2012

Applied policy analysis report : a solar garden for the Monterey Peninsula Unified School District: an applied analysis of solar power

Debra Gramespacher
California State University, Monterey Bay

Applied Policy Analysis Report

A Solar Garden for the Monterey Peninsula Unified School District:

An Applied Analysis of Solar Power

Submitted in Partial Satisfaction of the Requirements for the

Master of Public Policy Degree

California State University, Monterey Bay

Department of Health, Human Services, and Public Policy

&

Panetta Institute for Public Policy

May, 2012

Faculty Advisor: Monica Bray, Ph. D.

Signature ______________ Date 5/10/12

HHSPP Department Chair: Jim Raines, Ph. D

Signature ______________ Date 5/17/12

Master's Candidate: Debra Gramespacher

Signature ______________ Date 5-10-12

A Solar Garden for the Monterey Peninsula Unified School District

May 17

2012

An Applied Analysis of Solar Power

Converting the delivery of electricity from traditional carbon-based to photovoltaic energy may provide financial relief to the Monterey Peninsula Unified School District. State Assembly Bill 32 and the state superintendent's 'Schools of Future' vision direct school districts toward sustainable energy. Options to reduce power costs, generate revenue and to increase academic services using solar power are explored.

California State University at Monterey Bay, Master in Public Policy, APAR
by Debra Gramespacher

MPUSD provides public Early Childhood, Pre-school, Elementary, Middle-School, High-School and Adult Education services for 10,500 students for the cities of Monterey, Del Rey Oaks, Seaside, Sand City and Marina. Twenty sites consume 5,522,077 kilowatt hours of power at a cost of one million dollars, equaling two percent of general fund expenditures annually (District, 2010) .

California does not provide funding for energy costs. The state pays money based on the average number of students attending school within the district on a daily basis. This average is called the Average Daily Attendance rate, or ADA. Teacher salaries and utilities are paid from the general fund tied to the average daily attendance rate (ADA). A dollar spent on electricity is a dollar taken from classroom instruction.

Since 2008, funding to the school district has decreased twenty percent while state academic standards have risen. Reserves and temporary funding through the federal American Recovery and Reinvestment Act have preserved services through 2014, after which time, the district must identify new revenue sources to maintain current educational services.

To address decreasing tax revenues, the state seeks to support new job markets in green technologies. The 2006 Assembly Bill 32, California Global Warming Solutions Act, mandates that public agencies should lead the way in the implementation of sustainable energy projects. The goal of the legislation is to reduce state Green House Gas Emissions by 2020 to 1990 levels. Accordingly, the State Superintendent of Public Education, Tom Torlakson, envisions school districts as power independent through the implementation of solar power.

CONTENTS

1. INTRODUCTION

The Monterey Peninsula Unified School District mission is to provide public, free educational services. The recession and the California state budget deficit necessitates school districts identify sustainable methods to reduce operating expenses and increase revenue.

The state of California does not provide funding specifically for energy costs. All expenses, including teacher salaries and utilities, are paid from a fund tied to the average daily attendance rate (ADA). ADA monies are tracked in the district's General Fund.

To reduce energy costs, which compete with instructional expenditures, it is the goal of this paper to explore ways that the district can integrate solar power into the delivery of electrical power at a rate that is cheaper than the power provided by Pacific Gas and Electric (PG&E).

Responding to mandates from the state legislature, a Cap and Trade market for Renewable Energy Credits (REC) is projected to start in 2014 under AB 32. A Renewable Energy Credit equates to one megawatt hour of power produced using a non-polluting sustainable source in one year. A Solar Renewable Energy Credit (SREC) measures power produced by a certified photovoltaic solar project. The certifying process is tracked, creating a statewide register of SRECs in the state. The Cap and Trade market will place a price on SRECs for use by big polluters to offset their GHG emissions. The possibility of reselling MPUSD SRECs, through a broker like the local Offset Project, is examined as a method to generate revenue (Cushman, 2011).

The paper examines different finance models for installing and maintaining a solar power system and identifies how to integrate the science and mechanics of photovoltaic power into academic curriculum. A photovoltaic solar power system converts sunlight energy into consumable power using a network of solar panels. The word photovoltaic is derived from the Greek word *phos* meaning light and the word *volt; a* unit for electrical voltage named by *Alessandro Volta* (Lenardic, 2012). Solar academics have sparked a light of enthusiasm within MPUSD.

2. OBJECTIVES AND PROBLEM DEFINITION

Public agencies use general fund revenues to pay for electrical power, which diverts funds away from their core mission. Power provided by carbon based energy sources is harmful to the global climate.

Converting the delivery of electric power from traditional carbon-based to solar photovoltaic energy may provide financial relief and reduce Green House Gas emissions. The Monterey Peninsula Unified School District diverts one million dollars annually from instructional services to pay for increasing power consumption. Utility expenses may be reduced by integrating solar energy into the delivery of electrical power in a manner that also provides access to the academics of photovoltaic science as part of the district's academic mission.

The state legislature mandates that large producers of carbon-based greenhouse gases reduce emissions to 1990 levels by 2020 with AB 32 the Global Warming Solutions Act of 2006. This is approximately a 15% reduction in GHG emissions based on current state consumption levels. Research is needed to assess trends in the energy market to identify whether the Monterey Peninsula Unified School District can generate sustainable revenue through the sale of Solar Renewable Energy Credits, to supplement reduced state revenue and lead other county agencies to reduce dependence on traditional carbon-based power.

It is the district's mission to teach employable skills. The green industry is one of the most rapidly growing and thus employable industries in the state, according to a report from U.C. Berkeley. Implementing 33 percent renewable energy, combined with 1 percent annual improvement in energy efficiency, will increase Gross State Product (GSP) by $20 billion and generate 112,000 jobs (Roland-Holst, 2010).

3. BACKGROUND

3.1 The State of Public Education in California

Public school districts receive funding using a formula that funnels property taxes to the state comptroller and then back to school districts as a legislated percentage of the state's general fund. The money paid to a district by the state is based on the average daily student attendance for the district as well as the size of the state general fund. The state constitution designates that 48% of the annual state general fund should be apportioned for K-12 public education. As the general fund balance decreases, public education funding also decreases. In 1999, this formula amounted to spending sixty-two cents of every property tax dollar on public education in Monterey County (McCaty, Sexton, Sheffrin, & Shelby, 2001). The amount of property tax for schools has significantly declined due to the recession. Over the past five years, the total revenue given by the state legislature to schools in Monterey County has declined by $399 million dollars; $45 million of that would have gone to the Monterey Peninsula Unified School District. Because revenues are less than expenditures, the district has an operating deficit in 2012 of over $7 Million, from an ADA generated Revenue Limit general fund of $50 Million. The large deficit identifies a structural problem in state support for public education, and a challenge to local education agencies to identify alternative and sustainable revenue sources.

It is the challenge of the district board and administration to educate the public, that a large capital investment in solar technology today will provide long-term reduced expenditures. This paper attempts to identify how immediate reductions to the operating deficit can be achieved by redirecting electricity expenditures to investments in solar power financed by a third party, thereby allowing the district to redirect its general fund electricity monies toward financing additional instructional services.

3.2 Project Based Learning and Rigor

The Monterey Unified School District (MPUSD) is in the process of redefining traditional vocational classes into more rigorous Career Technical Education classes, which integrates STEM (Science Technology Engineering and Math) curriculum into career pathways to assist a transition into a technical two-year Associate or four-year College Degree. A key objective is to identify projects that provide real-world applications, like internships with local engineering firms in partnership with local education agencies.

Improving accessibility to project based learning through real-world technology, like solar panels, engages students and increases earning potential, thereby avoiding expensive negative externalities from post-secondary support services utilized by the under-educated. A study from the University of Minnesota asserts that 80% of participants taking project based Career Technical courses enrolled in college, especially community college, within two years of high school graduation (Lekes, et al., 2007).

Project based lesson plans covering solar projects have been favorably assessed by the Teacher Advisory Board (TAB) within the National Energy Education Project (NEED, 2011). The school district has successfully implemented projects building solar power first-aid suitcases at its Continuation High School site as part of a multi high school after school program. The suitcases are targeted for underdeveloped African regions that do not have an electrical grid, providing refrigeration and light in emergency circumstances (Jensen, 2012). The project is moving extremely fast. In less than six months, fifty students have signed up and are actively participating in the solar suitcase project-based curriculum; high risk students and high achievers are working together for a common cause. Students that do not engage when reading are enthusiastically engaged in a project that teaches the mechanics of wiring a battery to solar panels.

3.3 California Addresses Climate Change

The 2006 Assembly Bill 32 ‘California Global Warming Solutions Act’ mandates that Green House Gas (GHG) producers, which generate over 25 million metric tons of carbon emissions annually, reduce their GHG emissions by 15% by 2020. Based on the district’s kilowatt hour annual consumption, MPUSD generates approximately 4 metric tons of C02 annually (EPA, 2011).

The AB 32 GHG reduction mandate does not apply directly to MPUSD; however carbon reduction equivalents achieved by a solar power system would have value to large GHG producers as a method to offset their own pollution. For example, Chevron is actively partnering with school districts in the state to create their own pool of sustainable projects to offset their oil and refinery carbon-dioxide pollution (Mark Bebawi, 2011).

A component of AB 32 directs the integration of sustainable career paths into secondary career technical education (CTE). AB 32 asserts that within California, sustainable technologies will produce industries approximating thirty-three billion dollars by 2020.

3.4 The Case for Diverting Utility Expenditures to Instruction

The State superintendent for public education, Tom Torlakson identifies solar power as an ideal method to save costs, generate revenue (SRECs) and to provide a learning opportunity for students in his Schools of the Future report from September, 2011 (Torlakson, 2011). AB 32 asserts that access to green jobs provides social equity through upward mobility in society by supporting local students and local businesses with jobs. Improvements in graduation and test scores in CTE curriculums are most pronounced in high-poverty communities when 'work-based learning moved beyond episodic exposure to complex work-related knowledge and skills' (Lekes, et al., 2007). This is a relevant statistic, as over 50% of MPUSD’s student body is designated low-income based on the federal formula for qualifying for the Free and Reduced-Fare Lunch Program (FRLP).

Utility expenses are paid from the same general fund as classroom instruction. All expenses, including teacher salaries and utilities, are paid from a fund tied to the average daily student attendance rate (ADA). ADA monies are tracked in the district's General Fund. Every dollar spent on electricity is a dollar taken out of the classroom that could otherwise be directed toward providing educational services (Abraham, 2011). The Monterey Peninsula Unified School District spends approximately $1 Million annually for electricity. The PG&E tariff is projected to continue to rise 5% annually.

4. STAKEHOLDERS AND INTERESTS

Monterey County has multiple districts and non-profit corporations created to inventory renewable energy projects. The local 'Offset Project' non-profit tracks renewable energy projects on the peninsula for the purpose of creating a 'Monterey Bay Fund' of Renewable Energy Credits (RECs), created using local contractors partnering with local education agencies (Cushman, 2011). The project partners with San Francisco based Center for Resource Solutions (CRS) to verify that power produced by solar projects is Green-E certified. Certified Solar Renewable Energy Credits (SRECs) are power units produced using solar power. The SRECs are purchased by polluting events, industries and even private citizens to offset their pollution or 'carbon-footprint'. The Offset Project partners with local contractors on local solar projects for banking SRECs for resale to large events, like the Big Sur Marathon. Currently in California, the desire to 'offset' pollution is voluntary, except for very large GHG producers covered under AB 32.

A component of AB 32 is the establishment of a Cap and Trade Market in 2014. The market would function like the Chicago commodities market. The government would first issue or sell pollution permits to large GHG producers, who would then trade the permits amongst themselves. A permit would be purchased in lieu of investing in expensive pollution control retrofits. The secondary Cap and Trade market for SRECs is in a state of flux in California, but it is anticipated that the secondary market for offsets will include small renewable energy projects like MPUSD. The district's power units would be brokered like commodity shares through an agency like the Offset Project.

The Association of Monterey Bay Area Governments (AMBAG) is funding an energy watch project, designed to inventory pollution in the county for a comprehensive energy efficiency plan (AMBAG, 2008). The inventory of energy consumption is a basis for the County Supervisor's Environment and Energy Efficiency Committee, chaired by Jane Parker and Simon Salinas. The Committee's mission is to explore the establishment of a county Property Assessed Clean Energy (PACE) General Obligation (GO) bond funded solar power program for Monterey County (CSEEC, 2011). The program is modeled after Berkeley FIRST and the local nonprofit Community Energy Services Corporation (CESC), which provides free project management support for renewable power projects within the Berkeley First PACE Initiative area. The County is also investigating sustainable Community Development Agencies (CDA), like Marin County.

Pacific Gas and Electric (PG&E) is the California Public Utility Commission (PUC) licensed local power provider responsible for maintaining the county power grid. A solar power project that connects with PG&E's grid would need a Memorandum of Understanding (MOU) with PG&E as the local investor-owned utility (IOU).

Two known local solar power project providers included in the paper are Solar Edison and Chevron. Solar Edison has contracted with California State University at Monterey Bay (CSUMB), California Polytechical State University and San Bernardino (CSUSB) to provide photovoltaic power systems through a Power Purchase Agreement (PPA). Sun Edison manages the CSUMB 1.9 megawatt (MW), 4000 solar panel project on 6.3 acres (Lerch, 2012). Chevron leases an 800 MW power system to the Monterey County Office of Education (MCOE), installed on Carports (Boussom, 2011).

A district project would first need to be approved by the California State Department of Education Office of Public School Construction (PSC) and the Division of School Architects (DSA). Depending on the city where the panels are placed, city permits would also be required.

A source of regional information regarding pollution particulates, which affect panel maintenance, can be acquired from the Monterey Bay Unified Air Pollution Control District (MBUAPCD). The Association of Monterey Bay Area Governments (AMBAG) has conducted an inventory of Green House Gas Emissions (GHG), or Carbon Dioxide Equivalents (CO2e) for most of the jurisdictions in the region. These two agencies can provide metrics measuring the positive regional impact of switching to sustainable energy for use in permit requests sent to the PSC and in discussions with local communities.

Career Technical programs targeting solar technician and College Board approved courses should be coordinated with the Hartnell and Monterey Peninsula Community (MPC) colleges and the CSUMB engineering departments. The district Career Technical Education program is part of the Regional Occupational (ROP) Mission Trails Joint Power Agreement (JPA), which includes Hartnell and MPC. State rebates for solar power systems are coordinated through the California Solar Initiative (SCI). Local rebates are applied for directly with PG&E and AMBAG.

5. SOLAR GARDEN POLICY ALTERNATIVES

State public utility policies affect the feasibility of generating the power off-site as opposed to each school site. Accessibility is important in determining ability to integrate the technology into project based curriculum components. The impact to community landscaping and property improvements required to host a solar facility are relevant in the city and regional county permitting process.

5.1 Seaside Campus

Seaside High School consumes approximately one thousand megawatt hours of power per year (1,000,000 kilowatt hours). The NREL maintains a database of average hours of sunlight by geographic location, which is measured as the 'insolation factor'. For Seaside, the average insolation factor is between 1600 to 1800 kilowatt hours of power for 1 kilowatt of photovoltaic energy. One panel is approximately one square meter and produces approximately one kilowatt hour of power per day given Seaside's insolation factor. The efficiency of a panel reaching the ideal insolation factor is affected by multiple variables, including the panel quality, tilt and south-facing direction and weather; cloud cover and rain negatively affect the amount of power a panel produces.

Based on my own home solar power system, a solar panel should be able to produce 240 watts (w) of direct current in our area. A kilowatt equals 1000 watts. Therefore the 500 kilowatt (kW) power system for Seaside High School roughly equates to 2100 solar panels under ideal conditions: [(**1,000,100** kWh**)*.80**/yr.] / (366.5 kWh/m2/yr.) = 2183 (or 500 kW/240 w)(1000)). To calculate other sites, the variables are:

1. Annual power consumption measured in kilowatt hours (kWh) from PG&E bills
2. Percent power consumption to cover. (80%)

Locating a solar array of panels at the high school provides accessibility for integrating the science into instruction. The State superintendent for public education, Tom Torlakson directs school districts to support Career Technical Education (CTE) in a manner that integrates photovoltaic science into the curriculum to promote sustainable behaviors (Torlakson, 2011). Access to solar panels at our High Schools supports the intent of the superintendent's 'Schools of the Future' model.

5.2 Airport Site

The school district owns surplus property on Highway 68 that would be ideal for a solar array. The site originally purchased for a possible high school cannot be developed due to water and other restrictions. The very sunny site is large enough to support a solar garden capable of supplying 2.3 megawatt power array of 10,000 panels. A consideration for the site is proximity to the Airport which creates particulate pollution requiring additional maintenance. Additionally, the site is not adjacent to any current district buildings, which requires tracking the power kilowatt hour units produced and transported through PG&E's power grid against power units consumed on different power meters. Consolidating the district's power production on one site would simplify and thus reduce the installation, maintenance and insurance costs.

5.3 Solar Power Teaching Lab

Access to solar panels provides an academic opportunity for students to observe and learn about power production as part of the district's green pathway Career Technical Education (CTE). Under the current scenario, the district has limited access to the mechanics of photovoltaic science in the classroom. A pilot solar project has attracted 50 students in the after school academy at Central Coast High School. As reported in the Monterey County Herald (Salinas, 2012), solar technology can be used in many different projects, like a first-aid suitcase providing refrigeration, light and energy via small photovoltaic panels for use in rural areas that do not have access to a power grid, like Africa. Central Coast High School is a continuation school serving students behind in credits and thus at risk for dropping out of school. The Green Pathway curriculum provides real-world solutions, empowering the students with a new sense of purpose, while teaching them the science of one of the fastest growing industries in the United States, if not the world. As reported by the teacher leading the project, students who find it difficult to concentrate when reading are jumping at the opportunity to construct the solar suitcases. Project based learning engages students where textbooks do not (Jensen, 2012).

To provide a career pathway, the district may partner with construction firms and the local community college solar technician certification programs. Using a district solar project to connect engineering and construction firms with our students will provide real-world job training opportunities. A component of the solar suitcase project is to teach students how to describe their work in a resume.

6. METHODS OF FINANCING AND GOVERNANCE

The project should provide positive net savings from the current power purchased from PG&E. The system must be sustainable with affordable maintenance and insurance. The power capacity must not exceed current consumption. A power system that feeds excess power back into the PG&E grid would require a 'Net Metering Agreement' with PG&E, which obligates the district to provide account management and 24 x 7 hour electrical mechanical support for customers that are using the extra power, outside of our own district network, which is beyond the scope of this APAR (Lerch, 2012). These four goals provide a foundation for evaluating the different alternatives.

- Reduce power expenditures
- Provide project – based learning opportunities in STEM subjects
- Reduce Green House Gas Emissions
- Generate sustainable revenue.

6.1 Power Purchase Agreement and Leasing

With a Power Purchase Agreement (PPA) the district contracts with a financier who installs a system on district property, providing all maintenance. The district provides use of district property in exchange for a kilowatt hour tariff lower than what PG&E charges. Annual increases are indexed lower than PG&E price increases. The district has the option of receiving ownership of the system at some contracted future date. Locally, CSUMB has implemented a

Power Purchase Agreement with Solar Edison at a fixed kWh price of $.12 with an annual 2% rate increase for twenty years. Warranties for solar photovoltaic systems average twenty years.

The Monterey County Office (MCOE) of Education has contracted with Chevron to lease a solar power system installed on MCOE car ports. The agreement sets annual fixed finance payments, which equate to a kilowatt hour tariff lower than what PG&E charges.

With both a PPA and leasing, the power system is architected, installed and financed by the contracting power provider. Comparisons of the present value of the stream of payments for an 880 kilowatt hour system over 20 years, based on data from CSUMB and MCOE are provided in the Appendix. A system of this size would cover the power consumed at Seaside High School.

The kilowatt hour price savings are attributable to state and federal tax credits, which combined, currently cover approximately forty percent of a project's price. As a public entity, MPUSD cannot claim tax credits, but a private third-party partner would be eligible for tax credits. In addition to the tax credit, as owner of the system, the third-party would own the Solar Renewable Energy Credits, unless the contract specifically states that the district retains the SRECs.

Other than the theoretical opportunity cost from a loss of SRECs, there is almost no risk involved with a PPA or leasing. CSUMB chose to keep their SRECS. MCOE chose to sell their SRECS to Chevron at $30 per SREC. A PPA and Leasing would reduce utility expenses, provide access to project based learning, reduce Green House Gas Emissions and generate revenue through the sale of Solar Renewable Energy Credits.

6.2 Own and Operate

The district has the option to finance and own the power system through the sale of General Obligation (GO) bonds or a Certificate of Participation (COP). A COP is a district loan with interest, paid from the general fund. A GO bond is tied to private property owners within the school district's boundaries. Unlike a COP, financing GO bonds does not impact the district's general fund and therefore does not compete with funding instructional services.

The savings when owning a system are dependent on the 'pay-back-period'; the period in time when the combined initial investment, annual maintenance costs, and debt servicing costs are less than the savings in utility costs, creating annual positive net savings. With the current federal and state rebates, the payback period for privately financed systems averages eight to ten years.

The California Solar Initiative (CSI) legislation provides a utility price rebate for public agencies. The state money reserved for the rebates is allocated on a first-come, first served basis. The current 'Performance Based Initiative' (PBI) rebate is $ .088 per kilowatt hour. To calculate the total amount of the rebate, the $.088 rebate rate is multiplied by the estimated kilowatt hours of electricity that the project will generate for the first five years of the project. In December, 2011, the school district reserved rebates for a 2.3 megawatt solar project with an $80,000 deposit to the CSI program. If the project is not built, the district is at risk of losing the $ 80,000 deposit.

To break-even, a financed solar power system should not cost more than the expected PG&E power expense over the same time period. The appendix provides a twenty year calculation of a financed 880 kilowatt hour system based on and installed watt price of $4 with 5.5% interest. The $4 per watt price is based on discussions with the district's power project consultant, Terraverde Renewable Partners, who charges a fee of $ .40 per installed watt as a 10% system architect fee. The 5.5% interest rate is the rate MPUSD currently pays on its GO bonds.

The investments are compared with the status quo. The current PG&E tariff range is $ .16 to $.19 per kilowatt hour, depending on the school site's total annual consumption. The future value of 80% of the district's stream of electric utility payments over ten years, with a 5% annual price increase equates to $ 800,000 * 1.05 ^10 = $10 Million. The net present value of $10 Million is $ 9,769,246.35. The installed cost should be less than $10 Million to provide a net cost savings in utilities over ten years. After year ten, the system would provide essentially free power plus annual maintenance and insurance costs. The avoided energy costs of a 2.3 megawatt system over 20 years, with an average $ .19 per kilowatt hour PG&E tariff, equals $20 Million, with a net present value of $14 Million (Brown, 2012).

Owning and operating our own solar power garden provides access to revenue through the sale of Solar Renewable Credits, which can finance increased CTE instruction. Solar panel maintenance consists of keeping the panels clean through regular swiping. This task can be performed by integrating this task into the district's maintenance department. District maintenance would provide an easy project-based learning experience for students wishing to learn about solar technician professions.

6.3 Direct Access

In a pilot three year project called 'Direct Access', the California Public Utilities Commission allows ten percent of California's energy market to be supplied by power purchased from providers outside of the state. Purchasing power from outside California from power brokers is risky as the state cannot regulate the power source. Current state policy limits power use from non-state sources to ten percent of California's power demand. Direct Access (DA) differs from a Power Purchase Agreement (PPA) in that DA solar power is not generated on site. Sustainable energy enters the grid elsewhere using wind, biomass, geo-thermal and hydro-electric power plants. A PPA would require more administrative time to contract with a third party financier and a solar engineering company, thus, a DA solution is administratively quickly implemented, but the savings are lower than with a PPA and would not provide the school district with access to project-based photovoltaic learning opportunities. For these reasons, the Direct Access model is not recommended as a school district option.

6.4 Virtual Net Metering

The Public Utilities Commission has chartered PG&E with designing a fee-based model that allows geographically disconnected sites to offset consumption with power produced elsewhere in the local grid. Virtual Net Metering (VNM) allows multiple metered sites to be served at the same service delivery point. The electricity does not flow directly to a site where the power is generated but rather feeds into the grid (PG&E, 2011). This is a significant improvement over current state energy policy, which limits alternative energy production to one megawatt per PG&E meter per school site (Torlakson, 2011, p. 66).

The model was first piloted under the California Solar Initiative (CSI) Multi-family Affordable Solar Housing Program (MASH) as a way to provide the benefits of solar power to low income tenants in an affordable housing complex. One of the challenges of VNM is the cost of 'freewheeling', where power is distributed across the PG&E grid but customers pay nothing for use of the network. The transportation of power is free. The CPUC tasked PG&E to develop a tariff plan for VNM by Q1, 2012, to be followed with project applications up through December, 2015 or until applications equate to 5% of total state power consumption. For MPUSD, the ideal service delivery point would be the Highway 68 surplus property by the Airport.

The VNM systems should not produce more power than the benefiting tenants consume. For MPUSD, the VNM system would be sized at approximately 80% of the district's current use, or 2.3 megawatts, which equates to the sized system CSI rebates reserved by the district in 2011.

7. EVALUATION OF POLICY ALTERNATIVES

7.1 Status Quo

The district's current PG&E utility bill is $1 Million annually. Current efforts to reduce this expense center on conservation and replacing old gas boilers and room steam heating systems, which have inefficient thermostat systems, with new classroom heating, ventilation, air conditioning (HVAC) units, financed with General Obligation (GO) bond funds. The district does not have a policy nor does it have an organized plan in place to implement and track conservation. To achieve savings, the district could invest professional development monies to teach staff and students how to conserve electricity and gas.

Total General Obligation (GO) bond revenue received since passage of the Initiative in 2010 is $35 Million, of which approximately $20 Million has either been used for debt recovery or has been identified for funding ongoing deferred maintenance projects in the district, such as the HVAC (Heating Ventilation Air Conditioning), electrical, ADA (American Disability Act), IT networking, restroom, painting, fencing, windows, doors, flooring, playground and other site upgrades. Of the original $35 Million, $15 Million remains for upcoming projects (Silvestrini, 2012). Most sites in the district are fifty or more years old and have needs for major repair work.

In 2008, a state Fiscal Crisis & Management Assistance Team (FCMAT) conducted an extensive review of the finances in the district. Their report identified expenses that regularly exceed their budgeted amounts. In 2007, the Operations and Maintenance annual encroachment totaled almost $ 3 Million, which is an indication of the need for major facility upgrades and the justification for using GO bond funds for this purpose (FCMAT, 2008). Any GO bond expenditures for solar power would have to compete with annual general operations and maintenance work in the district.

The status quo methodology to reduce electrical expenses through conservation does not necessarily create savings for public agencies, as the tiered pricing charged by PG&E is the opposite of that charged private households. In a private household, the unit price per kilowatt hour of delivered power increases as consumption increases. For public agencies, the lower the consumption, the higher the kilowatt hour unit price. Conservation would therefore actually increase the kilowatt hour price charged by PG&E.

Savings cannot easily be predicted and therefore would be too risky to use for funding teaching positions. There is not a linear relationship between kilowatt hours of power saved and dollars saved. The more kilowatt hours consumed per site, the lower the tariff charged by PG&E per unit. For example, the Seaside High School site consumes one-fifth of all district power, but the expense from PG&E is only one-tenth of the total PG&E electricity bill. Conservation is also voluntary, making it impossible to predict how the amount of electricity expense can be reserved for funding instructional services when forecasting budgets for the upcoming fiscal year.

Reducing electricity consumption under the current tariff structure would not translate into dependable savings allowing for the district to hire staff to support the proposed CTE project-based instructional content defined in this analysis paper. Access to photovoltaic STEM based curriculum would be limited to current district courses and small solar power projects.

The status quo with conservation would not provide revenue for instructional services, although conservation would reduce Green House Gas emissions created by PG&E on a small scale. Although the district does expect considerable reductions in gas consumption through the installation of classroom HVAC units, the HVAC units will not affect electrical consumption, other than to eliminate the need for temporary electrical heaters used where site steam boilers are failing.

Because expense savings via conservation cannot be predicted, would not provide revenue and would have a minimal impact on reducing Green House Gas Emissions, this solution cannot be directly compared to the benefits provided by a solar power project. However, teaching conservation is always beneficial to students and should be a component within the sustainable Green Pathways curriculum.

7.2 Cost Benefit Analysis of Solar Garden Alternatives

Demand for electrical power is very inelastic, but the demand for a solar power system to deliver the electricity is very elastic. Justifications for allocating administrative, teaching, and site resources for a solar power system need to be academically and economically persuasive. The location should facilitate classroom observation of the mechanics and science of a solar power system.

Installed cost depends on the size of the system, therefore space heavily influences affordability; the larger the system, the lower the cost per installed watt. Car Ports are ideal for school site locations, as they are easily mounted and highly accessible. Operational heat is a factor, so panels need to be mounted above ground by at least six inches (Lerch, 2012). Roofs are not favored by first alert personnel as the panels are hot and can hinder accessing structures in an emergency, especially in the case of fire. The structure that supports the panels needs to be architecturally sound. To provide optimal power, the panels should face south. Some systems mechanically track the seasonal earth tilt. However the mechanics may increase the panel installed cost and maintenance of the system, making the benefit of increased power production negligible. A mechanical tracking platform that does not require electricity to operate is manufactured by Zomeworks corporation (Zomeworks, 2012).

With a COP, the initial power system cost and interest are paid with monies from the general fund, which would take money out of the classroom. In contrast, with a GO bond, the community property owners would pay for the power system, including interest and maintenance. This would divert the current general fund energy costs to property owners. General Obligation bond financing for a 2.3 megawatt system, covering eighty percent of the district's electrical demand, would redirect $ 800,000 in the first year of operation towards instruction.

A PPA provides modest financial gain (Torlakson, 2011, p. 65). To facilitate comparing a PPA with owning a system, this paper analyzes an 880,000 kilowatt hour power system at Seaside High School, which consumes 20% of all district power. The 880,000 kilowatt hours equal 80% of the amount of power consumed by the school in 2010. The insolation factor is set at 1760 kilowatt hours per kilowatt. A 500 kilowatt photovoltaic solar power array of panels would therefore provide 880,000 kilowatt hours using the equation: 500 kW * 1760 kWh/kW

Being the largest school site in the district, a SHS power project would provide easy access for students to observe the system as well as acreage for a car-port. Holding all other variables constant, we use excel to compare the impact of the SREC price, interest, maintenance, insurance, consultant fees, and inflation as factors influencing the net present value of savings over 20 years.

Net Present Value = (Total Payments) / (1 + .055)^{20}. $$PV = \frac{FV}{(1+i)^n}$$

PG&E charges a rate per kilowatt hour based on consumption. Contrary to private consumers, a public agency's PG&E kilowatt hour tariff is lower with increased consumption. The more a site consumes, the lower the per unit charge. A solar power system will significantly reduce the number of kilowatt hour units purchased from PG&E and the interval of consumption will switch from the daytime to primarily the evening. These two factors cause the PG&E kWh price supplementing a solar power system to vary significantly. For simplicity, this paper uses the PG&E kilowatt hour costs provided in the MCOE Chevron lease agreement, which averages $.17 per kWh in year one and reaches $.40 per kWh in year twenty. For an 880,000 kilowatt hour system, the cumulative savings for CSUMB over 20 years with a $ .12 per kWh price, annual 2% price increase, equates to $ 1.3 Million in 2012 dollars (net present value). Under the MCOE 880,000 kilowatt hour leased system cumulative savings attributable to the solar power project over twenty years is $ 313,000 in 2012 dollars.

Owning the system includes annual $100,000 installment payments with interest calculated on the principal. The interest is set to the district's GO bond rate of 5.5%. By financing the system, the district is able to take advantage of a California Solar Initiative Performance Based (PBI) rebate. The current PBI rate is $.088 per kilowatt hour for the first five years of operation. Annual maintenance expenses are based on costs provided by MCOE for their Chevron leasing agreement. Referencing a report from the National Renewable Energy Laboratory (NREL), insurance premiums range from .25% to .5% of the total installed system value (Speer, 2010). The net savings of a GO bond financed project would be the equal to the total avoided PG&E avoided electrical expense, minus costs for insurance, maintenance and administration, which is roughly 15,000 annually for the 880,000 kWh project. If the system is financed with a COP (General Fund), there are no net savings over the life of the project. For this reason, this report discourages the use of a COP to finance the project. If the system, maintenance and insurance costs are financed with GO bond funds, the total savings over twenty years in 2012 dollars would be $ 4.7 Million; considerably more than either the PPA or leasing agreements.

For a district-wide solution, a single site will lower maintenance costs, lower installation costs and simplify the permitting process. The large solar garden on the district's surplus property on Highway 68 is the preferred location depending on implementation of a virtual net metering tariff by PG&E for use of their grid.

The district has proposed publicly fielding another Parcel Tax Ballot Initiative to provide funding for classroom instruction. Redirecting $ 800,000 current power expenditures to the classroom by using already approved GO bond funds to finance a district-wide solar power system would be an alternative to the parcel tax and would save the district the expense of another ballot initiative.

7.3 Cost Benefit Analysis of Solar Power Teaching Lab

Making the solar PV system accessible as a learning tool would allow the district to apply for educational grants to develop CTE curriculum around project-based learning where students learn science by completing a hands-on project like Central Coast's solar suitcase donations for developing countries, as reported in the Herald on February 25, 2012. Each suitcase kit costs $1000 (Salinas, 2012).

The solar suitcases are an ideal introduction into learning the mechanics of the larger power system. To reduce the unit cost of the projects, it may be an option to include materials as a component in the request for proposal bidding process (RFP) as exemplified by the educational component in the South San Francisco Unified School District PV contract with Chevron Energy Solutions, included in the Appendix (Education, 2012).

Ideally, the district would partner with local contractors who are willing to help establish student internships, observing first and then participating in a Solar Technician certification program through a community college. Cabrillo Community College in Santa Cruz has modeled a certification course that partners with contractors, based on a photovoltaic power project at Bonnie Doon Elementary School (Rector, 2011).

7.4 Issues and Sensitivity Analyses

The status quo is to provide instructional small-scale project based learning opportunities for students fashioned after the Central Coast Solar Suitcase example. Given the political climate currently on the Central Coast regarding school finance in the state and within the Monterey Peninsula Unified School District, this may be the only alternative. Fielding a large solar project may be interpreted as competing for funds for other facility projects.

Sensitivity needs to be given to competition within the learning communities. Seaside High School has more acreage for a solar garden, but the other High Schools in the district will certainly want the same magnitude of investments made at their sites. City architectural review boards may object to the aesthetics of a large solar farm. In this case, out of site on High Way 68 would be the ideal alternative; however the district would have to contend with property owners in the area.

Over twenty years, owning and financing a district-wide power system using GO bonds would generate by far the most district savings; however there is the risk that property owners surrounding individual sites would object, suggesting that the single large net metering solution best addresses sensitivity issues surrounding neighborhood aesthetics. A single site with a large PV system decreases the installed watt price. Smaller panel systems would suffice at each high school for project learning purposes only.

8. CONCLUSIONS AND RECOMMENDATIONS

If return on investment were the most heavily weighted criteria for choosing a financing model, the General Obligation bond financing model is by far the best investment for a district-wide 2.3 megawatt solution, redirecting over $ 20 Million to instructional services over twenty years.

In accordance with PG&E tariff, net metering regulations and economies to scale, a system providing 80% of the district's consumption using Virtual Net Metering, should govern the size of the power system.

Comparing the CSUMB and Chevron solar models, the CSUMB PPA provides the largest net savings of $ 10 Million over twenty years for a 2.3 megawatt system. If the politics of diverting millions of GO bond monies to solar are considered more costly than the long-term savings then the CSUMB PPA negotiated kilowatt hour price is the suggested alternative.

A hybrid of a PPA with district ownership is presented in the Appendix for the Seaside High School example. The hybrid would finance the system with a PPA through year 5 to take advantage of the federal tax credit. Purchase of the system would be financed through the PPA with annual premium installments with interest. It may be possible to pay the premiums, interest, insurance and maintenance using GO bond funds. The interest rate charged by the PPA financier may also be less than the GO bond rate of 5.5%. The district would own the system in year five.

Without regard to the financing model chosen, the district should retain ownership of the Solar Renewable Energy Credits so that they may be brokered as a revenue stream locally or in the 2014 state Cap and Trade market.

A large solar power project would satisfy all four named criteria for this policy analysis. It would significantly reduce expenditures from the general fund, allowing the district to redirect monies toward classroom instruction. It would generate revenue through the sale of Renewable Energy Credits. Access to the local photovoltaic projects would provide real-world, project-based learning opportunities for the students and partnerships with local contractors for high school internships. A large 2.3 megawatt power system would significantly lower Green House Gas Emissions in the region and be a very positive investment in public relations.

8.1 What to Do Now

Based on the case study analysis preceding this applied analysis, the school district has contracted with a solar 'architect' to perform an energy audit and to design a PV system that provides power, a learning environment and revenue through the sale of Solar Renewable

Energy Credits. On February 21, 2012, the MPUSD school board unanimously approved $80,000 to reserve rebates with the California Solar Initiative (CSI) Performance Based Initiative (PBI) program for a 2.3 Mega Watt PV power system, to cover 80% of the district's power consumption.

My next step is to offer use of this report to assist in evaluating the district Request for Proposal (RFP) process and as a tool to educate the general public about the project.

Further research in the valuation of Renewable Energy Credits is needed with an analysis of legislative initiatives, lobbyists and other stakeholders that are shaping the secondary Carbon Trade Market. Preliminary analysis suggests that prior to 2014 that a SREC price ranges from $ .90 to $50. This compares with other states in the nation with established Cap and Trade markets, where an in-state produced Solar Renewable Credit sells for $300 to $600 annually (Network, 2012). The district is investigating a 2.3 megawatt solar power project, which with an insolation factor of 1760 kWh per kW for this area, would generate approximately 4,000 SRECs annually. Multiplying 4000 by a range of prices for SRECS, this could generate annual revenue from $4000 up to $2.4 Million.

8.2 Related Future Decisions and How to Think About Them

If this project is successful, future efforts would center on educating other local, county and federal public agencies in the community.

Based on policy successes observed in Germany during my Case Study, I would hope to have the opportunity to be able to shape policies that allow small power producers, like private homes, to become net power producers for the grid, generating income for those households that embrace revenue generating opportunities within the green industry, within a small Virtual Net Metering community or a larger Power Community Development Agency Corporation, like that in Marin County, providing twenty-four by seven consumer electrical support (MCCDC, 2012).

Policies governing the upcoming AB 32 Cap and Trade Market remain in flux and will be of great interest. A recent article in the San Jose Mercury News approximates initial permit sales to generate $1 Billion to $3 Billion in state funds in 2012 and 2013 with up to $ 14 Billion by 2015 (Rogers, 2012). As an alternative to purchasing pollution permits in the Cap and Trade state auction, large C02 producers may be allowed to offset their pollution through the purchase of Solar Renewable Energy Credits, as described in this report. The State must also decide how to spend the proceeds from the permit auctions. The news article emphasizes that the monies must be used to finance renewable energy projects within the state, for example subsidies for school district photovoltaic projects.

With broad bi-partisan political support, emphasizing business interests in Cap and Trade Markets, originating with the 1990 Bush Administration as an incentive to reduce emissions from acid rain, the probability of a mature market for the sale of MPUSD's SRECS is very promising.

9. BIBLIOGRAPHY

Abraham, K. (2011). *Bright Spots - Public Schools are Funding Learning Opportunities in Solar Energy.* Monterey: MontereyCountyWeekly.

AMBAG. (2008). *Montery Bay Regional Energy Plan.* Marina: Kammerer & Associates.

Boussom, G. (2011). *What a School District Should Consider When Evaluating a Solar Project.* Salinas: Monterey County Office of Education.

Brown, R. (2012). *Project Qualification Model.* Monterey: Terraverde Renewable Partners.

CSEEC. (2011). *County Alternative and Environment Committee.* Monterey County: Monterey County Board of Supervisors.

Cushman, K. (2011). *Monterey Offset Project.* Monterey.

District, M. P. (2010). *Power Use By Site.* Monterey: PG&E.

Franck, R. E. Ph.D. (2012). *Project Academic Advisor, Naval Postgraduate School,* Graduate School of Business and Public Policy & Department of Systems Engineering, Monterey : NPS.

Education, C. (2012). *Chevron Energy Solutions Services Contract.* San Francisco: South San Francisco Unifified School District.

EPA. (2011). *Green House Gas Equivalencies Calculator.* Washington DC: U.S. Department of Energy.

FCMAT. (2008). *Monterey Peninsula Unified School District Fiscal Review.* Kern County: State Fiscal Crisis and Management Assistance Team.

Jensen, A. (2012). *Solar Powered Suitcases.* Monterey: Monterey Peninsula Unified School District.

Lekes, N., Bragg, D., Loeb, J., Oleksiw, C., Marszalek, J., Brooks-LaRaviere, M., et al. (2007). *Career and Technical Education Pathway Programs, Academic Performance, and the Trasition to College and Career.* Minnesota: National Research Center for Career and Technical Education, University of Minnesota.

Lenardic, D. (2012). *Solar Energy Engineering Terminology.* PVResources: http://www.pvresources.com/Terminology/UnitsandMeasures.aspx.

Lerch, M. (2012). *Associate Director of Facilities Services and Operations .* Seaside: California State University at Monterey Bay.

Mark Bebawi, S. E. (2011). *The True Cost of Chevron: An Alternative Annual Report.* http://truecostofchevron.com/2011-alternative-annual-report.pdf: Crude Accountabilty Global Exchange.

McCaty, T., Sexton, T., Sheffrin, S., & Shelby, S. (2001). *Reallocating Property Tax Revenue According to Needs.* Davis, California: Public Policy Institute of California.

MCCDC. (2012). *Building Sustainable Communities Through Community and Economic Development.* Marin: Marin City Community Development Coproration.

NEED. (2011). *Putting Energy into Education, Schools Going Solar Grades 5 -12.* Manassas, VA: IREC - Interstate Renewable Energy Council, National Energy Education Project.

Network, G. P. (2012). *Green Power Markets.* Washington D.C.: U.S. Department of Energy.

Rector, J. (2011). *Bonny Doon Elementary solar project looks toward March completion.* Santa Cruz: Santa Cruz Sentinal.

Rogers, P. (2012). *California Could See Windfall From Global Warming Law.* San Jose: San Jose Mercury News Monterey County Herald.

Roland-Holst, D. (2010). *Energy Prices & California's Economic Security.* UC Berkeley.

Salinas, C. M. (2012). *Harnessing Energy For World's Poor.* Monterey: Monterey County Herald.

Silvestrini, J. (2012). *Director of Facilities.* Monterey: Monterey Peninsula Unified School District.

Speer, B. &. (2010). *Insuring Solar Photovoltaics:Challenges and Possible Solutions.* Washington D.C.: U.S. Department of Energy.

Torlakson, T. (2011). *Schools of the Future.* Sacramento: State Superintendent of Public Education, California Dept. of Education.

Zomeworks. (2012). *Passive Energy Products.* Albuquerque: http://www.zomeworks.com/.

10. APPENDICES

10.1 Annual Power Consumption by Site

Given the peninsula's latitude (38 degrees north) and weather, under ideal conditions, based on data from the City of Monterey, a solar panel will convert one kilo-Watt (kW) of photovoltaic energy collected by a panel into 1,820 kilo-watt hours of electricity with a 20% panel tilt.

Site	Annual kwh	Invoiced	PG& $/kwh	kw System Size
Bayview	98,677	$17,121	$0.17	54.22
Cabrillo	77,892	$14,272	$0.18	42.80
Colton Middle	215,126	$33,690	$0.16	118.20
Crumpton	176,160	$29,712	$0.17	96.79
Del Monte	103,720	$17,243	$0.17	56.99
Del Rey Woods	130,400	$23,934	$0.18	71.65
District Office	140,454	$24,972	$0.18	77.17
Foothill	172,480	$28,214	$0.16	94.77
Hayes	95,760	$16,716	$0.17	52.62
Highland	182,160	$35,855	$0.20	100.09
Imc	494,920	$74,054	$0.15	271.93
Ism	158,240	$26,302	$0.17	86.95
King	314,640	$48,201	$0.15	172.88
La Mesa	126,404	$21,332	$0.17	69.45
Los Arboles Middle	190,440	$31,626	$0.17	104.64
Marina Children Center	80,400	$13,691	$0.17	44.18
Marina High	195,360	$31,503	$0.16	107.34
Marina Vista	114,720	$20,063	$0.17	63.03
Marshall	187,520	$31,586	$0.17	103.03
Monterey High	584,529	$90,564	$0.15	321.17
Olson	151,080	$26,438	$0.17	83.01
Ord Terrace	147,360	$25,265	$0.17	80.97
Seaside Children Center	141,120	$22,814	$0.16	77.54
Seaside High	1,000,755	$144,485	$0.14	549.87
Seaside Middle	241,760	$38,131	$0.16	132.84
Total	5,522,077	$887,784		

The first column is the school site. The second column is the PG&E billed 2010 electricity consumed units in kilowatt hours. The third column is the charge per kilowatt hour electricity unit based on the PG&E tiered tariff. The fourth column is the size of solar power system for 100% of the site's electricity in kilowatts. The number of solar panels that the fourth column translates to depends on the efficiency of the panel, climate and latitude; measured as the 'Insolation factor', or kWh produced per kW.

10.2 Seaside High School Example

Variable	Factor	Source	
Architect	$.40/watt	Terraverde	
Installed Panel Cost with 30% rebate	$4.00	Terraverde	
Installed Panel Cost without 30% rebate	$5.71	$4/.70	
General Obligation Bond Interest	5.50%	MPUSD	
Installed System Cost	$2,200,000	Includes 30% federal tax credit	
Insolation Factor	1760 kWh/kw	CA Solar Initiative for Seaside	
SREC Price	$30	MCOE - Chevron	
Project Size	500 kw		
Annual Rate of Power Loss	0.50%	MCOE - Chevron	
Performance Based Incentive	$0.088	Senate Bill (SB) 585	
Maintenance Factor	1.00%	MCOE- Chevron	Increases .1% annually
Insurance Factor	.25%	NREL	Increases .1% annually
PG&E Price Index	5%		
Net Present Value Interest rate	3%	Consumer Price Index	

IDENTIFIED SAVINGS FOR PPA, LEASE AND GENERAL OBLIGATION BOND FINANCE MODELS

Year	Solar kWh Production	Avoided PG&E rate	PG&E Savings	*Performance Based Incentive (PBI) GO Bonds only*	SREC Sales
1	880,000	$0.172	$151,360	$77,440	$26,400
2	875,600	$0.180	$157,608	$77,053	$26,268
3	871,200	$0.188	$163,786	$76,666	$26,136
4	866,800	$0.196	$169,893	$76,278	$26,004
5	862,400	$0.205	$176,792	$75,891	$25,872
6	858,000	$0.214	$183,612	$0	$25,740
7	853,600	$0.224	$191,206	$0	$25,608
8	849,200	$0.234	$198,713	$0	$25,476
9	844,800	$0.245	$206,976	$0	$25,344
10	840,400	$0.256	$215,142	$0	$25,212
11	836,000	$0.267	$223,212	$0	$25,080
12	831,600	$0.279	$232,016	$0	$24,948
13	827,200	$0.292	$241,542	$0	$24,816
14	822,800	$0.305	$250,954	$0	$24,684
15	818,400	$0.319	$261,070	$0	$24,552
16	814,000	$0.333	$271,062	$0	$24,420
17	809,600	$0.348	$281,741	$0	$24,288
18	805,200	$0.364	$293,093	$0	$24,156
19	800,800	$0.380	$304,304	$0	$24,024
20	796,400	$0.397	$316,171	$0	$23,892
			$4,490,253	$383,328	$502,920

	Maintenance	Insurance	Annual Costs
1	($8,800)	($2,200)	($11,000)
2	($9,632)	($3,065)	($12,696)
3	($10,454)	($3,920)	($14,375)
4	($11,268)	($4,767)	($16,036)
5	($12,074)	($5,606)	($17,679)
6	($12,870)	($6,435)	($19,305)
7	($13,658)	($7,256)	($20,913)
8	($14,436)	($8,067)	($22,504)
9	($15,206)	($8,870)	($24,077)
10	($15,968)	($9,665)	($25,632)
11	($16,720)	($10,450)	($27,170)
12	($17,464)	($11,227)	($28,690)
13	($18,198)	($11,994)	($30,193)
14	($18,924)	($12,753)	($31,678)
15	($19,642)	($13,504)	($33,145)
16	($20,350)	($14,245)	($34,595)
17	($21,050)	($14,978)	($36,027)
18	($21,740)	($15,701)	($37,442)
19	($22,422)	($16,416)	($38,839)
20	($23,096)	($17,123)	($40,218)
	($323,972)	($198,242)	($522,214)

KWEfficiencyFactor .005 - Annual percent decrease in performance of the panel (MCOE, 2011)

InsuranceFactor = .025% - Premium multiple of total project value (Speer, 2010)

MaintenanceFactor = $.235 / kWh - Annual cost to maintain the system (MCOE, 2011)

Installed Price $ 4/watt - One-time installed price per watt (Terraverde, 2011)

Architect fee $ .40/watt - One-time project architect fee (Terraverde, 2011)

Insolation Factor 1780kWh/kw - An ideal measure of photovoltaic energy potential in Seaside (California Solar Initiative, 2011)

PPA tariff $ .12/kWh - (CSUMB, 2012)

PG&E tariff $.17 /kWh - Price per kilowatt hour (MCOE & MPUSD, 2011)

PG&E factor .05 - Percent increase in the price of a kilowatt hour (MCOE, 2011)

PBIRebateRate: $.088 / kWh - The Performance Based Initiative (PBI) rebate ends after year 5.

[(System Size in kilowatt hours) * (per kilowatt hour price + inflation)] – (maintenance and insurance)

PPA:

Savings = ∑ t [((1 – KWEfficiencyFactor)*KW * InsulationFactor) * [(PG&E tariff -PPA tariff)]*(1+ PG&E factor -PPA factor)]

Costs: The PPA financier absorbs all operating costs including CSUMB administration costs.

PPA factor 2%: Annual percent price increase.

Lease:

Savings = ∑ t [((1-KWEfficiencyFactor)*KW * InsulationFactor) * (PG&E tariff * (1 +PG&E factor))] - (Lease Price * (1 + Lease factor))

Costs = ∑ t Maintenance + Insurance

Own:

Savings = ∑ t[((1-KWEfficiencyFactor) * KW * InsulationFactor) *[(PG&E tariff - PBIRebateRate * (1 + PG&E factor))

Costs = ∑ t Maintenance + Insurance

An alternative to financing the project completely in year one using GO bond funds, would be to contract with a PPA, paying annual principal payments on the installed cost of the project until the system is paid for in year six. Using the 880,000 kilowatt hour example with 5.5% interest the system will be paid down to $0 in year five.

Hybrid PPA and Own Example:

Year	System Payments	Cum. Savings	Net Annual Cost	Purchase Price	Total Net Savings over 20 yrs.
1	$457,043	$45,760	$411,283	$1,742,957	$3,065,030
2	$457,043	$94,093	$362,950	$1,285,914	
3	$440,229	$147,062	$293,166	$845,686	
4	$423,414	$204,618	$218,797	$422,271	
5	$406,600	$267,573	$139,027	$15,671	
6	$389,786	$335,870	$1,425,223		

The cumulative savings over twenty years would be reduced by the sum of the annual system payments paid to the PPA over the duration of the five year contract. $ **4,490,253** - $1,425,233

= $3,065,030. The benefit of this option is that the GO Bond financing would be spread over five years. The district would be able to take advantage of the 30% federal tax credit with the PPA model.

Benefit vs. Risk comparisons: Seaside High School Finance Models:

0..5 benefit level	PPA Hybrid	GE Bond	Conservation	Direct District
Installation Cost	5	1	5	5
Revenue	5	5	0	0
Utility Savings	3.75 (own in yr. 5)	5	1	2
Academics	5	5	1	0
Political Feasibility	5	2	5	1
	23.75	18	12	8

It is useful to scale feasibility for each of the proposed solutions towards reaching optimal outcomes. A rating of zero indicates little probable benefit because of a high risk of failure or because it would not amount to much benefit above the status quo. A rating of 5 indicates strong benefit for the identified evaluation criteria. The PPA Hybrid finance model has the highest overall score because it combines the benefit for the 30% federal tax credit through a PPA as well as the increased savings through owning the system in year five. The GO bond solution risks a negative response from property owners asked to finance the high installation cost of the project.

10.3 Seaside High School Carport Panels

Terraverde Renewable Partners, 2/21/2012

10.4 Monterey County Office of Education 25 Year Lease Agreement with Chevron

Year	Solar Electricity Produced (kWh)(1)	Solar Avoided Electric Rate ($/kWh)(3)	Total Projected Utility Electricity Savings	Solar O&M and M&V Costs(4)	Renewable Energy Credits(5)	Net Solar Project Savings	Operational and Maintenance Savings	Energy Conservation Savings	Lease Payments (6)	Project Net Benefit	Cumulative Net Benefit
	A	C	F = A * C	G	H	I = (F - G) + H	J1	J	K	L= I + J - K	O
1	842,185	$0.172	$144,856		$25,266	$170,121	$2,000	$19,501	$165,512	$26,111	$26,111
2	837,974	$0.180	$150,617	$20,974	$25,139	$154,783	$2,060	$20,379	$149,218	$28,004	$54,114
3	833,784	$0.188	$156,608	$21,708	$25,014	$159,914	$2,122	$21,296	$155,390	$27,941	$82,056
4	829,615	$0.196	$162,837	$22,468	$24,888	$165,258	$2,185	$22,254	$161,816	$27,882	$109,937
5	825,467	$0.205	$169,314	$23,254	$24,764	$170,824	$2,251	$23,255	$168,506	$27,825	$137,762
6	821,340	$0.214	$176,049	$24,068	$24,640	$176,621	$2,319	$24,302	$175,470	$27,771	$165,534
7	817,233	$0.224	$183,051	$7,725	$24,517	$199,843	$2,388	$25,395	$182,720	$44,907	$210,440
8	813,147	$0.234	$190,332	$7,957	$24,394	$206,770	$2,460	$26,538	$180,569	$55,199	$265,639
9	809,081	$0.245	$197,902	$8,195	$24,272	$213,979	$2,534	$27,732	$188,033	$56,212	$321,851
10	805,036	$0.256	$205,774	$8,441	$24,151	$221,484	$2,610	$28,980	$195,805	$57,269	$379,120
11	801,011	$0.267	$213,959	$8,695	$24,030	$229,294	$2,688	$30,284	$203,911	$58,356	$437,476
12	797,005	$0.279	$222,469	$8,955	$23,910	$237,423	$2,768	$31,647	$212,331	$59,508	$496,985
13	793,020	$0.292	$231,317	$9,224	$23,791	$245,884	$2,852	$33,071	$221,093	$60,714	$557,699
14	789,055	$0.305	$240,518	$9,501	$23,672	$254,689	$2,937	$34,560	$230,231	$61,955	$619,654
15	785,110	$0.319	$250,085	$9,786	$23,553	$263,852	$3,025	$36,115	$239,739	$63,253	$682,907
16	781,185	$0.333	$260,032	$10,079	$23,436	$273,388	$3,116	$37,740	$209,664	$104,580	$787,487
17	777,279	$0.348	$270,375	$10,382	$23,318	$283,311	$3,209	$39,438	$218,160	$107,799	$895,286
18	773,392	$0.364	$281,129	$10,693	$23,202	$293,637	$3,306	$41,213	$227,028	$111,128	$1,006,414
19	769,525	$0.380	$292,311	$11,014	$23,086	$304,382	$3,405	$43,068	$236,232	$114,623	$1,121,036
20	765,678	$0.397	$303,937	$11,344	$22,970	$315,563	$3,507	$45,006	$245,808	$118,268	$1,239,304
21	761,849	$0.415	$316,026	$11,685	$22,855	$327,197			$255,780	$71,417	$1,310,721
22	758,040	$0.433	$328,596	$12,035	$22,741	$339,302			$266,148	$73,154	$1,383,875
23	754,250	$0.453	$341,666	$12,396	$22,627	$351,897				$351,897	$1,735,773
24	750,479	$0.473	$355,256	$12,768	$22,514	$365,002				$365,002	$2,100,775
25	746,726	$0.495	$369,386	$13,151	$22,402	$378,637				$378,637	$2,479,412
Total	**19,838,465**		**$6,014,402**		**$445,443**	**$6,303,057**		**$611,774**		**$2,479,412**	

10.5 MPUSD CSI Performance Based Rebate Reservation

$80,000 GO bond funds allocated to reserve CSI rebates for a 2.3 megawatt solar power project.

Monterey Peninsula Unified School District

Meeting: Regular Board Meeting : J. CONFERENCE / DISCUSSION / ACTION AGENDA

Created : March 08, 2012 at 09:21 AM

3. Approve and Authorize the Submission of Solar Rebate Applications Administered by Pacific Gas & Electric (PG&E) Under the California Solar Initiative *(D) (V)*

February 21, 2012
Status: Reviewed by Superintendent
Discussion Item

Recommendation
Authorize submission of solar rebate applications by Pacific Gas & Electric under the California Solar Initiative

Background
In December, 2011, the Monterey Peninsula Unified School District engaged the services of TerraVerde Renewable Partners ("TerraVerde") to develop a plan for implementing an energy management program, including installation of solar electricity generating facilities ("solar projects"). One component of the planning process is development of a preliminary project scope that describes the optimal size and location of potential solar projects across the District ("Optimal Meter Portfolio"). A key factor in this analysis is determining sites that provide both lowest cost of construction and highest savings opportunity (based on the specific site electricity use profile). This information is needed for solar rebate applications administered by Pacific Gas & Electric under the California Solar Initiative. Working with Facilities staff over the past six weeks, TerraVerde has recently completed a first draft of the Optimal Meter Portfolio that shows a potential project size of 2.36 megawatts (MW).

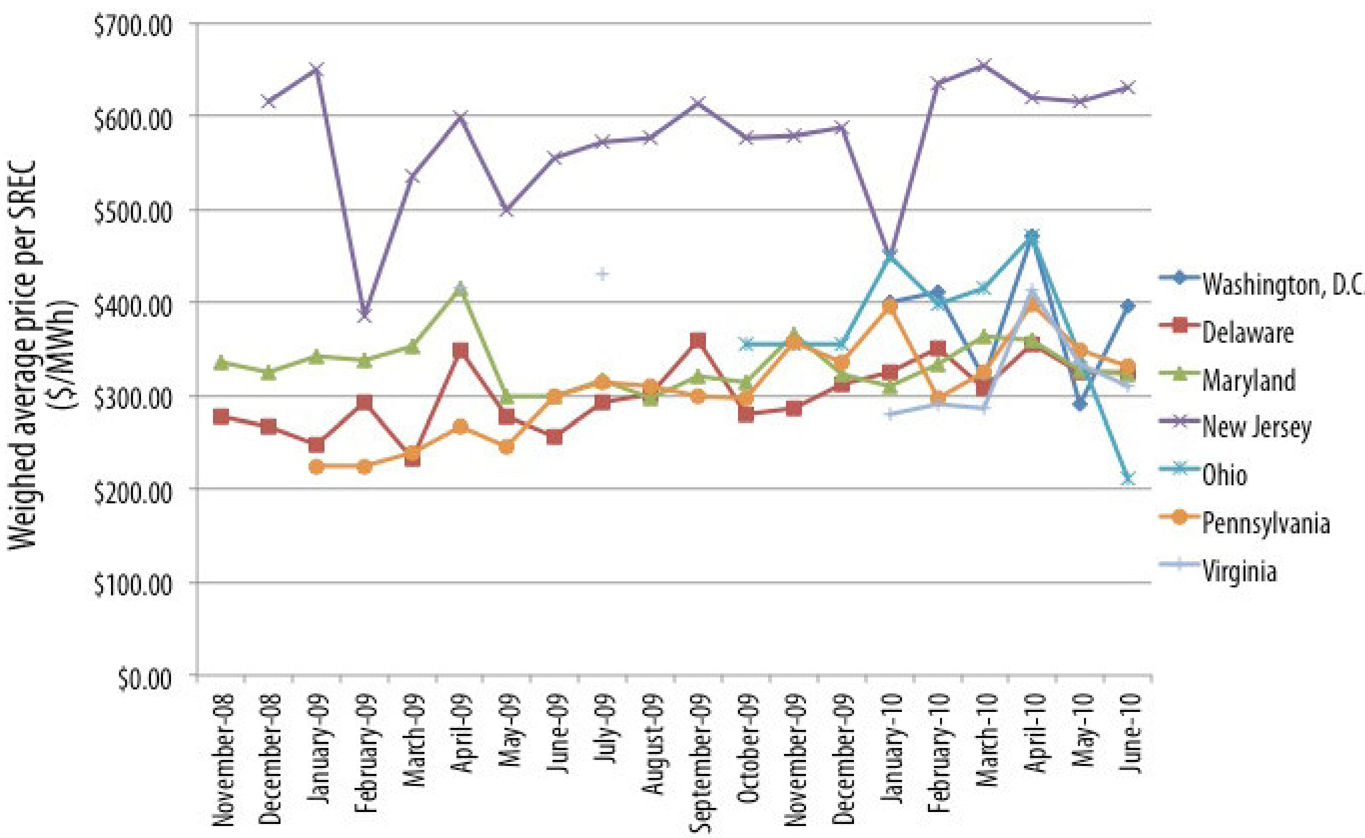
During TerraVerde's presentation to the Board in October, it was reported that due to the recent passage of increased funding for solar rebates (SB 585), demand for solar rebates was accelerating. In fact, applications have come in so quickly since then that the program has reached the final step (Step 10), 8.8 cents/kilowatt hour (kWh). Given the rate at which applications are being received and processed by PG&E, there is a risk that applications that are not submitted within the next 30 days may not receive funding. With the analysis that has been completed by TerraVerde, the District is now in a position to submit its rebate applications. Within approximately 45 days after rebate applications are submitted, rebate application fees must be submitted to secure a "rebate reservation".

Total application fees for a project scoped at 2.36 MW would be $80,000. Application fees are refunded at the time of project completion. In addition, if a project is withdrawn or cancelled after receiving a rebate reservation due to "extenuating circumstances" beyond the applicant's control, the application fee may be returned pending a discussion with and agreement of the Program Administrator (i.e., PG&E). Examples of "extenuating circumstances" could include: inability to secure an installation contract or financing that fulfills project savings requirements or discovery of site conditions that make the project unfeasible.

Fiscal Impact
Not to exceed $80,000. To be funded from General Obligation Bond. No impact to the

10.6 Solar Renewable Energy Credit Prices

Solar Renewable Energy Credits (SRECS) sell at a premium to RECS produced by other sustainable sources, as tracked in the below graph by the Department of Energy. Sixteen states and the District of Columbia have established Cap and Trade Markets. The states with the highest prices restrict offsets to be only in-state solar projects. The demand for SRECs by polluters is heavily impacted by the pollution penalties imposed by the state.



Compliance market SREC weighted average price, November 2008 to June 2010
http://apps3.eere.energy.gov/greenpower/markets/certificates.shtml?page=5

10.7 South San Francisco Unified School District Leasing Agreement with Chevron

This is an insert from the contract between SSSFU and Chevron for a $ 25 Million Solar Power project, a component of which targets project-based educational services centering on solar technology.

Energy Services Contract
South San Francisco USD and Chevron Energy Solutions

Educational Component

Curriculum Development

1. Professional Development Workshops: provide four workshops (up to four hours each workshop) to support topics covered in the Instructional Materials and to introduce activities involving the Solar Energy Kits as well as educational opportunities afforded by online data access.

Instructional Materials

1. Provide up to 60 customized binders covering background information about energy use and production and including standards-aligned activities and math problems related to solar energy.
2. Provide up to 20 per school of the "System At-A-Glance" cards, a quick-reference resource for information about the system installed at each school site.

Solar Energy Kits

1. Provide seven (7) sets of Solar Energy kits, each set containing 10 kits, and each kit containing: Four 3-watt solar panels; one water pump; one handheld digital multi-meter; eleven alligator clip leads; one switch; one compass; one set laminated instructions; one wooden case with panel-mounting lid; two buckets; one clipboard. Kits provide students with the opportunity to set up experiments and measure current and voltage delivered by small-scale solar panels.

Career Outreach

1. Provide up to three student tours of installation sites either during construction or within one month of solar PV construction completion.
2. Provide guest speakers from Chevron and/or their subcontractors for up to three one-hour presentations.

10.8 Monterey County Herald Article, Page 1, 5/18/2012

MPUSD's board president envisions vast solar power system

By CLAUDIA MELÉNDEZ SALINAS Herald Staff Writer Monterey County Herald
Posted:

MontereyHerald.com

The Monterey Peninsula Unified School District spends about $1 million a year in energy consumption.

Board President Debra Gramespacher has a plan that could eventually reduce those costs to zero.

As a final project for her master's degree in public policy, Gramespacher researched the possibility and benefits of installing a "solar garden" at MPUSD. For a cost of $10 million — payable through a bond — the district could be energy self-sufficient in 10 years, she found. As an added incentive, the district could sell Solar Renewable Credits.

"The question is, if we have that size (of solar campus), do we install it on individual school sites or is it possible to create one huge solar array?" she said Thursday as she presented her project at a public forum at CSU Monterey Bay.

Gramespacher, a systems engineer, said she became interested in the topic as a way to pursue her own interests and to benefit the district.

MPUSD officials have already taken several steps toward exploring solar energy. In December, they approved a contract with TerraVerde Renewable Partners to explore the district's solar panel possibilities. At TerraVerde's urging, officials in March approved an $80,000 deposit for rebates on a 2.3-megawatt solar project. This project is equivalent to 10,000 solar panels and would generate enough electricity to satisfy 80 percent of the district's needs.

It would be by far the largest solar power system in Monterey County. CSUMB's solar power generation facility has 3,900 panels and generates 1.9 megawatts. The solar canopy at Monterey County Office of Education, recently completed, generates 630 kilowatts a year and is expected to save MCOE about $2 million over the next 25 years.

The benefits for MPUSD would not only come from saving money, Gramespacher said. The project could generate revenue because the district could sell its solar credits to big polluters to offset their carbon footprint.

And the project would offer students in the district an opportunity to observe closely how solar energy works and inspire them to pursue careers in science, technology, engineering and math, known as STEM, she said.

"It would send a message that we can be good stewards. Solar power saves money and provides additional educational benefits to our students," she said. "STEM in secondary education and college and has to start somewhere, and with limited finances it's only going to happen if we find alternative methods in the classroom."

As part of his "Schools for the Future" campaign, California schools chief Tom Torlakson has been promoting the idea of installing solar campuses at every district so the money used for energy can be used in the classroom.

MPUSD officials are on board with the plan, Gramespacher said, although there are many details still to be worked out.

Trustee Helen Rucker, who attended Gramespacher's presentation Thursday, said she was excited about the plan.

"Any way to save money," she said. "This is the next big thing."

Claudia Meléndez Salinas can be reached at 753-6755 or cmelendez@montereyherald.com.