Solar Master Plan

BERKELEY UNIFIED SCHOOL DISTRICT (BUSD)

Chapter 4

Aerial Assessments of Selected Sites

Aerial Assessments of Selected Sites

Aerial Assessments were prepared for each individual district to allow each to integrate renewable energy systems into its Facilities Master Plan. The aerial assessments provide:

- an inventory of solar appropriate schools and facilities
- total annual electricity consumption and cost for the district
- each individual school's electricity annual consumption and cost
- gross and net space available for PV systems
- the maximum PV capacity for each school and the size of the PV systems that will meet 75% of a school's annual electricity consumption (reducing the school's electricity bill to the minimum)
- PV system cost estimates
- estimated rebates and savings from avoided electricity costs
- greenhouse gas emissions avoided and Renewable Energy Credits (RECs) earned

The above assessments will prepare school districts to seek local General Obligation bonds from their constituencies for financing the installation of renewable energy systems in conjunction with other school construction or modernization work.

In addition, when a district identifies the best locations for solar installations and their energy characteristics, it is prepared to take advantage of funding opportunities that may arise, such as low-interest federal bonds, low-interest state loans, or grants from regional agencies to reduce energy consumption and/or greenhouse gas emissions. As the need for renewable energy increases, other opportunities are sure to emerge. Districts that plan and assess their schools and facilities for renewable energy will be in a good position to take advantage of future funding opportunities.

SunPower Corporation, Richmond CA prepared the aerial assessments in consultation with the individual school districts. KyotoUSA volunteers assembled the electricity consumption and cost information from data provided by PG&E via Energy Star's Portfolio Manager.

The aerial assessment information in this chapter is specific to the school district for which this individual Solar Master Plan was prepared.

Berkeley Unified School District Solar Site Assessments

October 2011

Washington Elementary

BUSD's first solar school!

1. 103 kWp system installed by Eshone Electric in Summer 2008. It is still the largest single PV system in the City of Berkeley.
2. System offsets the cost of the building's electric load which was historically about $25K per year.
3. System avoids approximately 31 tons of CO2 and other toxic air pollutants each year.
4. School has a second meter tied to portable classrooms across the street. In the future, the value of electricity produced that exceeds the value of the electricity consumed, could be applied to the 2nd meter.
5. Panels should be cleaned at least twice a year and inspected annually to maintain maximum production.
6. System production is monitored by Fat Spaniel at http://view2.fatspaniel.net/PV2Web/merge?&view=PV/standard/Simple&eid=146113

SECTION ONE

- Assumptions and Benefits
- Roof Utilization Factors
- System Cost
- Scenario 1: Installing Maximum Capacity
- Scenario 2: Offsetting Electricity Costs Only

Assumptions and Benefits

Assumptions

All information is preliminary and intended to provide BUSD with estimates of PV system sizes, siting possibilities, production values, incentives, avoided electricity costs, and installation costs.

1. Annual electricity consumption and cost were provided by PG&E via Portfolio Manager. Twelve month periods vary slightly – ending in either April or May 2011.
2. Assumed PG&E Electric Rate A6 yielding year 1 solar savings = $0.223.
3. CSI incentive assumed: Tier 8 at $0.15/kWh (Emerson & Rosa Parks); Tier 9 at $0.12/kWh for all others. CSI rebates from PG&E are likely to be exhausted in late 2011/early 2012.
4. **Scenario 1** "Installing Maximum Capacity" Based on aerial assessments done by SunPower Corporation which shows how much solar each site is capable of hosting. Assumes a total cost per Wp = $6.20 for all schools except Berkeley High and Franklin Adult which are estimated at $5.77 per Wp. Pricing is based on using SunPower's 230 high efficiency solar panels and estimated based on industry pricing in February 2011.

Scenario 2 "Offsets Electricity Costs Only" Based on estimated PV system size that would eliminate electricity bill. (PV systems are typically designed to produce 75% of consumption, thus "zeroing out" a building's electricity expense.) Assumes a total cost per Wp = $6.20 for all schools except Berkeley High which is estimated at $5.77 per Wp. Pricing is based on using SunPower's 230 high efficiency solar panels and estimated based on industry pricing in February 2011.

5. Year one electric yield = 1,350 kWh per kWp. (This is a conservative estimate. Newer panels may provide a higher yield, making it possible to increase production values.)
6. Size and location of PV systems may vary significantly after design completion.
7. Although BUSD has locations that would be appropriate for shade/carport structures, BUSD is reluctant to consider these types of systems based on concerns about vandalism and/or theft potential.
8. Electricity costs and consumption are combined for all electric meters at each site and shown as a single total value. Further analysis is needed to evaluate impact of PV system on electric meter(s) where PV system will be connected.

Benefits

If the District installs PV systems as described in Scenario 2 (Offset Only), the following estimated benefits will accrue:

- Annual savings: $408,000
- Annual electricity production: 1,800,000 kWh
- Annual greenhouse gases avoided: 465 metric tons*
- Annual Renewable Energy Credits (RECs) earned: 1,830

*Avoided greenhouse gases were calculated by multiplying the number of kWh produced by the PV system by PG&E's estimated emissions factor for electricity for 2010–2011.

kWh x 0.000254

Roof Utilization Factors

Methodology

To determine how much electricity can be generated from a school rooftop or from a structure in a parking lot, it is necessary to determine how much usable space is available. Solar panel efficiency is affected by shadows cast by surrounding hills, buildings, trees, flagpoles, other obstructions, as well as equipment, conduit, walls, or structures placed on a roof. When a solar project is contemplated, it is important to determine if the roof or parking lot is free of shadow casting obstructions, making it possible to install a renewable energy system that will produce enough electricity to make the project viable. A school district does not have to make this determination on its own. A district can hire its own consultant to evaluate roof and parking lot conditions before soliciting bids for a renewable energy project or it can simply leave that determination to the Design-Build Request for Proposal process described elsewhere in this document.

For our aerial assessments shown here, SunPower Corporation used Google Map images of all district schools and facilities. District officials then reviewed the aerial photos with SunPower staff to determine which schools should be assessed. In some cases, schools were slated for closure, in other cases the schools were being razed and a new facility was planned, and in several cases, the orientation of the roof, its height, or the amount of equipment on it, made it an unlikely candidate for the installation of solar panels.

Once the appropriate schools and facilities were identified, SunPower Corporation used a web tool to outline the most appropriate sites. This tool is able to estimate the amount of square feet available (gross) on a roof or parking lot. Then technicians applied the "roof utilization factors" in the chart at right to estimate how much of the total space could be used (net) for solar panel arrays. Once this calculation was made, it was possible to determine how many panels could be installed and what their estimated output would be.

SunPower Corporation used conservative estimates for the "roof utilization factors" which means that it may be possible to install more PV than is described here. It is also the case that once a physical inspection of a roof or parking area is made, the district may find that there is less space for a PV installation. It is important to keep in mind that these calculations presented here are estimates based on an assessment of aerial imagery. The information included here is intended to be a guide for the district and should be relied on in that context only.

ROOF UTILIZATION FACTORS	
Clear	75%
Minimal	63%
Moderate	50%
Significant	38%

System Cost

The turn-key cost of a PV system is frequently described as the cost per Watt peak or "$/Wp." The primary factors that make up that cost are: equipment, design, permitting, installation, labor costs, commissioning, warranties, guarantees, and maintenance services. Other products may be included in the $/Wp, e.g. educational component, or provided as a separate cost.

Roof mounted systems are generally less expensive than carport or shade structures. The size of the PV project is also a factor in its cost. Generally, the larger the PV system, the lower the $/watt cost. This means that a district should benefit by aggregating its PV projects rather than doing them invididually.

See the chapter on the "Design-Build Contract for Photovoltaic Systems Installation" for a fuller description of the elements that make up the turn-key cost of a PV system.

Note: BUSD has installed a 103 kW PV system at Washington Elementary (2008) and an 83 kW PV system at Emerson Elementary (2011). The installed $/watt was $8.49 and $9.03 respectively.

SYSTEM SIZE	FEBRUARY 2011 COST ($/Wp)
Roof (100-250 kWp)	$6.20
Roof (250-500 kWp)	$5.77
Roof (500-750 kWp)	$5.52
Roof (750-1000 kWp)	$5.22
Carport (100-250 kWp)	$7.78
Carport (250-500 kWp)	$7.08

Please see Appendix D for updated pricing information (October 2011).

Scenarios

These tables summarize the data described in the individual school and facility assessments that follow. Scenario 1 demonstrates the total estimated potential PV capacity for the district. Scenario 2 demonstrates the estimated PV capacity when the PV system is sized to produce 75% of the school's consumption — an amount that brings the school's electricity cost close to $0.

SCENARIO 1 INSTALLING MAXIMUM CAPACITY*	
Estimated Gross Available Area (ft^2)	210,355
Net Available Area (ft^2)	109,268
Potential PV Capacity (kWp)	1,886
Estimated PV Production (Annual kWh)	2,530,650
Estimated Year 1 Savings	$564,335
Estimated Cost	$10,202,500
Estimated CSI Rebate	$1,373,323

**Based on aerial assessments done by SunPower Corporation, which show how much solar each site is capable of hosting.*

SCENARIO 2 OFFSETS ELECTRICITY COSTS ONLY	
Estimated Gross Available Area (ft^2)	210,355
Net Available Area (ft^2)	109,268
Potential PV Capacity (kWp)	1,367
Estimated PV Production (Annual kWh)	1,830,296
Estimated Year 1 Savings	$408,156
Estimated Cost	$7,195,502
Estimated CSI Rebate	$964,010

Scenario 1:
Installing Maximum Capacity

SCHOOL	ESTIMATED PV CAPACITY (FULL SCALE) (kWp)	ESTIMATED PV PRODUCTION (kWh)	ANNUAL USAGE OFFSET BY SOLAR	ESTIMATED COST OF FULL SCALE PV SYSTEM	ESTIMATED CSI REBATE (JUNE 2011)	NET COST
Berkeley Arts Magnet at Whittier	140	189,000	125%	$868,000	$112,272	$755,728
Cragmont	90	121,500	69%	$558,000	$72,175	$485,825
Emerson Elementary	83	112,050	83%	N/A	N/A	N/A
Jefferson Elementary	210	283,500	197%	$1,302,000	$168,408	$1,133,592
Leconte Elementary	210	283,500	158%	$1,302,000	$168,408	$1,133,592
Malcolm X Elementary	100	135,000	58%	$620,000	$80,194	$539,806
Oxford Elementary	100	135,000	101%	$620,000	$80,194	$539,806
Rosa Parks	50	67,500	33%	$310,000	$50,121	$259,879
Washington Elementary	103 kW installed	123,600	~100%	N/A	N/A	N/A
Martin Luther King Middle	50	67,500	8%	$310,000	$40,097	$269,903
Berkeley High	400	540,000	17%	$2,300,000	$320,776	$1,979,224
Franklin Adult School	350	472,500	162%	$2,012,500	$280,679	$1,731,821
Total	**1,886**	**2,530,650**	**36% of load**	**$10,202,500**	**$1,373,323**	**$8,829,177**

Installing Maximum Capacity = estimated PV capacity at each school based on available roof space. Does not include an estimate for potential carport or shade structures.

- *Emerson* system installed in September 2011; *Rosa Parks* is scheduled for early 2012.
- *John Muir, Thousand Oaks, Longfellow, Willard,* and *Berkeley Tech* are not considered to be good candidates for PV at this time due to roof types and/or ease of access. Aerial views of these sites are included in Appendix A.
- Pre-school sites and other district properties were not assessed, however, their energy use has been benchmarked using Portfolio Manager. See Appendix B for listing.

Scenario 2:
Offsetting Electricity Costs Only

SCHOOL	ESTIMATED PV CAPACITY (OFFSET ONLY) (kWp)	ESTIMATED PV PRODUCTION TO MATCH ANNUAL COST (kWh)	ANNUAL USAGE OFFSET BY SOLAR	ESTIMATED COST OF "OFFSET ONLY" PV SYSTEM	ESTIMATED CSI REBATE (JUNE 2011)	NET COST
Berkeley Arts Magnet at Whittier	84	113,418	75%	$520,883	$67,374	$453,509
* Cragmont Elementary	90	121,500	69%	$558,000	$72,175	$485,825
Emerson Elementary	75	100,740	75%	N/A	N/A	N/A
Jefferson Elementary	80	107,828	75%	$495,210	$64,053	$431,157
Leconte Elementary	99	134,220	75%	$616,418	$79,731	$536,687
* Malcolm X Elementary	100	135,000	58%	$620,000	$80,194	$539,806
Oxford Elementary	74	99,840	75%	$458,524	$59,308	$399,216
* Rosa Parks	50	67,500	33%	$310,000	$50,121	$259,879
Washington Elementary	103 kW installed	123,600	100%	N/A	N/A	N/A
* Martin Luther King Middle	50	67,500	8%	$310,000	$40,097	$269,903
* Berkeley High	400	540,000	17%	$2,300,000	$320,776	$1,979,224
Franklin Adult School	162	219,150	75%	$1,006,467	$130,182	$876,285
Total	**1,367**	**1,830,296**	**26% of load**	**$7,195,502**	**$964,010**	**$6,231,491**

Offsetting Electricity Costs Only = estimated PV capacity at each school based on current energy consumption.

* These schools may not have the physical capacity to site a PV system of the size needed to offset the cost of the school's consumption. The chart reflects the PV system sizes for these schools that are consistent with the available space. See "Contextual Data" in the sidebars for the PV system size that would offset the school's current electricity consumption.

• *John Muir, Thousand Oaks, Longfellow, Willard,* and *Berkeley Tech* are not considered to be good candidates for PV at this time due to roof types and/or ease of access. Aerial views of these sites are included in Appendix A.

• Pre-school sites and other district properties were not assessed, however, their energy use has been benchmarked using Portfolio Manager. See Appendix B for listing.

SECTION TWO

- **PV Capacity and Cost Breakdown by Individual School**

Key to Presentation of Data

SOLAR AMERICA SHOWCASE REPORT
Berkeley Unified School District

Berkeley Arts Magnet at Whittier

2015 Virginia Street

Annual Electricity Cost and Consumption
Cost: $26,445
Consumption: 151,224 kWh

Contextual Data
- Roof scheduled for replacement in 2012.
- PV scheduled to be installed in 2012.
- Preliminary roof structural assessment conducted by Interactive Resources (Oct. 2010) concluding that "positively anchored solar (PV) arrays can be supported on the
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Renewable Energy Credits Generated Annually:
113

LOCATION	GROSS AVAILABLE AREA (FT^2)	ESTIMATED PV CAPACITY (kWp)			ESTIMATED SYSTEM COST	CSI REBATE (STEP 9)	ESTIMATED OUTPUT OF PV SYSTEM (kWh)	% USAGE OFFSET BY PV
		ROOFTOP	PARKING	=TOTAL				
Roof A	22,000	140	0	140				
Totals	22,000	140	0	140	$868,000	$112,272	189,000	125%
System size and pricing to meet current electricity demand				84	$520,883	$67,374	113,418	75%

Data for Scenario 1: Installing Maximum Capacity

Data for Scenario 2: Offsetting Electricity Costs Only

Berkeley Arts Magnet at Whittier

2015 Virginia Street

LOCATION	GROSS AVAILABLE AREA (FT^2)	ESTIMATED PV CAPACITY (kWp)			ESTIMATED SYSTEM COST	CSI REBATE (STEP 9)	ESTIMATED OUTPUT OF PV SYSTEM (kWh)	% USAGE OFFSET BY PV
		ROOFTOP	PARKING	=TOTAL				
Roof A	22,000	140	0	140				
Totals	**22,000**	**140**	**0**	**140**	**$868,000**	**$112,272**	**189,000**	**125%**
System size and pricing to meet current electricity demand				**84**	**$520,883**	**$67,374**	**113,418**	**75%**

Annual Electricity Cost and Consumption
Cost: $26,445
Consumption: 151,224 kWh

Contextual Data

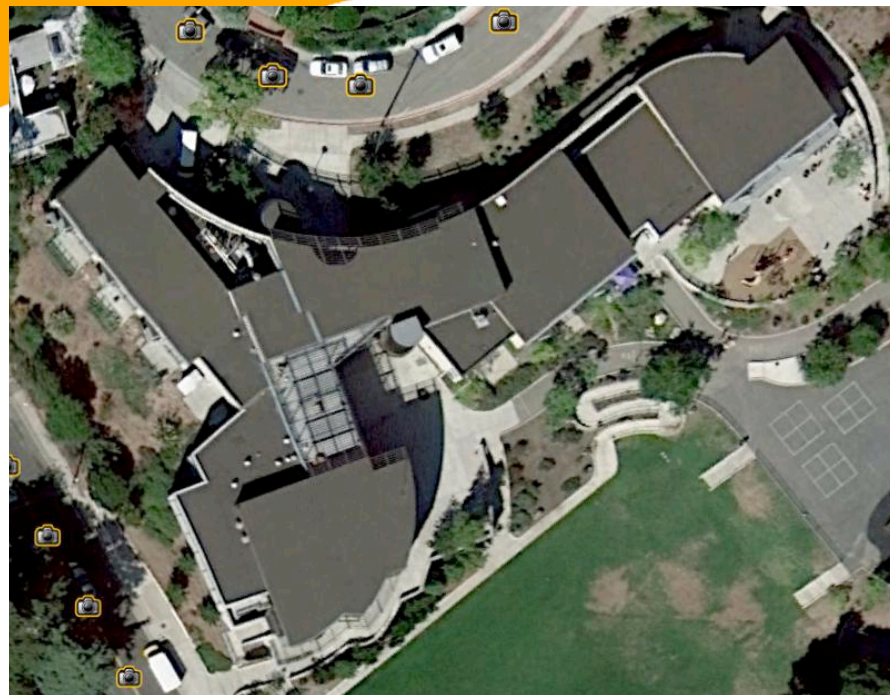
- Roof scheduled for replacement in 2012.
- PV scheduled to be installed in 2012.
- Preliminary roof structural assessment conducted by Interactive Resources (Oct. 2010) concluding that "positively anchored solar (PV) arrays can be supported on the existing structures." Full report included in Solar Master Plan.
- Roof obstructions: **significant**

Greenhouse Gases Avoided Annually:
29 metric tons

Renewable Energy Credits Generated Annually:
113

Cragmont Elementary

830 Regal Road



LOCATION	GROSS AVAILABLE AREA (FT^2)	ESTIMATED PV CAPACITY (kWp)			ESTIMATED SYSTEM COST	CSI REBATE (STEP 9)	ESTIMATED OUTPUT OF PV SYSTEM (kWh)	% USAGE OFFSET BY PV
		ROOFTOP	PARKING	=TOTAL				
Roofs	8,000	90	0	90				
Totals	**8,000**	**90**	**0**	**90**	**$558,000**	**$72,175**	**121,500**	**69%**
System size and pricing to meet current electricity demand				*	*	*	*	*

*Cragmont may not have sufficient roof space for a PV system that will meet current electricity demand.

Annual Electricity Cost and Consumption
Cost: $31,224
Consumption: 176,640 kWh

Contextual Data

- A system size of ~98 kWp would produce 75% of the school's load.
- Appropriate roofs not identified in this assessment. More than two roofs may be available to meet load.
- Roof scheduled for replacement in 2015.
- PV scheduled to be installed in 2015.
- The roof structure has not been analyzed as of the date of this report.
- Roof obstructions: ***minimal***

Greenhouse Gases Avoided Annually:
31 metric tons

Renewable Energy Credits Generated Annually:
122

Emerson Elementary

2800 Forest Avenue

LOCATION	GROSS AVAILABLE AREA (FT^2)	ESTIMATED PV CAPACITY (kWp)			ESTIMATED SYSTEM COST	CSI REBATE (STEP 9)	ESTIMATED OUTPUT OF PV SYSTEM (kWh)	% USAGE OFFSET BY PV
		ROOFTOP	PARKING	=TOTAL				
Roof A	8,500	*	0	*				
Roof B	10,500	83	0	*				
Totals	**19,000**	**83**	**0**	**83**	*	*	**112,050**	**83%**
System size and pricing to meet current electricity demand				*	*	*	*	*

*83 kWp PV system installed on Roofs A and B in September 2011.

Annual Electricity Cost and Consumption
Cost: $23,694
Consumption: 134,320 kWh

Contextual Data

- ~83 kWp PV system will be installed on Roofs A and B in Summer 2011 that will provide 83% of consumption. System production should offset all electricity costs at the school.
- Roofs were replaced in 2010.
- Preliminary roof structural assessment conducted by Interactive Resources (Oct. 2010) concluding that "positively anchored solar (PV) arrays can be supported on the existing structures". Full report included in Solar Master Plan.
- Roof obstructions: ***moderate***

Greenhouse Gases Avoided Annually:
26 metric tons

Renewable Energy Credits Generated Annually:
101

Jefferson Elementary

1400 Ada Street

LOCATION	GROSS AVAILABLE AREA (FT^2)	ESTIMATED PV CAPACITY (kWp)			ESTIMATED SYSTEM COST	CSI REBATE (STEP 9)	ESTIMATED OUTPUT OF PV SYSTEM (kWh)	% USAGE OFFSET BY PV
		ROOFTOP	PARKING	=TOTAL				
Roof A	7,650	80	0	80				
Roof B	6,750	70	0	70				
Roof C	5,400	60	0	60				
Totals	**19,800**	**210**	**0**	**210**	**$1,302,000**	**$168,408**	**283,500**	**197%**
System size and pricing to meet current electricity demand				**80**	**$495,210**	**$64,053**	**107,828**	**75%**

Annual Electricity Cost and Consumption
Cost: $27,560
Consumption: 143,771 kWh

Contextual Data

- Roof scheduled for replacement after 2021.
- Preliminary roof structural assessment conducted by Interactive Resources (Oct. 2010) concluding that "positively anchored solar (PV) arrays can be supported on the existing structures." Full report included in Solar Master Plan.
- Roof obstructions: ***minimal***

Greenhouse Gases Avoided Annually:
27 metric tons

Renewable Energy Credits Generated Annually:
108

LeConte Elementary

2241 Russell Street

LOCATION	GROSS AVAILABLE AREA (FT^2)	ESTIMATED PV CAPACITY (kWp)			ESTIMATED SYSTEM COST	CSI REBATE (STEP 9)	ESTIMATED OUTPUT OF PV SYSTEM (kWh)	% USAGE OFFSET BY PV
		ROOFTOP	PARKING	=TOTAL				
Roof A	11,760	100	0	100				
Roof B	2,700	20	0	20				
Roof C	10,274	90	0	90				
Totals	**24,734**	**210**	**0**	**210**	**$1,302,000**	**$168,408**	**283,500**	**158%**
System size and pricing to meet current electricity demand				**99**	**$616,418**	**$79,731**	**134,220**	**75%**

Annual Electricity Cost and Consumption
Cost: $32,088
Consumption: 178,960 kWh

Contextual Data

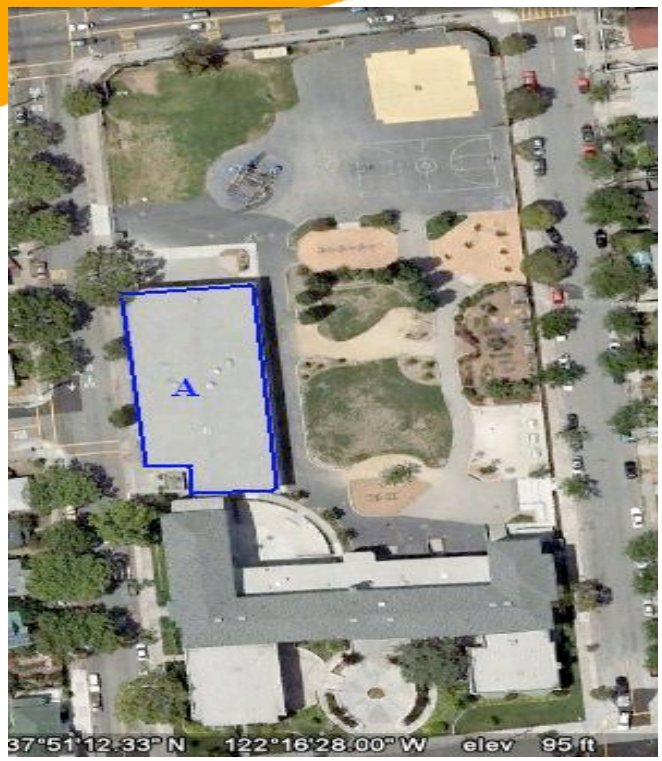
- Roof scheduled for replacement in 2020.
- No current plans to install PV.
- Preliminary roof structural assessment conducted by Interactive Resources (Oct. 2010) concluding that "positively anchored solar (PV) arrays can be supported on the existing structures". Full report included in Solar Master Plan.
- Roof obstructions: ***moderate***
- Condition of trees south of building A & C?

Greenhouse Gases Avoided Annually:
34 metric tons

Renewable Energy Credits Generated Annually:
134

Malcolm X Elementary

1731 Prince Street



LOCATION	GROSS AVAILABLE AREA (FT^2)	ESTIMATED PV CAPACITY (kWp)			ESTIMATED SYSTEM COST	CSI REBATE (STEP 9)	ESTIMATED OUTPUT OF PV SYSTEM (kWh)	% USAGE OFFSET BY PV
		ROOFTOP	PARKING	=TOTAL				
Roof A	11,840	100	0	100				
Totals	**11,840**	**100**	**0**	**100**	**$620,000**	**$80,194**	**135,000**	**58%**
System size and pricing to meet current electricity demand				*	*	*	*	*

*Estimated PV capacity is not enough to offset current electricity consumption

Annual Electricity Cost and Consumption
Cost: $37,270
Consumption: 234,080 kWh

Contextual Data

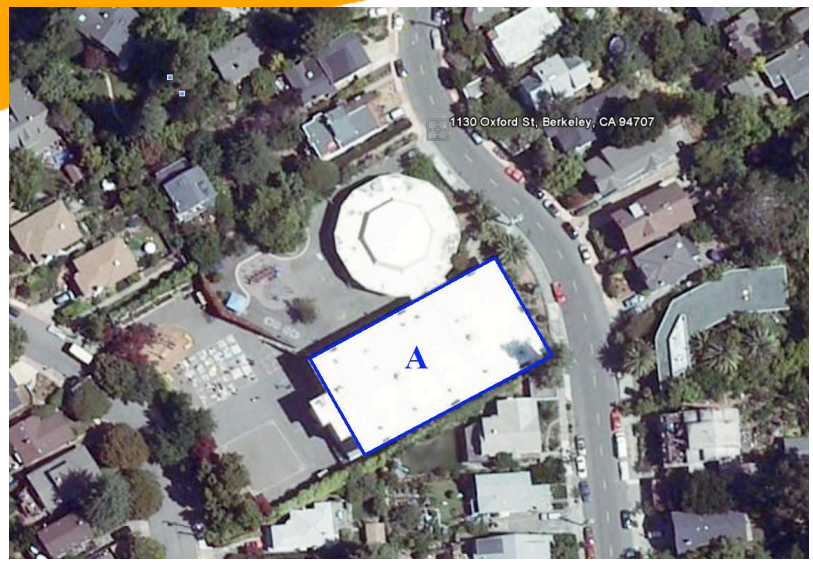
- A system size of ~130 kWp would produce 75% of the school's load.
- Roof A scheduled for replacement in 2012.
- PV scheduled to be installed in 2012.
- Are there roof structural concerns?
- Roof obstructions: ***moderate***

Greenhouse Gases Avoided Annually:
34 metric tons

Renewable Energy Credits Generated Annually:
135

Oxford Elementary

1130 Oxford Street



LOCATION	GROSS AVAILABLE AREA (FT^2)	ESTIMATED PV CAPACITY (kWp)			ESTIMATED SYSTEM COST	CSI REBATE (STEP 9)	ESTIMATED OUTPUT OF PV SYSTEM (kWh)	% USAGE OFFSET BY PV
		ROOFTOP	PARKING	=TOTAL				
Roof A	12,000	100	0	100				
Totals	**12,000**	**100**	**0**	**100**	**$620,000**	**$80,194**	**135,000**	**101%**
System size and pricing to meet current electricity demand				**74**	**$458,524**	**$59,308**	**99,840**	**75%**

Annual Electricity Cost and Consumption
Cost: $24,104
Consumption: 133,120 kWh

Contextual Data

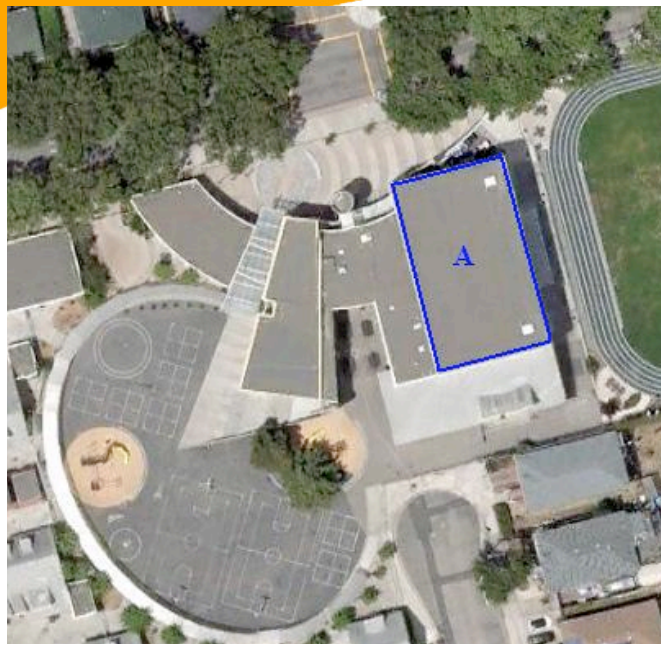
- Roof A scheduled for replacement in 2019.
- PV scheduled to be installed in 2019.
- Preliminary roof structural assessment conducted by Interactive Resources (Oct. 2010) concluding: "positively anchored solar (PV) arrays can be supported on the existing structures." Full report included in Solar Master Plan.
- Roof obstructions: ***moderate***
- It would be beneficial to consider modifying tree (remove and/or trim) to southeast of building

Greenhouse Gases Avoided Annually:
25 metric tons

Renewable Energy Credits Generated Annually:
100

Rosa Parks Environmental Science Magnet

920 Allston Way



LOCATION	GROSS AVAILABLE AREA (FT^2)	ESTIMATED PV CAPACITY (kWp)			ESTIMATED SYSTEM COST	CSI REBATE (STEP 9)	ESTIMATED OUTPUT OF PV SYSTEM (kWh)	% USAGE OFFSET BY PV
		ROOFTOP	PARKING	=TOTAL				
Roof A	5,400	50	0	50				
Totals	**5,400**	**50**	**0**	**50**	**$310,000**	**$50,121**	**67,500**	**33%**
System size and pricing to meet current electricity demand				*	*	*	*	*

*Estimated PV capacity is not enough to offset current electricity consumption

Annual Electricity Cost and Consumption
Cost: $31,808
Consumption: 203,040 kWh

Contextual Data

- A system size of ~113 kWp would produce 75% of the school's load.
- 50 kWp system slated to be installed on Roof A in Fall 2011/Winter 2012.
- District has applied for CSI rebate at Step 8 ($0.15 per kWh). CSI application is currently on waiting list pending approval of SB 585 (Kehoe).
- Roof obstructions: ***moderate***

Greenhouse Gases Avoided Annually:
17 metric tons

Renewable Energy Credits Generated Annually:
68

Martin Luther King, Jr. Middle School

1781 Rose Street

LOCATION	GROSS AVAILABLE AREA (FT^2)	ESTIMATED PV CAPACITY (kWp)			ESTIMATED SYSTEM COST	CSI REBATE (STEP 9)	ESTIMATED OUTPUT OF PV SYSTEM (kWh)	% USAGE OFFSET BY PV
		ROOFTOP	PARKING	=TOTAL				
Roof A	7,500	50	0	50				
Totals	**7,500**	**50**	**0**	**50**	**$310,000**	**40,097**	**67,500**	**8%**
System size and pricing to meet current electricity demand				*	*	*	*	*

*Estimated PV capacity is not enough to offset current electricity consumption

Annual Electricity Cost and Consumption
Cost: $133,066
Consumption: 852,278 kWh

Contextual Data

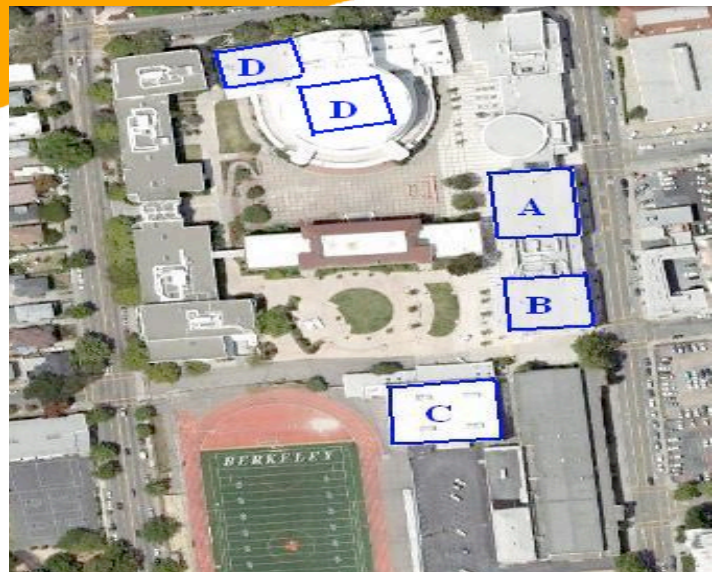
- A system size of ~473 kWp would produce 75% of the school's load.
- Roofs (Media and Gym) scheduled to be replaced in 2011.
- No current plans to install PV.
- Are there roof structural concerns?
- Are any areas appropriate for ground mounted PV shade structures?
- Roof obstructions: ***significant***

Greenhouse Gases Avoided Annually:
17 metric tons

Renewable Energy Credits Generated Annually:
68

Berkeley High School

1980 Allston Way



LOCATION	GROSS AVAILABLE AREA (FT^2)	ESTIMATED PV CAPACITY (kWp)			ESTIMATED SYSTEM COST	CSI REBATE (STEP 9)	ESTIMATED OUTPUT OF PV SYSTEM (kWh)	% USAGE OFFSET BY PV
		ROOFTOP	PARKING	=TOTAL				
Roof A	10,800	90	0	90				
Roof B	8,100	70	0	70				
Roof C	13,200	110	0	110				
Roof D	15,185	130	0	130				
Totals	**47,285**	**400**	**0**	**400**	**$2,300,000**	**$320,776**	**540,000**	**17%**
System size and pricing to meet current electricity demand				*	*	*	*	*

*Estimated PV capacity is not enough to offset current electricity consumption.

Annual Electricity Cost and Consumption
Cost: $452,132
Consumption: 3,102,728 kWh

Contextual Data

- A system size of ~1,724 kWp would produce 75% of the school's load.
- What is age & condition of roofs?
- Roofs will be replaced in stages starting in 2011.
- PV for Roof C (Donahue): 2015
- PV for Roof D (Community Theatre): 2019
- Roof obstructions: ***moderate***
- Could PV be installed on any of the rooftops on the buildings on the west side of the campus?
- Is there a parking area or other open space that could support a ground mounted PV system?

Greenhouse Gases Avoided Annually:
137 metric tons

Renewable Energy Credits Generated Annually:
540

Franklin Adult School

1701 San Pablo Avenue

LOCATION	GROSS AVAILABLE AREA (FT^2)	ESTIMATED PV CAPACITY (kWp)			ESTIMATED SYSTEM COST	CSI REBATE (STEP 9)	ESTIMATED OUTPUT OF PV SYSTEM (kWh)	% USAGE OFFSET BY PV
		ROOFTOP	PARKING	=TOTAL				
Roof A	6,688	70	0	70				
Roof B	7,260	80	0	80				
Roof C	8,672	90	0	90				
Roof D	10,176	110	0	110				
Totals	**32,796**	**350**	**0**	**350**	**$2,012,500**	**$280,679**	**472,500**	**162%**
System size and pricing to meet current electricity demand				**162**	**$1,006,467**	**$130,182**	**219,150**	**75%**

Annual Electricity Cost and Consumption
Cost: $46,029
Consumption: 292,200 kWh

Contextual Data

- Roof scheduled for replacement in 2020-21
- PV scheduled to be installed in 2020-21
- Parking lots offer significant opportunity for ground mounted PV structures.
- Roof obstructions: **minimal**

Greenhouse Gases Avoided Annually:
56 metric tons

Renewable Energy Credits Generated Annually:
219

APPENDICES

- Appendix A—Schools Not Assessed
- Appendix B—Other Facilities Not Assessed
- Appendix C—Annual Cost and Consumption
- Appendix D—System Cost, October 2011

APPENDIX A

Schools Not Assessed

These schools were not assessed for one or more of the following reasons: roof orientation, ease of access, roof type, presence of obstructions and shading.

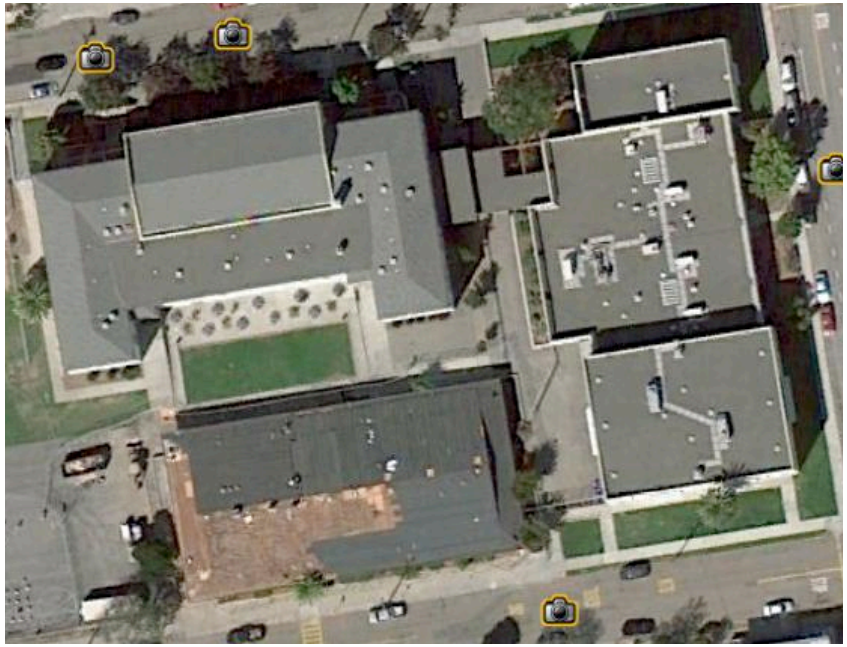
John Muir Elementary

Thousand Oaks Elementary

APPENDIX A *continued*

Schools Not Assessed

These schools were not assessed for one or more of the following reasons: roof orientation, ease of access, roof type, presence of obstructions and shading.



Longfellow Elementary

Willard Middle School

APPENDIX A *continued*
Schools Not Assessed

This school was not assessed for one or more of the following reasons: roof orientation, ease of access, roof type, presence of obstructions and shading.

Berkeley Tech Academy

APPENDIX B

Other Facilities Not Assessed

The following other BUSD facilities were not assessed for PV:

1. BUSD Administrative Office – 2134 Martin Luther King, Jr. Way
2. Old Adult School – 1222 University Avenue
3. Maintenance Building – 1707 Russell Street
4. Bus Depot – 1325 Sixth Street
5. Franklin Preschool – 1460 Eighth Street
6. Hopkins Early Childhood – 1810 Hopkins Street
7. King Child Development Center – 1939 Ward Street
8. Hillside School – 1581 Leroy Avenue

The energy consumption and cost for these facilities have been benchmarked using Energy Star's Portfolio Manager.

APPENDIX C

Annual Cost and Consumption: Electricity

BUSD FACILITY	ANNUAL kWh	ANNUAL COST	% OF TOTAL kWh	% OF TOTAL $
B- Tech Academy	150,240	$25,332	1.9%	2.0%
Berkeley Adult School	292,200	$46,029	3.7%	3.7%
Berkeley HS	3,102,728	$452,132	39.2%	36.2%
BUSD Admin Offices	216,562	$36,479	2.7%	2.9%
Cragmont	176,640	$31,224	2.2%	2.5%
Emerson	134,320	$23,694	1.7%	1.9%
Franklin PreSchool	78,080	$15,675	1.0%	1.3%
Hillside	24,720	$4,994	0.3%	0.4%
Hopkins Childcare	52,520	$9,792	0.7%	0.8%
Jefferson	143,771	$27,560	1.8%	2.2%
John Muir	163,760	$28,085	2.1%	2.2%
King Child Dev Ctr	69,760	$11,806	0.9%	0.9%
King Jr High	852,278	$133,066	10.8%	10.7%
LeConte	178,960	$32,088	2.3%	2.6%
Longfellow	308,387	$51,981	3.9%	4.2%
Maint Yard	206,240	$33,364	2.6%	2.7%
Malcolm X	234,080	$37,270	3.0%	3.0%
Old Adult School	195,787	$34,044	2.5%	2.7%
Oxford	133,120	$24,104	1.7%	1.9%
Rosa Parks Elementary	203,040	$31,808	2.6%	2.5%
Thousand Oaks	230,560	$35,471	2.9%	2.8%
Transportation Facility	95,040	$16,295	1.2%	1.3%
Washington Elementary	68,160	$7,406	0.9%	0.6%
Whittier / Arts Magnet	151,224	$26,445	1.9%	2.1%
Willard	450,920	$73,023	5.7%	5.8%
Total all BUSD facilities	**7,913,097**	**$1,249,166**	**100%**	**100%**

APPENDIX D

System Cost, October 2011

SunPower Corporation provided updated pricing information just before publication of this document. The last column in the table reflects a 3% to 5% decrease in the pricing since February 2011. This decrease is not reflected in the estimated pricing shown in other sections of this document. All estimated costs are based on February 2011 pricing.

SunPower Corporation's pricing is fairly conservative and reflects the higher end of current industry costs. The cost of the systems are driven by a variety of factors including mounting type, system size, location of the tie-in respect to the array, number of arrays, etc. In the case of urban school districts, it may be the case that a relatively small PV system is spread across a number of roofs and/or parking lots, which might require several points of interconnection or long DC/AC trenching that can elevate the cost.

These prices are meant to provide the district with an indication of what a quality PV system will cost. Actual pricing could be higher or lower depending on the complexity of the installation and the equipment used. Best pricing and best system value will be achieved by using a publicly bid design-build process.

SYSTEM SIZE	PREVIOUS COST ($/Wp)	FEBRUARY 2011 COST ($/Wp)	OCTOBER 2011 COST ($/Wp)
Roof (100-250 kWp)	$6.75	$6.20	$6.00
Roof (250-500 kWp)	$6.42	$5.77	$5.60
Roof (500-750 kWp)	$6.08	$5.52	$5.35
Roof (750-1000 kWp)	$5.75	$5.22	$5.00
Carport (100-250 kWp)	N/A	$7.78	$7.45
Carport (250-500 kWp)	N/A	$7.08	$6.75