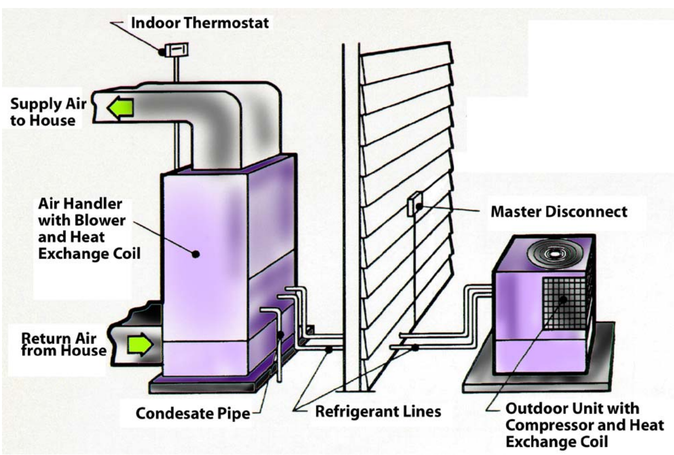
COOPERATIVE EXTENSION
WASHINGTON STATE UNIVERSITY
ENERGY PROGRAM

# Energy Efficiency FACTSHEET

## Energy Efficient Home Cooling:

Choosing an air conditioning system is an important decision. A poor choice may be costly to purchase and operate and yet fail to provide the desired cooling comfort. The type of system that is best for your home depends on your climate, cooling needs and the specific design of your house.

When the decision is made to install additional cooling, several options should be considered. In many parts of the Western U.S., evaporative coolers may be the best choice. They work well in warm dry climates. In other more humid areas, air conditioners or heat pumps based on a compressor cycle system much like your refrigerator will be your only options. In either case, proper sizing, selection, installation, maintenance and correct use are keys to cost-effective operation and lower overall costs.




*Split System Air Conditioner*

Before you select an air conditioner, you may want to examine other methods of keeping your home cool.

In many areas natural cooling strategies may reduce or eliminate the need for an electric air conditioning system. Natural cooling Strategies include:

- Light colored roof and walls
- Upgraded insulation in walls and roof
- Low-E windows
- Shading

- Nighttime cooling using fans

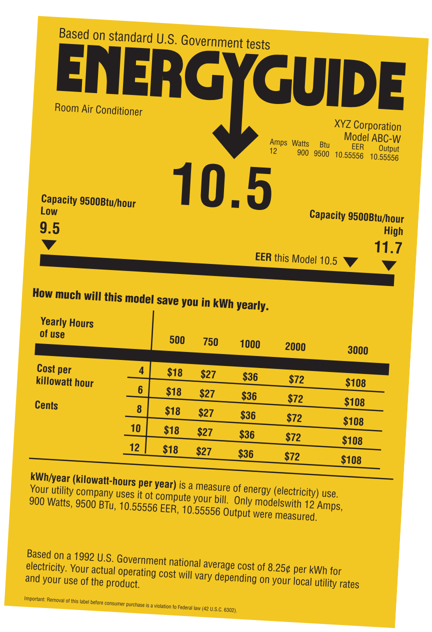
## Energy Efficient Room Air Conditioners:

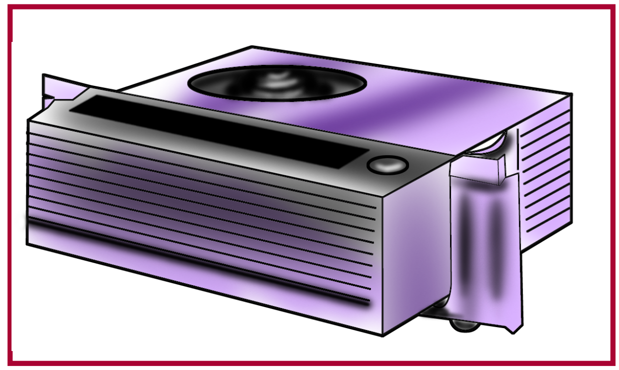
If you only need to cool 1-3 rooms in your home, a room air conditioner may be your most economical choice. Because you are only cooling part of your home, energy cost can be controlled.  To optimize the performance of your room air conditioner, select an energy efficient model that is properly sized for the room you are cooling.

**EER -** The **Energy Efficiency Ratio** is used to compare the efficiency of individual room air conditioners.  It is the measure of the number of BTU per hour of cooling provided for each watt of electricity used.  Room air conditioners typically provide from 5000 Btu/hr to 18,000 Btu/hr.  The average EERs of older units from the 1970's is about 5.  Newer units manufactured after January 1, 1990 must have an EER greater than 8. The best room air conditioners on the market have EERs of 11 or more.

**Energy Savings for a 10,000 Btu\hr. Room Air Conditioner.**

- An air conditioner with an EER of 10 will use half the electricity of an old unit with an EER of 5.
- An air conditioner with an EER of 11 will use 37% less energy than a new unit with an EER of 8.



*Window Mount Room Air Conditioner*

*All room air conditioners sold in the United States must be labeled with an Energy Guide This label states the EER.  Use this label to compare the efficiency of different room air conditioner models.*

### Room Air Conditioner Pros and Cons

**Pros:**

- Less costly to purchase than central systems(Smaller units start at just a few hundred dollars.)
- Less costly to operate than central systems(If you are only cooling part of your home.)
- Individual rooms may be kept at different temperatures.
- Easy installation (Smaller window units may be installed in most operable windows and use existing electrical outlets. Larger models may require special adaptations and dedicated 240-volt circuits.)
- Don't require a duct system in the home.

**Cons:**

- Noisier than remotely installed central systems
- May create a security problem.
- Window units - block views and incoming light and prevent the use of the window for natural ventilation..

The Energy Star web site can help you select an energy efficient room air conditioner.
http:\\www.energystar.gov

- Average efficiency is lower than central units.
- Often lack programmable controls.

### Bigger is not better

Bigger is not better. An oversized air conditioner does not provide more comfort. It costs more to purchase and operate and will make the house feel clammy. Purchase an air conditioner with the correct capacity (Btu/hr) for the room you are cooling. Oversized units will short cycle (turn off and on quickly with short on periods). As they short cycle, the indoor coil never gets cold enough to condense and remove excess moisture. Your home feels cold and clammy especially in humid climates.

### Room Air Conditioner Sizing Recommendations

| AREA TO BE COOLED ($Ft^2$) | CAPACITY\ (BUT/HR) |
|---|---|
| 100 to 150 | 5,000 |
| 150 to 250 | 6,000 |
| 250 to 300 | 7,000 |
| 300 to 350 | 8,000 |
| 350 to 400 | 9,000 |
| 400 to 450 | 10,000 |
| 450 to 550 | 12,000 |
| 550 to 700 | 14,000 |
| 700 to 1000 | 18,000 |

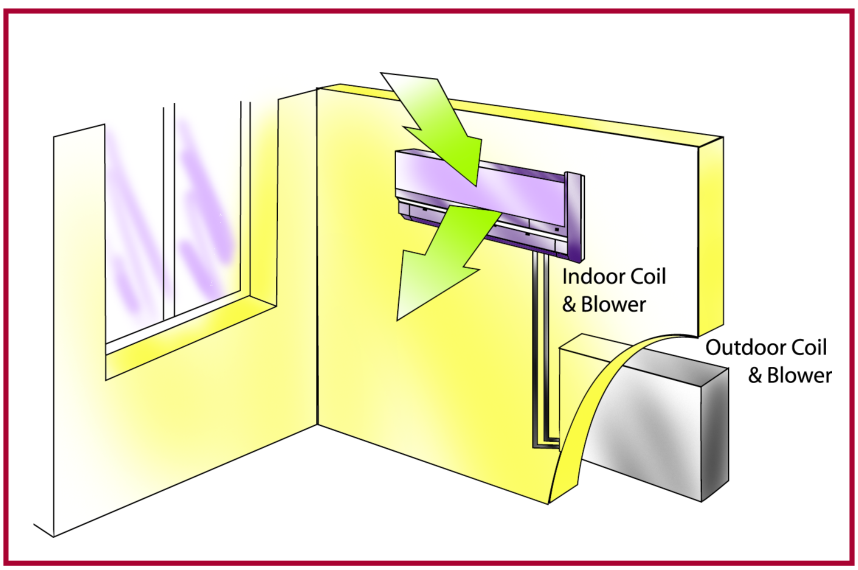
- If the room is heavily shaded, reduce capacity by 10%
- If the room is very sunny, increase capacity by 10%
- If more than 2 people regularly occupy the room, add 600 Btu/Hr for each additional person
- If the unit is for a kitchen, increase the capacity by 4,000 Btu/Hr.

### Energy Efficient Cooling with Central Air Conditioners and Heat Pumps

When you decide to cool your entire home, **split system air conditioners** that are part of your ducted heating and cooling system are the most common choice. In operation, the cool indoor coil that is installed in your furnace ductwork collects heat from your home. This heat is transferred to the outdoor coil through refrigeration lines where it is rejected to the outdoors.

**Heat pumps** operating in the cooling mode function as split system air conditioners. If you currently have an electric resistance furnace, a heat pump may be the right choice for you. In addition to the added cooling, the heat pump can provide significant savings during the heating season compared to an electric furnace. If you have gas or other fuel type for heating check with your local utility for comparative fuel costs to see if there is an advantage to using a heat pump.

In recent years **ductless split system central air conditioner systems** have become available. These systems place a heat exchanger coil in each room to be cooled and don't require a duct system. They are more expensive than ducted system when the ducts already exist, but they offer an excellent option for homes that




*Ductlesss Split-air Conditioner*

use something other than a central forced air-heating system.

### Central Split-system Air Conditioners

**Pros:**

- Quiet Indoors
- Programmable controls are common.
- Easily adapted to central forced air heating systems
- High average efficiencies

**Cons:**

- Higher installation costs than room air conditioners
- Most systems do not provide zonal control.
- Typically require duct system for distribution
- Efficiency losses in duct distribution
- Noisy outdoor units

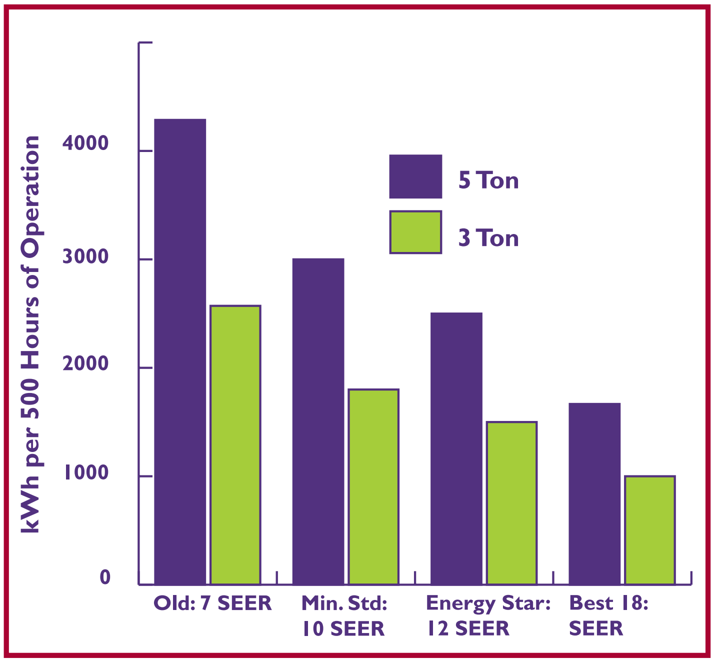
## Maximizing Cooling Efficiency of Central Systems

There are a number of variables that effect the efficiency of central cooling systems. As well as selecting an efficient air conditioner, you must make sure it is properly sized for the cooling load of your home. If you use a system with ductwork, make sure the ducts are large enough to provide proper airflow across the cooling coil. Also make sure the ducts are well sealed and insulated.

**SEER -** The **Seasonal Energy Efficiency Ratio** is used to compare the efficiency of central air conditioner systems. The SEER measures the ratio of the total amount of cooling provided in a typical cooling climate for an entire year to the energy consumed in the same period. Older 1970's vintage system SEERs ranged from 4.5 to 8. Newer central air conditioner systems built after January 1, 1992 require a minimum SEER of 9.7 for single-package and 10.0 for split-systems. Systems with SEERs over 16 are available. Typically residential central heating systems provide from 2 to 5 tons of cooling. One ton of cooling is equivalent to 12,000 Btu/hr.

**Equipment Sizing –** For central air conditioning systems, your contractor should calculate the cooling load of your home. This will make sure you are selecting a system that meets you peak cooling needs without oversizing the equipment. Oversized equipment is a common problem that can lead to poor performance, and early equipment failure. Check to see that they are using sizing guidelines such as the Air Conditioning Contractors of America's Manual J.

**Duct Sizing –** Another consideration when selecting a central air conditioner is the size of your ductwork. If the ducts are not large enough to allow adequate airflow, the air conditioner will not operate efficiently.




*Central Air Conditioning Energy Use*

This can lead to a frozen indoor coil, or premature failure of the compressor plus there will be more noise in the ducts from an oversized fan. Make sure your bid includes any duct modifications needed to optimize cooling system performance.

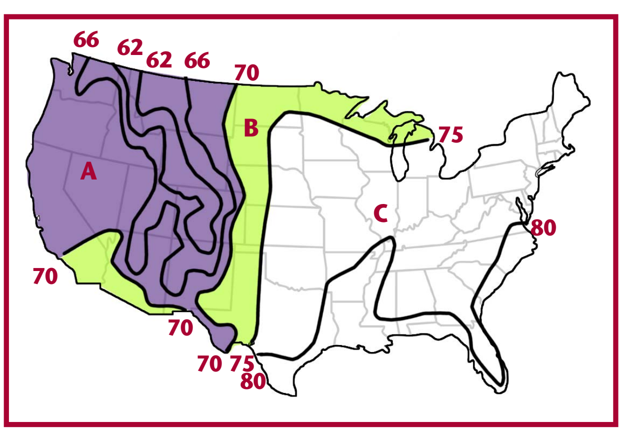
**Duct Sealing and Insulation –** If your ducts are located in the attic or crawl space of your home, it is important to assure they are well sealed and insulated. If not, your systems cooling capacity and efficiency may be reduced by as much as 50 percent. Ask your contractor to make recommendations for additional duct sealing and insulation as part of their bid.

This graph illustrates the electrical energy used per 500 hours of air conditioner operation. Your hours of operation will vary depending on climate, thermostat set point, and the quality of your homes construction.

## Evaporative Coolers

**Evaporative Coolers**, often referred to as "swamp" coolers have been popular for years because they offer an economical alternative to refrigeration based air conditioning. They use one-tenth to one-quarter the electrical energy and are much less expensive to buy. Compared to central air conditioners, Evaporative Coolers also operate without ozone harming chloroflourocarbons (CFCs) used by refrigeration based systems.

Much as evaporating perspiration cools our bodies on a hot day, air blown through a wet pad is cooled as the water evaporates. As an evaporative cooler using a fan draws outside air through a wet pad, the air becomes more humid but cooler. The cool air is blown into the house forcing warmer air out partially open windows or specially installed vents. Significant cooling requires dry outside air to enhance evaporation. The system, also, continually adds moisture to the air that enters the house. As a result, evaporative coolers work best in warm dry climates such as the Southwest and Western U.S.




An Evaporative Cooler should be able to provide most of the cooling required in the "A" area on the map. They have also worked well for many applications in the blue area. White areas should normally only consider refrigeration based cooling.

### Evaporative Coolers

**Pros:**

- Economical to operate
- Low cost equipment

**Cons:**

- Limited to areas with low humidity.
- Requires a good supply of clean water
- Large volumes of air required may not be desirable
- May require several units to cool an entire home

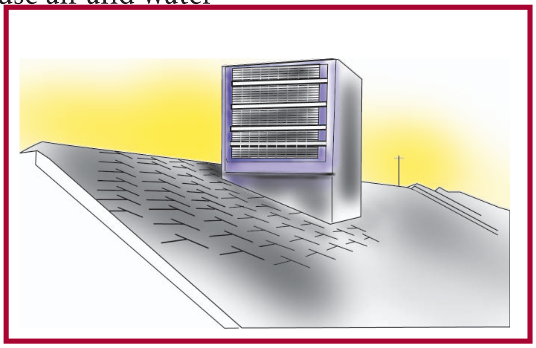
## Evaporative Cooler Types

There are **single stage** and **two stage** coolers. Single stage or direct evaporative coolers are the most common and are categorized by pad type, "Fiber" pads or "Sheet" pads.

**Fiber Pads** provide a wettable surface through which air is circulated. The most common pads are shredded aspen wood fibers sometimes called excelsior. There are other synthetic fiber pads but high quality aspen pads set the performance standard. Pads vary in thickness, quality and cost. Thicker, 2 inch pads are generally better. Fiber pads will normally need to be replaced annually as mineral deposits build-up.

**Rigid-Sheet Pads** are made of a stack of corrugated material and are usually 8 to 12 inches thick. These pads are more expensive than fiber pads but can last for many years when water quality is properly maintained. Rigid pads should be washed down at the end of the cooling season before any accumulated scale dries and hardens.

**Two-Stage Coolers** use an indirect evaporative cooling stage to pre-cool air, as much as 20 °F, before it enters a traditional direct second stage. Because air and water don't mix in the first stage, pre-cooling adds no humidity producing cooler and drier air than single stage coolers. Two-stage coolers work best on very hot (100 °F +) dry days. They normally have rigid pads and are the most expensive type of evaporative cooler.



*Roof Top AirConditioner*

### Types of Installations

**Roof top installations** using bottom discharge blowers are the most common and are usually the least expensive. Ground mounted side or up discharge units while often more expensive are easier to maintain (You don't need a ladder to get to them.) and can often be shaded by the building. Coolers can be installed as an add-on to existing refrigeration based central air conditioning systems, as independent stand-alone systems or even as window mounted units.

**A/C Add-ons:** Evaporative coolers can be used in conjunction with your conventional direct expansion air conditioner. This can typically reduce overall heating costs by 50%, improve indoor air quality by introducing additional outside air, and extend compressor life of the refrigeration unit by minimizing short cycling during periods of reduced load. These systems are ideal for low elevation desert regions with high cooling loads.

### Sizing Evaporative Coolers

Over sizing can create comfort and equipment durability problems with refrigeration based air conditioning but is not the same kind of issue for evaporative coolers. With evaporative coolers large volumes of air are needed to cool a house. Units are sized by Industry Standard CFM (cubic feet per minute) by the manufacturer. Ratings generally range from 2,000 to 6,500 CFM. A large evaporative cooler with a big blower and a low horsepower motor will out perform a small cooler with a high horsepower motor.

For best results a system should be engineered and sized based on calculated room by room cooling load analysis. When this isn't feasible use the following guidelines.

| Type of System | Sizing |
|---|---|
| A/C Add-on | 100 CFM per ton of regrigeration cooling |
| Independent Systems (Including window Mounted) | 2-3 CFM / FT2 of floor area (most climates) |
| | 3-4 CFM /FT2 of floor area (for hot desert) |

## Additional Resources:

### Books

Consumers Guide to Home Energy Savings, American Council for and Energy Efficient Ecomony.Berkeley, CA
http://www.aceee.org/consumerguide/index.htm

### Websites

Energy Star® web site - http://www.energystar.gov

Federal Trade Commission's Energy Guide -
http://www.ftc.gov/bcp/conline/pubs/homes/applnces.htm

Rocky Mountain Institute, Home Energy Brief -
http://www.greendesign.net/rmi/heb/index.html

Energy Savers, Department of Energy -
http://www.eren.doe.gov/consumerinfo/energy_savers/