

Conservation and a wise choice of home appliances is the key to making photovoltaic power work for you

By Jeff Fowler

The majority of Americans will not be building a home beyond the electric power lines, but as independent-minded people move away from the urban areas of centralized sewage, water, and utilities, you find more people who are interested in doing things for themselves. Some will even want to produce their own electricity through the use of photovoltaic cells.

PV and the mass market

The photovoltaic industry expects that photovoltaic, or PV, power will enter the mass market as large fields of modules, owned by the major utility companies who will sell electricity to the consumer.

That reasoning has an analogy in the computer industry not that many years ago. The computer industry once thought there would be a handful of super mainframe computers in this country and that everyone would have to buy time from them. Yet I have written this article on a \$3,000 computer that desktop publishes books and catalogs and manages a mailing Est for a large mail order company.

The independent route

In the northeast, every time the price of oil and propane goes up as it did in 1973 and again in 1990, we see people taking the independent route of cutting, stacking, and heating with wood. This does not happen solely because they can not afford propane and oil.

It happens because they have a strong inclination to be independent. But electricity is the one essential of our modern life that is largely out of an independent person's control. The



meter is on the wall, but the structure of the system is such that it is difficult to change your appliances or even know where those extra kilowatt hours went that increased your monthly bill.

The PV choices

In this article I will try to show you some of the choices you will make if you decide to have an independent PV system for your home. At the present prices of grid (major utility) electricity and the present price of solar electricity, we will see the majority of PV systems being installed at remote homes. But as the grid power goes up in price and the solar electric price falls, we think you will see more and more people showing their independence from the major electric utilities.

The remote home and PV

There are many reasons why a remote site home should be powered by photovoltaic electricity. For the majority of the people, the first reason to use PV is cost. If your home is \$10,000 from the nearest power line you are required to invest, or borrow and then invest, the full amount up front. You are responsible for an extra

\$1000 of cost to run a cable from the road to the house and install the service equipment. Then you have the privilege of purchasing power at the going rate, with guaranteed yearly increases.

PV costs more ...

PV electricity costs much more per kilowatt than the grid, about two to two and a half times as much even after you account for the full life of all the components. But often this is the choice between a Cadillac and a Volkswagen.

If you can happily decrease your usage by the same percentage increase in cost per kilowatt, with a home designed for efficiency, then you save the large cost of a line extension to your remote home.

...but people are making a statement

More and more we are selling PV systems to people in the Northeast who are building a new home that is well within reach of the power line.

These people are ignoring the economic reality that a PV system will produce electricity that will cost them two to three times per kilowatt what the power company charges. They are often making a political statement against the nuclear power plants or for saving the environment.

Some just plain want to do everything independently of the system. The recent instability of the oil market is making these people look more clever, as oil surcharges on electric bills are making the cost per kilowatt of electricity increase dramatically.

A PV system is modular

A PV system is modular. It can be purchased first as a beginning system

and then expanded to a medium or large system. In the 1980's, economically we were encouraged to buy now and pay later. With this process, we paid later, plus a large, amount of interest.

If you are not rich, the best way to beat the system is to borrow less and avoid the long term interest costs. Specifically for PV, buy a small system and add to it as your cash flow permits. Another approach is to use a short term loan to take advantage of the state tax credits still available in a few states such as here in Massachusetts.

PV users conserve

Some people should not own a PV system. These are the people who expect that it will magically get installed, will never need to be monitored, and will supply enough electricity under all conditions as the power company does.

With the power company, you just pay more when the relatives come for a week and leave all the lights on. With a PV system you will conserve or start the backup generator. There are, of course, very large installed, turnkey systems for those with the economic means.

A PV system comes in a set size. It will produce a certain amount of electricity for every day of sunshine. In the winter months there will be fewer sunny days and less electricity for you each month.

Your first choice when choosing a system will be a system that supplies all your needs in the winter, but has a surplus in the summer.

The second choice is a system that suits your needs for the majority of the year but undersupplies your needs in the winter. With this choice, you conserve and budget your loads in the winter. This of course is not the pay as you use system of grid power.

Owning and installing a PV system is a significant commitment. You will need to understand its use just as you had to learn to drive a car. You will also need to troubleshoot the basics of

the system to be able to call your dealer or the manufacturer.

PV is a costly way to produce electricity for a home. If the PV remote home were powering the same loads as its counterpart in the suburbs, the investment would be great, certainly out of the range of the average independent power producer.

The real way PV systems power a home is by extreme conservation of electricity. This does not necessarily result in substandard living. If done properly, a home operates quite normally. This is the challenge.

The real comparison to utility power

PV power is unfairly compared to utility power. We stated previously that PV power costs about two and a half times as much per kilowatt as grid power. This, however, is not true from a larger national perspective. There are costs other than the ten cents per kilowatt the consumer pays.

At the national level we are all paying taxes to support the Nuclear Regulatory Commission, exploration for oil, and the siting of waste facilities. At the state level we pay for power line extensions and the Department of Public Utilities. We all pay for the water and air pollution. What we have is an energy that appears to be much cheaper than it is because we pay for it out of many different pockets.

In Europe, electric power is much more expensive than in the United States. The Europeans, therefore, approach electrical use more conservatively. Consequently, the appliance sellers sell more efficient appliances. We PV users must take a questioning approach to all uses and appliances. Once the home is set up, it will run quite normally.

Your first year with PV

The first year of owning a PV system is the hardest. If people have never lived off the grid before, they have to completely rethink their orientation to

energy use. They often think many components are not working properly.

Ironically these same people will brag to us the next year about how well their PV systems are performing.

The first place to seek efficiency in the PV home is in the PV system and how it is used. We will try to get the most available sunlight into electricity and the greatest percentage of that electricity to the appliances.

Lighting with PV

The largest percentage of the load in a small PV system will most likely go to lighting. The efficiency of lighting is based on how many lumens of light are produced for how many watts of electricity. The second consideration is placement of lights. Light decreases in intensity by a square factor as the distance from the source increases. Thus a small light closely placed has as much usable light as a larger distant light. Hand in hand with light placement is fixture design. Some fixtures use a reflector to concentrate light in one area, some diffuse light, and some just plain waste it.

Take as much care and get as much help in designing your lighting system as you do in designing your PV system. Our recommendation is to wire your house up to code for AC distribution. This will give you AC receptacles and light fixtures everywhere you will ever need them, now or in the future. We recommend using mostly AC lighting. You will limit your use of standard incandescent light bulbs. They are grossly inefficient.

The best and most efficient light yet comes from the new Osram twin tube bulbs. These are 120V AC with a standard screw base. They are more compact and lighter than the Phillips, Mitsubishi, or Panasonic. They start instantly - no annoying flicker, flicker, flicker before they come on.

They come in four sizes and wattages —7W, 11W, 15W, and 20W. The trim sizes will fit in most fixtures and lamps designed to use a standard incandescent light bulb. They also have an 11W and a 15W with a reflector

built on the bulb. These replace the standard 75W incandescent spotlight. Their spectrum of light is very close to that of an incandescent light. The 15W bulb is rated with the same lumens as a 60 W 120V incandescent bulb. However this rating is for the lumens when the bulb is first turned on. In five minutes the bulb becomes 25% brighter.

Appliances

Appliances that use heating elements and that are on for more than a few minutes should be avoided. These appliances include electric water heaters, electric clothes dryers, electric heaters, dishwashers, hair dryers, and coffee makers. Other appliances that hurt the energy budget are those that use a small amount of power but are actually on for a long period of time. These include timers, circulating fans, circulating pumps, and refrigerating units.

Refrigeration

Refrigeration should not be provided by the standard refrigerator. Refrigerators are generally the most inefficient appliances in the conventional home. A standard efficient model household refrigerator uses 400 watts to run its compressor. The compressor is running 50% of the time.

This comes to a total of 4800 watt hours per day. After an electric stove and an electric water heater, the refrigerator is the highest use appliance in a grid house. This appliance is too demanding for the remote site home system and must be replaced. Sunfrost refrigerators are highly efficient low voltage DC refrigerators. These can be used in the PV home. They use about one eighth as much power as a conventional refrigerator.

Refrigeration can be powered by propane. A top quality Sibir brand refrigerator from Switzerland is manufactured and distributed in the U.S. The largest model sells for about \$1,100 depending where you buy it. It contains 8 cu.ft. of efficient space, two of which are a separate door freezer

compartment that is a true deep freezer. The Sibir company has recently been purchased by the Dometic company. They sell a similar 8 cu. ft. refrigerator that is manufactured in Sweden. This same unit is also sold under the name of Servel. They bought the name of the old Servel company. There is no relation.

Freezers are in demand at any homestead. Sunfrost makes a freezer. It uses considerably more electricity than the Sunfrost refrigerator since the food must be kept at a lower temperature. Gas freezers are available in a seven cubic foot model.

Home heating

Home heating should be supplied by woodstoves, passive solar, or propane space heaters. Most any furnace system will use circulating fans or circulating pumps that run a large percentage of the day, taxing the PV system in the time of year when production is least. The use of these circulating fans or pumps would necessitate a larger PV system. Any time you choose to avoid a centralized heating system you will need to have a well insulated home.

Hot water

Hot water can be heated by a propane tankless hot water heater, a conventional propane hot water heater, or a solar collector. Solar hot water should not use AC circulating pumps. They will use a lot of electricity. Thermosiphoning units or PV direct powered circulating systems are preferred.

Clothes dryer

Propane clothes dryers are popular in homes that have propane. The electrical requirements of these are small. A standard washing machine is acceptable. Water pumping may be done by a standard submersible pump. For some wells you will be able to use a super efficient low voltage pump.

Microwaves

Microwaves will work on PV systems. They sometimes take 20%

longer than the estimated manufacturers' cooking times. They use a small amount of the energy budget because they are on for short periods of time.

Propane stoves

We recommend propane stoves. If you have not yet purchased a stove, we recommend a model with pilots. The pilots on new stoves are much smaller and use much less gas than those on older stoves. Most companies carry at least one basic model with pilots; be persistent with the salesperson if you are told otherwise.

Part of the solution

In the first reading you may feel overwhelmed by the choices you will make to leave the electric company behind. In a second reading you will see that many of the choices are common. What you will have to do is think of your home the way you think about the mileage and efficiency of ~ car. The majority of the choices will be made once. After the home and PV system are integrated, you will not be living a less comfortable life. You will be part of the solution to save the world from our own waste.

(Jeffrey Fowler is the president and founder of Fowler Solar Electric Inc, and the author of *The Solar Electric Independent Home Book*. The new 1991 edition is available at \$16.95 plus \$2 UPS from him at 13 Bashan Hill Road, Worthington, MA 01098 413-238-5974.) Δ

And even should the cloud of barbarism and despotism again obscure the science and libraries of Europe, this country remains to preserve and restore light and liberty to them. In short, the flames kindled on the fourth of July, 1776, have spread over too much of the globe to be extinguished by the feeble engines of despotism; on the contrary, they will consume these engines and all who work them.

Thomas Jefferson