

PV pioneer describes his successful solar home

By Paul Jeffrey Fowler

My wife Lea, my three-year-old son Terry, and I live in a passive solar home nestled in a remote corner of a small town in the Berkshire Hills of western Massachusetts. Our house is located 1.3 miles and \$20,000 away from the nearest power line. To get to our land, we drive up and over the highest hill in Worthington on a one-lane gravel road. Bob and Karin Cook, our only year-round neighbors in the 2,500 acres of land that surround us, live a third of a mile up the road.

I was born and raised on a pretty little 120-acre farm in Worthington. Unfortunately, my parents had to sell the farm I was to have inherited, just before I graduated from college. Several years after college, I returned to Worthington when my parents left me their mobile home on the lower corner of the old farm.

The trailer was of poor quality construction. I have always been someone who thought I could make something out of nothing, but I could not find anything worth saving in that trailer. I soon bought the small house just up the road which a friend and I had built several years before for my sister and

her family. It was a better structure, but like the trailer, it was located at the bottom of a narrow valley.

A perfect solar site

At the time, I avidly read all the material I could find on solar energy. I could never successfully redesign the small house into a passive solar home, because there was too little sun in that valley. In 1981, I found a nine-acre piece of land for sale with perfect south-sloping solar exposure. The only drawback was that the nearest power line was 1.3 miles away at the main road.

For years I had also been reading about wind machines and alternative energy systems. I looked at this land, so far from the power line, as a chance to do it all: build a passive solar home and power it with alternative energy. In a few months I had sold my two properties, moved to a tent on my new land, and begun to build my new energy-efficient home.

When I bought the land, I expected to install a wind machine to produce electricity. I had determined that it was a good wind site. I purchased a large generator for the building project and planned to replace it with an alter-



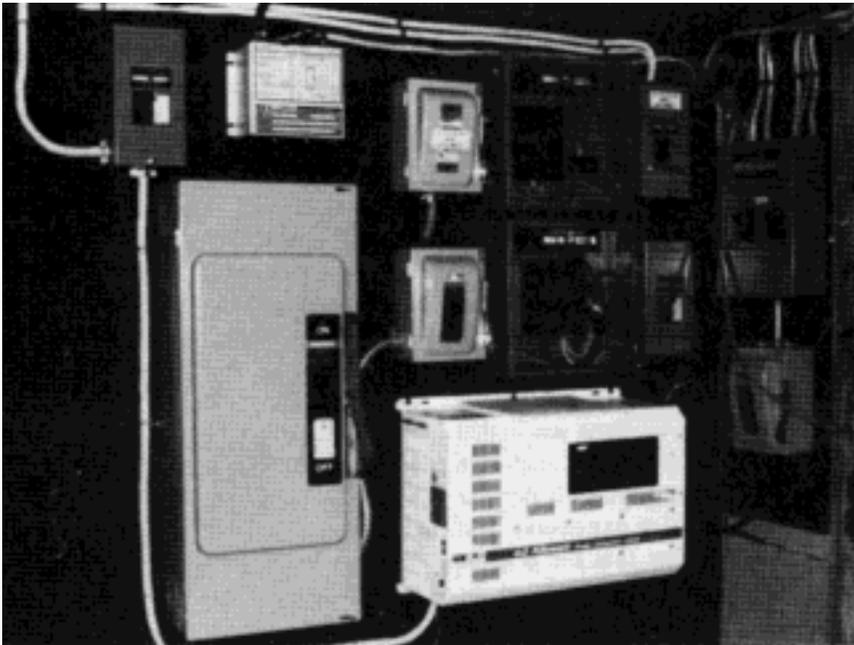
The author with his wife Lea and son Terry in front of the heat-storing stone wall in the sunspace

native energy system when I had time to design and install one. I never really expected a power line to come down the road to my house. Therefore, the whole house was designed from the beginning to be an alternative energy home, in addition to being energy-efficient. In 1982, I discovered solar electric modules and abandoned the inherent problems of a wind machine on top of a 90-foot tower. Besides, the sun shines more often than the wind blows.

Today, our house is powered by a large solar electric system. We have been more fortunate than most people who own solar electric systems. For one thing, our first systems were purchased back in the days of state and federal tax credits. Furthermore, my early research into solar electric systems evolved naturally into a successful business which sold solar electric systems throughout the Northeast.



Solar electric modules on the house and garage



System controls and 4000-watt sinewave inverter

Therefore, later expansions of our system were purchased at wholesale prices from our business. On the other hand, we were the pioneers who suffered the trials and errors of an emerging technology.

The system

On the south side of our house above the first floor windows are mounted 24 33-watt, nine-year-old Mobil Solar modules. For years, these were the sole power source for our solar electric system. Four years ago we added eight 48-watt Hoxan modules on the south side of the garage. At the time, our business offices were upstairs in the large building, and two of the three garage bays warehoused our inventory. The growing business required a lot of power to run computers and office equipment. Three years ago, we sold the remaining shares of the business, and it moved across town, leaving us with the additional electricity from the eight Hoxan modules for our home loads.

Our combined solar arrays are rated at 1,200 peak watts. This rating means

little to anyone but a solar electric engineer with a program to size systems. In practical terms, after we derate the modules for actual operating temperatures, and account for losses associated with charging lead-acid batteries, we have a daily summer average of 4,800 watt-hours to power loads in our home. In the winter, when the average insolation is low, we have a daily average of 2,400 watt-hours. Quite logically, we have approximately 3,600 watt-hours in the spring and the fall.

Figuring the angles

Our site is at 42° latitude. The standard angle to mount the modules on an adjustable mounting structure is latitude minus 15° in the summer (27° above the horizon), latitude in the spring or fall (42°), and latitude plus 15 degrees in the winter (57°). For a non-adjustable mounting structure, the array is typically installed at 42°, to obtain the greatest amount of power over the whole year. We have chosen to mount our modules on

non-adjustable structures at the winter adjustment of 57°.

Winter is the hardest time for our solar electric system. The insolation is low in the Northeast, and the short days require longer lighting loads. We are purists and do not depend on a generator to charge our battery bank in the winter. Instead, we have sized our system to meet our conservative winter loads and know we will have extra electricity in the other three seasons. Therefore, it is not necessary to adjust our arrays for the other three seasons to get additional power. The steep 57° angle of our arrays produces 20% extra power in the winter, because the modules can also pick up reflected sunlight from the snow on the ground.

Both the garage and house arrays have their own charge controllers and the associated fuses and disconnects to satisfy the requirements of the National Electrical Code (R). They both charge the same large battery bank in the basement of our house. The controller for the smaller garage array turns off before the controller for the house, so that the charging is somewhat “tapered” as the batteries approach full charge.

Our battery bank is composed of 32 6V (6-volt) 200-amp-hour golf-cart batteries wired in a 24V configuration. Many people in the industry recommend larger batteries. We sold the best quality Trojan golf-cart batteries in our business for years. We had fewer failures with them than with the larger Trojan L-16 batteries. The golf-cart batteries have the same plate composition as the larger L-16 batteries, but they are mass produced, so they cost 30% less per amp-hour. Our batteries are now 6½ years old. We expect them to last over eight years, while L-16 batteries are expected to last ten years.

Our solar electric system and home are wired to code and inspected. Our house wiring has about one circuit per room to power a selected 24V efficient lamp or lighting fixture. This

wiring system and DC (Direct Current)-rated circuit breaker box are left over from our earliest solar electric system. Some of these lights are used every day, while others now serve only as backups. The house is also fully wired for 120VAC (Alternating Current). This electricity is supplied by a 4000-watt, sine-wave, Trace 4024 inverter powered by the large 24V battery bank.

Conservation is the key

Our solar electric home uses about one-third as many watt-hours per month as my last grid-connected home. We live at a similar level of comfort in our present home, because our electrical usage has been decreased by the design of our home and the choices we have made for efficient appliances. Well-planned conservation is the real key to a successful independent home. The electricity we produce costs about 30¢ per kilowatt-hour after we factor in the costs of all the components and their maintenance and life expectancy. Solar electricity becomes a money-saver for us only after we consider our conservation and the \$20,000 we would have to pay the utility company up-front to extend the power line to our home.

We pride ourselves on having an alternative energy home that does not appear to be different to someone who visits for a weekend. We have no complicated systems of switches and *do's* and *don'ts* to follow. Conservation is designed into the system.

Solar heating

Our well-insulated, passive solar home is heated by the solar gain of our south-facing windows. The solar energy heats the house to 75° even on sunny days of subzero weather, which are quite common in our cold New England winters at 1700 ft. above sea level. Solar heat is stored in interior stone walls and in a concrete slab that is covered with Vermont slate. The

balance of our heat is provided by two cords of wood burned in our basement wood stove. We have none of the standard electrical loads of running a furnace and its circulating fans or pumps.

We have eliminated other common large electrical loads. We use a propane refrigerator, stove, and tankless hot-water heater. Our home was designed to utilize daylight. Most walls and ceilings are white, so no additional electric lighting is needed until sunset. Our electric lighting is carefully placed in all the rooms. We have chosen fixtures and lamp shades that efficiently transfer the light from the bulbs to the room, reducing the need for large bulbs or many lights in a given area. Wherever possible, we utilize compact fluorescent bulbs.

Our source of water is a deep drilled well 200 feet from our house. Because the static water level is 30 feet below grade, our best choice for pumping water was a standard 120VAC submersible pump. Our electrical loads would be less if we had a shallow well that could be pumped by an efficient low-voltage pump, or if we had a gravity-fed water supply, as our neighbors do. But we are fortunate to have crystal-clear pure water from a high-yielding well. We recently reduced our water budget and its associated electrical loads by installing a new washer that uses less water and by designing an efficient underground watering system in our raised-bed garden.

Normal appliances, plus a bit of planning

We have the common 120VAC appliances found in most American homes, such as a clothes washer, color TV, VCR, vacuum cleaner, computer, and stereo. We chose them carefully for efficiency. In addition, we think about each appliance's use, to keep in balance with our seasonal production of electricity. When possible, we have given extra consideration to certain

appliances. I now mostly use my notebook computer, which uses 15 watts, while my desktop computer uses 100 watts. Our 25-year-old Electrolux vacuum cleaner sent our ten-year-old Electrolux into retirement when I found it used 400 watts compared to 900 watts. A few months ago we purchased a Staber clothes washer because it uses 250 watt-hours per load instead of the 450 watt-hours per load needed by our standard model.

When the house was two-thirds built, I bought my first inverter and immediately sold the generator. The rest of the house, buildings, and additions were built with power tools powered by solar electricity. We own all the usual carpentry tools from drills and a circular saw to a screw gun and a router, plus some larger ones like a table saw, a radial-arm saw, and a planer. In the past, we carefully selected these tools to not exceed the surge capability of our inverter. Our new 4,000 watt inverter will start any of their large motors easily. The electrical energy used by these large wattage tools is not terribly significant, because they are running a very small amount of time during any given work day. However, we do plan our projects for the right time of year. When a project requires shiplapping the siding for a garage, or planing boards for a floor, we do the job during a sunny spell, or during a season of abundant sunshine.

We have no freezer. A standard freezer is too inefficient, and we feel the efficient low-voltage models on the market would still put a large strain on our system in the depth of winter, since we choose not to use a generator. We do have a one-cubic-foot deep-freezer in our gas refrigerator. For six months of the year, we eat fresh vegetables from our garden, utilizing cloches to extend our growing season. For seven months of the year, we can use our large walk-in cold-storage room as a giant refrigerator and almost root cellar. This area is cooled by passive air circulation whenever the outside temperature is



Propane refrigerator and freezer

lower than the temperature in the cold storage room.

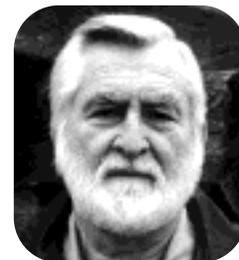
Living in an independent home with solar electricity is incredibly different from living in a grid home. A family in a grid home can use as much electricity as they want. If Grandma comes in January, a grid home can crank up the electric heat in the extra room. An alternative energy system requires an investment in a system that can produce a certain amount of electrical energy. After that, living is a matter of balancing the loads to the system's production and seasonal variances.

Over the years, I have watched some people live naturally in alternative homes and other people move or pay to bring in the power line. Sometimes one member of a couple loved the alternative-energy life while the spouse could not adapt. Lea, Terry, and I are successful in our independent home because our home and our solar electric system are well-designed, and because we work together naturally keeping our homestead in balance. The efficient raised-bed garden, the chickens, the passive solar house, the solar garage, the solar electric system, and our philosophy of life function interdependently.

(Paul Jeffrey Fowler is the author of [The Evolution of an Independent Home: The Story of a Solar Electric Pioneer](#) and [The Solar Electric Independent Home Book](#), both available from Backwoods Home Magazine [order form on page 96]. He is also the founder of Fowler Solar Electric, Inc.) Δ

A BHM Writer's Profile: Robert L. Williams

Robert L. Williams has been a freelance writer/photographer for more than 30 years. A former professional baseball player and a teacher for three decades on the high school, college, and university campus, he has sold several thousands of articles and photographs to leading national and international magazines. Among the publications that have purchased his writing and/or photos are *Money Magazine*, *House Beautiful*, *Southern Living*, *Our State*, *Sandlapper*, *Modern Maturity*, *American Legion*, *Rotarian*, *Our Navy*, *Elks Magazine*, *the Compass*, *Hughes' Rigway*, *Grit*, *Copper's Weekly*, *Baseball Digest*, and others.



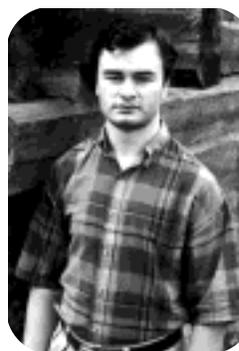
The author of 36 books, either published or under contract, Williams has written books published by G. P. Putnam, W. W. Norton, TAB, McGraw-Hill, Allyn and Bacon, Donning Publishers, Berkley Publications, Herald Books, Hastings House (subsidiary of United Publishers Group), Loompanics, and Southeastern Publishing, Inc. His books include how-to, self-help, autobiography, history, labor history, a college English textbook, pictorial histories, mystery and suspense novels, baseball nonfiction, and general interest novels.

Some of Williams' titles include [Starting Over](#), [The Thirteenth Juror](#), [Daytrips in the Carolinas and Georgia](#), and, most recently, [100 Practically Perfect Places in the North Carolina Mountains](#). He is also author of a book on how to build log houses.

At present, Williams is editor and author for Southeastern Publishing Corporation. He continues to write for *Backwoods Home Magazine* and for a series of travel and general-interest magazines.

A BHM Writer's Profile: Robert L. Williams III

Born in 1976, Robert L. Williams III was among the youngest writers/photographers ever to be published. At age 3 he had first appeared on NBC's Today Show where Tom Brokaw and Jane Pauley introduced him to the American public as the youngest photographer in history to be published. At age 4 he was selling photos to many magazines, book companies, and newspapers. At age 5 he was under contract with the Vivitar Corporation as a photographer, and that same year he had a one-man show at the Las Vegas Convention Center at the World Photo Marketing Trade Fair.



When he was in the sixth grade, Robert sold his first story to a national magazine: an article on gardening to *Mother Earth News*. Since that time he has written many articles and taken photos for newspapers, including the *Charlotte Observer*, and for magazines that include *Foothills*, *Our State*, *Backwoods Home Magazine*, *InSights*, and a number of others.

He had co-authored a hiking book (along with his parents) that is now in its sixth printing. He has also written a mystery/suspense novel based on events related to the tornado that destroyed the family home. Now in college, Robert was among 20 Honors Students selected at Cleveland Community College. He is now a junior at Gardner-Webb University. Robert makes his home with his parents in Belwood, North Carolina.