DIVISION OF THE
STATE ARCHITECT
DEPARTMENT OF GENERAL SERVICES

GRID NEUTRAL:

Electrical Independence for California Schools and Community Colleges

February 1, 2009

DGS
Department of General Services

GOVERNOR ARNOLD SCHWARZENEGGER

December 2008

GRID NEUTRAL: Electrical Independence for California Schools and Community Colleges

One of the cornerstones of my administration has been to reduce our state's carbon footprint. By making our schools more environmentally sound, we teach our students the value of preserving our natural resources.

This workbook is a fantastic guide on how to create grid neutral campuses and facilities. Grid neutral is defined as balancing the amount of electricity a facility consumes from an electrical grid with the amount of energy the facility produces. Becoming grid neutral is a sensible strategy for schools to both conserve energy use and explore how to access alternative energy sources for their needs.

I am proud that this workbook will serve as a valuable tool for California's schools, and I am looking forward to seeing grid neutral "green" campuses open their doors for our students.

Sincerely,

Arnold Schwarzenegger

STATE CAPITOL · SACRAMENTO, CALIFORNIA 95814 · (916) 445-2841

Business Case for Grid Neutral

Going grid neutral isn't a challenge—it is an opportunity.

It is an opportunity to lock in electricity costs providing financial predictability for your district and lower energy bills. It is an opportunity for cost avoidance for your district. And, if structured properly, it can all be done with no capital costs to your district.

Electricity costs represent the key element of the business case for schools and colleges going grid neutral. Imagine reducing payments to the utility company by 20 to 30 percent and sometimes more. Then imagine what you can do with money not spent on electricity. If a school district pays $6.2 million to its utility company per year, this might be used to hire more new teachers or purchase more than 104,000 textbooks, or buy 6,200 computers. Any one of these expenditures contributes directly to the district's mission of educating our children.

Now imagine achieving these results with no capital costs. The incentives available for solar energy systems dramatically impact the economics. The federal government offers federal energy tax credits for these systems, as well as accelerated depreciation. Utility companies offer additional incentives. There are also emerging markets for renewable energy credits and carbon reduction credits. Collectively, these incentives and revenues reduce the cost of ownership.

While community colleges and schools cannot claim tax credits and accelerated depreciation, businesses can. This is where third party power purchase agreements come in. As the name implies, under these agreements a business installs a solar power system at a school site with no upfront cost to the district. As a taxpayer, the business can take full advantage of the incentives—reducing the cost of ownership. The district purchases power from the provider at set rates usually at or below market rates—locking in predictable electricity costs. Terms of these agreements vary, but many of these agreements conclude with the district owning the system in 10 to 15 years.

As the cost for natural gas increases, the amount a district pays for electricity will increase as well. In these times of uncertain energy supply, curbing utility costs will reduce the exposure to this financial risk.

The cost of producing electricity on-site can even be lower with energy efficiency and conservation. If a school district plans to become grid neutral, it must first maximize the buildings' energy efficiency and start conserving energy. This will limit the amount of on-site electricity needed to become grid neutral. There are many financing options available to upgrade existing facilities and build new energy efficient campuses, and the return on the investment makes this a good, sound economic decision.

> **"With the solar tax incentives available, we have school districts like Milpitas USD and Los Angeles CCD installing solar with no capital costs by utilizing a third party power purchase agreement."**
>
> *—David F. Thorman, AIA*
> *California State Architect*

GRID NEUTRAL:
A site that produces at least as much electricity as it consumes in a year

Solar installation at playground area of Robert Randall Elementary School, Milpitas Unified School District

COST STUDY: Elk Grove Unified School District

In 2007, the Office of Public School Construction approached Elk Grove Unified School District to provide information on their total energy bill for the previous year. It was found that all the campuses combined, having approximately 62,000 students, consumed 58.2 million kilowatt hours (kWh) of electricity, which equated to $6.2 million at their 2006 rate structure.

How could a grid neutral project affect these energy costs?

Using the steps in this grid neutral workbook and proper long-term planning, this district could lower its bill with energy conservation policies and energy efficiency measures—starting with the low-cost, no-cost items; then adding retrofits to the lighting and heating/air conditioning systems. These changes have been found to have the highest return on investment and could cut costs by up to 30 percent.

Then, this district could install solar (photovoltaic) panels on its campuses by entering into a public/private partnership utilizing a power purchase agreement (PPA). Dependent on the agreement, the district could have fixed electricity costs that are up to 10 percent less than before. This could reap immediate savings of up to $620,000 per year.

In 15 to 20 years and depending on the purchase option in the PPA, the district would be responsible for the solar energy systems' production. After paying base utility charges and working toward grid neutral, a district could then see up to $6 million freed up for textbooks, teacher salaries, or computers each year.

—Rob Cook,
Executive Officer of the Office of Public School Construction

Alternative energy is one of America's few growth industries. This is happening because business leaders have accepted the fact that volatile energy costs can cripple their enterprise. School and community college districts, acting as enterprise businesses, can protect the community's investment at their campus facilities. Grid neutral is a way to take control of the increase that will occur with utility prices over time. Going grid neutral provides schools and community colleges the opportunity to conserve electricity so their utility bills are lower, to fix their electricity prices so they will not escalate over time, and to benefit from the current incentives and technological opportunities now available for alternative energy sources.

Grid Neutral Regulations for Educational Buildings

Future plans with grid neutral requirements include codifying grid neutral principles into the voluntary 2009 California Green Building Standards Code. Additionally, the State Architect has stated that it is a goal of the DSA that by December 2010, all plans coming through DSA will be reviewed for achieving grid neutrality. Neither of these is mandatory at this time; however, planning your grid neutral campus now is encouraged because the regulations are right around the corner. The California Green Building Standards Code could be in effect as early as 2012. Other ways of regulating the implementation of grid neutral schools and community colleges would require legislation or a bond to be passed.

California Global Warming Solutions Act of 2006

Planning and implementing grid neutral schools now will prepare schools and community colleges for compliance with the California Global Warming Solutions Act. It is estimated by the U.S. Green Building Council that 39 percent of all carbon (CO_2) emissions are attributed to buildings; this includes California's aging college and school facilities. The law will require that by the year 2010 the state must begin efforts to offset their carbon emissions from all sources, which includes educational buildings. By 2020, the state will be required to reduce their CO_2 emissions by 30 percent, based on 1990 levels as established by the California Air Resources Board. In 2050 this will be raised to 80 percent. This is why we need to find out how much energy our buildings use; start work toward more sustainable energy efficient buildings; and start producing on-site clean renewable energy. To meet these goals, many school districts have already begun renewable energy ventures and are aligned for success. Now is the time to start planning how to go grid neutral and maintain grid neutrality for the long term.

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The Los Angeles Community College District (LACCD) is moving towards a 40-megawatt Renewable Energy Plan, which calls for the installation of photovoltaic (solar) panels, architectural wind and geoexchange systems to produce enough electricity at each of its nine colleges to meet daytime and evening electricity needs and even take the campuses "off the grid." With power purchase agreements, the LACCD will see an immediate 30 percent savings in electricity cost.

Solar (photvoltaic) panels are installed on a shade structure above a parking structure, Los Angeles Community College District–121 kW–67% electricity offset.

District officials expect to have another 30 percent cost savings with the energy conservation measures they are implementing. The power purchase agreements are structured to run for 20 years, at the end of which the LACCD would own all of the renewable generation technology outright.

However, thanks to its most recent bond issue, the LACCD now plans to buy out the energy conservation agreements and power purchase agreements. This will result in a savings of approximately $9 million per year. As for AB 32, the Global Warming Solutions Act, it is estimated that this effort would save 31,539 metric tons of carbon emissions per year.

—Larry Eisenberg, Executive Director,
LACCD Facilities Planning & Development
http://www.laccdbuildsgreen.org/

A Note from David F. Thorman, AIA, California State Architect

Grid neutral is an idea whose time has come!

California school districts and community college districts are already installing solar collectors with no capital investment and reaping the benefits of clean energy at a lower cost. Banking and energy companies are eager to help make it happen by working with districts through public/private partnerships. The green movement is well underway and the resulting campuses are benefiting students and helping to power the emerging green collar workforce.

So, how can your school site produce as much electricity as it uses in a year?

We set out with subject matter experts to find out. The Division of the State Architect conducted a series of six workshops addressing comprehensive planning, energy efficient design, energy generating technology, innovative funding, energy measurement, and maintenance and operations in September 2008. The conclusions were presented to an audience and webcast viewers in October.

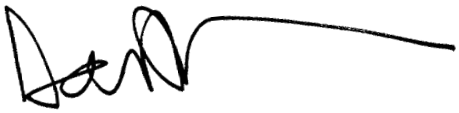
Throughout this collaborative process I recognized that many tough questions needed to be answered. I could sense school officials thinking: how will the state work with me to ensure my school is not only more energy efficient, but actually generates as much energy as we need?

This guidebook will answer your questions:

- What are the key concepts of going grid neutral?
- What type of solar panels or other renewable energy sources at school sites should we install?
- How do you maximize energy efficiency and passive solar technology?
- What are the options for financing?
- What have other school districts and community colleges done?
- What are some useful tips on how to attain higher energy efficiency and on-site energy generation?
- What is the business case for school districts to embark upon this movement?
- What solutions can be provided to school boards and stakeholders to achieve the means, methods and economics of becoming grid neutral?

Grid neutrality translates into cost savings, the reduction of greenhouse gas emissions, and a healthier learning environment for our children and young people. Grid neutral facilities can serve as environmental teaching laboratories.

With so much to gain, I strongly believe that all of California's schools and community colleges should strive for electrical independence. I want to make grid neutrality a reality for all California schools and community colleges!



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> **We are committed to quickly achieving grid neutrality... This means that through a combination of energy efficiency and self-generation, the California schools of the future will produce as much energy as they use.**
>
> *—Rosario Marin*
> *Secretary of the California State and Consumer Services Agency, Green Schools Summit 2007*

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Executive Order S-20-04, December 2004

Shortly after being elected, California Governor Arnold Schwarzenegger signed Executive Order S-20-04, requiring reduced energy use in State-owned facilities. Furthermore, it directs the Division of the State Architect (DSA) to encourage schools being built with State funds to be resource and energy efficient. State Architect David Thorman is now calling out to all California school districts and community college districts to make their schools grid neutral. In September and October of 2008, DSA hosted a series of grid neutral workshops that brought together experts from energy, finance, education, nonprofit and government sectors to brainstorm the key components of a successful grid neutral project. The discussions of their collective experience and knowledge were led by Butte Community College staff who facilitated each workshop to gather and organize the recommended means, methods and economics of becoming grid neutral that you will find in this guidebook.

Defining Grid Neutral

In a landscape awash in green terminology, it is helpful to first define what grid neutral is, as well as what it is not. Simply put, grid neutral is defined as "a site that produces at least as much electricity as it consumes in a year." Grid neutral is different from zero net energy. Grid neutral focuses on the amount of electricity you consume from the utility grid and the amount you produce on-site. Contrast this with the concept of zero net energy, which includes not only electricity, but all energy, including fossil fuels. Another concept is going off-the-grid; this requires a district to provide ways to store the energy that they produce. With grid neutral, the campus remains connected to the electrical grid.

Many of the workshop participants questioned why the DSA didn't start with zero net energy. When the concepts were clearly defined by the Collaborative for High Performance Schools (CHPS), the DSA decided that grid neutral was an excellent first step in further attaining energy independence such as zero net energy or even going off-the-grid. Additionally, grid neutral will substantially contribute to the milestone requirements of the Global Warming Solutions Act by reducing carbon emissions, as it has been determined that the energy consumption of buildings make up about 39 percent of the world's carbon emissions. So by focusing on electricity, a school can take a major bite out of its overall energy consumption, since electricity represents about 80 to 90 percent of a campus' annual energy bill. This starts a journey toward electrical independence which can lead to total energy independence.

Key Steps to Achieving Grid Neutral

Any school or community college can go grid neutral. While there are some variations for an existing versus a newly built school, many of the key steps are the same once the planning is started.

Step 1 is the most crucial: planning. For a new school, you need to establish your energy performance goals. For an existing school, you need to measure the electricity being used and then set goals. You will find in more detail how to develop a preliminary plan in the "Comprehensive Planning" section; and how to record and track the amount of electricity used in the "Energy Measurement" section.

Step 2 is to save energy and lower the use of electricity. See the "Energy Efficient Design" section for lots of recommended ways to do this. You can start to save energy immediately by establishing conservation policies

> **You may still take some energy off of the grid during peak energy use time, or give some energy back to the grid at a non-peak time, but at the end of the year, you're essentially neutral. You are not taking more from the grid than you're putting back.**
>
> *—David F. Thorman, AIA*
> *California State Architect*

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Key Steps to Achieve Grid Neutral

Step 1 **For a New School: Set energy performance goals. For an Existing School: Measure electricity use and set performance goals.**

Step 2 **Implement and maintain appropriate energy efficiency and conservation measures to lower electricity use.**

Step 3 **Install solar or wind systems to create electricity to meet remaining needs.**

Step 4 **Maintain energy systems. Monitor electricity consumption and production.**

and putting those into practice. You can further realize energy savings through retrofits or modernizations, or with sustainable design at new facilities. These efforts will reduce the amount of on-site electricity needed to be produced with energy generating systems.

Step 3 is the undertaking of installing renewable energy systems. The section titled "Energy-Generating Technology" gives an overview of the options. Integral to installing energy-generating technology is having the right team to plan and detail the construction of the systems. How to find monetary incentives and partnerships in this effort is discussed in the "Innovative Funding" section.

Step 4 is the on-going monitoring of the electricity consumption and production; and maintaining the energy systems in top operating condition. The "Maintenance and Operations (M&O)" section discusses the paradigm shifts needed to keep all the efforts of going grid neutral a success over the years to come.

Comprehensive Planning

Collaboration is key for planning grid neutral schools. Districts will assemble the legal, finance, and construction teams required to make the project happen, similar to any new facilities construction or major modernization. However, when planning a grid neutral school, you will be bringing more people to the table earlier in the process.

This section answers the questions:

- Who is the "dream team" for grid neutral facilities?
- What is the critical path in planning grid neutral facilities?

Assembling the Team for a Grid Neutral School or Community College

Assume that your board has determined to build a new grid neutral school or community college. Who are the members of the "dream team" to plan the construction project? Broadly speaking, they fall into three groups: sponsors, beneficiaries, and implementers.

Sponsors:

Sponsors are the project promoters and supporters—people just like you!

- Project champion
- School and community college board members
- Community stakeholders and media
- Utility companies
- Research/universities
- Government agencies
  - Federal
  - State
  - Local

Beneficiaries:

Beneficiaries are the constituents that receive both direct and indirect financial and environmental benefits from the project.

- Students
- Teachers
- Administrators
- Curriculum planners
- General public (who might also use facilities)
- Taxpayers (who benefit from lower energy bills)

Implementers:

Implementers are the people involved with planning and coordinating the project design and construction. Some implementers are experts in matters that will affect the long-term maintenance of building systems.

- School and community college facility planners
- Green building consultants
- Energy specialist (conservation/generation)
- Maintenance and operations staff
- Construction finance/legal counsel (energy)
- Site selection team—environmental consultant—soils and geo-technical engineering
- Design consultants
- Architectural and engineering team (mechanical; structural; civil; electrical)
- Major subcontractors
- Builder
- Construction team

> **"The success of any sustainable project must be a lifelong commitment made by all team members, beginning with the district and community members alike."**
>
> *—George Parker*
> *Director of Facilities*
> *Yuba City USD*

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Critical Path to Grid Neutral Schools and Community Colleges:

- Establish a Baseline
- Set Performance Goals
- Develop Electrical Power Master Plan
- Develop Districtwide Program

- Energy service company (ESCO)
- Potential suppliers/energy equipment manufacturers
- Commissioning agent

Although the sponsors, beneficiaries, and implementers have their own responsibilities, they also need to work together to get the end result. In fact, a number of people on the dream team may work under the same roof.

In addition to the sponsors, beneficiaries and implementers, there are other entities critical to the planning process for any construction project.

- Custodians
- School and college site staff (information technology, cafeteria, after-school, administration)
- Local fire marshal or city fire official
- Waste management/recycling expert
- Labor union, workforce development team
- Joint use partners such as local governments and jurisdictions that may share use of facilities
- DSA-certified inspector
- Law enforcement
- Educational organizations
- Legislative representatives

Critical Path to Planning a Grid Neutral School or Community College

This subsection discusses in more detail how to accomplish step one of the key steps to achieve grid neutral:

a.) Setting energy performance goals for new facilities; or

b.) Measuring current electricity use at existing facilities and then setting energy performance goals.

Start by establishing a feasibility committee to evaluate the opportunity to go grid neutral on a districtwide level. This is the time to assemble the appropriate "dream team" for your district and have them walk through the steps on the critical path to becoming grid neutral. Think in terms of long-range planning.

Establish a Baseline

Determine current electricity use for your district by analyzing annual electricity bills for existing facilities.

Set Performance Goals

Set energy performance goals for your district to meet or exceed best practices for the existing facilities and any new facilities. These goals can be based on criteria developed by nonprofit organizations such as the Collaborative for High Performance Schools (CHPS) or the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) for schools. Or you may decide to use the California Energy Code and exceed it by 15 percent or even 30 percent.

Develop Electrical Power Master Plan

The electrical power master plan is the result after setting the performance goals. This master plan, which may be part of an energy master plan, provides the foundation for future projects within the district.

Develop Districtwide Program

When developing a districtwide program, think ahead to the next 30 to 40 years in terms of the district's energy demand. Work with the key members of the dream team to do a life-cycle cost

Project Overview:

Butte College Photovoltaic System

Butte Community College, PV Installation

The Butte College Facilities Master Plan Committee released a comprehensive program for a phased approach to going grid neutral by 2015. Phase I included a one-megawatt solar field that generates 1.6 million kilowatt hours annually and provides 25 percent of the college's total energy. Phase II continues efforts to contain and reduce electrical costs by developing financially viable solar projects based on analysis of each electrical meter. The criteria set forth for each potential project was:

- The total maximum annual payment for both the cost of the solar installation and any residual utility cost must not exceed current annual cost of electricity for each meter.
- The annual payment for the solar project must remain fixed with no escalators attached.
- The payment must result in ownership of the system by the District.
- The payment period must not exceed 20 years.
- All meters need to be analyzed.
- The proposals must include a viable financial partner and contractual methodology.
- The contractor and contractual methodology must demonstrate a successful track record.

analysis of the systems needed to meet your performance goals.

See the "Innovative Funding" section of this document for more information on life-cycle cost analysis.

Preliminary Plan

The outcome of the districtwide program is a preliminary plan to help jumpstart your first project in your grid neutral program.

The preliminary plan includes:

- Program goals
- Overall strategy for meeting goals
- Financing strategy
- Life cycle cost analysis
- Recommended delivery method (see "Evaluating Project Delivery Methods and Means" in this section)
- Maintenance and operation

Once created, the preliminary plan can serve as a template to help fast-track individual projects that fall under the electrical power master plan.

Evaluating Project Delivery Methods and Means

A project delivery method is the system the district uses to organize and finance the design and construction services for a facility through legal agreements with one or more entities.

Unique to a grid neutral project is that you are being asked to deliver a project that meets energy performance goals.

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A project delivery method is the system the district uses to organize and finance the design and construction services for a facility through legal agreements with one or more entities.

It takes energy specialists, photovoltaic manufacturers and equipment fabricators.

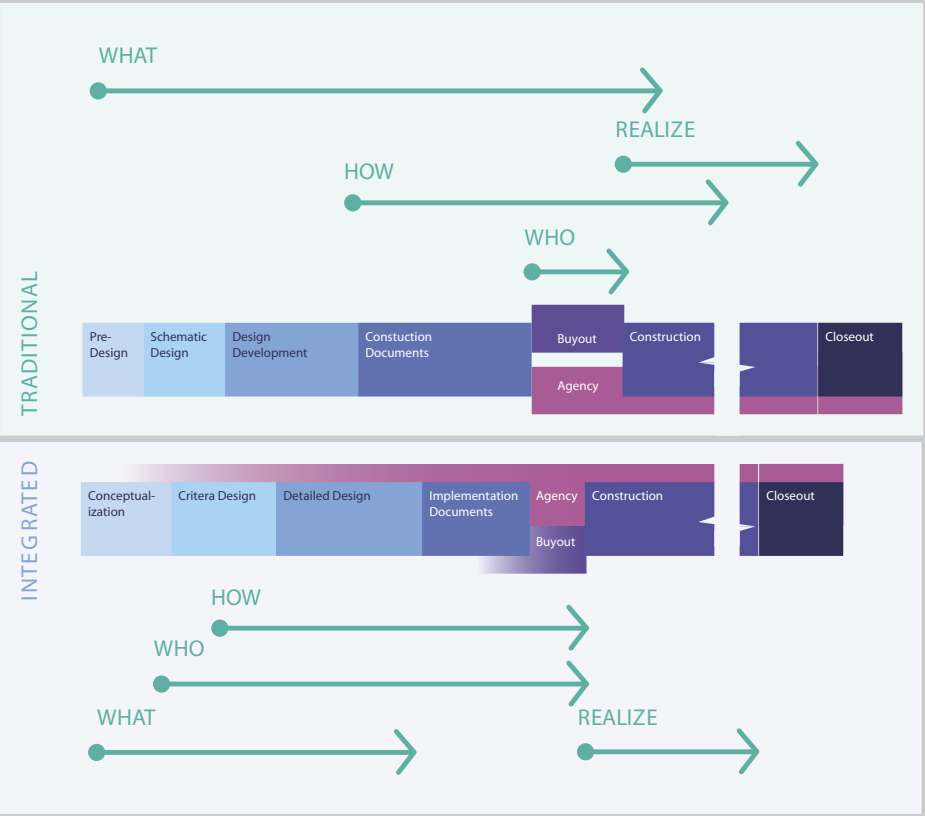
So what is the best way to approach a grid neutral project and deliver the final constructed building? What are the tools and means that are state-of-the-art today and being used to create a building with less costly change orders?

Traditional Project Delivery Methods

Most districts are familiar with the design-bid-build approach to school construction, which is driven by the lowest bidder. The challenge with design-bid-build is the builder, the manufacturers of the products, or the fabricators of the systems or equipment are not involved until the last phase, which is construction. Design-build does bring the builder in early; however, the fabricators and installers are still not involved until the construction phase. There is lease-lease back, construction management (CM)-at risk, and CM multi-prime as other current delivery methods. Many have inherent problems as the project information ends up being stored in discrete silos, making it difficult for team members to collaborate so late in the project phase. Constructors, installers, fabricators, suppliers and designers end up meeting "as needed" in a very linear and segmented process which creates few options for holistic solutions.

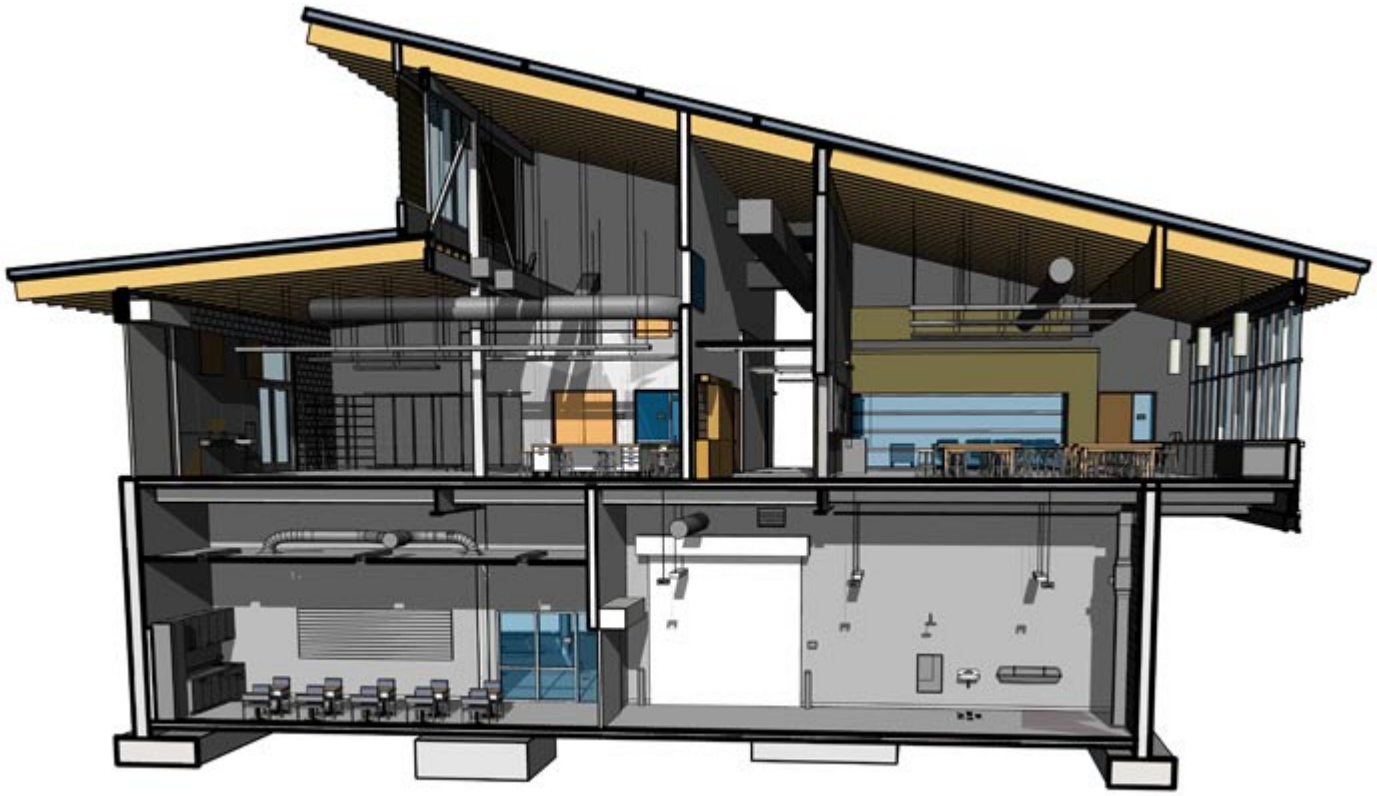
Integrated Project Delivery (IPD)

Integrated Project Delivery (IPD) is the preferred method for assembling a team of experts similar to the "dream team." Based on the collaboration and involvement of the team members very early in the planning process, IPD



Integrated Project Delivery (IPD): A working definition developed by the American Institute of Architects, California Council (AIACC) diagramming the difference between traditional delivery method and the integrated delivery method recommended for planning a grid neutral campus.

Building Information Model (BIM)–Cross Section of Classroom Building



allows expertise from the perspective of the builder or PV manufacturer, for example, to provide valuable input that may otherwise be revealed in the construction phase. Resolving design issues between trades is much easier in the planning stages when using computer-aided tools than working with an actual partially constructed building.

Building Information Modeling (BIM)

One of the computer-aided tools available today is Building Information Modeling (BIM). BIM is the process of generating and managing building data during its life cycle. BIM uses three-dimensional, real time, dynamic building modeling software.

It helps to increase the productivity in the design phase, assisting in the coordination of all the systems that will be installed in building. BIM also assists with the construction management of a project and provides information on the building geometry, spatial relationships, geographic information, and quantities and properties of all the building's components. BIM is a tool to help enhance the dream team's efforts and aid in the collaboration of combining designs by the many disciplines involved in the erection, fabrication and materials used on the project.

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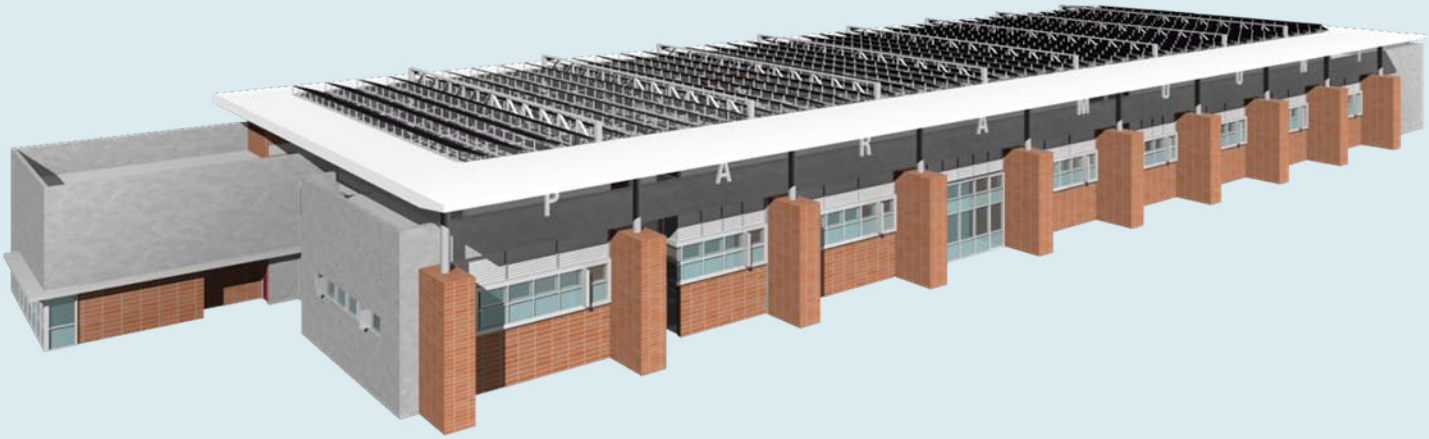
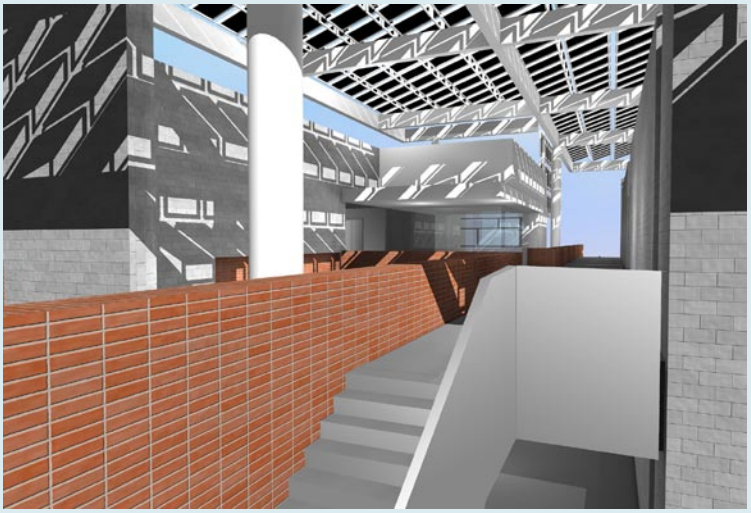
Project Overview:

Moving toward a Grid Neutral Campus at Paramount High School, Paramount Unified School District



The Paramount High School field house will be a new structure on an existing high school campus with photovoltaic (PV) panels designed for its roof top. The 29,000 square foot field house encompasses locker rooms, weight rooms and indoor classrooms. Along with energy efficient retrofits on the existing campus and PV panels to be installed on other buildings, this field house/campus project will move the campus one step closer to grid neutrality.

Using Integrated Project Delivery (IPD), a comprehensive team comprised of the traditional architect and engineering designers along with energy specialists and PV manufacturers was formed to set energy goals, plan and design the project, and analyze the expected energy demand and projected energy production. Life-cycle cost analysis (LCCA) was used in the preliminary planning of this project. With all the expertise at the planning table, it was determined that the PV panels proposed for this field house would produce over two times the need of that single building and would be available to offset the electrical needs of the other campus buildings. In order to achieve grid neutrality, other existing buildings would need to have PV panels installed. The photovoltaic (PV) panels at the field house cover 70 percent of the roof and were anticipated to produce almost 400,000 kilowatts hours per year (kWh/yr); where the expected campus annual demand without the PV panels was projected to be 1.8 million kWh/yr.



The comprehensive planning team used Building Information Modeling (BIM) to construct a computerized three-dimensional model to give depth perception on the building design. BIM also provided valuable information concerning cost data, square footages, coordinating of the mechanical and electrical systems with the structural walls; and allowing for construction analysis in real time.

Energy Measurement

Knowing how much energy your district currently uses on a monthly basis is helpful for planning the size of your renewable energy system, setting energy performance goals, and monitoring your performance against those goals. Data is needed at all levels of planning, design and implementation of your energy program.

This section provides an overview of the following key energy measurement topics for going grid neutral:

- How to measure grid neutrality
- Benchmarking your electricity use
- Database and reporting requirements
- Helpful benchmarking and reporting tools

Measuring Grid Neutrality

A grid neutral school produces at least as much electricity as it consumes in a year. How do you measure electricity production and consumption? For purposes of determining grid neutrality, it's simple: both production and consumption are measured by the utility billing meters. So when the total annual kilowatt hours sums to zero, your school is grid neutral.

Benchmarking Your Electricity Use

To determine your district's current electricity consumption, add up the kilowatt hours for each campus for an entire year. This is your baseline. After setting the initial baseline, districts should benchmark energy use on a continuing basis in order to monitor operations and performance. Benchmarking helps you to:

- See where you are starting from (the baseline).
- Set your electricity performance goals (your target reduction from the baseline).
- Monitor trends in electricity use to make sure you stay on target.

How to Benchmark

Any district can benchmark its own facilities by collecting monthly energy use values from historical electrical bills.

If bills are not collected or kept handy, you can call your utility representative to get copies. If you have questions on usage or your rate structure, talk with account representatives to clarify the terms and learn how to use the data. Many utility companies provide educational tips for understanding your utility bills and offer basic courses.

Benchmarking tools range from a simple spreadsheet to a complex software program designed specifically for energy tracking and management. See "Helpful Benchmarking and Reporting Tools" in this section. Another possibility is to hire consultants to help with benchmarking and efficiency goals.

Tracking Photovoltaic (PV) Energy Production

PV energy generation systems come with a production meter that works in parallel with the utility net billing meter. If the PV system produces more than the school uses, then the meter turns backward to credit the district for the excess electricity. Districts should track monthly electrical production from the PV system along with net meter values. Total on-site consumption can then be determined by adding monthly PV production values to the monthly net meter values.

Many utility companies provide educational tips for understanding your utility bills.

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Rule of Thumb: There should be one energy manager per district.

Recommended but Not Required

You can have a school or community college that measures grid neutral but is otherwise very energy inefficient when it comes to natural gas and other fuels. Consider taking a whole building approach to energy measurement by capturing data on all energy consumption. This ensures your district is not only grid neutral, but is also taking the necessary steps to reduce carbon emissions, which will soon be regulated by the State of California's Global Warming Solutions Act under Assembly Bill 32. When choosing an energy tracking tool, districts should consider those that allow for the calculation of carbon emissions.

Benchmarking and Reporting Requirements

Your district will need to determine your database and reporting requirements so you can monitor energy use and system performance.

Tracking energy use at the district level requires a database of basic energy use values including:

- Name of school or community college (if more than one)
- Meter number (if more than one)
- Monthly billing start date
- Monthly billing end date
- Monthly kWh consumption (prior to on-site generation)
- Monthly kWh generation (from PV or other renewable source)
- Net monthly kWh consumption (kWh consumed minus kWh generated)

Many other site-specific fields might be considered useful for benchmarking on a district-by-district basis, such as address, square footage, or number of pupils. Site data will be collected by, sent to, or otherwise rolled up into a district database. At the district level, maintenance and operations staff can then monitor each facility's performance and send out people to troubleshoot, as necessary.

Data and Reporting Requirements

Reporting requirements will differ from district to district. Most districts will at least want to have monthly and annual net kWh values. Some may want kWh consumption and production values in addition to net kWh values. When evaluating reporting systems, another key consideration is frequency. At minimum, reporting should be done monthly; however, some districts may want to run reports more often. Frequent reports help to ensure problems are indentified and resolved quickly.

Helpful Benchmarking and Reporting Tools

There are numerous tools on the market that help you understand your utility bill. At minimum, these tools should automatically capture the data needed for the benchmark reporting tool that the district is using. Additionally, these tools provide the ability to compare data across time.

Portfolio Manager

One tool available at no cost is Portfolio Manager, a benchmarking tool sponsored by the U.S. Energy Star program. Portfolio Manager can collect energy and cost data directly from the utility. You can then set an energy baseline, and view your data through custom reports. Portfolio Manager also has an Energy Performance Rating that can answer the question: "How do our facilities compare to each other and to other facilities in our peer group?"

Portfolio Manager is available from www.energystar.gov.

Target Finder

The sister tool to Portfolio Manager is Target Finder. Target Finder helps users establish an energy performance target for energy efficient design projects in new construction and major building renovations. By entering a project's estimated energy consumption, users can generate an energy performance rating based on the same rating system applied to existing buildings. Target Finder can be used in setting your energy efficiency performance goals. You can find more information online at www.energystar.gov.

Monitoring, Management and Reporting Tools

Energy monitoring systems are commercial products that can be used to monitor real-time energy use and performance of large end-uses, such as lighting and HVAC. The cost of purchasing these systems should be considered in relation to the expected savings. Such systems are likely to be more cost effective in larger facilities.

An energy management system (EMS) is a computer control system that can help you monitor, control, schedule and diagnose the operation of major energy using systems. An EMS can include the following features:

- Programmable equipment to operate systems according to your facilities' schedule with over-rides to allow operation outside of the normal schedule.
- System performance feedback.
- Cutting the electrical load automatically to help reduce utility bill.
- Start/stop of equipment based on indoor and outdoor temperature conditions and your schedule.
- Controls for fans and pumps.

Having the appropriate EMS in place with well-trained operators and an energy advocate on staff is the key to success to ensure that your facilities' grid neutral goals are on track.

Outdoor community activities using solar panels to power boats help educate students on the principles of photovoltaics.

Energy Management Systems (EMS) used to monitor real-time energy use and performance of large end-uses can also be displayed at the school at a kiosk or viewed by internet to serve as a teaching tool to students and the community.

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American Canyon High School, Napa Valley USD is a verified Collaborative for High Performance Schools (CHPS) campus.

Energy Efficient Design

Energy efficiency and conservation are the foundations for energy savings. To start, you need to implement and maintain appropriate energy efficiency measures to lower your electricity use. Once your foundation is firm, then you can add renewable energy systems for energy production.

This section covers:

- Best practices for energy efficient design.
- Energy efficient design for new facilities, including alternatives to typical Heating, Ventilation and Air Conditioning (HVAC) systems.
- Energy efficient renovations for existing facilities.

Best Practices for Energy Efficient Design

Whether you are designing a new school or community college facility, or retrofitting an existing one, there are best practices, rating systems, and criteria available to help with making the necessary decisions during the planning of a sustainable and high performing energy efficient facility.

Collaborative for High Performance Schools (CHPS)

CHPS has two certification programs: one which is a third party certification and one allowing for self-certification. CHPS publishes a six-volume best practices manual providing a flexible yardstick that precisely defines a high performance school. It provides valuable information on site planning, interior materials and surfaces, lighting, building enclosures and insulation, acoustics, and heat and air conditioning alternatives, commissioning, and more. Information on this rating system is available at www.chps.net.

Leadership in Energy and Environmental Design (LEED) for Schools

LEED is a third-party certification program and a nationally accepted standard for the design, construction and operation of green buildings. LEED reference guides are organized into the five environmental categories of sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality. There is also an additional category to facilitate innovative ideas

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Daylighting is by far the most effective energy efficiency measure, resulting in 12.7% of savings.

—Steve Oliver,
Manager, Savings by Design,
Sacramento Municipal Utilities District

Educational opportunities for students to build models, study daylighting, and learn about the built environment

and exemplary sustainable designs. Information on this rating system is available at www.usgbc.org.

Energy Efficient Design for New Schools and Community Colleges

Integrated design is critical when coordinating a successful grid neutral facility in order to maximize the energy efficiency of the facilities as a whole. Think of the building and site as a body. You need to ask: what design factors will help the body adapt to changing conditions in the environment? What systems need to be considered and affect the performance of other systems? For instance, how can you automatically control the classroom lights while bringing in natural daylight? Or how can the heat put off by computers and lights be minimized to reduce the heating and air conditioning (HVAC) system's design loads? How can you minimize the electricity drawn by computers, appliances and equipment when they are not being used?

Designing a grid neutral facility needs to start with choosing what green features will be included to make the facility most energy efficient. CHPS and LEED guidelines provide excellent resources for information on site planning, daylighting (bringing in natural light), building insulation, electrical lighting controls, and other building systems. So you may ask: what measures will provide the highest return on your investment? The workshop participants responded with the top five categories:

Program and Planning

Programming includes the requirements for the site and buildings based on their function. Programming is the written plan document, called the Program, by which the building and site design will be developed. The program specifies each necessary space and its size for the new facility; establishes the times and days that the spaces will be used; and identifies areas with specialty designs such as commercial kitchens, gymnasiums, and performing arts facilities. Programming is where assembling the dream team for a grid neutral school becomes valuable.

Site

How the buildings are orientated on the site is critical for a successful grid neutral school. Where possible, the long axis of each building should be oriented in an east-west direction with minimal windows on the east and west exposure. Newly designed schools have great opportunities to locate the buildings to maximize daylighting and optimize sun exposure to the solar panels so that they produce the most electricity. You can also locate shade trees to shade buildings in the summer and allow the warm sunshine through windows during the winters. Other site issues include:

- Combined community use of spaces.
- Geoexchange pipe locations (an alternative to traditional HVAC systems).
- Passive solar design features such as shading, natural cooling, and lighting.
- Building density (land availability can affect how close buildings are located and whether buildings need to be multistory).

Balancing the primary design objetive of program curriculum with specific site requirements for maximizing energy efficiencies can be complicated. Again, using the comprehensive planning "dream team" will successfully integrate a grid neutral solution with the needs of your educational program.

Building

Designing the building envelope (walls and windows) with the following features can ensure higher energy efficiency for each building:

- Building insulation
- Weather strip openings
- Integrating walls into the building with thermal mass—a passive solar technique that uses the temperatures of the each day to heat or cool spaces
- Daylighting—bringing in natural light can reduce electrical lighting need
- Clerestory windows—a daylighting technique of locating windows above space with high ceilings

Tip for daylighting: To alleviate glare, allow sunlight to hit one surface before entering a space.

Furnishings, Fixtures and Equipment

Although your entire campus will be designed energy efficiently, targeting spaces that consume large amounts of electricity can significantly impact the success of a new grid neutral campus. This would include focusing in on the energy efficiency of the furnishings, fixtures and equipment of spaces like commercial kitchens, welding, woodworking, and auto shops, along with other areas that have combined uses such as multipurpose rooms, gymnasiums, and performing arts centers.

The electrical load where equipment is plugged in (plug loads) also plays a large role in energy inefficiencies. Computers and monitors can be equipped with programs to turn them off when not in use and can largely reduce energy losses. Installing Energy Star appliances and equipment is highly recommended.

Electrical transformers can be evaluated for opportunities for energy savings. Additionally, you can have an electrical engineer look into upgrading the minimum required transformer and replace it with one of higher efficiency, like the CSL-3 transformers.

Reducing electrical losses in the building when the buildings are not in use can significantly reduce the number of PV arrays required to achieve grid neutral. Making sure that all the photovoltaic (solar) equipment is compatible with the other systems will make a difference, too.

Systems

Lighting, heating and air conditioning (HVAC) systems can be targeted as the largest energy users in a new facility.

Incorporating automated controls on the energy-efficient lighting and HVAC systems can increase energy efficiency:

- Occupancy sensors can help turn off lights when areas are not in use.
- Occupancy sensors will also control the electricity used at electrical outlets to help manage plug loads and the electricity used when equipment or appliances are plugged in and not being used (called “phantom loads”).
- Interlocking controls—turns HVAC off if doors, operable windows, or clerestory windows are opened.
- Daylight harvesting—dimming the light fixtures near windows to maximize the natural light when available.

Commissioning the systems with an outside agent that checks that the lights, HVAC and other systems are properly set at their optimum design helps to save a lot of energy. Sometimes fans are running or valves are open when not necessary, so they need to be reset to save electricity. Refer to CHPS’ Best Practices Manual for more detailed information.

Electrical Transformers

- Transformers operate 24 hrs a day/7 days a week for the life of a building. Even at night when buildings are not in use, transformers have electrical losses (called no-load losses).
- CSL-3 Transformers reduce the no-load electrical losses by 50 percent or more compared to the regularly installed TP-1 transformer.
- Electrical loads must be matched to transformer size. Often transformers are oversized for future expansion, which will offset the intended energy efficiencies.
- Replacing existing transformers with CSL-3 transformers can realize more energy savings.
- The number of transformers at facilities varies from 1 or 2; sometimes even 20 depending on the campus.
- CSL-3 Transformers can significantly reduce the number of PV arrays required to achieve grid neutrality.
- Work with your comprehensive planning team and find out details for your campuses using a life cycle cost analysis.

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Retrofitting Tips:

- Clean air filters
- Tune up HVAC system (recommissioning)
- Replace old cathode ray tube(CRT) monitors with LCD monitors
- Unplug things that are not being used to cut "phantom loads"
- Use Energy Star appliances and equipment

Short-term Projects:

- Efficient lamps and ballasts
- De-lamp (remove bulbs)

Commissioning ensures that systems are operating according to their design specifications.

Geoexchange systems can also reduce energy loads for heating and air conditioning. Sometimes referred to as ground source heat pumps, geoexchange takes the earth's ground temperatures and pumps that tempered water through a below grade, closed-pipe loop system. It can provide heated and cooled water to support all types of HVAC distribution and domestic hot water systems. Installing a geoexhange system is considered a very effective power reducing HVAC strategy for energy-efficient design. It also recognized as a renewable energy system. You will find geoexchange systems covered in more detail in the Energy-Generating Technology section.

Alternatives to Typical HVAC Systems

Alternative HVAC design options are dependent on the type of climate where the campus is located. Some areas have climates that have nice outdoor air temperatures where natural ventilation can be incorporated. Others have cold nights where water towers can store chilled water by night and deliver cooled air during warm afternoons. Still other climates might be best suited for evaporative cooling. Passive solar techniques can even be incorporated into these climate specific design options.

There are loads of ideas for alternative methods of heating and cooling schools and colleges. There are also ways to match the alternatives up with conventional heating and air conditioning to offset the energy used by mechanical means. It is helpful to categorize them into: the systems that provide the air (source), and systems that distribute the air (distribution). Refer to the HVAC chapter in the CHPS Best Practices Manual for more detailed information and alternatives.

Heating/Cooling Source Considerations

- Evaporative cooling cools the air through evaporation. It can be effectively integrated into mechanical systems for pre-cooling, first stage cooling, or into the primary form of cooling.
- Natural ventilation using operable and clerestory windows can create an automatic air movement. Installing automatic closers helps when the HVAC system is on.
- Geoexchange systems take the earth's ground temperatures and pump that tempered coolant or water through a below-grade loop (pipe) system and into the building's mechanical system.
- Under size the system: design the HVAC system to the most common temperature control needs in a day and not to the peak loads. Rely on ceiling fans and natural ventilation where they are needed.

Heating/Cooling Distribution Considerations

- Displacement ventilation systems bring in cool air close to the floor level at a low velocity and at a temperature below the room temperature. Cooler air then displaces the warmer air in the room.
- Interlocking controls automatically turn off HVAC systems when a door or window opens. These control systems need to include an override to allow users to adjust comfort levels.
- Zone control systems are programmed to distribute the air based on where and when it is needed. Establishing and adjusting the system to the different class schedules is important; for example, the administration office is still in use when classes are out, so those rooms don't need air conditioning.

- Dedicated outside air systems introduce outdoor air directly into the zones without mixing with return air and introducing it in a diluted fashion. This allows the delivery of the right amount of air where it is needed.

Energy Efficient Retrofits for Existing Schools and Community Colleges

When retrofitting existing facilities, the goal should be the same as for new facilities: to design a comfortable building that takes advantage of the existing climate. The following are the top five design measures with the highest return-on-investment. Keep in mind, along with financial gain, return-on-investment also includes reduced absenteeism, increased teacher retention, improved test scores, and higher levels of comfort for users.

- Daylighting (no dark classrooms)
- Heat avoidance (protection from the elements)
- Natural ventilation
- High efficiency HVAC
- Appliances, plug loads and special equipment

When retrofitting existing facilities, design with the goal of using the natural environment with all systems being supplemental systems. The primary comfort for the building should be driven by daylight and natural ventilation. The following provides considerations for making nonmechanical systems your primary systems.

Passive System as Primary

- Consider climate zone opportunities
- Shade trees to help with heat avoidance
- Daylighting improvements
- Natural ventilation
- Shades and blinds integrated into windows on south, east, and west exposures
- High reflective paint (interior and exterior)
- High performance glazing (window glass)

There are several other strategies that can help assist passive systems:

- Insulation in walls and ceiling
- High reflective roof (cool roof)
- Automatic window ventilation which closes windows when HVAC system switches on and opens them when off to allow for natural ventilation
- Daylight harvesting controls which will dim light system, and compensate for amount of daylight throughout the day
- Lighting, heating and HVAC systems that have automated controls

Project Overview:

Lighting Retrofit for Chico Unified School District

PG&E and school district staff developed an in-house lighting retrofit project.

1st Phase: Removed existing fluorescent lights using CHPS recommendations for lighting levels. This is referred to as “de-lamping.” Overlit areas need to be delamped. Installed Super T8 28-watt, high-efficiency fluorescent lamps and high efficiency electronic ballasts, where applicable.

2nd Phase: Replaced all outside lighting with Compact Fluorescent Lamps (CFLs).

Savings $150,000/yr

Anticipated Payback Time After PG&E Rebate ..... 1–2 months

Emissions Reduction ..... 900,000 lbs of CO_2 per year

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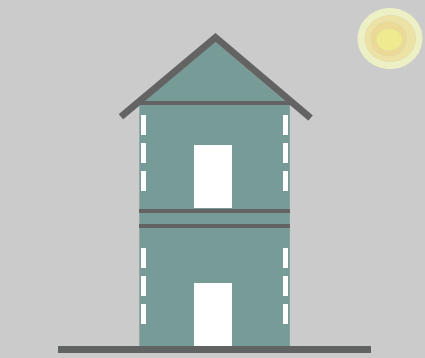
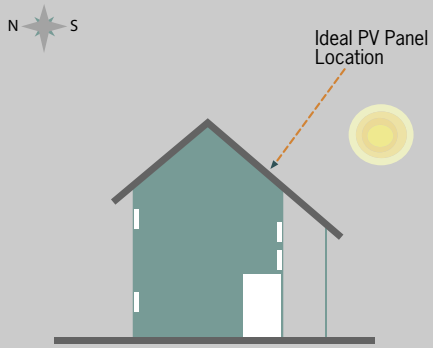
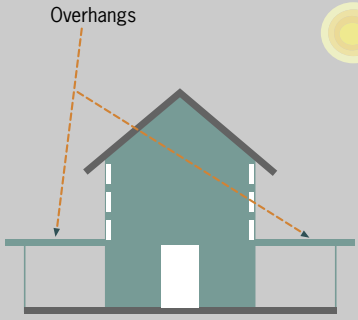


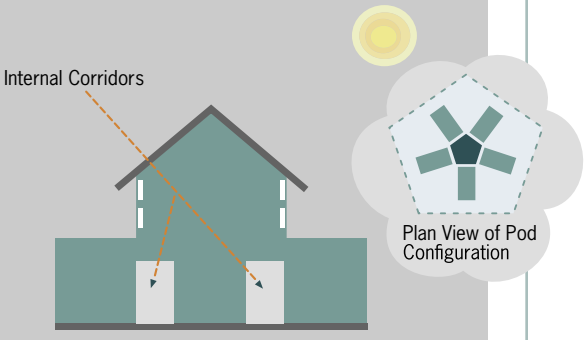
Pre War School Building



Post War School Building (1950–1965)



Wing School Building (1960–1970)



Pods School Building (1970's)

- Energy efficient electric lighting
- Ceiling fans
- Natural exhaust ventilation (whole house fan)

Energy-Efficient Retrofits Based on Design

The previous section lists the top five, somewhat generic energy efficient retrofits for existing schools. But have you ever wondered how the architectural design of your district's facilities impacts the potential for energy efficiency? This section presents the major architectural styles applied to schools and community colleges since World War II and provides retrofit guidelines based on those styles.

Pre-War

These are generally multistory buildings with lots of windows and masonry. Most pre-war school and community college stock has been repurposed, and sometimes lower ceilings have been installed in spaces with vaulted ceilings. The following are retrofits specific to pre-war building types:

- Replace heat and cooling with hydronic and radiant systems.
- Remove suspended ceiling and install high performance window glazing in original vaulted ceiling area.
- Install highly efficient multizone heating and cooling.
- Install separate HVAC system for large occupancies.
- Install interior duct work in conditioned space.
- Replace stairwell lighting with lighting that turns on only when people are present.
- Bring daylighting into corridors.

Post-War (1950–1965)

Originally, these buildings were energy efficient but have since been modified. The post-war design presents a high opportunity for energy efficient retrofits such as:

- Restoring daylight using high efficiency windows and skylights.
- Restoring natural exhaust ventilation with mechanical assistance such as automated windows, ceiling fans, and quiet natural exhaust ventilation.
- Avoiding heat and using landscaping to move paving away from classrooms to avoid heat buildup in the summer.
- Installing high-efficiency HVAC.
- Controls.

Wing (1960–1970)

These are one-story, back-to-back wings connected by overhangs. The classrooms often already have natural ventilation incorporated into the design. Recommend retrofits similar to the post-war model.

Pods (1970s)

These schools are generally shaped like a box with no natural daylight or ventilation. Total renovation or major modernization is advised.

Post-1970 Schools

Schools built from 1970 to the present are not all one type, and some of the later schools incorporate sustainable, energy efficient design.

Portables

Portables continue to dot the landscape and the need for them is projected to continue. Consider purchasing a grid neutral, high performance portable rather than trying to retrofit existing portables.

Ground-Mounted Photovoltaics

Ground-mounted photovoltaics and wind systems must comply with the California Environmental Quality Act (CEQA).

Energy-Generating Technology

Once you understand the facilities' energy consumption and have implemented energy efficient measures to lower the electricity use, you can now consider energy production through renewable energy systems.

This section covers:

- Photovoltaic systems (converts sunlight energy to electricity through solar cells)
- Solar-thermal (converts sunlight into heat for heating water)
- Geoexchange (pumps ground heat to a building for heating water and air)
- Wind (converts wind energy to electricity)
- Educational Opportunities for Students

Photovoltaic Systems (PV)

Photovoltaic systems can substantially reduce the amount of electricity you need to purchase from your utility provider. In addition, the electricity generated by your PV system is clean, renewable and reliable.

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California is blessed with vast resources... we rededicate ourselves to making California cleaner, greener and more prosperous. The green building approach builds in conservation from the ground up... It's good for business and it's great for the environment.

—Governor Arnold Schwarzenegger
State of California

Roof-Mounted PV/Stand-Alone Structures

Diablo Valley College in Pleasant Hill, CA has installed photovoltaic panels on shade structures over parking area.

Roof-Mounted PV

San Jose High School Academy in the San Jose Unified High School District has installed photovoltaic panels on their roof tops.

Photovoltaic technology converts sunlight directly into electricity through solar cells. An inverter is used to transform the direct current (DC) from the solar system to alternating current (AC) for use in the building.

There are numerous applications for photovoltaic systems at schools, including roof-mounted PV, ground-mounted PV, shade structures with PV, building integrated PV and stand-alone PV applications.

Ground-Mounted PV

Ground-mounted PV applications require open space, which may be more feasible for districts in rural California. Many school and community college facilities have grown to a size beyond what the acreage was initially intended to support. Therefore, ground-mounted PV may further impact the site. However, ground-mounted PV may be practical in areas of the property that are not suitable for students such as setbacks from freeways. Installation options for ground-mounted PV include fixed array, dual-tilt, single axis tracker and dual axis tracker.

Installation costs for ground-mounted PV are lower than attaching to a roof or structure. Considerations to take into account are that ground-mounted PV should not detract from any programs (indoors or outdoors), create vandalism problems, or require more supervision. These and other issues will need to be addressed to comply with the California Environmental Quality Act (CEQA) required for this site specific installation.

Roof-Mounted PV

Roof-mounted PV silicon-based solar panels or newer thin-film PV technologies such as “peel and stick” can be mounted on rooftops. New construction has greater roof-mounted PV opportunities since the design phase can incorporate factors for roof orientation, structural load, and slope of roof. Installation options range from roof-penetrating, nonpenetrating, flat, flush, raised rack, rolled roofing, and PV thin-film that can be adhered to single-ply roofing.

Stand Alone PV Structures include strips of photovoltaic panels incorporated into scoreboard structures.

Benefits of Roof-Mounted PV:

- Increases the life span of roof covering.
- Reduces cooling loads.
- Maximizes efficiency of available square footage for PV placement.
- Lessens potential for vandalism.
- Closer to the utility grid point of connection.
- Lessens distribution loss.
- No underground trenching.

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Solar pumps are used to power water fountains.

PV glass installation creates a visible statement of the sustainable design strategies... and provides necessary sun shading...

—Aaron Jobson, AIA, LEED AP
Quattrocchi Kwok Architects

Shade Structure PV

PV applications can also function as shade structures where roof-mounted PV can be attached. This could be a covered lunch area, walkway, supervision area, instructional area, parking lot, pick-up/drop off area, or even a bus shelter.

Building–Integrated Photovoltaic (BIPV)

You can seamlessly integrate energy-generating photovoltaic technology into the design of school buildings.

Applications include:

- Roof-integrated (roof shingles), wall-integrated, overhang-integrated
- PV glass for windows
- PV glazing used as shading devices
- Shade structures tied into buildings
- Rolled roofing manufactured with PV adhered to roofing (single-ply, high reflective)

Benefits of BIPV applications include:

- Refined design
- Easier to maintain
- Some savings in construction materials

Disadvantages of BIPV applications:

- Panels fixed in orientation
- High cost of replacement if vandalized

Stand-Alone PV Structures

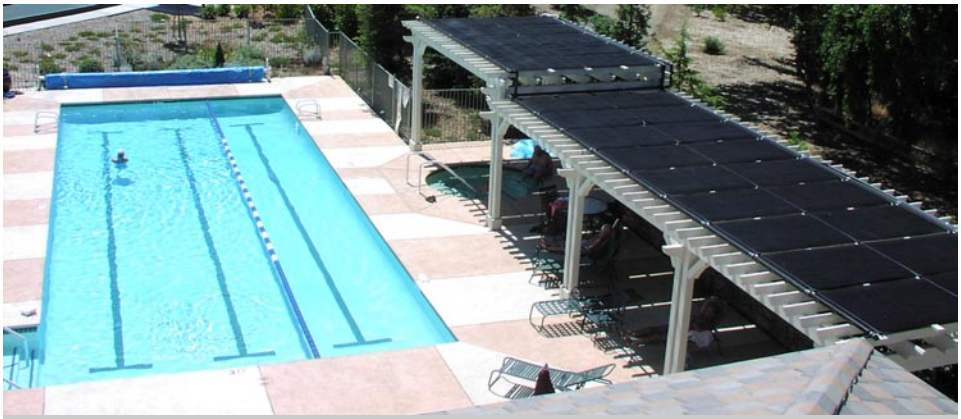
There are many creative stand-alone ways to offset electricity use. Light fixtures, water fountains, scoreboards, even restroom and attic exhaust fans can be equipped with photovoltaic panels and help lower the electricity needs of the campus. This also saves on the conduit and trenching required to bring electricity to the source.

Solar Thermal Converts Sunlight Into Heat

Solar thermal technology converts sunlight into heat for heating water and air. The California Solar Energy Industries Association estimates that solar thermal technology can meet 50 to 75 percent of water heating needs while reducing greenhouse gas emissions.

Examples of solar thermal applications include:

- Hot water for schools (lavatories, showers, cafeterias)
- Swimming pool heating
- Space heating
- Space cooling

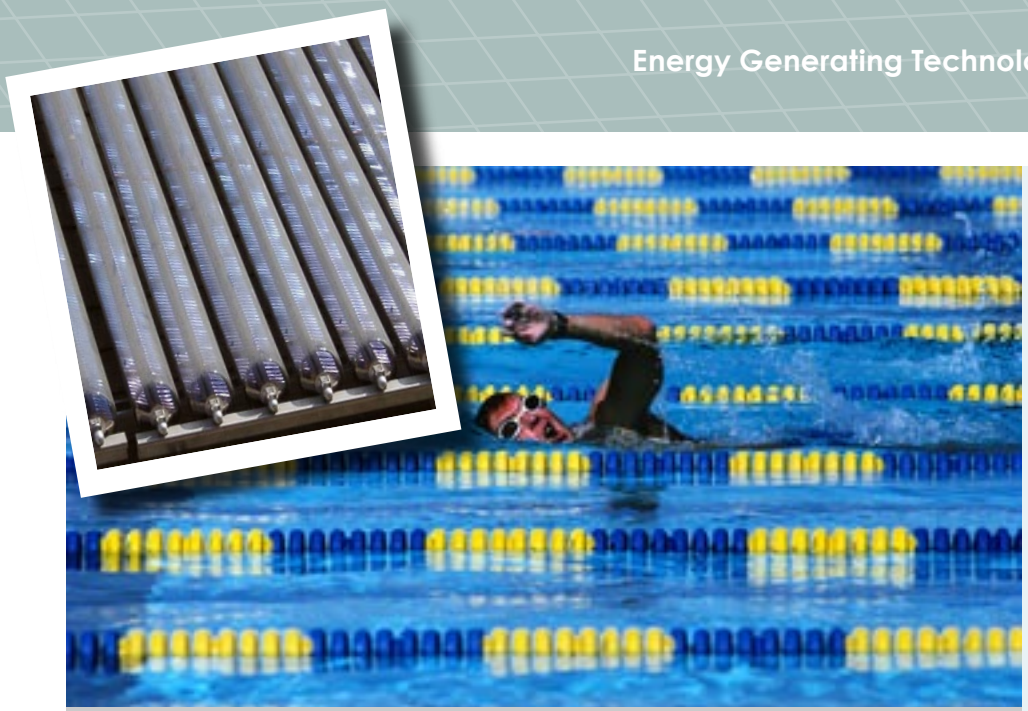


Solar Thermal Flat Plate Collectors attached on top of adjacent shade structure can help heat water for swimming pools.

Geoexchange Systems Transfer Heat From Ground

Regardless of how efficient conventional heating and cooling systems are, they still use or depend on fossil fuels (e.g., natural gas) which produce CO_2 emissions.

Geoexchange systems, also called ground source heat pumps, remove the need to burn fossil fuels for heating and cooling. They operate by transferring heat from the earth rather than creating heat. Ground source heat pumps transport water through a closed-loop system in the ground used for radiant heating and cooling, which is more effective than air distributed by mechanical ductwork. Geoexchange systems essentially replace cooling towers, chillers, and boilers.



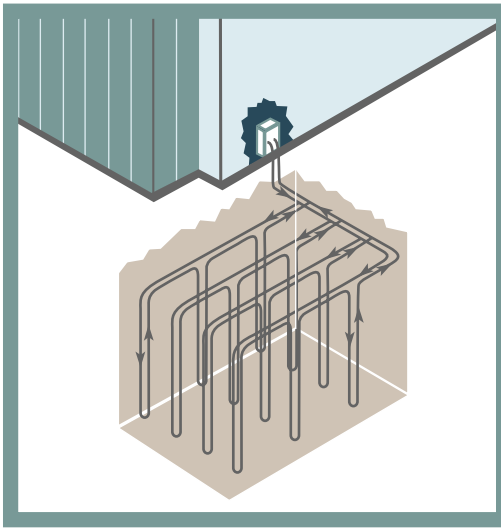
Solar thermal evacuated tubes are a second solar thermal heating technology for swimming pools.

Benefits of Geoexchange

- Reduced utility costs - 20 to 60 percent
- Reduced maintenance costs - 20 to 50 percent
- Design flexibility
- Improved comfort—individual room control
- Quiet operation
- No air quality or fire safety issues
- Saves water compared to evaporative cooling
- Low life-cycle costs

Disadvantages of Geoexchange

- Uses electricity to operate pumps
- Can cost more on the front-end for drilling a pipe installation; however, new technology is helping bring down costs
- Ground source heat pumps require open land for pipes to be installed.



Geoexchange Facts

- **Keeps interior space needs to a minimum**
- **Requires 225 to 400 square feet of surface area per ton of cooling**
- **Requires bore holes to be drilled for pipes; each bore is normally 5 to 6 inches in diameter and 200 to 300 feet deep**
- **Bores are sealed and filled with grout**

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Consider adopting existing energy education materials for K–12 schools from the National Energy Education Development (NEED) Project, the National Energy Foundation (NEF) and the Alliance to Save Energy (ASE)

Sculptural structure is equipped with solar panels on skin and designed to capture the wind power.

Large scale wind turbines can generate a big portion of a campus' electricty needs.

Wind Energy Technology Converts Wind Into Electricity

Wind technology is a clean source of electricity that also assists with reduction of greenhouse gas emissions.

New technologies for wind are currently being developed to incorporate wind into building structures. Wind energy is very site-specific. Climate zones play a large role in whether wind is right for your district's location. Standard three-bladed, small-to-mid-scale wind turbine technologies are commonly used at schools and community colleges.

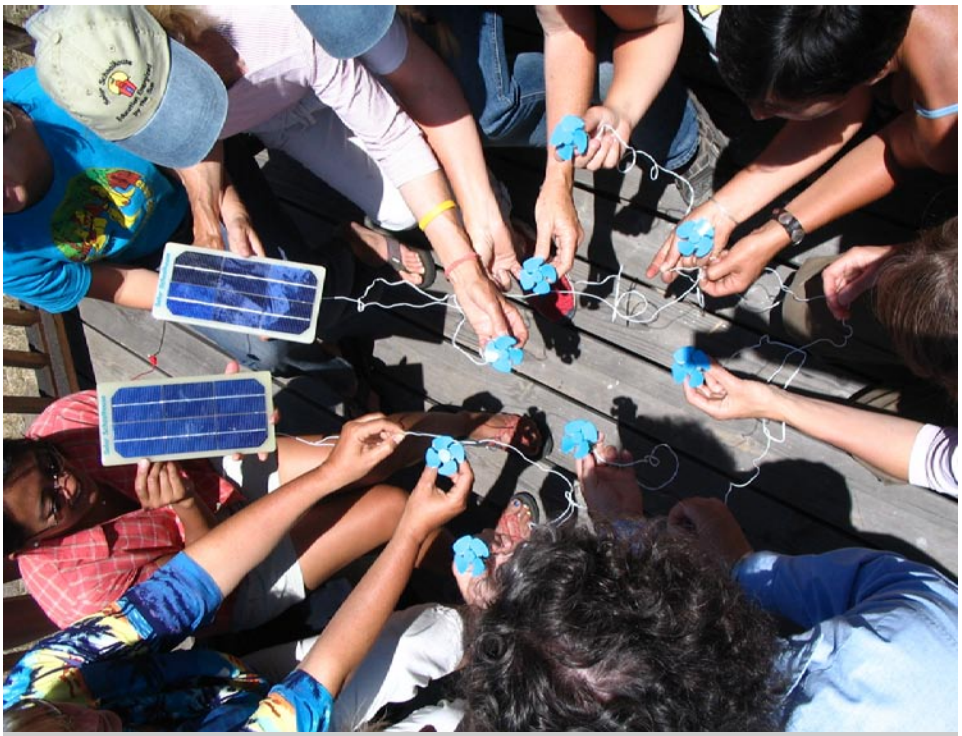
For large wind there are three basic project models:

- Behind the meter (a wind turbine sized to less than the school load is used to decrease energy bills)
- A community-scale wind turbine
- Piggybacking (for example, the district or community develops a financial agreement with a large-scale wind farm nearby)

Key Considerations for Energy-Generating Technology

When evaluating renewable energy options, districts need to consider the performance and reliability of the system, verify the qualifications of the suppliers, and ask how they will evaluate the performance of the system and maintain the system.

Consult with your "dream team" on the most state-of-the-art systems and monitoring equipment. Encourage innovative design and detailing for incorporating energy-generating technologies at your campus.



Grid Neutral provides the opportunity to integrate solar technology into the classroom curriculum.

Educational Opportunities for Students

The potential for incorporating energy-generating technology into education and curriculum is enormous.

The following are just a few suggestions:

- Hands-on experiments and curriculum provide discovery moments by allowing students to see, hear, and experience energy-generating technologies.
- Kiosks and reporting tools, complete with renewable energy systems, provide students opportunities to calculate energy production and greenhouse gas emissions, and compare data with other schools.
- Outdoor and weekend activities reinforce math and science components of renewable energy systems.
- Locate signs next to renewable energy systems describing their components and identifying their function.
- Install signs to encourage energy conservation measures, like reducing plug loads.
- Provide energy-awareness training for teachers and students.

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M&O staff need to be actively involved in the grid neutral project.

Maintenance and Operations

Grid neutral projects present a tremendous opportunity for cultural change in facilities construction projects and operations. You need to tap into your in-house maintenance and operations (M&O) staff throughout the process to ensure success. These are the folks who know the nuances of the existing site and equipment. They are often the ones tasked with maintaining and operating the new energy systems.

This section discusses:

- How to involve M&O staff throughout the phases of building a grid neutral school.
- The types of M&O evaluations that need to be conducted.
- Necessary training and education.

Involving M&O Staff in the Grid Neutral Project

M&O staff should be involved in all stages of decision making and development for grid neutral projects.

Bringing M&O staff in early will also entail earning their trust. The following lists M&O staff functions in relation to the construction phases for a grid neutral project.

PRE-CONSTRUCTION

- Act as agents of change to promote grid neutral
- Provide evaluation and assessments (See “Conducting M&O Evaluations” in this section)

PLANNING

- Provide input on existing policies/standards/equipment/systems
- Receive education on new policies/standards

PROJECT DESIGN

- Participate in mechanical and electical plan review
- Identify issues with maintainability, security and potential vandalism

> **Having M&O folks in at the beginning will have a profound impact on the project!**
>
> *—George Parker*
> *Director of Facilities*
> *Yuba City USD*

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Use the following checklist as a starting point for drafting an initial Request for Proposal for the energy generating system. Consider the financial needs of the district in relation to the project.

CHECKLIST FOR AN ENERGY GENERATING SYSTEM

- ☐ Cost and kilowatt hours (production)
- ☐ Minimum performance guarantee
- ☐ Location
- ☐ Reliability
- ☐ Safety
- ☐ Longevity/Warranty
- ☐ System provider's ability to provide "full service" agreement
- ☐ Low risk of voltage drop
- ☐ Minimum impact from temperature changes
- ☐ Does not degrade quality of grid energy consumption
- ☐ Meets UL 1741 standard for solar inverters
- ☐ Multifunctional (e.g., shade)
- ☐ Self-cleaning
- ☐ Educational component
- ☐ Theft and vandalism resistant
- ☐ Vibration-free for wind
- ☐ Meets utility interconnection requirements
- ☐ Meets all DSA and environmental permitting requirements

CONSTRUCTION

- Be continually present to observe systems and equipment being installed
- Participate in scheduled construction meetings
- Become familiar with maintenance that will be required of new systems and equipment
- Verify access to equipment and request photos of concealed components as needed
- Identifiy deficiencies/resolutions
- Review substitutions/"as builts"/change order documents and identify issues of M&O concern

CONSTRUCTION: Project Acceptance

- Review commissioning plans and observe while commissioning agents conduct their reviews at the site
- Receive training within six months if there are updates to the system
- Participate in "punch list" of outstanding items needed to be completed
- Receive, review and file warranty documentation, operations and equipment manuals, and scheduled maintenance documents
  - Clarifiy their role under warranty period
  - Receive training for the first warranty year
  - Address warranty issues with installer/manufacturer

POST-CONSTRUCTION: Ongoing Operation

- Identifiy construction defects:
  - Two years after acceptance
  - One year after warranty; request outside resources after project acceptance
- Develop plan to test systems periodically on a fixed schedule
- Develop plan to recommission building
- Plan for long-term and ongoing M&O
- Provide proper maintenance and training.
  - Systems should come with a replacement schedule for roofs, AC and PV
- Measure and monitor system performance
- Understand roles and responsibilities as related to third-party Power Purchase Agreements (PPA) to maintain PV systems
- Obtain all final "as-built" drawings and store in electronic format

M&O Evaluations

M&O evaluations help the district to evaluate the current state of equipment against what will be required to achieve grid neutral. To do this, districts should evaluate existing energy policies and standards, M&O staffing, facility use, and energy use. Evaluation of grid neutral projects will bring change to existing policies and energy standards, since the M&O model has itself changed over time. Specifically, districts should:

- Evaluate district's existing performance goals.
- Evaluate existing M&O policy and procedures. For example, if you have a policy of no appliances such as "no refrigerators in classrooms" and if that policy is not enforced, then it's not effective.
- Acknowledge the role of teachers in M&O and their awareness of energy use in their classrooms.
- Include M&O staff at meetings with the architectural/engineering team.

- Evaluate and assess the district's existing facilities energy efficiency criteria and policies.
- Assess and verify all utility meters and evaluate rate structures for each meter to ensure that they are the most advantageous for the campus.
- Evaluate existing energy systems.
- Locate and update M&O manuals.
- Evaluate M&O staffing needs and assess numbers of in-house staff versus contractors, and assess the ratio of staff assigned to preventative maintenance versus corrective maintenance.

Facility Evaluation

- Evaluate building site
  - What are the opportunities for installing and locating renewable energy systems on-site?
  - What is the existing buildings' orientation for roof-mounted systems? What would be the orientation of new stand-alone or shade structures?
  - Are there any constraints for renewable energy systems associated with the site? For example, do you have land available for a ground source heat pump system?
- Evaluate building use
  - What is the monthly schedule like for the building? For example, is school in session year-round?
  - What are the hours of operation for the building?
  - Will the building or site be used jointly by other organizations for community functions on weekends (for example, a community pool, or multipurpose room)?
  - Which areas of the building require more electricity (for example, gyms, shops, multipurpose)?
- Evaluate major energy-using equipment
  - What is the condition and lifespan of existing energy-using equipment such as HVAC?
  - How efficient is the existing equipment?
  - What is the condition of portables and are they leased or owned?
  - How much electricity is used by staff and where?
  - How is equipment controlled? Is there an opportunity to turn off lighting, HVAC, and other equipment when not used?

Energy Evaluation

- How much electricity are you using? (kWh /sq. foot)
- Where is the electricity being used? (percentage of HVAC, lighting)
- What is the potential for retrofitting or replacing existing equipment?
- What are the commissioning needs?
  - Recommissioning for older facilities
  - Commissioning for new construction
- Evaluate existing energy management systems (EMS). Does M&O staff use system capabilities to maximize energy savings?
- Building occupancy profiles—When is electricity used?
- Infra-red analysis tools can determine heat loss and heat gain in your facilities.

Recommissioning ensures that installed systems continue to operate the way they were designed.

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Infra-red analysis tools can determine heat loss and heat gain in your facilities.

M&O Training and Education includes teachers, students and administrators.

Conduct Investment-Grade Energy Audit

An investment grade energy audit is a comprehensive evaluation of all major energy using systems, such as lighting, HVAC, controls, domestic hot water, pumps and motors. This type of audit offers the most accurate estimate and analysis of energy efficiency projects and renewable energy projects for your facilities. Detailed analysis of project costs and savings for all cost effective energy technologies are presented. In many cases a life cycle cost analysis, internal rate of return and net present value evaluation are also conducted to assess the long term cost and benefit viability of an energy project. Energy audits are a good tool to help districts plan and budget for cost effective projects at each campus.

M&O Training and Education

Remember that *people* operate buildings; buildings do not operate themselves. Changing the existing culture of energy consumption in the classroom will result in immediate energy savings to districts.

There is both an educational (the "why") and training (the "how") component to this cultural shift.

Education (The "Why")

Districts need to invest in educating M&O staff about the renewable energy systems, and why these systems need proper maintenance and operation. Additionally, teaching staff, administrators, and students all need to be educated on the energy conservation policies of the campus and what systems are in place for energy efficiency purposes. Some suggestions to make change include:

- Create awareness of the need for energy monitoring and management systems.
- Foster M&O learning communities on green technologies so M&O staff become agents of this change.
- Emphasize the value of integrating M&O staff into other energy conservation efforts at the campus.

Teaching how solar energy works can be integrated into the classroom curriculum.

- Continually measure and monitor performance of renewable energy systems.
- Assemble a campus guidebook that creates energy advocacy in students, teachers, administrative staff and M&O staff.

Training (The "How")

To successfully meet your grid neutral goals, M&O staff need ongoing training on the energy efficient controls and equipment along with the energy generating systems installed. Just as important, teachers, administrators, and students need to be advised how to use the systems that save energy like light dimmers and controls or automatic closers for windows and doors that work in conjunction with the HVAC system. Here are some training opportunities to make this team effort a success:

- Training on how to operate all energy systems and controls, including energy management systems (EMS).
- Add funding for maintenance, training, and support from the vendor in the contract for renewable energy systems.
- Training for any controls (light, PV) in classrooms or buildings to all users.
- Function, operation, maintenance training for all staff on campus with in depth training for M&O staff.
- Performance measurement.
- Provide proper and up-to-date signage to ensure energy conservation in classrooms is understood and practiced.

"The students in the building are the only sustainable members of the school community to carry energy efficiency into the next century."

—Larry Schoff, P.E.
Energy Efficient Solutions

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Self-funded options include public/private partnerships.

Innovative Funding

California's school and community college districts want to be energy efficient and incorporate sources of renewable energy. But the question really comes down to funding. Fortunately, there are many funding opportunities available. This section outlines the considerations for evaluating funding options and provides an overview of the current funding sources for both energy efficiency projects and installing energy generating systems.

Renewable Energy Projects

Once you start considering the installation of energy generating technologies for producing electricity, the overriding question you must ask when evaluating funding sources is "who will own the renewable energy system?" The first option is that you own the system, and the second is you purchase power from a third-party taxable entity that can take advantage of the tax incentives available.

The District Owns the System

This means that you provide the up-front installation costs through your district's capital fund, or through another financing option such as a bond, loan, or lease payments. If you decide to own the system, then you will be responsible for providing the up-front installation costs along with the planning, financing, commissioning, and operations, tracking, and maintenance of the system you choose. The advantages of ownership are:

- Increased building value with the addition of the renewable energy system(s)
- A hedge against escalating energy costs
- Cost of system is known
- Less contractual complexity
- All energy savings go to you

A Power Purchase Agreement (PPA) is a long-term contract to buy power from a specific energy provider, usually at equal to or less than market rates. Solar PPA providers install and maintain solar facilities on customer rooftops or properties.

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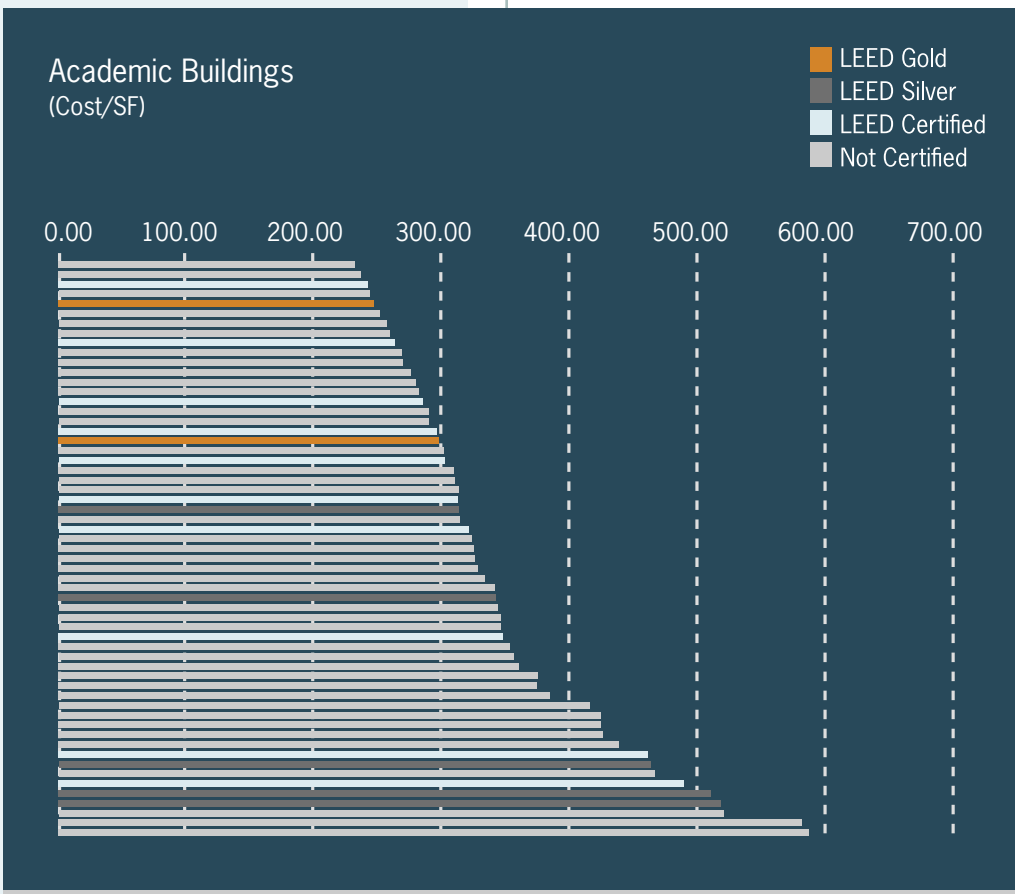
Office of Public School Construction and the State Allocation Board

The Office of Public School Construction serves as staff to the State Allocation Board and is responsible for providing State funding to eligible school districts for new construction and modernization of local public K–12 school facilities. This includes awarding funding to support the development of high performance "green" schools. For more information, visit the OPSC/SAB web site at http://www.opsc.dgs.ca.gov/AboutUs/aboutOPSC.htm.

A Third Party Owns the System

The other option is to have the renewable energy project hosted by a third-party owner referred to as the "provider." You don't pay for the up-front installation costs nor any associated maintenance and operations costs. Instead, you pay the provider for the electricity the system generates similar to the way you pay the utility bill now. This is typically done through a Power Purchase Agreement, or PPA, which is discussed later in this section. The advantages of a Third Party PPA are:

- No capital costs (some administrative costs)
- Predictable electricity rates for the term of the contract (typically 15 to 20 years)
- Option to purchase system at fair market value after set time period per agreement
- Third Party operates and maintains equipment, and monitors and meters performance



Studies have been done to look at the cost of green buildings which emphasize energy efficient design. "The Cost of Green Revisited" by Davis-Langdon reports that construction costs vary across a range of projects, those LEED certified and those that are not certified green.

Energy Efficiency Projects

Energy efficiency incentives are available in many of the funding options listed in this section. Whether you are incorporating energy efficient designs at your existing schools or building a new school, there are many incentive, loan, and partnering programs that you can pursue for the financing of an energy project.

"Free Money" Programs

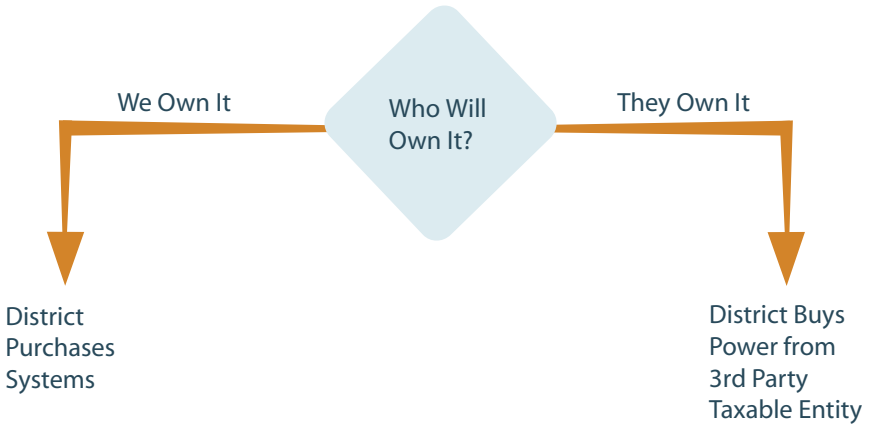
The term "free money" was given to this first category of innovative funding. Leaving the district's general fund intact is the premise for the definition of these programs. These programs provide funds which would be a separate line item on your general ledger.

Office of Public School Construction (OPSC) and the State Allocation Board (SAB)

In 2007, Assembly Bill 127 set aside $100 million through the High Performance Incentive (HPI) Grant program to promote the use of high performance attributes in new construction and modernization projects for K–12 schools. The plans go through the regular plan check process for schools at the Division of the State Architect with an additional review done by the High Performance Schools Section; they are verified with a final score. Depending on the type of green features incorporated into the design, the grant can increase the OPSC base grant for new construction or a major modernization by 2 to 10 percent.

OPSC grants require matching funds by the district. As of October 2008, there is approximately $89 million still available in HPI grant monies.

Who Will Own it?



California Energy Commission Bright Schools Program

The Bright Schools Program sponsored by the California Energy Commission provides technical assistance for identifying energy efficiency opportunities in existing and newly planned school facilities (K-12). This program provides assistance with commissioning, comparing different technologies, developing computer simulation models of your planned project, and performing investment-grade audits. As a district, you can apply more than once for up to $20,000 on each application.

Utility Rebates and Incentives

Utility companies offer rebates and incentives for energy-efficient new construction, retrofits and commissioning. The California Solar Initiative rebate pays on either system performance or as a one-time, up-front rebate after installation, depending on the size of the system. Small systems under 50 kilowatts currently can receive the up-front rebate.

Savings-By-Design

Savings-By-Design is a rebate program encouraging high performance, building design and construction for non-residential buildings, through incentives given to the design team and owner for exceeding the State's building energy efficiency standards (Title 24) by at least 10 percent. Savings-By-Design is run by the four major investor-owned utilities (PG&E, Southern California Edison, Southern California Gas, and San Diego Gas & Electric).

Mello-Roos

Mello-Roos bonds are land-secured bonds that provide a voter-approved source of revenue that leaves the district's general fund intact. Property owners agree to put a lien on the project property and pay off the lien through an annual special tax.

California Solar Initiative

The California Solar Initiative builds on 10 years of state solar rebates offered to customers in California's investor-owned utility territories: Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E). These rebates are

The Bright Schools Program provides technical assistance for identifying energy efficiency opportunities in existing and new school facilities.

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Project Overview:

Borrow-to-Buy
Anderson Union High School District Photovoltaic System

CEC Energy Efficiency Loan Program

Utility Rebates – California Self-Generation Incentive Program

In addition to PV, the project also included energy efficient lighting, controls, chiller for administration building and recommissioning. Here is the cost breakdown:

Total Project Cost $2,017,500
PG&E Rebate..... $857,000
CEC Loan $1,160,000
Cost Savings $118,333/year
Simple Payback after Rebate ..... 9.8 years

derived from a portion of the funds collected from the utilities. Starting in 2006, this $3.3 billion ten-year program provides incentives for schools and community colleges to put solar on roofs throughout the state.

Energy Efficiency Rebates

The investor-owned utilities offer cash rebates and incentives for energy efficient technologies. Some examples of rebate-eligible energy efficient equipment are: building envelope improvements (cool roofs, improved daylighting, weatherization measures, window film, and insulation), vending machine controllers, ENERGY STAR® appliances, and daylighting controls.

California Energy Commission (CEC) Emerging Renewable Program

The California Energy Commission (CEC) offers an Emerging Renewable Program to fund wind and renewable-powered fuel cell systems. Funds have been collected from electricity ratepayers to support this program and will continue through the year 2012. Although the Emerging Renewables Program is open to emerging renewable generating systems of various sizes, it was designed to favor small generating systems.

Flex Your Power

You can find financial incentives and technical help for energy efficient appliances, equipment, lighting and buildings with the Flex Your Power program. Utility companies, water agencies, and public and private organizations have joined together in this California based partnership to offer a variety of programs and provide information on where to get utility rebates and other funding.

Individual Grants and Donations

Identifying corporate donations and grant funding is a grassroots effort. What programs or opportunities exist depend on where you are located and how active you are in your pursuit. You

The California Energy Commission (CEC) offers an Emerging Renewable Program to fund wind and renewable-powered fuel cell systems.

would need to be proactive in visiting each corporation and inviting them to be part of your grid neutral program in order to receive these tax-free dollars as a grant or donation.

Borrow-to-Buy Programs

This category includes a low-interest loan from the California Energy Commission, tax-exempt financing, and little- or no-interest bonds.

Tax-Exempt Financing

General obligation bonds:
General obligation bonds provide a voter-approved source of revenue that leaves the district's general fund intact. This mechanism is an alternative for incremental funding and is used to fund big infrastructure projects and not smaller projects like lighting retrofits. The energy efficiency and/or renewable projects must be part of the stated goal of the general obligation bond for passage.

Certificates of participation:
Certificates are issued to finance construction and acquisition of school and community college facilities and purchases of equipment. They are secured through lease payments made by the district's general fund or through a combination of the general fund and available funds such as Mello-Roos. No voter approval is required.

Tax-exempt lease:
The California School Boards Association offers the Flex Fund, which provides tax-exempt financing for school projects (energy and non-energy).

The California Energy Commission (CEC) Energy Efficiency Financing Program

The California Energy Commission's (CEC) Energy Efficiency Financing program provides a fixed 3.95 percent low-interest loan for feasibility studies and installation of energy-saving measures. The maximum loan amount is $3 million per application.

Charter schools are not eligible for the CEC loan. However, they can take advantage of CEC's Bright Schools program.

Qualified Zone Academy Bonds (QZAB)

Qualified Zone Academy Bonds (QZAB) are federal tax credits given to investors that off-set the interest payments for local school districts. The QZABs may be used to rehabilitate existing structures that will be used for an academy. The academy must receive a private business contribution that is at least 10 percent of the net present value of the proceeds or the bond.

Federal Clean Renewable Energy Bonds (CREB)

Modeled in part after QZABs, CREBs provide an interest-free loan for renewable energy projects for K–12 schools. The federal government provides a tax credit to the bondholder in lieu of the district paying interest.

Self-Funding Options

This category includes self-funded renewable projects through the district's general fund, third-party financing through Power Purchase Agreements (PPAs), and third-party municipal lease financing, typically through an Energy Service Company (ESCO).

District General Fund

The funding of an energy project (capital fund) and money that is set aside for operational costs (general fund) start to overlap when the savings that come directly from a grid neutral project are considered. With these two state

The energy efficiency and/or renewable projects must be part of the stated goal of the General Obligation Bond for passage.

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DGS
Department of General Services
BUILDING GREEN · BUYING GREEN · WORKING GREEN

The California Department of General Services is leading the way for government agencies and schools to plug into affordable, on-site renewable power.

As part of the governor's Green Building Initiative, DGS has crafted Power Purchase Agreements to help state agencies and California State University campuses tap into solar power without paying the up-front costs traditionally associated with large solar projects.

Under these public-private partnerships, the solar service providers finance, build and operate the systems, while the customers—in this case, government agencies and colleges—pay only for the electricity at prices equal to or less than current retail rates.

For more information on DGS' power purchase agreements and other "green government" solutions, please visit: www.green.ca.gov.

At DGS, we are Building Green, Buying Green, Working Green.

allocations and careful life-cycle cost analysis, this is a great way to self-fund your energy projects. You can create a self-funded loan by borrowing money to do an energy project from your general fund and then pay back those funds with the savings from your energy bills. This is especially effective for smaller projects, and the payback is usually within the first few years.

Third-Party Power Purchase Agreements (PPA)

Power Purchase Agreements enable the third-party owner to leverage federal tax credits and take advantage of depreciation and utility incentives. The 30 percent federal investment tax credit is available to taxable entities.

A Power Purchase Agreement (PPA) is a long term contract to buy power from a specific energy provider, usually at equal to or less than market rates. Solar PPA providers install, monitor and maintain solar equipment on customers roof tops, free-standing structures or properties.

You would want to consult with your legal counsel to craft these agreements and there are sample agreements available by other districts like Los Angeles Community College District and Milpitas Unified School District that have already done this. For additional information refer to "The Customer's Guide to Solar Power Purchase Agreements"; a link to this publication can be found at: www.gosolarcalifornia.ca.gov.

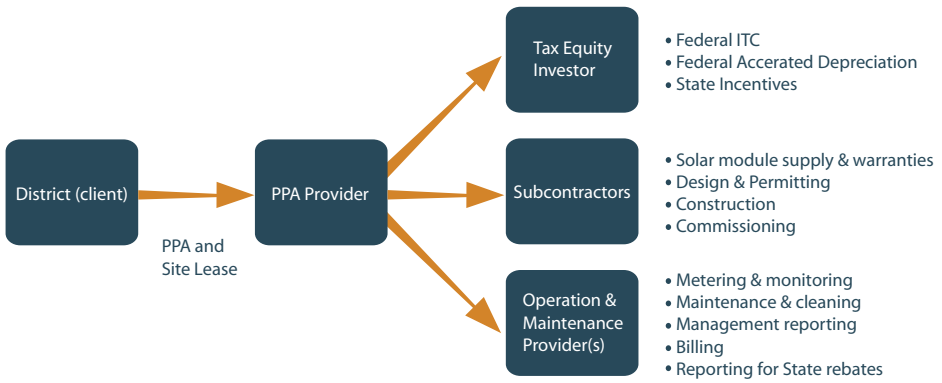
Federal Tax Incentives: The Emergency Economic Stabilization Act of 2008 extends federal investment and production tax credits for renewable energy.

Accelerated Depreciation: Accelerated depreciation is available on the depreciable basis of the system on the portion of the cost that is not covered by rebates or grants. The five-year accelerated depreciation remains effective beyond 2008.

Third-Party Financing (Energy Service Company)

An Energy Service Company (ESCO) can provide services based on what you want to choose. This can include an energy audit, construction management, project financing, project monitoring and guarantee of energy savings; equipment and M&O. ESCOs are not eligible for tax-exempt financing, so the financing they offer has higher interest because they are a taxable entity. Most ESCOs encourage districts to secure their own tax-exempt financing for their recommended projects.

How Power Purchase Agreement (PPA) Works



Project Overview:

District Owns Contra Costa Community College

3.2–megawatt solar energy system and energy efficiency improvements

- Designed, engineered and constructed by Chevron Energy Solutuons
- $35.2 million project
- Cost offset by:
  - – $85 million in rebates and other incentives administered by PG&E under the State of California's Solar Initiative, Self–Generation Incentive Program and Community College Partnership Program.
  - – Net $26.7 million, supported by Measure A bonds funds.
- Expected to save district more than $70 million over 25 years.

Evaluate Return on Investment

While third-party ownership provides an innovative funding solution, it may not necessarily be the best option for your district. Districts should conduct an investment analysis (with the help of the "dream team" discussed earlier) to assess the feasibility of the different ownership and funding methods relative to the initial capital outlay required, financial complexity, administrative complexity, and operational savings.

Life-Cycle Cost Analysis (LCCA)

Life-cycle costing is a decision-making tool to calculate and compare different designs to identify which is the best investment. Districts can use a LCCA to assess the total cost of ownership for a facility over its lifetime. A LCCA integrates all positive and negative cash flows to a project over its useful lifetime. The analysis includes the costs of acquiring, installing, owning, operating and disposing of a piece of equipment, energy generating system, or energy saving system. You would also include the calculations for cost savings associated with optimizing operations based on reduced energy use, lower energy rates and other efficiencies. Life-cycle cost analysis is the key to making comparisons between energy generating and efficiency measures, resulting in strategies with the lowest long-term cost of ownership.

For additional information refer the U.S. Department of Energy's Guide to Financing Energy Smart Schools at www.energysmartschools.gov.

> **Using life cycle cost analysis, the high performance, green features of our new campus will more than pay for themselves.**
>
> —Douglas Atkins,
> Chartwell Executive Director

Life-cycle costing is a decision-making tool to calculate and compare different designs to identify which is the best investment.

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Grid Neutral Funding Options

"Free-Money" Programs

- Office of Public School Construction (OPSC) and the State Allocation Board (SAB)
- California Energy Commission Bright Schools Program
- Utility Rebates and Incentives
- Savings-By-Design
- Mello-Roos
- California Solar Initiative
- Energy Efficiency Rebates
- California Energy Commission Emerging Renewable Program
- Flex Your Power
- Individual Grants and Donations

Borrow-to-Buy Programs

- Tax-Exempt Financing
- California Energy Commission's (CEC) Energy Efficiency Financing Program
- Qualified Zone Academy Bonds (QZAB)
- Federal Clean Renewable Energy Bonds (CREB)

Self-Funding Options

- District General Fund
- Third-Party Power Purchase Agreement (PPA)
- Third-Party Financing (Energy Service Company)

Chartwell School, located in Seaside, California, achieved both LEED Platinum and CHPS certification.

Project Overview:

Milpitas Unified School District embarks on a Solar Energy Project

In late 2007, the Milpitas Unified School District met with Chevron Energy Solutions to discuss the development of a solar power and energy efficiency initiative that would support four key objectives: (1) economic leadership, (2) environmental stewardship, (3) educational opportunity, and (4) positive public recognition and community outreach. The district wanted to build a project that would have a lasting impact and serve as a successful model for renewable power, energy efficiency and energy education for other school districts. The district envisioned a program that would promote clean energy while saving general fund dollars and serve as a living laboratory for teachers and students.

Milpitas Unified School District, PV Installation

In a private/public partnership with Chevron Energy Solutions and Bank of America, electricity will be produced at school campuses and a district site in the Milpitas Unified School District with photovoltaic (PV) panels attached to stand-alone structures that shade parking and playground areas of the campuses shown below.

Milpitas Unified School District's Solar Energy Project

Schools Proposed	Proposed Capacity (kW)	Percent Energy Offset
Burnett	172	80 %
Calaveras High	424	71 %
Corporation Yard	181	61 %
Curtner	139	77 %
Milpitas High	1,002	70 %
Pomeroy	210	82 %
Rancho	216	80 %
Randall	113	65 %
Rose	109	51 %
Russell	221	89 %
Sinnott	195	77 %
Spangler	134	76 %
Weller	149	89 %
Zanker	134	66 %
Total	**3,403**	**73 %**

Refer to MUSD website for their Solar Energy Project page to view sample Power Purchase Agreement: https://www.musd.org

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Conclusion: Grid Neutral and Beyond

The opportunity to go grid neutral is now. This guidebook provides the markers for getting you there. Assemble your dream team and draft a district resolution. Measure your energy use and set performance goals. Make existing facilities more energy efficient and design new facilities using CHPS or LEED criteria. Install renewable energy systems such as solar, geoexchange, and wind. Capture additional cost benefits by monitoring and maintaining your energy production. And finally, choose the financing method that makes the most business sense for your district. Remember that there are numerous resources available and many workshop participants who can help you through the process.

So what's the next opportunity after grid neutral? Many workshop participants asked this very question and wondered why the workshops did not focus on zero net energy—the reason being that grid neutral is an excellent starting point for districts, something achievable, and electricity is the largest energy consumer in buildings. However, this does not preclude districts from tackling total energy independence and going beyond grid neutral. Other districts have—your district can seize this opportunity. Grid neutral is a huge step in the right direction… Start planning for a grid neutral campus now!

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WORKSHOP PARTICIPANTS

I would like to thank all the enthusiastic and knowledgeable people who participated in these workshops and who helped to formulate this information along with Butte Community College as the facilitator and curriculum developer. In the future, I plan to launch a grid neutral course through my Division of the State Architect Academy that works with design professionals and school districts.

—David F. Thorman, AIA, California State Architect

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The Rahus Institute and Solar Schoolhouse

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Pacific Gas & Electric

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General Information

Air Resources Board: www.arb.ca.gov

California Building Standards Commission: www.bsc.ca.gov

California Department of Education: www.cde.ca.gov

California Public Utilities Commission: www.CaliforniaEnergyEfficiency.com

Department of General Services: www.dgs.ca.gov

Green California: www.green.ca.gov

Lawrence Berkeley National Laboratory: epb.lbl.gov

National Renewable Energy Laboratory: www.nrel.gov/buildings

Office of Public School Construction: www.opsc.dgs.ca.gov

United States Department of Energy: www.energy.gov

Energy Measurement

How to read your utility bill, California Public Utilities Commission: www.cpuc.ca.gov/puc

Tracking and benchmarking energy use by Portfolio Manager: www.energystar.gov

Energy Efficient Design

California Lighting Technology Center: cltc.ucdavis.edu

Energy Efficiency Strategic Plan: www.CaliforniaEnergyEfficiency.com

Rating systems for energy efficient design criteria:

Collaborative for High Performance Schools (CHPS): www.chps.net

Leadership in Energy and Environmental Design (LEED) for Schools: www.usgbc.org

Passive Solar Design Principles, Energy Generating Technology, The California Environmental Quality Act (CEQA): ceres.ca.gov/ceqa

Innovative Funding

California Waste Managemant Board : “Managing the Cost of Green Buildings” http://www.ciwmb.ca.gov/greenbuilding/Design/ManagingCost.pdf and “The Cost and Financial Benefits of Green Buildings” http://www.ciwmb.ca.gov/Greenbuilding/Design/CostBenefit/Report.pdf

“The Customer’s Guide to Solar Power Purchase Agreements”: California Solar Initiative: www.gosolarcalifornia.ca.gov

Federal Government Grants: www.grants.gov

Financing opportunities through California Energy Commission: www.energy.ca.gov/efficiency/brightschools/index.html and www.energy.ca.gov/efficiency/financing/index.html

Samples of Power Purchase Agreements used by LACCD and Milpitas USD: www.laccdbuildsgreen.org and www.musd.org

U.S. Department of Education: www.ed.gov/fund/

U.S. Department of Energy Guide to Financing Energy Smart Schools: www.eere.energy.gov

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