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IDAHO PUBLIC
UTILITIES COMMISSION

BEFORE THE IDAHO PUBLIC UTILITIES COMMISSION

IN THE MATTER OF IDAHO POWER COMPANY'S APPLICATION FOR AUTHORITY TO IMPLEMENT A RESIDENTIAL AIR CONDITIONER CYCLING PILOT PROGRAM AND TARIFF SCHEDULE 81.

CASE NO. IPC-E-02-13

COMMENTS OF THE COMMISSION STAFF

COMES NOW the Staff of the Idaho Public Utilities Commission, by and through its Attorney of record, Lisa D. Nordstrom, Deputy Attorney General, and submits the following comments in response to the Notice of Application, Notice of Modified Procedure and Notice of Comment Deadline issued in Order No. 29176 on January 14, 2003.

BACKGROUND

On December 23, 2002, Idaho Power Company filed an Application seeking authority to institute a Residential Air Conditioner Cycling Pilot Program (AC Cycling Pilot Program or Program) and implement proposed Tariff Schedule 81. In Idaho Power's 2002 Integrated Resource Plan (IRP), the Company identified peak resource deficiencies facing its system in upcoming years. To address those deficiencies, the IRP suggested targeting demand side management (DSM) measures that reduce peak-hour demand like the Irrigation Time-of-use (TOU) Pilot Program. The proposed Program in this Application would enable Idaho Power to begin testing the costs and benefits of reducing summer peak loads by directly controlling residential air conditioners and/or thermostats. If properly implemented, this could potentially decrease Idaho Power's overall energy costs, which in turn, would result in savings for all customers.

The proposed pilot program is an optional service in which participating residential customers would permit the Company to cycle their air conditioners or adjust their thermostats in exchange for a programmable thermostat and a $5 monthly incentive ($15 per summer). To monitor energy usage, Idaho Power will also install advanced time-of-use (TOU) meters at participants' residences, but without TOU rates. The two-year dispatchable load control program will expire on September 30, 2004 unless extended by the Company. Idaho Power will restrict Program participation to 200 customers in the first year and 300 additional customers in the second year. The Company will initiate AC cycling for up to four hours per day between 1 p.m. and 9 p.m., 10 weekdays per summer month, by sending a signal to the programmable thermostat. The signal would instruct it to:

- cycle the AC compressor for a specified length of time on a percentage basis, or
- cycle the AC compressor until a specified temperature change is attained, or
- change the temperature set-point on the thermostat for a specified length of time.

While all three of the above options are listed in the proposed tariff, the Company has indicated to Staff that it may later choose just one of the options to test and evaluate.[1]

STAFF COMMENTS

Evaluate All Options

Staff generally supports the Company's Application as a method to achieve peak-hour demand reductions. This proposed program directly responds to the Commission's directive for the Company to "...give balanced consideration to demand side and supply side resources when formulating resource plans and when procuring resources."[2] In that spirit, Staff recommends that the Company implement and evaluate more than one of the AC cycling options that are listed above and offered in the proposed tariff. In particular, Staff prefers having the temperature set-point method included in the pilot. Staff believes that cycling the compressor will have much the

[1] Idaho Power Response to Staff Production Request No. 4(b)
[2] Order No. 22299, Case No. U-1500-165, p 20 and Order No. 29189, case No. IPC-E-02-8, p. 20

same effect as adjusting the thermostat to a higher set-point, but that it may result in too high temperatures for some participants. Obviously, the effectiveness of changing the thermostat's temperature set-point for a specified length of time cannot be compared to the effectiveness of the two compressor cycling methods unless all three options are tested.

According to the Company's presentation to its Energy Efficiency Advisory Group (EEAG) on November 14, 2002, cycling AC compressors for a specified length of time will result in a maximum temperature increase of two degrees for most customers. Notwithstanding this relatively small maximum increase for most customers, Staff notes that cycling the compressor will result in a wider range of temperatures among all participating households than would occur with thermostat adjustments. For example, a few customers with undersized AC units, faulty ducts, poor building envelopes, or large, west-facing windows will likely experience higher temperatures that may not be acceptable when their compressors are cycled for a specified length of time. The option of adjusting the thermostat set-point by two degrees would limit the range of temperature effects and may increase customer satisfaction with the Program. In any case, Staff believes that the value of the pilot program is greatly reduced if all the options are not tested. As explained later in these Comments, we believe the proposed $810,220 budget should be sufficient to test and evaluate more than a single AC cycling option.

Emergency Situations

Although Staff has no reason to dispute the Company's assertion that compressor cycling will result in a maximum indoor temperature increases of only two degrees for most customers, we are concerned about those few customers whose indoor temperatures may increase much more due to their particular circumstances or an unusual, perhaps emergency, situation. When this concern was expressed at its EEAG meeting, the Company's initial response was that those customers should not volunteer for the program or that they will be able to notify the Company the day before they expect to experience the unusual situation. Later, in response to Staff Production Request No 8(b), the Company said that in rare cases of emergency it "...will work with the customer on a case-by-case basis to reach a mutually satisfactory outcome." Although Staff is not certain what this will entail, we trust that the Company will treat its volunteer customers in a reasonable and fair manner.

Effects on Compressor Life

Staff is concerned about the possible detrimental effect of cycling air conditioners on the life of the compressor. The Company dismisses this concern based on: 1) consultation with purveyors of thermostats and load control equipment; 2) consultation with managers of AC cycling programs at other utilities, and 3) AC cycling parameters published by the Air Conditioning & Refrigeration Institute (ARI).[3] Staff notes that ARI's Guideline A cautions that "the effect of [load control] devices on <u>equipment warranties</u> may vary product-by-product" and therefore, "...that equipment manufacturers be contacted for specific recommendations." (emphasis added) ARI's Guideline A also states that it does not guarantee that any tests conducted under its standards will be non-hazardous or free from risk. (See Attachment A) Staff appreciates that Idaho Power has conducted research regarding possible detrimental effects of its proposed program, but we do not believe that it presents conclusive evidence that there are no detrimental effects. Instead, we believe this research shows that the detrimental effects will likely be relatively small for most participants and that they are unlikely to result in air conditioners failing during their warranty periods. Staff is more concerned about air conditioners that are older than their warranty periods because these are the ones that are most apt to fail and whose owners may believe that Idaho Power's cycling of the compressors caused or contributed to the failure.

Although Idaho Power acknowledges a report (Attachment B) by the United States Department of Energy (DOE) indicating that frequent cycling of air conditioners reduces efficiency and wears out the compressor and electrical parts more rapidly,[4] the Company dismisses the reported detrimental effects because DOE's purpose was to report the effects of over-sizing rather than utility-controlled cycling.[5] Staff believes that the adverse effects of frequent cycling are not dependent upon the cause of the frequent cycling as suggested by Idaho Power. The detrimental mechanical and electrical effects of frequent cycling occur whether such cycling is caused by an over-sized unit or by a utility controlling it. While Staff believes the potential incremental [6] effects from the Program may be small due to the limited hours of cycling proposed, we cannot simply dismiss the likelihood that some of Idaho Power's proposed

[3] Idaho Power Response to Staff Production Request No. 1
[4] Energy Efficient Air Conditioning, DOE/GO-10099-379, FS 206, June 1999, p. 5
[5] Idaho Power Response to Staff Production Request No. 3
[6] Staff also believes air conditioners are often over-sized and thus already cycle on and off frequently. The Program may not significantly increase the cycling frequency of these air conditioners.

program options will accelerate wear on air conditioners--especially AC units that are sized correctly, i.e. sized to run at optimum efficiency rather than sized to compensate for inadequate building envelopes and/or poor ductwork. Staff believes the option of adjusting the thermostat's temperature set-point will not have this effect because it will not cause compressors to cycle more frequently. In conclusion, we believe that it would be prudent for Idaho Power to advise its Program participants of DOE's findings regarding the detrimental effects of frequent cycling on compressor longevity and efficiency, and the reasons why the Company does not believe that this should cause concern. Staff suggests that the Company provide each participant a copy of the DOE Energy Efficient Air Conditioning report and ARI Guideline A. (Attachments A and B)

Evaluate Effects of Advanced Thermostat

As part of this program, Idaho Power will install advanced, programmable thermostats in the homes of participants that customers will be able to program and adjust from remote locations via the Internet. Clearly these advanced thermostats, by themselves, will provide the opportunity and perhaps incentive for participants to change their electricity consumption patterns. In fact, the Company suggested to the EEAG that the thermostats would enable participants to reduce their energy costs and stated that the thermostats "may reduce overall energy use."[7] However, the Company does not intend to evaluate the thermostats' effects on either energy consumption or demand, and will instead focus only on the effects of the AC cycling.[8] By not assessing the effects of the advanced thermostats, Staff believes the Company will miss not only the opportunity to evaluate the effects of such thermostats, but that it will be unable to isolate the effects of the thermostats from the AC cycling effects. Staff believes that assessing the effects of the programmable thermostats is important and could be achieved through the analysis of the load profiles of customers in a control group. Staff suggests that this control group (i.e., households whose air conditioners and thermostats are not controlled by the Company) should include customers who get a programmable thermostat in addition to a TOU meter. However, for reasons explained below, we suggest that another control group should include customers who only get a TOU meter and are not told that they are part of a control group for this pilot program.

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[7] Application at 2
[8] Idaho Power Response to Staff Production Request No. 4(a)

Need for Pilot Program

Air conditioning cycling and other residential direct load control programs (e.g. water heaters) have been used successfully by hundreds of other electricity utilities for many years.[9] Idaho Power states that it wants to assess the feasibility, practicality, cost-effectiveness and customer satisfaction of this type of dispatchable program given the geographic and climate characteristics of its service area.[10] Staff agrees that the climate, housing, topographic and demographic characteristics in Idaho Power's service area combined with its relatively low electricity rates warrant a pilot program. However, to properly evaluate this pilot, generally accepted program evaluation methods prefer use of a control group to provide a more accurate basis for statistical comparisons. Staff is concerned that Idaho Power does not plan to include a control group in its evaluation. Instead, the Company said that program effectiveness "will be evaluated by comparing average load profiles of the participants on cycling days with the average load profiles of the participants on similar non-cycling days."[11] Staff notes that days with similar cooling degree days are not necessarily similar in other important ways, such as cloud cover, humidity, wind speed and direction, hours of daylight and solar angle and intensity. A control group would help explain the variability between so-called similar days. Furthermore, a control group will help determine the extent to which the volunteers' electricity usage is influenced by the fact that they are part of a test.[12]

Additional Air Conditioning Program Options

Staff believes that air conditioner programs focusing on the proper sizing of AC units, adequate return air flow, proper charging, clean coils, properly sealed ducts, and well-insulated and sealed building envelopes may offer additional opportunities to reduce summer peak loads. It would be prudent for the Company to measure and evaluate these variables, together with the interactive effects with the proposed AC Cycling, as part of this Program. In its response to Staff Production Request No. 5(b), the Company agreed that the AC cycling program may complement other programs designed to correct air conditioning inefficiencies. While the

[9] Impact of Direct Load Control Programs: A Duty-Cycle Approach, EPRI Report CU-7028-V2, 1991, Abstract
[10] Idaho Power Response to Staff Production Request No. 5(b)
[11] Idaho Power Response to Staff Production Request No. 4(b) and (c)
[12] As previously discussed, isolation of the effects of installing advanced programmable thermostats requires its own control group.

addition of an AC maintenance control group would expand the scope of the pilot program proposed by the Company, this is an opportune time to evaluate programs that affect air conditioners.

An additional AC program the Company and its EEAG should consider is one that would encourage the use of evaporative coolers instead of air conditioners. DOE reports that evaporative coolers are suitable for areas with low humidity, cost about one-half as much as air conditioners, and use about one-fourth the energy required by air conditioners.

Importance of Reporting

As previously stated, the Company's choice of a pilot program is appropriate because of the particular characteristics of its rates and service area. In discussion of Idaho Power's irrigation pilot program in its 2002 IRP the Company recognized:

> The purpose of the Pilot Program is to gather meaningful information regarding irrigation customers' ability to shift energy consumption from higher-cost peak hours to lower-cost off-peak periods. The data collected during the pilot program is expected to provide Idaho Power Company, the customers of Idaho Power, and the Idaho PUC with the information necessary to evaluate the impacts, costs, and benefits of time-of-use pricing.[13]

Although information gathering is the primary goal of a pilot program, Staff notes that it has still not received a full report for the Company's 1999 Idaho City automated meter reading trial. Absent a report containing detailed evaluation of the effects of the proposed AC cycling options and a comparison to appropriate control groups, the Commission may have difficulty finding that the costs of this pilot program were prudently incurred given that the program did not meet its informational objectives.

Costs of Customer Incentives and Program Promotion and Recruitment

The Company's estimated $810,220 budget for this 2-year pilot program contains $200,000 for promotion and an additional, unspecified amount for recruitment, but allocates only $10,500 for customer incentives. (See Attachment C)[14] Staff believes that tripling of the budget for customer incentives (i.e., $15 per month instead of $5 per month) would reduce the budget

[13] Idaho Power Company 2002 Integrated Resource Plan, page 47.

[14] Attachment C, lines 15, 16 and 18 of the Estimated Costs that Idaho Power provided in response to Staff Production Request No. 7.)

requirements for recruitment and promotion to a more reasonable level. If the Company were to spend an additional $21,000 on incentives to make the program more attractive to customers, it would likely save a couple hundred thousand dollars on promotion and recruitment. Some of the savings from reduced promotion and recruitment costs could be spent on monitoring control groups and more comprehensive program evaluation. At the November 14, 2002 EEAG meeting, the Company estimated that by not paying an incentive to participants and assuming 50,000 ultimate participants, the levelized cost of system-wide AC cycling program equates to $54 per kilowatt of capacity. By paying a $5 monthly incentive ($15 per summer) to participants, the Company estimated the levelized cost of AC cycling increases to $69 per kilowatt. Accordingly, Staff estimates that by paying participants $15 per month ($45 per summer) the levelized cost will increase to $99 per kilowatt. At the same EEAG meeting, Idaho Power said that the Program's relatively low cost per kilowatt of capacity compares favorably to the $600 to $800 per kilowatt capacity of a gas-fired peaker combustion turbine.

STAFF CONCLUSIONS AND RECOMMENDATIONS

While the Company acknowledges the importance of data collection in order to evaluate the Program, it appears that Idaho Power may not evaluate all the available options or compare the demand of Program participants to any control groups. It is essential that this pilot program include adequate data collection, evaluation and reporting of all options as well as distinguish the effects of these options from the effects of the advanced thermostat. Specifically, Staff believes that all three options listed in the Company's proposed tariff (i.e., cycling the AC unit for a specified length of time, cycling the AC unit until specified temperature change is attained, and changing the temperature set point) should be tested and evaluated. If the Company believes it can implement and evaluate only one of those options, Staff believes the thermostat adjustment is the best single option.

Staff also believes that monitoring the energy use of two control groups, one with the advanced thermostats and one without, would provide valuable data necessary to evaluate the success of this program. Furthermore, we believe summer peak and overall energy use can be reduced by promoting proper sizing, installation and maintenance of air conditioners and ducts, and perhaps by promoting evaporative coolers. Utilizing all three AC cycling options, two control groups, plus an AC maintenance control group would provide a full spectrum of data and allow the Company and the Commission to determine which AC program variation is the most energy efficient and acceptable to customers.

In conclusion, Staff supports the Company's proposal with the suggestions offered above.

Respectively submitted this 21st day of February 2003.

Lisa D. Nordstrom
Deputy Attorney General

Technical Staff: Dave Schunke
Lynn Anderson

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1987
GUIDELINE for
(REAFFIRMED 1997)

ENERGY MANAGEMENT SYSTEMS AND LOAD MANAGEMENT THROUGH DUTY CYCLING

AIR-CONDITIONING &
REFRIGERATION
INSTITUTE

Guideline A

Attachment A
Case No. IPC-E-02-13
Staff Comments
02/21/03 Page 1 of 3

4301 NORTH FAIRFAX DRIVE • ARLINGTON, VIRGINIA 22203

IMPORTANT

SAFETY RECOMMENDATIONS

It is strongly recommended that the product be designed, constructed, assembled and installed in accordance with nationally recognized safety requirements appropriate for products covered by this guideline.

ARI, as a manufacturers' trade association, uses its best efforts to develop guidelines employing state-of-the-art and accepted industry practices. However, ARI does not certify or guarantee safety of any products, components or systems designed, tested, rated, installed or operated in accordance with these guidelines or that any tests conducted under its standards will be non-hazardous or free from risk.

Note:

This is a new guideline.
(Reaffirmed 1997)

Attachment A
Case No. IPC-E-02-13
Staff Comments
02/21/03 Page 2 of 3

Price $5.00 (M) $10.00 (NM)
Printed in U.S.A.

ARI GENERAL GUIDELINES ON ENERGY MANAGEMENT SYSTEMS AND LOAD MANAGEMENT THROUGH DUTY CYCLING

ARI recognizes the desire of many customers, users and other building owners to install some sort of energy management system (EMS) device on heating, ventilating, air conditioning and refrigeration equipment. It is also recognized that some power suppliers feel the need to effect "load management through duty cycling," a program designed to reduce the peak load on a power distribution system and hence delay or eliminate the need for additional generating capacity. ARI offers these guidelines without stipulating that either energy savings, user comfort or equipment performance will be achieved.

The product scope of ARI encompasses a wide variety of products. The availability of various type of EMS devices is very broad and the effect of such devices on equipment warranties may vary product-by-product and manufacturer-to-manufacturer. Therefore, ARI urges that the equipment manufacturer be contacted for specific recommendations concerning that equipment.

The general guidelines are as follows:

1. **Safety**

   Do not alter, disable or bypass any of the safety controls.

2. **Control Circuits**

   Control the unit operation through the control wiring. An auxiliary power supply may be required to carry the load of any additional field supplied controls. Additional load on the equipment transformer can cause voltage drop, chattering contactors, and ultimate failure of motor-compressor or other components.

3. **Fail-Safe Requirement**

   In the event of failure of an add-on control device(s), the normal operation of the equipment being controlled should not be jeopardized.

4. **Cycle Rate**

   Do not short cycle motor controllers, motors, or motor-compressors. The compressor off cycle must be five (5) minutes or longer. If more than four (4) cycles per hour are anticipated, contact the equipment manufacturer for specific recommendations.

5. **Fossil Fuel Heating Equipment**

   Do not short cycle or underfire fossil fuel heating equipment. Adequate burner operating time and temperature is necessary to prevent condensation damage to heat exchanger and/or flue.

In the event of any conflict between the manufacturers' specific instructions and these Guidelines, such instructions should prevail over these Guidelines.

The information in these Guidelines is current as of the date of publication. These Guidelines are only guidelines and should not be referred to or construed as a standard, certification or warranty. The appropriate steps to be taken with respect to duty cycling devices should be done by and under the supervision of qualified and experienced personnel to insure proper installation, and should be properly inspected. However, no changes in these Guidelines (when identified as ARI guidelines) shall be made without the approval of ARI.

Released for publication by the ARI General Standards Committee on June 12, 1985.

Note: Published in the approved ARI Guideline Format in 1987 without change.

DOE/GO-10099-379
FS 206
June 1999

ENERGY EFFICIENCY AND RENEWABLE ENERGY CLEARINGHOUSE

Energy-Efficient Air Conditioning

Are you considering buying a new air conditioner? Or, are you dissatisfied with the operation of your current air conditioner? Are you unsure whether to fix or replace it? Are you concerned about high summer utility bills? If you answered yes to any of these questions, this publication can help. With it, you can learn about various types of air conditioning systems and how to maintain your air conditioner, hire professional air conditioning services, select a new air conditioner, and ensure that your new air conditioner is properly installed.

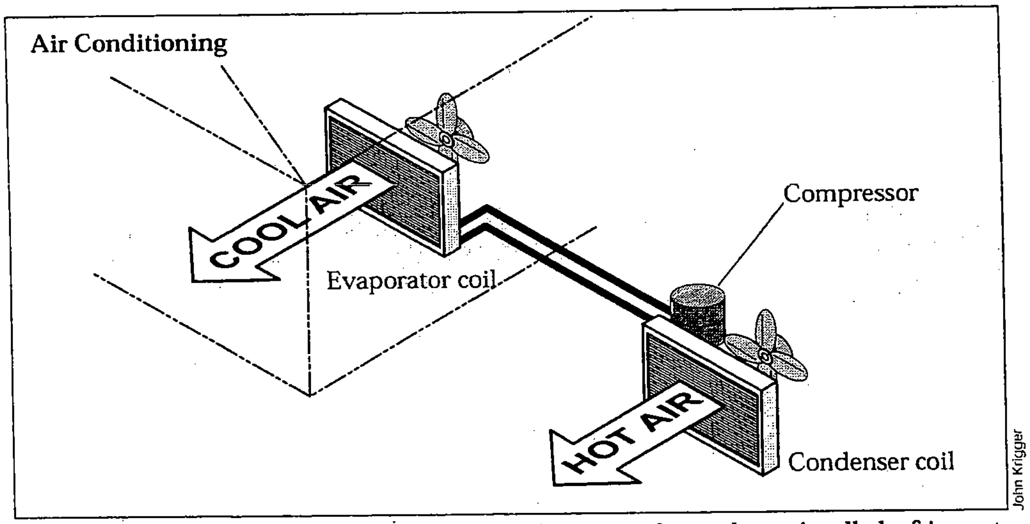
Understanding Air Conditioners

Many people buy or use air conditioners without understanding their designs, components, and operating principles. Proper sizing, selection, installation, maintenance, and correct use are keys to cost-effective operation and lower overall costs.

This publication discusses both central and room air conditioners. Heat pumps, which provide both home cooling and heating, are not covered in this publication. Contact the Energy Efficiency and Renewable Energy Clearinghouse (EREC–see *Source List* below) for more information about heat pumps of all kinds.

How Air Conditioners Work

Air conditioners employ the same operating principles and basic components as your home refrigerator. An air conditioner cools your home with a cold indoor coil called the evaporator. The condenser, a hot outdoor coil, releases the collected heat outside. The evaporator and condenser coils are serpentine tubing surrounded by aluminum fins. This tubing is usually made of copper. A pump, called the compressor, moves a heat transfer fluid (or refrigerant) between the evaporator and the condenser. The pump forces the



The fluid that collects heat at the evaporator and releases it at the condenser is called refrigerant. A pump, called the compressor, forces the refrigerant through the circuit of tubing and fins in the coils. Air moves through the tiny spaces between the fins and is cooled by the refrigerant in the coils.

This document was produced for the U.S. Department of Energy (DOE) by the National Renewable Energy Laboratory (NREL), a DOE national laboratory. The document was produced by the Information Services Program, under the DOE Office of Energy Efficiency and Renewable Energy. The Energy Efficiency and Renewable Energy Clearinghouse (EREC) is operated by NCI Information Systems, Inc., for NREL / DOE. The statements contained herein are based on information known to EREC and NREL at the time of printing. No recommendation or endorsement of any product or service is implied if mentioned by EREC.

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refrigerant through the circuit of tubing and fins in the coils. The liquid refrigerant evaporates in the indoor evaporator coil, pulling heat out of indoor air and thereby cooling the home. The hot refrigerant gas is pumped outdoors into the condenser where it reverts back to a liquid giving up its heat to the air flowing over the condenser's metal tubing and fins.

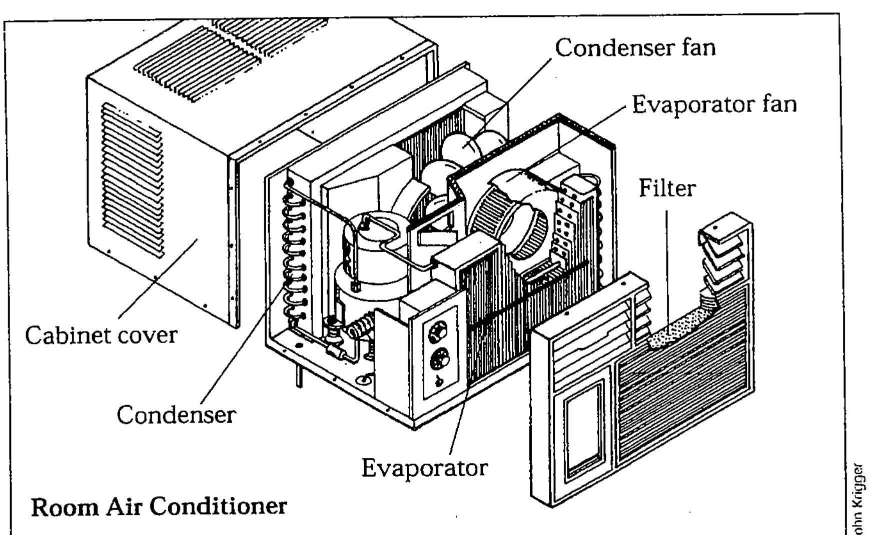
Types of Air Conditioners

The basic types of air conditioners are room air conditioners, split-system central air conditioners, and packaged central air conditioners.

Room Air Conditioners

Room air conditioners cool rooms rather than the entire home. If they provide cooling only where they're needed, room air conditioners are less expensive to operate than central units, even though their efficiency is generally lower than that of central air conditioners.

Smaller room air conditioners (i.e., those drawing less than 7.5 amps of electricity) can be plugged into any 15- or 20-amp, 115-volt household circuit that is not shared with any other major appliances. Larger room air conditioners (i.e., those drawing more than 7.5 amps) need their own dedicated 115-volt circuit. The largest models require a dedicated 230-volt circuit.



Room air conditioners are installed directly in windows or walls, which means they have no ductwork. The evaporator's fan faces indoors, while the condenser's fan faces outdoors.

Central Air Conditioners

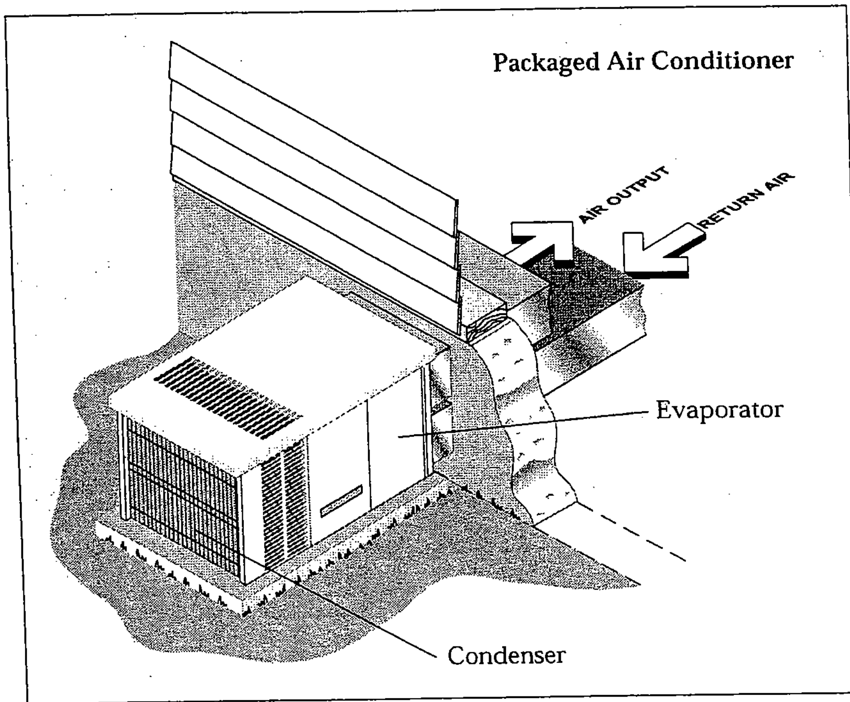
Central air conditioners circulate cool air through a system of supply and return ducts. Supply ducts and registers (i.e., openings in the walls, floors, or ceilings covered by grills) carry cooled air from the air conditioner to the home. This cooled air becomes warmer as it circulates through the home; then it flows back to the central air conditioner through return ducts and registers. A central air conditioner is either a split-system unit or a packaged unit.

In a **split-system central air conditioner**, an outdoor metal cabinet contains the condenser and compressor, and an indoor cabinet contains the evaporator. In many split-system air conditioners, this indoor cabinet also contains a furnace or the indoor part of a heat pump. The air conditioner's evaporator coil is installed in the cabinet or main supply duct of this furnace or heat pump. If your home already has a furnace but no air conditioner, a split-system is the most economical central air conditioner to install.

In a **packaged central air conditioner**, the evaporator, condenser, and compressor are all located in one cabinet, which usually is placed on a roof or on a concrete slab next to the house's foundation. This type of air conditioner also is used in small commercial buildings. Air supply and return ducts come from indoors through the home's exterior wall or roof to connect with the packaged air conditioner, which is usually located outdoors. Packaged air conditioners often include electric heating coils or a natural gas furnace. This combination of air conditioner and central heater eliminates the need for a separate furnace indoors.

Maintaining Existing Air Conditioners

Older air conditioners may still be able to offer years of relatively efficient use. However, making your older air conditioner last requires you to perform proper operation and maintenance.

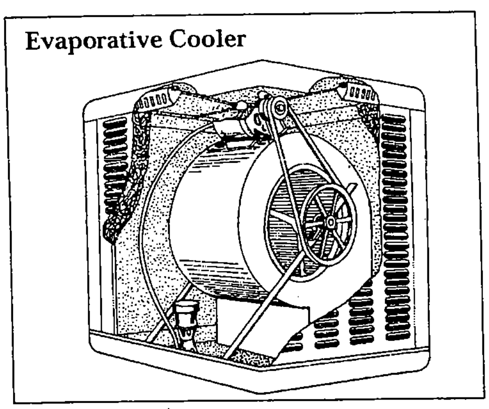


A packaged air conditioner sits outside the house next to the foundation or on the roof. Its cabinet contains the evaporator, condenser, compressor, and all other parts of the air conditioner. Supply and return ducts connect to this outdoor cabinet.

Evaporative Coolers

An evaporative cooler (also called a "swamp cooler") is a completely different type of air conditioner that works well in hot, dry climates.

Evaporative Cooler



Evaporative coolers cost about half as much as central air conditioners and use about ~~25%~~ 75% less energy.

These units cool outdoor air by evaporation and blow it inside the building, causing a cooling effect much like the process when evaporating perspiration cools your body on a hot (but not overly humid) day. When operating an evaporative cooler, windows are opened part way to allow warm indoor air to escape as it is replaced by cooled air.

Evaporative coolers cost about one-half as much to install as central air conditioners and use about one-quarter as much energy. However, they require more frequent maintenance than refrigerated air conditioners and they're suitable only for areas with low humidity.

Air Conditioning Problems

One of the most common air conditioning problems is improper operation. If your air conditioner is on, be sure to close your home's windows and outside doors.

Other common problems with existing air conditioners result from faulty installation, poor service procedures, and inadequate maintenance. Improper installation of your air conditioner can result in leaky ducts and low air flow. Many times, the refrigerant charge (the amount of refrigerant in the system) does not match the manufacturer's specifications. If proper refrigerant charging is not performed during installation, the performance and efficiency of the unit is impaired. Service technicians often fail to find refrigerant charging problems or even worsen existing problems by adding refrigerant to a system that is already full. Air conditioner manufacturers generally make rugged, high quality products. If your air conditioner fails, it is usually for one of the common reasons listed below:

- ***refrigerant leaks.*** If your air conditioner is low on refrigerant, either it was undercharged at installation, or it leaks. If it leaks, simply adding refrigerant is not a solution. A trained technician should fix any leak, test the repair, and then charge the system with the correct amount of refrigerant. Remember that the performance and efficiency of your air conditioner is greatest when the refrigerant charge exactly matches the manufacturer's specification, and is neither undercharged nor overcharged.
- ***inadequate maintenance.*** If you allow filters and air conditioning coils to become dirty, the air conditioner will not work properly, and the compressor or fans are likely to fail prematurely.
- ***electric control failure.*** The compressor and fan controls can wear out, especially when the air conditioner turns on and off frequently, as is common when a system is oversized. Because corrosion of wire and terminals is also a problem in many systems, electrical connections and contacts should be checked during a professional service call.

Regular Maintenance

An air conditioner's filters, coils, and fins require regular maintenance for the unit to function effectively and efficiently throughout its years of service. Neglecting necessary maintenance ensures a steady decline in air conditioning performance while energy use steadily increases.

The most important maintenance task that will ensure the efficiency of your air conditioner is to routinely replace or clean its filters.

Air Conditioner Filters

The most important maintenance task that will ensure the efficiency of your air conditioner is to routinely replace or clean its filters. Clogged, dirty filters block normal air flow and reduce a system's efficiency significantly. With normal air flow obstructed, air that bypasses the filter may carry dirt directly into the evaporator coil and impair the coil's heat-absorbing capacity. Filters are located somewhere along the return duct's length. Common filter locations are in walls, ceilings, furnaces, or in the air conditioner itself.

Some types of filters are reusable; others must be replaced. They are available in a variety of types and efficiencies. Clean or replace your air conditioning system's filter or filters every month or two during the cooling season. Filters may need more frequent attention if the air conditioner is in constant use, is subjected to dusty conditions, or you have fur-bearing pets in the house.

Air Conditioner Coils

The air conditioner's evaporator coil and condenser coil collect dirt over their months and years of service. A clean filter prevents the evaporator coil from soiling quickly. In time, however, the evaporator coil will still collect dirt. This dirt reduces air flow and insulates the coil which reduces its ability to absorb heat. Therefore, your evaporator coil should be checked every year and cleaned as necessary.

Outdoor condenser coils can also become very dirty if the outdoor environment is dusty or if there is foliage nearby. You can easily see the condenser coil and notice if dirt is collecting on its fins.

You should minimize dirt and debris near the condenser unit. Your dryer vents, falling leaves, and lawn mower are all potential sources of dirt and debris. Cleaning the area around the coil, removing any debris, and trimming foliage back at least 2 feet (0.6 meters) allow for adequate air flow around the condenser.

Coil Fins

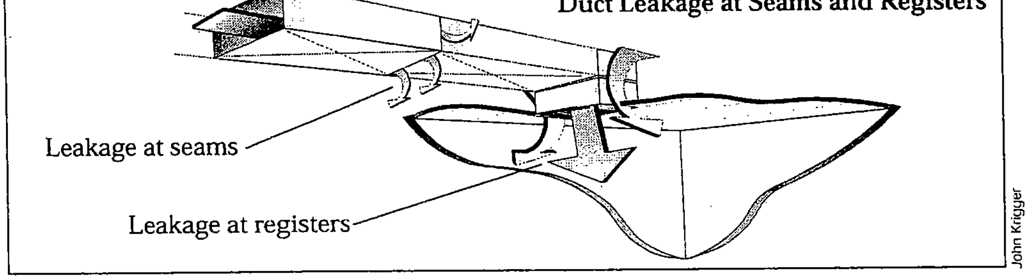
The aluminum fins on evaporator and condenser coils are easily bent and can block air flow through the coil. Air conditioning wholesalers sell a tool called a "fin comb" that will comb these fins back into nearly original condition.

Sealing and Insulating Air Ducts

An enormous waste of energy occurs when cooled air escapes from supply ducts or when hot attic air leaks into return ducts. Recent studies indicate that 10% to 30% of the conditioned air in an average central air conditioning system escapes from the ducts.

For central air conditioning to be efficient, ducts must be airtight. Hiring a competent professional service technician to detect and correct duct leaks is a good investment, since leaky ducts may be difficult to find without experience and test equipment.

Duct Leakage at Seams and Registers



Air from hot attics can leak into the home around registers of the duct system. Air in the ducts can leak out through holes and seams.