INTRODUCTION TO SOLAR ELECTRICITY

This catalog is designed to be used by the owner or potential owner of a PV system. Much of the product information has been selected and digested to specifically apply to the remote site home owner. After twenty years of research into the components and design of alternative energy systems, we've come to believe that not everyone should engage in the same cumbersome information-gathering process. We discuss all the components, including solar modules, batteries, inverters and even refrigerators, necessary for remote home use. Hopefully you will find it more valuable to read about the components you can use in your remote site home rather than the components available for all PV applications.

Our System Design Philosophy

The PV systems we have designed have sold themselves. The owners are happily committed to their alternative sources of energy. This catalog proposes several system designs. The logic behind this kit technology is that you will not make the same expensive mistakes others have. A wrong guess or a little misinformation can result in a wrong choice or a poor design. If you purchase the wrong piece of equipment you forever live with poor performance, or suffer the economic loss incurred in a trade-in. The solution is to profit from the previous mistakes of others.

Why Photovoltaics?

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 $20,000 from the 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 electricity costs much more per kilowatt than the power from the power company. If you can decrease your usage by the same percentage increase in cost per kilowatt-hour with a home designed for efficiency, then you can save the large cost of a line extension to your remote home.

A PV system is modular. It can be purchased first as a beginning system and then expanded to a medium or large system. If you cannot afford a large PV system immediately, buy a small system and add to it as your cash flow permits.

A PV system is superior to a wind system in the home application. There is less maintenance, and what there is does not require an owner to choose between climbing a tower in an ice storm or watching his or her investment go down the drain. The sun shines more frequently than the wind blows. Long periods of no power in a wind system require a large and expensive battery bank.

A PV system is a welcome replacement to a life with a generator. Generators are inefficient in cost per kilowatt because they must run constantly at full RPM even if only a light bulb or a TV is being powered. They are noisy and require a lot of maintenance. They are much more expensive than a PV system if length of life and periodic maintenance are realistically considered. If a generator is needed, it should be used in conjunction with a PV system to create a PV/GEN hybrid. This increases the generator's efficiency while at the same time decreasing its running time and thus extending the generator's life.

A remote home is usually sited where it is because the owner wants privacy. Any owner who pays the price for power from the grid will automatically get some neighbors in the process. On the other hand, a person can purchase a piece of land inaccessible to power, have his or her privacy, and pay less because it is not attractive to the majority of people who feel that grid power is a necessity. The money saved buying lower priced land can be used to pay for a large PV system. For the complete recluse, there will be no monthly visit from the meterman.

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.

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 times per kilowatt what the power company charges. They

just plain want to do everything independently of the system.

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.

We hope you will view your PV home as a model for PV homes to follow and therefore spend a little extra time and a little extra money to do the best job possible. We hope you will bring your system up to the standards of the National Electrical Code® (or NEC®), have it inspected by the local electrical inspector, show it to everyone you meet, and spread the word that there is a new, better, and independent way for us to produce our home electricity.

How A PV System Works

The simple PV system contains a PV module, a battery, and a load. (See Figure 1) The module transforms light energy to low voltage DC electricity that is stored in the battery until the electrical load is activated. The load uses the energy stored in the battery and the PV module then recharges the battery. The PV module could directly power the load. A 50 watt PV panel could power a 50 watt light bulb, but only in the daytime, and only on a sunny day. The battery can power the load at a time when the PV module is not producing electricity. On a sunny day a 50 watt PV module produces 50 watt-hours per hour for six hours, or 300 watt-hours per day. In this case the module could recharge the battery after the battery has been depleted 300 watt-hours. A possible load might be three 50 watt bulbs run for two hours each.

A PV system does not run on a scheduled daily basis. The sun may shine for two days and produce 300 watt-hours and then not produce any electricity on a third cloudy day. The load can also be distributed unequally. No energy might be used for two days, then three days of charging might all be used on the third day. A PV system produces an average amount of electricity dependent on the average amount of sunshine. When a PV module produces an average of 100 watt-hours per day for ten days, it stores 1000 watt-hours in the battery. In this same ten day period no more than 1000 watt-hours should be used to power the loads.

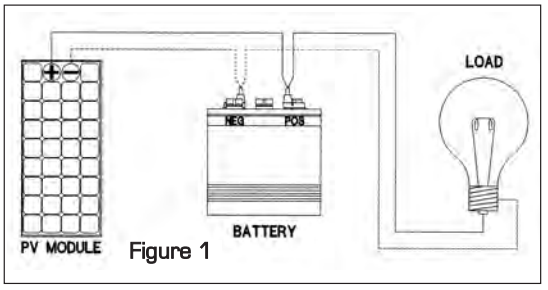

Figure 1

A remote home system consists of a PV array, a charge controller, a battery bank, a DC fuse box, an inverter, and an AC fuse box. (See Figure 2.) Functionally, the PV array and charge controller together are no more than a simple battery charger that uses sunlight as its energy source.

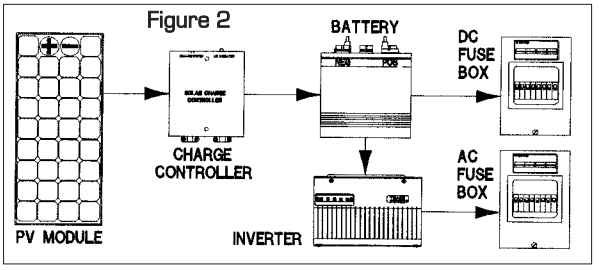

Figure 2

The PV array produces electricity when the sun shines. The charge controller regulates the flow from the array to the battery bank. When the battery bank is low the charge controller feeds all of the electricity from the array to the batteries. As the batteries approach a state of full charge, the charge controller tapers the supply of electricity to prevent overcharging of the battery. At night it prevents a reverse flow of current from the batteries to the array. The battery bank stores the electricity as low voltage DC, normally at 12V, 24V or even 48V. The electricity is distributed through a DC fuse box to power low voltage DC appliances. The batteries supply electricity to a device called an inverter which changes the low voltage DC to 120V alternating current and then sends it to an AC circuit breaker box.

The charge controller and inverter are purchased in a specific voltage and a specific size based on the proposed performance. The PV modules are modular. A PV array may consist of one PV module at 12V, or 10 modules producing 10 times the current, but still at 12 volts. A small system can be enlarged by simply adding more modules. A battery bank may be enlarged by increasing the number of batteries but this is usually not recommended. It is best to properly size the battery bank in the beginning for whatever size system one intends to end up with.