pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

SOLAR FOR SCHOOLS

2024

SOLAR FOR SCHOOLS TOOLKIT

A Guide to Help Pennsylania Schools Go Solar and Save

This booklet is a product of the Pennsylvania Department of Environmental Protection.

This guide is intended to provide accurate, objective information on all the new financial incentives and the aspects of the process all schools will need to follow in order to go solar and save.

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Introduction

PART 1

There has never been a better time to go solar, especially for schools. The cost of implementing solar has plummeted over the last decade and the technologies are more efficient and durable. Solar is now the lowest cost and fastest growing form of new electric generation in the U.S. and globally. The federal Inflation Reduction Act ("IRA") provides several additional incentives, making installing solar even more compelling.
So, let's get started.

This Toolkit provides the information and tools your school can use to successfully go solar and get the most out of a solar photovoltaic ("PV") system. Solar can save on operating costs for your school, providing financial savings to invest back into educational programming. Solar with storage can increase resilience and reliability during power outages. Solar also provides hands-on learning opportunities for students, teachers, staff, parents and visitors. For a high school or a technical school, solar provides an on-site laboratory for students to learn skills they can apply in the clean energy field.

The Toolkit is organized in 10 steps. The Toolkit works for schools and districts of all sizes. Some schools will be able to use it to successfully undertake the solar installation process by themselves, essentially a Do It Yourself ("DIY") experience. Others may need professional help, which is also readily available.

Pennsylvania has a number of highly qualified solar contracting companies that have extensive experience installing solar PV systems on schools and other commercial buildings. Costs have come way down in the last decade and the efficiency, durability and longevity of the panels, inverter, batteries and other components have improved, all making it easier to install solar than it might have been a few years ago. Nonetheless, there are still plenty of people who need more information and who will need to be convinced. So don't be discouraged if you run into a few barriers along the way. There is plenty of support available. This step-by-step approach is tried and true. The first steps can be taken in any order, whatever works best for your situation.

This Toolkit uses terms that may be new to people not familiar with solar and electricity. Useful glossaries developed by other entities can be found at:

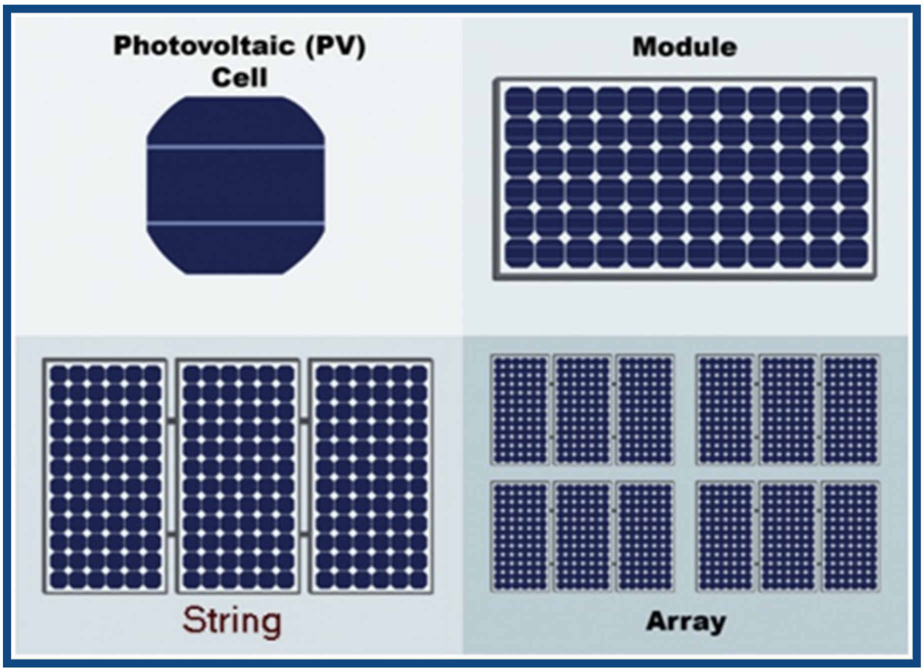
- Schneider Electric Solar School Glossary
- Sunrun Solar Terms

A Quick Overview of Solar System Basics

PART 2

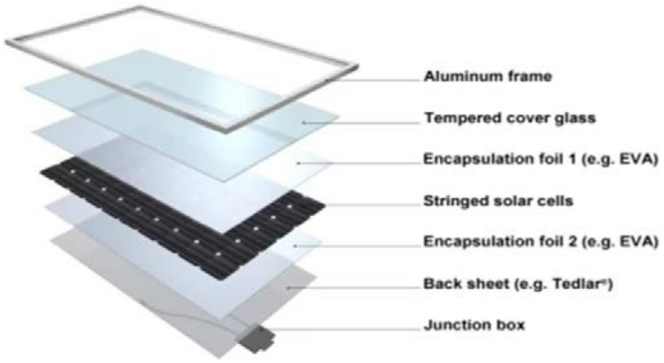
The major components of a solar photovoltaic ("PV") system are: the solar PV modules, the inverter and the racking system (the structural support for the solar PV modules). The balance of system ("BOS") or other components include disconnects (i.e., switches), wiring, conduit, fuses, circuit breakers and other devices that may be specific to certain system configurations. In addition, a solar PV system often includes a monitoring system to keep track of the solar generation produced. Batteries may be included for electricity storage, but that is optional, and requires other specific equipment in the solar PV system design, adding cost.

Solar PV Module - The typical solar PV module is basically a large crystalline silicon-based semiconductor, which collects solar irradiance and transfers solar energy to direct current ("DC") electricity, with rated efficiencies of 18% to over 22%. Silicon-based PV modules have declined in price by about 85% while doubling in efficiency, over the last 15 years. For typical commercial applications, the nameplate power rating and physical dimensions of a solar PV module range from about 320 watts DC to about 550 watts DC or more, and can be ~ 40" – 45" wide by 60" to more than 90" tall.



Credit: Florida Solar Energy Center w/modification

This figure shows a typical silicon based solar PV cell, many of which are wired in series and in parallel to comprise a solar PV module. Several modules are wired in series to make up a solar PV string, and many strings are configured together to make a PV array for a solar PV system.



Credit: Nickey Janse van Rensburg

Credit: BIMOBJECT

The picture on the left, above, shows the material layers that make up a typical silicon based framed PV module, which is also shown as a fully assembled product on the right.

Growing in popularity is the bi-facial solar PV module, consisting of solar cells on both the back and front of the module, enabling it to pick up additional diffuse or reflected solar radiation.

Credit: Engineering News-Record

This photo shows bifacial solar PV modules, consisting of glass on the front and back, with PV cells facing both directions between the glass layers, making the bifacial modules a little heavier.

Thin-film PV, another commercially available technology, consists of one or more layers of semiconductor compounds, such as cadmium-telluride (“CdTe”), copper indium gallium-diselenide (“CIGS”), or amorphous silicon (“a-Si”), which are applied onto glass, plastic or metal substrate material. Other types of thin-film PV include perovskites, organics, dye sensitized, gallium arsenide and copper zinc tin sulfide. Thin film PV is typically less efficient than crystalline silicon PV, but it is less expensive, lighter in weight, more heat and shade tolerant, as well as physically flexible to curved surfaces.

Inverter - Most solar PV systems include inverters, electronic devices that change direct current ("DC") from the solar PV modules to alternating current ("AC"), used by the grid. Most of the inverters for PV systems are interconnected to an electric service provided by the electric utility – these are called grid-tied solar PV systems. Some solar PV systems do not have inverters, or the inverters are not interconnected to the utility's electric distribution system – these are typically called off-grid solar PV systems, and they usually include battery storage. Grid-tied inverters come in various sizes, but for residential and commercial applications, there are string inverters typically ranging from 3 kilowatts ("kW") to 100 kW or more. There are also micro-inverters, which are mounted behind each solar PV module or pair of modules. Grid-tied inverter efficiencies range from about 95% to 99%, converting DC to AC electricity. Below are a few of the common commercial string inverters used for grid-tied applications.

Credit: PV Tech, RENVU Inc, Unbound Solar

Credit: Unbound Solar, altE Store, Zhejiang Benyi Electrical Company Ltd

From left to right, above, are: a micro inverter, a DC optimizer, and another device all of which mount behind solar PV modules. Each of these devices has a different function, but they are all considered rapid shutdown devices, which comply with current National Electric Code standards. When a grid-tied PV system is shut off or disconnected from the grid, or if the grid goes down (i.e., blackout) during the daytime, the solar PV strings would normally shift into a state of high voltage (or open circuit voltage), which could be dangerous if exposed wires or terminals were touched with bare hands. Under these circumstances, the rapid shutdown devices immediately reduce the string voltages to zero or to a safe low level.

Racking Systems – Solar PV modules are structurally supported by racking systems and hardware, either ground-mounted or roof-mounted. Ground mounted solar arrays can have either a fixed-tilt configuration or have single or dual axis tracking devices to follow the sun. Roof-mounted systems can be for pitched roofs or flat roofs. The most common commercial system is a ballasted system on a flat roof, where the solar PV modules are attached to a racking system that is weighted down with a ballast of concrete block or equivalent to avoid roof penetrations. This type of mounting system is most likely for schools and other commercial buildings. Structural analysis of the flat roof should be conducted to assure that 3 - 8 pounds per square foot of additional load can be placed on the roof for the ballasted solar PV array.

Credit: YSG Solar ballasted rooftop system

05

Balance-of-System ("BOS") - Generally this includes all other electrical components and devices for the solar PV system, other than the PV modules and the inverter, such as disconnects (i.e., switches), wiring, conduit, fuses and circuit breakers (i.e., overcurrent protection devices), transformers, and other devices that may be specific to certain system configurations.

Credit: BENY New Energy, Eaton, MrSolar.com, Eco-Worthy

The figure above shows some of the BOS equipment that may be used for solar PV systems, including circuit breakers, also known as overcurrent protection devices ("OCPD"), a disconnect switch, wiring and a fused PV string combiner box.

Batteries – Battery storage is not necessary for solar PV grid-tied systems, however, it is typically required for off-grid applications. It should be noted that a grid-tied solar PV system without battery storage will shut down if the utility grid shuts down (i.e., blackout), regardless of how much solar radiation is available. When a grid outage occurs, grid-tied inverters have a built-in safety feature that immediately shuts them down and prevents “solar-islanding” so that electricity does not flow back into the distribution lines, endangering utility workers.

Battery storage can be incorporated with grid-tied systems to provide resiliency, as back-up power for critical loads for a designated period of time, if the electric grid goes down. During normal grid operation, battery storage could also be used to help reduce demand charges for commercial applications, or for reducing grid energy usage during on-peak periods for residential or commercial applications under time-of-use rates. Energy storage technologies such as lithium-ion batteries are well-suited to provide ancillary services, such as for supporting frequency regulation on the grid (a less common application for commercial projects but is expected to grow in the future). In general, battery storage technologies add cost to a grid-tied solar PV system.

There are different types of battery storage topologies for commercial applications, including lead acid, lithium based, flow batteries, and others, all of which have several characteristics, such as storage density (kWh/lb), number of lifetime charging/discharging cycles, depth of discharge limits, round trip efficiencies, and other parameters.

- **Lead acid batteries** have been around the longest, by far, and they are the least expensive, but they rank very low with storage density, depth of discharge and number of lifetime cycles.

- Two common types of **lithium-based batteries** include lithium-ion and lithium ferrous phosphate (“LiFePO4” and “LFP”). In comparison, lithium-ion batteries have a higher storage density and are slightly less expensive, but LFP battery storage has a much lower risk of combustion and thermal runaway, as well as three times the number of lifetime cycles as lithium-ion.

- **Flow batteries** are becoming more popular, as they consist of water-based electrolyte liquids, which provide chemical energy for charging and discharging electrical storage. Flow batteries have a very low risk of thermal runaway, full depth of discharge and the longest lifetime, but on the downside, they have a low storage density, lower round trip efficiency, and are much more expensive than other battery types.

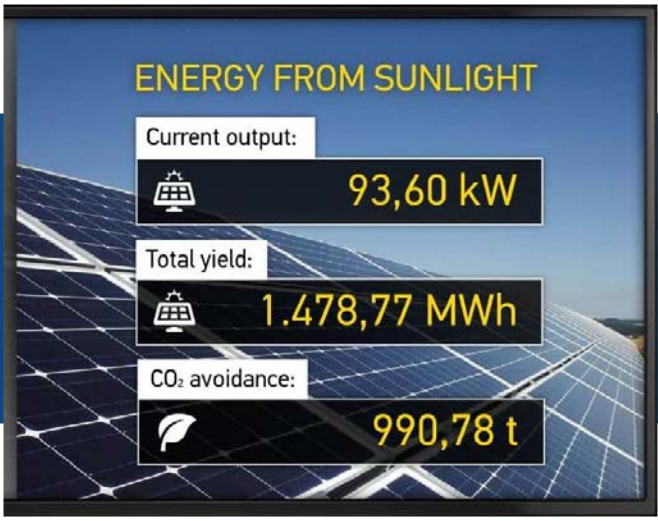
Batteries can be installed inside...

or outside...

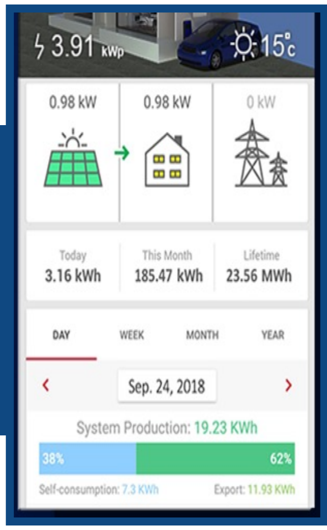
Schools in a growing number of states, especially those in areas prone to extreme weather and power outages, are beginning to plan for the utilization of their electric school buses as mobile batteries in emergency situations. Electric Vehicles in the Community: Benefits and Challenges provides additional detail. However, the most practical and reliable battery storage system for resiliency is from a stationary energy storage configuration.

Monitoring System – Most grid-tied systems have a monitoring system to keep track of the real time, instantaneous power being generated, as well as solar electric energy produced by day, month, and year. This data is used by most solar schools for maintenance and educational purposes as well as for budgeting. Many schools equipped with solar use this data in their STEM education curriculum, converting solar energy generated to monetary savings for the school, or carbon emissions avoided, trees planted, etc. Monitoring the system's performance is very important to the school to make sure that this investment is performing as designed. Additional information about monitoring systems is in Section 10.

Two examples of solar PV system monitoring displays are illustrated below:



Credit: Solar Data Systems, Inc



Credit: Solar Edge Technologies, In

Interconnection with the Local Distribution Grid

Interconnection of the solar PV system to the electric service might be on a spare set of circuit breakers in the main electric panel, which is termed a "load side connection". Or it may be a line-side connection, also known as a "supply side connection," which is on the feeders to the main electric panel(s). Usually the point of interconnection ("POI") is relatively close to the utility meter, where a utility isolation switch is required to be installed between the POI and the inverters and is accessible from outside the facility.

In PA, it is required that a utility interconnection application (which is in two parts) is prepared and submitted by the solar installer to the local utility, which includes specific details about the solar PV system design, spec information on inverters and other equipment proposed, wiring diagrams and site plans regarding the interconnection point location. Sometimes this process can take a considerable amount of time to clear the utility's assessment, as it may require an engineering review, scoping study, and other evaluations. After the utility's approval for the initial interconnection application (Part 1), the project can be built.

After the project passes an electrical inspection, the Certificate of Completion or Part 2 of the interconnection application is submitted (which consists of documenting the installed equipment, relative to the proposed equipment listed in Part 1). After the utility approves and authorizes the Certificate of Completion, the utility replaces the utility meter with one that is bi-directional, if needed, then the customer-generator has Permission to Operate ("PTO") the solar PV system. The interconnection process can take several weeks or longer, due to various issues, so it is best to start this process very early on.

Permitting

Depending on local rules, your solar system may need to be permitted by your local township or city. Common permits are for construction and for electrical. Securing necessary permits is the responsibility of the solar installer.

Resources

For more information of solar for commercial customers, interconnection, developers, and other related information, see below:

01 PA DEP Solar for Business

02 PA PUC, Bureau of Technical Utiility Services Energy Line
717-425-7584
ra-aeps@pa.gov

03 PA PUC webpage on solar and other renewable energy

04 PA PUC Directory of EDC Contacts for Interconnection

05 PA Solar Center's Qualified Solar Developer Directory

06 DCNR Conservation Considerations for Grid Scale Solar Systems in PA

PART III
Key Steps in a School Solar Project

This Toolkit outlines ten steps to make your solar project a reality. These steps do not assume that you are a solar expert, but it is important to be an educated consumer and the steps highlight different specific issues that you will need to investigate and consider. These steps are not entirely sequential. Preliminary sizing of a solar PV system in Step 3 is only preliminary and needs to be finalized in the contracting process (Step 8) once the selected installer has designed the system. Solar financing in Step 6 is not completed until you have a final contract and are ready to begin construction. But working on these steps in the order given will help you shape the project in a reasonable way. Just be flexible and prepared to revisit earlier steps when the final information becomes available.

1. Build a team
2. Assess school's energy use
3. Assess solar potential
4. Decide on ownership model
5. Determine $ benefits of going solar
6. Secure funding
7. Request for Proposal
8. Select installer and issue contract
9. Begin construction
10. Monitor performance and maintenance.

Step 1: Build a Team

The first step in the process of developing a solar project for your school is to gather a group of solar supporters at your school to help you with your solar project - a Green Team, if you will. This could include parents, teachers, students, administrators, and facilities staff. It will be important to bounce ideas off and make decisions with a small, interested group. Ideally, the Facilities Manager for your school can be on the team, because they have access to utility billing data and other key information you will need (such as the age of the roof) and can suggest practical locations where the solar PV array and BOS could be installed, etc.

Having students on the team will provide an invaluable learning experience for them as well as helping to push through any barriers that may arise. If possible, having someone from the School District, especially from the Finance Office, with knowledge about local finance tools and issues, will also be helpful. Your solar project may need to be approved by the School Board, so it would be helpful to include a School Board member interested in evaluating the potential benefits of installing a solar system. The team does not need to be large, but it will need to meet regularly to make steady progress.

Do you need help convincing the school or district leadership to go solar?

Generation 180 has developed a Solar Schools Campaign Toolkit that provides step-by-step guidance and resources to help you be a clean energy champion and win a committment to go solar from your school or district. You can find a school in Pennsylvania that has already gone solar in the Generation 180's report or in the Philadelphia Energy Authority's Solar Schools Report.

Consultants - At some point you may want to retain a solar expert, as they can provide a wide range of support and guidance through the project. This may include preparing a preliminary assessment of a solar design; assisting with drafting an RFP and the solicitation process for solar contractors or developers; review of proposals and help with the final selection of the winning contractor/developer; evaluation of the contractor's solar installation design; oversight of the installation itself to assure the system is being installed as designed; and finally conducting commissioning and carrying out performance tests.

Step 2: Access School's Energy Use

Before you can determine the size of your solar project, you will need to quantify your school's electricity use. Many schools are sizing their solar PV systems to offset 100% of their usage. An understanding of your electricity bills is needed to estimate the dollar savings from your solar PV system. What is needed though, is not simply a record of the dollars billed, but also an understanding of a number of other metrics that describe your electricity usage, including energy and power.

Energy vs. Power (aka Demand)

It is important to understand the difference between "energy" and "power" in order to better understand your electricity usage, and how a solar PV system can help reduce the charges in the electric bill. The metrics typically used for energy and power (or demand) in an electric bill are kilowatt-hours ("kWh") and kilowatts ("kW"), respectively.

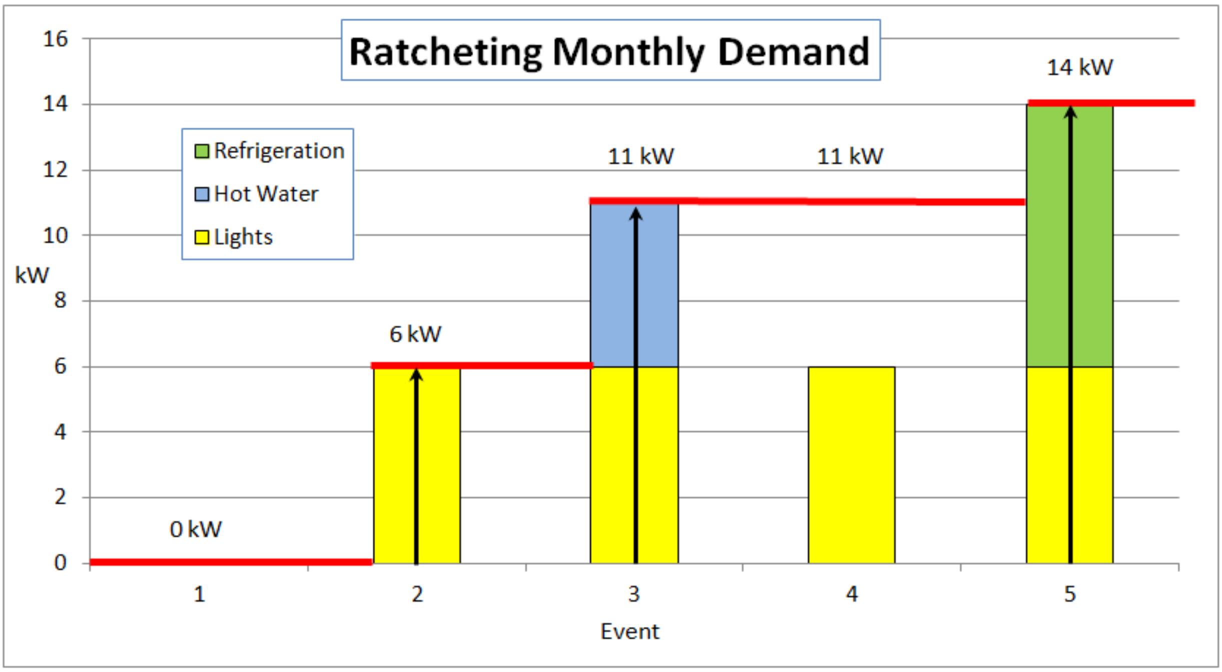
$$\text{Energy (kWh)} = \text{Power (kW)} \times \text{Time (hours)}$$

For illustration, this is analogous to driving a car – the odometer represents the energy meter, and the speedometer represents the power (or demand) meter. Driving at 10 miles an hour for 10 hours, the odometer would indicate that 100 miles was traveled, which is the same distance traveled when driving at 50 miles an hour for 2 hours.

The residential electric charges most people are familiar with are based on energy consumed - kWh - multiplied by a volumetric rate (cents/kWh) over a monthly period. Commercial electric charges (the tariff category applicable to schools) are also based on energy consumed and volumetric rates, but they include an additional component based on the highest power draw, also known as the peak demand over the monthly period, multiplied by the demand charge, in dollars/kW.

Peak demand is measured as the largest bucket of energy consumed over a 15 or 30 minute interval (depending on the utility). For example, at the beginning of the month, a hair dryer is turned on, drawing 1 kW of power, and it is left on for 15 minutes, thus it consumes 0.25 kWh over that time period. The utility multiplies that value by 4 equaling 1 kW for that period. No matter how many times the hair dryer is turned on (or not turned on at all) over the rest of that hour or even over the course of the month, the demand charge will be based on 1 kW. But, if the microwave turns on drawing 1.5 kW at the same time as when the hair dryer was on, then the demand ratchets up to 2.5 kW, and the demand charge will be based on that higher value.

To apply this example to a school, the following figure graphically illustrates the ratcheting of the demand as electrical events occur. At the beginning of the billing period the demand value starts at zero; then the first peak demand might occur when all the internal lights are turned on, equaling 6 kW; then an electric water heater kicks on, adding another 5 kW demand, increasing the demand to 11 kW. Then the water heater element shuts off and the kitchen's refrigeration system turns on, drawing 8 kW of power. This would increase the peak demand to 14 kW (= 6 kW + 8 kW). At the beginning of every billing period, the demand value is reset to zero, and it begins to rise through the next billing period.



Credit: Celentano Energy Services

Benchmarking Current Energy Usage

Some schools pay little attention to their electricity bill other than once a month when it must be paid, but the electricity bill contains important information that you should understand and note early in your solar project work.

The best way to do this is to benchmark your school's energy use. Ask your Facility Manager if your school has already done this. If so, ask for a copy of the most recent report and invite him/her to explain the benchmarking analysis to the Green Team at an upcoming meeting.

Benchmarking is very important because it may provide opportunities to control and/or upgrade equipment, resulting in reduced electricity usage. This, in turn, may result in reducing the size of the solar PV system capacity for the school or at least improve the overall cost effectiveness by implementing energy efficiency measures and solar PV together.

It is relatively easy and inexpensive to benchmark your school's energy use. Benchmarking has a variety of benefits, including easy access to regular reports on the amount and cost of energy consumed in the district. Benchmarking also provides the ability to compare a school's energy performance against other schools with similar building characteristics. Administered by the U.S. Environmental Protection Agency ("EPA") the ENERGY STAR's Portfolio Manager is a useful free, online energy management tool. Most utilities can automatically upload your cost and consumption data (in kWh) to Portfolio Manager once the account is established. Click here to see if your utility provides energy data for benchmarking in Portfolio Manager.

Components of a Commercial Electric Bill

The four major billing components of a commercial electric bill are:

1. customer charge (typically a flat monthly fee from $5 to $50 or more)
2. distribution charges
3. supply charges
4. demand charges (often part of the distribution charge)

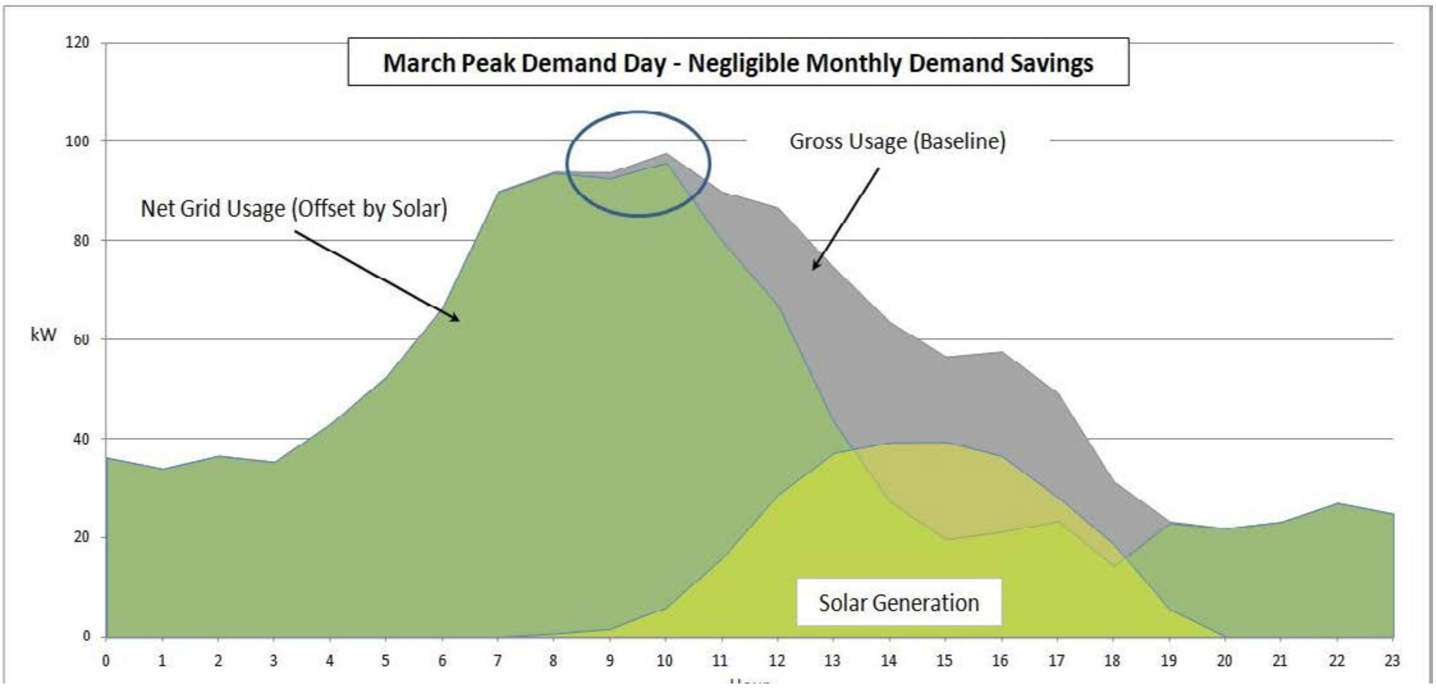
Distribution Charge: The distribution charge is associated with the use of local wires, transformers, substations, and other equipment used to deliver electricity to end-use consumers from the high voltage transmission lines. The distribution charges include the cost of consumed electricity in kWh multiplied by the distribution volumetric rate ($/kWh) and a demand charge based on the monthly peak demand in kW multiplied by the distribution demand rate ($/kW). Often the distribution volumetric rate is very small, and sometimes it is actually a negative rate. These are both local utility charges.

Supply Charge: The supply charge is for the energy being supplied to the customer. The supply charge includes the cost of consumed electricity in kWh multiplied by the generation rate ($/kWh), in addition to the transmission charge, which could be based on either the consumed electricity in kWh multiplied by the transmission rate ($/kWh), or the monthly peak demand in kW multiplied by the transmission demand rate ($/kW), or both.

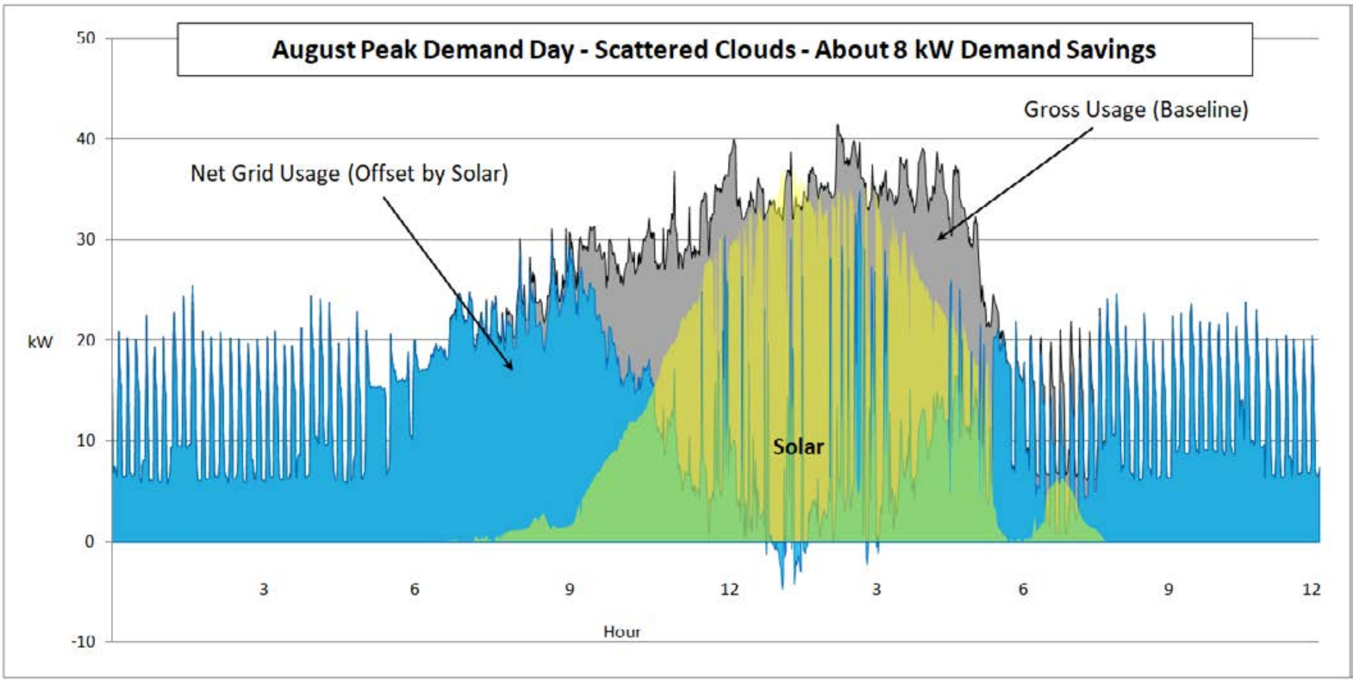
Demand Charge: Be sure to examine and consider all costs, including the demand charges. A demand charge is a fee based on the highest amount of power used during a specific time interval, e.g., in PECO's territory it's the highest 30 minutes during the billing month. In Pennsylvania, demand charges are applied to commercial and industrial customers, including schools. Each month's bill will show the peak demand for that month in kilowatts, or "kW." **The cost from these demand charges can make up 10%-50%, or more of the total electricity bill.** How much a solar PV system reduces the demand charges depends on how well the system's generation synchronizes with the account's peak demand. If the school's peak demand occurs during a hot afternoon when the air-conditioning is on and solar is most productive, the peak production and peak demand are coincident, and you may see demand savings that particular day. But if the school's peak demand occurs at a time when the solar PV system is not generating much power, such as during a cloudy period (which will occur many times during the month) or early morning or late afternoon, the peak demand savings will be much less, if any at all for a given month.

Demand Profile - When does your school typically experience its peak demand? This may be helpful for evaluating the financial value of your solar PV system's output.

The figures below show two graphs of the total baseline usage, solar generation, and the net usage profile (total baseline minus solar) on a March peak demand day of the month for a medium sized commercial building. The heating/ventilation/air conditioning ("HVAC") system is an air source heat pump, and as illustrated below, the peak demand occurs early to mid-morning, mostly outside of the solar window in this particular case. As a result, the solar PV system hardly reduces the building's monthly peak demand.



The following figure shows the building's maximum peak demand day in August, along with the solar generation and net usage load profile. This graph demonstrates that the peak demand savings of ~ 8 kW from the solar PV system isn't as large as might be expected. This is because intermittent cloud cover reduced the solar generation for short periods of time, resulting in the building's demand reduction being very modest.



Another challenge in predicting demand savings is that the impact of solar generation on the building's monthly peak demand day will often shifts to a different day of the month. The bottom line - there is far too much uncertainty to use simple rules of thumb or assume an expected percentage of demand savings can result from a solar PV system when assessing the cost effectiveness of a given project. However, it is possible to estimate monthly peak demand savings when analyzing detailed hourly or 15-minute demand profiles and simulated solar generation load profiles.

Your electric utility will be able to provide your school's demand profile and other billing information; however, the demand profile or annual 15-minute interval load shape data may be a massive data set, and it would best be evaluated by someone with the appropriate experience and expertise in evaluating this kind of data.

Electricity Generation Suppliers: Pennsylvania restructured its electricity industry in the late 1990's, permitting customers to shop and contract with third party Electricity Generation Suppliers ("EGSs") to supply their electricity. If a school is receiving electricity from an EGS, it will be noted on the electric utility bill. If your school is purchasing from an EGS, it is important to check with your EGS to learn if they will reimburse the school for any electricity exported to the grid (typically EGSs do not offer net metering to their customers). Also check the supplier's contract to see if there is a minimum purchase of monthly electricity in kWh from the EGS.

If the solar PV system is large enough to generate a monthly surplus of electricity or if it will generate too much monthly electricity, thus violating the minimum energy purchase clause in the contract, then it is strongly recommended that the school purchase its electric supply from the utility, instead of an EGS.

Example of an Electric Bill

The following shows an example of a simple electric bill for a small commercial building located in the PECO service territory. It has been marked-up to illustrate key billing values that would be used for evaluating electric usage and for sizing a solar PV system.

Electric Commercial Service 0-100kW

Service Period 07/18/2022 to 08/16/2022 - 29 days

PECO ELECTRIC DELIVERY		B	$510.56
Customer Charge		C	77.00
Distribution Charges	46.10 kW X 9.19000	D	423.66
Distribution Charges	6,920 kWh X -0.00060		-4.15
Energy Efficiency Charge	6,920 kWh X 0.00203		14.05
ELECTRIC SUPPLY		E	$566.88
Generation Charges	6,920 kWh X 0.07026	F	486.20
Transmission Charges	46.10 kW X 1.75000	G	80.68
TAXES & FEES			-$0.05
State Tax Adjustment			-0.05
Total Current Charges		A	$1,077.39

Period	Usage	Avg Daily Usage	Days	Avg Daily Temp
Current Month	6,920	238.6	29	83
Last Month	4,280	133.8	32	77
Last Year	6,040	194.8	31	78

Avg kWh per Month 2,800
Total Annual kWh Usage 33,600 H

A – Shows the total electric bill cost of $1,077.39 for this particular month.

B – Shows the total distribution or delivery charges of $510.56 from the electric utility, which include the following two key components:

C – Shows a Customer Charge of $77.00, which is a fixed monthly fee, as part of the distribution charge - this fee will not be offset by the generation of a solar PV system.

D – Shows the demand charge of $423.66, which is based on the peak demand of 46.10 kW times the distribution demand rate of $9.19/kW; for most months, it is unlikely that this demand charge will be offset significantly by the solar generation.

Note: The remaining distribution charges are insignificant and will not likely be offset by the generation of a solar PV system.

E – Shows the total electric supply charges of $566.88 from the electric utility, as the default supplier, which include the following two key components:

F – Shows the volumetric generation charge of $486.20, which is based on the total volumetric energy usage of 6,920 kWh times the retail supply rate of $0.07026/kWh; this cost can be fully offset by the generation of a solar PV system depending on the system size and how much is generating during the given month.

G – Shows the transmission demand charge of $80.68, which is based on the peak demand of 46.10 kW times the transmission demand rate of $1.75/kW; for most months, it is very unlikely that this demand charge will be offset very much by the generation of a solar PV system.

Note: Of the entire electric bill, only $486.88 (~ 45%) of the electric bill can conservatively be offset by the generation of a solar PV system for this month. It's possible that some demand charges could also be saved, but an assessment of the building's load profile and impacts from simulated solar generation would have to be conducted to estimate the savings.

H – Finally, this shows the estimated annual electric usage of 33,600 kWh/yr for this building.

The next section, Step 3: Assess your School's Potential for Solar Energy Generation, shows a simple equation that can be used to roughly estimate the capacity of a solar PV system based on the annual usage, assuming the solar PV arrays would be installed on a flat roof. This equation is the solar PV system capacity (kW_{DC}) = Annual Electric Usage ÷ 1,220, or in this example the solar PV system capacity would be about 27.5 kW_{DC} (= 33,600 ÷ 1,220). The next step would be to determine if there is enough qualified roof area to fit this capacity.

Step 3:
Assess Your School's Potential for Solar Energy Generation

The design of your solar PV system is the responsibility of the solar installer/developer you select. However, to be a smart solar consumer, an assessment of your school's solar potential is recommended before you issue an RFP and select a solar installer.

Solar System Location

To get the most out of your solar PV system, you need to determine the optimal location for solar. Ask questions like:

- Are other buildings or trees shading your roofs?
- Which roofs have the best southern or western exposure?
- Are those roofs in good condition or do they need repair? When are they due for replacement?
- Would a ground-mounted system be best, even though ground-mounted systems are usually more expensive?
- Is the parking lot suitable for a solar carport?
- Is the proposed location near the electric meter, an electric room or main panel?
- Does the school need EV charging stations?
- Should the school consider including storage, e.g., batteries?

From the answers to these questions, the cost of the PV system, its generation potential and savings can be roughly estimated for all buildings and open spaces (e.g., parking lots, fields, etc.) to find the best location for your solar project.

There are free online tools that can help you estimate your solar potential and projected potential cost savings, such as:

- National Renewable Energy Laboratory's ("NREL") PVWatts Calculator
- NREL's System Advisor Model (SAM)
- NREL's REopt
- Google's Project Sunroof

Wherever you decide to install a solar PV system, you will need to work with the selected solar installer (Step 8) to finalize the layout and design of your system. Solar contractors will request at least 1 month of an electric bill, but more likely 12 months of bills, and they may use one of several solar generation simulation tools such as PVWATTS, HelioScope, PVsyst, SAM, Aurora, Homer or others to help with solar auditing. They will carefully assess solar access and also determine where the inverter(s) should be located and how the system interconnects with the building's electric service.

Solar Parking Canopy at Freedom High School, BASD

A Useful Rule of Thumb

One thousand watts of solar moduled - 1 kW_{DC} - installed on a flat roof in Pennsylvania will generate about 1,2000 kWh of electricity annually. For example, if your school consumes 951,000 kWh of electricity per year, it will need about $780kW_{DC}$ of solar modules to satisfy 100% of its annual electricity consumption.

$$951{,}000 \div 1{,}220 = 779.5kW_{DC}$$

The following table shows the average solar generation estimates across seven major cities in Pennsylvania, based on PVWATTS simulations. Replacing the 1,220 figure in the equation above with the figure from the table below for your location will increase the accuracy of your system size estimate.

Annual Solar Generation by City ($kWh/kW_{DC}/Year$)	
City	**Average**
Erie	1,182
Harrisburg	1,269
Lancaster	1,288
Philadelphia	1,302
Pittsburgh	1,175
Wilkes-Barre	1,172
Williamsport	1,184
PA Average	**1,220**

The following images show solar PV array layouts on 2 different school rooftops:

Henry A. Brown Elementary School
Philadelphia School District

Franklin Elementary School
North Allegheny School District

Step 4: Decide on Your Own Ownership Model

How the solar project is implemented depends on the ownership model the school selects. There are 2 major options: Direct Ownership in which a school owns the solar PV system itself, or Third-Party Ownership in which a third party will initially own the project and provide the solar generated electricity to the school under a Power Purchase Agreement or a Lease Agreement. Each of these models are addressed below.

Direct Ownership - With Direct Ownership, the school owns the system outright from the beginning of the project. With this option, the school selects and contracts with a solar installer to engineer the solar project, procure the necessary hardware and construct the system, hence the name “EPC” or Engineering, Procurement and Construction contract.

In addition to selecting a solar installer, the Direct Ownership option requires the school to obtain the funding it needs to pay for the system (see Step 6). Because of legal caps on school district financial borrowing capacity, public school financing has constraints that do not exist for other sectors. Include your school district CFO on your project team and talk to them early and often about your district’s financing priorities. The school is responsible for seeking any incentives or grants for the system (especially the Elective Payment under the new IRS Investment Tax Credit - see (Step 7) - and any necessary bridge financing until the credits and rebates are fully paid. The school will immediately see electricity bill reductions because the solar generation offsets the school’s electricity usage.

Maintenance - In addition to the need to obtain financing, schools may be concerned about on-going system maintenance. This concern is real but is not as significant as some may think. PV systems have no moving parts and there is usually very little on-going maintenance. PV modules come with a 20-to-25-year warranty, and the inverter generally comes with at least a 10-year warranty. You’ll need to replace the inverter at some point in the life of the system. The other system components typically last as long as the PV modules. The ballast material, such as concrete block, may need replacing during the PV system’s lifetime, depending on the quality of the concrete and how it is treated (i.e., freezing/thawing may break down the ballast material).

If a school chooses the direct ownership option, it is strongly recommended that it enter into a long-term Operations and Maintenance Agreement with the solar installer, to provide the necessary maintenance. Much of that maintenance involves inspecting the different components of the system to ensure they have not been damaged or disconnected. On-site visual inspections are encouraged once or twice a year. In addition, an assessment and clean-up of any accumulation of leaves, sticks, organic debris, moss, etc. located under or between the ballasted solar PV rows on a flat roof installation, which could obstruct water drainage off the roof, should be conducted.

The O&M contractor will review data generated by the monitoring system to learn of any inconsistencies in generation or any equipment error codes that might arise. The school's Facility Manager or other staff should also periodically review the generation data, as well, in addition to including student participation as an educational exercise.

Solar Operations and Maintenance Contracts

Items to Include in an O&M Agreement:

- Qualifications and ceritifcations of Contractor's staff
- Proof of Contractor liability insurance - at agreed-to levels - shared annually with the school
- Priority for student safety
- Provided serviced: in-person inspections, module cleaning, debris removal, etc.
- Sinking fund for future inverter replacement
- Contractor's response time in event of system failure or anomalies
- Communication with electric utility when appropriate

Things to watch out for in an O&M Agreement:

- Unreasonable caps on Contractor liability
- Excessive prince escalation rates
- Unreasonable expectations on school staff
- Slow generated response times

Third Party Ownership - **Power Purchase Agreement** - Under a Power Purchase Agreement ("PPA"), the system is owned by a third party, usually the solar developer and the school purchases the solar power from the third party owner at a negotiated rate, usually on a kWh basis. The solar developer is responsible for securing the necessary financing, permits and interconnection approval. They also receive any tax credits and other available incentives. The developer is also responsible for ongoing system operation and maintenance.

A PPA is a specialized form of lease under which the school pays a contracted amount per kWh the system delivers. This rate may be fixed for the life of the term of the agreement, or it may escalate over time. The PPA agreement is attractive because the school pays only for the electricity the solar project generates, so the PPA developer bears the performance risk.

Securing solar electricity through a PPA is considered securing a resource like printer paper and is legally and contractually different from a construction project, which has its own procurement statutes, regulations and practices.

The PPA agreement is structured to terminate in one of two ways. Some agreements are structured so that the developer fully recovers the cost of its investment (and a return) over the life of the PPA agreement, so at the conclusion of the PPA, the property is transferred to the school at zero cost. These agreements usually have a term of 20 years. Other PPA agreements have shorter terms and some buy-out is required from the school at the conclusion of the agreement. In these agreements, typically savings are guaranteed from the first year, but once the school owns the system, the savings increase dramatically.

The PPA agreement must have at least a five-year term under IRS rules for the developer to be eligible for the Investment Tax Credit benefit. Different schools may wish a different PPA term, depending on your capacity to pay off the system early and your appetite for receiving the full electricity cost savings generated by the project sooner rather than later.

The two most important financial issues in a PPA are (a) the starting price of the solar generation per kWh; and (b) the escalation rate of the PPA price per kWh over the term of the agreement. Make certain that the basis of the Year One PPA price is not based on a default electricity price that is calculated by dividing the school's total electric bill by its energy usage, since this gives an inaccurately high estimate of electricity costs. For example, based on the example of an Electric Bill, it would be expected that the PPA price would be less than the generation rate of $0.07026/kWh shown in the example bill. However, dividing the total electric bill of $1,077.39 by the total energy usage of 6,920 kWh would yield an inaccurate and overstated default electricity rate of $0.1557/kWh, which in turn could result in an excessively high PPA price.

Finally, no matter how the school structures the PPA terms, make certain the PPA includes a clause that guarantees savings every year for the school. Unfortunately, there are schools who have executed PPAs where the combination of no savings guarantee and an unreasonably high escalation rate in the PPA's price per kWh has resulted in no savings for the schools.

Until now, PPAs were very common for solar projects at schools and other nonprofit entities because the Federal Investment Tax Credit ("ITC") benefits could be realized only by entities that pay federal income tax, but the Inflation Reduction Act expanded the solar ITC incentives by allowing nonprofits including schools to receive an "Elective Payment" (formerly called a "Direct Payment") in lieu of a federal income tax credit (see the ITC information in Step 6.

Steelton-Highspire School District, 1.6 MW

The IRA did not expand the second major federal solar tax incentive - Bonus Depreciation - to nonprofits like schools. Under the IRS rules for Bonus Depreciation, a taxpayer can depreciate 80% of the solar project costs in the first year of operation for projects coming on-line in 2023, with declining percentages in future years.

It will be interesting to see how many schools migrate in the future to the Direct Ownership model, willing to take on project risk in exchange for 100% of the project's benefits. PPAs meet the needs of schools that prefer to have a third-party developer handle and be responsible for the financing, construction, and project operation and maintenance. We anticipate that PPA terms may change in response to the IRA's elective payment provision that expands the ITC to tax-exempt entities such as schools. Will the superior capital access of large PPA providers, coupled with bonus depreciation, allow PPA providers to sharpen their pencils and remain a viable business model? Will the solar industry and the project finance industry develop the products and services to make purchasing a megawatt of solar PV less complicated than purchasing a new HVAC system? It will be fascinating to observe the coming market changes.

A table in Step 8 lists the key elements of a PPA agreement and some issues schools should pay particular attention to when negotiating these agreements.

Lease Agreements - The solar lease agreement is another form of third-party ownership. These are very similar to PPA agreements except the lease payments are based on some value other than a contract rate per kWh generated. Instead, the lease may be set at a fixed monthly payment amount. Often this amount is determined based on the estimated annual solar generation, with a generation price similar to a solar PPA, then divided by 12 resulting in a fixed monthly payment. There may be a truing-up at the end of a 12-month period, with actual vs. originally estimated annual solar generation, and excess generation is banked for crediting against other years of lower-than-expected generation.

These lease agreements have the same benefits and shortcomings as a PPA agreement, except the school generally carries more of the performance risk. The system is owned by a third party and simply leased by the school. A table in Step 8 lists the key elements of lease agreements and some issues schools should pay particular attention to when negotiating these agreements.

Step 5:
Evaluate the Financial Benefits of Solar

One of the most important reasons to install solar is the financial savings that will be realized with the solar PV system. This step identifies the different revenue streams that should be assessed to answer the question, "What will the system save?"

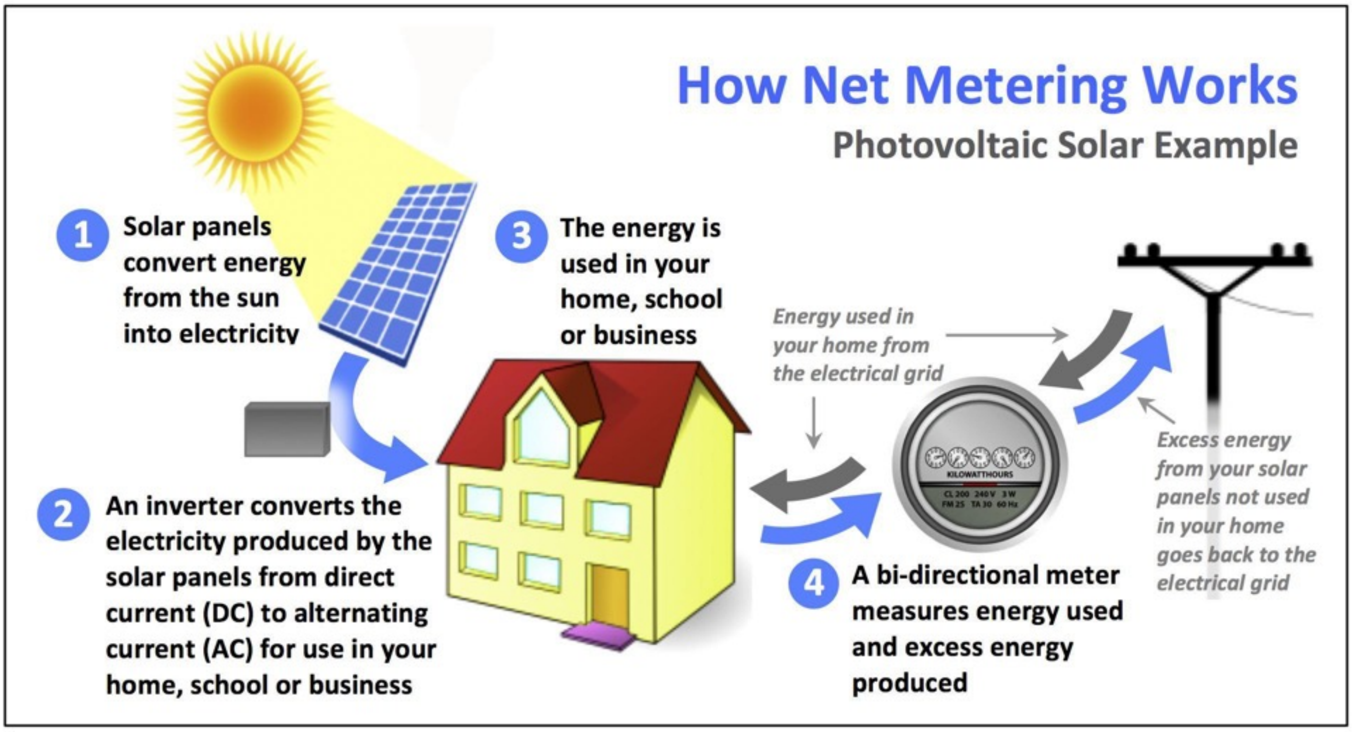
As with Step 3 (Assess your School's Potential for Solar Energy Generation), it is worthwhile to understand the elements that determine the financial value of your solar project. Of course, the project's true financial value cannot be calculated until the project's actual size and cost are finalized in the project contracts and agreements, but an initial assessment of these issues is important in order to prepare the school for the negotiations with the parties.

Cost of the Do-Nothing Strategy - The cost and financial value of any solar project should be compared with the cost of purchasing electricity from your electric distribution company ("EDC") and, if your school is shopping for electricity, from an electricity generation supplier ("EGS"). If you do not install solar, your school will still be paying for electricity and those costs should be included in your assessment.

Net Metering – This is a billing mechanism that credits solar PV system owners for the electricity they export to the grid. Pennsylvania's Alternative Energy Portfolio Standard Act requires Pennsylvania electric distribution companies or utilities to offer net metering to customer-generators including owners of non-residential solar PV systems with the total nameplate inverter capacity no greater than 3 MWAC (or no greater than 5 MWAC if additional conditions are met), per account. **EGSs are not required to offer net metering billing benefits.**

Under Pennsylvania's net metering regulations, a solar customer-generator receives full retail value in the form of a bill credit for all the electricity that is generated by the solar PV system throughout the year, and any annual surplus of generation is compensated at the "price to compare" value (i.e., including only generation and transmission, not distribution).

The net metering billing mechanism credits the customer-generator full retail value for the solar generation that offsets only the electric kWh usage. When estimating the bill savings from a proposed solar PV system, only the energy part of the bill should be considered in a simple analysis. A reduction in demand charges should not be included as they are very difficult to predict, unless a detailed assessment of the building's load profile data and simulated solar generation data is conducted.



Steelton-Highspire School District, 1.6 MW

Virtual Meter Aggregation - In addition to single-meter net metering, Pennsylvania electricity customers that have more than one account have the option of virtual meter aggregation, which allows generation and load at multiple physical meters to be aggregated. Schools may have multiple electric accounts in a single facility, or may have several different schools in close proximity to each other. Virtual meter aggregation is permitted in Pennsylvania provided that:

1. The accounts are with the same utility;
2. The accounts are under the same customer name; and,
3. The electric meters are within a 2-mile radius of each other.

For example, a large solar PV system could be installed on the roof of a building that has very little electric usage, and the surplus solar energy generation could offset part of the electric bill of another building or buildings, using the virtual meter aggregation billing mechanism, provided the three conditions described above are met.

Time-of-Use Rates - In the typical commercial customer tariff, there is a flat energy generation rate for commercial customers, in cents per kilowatt-hour ("kWh"), 24 hours a day, 7 days a week. Some commercial customers in some Electric Distribution Companies ("EDCs") may have the option of a Time-of-Use rate ("TOU"), which divides the day into on-peak and off-peak time periods, based on the level of electricity use across the grid.

Several utilities in Pennsylvania now offer TOU rates to encourage customers to shift their usage to off-peak times. TOU rates make sense for customers that are able to shift much of their electric consumption to off-peak times, but **schools are usually not good candidates for TOU rates** since most of their electric usage will be during peak hours.

Commercial Bill Savings from Solar Generation

As described above, net metering is the mechanism that provides the bill savings from on-site or virtual solar generation. But net metering is only designed to save on the volumetric energy or kWh part of the electric bill. A residential electric bill is entirely based on the kWh consumed over the billing period, except for the customer charge and some small line-item charges. Consequently, the residential customer with solar PV saves the most on their electric bill from the solar generation, as it offsets distribution and transmission kWh as well as generation. For example, as of February 2023, PECO's residential bundled rate (distribution, transmission and generation) is $0.17562/kWh. Assuming 1,000 kWh of solar generation is produced in a given month, this bill would effectively be reduced by $175.62.

However, as described above (see Components of a Commercial Electric Bill), the commercial billing charges are calculated based on both energy consumed (kWh) and peak demand (kW). The net metering mechanism can only help save the billing charges on the volumetric or energy part of the bill. For example, under PECO's General Service rate for small commercial accounts, the supply charges include the default generation rate of $0.08881/kWh, and a $1.82/kW for the transmission demand charge; and the distribution charges primarily include a distribution demand charge of $9.01/kW. Because of how peak demand is measured, generally the solar generation will not reduce the peak demand by much for most months, so the same 1,000 kWh of solar generation would reduce the commercial customer's bill by $88.81. Whereas, the demand charges, which may have represented 10% to 50% or more of the total bill, would be about the same, with or without solar generation, assuming a simple economic assessment is conducted.

The reason why solar generation usually has minimal impact on reducing the peak demand of the building electric load is because the peak could occur during hours outside of the solar generation period, such as 4:00 p.m. to 10:00 a.m. But, more so, it just takes one very overcast day during the billing period when the solar PV system's output is much reduced, when the building demand will ratchet a high peak value. Even when a solar PV system is exporting two or three times the kW of power as compared to the typical building demand at the same time, thus significantly offsetting the building's peak demand, one very overcast day can shrink that demand savings to almost zero. Therefore, the conservative approach is to only consider the energy savings part of a commercial bill from expected solar generation.

Other Considerations

- Your electricity supplier should be the default supplier (i.e., PECO, PPL, MetEd, etc.)
- Or if staying with an EGS, note the term of the contract and more importantly the minimum monthly energy requirement, and make sure the proposed solar generation does not drop the energy usage below that minimum.
- If the school - rather than the electric utility - owns its distribution transformer (the electrical equipment that reduces the voltage of the power coming off the distribution line to the 208 or 480 volts that is used by the school), it is very likely that the school will have a very low supply rate from an EGS, or they may have real-time pricing for their energy supply. In either case, it may be challenging for solar to compete against very low energy rates, which could be $0.05/kWh or less.

SRECS - Solar Renewable Energy Credits ("SRECs") under Pennsylvania's Alternative Energy Portfolio Standards Act ("AEPS") provides another source of revenue to offset the cost of a solar PV system installation. One SREC equals one megawatt hour ("MWh") - or 1,000 kWh - of solar generation. When a solar PV system generates electricity, it produces both the electrons that offset the customer-generator's electric bill, and it also generates environmental attributes that are a commodity valued at offsetting emissions that would otherwise be produced from a conventional power plant for the same energy generation. The generated SRECs are sold to Pennsylvania EDCs and EGSs - the companies that sell electricity to customers and that are required under AEPS to purchase a specific amount of SRECs per year based on the AEPS percentage and the annual electricity sales. In addition to these regulated markets, some SRECs are sold in the voluntary market to entities which want to reduce their carbon footprint.

Usually, SRECs are sold into the compliance marketplace for added revenue, in addition to the net metering bill savings, in order to maximize the economic benefits of a solar investment. As of June, 2023, Pennsylvania SRECs were selling for about $46/SREC (or $46/MWh of gross solar generation). For example, a 100 kWDC solar PV system may generate about 122,000 kWh a year or 122 MWh/year, or 122 SRECs/year, yielding about $5,612 of revenue at current SREC prices. SRECs can be sold on the spot market, or under long-term contracts. Most solar installers can assist in registering your system with an SREC broker so you can sell your SRECs and realize this additional project revenue.

One important caveat about SRECs is that if a school is selling the SRECs, it can no longer claim its solar production in meeting greenhouse gas reduction goals since the clean energy attributes of the solar belong to the SREC holder. A school that wishes official credit for its solar generation must retire the SRECs, not sell them to another.

SREC Links:

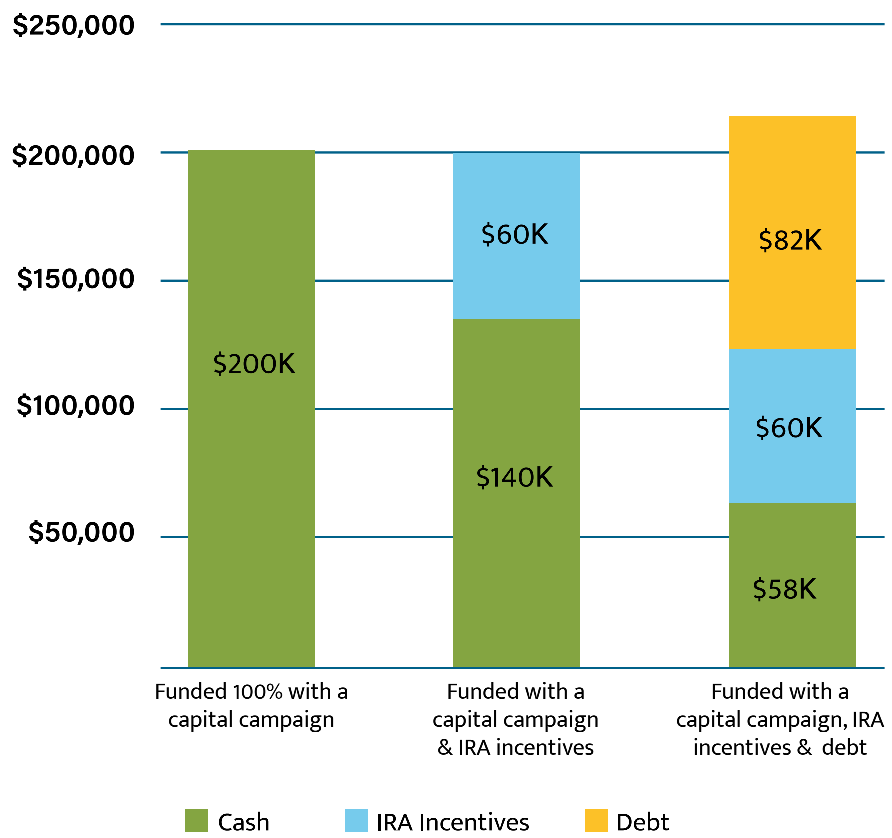
- PA Public Utility Commission AEPS web page
- SREC Trade Pennsylvania page **(tracks market prices)**
- **U.S. Federal Trade Commission,** Guides for the Use of Environmental Marketing Claims

Step 6:
Secure the Financing for Your Solar Project

If your school has decided in Step 4 to enter into a PPA or a lease agreement for its solar project, system finance is the responsibility of the solar developer. You may skip to Step 7.

But if your school has decided to directly own its solar PV system, determining how to pay for the system is on you. This Step will review the 5 major financing tools available for obtaining the capital needed to pay for the system: cash, the federal Investment Tax Credit elective payments, grants, public finance and private finance.

Steps 1–5 above have laid the groundwork for determining the school's ideal PV site and size, the project's estimated costs, and estimated savings. Identifying financing options helps the school district determine how a project will benefit the district financially. This is often the actual tipping point for stakeholders, who will decide to proceed—or not—based on the estimated costs and savings. With the new incentives provided by the IRA, it is becoming easier to finance solar projects and achieve a positive benefit for your school district's General Fund.



Examples of Solar Systems Financing Options

Credit: Philadelphia Green Capital Corporation

This Toolkit has two Excel files that will help you build a proforma - a financial model - for your project: one for direct ownership projects and one for PPA projects. These proforma models allow you to choose various assumptions (project cost, project output, the escalation rate of grid electricity, etc.) to predict the project's financial value. The proforma spreadsheet for direct ownership projects can be downloaded here and the proforma spreadsheet for PPA projects can be downloaded here.

Financing Option 1 - Cash on Hand

In determining how to pay for the solar project, the logical place to begin is cash on hand at the School District. Whatever cash can be applied to the project will reduce the amount of debt or bond finance needed, and therefore reduce overall project costs.

Public schools in Pennsylvania use the uniform Chart of Accounts for PA Local Educational Agencies to report their financial picture to the Commonwealth and the public. Pages D-6 to D-8 of the manual describes how school districts are to report their fund balance and net position in their reporting. This section has sub-categories to show these reserves, depending on whether they are restricted to specific purposes or projects. The most relevant categories are Code 0793 - Restricted for Capital Projects - and Code 0850 - Unassigned Fund Balance.

The school district's treasurer will know how many dollars are in these two categories. This is the starting point to determine if the school has any ability to provide cash towards the solar project. Note that whether a school district will be willing to use cash on hand for the solar PV system depends on many issues. Schools, like most financial entities, prefer the safety of large fund balances to deal with future contingencies. The school district may have other pressing capital needs and be unable to divert any cash to the solar project because of the borrowing caps imposed by Pennsylvania law. Learning about the district's financial situation, and how much cash the district has on hand that might be budgeted for a solar investment is the place to begin your discussions with the school CFO and the School Board.

Financing Option 2 - Elective Payments in the Federal Investment Tax Credit

The first federal Investment Tax Credit ("ITC") for alternative energy was enacted in 1978 (the Energy Tax Act of 1978 - P.L. 95-618) and has been modified many times since then. But the most significant changes to the ITC, especially for schools and other nonprofits, were made by the Inflation Reduction Act ("IRA") in 2022.

First, the IRA made the ITC applicable to nonprofit entities, like schools, by directing the IRS to issue cash incentives – now called **"Elective Payments"** but once called "Direct Payments" - to entities that do not pay federal income taxes. Before the IRA, the solar ITC offered no benefit to schools. With the IRA, schools are now eligible to receive a direct payment of cash in lieu of a tax credit for their solar project, which dramatically reduces the cost of solar for schools and other nonprofit entities.

Second, the IRA increased the level of the solar investment tax credit. The ITC has now been increased to 30% through 2032. That percentage can be further increased if the school qualifies for one or more of the "adders" that the IRA added to the Internal Revenue Code.

General Information about the Inflation Reduction Act:

Implementation of the IRA's investment tax credit provisions fall on the IRS, which is in the process of issuing guidance on the specific requirement of the IRA.

Two useful sites for discovering current and future guidance about the IRA are:

- Inflation Reduction Act Guidebook
- IRA Updates

For the Process of claiming an Elective Payment:

- **The** Final Guidelines **were issued in January of 2024.**

The 30% Base Level applies to projects that went into service after January 1, 2022. Solar projects that began construction after January 28, 2023, must satisfy one of two threshold requirements: (1) the project must have an Alternating Current ("AC") generating capacity of less than 1 megawatt ("MW_{AC}"); or (2) for projects 1 MW_{AC} and larger, the project must satisfy prevailing wage and apprenticeship requirements.

Note that there are several issues which can potentially modify the 30% tax credit rate:

- If a project is 1MW_{AC} or larger and the solar installer fails to pay prevailing wages for construction or satisfy the apprenticeship requirements, the investment tax credit is 6%, not 30%. Failure to satisfy the prevailing wage/apprenticeship requirement also reduces the adder for Domestic Content (see below).

- If schools finance all or part of their project with proceeds from a tax-exempt school bond, the 30% base ITC credit is reduced, depending on how much of the project's total cost was financed with tax-exempt financing. The IRA amended 26 U.S. Code §45(b)(3) to reduce the dollar value of the base ITC credit by the lesser of: (a) 15%; or (b) the percentage of the project's total cost provided by tax-exempt financing. **Schools should carefully consider whether the savings in financing costs from tax-exempt sources are sufficient to offset the reduction in the Elective Payment that results from the use of tax-exempt financing.**

Prevailing Wages and Apprenticeship.

As noted, projects sized 1 MWAC and more qualify for the full 30% credit level only if they have satisfied federal Davis-Bacon Act prevailing wage requirements and new apprenticeship requirements for the construction of the project and for project maintenance during the first 5 years of operation. Since public schools in Pennsylvania are mandated to pay prevailing wages for all their capital projects.

In addition to prevailing wages, the IRA sets certain apprenticeship requirements. Depending on when the solar project construction begins, 10%, 12.5% or 15% of the total labor hours must be performed by qualified apprentices (the Apprenticeship Labor Hours Requirement). Projects must also adhere to required apprentice/journey worker ratios (the Apprenticeship Ratio Requirements). Also, participating contractors and subcontractors who employ four or more individuals to perform construction, alteration, or repair work with respect to the construction of a qualified facility must employ one or more qualified apprentices to perform such work (Apprenticeship Participation Requirements).

Schools should ensure these prevailing wage and apprenticeship requirements are contained in all contracts for the construction of the solar project. Meeting this requirement for the full ITC Elective Payment should not be an issue.

Prevailing Wages:

Important links for prevailing wage information are:

- *IRS Guidance on the prevailing wage and apprenticeship requirements under the IRA was issued on November 30, 2022*
- *U.S. Department of Labor guidelines on prevailing wages and the IRA*
- PA Department of Labor - *Prevailing Wage Project*

Increasing the credit above 30%. In addition to the 30% credit, the IRA provides several options that allow entities to increase that percentage if the project meets other requirements:

a. 10% adder for Domestic Content.

To encourage the use of US-manufactured systems, the IRA increases the ITC an additional 10% for systems that satisfy 2 specified domestic content thresholds. First, 100% of any iron/steel products that are components of the project must be produced in the US. and second, 40% of the total cost of all "manufactured products" that are components of the entire "facility" must be produced in the U.S. If a project does not qualify for the 30% tax credit level, the domestic content adder is not 10%, but falls to only 2%. The domestic content requirement for manufactured components under this adder is scheduled to increase from 40% to 55% in 2027.

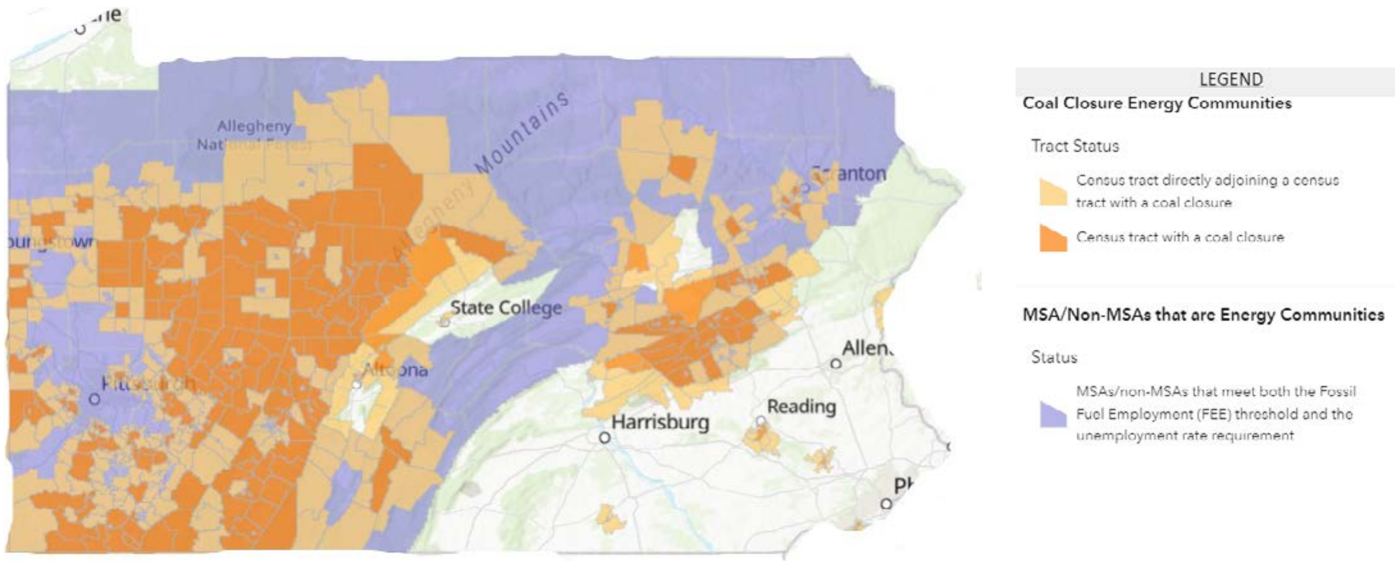
DOMESTIC CONTENT

IRS Notice 2023-39: Domestic Content Bonus Credit Guidance under Sections 45, 45Y, 48, and 48E.

b. 10% adder for Energy Communities. The IRA established a 10% adder for projects located in "energy communities." An energy community is defined as:

- A Census tract — and any adjacent census tracts — in which any coal mine has closed after December 31, 1999, or in which any coal power plant has been retired after December 31, 2009.
- Metropolitan Statistical Areas ("MSAs") and non-MSAs where, after December 31, 2009, industries tied to fossil fuels have accounted for (a) at least 0.17% of direct employment or 25% of local tax revenue; and (b) where the unemployment rate is above the national average for the previous year.
- Brownfield sites (as defined by 42 U.S.C. § 9601(39)(A)).

A large percentage of Pennsylvania meets one or more of these Energy Community criteria. The U.S. Department of Energy's National Energy Technology Laboratory is developing an interactive mapping tool to show which communities qualify as an "energy community."



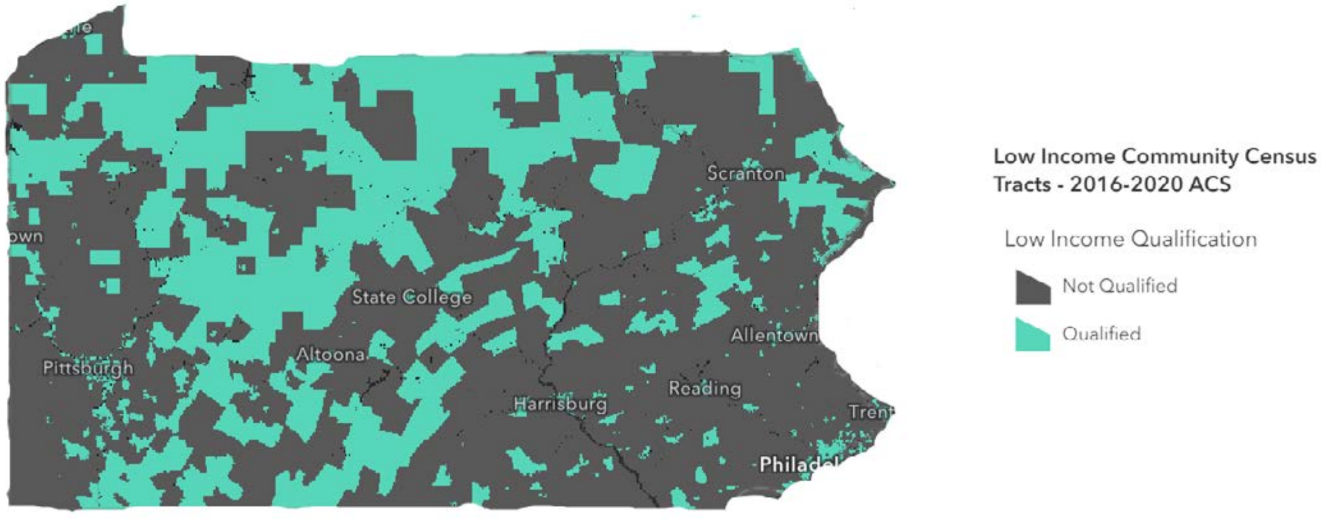
Note: This image is a screenshot of the NETL interactive map as of June 28, 2023. This map is incomplete, as it does not show brownfield sites, but it does show the census tracts (in brown) and adjacent census tracts (in tan) with closed coal mines or closed coal power plants. The area in purple shows the MSAs/non-MSAs that meet the Fossil Fuel Energy thresholds of at least 0.17% of direct employment or 25% of local tax revenue from fossil fuels and that have the requisite level of unemployment. The link to this map that allows you to zoom into an area by census tract in the text box below.

Energy Communities:

- **IRS Notice 2023-29 -** Administrative, Procedural, and Miscellaneous Energy Community Bonus Credit Amounts under the Inflation Reduction Act of 2022
- **US DOE/NETL interactive map -** Energy Community Tax Credit Bonus

c. 10% adder for Low-Income Communities

The third adder that can apply to school solar projects is a 10% adder if the project is physically located in a low-income community. A low-income community is defined as those census tracts where the poverty rate is at least 20 percent, or the median family income does not exceed 80 percent of statewide median family income.



Unlike the other adders which can be claimed if the requirements are satisfied, the Low-Income Community adder is limited to 2 years, and is awarded through a competitive process. The total credits awarded are capped at 700 MW of project awards in 2023 and again in 2024 (and 0 MW thereafter).

The Low-Income Communities adder has other provisions for Indian Land, Qualified Low-Income Residential Building Projects, and Qualified Low-Income Economic Benefit Projects, but these categories are probably not applicable to most Pennsylvania school solar projects.

Low-income Communities Bonus Credit

- **Federal Register:** Additional Guidance on Low-Income Communities Bonus Credit Program
- IRS Final Rules and Guidance
- **U.S. Council on Environmental Quality** Climate and Economic Justice Screening Tool
- White House Guidebook
- **USDA** Persistent Poverty Counties Mapping Tool

d. Procedure for Claiming an Elective Payment under the Solar Investment Tax Credit

The IRS published a proposed regulation in the Federal Register on June 21, 2023, describing the process for schools and other tax-exempt entities to claim elective payments in lieu of a tax credit for their solar projects. The first step of the process for claiming an elective payment is to complete a pre-filing registration of the project on-line through an IRS electronic portal. The school must provide the specific information about itself, its tax status, the credit being claimed, the project (including its beginning of construction date and its placed-in-service date) and other information. Each project must be registered separately, so solar projects by a school district on multiple schools will require multiple registrations.

The IRS will review the information provided and will issue a separate registration number for each applicable credit property for which the applicable entity or electing taxpayer provided sufficient verifiable information. A school must complete this registration process and receive a registration number prior to filing a tax return to claim the elective payment.

Once a school has a registration number for its project, it can then claim the elective payment in the federal tax return (generally Form 990) for the tax year during which the project was completed and was placed in service. For schools using the calendar year as their taxable year, Form 990 is due on May 15th of the following year. For schools with a different tax year, Form 990 is due on the 15th day of the 5th month following the end of the school's taxable year.

The elective payment is treated as an overpayment of the taxes owed by the school. After the return is processed, the IRS will issue a tax refund equal to the amount the school is entitled to under the federal solar investment tax credit.

Example: If a school on a calendar year tax year begins constructing its solar project in late 2024 and the project is completed and goes online in June of 2025, the school must complete the online registration process and receive a registration number for its solar project before it files its 2025 tax return on May 15, 2026. The school must claim the elective payment in its 2025 tax return.

Depending on when the solar project is placed in service, there could be a significant delay before the school receives its elective payment from the IRS. It is likely that the school will need to secure a short-term bridge loan in the amount it will receive under the federal solar investment tax credit (and for other grants or rebates that are paid after projects are completed and verified).

It should be noted that the IRS reserves the right to audit all claims for elective payments. If a school is later found to have received an elective payment larger than what it can legally claim (for example, if the project is later found not to have followed the prevailing wage and apprenticeship requirements so the proper credit percentage was 6% rather than 30%), the Proposed Regulations require repayment of the excess payment plus a penalty equal to 20% of the excess payment.

Also on June 21, 2023, the IRS published in the Federal Register its proposed regulations for the IRA's expanded right of a taxpayer to transfer its federal tax credits to another taxpayer for remuneration, but this provision is not available for entities such as schools that are eligible for elective payments.

The IRS issued final regulations in late 2023 and will set up the on-line system for registering projects and finalizing the necessary forms. Schools should check with tax counsel to be updated on the procedure for claiming the elective payment.

Important Note

Elective payments will soon have a domestic content requirement for systems sized 1 MWAC and larger that is distinct from the domestic content adder. If the system is under 1 MWAC, there will be no domestic content requirement as part of the elective payment. For systems sized 1 MWAC and larger that do not satisfy the domestic content requirements, the amount of the elective payment will be reduced in the future. These larger systems that start construction in 2024 but do not satisfy the domestic content requirements will see the total dollars of the elective payment reduced by 10%. Those that start construction in 2025 without meeting domestic content requirements will see the elective payment reduced by 15%. And those large systems not meeting the domestic content requirement that start construction in 2026 and thereafter will lose the ability to claim the elective payment altogether.

These reductions to the elective payment will not go into effect if the Secretary of the Treasury determines either that (1) the domestic content requirements increase the overall costs of construction of qualified facilities by more than 25%; or (2) relevant steel, iron, or manufactured products are not produced in the U. S. in sufficient and reasonably available quantities or of a satisfactory quality.

It is unclear how much flexibility the Secretary has in waiving the domestic content requirements. Treasury has promised future guidance on the IRA's elective payment phaseout provisions found in 26 U.S.C. §48(a)(13) and §45(b)(10).

Financing Option 3 - Grants

The next logical step to finance your solar project is to determine if any grants are available to support your system. To incentivize people to install solar, the federal government and Pennsylvania have adopted several grant programs.

Grants reduce the amount of project costs that you may need to otherwise finance, so it is important to learn early what grants are available. But do not hold up your solar project as you seek out every grant dollar that may be available. This is particularly tempting today, when recent federal legislation provides significant financial support. Much of this federal funding is being deployed through state agencies and the Commonwealth of Pennsylvania is currently consolidating and reworking many of its earlier programs that support solar and other renewable energy projects. The details of these federal and state programs are being settled now, so it is important to check regularly to catch the announcements of new opportunities. Also note that cash grants are not the only useful form for a grant. Grants in the form of loan guarantees or other credit enhancement can lower the cost of debt financing.

a. U.S. Department of Energy's Renew America's Schools Grants

Using funding from the Infrastructure Investment and Jobs Act, the U.S. Department of Energy has a 5-year program that will award $500 million for energy improvements at America's K-12public schools. The first Funding Opportunity Announcement ("FOA") was issued in November of 2022 and additional funding rounds will extend through Fiscal Year 2026. Solar PV is eligible under Topic Area 2 – Innovative Energy Technology Packages (page 10 of the 2022 FOA – see link in text box, below) – provided the solar is combined with electric vehicle infrastructure on school grounds; the purchase or lease of electric vehicles to be used by a school; or building energy efficiency measures. A link below will provide update information, including all subsequent FOAs.

U.S. Department of Energy's Renew America's Schools Program:

- Renew America's Schools program **homepage (sign up for updates)**
- Renew America's Schools 2022 Funding Opportunity Notice **(DE-FOA-0002756)**
- **US DOE:** 2024 Renew America's School Prize (closes June 2024)

b. PA Funding under the Federal IIJA and IRA

Pennsylvania expects to receive millions of federal dollars for clean energy under the Infrastructure Investment and Jobs Act ("IIJA") and the Inflations Reduction Act ("IRA") in the near future. As noted above, the Pennsylvania Department of Environmental Protection and other state agencies are working to develop how these dollars will be deployed. Many prior Commonwealth programs that once supported clean energy are being reviewed and some are likely to be reactivated. The text box below provides links to the major web pages that can be checked to determine what grants are available.

Links to PA Support for Clean Energy:

- Pennsylvania Energy Development Authority (PEDA)
- **PA Department of Environmental Protection's Solar Energy to Power Your Business webpage:** Businesses
- **PA DEP's:** Infrastructure Investment and Jobs Act ("IIJA") webpage
- **Commonwealth Financing Authority's Solar Energy Program:** Solar Energy Program ("SEP") - PA Department of Community & Economic Development
- **PA Department of Education's Plan-Con Program:** School Construction and Facilities ("PlanCon")
- **A national database of clean energy funding:** Database of State Incentives for Renewables & Efficiency **("DSIRE")**

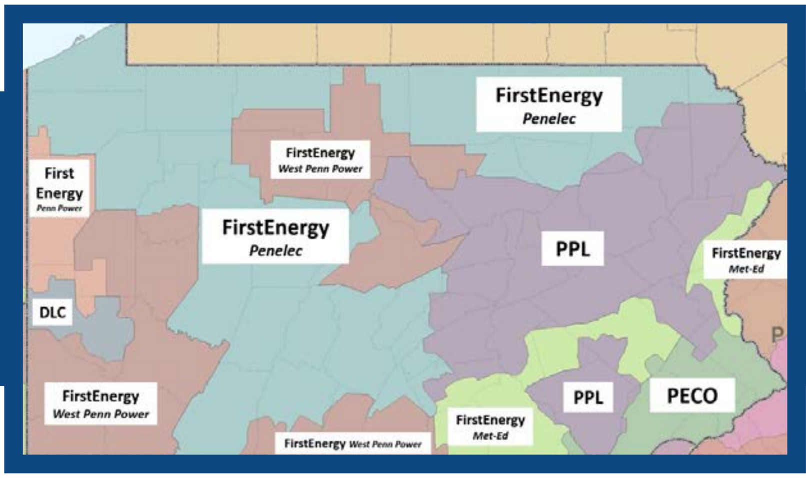
c. Electric Utility Programs

Pennsylvania Act 129 of 2008 mandates that Pennsylvania's electric distribution companies pursue cost-effective energy conservation and efficiency when it is cost effective. Through Act 129, the electric utilities provide energy conservation and efficiency products and technologies for all customer classes, including schools. EDCs file multi-year Energy Efficiency and Conservation Program Plans for review and approval by the PA Public Utility Commission.

Four utilities currently provide an incentive for solar projects for commercial customers, including schools, under their Act 129 energy efficiency plans. PECO, Duquesne Light Company (DLC), First Energy (including Met-Ed, Penn Power, Penelec and West Penn Power) and PPL have announced solar incentives in their current Act 129 plans. Most of them require the project meets a minimum Total Resource Cost Test ("TRC") value. The utilities will reimburse commercial/industrial customers for every solar kWh generated and used on site for the first 12-month period. The way they estimate solar usage varies, so check with your utility for details and apply directly to them.

Utility	Payment per kWh	Min TRC Requirement	For solar systems put in service	Cap
PECO	$0.10	May not apply	1/1/23 - 5/31/26	Must not exceed system cost
DLC - Duquesne	$0.05	0.90 is acceptable	Uncertain	Up to 90% of system costs, capped at $500,000
First Energy	$0.03	0.85	1/1/23 - 5/31/26	Up to 50% of system costs, capped at $500,000
PPL	$0.03	0.85	1/1/23 - TBD	Up to 50% of system costs, capped at $500,000

Note: Utility program availability & incentive levels are subject to change without prior notice.



Credit: PJM Data, Prepared by PA DEP

PA Utility Solar Programs Under Act 129:

- PECO
- First Energy
- PPL
- **DLC contact: David Defide,** DDefide@duqlight.com**, 412-393-6107**
- PA PUC webpage on Act 129
- EDC contacts for utility Act 129 programs

Financing Option 4 - Public Finance

After looking for incentives and grants to help with your solar project costs, the next logical place to turn is to public finance. Schools have a long history of using bonds and debt financing to pay for a large variety of their needs, from large capital projects to smaller needs.

The key to debt that works for your project is to find longer-term financing. In the ideal financial structure, the monthly revenue from the solar project exceeds the monthly debt service so the project enjoys positive cash flow from the beginning. The surest way to realize this is to use long-term financing rather than short-term financing for any debt portion of the project.

EXAMPLE

- A $500,000, 20-year loan, with 7% interest rate, has a monthly payment of $3,876.49.
- A 5-year loan for the same amount, with 0% interest rate, has a monthly payment of $8,333.33.
- To reduce the monthly payment, a longer loan term is more effective than a lower interest rate.

1. Tax Exempt Financing

Nonprofits may have access to tax exempt financing from government sources. While the terms of these bonds – interest rate and term of the lending – can be quite favorable, it is important to understand that tax exempt financing will reduce the size of the Elective Payment your project can receive under the federal solar Investment Tax Credit. If nonprofits finance all or part of their project with proceeds from a tax-exempt bond, the basic 30% ITC credit is reduced, depending on how much of the project's total cost was financed with tax-exempt financing. The IRA amended 26 U.S. Code §45(b)(3) to reduce the dollar value of the ITC credit by the lesser of: (a) 15% or (b) the percentage of the tax-exempt financing over the total investment in the project. **Nonprofits should carefully consider whether the savings in financing costs from tax-exempt sources are sufficient to offset the reduction in the Elective Payment that results from the use of tax-exempt financing.**

2. PA State Loan Programs for Solar Energy

In the past, the Pennsylvania Energy Development Authority, the Commonwealth Financing Authority, the Pennsylvania Economic Development Financing Authority and the Pennsylvania Department of General Services operated loan programs that could support solar projects.

These programs are currently under review and are likely to be consolidated or amended in light of new federal funding. Links to these programs are in the text box above.

PA Agency Loan Programs Applicable for Solar Projects:

- Pennsylvania Energy Development Authority (PEDA)
- Solar Energy Program (SEP) - PA Dept of Community & Economic Development
- Pennsylvania Economic Development Financing Authority (PEDFA) Tax Exempt Bond Program
- **PA Dept. of General Services' GESA webpage:** Energy & Resource Management

3. Green Banks: Philadelphia Green Capital Corporation / Pennsylvania Green Bank

PHILADELPHIA GREEN CAPITAL CORP

The Coalition for Green Capital defines a "green bank" as a mission-driven institution that uses innovative financing to accelerate the transition to clean energy and fight climate change. The **Philadelphia Green Capital Corporation**, an entity of the Philadelphia Energy Authority, is the first green bank to operate in Pennsylvania, financing projects in Philadelphia and its suburban counties.

The **Pennsylvania Energy Development Authority (PEDA)** has the ability to serve as a green bank within the Commonwealth. In 2023, PEDA initiated the development of a statewide green bank to leverage other sources of private capital, as well as federal opportunities such as the Greenhouse Gas Reduction Fund (GGRF) to create service offerings in the future to include municipal governments and school districts. PEDA seeks to offer products, such as reduced interest rates, extended loan terms, and low- or no-money-down finance offerings, to assist the development of projects in various clean energy sectors including renewable energy, distributed energy, and energy storage.

Green Banks:

- Coalition for Green Capital
- Philadelphia Green Capital Corp
  Maryrose Myrtetus, mmyrtetus@phillygreencapital.org

4. Greenhouse Gas Reduction Fund

The Greenhouse Gas Reduction Fund ("GGRF") provides grants to support technical and financial assistance to reduce greenhouse gas emissions. The U.S. Environmental Protection Agency ("EPA") has issued a notice for three complementary competitions- a $14 billion National Clean Investment Fund; a $6 billion Clean Communities Investment Accelerator; and a $7 billion Solar for All grant program. A link to the EPA notice is in the text box below. EPA issued a Notice of Funding Opportunity ("NOFO") on June 20, 2023, for the first Solar for All grants. GGRF funds will be administered at the state, municipal and tribal levels. Programs that will assist schools may be supported with these funds so check back regularly as announcements are made.

EPA Greenhouse Gas Reduction Fund:

- **U.S. EPA's** Greenhouse Gas Reduction Fund
- **U.S. EPA's** Solar for All Program
- **U.S. EPA's** Greenhouse Gas Reduction Fund Factsheet

Financing Options - Private Finance

1. Pennsylvania Regional Sustainable Energy Funds (SEFs)

The settlement agreements of many of the Pennsylvania electric utility restructuring cases set aside funds to support renewable energy, including solar. Five regional sustainable energy funds were created under these settlement agreements. The SEFs are managed separately by utility service territory, though several provide debt financing to projects outside of their territory. These funds have experience with solar financing and could be a good source of capital for your solar project. A link to each of the funds listed below can be found here.

PA Regional SEFs:

Fund	Sustainable Development Fund	Sustainable Energy Fund	West Penn Sustainable Energy Fund	Met Ed Sustainable Energy Fund	Penelec Sustainable Energy Fund
Territory	PECO	PP&L	West Penn	Met Ed	Penelec

Additional information about the SEFs is available from the PA Public Utility Commission.

2. Private Banks

Schools routinely secure debt financing from private banks. The key to finding a bank willing to finance a solar project is to find a bank with experience with these types of loans so they can properly assess the risk of the loan and underwrite it. As lending to a remarkable extent is based on business relationships, schools should first contact any banks they have used for earlier financing to see if they are interested in financing your solar project.

To find other lenders familiar with solar, one suggestion is to look at the lenders participating in Pennsylvania's Commercial - Property Assessment for Clean Energy ("C-PACE") program. Schools are not eligible for C-PACE financing (because schools are not liable for local property taxes and a C-PACE loan is repaid through the property tax assessment), but lenders participating in C-PACE are financial institutions already familiar with solar, and many may be willing to finance a school solar project outside of the C-PACE model. Another suggestion for finding a private lender is to ask your solar installer for the lenders they've worked with before.

Lenders Participating in Pennsylvania's C-PACE Program

- Sustainable Energy Fund's Pennsylvania C-PACE list

Step 7:
Issue a Request for Proposal

If you have decided to do the PPA or other lease option, then your Step 7 is to draft and issue a Request for Proposals "("RFP") to secure a solar developer to engineer, procure, construct and operate your solar project. Skip down to "Your RFP Will Need to Include" section below.

But if your choice is the direct ownership model, public school construction or alteration projects are governed by a long tradition of laws, regulations and practices that control the procurement process. An early decision you will need to make, if you are going the Direct Ownership route, is how must your procurement process be shaped to satisfy the PA School Code; the PA Procurement Code, the PA Separations Act and local district procurement rules. Consult with your school district solicitor and other district officials with relevant experience.

There are two schools of thought about how best to satisfy the multi-prime bid requirements of the PA Separations Act. One is for the school to select a project developer by RFP who designs the system (a professional service), then hold bids for the separate trades for prime contracts.

The other school of thought is to utilize the Pennsylvania Guaranteed Energy Savings Act (GESA), which creates a distinct contracting process for state entities to pay for energy savings in their facilities. Schools can follow the GESA rules for RFPs and competitive sealed proposals to select their "qualified provider"; require an audit showing project payback is 20 years or less; include the energy savings guarantee, the performance bond, the reporting requirements and the other GESA terms in the contract. A qualified provider under GESA is able to be a single prime contractor, so schools can have a single point of responsibility for the entire solar project.

Solar Contractors in PA:

PA Solar Center Installer List:

The PA Solar Center provides a county-by-county Qualified Solar Developer Directory. This provides information on solar installation companies with staff who successfully completed a solar certification program through the North American Board of Certified Energy Professionals (NABCEP).

Your project team will need to work closely with the school district solicitor and other district officials to develop a procurement pathway acceptable to all. Once you settle on the structure of the services you are securing and have gathered all the information you need and gotten the approval of the school or school district, you are ready to issue a Request for Proposal ("RFP") to qualified solar contractors.

Your RFP will need to include:

- Protection of roof integrity and warranties
- Provisions for performance monitoring/guarantees
- System technical specifications
- All necessary permits, inspections and interconnection with the electric utility
- Specification of a contractor required interconnection fee allowance
- Requirements for an operation and maintenance plan
- Leveraging project educational value with online data monitoring

The RFP should state your thinking on the ownership model you wish to use for your solar project, but it is recommended that the RFP seek proposals for both the direct ownership model and the third-party ownership model (PPA and leases). Not all contractors will be willing to offer both models, but it is useful to get a comparison of the costs under each.

You can choose to develop and issue the RFP yourself, using the sample RFP included here. As with any large construction project, you should get at least three competitive bids from qualified solar contractors - you will learn valuable information from each of the contractors. Make sure you require the bids to provide the same information, ideally in the same format so that you can compare them accurately. As with any construction project, the school or district needs to meet all applicable state procurement requirements.

As noted above in Step 1, schools can seek the help of a consultant to help finalize the RFP, review the proposals, and negotiate the agreements with the successful proposer.

A model RFP for Schools in Microsoft Word® is available *here*.

Step 8:
Select Your Solar Installer and Issue a Contract

In reviewing the proposals submitted in response to the RFP, consider the following:

- The qualifications and experience of the solar contractor
- The proposed project design, layout and components
- The price (for direct ownership, often the unitized price metric is $/wattDC; but for third party ownership, it is typically the solar generation rate or $/kWh, possibly with an annual escalator)
- Ability to deliver the project on time and on budget
- References of similarly sized and configured projects

The Facilities Manager will want to control the timing of the installation to avoid conflicts. Ideally one person will be the point of contact for the contractor - likely, the Facilities Manager.

Two Pennsylvania schools' solar PV installations, below:

Bellefonte Area School District, Centre County

East Hills Middle School, Bethlehem ASD

Key Elements in Engineering/Procurement/Construction Contracts for Direct Ownership Projects

Items to Include in EPC contracts:

- Qualifications (NABCEP certifications) of Contractor's staff
- Proof of Contractor liability insurance - at agreed-to levels
- Compliance with all school procurement requirements
- Student safety in all aspects of project construction
- Certification that system will comply with IRA's prevailing wage and apprenticeship requirements
- Certification that system will comply with Domestic Content requirements under the IRA
- Year One solar generation guarantee (and remedy if guaranteed production is not met)
- Contractor to secure all required permits
- Contractor to secure all required interconnection approvals
- Contractor to secure final utility Permission to Operate
- Warranties for system components
- Construction and electrical drawings
- Clear project construction schedule (and remedy if there are unreasonable delays)
- Final as-built drawings and equipment lists to be provided to the school.

Items to Watch Out for in EPC contracts:

- Project tasks that are up to the school to perform (i.e. securing permits or utility interconnection approval)
- Unreasonable delegation of work to unknown subcontractors
- Unreasonable payment schedules that do not allow time for inspection and work approval.
- Unreasonable waiver of project timelines.

Key Elements of a Power Purchase Agreement

Items to Include in a Power Purchase Agreement:

- Proper calculation of school's default electricity supply price.
- Reasonable Year One PPA price per kWh
- Reasonable escalation rate (ideally linked so PPA price never exceeds default electricity price)
- Guarantee of electricity bill savings (and a specified remedy if guaranteed savings are not realized)
- Clear provisions for buy-out price and terms at the end of the PPA

Items to Watch Out for in the Power Purchase Agreement:

- A default electricity price calculated by dividing school's annual electricity cost by the school's annual kWh usage
- Excessive escalation rate for price of delivered electricity
- No guarantee of bill savings
- Excessive term of PPA agreement
- Poorly defined and/or unreasonable buy-out provisions

Key Elements of a Solar Lease Agreement

Items to Include in a Solar Lease Agreement:

- Reasonable lease payments
- Fixed lease price or reasonable lease price escalation rate (ideally linked to actual electricity prices)
- Guarantee of electricity bill savings (& remedy if guaranteed savings aren't met)
- Clear provisions for buy-out price and terms at the end of the lease

Items to Watch Out for in a Solar Lease Agreement:

- Excessive escalation rate in lease amounts
- Excessive lease term
- Poorly defined and/or unreasonable buy-out provisions

Step 9:
Oversee Construction and Installation

Once the solar installer is chosen, resources should be dedicated to overseeing the construction and installation process and maintaining regular communication with the installer throughout the process. This is most important if the school has decided to go the Direct Ownership route, but is important even if the PPA route has been chosen.

The school should monitor progress towards the major project milestones in the contract: system design, equipment selection, interconnection approvals, other permitting and regulatory approvals, construction, testing and commissioning and contract closeout.It is especially important to ensure that regulatory compliance is properly documented, and that the system is performing properly prior to contract closeout.

It is especially important to ensure that regulatory compliance is properly documented, and that the system is performing properly prior to contract closeout. If the School District agrees to third-party ownership, the chosen developer will be responsible for selecting the installer and overseeing the installation process. Because the developer will own the system, they have a financial incentive to ensure the system is properly installed and efficiently producing electricity. Nevertheless, the district facilities staff should hold regular meetings with the developer and installation manager to review the schedule and potential change orders.

A district that retains ownership will typically hire a full-service solar contractor to install the system. Since the contractor is not financially tied to the long-term performance of the system, the district should take a more active role in monitoring the cost, schedule and quality of installation. Districts should regularly assess the risks and risk mitigation strategies associated with those factors.

In either case, direct or third-party ownership, hiring a solar consultant on behalf of the school's best interest is a worthwhile investment for assuring a successful project.

Step 10:
Monitor and Maintain Ongoing System

Once the system is built and goes into operation, monitoring and maintenance is necessary. To ensure the solar energy system operates as it should for decades to come, School Districts often contract with a solar company for that service. In addition to a maintenance contract, one of the best ways to ensure the system is operating properly is to have a monitoring station showing the system's real-time solar production in-stalled in a very public location, i.e., the school's main lobby, cafeteria or both so that students, teachers, administrators, staff, and visitors can see for themselves how the system is doing. This monitoring station is also invaluable for incorporation into the school's STEM education.

If the district has a PPA, the developer will be responsible for these tasks throughout the term of the agreement. Otherwise, the district will typically enter into an Operations & Maintenance ("O&M") Agreement with the contractor that installed the system or another third party.

The O&M agreement should include a schedule to monitor, inspect, and clean the equipment and maintain the warranty on the system's components. For ground-mounted systems, the agreement should consider maintenance of the grounds and any environmental commitments, such as the preservation of pollinating vegetation. The O&M contractor should monitor system safety and report on performance.

A PV system is an electrical generator, and precautions must be taken to keep school children and non-authorized personnel away from the system. The contract should not only address ongoing maintenance but also the replacement of key parts. If major replacements are not part of the O&M contract, the district should set up a reserve account to fund them. Inverters and batteries, if incorporated in the system, are typically the largest replacement cost items, and typically last 10–15 years.

CASE STUDIES

Part 4:
Case Studies of Solar Schools in Pennsylvania

Midd-West School District

Joe Stroup, Superintendent
Rick Musselman, Fmr. Superintendent

County: Middleburg
Year installed: 2020
Ownership Model: PPA
System Size: 2.56 MW (2 systems: 2.1 MW & 460 kW); 6,268 bi-facial panels across 16 acres and 2 systems

Total cost: $ 5 million

Financing: Power Purchase Agreement with Greenworks Development. Savings from first full year, buyout after 5 years for $3.1m. Midd-West owns the SRECs and has been selling them into the market to raise additional funds for the District.

Solar system contractor: Solar Renewable Energy LLC
Ground mounted 2 systems: 2.1 MW on a 6-acre field behind a High School

West Snyder Elementary School in Beaver Springs 460 kw on 1.25 acres

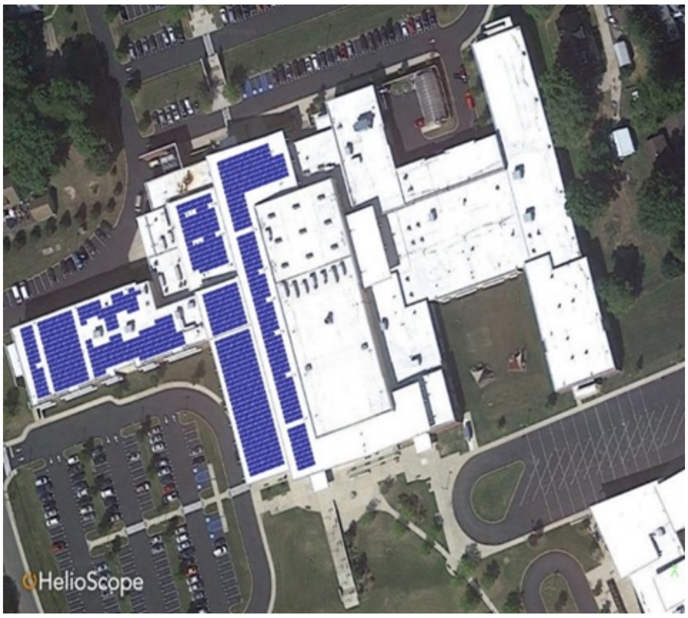
Annualized Savings: The two systems provide 90% of the District's load. The District is now expanding the system to provide 110% of their load. Savings in 2022 = $80,548, projected to grow to $280,000 in 2023. Estimated savings = $15 million over 40 years. The chart below shows actual savings in 2021-22 and projected savings in 2022-23 (in green). PP&L had a significant rate increase in 2022.

Year	Projected Electricity Cost (no solar)	Paid to PPA provider	Paid to PP&L	SREC Revenue	Cost with Solar	Savings
2021-22	$630,000	$358,550	$297,548	$106,646	$549,452	$ 80,548
2022-23	$840,000	$362,136	$307,462	$110,000	$559,598	$280,402

Maintenance: Provided by Greenworks Energy. To reduce maintenance costs, sheep are brought in by a local farmer to "mow" the grass and weeds around the system.

Education: The solar generation is monitored in science classes, enabling students to learn more about electricity, especially solar production and to convert generation to savings, emissions avoided etc.

Energy Efficiency and Decarbonization: Midd-West saw the value of energy savings in 2013 when it implemented a comprehensive energy efficiency strategy at West Snyder Elementary School, including swapping all the lighting to LEDs, installing white roofs, and switching from coal-powered heating to a geothermal energy system. The success of those cost-saving upgrades prompted the district to consider the potential opportunity to go solar and find more operational savings.



Lessons Learned: "It was a simple project." "This is nothing compared to many other building maintenance and construction projects in the District," stated Rick Musselman. However, there were difficulties and unanticipated costs in the interconnection process with PP&L.

Joe Stroup: "Not only is there a positive financial impact to the district, enabling us to support educational programs, but the site serves as a model for solar energy production in our community." Solar creates a new mode of business for schools and their communities looking to collaborate with area businesses to support both interests and finding sustainable partnerships.

Future Plans: The District is expanding the system to cover 110% of load with a 437 kW rooftop system on Midd-West High School. This is designed to create an additional $50,000/year in savings.

Phase 3: Exploring Lease of Land: The District is currently exploring the possibility of leasing additional land to a solar developer as a means of generating additional revenue for the schools and for the District, and to relieve pressure on local taxpayers.

Steelton-Highspire School District

250 Reynders Avenue
Steelton, PA 17113
www.shsd.k12.pa.us

Year Installed: 2021
Ownership Model: PPA
System Size: 1.6 MW (generating 100% of district electric usage)
Total Cost: $4.5 million

In many ways the story of how the Steelton-Highspire School District went solar is a story of Pennsylvania's on-going energy transition. The Steelton plant, constructed in 1866, was the nation's first mill in the United States dedicated exclusively to the process of making steel. The town was a thriving manufacturing center until the 1970's when the steel industry in Pennsylvania began to move offshore. As the town shrank, so did the incomes of its residents. Superintendent Mick Iskric, Jr., always working to balance the district's budget, realized that solar energy could help, not just one year but every year.

After doing their due diligence, the School District decided to negotiate a Power Purchase Agreement for 100% of the School District's electricity load. The site selected for this 1.6-Megawatt system is on top of a settled landfill right behind the football field. This landfill is another important part of Steelton's history: In 1972, Hurricane Agnes caused severe flooding of the Susquehanna River in the Harrisburg area. In fact, much of the western side of the town flooded and many buildings had to be torn down. The area behind the high school became a landfill and houses many of the remnants of the neighborhood known as the "West Side".

Savings: The contract negotiated with McClure guarantees the district a savings of $13,000 a year for the first 13 years, and approximately a savings of $200,000 a year going forward.

Education: Both the elementary and high schools have monitors displaying the solar array's production. All teachers have access to this dashboard in their classrooms. Students, especially in STEM classes are using this data to convert solar generation to dollars saved, CO_2 emissions avoided, and other applications.

Lessons Learned: "As an underfunded, urban school district, the Steelton-Highspire School District supports innovative ways to offset expenditures that will directly support our students," said Superintendent Mick Iskric, Jr.. "Our solar energy project directly offsets 100% of the district's electric energy use. Utilizing solar to support our Clean School Bus initiative of seven electric school buses will continue the School District's mission to reduce our carbon footprint as well as continuing to offset daily expenditures."

Future plans: EV School Buses and Charging Facility: Through the hard work of Business Manager, Mark "JJ" Carnes, the Steelton-Highspire School District has recently acquired 6 EV school buses, which it plans to charge using its own solar array. This will provide additional financial savings and potential revenue.

EV Car Charging: Steelton-Highspire School District is also considering installing charging stations for EV charging for community members and visitors, as well as for school faculty and staff. The School District believes that this could help them attract teachers and assist with the ongoing teacher shortage that encompasses the state.

Solar Schools Tour Video: https://www.youtube.com/watch?v=_mpusYVC5I4
Recent article: https://www.pahouse.com/InTheNews/NewsRelease/?id=128682

Bethlehem Area School District

Mark Stein, Director, Facilities & Operations

Northampton and Lehigh Counties
- James Buchanan Elementary (280KW)
- Farmersville Elementary (400KW)
- Spring Garden Elementary (270KW)
- East Hills Middle (295KW)
- Freedom High (380KW)

Year installed: 2010-2011
Total cost: $7,172,237
Cost per watt: $4.41/watt
Financing: DCED Grants ($1.8M), PPA fixed $.09/KWH, $.10/KWH for Freedom HS to fund parking canopy.
PPA: Tangent Energy Solutions was the initial PPA provider.
Solar system installer: Tri-M Group of Kennett Square (4 of 5), Baja Group (Freedom)

Ground mounted/Rooftop: Buchanan, Farmersville, Spring Garden = Ground mounted; East Hills = rooftop; Freedom = parking canopy. An interesting solution was developed at Spring Garden. The City of Bethlehem allowed the school district to use part of a retention basin in which to site the panels, so the amount of usable green space was minimized by using the otherwise unusable retention basin space. Two of the schools (James Buchanan and Farmersville) are fully powered by solar energy.

Annualized Savings: The PPA agreement broke even over the first five years, but the fact that electricity rates actually declined below the negotiated PPA price, has cost the District an additional $163,000 over the last seven years. Annualized it is $13,603/year over 12 years on an average electricity spend of $1.4M. The PPA breaks even again beginning in July 2023.

Percent of total usage offset: Approximately 9% of the district's consumption.

Future Plans: BASD received a state grant to purchase 2 electric school buses. Infrastructure upgrades are planned for completion during summer 2023 with buses expected to arrive in February 2024. The district will continue with a district-wide energy conservation program which has resulted in a $20M cost saving for BASD community by focusing on efficient operation of existing building HVAC plants, energy efficient lighting upgrades and demand response programs.

F.A.Q.

Q: Can our school afford to go solar?

A: If you can afford to pay your current electric bill, you can afford to go solar.

Q: Demand Charge: We have a high demand charge. How can we use solar to reduce it?

A: Determining if solar can reduce demand charges is very difficult to estimate without conducting detailed analysis of solar generation against the school's load profile in 15- or 30-minute intervals. The school will see a reduction in the demand charge for each month during which the month's peak demand (that 15- or 30-minute period when usage is highest) and the month's PV output occur simultaneously. Depending on the size of the solar PV system and the school's load profile, it may be possible to reduce demand charges for several months of the year. The conservative approach is to assume no demand savings, only supply or generation savings to the school's electric bill.

Q: Net Metering: If our system produces more in a year than we actually use, will the utility pay us for the extra generation?

A: Yes, but only if the school buys its electric supply or generation from the local electric distribution company ("EDC"), such as PECO or PPL, etc. Third party suppliers do not pay or credit customer-generators for excess solar generation.

Q: Loans: Is the Commonwealth of PA going to provide loans to help Schools go Solar?

A: The Governor's Office, PA DEP and other Commonwealth agencies are studying IIJA, IRA and other potential sources of clean energy funding and developing a comprehensive strategy for applying for and securing funds and then deploying them to financial entities in PA to benefit individual projects.

Q: Elective Payment: Given that it may take a year or more for a school to actually receive the ITC Elective payment from the IRS, where can our school get a short term or "bridge" loan at a reasonable rate?

A: Any of the debt financing sources listed in the Finance step can provide a "bridge" loan. What makes a bridge loan different than other loans is that they are short-term loans, usually interest-only and are generally paid off in a lump-sum when the awaited grant or tax credit is received.

Q: What is a reasonable kWh price to pay in a PPA agreement?

A: It will depend of course, but it is most important that the PPA price should be less than your current supply or generation rate. It is also best that there is no annual escalation rate or rate increase, or that any increases be capped so the PPA price does not exceed the default electricity cost. That ensures the PPA will always offer savings to the school.

Q: Are there any consultants who can help our school put together a proposal for U.S. DOE's Renew America's Schools grant?

A: Yes, there are highly qualified consultants. Contact DOE's Efficient and Healthy Schools campaign - https://efficienthealthyschools.lbl.gov/join - for possible solar consultants.

Q: Which are the highest efficiency solar modules? Is it worth the extra cost to get bifacial modules?

A: Some solar modules are over 22% efficient, but efficiency should not be the only criteria. Well known solar module manufacturers with a good track record and a good performance warranty should be considered.

Regarding bifacial solar modules - it might come as a surprise, but they are not necessarily more expensive than conventional solar modules. Foreign-made bifacial modules are exempt from the tariffs imposed on PV modules (Section 201 tariff) which reduces their price premium. Bifacial solar modules are best used where there may be reflected solar radiation on the back of the solar module, such as on a ballasted racking system on a white flat roof.

Q: Is expert technical assistance available to help schools with providing solar assessments and develop a plan for going solar?

A: Yes, there are several sources of technical assistance available to Pennsylvania schools, with two shown below:

- PA Solar Center (https://pasolarcenter.org) - Click the following link to GET Solar - Municipalities. G.E.T. Solar Connect 2023 | The Pennsylvania Solar Center.
- U.S. Department of Energy's Lawrence Berkeley National Laboratory can provide free technical assistance through the Efficient and Healthy Schools campaign: Contact: https://efficienthealthyschools.lbl.gov/join.

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- Joe Stroup, Superintendent of Midd West School District.
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- Jack Barnett, Community Energy Cooperative
- Chris Fraga and Fritz Krussman, Alternative Energy Development Group
- Jim Kurtz and Mark Connolly, Renewable Energy Group

Part 6: Additional Resources

Pro Forma

- **Direct Ownership:**
  https://files.dep.state.pa.us/Energy/Solar/Schools/PASolarSchoolToolkit_Proforma_DirectOwnership.xlsx

- **Power Purchase Agreement:**
  https://files.dep.state.pa.us/Energy/Solar/Schools/PASolarSchoolToolkit_Proforma_PPA.xlsx

- **Model Request for Proposal (RFP) for Solar Contractor:**
  https://files.dep.state.pa.us/Energy/Solar/Schools/PASolarSchoolToolkit_ModelRFP.docx

Contacts:

- Southwest Regional Office: 412-442-4000
- Northwest Regional Office: 814-332-6945
- North-central Regional Office: 570-327-3636
- South-central Regional Office: 717-705-4700
- Southeast Regional Office: 484-250-5900
- Northeast Regional Office: 570-826-2511

PA Regional SEF Links:

PECO - Sustainable Development Fund
https://www.reinvestment.com/sustainable-development-fund/

PPL - Sustainable Energy Fund
https://thesef.org/

West Penn - West Penn Sustainable Energy Fund
https://www.wppsef.org/

Met Ed - Met Ed Sustainable Energy Fund
https://bccf.org/sustainable-energy-fund/

Penelec - Penelec Sustainable Energy Fund
https://www.cfalleghenies.org/penelec-sustainable-energy-fund/

Josh Shapiro, Governor

Jessica Shirley, Interim Acting Secretary, DEP

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