SOLAR ON SCHOOLS

midwest renewable energy association

Getting Solar at Your School: FAQs

Pictured: A 646 kW DC PV system in Oregon, WI. This PV system helps to make this school net-zero, meaning the total amount of energy used by the building on an annual basis is roughly equal to the amount of renewable energy created on site.

Q: What are the components of a solar PV system?

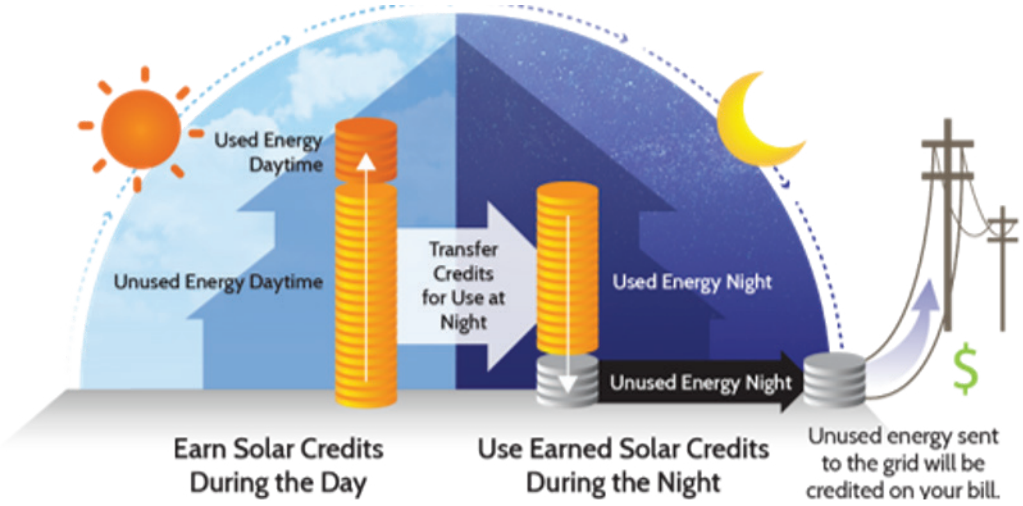
A: A PV system consists of:

- **Solar panels:** Also called solar modules, these are the door-sized components that collect the sun's energy, creating DC energy. Modules are rated at how much energy they can individually produce under ideal conditions. Currently, modules are commonly rated starting at 300 watts and reaching around 450 watts apiece.
- **Racking**: This is the collection of components that hold your PV modules and system together and attach it to your roof or the ground. Rack designs vary depending on if your system is ground-mounted, on a flat roof, or on a sloped roof.
- **Inverters:** These take direct current (DC) power from the solar panels and invert it to alternating current (AC) power, which is what most of our appliances and systems run off.
- **Balance of System (BOS):** This includes other electrical components of the system such as wire, conduit, combiner boxes, switches, circuit breaker panels, and more.
- **Battery:** Batteries are not yet common on most solar school installations. However, as the price of batteries decreases, they are drawing more interest. Batteries can provide backup power in the event of electric utility outages, and they allow you to maximize your system's energy production, especially in cases where you are on a time of use utility tariff.

>> Pictured Right: BOS—the inverter, breaker panel, and point of interconnection with the utility service.

Q: How does my utility credit me for energy our system produces?

A: If you use the energy you produce instantaneously, your utility does not need to credit you for anything. If there are times when the PV system is producing more energy than the school is consuming, then the excess energy will go back onto the grid and power your neighbor or someone else's nearby electrical needs. In many cases, you can be credited for this energy production that you send back to the grid. This is called net metering, and in Wisconsin, is typically limited to PV system sizes up to 20 kW, 100 kW, or 300 kW, depending on the electric utility. If you do have access to net metering, this can be credited to you at the retail rate (what you pay for electricity), at a wholesale rate (typically 3-5 cents/kWh), or other rates as specified by the utility. It is important to consult with your solar installer and electric utility to determine net-metering policies for your school, since this will likely impact your ideal PV system size. In some cases, you may be able to set up a unique negotiated arrangement for your system, such as getting credit for summer production if your school is not in session at that time.



^^ *Pictured Above: Net Metering Basics Explained, for When Your System Produces More Than You Use at a Given Time*

Q: How do we determine our ideal solar PV system size?

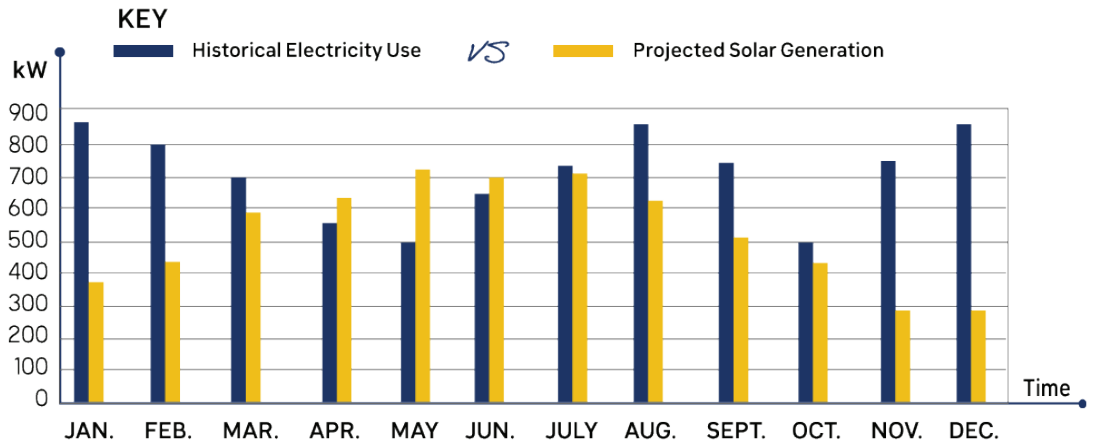
A: This largely depends on what your goals and limitations are:

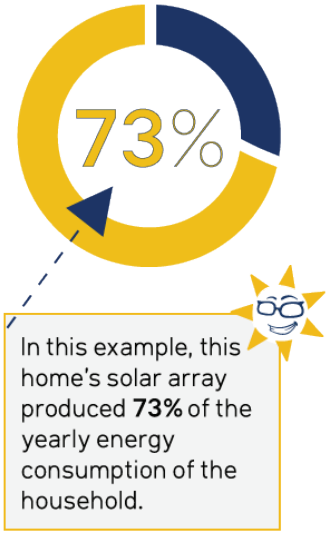
- ***Is your goal to offset as much of your energy use as possible?*** A key place to start is by looking at your energy bills and determining how much energy you consume annually. Ideally, you'll want to average out 1-3 years' worth of data (and consider any energy efficiency upgrades that will reduce your consumption in the future). You can use PVwatts.nrel.gov or work with your solar installer to help determine an ideal system size that will produce all or a portion of the energy that your building consumes. Additionally, you may want to consider adding batteries to your system to store excess energy produced, or at least design the system to be battery ready so that you have the option to add them when prices come down in the future.
- ***Are you limited by roof/other space?*** You'll want to work with your installer to calculate the space available for solar. You'll need to consider any mechanicals that are on your roof. Current rooftop racking designs typically accommodate about 15-20 Watts of PV per square foot of roof space. However, this number is dependent on the panel type, orientation, tilt angle and inter-row spacing. Furthermore, this rule of thumb number has been inching upwards as the capacity of modules (how much energy they can produce per module) increases each year.
- ***Are you limited by funding?*** In recent years, school sized solar installations (100-400 kW DC) in the Midwest have been completed for below $2/watt, often at $1.50-1.60/watt. For example, a 100 kW DC sized system would likely cost less than $200,000. You can use these estimates to help determine your ideal system size.
- ***Do you want to maximize your ROI?*** This can depend on many factors including your electricity tariff, the availability and type of net metering, grants or other incentive payments, and the type of financing used for the project. If

you will not have access to net metering, it may be ideal to size your system to offset only a portion of your annual electricity consumption (30-60%) to make sure that the PV system is never producing more electricity than you're using at any given time.

"A year in the life" of a grid-tied / net metered home

The Below Figure Demonstrates Energy Use of a PV System over an Example Year





Q: What do I need to know about my roof and solar?

- **Age Considerations:** Solar is suited best for new or fairly new roofs. Contractors typically model PV systems for 25-30-year time horizons. Twenty-five-year module warranties have become a de-facto industry standard, and they typically guarantee that panels will still produce 80% of what they originally did at the time of purchase.
- **Roof Penetrations:** If you install solar on a flat roof (most common for schools), the modules are typically held onto the roof using concrete ballasts to weigh them down, or stone ballast from the existing roof. These types of installations often require no new roof penetrations. You and your solar installer can consult with your roofing company to make sure the PV installation is in compliance and does not void your warranty.
- **Weight Considerations:** Weight-bearing capacity can vary widely from roof to roof, and it is common for a flat-roof ballasted PV system to weigh 3-7 pounds per square foot. A structural engineer will be required to confirm that your roof can handle the additional weight. If there is existing stone ballast on the roof, it is generally possible to remove a portion of the stone to accommodate the additional weight of the solar array.
- **Solar Impacts on Roof Quality:** Solar PV systems tend to protect the quality of the roof. The shade from the system can slow down aging due to weather and ultraviolet light. Also, pieces of rubber membrane, or slip-sheets, are located between the base of the racking and the existing roof, protecting it from any wear and tear. However, it is important to minimize foot traffic on the roof and lay down extra roof mats to protect the roof in high traffic areas. This is important to consider if you plan on making a portion of the system available to students or others for tours.

>>This PV system is on a flat roof and uses concrete ballast rock to mount the modules to the roof without roof penetrations. Photo courtesy of the Merton Community School District

Q: What if my roof isn't suitable for solar?

A: Solar does not need to be installed on a roof. If it is a matter of poor roof condition, schools can choose to time the installation of solar to coincide with roof replacement. If site conditions dictate, installing a ground-mounted solar system is a good alternative to going on the roof. If a ground-mounted system is chosen, surrounding the array with a fence will be required for the safety of students and the public.

Q: What kind of maintenance is required for these systems?

A: Solar without battery storage requires little maintenance. You do not need to brush off the snow or clean the modules from soot or dust. Production losses due to snow cover and dirt should be included in the power generation estimates provided by your contractor. In fact, the rain and snow tend to help keep the modules fairly clean. It is recommended to inspect the system once annually, looking for loose wiring or modules or other pieces that aren't working properly. If you have small staff, have personnel that are already stretched thin, and/or are worried about maintenance requirements, you can include maintenance services in your solar Request For Proposals (RFP) and in the subsequent solar installation contract. Cost of maintenance can be estimated to be 0.35% of the system's installed cost each year, and contracts can be implemented for durations ranging from a single year up to the expected life of the system.

Q: What happens if something breaks?

A: Although failures are quite rare, there are times where a module or another component of the system has issues, and these components will need to be replaced. Modules typically have a production warranty for 25 years and inverters will have warranties for 10-15 years, ensuring the replacement of any faulty components. The glass on a solar panel is tempered glass and is rated at minimum to take a 1-inch hailstone at 50 mph. The expected lifespan of string inverters is generally 10-15 years and is typically the most significant maintenance event required for stationary systems. The cost of inverter replacement at 12 years is most often figured into financial models and payback calculations. Module level power electronics (optimizers, rapid shutdown devices, and microinverters) have varying warranties and can have failures, but also add to the fire safety of the system. Hardware warranties typically do not cover labor. Some contractors will include or offer a 5-year workmanship warranty that covers labor costs.

>> Pictured: Modules can continue to work despite the broken glass, but this does pose production and safety issues. This was the only repair necessary to the system in 10 years. Photo courtesy of Milwaukee Central Library

Q: Will my insurance cover damage to the system?

A: Consult with your insurance company early on to determine if you need to expand your coverage. Typically, existing insurance will cover the PV system in the case of external damage. If you need to purchase additional insurance, you can estimate it will be 0.35% of the system's installed cost each year.

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Q: How much will the system cost?

A: A typical school-sized PV system (100 kW – 300 kW DC) will cost less than $2 per watt (as of 2021), often at $1.50-1.60 per watt. For example, a 100 kW DC sized system would likely cost less than $200,000. You can use these estimates when estimating how much various system sizes will cost.

Q: How much can I expect to save on my electrical bills from my PV system?

- **Internal Work:** If you want to do some of these calculations yourself, a good place to start is using PVwatts.nrel.gov to determine an approximation of how much energy your system will produce in one year. A rough estimation of savings will be what you pay per kWh multiplied by the estimate of the annual energy production of your system. To fine-tune this estimate, you can use resources such as SolarProjectBuilder.org or System Advisor Model.
- **External Work:** Alternatively, you can hire a consultant or work with a contractor prior to going out to bid (if you are able to do so). They can provide much of this information through site assessments and financial modeling of various system scenarios. Either way, you will likely also see a savings in demand charges, but these are more difficult to predict and can change on a monthly basis. Some consultants will provide you a savings estimate that takes demand reduction into account. Keep in mind, modeled financial savings depend heavily on access to net metering rates, and policies which vary widely by utility.

>> Pictured: Example of a Solar Proposal. Courtesy of Merton Community School District.

Q: What technical and other considerations should I include on our RFP?

- **Base Bid Requests:** Ideally you want to dictate a specific system size and site location, among other considerations, so that you can compare apples to apples. You can always openly ask for alternate bids which are open to a change in things such as system size, location, ROI, and other details. This allows the contractors to use their expertise to design a system ideal to your location and needs.
- **Technical Considerations:** There are a few technical considerations you may also want to include in your RFP including the location of the PV array, balance of system components, and utility disconnecting means. A good place to start is with the Solar on Schools RFP template available through CREATE's Solar on School's Toolkit or MREA's Solar on School's online Resource Center. This template is intended to be used as a starting point document that a school can edit, revise, and add or delete details as needed.
- **Educational Considerations:** It is important to include any curriculum requirements into the design process and RFP early on. Do you want access to the system for students or tours? What safety considerations should you have in mind? Do you want the contractor to provide training to teachers or give a presentation to students? Do you want solar dashboards made available within certain classrooms or the hallway? Contractors aren't necessarily used to designing systems with educational components in mind, so make sure you ask for what you want.

Q: How should we best evaluate our received bids?

A: It is recommended to have your RFP team score bids individually, and then average the scores. We recommend using the draft template scoring rubric available through CREATE's Solar on School's Toolkit or MREA's Solar on School's online Resource Center which recommends scoring bids based on things such as the location of installer, industry certifications

(e.g. NABCEP), experience, diversity, and more. We recommend you utilize this as a starting point, edit, and weight the categories as desired. This will help ensure that your bids are being evaluated objectively on all of the important metrics.

Q: Where can I go to get resources to add solar into our curriculum?

- **The Wisconsin K-12 Energy Education Program (KEEP)** was created to promote energy education in Wisconsin schools. They have a host of free, downloadable solar curriculum and activities organized by grade level as well as classroom visits, hand-on lending, and partner programs. Activities are categorized by age group and offered to students in elementary through high school.
- **Center for Renewable Energy Advanced Technological Education (CREATE)** has a host of downloadable curriculum and in-person teacher training. Each of their teaching materials include teacher lesson plans, student handouts, answer keys, and resources for each of the lessons explored. Documentation is also provided for each lesson referencing the U.S. DOE Energy Literacy Standards (ELS) and the Next Generation Science Standards (NGSS). Curriculum is intended for an 8th-12th grade audience.
- **The MREA's Solar Corps initiative** has partnered with Technical Schools to help colleges across the Midwest establish solar career pathways for students. The Solar Corps is a regional workforce partnership designed to assist colleges with two common needs: providing hands-on and work-site experience for students and supporting student job placement and professional certification to advance in the solar industry.

Q: How long does the PV system last?

A: PV systems are being modeled with projected lifetimes from 20-30 years. Typically, the energy production of a PV panel decreases by about 0.5% each year. So even after 20 years, the panel will still produce roughly 80% of what it did when it was originally purchased.

Q: How can we pay for our PV system?

A: The path to solar ownership is a completely unique experience to your school's resources. Some schools fundraise for a good portion of the system, applying for grants along the way. You can also use capital budgets or reserve funds to pay for the system, tie solar into a facilities referendum or sustainability roadmaps, or utilize low-interest loans or bonds. You may also be able to utilize third-party financing mechanisms, the availability of which may vary by which utility service territory the installation will take place in. This type of ownership model allows you to purchase the energy produced from the system, with another entity owning the system at the onset. Often, you can see a savings from day one and are usually offered the chance to purchase the system for fair market value at some specified time in the future. This is not available in all areas but can provide a means for schools to go solar without paying for the entire project upfront.

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mrea midwest renewable energy association
www.midwestrenew.org

For more resources and information, visit:
MidwestRenew.org/solar-on-schools