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Zero Energy Homes in Montana

Given the option to have a home with a zero to very low energy bill or have components installed to make it easier to have a zero-energy bill in the future, many homebuyers would take one of those options. With the availability of more efficient buildings products, reduction in solar photovoltaic (PV) system costs, cold-climate heat pumps, and net metering options, zero energy (ZE) homes are becoming more popular in Montana.

On an annual basis, a ZE home produces as much energy as it uses. Typically, the energy is produced with a PV system. Zero Energy Ready Homes (ZERH) are built to net-zero standards, but do not have a PV system. However, the home is designed with features that allow for easier installation of a PV system in the future.

The US Department of Energy (DOE) defines a ZERH as “a high-performance home so energy efficient that all or most annual energy consumption can be offset with renewable energy.” The DOE ZERH program requires independent verification to ensure homes will perform as intended, and it offers guidance for builders who are new to building ZERH homes. For more information, visit energy.gov/eere/buildings/zero-energy-ready-home-program.

No Need for Batteries

Batteries are not needed in ZE houses serviced by Montana utilities offering net metering. Net metering is a billing mechanism that credits solar PV system owners for the electricity they add to the grid. For example, if a residential customer has a solar PV system, it may generate more electricity than the home uses during daylight hours. If the home is net-metered, the electric meter will run backwards to provide a credit against what electricity is consumed at night or other periods when the home's electricity use exceeds the system's output. A ZE home will usually build a utility credit in the summer months with more sunshine and lower electrical usage and use the built-up credit in the winter months when the heating portion of the utility bills is greater.

Federal Tax Credit

Starting in 2023, there is a \$5,000 federal tax credit available for Net Zero Ready Homes. [Federal tax credit information](#) and [checklists](#) are available from the US Department of Energy. To receive the tax credit, a home must be ENERGY STAR

certified; however, a concern in Montana is the lack of people who can provide the required ENERGY STAR certification. To find a certifier in your area, visit energystar.gov/partner_resources/partner_locator.

For information on becoming an ENERGY STAR certifier, visit resnet.us/resources/path-to-becoming-a-resnet-certified-home-energy-rater.

A standard Montana energy code level home would need some modifications to meet the ZERH standards. The house must be ENERGY STAR certified, have at least R-26 exterior walls (R-21 cavity insulation with a continuous R-5 insulation layer, or some combination of insulation layers), windows with U-.27 or better, air sealing with a blower door test of 2 ACH 50 or less ([Montana code is 4 ACH 50](#)), and installation of an upgraded ventilation system (i.e., heat recovery ventilation system).

Features of a ZE Home

Most Montana ZE homes have several features in common including:

- The long axis of the home faces within 30 degrees of true south
- Less than 1,600 square feet in size
- [Slab-on-grade shallow frost protected foundations](#)
- Insulation extending under the entire floor
- Exterior wall insulation of at least R-26
- Windows with a U-.27 or better
- Upgraded ventilation system (heat recovery ventilation)
- [Cold climate heat pumps](#)
- [Heat pump water heaters](#)
- 7 to 10-kW solar PV systems
- ENERGY STAR-rated appliances
- Serviced by utility offering net metering

Solar PV System Sizing and Cost

The National Renewable Energy Laboratory has developed a tool to model production of PV systems called the [PVWatts Calculator](#). Using PVWatts, entering an electrical rate of \$0.15 kwh, an 8-kw system on an annual basis would produce about \$1,600 worth of electricity. The Alternative Energy Revolving Loan Program (AERLP) provides low-interest loans to increase investments in alternative energy systems and energy conservation measures in Montana. So far in fiscal year 2023, the AERLP has seen an average cost of \$2.92 per watt for PV systems. Using that pricing information, the cost of an 8-kw system would be approximately \$23,360. With the 30% federal solar tax credit, the final cost is approximately \$16,352. Using the annual production of about \$1,600, the simple return on investment works out to about 10.22%. The current (2023) interest rate for a loan through the AERLP is 3.5%. For more information on the AERLP, visit deg.mt.gov/energy/Programs/AERLP



Montana Home with an 8.75 kW Solar PV System

Suggestions for Homebuilders

A homebuilder could minimize the cost of installing a solar PV system by using some of the following features:

- Use roofing material that does not require roof penetration to mount the solar systems, such as metal standing seam roofs.
- Avoid complicated roof designs and use simple gable end roof framing.
- Orient the house to maximize southern exposure.
 - An 8-kW system would typically require about 600 square feet of roof space. If there is not enough adequate roof space facing south, an east-facing system size would need to be increased by about 16% and about 23% for a west-facing array.
- Install EMT or PVC conduit of at least 1 inch from a roof connection box to monitoring equipment, usually near the electrical meter base.
- Allow for 3 ft. by 4 ft. space for the solar energy system, equipment load center, disconnect switch, and other necessary components.
- Install CAT 5 or better cable from the equipment area to router area to allow for monitoring of the solar PV system.
- Minimize rooftop equipment, vents, and other obstructions.
- Install mounting hardware and safety harness connection points during roof construction for safer installation and maintenance of the system.
- Ensure landscaping and neighboring structures do not block solar exposure.

If there are curb appeal issues, the roof isn't at the optimal angle, the roof is not big enough, or has obstructions (chimneys, skylights, etc.) a ground-mounted solar PV system may be an option. A ground-mounted system can be located where conditions are best and can be sized to match your electricity consumption without the space restrictions of a rooftop system. A ground-mounted system typically adds about 25% to the cost of the project. In addition, ground-mounted solar panels are very easy to access for cleaning and maintenance.

Examples of Montana Zero Energy Homes

Whitehall, Montana: nahn.com/case-study-mountain-horizons-solar-subdivision

Lewistown, Montana: zeroenergyproject.com/2017/11/06/montana-builder-blends-zero-energy-efficiency-historic-preservation



For questions, suggestions, or to be removed from the newsletter distribution list, email: carl.little@littlewise.net



Residential Energy Code and Energy Efficiency Website:
<https://deq.mt.gov/energy/Programs/code>