Power from Above

Future is Brighter for Solar Cells

by Jim Muench

photographs by Nick Decker

Bob Cessac needed to water his thirsty cattle. And he had to cart it uphill from a pond that was half-a-mile from the nearest power pole.

Cessac, who farms 330 acres near Fayette found his answer in solar power. In a 1996 demonstration project funded by the Missouri Department of Agriculture, he developed a solar power system to pump water for his cattle and compared it to both a traditional electric water pumping system and a watering system that relied on gravity. Cessac's system uses a portable solar panel.

"Gravity feed is most economical if you just have one pond and if terrain allows you to do it, but the pond has to be uphill from the pipe," Cessac said. "I'm still using the solar system; I'm real happy with it."

Cessac's solar system allows him to move his solar panel and pump to any of his three ponds, and it allows him to pump water uphill to his 50-acre pasture, which is divided into ten 5-acre plots which affords rotational grazing. He said he can pump between 300 and 1,300 gallons per day, at a rate of 2 gallons a minute, depending on the cloud cover.

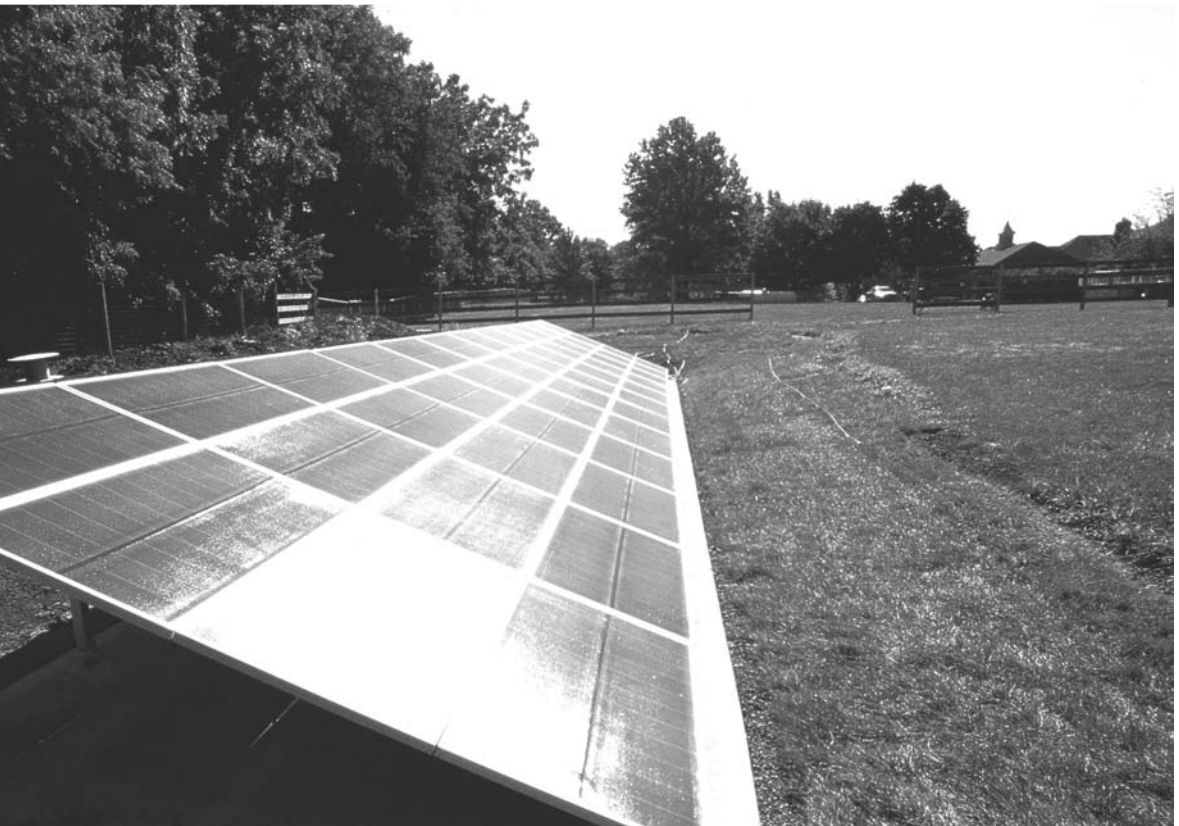
Increasingly, people like Cessac are turning to solar power when conventional electric power is not the best fit. In many remote applications, electricity produced by solar cells is now price-competitive with traditional electric power. The cost of photovoltaic power panels has decreased from about $100 per watt in the early 1970s to less than $5 per watt today, according to James E. Rannels, acting director of the federal Office of Photovoltaic and Wind Technologies.

Photovoltaic cells, commonly called solar cells and usually made from highly purified silicon, convert sunlight directly into electric power without the use of moving parts and without producing fuel wastes or air pollution. Solar panels now sit atop a million buildings and heat the water in 300,000 swimming pools in the United States. The Solar Energy Industries Association estimates these numbers should rise about tenfold in the next decade.

The marketplace is changing quickly, and the U.S. solar industry leads the way into new markets, both domestic and overseas. For instance, U.S. manufacturers export more than two-thirds of their photovoltaic products to developing countries that need to provide electricity to remote villages without a traditional electric infrastructure in place.

Interest in solar power is rising in Missouri as well. The University of Missouri-Rolla's victory in the national Sunrayce for solar cars, along with a strong sixth-place finish by the University of Missouri-Columbia, raised the visibility of solar power recently. Likewise, the state's solar industry received a boost in April 1999 when Soltech 99,

Experts predict solar panels, similar to this one in the backyard of a Blue Springs residence, will become a more common scene in Missouri neighborhoods. (Opposite page) Solar energy consumers often employ modern windmills to back up their solar systems.



the national conference of the Solar Energy Industries Association, came to Kansas City. The Department of Natural Resources' Division of Energy co-sponsored the conference and provided funding for the cars.

Distributors in Missouri report that interest in solar power picked up in the past year. "Last year, I got maybe a hundred calls; this year it's more like 400 calls," said Pat Pavlovic of Suncraft in St. Louis, a company that specializes in solar and wind electricity for homes. "People are getting interested in solar this year because of Y2K (the Year 2000 computer compliance issue that some believe will disrupt electric services). They are interested in solar either for backup power in an emergency, environmental reasons or self-sufficiency."

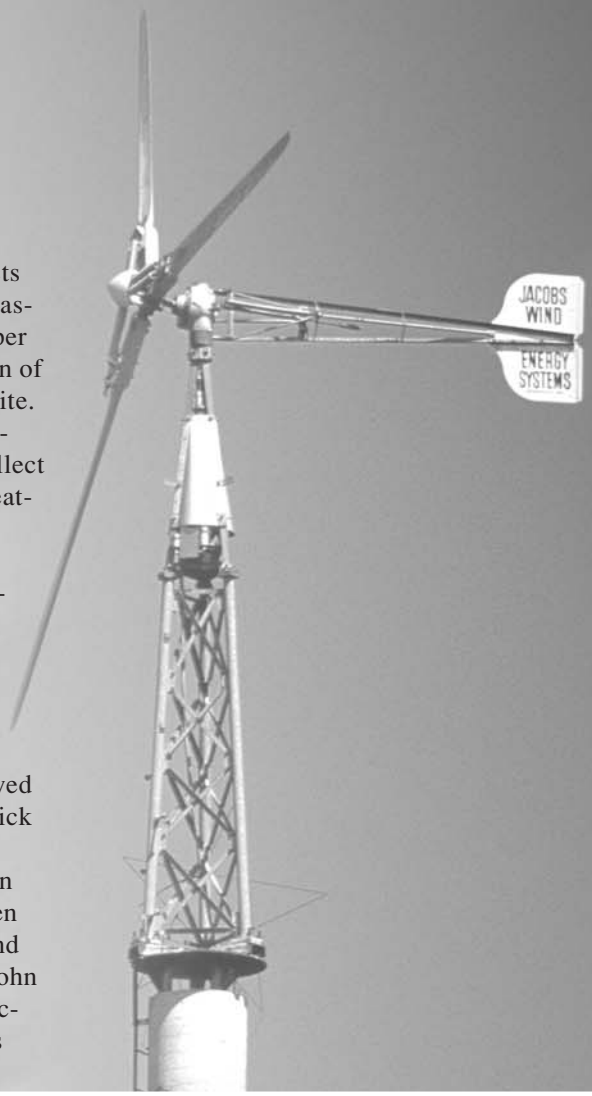
According to Bill Roush, president of the Heartland Solar Energy Industries Association and of Solar Electric Systems Inc. of Kansas City, the industry has been growing about 20 percent a year in the last three years. "People are getting used to using solar power," he said. "More and more people now have seen solar work, either in boating or in an RV (recreational vehicle), where they're recharging batteries, and they say, 'Well, maybe I can use solar in another application.'"

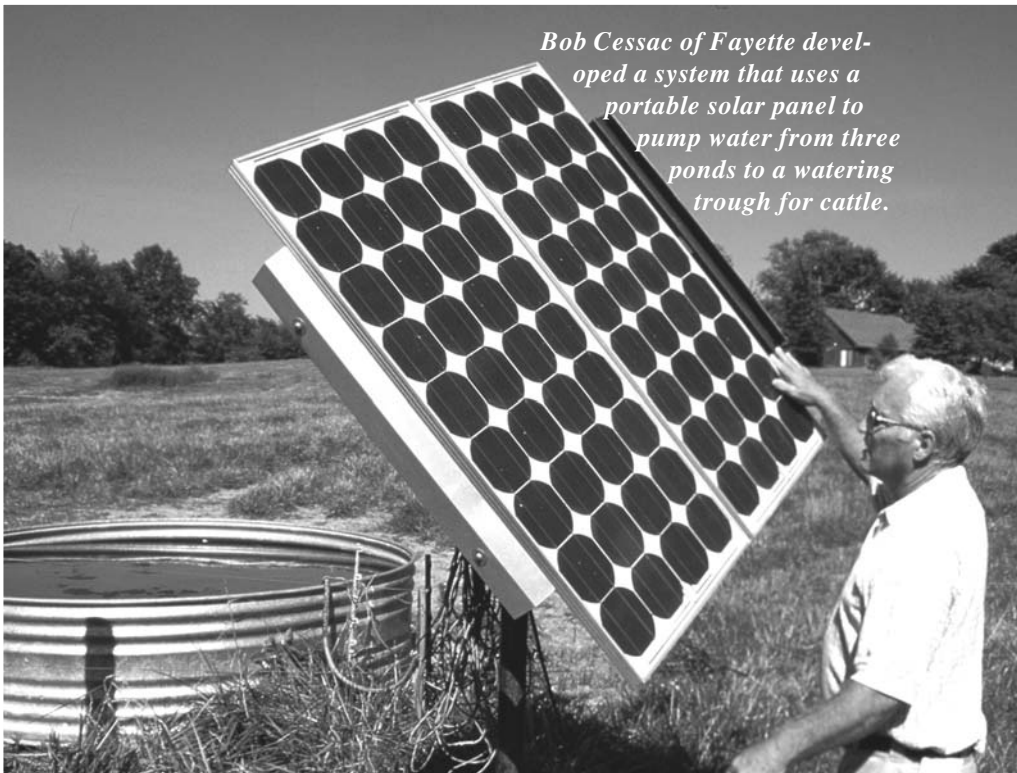
In Kansas City, he said, customers mainly use solar as a backup power source. "For cabins or small getaways, solar is the primary option," he said. "Also, the solar systems can solve power quality problems. It acts as a big, uninterrupted power supply for heating or lighting."

In tandem with photovoltaic systems, passive solar design techniques can help use the sun to great advantage in buildings. Building projects often start with designs that use passive solar techniques such as proper window placement and orientation of the building on the construction site. Good use of natural sunlight, windows and well-placed shading collect and use the sun's energy to its greatest heating and cooling potential.

Passive solar design is best incorporated early in the design stage of a building, but the techniques can be applied when renovating older buildings, too. Designers must factor in the amount of sunlight and heat allowed inside and retained by stone or brick materials in the building.

"Renovation is a passive design issue because older buildings often used stone and many windows, and concrete floors and walls," said John Hoag of Hoag Associates Architecture & Planning in St. Louis. "It's





Bob Cessac of Fayette developed a system that uses a portable solar panel to pump water from three ponds to a watering trough for cattle.

often a question of utilizing those materials as best you can."

Hoag said there are plenty of architects interested in solar energy. "The client base is the constraint," he said. "The design talent is there. There are enough (professionals) who are sufficiently skilled or educated."

Increasingly, architects see exciting potential to integrate photovoltaics in buildings. Building designers would place solar cells around windows, attach them to roofs, affix them as roof shingles, laminate them on metal roofs or integrate them into specially designed walls.

Two fundamental recent developments in the United States are profoundly influencing the market for building-integrated solar power, said Steven Strong, president of Solar Design Associates in Harvard, Mass. First, architects have begun to perceive photovoltaics as a design element and not simply as a utilitarian mechanism. He said photovoltaics are gaining the status of a high-quality, prestigious building material such as ornamental granite. What once was considered unattractive is becoming an attractive status symbol.

"Ten years ago, architects would incorporate solar panels, but they would pay for an additional screen to shield them from view," Strong said. "Now manufacturers have come to realize that photovoltaics must be integrated into the design elements and incorporated as highly visible and public statements of their "green" (environmental) credentials."

Strong said the second profound development is that manufacturers are starting to make photovoltaics integral components of standard building products. For instance, they are developing a new generation of products such as overhead window glazing for skylights or atriums that incorporate photovoltaics. "Instead of letting the light through and reflecting the heat away, as it has been historically, it will be used to generate electricity," he said.

At present, solar power is used most in specialty markets where electricity is needed, but where traditional utility lines are too costly to extend. The fastest growing applications of photovoltaic power systems lie in such areas as water pumping; lighting and traffic signals; refrigeration of medicines and food; emergency services; and telephone, television and satellite communications.

When connecting an electric line to a remote location is too costly, photovoltaics can be an attractive alternative, especially when the environmental benefits are factored in. These factors have led some states, including Missouri, to use photovoltaics to power signs at remote construction sites, to run navigational aids along waterways, and to operate emergency phones along rural interstates. In Missouri, the Department of Natural Resources plans to use photovoltaics at remote locations in some state parks to run exhaust fans in restrooms and is looking at other options as well. DNR's Division of Energy has received a special $21,000 grant from the U.S. Department of Energy to fund solar power projects in remote locations.

The Springfield school district, recently installed four solar-powered lights for its nearby school-zone warning signs at McBride Elementary School. The cost of running wires to the meters was prohibitive, said Dave Abbott, assistant coordinator of maintenance for the Springfield Public Schools.

"By not going with the standard electrical power lines, we saved $30,000 up front because of trenching, backfill, electrical conduit and wiring," Abbott said. "In addition, we estimate $530 per year in operating cost savings."

Another important use for photovoltaics lies in protecting pipelines, underground storage tanks and suspension bridges from metal corrosion. Solar cells provide a small electric current that combats the natural process of corrosion.

The ability to provide remote power also makes photovoltaics a good choice on farms. Parker-McCro-

In a remote location without electricity, this restroom at Ha Ha Tonka State Park uses photovoltaics to run exhaust fans. (Inset) The restroom's roof-mounted solar panels are much more affordable than the cost of connecting an electrical line.

Most of the U.S. Geological Survey's 105 stream-flow gauging stations, like this one on the Meramec River in St. Louis County, employ solar panels. The units relay stream-flow information to a satellite.

ry Manufacturing Company, headquartered in Kansas City, uses solar panels in its Parmak line of electric fences. The solar cell recharges a battery that provides power to the fence. In traditional systems, farmers have to constantly swap batteries to keep the system running.

When Parmak pioneered the system in 1978, the solar unit cost $160. Twenty years later, it costs $180, an increase of just 12.5 percent, compared to the Consumer Price Index of goods, which increased 149 percent during that time. The efficiency of the solar cell also has increased 42 percent over previous panels, according to Ken Turner, president of Parker-McCrory. The system's six-volt battery holds its charge for 24 or 25 days, even if the sun doesn't shine.

"If we have 24 or 25 days of complete darkness, your solar fencing system will be the least of your worries," Turner said.

As farmer Bob Cessac found, another Missouri farm application is pumping water for livestock, which offers the environmental benefit of fewer herds tearing up and depositing wastes in stream banks to get a drink.

DNR's Soil and Water Conservation Program supports the use of such solar-powered agricultural products. The Soil and Water Conservation Districts Commission provides funding, through the state's cost-share program, for solar panels and solar-power fence chargers when used in a planned-grazing-system practice. The cost-share program is administered locally by soil and water districts.

In conjunction with the local soil and water conservation districts, the Missouri Department of Conservation (MDC) has promoted a system in recent years that works well with rotational grazing, a type of grazing in which a large field is sectioned into smaller paddocks. A watering tank can be moved to whichever paddock is being used.

"When it is not cost-effective to run an electric line, then solar can get the job done," said Bill Turner, streams technical leader for MDC. "The systems function well as long as the right system is selected for the operator's needs."

For a copy of the MDC's handbook, Watering Livestock with Solar Water Pumping Systems, contact Bill Turner c/o MDC at 1014 Thompson, Sedalia, MO, 65301.

Where might solar power have the most impact in the near future? Probably in telecommunications, as cellular phone towers begin to use solar cells to power their microwave repeaters. "The solar industry is going to ride on the back of cellular phones," said Scott Sklar, executive director of the Solar Energy Industries Association. "As the wireless communication industry goes, so will we."

Jim Muench is division information officer for the Missouri Department of Natural Resources' Division of Energy.

Storage batteries in Tim Harrington's garage are charged by generating electricity from the sun and wind. The cells provide five days of backup power.