# GO SOLAR AND SAVE BIG

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Installing photo-voltaic solar panels on or near your home to generate electricity can be a very effective way to reduce long-term energy costs, and can significantly reduce your carbon footprint. When combined with other energy conservation technologies, solar technology can enhance your sense of well-being, knowing that you are saving money and helping to protect the environment.

Before you can make an informed decision about the suitability of a photovoltaic generating system for your home, several basic factors need to be considered. They include: the availability of sunlight, tax credits, connection to the electrical grid, and back-up batteries.

**Sun Availability** In most regions of the U.S., the amount of available daily sunlight is sufficient to make a photovoltaic system cost-effective. Of course some geographical areas—like the Southwest states—have substantially more raw solar energy available than other locations. And the specific location of a home matters, too. Beyond the amount of sunlight provided by local weather patterns, the ability of a photovoltaic system to generate power is greatly influenced by the orientation of the installed system to the sun, the latitude of the location; and the presence of trees, tall buildings, and other obstructions that can block the light.

The ideal rooftop or ground mounted photovoltaic system would be installed facing true South, and angled to the latitude of the location where it is installed—with no obstructions such as buildings, trees, hills, etc. that block sunlight from hitting the panels during daylight hours. In practice, many less than optimal locations can provide enough power output to justify the cost of adding photovoltaic generation to a home energy system—although the payback period will be longer (see below).

**Tax Credit** In the past, **a** Federal Tax Credit has been available to purchasers of residential photovoltaic electric generating systems. (See Federal website below for current information). Some states, localities, and electrical grid systems provide additional incentives for installing photovoltaic systems in homes located within their jurisdictions. The Federal Tax Credit and other incentives— coupled with recent significant reductions in the cost of photovoltaic systems– makes the installation of a solar generating system worth considering as part of any overall home energy management system.

**Power Grid Connection** Most homeowners who install photo-voltaic panels opt for a system that cross-connects to their existing electricity supply. These grid-connected

systems use this connection to sell any power their system generates which exceed their demand at that moment back to the power company. The grid in turn provides power to the home when it is needed: at night, or at times when their need for electric power exceeds the output of their photovoltaic system.

**Battery Back-Up** For some homeowners, a system that is independent of the grid may make sense. Instead of cross-connecting to the electrical utility company, this approach balances the supply and demand for power by using actual batteries or other technology to store excess energy produced by the panels. Of course, a spell of bad weather can deplete the energy reserves stored in the batteries. Battery back-up systems are typically employed when a grid connection is not available (for a remote cabin, for example). But some people prefer to live off the grid as a matter of principal.

**Product Choices** An increasing range of choices for photovoltaic panels is emerging as this smart home solution becomes more popular. They vary in price, efficiency, and country of origin. Differences in panel efficiency are typically reflected in the price.

A second important difference in photo-voltaic panel models is the expected service life. All panels will deteriorate and lose efficiency over time, but this can vary significantly from model to model. As with other manufactured goods, some panels hold up better than others, and come with longer performance warranties. If you have space for a large installation, less efficient panels may make better economic sense. But if space is limited, more costly high efficiency panels may be necessary to harvest the available sunlight.

**Installation** Whichever photovoltaic panels you chose, they will need to be installed on a racking or mounting system to hold the panels securely and safely in place for the life of the system. These racking systems are generally roof mounted, but can be mounted on the ground if a suitable location is available in reasonably close proximity to the point where the power is needed.

Roof mounted racking systems must be compatible with the roofing materials used on the structure, and must allow for the maintenance of the photovoltaic panels and other system components—as well as the underlying roofing materials—during the life of the photovoltaic system. Many different racking systems are now available, of widely differing quality, reliability, durability, and ease of maintenance. Choice of a racking system is an important consideration that should be considered carefully.

**DC to AC Conversion** Wiring and power conditioning systems are used to collect the DC power produced by each individual photovoltaic panel, consolidate it, and transport it to a DC to AC inverter. Photo-voltaic solar panels produce variable-voltage direct current (DC), while all modern home electrical devices run (in the US) on 120 volt

alternating current (AC). This means that the inverter must be used to change DC to AC power, and then regulate the voltage for use throughout the home. As with other components in the system, DC collection and conditioning systems and DC to AC inverters are increasingly available, and differ in quality, reliability, durability and warranty terms.

**Grid Cross-Connect Agreements** The arrangements under which owners of photovoltaic generating systems are permitted to connect to their local electric grids differ from state to state, and sometimes by locality and power supplier. When a photovoltaic system is connected to an electric grid, an electric meter must be used that can run forward and backward, depending on whether the homeowner's system is consuming energy from the grid or feeding excess energy back onto the grid.

**Net Metering** Most states support some form of arrangement where the owner of a photo-voltaic system gets credit for excess electric power they provide to the grid (when the sun shines) to offset some portion of the cost of the power they draw from the grid (when they need more power than their panels can provide). This is called "net metering."

Under some net metering arrangements, the utility gives the household credit for the power it provides at the same retail price the household would have paid if the same amount of power was supplied to them by the grid. In other localities the utility gives

credit for the wholesale price of the power only, or another amount specified in the local grid connection arrangement. In virtually all net metering jurisdictions, some credit is given for surplus power provided to the connected grid, which is credited back against the cost of the power the homeowner draws from the grid.

**Professional Help** Designing, installing, and maintaining a household photovoltaic electric system is not a do-it-yourself project. It should be left to a properly licensed photovoltaic design and installation specialist. Please use care in selecting a contractor—the initial purchase price of a photovoltaic system is considerable, and the system will likely have a useful life of twenty-five or more years.

The contractor you select should have substantial experience in designing, installing, and maintaining photovoltaic systems, be licensed in your jurisdiction, and have a reasonable likelihood of being available when future warranty and maintenance needs arise. In addition, since a number of variables are involved in the design of a photovoltaic system (efficiency, reliability, and serviceability of the components), you should get a detailed proposal (with specifications) from the contractor you are considering—more than one if needed— before proceeding with the purchase of a photovoltaic system.

**Design Details** Determining the appropriate size of a household photovoltaic system is based on a number of key variables. To start, look at the household's historic electric power consumption over at least the last twelve months and establish its monthly and annual power consumption profile. Under normal circumstances, there is no point in considering a system that will produce more power than the household is likely to use. In localities with sharply progressive power rates, it may be most economical to choose a system that simply displaces the most costly tiers of electric utilization and to continue purchasing some power in the lower priced tiers from the grid.

Once an estimate of the maximum monthly and annual power that your household is likely to use is in hand, the photovoltaic system designer will look at the available sunlight at the home and the possible roof areas or other locations where a photovoltaic system may be installed. He can then determine what solutions are available, using the system components that he sells and installs. The designer will then make one or more design proposals, with cost estimates for the various options.

In addition to the cost, the design proposals should include an estimate of the monthly power output of each proposed system, based on the efficiency of the proposed photovoltaic panels and other components, the raw solar resources available at that location, the orientation of the proposed installations sites to the sun, seasonal changes in the available solar resources, and other variables.

**Payback Period** With the cost of a proposed system and estimates of its monthly power output in hand—together with the current cost of purchasing power from the local utility grid—you can estimate how long it is likely to take to recover the cost of substituting photovoltaic power for utility power. This is called the payback period. This estimate will of necessity be an educated guess, since the actual power output of the proposed system will vary to some degree from the estimate. Also, it is likely that utility rates for purchased power will rise over time, that photovoltaic power production will vary widely from day to day with changes in cloud cover and month to month as the seasons change, that power production will broadly decline over time as the system ages, and that there will probably be some post installation maintenance costs.

Regardless of the inexact nature of a payback calculation, and whether the system is forecast to pay for itself in reduced electricity bills in eight, ten, or some other number of years, there will come a day when the power production of a photovoltaic system becomes free power. This is good news indeed—for your budget, and for the environment.

**System Leasing** In the present environment of tax credits and low interest rates, many homeowners buy a system outright from the photovoltaic provider, if they have the financial resources to do so. This approach will garner all of the financial benefits of the purchase for himself or herself. In addition, there will be no long term third party equipment leases or power purchase contracts, (other than standard utility connection arrangements for grid connected systems) to potentially complicate the future sale of the home or other property where the photovoltaic system is located.

But an alternate pathway also exists. Many photovoltaic system installers have various financing programs available under which investors are willing to finance or purchase a residential photovoltaic system to be installed on your home, then sell the power to you for less than the cost of that electric power from the grid system. If third party investors are willing to fund residential photovoltaic systems for homes in your area, you might want to investigate this possibility as you consider the benefits of installing photovoltaic electric generation as part of a home energy savings plan.

Such an arrangement can provide many of the benefits of installing a photovoltaic electric power system on your home without a large upfront investment. However, it may be advisable to consult with a real estate professional regarding the possible impact of owned versus leased photovoltaic systems on the value and marketability of your home before selecting an alternative to purchasing your photovoltaic system.

**Government Resources** The U.S. Department of Energy's website found at **www.doe.gov**, and the National Renewable Energy Laboratory's website at

**http://www.nrel.gov/rredc/pvwatts** provide substantial additional useful information on photovoltaic electric and other small scale household renewable energy systems. Check out the information on these websites, consider the possibility of installing a photovoltaic system for your home, and see if a photovoltaic electric generating system coupled with home energy conservation makes economic sense for you—given the current cost of photovoltaic systems, the price of grid connected power in your area, the current cost of money, and the availability of tax credits and other incentives in your location.

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