

# Making the Grade with Clean Energy

## Case Studies of California Solar Schools



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# Table of Contents

<b>Executive Summary</b> .....	<b>4</b>
<b>Introduction</b> .....	<b>7</b>
<b>Solar Energy Makes the Grade</b> .....	<b>9</b>
Antelope Valley Union Installs Expansive Solar System. ....	10
Sweetwater Union Makes a Splash by Combining Solar PV and Solar Thermal. ....	11
Golden Valley Unified Brings Cleaner Air to the Central Valley .....	12
Milpitas Unified’s Proactive Approach to Electricity Savings .....	13
Irvine Unified Lights Up Young Minds with Clean Energy Curriculum .....	14
Berkeley Unified Teaches Other Districts about Going Solar .....	15
Los Angeles Unified Expands Solar Commitment to 42,000 kW .....	16
Mt. Diablo Unified Taps into the Power of the Sun and the Internet .....	17
<b>Other Solar School Success Stories</b> .....	<b>18</b>
Palmdale School District .....	19
Paradise Unified School District. ....	19
Poway Unified School District .....	19
Red Bluff Joint Union High School District. ....	19
Riverside Unified School District .....	19
San Francisco Unified School District. ....	20
San Ramon Valley Unified School District .....	20
Santa Ana Unified School District .....	20
Santa Cruz City Schools. ....	21
William S. Hart Union High School District .....	21
<b>Conclusions and Recommendations</b> .....	<b>22</b>
<b>Appendix</b> .....	<b>25</b>
<b>Notes</b> .....	<b>34</b>

# Executive Summary

**S**olar energy makes sense for California's schools. Each new solar school project helps **clean California's air, fight global warming, save schools money on energy bills, create local jobs, and educate and excite students about renewable energy.**

This report presents case studies from 18 California school districts that have installed solar energy projects at nearly 200 schools combined, illustrating the environmental, economic and educational benefits of going solar in our schools. While not a comprehensive collection of all the schools that have invested in solar power in California, this report is a first-of-its-kind collection of success stories of public kindergarten through grade 12 (K-12) schools going solar.

California's schools have only begun to tap into the tremendous potential of solar energy. School districts, com-

munities, solar companies, utilities and governments should continue to work together toward a clean energy future for the students of today and tomorrow.

**Powering our schools with solar energy reduces California's consumption of fossil fuels, producing cleaner air for our children to breathe.**

- Among the schools surveyed for this report, the average size of the solar photovoltaic (PV) projects installed on roofs, carports and open spaces is 313 kilowatts (kW) per school.<sup>1</sup>
- By generating clean energy, a 313 kW system prevents the emission of an estimated 200 pounds of smog-forming pollution per year<sup>2</sup> and reduces global warming pollution by approximately 265 metric tons per year.<sup>3</sup>

- Over a 20-year period, the Antelope Valley Union School District's 9,600 kW solar PV system in Los Angeles County will reduce greenhouse gas emissions by an estimated 250,000 tons.
- The Golden Valley Unified School District in Madera County recently installed a 1,100 kW solar PV system that is estimated will prevent the emission of more than 2,300 pounds of unhealthy chemical pollutants like sulfur dioxide, oxides of nitrogen, particulate matter and volatile compounds each year.

**Solar energy systems are saving cash-strapped schools money.**

- California's schools spend an estimated \$700 million each year on energy expenses, which is roughly the equivalent of what the state's schools spend on books and supplies.<sup>4</sup> This poses a significant drain on school finances.
- A school with a 313 kW solar PV system can save roughly \$40,000 to \$125,000 per year.<sup>5</sup> This is energy that school districts do not have to buy from a utility, saving money that the schools can use to pay for more teachers, staff, books and facilities.
- The Milpitas Unified School District in Santa Clara County hosts a 3,450 kW solar PV system that is performing above expectations, and is projected to produce millions in savings over 20 years.
- When completed, the Los Angeles Unified School District's planned 42,700 kW solar PV system will result in average savings of up to \$800,000 each month, freeing up funds to be applied towards educational programs.

**Profiled Solar School Districts**



**School districts are maximizing their solar potential by investing in both solar photovoltaic systems and solar thermal technologies.**

- In addition to installing a 5,310 kW solar PV system, Sweetwater Union High School District in San Diego County also has a solar thermal system that heats two swimming pools, reducing greenhouse gas emissions by 220,000 pounds annually.

**School energy systems provide learning opportunities for students.**

- 5th and 6th graders at Irvine Unified School District in Orange County complete an 18 lesson sustainable energy curriculum, covering topics from electricity consumption to

energy conservation to various forms of renewable energy.

- Students in Mt. Diablo Unified School District in Contra Costa County use an online monitoring program that provides real-time information on the clean energy generated by their school.

**Solar school pioneers are sharing lessons learned with other districts.**

- Berkeley Unified School District in Alameda County was one of three California districts to participate in a program that created Solar Master Plans (SMP) for the districts to follow when going solar. The SMPs provide districts that are considering solar projects with detailed information on all aspects of a solar transaction, providing detailed information about how solar technology works as well as siting, financing and contracting information specific to the individual school districts.<sup>6</sup>

**California should make it possible for more school districts to participate in the state's solar transformation. Key steps include:**

- Ensuring that California's Million Solar Roofs Initiative (SB 1) reaches

its goal of driving a market for 3,000 megawatts (MW) of rooftop solar across the state by the end of 2016, and then moving beyond that goal to reach 12,000 MW of local clean power by 2020, as envisioned by Governor Brown.

- Continuing rebates on solar water heating systems and expanding these programs to ensure there is enough support to increase California's promising solar water heating market.
- Expanding net metering so that all California schools can go solar.
- Expanding feed-in-tariff programs at the state and municipal levels.
- Continuing to offer strong financing programs and policies—including rebates, bonds, grants and other incentives—for schools to go solar.
- Encouraging school districts to perform due diligence on technologies, partners and financing options in order to ensure the best value for the districts.
- Removing barriers to going solar at the local and state levels, such as streamlining permitting and interconnection processes.

# Introduction

The state of California is grappling with an oppressive \$16 billion budget deficit, putting the state's public schools into deep financial crisis.<sup>7</sup> Teachers are contending with severely reduced budgets and facing the threat of additional furlough days, program cuts, scaled back curricula and layoffs.

Compounding these financial problems, rising energy costs continue to strain school district budgets. According to the California Department of Education, California's K-12 schools spend an estimated \$132 per student each year on energy expenses.<sup>8</sup> When totaled across California's school system—the largest in the country—the energy expenses amount to \$700 million, which is roughly the equivalent of expenses for books and supplies.<sup>9</sup> This poses a significant drain on school finances.

Meanwhile, California continues to rely heavily on fossil fuels to meet our energy needs. This dependence perpetuates California's chronic air pollution problems, which have a pronounced impact on children. It is estimated that a staggering 15 percent of children in California have been diagnosed with asthma, resulting in approximately 1.6 million missed school days each year in asthma-related complications, which can be triggered by air pollution.<sup>10</sup>

At the same time, California's long commitment to renewable energy—in particular distributed solar power—is beginning to pay off. California now has more than 1,300 MW of rooftop solar across the state,<sup>11</sup> which is more than in all but five nations in the world.<sup>12</sup> Thanks to innovative and bold policies like the Million Solar Roofs Initiative

(Senate Bill 1) that are driving market growth and helping create economies of scale, the price of solar power has dropped 25-40% in the past five years and there are now over 3,500 solar companies employing over 25,000 people throughout the state, more than in any other state in the country.<sup>13</sup> As a result, California's market is diversifying with cities like Fresno and Bakersfield installing more solar than San Francisco, and thousands of homeowners, businesses, farms and military bases, among others, going solar throughout the state.

Against this backdrop, California school districts are beginning to embrace the financial relief, green attributes, educational benefits and community recognition of leading the way towards a clean energy future. In the process, our school districts are creating a brighter future for their students and their communities, while putting Californians to work and helping the state meet its renewable energy and global warming goals.

In this report, Environment California Research & Policy Center provides a glimpse into the solar achievements of 18 public school districts that are among

those leading the solar transformation by installing solar energy systems at their K-12 facilities. Together, these districts serve over 1 million students, or approximately 17 percent of the students in California's public K-12 schools, who are experiencing firsthand the environmental, economic and educational benefits of making a commitment to clean energy.<sup>14</sup>

California school districts—whether serving a few thousand or hundreds of thousands of students, whether located in inland or coastal communities—are increasingly united by their commitment to a clean energy future. From Red Bluff Union Joint High School District, which serves less than 2,000 students in northern California, to the Los Angeles Unified School District, serving nearly 660,000 students, our schools are putting solar to work for students and our communities.

As California builds upon these achievements, our schools can continue laying the groundwork for the next great energy transition—one that will transform our economy, generate jobs, protect our health and preserve our environment for decades to come.

# Solar Energy Makes the Grade

## Profiled School Districts



## Antelope Valley Union Installs Expansive Solar System



Eastside High's 1169 kW carport system, which teachers and students alike use to shade their cars in the desert community of Lancaster, CA.

Photo: PsomasFMG

- Installed a 9,600 kW system—the largest school district solar project in the United States at the time of completion
- Generates 80 percent of the District's energy needs with clean energy
- Over 20 years, will reduce greenhouse gas emissions by an estimated 250,000 tons

In June 2011, the Antelope Valley Union School District (AVUHSD) celebrated the completion of a 9,600 kW solar energy system, the largest school-based solar project in the United States at that time.<sup>15</sup> AVUHSD serves nearly 26,000 students in the high desert cities of Palmdale and Lancaster in northern Los Angeles County.

As is the case for most California school districts, AVUHSD was initially drawn to solar for the cost savings. By entering into a power purchase agreement with PsomasFMG, the District was able to go solar with no upfront capital costs. By installing carport systems at 10 schools, ranging from 151 kW to 1,172 kW, the District has benefitted from over \$360,000 in savings in the first year of operation, funds that can be redirected to cover other aspects of the District's budget. It is anticipated that the savings will amount to \$40

million over the course of the 20-year agreement. The total system is meeting 80 percent of the District's energy needs and it is estimated that the District will reduce its greenhouse gas emissions by 250,000 tons over the course of the agreement.<sup>16</sup>

In addition to enjoying the cost savings, the District is maximizing the experience by incorporating information about its solar energy system into its science and math curricula, and tracking the energy output of the system through a real-time, online monitoring system. The educational benefits are apparent. Students scored an average of 60 percent higher on science and math tests after participating in a weeklong trial run of solar-based science and algebra lessons, supporting the idea that learning is aided by real-life applications, in this case the solar energy systems at work just outside the classroom windows.<sup>17</sup>

## Sweetwater Union Makes a Splash by Combining Solar PV and Solar Thermal



Nearly completed 507 kW carport solar power system at Montgomery High School in San Diego.

Photo: SunPower Corp.

- Installing 5,310 kW solar photovoltaic system
- Solar thermal system heats two swimming pools, reducing greenhouse gas emissions by 220,000 pounds annually

Sweetwater Union High School District, which serves nearly 41,000 secondary students in San Diego County, is installing solar photovoltaic projects at ten of its high school campuses. The projects include a mixture of rooftop and carport systems that range in capacity from 254 kW to 926 kW. Put together, the projects have a combined capacity of 5,310 kW.

Proposition O, a \$644 million local bond measure that voters approved in 2006, made the move to solar power possible as part of a larger effort to upgrade school facilities. The District selected SunPower to construct and install the solar installations, which are expected to come online by the end of 2012. The District opted to sign a power purchase agreement with SunPower to finance the project, which will allow the District to accumulate up to \$11 million in savings over a 20-year period.

The solar photovoltaic projects are not the District's first foray into solar energy.

At Mar Vista High School, the planned 390-kilowatt solar PV array will join a solar thermal heating system used to heat the school's two swimming pools. The swimming pools, which have a combined capacity of 267,000 gallons, are the only such facilities in the District that allow students to participate in aquatic sports and other extracurricular activities. Prior to the installation of the solar heating system, the District relied on a traditional boiler that was expensive to run because of rising fossil fuel prices.

Thanks to an \$18,612 incentive payment from San Diego Gas & Electric, the cost to replace the old boiler with solar heating was just \$37,000. This cost was paid off after just one and a half years, as the significant leap in energy efficiency allowed the District to trim annual energy costs at the school by \$25,000. The solar heating system also reduces greenhouse gas emissions by 220,000 pounds annually.<sup>18</sup>

## Golden Valley Unified Brings Cleaner Air to the Central Valley



This ground-mounted system is situated in a previously vacant site between Liberty High School and Ranchos Middle Schools.

Photo: TerraVerde Renewable Partners

- Expected to generate 80 percent of the District's energy needs with clean energy; and to offset 99 percent of the District's electricity bills
- Estimated to prevent the emission of more than 2,300 pounds of unhealthy chemical pollutants into the air each year
- Over a 25-year period, could save the District nine million dollars

The Golden Valley Unified School District (GVUSD), which serves a total of nearly 2,000 students in the Central Valley's Madera County, has adopted a strategy to reduce energy costs through renewable energy, thereby preserving precious dollars for its schools. In June 2012, the District oversaw the finishing touches on several brand new solar power systems installed at four schools and its headquarters building.

TerraVerde Renewable Partners assisted the District in project scoping and feasibility, running a competitive bid process to select the contractor (Cupertino Electric), managing the installation, and arranging for financing and rebates. The solar photovoltaic systems range from 31 kW to 550 kW in size, with a combined capacity of more than 1,100 kW. Eighty percent of the panels are mounted at ground level on unused property, while twenty percent of the panels are elevated and double as shade structures for parking lots and

other outdoor areas. GVUSD expects to produce approximately 1,700 megawatt-hours of electricity annually, accounting for over 80 percent of its total electricity consumption on a net annual basis.

The solar installation will also have tremendous benefits for the environment, eliminating a projected 2.3 million pounds of carbon dioxide pollution on an annual basis.<sup>19</sup> The project will also help alleviate the Central Valley's notoriously poor air quality.<sup>20</sup> The District's solar electricity usage will prevent the emission of more than 2,300 pounds of unhealthy chemical pollutants like sulfur dioxide, oxides of nitrogen, particulate matter, and volatile organic compounds each year.<sup>21</sup>

GVUSD decided to purchase the solar installation outright, rather than rely on a leasing agreement. This was possible without upfront expenditures, as the District took advantage of several affordable funding mechanisms. The California Energy

Commission approved a subsidized low-interest loan to cover approximately half the cost, payable over 15 years. The rest is covered through certificates of participation, a tax-exempt investment vehicle with an expected payback period of 25 years. Both mechanisms will allow the District to make payments early, if surplus funding allows.<sup>22</sup>

By 2017, the District is projected to achieve a net cumulative savings of more than a quarter million dollars. Over a twenty-five year period, the District has the potential to accumulate \$9 million in total savings.

There are also substantial revenue opportunities for the District. The District will have access to a performance-based incentive program offered by Pacific Gas & Electric via the California Solar Initiative. The District will enjoy five years of eligibility for the program, during which it will receive a monthly rebate based on the amount of solar electricity it generates.

## Milpitas Unified's Proactive Approach to Electricity Savings



Curtner Elementary School in Milpitas benefits from a 139 kW carport solar system. Photo: Chevron Energy Solutions

- 3,450 kW solar photovoltaic system performing above expectations and projected to produce millions in savings over 20 years
- Expected to reduce District's carbon dioxide emissions by 26,000 metric tons over a 25-year period—the equivalent of planting 270 acres of trees

The Milpitas Unified School District (MUSD), which serves a total of nearly 10,000 students in Santa Clara County, decided in 2007 to go solar in order to promote clean energy, save general fund dollars and create “a living laboratory for teachers and students.”<sup>23</sup> District leaders educated themselves on the experience of another district that had recently installed solar, undertook comprehensive research on technologies that will perform at high standards over the long-term, selected a developer with a proven track record, and engaged all of the stakeholders early and regularly throughout the entire process, ensuring that this was a true team effort.

All of the District's homework is beginning to pay off. In January 2009, 13 schools and the Corporation Yard installed a total of 3,450 kW in solar carport projects, ranging in capacity from 113 kW to 1,002 kW. The system, constructed by Chevron Energy Solutions, generates 75 percent of the District's annual electricity needs and 100 percent of the District's electricity needs during the peak-demand sum-

mer months. This is one the highest percentages of solar power generated by any K-12 school district in the entire country.<sup>24</sup>

The solar energy system was financed through a 20-year power purchase agreement with Bank of America, allowing the District to go solar without any upfront capital costs. Already, the system is exceeding performance expectations by nine percent, resulting in more savings than anticipated for the general fund. To date, the District has enjoyed more than \$280,000 in electrical savings. Over the course of the agreement, the system is expected to produce millions in savings to the District's general fund and provide predictability in energy costs, thereby enabling the District to more accurately plan its budgets. Once the system has been in place for six years, the District will have the option to buy the system at a discounted rate. This would allow the District to reap the full economic savings generated by the system, translating to more money for programs and classrooms.

In addition to the financial benefits, the District's solar commitment is producing multiple educational and environmental benefits. The District is utilizing the solar energy projects in its energy science curricula for 5th and 6th graders, who are learning how clean energy technology works and how their District is promoting environmental stewardship. As they learn from this living laboratory, the students and teachers can take pride in the fact that their District is generating clean energy. Over a 25-year time period, the system will reduce 26,000 metric tons of carbon dioxide pollution, which is the equivalent of planting 270 acres of trees, a real impact that the students can visualize.<sup>25</sup>

The students are not the only ones who are proud of their District's clean energy accomplishments. Indeed, the District's leadership on solar energy has been recognized by awards from the City of Milpitas, the State of California, elected officials and environmental organizations.

## Irvine Unified Lights up Young Minds with Clean Energy Curriculum



Rooftop solar installation on the District's Maintenance and Operations Facility. Photo: Joe Hoffman, IUSD's Director of Maintenance and Operations

- 1,900 kW system projected to generate energy equivalent of powering more than 5,000 homes for one year
- 5th and 6th graders complete sustainable energy curriculum

The Irvine Unified School District (IUSD), which serves more than 28,000 students in Orange County, has installed solar photovoltaic projects at twelve K-12 schools, an early childhood learning center, the IUSD District office and a maintenance & operations facility. The projects include roof and carport systems, ranging in capacity from 42 kW to 285 kW, for a total system size of 1,900 kW.

Under a 20-year power purchase agreement, the District is leasing space to SunEdison in exchange for purchasing the power produced by the solar panels at a rate lower than the District would otherwise have paid its utility company, Southern California Edison, for the same amount of power. The installations came online between November 2010 and February 2011, and had resulted in over \$243,000 in savings by the end of May 2012. As the savings from the solar energy system contribute to the District's general fund, the District now has more money to invest in other needs.

According to SPG Solar, which designed and built the solar panels, over the course of the 20-year agreement, the District's system will generate the energy equivalent of powering more than 5,000 homes for one year.<sup>26</sup>

Over the course of the school year, students in the District's 5th and 6th grade science program complete 18 lessons on sustainable energy, covering topics from electricity consumption to energy conservation to various forms of renewable energy. In addition, students are able to track the performance of the District's system via real-time online monitors, further contributing to the District's enthusiasm for future solar investments.

In July 2012, the Irvine Unified School District School Board approved nine additional solar school projects under a new power purchase agreement with SunEdison, slated for completion by September 2013. The District estimates that the approved projects will save the District over \$300,000 in spending

annually and more than \$9.6 million over the course of the 20-year power purchase agreement<sup>27</sup>

### Sustainable Energy Lesson Titles

#### 5th Grade:

- Electricity Snap Circuits
- Getting Leverage
- Roller Coasters
- Rocket Balloon Blast-Off
- Motors
- Water Turbines
- Electrical Consumption
- PEAK Power Mix

#### 6th Grade:

- Carbon Cycle
- Potential and Kinetic Energy
- Conserving Energy
- Renewable vs. Nonrenewable Energy
- Testing Wind Turbines
- Energy from the Sun
- Using Solar Power
- Testing Solar Cars
- Biomass
- Hydrogen Fuel Cells

## Berkeley Unified Teaches Other Districts about Going Solar



Washington Elementary in Berkeley, CA before solar installation.

Photo: GoogleEarth



Washington Elementary in Berkeley, CA after installation of a 103 kW rooftop system.

Photo: GoogleEarth

- Created a Solar Master Plan as a template for other school districts

The Berkeley Unified School District (BUSD) was first compelled to go solar in 2006, as a means to save money. This desire to invest in solar was complemented by strong community support, which resulted in the passage of a new general obligation bond in 2010. In addition, the District received Office of Public Schools Construction (OPSC) bonds and rebates from Pacific Gas & Electric.

BUSD, which serves a total of nearly 10,000 students in Alameda County, has now installed solar photovoltaic systems at four elementary schools. These rooftop systems range from 47 kW to 103 kW in size, for a combined system size of 320 kW. Plans are in place for a fifth system to be installed at Rosa Parks Elementary. The planned 52 kW system will utilize a revolutionary installation technique—a ballasted system that requires no roof penetration. SunPower Inc.'s ballasted system will reduce roof leaks and bring down the cost of installation.

The first of the two BUSD projects taught KyotoUSA, a Berkeley-based volunteer grassroots organization, an important lesson in planning solar projects

within a school district. Many districts map out all major facilities' projects under a multiple-year master plan. Thus, it is advised to propose solar projects in coordination with the master planning process, developing a district-wide blueprint for going solar. With this understanding, KyotoUSA and the Sequoia Foundation obtained a U.S. Department of Energy technical assistance grant to develop a Solar Master Plan (SMP) that could serve as a template for other school districts.<sup>28</sup> Together with the National Renewable Energy Laboratory, KyotoUSA worked with not only Berkeley Unified School District, but also nearby Oakland and West Contra Costa Unified School Districts to develop plans for each district. These plans include detailed information about how solar technology works as well as siting, financing and contracting information specific to schools.<sup>29</sup> In essence, these districts took to heart their mission to teach others, and these master plans can now serve as a model for other districts throughout California and the nation.

Thanks to additional local bonds, BUSD may install an additional 800 kW in solar energy systems in coming years.<sup>30</sup>

## Los Angeles Unified Aims to Expand Solar Commitment to 42,000 kW



This 116 kW solar carport system was installed at the South Region Elementary School in the City of South Gate, CA.

Photo: Los Angeles Unified School District

- When completed, the District's solar photovoltaic projects are anticipated to produce over 42,000 kW of clean energy
- Expected savings of up to \$800,000 each month on average

The Los Angeles Unified School District (LAUSD) decided to become a leader in solar power as part of its efforts to become more energy efficient. Serving a total of nearly 660,000 students in Los Angeles County, the District has installed solar projects at 25 schools and two non-school sites to date. The existing projects include rooftop and carport systems that range in capacity from 116 kW to 1,000 kW, for a total system size of 9,000 kW. The individual school projects, which were installed by Chevron Energy Solutions, PermaCity, SolarCity, SolarMonkey and SunPower, came online between August 2010 and August 2012. Another 38 projects are in the works, set for completion in April 2013. Once all of these projects are installed, the District's solar power capacity will reach 20,700 kW, which is projected to result in over \$112 million in savings over a 20-year period.

In order to maximize the savings of its solar power systems, the District decided to purchase the solar installations rather than enter into power purchase agreements. Ninety-eight million dollars in construction bonds, \$31 million in energy-saving rebates from the Los Angeles Department of Water and Power and \$14 million in settlement fees covered the costs of these initial projects.<sup>31</sup>

Further solidifying its commitment to going solar, LAUSD's goal is to expand its solar program to an additional 60 solar school sites, which will produce an additional 22,000 kW of clean energy. These installations will be purchased through the funds from the state's Modernization Program, rebate dollars, and future bond funds.<sup>32</sup>

Once all 123 projects are complete, the system will produce a total of 42,700 kW of clean power, resulting in average savings of up to \$800,000 each month.<sup>33</sup>

## Mt. Diablo Unified Taps into the Power of the Sun and the Internet



This 94 kW carport and roof solar photovoltaic system was installed at Hidden Valley Elementary School in Martinez, CA in summer 2012.

Photo Credit: Brad Hunter, Mt. Diablo Unified School District

- Nearly 8,000 kW solar photovoltaic system expected to reduce energy costs by 91 percent
- Real-time online monitoring program tells students how much clean energy their school generates

On June 8, 2010, the voters of Mt. Diablo Unified School District approved Measure C, a \$348 million General Obligation Bond measure intended to enhance the education experience.<sup>34</sup> The passage of a bond measure allowed the District, which serves a total of nearly 34,000 students in Contra Costa County, to install an \$80 million solar energy system at 50 sites across the District.

At the time that the bond measure passed, the District was spending more than \$3.6 million each year in electricity costs from its general fund. By making a District-wide commitment to solar power, the District expects to reduce its annual energy costs by an impressive 91 percent, leaving an electricity bill of just over \$330,000 per year.

The solar energy projects, which are being installed by SunPower, include rooftop and carport systems and will amount to 12,500 kW when completed. Since the initial installations came online in late 2011/early 2012, the District has already generated 10,354 MWh of clean energy and saved \$1,553,100 in electricity spending.<sup>35</sup>

Teachers, students and the general public are able to track the performance of the systems at individual schools and at the District as a whole via a real-time online monitoring program, further enhancing the educational value of the District's solar commitment. In addition to providing data about a particular school's energy generation, as measured in kWh, the program contextualizes the benefits in ways that are easy for students to visualize. For instance, a student at Oak Grove Middle School who visited the online program on August 29, 2012 could find out that her school had produced a total of 252.79 MWh of solar power to date. She would also discover that this amount of clean energy equals the reduction of 134 tons of carbon dioxide, and enough energy to power 21 homes for a year.<sup>36</sup>

The Mt. Diablo Unified School District also has 11 projects in progress, with a projected capacity of 2,040 kW. It is anticipated that, upon completion, the District's solar energy system will have created over 140 construction jobs and contributed \$24 million to the regional economy.<sup>37</sup>

# Other Solar Success Stories

## Palmdale School District



334 kW carport solar PV system at Desert Willow Intermediate in Palmdale, CA.

Photo: PsomasFMG

The Palmdale School District, which serves nearly 21,000 students in Los Angeles County, has installed solar energy projects at nearly 20 schools. The projects include ground-mounted and carport systems and range in capacity from 232 kW to 472 kW, cumulating in a total system size of 6,300 kW. The installations came online December 31, 2011, and are projected to result in \$25 million in savings over the course of the 20-year power purchase agreement with PsomasFMG.<sup>38</sup>

## Paradise Unified School District

The Paradise Unified School District, which serves a total of over 4,300 students in the foothills of the Central Valley in Butte County, has installed two solar PV projects: one at an elementary school and one at a bus yard, for a total system size of 180 kW.<sup>39</sup> The projects, installed by SolarCity, came online between in the

spring of 2011 and resulted in over \$1400 in savings in the first three months online. Both the elementary school and the District's middle school incorporate the solar arrays into their green energy curriculum.<sup>40</sup>

## Poway Unified School District

The Poway Unified School District, which serves a total of nearly 35,000 students in San Diego County, has installed solar PV projects at six school sites. The systems include rooftop and ground-mount systems and range in capacity from 40 kW to 389 kW, adding up to a total system size of 932 kW. The installations came online between November 2006 and January 2011. Based on the success of these projects, the District is considering expanding their solar commitment to additional schools.<sup>41</sup>

## Red Bluff Joint Union High School District

The Red Bluff Joint Union High School District, which serves a total of almost 1,800 students in Tehama County, has installed solar PV projects at two schools, cumulating in a total installed capacity of 755 kW. The installations came online in December 2011.<sup>42</sup>

## Riverside Unified School District

The Riverside Unified School District, which serves a total of over 42,000 students in Riverside County, has installed rooftop solar PV projects at two schools, for a total system size of 50 kW. The installations came online in 2011, and have brought over \$16,000 in savings in the first year.<sup>43</sup>

## San Francisco Unified School District

The San Francisco Unified School District, which serves nearly 57,000 students, is currently installing its first solar rooftop system at Alvarado Elementary School. The 50 kW system is anticipated to come online in October 2012 and produce an estimated 40 percent of the school's energy.<sup>44</sup>

## San Ramon Valley Unified School District

San Ramon Valley Unified School District, which serves nearly 30,000 students in Contra Costa County, has installed solar PV projects at four of its high schools and one middle school. The District contracted with SunPower to design and install the \$23.3 million, 3,360 kW project.

The solar installations were funded with \$25 million in American Recovery and Reinvestment Act qualified school construction bonds. The bonds have a near-zero interest rate, and the District will use the energy savings that the solar panels provide to pay off the debt within sixteen years. At the time that the bonds have been repaid, the District expects to



102 kW solar PV system at Dougherty Valley High in San Ramon, CA.

Photo: John Forkey, San Ramon Valley Unified School District

have accumulated \$3 to \$5 million in savings, with a cumulative savings of up to \$23 million after 25 years.<sup>45</sup> The project is also receiving rebates from the California Solar Initiative.

The project includes 10,000 solar panels, the majority of which are mounted on carport systems in school parking lots. The individual school site capacities range from 259 kW at Diablo Vista Middle School to 1,023 kW at Dougherty Valley High School, with a District-wide total of 3,360 kW.<sup>46</sup> As a whole, the system is expected to produce nearly 6.2 million kilowatt-hours of energy in its first year of operation, providing nearly two-thirds of the electricity needs for the schools with the solar projects.<sup>47</sup> The installations came online in October 2011.

## Santa Ana Unified School District

The Santa Ana Unified School District serves over 57,000 students in Orange County. At Saddleback High School, which serves 2,080 students, the District is operating an 809 kW solar PV system that is mounted on building rooftops and solar shade structures. The system cost \$5.6 million and was funded by general obligation bonds approved by Santa Ana voters.<sup>48</sup>

The solar PV system came online in summer 2010. Since then, it has produced three quarters of the school's electricity consumption on an annual basis. In addition, the bond measure also approved the installation of a solar thermal heating system that heats 75 percent of the school's hot water. The projects were paired with the installation of an energy efficient roof and an upgraded HVAC system.

The two solar energy systems have put a significant dent in SAUSD's utility bills. In the first year of operation, they produced \$250,000 in energy sav-

ings, and when financial incentives are included, the savings over the first five years will average out to over \$640,000 per year. This will provide SAUSD with approximately \$3.3 million in general fund savings that can be repurposed for educational programs. And over the twenty-five year lifespan of the project, the District expects to cumulatively save up to \$15 million.<sup>49</sup>

## Santa Cruz City Schools

Santa Cruz City Schools, an organization of small school districts that serve approximately 7,000 K-12 students in Santa Cruz County, has installed solar PV projects on two of its secondary schools. The systems have a combined capacity of 522 kW and bring a total of \$50,000 to \$60,000 in savings annually.<sup>50</sup>

At Soquel High School, located just east of the city proper, Santa Cruz City Schools supported green jobs at a local business by having Sandbar Solar and Electric install 1,800 solar panels for the rooftops of several buildings in 2008. The panels have a combined capacity of 315 kW, enough to provide 40 percent of the school's power needs each year.<sup>51</sup> According to Sandbar, the project was envisioned not just as a way to save money, but also to foster a sense of environmental and social responsibility among the school's 1800 students.

Santa Cruz High School was the next to receive a solar energy system. Santa Cruz City Schools brought in SolarCity to install a 207 kW flat roof system, which was activated in late 2009. To help demonstrate the benefits of the system, SolarCity provides a website that allows

students to track the energy output and carbon reductions of the solar panels. For example, the website shows how much power is produced at different times of the day and different months of year, conveying valuable lessons about renewable energy. According to the website, the solar energy system had produced nearly 800,000 kilowatt-hours of energy and offset over one million pounds of carbon dioxide pollution by late August 2012.<sup>52</sup>

## William S. Hart Union High School District

The William S. Hart Union School District, which serves a total of over 26,000 students in northern Los Angeles County, has recently installed solar PV projects at nine schools that will be fully online by October 2012. The systems include carport, ground-mounted and elevated solar energy systems and range in capacity from 302 kW to 998 kW, for a total system size of 6,660 kW. The installations are projected to result in \$15 to 18 million in savings over the course of the 20-year power purchase agreement.

PsomasFMG, which designed, financed, built and is operating the project, is working hand-in-hand with the Career Development Coordinator of the District to incorporate a solar curriculum into the high school classrooms, using the installations to teach the students about math, science and electricity concepts. In addition, a high school student from Valencia High School interned over the summer of 2012 with PsomasFMG, learning firsthand about working in the clean energy field.<sup>53</sup>

# Conclusions and Recommendations

**T**hese 18 case studies demonstrate that California's school districts are leading the way towards a new, clean energy future.

Acting as environmental stewards, creative problem solvers and economic leaders, these school districts are taking advantage of the opportunities presented by solar power to bring cleaner air, financial savings and greater educational opportunities to the students of today and tomorrow.

California's leaders should continue to support the growth of solar school projects across the state. Key recommendations include:

**Ensuring that California's Million Solar Roofs Initiative (SB 1) reaches its goal of driving a market for 3,000 MW of rooftop solar across the state by the end of 2016, and then moving beyond that goal to reach 12,000 MW of local clean power by 2020, as envisioned by Governor Brown.**

- State leaders should work to make sure that the Million Solar Roofs Initiative continues to stay on track, providing incentives for schools as well as residential, commercial and non-profit customers to go solar.

- Governor Jerry Brown’s goal of installing 12,000 MW of distributed electricity generation in California by 2020 is a strong step above and beyond the Million Solar Roofs Initiative. California should adopt innovative policies to ensure that the state meets this visionary goal. In particular, schools should increasingly be able to participate in these policies so that California’s schools are at the front of the class, leading the nation’s transformation to a clean energy future.

**Continuing rebates on solar water heating systems and expanding these programs to ensure there is enough support to increase California’s promising solar water heating market.**

- The Public Utilities Commission should implement AB 1470 in such a way that helps bring solar water heating technologies to the market throughout the state.
- Legislation to fund solar water heating systems in municipal and commercial swimming pools, such as AB 2249, which was signed into law in September 2012, must be fully implemented.

**Expanding net metering so that all California schools can go solar.**

- Net metering is critical to the financial viability of solar school systems. Net metering is the ability to send solar electricity back to the grid during sunny days for use by neighboring homes and businesses, and to draw from the grid on credit during the night. This is a simple and effective way to help make going solar affordable for consumers, while incentivizing energy efficiency and the generation of pollution-free solar

electricity. Given the seasonal nature of schools, most districts use very little electricity during the summer months when electricity prices command a premium. Thanks to net metering, solar school districts are credited for the unused solar power they generate, saving significantly on their electricity bills.

- Utility companies have lobbied successfully over the past decade to limit the net metering program to five percent of a utility’s peak aggregate demand. This cap is set too low to ensure that all solar energy system owners who participate in the Million Solar Roofs Initiative earn fair compensation for the benefits that their systems will provide to all ratepayers. Without the ability to turn their meters backwards, today’s solar schools would see their electricity bills increase substantially and schools would have little incentive to embark upon new solar projects going forward. Therefore, California should expand its net metering program or eliminate the cap altogether.
- California’s net metering program also places a cap on the size of systems that are eligible for participation, currently set at 1 MW. This cap is an obstacle for schools—particularly colleges—whose campuses are often much larger than those of K-12 schools. Raising the cap on the system size would enable these larger schools to go solar in a more efficient and effective manner.

**Expanding feed-in-tariff programs.**

- California has a 750 MW feed-in tariff program, through which the state’s utilities are required to purchase the electricity fed into the

grid from a solar energy system under a long-term contract at a set rate. This program could help drive the market for medium-sized solar projects installed on school properties, such as warehouses and parking lots, where there is little on-site electricity demand, but ample space to install solar panels. Some of the municipal utilities also have feed-in-tariff programs, such as LADWP's recently announced 150 MW program. Expanding feed-in tariff programs could open up more opportunities for schools to go solar.

**Continuing to offer strong financing programs and policies for schools to go solar.**

- Local, state and federal leaders should encourage financing opportunities—including rebates, bonds, grants and other incentives—to ensure that schools are able to go solar and maximize the return on their investments.
- Federal programs, such as the Qualified Zone Academy Bond (QZAB) program and the Qualified School Construction Bond (QSCB) program, can encourage schools throughout California and the country as a whole to invest in solar power projects.

**Encouraging school districts to perform due diligence on technologies, partners and financing options in**

**order to ensure the best value for the districts.**

- Just as a homeowner would shop around before making a major home renovation, school districts should be encouraged to conduct detailed research on the best technologies, project partners and financing strategies, and to consult with a credible third party consultant before going solar. Whether the district decides to purchase the solar energy system itself or pursue a power purchase agreement, a competitive bidding process is advised to increase transparency and enable the district to select the option that will result in the best value for the district.

**Removing barriers to going solar at the local and state levels.**

- Local and state leaders should work to standardize procedures and streamline the process of installing a new solar energy system and integrating it into the electricity grid. Different jurisdictions have varying permitting and interconnection procedures, which can add unnecessary friction to the process of installing solar energy systems. Streamlining the process could make it easier and faster for schools that want to go solar to navigate through the entire process, turning solar plans into solar schools more efficiently.

# Appendix

## Solar School Projects by District

The charts below contain data on individual solar school projects completed and underway in the school districts profiled in this report, listed in alphabetical order by district.

### Antelope Valley Union High School District Solar Installations

Project Site	City	Installed Capacity (kW)	Type of System
Lancaster High	Lancaster	1169	Carport
Antelope Valley Adult	Lancaster	151	Carport
Eastside High	Lancaster	1169	Carport
Highland High	Palmdale	1169	Carport
Antelope Valley High	Lancaster	1172	Carport
Palmdale High	Palmdale	1172	Carport
Desert Winds West Valley Campus	Lancaster	197	Carport
Knight High	Palmdale	1166	Carport
Littlerock High	Littlerock	927	Carport
Quartz Hill High	Quartz Hill	1166	Carport

### Berkeley Unified School District Solar Installations

Project Site	City	Installed Capacity (kW)	Type of System
Emerson Elementary	Berkeley	76	Roof
Washington Elementary	Berkeley	103	Roof
Malcolm X Elementary	Berkeley	47	Roof
Berkeley Arts Magnet at Whittier	Berkeley	94	Roof
Rosa Parks Elementary*	Berkeley	52	Roof

\*Planned

### Golden Valley Unified School District Solar Installations

Project Site	City	Installed Capacity (kW)	Type of System
District Office	Madera	31	Shade structure
Liberty High	Madera	550	Ground-mount
Ranchos Middle	Madera	191	Ground-mount
Sierra View Elementary	Madera	150	Shade Structure
Webster Elementary	Madera	207	Shade Structure

### Irvine Unified School District Solar Installations

Project Site	City	Installed Capacity (kW)	Type of System
College Park Elementary	Irvine	141	Roof
IUSD District Office	Irvine	210	Carport
Early Childhood Learning Center	Irvine	66	Roof
Irvine High	Irvine	211	Roof
Lakeside Middle	Irvine	52	Roof
Maintenance and Operations Facility	Irvine	165	Roof & Carport
Northwood Elementary	Irvine	85	Roof
Plaza Vista Elementary	Irvine	118	Roof
Rancho San Joaquin Middle	Irvine	258	Roof
Santiago Hills Elementary	Irvine	56	Roof
South Lake Middle	Irvine	74	Roof
Springbrook Elementary	Irvine	52	Roof
Turtle Rock Elementary	Irvine	46	Roof
University High	Irvine	285	Roof
Venado Middle	Irvine	79	Roof

### Irvine Unified School District Solar Installations—Planned

Project Site	City	Estimated Installed Capacity (kW)	Type of System
Alderwood Elementary	Irvine	334	Carport
Irvine High	Irvine	705	Carport
Jeffrey Trail Middle	Irvine	502	Carport
Northwood High	Irvine	911	Carport
Stonegate Elementary	Irvine	244	Carport
University High	Irvine	710	Carport
Vista Verde Elementary	Irvine	335	Carport
Woodbridge High	Irvine	426	Carport
Woodbury Elementary	Irvine	295	Carport

## Los Angeles Unified School District Solar Installations

<b>Project Site</b>	<b>City</b>	<b>Installed Capacity (kW)</b>	<b>Type of System</b>
Ann Elementary	Los Angeles	122	Roof
Banning High	Wilmington	795	Roof
Byrd Middle	Sun Valley	362	Carport
Canoga Park High	Canoga Park	273	Roof
Cleveland High	Reseda	508	Roof/Carport
El Dorado Elementary	Sylmar	181	Roof
Gage Middle	Huntington Park	313	Carport
Grant High	Van Nuys	126	Carport
Narbonne High	Harbor City	444	Carport
Roybal Learning	Los Angeles	525	Roof
South Gate High	South Gate	197	Carport
Southeast High	South Gate	464	Carport
Southeast Middle	South Gate	230	Carport
Taft High	Woodland Hills	492	Carport
Venice High	Los Angeles	180	Carport
Washington Prep High	Los Angeles	267	Carport
White Middle	Carson	313	Carport
LD 5*	Los Angeles	326	Carport
HeHesby Oaks School	Encino	134	Carport
Maywood Academy High	Maywood	265	Carport
Reseda High	Reseda	390	Carport
South Region Elementary #9	Southgate	116	Carport
South Region High #9	Los Angeles	244	Carport
South Region Elementary #9	Southgate	128	Carport
Mosk Elementary	Winnetka	165	Carport
Westchester High	Los Angeles	735	Carport
Pico Rivera*	Pico Rivera	1000	Roof

\*Non-school site (office, warehouse, etc.)

### Milpitas Unified School District Solar Installations

<b>Project Site</b>	<b>City</b>	<b>Installed Capacity (kW)</b>	<b>Type of System</b>
Burnett Elementary	Milpitas	172	Carport
Calaveras High	Milpitas	424	Carport
Corporation Yard	Milpitas	181	Carport
Curtner Elementary	Milpitas	139	Carport
Milpitas High	Milpitas	1002	Carport
Pomeroy Elementary	Milpitas	210	Carport
Rancho Middle	Milpitas	216	Carport
Randall Elementary	Milpitas	113	Carport
Rose Elementary	Milpitas	159	Carport
Russell Middle	Milpitas	221	Carport
Sinnott Elementary	Milpitas	195	Carport
Spangler Elementary	Milpitas	134	Carport
Weller Elementary	Milpitas	149	Carport
Zanker Elementary	Milpitas	134	Carport

## Mt. Diablo Unified School District Solar Installations

<b>Project Site</b>	<b>City</b>	<b>Installed Capacity (kW)</b>	<b>Type of System</b>
Mt. Diablo High	Concord	651	Carport
Concord	Concord	497	Carport
Northgate High	Walnut Creek	900	Carport
Clayton Valley High	Concord	653	Carport
Cambridge Elementary	Concord	163	Carport
College Park High	Pleasant Hill	497	Carport
Westwood Elementary	Concord	115	Carport
El Dorado Middle	Concord	255	Carport
Ygnacio Valley High	Concord	535	Carport
Admin/ Monte Gardens Elementary	Concord	473	Carport
Bel Air Elementary	Bay Point	158	Carport
Sun Terrace Elementary	Concord	191	Carport
Shore Acres Elementary	Bay Point	115	Carport
Olympic High	Concord	153	Carport
Rio Vista Elementary	Bay Point	138	Carport
Wren Ave Elementary	Concord	115	Carport
Riverview Middle	Bay Point	359	Carport
Delta View Elementary	Pittsburg	245	Carport
El Monte El Monte	Concord	130	Carport
M&O	Concord	140	Carport
Oak Grove Middle	Concord	268	Carport
Valle Verde Elementary	Walnut Creek	140	Carport
Mountain View Elementary	Concord	153	Carport
Strandwood Elementary	Pleasant Hill	128	Carport
Ygnacio Valley Elementary	Concord	102	Carport
Foothill Middle	Walnut Creek	334	Carport
Eagle Peak Elementary	Walnut Creek	46	Carport
Walnut Acres Elementary	Walnut Creek	191	Carport
Pine Hollow Middle	Clayton	271	Carport
Diablo View Middle	Clayton	248	Carport
Ayers Elementary	Concord	130	Carport
Silverwood Elementary	Concord	128	Carport
Pleasant Hill Middle	Pleasant Hill	525	Carport
Willow Creek Center	Concord	104.55	Carport
Sequoia Elementary	Pleasant Hill	99	Carport
Woodside Elementary	Concord	143	Carport
Gregory Gardens Elementary	Pleasant Hill	153	Carport
Fair Oaks Elementary	Pleasant Hill	115	Carport
Valley View Middle	Pleasant Hill	242	Carport
Loma Vista Adult Center	Concord	357	Carport

### Mt. Diablo Unified School District Solar Installations—In Progress\*

Project Site	City	Installed Capacity (kW)	Type of System
Valhalla Elementary	Pleasant Hill	165.75	Carport
Bancroft Elementary	Walnut Creek	165.75	Carport
Glenbrook/Seneca Center	Concord	204	Carport
Hidden Valley Elementary	Martinez	94.35	Carport & Roof
Highlands Elementary	Concord	214.2	Carport & Roof
Mt. Diablo Elementary	Clayton	170.85	Carport & Roof
Pleasant Hill Elementary	Pleasant Hill	104.25	Carport & Roof
Sequoia Middle	Pleasant Hill	237.15	Carport & Roof
Holbrook Elementary	Concord	127.5	Carport & Roof
Meadow Homes Elementary	Concord	204	Carport & Roof

\*With the exception of Meadow Homes Elementary, these schools are scheduled to come online by the end of September 2012, as this report goes to print.

### Palmdale School District Solar Installations

Project Site	City	Installed Capacity (kW)	Type of System
Barrel Springs Elementary	Palmdale	311	Carports & Elevated Solar Arrays
Buena Vista Elementary	Palmdale	418	Carports & Elevated solar Arrays
Cactus Elementary School	Palmdale	390	Carports
Chaparral Elementary	Palmdale	261	Carports & Elevated Solar Arrays
Cimarron Elementary	Palmdale	321	Carports and Ground-mounts
Desert Rose Elementary	Palmdale	236	Carport, Elevated Solar Array, and Ground-mount
Desert Willow Intermediate	Palmdale	334	Carports & Elevated Solar Arrays
Golden Poppy Elementary	Palmdale	311	Carports & Elevated Solar Arrays
Joshua Hills Elementary	Palmdale	237	Carports & Elevated Solar Arrays
Juniper Middle School	Palmdale	251	Carports and Ground-mounts
Los Amigos School	Palmdale	345	Carports & Elevated Solar Arrays
Ocotillo School	Palmdale	425	Carports & Elevated Solar Arrays
Palm Tree Elementary	Palmdale	252	Carports & Elevated Solar Arrays
Palmdale Learning Plaza	Palmdale	420	Carports and Ground-mounts
Quail Valley Elementary	Palmdale	336	Carports & Elevated Solar Arrays
Shadow Hills Intermediate	Palmdale	472	Carports & Elevated Solar Arrays
Summerwind Elementary	Palmdale	280	Carports & Elevated Solar Arrays
Tumbleweed Elementary School	Palmdale	232	Ground-mounts

### Paradise Unified School District Solar Installations

Project Site	City	Installed Capacity (kW)	Type of System
Paradise Elementary	Paradise	108.5	Carport
Bus Yard	Paradise	72	Carport

### Poway Unified School District Solar Installations

Project Site	City	Installed Capacity (kW)	Type of System
Poway High	Poway	389	Roof
Chaparral Elementary	Poway	121	Roof
Oak Valley Middle	San Diego	63	Roof
Westview High	San Diego	121	Roof & Ground-mount
Monterey Ridge Elementary	San Diego	198	Ground-mount
Del Sur Elementary	San Diego	40	Roof

### Red Bluff Joint Union High School District Solar Installations

Project Site	City	Installed Capacity (kW)	Type of System
Red Bluff High	Red Bluff	700	Dual axis trackers from PV tracker
Salisbury High	Red Bluff	55	Ground-mount

### Riverside Unified School District Solar Installations

Project Site	City	Installed Capacity (kW)	Type of System
Central Middle	Riverside	20	Roof
Frank Augustus Miller Middle	Riverside	30	Roof

### San Francisco Unified School District Solar Installations

Project Site	City	Installed Capacity (KV)	Type of System
Alvarado Elementary	San Francisco	50	Roof

### San Ramon Valley Unified School District Solar Installations

Project Site	City	Installed Capacity (kW)	Type of System
California High	San Ramon	750	Carpport
Dougherty Valley High	San Ramon	1023	Carpport
Monte Vista High	Danville	825	Carpport
San Ramon Valley High	Danville	499	Carpport & Roof
Diablo Vista Middle	Danville	259	Carpport

### Santa Ana Unified School District Solar Installations

Project Site	City	Installed Capacity (kW)	Type of System
Saddleback High	Santa Ana	809	Roof & Solar Shade Structures

### Santa Cruz City School District Solar Installations

Project Site	City	Installed Capacity (kW)	Type of System
Soquel High	Watsonville	315	Roof
Santa Cruz High School	Santa Cruz	207	Roof

### Sweetwater Union High School District Solar Installations – In Progress

Project Site	City	Installed Capacity (kW)	Type of System
Bonita Vista High	Chula Vista	588	Carpport
Castle Park High	Chula Vista	488	Carpport
Chula Vista High	Chula Vista	267	Carpport
Mar Vista High	Imperial Beach	390	Roof
Montgomery High	San Diego	507	Carpport
Olympian High	Chula Vista	557	Roof
Otay Ranch High	Chula Vista	926	Carpport & Roof
San Ysidro High	San Diego	515	Roof
Southwest High	San Diego	822	Carpport
Sweetwater High	Chula Vista	254	Roof

**William S. Hart Union High School District Solar Installations – In Progress**

<b>Name of School</b>	<b>City</b>	<b>Installed Capacity (kW)</b>	<b>Type of System</b>
Golden Valley High	Santa Clarita	998	Carports
Canyon High	Canyon Country	998	Carports & Ground-mounts
Valencia High	Valencia	998	Carports
West Ranch High	Valencia	998	Carports
Saugus High	Saugus	995	Carports & Ground-mounts
La Mesa Jr. High	Santa Clarita	488	Carports & Elevated Solar Array
Rancho Pico Junior High	Valencia	450	Carports
Rio Norte Junior High	Valencia	429	Carport & Elevated Solar Array
Sierra Vista Junior High	Santa Clarita	302	Elevated Solar Arrays & Ground-mounts

# Notes

1. Our survey included 18 school districts, who reported specific system sizes for 193 individual solar projects. The average size of these systems is 312.50 kW.

2. A school with a 313 kW solar system can produce an estimated 493,000 kWh of clean energy every year, assuming an 18% capacity factor. Specific electricity generation for a specific system will depend on a number of factors, including the location of the school, direction the system is facing, shade cover, the specific technology installed, etc. The calculation for smog-forming emissions is based upon estimated solar electricity generation in Los Angeles per National Renewable Energy Laboratory, *PV Watts Tool*, accessed at [http://mapserve3.nrel.gov/PVWatts\\_Viewer/index.html](http://mapserve3.nrel.gov/PVWatts_Viewer/index.html), 22 August 2012, and the non-baseload emission rate for NO<sub>x</sub> pollution in California from 2009, per U.S. Environmental Protection Agency, per *eGRID2012 Version 1.0*, 10 May 2012.

3. Based upon estimated solar electricity generation in Los Angeles per National Renewable Energy Laboratory, *PV Watts Tool*, accessed at [http://mapserve3.nrel.gov/PVWatts\\_Viewer/index.html](http://mapserve3.nrel.gov/PVWatts_Viewer/index.html), 22 August 2012, and the non-baseload emission rate for carbon dioxide pollution in California from 2009, per U.S. Environmental Protection Agency, per *eGRID2012 Version 1.0*, 10 May 2012.

4. California Energy Commission, *Consumer Energy Center: Energy Tips for Schools*, accessed 22 August 2012, available at <http://www.consumerenergycenter.org/tips/schools.html>.

5. This calculation assumes that avoided costs range from eight to 25 cents per kWh. Specific savings for any given solar project will differ based on a range of factors, including which utility territory the school is located in, the school's pre-solar usage pattern, pre-solar tariffs, post-solar tariffs, etc.

6. An example of a Solar Master Plan can be found at the website KyotoUSA's HELIOS project, available at [www.heliosproject.org](http://www.heliosproject.org).

7. Tom Torlakson, State Superintendent of Public Instruction, Governor's Budget for 2012-13, 28 February 2012, available at <http://www.cde.ca.gov/nr/el/le/yr12tr0228.asp>.

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10. Ying-Ying Meng, Susan H. Babey, and Joelle Wolstein, "Asthma-Related School Absenteeism and School Concentration of Low-Income Students in California," *Preventing Chronic Disease*, May 2012, available at [http://www.cdc.gov/pcd/issues/2012/11\\_0312.htm](http://www.cdc.gov/pcd/issues/2012/11_0312.htm).

11. California Energy Commission & California Public Utilities Commission, *California Solar Statistics: California Leads the Nation*, updated 13 September 2012.

12. Travis Madsen, Frontier Group, and Michelle Kinman and Bernadette Del Chiaro, Environment California Research & Policy Center, *Building a Brighter Future: California's Progress Toward a Million Solar Roofs*, November 2011.

13. Ibid.

14. Total number of students enrolled in California public K-12 schools for 2011-2012 from the California Department of Education's DataQuest system, available at <http://dq.cde.ca.gov/dataquest/DQ/EnrTimeRptSt.aspx?Level=State&cChoice=TSEnr1&cYear=2011-12&cLevel=State&cTopic=Enrollment&myTimeFrame=S>, accessed September 14, 2012. All district enrollment figures cited throughout this report are from the California Department of Education's 2011-2012 Enrollment Data available at <http://dq.cde.ca.gov/dataquest/SearchName.aspx?rbTimeFrame=oneyear&rYear=2011-12&cName=&Topic=Enrollment&Level=District&submit1=Submit>, accessed 23 August 2012.

15. PsomasFMG, "PsomasFMG Completes Largest School-Based Solar Project in the United States," 27 October 2011, available at <http://psomasfmg.com/news/10-27-2011.pdf>.

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17. Tom Schueneman, "How One School District's Solar Array Raises Student Test Scores," *TriplePundit*, 19 August 2011.

18. San Diego Regional Energy Office, *TEC Case Study: Mar Vista High School*, 15 March 2006, available at <http://www.innovativenrg.com/references/update/ThermalSolar-MarVistaHighSchoolPools.pdf>.
19. Rick Brown, President of TerraVerde Renewable Partners. *Solar project at a glance*, obtained on 26 June 2012.
20. Nate Berg, "Why Does California's Central Valley Have Such Bad Air Pollution?" *The Atlantic Cities*, 28 September 2011.
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