Residential Photovoltaic (Solar Electric) Stand Alone Systems

Photovoltaic systems are appearing across the Arizona landscape. Current trends show an increasing number of urban and rural installations as Arizonans search for energy stability and security.

In response to the Arizona Corporation Commission implementation of the Environmental Portfolio Standard directing Arizona utilities to provide a portion of their energy from renewable sources, utilites are installing solar power lants; providing incentives and buydowns to their customers who purchase and install solar systems; and some are even offering packaged units of stand-alone systems for remote settings.

While the economics of photovoltiacs continues to get better and better, the obvious advantage is in locations where there is no utility grid, and remote enough to make extensions of the existing power grid costly. Rural Arizonans continue the incorporation and use of solar, and leading the State into a solar future.

HOW TO CHOOSE A PHOTOVOLTAIC (P.V.) SYSTEM

DO NOT THINK ABOUT PV WITHOUT CONSIDERING ENERGY EFFICIENCY.

PV only makes sense when electricity is consumed efficiently.. Energy efficiency is the key goal before considering any PV system, since it will have a direct impact upon the type and quantity of PV equipment needed.

FIRST STEPS

* Consider an energy audit
* Consider energy efficiency
  - Insulation
  - Effective windows and covers
  - Roof exposure and impacts
  - Efficient appliances
  - Time of use utility rates
  - Site conditions
  - Architecture and construction
* Use Passive solar techniques to mitigate negative conditions, and take advantage of site resources to reduce power requirements.

There are 2 types of photovoltaic applications: those connected to an existing power grid (Grid-Tie), and those independent from any power grid (Stand Alone).

STAND ALONE SYSTEMS

Choosing a System

System choice is based on
*What do you need it to do?
*How much power do you want?
*What is the daily & annual profile of power use and projected need?.
*What happens if the power system fails?

STAND ALONE SYSTEMS

Stand alone systems are totally self-sufficient with no connection to the utility grid system. They generate electricity during daylight hours, and store excess for nighttime use.

Stand Alone Systems
* Total independence from utility power.
* Provide for all electric needs
* Require large battery bank for night and cloudy days.
* Consider a backup generator/inverter in case of system failure.
* Minimize electricity use
  Energy Efficient appliances
  Use only electric appliances
* Minimize “parasitic loads” that are always on but don’t need to be (VCR, clocks,etc.)

OTHER APPLICATIONS
- SOLAR WATER PUMPING
- POOL PUMPS
- IRRIGATION CONTROL
- LIGHTING
- DC POWERED
- EVAPORATIVE COOLERS

ALLIED EQUIPMENT TO BE USED WITH STAND ALONE APPLICATIONS
- Propane generator
- Gas stove and dryer
- Solar Cooker
- Solar water heater
- Wind generator

WHAT WILL IT DO?

Stand Alone systems

* Provide power whenever the sun is shining, eliminating dependency on utility provided electricity, and reducing utility bills
* Provide power for a variety of applications other than residential use. Can be used for pumping water from a well, outdoor lighting, etc..
* Care must be taken to correctly size and maintain the system.
* Amount of solar power available depends on array and inverter.
* Back-up power and time depend on Battery and Inverter choices.

STAND ALONE COMPONENTS

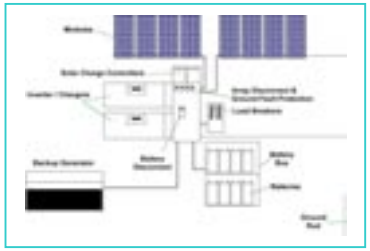
PV array – The part of the system that converts sunlight to electricity

Stand Alone Inverter – The part of the system that changes the quality of the electricity the panel produces (Direct Current) to the quality required by the building equipment. (120 volt Alternating current)

Batteries – The electricity storage system

Battery Cut Off Switch – Safety item to isolate the battery bank

Inverter.Safety Switch – So the Utility can shut system off in emergencies or work



SYSTEM INFO

SOLAR MODULES

Solar modules that convert sunlight to electricity are very similar for all systems, with larger modules being normally cheaper in terms of dollars per watt delivered. Modules produce more power when cooler.

A current development in photovoltaic modules and engineering plastics is toward Building Integrated PV (BIPV), that make the system a part of the building structure, where the PV system is both the roof, or wall, as well as the power generator of the building.

INVERTERS

Inverters convert DC (direct Current) electricity to AC (alternating current) electricity. There are 2 types of Inverters – sine wave and non-sine wave (for non-critical power requirements like power tools, etc,) Inverters. Non-sine wave inverters are cheaper and should ONLY be used in stand Alone applications, N E V E R in grid connected systems.

Inverter Choice Consideration

* How much power is needed?
* How flexible is the battery charging?
* Will the Inverter control a backup generator?
* What other equipment will be a part of the system?

Additionally, there are application elements to be considered.

MODULE MOUNTING

Module mounts are used to position the collector relative to the sun. There are fixed mounts and trackers (which increase the amount of power from an array). Where these are placed affects performance and aesthetics.

BATTERIES

Batteries store DC electricity for later use.

*Use ONLY deep cycle batteries.

*Wet batteries need to be checked for fluids and tightness at least every 6 months

*Sealed batteries do not need water but may not last as long as wet batteries.

*Capacity – Larger capacity store more energy and are more expensive.

*Voltage of the batteries MUST ALWAYS be matched to the iinverter.

*Never run more than 4 para-llel strings of batteries. Since batteries do not share loads equally, the life of the battery bank will suffer.

* Safety –
  Keep in a ventlated area
  Use insulated tools

OTHER COMPONENTS

Charge Controllers –

(Solar Battery Charger) Conditions the power from the solar module to charge a battery.

Disconnects and Switches –

National Electric Code and local codes require disconnects for safety of owners and workers.

Remote Controls –

Many systems offer remote controls for convenience and some offer performance monitoring by computer..

Meters and Data acquisition–

Collect data about the system's performance Useful for isolating performance problems Often linked to the Remote Control package.

Wind Generators

Small wind generators can be a compliment to a solar system installation, in providing for night-time power. Effectivenesss is a function of wind speed and the minimum requirement is 5 to 7 miles per hour wind velocity. Like any other equipment, a wind generator requires regular maintenance and occasional replacement of parts.

COMMON QUESTIONS

Can run my air conditioner on solar?

In principle yes, but in practice it is not economically feasible. In a line tie system the energy savings realized by the solar power generated will offset some of the power needed to run an A/C unit

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How Much Does a Solar System Cost?.

Currently installed cost is about $8 to $9 per watt, before incentives. Incentives include a State tax credit; a State sales tax exemption ;and utility buy-down programs which significantly reduce the overall cost of a photovoltaic system.

What is the Payback Time?

With a solar PV system you are buying power at a known fixed cost of todays market. Payback can be calculated by guessing future energy value impacted by supply, inflation rates, and other market factors.

Can the Meter Spin Backwards?

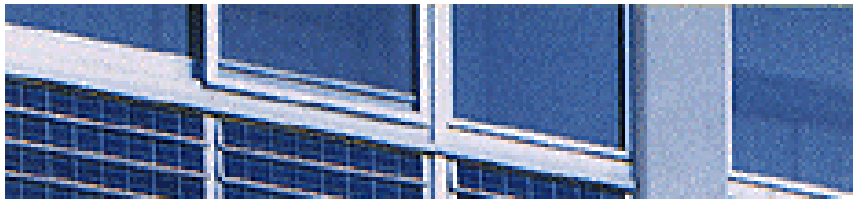
Yes, if more energy is generated than used, it can be put into the utility grid and the Owner compensated. The compensation rate depends on the utility company and State requirements and law.

How Do I Get More Information?

* Ask PV system owners .
* Call the utility company.
* Find a local PV dealer in the phone book.
* Check Magazines – Solar Today and Home power magazines are the most widely available sources of information on photovoltaic systems.

*Check the Internet

* Arizona Solar Center www.azsolarcenter.com
* Az. Dept. of Commerce Energy Office www.commerce.state.az.us/energy
* PV & systems manufacturers sites
* National Renewable Energy Lab www.NREL.gov
* U.S. Dept. of Energy www.doe.gov
* California Energy Commission www.energy.ca.gov
* Florida Solar Center www.fsec.ucf.edu



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