RENEWABLE ENERGY

Farming the Sun:

Small-scale solar technologies for agriculture

FACT SHEET

BIOMASS

GEOTHERMAL

HYDROPOWER

SOLAR

WIND

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Many farms in Wisconsin offer opportunities to increase productivity using small-scale solar technnologies.

Solar energy can help farmers save money, reduce pollution and increase their self-reliance. Because farming can be very energy intensive, small-scale solar technologies can help farmers meet their energy needs and reduce their dependence on fossil fuels. Some of these technologies also help increase productivity and product quality. Solar technologies can be used to provide space and water heating or to generate electricity to provide power for a variety of applications.

Depending on the price of electricity in the local area, solar electricity can be economical even fifty feet from a grid connection, depending on the application. Solar powered electric fence equipment can be moved from one remote location to another, eliminating the need for running and maintaining a diesel or gasoline powered generator.

A solar electric system is reliable and versatile. Basic components include the panel, the battery and a charge controller to keep the battery from overcharging. These systems can be used with efficient light fixtures, ventilation fans, pond aerators and deicers, and small appliances or other equipment with small motors (see Solar Electric Applications table on page 3).

Heating water accounts for 25 percent of the energy used on a dairy farm, and can be as much as 40 percent for large, commercial dairy farms. Solar water heating systems (also called solar thermal) can assist other farming operations as well by providing hot water for cleaning equipment, maintaining livestock, and reducing the need for conventional water heating. The sun's heat can also be harnessed to heat building spaces (see Solar Thermal Applications table on page 4).

Some systems combine electricity and heat from the sun. For example, poultry and pig farmers, who raise animals in enclosed buildings, can incorporate both electric and thermal solar technologies to provide supplemental heat and power to operate ventilation systems. A combination of solar applications also can be used for a reliable source of heat, light and power for greenhouses.

These are just some of the many ways solar energy can be harnessed on a small farm that can improve both agricultural and economic productivity. The primary advantage of these technologies is their ability to produce energy in remote locations for specific purposes for a reasonable cost. Small systems can be particularly economical.

This solar powered fence charger protects a garden in Spring Green, Wisconsin. Costing about $100, it incorporates both battery and charge controller within the unit, and mounts on a standard fence post. This small-scale unit can power a fence up to three miles in length and was purchased at a farm supply store.

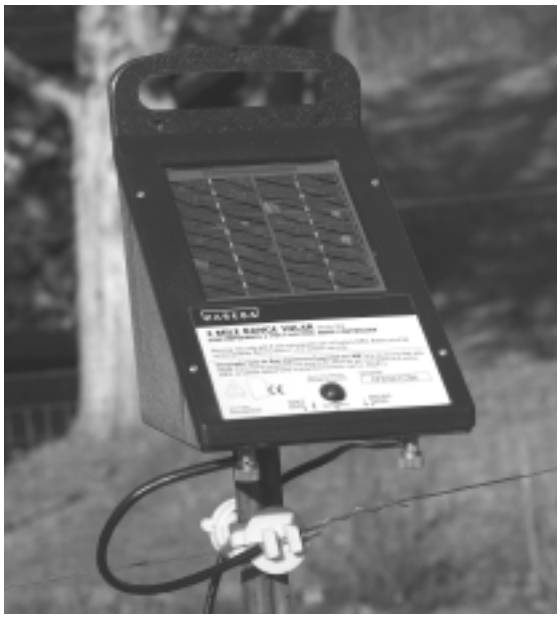

PHOTO COURTESY LARRY KROM

SOLAR ELECTRICITY

For farmers, there is the constant challenge of raising productivity or saving labor in their operations. Sometimes the availability of electric power makes specific tasks more productive and easier. Wherever power is needed on the farm, there is usually a way to install a solar electric panel to do the job. And powering with solar systems adds the advantage of lowering the environmental impact of generating that electricity.

Solar electric panels can provide power for everything from a wristwatch to a large building. A popular solar electric application on the farm is electric fencing, in common use to contain livestock as well as to protect it from predators. A variety of 6V and 12V solar chargers for livestock fencing is available, typically able to charge a fence up to 30 miles in length. Smaller scale systems are available to protect gardens and ponds from small predators and pets.

Other solar electric applications include providing electricity for lighting and ventilation in remote locations and powering gate openers and pond aerators. Solar powered lighting can make a remote building or work area useable after dark without running grid power to that location. It can also be used for security lighting to illuminate paths, driveways or building entrances. Solar power can provide lighting and heat for poultry, including egg incubators. Newly available and highly efficient LED (light-emitting diode) lamps work well with solar panels and also perform reliably in cold climates.

A solar electric system mounted on a trailer becomes a portable source of electricity, like a standard generator. Such a system could be used to pump water to maintain a wetland for waterfowl during the summer and then to power an aeration fan for grain storage in the winter.

SOLAR ELECTRIC SYSTEM AT INN SERENDIPITY, BED & BREAKFAST AND SMALL SCALE ORGANIC FARMING OPERATION IN BROWNTOWN,WI

PHOTO COURTESY NIELS WOLTER

Installed in 2002 on the south side of an existing equipment shed, this 0.5kW grid-intertied system has no battery backup. Owners John Ivanko (pictured) and Lisa Kivirist use less utility power because of their solar electric system. They could also sell any excess electricity production back to the electric utility power company. The system has been providing about 530 kWh/year to offset power requirements for the fans and pumps in the active, closed loop, solar water heating system in the greenhouse, and in other farm buildings used for llamas and the CSA operation. The owners expect the system to help avoid emissions of almost 50,000 pounds of CO_2 over its 50-year projected lifetime. Approximate cost of this system was $5,000.

SOLAR ELECTRIC APPLICATIONS FOR THE FARM			
APPLICATION	**DESCRIPTION**	**CONSIDERATIONS**	**COST RANGE**
Electric Fencing Web search: solar fence charger	A solar fence charger replaces a utility grid connection or a battery that must be recharged by a fossil fuel powered generator.	There are many models available from which to choose the appropriate unit for any given application.	$100 to $400 (usually includes everything but grounding rods and wiring supplies.)
Lighting Web search: solar lighting	A solar powered lighting system is comprised of the solar panel, a battery, a charge controller and an efficient DC lighting fixture.	Light is available during power outages.	$50 to $200 (each)
Water Pumping Web search: solar pumping	Solar electric systems can pump water from ponds or streams and stored elsewhere to move livestock away from ecologically sensitive banks. Solar pumping can also be used for irrigation in isolated fields.	Solar pumping systems are most cost effective in low-head and low-volume applications.	$1,500 to $7,500, depending on size of system (well drilling not included).
Pond Aeration Web search: solar pond aeration	Aerators oxygenate ponds in the summer, and create open water in ponds and stock tanks in the winter.		$350 to $400
Gate Opener Web search: solar gate opener	Electric gate openers can be cost effectively connected to solar PV systems in locations over 1,000 feet from grid power.		$750 to $1,500
Dashboard Battery Charger Web search: solar vehicle battery charger	A solar electric panel feeds a trickle charge to the battery in seldom-used vehicles or farm equipment.	Requires only that the panel be oriented toward the sun.	$30 to $40
Ventilation Web search: solar powered ventilation	A rooftop fan powered by a solar panel can provide ventilation or air flow for cooling in livestock buildings, storage sheds or other outbuildings.	Some models feature a built-in solar panel. Most efficient ventilation or cooling fans can be powered by a solar PV system.	$200 to $500 depending on cfm—including fan and panel.

Depending on when a solar electric system will be used, a battery may or may not be required. Deep cycle or gel cell batteries are recommended for solar applications over standard car batteries because they are safer and less time consuming to maintain. Fluid levels don't need to be checked and they can be moved easily without any chance of corrosives spilling.

Solar electric panels will withstand Wisconsin's extreme winter weather conditions. Currently available solar panels are designed to resist hail and other adverse conditions, and usually are warranteed for at least 20 years.

Equipment Availability

Farm equipment stores like Farm and Fleet are beginning to offer solar electric devices such as the fence charger, and might consider carrying other items if they receive customer requests. However, the best current source for many of these items is the internet. For that reason, Web search phrases are suggested in the table. A wide variety of companies offer solar equipment through their Web sites, and some provide toll-free numbers for further information.

SOLAR THERMAL TECHNOLOGIES

Solar thermal refers to ways of using the sun's heat directly or indirectly for heating water or air. Active

SOLAR THERMAL APPLICATIONS FOR THE FARM		
APPLICATION	**DESCRIPTION**	**CONSIDERATIONS**
Greenhouse Vent and Louver Openers	A piston device that extends to open and close greenhouse vents or ventilation louvers automatically by employing the sun's heat to expand wax contained in the mechanism, adjusting the vent as temperatures change.	Averaging $45 to $50 each, these are also useful for automatically ventilating small cold frames.
Solar Thermal Air Heating	There is a perforated metal siding product available which is installed with a ventilation system so that solar heated air is drawn up and into the building to be distributed by ducts inside. In the summer the hot air is directed out of the building by dampers, providing ventilation benefits.	This can be installed either when the building is constructed or added later.
Crop Drying	A combination of passive and active solar air heating, with potential for use with solar electric powered ventilation.	
Root Zone Heating	A way of extending crop seasons in greenhouses, a solar hot water system can be used to distribute heat in bench or floor planting areas by use of hydronic thermal tubing in the soil.	Can be used as a preheating method for conventionally fueled root zone heating.
Water Heating	Solar heated water can be used for barn cleaning, tempering of drinking water and other livestock applications. In Wisconsin's winter months, the solar panels can produce up to 40 percent of water heating needs, creating savings through preheating.	This technology can be particularly economical if the farm relies on propane for water heating.
Passive Heating and Daylighting	Translucent roofing panels on livestock barns and other outbuildings can cut use of lighting fixtures during daylight hours, as can appropriate installation of windows on the south side of the building. Thermal mass inside buildings, including stone or brick floors, walls or fireplaces, can capture and store the sun's heat to cut or eliminate the need for other heating sources.	Most economical when incorporated at the time of building construction.

solar thermal technologies include solar hot water panels for greenhouse heating, livestock barn heating and washing, crop drying, and air heating and distribution in barns and storage buildings.

Passive solar thermal technologies are usually designed into a building structure when it is constructed, although it is possible to add them later. These include daylighting in barns and outbuildings, passive solar heat for livestock and storage buildings, and some methods of crop drying.

In Wisconsin, solar thermal systems must be well insulated. They will likely not provide the total heat required during the winter months but will still save energy costs by preheating the air or water. Cost for a solar thermal system varies widely depending on size, technology and use, but the currently volatile prices of fossil fuels are making the economics of solar thermal systems increasingly attractive. It is possible for a system loan payment to be less than the average monthly fossil fuel bill.

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