PV FAQs

How do solar cells generate electricity?

Photovoltaics or PV for short can be thought of as a direct current (DC) generator powered by the sun. When light photons of sufficient energy strike a solar cell, they knock electrons free in the silicon crystal structure forcing them through an external circuit (battery or direct DC load), and then returning them to the other side of the solar cell to start the process all over again.

The voltage output from a single crystalline solar cell is about 0.5V with an amperage output that is directly proportional to the cell's surface area (approximately 7A for a 6 inch square multicrystalline solar cell). Typically 30-36 cells are wired in series (+ to -) in each solar module. This produces a solar module with a 12V nominal output (~17V at peak power) that can then be wired in series and/or parallel with other solar modules to form a complete solar array to charge a 12, 24 or 48 volt battery bank.

What components do I need for a grid-tie system?

Grid-tie systems are inherently simpler than either grid-tie with battery back-up or stand-alone solar systems. In fact, other than safety disconnects, mounting structures and wiring, a grid-tie system is just solar modules and a grid-tie inverter!

Today's sophisticated grid-tie inverters incorporate most of the components needed to convert the direct current form the modules to alternating current, track the maximum power point of the modules to operate the system at peak efficiencies and terminate the grid connection if grid power is interrupted from the utility.

What components do I need for a grid-tie system with battery backup?

There are many components that make up a complete solar system, but the four main items are: solar modules, charge controller(s), batteries and inverter(s). The solar modules are physically mounted on a mount structure (see question 7) and the DC power they produce is wired through a charge controller before it goes on to the battery bank where it is stored.

The two main functions of a charge controller are to prevent the battery from being overcharged and eliminate any reverse current flow from the batteries back to the solar modules at night. The battery bank stores the energy produced by the solar array during the day for use at any time of the day or night. Batteries come in many sizes and grades. The inverter takes the DC energy stored in the battery bank and inverts it to 120 VAC to run your AC appliances.

Will solar work in any location?

Solar is universal and will work virtually anywhere, however some locations are better than others. Irradiance is a measure of the sun's power available at the surface of the earth and it averages about 1000 watts per square meter. With typical crystalline solar cell efficiencies around 14-16%, that means we can expect to generate about 140-160W per square meter of solar cells placed in full sun.

Insolation is a measure of the available energy from the sun and is expressed in terms of "full sun hours" (i.e. 4 full sun hours = 4 hours of sunlight at an irradiance level of 1000 watts per square meter). Obviously different parts of the world receive more sunlight than others, so they will have more "full sun hours" per day. The solar insolation time is approximately an average of six full sun hours a day in New Mexico.

How much will a system cost for my 2000 square foot home?

Unfortunately there is no per square foot "average" since the cost of a system actually depends on your daily energy usage and how many full sun hours you receive per day in your area; and if you have other sources of electricity. To accurately size a system to meet your needs, we need to know how much energy you use, your costs of electricity usage, and the average peak sun hours in your area. The cost of the system will depend on the percentage of electricity you hope to gain for your energy needs.

If your home is connected to the utility grid, simply look at your monthly electric bill, then **call Mirasol Solar Energy Systems** at **(505) 892-6406** to speak to our PV System Designer. We're here to help you 'electrify a sustainable world!'

What type of system is right for me?

The type of system you might want for your home or business depends on a number of variables, including geographic location, the amount of energy you need to produce, and the size of the investment you plan on making.

For a better understanding of both off-grid and grid-tie systems, check out the applicable sections in our website.

What's my incentive to invest in a solar power system?

Most people associate solar energy with remote installations and off-grid implementations. In those cases, the choice may be an easy one, but in towns and cities there are still reasons to turn to solar energy as a supplement and alternative to electrical utility grids.

The best reason is the reduction in utility bills. Once your system is working, it requires no monthly fees and little or no maintenance (and most parts are warranted). While it runs, it also reduces your electrical bills. Eventually it will pay for itself and keep saving you money. Large systems may even make you money by giving you perpetual credit with your local utility company.

Not only is your investment going to save you money and pay for itself, but solar installations frequently raise property value in both industrial and residential settings. Adding a solar energy

system to your home or business will also supplement the investment you've made in your property.

Another great incentive--the State of New Mexico and the Federal government offer rebates and incentives for implementing solar power systems. Residential solar systems will generally qualify for a 30% tax rebate. Solar systems installed by businesses have similar rebates. Take a look at our incentives and pricing section for more information.

Finally, solar energy is a clean source of renewable energy. It reduces dependence on fossil fuels in a practical and effective way, and helps keep our environment clean.

But where do I begin?

Getting started might seem like a daunting task, but it's not as complicated as it first seems. You can determine the minimum system size you'll need from your electric bill. Once you've determined your average usage, you can determine how many solar panels you'll need.

To begin, you'll need the average monthly electrical use--which you should be able to find on your utility bill. This number will be in kWH (kilowatt-hours).

Below is a formula to help calculate the type of energy you hope to gain utilizing solar energy. Fill it out and then call **Mirasol Solar Energy Systems** at **(505) 892-6406** to help you determine the type of system that will suit your needs and answer any questions you may have.

Record average monthly kWH electrical use: _____kWH

Multiply line 1 by the percentage you want the solar system to produce: _____kWH ie: 1000kWH X 50% = 500kWH

Divide by 30 for the daily output from your solar power system: _____kW

Divide by 6 which is the daily average sun hours for New Mexico: _____

Divide by 70% to compensate for system efficiency: _____kW

Can I use my normal 120/240 Vac appliances?

Maybe.

Many older homes were not designed or built with energy efficiency in mind. When you purchase and install a renewable energy system for your home, you become your own power company so every kWh of energy you use means more equipment (and hence more money) is required to meet your energy needs. Any appliances that operate at 240 VAC (such as electric water heaters, cook-stoves, furnaces and air conditioners) are impractical loads to run on solar. You should consider using Solar Thermal System for water/space heating or alternatives such as LP or natural gas for cooking; evaporative cooling instead of compressor based AC units; and passive solar versus active solar, design in your new home construction, if possible.

Refrigeration and lighting are typically the largest 120 VAC energy consumers in a home (after electric heating loads) and these two areas should be looked at very carefully in terms of getting the most energy efficient units available.

Great strides have been made in the past 5 years towards improving the efficiency of electric refrigerators/freezers. Compact fluorescent lights use a quarter to a third of the power of an incandescent light for the same lumen output and they last ten times longer. These fluorescent lights are now readily available at your local hardware or discount store.

The rule of thumb in the renewable energy industry is that for every dollar you spend replacing your inefficient appliances, you will save three dollars in the cost of a renewable energy system to run them. So, you can see that energy conservation is crucial and can really pay off when considering a renewable energy system.

What type of solar module mounting structure should I use?

There are four basic types of mount structures: roof, ground, top-of-pole, side-of-pole and tracking mounts, each having their own pros and cons.

Roof mount structures typically keep the wire run distances between the solar array and battery bank to a minimum, which is good. But they also require roof penetrations in multiple locations (a potential source of leakage) and they require an expensive ground fault protection(GFP-device to satisfy article 690-5 of the National Electrical Code- NEC).

On the other hand, ground mounted solar arrays require fairly precise foundation setup, are more susceptible to theft/vandalism and excessive snow accumulation at the bottom of the array.

Top-of-pole mounts which are relatively easy to install (you sink a 2-6 inch diameter SCH40 steel pole up to 4-6 feet in the ground with concrete). Make sure that the pole is plumb and mount the solar modules and rack on top of the pole. Top-of-pole mounts reduce the risk of theft/vandalism (as compared to a ground mount). They are also a better choice for cold climates because snow slides off easily.

Side of pole mounts are easy to install, but are typically used for small numbers of solar modules (1-4) for remote lighting systems where there already is an existing pole to attach them.

Last but not least are the trackers, which increase the daily number of full sun hours and are used for solar water pumping applications. Trackers are extremely effective in the summer time when water is needed the most. In the northern U.S., typical home energy usage peaks in the winter where a tracker mount makes very little difference as compared to any type of fixed mount (roof, ground or top-of-pole). In this situation, having more modules on a less expensive fixed mount will serve you better in the winter than fewer modules on a tracker. However, if you are in the southern U.S. and your energy usage peaks in the summer, then a tracker may be beneficial to match the time of your highest energy consumption with a tracking solar array's maximum energy output.

Where should I mount the solar modules and what direction should I face them?

In the Northern Hemisphere, you need to aim your solar modules to the true south direction (the reverse is true for locations in the Southern Hemisphere) to maximize your daily energy output.

There is quite a difference between magnetic south and true south. In Albuquerque, true south is 13 degrees east of magnetic south. The solar modules should be tilted up from horizontal to get a better angle at the sun and help keep the modules clean by shedding rain or snow.

For best year round power output with the least amount of maintenance, you should set the solar array facing true south at a tilt angle equal to your latitude with respect to the horizontal position. If you plan to adjust your solar array tilt angle seasonally, a good rule of thumb to go by is latitude minus 15° in the summer, latitude in the spring/fall and latitude plus 15° in the winter.

Most mount structures provide for a seasonal adjustment of the tilt angle from horizontal to 65°. **Mirasol Solar Energy Systems** will determine if your proposed array site will be shaded at any time of the day or year..

Should I set my system's battery back up for 12, 24 or 48 VDC?

The PV industry really began with the 12V recreational vehicle market. These systems were typically small (1-2 solar modules) and had all 12 VDC loads. As the solar industry matured and entered the home market, systems became much larger (16+ solar modules) and no longer used DC loads exclusively.

Most home systems today are 24 or 48 VDC since the higher system voltage gives you a lot more flexibility as to how far away you can place your solar modules from the battery bank as compared to a 12V system. For a given power output, a higher system voltage reduces your amperage flow (but not your power) which allows you to use a smaller and less expensive gauge wire for your solar to battery and battery to inverter wire runs. Of course, if you already have a lot of 12VDC loads, that may be your deciding factor as to what voltage you set your system up at. Most grid-tied systems operate at 48 volts or higher.

Should I wire my home for AC or DC loads?

It depends on the size of the system and what type of loads you want to run. DC appliances are usually more efficient than AC since you don't have to worry about the loss of power through the inverter, but DC loads are typically more expensive and harder to find than their AC counterparts.

Small cabin and RV systems are typically wired DC while most home systems are wired for AC loads, exclusively. With improvements in inverter efficiency and reliability over the years, AC is the way to go for a home system. Another advantage AC has over DC is that the voltage drop for a 120VAC circuit is much less than a 12VDC circuit carrying the same power, which allows you to use smaller gauge wire.

Can I use PV to heat water or for space heating?

No.

Photovoltaics converts the sun's energy into DC electricity at a relatively low efficiency level (14-16%), so trying to operate a high power electric heating element from PV would be very inefficient and expensive. Solar thermal is the direct heating of air or water from the heat of the sun and is much more efficient for heating applications than photovoltaics.

What sort of Federal incentives am I eligible for?

Based on the type and size of your system, you may be eligible for special Federal energy rebates, which can help buy and improve your solar energy system. Federal rebates and incentives, unlike the state incentives, are the same all across the country and are dependent are your particular system..

Am I eligible for state rebates?

The State of New Mexico offers incentives for buying and implementing solar power systems. For more information about the rebates and incentives offered by New Mexico, check out our helpful guide under Incentives and Pricing in this website.

Should I consider a hybrid system over a conventional solar grid-tie system?

Hybrid systems can be more inexpensive than solar grid-tie systems. These systems, however, may not be efficient where you live. Wind systems require certain climate conditions, and wind generators tend to have many movable parts, which only increase the need for maintenance.

What sort of back-ups work best for an off-grid system?

There are several kinds of back-ups, each of which works fairly well. Gasoline generators are fairly cost-effective, but tend to be loud and give off fumes. Wind generators work when there is no sun, but are like-wise constrained by the weather.