LEVEL II ENERGY AUDIT

Sacramento City Unified School District
5735 47th Avenue
Sacramento, California 95824

DLR Group
1050 20th Street, Suite 250
Sacramento, California 95811

ZERO NET ENERGY ASHRAE LEVEL II AUDIT

KIT CARSON INTERNATIONAL ACADEMY

5301 North Street

Sacramento, California 95819

PREPARED BY:
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EMG PROJECT #:

136988.19R000-089.268

DATE OF REPORT:

November 25, 2019

ONSITE DATE:

September 9-10, 2019

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Certification

EMG has completed an Energy Audit of Kit Carson International Academy located at 5301 North Street in Sacramento, California. EMG visited the site on September 9-10, 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: Henry Guo
Energy Auditor
Project Manager

Reviewed by: 

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 Kit Carson International Academy 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	00A	Library	6,375	53
2	00B	Classrooms B1-B8	8,700	72
3	00C	Classrooms C1-C6	6,525	54
4	00D	Classrooms D1-D6	8,625	72
5	00E	Multipurpose Room / Kitchen	10,070	83
6	00F	Admin	11,175	93
7	00G	Gymnasium / Mechanical	10,770	89
8	P01	Restrooms	600	5
9	P02	Classrooms H1-H4, Theatre	8,800	73

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 six 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)*	$170,345 *(In Current Dollars)*
Estimated Annual Cost Savings *(Current Dollars Only)*	$27,350 *(In Current Dollars)*

ECM Effective Payback	6.23 years
Estimated Annual Energy Savings	37.79%
Estimated Annual Energy Utility Cost Savings *(Excluding Water)*	27.95%
Estimated Annual Water Cost Saving	3.89%

Solar Photovoltaic (PV) Screening for KIT CARSON INTERNATIONAL ACADEMY

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS		
Estimated Number of Panels	793	
Estimated KW Rating	250	KW
Potential Annual kWh Produced	383,618	kWh
% of Current Electricity Uses	79.7%	
FINANCIAL SUMMARY		
Investment Cost	$874,650	
Estimated Energy Cost Savings	$67,133	
Payback without Incentives	13.0	Years
Incentive Payback but without SRECs	7.9	Years
Payback with All Incentives	7.9	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)	24 kBtu/ft^2
Post ECM Site Energy Use Intensity (EUI)	15 kBtu/ft^2
SOURCE ENERGY USE INTENSITY (EUI)	**RATING**
Current Source Energy Use Intensity (EUI)	69 kBtu/ft^2
Post ECM Source Energy Use Intensity (EUI)	49 kBtu/ft^2
BUILDING COST INTENSITY (BCI)	**RATING**
Current Building Cost Intensity	$0.98/ft^2
Post ECM Building Cost Intensity	$0.70/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	786 MMbtu
Total CO_2 Emissions Reduced	57.93 $MtCO_2$/Yr
Total Cars Off the Road (Equivalent)*	11
Total Acres of Pine Trees Planted (Equivalent)*	13

**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	2,079,507 kBtu
Total Annual Energy Savings for Non-Renewable Energy Measures	785,756 kBtu
Total Annual Energy Savings from Renewable Energy Measures	1,308,905 kBtu
Total Annual Energy Savings	2,094,661 kBtu
Net Energy Consumption from Grid Post Implementation	-4,428 kBtu
% Energy Reduction (Annual Energy-Net Energy) / (Annual Energy)	101%

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 Kit Carson International Academy

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 & Cafeteria	$427	303	0	56	$667	$0	$667	0.64	13.34	$5,263	10.00
Totals for No/Low Cost Items		**$427**	**303**	**0**	**56**	**$667**	**$0**	**$667**	**0.64**			
Capital Cost Recommendations												
1	Install Timers On Exhaust Fans Location: Throughout	$1,416	678	5,133	0	$1,766	$0	$1,766	0.80	14.89	$19,666	15.00
2	Upgrade Building Lighting to LED and Install Automatic Lighting Controls Location: Building Interior And Exterior	$36,459	0	69,051	0	$11,203	$1,868	$13,070	2.79	4.28	$119,572	15.00
3	Control External Air Leakage In Commercial Buildings Location: Extrior Doors	$48,619	3,068	17,688	0	$7,091	$355	$7,446	6.53	1.83	$40,266	15.00
4	Install Low Flow Tankless Restroom Fixtures Location: Restrooms	$22,597	0	0	401	$1,788	$0	$1,788	12.64	0.94	-$1,256	15.00
5	Re-Commission The Building & Its Control Systems Location: Throughout	$38,609	505	30,558	0	$5,653	$0	$5,653	6.83	1.75	$28,875	15.00
Total For Capital Cost		**$147,700**	**4,251**	**122,430**	**401**	**$27,500**	**$2,222**	**$29,722**	**4.97**			
	Interactive Savings Discount @ 10%		-455	-12,243	-46	-$2,817	-$222	-$3,039				
	Total Contingency Expenses @ 15%	$22,219										
Total for Improvements		**$170,345**	**4,098**	**110,187**	**411**	**$25,350**	**$2,000**	**$27,350**	**6.23**			

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 Kit Carson International Academy

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 External Windows Location: Throughout	$113,286	2,843	22,830	0	$7,617	$76	$7,693	14.73	1.18	$20,672	25.00
2	Upgrade Insulation Location: Attic/Ceiling Throughout	$218,787	3,573	19,147	0	$8,023	$0	$8,023	27.27	0.24	-$79,078	25.00
3	Retrofit Apartment Tank Toilets to Dual Flush Location: Restrooms And Locker Rooms	$2,990	0	0	0	$48	$0	$48	62.63	0.24	-$2,280	20.00
Total for Improvements		**$113,286**	**2,843**	**22,830**	**0**	**$7,617**	**$76**	**$7,693**	**14.73**			

2. Introduction

The purpose of this Energy Audit is to provide Kit Carson International Academy 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	50
Operational Weeks / Year	38
Estimated Facility Occupancy	594
% of Male Occupants	297

POINT OF CONTACT	
Point of Contact Name	Wendell Birt
Point of Contact Title	Plant Manager
Point of Contact – Contact Number	916-320-7621

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

Description:

Most MEPF systems and components are original to the 1976 campus construction and have been well-maintained since that time. Some HVAC components such as pump motors and terminal units have required isolated replacements and are nearing the end of their anticipated lifecycles. The HVAC infrastructure of the newer buildings, and the buildings that have had HVAC renovations, buildings 00A, 00F, 00G, itself is generally in good working condition with no major expenditures anticipated in the short term.

The remaining original buildings, 00B, 00C, 00D, 00E, of the campus are supplied by chilled water generated from a dedicated central chiller.

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

BUILDING CENTRAL HEATING SYSTEM	
Primary Heating System	Electric baseboard Heating
Secondary Heating System	Forced Air Furnace
Hydronic Distribution System	Not Applicable
Primary Heating Fuel	Natural Gas
Heating Mode Set-point	68 °F
Heating Mode- Set-back Temperature	65 °F

BUILDING COOLING SYSTEM	
Primary Cooling System	Air Cooled Chillers
Secondary Cooling System	Split Systems
Hydronic Distribution System	Two Pipe
Cooling Mode Set-point	68 °F
Cooling Mode- Set-back Temperature	74 °F

AIR DISTRIBUTION SYSTEM	
Building Ventilation	Central AHU with Fresh Air Intake
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 D

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	$1.38/therm	$ 4.46/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.

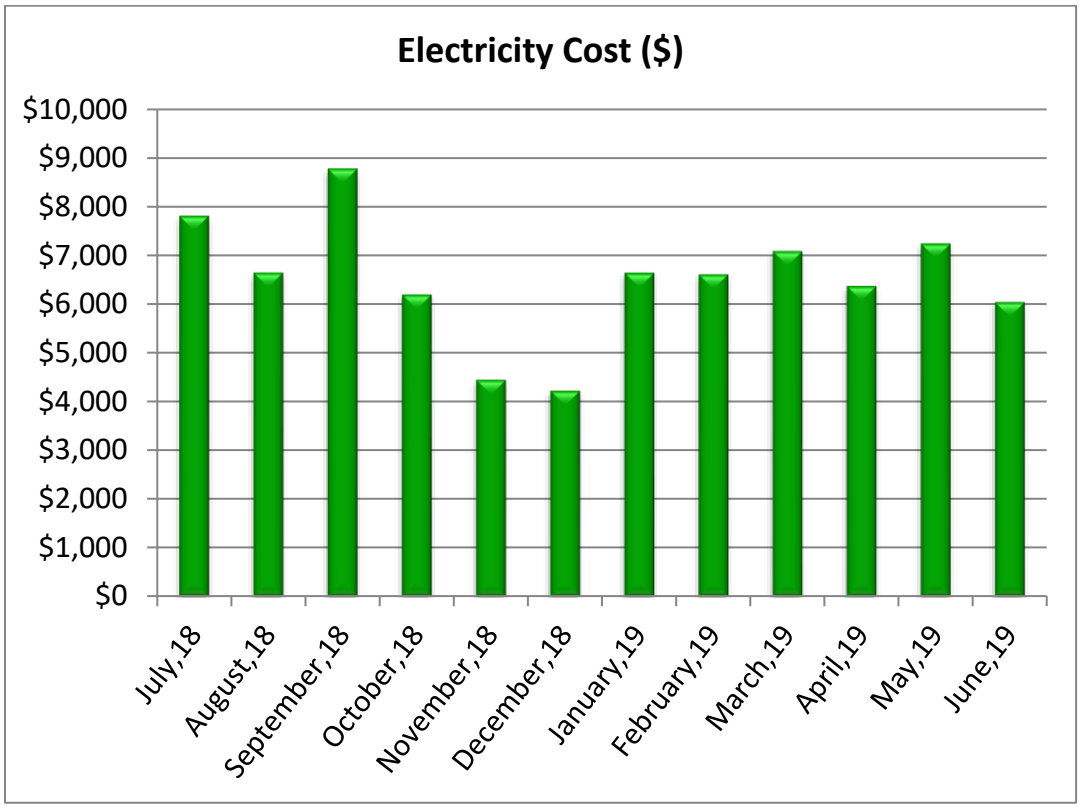
4.1. Electricity

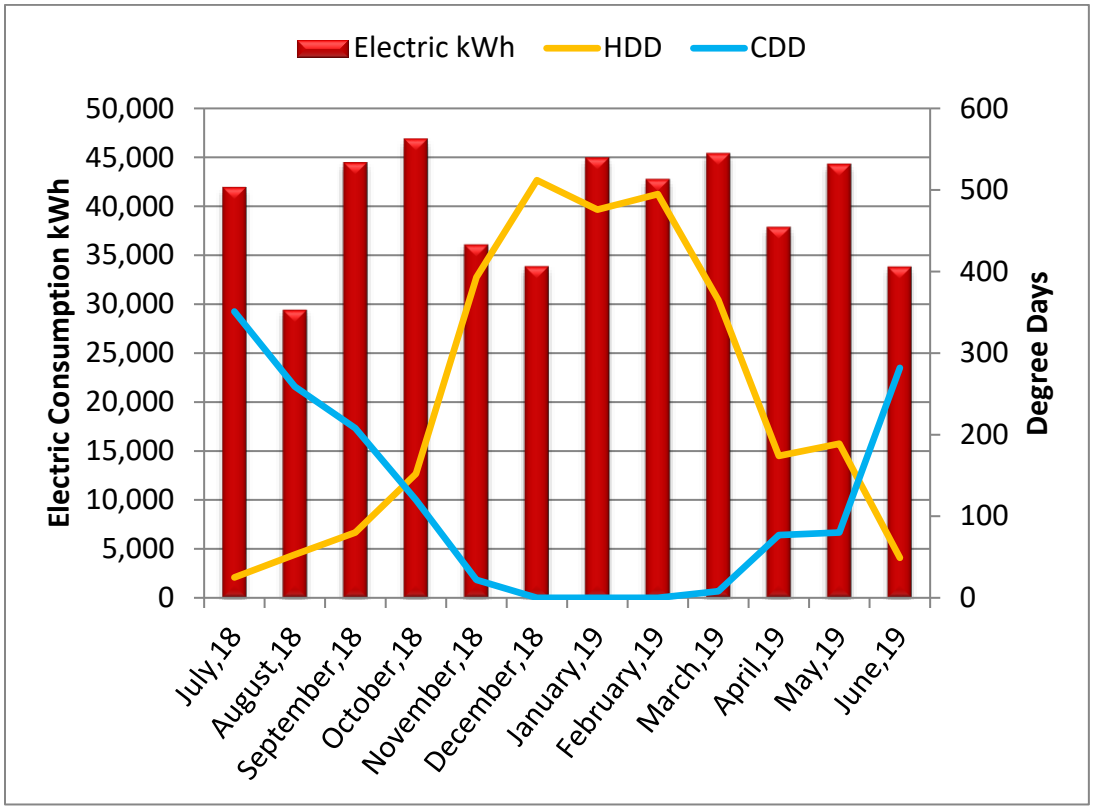
PGE satisfies the electricity requirements for the facility. The primary end uses for electric utility compromises of lighting, cooling, office/school equipment, and appliances in the break room.

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	41,930	$0.19	$7,817
August,18	29,390	$0.23	$6,650
September,18	44,462	$0.20	$8,787
October,18	46,886	$0.13	$6,198
November,18	36,056	$0.12	$4,449
December,18	33,842	$0.12	$4,227
January,19	44,949	$0.15	$6,645
February,19	42,746	$0.15	$6,612
March,19	45,390	$0.16	$7,090
April,19	37,859	$0.17	$6,372
May,19	44,297	$0.16	$7,246
June,19	33,806	$0.18	$6,042
Total/average	**481,610**	**$0.16**	**$78,135**


Electricity Cost ($)
$10,000
$9,000
$8,000
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$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


Electric kWh
HDD
CDD
Electric Consumption kWh
50,000
45,000
40,000
35,000
30,000
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

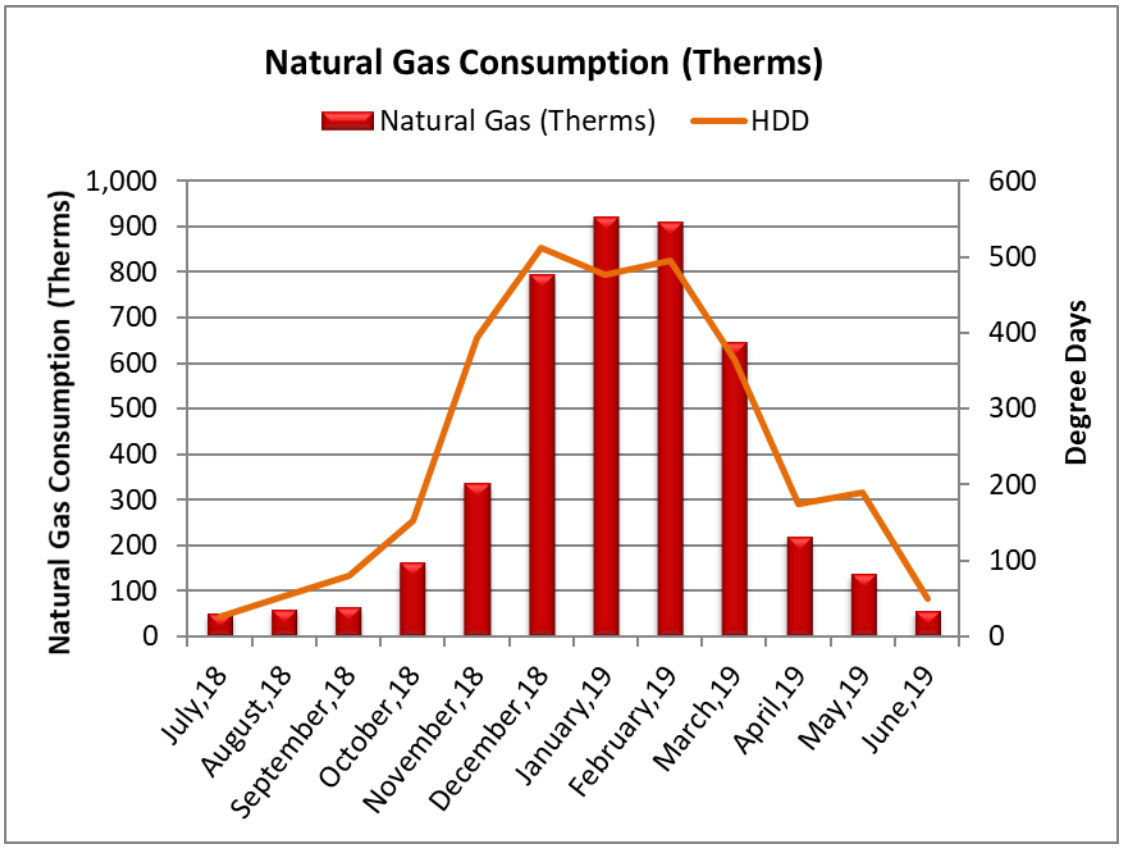
4.2. Natural Gas

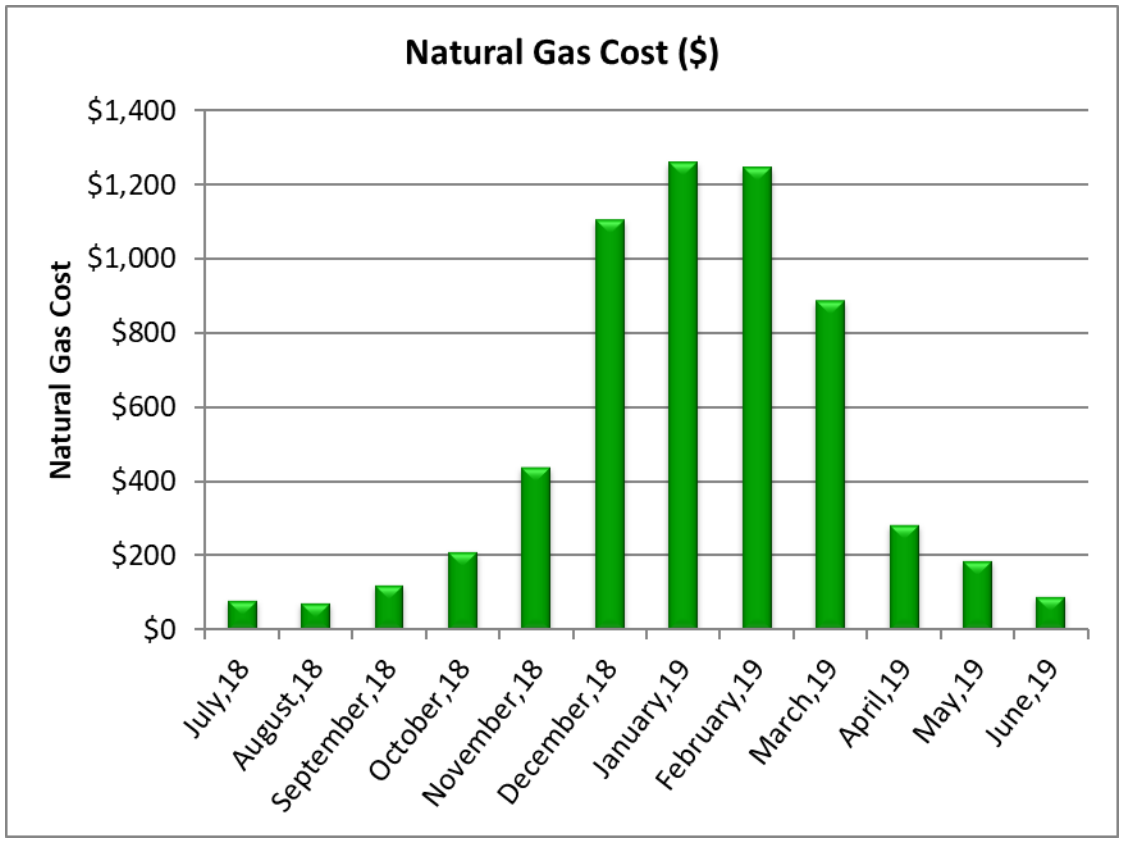
Spurr Gas satisfies the natural gas requirements of the facility. The primary end use of natural gas is for building heating, domestic water heating, and cooking in the cafeteria.

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	50	$1.63	$81
August,18	58	$1.28	$75
September,18	65	$1.90	$123
October,18	163	$1.30	$211
November,18	336	$1.31	$441
December,18	795	$1.39	$1,107
January,19	922	$1.37	$1,261
February,19	912	$1.37	$1,250
March,19	648	$1.37	$890
April,19	219	$1.29	$283
May,19	138	$1.37	$188
June,19	56	$1.63	$92
Total/average	4,363	$1.38	$6,004


Natural Gas Consumption (Therms)
Natural Gas (Therms)
HDD
Natural Gas Consumption (Therms)
Degree Days
1,000
900
800
700
600
500
400
300
200
100
0
600
500
400
300
200
100
0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

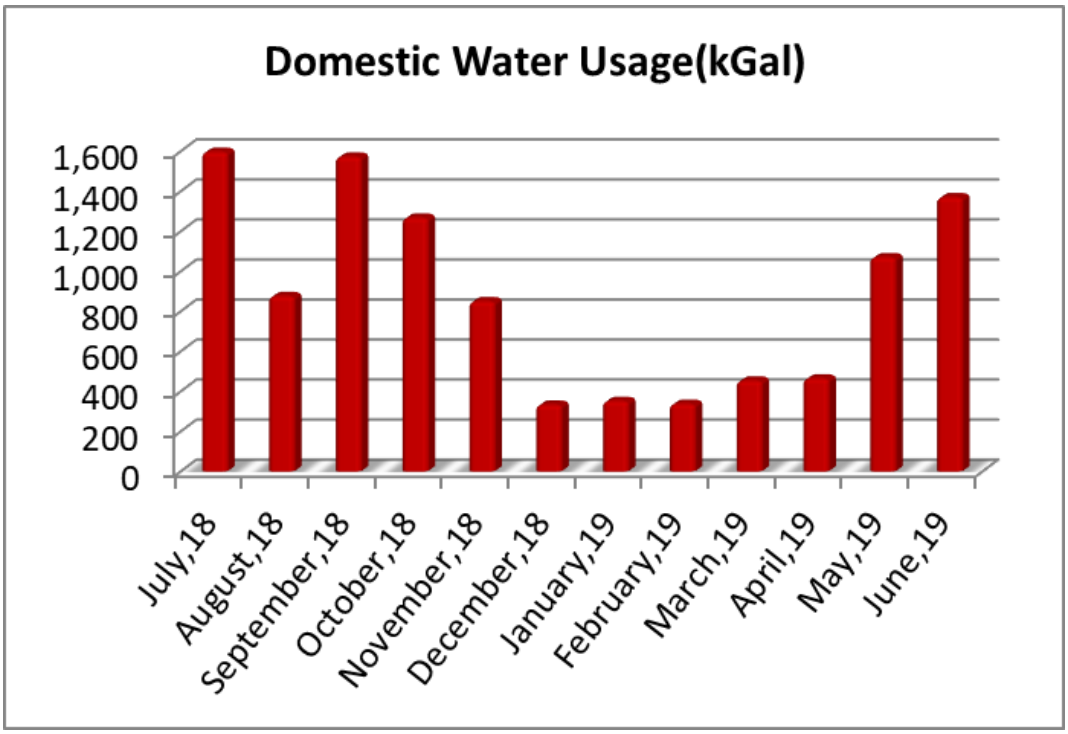

Natural Gas Cost ($)
Natural Gas Cost
$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

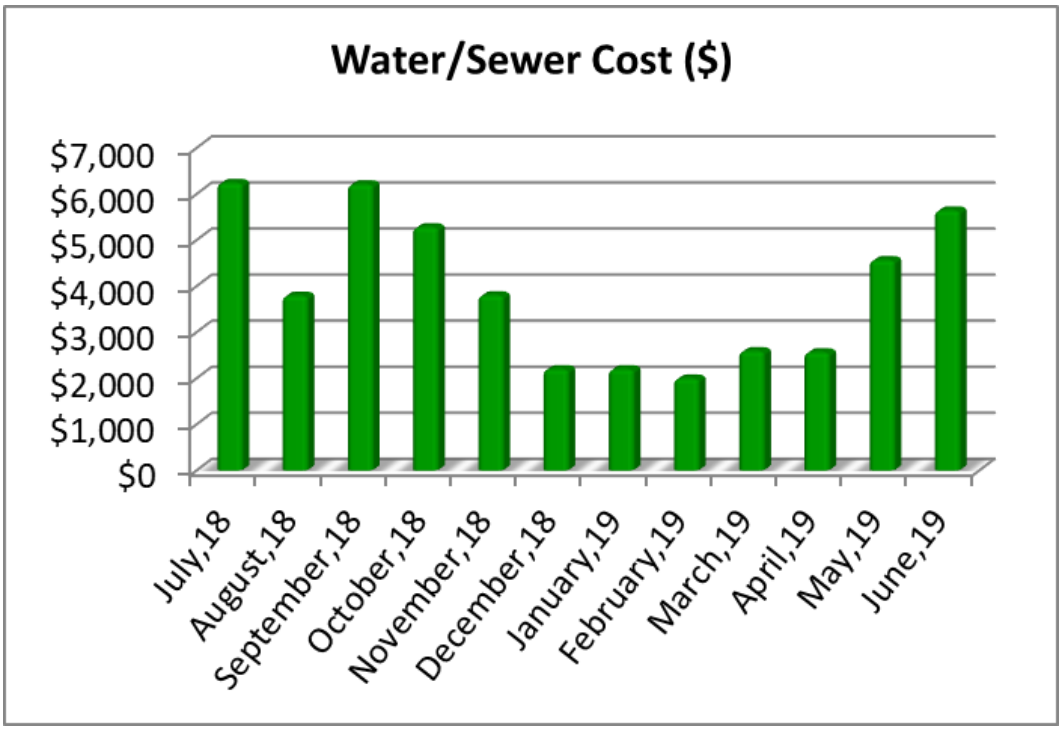
4.3. Water and Sewer

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	1,598	$3.91	$6,243
August,18	877	$4.33	$3,795
September,18	1,574	$3.95	$6,214
October,18	1,269	$4.16	$5,281
November,18	851	$4.47	$3,804
December,18	334	$6.58	$2,200
January,19	353	$6.23	$2,200
February,19	339	$5.90	$1,997
March,19	455	$5.70	$2,592
April,19	466	$5.51	$2,566
May,19	1,071	$4.26	$4,567
June,19	1,371	$4.12	$5,647
Total/average	**10,558**	**$4.46**	**$47,105**


Domestic Water Usage(kGal)
1,600
1,400
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


Water/Sewer Cost ($)
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$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?	To be analyzed
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	793	
Estimated KW Rating	250	KW
Potential Annual kWh Produced	383,618	kWh
% of Current Electricity Uses	79.7%	
FINANCIAL SUMMARY		
Investment Cost	$874,650	
Estimated Energy Cost Savings	$67,133	
Payback without Incentives	13.0	Years
Incentive Payback but without SRECs	7.9	Years
Payback with All Incentives	7.9	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
Air Handler (AHU)	Trane	No tag/plate found	U5L-042836	1500 CFM	-	Attic	C6	1
Air Handler (AHU)	Trane	No tag/plate found	U5L-042810	1500 CFM	-	Attic	00C Classrooms C1 to C6	1
Air Handler (AHU)	Trane	Inaccessible	Inaccessible	1500 CFM	-	Attic	00C Classrooms C1 to C6	1
Air Handler (AHU)	Trane	No tag/plate found	U5L-042844	1500 CFM	-	Attic	00C Classrooms C1 to C6	1
Air Handler (AHU)	Trane	No tag/plate found	U5L-42816	2000 CFM	-	Attic	00D Classrooms D1 to D8	1
Air Handler (AHU)	Trane	No tag/plate found	U5L-042819*	2000 CFM	-	Attic	00B Classrooms B1 to B8	1
Air Handler (AHU)	Trane	No tag/plate found	U5L-0428313	2000 CFM	-	Attic	00D Classrooms D1 to D8	1
Air Handler (AHU)	Trane	No tag/plate found	UGA-0428332	2000 CFM	-	Attic	00E Multipurpose Room/Kitchen	1
Air Handler (AHU)	Trane	No tag/plate found	U5L-042822	2000 CFM	-	Attic	00B Classrooms B1 to B8	1
Air Handler (AHU)	Trane	No tag/plate found	UGA-042833	2000 CFM	-	Attic	00E Multipurpose Room/Kitchen	1
Air Handler (AHU)	Trane	No tag/plate found	U5L-042841	2000 CFM	-	Attic	00B Classrooms B1 to B8	1
Air Handler (AHU)	Trane	No tag/plate found	U5L-042808	2000 CFM	-	Attic	00B Classrooms B1 to B8	1
Air Handler (AHU)	Trane	No tag/plate found	U5L-042847	2000 CFM	-	Attic	00D Classrooms D1 to D8	1
Air Handler (AHU)	Trane	No tag/plate found	U5L-042819	2000 CFM	-	Attic	00B Classrooms B1 to B8	1
Air Handler (AHU)	Trane	No tag/plate found	U5L-042834	2000 CFM	-	Attic	00B Classrooms B1 to B8	1
Air Handler (AHU)	Trane	No tag/plate found	U5L-042843	2000 CFM	-	Attic	00D Classrooms D1 to D8	1
Air Handler (AHU)	Trane	No tag/plate found	Inaccessible	2000 CFM	-	Attic	00D Classrooms D1 to D8	1
Air Handler (AHU)	Trane	No tag/plate found	UGA-042831	2000 CFM	-	Attic	00E Multipurpose Room/Kitchen	1
Central AC Split Condensing Unit	Carrier	24ABB360A0062011	1517E07361	5 TON	-	Building exterior	00A Library	1
Central AC Split Condensing Unit	Carrier	24ABB360A0062011	1517E073623	5 TON	-	Building exterior	00A Library	1
Central AC Split Condensing Unit	Carrier	24ABB360A0062011	1517E07362	5 TON	-	Building exterior	00A Library	1
Central AC Split Condensing Unit	Carrier	24ABB360A0062011	1517E07371	5 TON	-	Building exterior	00A Library	1
Central AC Split Condensing Unit	Carrier	ZI24ABB348A0061011	0417E09199	4 TON	-	Building exterior	00F Admin	1
Central AC Split Condensing Unit	Carrier	ZI24ABB348A0061011	0417E091956	4 TON	-	Building exterior	00F Admin	1
Central AC Split Condensing Unit	Carrier	ZI24ABB348A0061011	0417E16419	4 TON	-	Building exterior	00F Admin	1
Central AC Split Condensing Unit	Carrier	ZI24ABB348A0061011	0417E09195	4 TON	-	Building exterior	00F Admin	1
Central AC Split Condensing Unit	Carrier	ZI24ABB348A0061011	S4316E01917	4 TON	-	Building exterior	00F Admin	1
Central AC Split Condensing Unit	Carrier	ZI24ABB348A0061011	0517E00633	3 TON	-	Building exterior	00F Admin	1
Central AC Split Condensing Unit	Carrier	24ABB360A0062011	1517E07349	5 TON	-	Building exterior	00A Library	1
Chiller	Trane	RTA1004XN01A3D0BG	U03G0628	100 TON	-	Site	00G Gymnasium/Mechanical	1
Commercial 8 - 10 LF	Aqua matic	S.CA	42542	10 LF	-	Kitchen	00E Multipurpose Room/Kitchen	1
Distribution Pump	GE	5K213FL2023	45BC03XP	7.5 HP	-	Site	00G Gymnasium/Mechanical	1
Domestic Circulation/Booster Pump	U.S. Electrical Motors	Illegible	Illegible		-	Site	Site	1
Ductless Split System	Mitsubishi	PUZ-A18NKA7	6XU00571A	1.5 TON	-	Building exterior	00A Library	1
Exhaust Fan	Greenheck	VK-H-10-A7-X	14891556	1500 CFM	-	Roof	P02 Classrooms H1-H4, Theatre	1
Exhaust Fan	Greenheck	QUE-141-B-X	14896324	1500 CFM	-	Roof	P02 Classrooms H1-H4, Theatre	1
Exhaust Fan	Greenheck	QUE-099-B-X	14896343	1000 CFM	-	Roof	P02 Classrooms H1-H4, Theatre	1
Exhaust Fan	Greenheck	QUE-141-B-X	14896333	1500 CFM	-	Roof	P02 Classrooms H1-H4, Theatre	1
Fan	Trane	Inaccessible	Inaccessible	4000 CFM	-	Attic	D8	1

Fan	Westinghouse	-	-	4000 CFM	-	Attic	00C Classrooms C1 to C6	1
Fan	Marathon	5K46KN4085X	J11J120066	2000 CFM	-	Move to 00E	00E Multipurpose Room/Kitchen	1
Fan	Trane	Inaccessible	Inaccessible	4000 CFM	-	Attic	00D Classrooms D1 to D8	1
Fan	Trane	No tag/plate found	No tag/plate found	4000 CFM	-	Attic	00B Classrooms B1 to B8	1
Fan	Trane	No tag/plate found	No tag/plate found	4000 CFM	-	Attic	00B Classrooms B1 to B8	1
Fan	Trane	No tag/plate found	No tag/plate found	4000 CFM	-	Attic	00B Classrooms B1 to B8	1
Fan	Marathon	5K46KN4085X	H12J170072	2000 CFM	-	Move to 00E	00E Multipurpose Room/Kitchen	1
Fan	Trane	No tag/plate found	No tag/plate found	4000 CFM	-	Attic	00B Classrooms B1 to B8	1
Furnace	Carrier	ZI59SP5A080E211220	S0517A58206	80 MBH	-	Attic	00F Admin	1
Furnace	Carrier	ZI59SP5A080E211220	S0517A58209	80 MBH	-	Attic	00F Admin	1
Furnace	Carrier	ZI59SP5A080E211220	S0517A58226	80 MBH	-	Attic	00F Admin	1
Furnace	Carrier	ZI59SP5A080E211220	S0517A58208	80 MBH	-	Attic	00F Admin	1
Furnace	Carrier	ZI59SP5A080E211220	S0517A58224	80 MBH	-	Attic	00F Admin	1
Furnace	Carrier	ZI59SP5A080E211220	S0517A58497	80 MBH	-	Attic	00F Admin	1
Furnace	Carrier	ZI59SP5A080E211220	S1317A60694	80 MBH	-	Attic	00A Library	1
Furnace	Carrier	ZI59SP5A080E211220	S1317A60696	80 MBH	-	Attic	00A Library	1
Furnace	Carrier	ZI59SP5A080E211220	S1317A60683	80 MBH	-	Attic	00A Library	1
Furnace	Carrier	ZI59SP5A080E211220	S1317A60699	80 MBH	-	Attic	00A Library	1
Furnace	Carrier	ZI59SP5A080E211220	S1317A60706	80 MBH	-	Attic	00A Library	1
Laboratory Exhaust Hood	-	-	-		-	Classroom	P02 Classrooms H1-H4, Theatre	1
Packaged Unit (RTU)	AAON, Inc.	RN-018-3-0-EB09- 244	201607-BNGN54055	270 MBH, 18 TON	-	Site	00G Gymnasium/Mechanical	1
Packaged Unit (RTU)	AAON, Inc.	RN-018-3-0-EB09-244	201607-BNGN54056	270 MBH, 18 TON	-	Site	00G Gymnasium/Mechanical	1
Packaged Unit (RTU)	Aaon, Inc.	RN-006-3-0-EB09-222	201702-ANGF5923 1	90 MBH, 4 TON	-	Roof	P02 Classrooms H1-H4, Theatre	1
Packaged Unit (RTU)	Aaon, Inc.	RN-006-3-0-EB09-222	201702-ANGF58742	90 MBH, 6 TON	-	Roof	P02 Classrooms H1-H4, Theatre	1
Packaged Unit (RTU)	Aaon, Inc.	RQ-005-3-V-CB01 -212	201702-AYGE 15425	60 MBH, 5 TON	-	Roof	P02 Classrooms H1-H4, Theatre	1
Packaged Unit (RTU)	Aaon, Inc.	RQ-004-3-V-CB01-212	201702-AYGD15424	60 MBH, 11 TON	-	Roof	P02 Classrooms H1-H4, Theatre	1
Packaged Unit (RTU)	Aaon, Inc.	RN-011-3-0- EA09 - 2 F2	201702-ANGZ58724	195 MBH, 11 TON	-	Roof	P02 Classrooms H1-H4, Theatre	1
Water Heater	Rheem / Ruud	-	-	30 GAL	-	Attic	00B Classrooms B1 to B8	1
Water Heater	A. O. Smith	DEL-30 110	1643103717314	30 GAL	-	Attic	00F Admin	1
Water Heater	Lochinvar	30SCX	MM 279092	30 GAL	-	Utility closet	00C Classrooms C1 to C6	1
Water Heater	-	-	-	30 GAL	-	Utility closet	00C Classrooms C1 to C6	1
Water Heater	Rheem	GNU100-400	A211803373	400 MBH, 100 GAL	-	Throughout building	00E Multipurpose Room/Kitchen	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	MPR Building	Interior	1	OFFICE	C020		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	18	1x4 Prism Troffer	9	0	8	2,280	1,313
2	MPR Building	Interior	1	OFFICE	C020		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	2	0	8	2,280	438
3	Admin Building	Interior	1	OPEN OFFICE	Admin		100	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	16	1x4 Prism Troffer	8	0	8	2,280	1,167
4	Admin Building	Interior	1	OPEN OFFICE	Conference		300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	8	2,280	584
5	Admin Building	Interior	1	OPEN OFFICE	Career Center		300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	30	1x4 Prism Troffer	15	0	8	2,280	2,189
6	Admin Building	Interior	1	OFFICE	Office Manager		350	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	8	2,280	292
7	Admin Building	Interior	1	OFFICE	Principle		380	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	8	2,280	584
8	Admin Building	Interior	1	OFFICE	Coordinator		385	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	8	2,280	292
9	Admin Building	Interior	1	OFFICE	Testing Materials		400	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	8	2,280	292
10	Admin Building	Interior	1	OFFICE	Assistant Principal		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	8	2,280	292
11	Admin Building	Interior	1	CLASSROOM	F3		230	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	8	2,280	2,627
12	C Building	Interior	1	CLASSROOM	O0C1		250	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	10	2,280	2,627
13	C Building	Interior	1	CLASSROOM	C003		280	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	2	0	8	2,280	438
14	C Building	Interior	1	CLASSROOM	Z002		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	1x4 Prism Troffer	4	0	8	2,280	876
15	C Building	Interior	1	CLASSROOM	O0C4		250	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	10	2,280	2,627
16	C Building	Interior	1	CLASSROOM	O0C3		250	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	10	2,280	2,627
17	C Building	Interior	1	CLASSROOM	O0C2		250	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	10	2,280	2,627
18	C Building	Interior	1	CLASSROOM	O0C5		250	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	10	2,280	2,627
19	C Building	Interior	1	CLASSROOM	T0C2		300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	20	1x4 Prism Troffer	10	0	8	2,280	1,459
20	C Building	Interior	1	CLASSROOM	T01C		300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	20	1x4 Prism Troffer	10	0	8	2,280	1,459
21	B Building	Interior	1	CLASSROOM	O0B4		200	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	10	2,280	2,627
22	B Building	Interior	1	CLASSROOM	O0B8		220	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	10	2,280	2,627
23	B Building	Interior	1	CLASSROOM	O0B7		250	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	10	2,280	2,627
24	B Building	Interior	1	CLASSROOM	O0B6		220	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	10	2,280	2,627
25	B Building	Interior	1	CLASSROOM	O0B5		230	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	10	2,280	2,627
26	B Building	Interior	1	CLASSROOM	O0B2		235	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	10	2,280	2,627
27	B Building	Interior	1	CLASSROOM	O0B1		220	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	10	2,280	2,627
28	B Building	Interior	1	CLASSROOM	O0B3		225	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	10	2,280	2,627
29	Admin Building	Interior	1	CLASSROOM	O0F1		235	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	8	2,280	2,627
30	Admin Building	Interior	1	CLASSROOM	O0F2		230	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	8	2,280	2,627
31	MPR Building	Interior	1	CLASSROOM	U001		210	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	160	2x2 Indirect Troffer	40	0	14	2,280	11,674
32	MPR Building	Interior	1	JANITORIAL	Z014		85	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	3	0	8	722	139
33	MPR Building	Interior	1	HALLWAY	H012		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	2	0	8	2,280	438
34	MPR Building	Interior	1	RESTROOM	T013		230	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	3	0	8	2,280	438
35	MPR Building	Interior	1	RESTROOM	T015		230	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	3	0	8	2,280	438
36	MPR Building	Interior	1	HALLWAY	H017		110	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	8	2,280	146
37	MPR Building	Interior	1	HALLWAY	J016		160	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	8	2,280	292
38	MPR Building	Interior	1	KITCHEN	K002		310	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	81	2x4 Indirect Troffer	27	0	10	1,900	4,925
39	MPR Building	Interior	1	KITCHEN	K002		310	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	24	1x4 Indirect Troffer	12	0	10	1,900	1,459
40	MPR Building	Interior	1	CLASSROOM	U01A Band		100	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	40	1x4 Prism Troffer	20	0	14	2,280	2,918
41	MPR Building	Interior	1	OFFICE	Z011		300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	8	2,280	292
42	MPR Building	Interior	1	OFFICE	Z009		290	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	1x4 Prism Troffer	6	0	10	2,280	876
43	Library Buidling	Interior	1	LIBRARY	X001		250	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	120	2x4 Prism Troffer	60	0	10	2,280	8,755
44	H Building	Interior	1	JANITORIAL	Janitor		-	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	10	722	46
45	H Building	Interior	1	RESTROOM	T001		450	1	Ceiling-Mounted Sensor	LED	-	-	4	2x4 Prism Troffer	2	0	10	2,280	-
46	H Building	Interior		RESTROOM	T002		-	1	Ceiling-Mounted Sensor	LED	-	-	4	2x4 Prism Troffer	2	0	10	2,280	-
47	D Building	Interior	1	HALLWAY	H01C		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	3	0	10	2,280	438
48	D Building	Interior	1	OFFICE	C01B		300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	2	0	10	2,280	438
49	D Building	Interior	1	OFFICE	C01A		300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	4	0	10	2,280	876
50	D Building	Interior	1	CLASSROOM	Z01D		300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	9	2x4 Prism Troffer	3	0	10	2,280	657
51	D Building	Interior	1	CLASSROOM	O0D6		380	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	54	2x4 Prism Troffer	18	0	10	2,280	3,940
52	D Building	Interior	1	OFFICE	C01E		285	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	3	2x4 Prism Troffer	1	0	10	2,280	219
53	D Building	Interior	1	STORAGE	S00D		200	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	3	2x4 Prism Troffer	1	0	10	608	58
54	D Building	Interior	1	HALLWAY	H00D		285	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	4	0	10	2,280	876
55	D Building	Interior	1	CLASSROOM	O0D3		250	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	2x4 Prism Troffer	18	0	10	2,280	2,627
56	D Building	Interior	1	CLASSROOM	O0D2		225	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	2x4 Prism Troffer	18	0	10	2,280	2,627
57	D Building	Interior	1	CLASSROOM	O0D1		288	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	2x4 Prism Troffer	18	0	10	2,280	2,627
58	D Building	Interior	1	CLASSROOM	O0D8		300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	2x4 Prism Troffer	18	0	10	2,280	2,627
59	D Building	Interior	1	CLASSROOM	D9		430	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	18	2x4 Prism Troffer	6	0	10	2,280	1,313
60	D Building	Interior	1	CLASSROOM	O0D4		250	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	2x4 Prism Troffer	18	0	10	2,280	2,627
61	D Building	Interior	1	CLASSROOM	O0D5		250	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	2x4 Prism Troffer	18	0	10	2,280	2,627
62	D Building	Interior	1	CLASSROOM	O0D7		230	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	2x4 Prism Troffer	18	0	10	2,280	2,627
63	Gymnasium Building	Interior	1	OFFICE	C010		400	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	1x4 Prism Troffer	6	0	10	2,280	876
64	Gymnasium Building	Interior	1	RESTROOM - PRIVAT	T011		165	1	Light Switch	Incan/H/MR	Incan	I60-Globe	1	Vanity-Direct	1	0	10	2,280	137
65	Gymnasium Building	Interior	1	LOCKER ROOM	R002		120	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	40	1x4 Prism Troffer	20	0	10	2,280	2,918
66	Gymnasium Building	Interior	1	RESTROOM	T012		350	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	10	2,280	584
67	Gymnasium Building	Interior	1	LOCKER ROOM	C004		430	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	14	1x4 Prism Troffer	7	0	10	2,280	1,021
68	Gymnasium Building	Interior	1	LOCKER ROOM	R001		120	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	38	1x4 Prism Troffer	19	0	10	2,280	2,772
69	Gymnasium Building	Interior	1	RESTROOM	T002		240	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	10	2,280	584
70	Admin Building	Interior		CLASSROOM	Exterior Parking		-	1	Timer	HID	MH	MH400	4	Pole Square Spider-Mount	4	0	24	2,280	3,648
	Totals												1,717		783			154,052	126,272

									Fixture Details						Existing Consumption				Proposed- Post Retrofit					
Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	Additional Area Description	Existing Control	Control Quantity	Technology	Sub-Technology	Lamp- Fixture	Fixture Quantity	Total Lamps	Fixture Height	Annual Hours	Existing Annual kWh	ECM	ECM Type	Recommended Sensor	LED Lamp Retrofit	Annual Hours of Operation	Proposed Annual kWh	Annual Savings From LED Retrofit
																							kWh
1	MPR Building	Interior	1	OFFICE	C020		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	9	18	8	2,280	1,313	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,938	593	720
2	MPR Building	Interior	1	OFFICE	C020		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	6	8	2,280	438	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,938	198	240
3	Admin Building	Interior	1	OPEN OFFICE	Admin		Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	8	16	8	2,280	1,167	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	620	547
4	Admin Building	Interior	1	OPEN OFFICE	Conference		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	8	2,280	584	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	310	274
5	Admin Building	Interior	1	OPEN OFFICE	Career Center		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	15	30	8	2,280	2,189	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	1,163	1,026
6	Admin Building	Interior	1	OFFICE	Office Manager		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	8	2,280	292	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	155	137
7	Admin Building	Interior	1	OFFICE	Principle		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	8	2,280	584	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	310	274
8	Admin Building	Interior	1	OFFICE	Coordinator		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	8	2,280	292	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	155	137
9	Admin Building	Interior	1	OFFICE	Testing Materials		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	8	2,280	292	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	155	137
10	Admin Building	Interior	1	OFFICE	Assistant Principal		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	8	2,280	292	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	155	137
11	Admin Building	Interior	1	CLASSROOM	F3		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	18	36	8	2,280	2,627	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	1,395	1,231
13	C Building	Interior	1	CLASSROOM	C003		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	6	8	2,280	438	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	198	240
15	C Building	Interior	1	CLASSROOM	O0C4		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
17	C Building	Interior	1	CLASSROOM	O0C2		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
19	C Building	Interior	1	CLASSROOM	T0C2		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	10	20	8	2,280	1,459	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	659	800
21	B Building	Interior	1	CLASSROOM	O0B4		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
22	B Building	Interior	1	CLASSROOM	O0B8		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
24	B Building	Interior	1	CLASSROOM	O0B6		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
25	B Building	Interior	1	CLASSROOM	O0B5		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
26	B Building	Interior	1	CLASSROOM	O0B2		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
27	B Building	Interior	1	CLASSROOM	O0B1		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
28	B Building	Interior	1	CLASSROOM	O0B3		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
32	MPR Building	Interior	1	JANITORIAL	Z014		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	3	6	8	722	139	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	614	63	76
33	MPR Building	Interior	1	HALLWAY	H012		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	6	8	2,280	438	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,938	198	240
34	MPR Building	Interior	1	RESTROOM	T013		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	3	6	8	2,280	438	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,938	198	240
35	MPR Building	Interior	1	RESTROOM	T015		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	3	6	8	2,280	438	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,938	198	240
36	MPR Building	Interior	1	HALLWAY	H017		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	8	2,280	146	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	66	80
37	MPR Building	Interior	1	HALLWAY	J016		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	8	2,280	292	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	132	160
38	MPR Building	Interior	1	KITCHEN	K002		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	27	81	10	1,900	4,925	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,615	2,224	2,701
39	MPR Building	Interior	1	KITCHEN	K002		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	12	24	10	1,900	1,459	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,615	659	800
40	MPR Building	Interior	1	CLASSROOM	U01A Band		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	20	40	14	2,280	2,918	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,318	1,601
41	MPR Building	Interior	1	OFFICE	Z011		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	8	2,280	292	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	132	160
42	MPR Building	Interior	1	OFFICE	Z009		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	6	12	10	2,280	876	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	395	480
45	H Building	Interior	1	RESTROOM	T001		Ceiling-Mounted Sensor	1	LED	-		2	4	10	2,280				Retain Existing Controls				
48	D Building	Interior	1	OFFICE	C01B		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	6	10	2,280	438	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	198	240
49	D Building	Interior	1	OFFICE	C01A		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	12	10	2,280	876	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	395	480
50	D Building	Interior	1	CLASSROOM	Z01D		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	3	9	10	2,280	657	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	297	360
51	D Building	Interior	1	CLASSROOM	O0D6		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	18	54	10	2,280	3,940	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,779	2,161
52	D Building	Interior	1	OFFICE	C01E		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	3	10	2,280	219	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	99	120
53	D Building	Interior	1	STORAGE	S00D		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	3	10	608	58	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	517	26	32
54	D Building	Interior	1	HALLWAY	H00D		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	12	10	2,280	876	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	395	480
55	D Building	Interior	1	CLASSROOM	O0D3		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
56	D Building	Interior	1	CLASSROOM	O0D2		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
58	D Building	Interior	1	CLASSROOM	O0D8		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
60	D Building	Interior	1	CLASSROOM	O0D4		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
62	D Building	Interior	1	CLASSROOM	O0D7		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	18	36	10	2,280	2,627	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,186	1,441
64	Gymnasium Building	Interior	1	RESTROOM - PRIVATE	T011		Light Switch	1	Incan/H/MR	Incan	I60-Globe; Vanity-Direct	1	1	10	2,280	137	ECM	RB - Replace Bulb	Wall Mounted	11W LED A19	1,938	21	115
65	Gymnasium Building	Interior	1	LOCKER ROOM	R002		Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	20	40	10	2,280	2,918	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,318	1,601
66	Gymnasium Building	Interior	1	RESTROOM	T012		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	10	2,280	584	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	264	320
67	Gymnasium Building	Interior	1	LOCKER ROOM	C004		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	7	14	10	2,280	1,021	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	461	560
68	Gymnasium Building	Interior	1	LOCKER ROOM	R001		Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	19	38	10	2,280	2,772	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	1,252	1,521
69	Gymnasium Building	Interior	1	RESTROOM	T002		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	10	2,280	584	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,938	264	320
70	Admin Building	Interior		CLASSROOM	Exterior Parking		Timer	1	HID	MH	MH400; Pole Square Spider-Mount	4	4	24	2,280	3,648	ECM	RF - Replace Entire Fixture	Photo Sensor	98W LED Flood	2,052	804	2,844
	Totals												1,717									57,222	69,051

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 & Cafeteria

Property Type:	**Commercial**	Estimated No. of Operational Weeks	38
		Number of Occupied Days/Week (Max 7)	5

KITCHEN FAUCETS			**BATHROOM FAUCETS**		
Number of Occupants Affected By Retrofit	15		Number of Occupants Affected by Retrofit	594	
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	0		Total Number of Faucet Aerators To Be Replaced	28	
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	0.5	GPM	GPM of Proposed Faucet Aerator	0.5	GPM
Estimated Number of Uses Per Day	2		Estimated Number of Uses Per Day	3	

Annual Water Savings From Installing Low Flow Aerators: 56.19 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	$1.38	$/Therm
Hot Water Discharge Temperature at Faucet	110.00	°F	Water Tariff ($/1000 Gal)	$4.46	$/kGal
Equivalent Heating Fuel Savings:	303	Therms	Annual Cost Savings In Form of Water	$251	$
Savings Discounted by 15% to Account For Cold Water Use					
Annual Water Savings	56.19	kGal	Annual Energy Savings From Water Heater	$416	$

COST BENEFIT ANALYSIS				
Estimated Total Annual Cost Savings	$667	$$	Estimated Total Installation Cost	$427 $$
Simple Payback Period	0.64	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: $427 Estimated Annual Cost Savings: $667 Simple Payback Period (Yrs): 0.64

UIC	Install Timers On Exhaust Fans
EAC7A	Location: Throughout

Type of Exhaust Fan: Rooftop Exhaust Fans

EXISTING CONDITION

No. of Timers to Be Installed:	4	Qty	HP of Individual Fan Motor:	0.15	HP
No. of Exhaust Fans:	4		Total kW:	0.45	kW
Existing Daily Hours of Operation/Exhaust Fan:	20.00	Hrs/Day	Annual kWh For All Fans:	3,267	kWh

PROPOSED CONDITION

New Daily Hours With Timers/Exhaust Fan:	12.00	Hrs/Day	New Annual kWh For All Fans:	1,960	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	26	
			No. of Urinals In Building	5	
Total Exhuast CFM From All Fans	360	CFM	Total CFM for All Restroom Exhaust	1,550	CFM
Annual Heating Energy Savings	0	kbtu	Annual Heating Energy Savings	53,568	kbtu
Annual Cooling Energy Savings	0	kbtu	Annual Cooling Energy Savings	26,784	kbtu

Energy & Cost Savings

Estimated Annual Heating Plant Efficiency	79.00	**%**	Estimated Annual Cooling Plant Efficiency	7.00	EER
Annual Heating Energy Savings	678	Therms	Annual Cooling Energy Savings	3,826	kWh
Annual Electric Fan Motor Savings	1,307	kWh			

COST ANALYSIS

Electric Rate:	**$0.16**	$/kWh	Total Annual Electric Savings	5,133	kWh
Material Cost For Timers:	$677	$	Total Annual Non Electric Savings	678	Therms
Total Cost for Installing Timers	$1,416	$	Annual Cost savings:	$1,766	$
Simple Payback:	0.80	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:	$677	Simple Payback:	0.80	Years
Energy Cost Savings:	$1,766			

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

	No. of ECMs	No. of Fixtures	No. of Lamps	KWh Saved	Energy Cost Saving	O & M Savings
Upgrade Lighting to LED	296	779	1,709	69,051	$11,200.05	$1,867.54

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	1	1	1	115	$19	$52
Incan/H/MR	MR	0	0	0	0	$0	$0
HID	HPS	0	0	0	0	$0	$0
HID	MH	1	4	4	2,844	$461	$91
HID	MV	0	0	0	0	$0	$0
HID	QL	0	0	0	0	$0	$0
Linear Fluorescent	T8	66	774	774	66,092	$10,720	$1,724
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	6
Wall Mounted	56		

Initial Investment		**Equipment Rentals**	
Material Cost	$13,718.80	Scissor Lift 26' - Interior Space:	$185.00
Labor Cost	$22,555.23	Bucket Truck - Exterior Spaces	$0.00
Local Electric Rate:	$0.17 $/kWh	Estimated Annual Energy Savings:	69,051
Hourly Labor Rate For Electrician:	$72.40	Estimated Annual Energy Cost Savings:	$11,200
Budgeted Initial Investment:	$36,459	Estimated Annual O&M Cost Savings:	$1,868
Estimated Return on Investment: *(Including O&M Savings)*	2.79 Years	Estimated Annual Cost Savings:	$13,068

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

ENTER EXISTING CONDITION

Insert Existing Estimated Air Change Rate/Hr (ACH 1): *(Existing Air Changes Per Hour, 3 is very leaky and 0.35 ideal)*	0.75	Cubic Feet/Min (CFM 1):	7,275
Insert Proposed Estimated Air Change Rate/Hr (ACH 2):	0.40	Cubic Feet/Min (CFM 2):	3,880
Estimated Space Volume Under Consideration	582,000.00 Cu.Ft		

WINTER			SUMMER		
Select Type of Heating Fuel	Natural Gas (Select)		Is The Building Cooled?	Yes	
Estimated Annual Heating Plant Efficiency	85.00	%	Estimated Annual Cooling Plant Efficiency	7.00	EER
Annual Heating Degree Days(HDD):	2,963		Annual Cooling Degree Days(CDD):	1,407	
Estimated Total Annual Input Heating Energy Savings	3,068	Therms	Estimated Total Annual Input Cooling Energy Savings	17,688	kWh
Cost/Unit of Heating Fuel:	$1.38	$/Therm	Cost/Unit For Electricity	$0.16	$$
Estimated Annual Heating Cost Savings	$4,221	$$	Estimated Annual Cooling Cost Savings	$2,870	$$

Cost Analysis

Install Flush Mounted, Vinyl Door Sweeps ?	Yes	Total Length of Door Sweeps to Be Installed: *(3.5' Standard Width Door)*	490 LF
Install Window Air Conditioner Covers For Winter:	Yes	Number of Air Conditioner Covers To Be Installed: *(Covers would meet HUD Chapter-12 Energ Conservation Compliance Section 329C)*	11
Estimated Annual O&M Savings	$355	Estimated Length of Joints To Be Re-Caulked: *(Includes Demolition and Re-Caulking)*	9533 LF
Total Estimated Annual Cost Savings	$7,446	Total Cost For Controlling Air Leakage	$48,619
Simple Pay Back Period	6.53 Yrs	*Type of Recommendation*	Capital Cost ECM Recommendation

ECM DESCRIPTION:

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

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

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

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

SUMMARY:

Initial Investment:	$48,619	Simple Pay Back Perio	6.53 Yrs
Annual Energy Cost Savings	$7,446		

UIC	Install Low Flow Tankless Restroom Fixtures
EAP4	Location: Restrooms

ECM FOR DETERMINING WATER SAVINGS IN COMMERCIAL PROPERTIES

Number of Males	297	
Number of Females	297	
Number of Occupied Days Per Week (Max 7)	5	
Number of Occupied Weeks/Year (Max 52)	38	
Number of Urinals To Be Retrofitted	5	
Number of Water Closets To Be Retrofitted	26	
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**	0.125	GPF
Estimated Annual Water Savings From Urinal	158.00	kGal

***(1992 EpACT Energy Act Mandates 1.0GPF Max on Urinals)*

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		26	
GPF of Proposed Dual Flush- Water Closet Valve*	*Solid Waste (20%)*	1.60	GPF
**(Federal Law Requires All Flushes Not To Exceed 1.6 GPF)*	*Liquid Waste (80%)*	0.48	GPF
Estimated Annual Water Savings From Male Users		40.45	kGal
Estimated Annual Water Savings From Female Users		202.25	kGal
Total Water Savings From Water Closets		242.69	kGal

Water & Cost Saving Calculations

Water Savings Calculation

Water Savings By The Use of Low Flow Water Closet Flush Valves/Yr	242.69	kgal
Water Savings By The Use of Low Flow Urinal Flush Valves/ Yr	158.00	kgal
Total Annual Water Savings in kgal	400.70	kgal

Cost Savings Calculations

Enter Water Tariff Rate ($/1000Gal)	$4.46	$$
Estimated Cost Savings From Water	$1,787	$$

Estimated Cost of Retrofit

Cost For Replacing Existing Urinal Fixture With A Low Flow Fixture *(Includes Labor)*	$6,502	$$
Cost For Replacing Existing Flush Valves With Low Flow - Dual Flush Valves ($80 Per Unit) *(Up For Liquid Waste And Down For Solid Waste)* *(Includes Labor)*	$16,095	$$
Estimated Total Cost For Retrofit	$22,597	$$
Simple Pay Back Period	12.64	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:	$22,597	Simple Payback Period:	12.64 Yrs
Annual Cost Savings:	$1,787		

UIC	Re-Commission The Building & Its Control Systems	
EAC10	Location: Throughout	
Enter the Total Area of The Facility	86,226	SqFt
Select the Type of Heating Fuel:	Natural Gas	*(Select)*
Estimated Annual Heating Fuel Consumption:	3,368	Therms
Is the Property Cooled?	Yes	*(Select)*
Estimated Annual Electrical Energy Consumed For Cooling:	203,721	kWh
Estimated Energy Savings From Re-Commissioning on Building Systems:	15%	*(Select)*
Estimated Heating Energy Saving Post Re-Commissioning:	505	Therms
Estimated Cooling Energy Saving Post Re-Commissioning:	30,558	kWh
Average Heating Fuel Rate Paid By The Property:	$1.38	$/Therm
Average Electrical Rate Paid By The Property:	$0.16	$/kWh
Annual Energy Cost Savings:	$5,653	$
Estimated Cost For Re-Commissioning The Facility: *(LBNL 2009 Report on Building Commissioning)*	$38,609	$
Simple Payback Period:	6.83	Yrs
Type of Recommendation	Capital Cost ECM Recommendation	

ECM DESCRIPTION

The goal of commissioning of a facility is to ensure that the equipments in the facility are performing as per the desired standards or as per design standards. The role of commissioning in existing buildings is to identify the almost inevitable "drift" from where things should be and puts the things back on track. Based on the LBNL 2009 Report on Building Commissioning the average re-commissioning of existing buildings yielded atleast 16% of energy savings across the facility. This average has been developed based on over 643 buildings that were commissioned across United States in different climatic zones.

Thus EMG strongly recommends re-commissioning of all existing buildings in order to ensure that all the sensors, equipments and control systems are working as per the design conditions.

SUMMARY:

Initial Investment: $38,609 Simple Payback: 6.83 Years
Energy Cost Savings: $5,653

UIC	Replace External Windows
EAE2	Location: Throughout

ENTER EXISTING CONDITIONS

Existing and Proposed Window Properties

Total Sq.Ft window area:	1,656	sq.ft
Approximate number of windows:	138	
Total existing window area:	1,656	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):	0.75	
(Existing Air Changes Per Hour, 1.5 is very leaky and 0.35 ideal)		
Insert Proposed Estimated Air Change Rate/Hr (ACH 2):	0.53	
Estimated Space Volume Under Consideration	776,000.00	Cu. Ft
Is the Property Cooled ?	Yes	*(Select)*

WINTER

Select Type of Heating Fuel	Natural Gas	*(Select)*
Net heating plant & distribution system efficiency:	79.00	**%**
Annual Heating Hours:	2,963	HDD
Estimated Total Annual Input Heating Energy Savings By Replacing Windows	14.31	Therms
Estimated Total Annual Input Heating Energy Savings Achieved By Controlling Air Leakage Through Windows	2,829	Therms
Estimated Total Input Heating Fuel Savings From Replacing Windows	2,843	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	7,669	kWh
Estimated Total Annual Input Cooling Energy Savings Achieved By Controlling Air Leakage Through Windows	15,161	kWh
Estimated Total Input Cooling Fuel Savings From Replacing Windows	22,830	kWh

ENERGY & COST ANALYSIS

Insert Cost of Heating Fuel:	$1.38	$/Therm	Annual Heating Cost Savings:	$3,912.87 $$
Insert Cost of Cooling Fuel:	$0.16	$/kWh	Annual Cooling Cost Savings:	$3,703.85 $$
Total Annual Cost Savings	$7,693		Total Annual Cost Savings From Heating & Cooling:	$7,617 $$
Cost of window upgrade:	$113,286		Estimated Annual O&M Savings	$76 $
Simple payback:	14.73	**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:	$113,286	Simple Payback	14.73 Yrs
Annual Energy Cost Savings:	$7,693		

UIC	**Upgrade Insulation**
EAE3B	**Location: Attic/Ceiling Throughout**

ENTER EXISTING CONDITION

Property Zone	Surface Under Consideration	Min. R-Value
Zone-3	**Ceiling/Attic**	R-30

Source: 2009 IECC For Residential Bldgs

"-" Not Specified

Enter Total Surface Area Under Consideration: 86,226 Sq.Ft

Existing Net Effective R-Value: (Sq.Ft deg F/btu) 13

Proposed Net Effective R-Value: (Sq.Ft deg F/btu) 30

ENTER CLIMATIC & SYSTEM DATA

Annual Cooling Degree Days (CDD): 1,407

Annual Heating Degree Days (HDD): 2,963

Estimated Annual Cooling Plant Efficiency (EER): 7.00 EER

Estimated Annual Heating Plant Efficiency: % 79.00 %

WINTER

Select Type of Heating Fuel: **Natural Gas** (Select)

Annual Conduction Losses From Existing Insulation: 486,643 kBtu

Annual Conduction Losses From Proposed Insulation: 204,390 kBtu

Savings In Conduction Losses After Adding Insulation: 282,253 kBtu

Estimated Total Annual Input Heating Energy Savings: 3,573 Therms

Cost of Heating Fuel/Unit: $1.38 $/Therm

Annual Heating Cost Savings: $4,917 $$

SUMMER

Is the Property Cooled ? **Yes** (Select)

Annual Conduction Losses From Existing Insulation: 231,086 Kbtu

Annual Conduction Losses From Proposed Insulation: 97,056 kBtu

Savings In Conduction Losses After Adding Insulation: 134,030 kBtu

Estimated Total Annual Input Cooling Energy Savings: 19,147 kWh

Cost of Electricity/Unit: $0.16 $/kWh

Annual Cooling Cost Savings: $3,106 $$

COST ANALYSIS

Estimated O&M Savings: $0.00 $$

Total Estimated Annual Cost Savings: $8,023 $$

Simple Pay Back Period: 27.27 Years

Estimated Cost To Add Insulation/Sqft: $1.70

Estimated Total Installation Cost: $218,787 $$

Type of Recommendation: Capital Cost ECM Recommendation

UIC	Retrofit Apartment Tank Toilets to Dual Flush
EAP3	Location: Restrooms and Locker Rooms

EXISTING CONDITION

Total Occupants:	55	
Number of Water Closets To Be Replaced	19	
Number of Occupied Days Per Week (Max 7)	5	
Number of Occupied Weeks/Year (Max 52)	38	
Estimated Restroom Usage/Individual/Day	4	(Select)

5.05 flushes/person/day@American Water Works Association (AWWA)

PROPOSED RETROFIT/REPLACEMENT

Existing Gallons Per Flush Ratings For Water Closet Flushes	1.60	GPF
Replace or Retrofit Toilets With Dual Flush Toilets	Retrofit	

Replace

Proposed Toilet: 0.8GPF -Floor Mount, 10" Rough-In

GPF of Proposed New Low Flow Water Closet Fixture*	0.80	GPF

Retrofit

Dual Flush - Retrofit Setup Valve for Flush Tank Toilet	*Solid Waste (20%)* 1.60	GPF
**(Federal Law Requires All Flushes Not To Exceed 1.6 GPF)*	*Liquid Waste (80%)* 1.28	GPF

Water & Cost Saving Calculations

Water Savings By The Use of Low Flow Water Closet Flush Valves/Day	56.32	gal
Total Annual Water Savings in gallons	10.70	kgal

Cost Savings Calculations

Enter Water Tariff Rate ($/1000Gal)	$4.46	$$
Estimated Cost Savings From Water	$48	$$

Estimated Cost of Retrofit

Estimated Total Cost For Retrofit	$2,990	$$
Simple Pay Back Period	62.63	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.

Existing toilets can be retrofitted with pressure-assisted flush technology to reduce the flush rate to 1.0 GPF or less. Though water efficient these toilets make considerable amount of noise as this involves release of pressurized air during the course of flushing. Thus making them unpopular among residential properties.

Thus EMG recommends replacing the existing high flow toilets with new low flow 1.28GPF rated flush tank toilets, which are comparatively more water efficient at the same time considerably quiter as compared to the pressure assisted technology retrofitted toilets.

Summary:

Initial Investment:	$2,990			
		Simple Payback:	62.63	Years
Annual Cost Savings	$48			

APPENDIX F:
Solar PV

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

Select State: Northern California **Electric Rate:** $0.18 $/KWH Annual Electric Consumption: 481,610 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	96.20	96	305	147,675	147,675	$25,843	$336,700	13.0	$0	$101,010	$3,249	$0	7.9
2	Building 2	1	68	68	217	104,693	104,693	$18,321	$238,700	13.0	$0	$71,610	$2,303	$0	7.9
3	Building 3	1	61	61	194	93,947	93,947	$16,441	$214,200	13.0	$0	$64,260	$2,067	$0	7.9
4	Building 4	1	24	24	77	37,303	37,303	$6,528	$85,050	13.0	$0	$25,515	$821	$0	7.9
5				0	0		0	$0	$0		$0	$0	$0	$0	
6				0	0		0	$0	$0		$0	$0	$0	$0	
7				0	0		0	$0	$0		$0	$0	$0	$0	
8				0	0		0	$0	$0		$0	$0	$0	$0	
9				0	0		0	$0	$0		$0	$0	$0	$0	
10				0	0		0	$0	$0		$0	$0	$0	$0	
		4		**250**	**793**	**383,618.0**	**383,618**	**$67,133**	**$874,650**	**13.03**	**$0**	**$262,395**	**$8,440**	**$0**	**7.86**

Solar Rooftop Photovoltaic Analysis		
Total Number of Roofs	4	
Estimated Number of Panels	793	
Estimated KW Rating	250	KW
Potential Annual KWh Produced	383,618	KWh
% of Current Electricity Load	79.7%	

Financial Analysis		
Investment Cost	$874,650	
Estimated Energy Cost Savings	$67,133	
Potential Rebates	$262,395	
Potential Annual Incentives	$8,440	
Payback without Incentives	13.0	years
Incentive Payback but without SRECS	7.9	years
Payback with All Incentives	7.9	years