Independent Energy Runs

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Independent energy runs Backwoods Home Magazine

by Dave Duffy

Backwoods Home Magazine is a business situated in the forested mountains of Southern Oregon, about five miles from the nearest utility power line. Because we are so remote, it was more cost effective for us to generate our own electricity, rather than pay the utility company to bring in lines to us. The most practical system for us was a combination of solar (photovoltaic) panels and a diesel generator.

The solar panels

We have 24 photovoltaic modules (or solar panels) producing electricity for us, 12 of which are Solarex brand modules, which is an American brand, and 12 of which are Hoxan brand, a Japanese module no longer available on the American market. The Solarex modules have a peak power output of 60 watts each, the Hoxan 52 watts each.

Solarex and Hoxan are among the excellent American, Japanese, and German modules on the market. Most of the brands are very durable, and it is fairly typical in the industry to give a 20- year warranty with them. One of my neighbors, in fact, put up 24 30- year- old used Arco modules and they work just fine.

There are simply no moving parts on these modules to wear out; you have to throw a brick through them to damage them. We did, however, take the precaution of locating the panels in our fenced garden area, safe from Buddy, my daughter's gelding, and the company donkey, Donna Quixote.

Tracking the sun

Because you can significantly increase the power output of solar panels by keeping them perpendicular to the sun, we mounted our modules on two solar trackers that follow the sun as it travels its east to west course throughout the day. The 12 Solarex modules comprise a solar array that sit on a Zomeworks tracker, manufactured by Zomeworks in Albuquerque, New Mexico. The Hoxan modules make up an array on a WattSun tracker, manufactured by Array Technologies, also of Albuquerque.

The trackers work differently. The WattSun tracker uses an electronic sensor that controls motor- driven actuators that move the tracker on both its horizontal and vertical axes, keeping its photovoltaic array perpendicular to the sun. The sensor is powered by a small battery pack that is charged by the panels.

The Zomeworks tracker uses no motors or sensors, but relies instead on two steel tubes partially filled with Freon that are mounted on the east and west sides of the frame. The frame is angled towards the east-west path of the sun, and it works by gravity. Reflector shades on the outside of the tubes cause the morning sun to shine only on the western tube, causing the Freon to boil and rise in the tube, thus making the bottom of the east tube heavier and forcing the tracker to swing so the array is facing the



BHM staffers Christopher Maxwell and Eric Batie adjust the company's Zomeworks tracker.

rising sun. Throughout the day the heat of the sun
keeps the Freon alternately boiling and rising in one tube, while liquefying and falling in the other, letting the weight at the bottom of the tubes orient the tracker to the sun. Is that clever, or what!

Inverters and voltage

Only a few years ago many people with their own Independent Energy system stored their power in 12- volt batteries, so had to use 12- volt lights and other 12- volt appliances, which were often both expensive and poorly made. But with the development in recent years of reliable inverters, which are devices that convert 12 or 24 or 48- volt battery voltage into the standard 110- volt house electricity the utility company provides, most people who build their own Independent Energy system include an inverter as part of the system.

Inverters have several major advantages. Because they convert your battery power into standard 110- volt power, you can buy the well- made and relatively inexpensive appliances at your favorite store, rather than pay highwayman prices for the second- rate 12- volt products at the RV shops. Inverters also make it easier for you to design a battery storage system that is greater than the 12- volt systems of the past. Our system is 24- volt, which is more efficient than 12- volts. Some people opt for a 48- volt system, which is more efficient still.

We use the new Trace 4000- watt pure sine wave inverter, which is a true marvel of engineering. Only a few months prior to writing this article, BHM operated on two Trace modified sine wave inverters, which are great inverters and standards in the industry, but its modified sine wave was not acceptable to our LaserJet printer, on which we produce camera- ready pages.

To solve this problem, we had purchased a DeskJet printer, which was much slower and less clear than the LaserJet but which accepted the modified sine wave. We used it to print rough drafts of articles. Bur for camera- ready copy, we still needed the LaserJet so had to install a special plug near the printer that led to the diesel generator shed outside. Every time we ran that LaserJet, we had to fire up the generator. Very inconvenient.

Trace's introduction of their new sine wave inverter changed all that. It produces a sine wave just like the one you get from the electric utility company. Our LaserJet printer likes it fine. The DeskJet printer, meanwhile, has been relegated to the role of spare printer.

The new Trace inverter not only produces a pure sine wave, but it contains its own very powerful battery charger which is programmable and operates automatically.

Batteries

Although you can use the electricity directly from the photovoltaic panels, it is usually smarter to store it in batteries. The batteries for a home power system are the weak part of the system, considering how reliable all the other components are. You need large batteries—golf cart type or larger—to store power properly. Forget the kind you've seen in motor homes or travel trailers; they are too flimsy for a home system.

We use 16 Trojan L- 16 batteries, which is an excellent battery that should give years of trouble- free use with proper maintenance. The Trojans are 6- volts each and have a 350 amp- hour capacity for a total storage capacity of 1400 amp- hours. Just as our photovoltaic array is wired for 24 volts, so too our batteries are arranged to store it as 24

volts. A variety of types and sizes of batteries are available, however. We suggest you shop around.

If we use no more than 50% of the batteries' capacity—and it is better for the life of the batteries if you do not discharge them below 50%—we can store a little under 17 kilowatt hours of electricity. In layman's terms, we have enough juice to run all our equipment in our 2500- square- foot building for about two days. If the sun doesn't shine for about two days, however, we must start up our backup diesel generator to recharge the batteries and provide us with power.

Diesel generator

When the sun does not shine for a couple of days, or when it shines only intermittently for several days in a row, we must recharge our batteries from our backup 8000- watt China Diesel generator. We chose a China Diesel generator because it runs at a slow rpm (revolutions per minute) and is built, like a truck diesel, for the long haul.

Gas generators are usually not a good choice for a home power system. They are noisy, consume too much fuel, and run at too high an rpm to live a very long life.

We use our generator only in winter. Once spring arrives and the days become longer, we seldom need to go out to the generator shack.

Our generator shack, by the way, is a home- built soundproof shed built according to a design by Skip Thomsen. It is contained in his book, More Power to You.

And of course the key to making any generator live a long and productive life is to change the oil frequently. Like your automobile, changing the oil is 80% percent of the maintenance that needs to be done.

Although our diesel generator works fine and would, if we let it, provide for all our electrical needs, we chose to go with photovoltaic-produced electricity as our prime source because a photovoltaic system is noiseless, clean, safe, requires no fuel, and taps an inexhaustible resource.

Cabling and controls

Although the panels, generator, inverter, and batteries are the main components of our Independent Energy system, they must be tied together and controlled by means of cabling and regulating equipment.

Since our two solar towers are located across the creek about 100 feet away from the office's battery and control room, we needed heavy gage wire (double ott) to handle the approximate 40 amps of current it would be carrying. The wire runs to the office's battery room, which contains all of the necessary equipment used in storing, regulating, converting, and distributing power to the rest of the building.

One convenient piece of equipment installed in the battery room is an Ananda Power Center, a power control and distribution cabinet from Ananda Power Technologies of Nevada City, California. It contains the PV system controls, metering, and overcurrent protection in a prewired, preassembled, tested, and certified cabinet for a safe and code-approved installation. A handy feature of the Ananda cabinet is a digital amp- hour meter, which lets you know at a glance just how much electricity you have taken out of or supplied to your batteries. It's an important feature that allows close monitoring of the condition of the batteries, which is important to extending their life.

Conserving

Generating your own electricity brings you into the world of conserving the power you have so carefully created. Creating power by means of photovoltaics is a daylong process. When the sun does not shine enough, that photovoltaic- created power becomes very dear. So you'd have to be a fool to waste it on incandescent light bulbs and inefficient appliances. So we use fluorescent light bulbs, which use 20% of the power of their incandescent counterparts but whose life expectancy is measured in years rather than months. And since a refrigerator typically consumes about 20% of the electricity in the average household, we use a propane refrigerator, although there are electric models on the market now that are fairly efficient.

So that is our story in a nutshell. It is a brief and fairly superficial overview, and it is only one of many ways to arrange your Independent Energy system. The index in the center of this issue lists the many articles we have published about Independent Energy in the past. I recommend them to you.