Sustainable Development Fund Solar Photovoltaics Grant Program

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Solar PV Grant Program Questions & Answers

General Questions About the Technology

What are Photovoltaics (Solar Cells)?

Photovoltaics, or PV, are electrical devices that convert light into electricity. The light can be from any source. As long as the light is the right color (white light is all colors) some electricity will be produced from a solar cell. The more intense the light, the more electricity is produced. Each cell produces only a small amount of power, but when the cells are hooked together in larger configurations, the total energy output over a day, month, or year can be quite substantial. More technical information about PV is explained later in this list of questions and answers.

How does a cell work?

A solar cell is a semiconductor diode that when stimulated with light, produces an electron and a positive charge on opposite sides of the cell. Wires collect the charge off each side of the cell and take this electricity to the load circuit, such as a light bulb. Wiring cells in series increases the voltage, and in parallel increases the current output. For the cells to be useful, they must be put together in a system with other components, called a "solar energy system," or a "solar electric system."

What are some common uses of photovoltaics?

- Highway call boxes
- Coast Guard buoys & navigation
- Mountain top radio transmitting & repeating stations
- Off-Grid (rural) homes
- Grid-tied homes
- Utility interconnected for Demand Side Management (DSM)
- Utility grid support and bulk power generation
- Railroad signaling
- Satellites and space stations
- Outdoor lighting
- Calculators and watches
- Telecommunications, mountaintop relay stations
- Cathodic protection for metal exposed to the weather & earth
- Water pumping all over the world

What are the advantages & disadvantages of PV?

Advantages:

- Produces high quality electrical power (better than utility power in most cases)
- On-site green power production – absolutely no emissions
- Longevity, 20-30 year lifetime for most components, some will last longer.
- Very safe and reliable
- Provides an uninterrupted power supply or UPS (when batteries are included) during utility power outages
- Silent & low maintenance, replaces noisy & unreliable generators.
- Solid State, no moving parts, nothing to break.
- Available anywhere in the world where there is sunlight.
- Transportable, lightweight, good for mobile applications
- Modular - expandable & easily up-gradable

Disadvantages:

- High initial cost
- Higher overall cost depending on situation

How long has PV been around?

The photovoltaic effect was first recognized by Edmund Bacquerel, in France, in 1839. Scientists made solar cells of selenium in the 1880s. And, modern PV technologies were developed at Bell Labs and RCA Labs in the mid 1950s. Early on, they were used for satellites, space ships, solar calculators and electronic watches. PV has been powering off-grid homes for nearly 20 years, and has more recently powering grid-tied homes for almost 10 years.

How long do the solar modules typically last?

Most solar modules have a 20-25 year output warranty, but should last even longer since there are no moving parts. Experience shows most system problems occur because they have not been installed properly. It is important to routinely observe the general performance of the PV system in order to maximize its production.

What can PV power in a home?

Photovoltaic can power just about any electrical load. However, air conditioning, heat pumps and electric heating elements (cook stove, water heater or furnace) use large amounts of electricity. PV systems are often designed not to power these loads. But, when a PV system is grid-tied with the utility (under normal operating conditions), generally all the house loads are met by a combination of the PV system and the utility grid in the daytime; although, sometimes these loads can be totally met by the PV system in the daytime and most always they are met by the utility grid at night.

GENERAL QUESTIONS ABOUT THE APPLICATION, SIZING AND PERFORMANCE

Will a PV system heat my hot water?

As mentioned above, it can, but it is a strongly discouraged, especially if that is the only load. Utilizing PV to generate electric heat is extremely inefficient and uneconomical. You should use a thermal solar system to heat hot water.

Should I switch from gas or oil heat to electric heat and install a PV system?

Absolutely not! Fossil fuel prices would have to increase many times over to ever make this a reasonable application. As mentioned above, PV systems should not be utilized to generate electric resistance heat, rather they should be used for powering appliance type loads.

Will my system have batteries?

Grid-tied PV systems can either have batteries or not; however, you need to determine this before the installation. PV systems with batteries provide backup power typically for one to four days of overcast weather (depending on the design and use); however, this type of PV system operates less efficiently – (typically 10% to 20% less) than a batteryless PV system. Batteryless PV systems are simpler, more efficient, easier to install, have less hardware to breakdown and are less costly (e.g., 10% to 20% less than one with batteries), which make them more cost effective.

Whether you have a PV system with or without batteries, excess electricity produced by the solar panels will be directed back to the local utility grid, virtually spinning your existing meter backwards in the process. You will receive full retail credit for any power that you "sell" to the utility Company, up to your gross electric consumption per billing cycle (unless you choose other net metering options with PECO).

What happens during a blackout?

With a grid-tied solar PV system, the inverter will automatically disconnect itself from the utility grid within a few milliseconds of a blackout, to avoid the potential of a dangerous "brown-out" in your home and to prevent back feeding the grid. If you have a batteryless PV system, you will lose power since your system needs the utility power signal to operate under. On the other hand, a PV system with batteries will automatically switch to backup power almost without detection. Both these systems will automatically hook backup to grid power once it is restored.

How much will my PV system generated?

The amount of electricity that is generated is unique to your site. As a requirement for the SDF Solar PV Grant Program, your contractor will conduct a solar audit and estimate the production of a proposed PV system at your location. Some of the factors include the tilt of the modules, their orientation in relation to due south, shading from trees and other obstructions, and the wattage of the modules, along with the inverter efficiency and system losses.

In Southeastern Pennsylvania, about 1000 kWh per year of AC electricity can be produced for every kW of nominal PV capacity installed (this is conservative). So, a 2 kW_{DC} PV system could produce about 2000 kWh_{AC} per year.

To roughly estimate monthly production from a PV system, use the PVWATTS program (version 1) of the National Renewable Energy Lab for Philadelphia. This program is located at:

http://rredc.nrel.gov/solar/codes_algs/PVWATTS/version1/Pennsylvania/Philadelphia.html.

All you need is the PV module orientation and tilt, and the overall capacity of the PV system in AC (assume the AC capacity is about 70% or the overall nominal DC capacity, which is the sum of the PV module wattages).

How do I know if I have a good site for a PV system?

A Participating Contractor can help you determine this, particularly if you provide them with some information, such as,

How large is your roof? Rule of thumb is 10 watts of PV module capacity (DC_{STC}) per square foot of roof area; so, a 2 kW PV system will roughly require 200 square feet of roof area (assuming these are poly- or mono-crystalline PV modules; assume 6 watts per square feet of roof area for thin film modules).

How old is you roof? Although this doesn't affect the solar production, it is an important question for the installer (see **What happens when I need to re-roof?**)

Does your roof face the Southern direction? Of course, facing due South is optimal. But, your roof can face as much a 45^{o} off from true South, and assuming little or no shading, your PV system could still produce more than 90% of what it could if facing true South. (See **How do I find true South?**)

Does my roof have good solar exposure? As implied above, as long as you see the direct sun on your roof from 9am to 4 pm, it is potentially an excellent location for mounting the PV modules. Even if solar exposure is only from 10am to 3pm, it could still be a good location, but in order to benefit from the SDF Solar PV Grant Program, the annual exposure must be 70% or more compared to the optimum tilt and orientation with no shading. The Participating Contractor will be able to determine this.

How do I find true South?

Using a compass can roughly estimate the Southern direction, but this will show you magnetic South, which is about 14^{o} West of true South (in the Philadelphia area). A reasonably accurate way identifying true South is to observe the sun's location at solar noon (in the Philadelphia area, this is roughly at 12 pm EST or at 1 pm Daylight Savings Time). Solar noon can be more accurately determined by finding the midpoint in time between the local sunrise and sunset times posted in the local paper for that day. For example, on January 7 the sunrise is at 7:23am and sunset is at 4:51pm, the midpoint or solar noon is then at 12:07pm.

A good way to record the true southern direction at your site is to tie a weight, such as a pair of scissors, to the end of a 3 or 4 foot string and hold the other end so it hangs vertically during solar. The shadow of the string on the ground will show the true North/South axis. Lay a straight edged object, such as a piece of lumber, along the shadow to mark the true South direction, and leave it for the Participating Contractor to use as reference.

Sometimes compass readings can be off significantly due to local interference at the site – by identifying true South as described above, can help the contractor calibrate their compass for conducting an accurate solar audit.

How much system maintenance is required?

Preventive maintenance is the least costly of all maintenance! After more than 20 years of experience with PV systems, it is clear that the amount and type of maintenance performed directly affects performance and lifetime of a system. PV systems require much less maintenance than conventional backup power generators. Anyone considering a PV power system must answer two questions about maintenance: how to and how often? The technical procedures, the how to, are similar for systems large or small. The 'how often' is just as important and may have a bigger effect on your system's life cycle cost. Many PV systems are located in remote areas where frequent visits are impractical. Yet, experience shows a clear relation between too little maintenance and a short-lived system with too much downtime. Provide too much maintenance and your cost per kilowatt-hour may be doubled or tripled. These maintenance issues must be an integral part of the system design. Component selection should be based, in part, on the type and frequency of maintenance that will be performed.

But, generally the system owner should periodically check various indicators to be sure their PV system is operating as expected. These indicators should be identified and explained by the PV contractor. The SDF Solar PV Grant Program requires the installation of an kWh_{AC} production meter, which is one of the best indicator of all. Most likely, a PV system may not need servicing for several years at a time.

QUESTIONS ABOUT THE SDF SOLAR PV GRANT PROGRAM, INSTALLATION COSTS, FINANCING & OTHER INCENTIVES

What is the SDF Solar PV Grant Program?

PECO Energy customers can participate in a program to install a photovoltaic system for their home, business, government or educational facility. Photovoltaic (PV) panels convert sunlight into electricity. The electricity can then power the home or business, with any excess going to battery storage or back into PECO Energy's electric system. Although remote PV systems are eligible for this grant, grid-tied PV system are preferred. This multi-year program is overseen by the Sustainable Development Fund, which is a project of The Reinvestment Fund in Philadelphia. The program administrator is Ron Celentano, who will be assisted by Andrew Rudin. Complete information and updates about this program, including all associated forms and standards, are available on the SDF website above. For more detail, see the ***SDF Solar PV Grant Program - Program Description*** document.

How does the SDF PV Solar Grant Program work?

You first request a Customer Packet which includes,

- ***Program Description*** – Detailed description of the SDF Solar PV Grant Program
- ***Question & Answers*** – This document
- ***Participating Contractors*** – Includes the list of Participating Contractors which are qualified to apply for the SDF Solar PV Grant on your behalf, as well as suggested questions for you to ask the contractor during the interviewing process (***Tips on Choosing a PV Installer***)

How about getting grant payments?

The PV Grant will be paid for qualifying systems in three installments:

The first grant payment follows the installation inspection. The amount of this first payment is equal to $4 per watt dc (based on the nominal STC rating), up to a maximum payment of $20,000 – until further notice; then it will be revised to $3/watt, up to a maximum of $15,000. [See note on grant payment limitation]. This payment will be made directly to the Participating Contractor.

The second grant payment is a solar production subsidy. The amount of this second payment is equal to $1 per kWh generated by the system in its first 12 months of operation, up to the remaining balance of the total

incentive maximum of $25,000. [See note on grant payment limitation]. This payment will be made to the system owner.

A third grant payment will be made directly to the Participating Contractor at the completion of the first 12 months of operation. The amount of this installer payment is equal to $0.10 per kWh generated by the system in its first 12 months of operation, up to a maximum payment of $250 per system.

Note on grant payment limitation: The combination of the first and second grant payments (i.e., buydown and production subsidies) will be limited to 80% of the total installed cost of the PV system.

How much does a PV system cost and how does the grant help?

In general, a fully installed PV system can cost between $8/watt and $12/watt, excluding the SDF Solar PV Grant, depending on the size of the system and whether batteries are included (however, it can cost either below or above this range). The SDF Solar PV Grant may reduce the installed cost by 50% or more. The reference to "watts" regards to the nominal capacity (standard testing condition or STC) of the PV system . All PV modules have a nominal capacity rating, such as 75 watts, 120 watts, etc. Simply summing up the module wattages yields the nominal capacity of the PV system. The Participating Contractor will receive $4/watt for the buy down portion of the grant. The bid they provide you should show the full installed cost of the system, the buy down grant portion which they are receiving, and the balance of costs which is your cost to them.

For example the fully installed cost of a 2.0 kW (2,000 watts) PV system consisting of twenty 120 watt modules and battery backup could be estimated at $20,000. The installer would receive an incentive from SDF for $8,000 (2,000 watts x $4/watt), which should reduce your costs to $12,000. The installer should show all of these costs when they submit a bid to you.

The second part of the grant goes directly to you based on the first year's production of your PV system, based on $1/kWh$_{AC}$. It can be estimated that a 2 kW PV system can produce about 2,000 kWh per year, so that you would receive a production subsidy of $2,000 at the end of one year. Thus, the PV system installation cost has been reduced to $10,000 or 50% of the original cost.

Are co-funded PV projects eligible for a SDF Solar PV Grant?

The SDF Solar PV Grant Program will fund PV projects which are funded by other sources using its current incentive mechanism (i.e., $4/watt buydown and $1/kWh production); however, it will depend on how the other funding is structured. The total payment of a SDF Solar PV Grant will be limited relative to the total installed cost of the PV system based on $10/watt – each project will be reviewed individually and a final payment will be determined at the discretion of the PV Program Administrator.

Can I sell my PV power?

Yes. Currently, there is a by a local company running a pilot program which will purchase solar power from PV system owners; however, it is on a limited first come, first serve basis. See the PV pricing details from the Energy Cooperative of Pennsylvania toward the rear of this

packet. If you have questions about it, see their website at

www.theenergyco-op.com

or contact ECAP's coordinator, Nadia Adawi, at 215-413-2120 directly.

Are there any tax breaks or refunds available for installing a PV system?

If you operate a business or home/business, you can obtain a 10% tax credit on the system's original installed cost. You can also take advantage of a five year accelerated depreciation schedule, which will substantially reduce the costs further. For more information on this, see the Philadelphia Million Solar Roofs website at

www.phillysolar.org

under the *Resources for Consumers* webpage, then click on *Tax Relief* to learn more about commercial tax breaks for solar PV systems.

For example, assuming a total installation cost at $8/watt :

• Total Job Cost for 5,000-watt Solar Equipment Installation =	$40,000
• Less Solar PV Grant of $4 per Watt (less $20,000) =	($20,000)
• First Year 10% Federal Tax Credit for Solar Equipment (less $2,000) =	($ 2,000)
• First Year Generated kWh Grant for Estimated 5,000 kWh @ $1/kWh =	($ 5,000)
• 5-year Accelerated Depreciation (less total below) =	($6,459)
Net cost to commercial customer =	$6,541

How do I determine what size of system I need?

In the SDF Solar PV Grant Program, your first step is to contact a qualified installer (from the SDF Solar PV Grant Program list of Participating Contractors) to determine the size and type of PV system you need. Any size solar system will make in impact on your annual electric consumption. The bigger the system, the bigger the impact, but this specific grant program funds systems up to 5 kW, although it could be larger than that.

In almost all cases, grid-tied PV systems are not typically sized to meet all of the electric loads of the home. The PV capacity is limited by many factors, including roof area, shading from nearby buildings and trees, the tilt of the roof and its orientation in relation to the sun; but, most likely it is be limited by how much you are willing to pay. Nevertheless, typical sizes range between 2 kW and 3 kW.

Can I install the system by myself?

In this program, you need to use a currently listed Participating Contractor for the SDF Solar PV Grant Program. Check the SDF website for the current list of Participating Contractors at

www.trfund.com/sdf/solarpv/PV_Con_List.html

or contact the PV Program Administrator at 215-635-0900 or at **solarpv@trfund.com**.

However, if you meet the program's criteria for being a listed contractor, it is possible for you to install your own PV system. At a minimum, you need to take a PV installation training workshop from FSEC, SEI, NYSEIA, or Xantrex and pass the exam given after the training. Contact the PV Program Administrator for more information. on this.

What happens when I need to re-roof?

If the age of your roof is more than 10 years old, re-roofing should be considered. PV panels shade your roof, making it slightly cooler and less exposed to damaging ultraviolet radiation. In most situations where roofs must be replaced after a PV system has been installed, the PV panels can be easily removed and reinstalled. This is a common obstacle for roofers. If the roof is a tar and gravel design, it may be possible to simply tilt the panels up and re-tar and gravel.

What about permits?

Depending on the requirements of your township, either a building permit and/or an electrical permit may be needed; it is also possible no permits will be needed. In any case, PECO will require an electrical inspection after the system is installed. If a building permit is required, the township may also require a structural analysis or review of the roof by a licensed architect or professional engineer. Unfortunately, these requirements may drive up the costs by several hundred dollars. Nevertheless, your PV contractor will determine what are the township requirements and associated fees and should prepare all the documents to meet those criteria.