Residential Buildings
Energy Code Summary

Overview
Montana homebuyers appreciate the comfort and warmth of a well-designed energy-efficient home. All new houses in Montana must meet the minimum requirements of the 2012 International Energy Conservation Code (2012 IECC) with Montana amendments. This publication is a summary of the 2012 IECC residential provisions with Montana amendments. A copy of the 2012 IECC can be ordered from the International Code Council at www.iccsafe.org or by calling 800-786-4452. For more information regarding the Montana Energy Code please call the Montana Department of Environmental Quality at 406-444-0281 or visit deq.mt.gov/energy.

The current statewide energy code took effect on November 7, 2014. The 2018 International Energy Conservation code with probable Montana amendments may be adopted in 2020. Certified jurisdictions may take up to 90 days from their notification date to adopt the code.

Cities, towns, and counties who choose to adopt the building code are required to enforce the state energy code in their jurisdictions. A listing of certified jurisdictions that have adopted building codes are available at www.buildingcodes.mt.gov. Outside of these building code jurisdictions, builders are required to meet the requirements of the energy code and to show energy code compliance through a self-certification process. This means the builder is required to provide a written statement to the homeowner stating the house meets the state energy code requirements. The home builder may provide this certification by signing and dating the Energy Code Compliance label as shown on page 12 of this document.

Below are significant changes in the Montana energy code explained in more detail in this document:

- Blower door (air tightness) testing for all new houses
- Efficient windows and skylights
- Additional air sealing, air barrier, and insulation requirements
- At least 75% of permanent light fixtures must have high efficiency bulbs, such as CFLS and LEDs
- Testing is required for heating system ductwork located outside of the conditioned part of the home
- Whole-house mechanical ventilation required for all new houses

The statewide energy code gives house buyers an additional tool to use in making their purchase decision. The Energy Code Compliance Label is required in all new residential construction and is a way for the builder to certify the house meets the minimum code levels for insulation, window, and heating system efficiencies and other energy features required in new residential construction. A sample is shown in figure 6 on page 12. The label also ensures the information about these features is not lost over time. The label should be permanently affixed to the house’s electrical breaker box, so subsequent owners will have the same information available to them.

Not only do home builders and home buyers benefit from this code, but Montana wins too. Energy-efficient homes consume less energy than homes not built to meet the energy code. Less energy must be produced to heat and cool energy-efficient homes which helps conserve Montana’s fossil fuel resources and protects our environment.
What Buildings are Covered Under the Statewide Energy Code?
The energy code applies to all new residential buildings, additions, repairs and renovations in Montana (with exceptions noted below) regardless of fuel type (gas, electricity or other). Unaltered portions of existing buildings do not need to comply with this code. Residential buildings (R-2, R-3, and R-4) with more than three floors above ground must comply with the commercial energy code portions of the 2012 IECC.

The following buildings are exempt from this code:
- Farm and ranch buildings, any private garage or private storage structure attached to a home, buildings that are classified or determined to be eligible for a listing in the National Register of Historic Places, and Housing and Urban Development (HUD) code manufactured homes.
- Low energy use buildings or portions of a building which have a peak design rate energy use of less than 3.4 Btu/h per square foot of floor area for space conditioning (heating and cooling) are only exempt from the building thermal envelope provisions of the code.

Ways to Show Energy Code Compliance
There are two primary ways to demonstrate the thermal envelope of one- and two-family dwellings meet the requirements of the Montana Energy Code (2012 International Energy Conservation Code with Montana amendments).
- Follow the prescriptive path listed below in Table 1
- Use REScheck™, a computer analysis, to show compliance
  - A free download of REScheck™ is available at www.energycodes.gov
  - REScheck™ requires inputs of the areas and insulation efficiency levels for ceilings, walls, and windows

Table 1 – Insulation and Window Requirements by Component

<table>
<thead>
<tr>
<th>Component</th>
<th>Insulation or Efficiency Level*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling</td>
<td>R-49/38 A</td>
</tr>
<tr>
<td>Exterior Wall</td>
<td>R-21 or R13+R10 CI B</td>
</tr>
<tr>
<td>Mass Wall</td>
<td>R15/20 C</td>
</tr>
<tr>
<td>Floor</td>
<td>R-30 D</td>
</tr>
<tr>
<td>Basement Wall</td>
<td>R-19/15 CI E</td>
</tr>
<tr>
<td>Slab Perimeter</td>
<td>R-10, f from top edge for 4 ft. R-15 for in-floor heated slab.</td>
</tr>
<tr>
<td>Crawlspace Wall</td>
<td>R-19/15 CI G</td>
</tr>
<tr>
<td>Window/Door U</td>
<td>U-.32 H</td>
</tr>
<tr>
<td>Skylight</td>
<td>U-.55</td>
</tr>
</tbody>
</table>

*Contain some Montana Amendments
The R-value requirement listings are for insulation material only, not for structural components such as drywall or siding. All materials, systems, and equipment must be installed in accordance with the manufacturer’s installation instructions.

A. R-38 is acceptable if the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. See figure 4, page 9.
   a. Where there is not enough space to achieve Table 1 ceiling insulation levels, R-30 is allowed in up to 250 sq. ft. or 10 percent of the space, whichever is less.
   b. Insulation markers with at least one-inch sized numbers are required at least every 300-sq. ft. of attic space and must face the access opening.
   c. Attic access hatches and doors must be weather-stripped or sealed and baffled to prevent loose insulation from spilling into the living space and insulated to its surrounding area’s requirement.

B. The second number is a listing for continuous Insulation (CI), which is insulation that runs continuously over structural members and is free of thermal bridging. Foam sheathing over exterior wall framing is an example of continuous insulation.

| Table 2 – R402.26 Requirement for Steel-Frame Wall (R-Value) |
|-----------------|-----------------|-----------------|-----------------|
| Steel-Framed Wall 16'' O.C. – R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 |
| Steel-Framed Wall 24'' O.C. – R-13 + 9.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 |

C. Mass walls are above grade walls of concrete, concrete block, insulated concrete form (ICF), brick, (other than brick veneer), earth and solid timber/logs. R-20 applies when more than half the insulation is on the interior of the mass wall. Log walls use mass wall requirements. Usually 14-inch and larger log walls will meet the R-15 requirement or REScheck™ can be used to show compliance.

D. Floor insulation must be in contact with the underside of the floor sheathing.

E. Basement walls, whether the space is finished or not, require R-19 cavity or R-15 continuous insulation level.

F. R-15 is required for heated slab-on-grade floors. Heated slab includes floors with heating elements, hydronic tubing and ductwork within and under the slab. Slab-on-grade floors with a floor surface less than 12 inches below grade require R-10 insulation, adding R-5 for heated slabs. Slab-on-grade insulation should extend downward from the top of the slab on the outside or inside of the foundation wall. The insulation should extend 4 feet by any combination of vertical and horizontal placement that extends out from the slab or under the slab (see the Insulated Slab Options, figure 1). Insulation extending away from the building must be protected by pavement or at least 10 inches of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab may be cut at a 45-degree angle. Exposed insulation shall have a weather-resistant protective covering extending at least 6 inches below grade level.

G. Unvented crawlspace walls require a minimum of R-19 cavity or R-15 continuous insulation. Insulation must cover the entire foundation wall.

H. Because the U-factor is the inverse of the R-value, a lower U-factor indicates a window that has better thermal capabilities than a window with a higher U-value. Example: A U-.32 rated window is more efficient than a U-.33 rated window. Up to 15 sq. ft. of glazing is exempt for the U-factor value requirement. Skylights must have a U-factor of at least .55.
**Insulated Slab Options**

Slab perimeter insulation of at least R-10 (R-15 for in-floor heat) from the top edge for at least 4 feet.

**Figure 1**

**Option 1**

Exposed exterior insulation requires protection (at least 6" below grade).

Insulation must extend a total of 4 feet either vertically or horizontally or a combination of vertically/horizontally.

**Option 2**

Insulation must extend a total of 4 feet either vertically or horizontally or a combination of vertically/horizontally.

**Option 3**

2012 IRC Section 403.3 allows frost protected shallow foundation footing depth of 2 feet.

Exposed exterior insulation requires protection (at least 6" below grade).

Insulation must extend a total of 4 feet either vertically or horizontally or a combination of vertically/horizontally.

**Option 4**

45 degree cut allowed with all options.

Insulation must extend a total of 4 feet either vertically or horizontally or a combination of vertically/horizontally.
**Vented Non-Heated Crawlspace with Floor Insulation**

An option for insulating a crawlspace is to insulate the floor and install code-required venting. This option treats the crawlspace as an unconditioned space. Insulation levels are listed in Table 1 under the floor requirements or follow REScheck™ results for the building. Venting, air sealing, heating system sealing, duct, and pipe insulation requirements are listed on figure 2.

![Figure 2](image.jpg)

**Unvented Heated Crawlspace with Insulated Foundation Walls**

As an alternative to insulating floors over a crawlspace, crawlspace walls may be insulated when the crawlspace is not vented to the outside. Temporary crawlspace vent openings are allowed during construction. These vent openings must be closed, sealed, and insulated to the same R-value of the surrounding crawlspace wall when construction is complete and prior to final inspection. Crawlspace wall insulation must be permanently attached to the wall and cover the entire height of the crawlspace wall. Exposed earth in the unvented crawlspace must be covered with a continuous Class 1 vapor retarder, such as 6 mil polyethylene. All joints of the ground cover must be overlapped at least 6 inches and be sealed or taped. The edges of the ground cover must extend at least 6 inches up the foundation wall and be attached to and sealed to the foundation wall. See figure 3, page 6.

Unvented Heated Crawlspace require air flow with an exhaust or supply air option.

**Exhaust Air Option**

This code option requires continuously exhausted air from the crawlspace at a rate of 1 cubic foot per minute (cfm) for each 50 square feet of crawlspace. The ground in the crawlspace must be covered with a Class 1 vapor retarder, such as 6 mil polyethylene. Section 408.3 of the IRC requires an air pathway to the common area (such as a duct or transfer grille).
**Crawlspace Exhaust Air Option**

A sealed vapor retarder is part of a radon mitigation system. See figure 5, page 11. Note: Radon mitigation systems are not required by the energy code.

![Diagram of a sealed vapor retarder in a radon mitigation system.](image)

Section 408.3 of the IRC requires the exposed earth to be covered with a continuous vapor retarder. Joints of the vapor retarder must be overlapped by 6 inches and must be sealed or taped. The edges of the vapor retarder must extend at least 6 inches up the stem wall and be attached and sealed to the stem wall.

**Supply Air Option**

This code option is accomplished by supplying a small amount of airflow into the crawlspace; 1 cfm of airflow for each 50 square feet of crawlspace. Below are three ways used for supplying air into crawlspaces:

1. Heat recovery ventilator providing supply and return air
2. Heating/air conditioning system providing supply air
3. Supplemental fan providing supply air

During the season when the heating/air conditioning system would not be operating, the recommendation is to have the air handler or supplemental fan cycled on for 5 minutes each hour.

The IRC requires an air pathway from the crawlspace to the common area (such as a duct or transfer grille). See figure 3, page 6.
Air Sealing Requirements – Section R402.4.1
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 for control of air leakage. An air barrier is a material or assembly of materials that reduces air flow through or into the building envelope. The new Montana energy code requires compliance with the Air Barrier and Insulation Installation requirements (visual checklist) and requires the house tightness be blower door tested.

Blower Door Test – Required 2012 IECC Section R402.4.1.2 (Montana Amended)
A blower door test measurement of building air tightness showing four air changes per hour or less when tested at 50 Pascal (4 ACH50) is required. A blower door test is performed using a large fan assembly placed in an exterior door opening. The fan draws air out of the building while measuring the air flow required to create a pressure difference of 50 Pascals with reference to outside. Where required by the code official, testing shall be conducted by an approved party. Multi-unit residential buildings may be tested as an entire building or individual units may be tested.

Air Barrier and Insulation Installation Requirements
The energy code includes table R402.4.1 that lists the air barrier and insulation installation requirements for sixteen building envelope components. Some of the requirements of that table are listed below.

Insulation placed in the thermal envelope of the building (walls, ceilings, dropped ceilings/soffit, rim joists, fireplace walls, shower/tub) must be in substantial contact and continuous alignment with the building envelope air barrier. See figure 4, page 9.

Some of the air leakage (visual checklist) areas that must be sealed with an air barrier material, durable caulk, or foam sealant are:

1. Openings between the building structure and exterior windows and door frames
2. Openings around electrical wire, boxes, recessed light fixtures, and plumbing piping through the attic, exterior walls and other unheated spaces
3. Dropped ceilings or chases adjacent to the thermal boundary
4. Behind tub and showers on exterior walls
5. Common walls between dwelling units
6. Attic access openings, drop-down stairs, and knee-wall doors
7. Rim/band joist junctions
8. Top plate at exterior walls
9. Electrical/phone boxes on the exterior wall or air sealed boxes are installed
10. HVAC registered boots
11. Recessed lighting – recessed lighting installed in the thermal envelope shall be air tight, IC rated and sealed to the drywall
12. Fireplace – An air barrier shall be installed on fireplace walls and fireplaces shall have gasketed doors

Some of these locations are shown on figure 4. Note: Fiberglass and cellulose are not an acceptable air barrier material. Generally, the facing materials used on fiberglass batt insulation cannot be adequately sealed to be considered an air barrier.
**Insulation Installation Requirements**

Batt insulation must be cut to fit around wiring, piping and fill narrow cavities and must be in contact with the air barrier. Wall corners and headers located in the thermal boundary must be insulated.

Insulation markers must be placed facing the attic access showing the thickness of insulation. The markers must be placed at least one every 300 square feet throughout the attic.

Eave baffles are required in vented attics insulated with air permeable insulation (fiberglass and cellulose). The baffles (any solid material) must extend from the soffit and eave vents, over the top of the insulation and maintain an opening at least the size of the vent.

**Mechanical Ventilation Requirements – Section R403.5**

*Kitchen and Bathroom Exhaust Fan Requirements*

Kitchen fans must provide at least 100 cfm (cubic feet per minute) intermittent or 25 cfm of continuous air flow. Bathroom-toilet room fans must provide at least 50 cfm of intermittent or 20 cfm of continuous air flow. Bathroom and toilet room fans must be vented/exhausted to the outdoors; these fans cannot have discharge into the attic, crawlspace, or any area inside the building.

**Whole House Mechanical Ventilation Requirements**

The energy code requires a whole-house mechanical ventilation system that at least meets the specifications listed in International Residential Code (IRC) or International Mechanical Code (IMC). Those requirements can be accomplished by installing a fan in a bathroom, utility room, hallway, or another location, sized according to the square-foot size of the house and number of bedrooms as specified on the following IRC Table M1507.3.3(1)

**IRC Table M1507.3.3(1)**

Continuous whole-house mechanical ventilation system airflow rate requirements in cubic feet per minute:

<table>
<thead>
<tr>
<th>Dwelling Unit Floor Area (sq. ft.)</th>
<th>Number of Bedrooms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 to 1</td>
</tr>
<tr>
<td>&lt;1,500</td>
<td>30</td>
</tr>
<tr>
<td>1,501 – 3,000</td>
<td>45</td>
</tr>
<tr>
<td>3,001 – 4,500</td>
<td>60</td>
</tr>
<tr>
<td>4,501 – 6,000</td>
<td>75</td>
</tr>
<tr>
<td>6,001 – 7,500</td>
<td>90</td>
</tr>
<tr>
<td>&gt;7,500</td>
<td>105</td>
</tr>
</tbody>
</table>

If non-continuous ventilation is provided, then the capacity of the fans must be increased as specified by Table M1507.3 below.

**Table 7.4 M1507.3.3(2)**

Intermittent Whole-House Mechanical Ventilation Rate Factors

<table>
<thead>
<tr>
<th>Run-Time Percentage in Each 4-Hour Segment</th>
<th>25%</th>
<th>33%</th>
<th>50%</th>
<th>66%</th>
<th>75%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
<td>4.0</td>
<td>3.0</td>
<td>2.0</td>
<td>1.5</td>
<td>1.3</td>
<td>1.0</td>
</tr>
</tbody>
</table>

For example, a 1,600-square foot, 3-bedroom house requires a continuously operating 60 cubic feet per minute (cfm) fan. If the fan runs half of the time the fan should be sized at 120 cfm.

The whole-house mechanical ventilation fan must meet minimum efficiency requirements. Bathroom and utility room fans between 10 and 90 cubic feet per minute (cfm) must deliver at least 1.4 cfm per watt. Fans larger than 90 cfm, range hoods, and in-line fans, must deliver at least 2.8 cfm per watt.
Recessed Light Requirements – Section R402.4.5

Recessed lights that are installed in the building thermal envelope (typically a ceiling with unheated space above) must be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed lights must be IC rated and labeled as meeting ASTM E 283. All recessed lights shall be sealed with a gasket or caulk between the housing and interior ceiling or wall covering.
**Heating Systems – Section R403**

**Programmable Thermostats – Section R403.1.1**
Programmable thermostats are required on forced air (furnaces). The thermostat must be able to set back or temporarily operate the system to maintain temperatures down to 55 degrees or up to 85 degrees. It must be initially programmed with a heating temperature no higher than 70 degrees and a cooling temperature no lower than 78 degrees.

**Duct Insulation – Section R403.2.1**
Supply ducts in unconditioned attics must be insulated to at least R-8. All other ducts, both supply and return, located outside the thermal boundary must be insulated to at least R-6.

Heating system ductwork and air handler (cabinet) that are located outside of the conditioned boundary, such as in the attic or garage, must be tested for tightness.

**Duct Sealing and Testing – Section R403.2.2**
All ducts, both supply and return, air handlers, filter boxes, and building cavities used as ducts, shall be sealed. Building cavities cannot be used for supply ducts. Montana amended the 2012 IECC to only allow post construction (completed system) duct testing. Duct leakage testing is not required if all ducts and the air handler are located within the thermal envelope.

Post Construction – If tested after completion (post-construction), a total leakage equal to or less than 4 cfm per 100 sq. ft. of conditioned floor area when tested at a pressure differential of 25 Pascal across the entire system, including the manufacturer’s air handler enclosure, or the leakage to the outdoors must be equal to or less than 4 cfm per 100 sq. ft. of conditioned floor area.

**Mechanical System Pipe Insulation – Section R403.3**
Mechanical system piping such as boiler or cooling (AC) system piping that can carry 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.

**Hot Water Pipe Insulation – Section R403.4.2 (Montana Amended)**
R-3 insulation is required for the following:

- Piping larger than ¾ inch diameter
- Piping serving more than one dwelling unit
- Piping located outside conditioned space
- Piping from the water heater to a distribution manifold
- Piping located under a floor slab. (not part of in-floor heating system)
- Buried piping
- Supply and return piping in recirculating systems other than demand recirculation systems

**Proper Sizing of Heating and Cooling Equipment – Section R403.6**
Heating and cooling equipment sizing shall be based on building loads calculated in accordance with ACCA Manual S & J or other approved heating and cooling calculation method. In the past many heating and cooling systems were oversized, resulting in increased installation and operating costs.

**Lighting Requirements – Section R404**
At least 75 percent of the permanently installed lighting fixtures must have high-efficiency lamps or light bulbs. These bulbs 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 over 15 watts to 40 watts, and 40 lumens per watt if 15 watts or less. Low voltage lighting is exempt.
**Radon Mitigation**

Because of the potential for high indoor levels of radon, the Montana Department of Environmental Quality recommends new houses have basic radon mitigation systems installed during construction. Contact the Montana Radon hotline for more information at 1-800-546-0483.

*Figure 5 – Radon Mitigation System in Crawlspace (not required by code)*

- **Exhaust**: 10' from opening into conditioned spaces of building, 12' minimum above roof
- **Flashing**: A ventilation fan installed in the vertical exhaust vent pipe will assist with the removal of radon gas and ground moisture. Because of back drafting concerns, caution is advised when exhausting air from an area with a natural venting combustion appliance.
- **Electrical junction box**: for future installing of vent fan if needed.
- **Support Strapping**: 3”- 4” diameter vent pipe (PVC or equivalent)
- **Seal membrane**: around pipe penetration
- **Soil gas retarder membrane**: sealed against wall and around penetrations. Minimum of 6-millimeter polyethylene sheeting or equivalent.
- **Adjoining sheets of membrane overlap and sealed**
- **Perforated Drain Tile**: Recommend a continuous 4-inch layer of ½ inch to ¾ inch gravel
- **PVC T-fitting**: (or equivalent) to support vent pipe
Energy Efficiency Component Labels

Labels are available at no cost from many sources. Several utility companies distribute labels as a public service. Local Montana Homebuilder Association offices in Billings, Bozeman, Great Falls, Helena, Kalispell, and Missoula distribute labels to their members. Labels are also available from the Montana Department of Environmental Quality’s Energy Bureau at 1520 East 6th Avenue in Helena, Montana. You can also call the Energy Bureau at 406-444-0281 for information. Blank printable copies are also available on our website at deq.mt.gov/Energy/eec/EnergyCode.

Figure 6 – Energy Code Compliance Certificate with Prescriptive Path Listings
Montana Energy Conservation Tax Credit
Homebuyers are eligible for a state tax credit of up to $500 per individual and $1000 per couple when they purchase or build an above energy code home or improve the efficiency of their existing home. Certified ENERGY STAR® or Montana Green Building Program (above Bronze level) homes with an ENERGY STAR® heating system receive a $500 Montana tax credit. Only one of these credits can be used. For new houses, the credit is 25 percent of certain high efficiency heating, cooling, water heating, ventilation equipment, and the extra cost of the building components, such as windows, doors, and insulation levels, that are more energy efficient than the Montana energy code requirements. Go to deq.mt.gov/energy for additional information.

Refrigerators, washing machines, and dryers do not qualify for the credit. Taxpayers should use tax form ENRG-C to claim the energy conservation tax credit.

Alternative Energy Tax Incentives

Alternative Energy Systems Income Tax Credit
A $500 income tax credit is available to individuals living and paying taxes in Montana who have installed a new alternative energy system in their primary dwelling. If you and your spouse both paid for the system, and the cost is $1,000 or more, you both may claim up to $500. Unused credit may be carried forward for up to four years. File MT Revenue form ENRG-B to claim the credit. Qualifying expenditures include installation costs for an alternative energy system, such as:
- Solar photovoltaics (PV)
- Solar thermal system
- Ground Source Heat Pump
- EPA certified low-emission pellet or wood stove
- Wind turbine
- Hydroelectric plant under 1 megawatt

Geothermal System Income Tax Credit
A $1,500 income tax credit is available to individuals living and paying taxes in Montana who have installed a new geothermal energy system or ground source heat pump for heating or cooling their principal dwelling. Home builders that are individuals or C corporations are also eligible for the credit, however the builder and home buyer may not both claim the credit. The credit may not exceed $1,500 per installation. Unused credit may be carried forward for up to seven years. File MT Revenue form ENRG-A to claim the credit.

Federal Solar Investment Tax Credit
A federal income tax credit of up to 30% of the installation costs for a solar PV or solar water heating system 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 next tax year. The Federal tax credit is scheduled to step down to 26% for systems placed in service in 2020, 22% for systems installed in 2021, and will expire after December 2021.

Glossary of Energy Efficient Terms
A good comparison shopper needs to understand certain units of measurement, such as MPG (miles per gallon) when shopping for a new car. Shopping for energy efficiency also involves knowing a few units of measurement. Each Energy Efficiency Components Label may contain five or more different units of measurement. The following definitions will help you crack the code of energy efficiency.

R-Value – The units used to measure the insulating value of an object. The higher the R-value, the more insulating value an object has. For example, a high-density batt of fiberglass insulation for a 2” x 6” wall has an R-value of 21.

U-Value – Insulation measurement, measure heat loss through windows. The U-value of a window is the reciprocal of its R-Value (U = 1/R). For instance, a window with a U-value of 0.33 is equivalent to an R-value of 3 (0.33 = 1/3). Because the U-value is the inverse of the R-value, a lower U-value indicates a window that has better insulating capabilities than a window with a higher U-value.

BTU – A British Thermal Unit is the amount of heat energy needed to raise the temperature of one pound of water by one-degree F.
**NFRC Unit Rating** – The National Fenestration Rating Council (NFRC) determines the U-value for most windows. This rating is placed on a label attached to all new NFRC rated windows. If the NFRC rating is available, the home builder should use this number when filling in the U-value on the Energy Efficiency Components Label.

**EF** – Used to determine the energy efficiency of hot water tanks, EF is the abbreviation for Energy Factor. This unit is a ratio of the heat energy contained in the water in a hot water tank over a certain period divided by the energy that the hot water heater consumes over the same period. The most efficient electric water heaters have an EF rating of 0.93 to 0.96, while the most efficient gas-fired water heaters have energy factors ranging from 0.8 to 0.9. To be eligible for the Montana Energy Conservation tax credit, a gas water heater must have an EF of at least .82 or thermal efficiency of at least 90. Electric heat pump water heaters must have an EF of at least 2.

**AFUE** – An abbreviation for Annual Fuel Utilization Efficiency, AFUE is a measure of the effectiveness of gas and oil space heating systems. All furnaces and boilers in the United States are required to have an AFUE rating of at least 78 percent. The most efficient gas furnaces have an AFUE of 92 percent to over 96 percent, while the most efficient gas hot-water boilers have AFUE ratings of around 84 percent to 95 percent. Energy-efficient oil furnaces have similar AFUE ratings, in the mid-80s to 90 percent. The most efficient oil-fired hot water boilers have efficiencies that are slightly lower, with AFUE ratings up to around 90 percent. To be eligible for the Montana Energy Conservation tax credit, a gas furnace must have an AFUE of at least 95 percent.

**HSPF** – Heating Season Performance Factor is the measurement unit for determining the efficiency of heat pumps. It is calculated by dividing the estimated seasonal heating output (in Btu) by the seasonal power consumption (in watts). To be eligible for the Montana Energy Conservation tax credit, an air source heat pump split system must have an HSPF of at least 8.5

**SEER** – Seasonal Energy Efficiency Ratio. The total cooling output of an air conditioner during its normal annual usage period for cooling, in Btu/hours, divided by the total electric energy input during the same period in watt-hours. To be eligible for the Montana Energy Conservation tax credit, a central air conditioning split system must have a SEER of at least 16.

**EER** – Energy Efficiency Ratio. Energy Efficiency Ratio is the ratio of the cooling capacity in BTUs per hour to the power input (in watts). The higher the EER rating, the more efficient the air conditioner. To be eligible for the Montana Energy Conservation tax credit, a central air conditioning split system must have an EER of at least 13.

**Additional Energy Conservation Resources**

<table>
<thead>
<tr>
<th>Organization</th>
<th>Location</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building American Solution Center</td>
<td>Washington, DC</td>
<td>basc.pnnl.gov</td>
</tr>
<tr>
<td>Building Science Corporation</td>
<td>Westford, MA</td>
<td>buildingscience.com</td>
</tr>
<tr>
<td>Better Built Northwest</td>
<td>Portland, OR</td>
<td>betterbuiltnw.com</td>
</tr>
<tr>
<td>Efficient Windows Collaborative</td>
<td>Washington, DC</td>
<td>efficientwindows.org</td>
</tr>
<tr>
<td>Energy and Environmental Building Association</td>
<td>Bloomington, MN</td>
<td>eeba.org</td>
</tr>
<tr>
<td>EPA Home Performance with Energy Star</td>
<td>Washington, DC</td>
<td>energystar.gov</td>
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<tr>
<td>MT. Dept. of Environmental Quality</td>
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<td>deq.mt.gov/energy</td>
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<td>National Center for Appropriate Technology</td>
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<td>ncat.org</td>
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<td>National Fenestration Rating Council</td>
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<td>Montana Green Power</td>
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<td>ncat.org/montana-green-power</td>
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