evaporative fan controller on walk-in
Non-Res	F96T12 to T8HP-Anchor-New-GasHt

Non-Res	F96T12 to T8HP-Anchor-Retro-ElecHt-PRE1987
Non-Res	F96T12 to T8HP-Anchor-Retro-ElecHt-V1987_1994
Non-Res	F96T12 to T8HP-Anchor-Retro-ElecHt-V1995_2001
Non-Res	F96T12 to T8HP-Anchor-Retro-GasHt-PRE1987
Non-Res	F96T12 to T8HP-Anchor-Retro-GasHt-V1987_1994
Non-Res	F96T12 to T8HP-Anchor-Retro-GasHt-V1995_2001
Non-Res	F96T12 to T8HP-Anchor-Retro-HtPmpHt-PRE1987
Non-Res	F96T12 to T8HP-Anchor-Retro-HtPmpHt-V1987_1994
Non-Res	F96T12 to T8HP-Anchor-Retro-HtPmpHt-V1995_2001
Non-Res	F96T12 to T8HP-Big Box-Retro-ElecHt-V1987_1994
Non-Res	F96T12 to T8HP-Big Box-Retro-ElecHt-V1995_2001
Non-Res	F96T12 to T8HP-Big Box-Retro-GasHt-V1987_1994
Non-Res	F96T12 to T8HP-Big Box-Retro-GasHt-V1995_2001
Non-Res	F96T12 to T8HP-Big Box-Retro-HtPmpHt-V1987_1994
Non-Res	F96T12 to T8HP-Big Box-Retro-HtPmpHt-V1995_2001
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Non-Res	F96T12 to T8HP-High End-Retro-GasHt-V1987_1994
Non-Res	F96T12 to T8HP-High End-Retro-HtPmpHt-V1987_1994
Non-Res	F96T12 to T8HP-Hospital-New-GasHt
Non-Res	F96T12 to T8HP-Hospital-Retro-ElecHt-PRE1987
Non-Res	F96T12 to T8HP-Hospital-Retro-ElecHt-V1987_1994
Non-Res	F96T12 to T8HP-Hospital-Retro-ElecHt-V1995_2001
Non-Res	F96T12 to T8HP-Hospital-Retro-GasHt-PRE1987
Non-Res	F96T12 to T8HP-Hospital-Retro-GasHt-V1987_1994
Non-Res	F96T12 to T8HP-Hospital-Retro-GasHt-V1995_2001
Non-Res	F96T12 to T8HP-Hospital-Retro-HtPmpHt-PRE1987
Non-Res	F96T12 to T8HP-Hospital-Retro-HtPmpHt-V1987_1994
Non-Res	F96T12 to T8HP-Hospital-Retro-HtPmpHt-V1995_2001
Non-Res	F96T12 to T8HP-K-12-Retro-ElecHt-V1995_2001

Non-Res	F96T12 to T8HP-K-12-Retro-GasHt-V1995_2001
Non-Res	F96T12 to T8HP-K-12-Retro-HtPmpHt-V1995_2001
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Non-Res	F96T12 to T8HP-Large Off-Retro-ElecHt-V1995_2001
Non-Res	F96T12 to T8HP-Large Off-Retro-GasHt-PRE1987
Non-Res	F96T12 to T8HP-Large Off-Retro-GasHt-V1995_2001
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Non-Res	F96T12 to T8HP-Small Box-Retro-HtPmpHt-V1995_2001
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Non-Res	F96T12 to T8HP-Small Off-Retro-ElecHt-V1987_1994
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Non-Res	F96T12 to T8HP-Warehouse-Retro-HtPmpHt-V1987_1994
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Non-Res	F96T12VHO to T8HP-4-Medium Off-Retro-GasHt-PRE1987
Non-Res	F96T12VHO to T8HP-4-Medium Off-Retro-GasHt-V1987_1994
Non-Res	F96T12VHO to T8HP-4-Medium Off-Retro-HtPmpHt-PRE1987
Non-Res	F96T12VHO to T8HP-4-Medium Off-Retro-HtPmpHt-V1987_1994

Non-Res	F96T12VHO to T8HP-4-MIniMart-Retro-ElecHt-V1987_1994
Non-Res	F96T12VHO to T8HP-4-MIniMart-Retro-GasHt-V1987_1994
Non-Res	F96T12VHO to T8HP-4-MIniMart-Retro-HtPmpHt-V1987_1994
Non-Res	F96T12VHO to T8HP-4-Small Off-Retro-ElecHt-PRE1987
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Non-Res	F96T12VHO to T8HP-4-Small Off-Retro-GasHt-PRE1987
Non-Res	F96T12VHO to T8HP-4-Small Off-Retro-GasHt-V1987_1994
Non-Res	F96T12VHO to T8HP-4-Small Off-Retro-HtPmpHt-PRE1987
Non-Res	F96T12VHO to T8HP-4-Small Off-Retro-HtPmpHt-V1987_1994
Non-Res	F96T12VHO to T8HP-4-Supermarket-Retro-ElecHt-V1987_1994
Non-Res	F96T12VHO to T8HP-4-Supermarket-Retro-GasHt-V1987_1994
Non-Res	F96T12VHO to T8HP-4-Supermarket-Retro-HtPmpHt-V1987_1994
Non-Res	F96T12VHO to T8HP-4-Warehouse-Retro-ElecHt-PRE1987
Non-Res	F96T12VHO to T8HP-4-Warehouse-Retro-ElecHt-V1987_1994
Non-Res	F96T12VHO to T8HP-4-Warehouse-Retro-GasHt-PRE1987
Non-Res	F96T12VHO to T8HP-4-Warehouse-Retro-GasHt-V1987_1994
Non-Res	F96T12VHO to T8HP-4-Warehouse-Retro-HtPmpHt-PRE1987
Non-Res	F96T12VHO to T8HP-4-Warehouse-Retro-HtPmpHt-V1987_1994
Non-Res	Floating Head Pressure Controller
Non-Res	Glass Doors on Open Display Cases (LT)
Non-Res	Glass Doors on Open Display Cases (MT)
Non-Res	INC to CFL-Hospital-New-ElecHt
Non-Res	INC to CFL-Hospital-New-GasHt
Non-Res	INC to CFL-Hospital-New-HtPmpHt
Non-Res	INC to CFL-Hospital-Retro-ElecHt-PRE1987
Non-Res	INC to CFL-Hospital-Retro-ElecHt-V1987_1994
Non-Res	INC to CFL-Hospital-Retro-ElecHt-V1995_2001
Non-Res	INC to CFL-Hospital-Retro-GasHt-PRE1987
Non-Res	INC to CFL-Hospital-Retro-GasHt-V1987_1994
Non-Res	INC to CFL-Hospital-Retro-GasHt-V1995_2001
Non-Res	INC to CFL-Hospital-Retro-HtPmpHt-PRE1987
Non-Res	INC to CFL-Hospital-Retro-HtPmpHt-V1987_1994
Non-Res	INC to CFL-Hospital-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CFL-K-12-New-ElecHt
Non-Res	INC to CFL-K-12-New-GasHt
Non-Res	INC to CFL-K-12-New-HtPmpHt
Non-Res	INC to CFL-K-12-Retro-ElecHt-PRE1987

Non-Res	INC to CFL-K-12-Retro-ElecHt-V1987_1994
Non-Res	INC to CFL-K-12-Retro-ElecHt-V1995_2001
Non-Res	INC to CFL-K-12-Retro-GasHt-PRE1987
Non-Res	INC to CFL-K-12-Retro-GasHt-V1987_1994
Non-Res	INC to CFL-K-12-Retro-GasHt-V1995_2001
Non-Res	INC to CFL-K-12-Retro-HtPmpHt-PRE1987
Non-Res	INC to CFL-K-12-Retro-HtPmpHt-V1987_1994
Non-Res	INC to CFL-K-12-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CFL-Large Off-New-ElecHt
Non-Res	INC to CFL-Large Off-New-GasHt
Non-Res	INC to CFL-Large Off-New-HtPmpHt
Non-Res	INC to CFL-Large Off-Retro-ElecHt-PRE1987
Non-Res	INC to CFL-Large Off-Retro-ElecHt-V1987_1994
Non-Res	INC to CFL-Large Off-Retro-ElecHt-V1995_2001
Non-Res	INC to CFL-Large Off-Retro-GasHt-PRE1987
Non-Res	INC to CFL-Large Off-Retro-GasHt-V1987_1994
Non-Res	INC to CFL-Large Off-Retro-GasHt-V1995_2001
Non-Res	INC to CFL-Large Off-Retro-HtPmpHt-PRE1987
Non-Res	INC to CFL-Large Off-Retro-HtPmpHt-V1987_1994
Non-Res	INC to CFL-Large Off-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CFL-Lodging-New-ElecHt
Non-Res	INC to CFL-Lodging-New-GasHt
Non-Res	INC to CFL-Lodging-New-HtPmpHt
Non-Res	INC to CFL-Lodging-Retro-ElecHt-PRE1987
Non-Res	INC to CFL-Lodging-Retro-ElecHt-V1987_1994
Non-Res	INC to CFL-Lodging-Retro-ElecHt-V1995_2001
Non-Res	INC to CFL-Lodging-Retro-GasHt-PRE1987
Non-Res	INC to CFL-Lodging-Retro-GasHt-V1987_1994
Non-Res	INC to CFL-Lodging-Retro-GasHt-V1995_2001
Non-Res	INC to CFL-Lodging-Retro-HtPmpHt-PRE1987
Non-Res	INC to CFL-Lodging-Retro-HtPmpHt-V1987_1994
Non-Res	INC to CFL-Lodging-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CFL-Medium Off-New-ElecHt
Non-Res	INC to CFL-Medium Off-New-GasHt
Non-Res	INC to CFL-Medium Off-New-HtPmpHt
Non-Res	INC to CFL-Medium Off-Retro-ElecHt-PRE1987
Non-Res	INC to CFL-Medium Off-Retro-ElecHt-V1987_1994
Non-Res	INC to CFL-Medium Off-Retro-ElecHt-V1995_2001
Non-Res	INC to CFL-Medium Off-Retro-GasHt-PRE1987
Non-Res	INC to CFL-Medium Off-Retro-GasHt-V1987_1994
Non-Res	INC to CFL-Medium Off-Retro-GasHt-V1995_2001
Non-Res	INC to CFL-Medium Off-Retro-HtPmpHt-PRE1987
Non-Res	INC to CFL-Medium Off-Retro-HtPmpHt-V1987_1994

Non-Res	INC to CFL-Medium Off-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CFL-OtherHealth-New-ElecHt
Non-Res	INC to CFL-OtherHealth-New-GasHt
Non-Res	INC to CFL-OtherHealth-New-HtPmpHt
Non-Res	INC to CFL-OtherHealth-Retro-ElecHt-PRE1987
Non-Res	INC to CFL-OtherHealth-Retro-ElecHt-V1987_1994
Non-Res	INC to CFL-OtherHealth-Retro-ElecHt-V1995_2001
Non-Res	INC to CFL-OtherHealth-Retro-GasHt-PRE1987
Non-Res	INC to CFL-OtherHealth-Retro-GasHt-V1987_1994
Non-Res	INC to CFL-OtherHealth-Retro-GasHt-V1995_2001
Non-Res	INC to CFL-OtherHealth-Retro-HtPmpHt-PRE1987
Non-Res	INC to CFL-OtherHealth-Retro-HtPmpHt-V1987_1994
Non-Res	INC to CFL-OtherHealth-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CFL-Other-New-ElecHt
Non-Res	INC to CFL-Other-New-GasHt
Non-Res	INC to CFL-Other-New-HtPmpHt
Non-Res	INC to CFL-Other-Retro-ElecHt-PRE1987
Non-Res	INC to CFL-Other-Retro-ElecHt-V1995_2001
Non-Res	INC to CFL-Other-Retro-GasHt-PRE1987
Non-Res	INC to CFL-Other-Retro-GasHt-V1995_2001
Non-Res	INC to CFL-Other-Retro-HtPmpHt-PRE1987
Non-Res	INC to CFL-Other-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CFL-Restaurant-New-ElecHt
Non-Res	INC to CFL-Restaurant-New-GasHt
Non-Res	INC to CFL-Restaurant-New-HtPmpHt
Non-Res	INC to CFL-Restaurant-Retro-ElecHt-PRE1987
Non-Res	INC to CFL-Restaurant-Retro-ElecHt-V1987_1994
Non-Res	INC to CFL-Restaurant-Retro-ElecHt-V1995_2001
Non-Res	INC to CFL-Restaurant-Retro-GasHt-PRE1987
Non-Res	INC to CFL-Restaurant-Retro-GasHt-V1987_1994
Non-Res	INC to CFL-Restaurant-Retro-GasHt-V1995_2001
Non-Res	INC to CFL-Restaurant-Retro-HtPmpHt-PRE1987
Non-Res	INC to CFL-Restaurant-Retro-HtPmpHt-V1987_1994
Non-Res	INC to CFL-Restaurant-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CFL-Small Off-New-ElecHt
Non-Res	INC to CFL-Small Off-New-GasHt
Non-Res	INC to CFL-Small Off-New-HtPmpHt
Non-Res	INC to CFL-Small Off-Retro-ElecHt-PRE1987
Non-Res	INC to CFL-Small Off-Retro-ElecHt-V1987_1994
Non-Res	INC to CFL-Small Off-Retro-ElecHt-V1995_2001

Non-Res	INC to CFL-Small Off-Retro-GasHt-PRE1987
Non-Res	INC to CFL-Small Off-Retro-GasHt-V1987_1994
Non-Res	INC to CFL-Small Off-Retro-GasHt-V1995_2001
Non-Res	INC to CFL-Small Off-Retro-HtPmpHt-PRE1987
Non-Res	INC to CFL-Small Off-Retro-HtPmpHt-V1987_1994
Non-Res	INC to CFL-Small Off-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CFL-University-Retro-ElecHt-PRE1987
Non-Res	INC to CFL-University-Retro-ElecHt-V1995_2001
Non-Res	INC to CFL-University-Retro-GasHt-PRE1987
Non-Res	INC to CFL-University-Retro-GasHt-V1995_2001
Non-Res	INC to CFL-University-Retro-HtPmpHt-PRE1987
Non-Res	INC to CFL-University-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CFL-Warehouse-New-ElecHt
Non-Res	INC to CFL-Warehouse-New-GasHt
Non-Res	INC to CFL-Warehouse-New-HtPmpHt
Non-Res	INC to CFL-Warehouse-Retro-ElecHt-V1995_2001
Non-Res	INC to CFL-Warehouse-Retro-GasHt-V1995_2001
Non-Res	INC to CFL-Warehouse-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CMH-Anchor-Retro-ElecHt-V1987_1994
Non-Res	INC to CMH-Anchor-Retro-GasHt-V1987_1994
Non-Res	INC to CMH-Anchor-Retro-HtPmpHt-V1987_1994
Non-Res	INC to CMH-Big Box-New-ElecHt
Non-Res	INC to CMH-Big Box-New-GasHt
Non-Res	INC to CMH-Big Box-New-HtPmpHt
Non-Res	INC to CMH-Big Box-Retro-ElecHt-V1995_2001
Non-Res	INC to CMH-Big Box-Retro-GasHt-V1995_2001
Non-Res	INC to CMH-Big Box-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CMH-High End-New-ElecHt
Non-Res	INC to CMH-High End-New-GasHt
Non-Res	INC to CMH-High End-New-HtPmpHt
Non-Res	INC to CMH-High End-Retro-ElecHt-PRE1987
Non-Res	INC to CMH-High End-Retro-ElecHt-V1987_1994
Non-Res	INC to CMH-High End-Retro-ElecHt-V1995_2001
Non-Res	INC to CMH-High End-Retro-GasHt-PRE1987
Non-Res	INC to CMH-High End-Retro-GasHt-V1987_1994
Non-Res	INC to CMH-High End-Retro-GasHt-V1995_2001
Non-Res	INC to CMH-High End-Retro-HtPmpHt-PRE1987
Non-Res	INC to CMH-High End-Retro-HtPmpHt-V1987_1994
Non-Res	INC to CMH-High End-Retro-HtPmpHt-V1995_2001

Non-Res	INC to CMH-MIniMart-New-ElecHt
Non-Res	INC to CMH-MIniMart-New-GasHt
Non-Res	INC to CMH-MIniMart-New-HtPmpHt
Non-Res	INC to CMH-MIniMart-Retro-ElecHt-PRE1987
Non-Res	INC to CMH-MIniMart-Retro-ElecHt-V1987_1994
Non-Res	INC to CMH-MIniMart-Retro-ElecHt-V1995_2001
Non-Res	INC to CMH-MIniMart-Retro-GasHt-PRE1987
Non-Res	INC to CMH-MIniMart-Retro-GasHt-V1987_1994
Non-Res	INC to CMH-MIniMart-Retro-GasHt-V1995_2001
Non-Res	INC to CMH-MIniMart-Retro-HtPmpHt-PRE1987
Non-Res	INC to CMH-MIniMart-Retro-HtPmpHt-V1987_1994
Non-Res	INC to CMH-MIniMart-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CMH-Small Box-New-ElecHt
Non-Res	INC to CMH-Small Box-New-GasHt
Non-Res	INC to CMH-Small Box-New-HtPmpHt
Non-Res	INC to CMH-Small Box-Retro-ElecHt-V1987_1994
Non-Res	INC to CMH-Small Box-Retro-ElecHt-V1995_2001
Non-Res	INC to CMH-Small Box-Retro-GasHt-V1987_1994
Non-Res	INC to CMH-Small Box-Retro-GasHt-V1995_2001
Non-Res	INC to CMH-Small Box-Retro-HtPmpHt-V1987_1994
Non-Res	INC to CMH-Small Box-Retro-HtPmpHt-V1995_2001
Non-Res	INC to CMH-Supermarket-Retro-ElecHt-PRE1987
Non-Res	INC to CMH-Supermarket-Retro-ElecHt-V1987_1994
Non-Res	INC to CMH-Supermarket-Retro-GasHt-PRE1987
Non-Res	INC to CMH-Supermarket-Retro-GasHt-V1987_1994
Non-Res	INC to CMH-Supermarket-Retro-HtPmpHt-PRE1987
Non-Res	INC to CMH-Supermarket-Retro-HtPmpHt-V1987_1994
Non-Res	INC to CMH-University-New-ElecHt
Non-Res	INC to CMH-University-New-GasHt
Non-Res	INC to CMH-University-New-HtPmpHt
Non-Res	Large MH to T5HO-Big Box-New-ElecHt
Non-Res	Large MH to T5HO-Big Box-New-GasHt
Non-Res	Large MH to T5HO-Big Box-New-HtPmpHt
Non-Res	Large MH to T5HO-Big Box-Retro-ElecHt-PRE1987
Non-Res	Large MH to T5HO-Big Box-Retro-ElecHt-V1987_1994
Non-Res	Large MH to T5HO-Big Box-Retro-ElecHt-V1995_2001
Non-Res	Large MH to T5HO-Big Box-Retro-GasHt-PRE1987
Non-Res	Large MH to T5HO-Big Box-Retro-GasHt-V1987_1994

Non-Res	Large MH to T5HO-Big Box-Retro-GasHt-V1995_2001
Non-Res	Large MH to T5HO-Big Box-Retro-HtPmpHt-PRE1987
Non-Res	Large MH to T5HO-Big Box-Retro-HtPmpHt-V1987_1994
Non-Res	Large MH to T5HO-Big Box-Retro-HtPmpHt-V1995_2001
Non-Res	Large MH to T5HO-Other-New-ElecHt
Non-Res	Large MH to T5HO-Other-New-GasHt
Non-Res	Large MH to T5HO-Other-New-HtPmpHt
Non-Res	Large MH to T5HO-Other-Retro-ElecHt-PRE1987
Non-Res	Large MH to T5HO-Other-Retro-ElecHt-V1987_1994
Non-Res	Large MH to T5HO-Other-Retro-GasHt-PRE1987
Non-Res	Large MH to T5HO-Other-Retro-GasHt-V1987_1994
Non-Res	Large MH to T5HO-Other-Retro-HtPmpHt-PRE1987
Non-Res	Large MH to T5HO-Other-Retro-HtPmpHt-V1987_1994
Non-Res	Large MH to T5HO-Warehouse-New-ElecHt
Non-Res	Large MH to T5HO-Warehouse-New-GasHt
Non-Res	Large MH to T5HO-Warehouse-New-HtPmpHt
Non-Res	Large MH to T5HO-Warehouse-Retro-ElecHt-PRE1987
Non-Res	Large MH to T5HO-Warehouse-Retro-ElecHt-V1987_1994
Non-Res	Large MH to T5HO-Warehouse-Retro-ElecHt-V1995_2001
Non-Res	Large MH to T5HO-Warehouse-Retro-GasHt-PRE1987
Non-Res	Large MH to T5HO-Warehouse-Retro-GasHt-V1987_1994
Non-Res	Large MH to T5HO-Warehouse-Retro-GasHt-V1995_2001
Non-Res	Large MH to T5HO-Warehouse-Retro-HtPmpHt-PRE1987
Non-Res	Large MH to T5HO-Warehouse-Retro-HtPmpHt-V1987_1994
Non-Res	Large MH to T5HO-Warehouse-Retro-HtPmpHt-V1995_2001
Non-Res	Med MH to T5HO-Other-New-ElecHt
Non-Res	Med MH to T5HO-Other-New-GasHt
Non-Res	Med MH to T5HO-Other-New-HtPmpHt
Non-Res	Med MH to T5HO-Supermarket-New-ElecHt
Non-Res	Med MH to T5HO-Supermarket-New-GasHt
Non-Res	Med MH to T5HO-Supermarket-New-HtPmpHt
Non-Res	Med MH to T8HP-Anchor-New-GasHt
Non-Res	Med MH to T8HP-Anchor-Retro-ElecHt-V1987_1994
Non-Res	Med MH to T8HP-Anchor-Retro-ElecHt-V1995_2001
Non-Res	Med MH to T8HP-Anchor-Retro-GasHt-V1987_1994

Non-Res	Med MH to T8HP-Anchor-Retro-GasHt-V1995_2001
Non-Res	Med MH to T8HP-Anchor-Retro-HtPmpHt-V1987_1994
Non-Res	Med MH to T8HP-Anchor-Retro-HtPmpHt-V1995_2001
Non-Res	Med MH to T8HP-High End-Retro-ElecHt-V1987_1994
Non-Res	Med MH to T8HP-High End-Retro-GasHt-V1987_1994
Non-Res	Med MH to T8HP-High End-Retro-HtPmpHt-V1987_1994
Non-Res	Med MH to T8HP-Hospital-New-GasHt
Non-Res	Med MH to T8HP-Hospital-Retro-ElecHt-V1995_2001
Non-Res	Med MH to T8HP-Hospital-Retro-GasHt-V1995_2001
Non-Res	Med MH to T8HP-Hospital-Retro-HtPmpHt-V1995_2001
Non-Res	Med MH to T8HP-K-12-Retro-ElecHt-PRE1987
Non-Res	Med MH to T8HP-K-12-Retro-ElecHt-V1987_1994
Non-Res	Med MH to T8HP-K-12-Retro-ElecHt-V1995_2001
Non-Res	Med MH to T8HP-K-12-Retro-GasHt-PRE1987
Non-Res	Med MH to T8HP-K-12-Retro-GasHt-V1987_1994
Non-Res	Med MH to T8HP-K-12-Retro-GasHt-V1995_2001
Non-Res	Med MH to T8HP-K-12-Retro-HtPmpHt-PRE1987
Non-Res	Med MH to T8HP-K-12-Retro-HtPmpHt-V1987_1994
Non-Res	Med MH to T8HP-K-12-Retro-HtPmpHt-V1995_2001
Non-Res	Med MH to T8HP-Large Off-Retro-ElecHt-V1987_1994
Non-Res	Med MH to T8HP-Large Off-Retro-ElecHt-V1995_2001
Non-Res	Med MH to T8HP-Large Off-Retro-GasHt-V1987_1994
Non-Res	Med MH to T8HP-Large Off-Retro-GasHt-V1995_2001
Non-Res	Med MH to T8HP-Large Off-Retro-HtPmpHt-V1987_1994
Non-Res	Med MH to T8HP-Large Off-Retro-HtPmpHt-V1995_2001
Non-Res	Med MH to T8HP-Medium Off-Retro-ElecHt-V1987_1994
Non-Res	Med MH to T8HP-Medium Off-Retro-ElecHt-V1995_2001
Non-Res	Med MH to T8HP-Medium Off-Retro-GasHt-V1987_1994
Non-Res	Med MH to T8HP-Medium Off-Retro-GasHt-V1995_2001
Non-Res	Med MH to T8HP-Medium Off-Retro-HtPmpHt-V1987_1994

Non-Res	Med MH to T8HP-Medium Off-Retro-HtPmpHt-V1995_2001
Non-Res	Med MH to T8HP-MIniMart-Retro-ElecHt-V1987_1994
Non-Res	Med MH to T8HP-MIniMart-Retro-ElecHt-V1995_2001
Non-Res	Med MH to T8HP-MIniMart-Retro-GasHt-V1987_1994
Non-Res	Med MH to T8HP-MIniMart-Retro-GasHt-V1995_2001
Non-Res	Med MH to T8HP-MIniMart-Retro-HtPmpHt-V1987_1994
Non-Res	Med MH to T8HP-MIniMart-Retro-HtPmpHt-V1995_2001
Non-Res	Med MH to T8HP-OtherHealth-New-GasHt
Non-Res	Med MH to T8HP-OtherHealth-Retro-ElecHt-V1995_2001
Non-Res	Med MH to T8HP-OtherHealth-Retro-GasHt-V1995_2001
Non-Res	Med MH to T8HP-OtherHealth-Retro-HtPmpHt-V1995_2001
Non-Res	Med MH to T8HP-Other-Retro-ElecHt-V1995_2001
Non-Res	Med MH to T8HP-Other-Retro-GasHt-V1995_2001
Non-Res	Med MH to T8HP-Other-Retro-HtPmpHt-V1995_2001
Non-Res	Med MH to T8HP-Small Box-New-GasHt
Non-Res	Med MH to T8HP-Small Box-Retro-ElecHt-PRE1987
Non-Res	Med MH to T8HP-Small Box-Retro-ElecHt-V1987_1994
Non-Res	Med MH to T8HP-Small Box-Retro-ElecHt-V1995_2001
Non-Res	Med MH to T8HP-Small Box-Retro-GasHt-PRE1987
Non-Res	Med MH to T8HP-Small Box-Retro-GasHt-V1987_1994
Non-Res	Med MH to T8HP-Small Box-Retro-GasHt-V1995_2001
Non-Res	Med MH to T8HP-Small Box-Retro-HtPmpHt-PRE1987
Non-Res	Med MH to T8HP-Small Box-Retro-HtPmpHt-V1987_1994
Non-Res	Med MH to T8HP-Small Box-Retro-HtPmpHt-V1995_2001
Non-Res	Med MH to T8HP-Supermarket-Retro-ElecHt-V1995_2001
Non-Res	Med MH to T8HP-Supermarket-Retro-GasHt-V1995_2001
Non-Res	Med MH to T8HP-Supermarket-Retro-HtPmpHt-V1995_2001
Non-Res	Med MH to T8HP-University-Retro-ElecHt-V1987_1994
Non-Res	Med MH to T8HP-University-Retro-GasHt-V1987_1994

Non-Res	Med MH to T8HP-University-Retro-HtPmpHt-V1987_1994
Non-Res	Night Covers for Display Cases - Horizontal
Non-Res	Night Covers for Display Cases - Vertical
Non-Res	Outdoor Sign Ballast - 24
Non-Res	Outdoor Sign Ballast - 24 - Retro
Non-Res	Outdoor Sign Ballast - Night
Non-Res	Outdoor Sign Ballast - Night - Retro
Non-Res	Perimeter Day lighting Controls (Advanced)-New-K-12-ElecHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-K-12-GasHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-K-12-HtPmpHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-Large Off-ElecHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-Large Off-GasHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-Large Off-HtPmpHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-Medium Off-ElecHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-Medium Off-GasHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-Medium Off-HtPmpHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-OtherHealth-ElecHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-OtherHealth-GasHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-OtherHealth-HtPmpHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-Small Off-ElecHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-Small Off-GasHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-Small Off-HtPmpHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-University-ElecHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-University-GasHt
Non-Res	Perimeter Day lighting Controls (Advanced)-New-University-HtPmpHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-K-12-ElecHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-K-12-GasHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-K-12-HtPmpHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-Large Off-ElecHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-Large Off-GasHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-Large Off-HtPmpHt

Non-Res	Perimeter Day lighting Controls (Advanced)-NR-Medium Off-ElecHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-Medium Off-GasHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-Medium Off-HtPmpHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-OtherHealth-ElecHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-OtherHealth-GasHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-OtherHealth-HtPmpHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-Small Off-ElecHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-Small Off-GasHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-Small Off-HtPmpHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-University-ElecHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-University-GasHt
Non-Res	Perimeter Day lighting Controls (Advanced)-NR-University-HtPmpHt
Non-Res	Replace 12 inch Green Incandescent Left Turn Bay with 12 inchGreen LED module
Non-Res	Replace 12 inch Green Incandescent Thru Lane with 12 inch Green LED module
Non-Res	Replace 12 inch Red Incandescent Left Turn Bay with 12 inch Red LED module
Non-Res	Replace 12 inch Red Incandescent Thru Lane with 12 inch Red LED module
Non-Res	Replace 8 inch Red Incandescent Left Turn Bay with 8 inch Red LED module
Non-Res	Replace 8 inch Red Incandescent Thru Lane with 8 inch Red LED module
Non-Res	Special Doors with Low/No Anti-Sweat Heat
Non-Res	Strip Curtains for Walk-in Boxes
Non-Res	T12-2 to T8HP-1-Other-Retro-ElecHt-PRE1987
Non-Res	T12-2 to T8HP-1-Other-Retro-GasHt-PRE1987
Non-Res	T12-2 to T8HP-1-Other-Retro-HtPmpHt-PRE1987
Non-Res	T12-3 to T8HP-2-High End-New-GasHt
Non-Res	T12-3 to T8HP-2-High End-Retro-ElecHt-V1995_2001
Non-Res	T12-3 to T8HP-2-High End-Retro-GasHt-V1995_2001
Non-Res	T12-3 to T8HP-2-High End-Retro-HtPmpHt-V1995_2001
Non-Res	T12-3 to T8HP-2-K-12-Retro-ElecHt-V1987_1994
Non-Res	T12-3 to T8HP-2-K-12-Retro-GasHt-V1987_1994
Non-Res	T12-3 to T8HP-2-K-12-Retro-HtPmpHt-V1987_1994
Non-Res	T12-3 to T8HP-2-Small Off-Retro-ElecHt-V1995_2001

Non-Res	T12-3 to T8HP-2-Small Off-Retro-GasHt-V1995_2001
Non-Res	T12-3 to T8HP-2-Small Off-Retro-HtPmpHt-V1995_2001
Non-Res	T12-3 to T8HP-3-Anchor-Retro-ElecHt-V1987_1994
Non-Res	T12-3 to T8HP-3-Anchor-Retro-GasHt-V1987_1994
Non-Res	T12-3 to T8HP-3-Anchor-Retro-HtPmpHt-V1987_1994
Non-Res	T12-3 to T8HP-3-Big Box-Retro-ElecHt-PRE1987
Non-Res	T12-3 to T8HP-3-Big Box-Retro-GasHt-PRE1987
Non-Res	T12-3 to T8HP-3-Big Box-Retro-HtPmpHt-PRE1987
Non-Res	T12-3 to T8HP-3-High End-Retro-ElecHt-PRE1987
Non-Res	T12-3 to T8HP-3-High End-Retro-ElecHt-V1987_1994
Non-Res	T12-3 to T8HP-3-High End-Retro-GasHt-PRE1987
Non-Res	T12-3 to T8HP-3-High End-Retro-GasHt-V1987_1994
Non-Res	T12-3 to T8HP-3-High End-Retro-HtPmpHt-PRE1987
Non-Res	T12-3 to T8HP-3-High End-Retro-HtPmpHt-V1987_1994
Non-Res	T12-3 to T8HP-3-MIniMart-Retro-ElecHt-PRE1987
Non-Res	T12-3 to T8HP-3-MIniMart-Retro-GasHt-PRE1987
Non-Res	T12-3 to T8HP-3-MIniMart-Retro-HtPmpHt-PRE1987
Non-Res	T12-3 to T8HP-3-OtherHealth-Retro-ElecHt-PRE1987
Non-Res	T12-3 to T8HP-3-OtherHealth-Retro-ElecHt-V1987_1994
Non-Res	T12-3 to T8HP-3-OtherHealth-Retro-GasHt-PRE1987
Non-Res	T12-3 to T8HP-3-OtherHealth-Retro-GasHt-V1987_1994
Non-Res	T12-3 to T8HP-3-OtherHealth-Retro-HtPmpHt-PRE1987
Non-Res	T12-3 to T8HP-3-OtherHealth-Retro-HtPmpHt-V1987_1994
Non-Res	T12-3 to T8HP-3-Restaurant-Retro-ElecHt-PRE1987
Non-Res	T12-3 to T8HP-3-Restaurant-Retro-ElecHt-V1987_1994
Non-Res	T12-3 to T8HP-3-Restaurant-Retro-GasHt-PRE1987
Non-Res	T12-3 to T8HP-3-Restaurant-Retro-GasHt-V1987_1994
Non-Res	T12-3 to T8HP-3-Restaurant-Retro-HtPmpHt-PRE1987

Non-Res	T12-3 to T8HP-3-Restaurant-Retro-HtPmpHt-V1987_1994
Non-Res	T12-3 to T8HP-3-Supermarket-Retro-ElecHt-PRE1987
Non-Res	T12-3 to T8HP-3-Supermarket-Retro-GasHt-PRE1987
Non-Res	T12-3 to T8HP-3-Supermarket-Retro-HtPmpHt-PRE1987
Non-Res	T12-3 to T8HP-3-University-Retro-ElecHt-V1987_1994
Non-Res	T12-3 to T8HP-3-University-Retro-GasHt-V1987_1994
Non-Res	T12-3 to T8HP-3-University-Retro-HtPmpHt-V1987_1994
Non-Res	T12-4 to T8HP-2-Large Off-Retro-ElecHt-PRE1987
Non-Res	T12-4 to T8HP-2-Large Off-Retro-ElecHt-V1987_1994
Non-Res	T12-4 to T8HP-2-Large Off-Retro-GasHt-PRE1987
Non-Res	T12-4 to T8HP-2-Large Off-Retro-GasHt-V1987_1994
Non-Res	T12-4 to T8HP-2-Large Off-Retro-HtPmpHt-PRE1987
Non-Res	T12-4 to T8HP-2-Large Off-Retro-HtPmpHt-V1987_1994
Non-Res	T12-4 to T8HP-2-Medium Off-Retro-ElecHt-PRE1987
Non-Res	T12-4 to T8HP-2-Medium Off-Retro-ElecHt-V1987_1994
Non-Res	T12-4 to T8HP-2-Medium Off-Retro-GasHt-PRE1987
Non-Res	T12-4 to T8HP-2-Medium Off-Retro-GasHt-V1987_1994
Non-Res	T12-4 to T8HP-2-Medium Off-Retro-HtPmpHt-PRE1987
Non-Res	T12-4 to T8HP-2-Medium Off-Retro-HtPmpHt-V1987_1994
Non-Res	T12-4 to T8HP-2-MIniMart-Retro-ElecHt-V1987_1994
Non-Res	T12-4 to T8HP-2-MIniMart-Retro-GasHt-V1987_1994
Non-Res	T12-4 to T8HP-2-MIniMart-Retro-HtPmpHt-V1987_1994
Non-Res	T12-4 to T8HP-2-Small Off-Retro-ElecHt-PRE1987
Non-Res	T12-4 to T8HP-2-Small Off-Retro-ElecHt-V1987_1994
Non-Res	T12-4 to T8HP-2-Small Off-Retro-GasHt-PRE1987
Non-Res	T12-4 to T8HP-2-Small Off-Retro-GasHt-V1987_1994
Non-Res	T12-4 to T8HP-2-Small Off-Retro-HtPmpHt-PRE1987
Non-Res	T12-4 to T8HP-2-Small Off-Retro-HtPmpHt-V1987_1994

Non-Res	T12-4 to T8HP-2-Supermarket-Retro-ElecHt-V1987_1994
Non-Res	T12-4 to T8HP-2-Supermarket-Retro-GasHt-V1987_1994
Non-Res	T12-4 to T8HP-2-Supermarket-Retro-HtPmpHt-V1987_1994
Non-Res	T12-4 to T8HP-3-Anchor-Retro-ElecHt-PRE1987
Non-Res	T12-4 to T8HP-3-Anchor-Retro-GasHt-PRE1987
Non-Res	T12-4 to T8HP-3-Anchor-Retro-HtPmpHt-PRE1987
Non-Res	T12-4 to T8HP-3-Big Box-Retro-ElecHt-V1987_1994
Non-Res	T12-4 to T8HP-3-Big Box-Retro-GasHt-V1987_1994
Non-Res	T12-4 to T8HP-3-Big Box-Retro-HtPmpHt-V1987_1994
Non-Res	T12-4 to T8HP-3-Small Box-Retro-ElecHt-PRE1987
Non-Res	T12-4 to T8HP-3-Small Box-Retro-GasHt-PRE1987
Non-Res	T12-4 to T8HP-3-Small Box-Retro-HtPmpHt-PRE1987
Non-Res	Vending Machine Controller-Large Machine w/Illuminated Front
Non-Res	Vending Machine Controller-Small Machine or Machine without Illuminated Front
Non-Res	VSD Large Fan
Non-Res	VSD Medium fan
Non-Res	VSD Pump
Non-Res	VSD Small Fan
Res	Biradiant Oven
Res	Bottom Freezer - No Ice
Res	Energy Conservation School Program
Res	Energy Star Dishwasher (EF 68) - PNW DHW Fuel Average + NEB Waste Water Treatment Savings
Res	Energy Star Dishwasher (EF58) - PNW DHW Fuel Average + NEB of Waste Water Treatment Savings
Res	Energy Star Dishwasher (EF76) - PNW DHW Fuel Average + NEB Waste Water Treatment Savings
Res	Energy Star Dishwasher (EF85) - PNW DHW Fuel Average + NEB Waste Water Treatment Savings
Res	Heat Traps + Increased Insulation (3 1/2" foam) + Insulated Tank Bottom & Plastic Tank w/minimum 10 yr warranty
Res	Heat Traps + Increased Insulation (3" foam) + Insulated Tank Bottom w/minimum 10 year Warranty
Res	Heating System Maintenance (tune-up/filter)
Res	Improved Oven Insulation
Res	Improved Oven Seals

Res	Manufactured Home NonSGC Forced Air Furnace w/CAC - PTCS Duct Sealing and System Commissioning Heat Zone 1
Res	Manufactured Home NonSGC Forced Air Furnace w/CAC - PTCS Duct Sealing and System Commissioning Heat Zone 2
Res	Manufactured Home NonSGC Forced Air Furnace w/CAC - PTCS Duct Sealing Heat Zone 1
Res	Manufactured Home NonSGC Forced Air Furnace w/CAC - PTCS Duct Sealing Heat Zone 2
Res	Manufactured Home NonSGC Forced Air Furnace w/o CAC - PTCS Duct Sealing Heat Zone 1
Res	Manufactured Home NonSGC Forced Air Furnace w/o CAC - PTCS Duct Sealing Heat Zone 2
Res	Manufactured Home NonSGC Heat Pump - PTCS Duct Sealing and System Commissioning Heat Zone 1
Res	Manufactured Home NonSGC Heat Pump - PTCS Duct Sealing and System Commissioning Heat Zone 2
Res	Manufactured Home NonSGC Heat Pump - PTCS Duct Sealing Heat Zone 1
Res	Manufactured Home NonSGC Heat Pump - PTCS Duct Sealing Heat Zone 2
Res	Manufactured Home NonSGC Heat Pump - PTCS Duct Sealing, Commissioning and Controls Heat Zone 1
Res	Manufactured Home NonSGC Heat Pump - PTCS Duct Sealing, Commissioning and Controls Heat Zone 2
Res	Manufactured Home NonSGC Heat Pump - PTCS System Commissioning Heat Zone 1
Res	Manufactured Home NonSGC Heat Pump - PTCS System Commissioning Heat Zone 2
Res	Manufactured Home SGC Forced Air Furnace w/CAC - PTCS Duct Sealing and System Commissioning Heat Zone 1
Res	Manufactured Home SGC Forced Air Furnace w/CAC - PTCS Duct Sealing and System Commissioning Heat Zone 2
Res	Manufactured Home SGC Forced Air Furnace w/CAC - PTCS Duct Sealing Heat Zone 1
Res	Manufactured Home SGC Forced Air Furnace w/CAC - PTCS Duct Sealing Heat Zone 2
Res	Manufactured Home SGC Forced Air Furnace w/o CAC - PTCS Duct Sealing Heat Zone 1
Res	Manufactured Home SGC Forced Air Furnace w/o CAC - PTCS Duct Sealing Heat Zone 2
Res	Manufactured Home SGC Heat Pump - PTCS Duct Sealing and System Commissioning Heat Zone 1

Res	Manufactured Home SGC Heat Pump - PTCS Duct Sealing and System Commissioning Heat Zone 2
Res	Manufactured Home SGC Heat Pump - PTCS Duct Sealing Heat Zone 1
Res	Manufactured Home SGC Heat Pump - PTCS Duct Sealing Heat Zone 2
Res	Manufactured Home SGC Heat Pump - PTCS Duct Sealing, Commissioning and Controls Heat Zone 1
Res	Manufactured Home SGC Heat Pump - PTCS Duct Sealing, Commissioning and Controls Heat Zone 2
Res	Manufactured Home SGC Heat Pump - PTCS System Commissioning Heat Zone 1
Res	Manufactured Home SGC Heat Pump - PTCS System Commissioning Heat Zone 2
Res	Manufactured Home Weatherization - Heating Zone 1
Res	Manufactured Home Weatherization - Heating Zone 2
Res	Multifamily Weatherization - Heating Zone 1
Res	Multifamily Weatherization - Heating Zone 2
Res	New MultiFamily Construction, DHW & Shower Preheat, Electric Resistance
Res	New MultiFamily Construction, DHW Preheat, Electric Resistance
Res	New MultiFamily Construction, Shower Preheat, Electric Resistance
Res	New Single Family Construction, DHW & Shower Preheat, Electric Resistance
Res	New Single Family Construction, DHW Preheat, Electric Resistance
Res	New Single Family Construction, Shower Preheat, Electric Resistance
Res	Post79/Pre93 Single Family Construction CAC Upgrade SEER - Cooling Zone 3
Res	Post79/Pre93 Single Family Construction CAC Upgrade SEER - Cooling Zone 3
Res	Post79/Pre93 Single Family Construction CAC Upgrade SEER - Cooling Zone 3
Res	Post79/Pre93 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Post79/Pre93 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Post79/Pre93 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Post79/Pre93 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Post79/Pre93 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating

Res	Post79/Pre93 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Post79/Pre93 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat
Res	Post79/Pre93 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat
Res	Post79/Pre93 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat
Res	Post79/Pre93 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat
Res	Post79/Pre93 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat
Res	Post79/Pre93 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat
Res	Post79/Pre93 Single Family Construction Convert Zonal Heating w/o CAC to HP HSPF 8/SEER 13 - Heat
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 1
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 1
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 1
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 2
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 2

Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 2
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 1
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 1
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 1
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 2
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 2
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 2
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 1
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 1
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 1
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 2
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 2
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 2
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 1
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 1
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 1
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 2
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 2
Res	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 2

Res	Post79/Pre93 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1
Res	Post79/Pre93 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1
Res	Post79/Pre93 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1
Res	Post79/Pre93 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2
Res	Post79/Pre93 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2
Res	Post79/Pre93 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2
Res	Post92 Single Family Construction CAC Upgrade SEER - Cooling Zone 3
Res	Post92 Single Family Construction CAC Upgrade SEER - Cooling Zone 3
Res	Post92 Single Family Construction CAC Upgrade SEER - Cooling Zone 3
Res	Post92 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Post92 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Post92 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Post92 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Post92 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Post92 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Post92 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Post92 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Post92 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Post92 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Post92 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Post92 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Post92 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat
Res	Post92 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat
Res	Post92 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat
Res	Post92 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat
Res	Post92 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat

Res	Post92 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1
Res	Post92 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1
Res	Post92 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1
Res	Post92 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2
Res	Post92 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2
Res	Post92 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2
Res	Post92 Single Family Contruction Geothermal Heat Pump vs Air Source Heat Pump - Zone 1
Res	Post92 Single Family Contruction Geothermal Heat Pump vs Air Source Heat Pump - Zone 2
Res	Post92 Single Family Contruction Geothermal Heat Pump vs Air Source Heat Pump - Zone 2
Res	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/CAC - Zone 1
Res	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/CAC - Zone 1
Res	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/CAC - Zone 1
Res	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/CAC - Zone 2
Res	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/CAC - Zone 2
Res	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/CAC - Zone 2
Res	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/oCAC - Zone 1
Res	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/oCAC - Zone 1
Res	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/oCAC - Zone 1
Res	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/oCAC - Zone 2
Res	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/oCAC - Zone 2
Res	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/oCAC - Zone 2
Res	Post92 Single Family Contruction Geothermal Heat Pump vs Zonal Heating - Zone 2
Res	Post92 Single Family Contruction Geothermal Heat Pump vs Zonal Heating - Zone 2
Res	Post92 Single Family Contruction Geothermal Heat Pump vs Zonal Heating - Zone 2
Res	Post93 Manufactured Home NonSGC CAC Upgrade SEER w/PTCS - Cooling Zone 3
Res	Post93 Manufactured Home NonSGC Convert FAF w/CAC to HP HSPF 8/SEER 12 - Heating
Res	Post93 Manufactured Home NonSGC Convert FAF w/CAC to HP HSPF 8/SEER 12 - Heating
Res	Post93 Manufactured Home NonSGC Convert FAF w/o CAC to HP HSPF 8/SEER 12 - Heating

Res	Post93 Manufactured Home NonSGC Convert FAF w/o CAC to HP HSPF 8/SEER 12 - Heating
Res	Post93 Manufactured Home NonSGC HP Upgrade HSPF 8 w/PTCS - Cooling Zone 1
Res	Post93 Manufactured Home NonSGC HP Upgrade HSPF 8 w/PTCS - Cooling Zone 2
Res	Post93 NonSGC Manufactured Home Convert FAF w/CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 1
Res	Post93 NonSGC Manufactured Home Convert FAF w/CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 2
Res	Post93 NonSGC Manufactured Home Convert FAF w/o CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 1
Res	Post93 NonSGC Manufactured Home Convert FAF w/o CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 2
Res	Pre80 Single Family Construction CAC Upgrade SEER - Cooling Zone 3
Res	Pre80 Single Family Construction CAC Upgrade SEER - Cooling Zone 3
Res	Pre80 Single Family Construction CAC Upgrade SEER - Cooling Zone 3
Res	Pre80 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Pre80 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Pre80 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Pre80 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Pre80 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Pre80 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating
Res	Pre80 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Pre80 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Pre80 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Pre80 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Pre80 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Pre80 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating
Res	Pre80 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat
Res	Pre80 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat
Res	Pre80 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat

Res	Pre80 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 1
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 1
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 1
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 2
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 2
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 1
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 1
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 1
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 2
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 2
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 2
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 1
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 1
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 1
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 2
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 2
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 2
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 1

Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 1
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 1
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 2
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 2
Res	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 2
Res	Pre80 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1
Res	Pre80 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1
Res	Pre80 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1
Res	Pre80 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2
Res	Pre80 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2
Res	Pre80 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2
Res	Pre94 Manufactured Home CAC Upgrade SEER w/PTCS - Cooling Zone 3
Res	Pre94 Manufactured Home Convert FAF w/CAC to HP HSPF 8/SEER 12 - Heating
Res	Pre94 Manufactured Home Convert FAF w/CAC to HP HSPF 8/SEER 12 - Heating
Res	Pre94 Manufactured Home Convert FAF w/o CAC to HP HSPF 8/SEER 12 - Heating
Res	Pre94 Manufactured Home Convert FAF w/o CAC to HP HSPF 8/SEER 12 - Heating
Res	Pre94 NonSGC Manufactured Home Convert FAF w/CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 1
Res	Pre94 NonSGC Manufactured Home Convert FAF w/CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 2
Res	Pre94 NonSGC Manufactured Home Convert FAF w/o CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 1
Res	Pre94 NonSGC Manufactured Home Convert FAF w/o CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 2
Res	Reduced Oven Ventilation Rate
Res	SGC - Heating Zone 1
Res	SGC - Heating Zone 2
Res	SGC - Zone 1
Res	SGC - Zone 2
Res	SGC Manufactured Home CAC Upgrade SEER w/PTCS - Cooling Zone 3

Res	SGC Manufactured Home Convert FAF w/CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 2
Res	SGC Manufactured Home Convert FAF w/CAC to HP HSPF 8/SEER 12 - Heating
Res	SGC Manufactured Home Convert FAF w/CAC to HP HSPF 8/SEER 12 - Heating
Res	SGC Manufactured Home Convert FAF w/o CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 2
Res	SGC Manufactured Home Convert FAF w/o CAC to HP HSPF 8/SEER 12 - Heating
Res	SGC Manufactured Home Convert FAF w/o CAC to HP HSPF 8/SEER 12 - Heating
Res	SGCSF - Heating Zone 1
Res	SGCSF - Heating Zone 2
Res	Side-by-Side Model - Ice
Res	Side-by-Side Model - No Ice
Res	Single Family Heat Pump - PTCS Duct Sealing and System Commissioning Heat Zone 1
Res	Single Family Heat Pump - PTCS Duct Sealing and System Commissioning Heat Zone 2
Res	Single Family Heat Pump - PTCS System Commissioning Heat Zone 1
Res	Single Family Heat Pump - PTCS System Commissioning Heat Zone 2
Res	Single Family Weatherization - Zone 1
Res	Single Family Weatherization - Zone 2
Res	Top Freezer - Ice
Res	Top Freezer - No Ice
Res	Weighted Average - Interior & Exterior Wattage - 92 Watt

2009

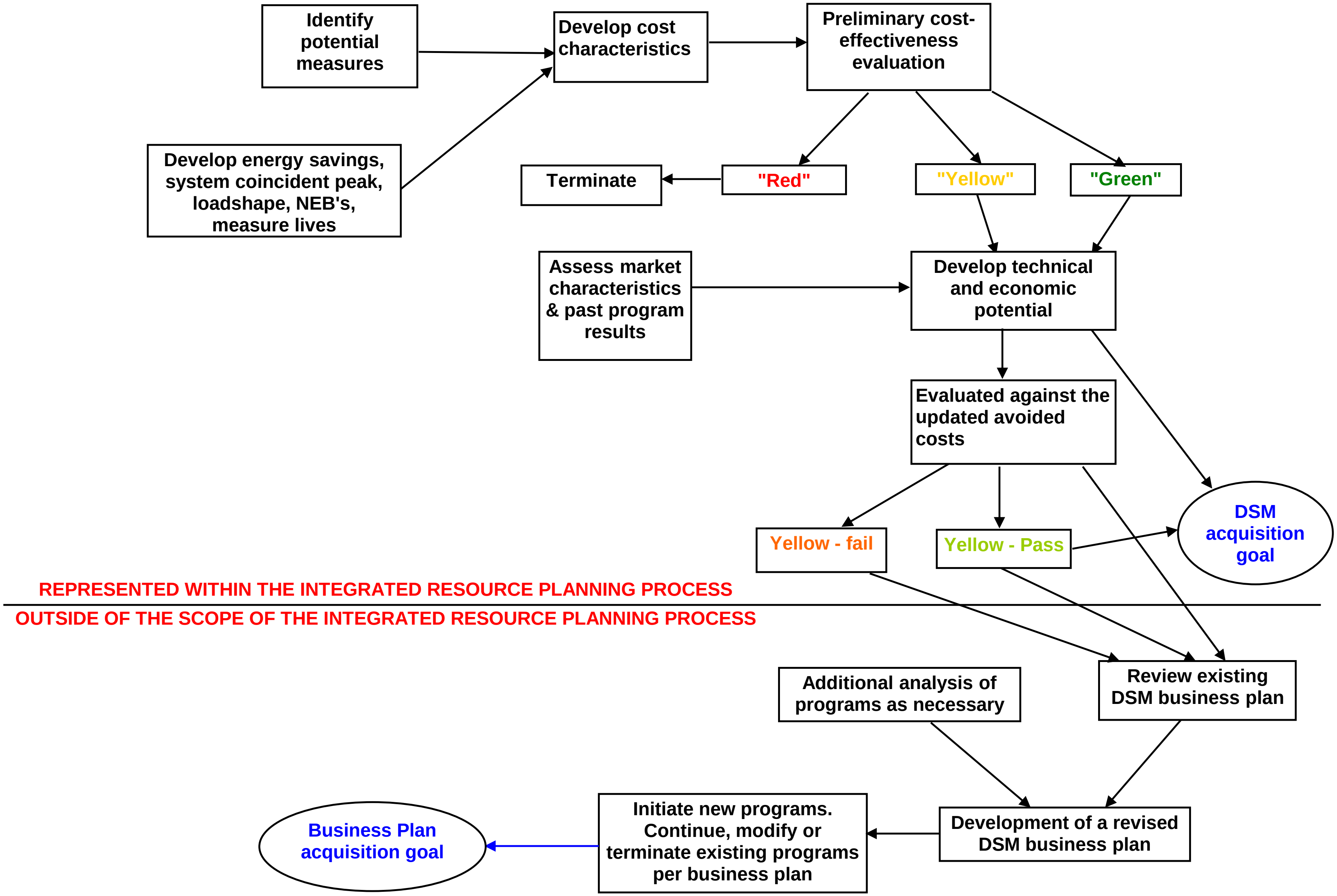
Electric
Integrated Resource Plan

Appendix E – Integration of DSM within the 2009 Electric IRP

August 31, 2009

Exhibit No. 4
Case Nos. AVU-E-12-08
R. Lafferty, Avista
Schedule 5, Page 680 of 729

Integration of DSM within the 2009 Electric IRP



2009

Electric
Integrated Resource Plan

Appendix F – Achievable 20-Year Potential for Residential and Non-Residential DSM Programs

August 31, 2009

Acheiveable Potential (20-yr) for Res and Non-Res (excludes low-income/non-res site specific)

(in 2009 $s)

Meas #	Segment	Category	Measure	achievable potential (20 yr)	levelized trc cost 2009	Life
46.5	Res	Dishwash	Energy Star Dishwasher (EF58) - PNW DHW Fuel Average + NEB of Waste Water Treatment Savings	835,250	0.00	9
52.5	Res	Dishwash	Energy Star Dishwasher (EF 68) - PNW DHW Fuel Average + NEB Waste Water Treatment Savings	835,250	0.01	9
58.5	Res	Dishwash	Energy Star Dishwasher (EF76) - PNW DHW Fuel Average + NEB Waste Water Treatment Savings	835,250	0.61	9
64.5	Res	Dishwash	Energy Star Dishwasher (EF85) - PNW DHW Fuel Average + NEB Waste Water Treatment Savings	835,250	1.98	9
104	Res	Lighting	Weighted Average - Interior & Exterior Wattage - 92 Watt	250,452,883	0.03	9
106	Res	Appliance	Bottom Freezer - No Ice	659,410	0.04	19
107	Res	Appliance	Side-by-Side Model - No Ice	659,410	0.03	19
108	Res	Appliance	Side-by-Side Model - Ice	659,410	0.52	19
109	Res	Appliance	Top Freezer - No Ice	659,410	0.24	19
110	Res	Appliance	Top Freezer - Ice	659,410	0.13	19
111	Res	DHW	New Single Family Construction, Shower Preheat, Electric Resistance	44,117	0.11	40
113	Res	DHW	New Single Family Construction, DHW & Shower Preheat, Electric Resistance	126,027	0.08	40
115	Res	DHW	New Single Family Construction, DHW Preheat, Electric Resistance	50,419	0.10	40
117	Res	DHW	New MultiFamily Construction, Shower Preheat, Electric Resistance	17,638	0.09	40
119	Res	DHW	New MultiFamily Construction, DHW & Shower Preheat, Electric Resistance	50,419	0.07	40
121	Res	DHW	New MultiFamily Construction, DHW Preheat, Electric Resistance	20,155	0.08	40
129	Res	Cooking	Reduced Oven Ventilation Rate	24,336	0.03	20
130	Res	Cooking	Improved Oven Insulation	23,712	0.11	20
131	Res	Cooking	Improved Oven Seals	7,904	0.86	20
132	Res	Cooking	Biradiant Oven	163,072	0.26	20
133	Res	DHW	Heat Traps + Increased Insulation (3" foam) + Insulated Tank Bottom w/minimum 10 year Warranty	92,976	0.03	12
134	Res	DHW	Heat Traps + Increased Insulation (3 1/2" foam) + Insulated Tank Bottom & Plastic Tank w/minimum 10 yr warranty	29,370	0.04	12
172	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 1	892,459	0.18	30
175	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 2	892,459	0.13	30
178	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 1	892,459	0.09	30

181	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 2	892,459	0.07	30
184	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 1	892,459	0.09	30
187	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 2	892,459	0.06	30
190	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 1	892,459	0.09	30
193	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 2	892,459	0.06	30
196	Res	HP Upgrade	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 1	892,459	0.15	30
199	Res	HP Upgrade	Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 2	892,459	0.11	30
202	Res	HP Upgrade	Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 1	892,459	0.08	30
205	Res	HP Upgrade	Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 2	892,459	0.06	30
208	Res	HP Upgrade	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 1	892,459	0.06	30
211	Res	HP Upgrade	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 2	892,459	0.04	30
214	Res	HP Upgrade	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 1	892,459	0.06	30
217	Res	HP Upgrade	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 2	892,459	0.04	30
223	Res	HP Upgrade	Post92 Single Family Contruction Geothermal Heat Pump vs Zonal Heating - Zone 2	892,459	0.18	30
226	Res	HP Upgrade	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/oCAC - Zone 1	892,459	0.11	30
229	Res	HP Upgrade	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/oCAC - Zone 2	892,459	0.07	30
232	Res	HP Upgrade	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/CAC - Zone 1	892,459	0.11	30
235	Res	HP Upgrade	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/CAC - Zone 2	892,459	0.07	30
238	Res	HP Upgrade	Post92 Single Family Contruction Geothermal Heat Pump vs Air Source Heat Pump - Zone 1	892,459	0.14	30
241	Res	HP Upgrade	Post92 Single Family Contruction Geothermal Heat Pump vs Air Source Heat Pump - Zone 2	892,459	0.10	30
244	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 1	892,459	0.17	30
247	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 2	892,459	0.12	30
250	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 1	892,459	0.17	30

256	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 1	892,459	0.11	30
259	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 2	892,459	0.08	30
262	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 1	892,459	0.11	30
265	Res	HP Upgrade	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 2	892,459	0.08	30
268	Res	HP Upgrade	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 1	892,459	0.15	30
271	Res	HP Upgrade	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 2	892,459	0.11	30
274	Res	HP Upgrade	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 1	892,459	0.14	30
277	Res	HP Upgrade	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 2	892,459	0.11	30
280	Res	HP Upgrade	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 1	892,459	0.08	30
283	Res	HP Upgrade	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 2	892,459	0.06	30
286	Res	HP Upgrade	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 1	892,459	0.08	30
289	Res	HP Upgrade	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 2	892,459	0.06	30
295	Res	HP Conv	Post92 Single Family Contruction Geothermal Heat Pump vs Zonal Heating - Zone 2	484,272	0.17	30
298	Res	HP Conv	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/oCAC - Zone 1	484,272	0.14	30
301	Res	HP Conv	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/oCAC - Zone 2	484,272	0.10	30
304	Res	HP Conv	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/CAC - Zone 1	484,272	0.14	30
307	Res	HP Conv	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/CAC - Zone 2	484,272	0.10	30
313	Res	HP Conv	Post92 Single Family Contruction Geothermal Heat Pump vs Air Source Heat Pump - Zone 2	484,272	0.18	30
316	Res	HP Conv	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 1	484,272	0.17	30
319	Res	HP Conv	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 2	484,272	0.12	30
322	Res	HP Conv	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 1	484,272	0.22	30

325	Res	HP Conv	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 2	484,272	0.17	30
328	Res	HP Conv	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 1	484,272	0.13	30
331	Res	HP Conv	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 2	484,272	0.09	30
334	Res	HP Conv	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 1	484,272	0.13	30
337	Res	HP Conv	Pre80 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 2	484,272	0.09	30
340	Res	HP Conv	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 1	484,272	0.14	30
343	Res	HP Conv	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Zonal Heating - Zone 2	484,272	0.10	30
346	Res	HP Conv	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 1	484,272	0.18	30
349	Res	HP Conv	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on Air Source HP - Zone 2	484,272	0.14	30
352	Res	HP Conv	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 1	484,272	0.09	30
355	Res	HP Conv	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/oCAC - Zone 2	484,272	0.07	30
358	Res	HP Conv	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 1	484,272	0.09	30
361	Res	HP Conv	Post79/Pre93 Single Family Construction Geothermal Heat Pump Retrofit w/PTCS on FAF w/CAC - Zone 2	484,272	0.07	30
367	Res	HP Conv	Post92 Single Family Contruction Geothermal Heat Pump vs Zonal Heating - Zone 2	484,272	0.17	30
370	Res	HP Conv	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/oCAC - Zone 1	484,272	0.16	30
373	Res	HP Conv	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/oCAC - Zone 2	484,272	0.11	30
376	Res	HP Conv	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/CAC - Zone 1	484,272	0.16	30
379	Res	HP Conv	Post92 Single Family Contruction Geothermal Heat Pump vs FAF w/CAC - Zone 2	484,272	0.11	30
388	Res	MH HP Conv	Pre94 Manufactured Home Convert FAF w/o CAC to HP HSPF 8/SEER 12 - Heating	410,091	0.09	18
390	Res	MH HP Conv	Pre94 Manufactured Home Convert FAF w/o CAC to HP HSPF 8/SEER 12 - Heating	527,124	0.07	18
392	Res	MH HP Conv	Post93 Manufactured Home NonSGC Convert FAF w/o CAC to HP HSPF 8/SEER 12 - Heating	341,756	0.10	18
394	Res	MH HP Conv	Post93 Manufactured Home NonSGC Convert FAF w/o CAC to HP HSPF 8/SEER 12 - Heating	450,441	0.08	18
396	Res	MH HP Conv	SGC Manufactured Home Convert FAF w/o CAC to HP HSPF 8/SEER 12 - Heating	217,385	0.14	18

398	Res	MH HP Conv	SGC Manufactured Home Convert FAF w/o CAC to HP HSPF 8/SEER 12 - Heating	300,697	0.10	18
400	Res	MH HP Conv	Pre94 Manufactured Home Convert FAF w/CAC to HP HSPF 8/SEER 12 - Heating	410,091	0.08	18
402	Res	MH HP Conv	Pre94 Manufactured Home Convert FAF w/CAC to HP HSPF 8/SEER 12 - Heating	527,124	0.07	18
404	Res	MH HP Conv	Post93 Manufactured Home NonSGC Convert FAF w/CAC to HP HSPF 8/SEER 12 - Heating	341,756	0.10	18
406	Res	MH HP Conv	Post93 Manufactured Home NonSGC Convert FAF w/CAC to HP HSPF 8/SEER 12 - Heating	450,441	0.08	18
408	Res	MH HP Conv	SGC Manufactured Home Convert FAF w/CAC to HP HSPF 8/SEER 12 - Heating	217,385	0.13	18
410	Res	MH HP Conv	SGC Manufactured Home Convert FAF w/CAC to HP HSPF 8/SEER 12 - Heating	300,697	0.10	18
412	Res	Shell	SGC - Heating Zone 1	31,387	0.05	70
413	Res	Shell	SGC - Heating Zone 2	92,577	0.05	70
414	Res	Shell	Single Family Weatherization - Zone 1	2,263,516	0.04	45
415	Res	Shell	Single Family Weatherization - Zone 2	4,334,121	0.03	45
416	Res	Shell	Multifamily Weatherization - Heating Zone 1	1,060,596	0.05	45
417	Res	Shell	Multifamily Weatherization - Heating Zone 2	1,394,411	0.04	45
418	Res	Shell	SGCSF - Heating Zone 1	2,416,877	0.06	70
419	Res	Shell	SGCSF - Heating Zone 2	3,931,820	0.05	70
420	Res	HP Conv	Pre80 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.12	18
422	Res	HP Conv	Pre80 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.10	18
424	Res	HP Conv	Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.07	18
426	Res	HP Conv	Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.06	18
428	Res	HP Conv	Post92 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.11	18
430	Res	HP Conv	Post92 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.09	18
432	Res	HP Conv	Pre80 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.12	18
434	Res	HP Conv	Pre80 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.10	18
436	Res	HP Conv	Post79/Pre93 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.07	18
438	Res	HP Conv	Post79/Pre93 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.06	18
440	Res	HP Conv	Post92 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.11	18
442	Res	HP Conv	Post92 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.09	18
444	Res	HP Conv	Pre80 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.15	18
446	Res	HP Conv	Pre80 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.13	18
448	Res	HP Conv	Post79/Pre93 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.09	18

450	Res	HP Conv	Post79/Pre93 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.08	18
452	Res	HP Conv	Post92 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.13	18
454	Res	HP Conv	Post92 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.11	18
468	Res	HP Conv	Pre80 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.14	18
470	Res	HP Conv	Pre80 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.12	18
472	Res	HP Conv	Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.08	18
474	Res	HP Conv	Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.07	18
476	Res	HP Conv	Post92 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.13	18
478	Res	HP Conv	Post92 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.10	18
480	Res	HP Conv	Pre80 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.14	18
482	Res	HP Conv	Pre80 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.12	18
484	Res	HP Conv	Post79/Pre93 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.08	18
486	Res	HP Conv	Post79/Pre93 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.07	18
488	Res	HP Conv	Post92 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.13	18
490	Res	HP Conv	Post92 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.10	18
492	Res	HP Conv	Pre80 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.14	18
494	Res	HP Conv	Pre80 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.12	18
496	Res	HP Conv	Post79/Pre93 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.08	18
498	Res	HP Conv	Post79/Pre93 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.07	18
500	Res	HP Conv	Post92 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.13	18
502	Res	HP Conv	Post92 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.10	18
510	Res	HP Conv	Post79/Pre93 Single Family Construction Convert Zonal Heating w/o CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.13	18

516	Res	Shell	Manufactured Home Weatherization - Heating Zone 1	6,151,873	0.07	25
517	Res	Shell	Manufactured Home Weatherization - Heating Zone 2	7,870,990	0.06	25
529	Res	MF Duc Seal	Manufactured Home NonSGC Forced Air Furnace w/o CAC - PTCS Duct Sealing Heat Zone 1	60,322	0.05	20
530	Res	MF Duc Seal	Manufactured Home NonSGC Forced Air Furnace w/o CAC - PTCS Duct Sealing Heat Zone 2	89,539	0.04	20
531	Res	MF Duc Seal	Manufactured Home SGC Forced Air Furnace w/o CAC - PTCS Duct Sealing Heat Zone 1	32,672	0.10	20
532	Res	MF Duc Seal	Manufactured Home SGC Forced Air Furnace w/o CAC - PTCS Duct Sealing Heat Zone 2	52,508	0.06	20
537	Res	SF Com	Single Family Heat Pump - PTCS System Commissioning Heat Zone 1	222,025	0.26	5
539	Res	SF Com	Single Family Heat Pump - PTCS System Commissioning Heat Zone 2	383,505	0.15	5
541	Res	SF Com	Single Family Heat Pump - PTCS Duct Sealing and System Commissioning Heat Zone 1	1,183,530	0.05	20
543	Res	SF Com	Single Family Heat Pump - PTCS Duct Sealing and System Commissioning Heat Zone 2	2,038,711	0.03	20
549	Res	MH Duct Seal	Manufactured Home NonSGC Heat Pump - PTCS Duct Sealing Heat Zone 1	37,507	0.09	20
551	Res	MH Duct Seal	Manufactured Home NonSGC Heat Pump - PTCS Duct Sealing Heat Zone 2	65,568	0.05	20
553	Res	MH Com	Manufactured Home NonSGC Heat Pump - PTCS System Commissioning Heat Zone 1	17,514	0.28	5
555	Res	MH Com	Manufactured Home NonSGC Heat Pump - PTCS System Commissioning Heat Zone 2	30,317	0.16	5
557	Res	MH Duct Seal	Manufactured Home NonSGC Heat Pump - PTCS Duct Sealing and System Commissioning Heat Zone 1	55,020	0.09	20
559	Res	MH Duct Seal	Manufactured Home NonSGC Heat Pump - PTCS Duct Sealing and System Commissioning Heat Zone 2	95,885	0.05	20
561	Res	MH Duct Seal	Manufactured Home NonSGC Heat Pump - PTCS Duct Sealing, Commissioning and Controls Heat Zone 1	62,104	0.10	20
563	Res	MH Duct Seal	Manufactured Home NonSGC Heat Pump - PTCS Duct Sealing, Commissioning and Controls Heat Zone 2	92,314	0.06	20
565	Res	MH Duct Seal	Manufactured Home SGC Heat Pump - PTCS Duct Sealing Heat Zone 1	20,752	0.15	20
567	Res	MH Duct Seal	Manufactured Home SGC Heat Pump - PTCS Duct Sealing Heat Zone 2	39,129	0.08	20
569	Res	MH Com	Manufactured Home SGC Heat Pump - PTCS System Commissioning Heat Zone 1	9,692	0.51	5
571	Res	MH Com	Manufactured Home SGC Heat Pump - PTCS System Commissioning Heat Zone 2	18,094	0.27	5
573	Res	MH Duct Seal	Manufactured Home SGC Heat Pump - PTCS Duct Sealing and System Commissioning Heat Zone 1	30,444	0.17	20
575	Res	MH Duct Seal	Manufactured Home SGC Heat Pump - PTCS Duct Sealing and System Commissioning Heat Zone 2	57,223	0.09	20
577	Res	MH Duct Seal	Manufactured Home SGC Heat Pump - PTCS Duct Sealing, Commissioning and Controls Heat Zone 1	34,399	0.17	20

579	Res	MH Duct Seal	Manufactured Home SGC Heat Pump - PTCS Duct Sealing, Commissioning and Controls Heat Zone 2	55,088	0.11	20
593	Res	MH Duct Seal	Manufactured Home NonSGC Forced Air Furnace w/CAC - PTCS Duct Sealing Heat Zone 1	60,322	0.05	20
595	Res	MH Duct Seal	Manufactured Home NonSGC Forced Air Furnace w/CAC - PTCS Duct Sealing Heat Zone 2	89,539	0.04	20
601	Res	MH Duct Seal	Manufactured Home NonSGC Forced Air Furnace w/CAC - PTCS Duct Sealing and System Commissioning Heat Zone 1	60,322	0.05	20
603	Res	MH Duct Seal	Manufactured Home NonSGC Forced Air Furnace w/CAC - PTCS Duct Sealing and System Commissioning Heat Zone 2	89,539	0.04	20
605	Res	MH Duct Seal	Manufactured Home SGC Forced Air Furnace w/CAC - PTCS Duct Sealing Heat Zone 1	32,672	0.10	20
607	Res	MH Duct Seal	Manufactured Home SGC Forced Air Furnace w/CAC - PTCS Duct Sealing Heat Zone 2	52,508	0.06	20
613	Res	MH Duct Seal	Manufactured Home SGC Forced Air Furnace w/CAC - PTCS Duct Sealing and System Commissioning Heat Zone 1	32,672	0.10	20
615	Res	MH Duct Seal	Manufactured Home SGC Forced Air Furnace w/CAC - PTCS Duct Sealing and System Commissioning Heat Zone 2	52,508	0.06	20
617	Res	Shell	SGC - Zone 1	538,582	0.05	45
618	Res	Shell	SGC - Zone 2	1,089,896	0.04	45
625	Res	HP Conv	Pre94 NonSGC Manufactured Home Convert FAF w/o CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 1	484,272	0.09	30
628	Res	HP Conv	Pre94 NonSGC Manufactured Home Convert FAF w/o CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 2	484,272	0.07	30
631	Res	HP Conv	Pre94 NonSGC Manufactured Home Convert FAF w/CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 1	484,272	0.09	30
634	Res	HP Conv	Pre94 NonSGC Manufactured Home Convert FAF w/CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 2	484,272	0.07	30
643	Res	HP Conv	Post93 NonSGC Manufactured Home Convert FAF w/o CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 1	484,272	0.13	30
646	Res	HP Conv	Post93 NonSGC Manufactured Home Convert FAF w/o CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 2	484,272	0.09	30
649	Res	HP Conv	Post93 NonSGC Manufactured Home Convert FAF w/CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 1	484,272	0.13	30
652	Res	HP Conv	Post93 NonSGC Manufactured Home Convert FAF w/CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 2	484,272	0.09	30
658	Res	HP Conv	SGC Manufactured Home Convert FAF w/o CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 2	484,272	0.13	30
664	Res	HP Conv	SGC Manufactured Home Convert FAF w/CAC to Energy Star Geothermal Heat Pump w/PTCS Specifications - Heating Zone 2	484,272	0.13	30
673	Res	AC Upgrade	Pre80 Single Family Construction CAC Upgrade SEER - Cooling Zone 3	224,848	0.56	18

674	Res	AC Upgrade	Post79/Pre93 Single Family Construction CAC Upgrade SEER - Cooling Zone 3	224,848	0.36	18
675	Res	AC Upgrade	Post92 Single Family Construction CAC Upgrade SEER - Cooling Zone 3	224,848	0.47	18
676	Res	HP Upgrade	Pre80 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1	892,459	0.17	18
678	Res	HP Upgrade	Pre80 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2	892,459	0.10	18
680	Res	HP Upgrade	Post79/Pre93 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1	892,459	0.10	18
682	Res	HP Upgrade	Post79/Pre93 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2	892,459	0.06	18
684	Res	HP Upgrade	Post92 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1	892,459	0.16	18
686	Res	HP Upgrade	Post92 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2	892,459	0.09	18
688	Res	AC Upgrade	Pre80 Single Family Construction CAC Upgrade SEER - Cooling Zone 3	224,848	0.33	18
689	Res	AC Upgrade	Post79/Pre93 Single Family Construction CAC Upgrade SEER - Cooling Zone 3	224,848	0.21	18
690	Res	AC Upgrade	Post92 Single Family Construction CAC Upgrade SEER - Cooling Zone 3	224,848	0.28	18
691	Res	HP Upgrade	Pre80 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1	892,459	0.06	18
693	Res	HP Upgrade	Pre80 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2	892,459	0.04	18
695	Res	HP Upgrade	Post79/Pre93 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1	892,459	0.04	18
697	Res	HP Upgrade	Post79/Pre93 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2	892,459	0.02	18
699	Res	HP Upgrade	Post92 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1	892,459	0.06	18
701	Res	HP Upgrade	Post92 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2	892,459	0.03	18
703	Res	AC Upgrade	Pre94 Manufactured Home CAC Upgrade SEER w/PTCS - Cooling Zone 3	224,848	0.28	18
704	Res	AC Upgrade	Post93 Manufactured Home NonSGC CAC Upgrade SEER w/PTCS - Cooling Zone 3	224,848	0.29	18
705	Res	AC Upgrade	SGC Manufactured Home CAC Upgrade SEER w/PTCS - Cooling Zone 3	224,848	0.39	18
710	Res	HP Upgrade	Post93 Manufactured Home NonSGC HP Upgrade HSPF 8 w/PTCS - Cooling Zone 1	892,459	0.09	18
712	Res	HP Upgrade	Post93 Manufactured Home NonSGC HP Upgrade HSPF 8 w/PTCS - Cooling Zone 2	892,459	0.04	18
718	Res	HP Conv	Pre80 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.10	18
720	Res	HP Conv	Pre80 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.08	18
722	Res	HP Conv	Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.06	18
724	Res	HP Conv	Post79/Pre93 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.05	18
726	Res	HP Conv	Post92 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.09	18
728	Res	HP Conv	Post92 Single Family Construction Convert FAF w/o CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.07	18

730	Res	HP Conv	Pre80 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.10	18
732	Res	HP Conv	Pre80 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.08	18
734	Res	HP Conv	Post79/Pre93 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.06	18
736	Res	HP Conv	Post79/Pre93 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.05	18
738	Res	HP Conv	Post92 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.09	18
740	Res	HP Conv	Post92 Single Family Construction Convert FAF w/CAC to HP HSPF 8/SEER 13 - Heating	484,272	0.07	18
746	Res	HP Conv	Post79/Pre93 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.11	18
748	Res	HP Conv	Post79/Pre93 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.10	18
752	Res	HP Conv	Post92 Single Family Construction Convert Zonal Heating w/CAC to HP HSPF 8/SEER 13 - Heat	484,272	0.15	18
766	Res	AC Upgrade	Pre80 Single Family Construction CAC Upgrade SEER - Cooling Zone 3	224,848	0.41	18
767	Res	AC Upgrade	Post79/Pre93 Single Family Construction CAC Upgrade SEER - Cooling Zone 3	224,848	0.26	18
768	Res	AC Upgrade	Post92 Single Family Construction CAC Upgrade SEER - Cooling Zone 3	224,848	0.34	18
769	Res	HP Upgrade	Pre80 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1	892,459	0.12	18
771	Res	HP Upgrade	Pre80 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2	892,459	0.07	18
773	Res	HP Upgrade	Post79/Pre93 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1	892,459	0.07	18
775	Res	HP Upgrade	Post79/Pre93 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2	892,459	0.04	18
777	Res	HP Upgrade	Post92 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 1	892,459	0.11	18
779	Res	HP Upgrade	Post92 Single Family Construction HP Upgrade HSPF 8 - Heating Zone 2	892,459	0.06	18
783	Res	Lighting	Energy Conservation School Program	13,728,000	0.02	7
785	Res	HVAC	Heating System Maintenance (tune-up/filter)	416,000	0.00	12
21	Non-Res	HVAC	VSD Small Fan	13,000,000	0.16	15
22	Non-Res	HVAC	VSD Medium fan	13,000,000	0.10	15
23	Non-Res	HVAC	VSD Large Fan	13,000,000	0.07	15
24	Non-Res	HVAC	VSD Pump	13,000,000	0.11	15
27	Non-Res	Energy Smart	Night Covers for Display Cases - Vertical	9,464,000	0.02	5
28	Non-Res	Energy Smart	Night Covers for Display Cases - Horizontal	9,464,000	0.04	5
29	Non-Res	Energy Smart	Strip Curtains for Walk-in Boxes	9,464,000	0.00	4
30	Non-Res	Energy Smart	Glass Doors on Open Display Cases (LT)	9,464,000	0.03	12
31	Non-Res	Energy Smart	Glass Doors on Open Display Cases (MT)	9,464,000	0.08	12
34	Non-Res	Energy Smart	Special Doors with Low/No Anti-Sweat Heat	9,464,000	0.05	12
35	Non-Res	Energy Smart	Anti-Sweat Heat Controls	9,464,000	0.03	11
36	Non-Res	Energy Smart	Auto-Closers for Coolers and Freezers	9,464,000	0.01	8
37	Non-Res	Energy Smart	Evaporative fan controller on walk-in	9,464,000	0.07	5
40	Non-Res	Energy Smart	Floating Head Pressure Controller	9,464,000	0.04	12
44	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Large Off-GasHt-Retro	260,000	0.07	8

45	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Medium Off-GasHt-Retro	260,000	0.08	8
46	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Small Off-GasHt-Retro	260,000	0.25	8
47	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Big Box-GasHt-Retro	260,000	0.10	8
48	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Small Box-GasHt-Retro	260,000	0.23	8
49	Non-Res	HVAC	Built-Up HVAC Controls Optimization-High End-GasHt-Retro	260,000	0.17	8
50	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Anchor-GasHt-Retro	260,000	0.06	8
51	Non-Res	HVAC	Built-Up HVAC Controls Optimization-K-12-GasHt-Retro	260,000	0.29	8
52	Non-Res	HVAC	Built-Up HVAC Controls Optimization-University-GasHt-Retro	260,000	0.10	8
53	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Warehouse-GasHt-Retro	260,000	0.28	8
54	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Supermarket-GasHt-Retro	260,000	0.08	8
55	Non-Res	HVAC	Built-Up HVAC Controls Optimization-MIniMart-GasHt-Retro	260,000	0.11	8
56	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Restaurant-GasHt-Retro	260,000	0.10	8
57	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Lodging-GasHt-Retro	260,000	0.08	8
58	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Hospital-GasHt-Retro	260,000	0.06	8
59	Non-Res	HVAC	Built-Up HVAC Controls Optimization-OtherHealth-GasHt-Retro	260,000	0.07	8
60	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Other-GasHt-Retro	260,000	0.23	8
61	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Large Off-ElecHt-Retro	260,000	0.05	8
62	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Medium Off-ElecHt-Retro	260,000	0.05	8
63	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Small Off-ElecHt-Retro	260,000	0.15	8
64	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Big Box-ElecHt-Retro	260,000	0.09	8
65	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Small Box-ElecHt-Retro	260,000	0.17	8
66	Non-Res	HVAC	Built-Up HVAC Controls Optimization-High End-ElecHt-Retro	260,000	0.14	8
67	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Anchor-ElecHt-Retro	260,000	0.05	8
68	Non-Res	HVAC	Built-Up HVAC Controls Optimization-K-12-ElecHt-Retro	260,000	0.05	8
69	Non-Res	HVAC	Built-Up HVAC Controls Optimization-University-ElecHt-Retro	260,000	0.06	8
70	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Warehouse-ElecHt-Retro	260,000	0.11	8
71	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Supermarket-ElecHt-Retro	260,000	0.05	8
72	Non-Res	HVAC	Built-Up HVAC Controls Optimization-MIniMart-ElecHt-Retro	260,000	0.09	8
73	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Restaurant-ElecHt-Retro	260,000	0.08	8

74	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Lodging-ElecHt-Retro	260,000	0.05	8
75	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Hospital-ElecHt-Retro	260,000	0.04	8
76	Non-Res	HVAC	Built-Up HVAC Controls Optimization-OtherHealth-ElecHt-Retro	260,000	0.04	8
77	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Other-ElecHt-Retro	260,000	0.13	8
78	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Large Off-HtPmpHt-Retro	260,000	0.06	8
79	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Medium Off-HtPmpHt-Retro	260,000	0.07	8
80	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Small Off-HtPmpHt-Retro	260,000	0.19	8
81	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Big Box-HtPmpHt-Retro	260,000	0.09	8
82	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Small Box-HtPmpHt-Retro	260,000	0.20	8
83	Non-Res	HVAC	Built-Up HVAC Controls Optimization-High End-HtPmpHt-Retro	260,000	0.17	8
84	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Anchor-HtPmpHt-Retro	260,000	0.06	8
85	Non-Res	HVAC	Built-Up HVAC Controls Optimization-K-12-HtPmpHt-Retro	260,000	0.08	8
86	Non-Res	HVAC	Built-Up HVAC Controls Optimization-University-HtPmpHt-Retro	260,000	0.08	8
87	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Warehouse-HtPmpHt-Retro	260,000	0.17	8
88	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Supermarket-HtPmpHt-Retro	260,000	0.07	8
90	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Restaurant-HtPmpHt-Retro	260,000	0.10	8
91	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Lodging-HtPmpHt-Retro	260,000	0.06	8
92	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Hospital-HtPmpHt-Retro	260,000	0.05	8
93	Non-Res	HVAC	Built-Up HVAC Controls Optimization-OtherHealth-HtPmpHt-Retro	260,000	0.05	8
94	Non-Res	HVAC	Built-Up HVAC Controls Optimization-Other-HtPmpHt-Retro	260,000	0.17	8
115	Non-Res		Controls Commission-New	21,960	0.07	12
117	Non-Res	Traffic Lights	Replace 12 inch Red Incandescent Left Turn Bay with 12 inch Red LED module	208,000	0.02	5
118	Non-Res	Traffic Lights	Replace 12 inch Green Incandescent Left Turn Bay with 12 inchGreen LED module	208,000	0.06	16
119	Non-Res	Traffic Lights	Replace 12 inch Red Incandescent Thru Lane with 12 inch Red LED module	208,000	0.02	6
120	Non-Res	Traffic Lights	Replace 12 inch Green Incandescent Thru Lane with 12 inch Green LED module	208,000	0.05	7
121	Non-Res	Traffic Lights	Replace 8 inch Red Incandescent Left Turn Bay with 8 inch Red LED module	208,000	0.04	5
123	Non-Res	Traffic Lights	Replace 8 inch Red Incandescent Thru Lane with 8 inch Red LED module	208,000	0.04	6
129	Non-Res	Lighting-CFL	INC to CFL-Large Off-New-ElecHt	163,800	0.01	15
132	Non-Res	Lighting-CFL	INC to CFL-Large Off-New-HtPmpHt	163,800	0.01	15
135	Non-Res	Lighting-CFL	INC to CFL-Large Off-New-GasHt	163,800	0.01	15
138	Non-Res	Lighting-CFL	INC to CFL-Medium Off-New-ElecHt	163,800	0.01	15
141	Non-Res	Lighting-CFL	INC to CFL-Medium Off-New-HtPmpHt	163,800	0.01	15

144	Non-Res	Lighting-CFL	INC to CFL-Medium Off-New-GasHt	163,800	0.01	15
148	Non-Res	Lighting-CFL	INC to CFL-Small Off-New-ElecHt	163,800	0.01	15
152	Non-Res	Lighting-CFL	INC to CFL-Small Off-New-HtPmpHt	163,800	0.01	15
154	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Off-New-GasHt	602,173	0.01	15
156	Non-Res	Lighting-CFL	INC to CFL-Small Off-New-GasHt	163,800	0.02	15
159	Non-Res	Lighting-CFL	INC to CMH-Big Box-New-ElecHt	81,900	0.04	15
161	Non-Res	Lighting-HID	Large MH to T5HO-Big Box-New-ElecHt	441,447	0.00	15
163	Non-Res	Lighting-CFL	INC to CMH-Big Box-New-HtPmpHt	81,900	0.03	15
165	Non-Res	Lighting-HID	Large MH to T5HO-Big Box-New-HtPmpHt	441,447	0.00	15
167	Non-Res	Lighting-CFL	INC to CMH-Big Box-New-GasHt	81,900	0.04	15
169	Non-Res	Lighting-HID	Large MH to T5HO-Big Box-New-GasHt	441,447	0.01	15
173	Non-Res	Lighting-CFL	INC to CMH-Small Box-New-ElecHt	81,900	0.06	15
178	Non-Res	Lighting-CFL	INC to CMH-Small Box-New-HtPmpHt	81,900	0.04	15
180	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Box-New-GasHt	602,173	0.01	15
183	Non-Res	Lighting-CFL	INC to CMH-Small Box-New-GasHt	81,900	0.05	15
184	Non-Res	Lighting-HID	Med MH to T8HP-Small Box-New-GasHt	441,447	0.01	15
187	Non-Res	Lighting-CFL	INC to CMH-High End-New-ElecHt	81,900	0.06	15
192	Non-Res	Lighting-CFL	INC to CMH-High End-New-HtPmpHt	81,900	0.05	15
195	Non-Res	Lighting-T12T8	T12-3 to T8HP-2-High End-New-GasHt	602,173	0.00	15
197	Non-Res	Lighting-CFL	INC to CMH-High End-New-GasHt	81,900	0.05	15
208	Non-Res	Lighting-T12T8	F96T12 to T8HP-Anchor-New-GasHt	602,173	0.01	15
211	Non-Res	Lighting-HID	Med MH to T8HP-Anchor-New-GasHt	441,447	0.01	15
214	Non-Res	Lighting-CFL	INC to CFL-K-12-New-ElecHt	145,600	0.02	15
218	Non-Res	Lighting-CFL	INC to CFL-K-12-New-HtPmpHt	145,600	0.01	15
222	Non-Res	Lighting-CFL	INC to CFL-K-12-New-GasHt	145,600	0.03	15
225	Non-Res	Lighting-CFL	INC to CMH-University-New-ElecHt	145,600	0.08	15
228	Non-Res	Lighting-CFL	INC to CMH-University-New-HtPmpHt	145,600	0.06	15
231	Non-Res	Lighting-CFL	INC to CMH-University-New-GasHt	145,600	0.06	15
235	Non-Res	Lighting-CFL	INC to CFL-Warehouse-New-ElecHt	655,200	0.01	15
237	Non-Res	Lighting-HID	Large MH to T5HO-Warehouse-New-ElecHt	441,447	0.00	15
240	Non-Res	Lighting-CFL	INC to CFL-Warehouse-New-HtPmpHt	655,200	0.01	15
242	Non-Res	Lighting-HID	Large MH to T5HO-Warehouse-New-HtPmpHt	441,447	0.00	15
243	Non-Res	Lighting-T12T8	F96T12 to T8HP-Warehouse-New-GasHt	602,173	0.00	15
245	Non-Res	Lighting-CFL	INC to CFL-Warehouse-New-GasHt	655,200	0.02	15
247	Non-Res	Lighting-HID	Large MH to T5HO-Warehouse-New-GasHt	441,447	0.01	15
252	Non-Res	Lighting-HID	Med MH to T5HO-Supermarket-New-ElecHt	441,447	0.01	15
257	Non-Res	Lighting-HID	Med MH to T5HO-Supermarket-New-HtPmpHt	441,447	0.01	15
258	Non-Res	Lighting-T12T8	F96T12 to T8HP-Supermarket-New-GasHt	602,173	0.00	15
262	Non-Res	Lighting-HID	Med MH to T5HO-Supermarket-New-GasHt	441,447	0.01	15
265	Non-Res	Lighting-CFL	INC to CMH-MIniMart-New-ElecHt	81,900	0.03	15
269	Non-Res	Lighting-CFL	INC to CMH-MIniMart-New-HtPmpHt	81,900	0.03	15
271	Non-Res	Lighting-T12T8	F96T12 to T8HP-MIniMart-New-GasHt	602,173	0.01	15
273	Non-Res	Lighting-CFL	INC to CMH-MIniMart-New-GasHt	81,900	0.04	15
278	Non-Res	Lighting-CFL	INC to CFL-Restaurant-New-ElecHt	72,800	0.01	15
283	Non-Res	Lighting-CFL	INC to CFL-Restaurant-New-HtPmpHt	72,800	0.01	15
285	Non-Res	Lighting-T12T8	F96T12 to T8HP-Restaurant-New-GasHt	602,173	0.01	15
288	Non-Res	Lighting-CFL	INC to CFL-Restaurant-New-GasHt	72,800	0.03	15
292	Non-Res	Lighting-CFL	INC to CFL-Lodging-New-ElecHt	218,400	0.01	15
297	Non-Res	Lighting-CFL	INC to CFL-Lodging-New-HtPmpHt	218,400	0.01	15
300	Non-Res	Lighting-T12T8	F96T12 to T8HP-Lodging-New-GasHt	602,173	0.01	15
302	Non-Res	Lighting-CFL	INC to CFL-Lodging-New-GasHt	218,400	0.02	15
307	Non-Res	Lighting-CFL	INC to CFL-Hospital-New-ElecHt	9,100	0.02	15
311	Non-Res	Lighting-CFL	INC to CFL-Hospital-New-HtPmpHt	9,100	0.01	15
313	Non-Res	Lighting-T12T8	F96T12 to T8HP-Hospital-New-GasHt	602,173	0.02	15
315	Non-Res	Lighting-CFL	INC to CFL-Hospital-New-GasHt	9,100	0.03	15
316	Non-Res	Lighting-HID	Med MH to T8HP-Hospital-New-GasHt	441,447	0.02	15

319	Non-Res	Lighting-CFL	INC to CFL-OtherHealth-New-ElecHt	9,100	0.01	15
324	Non-Res	Lighting-CFL	INC to CFL-OtherHealth-New-HtPmpHt	9,100	0.01	15
329	Non-Res	Lighting-CFL	INC to CFL-OtherHealth-New-GasHt	9,100	0.01	15
331	Non-Res	Lighting-HID	Med MH to T8HP-OtherHealth-New-GasHt	441,447	0.00	15
334	Non-Res	Lighting-CFL	INC to CFL-Other-New-ElecHt	145,600	0.01	15
335	Non-Res	Lighting-HID	Med MH to T5HO-Other-New-ElecHt	441,447	0.01	15
336	Non-Res	Lighting-HID	Large MH to T5HO-Other-New-ElecHt	441,447	0.00	15
339	Non-Res	Lighting-CFL	INC to CFL-Other-New-HtPmpHt	145,600	0.01	15
340	Non-Res	Lighting-HID	Med MH to T5HO-Other-New-HtPmpHt	441,447	0.01	15
341	Non-Res	Lighting-HID	Large MH to T5HO-Other-New-HtPmpHt	441,447	0.00	15
344	Non-Res	Lighting-CFL	INC to CFL-Other-New-GasHt	145,600	0.01	15
345	Non-Res	Lighting-HID	Med MH to T5HO-Other-New-GasHt	441,447	0.02	15
346	Non-Res	Lighting-HID	Large MH to T5HO-Other-New-GasHt	441,447	0.01	15
347	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Large Off-Retro-ElecHt-PRE1987	602,173	0.02	15
350	Non-Res	Lighting-CFL	INC to CFL-Large Off-Retro-ElecHt-PRE1987	163,800	0.03	15
351	Non-Res	Lighting-T12T8	F96T12 to T8HP-Large Off-Retro-ElecHt-PRE1987	602,173	0.08	15
352	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Large Off-Retro-HtPmpHt-PRE1987	602,173	0.01	15
355	Non-Res	Lighting-CFL	INC to CFL-Large Off-Retro-HtPmpHt-PRE1987	163,800	0.03	15
356	Non-Res	Lighting-T12T8	F96T12 to T8HP-Large Off-Retro-HtPmpHt-PRE1987	602,173	0.07	15
357	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Large Off-Retro-GasHt-PRE1987	602,173	0.02	15
360	Non-Res	Lighting-CFL	INC to CFL-Large Off-Retro-GasHt-PRE1987	163,800	0.03	15
361	Non-Res	Lighting-T12T8	F96T12 to T8HP-Large Off-Retro-GasHt-PRE1987	602,173	0.07	15
362	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Medium Off-Retro-ElecHt-PRE1987	602,173	0.02	15
365	Non-Res	Lighting-CFL	INC to CFL-Medium Off-Retro-ElecHt-PRE1987	163,800	0.04	15
366	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Medium Off-Retro-ElecHt-PRE1987	602,173	0.01	15
368	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Medium Off-Retro-HtPmpHt-PRE1987	602,173	0.02	15
371	Non-Res	Lighting-CFL	INC to CFL-Medium Off-Retro-HtPmpHt-PRE1987	163,800	0.03	15
372	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Medium Off-Retro-HtPmpHt-PRE1987	602,173	0.01	15
374	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Medium Off-Retro-GasHt-PRE1987	602,173	0.02	15
377	Non-Res	Lighting-CFL	INC to CFL-Medium Off-Retro-GasHt-PRE1987	163,800	0.04	15
378	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Medium Off-Retro-GasHt-PRE1987	602,173	0.02	15
380	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Small Off-Retro-ElecHt-PRE1987	602,173	0.03	15
383	Non-Res	Lighting-CFL	INC to CFL-Small Off-Retro-ElecHt-PRE1987	163,800	0.06	15
384	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Small Off-Retro-ElecHt-PRE1987	602,173	0.02	15
386	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Small Off-Retro-HtPmpHt-PRE1987	602,173	0.02	15
389	Non-Res	Lighting-CFL	INC to CFL-Small Off-Retro-HtPmpHt-PRE1987	163,800	0.04	15
390	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Small Off-Retro-HtPmpHt-PRE1987	602,173	0.02	15
392	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Small Off-Retro-GasHt-PRE1987	602,173	0.03	15

395	Non-Res	Lighting-CFL	INC to CFL-Small Off-Retro-GasHt-PRE1987	163,800	0.05	15
396	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Small Off-Retro-GasHt-PRE1987	602,173	0.03	15
398	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Big Box-Retro-ElecHt-PRE1987	602,173	0.04	15
401	Non-Res	Lighting-HID	Large MH to T5HO-Big Box-Retro-ElecHt-PRE1987	441,447	0.05	15
402	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Big Box-Retro-HtPmpHt-PRE1987	602,173	0.03	15
405	Non-Res	Lighting-HID	Large MH to T5HO-Big Box-Retro-HtPmpHt-PRE1987	441,447	0.04	15
406	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Big Box-Retro-GasHt-PRE1987	602,173	0.04	15
409	Non-Res	Lighting-HID	Large MH to T5HO-Big Box-Retro-GasHt-PRE1987	441,447	0.05	15
410	Non-Res	Lighting-T12T8	T12-4 to T8HP-3-Small Box-Retro-ElecHt-PRE1987	602,173	0.03	15
412	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Box-Retro-ElecHt-PRE1987	602,173	0.12	15
414	Non-Res	Lighting-HID	Med MH to T8HP-Small Box-Retro-ElecHt-PRE1987	441,447	0.13	15
415	Non-Res	Lighting-T12T8	T12-4 to T8HP-3-Small Box-Retro-HtPmpHt-PRE1987	602,173	0.02	15
417	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Box-Retro-HtPmpHt-PRE1987	602,173	0.09	15
419	Non-Res	Lighting-HID	Med MH to T8HP-Small Box-Retro-HtPmpHt-PRE1987	441,447	0.09	15
420	Non-Res	Lighting-T12T8	T12-4 to T8HP-3-Small Box-Retro-GasHt-PRE1987	602,173	0.03	15
422	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Box-Retro-GasHt-PRE1987	602,173	0.09	15
424	Non-Res	Lighting-HID	Med MH to T8HP-Small Box-Retro-GasHt-PRE1987	441,447	0.10	15
425	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-High End-Retro-ElecHt-PRE1987	602,173	0.05	15
427	Non-Res	Lighting-CFL	INC to CMH-High End-Retro-ElecHt-PRE1987	81,900	0.09	15
430	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-High End-Retro-HtPmpHt-PRE1987	602,173	0.04	15
432	Non-Res	Lighting-CFL	INC to CMH-High End-Retro-HtPmpHt-PRE1987	81,900	0.07	15
435	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-High End-Retro-GasHt-PRE1987	602,173	0.05	15
437	Non-Res	Lighting-CFL	INC to CMH-High End-Retro-GasHt-PRE1987	81,900	0.08	15
440	Non-Res	Lighting-T12T8	T12-4 to T8HP-3-Anchor-Retro-ElecHt-PRE1987	602,173	0.03	15
442	Non-Res	Lighting-T12T8	F96T12 to T8HP-Anchor-Retro-ElecHt-PRE1987	602,173	0.11	15
445	Non-Res	Lighting-T12T8	T12-4 to T8HP-3-Anchor-Retro-HtPmpHt-PRE1987	602,173	0.02	15
447	Non-Res	Lighting-T12T8	F96T12 to T8HP-Anchor-Retro-HtPmpHt-PRE1987	602,173	0.08	15
450	Non-Res	Lighting-T12T8	T12-4 to T8HP-3-Anchor-Retro-GasHt-PRE1987	602,173	0.03	15
452	Non-Res	Lighting-T12T8	F96T12 to T8HP-Anchor-Retro-GasHt-PRE1987	602,173	0.08	15
455	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-K-12-Retro-ElecHt-PRE1987	602,173	0.03	15
458	Non-Res	Lighting-CFL	INC to CFL-K-12-Retro-ElecHt-PRE1987	145,600	0.09	15
459	Non-Res	Lighting-HID	Med MH to T8HP-K-12-Retro-ElecHt-PRE1987	441,447	0.25	15

460	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-K-12-Retro-HtPmpHt-PRE1987	602,173	0.02	15
463	Non-Res	Lighting-CFL	INC to CFL-K-12-Retro-HtPmpHt-PRE1987	145,600	0.06	15
464	Non-Res	Lighting-HID	Med MH to T8HP-K-12-Retro-HtPmpHt-PRE1987	441,447	0.16	15
465	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-K-12-Retro-GasHt-PRE1987	602,173	0.03	15
468	Non-Res	Lighting-CFL	INC to CFL-K-12-Retro-GasHt-PRE1987	145,600	0.07	15
469	Non-Res	Lighting-HID	Med MH to T8HP-K-12-Retro-GasHt-PRE1987	441,447	0.16	15
470	Non-Res	Lighting-T12T8	F96T12 to T8HP-University-Retro-ElecHt-PRE1987	602,173	0.15	15
473	Non-Res	Lighting-CFL	INC to CFL-University-Retro-ElecHt-PRE1987	145,600	0.06	15
475	Non-Res	Lighting-T12T8	F96T12 to T8HP-University-Retro-HtPmpHt-PRE1987	602,173	0.11	15
478	Non-Res	Lighting-CFL	INC to CFL-University-Retro-HtPmpHt-PRE1987	145,600	0.04	15
480	Non-Res	Lighting-T12T8	F96T12 to T8HP-University-Retro-GasHt-PRE1987	602,173	0.11	15
483	Non-Res	Lighting-CFL	INC to CFL-University-Retro-GasHt-PRE1987	145,600	0.05	15
485	Non-Res	Lighting-T12T8	F96T12 to T8HP-Warehouse-Retro-ElecHt-PRE1987	602,173	0.14	15
487	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Warehouse-Retro-ElecHt-PRE1987	602,173	0.02	15
489	Non-Res	Lighting-HID	Large MH to T5HO-Warehouse-Retro-ElecHt-PRE1987	441,447	0.09	15
490	Non-Res	Lighting-T12T8	F96T12 to T8HP-Warehouse-Retro-HtPmpHt-PRE1987	602,173	0.11	15
492	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Warehouse-Retro-HtPmpHt-PRE1987	602,173	0.02	15
494	Non-Res	Lighting-HID	Large MH to T5HO-Warehouse-Retro-HtPmpHt-PRE1987	441,447	0.07	15
495	Non-Res	Lighting-T12T8	F96T12 to T8HP-Warehouse-Retro-GasHt-PRE1987	602,173	0.10	15
497	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Warehouse-Retro-GasHt-PRE1987	602,173	0.03	15
499	Non-Res	Lighting-HID	Large MH to T5HO-Warehouse-Retro-GasHt-PRE1987	441,447	0.07	15
500	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Supermarket-Retro-ElecHt-PRE1987	602,173	0.03	15
502	Non-Res	Lighting-CFL	INC to CMH-Supermarket-Retro-ElecHt-PRE1987	81,900	0.04	15
504	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Supermarket-Retro-HtPmpHt-PRE1987	602,173	0.02	15
506	Non-Res	Lighting-CFL	INC to CMH-Supermarket-Retro-HtPmpHt-PRE1987	81,900	0.04	15
508	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Supermarket-Retro-GasHt-PRE1987	602,173	0.03	15
510	Non-Res	Lighting-CFL	INC to CMH-Supermarket-Retro-GasHt-PRE1987	81,900	0.04	15
512	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-MIniMart-Retro-ElecHt-PRE1987	602,173	0.03	15
514	Non-Res	Lighting-CFL	INC to CMH-MIniMart-Retro-ElecHt-PRE1987	81,900	0.05	15
515	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-MIniMart-Retro-HtPmpHt-PRE1987	602,173	0.02	15
517	Non-Res	Lighting-CFL	INC to CMH-MIniMart-Retro-HtPmpHt-PRE1987	81,900	0.04	15
518	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-MIniMart-Retro-GasHt-PRE1987	602,173	0.04	15
520	Non-Res	Lighting-CFL	INC to CMH-MIniMart-Retro-GasHt-PRE1987	81,900	0.05	15
521	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Restaurant-Retro-ElecHt-PRE1987	602,173	0.07	15
522	Non-Res	Lighting-CFL	INC to CFL-Restaurant-Retro-ElecHt-PRE1987	72,800	0.06	15

523	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Restaurant-Retro-HtPmpHt-PRE1987	602,173	0.04	15
524	Non-Res	Lighting-CFL	INC to CFL-Restaurant-Retro-HtPmpHt-PRE1987	72,800	0.03	15
525	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Restaurant-Retro-GasHt-PRE1987	602,173	0.05	15
526	Non-Res	Lighting-CFL	INC to CFL-Restaurant-Retro-GasHt-PRE1987	72,800	0.05	15
527	Non-Res	Lighting-T12T8	F96T12 to T8HP-Lodging-Retro-ElecHt-PRE1987	602,173	0.12	15
529	Non-Res	Lighting-CFL	INC to CFL-Lodging-Retro-ElecHt-PRE1987	218,400	0.05	15
530	Non-Res	Lighting-T12T8	F96T12 to T8HP-Lodging-Retro-HtPmpHt-PRE1987	602,173	0.10	15
532	Non-Res	Lighting-CFL	INC to CFL-Lodging-Retro-HtPmpHt-PRE1987	218,400	0.04	15
533	Non-Res	Lighting-T12T8	F96T12 to T8HP-Lodging-Retro-GasHt-PRE1987	602,173	0.09	15
535	Non-Res	Lighting-CFL	INC to CFL-Lodging-Retro-GasHt-PRE1987	218,400	0.05	15
536	Non-Res	Lighting-T12T8	F96T12 to T8HP-Hospital-Retro-ElecHt-PRE1987	602,173	0.18	15
538	Non-Res	Lighting-CFL	INC to CFL-Hospital-Retro-ElecHt-PRE1987	9,100	0.07	15
539	Non-Res	Lighting-T12T8	F96T12 to T8HP-Hospital-Retro-HtPmpHt-PRE1987	602,173	0.08	15
541	Non-Res	Lighting-CFL	INC to CFL-Hospital-Retro-HtPmpHt-PRE1987	9,100	0.03	15
542	Non-Res	Lighting-T12T8	F96T12 to T8HP-Hospital-Retro-GasHt-PRE1987	602,173	0.08	15
544	Non-Res	Lighting-CFL	INC to CFL-Hospital-Retro-GasHt-PRE1987	9,100	0.05	15
545	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-OtherHealth-Retro-ElecHt-PRE1987	602,173	0.04	15
547	Non-Res	Lighting-CFL	INC to CFL-OtherHealth-Retro-ElecHt-PRE1987	9,100	0.04	15
548	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-OtherHealth-Retro-HtPmpHt-PRE1987	602,173	0.04	15
550	Non-Res	Lighting-CFL	INC to CFL-OtherHealth-Retro-HtPmpHt-PRE1987	9,100	0.03	15
551	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-OtherHealth-Retro-GasHt-PRE1987	602,173	0.04	15
553	Non-Res	Lighting-CFL	INC to CFL-OtherHealth-Retro-GasHt-PRE1987	9,100	0.04	15
554	Non-Res	Lighting-T12T8	F96T12 to T8HP-Other-Retro-ElecHt-PRE1987	602,173	0.09	15
556	Non-Res	Lighting-T12T8	T12-2 to T8HP-1-Other-Retro-ElecHt-PRE1987	602,173	0.03	15
557	Non-Res	Lighting-CFL	INC to CFL-Other-Retro-ElecHt-PRE1987	145,600	0.04	15
558	Non-Res	Lighting-HID	Large MH to T5HO-Other-Retro-ElecHt-PRE1987	441,447	0.06	15
559	Non-Res	Lighting-T12T8	F96T12 to T8HP-Other-Retro-HtPmpHt-PRE1987	602,173	0.08	15
561	Non-Res	Lighting-T12T8	T12-2 to T8HP-1-Other-Retro-HtPmpHt-PRE1987	602,173	0.02	15
562	Non-Res	Lighting-CFL	INC to CFL-Other-Retro-HtPmpHt-PRE1987	145,600	0.03	15
563	Non-Res	Lighting-HID	Large MH to T5HO-Other-Retro-HtPmpHt-PRE1987	441,447	0.05	15
564	Non-Res	Lighting-T12T8	F96T12 to T8HP-Other-Retro-GasHt-PRE1987	602,173	0.08	15
566	Non-Res	Lighting-T12T8	T12-2 to T8HP-1-Other-Retro-GasHt-PRE1987	602,173	0.03	15
567	Non-Res	Lighting-CFL	INC to CFL-Other-Retro-GasHt-PRE1987	145,600	0.04	15
568	Non-Res	Lighting-HID	Large MH to T5HO-Other-Retro-GasHt-PRE1987	441,447	0.05	15
569	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Large Off-Retro-ElecHt-V1987_1994	602,173	0.02	15
572	Non-Res	Lighting-CFL	INC to CFL-Large Off-Retro-ElecHt-V1987_1994	163,800	0.03	15
573	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Large Off-Retro-ElecHt-V1987_1994	602,173	0.01	15

574	Non-Res	Lighting-HID	Med MH to T8HP-Large Off-Retro-ElecHt-V1987_1994	441,447	0.08	15
575	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Large Off-Retro-HtPmpHt-V1987_1994	602,173	0.01	15
578	Non-Res	Lighting-CFL	INC to CFL-Large Off-Retro-HtPmpHt-V1987_1994	163,800	0.03	15
579	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Large Off-Retro-HtPmpHt-V1987_1994	602,173	0.01	15
580	Non-Res	Lighting-HID	Med MH to T8HP-Large Off-Retro-HtPmpHt-V1987_1994	441,447	0.08	15
581	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Large Off-Retro-GasHt-V1987_1994	602,173	0.02	15
584	Non-Res	Lighting-CFL	INC to CFL-Large Off-Retro-GasHt-V1987_1994	163,800	0.03	15
585	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Large Off-Retro-GasHt-V1987_1994	602,173	0.02	15
586	Non-Res	Lighting-HID	Med MH to T8HP-Large Off-Retro-GasHt-V1987_1994	441,447	0.08	15
587	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Medium Off-Retro-ElecHt-V1987_1994	602,173	0.02	15
589	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Medium Off-Retro-ElecHt-V1987_1994	602,173	0.01	15
590	Non-Res	Lighting-CFL	INC to CFL-Medium Off-Retro-ElecHt-V1987_1994	163,800	0.04	15
591	Non-Res	Lighting-HID	Med MH to T8HP-Medium Off-Retro-ElecHt-V1987_1994	441,447	0.10	15
592	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Medium Off-Retro-HtPmpHt-V1987_1994	602,173	0.02	15
594	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Medium Off-Retro-HtPmpHt-V1987_1994	602,173	0.01	15
595	Non-Res	Lighting-CFL	INC to CFL-Medium Off-Retro-HtPmpHt-V1987_1994	163,800	0.03	15
596	Non-Res	Lighting-HID	Med MH to T8HP-Medium Off-Retro-HtPmpHt-V1987_1994	441,447	0.09	15
597	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Medium Off-Retro-GasHt-V1987_1994	602,173	0.02	15
599	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Medium Off-Retro-GasHt-V1987_1994	602,173	0.02	15
600	Non-Res	Lighting-CFL	INC to CFL-Medium Off-Retro-GasHt-V1987_1994	163,800	0.04	15
601	Non-Res	Lighting-HID	Med MH to T8HP-Medium Off-Retro-GasHt-V1987_1994	441,447	0.09	15
602	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Small Off-Retro-ElecHt-V1987_1994	602,173	0.03	15
604	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Small Off-Retro-ElecHt-V1987_1994	602,173	0.02	15
605	Non-Res	Lighting-CFL	INC to CFL-Small Off-Retro-ElecHt-V1987_1994	163,800	0.06	15
606	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Off-Retro-ElecHt-V1987_1994	602,173	0.14	15
608	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Small Off-Retro-HtPmpHt-V1987_1994	602,173	0.02	15
610	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Small Off-Retro-HtPmpHt-V1987_1994	602,173	0.02	15
611	Non-Res	Lighting-CFL	INC to CFL-Small Off-Retro-HtPmpHt-V1987_1994	163,800	0.04	15
612	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Off-Retro-HtPmpHt-V1987_1994	602,173	0.10	15

614	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Small Off-Retro-GasHt-V1987_1994	602,173	0.03	15
616	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Small Off-Retro-GasHt-V1987_1994	602,173	0.03	15
617	Non-Res	Lighting-CFL	INC to CFL-Small Off-Retro-GasHt-V1987_1994	163,800	0.05	15
618	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Off-Retro-GasHt-V1987_1994	602,173	0.10	15
620	Non-Res	Lighting-T12T8	T12-4 to T8HP-3-Big Box-Retro-ElecHt-V1987_1994	602,173	0.02	15
622	Non-Res	Lighting-T12T8	F96T12 to T8HP-Big Box-Retro-ElecHt-V1987_1994	602,173	0.07	15
624	Non-Res	Lighting-HID	Large MH to T5HO-Big Box-Retro-ElecHt-V1987_1994	441,447	0.05	15
625	Non-Res	Lighting-T12T8	T12-4 to T8HP-3-Big Box-Retro-HtPmpHt-V1987_1994	602,173	0.01	15
627	Non-Res	Lighting-T12T8	F96T12 to T8HP-Big Box-Retro-HtPmpHt-V1987_1994	602,173	0.06	15
629	Non-Res	Lighting-HID	Large MH to T5HO-Big Box-Retro-HtPmpHt-V1987_1994	441,447	0.04	15
630	Non-Res	Lighting-T12T8	T12-4 to T8HP-3-Big Box-Retro-GasHt-V1987_1994	602,173	0.02	15
632	Non-Res	Lighting-T12T8	F96T12 to T8HP-Big Box-Retro-GasHt-V1987_1994	602,173	0.06	15
634	Non-Res	Lighting-HID	Large MH to T5HO-Big Box-Retro-GasHt-V1987_1994	441,447	0.04	15
635	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Box-Retro-ElecHt-V1987_1994	602,173	0.11	15
637	Non-Res	Lighting-CFL	INC to CMH-Small Box-Retro-ElecHt-V1987_1994	81,900	0.09	15
638	Non-Res	Lighting-HID	Med MH to T8HP-Small Box-Retro-ElecHt-V1987_1994	441,447	0.12	15
639	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Box-Retro-HtPmpHt-V1987_1994	602,173	0.08	15
641	Non-Res	Lighting-CFL	INC to CMH-Small Box-Retro-HtPmpHt-V1987_1994	81,900	0.06	15
642	Non-Res	Lighting-HID	Med MH to T8HP-Small Box-Retro-HtPmpHt-V1987_1994	441,447	0.09	15
643	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Box-Retro-GasHt-V1987_1994	602,173	0.09	15
645	Non-Res	Lighting-CFL	INC to CMH-Small Box-Retro-GasHt-V1987_1994	81,900	0.07	15
646	Non-Res	Lighting-HID	Med MH to T8HP-Small Box-Retro-GasHt-V1987_1994	441,447	0.09	15
647	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-High End-Retro-ElecHt-V1987_1994	602,173	0.05	15
649	Non-Res	Lighting-T12T8	F96T12 to T8HP-High End-Retro-ElecHt-V1987_1994	602,173	0.11	15
650	Non-Res	Lighting-CFL	INC to CMH-High End-Retro-ElecHt-V1987_1994	81,900	0.09	15
652	Non-Res	Lighting-HID	Med MH to T8HP-High End-Retro-ElecHt-V1987_1994	441,447	0.12	15
653	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-High End-Retro-HtPmpHt-V1987_1994	602,173	0.04	15
655	Non-Res	Lighting-T12T8	F96T12 to T8HP-High End-Retro-HtPmpHt-V1987_1994	602,173	0.09	15
656	Non-Res	Lighting-CFL	INC to CMH-High End-Retro-HtPmpHt-V1987_1994	81,900	0.07	15

658	Non-Res	Lighting-HID	Med MH to T8HP-High End-Retro-HtPmpHt-V1987_1994	441,447	0.10	15
659	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-High End-Retro-GasHt-V1987_1994	602,173	0.06	15
661	Non-Res	Lighting-T12T8	F96T12 to T8HP-High End-Retro-GasHt-V1987_1994	602,173	0.10	15
662	Non-Res	Lighting-CFL	INC to CMH-High End-Retro-GasHt-V1987_1994	81,900	0.08	15
664	Non-Res	Lighting-HID	Med MH to T8HP-High End-Retro-GasHt-V1987_1994	441,447	0.11	15
665	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Anchor-Retro-ElecHt-V1987_1994	602,173	0.05	15
667	Non-Res	Lighting-T12T8	F96T12 to T8HP-Anchor-Retro-ElecHt-V1987_1994	602,173	0.10	15
668	Non-Res	Lighting-CFL	INC to CMH-Anchor-Retro-ElecHt-V1987_1994	81,900	0.08	15
670	Non-Res	Lighting-HID	Med MH to T8HP-Anchor-Retro-ElecHt-V1987_1994	441,447	0.11	15
671	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Anchor-Retro-HtPmpHt-V1987_1994	602,173	0.03	15
673	Non-Res	Lighting-T12T8	F96T12 to T8HP-Anchor-Retro-HtPmpHt-V1987_1994	602,173	0.08	15
674	Non-Res	Lighting-CFL	INC to CMH-Anchor-Retro-HtPmpHt-V1987_1994	81,900	0.06	15
676	Non-Res	Lighting-HID	Med MH to T8HP-Anchor-Retro-HtPmpHt-V1987_1994	441,447	0.08	15
677	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Anchor-Retro-GasHt-V1987_1994	602,173	0.06	15
679	Non-Res	Lighting-T12T8	F96T12 to T8HP-Anchor-Retro-GasHt-V1987_1994	602,173	0.09	15
680	Non-Res	Lighting-CFL	INC to CMH-Anchor-Retro-GasHt-V1987_1994	81,900	0.07	15
682	Non-Res	Lighting-HID	Med MH to T8HP-Anchor-Retro-GasHt-V1987_1994	441,447	0.10	15
683	Non-Res	Lighting-T12T8	T12-3 to T8HP-2-K-12-Retro-ElecHt-V1987_1994	602,173	0.05	15
686	Non-Res	Lighting-CFL	INC to CFL-K-12-Retro-ElecHt-V1987_1994	145,600	0.09	15
687	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-K-12-Retro-ElecHt-V1987_1994	602,173	0.03	15
688	Non-Res	Lighting-HID	Med MH to T8HP-K-12-Retro-ElecHt-V1987_1994	441,447	0.24	15
689	Non-Res	Lighting-T12T8	T12-3 to T8HP-2-K-12-Retro-HtPmpHt-V1987_1994	602,173	0.04	15
692	Non-Res	Lighting-CFL	INC to CFL-K-12-Retro-HtPmpHt-V1987_1994	145,600	0.06	15
693	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-K-12-Retro-HtPmpHt-V1987_1994	602,173	0.02	15
694	Non-Res	Lighting-HID	Med MH to T8HP-K-12-Retro-HtPmpHt-V1987_1994	441,447	0.16	15
695	Non-Res	Lighting-T12T8	T12-3 to T8HP-2-K-12-Retro-GasHt-V1987_1994	602,173	0.05	15
698	Non-Res	Lighting-CFL	INC to CFL-K-12-Retro-GasHt-V1987_1994	145,600	0.07	15
699	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-K-12-Retro-GasHt-V1987_1994	602,173	0.04	15
700	Non-Res	Lighting-HID	Med MH to T8HP-K-12-Retro-GasHt-V1987_1994	441,447	0.15	15
701	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-University-Retro-ElecHt-V1987_1994	602,173	0.07	15
705	Non-Res	Lighting-HID	Med MH to T8HP-University-Retro-ElecHt-V1987_1994	441,447	0.16	15
706	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-University-Retro-HtPmpHt-V1987_1994	602,173	0.05	15

710	Non-Res	Lighting-HID	Med MH to T8HP-University-Retro-HtPmpHt-V1987_1994	441,447	0.11	15
711	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-University-Retro-GasHt-V1987_1994	602,173	0.06	15
715	Non-Res	Lighting-HID	Med MH to T8HP-University-Retro-GasHt-V1987_1994	441,447	0.11	15
716	Non-Res	Lighting-T12T8	F96T12 to T8HP-Warehouse-Retro-ElecHt-V1987_1994	602,173	0.14	15
718	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Warehouse-Retro-ElecHt-V1987_1994	602,173	0.02	15
720	Non-Res	Lighting-HID	Large MH to T5HO-Warehouse-Retro-ElecHt-V1987_1994	441,447	0.09	15
721	Non-Res	Lighting-T12T8	F96T12 to T8HP-Warehouse-Retro-HtPmpHt-V1987_1994	602,173	0.10	15
723	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Warehouse-Retro-HtPmpHt-V1987_1994	602,173	0.02	15
725	Non-Res	Lighting-HID	Large MH to T5HO-Warehouse-Retro-HtPmpHt-V1987_1994	441,447	0.07	15
726	Non-Res	Lighting-T12T8	F96T12 to T8HP-Warehouse-Retro-GasHt-V1987_1994	602,173	0.10	15
728	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Warehouse-Retro-GasHt-V1987_1994	602,173	0.03	15
730	Non-Res	Lighting-HID	Large MH to T5HO-Warehouse-Retro-GasHt-V1987_1994	441,447	0.07	15
731	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Supermarket-Retro-ElecHt-V1987_1994	602,173	0.01	15
733	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Supermarket-Retro-ElecHt-V1987_1994	602,173	0.01	15
734	Non-Res	Lighting-CFL	INC to CMH-Supermarket-Retro-ElecHt-V1987_1994	81,900	0.04	15
737	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Supermarket-Retro-HtPmpHt-V1987_1994	602,173	0.01	15
739	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Supermarket-Retro-HtPmpHt-V1987_1994	602,173	0.01	15
740	Non-Res	Lighting-CFL	INC to CMH-Supermarket-Retro-HtPmpHt-V1987_1994	81,900	0.04	15
743	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-Supermarket-Retro-GasHt-V1987_1994	602,173	0.03	15
745	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-Supermarket-Retro-GasHt-V1987_1994	602,173	0.02	15
746	Non-Res	Lighting-CFL	INC to CMH-Supermarket-Retro-GasHt-V1987_1994	81,900	0.05	15
749	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-MIniMart-Retro-ElecHt-V1987_1994	602,173	0.01	15
751	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-MIniMart-Retro-ElecHt-V1987_1994	602,173	0.01	15
752	Non-Res	Lighting-CFL	INC to CMH-MIniMart-Retro-ElecHt-V1987_1994	81,900	0.05	15
754	Non-Res	Lighting-HID	Med MH to T8HP-MIniMart-Retro-ElecHt-V1987_1994	441,447	0.07	15
755	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-MIniMart-Retro-HtPmpHt-V1987_1994	602,173	0.01	15
757	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-MIniMart-Retro-HtPmpHt-V1987_1994	602,173	0.01	15
758	Non-Res	Lighting-CFL	INC to CMH-MIniMart-Retro-HtPmpHt-V1987_1994	81,900	0.04	15
760	Non-Res	Lighting-HID	Med MH to T8HP-MIniMart-Retro-HtPmpHt-V1987_1994	441,447	0.05	15
761	Non-Res	Lighting-T12T8	T12-4 to T8HP-2-MIniMart-Retro-GasHt-V1987_1994	602,173	0.03	15

763	Non-Res	Lighting-T12T8	F96T12VHO to T8HP-4-MIniMart-Retro-GasHt-V1987_1994	602,173	0.03	15
764	Non-Res	Lighting-CFL	INC to CMH-MIniMart-Retro-GasHt-V1987_1994	81,900	0.05	15
766	Non-Res	Lighting-HID	Med MH to T8HP-MIniMart-Retro-GasHt-V1987_1994	441,447	0.07	15
767	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Restaurant-Retro-ElecHt-V1987_1994	602,173	0.06	15
768	Non-Res	Lighting-CFL	INC to CFL-Restaurant-Retro-ElecHt-V1987_1994	72,800	0.06	15
770	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Restaurant-Retro-HtPmpHt-V1987_1994	602,173	0.04	15
771	Non-Res	Lighting-CFL	INC to CFL-Restaurant-Retro-HtPmpHt-V1987_1994	72,800	0.03	15
773	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-Restaurant-Retro-GasHt-V1987_1994	602,173	0.06	15
774	Non-Res	Lighting-CFL	INC to CFL-Restaurant-Retro-GasHt-V1987_1994	72,800	0.05	15
776	Non-Res	Lighting-T12T8	F96T12 to T8HP-Lodging-Retro-ElecHt-V1987_1994	602,173	0.12	15
778	Non-Res	Lighting-CFL	INC to CFL-Lodging-Retro-ElecHt-V1987_1994	218,400	0.05	15
779	Non-Res	Lighting-T12T8	F96T12 to T8HP-Lodging-Retro-HtPmpHt-V1987_1994	602,173	0.09	15
781	Non-Res	Lighting-CFL	INC to CFL-Lodging-Retro-HtPmpHt-V1987_1994	218,400	0.04	15
782	Non-Res	Lighting-T12T8	F96T12 to T8HP-Lodging-Retro-GasHt-V1987_1994	602,173	0.09	15
784	Non-Res	Lighting-CFL	INC to CFL-Lodging-Retro-GasHt-V1987_1994	218,400	0.05	15
785	Non-Res	Lighting-T12T8	F96T12 to T8HP-Hospital-Retro-ElecHt-V1987_1994	602,173	0.17	15
787	Non-Res	Lighting-CFL	INC to CFL-Hospital-Retro-ElecHt-V1987_1994	9,100	0.07	15
788	Non-Res	Lighting-T12T8	F96T12 to T8HP-Hospital-Retro-HtPmpHt-V1987_1994	602,173	0.08	15
790	Non-Res	Lighting-CFL	INC to CFL-Hospital-Retro-HtPmpHt-V1987_1994	9,100	0.03	15
791	Non-Res	Lighting-T12T8	F96T12 to T8HP-Hospital-Retro-GasHt-V1987_1994	602,173	0.08	15
793	Non-Res	Lighting-CFL	INC to CFL-Hospital-Retro-GasHt-V1987_1994	9,100	0.05	15
794	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-OtherHealth-Retro-ElecHt-V1987_1994	602,173	0.04	15
796	Non-Res	Lighting-CFL	INC to CFL-OtherHealth-Retro-ElecHt-V1987_1994	9,100	0.04	15
797	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-OtherHealth-Retro-HtPmpHt-V1987_1994	602,173	0.04	15
799	Non-Res	Lighting-CFL	INC to CFL-OtherHealth-Retro-HtPmpHt-V1987_1994	9,100	0.03	15
800	Non-Res	Lighting-T12T8	T12-3 to T8HP-3-OtherHealth-Retro-GasHt-V1987_1994	602,173	0.04	15
802	Non-Res	Lighting-CFL	INC to CFL-OtherHealth-Retro-GasHt-V1987_1994	9,100	0.04	15
803	Non-Res	Lighting-T12T8	F96T12 to T8HP-Other-Retro-ElecHt-V1987_1994	602,173	0.08	15
807	Non-Res	Lighting-HID	Large MH to T5HO-Other-Retro-ElecHt-V1987_1994	441,447	0.05	15
808	Non-Res	Lighting-T12T8	F96T12 to T8HP-Other-Retro-HtPmpHt-V1987_1994	602,173	0.07	15
812	Non-Res	Lighting-HID	Large MH to T5HO-Other-Retro-HtPmpHt-V1987_1994	441,447	0.05	15
813	Non-Res	Lighting-T12T8	F96T12 to T8HP-Other-Retro-GasHt-V1987_1994	602,173	0.08	15

817	Non-Res	Lighting-HID	Large MH to T5HO-Other-Retro-GasHt-V1987_1994	441,447	0.05	15
818	Non-Res	Lighting-T12T8	F96T12 to T8HP-Large Off-Retro-ElecHt-V1995_2001	602,173	0.07	15
821	Non-Res	Lighting-CFL	INC to CFL-Large Off-Retro-ElecHt-V1995_2001	163,800	0.03	15
822	Non-Res	Lighting-HID	Med MH to T8HP-Large Off-Retro-ElecHt-V1995_2001	441,447	0.08	15
823	Non-Res	Lighting-T12T8	F96T12 to T8HP-Large Off-Retro-HtPmpHt-V1995_2001	602,173	0.07	15
826	Non-Res	Lighting-CFL	INC to CFL-Large Off-Retro-HtPmpHt-V1995_2001	163,800	0.03	15
827	Non-Res	Lighting-HID	Med MH to T8HP-Large Off-Retro-HtPmpHt-V1995_2001	441,447	0.08	15
828	Non-Res	Lighting-T12T8	F96T12 to T8HP-Large Off-Retro-GasHt-V1995_2001	602,173	0.07	15
831	Non-Res	Lighting-CFL	INC to CFL-Large Off-Retro-GasHt-V1995_2001	163,800	0.03	15
832	Non-Res	Lighting-HID	Med MH to T8HP-Large Off-Retro-GasHt-V1995_2001	441,447	0.08	15
833	Non-Res	Lighting-T12T8	F96T12 to T8HP-Medium Off-Retro-ElecHt-V1995_2001	602,173	0.09	15
836	Non-Res	Lighting-CFL	INC to CFL-Medium Off-Retro-ElecHt-V1995_2001	163,800	0.04	15
837	Non-Res	Lighting-HID	Med MH to T8HP-Medium Off-Retro-ElecHt-V1995_2001	441,447	0.10	15
838	Non-Res	Lighting-T12T8	F96T12 to T8HP-Medium Off-Retro-HtPmpHt-V1995_2001	602,173	0.08	15
841	Non-Res	Lighting-CFL	INC to CFL-Medium Off-Retro-HtPmpHt-V1995_2001	163,800	0.03	15
842	Non-Res	Lighting-HID	Med MH to T8HP-Medium Off-Retro-HtPmpHt-V1995_2001	441,447	0.09	15
843	Non-Res	Lighting-T12T8	F96T12 to T8HP-Medium Off-Retro-GasHt-V1995_2001	602,173	0.08	15
846	Non-Res	Lighting-CFL	INC to CFL-Medium Off-Retro-GasHt-V1995_2001	163,800	0.04	15
847	Non-Res	Lighting-HID	Med MH to T8HP-Medium Off-Retro-GasHt-V1995_2001	441,447	0.09	15
848	Non-Res	Lighting-T12T8	T12-3 to T8HP-2-Small Off-Retro-ElecHt-V1995_2001	602,173	0.03	15
851	Non-Res	Lighting-CFL	INC to CFL-Small Off-Retro-ElecHt-V1995_2001	163,800	0.06	15
853	Non-Res	Lighting-T12T8	T12-3 to T8HP-2-Small Off-Retro-HtPmpHt-V1995_2001	602,173	0.03	15
856	Non-Res	Lighting-CFL	INC to CFL-Small Off-Retro-HtPmpHt-V1995_2001	163,800	0.04	15
858	Non-Res	Lighting-T12T8	T12-3 to T8HP-2-Small Off-Retro-GasHt-V1995_2001	602,173	0.04	15
861	Non-Res	Lighting-CFL	INC to CFL-Small Off-Retro-GasHt-V1995_2001	163,800	0.05	15
863	Non-Res	Lighting-T12T8	F96T12 to T8HP-Big Box-Retro-ElecHt-V1995_2001	602,173	0.07	15
865	Non-Res	Lighting-CFL	INC to CMH-Big Box-Retro-ElecHt-V1995_2001	81,900	0.06	15
867	Non-Res	Lighting-HID	Large MH to T5HO-Big Box-Retro-ElecHt-V1995_2001	441,447	0.05	15
868	Non-Res	Lighting-T12T8	F96T12 to T8HP-Big Box-Retro-HtPmpHt-V1995_2001	602,173	0.06	15
870	Non-Res	Lighting-CFL	INC to CMH-Big Box-Retro-HtPmpHt-V1995_2001	81,900	0.05	15

872	Non-Res	Lighting-HID	Large MH to T5HO-Big Box-Retro-HtPmpHt-V1995_2001	441,447	0.04	15
873	Non-Res	Lighting-T12T8	F96T12 to T8HP-Big Box-Retro-GasHt-V1995_2001	602,173	0.06	15
875	Non-Res	Lighting-CFL	INC to CMH-Big Box-Retro-GasHt-V1995_2001	81,900	0.05	15
877	Non-Res	Lighting-HID	Large MH to T5HO-Big Box-Retro-GasHt-V1995_2001	441,447	0.04	15
878	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Box-Retro-ElecHt-V1995_2001	602,173	0.10	15
881	Non-Res	Lighting-CFL	INC to CMH-Small Box-Retro-ElecHt-V1995_2001	81,900	0.08	15
882	Non-Res	Lighting-HID	Med MH to T8HP-Small Box-Retro-ElecHt-V1995_2001	441,447	0.12	15
883	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Box-Retro-HtPmpHt-V1995_2001	602,173	0.08	15
886	Non-Res	Lighting-CFL	INC to CMH-Small Box-Retro-HtPmpHt-V1995_2001	81,900	0.06	15
887	Non-Res	Lighting-HID	Med MH to T8HP-Small Box-Retro-HtPmpHt-V1995_2001	441,447	0.09	15
888	Non-Res	Lighting-T12T8	F96T12 to T8HP-Small Box-Retro-GasHt-V1995_2001	602,173	0.08	15
891	Non-Res	Lighting-CFL	INC to CMH-Small Box-Retro-GasHt-V1995_2001	81,900	0.07	15
892	Non-Res	Lighting-HID	Med MH to T8HP-Small Box-Retro-GasHt-V1995_2001	441,447	0.09	15
893	Non-Res	Lighting-T12T8	T12-3 to T8HP-2-High End-Retro-ElecHt-V1995_2001	602,173	0.03	15
895	Non-Res	Lighting-CFL	INC to CMH-High End-Retro-ElecHt-V1995_2001	81,900	0.08	15
898	Non-Res	Lighting-T12T8	T12-3 to T8HP-2-High End-Retro-HtPmpHt-V1995_2001	602,173	0.02	15
900	Non-Res	Lighting-CFL	INC to CMH-High End-Retro-HtPmpHt-V1995_2001	81,900	0.07	15
903	Non-Res	Lighting-T12T8	T12-3 to T8HP-2-High End-Retro-GasHt-V1995_2001	602,173	0.04	15
905	Non-Res	Lighting-CFL	INC to CMH-High End-Retro-GasHt-V1995_2001	81,900	0.08	15
908	Non-Res	Lighting-T12T8	F96T12 to T8HP-Anchor-Retro-ElecHt-V1995_2001	602,173	0.10	15
911	Non-Res	Lighting-HID	Med MH to T8HP-Anchor-Retro-ElecHt-V1995_2001	441,447	0.11	15
912	Non-Res	Lighting-T12T8	F96T12 to T8HP-Anchor-Retro-HtPmpHt-V1995_2001	602,173	0.08	15
915	Non-Res	Lighting-HID	Med MH to T8HP-Anchor-Retro-HtPmpHt-V1995_2001	441,447	0.08	15
916	Non-Res	Lighting-T12T8	F96T12 to T8HP-Anchor-Retro-GasHt-V1995_2001	602,173	0.09	15
919	Non-Res	Lighting-HID	Med MH to T8HP-Anchor-Retro-GasHt-V1995_2001	441,447	0.10	15
920	Non-Res	Lighting-T12T8	F96T12 to T8HP-K-12-Retro-ElecHt-V1995_2001	602,173	0.21	15
923	Non-Res	Lighting-CFL	INC to CFL-K-12-Retro-ElecHt-V1995_2001	145,600	0.08	15
924	Non-Res	Lighting-HID	Med MH to T8HP-K-12-Retro-ElecHt-V1995_2001	441,447	0.23	15
925	Non-Res	Lighting-T12T8	F96T12 to T8HP-K-12-Retro-HtPmpHt-V1995_2001	602,173	0.14	15
928	Non-Res	Lighting-CFL	INC to CFL-K-12-Retro-HtPmpHt-V1995_2001	145,600	0.06	15
929	Non-Res	Lighting-HID	Med MH to T8HP-K-12-Retro-HtPmpHt-V1995_2001	441,447	0.16	15

930	Non-Res	Lighting-T12T8	F96T12 to T8HP-K-12-Retro-GasHt-V1995_2001	602,173	0.14	15
933	Non-Res	Lighting-CFL	INC to CFL-K-12-Retro-GasHt-V1995_2001	145,600	0.06	15
934	Non-Res	Lighting-HID	Med MH to T8HP-K-12-Retro-GasHt-V1995_2001	441,447	0.15	15
935	Non-Res	Lighting-T12T8	F96T12 to T8HP-University-Retro-ElecHt-V1995_2001	602,173	0.14	15
937	Non-Res	Lighting-CFL	INC to CFL-University-Retro-ElecHt-V1995_2001	145,600	0.06	15
939	Non-Res	Lighting-T12T8	F96T12 to T8HP-University-Retro-HtPmpHt-V1995_2001	602,173	0.10	15
941	Non-Res	Lighting-CFL	INC to CFL-University-Retro-HtPmpHt-V1995_2001	145,600	0.04	15
943	Non-Res	Lighting-T12T8	F96T12 to T8HP-University-Retro-GasHt-V1995_2001	602,173	0.10	15
945	Non-Res	Lighting-CFL	INC to CFL-University-Retro-GasHt-V1995_2001	145,600	0.05	15
947	Non-Res	Lighting-T12T8	F96T12 to T8HP-Warehouse-Retro-ElecHt-V1995_2001	602,173	0.14	15
949	Non-Res	Lighting-CFL	INC to CFL-Warehouse-Retro-ElecHt-V1995_2001	655,200	0.06	15
951	Non-Res	Lighting-HID	Large MH to T5HO-Warehouse-Retro-ElecHt-V1995_2001	441,447	0.09	15
952	Non-Res	Lighting-T12T8	F96T12 to T8HP-Warehouse-Retro-HtPmpHt-V1995_2001	602,173	0.10	15
954	Non-Res	Lighting-CFL	INC to CFL-Warehouse-Retro-HtPmpHt-V1995_2001	655,200	0.04	15
956	Non-Res	Lighting-HID	Large MH to T5HO-Warehouse-Retro-HtPmpHt-V1995_2001	441,447	0.07	15
957	Non-Res	Lighting-T12T8	F96T12 to T8HP-Warehouse-Retro-GasHt-V1995_2001	602,173	0.10	15
959	Non-Res	Lighting-CFL	INC to CFL-Warehouse-Retro-GasHt-V1995_2001	655,200	0.05	15
961	Non-Res	Lighting-HID	Large MH to T5HO-Warehouse-Retro-GasHt-V1995_2001	441,447	0.07	15
962	Non-Res	Lighting-T12T8	F96T12 to T8HP-Supermarket-Retro-ElecHt-V1995_2001	602,173	0.05	15
966	Non-Res	Lighting-HID	Med MH to T8HP-Supermarket-Retro-ElecHt-V1995_2001	441,447	0.06	15
967	Non-Res	Lighting-T12T8	F96T12 to T8HP-Supermarket-Retro-HtPmpHt-V1995_2001	602,173	0.05	15
971	Non-Res	Lighting-HID	Med MH to T8HP-Supermarket-Retro-HtPmpHt-V1995_2001	441,447	0.05	15
972	Non-Res	Lighting-T12T8	F96T12 to T8HP-Supermarket-Retro-GasHt-V1995_2001	602,173	0.06	15
976	Non-Res	Lighting-HID	Med MH to T8HP-Supermarket-Retro-GasHt-V1995_2001	441,447	0.06	15
977	Non-Res	Lighting-T12T8	F96T12 to T8HP-MIniMart-Retro-ElecHt-V1995_2001	602,173	0.06	15
979	Non-Res	Lighting-CFL	INC to CMH-MIniMart-Retro-ElecHt-V1995_2001	81,900	0.05	15
980	Non-Res	Lighting-HID	Med MH to T8HP-MIniMart-Retro-ElecHt-V1995_2001	441,447	0.07	15
981	Non-Res	Lighting-T12T8	F96T12 to T8HP-MIniMart-Retro-HtPmpHt-V1995_2001	602,173	0.05	15
983	Non-Res	Lighting-CFL	INC to CMH-MIniMart-Retro-HtPmpHt-V1995_2001	81,900	0.04	15
984	Non-Res	Lighting-HID	Med MH to T8HP-MIniMart-Retro-HtPmpHt-V1995_2001	441,447	0.05	15

985	Non-Res	Lighting-T12T8	F96T12 to T8HP-MIniMart-Retro-GasHt-V1995_2001	602,173	0.07	15
987	Non-Res	Lighting-CFL	INC to CMH-MIniMart-Retro-GasHt-V1995_2001	81,900	0.05	15
988	Non-Res	Lighting-HID	Med MH to T8HP-MIniMart-Retro-GasHt-V1995_2001	441,447	0.07	15
989	Non-Res	Lighting-T12T8	F96T12 to T8HP-Restaurant-Retro-ElecHt-V1995_2001	602,173	0.14	15
992	Non-Res	Lighting-CFL	INC to CFL-Restaurant-Retro-ElecHt-V1995_2001	72,800	0.06	15
994	Non-Res	Lighting-T12T8	F96T12 to T8HP-Restaurant-Retro-HtPmpHt-V1995_2001	602,173	0.08	15
997	Non-Res	Lighting-CFL	INC to CFL-Restaurant-Retro-HtPmpHt-V1995_2001	72,800	0.03	15
999	Non-Res	Lighting-T12T8	F96T12 to T8HP-Restaurant-Retro-GasHt-V1995_2001	602,173	0.09	15
1002	Non-Res	Lighting-CFL	INC to CFL-Restaurant-Retro-GasHt-V1995_2001	72,800	0.05	15
1004	Non-Res	Lighting-T12T8	F96T12 to T8HP-Lodging-Retro-ElecHt-V1995_2001	602,173	0.12	15
1006	Non-Res	Lighting-CFL	INC to CFL-Lodging-Retro-ElecHt-V1995_2001	218,400	0.05	15
1008	Non-Res	Lighting-T12T8	F96T12 to T8HP-Lodging-Retro-HtPmpHt-V1995_2001	602,173	0.09	15
1010	Non-Res	Lighting-CFL	INC to CFL-Lodging-Retro-HtPmpHt-V1995_2001	218,400	0.04	15
1012	Non-Res	Lighting-T12T8	F96T12 to T8HP-Lodging-Retro-GasHt-V1995_2001	602,173	0.09	15
1014	Non-Res	Lighting-CFL	INC to CFL-Lodging-Retro-GasHt-V1995_2001	218,400	0.05	15
1016	Non-Res	Lighting-T12T8	F96T12 to T8HP-Hospital-Retro-ElecHt-V1995_2001	602,173	0.17	15
1018	Non-Res	Lighting-CFL	INC to CFL-Hospital-Retro-ElecHt-V1995_2001	9,100	0.07	15
1019	Non-Res	Lighting-HID	Med MH to T8HP-Hospital-Retro-ElecHt-V1995_2001	441,447	0.19	15
1020	Non-Res	Lighting-T12T8	F96T12 to T8HP-Hospital-Retro-HtPmpHt-V1995_2001	602,173	0.08	15
1022	Non-Res	Lighting-CFL	INC to CFL-Hospital-Retro-HtPmpHt-V1995_2001	9,100	0.03	15
1023	Non-Res	Lighting-HID	Med MH to T8HP-Hospital-Retro-HtPmpHt-V1995_2001	441,447	0.08	15
1024	Non-Res	Lighting-T12T8	F96T12 to T8HP-Hospital-Retro-GasHt-V1995_2001	602,173	0.08	15
1026	Non-Res	Lighting-CFL	INC to CFL-Hospital-Retro-GasHt-V1995_2001	9,100	0.05	15
1027	Non-Res	Lighting-HID	Med MH to T8HP-Hospital-Retro-GasHt-V1995_2001	441,447	0.09	15
1028	Non-Res	Lighting-T12T8	F96T12 to T8HP-OtherHealth-Retro-ElecHt-V1995_2001	602,173	0.09	15
1030	Non-Res	Lighting-CFL	INC to CFL-OtherHealth-Retro-ElecHt-V1995_2001	9,100	0.04	15
1031	Non-Res	Lighting-HID	Med MH to T8HP-OtherHealth-Retro-ElecHt-V1995_2001	441,447	0.10	15
1032	Non-Res	Lighting-T12T8	F96T12 to T8HP-OtherHealth-Retro-HtPmpHt-V1995_2001	602,173	0.08	15
1034	Non-Res	Lighting-CFL	INC to CFL-OtherHealth-Retro-HtPmpHt-V1995_2001	9,100	0.03	15
1035	Non-Res	Lighting-HID	Med MH to T8HP-OtherHealth-Retro-HtPmpHt-V1995_2001	441,447	0.09	15
1036	Non-Res	Lighting-T12T8	F96T12 to T8HP-OtherHealth-Retro-GasHt-V1995_2001	602,173	0.08	15
1038	Non-Res	Lighting-CFL	INC to CFL-OtherHealth-Retro-GasHt-V1995_2001	9,100	0.04	15

1039	Non-Res	Lighting-HID	Med MH to T8HP-OtherHealth-Retro-GasHt-V1995_2001	441,447	0.09	15
1040	Non-Res	Lighting-T12T8	F96T12 to T8HP-Other-Retro-ElecHt-V1995_2001	602,173	0.08	15
1042	Non-Res	Lighting-CFL	INC to CFL-Other-Retro-ElecHt-V1995_2001	145,600	0.03	15
1043	Non-Res	Lighting-HID	Med MH to T8HP-Other-Retro-ElecHt-V1995_2001	441,447	0.09	15
1044	Non-Res	Lighting-T12T8	F96T12 to T8HP-Other-Retro-HtPmpHt-V1995_2001	602,173	0.07	15
1046	Non-Res	Lighting-CFL	INC to CFL-Other-Retro-HtPmpHt-V1995_2001	145,600	0.03	15
1047	Non-Res	Lighting-HID	Med MH to T8HP-Other-Retro-HtPmpHt-V1995_2001	441,447	0.08	15
1048	Non-Res	Lighting-T12T8	F96T12 to T8HP-Other-Retro-GasHt-V1995_2001	602,173	0.07	15
1050	Non-Res	Lighting-CFL	INC to CFL-Other-Retro-GasHt-V1995_2001	145,600	0.03	15
1051	Non-Res	Lighting-HID	Med MH to T8HP-Other-Retro-GasHt-V1995_2001	441,447	0.08	15
1058	Non-Res	Lighting-Signs	Outdoor Sign Ballast - Night	546,000	0.01	13
1059	Non-Res	Lighting-Signs	Outdoor Sign Ballast - 24	546,000	0.01	7
1060	Non-Res	Lighting-Signs	Outdoor Sign Ballast - Night - Retro	546,000	0.11	13
1061	Non-Res	Lighting-Signs	Outdoor Sign Ballast - 24 - Retro	546,000	0.09	7
1065	Non-Res		EE Reach-In Refrigerator from E-Star Baseline	189,800	0.03	9
1067	Non-Res		EE Reach-In Freezer from E-Star Baseline	351,800	0.01	9
1070	Non-Res		EE Ice Maker from FEMP Baseline	82,043	0.07	9
1071	Non-Res		EE Vending Machine from Average Baseline	147,056	0.04	9
1072	Non-Res		EE Vending Machine from E-Star Baseline	115,544	0.02	9
1146	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-Large Off-ElecHt	60,667	0.09	21
1147	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-Large Off-HtPmpHt	60,667	0.08	21
1148	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-Large Off-GasHt	60,667	0.08	21
1149	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-Medium Off-ElecHt	60,667	0.13	21
1150	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-Medium Off-HtPmpHt	60,667	0.12	21
1151	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-Medium Off-GasHt	60,667	0.11	21
1152	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-Small Off-ElecHt	60,667	0.18	21
1153	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-Small Off-HtPmpHt	60,667	0.13	21
1154	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-Small Off-GasHt	60,667	0.11	21
1155	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-K-12-ElecHt	60,667	0.22	21
1156	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-K-12-HtPmpHt	60,667	0.15	21
1157	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-K-12-GasHt	60,667	0.13	21
1158	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-University-ElecHt	60,667	0.17	21
1159	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-University-HtPmpHt	60,667	0.13	21
1160	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-University-GasHt	60,667	0.11	21
1161	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-OtherHealth-ElecHt	60,667	0.11	21

1162	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-OtherHealth-HtPmpHt	60,667	0.10	21
1163	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-New-OtherHealth-GasHt	60,667	0.10	21
1164	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-Large Off-ElecHt	60,667	0.09	21
1165	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-Large Off-HtPmpHt	60,667	0.08	21
1166	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-Large Off-GasHt	60,667	0.08	21
1167	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-Medium Off-ElecHt	60,667	0.13	21
1168	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-Medium Off-HtPmpHt	60,667	0.12	21
1169	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-Medium Off-GasHt	60,667	0.11	21
1170	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-Small Off-ElecHt	60,667	0.18	21
1171	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-Small Off-HtPmpHt	60,667	0.13	21
1172	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-Small Off-GasHt	60,667	0.11	21
1173	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-K-12-ElecHt	60,667	0.23	21
1174	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-K-12-HtPmpHt	60,667	0.15	21
1175	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-K-12-GasHt	60,667	0.13	21
1176	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-University-ElecHt	60,667	0.18	21
1177	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-University-HtPmpHt	60,667	0.13	21
1178	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-University-GasHt	60,667	0.11	21
1179	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-OtherHealth-ElecHt	60,667	0.11	21
1180	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-OtherHealth-HtPmpHt	60,667	0.10	21
1181	Non-Res	Lighting-Daylig	Perimeter Day lighting Controls (Advanced)-NR-OtherHealth-GasHt	60,667	0.10	21
1290	Non-Res	Appliances	Vending Machine Controller-Large Machine w/Illuminated Front	49,920	0.02	10
1291	Non-Res	Appliances	Vending Machine Controller-Small Machine or Machine without Illuminated Front	33,280	0.03	10

2009

Electric Integrated Resource Plan

Appendix G – Avista Distribution System Efficiencies Program

August 31, 2009

Avista Distribution System Efficiencies Program

Programs to Reduce Energy Loss across Avista's Distribution System

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Executive Summary

Avista's Distribution System consists of approximately three hundred and thirty feeders covering a geographical area of 30,000 square miles. The distribution feeders range in distribution voltage from 4.16 kV to 34.5 kV phase to phase and are typically rated to meet 10 MVA load for the typical 13.2 kV feeder. The distribution feeders reside in urban, suburban and rural areas and can range in length from 3 to 73 miles. The distribution feeders are typically designed to provide service for approximately one to two thousand residential customers.

The engineering analysis summarized in this report determines losses across the distribution system for the following program areas: 1) Conductor losses, 2) Distribution Transformers, 3) Secondary Districts and 4) VAr compensation. Although additional programs like phase balancing and Conservation Voltage Reduction (CVR) could have been included in the analysis, they were intentionally left out since daily operational activity may negate the energy savings. The energy loss, capital investment and reduction in O&M costs resulting from the individual efficiencies programs were combined on a per feeder basis. This approach provided a means to rank and compare energy savings and net resource cost for each feeder.

The efficiency analysis of the distribution feeders evaluated the existing energy losses and energy savings resulting from implementing the program upgrades. The study identified the existing distribution system losses to be approximately 3.6%. Assuming, all of the distribution feeders studied were economically viable to upgrade, the resulting system energy losses would be reduced by 2%. The total energy savings corresponding to the implementation of the upgrades would correspond to an energy savings of approximately 29.2 MW on peak and 13.5 MW on average.

Although it may not be prudent to upgrade all of the distribution feeders, this study ranks the feeders by diminishing economic return. The economic metric used to rank feeders was net resource cost. The net resource cost for each feeder was determined for O&M offsets forecasted on a five, ten and fifteen year time horizon. This variable O&M forecast provided a means to filter on or off the number of economically viable feeder upgrades. Other criteria used to reduce the number of viable feeder upgrade projects included capital investment greater then $0.5 million and net resource cost less then $100 per Mwh.

The feeder upgrade program by itself falls short of being a strategic vision. However, it can be used as a first step towards a broader strategic view to be included in programs like capital budgeting, energy efficiency, and O&M reduction. A more robust corporate strategic vision for aging infrastructure rehabilitation would need to incorporate the following elements: 1) Movement of bulk power across our transmission system, 2) Optimum distribution topologies, 3) Substation size, locations and architectures, and 4) Reliable forecasts of geographical centered load growth. Once these elements are incorporated into the existing feeder upgrade program, a long term plan for Avista's electric infrastructure can be developed to move infrastructure upgrades from a tactical or reactive approach to a planned replacement strategy.

Introduction

Objective

The objective of the system efficiency analysis was to obtain a first order of magnitude assessment of energy savings across Avista's electric distribution system. The analysis was constructed to address the following two questions: 1) How much energy savings is available across Avista's distribution system? 2) Which feeders provide the most cost-effective for the least investment across the system?

Concession

The analysis did not include operational or design options to assist in refining cost estimates or selecting feeders for upgrade. Also, this analysis focused solely on the distribution system and did not consider system changes which may incorporate the installation of substations or new transmission lines.

Background

Avista's electric distribution system consists of approximately three hundred and thirty feeders covering a geographical area of 30,000 square miles. The distribution feeders range in voltage from 4.16 kV to 34.5 kV phase to phase and are typically rated to meet 10 MVA load for a typical 13.2 kV feeder. The distribution feeders reside in urban, suburban and rural areas and can range in length from 3 to 73 miles. The distribution feeders are typically designed to provide service from one to two thousand residential customers.

Past efficiency studies on Avista's distribution system have typically focused on either individual reinforcement projects or specific equipment upgrades. This current analysis differs from past analysis by combining several efficiency programs across most of Avista's distribution feeders. The results of the analysis provided an overall assessment of the energy savings on a per feeder basis. Also, this analysis incorporated capital, operational and maintenance costs into the economic assessment in order to determine the net resource value.

Analysis Tool Set

To determine efficiency gains associated with upgrading the distribution feeders, an analysis framework was developed by combining complementary technologies existing at Avista. For example, the SynerGEE Electric tool and its corresponding analysis engine Solver was leveraged to perform power flow analysis. Avista's Facility Management (AFM) system and Major Equipment Tracking (MET) system were queried to obtain the number, age and sizes of transformers on the distribution feeders. In addition, Avista's Substation Control and Data Acquisition (SCADA) system provided annual peak load and VAr consumption at the substation buses. Finally, the economic analysis of the annual Operation and Maintenance (O&M) forecast was approximated by Asset Managements Isograph Availability Workbench.

Engineering Analysis Methodology

The engineering analysis evaluated losses across the distribution system for the following program areas: 1) Conductor losses, 2) Distribution Transformers, 3) Secondary Districts and 4) VAr compensation. The energy losses, capital investment and reduction in O&M costs resulting from the individual efficiencies programs were combined on a per feeder basis. This analysis approach provided a means to rank and compare energy savings, along with return on investment, for each feeder. The individual programs methodology and assumptions are summarized in the descriptions below.

Reconductoring

The Distribution Engineering Group builds and maintains the SynerGEE distribution databases. The SynerGEE databases require material size, type and network topology for Avista's distribution feeders as provided by the Avista Facilities Management (AFM) system. These databases provide a network model from which a power flow analysis can be performed to evaluate thermal and voltage performance of each feeder. The power flow analysis accuracy is dependent upon these SynerGEE databases being both current and accurate. The internal work processes used to maintain the SynerGEE models are summarized below.

- *Avista's AFM system is maintained by applications which support the design of new facilities, outages, operations and maintenance activities on the distribution system.*
- *An internally developed AFM application called Model Builder is used to upload the AFM data into a SynerGEE Model database*
- *Distribution Engineering reviews the SynerGEE Models and performs system calibration of the models.*
- *At the distribution feeder bus, a peak current meter read is recorded and inputted by Distribution Planning.*

In order to perform a power flow analysis for all three hundred plus feeders, in this system efficiency analysis, the process was automated by utilizing Advantica's Solver engine. By using Solver, a scripting tool was developed to run multiple power flow iterations utilizing the SynerGEE models. The first iteration evaluated the energy loss with existing conductor and flagged conductor which did not adhere to Distribution Engineering's new economic conductor standard summarized in Table 1. The second iteration updated the flagged conductor with the new conductor standard and evaluated the energy loss.

Table 1 Economic Conductor Standard

Ampacity Range	Selected Conductor
0 to 25 Amps	2ACSR
26 to 100 Amps	4/0AAC
101 to 250 Amps	556AAC
251 to 700 Amps	795AAC

The incremental energy savings resulting from reconductoring the feeder was determined by evaluating the peak loss of KW for the existing conductor versus the new conductor standards. Once the peak incremental loss was determined between the two runs, an average energy loss was calculated. The average energy loss was determined by multiplying the peak loss by a loss factor. The loss factor was determined by squaring the load factor. The assumptions used in the analysis are summarized in the list below.

- *The load factor for the distribution feeders were approximated by evaluating the load factor at several of the substation buses with hourly SCADA data*
- *The load factor used for the distribution analysis was 50 percent*
- *The loss factor used for the distribution analysis was 25 percent*

Overhead Transformers
Between 1986 and 1987, Distribution Engineering conducted a set of no-load tests on approximately two hundred overhead transformers of various sizes, types and vintages. From the tests, a set of curves were developed to approximate the no-load losses for a transformer rating and age class (see Appendix). As a result, the no-load curves showed the loss for a particular transformer could be categorized into the following three vintages of transformers: 1) Pre-1960, 2) 1960 – 1983, 3) Post 1983.

In 2008, Distribution Engineering implemented a new design standard for overhead transformers which is based on a life-cycle cost analysis and recently established an avoided cost of energy value of $66/MW. Consequently, the new transformer design standards specify transformers with no-load losses less then recently enacted Department of Energy (DOE) transformer efficiency standards. Upgrading the older overhead transformers accounted for a significant incremental energy savings in no-load losses.

A software script was developed within the AFM system to retrieve the number, size and vintage of transformers located on distribution feeders. The analysis assumed the overhead transformers would be replaced in-kind with the new lower no load loss overhead transformers. The difference between the no-load loss of the old and new transformer accounts for the incremental energy savings. The overhead transformer no-load loss occurs every hour of the year and is independent of the actual load. Therefore, the incremental energy savings are an average value. The transformer population for particular vintage classes is summarized in Table 2, for overhead transformers only.

Table 2 Overhead Transformer Vintages

Vintage	Population Number
Pre1963	10,416
1963 - 1983	32,788
Post 1983	43,204

Secondary Districts
Up to the late 1960's, Avista designed and constructed large secondary districts in residential neighborhoods. A secondary district is designed with a distribution transformer and a three wire secondary lines which provided service tie positions for up to thirty customers. At the time of construction, these districts were economically viable since they increased the customer to transformer ratio. Due to the increased cost of energy and associated operational O&M costs, the elimination or redesign of the secondary districts were evaluated for efficiency gains.

To determine the number of secondary districts on a feeder, an AFM script was written to identify the number of customers connected to a distribution transformer. To support the analysis, a secondary district was defined as an overhead transformer with twelve or more service premises. Using this classification, the ten feeders with the most secondary districts returned from the AFM query is summarized in Table 3.

Table 3 Feeder Secondary Districts

Feeder Name	Number of Secondary Districts
Ross Park 12F1	56
Ross Park 12F6	55
Ross Park 12F5	53
Sunset 12F3	52
Lyons & Standard 12F2	49
Francis & Cedar 12F1	47
Fort Wright 12F1	43
Beacon 12F5	40
Collage & Walnut 12F5	39
Third & Hatch 12F2	37

In order to evaluate the reduction in energy losses, a SynerGEE power flow analysis was performed on some typical secondary districts. To improve the efficiency of the secondary districts, two options were considered: 1) Reduce the district length by the addition of a transformer, 2) Reconductoring the district with insulated triplex conductor. The power flow analysis concluded districts with more then twenty two service premises should be reduced in length by the addition of an overhead transformer, while districts with less then twenty two service premises should be replaced using overhead triplex wire.

The secondary district analysis only reviewed the reduction of energy loss and did not consider other design considerations such as flicker and reliability. Although an operational case could be made to eliminate districts by the addition of transformers for every four services, the energy loss in the transformers exceed the energy savings in the elimination of the district. The average KW loss associated with the district types is summarized in Table 4 below.

Table 4 Secondary District Type

Secondary District Type	Average KW Loss
10-12	.234
12-22	.356
22 and up	1.03

VAr Compensation

Another efficiency program evaluated the reduction of current on the line by offsetting the reactive load with the installation of switched capacitors. A VAr controller operates the switched capacitor to respond to adverse reactive loading on a feeder. The amount of energy savings associated with the installation of switched capacitors depends upon the feeder power factor. To a large extent, motor loading required for air conditioning drives the reactive loading on a feeder. Consequently, the number of hours a switched capacitor operates is seasonal. The analysis methodology developed for evaluating the energy savings associated for a feeder is described below.

The Ninth and Central feeders were modeled to determine the size and type of switched capacitors as well as the annual hours of operation. A SCADA point located at Ninth and Central provided the amount of MVAr loading on a substation transformer on a per hour basis. A load duration curve developed from this data determined the capacitor size and hours of operation. Once sized, SynerGEE's capacitor placement application optimized both the peak power savings and the ideal placement of the capacitor. The energy savings obtained by installing the capacitor was determined by multiplying the number of hours of operation by the KW savings to MVAr ratio.

This analysis methodology was simplified for the rest of the feeders by assuming the KW to MVAr ratio for all distribution feeders. The capacitor size for the rest of the feeders was assumed to be a single 900 KVAr bank. The hours of operation for the 900 KVAr were based on the load duration curve.

Economic Analysis
The economic analysis for the feeder upgrade programs estimated the capital investment, calculated the energy savings and forecasted operational and maintenance expense and interim capital investments. The capital investment required to implement the efficiencies programs were obtained from engineering estimates described below. The energy savings for a feeder upgrade was determined by the efficiency programs described previously. Finally, Asset Management modeled the feeders using their tools and forecasted the reduction in operational and maintenance expense resulting from the feeder upgrade, also described below.

Engineering Estimate
Reconductoring
The material and labor estimate were performed by Distribution Engineering in conjunction with Planning and are based on 2008 material and labor costs. The reconductoring estimate was based on whether the conductor was being replaced or whether new construction was necessary to install the conductor. The assumptions made in the unit pricing for each case are summarized in the list below.

New Construction
- New Pole
- New Anchors
- New Cross Arms

Replacement
- 40 % replacement of the poles, cross arms and anchors

The conductor replacement unit price is summarized in the Table 5 below.

Table 5 Conductor Unit Price

CONDUCTOR_TYPE	Replacement $/Per Mile	New Construction $/Per Mile
795AAC	$60,000	$85,000
556AAC	$45,000	$71,000
4/0AAC	$35,000	$52,000
2ACSR	$30,000	$42,000

Distribution Transformers
The engineering estimates for distribution transformers were obtained from Purchasing and are based on 2008 material and labor costs. The overhead transformers met the new design requirements for no-load losses. The estimated unit prices for various sized overhead transformers are summarized in Table 6.

Table 6 Overhead Transformers

Overhead Transformers	Installed Cost
15 KVA	$1,014
25 KVA	$1,301
37.5 KVA	$1,952
75 KVA	$2,519
100 KVA	$3,278
150 KVA	$3,430
225 KVA	$3,936
300 KVA	$4,310

Secondary Districts

The engineering estimates to redesign secondary districts were determined for three distinct archetypes. The secondary district archetypes were based on the number of customers attached to overhead transformers. The labor and material costs to redesign the secondary districts for the distinct archetypes are listed in Table 7.

Table 7 Secondary Districts

Secondary District Archetypes	Cost
10-12 Customer Service Points	$5,728 - $8,687
13-22 Customer Service Points	$6,181 - $8,820
>22 Customer Service Points	$7,539 - $10,498

VAr Compensation

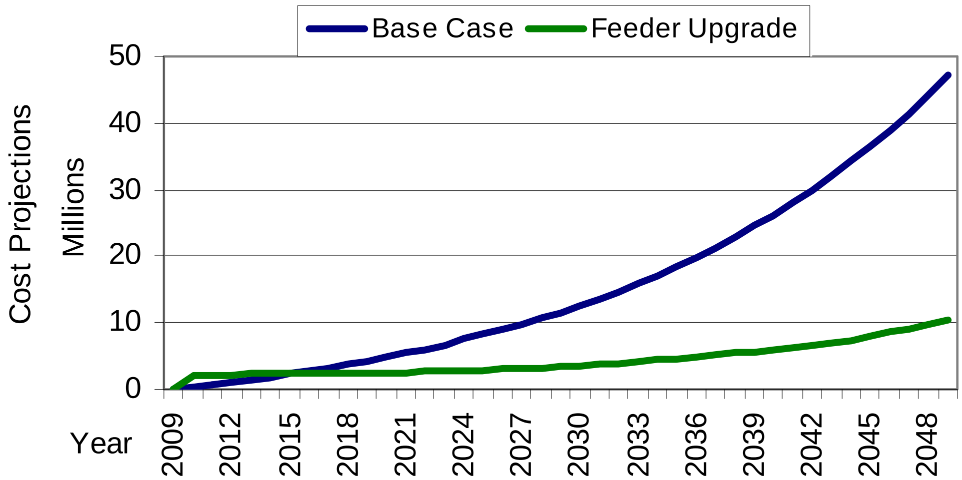
The labor and material estimate for switched capacitors were based on recently purchased and installed capacitors. The cost for the purchased and installed capacitors for a 900 KVAr bank was $11,000.

Asset Management

The Asset Management team developed the Availability Workbench Model for six distribution feeders. The Availability Workbench Model combines input from the following areas: 1) system performance, 2) facility data, 3) manager and crafts 4) industry data, and 5) key performance indicators. From these inputs, the workbench application generates a forecasted annualized O&M and Capital cost model. The cost model is generated by comparing O&M expense resulting after a feeder upgrade versus the O&M expense for a base case. Asset Managements base case assumes the equipment will be replaced upon failure.

The Asset Management analysis results indicated that upgrading the feeders reduces forecasted O&M expense when compared to the base case. The feeder upgrade program replaces aged equipment with new equipment to improve system efficiencies and reliability. The replacement of equipment reduces future O&M expenditures which is an economic benefit to the project and is included in the analysis. The reduction and avoidance of future increases in O&M expenditures are illustrated in Figure 1. The base case curve shows an exponential growth in O&M costs resulting from failure of the aging equipment failing. The feeder upgrade curve shows an initial increase in revenue requirement corresponding to the cost of the upgrade but shows how the revenue requirement rises slower due to the replacement of the aging facility.

Figure 1 O&M Cost Programs



The Asset Management program conducted an O&M analysis for the following six feeders: 1) 9CE12F4, 2) SUN12F3, 3) SUN12F1, 4) SUN12F2, 5) COL12F2, 6) KET12F2. The Asset Management team estimated the time to develop a Workbench model to determine the O&M expenditure was approximately thirty hours per feeder. To reduce the time to perform the analysis, the O&M expenditure curve determined for the six feeders was used to interpolate the expenditure for the other feeders. The linear interpolation was based on a strong correlation between the O&M expense and the length of the feeders analyzed.

In order to limit the interpolation, the O&M expense was generated only for feeders with lengths between 12.5 miles (SUN12F3) and149 miles (KET12F2). Consequently, feeders with lengths outside this range were not included in the net resource cost analysis. Although the feeders were not included in the analysis the may still be economically viable. One example is the ORI12F3 feeder which ranks first in energy savings as shown Table 12. However, the feeder was not included in the net resource cost analysis since its length of 170 miles exceeded the maximum mileage criteria used for the analysis.

Energy Results

The efficiency analysis of the distribution feeders evaluated the existing energy losses and energy savings resulting from implementing the program upgrades. The study identified the existing distribution system losses to be approximately 3.6%. Assuming, all of the distribution feeders studied were economically viable to upgrade, the resulting system energy losses would be reduced by 2%. The total energy savings corresponding to the implementation of the upgrades would correspond to an energy savings of approximately 29.2 MW on peak and 13.5 MW on average. The energy savings break down across each program is described below.

Reconductoring

The reconductoring program as mentioned previously used the SynerGEE application to determine the conductor losses across our feeders. The distribution conductor operating at twenty percent or greater of its rated ampacity was upgraded to the new distribution standard, if warranted. The analysis was run again to determine the incremental reduction in conductor losses corresponding to the conductor upgrade. The results of the analysis are summarized in Table 8.

Table 8 Reconductoring Power Savings

Number of Feeders	Peak Loss KW	Average Loss KW	Peak Loss Savings KW	Average Loss Savings KW
302	35,676	8,919	14,973	3,743

Overhead Transformers

The efficiency analysis evaluated the no-load losses across the existing transformer population to determine the average no-load transformer loss on Avista's distribution feeders. The incremental energy savings was determined by taking the difference between the no-load losses of the new transformer standard versus the older vintage transformers. The results of the analysis are summarized in Table 9.

Table 9 Overhead Transformer Power Savings

Vintage	Total number of Transformers	Average Loss KW	Average Loss Savings KW
Pre1963	10,416	4700	1,907
1963 To 1983	32,788	9470	5,710

Secondary Districts

The energy losses corresponding to the secondary districts were categorized by the number of service premises connected to the district. The incremental energy savings from the redesign of these districts was determined by taking the difference between the existing losses and the new designed district losses. The results of the analysis are summarized in Table 10.

Table 10 Secondary Districts Power Savings

Archetypes	Number of Districts	Peak Loss KW	Avg. Power Loss KW	Peak Loss Savings KW	Avg. Power Savings KW
10 - 12 Customer Service Points	3,414	5,516	1,379	3,196	799
13 - 22 Customer Service Points	1,302	3,156	789	1,856	464
> 22 Customer Service Points	32	196	49	132	33
TOTAL	4,748	8,868	2,217	5,184	1,296

VAr Compensation

A VAr duration curve across Avista's load was developed from the electric transmission SCADA data. This load duration curve helped to book mark the amount of reactive load on Avista's system. The analysis assumed approximately 100 MVAr of reactive load could be offset in the distribution system. It was also assumed that standard switched bank installation of 900 KVAr would be deployed for a single feeder. Therefore, approximately 112 feeders would have switched capacitors installed. Finally, as mentioned previously the ratio between kilowatts savings for megavar compensation was determined by evaluating several distribution feeders. The results of the savings are shown in Table 11.

Table 11 VAr Compensation Power Savings

Number of Feeders	Bank Size	KW Savings	Average Hours Operation	Peak Power Savings KW	Avg Power Savings KW
112	900 KVAr	13	5100	1456	847

In addition to reviewing the individual programs for energy savings, the programs were combined on a per feeder basis. This allowed the feeders to be ranked on the total amount of energy savings available on a per feeder basis. Table 12 provides the number of feeders which would provided power savings over one hundred kilowatts. The list of feeders and corresponding power savings is listed in Table 12.

Table 12 Top Feeder Power Savings

Feeder Name	Total Cost	Total Average kW
ORI12F3	$1,170,357	201
CHW12F3	$1,682,503	184
SPI12F1	$1,243,066	172
WIL12F2	$1,705,623	155
KET12F2	$968,669	143
STM631	$1,211,798	139
CLV34F1	$1,765,413	127
F&C12F1	$1,499,055	123
ROX751	$1,069,310	120
BEA12F2	$1,423,808	116
SUN12F3	$1,224,379	113
GIF34F2	$1,253,973	112
BEA12F1	$1,221,446	111
COB12F2	$822,727	109
RAT231	$1,111,882	108
ORO1281	$669,953	107
CLV12F4	$907,259	105
ROS12F1	$1,428,530	104
ROS12F6	$1,316,652	102
L&S12F2	$1,101,072	101
BEA12F5	$1,210,094	101

Economic Ranking
Although it may not be prudent to upgrade all of the distribution feeders, this study ranks the feeders by diminishing economic return. The economic metric used to rank feeders was net resource cost. The net resource cost for each feeder was determined for O&M offsets forecasted on a five, ten and fifteen year time horizon. This variable O&M forecast provided a means to filter on or off the number of economically viable feeder upgrades. Other criteria used to reduce the number of viable feeder upgrade projects included capital investment greater then $0.5 million and net resource cost less then $100 per MW.

The ranking of the most viable economic feeder upgrades are illustrated in the following three tables. Table 13, Table 14 and Table 15 is based on a five, ten and fifteen year O&M time horizon respectively.

Table 13 Net Resource Cost - Five Year O&M

Feeder	Net Resource Cost $/Mwh	Capital Investment	KW
KET12F2	$55.00	$968,669.0	142.99
SPI12F1	$67.73	$1,243,065.8	171.98
ORO1281	$68.58	$669,953.1	106.53
COL12F2	$74.92	$822,726.8	108.96
COB12F2	$74.92	$822,726.8	108.96
LF34F1	$76.29	$595,875.0	72.71
COB12F1	$82.87	$671,737.4	77.55
PVW241	$89.40	$528,985.4	53.68
CLV12F4	$89.83	$907,259.4	105.03
L&R512	$94.53	$546,237.7	55.02
OLD721	$94.87	$608,545.7	67.75
ARD12F2	$95.35	$817,711.5	82.33
STM631	$97.26	$1,211,797.7	139.36
ROX751	$99.44	$1,069,309.6	120.48

Table 14 Net Resource Cost – Ten Year O&M

Feeder	Net Resource Cost $/Mwh	Capital Investment	KW
KET12F2	$31.00	$968,669.0	142.99
SPI12F1	$49.19	$1,243,065.8	171.98
LF34F1	$51.54	$595,875.0	72.71
PVW241	$56.55	$528,985.4	53.68
ORO1281	$56.75	$669,953.1	106.53
COL12F2	$57.56	$822,726.8	108.96
COB12F2	$57.56	$822,726.8	108.96
COB12F1	$59.29	$671,737.4	77.55
CHW12F2	$60.29	$600,325.8	41.95
L&R512	$63.81	$546,237.7	55.02
ARD12F2	$70.17	$817,711.5	82.33

Feeder	Net Resource Cost $/Mwh	Capital Investment	KW
CLV12F4	$72.60	$907,259.4	105.03
GIF34F2	$72.61	$1,253,972.5	112.27
OLD721	$73.12	$608,545.7	67.75
MIS431	$79.16	$780,915.9	57.44
F&C12F2	$80.57	$610,746.1	65.07
RDN12F1	$81.47	$519,904.7	34.81
ORI12F1	$81.53	$832,306.2	75.82
FOR12F1	$81.55	$560,782.7	39.13
CKF711	$83.62	$912,659.4	88.03
STM631	$85.11	$1,211,797.7	139.36
PF213	$85.38	$579,843.8	55.23
PRA222	$85.48	$543,659.3	51.64
NE12F2	$85.54	$508,476.3	45.31
ROX751	$86.10	$1,069,309.6	120.48
RAT231	$86.36	$1,111,881.6	108.16
PUL112	$86.42	$528,311.9	44.24
SE12F2	$86.66	$714,903.4	69.83
TEN1256	$87.12	$789,201.9	85.49
GLN12F2	$88.33	$584,770.4	51.32
LIB12F3	$88.64	$529,971.6	46.50
CLV12F2	$88.87	$904,207.9	90.25
PUL116	$89.22	$537,639.7	45.27
CRG1261	$89.84	$561,702.8	44.85
APW112	$91.22	$522,196.7	45.53
WAK12F1	$93.01	$560,901.0	48.81
DEE12F2	$93.14	$743,960.8	69.63
GRV1274	$94.16	$671,626.1	66.96
PDL1202	$94.22	$581,246.6	55.32
SUN12F5	$95.38	$642,722.3	52.58
LIB12F2	$95.47	$726,778.1	58.98
DAL131	$97.14	$870,985.5	84.97
SAG741	$97.29	$634,916.4	44.82
BKR12F1	$98.20	$683,595.8	64.18
DEE12F1	$98.39	$996,523.0	67.68
M15515	$99.16	$540,077.6	44.53
SE12F4	$99.42	$686,532.3	59.34
M15512	$99.50	$531,004.8	43.84

Table 15 Net Resource Cost - Fifteen Year O&M

Feeder	Net Resource Cost $/Mwh	Capital Investment	KW
CHW12F2	$2.9	$600,325.8	41.95
KET12F2	$4.6	$968,669.0	142.99
PVW241	$23.3	$528,985.4	53.68

Feeder	Net Resource Cost $/Mwh	Capital Investment	KW
LF34F1	$26.4	$595,875.0	72.71
SPI12F1	$28.9	$1,243,065.8	171.98
RDN12F1	$29.4	$519,904.7	34.81
L&R512	$32.8	$546,237.7	55.02
FOR12F1	$34.0	$560,782.7	39.13
MIS431	$35.1	$780,915.9	57.44
COB12F1	$35.3	$671,737.4	77.55
GIF34F2	$39.5	$1,253,972.5	112.27
COL12F2	$39.9	$822,726.8	108.96
COB12F2	$39.9	$822,726.8	108.96
ARD12F2	$44.1	$817,711.5	82.33
ORO1281	$44.8	$669,953.1	106.53
AIR12F1	$48.7	$615,395.6	49.12
OLD721	$51.3	$608,545.7	67.75
PUL112	$51.6	$528,311.9	44.24
CRG1261	$54.0	$561,702.8	44.85
ORI12F1	$54.7	$832,306.2	75.82
CLV12F4	$55.1	$907,259.4	105.03
NE12F2	$55.5	$508,476.3	45.31
PUL116	$56.2	$537,639.7	45.27
DEE12F1	$56.5	$996,523.0	67.68
SAG741	$57.4	$634,916.4	44.82
GLN12F2	$58.3	$584,770.4	51.32
LIB12F3	$59.0	$529,971.6	46.50
PF213	$60.1	$579,843.8	55.23
PRA222	$60.3	$543,659.3	51.64
F&C12F2	$60.5	$610,746.1	65.07
CKF711	$61.5	$912,659.4	88.03
ODN731	$61.9	$627,946.4	44.01
APW112	$62.8	$522,196.7	45.53
SE12F2	$64.1	$714,903.4	69.83
SUN12F5	$64.6	$642,722.3	52.58
WAK12F1	$65.2	$560,901.0	48.81
LIB12F2	$65.8	$726,778.1	58.98
RAT231	$65.9	$1,111,881.6	108.16
CLV12F2	$70.0	$904,207.9	90.25
M15515	$70.7	$540,077.6	44.53
DEE12F2	$70.8	$743,960.8	69.63
M15512	$71.5	$531,004.8	43.84
TEN1256	$71.6	$789,201.9	85.49
ROX751	$72.7	$1,069,309.6	120.48
STM631	$72.8	$1,211,797.7	139.36
SE12F4	$74.2	$686,532.3	59.34
PDL1202	$74.6	$581,246.6	55.32
SPT4S30	$75.7	$541,420.5	44.99

Feeder	Net Resource Cost $/Mwh	Capital Investment	KW
CHE12F4	$76.2	$667,293.8	57.48
OGA611	$76.5	$780,992.8	58.08
GRV1274	$77.5	$671,626.1	66.96
SOT522	$77.7	$632,142.6	51.02
CFD1210	$78.0	$563,163.3	45.20
SOT521	$78.4	$538,938.7	46.10
BKR12F1	$79.3	$683,595.8	64.18
NE12F1	$79.6	$687,832.8	62.33
DAL131	$79.8	$870,985.5	84.97
PDL1203	$81.8	$559,682.9	45.75
CFD1211	$82.4	$734,775.9	65.51
MIL12F3	$82.8	$619,499.7	55.10
CDA123	$83.5	$672,854.8	56.29
9CE12F1	$83.5	$616,123.8	54.88
MEA12F2	$83.7	$750,315.2	63.99
SIP12F4	$84.3	$634,440.7	53.05
CHE12F1	$84.3	$629,576.6	54.28
SOT523	$84.9	$1,023,389.6	89.92
NW12F1	$85.1	$788,923.6	73.66
WIL12F2	$86.5	$1,705,622.8	155.22
TEN1254	$86.6	$582,980.2	48.35
ECL222	$86.7	$686,592.4	60.28
CDA124	$86.8	$641,838.7	55.52
M15513	$87.1	$736,558.1	67.36
F&C12F6	$88.2	$658,978.5	57.70
TEN1255	$89.2	$607,926.6	50.49
SLK12F1	$89.4	$854,712.8	72.56
MIL12F4	$89.6	$831,468.1	75.37
LOL1359	$90.7	$830,015.9	73.31
CHE12F2	$90.8	$642,694.9	54.26
SPU123	$91.2	$724,338.0	60.68
9CE12F2	$92.9	$764,865.0	66.97
CDA121	$92.9	$623,762.0	50.00
TEN1257	$93.0	$740,138.0	65.15
WAK12F2	$93.6	$765,628.4	67.80
9CE12F4	$93.7	$774,787.7	68.61
SLW1358	$93.7	$717,636.7	62.17
CDA125	$94.4	$863,793.5	70.73
EFM12F1	$95.0	$950,734.3	79.18
NW12F3	$96.7	$746,886.7	62.10
M23621	$97.1	$641,972.3	43.52
MIL12F1	$100.3	$798,146.0	68.01
SUN12F6	$101.5	$789,282.4	66.28

Conclusion

The intent of this system efficiency analysis was to develop and implement a methodology to identify and quantify remedies to reducing losses across Avista's distribution system. The results of this analysis can then be folded into a broader infrastructure strategy. A program to systematically refresh feeders can be combined with existing internal programs like asset management and capital budgeting to identify synergistic work alignments. For example, a project schedule could be developed to upgrade feeders based on energy, operational, reliability and maintenance priorities. Today, capital work is typically driven by system capacity constraints. With the results obtained in this analysis, capital projects could be aligned with corporate economic goals of reducing energy loss and offsetting O&M expenditures.

The benefits identified in the feeder upgrade program assumed the upgrades would be deployed in a comprehensive manner. The temptation to implement individual efficiency program components across the system may compromise the performance of a feeder as an energy delivery system. The efficient and reliable delivery of electrical energy across the Avista feeders is best met by incorporating all of the electrical components in the upgrade. This systemic approach may help guide how programs should be implemented across the organization.

Today, Avista implements projects in fairly discrete work silos influenced by departmental task structure and budget constraints. Examples of these type of programs are joint use, pole test and treat, failed equipment, new revenue and specific capital project budgeting. Consequently, the programs are dispersed across multiple feeders resulting in different crews working on the same feeder at different times over multiple years. The feeder upgrade program could be used not only to achieve energy savings but also be used as a springboard to consolidate and coordinate work efforts. Rather than referring to work groups by departmental names like Distribution Engineering, Operations or Asset Management, they may be better served by being aligned with actual work processes like capital and operational feeder programs.

The feeder upgrade program by itself falls short of being a strategic vision. However, it can be used as a first step towards a broader strategic view to be included in programs like capital budgeting, energy efficiency, and O&M cost reduction. A more robust corporate strategic vision for aging infrastructure rehabilitation would need to incorporate the following elements: 1) Movement of bulk power across our transmission system, 2) Optimum distribution topologies, 3) Substation size, locations and architectures, and 4) Reliable forecasts of geographical centered load growth. Once these elements are incorporated into the existing feeder upgrade program, a long term plan for Avista's electric infrastructure can be developed to move infrastructure upgrades from a tactical or reactive approach to a planned replacement strategy.

2009

Electric
Integrated Resource Plan

Appendix H – 2009 Electric IRP Avista New Resource Table

August 31, 2009

2009 Avista IRP
New Resource Table

Resource	Resource Location	POR or Local Area	POD	Start	Stop	Capacity MW	Year Total
Lancaster CCCT	Rathdrum, ID	Bell/Westside	AVA System	1/1/2010	10/31/2026	125.0	
Lancaster CCCT	Rathdrum, ID	Mid-C	AVA System	1/1/2010	10/31/2026	150.0	275.0
Noxon 3 (incremental)	Noxon, MT	Noxon, MT	AVA System	1/1/2010	Indefinite	14.0	14.0
Noxon 2 (incremental)	Noxon, MT	Noxon, MT	AVA System	1/1/2011	Indefinite	14.0	14.0
Noxon 4 (incremental)	Noxon, MT	Noxon, MT	AVA System	1/1/2012	Indefinite	14.0	
Nine Mile (incremental)	Nine Mile, WA	Nine Mile, WA	AVA System	1/1/2012	Indefinite	8.8	
Wind	Reardan, WA	Reardan, WA	AVA System	1/1/2012	Indefinite	90.0	
Wind	TBD	TBD	AVA System	1/1/2012	Indefinite	60.0	172.8
Little Falls (incremental)	Ford, WA	Little Falls, WA	AVA System	1/1/2013	Indefinite	1.0	1.0
Little Falls (incremental)	Ford, WA	Little Falls, WA	AVA System	1/1/2014	Indefinite	1.0	1.0
Little Falls (incremental)	Ford, WA	Little Falls, WA	AVA System	1/1/2016	Indefinite	1.0	1.0
Wind	TBD	TBD	AVA System	1/1/2019	Indefinite	150.0	
CCCT	TBD	Bell/Westside	AVA System	1/1/2019	Indefinite	250.0	400.0
Upper Falls (incremental)	Spokane, WA	Spokane, WA	AVA System	1/1/2020	Indefinite	2.0	2.0
Wind	TBD	TBD	AVA System	1/1/2022	Indefinite	50.0	50.0
CCCT	TBD	TBD	AVA System	1/1/2024	Indefinite	250.0	250.0
CCCT	TBD	TBD	AVA System	1/1/2027	Indefinite	250.0	250.0
					Total	1431	1431

August 26, 2009

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Palouse Wind Board Involvement Documentation

Pages 1 through 24

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2011 Renewables Request for Proposal Process and Results

Pages 1 through 93

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Compact Disc Exhibit

Palouse Wind Power Purchase Agreement

Pages 1 through 261