



BRIGHTER FUTURE

A Study on Solar in U.S. Schools

Second Edition | November 2017



REPORT AUTHORS

The Solar Foundation

The Solar Foundation® is an independent 501(c)(3) nonprofit organization whose mission is to accelerate adoption of the world's most abundant energy source. Through its leadership, research, and capacity building, The Solar Foundation creates transformative solutions to achieve a prosperous future in which solar technology is integrated into all aspects of our lives. The Solar Foundation is considered the premier research organization on the solar labor workforce, employer trends, and the economic impacts of solar. It has provided expert advice to leading organizations such as the National Academies, the Inter-American Development Bank, the U.S. Department of Energy, and others during a time of dynamic industry growth and policy and economic uncertainty. While The Solar Foundation recognizes that solar energy is a key part of our energy future, it is committed to excellence in its aim to help people fairly and objectively gauge the value and importance of solar and solar-compatible technologies. Learn more at [TheSolarFoundation.org](https://www.solarfoundation.org).

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EXECUTIVE SUMMARY

Solar panels are an increasingly common sight at schools across America, providing clean and affordable electricity for students and teachers while creating new educational opportunities. In a sign of the rapid growth of solar schools, 61% of the solar capacity in K-12 schools has been installed in the last five years. A dramatic decline in the cost of solar panels has made solar schools an increasingly realistic possibility that makes financial sense.

2016 ranked as the third-largest year for school solar installations, and 2017 is on pace to finish ahead of 2016. As of the fall of 2017, there were 5,489 K-12 school solar photovoltaic (PV) installations in the U.S. This represents an addition of 1,748 new schools (or 47% growth) since the first edition of our report in 2014.

The Solar Foundation, Generation 180, and the Solar Energy Industries Association (SEIA) prepared this second edition of the report, *Brighter Future: A Study on Solar in U.S. Schools*, first published in 2014. This latest study represents the most comprehensive inventory of solar schools across America.



Photo Credit: SCUSD District, Borrego Solar

The primary goals of this report are to:

- Show the adoption rate and potential growth in solar schools;
- Help K-12 school districts and stakeholders understand the motivations and successes of current solar schools;
- Supply prospective solar schools with lessons learned from past development;
- Provide insight into the process of solar development for schools; and
- Provide a how-to guide on the solar development process so schools can install solar with greater confidence and success.

Reasons Schools Are Going Solar

We found there are many compelling reasons for schools to go solar today, including:

- *Financial considerations.* Solar is gaining ground because it makes sense financially. Declines in the price of solar and new financing options have increased the return on investment for solar development. In some

states, schools can avoid the upfront investment and ongoing maintenance through third-party ownership such as a power purchase agreement (PPA).

- *Job Creation.* Solar development creates jobs. There were more than 260,000 solar jobs in the U.S. in 2016. Solar employs slightly more workers than natural gas, over twice as many as coal, over three times that of wind energy, and almost five times the number employed in nuclear energy.
- *Educational opportunity.* Access to solar allows students to connect classroom learning with a real, working technology that is adding jobs and reshaping the energy industry.
- *Environmental and health benefits.* Solar schools offset an estimated 1 million metric tons of carbon dioxide annually, equivalent to the greenhouse gas emissions from nearly 221,000 cars.
- *Emergency response and resilience.* Solar energy can be combined with battery systems to provide onsite energy storage and backup power in times of emergency.
- *Community solar.* Schools can host or take part in shared solar projects that open solar access to other community members, such as neighbors who are unable to put solar on their roofs.
- *Student-led action.* Students have led campaigns to bring solar to their schools, gaining a valuable learning experience.
- *Schools represent the community.* Schools are a centerpiece in the community and provide a vehicle to demonstrate civic values.

Solar School Trends

Our comprehensive survey of solar in U.S. schools has found:

- Solar installations on schools have a combined capacity of 910 megawatts (MW) and produce an estimated 1.4 million megawatt-hours (MWh) of electricity annually. That is equivalent to the amount of electricity needed to power over 190,000 homes.
- The cumulative solar capacity of U.S. K-12 schools grew an impressive 86%, increasing from the 490 MW found in the 2014 report.



Photo Credit: Secure Futures

- Nationwide, 4.4% of schools have a solar installation. Nearly 3.9 million students attend one of these solar schools, meaning that 7.3% of U.S. students attend a school with solar.
- California leads the nation in school solar adoption with over 489 MW installed, representing 54% of all U.S. school solar PV capacity. New Jersey, Arizona, Massachusetts, and New York round out the top five, and combined with California, account for 87% of all K-12 school solar capacity installed.
- Arizona ranks the highest in solar watts per student. It is followed by New Jersey, California, Massachusetts, and Nevada.
- Nevada takes the top spot for percentage of schools with solar. Within Nevada, 23% of schools have installed solar. In California and Hawaii, 14.5% of schools have solar.
- Over the last 10 years, the average price of a school solar PV installation has dropped by 67%. That price trend includes a drop of 19% in 2016 alone.
- Power purchase agreements have grown to become the primary financing method in school solar adoption, representing nearly 90% of all installed school solar systems for which data is available over the last three years.
- The average school solar system size has grown from 100 kilowatts (kW) in 2010, to 200 kW in 2014, and 300 kW in 2017.

Case Studies

To illustrate the challenges and opportunities of school-initiated solar development, this report includes several in-depth case studies. The cases demonstrate that there are many ways to develop solar. It can be initiated by students or by district officials. Solar can be developed for a single school or as a districtwide effort. It can be financed through traditional debt such as bonds and loans or through third-party ownership such as a PPA.

Sacajawea Middle School, Bozeman, Montana -- An eighth-grader, Claire Vlases, led a successful campaign to raise \$115,000 to install solar on her middle school.

Washoe County School District, Reno, Nevada -- The school district is well on its way to a 20% renewable energy goal by 2020. About 12% of the district's energy consumption comes from 39 installations across 35 schools with a total capacity of 4.2 MW.

Broadalbin-Perth Central School District, New York -- The district is developing solar to help offset the costs of a \$40 million capital improvement campaign. Privately financed through a PPA, the 8,000-panel, 2 MW offsite solar array is projected to save \$5.3 million over the 25-year period.

Discovery Elementary School, Arlington, Virginia -- The school's net-zero design is a large part of the school's interactive curriculum. For example, each fifth-grade student is required to complete a research project on a specific design aspect of the school. At the end of the year, the students lead tours of the building on their topic.

Kern High School District, Bakersfield, California -- This 22 MW, privately financed project includes solar parking canopies on 27 district sites. The differential between the lower PPA rate and the higher utility rate is estimated to save the district \$80 million over 25 years.

Grayslake Community High School District, Illinois -- Through a bank loan, the district financed rooftop solar on two high schools and a third, ground-mounted system. The three systems have a combined capacity of 3 MW and can generate enough energy to cover 36% of the district's electricity needs.

Challenges and Insights

The report includes a discussion of challenges and lessons learned by schools that have already gone solar. As more schools explore the potential of solar energy, this section provides school administrators with the insights needed to make informed decisions.

Let's Go Solar! A How-to Guide for Schools

This guide provides a step-by-step outline of how to pursue solar energy development at K-12 schools, focusing on the pre-development process.

To read the full report, visit <http://www.thesolarfoundation.org/solar-schools>.



Photo Credit: Sage Renewables



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Thank you to our donors!

Photo credit: Photo by David Brown, courtesy of NC GreenPower

REASONS SCHOOLS ARE GOING SOLAR

Today, nearly 5,500 schools nationwide have chosen to go solar, a number that has increased 46% since this report was last released in 2014. There is good reason that more school districts are making that choice: Solar energy can provide a myriad of benefits for schools. One immediate benefit is that solar is often more affordable than electricity from fossil fuels. Installing solar can significantly decrease schools' electricity rates and shield them from fluctuating energy prices. For teachers, solar arrays are an excellent hands-on educational tool for science, technology, engineering, and mathematics (STEM) subjects. As the world's most abundant energy source, solar provides clean electricity without emitting air pollution or greenhouse gases, helping schools and cities meet carbon offset goals.

Having access to solar energy can also protect schools in emergencies, providing an alternate source of power in the event of an outage. Solar also presents opportunities for schools to share the costs and benefits with other community members. Finally, solar installations have often come about through student-led action, providing students an opportunity to work with school boards and other community stakeholders as they gain experience in persuasion, negotiation, and business development.

Financial Stability

Solar energy provides financial returns to schools and school districts. Stunning declines in the price of solar, as well as new financing options, have made school solar investments significantly easier. Average installed costs for U.S. school solar photovoltaic systems decreased by 67% over the last 10 years.

Schools have access to a broad set of solar financing options, including:

- Traditional debt financing such as loans and bonds;
- State financing programs designed to incentivize solar schools; and
- Third-party system ownership through power purchase agreements (PPAs).

In states where it is allowed, third-party ownership can enable schools to host solar with little or no upfront costs. Investing in solar systems can protect school administrators from unpredictable fluctuations in energy costs, providing greater certainty in funding for other budget items such as teacher salaries and educational programs.

Schools across the country have enjoyed significant financial savings from the installation of solar energy systems.

- The 1,200 kW solar arrays installed at **Rio Rancho High School** and **Cleveland High School** in New Mexico came online in November 2013. Since then, the system has saved the school district approximately \$700,000 a year, according to Patrick Dyer, the district's director of maintenance.
- In Greenfield, Missouri, the **Greenfield School District** installed a 376 kW system that is expected to reduce the electricity bill from \$8,000-\$10,000 per month to \$2,000-\$3,000 per month, amounting to more than \$3 million in savings over the next 30 years. The school district paid for the \$676,000 system through a combination of local solar rebates and state-level energy loans.¹

- In New York, the **Warwick Valley School District** broke ground in July on the largest solar project owned by a school district in the state, which is estimated to save approximately \$250,000 a year in energy costs.
- In Grayslake, Illinois, **Grayslake Community High School District** built three arrays totaling 2.9 MW, or enough to power 500 homes. Completed in 2017, the district expects to save \$10 million over the lifetime of the system (see p. 46).

Educational Opportunity

Solar technologies also provide a unique educational opportunity for teachers and students. Access to solar arrays lets students connect classroom learning to a real, working technology. Students learn about solar power, electrical systems, and energy markets. They can see a solar panel, examine an inverter, and understand a solar system on a comprehensive level. This type of hands-on training can fuel student interest in renewable technologies and improve the next generation's understanding of solar energy. The hands-on exposure to solar also builds support for clean energy for future generations.

Over the past decade, the U.S. government has prioritized science, technology, engineering, and math (STEM) education. Access to solar energy can help spike student interest in, and understanding of, STEM subjects. For example, in California at the **Antelope Valley Union School District**, school administrators incorporated information about the school district's 9,600 kW solar energy system into the science and math curricula, including a real-time, online monitoring system that tracked energy output. After participating in a week-long trial run of solar-focused science and algebra lessons, students scored an average of 60% higher on subsequent science and math tests, illustrating the effectiveness of learning aided by real-life applications.²

In Arlington, Virginia, the **Discovery Elementary** school building was built with sustainability and renewable energy in mind. The entire facility is net-zero, generating all of its energy consumption needs with onsite sources, including a 495 kW solar system. The school's net-zero design is a large part of the school's interactive curriculum. For example, each fifth-grade student is required to complete a research project on a specific design aspect of the school. At the end of the year, the students are able to lead tours of the building for school visitors (see p. 28).

In Philadelphia, two companies, Solar States and Clean Currents, began a program called the **Philadelphia Solar Schools Initiative**. The program provides daily solar energy classes at **Youthbuild Charter School**, a school dedicated to giving young adults a second chance to earn a high school diploma. The initiative has placed some students in clean energy jobs after graduation. In the future, the companies plan to install solar panels on the roofs of 20 Philadelphia-area schools.³

In North Carolina, Raleigh-based nonprofit **NC GreenPower** runs a solar schools program specifically created to educate students and raise awareness about solar power. The organization not only provides funding for systems, but also leads solar training for educators and shares sample curricula. The program has already provided solar systems for nine schools, including **Mount Pleasant High School** outside of Charlotte (see p. 17).

Environmental and Health Benefits

Schools that install solar are helping both the global environment and their local communities. As explained later in this report, most electric generation from these solar systems directly replaces electrical generation from fossil-fuel sources. The total electricity produced every year from these systems offsets an estimated 1 million metric tons of carbon dioxide annually, equivalent to the greenhouse gas emissions from nearly 221,000 cars annually or the carbon sequestered by 27 million trees.⁴



Photo Credit: Johnston City High School

Over 150 mayors across the United States have already committed to 100% renewable energy goals. Solar arrays are a useful way for schools to help meet municipal standards. For example, when Chicago committed to providing 100% of its municipal energy needs with renewable energy, the city's public schools were already leading the charge. When the renewable energy commitment was announced, a dozen Chicago public schools already had solar systems on their premises.⁵ School districts often make their own renewable energy commitments as well. For example, in Washoe County, Nevada, the school district is well on its way to reaching a stated commitment of 20% renewable energy by 2020 (see p.18).

Individual schools also set their own environmental goals as reasons for going solar. For example, **The Athenian School**, a high school in Danville, California, installed a 220 kW system as part of their effort toward environmental sustainability. Athenian is a member of the Green Schools Alliance, a consortium of public and private schools working to conserve resources and reduce greenhouse gas emissions. The solar array will avoid generating nearly 12,800 pounds of smog-producing emissions and 66,087,654 pounds of carbon dioxide. The reduction in greenhouse gases alone is the approximate equivalent of taking 55 passenger cars off California's roads each year.⁶

Emergency Response and Resilience

Solar energy can be combined with battery systems to provide onsite energy storage and backup power in times of emergency or when electricity from the grid is otherwise unavailable. In the aftermath of 2017 devastation from hurricanes in Texas, Florida, and Puerto Rico, backup power has come into increasing focus.

In Rutland, Vermont, often referred to as the solar capital of New England, **Rutland High School** serves as a solar-powered emergency shelter. Local utility Green Mountain Power built Stafford Hill Solar Farm, a solar + battery storage system, on a former landfill. The system combines 2 MW of solar panels with 3.4 MWh of battery storage. During normal conditions, the solar + storage system supports the grid and saves utility customers money by reducing peak power usage. During an emergency power outage, the system can be used to power the critical loads in the high school.⁷

In Staten Island, the New York City Department of Education emergency resilience plan includes a coastal hurricane shelter at **Susan Wagner High School**, supported by a solar + storage system on the school's grounds. During Hurricane Sandy in 2012, the school was used as an emergency shelter, and diesel generators were brought in after the power was cut. The new solar + storage system is being designed for future emergency response.⁸

STUDENT SOLAR CHAMPION

Middle School Student Leads the Charge and Raises the Funds to Bring Solar to Sacajawea Middle School

In her seventh-grade independent study class, Claire Vlases was not sure what project to undertake. Ideally, she wanted to pursue something that could improve her school, the community, and the environment. "I spend most of my time in school, and the rest of it outdoors, and it was important for me to connect the two," she said.

She decided to look into solar panels. Her school, Sacajawea Middle School (SMS) in Bozeman, Montana, was undergoing a large-scale renovation, and Claire became convinced that a solar system should be part of the process. She approached her school's principal, Gordon Grissom, and pitched the idea to him. Principal Grissom agreed to consider the proposal, but was honest about potential challenges like regulations, stakeholder approval, and, most daunting of all: funding. He talked over the idea with Todd Swinehart, the district facilities manager, and

they discussed the proposal with other stakeholders in the community. According to Swinehart, the renovated roof was built to support the load of a solar system. However, because of Montana's 50 kW system limit and the lack of dedicated funding, the district had not planned to install a system in the near future.

Claire was not deterred. In the next few weeks, Claire brought the idea to the school board at their weekly meeting. It was Claire's first experience pitching an idea to a large audience, and she admitted being nervous. Douglas Fischer, a member of the Bozeman School Board, recounts that Claire's presentation followed an update from the architects of the school renovation, explaining that the renovations would bring the school into the 21st century. Claire brought to light that a real 21st-century school needed solar panels. According to Fischer, Claire was well-prepared

Photo Credit: Rachel Leathe, Bozeman Daily Chronicle

SCHOOL:

Sacajawea Middle School

SCHOOL DISTRICT:

Bozeman, Montana

SOLAR CAPACITY:

50 kW

SYSTEM COST:

\$115,000

FINANCING:

Purchased the system with approximately 20% district funds, 70% grant funding and 10% local fundraising

PAYBACK PERIOD:

9 Years





with facts and figures demonstrating the benefits of a potential solar array. Her idea was subsequently met with interest and support from the board. Once a feasibility study was conducted at the school, the school district quickly pledged to pay \$25,000 of the estimated \$130,000 price tag.

“My favorite part about this project was that one person like me could start something small and then the project could grow and have a big impact on the community.”

Claire Vlases, Student

“SOLAR MAKES SENSE AT SMS”

To raise the remaining funds, Claire started writing grants and meeting with potential donors. She connected with the Bozeman School Foundation, which provided consulting and managed donations to make them tax deductible. Fundraising for the project continued into her 8th-grade year, when Claire got student organizations involved. She dubbed her movement “Solar Makes Sense at SMS” and created a website to share information and attract funds. Claire explained, “Solar benefits everyone, so I tried to make the campaign something everyone could participate in.”

At school, Claire and other students raised \$11,000 toward the solar panels. The students organized a talent show and a “Pennies for Power” homeroom competition. Claire’s sister, a 6th grader at the time, raised \$3,000 by applying for a grant from the

Bozeman Area Community Foundation’s Youth Giving project. In May 2017, the estimated price of the system had dropped to \$115,000, and an \$80,000 grant from the Kendeda Fund put the project over the edge.

LASTING IMPACTS

Installation of solar panels at Sacajawea Middle School is expected to begin in 2017, and the system is to pay for itself in nine years. An informational kiosk will be set up in the school to inform visitors about the solar project.

“My favorite part about this project was that one person like me could start something small and then the project could grow and have a big impact on the community,” Claire said.

After Claire presented her idea and challenged the school board to pursue solar, the conversation about energy and sustainability in the school district completely shifted. The potential for solar and other renewables is now heavily considered in the design of new construction and renovation of school facilities. Currently, an open-loop ground source geothermal system is being considered for a new high school. The leftover money raised for Sacajawea Middle School’s solar system is now earmarked for a new solar array in the school district. The initiative started by one middle school student will have a long-lasting impact on the school and greater community.

Claire’s advice to others pursuing this type of project? She says, “Never give up. Even if it seems like a lot of hard work, it will pay off.”

Meanwhile, in California, Generate Capital and Sharp Electronics Corporation's Energy Systems and Services Group announced planned construction of a six-site solar + storage project at the **Santa Rita Union School District** in Salinas, California. The initiative is supported by California's Self-Generation Incentive Program, which is focused on bringing more storage to California's energy system. The solar + storage system will allow the school district to cut energy costs and reduce its utility demand charges. In addition, the system will provide critical backup power to schools in the event of a power outage.

Community Solar Opportunities

Schools are beginning to take advantage of community solar.⁹ Shared community solar projects are intended to open solar access to a variety of stakeholders, such as residents who are unable to put solar on their roofs. Community solar can be provided in a variety of formats. For example, a utility or third party can develop, own, and operate a solar project that is open to participation through purchase of "blocks" of a certain amount of electricity per month. They typically participate in either a Special Purpose Entity (SPE) model, where individuals join in a business enterprise to develop a shared solar project, or a nonprofit model, where a nonprofit organization oversees a shared project on behalf of donors or project members.

The **Sidwell Friends School** in Washington, D.C. worked with the national installer SolarCity (now Tesla) to install solar panels on school rooftops, and with nonprofit Common Cents Solar to cover the costs via a shared "solar bonds" strategy.¹⁰ The school and Common Cents Solar marketed solar bonds to parents, friends, faculty, alumni, and investors, who purchased them in increments of \$5,000 to collectively own the solar energy system and earn a modest rate of return on their investment of around 10 years. The 27.6 kW system cost a total of \$200,000.¹¹ After the system is fully paid off, the investors will convey the system to the school as a charitable deduction.

Student-Led Action

In some cases, schools have gone solar because of student-led campaigns. This avenue gives student leaders relevant skills in fundraising, campaigning, cost analysis, and public speaking. Students that lead solar campaigns have even gone on to pursue a career in the industry. In the Spring of 2013, high school senior Amory Fischer launched a campaign in favor of solar at **Albemarle High School** in Charlottesville, Virginia. In the fall of 2014, Albemarle County Public Schools issued a request for proposal for a solar power purchase agreement. The contract was awarded in spring of 2015 to Staunton, Virginia-based company Secure Futures. The company installed a total of 1.1 MW in 2016 at Albemarle High and five other county schools.¹² Already in college at Virginia Tech at that time, Fischer was brought on as an intern at Secure Futures and hired as a program coordinator after graduation.¹³ Fischer has passed down his knowledge to a new generation of student leaders by offering assistance to Virginia students who also want to bring solar to their schools.



Virginia's governor joins Amory Fischer at his school's solar installation ribbon cutting

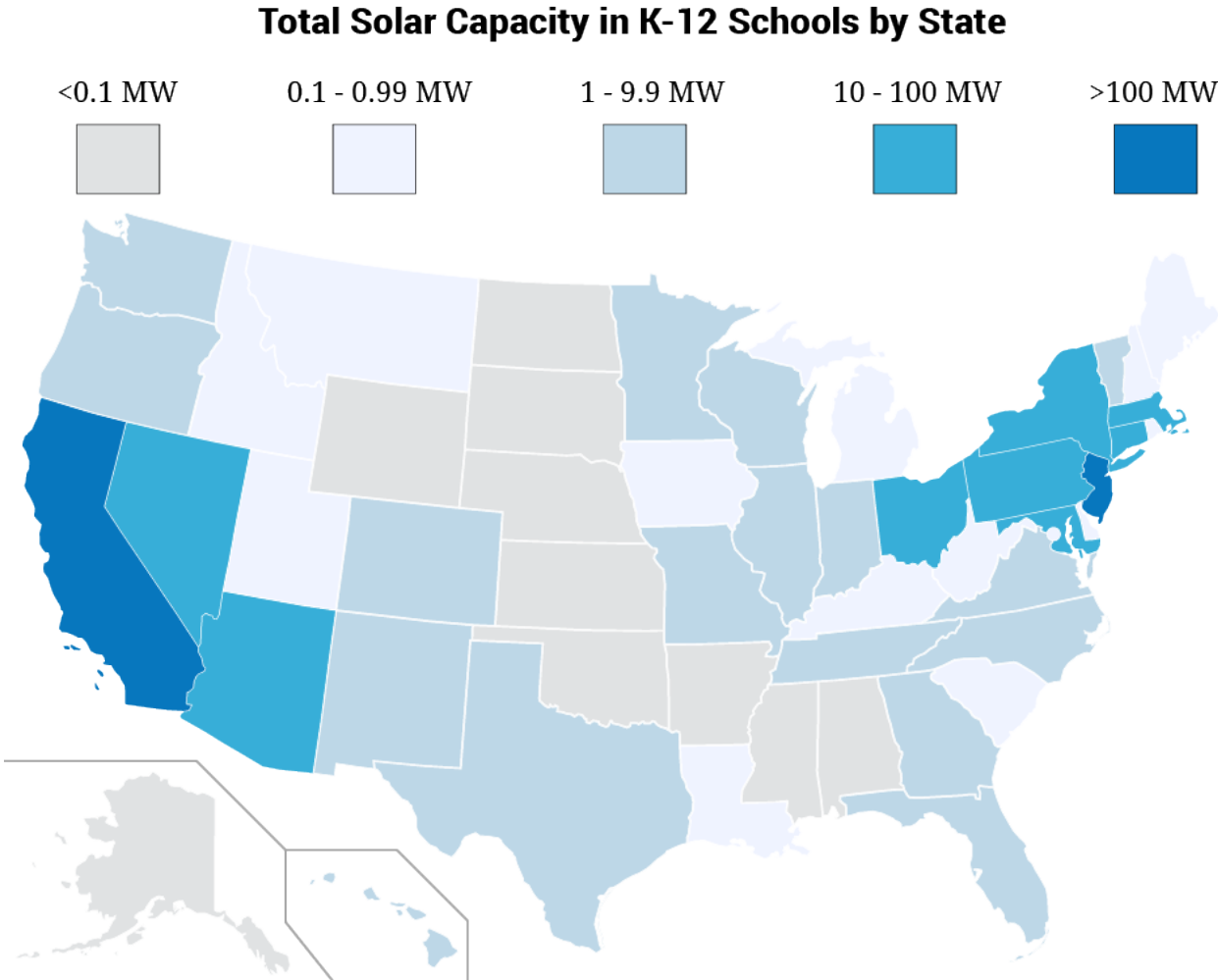
Across the country in Bozeman, Montana, an eighth grader, Claire Vlases, led a campaign to raise \$115,000 to install a solar system at **Sacajawea Middle School**. Throughout the process, Claire negotiated with the school board, organized cost analyses, and obtained grants from multiple sources. The panels will be installed in the fall of 2017, and are expected to pay for themselves in 9 years. For her leadership of this project, Claire won a community champion award from the U.S. Green Building Council of Montana and was invited to the governor's SMART School Symposium (see p.12).

COUNTING SOLAR SCHOOLS COAST TO COAST

The first edition of this report, released in 2014, provided the first comprehensive accounting of solar adoption by K-12 schools across the country. In this second edition, we've used a similar methodology to track school solar adoption since 2014, while taking advantage of new data sources to further populate our original database. These efforts have yielded the most comprehensive tally of solar schools available today.

This section of the study will examine the trends driving K-12 school solar adoption in the U.S., highlighting the dramatic increase in schools going solar. We look at the rapid changes in system pricing, purchasing behavior, and system characteristics that have impacted the market over the last several years. Additionally, we'll examine the potential for growth in school solar adoption as the market moves past early adopter communities and into the mainstream marketplace.

Figure 1: School Solar Installations by State



Overview

As of October 2017, there are 5,489 K-12 school solar installations in the U.S., including 5,458 solar PV installations and 31 solar water heating (SWH) installations. This represents an addition of 1,748 new schools since the first edition of our report in 2014. Overall, these PV installations have a combined capacity of 910 MW and produce an estimated 1.4 million MWh of electricity annually. That is equivalent to the amount of electricity needed to power over 190,000 homes.

In most of these schools, electric generation from solar systems directly replaces electrical generation from fossil-fuel sources. The total electricity produced every year from these systems offsets an estimated 1,030,873 metric tons of carbon dioxide annually, equivalent to the greenhouse gas emissions from nearly 221,000 cars or the carbon sequestered by 27 million trees.¹⁴

Of the more than 125,000 public and private K-12 schools nationwide, 4.4% of these schools have a solar installation. Nearly 3.9 million students attend one of these solar schools, meaning that 7.3% of U.S. students attend a school with solar. Nationally, there are roughly 17 watts of installed solar capacity for each student.

These projects include an important economic development component as well. Schools have spent nearly \$3.6 billion to construct projects that not only lead to billions in savings on electricity bills, but also help create thousands of well-paying jobs in the communities served by the installations.

These solar installations are not distributed evenly across the country due to differences in solar resources, state-level policy, solar market presence, and electricity prices. California leads the nation in school solar adoption with over 489 MW installed, representing 54% of all school solar PV capacity. New Jersey, Arizona, Massachusetts, and New York round out the top five, and combined with California, account for 87% of all K-12 school solar capacity installed.

Several smaller states are ranked highly when solar PV capacity is considered on a per-student basis, with Hawaii, Vermont, Connecticut and New Mexico each breaking into the top 10 ahead of states with larger student populations. Nevada takes the top spot for percentage of schools with solar, due to its strong solar resource and high student per school ratio. Within Nevada, 23% of schools have installed solar. In California and Hawaii, 14.5% of schools have done so. Details on the top 10 states in terms of system count, installed capacity, and per-student and per-school ratios are available in the following Tables 1-4, while a complete listing of these rankings for all states is available in Appendix B.

Tables 1 - 3: Top 10 State Rankings by Installed Capacity, System Count and Watts per Student

Rank	State	Installed School Capacity (kW)	Rank	State	Number of Schools with Solar	Rank	State	Installed Watts per Student
1	CA	489,280	1	CA	1,946	1	AZ	86.27
2	NJ	131,401	2	NJ	487	2	NJ	82.95
3	AZ	97,590	3	AZ	378	3	CA	72.84
4	MA	53,820	4	IL	337	4	MA	49.86
5	NY	21,749	5	MA	261	5	NV	33.30
6	NV	15,256	6	NY	204	6	HI	23.31
7	CT	13,386	7	NV	190	7	VT	21.87
8	MD	12,283	8	FL	181	8	CT	21.34
9	PA	10,892	9	WI	161	9	MD	12.47
10	OH	10,357	10	CT	118	10	NM	10.15



Photo Credit: AOES Academy, Mt. Pleasant High School



NONPROFIT FUELING SOLAR EDUCATION AT NORTH CAROLINA SCHOOLS

In 2015, the Raleigh, North Carolina-based nonprofit NC GreenPower (NCGP) launched a solar schools pilot program to raise awareness about solar energy and bring new learning opportunities to schools across the state. When developing the project, the nonprofit consulted with focus groups of educators and collaborated with the National Energy Education Development Project (NEED) to solidify a solar curriculum in line with state-level standards. After a successful pilot, the program continued. It has provided nine schools with 5-kW, pole-mounted solar systems. Five more installations are planned for this year.

Participating schools are required to raise \$10,000. They subsequently receive matching grants from both NC GreenPower and the NC State Employees' Credit Union Foundation.

In addition to funding the systems, NC GreenPower provides monitoring equipment, as well as educational resources for teachers and students. The teacher training includes a comprehensive overview of solar energy, various experiment and project examples, and a packet of resources for developing solar-focused classes including NEED's curriculum plans.

At Mount Pleasant High School outside of Charlotte, the solar system was a very welcome addition. Mount Pleasant houses

the Academy of Energy and Sustainability (AOES), a new 4-year program for students interested in engineering, energy systems, and sustainable solutions. The academy runs under the umbrella of the National Academy Foundation (NAF), and is one of several programs created to prepare high school students for jobs of the future. Program leaders and teachers regularly meet with an industry advisory board to ensure that curriculum materials are updated with the latest technologies and standards.

Students will form a monitoring committee that will regularly provide updates on the system to NC GreenPower and the rest of the student body. The panels will also be incorporated into a new course focused on renewable energy called Green Methods.

Academy coordinator Lyndon Westmoreland hopes to make the system's monitoring platform accessible not only to the Academy, but also to the entire Mount Pleasant school. He says that the system will be an extremely valuable contribution to the academy's mission: "Students now have access to live data and can better grasp the dynamics of solar energy. They will be able to understand how much energy the system produces over time, and examine the viability of adding more solar to the energy mix down the line."

COMMITMENT TO RENEWABLE ENERGY

Nine Years of Successful Solar Development Leads to 20% Renewable Energy Goal at Washoe County School District

With solar on over a third of its schools, Washoe County, Nevada, is one of the largest districts in the country to commit to going solar. It all started in 2008. The school district partnered with Black Rock Solar, a Burning Man Festival-affiliated nonprofit, to install the solar panels used during that year's festival for two adjacent schools. By 2017, solar was meeting 12% of the district's energy needs. Most of the installations are mounted on rooftops or shade structures over parking lots.

Solar energy has and will continue to be a big part of the district's sustainability goals. "The district is committed to 20% renewable by the year 2020," notes Dr. Jason Geddes, the district's energy and sustainability manager.

EXPLORING NEW OPTIONS

The district is exploring additional ways to develop solar power but has hit some bumps. They are interested in building larger solar farms to serve multiple schools, but it is challenging, Geddes explained. "With our schools being spread out over a large geographic area, it has been difficult to take advantage of a larger, more cost-effective solar installation. Entering into an agreement with the utility to connect our schools to a single solar farm has been too complicated, requiring individual utility price negotiations for each school, making it almost impossible to get an upfront price." Things are improving. NV Energy now has agreed to a straight tariff, reducing the need for such extensive negotiations.

Edward Reed High School has the largest solar array in the district at just over 1 MW.



SCHOOL DISTRICT:

Washoe County

DISTRICT SIZE:

64,000 Students in 93 Schools

LOCATION:

Reno, Nevada

SOLAR CAPACITY:

4.2 MW on 35 Schools

FINANCING:

Bonds, utility rebates, capital improvement funds, American Recovery and Reinvestment Act (ARRA) funds

ELECTRICITY CHARGES:

Standard commercial rates including demand charges



Stead Elementary School's 125 kW array allows 100% of savings to stay at this Title I school.

The district would like to develop community solar power to allow multi-family buildings and homes to access clean energy. However, this idea has been temporarily shelved following the Nevada governor's decision to veto legislation that would accommodate community solar.

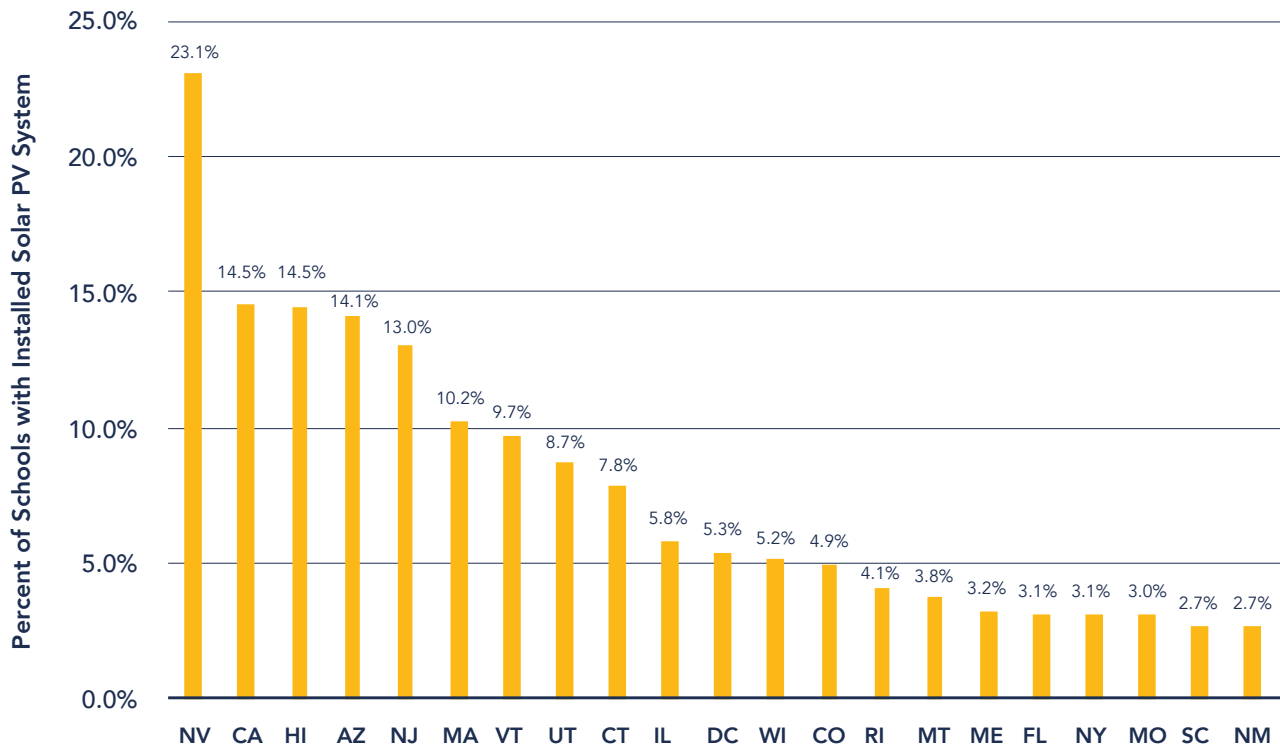
Looking to the future, the district is considering power purchase agreements (PPAs), which offer the district the most flexibility when it comes to funding, requiring little cost upfront. Fewer funds are available for solar since, with the district schools overcrowding, capital funds are being dedicated to new school construction. Utilizing PPAs will allow the district to continue installing solar on its schools to reach their 20% renewable target.

One piece of advice Geddes has for other districts is to work on energy efficiency before moving to solar. This, he says, allows for schools to build up more support to have district improvement funds released for solar projects.

STATE AND NONPROFIT SUPPORT FOR LOW-INCOME SCHOOLS

As a low-income school district, Washoe County was eligible for the utility NV Energy's Lower Income Solar Energy Pilot Program (LISEPP). In 2016, Stead Elementary was one of eight schools that participated in the program, receiving a 125 kW solar array. This ground-mounted system offsets 66% of the school's energy consumption. Through the LISEPP program, schools are provided solar panels at no cost by NV Energy and no-cost installation by Black Rock Solar. All the energy savings are given back to the school, with 75% of the total being unrestricted and the remaining 25% set aside for the operation and maintenance of the solar array.

Figure 2: Percentage of Schools with Installed Solar PV Systems, by State



Historical Trends

K-12 Solar School adoption is a relatively recent trend. 99% of all school solar capacity has been installed in the last 10 years and 61% has been installed in the last five. From 2006-2016, the compound annual growth rate (CAGR) for school solar adoption was 66%. Though this has leveled to 33% over the last five years, 2016 ranked as the third-largest year for school solar installations with 131.6 MW installed, and 2017 is on pace to finish ahead of 2016 with 110.5 MW installed through the first three quarters (See Figure 3).

School solar adoption peaked in 2012 and 2013 as American Recovery and Reinvestment Act (ARRA) funding, utility and nonprofit grant programs, and state and local incentive programs all began to expire, thereby pulling demand into those years. More recent growth is expected to continue, due primarily to rapid declines in cost and greater availability of financing options.

As Figure 4 illustrates, over the last 10 years, the average price of a school solar PV installation has dropped by 67%. That price trend includes a drop of 19% over the last year alone. A school can now purchase a 500 kW solar PV system installed at the same price needed to install a 200 kW system in 2012. These price drops align closely with those observed in the broader non-residential solar PV market (which includes commercial, industrial, nonprofit, and government installations) and those observed in the solar PV industry at large.¹⁵ These price drops have emerged primarily from reductions in hardware costs, such as in the solar module and the racking system, but also in reduced installation labor costs derived from improvements in productivity.

The relatively small difference observed in pricing between school systems and the broader non-residential segment is primarily explained by the presence of carport systems, especially in California. These systems carry a price premium over conventional rooftop systems due to the construction and materials cost related to

Figure 3: Annual and Cumulative K-12 School Solar Adoption

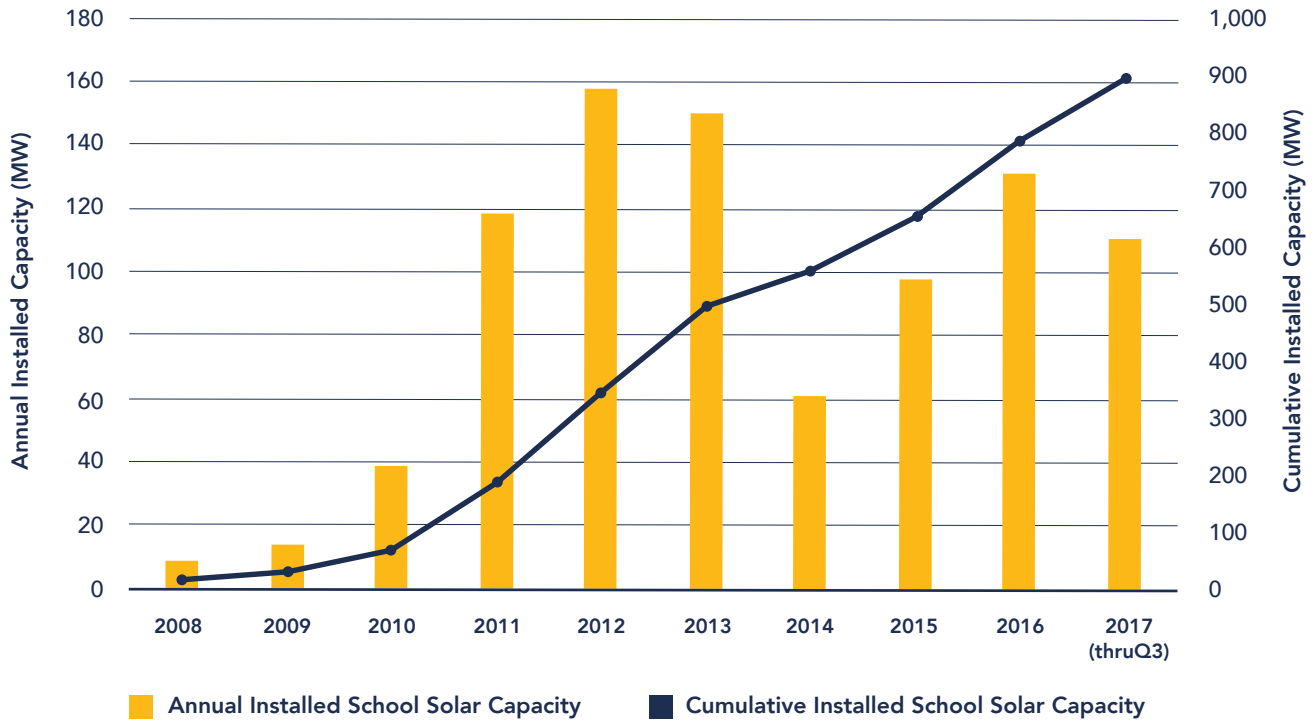
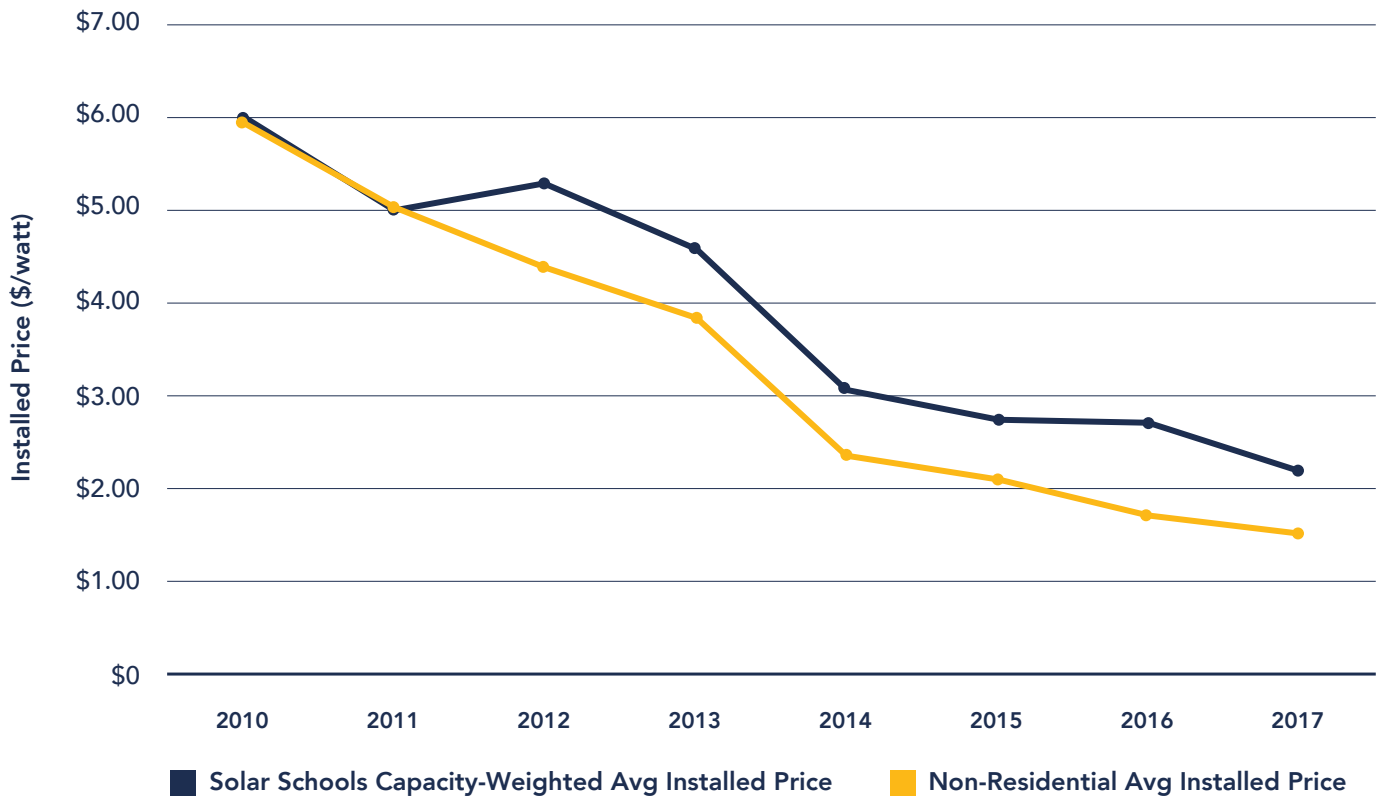


Figure 4: K-12 School Installed Solar Price vs Non-Residential Installed Solar Price



the actual carport structure. Still, the systems have proved popular as dual-purpose structures, providing both electricity and important shading in a hot climate. While data on structure type is not complete, we find that most school solar PV systems in California have included carports over the last four years. Figure 5 illustrates this shift toward carport systems over recent years.

The effect of the carport price premium on average installed school PV system prices is offset somewhat by the larger average system sizes seen in school PV systems relative to non-residential systems. As large electricity users, PV system sizing for schools was formerly determined primarily by what a school could afford. As prices have dropped and new financing options have become available, price is less of a limiting factor. Today, site characteristics and electricity load are the dominant factors in determining appropriate system size.

As the size of a PV system increases, price generally falls correspondingly, in line with basic economies of scale principles. Because the average size of a school PV system has increased faster than that of a non-residential system, non-carport school solar PV prices will track lower. Figures 5 and 6 illustrate this trend.

In addition to sharp declines in the price to install a solar PV system, system size has been growing due to a change in the way projects are financed. From 2005-2009, projects below 5 kW were the most common system size, with significant shares of these projects existing into 2014. Most of these projects were funded by state, utility, and nonprofit grants and were aimed more at introducing students and communities to solar energy than at offsetting significant electricity usage. As the price of solar fell, increased demand and increases in capital availability led to the emergence of the PPA as the dominant mechanism by which tax-exempt schools procured solar. Because these systems are aimed at cost savings, increasing the scale of the system often improves the payback rate and total lifetime return on investment.

Figure 5: California Solar School Mounting Type

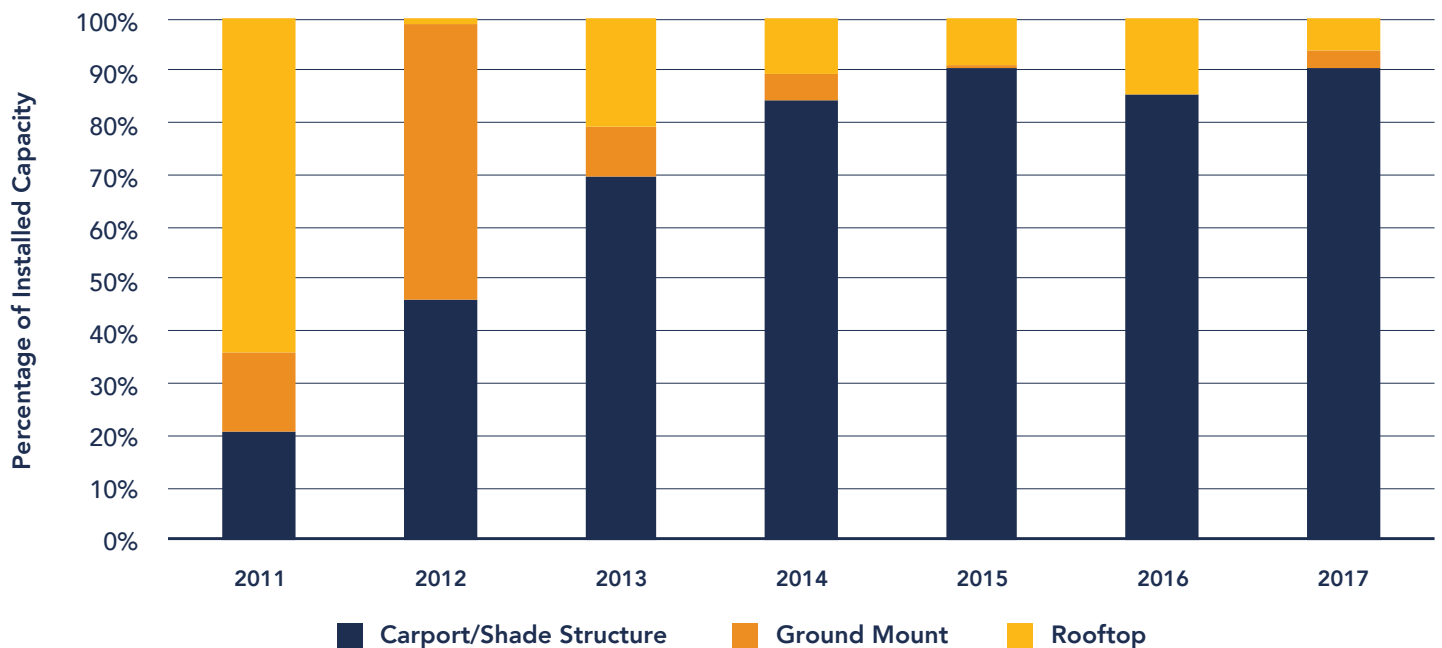
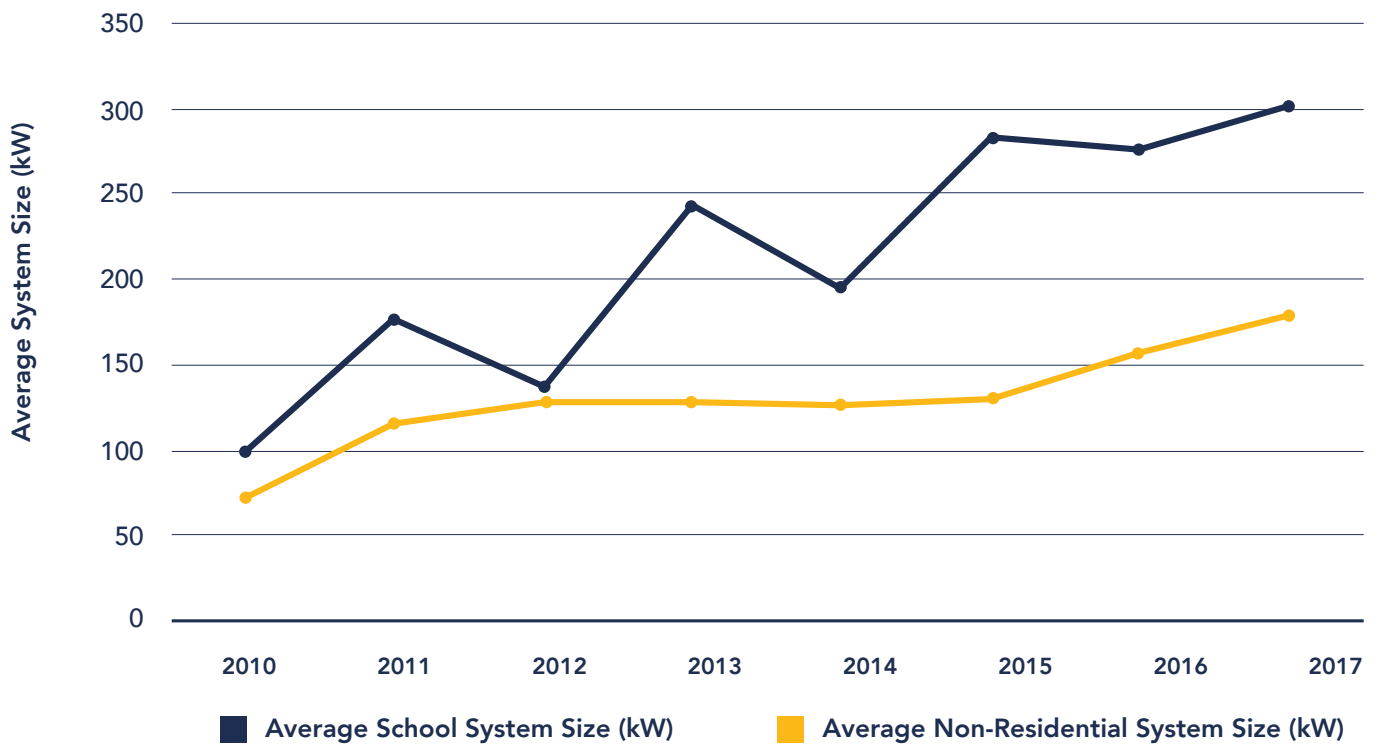




Photo Credit: Secure Futures

Figure 6: Average School Solar PV System Size vs Average Non-Residential Solar PV System Size



SOLAR SUPPORTS CAPITAL IMPROVEMENTS

Solar Array Will Offset 100% of Utility Costs at Broadalbin-Perth Central School District

The Broadalbin-Perth Central School District is in the midst of a \$40 million capital improvement project to modernize classrooms, develop new sports fields, and address district infrastructure needs in each of its four schools in upstate New York. 80% of project costs are being paid through state building aid, with the remaining 20% covered by local taxpayers.

To help pay for the capital improvements, the district is installing an offsite solar array on 10 acres owned by the district. The school district's solar development is projected to generate enough revenue to offset a portion of the debt service on the bonds issued for the local share of the capital improvements. After two years of pre-development work, construction is expected to begin in the fall of 2017.

The district selected Buffalo-based Liberty Solar for a 25-year power purchase agreement (PPA). The arrangement is projected to save \$5.3 million over the 25-year period, based on the lower rate that

the district will pay Liberty Solar for solar power compared to the rate the district would have paid to the utility.

NET METERING CHALLENGES

The 8,000-panel, 2 MW solar array will offset 100% of the district's annual utility costs through remote net metering at the retail rate. Remote net metering will allow the school to sell electricity back to the grid for a direct monetary credit to the district, rather than the kWh credit that is commonly provided for onsite net metering from behind the meter. Thus, the district will offset demand charges which might have been an additional cost if the system were onsite (without energy storage).¹⁶

However, in 2017, the state net metering rates changed to a less favorable value of solar rate, which would reduce the amount of monetary credit provided to the district. Therefore, the district



NEW YORK K-SOLAR PROGRAM: BUYING CONSORTIUM FACILITATES SOLAR SCHOOL DEVELOPMENT

The K-Solar program is a large, multi-agency solar "buying consortium" for New York schools. A joint program of the New York Power Authority (NYPA) and New York State Energy Research and Development Authority (NYSERDA), K-Solar issued an RFP and selected solar vendors who "met eligibility and capacity requirements."¹⁷ Vendors provide PPAs to participating schools and NYPA provides

free assessment and advisory services. As of June 2017, 25 districts had signed PPAs and one school, Somers Middle School in Westchester County, has a new 120-kW rooftop solar system.¹⁸ NYPA also provides materials and workshops for teachers to include renewable energy in their curriculum. All public school districts and non-public K-12 schools are eligible.¹⁹

**SCHOOL DISTRICT:**

Broadalbin-Perth Central School

LOCATION:

Portions of Fulton, Montgomery and Saratoga Counties, New York

DISTRICT SIZE:

Four Schools

SOLAR CAPACITY:

2 MW on 10 Acres Offsite

FINANCING:

Power Purchase Agreement (PPA)

PROJECTED SAVINGS:

\$5.3 Million Over 25 Years

needed to move quickly to be grandfathered in at the favorable rate. The district also sought state incentives which rewarded early applicants. The sooner that the contractor agreement was reached, the sooner that they could apply for the state incentive program.

There were many challenges to overcome. It took about six months to prepare and approve the request for proposal (RFP), solicit and evaluate bids, and select and negotiate an agreement with the contractor, Liberty Solar. It took another 12 months for the installer to secure environmental and interconnection approval and the building and other permits. (In New York, school development requires permits from the state education department rather than the local government.) While it took longer than anticipated, the district's solar development was grandfathered in at the favorable rate.

INTERCONNECTION CHALLENGES

Interconnection is especially challenging since both the cost and the time that the process will

take are uncertain. "It's a huge problem. I've seen interconnection costs range from \$132,000 to \$1,400,000," said Gillian Black, a representative of the architectural firm CSArch who advised the district through the process. "And the developer doesn't know the costs until they've committed \$100,000 to \$300,000 into the project." He says that utilities are making interconnection costs more predictable. Given the likely magnitude of the costs, the developer was required to set aside a 10 cent per watt allowance for interconnection. Subsequent RFPs issued by CSArch have included a 20 cent per watt interconnection allowance.

The Broadalbin-Perth School District is excited about the educational benefits of the solar array. In fact, the RFP included an educational component. An energy dashboard will provide website metrics on solar performance for instructional purposes. Furthermore, Liberty Solar is working with the teachers to develop a solar-related curriculum.

Figure 7: School Solar PV System Size Distribution by Percentage of Total Systems

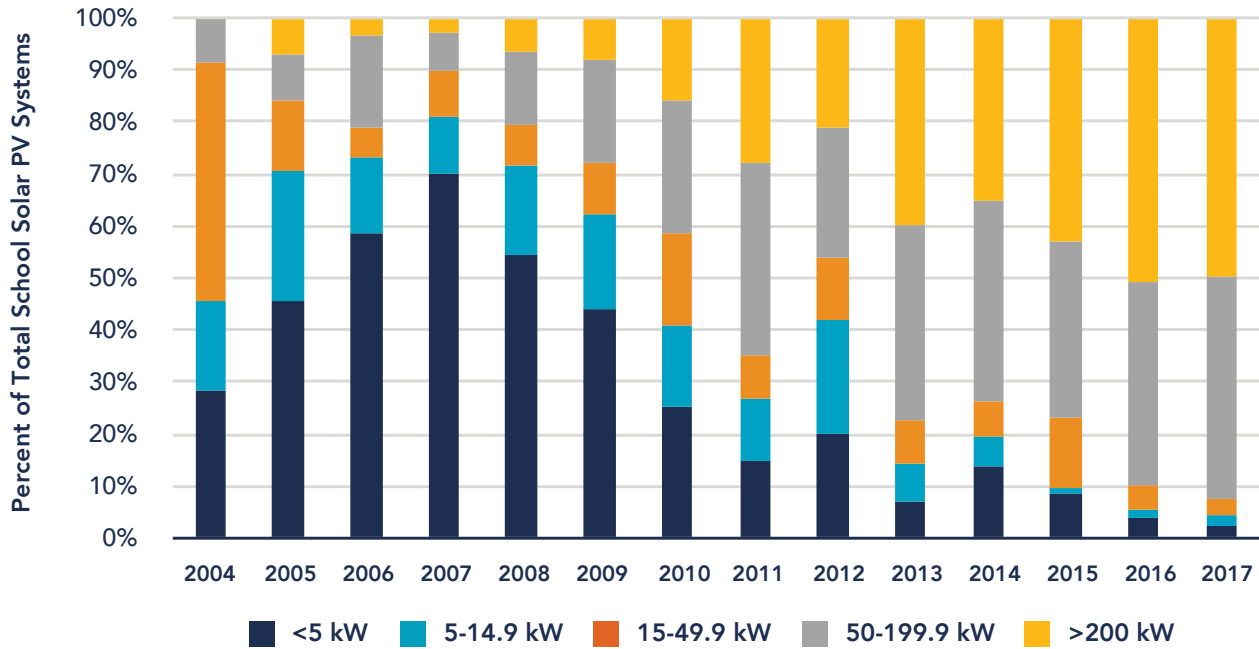


Figure 8 demonstrates the relationship between system size and financing type, while Figure 9 shows how PPAs have grown to become the primary financing method in school solar adoption, representing nearly 90% of all installed school solar systems for which data is available over the last three years.

Figure 8: School System Size Distribution by Financing Type

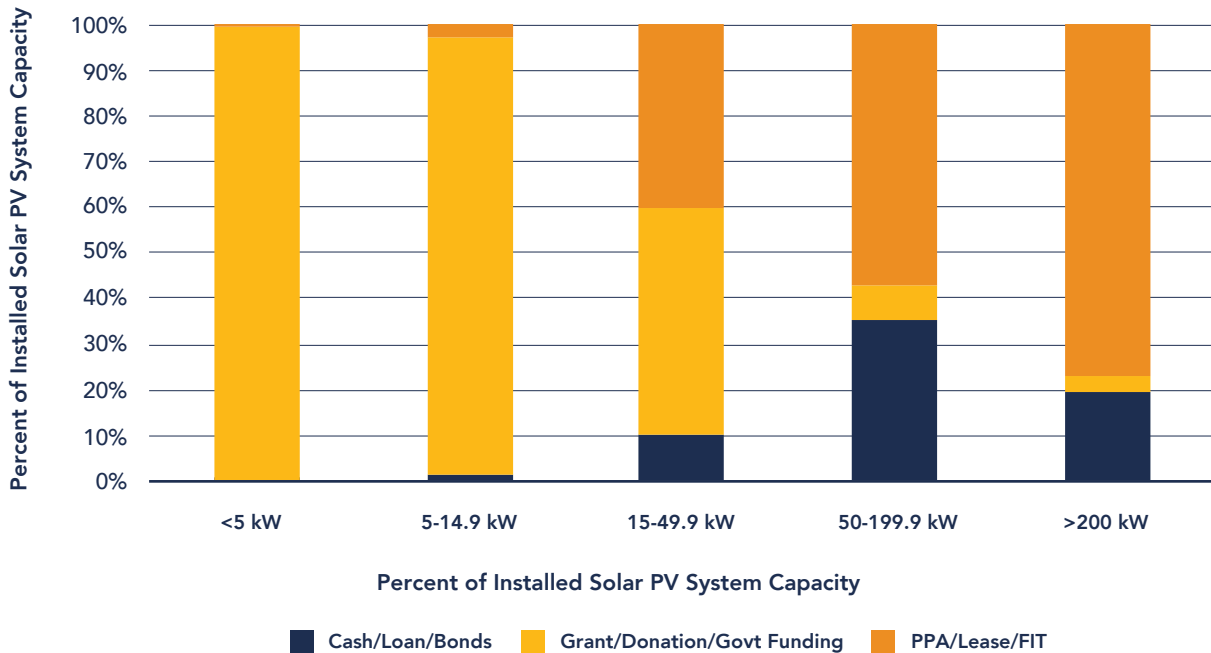
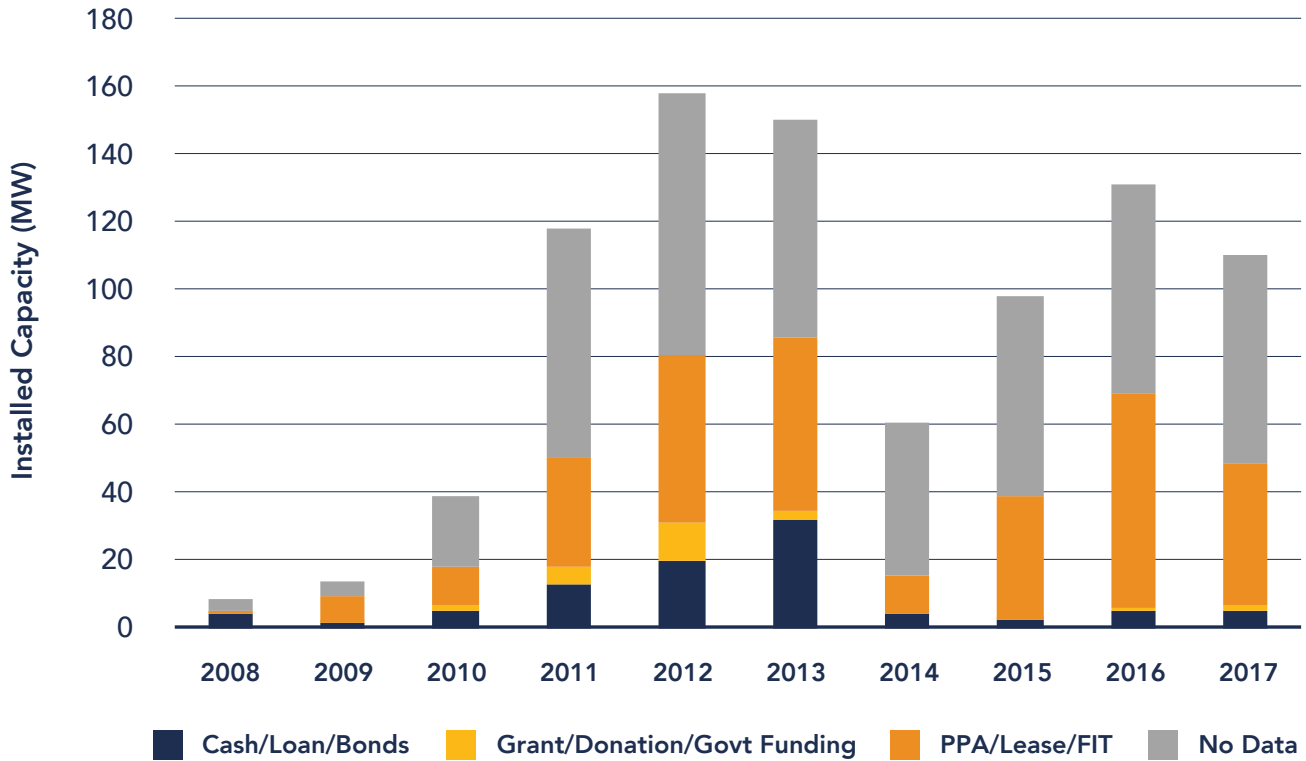


Figure 9: Annual Installed School Solar Capacity by Financing Type



STUDENT ADVOCATE

As a sophomore at San Mateo, California’s Aragon High School, Jason Bode thought that the school’s flat roof was ideal for solar. But how could he convince school officials? He didn’t think that his recycling club had enough cache, so he decided to create a more official-sounding organization. Seeing little appetite for solar, he called it the Environmental Impact Committee. He created official letterhead and convinced the principal and some faculty to join the student members. By chance, a school board candidate canvassed his house, and Jason landed another committee member -- a future school board member.

With the committee, Jason could keep solar at the top of everyone’s mind.

A local congresswoman organized a competition for ideas for funding support. Jason convinced the committee to propose a solar project for their school. The proposal was one of five finalists but didn’t win; however, now there was a heightened awareness of solar. With the need to show a revenue stream in a school bond issue, the school board latched on to solar. The bond included an energy retrofit and solar on six district schools. At the ribbon cutting, Jason returned from college to speak.

His advice for other students who wish to advocate for solar? “Find a way to amplify your voice, such as establishing a committee of key stakeholders and using their names to create letterhead. Be patient but be persistent so when the moment arrives, you’re ready and decision makers can move forward.”

STUDENT TOUR LEADERS

New Net-Zero School Enhances Student Learning Experience at Discovery Elementary

Expanding school districts are uniquely suited to benefit from solar energy and sustainable design. Designing a new school building that incorporates these elements from the very start is a very cost-effective way to adopt solar energy. Arlington County Public Schools took this under consideration while developing the district's strategic plan, which was necessary to accommodate increases in enrollment. With optimal learning environments, sustainability, and environmental stewardship as key goals, the Discovery Elementary Build Committee seized the opportunity to construct an entirely new school with solar energy and sustainable features.

DEVELOPMENT

From the outset, Discovery Elementary was designed to be a net-zero building, offsetting all energy consumption with onsite generation. To achieve this, Discovery Elementary installed a 495 kW system comprised of roughly 1,700 roof-mounted solar panels. John Chadwick, associate superintendent and facilities manager, estimates the school saves nearly \$100,000 annually from the solar installation even with a \$1,000 per month interconnection fee.

To secure net-zero energy use, the solar array is used in conjunction with multiple sustainable features designed to increase energy efficiency. Solar thermal water heating allows the school's kitchen to waste less energy to heat water, while the geothermal pumps aid in the school's heating and cooling. Furthermore, Discovery Elementary uses a combination of LED lighting and skylights to minimize energy expenditures on lighting. With these sustainability features, Discovery Elementary produces an energy surplus, allowing the school to offset some of a neighboring school's energy consumption.

"If the building itself is designed as an integrated system from the outset, it should not cost any more than a traditional school building to make it ready for zero energy."

John Chadwick, Associate Superintendent and Facilities Manager

Photovoltaic arrays at Discovery Elementary School © Lincoln Barbour





SCHOOL:
Discovery Elementary

SCHOOL DISTRICT:
Arlington County Public Schools

LOCATION:
Arlington, Virginia

SOLAR CAPACITY:
495 kW on Rooftop

FINANCING:
Bonds for New Construction

SAVINGS:
\$100,000 Annually

Light is celebrated in multiple ways throughout the school, culminating in a rooftop solar lab that allows students to conduct real time and ongoing experiments. © Lincoln Barbour

Discovery Elementary was funded with school bonds. The solar panels were bid as an alternate, and were approved for inclusion in the project by the school board once it was shown that they could be installed within the original budget. While Discovery Elementary owns the solar panels, Arlington County Public Schools has indicated a preference for utilizing a power purchase agreement (PPA) for future construction to lower the cost even further.

The school district is moving away from the traditional Design-Bid-Build process they used with Discovery to the more predictable Construction Management at Risk process. Chadwick is confident this new procurement method will reduce the risk of project delays, budget overruns, and poor quality construction, which can jeopardize energy goals. This is accomplished through hiring the construction team along with the architecture/engineering team to ensure everyone is working together as a team from the beginning.

EDUCATIONAL BENEFITS

Discovery Elementary's net-zero design has provided substantial educational benefits. As part of the development, the architects and engineers of the project, VMDO and CMTA, created a comprehensive energy dashboard. It is viewable on the school's website and in the classrooms, providing real-time information related to the school's sustainable

practices. The dashboard shows the amount of energy produced and consumed, the number of riders per transportation mode, and the amount of waste created.

The dashboard and sustainable features are often used by teachers to facilitate learning. The school's administration believes that the school's design makes students more aware of environmental issues. Every fifth-grade student researches different design features of the school, and toward the end of the semester they lead tours on their topic. The dashboard has been used to start conversations, Principal Erin Russo explains. "Teachers will ask their students why the car ridership might have been higher today than the previous day, and the students will debate it to come up with theories on why that was the case."

The success of Discovery Elementary's solar energy and sustainable design can be attributed to strategic planning and finding the right team. Chadwick stressed the importance of a good team, stating: "It is absolutely vital to have the right team and use an integrated approach to get the best result [out of a net-zero building]. The fear will be the cost. If the building itself is designed as an integrated system from the outset, it should not cost any more than a traditional school building to make it ready for zero energy. If the school division cannot then afford to buy the solar panels outright, it may obtain them through a PPA."

Market Opportunities

Though school solar adoption has continued to grow in recent years, America’s schools are only beginning to realize their potential for going solar. Only 4.4% of K-12 schools in the U.S. have installed solar, and only six states have solar installed at 10% or more of their schools, while 18 states have solar installed at fewer than 1% of their schools. While some of this disparity is due to poor solar resources in specific areas, or barriers posed by state or local policy, many schools are simply unaware of the benefits provided by a solar energy installation. Installations at a neighborhood center, like a school, can serve as a base for entire communities to learn about solar, potentially creating the same kind of ‘neighborhood effects’ demonstrated in residential solar adoption.²⁰

While solar adoption opportunities abound for schools in most markets, particular school types and markets are underrepresented in the existing distribution of K-12 school installations, as Tables 4 and 5 show below. Only 12% of school installations occur in schools in non-metropolitan counties (i.e. micropolitan or rural) even though these areas represent 23% of schools nationwide.²¹ There is a similar disparity in the number of solar installations at private schools, which make up only 8% of schools with solar despite representing 22% of schools nationwide. Conversations with installers indicate that private schools can sometimes be easier to work with due to a smaller group of decision makers and a more streamlined decision-making process. When that is the case, private schools should consider seizing the opportunity to install solar and take advantage of its many benefits.

Table 4: K-12 School Solar Adoption, Metro vs Non-Metro

School Type	Solar Schools	All Schools	Percent with Solar
Metro	4,616	95,646	4.8%
Micro	393	15,708	2.5%
Rural	240	13,779	1.7%
All	5,488	125,589	4.4%
Percent Non-Metro	11.5%	23.5%	

Table 5: K-12 School Solar Adoption, Private vs Public Schools

School Type	Solar Schools	All Schools	Percent with Solar
Private	457	27,706	1.6%
Public	4,820	97,672	4.9%
All	5,488	125,589	4.4%
Percent Private	8.3%	22.1%	

Methodology

Data for this report was collected between June and October 2017 and added to the original K-12 school database created for the 2014 edition of this report. The bulk of this information was sourced from publicly available data provided by state incentive and net metering programs, utility and nonprofit-sponsored solar school grant programs, and the National Renewable Energy Laboratory's Open PV Database.²² Additional data was provided by SEIA member companies. These bulk data sources were supplemented by targeted state-level research into press releases and other publicly available materials describing solar school adoption. Data was cross-checked across sources and database editions to prevent double counting and to verify new sources, when necessary.

The original database was built around a complete listing of private and public U.S. K-12 schools, maintained by the Department of Education's National Center for Education Statistics. A full listing of data contributors is provided in the Acknowledgements section on page 1.

While we have made every effort to ensure this database is as complete as possible, the distributed nature of these systems makes a completely comprehensive accounting of school solar adoption impossible at present. We invite readers to contribute to this effort by providing any new data or updates at www.gosolarschools.org.



Solar awning at Herrin High School in Herrin, Illinois. Photo Credit: WindSolar USA



STATE POLICIES MATTER

How do state policies affect the feasibility of solar on schools? A lot. Policies can be critical to successful development. Take California, for example, where there are hundreds of successful school projects. With its high electricity rates, good solar exposure, and a highly supportive state legislature, California is a very strong market for solar power.

About 70% of the state's electricity is provided by three large investor-owned utilities. They are regulated by the public utility commission, which works to implement state government policy.

As of this writing, the three large California electrical utilities have proposed significantly changing time-of-use (TOU) periods and associated rates. Commercial customers, including schools, typically pay different rates for their electricity depending on the time of day. When demand is high relative to supply (peak demand), rates are higher. In most states, the highest rates are during the day, when demand is the highest. But since California has developed a substantial amount of wind and solar power, the greatest need for electricity is in the early evening, after the solar power generation peak has passed. In response, the electrical utilities have proposed shifting their higher-priced peak times from the afternoon to the early evening and flattening out the cost differences between peak and off-peak rates. The resulting lower rates during the day will reduce the value of energy generated by solar PV systems.

In California and most other states with net metering, an establishment that generates solar power, such as a school, receives nearly full retail credit for sending excess power back to the grid. With the change in peak periods and rates, California daytime rates will decrease, so the revenue from solar power generation will decline. These changes to TOU periods and associated rates can significantly lower the return on investment for solar power.

One possible solution is energy storage. More and more school districts are considering co-locating battery storage with their solar development. Currently, battery energy storage systems (BESS) create value by offsetting demand peaks, decreasing demand charges. Thus, BESS systems work best with tariff rates that include high demand charges. Energy storage costs are still too high to be feasible in many cases, but that is changing as costs decline. California's Colton School District is putting solar on 28 sites, seven of which will also get storage.

Policies can also affect design. For a California school to put solar on the roof requires review by the Department of the State Architect (DSA), with challenging structural requirements. This review is typically a long and expensive process. Therefore, more and more schools are building canopies over parking lots to host solar arrays, where the lengthy review process and high structural costs can be avoided.

Solar awning at Washington School in Johnston City, Illinois. Photo Credit: WindSolar USA



CHALLENGES AND INSIGHTS

Like many major undertakings, shepherding a solar project from inception through construction can entail unforeseen challenges. Nevertheless, the schools and districts we interviewed for this report all had positive experiences and achieved the outcomes desired from their investment. In the next few years, many more schools will be starting the process and deciding that solar is right for them. This section summarizes the common challenges and lessons learned by schools that have already gone solar.

Education and Stakeholder Engagement

Because solar technology is relatively new for schools, there is often a lack of awareness. Thus, district staff and officials need to be educated about solar before they are comfortable committing resources. A broader community of stakeholders may also be involved in the decision making, so they will need to learn about solar development. Besides district staff, they typically include students, faculty, the school board, neighbors, and other community representatives.

Common topics include:

- Costs, return on investment, and feasibility;
- Method of financing;
- Size and location of the solar array;
- Regulatory issues;
- Procurement process;
- System performance; and
- Solar education in the school curriculum.

Often, the primary concern is cost. Is there a favorable return on investment given the time and resources necessary to install the system? Other concerns include the location of the panels. Where could a system go? On the roof, over a parking canopy, or even off-site? Is the roof adequate to support solar? Like any property development, the system will require permits. But unlike most property development, it will need to link to the utility (interconnection) to operate with the grid. How much time will be required for interconnection, and at what cost? What is the installer's experience in permitting and interconnection?

There are some approaches that have helped other schools make the transition. Stakeholders can visit a nearby school or district with solar power. For example, in Illinois, the **Grayslake Community High School District's** associate superintendent saw the merits of solar after visiting several nearby schools (see p. 46). Facility managers can attest to the challenges, lessons learned, and benefits of solar power. Informational meetings can be arranged with the school board and its staff and the community, with presentations from local solar companies or other experts. The schools featured in this study organized at least a couple of months of meetings and presentations to dispel misconceptions and garner community support.

Feasibility

Schools can gain a more informed opinion by reaching out to a solar installer, design professional, or consultant. Installers are often more than willing to present an overview of costs and return on investment potential for a solar project, or even provide an estimate prior to a formal bid. A district or school may want to conduct a preliminary assessment first. The preliminary assessment would include a review of the existing electricity costs, available space for solar, and a rough cost estimate and return on investment analysis. Should that appear promising, a more thorough analysis may be warranted. This may include a survey of each school or site to provide more specific guidelines to develop an RFP for installers to provide bids.

The school or district may need to assess solar feasibility as they pursue other clean energy initiatives. At the **Kern High School District** in California, solar consultants worked with their energy efficiency consultants in determining the size of the solar system (see p. 36). At the net-zero **Discovery Elementary** in Arlington County, in Virginia (see p. 28), the district assessed solar along with a package of other renewable energy tools and resources for new construction.

Financing for Solar Energy

Fortunately, there are more financing options than ever before, enabling schools to make the investment with confidence. The two primary ways of financing are traditional financing and third-party ownership. Traditional financing allows the districts to own their solar systems. Ownership often generates the highest return on investment, especially if the state has favorable public incentives and financing options.

Solar development is often funded through bonds, although funds can also come from capital budgets, grants, loans (in some states), rebates, and solar renewable energy credits (SRECs). Several districts and schools in this report financed solar power primarily with debt. Districtwide projects include **Washoe County School District** in Reno, Nevada, and Grayslake Community High School District in Illinois. The first issued bonds and the later financed with a bank loan (although in some states, such as California, public entities can't take on private debt). There are many varieties and permutations of debt (see Appendix D).

A district may finance solar through a school bond issue that includes a larger renovation or new school construction. The Washoe County district has typically financed solar along with other capital improvements, including new construction and energy efficiency. The energy efficiency improvements helped to focus stakeholders on energy savings and thus, helped to convince them to consider the merits of solar power.

Traditional financing may require the district to put together a package of grants, loans, rebates, and solar renewable energy certificates (SRECs).²³ While many such funding sources can offer a higher return on investment to the district, such creative financing efforts can be time consuming and costly, as the district must negotiate with various funding sources to secure commitment and bear the cost of financial advisors and issuance. Ownership of systems requires that the district also maintain them, usually requiring a separate operations and maintenance contract.

Third-party ownership is growing in popularity. It allows third parties to generate tax savings and presumably pass along some of those savings to the school. Schools -- because they lack the tax liability -- are unable to directly take advantage of federal or state tax credits or accelerated depreciation for solar equipment. However, they can indirectly take advantage of tax savings by allowing a third-party to own the solar system. To do so, states must allow third-party ownership, which is currently allowed in about half of all U.S. states.²⁴

With third-party ownership, a school can have solar with little to no upfront capital costs. The third party finances, builds, owns, and maintains the solar system under a lease or PPA. Recently, due to lower rates and more mature contracts, which provide better protection for schools, PPAs have become the most popular option. Nearly 90% of all installed school solar systems over the last three years for which data is available are utilizing PPAs. Both Washoe County and Arlington County, Virginia are both considering third party ownership even though previous systems were bond financed.

Kern High School District in California, which developed one of the largest school solar projects in the country (22.7 MW), financed the project through a PPA. The district's consultant, Tom Williard of Sage Renewables, has been advising more districts to consider PPAs in the past three years. "PPA offerings have improved significantly. Lower installed cost and financing innovations have resulted in PPA base prices well below utility energy costs. We avoided early PPAs, many with 4-5% escalators, which have left some schools at risk of being underwater," notes Williard. For the past three years, Sage has required PPAs without escalation to reduce risk to their school clients. In California, he says about two-thirds of districts are opting for PPAs.

Policy Risk and Regulatory Requirements

Schools frequently encounter difficulty understanding and complying with state policy and local regulatory requirements for solar development. Such requirements are compounded when the state is enacting major policy changes. Both the Kern High School District in California and **Broadalbin-Perth Central School District** in upstate New York have faced major policy changes during the development process. Both carefully monitored policies and took steps to speed up the development process to garner more favorable net metering rates.

Interconnection is often one of the biggest regulatory challenges. The interconnection process can be costly and lengthy. The Broadalbin-Perth District required that the developer provide an interconnection allowance to cover the state's unpredictable interconnection costs that could exceed \$500,000. The Kern High School District determined that it could host up to 1 MW per school for a nominal interconnection fee, but for a system over 1 MW, the district faced an uncertain approval time and cost. Therefore, it kept most of its systems under 1 MW. The Arlington County district spent six months negotiating the interconnection costs for Discovery Elementary, settling on a \$1,000 per month connectivity charge.

Despite the challenges noted above, policy changes can also favor solar. New York is working with the utilities to make interconnection more transparent, which should lower uncertainty about costs. It also initiated the K-Solar program, which provides no-cost consulting and a pre-vetted list of installation contractors. To successfully develop solar, districts need to be knowledgeable about policy and regulatory challenges and opportunities.

Solar in the Educational Curriculum

Solar schools and districts see a tremendous opportunity to incorporate solar energy into the curriculum. Many of the schools featured in this study included this as part of their contractor requirements. The installer for **Sacajawea Middle School** in Montana has designed a solar-focused curriculum for middle school science classes. Discovery Elementary's real-time energy dashboard is viewable on the school's website and in the classrooms, where students can see how well the school is meeting its net-zero energy goals. In North Carolina, NC GreenPower launched a solar schools program to raise awareness about renewable energy and raise funds to support solar development, including monitoring devices and educational resources for teachers and students.

\$80 MILLION IN SAVINGS

Kern High School District Negotiates Favorable Returns at one of the Country's Largest Solar School Systems

In 2014, the Kern High School District (KHSD) in Bakersfield, California was experiencing the effects of budget cuts made to public education after the economic downturn. Slimmer budgets and growing enrollment made it urgent for the district to act on increasing energy costs.

The district commissioned an initial feasibility study which concluded it could realize significant energy savings from a district-wide solar project. The study consultants recommended a two-phase implementation schedule to simplify planning and minimize disruptions.

In early 2015, the district contracted with Sage Renewable Energy Consulting to develop a competitive request for proposal (RFP) and provide an analysis of proposals. With Sage's input, the district selected SunPower Corporation to design, build, and operate the system under a power purchase agreement (PPA). At 22 MW, it is one of the

largest commitments to solar power by any school district in the United States. Most of the solar panels are mounted on parking lot shade structures which provide lighting and shade in the school parking lots, preserving use of other district land and property.

"[The district] will significantly reduce the percentage of our budget allocated for electricity, allowing us to enhance academic and extracurricular programs and plan additional facility upgrades," said Dr. Scott Cole, associate superintendent of the business division for KHSD, when the project was announced.²⁵

DEVELOPMENT PROCESS

Sage reviewed the feasibility study. "As a high school district with large parking facilities in Southern California, it was obvious that the project was going to be financially feasible at all sites under consideration. That, together with the district's desire to move forward expediently, resulted in Sage going directly

Photo Credit: Sage Renewables

SCHOOL DISTRICT:

Kern High School

LOCATION:

Bakersfield, California

DISTRICT SIZE:

35,000 Students, 27 Campuses

SOLAR CAPACITY:

22.7 MW

FINANCING:

Power Purchase Agreement (PPA)

PROJECTED SAVINGS:

\$80 Million Over 25 Years

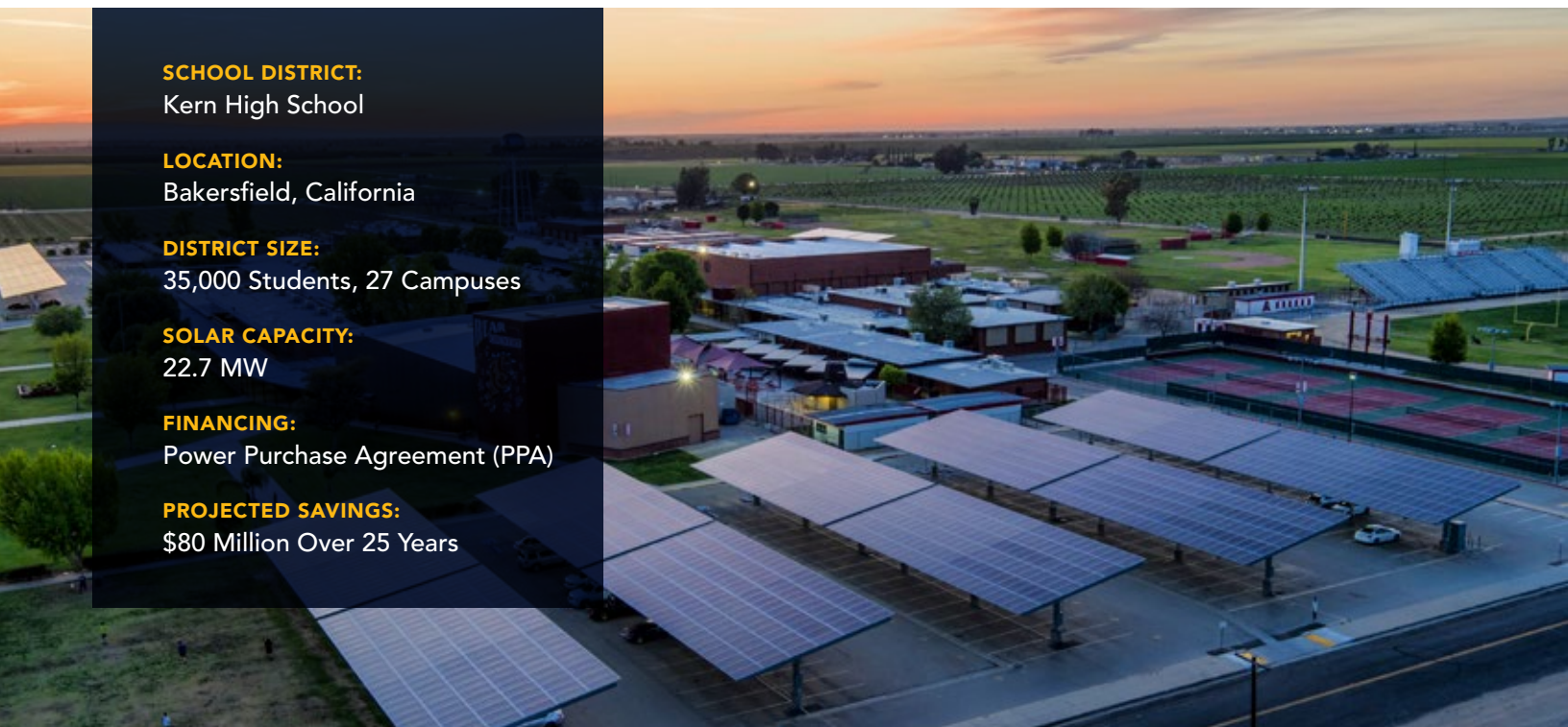




Photo Credit: Sage Renewables

to the RFP phase,” said Tom Williard, who advised the district for Sage.

In determining the size of the systems at each site, Sage worked with the district’s energy efficiency consultants. Since the district was investing in energy efficiency, the consulting teams needed to coordinate on the likely efficiency savings to determine the optimal size of the solar arrays. In most of California, year-end excess generation is of little value, so the district didn’t want to oversize the system. Furthermore, each of the schools needed to be under 1 MW to meet the state’s net metering cap that was in place at the time.

It took about six months to prepare and approve the RFP, solicit and evaluate bids, select and negotiate an agreement with the contractor, and approve their design. Following design approval, the developer, SunPower, applied for permits and interconnection. In California, K-14 school development requires permits from the Department of the State Architect (DSA) rather than the local government. Once the permits were obtained, construction was scheduled for the following summer, with construction lasting about six months for Phase 1. The whole process for Phase 1 took 20 months; it was operational by the fall of 2016.

POLICY CHALLENGES

During the design of Phase 2, in early 2016, the California Public Utilities Commission announced new rules for the state’s Net Energy Metering (NEM) regulations. The rules allow solar installations on a single site to exceed 1 MW of capacity and still take advantage of NEM. However, for those sites

that do exceed 1 MW, the new regulations make the interconnection process and costs less certain. In contrast, for schools with under 1 MW of solar, there is still a straightforward process and nominal interconnection fee.

There were advantages to grandfathering schools under the state’s previous NEM policy (see p. 32 for sidebar on “state policies”). Therefore, the district sought to ensure that the selected developer quickly obtain permits and complete construction. The contract included liquidated damages should the contractor miss the deadlines. Some sites were completed on time for NEM 1.0, while others will be regulated under NEM 2.0.

Fortunately, with such a large project, the negotiated PPA will provide a very high return on investment for the district. The PPA has a 20-year flat rate of 11.9 cents per kWh that steps down to 7 cents in years 21-25. The differential between the PPA rate and the utility rate is estimated to save the district \$80 million over 25 years.

Overall, the project includes solar PV shade structures on 27 district sites. It eliminates 17,000 tons of carbon dioxide emissions per year, equivalent to removing 81,000 cars from the road. It creates over 1.1 million square feet of shade on school campuses.

The KHSD project served as a landmark proof of concept for fiscal and environmental stewardship in Kern County. Several other nearby school districts, as well as the city government, are currently planning or have already implemented projects based on the exemplary work and results achieved by KHSD.



Discovery Elementary's energy use, along with experiments conducted in real-time on the rooftop solar lab, can be tracked using a customized building dashboard system. © Lincoln Barbour

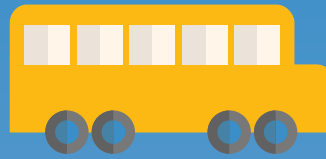
LET'S GO SOLAR!

A HOW-TO GUIDE FOR SCHOOLS

First Steps for Schools Going Solar

With less than 5% of schools nationwide using solar energy, there is tremendous untapped potential for schools to realize a brighter future through clean energy. Solar can provide numerous benefits to schools, including financial savings, educational opportunities for students, and a healthier community.

The following is a resource for educational leaders and decision-makers, teachers and students, and any community stakeholders interested in championing solar energy development at K-12 schools. This step-by-step outline provides insight into the predevelopment process, which is the time when community stakeholders are most actively involved.



Assess Interest and Identify Solar Champions

- Find and engage key students, teachers, parents, staff, or community members
- Identify leaders who can advocate for the project
- Educate the school community on benefits and opportunities of solar
- Build consensus



STEP 1



STEP 2

Determine Energy Savings, System Size, and Economic Feasibility

- Assess your current energy use and costs
- Determine the energy savings potential from solar
- Consider rooftop, parking lot, and ground-mounted systems
- Estimate project costs

Identify Financing Options

- Determine if system will be financed as part of a larger capital improvement campaign
- Determine whether district will own the system or will accept third-party ownership
- Investigate federal, state, and utility incentives
- Determine if net metering is available



STEP 3



STEP 4

Identify Regulatory Requirements

- Understand state and local regulations
- Anticipate, plan, and budget for regulatory requirements
- Address regulatory constraints where feasible

Prepare and Issue the Request for Proposal

- Include information on project feasibility and regulatory requirements in the RFP
- Make sure to follow all state procurement procedures
- Establish common criteria and scoring parameters



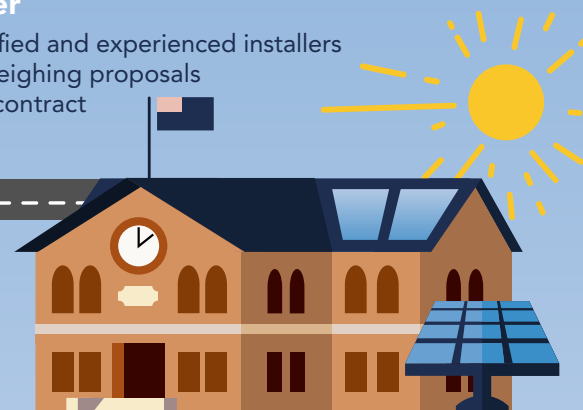
STEP 5



STEP 6

Evaluate and Select the Solar Installer

- Aim for at least three submissions from qualified and experienced installers
- Consider educational opportunities when weighing proposals
- Evaluate responses, select and negotiate a contract with the preferred contractor





Step 1: Assess Interest and Identify Solar Champions

At the start of the process for going solar, you should engage a variety of stakeholders, including students, teachers, parents, school and district staff, and community members. Assess their interest and identify solar champions. While the groundswell of support for solar can start with a student club, classroom, or community member, the influential leaders and school district decision-makers will need to be brought on board. Resources are available to support and prepare solar champions to effectively advocate for solar at their schools, such as Generation 180's solar champion toolkit (gosolarschools.org).

Identify potential leaders early and meet with them individually to gauge their interest and concerns about solar power. Once the influential leaders have been secured, hold meetings with other school officials and community members to broaden the discussion and seek consensus. Some of the case studies and charts in this report can be shared to help support the transition to solar. Have the leaders participate to the extent possible, respecting their time constraints. Be prepared to address the concerns raised in the individual meetings.

As discussions progress, there will be a need to address concerns in greater depth. This is a good time to bring in someone from the outside, such as a nearby solar school facilities manager, solar installer, designer, or consultant to present to the group. If nearby districts have solar, organize visits to see their solar operations firsthand.

This educational process can take a long time. If there is a lot of skepticism early on, it could take months to change thinking. However, the advantages of solar energy are very clear and with time, skeptics are likely to see the benefits. Always be on the lookout for new leaders who can inject new energy into the process. Celebrate small victories and don't be afraid to let others take credit to further buy-in.

Once a school or district has a clear understanding of its needs and values, and those of the surrounding community, it is ready to begin the more formal process of going solar.



Step 2: Determine Energy Savings, System Size, and Economic Feasibility

First, determine the energy savings potential for a solar energy system. Facilities staff should review school or district electric and gas utility bills over the previous 12 months to establish current energy use and costs. This review will provide a baseline to assess energy and cost savings from a solar system. Be sure to include all costs, including demand charges or other utility charges.

Next, estimate how large the school's solar project will be. The amount of energy that can be offset by solar is directly related to the size of the system. Start by determining what physical assets are available. You can consider the rooftop, parking lots (for shade structures), and open space that's available for ground-mounted systems. From that inventory, you can determine available space that school rooftops or grounds can support. For rooftop systems, determine the roof condition and age and whether the structure can support the loads associated with the solar installation. Since all this can get complicated, it often helps to hire a consultant or solar company to conduct a full solar site assessment. This includes an evaluation of site characteristics including the site orientation, available space, and amount of shading during peak solar hours.

A school may not be ready or able to commit to a full site assessment right away. In these cases, facilities staff can use free online tools to develop a general sense of a school's suitability for solar. Sun Number

(www.sunnumber.com) provides users with a single score based on the building's potential for solar, regional climate, utility electricity rates, and the cost of solar. While not currently available for the entire United States, Sun Numbers can be obtained for most sites in three dozen major cities and metropolitan areas. Another option is available through Geostellar (www.geostellar.com), which has mapped the solar potential of rooftops in some parts of the country and provides free access to heat maps showing how much sunlight each portion of a given roof receives. In addition, some state and federal agencies have developed resources outlining the site screening process.²⁶

Having obtained a basic idea of the system size, the next step is to estimate costs. An installer, architect, or consultant can often provide cost estimates. Also, staff can evaluate potential energy cost savings using a number of free online tools, including the National Renewable Energy Laboratory's *PVWatts Calculator* (pvwatts.nrel.gov), *REopt* (<https://reopt.nrel.gov>) or the *System Advisor Model* (sam.nrel.gov).



Step 3: Identify Financing Options

Once the school or district has a general idea of feasibility, site suitability, and solar system size, the next step is to identify financing options. Though the installed cost of solar has fallen quickly over the past few years, these systems still represent a significant investment, usually requiring some form of financing.

To finance, determine whether the school will own the system or is willing to accept third-party ownership (TPO). School ownership often generates the highest return on investment, especially if the state has favorable public incentives and financing options. However, the advantage of TPO is that the third party finances, builds, owns, and maintains the system, so there is little or no upfront capital investment. If interested in TPO, determine if this option is available in your state by first viewing the third-party ownership map at the summary maps section of the Database of State Incentives for Renewables and Efficiency (DSIRE) website.²⁷

TPO arrangements are typically structured as a power purchase agreement (PPA). In a PPA, the school agrees to pay the solar company an agreed-upon rate for the solar power that is typically below the market rate. The rate may or may not escalate over the typical 15 to 25-year life of the PPA. At the end of the PPA, ownership of the solar array often reverts back to the school.

If TPO is not available, or the district prefers to own the system, the district will likely secure traditional financing through mechanisms such as bonds and capital budgets. If you pursue traditional financing, determine if the solar system will be financed on its own, or as part of a larger school expansion or building improvement capital campaign. If it is part of a broader financing effort, the larger components of the funding package will likely drive the financing approach. Nonetheless, identify any financial incentives that might support solar development.

Fortunately, many public and private incentives are obtainable. Because of the tax-exempt status of public schools and the local nature of some of these programs, however, not all options will be available in every case. For information on specific incentives or programs for which your school may qualify, check with state renewable energy offices and organizations, other solar schools, and local solar professionals. For a comprehensive list of state policies and laws, including ones that provide solar incentives, visit the DSIRE website at www.dsireusa.org.

Below are some of the major incentives that may be available. The federal incentives only apply if the school is financing through third-party ownership, such as a PPA. Because of their tax-exempt status, the schools do not

receive these benefits directly. However, the third-party owner receives the tax benefit, presumably passing on some of the savings to the school by offering a favorable rate in a competitive bid.

Federal Incentives

The two primary federal incentives supporting solar are the **Investment Tax Credit (ITC)** and the Modified Accelerated Cost-Recovery System (MACRS). The ITC provides a federal income tax credit equal to 30% of total installed system costs for commercial solar systems, including projects at schools. The ITC 30% credit is available provided that construction starts by 2019, after which it will decline to 26% in 2020, 22% in 2021, and 10% thereafter. Meanwhile, MACRS allows non-residential solar customers to recover the value of investments in solar equipment through accelerated depreciation deductions on federal taxes.

State Incentives and Financing

Many states offer some form of incentives or other financing options for solar. Common incentives or programs include tax credits, deductions, or exemptions; and grants, loans, or rebates. In addition, some states have chosen to promote solar through their renewable portfolio standards (RPS)—requirements for utilities to derive a certain percentage of their retail electricity sales from renewable sources by a target year—by mandating that solar electricity constitute a defined portion of this renewable mandate.²⁸ In a handful of states with “solar carve-outs,” these requirements have given rise to solar renewable energy certificate (SREC) markets. These SRECs, which can be traded and sold, represent the environmental or non-energy attributes of solar electricity and can provide system owners with a significant revenue stream.²⁹

Utility Incentives and Financing

Utilities may also offer consumer grants, loans, or rebates for solar energy. In addition to, or instead of, these incentives and programs, some utilities provide performance-based incentives (PBIs) for their solar customers. Rather than being based on the cost of the investment in solar (as is the case with grants, loans, or rebates), PBIs are tied to the amount of electricity produced by a solar energy system. For example, some utilities arrange to purchase all the electricity produced by an eligible solar energy system at a rate higher than the retail price of electricity. In these “buy all, sell all” arrangements, solar customers receive larger total payments as their systems generate more electricity.

Net Metering for Excess Power Generation

In addition to these incentives, most utilities in 43 states and the District of Columbia are required to offer net metering programs to their solar customers.³⁰ With net metering, a utility provides a financial credit for any excess energy exported to the grid. The credit is at, or near, the retail rate. These credits can in turn be used to offset the cost of electricity used from the grid at night or other times when solar systems are not producing enough electricity to meet on-site needs. When classes are in session and the school consumes a large amount of energy, schools may not contribute much electricity to the grid. During summer months, however, when energy demand is lower but the solar system is still producing a lot of electricity, a school might generate excess solar power.

Even if net metering is required in your state, that doesn't necessarily mean it's available from your local utility. States typically regulate investor-owned utilities but not municipal-owned utilities or co-ops. Conversely, in a state that doesn't require net metering, local utilities may still offer it. Net metering can also affect solar array location. Net metering may be available for onsite solar, but not for solar developed offsite.



Photo Credit: Sage Renewables



STEP 4

Step 4: Identify Regulatory Requirements

Identify regulatory hurdles and address them if feasible. Ensuring state and local requirements are satisfied should mainly be the responsibility of the contractor. The time and money it takes to comply with these rules are typically passed on to the solar customer in the form of increased project cost. Complex, or even nonexistent, planning and zoning requirements and permitting, inspection, and interconnection processes can serve to drive up the “soft” costs (the non-hardware or business process costs) of going solar. Taken together, these soft costs account for just over half of the total cost of installed solar in the U.S.³¹

In the initial feasibility analysis, the district should identify potential regulatory barriers and, if feasible, take steps to address them. Lower levels of regulatory uncertainty will result in lower installer bids. In contrast, if uncertainty is high, the installers will need to increase their bids accordingly. Alternatively, installers may submit a low bid and subsequently claim hardship, negotiating for a higher price based on unforeseen regulatory hurdles. When the time comes to select an installer for your project, make sure to ask them about their experience with local and state regulations. Get specific feedback on their recommendations on how to navigate the regulatory landscape.

Fortunately, there are many actions state and local governments can take to help reduce regulatory uncertainty and lower soft costs. These include:

- Incorporating solar energy into local planning processes and zoning codes;
- Streamlining and expediting the solar permitting process; and
- Developing statewide interconnection standards.

The Solar Foundation co-manages a national program, SolSmart, that provides national recognition and no-cost technical assistance to municipalities and counties that have taken steps to make it faster, easier, and more affordable for residents and businesses to install solar energy systems. More information on these topics is available at www.SolSmart.org or by contacting The Solar Foundation.



Step 5: Prepare and Issue the Request for Proposal

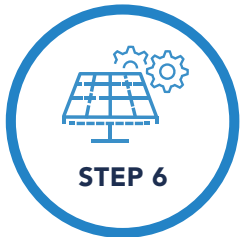
Once the school or district has selected financing options, the next step is to prepare and issue a request for proposal (RFP). The school or district issues an RFP for installation, evaluates responses, and selects and negotiates a contract with the preferred contractor. If the district intends to own the system, the RFP is issued to engineering, procurement and construction (EPC) contractors. If the district seeks a PPA, the RFP is issued to prospective PPA providers who in turn develop the project or contract with an EPC.

The solar procurement process shares similarities with many other large equipment purchases. For example, in developing the RFP, the district needs to meet state procurement statutory requirements. The RFP should require that the responses be provided in a common format so that it will be relatively easy to compare proposals. The RFP also needs to convincingly convey the development opportunity. It should include information on project feasibility and regulatory requirements so that the installer has enough information to provide a meaningful response.

The unique nature of solar energy necessitates the inclusion of particular elements in RFPs. A list of potential solar-specific RFP elements may include, but is not limited to:

- Protection of Roof Integrity and Warranties
- Specifying a Contractor Required Interconnection Fee Allowance
- Provisions for Performance Monitoring/Guarantees
- Requirements for an Operation and Maintenance Plan
- System Technical Specifications

- Leveraging Project Educational Value
- Assigning Responsibility to Contractors for Obtaining Permits or Interconnection Agreements



Step 6: Evaluate and Select the Solar Installer

Once you have issued your RFP, it is critical to establish a protocol to assess the installers and select the best partner for your institution and project. You should aim to have at least three submissions to consider.

To ensure that the RFP evaluators are consistent in their assessments, you should establish a list of criteria and scoring parameters in advance. The criteria may include:

- Knowledge and experience with similar size and type of project. What is the quality and quantity of other solar projects completed?
- Regulatory knowledge and experience. Have they successfully navigated your region's regulations? Does their team have relationships with decision makers? Are they realistic with timelines for regulatory approval and interconnection?
- Financial capacity to complete proposed deal. Review financial reports and audits. If a PPA, have they secured their investors, and who are they? If not, can they point to a track record of securing investor funding? How do they intend to select an EPC contractor?
- Technical specifications. What is the quality of their proposed equipment including panels, inverters, monitoring equipment, and balance of system components?
- Operations and maintenance. How adequate is their proposed operations and maintenance plan?
- Project leadership: Do they identify a key contact? What is that person's experience? What is their time commitment to the project, and what other projects will they be managing?
- Thoroughness and clarity of the response.
- Financial return. What is the expected return on investment for the school or district?
- Customer testimonials. Speak with past customers about the experience with the contractor. Ask about negotiations following contractor selection:
 - Were negotiations fair to both parties?
 - Was the final negotiated agreement consistent with the spirit of the proposal?
 - After the agreement, were they responsive to customer concerns?
 - Were they consistent and transparent with how they track and report costs?
 - Did they meet their project timeline?
 - Did the solar system perform as promised?
 - Is the system being maintained as promised?

Schools should also consider the educational opportunities for solar during the contracting process. Many contractors have, or would be willing to, develop devices to monitor solar production to support classroom learning. This is the time to consider preferences for the accessibility of the monitoring data for use in the classroom, including physical and digital location and level of sophistication of the monitoring system. Preference can be given for contractors that include resources for teacher training or curriculum development.

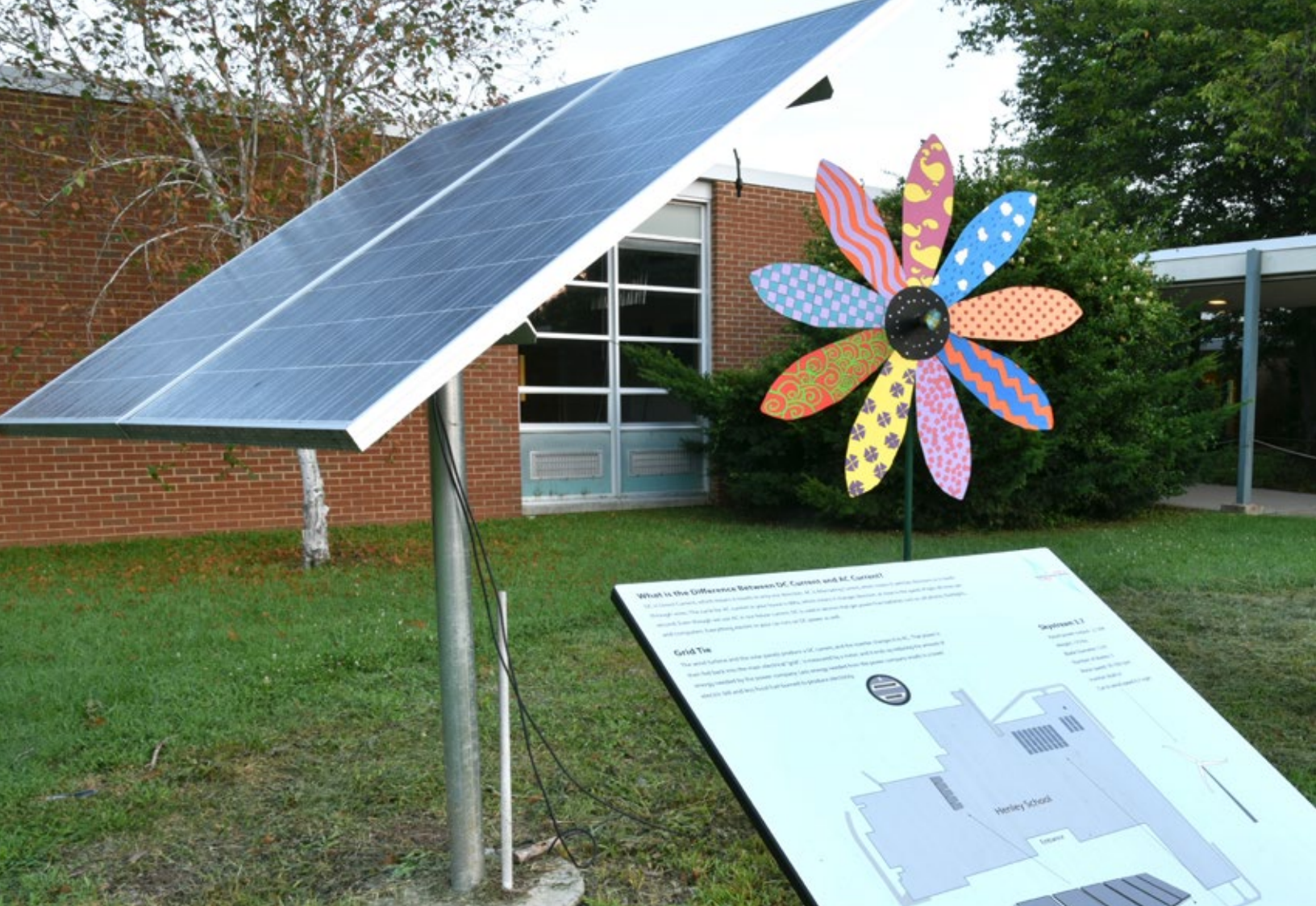


Photo Credit: Bill Sublette, Henley Middle School

Solar Development Timeline

For a major installation, solar development on multiple district schools can take one to two years or more from inception to completion. This assumes the school is planning to install a system to meet a significant portion of the school's electricity needs. Specifically:

- Feasibility, funding, and procurement can take up to six months overall.
- Following developer selection, the permitting and interconnection process can be unpredictable depending on the state. The selected contractor might spend a few months to over a year addressing regulatory requirements and performing other predevelopment work.
- Construction usually lasts no more than six months.

CONCLUSION

Just in the past few years, thousands of U.S. schools have installed solar systems and realized many benefits as a result. Putting solar on schools can save money, create jobs, protect the environment, back up critical infrastructure, and support classroom learning. It can provide such benefits across the country, in the northern states as well as the sunbelt.

As this report has shown, there is no single path for schools to develop solar projects, and there are many ways to get started. It can be initiated by students for a single school or by district officials for districtwide development. It can be built on a rooftop, parking canopy, or offsite. It can be financed through traditional debt, such as bonds and loans, or through third-party ownership. It can be part of a larger capital improvement campaign or a stand-alone project. There is no right strategy, but there are many successful ones.

Thousands of schools have gone solar, with 1,750 additional solar schools since we published the first edition in 2014. Yet over 100,000 schools are remaining that continue to rely exclusively on fossil fuels. With the price of solar panels declining precipitously, there's never been a better opportunity for schools to reap the benefits of going solar. Adopting solar energy presents a great opportunity for our nation's educational institutions to take a leadership position in our country's transition to clean energy for the health of future generations. The examples, guidance, and role models included in this report should help students, administrators, and community leaders take the first steps to powering their schools with solar.



STUDENTS MEAN BUSINESS

Students often advocate for solar, working with stakeholders to develop consensus and initiate the development process. But once the business minutia of feasibility studies and procurement take over, students typically lose interest. After all, by the time that the solar power is up and running, many of the students will have graduated.

Things are different at California's Capistrano School District, where students are deeply involved in solar procurement. The district is putting 6 MW of solar on six

high schools and a district office after student groups had been pushing for solar for years. "They came to board meetings and got to know the board on a first-name basis," notes Russell Driver of Arc Alternatives, who advises the district on the solar installation. Now there are a dozen students on an advisory board reviewing feasibility studies and RFPs. The students self-selected. One of the high school eco-clubs reached out to other schools to recruit participants. It has a mix of juniors and seniors; the seniors expect to remain involved after graduation to see the anticipated summer 2018 installation.

ENERGY SAVINGS HELP BALANCE THE BUDGET

Grayslake Community High School District Obtains 36% of Electricity Needs Through Solar

With school districts trying to stretch already constrained budgets, many are finding the answer in energy savings.

THE DECISION

Before installing solar, Grayslake Community High School District in Illinois was already interested in reducing its energy bills. The district joined an electric co-op, enabling it to receive lower electricity rates and participate in a demand response program. The program is offered by ComEd, the local utility, and pays the school district for reducing electricity use during peak hours. The district created additional savings through energy efficiency improvements at

its two high school buildings, Grayslake Central and Grayslake North.

Following the energy efficiency upgrades, Dr. Michael Zelek, the associate superintendent and chief school business officer, explored additional ways to reduce the district's energy consumption. Zelek initially thought wind turbines might be the best option. However, research conducted by Performance Services, a design-build firm hired by Grayslake, determined that solar was more cost-effective for the district. Zelek conducted his own due diligence, speaking with administrators of districts who had previously installed solar. "It was an easy choice at that point, everybody I spoke to was thrilled with solar," Zelek says.

SCHOOL DISTRICT:

Grayslake Community High School

DISTRICT SIZE:

Two High Schools

LOCATION:

Village of Grayslake, Lake County, Illinois

COST:

\$5.3 Million

SOLAR CAPACITY:

3 MW on Three Sites - Two Schools and Offsite

FINANCING:

Bank Loan

PROJECTED SAVINGS:

\$10 Million Over 25 Years



DEVELOPMENT AND FINANCING

Once Grayslake decided to move forward with the project, Performance Services then designed and built two solar installations which utilized the large roofs on the district's two high schools, Grayslake Central and Grayslake North. A third, ground-mounted system was installed on underutilized land owned by the district. With a total cost of \$5.9 million, the combined output of the three systems is just under 3 MW, accounting for 36% of the district's energy consumption.

Financing such a large solar installation can be challenging for many schools. Grayslake explored leasing panels, buying the system upfront, and financing the system through debt service certificates. In the end, Grayslake decided that debt service certificates through a local bank made the most sense. The certificates had a market 2.9% interest

rate, 12-year term, and no prepayment penalty. The opportunity to prepay was important, Zelek explains: "We are expecting \$100,000 in cash savings to pay off the loan in eight years."

In addition to energy savings, Zelek is excited to "bring the students out to the solar farm" and believes that it will be a valuable educational tool. The district is partnering with the National Energy Education Development project to develop curriculum utilizing the new solar installations.

With Grayslake's investment in solar expected to save the district \$9.8 million over the lifetime of the system, districts across the region are expressing interest. According to Ryan Stout of Performance Services: "When districts like Grayslake go solar, other districts take notice and start exploring their own options to install solar."

"When districts like Grayslake go solar, other districts take notice and start exploring their own options to install solar."

Ryan Stout, Performance Services

Photo Credit: Grayslake Community High School District



APPENDIX A: ADDITIONAL RESOURCES

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APPENDIX B: SCHOOL SOLAR RANKINGS BY STATE

State	Installed School Capacity		Schools With Solar		Watts/Student		Percentage of Schools With Solar	
	Rank	kW	Rank	# of Schools	Rank	Watts	Rank	Percentage
AK	45	5.8	44	2	44	0.04	41	0.4%
AL	44	18.0	45	2	45	0.02	45	0.1%
AR	46	4.0	47	1	47	0.01	46	0.1%
AZ	3	97,589.7	3	378	1	86.27	4	14.1%
CA	1	489,280.4	1	1,946	3	72.84	2	14.5%
CO	11	7,241.9	11	104	11	8.24	13	4.9%
CT	7	13,386.2	10	118	8	21.34	9	7.8%
DC	35	432.1	35	16	16	5.11	11	5.3%
DE	32	645.6	37	9	17	4.30	23	2.6%
FL	15	3,423.7	8	181	28	1.16	17	3.1%
GA	26	1,049.1	26	35	37	0.58	30	1.1%
HI	13	5,018.5	16	60	6	23.31	3	14.5%
IA	37	302.4	41	5	36	0.58	43	0.3%
ID	34	558.6	32	23	24	1.95	22	2.7%
IL	25	1,155.9	4	337	39	0.49	10	5.8%
IN	18	2,586.5	36	16	22	2.28	39	0.6%
KS	43	24.1	40	6	43	0.05	40	0.4%
KY	29	777.0	42	3	29	1.06	44	0.2%
LA	38	265.1	39	6	41	0.33	42	0.3%
MA	4	53,819.5	5	261	4	49.86	6	10.2%
MD	8	12,282.9	18	45	9	12.47	28	2.1%
ME	33	596.4	31	25	19	3.02	16	3.2%
MI	36	397.2	27	35	42	0.23	36	0.8%
MN	21	1,925.9	30	26	23	2.10	34	0.9%
MO	17	2,632.6	14	90	20	2.60	19	3.0%
MS	48	2.8	48	1	48	0.01	47	0.1%
MT	40	126.2	25	35	34	0.84	15	3.8%
NC	24	1,319.7	24	36	33	0.84	29	1.2%
ND	50	-	50	-	50	0.00	50	0.0%
NE	47	4.0	46	1	46	0.01	48	0.1%
NH	28	941.4	33	19	18	4.24	25	2.5%
NJ	2	131,401.3	2	487	2	82.95	5	13.0%
NM	14	3,557.9	29	27	10	10.15	21	2.7%
NV	6	15,255.9	7	190	5	33.30	1	23.1%
NY	5	21,749.2	6	204	12	6.93	18	3.1%
OH	10	10,357.3	19	45	15	5.31	32	1.0%
OK	49	2.4	49	1	49	0.00	49	0.1%
OR	23	1,432.0	21	42	21	2.37	27	2.5%
PA	9	10,892.4	23	41	14	5.40	35	0.8%
RI	39	154.7	34	19	31	0.94	14	4.1%
SC	30	760.7	22	42	30	0.98	20	2.7%
SD	51	-	51	-	51	0.00	51	0.0%
TN	12	6,306.0	17	56	13	6.00	24	2.5%
TX	16	2,903.0	13	100	38	0.57	33	1.0%
UT	31	721.4	12	100	27	1.20	8	8.7%
VA	20	1,928.7	28	29	26	1.42	31	1.0%
VT	19	2,083.7	20	42	7	21.87	7	9.7%
WA	27	1,003.5	15	72	32	0.90	26	2.5%
WI	22	1,709.0	9	161	25	1.72	12	5.2%
WV	41	122.9	38	6	40	0.42	38	0.7%
WY	42	75.8	43	3	35	0.84	37	0.8%
TOTALS		910,230.9		5,489		17.01		4.4%

APPENDIX C: OTHER FINANCING OPTIONS

Schools have several other financing options if they do not wish to pursue third-party ownership. One alternative is to issue bonds to cover the up-front cost of going solar. Energy cost savings can then be used to repay the principal and interest due to bondholders. Because municipal bond holders are usually willing to accept lower interest rates than they would on other debt investments, school projects can be funded at a lower cost of capital compared with most private sources of debt. The financing efficiency of the various mechanisms described here changes over time as tax benefits and other incentives, project costs, and market changes come into play. Along with third-party ownership, some of the preferred school financing vehicles include:

- General obligation (GO) bonds
- Municipal revenue bonds
- Clean renewable energy bonds (CREBs)
- Qualified energy conservation bonds (QECBs)
- Tax-exempt lease purchases
- Energy services performance contracts (ESPCs)

General Obligation (GO) Bonds

GO bonds are backed by the full faith and credit of the government entity. They are repaid from general revenue such as fees and tax collections. Local jurisdictions issue GO bonds typically to fund uses such as government buildings, roads, and schools that don't have a revenue source. Because of the high transaction costs for bond financing, solar development is typically combined with other capital improvements. Since GO bonds encumber the taxing authority debt capacity, they often require a public referendum.

Revenue Bonds

These municipal bonds are paid back from earnings of the facility acquired or constructed with the issued bonds. Examples include projects that generate revenue such as parking garages, toll roads, utilities, and higher education. Since repayment depends on the success of the project or projects funded, investors typically require a higher interest rate than for GO bonds. But since they don't typically encumber the government's debt capacity, they don't typically require a public referendum.

Clean Renewable Energy Bonds (CREBs)

CREBs may be used by government, public power providers, and electric cooperatives to finance renewable energy projects. The bondholder receives federal tax credits in lieu of a portion of the traditional bond interest, resulting in a lower effective interest rate for the borrower. Funds are allocated by Congress so there is a limited amount of resources available. Check with your state government on the availability of these funds.

Qualified Energy Conservation Bonds (QECBs)

QECBs may be used by state, local, and tribal governments to finance certain energy efficiency upgrades and renewable energy projects. Through QECBs, the federal government provides bond issuers with direct interest rate subsidies. While the subsidy amount varies with U.S. Treasury Qualified Tax Credit Bond Rates, bond issuers

have generally received subsidies between approximately 3-4% of the bond amount. Funds are allocated by Congress so there is a limited amount of funds available. Check with your state government on the availability of these funds.

Tax-exempt Lease Purchases

Schools are also somewhat unique in their ability to enter into a tax-exempt lease purchase agreement. Also known as a “Municipal Lease,” this financing mechanism allows some local governments or districts to lease solar energy equipment from a solar company at lower payments and longer terms than other leasing options. Lease payments to the solar company are low because, like a municipal bond, the company, as the investor, is not taxed on the interest they receive through repayment.

These agreements are usually not considered long-term debt, with lease payments made from operating rather than capital budgets. Unlike a true lease, title is granted to the school district when the lease is signed.³² Therefore, school districts are unable to take advantage of federal solar tax incentives through these arrangements. In considering this option, schools should weigh the benefits of low tax-exempt interest payments and a longer lease term against alternatives, such as PPAs, that do allow for tax incentives to be passed on to the solar company.

Energy Services Performance Contracts (ESPCs)

Energy services performance contracts (ESPCs) can provide schools with another cost-effective means of investing in solar. Through these agreements, customers contract with an energy services company (ESCO) to assess the current energy use at one or more buildings and to propose a package of energy conservation measures to reduce consumption. The ESCO provides a customer with a guaranteed level of performance for these energy upgrades and ensures a minimum level of cost savings. A portion of these energy cost savings is used to compensate the ESCO for their work in making the energy upgrades, with the remainder retained by the customer.

While ESPCs have typically involved energy efficiency measures with a relatively short payback (such as energy efficient lighting, building envelope improvements, etc.), these contracts can also include upgrades with a slower payback, such as solar PV. In states that allow for third-party ownership, tax-exempt customers such as public schools could enter into a PPA with the ESCO for the solar PV system included as part of the performance contract, allowing the customer to invest in solar with little or no upfront cost and for the ESCO to take any available tax credits and pass their value on to the customer. For more information on solar in ESPCs, see *Integrating Solar PV into Energy Services Performance Contracts: Options for Local Governments Nationwide* from the North Carolina Clean Energy Technology Center.³³

APPENDIX D: CONTRACTUAL CONSIDERATIONS

All solar installation contracts should be developed under the guidance of experienced legal counsel. Below are some of the factors to consider.

Contracts and other procurement documents should require contractors to submit and adhere to a list of major project milestones and expected completion dates, and potentially make contractor payments contingent on their ability to do so. Contract language should ensure timely contractor responsiveness to any technical issues that may arise after the installation process, especially for those that jeopardize system performance or safety. Finally, schools should consider including language to protect their interests should a company back out of a contract altogether.

Rooftop solar poses a set of unique challenges. Installers should maintain the existing roof warranty after the PV system is placed in service. Contractors may have to puncture the roof to install equipment to hold the system in place, which may violate the existing roof warranty. To avoid this issue, solar contractors should be required to obtain written certification from the company providing the roof warranty that the proposed solar installation will not nullify the warranty. In the event this certification cannot be obtained, the contractor should bear the responsibility of securing a new warranty.

Schools need to ensure that the system performs. Some schools we contacted for this study noted that their realized cost savings were less than anticipated. The discrepancy can be because of poor system performance. However, the solar resource varies from year to year. While estimates of solar production are based on a “typical meteorological year,” the actual weather experienced varies. For example, 45 years of weather data from Atlantic City, New Jersey shows that annual solar resource availability ranged from 12% below to 9% above the average estimate that would be used in production calculations. Erroneous assumptions regarding baseline facility energy use can also cause lower than expected cost savings.

Schools should require that contractors provide an accurate estimate of system performance. Contractors should guarantee that the system, when properly maintained, will produce electricity equal to a predefined percentage of this estimate. Consultants with expertise in solar technology, policy, and energy markets can review the assumptions underlying cost saving estimates provided in contractor proposals. These consultants can also help review final contract terms and provide input on the current policy, regulatory, and legal landscape to help ensure the school is receiving the best deal possible.



Photo Credit: Sage Renewables

NO PARKING

ENDNOTES

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www.TheSolarFoundation.org