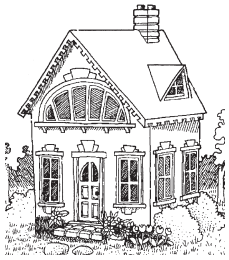
ROCKY MOUNTAIN INSTITUTE

Home Energy Brief



#8 HOME COOLING

Cooling your home more efficiently will save money on energy bills, reduce your impact on the environment, and make your home more comfortable. But, as with all efficiency improvements, it's important to prioritize.

The first, most important, and most often overlooked step is to relearn the lost art of "passive" cooling—that is, cooling techniques that don't require energy. Passive techniques keep your home from getting hot in the first place, thus minimizing the cooling "load" that must be handled by mechanical equipment.

Next, tackle as much of the remaining load as possible with simple mechanical devices like fans and swamp coolers, which move air around or remove heat without refrigeration. Refrigeration, the process used by air conditioners, is much more energy-intensive, and should be considered a last resort.

Not all of the techniques described here will be appropriate for your situation; which ones you pursue will depend on your home and your local climate. Humid climates require different measures from dry ones, and climates with heating as well as cooling needs make different demands from those in which only cooling is necessary.

Check with your state energy office or your electric utility to see if they offer rebate programs for implementing any of the techniques listed here.

PASSIVE COOLING METHODS

Trees and Landscaping

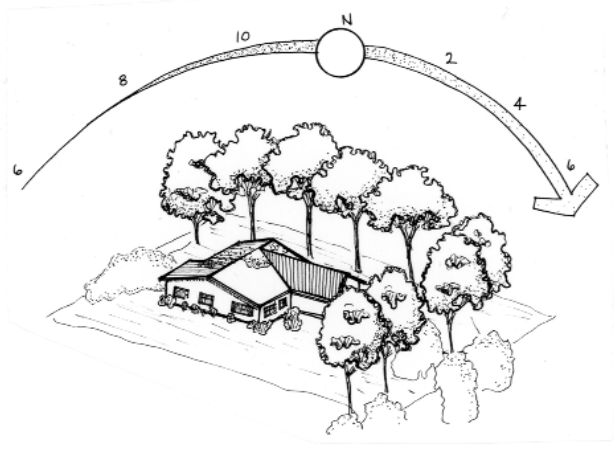
Perhaps the best way to keep your house cool is to prevent the sun's rays from reaching it in the first place. Planting **shade trees** or trellised vines on the western and eastern sides of your house will reduce the amount of sunlight absorbed by windows, walls, and roof (they'll also offset some of your home's contribution to greenhouse gas emissions).

Energy-efficient **landscaping** can reduce exterior temperatures around your house by 10–20°F, help channel cooling breezes, and make your yard more pleasant. In desert climates, choose plants that are natural to your area; they'll need less water and will survive the seasons. Ask local professionals for specific recommendations for your climate.

Window Shading

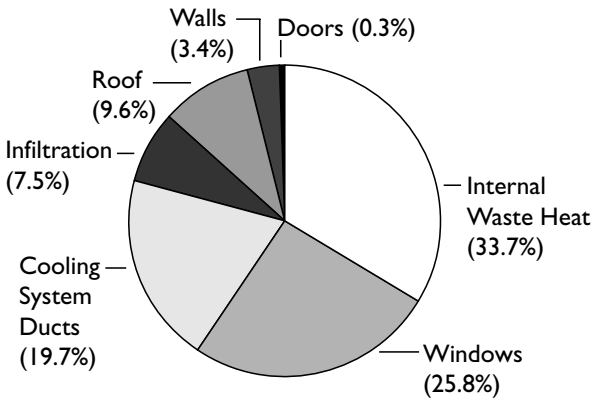
Various forms of window shading also help keep the sun out, particularly when mounted on south- and west-facing windows. Devices installed on the outside, such as **awnings**, are generally more effective than interior shades because they stop sunlight before it enters the home. **Porches** and **roof overhangs** fulfill the same function.

Window **shades**, **curtains**, or **blinds**, though installed on the inside, are still better than nothing—they can reduce solar heat gain by up to 50%.



Mature shade trees will keep your house much cooler by blocking unwanted solar radiation and creating a cooler surrounding microclimate.

WHERE DOES THE HEAT COME FROM?



The chart gives a breakdown of the major sources of unwanted heat gain in a typical Orlando, Florida home (R-19 ceiling insulation, no attic insulation, and uninsulated ductwork in the attic). Source: Florida Solar Energy Center.

Roof Whitening

A specially whitened roof reflects about 70% of the sun's rays. By comparison, white asphalt shingles reflect about 25%, and black shingles only about 5%. Tests indicate that whitening the roof of a poorly insulated home in a hot, sunny climate can save up to 43% on cooling bills, but that savings are only 10% in a home with R-25 insulation already in place.

If you have a tile, metal, or concrete roof, you can lighten it with a coat of white **elastomeric (rubberized) paint**. Be sure to get paint specifically designed for roof whitening: normal latex will not work. The cost is relatively high—30–70¢ per square foot of roof area. Ventilation, insulation, or radiant barriers (see below) may work out cheaper.

Elastomeric paint isn't suitable for other roofing materials, such as shingle. An alternative is to install special **white** or **reflective roofing materials**, which similarly reduce cooling loads. These materials probably will repay their extra cost only if you're installing a new roof anyway.

Attic Ventilation

Without good **ventilation**, the temperature in your attic may reach 130°F or more, causing heat transfer into the living space below. If your attic temperature goes above 100°F you should increase its ventilation. The minimum ventilation area recommended is 1 square foot per 150 square feet of attic floor area.

To maximize ventilation, create a "stack effect" by using ridge or gable vents for the top of the attic and soffit vents for the eaves. Soffit vents cost about $2 for each truss section and gable vents cost around $100 each.

Radiant Barriers

Radiant barriers are thin plastic sheets coated with a shiny surface designed to reflect radiant heat. They're typically stapled to attic rafters or sloped trusses, shiny side down, to reduce high attic temperatures. Properly installed, radiant barriers may reduce heat flow from the attic to the living space by up to 50% and cooling loads by up to 12%.

Radiant barriers cost 10–15¢ per square foot of roof area (add about 5¢ per foot for installation).

Insulation

Ventilation and radiant barriers reduce, but don't eliminate, high attic temperatures, so adding **insulation** may be advisable to slow heat penetration into the living space. It's cost-effective to increase attic insulation to R-19 or more in a hot climate (R-19 should be adequate if your roof is white). If you live in a climate with a significant winter heating season, insulation is even more important and you should consider adding attic insulation to R-30 or even higher.

Fiberglass rolls or batt (thick strip) insulation can be added for about 30–40¢ per square foot for R-19. Loose-fill cellulose insulation is messier but cheaper, and can be blown into inaccessible attic spaces.

Reducing Internal Waste Heat

Waste heat from internal sources—appliances, lighting, and people—is the biggest single cause of unwanted heat gain in a typical hot-climate home (see chart). Buying **energy-efficient appliances** and **lighting** will greatly reduce the waste heat produced while lowering your utility bills. Your refrigerator represents the biggest opportunity for improvement, since it runs year-round and releases its waste heat into the house. For more information, see other titles in this series.

Using Natural Ventilation

It's just common sense, but taking advantage of natural ventilation is a free way to reduce your cooling load. At night, or anytime it's cooler outside than in, open windows—especially those that catch prevailing breezes to provide cross-ventilation. (Exception: in very humid regions, this may make your

home less comfortable.) Placing a window fan on the downwind side of the house, blowing outward, can enhance nighttime ventilation.

Windows and Window Films

Sunlight passing through windows contributes a fourth of total unwanted heat gain in a typical house—mainly through east- and west-facing windows, which receive more summer sun and at lower, more direct angles than do south-facing ones.

High-performance windows with "low-emissivity" (low-e) films selectively block infrared radiation (heat). Most low-e films are designed for cold climates, where the main consideration is to keep heat *in*, but in a hot climate you need a film designed to keep heat *out*. Low-e windows are worth their extra cost if you're replacing windows anyway, but otherwise the shading and cooling options listed above will probably be better buys. Cheaper **retrofit window films** may be worthwhile for certain problem windows.

For more tips, see the "Windows" brief in this series.

Weatherization

Weatherization is a sound investment if you live in an area with a heating season, but in a year-round warm climate it will only be cost-effective if your house is very leaky. Windows, doors, foundation, attic, ductwork, and electrical and plumbing penetrations are where most leaks are found. Rule of thumb: first seal up the holes that a cat could crawl through.

LOW-ENERGY COOLING METHODS

These are mechanical devices that cool the home, or make occupants feel cooler, without the very high energy demands of air conditioning.

Fans

A **whole-house fan** is an effective means of cooling in drier climates, consuming a tenth as much energy as air conditioning. If it's cooler outside than in, the fan blows the hot air out and draws cooler air in through the windows. The fan should be centrally located in the attic so that it draws air from all around the house. Be sure your attic has adequate gable or ridge vents to get rid of the hot air. Have a professional do the insulation, as local building codes will probably require automatic shut-off in case of fire.

Ceiling and **portable fans** make you *feel* cooler rather than actually cooling the air, but the net result is the same. A moderate breeze can extend your comfort range by several degrees, and will save energy by allowing you to set your air conditioner's thermostat higher or turn it off altogether.

Evaporative (Swamp) Coolers

If you live in a dry climate, an **evaporative** or **"swamp" cooler** can be substituted for air conditioning in almost any application, saving 50% of the initial cost and up to 80% of the operating cost of air conditioning. An evaporative cooler cools the air by evaporating water, usually by drawing fresh outside air through wet porous pads. As the dry air absorbs the water, it becomes cooler. "Indirect" or "two-stage" models that yield cool, *dry* air rather than cool, moist air are also available.

AIR CONDITIONING

Air conditioning is expensive to run, and its high energy consumption exacts a high price on the environment. In the average air-conditioned home, air conditioning consumes more than 2,000 kilowatt-hours of electricity per year, causing about 3,500

HUMIDITY CONTROL

When it's hot, **humidity** makes it feel hotter. Why? Because we keep cool by sweating, which is a form of evaporative cooling. The more humid the air, the slower the evaporation.

In the average house, interior sources of humidity—cooking, showers, even breathing—put nearly two gallons of water a day into the air. Installing timer ventilation fans, which shut off automatically, in the kitchen and bathroom is an effective way to remove humidity from spot sources.

In a humid climate, an important part of what an air conditioner does is remove moisture from the air. Some models don't dehumidify as well as others. You can increase your system's dehumidifying capacity by reducing its fan speed, but the tradeoff is that you'll lose cooling capacity. If you're in the market for a new air conditioner, choose one with a variable-speed indoor cooling fan and a sensible heat fraction (SHF) less than 0.8. The lower the SHF, the better the dehumidification ability. You might also consider installing add-on devices such as heat pipes or desiccant dehumidifiers.

pounds of carbon dioxide and 31 pounds of sulfur dioxide to be emitted at the power plant.

Improving Air Conditioner Efficiency

If you've already got an air conditioning system and you still need to use it, don't despair. Here are some tips for operating it less often and more efficiently without sacrificing comfort:

- Set your **thermostat** to 78°F—or higher if you've got ceiling fans. Each degree that the house is cooled below 80°F increases your annual cooling bill by 12%.
- Close off unused rooms, and **turn the unit off** when you leave for more than an hour. It's a myth that leaving the air conditioner on saves energy.
- Use the **recirculate** option to reuse inside air instead of cooling hot, humid outdoor air.
- Install a **programmable thermostat**: this allows you to select the times when you need your home to be cooled.
- Perform regular **maintenance**. Clean the filters every month and the coils and fins once a year, and have the refrigerant charge checked by a trained technician if performance decreases.
- **Seal leaks** in central air conditioning ducts, and **insulate** ducts where they run through the attic or other warm spaces.

Buying a New Air Conditioner

The most efficient air conditioners on the market are up to 70% more efficient that the current average, so it does pay to check ratings. It may even be worth retiring an older, inefficient unit before its time to make way for a better one. According to one study, a top-rated room air conditioner, costing $70 more than a standard one, will pay back its extra cost in energy savings in six and a half years.

Size your air conditioner properly; most systems are installed by rules of thumb, which commonly result in oversizing of 50% or more. Have the contractor show you the "Manual J" sizing calculations specific for your home's heat gain, insulation levels, and other factors.

Room air conditioners are rated by their energy efficiency ratio (**EER**), which is cooling capacity divided by energy consumption. The higher the EER the better. Typical new room air conditioners have EERs of about 9, but the best ones are 12 or better. Central air conditioners are rated on their seasonal energy efficiency ratio (**SEER**). Models with SEER values of 12 or better are recommended.

ADDITIONAL INFORMATION

Air-Conditioning and Refrigeration Institute, 4301 North Fairfax Drive, Suite 425, Arlington, VA 22203; fax: (703) 528-3816. Write or fax for consumer cooling tips.

American Council for an Energy-Efficient Economy, 2140 Shattuck Avenue, Suite 202, Berkeley, CA 94704; (510) 549-9914. ACEEE's *Consumers' Guide to Home Energy Savings* lists the most efficient air conditioners and contains other useful tips on home cooling.

American Society of Heating, Refrigeration, & Air Conditioning Engineers, 1791 Tullie Circle NE, Atlanta, GA 30329; (404) 636-8400. Offers a technical inquiry service.

Energy Efficiency & Renewable Energy Clearinghouse, PO Box 3048, Merrifield, VA 22116; (800) 363-3732. Has several publications on air conditioning and space cooling that are worth checking out, including one on passive cooling.

Evaporative Cooling Institute, PO Box 3ECI, Las Cruces, NM 88003; (505) 646-3948. Provides information on evaporative cooling strategies and equipment.

Florida Solar Energy Center, 1679 Clear Lake Road, Cocoa, FL 32922-5703; (407) 638-1015. Offers many publications on passive cooling, dealing with heat and humidity, shading techniques, radiant barriers, roof whitening, etc.

 Written by Owen Bailey and Robert Alcock. Thanks to Danny Parker of the Florida Solar Energy Center. For more information on household resource efficiency, see RMI's *Homemade Money: How to Save Energy and Dollars in Your Home*. Other titles in this series of Home Energy Briefs include *Lighting*; *Windows*; *Water Heating*; *Refrigerators & Freezers*; *Cooking Appliances & Dishwashers*; *Washers, Dryers & Miscellaneous Appliances*; and *Computers & Peripherals*.