

Montana Energy Savers Guidebook

Practical Ways to
Save Money and
Improve Comfort



Montana Energy Savers Guidebook

Montana Department of Environmental Quality

DEQ technical review by
Paul Tschida, with Paul Driscoll

Written by John Krigger

Edited by Darrel Tenter

Illustrations by Bob Starkey and John Krigger

Design and Layout by Darrel Tenter

Published by Saturn Resource Management, Inc.

Helena, Montana • www.srmi.biz

The Montana Department of Environmental Quality appreciates your interest in energy conservation and encourages your participation. Wise use of energy allows you to save money, conserve our natural resources, and reduce pollution. Most Montanans could reduce their energy consumption from 10 to 30 percent by taking actions described in this guidebook.

Many Montana homes were built when energy prices were low and equipment and materials did not exist for building energy efficient houses. Advances in technology have made many new appliances, lights, heating and ventilation equipment, building materials, and techniques more energy efficient and more cost-effective. This booklet will show you how to reduce energy use in your home, making it more comfortable and increasing its value.

Please follow the recommendations and use the checklist on the next page to make an energy conservation plan for your home.

This project was originally funded with support from
the U.S. Department of Energy State Energy Program Grant EE0007481

Copyright ©2021 • Saturn Resource Management and
Montana Department of Environmental Quality

Document Version 09.01.2021

Planning Your Energy Improvements

To do this week

- ✓ Make sure your fireplace damper is closed when not in use. *Page 8.*
- ✓ Inspect furnace filter and clean or replace if dirty. *Page 16.*
- ✓ Measure hot water temperature at a faucet and adjust down to 120°F. *Page 21.*
- ✓ Try setting your clothes washer at lower wash and rinse temperatures and see if clothes come clean enough to continue to use these lower settings. *Page 24.*

To do this month

- ✓ Schedule a utility energy audit. *Page 6.*
- ✓ Repair all faucet leaks and install a low-flow shower head. *Page 21.*
- ✓ Insulate your water heater and water pipes near the water heater. *Page 22.*
- ✓ 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. *Page 23.*
- ✓ Buy and install CFL or preferably LED bulbs in fixtures used at least two hours a day. *Page 26.*
- ✓ Buy a timer for engine heaters to limit their on-time to one hour per night or two hours in very cold weather. *Page 33.*
- ✓ Buy a watt-hour meter and measure the stand-by or “phantom” power consumption of electrical devices in your home. *Page 33.*

To do this year

- ✓ Install a programmable thermostat if family members have regular schedules of sleep and daytime activities. *Page 7.*
- ✓ Find the major air leaks in your attic around chimneys, recessed light fixtures, pipes, and wires, and seal them. *Page 8.*
- ✓ Determine the insulation levels of your home. Plan and carry out insulation improvements. *Page 10.*
- ✓ Seal and insulate ducts, located in a crawl space, unheated basement, or garage. Do it yourself, or hire a contractor. *Page 16.*
- ✓ Assess efficiency of furnace and water heater, and decide whether to repair, replace, or leave as-is. *Page 18 and 22.*
- ✓ Inspect your windows to ensure that each has at least two layers of glazing. If you have any single-pane glazing, have those windows fitted with storm windows or replace them. *Page 29.*
- ✓ Assess the age and energy efficiency of your refrigerator, dishwasher, and clothes washer. Consider appliance replacements with ENERGY STAR® labeled appliances when financially possible. *Page 23.*

Table of Contents

1.	Know Your Energy Dollar.....	6
2.	Practice Thermostat Setback	7
3.	Seal Air Leaks	8
4.	Add Insulation	10
5.	Improve Your Heating System.....	16
6.	Cut Water-Heating Costs	21
7.	Consider Appliance Replacement	23
8.	Use Energy-Efficient Lighting.....	26
9.	Make Wise Window Choices.....	29
10.	Be Cool Without Air Conditioning	32
11.	Use Energy Wisely	33
12.	Building a New Home	34
13.	Choosing a Contractor	41
14.	Finding More Information.....	42

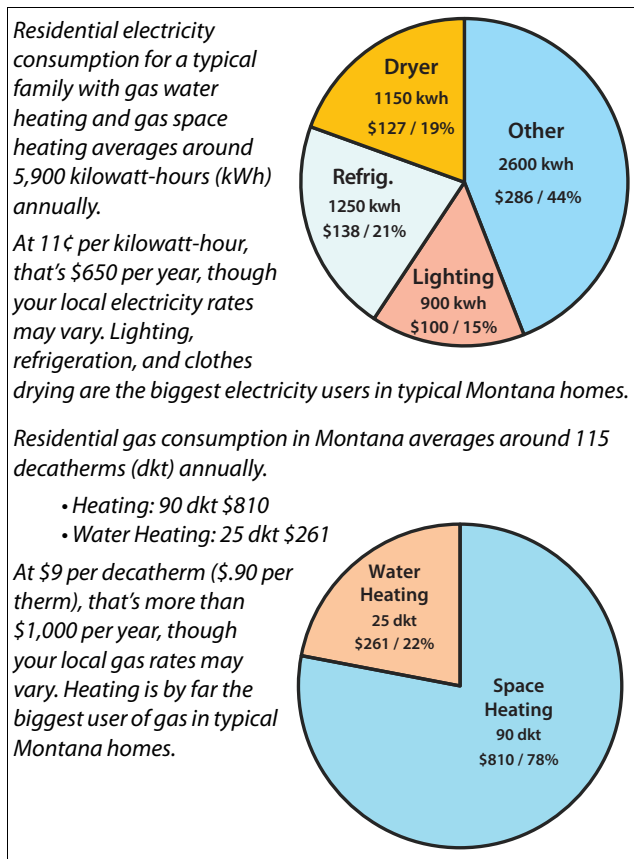
Montana Energy Savers Guidebook

Montanans have a choice of spending money today to improve our homes' 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.

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 previous page to help you begin planning your energy improvements.

Average annual electrical and gas usage



1. Know Your Energy Dollar

When 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 consumption and heating consumption. Baseload usage consists of year-round energy uses including water heating, refrigeration, and lighting.

Your monthly baseload energy cost is approximately equal to your total June, July, or August energy usage, since your heating system is not operating. If you multiply your June gas and electric usage by 12 (the months per year), and subtract that figure from your annual electric and gas usage, the amount left over is your approximate heating energy consumption. This heating consumption is the biggest utility expense for most Montana families.

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.

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.

The U.S. Department of Energy and the EPA have a partnership called ENERGY STAR, which only gives its approval to energy-efficient products. Look for the ENERGY STAR label whenever you're shopping.

Compare your home's energy consumption with other homes of similar age and climate on the internet, by using the Environmental Protection Agency's (EPA's) energy yardstick at its website at: <https://www.energystar.gov/campaign/home-energy-yardstick>

Find a do-it-yourself energy audit tool at: to <https://www.energy.gov/energysaver/home-energy-audits/do-it-yourself-home-energy-audits>

Recommendation: Know Your Energy Dollar

- ✓ Focus first on heating, water heating, appliances, and lighting for maximum energy savings.
- ✓ Increase insulation in attic, walls, floor, and foundation before replacing the heating system.
- ✓ Check with your local utility for rebates and other incentives.
- ✓ Find out about possible Montana State and federal tax credits and utility incentives at the following website: www.dsireusa.org

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 consistent 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. You can save up to one percent of your heating cost annually for each degree of setback for a daily eight-hour setback period.

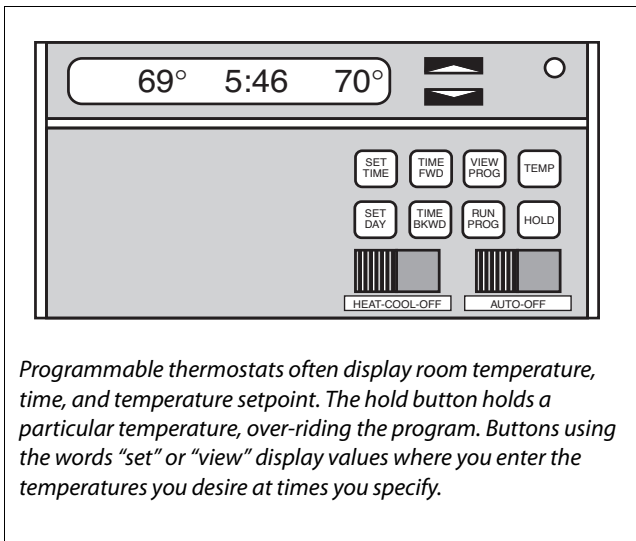
Programmable thermostats, which automatically set temperature settings back while residents sleep or are away from home, are valuable energy-savers for some consumers. However, it takes commitment from the homeowner to program the thermostat and operate it properly. If you have trouble programming electronic devices, 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 are convenient and effective 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 during 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 wake up in the morning and then again before you return from work or school in the afternoon or evening. So in the morning, your house will already be warm when it's time to wake up, and in the afternoon you'll be comfortable as soon as you walk through the door.

Programmable thermostats



Deep setbacks can cut 20 percent or more from the heating costs, especially when both 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, mounted in the ceiling and controlled by a 15 minute timer, make this deep night setback easier to tolerate. During the day, thermostats can be set at 68°F, which most people find comfortable.

A single individual or couple can often use a space heater during the day to heat a room, in order 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: Setback Thermostats

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

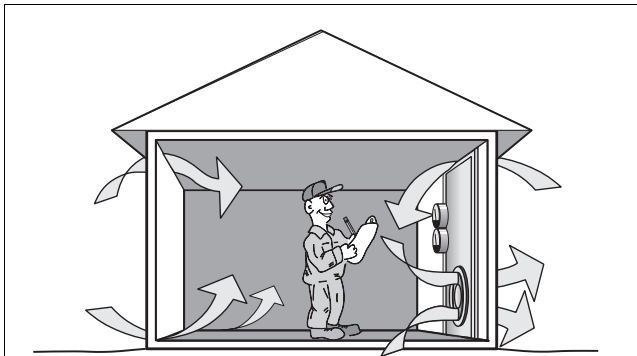
3. Seal Air Leaks

Big air leaks in homes waste energy and money. Air leaks waste 10 to 25 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 depressurizes a home and actually measures the home's air leakage under pressure. You may be able to obtain a blower door test through a utility-sponsored energy audit or from a private energy contractor.

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 airflow.

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

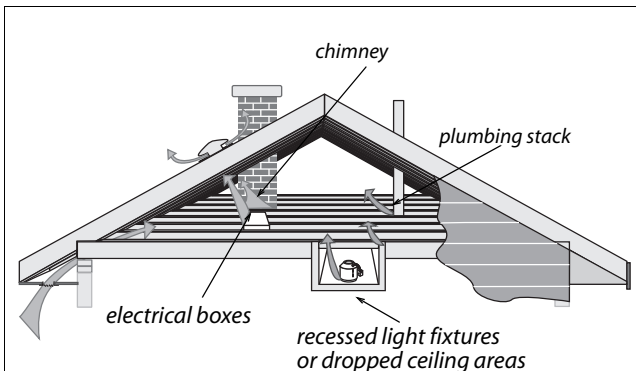
Blower-door testing and what it tells you



The Blower Door Test

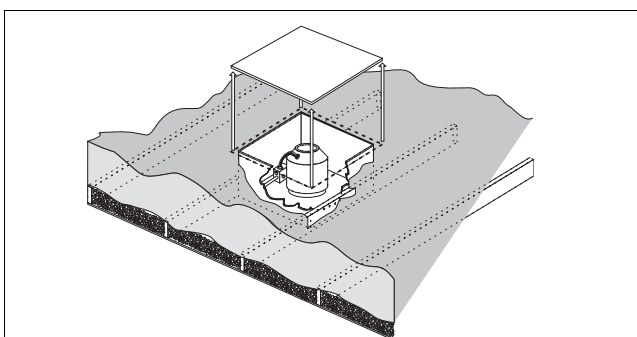
A blower door creates a large suction by blowing air out of the home. The rate at which the outdoor air enters depends on the size of the air leaks. The blower door measures the air-leakage rate, which reveals whether a house is too tight or too loose and if air sealing or mechanical ventilation is required.

Air leakage into attics



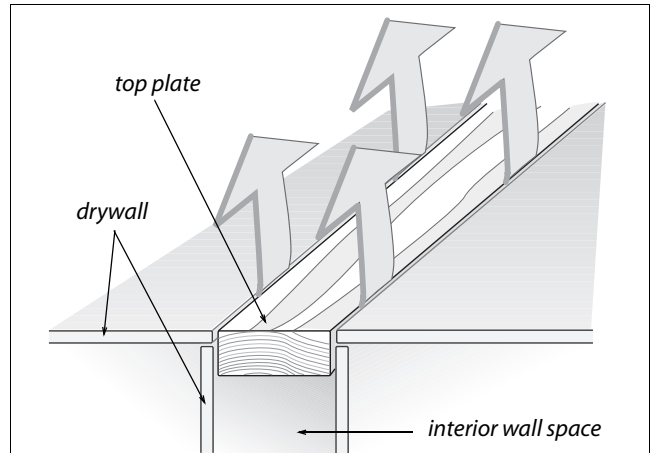
Attics harbor a variety of air leaks that should be sealed before installing insulation.

Airtight recessed lights



The two solutions to leaking recessed light fixtures are to build a drywall or sheet-metal box around the fixture and seal the box to the ceiling or to replace the light fixture with an ENERGY STAR rated LED replacement bulb with a gasketed trim. See "Light Emitting Diodes (LEDs)" on page 26.

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.

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

In attic:

- Where chimneys, pipes, wires, recessed lights, electrical boxes, and open walls penetrate the ceilings
- Top plates of interior and exterior walls, leaking into the attic

In the living space:

- Open fireplace dampers
- Junction of exterior wall and floor
- Gap between structural framing and door or window frame
- Poor window and door weather-stripping
- Outlets and switches in walls

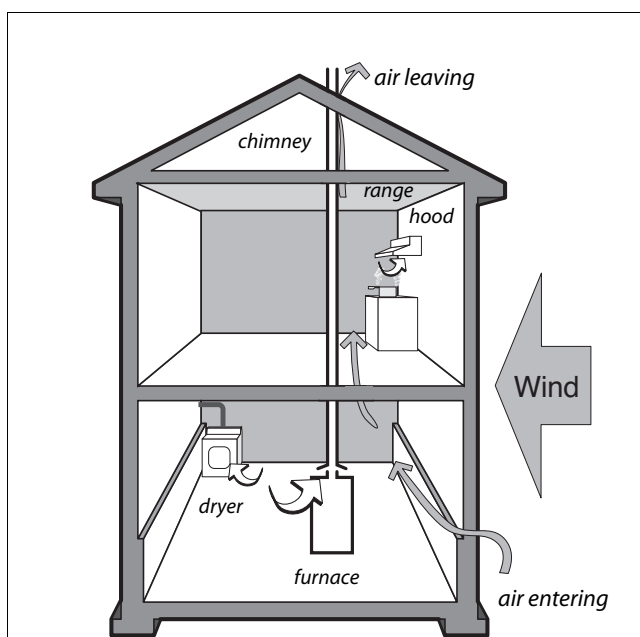
In the basement or crawlspace:

- Gaps at the rim or band joist
- Gaps around and through vents and windows (Use caution when closing vents. See page 15.)
- Gaps around pipes and wires open to the exterior

Smaller air leaks can be sealed with caulking, weatherstripping, and outlet and switch cover gaskets. These smaller fixes improve comfort by reducing drafts; however they are a small part of the overall air sealing of your home. So air seal the largest air leaks first.

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

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.

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

of around one-third of your home's volume per hour 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 an adequate air supply for combustion appliances, like furnaces and water heaters. Too little combustion air can cause furnaces to produce carbon monoxide and chimneys to backdraft. See "Ensuring Your System's Safety" on page 18. New airtight homes should have central mechanical ventilation systems.

Recommendation: Air Sealing

- ✓ 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.

4. Add Insulation

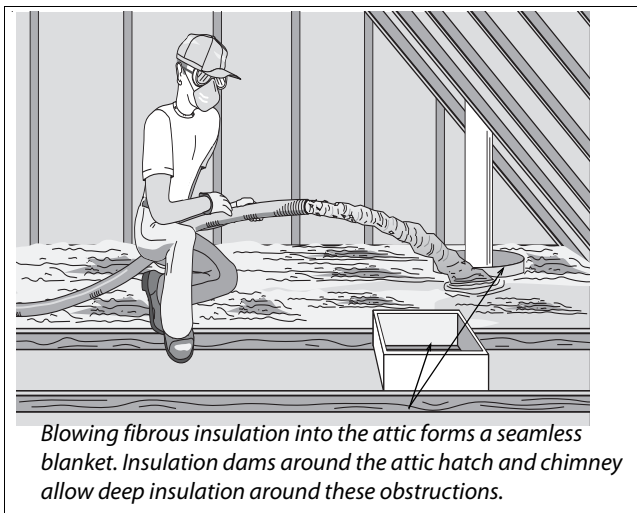
Insulation is the key element in making a home comfortable and energy-efficient. But air leaks, especially those in the ceiling, can bypass insulation and reduce its effectiveness. So before adding any new insulation, air seal the home first. Attic and wall insulation can be the best energy investments 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 Montana Energy Code requires that new homes have total R-values

of at least R-49 in attics, R-21 in walls, R-19 in basement walls, and R-30 in floors above un-conditioned spaces. This section will examine attic, wall, floor, and foundation insulation for existing homes. For information on new-home insulation, See “*Building a New Home*” on page 34.

Insulation Types and Choices

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.

Insulating attics



There are many material choices for insulating your home. 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 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 13. The denser the loose-fill insulation is blown by the blowing machines, the less it will settle. Many local lumber yards and rental businesses rent small insulation blowing machines, but these machines may not be strong enough to achieve a high-enough density to prevent settling when installed in walls.

Approximate R-Values per inch for materials

Insulation Type	R/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
Open-cell polyurethane foam (spray or pour filled)	3.6–4.0 ¹
Closed-cell polyurethane/polyisocyanurate foam	5.5–6.5 ³
Extruded polystyrene foam board (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 insula-

tion is a moisture and air barrier, unlike fibrous insulation. Foam sheets can be used to insulate masonry walls and serve as insulated sheathing 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.

Be sure to complete any air sealing work before installing insulation. Air sealing is much more difficult after insulation is already in place.

Attic insulation

Insulators blow loose-fill insulation into attics using an insulation-blowing machine. It is inexpensive and easy to install. If your ceiling has less than 10 inches of insulation (R-30), adding insulation to achieve at least R-49 is an excellent investment.

Before working in an attic, examine it for the presence of Vermiculite. Vermiculite is a lightweight mineral insulation with broad commercial applications. Between roughly 1920 and 1990, builders commonly used it as a pour-in attic insulation in homes. You can easily identify vermiculite by its large granular properties, and gray-brown or silver-gold color. Several locations in Montana manufactured vermiculite in insulation, and some product may have been imported into the state as well. However, you should assume that vermiculite manufactured under the trade-names Zonolite or Karstolite and certain other brands contains asbestos fibers. The EPA cautions that ALL attic vermiculite should be left undisturbed until testing confirms that it does not contain asbestos. Your strategies may include leaving the stabilized vermiculite product in-place and adding new insulation on top of it, or having the ver-

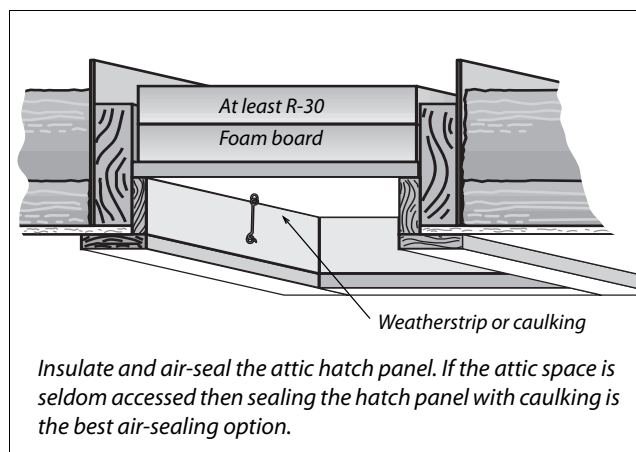
miculite safely removed by a professional. See “*Finding More Information*” on page 42 for resources about dealing with vermiculite and asbestos.

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.

Before closing up the attic hatch be sure to add several inches of foam board insulation to the top side of the attic hatch panel. Then use adhesive weatherstripping, mechanical fasteners, or caulking to air-seal the attic hatch.

Also install baffles at the perimeter of the attic. Baffles prevent insulation from falling into the soffit and blocking the attic ventilation. Build an attic dam around the attic hatch to keep attic insulation from falling into the opening. And if your ceiling has recessed lights rated for insulation contact (IC), those should be air sealed and covered. If they are not IC-rated, consider replacing them with fixtures that are IC-rated and airtight.

Attic hatch



Wall insulation

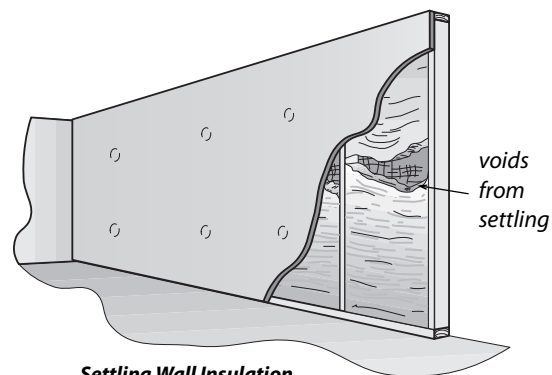
Wall insulation for existing homes must usually be blown in through a hole in the wall's exterior or

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. Fill tubes work best when the wall cavity has at least 2" of air space that needs to be insulated. Avoid insulating wall cavities that contain knob-and-tube wiring, or that are used as returns for the heating system.

Most home walls, built in the past 40 years, are insulated with fiberglass batts. The most common batt is the 3.5-inch-thick R-11 batt. Newer 3.5-inch high-density batts have up to an R-15, due to containing more insulation fibers. Newer 5.5-inch batts have an R-21 compared to the older style 6.25-inch batts which have an R-19. When these older style batts are compressed into a 5.5 inch wall cavity, their R-value is reduced to 17.8. When using batts to insulate your new home's walls, ask for the newer and better types.

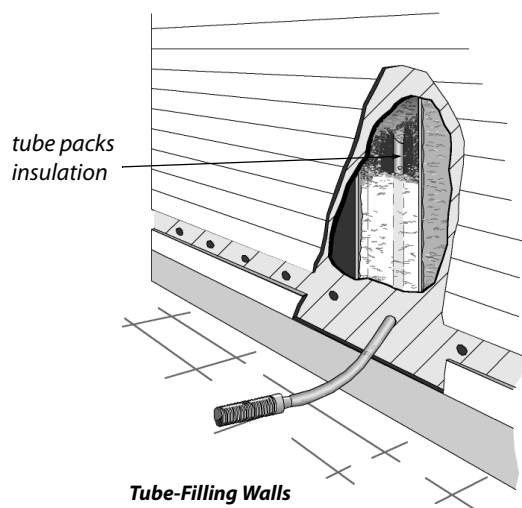
Re-siding or repainting of the interior or exterior are good opportunities to blow insulation into uninsulated or partially insulated wall cavities. While these cosmetic improvements are being made, it costs less to patch the holes necessary to blow in the insulation. Foam sheets can be attached to walls 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 from the interior or exterior. 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.

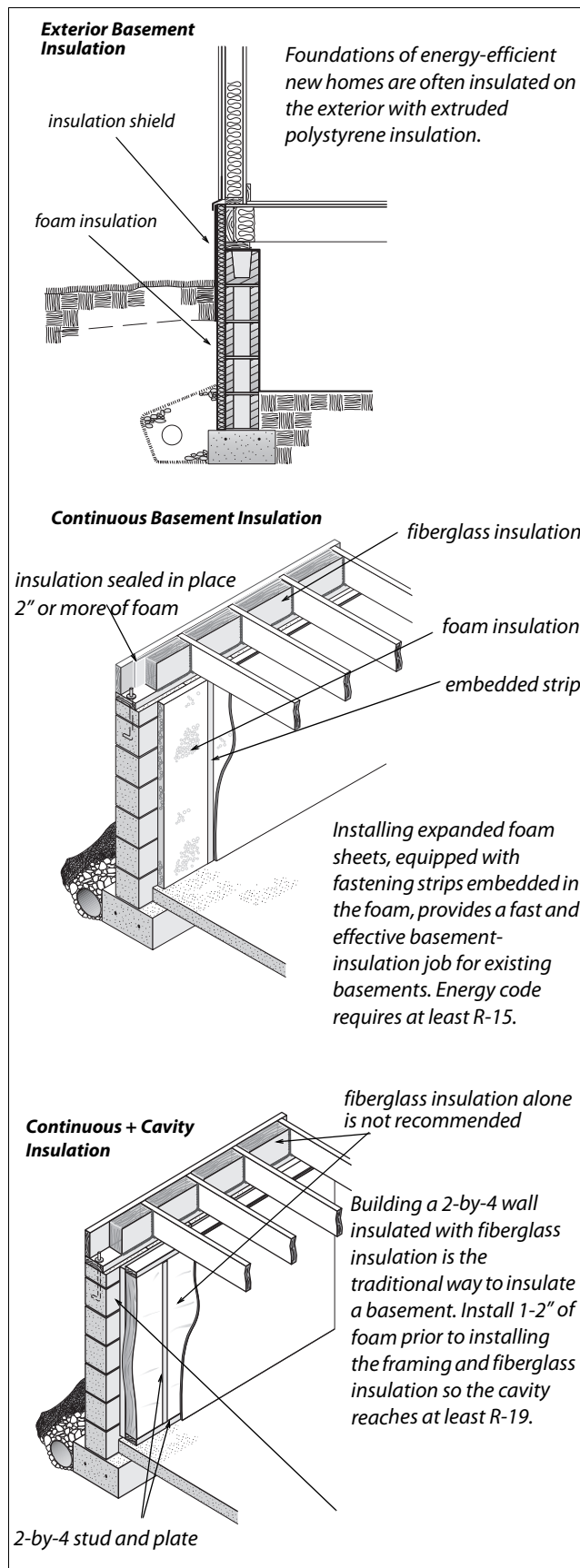
When a home has a heated basement, the basement walls are insulated and the floor above the basement isn't usually insulated. Foundations, insulated on the outside during construction,

require very water-resistant insulation, like extruded polystyrene insulation. See “*Foundations and floors*” on page 36 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. Additional information on crawlspace ventilation is available on the web at <https://deq.mt.gov/energy/programs/code>

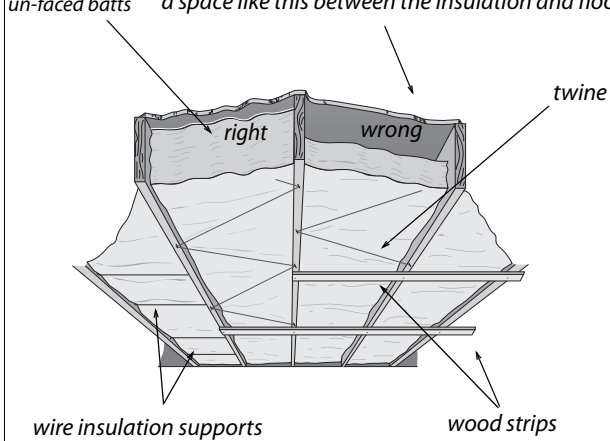
If you insulate the foundation walls of your crawl space, you should close off the foundation vents. If you have furnace or water heater in the crawlspace, see “*Use Caution when Closing Vents*” on page 15. Be sure you have a tight-sealing ground-moisture barrier if you plan to close crawl-space vents, 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. A crawl-space ventilation system is 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.

Insulating basements



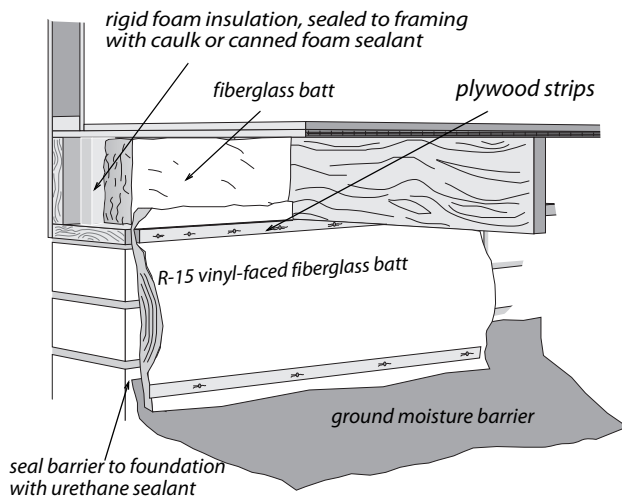
Insulating crawl spaces and floors

Either buy insulation deep enough to fill the cavity, or push the insulation up to avoid creating a space like this between the insulation and floor.



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.

Use Caution when Closing Vents

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 18.

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

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, air can circulate behind the insulation which can lead to moisture problems such as mold. Better options are to install 1 or 2 inches of foam insulation on the concrete wall behind the framed wall, or to use foam panels with embedded wood fastening strips in place of the framed wall. Air can’t circulate behind the foam insulation as it can with a fiberglass insulated 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.

Recommendation: Insulation Improvements

- ✓ Hire a well-respected professional insulator to install wall, ceiling, and floor 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.
- ✓ If your home lacks ceiling insulation, make this your first priority.
- ✓ Increase attic insulation to R-49 if your current attic R-value is less than R-30.
- ✓ Install foundation or floor insulation if your home currently lacks foundation or floor insulation.
- ✓ Make sure that you or your insulation contractor seal air leaks in the attic before adding insulation as shown in the illustration "Air leakage into attics" on page 9.

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.

5. Improve Your Heating System

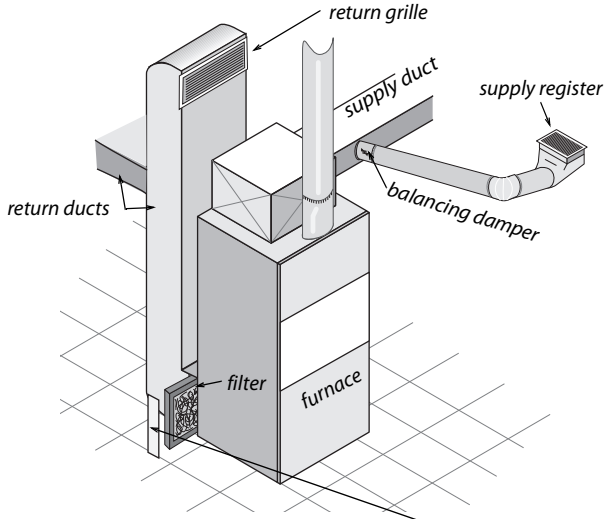
Between 60 and 70 percent of Montana homes are heated by natural-gas or propane furnaces. A furnace consists of a metal box connected to supply and return ducts. Inside this box are a large fan and a heat exchanger, where the gas burners

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 grille 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 loss, 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.

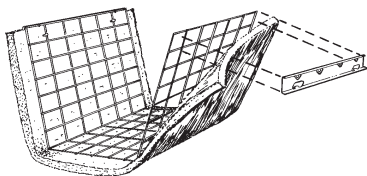
Sealing supply leaks without sealing return-duct leaks can create a vacuum in your furnace room, causing your chimney to backdraft. Backdrafting occurs when the combustion gases flow out into the room instead of up the chimney. This potential backdrafting problem is one good reason to have your ducts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

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. Montana energy code requires sealing with duct mastic or UL-181 tape when duct work is repaired or replaced. Duct mastic is available in buckets and caulking tubes from heating wholesalers.

All supply and return ducts should be insulated and air-sealed whenever they are located in any un-conditioned crawl space, unoccupied basement, or attached garage.

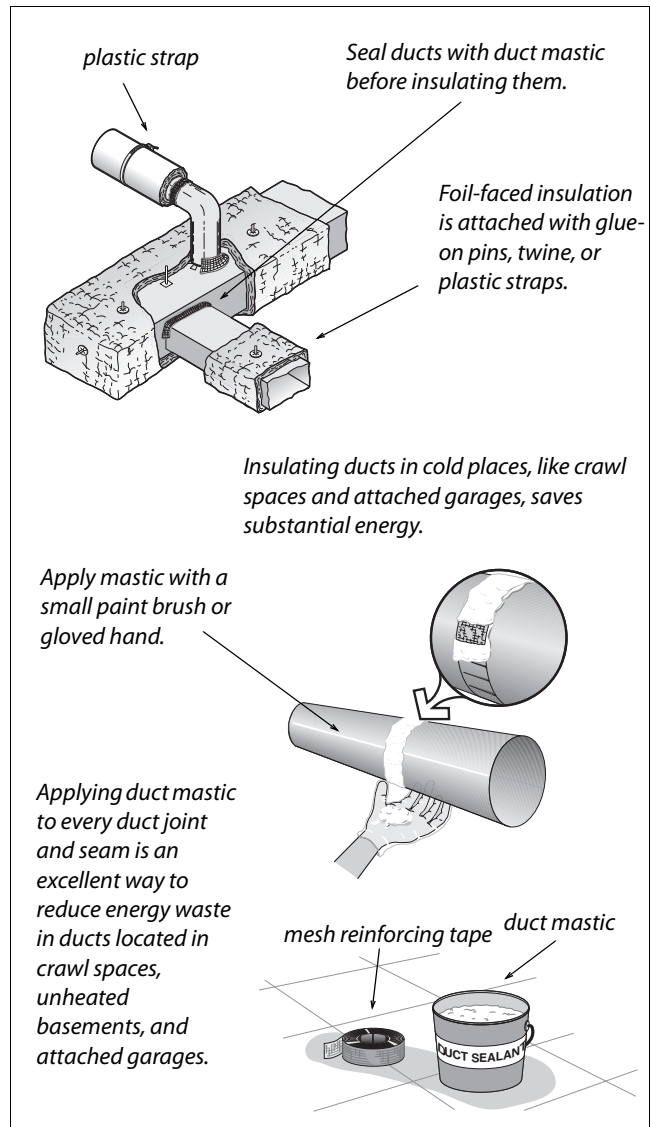
Locating air filters

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.



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

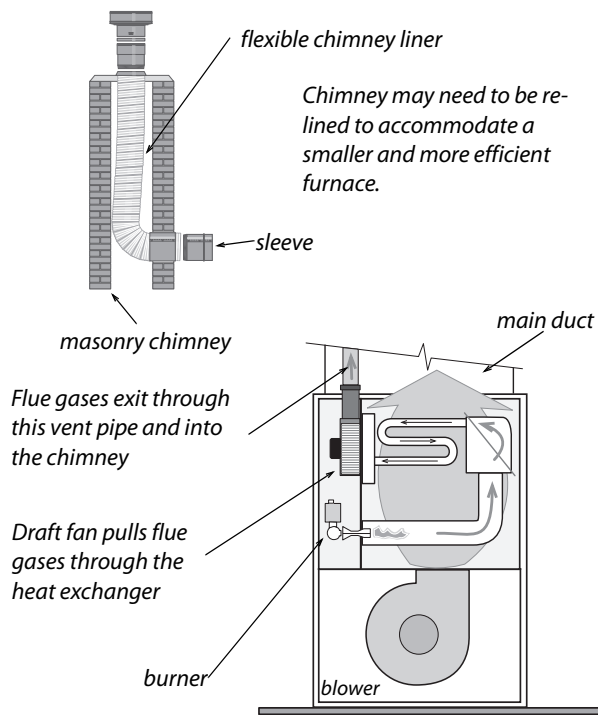
Sealing and insulating ducts



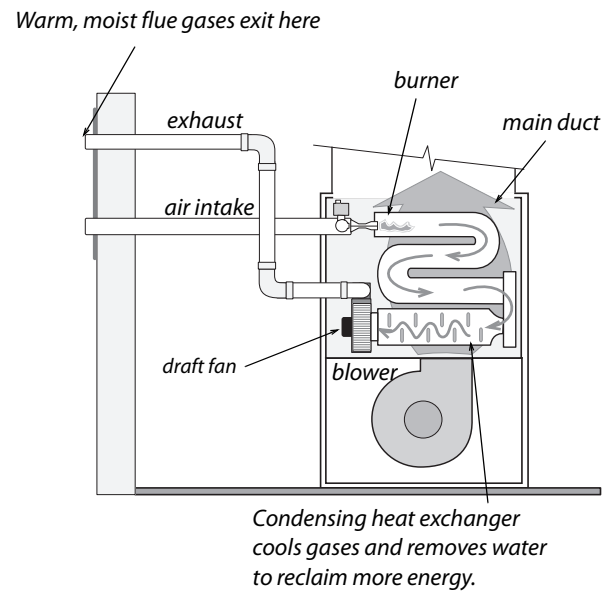
Recommendation: Duct Improvements

- ✓ Seal and insulate all supply and return ducts that are located in crawl spaces, unheated basements, or attached garages.
- ✓ Use effective materials: Duct mastic is preferred for most duct air sealing. If used, duct mastic should be clearly marked UL-181A or B. Montana energy code requires sealing with duct mastic or UL-181 tape when duct work is replaced or repaired.

Comparing 80+ and 90+ Furnaces



80+ Furnace With its Re-Lined Chimney



90+ Furnace With its Plastic Vent and Air Intake

Ensuring Your System's Safety

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.)

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

Recommendation: CO Alarms

- ✓ 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 each floor of your home.

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 24 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 the better option by far. When estimating your heating-cost reduction, remember to subtract the baseload gas usage as described in “*Know Your Energy Dollar*” on page 6.

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 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.

Mini-Splits for Heating and Cooling

Mini splits use electricity and heat pump technology to provide heating and cooling and allow you to control the temperatures in individual rooms or spaces. Mini splits have two main components: an outdoor compressor/condenser, and an indoor air-handling unit. A conduit, which houses the power cable, refrigerant tubing, suction tubing, and a condensate drain, links the outdoor and indoor units.

The main advantages of mini splits are their small size and flexibility for zoning or heating and cooling individual rooms.

Since mini splits have no ducts, they avoid the energy losses associated with ductwork of central forced air systems. Duct losses can account for more than 30% of energy consumption for space conditioning, especially if the ducts are in an unconditioned space such as a garage or attic.

The installer must also correctly size each indoor unit and judge the best location for its installation. Oversized or incorrectly located air-handlers often result in short-cycling, which wastes energy and does not provide proper temperature or humidity control. Too large a system

is also more expensive to buy and operate. For more information on mini-split heat pumps and air conditioners follow this link:

https://www.energystar.gov/products/heating_cooling/ductless_heating_cooling

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.

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 grilles, located in central living areas with no return air grilles 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 grille outside the bedroom, producing a positive pressure in the bedroom.

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.

Hydronic Systems

Many homes in Montana have hydronic heating systems that use warm water, heated by a boiler, that circulates through radiators, baseboards, or

floors to heat the living spaces. It is a very comfortable heat, but it has a slower response time than forced air heating systems.

Choosing a New Boiler

New high-efficiency condensing gas boilers can save a lot of energy for customers in newly built, energy-efficient homes. Condensing boilers save energy by circulating lower-temperature water than conventional boilers. To use your existing radiators effectively with a condensing boiler, you may need to add insulation, perform air sealing measures and have very efficient windows.

If you need to replace your current boiler, a condensing boiler might not be your best choice. An 80+ percent efficient boiler is cheaper than a condensing boiler, and more suitable for delivering water to your existing radiators at a higher design water temperature. However, if your existing boiler is already near 80 percent AFUE, the savings available from boiler replacement may not be enough to make the investment worthwhile.

There are a few other ways to improve efficiencies in existing hydronic (boiler) systems. Outdoor temperature resets can help the boiler in existing houses anticipate changes in temperature demand, but they need to be set correctly for the hydronic system. And insulating the hydronic distribution pipes will keep heat directed to the spaces where it's needed.

Recommendation: Heating System Service and Replacement

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

- ✓ Ask your heating contractor to select an ENERGY STAR furnace. This new furnace should have an AFUE greater than 95 percent and have sealed combustion.
- ✓ Montana energy code requires a home heating load calculation prior to system replacement. This sizing should account for energy-efficiency improvements you've made to the building shell, so your new heating system may be smaller than your old one.
- ✓ Confirm that any chimney problems associated with the new furnace's installation are solved during replacement.
- ✓ The contractor should install additional return ducts or supply ducts to improve air distribution, if needed. Montana code requires that new or replaced duct sections be sealed with mastic.
- ✓ Main supply and return ducts should be fastened to the furnace with screws on all sides and then sealed 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.
- ✓ 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.

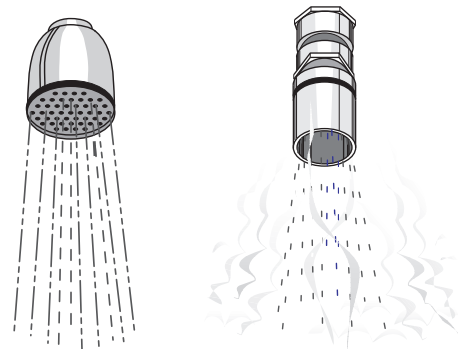
6. Cut Water-Heating Costs

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.

Water-saving shower heads

Low-flow shower heads save substantial energy when they replace shower heads that consume more than 3 gallons per minute.



Some shower heads produce fine laminar streams.

Some water-saving shower heads produce a misty, steamy shower.

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.

Reducing water-heating energy costs

When you find the setting that corresponds to 120°F, mark it with a permanent marker. Then you can set the water heater at a lower temperature while you are on vacation.

Don't think that the temperature setting is accurate without measuring tap temperature. The top control should be set lower than the bottom control.

Water-Heater Controls

Don't insulate the top of gas water heaters.

Keep insulation away from a gas water heater's gas valve and burner door.

Insulate the top of electric water heaters.

Remove small rectangles over the elements and controls of electric water heaters.

Water-Heater Insulation Blanket

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 inad-

equate. 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.

Replacing Your Water Heater

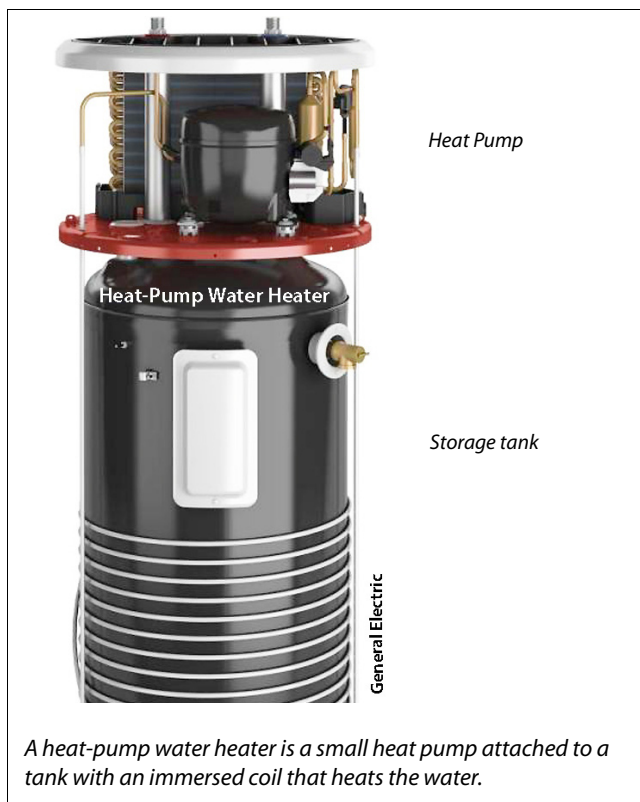
Standard new water heaters have an inch of foam insulation installed between the inner tank and outer shell. However, the better gas water heaters have 2 inches of foam insulation (R-12 or more), and better electric models have 3 inches of foam (R-18 or more). If your water heater is eight or more years old, it may be time to replace it. A tank leak or other failure will force you to settle for whatever replacement you find at the store, likely 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.

Tankless Water Heaters

Tankless or instantaneous water heaters provide heated water only when needed, thereby reducing standby losses. They can provide unlimited heated water if operating within their capacity. They can provide heated water to remote rooms and less water is wasted waiting for heated water to reach a remote faucet. Installing a tankless water heater can save 10-30 percent on your water-heating bill.

However, tankless water heaters may have problems with mineral buildup in areas with hard water. Mineral buildup will reduce the efficiency of the heat exchanger. So regular maintenance is required. These water heaters are also expensive and may be more expensive to install than regular water heaters.

Heat-pump water heater



Heat-Pump Water Heaters

Heat-pump water heaters use electricity and heat-pump technology to remove heat from the air and transfer that heat to water. They can be two to three times more energy efficient than conventional electric resistance water heaters. To move the heat, heat pumps work like a refrigerator in reverse.

While a refrigerator pulls heat from inside a box and dumps it into the surrounding room, a stand-alone air-source heat-pump water heater pulls heat from the surrounding air and dumps it, at a higher temperature, into a tank to heat water.

Heat-pump water heaters require installation in locations that remain in the 40 – 90°F range year-round and provide at least 1,000 cubic feet (about 10 ft X 12 ft) of air space around the water heater. Install heat-pump water heaters in a space with excess heat, such as a furnace room. Heat-pump water heaters will not operate efficiently in a cold space. They tend to cool the spaces they are in. Most can be set to electric-resistance heat only and not operate as a heat pump, if necessary.

Recommendations: Water Heating

- ✓ 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 (\$50 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.

When buying a new refrigerator or freezer, observe the following guidelines.

- 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.

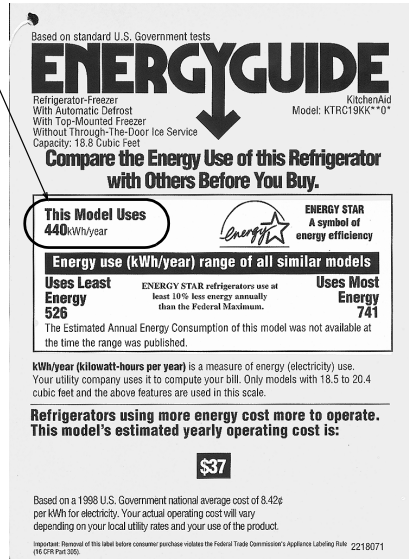
City landfills and other disposal facilities are required to recycle refrigerators in a way that prevents the refrigerant vapor from escaping into the atmosphere where it could damage the earth's ozone layer. Be sure to ask how to dispose of your old refrigerator at the disposal facility.

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 1,000–1,500 kilowatt-hours annually.

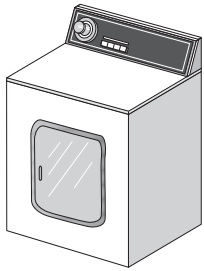


Energy Guide Labels are posted on all major appliances before they are sold. They help you compare the annual energy use or cost of the labeled model to its competitors.

Savings in the Laundry

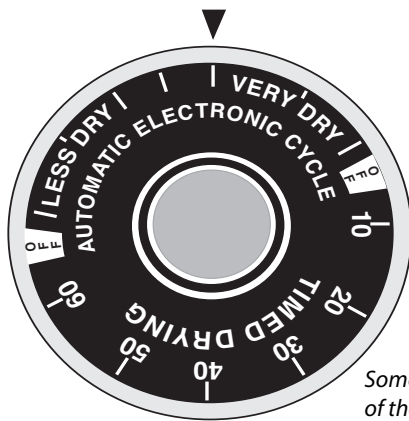
Front-loading clothes washers use far less energy and water than top-loading machines. In fact, you can save up to 60 percent of the energy, 40 percent of the water, and 20 percent of the detergent with a front-loading machine versus a top-loading one, according to recent field tests. Someday, we'll 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 Washer

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



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 one and one-half times 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 shorten drying time and save energy. Smooth vent pipe has far less airflow resistance. 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.

Recommendation: Laundry

- ✓ Use cold water whenever possible. Clothes washers often perform as well with cold water as with warm or hot water, especially with lightly soiled clothes.
- ✓ Run full loads in your clothes washer and dryer.
- ✓ 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.

Buying Appliances

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 42 for ordering information.

Recommendation: Buying Appliances

- ✓ 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.

Large Users of Electricity

Appliance	Usage kWh/year*	Annual Cost**
Ten-year-old refrigerator or freezer	1250	\$125
New ENERGY STAR refrigerator or freezer	550	\$55
Hot tub / spa	2300	\$230
Water bed	1000	\$100
Standard TV	100-1000	\$10-\$100
Large format TV	400-2250	\$40-\$225
Well pump	500	\$50
Furnace fan	500	\$50
Computer	50-400	\$5-\$40
Humidifier	50-1500	\$5-\$150
Engine heater	100-400	\$10-\$40

*Data from Lawrence Berkeley Laboratory and others.
 **Based on 10¢ per kilowatt-hour for electricity.

8. Use Energy-Efficient Lighting

Lighting typically consumes about 15 percent of baseload electricity use. Lighting retrofits are among the easiest to perform. CFLs were a viable replacement choice when compared to incandescent lamps, however the future now belongs to LEDs. LEDs start instantly, tolerate high and low temperatures, are cost competitive, and have a longer service life.

If you replace CFLs, be sure to recycle them properly at stores, municipal waste departments, or other recycling organizations that accept used CFLs.

Light Emitting Diodes (LEDs)

LEDs are the newest type of lighting. Commonly available LED lamps produce more lumens per watt than incandescent or CFLs and these efficiencies continue to improve. Common incandescent light bulbs use 90 percent of their energy for producing heat instead of light. LEDs on the other hand produce very little heat. LED use almost all of their energy to produce light.

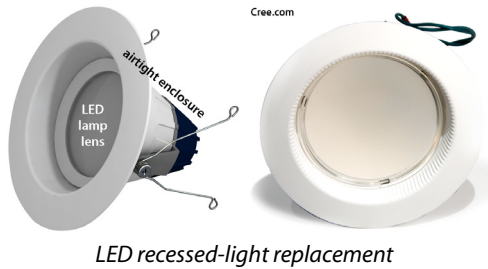


LEDs provide a higher value since you don't have to replace them as often. LEDs last 15-25 years compared to 10 years for a typical CFL and 5 years or less for incandescents. LEDs are also durable. They don't have a filament that can burn out like incandescents, they don't contain mercury like CFLs, and they aren't typically made of glass so they don't break easily.

LED lamps come in variety of styles, lumen outputs, and color temperatures. Install bulbs, fixtures, and controls designed for their intended

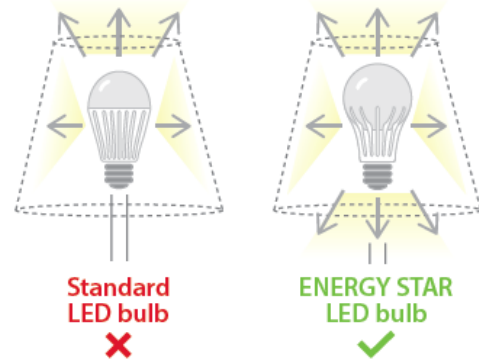
application (for example: enclosed, dimmable, indoor, outdoor, etc.).

Replace incandescent or CFL bulbs in a recessed light fixture use an LED assembly intended for this purpose. The replacement LED should have the correct retainers or clips to match the recessed light fixture assembly. The LED will replace the trim ring of the existing recessed fixture. Choose a LED replacement that has an air sealing gasket on its trim ring. This will help to seal the LED fixture against the ceiling which could potentially save some energy if the existing trim ring isn't air tight.



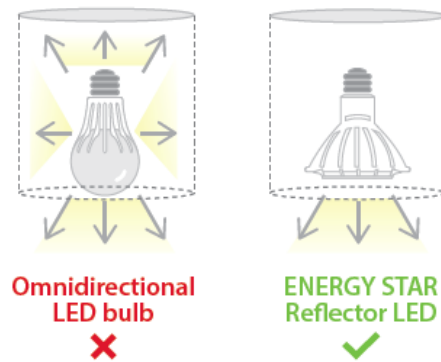
Be sure to look for the ENERGY STAR label when shopping for LED lamps. Not all LED bulbs are ENERGY STAR, which certifies the rated efficiency of the lamps, but also that the lamps are designed correctly for their purpose. The more LEDs that Montanans install, the more energy savings we will achieve from lighting retrofits.

Table lamp comparison



In table and floor lamps, you want the light to shine in all directions, so look for ENERGY STAR-labeled bulbs that are omnidirectional.

Recessed can comparison



For downlights and recessed cans, install ENERGY STAR reflector LED bulbs. The light going upward from omnidirectional bulbs can be wasted inside the fixture.

Wattage vs. Lumens

As consumers we are familiar with watts when shopping light bulbs. We know what wattage bulb is the right one for different tasks. But with LEDs the wattage numbers don't work the same way. There isn't a direct connection between incandescent or CFL wattage and LED wattage. Instead we need to start looking at the lumen output of the lamp. Lumens is a measurement of how much light the bulb emits. Higher lumen output equal more light.

However manufacturers understand that consumers are familiar with wattage. So many LED lamps will display an "equivalent wattage" on the

package. This allows shoppers to understand that the LED will produce the same amount of light (or lumen output) as incandescent lamp with that equivalent wattage.

For example, a 60 watt incandescent bulb produces about 800 lumens. An LED that produces 800 lumens consumes about 8-12 watts. Consumers that are looking for a 60w bulb may not understand that a 10w LED has the same lumens, so they label the box as a “60w Replacement”.

Incandescent/CFL Watts	Equivalent LED Lumen Output
100/25	1600
75/19	1100
60/15	800
40/10	450

Light Color and Temperature

Some people are sensitive to light color. We perceive colors at the blue-green end of the color spectrum as cool and those at the spectrum’s red end as warm. Morning sunlight from the north is a cool blue-green and evening sunlight from the southwest is a warm red-yellow.

Lamp manufacturers design and label lamps with a color temperature (°K), depending on the “coolness” or “warmness” of the lamps. The lower ranges of 2000K to 3000K are considered warm white, while ranges between 3000K and 4500K are considered cool white. Cooler light colors are generally preferred for visual tasks, since cool light produces better illumination and contrast at the printed page, workbench, or other task. People often prefer warm light sources for living spaces, because warm light seems to many to illuminate people’s skin and clothing in a flattering way.

Lighting color is another great advantage of LEDs. The lamps come in various colors, and some can even change color, and color temperature on demand using technologies like smart phones and in-home control devices.

T8 and T12 Tube Lighting

LED manufacturers have also made progress with standard-tube lights. The newer, more efficient LED tubes have the same advantages as standard LED bulbs when it comes to efficiency, color, and color temperature. LED T8 tubes fit into standard fluorescent fixtures. But there are two options for LED tube replacements. Direct Wire and Direct Connect.

Direct Wire LED tubes don’t use an external ballast. So you will need to remove or bypass the existing ballast. This makes the replacement more difficult and may require an electrician, but it also means that there is no longer a ballast that can fail.

Direct Connect LED tubes work with existing electronic ballasts. So the replacement is very easy. But there is still a ballast in place that can fail. If the fixture has older magnetic ballast then you will need to remove it and install a Direct Wired LED tube.

So when you consider replacing fluorescent tubes with LED tubes, assess the current fixtures and their types of ballasts so you can choose the correct type of LED tube. Also consider the cost of removing the ballast to allow for Direct Wire tubes vs. the cost of Direct Connected LED tubes and potentially replacing a failed electronic ballast in the future.

Recommendation: Lighting

- ✓ Install LED lamps in every light socket in your home that is used two hours or more each day.
- ✓ Choose LED lamps with the correct lumen output and “equivalent wattage” for the lamp that you will replace.

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 LED torchiere.

Fluorescent torchiere



LED torchieres use about 10% of the energy of halogen torchieres, and are much safer. The best models are dimmable.

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.

Window Moisture

Windows may create water condensation and ice during cold weather. Two factors affect how much condensation occurs.

- The higher the indoor humidity level, the more condensation and ice will form.
- The less a window’s insulating ability, the more condensation and ice will form because the interior window surface will stay cooler.

To reduce window condensation, you can reduce your home’s humidity level, or increase your windows’ thermal resistance, or both. If the humidity is quite high, installing new windows or storm windows may not solve window condensation problems. Instead find and reduce the moisture source—a wet crawl space or a clothes dryer venting indoors, for example.

Selecting Storm Windows

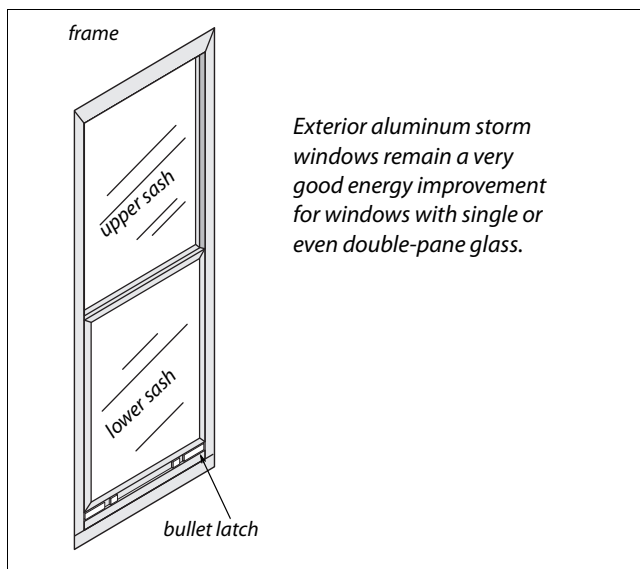
Single-pane glass is a prolific energy waster in northern climates. More layers of glass or clear plastic will slow heat loss, reduce energy costs, and increase comfort compared to single-pane glass.

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.

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.

Exterior aluminum storm window



Recommendation: Existing Windows

- ✓ If you have old double-hung windows, be sure that each one has an exterior storm window to save energy, improve comfort, and protect the primary window from the elements.
- ✓ Confirm that your 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. Fixed 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. Check with the manufacturer of your windows to make sure their warranty won't be voided by the use of externally mounted storm windows.

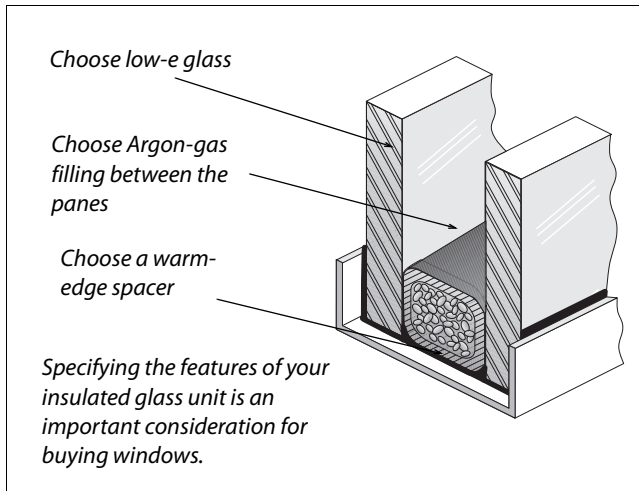
Interior storm windows are usually more airtight than exterior storm windows, but they don't protect the primary window from weather. Their glazing material is usually clear plastic, which loses transparency with exposure to ultraviolet sunlight over the years. In some temporary applications, plastic 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 windows 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.

Insulated glass unit (IGU)



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.

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.

The lower the U-factor is, the better the window minimizes heat loss and moisture condensation during cold weather. A U-factor of 0.30 is considered the maximum U-factor (heat loss) acceptable for cold climates. Single-pane glass has a U-factor of about 1.0. Double-pane insulated glass units (IGUs) with a low-e coating on one of the panes have become standard for new and retrofit installation. A low-e coating is a thin metal coating that reduces heat loss through the IGU. Argon gas filling between the panes instead of air drops the U-


factor to around 0.30, which is an R-value of more than 3.3. Double-pane, triple-pane, and even quad-pane windows with insulated fiberglass casings are available at higher costs, giving U-factors of 0.08, which is R-12.5. Some manufacturers use plastic films as interior panes of these multi-pane windows.

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 special 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 brand names: Sungate 2 and Low-e². 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.

Consumers often buy new windows without thinking whether that purchase is cost-effective. Because of their high material and installation costs, replacing your windows usually has a payback of 20 years or more, making it one of the least cost-effective energy measures discussed in this booklet.

National Fenestration Rating Council Label



National Fenestration Rating Council
CERTIFIED

World's Best Window Co.
Millennium 2000+ Casement
Vinyl-Clad Wood Frame
Double Glaze • Argon Fill • Low E

ENERGY Performance

- Energy savings will depend on your specific climate, house and lifestyle
- For more information, call (manufacturer's phone number) or visit NFRC's web site at www.nfrc.org

Technical Information				
	U-Factor	Solar Heat Gain Coefficient	Visible Transmittance	Air Leakage
Res	.32	.45	.58	.3
Non-Res	.31	.45	.60	.3

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product energy performance. NFRC ratings are determined for a fixed set of environmental conditions and specific product sizes.

Observe top row only; bottom row contains commercial ratings.

U-factor

Solar heat gain coefficient

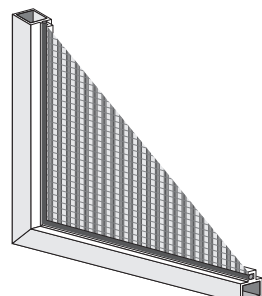
Visible transmittance

Air leakage (optional)

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

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.

Recommendation: Buying Windows

- ✓ 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.
- ✓ If you do plan to buy windows, spend the extra money to buy premium windows that bear the ENERGY STAR label.
- ✓ 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.

The keys to staying cool during hot weather without air conditioning are shading and reflectivity. Indoor comfort is less dependent on the temperature outside and more dependent 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.

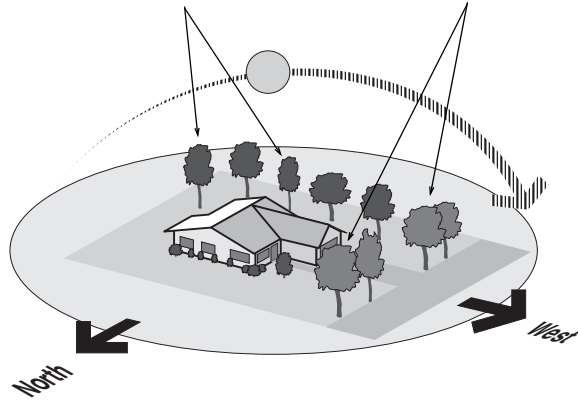
10. Be Cool Without Air Conditioning

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 p.m. has created electricity shortages and

Where to plant trees

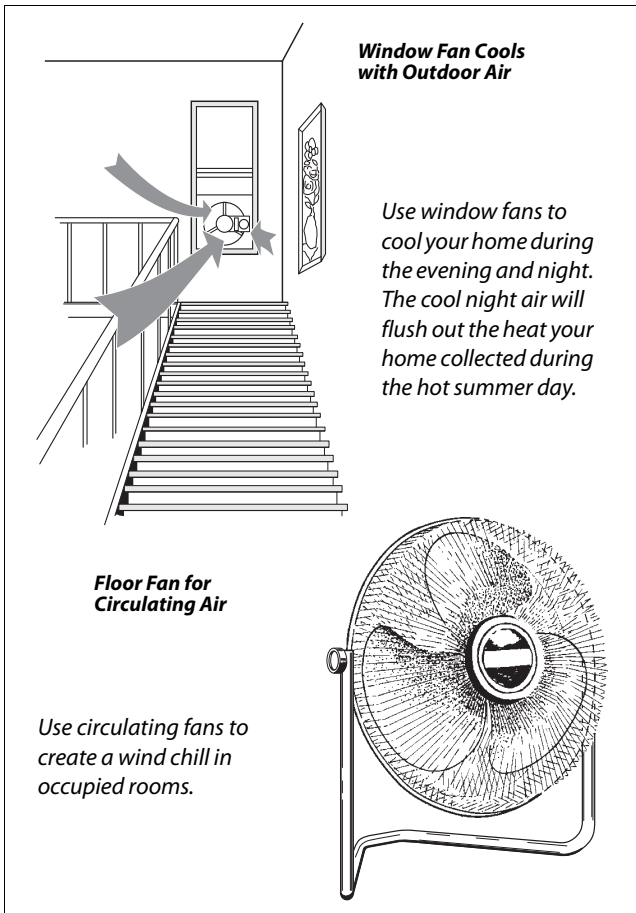
Plant tall leaf-bearing trees 10 to 15 feet away from the south-facing side of the home to block solar heat from high in the summer sky.

Plant wide trees 15 to 30 feet away from the home's west side to block low-angle solar heat during hot summer afternoons.



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

Two ways to use fans for cooling



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.

Recommendation: Low-Cost Cooling

- ✓ Provide shade for your sunniest windows by planting trees, or installing awnings and sunshades.
- ✓ Use fans as an alternative to air conditioning.

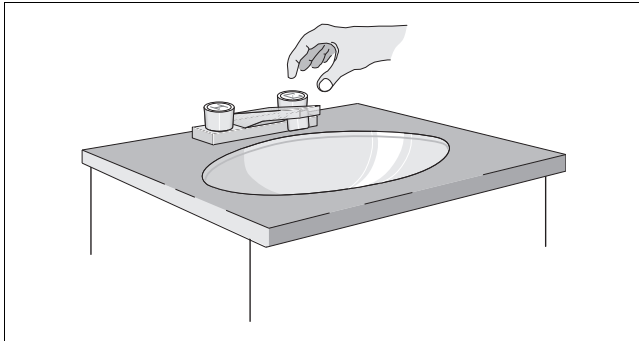
11. Use Energy Wisely

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.

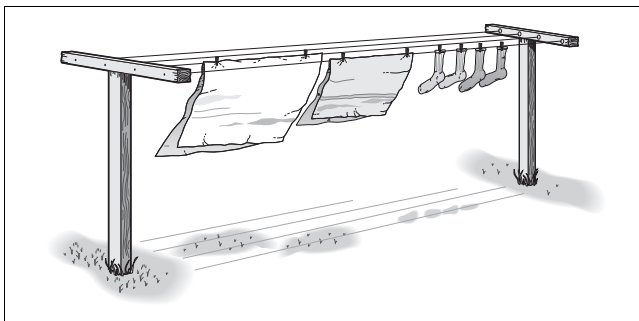
- Reach for the cold-water tap unless you need hot water.

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.
- Use a watt-hour meter to measure the standby consumption of electrical devices. Unplug the larger consumers when not in use or use a power-strip to control the power. Some devices need continuous power to maintain programming, such as clocks or channel settings.

Dry clothes outdoors on a clothesline



12. Building a New Home

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 statewide 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.

Ways to Show Energy Code Compliance

There are two primary ways to demonstrate that residences meet the requirements of the statewide Energy Code.

1. Build the home to meet or exceed the prescriptive values shown on the ECC label on page 35.
2. Perform a REScheck™ computer analysis to show compliance (a free download at www.energycodes.gov). This method requires inputs of areas and efficiency levels for ceilings, walls, floors, windows, and doors. Generally, installing more windows requires higher insulation levels.

Montana law requires all new homes to display the Energy Code Compliance label, placed in or on the main electrical breaker panel.

Montana's new-home ECC label

ENERGY CODE COMPLIANCE LABEL		
Address: _____		
Ceiling:	Flat	R - <u>49</u>
	Vaulted	R - <u>38</u>
Walls	Above grade walls	R - <u>21</u>
	Basement walls	R - <u>19/15</u>
	Crawlspace walls	R - <u>19/15</u>
Floors:	Over unheated spaces	R - <u>30</u>
	Perimeter slab for <u>4</u> feet	R - <u>10</u>
	Under slab for _____ feet _____ full	R - _____
Exterior doors:		U - <u>.30</u>
Windows:	NFRC unit rating	U - <u>.30</u>
Water heater:	Energy factor (EF) rating _____	
Heating system:	Energy efficiency rating <u>80%</u> (AFUE for gas; HSPF heat pump)	
Cooling system:	EER _____ SEER _____	
Heating ducts:	Systems sealed: <input checked="" type="checkbox"/> Yes per code	
	In non-conditioned areas insulated to	
	Supply R- <u>8</u> Return R- <u>6</u>	
	Leakage test at rough in _____ or final _____ results _____ CFM 25 per 100 sq. ft or N/A _____	
Air Sealing:	Blower door test results <u>4</u> ACH 50	
Whole house mechanical ventilation:	_____ Yes per code	
Other (i.e., radon mitigation, solar ready)	_____	
_____ _____ _____		
Builder: _____	Date: _____	
Signature: _____		
<small>The builder or representative certifies compliance with ARM 24.301.161 and MCA 50-60-802, by completing and signing this label. March 2021</small>		
THIS LABEL MUST BE PERMANENTLY AFFIXED BY HOME BUILDERS TO THE BREAKER PANEL ON ALL NEW RESIDENTIAL BUILDINGS, AS REQUIRED BY SECTION 50-60-803, MONTANA CODE ANNOTATED AND 2018 IECC – SECTION 401.3		
<i>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-factors you can afford.</i>		

Help for New-Home Buyers

A better-than-code house, using the features discussed in this guide, 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. Depending on your lender, you may be able to finance the extra cost

with an Energy Efficient Mortgage. Ask your lender about the program.

We suggest going to: *Database of State Incentives for Renewables & Efficiency* website to search for tax credits, rebates, and other incentives — www.dsireusa.org

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

Rising energy costs have 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 new-home energy programs. An ENERGY STAR home is more efficient than a minimum energy code home and is certified by an independent rater. For more information visit: <https://www.energystar.gov/newhomes>

Recommendation: New Homes

- ✓ When building a new home, use airtight construction, high levels of insulation, and an efficient heating system to provide superior energy-efficiency.
- ✓ Install a central ventilation system to improve building durability and protect indoor air quality.

All new houses in Montana must meet the requirements of the energy code, the 2018 International Energy Code (2018 IECC) with Montana amendments. Exceptions are buildings that are neither heated nor cooled and buildings that are classified or determined to be eligible for listing in the National Register of Historic Places. To find out about the new energy code go to https://deq.mt.gov/files/Energy/Documents/Energy_Code/Residential_Energy_Code_Summary.pdf.

A new energy code became effective February 13, 2021 and contains some significant changes over previous versions of the code.

- More efficient windows and doors with a minimum U factor of 0.30
- Combustion closets (sealed and insulated separate room) required for open combustion appliances, such as typical gas water heater.
- At least R-5 insulation required under entire heated slab-on- grade floor.
- At least 90 percent of the home's permanent light fixtures must have high efficiency bulbs such as LEDs.
- Building cavities used as heating ducts must be tested for tightness.

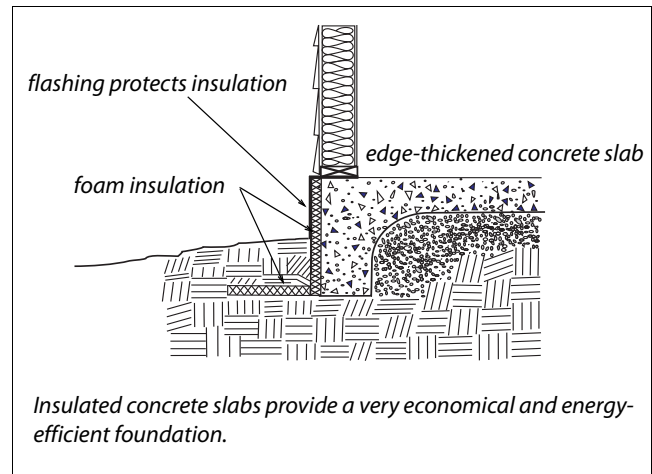
Contact the DEQ or go to:

<https://deq.mt.gov/energy/resources> for more information on the code or for tax credit details.

Foundations and floors

Finishing the basement wall is not required by the energy code, but installing insulation on the exterior or interior of the basement wall is required. The Energy Code Path requires framed basement walls to be insulated to at least R-19. Non-framed walls such as those with exterior foam insulation or interior walls with continuous insulation must be insulated to at least R-15. Note that a REScheck analysis may qualify a house with a lower level of basement insulation.

Frost-protected shallow foundation



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

The Energy Code Path requires crawlspace walls to be insulated with at least R-15 continuous insulation, or R-19 cavity insulation if a framed wall is installed on the inside the foundation. See "Insulating basements" on page 14 for more details. If the floor above is to be insulated then at least R-30 is required in the floor cavities. The Energy Code further requires that if the floor above the crawlspace is not insulated and the crawlspace walls are insulated, then the crawlspace cannot be ventilated to the exterior with traditional crawlspace vents. Rather, the code calls for continuous exhausting of air from the crawlspace at a rate of 20 cfm (cubic feet per minute) for each 1,000 square feet of crawlspace, or to supply conditioned air into the crawlspace. The code requires installation of a pathway, usually a transfer grille open to the floor above. It also requires that the ground be covered with a continuous vapor retarder, sealed at joints and extending at least 6 inches up and sealed to the foundation wall. Consider radon resistant construction methods when planning new home construction. Additional radon and crawlspace ventilation

information is available at:
<https://deq.mt.gov/energy/programs/radon>

Also for more information see “*Floor / Foundation Insulation*” on page 13.

The Energy Code Path requires the ceiling of tuck-under garages, a feature in some new homes, to be insulated to at least R-30. The insulation must be in contact with the subfloor; a better home will use R-38.

Insulated concrete forms



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

Above ground walls

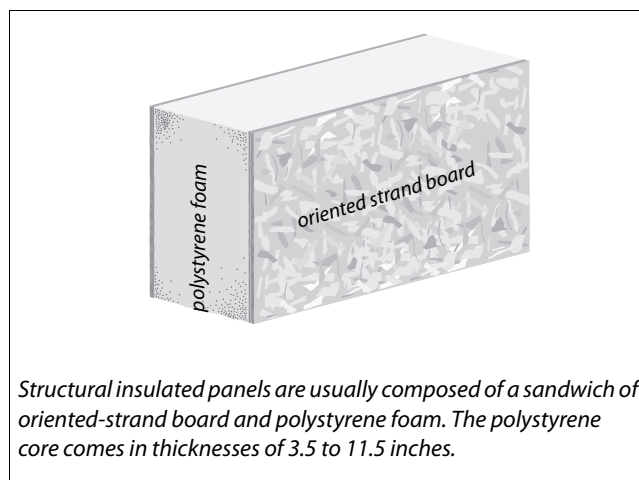
The Energy Code Path requires a minimum insulation level of R-21 — normally achieved by a 2-by-6 wood wall, using the high-density 5.5-inch fiberglass batt. A better house will have an R-25 wall or higher. Wood has a relatively poor insulat-

ing 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. To reduce the flow of heat through wooden wall studs, consider insulated foam sheathing as an exterior or interior cladding, or both.

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.

Windows

The typical home loses about 25 percent of its heat through windows. The Energy Code Path requires windows and doors with at least a U-.30 rating. A more efficient house will have a U-.28 rating or better with an ENERGY STAR rating. A

rule of thumb for a better house is that window area should not exceed 15 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 30 for more energy-efficient window information.

Roofs

The Energy Code Path requires a minimum insulation level of R-49, or R-38 if achieved in the entire attic. Standard roof trusses limit the amount of insulation that can be placed directly over the outer wall. A raised-heel or energy truss allows for 12 inches or more of insulation to be placed over the outer wall. Before installing attic insulation, make sure to complete the code required attic air sealing, illustrated in *"Energy Code Air Sealing and Energy Code Path Insulation Requirements"* on page 40.

Air Barriers

Uncontrolled air leakage in the building envelope can significantly increase heating bills, allow warm moist interior air to enter building cavities, with potential for moisture damage, and cause uncomfortable drafts. Therefore, the energy code requires an air barrier to control air leakage. An air barrier is a material, or assembly of materials, that reduces air flow through or into the building envelope. See the diagram on page 40 for required air-sealing locations that make up a complete air barrier. The Montana Energy Code requires compliance with the Air Barrier and Insulation Installation requirement, and requires that the house tightness be tested with a blower door to show air leakage of four air changes per hour or less when tested at 50 Pascals — (4 ACH50). Where the blower door test is required by the code official

the test should be conducted by a third party, a trained worker should do the blower door test.

A blower door test measures the airtightness of a house and tells you how effective the air barrier is at stopping air flow through the building's envelope. To conduct a blower door test, a technician installs a large fan assembly in an exterior doorway. During the test the blower door fan draws air out of the building and the technician measures the volume of air moving through the fan. This measurement is an indicator of how tight or leaky the building envelope is.

Insulation

To form a complete thermal boundary the home's air barrier should be in substantial and continuous contact with the insulation. The energy code requires that wall insulation be installed to fit around obstructions like wiring and plumbing, and that locations like wall corners and headers be insulated. In the attic, insulation depth markers must be installed so the insulation depth can be seen from the attic access. In ventilated attics, eave baffles are required to keep insulation from falling into the eaves and blocking soffit ventilation, and to prevent wind from disturbing the attic insulation.

Heating Systems

The Montana Energy Code requires heating and cooling systems to be designed using ACCA Manuals J and S or other approved methods. In the past many heating and air conditioning systems were substantially oversized, resulting in increased installation and operating costs.

An energy efficient home will have a properly sized ENERGY STAR-certified heating and cooling system. Make sure to demand a furnace with at least a 95 AFUE or boiler with at least a 90

AFUE. See “*Consider Heating-System Replacement*” on page 18.

The code requires all joints and connections in the ductwork to be sealed with mastics or tape. Note that regular duct tape does not meet the code requirements. Building cavities cannot be used for supply ducts. All ducts, both supply and return, located outside the conditioned boundary must be insulated to at least R-6. Supply ducts in non-conditioned attics must be insulated to at least R-8. Heating system ductwork and air handlers that are located outside of the conditioned boundary, such as in the attic or garage, must be tested for air-tightness. Duct testing is not required if all ductwork and the air handler (furnace cabinet) are located within conditioned space.

Mechanical system piping such as boiler or cooling (AC) system piping that is capable of carrying fluids above 105 degrees F or below 55 degrees F must be insulated to at least R-3. Circulating hot water system piping must be insulated to at least R-3. These systems must also include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not operating. See pages 8 and 9 of the *Residential Building Energy Code Summary* for more details.

Mechanical Ventilation

An energy efficient house is sealed for comfort and efficiency; therefore, it is important to intentionally ventilate a home in a controlled way. Code required mechanical ventilation options range from an upgraded 30 to 120 cubic feet per minute (cfm) bathroom fans or a centrally located fan, to heat recovery ventilation systems (HRVs). HRVs bring fresh air into the house and reclaim or recover about 70 percent of the heat from the stale air that is being drawn out of the house. HRVs may be eligible for the Montana energy tax

credit. The energy code sets minimum ventilation rates based on various factors. Refer to the *Residential Buildings Energy Code Summary* booklet for how to calculate those rates.

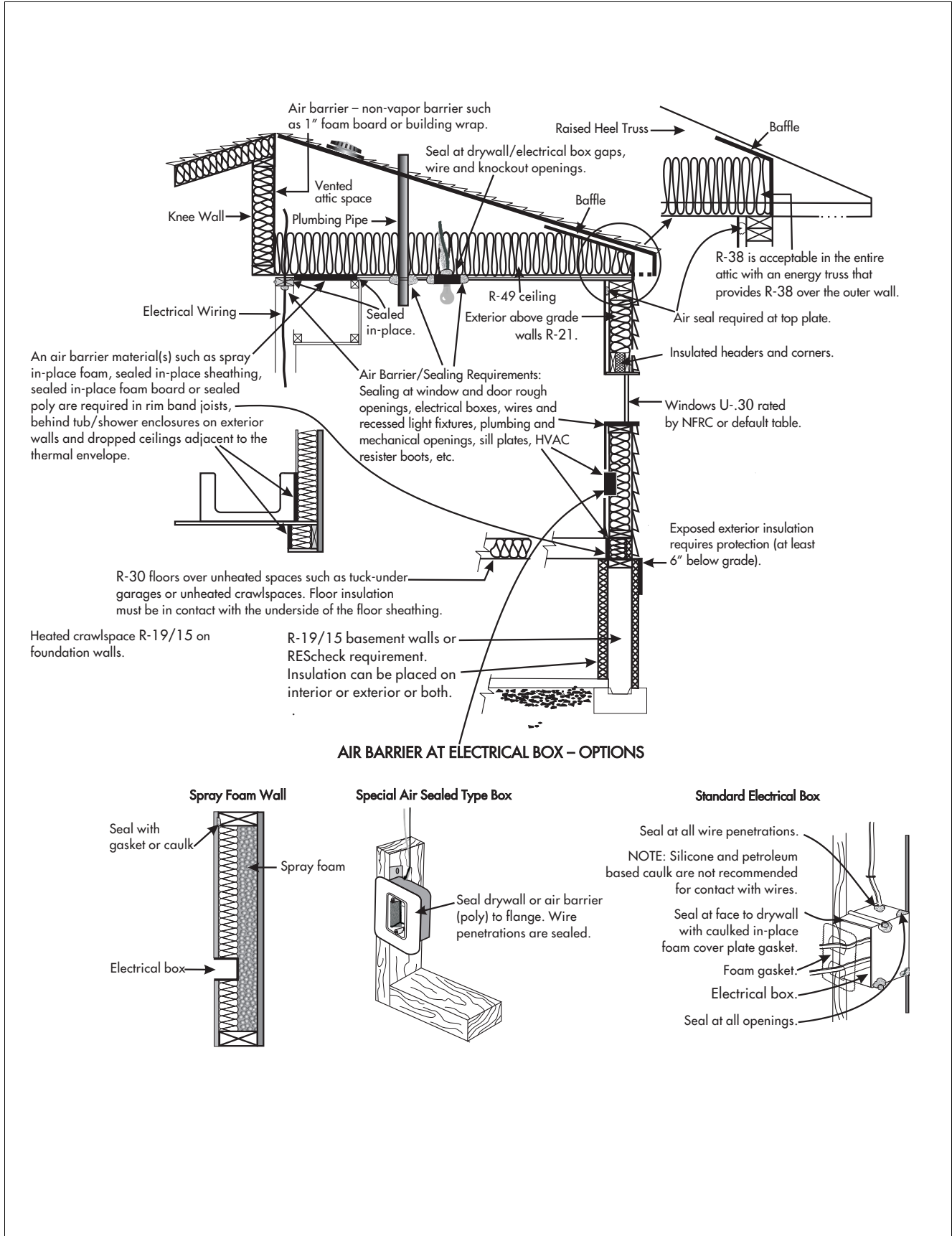
Lighting Requirement

At least 90% of the permanent installed lighting fixtures must have high-efficiency bulbs (need not be installed fixtures) which include compact fluorescent (CFL), T-8 or smaller linear fluorescent or LED, or lamps with a minimum efficacy of 60 lumens per watt if over 40 watts, 50 lumens per watt if 15 to 40 watts, and 40 lumens per watt if 15 watts or less. The code requires recessed lights which are installed in a ceiling with unheated attic space above to be airtight IC-rated fixtures. These fixtures must be sealed or gasketed to the ceiling or have an airtight assembly built around them to prevent air leakage into the attic around the fixture. Look for the ENERGY STAR seal on these light fixtures. Follow manufacturer's recommendations and check with the manufacturer before adding seals to any recessed light fixture.

Federal Residential Renewable Energy Tax Credit

A federal income tax credit of 26% for systems installed in 2021 and 2022, of expenses (material and labor) of a solar PV, solar water heating system, a wind turbine no larger than 100 kilowatts, geothermal heat pump and wood or pellet stoves of at least 75% efficiency is available to individuals, with no upper limit. For individuals, the system does not have to be installed on the taxpayer's principal residence. Excess credit generally may be carried forward to the next tax year. The Federal tax credit is scheduled to step down to 22% for systems installed in 2023 and expires on December 31, 2023.

Energy Code Air Sealing and Energy Code Path Insulation Requirements



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, search online, 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 ensuring completion and performance, while being fair to the contractor. The payment plan should be part of the contract.
- Confirm the contractor obtains a building permit, if required.
- 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. One is the ENERGY STAR program which provides energy efficiency information about appliances, office equipment, and many other products for work and home through its website: <https://www.energystar.gov/> The other is the Office of Energy Efficiency and Renewable Energy which connects you to a wide range of energy efficiency and renewable energy information at <https://energy.gov/eere/office-energy-efficiency-renewable-energy>

The Montana Department of Environmental Quality (DEQ) maintains a website that informs Montanans about energy and resource efficiency. Visit this website at the following web address:

<http://.deq.mt.gov/energy>

For Montana radon information, call 800-546-0483 or visit the U.S. EPA website:

<http://epa.gov/iaq/radon>

For Montana asbestos information, call 406-444-3490, or visit the Montana DEQ website:

<http://deq.mt.gov/public/asbestos>

For information on incentives and policies for renewables and energy efficiency:

<http://dsireusa.org>

EPA brochure on vermiculite insulation.

<https://www.epa.gov/asbestos/protect-your-family-asbestos-contaminated-vermiculite-insulation>

If you think your home has Zonolite Attic Insulation.

zonoliteatticinsulation.com

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; 6th ed., J. Krigger, Saturn Resource Management, Helena, MT 2014.