LEVEL II ENERGY AUDIT

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

DLR GROUP
1050 20th Street, Suite 250
Sacramento, California 95963

PREPARED BY:
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EMG PROJECT #:

136988.19R000-063.268

DATE OF REPORT:

October 24, 2019

ONSITE DATE:

September 24, 2019

ZERO NET ENERGY ASHRAE LEVEL II AUDIT

SACRAMENTO ACCELERATED ACADEMY

5601 47th Avenue

Sacramento, California 95824

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Certification

EMG has completed an Energy Audit of Sacramento Accelerated Academy located at 5601 47th Avenue in Sacramento, California 95824. EMG visited the site on September 24, 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: Galileo Atalig
Energy Auditor
Project Manager

Reviewed by:

Bhaskar Ale, CEM

Technical Report Reviewer for

Kaustubh Anil Chabukswar, CEM CRM
Program Manager

1. Executive Summary

The purpose of this Energy Audit is to provide Sacramento City Unified School District and Sacramento Accelerated 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	001 Building A Classrooms 11-15	School Building	5130	30-50
2	002 Building B Classrooms 21-25	School Building	5130	30-50
3	003 Building C Classrooms 6-10	School Building	5130	30-50
4	004 Building D Classrooms 16-20	School Building	5130	30-50
5	005 Building E Classrooms 1-5	School Building	5130	30-50
6	006 Multipurpose	School Building	15595	120-150
7	007 Building F Restrooms	School Building	900	5-10

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 three 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)*	$ 97,000 *(In Current Dollars)*
Estimated Annual Cost Savings *(Current Dollars Only)*	$12,116 *(In Current Dollars)*
ECM Effective Payback	8.01 years
Estimated Annual Energy Savings	18.71%
Estimated Annual Energy Utility Cost Savings *(Excluding Water)*	18.64%

ITEM	ESTIMATE
Estimated Annual Water Cost Saving	14.94%

Solar Photovoltaic (PV) Screening for Sacramento Accelerated Academy

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS		
Estimated Number of Panels	274	
Estimated KW Rating	86	KW
Potential Annual kWh Produced	133,936	kWh
% of Current Electricity Uses	43.3%	
FINANCIAL SUMMARY		
Investment Cost	$301,700	
Estimated Energy Cost Savings	$20,090	
Payback without Incentives	15	Years
Incentive Payback but without SRECs	9	Years
Payback with All Incentives	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)	38 kBtu/ft^2
Post ECM Site Energy Use Intensity (EUI)	31 kBtu/ft^2
SOURCE ENERGY USE INTENSITY (EUI)	**RATING**
Current Source Energy Use Intensity (EUI)	97 kBtu/ft^2
Post ECM Source Energy Use Intensity (EUI)	79 kBtu/ft^2
BUILDING COST INTENSITY (BCI)	**RATING**
Current Building Cost Intensity	$1.30/ft^2
Post ECM Building Cost Intensity	$1.05/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	300 MMbtu
Total CO_2 Emissions Reduced	24.39 $MtCO_2$/Yr
Total Cars Off the Road (Equivalent)*	4
Total Acres of Pine Trees Planted (Equivalent)*	6

**Equivalent reductions per DOE emissions calculation algorithms*

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

ZERO NET ENERGY ANALYSIS	
Building Annual Net Energy Consumption	1,603,630 kBtu
Total Annual Energy Savings for Non-Renewable Energy Measures	299,989 kBtu
Total Annual Energy Savings from Renewable Energy Measures	456,990 kBtu
Total Annual Energy Savings	756,979 kBtu
Net Energy Consumption from Grid Post Implementation	846,652 kBtu
% Energy Reduction (Annual Energy-Net Energy) / (Annual Energy)	47%

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 Sacramento Accelerated 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)
			Electricity								
		$	kWh	kgal	$	$	$	Years		$	Years
Capital Cost Recommendations											
1	Reduce HVAC Hours of Operation Location: Throughout	$11,179	22,221	0	$4,797	$0	$4,797	2.33	5.12	$46,092	15.00
2	Install Low Flow Faucet Aerators Location: Throughout Building	$1,097	0	29	$370	$0	$370	2.96	2.88	$2,060	10.00
3	Upgrade Building Lighting to LED and Install Automatic Lighting Controls Location: Building Interior And Exterior	$72,072	41,647	0	$6,311	$1,983	$8,294	8.69	1.37	$26,945	15.00
Total For Capital Cost		**$84,348**	**63,869**	**29**	**$11,479**	**$1,983**	**$13,462**	**6.27**			
	Interactive Savings Discount @ 10%		-6,387	-3	-$1,148	-$198	-$1,346				
	Total Contingency Expenses @ 15%	$12,652									
Total for Improvements		**$97,000**	**57,482**	**26**	**$10,331**	**$1,785**	**$12,116**	**8.01**			
TOTALS		**$97,000**	**57,482**		**$10,331**					**$0**	

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 Sacramento Accelerated 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)
		$	Electricity	kgal	$	$	$	Years		$	Years
1	Replace Inefficient Furnace and Air Conditioning System Location: Sacramento Accelerated Academy	$263,787	8,929	0	$1,912	$96	$2,008	131.39	0.11	-$233,918	20.00
2	Install Low Flow Tankless Restroom Fixtures Location: Throughout Building	$16,344	0	112	$632	$0	$632	25.85	0.46	-$8,795	15.00
Total for Improvements		**$280,132**	**8,929**	**112**	**$2,544**	**$96**	**$2,640**	**106.11**			

2. Introduction

The purpose of this Energy Audit is to provide Sacramento Accelerated 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	40
Operational Weeks / Year	37
Estimated Facility Occupancy	350
% of Male Occupants	50%

POINT OF CONTACT	
Point of Contact Name	Mike Taxara
Point of Contact Title	Facilities Project Technician
Point of Contact – Contact Number	916.796.6538

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

Description:

Heating and cooling is mainly provided by split system units. The multipurpose building uses rooftop packaged units. The Mechanical Equipment Schedule in Appendix contains a summary of the HVAC Equipment at the property.

BUILDING CENTRAL HEATING SYSTEM	
Primary Heating System	Forced Air Furnace
Secondary Heating System	Rooftop Packaged Units
Hydronic Distribution System	NA
Primary Heating Fuel	Gas
Heating Mode Set-point	69 °F
Heating Mode- Set-back Temperature	53 °F

BUILDING COOLING SYSTEM	
Primary Cooling System	Split Systems
Secondary Cooling System	Package Units
Hydronic Distribution System	NA
Cooling Mode Set-point	73 °F
Cooling Mode- Set-back Temperature	93 °F

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

DOMESTIC HOT WATER SYSTEM	
Primary Domestic Water Fuel	Natural Gas

3.3. Lighting

Description:

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

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

4. Utility Analysis

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

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

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

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

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

Utility Rates used for Cost Analysis

ELECTRICITY (BLENDED RATE)	NATURAL GAS	WATER / SEWER
$0.15 /kWh	$1.42 /therm	$ 5.65 /kGal

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

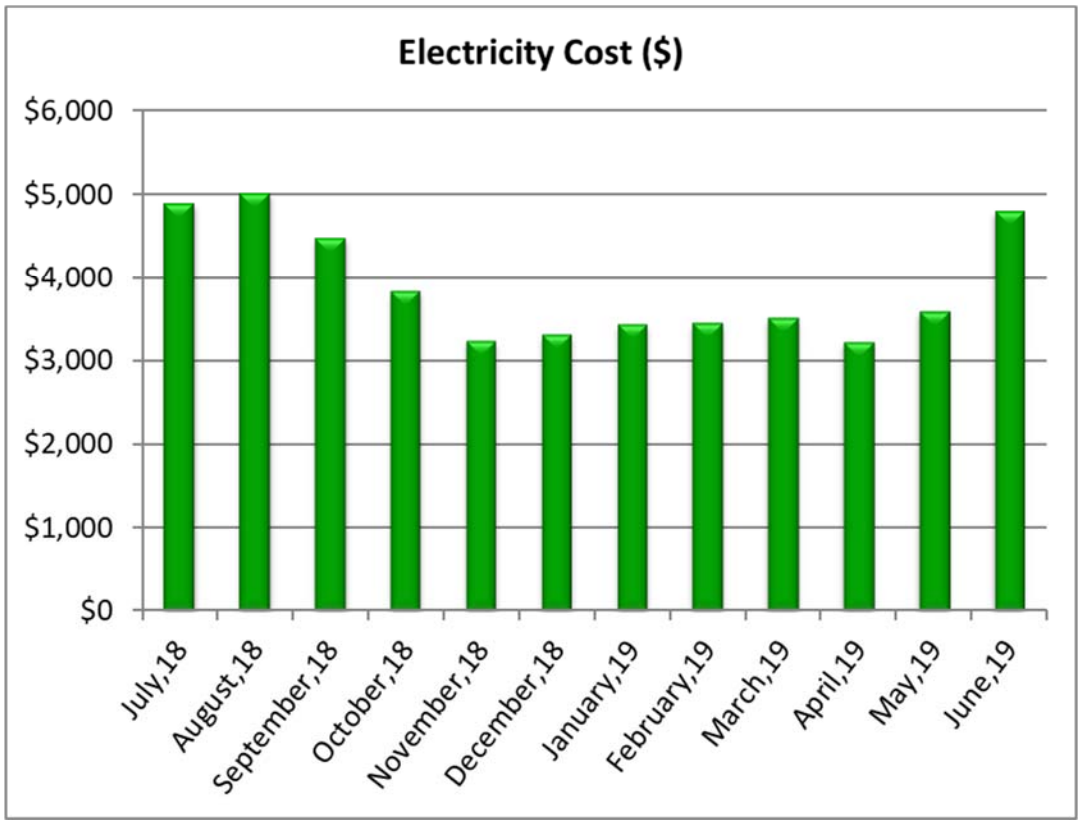
4.1. Electricity

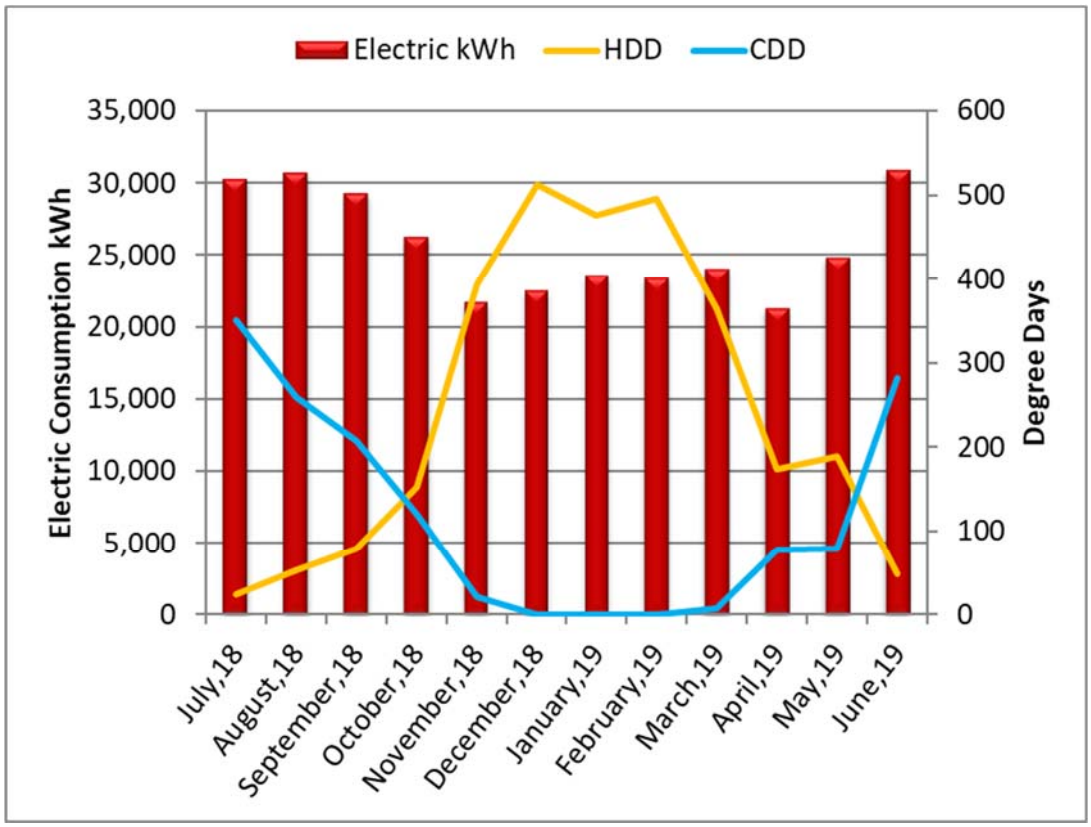
SMUD satisfies the electricity requirements for the facility. The primary end uses for electric utility compromises of lighting, cooling, office/school equipment, and appliances in the break room.

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

Electric Consumption and Cost Data

BILLING MONTH	CONSUMPTION (KWH)	UNIT COST/KWH	TOTAL COST
July,18	30,299	$0.16	$4,896
August,18	30,700	$0.16	$5,021
September,18	29,289	$0.15	$4,487
October,18	26,310	$0.15	$3,844
November,18	21,768	$0.15	$3,243
December,18	22,555	$0.15	$3,324
January,19	23,661	$0.15	$3,449
February,19	23,454	$0.15	$3,452
March,19	24,050	$0.15	$3,514
April,19	21,317	$0.15	$3,231
May,19	24,883	$0.14	$3,600
June,19	30,955	$0.16	$4,803
Total/average	**309,241**	**$0.15**	**$46,863**


Electricity Cost ($)
$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
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
600
500
400
300
200
100
0
Degree Days
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

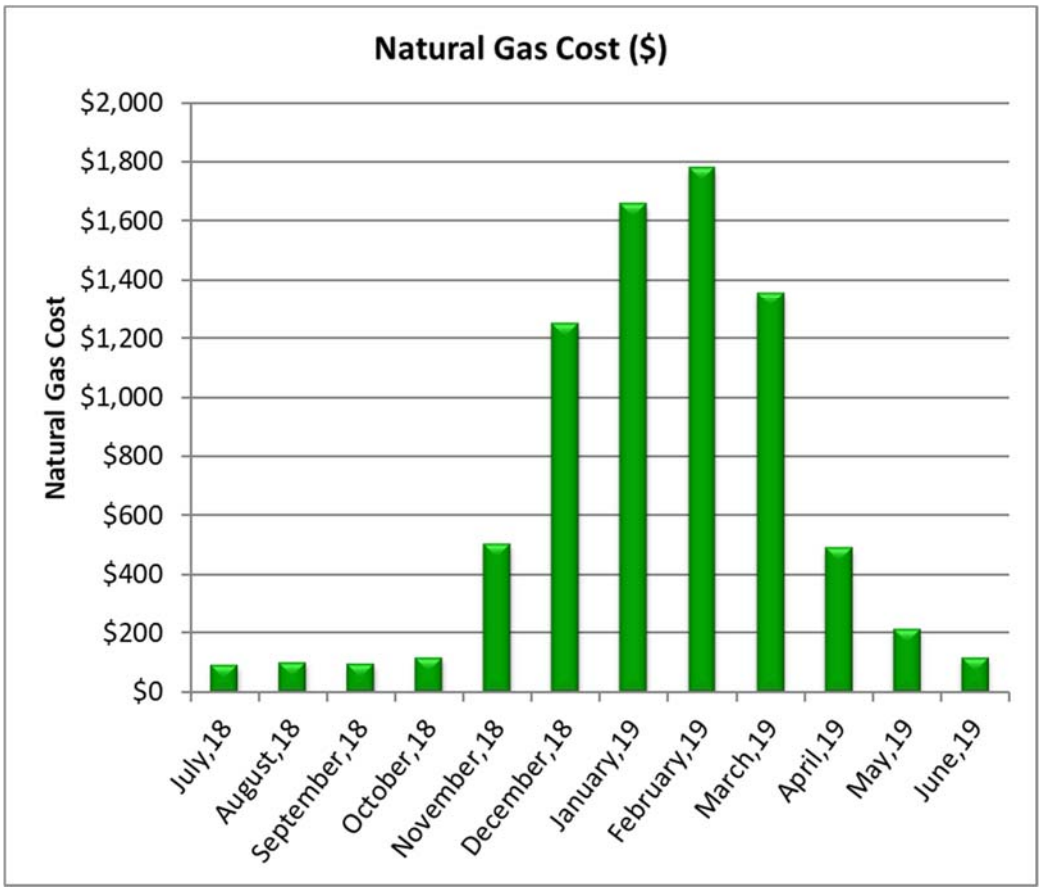
4.2. Natural Gas

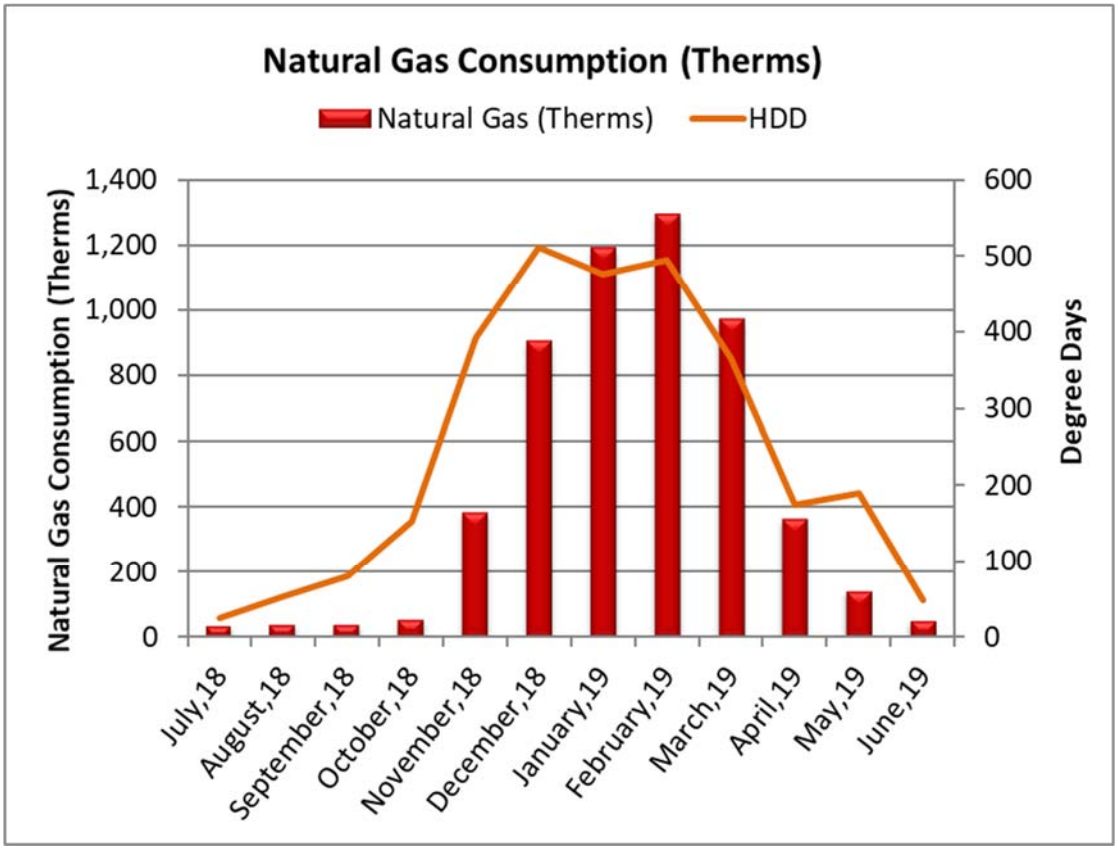
PGE satisfies the natural gas requirements of the facility. The primary end use of natural gas is for building heating, domestic water heating, and cooking in the cafeteria.

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

Natural Gas Consumption and Cost Data

BILLING MONTH	CONSUMPTION (THERMS)	UNIT COST/THERM	TOTAL COST
July,18	36	$2.58	$93
August,18	40	$2.52	$101
September,18	41	$2.37	$97
October,18	57	$2.06	$117
November,18	385	$1.31	$504
December,18	905	$1.38	$1,251
January,19	1,192	$1.39	$1,657
February,19	1,292	$1.38	$1,782
March,19	974	$1.39	$1,355
April,19	365	$1.34	$491
May,19	144	$1.48	$214
June,19	54	$2.11	$114
Total/average	**5,485**	**$1.42**	**$7,775**


Natural Gas Cost ($)
Natural Gas Cost
$2,000
$1,800
$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

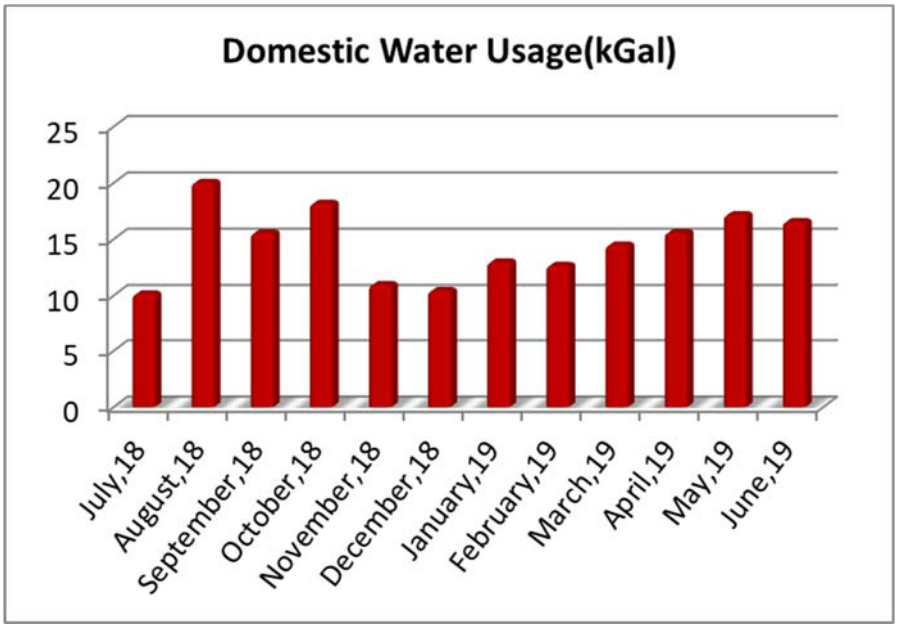

Natural Gas Consumption (Therms)
Natural Gas (Therms)
HDD
Natural Gas Consumption (Therms)
1,400
1,200
1,000
800
600
400
200
0
Degree Days
600
500
400
300
200
100
0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

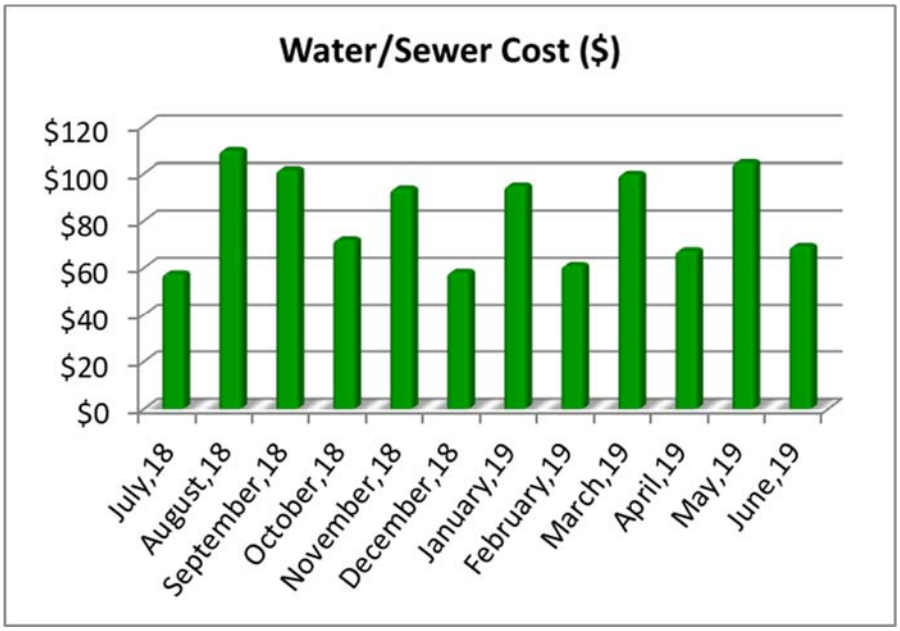
4.3. Water and Sewer

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	10	$5.67	$58
August,18	20	$5.46	$110
September,18	16	$6.53	$102
October,18	18	$3.95	$72
November,18	11	$8.52	$93
December,18	10	$5.57	$58
January,19	13	$7.30	$95
February,19	13	$4.81	$61
March,19	14	$6.88	$100
April,19	16	$4.32	$67
May,19	17	$6.08	$104
June,19	17	$4.17	$69
Total/average	**175**	**$5.65**	**$989**


Domestic Water Usage(kGal)
25
20
15
10
5
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 ($)
$120
$100
$80
$60
$40
$20
$0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

5. Renewable Energy Discussions

5.1. Rooftop Solar Photovoltaic Feasibility

Solar Energy Feasibility

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

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

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

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

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

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

1) Conducting a preliminary sizing of solar PV panels on the roofs and on the ground and its potential electricity production for its first year of installment using the National Renewable Energy Laboratory (NREL) PV WATTS Version 2 Software.

2) Calculate 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	274	
Estimated KW Rating	86	KW
Potential Annual kWh Produced	133,936	kWh
% of Current Electricity Uses	43.3%	
FINANCIAL SUMMARY		
Investment Cost	$301,700	
Estimated Energy Cost Savings	$20,090	
Payback without Incentives	15	Years
Incentive Payback but without SRECs	9	Years
Payback with All Incentives	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	Location	Location- Floor
Water Heater	Instant-Flow	SR-30L/120	461932	3600 WATT	Sacramento Accelerated Academy / 001 A Classrooms 11-15	Rooom 13
Water Heater	A. O. Smith	BTH 199 970	MD040002617	100 GAL	Sacramento Accelerated Academy / 006	Utility closet
Water Heater	A. O. Smith	BTH 250 970	MD04000270w	100 GAL	Sacramento Accelerated Academy / 006	Utility closet
Water Heater	Instant-Flow	SR-30L	461911	3.6 KW	Sacramento Accelerated Academy / 004 D Classrooms 16-20	Room 20
Water Heater	Instant-Flow	SR-30L/12P	461916	3.6 KW	Sacramento Accelerated Academy / 002 B Classrooms 21-25	Room 25
Water Heater	Instant-Flow	SR-30L/120	461186	3.6 KW	Sacramento Accelerated Academy / 004 D Classrooms 16-20	Room 20
Water Heater	Instant-Flow	SR-30L/12P	461919	3.6 KW	Sacramento Accelerated Academy / 002 B Classrooms 21-25	Room 21
Water Heater	Instant-Flow	SR-30L	Illegible	3.6 KW	Sacramento Accelerated Academy / 004 D Classrooms 16-20	Room 18
Water Heater	Instant-Flow	SR-30L	457904	3600 WATT	Sacramento Accelerated Academy / 003 C Classrooms 6-10	Room 10
Water Heater	Instant-Flow	SR-30L	457882	3600 WATT	Sacramento Accelerated Academy / 003 C Classrooms 6-10	Room 6
Water Heater	Instant-Flow	SR-30L	457878	3600 WATT	Sacramento Accelerated Academy / 003 C Classrooms 6-10	Room8
Water Heater	A. O. Smith	FPST 50 270	MM0300096786	50 GAL	Sacramento Accelerated Academy / 007 F Restrooms	Fire Riser Room
Water Heater	Instant-Flow	SR-30L/120	633957		Sacramento Accelerated Academy / 004 D Classrooms 16-20	Room 20
Water Heater	Instant-Flow	SR-301/12P	461912	3.6 KW	Sacramento Accelerated Academy / 002 B Classrooms 21-25	Room 23
Water Heater	In sink erator	W-152-3	11O38569925	2.5 GAL	Sacramento Accelerated Academy / 005 E Classrooms 1-5	Room 3
Expansion Tank	No tag/plate found	No tag/plate found	No tag/plate found	4.8 GAL	Sacramento Accelerated Academy / 007 F Restrooms	Fire Riser Room
Expansion Tank	No tag/plate found	No tag/plate found	No tag/plate found	4.8 GAL	Sacramento Accelerated Academy / 006	Utility closet
Condensing Unit/Heat Pump	Carrier	38CK080570	804E19305	5 TON	Sacramento Accelerated Academy / 001 A Classrooms 11-15	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKCO60570	1804E19311	5 TON	Sacramento Accelerated Academy / 003 C Classrooms 6-10	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKC060570	1704E46676	5 TON	Sacramento Accelerated Academy / 002 B Classrooms 21-25	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKC060570	1704E46705	5 TON	Sacramento Accelerated Academy / 002 B Classrooms 21-25	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKC060570	1704E46707	5 TON	Sacramento Accelerated Academy / 005 E Classrooms 1-5	Building Exterior
Condensing Unit/Heat Pump	Carrier	Illegible	Illegible	5 TON	Sacramento Accelerated Academy / 005 E Classrooms 1-5	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKC06057	2104E34603	5 TON	Sacramento Accelerated Academy / 003 C Classrooms 6-10	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKCO60570	1704E46701	5 TON	Sacramento Accelerated Academy / 003 C Classrooms 6-10	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKCO60570	2104E34605	5 TON	Sacramento Accelerated Academy / 005 E Classrooms 1-5	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKC060570	1704E46675	5 TON	Sacramento Accelerated Academy / 001 A Classrooms 11-15	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKCO60570	2104E34650	5 TON	Sacramento Accelerated Academy / 004 D Classrooms 16-20	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKC060570	1704E46699	5 TON	Sacramento Accelerated Academy / 004 D Classrooms 16-20	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKC060570	2104E34648	5 TON	Sacramento Accelerated Academy / 004 D Classrooms 16-20	Building Exterior
Condensing Unit/Heat Pump	Carrier	3860570	1804E19310	5 TON	Sacramento Accelerated Academy / 002 B Classrooms 21-25	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKC060570	1704E46709	5 TON	Sacramento Accelerated Academy / 005 E Classrooms 1-5	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKC060570	1704E46710	5 TON	Sacramento Accelerated Academy / 005 E Classrooms 1-5	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKC060570	1804E19306	5 TON	Sacramento Accelerated Academy / 003 C Classrooms 6-10	Building Exterior

Mechanical Inventory						
System	Make	Model	Serial Number	Input Capacity	Location	Location- Floor
Condensing Unit/Heat Pump	Carrier	38CKC060570	1704E46703	5 TON	Sacramento Accelerated Academy / 002 B Classrooms 21-25	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKCO60570	1704E46711	5 TON	Sacramento Accelerated Academy / 004 D Classrooms 16-20	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKCO60570	1804E19308	5 TON	Sacramento Accelerated Academy / 001 A Classrooms 11-15	Building Exterior
Condensing Unit/Heat Pump	Carrier	38060578	1804E19309	5 TON	Sacramento Accelerated Academy / 003 C Classrooms 6-10	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKC060570	1704E46678	5 TON	Sacramento Accelerated Academy / 001 A Classrooms 11-15	Building Exterior
Condensing Unit/Heat Pump	Carrier	38CKCO60570	1804E19302	5 TON	Sacramento Accelerated Academy / 002 B Classrooms 21-25	Building Exterior
Condensing Unit/Heat Pump	Carrier	38KC60570	1704E46698	5 TON	Sacramento Accelerated Academy / 001 A Classrooms 11-15	Building Exterior
Condensing Unit/Heat Pump	Carrier	38C060570	1804E19307	5 TON	Sacramento Accelerated Academy / 004 D Classrooms 16-20	Building Exterior
Ductless Split System	Carrier	Illegible	Illegible	2 TON	Sacramento Accelerated Academy / 006	Roof
Ductless Split System	Carrier	No tag/plate found	No tag/plate found	1 TON	Sacramento Accelerated Academy / 006	Multipurpose
Make-Up Air Unit	Reznor	Inaccessible	Inaccessible	6000 TON	Sacramento Accelerated Academy / 006	Roof
Make-Up Air Unit	Reznor	No tag/plate found	No tag/plate found	10000 CFM	Sacramento Accelerated Academy / 006	Roof
Exhaust Fan	Greenheck	No tag/plate found	No tag/plate found	2001 - 5000 CFM	Sacramento Accelerated Academy / 006	Roof
Exhaust Fan	Greenheck	GB-161-5X-QD	04C03161	2200 CFM	Sacramento Accelerated Academy / 006	Roof
Exhaust Fan	Greenheck	No tag/plate found	No tag/plate found	2001 - 5000 CFM	Sacramento Accelerated Academy / 006	Roof
Furnace	Carrier	ZI58DLX155---10120	S4803A29024	154 MBH	Sacramento Accelerated Academy / 002 B Classrooms 21-25	Room 23
Furnace	Carrier	Inaccessible	Inaccessible	154 MBH	Sacramento Accelerated Academy / 004 D Classrooms 16-20	Room 20
Furnace	Carrier	ZI58DLX155---10120	S1604A29143	154 MBH	Sacramento Accelerated Academy / 004 D Classrooms 16-20	Room 19
Furnace	Carrier	ZI58DLX155---10120	S4803A29041	154 MBH	Sacramento Accelerated Academy / 004 D Classrooms 16-20	Room 18
Furnace	Carrier	ZI58DLX155---10120	S4803A29038	154 MBH	Sacramento Accelerated Academy / 004 D Classrooms 16-20	Room 16
Furnace	Carrier	ZI58DLX155---10120	S4803A29044	154 MBH	Sacramento Accelerated Academy / 001 A Classrooms 11-15	Room 11
Furnace	Carrier	ZI58DLX155---10120	S4803A29036	154 MBH	Sacramento Accelerated Academy / 001 A Classrooms 11-15	Rooom 13
Furnace	Carrier	ZI58DLX155---10120	S4803A29045	154 MBH	Sacramento Accelerated Academy / 001 A Classrooms 11-15	Room 12
Furnace	Carrier	ZI58DLX155---10120	S4803A29039	154 MBH	Sacramento Accelerated Academy / 002 B Classrooms 21-25	Room 25
Furnace	Carrier	ZI58DLX155---10120	S1404A25951	154 MBH	Sacramento Accelerated Academy / 003 C Classrooms 6-10	Room 10
Furnace	Carrier	ZI58DLX155---10120	S4803A29033	154 MBH	Sacramento Accelerated Academy / 005 E Classrooms 1-5	Room 5
Furnace	Carrier	ZI58DLX155---10120	S4803A29040	154 MBH	Sacramento Accelerated Academy / 002 B Classrooms 21-25	Room 24
Furnace	Carrier	58DLX15510120	S1404A25985	154 MBH	Sacramento Accelerated Academy / 005 E Classrooms 1-5	Room 2
Furnace	Carrier	ZI58DLX155---10120	S4803A29037	154 MBH	Sacramento Accelerated Academy / 003 C Classrooms 6-10	Room8
Furnace	Carrier	ZI58DLX155---10120	S4803A29042	154 MBH	Sacramento Accelerated Academy / 001 A Classrooms 11-15	Rooom 15
Furnace	Carrier	ZI58DLX155---10120	S4803A29047	154 MBH	Sacramento Accelerated Academy / 002 B Classrooms 21-25	Room 21
Furnace	Carrier	ZI58DLX155---10120	S1604A29140	154 MBH	Sacramento Accelerated Academy / 004 D Classrooms 16-20	Room 17
Furnace	Carrier	ZI58DLX155---10120	S4803A29028	154 MBH	Sacramento Accelerated Academy / 003 C Classrooms 6-10	Room 7
Furnace	Carrier	ZI58DLX155---10120	S4803A29046	154 MBH	Sacramento Accelerated Academy / 001 A Classrooms 11-15	Rooom 14

Mechanical Inventory						
System	Make	Model	Serial Number	Input Capacity	Location	Location- Floor
Furnace	Carrier	Inaccessible	Inaccessible	154 MBH	Sacramento Accelerated Academy / 005 E Classrooms 1-5	Room 3
Furnace	Carrier	Inaccessible	Inaccessible	154 MBH	Sacramento Accelerated Academy / 005 E Classrooms 1-5	Room 1
Furnace	Carrier	Inaccessible	Inaccessible	154 MBH	Sacramento Accelerated Academy / 005 E Classrooms 1-5	Room 4
Furnace	Carrier	ZI58DLX155---10120	S1404A25948	15r MBH	Sacramento Accelerated Academy / 003 C Classrooms 6-10	Room 9
Furnace	Carrier	ZI58DLX155---10120	S4803A29031	154 MBH	Sacramento Accelerated Academy / 002 B Classrooms 21-25	Room 22
Furnace	Carrier	ZI58DLX155---10120	S4803A29043	154 MBH	Sacramento Accelerated Academy / 003 C Classrooms 6-10	Room 6
Packaged Unit (RTU)	AAON, Inc.	RN-040-3-0-AA02-2A2	200405-ANGV0036	40 TON	Sacramento Accelerated Academy / 006	Roof
Packaged Unit (RTU)	AAON, Inc.	Illegible	Illegible	13 TON	Sacramento Accelerated Academy / 006	Roof
Packaged Unit (RTU)	AAON, Inc.	Illegible	No tag/plate found	7 TON	Sacramento Accelerated Academy / 006	Roof
Air Curtain	Mars	48COMBI 0	0408PF48COMBI-L(F3)	1/2 CFM	Sacramento Accelerated Academy / 006	Kitchen
Motor	Elite	SW-200UL	Illegible	3 HP	Sacramento Accelerated Academy / Site	Site
Motor	Elite	CSW 200 UL	Illegible	3 HP	Sacramento Accelerated Academy / Site	Site

APPENDIX C:
Lighting System Schedule

									Lamp Details				Fixture Details				Existing Consumption	
Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	LUX	Control Quantity	Existing Control	Technology	Sub-Technology	Lamp Type	Total Lamps	Fixture Type	Fixture Quantity	24x7 Fixture Count	Fixture Height	Annual Hours	Existing Annual kWh
1	004 Rooms 16-20	Interior	1	CAFETERIA	20	254	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	24	Industrial	2	0	9	2,220	1,705
2	004 Rooms 16-20	Interior	1	CAFETERIA	20	254	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	7	2,220	284
3	004 Rooms 16-20	Interior	1	OPEN OFFICE	18	276	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	28	Industrial	2	0	9	2,220	1,989
4	004 Rooms 16-20	Interior	1	OFFICE	18 office	150	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	Industrial	4	0	8	2,220	568
5	004 Rooms 16-20	Interior	1	CLASSROOM	17	254	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	72	Industrial	6	0	9	1,480	3,410
6	001 Rooms 11-15	Interior	1	CLASSROOM	15	330	8	Light Switch	Linear Fluorescent	T8	4' 32W T8	96	Industrial	8	0	9	1,480	4,547
7	001 Rooms 11-15	Interior	1	CLASSROOM	15	330	8	Light Switch	Linear Fluorescent	T8	4' 32W T8	16	1x4 Prism Troffer	8	0	7	1,480	758
8	001 Rooms 11-15	Interior	1	OPEN OFFICE	13	276	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	28	Industrial	2	0	9	2,220	1,989
9	001 Rooms 11-15	Interior	1	OFFICE	13 office	150	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	8	2,220	568
10	003 Rooms 6-10	Interior	1	CLASSROOM	6	268	8	Light Switch	Linear Fluorescent	T8	4' 32W T8	96	Industrial	8	0	9	1,480	4,547
11	003 Rooms 6-10	Interior	1	CLASSROOM	6	268	8	Light Switch	Linear Fluorescent	T8	4' 32W T8	16	1x4 Prism Troffer	8	0	7	1,480	758
12	003 Rooms 6-10	Interior	1	OPEN OFFICE	8	320	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	28	Industrial	2	0	9	2,220	1,989
13	003 Rooms 6-10	Interior	1	OFFICE	8 Office	295	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	7	2,220	568
14	005 Rooms 1-5	Interior	1	OPEN OFFICE	5	300	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	48	Industrial	4	0	9	2,220	3,410
15	005 Rooms 1-5	Interior	1	OPEN OFFICE	5	300	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	7	2,220	568
16	005 Rooms 1-5	Interior	1	OPEN OFFICE	4	282	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	24	Industrial	2	0	9	2,220	1,705
17	005 Rooms 1-5	Interior	1	OPEN OFFICE	4	282	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	7	2,220	284
18	005 Rooms 1-5	Interior	1	OPEN OFFICE	3	310	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	28	Industrial	2	0	9	2,220	1,989
19	005 Rooms 1-5	Interior	1	OPEN OFFICE	3 office	257	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	7	2,220	568
20	005 Rooms 1-5	Interior	1	OPEN OFFICE	2	282	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	24	Industrial	2	0	9	2,220	1,705
21	005 Rooms 1-5	Interior	1	OPEN OFFICE	2	282	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	7	2,220	284
22	004 Rooms 16-20	Interior	1	CLASSROOM	17	254	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	1x4 Prism Troffer	6	0	7	2,220	852
23	002 Rooms 21-25	Interior	1	CLASSROOM	23	308	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	28	Industrial	2	0	9	2,220	1,989
24	002 Rooms 21-25	Interior	1	OFFICE	23 Office	363	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	7	2,220	568
25	002 Rooms 21-25	Interior	1	CLASSROOM	25	305	8	Light Switch	Linear Fluorescent	T8	4' 32W T8	96	Industrial	8	0	9	1,480	4,547
26	002 Rooms 21-25	Interior	1	CLASSROOM	25	305	8	Light Switch	Linear Fluorescent	T8	4' 32W T8	16	1x4 Prism Troffer	8	0	7	1,480	758
27	006 Multipurpose	Interior	1	RESTROOM	Restrooms	304	8	Timer	Linear Fluorescent	T8	4' 32W T8	32	2x4 Prism Troffer	16	0	9	1,480	1,516
28	006 Multipurpose	Interior	1	RESTROOM	Restrooms	235	4	Timer	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	9	1,480	379
29	006 Multipurpose	Interior	1	HALLWAY	Hallway	146	1	Ceiling-Mounted Sensor	CFL	CFL - 2 Pin	CFL7	18	Can-Surf Mount	18	0	14	2,220	280
30	006 Multipurpose	Interior	1	HALLWAY	Hallway	146	1	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	Industrial	1	0	25	2,220	142
31	006 Multipurpose	Interior	1	GYMNASIUM	Enrollment Center	370	6	Timer	HID	MH	MH400	30	Highbay	30	0	28	2,220	26,640
32	006 Multipurpose	Interior	1	KITCHEN	Kitchen	491	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	60	1x4 Prism Troffer	30	0	10	1,850	3,552
33	006 Multipurpose	Interior	1	HALLWAY	Hallway	146	1	Timer	CFL	CFL - 2 Pin	CFL7	12	Surface Mount Can	12	0	8	2,220	186
34	006 Multipurpose	Interior	1	OFFICE	5	240	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	1x4 Indirect Troffer	3	0	9	2,220	426
35	006 Multipurpose	Interior	1	OFFICE	4	181	10	Light Switch	Linear Fluorescent	T8	4' 32W T8	20	1x4 Indirect Troffer	10	0	9	2,220	1,421
36	006 Multipurpose	Interior	1	OPEN OFFICE	Connect Center	112	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	18	1x4 Indirect Troffer	9	0	9	2,220	1,279
37	006 Multipurpose	Interior	1	OFFICE	6	158	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Indirect Troffer	4	0	12	2,220	568
38	006 Multipurpose	Interior	1	OPEN OFFICE	Staff Lounge	279	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	1x4 Indirect Troffer	6	0	10	2,220	852
39	Exterior	Interior	1	CLASSROOM	Exterior	-	1	Timer	CFL	CFL - 2 Pin	CFL7	20	Recessed Can-hor4"	20	0	10	2,220	311
40	Exterior	Interior	1	CLASSROOM	Exterior	-	1	Timer	HID	MH	MH250	10	Surface Mount	10	0	12	2,220	5,550
41	Exterior	Interior	1	CLASSROOM	Exterior	-	1	Timer	CFL	CFL - 2 Pin	CFL28	3	Jelly Jar-vert	3	0	8	2,220	186
42	Exterior	Interior	1	CLASSROOM	Exterior	-	1	Timer	CFL	CFL - 2 Pin	CFL28	50	Jelly Jar-vert	50	0	8	2,220	3,108
43	Exterior	Interior	1	CLASSROOM	Exterior	-	1	Timer	HID	MH	MH250	2	Surface Mount	2	0	7	2,220	1,110
	Totals											1,051		338			88,430	90,415

								Fixture Details						Existing Consumption				Proposed- Post Retrofit				
Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	Existing Control	Control Quantity	Technology	Sub-Technology	Lamp- Fixture	Fixture Quantity	Total Lamps	Fixture Height	Annual Hours	Existing Annual kWh	ECM	ECM Type	Recommended Sensor	LED Lamp Retrofit	Annual Hours of Operation	Proposed Annual kWh	Annual Savings From LED Retrofit
																						kWh
1	004 Rooms 16-20	Interior	1	CAFETERIA	20	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Industrial	2	24	9	2,220	1,705	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	906	799
2	004 Rooms 16-20	Interior	1	CAFETERIA	20	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	7	2,220	284	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	151	133
3	004 Rooms 16-20	Interior	1	OPEN OFFICE	18	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Industrial	2	28	9	2,220	1,989	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	1,057	932
4	004 Rooms 16-20	Interior	1	OFFICE	18 office	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; Industrial	4	8	8	2,220	568	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	302	266
5	004 Rooms 16-20	Interior	1	CLASSROOM	17	Light Switch	6	Linear Fluorescent	T8	4' 32W T8; Industrial	6	72	9	1,480	3,410	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	1,812	1,598
6	001 Rooms 11-15	Interior	1	CLASSROOM	15	Light Switch	8	Linear Fluorescent	T8	4' 32W T8; Industrial	8	96	9	1,480	4,547	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	2,415	2,131
7	001 Rooms 11-15	Interior	1	CLASSROOM	15	Light Switch	8	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	8	16	7	1,480	758	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	403	355
8	001 Rooms 11-15	Interior	1	OPEN OFFICE	13	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Industrial	2	28	9	2,220	1,989	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	1,057	932
9	001 Rooms 11-15	Interior	1	OFFICE	13 office	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	8	2,220	568	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	302	266
10	003 Rooms 6-10	Interior	1	CLASSROOM	6	Light Switch	8	Linear Fluorescent	T8	4' 32W T8; Industrial	8	96	9	1,480	4,547	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	2,415	2,131
11	003 Rooms 6-10	Interior	1	CLASSROOM	6	Light Switch	8	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	8	16	7	1,480	758	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	403	355
12	003 Rooms 6-10	Interior	1	OPEN OFFICE	8	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Industrial	2	28	9	2,220	1,989	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	1,057	932
13	003 Rooms 6-10	Interior	1	OFFICE	8 Office	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	7	2,220	568	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	302	266
14	005 Rooms 1-5	Interior	1	OPEN OFFICE	5	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; Industrial	4	48	9	2,220	3,410	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	1,812	1,598
15	005 Rooms 1-5	Interior	1	OPEN OFFICE	5	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	7	2,220	568	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	302	266
16	005 Rooms 1-5	Interior	1	OPEN OFFICE	4	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Industrial	2	24	9	2,220	1,705	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	906	799
17	005 Rooms 1-5	Interior	1	OPEN OFFICE	4	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	7	2,220	284	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	151	133
18	005 Rooms 1-5	Interior	1	OPEN OFFICE	3	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Industrial	2	28	9	2,220	1,989	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	1,057	932
19	005 Rooms 1-5	Interior	1	OPEN OFFICE	3 office	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	7	2,220	568	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	302	266
20	005 Rooms 1-5	Interior	1	OPEN OFFICE	2	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Industrial	2	24	9	2,220	1,705	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	906	799
21	005 Rooms 1-5	Interior	1	OPEN OFFICE	2	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	7	2,220	284	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	151	133
22	004 Rooms 16-20	Interior	1	CLASSROOM	17	Light Switch	6	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	6	12	7	2,220	852	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	453	400
23	002 Rooms 21-25	Interior	1	CLASSROOM	23	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Industrial	2	28	9	2,220	1,989	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	1,057	932
24	002 Rooms 21-25	Interior	1	OFFICE	23 Office	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	7	2,220	568	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	302	266
25	002 Rooms 21-25	Interior	1	CLASSROOM	25	Light Switch	8	Linear Fluorescent	T8	4' 32W T8; Industrial	8	96	9	1,480	4,547	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	2,415	2,131
26	002 Rooms 21-25	Interior	1	CLASSROOM	25	Light Switch	8	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	8	16	7	1,480	758	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	403	355
27	006 Multipurpose	Interior	1	RESTROOM	Restrooms	Timer	8	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	16	32	9	1,480	1,516	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	805	710
28	006 Multipurpose	Interior	1	RESTROOM	Restrooms	Timer	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	8	9	1,480	379	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	201	178
29	006 Multipurpose	Interior	1	HALLWAY	Hallway	Ceiling-Mounted Sensor	1	CFL	CFL - 2 Pin	CFL7; Can-Surf Mount	18	18	14	2,220	280			Retain Existing Controls				
30	006 Multipurpose	Interior	1	HALLWAY	Hallway	Ceiling-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; Industrial	1	2	25	2,220	142	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,220	75	67
31	006 Multipurpose	Interior	1	GYMNASIUM	Enrollment Center	Timer	6	HID	MH	MH400; Highbay	30	30	28	2,220	26,640	ECM	RF - Replace Entire Fixture	Ceiling Mounted	220W LED Highbay	2,220	14,652	11,988
32	006 Multipurpose	Interior	1	KITCHEN	Kitchen	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	30	60	10	1,850	3,552	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,850	1,887	1,665
33	006 Multipurpose	Interior	1	HALLWAY	Hallway	Timer	1	CFL	CFL - 2 Pin	CFL7; Surface Mount Can	12	12	8	2,220	186			Retain Existing Controls				
34	006 Multipurpose	Interior	1	OFFICE	5	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	3	6	9	2,220	426	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	226	200
35	006 Multipurpose	Interior	1	OFFICE	4	Light Switch	10	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	10	20	9	2,220	1,421	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,220	755	666
36	006 Multipurpose	Interior	1	OPEN OFFICE	Connect Center	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	9	18	9	2,220	1,279	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,220	679	599
37	006 Multipurpose	Interior	1	OFFICE	6	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	4	8	12	2,220	568	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,220	302	266
38	006 Multipurpose	Interior	1	OPEN OFFICE	Staff Lounge	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	6	12	10	2,220	852	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,220	453	400
39	Exterior	Interior	1	CLASSROOM	Exterior	Timer	1	CFL	CFL - 2 Pin	CFL7; Recessed Can-hor4"	20	20	10	2,220	311			Retain Existing Controls				
40	Exterior	Interior	1	CLASSROOM	Exterior	Timer	1	HID	MH	MH250; Surface Mount	10	10	12	2,220	5,550	ECM	RF - Replace Entire Fixture	Retain Existing Controls	70W LED Canopy	2,220	1,554	3,996
41	Exterior	Interior	1	CLASSROOM	Exterior	Timer	1	CFL	CFL - 2 Pin	CFL28; Jelly Jar-vert	3	3	8	2,220	186			Retain Existing Controls				
42	Exterior	Interior	1	CLASSROOM	Exterior	Timer	1	CFL	CFL - 2 Pin	CFL28; Jelly Jar-vert	50	50	8	2,220	3,108			Retain Existing Controls				
43	Exterior	Interior	1	CLASSROOM	Exterior	Timer	1	HID	MH	MH250; Surface Mount	2	2	7	2,220	1,110	ECM	RF - Replace Entire Fixture	Retain Existing Controls	70W LED Canopy	2,220	311	799
	Totals											1,051									44,696	41,647

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**: Throughout building

Property Type:	Commercial	Estimated No. of Operational Weeks	36
		Number of Occupied Days/Week (Max 7)	5

KITCHEN FAUCETS			BATHROOM FAUCETS		
Number of Occupants Affected By Retrofit	350		Number of Occupants Affected by Retrofit	350	
Do You Want To Replace Kitchen Faucets Aerators	Yes	*(Select)*	Do You Want To Replace Bathroom Faucets Aerators	Yes	*(Select)*
Total Number of Faucet Aerators To Be Replaced	52		Total Number of Faucet Aerators To Be Replaced	20	
Total Number of Faucets To Be Replaced:	0		Total Number of Faucets To Be Replaced:	0	
GPM of Existing Faucet Aerators	2.2	GPM	GPM of Existing Faucet Aerators	2.2	GPM
GPM of Proposed Faucet Aerator	1.5	GPM	GPM of Proposed Faucet Aerator	0.5	GPM
Estimated Number of Uses Per Day	2		Estimated Number of Uses Per Day	2	

Annual Water Savings From Installing Low Flow Aerators: 29.03 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:	0.85	EF	Heating Fuel Tariff	$1.42	$/Therm
Hot Water Discharge Temperature at Faucet	110.00	°F	Water Tariff ($/1000 Gal)	$5.65	$/kGal
Equivalent Heating Fuel Savings:	145	Therms	Annual Cost Savings In Form of Water	$164	$
Savings Discounted by 15% to Account For Cold Water Use					
Annual Water Savings	29.03	kGal	Annual Energy Savings From Water Heater	$206	$

COST BENEFIT ANALYSIS				
Estimated Total Annual Cost Savings	$370	$$	Estimated Total Installation Cost	$1,097 $$
Simple Payback Period	2.96	Years	*Type of Recommendation*	Capital 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: $1,097 Estimated Annual Cost Savings: $370 Simple Payback Period (Yrs): 2.96

UIC	Install Low Flow Tankless Restroom Fixtures
EAP4	Location: Throughout building

ECM FOR DETERMINING WATER SAVINGS IN COMMERCIAL PROPERTIES

Number of Males	175	
Number of Females	175	
Number of Occupied Days Per Week (Max 7)	5	
Number of Occupied Weeks/Year (Max 52)	36	
Number of Urinals To Be Retrofitted	4	
Number of Water Closets To Be Retrofitted	18	
No. of Water Closets With Separate Flush Tank *(Typical Residential Type)*	0	
Estimated Restroom Usage/Individual/Day *Default is 4 Uses/Day For Residential/Office*	2	(Select)

Urinal Water Savings

Do you Want To Make Any Changes To The Urinals?	Yes	
Estimated Existing Use of Urinal/Day/Man	80%	
Existing Gallons Per Flush Ratings For Urinal Flushes	1.00	GPF
Proposed Urinal	0.125 GPF -Wall Mount	
GPF of Proposed Urinal Flush Valve** ***(1992 EpACT Energy Act Mandates 1.0GPF Max on Urinals)*	0.125	GPF
Estimated Annual Water Savings From Urinal	44.10	kGal

Water Closet Water Savings

Tankless Water Closets

Do The Water Closet Need To Be Retrofitted?	*(Select)*	Yes	
Existing Gallons Per Flush Ratings For Water Closet Flushes		1.60	GPF
Are The Existing Water Closet Being Replaced? *(If No; Then Only The Flush Valve Would Be Replaced With Dual Flush Retrofit Kit)*	*(Select)*	No	
No. of Tankless Water Closets		18	
GPF of Proposed Dual Flush- Water Closet Valve* **(Federal Law Requires All Flushes Not To Exceed 1.6 GPF)*	*Solid Waste (20%)*	1.60	GPF
	Liquid Waste (80%)	0.48	GPF
Estimated Annual Water Savings From Male Users		11.29	kGal
Estimated Annual Water Savings From Female Users		56.45	kGal
Total Water Savings From Water Closets		67.74	kGal

Water & Cost Saving Calculations

Water Savings Calculation

Water Savings By The Use of Low Flow Water Closet Flush Valves/Yr	67.74	kgal
Water Savings By The Use of Low Flow Urinal Flush Valves/ Yr	44.10	kgal
Total Annual Water Savings in kgal	111.84	kgal

Cost Savings Calculations

Enter Water Tariff Rate ($/1000Gal)	$5.65	$$
Estimated Cost Savings From Water	$632	$$

Estimated Cost of Retrofit

Cost For Replacing Existing Urinal Fixture With A Low Flow Fixture	$5,201 *(Includes Labor)*	$$
Cost For Replacing Existing Flush Valves With Low Flow - Dual Flush Valves ($80 Per Unit) *(Up For Liquid Waste And Down For Solid Waste)*	$11,143 *(Includes Labor)*	$$
Estimated Total Cost For Retrofit	$16,344	$$
Simple Pay Back Period	25.85	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:	$16,344	Simple Payback Period:	25.85 Yrs
Annual Cost Savings:	$632		

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	235	948	41,647	$6,247.08	$1,982.92

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	0	0	0	0	$0	$0
Incan/H/MR	MR	0	0	0	0	$0	$0
HID	HPS	0	0	0	0	$0	$0
HID	MH	3	42	42	16,783	$2,517	$953
HID	MV	0	0	0	0	$0	$0
HID	QL	0	0	0	0	$0	$0
Linear Fluorescent	T8	35	193	193	24,864	$3,730	$1,030
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	0	Ceiling Mounted	6
Wall Mounted	124		

Initial Investment			**Equipment Rentals**	
Material Cost	$45,958.00		Scissor Lift 26' - Interior Spaces	$890.00
Labor Cost	$25,223.52		Bucket Truck - Exterior Spaces	$0.00
Local Electric Rate:	$0.15	$/kWh	Estimated Annual Energy Savings:	41,647
Hourly Labor Rate For Electrician:	$82.45		Estimated Annual Energy Cost Savings:	$6,247
Budgeted Initial Investment:	$72,072		Estimated Annual O&M Cost Savings:	$1,983
Estimated Return on Investment: *(Including O&M Savings)*	8.76	Years	Estimated Annual Cost Savings:	$8,230

UIC	Reduce HVAC Hours of Operation
EAC3	Location: Throughout

No of Programmable Thermostats To Be Installed : 7 Qty.

Select Type of Programmable Thermostat Recommended: Centrally Controlled Thermostats For Multi-Unit Property -(BMS) *(Select)*
(Selection Based on Type of Property)

Heating Load Calculation

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

Estimated Current Annual Energy Consumption For Winter Heating: 4,200 Therms

	Weekdays	Weekends
Day Time Set Back Hours	5.00	8.00
Night Time Set Back Hours	9.00	8.00
Hours Without Set Back	10.00	8.00

Typical Indoor Temp	69.00	°F
Temp Set Point With Set Back During Day Time	60.00	°F
Temp Set Point With Set Back During Night Time	53.00	°F
Average Heating Set Point	60.99	°F
Savings Per Degree Set Back For Heating Season *(Industry Standard, 2004)*	3%	
Estimated Annual Heating Energy Consumption	420,000	kBtu
Estimated New Annual Heating Energy Consumption	319,125	kBtu
Estimated Annual Heating Energy Savings	1,009	Therms

Cooling Load Calculation

Select Type of Cooling Fuel: Electric *(Default)*

Estimated Current Annual Energy Consumption For Summer Cooling: 61,000 kWh

	Weekdays	Weekends
Day Time Set Back Hours	5.00	8.00
Night Time Set Back Hours	7.00	8.00
Hours Without Set Back	12.00	8.00

Typical Indoor Temp	73.00	°F
Temp Set Point With Set Back During Day Time	73.00	°F
Temp Set Point With Set Back During Night Time	93.00	°F
Average Cooling Set Point	79.07	°F
Savings Per Degree Set Back For Cooling Season *(Industry Standard, 2004)*	6%	
Estimated Annual Cooling Energy Consumption	208,132	kBtu
Estimated New Annual Cooling Energy Consumption	132,312	kbtu
Estimated Annual Cooling Energy Savings	22,221	kWh

Cost Analysis

Average Annual Cost of Heating Fuel:	$1.42	$/Therm	Estimated Installation Cost Per Thermostats: *(Includes Material, Labor & Installation Costs)*	$1,070 $$
Average Annual Cost of Electricity:	$0.15	$/kWh		$11,179 $$
			Total Estimated Cost For All Programmable Thermostats	
Estimated Annual Heating Cost Savings:	$1,430	$$	Total Estimated Cost Savings From All Programmable Thermostats	$4,797
Estimated Annual Cooling Cost Savings:	$3,367	$$	Estimated Simple Pay Back Period	2.33 Yrs

Type of Recommendation: Capital Cost ECM Recommendation

ECM DESCRIPTION:

Turning off energy-consuming systems when they are not needed is the most basic energy conservation technique. When a building is occupied intermittently, energy savings can be realized by minimizing the time the heating or cooling system is operated when the building is closed. Building control algorithms should be implemented to delay startup until the last moment and to shut down as early as possible.
Because of the thermal inertia of both the building structure and its heating and cooling equipment, preheat or precool time is almost always required to raise or lower the space temperature to the desired level before the occupants return. This start-up time depends on the outdoor environment, the thermal response of the building, and the thermal performance of the space conditioning equipment. Similarly, the thermal inertia of the building maintains the indoor temperature at a comfortable level for a short period of time after the equipment is shut off. It allows the system to be turned off before the end of an occupied period. An optimum start/stop control accounts for these factors.

SUMMARY

Initial Investment: $11,179 Simple Payback Period: 2.33 Yrs
Annual Energy Cost Savings $4,797

UIC	Replace Inefficient Furnace and Air Conditioning System
EAH12-A	Location: Sacramento Accelerated Academy

Estimated Annual Cooling Hours:	375 Hrs		Estimated Annual Heating Hours:	120 Hrs	
Are The Condensing Units Being Replaced	Yes		Replace Furnace?	Yes	Heating Fuel: Natural Gas
Existing Cooling System			**Existing Heating System**		
No. of Cooling Plants To Be Replaced:	25		No. of Furnaces To Be Replaced:	25	
Input the Btu/Hr of the air conditioner:	60,000		Input the MBH Rating of the Furnace:	154 MBH	
Input Existing EER of the Air Conditioner:	9.00		Input Existing AFUE for the Furnace:	75% %	
Estimated Current Annual Energy Consumption For Cooling: *(For All Units)*	62,500 kWh		Estimated Annual Current Energy Consumption For Heating: *(For All Units)*	4,620 Therms	
Proposed Cooling System			**Proposed Heating System**		
Input the Btu/Hr of the Proposed Air Conditioner:	60,000 Btuh		Proposed Furnace:	Gas Fired -150MBH	
Input EER of the Proposed Air Conditioner:	10.50		Input AFUE for the Proposed Furnace:	82%	
Estimated Annual Energy Consumption With New AC's *(For One Unit)*	2,143 kWh		Estimated Annual Energy Consumption With New Furnace *(For One Unit)*	169 Therms	
Energy & Cost Savings From New Cooling System			**Energy & Cost Savings From New Heating System**		
Estimated Annual Energy Savings From New Cooling System: *(Total)*	8,929 kWh		Estimated Annual Energy Consumptions From New Heating System: *(Total)*	4,226 Therms	
Average Electric Rate:	$0.15 $/kWh		Average Heating Fuel Cost For New Furnace:	$1.42 $/Therm	
Estimated Annual Cost Savings From Cooling:	$1,353		Estimated Annual Cost Savings From Heating:	$559 $$	
Estimated Cost of New Condensing Unit: *(Material + Installation+Labor)*	$111,250		Estimated Cost of New Furnace Unit: *(Material + Installation+Labor)*	$1,474 $$	
Estimated Cost of New Evaporator Coils In Furnace: *(Material + Installation+Labor)*	$28,625		Estimated Total Cost of New Furnace Unit: *(Material + Installation+Labor)*	$36,859 $$	

Total Estimated Installed Cost For A New Air Conditioning System Setup + New High Efficiency Furnace : *(Includes Location Factor)*	$263,787 $$			
Estimated Total Energy Cost Savings From New HVAC System:	$1,912 $$	Estimated O&M Savings:	$96	Total Annual Savings: $2,008 $$
Estimated Simple Pay Back Period:	131.39 Years			
Type of Recommendation	Capital Cost ECM Recommendation			

APPENDIX F:
Solar PV

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

Select State: Northern California **Electric Rate:** **$0.15** $/KWH Annual Electric Consumption: 309,241 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	26.40	26	84	41,020	41,020	$6,153	$92,400	15.0	$0	$27,720	$902	$0	9.0
2	Building 2	1	12	12	37	18,179	18,179	$2,727	$40,950	15.0	$0	$12,285	$400	$0	9.0
3	Building 3	1	25	25	79	38,689	38,689	$5,803	$87,150	15.0	$0	$26,145	$851	$0	9.0
4	Building 4	1	14	14	44	21,753	21,753	$3,263	$49,000	15.0	$0	$14,700	$479	$0	9.0
5	Building 5	1	9	9	29	14,295	14,295	$2,144	$32,200	15.0	$0	$9,660	$314	$0	9.0
		5		**86**	**274**	**339,071.0**	**133,936**	**$20,090**	**$301,700**	**15.02**	**$35**	**$90,510**	**$2,947**	**$0**	**9.04**

Solar Rooftop Photovoltaic Analysis		
Total Number of Roofs	5	
Estimated Number of Panels	274	
Estimated KW Rating	86	KW
Potential Annual KWh Produced	133,936	KWh
% of Current Electricity Load	43.3%	

Financial Analysis		
Investment Cost	$301,700	
Estimated Energy Cost Savings	$20,090	
Potential Rebates	$90,545	
Potential Annual Incentives	$2,947	
Payback without Incentives	15.0	years
Incentive Payback but without SRECS	9.0	years
Payback with All Incentives	9.0	years