LEVEL II ENERGY AUDIT

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

DLR GROUP
1050 20th Street, Suite 250
Sacramento, California 95841

ZERO NET ENERGY ASHRAE LEVEL II AUDIT

OAK RIDGE ELEMENTARY SCHOOL

4501 Martin L. King Jr. Boulevard

Sacramento, California 95820

PREPARED BY:
EMG / A Bureau Veritas Company
10461 Mill Run Circle, Suite 1100
Owings Mills, Maryland 21117
800.733.0660
www.emgcorp.com

EMG CONTACT:
Kaustubh Anil Chabukswar
Program Manager
800.733.0660 x7512
kachabukswar@emgcorp.com

EMG PROJECT #:

136988.19R000-040.268

DATE OF REPORT:

October 28, 2019

ONSITE DATE:

September 4, 2019

TABLE OF CONTENTS

Certification

EMG has completed an Energy Audit of Oak Ridge Elementary School located at 4501 Martin L. King Jr. Boulevard in Sacramento, California 95820. EMG visited the site on September 4, 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 95820. 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

Kathleen Wright

Reviewed by:

Kathleen Wright

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 Oak Ridge 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	001	School Building	16,803	171
2	002	School Building	5,095	55
3	P01	Portable Restrooms	491	8
4	P02	Portable School Building	6,878	75
5	P03	Portable School Building	960	15
6	P04	Portable School Building	960	15
7	P05	Portable School Building	960	15
8	P06	Portable School Building	960	15
9	P07	Portable School Building	983	15
10	P08	Portable School Building	960	15
11	P09	Portable School Building	1,920	30
12	P10	Portable School Building	1,920	30
13	P11	Portable School Building	983	15
14	P12	Portable School Building	983	15

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 four 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 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)*	$55,693 *(In Current Dollars)*
Estimated Annual Cost Savings *(Current Dollars Only)*	$9,285 *(In Current Dollars)*
ECM Effective Payback	6.0 years
Estimated Annual Energy Savings	11%
Estimated Annual Energy Utility Cost Savings *(Excluding Water)*	15%
Estimated Annual Water Cost Saving	16%

Solar Photovoltaic (PV) Screening for OAK RIDGE ELEMENTARY SCHOOL

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS		
Estimated Number of Panels	291	
Estimated KW Rating	92	KW
Potential Annual kWh Produced	122,752	kWh
% of Current Electricity Uses	52%	
FINANCIAL SUMMARY		
Investment Cost	$320,950	
Estimated Energy Cost Savings	$20,856	
Payback without Incentives	15.4	Years
Incentive Payback but without SRECs	9.5	Years
Payback with All Incentives	9.5	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)	30 kBtu/ft^2
Post ECM Site Energy Use Intensity (EUI)	26 kBtu/ft^2
SOURCE ENERGY USE INTENSITY (EUI)	**RATING**
Current Source Energy Use Intensity (EUI)	76 kBtu/ft^2
Post ECM Source Energy Use Intensity (EUI)	65 kBtu/ft^2
BUILDING COST INTENSITY (BCI)	**RATING**
Current Building Cost Intensity	$1.11/ft^2
Post ECM Building Cost Intensity	$0.95/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	136 MMbtu
Total CO_2 Emissions Reduced	13.1 $MtCO_2$/Yr.
Total Cars Off the Road (Equivalent)*	2
Total Acres of Pine Trees Planted (Equivalent)*	3

**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	1,217,122 kBtu
Total Annual Energy Savings for Non-Renewable Energy Measures	135,891 kBtu
Total Annual Energy Savings from Renewable Energy Measures	418,830 kBtu
Total Annual Energy Savings	554,721 kBtu
Net Energy Consumption from Grid Post Implementation	662,401 kBtu
% Energy Reduction (Annual Energy-Net Energy) / (Annual Energy)	54%

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.

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

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 Energy Conservation Measures For Oak Ridge 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	Electricity								
		$	Therms	kWh	kgal	$	$	$	Years		$	Years
No/Low Cost Recommendations												
1	Install Low Flow Faucet Aerators Location: Restrooms And Classrooms	$640	0	16,827	93	$3,431	$0	$3,431	0.19	45.74	$28,625	10.00
Totals for No/Low Cost Items		**$640**	**0**	**16,827**	**93**	**$3,431**	**$0**	**$3,431**	**0.19**			
Capital Cost Recommendations												
1	Upgrade Building Lighting to LED and Install Automatic Lighting Controls Location: Building Interior And Exterior	$3,617	0	2,808	0	$477	$128	$605	5.97	2.00	$3,611	15.00
2	Upgrade Electric Heating System To Heat Pumps Location: Portable Classrooms	$26,528	0	24,618	0	$4,182	$0	$4,182	6.34	2.35	$35,695	20.00
3	Install Low Flow Tankless Restroom Fixtures Location: Restrooms	$17,645	0	0	342	$2,098	$0	$2,098	8.41	1.42	$7,405	15.00
Total For Capital Cost		**$47,789**	**0**	**27,426**	**342**	**$6,758**	**$128**	**$6,886**	**6.94**			
	Interactive Savings Discount @ 10%		0	-4,425	-43	-$1,019	-$13	-$1,032				
	Total Contingency Expenses @ 15%	$7,264										
Total for Improvements		**$55,693**	**0**	**39,828**	**391**	**$9,170**	**$116**	**$9,285**	**6.00**			

List of Recommended For Consideration Energy Conservation Measures For Oak Ridge Elementary School

ECM #	UIC	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	EAH12-B	Replace Rooftop Package Unit Location: Rooftop	$68,250	962	0	0	0	8,375	0	$2,680	$134	$2,814	24.25	0.61	-$26,383	20.00
1	EAE2	Replace External Windows Location: Throughout	$70,598	700	0	0	0	9,201	0	$2,478	$25	$2,503	28.21	#DIV/0!	-$27,014	25.00
Total for Improvements			**$68,250**	**962**	**0**	**0**	**0**	**8,375**	**0**	**$2,680**	**$134**	**$2,814**	**24.25**			

2. Introduction

The purpose of this Energy Audit is to provide Oak Ridge 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	501
% of Male Occupants	50%

POINT OF CONTACT	
Point of Contact Name	Charmaie Brown
Point of Contact Title	Office Manager
Point of Contact – Contact Number	916-395-4665

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

Description:

Heating and cooling for the permanent buildings 001 and 002 is provided primarily by packaged rooftop units utilizing natural gas for heating. Portable classrooms P02, P09, P11 and P12 are served primarily by split system condensing units and natural gas fired furnaces. Wall mounted heat pumps serve portable classrooms P03, P04, P05, P06, P07 and P10.

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

BUILDING CENTRAL HEATING SYSTEM	
Primary Heating System	Rooftop Packaged Units
Secondary Heating System	Forced Air Furnace and Wall Mounted Heat Pumps
Hydronic Distribution System	Not Applicable
Primary Heating Fuel	Natural Gas
Heating Mode Set-point	69 °F
Heating Mode- Set-back Temperature	53 °F

BUILDING COOLING SYSTEM	
Primary Cooling System	Packaged Units
Secondary Cooling System	Split Systems
Hydronic Distribution System	Not Applicable
Cooling Mode Set-point	73 °F
Cooling Mode- Set-back Temperature	93 °F

AIR DISTRIBUTION SYSTEM	
Building Ventilation	Roof-top 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	Electricity

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
$0.17 /kWh	$1.31 /therm	$6.14 /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.

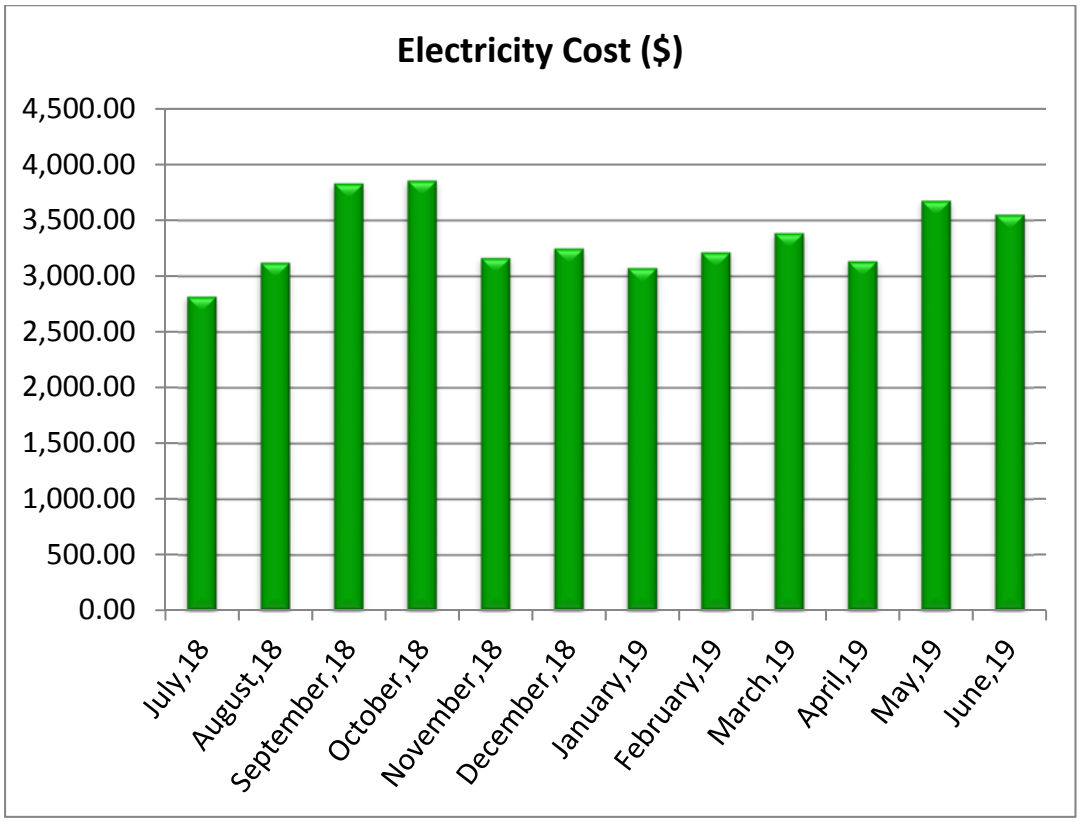
4.1. Electricity

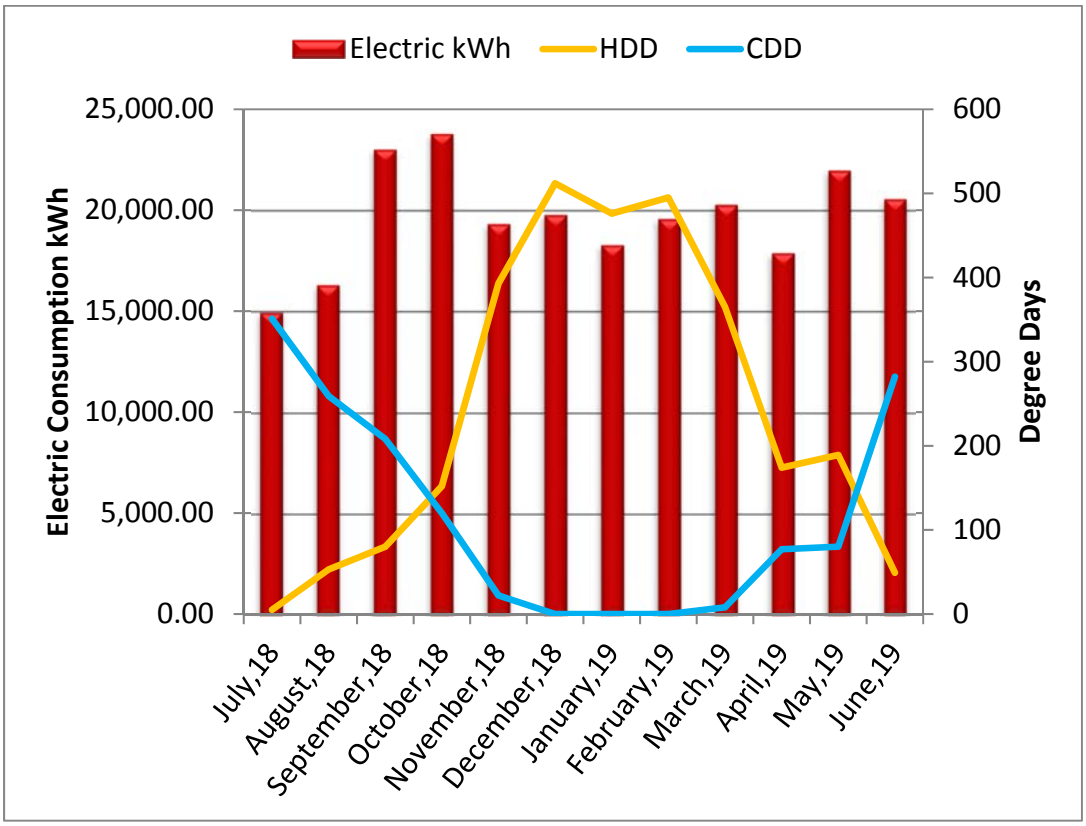
PGE satisfies the electricity requirements for the facility. The primary end uses for electric utility compromises of lighting, cooling, office/school equipment, and appliances in the break room.

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	14,973.00	0.19	2,817.00
August,18	16,327.34	0.19	3,121.73
September,18	23,017.94	0.17	3,829.30
October,18	23,790.29	0.16	3,855.76
November,18	19,333.75	0.16	3,162.67
December,18	19,785.21	0.16	3,247.28
January,19	18,297.21	0.17	3,074.67
February,19	19,589.07	0.16	3,213.75
March,19	20,290.42	0.17	3,386.03
April,19	17,904.18	0.17	3,132.93
May,19	21,972.19	0.17	3,676.05
June,19	20,564.09	0.17	3,551.31
Total/average	**235,844.71**	**0.17**	**40,068.48**


Electricity Cost ($)
4,500.00
4,000.00
3,500.00
3,000.00
2,500.00
2,000.00
1,500.00
1,000.00
500.00
0.00
July,18
August,18
September,18
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

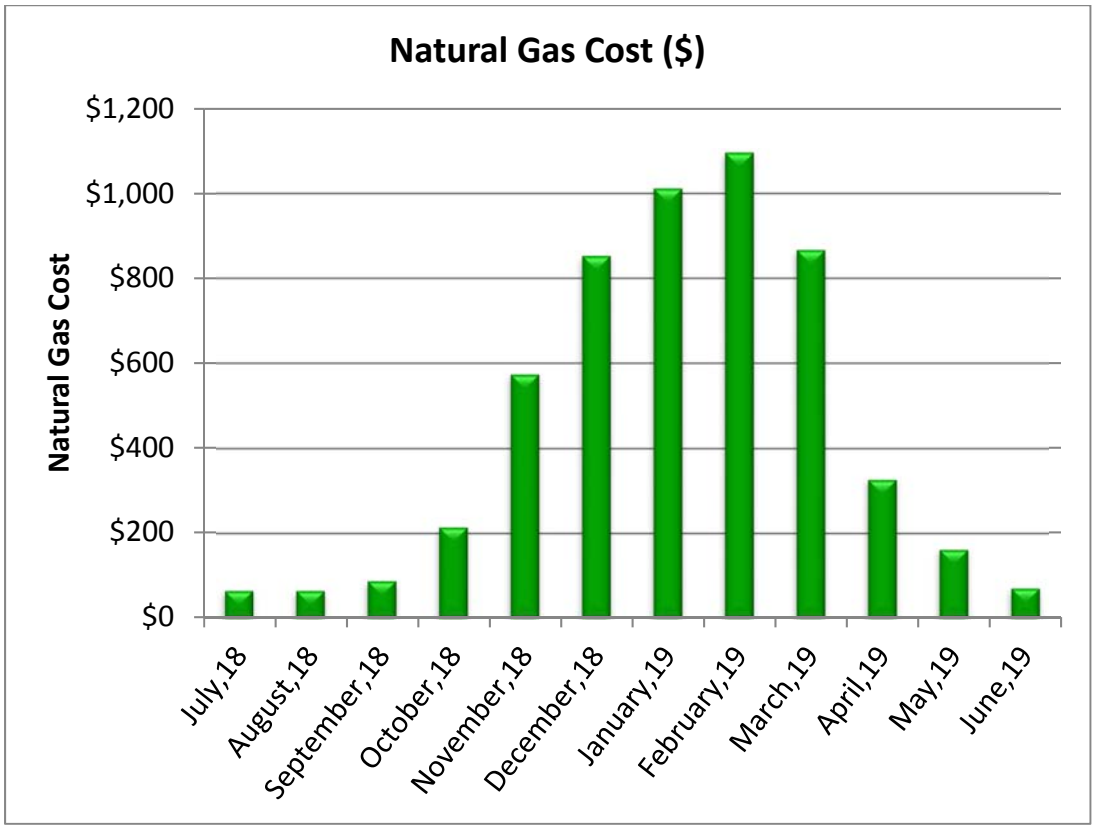
4.2. Natural Gas

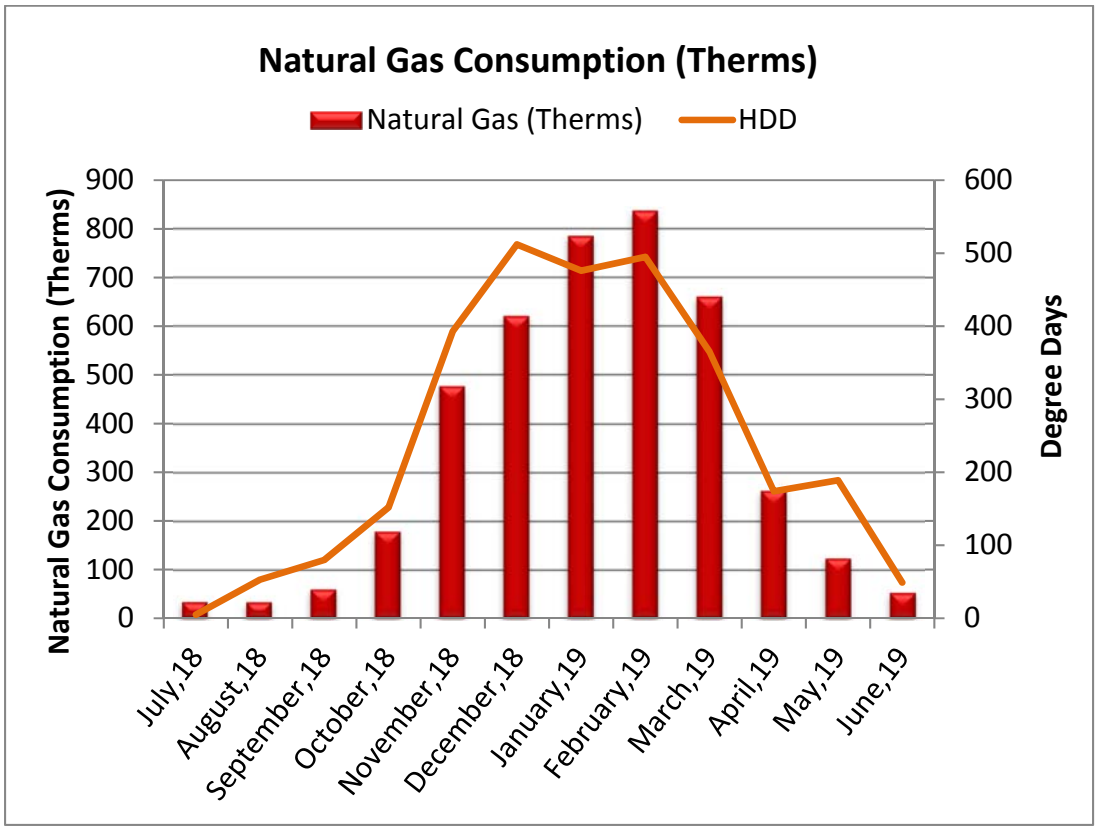
SMUD Gas satisfies the natural gas requirements of the facility. The primary end use of natural gas is for building heating, domestic water heating, and cooking in the cafeteria.

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	34	$1.92	$65
August,18	34	$1.92	$65
September,18	60	$1.47	$88
October,18	179	$1.20	$215
November,18	477	$1.20	$574
December,18	620	$1.37	$852
January,19	785	$1.29	$1,011
February,19	836	$1.31	$1,095
March,19	660	$1.31	$867
April,19	263	$1.25	$328
May,19	124	$1.31	$162
June,19	53	$1.33	$70
Total/average	**4,124**	**$1.31**	**$5,391**


Natural Gas Cost ($)
Natural Gas Cost
$1,200
$1,000
$800
$600
$400
$200
$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

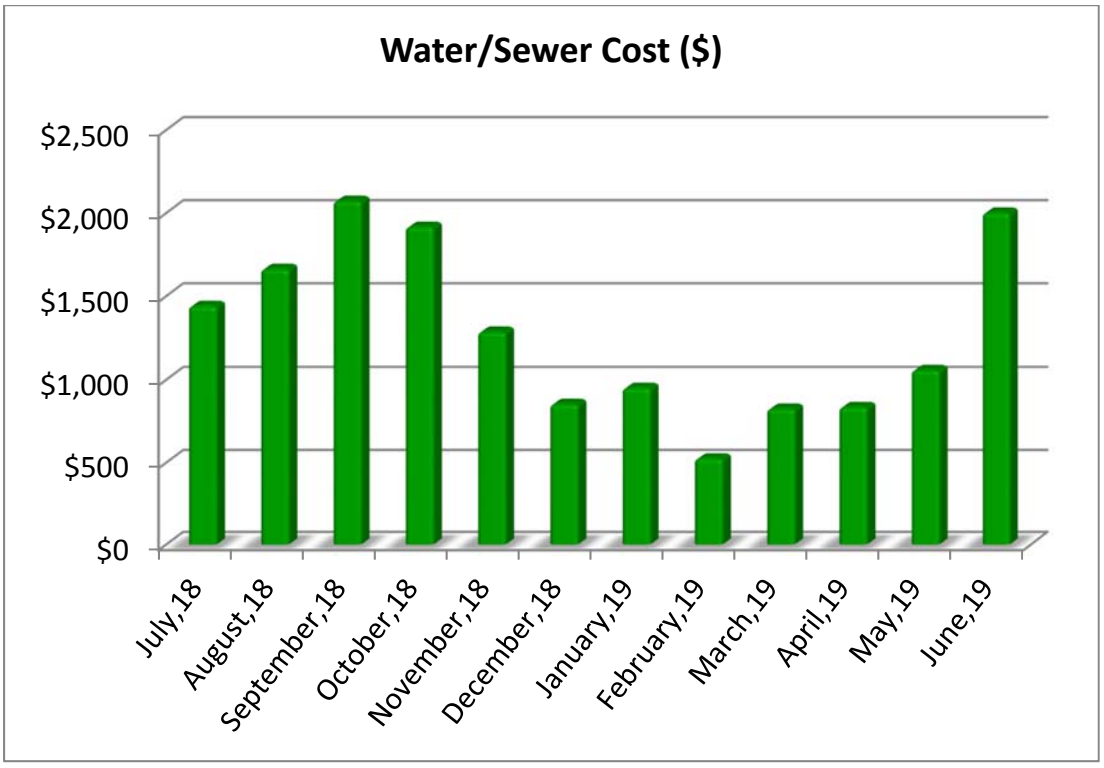

Natural Gas Consumption (Therms)
Natural Gas (Therms)
HDD
Natural Gas Consumption (Therms)
900
800
700
600
500
400
300
200
100
0
600
500
400
300
200
100
0
Degree Days
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

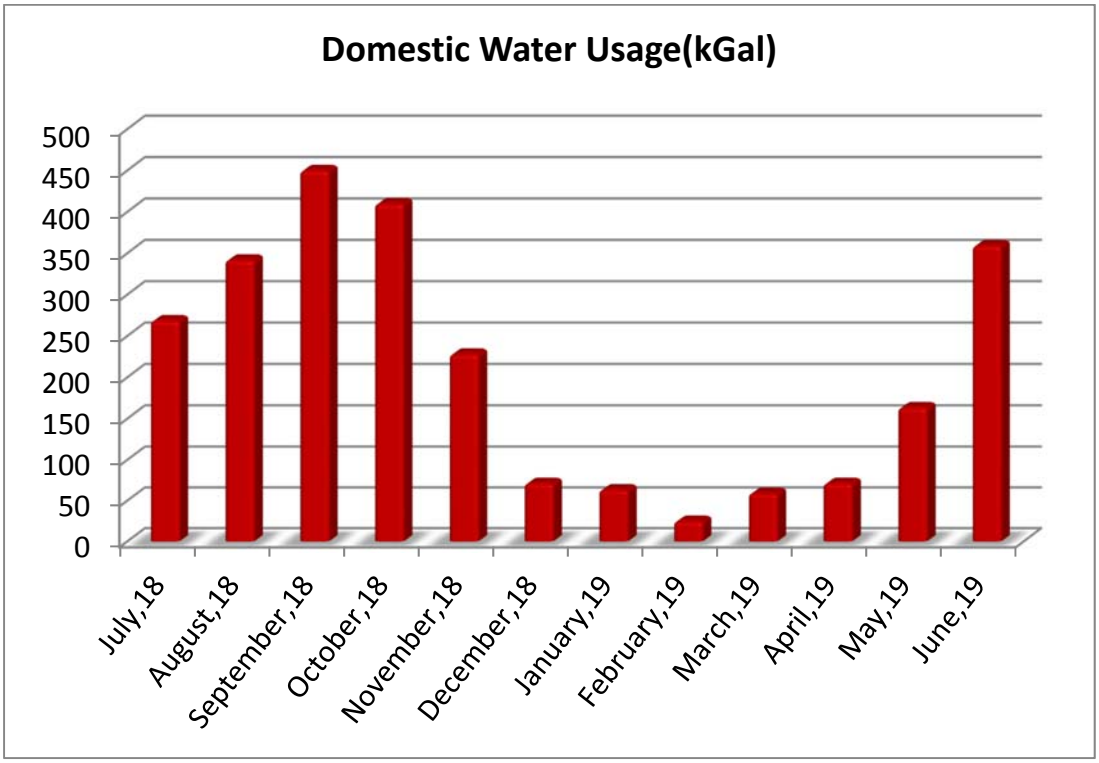
4.3. Water and Sewer

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	269	$5.36	$1,443
August,18	342	$4.86	$1,666
September,18	451	$4.61	$2,076
October,18	411	$4.67	$1,919
November,18	229	$5.63	$1,288
December,18	72	$11.93	$857
January,19	64	$14.90	$954
February,19	25	$20.77	$527
March,19	60	$13.88	$828
April,19	72	$11.67	$838
May,19	164	$6.47	$1,061
June,19	360	$5.57	$2,004
Total/average	**2,518**	**$6.14**	**$15,460**


Water/Sewer Cost ($)
$2,500
$2,000
$1,500
$1,000
$500
$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


Domestic Water Usage(kGal)
500
450
400
350
300
250
200
150
100
50
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 energy 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 production to the building.

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS		
Estimated Number of Panels	291	
Estimated KW Rating	92	KW
Potential Annual kWh Produced	122,752	kWh
% of Current Electricity Uses	52%	
FINANCIAL SUMMARY		
Investment Cost	$320,950	
Estimated Energy Cost Savings	$20,856	
Payback without Incentives	15.4	Years
Incentive Payback but without SRECs	9.5	Years
Payback with All Incentives	9.5	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	Output Capacity	Room Number	Space Served	Quantity
Water Heater	A. O. Smith	EES 30 915	GJ94-2013725-S06	30 GAL, 4.5 kW	-	Janitor - J001	001 Main Building	1
Water Heater	State	8220RTA	1242M001401	80 GAL, 4.5 kW	-	Utility - TS11	001 Main Building	1
Packaged Unit (RTU)	BDP	581BPV060072ADA	2199G20430	72 MBH	59 MBH	Classroom - 003	002 Classrooms 1 to 4	1
Exhaust Fan	Penn Ventilator Company	FX8B	No tag/plate found	2000 CFM	-	Roof	P01 Portable Restrooms	1
Packaged Unit (RTU)	BDP	581BPV060872ADAA	2199G29415	72 MBH	59 MBH	Classroom 1 - O001	002 Classrooms 1 to 4	1
Packaged Unit (RTU)	BDP	581BPV060072ADA	2299G20342	72 MBH	59 MBH	Classroom - 004	002 Classrooms 1 to 4	1
Furnace	Bryant	350MAV060080ADKA	0499A00808	80 MBH	75 MBH	Classroom - 0012	P02 Portable Classrooms 9 to 15	1
Furnace	Bryant	350MAV060080ADKA	0499A00002	80 MBH	75 MBH	Classroom - 0014	P02 Portable Classrooms 9 to 15	1
Furnace	Bryant	350MAV060080ADKA	8499A00885	80 MBH	75 MBH	Classroom - 0011	P02 Portable Classrooms 9 to 15	1
Furnace	Bryant	350MAV060080ADKA	1999A00970	80 MBH	75 MBH	Classroom - 0015	P02 Portable Classrooms 9 to 15	1
Furnace	Bryant	350MAV060080ADKA	1999A00971	80 MBH	75 MBH	Classroom - 0010	P02 Portable Classrooms 9 to 15	1
Furnace	Bryant	350MAV060080ADKA	1999A00974	80 MBH	75 MBH	Classroom - 0013	P02 Portable Classrooms 9 to 15	1
Furnace	Bryant	350MAV060080ADKA	-	80 MBH	75 MBH	Classroom - 0009	P02 Portable Classrooms 9 to 15	1
Split System Condensing unit	Bryant	597CNX048000ADAA	0499E01150	4 TON	-	Classroom - 0013	P02 Portable Classrooms 9 to 15	1
Split System Condensing unit	Bryant	597CNX048000ADAA	Inaccessible	4 TON	-	Classroom - 0010	P02 Portable Classrooms 9 to 15	1
Split System Condensing unit	Bryant	597CNX048000ADAA	Inaccessible	4 TON	-	Classroom - 0009	P02 Portable Classrooms 9 to 15	1
Unit Ventilator	No tag/plate found	No tag/plate found	No tag/plate found	3 TON	-	Classroom - 018	P03-P04-P05 Portable Classrooms 16 to 18	1
Split System Condensing unit	Bryant	597CNX048000ADAA	Inaccessible	4 TON	-	Classroom - 0014	P02 Portable Classrooms 9 to 15	1
Wall Mounted Heat Pump	Bard	No tag/plate found	No tag/plate found	3.5 TON	-	Classroom - 028	P10 Portable Classrooms 26 to 28	1
Split System Condensing unit	Bryant	Inaccessible	Inaccessible	5 TON	-	Teachers' lounge - 029	P11-P12 Lounge 29 and Portable Classroom 30	1
Split System Condensing unit	Bryant	Inaccessible	Inaccessible	5 TON	-	Classroom - 030	P11-P12 Lounge 29 and Portable Classroom 30	1

Furnace	Bryant	350MAV060080	0499A00807	80 MBH	75 MBH	Classroom - 030	P11-P12 Lounge 29 and Portable Classroom 30	1
Furnace	Bryant	350MAV060080	1799A01535	80 MBH	75 MBH	Teachers' lounge - 029	P11-P12 Lounge 29 and Portable Classroom 30	1
Split System Condensing unit	Bryant	597CNX048000ADAA	0499E01112	4 TON	-	Classroom - 0015	P02 Portable Classrooms 9 to 15	1
Wall Mounted Heat Pump	Bard	No tag/plate found	No tag/plate found	3.5 TON	-	Classroom - 017	P03-P04-P05 Portable Classrooms 16 to 18	1
Wall Mounted Heat Pump	Bard	Illegible	Illegible	3.5 TON	-	Classroom - 016	Classrooms 16 to 18	1
Wall Mounted Heat Pump	Bard	WH431-A10X4XXX	176D991339418-02	3.5 TON	-	Classroom - 020	P06 Portable Classrooms 19 and 20	1
Wall Mounted Heat Pump	Bard	WH431-A10CX4XXX	17GD99133979702	3.5 TON	-	Classroom - 019	P06 Portable Classrooms 19 and 20	1
Wall Mounted Heat Pump	Sun Mfg	HVA36105C	B900610C	3 TON	-	Classroom - 022	P07-P08 Portable Classrooms 21 and 22	1
Wall Mounted Heat Pump	Bard	No tag/plate found	No tag/plate found	3.5 TON	-	Classroom - 021	P07-P08 Portable Classrooms 21 and 22	1
Split System Condensing unit	CAC/BDP	PA13NR048-J	0612X75374	4 TON	-	Classroom - 025	P09 Portable Classrooms 23 to 25	1
Split System Condensing unit	CAC/BDP	PA13NR048-J	0612X75386	4 TON	-	Classroom - 024	P09 Portable Classrooms 23 to 25	1
Furnace	Bryant	350MAV060080	Q799A01539	80 MBH	75 MBH	Classroom - 025	P09 Portable Classrooms 23 to 25	1
Furnace	Bryant	350MAV060080	1999A00963	80 MBH	75 MBH	Classroom - 024	P09 Portable Classrooms 23 to 25	1
Wall Mounted Heat Pump	Bard	WH361-A05XX4XXX	125B981201251-02	3 TON	-	Classroom - 027	P10 Portable Classrooms 26 to 28	1
Wall Mounted Heat Pump	Bard	WH361-A05XX4XXX	125C981217026-02	3 TON	-	Classroom - 026	P10 Portable Classrooms 26 to 28	1
Packaged Unit (RTU)	BDP	581BPV060072ADA	2299G20347	72 MBH	59 MBH	Classroom - 002	002 Classrooms 1 to 4	1
Split System Condensing unit	Bryant	597CNX048000ADAA	0499E01157	4 TON	-	Classroom - 0011	P02 Portable Classrooms 9 to 15	1
Exhaust Fan	Penn Ventilator Company	FX8B	No tag/plate found	2000 CFM	-	Roof	P01 Portable Restrooms	1
Split System Condensing unit	Bryant	597CNX048000ADAA	Inaccessible	4 TON	-	Classroom - 0012	P02 Portable Classrooms 9 to 15	1
Packaged Unit (RTU)	BDP	583ANW024040AAHD	2199G11134	40 MBH	32.8 MBh	Kitchen - K001	001 Main Building	1
Packaged Unit (RTU)	BDP	581BPV150224AEAA	2399G30882	224 MBH	183 MBh	MPR - U001	001 Main Building	1
Packaged Unit (RTU)	BDP	581BPV048072ADAA	2199G20344	72 MBH	59 MBH	Classroom 8 - O012	001 Main Building	1
Packaged Unit (RTU)	BDP	581BPV8072ADAA	2199G20354	72 MBH	59 MBH	Classroom 31 - O008	001 Main Building	1
Packaged Unit (RTU)	BDP	581BPV048072ADAA	2199G20345	72 MBH	59 MBH	Classroom 6 - O010	001 Main Building	1
Packaged Unit (RTU)	BDP	581BPV048872ADAA	2199G20355	72 MBH	59 MBH	Classroom 34 - I005	001 Main Building	1
Packaged Unit (RTU)	BDP	581BPV048072ADAA	2199G20362	72 MBH	59 MBH	Library - X009	001 Main Building	1
Packaged Unit (RTU)	BDP	581BPV048072ADAA	2199G20358	72 MBH	59 MBH	Classroom 32 - O007	001 Main Building	1

Exhaust Fan	Penn Ventilator Company	FX13BT	No tag/plate found	1500 CFM	-	Kitchen - K001	001 Main Building	1
Packaged Unit (RTU)	BDP	581BPV048072ADAA	2199G26349	72 MBH	59 MBH	Offices	001 Main Building	1
Packaged Unit (RTU)	BDP	581BPV048072ADAA	2199G20353	72 MBH	59 MBH	Classroom 33 - O006	001 Main Building	1
Packaged Unit (RTU)	BDP	581BPV036072ADAA	2099G20253	72 MBH	59 MBH	MPR - U001	001 Main Building	1
Packaged Unit (RTU)	Bryant	580JP05A072A2A0AAA	0812C75659	72 MBH	59 MBH	Classroom 7 - O011	001 Main Building	1
Water Heater	Gaffers & Sattler	Mission	No tag/plate found	20 GAL,	-	Plant Mgr - C001	001 Main Building	1
Exhaust Fan	No tag/plate found	No tag/plate found	No tag/plate found	Tpp CFM	-	Roof, east	001 Main Building	1

APPENDIX C:
Lighting System Schedule

										Lamp Details				Fixture Details				Existing Consumption	
Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	Additional Area Description	LUX	Control Quantity	Existing Control	Technology	Sub-Technology	Lamp Type	Total Lamps	Fixture Type	Fixture Quantity	24x7 Fixture Count	Fixture Height	Annual Hours	Existing Annual kWh
1	PO7 to PO11	Interior		CLASSROOM	21		-	6	Light Switch	LED	-	-	60	2x4 Prism Troffer	30	0	8	2,160	-
2	PO6	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 2 Pin	CFL13	2	Wallpack-Vertical	2	0	10	2,160	56
3	PO6	Interior		CLASSROOM	19		-	4	Light Switch	LED	-	-	96	2x4 Prism Troffer	32	0	8	2,160	-
4	PO6	Exterior		HALLWAY	Exterior		-	1	Timer	HID	MH	MH250	1	Wallpack-Horizontal	1	0	12	2,160	540
5	PO3 to PO5	Interior		CLASSROOM	16		-	6	Light Switch	LED	-	-	60	2x4 Prism Troffer	30	0	8	2,160	-
6	PO3 to PO5	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 4 Pin	CFL42	7	Surface Mount Hor	7	0	8	2,160	635
7	PO7 to PO11	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 2 Pin	CFL13	4	Wallpack-Vertical	4	0	10	2,160	112
8	PO7 to PO11	Interior		CLASSROOM	23		-	2	Ceiling-Mounted Sensor	LED	-	-	24	2x4 Prism Troffer	12	0	8	2,160	-
9	PO7 to PO11	Interior		CLASSROOM	25		-	2	Ceiling-Mounted Sensor	LED	-	-	18	2x4 Prism Troffer	9	0	8	2,160	-
10	PO12	Interior		CLASSROOM	26		-	2	Light Switch	LED	-	-	36	2x4 Prism Troffer	12	0	8	2,160	-
11	PO12	Interior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 4 Pin	CFL42	3	Surface Mount Can	3	0	8	2,160	272
12	PO13 to PO14	Interior		CLASSROOM	30		-	1	Light Switch	LED	-	-	28	2x4 Prism Troffer	14	0	8	2,160	-
13	PO13 to PO14	Interior		CLASSROOM	29		-	1	Light Switch	LED	-	-	28	2x4 Prism Troffer	14	0	8	2,160	-
14	PO2	Interior		CLASSROOM	15		-	14	Light Switch	LED	-	-	196	2x4 Prism Troffer	98	0	8	2,160	-
15	001	Interior		CLASSROOM	8		-	16	Light Switch	LED	-	-	360	2x4 Prism Troffer	120	0	8	2,160	-
16	002	Interior		CLASSROOM	4		-	16	Ceiling-Mounted Sensor	LED	-	-	136	2x4 Prism Troffer	68	0	8	2,160	-
17	002	Interior		CLASSROOM	4		-	16	Light Switch	Incan/H/MR	Incan	I10-Globe	4	High hat	4	0	8	2,160	86
18	002	Interior		CLASSROOM	4		-	16	Light Switch	Incan/H/MR	Incan	I10-Globe	4	High hat	4	0	8	2,160	86
19	001	Interior		CAFETERIA	U001		-	2	Light Switch	LED	-	-	72	2x4 Prism Troffer	18	0	18	2,160	-
20	001	Interior		KITCHEN	K001		-	3	Light Switch	LED	-	-	24	2x4 Prism Troffer	12	0	8	1,800	-
21	001	Interior		AUDITORIUM	Z001		-	2	Light Switch	LED	-	-	20	2x4 Indirect Troffer	5	0	8	720	-
22	001	Exterior		HALLWAY	Exterior		-	1	Timer	HID	MH	MH250	3	Wallpack-Horizontal	3	0	8	2,160	1,620
23	001	Interior		OFFICE	Plant manager		-	1	Light Switch	LED	-	-	2	2x4 Prism Troffer	1	0	8	2,160	-
24	001	Interior		HALLWAY	Hallway		-		Ceiling-Mounted Sensor	LED	-	-	22	2x4 Prism Troffer	11	0	8	2,160	-
25	001	Interior		OFFICE	C003	Nurse	-	1	Light Switch	LED	-	-	2	2x4 Prism Troffer	1	0	8	2,160	-
26	001	Interior		RESTROOM	Restroom		-	2	Light Switch	LED	-	-	4	2x4 Prism Troffer	2	0	8	2,160	-
27	001	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 2 Pin	CFL13	3	Wallpack-Vertical	3	0	8	2,160	84
28	PO13 to PO14	Exterior		HALLWAY	Exterior		-	1	Light Switch	HID	MH	MH250	1	Wallpack-Horizontal	1	0	8	2,160	540
29	001	Interior		RESTROOM	T002		-	2		LED	-	-	4	2x4 Prism Troffer	2	0	8	2,160	-
30	001	Interior		OFFICE	CooC		-	1	Light Switch	LED	-	-	4	2x4 Prism Troffer	2	0	8	2,160	-
31	001	Interior		OFFICE	Z003		-	2	Light Switch	LED	-	-	4	2x4 Prism Troffer	2	0	8	2,160	-
32	001	Interior		RESTROOM	T00G		-	2	Light Switch	LED	-	-	8	2x4 Prism Troffer	4	0	8	2,160	-
33	PO1	Interior		RESTROOM	T00g		-	3	Light Switch	LED	-	-	6	2x4 Prism Troffer	3	0	8	2,160	-
34	PO1	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 2 Pin	CFL13	2	Wallpack-Vertical	1	0	8	2,160	56
35	PO2	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 2 Pin	CFL13	6	Wallpack-Vertical	3	0	8	2,160	168
36	002	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 4 Pin	CFL42	4	Surface Mount Can	4	0	8	2,160	363
37	002	Exterior		HALLWAY	Exterior		-	1	Timer	HID	MH	MH250	2	Wallpack-Horizontal	2	1	8	2,160	1,080
38	001	Interior		OFFICE	C001		-	1	Light Switch	LED	-	-	18	2x4 Prism Troffer	9	0	8	2,160	-
39	001	Interior		OFFICE	C002		-	1	Light Switch	LED	-	-	4	2x4 Prism Troffer	2	0	8	2,160	-
	Totals												1,282		555			82,440	5,700

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	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	550		Number of Occupants Affected by Retrofit	550	
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	23		Total Number of Faucet Aerators To Be Replaced	19	
Total Number of Faucets To Be Replaced:	0		Total Number of Faucets To Be Replaced:	0	
GPM of Existing Faucet Aerators	2	GPM	GPM of Existing Faucet Aerators	2.2	GPM
GPM of Proposed Faucet Aerator	0.5	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: 93.14 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:	0.69	EF	Heating Fuel Tariff	$0.17	$/kWh
Hot Water Discharge Temperature at Faucet	110.00	°F	Water Tariff ($/1000 Gal)	$6.14	$/kGal
Equivalent Heating Fuel Savings: *Savings Discounted by 15% to Account For Cold Water Use*	16,827	kWh	Annual Cost Savings In Form of Water	$572	$
Annual Water Savings	93.14	kGal	Annual Energy Savings From Water Heater	$2,859	$

COST BENEFIT ANALYSIS					
Estimated Total Annual Cost Savings	$3,431	$$	Estimated Total Installation Cost	$640	$$
Simple Payback Period	0.19	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: $640 Estimated Annual Cost Savings: $3,431 Simple Payback Period (Yrs): 0.19

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	6	15	15	2,808	$477.08	$128.37

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	0	0	0	0	$0	$0
Circiline	T9	0	0	0	0	$0	$0
Incan/H/MR	H	0	0	0	0	$0	$0
Incan/H/MR	Incan	2	8	8	86	$15	$36
Incan/H/MR	MR	0	0	0	0	$0	$0
HID	HPS	0	0	0	0	$0	$0
HID	MH	4	7	7	2,722	$462	$93
HID	MV	0	0	0	0	$0	$0
HID	QL	0	0	0	0	$0	$0
Linear Fluorescent	T8	0	0	0	0	$0	$0
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	4	Ceiling Mounted	0
Wall Mounted	0		

Initial Investment			**Equipment Rentals**	
Material Cost	$2,802.71		Scissor Lift 26' - Interior Spaces	$0.00
Labor Cost	$814.19		Bucket Truck - Exterior Spaces	$0.00
Local Electric Rate:	$0.17	$/kWh	Estimated Annual Energy Savings:	2,808
Hourly Labor Rate For Electrician:	$82.45		Estimated Annual Energy Cost Savings:	$477
Budgeted Initial Investment:	$3,617		Estimated Annual O&M Cost Savings:	$128
Estimated Return on Investment: *(Including O&M Savings)*	5.97	Years	Estimated Annual Cost Savings:	$605

UIC	Upgrade Electric Heating System To Heat Pumps
EAH11-A	Location: Portable Classrooms

ASHRAE Climatic Zone: Zone-3	*Portable Classrooms*		*Portable Classrooms*		*Specify Location Here*		*Specify Location Here*	
Select Existing Heating System Type	Heat Pump - Split System		Heat Pump - Split System		PTAC		PTAC	
Number of Existing Systems:	3	Qty	6	Qty		Qty		Qty
Output Capacity of Heating System/Unit:	17,000.00	btuh	34,000.00	btuh		kW		kW
Output Capacity of Heating System:	17,000	Btuh	34,000	Btuh	0	Btuh	0	Btuh
Existing COP of Heating System:	3.00	COP	3.00	COP		COP		COP
Estimated Annual Heating Hours:	950	Hrs	950	Hrs		Hrs		Hrs
Auxiliary Heating In Heatpumps:	5	kW	10	kW		kW		kW
Cooling Capacity of Each System:	36,000	Btuh	43,000	Btuh		Btuh		Btuh
Existing EER of Cooling System:	8.70	EER	8.70	EER		EER		EER
Estimated Annual Cooling Hours:	680	Hrs	680	Hrs		Hrs		Hrs
Install Programmable Thermostats With Heatpumps:	No		No		Yes		Yes	
Current Energy Consumption From Cooling:	8,441	kWh	20,166	kWh	0	kWh	0	kWh
Current Energy Consumption From Heating:	6,637	kWh	26,547	kWh	0	kWh	0	kWh
Total Existing Electric Consumption:	15,078	kWh	46,712	kWh	0	kWh	0	kWh

Proposed System

Heat pump Type	Air-Source Split Heat Pump System		Air-Source Split Heat Pump System		Water-Source System		Water-Source System	
Proposed Number of Systems:	3	Qty	6	Qty		Qty		Qty
Proposed Heat pump Capacity:	30,000	Btuh	36,000	Btuh	-	Btuh	-	Btuh
Proposed COP:	3.59	COP	3.85	COP	-	COP	-	COP
Proposed Emergency Heat Rating:	8.79	kW	10.55	kW	0.00	kW	0.00	kW
Proposed Energy Consumption From Cooling:	4,996	kWh	11,191	kWh	0	kWh	0	kWh
Proposed Energy Consumption From Heating:	6,873	kWh	14,113	kWh	0	kWh	0	kWh
Total Proposed Electric Consumption:	11,869	kWh	25,304	kWh	0	kWh	0	kWh
Total Electric Savings:	3,209	kWh	21,408	kWh	0	kWh	0	kWh
Total Cost For Replacement:	$7,690.34		$18,837.44		$0.00		$0.00	
Annual Energy Cost Savings:	$545		$3,637		$0		$0	
Individual Simple Payback	14.11	Yrs	5.18	Yrs	-	Yrs	-	Yrs
Total Initial Investment:	$26,527.78		Total Annual Electric Savings				24,618	kWh
Total Annual Cost Savings	$4,182.38		Overall Simple Payback Period:				6.34	Yrs

UIC	Install Low Flow Tankless Restroom Fixtures
EAP4	Location: Restrooms

ECM FOR DETERMINING WATER SAVINGS IN COMMERCIAL PROPERTIES

Number of Males	275	
Number of Females	275	
Number of Occupied Days Per Week (Max 7)	5	
Number of Occupied Weeks/Year (Max 52)	35	
Number of Urinals To Be Retrofitted	5	
Number of Water Closets To Be Retrofitted	18	
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?	Yes	
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	134.75	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		18	
GPF of Proposed Dual Flush- Water Closet Valve* **(Federal Law Requires All Flushes Not To Exceed 1.6 GPF)*	*Solid Waste (20%)*	1.60	GPF
	Liquid Waste (80%)	0.48	GPF
Estimated Annual Water Savings From Male Users		34.50	kGal
Estimated Annual Water Savings From Female Users		172.48	kGal
Total Water Savings From Water Closets		206.98	kGal

Water & Cost Saving Calculations

Water Savings Calculation

Water Savings By The Use of Low Flow Water Closet Flush Valves/Yr	206.98	kgal
Water Savings By The Use of Low Flow Urinal Flush Valves/ Yr	134.75	kgal
Total Annual Water Savings in kgal	341.73	kgal

Cost Savings Calculations

Enter Water Tariff Rate ($/1000Gal)	$6.14	$$
Estimated Cost Savings From Water	$2,098	$$

Estimated Cost of Retrofit

Cost For Replacing Existing Urinal Fixture With A Low Flow Fixture	$6,502 *(Includes Labor)*	$$
Cost For Replacing Existing Flush Valves With Low Flow - Dual Flush Valves ($80 Per Unit) *(Up For Liquid Waste And Down For Solid Waste)*	$11,143 *(Includes Labor)*	$$
Estimated Total Cost For Retrofit	$17,645	$$
Simple Pay Back Period	8.41	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:	$17,645	Simple Payback Period:	8.41 Yrs
Annual Cost Savings:	$2,098		

UIC	Replace Rooftop Package Unit
EAH12-B	Location: Rooftop

Estimated Annual Cooling Hours:	680	Hrs	Estimated Annual Heating Hours:	350	Hrs
Units to Replace	Air Conditioning: Yes	Heating System: Yes	Existing Type of Heating Fuel:	Natural Gas	

Existing Package System

	Cooling	Heating	Total Combined Units
Number of Package Units to be Replaced:	13	13	13

Capacity of the air conditioner:	4 Tons	EER of the Existing Air Conditioner:	8.00	
Capacity of Existing Heating System:	72 MBH	Input Existing AFUE for the Furnace:	82%	
Estimated Annual Cooling Consumption: *(For All Units)*	53,040 kWh	Estimated Annual Heating Consumption : *(For All Units)*	3,995	Therms

Proposed Package System

Capacity of the Proposed Air Conditioner:	4 Tons	EER of the Proposed Air Conditioner:	9.50	EER
Capacity of Proposed Heating System:	Gas Fired -60MBH MBH	AFUE of Proposed Heating System:	90%	%
Estimated Annual Energy Consumption With New Package Units				
Annual Electric Fuel Consumption:	44,665 kWh	Annual Heating Fuel Consumption:	3,033	Therms

Energy and Cost Analysis

Average Electric Rate:	$0.17 $/kWh	Average Heating Rate:	$1.31	$/Therm
Estimated Annual Electric Savings : *From All New Package Systems*	8,375 kWh	Estimated Annual Heating Savings : *From All New Package Systems*	96,179	kBtus
Annual Electric Cost Savings: *From All New Package Systems*	$1,423	Annual Electric Cost Savings: *From All New Package Systems*	$1,257	$

Proposed Type of System to be installed: Package Heating and Cooling System

Estimated Material and Labor Cost Including Overheads and Profits For All Units:	$68,250.00	$
Estimated Total Energy Cost Savings From New HVAC System:	$2,680	$
Estimated O&M Savings:	$134	
Estimated Simple Pay Back Period:	24.2527241 Yrs	

Capital Cost ECM Recommendation

UIC	Replace External Windows
EAE2	Location: Throughout

ENTER EXISTING CONDITIONS

Existing and Proposed Window Properties

Total Sq.Ft window area:	1,152	sq.ft
Approximate number of windows:	86	
Total existing window area:	1,152	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)	0.35	Btu/ ft².°F·h

AHRAE 90.1 Recommended Value

Existing & Proposed Air Leakage Through Windows

Insert Existing Estimated Air Change Rate/Hr (ACH 1):	1.25	
(Existing Air Changes Per Hour, 1.5 is very leaky and 0.35 ideal)		
Insert Proposed Estimated Air Change Rate/Hr (ACH 2):	0.88	
Estimated Space Volume Under Consideration	118,739.00	Cu. Ft
Is the Property Cooled ?	Yes	*(Select)*

WINTER

Select Type of Heating Fuel	Natural Gas	*(Select)*
Net heating plant & distribution system efficiency:	82.00	**%**
Annual Heating Hours:	2,943	HDD
Estimated Total Annual Input Heating Energy Savings By Replacing Windows	9.53	Therms
Estimated Total Annual Input Heating Energy Savings Achieved By Controlling Air Leakage Through Windows	690	Therms
Estimated Total Input Heating Fuel Savings From Replacing Windows	700	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	5,335	kWh
Estimated Total Annual Input Cooling Energy Savings Achieved By Controlling Air Leakage Through Windows	3,866	kWh
Estimated Total Input Cooling Fuel Savings From Replacing Windows	9,201	kWh

ENERGY & COST ANALYSIS

Insert Cost of Heating Fuel:	$1.31	$/Therm	Annual Heating Cost Savings:	$914.95	$$
Insert Cost of Cooling Fuel:	$0.17	$/kWh	Annual Cooling Cost Savings:	$1,563.25	$$
Total Annual Cost Savings	$2,503		Total Annual Cost Savings From Heating & Cooling:	$2,478	$$
Cost of window upgrade:	$70,598		Estimated Annual O&M Savings	$25	$
Simple payback:	28.21	**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:	$70,598	Simple Payback	28.21 Yrs
Annual Energy Cost Savings:	$2,503		

APPENDIX F:
Solar PV

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

Select State: Northern California **Electric Rate:** **$0.17** $/KWH Annual Electric Consumption: 235,844 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	19.90	20	63	26,639	26,639	$4,526	$69,650	15.4	$0	$20,895	$586	$0	9.5
2	Building 2	1	36	36	115	48,458	48,458	$8,233	$126,700	15.4	$0	$38,010	$1,066	$0	9.5
3	Building 3	1	13	13	41	17,268	17,268	$2,934	$45,150	15.4	$0	$13,545	$380	$0	9.5
4	Building 4	1	15	15	46	19,544	19,544	$3,321	$51,100	15.4	$0	$15,330	$430	$0	9.5
5	Building 5	1	8	8	26	10,843	10,843	$1,842	$28,350	15.4	$0	$8,505	$239	$0	9.5
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	
		5		**92**	**291**	**122,752.0**	**122,752**	**$20,856**	**$320,950**	**15.39**	**$0**	**$96,285**	**$2,701**	**$0**	**9.48**

Solar Rooftop Photovoltaic Analysis		
Total Number of Roofs	5	
Estimated Number of Panels	291	
Estimated KW Rating	92	KW
Potential Annual KWh Produced	122,752	KWh
% of Current Electricity Load	52.0%	

Financial Analysis		
Investment Cost	$320,950	
Estimated Energy Cost Savings	$20,856	
Potential Rebates	$96,285	
Potential Annual Incentives	$2,701	
Payback without Incentives	15.4	years
Incentive Payback but without SRECS	9.5	years
Payback with All Incentives	9.5	years