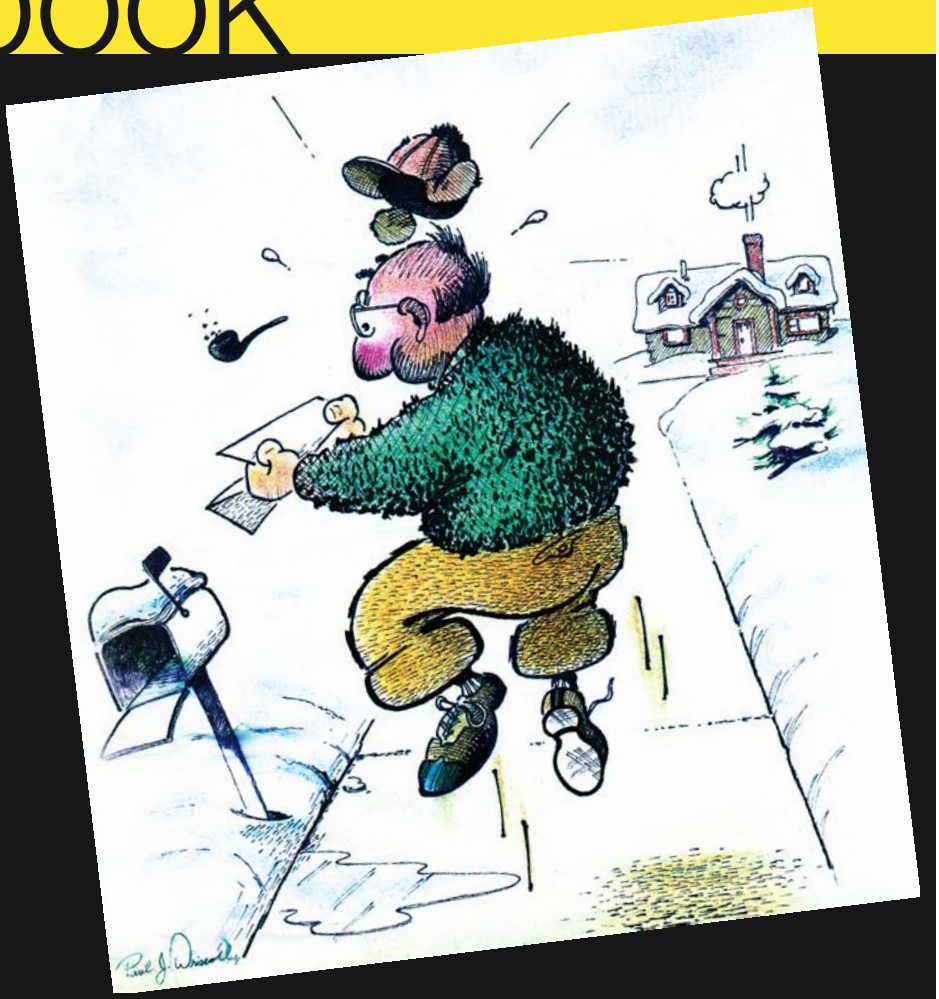
Montana Department of Environmental Quality

Montana Energy Savers Guidebook



Practical Ways to Save Money and Improve Comfort

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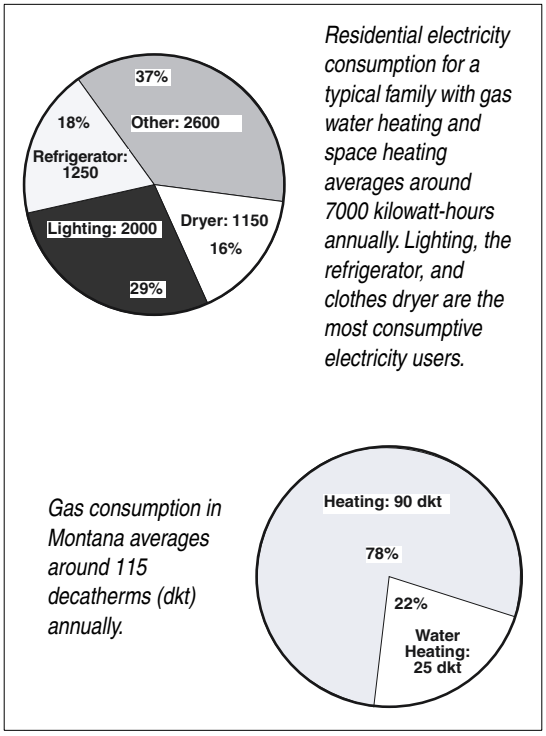
Montana Energy Saver's Guidebook

We Montanans have a choice of spending money today to improve our home's energy efficiency or paying more in the future for the energy we waste. This choice will become even more important in the coming years as energy costs inevitably rise.

We at the Department of Environmental Quality (DEQ) created this booklet to help homeowners save money and energy *right now*. We hope to help you select only the energy-saving measures that will save you energy and money quickly and reliably. This booklet includes a number of recommendations, which are enclosed in shaded boxes. Selected recommendations are summarized on the inside of the back cover for the purpose of helping you begin planning your energy improvements.

Electrical and gas usage



Energy-efficiency improvements can reduce your Montana tax bill as well as your monthly energy bills. Montana homeowners are eligible for a tax credit for a portion of the costs of their energy investments. Beginning January 1, 2002, you may take 25 percent of the costs of energy improvements as a tax credit, up to a maximum of $500.

Recommendation:

For more information on the tax credit, go to the DEQ web site at: http://www.EnergizeMontana.com and click on Home, or call the Montana Department of Revenue at 406-444-6900.

1. Know where your energy dollar goes

Before discussing any specific energy-saving ideas, it's useful to know how your home uses energy. The reason is that energy equates directly to dollars. We pay a certain amount of money for every unit of energy used.

Your energy bill contains two types of usage: baseload and heating. Baseload usage consists of year-round energy uses including water heating, refrigeration, and lighting. Your monthly baseload energy cost is approximately equal to your June energy usage, when your heating system is not operating. If you multiply your June gas and electric usage by 12 (months per year) and subtract that figure from your annual electric and gas usage, you arrive at heating energy consumption.

Heating energy consumption typically occurs in the fall, winter and spring months. Natural gas is usually the most economical heating fuel and is used by approximately 60 percent of Montana homeowners. Propane, electricity, oil, and wood are other types of heating fuels. Heating-fuel costs vary widely by region and market availability. Contact your utility or supplier for current and future projected costs.

Recommendation:

Focus first on heating, water heating, appliances, and lighting for maximum energy savings.

Electricity is measured in kilowatt-hours, abbreviated kWh. One kilowatt-hour is the amount of electricity consumed by a 100 watt bulb burning for 10 hours. Natural gas is measured in therms or decatherms (dkt). A decatherm is 10 therms and represents about one thousand cubic feet of gas volume.

You can compare your home's energy consumption with other homes of similar age and climate on the internet, by visiting the Environmental Protection Agency's (EPA's) web site at http://www.epa.gov/hhiptool/. The U.S. Department of Energy and the EPA have a partnership called Energy Star®, which gives its approval only to the most energy-efficient products. Look for the Energy Star® label whenever you're shopping.

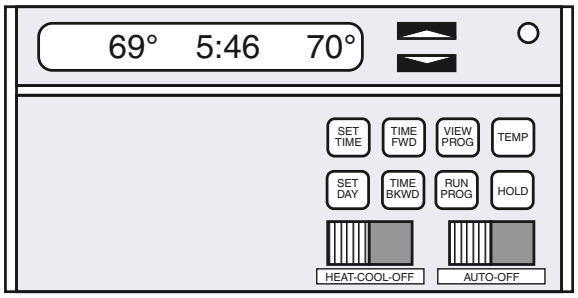
2. Practice thermostat setback

Your thermostat is simply an automatic on-off switch for your furnace. You set your thermostat at a comfortable temperature. When your home's temperature dips a degree or two below that setting, the thermostat turns the furnace on. After the temperature rises to the desired level, the thermostat turns the furnace off. The lower the temperature setting on the thermostat, the less energy the furnace consumes to heat the household.

Some homeowners are consistant at setting temperatures back at night and when they're gone, but many aren't. Some homeowners even believe that setting the thermostats back doesn't save any energy. This belief is a myth. Programmable thermostats, which automatically set temperature settings back while residents sleep or are away from home, are one of the most reliable energy-savers available. Automatic thermostats provide savings of 10 to 20 percent on heating costs, when used as directed.

However, it takes commitment from the homeowner to operate the programmable thermostat properly. If you have trouble programming electronic devices, maybe a programmable thermostat isn't a good idea for you. Instead, adopt the habit of setting the thermostat back each night before going to bed and again in the morning before leaving the house.

Programmable thermostats



Programmable thermostats often display room temperature, time, and temperature setpoint. The hold button holds a particular temperature, over-riding the program. Buttons using the words "set" or "view" display values where you enter the temperatures you desire at times you specify.

Programmable thermostats are convenient and effective for for families who have regular schedules. Most programmable thermostats have the capacity to set back the temperature twice daily and also to allow different schedules for weekdays and weekends. Families who are gone dur-

ing the day at work or at school will save the most because they can schedule two setback periods, providing more hours of the low-temperature setting.

You can program the thermostat to heat your home to a comfortable temperature before you awaken in the morning and then again before you return from work or school in the afternoon or evening. In the morning, you'll know its time to get up when you're too warm under the blankets. In the afternoon you'll be comfortable as soon as you walk through the door because the thermostat brings the temperature up from setback before you arrive home.

Deep setbacks can cut 20 percent or more from the heating costs, especially when both a nighttime and daytime setbacks are used. If you have warm blankets and can tolerate a cool house at night, you can set the thermostat to as low as 55˚F at night. A heat lamp or lamps in the bathroom make this deep night setback easier to tolerate. During the day, thermostats can be set at 68˚F, which most people find comfortable. Wearing extra clothing helps you be comfortable at lower indoor temperatures.

A single individual or couple can often use a space heater during the day, to keep the central heating system from having to heat the whole house to a comfortable temperature.

To avoid wasting energy when you return to a cold house, remember that the thermostat isn't like the gas pedal of your car. Setting the temperature higher than you need it doesn't speed up the furnace's heating ability.

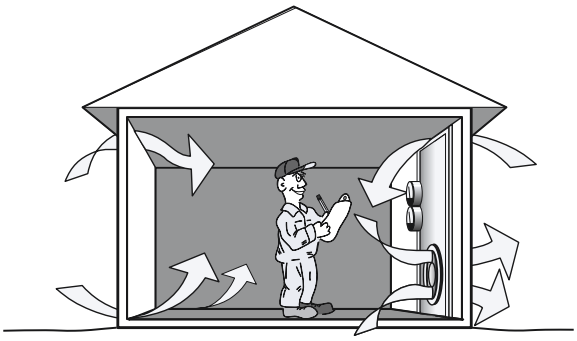
Recommendation:

Install a programmable thermostat and learn how to use it effectively.

3. Seal air leaks

Big air leaks in homes waste energy and money. Air leaks waste 10 to 30 percent of a home's heating energy and these holes and gaps may allow dust, moisture, pollutants, noise, insects, and rodents to enter the home. Measuring air leakage with a blower door test and then sealing the largest leaks can save significantly on heating costs. A blower door is a measuring device that pressurizes a home and actually measures the home's air leakage under pressure. You should be able to obtain a blower door test through a utility-sponsored energy audit or from a number of private contractors.

Blower-door testing and what it tells you



The Blower Door Test

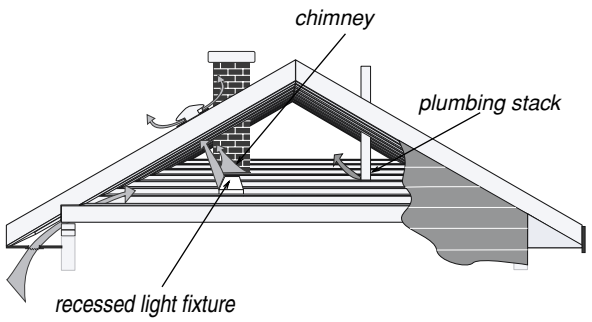
A blower door creates a large suction by blowing air out of the home. The rate at which the outdoor air enters depends on the size of the air leaks. The blower door measures the air-leakage rate, which reveals whether a house is too tight or too loose or 'about right'.

Seal large air leaks with plywood or rigid-foam insulation. Seal large cracks with expanding foam insulation, which expands like shaving cream into cracks through a tube attached to a pressurized can.

The list of potential large air leaks includes the following locations.

- Open fireplace dampers
- Where chimneys, pipes, wires, and electrical boxes penetrate floors and ceilings

Variety of serious air leaks into attics



Attics harbor a variety of air leaks that should be sealed before installing insulation.

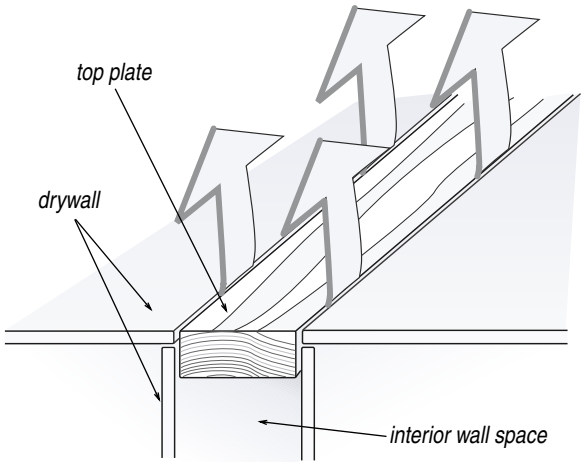
- Rim joist areas with their abundance of seams
- Junction of exterior wall and floor
- Gap between structural framing and door or window frame
- Top plates of interior walls, leaking into the attic
- Around and through recessed light fixtures
- Outlets and switches in walls

Caulking and weatherstripping improve comfort by reducing drafts. The cracks you seal by caulking or weatherstripping, however, are a small part of the overall air leakage of your home.

Fibrous insulation, like fiberglass and cellulose, is not an air barrier; air travels easily through loose-fill fibrous insulation in attics. However, densely packed insulation in walls does reduce air leakage through walls by plugging small cracks and resisting to airflow.

There are ways to judge whether your home may be too tight, too loose, or acceptable. Think about how your home feels during cold weather. If your home is drafty and excessively dry, leading to static electricity shocks, excessive air leakage is probably the cause. If your home is moist with condensed water collecting on windows, and if cooking odors linger, your home may be too tight. Blower-door testing, however, is the only accurate way to test a home's airtightness.

Air leakage through interior walls



Air enters interior walls through outlets, beneath the baseboard, and through other penetrations, and enters the attic through cracks between the drywall and the top plate. The air then passes easily through the fibrous attic insulation.

Recommendation:

Have a blower door test done on your home, and fix the biggest leaks found. If your home is too tight, find a way to increase wintertime ventilation.

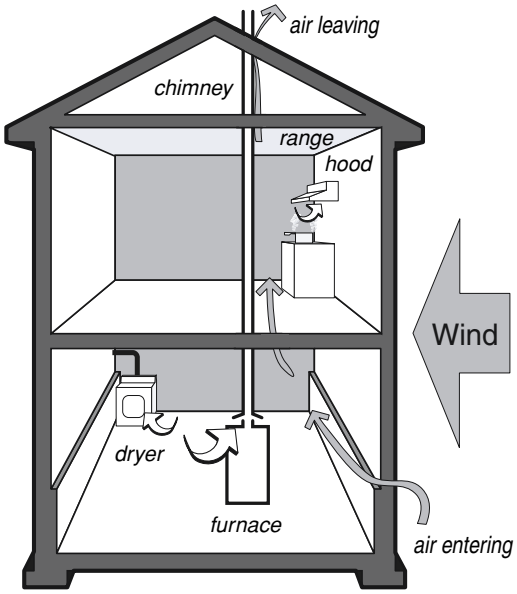
Air exchange between the home and outdoors is essential for good indoor air quality. Either unintentional air leakage or a mechanical ventilation system must exchange the air at a minimum rate to keep the indoor air acceptably fresh and to remove moisture. Air leakage caused by wind and stack effect vary widely, over-ventilating homes during cold windy weather and under-ventilating them during mild calm weather.

To remove moisture and odors, kitchens and bathrooms should have exhaust fans vented to the outdoors. Clothes dryers should always be vented to the outdoors too, because their exhaust contains moisture, lint, and chemicals from fabrics and soap. Moisture itself isn't a pollutant, but excessive moisture encourages mold growth, and mold spores can cause respiratory ailments.

Tight homes may lack adequate air for combustion appliances, like furnaces and water heaters.

Too little combustion air can cause furnaces to produce carbon monoxide and chimneys to backdraft. *See "Insuring your system's safety" on page 11.*

Sources of house pressures



Dense outdoor air enters low and light indoor air exits high in the home because of the stack effect. Exhaust appliances like dryers, range hoods, and the chimneys of furnaces, fireplaces, and water heaters tend to cause a suction inside the house. Wind pressurizes one side of the house and creates a suction on the other. These house pressures drive air leakage through the shell.

4. Add insulation

Insulation is the key element in making a home comfortable and energy-efficient. Attic and wall insulation can be the best energy investments for many homes. Insulation is rated by its R-value, which measures thermal resistance. Each type of insulation has a particular R-value for each inch of thickness. The U.S. Department of Energy (DOE) recommends that new homes have total R-values of at least R-49 in attics, R-19 in walls, R-11 in basement walls, and R-25 in floors above crawl spaces. This section will examine attic, wall, floor, and foundation insulation for existing homes. *For information on new-home insulation, see "When building new…" on page 24.*

Insulation types and choices

There are many material choices for insulating your home. Before deciding to add insulation, first determine your existing insulation level. For walls, try looking through the crack around an electrical box after removing its cover plate. Walls may need insulation if the wall cavity is empty or has a 2 to 3 inch air space on either side of the existing insulation.

Fiberglass batts are the most common insulation materials found in existing homes. Many existing homes have batts in the wall cavities and attic. Most new homes, however, have fiberglass or cellulose loose-fill insulation installed in the attic. Loose-fill insulation is blown into place in existing homes, using an insulation-blowing machine. This loose-fill insulation, blown into attics and walls, usually has better thermal resistance than batts because the blown blanket has no seams.

Loose-fill insulation comes in two common varieties: fiberglass and cellulose. Both fiberglass and cellulose settle after they're blown. Cellulose settles 15 to 20 percent and fiberglass settles 3 to 5 percent. Settling isn't much of a problem in attics as long as you plan for it by adding more

Recommendation:

- ✓ If your home lacks wall insulation, make this your first priority.
- ✓ Increasing attic insulation to R-49 is an excellent investment if your current attic R-value is less than R-25.
- ✓ Install foundation or floor insulation if your home currently lacks foundation or floor insulation.

insulation in the first place. Settling in walls is common but can be avoided by following recommendations shown in the illustrations titled "Dense-packing insulation in walls" on page 7. The denser the loose-fill insulation is blown by the blowing machines, the less it will settle.

Approximate R-Values per inch for materials

Insulation Type	R-value/inch
Concrete	0.1
Wood	1.0
Fiberglass or rock wool batts and blown	2.8–4.0[1]
Cellulose	3.0–4.0[2]
Vermiculite	2.2
White expanded polystyrene foam (beadboard)	3.9–4.3[1]
Polyurethane/polyisocyanurate foam	5.5–6.5[3]
Extruded polystyrene (usually blue, yellow, or pink)	5.0

1. Varies according to density.
2. Varies according to density and quality.
3. Varies according to age and formulation.

Plastic foam insulation, like polystyrene and polyurethane, is available in 4-by-8 or 2-by-8-foot sheets of various thicknesses. Plastic foam insulation is a moisture and air barrier, unlike fibrous insulation. Foam sheets can be used to insulate masonry walls and serve as insulated sheeting for frame walls to reduce the heat transfer through the framing.

Sprayed polyurethane insulates walls, foundations, or roofs. It is expensive but worth its higher price when adhesion, moisture-resistance, air-sealing ability, and structural strength are important.

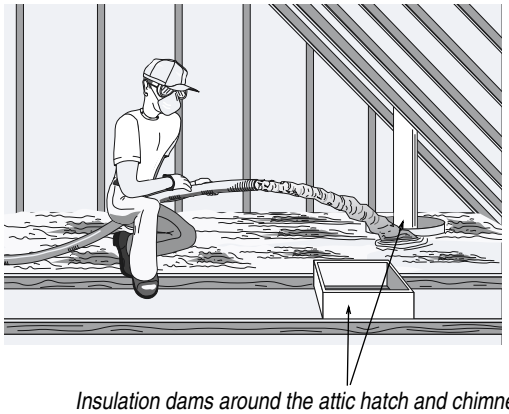
Recommendation:

Hire a well-respected professional insulator to install wall and ceiling insulation. Make sure the insulator uses the best insulation material and installation techniques for the job. Obtain proposals from at least two insulators and check their references.

Attic insulation

Loose-fill attic insulation is blown into attics, using an insulation-blowing machine. It is inexpensive and easy to install. If your ceiling has less than 8 inches of insulation (R-25), adding insulation to achieve at least R-49 is an excellent investment.

Insulating attics



Insulation dams around the attic hatch and chimney allow deep insulation around these obstructions.

Blowing fibrous insulation into the attic forms a seamless blanket.

Many lumber yards and rental businesses rent small insulation-blowing machines. If you are handy and don't mind getting dirty, you can install the insulation yourself. However, you

might not save much money over professional installation.

Recommendation:

Make sure that you or your insulation contractor seal air leaks in the attic before adding insulation as shown in the illustration "Variety of serious air leaks into attics" on page 4.

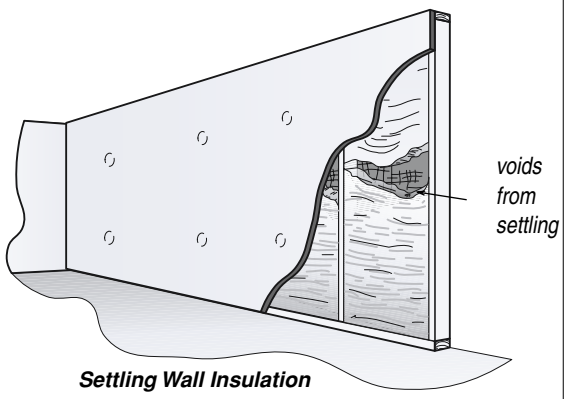
Wall insulation

Wall insulation for existing homes must usually be blown in through a hole in the wall's exterior or interior surface. Settling of fiberglass or cellulose loose-fill insulation in walls is a common problem. Settling reduces the thermal resistance of the insulated wall significantly. Installing the loose-fill wall insulation at a high density is also essential for good thermal resistance. Better insulation contractors insert a tube into the wall, to insure that density is uniformly high throughout the wall cavity.

Most home walls, built in the past 40 years, are insulated with fiberglass batts. The most common batt is the $3^1/_2$-inch-thick R-11 batt. Newer $3^1/_2$-inch batts have higher R-values: 13 and 15, due to containing more insulation fibers. Newer $5^1/_2$-inch batts have an R-21 compared to R-19 for the older style. When using batts to insulate your new home's walls, ask for these newer and better types.

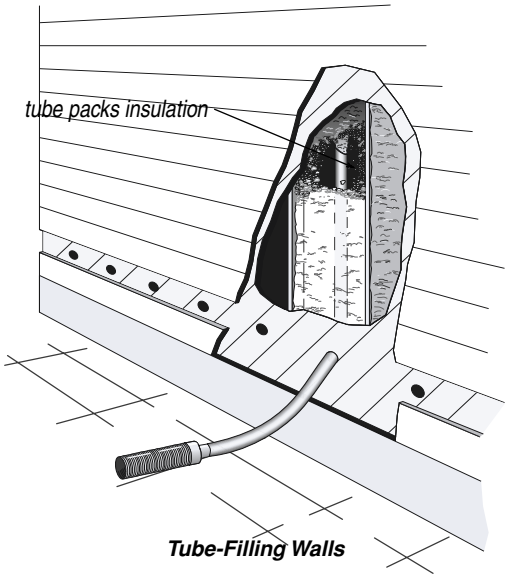
Re-siding or repainting of the interior or exterior are good opportunities to blow insulation into uninsulated or partially insulated wall cavities. While these cosmetic improvements are being made, it costs less to patch the holes necessary to blow in the insulation. Foam sheets can be attached to walls after existing siding is removed and before a home is re-sided, adding valuable extra thermal resistance.

Dense-packing insulation in walls



Settling Wall Insulation

Wall insulation, especially cellulose, can settle if not blown at a high density. These voids can be detected by an infrared scanner, which is a device used to view heat loss.



Tube-Filling Walls

Exterior walls of older homes are best insulated using a fill tube inserted into the wall cavity. The tube helps achieve the high density needed to prevent settling by packing the insulation throughout the height of the wall.

Floor/foundation insulation

Many homes have no floor or foundation insulation. However, homes in cold climates need either foundation insulation or floor insulation in order to be energy-efficient.

When a home has a heated basement, the basement walls are insulated and the floor above the basement isn't usually insulated. Foundations,

insulated on the outside during construction, require very water-resistant insulation, like extruded polystyrene insulation. *See "Foundations and floors" on page 25 for information on insulated concrete forms.*

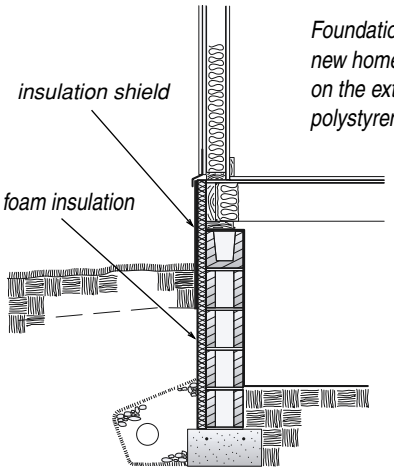
In crawl spaces, there's a choice of insulating the foundation walls or floor. The choice depends on whether the crawl space must be vented in winter, which would allow outdoor air to pass through a hole in the insulated foundation wall, greatly reducing the insulation's effectiveness.

If you decide to insulate the foundation walls of your crawl space, you should close off the foundation vents—at least during the winter. Be sure you have a tight-sealing ground-moisture barrier if you plan to close crawl-space vents, to prevent ground moisture from entering the crawl space. A ground-moisture barrier is a sheet of heavy polyethylene plastic that covers the ground, preventing moisture from rising. A ground-moisture barrier is essential for keeping either the insulated foundation wall or the insulated floor dry. Crawl-space vents are designed to remove moisture from the crawl space. The ground-moisture barrier is designed to prevent moisture from entering the crawl space, which is a far better strategy than removing moisture.

Check with a local code official or heating technician before closing the vents, especially if a combustion appliance is located in the crawl space. The vents might be supplying combustion air to the appliance. Sealed-combustion appliances would eliminate this concern about vents providing combustion air. *See "Comparing 80+ and 90+ furnaces" on page 12.*

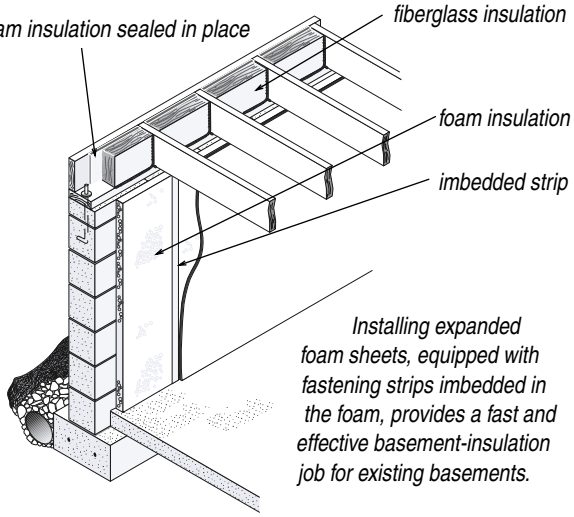
Whether you insulate the floor or foundation wall, you should insulate the rim joist at the same time. Although fiberglass is most commonly used, foam or a combination of foam insulation and fiberglass is better because moisture sometimes migrates behind the fiberglass and condenses on the cold rim joist, causing damage

Insulating basements



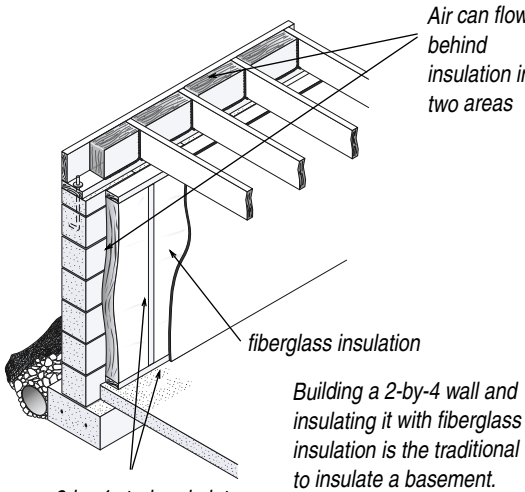
Foundations of energy-efficient new homes are often insulated on the exterior with extruded polystyrene insulation.

Exterior Basement Insulation



Installing expanded foam sheets, equipped with fastening strips imbedded in the foam, provides a fast and effective basement-insulation job for existing basements.

Improved Basement Insulation



Building a 2-by-4 wall and insulating it with fiberglass insulation is the traditional way to insulate a basement. However airflow behind the insulation can be an energy and moisture problem.

Standard Basement Insulation

from mold or rot. Spraying polyurethane foam in the rim-joist area is now a common practice.

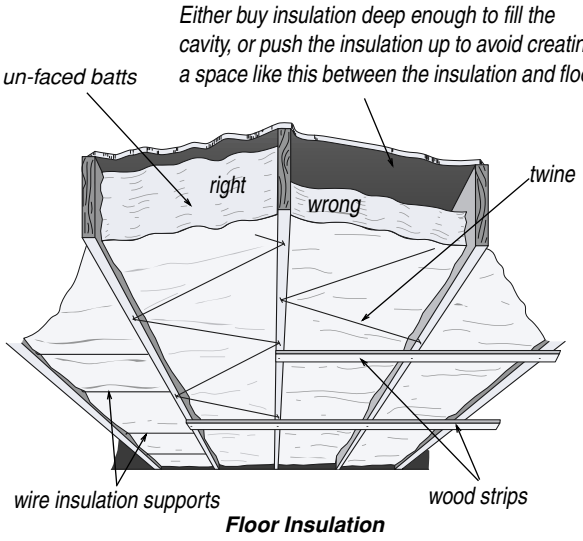
Some building inspectors may insist that foam be covered by a drywall fire barrier whenever installed toward the interior of the home's crawl space.

Insulating basements by building a framed wall, filled with fiberglass insulation and covered with drywall, is the most common way to insulate a basement. However, polystyrene insulation with imbedded fastening strips is a better choice because air can't circulate behind the wall as it can with the stud wall.

Floors, when insulated, are usually insulated with batts. Floor batts are normally un-faced. Batt facing should face up toward the floor if faced batts are used. Air leaks through the floor should be sealed before floor insulation is installed. Water pipes near the foundation's perimeter should be insulated at the same time the floor is insulated, to prevent freezing. In crawl spaces where the floor is insulated, the crawl-space ducts should be carefully air-sealed and insulated.

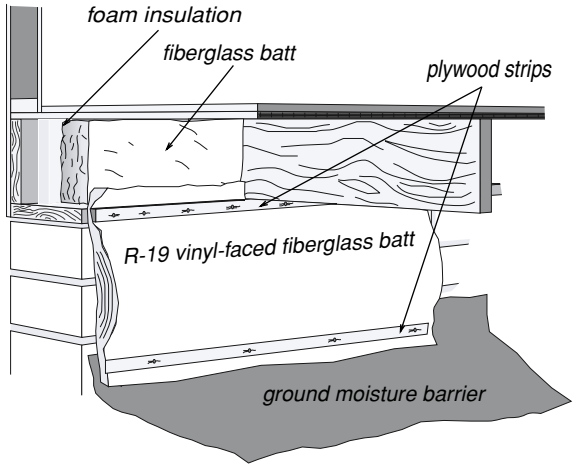
Installing floor insulation slightly increases the probability of pipe freezing in very cold weather. The most common pipe-freezing locations are where pipes in crawl spaces travel near the foundation wall and especially near foundation vents. Insulating the pipes or wrapping them with self-regulating heat tape may be necessary to prevent freezing.

Insulating crawl spaces and floors



Floor Insulation

There are a number of effective ways to attach and support floor insulation, including twine, wire insulation supports, and wood strips.



Interior Crawl-Space Insulation

A type of vinyl-faced fiberglass batt, sold as metal-building insulation, is often used to insulate crawl space foundation walls.

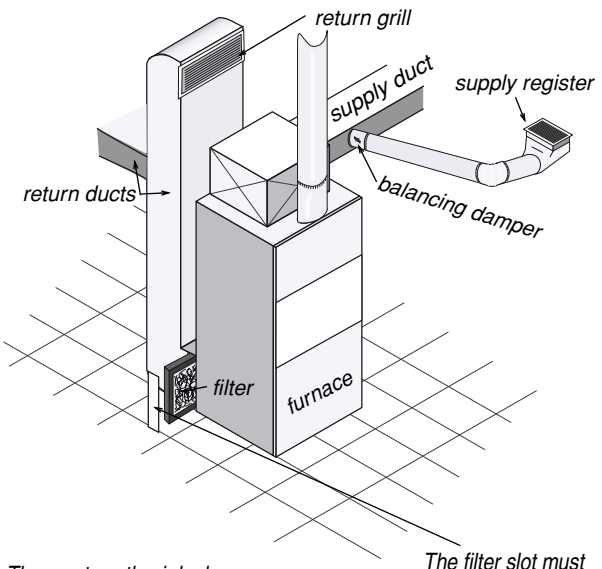
5. Improve your forced-air heating system

Between 60 and 70 percent of Montana homes are heated by natural-gas or propane furnaces. A furnace consists of a metal box connected to supply and return ducts. Inside this box are a large fan and a heat exchanger, where the gas burners produce heat. Supply ducts carry air from the furnace to the rooms, and return ducts carry room air back to the furnace.

Improving forced-air heating systems

Some furnaces are so starved for return air that you need to add an additional return grill and ducts to get adequate airflow.

Your heating contractor can balance supply air, using the balancing damper and the adjustable damper in the supply register.



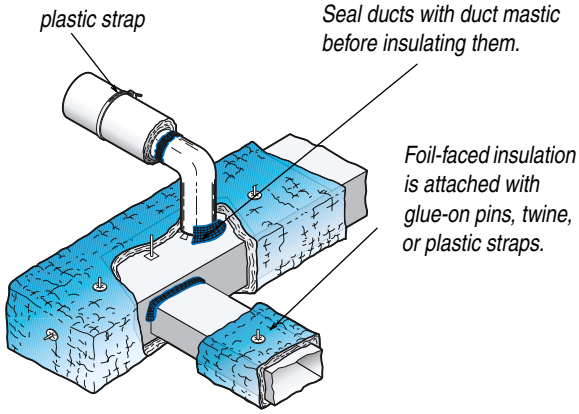
The most costly air leaks occur near the furnace at the connections to main ducts and through holes in the furnace itself.

The filter slot must be covered to prevent chimney backdrafting.

There are three common problems that waste a furnace's energy: duct air leakage, duct heat leakage, and inadequate airflow through the ducts. If your ducts are located in a crawl space, cold basement, or attached garage, the air and heat leaking out of supply ducts wastes a lot of energy. The EPA states that ducts leak 15 to 20 percent of the energy they convey in a typical home. Duct air and heat leakage into a warm basement or living space isn't much of an energy problem. However, return leaks, which suck air in from their surroundings, can cause a furnace or water heater to backdraft, delivering combustion gases to the living space.

You or your contractor should be particularly careful to seal all return leaks near the furnace. Sealing supply leaks without sealing return-duct leaks can create a vacuum in your furnace room, causing your chimney to backdraft. Backdrafting occurs when the combustion gases flow out into the room instead of up the chimney. This potential backdrafting problem is one good reason to have your ducts sealed by a professional, who should have measuring equipment to test for possible safety problems.

Insulating ducts



Insulating ducts in cold places, like crawl spaces and attached garages, saves substantial energy.

The most important duct leaks to seal are the ones near the furnace because the pressure is greatest there. The furnace itself isn't usually airtight, although it should be. Sealing holes and cracks in the furnace and its connections to the main ducts is a good way to begin air sealing. Duct tape is not a good duct-sealing material because its adhesive often fails. Duct mastic,

available in buckets and caulking tubes from heating wholesalers, is the preferred sealant.

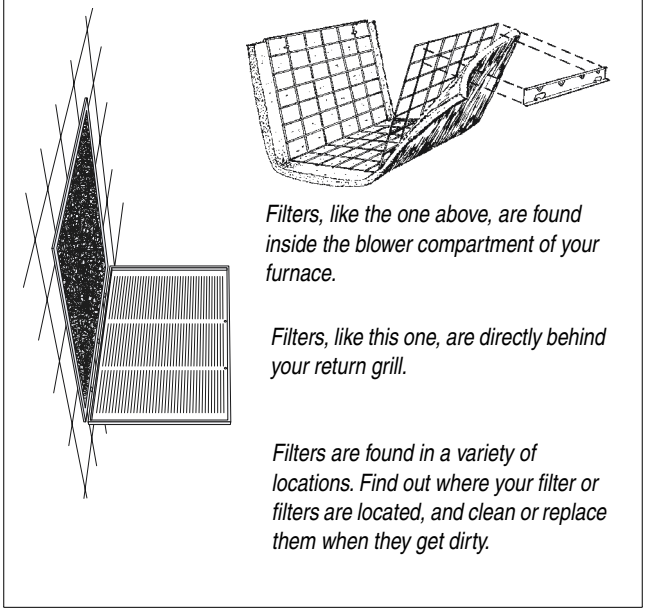
The supply ducts are the important ones to insulate whenever they are located in a crawl space, unoccupied basement, or attached garage.

Recommendation:

First seal, then insulate all supply ducts located in a crawl space, cold basement, or attached garage.

Furnace efficiency suffers when too little air flows through the ducts. Dirty filters, a dirty blower, damaged ducts, or blocked registers can cause too-low airflow. Another very common cause of low airflow is inadequately sized and installed return ducts. Most homes have only one or two return grills, located in central living areas with no return air grills in bedrooms. When the bedroom doors are closed, the bedrooms are being supplied with warm air, but cooler bedroom air is blocked from returning to a return grill outside the bedroom, producing a positive pressure in the bedroom.

Locating air filters



Filters, like the one above, are found inside the blower compartment of your furnace.

Filters, like this one, are directly behind your return grill.

Filters are found in a variety of locations. Find out where your filter or filters are located, and clean or replace them when they get dirty.

This blockage has two major effects. The first effect is to reduce airflow through the ducts, which reduces heating efficiency. The second effect is increased air leakage through the building shell due to the house pressures, created by the blockage. Both these effects waste energy.

Insuring your system's safety

The U.S. Consumer Product Safety Commission (CPSC) recommends that consumers purchase and install carbon monoxide (CO) detectors with labels showing they meet the requirements of the new Underwriters Laboratories, Inc. (UL) standard (UL 2034).

Recommendation:

Ask your heating contractor to perform a carbon monoxide test and to repair the causes of CO if it is found. Install a CO sensor on every floor of your home.

Whether you decide to have your old furnace serviced or replaced, your heating contractor should perform the following safety checks:

- Check for cracks or holes in the heat exchanger.
- Check furnace-safety controls.
- Make sure that the chimney removes combustion gases even in extreme conditions. (Extreme conditions like wind and house pressures can be simulated.)

Consider heating-system replacement

If your furnace is more than 15 years old, you should consider replacing it. This section discusses the choices of furnaces and what every homeowner should know about chimneys.

Furnaces are rated by their Annual Fuel Utilization Efficiency (AFUE), which must be posted on the furnace's Energy Guide Label. The Energy Guide Label is a federal requirement for many types of energy-using appliances. *See "ENERGY*

STAR and Energy Guide Labels" on page 15 for more information.

If your existing furnace is an older model with a standing pilot and no draft fan, you have two efficiency choices when shopping for a new gas furnace.

- An improved version of your existing furnace that has an AFUE of 82 percent or less. This furnace is equipped with electronic ignition and a draft fan. We'll call this choice the 80+ furnace.
- A condensing furnace with an AFUE over 90 percent. The condensing furnace recovers extra heat from combustion gases by extracting water from the combustion gases with a special corrosion-resistant heat exchanger. We'll call this choice the 90+ furnace.

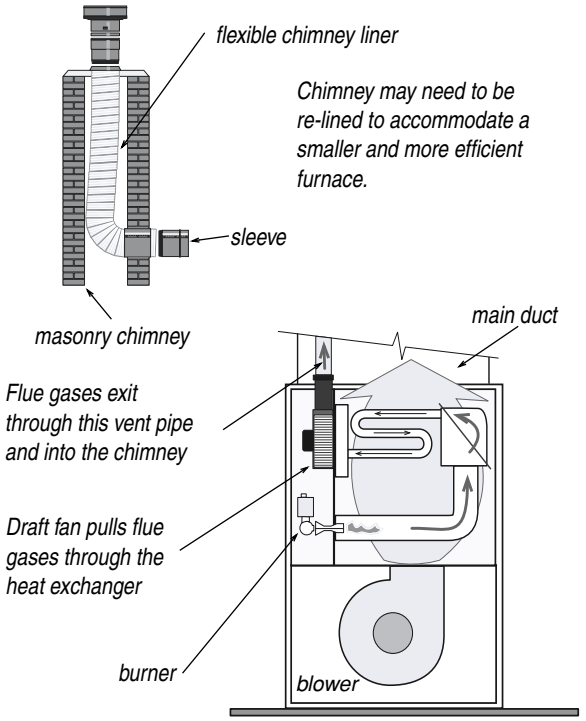
An 80+ furnace should save you between 10 and 15 percent of your current heating costs, and a 90+ furnace should save you between 20 and 25 percent. Considering the cost difference between the two options, the 90+ furnace is usually the better option. *When estimating your heating-cost reduction, remember to subtract the baseload gas usage as described in "Know where your energy dollar goes" on page 1.*

Recommendation:

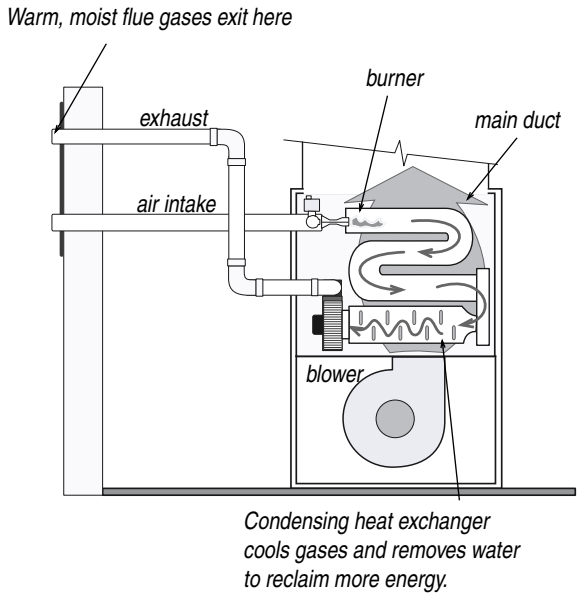
Ask your heating contractor to select a furnace with an ENERGY STAR® label. This new furnace will have an AFUE greater than 90 percent and should have sealed-combustion.

Replacing your old furnace with a new one can require additional changes that are often overlooked by both contractors and homeowners. Chimneys lead the list of often-neglected items. Many existing furnaces are grossly oversized, so the existing chimney is often too large for a new 80+ furnace. An 80+ furnace often produces less combustion gases than the old furnace and the gases are cooler. This often requires the existing

Comparing 80+ and 90+ furnaces



80+ Furnace With Its Re-Lined Chimney



90+ Furnace With Its Plastic Vent and Air Intake

chimney to be re-lined with a new metal chimney liner, which adds significantly to the cost of the new furnace. Neglecting the chimney could result in acidic condensation deteriorating the chimney.

The 90+ furnace doesn't use a standard vertical chimney but instead employs plastic pipe for venting. Combustion air is drawn from outdoors through another dedicated plastic pipe. This venting system provides superior health-and-safety benefits, compared to furnaces venting into vertical chimneys and drawing their combustion air from indoors. However, installing a new 90+ furnace often leaves a gas water heater venting into a chimney that was sized to accommodate both a furnace and water heater. The old chimney is now far too large for the water heater by itself and requires a metal liner, sized for just the water heater.

Heating-system service or replacement—what to ask for

Your primary goals in servicing or replacing your heating system are to reduce your heating costs and to increase comfort. Also, you want to own a properly functioning heating system with no major flaws. That means that your heating contractor should service the chimney, ducts, furnace filter, and other components, rather than just swapping one furnace for another.

Recommendation:

Your heating contractor should agree to include the following best practices as part of your heating-system replacement or major service call.

- ✓ Furnace should be sized correctly to your home's heating load, accounting for the improvements you've made to the building shell. Your new furnace may be smaller than your old one to account for these improvements.
- ✓ Contractor should install additional return ducts or supply ducts to improve air distribution, if appropriate.
- ✓ The main supply and return ducts should be fastened to the furnace with screws on all sides. The main ducts should be sealed to the furnace with duct mastic.
- ✓ Holes in the furnace itself should be sealed with mastic or high-quality metal tape. Joints between the main ducts and branch ducts should be sealed with mastic.
- ✓ Filters should completely fill the opening where they're installed and be held firmly in place with brackets, retainer springs, or other means. A filter slot near the furnace should have a sealed cover to prevent air leakage.
- ✓ Existing chimney problems and problems associated with the new furnace's installation should be solved during replacement.
- ✓ Airflow to the home's supply registers should be balanced using balancing dampers located near the branch duct's joint with the main duct and/or dampers in the supply register. Room temperatures should be consistent throughout the house after the installation or service.

6. Cut water-heating costs

Water heating constitutes the second largest energy demand in most homes, after heating. A few simple tasks can significantly reduce your water-heating cost. The most basic energy-saver is to reduce the hot-water temperature to 120°F. Measure water temperature with a thermometer at the tap closest to the water heater. Hot water leaks are also a serious energy waster. Check your plumbing system, and fix all leaks.

The shower is typically the household's biggest hot-water user. You can measure shower volume by measuring the time it takes to fill a one-gallon plastic milk jug with the top cut out to fit over the shower head. If the jug fills in less than 20 seconds, your flow rate is more than 3 gallons per minute. In this case, buy a shower head rated for a flow of 1.5 to 2.5 gallons per minute.

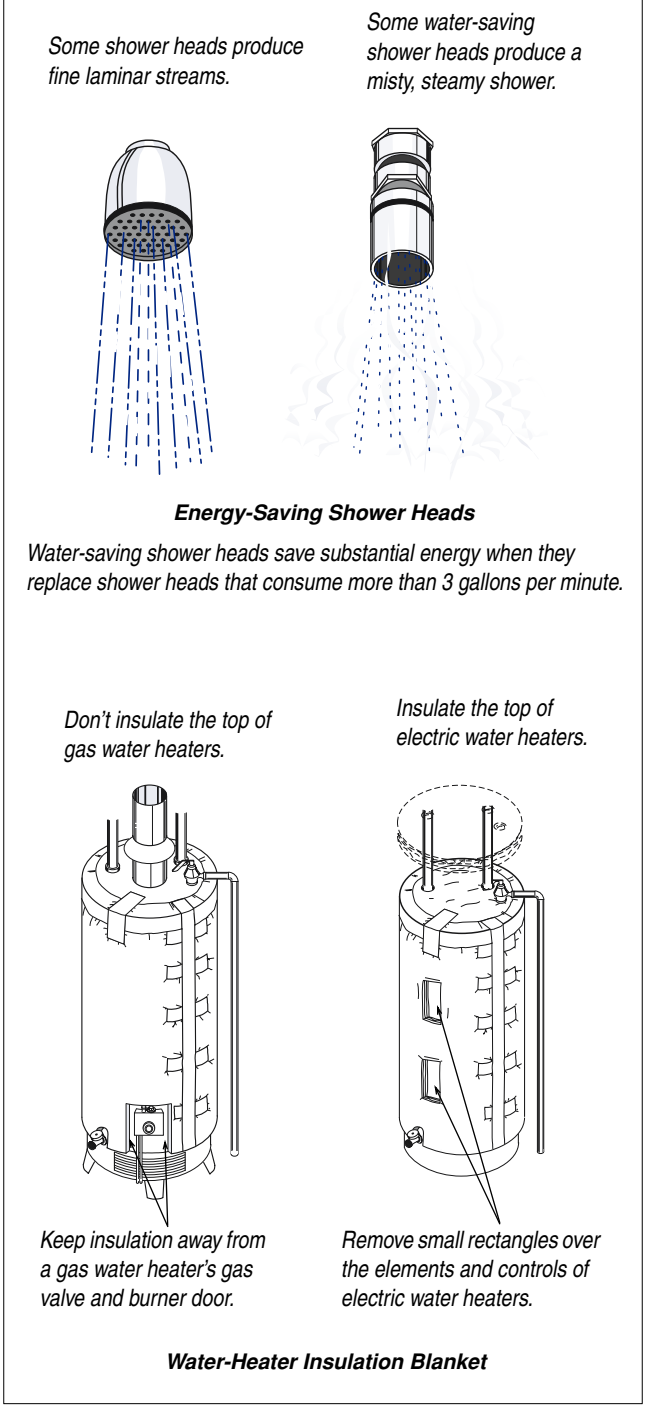
A majority of the energy used by dishwashers and clothes washers is consumed through the water heater. New improved dishwashers and clothes washers use far less water and energy than their predecessors. For example, front-loading clothes washers save up to half of the water and energy compared to top-loading machines.

Insulating your existing water heater

Most existing water heaters have only an inch of fiberglass insulation. Considering that the water heater is full of hot water year-round, this is inadequate. Water-heater insulation blankets are available in many hardware and department stores.

Install a water-heater blanket with at least R-12 insulation level. Safety is the primary consideration when installing the blanket. Follow the manufacturer's printed instructions that come with it. When you install the blanket, insulate the first five feet of hot water pipe with pipe insulation. This short piece of pipe insulation reduces heat loss from hot water rising into the supply piping.

Reducing water-heating energy costs



Replacing your water heater

Standard new water heaters have an inch of foam insulation installed between the inner tank and outer shell. However, the better gas water heaters have 2 inches of foam insulation (R-12 or more), and better electric models have 3 inches of foam

(R-18 or more). If a water heater is eight or more years old, it may be time to replace it before a tank leak or other failure forces you to settle for a standard water heater with less insulation. Look for R-12 or more when shopping for a gas water heater and R-18 or more for an electric unit. This R-value information is usually found on a specification sheet attached to the water heater.

Recommendations:

- ✓ Reduce the setting on the water heater's dial until the thermometer's temperature reads 120°F. For electric water heaters, disconnect the power at the breaker before adjusting the temperature.
- ✓ Buy a water-saving shower head as soon as possible if your existing shower head uses more than 3 gallons per minute.
- ✓ Wrap your water heater with an insulation blanket, or replace it with a new energy-efficient unit.

7. Consider appliance replacement

Appliances account for up to one quarter of a home's energy consumption. New appliances all have yellow Energy Guide Labels that give you an estimate of the annual electricity consumption and let you compare the appliance you're considering to the most efficient appliances available.

Refrigerators and freezers

The refrigerator is the most expensive appliance to operate after your furnace and water heater. New refrigerators consume as little as one-third of the energy of older models (at least 10 years old). Replacing a refrigerator with a model that uses less than 500 kWh per year ($40 per year) is a sure and easy way to reduce your electricity costs significantly.

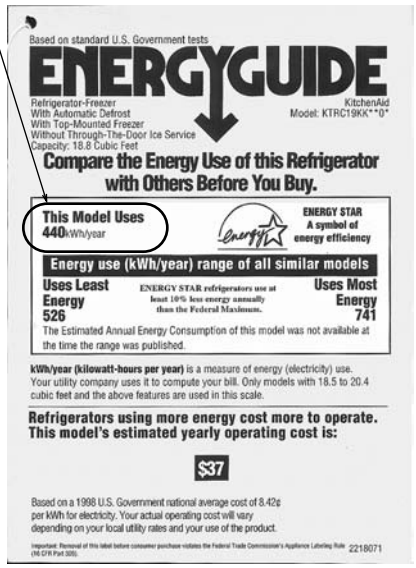
Follow these operating tips to save energy and money on refrigeration.

- Using a thermometer, measure refrigerator and freezer temperature. If the refrigerator temperature is less than 38°F or freezer temperature is below 0°, adjust temperature settings on the dials inside the refrigerator to 38–40°F for the refrigerator and 0–5°F for the freezer.
- Whenever possible, decide exactly what you want before opening the refrigerator or freezer door to limit door openings.
- Avoid operating two refrigerators. Instead, use one larger model.

ENERGY STAR and Energy Guide Labels

Look for the ENERGY STAR label on every major appliance you buy.

Wow! This refrigerator only uses 440 kilowatt-hours annually. Your existing refrigerator probably uses 1000–1500 kilowatt-hours annually.


Based on standard U.S. Government tests

ENERGYGUIDE

Refrigerator-Freezer
With Automatic Defrost
With Top-Mounted Freezer
Without Through-The-Door Ice Service
Capacity: 18.8 Cubic Feet

KitchenAid
Model: KTRC19KK**0*

Compare the Energy Use of this Refrigerator with Others Before You Buy.

This Model Uses 440 kWh/year

ENERGY STAR
A symbol of energy efficiency

Energy use (kWh/year) range of all similar models

Uses Least Energy 526

ENERGY STAR refrigerators use at least 10% less energy annually than the Federal Maximum.

Uses Most Energy 741

The Estimated Annual Energy Consumption of this model was not available at the time the range was published.

kWh/year (kilowatt-hours per year) is a measure of energy (electricity) use. Your utility company uses it to compute your bill. Only models with 18.5 to 20.4 cubic feet and the above features are used in this scale.

Refrigerators using more energy cost more to operate. This model's estimated yearly operating cost is:

$37

Based on a 1998 U.S. Government national average cost of 8.42¢ per kWh for electricity. Your actual operating cost will vary depending on your local utility rates and your use of the product.

Important: Removal of this label before consumer purchase violates the Federal Trade Commission's Appliance Labeling Rule (16 CFR Part 305).

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Energy Guide Labels are posted on all major appliances before they are sold. They help you compare the annual energy use or cost of the labeled model to its competitors.

When buying a new refrigerator or freezer, consider the following suggestions.

- Buy a unit with an upper freezer compartment because side-by-side refrigerator/freezers use more energy.
- Buy a chest freezer instead of an upright model, because chest freezers use less energy.
- Resist the temptation to move your old refrigerator out to the garage or to sell it. Older refrigerators are very inefficient and should be recycled.

City landfills and other disposal facilities are required to recycle refrigerators in a way that prevents the refrigerant vapor from escaping into the atmosphere, where it could damage the earth's ozone layer. Be sure to ask how to dispose of your old refrigerator at the disposal facility.

Savings in the laundry

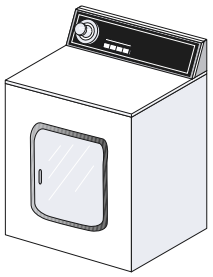
Recommendation:

Save laundering energy with the following laundry suggestions.

- Buy an energy- and water-saving front-loading washer.
- Clothes washers often perform as well with cold water as with warm or hot water, especially with lightly soiled clothes, so use cold water whenever possible.
- Fully loaded clothes washers and dryers use energy more efficiently than lightly loaded machines.
- Clean the dryer lint filter after each cycle.
- Choose your dryer's electronic or automatic cycle instead of the timer.
- Consider drying clothes on a clothesline whenever possible.

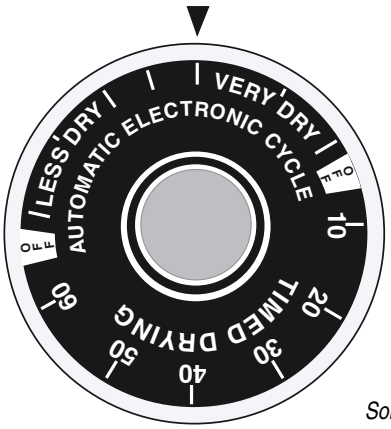
Front-loading clothes washers use far less energy and water than top-loading machines. In fact, you can save up to 60 percent of the energy, 40 percent of the water, and 20 percent of the detergent with a front-loading machine versus a top-loading one, according to recent field tests. Someday, we'll all be using the front-loading design—the sooner the better for the sake of our wallets and the environment.

Reducing laundry energy costs



Front-loading clothes washers are expensive, but if you wash with warm or hot water, they have an excellent return on your investment.

Front-Loading Washer



Dryer Control

Somewhere in the middle of the automatic cycle, you'll find a setting that dries your clothes but doesn't over-dry them.

The front-loading washers cost about twice as much as conventional top-loading models but will repay this initial investment in 3 to 6 years if you currently use warm or hot water for clothes washing. The faster spinning front-loading washer gets the clothes far drier than its top-loading counterpart. This saves approximately 20 percent of the energy needed for clothes drying.

Whenever possible, install the dryer on an outside wall because every foot of vent and every bend in the vent pipe increases drying time and reduces dryer efficiency. When you vent your

clothes dryer, use smooth aluminum vent pipe instead of flexible tubing if you can. This may require extra effort on the part of the installer, but it will save energy. Smooth vent pipe has far less airflow resistance and results in faster and more economical drying. If you must use a flexible vent, keep it short, support it to prevent drooping, and make sure there are no kinks.

A temperature-sensing dryer control saves about 10 percent and the humidity-sensing control about 15 percent of the energy consumed by dryers operated by timers. Remember that to save money with these temperature- or humidity-sensing controls, you must use the automatic cycle, which will give you a choice of dryness levels rather than a choice of on-time.

The American Council for an Energy Efficient Economy publishes an excellent book, which gives ratings of furnaces, boilers, water heaters, and major home appliances by make and model. *See "Books" on page 28 for ordering information.*

Recommendation:

When buying a new appliance, look for the ENERGY STAR label on appliances you're considering, and you'll be buying the most energy-efficient appliances on the market. The ENERGY STAR Program dispenses information about energy efficiency through its website: http://www.energystar.gov.

Large Users of Electricity

Appliance	Usage kWh/year	Annual Cost
Ten-year-old refrigerator or freezer	1250	$96
New Energy Star® refrigerator or freezer	550	$44
Hot tub / spa	2300	$208
Water bed	1000	$80
Television	100–1000	$8–$80
Well pump	500	$40
Furnace fan	500	$40
Computer	50–400	$4–$32
Humidifier	50–1500	$4–$120
Engine heater	100-400	$8–$32

Data from Lawrence Berkeley Laboratory and others. Based on 8¢ per kilowatt-hour for electricity.

8. Use energy-efficient lighting

Lighting typically consumes about 25 percent of baseload electricity use. Lighting retrofits are among the easiest to perform. Compact fluorescent bulbs simply screw in to replace standard incandescent light bulbs. New fluorescent fixtures offer superior efficiency to older models. Replacing halogen torchieres, which have come into fashion in the last 10 years, can improve both the efficiency and safety of your lighting.

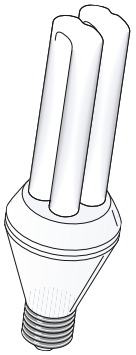
Compact fluorescent lights

Common incandescent light bulbs use 90 percent of their energy for producing heat instead of light. Compact fluorescent lights (CFLs) use one-quarter to one-third the energy of incandescent lights. They last 10 times longer than incandescent bulbs and screw into a standard light socket. CFLs can

save you 60 percent or more on lighting costs and you only need them in the light fixtures that you use most often and for the longest continuous duration. Start by replacing incandescent lights that are on for four hours a day or more, such as those in the kitchen, bathroom and living room.

Compact fluorescent lamps

Replacing standard bulbs with compact fluorescent bulbs is the easiest and one of the best energy savers available.



The smallest compact fluorescent lights, called sub-compact fluorescents, are nearly as compact as incandescent light bulbs. Standard CFLs are slightly larger than incandescent light bulbs and may not fit all fixtures. A website, funded by the Department of Energy lists the physical sizes of standard and sub-CFLs, along with prices and ordering information. Visit this website at http://www.BetterBulbsDirect.com.

Recommendation:

Install compact fluorescent lamps in every light socket in your home that is used four hours or more each day. Choose a wattage approximately one-third the wattage of the incandescent bulb that the CFL will replace.

If you plan to replace light fixtures or are choosing fixtures for a new home, select compact fluorescent light fixtures. These CFL fixtures have plug-in replaceable CFL bulbs. Noteworthy among these fixtures is the CFL recessed can fixture, which reduces the problem of air leakage through the fixture housing because it needs little or no ventilation. The standard incandescent recessed light fixtures are some of the most common and serious air leaks found in modern homes.

Standard tube fluorescent lighting

Standard-tube fluorescent lights have dramatically improved in the past ten years. The newer, more efficient tubes have a smaller diameter than the old ones and produce a warmer color of light, in addition to being more efficient. These skinnier T-8 tubes fit in standard fixtures to improve fluorescent lighting efficiency about 15 percent. New T-8 tube-type fluorescent fixtures feature electronic ballasts, which eliminate flicker and increase efficiency beyond what a T-8 tube with a standard ballast will produce. Some electronic ballasts even allow dimming.

Many models of new T-8 fixtures provide a pleasing enough color to use in bathrooms. These provide a great replacement option for the inefficient multi-bulb fixtures found above many bathroom mirrors. Installing a specially designed dimmer for the fixture is an extra-nice touch. Dimmable fluorescent fixtures also work well for indirect lighting, when installed in a wall-mounted valance and bouncing their light off the ceiling.

Torchieres

Torchieres are modern dimmable floor lamps that shine light onto the ceiling, producing a comfortable diffuse light. Halogen torchieres use a very high wattage incandescent lamp that can reach temperatures as high as 800° F. These are extremely inefficient and have caused many house fires.The best fix for the halogen torchiere is to haul it to the scrap yard and replace it with a dimmable fluorescent torchiere.

9. Make wise window choices

Windows are usually the weak link in your home's thermal barrier because they must provide light and a view. Consider replacing your windows only after you've performed the more cost-effective energy improvements described in this booklet because replacing windows is expensive and takes many years to return your investment.

Storm windows are more cost-effective than window replacement. Storm windows can be installed on either the inside or outside.

Insulating shades and shutters, like new windows, can be expensive and require the homeowner's opening and closing them at the correct times to be effective. However, they may be worth the cost and effort for large windows in the coldest regions of our State.

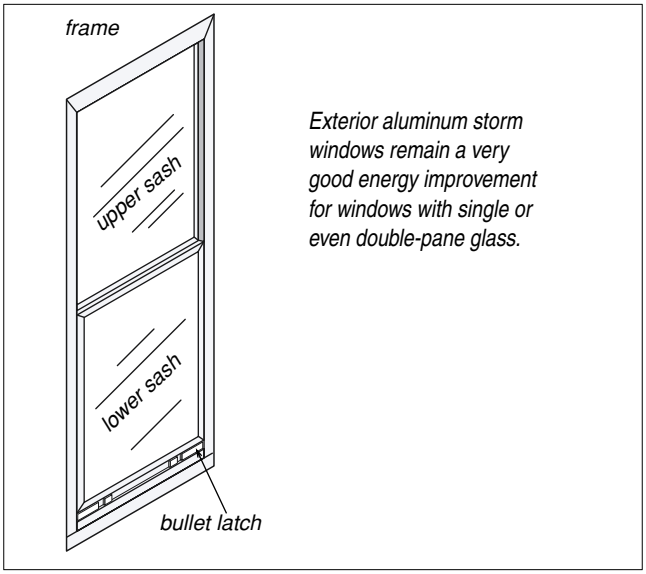
Windows may collect condensed water and ice during cold weather. Two factors affect how much condensation occurs. First, the higher a home's humidity level, the more condensation and ice will form. Second, the less a window's insulating ability, the more condensation and ice will form because the interior window surface will stay cooler. If the humidity in your home is quite high, installing new windows or storm windows may not solve your window condensation problems.

Selecting storm windows

Single-pane glass is a prolific energy waster in northern climates. More layers of glass or clear plastic will slow heat loss, reduce energy costs, and increase comfort compared to single-pane glass.

Storm windows are fairly cost-effective and necessary for comfort in our cold climate. Exterior storms are appropriate for older windows, like wooden double-hung windows. Interior or exterior clip-on storm panels work well, especially on fixed windows. Installing new, inexpensive sliding windows on the interior of existing horizontal or vertical sliding windows is also a good option. Any of these options approximately doubles the thermal resistance of a single-pane window.

Exterior aluminum storm window



The most familiar type of storm window is made of aluminum and permanently applied to the exterior of the primary window. Most exterior storm windows have sliding mechanisms and built-in insect screens for summer ventilation.

The sliding sashes of an exterior storm window should be removable from the inside to allow easy cleaning. A little silicon lubricant, occasionally sprayed in the track, helps the sashes slide up and down in their tracks.

Recommendation:

If you have old double-hung windows, make sure that each one has an exterior storm window to save energy, improve comfort, and protect the primary window from the elements. Make sure storm windows remain closed tightly during the heating season.

Fixed primary window sashes may be fitted with a fixed exterior or interior storm window for less cost than a sliding storm window. Unmovable storm windows can be clipped or permanently

attached to existing window frames or sashes. You can even order low-e glass (described later) for these storm panels. In this case, the low-e surface should face the space between the glass panes to protect the fragile coated-glass surface.

Interior storm windows are usually more airtight than exterior storm windows, but they don't protect the primary window from weather. Their glazing material is usually clear plastic, which loses transparency with exposure to ultraviolet sunlight over the years. In some temporary applications, plastic film is applied directly to the window frame. Other models of interior storm windows use a rigid frame with plastic or glass glazing. The airtight seal of indoor storm windows is created by closed cell foam tape, Velcro, or magnetic tape.

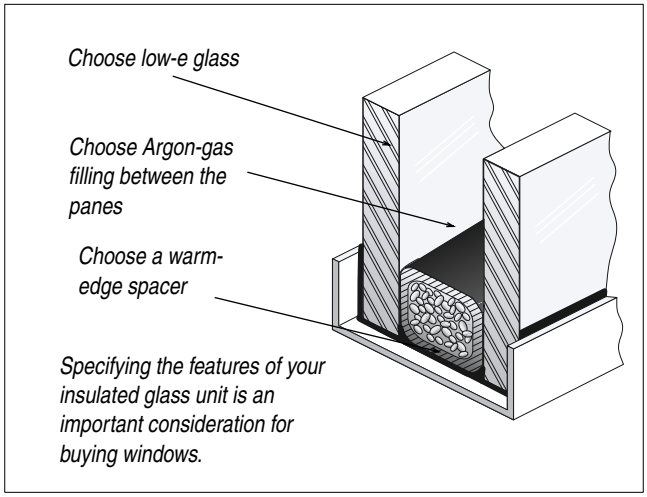
Choosing new windows

Replacement window commonly cost between $30 to $70 per square foot of window area, installed. Vinyl and aluminum-clad wood windows now dominate the window market. Vinyl window frames have good thermal resistance, low cost, and no maintenance. However vinyl windows are generally less durable than aluminum-clad wood windows. Aluminum-clad wood windows have excellent life span and low maintenance but are significantly more expensive than vinyl.

To save energy, window replacements or retrofits must be designed to significantly reduce heat loss. A window's U-factor, which measures heat loss, is the most important information for window-shopping comparisons in cold climates. *(R-values are also used to compare window heat transmittance and are shown in the table titled, "Thermal Properties of Insulated Glass Units" on page 20.)*

Energy-efficient windows use four strategies to reduce the glass's U-factor (or increase its R-value): multiple panes, low-e glass coatings, Argon-gas filling, and warm edge spacers. The best windows combine three or more of these strategies.

Insulated glass unit (IGU)



Thermal Properties of Insulated Glass Units

Glass Type	U-factor	R-value
Single-pane clear glass	1.1	0.9
Insulated glass unit (IGU) clear glass, 1/2" space	0.5	2.0
Low-e IGU with 1/4" space	0.44	2.3
Low-e IGU with 1/4" space and Argon gas filling	0.38	2.6
Low-e IGU with 1/2" space	0.33	3.0
Low-e IGU with 1/2" space and Argon gas filling	0.29	3.4

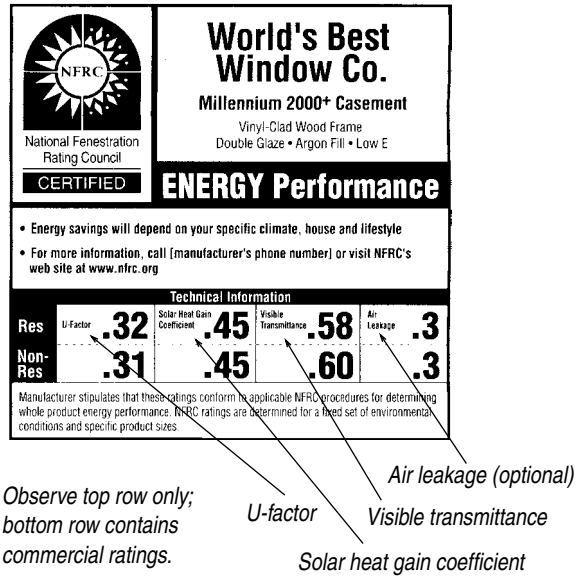
The lower the U-factor is, the better the window will minimize heat loss and also minimize moisture condensation on the glass during cold weather. Single-pane glass starts at a U-factor of 1.1. A U-factor of 0.40 is considered the maximum U-factor (heat loss) for an energy-efficient window for cold climates. Achieving a U-factor of 0.40 or less requires a double-pane insulated glass unit (IGU) with a low-e coating on one of the panes. A low-e coating is a thin metal coating that reduces heat loss through the IGU. Add argon

gas filling between the panes instead of air and the U-factor may drop below 0.30, resulting in an R-value of more than 3.3. Double-pane, triple-pane, and even quad-pane windows are available at higher costs, giving R-values up to R-10. Some manufacturers use plastic films as interior panes of these multi-pane windows.

Recommendation:

When replacing windows or building new, spend the extra money to buy premium windows, and ones that bear the ENERGY STAR label. Before replacing your existing windows, invest first in insulation, appliances, lighting, and an energy-efficient heating system—improvements that usually have a higher return on investment than windows.

National Fenestration Rating Council Label



The most energy-efficient windows will have an ENERGY STAR logo on the NFRC label, usually in the upper right corner of the label.

Warm edge spacers significantly improve a window's thermal performance. They also improve comfort and reduce condensation on the edges of the glass and frame. Warm edge spacers are well worth their extra cost.

A recent glass innovation is a low-e coating that blocks solar heat, while admitting visible light. This innovation is widely employed by window buyers in the South where air conditioning is a major expense. Montanans sometimes buy windows with this new glass product for troublesome east and west windows that allow sunlight to heat up homes during hot summers. The heat-blocking low-e glass is sold under the names: Sungate 2 and Low-e^2. These innovative new glass products have a low Solar Heat Gain Coefficient (SHGC) and a high Visible Transmittance as listed on the National Fenestration Rating Council (NFRC) label, which is attached to most new windows (as shown above).

Recommendation:

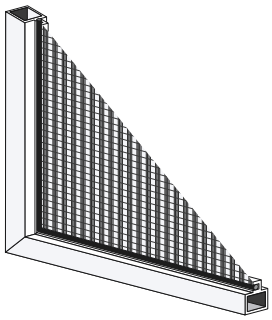
Whether you choose vinyl-frame windows or wood-frame windows, order low-e insulated glass units with Argon gas filling and warm-edge glass spacers.

Consumers often buy new windows without thinking about whether that purchase is cost-effective. Replacing your windows usually has a payback of 20 years or more, making it one of the last energy conservation priorities discussed in this booklet.

10. Be cool without air conditioning

The trouble with air conditioning is that so many homes and businesses need it at the same time. This simultaneous need between 12:00 noon and 6:00 PM has created electricity shortages and high electricity costs. Our summer peak electricity usage in Montana may affect the cost that we pay for electricity year-round. Since our climate is mild, compared to the more southern states of our region, we may be wiser avoiding air-conditioner use in order to help keep our electricity costs reasonable. Well-insulated and well-sealed homes stay cooler in the summer compared to less-efficient homes.

Sun screens block solar heat

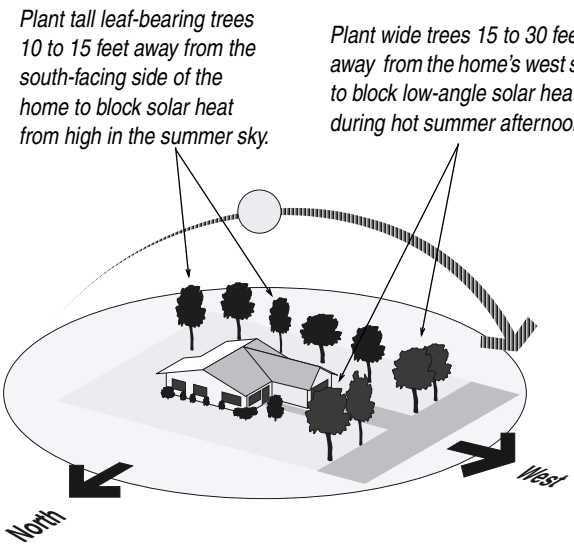


Sun screens block around 70 percent of solar heat before it enters the window. Sun screens work particularly well for un-shaded windows facing west or east.

The keys to staying cool during hot weather without air conditioning are shading and reflectivity. Indoor comfort is less dependant on the temperature outside and more dependant on how much solar heat falls on your roof and penetrates your windows. Trees offer the best window and roof shading if located correctly. Sun screens, which are fabric shade cloth on a frame, are also reasonably priced and effective at blocking solar heat through windows.

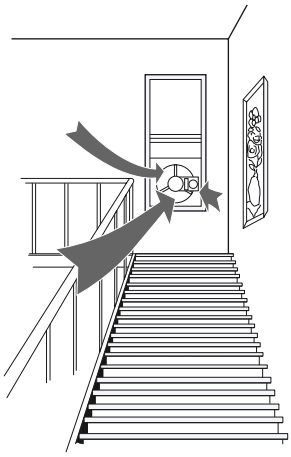
Use fans two ways to maximize their benefits. First, use them to create a wind-chill in occupied rooms. Scientific studies show that you feel an average of 4° F cooler when the air is moving around you. Second, use a window fan or fans to flush heat out of your home at night. Running the fan all night and closing up the thoroughly cooled house in the morning preserves the coolness all day or at least into the afternoon during very hot weather.

Where to plant trees



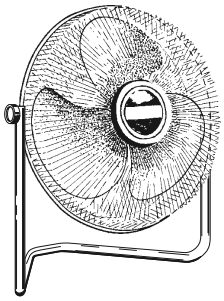
Trees provide the best shading and may also be the most cost-effective shading devices available.

Two ways to use fans for cooling



Use window fans to cool your home during the evening and night. The cool night air will flush out the heat your home collected during the hot summer day.

Window Fan Cools With Outdoor Air



Use circulating fans to create a wind chill in occupied rooms.

Floor Fan for Circulating Air

Recommendation:

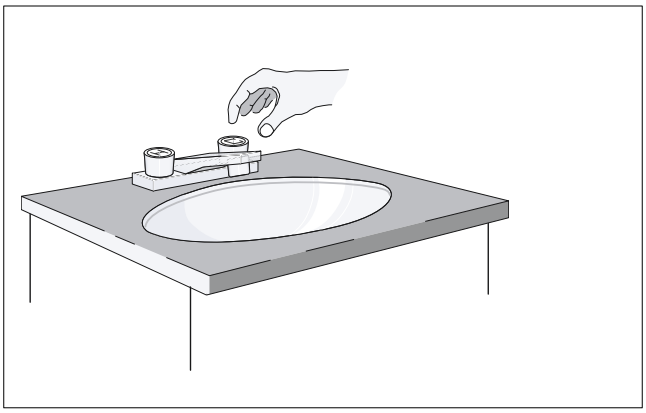
Buy and use fans as an alternative to air conditioning.

11. Use energy wisely

Wise energy use is a collection of habits that everyone would follow if energy were more expensive. The following list contains energy-saving practices you can use right now. Some of these may require some behavioral changes for you and your family, but will not affect the beneficial services that energy provides to the household.

- Choose appliances with ENERGY STAR labels when buying new.
- If you leave lights on when away from home for security, use a timer to avoid wasting energy during the daytime.
- Also, use a timer to control your engine heater during cold weather. Heating the engine for an hour should be adequate in all but the coldest weather when you can change the timer to heat for two hours. A timer can pay for itself in a month or two during very cold weather.
- Reduce the temperature setting on your hot tub between uses. Always cover your hot tub with an insulated blanket.
- Reach for the cold-water tap unless you need hot water.

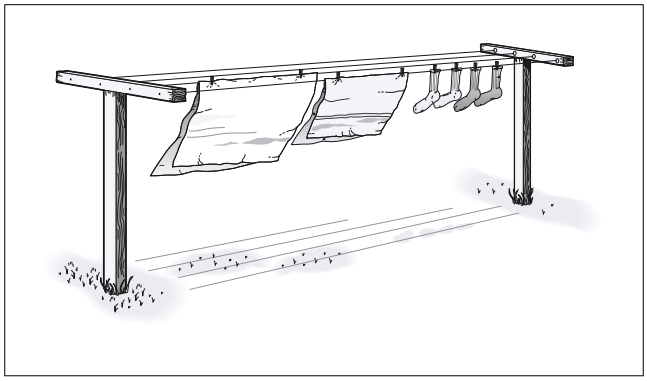
Reach for the cold-water control



- Microwave ovens save energy over electric ranges and ovens, especially when cooking small meals.
- Use lids on pots and pans.

- Cook vegetables with minimal water.
- Employ pressure cookers to markedly reduce cooking time.
- Cook double or triple portions and freeze leftovers.
- Defrost frozen food in the refrigerator before cooking.
- Always turn computers and lights off when not in use.
- Take shorter showers, and turn off water while shaving and brushing teeth.
- Dry clothes on a clothesline in good weather.

Drying clothes outdoors on a clothesline



12. When building new…

If you are building a new home, you have the opportunity to design and build a house that will be uncommonly comfortable and use 20 to 50 percent less energy than an average home. The Montana Energy Code establishes a minimum level of efficiency; a wise consumer will construct a home better than the Energy Code requires. There are many building options available for exemplary new homes. All these options have features in common: high levels of insulation, tightly sealed structure, controlled ventilation, efficient appliances, and as a bonus, solar orientation.

Advances in building materials and techniques can be applied to any house design without sacrificing comfort, indoor air quality, or appearance.

Listed here are some suggestions for a better-than-code, energy-efficient house.

Roof

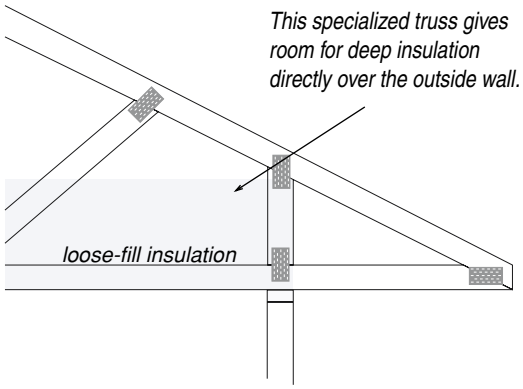
The Montana Energy Code requires a minimum insulation level of R-38 in the attic. More efficient homes have attics insulated to around R-60. Standard roof truss limits the amount of insulation that can be placed directly over the outer wall. A raised-heel or energy truss allows for 8 inches or more of insulation to be placed over the outer wall. Make sure the air leakage sites into the attic, illustrated in *"Variety of serious air leaks into attics" on page 4,* are sealed before installing insulation.

Montana law requires all new homes to display an energy component label, usually placed in or near the breaker box. An illustration on the next page shows a label of the minimum Energy Code requirements.

Above ground walls

The Montana Energy Code requires a minimum insulation level of R-19—normally achieved by a

Raised-heel truss



Raised-heel trusses allow eight inches or more of insulation to cover the area directly over the outside wall. Ask your building contractor to include this energy-saving option.

Montana's new-home energy label

ENERGY EFFICIENCY COMPONENTS

Address: Sample Minimum Energy Code House, Montana

		Insulation* Value
Ceiling	Flat	R-38
	Vaulted	R-38
Walls:	Above grade walls	R-19
	Basement walls (finished)	R-10
	Crawlspace foundation	R-19
Floors:	Over unheated spaces	R-19
	Perimeter slab	R-6
	Under slab	R-
Exterior doors:		R-2
Windows:	NFRC unit rating (or)	U-.4
	Default window rating	U-
Water heater:	Energy factor (EF) rating	.54
Heating system:	Energy efficiency rating (AFUE for gas; HSPF heat pump)	78%
Heating ducts:	Systems sealed Yes X No	
	In non-conditioned areas Insulated	R-5

Other (i.e., ventilation systems, radon abatement)

Insulation Subcontractor

Certified by: Date:

Builder (Company):

***R-value** - The higher the R-value, the greater the insulating effectiveness. **U-value** refers to heat flow through windows. The U-value is the reciprocal or inverse of the R-value. For example, a window with a U-value of .4 would have an R-value of 2.5 (1 / 2.5 = .4).

The home builder certifies compliance with ARM 8.70.104 by completing and signing this label.

THIS LABEL MUST BE PERMANENTLY AFFIXED BY HOME BUILDERS TO THE INTERIOR BREAKER PANEL ON ALL NEW RESIDENTIAL BUILDINGS, AS REQUIRED BY SECTION 50-60-803, MONTANA CODE ANNOTATED

When shopping for a new home or planning to build one, consider what you want to see on this label when the house is finished. You want the highest R-values and the lowest U-values you can afford.

2-by-6 wood wall, using the standard 5.5-inch fiberglass batt. A better house will have an R-25 wall or higher. Wood has a relatively poor insulating value, so when possible, insulating materials should occupy the maximum possible volume within a home's wall. There are a few common ways to reduce the wood content of an exterior wall.

1. Wood walls should be framed with 24-inch on-center spacing, rather than 16-inch spacing.
2. Exterior wall corners and intersections with interior walls should have as much insulation and as little wood as possible.
3. Support framing members above doors and windows (called headers) should be filled with foam insulation.
4. Consider insulated foam sheathing as an exterior cladding underneath the siding, to reduce the flow of heat through wood wall studs.

Some of the most comfortable and energy-efficient homes in Montana have walls made of structural insulated panels (SIPs). These walls have far less structural lumber, which increases their R-value compared to standard wood-framed walls.

Structural insulated panels

Structural insulated panels are usually composed of a sandwich of oriented-strand board and polystyrene foam. The polystyrene core comes in thicknesses of 3.5 to 11.5 inches.

Foundations and floors

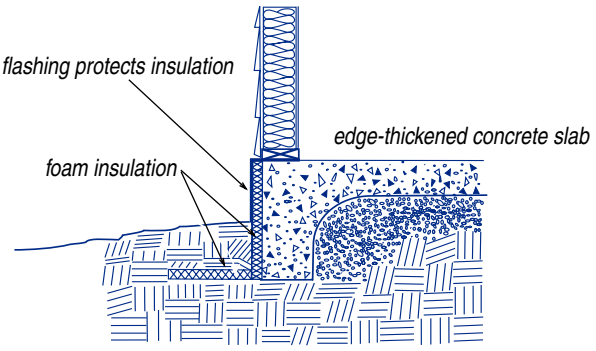
The Montana Energy Code requires basement walls, when finished, to be insulated to R-10. A better house will have R-20.

Insulated concrete forms (ICFs), made of foam and filled with concrete, provide excellent insulating value for foundations, basements, and above ground walls (R-16–R-25). There are a variety of ICFs available.

The Montana Energy Code requires R-19 insulation in crawl spaces, which can be placed either in the floor cavity or on the foundation wall. A combination of floor and wall insulation is also acceptable. A better house will have its crawl space insulated to R-30. *See "Insulating crawl spaces and floors" on page 9 for more information.*

A tuck under garage ceiling is a common feature in new homes. Code requires insulating to R-19; a better home will use R-30 in the garage ceiling.

Frost-protected shallow foundation

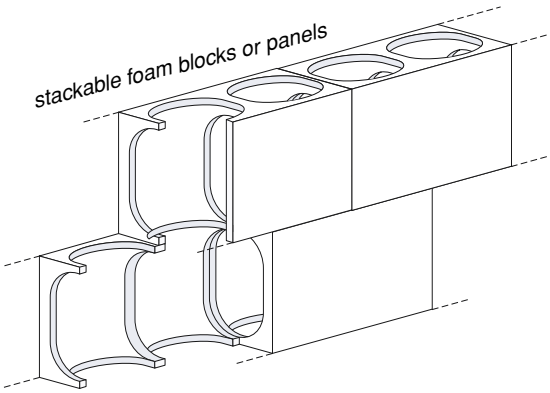


Insulated concrete slabs provide a very economical and energy-efficient foundation.

Windows

For most house designs the Energy Code requires a window with R-2.5 (U - 0.40) rating. A better house will have R-3 (U-0.33) or better and have an Energy Star® rating. The typical home loses about 25 percent of its heat through windows. A rule of thumb for a better house is that window area should not exceed 12 percent of the floor area. Also, 50 percent of the windows should be on the south side with a minimum on the north side. Roof overhang or awnings should be included on south and west windows to prevent summer overheating. *See "Choosing new windows" on page 20 for more energy-efficient window information.*

Insulated concrete forms



Insulated concrete forms contain poured concrete and provide excellent thermal resistance for basements and home walls.

Air sealing and ventilation

The Montana Energy Code requires air sealing around windows, doors, and penetrations where pipes and wires pass through the building shell. A well-constructed house requires sealing to be effective and thorough. Sealing air leaks significantly reduces energy loss.

An energy-efficient house is sealed for comfort and efficiency, therefore it is important to intentionally ventilate a home in a controlled way. Mechanical ventilation is the controlled operation of fan or fans, which allows homeowners to control their indoor air quality.

Help for new-home buyers

A better-than-code house, using the features discussed above, has many advantages: increased comfort, stable indoor temperature, good indoor air quality, and lower energy bills. There may be some disadvantages such as added costs and reluctant builders. The State of Montana recognizes there will be extra cost and offers a tax credit incentive to pay for part of the extra cost. Beginning January 1, 2002, a tax credit of up to

$500 is offered for energy conservation features that are better than the Energy Code. The credit will be calculated by taking 25 percent of the cost of upgraded features. So if you spend $2,000 for items better than the code, you can reduce your Montana State income tax with a $500 tax credit. Depending on your lender, you may be able to finance the extra cost with an Energy Efficient Mortgage. Ask your lender about the program.

If your builder is reluctant to include any of these features in your house, he should contact the Montana DEQ for more information and training.

Rising energy cost has increased interest in energy-efficient home construction. The ENERGY STAR Home program sponsored by the U.S. Environmental Protection Agency and Department of Energy is one of the most popular. An Energy Star home is at least 30 percent more efficient than the Model Energy Code and is certified by an independent rater. For more information go online to www.Energystar.gov.

Recommendation:

Building an airtight new home, equipped with a heat-recovery ventilator, is probably the best way to provide superior energy-efficiency and comfort with good indoor air quality.

13. Choosing a contractor

Use the technical information given here to guide your decisions about home improvements. For information about contractors, consult with friends who have recently made home improvements, look in the Yellow Pages, and talk to your utility company or lender. Formulate a list of several contractors to consider.

Ask each contractor to give you a cost estimate or bid. Be as specific as you can about exactly what benefits you want from the job and what technical details are important to you. Note differences between the suggestions and comments each contractor makes. Ask contractors whether they offer a warranty on labor or materials or both. Also ask contractors if you can see their Montana Contractor Registration Certificate.

The more informed and interested you are about the details, the better job you're likely to receive. Note these suggestions.

- Accompany contractors on their inspections.
- Don't purchase on price alone. For example, when contracting for insulation, compare both R-value and price.
- Get a written bid that includes all the important details.
- Hire a Montana-registered contractor.
- Work with the successful bidder to convert the details on the bid to a written, legally binding contract.
- Help your contractor formulate a payment plan that insures you completion and performance, while being fair to the contractor. The payment plan should be part of the contract.
- Get a building permit, if needed.
- Monitor the job for compliance with the contract.
- Compare the warranties offered by the contractors you're considering.

Avoid contractors who display the following characteristics.

- Willing to do the job at an unusually low price.
- Won't provide references.
- Won't provide a written estimate or contract.
- Requires full or substantial payment before work begins.
- Uses high-pressure sales methods.
- Asks you to obtain the necessary permits.

14. Finding more information

Several excellent information services are available to Montanans. Mentioned previously is the partnership between the U.S. Environmental Protection Agency and The U.S. Department of Energy called ENERGY STAR®. The ENERGY STAR Program dispenses information about energy efficiency through its website: http://www.energystar.gov. You can find information about energy efficient appliances, office equipment, and many other products for work and home.

The Department of Energy (DOE) has two services that every homeowner should know about. The Energy Efficiency and Renewable Energy Network (EREN) connects you to the wide range of information available through DOE and other sources. Visit their website at http://www.eren.doe.gov/. The Energy Efficiency and Renewable Energy Clearinghouse (EREC) is responsible for answering consumers' specific questions about energy efficiency and renewable energy. Contact EREC through the EREN web site listed above or at one of these two phone numbers:

1-800-DOE-EREC (363-3732)

1-703-893-0400

You can also write to EREC at:

EREC

P.O. Box 3048

Merrifield, VA 22116

You can also e-mail EREC at:

doe.erec@nclinc.com

The Montana Department of Environmental Quality (DEQ) maintains a web site to inform Montanans about energy and resource efficiency. Visit this web site at the following web address.

http://www.EnergizeMontana.com

Radon information 800-546-0483 and

http://www.epa.gov/iaq/radon

Asbestos information 406-444-3490 and

http://www.deq.state.mt.us/pcd

Books

Consumer Guide to Home Energy Savings 5th ed., A. Wilson and J. Morrill, American Council for an Energy Efficient Economy, Washington, DC 1996.

No Regrets Remodeling, Energy Auditor and Retrofitter Inc., Berkeley, CA 1997

Residential Energy: Cost Savings and Comfort for Existing Buildings, J. Krigger, Saturn Resource Management, Helena, MT 1998.

Plan your energy improvements

To do this week

- ✓ Measure hot water and adjust water-heater temperature down to 120°F. *See page 14*.
- ✓ Inspect furnace filter and clean or change if dirty. *See page 11*.
- ✓ Make sure that your fireplace damper is closed. *See "Seal air leaks" on page 3*.
- ✓ Try setting your clothes washer at lower wash and rinse temperatures to see if clothes come clean enough to continue to use these lower settings. *See "Savings in the laundry" on page 16*.

To do this month

- ✓ Schedule a utility energy audit. *See page 1*.
- ✓ Buy and install compact fluorescent bulbs in fixtures used at least 4 hours a day. *See page 17*.
- ✓ Measure freezer temperature and set to 0–5°F if you measure a colder temperature. Measure refrigerator temperature and set at 38–40°F if you measure a colder temperature. *See page 15*.
- ✓ Repair all faucet leaks and install a low-flow shower head. *See page 14*.
- ✓ Insulate your water heater and water pipes near the water heater.
- ✓ Buy a timer for engine heaters to limit their on-time to one hour per night or two hours in very cold weather. *See page 23*.

To do this year

- ✓ Install a programmable thermostat if family members have regular schedules of sleep and daytime activities. *See page 2*.
- ✓ Find the major air leaks in your attic around chimneys, recessed light fixtures, pipes, and wires, and seal them. *See page 3*.
- ✓ Determine the insulation levels of your home. Plan and carry out insulation improvements. *See page 5*.
- ✓ Inspect your windows to ensure that each has at least two layers of glass. If you have any single-pane glass, have those windows fitted with storm windows or replace them. *See page 19*.
- ✓ Assess the age and energy efficiency of your refrigerator, dishwasher, and clothes washer. Consider appliance replacements with Energy Star® labeled appliances when financially possible. *See page 15*.
- ✓ Hire a contractor to seal and insulate ducts, located in a crawl space, unheated basement, or garage. *See page 10*.
- ✓ Assess efficiency of furnace and water heater, and plan their future. *See page 13 and page 14*.