IOWA ENERGY CENTER

Home Series 2

Home Heating and Cooling

- **Reduce your utility bills** with low-cost, low-tech tips
- **Get more heat** from every energy dollar you spend—page 3
- **Make the most** of your air-conditioning system—page 10
- **Landscape your yard** for year-round comfort—page 19

Save with a whole-house approach

Did you know?

The **Energy Policy Act of 2005** includes special tax credits for homeowners who make energy-saving improvements to their homes:

- Up to $500 for thermostats, caulk or fixing energy waste.
- $200 for installation of new windows; $300 for an efficient central air conditioner, heat pump or water heater; and $150 for an efficient furnace or boiler.
- Up to $2,000 for a solar-powered hot-water system used for a purpose other than heating a swimming pool or a hot tub.

Every year, a typical family in the United States spends almost half of its home energy budget on heating and cooling. In Iowa, that percentage is even higher, due to temperature extremes reached during the winter and summer months. Unfortunately, many of those dollars often are wasted because conditioned air escapes through leaky ceilings, walls and foundations—or flows through inadequately insulated attics, exterior walls and basements. In addition, many heating systems and air conditioners aren't properly maintained or are more than 10 years old and inefficient, compared to models being sold today.

As a result, it makes sense to analyze your home as a collection of systems that must work together in order to achieve peak energy savings. For example, you won't get anywhere near the savings you're expecting from a new furnace if your air-handling ducts are uninsulated and leak at every joint. The most energy-efficient central air-conditioning setup won't perform to your expectations if your attic insulation is inadequate and can't reduce solar heat gain to help keep your home cool. And planting the wrong types of trees or shrubs close to your home adversely can affect potential energy savings all year long.

Here's the bottom line

By properly maintaining your existing heating and cooling equipment (or replacing aging units with high-efficiency models), addressing weatherization and insulation issues at your house and getting into the habit of using energy efficiently all the time, you can save **10 to 30 percent (or more)** on your utility bills every year. You'll also help **reduce pollution** at utility plants that use fossil fuels to generate electricity. (According to the U.S. Department of Energy, the electricity generated by fossil fuels for a single home creates more carbon dioxide than two average-sized cars.)

How much of the work can you do?

If you're a competent do-it-yourselfer, you can handle many of the maintenance chores and energy-saving projects described in this book. However, if you're uncomfortable with the idea of working around electricity or would rather hire someone to handle a job, don't hesitate to call a professional; the dollars saved through energy savings in future years will be worth the expense. (Of course, only a trained technician should handle jobs that require working with refrigerants or control units.) For details on hiring a heating and cooling contractor, see page 23.

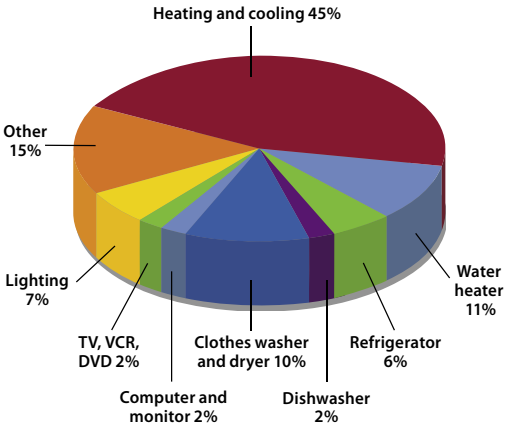
Your utility or bank might be able to help with project costs

Small energy-efficiency projects such as sealing air leaks or weather-stripping windows are relatively inexpensive. However, when it's time to purchase a new heating and cooling system, it makes sense to talk with your utility company and bank before buying. Some utility companies, for example, offer **rebates** on high-efficiency air-source heat pumps, geothermal heat pumps, gas furnaces, boilers and central air-conditioning systems.

Ask a banker about a **low-interest loan** to cover the cost of your energy-saving projects, or consider a **home-improvement loan**. If you're planning to refinance your home mortgage, look for an **energy-efficiency mortgage** that allows a lender to use a higher-than-normal debt-to-income ratio to qualify you for the loan.

Finally, check for government-sponsored assistance and grant programs designed for low-income and elderly homeowners. Get in touch with a Community Action Agency in your area, or see page 24 for information on contacting the Iowa Department of Human Rights/ Division of Community Action Agencies.

Energy use in a typical home



Across the country, heating and cooling an average home consumes almost as much power as all other energy uses combined. The "Other" category includes a variety of household devices such as stoves, ovens, microwaves and small appliances that individually account for no more than about two percent of a household's energy bills.

Source: *ENERGY STAR*

Heating

Lower energy consumption means lower costs

No matter what kind of equipment heats your home, one thing is certain: The more energy-efficient the heating system is, the lower your utility bills will be. Using less energy also is good for the environment, because doing so reduces air pollution and helps conserve natural resources. In fact, according to the U.S. Department of Energy, the combination of a tight, well-insulated home, a properly maintained, high-efficiency heating system and reasonable thermostat settings can **cut both your heating bill and your pollution output in half.**

Is it time for a change?

If you've lived in your home for several years—and the heating system was in place when you bought the house—it may be hard for you to determine if you've gotten your money's worth out of your current equipment. But consider this: ENERGY STAR® recommends replacing a furnace or boiler that's more than 15 years old (or a heat pump that's more than 10 years old) with a new, high-efficiency unit.

Here are some other clues that it's time to go shopping for a new heating system:

- Your heating bills are going up because the system is using more energy than in past years.
- The equipment needs to be repaired frequently—often for a different reason each time.
- Some of the rooms in your house are too hot or too cold, no matter how you adjust the airflow through the ducts.
- The system just doesn't seem to be working properly, even after a recent service call.
- The air in your home is exceptionally dry during the heating months.

Unfortunately, you often can't see what causes a heating system to waste energy. Beyond obvious clues such as a sagging duct that blows heated air into the basement, a noisy fan motor on a forced-air furnace or a leaking fuel line on a boiler, most of the energy-wasting problems will be hidden from view.

Make a responsible, long-term choice

Even if you decide to replace your heating system with one of the same type, buy the most energy-efficient unit your budget allows. Although you'll spend a little more money up front, you'll be many dollars ahead in the long run because lower utility bills will shorten the new equipment's payback period.

On the other hand, now may be the perfect time to significantly reduce your family's reliance on conventional energy sources by installing a more efficient heating (and cooling) system. For example, a **geothermal heat pump** (sometimes referred to as a "ground-source" heat pump) can give you up to four dollars of heating (or cooling) for every electrical energy dollar spent. As an alternative, a **passive solar sunspace** can reduce annual heating costs by up to 50 percent (compared to a similar house without passive solar heat), as well as allowing you to install a smaller conventional heating system as a backup for overcast days.

You can have a major impact on reducing heating costs at home

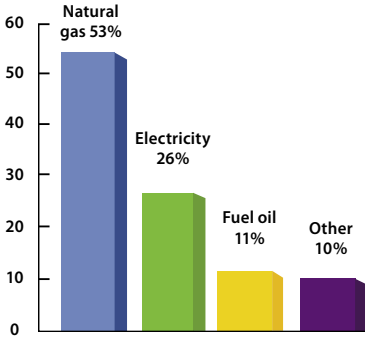
If the time isn't right to replace your heating system, there are a couple of things you can do to keep your home warm and comfortable at an affordable cost with the existing equipment. First, **reduce the heating load** on your home by eliminating air leaks, adding insulation and promoting a change in your family's energy-wasting habits. Second, call a professional heating and cooling contractor to **tune up and optimize the heating system,** including an update of its controls and other internal parts—and adding a programmable thermostat.

In the sections that follow, you'll find many proven low-cost, low-tech methods for saving energy (and money) on your heating needs, in addition to finding out what to consider when upgrading a heating system and maintaining your heating equipment.

Did you know?

On the Energy Star Web site at http://www.energystar.gov, you'll find a lot of valuable information in the Home Improvement section. The **Home Energy Yardstick**, for example, takes about five minutes to fill out and will help you discover whether your energy use is above average. The **Remodeling Guide** gives you a list of customized energy improvements (with estimated savings) for different areas of your house. And the **Home Sealing** section offers tips on tightening your home's "envelope" to lower energy bills.

Heating fuels



Although there are several different types of fuel available for heating, today more than half of the homes across the country use natural gas.

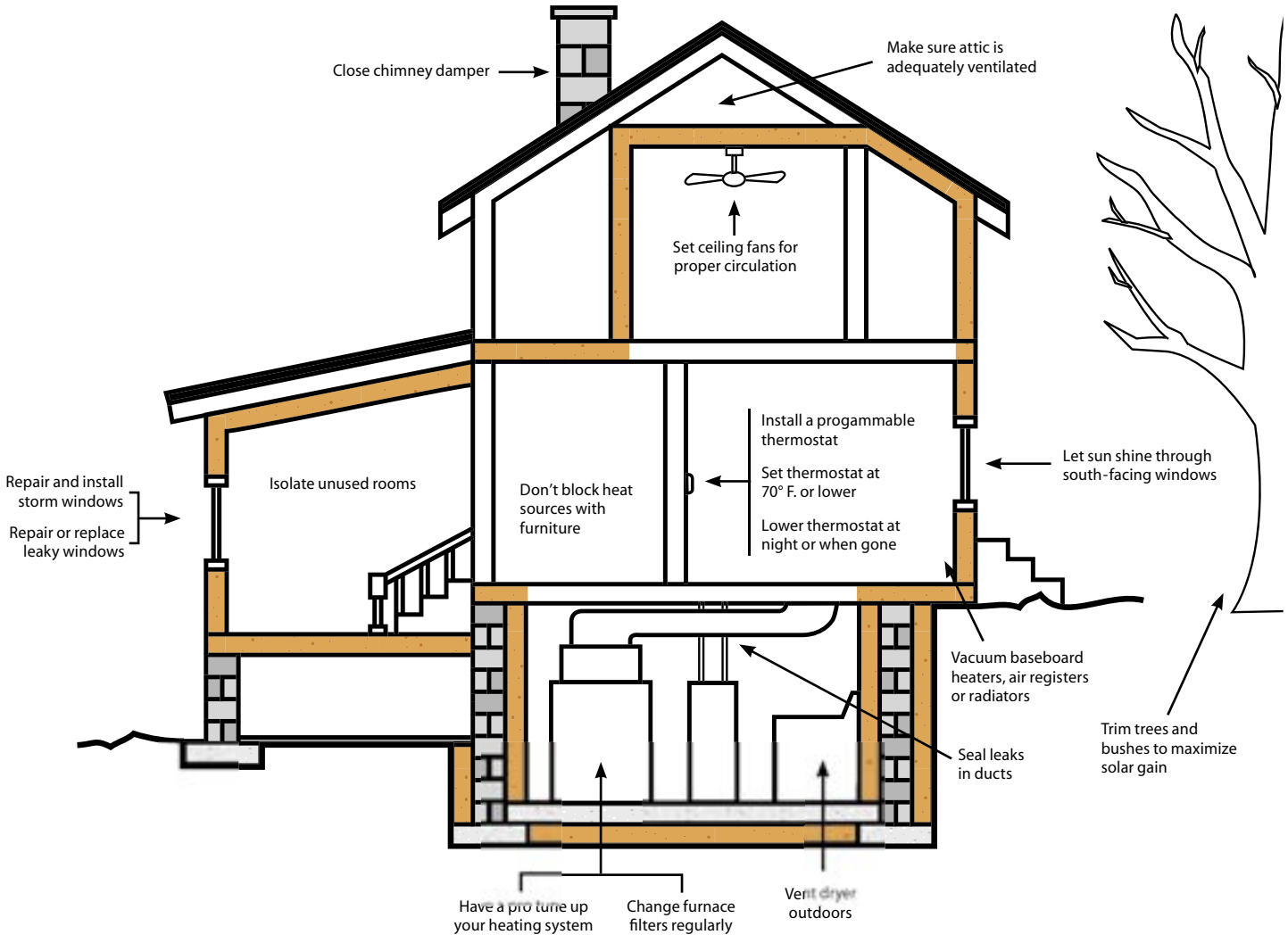
Source: *U.S. Department of Energy Office of Energy Efficiency and Renewable Energy*

Make your heating dollars work harder for you

No matter what type of heating system you have, there are some things you can do to **save energy and still stay comfortable at home** during the cold-weather months. Besides calling a professional to check your heating system, try several of the tips in this section to reduce your home's energy usage. Some of these ideas won't cost you a penny—such as opening the curtains on south-facing windows to harvest the sun's warmth during daylight hours—and some may cost a few dollars that you'll recoup within a year through reduced energy bills—such as installing a programmable thermostat. However, they're all worth considering.

From a whole-house perspective, first look for leaks that allow cold air into your home—and heated air out. Then evaluate the insulation levels in your home and add insulation where necessary; attic insulation likely will have the most immediate impact on energy savings, but don't overlook areas such as the foundation, unfinished basement walls and floors above unheated spaces. For more information on improving your home's energy-saving "envelope," ask your utility or the Iowa Energy Center for the book, *Home Series 1: Home Tightening, Insulation and Ventilation.* (See contact list on page 24.)

Survey your home to save



Follow these tips to stay warm

A plan for saving energy during cold weather includes analyzing all the elements that go into heating a home—including the habits of the people who live there. So, in addition to making sure your existing heating system is in peak operating condition (or replacing it with a more energy-efficient unit), talk with family members about how a little effort can yield significant results in cutting heating bills—without adversely affecting anyone's comfort.

Living areas

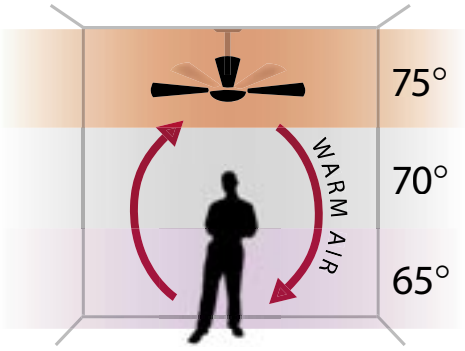
Walk around your home with this list to discover how many opportunities you have to reduce energy use during the winter. Most of these ideas won't cost anything more than a few minutes of time; the tips that do require a small outlay of cash quickly should pay for themselves through smaller heating bills.

Set the direction of ceiling fans for proper circulation.	Run ceiling fans in a *clockwise* direction during cold-weather months to move the warm air that gathers near ceilings back into the rooms.
Warm up your bed.	Turn down your thermostat and use extra blankets or quilts—or an electric blanket or mattress pad—to stay toasty at night.
Vacuum baseboard heaters, air registers or radiators.	When you see dust, dirt and lint building up, clean any of these devices that are part of your home's heating system.
Move furniture or window coverings that are blocking air registers, baseboard heaters or radiators.	Make sure all the heated air you're paying for reaches its destination! A blocked air register can cause an adjoining room to overheat, and upholstery or curtains can trap heat between the wall and the fabric—preventing it from being distributed throughout a room.
Install radiator reflectors.	These panels will help reflect heat away from walls and into rooms.
Isolate unused rooms, as long as doing so will not hurt water pipes.	Turn down the thermostat in a room with baseboard heat, or close the registers for a forced-air furnace. However, don't allow temperatures in rooms with water pipes to approach the freezing point.
Remove wall or window air conditioners during cold-weather months.	For a *wall unit*, cover the opening with a thick plywood panel backed by rigid foam insulation; caulk to ensure the unit is weather-tight. For a *window unit*, remove it, close the window and fix air leaks. If you can't remove the air conditioner, wrap it in an insulated, waterproof cover made for the job.
Remove humidity from the kitchen and bathroom with a properly sized exhaust fan.	Too much humidity can cause condensation and frost on windows and possibly damage them. But don't leave an exhaust fan on longer—or at a higher speed—than necessary. In one hour, an exhaust fan can blow a "houseful" of heated air outside. In addition make sure these fans are not discharging air and moisture into the attic; they should be vented outdoors.

Did you know?

Adequate attic ventilation is important during the winter. If air leaks to the attic from the living spaces below aren't adequately sealed, moisture-laden warm air can flow to the attic and freeze in your attic insulation, on the rafters and on the underside of the roof. When the temperature gets above freezing, the ice can melt and run down to your ceilings and walls, damaging them. If moisture buildup in your attic is a problem, check to make sure all existing attic vents are not blocked. If they appear to be okay, look for (and seal) air leaks and consider installing additional attic vents.

Ceiling fan evens temperatures



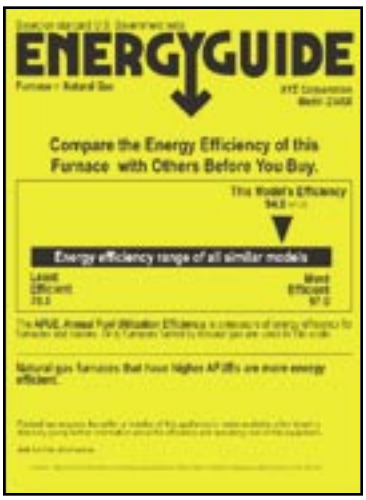
To help eliminate the chilly feeling caused by temperature layering in a room, run your ceiling fan—on the lowest speed, in a clockwise direction—all winter long.

Did you know?

Furnaces and boilers fueled by natural gas, propane or oil are rated by **AFUE** (Annual Fuel Utilization Efficiency). For heating, air-to-air heat pumps are rated by **HSPF** (Heating Seasonal Performance Factor) and geothermal heat pumps are rated by **COP** (Coefficient of Performance).

Use these numbers to compare units of the same type; in all cases, higher numbers are better. Check with your utility company for recommended minimum ratings, and buy the most efficient unit your budget will allow.

Read the label



The EnergyGuide label on heating equipment is a summary of the detailed energy-efficiency information manufacturers are required to furnish with their equipment. Compare labels on different units when you shop; higher efficiency numbers indicate lower energy usage and operating costs. Look for the ENERGY STAR logo, too, which means the equipment exceeds federal minimum efficiency standards and uses significantly less energy than a standard unit.

Buying a new heating system

A new heating system is one of the largest investments you'll make in your home, and it's one of the few that actually could pay for itself over a period of several years. Accordingly, it's worth your time to research all the possibilities and "run the numbers" to determine what equipment makes the most sense for your situation.

Ask a pro for help

Talk with several heating and cooling contractors about choosing a system and handling the installation for you. (See page 23 for tips on finding a heating and cooling contractor.)

In some cases, you may be limited by the choices available to you. For example, if you live in an older two-story home that already has radiators in place, it could be very difficult and expensive to install a new duct system for a forced-air furnace instead of a new boiler. However, if you're thinking about making a change—perhaps from a gas forced-air furnace to an air-to-air heat pump or a geothermal heat pump—be sure to ask the contractors to run cost comparisons for the fuels and energy sources available in your area. This is a somewhat complicated process, but there are formulas that make these comparisons possible.

In addition, make sure the contractor **properly sizes** the new heating equipment for your home, using a computer program or calculations based on the Air Conditioning Contractors of America Manual J. This is especially important if you've made recent energy-saving improvements such as sealing air leaks or adding insulation, which may allow you to choose a smaller unit than you presently own. An oversized system (the installation of which was a common practice in poorly weatherized and insulated homes for many years) will cost more initially—and then will waste heating dollars by running in short, inefficient cycles that won't be able to evenly heat all the rooms in your house.

Then consider the **cost to purchase** and the **cost to operate.** For example, compare a new, super-efficient forced-air furnace that costs $1,200 installed with a no-frills, low-efficiency furnace that costs $750 installed. Because of its reduced energy usage—and the resulting lower utility bills—the annual operating expense for the more efficient unit might be $400, while the basic unit might run $550. The difference in initial cost, $450, would be paid back during just three years by choosing the more efficient system—and, of course, the savings would continue to accrue for many years to come. Also ask the contractor for **projected repair and maintenance expenses** to factor into your decision-making process.

There really are differences among systems

Buy the most energy-efficient system you can afford, even if you have to stretch the budget a little. Here are some things to consider when evaluating each type of heating system.

Forced-air furnaces

According to ENERGY STAR, about 25 percent of the furnaces in use today are more than 20 years old. Many of these units had efficiencies ranging from 56 to 70 percent, compared to the best systems today that are up to 97 percent efficient. By making energy-saving improvements in your home and upgrading from a 56-percent-efficient furnace to a 90-percent-efficient one, every year you'll **cut heating bills by as much as one-half**—and reduce carbon dioxide emissions by 1.5 tons if you heat with gas and 2.5 tons if you heat with oil.

Look for an AFUE rating over 90 for all types of forced-air furnaces. Gas- and oil-fired units at this level include electronic ignition instead of a continuous pilot light, as well as a sealed combustion chamber that brings fresh outside air to the burner through one pipe and vents exhaust gases outside through another.

Electric resistance

Besides forced-air furnaces, electric resistance heating takes many forms, such as baseboard heaters, cove units or radiant ceiling and floor systems. The energy advantage of these systems is that they allow individual room temperature control, allowing low temperatures in seldom-used rooms and "normal" temperatures in frequently used rooms. In addition, some people prefer non-forced-air options—especially in bathrooms—because they don't create drafts. For baseboard heaters, choose liquid-filled units that quietly and evenly release heat over a long time period. To save money, ask your utility about special rates for electric heating.

Boilers

Shop for a boiler that features the latest technologies for extracting the most heat from a specified amount of fuel, in addition to including electronic ignition and sealed combustion. If you need to replace radiators or baseboard units, pick ones designed to most effectively heat the space. For new construction or a remodeling project, consider a radiant floor system.

Air-source heat pumps

This system gets its name from the way it uses the difference between the outdoor air temperature and the indoor air temperature to heat (or cool) a home. During the summer, the air-source heat pump functions as an air conditioner; during the winter, it runs in reverse to provide heat. Properly installed and connected to a well-designed (and tight) duct system, an air-source heat pump can deliver up to three units of heating (or cooling) energy for every unit of electric energy it consumes—except in very cold weather, when a backup resistance heating system must supplement the heat pump's output.

Because it heats and cools, an air-source heat pump is a good choice for replacing an existing heating and cooling system or when you need a new furnace and want to add central air-conditioning. Look for a heat pump with a high HSPF and SEER rating. The best units have a two-stage compressor that runs in a low-power, energy-saving mode most of the time, along with a variable speed blower motor that minimizes noise and energy consumption.

Geothermal (ground source) heat pumps

A geothermal heat pump is the most efficient heating and cooling system available, because it returns up to four dollars of heating (or cooling) energy for one dollar of electricity consumed.

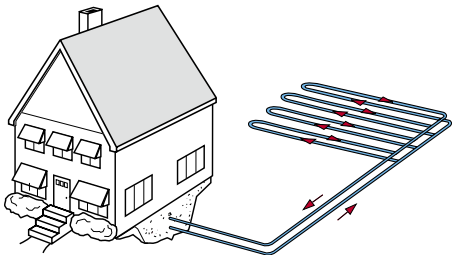
A geothermal heat pump doesn't burn fuel to create heat; instead, it uses electricity to move heat from the ground through a large loop of buried, fluid-filled pipes to a compressor located inside the home.

For a forced-air system, the compressor "concentrates" (or "amplifies") the heat, before it is distributed throughout the home by a blower motor feeding a conventional duct system. Another heat pump option uses a "water-to-water" heat exchanger to transfer the warmth from the fluid to an in-floor radiant heating system or baseboard units.

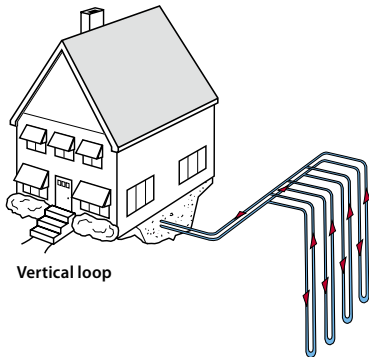
The greatest drawback to a geothermal heat pump is its high installation cost, which can be several thousand dollars more than the cost of a forced-air furnace/central air-conditioning system. However, depending on local electricity costs, the payback period can be just a few years—but certainly will be much shorter than the heat pump's anticipated lifetime of 20 years or more. In addition, some utilities offer rebates on installation costs and special electric rates for geothermal heat pump users—and maintenance costs are low.

For the greatest efficiency, look for a geothermal heat pump with a two-stage compressor and a variable-speed blower.

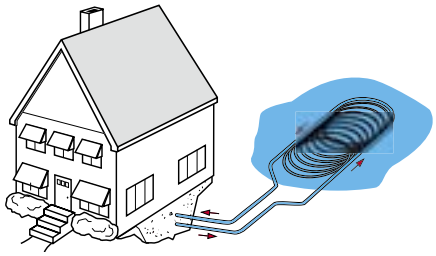
What's the scoop on the loops?



Horizontal loop



Vertical loop



Pond loop

The most common types of loops for geothermal heat pump systems fall into three categories: a horizontal loop *(top)*, a vertical loop *(center)* and a pond loop *(bottom)*. Some loops are "closed," meaning they circulate a fluid through a sealed loop underground; others are "open" and circulate well or ground water directly through the heat pump unit. In addition, many systems use coiled "slinky" pipes buried in the ground (similar to the ones shown in the pond illustration) instead of straight pipes, which concentrates the heat transfer surface into a smaller space; this is especially useful for installations in smaller yards.

Maintenance

CAUTION!

Always turn off the power to your heating system at the shutoff located next to the unit or the circuit-breaker panel (or fuse box) before performing any cleaning or maintenance tasks.

Regular tune-ups are important for maintaining the efficiency of any type of home heating system. You can handle a few simple tasks yourself if you're mechanically inclined, but you should call a professional technician for anything but the simplest service or repairs.

For example, a forced-air furnace or heat pump will run longer than necessary to warm your home if it has to fight to push air through a dirty air filter; regularly changing the furnace or heat-pump filter is a job you easily can manage. In addition, if you feel comfortable working on the system (with the power turned off), you can handle jobs such as vacuuming the blower, adjusting the blower belt, oiling the blower motor and flushing the condensation drain tube. However, for a gas furnace, make sure you call a professional to adjust the burner.

If you have a hydronic (boiler) system, you can bleed the radiators or check the water level in the sight glass on the boiler—but call a technician for other jobs.

Many heating and cooling companies offer discounted maintenance specials every fall, but make sure you know what's included in a checkup before hiring a company to do the work on your heating system. You may have to pay a little more than the special price to get a complete system evaluation and tune-up, but you'll likely recoup the higher service cost within a few months from lower utility bills.

Humidification

Did you know?

You can buy a **hygrometer** to measure your home's humidity for as little as $10-$20; more expensive units are a little more accurate and allow you to check (and reset) their calibration. You also can watch for condensation on the windows; good-quality windows that are properly installed and weather-stripped should not show excessive condensation buildup at a 35 percent humidity level.

Humidity levels are lowest during cold-weather months, and the humidity in your home will be even lower if your home has an inefficient gas-forced-air furnace, all-electric heat or a system that uses outside air for combustion. When room air is very dry, moisture evaporates from your skin—just as if you were perspiring—making you feel chilly. Your natural inclination may be to raise the thermostat a couple of degrees, but a better, energy-saving solution *might* be to **add a humidifier** to your home's heating system.

To humidify or not to humidify, that is the question

The proper humidity level—many experts suggest around 35 percent—is a good thing for both you and your house during the winter. Besides allowing you to lower your thermostat setting two or three degrees because you'll feel warmer at higher humidity levels, a humidifier will minimize shocks from static electricity and reduce dry-skin and respiratory problems for your family. In addition, a little extra humidity will help prevent hardwood floors from shrinking, doors from sticking and furniture from drying out. On the other hand, too much humidity can create a breeding ground for mold, mildew and insects—and damage the drywall (or plaster), the insulation and the structure of your home.

Not all homes need additional humidity during the winter. For example, in a tightly constructed home built during the last several years, normal daily activities such as cooking, bathing, doing laundry and even breathing may provide adequate humidity levels. In fact, because of the low level of air infiltration in a newer home, some of these activities may add too much humidity, so be sure to use the kitchen exhaust fan when cooking and the bathroom fan during a shower. (Run the bathroom fan about 15 minutes after a shower to remove the humidity; running it longer will just pull heated air out of your home.) If you still note high humidity during cold-weather months, consider adding a heat recovery ventilator to your heating system. (See page 22 for more details on this option.)

Older, drafty homes need more help with humidity than newer homes. You may want to try a couple of *portable humidifiers* to place around your home, but a better choice (if you have forced-air heat) is to install a *whole-house humidifier* that attaches to the ductwork on your heating system. For a home with baseboard heat, radiant heat or radiators, look for a self-contained humidifier that hangs from the floor joists in the basement (or a heated crawl space) and connects to a floor vent mounted near the center of the home.

Passive Solar Energy

During daylight hours in winter, every time you let the sun shine into your home through south-facing windows, you're taking advantage of passive solar energy to help warm a room or two. On a larger scale, a well-designed passive solar home can cost about half as much to heat as a similarly sized home without solar features. But even if you're not planning to build a new home, there are some features you can add during a remodeling project to incorporate the energy-saving and environmental benefits of passive solar energy into your existing home.

A passive solar structure includes five elements

Taking advantage of passive solar techniques doesn't have to cost more than traditional construction. Consider, instead, that a passive solar structure includes a different arrangement of many of the same building materials you'd use in a conventional home.

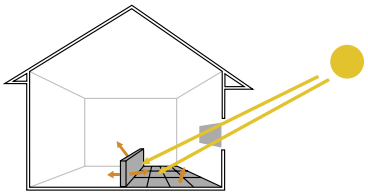
- The **aperture** is the large window area through which sunlight enters a home. The majority of windows should face within 30 degrees of true south and remain unshaded from 9 a.m. to 3 p.m. during the heating season.
- The **absorber** is a dark surface—on a concrete floor, masonry wall or water container—that sits in the direct path of sunlight and collects the sun's heat.
- The **thermal mass** is the material that stores the heat collected by the absorber. The absorber and thermal mass may be part of the same floor or wall; the absorber is the surface of the material, while the thermal mass is the storage medium under or behind it.
- The **distribution method** is the way the solar heat circulates from the thermal mass to other areas of the house. Some designs rely on natural heat transfer—radiation, convection and conduction—while other designs use supplemental fans, blowers and/or duct systems.
- The **control system** includes components that help manage temperatures. Some of these features may be structural, such as roof overhangs or blinds to shade the aperture during summer. Others are more high-tech, and could include electronic sensing devices that signal fans to start, as well as remote-control motorized dampers or vents that direct heat flow.

There are three types of passive solar designs

Whether you're building a new home or retrofitting the one you live in now, your passive solar project will fit into one of these three categories. Be sure to contact an architect who specializes in passive solar designs for your project, no matter what its scale.

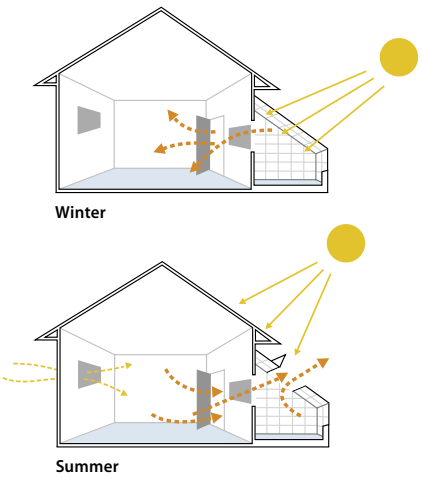
- A **direct-gain** design is the simplest passive solar system; the sun shines into the home and heats a thermal mass—typically a dark-colored masonry floor and/or wall—that holds and slowly releases the heat as the room cools at night. Some direct-gain designs use water-filled containers as the thermal mass, since water can store about twice as much heat as the same volume of masonry. However, a room filled with heavy water containers will need extra structural support, and the water must be treated regularly to prevent bacterial buildup.
- An **indirect-gain** design uses a thermal mass that's placed between the windows and the living space in a home. The most common type of thermal mass is a *Trombe wall*, an eight- to 16-inch-thick, dark masonry wall with a layer of insulated glass mounted to it. (There's an air space between the glass and the wall.) Heat from the sun is absorbed by the wall and slowly conducts through the masonry into the home, when the indoor temperature falls below the temperature of the wall's surface.
- An **isolated gain** design is a sunspace added onto a home, either as part of the home's original design or as a retrofit project. Some are designed as year-round rooms, while others can be closed off from the rest of the house when heating isn't needed and during warm-weather months. By the way, even though a greenhouse may seem to be a good design for solar heating a home, in reality it's not. The structure's overhead or sloped glazing is difficult to shade and can cause overheating of the space (especially during the summer), while the natural growth process of plants consumes heat energy through the evaporation of water.

Use simple physics to warm your home



Heat naturally moves from warmer materials to cooler ones through radiation, convection and conduction. During cold weather, sunlight enters this home and strikes a thermal mass that collects and stores the sun's heat energy. At night—as the home cools—the heat is released from the thermal mass into the home. The next morning, the cycle starts again.

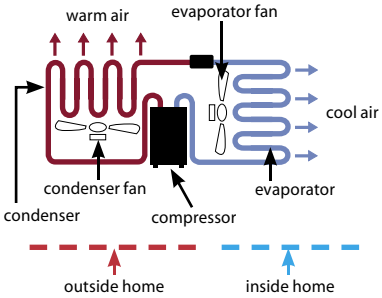
Here's how a passive solar sunspace works



(Top) In this example, the low winter sun heats a sunspace and convection carries the heat from this area to adjoining rooms. *(Bottom)* During the summer, large roof overhangs and window shades inside keep the high sun from entering the house, while natural ventilation helps cool the home and prevents overheating in the sunspace.

Cooling

How an air conditioner works

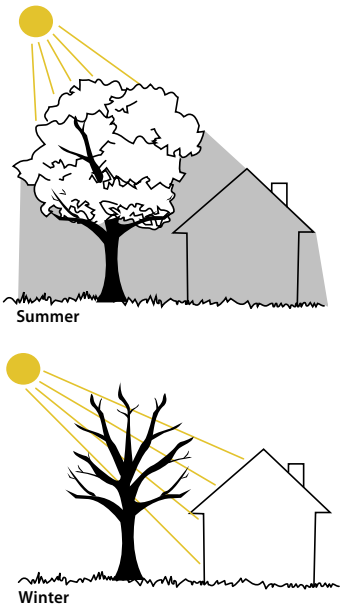


In a conventional central air-conditioning system, the evaporator is located inside the home, while the compressor sits outside.

Did you know?

Let your air conditioner run while you're on vacation—especially during rainy or humid months. Set your thermostat to 85° F., so the system occasionally will run and dehumidify your home. This will help prevent mold and mildew.

Trees are year-round energy savers



Deciduous trees not only provide shade during the summer but also allow the sun's warmth to reach the house throughout the winter.

Make the most of your air-conditioning system

Even though the first home air conditioner appeared during the late 1920s, home cooling didn't become a major consumer of energy until about 30 years ago. Today, it's hard to imagine not being able to escape to the comfort of an air-conditioned home on one of Iowa's hot and humid summer days.

Across the state, most residential cooling is handled by central air conditioners or room (window) air conditioners, although energy-efficient air-source heat pumps, add-on heat pumps and geothermal heat pumps are seeing greatly increased usage. However, no matter what type of system cools your home, there are many things you can do to cut the cost of running your air-conditioning unit while still staying comfortable.

Do you really know how an air conditioner works?

Many people think that a room air conditioner or a central air-conditioning system produces cool air, but technically that's not accurate. Instead, an air conditioner moves the heat from inside your home to the outdoors.

More specifically, a **compressor** pumps **refrigerant** from the **evaporator** inside your home to the **condenser** outside (The evaporator and condenser are made up of coils of copper tubing surrounded by aluminum fins.) As the warm indoor air passes through the evaporator coil, the liquid refrigerant inside evaporates; the resulting hot refrigerant gas is then pumped outdoors through the condenser, where it converts back to a liquid and releases the heat outdoors.

You can have a major impact on reducing cooling costs at home

There are four ways to keep your home cool and comfortable at an affordable cost.

- Reduce the cooling load on your house.
- Explore alternative cooling methods, such as natural ventilation and using fans.
- Buy a new, energy-efficient air conditioner.
- Increase the efficiency of your existing air conditioner.

In the sections that follow, you'll find many proven low-cost, low-tech methods for saving energy (and money) on your cooling needs, in addition to finding out what to consider when upgrading an existing air conditioner and maintaining your cooling equipment.

Reduce the cooling load on your house

The best strategy for keeping your home cool in the summer is to prevent it from getting hot in the first place. This means trying to keep the heat outside from being conducted inside—and reducing the amount of heat generated by things such as your appliances, television, computer, lights, water heater, bathing and cooking.

During Iowa's hot, humid summers, about half of the heat that accumulates in a home comes from solar gain; the other half comes from air leaks and heat-producing activities inside the home. In light of these figures, it makes sense to cut these loads before investing in a new air conditioner. Also, if you can reduce the heat entering your home, you should be able to get by with a smaller air-conditioning unit when you upgrade to new equipment.

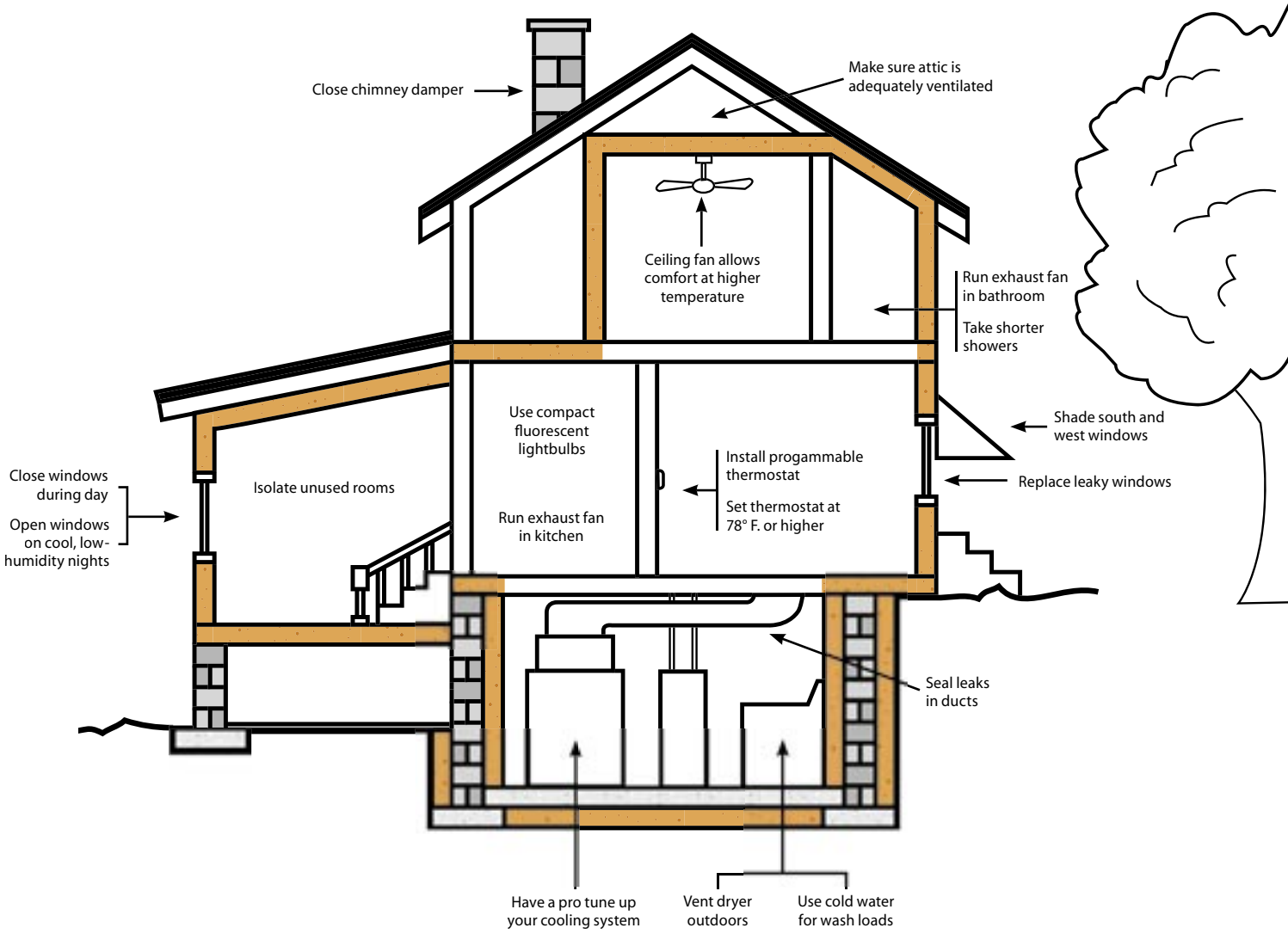
Cut down on hot spots

Most of the heat gain inside a house comes from sunlight (or solar energy) hitting the roof and streaming through the windows. Energy conservation measures that block the sun before it strikes the roof or windows are the most effective ones to implement. Trees and other plants that provide shade are your best long-term investment for reducing cooling costs.

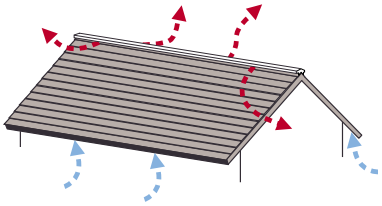
Solar heat gain is greatest in homes with dark roofs, inadequate insulation and poor attic ventilation. You can **reduce heat gain by a third by shading your house** with trees, adding insulation and ventilating the attic.

Air leaks that allow warm air into your home—and cooled air out—also are a costly problem if you have air-conditioning, especially in a humid climate such as Iowa's. For more information on improving your home's energy-saving "envelope," ask your utility or the Iowa Energy Center for the book, *Home Series 1: Home Tightening, Insulation and Ventilation.* (See contact list on page 24.)

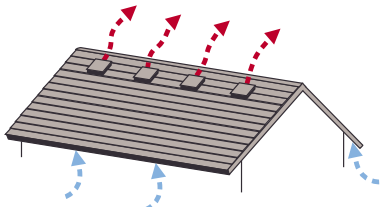
Survey your home to save



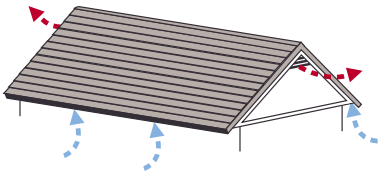
Common attic vent types



Soffit and continuous ridge vents



Soffit and box vents



Soffit and gable-end vents

A combination of high and low roof vents in any of these configurations allows air to circulate naturally and prevent heat buildup in the attic.

Did you know?

Your utility may offer options that can save you money.

- **Special off-peak rates** may be available in late-evening or early-morning hours, offering you the opportunity to pay less for running high-consumption appliances during those periods.
- **Load-management programs** allow your utility to briefly cut power to your central air-conditioning system during peak load periods when the demand for power is high.
- **Budget billing charges** are the same every month so you won't get surprised by an unusually high power bill; your utility will adjust the amount regularly.

Follow these tips to keep your cool

Making a few minor changes in your daily habits—and tackling a few home-improvement projects around the house—can help you reduce your need for air-conditioning and add to energy savings during the dog days of summer. While all of the following suggestions may not be possible or practical for your situation, try incorporating several of them into your summer routine.

Natural Ventilation

Wind creates areas of positive and negative pressure around your house, so the windows near upwind areas will be **cool air inlets** and the windows near suction areas will be **warm air outlets.** Try a few tests to find out which windows to open to maximize natural ventilation.

Don't locate inlets and outlets directly opposite each other, because the only area that will be cooled will be in the direct path of the airflow. If the air has to take a longer path between an inlet and an outlet, more of your house will be cooled. Additionally, a slightly opened window will create a better air current than a fully opened one.

Close windows and doors during the hottest part of the day.	If your house is well-tightened and insulated, your inside rooms should stay relatively cool during mid- to late-afternoon hours.
Open windows on cool, low-humidity nights.	Natural or (fan-boosted) nighttime ventilation flushes out internal and solar heat that builds up during the day.
Use fans to boost a cross breeze.	Blow air from the cool side (the shady side) of your house to the hotter side.
Close windows early in the morning.	If you don't let warm air into your home, you can delay using your air conditioner until later in the day.
Leave windows closed when the humidity is high.	If it's humid and you use your air-conditioning regularly, you're better off not opening your windows on cooler days or at night. Your air conditioner will have to work extra hard to remove excessive humidity from your house before it can begin to cool it.
Make sure your attic is adequately ventilated.	Your roof can absorb a tremendous amount of heat during the summer. If it isn't properly insulated and ventilated, the temperature could reach 150° F., which is like having a gigantic radiator above your living spaces.
A home with a well-ventilated attic will have a solid comfort and energy-efficiency advantage over a home with a poorly ventilated attic.	Effective attic ventilation helps keep attic temperatures below 110° F. during hot weather, reducing the load on your air-conditioning system. If your attic gets too hot, the natural ventilation supplied by soffit vents and attic vents may not be adequate; you may need to add more vents. In addition, seal air leaks between the attic and the living spaces below—and add insulation, if necessary.

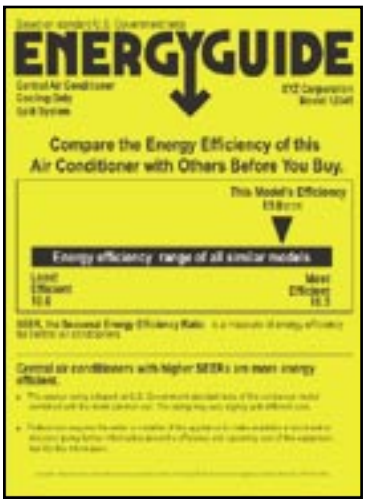
All around your house

The time you spend reducing or eliminating conditions that add heat (and humidity) to your home will be well spent; the smaller the difference between the temperature outside and the temperature inside, the lower your annual cooling bill. Take a tour of your home with the following lists in hand, to discover what you can do to save energy and cut utility costs.

Living areas

Shade south and west windows to keep out the solar heat.	Stopping the sun's warmth before it gets into your home with awnings or exterior solar screens is best. If that's not possible, close inside blinds and curtains during the day; light colors will reflect the most heat. As an alternative, apply tinted plastic sun-control films or reflective coatings to the inside of your windows.
Keep the doors and windows closed during the day.	But on cool, low-humidity nights, open the windows and use natural ventilation (with or without fans) to cool your home.
Keep interior lights dimmed or turned off during daylight hours.	Turning on a table lamp for reading in a darkened room is a better choice than letting the sun stream in through a south or west window. On the other hand, north or east windows could provide enough light without significantly adding to the heat gain in an individual room.
Check your family's lighting use.	Light fixtures generate heat and can add significantly to cooling costs. Turn off lights that really don't need to be on.
In high-use areas, replace incandescent lightbulbs with compact fluorescent units.	Incandescent bulbs are very inefficient, using most of the energy they consume to create heat. A compact fluorescent lightbulb (CFL) produces the same light (and less heat) from 65%-75% less energy than a regular bulb—so a CFL can pay for itself during the life of the bulb.
Turn off or unplug the television and other electronic equipment when not in use.	Many video and audio components consume power and produce heat in the standby mode, so unplug them if you won't be using them for several days. The only way to turn off the power supply for a device such as a cordless phone or cable TV box is to unplug it.
Minimize your computer's power consumption when you're not using it.	Shut down your computer if you're not going to be using it for several hours. If you're just going to be away for a few minutes, turn off the monitor—it still uses considerable power in the "screen-saver" mode—and put the hard drive in your CPU to sleep.
Construct a sunshade over a concrete patio.	A concrete slab will become a large heat sink during summer months, reflecting sunlight and radiating heat into your house. A shading structure will solve both problems, as well as making the outdoor space more usable on hot days.
If you're building a room addition, keep cooling in mind.	Besides adequately insulating and weatherizing the new space, add 24-inch (or wider) overhangs to shade windows on the sunny sides of the new room. Also ask your contractor if your present cooling system can handle the additional load; if not, consider an energy-efficient supplemental system.

Read the label

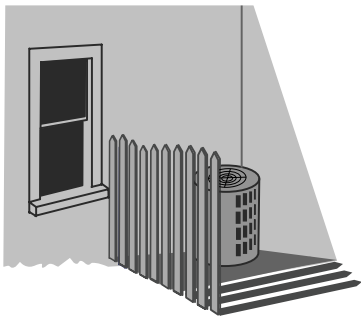


When shopping for an air conditioner, look for the EnergyGuide label that shows the energy efficiency of each model and allows you to compare the energy usage of competing systems.

Did you know?

You should reduce electricity use during summer **peak periods,** when energy demand at your local utility is highest. With so many people using electricity for air-conditioning at the same time, the price of power for this period may increase, because it costs the utility more to generate electricity when consumer demand soars. Although peak hours can vary due to weather conditions and demand, they generally fall from 3 p.m. to 9 p.m. on the hottest summer days.

Shade your compressor



An air-conditioning compressor will run more efficiently if it's shaded by a fence, tree or landscaping during the hottest part of the day. Be sure to allow enough space around the unit for adequate air circulation.

Did you know?

Many of the air leaks in a central air-conditioning system occur in the return air plenum, which is the large duct above or below the air handler. When these leaks occur, warm air is pulled into the system, making the air conditioner work harder. If your air conditioner is unable to satisfactorily cool your home, leaky ducts may be the cause.

Kitchen

Cover pots and pans on the cooktop or stove.	Cooking creates lots of heat and humidity, so contain it as much as possible.
Use an exhaust fan.	Vent steam and heat from cooking to the outdoors.
Run your dishwasher late at night.	Start the dishwasher when you go to bed. If it has a timer, set the dishwasher to run during nonpeak hours in the middle of the night.
Use the most energy-efficient appliances for cooking.	Instead of using your stove or oven, use your microwave oven or a countertop appliance such as a toaster oven, crock-pot, steamer or pressure cooker.
Replace old, inefficient appliances.	Even if an appliance still has a couple of years of serviceable life, replacing it with an efficient, ENERGY STAR qualified unit is a good investment.
Use cold water for cooking.	Heating the water on your stove or cooktop consumes less energy than using hot water from your water heater—especially if doing so causes your water heater to cycle.
Check the temperatures in the refrigerator and freezer.	The temperatures should run 38°-40° F. in the refrigerator and 0°-5° F. in the freezer. Setting colder temperature levels wastes energy and makes these heat-producing appliances run too often.

Bathroom

Use an exhaust fan.	Reduce humidity by running an exhaust fan while you're in the shower. However, don't let it run too long, or it will pull cooled air out of your entire house.
Take shorter baths and showers.	Long baths and steamy showers add a lot of humidity to your home and can increase the time your air conditioner runs to overcome it. Install a water-saving showerhead too.

Laundry

Vent your dryer outdoors.	Check the lint trap, ducting and exterior vent frequently, to make sure they're clear. Excessive lint buildup can make your dryer run longer.
Dry clothes on an outdoor clothesline.	Wet clothes on an indoor clothesline will add humidity to your home and increase the load on your air-conditioning system.
Use cold water for wash loads.	Most clothes and other items will get clean in cold water, if you use the proper detergent. If you need to wash a warm- or hot-water load, run it during the late-evening or early-morning hours.
Only wash full loads.	If you don't have enough clothes for a full load, set the washer's water level to match the load's size.
Insulate the water heater tank.	The less often it cycles, the more energy you'll save.
Build a utility room to enclose the water heater and laundry.	Separating these heat producers from the rest of the house will reduce the load on your air-conditioning system. As a bonus, the rest of your home will be quieter too.

Fans

Fans are one of the oldest and most reliable mechanical means of cooling a home, and they use far less energy than air conditioners. In fact, you conceivably could run several fans and still consume a smaller amount of energy than you would by running a single room air conditioner.

However, fans don't cool rooms the same way air conditioners do; instead, **fans create a cooling effect by moving air across your skin**. So, opening the windows and using one or more fans during very hot and humid weather won't be an effective cooling strategy—especially if you're accustomed to using an air conditioner most of the time. Your cooling costs might go up by a significant amount, because opening the windows will increase the humidity your air-conditioning unit needs to remove, forcing the system to run longer than normal.

Window fans and whole-house fans are the best choices for accomplishing power ventilation in your home. Smaller floor, table and ceiling fans are best used to create a single-room "wind-chill" effect and are much less effective as whole-house ventilators. (During warm-weather months, make sure you run ceiling fans in a counterclockwise direction for maximum cooling.) No matter what type of fan you need, when you go shopping look for a fan that's ENERGY STAR qualified—and be sure to note its noise rating too. Also consider a fan with "airfoil-style" blades that are designed to maximize airflow.

Use window fans to create cross-ventilation on warm, still days.	Open windows on the shady side of your house and position the fans so they blow air out of windows on the hot side of the house. The resulting pressure difference will cause air from the outside to flow through your house. While this option doesn't work well on very hot and humid days, you might be surprised at how well it works the rest of the time.
A ceiling fan will allow you to be comfortable at a higher temperature in occupied rooms and let you raise the thermostat in those areas.	A good ceiling fan should create enough air movement that you will be comfortable at 82° F. and 80% relative humidity. If you're using the fan to supplement or circulate air-conditioning, you should be able to raise the thermostat a full 4° F. above the standard 78° F. setting and still be comfortable. For every degree you raise your air conditioner's thermostat above 78° F., you'll save about 3%-5% on your cooling costs.
Choose the correct ceiling fan for damp or wet areas.	For a bathroom, buy a fan that has been U.L. listed with a *damp* rating. For a location where a fan might come into direct contact with water—such as a porch—select a fan with a *wet* rating.
On a cool, low-humidity night, a whole-house fan can cut the temperature in your home in a relatively short time.	A whole-house fan can reduce your home's indoor temperature by up to 20° F., depending on the temperature outside. This type of fan usually is installed in a hallway ceiling on the top floor of your house. It works by pulling the cool outside air from open windows on the lowest living level of the house into the attic, where warm air is vented to the outside.
A small fan is not adequate for cooling large areas.	An oscillating fan, box fan or table fan are good choices for one-person cooling, circulating the air in a small room or extending the cooling range of a window- or wall-mounted air conditioner.
Remove heat, humidity and odors from the kitchen and bathroom with a properly sized exhaust fan.	Don't leave an exhaust fan on longer—or at a higher speed—than necessary. In one hour, an exhaust fan can blow a house full of cooled air outside. Oven heat and shower humidity usually are removed within 15 minutes; a slightly opened window in the room can speed up this process.

Did you know?

You should size a ceiling fan to the area of the room in which it's located.

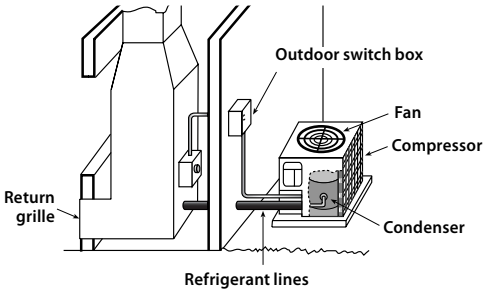
Room Area (sq. ft.)	Fan Diameter (in.)
Up to 75	29-36
75-144	36-42
144-225	44
225-400	50-54

Source: *ENERGY STAR and American Lighting Association*

Did you know?

Ceiling fans are available with a variety of mounts and downrod lengths for different slopes and heights of ceilings. Mount the fan as closely as possible to the middle of the room—at least seven feet above the floor; if the ceiling allows, a height of eight or nine feet is better for optimal airflow. A "hugger" fan, which mounts flush to the ceiling, will not move as much air because its blades will be just a few inches from the ceiling.

Central air conditioner



The most common residential central air conditioner is a split system where the evaporator is located inside, with the blower and other components of the furnace (or heat pump) connecting to ducts that run throughout the home. The outdoor unit includes the compressor and condenser; position it on the north or east side of your home, where it will be shielded from intense sunlight. Leave four to five feet of open air space around the unit to ensure enough air circulation for proper operation.

Did you know?

One way to get around all of the construction necessary for adding ducts in a home built without them is to use a **mini-duct central air-conditioning system.** It uses a conventional air-conditioning compressor or heat pump outdoors and a special high-powered blower in the basement (the preferred location) or the attic. The system uses ducts with a two-inch inside diameter, so it's easy to run them through walls or the corners of closets to rooms above. You can buy heavily insulated ducts to run through an attic or other unfinished space, and ceiling, wall and floor outlets are available.

Central air-conditioning

A central air conditioner is more than just the largest appliance in a home—it's part of a carefully designed system that also incorporates a thermostat and an array of ducts that deliver and circulate cooled air throughout the structure. In most cases, a central air-conditioning system is a more energy-efficient choice for regularly cooling a home than using room air conditioners in three or four different rooms.

However, there's no getting around the fact that a central air conditioner can be fairly expensive to purchase—and that it must be installed by a qualified heating and cooling contractor. If your home doesn't have central air-conditioning—but does have a network of ducts for a forced-air furnace—you likely can use the same ducts for cooling, as long as they're the proper size and free of leaks and obstructions. On the other hand, if your home is heated by a boiler or electric baseboard units, you'll need to add a duct system, which can be both difficult and expensive—especially in a multi-level home, where you might have to sacrifice closet space or build "chases" along walls or in corners to hold the ducts.

You may want to upgrade if your system is 10 to 15 years old

If your home already has central air-conditioning, there are a couple of times to consider upgrading to a new system. First, start shopping if you will need to spend almost as much (or more) to repair your present unit as you would to replace it. Second, if your system is 10 years old or older, it's probably pretty inefficient, and you should consider replacing it with a newer one. (Some of the best models being sold today are **twice as efficient** as ones that were available 10 years ago.) Depending on the use, cost of electricity and temperature, the utility bill savings gained can pay back the cost of a new cooling system within a few years.

This may be the right time to upgrade your heating system too. Since both systems share components, it doesn't make sense to add a super-efficient air conditioner to an aging forced-air furnace—and you'll likely save money by updating both systems at the same time, as opposed to changing one now and the other in a couple of years.

When you go shopping, first consider the type of unit you need

If you're adding an air conditioner to an existing furnace—or just upgrading your existing central air-conditioning unit—you have two choices: a **conventional split system** (with the compressor unit outside and the evaporator inside) or an **add-on, air-source heat pump** that can cool your home in the summer and help with the heating load in the winter. If you're upgrading your entire heating and cooling system (or building a new home), you have other possibilities; in addition to a conventional split system, look at an **air-source heat pump** or a **geothermal heat pump.** (Heat pumps operate like conventional air conditioners, except they also run in reverse to provide heat during cold weather.) For more information on heat pumps, see page 7 in the Heating section of this book, contact your local utility or visit the Iowa Heat Pump Association Web site at http://www.iaheatpump.org.

No matter which type of cooling unit you choose, be sure to fully explore all of the **energy-saving options** available, including two-stage compressors that run in a special energy-saving mode on mild or less-humid days, new compressor designs with fewer moving parts than used in the past and environmentally friendly refrigerants.

Bigger isn't necessarily better

According to the U.S. Department of Energy, national surveys have indicated that more than half of all heating and cooling contractors don't properly size heating and cooling systems. For air-conditioning systems, **oversizing** is a real problem; not only do oversized units consume more energy, they also remove less moisture from your home and have a shorter service life.

The size of central air conditioners is measured in **Btu/hour** (British thermal units per hour). A reputable contractor will need to do a lot of investigating and calculating on a worksheet or computer to come up with the correct rating for your cooling system, considering things such as the size, style, orientation and shading of your home; insulation levels; window types, locations and sizes; air infiltration; location and condition of ducts; lighting and appliances in use; weather; your family's lifestyle; and your comfort preferences.

The **written bid** you receive should detail the sizing calculations in writing. Don't accept an estimate that is based only on the size of the existing unit, the square footage of your house or any other "rule of thumb."

What's SEER?

Buying an inefficient central air conditioner will guarantee high electric bills during the device's lifetime, so buy the most energy-efficient unit your budget allows. A central air conditioner's Seasonal Energy Efficiency Rating—**SEER**—measures the seasonal performance of the unit based on the cooling accomplished.

During the past few years, new technologies have caused the SEER ratings on the most efficient central air conditioners to skyrocket to around 20. (The minimum SEER required by the Department of Energy for central air conditioners and heat pumps built on or after Jan. 23, 2006, is 13, which was ENERGY STAR's current standard.) Both are a long way from a 1970's-vintage central air conditioner with a SEER of 6; by replacing that unit today with one that has a SEER of 18, you should cut your air-conditioning costs by as much as two-thirds.

Regular maintenance equals lower costs

A spring tune-up of your air-conditioning system will keep it working at top efficiency. Call a qualified heating and cooling specialist to handle these items.

- Check the refrigerant charge and repair leaks. A system that is undercharged by 10 percent may drop 20 percent in efficiency. By the same token, an overcharged system can cause the refrigerant to flood and damage the air-conditioning unit.
- Oil the bearings on the fan and compressor, if they're not sealed.
- Test the compressor and blower controls.
- Clean the condenser and fan.
- Check all electrical connections for corrosion.
- Clean the evaporator and blower, and flush the drain line.
- Readjust the duct dampers.
- Check the temperature rise of the outside unit while it's running, and check the temperature drop through the indoor coil.
- Test overall operation of the unit (including thermostat).

You may be able to handle the following maintenance items. Read the instructions that came with your system, and be sure to turn off power to the unit before you start.

- Check filters monthly and clean or replace them as needed.
- Once a year, clean the evaporator coil with a biodegradable cleaner and a soft brush if it's easily accessible; if not, leave the job for a trained technician.
- Clean the condensate pan, too, and make sure the drain hose isn't plugged.
- When dirt has built up, clean the condenser coils. Use a biodegradable cleaner and a soft brush to gently clean the coils and flush them with clean water. Clean the blower's fan blades too. Don't just blast the parts with a hose!
- Straighten the fins in evaporator and condenser coils with a "fin comb" from an air-conditioning parts supplier.
- Remove debris around condensing unit and trim bushes and grass to maintain airflow.

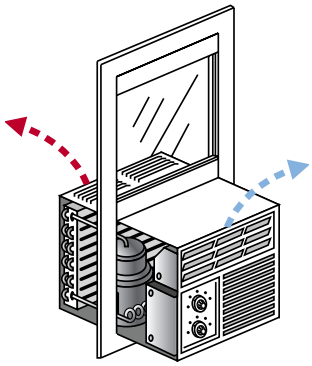
Did you know?

A central air-conditioning system or heat pump can heat water with the addition of a **desuperheater**—a heat recovery unit that captures waste heat from a central air conditioner, heat pump or geothermal heat pump and uses it to heat the water in a water heater. Since the desuperheater only works when the system's compressor is running—and the equipment is relatively expensive—the payback period for a home in Iowa's climate will be pretty slow. Ask a heating and cooling contractor for a detailed analysis on whether a desuperheater makes sense for your home.

CAUTION!

Always turn off the power to your central air-conditioning unit at the shutoff located next to the compressor outside your home or the circuit-breaker panel (or fuse box) before performing any cleaning or maintenance tasks.

Room (window) air conditioner



A room air conditioner functions in the same way as a central air-conditioning system, but on a much smaller scale.

CAUTION!

Don't remove the third prong on the plug for a room air conditioner to make the plug fit into an older two-slot wall outlet. The third prong is a safety device that protects you from a shock in the event of a malfunction in the unit. Instead, call an electrician to install a properly grounded outlet for the exclusive use of the air conditioner. In addition, never use an extension cord with an air conditioner; plug the unit's cord directly into the closest outlet.

Made in the shade

For peak operating efficiency, locate room air conditioners on the north side of your home or in a shaded area—and, if possible, in the middle of each room for better air distribution.

Room air conditioners

Room air conditioners—sometimes called window units—mount in a hole cut into an exterior wall or in a window frame. (Portable units that roll from room to room and vent through a window also are available.) Room air-conditioning units are designed to cool one room at a time, and you would need multiple units to cool an entire house. However, room air conditioners are a good choice if you only need to cool one or two rooms, live in an apartment or own a very small, well-insulated home. One or more energy-efficient room units can be less costly to run than an older, full-sized central air-conditioning system; on the other hand, a couple of older room units can be more expensive to operate than a new central unit.

Energy-efficient room air conditioners are moderately inexpensive and fairly easy to install in a wall using basic carpentry skills—although some models weigh around 100 pounds, so installation could be a two-person job. The opening around the unit, whether it's mounted in a wall or window, must be sealed to prevent air leaks. And if you don't remove the unit every fall for winter storage, cover it with a fitted, insulated blanket made specifically for that purpose to keep cold air from infiltrating your home.

When shopping for a new unit, consider size and efficiency

A room air conditioner that's sized correctly will handle both the heat and humidity in a room. Some people buy an oversized unit, assuming that it will do a better job of cooling. But remember that an air conditioner must remove heat and humidity from the air, and it's designed to do both during a normal cycle. A unit that's too large may cool a room quickly, but the resulting short cycle won't allow it to reduce the humidity to an acceptable level.

The cooling capacity (size) of a room air conditioner is measured in **Btu/hour** (British thermal units per hour) and is dependent on the square footage of the room you want to cool. After figuring the square footage of the room, use the chart *(right)* to determine what size air conditioner best fits your needs. If the room is on the sunny side of your house, increase the air conditioner's capacity by 10 percent; if the room is shaded, subtract 10 percent. For a kitchen-mounted unit, boost the capacity by 4,000 Btu/hour. And if more than two people usually occupy the room, add 600 Btu/hour for every additional person.

Room Area (sq. ft.)	Capacity (Btu/hour)
100-150	5,000
150-250	6,000
250-350	7,000
350-400	9,000
400-450	10,000
450-550	12,000
550-700	14,000
700-1,000	18,000

Source: *ENERGY STAR*

At the store, check the yellow EnergyGuide label on each air conditioner for its **EER**—Energy Efficiency Ratio—the unit's cooling output (Btu/hour) divided by its power consumption. Average units have an EER around 10, but buy a unit with an EER of 11 or higher for maximum efficiency; you'll more than make up the higher cost of the more efficient unit through future energy savings.

What about maintenance?

After unplugging the air conditioner, check its owner's manual for tips on cleaning or replacing the inside air filter. (Usually you have to remove an access panel to reach it.) Then gently clean the aluminum fins on the evaporator coils behind the filter with a soft brush, working in the same direction the fins run. Finally, use a biodegradable disinfectant solution to flush the drain pan in the bottom of the unit that collects condensation from the evaporator coils and directs it outside. This is a good time to make sure the pan is draining completely too.

You also can remove the outside cover of the air conditioner and use a soft brush and disinfectant solution to carefully clean the condenser coils and aluminum fins. If the dirt doesn't come off easily, don't scrub too hard or you may damage the fins.

Call a professional service technician for all other maintenance work.

Landscaping for comfort

Besides making your homestead a greener and more beautiful place to live, trees and landscaping are the most effective long-term measures for reducing your home's energy consumption for heating and cooling. For example, **deciduous trees**—which are bare in the winter and leafy during the summer—allow winter sunshine to come through their branches when it's cold and warm your home, and screen out the summer sun when the branches are filled with leaves. Choose deciduous trees that don't have a heavy branch structure (which could block the sun), and plant them on the east, south and west sides of your home for the maximum shading effect. On the north and west sides of your home, use **evergreens** as a windbreak to reduce the chilling effect of winter winds. And add **low bushes or hedges** to direct summer breezes toward your home.

Mature trees and shrubs "protecting" your home can have a dramatic effect on utility bills, according to the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy. For example, an energy-saving landscaping design can **cut heating bills by about one-third** during cold-weather months. The potential savings during warm-weather months are equally dramatic: A well-planned landscape can **reduce an unshaded home's summer air-conditioning costs by 15 to 50 percent,** depending on how tight the structure is and how well it's insulated.

Keep these things in mind as you plan your energy-saving landscape design:

- Talk with local tree and landscaping experts or state extension staff for help in choosing the right trees for your home size and soil type.
- Plant trees so there will be enough space between the trees at maturity and the house (for both branches and root systems). Consider the proximity to neighbors' homes too.
- A windbreak can reduce wind speed for as far as 30 times the height of the windbreak. However, for maximum effect, plant your windbreak a distance from your home that's two to five times the mature height of the trees you're using.
- For the most effective type of winter windbreak that slows both wind and snow drifting, plant shrubs, build a fence or create an earth berm on the windward side—near the bases—of tall evergreens.
- Ultimately, trees should shade your roof, as well as the sides of your home during late spring, summer and early fall. Dark-colored home exteriors absorb up to 90 percent of the sun's radiant energy; some of this heat gain is conducted to the interior of your home, no matter how well it's insulated.
- The more shade you have, the more effectively you can use natural ventilation. Shade makes the air around the house cooler, and it prevents solar heat from being conducted indoors.
- Temperatures directly under trees can be up to 25° F. cooler than air temperatures around nearby blacktop, due to shading and evaporative cooling.
- Use light-colored mulch or ground cover to reflect heat away from your house.
- Trees are a good investment. Studies by real estate agents and professional foresters estimate that trees raise a home's resale value seven to 20 percent. In addition, your home's roof and siding materials will last longer due to reduced exposure to the sun's ultraviolet rays.

Did you know?

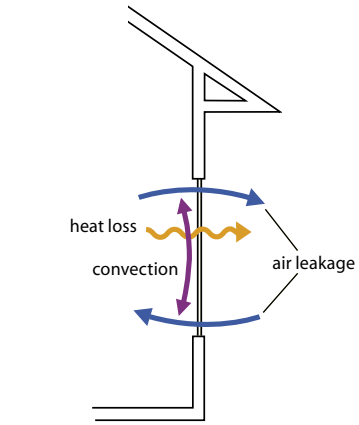
The National Arbor Day Foundation's Web site at http://www.arborday.org is a good resource for information on choosing the right trees for your energy-saving landscape. You can search by tree category, soil type, sun exposure and hardiness zone — most of Iowa is in Zone 5—and even order trees.

Create an energy-saving landscape

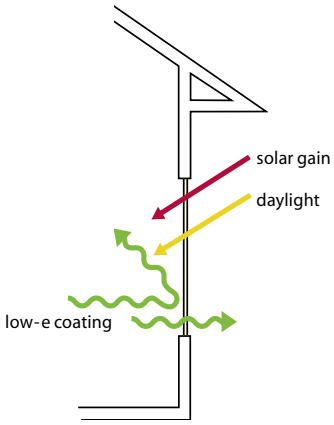
A carefully developed landscape can reduce your annual heating and cooling bills by a substantial amount.

Windows

A window is a complex system



Heat effects



Radiation effects

Besides style and frame materials, there are many other factors to evaluate when buying windows for your home. *(Top)* Heat effects include *U-factor* (heat loss), *convection* (glazing and low-conductivity gas between panes) and *air leakage* (infiltration). *(Bottom)* Radiation effects consist of *solar heat gain coefficient* (amount of sun's radiation transmitted through window), *visible transmittance* (level of daylight coming through window) and emissivity (low-e coating on glass to reflect heat back into the heated space and reduce heat loss). Some manufacturers also include a rating for *condensation*, on a scale from 1 to 100; the higher the number, the better a window resists condensation.

You may not think of your windows as being an integral part of your home's heating system, but consider this: According to the U.S. Department of Energy, **windows account for 10 to 25 percent of your heating bill**. As a result, it's important to make the most of their virtues—light, view, solar gain and comfort—and reduce their vices—heat loss at night, air leaks and that chilly feeling when you're standing nearby.

Open window coverings on south-facing windows to take advantage of solar heat gain.	Letting the sun shine into your home—even through just a couple of south-facing windows—can provide enough heat to reduce the load on your heating system. As soon as the sun stops shining into your home, cover the windows to minimize heat loss.
Cover east-, north- and west-facing windows whenever possible.	Heavy curtains or insulated shades are best for reducing chills when it's dark. Also keep windows covered during the day—unless you need the natural light—since there will be little solar heat gain.
Keep the doors and windows closed as much as possible.	Besides diluting the heated air in your home, a wintry blast reaching your thermostat can fool it into thinking the whole house is too cool and signal your heating system to start unnecessarily.
Repair and install storm windows.	Storm windows can reduce heat loss by 25%-50%. Make sure the glass isn't cracked and that the gaskets are in good shape.
Wash south-facing windows.	Dirt and grime on windows can reflect part of the solar heat gain you'd otherwise get from these windows.
Trim trees and bushes in front of windows.	Deciduous trees and shrubs will drop their leaves to let in sunshine. Cut back other types that block the low winter sun.

Of course, **solar heat gain through windows during the summer will increase your home's air-conditioning load** and raise cooling costs. See pages 13 and 19 for tips on reducing the effects of the sun's warmth on your house during the warm-weather months.

Replace leaky old windows with energy-saving units

If you're remodeling or building a new home, buy the most energy-efficient windows you can afford; your being able to use a smaller-capacity heating and cooling system should offset their higher initial installation cost. Shop for windows that include **double or triple glazing,** a **low-conductivity gas such as argon between the panes** and a **low-e (emissivity) coating** on the glass. Also look for high-quality wood, clad or insulated vinyl window frames.

The National Fenestration Rating Council rates windows in these performance categories, although not all window manufacturers display them on the window packaging.

- **U-factor** is the rate of heat loss through a window. Lower is better, so look for double- or triple-glazed windows with a U-value of 0.35 or below.
- **Solar heat gain coefficient** (SHGC) is the amount of solar radiation transmitted through a window. To maximize the benefit of warmth from the sun, choose the highest SHGC possible (about 0.30-0.60) for the appropriate U-factor.
- **Visible transmittance** indicates the amount of visible light transmitted through a window. To maximize daylight, look for windows with the highest visible transmittance rating.
- **Air leakage** measures the heat loss (and gain) that occurs by air infiltration through a window. The lower the number, the less air will go through a window assembly; look for a rating of .030 or less.

Check the Web sites of the National Fenestration Rating Council (http://www.nfrc.org/) and the Efficient Windows Collaborative (http://www.efficientwindows.org/) for details.

Thermostats

A thermostat is a simple device—it's just a temperature-controlled on/off switch for your heating and cooling system. However, a thermostat can have a major impact on your annual heating and cooling costs; during cold weather set it as low as possible, and during warm weather set it as high as possible—without sacrificing comfort. According to the U.S. Department of Energy, setting back your thermostat by 10 to 15 percent for eight hours a day can **reduce your annual heating and cooling bill by as much as ten percent.**

This energy saver can pay for itself in less than a year

A **programmable thermostat**—a thermostat combined with a clock—can handle daily system temperature changes for you automatically, all year long. Once you set a programmable thermostat, you can forget it—unless you want to change the program. In fact, some programmable thermostats come preprogrammed from the factory, so you can use the standard program or easily modify it to meet your family's needs.

For example, during warm-weather months, the thermostat program will cycle the cooling system so your home is a comfortable 78° when you get up in the morning—and then allow the temperature to go to 85° during the day while you're at work. Later, when you arrive home from work, the system will have cooled your home back to 78° again. After you go to bed, the thermostat can raise the temperature a few degrees to save even more energy before repeating the cycle the next day.

Look for these features

The least-expensive (under $40) ENERGY STAR qualified programmable thermostats are pretty basic and offer a single program with four settings—*wake, leave (day), return (night)* and *sleep*—for weekdays and a second program with four settings for the weekend. Some also include a few other features such as battery backup for the program, a monitor that indicates when to change the furnace filter and a temporary program override to use, for example, if you stay home from work.

However, if your budget allows, spend $50-$100 (or more) for a **smart programmable thermostat**. A "7-day" smart thermostat, for instance, will let you set a separate program for each day of the week. Some upscale thermostats offer six programs per day, automatic switching between heating and cooling modes and one-button *hold temperature* and *vacation* settings. In addition, several thermostats include a separate program for the blower fan, as well as offering control of a whole-house humidifier (for winter), a variable-speed fan blower (for humidity control during summer) or a fresh-air ventilator (year-round). You even can remove most programmable thermostats from the wall to program them—and a couple come with remote controls, so you can change thermostat settings from anywhere in your home.

Finally, look for a thermostat with an *advanced recovery* or *ramping* feature that helps your heating and cooling system deliver the correct temperature at the right time, in the most economical way possible. This feature monitors indoor and outdoor temperatures and humidity and gradually brings your home to the requested temperature (usually over a period of hours), so the system doesn't have to deal with a large temperature shift all at once.

Mount your thermostat away from windows or doors; sunlight streaming through a window or a chilly breeze from an open door can trick your thermostat into thinking your heating or cooling system should cycle. Many thermostats—from the simplest, most inexpensive ones to the fanciest, programmable units—are designed for do-it-yourself installation. Just turn off the power to your heating and cooling system, remove the old thermostat and attach the existing system wires to the correct terminals on the new thermostat. However, if the wires aren't color-coded or the new thermostat requires additional wires, call a professional installer for help.

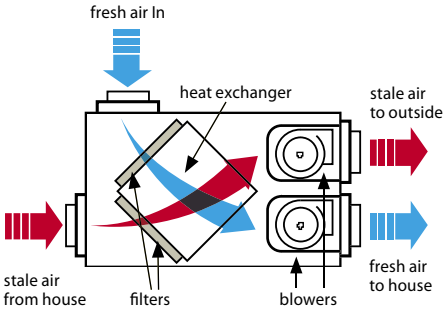
Typical programmable thermostat settings for winter

	Wake 70°	Leave 60°	Return 70°	Sleep 62°
Mon	6:00a	7:30a	5:30p	10:00p
Tue	6:00a	7:30a	5:30p	10:00p
Wed	6:00a	7:30a	5:30p	10:00p
Thu	6:00a	7:30a	5:30p	10:00p
Fri	6:00a	7:30a	5:30p	11:00p
Sat	8:00a	9:00a	6:00p	11:00p
Sun	8:00a	9:30a	1:30p	10:00p

In this example showing heating settings, the system will warm the house to 70° by the time the family wakes up during weekdays, but wait until 8:00 a.m. on weekends because the family sleeps later. After everyone leaves for work or school Monday through Friday, the thermostat will let the house cool to 60°—and raise the temperature back to 70° again for everyone's arrival around 5:30 p.m. On Saturday and Sunday, the program varies according to the family's schedule.

Heat recovery ventilators

Out with the bad air, in with the good



Although there are several different styles of HRV, they're all designed to do the same thing: exhaust stale air from—and bring fresh air into—a home. When shopping for an HRV, be sure to consider the controls that come with each unit. Certain HRVs include automatic controls with humidity sensors, while others include only manual fan speed and/or timer switches. Some HRVs also include a defrost cycle or vent to prevent buildup of ice during very cold weather.

One of the problems with new homes that are constructed very tightly—or existing ones that are remodeled to significantly reduce air leaks—is that the air inside can get pretty stale. Besides stuffy air, **some of the signs of inadequate ventilation** in a home include mold and mildew growth on walls, excessive condensation on windows and other cold surfaces (during the heating season) and high humidity (any time of year); for your family, the symptoms include headaches, dizziness, fatigue and respiratory problems.

There are many sources of indoor pollution, including things such as fuel-burning heating systems and appliances, gasses released by adhesives used in building materials, vapors from home-cleaning products and radon. Eliminating these pollution sources from your home is only part of the answer; you also need to bring fresh outdoor air into your home.

Of course, you can open a couple of windows to help reduce the pollution, but obviously that defeats the energy-saving purpose of creating a tight home in the first place. A better idea is to install an air-to-air **heat recovery ventilator** (HRV) to remove pollutants and bring fresh air into your home, without wasting your energy dollars. An HRV is designed to exchange contaminated air from your home with fresh air from outside—without wasting the energy dollars you've spent to heat or cool your home.

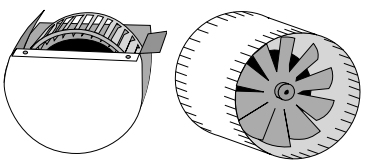
During the winter, stale, heated air from your home runs through a heat exchanger in the HRV that captures up to 80 percent of the air's heat energy, before exhausting the contaminated air outdoors. At the same time, fresh outdoor air passing through the heat exchanger is warmed before it's released inside the home, either through existing heating system ducts or a separate system of ducts connected only to the heat exchanger. *During the summer*, stale, cooled air runs through the heat exchanger, cooling the fresh, hot outdoor air before it reaches the distribution ducts.

A similar system, called an **energy recovery ventilator** (ERV), adds an important function to the ventilation process: It also transfers humidity. During cold months, the ERV sends humidity from the exhaust air to the incoming fresh air, helping to raise the home's humidity to a comfortable level—unless there's already enough humidity in the home, at which point the ERV vents the excess humidity outdoors. During warm months, the ERV can exhaust humid air outside, assisting the central air-conditioning unit.

Note that the need for humidity control is different in every house on every day of the year. Ask your heating and cooling contractor for recommendations on using an HRV or ERV.

Ducts

Turbocharge your ducts



If a room at the end of a long duct run always seems to be cooler than other rooms—and you've already fixed duct leaks, insulated the ducts and rebalanced the whole duct system—an electric **booster fan** that mounts to the problem duct may help.

According to the U.S. Department of Energy, a typical duct system can waste 25 percent to 40 percent of the energy put out by a forced-air heating and cooling system or a heat pump. That can add up to hundreds of dollars per year on your heating and cooling bills!

As a result, it's very important to hire a **professional to pressure test and inspect the network of ducts** in your home to ensure that all the heated or cooled air is reaching the appropriate rooms. The technician should look for loose joints, holes or leaks and fix those problems using metal-backed tape (not cloth-backed duct tape), mastic or an aerosol-based sealing material. In addition, **insulate the ducts with** a material rated R-6 or higher—especially if they run through an unheated basement or crawl space. Remember that doing so will make those areas colder, so insulate the walls in the basement or crawl space too.

Another common problem with ducted systems is **uneven temperatures** in rooms throughout a home. This situation may be caused by leaks, but it also may be due to the duct system's original design. If each branch of the duct network doesn't include simple metal dampers in the ducts, have them installed; then you'll be able to adjust the amount of conditioned air that goes to each room and balance the temperatures throughout your home. If installing dampers is not a practical solution—for example, if the supply ducts are hidden above a finished basement ceiling—add adjustable registers in each room.

Hiring a contractor

1. **Be prepared.** Find out about license and insurance requirements for contractors in your area. Before you call a contractor, know the model of your current heating and cooling system, as well as its maintenance history.
2. **Consider a certified professional.** Look for a contractor who employs technicians certified by NATE (North American Technician Excellence), the leading industry-supported testing and certification program.
3. **Call references.** Ask each contractor for customer references, and call them. Ask about the contractor's installation or service performance—and if the job was completed on time and within budget.
4. **Find special offers.** A heating and cooling system is one of the largest purchases you'll make as a homeowner. Keep your costs down by checking around for available rebates on energy-efficient, ENERGY STAR qualified heating and cooling equipment. Begin your search at www.energystar.gov, and ask the contractors and your utility company too.
5. **Look for ENERGY STAR qualified products.** They meet strict energy-efficiency guidelines set by the U.S. Environmental Protection Agency and offer significant long-term energy savings. Contractors should be able to show you calculations of savings for ENERGY STAR heating and cooling equipment.
6. **Expect a home evaluation.** The contractor should spend significant time inspecting your current system and home to assess your needs. A bigger system isn't always better; a contractor should size the heating and cooling system based on criteria such as the square footage of your house, level of insulation and total window area. A good contractor also will inspect your duct system (if applicable) for air leaks and insulation, as well as measure airflow to make sure it meets manufacturers' specifications.
7. **Get written, itemized estimates.** When comparing bids, be sure to consider warranties and equipment disposal.
8. **Get it in ink.** Sign a written proposal with a contractor before work gets started. The document should specify project cost, model numbers, schedule and warranty.
9. **Pass it on.** Tell friends and family about ENERGY STAR and a good contractor.
10. **Get the ENERGY STAR Guide.** For information on keeping your home comfortable year-round, download the *ENERGY STAR Guide to Energy Efficient Cooling and Heating* at http://www.energystar.gov or call 888-782-7937 to order a copy.

Did you know?

Energy specialists offer many different services, so make sure you ask the right questions and provide enough information to find one that specializes in the type of work you need.

- A **home energy rater**, for example, is a specialized contractor who performs a standardized evaluation of the energy efficiency of a home. The evaluation should include an on-site inspection, air leakage test of your home and ductwork, computer analysis of estimated savings and home energy rating.
- An **energy auditor**, on the other hand, completes an evaluation of the efficiency of a home that may or may not be as comprehensive as a home energy rating.
- A **heating and cooling contractor** sells, services and installs furnaces, boilers, central air conditioners, heat pumps, ducts and programmable thermostats. Some heating and cooling contractors also provide specialized services such as airflow balancing, duct sealing and energy or comfort audits.

Source: *ENERGY STAR*

Disposing of old equipment

In the past, old furnaces and air conditioners often were dumped in landfills or even ditches. Very few were recycled, and the **hazardous materials** in them contaminated the soil and ground water. Today, the state of Iowa requires that a demanufacturer remove the hazardous components from a discarded appliance, before disposing of it in an environmentally sound manner and recycling the remaining metals. There are many locations across the state that gather discarded appliances for processing by a demanufacturer; to locate a collection site near you, contact your local solid waste agency.

A similar scenario applies to throwing away old-style thermostats that contain **mercury** switches. When you replace yours with a programmable thermostat, don't just dump the old one in the trash. Instead, call your local solid waste agency for proper disposal instructions.

FOR MORE INFORMATION

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Web site: http://www.ase.org/

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Madison, WI 53707-1007
Phone: 800-255-4268
Web site: http://www.alliantenergy.com/

American Council for an Energy-Efficient Economy
1001 Connecticut Avenue, NW, Suite 801
Washington, DC 20036
Phone: 202-429-8873
Fax: 202-429-2248
Web site: http://www.aceee.org/

Aquila, Inc.
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Web site: http://www.aquila.com

Atmos Energy Corporation
24 South 10th Street
Keokuk, IA 52632
Phone: 888-824-3434
Web site: http://www.atmosenergy.com/

Energy Efficient Rehab Advisor
Web site: http://rehabadvisor.pathnet.org/

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Web site: http://www.energystar.gov/

Home Energy Saver
Environmental Energy Technologies Division
at the Lawrence Berkeley National Laboratory
Web site: http://hes.lbl.gov/

IowaENERGY.org
Web site: http://www.iowaenergy.org/

Iowa Association of Electric Cooperatives
8525 Douglas, Suite 48
Des Moines, IA 50322-2992
Phone: 515-276-5350
Fax: 515-276-7946
Web site: http://www.iowarec.org/

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735 NE 70th Avenue
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Fax: 515-289-2499
Web site: http://www.iamu.org/

Iowa Department of Human Rights/ Division of Community Action Agencies
Lucas State Office Building
Des Moines, IA 50319
Phone: 515-281-0859
Fax: 515-242-6119
Web site: http://www.state.ia.us/government/dhr/caa/

Iowa Department of Natural Resources
502 E. 9th Street
Des Moines, IA 50319-0034
Phone: 515-281-5918
Web site: http://www.iowadnr.com/

Iowa Renewable Energy Association
P.O. Box 3405
Iowa City, IA 52244-3405
Phone: 563-432-6551
Web site: http://www.irenew.org/

Iowa State University Extension
Answer Line Phone: 800-262-3804
Web site: http://www.extension.iastate.edu/answerline/
or http://www.extension.iastate.edu/housing/

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Web site: http://www.midamericanenergy.com/

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IOWA ENERGY CENTER

This is an Iowa Energy Center publication.

The Iowa Energy Center is a research, demonstration and education organization dedicated to improving Iowa's energy efficiency and use of renewable energy. The Energy Center meets its goals by developing in-house energy research and education programs and by sponsoring energy projects developed by other groups. The projects supported by the Energy Center, which vary in size and complexity, are conducted throughout the state in Iowa's universities, colleges, community colleges and private nonprofit organizations.

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