

Solar electricity for your home or business

The amount of sunlight that strikes the earth in one minute could supply the world's energy needs for an entire year. In fact, the solar resource is so massive it dwarfs every other resource on the planet. All we have to do is harness it. With help from Focus on Energy, Wisconsin utilities' statewide program for energy efficiency and renewable energy, residents and businesses across Wisconsin are taking the lead in utilizing this abundant resource.

Solar electric (also known as photovoltaic or PV) systems:

- Generate electricity whenever there is sunlight.
- Operate silently with few or no moving parts, requiring very little maintenance.
- Reduce monthly electricity bills.
- Reduce our dependence on imported energy while creating jobs and lowering greenhouse-gas emissions.
- Demonstrate a commitment to the environment.

FIRST THINGS FIRST

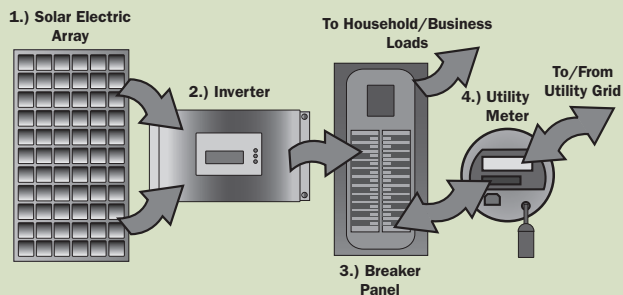
It is important to maximize the energy efficiency of your home or business before you purchase any renewable energy system. The smaller your energy needs, the lower your monthly energy bills—and the less you'll need to spend on a renewable energy system that's capable of meeting your needs.

And now, home and business owners who invest in energy-efficiency upgrades prior to installing a solar electric system may be eligible to receive enhanced financial incentives of up to double the standard Focus incentive. To learn more about these enhanced efficiency incentives, visit focusonenergy.com/efficiencyfirst.

HOW MUCH ELECTRICITY CAN A SOLAR ELECTRIC SYSTEM GENERATE?

Electric generation depends on size, orientation, and siting of the solar electric system. Each kilowatt (kW) of unshaded, stationary solar electric modules generates about 1,200 kilowatt-hours (kWh) of electricity per year in Wisconsin. A 1 kW, dual-axis tracking system will generally create about 1,600 kWh per year.

HOW DOES A SOLAR ELECTRIC SYSTEM WORK?



- 1) **Solar electric array**—sunlight shines on the solar electric array, causing a flow of electrons, and creates direct current (DC) electricity.
- 2) **Inverter**—the inverter converts DC electricity to alternating current (AC) electricity. AC electricity is fully compatible with the utility grid.
- 3) **Breaker panel**—the solar AC electricity is delivered to the breaker panel and to any building loads.
- 4) **Utility meter**—solar electricity not used by the building loads flows to the utility grid. The utility meter measures the excess production delivered to the grid.

SYSTEM CONSIDERATIONS

Size

The size of a system is typically based on the available budget, energy independence goals, current energy usage, and the amount of shading at a location. Combined, these factors will determine how many kilowatts of solar electric modules should be installed. Each kilowatt of modules requires 70 to 100 square feet of area.

Orientation

In Wisconsin, the ideal orientation for solar electric panels is due south and tilted 25° to 45°. Solar electric arrays can face within 30° of due south or have a tilt of 15° to 60° without significant reduction in power generation. Solar panels should be located where they have a clear view of the sun and are unobstructed by trees, roof gables, chimneys, or other nearby features. A module's power output is significantly reduced anytime it is shaded. Snow

For more information,
call 800.762.7077 or visit focusonenergy.com.



4.55 kW flush-mounted rooftop solar electric system located at a residential property in Middleton, Wis.



135 kW ballasted rack-mounted solar electric system located on the roof of the GE Health Care building in Waukesha, Wis.



2.16 kW pole-mounted tracker solar electric system located on the grounds of the Conservation School in Land O' Lakes, Wis.

accumulation on solar panels is a reality in Wisconsin. Solar electric production loss due to snow cover increases as the panel's tilt decreases since snow will not be shed as quickly.

Mounting options

There are several different types of mounting systems available to meet the needs of most sites.

Rooftop-mounted solar electric systems generate electricity without compromising the customary weather protection that standard roofing materials provide. They are a great way to utilize unused space and are most popular in urban settings. The weight of the system and the capacity of the roof must be considered.

- Flush-mounted rooftop solar electric systems are simple and unobtrusive. Solar electric panels are typically mounted using water-tight brackets tied in to the roof joists. These systems are the most economical type of rooftop mount. However, as opposed to rack-mounted systems, flush-mounted systems offer little orientation flexibility.
- Roof-top rack-mounted solar electric systems are great for flat roofs and roofs that are not optimally orientated for solar power production. Sloped roof racks typically require attachment to the roof. Ballasted racks attach to large, shallow pans that are weighted to hold them in place; therefore, roof penetrations are not necessary. Rack-mounted solar electric systems are more expensive than flush-mounted solar electric systems. Also, snow can pile up at their base and the roof structure must be able to support the solar electric system as well as snow and wind loading.

Ground-mounted solar electric systems can be installed in highly visible locations and positioned to optimally capture sunlight while displaying a public commitment to renewable energy and the environment. Installation does not involve attaching anything to a building, and the occasional maintenance requirements do not require a trip to the roof. Also, ground-mounted systems do not need to be removed and reinstalled when a roof is replaced. Ground-mounted systems are commonly installed when a roof area is too small to hold a solar electric array, is shaded by trees, is not facing approximately south, or is not able to support loads associated with the system. They are also common on open, often rural, sites. These systems are commonly pole-mounted or rack-mounted using four or more posts.

- Pole-mounted systems offer the option of adjusting the array's orientation to capture more sunlight and generate more power. The tilt angle of a manually adjusted system is adjusted in the spring and fall, increasing system production by about five percent per year. A dual-axis tracking system provides optimal panel inclination throughout the day and year by automatically following the sun's daily movement from east to west and its change in

ESTIMATED SOLAR ELECTRIC SYSTEM ECONOMICS OF A FIX-MOUNTED SYSTEM FACING SOUTH WITH MINIMAL SHADING

	RESIDENTIAL HOMEOWNER	FOR-PROFIT ² (TAX PAYER)	NONPROFIT ³ (501.(C).3 AND GOVERNMENT)
System Annual Generation kWh	3,250	24,000	24,000
ESTIMATED SYSTEM PRICE¹	\$18,900	\$120,000	\$120,000
INCENTIVES			
Focus on Energy Enhanced Efficiency Incentive ⁴	\$3,250	\$24,000	\$30,000
Tax on Focus Incentive	0	(\$9,100)	0
Federal 30% Investment Tax Credit ⁵	\$4,700	\$36,000	0
Federal and State Accelerated Depreciation	0	\$38,650	0
FINAL SYSTEM PRICE	\$10,950	\$30,450	\$90,000
ENERGY SAVINGS			
ELECTRICITY SAVINGS OVER 10 YEARS⁶	\$5,600	\$38,750	\$38,750

altitude through the seasons. Dual-axis trackers increase electricity production by about 30 percent compared to stationary systems.

Maintenance

Solar electric modules are generally warranted for 20 to 25 years and inverters for 10 to 15. The life expectancy of a typical system is 30 to 40 years. No solar electric system is completely maintenance-free, however most solar electric systems have no moving parts and require little maintenance. Tracking systems have moving parts and will require more maintenance. Regular system inspections are necessary to ensure that the wiring and contacts are free from corrosion, the modules are clear of debris, and the mounting equipment is well secured. Power output should be monitored to ensure system performance is maintained.

Site assessment

To better understand the suitability and economics of a solar electric system for your location, Focus recommends a site assessment. During the assessment, a certified assessor will visit your location to evaluate its viability for a solar electric system and make recommendations for the best size, orientation, location, and type of mounting required to meet your needs. Visit focusonenergy.com/siteassessments to learn more.

HOW MUCH DOES A SOLAR ELECTRIC SYSTEM COST?

Review the following examples to gain a better understanding of how to roughly estimate the cost of a solar electric system for your business or home before Focus on Energy and federal incentives. Keep in mind, these are simple examples; costs will vary depending on the type and complexity of the system.

Home

An energy efficient single-family home in Wisconsin consumes about 6,500 kWh of electricity per year. Let's imagine an energy efficient homeowner wants to supply 50 percent of their home's energy needs (3,250 kWh per year) with a solar electric system. A fixed-mounted 1 kW system generates about 1,200 kWh annually, so a 2.7 kW system would be required—that's 3,250 kWh per year divided by 1,200 kWh. Currently, a smaller grid-connected fixed-mounted system costs about \$7,000¹ per kW installed, so a 2.7 kW system costs about \$18,900 before incentives. A system of this size would likely consist of about eight modules or 200 square feet of modules.

Business

Let's imagine a business is looking to install a system that generates 24,000 kWh per year. A fixed-mounted 1 kW system generates about 1,200 kWh annually, so a 20 kW system would be required to meet the business' needs—that's 24,000 kWh divided by 1,200 kWh. Currently, a larger grid-connected fixed-mounted system costs about \$6,000¹ per kW installed, so a 20 kW system costs about \$120,000 before incentives. A system of this size would likely consist of about 80 modules or 1,650 square feet of modules.

WHAT INCENTIVES ARE AVAILABLE?

There are a variety of renewable energy incentives available to residents and businesses including but not limited to:

- Residential Renewable Energy Tax Credit.
- Business Renewable Energy Investment Tax Credit (or U.S. Department of Treasury Renewable Energy Grants).
- Corporate Depreciation—Modified Accelerated Cost Recovery.
- U.S.D.A.—Rural Energy for America Program (REAP) Grants.
- Focus on Energy incentives.

1. Price based on average solar electric systems co-funded by Focus on Energy during the fourth quarter of 2010. Prices will vary depending on system size, system specifications, site and roof characteristics, etc. Focus on Energy recommends getting three system quotes.
2. Business tax payers assumed to be at 30% federal and 7.9% state tax rates.
3. Nonprofit and governmental customers may be eligible for additional incentives from their electric provider.
4. Home and business owners who invest in energy efficiency upgrades prior to the installation of a solar electric system may qualify for the Focus enhanced efficiency incentive. Please note this offer is subject to change.
5. The investment tax credit can only offset tax liabilities. In 2011 a Treasury Grant for this amount is available to for-profit tax payers.
6. For-profit and nonprofit owners, the electric price based on an electric rate of \$0.10/kWh increasing six percent per year. Electric demand charge of \$200 per year per kW increasing six percent per year. Fifteen percent of the solar electric system's DC-rated capacity offsets demand charges. Residential electric price based on an electric rate of \$0.13/kWh increasing six percent per year.

Solar electricity for your home or business

DEFINITION OF TERMS:

Kilowatt (kW): 1,000 watts.

Kilowatt Hour (kWh): 1 kWh is equal to 1,000 watts working for one hour.

Net Energy Billing: a billing and metering practice in which a utility customer's excess electricity is banked with the utility at the retail rate.

Power Purchase Arrangement: this is an arrangement between the utility and the owner of a solar electric system. The agreement defines the charges to the user for standard electricity, as well as the buy-back rate that the utility will pay for the excess energy generated by the solar electric system.

Solar Electric Module: a packaged interconnected assembly of solar cells that respond to sunshine by generating a direct current of electricity.

Time-of-Use Pricing: rates designed to reflect the different costs a utility incurs in providing electricity during peak periods and off-peak periods.

The Database of State Incentives for Renewables & Efficiency (DSIRE) is a comprehensive source of information on state, local, utility, and federal incentives and policies that promote renewable energy and energy efficiency. Visit dsireusa.org for a listing of all available incentives for your state. Visit focusonenergy.com/incentives for the most up-to-date information regarding Focus on Energy incentives specifically.

DOES AN INVESTMENT IN A SOLAR ELECTRIC SYSTEM MAKE ECONOMIC SENSE?

The value of a solar electric system's power production depends on how much is paid to a utility for electricity and how much the utility will pay for excess energy generated. Solar electric production takes place during the daylight hours, and this matches many of the hours that electric provider power costs are at their highest. For businesses, this is generally when energy use is also at its highest. For residents, this is generally when you are away from your home, making it a great opportunity to generate electricity to direct back to the utility grid.

In Wisconsin, systems sized 20 kW and less fall under net energy billing, where excess solar power is directed back to the utility grid and credited for later use. A customer can use any eligible rate, including time-of-use rates, when net metering. For systems larger than 20 kW with the potential to feed power into the utility grid, a power purchase arrangement with the local utility is required in advance of installation. Some utilities offer higher buy-back rates for solar power. Be sure to check with your utility to determine if this option is available to you.

Solar electric systems fix future electricity costs, thereby insulating businesses and residents from escalating energy prices. Many solar owners look at solar electric investments as pre-paying their energy bills. The great benefit of this type of investment is that eventually the energy savings provided by the solar energy system will completely pay for the system. After that, all of the energy produced is free. Residential systems typically have a 10 to 20 year payback period. Tax-paying business owned systems typically have a 5 to 15 year pay back period.

BOTTOM LINE

A solar electric system may be a wise investment—however, energy efficiency is the first step toward implementation. Work with Focus on Energy at **800.762.7077** or visit focusonenergy.com for more information.

STAY CURRENT AND CONNECTED!

Join our online conversation at focusonenergy.com/socialnetworks to connect with people who share your interest in saving energy and money at home and work. Also, visit focusonenergy.com/incentives for the latest incentives and requirements as Focus offers are subject to change.

Focus on Energy works with eligible Wisconsin residents and businesses to install cost-effective energy efficiency and renewable energy projects. Focus information, resources, and financial incentives help to implement projects that otherwise would not be completed, or to complete projects sooner than scheduled. Its efforts help Wisconsin residents and businesses manage rising energy costs, promote in-state economic development, protect our environment, and control the state's growing demand for electricity and natural gas. For more information, call **800.762.7077** or visit focusonenergy.com.

