LEVEL II ENERGY AUDIT

SACRAMENTO CITY UNIFIED SCHOOL DISTRICT
5735 47th Avenue
Sacramento, California 95824

DLR GROUP
1050 20th Street, Suite 250
Sacramento, California 95927

ZERO NET ENERGY ASHRAE LEVEL II AUDIT

HOLLYWOOD PARK ELEMENTARY SCHOOL

4915 Harte Way

Sacramento, California 95822

PREPARED BY:
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Program Manager
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EMG PROJECT #:

136988.19R000-026.268

DATE OF REPORT:

November 19, 2019

ONSITE DATE:

August 19, 2019

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CERTIFICATION

EMG has completed an Energy Audit of Hollywood Park Elementary School located at 4915 Harte Way in Sacramento, California 95822. EMG visited the site on August 19, 2019.

The assessment was performed at the Client's request using methods and procedures consistent with ASHRAE Level II Energy Audit and using methods and procedures as outlined in EMG's Proposal.

This report has been prepared for and is exclusively for the use and benefit of the Client identified on the cover page of this report. The purpose for which this report shall be used shall be limited to the use as stated in the contract between the client and EMG.

This report, or any of the information contained therein, is not for the use or benefit of, nor may it be relied upon by any other person or entity, for any purpose without the advance written consent of EMG. Any reuse or distribution without such consent shall be at the client's or recipient's sole risk, without liability to EMG.

Estimated installation costs are based on EMG's experience on similar projects and industry standard cost estimating tools including *RS Means and Whitestone CostLab*. In developing the installed costs, EMG also considered the area correction factors for labor rates for Sacramento, California 95822. Since actual installed costs may vary widely for particular installation based on labor & material rates at time of installation, EMG does not guarantee installed cost estimates and shall in no event be liable should actual installed costs vary from the estimated costs herein. We strongly encourage the owner to confirm these cost estimates independently. EMG does not guarantee the costs savings estimated in this report. EMG shall in no event be liable should the actual energy savings vary from the savings estimated herein.

EMG certifies that EMG has no undisclosed interest in the subject property and that EMG's employment and compensation are not contingent upon the findings or estimated costs to remedy any deficiencies due to deferred maintenance and any noted component or system replacements.

Any questions regarding this report should be directed to Kaustubh Anil Chabukswar at 800.733.0660, ext. 7512.

Prepared by: Noah Strafford
Energy Auditor
Project Manager

Reviewed by:

Aren Hofland

Technical Report Reviewer for

Kaustubh Anil Chabukswar, CEM CRM
Program Manager

1. Executive Summary

The purpose of this Energy Audit is to provide Sacramento City Unified School District and Hollywood Park Elementary School with a baseline of energy usage and the relative energy efficiency of the facility and specific recommendations for Energy Conservation Measures. Information obtained from these analyses may be used to support a future application to an Energy Conservation Program, Federal & Utility grants towards energy conservation, support performance contracting, justify a municipal bond funded improvement program, or as a basis for replacement of equipment or systems.

Bldg #	Structures Assessed	Building Type	EMG Calculated Area (SF)	Estimated Occupancy
1	Bldg. 001	School Building	4,628	75
2	Bldg. 002	School Building	4,870	75
3	Bldg. 003	School Building	5,591	90
4	Bldg. 004	School Building	5,607	90
5	P01	Portable School Building	1,920	30
6	P02	Portable School Building	960	15
7	P03	Portable School Building	960	15
8	P04	Portable School Building	1,920	30

The study included a review of the building's construction features, historical energy and water consumption and costs, review of the building envelope, HVAC equipment, heat distribution systems, lighting, and the building's operational and maintenance practices.

1.1. Energy Conservation Measures

EMG has identified eight Energy Conservation Measures (ECMs) for this property. The savings for each measure is calculated using standard engineering methods followed in the industry, and detailed calculations for ECM are provided in Appendix E for reference. A 10% discount in energy savings was applied to account for the interactive effects amongst the ECMs. In addition to the consideration of the interactive effects, EMG has applied a 15% contingency to the implementation costs to account for potential cost overruns during the implementation of the ECMs.

The following table summarizes the recommended ECMs in terms of description, investment cost, energy consumption reduction, and cost savings.

Summary of Financial Information for Recommended Non-Renewable Energy Conservation Measures

ITEM	ESTIMATE
Net Initial ECM Investment *(Current Dollars Only)*	$107,253 *(In Current Dollars)*
Estimated Annual Cost Savings *(Current Dollars Only)*	$14,896 *(In Current Dollars)*
ECM Effective Payback	7.20 years
Estimated Annual Energy Savings	30.56%
Estimated Annual Energy Utility Cost Savings *(Excluding Water)*	27.45%
Estimated Annual Water Cost Saving	39.13%

Solar Photovoltaic (PV) Screening for HOLLYWOOD PARK ELEMENTARY SCHOOL

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS		
Estimated Number of Panels	430	
Estimated KW Rating	135	KW
Potential Annual kWh Produced	207,913	kWh
% of Current Electricity Uses	96.3%	
FINANCIAL SUMMARY		
Investment Cost	$473,900	
Estimated Energy Cost Savings	$34,160	
Payback without Incentives	13.9	Years
Incentive Payback but without SRECs	8.4	Years
Payback with All Incentives	8.4	Years

Key Metrics to Benchmark the Subject Property's Energy Usage Profile

- Building Site Energy Use Intensity - The sum of the total site energy use in thousands of Btu per unit of gross building area. Site energy accounts for all energy consumed at the building location only not the energy consumed during generation and transmission of the energy to the site.
- Building Source Energy Use Intensity – The sum of the total source energy use in thousands of Btu per unit of gross building area. Source energy is the energy consumed during generation and transmission in supplying the energy to your site.
- Building Cost Intensity - This metric is the sum of all energy use costs in dollars per unit of gross building area.
- Greenhouse Gas Emissions - Although there are numerous gases that are classified as contributors to the total for Greenhouse Emissions, the scope of this energy audit focuses on carbon dioxide (CO_2). Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement).

SITE ENERGY USE INTENSITY (EUI)	RATING
Current Site Energy Use Intensity (EUI)	40 $kBtu/ft^2$
Post ECM Site Energy Use Intensity (EUI)	28 $kBtu/ft^2$
SOURCE ENERGY USE INTENSITY (EUI)	RATING
Current Source Energy Use Intensity (EUI)	106 $kBtu/ft^2$
Post ECM Source Energy Use Intensity (EUI)	76 $kBtu/ft^2$
BUILDING COST INTENSITY (BCI)	RATING
Current Building Cost Intensity	$1.50/ft^2$
Post ECM Building Cost Intensity	$1.09/ft^2$

Summary of the Greenhouse Gas Reductions from Recommended Non-Renewable Energy Conservation Measures

The following table provides a summary of the projected Greenhouse Gas Emissions reductions as a result of the recommended Energy Conservation Measures:

GREENHOUSE GAS EMISSIONS REDUCTION	
Estimated Annual Thermal Energy Reduction	324 MMbtu
Total CO_2 Emissions Reduced	25.36 $MtCO_2$/Yr
Total Cars Off the Road (Equivalent)*	5
Total Acres of Pine Trees Planted (Equivalent)*	6

**Equivalent reductions per DOE emissions calculation algorithms*

Zero Net Energy Analysis for Renewable and Non-Renewable Recommended Measures

ZERO NET ENERGY ANALYSIS	
Building Annual Net Energy Consumption	1,058,625 kBtu
Total Annual Energy Savings for Non-Renewable Energy Measures	323,533 kBtu
Total Annual Energy Savings from Renewable Energy Measures	709,399 kBtu
Total Annual Energy Savings	1,032,932 kBtu
Net Energy Consumption from Grid Post Implementation	25,700 kBtu
% Energy Reduction (Annual Energy-Net Energy) / (Annual Energy)	98%

Energy Conservation Measures Screening:

EMG screens ECMs using two financial methodologies. ECMs which are considered financially viable must meet both criteria.

1. Simple Payback Period –The number of years required for the cumulative value of energy or water cost savings less future non-fuel or non-water costs to equal the investment costs of the building energy or water system, without consideration of discount rates. ECMs with a payback period greater than the Expected Useful Life (EUL) of the project are not typically recommended, as the cost of the project will not be recovered during the lifespan of the equipment. These ECMs are recommended for implementation during future system replacement. At that time, replacement may be evaluated based on the premium cost of installing energy efficient equipment.

$$Simple\ Payback = \frac{Initial\ Cost}{Annual\ Savings}$$

2. Savings-to-Investment Ratio (SIR) – The savings-to-investment ratio is the ratio of the present value savings to the present value costs of an energy or water conservation measure. The numerator of the ratio is the present value over the estimated useful life (EUL) of net savings in energy or water and non-fuel or non-water operation and maintenance costs attributable to the proposed energy or water conservation measure. The denominator of the ratio is the present value of the net increase in investment and replacement costs less salvage value attributable to the proposed energy or water conservation measure. It is recommended that energy efficiency recommendations should be based on a calculated SIR, with larger SIRs receiving a higher priority. A project is typically only recommended if SIR is greater than or equal to 1.0, unless other factors outweigh the financial benefit.

$$SIR = \frac{Present\ Value\ (Annual\ Savings, i\%, EUL)}{Initial\ Cost}$$

List of Recommended Energy Conservation Measures For Hollywood Park Elementary School

ECM #	Description of ECM	Projected Initial Investment	Estimated Annual Energy Savings					Estimated Annual Water Savings	Estimated Cost Savings	Estimated Annual O&M Savings	Total Estimated Annual Cost Savings	Simple Payback	S.I.R.	Life Cycle Savings	Expected Useful Life (EUL)
			Natural Gas	Propane	No.2 Oil	Steam	Electricity								
		$	Therms	Gallons	Gallons	Mlbs	kWh	kgal	$	$	$	Years		$	Years
No/Low Cost Recommendations															
1	Install Low Flow Faucet Aerators Location: Restrooms And Classrooms	$762	508	0	0	0	0	73	$1,415	$0	$1,415	0.54	15.84	$11,305	10.00
Totals for No/Low Cost Items		**$762**	**508**	**0**	**0**	**0**	**0**	**73**	**$1,415**	**$0**	**$1,415**	**0.54**			
Capital Cost Recommendations															
1	Reduce HVAC Hours of Operation Location: Throughout	$1,597	412	0	0	0	20,248	0	$3,872	$0	$3,872	0.41	28.94	$44,622	15.00
2	Control External Air Leakage In Commercial Buildings Location: Extrior Doors	$5,490	568	0	0	0	2,703	0	$1,197	$60	$1,257	4.37	2.73	$9,515	15.00
3	Upgrade Building Lighting to LED and Install Automatic Lighting Controls Location: Building Interior And Exterior	$31,676	0	0	0	0	24,909	0	$4,091	$949	$5,041	6.28	1.90	$28,499	15.00
4	Upgrade Electric Heating System To Heat Pumps Location: Portable Classrooms	$21,977	0	0	0	0	13,901	0	$2,283	$0	$2,283	9.62	1.55	$11,994	20.00
5	Install Low Flow Tankless Restroom Fixtures Location: Restrooms	$31,762	0	0	0	0	0	263	$2,684	$0	$2,684	11.84	1.01	$275	15.00
Total For Capital Cost		**$92,501**	**980**	**0**	**0**	**0**	**61,762**	**263**	**$14,127**	**$1,009**	**$15,136**	**6.11**			
	Interactive Savings Discount @ 10%		-149	0	0	0	-6,176	-34	-$1,554	-$101	-$1,655				
	Total Contingency Expenses @ 15%	$13,989													
Total for Improvements		**$107,253**	**1,339**	**0**	**0**	**0**	**55,586**	**302**	**$13,988**	**$908**	**$14,896**	**7.20**			

In addition to the above measures, EMG has identified the following measure(s) but has not recommended as they fail to meet the above-mentioned financial criteria of SIR>1.0. Thus, EMG has classified the measure(s) as recommended for consideration.

List of Recommended For Consideration Energy Conservation Measures For Hollywood Park Elementary School

ECM #	Description of ECM	Initial Investment	Annual Energy Savings					Annual Water Savings	Cost Savings	Estimated Annual O&M Savings	Total Estimated Annual Cost Savings	Payback	S.I.R.	Life Cycle Savings	Expected Useful Life (EUL)
		$	Natural Gas	Propane	No.2 Oil	Steam	Electricity	kgal	$	$	$	Years		$	Years
1	Replace Rooftop Package Unit Location: Rooftop	$83,200	1,353	0	0	0	10,063	0	$3,446	$172	$3,618	23.00	0.65	-$29,372	20.00
Total for Improvements		**$83,200**	**1,353**	**0**	**0**	**0**	**10,063**	**0**	**$3,446**	**$172**	**$3,618**	**23.00**			

2. Introduction

The purpose of this Energy Audit is to provide Hollywood Park Elementary School and Sacramento City Unified School District with a baseline of energy usage, the relative energy efficiency of the facility, and specific recommendations for Energy Conservation Measures. Information obtained from these analyses may be used to support a future application to an Energy Conservation Program, Federal and Utility grants towards energy conservation, as well as support performance contracting, justify a municipal bond-funded improvement program, or as a basis for replacement of equipment or systems.

The energy audit consisted of an onsite visual assessment to determine current conditions, itemize the energy consuming equipment (i.e. Boilers, Make-Up Air Units, DWH equipment); review lighting systems both exterior and interior; and review efficiency of all such equipment. The study also included interviews and consultation with operational and maintenance personnel. The following is a summary of the tasks and reporting that make up the Energy Audit portion of the report.

The following is a summary of the tasks and reporting that make up the Energy Audit portion of the report.

ENERGY AND WATER USING EQUIPMENT

- EMG has surveyed the common areas, office areas, rooms, maintenance facilities and mechanical rooms to document utility-related equipment, including heating systems, cooling systems, air handling systems and lighting systems.

BUILDING ENVELOPE

- EMG has reviewed the characteristics and conditions of the building envelope, checking insulation values and conditions. This review also includes an inspection of the condition of walls, windows, doors, roof areas, insulation and special use areas

RECOMMENDATIONS FOR ENERGY SAVINGS OPPORTUNITIES

- Based on the information gathered during the on site assessment, the utility rates, as well as recent consumption data and engineering analysis, EMG has identified opportunities to save energy and provide probable construction costs, projected energy/utility savings and provide a simple payback analysis.

ANALYSIS OF ENERGY CONSUMPTION

- Based on the information gathered during the on-site assessment, EMG has conducted an analysis of the energy usage of all equipment, and identified which equipment is using the most energy and what equipment upgrades may be necessary. As a result, equipment upgrades, or replacements are identified that may provide a reasonable return on the investment and improve maintenance reliability.

ENERGY AUDIT PROCESS

- Interviewing staff and review plans and past upgrades
- Performing an energy audit for each use type
- Performing a preliminary evaluation of the utility system
- Analyzing findings, utilizing ECM cost-benefit worksheets
- Making preliminary recommendations for system energy improvements and measures
- Estimating initial cost and changes in operating and maintenance costs based on implementation of energy efficiency measures
- Ranking recommended cost measures, based on the criticality of the project and the largest payback

REPORTING

The EMG Energy Audit Report includes:

- A comprehensive study identifying all applicable Energy Conservation Measures (ECMs) and priorities, based on initial cost and payback
- A narrative discussion of building systems/components considered and a discussion of energy improvement options;
- A summary of ECMs including initial costs and simple paybacks, based on current utility rates and expected annual savings.

3. Facility Overview and Existing Conditions

3.1. Building Occupancy and Point of Contact

FACILITY SCHEDULE	
Hours of Operations / Week	35
Operational Weeks / Year	36
Estimated Facility Occupancy	413
% of Male Occupants	50%

POINT OF CONTACT	
Point of Contact Name	Sergio Bravo
Point of Contact Title	Plant Manager
Point of Contact – Contact Number	(916) 395-4590

3.2. Building Heating, Ventilating and Air-Conditioning (HVAC)

Description:

Heating and cooling to permanent school buildings 001-004 is provided primarily by packaged rooftop units which utilize natural gas for heating. The portable classrooms are served by a mixture of wall mounted gas/electric package units and wall mounted heat pumps.

The Mechanical Equipment Schedule in Appendix B contains a summary of the HVAC Equipment at the property.

BUILDING CENTRAL HEATING SYSTEM	
Primary Heating System	Package Rooftop units
Secondary Heating System	Wall Mounted Heat Pump
Hydronic Distribution System	Not Applicable
Primary Heating Fuel	Natural Gas
Heating Mode Set-point	69
Heating Mode- Set-back Temperature	53

BUILDING COOLING SYSTEM	
Primary Cooling System	Package Rooftop Unit
Secondary Cooling System	Wall Mounted Heat Pump
Hydronic Distribution System	Not Applicable
Cooling Mode Set-point	73
Cooling Mode- Set-back Temperature	93

AIR DISTRIBUTION SYSTEM	
Building Ventilation	Exhaust Fans
On-Demand Ventilation System in Use?	No
Energy Recovery Wheel / Enthalpy Wheel Exhaust Fans	No

DOMESTIC HOT WATER SYSTEM	
Primary Domestic Water Fuel	Natural Gas

3.3. Lighting

Description:

The lighting in the school building primarily consists of T8 linear fluorescent lamp fixtures in classrooms and hallways. The fixtures were observed to be operating on bi-level mode in the classrooms. The exterior lights were primarily High Intensity Discharge (HID) fixtures.

The detailed lighting schedule and the proposed LED alternative is provided in Appendix C.

4. Utility Analysis

Establishing the energy baseline begins with an analysis of the utility cost and consumption of the building. Utilizing the historical energy data and local weather information, we evaluate the existing utility consumption and assign it to the various end-uses throughout the buildings. The Historical Data Analysis breaks down utilities by consumption, cost and annual profile.

This data is analyzed, using standard engineering assumptions and practices. The analysis serves the following functions:

- Allows our engineers to benchmark the energy and water consumption of the facilities against consumption of efficient buildings of similar construction, use and occupancy.
- Generates the historical and current unit costs for energy and water
- Provides an indication of how well changes in energy consumption correlate to changes in weather.
- Reveals potential opportunities for energy consumption and/or cost reduction. For example, the analysis may indicate that there is excessive, simultaneous heating and cooling, which may mean that there is an opportunity to improve the control of the heating and cooling systems.

By performing this analysis and leveraging our experience, our engineers prioritize buildings and pinpoint systems for additional investigation during the site visit, thereby maximizing the benefit of their time spent on-site and minimizing time and effort by the customer's personnel.

Based upon the utility information provided about the Sacramento City Unified School District, the following energy rates are utilized in determining existing and proposed energy costs.

Utility Rates used for Cost Analysis

ELECTRICITY (BLENDED RATE)	NATURAL GAS	WATER / SEWER
$1.33/kWh	$0.16/therm	$10.19/kGal

The data analyzed provides the following information: 1) breakdown of utilities by consumption, 2) cost and annual profile, 3) baseline consumption in terms of energy/utility at the facility, 4) the Energy Use Index, or Btu/sq ft, and cost/sq ft. For multiple water meters, the utility data is combined to illustrate annual consumption for each utility type.

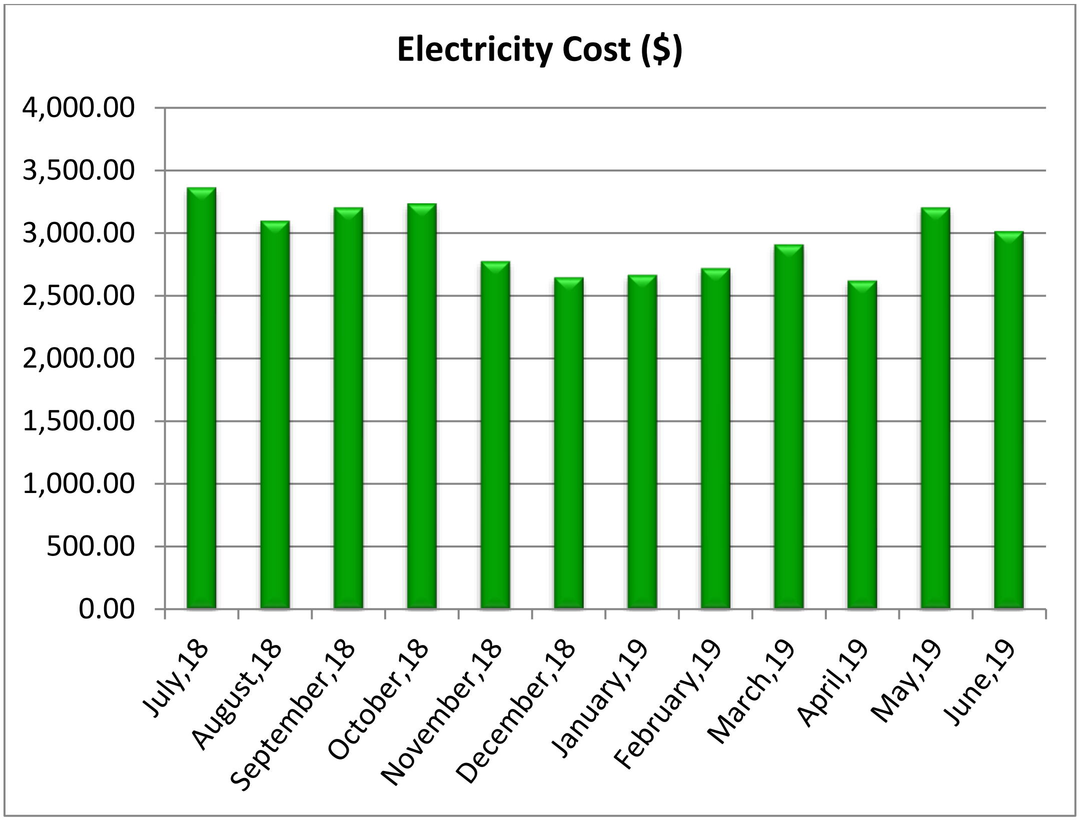
4.1. Electricity

SMUD satisfies the electricity requirements for the facility. The primary end uses for electric utility compromises of lighting, cooling, office/school equipment, and appliances in the break room.

The table below provides the electric use for the period of twelve continuous months.

Electric Consumption and Cost Data

BILLING MONTH	CONSUMPTION (KWH)	UNIT COST/KWH	TOTAL COST
July,18	19,687.54	0.17	3,363.31
August,18	17,502.67	0.18	3,097.14
September,18	19,791.57	0.16	3,204.08
October,18	20,491.29	0.16	3,235.59
November,18	17,490.64	0.16	2,774.15
December,18	16,691.50	0.16	2,645.13
January,19	16,598.97	0.16	2,666.48
February,19	17,091.39	0.16	2,719.69
March,19	17,794.18	0.16	2,909.08
April,19	15,656.47	0.17	2,620.36
May,19	19,735.34	0.16	3,202.99
June,19	17,304.14	0.17	3,014.94
Total/average	**215,835.69**	**0.16**	**35,452.94**


Electricity Cost ($)
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3,500.00
3,000.00
2,500.00
2,000.00
1,500.00
1,000.00
500.00
0.00
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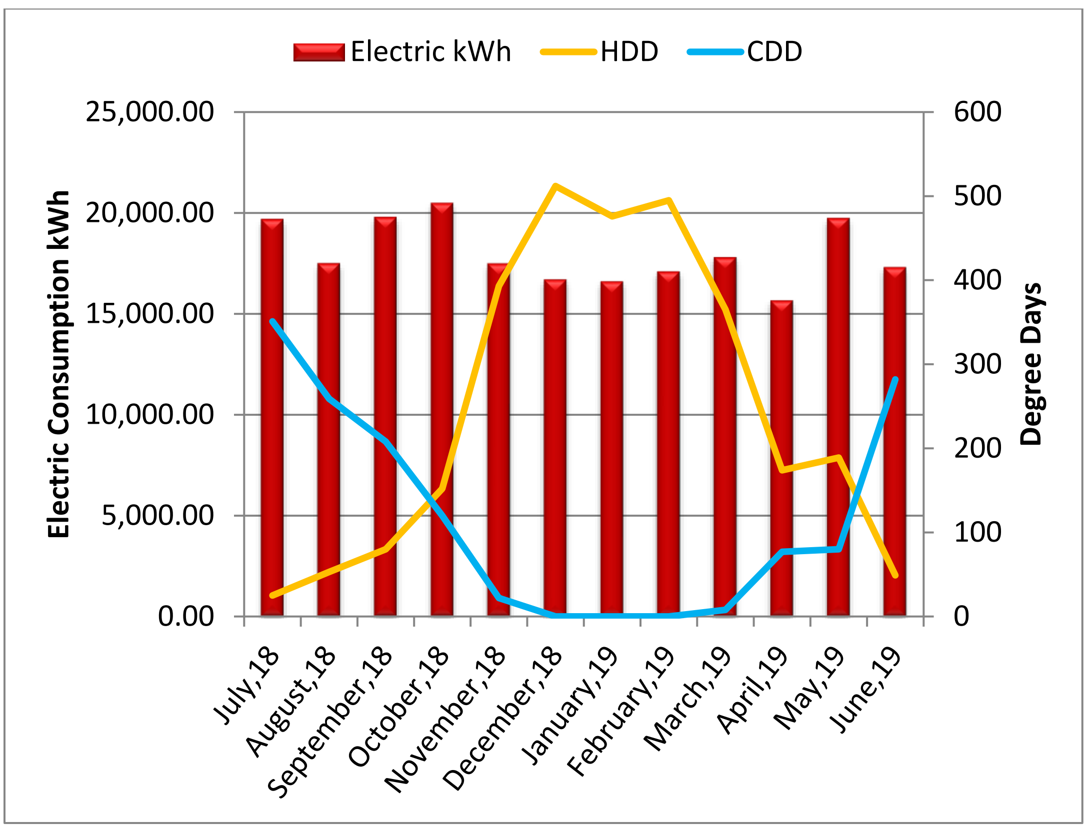
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19


Electric kWh
HDD
CDD
Electric Consumption kWh
25,000.00
20,000.00
15,000.00
10,000.00
5,000.00
0.00
Degree Days
600
500
400
300
200
100
0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

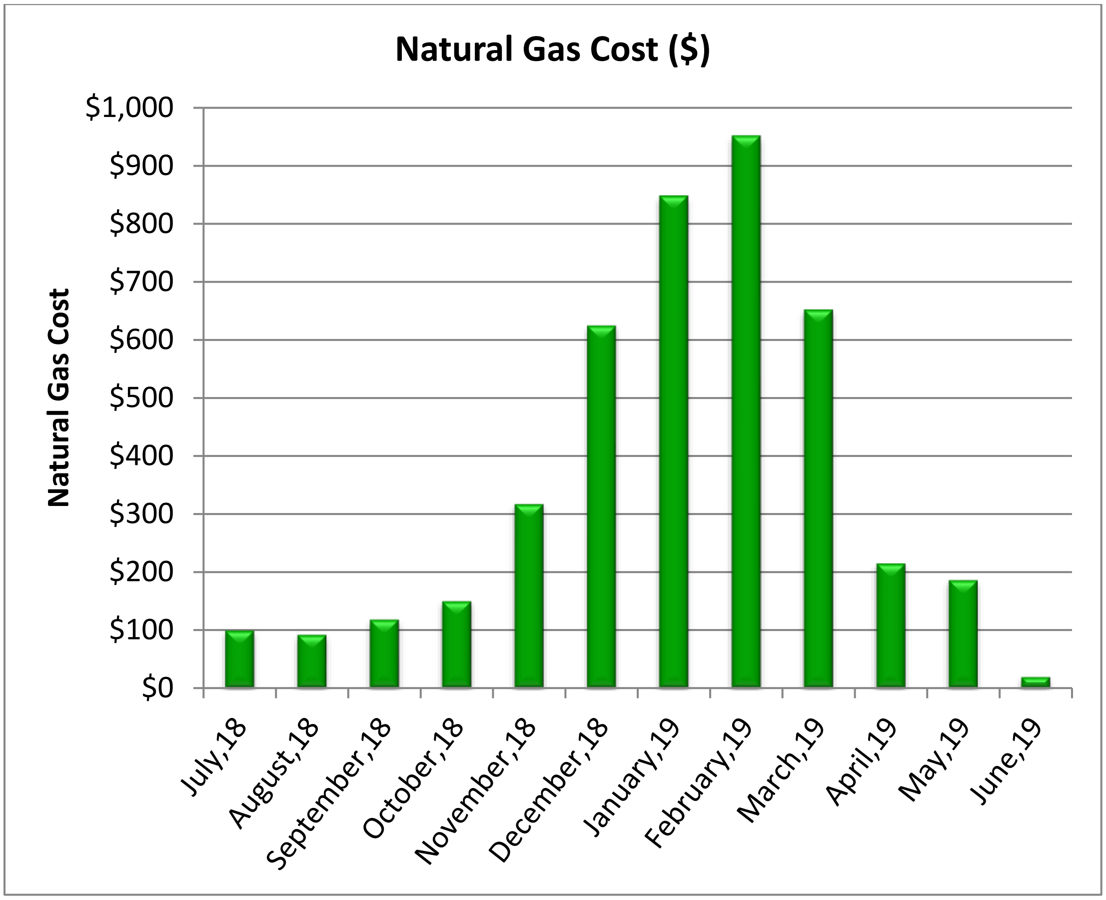
4.2. Natural Gas

PG&E satisfies the natural gas requirements of the facility. The primary end use of natural gas is for building heating, domestic water heating, and cooking in the cafeteria.

The analysis of the 12 months of consumption is provided below.

Natural Gas Consumption and Cost Data

BILLING MONTH	CONSUMPTION (THERMS)	UNIT COST/THERM	TOTAL COST
July,18	64	$1.54	$99
August,18	62	$1.47	$91
September,18	86	$1.36	$118
October,18	119	$1.26	$149
November,18	247	$1.28	$317
December,18	453	$1.38	$625
January,19	649	$1.31	$849
February,19	725	$1.31	$952
March,19	489	$1.33	$652
April,19	169	$1.27	$215
May,19	146	$1.27	$186
June,19	14	$1.29	$18
Total/average	**3,222**	**$1.33**	**$4,270**


Natural Gas Cost ($)
Natural Gas Cost
$1,000
$900
$800
$700
$600
$500
$400
$300
$200
$100
$0
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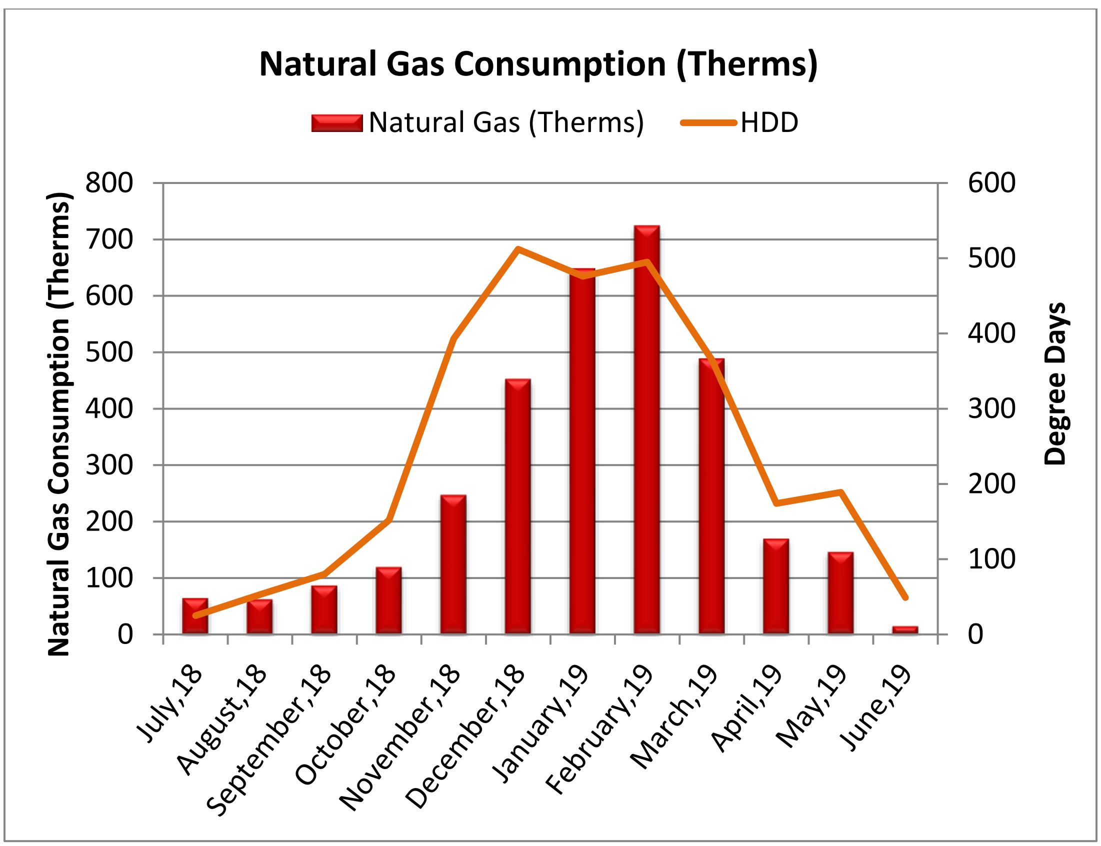
April,19
May,19
June,19

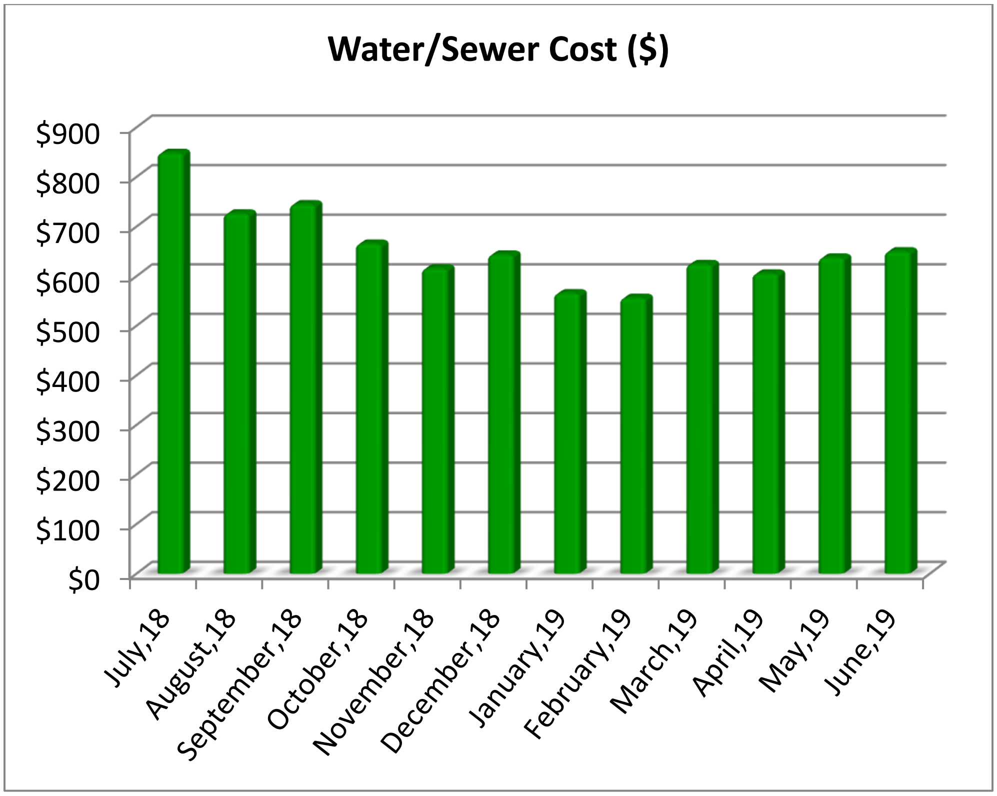

Natural Gas Consumption (Therms)
Natural Gas (Therms)
HDD
Natural Gas Consumption (Therms)
Degree Days
800
700
600
500
400
300
200
100
0
600
500
400
300
200
100
0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

4.3. Water and Sewer

The City of Sacramento satisfies the water requirements for the facility. The primary end use of water is the plumbing fixtures such as staff showers, water closets, and lavatories. The table below provides the twelve continuous months' worth of consumption and cost for water in kGal for the facility.

Water and Sewer Consumption and Cost Data

BILLING MONTH	CONSUMPTION (KGAL)	UNIT COST/KGAL	TOTAL COST
July,18	138	$6.14	$848
August,18	96	$7.54	$726
September,18	102	$7.33	$745
October,18	80	$8.32	$665
November,18	60	$10.34	$615
December,18	36	$17.66	$643
January,19	26	$21.67	$565
February,19	36	$15.66	$556
March,19	38	$16.51	$624
April,19	38	$15.73	$605
May,19	75	$8.44	$637
June,19	48	$13.56	$650
Total/average	**773**	**$10.19**	**$7,880**


Water/Sewer Cost ($)
$900
$800
$700
$600
$500
$400
$300
$200
$100
$0
July,18
August,18
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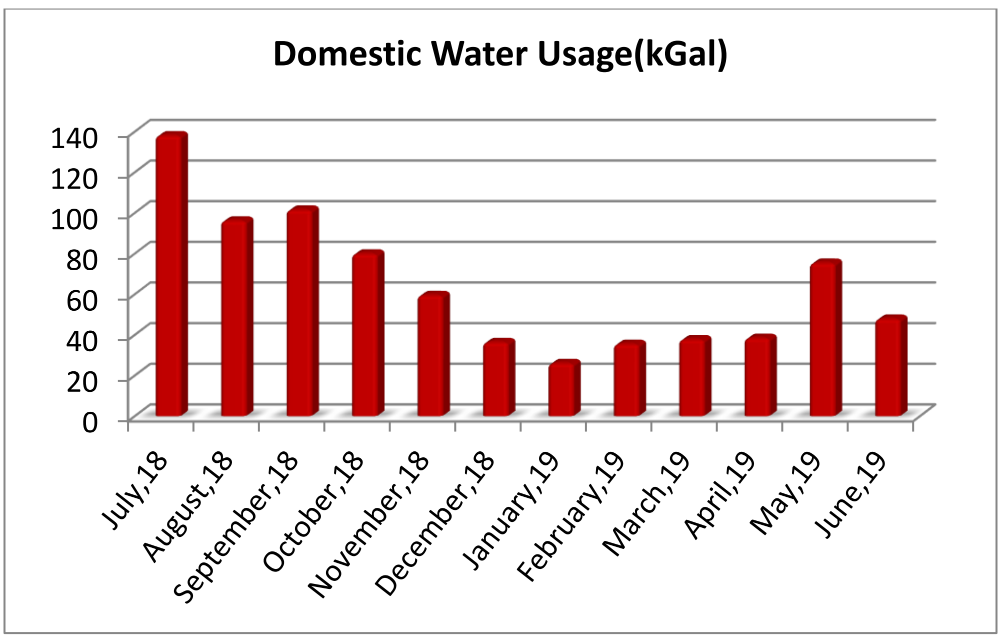
April,19
May,19
June,19


Domestic Water Usage(kGal)
140
120
100
80
60
40
20
0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

5. Renewable Energy Discussions

5.1. Rooftop Solar Photovoltaic Feasibility

Solar Energy Feasibility

A photovoltaic array is a linked collection of photovoltaic modules, which are in turn made of multiple interconnected solar cells. The cells convert solar energy into direct current electricity via the photovoltaic effect. The power that one module can produce is seldom enough to meet requirements of a home or a business, so the modules are linked together to form an array. Most PV arrays use an inverter to convert the DC power produced by the modules into alternating current that can plug into the existing infrastructure to power lights, motors, and other loads. The modules in a PV array are usually first connected in series to obtain the desired voltage; the individual strings are then connected in parallel to allow the system to produce more current. Solar arrays are typically measured by the peak electrical power they produce, in watts, kilowatts, or even megawatts.

When determining if a site is suitable for a solar application, two basic considerations must be evaluated:

- At minimum, the sun should shine upon the solar collectors from 9 AM to 3 PM. If less, the application may still be worthwhile, but the benefit will be less.
- The array should face south and be free of any shading from buildings, trees, rooftop equipment, etc. If the array is not facing directly south, there will be a penalty in transfer efficiency, reducing the overall efficiency of the system.

SOLAR PV QUESTIONNAIRE	RESPONSE
Does the property have a south, east, or west facing roof or available land of more than 250 square feet per required Solar Array Panel?	Yes
Is the area free from any shading such as trees, buildings, equipment etc throughout the whole day?	Yes
Can the panels be mounted at an incline of roughly 25-45 degrees? (equal to latitude of property)	Yes
Is the property in an area with acceptable average monthly sunlight levels?	Yes
Has the roofing been replaced within the past 3-5 years?	No
Is the roof structure sufficient to hold solar panels?	Additional study required
Is the property located in a state eligible for net metering?	Yes

A solar feasibility analysis of the site has resulted in the building containing more than sufficient amount of roof area for solar electricity generation. The analysis through the use of National Renewable Energy Laboratory's solar photovoltaic software assisted in calculating the potential electricity generated from the allocated land and roof area set for solar photovoltaic installment. The allocated roof area was through looking at the roof and surrounding areas at a bird's eye view. Also detailed in the report are incentives and rebates that can potentially bring down the installation cost of the ECMs and result in a higher return on investment and quicker payback period.

The approach taken in the solar photovoltaic (PV) roof analysis begins with surveying the roof and determine areas on the roof where solar PV panels can potentially be installed.

1) Conducting a preliminary sizing of solar PV panels on the roofs and on the ground and its potential electricity production for its first year of installment using the National Renewable Energy Laboratory (NREL) PV WATTS Version 2 Software.
2) Calculate engery and cost savings for the site as a sole proprietor of the system capable of collecting state, local, and federal tax credits and incentives and interconnecting and selling the renewable energy electrical productive to the building.

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS		
Estimated Number of Panels	430	
Estimated KW Rating	135	KW
Potential Annual kWh Produced	207,913	kWh
% of Current Electricity Uses	96.3%	
FINANCIAL SUMMARY		
Investment Cost	$473,900	
Estimated Energy Cost Savings	$34,160	
Payback without Incentives	13.9	Years
Incentive Payback but without SRECs	8.4	Years
Payback with All Incentives	8.4	Years

A photovoltaic array is a linked collection of photovoltaic modules, which are in turn made of multiple interconnected solar cells. The cells convert solar energy into direct current. Modules of cells are linked together to form an array. Most PV arrays use an inverter to convert the DC power produced by the modules into alternating current that can connect to existing AC infrastructure to power lights, motors, and other loads.

Cost of production has fallen years with increasing demand and through production and technological advances. The cost dropped from $8–10/watt in 1996 to $4–7/watt in 2006. The market is diversifying with new types of panels suited to unique installation methods including stick on sheets and PV spray coating. The solar PV cost used in the analysis was set at $7.0/Watt which includes design, construction, administration, and installation and maintenance cost throughout the life of the solar panels.

One breakthrough for PV is “Net Metering”. When more PV electric power is generated than is consumed on site, the electric service meter reverses to “sell” the excess power directly back onto the power grid. The economics of PV for commercial industrial installations become attractive when coupled with incentives from Federal and state agencies, as well utility companies.

A kilowatt-hour costing $0.15 might be valued at $0.30 when produced by PV and sent to the grid. The economics of PV for commercial industrial installations become attractive when coupled with incentives from Federal and state agencies, as well utility companies.

The low payback period is highly dependent on the marketing potential of selling Solar Renewable Certificates to electricity generated providers who are under state regulations to contain a certain percentage of their electricity generation derived from renewable energy such as wind and solar.

Solar facilities are encouraged to sell their SRECs on the market (either spot market or through long-term contracts). Utilities may use SRECs for compliance under the state RPS for the year in which they are generated. Utilities may purchase up to 10% more SRECs than they require for compliance and "bank" those surplus SRECs for compliance during the following two years. Any SRECs pricing can range from $300 - $450/MWh and can be sold across state borders to other utility providers looking to purchase SRECs. EMG has selected to use the market value of $300/MWh minus 5% administrative fee in the analysis.

A number of states and corresponding electrical utility supplier are required under regulation to have a certain percentage of its electricity be produced by solar energy. To offset that they allow other utility companies to buy Renewable Energy Credits (REC) credit off their customers and facilities that produce their own solar energy. Typically, the national market, the utility market is $400 per MWh to Utility Suppliers for not meeting this standard percentage so these REC credits are sold for $350 per MWH. (1 REC credit = 1 MWH).

State charges these utility companies to meet their state compliance of 0.2% of the entire electricity consumption from solar energy by 2022 (from.005% in 2008 aggregated up to 0.2% by 2022). The REC credits correspond to these percentages as they aggregate each year.

6. Operations and Maintenance Plan

The quality of the maintenance and the operation of the facility's energy systems have a direct effect on its overall energy efficiency. Energy-efficiency needs to be a consideration when implementing facility modifications, equipment replacements, and general corrective actions. The following is a list of activities that should be performed as part of the routine maintenance program for the property.

Building Envelope

- ✓ Ensure that the building envelope has proper caulking and weather stripping.
- ✓ Patch holes in the building envelope with foam insulation and fire rated caulk around combustion vents
- ✓ Inspect building vents semiannually for bird infestation
- ✓ Inspect windows monthly for damaged panes and failed thermal seals
- ✓ Repair and adjust automatic door closing mechanisms as needed.

Heating and Cooling

- ✗ Pilots lights on furnaces and boilers be turned off in summer
- ✗ All preventive maintenance should be performed on all furnaces and boilers, which would include cleaning of burners and heat exchanger tubes.
- ✓ Ensure that the combustion vents exhaust outside the conditioned space and the vent dampers are functional
- ✓ Ensure that the control valves are functioning properly before start of every season
- ✗ Ensure steam traps are functional before start of each heating season
- ✗ Ensure use of chemical treatment for boiler make up water
- ✗ Ensure boiler outside temperature re-set is set to 55F
- ✗ Ensure use of chemical treatment for Colling tower water to prevent corrosion
- ✓ Ensure the duct work in unconditioned space is un-compromised and well insulated
- ✓ Duct cleaning is recommended every 10 years. This should include sealing of ducts using products similar to 'aero-seal'
- ✓ Ensure use of economizer mode is functional and used
- ✓ Ensure that the outside air dampers actuators are operating correctly
- ✗ Ensure air coils in the AHU and FCA's are pressure washed annually
- ✓ Return vents should remain un-obstructed and be located centrally
- ✓ Temperature settings reduced in unoccupied areas and set points seasonally adjusted.
- ✓ Evaporator coils and condenser coils should be regularly cleaned to improve heat transfer
- ✓ Refrigerant pipes should be insulated with a minimum of ¾" thick Elastomeric Rubber Pipe Insulation
- ✓ Ensure refrigerant pressure is maintained in the condensers
- ✓ Change air filters on return vents seasonally. Use only filters with 'Minimum Efficiency Rating Value'(MERV) of 8

Central Domestic Hot Water Heater

- ✓ Never place gas fired water heaters adjacent to return vents so as to prevent flame roll outs
- ✓ Ensure the circulation system is on timer to reduce the losses through re-circulation
- ✓ Ensure all hot water pipes are insulated with fiberglass insulation at all times
- ✓ Replacement water heater should have Energy Factor (EF)>0.9
- ✓ Tank-type water heaters flushed monthly

Lighting Improvements

- ✓ Utilize bi-level lighting controls in stairwells and hallways.
- ✓ Use LED replacement lamps
- ✓ Clean lighting fixture reflective surfaces and translucent covers.
- ✓ Ensure that timers and/or photocells are operating correctly on exterior lighting
- ✓ Use occupancy sensors for offices and other rooms with infrequent occupancy

Existing Equipment and Replacements

- ✓ Ensure that refrigerator and freezer doors close and seal correctly
- ✓ Ensure kitchen and bathroom exhaust outside the building and the internal damper operates properly
- ✓ Ensure that bathroom vents exhaust out
- ✓ Office/ computer equipment either in the “sleep” or “off” mode when not used

7. Appendices

APPENDIX A: Glossary of Terms

APPENDIX B: Mechanical Equipment Inventory

APPENDIX C: Lighting System Schedule

APPENDIX D: ECM Checklist

APPENDIX E: ECM Calculations

APPENDIX F: Solar PV

APPENDIX A:
Glossary of Terms

Glossary of Terms and Acronyms

ECM – Energy Conservation Measures are projects recommended to reduce energy consumption. These can be No/Low cost items implemented as part of routine maintenance or Capital Cost items to be implemented as a capital improvement project.

Initial Investment – The estimated cost of implementing an ECM project. Estimates typically are based on R.S. Means Construction cost data and Industry Standards.

Annual Energy Savings – The reduction in energy consumption attributable to the implementation of a particular ECM. These savings values do not include the interactive effects of other ECMs.

Cost Savings – The expected reduction in utility or energy costs achieved through the corresponding reduction in energy consumption by implementation of an ECM.

Simple Payback Period –The number of years required for the cumulative value of energy or water cost savings less future non-fuel or non-water costs to equal the investment costs of the building energy or water system, without consideration of discount rates.

EUL – Expected Useful Life is the estimated lifespan of a typical piece of equipment based on industry accepted standards.

RUL – Remaining Useful Life is the EUL minus the effective age of the equipment and reflects the estimated number of operating years remaining for the item.

SIR - The savings-to-investment ratio is the ratio of the present value savings to the present value costs of an energy or water conservation measure. The numerator of the ratio is the present value of net savings in energy or water and non-fuel or non-water operation and maintenance costs attributable to the proposed energy or water conservation measure. The denominator of the ratio is the present value of the net increase in investment and replacement costs less salvage value attributable to the proposed energy or water conservation measure. It is recommended that energy-efficiency recommendations be based on a calculated SIR, with larger SIRs receiving a higher priority. A project typically is recommended only if the SIR is greater than or equal to 1.0, unless other factors outweigh the financial benefit.

Life Cycle Cost - The sum of the present values of (a) **I**nvestment costs, less salvage values at the end of the study period; (b) Non-fuel operation and maintenance costs: (c) Replacement costs less salvage costs of replaced building systems; and (d) Energy and/or water costs.

Life Cycle Savings – The sum of the estimated annual cost savings over the EUL of the recommended ECM, expressed in present value dollars.

Building Site Energy Use Intensity - The sum of the total site energy use in thousands of Btu per unit of gross building area. Site energy accounts for all energy consumed at the building location only not the energy consumed during generation and transmission of the energy to the site.

Building Source Energy Use Intensity – The sum of the total source energy use in thousands of Btu per unit of gross building area. Source energy is the energy consumed during generation and transmission in supplying the energy to your site.

Building Cost Intensity - This metric is the sum of all energy use costs in dollars per unit of gross building area.

Greenhouse Gas Emissions - Although there are numerous gases that are classified as contributors to the total for Greenhouse Emissions, the scope of this energy audit focuses on carbon dioxide (CO_2). Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement).

APPENDIX B:
Mechanical Equipment Inventory

Mechanical Inventory							
System	Make	Model	Serial Number	Input Capacity	Room Number	Space Served	Quantity
Water Heater	Rheem	82SV30-2	RH 0908R00995	30 GAL	001-B100-Boiler room	Isador Cohen Elementary School / 001-Main Building	1
Domestic Circulation/Booster Pump	Peerless Pumps	Illegible	Illegible	10 HP	Site	Isador Cohen Elementary School / Site	1
Packaged Unit (RTU)	AAON, Inc.	RQ-004-3-V-GA02-212	201108-AYGD02220	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RQ-004-3-V-GA02-212	201108-AYGD02222	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RQ 005-3-V-GA02-212	201108-AYGE02227	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RQ-004-3-V-GA02-212	201108-AYGD02221	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RQ-004-3-V-GA02-212	201108-AYGD02215	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RQ-004-3-V-GA02-212	201108-AYGDO2217	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RN-009-3-0-BA02-2F2	201108-ANGQ18234	9 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RQ-004-3-V-GA02-212	201108-AYGDO2216	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RQ 005-3-V-GA02-212	201108-AYGE02226	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RN-007-3-0-EA09-222	201108-ANGG18237	7 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RQ-004-3-V-GA02-212	201108-AYGD02214	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AaoN, Inc.	RN-009-3-0-BA02-2F2	201108-ANGQ18233	9 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RQ 005-3-V-GA02-212	201108-AYGE02225	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RQ-004-3-V-GA02-212	201108-AYGD02223	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RQ-004-3-V-GA02-212	201108-AYGO02213	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Packaged Unit (RTU)	AAON, Inc.	RQ-004-3-V-GA02-212	201108-AYGD02224	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Heat Pump	Bard Manufacturing Company	WG422-ANBVX4XXX	253F041910556-1	3.5 TON	P03-O021-Building exterior	Isador Cohen Elementary School / P03-Classrooms 20-21	1
Packaged Unit (RTU)	AAON, Inc.	RQ-004-3-V-GA02-212	201108-AYGD02219	4 TON	001-Roof	Isador Cohen Elementary School / 001-Main Building	1
Heat Pump	Bard Manufacturing Company	WG422-ANBVX4XXX	253F041910551-1	3.5 TON	P01-O015-Building exterior	Isador Cohen Elementary School / P01-Classrooms 14-16	1
Heat Pump	Bard Manufacturing Company	WG422-ANBVX4XXX	253F041910557-1	3.5 TON	P02-O016-Building exterior	Isador Cohen Elementary School / P02-Classrooms 17-19	1
Water Storage Tank	Butane Tank Co.	-	35476	2200 GAL	Site	Isador Cohen Elementary School / Site	1
Heat Pump	Bard Manufacturing Company	WG422-ANBVX4XXX	253F041910558-1	3.5 TON	P02-O018-Building exterior	Isador Cohen Elementary School / P02-Classrooms 17-19	1
Heat Pump	Bard Manufacturing Company	WG422-ANBVX4XXX	253F041910559-1	3.5 TON	P01-O014-Building exterior	Isador Cohen Elementary School / P01-Classrooms 14-16	1
Heat Pump	Bard Manufacturing Company	WG422-ANBVX4XXX	253F041910555-1	3.5 TON	P03-O020-Building exterior	Isador Cohen Elementary School / P03-Classrooms 20-21	1
Heat Pump	Bard Manufacturing Company	WG422-ANBVX4XXX	253F041910553-1	3.5 TON	P03-O019-Building exterior	Isador Cohen Elementary School / P03-Classrooms 20-21	1
Water Heater	Rheem	ELD 52	GLO297 R1096C24384	50 GAL	001-SK02	Isador Cohen Elementary School / 001-Main Building	1
Heat Pump	Bard Manufacturing Company	No tag/plate found	No tag/plate found	3 TON	P02-O017-Building exterior	Isador Cohen Elementary School / P02-Classrooms 17-19	1

APPENDIX C:
Lighting System Schedule

Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	LUX	Control Quantity	Existing Control	Lamp Details: Technology	Sub-Technology	Lamp Type	Total Lamps	Fixture Details: Fixture Type	Fixture Quantity	24x7 Fixture Count	Fixture Height	Existing Consumption: Annual Hours	Existing Annual kWh
1	Isador Cohen	Interior		CLASSROOM	Y10B	150	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	30	2x4 Prism Troffer	15	0	10	1,260	1,210
2	Isador Cohen	Interior		CLASSROOM	Y10B	150	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	20	2x4 Prism Troffer	10	0	10	1,260	806
3	Isador Cohen	Interior		RESTROOM	Ty10	130	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	10	2,160	276
4	Isador Cohen	Interior		RESTROOM	Sy10	160	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	10	2,160	276
5	Isador Cohen	Interior		CLASSROOM	Y10A	180	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	20	2x4 Prism Troffer	10	0	10	1,260	806
6	Isador Cohen	Interior		CLASSROOM	Y10A	180	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	30	2x4 Prism Troffer	15	0	10	1,260	1,210
7	Isador Cohen	Interior		HALLWAY	Hy10	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	10	2,160	276
8	Isador Cohen	Interior		CLASSROOM	Y10c	130	5	Light Switch	Linear Fluorescent	T8	4' 32W T8	150	2x4 Prism Troffer	75	0	10	1,260	6,048
9	Isador Cohen	Interior		CLASSROOM	Ow0a	200	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	102	2x4 Prism Troffer	51	0	10	1,260	4,113
10	Isador Cohen	Interior		CLASSROOM	Ow0B	220	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	76	2x4 Prism Troffer	38	0	10	1,260	3,064
11	Isador Cohen	Interior		CLASSROOM	Ow0B	220	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	10	1,260	323
12	Isador Cohen	Interior		CLASSROOM	O21	500	6	Ceiling-Mounted Sensor	LED	-	-	72	Troffer 1'x4'	72	0	10	1,260	-
13	Isador Cohen	Interior		CLASSROOM	1	-	1	Ceiling-Mounted Sensor	LED	-	-	15	Troffer 1'x4'	15	0	10	1,260	-
14	Isador Cohen	Interior		RESTROOM	T1	-	2	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	10	2,160	553
15	Isador Cohen	Interior		ESTROOM - PRIVAT	T2	-	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	10	900	58
16	Isador Cohen	Interior		CLASSROOM	Ext	-		Timer	LED	-	-	10	Wallpack-Horizontal	10	0	10	2,160	-
17	Isador Cohen	Interior		MECHANICAL	B100	-	1	Light Switch	CFL	CFL - Screw-in	CFL23	4	Sconce-vert	4	0	10	1,512	139
18	Isador Cohen	Interior		RESTROOM	Tb1	-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	10	1x4 Prism Troffer	10	0	10	2,160	691
19	Isador Cohen	Interior		STORAGE	Su1	-	9	Light Switch	Incan/H/MR	Incan	I15-A19	9	Vanity-Direct	9	0	10	684	92
20	Isador Cohen	Interior		LIBRARY	X102	100	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	48	2x4 Prism Troffer	12	0	10	1,260	1,935
21	Isador Cohen	Interior		LIBRARY	X102	100	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	6	0	10	1,260	484
22	Isador Cohen	Interior		STORAGE	Sx1	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	10	684	88
23	Isador Cohen	Interior		STORAGE	Cx1	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	10	684	44
24	Isador Cohen	Interior		CAFETERIA	U101	85	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	48	2x4 Prism Troffer	12	0	10	2,160	3,318
25	Isador Cohen	Interior		CAFETERIA	U101	85	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	16	2x4 Prism Troffer	4	0	10	2,160	1,106
26	Isador Cohen	Interior		CAFETERIA	U101	85	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	48	2x4 Prism Troffer	12	0	10	2,160	3,318
27	Isador Cohen	Interior		KITCHEN	K1	170	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	1x4 Prism Troffer	6	0	10	1,800	691
28	Isador Cohen	Interior		KITCHEN	K1	170	1	Light Switch	CFL	CFL - Screw-in	CFL18	1	Sconce-vert	1	0	10	1,800	32
29	Isador Cohen	Interior		OFFICE	C107	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	10	2,160	138
30	Isador Cohen	Interior		ESTROOM - PRIVAT	Tw1	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	10	900	58
31	Isador Cohen	Interior		ESTROOM - PRIVAT	Tm1	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	3	0	10	900	173
32	Isador Cohen	Interior		CONFERENCE ROOM	I105	350	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	10	2,160	276
33	Isador Cohen	Interior		CONFERENCE ROOM	I105	350	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	10	2x4 Prism Troffer	5	0	10	2,160	691
34	Isador Cohen	Interior		CONFERENCE ROOM	I105	350	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	16	1x4 Prism Troffer	16	0	10	2,160	1,106
35	Isador Cohen	Interior		OPEN OFFICE	C100	140	2	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	10	2,160	138
36	Isador Cohen	Interior		OPEN OFFICE	C100	140	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	16	2x4 Prism Troffer	8	0	10	2,160	1,106
37	Isador Cohen	Interior		OPEN OFFICE	C101	150	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	10	2,160	276
38	Isador Cohen	Interior		OPEN OFFICE	C106	200	2	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	16	2x4 Prism Troffer	8	0	10	2,160	1,106
39	Isador Cohen	Interior		HALLWAY	H101	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	38	2x4 Prism Troffer	19	0	10	2,160	2,627
40	Isador Cohen	Interior		CLASSROOM	O0V	300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	24	2x4 Prism Troffer	12	0	10	1,260	968
41	Isador Cohen	Exterior		CLASSROOM	Ext	-	1	Timer	HID	HPS	HPS200	1	Shoebox	1	0	15	1,260	252
42	Isador Cohen	Exterior		CLASSROOM	Ext	-	1	Timer	HID	HPS	HPS200	2	Pole Pendant	2	0	15	1,260	504
	Totals											912		486			67,644	40,377

									Fixture Details						Existing Consumption				Proposed- Post Retrofit				
Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	Additional Area Description	Existing Control	Control Quantity	Technology	Sub-Technology	Lamp- Fixture	Fixture Quantity	Total Lamps	Fixture Height	Annual Hours	Existing Annual kWh	ECM	ECM Type	Recommended Sensor	LED Lamp Retrofit	Annual Hours of Operation	Proposed Annual kWh	Annual Savings From LED Retrofit
																							kWh
1	Isador Cohen	Interior		CLASSROOM	Y10B	2L 15 10F ref	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	15	30	10	1,260	1,210	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,260	643	567
2	Isador Cohen	Interior		CLASSROOM	Y10B	2L 15 10F ref	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	10	20	10	1,260	806	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,260	428	378
3	Isador Cohen	Interior		RESTROOM	Ty10	2L 2F	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	10	2,160	276	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	2,160	147	130
4	Isador Cohen	Interior		RESTROOM	Sy10	2L 2F	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	10	2,160	276	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	2,160	147	130
5	Isador Cohen	Interior		CLASSROOM	Y10A	2L 10 15F	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	10	20	10	1,260	806	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,260	428	378
6	Isador Cohen	Interior		CLASSROOM	Y10A	2L 10 15F	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	15	30	10	1,260	1,210	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,260	643	567
7	Isador Cohen	Interior		HALLWAY	Hy10	2L 2F	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	10	2,160	276	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	2,160	147	130
8	Isador Cohen	Interior		CLASSROOM	Y10c	2L 15F	Light Switch	5	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	75	150	10	1,260	6,048	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,260	3,213	2,835
9	Isador Cohen	Interior		CLASSROOM	Ow0a	2L 17F	Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	51	102	10	1,260	4,113	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,260	2,185	1,928
10	Isador Cohen	Interior		CLASSROOM	Ow0B	2L 2 19F	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	38	76	10	1,260	3,064	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,260	1,628	1,436
11	Isador Cohen	Interior		CLASSROOM	Ow0B	2L 2 19F	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	8	10	1,260	323	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,260	171	151
13	Isador Cohen	Interior		CLASSROOM	1		Ceiling-Mounted Sensor	1	LED	-		15	15	10	1,260				Retain Existing Controls				
15	Isador Cohen	Interior		RESTROOM - PRIVATE	T2	2L 1F ws	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	10	900	58	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	900	31	27
17	Isador Cohen	Interior		MECHANICAL	B100		Light Switch	1	CFL	CFL - Screw-in	CFL23; Sconce-vert	4	4	10	1,512	139	ECM	RB - Replace Bulb	Retain Existing Controls	14W LED A19	1,512	85	54
19	Isador Cohen	Interior		STORAGE	Su1	1 inc	Light Switch	9	Incan/H/MR	Incan	I15-A19; Vanity-Direct	9	9	10	684	92	ECM	RB - Replace Bulb	Ceiling Mounted	5W LED A19	684	31	62
21	Isador Cohen	Interior		LIBRARY	X102		Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	6	12	10	1,260	484	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,260	257	227
22	Isador Cohen	Interior		STORAGE	Sx1	2L 2F	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	10	684	88	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	684	47	41
24	Isador Cohen	Interior		CAFETERIA	U101		Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	12	48	10	2,160	3,318	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	2,160	1,763	1,555
25	Isador Cohen	Interior		CAFETERIA	U101		Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	16	10	2,160	1,106	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	2,160	588	518
26	Isador Cohen	Interior		CAFETERIA	U101		Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	12	48	10	2,160	3,318	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	2,160	1,763	1,555
27	Isador Cohen	Interior		KITCHEN	K1		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	6	12	10	1,800	691	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,800	367	324
28	Isador Cohen	Interior		KITCHEN	K1		Light Switch	1	CFL	CFL - Screw-in	CFL18; Sconce-vert	1	1	10	1,800	32	ECM	RB - Replace Bulb	Ceiling Mounted	11W LED A19	1,800	20	13
32	Isador Cohen	Interior		CONFERENCE ROOM	I105		Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	10	2,160	276	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	2,160	147	130
33	Isador Cohen	Interior		CONFERENCE ROOM	I105		Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	5	10	10	2,160	691	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	2,160	367	324
34	Isador Cohen	Interior		CONFERENCE ROOM	I105		Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	16	16	10	2,160	1,106	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	2,160	588	518
35	Isador Cohen	Interior		OPEN OFFICE	C100		Wall-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	10	2,160	138	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	2,160	73	65
36	Isador Cohen	Interior		OPEN OFFICE	C100		Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	8	16	10	2,160	1,106	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	2,160	588	518
37	Isador Cohen	Interior		OPEN OFFICE	C101	2L 2F ws	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	10	2,160	276	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	147	130
38	Isador Cohen	Interior		OPEN OFFICE	C106	2L 4F	Wall-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	8	16	10	2,160	1,106	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	588	518
39	Isador Cohen	Interior		HALLWAY	H101		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	19	38	10	2,160	2,627	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	1,395	1,231
40	Isador Cohen	Interior		CLASSROOM	O0V		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	12	24	10	1,260	968	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,260	514	454
41	Isador Cohen	Exterior		CLASSROOM	Ext		Timer	1	HID	HPS	HPS200; Shoebox	1	1	15	1,260	252	ECM	RF - Replace Entire Fixture	Photo sensor	54W LED Shoebox	1,260	68	184
42	Isador Cohen	Exterior		CLASSROOM	Ext		Timer	1	HID	HPS	HPS200; Pole Pendant	2	2	15	1,260	504	ECM	RF - Replace Entire Fixture	Photo sensor	54W LED Post	1,260	136	368
	Totals												912									21,248	19,129

APPENDIX D:
ECM Checklist

NA	In Place	Evaluate	ECM Description
✓			Add Reflective Coating To Exterior Windows
		✓	Replace External Windows
✓			Upgrade Insulation
		✓	Control External Air Leakage In Commercial Buildings
✓			Install Reflective Insulation Between Radiators And External Wall
✓			Replace Existing Motors With High Efficiency Motors
✓			Install On-Demand Ventilation on Air Handlers
	✓		Reduce HVAC Hours of Operation
✓			Install Variable Frequency Drives (VFD)
✓			Install Outside Air Temperature Reset Controls For Hot Water Boilers
✓			Install Chilled Water Reset Control
✓			Install Timers On Exhaust Fans
✓			Install Energy Savers on Vending, Snack Machines
	✓		Install Building Energy Management System and Replace Terminal Units
	✓		Re-Commission The Building & Its Control Systems
✓			Replace Inefficient Heating Plant
✓			Replace Inefficient Cooling Plant
	✓		Replace Existing Air Conditioners with Energy Star Air Conditioners
✓			Replace Unit Electric Heaters with Natural Gas Fired Unit Heaters
✓			Convert From Gas Pilot to Electronic Ignition for Boilers
✓			Insulate Hot Water Pipes
	✓		Insulate Refrigerant Lines
	✓		Insulate Hot Surfaces And Tanks
	✓		Insulate Air Ducts
✓			Replace Defective Steam Traps
✓			Upgrade Electric Heating System To Heat Pumps
✓			Replace Inefficient Furnace System
✓			Replace Rooftop Package Unit
	✓		Install Energy Recovery Wheel on Air Handling Unit
✓			Replace Existing Water Heater With New Energy Efficient Units
		✓	Replace Incandescent/Halogen Lamps With Energy Efficient Lamps
		✓	Upgrade Inefficient Linear Fluorescent Lamps And Fixtures
	✓		Upgrade EXIT SIGNS With LED EXIT Signs
✓			Bilevel and Tandem Linear Fluorescent Lighting ECM
		✓	Replace High Intensity Discharge (HID) Lamps With Energy Efficienct Lamps
✓			Replace Existing Refrigerator(s) With Energy Star Certified Refrigerator(s)
✓			Replace Existing Freezers With High Efficiency Freezers
✓			Install Low Flow Shower Heads
		✓	Install Low Flow Faucet Aerators
✓			Install Low Flow Restroom Flush Tank Toilets
		✓	Install Low Flow Tankless Restroom Fixtures

APPENDIX E:
ECM Calculations

UIC	**Upgrade Building Lighting to LED and Install Automatic Lighting Controls**
EAL10	**Location: Building Interior and Exterior**

	No. of ECMs	No. of Fixtures	No. of Lamps	KWh Saved	Energy Cost Saving	O & M Savings
Upgrade Lighting to LED	296	389	815	19,129	$3,049.17	$1,764.09

Existing Technology	Sub-Technology	No. of ECMs	No. of Fixtures	No. of Lamps	KWh Saved	Energy Cost Saving	O & M Savings
CFL	CFL - 2 Pin	0	0	0	0	$0	$0
CFL	CFL - 4 Pin	0	0	0	0	$0	$0
CFL	CFL - Screw-in	2	5	5	67	$11	$41
Circiline	T9	0	0	0	0	$0	$0
Incan/H/MR	H	0	0	0	0	$0	$0
Incan/H/MR	Incan	1	9	9	62	$10	$520
Incan/H/MR	MR	0	0	0	0	$0	$0
HID	HPS	2	3	3	552	$88	$47
HID	MH	0	0	0	0	$0	$0
HID	MV	0	0	0	0	$0	$0
HID	QL	0	0	0	0	$0	$0
Linear Fluorescent	T8	34	372	815	18,449	$2,941	$1,156
Linear Fluorescent	T12	0	0	0	0	$0	$0
Linear Fluorescent	T8 U	0	0	0	0	$0	$0
Linear Fluorescent	T12 U	0	0	0	0	$0	$0
Linear Fluorescent	T5	0	0	0	0	$0	$0
Linear Fluorescent	T6	0	0	0	0	$0	$0
Linear Fluorescent	T10	0	0	0	0	$0	$0

Proposed Controls	**No. of Controls**		**No. of Controls**
Photo Sensor	2	Ceiling Mounted	69
Wall Mounted	0		

Initial Investment		**Equipment Rentals**	
Material Cost	$13,432.63	Scissor Lift 26' - Interior Spaces	$0.00
Labor Cost	$23,256.05	Bucket Truck - Exterior Spaces	$0.00
Local Electric Rate:	$0.17 $/kWh	Estimated Annual Energy Savings:	19,129
Hourly Labor Rate For Electrician:	$72.40	Estimated Annual Energy Cost Savings:	$3,049
Budgeted Initial Investment:	$36,689	Estimated Annual O&M Cost Savings:	$1,764
Estimated Return on Investment: *(Including O&M Savings)*	7.62 Years	Estimated Annual Cost Savings:	$4,813

UIC	Control External Air Leakage In Commercial Buildings
EAE4A	Location: Exterior Doors

ENTER EXISTING CONDITION

Insert Existing Estimated Air Change Rate/Hr (ACH 1): *(Existing Air Changes Per Hour, 3 is very leaky and 0.35 ideal)*	0.75		Cubic Feet/Min (CFM 1):	875	
Insert Proposed Estimated Air Change Rate/Hr (ACH 2):	0.53		Cubic Feet/Min (CFM 2):	613	
Estimated Space Volume Under Consideration	70,000.00	Cu.Ft			

WINTER			SUMMER		
Select Type of Heating Fuel	Natural Gas	(Select)	Is The Building Cooled?	Yes	
Estimated Annual Heating Plant Efficiency	85.00	%	Estimated Annual Cooling Plant Efficiency	7.00	EER
Annual Heating Degree Days(HDD):	2,963		Annual Cooling Degree Days(CDD):	1,407	
Estimated Total Annual Input Heating Energy Savings	237	Therms	Estimated Total Annual Input Cooling Energy Savings	1,368	kWh
Cost/Unit of Heating Fuel:	$1.40	$/Therm	Cost/Unit For Electricity	$0.16	$$
Estimated Annual Heating Cost Savings	$331	$$	Estimated Annual Cooling Cost Savings	$218	$$

Cost Analysis

Install Flush Mounted, Vinyl Door Sweeps ?	Yes		Total Length of Door Sweeps to Be Installed: *(3.5' Standard Width Door)*	100	LF
Install Window Air Conditioner Covers For Winter:	No		Number of Air Conditioner Covers To Be Installed: *(Covers would meet HUD Chapter-12 Energ Conservation Compliance Section 329C)*	0	
Estimated Annual O&M Savings	$27		Estimated Length of Joints To Be Re-Caulked: *(Includes Demolition and Re-Caulking)*		LF
Total Estimated Annual Cost Savings	$576		Total Cost For Controlling Air Leakage	$1,824	
Simple Pay Back Period	3.16	Yrs	*Type of Recommendation*	Capital Cost ECM Recommendation	

ECM DESCRIPTION:

One of the most commonly used methods for reducing air leakage through building structures is caulking and weather stripping.

Particularly effective measures include caulking cracks around windows and door frames and weather stripping around windows and doors. Weather-stripping and caulking of doors and windows, helps in thermally isolating of the building with the outside atmosphere. This prevents the infiltration of external un-conditioned air along with moisture and humidity into the conditioned space at the same time, prevents the conditioned air from escaping out. A precisely thermally isolated building directly affects the cooling and heating load on the facilities HVAC system as it has to put in less effort in maintaining the desired temperature inside the facility. As per ASHRAE a well insulated and ventilated building should have an air change rate not more than 0.35 per hour.

In order to ensure proper thermal isolation of the property, EMG recommends ensuring that the weather-stripping and caulking of all external doors and windows remains intact. Its also recommended that door sweeps be installed under all the doors opening into conditioned space. Any visible cracks between the window frame and wall should be plugged by caulking.

In case of building with window airconditioners, EMG recommends use of interior/exterior window airconditioner covers so as to prevent cold air drafts into the conditioned space during the winter so as to save on heating costs.

SUMMARY:

Initial Investment:	$1,824	Simple Pay Back Perioc	3.16 Yrs
Annual Energy Cost Savings:	$576		

UIC	Install Low Flow Faucet Aerators
EAP2-b	**Location**: Restrooms and Classrooms

Property Type:	Commercial		Estimated No. of Operational Weeks	36	
			Number of Occupied Days/Week (Max 7)	5	
KITCHEN FAUCETS			**BATHROOM FAUCETS**		
Number of Occupants Affected By Retrofit	320		Number of Occupants Affected by Retrofit	320	
Do You Want To Replace Kitchen Faucets Aerators	Yes	*(Select)*	Do You Want To Replace Bathroom Faucets Aerators	Yes	*(Select)*
Total Number of Faucet Aerators To Be Replaced	11		Total Number of Faucet Aerators To Be Replaced	13	
Total Number of Faucets To Be Replaced:	0		Total Number of Faucets To Be Replaced:	0	
GPM of Existing Faucet Aerators	2.2	GPM	GPM of Existing Faucet Aerators	2.2	GPM
GPM of Proposed Faucet Aerator	1.5	GPM	GPM of Proposed Faucet Aerator	0.5	GPM
Estimated Number of Uses Per Day	2		Estimated Number of Uses Per Day	4	
Annual Water Savings From Installing Low Flow Aerators:			45.34	kGal	
WATER & ENERGY SAVING CALCULATION			**COST SAVING CALCULATION**		
Select Type of Water Heater Fuel:	Electric	(Select)	Property Location in United States	North Central Localities	
Energy Factor of Domestic Hot Water Heater:	0.77	EF	Heating Fuel Tariff	$0.16	$/kWh
Hot Water Discharge Temperature at Faucet	110.00	°F	Water Tariff ($/1000 Gal)	$18.72	$/kGal
Equivalent Heating Fuel Savings: *Savings Discounted by 15% to Account For Cold Water Use*	7,341	kWh	Annual Cost Savings In Form of Water	$849	$
Annual Water Savings	45.34	kGal	Annual Energy Savings From Water Heater	$1,170	$
COST BENEFIT ANALYSIS					
Estimated Total Annual Cost Savings	$2,019	$$	Estimated Total Installation Cost	$366	$$
Simple Payback Period	0.18	Years	*Type of Recommendation*	No/Low Cost ECM Recommendation	

ECM EXPLANATION:

By reducing the flow of water coming from the restroom faucets, aerators can generate energy savings at low cost and with easy installation. The savings generated would be in the form of reduced water and sewer costs and at the same time aerators would save energy by reducing the demand for hot water. The average faucet has a flow rate of about 2 to 4 GPM. Adding a screw-in faucet aerator reduces the flow to 0.5 to 1.5 GPM in the bathroom and 2.2 GPM in the kitchen. In addition to saving energy and water, the "foamier" water that comes from faucet aerators wets objects better than water from a faucet with no aerator, which tends to bounce off the object rather than thoroughly wetting it.

EMG recommends replacing the proposed faucet aerators with new low flow aerators as mentioned above. The proposed ECM shall also result in an annual energy saving in form of reduction in water heating bills.

Summary:

Initial Investment: $366 Estimated Annual Cost Savings: $2,019 Simple Payback Period (Yrs): 0.18

UIC	Install Low Flow Tankless Restroom Fixtures
EAP4	Location: Restrooms

ECM FOR DETERMINING WATER SAVINGS IN COMMERCIAL PROPERTIES

Number of Males	160	
Number of Females	160	
Number of Occupied Days Per Week (Max 7)	5	
Number of Occupied Weeks/Year (Max 52)	36	
Number of Urinals To Be Retrofitted	6	
Number of Water Closets To Be Retrofitted	21	
No. of Water Closets With Separate Flush Tank *(Typical Residential Type)*	0	
Estimated Restroom Usage/Individual/Day *Default is 4 Uses/Day For Residential/Office*	4	(Select)

Urinal Water Savings

Do you Want To Make Any Changes To The Urinals?	No	
Estimated Existing Use of Urinal/Day/Man	80%	
Existing Gallons Per Flush Ratings For Urinal Flushes	1.00	GPF
Proposed Urinal	0.125 GPF -Wall Mount	
GPF of Proposed Urinal Flush Valve** ***(1992 EpACT Energy Act Mandates 1.0GPF Max on Urinals)*	0.125	GPF
Estimated Annual Water Savings From Urinal	0.00	kGal

Water Closet Water Savings

Tankless Water Closets

Do The Water Closet Need To Be Retrofitted?	*(Select)*	Yes	
Existing Gallons Per Flush Ratings For Water Closet Flushes		1.60	GPF
Are The Existing Water Closet Being Replaced? *(If No; Then Only The Flush Valve Would Be Replaced With Dual Flush Retrofit Kit)*	*(Select)*	No	
No. of Tankless Water Closets		21	
GPF of Proposed Dual Flush- Water Closet Valve*	*Solid Waste (20%)*	1.60	GPF
**(Federal Law Requires All Flushes Not To Exceed 1.6 GPF)*	*Liquid Waste (80%)*	0.48	GPF
Estimated Annual Water Savings From Male Users		103.22	kGal
Estimated Annual Water Savings From Female Users		103.22	kGal
Total Water Savings From Water Closets		206.44	kGal

Water & Cost Saving Calculations

Water Savings Calculation

Water Savings By The Use of Low Flow Water Closet Flush Valves/Yr	206.44	kgal
Water Savings By The Use of Low Flow Urinal Flush Valves/ Yr	0.00	kgal
Total Annual Water Savings in kgal	206.44	kgal

Cost Savings Calculations

Enter Water Tariff Rate ($/1000Gal)	$18.72	$$
Estimated Cost Savings From Water	$3,865	$$

Estimated Cost of Retrofit

Cost For Replacing Existing Urinal Fixture With A Low Flow Fixture	$0 *(Includes Labor)*	$$
Cost For Replacing Existing Flush Valves With Low Flow - Dual Flush Valves ($80 Per Unit) *(Up For Liquid Waste And Down For Solid Waste)*	$13,000 *(Includes Labor)*	$$
Estimated Total Cost For Retrofit	$13,000	$$
Simple Pay Back Period	3.36	Yrs
Type of Recommendation	Capital Cost ECM Recommendation	

ECM EXPLANATION:

The highest water utilization at any home/office occurs in the restrooms. It is estimated that on an average a normal human being uses the restroom at least four times a day. Keeping with the global water conservation objectives, federal law prohibits use of any new water closet flushes over 1.6 GPF. At the same time the '1992 EpACT' mandates all new Urinals to have a maximum 1.0 GPF flush valves on urinals.

EMG recommends replacing all urinals above 1.0 GPF with a new 0.5 GPF or lesser urinals. At the same time EMG also recommends replacing all the water closets having a GPF rating of 1.6 and over with low flow water closet fixtures equipped with dual flush valves.

In case the property doesn't wish to replace the entire water closet fixtures, EMG recommends retrofitting all the tankless water closet flush fixtures with new dual flush fixtures that would result in a 30% water savings per flush for liquid wastes, while retaining the same flush rate for solid wastes.

SUMMARY:

Initial Investment:	$13,000	Simple Payback Period:	3.36 Yrs
Annual Cost Savings:	$3,865		

UIC	**Replace External Windows**
EAE2	**Location: Throughout**

ENTER EXISTING CONDITIONS

Existing and Proposed Window Properties

Total Sq.Ft window area:	1,416	sq.ft
Approximate number of windows:	89	
Total existing window area:	1,416	Sq.Ft
Select The Existing Window Type	Metal Frame & Single Glazing	*(Select)*
Existing U-value of window: (1/R)	1.31	Btu/ ft²·°F·h
ASHRAE Climatic Zone	Zone-3	
New U-value with Double pane Low E window: (1/R) *AHRAE 90.1 Recommended Value*	0.35	Btu/ ft²·°F·h

Existing & Proposed Air Leakage Through Windows

Insert Existing Estimated Air Change Rate/Hr (ACH 1): *(Existing Air Changes Per Hour, 1.5 is very leaky and 0.35 ideal)*	0.75	
Insert Proposed Estimated Air Change Rate/Hr (ACH 2):	0.53	
Estimated Space Volume Under Consideration	350,604.00	Cu. Ft
Is the Property Cooled ?	Yes	*(Select)*

WINTER

Select Type of Heating Fuel	Natural Gas	*(Select)*
Net heating plant & distribution system efficiency:	79.00	**%**
Annual Heating Hours:	2,963	HDD
Estimated Total Annual Input Heating Energy Savings By Replacing Windows	12.24	Therms
Estimated Total Annual Input Heating Energy Savings Achieved By Controlling Air Leakage Through Windows	1,278	Therms
Estimated Total Input Heating Fuel Savings From Replacing Windows	1,290	Therms

SUMMER

Select Type of Cooling Fuel:	**Electric**	*(Default)*
Cooling Plant Efficiency **(EER)**:	7.00	**EER**
Annual Cooling Hours:	1,407	CDD
Annual Total Input Cooling Fuel Savings During Summer Season By Replacing Windows	6,558	kWh
Estimated Total Annual Input Cooling Energy Savings Achieved By Controlling Air Leakage Through Windows	6,850	kWh
Estimated Total Input Cooling Fuel Savings From Replacing Windows	13,407	kWh

ENERGY & COST ANALYSIS

Insert Cost of Heating Fuel:	$1.40	$/Therm	Annual Heating Cost Savings:	$1,801.02	$$
Insert Cost of Cooling Fuel:	$0.16	$/kWh	Annual Cooling Cost Savings:	$2,137.11	$$
Total Annual Cost Savings	$3,978		Total Annual Cost Savings From Heating & Cooling:	$3,938	$$
Cost of window upgrade:	$73,061		Estimated Annual O&M Savings	$39	$
Simple payback:	18.37	**Yrs**	*Type of Recommendation*	Capital Cost ECM Recommendation	

ECM DESCRIPTION:

Windows play a major role in the energy use and comfort of an interior space. In the winter, heat in a room is lost when cold outside air infiltrates around the edges of windows. Heat also can be lost by conduction directly through the pane, even if the window fits tightly. Windows with insulated panes, such as those filled with Argon address this issue, while proper caulking and sealant address the infiltration issue. The cold drafts and the chilly windowpane make the room uncomfortable. Windows also can help to heat a room by letting the sun's rays enter. While this solar radiation is beneficial in the winter, it can be a major source of discomfort in hot, summer climates. Energy Star rated windows with Low-E glazing are designed to keep the solar heat gain minimized during the summer months. Choosing a replacement window that fits properly has the desired U-value, and proper glazing characteristics is critical to energy conservation through window upgrades.

Summary:

Initial Investment:	$73,061	Simple Payback	18.37 Yrs
Annual Energy Cost Savings:	$3,978		

APPENDIX F:
Solar PV

UIC	Install Fixed Tilt Solar Photovoltaic System
EAR-2	Details:

Select State: Northern California　**Electric Rate:** $0.16 $/KWH　Annual Electric Consumption: 190,992 KWh

Roof No.	Description	Number of Roofs	DC System Size Per Roof	PV System Sizing For All Roofs	Estimated Number of 315 Watt PV Panels:	Total Estimated Annual Electricity Generated/ Roof	Total Estimated Electricity Generated (All Roofs)	Total Cost Savings	Installation Cost: ($3.5/Watt)	Simple Pay Back Period without Incentives	One Time Potential Utility or State Incentives	One Time Potential Federal Incentives	Annual Potential Incentives and Rebates		Simple Pay Back Period with All Incentives
			kW	kW		kWh	kWh			Yrs		Dept. of Treasury Renewable Grant (30%)	Federal REPI Incentive	Solar Renewable Certificates (SRECS)- (~$0/MWH)	Years
												30%	$0.02	$0	
1	Building 1	1	35.20	35	112	53,791	53,791	$8,574	$123,200	14.4	$0	$36,960	$1,183	$0	8.7
2	Building 2	1	13	13	40	19,255	19,255	$3,069	$44,100	14.4	$0	$13,230	$424	$0	8.7
3	Building 3	1	20	20	63	30,105	30,105	$4,799	$68,950	14.4	$0	$20,685	$662	$0	8.7
4				0	0		0	$0	$0		$0	$0	$0	$0	
5				0	0		0	$0	$0		$0	$0	$0	$0	
6				0	0		0	$0	$0		$0	$0	$0	$0	
7				0	0		0	$0	$0		$0	$0	$0	$0	
8				0	0		0	$0	$0		$0	$0	$0	$0	
9				0	0		0	$0	$0		$0	$0	$0	$0	
10				0	0		0	$0	$0		$0	$0	$0	$0	
		3		**68**	**214**	**103,151.0**	**103,151**	**$16,442**	**$236,250**	**14.37**	**$0**	**$70,875**	**$2,269**	**$0**	**8.68**

Solar Rooftop Photovoltaic Analysis		
Total Number of Roofs	3	
Estimated Number of Panels	214	
Estimated KW Rating	68	KW
Potential Annual KWh Produced	103,151	KWh
% of Current Electricity Load	54.0%	

Financial Analysis		
Investment Cost	$236,250	
Estimated Energy Cost Savings	$16,442	
Potential Rebates	$70,875	
Potential Annual Incentives	$2,269	
Payback without Incentives	14.4	years
Incentive Payback but without SRECS	8.7	years
Payback with All Incentives	8.7	years