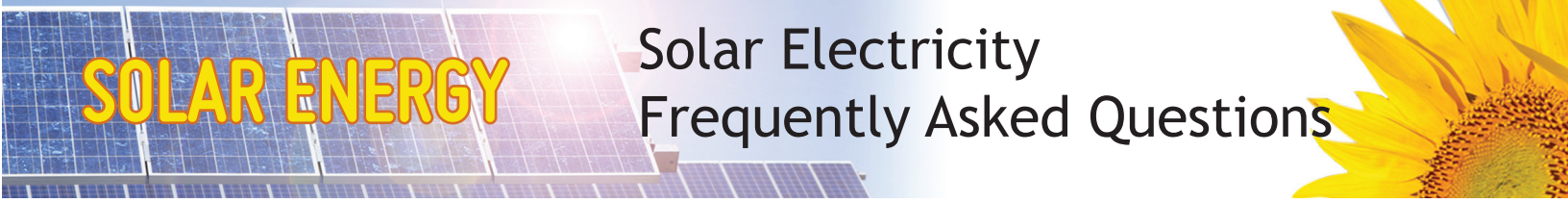

Solar Electricity Frequently Asked Questions

Solar Photovoltaic Systems and Components

What is a solar photovoltaic system and what does it typically consist of?

A solar photovoltaic (PV) system, or solar PV system, is a power system designed to supply usable solar power by means of photovoltaics. Solar cells, also called photovoltaic cells, convert sunlight directly into direct current (DC) electricity. To withstand the outdoors for many years, cells are sandwiched between protective materials in combination of glass and/or plastic to make a PV module or panel. Individual panels are arranged into an array, as illustrated in the roof-mounted picture above. Mounting hardware fastens the solar array to either a rooftop or will involve a ground-mount system, which can either be fixed in place or track the sun's movement. The DC electricity produced is then converted to alternating current (AC), via an inverter. This is essential as our electric distribution grid, our buildings, and our appliances operate on AC. Finally, there are other electrical components, commonly referred to as the "balance of system" (BOS), that include the wires, disconnects, surge protection and overcurrent protection devices, and other equipment. Battery storage can be incorporated into a solar PV system but is a less common option. Battery storage is typically used for and during grid interruptions (blackouts) but may also involve other components such as a charger controller and a second inverter.

What is the difference between solar thermal electric generation and solar PV?

It is important to understand that solar thermal electric is not the same as solar PV. Solar thermal electric energy generation, which is predominantly found in the desert southwest U.S., concentrates the light from the sun to create heat, and that heat is used to run a heat engine, which turns a generator to make electricity. The working fluid that is heated by the concentrated sunlight can be a liquid or a gas. Different working fluids include water, oil, salts, air, nitrogen, helium, etc. Different engine types include steam engines, gas turbines, etc. Solar PV energy conversion, on the other hand, directly converts the sun's light into electricity. This means that solar panels are only effective during daylight hours because storing electricity is not a particularly efficient process. Heat storage is a far easier and efficient method, which is what makes solar thermal electric so attractive for large-scale energy production. Heat can be stored during the day and then converted into electricity at night.

Will a solar PV system also provide hot water?

Solar PV systems are different than solar hot water systems. Solar PV systems generate electricity whereas solar hot water systems collect and convey the thermal energy from the sun's rays to provide domestic hot water. If a customer has an electric hot water heater, that water heater contributes to the customer's overall electric load (consumption) that a solar PV system is designed to offset; therefore, a solar PV system can provide the source of energy used for electric hot water heating.

Will a solar PV system operate during a power outage?

Solar PV systems must be installed in a manner such that they are not producing electricity that could back feed onto the grid during a grid outage (blackout) to protect electric utility personnel who may working to restore power. A solar PV system will have an automated internal disconnect switch to

For further information contact the Public Utility Commission

Write
PA Public Utility Commission
Bureau of Consumer Services
400 North Street
Harrisburg, PA 17120

Call
1-800-692-7380
For those with speech or hearing loss, dial 7-1-1
(Telecommunications Relay Service)

Visit our websites
www.PAPowerSwitch.com
www.puc.pa.gov

May 2018

prevent the ability of any electricity produced by the solar panels from feeding back into the grid. PV systems that include battery storage may be able to power the home during a grid outage, provided they are equipped with an automated transfer switch. The automated transfer switch allows the solar PV system to operate exactly the way an integrated back-up generator would work during an electrical outage.

Will I need a battery or battery back-up for a solar PV system?

The simple answer is no, unless the customer is not connected to the electric distribution grid. Solar battery storage can be beneficial, particularly for grid outages, but it will significantly add to the cost of the solar PV system. Most solar PV systems are grid-tied to the electric utility's electric distribution system and therefore adding battery backup is simply an option to consider. The customer should contact the solar installer for more detailed information.

What value does adding battery backup provide?

Value is subjective and based on each customer's needs or desires. The added costs of battery storage should be weighed against factors such as the inconvenience and duration associated with power outages on the utility's electric distribution grid. Batteries or battery systems are often sized to provide up to about 1 or 2 days of backup power, because the electric grid is rarely out or down longer than that but this should be based on local conditions and your needs. However, solar PV systems for off-grid customers (those without electric utility connection) always include battery storage, where the batteries are charged up in the daytime from the solar array and discharged to power electric loads at night. For grid-tied systems, unless there are reasons to do so, it is not wise to routinely operate the system in this manner, as it will significantly shorten the life of the battery, leading to more frequent battery replacements over the life of the solar PV system, and therefore adding costs.

How much maintenance does a solar PV system need and what is the lifespan?

Solar panels require very little maintenance. Consumers should consult with their solar installer for tips on how to maintain the panels but customers should also periodically check to ensure that the panels are free of debris and shading. In the winter, customers should clear the panels of any snow that may have accumulated on them, to help prevent a loss of functionality. Note that the dark color of most PV panels helps to melt the snow. Solar PV systems are usually operational for approximately 20-25 years, though there is a performance degradation of about 0.5% per year, and the inverters will most likely need to be replaced at least once during this period.

Are solar PV systems warrantied?

A solar panel has two warranties: a performance and a product (or materials) warranty. A solar panel's performance warranty will typically guarantee 90% production at 10 years and 80% at 25 years. Product warranties typically provide 10-12 years of coverage for the integrity of the panel itself, and protects the consumer against problems such as manufacturing defects, environmental issues, premature wear and tear, etc. Inverters typically have a 10-year warranty. The amount of electricity a solar panel produces declines slightly every year. A common practice in the solar energy industry is to guarantee that the panels will not lose more than 10%-20% of their power output capacity over the first 25 years and is a crucial benefit of a good solar panel warranty. Said another way, a performance warranty will generally guarantee that the panels will produce electricity at 80%-90% of their power output rating at the end of 25 years. As with most warranties, a longer period is generally more advantageous to the customer, if the solar PV system is owned and not leased. When evaluating a solar panel warranty and its manufacturer, the two most important factors on which a consumer should focus are the product (or materials) warranty, and the performance warranty. The customer should contact the solar installer for more detailed information.

How much electricity can a solar PV system produce?

The amount of electricity produced depends on three main things: the size of the solar panels, the efficiency of the solar cells inside, and the amount of sunlight the panels receive. Most grid-tied inverters are extremely efficient with converting DC power to AC power, typically rated at 96% to 98%. On average, Pennsylvania homeowners consume about 10,000 kilowatt hours (kWh) per year. In the southeastern part of Pennsylvania, an optimally orientated solar PV array with an array tilt of about 35 degrees and facing due south and with no shading impacts from surrounding vegetation or building obstacles, could generate well over 1,300 kWh per year for every kW of installed PV capacity. Said differently, a 7.6 kW solar PV system could generate 100% of the annual electric usage for many homes in Pennsylvania. It is worth noting that solar insolation (amount of solar energy reaching the surface) is not uniform across the state but doesn't vary too significantly.

Location, Siting and Performance

Is my site a good location for a solar PV system?

Solar PV systems are built to work in all climates, but in some cases, rooftops may not be suitable for solar panels due to the age of a roof, tree cover or other obstacles that would shade or partially shade the panels. If trees create excessive shade on the customer's roof, rooftop panels may not be the most ideal option. Typically, solar panels perform best when installed on a sunny southeast to southwest facing roof with a slope between 15 and 40 degrees or mounted on the ground in an open location. Solar installers should conduct a shading impact assessment. If shading is expected to be problematic; experienced installers use one of several commercially available shading impact measurement tools, such as the 'Solar Pathfinder', the 'Solmetric SunEye' or the 'Acme Solar Site Evaluation Tool'. Consumers should contact a solar installer for a detailed solar assessment of their home or site.

Will a solar PV system work on a cloudy day?

Solar panels generate the most electricity on clear days with abundant sunshine, but they do work in cloudy weather, just not quite as well. On a cloudy day, typical solar panels can produce 10-25% of their rated capacity. The exact amount will vary depending on the density of the clouds, and may also vary by the type of solar panel.

Will a solar PV system work in Pennsylvania?

Yes, absolutely. As of mid-2017, well over 14,000 solar PV systems were operating in Pennsylvania. Even Western Pennsylvania and the surrounding region receives more than enough sunshine to make solar PV systems a viable option. For many years, until recently, Germany had the most solar PV capacity installed in the world and it has about as much annual solar insolation (amount of solar energy reaching the surface) as Southern Alaska. Germany receives an average of 2.6-3.6 daily hours of sunshine. Global location (longitude and latitude), elevation and other factors determine the amount of solar insolation for an area and the area's solar PV production potential. Pennsylvania receives an average of 4-4.5 daily hours of sunshine, clearly more than Germany, thereby dispelling the myth that the solar resource in Pennsylvania is insufficient to support PV systems. For more information about solar potential in the United States visit the U.S. Department of Energy at Solar Energy Potential or visit Goggle at Project Sunroof.

Installation

What should I do before installing a solar PV system?

To get a better understanding of the basics of solar energy, options on how to finance a solar PV system, and what questions to ask the solar installer, consumers can read the Residential Consumer Guide to Solar Power developed by the Solar Energy Industries Association. The Pennsylvania Public Utility Commission (PUC) prepared other resources that can assist, educate and help consumers before installing a solar PV system by visiting www.puc.pa.gov.

Can I install a solar PV system myself?

It is strongly advised to have the solar PV system installed by a qualified professional who holds a certification to install solar PV systems and works with high-quality solar panels. The most notable industry-standard certification is awarded through the North American Board of Certified Energy Practitioners (NABCEP), but there is also the UL PV Installer Certification, as well. Designing and installing grid-tied solar PV requires a significant amount of training on the solar PV technology, as well as working with electrical circuits. Considering that there are very high risks of injury associated with working with electricity, as well as working on a roof, the combined risks of injury should clearly be evaluated.

Will I save money by installing a solar PV system?

The amount of money a customer can save with a solar PV system depends upon how much electricity is consumed, the size of the solar PV system, if the customer choses to buy or take on a PPA or lease the system, and how much power the system can generate given the orientation of the PV array and how much sunlight it receives. The savings also depend on the electricity rates set by the electric utility and how much the electric utility will compensate the consumer for any excess energy from the customer that was sent back to the grid. The cost of going solar has dropped about 70% since 2009 and it should also be noted that investing in energy efficiency upgrades complement solar energy economically. It is more cost effective to install Energy Star approved appliances and lighting and have your home or building properly insulated and weatherized, so that the installed solar PV system can be smaller and less expensive, regardless whether the customer owns or signs a PPA or leases a system.

How do I size a system to meet my needs?

The solar installer will work with the consumer to assess the energy needs for the home. A good starting point is to gather a year's worth of energy bills. Add to this information any increased electric load that might result from any anticipated increases in your electric load, such as from a home addition, the purchase of an electric vehicle, or changes to the HVAC system. The installer can use that information along with assessing the building's solar exposure, the size and slope of the roof, available roof space and other factors to best meet the needs of the customer. The customer's budget is an important factor, as everyone's finances are different. The ability to take advantage of any financial incentives (tax credits, rebates, etc.) may also play a role in determining a system size that meets the customer's needs.

Whom should I call to install or purchase my solar PV system?

Neither the PUC nor the electric utilities offer a list of vendors or installers. Interested consumers can find a directory of Pennsylvania solar electric installers at the following website: https://themarea.org/downloads/MAREA-Directory-of-PA-Solar-Electric-Installers.pdf.
To find a list of North American Board of Certified Energy Practitioners (NABCEP)-certified installers customers can also use the following link: www.nabcep.org/certified-installer-locator.

System Costs and Financing

How much will a solar PV system cost?

The cost will depend on the system size, solar module or panel efficiency rating, site conditions, equipment selected, and the financing model. Consumer should check references and get price quotes from a few different solar installers to determine the cost and financing model that is best for their home. As of the Fall of 2017, a rough approximation is about $3.10/watt to $3.70/watt, based on the DC rated capacity of the solar PV array. However, the installation cost could be lower or higher than these unit prices. Typically, the installation cost will be a turn-key cost, meaning that it usually includes the permit, inspection, and electric utility interconnection fees, as well as all system equipment and labor costs; but it is important to confirm this very early in the project. Also, note that the efficiency of solar PV modules range considerably. A 340-watt panel from one manufacturer could be rated at 15% efficient compared to 22% from another manufacturer so, the $/watt cost metric should be looked at carefully.

How can I determine if it is cost effective for me to install a solar PV system?

This is a decision that each consumer must make for themselves. There are many factors to consider such as the total installed cost of the system including the maintenance costs, how much energy it will produce, the value of net metering compensation, the value of solar energy credits, how long the system will last and very importantly, the finance costs associated with purchasing and installing the system. There are several analysis tools available on the internet that can be accessed at the following websites: PVWatts, and Sizing Tool for Solar PV and Battery Storage Systems. These tools are great for getting started, and maybe getting an idea of sizing the system, but working with a solar installer for a custom estimate of how much power the solar PV system is likely to generate is recommended, as well as for providing a basis for comparing installation costs, expertise and quality assurance among installers.

What options may be available to help finance a solar PV system?

Third-party financing has the potential to significantly lower the cost of solar installation and maintenance of a solar PV system. In Pennsylvania, those options are solar energy loans, power purchase agreements (PPAs) and solar leases. Solar energy loans function the same way as home improvement loans and some loans are offered with below-market interest rates, making solar even more affordable. In most cases, monthly loan payments are smaller than a typical energy bill, which will help save money from the start and safeguard against rising electricity rates. Usually with a PPA, a solar installer/developer builds the solar PV system on the consumer's property at no cost. The solar PV system offsets the consumer's electric utility bill, and the developer sells the power generated to the consumer at a pre-determined rate, typically lower than the electric utility, but typically builds in an annual rate escalator. At the end of the PPA contract term, property owners can extend the contract and even buy the solar PV system from the developer. With a solar lease, a consumer will sign a contract with a solar installer/developer and pay for the solar PV system over a period of years or decades, rather than paying for the power produced. Solar leases can be structured so consumers pay no up-front costs, some of the system cost, or purchase the system before the end of the lease term. Similar leasing structures are commonly used in many other industries, including automobiles and office equipment.

Are there incentives from the PUC, other state agencies or my electric utility if I install a solar PV system?

State or electric utility sponsored rebate or incentive programs are not available at this time for customer owned solar PV systems. However, there is currently a federal Solar Investment Tax Credit (ITC). For residential solar, projects that start construction by 2019 will receive the current 30% ITC, while projects that begin construction in 2020 and 2021 will receive 26% and 22%, respectively. All projects must be completed by 2024 to obtain these elevated ITC rates. Note that the tax paying customer does not have to take the entire tax credit in the first year of the installation; the customer can allow the credit to roll over for several years if so desired. More information on the solar ITC can be found here. A good resource for information on different programs, legislation and regulation by state is www.dsireusa.org.

Will I incur unexpected costs associated with the installation of a solar PV system?

In Pennsylvania, in many areas, the interconnection process is complex and may be expensive, and it can be a significant barrier to bringing a solar PV system online. The ability to interconnect to the electric utility's distribution system on a cost-effective and timely basis may determine whether the project moves forward or not. An experienced installer can provide you a reasonable idea of what you should anticipate. Additionally, before a solar PV system can be installed on a property, the system owner or the installer must comply with any local zoning and permitting requirements. Depending on the municipality, the type and size of the system, whether the proposed system is to be ground mounted or mounted on a roof, the permitting process may require significant time and cost. Furthermore, local ordinances or homeowner's association (HOA) rules can affect the installation of solar PV systems.

While these rules are often created to ensure uniformity, or uphold a community's aesthetic standard, they may inadvertently prohibit the installation of solar PV systems. In lieu of outright prohibition, some rules require that solar customers make modifications to their system design which may increase costs, decrease efficiency, or both. The solar installer should be able to determine most, if not all these issues.

Solar Credits

What are solar renewable energy credits (SRECs), also called alternative energy credits (AECs), how are they created and what value do they have?

Many states have Renewable Energy Portfolio Standards; however, Pennsylvania, has an Alternative Energy Portfolio Standard. These laws require electric utilities and alternative electric suppliers to obtain a portion of their electricity from renewable or alternative energy. Rather than building their own solar projects, utilities can purchase SRECs/solar AECs generated from qualified systems. AECs are separate from the physical electricity that a solar PV systems produces. An AEC is created for each 1,000 kWh of electricity produced from a qualified alternative energy source. The AEC is then sold or traded separately from the power. Higher credit prices can help individuals to finance and invest in a solar PV system. Credit prices do fluctuate in value. Because AECs are bought and sold on an open market, there are several factors that influence their price. However, the most important thing to remember is that AEC prices are determined by supply and demand.

How do I sell Solar AECs?

In Pennsylvania, as part of the AEPS program, operators of a solar PV system must apply to the PUC's Alternative Energy Credit Administrator to be qualified as an alternative energy facility. More information is available on the PUC website at www.puc.pa.gov by clicking on Electricity, then Alternative Energy, then AEPS Website. In addition to registering with the PUC's alternative energy credit administrator, all qualified systems also must register with the PJM Generation Attribute Tracking System (GATS), which is a credit issuance and tracking system for AECs. Once the application is approved and the system is registered in GATS, owners of solar PV systems will eligible to earn AECs. Often a solar credit aggregator will offer to provide the necessary registration services and offer to market the solar credits in exchange for a portion of the value of the credits. The customer can elect to perform these same services, but they will need to know various technical details about the solar PV system and its installation. The GATS website does provide an online bulletin board as a means of facilitating selling and trading of credits. Note, however, that selling solar credits from small, individual solar PV systems is more difficult because electric utilities typically prefer to buy larger volumes of credits from fewer sources, a benefit provided by credit aggregators. More information on GATS is available at www.pjm-eis.com.

Interconnection

What are the electric utility's requirements to connect a solar PV system and what forms do I need?

Connecting a customer's solar PV system to the electric distribution grid is referred to as interconnection. All electric utilities require documentation and submission of application forms for interconnection requests, and for net metering, as may be appropriate. Though each electric utility will have its own forms; they all follow a statewide standardized interconnection process. Information on electric utility requirements is available at the Alternative Energy page of the PUC website.
An alphabetical list of Pennsylvania's electric utilities, along with the associated interconnection website address or phone number is available from the PA Public Utility Commission at Electric Utility Interconnection Contact Information.

Net Metering

How does net metering work?

Basically, excess electricity produced can become a credit on the consumer's energy bill. In Pennsylvania, the electric utility credits the full retail rate for each kilowatt-hour produced up to the amount of electricity used during a billing period. If the solar PV system produces more electricity than the customer uses in a month the electric utility applies a credit, equal to the amount of excess generation, towards the customer's next electric bill. This may continue month-to-month until the end of the twelve-month cycle at which time, the electric utility will compensate the customer at the "Price to Compare" rate, which includes the full, retail generation and transmission rates. More details are available at the PUC's Alternative Energy webpage.

Is net metering an option if I choose an alternative electric supplier?

It is imperative to understand that in Pennsylvania, alternative electric suppliers are not required to provide net metering, though some do. Therefore, prior to enrollment with an alternative electric supplier, net metering/renewable service customers should contact prospective alternative electric suppliers to find out if these alternative electric suppliers offer any credits for customer-generated electricity. If a customer is transitioning from net metering with an electric utility and chooses to shop for electricity from an alternative electric supplier, the customer will no longer receive credit for excess generation from the electric utility after switching to an alternative electric supplier. The electric utility will provide the customer with a final credit for all excess energy produced prior to the switch. Additional information on net metering standards can be found on the PUC website at www.puc.pa.gov by clicking on Electricity, then Alternative Energy.

Will I still get an electric bill after I installed a solar PV system?

Yes, the customer will still receive a bill from their electric utility if the home is connected to the utility's electric distribution system.

Health and the Environment

Will a solar PV system reduce air pollution emissions?

Yes, using solar energy conserves natural resources and significantly reduces emissions of pollutants that threaten human health and the environment. For example, a 10-kW solar PV system that produces approximately 13,000 kWh of electricity per year will displace or avoid the generation of about 19,000 pounds of carbon dioxide (CO2) per year. This is equivalent to avoiding the use of nearly 1,000 gallons of gasoline or 9,400 pounds of coal being burned. This amount of solar electricity will also reduce nitrogen oxide (NOx) emissions, which contribute to ground-level ozone formation that adversely affects the human respiratory system, by 15 pounds. Beyond these avoided air pollution benefits, solar PV systems also use much less water per unit of electricity generated compared with conventional energy sources. Offsetting this amount of electricity with solar PV results in an annual savings of nearly 12,000 gallons of water over the same amount of production from a natural gas combined-cycle plant. Most meters installed for solar systems track how much CO2 is saved by having a solar PV system installed instead of using grid power.

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May 2018