LEVEL II ENERGY AUDIT

A Bureau Veritas Group Company

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

DLR GROUP
1050 20th Street, Suite 250
Sacramento, California 95933

ZERO NET ENERGY ASHRAE LEVEL II AUDIT

JOHN D. SLOAT ELEMENTARY SCHOOL

7525 Candlewood Way

Sacramento, California 95822

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 #:
136988.19R000-032.268

DATE OF REPORT:
October 30, 2019

ONSITE DATE:
August 23, 2019

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Certification

EMG has completed an Energy Audit of John D. Sloat Elementary School located at 7525 Candlewood Way in Sacramento, California. EMG visited the site on August 23, 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. 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:

Bhaskar Ale, CEM

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 John D. Sloat 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.

Building #	Structures Assessed	Building Type	EMG Calculated Area (SF)	Estimated Occupancy
1	Building 001	School Building	6,400	70
2	Building 002	School Building	6,300	70
3	Building 003	School Building	6,000	65
4	Building 004	School Building	6,000	65
5	Building P01	School Building	3,600	40
6	Building P02	School Building	1,800	20
7	Building P03	School Building	1,800	20

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)*	$50,038 *(In Current Dollars)*
Estimated Annual Cost Savings *(Current Dollars Only)*	$9.049 *(In Current Dollars)*
ECM Effective Payback	5.53 years
Estimated Annual Energy Savings	12.21%
Estimated Annual Energy Utility Cost Savings *(Excluding Water)*	15.06%
Estimated Annual Water Cost Saving	16.46%

Solar Photovoltaic (PV) Screening for JOHN D. SLOAT ELEMENTARY SCHOOL

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS		
Estimated Number of Panels	397	
Estimated KW Rating	125	KW
Potential Annual kWh Produced	191,621	kWh
% of Current Electricity Uses	88.1%	
FINANCIAL SUMMARY		
Investment Cost	$437,500	
Estimated Energy Cost Savings	$31,023	
Payback without Incentives	14.1	Years
Incentive Payback but without SRECs	8.5	Years
Payback with All Incentives	8.5	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)	40 kBtu/ft^2
Post ECM Site Energy Use Intensity (EUI)	35 kBtu/ft^2
SOURCE ENERGY USE INTENSITY (EUI)	**RATING**
Current Source Energy Use Intensity (EUI)	95 kBtu/ft^2
Post ECM Source Energy Use Intensity (EUI)	81 kBtu/ft^2
BUILDING COST INTENSITY (BCI)	**RATING**
Current Building Cost Intensity	$1.32/ft^2
Post ECM Building Cost Intensity	$1.12/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	154 MMbtu
Total CO_2 Emissions Reduced	13.6 $MtCO_2$/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	1,263,058 kBtu
Total Annual Energy Savings for Non-Renewable Energy Measures	154,173 kBtu
Total Annual Energy Savings from Renewable Energy Measures	653,811 kBtu
Total Annual Energy Savings	807,984 kBtu
Net Energy Consumption from Grid Post Implementation	455,074 kBtu
% Energy Reduction (Annual Energy-Net Energy) / (Annual Energy)	64%

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 John D. Sloat 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	$685	78	0	15	$285	$0	$285	2.41	3.54	$1,744	10.00
Totals for No/Low Cost Items		**$685**	**78**	**0**	**15**	**$285**	**$0**	**$285**	**2.41**			
Capital Cost Recommendations												
1	Upgrade Building Lighting to LED and Install Automatic Lighting Controls Location: Building Interior And Exterior	$25,490	0	37,976	0	$6,148	$1,419	$7,568	3.37	3.54	$64,851	15.00
2	Install Timers On Exhaust Fans Location: Throughout	$4,955	242	2,849	0	$775	$0	$775	6.39	1.87	$4,300	15.00
3	Install Low Flow Tankless Restroom Fixtures Location: Restrooms	$12,381	0	0	113	$1,426	$0	$1,426	8.68	1.38	$4,648	15.00
Total For Capital Cost		**$42,826**	**242**	**40,826**	**113**	**$8,350**	**$1,419**	**$9,769**	**4.38**			
	Interactive Savings Discount @ 10%		-32	-4,083	-13	-$863	-$142	-$1,005				
	Total Contingency Expenses @ 15%	$6,527										
Total for Improvements		**$50,038**	**288**	**36,743**	**115**	**$7,771**	**$1,278**	**$9,049**	**5.53**			

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 John D. Sloat 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	Electricity	kgal	$	$	$	Years		$	Years
1	Replace Existing Water Heater With New Energy Efficient Units Location: Building 001 And 002	$3,508	114	0	0	$148	$0	$148	23.76	0.58	-$1,477	18.00
2	Upgrade Electric Heating System To Heat Pumps Location: Portable Classrooms	$27,018	0	6,270	2	$1,015	$0	$1,015	26.62	0.50	-$11,916	20.00
3	Replace Rooftop Package Unit Location: Rooftop	$19,000	252	1,711	0	$604	$30	$634	29.96	0.50	-$9,564	20.00
Total for Improvements		**$3,508**	**114**	**0**	**0**	**$148**	**$0**	**$148**	**23.76**			

2. Introduction

The purpose of this Energy Audit is to provide John D. Sloat 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	350
% of Male Occupants	50%

POINT OF CONTACT	
Point of Contact Name	Greg Turner
Point of Contact Title	Plant Manager
Point of Contact – Contact Number	916.995.0918

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

Description:

Heating and cooling to permanent building classrooms is provided by several central AC split systems with natural gas forced air furnaces. The admin building and cafeteria are served by packaged roof top units which utilize natural gas for heating. Portable classrooms are served by wall-mounted heat pumps.

The Mechanical Equipment Schedule in Appendix 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
Hydronic Distribution System	Not Applicable
Primary Heating Fuel	Natural Gas
Heating Mode Set-point	69ºF
Heating Mode- Set-back Temperature	53ºF

BUILDING COOLING SYSTEM	
Primary Cooling System	Split Systems

BUILDING COOLING SYSTEM	
Secondary Cooling System	Wall Mounted Heat Pumps
Hydronic Distribution System	Not Applicable
Cooling Mode Set-point	73ºF
Cooling Mode- Set-back Temperature	93ºF

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	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.

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
$0.16 /kWh	$1.30 /therm	$ 12.63 /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.

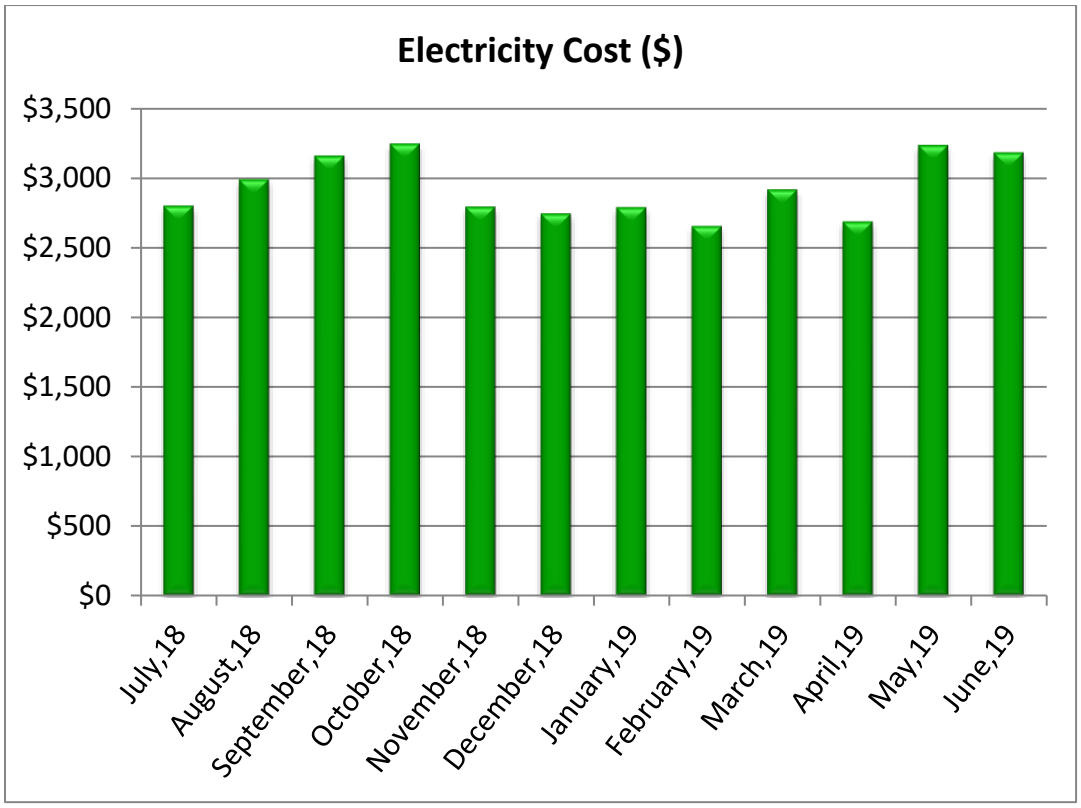
4.1. Electricity

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	15,090	$0.19	$2,802
August,18	17,303	$0.17	$2,991
September,18	19,999	$0.16	$3,161
October,18	20,808	$0.16	$3,248
November,18	17,996	$0.16	$2,795
December,18	17,576	$0.16	$2,746
January,19	17,736	$0.16	$2,790
February,19	17,263	$0.15	$2,655
March,19	17,979	$0.16	$2,918
April,19	16,329	$0.16	$2,688
May,19	20,683	$0.16	$3,237
June,19	18,751	$0.17	$3,184
Total/average	**217,514**	**$0.16**	**$35,214**


Electricity Cost ($)
$3,500
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$0
July,18
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September,18
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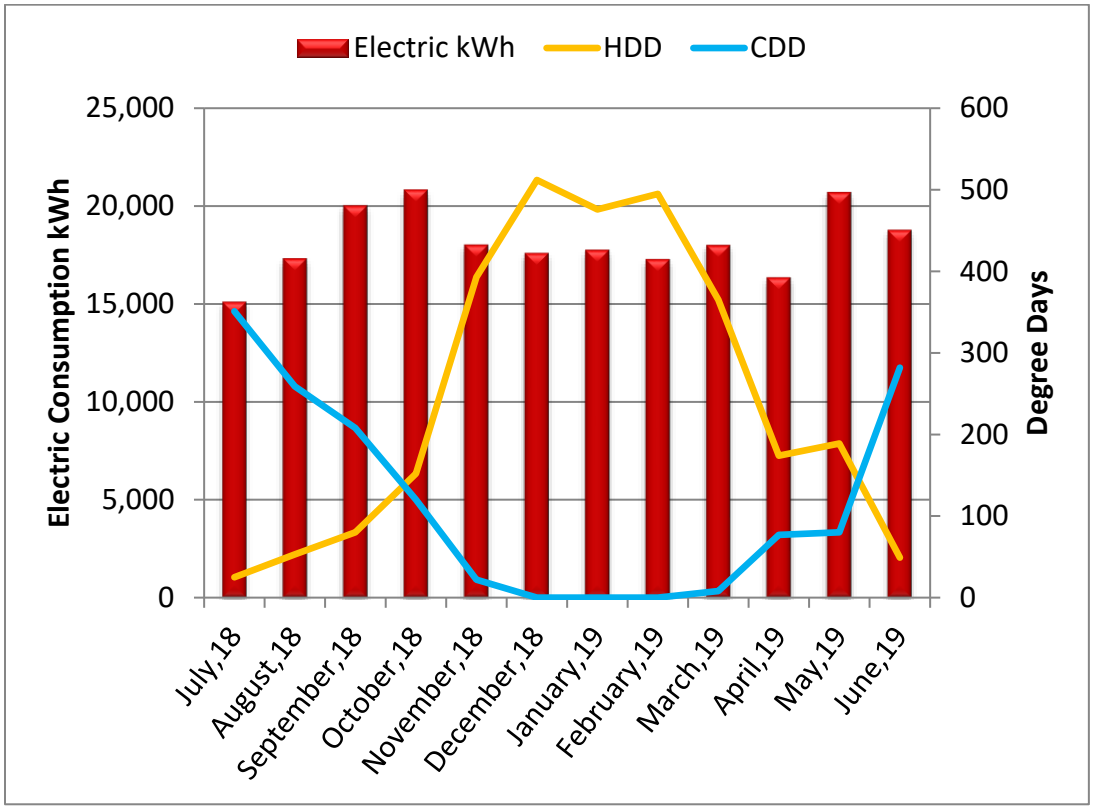
December,18
January,19
February,19
March,19
April,19
May,19
June,19


Electric kWh
HDD
CDD
Electric Consumption kWh
25,000
20,000
15,000
10,000
5,000
0
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

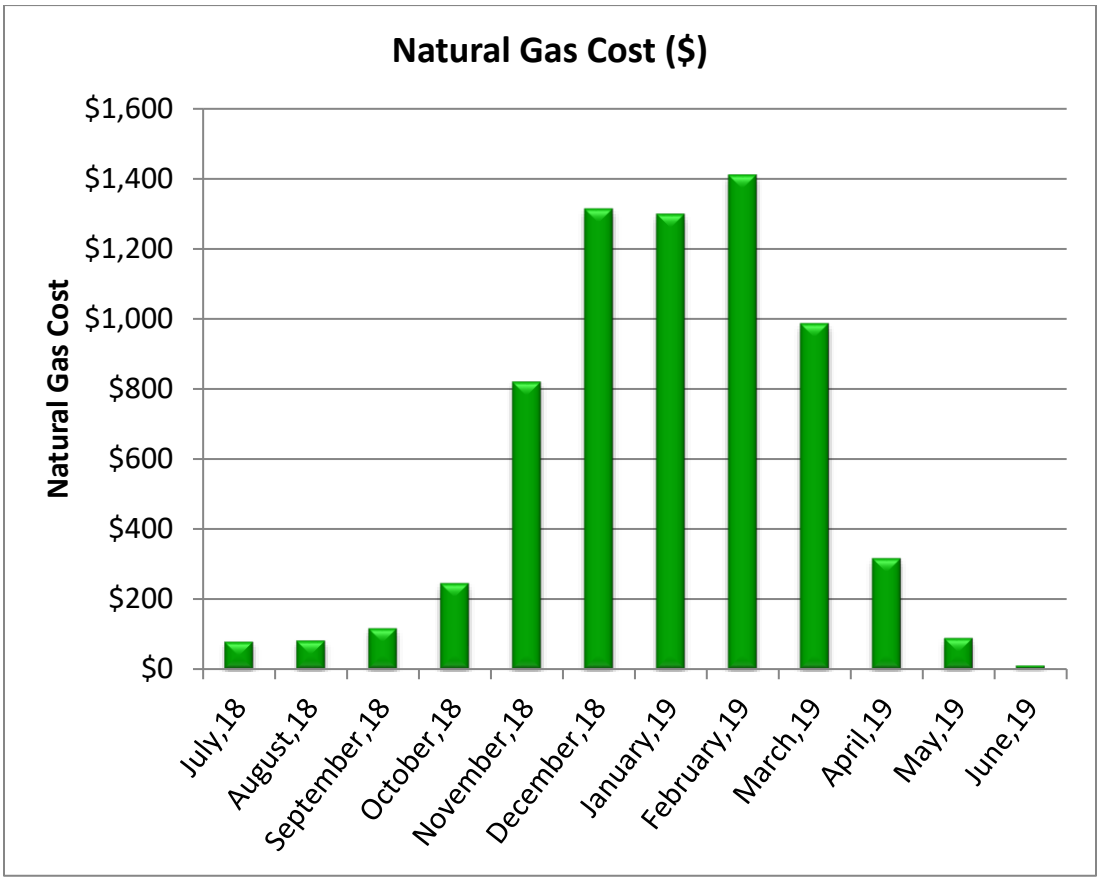
4.2. Natural Gas

PGE 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	46	$1.69	$77
August,18	48	$1.66	$80
September,18	87	$1.32	$115
October,18	213	$1.15	$244
November,18	679	$1.21	$820
December,18	975	$1.35	$1,314
January,19	1,007	$1.29	$1,299
February,19	1,084	$1.30	$1,411
March,19	752	$1.31	$986
April,19	260	$1.22	$316
May,19	54	$1.62	$88
June,19	5	$1.94	$9
Total/average	**5,209**	**$1.30**	**$6,759**


Natural Gas Cost ($)
Natural Gas Cost
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
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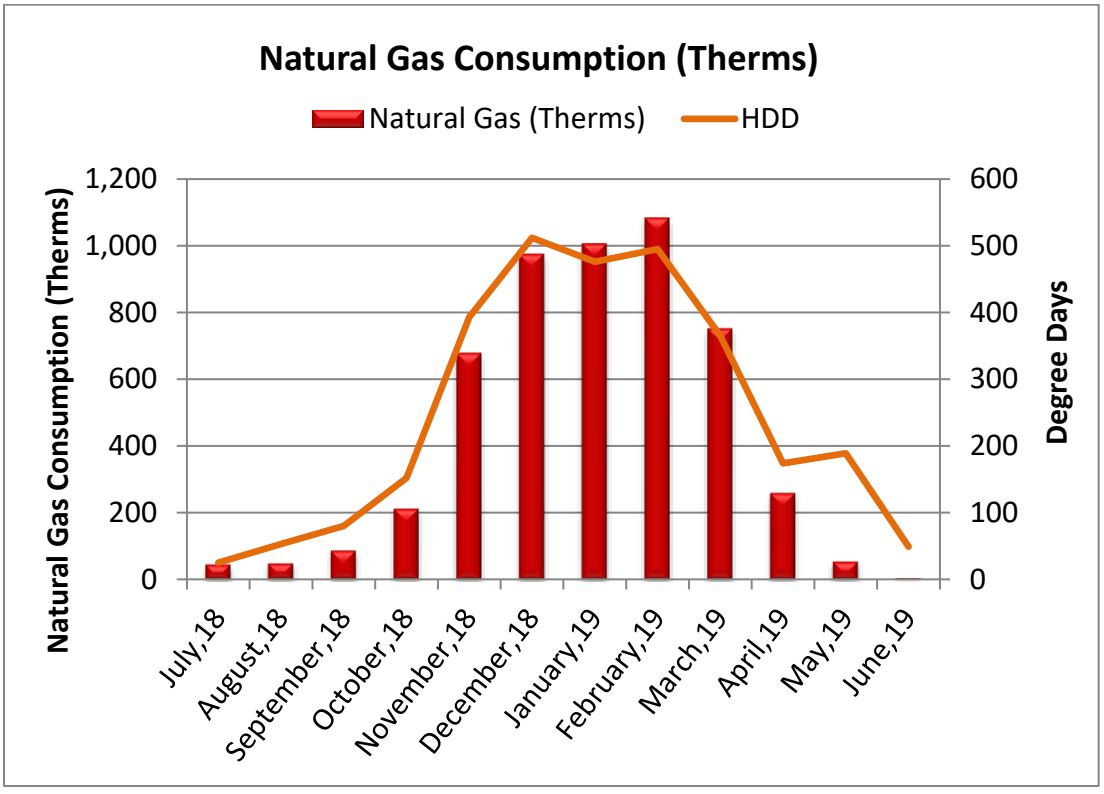
December,18
January,19
February,19
March,19
April,19
May,19
June,19

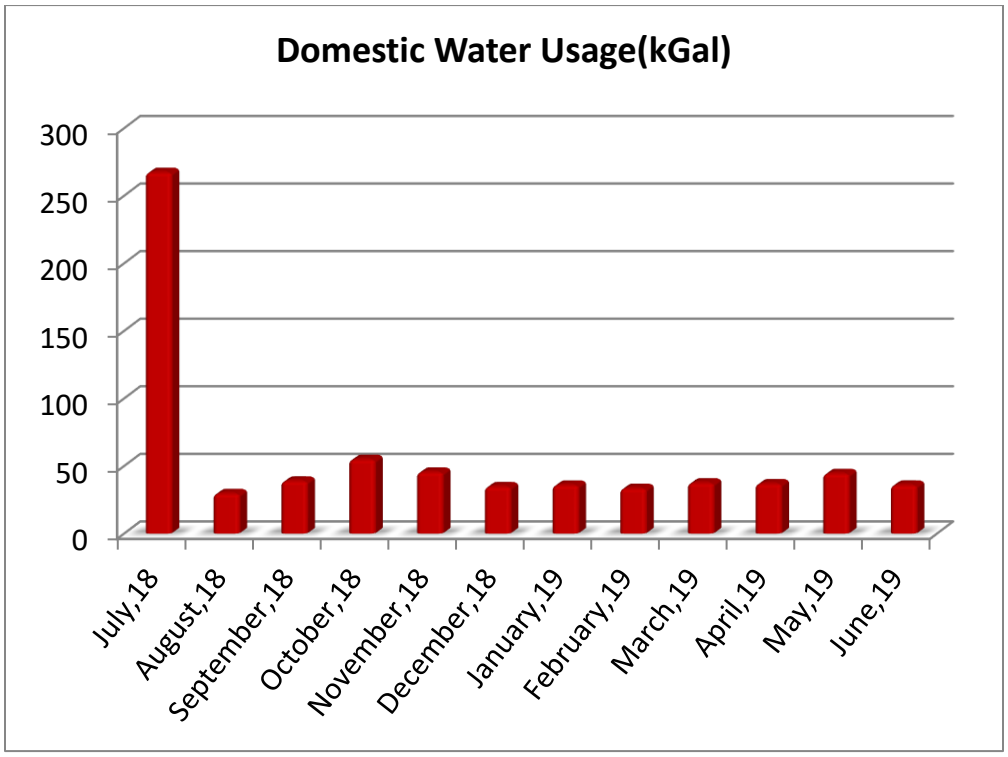

Natural Gas Consumption (Therms)
Natural Gas (Therms)
HDD
Natural Gas Consumption (Therms)
1,200
1,000
800
600
400
200
0
600
500
400
300
200
100
0
Degree Days
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

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	267	$4.39	$1,175
August,18	30	$21.64	$644
September,18	39	$17.31	$675
October,18	55	$13.08	$719
November,18	46	$15.17	$692
December,18	35	$20.81	$726
January,19	36	$19.60	$705
February,19	34	$18.60	$625
March,19	38	$19.39	$730
April,19	37	$19.56	$724
May,19	45	$15.76	$702
June,19	36	$18.93	$682
Total/average	**697**	**$12.63**	**$8,801**


Domestic Water Usage(kGal)
300
250
200
150
100
50
0
July,18
August,18
September,18
October,18
November,18
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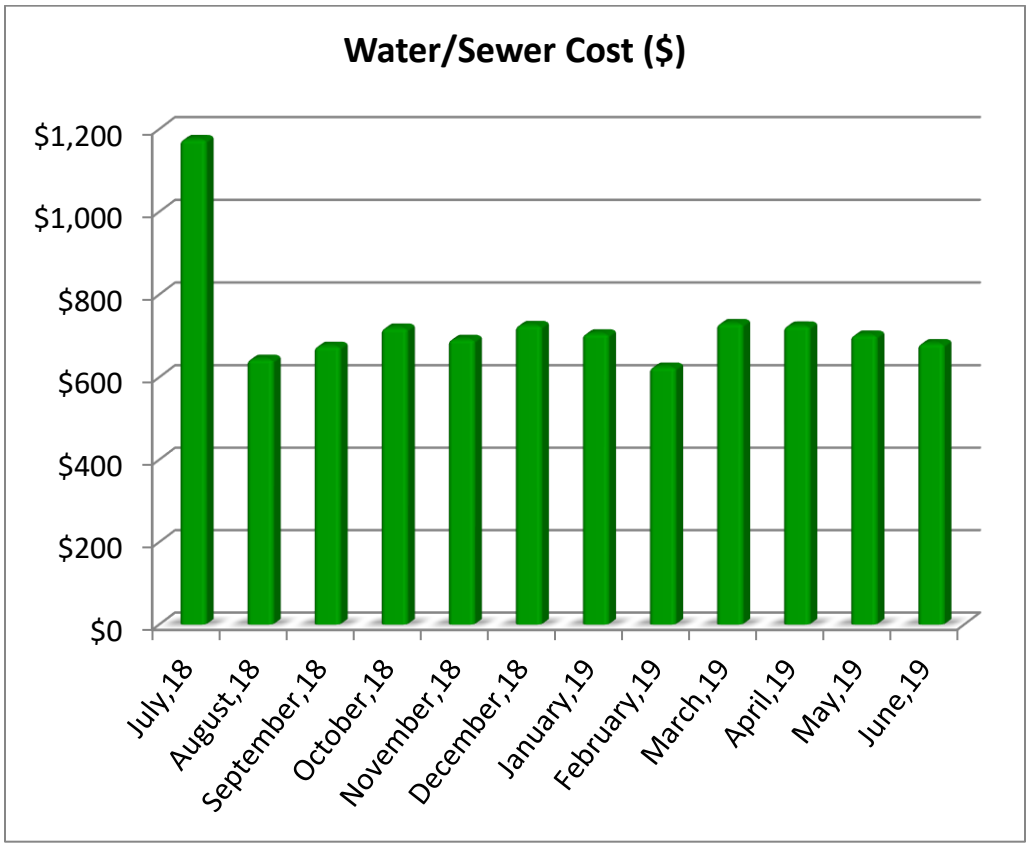
January,19
February,19
March,19
April,19
May,19
June,19


Water/Sewer 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

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	397	
Estimated KW Rating	125	KW
Potential Annual kWh Produced	191,621	kWh
% of Current Electricity Uses	88.1%	
FINANCIAL SUMMARY		
Investment Cost	$437,500	
Estimated Energy Cost Savings	$31,023	
Payback without Incentives	14.1	Years
Incentive Payback but without SRECs	8.5	Years
Payback with All Incentives	8.5	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
Furnace	Carrier	58MXA100-F-1	2401A14445	100 MBH	93 MBH	Classrooms	0012	1
Air Conditioner	Comfort Aire	No tag/plate found	No tag/plate found	2.5 TON	-	Building exterior	P01 Portable Classrooms 0014 - 0017	1
Furnace	Carrier	58MXA100-F-1	2401A12462**	100 MBH	93 MBH	Classrooms	004 Classrooms X008 - 0012	1
Furnace	Carrier	58MXA100-F-1	2401A12462	100 MBH	93 MBH	Classrooms	004 Classrooms X008 - 0012	1
AC Split System Condenser	Carrier	38TXA060-321	Illegible	5 TON	-	Roof	002 Admin Classrooms Y001 - Y002	1
AC Split System Condenser	Carrier	38TXA060-321	2501E14003	5 TON	-	Roof	002 Admin Classrooms Y001 - Y002	1
AC Split System Condenser	Carrier	Illegible	Illegible	5 TON	-	Roof	004 Classrooms X008 - 0012	1
Packaged Unit (RTU)	Carrier	48HJD006G-531	2501G23495	72 MBH	59 MBH	Roof	001 Cafeteria/Kitchen	1
Packaged Unit (RTU)	Carrier	48HJE004G-531	2501G23639	72 MBH	59 MBH	Roof	002 Admin Classrooms Y001 - Y002	1
Packaged Unit (RTU)	Carrier	48HJE004---541--	2501G23652	72 MBH	59 MBH	Roof	002 Admin Classrooms Y001 - Y002	1
Packaged Unit (RTU)	Carrier	48HJE004---541--	2908G30426	72 MBH	59 MBH	Roof	002 Admin Classrooms Y001 - Y002	1
Packaged Unit (RTU)	Carrier	48HGD016A	Illegible	250 MBH	205 MBH	Roof	001 Cafeteria/Kitchen	1
Wall mounted Heat Pump	Bard	WH361-A05XX4XXX	125B981201261-02	3 TON	-	Building exterior	P03 Portable Classroom 0018 - 0020	1
Wall mounted Heat Pump	Bard	WH361-A05XX4XXX	125C981212986-02	3 TON	-	Building exterior	P03 Portable Classroom 0018 - 0020	1
Wall mounted Heat Pump	Bard	WH361-A05XX4XXX	125H981244523-02	3 TON	-	Building exterior	P03 Portable Classroom 0018 - 0020	1
Wall mounted Heat Pump	Bard	WH483-A04VP4XXX	236C021715655-02	4 TON	-	Building exterior	P02 Portable Classroom 0001	1
Wall mounted Heat Pump	INTERTHERM	Illegible	A000934783	3.5 TON	-	Building exterior	P01 Portable Classrooms 0014 - 0017	1
Wall mounted Heat Pump	Bard	Illegible	Illegible	3 TON	-	Building exterior	P02 Portable Classroom 0001	1
Wall mounted Heat Pump	Marvair	Illegible	Illegible	3.5 TON	-	Building exterior	P01 Portable Classrooms 0014 - 0017	1
Wall mounted Heat Pump	Marvair	Illegible	Illegible	3.5 TON	-	Building exterior	P01 Portable Classrooms 0014 - 0017	1
Water Heater	State	PR640NOCT52	A03133632	40 GAL, 35 MBH	-	Boiler Room #1	002 Admin Classrooms Y001 - Y002	1
Water Heater	A. O. Smith	BT 100 230	MD97-0643402-230	100 GAL, 75 MBH	-	Utility closet	001 Cafeteria/Kitchen	1
AC Split System Condenser	Carrier	38TXA060320	2501E1832	5 TON	-	Roof	003 Classrooms 0003-0007	1
AC Split System Condenser	Carrier	Illegible	1307E41965	5 TON	-	Roof	003 Classrooms 0003-0007	1
AC Split System Condenser	Carrier	38TXA060320	2901E13987**	5 TON	-	Roof	0007	1
AC Split System Condenser	Carrier	38TXA060320	2901E13987	5 TON	-	Roof	003 Classrooms 0003-0007	1
AC Split System Condenser	Carrier	24ACB360A0030010	3008E04888	5 TON	-	Roof	003 Classrooms 0003-0007	1
AC Split System Condenser	Carrier	38TXA060-321	2501E18336	5 TON	-	Roof	004 Classrooms X008 - 0012	1
AC Split System Condenser	Carrier	38TXA060-321	2501E13993	5 TON	-	Roof	004 Classrooms X008 - 0012	1
AC Split System Condenser	Carrier	24ACB360A0030010	3008E04880	5 TON	-	Roof	004 Classrooms X008 - 0012	1
Distribution Pump	Illegible	Illegible	Illegible	4 HP	-	Site	SITE	1
AC Split System Condenser	Carrier	38TXA060-321	3008E04889	5 TON	-	Roof	004 Classrooms X008 - 0012	1
Ductless Split System	Mitsubishi Electric	MUY-GL12NA	63C02911	1 TON	-	Roof	003 Classrooms 0003-0007	1
Exhaust Fan	JennAir	241 CK G	Illegible	1000 CFM	-	Roof	001 Cafeteria/Kitchen	1
Exhaust Fan	JennAir	70 CR A C1	No tag/plate found	500 CFM	-	Roof	002 Admin Classrooms Y001 - Y002	1

Mechanical Inventory								
System	Make	Model	Serial Number	Input Capacity	Output Capacity	Room Number	Space Served	Quantity
Exhaust Fan	JennAir	70 CR A C1	No tag/plate found*	500 CFM	-	Roof	002 Admin Classrooms Y001 - Y002	1
Exhaust Fan	JennAir	91 CR A CJ	No tag/plate found	500 CFM	-	Roof	002 Admin Classrooms Y001 - Y002	1
Exhaust Fan	JennAir	91 CR A CC	Illegible	500 CFM	-	Roof	001 Cafeteria/Kitchen	1
Exhaust Fan	Greenheck	GB-060-4X-QD-R2	03E17636	500 CFM	-	Roof	003 Classrooms 0003-0007	1
Exhaust Fan	Greenheck	GB-060-4X-QD-R2	03E17634	500 CFM	-	Roof	003 Classrooms 0003-0007	1
Exhaust Fan	Penn Ventilator Company	DX08SR	Illegible*	250 CFM	-	Roof	001 Cafeteria/Kitchen	1
Exhaust Fan	Penn Ventilator Company	DX08SR	Illegible	250 CFM	-	Roof	001 Cafeteria/Kitchen	1
Exhaust Fan	Greenheck	GB-080-4X-QD-R2	03E17640	500 CFM	-	Roof	004 Classrooms X008 - 0012	1
Exhaust Fan	Greenheck	GB-080-4X-QD-R2	03E17632	500 CFM	-	Roof	004 Classrooms X008 - 0012	1
Exhaust Fan	Penn Ventilator Company	Illegible	Illegible	250 CFM	-	Roof	001 Cafeteria/Kitchen	1
Exhaust Fan	No tag/plate found	No tag/plate found	No tag/plate found	1000 CFM	-	Roof	002 Admin Classrooms Y001 - Y002	1
Exhaust Fan	No tag/plate found	No tag/plate found	No tag/plate found	500 CFM	-	Roof	002 Admin Classrooms Y001 - Y002	1
Furnace	Carrier	5MXA100-F-1-20	2401A14435	100 MBH	93 MBH	Classrooms	002 Admin Classrooms Y001 - Y002	1
Furnace	Carrier	5MXA100-F-1-20	2401A14438	100 MBH	93 MBH	Classrooms	002 Admin Classrooms Y001 - Y002	1
Furnace	Carrier	58MXA100-F-1-20	-	100 MBH	93 MBH	Classrooms	003 Classrooms 0003-0007	1
Furnace	Carrier	58MXA100-F-1-20	2401A14430	100 MBH	93 MBH	Classrooms	003 Classrooms 0003-0007	1
Furnace	Carrier	58MXA100-F-1-20	2401A14432	100 MBH	93 MBH	Classrooms	003 Classrooms 0003-0007	1
Furnace	Carrier	58MXA100-F-1-20	2401A14432*	100 MBH	93 MBH	Classrooms	003 Classrooms 0003-0007	1
Furnace	Carrier	58MXA100-F-1-20	2401A14432**	100 MBH	93 MBH	Classrooms	003 Classrooms 0003-0007	1
Furnace	Carrier	58MXA100-F-1	2401A12462*	100 MBH	93 MBH	Classrooms	004 Classrooms X008 - 0012	1
Furnace	Carrier	58MXA100-F-1	2401A12462***	100 MBH	93 MBH	Classrooms	004 Classrooms X008 - 0012	1
Air Conditioner	Fedders	No tag/plate found	No tag/plate found	2 TON	-	Building exterior	P02 Portable Classroom 0001	1

APPENDIX C:
Lighting System Schedule

									Lamp Details				Fixture Details				Existing Consumption	
Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	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	Exterior	Interior	1	CLASSROOM	Exterior	-	1	Timer	CFL	CFL - 4 Pin	CFL32	14	Wallpack-Horizontal	14	0	7	1,260	564
2	P02	Interior	1	CLASSROOM	O001	400	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	72	2x4 Indirect Troffer	24	0	9	1,260	2,903
3	001	Interior	1	CLASSROOM	T002	350	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	1	2x4 Prism Troffer	1	0	8	1,260	40
4	002	Interior	1	OPEN OFFICE	C001	224	1	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	30	2x4 Indirect Troffer	10	0	10	2,160	2,074
5	002	Interior	1	OFFICE	I001	421	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	18	2x4 Indirect Troffer	6	0	10	2,160	1,244
6	002	Interior	1	STORAGE	S002	115	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	10	684	44
7	002	Interior	1	KITCHEN	K001	205	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	10	1,800	115
8	002	Interior	1	OPEN OFFICE	C003	177	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	10	2,160	276
9	002	Interior	1	ESTROOM - PRIVAT	T003	270	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	10	2,160	138
10	002	Interior	1	OFFICE	C002	488	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	2x4 Indirect Troffer	2	0	10	2,160	415
11	002	Interior	1	STORAGE	S003	116	1	Light Switch	Incan/H/MR	Incan	I7-Globe	1	Pendant-Direct	1	0	10	684	5
12	002	Interior	1	OPEN OFFICE	Z001	667	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	2x4 Indirect Troffer	2	0	10	2,160	415
13	002	Interior	1	STORAGE	S001	171	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	10	684	44
14	002	Interior	1	JANITORIAL	J001	203	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	10	684	44
15	002	Interior	1	RESTROOM	T002	207	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	10	900	58
16	002	Interior	1	STORAGE	B001	110	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	10	684	44
17	002	Interior	1	RESTROOM	T001	373	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	10	2,160	138
18	003	Interior	1	RESTROOM	T002	538	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	2,160	138
19	003	Interior	1	STORAGE	S001	223	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	684	88
20	003	Interior	1	STORAGE	ZC01	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	1	2x4 Prism Troffer	1	0	8	684	22
21	003	Interior	1	MECHANICAL	B002	109	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	1,512	97
22	003	Interior	1	RESTROOM	T001	455	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	2,160	276
23	003	Interior	1	CLASSROOM	O006	383	12	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	144	2x4 Indirect Troffer	48	0	10	1,260	5,806
24	003	Interior	1	CLASSROOM	O003	361	4	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	36	2x4 Indirect Troffer	12	0	10	1,260	1,452
25	003	Interior	1	ESTROOM - PRIVAT	Restroom	161	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	10	2,160	138
26	003	Interior	1	CLASSROOM	O003	361	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	1,260	161
27	003	Interior	1	STORAGE	Storage	449	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	10	684	44
28	002	Interior	1	STORAGE	S006	98	1	Light Switch	Incan/H/MR	Incan	I7-Globe	1	Pendant-Direct	1	0	8	684	5
29	002	Interior	1	CLASSROOM	Y002	327	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	78	2x4 Indirect Troffer	26	0	10	1,260	3,145
30	002	Interior	1	STORAGE	S005	83	2	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	10	684	88
31	002	Interior	1	ESTROOM - PRIVAT	T005	231	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	10	2,160	276
32	P03	Interior	1	CLASSROOM	O018	374	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	108	2x4 Indirect Troffer	36	0	8	1,260	4,355
33	P01	Interior	1	CLASSROOM	O014	653	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	18	Industrial	9	0	9	1,260	726
34	P01	Interior	1	CLASSROOM	O015	355	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	2x4 Indirect Troffer	12	0	10	1,260	1,452
35	P01	Interior	1	OPEN OFFICE	O016	366	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	45	2x4 Indirect Troffer	15	0	10	2,160	3,110
36	P01	Interior	1	OPEN OFFICE	O017	366	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	45	2x4 Indirect Troffer	15	0	10	2,160	3,110
37	004	Interior	1	RESTROOM	T001	485	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	3	0	8	2,160	415
38	004	Interior	1	MECHANICAL	B003	109	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	1,512	97
39	004	Interior	1	OFFICE	C001	229	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	2,160	276
40	004	Interior	1	ESTROOM - PRIVAT	T003	213	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	10	2,160	276
41	004	Interior	1	RESTROOM	T002	466	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	3	0	10	2,160	415
42	004	Interior	1	LIBRARY	X008	313	3	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	45	2x4 Indirect Troffer	15	0	10	2,160	3,110
43	004	Interior	1	CLASSROOM	O009	383	8	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	144	2x4 Indirect Troffer	48	0	10	1,260	5,806
44	P02	Interior	1	OFFICE	C001	317	2	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	9	2x4 Indirect Troffer	3	0	9	2,160	622
45	P02	Interior	1	ESTROOM - PRIVAT	T01	249	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	9	2,160	276
46	001	Interior		CLASSROOM	T003	283	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	1	2x4 Prism Troffer	1	0	8	1,260	40
47	001	Interior	1	GYMNASIUM	U001	323	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	64	2x4 Indirect Troffer	16	0	16	2,160	4,424
48	001	Interior	1	STORAGE	S001	118	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	684	88
49	001	Interior	1	KITCHEN	K001	413	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	24	2x4 Prism Troffer	8	0	8	1,800	1,382
50	001	Interior	1	HALLWAY	H001	411	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	684	88
51	001	Interior	1	STORAGE	S002	300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	684	44
52	001	Interior	1	ESTROOM - PRIVAT	T001	491	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	2,160	138
53	001	Interior	1	OPEN OFFICE	C001	448	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	2,160	138
54	001	Interior	1	JANITORIAL	J001	181	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	684	44
55	001	Interior	1	GYMNASIUM	Stage	-	1	Light Switch	Incan/H/MR	Incan	I7-Globe	48	Pendant-Direct	48	0	8	2,160	726
56	Exterior	Exterior	1	CLASSROOM	Exterior	-	1	Timer	LED	-	-	8	Troffer 1'x2'	8	0	7	2,160	-
57	Exterior	Exterior	1	CLASSROOM	Exterior	-	1	Timer	HID	MH	MH400	20	Wallpack-Horizontal	20	0	7	2,160	17,280
	Totals											1,113		447			88,380	68,734

								Fixture Details						Existing Consumption				Proposed- Post Retrofit				
Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	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	Exterior	Interior	1	CLASSROOM	Exterior	Timer	1	CFL	CFL - 4 Pin	CFL32; Wallpack-Horizontal	14	14	7	1,260	564			Retain Existing Controls				
2	P02	Interior	1	CLASSROOM	O001	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	24	72	9	1,260	2,903	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,260	1,542	1,361
3	001	Interior	1	CLASSROOM	T002	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	1	8	1,260	40	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,260	21	19
4	002	Interior	1	OPEN OFFICE	C001	Ceiling-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	10	30	10	2,160	2,074	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	1,102	972
5	002	Interior	1	OFFICE	I001	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	6	18	10	2,160	1,244	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	661	583
6	002	Interior	1	STORAGE	S002	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	10	684	44	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	23	21
7	002	Interior	1	KITCHEN	K001	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	10	1,800	115	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,800	61	54
8	002	Interior	1	OPEN OFFICE	C003	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
9	002	Interior	1	RESTROOM - PRIVATE	T003	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	10	2,160	138	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	73	65
10	002	Interior	1	OFFICE	C002	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	2	6	10	2,160	415	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	220	194
11	002	Interior	1	STORAGE	S003	Light Switch	1	Incan/H/MR	Incan	I7-Globe; Pendant-Direct	1	1	10	684	5	ECM	RB - Replace Bulb	Wall Mounted	5W LED A18	684	3	1
12	002	Interior	1	OPEN OFFICE	Z001	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	2	6	10	2,160	415	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	220	194
13	002	Interior	1	STORAGE	S001	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	10	684	44	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	23	21
14	002	Interior	1	JANITORIAL	J001	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	10	684	44	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	684	23	21
15	002	Interior	1	RESTROOM	T002	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
16	002	Interior	1	STORAGE	B001	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	10	684	44	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	23	21
17	002	Interior	1	RESTROOM	T001	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	10	2,160	138	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	73	65
18	003	Interior	1	RESTROOM	T002	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	8	2,160	138	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	73	65
19	003	Interior	1	STORAGE	S001	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	684	88	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	47	41
20	003	Interior	1	STORAGE	ZC01	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	1	8	684	22	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	12	10
21	003	Interior	1	MECHANICAL	B002	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	8	1,512	97	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,512	51	45
22	003	Interior	1	RESTROOM	T001	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	2,160	276	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	147	130
23	003	Interior	1	CLASSROOM	O006	Wall-Mounted Sensor	12	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	48	144	10	1,260	5,806	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,260	3,084	2,722
24	003	Interior	1	CLASSROOM	O003	Wall-Mounted Sensor	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	12	36	10	1,260	1,452	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,260	771	680
25	003	Interior	1	RESTROOM - PRIVATE	Restroom	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	10	2,160	138	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	73	65
26	003	Interior	1	CLASSROOM	O003	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	1,260	161	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,260	86	76
27	003	Interior	1	STORAGE	Storage	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	10	684	44	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	684	23	21
28	002	Interior	1	STORAGE	S006	Light Switch	1	Incan/H/MR	Incan	I7-Globe; Pendant-Direct	1	1	8	684	5	ECM	RB - Replace Bulb	Wall Mounted	5W LED A18	684	3	1
29	002	Interior	1	CLASSROOM	Y002	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	26	78	10	1,260	3,145	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,260	1,671	1,474
30	002	Interior	1	STORAGE	S005	Wall-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	10	684	88	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	684	47	41
31	002	Interior	1	RESTROOM - PRIVATE	T005	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	10	2,160	276	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	147	130
32	P03	Interior	1	CLASSROOM	O018	Light Switch	6	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	36	108	8	1,260	4,355	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,260	2,313	2,041
33	P01	Interior	1	CLASSROOM	O014	Light Switch	3	Linear Fluorescent	T8	4' 32W T8; Industrial	9	18	9	1,260	726	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,260	386	340
34	P01	Interior	1	CLASSROOM	O015	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	12	36	10	1,260	1,452	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,260	771	680
35	P01	Interior	1	OPEN OFFICE	O016	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	15	45	10	2,160	3,110	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	1,652	1,458
36	P01	Interior	1	OPEN OFFICE	O017	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	15	45	10	2,160	3,110	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	1,652	1,458
37	004	Interior	1	RESTROOM	T001	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	3	6	8	2,160	415	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	220	194
38	004	Interior	1	MECHANICAL	B003	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	8	1,512	97	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,512	51	45
39	004	Interior	1	OFFICE	C001	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	2,160	276	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	147	130
40	004	Interior	1	RESTROOM - PRIVATE	T003	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
41	004	Interior	1	RESTROOM	T002	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	3	6	10	2,160	415	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	220	194
42	004	Interior	1	LIBRARY	X008	Wall-Mounted Sensor	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	15	45	10	2,160	3,110	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	1,652	1,458
43	004	Interior	1	CLASSROOM	O009	Wall-Mounted Sensor	8	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	48	144	10	1,260	5,806	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,260	3,084	2,722
44	P02	Interior	1	OFFICE	C001	Wall-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	3	9	9	2,160	622	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	330	292
45	P02	Interior	1	RESTROOM - PRIVATE	T01	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	9	2,160	276	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	147	130
46	001	Interior		CLASSROOM	T003	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	1	8	1,260	40	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,260	21	19
47	001	Interior	1	GYMNASIUM	U001	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	16	64	16	2,160	4,424	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	2,350	2,074
48	001	Interior	1	STORAGE	S001	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	684	88	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	684	47	41
49	001	Interior	1	KITCHEN	K001	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	8	24	8	1,800	1,382	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,800	734	648
50	001	Interior	1	HALLWAY	H001	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	684	88	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	47	41
51	001	Interior	1	STORAGE	S002	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	8	684	44	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	684	23	21
52	001	Interior	1	RESTROOM - PRIVATE	T001	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	8	2,160	138	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	73	65
53	001	Interior	1	OPEN OFFICE	C001	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	8	2,160	138	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	73	65
54	001	Interior	1	JANITORIAL	J001	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	8	684	44	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	23	21
55	001	Interior	1	GYMNASIUM	Stage	Light Switch	1	Incan/H/MR	Incan	I7-Globe; Pendant-Direct	48	48	8	2,160	726	ECM	RB - Replace Bulb	Photo Sensor	5W LED A18	2,160	518	207
56	Exterior	Exterior	1	CLASSROOM	Exterior	Timer	1	LED	-		8	8	7	2,160				Retain Existing Controls				
57	Exterior	Exterior	1	CLASSROOM	Exterior	Timer	1	HID	MH	MH400; Wallpack-Horizontal	20	20	7	2,160	17,280	ECM	RF - Replace Entire Fixture	Retain Existing Controls	70W LED Canopy	2,160	3,024	14,256
	Totals											1,113									30,194	37,976

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	55	425	1,091	37,976	$6,148.33	$1,419.45

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	3	50	50	210	$34	$334
Incan/H/MR	MR	0	0	0	0	$0	$0
HID	HPS	0	0	0	0	$0	$0
HID	MH	1	20	20	14,256	$2,308	$371
HID	MV	0	0	0	0	$0	$0
HID	QL	0	0	0	0	$0	$0
Linear Fluorescent	T8	51	355	355	23,510	$3,806	$715
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	1	Ceiling Mounted	0
Wall Mounted	49		

Initial Investment			**Equipment Rentals**	
Material Cost	$8,734.00		Scissor Lift 26' - Interior Spaces	$185.00
Labor Cost	$16,571.42		Bucket Truck - Exterior Spaces	$0.00
Local Electric Rate:	$0.16	$/kWh	Estimated Annual Energy Savings:	37,976
Hourly Labor Rate For Electrician:	$82.45		Estimated Annual Energy Cost Savings:	$6,148
Budgeted Initial Investment:	$25,490		Estimated Annual O&M Cost Savings:	$1,419
Estimated Return on Investment: *(Including O&M Savings)*	3.37	Years	Estimated Annual Cost Savings:	$7,568

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	350		Number of Occupants Affected by Retrofit	350	
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	26		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	2.2	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	1		Estimated Number of Uses Per Day	1	

Annual Water Savings From Installing Low Flow Aerators: 14.52 kGal

WATER & ENERGY SAVING CALCULATION			COST SAVING CALCULATION		
Select Type of Water Heater Fuel:	Natural Gas	(Select)	Property Location in United States	North Central Localities	
Energy Factor of Domestic Hot Water Heater:	0.79	EF	Heating Fuel Tariff	$1.30	$/Therm
Hot Water Discharge Temperature at Faucet	110.00	°F	Water Tariff ($/1000 Gal)	$12.63	$/kGal
Equivalent Heating Fuel Savings:	78	Therms	Annual Cost Savings In Form of Water	$183	$
Savings Discounted by 15% to Account For Cold Water Use					
Annual Water Savings	14.52	kGal	Annual Energy Savings From Water Heater	$101	$

COST BENEFIT ANALYSIS				
Estimated Total Annual Cost Savings	$285	$$	Estimated Total Installation Cost	$685 $$
Simple Payback Period	2.41	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: $685 Estimated Annual Cost Savings: $285 Simple Payback Period (Yrs): 2.41

UIC	Install Low Flow Tankless Restroom Fixtures
EAP4	Location: Restrooms

ECM FOR DETERMINING WATER SAVINGS IN COMMERCIAL PROPERTIES

Number of Males	175	
Number of Females	175	
Number of Occupied Days Per Week (Max 7)	5	
Number of Occupied Weeks/Year (Max 52)	36	
Number of Urinals To Be Retrofitted	8	
Number of Water Closets To Be Retrofitted	20	
No. of Water Closets With Separate Flush Tank *(Typical Residential Type)*		
Estimated Restroom Usage/Individual/Day *Default is 4 Uses/Day For Residential/Office*	2	(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		20
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		56.45 kGal
Estimated Annual Water Savings From Female Users		56.45 kGal
Total Water Savings From Water Closets		112.90 kGal

Water & Cost Saving Calculations

Water Savings Calculation

Water Savings By The Use of Low Flow Water Closet Flush Valves/Yr	112.90	kgal
Water Savings By The Use of Low Flow Urinal Flush Valves/ Yr	0.00	kgal
Total Annual Water Savings in kgal	112.90	kgal

Cost Savings Calculations

Enter Water Tariff Rate ($/1000Gal)	$12.63	$$
Estimated Cost Savings From Water	$1,426	$$

Estimated Cost of Retrofit

Cost For Replacing Existing Urinal Fixture With A Low Flow Fixture	$0 *(Includes Labor)*	$$
Cost For Replacing Existing Flush Valves With Low Flow - Dual Flush Valves ($80 Per Unit) *(Up For Liquid Waste And Down For Solid Waste)*	$12,381 *(Includes Labor)*	$$
Estimated Total Cost For Retrofit	$12,381	$$
Simple Pay Back Period	8.68	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:	$12,381	Simple Payback Period:	8.68 Yrs
Annual Cost Savings:	$1,426		

UIC	Replace Existing Water Heater With New Energy Efficient Units
EAD3	**Location: Building 001 and 002**

		Building 1		Building 2		Specify Location Here		Specify Location Here	
Step 1	**Existing Water Heater Details**								
	Number of Water Heaters Being Replaced:	1		1					
	Select Existing Hot Water Heater Fuel	Natural Gas		Natural Gas		Natural Gas		Electric	
	Insert Energy Factor of Existing Water Heater	0.54	EF	0.50	EF		EF		EF
	Input Existing Water Heater Input Rating	75.00	kBtus	35.00	kBtus		kBtus		kW
	Select One Method For Calculation	Annual Heating Hours		Annual Heating Hours		Annual DWH Load		Annual DWH Load	
	Insert Average Annual Hours of Operation	650	hrs	650	hrs		Therms		kWh
	Annual Water Heater Energy Consumption/Heater	488	Therms	228	Therms	#DIV/0!	hrs	#DIV/0!	hrs
	Total Estimated Annual Energy Consumption For all Heaters	488	Therms	228	Therms	0	Therms	0	kWh
	Total Estimated Annual Operating Energy Costs For all Heaters	$633	$	$295	$	$0	$	$0	$
Step 2	**Proposed New Water Heater**								
	Proposed Hot Water Heater Fuel	Natural Gas		Natural Gas		Electric		Natural Gas	
	Capacity of the Proposed New Water Heater	75-Gal,75-kBtu		40-Gal,40-kBtu					
	Energy Factor of Proposed Water Heater	0.60	EF	0.70	EF	0.00	EF	0.00	EF
	Proposed Water Heater Input Rating	75.00	kBtuh	40.00	kBtuh	0.00	kW	0.00	kBtuh
	Annual kBtuh Consumption For All The Proposed Water Heaters	43,875	kBtuh	16,250	kBtuh	#DIV/0!	kBtuh	#DIV/0!	kBtuh
	Estimated Annual Water Heater Fuel Consumption (All Heaters)	439	Therms	163	Therms	0	kWh	0	Therms
	Estimated Total Annual Energy Costs	$569	$	$211		$0		$0	
Step 3	**Energy & Cost Saving Calculation**								
	Estimated Cost of New Water Heater/Unit	$1,190	$	$1,160	$	$0	$	$0	$
	Total Estimated Installation Cost	$1,776	$	$1,731	$	$0	$	$0	$
	Total Estimated Annual Cost Savings	$63	$	$84	$	$0	$	$0	$
	Total Annual Cost Savings:	$148		Total Initial Investment::		$3,508			
	Simple Pay Back Period	23.76							
	Type of Recommendation	Capital Cost ECM Recommendation							

ECM SUMMARY:

Electric resistance is the most expensive method for heating domestic hot water. A natural gas or propane fired water system provide more units of heat with direct burning of fuel while high wattage draw is required for electric water heaters to create resistance heat. This electric usage can be seen with the increase power demand for the site and the additional kWh consumption. The installation process of the gas/propane fired water heater requires additional measures with tying a gas line or fuel tank to the system along with installing an exhaust gas vent. This process is not a costly retrofit if a current gas line or tank is at the site. The hot water exhaust duct can be tied to the existing gas fired furnaces or boilers for an easy retrofit.

SUMMARY:

Initial Investment: $1,776 Simple Payback: 23.76 yrs
Annual Cost Savings: $63

UIC	Install Timers On Exhaust Fans
EAC7A	Location: Throughout

Type of Exhaust Fan: Rooftop Exhaust Fans

EXISTING CONDITION

No. of Timers to Be Installed:	14	Qty	HP of Individual Fan Motor:	0.15	HP
No. of Exhaust Fans:	14		Total kW:	1.57	kW
Existing Daily Hours of Operation/Exhaust Fan:	15.00	Hrs/Day	Annual kWh For All Fans:	8,577	kWh

PROPOSED CONDITION

New Daily Hours With Timers/Exhaust Fan:	12.00	Hrs/Day	New Annual kWh For All Fans:	6,862	kWh
Type of Heating Fuel:	Natural Gas		Is The Property Cooled?	Yes	

Only For Apt. Bathroom Exhaust Fans			Only For Roof Top Exhaust Fans- Commerical Spaces		
CFM for Individual Bathroom Exhaust Fans *(For bathrooms<100Sqft)*	90	CFM	No. of Water Closets In Building	20	
			No. of Urinals In Building	8	
Total Exhuast CFM From All Fans	1,260	CFM	Total CFM for All Restroom Exhaust	1,400	CFM
Annual Heating Energy Savings	0	kbtu	Annual Heating Energy Savings	18,144	kbtu
Annual Cooling Energy Savings	0	kbtu	Annual Cooling Energy Savings	9,072	kbtu

Energy & Cost Savings

Estimated Annual Heating Plant Efficiency	75.00	%	Estimated Annual Cooling Plant Efficiency	8.00	EER
Annual Heating Energy Savings	242	Therms	Annual Cooling Energy Savings	1,134	kWh
Annual Electric Fan Motor Savings	1,715	kWh			

COST ANALYSIS

Electric Rate:	$0.16	$/kWh	Total Annual Electric Savings	2,849	kWh
Material Cost For Timers:	$2,370	$	Total Annual Non Electric Savings	242	Therms
Total Cost for Installing Timers	$4,955	$	Annual Cost savings:	$775	$
Simple Payback:	6.39	Yrs			

Type of Recommendation Capital Cost ECM Recommendation

ECM DESCRIPTION:

Exhaust fans are generally used in areas with high concentrations of pollutants generated from occupants' activities. These exhaust requirements are rarely continuous, and the fans should operate only as needed. Continuous operations of bathroom exhaust fans results in exhausting conditioned air out. This causes low pressures in the conditioned space, which is filled up by infiltrated air from unconditioned spaces. Air infiltration leads to increase loads on heating and cooling system increasing the energy consumed to condition the space. In addition to this the fan motor is also consumes energy to operate, though insignificant as compared to the HVAC losses.

In case of the residential properties with individual exhaust fans in the bathrooms, EMG recommends installing timer switches on each bathroom fan to control the fan operations. Bathroom fans are essential to exhaust out the excess humidity and odor control. The timer switch will limit the operation time to 20 mins.

In case of central exhaust systems that have roof top or side wall mounted exhaust fans, EMG recommends a single electronic timer control to restrict the exhaust fan operations to typical building occupancy hours +/- 2 hrs. A single electronic timer would be able to control all the exhaust fans.

Summary:

Initial Investment:	$2,370	Simple Payback:	6.39	Years
Energy Cost Savings	$775			

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

ASHRAE Climatic Zone: Zone-3	*Portable Classrooms*	*Portable Classrooms*	*Portable Classrooms*	*Specify Location Here*
Select Existing Heating System Type	Heat Pump - Split System	Heat Pump - Split System	Heat Pump - Split System	PTAC
Number of Existing Systems:	4 Qty	3 Qty	1 Qty	Qty
Output Capacity of Heating System/Unit:	36,000.00 btuh	42,000.00 btuh	48,000.00 btuh	kW
Output Capacity of Heating System:	36,000 Btuh	42,000 Btuh	48,000 Btuh	0 Btuh
Existing COP of Heating System:	3.00 COP	3.00 COP	3.00 COP	COP
Estimated Annual Heating Hours:	200 Hrs	200 Hrs	200 Hrs	Hrs
Auxiliary Heating In Heatpumps:	kW	kW	kW	kW
Cooling Capacity of Each System:	36,000 Btuh	42,000 Btuh	48,000 Btuh	Btuh
Existing EER of Cooling System:	8.00 EER	8.00 EER	8.00 EER	EER
Estimated Annual Cooling Hours:	300 Hrs	300 Hrs	300 Hrs	Hrs
Install Programmable Thermostats With Heatpumps:	Yes	Yes	Yes	Yes
Current Energy Consumption From Cooling:	5,400 kWh	4,725 kWh	1,800 kWh	0 kWh
Current Energy Consumption From Heating:	2,251 kWh	1,970 kWh	750 kWh	0 kWh
Total Existing Electric Consumption:	7,651 kWh	6,695 kWh	2,550 kWh	0 kWh

Proposed System

Heat pump Type	Air-Source Split Heat Pump System	Air-Source Split Heat Pump System	Air-Source Split Heat Pump System	Water-Source System
Proposed Number of Systems:	4 Qty	3 Qty	1 Qty	Qty
Proposed Heat pump Capacity:	36,000 Btuh	42,000 Btuh	48,000 Btuh	- Btuh
Proposed COP:	3.85 COP	3.72 COP	3.85 COP	- COP
Proposed Emergency Heat Rating:	10.55 kW	12.31 kW	14.07 kW	0.00 kW
Proposed Energy Consumption From Cooling:	2,765 kWh	2,503 kWh	922 kWh	0 kWh
Proposed Energy Consumption From Heating:	1,787 kWh	1,686 kWh	964 kWh	0 kWh
Total Proposed Electric Consumption:	4,551 kWh	4,188 kWh	1,886 kWh	0 kWh
Total Electric Savings:	3,099 kWh	2,506 kWh	664 kWh	0 kWh
Total Cost For Replacement:	$12,558.29	$10,442.98	$4,016.82	$0.00
Annual Energy Cost Savings:	$502	$406	$108	$0
Individual Simple Payback	25.03 Yrs	25.74 Yrs	37.34 Yrs	- Yrs

Total Initial Investment:	$27,018.10	Total Annual Electric Savings	6,270 kWh
Total Annual Cost Savings	$1,015.09	Overall Simple Payback Period:	26.62 Yrs

UIC	Replace Rooftop Package Unit
EAH12-B	Location: Rooftop

Estimated Annual Cooling Hours:	500	Hrs	Estimated Annual Heating Hours:	300	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:	4	4	4

Capacity of the air conditioner:	3	Tons	EER of the Existing Air Conditioner:	7.75	
Capacity of Existing Heating System:	72	MBH	Input Existing AFUE for the Furnace:	75%	
Estimated Annual Cooling Consumption: *(For All Units)*	9,290	kWh	Estimated Annual Heating Consumption : *(For All Units)*	1,152	Therms

Proposed Package System

Capacity of the Proposed Air Conditioner:	3	Tons	EER of the Proposed Air Conditioner:	9.50	EER
Capacity of Proposed Heating System:	Gas Fired -60MBH	MBH	AFUE of Proposed Heating System:	80%	%

Estimated Annual Energy Consumption With New Package Units

Annual Electric Fuel Consumption:	7,579	kWh	Annual Heating Fuel Consumption:	900	Therms

Energy and Cost Analysis

Average Electric Rate:	$0.16	$/kWh	Average Heating Rate:	$1.30	$/Therm
Estimated Annual Electric Savings : *From All New Package Systems*	1,711	kWh	Estimated Annual Heating Savings : *From All New Package Systems*	25,200	kBtus
Annual Electric Cost Savings: *From All New Package Systems*	$277		Annual Electric Cost Savings: *From All New Package Systems*	$327	$

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

Estimated Material and Labor Cost Including Overheads and Profits For All Units:	$19,000.00	$
Estimated Total Energy Cost Savings From New HVAC System:	$604	$
Estimated O&M Savings:	$30	
Estimated Simple Pay Back Period:	29.9562325 Yrs	

Capital Cost ECM Recommendation

APPENDIX F:
Solar PV

UIC	Install Fixed Tilt Solar Photovoltaic System
EAR-2	Details: John D. Sloat Elementary

Select State: Northern California **Electric Rate:** **$0.16** $/KWH Annual Electric Consumption: 217,514 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	16.30	16	52	25,108	25,108	$4,065	$57,050	14.0	$0	$17,115	$552	$0	8.5
2	Building 2	1	25	25	79	38,663	38,663	$6,260	$87,500	14.0	$0	$26,250	$851	$0	8.4
3	Building 3	1	17	17	54	25,570	25,570	$4,140	$59,500	14.4	$0	$17,850	$563	$0	8.7
4	Building 4	1	26	26	83	39,279	39,279	$6,359	$91,000	14.3	$0	$27,300	$864	$0	8.7
5	Building 5	1	19	19	60	29,575	29,575	$4,788	$66,500	13.9	$0	$19,950	$651	$0	8.4
6	Building 6	1	22	22	69	33,426	33,426	$5,412	$75,950	14.0	$0	$22,785	$735	$0	8.5
		6		**125**	**397**	**191,621.0**	**191,621**	**$31,023**	**$437,500**	**14.10**	**$0**	**$131,250**	**$4,216**	**$0**	**8.51**

Solar Rooftop Photovoltaic Analysis		
Total Number of Roofs	6	
Estimated Number of Panels	397	
Estimated KW Rating	125	KW
Potential Annual KWh Produced	191,621	KWh
% of Current Electricity Load	88.1%	

Financial Analysis		
Investment Cost	$437,500	
Estimated Energy Cost Savings	$31,023	
Potential Rebates	$131,250	
Potential Annual Incentives	$4,216	
Payback without Incentives	14.1	years
Incentive Payback but without SRECS	8.5	years
Payback with All Incentives	8.5	years