Photovoltaics in Arkansas' Meadowcreek community help make its self reliant ideas a model for the future

By Vern Modeland

It's the biggest photovoltaic installation in a six state area, they say. "They" are the folks who designed and who work with the 10,000-watt peak PV system that provides a significant portion of electrical power for Meadowcreek, a self reliant sustainable model community near Fox, Arkansas.

So far, no one has come forward to contest the claim to regional celebrity. But people in growing numbers are making their way to the Ozark Mountain valley about 120 miles north of Little Rock to see this exceptional grid-connected PV system and learn more about its place in a sustainable future.

Luke Elliott, director of the not-for-profit environmental education center, likes to point out that, when producing at its full design output level of 14,000 to 16,000 kilowatt hours of electrical power per year, Meadowcreek's PV system would more than meet the needs of two of today's average households.

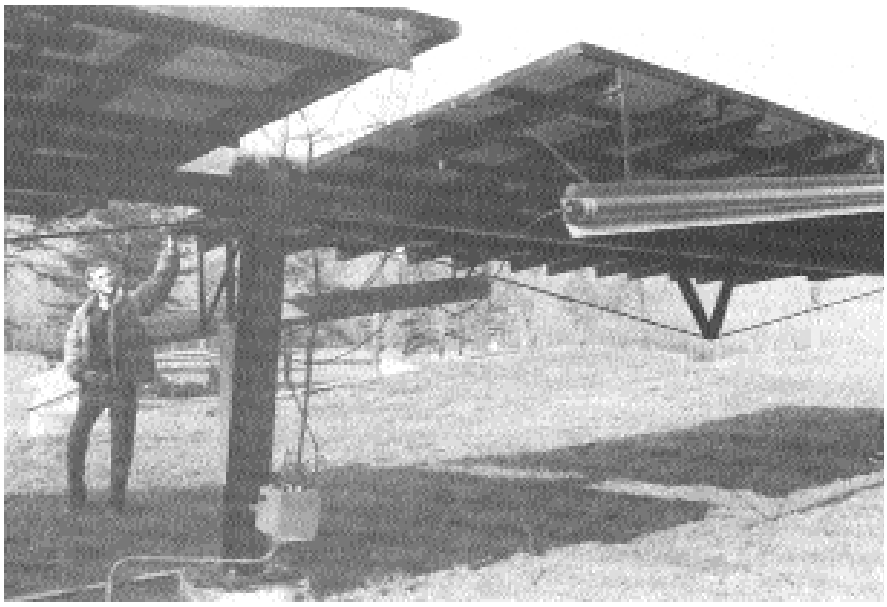
"But the interesting thing is that if we look at households that really used electricity efficiently, we'd be producing enough power for probably 10 to 15 very efficient households. Sort of a micro-utility."

Hmmm. At 8 or 10 cents a kilowatt hour for utility-source electricity (or even as low as the 5 cent per KW base rate in Springfield, MO) and an average inefficient household's consumption of around 1,000 KWH a month, investing in a neighborhood-owned, PV-clean electrical system suddenly doesn't seem entirely out of reason.

That's the kind of train of thought that Luke Elliott likes to switch onto the track.

"We want to give people an idea of the problems and an idea of the solu-

The energy-efficient education center at Meadowcreek nestles into a hillside. Solar hot water collectors are left-center. Fixed 5KW photovoltaic array is at right.



Meadowcreek's director, Luke Elliott, explains how a freon-powered tracking system works on the ground-mounted 5KW photovoltaic array. The gas in light-fixture-like tubes at front and at the rear of panel expands in the sun warmth to push at a piston in the container visible center-photo.

tions also - practical solutions that are applicable in the real world," he says.

Meadowcreek's very remote location posed the power problem that sped the development of its showcase solution in alternative energy generation.

"The quality of electrical service at Meadowcreek was inconsistent due to its distance from the nearest voltage support and the rugged, heavily-forested terrain that the electric service had to pass through," recalls Chris M. Benson. Benson was project coordinator for the PV installation. He also is a senior policy analyst for the Energy Office, a division of the Arkansas Industrial Development Commission in Little Rock.

Electricity from the public power grid gets to Meadowcreek over a long single-phase distribution line. The nearest voltage regulation point is about seven miles away. The substation serving the area is nearly 20 miles distant.

Funding was obtained in 1990. The money came from federally mandated oil overcharge reimbursements earmarked for energy- related projects in Arkansas. The dollars came with a stipulation that an adequate PV system for Meadowcreek must also serve a role in energy education for visitors.

The installation was developed with support from the PV Systems Design Assistance Center at Sandia National Laboratories, Albuquerque, NM, the United States Dept. of Energy, and the Arkansas' Energy Office.

After everything was hooked up, plugged in and generating power, the bill added up to $118,635. Of that amount, $89,068 went directly for equipment and materials.

The Meadowcreek PV design includes two arrays operated in parallel. Output at peak power levels is five KW from a tracking mount array and five from a fixed array.

Each array is composed of three paralleled strings of 14 series-connected modules with a total of 84 Solarex photovoltaic cells in each. Each module operates at an average power level of approximately 55 watts and a nominal 230 volts DC. That is converted to 120 volts AC inverters made by Omnion Power Engineering Corp.

Solar Engineering Services, Lacy, WA, was the vendor for the equipment and engineering services, Benson says.

Utility-connected

The utility-interactive I connection is real-time. There is no attempt to store PV-generated electrical energy in batteries. Rather, the system is connected to building wiring in parallel with incoming utility lines. The area's electrical utility became the supplementary supplier of power to Meadowcreek, Benson explains.

Meadowcreek doesn't attempt to sell back to the utility any surplus power it might generate.

"The economics of it were just not there for us. We'd be paid something like two cents a kilowatt hour for power we sold back. We would have to pay a monthly meter charge to do that. We figured the power 'we could sell back wouldn't pay the monthly meter charge.

And I think that is one of the misconceptions people have for alternative energy. People new to it come in and say, 'This stuff is great; I'm gonna put it on and sell power back to the utility!' The reality is that it makes better sense to produce only what you can use and not try for some scheme to sell it back," says Elliott.

All lighting and appliances in the building are standard 120 volt AC versions. No attempt was made to include direct current wiring or devices.

"People can see this is normal everyday stuff," Elliott explains.

Safety considerations for a grid-connected system

Hooking a PV system -up to local power lines poses safety considerations as well as technical problems. According to Benson, the primary safety concern is to be sure any private system will quickly disconnect from the utility during any abnormal operations or outages for the safety of power company linemen who might be exposed to dangerous levels of power from a generation source of which they might not be aware.

The Omnion inverters were designed to disconnect within 25 frequency cycles. They've demonstrated an ability to go off-grid in two to five

cycles after sensing an abnormality. A manual disconnect switch also is readily accessible in case of emergency and for system and utility servicing and inspections.

Fixed and tracker arrays

Another unusual feature of the system is that half of the solar panel array is affixed to the building roof while the other is ground-mounted as a tracker. Up on the south-facing roof of the, education center, one array is pitched at the local optimum angle for the latitude of 33 degrees.

The second array is behind the building, on a hill, on a rugged, north-south oriented pivoting steel frame. This design allows it to roll on its long axis. That's supposed to expose more of its face directly toward the sun. Energy to drive the pivoting movement is supplied by freon refrigerant in a device from Robbins Engineering, Lake Havasu City, AZ. The freon expands when heated and pushes a piston to rotate the array.

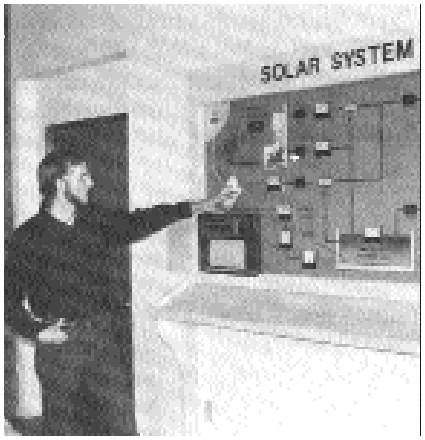
Collectively, the two arrays are producing 30 percent of the education center's annual electrical requirements. That's an average annual output of 15,000 KWH. Elliott and Meadowcreek's engineer-handyman, Reedis Allen, keep trying to push the percentage higher through a continuing program of uncovering and eliminating or reducing power-robbers practicing the energy-conservation that is a part of the Meadowcreek commitment.

In summer, spring and fall, Meadowcreek echoes to youth leadership and educational retreats, Elderhostels, an internship program of global proportions, and workshops and conferences on topics related to energy, ecology, and agriculture that are as varied as PV water pumping and growing Shitake mushrooms for profit.

The education center building itself shows off environmentally innovative construction ideas that also are aesthetically pleasing. In its 18,000 square feet of floor space are an auditorium, environmental library, lounge, gift shop, kitchen and dining facilities, greenhouse, and offices. Eight-hundred-square-feet of solar panels on the roof above the lounge heat water that is pumped to hot water heaters on demand or into the 5,000 gallon storage tank located in the mechanical room. The water storage tank was partially buried in the ground and bottom and sides insulated to R40-45. It keeps water at a temperature of 120-140 degrees Fahrenheit, according to Allen.

A wood-fired furnace and the big stone fireplace in the center's lounge are backup sources for warmth, if needed.

Solar energy also produces an average two gallons of water a day in a demonstration distillation unit located near the building's greenhouse. Seedlings grow there from late winter until early spring planting. Excess solar heat from the greenhouse vents into the main part of the building as needed.



The workings of Meadowcreek's solar water heating system is outlined for visitors in a wall graphic that includes a real-time display of temperatures and status.

Low-E glazing in a couple of dozen skylights, and the abundance of windows that face a spectacular view of towering sandstone outcroppings and forested bluffs across the valley, keep the building sunny and serene most days.

Low-wattage compact fluorescent lighting is in evidence throughout the building. Replacing 75-watt incandescent bulbs with 7-watt compact fluorescents in overhead fixtures reduced their power consumption by about 80 percent, Elliott figures. Thirty-two T-8 fluorescents with high frequency ballasts have been installed in other fixtures. Motion sensors in many rooms, including the rest rooms, automatically turn lights on only when someone is present, and see that they are off otherwise.

A food service-size refrigerator and a walk-in cooler are the center's major offenders to energy efficiency, according to the director. The appliances are destined for replacement when funds allow, he says. So is the hot water booster heater necessary for sterilization during cleanup after meal service.

"It pulls 12 KW on just one shot. When we have a sunny day and we fire that thing up; it takes all the power we can produce."

The kitchen is staffed only as needed. Its two cooks see that menu selections lean to the healthy and also include a vegetarian choice. Produce from the center's terrace gardens and organic products, purchased locally, are used in cooking that stress natural ingredients and lots of "scratch." Food scraps go to compost that is returned to regenerate the Meadowcreek terrace vegetable gardens.

Recycling paper, newsprint, glass, aluminum, and plastic also are a way of life as Meadowcreek practices what it attempts to preach and, hopefully, spread as its gospel.

"We want to continue the demonstration aspect, but we want to build some good practical program

that have outreach and have something that we can take out into the world rather than have sitting down in this secluded valley," says Elliott of his plans for 1992.

He explains a concept that would target businesses:

"We would go into a business and look at what they're using energy-wise, look at what the environmental impact is, and provide a set of solutions that give a net dollar return, a good environmental return, and also offset C02 production by virtue of tree planting. My idea is to do it grass roots. I feel there are a lot of people that want to do something but so often organizations do a lot of talking and publicizing the problems with very lit-

tle action. I think there is a grass roots audience -the wife of the plant manager, the son of the vice president those connections. That's where we can implement change. I think."

Youth residency program

Meadowcreek offers a residency program each June for children entering 7th and 8th grades in Arkansas public schools. It's funded by the state department of education. Last year, 400 students applied for the 30 available openings.

"They come here for two weeks and learn about agriculture and organic gardening, renewable energy and energy efficiency. There's applied ecology and learning to appreciate what's in the natural world," says Elliott.

Another eight-week residential internship program for older folks integrates reading and lecture-based sessions with hands-on experience aimed at providing participants with knowledge and skills for making informed living choices.

'What we're trying to do is give people something they can take back to their own house, their own community, and apply. It's not a new idea but there are very few places where people can really learn about alternative energy and organic gardening and install a photovoltaic system or an active solar heater."

The Meadowcreek enterprise began in the 1970s as the commitment to action of two brothers who grew tired of only talking about the unsustainable direction in which they saw the world headed. David and Wilson Orr became of a mind to put their energy and money where their ideas were. They looked at locations in the Rockies, the Smoky Mountains, and elsewhere across the United States, then chose Meadow Creek Valley in the Ozarks.

Meadow Creek had the greatest combination of natural resources, David Orr observed. There were abandoned acres of farmland, stands of mixed hardwood forest, abundant water, a mild climate, and diverse wildlife.

The brothers bought 1500 acres.

Meadowcreek as David Orr envisioned it would be a model for viable communities and neighborhoods in an irrevocably interdependent world. But not a commune.

"Taking the best that 'soft technology' has to offer, we plan to set up not just a community, but an educational and research center that will encourage the exchange of information on successful responses to problems of sustainability," he wrote in describing his vision.

"I think we succeeded in many ways, including the construction of an extraordinary facility, the establishment of a variety of creative educational programs, some great conferences, and the initiation of off-site projects like the food studies we did at Hendrix, Oberlin, St. Olaf, and Carleton Colleges," he reflects today.

Wil Orr stayed with the project until 1989. David moved on in 1990 to teach in the environmental studies program at Oberlin. Luke Elliott arrived in 1990, taking over Wil Orr's role as energy specialist. Elliott then inherited David Orr's position as director, infusing a 32-year-old's enthusiasm and energy.

His biggest task he says, has been to find funding that would keep Meadowcreek alive. One of his achievements in 1991 was a management and financial relationship with the Kerr Center for Sustainable Agriculture, Poteau, OK The Kerr Center is a research and demonstration center providing education and technical assistance in agriculture.

"The ideas of self-reliance and sustainability are highly practical," David Orr observed more than a decade ago. "Applied widely enough, they would rejuvenate neighborhoods and communities, reduce environmental costs, lower energy demands, minimize burdens on government, cut inflation and unemployment, and preserve islands of diversity in an overly homogenized and vulnerable society."

Self-reliant thinking gave birth to Meadowcreek. Now, the largest photovoltaic installation in Arkansas attracts the people who can make such

Semblances

You
Are trying
To be,
Like the person
In your poems;
Deep,
And intellectual,

While I
Am trying
Not
To be,
Like the
Dark
Brooding
Monster
In my own.

John Earl Silveira
Ojai, CA

dreams come true. Δ