# SOLAR ELECTRICITY IN MONTANA

Today solar panels cost a fraction of what they did a decade ago, making solar electric systems more attractive and widely utilized in residential, commercial, agricultural, and institutional applications across Montana. Some choose solar for financial reasons, others for independent power, others for environmental reasons or a combination of all three. Long-term system performance and capabilities largely depend on site, local regulations/incentives, and type of components selected.

The most basic components of all solar electric systems are the solar panels, which collect energy, and the inverter(s), which convert that energy to a usable form. Panels, inverters and a supporting rack system make a basic grid-tied solar system. A grid-tied solar electric system feeds electricity directly to an existing house or building electric system. Any extra energy flows past the utility meter into the grid. Depending on state and/or local utility regulation, excess power is compensated to the solar system owner in one of two ways. One way is the energy is sold at a wholesale rate to the utility. The second way is by receiving credits on a one-to-one basis for energy fed to the grid for use at night or during seasons with less solar production. This second approach is called Net Metering. In the case of net metering, it doesn't matter when the energy is produced during the year, nor when the building consumes energy, but only how production and consumption compare for the year. Typically, a solar system is sized to offset 100% (net zero) of power consumed, but larger or smaller sizing is also possible. A basic net metering system is intended to use the grid like a storage battery and is not intended to make backup power when the grid is down.

Grid-tied systems which send any unused power to the grid for credit are popular, but there are three other common ways to configure a solar electric system. One is with batteries and/or battery-based inverters, which may be easily added to most grid-tied systems at any time and will provide backup power during utility outage. A second configuration is self-consumption. In this case, users choose not to send power to the grid at all, if for instance, they are not satisfied with available net metering or interconnection agreements. A self-consumption system can be designed to produce and locally use as much energy as possible. With self-consumption, the grid is still used (minimally) during times of low production such as extended poor weather, short winter days, or exceptional power usage. The third common configuration is an off-grid system. Typically used in remote locations, this is effectively a small power plant and may include a wind turbine and/or a small generator with batteries in addition to solar panels to ensure adequate power year-round and through all types of weather.

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## The Site Assessment

Today solar panels are commonly located on roof surfaces that are south facing, east facing, west facing, or completely flat. They may also be installed on a ground-mounted racking system that extends east-west on flat ground, a single steel pole on uneven ground, or on a tracking array that follows the sun throughout the day. The first factor when assessing the suitability of any location is shade. Solar panels will not make adequate power when shaded; even small objects like tree branches without leaves are detrimental. A professional solar installation company will have tools to assess shading and make solar panel location recommendations. An easy, free tool to look at a property to find the best location option is at Google's Project Sunroof, www.google.com/get/sunroof. This page uses LIDAR data and clearly illustrates how much sun energy falls on a property and where. If some shade is present, it may be possible just to add a few more solar panels to make up for any potential losses. Of course, the losses may be minimal enough to justify the installation regardless.

For roof mount applications, the next important siting consideration is the type and condition of roofing materials in place. Solar panels are expected to operate for more than 25 years. To avoid removing and reinstalling the panels, it is best if a roof surface is in good condition. Most common roof surfaces are easily fitted with solar panel racking systems. Asphalt shingle and most metal surface roofs pose no problems. Slate, tile, or terra cotta surfaces require special consideration. Cedar shake or shingle roof surfaces pose challenges, but may be used if the project is new construction or during roof replacement. A final and major consideration is the structure underneath. A solar array adds weight to the roof and must meet local wind and snow load building code requirements. The weight of a solar array is typically under 3.5 lb/ft$^2$. For comparison, snow load requirements in much of Montana are over 30 lb/ft$^2$. Few homes or commercial buildings have structural problems, however older structures, namely barns and/or outbuildings, may require an engineering review.

Mounting panels on the ground is another option. Unlike rooftop solar, which is dependent upon the orientation and angles of the roof, a ground mount can be sited for optimal collection of sunlight. Another benefit is increased airflow around the panels which helps them keep cooler and thus operate more efficiently. An important consideration for ground-mount system siting is distance to the electrical tie-in; this is commonly a main breaker panel at or near the utility meter. Distances under 500 feet are preferred, though longer may be considered. This wire must be buried the same as any electrical circuit, so a path free of tree roots, gas lines, etc. is preferred. Just like with rooftop solar, another important consideration is available space. Ground-mount systems are usually height limited. To compensate, they are usually designed to be wider, which means they can take a fair amount of space in the east/west direction. Alternatively, a system featuring dual-axis tracking allows the panels to follow the sun throughout the day. These systems can optimize production that could be up to 40% higher than a non-tracking system. This means they can be designed to use fewer panels, taking up less space. However, to realize this optimal performance there can be no shading in any direction.

**Two grid-tied solar inverters for a residential installation.**

If the intent is to offset 100% of power use, an electrical bill with a full year of energy consumption information will enable a solar professional to accurately determine how many panels can be used to offset the electricity used. With this and a review of suitable sites on the property, the contractor can put together cost estimates for different systems. Solar electric system prices are highly dependent on project size, type of equipment selected, and siting considerations. To help with financing, research the Federal and State incentives that are available, as well as any area loan program offerings. State and Federal incentives may reduce the cost of a solar system by 30% to 65%. Solar professionals can guide you and a tax advisor to what is suitable for a specific application. There is also extensive information on federal, state, and local incentives and other programs at: www.dsireusa.org. ■

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