Getting started with solar power

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We call this "The Homestead System" because this is how we, and so many others, started with solar electric. You can do it, too. Get your foot, or your whole self, into this circle called Alternative Energy. But be forewarned! Living ever closer to the Sun and the Wind and the Earth can be addictive. Here is a way to start cutting yourself out of the game of destruction played by oil, gas, coal and nuclear industries.

This is your basic photovoltaic system. How much usable electricity you get from this setup will depend on where you are located (both geographically and site specifically) and what Mother Nature is doing with the weather. You need sun to shine on your solar modules in order for that sun energy to be converted into electricity for you to utilize. Get out and look at your site, track the sun's pattern, draw sun charts. Few sites are 100% great. You will probably have to figure, think and compromise, but that is half the fun!

There is a nifty device called the Solar Pathfinder that can chart your site for direct sun for every month of the year (SolarPathfinder, 3680 Hwy. 438, Pleasantville, TN 37147, 931-593-3552, pathfinder@mlec.net, www.solarpathfinder.com). It's a great way to find that certain spot with the best solar gain. Check with local alternative energy dealers-many offer a site survey service. Or you can make your own sun chart. See The Passive Solar Energy Book by Edward Mazria, Rodale Press (1979) for detailed instructions. Or just observe your own particular site over a year's time.

Generally, the closer to your home (and the batteries) you can place your panels, the better. The farther away you get, the more expensive it's going to be, because you'll need larger wire or more equipment. This article is an overview of a small, simple system.

This is not a project you can do from your armchair, you have to get involved. So get as much information as you need to install your system (or help someone else install your system) safely. Talk with dealers and users in your area. Check out Home Power magazine (www.homepower.com, PO Box 520, Ashland, OR 97520). Dealer catalogs/design guides can also be a good source of information.

The heart of the system


Sue Robishaw and Steve Schmeck's off-grid home in Cooks, Michigan

So what might your system include? The heart of the system is the batteries. If you want to know how long someone has been involved in renewable energy (RE) ask them how they started. You are likely to get a variation on the tale of "Well, I had an old car battery and wired it up to run a few tail light bulbs for lights and a radio. When it ran down I'd jury rig it up to my truck and charge it up while I ran into town"...or, "I'd haul my battery over to a neighbor's house to charge it up." And since the battery usually wasn't intended for this type of use, it would soon die and another old battery scrounged up to put into service.

We started that way, though we used the 12 volt marine deep cycle battery. They last longer than a regular car battery, but are still not the best, no matter what their name, or advertising, suggests.

Some lucky (smart) people start right off with a good home system battery-the golf cart battery. Readily available and recyclable, they are relatively inexpensive. With good care they can last five to eight years, and they can limp along much longer than that when necessary. They are six volt batteries, so you need two (or sets of two) for your 12 volt system. (Ed. note: Regular car batteries are 12 volt, for those who don't know.) One set will give you a 220 amp hour battery bank for about $170. To help the batteries to a good, long life, plan on not using more than 50% of that capacity. So for this system we can plan on 110 amp hours of usable energy from the two golf cart batteries.

The best bet for battery housing is a place above freezing temperature and close to where you will be using the electricity. But-batteries can be dangerous. Just because they are common doesn't mean you should thoughtlessly stick them just anywhere. Batteries can explode, though, luckily, this isn't common. So build them their own place. A simple enclosed box can be made, with a vent to the outside (batteries give off small amounts of explosive gases when charging).

Also keep in mind that you want easy access to the batteries for checking the water levels and adding distilled water when needed. And keep a good supply of baking soda handy nearby "just in case." The baking soda will neutralize the battery acid in case of a spill. Learn how to take good care of your batteries and they will respond by giving you longer service.

The photovoltaic panel

Now the showy part-your photovoltaic (PV) panels. They come in many brands and sizes, new and used, big and small. They each have their pluses and minuses but mostly one is as good as another. Today (2004) new panels come with a guarantee of at least 20 years. Used units can also be a good option. But for our purposes here we'll go with one of the common modules sold, a Shell Solar, SQ80. The panel costs about $375 and puts out 80 watts (4.5 amps) of power in full sun. It is interesting that when we bought our first PV module back in 1981, the cost was about the same, but

its output was only 32 watts (2.2 amps). PV technology has come a long way.

PV rack or mount

A solid rack to install your panel(s) on can be purchased, but you can make one yourself fairly easily using readily available materials, either purchased or scrounged. You don't want to skimp here. This rack is holding quite an investment of your money (not to mention your power source). Your rack can be set at one angle or be adjustable, be roof mounted or pole mounted. Your dealer should be able to give you help with a design.

A simple control panel

Your "control panel" for a system such as this can be fairly simple. A Schottky blocking diode between the panel and the batteries will prevent bleeding of your battery power back into the panels (and into the night) when you are not charging. Cost: $10. You should have a disconnect, such as a 25 amp SPST switch ($7), between the panel and battery. Another disconnect should be installed between the battery and all loads, along with an automotive-type in-line 10 amp fuse. You will also want a minimum metering of at least an inexpensive digital multi meter ($50 from Radio Shack). You need to keep track of your battery voltage to monitor how full, or empty, your batteries are powerwise. The meter also comes in handy for various other checking and monitoring chores.

Additional in-line meters are also nice to have, and I'd recommend them if you can swing it. An analog amp meter (to monitor your power use) is about $20, and simple volt meters (analog, digital or LED) can be purchased for $20-$60. You can buy new meters, or maybe even used meters, from most alternative energy dealers. Or check out used units from Fair Radio Sales, PO Box 1105, Lima, OH 45820.

Put your meters where they can be easily seen-not only for regular monitoring purposes, but for the meter reading mania that comes over folks with home power systems.

The all important wire

Wire is an essential, important, and sometimes overlooked part of the system. Twelve volt systems require larger wire than 110 volt. There are plenty of wire charts around, and articles in Home Power and catalogs can help you decide the size and wire to use.

The main considerations are distance from one component to another, system voltage, and amount of amperage running through the wire. Whoever you buy your components from will be able to help you with this (if not, go elsewhere). For our simple system, we're going to put the panels within 40 feet of the batteries. We will size the wire to handle our anticipated future system of two modules (total of nine amps). So, 80 feet of #8 USE wire at about $50 should do us. This wire will connect the panels to the battery. Battery interconnects (to connect the two 6 volt batteries together to form a 12 volt battery) can be two gauge, two cables for $15. For this system, lighter cables would do, but for the price we might as well go with the heavier wire and be prepared for future upgrades. You will also need appropriately sized wire from the battery to the loads (such as lights and radio).

Now, there isn't much chance of overcharging your 220 amp hour battery bank with one 4.5 amp module if you're using the power now and then, and monitoring it regularly. But if you'll be leaving the system for some time without using or monitoring it, then you'll want a charge controller to prevent the PV module from overcharging your battery. This gets more important as you add panels (and add additional charging capacity). A 4.5 amp charge controller is about $35, a 12 amp charge controller (large enough for two modules) is about $110.

What will this system do?

So what can you run with one or two PV modules? That depends on your use. You can get a whole lot more hours of lighting if you use efficient lights and turn them off when not in use, than if you have incandescent bulbs on all over the place. There is a very direct cause and effect here. A closet or pantry light that gets turned on and off often, but runs briefly, can be a low wattage incandescent light. A light that is on for an hour or more at a time should be a fluorescent or compact fluorescent. Lights needed for only minimal illumination such as an entryway or hallway can be very small amperage bulbs. Don't use any more light than you need, and put it where you are going to use it.

And, of course, turn it off when it's not needed. This goes for any and all electric appliances. Conservation is the most important part of the alternative energy system, or any energy system for that matter. If you don't use it, it doesn't have to be produced or transported in the first place. So spend some time looking closely at your electrical use, and how you can reduce it.

To give you an idea, we lived for 10 years on two panels (older 2.2 amp models), running lights, radio/tape player, computer, printer, and small tools. For many years we simply reduced our use in the short-sun days of winter and went back to candles and kerosene lamps for lighting. In the summer we had more than enough power.

At some point we purchased a gasoline generator to run the washer and power tools. It also anemically served as a backup battery charger in the winter. Then Steve made his own, much better, gasoline battery charger using an old car alternator and the engine from our tiller. Several years later, we added two more used panels (of the same old model) so we then had about 8.8 amps of charging power in full sun. Our use also went up as we switched to run almost everything from the batteries. In the summer, we still had plenty of power from our PV panels, but we continued to use our backup generator to charge up the batteries in the winter or during extensive cloudy weather.

Eventually we ended up with 14 panels, all of the older 32 to 35 watt size, with a 1200 watt battery bank and a large inverter. And our use grew as our system did. We still have extra power in the summer, but usually have to use the gas generator several times in November and December to help charge the batteries.

Inverters

Which brings us to another option that you will want to consider for this system (the options are almost endless!). So far we've been talking about a simple 12 volt system. That means all of your lighting, tools, and appliances will need to be 12 volt. Unfortunately, 12 volt lights are more expensive than 110 volt, and the tools and appliances are often inferior as well as more expensive.

We ran for years on 12 volt power, as have many other people. It is simple and straightforward, running lights, radio, computer, washer and flour grinder. But if you want to run 110 volt appliances and lighting, you will need an inverter to change the 12 volt DC power of the battery into the 120 volt AC power that those appliances require. The downside is that it is one more piece of equipment to buy and be dependent upon, but today's inverters are reliable enough to make this a reasonable option. We eventually switched everything in our house and shop to run off the inverter except for a few 12 volt lights and the flour grinder.

For most home power use you will want at least a modified square wave inverter. There are many brands, and they all have their pros and cons and loyal users. Check out Home Power's reviews, talk with folks involved in the industry, and ask around for other's experiences. Intended use and price will probably dictate which one you will want, as they are all readily available. They come in all sizes and shapes. You can run your whole system on an inverter, thereby being able to use commonly available appliances and smaller wiring. Or you can run a mainly 12 volt system, using your inverter just for specific uses.

We started with a venerable old (and noisy) 250 watt square wave TrippLite, but when the new small, inexpensive modified square wave inverters became available, we were happy to change to a 100 watt Statpower unit for computer, printers and small power tools. Then we made it to a 1300 watt PowerStar inverter to run vacuum, sewing machine and larger power tools. When we got a laser printer, we had to add a 500 watt pure sine wave ExelTech. Some things, like the laser printer, don't like modified sine wave so require pure sine wave inverters. Now we have a sine wave Trace 2500 that runs just about everything. But we still have and use the old Statpower 100 and PowerStar 1300. But do remember, an inverter does not produce more power, it just helps you use it. A Trace 2500 when we only had 2 or 4 PV modules would have been rather pointless. We simply didn't have enough charging capacity then and would have had to run the gas generator to charge the batteries to use the inverter to run the equipment. Better to just run those tools directly from the gasoline generator until you get more PV charging capacity.

But back to the realities of our small system. We're running a basic 12 volt operation, but will add a small inverter for small 110 volt use. You can get a good 100 to 250 watt inverter for $80 to $150. Inverters in the 400 to 800 watt range are around $100 to $300. Check your 110 volt power use requirements (read the labels) and size your inverter accordingly.

Labeling

Labeling-an extra, important, touch for your system. Do a lot of it. Make it easy. Make it readable. Do it for someone who has no idea what your system is all about. Assume that someday, someone else will need to walk into your home and be able to figure out your electrical system. And, of course, think it through and err on the margin of safety. Make sure everyone in the family understands at least the basics of the system, and how to run it.

Cost and availability

Total cost of the one module Homestead System, assuming you are doing the work yourself, might be about $700. Where can you get the equipment and more information? I've already mentioned Home Power magazine, and COUNTRYSIDE articles, of course. Check out local sources. Ask around. Many small dealers are on

limited advertising budgets so you may have to do some legwork to ferret them out. Search out other users and ask where they purchased their equipment and their experiences.

Mail order and Internet suppliers are numerous. Send for catalogs, talk with them. Find a dealer who you are comfortable with, whether local or long-distance, and stick with them. When you honestly add up the prices for the same components, including shipping and handling, you'll find little difference in the total price of a system among most dealers. A big consideration is service. This can be far and away more important than price. If you need help, you want to have someone who is willing and able to give you needed advice. As is true with any purchase, when it comes time to buy, it is up to us to decide who we want to support.

Another great source for A. E. information are the many regional energy fairs being held throughout the country. The largest is the Midwest Renewable Energy Fair in Custer, Wisconsin. Held the Summer Solstice weekend, this is a three day affair packed to overflowing with workshops, displays and events (and people!). There are many such events now across the country.

The important thing is to get started however you can, and have a good time doing it. If you are already hooked into the grid, consider putting one small circuit on your own PV system. You'll have lights and radio when the rest of your neighborhood is blacked out. You'll be able to feel good about the source of that power. If you are running now from a gasoline or propane generator, think how great it would be to turn on a light or listen to the radio without that generator guzzling fuel and hammering away in the background. If you're running a "roving battery" system, I don't need to tell you how great it would be not to have to move that battery again. PV power is not costless, but it is quiet. And it is available to anyone who wants to go that extra step to install a renewable energy, photovoltaic solar system. It will make you aware of the sun in a whole new way.

The photovoltaic cell

These silicon wafers are the heart of a solar panel. Semiconducting cells convert sunlight into electrical energy through the photovoltaic process, hence the name. Like computer chips, the silicon in solar cells is made from highly refined sand. The wafers are layered with boron and phosphorus atoms before a metal coating is applied.

The top side of the cell is painted with anti-reflective coating. This vastly increases the cell's ability to absorb sunlight. The cells are wired together in panels or modules for increased efficiency and energy output. Photons, which are bundles of energy from the light, strike the cell and provide enough power to dislodge the positively charged boron atoms and the negatively charged phosphorus atoms. When the cell is exposed to sunlight, these imbalanced electrons flow in an effort to equalize the balance. This activity creates an electrical current, which can be transferred to a power storage unit such as a battery.