



A Bureau Veritas Group Company

LEVEL II ENERGY AUDIT

SACRAMENTO CITY UNIFIED SCHOOL DISTRICT

5735 47th Avenue
Sacramento, California 95824

DLR GROUP

1050 20th Street, Suite 250
Sacramento, California 95980



ZERO NET ENERGY ASHRAE LEVEL II AUDIT

ROSA PARKS SCHOOL

2250 68th Avenue
Sacramento, California 95822

PREPARED BY:

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EMG PROJECT #:

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DATE OF REPORT:

October 14, 2019

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September 16-18, 2019



engineering | environmental | capital planning | project management

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Certification

EMG has completed an Energy Audit of Rosa Parks School located at 2250 68th Avenue in Sacramento, California. EMG visited the site on September 16-18, 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 and 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.

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1. Executive Summary

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

Building #	Structures Assessed	Building Type	EMG Calculated Area (SF)	Estimated Occupancy
1	00A Classrooms	School	17,400	127
2	00B Administration and Classrooms	School	43,500	318
3	00C Classrooms	School	10,800	79
4	00D Gymnasium	School	23,800	174
5	00E Classrooms	School	14,900	109
6	00F MPR	School	14,300	105
7	00G Classrooms	School	10,200	75
8	P01 Classrooms	School	1,920	14
9	P02 Restrooms	School	480	4
10	P03 Classrooms	School	1,440	11

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 five 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 (<i>Current Dollars Only</i>)	\$193,145 (<i>In Current Dollars</i>)
Estimated Annual Cost Savings (<i>Current Dollars Only</i>)	\$27,495 (<i>In Current Dollars</i>)
ECM Effective Payback	7.02 years

Item	Estimate
Estimated Annual Energy Savings	11.38%
Estimated Annual Energy Utility Cost Savings <i>(Excluding Water)</i>	17.01%
Estimated Annual Water Cost Saving	5.50%

Solar Photovoltaic (PV) Screening for ROSA PARKS SCHOOL

Solar Rooftop Photovoltaic Analysis	
Estimated Number of Panels	1,045
Estimated KW Rating	309
Potential Annual kWh Produced	506,933
% of Current Electricity Uses	89.3%
Financial Summary	
Investment Cost	\$1,151,850
Estimated Energy Cost Savings	\$75,503
Payback without Incentives	15.3
Incentive Payback but without SRECs	9.2
Payback with All Incentives	9.2

KW

kWh

Years

Years

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 (CO₂). 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)	31 kBtu/ft ²
Post ECM Site Energy Use Intensity (EUI)	27 kBtu/ft ²
Source Energy Use Intensity (EUI)	Rating
Current Source Energy Use Intensity (EUI)	64 kBtu/ft ²
Post ECM Source Energy Use Intensity (EUI)	54 kBtu/ft ²
Building Cost Intensity (BCI)	Rating
Current Building Cost Intensity	\$0.82/ft ²
Post ECM Building Cost Intensity	\$0.68/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	488 MMbtu
Total CO ₂ Emissions Reduced	44.25 MtCO ₂ /Yr
Total Cars Off the Road (Equivalent)*	8
Total Acres of Pine Trees Planted (Equivalent)*	10

**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	4,292,830 kBtu
Total Annual Energy Savings for Non-Renewable Energy Measures	488,371 kBtu
Total Annual Energy Savings from Renewable Energy Measures	1,729,655 kBtu
Total Annual Energy Savings	2,218,026 kBtu
Net Energy Consumption from Grid Post Implementation	2,074,803 kBtu
% Energy Reduction (Annual Energy-Net Energy) / (Annual Energy)	52%

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.

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

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.

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

List of Recommended Energy Conservation Measures For Rosa Parks School												
ECM #	Description of ECM	Projected Initial Investment	Estimated Annual Energy Savings		Estimated Annual Water Savings	Estimated Cost Savings	Estimated Annual O&M Savings	Total Estimated Annual Cost Savings	Simple Payback	S.I.R.	Life Cycle Savings	Expected Useful Life (EUL)
			Natural Gas	Electricity								
		\$	Therms	kWh	kgal	\$	\$	\$	Years		\$	Years
Capital Cost Recommendations												
1	Install Low Flow Faucet Aerators	\$1,036	0	24,926	152	\$4,385	\$0	\$4,385	0.24	36.11	\$36,373	10.00
	Location: Restrooms And Classrooms											
2	Control External Air Leakage In Commercial Buildings	\$7,168	711	3,165	0	\$1,348	\$67	\$1,416	5.06	2.36	\$9,731	15.00
	Location: Exterior Doors											
3	Upgrade Building Lighting to LED and Install Automatic Lighting Controls	\$123,666	0	100,742	0	\$15,005	\$5,285	\$20,290	6.09	1.96	\$118,553	15.00
	Location: Building Interior And Exterior											
4	Upgrade Electric Heating System To Heat Pumps	\$12,558	0	9,371	0	\$1,396	\$0	\$1,396	9.00	1.65	\$8,207	20.00
	Location: Portable Classrooms											
5	Install Low Flow Tankless Restroom Fixtures	\$23,524	0	0	692	\$3,064	\$0	\$3,064	7.68	1.55	\$13,049	15.00
	Location: Restrooms											
Total For Capital Cost		\$167,952	711	138,203	844	\$25,198	\$5,352	\$30,550	5.50			
	Interactive Savings Discount @ 10%		-71	-13,820	-84	-\$2,520	-\$535	-\$3,055				
	Total Contingency Expenses @ 15%	\$25,193										
Total for Improvements		\$193,145	640	124,383	759	\$22,678	\$4,817	\$27,495	7.02			

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 Rosa Parks School												
ECM #	Description of ECM	Initial Investment	Annual Energy Savings		Annual Water Savings	Cost Savings	Estimated Annual O&M Savings	Total Estimated Annual Cost Savings	Payback	S.I.R.	Life Cycle Savings	Expected Useful Life (EUL)
		\$	Natural Gas	Electricity	kgal	\$	\$	\$	Years		\$	Years
1	Re-Commission The Building & Its Control Systems	\$62,124	2,729	3,750	0	\$3,925	\$0	\$3,925	15.83	0.75	-\$15,266	15.00
	Location: Throughout											
2	Upgrade Insulation	\$352,033	5,976	26,957	0	\$11,386	\$0	\$11,386	30.92	0.56	-\$153,764	25.00
	Location: Attic/Ceiling Throughout											
3	Replace Inefficient Furnace and Air Conditioning System	\$30,881	659	1,952	2	\$1,103	\$55	\$1,159	26.66	0.56	-\$13,645	20.00
	Location: Throughout											
4	Replace External Windows	\$587,772	1,129	45,215	0	\$8,128	8,128	\$81.28	7231.76	0.24	-\$444,829	25.00
	Location: Throughout											
Total for Improvements		\$62,124	2,729	3,750	0	\$3,925	\$0	\$3,925	15.83			

2. Introduction

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

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

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

ENERGY AND WATER USING EQUIPMENT

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

BUILDING ENVELOPE

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

RECOMMENDATIONS FOR ENERGY SAVINGS OPPORTUNITIES

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

ANALYSIS OF ENERGY CONSUMPTION

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

ENERGY AUDIT PROCESS

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

REPORTING

The EMG Energy Audit Report includes:

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

3. Facility Overview and Existing Conditions

3.1. Building Occupancy and Point of Contact

Facility Schedule	
Hours of Operations / Week	40
Operational Weeks / Year	38
Estimated Facility Occupancy	1016
% of Male Occupants	50%

Point of Contact	
Point of Contact Name	Steven Ramirez
Point of Contact Title	Plant manager
Point of Contact – Contact Number	916.704.6178

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

Description:

The majority of the buildings are heated and cooled by a single-zone rooftop packaged units. Modular classrooms are heated and cooled by wall-mounted heat pumps. There are three split system condensing units at building 00G. A significant portion of the packaged heating and cooling equipment was installed prior to 2003 and is approaching the end of useful life. Lifecycle replacement of this equipment is anticipated.

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

Building Central Heating System	
Primary Heating System	Rooftop Packaged Units
Secondary Heating System	Heat Pump System and Forced Air Furnace
Hydronic Distribution System	NA
Primary Heating Fuel	Natural Gas
Heating Mode Set-point	69 °F
Heating Mode- Set-back Temperature	53 °F

Building Cooling System	
Primary Cooling System	Package Units
Secondary Cooling System	Split System, Heat Pumps
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	\$1.23/therm	\$4.43/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.

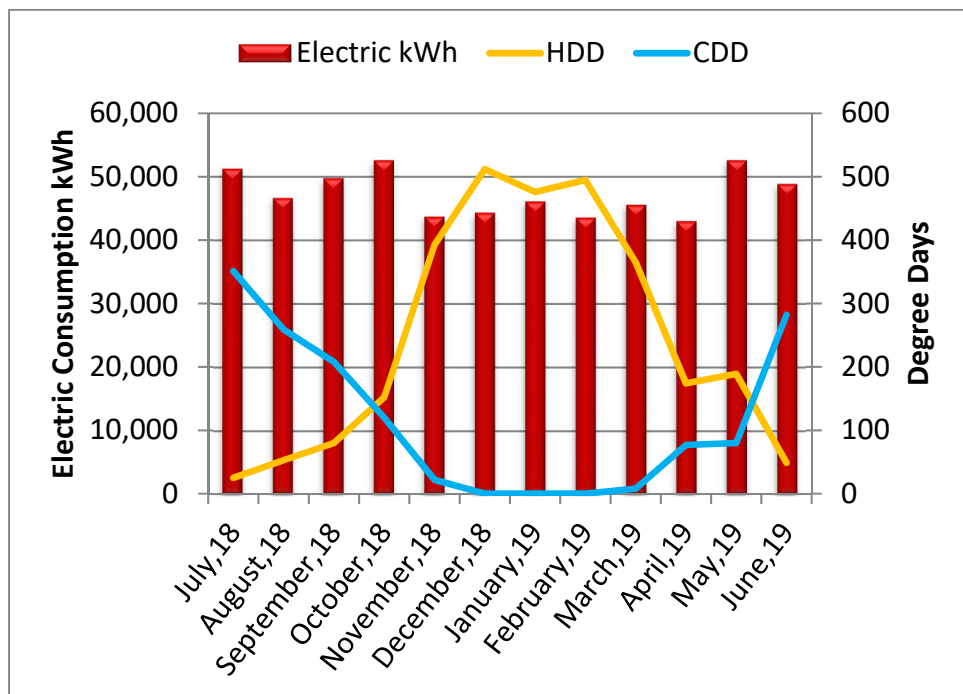
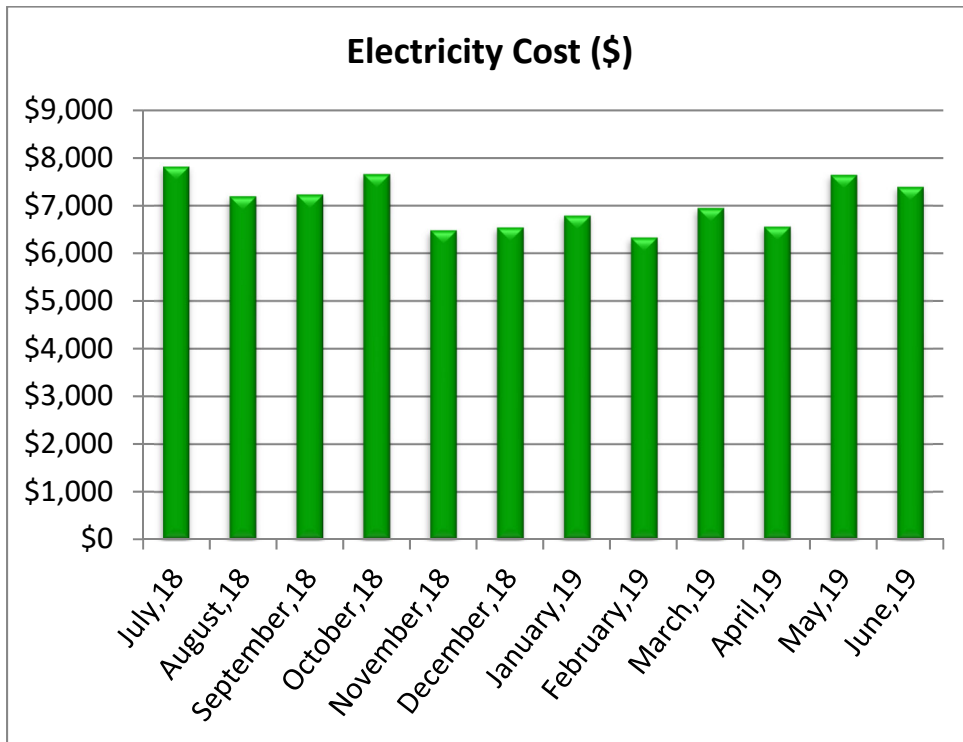
4.1. Electricity

PGE satisfies the electricity requirements for the facility. The primary end uses for electric utility comprises 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	51,212	\$0.15	\$7,815
August, 18	46,595	\$0.15	\$7,188
September, 18	49,722	\$0.15	\$7,222
October, 18	52,541	\$0.15	\$7,653
November, 18	43,660	\$0.15	\$6,476
December, 18	44,281	\$0.15	\$6,535
January, 19	46,068	\$0.15	\$6,782
February, 19	43,510	\$0.15	\$6,325
March, 19	45,525	\$0.15	\$6,943
April, 19	42,961	\$0.15	\$6,554
May, 19	52,539	\$0.15	\$7,635
June, 19	48,801	\$0.15	\$7,385
Total/average	567,414	\$0.15	\$84,513



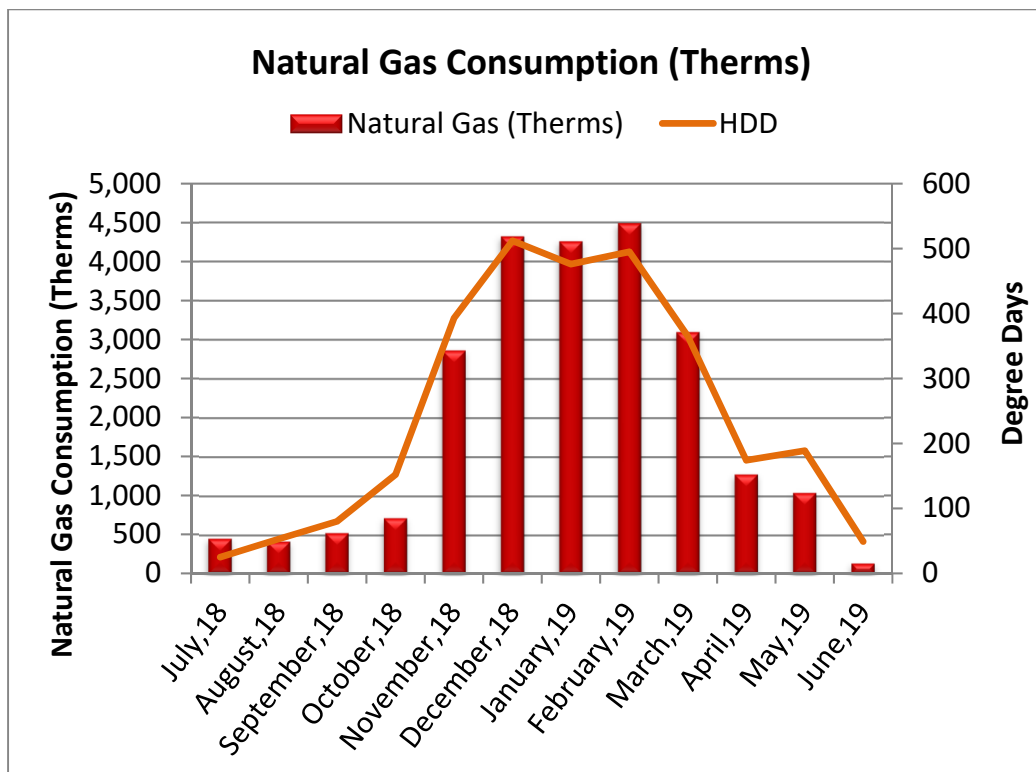
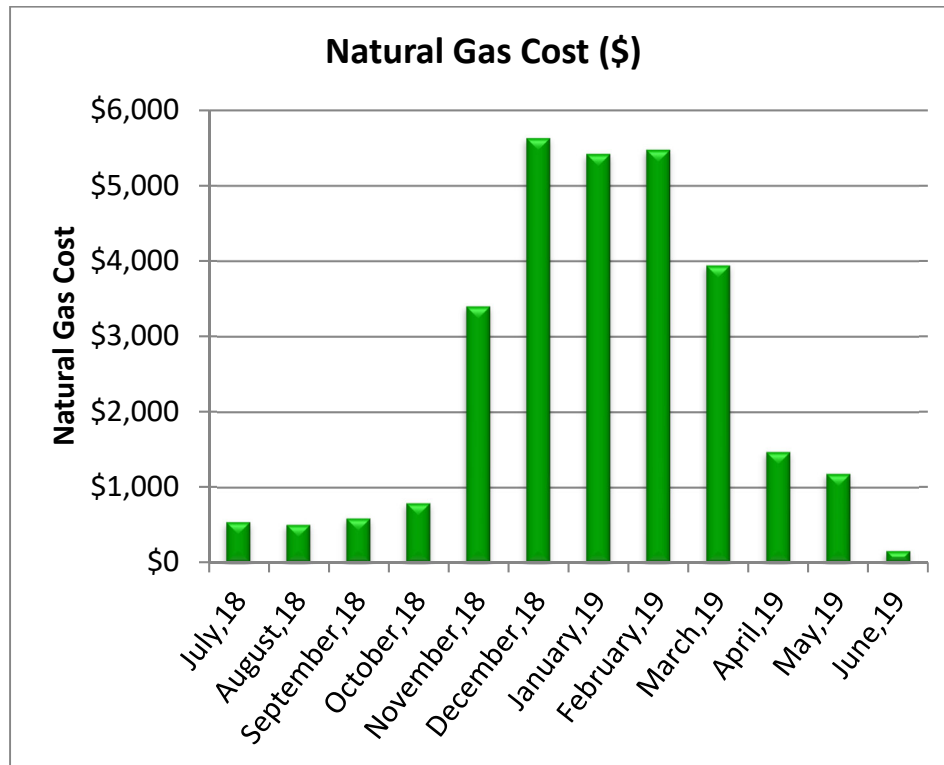
4.2. Natural Gas

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	452	\$1.19	\$538
August, 18	415	\$1.21	\$501
September, 18	524	\$1.12	\$586
October, 18	715	\$1.10	\$788
November, 18	2,862	\$1.19	\$3,400
December, 18	4,317	\$1.30	\$5,628
January, 19	4,256	\$1.27	\$5,418
February, 19	4,486	\$1.22	\$5,473
March, 19	3,095	\$1.27	\$3,941
April, 19	1,275	\$1.15	\$1,468
May, 19	1,039	\$1.13	\$1,178
June, 19	132	\$1.15	\$152
Total/average	23,568	\$1.23	\$29,071

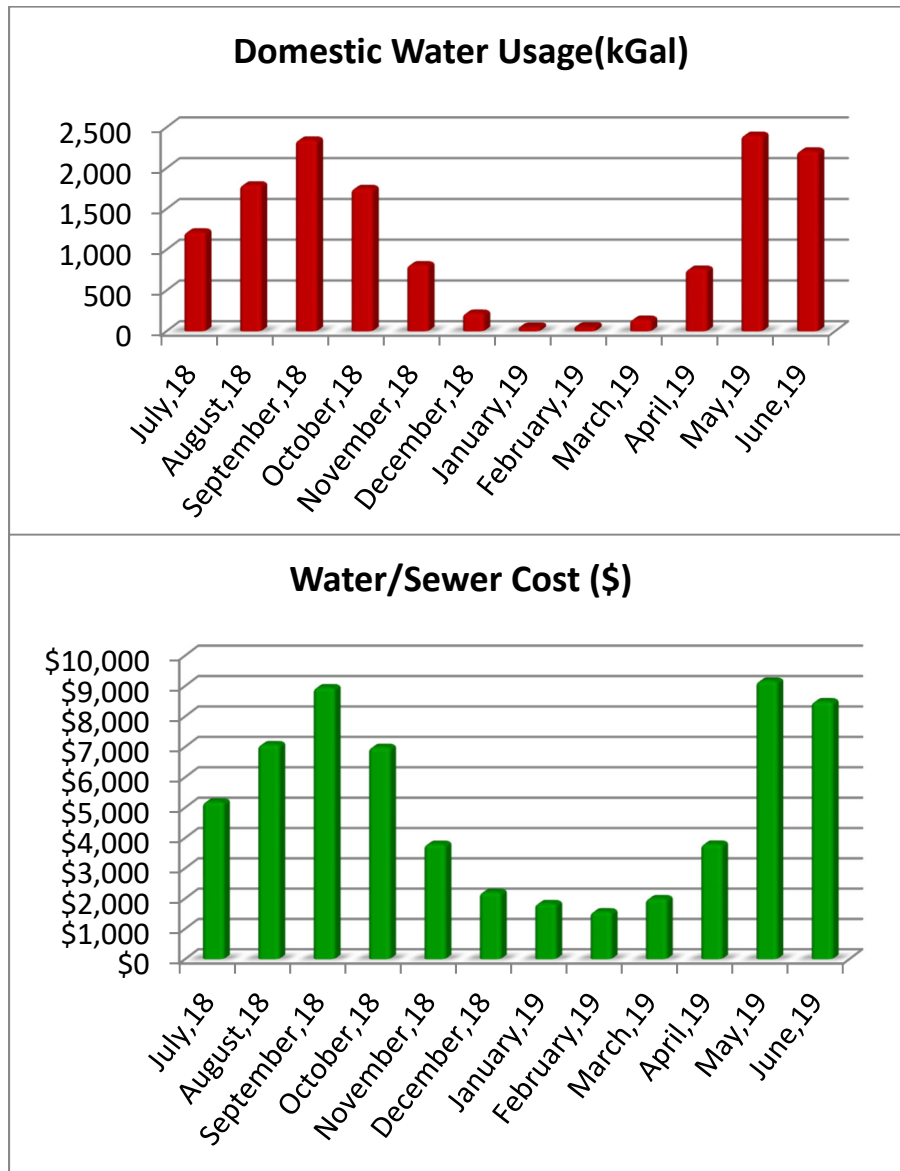


4.3. Water and Sewer

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	1,220	\$4.26	\$5,198
August, 18	1,796	\$3.94	\$7,077
September, 18	2,346	\$3.82	\$8,952
October, 18	1,752	\$3.99	\$6,990
November, 18	817	\$4.65	\$3,799
December, 18	223	\$9.92	\$2,214
January, 19	55	\$33.24	\$1,840
February, 19	60	\$25.97	\$1,568
March, 19	149	\$13.47	\$2,004
April, 19	763	\$4.99	\$3,804
May, 19	2,405	\$3.81	\$9,166
June, 19	2,212	\$3.84	\$8,491
Total/average	13,799	\$4.43	\$61,103



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		KW kWh
Estimated Number of Panels	1,045	
Estimated KW Rating	329	
Potential Annual kWh Produced	506,933	
% of Current Electricity Uses	89.3%	
Financial Summary		Years
Investment Cost	\$1,151,850	
Estimated Energy Cost Savings	\$75,503	
Payback without Incentives	15.3	
Incentive Payback but without SRECs	9.2	
Payback with All Incentives	9.2	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 0.005% 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

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) Investment 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 (CO₂). Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement).

APPENDIX B:

Mechanical Equipment Inventory

Mechanical Inventory							
System	Make	Model	Serial Number	Input Capacity	Room Number	Space Served	Quantity
Boiler	Systems	PW1430IN09C1ADXX	C03G04722	1430 MBH	Boiler room	00E Classrooms	1
Boiler	Laars Heating Systems	PW1430IN09C1ADXX	C03G04728	1430 MBH	Boiler room	00E Classrooms	1
Condensing Unit/Heat Pump	Carrier	Illegible	Illegible	5 TON	Rear of building	00G Classrooms	1
Condensing Unit/Heat Pump	Carrier	24ACA360A300	3707E12041	3 TON	Rear of building	00G Classrooms	1
Condensing Unit/Heat Pump	Carrier	3BTXA060320	2803E05388	5 TON	Rear of building	00G Classrooms	1
Distribution Pump	Nidec Motor Corporation	DT01	-	15 HP	Boiler room	00E Classrooms	1
Exhaust Fan	JennAir	80 CR F CC	No tag/plate found	500 CFM	Roof	00E Classrooms	1
Exhaust Fan	Greenheck	CW-065-DGEX-QD	02H19919	800 CFM	Building exterior	00B Administration & Classrooms	1
Exhaust Fan	Greenheck	G-070-DGEX-QD	03E04236	800 CFM	Roof	00C Classrooms	1
Exhaust Fan	Greenheck	G-121-AX-QD	03F12783	800 CFM	Roof	00D Gymnasium	1
Exhaust Fan	Greenheck	G-121-AX-QD	03F12787	800 CFM	Roof	00D Gymnasium	1
Exhaust Fan	Greenheck	G-098-A-X	13422068	800 CFM	Roof	00C Classrooms	1
Exhaust Fan	JennAir	28 HRV CC	No tag/plate found	500 CFM	Roof	00E Classrooms	1
Exhaust Fan	Greenheck	G-095-DGEX-QD	03F16429	800 CFM	Roof	00D Gymnasium	1
Exhaust Fan	Greenheck	G-121-AX-QD	03F12789	800 CFM	Roof	00D Gymnasium	1
Exhaust Fan	JennAir	108CR 4 CC	No tag/plate found	800 CFM	Roof	00E Classrooms	1
Exhaust Fan	No tag/plate found	No tag/plate found	No tag/plate found	500 CFM	Roof	00E Classrooms	1
Exhaust Fan	JennAir	108CR 4 CC	No tag/plate found	500 CFM	Roof	00E Classrooms	1
Exhaust Fan	JennAir	273 CK SPF	CC	500 CFM	Roof	00E Classrooms	1
Exhaust Fan	JennAir	28 HRV CC	No tag/plate found	500 CFM	Roof	00E Classrooms	1
Exhaust Fan	JennAir	Illegible	CC	500 CFM	Roof	00E Classrooms	1
Exhaust Fan	Greenheck	G-085-DGEX-QD	03E06971	800 CFM	Roof	00C Classrooms	1
Exhaust Fan	JennAir	222 CK G	CC	500 CFM	Roof	00E Classrooms	1
Exhaust Fan	Greenheck	G-123-A-X	14590035 16E	800 CFM	Roof	00D Gymnasium	1
Exhaust Fan	JennAir	222 CK G	CC	500 CFM	Roof	00E Classrooms	1
Exhaust Fan	Greenheck	G-121-BX-QD	03F27394	800 CFM	Roof	00E Classrooms	1
Exhaust Fan	Greenheck	G-141-BX-QD	03608435	800 CFM	Roof	00D Gymnasium	1
Exhaust Fan	Greenheck	G-121-AX-QD	03F12786	800 CFM	Roof	00C Classrooms	1
Exhaust Fan	Greenheck	CW-065-DGEX-QD	03E05910	800 CFM	Building exterior	00B Administration & Classrooms	1
Exhaust Fan	Jenn-Aire	Illegible	Illegible	500 CFM	Roof	00F MPR	1
Exhaust Fan	Greenheck	CW-065-DGEX-QD	02C02990	800 CFM	Building exterior-restroom	00B Administration & Classrooms	1
Exhaust Fan	Greenheck	G-141-BX-QD	03608437	800 CFM	Roof	00D Gymnasium	1
Exhaust Fan	Greenheck	CW-065-DGEX-QD	5062G6506	800 CFM	Building exterior	00B Administration & Classrooms	1
Exhaust Fan	Greenheck	CW-065-DGEX-QD	38SP21560	800 CFM	Building exterior	00B Administration & Classrooms	1
Exhaust Fan	Jenn-Aire	Illegible	Illegible	500 CFM	00F MPR & Library	00F MPR	1
Exhaust Fan	Greenheck	CW-065-DGEX-QD	03F205B0	800 CFM	Building exterior	00B Administration & Classrooms	1
Exhaust Fan	Greenheck	G-075-DSEX-QD	03F24680	500 CFM	Roof	00F MPR	1
Exhaust Fan	Greenheck	CW-065-DGEX-QD	02B20196	800 CFM	Building exterior-restroom	00B Administration & Classrooms	1
Exhaust Fan	Greenheck	G-141-BX-QD	03816436	800 CFM	Roof	00D Gymnasium	1
Exhaust Fan	Jenn-Aire	Illegible	Illegible	800 CFM	Roof	00F MPR	1
Exhaust Fan	Greenheck	G-141-BX-QD	03608430	800 CFM	Roof	00D Gymnasium	1
Exhaust Fan	Greenheck	CW-060-DGEX-QD	02C03003	800 CFM	Building exterior	00B Administration & Classrooms	1
Exhaust Fan	Greenheck	CW-065-DGEX-QD	03626507	800 CFM	Building exterior	00B Administration & Classrooms	1
Exhaust Fan	Greenheck	CW-070-D6EX-QD	03605467	800 CFM	Building exterior	00A Classrooms	1
Furnace	Carrier	Inaccessible	Inaccessible	25 MBH	Attic	00G Classrooms	1
Furnace	Carrier	Inaccessible	Inaccessible	25 MBH	Attic	00G Classrooms	1
Furnace	Carrier	Inaccessible	Inaccessible	25 MBH	Attic	00G Classrooms	1
Heat Pump	Bard	WH431-A0ZCX4XXB	176L981277068-02	4 TON	Rear of building	P01 Classroom	1
Heat Pump	Bard	WH402-A05VX4XXX	149C011599741-01	4 TON	Rear of building	P03 Classroom	1
Heat Pump	Bard	WH431-A0ZCX4XXB	176L981277074-02	4 TON	Rear of building	P01 Classroom	1
Make-Up Air Unit	Reznor	No tag/plate found	No tag/plate found	2000 CFM	Roof	00F MPR	1
Packaged Unit (RTU)	AAON, Inc.	RK-08-3-E0-212	200308-AKGB50287	8 TON	Roof	00C Classrooms	1
Packaged Unit (RTU)	AAON, Inc.	RK-06-3-E0-222	200308-AKGE50341	6 TON	Roof	00C Classrooms	1
Packaged Unit (RTU)	Aaon	Illegible	Illegible	5 TON	Roof	00A Classrooms	1
Packaged Unit (RTU)	Aaon	RK-04-3-E0-222	200308-AKGC50330	4 TON	Roof	00B Administration & Classrooms	1
Packaged Unit (RTU)	Aaon	RK-05-3-E0-222	200308-AKGD50315	5 TON	Roof	00B Administration & Classrooms	1
Packaged Unit (RTU)	AAON, Inc.	RK-03-3-E0-212	200308-AKGB50342	3 TON	Roof	00E Classrooms	1
Packaged Unit (RTU)	AAON, Inc.	RK-06-3-E0-222	200308-AKGE50339	6 TON	Roof	00C Classrooms	1

Packaged Unit (RTU)	Aaon	RK-04-3-EO-222	200308-AKGC300--	5 TON	Roof	00B Administration & Classrooms	1
Packaged Unit (RTU)	Aaon	RK-04-3-EO-222	Illegible	6 TON	Roof	00B Administration & Classrooms	1
Packaged Unit (RTU)	Aaon	Illegible	Illegible	4 TON	Roof	00A Classrooms	1
Packaged Unit (RTU)	Aaon	RK-04-3-EO-222	200305-AKGC50331	4 TON	Roof	00B Administration & Classrooms	1
Packaged Unit (RTU)	Aaon	RK-04-3-EO-222	200308-AKG05031	5 TON	Roof	00B Administration & Classrooms	1
Packaged Unit (RTU)	Aaon	RK-06-3-EO-222	200308-AKGE50332	6 TON	roof	00B Administration & Classrooms	1
Packaged Unit (RTU)	Aaon	Illegible	Illegible	5 TON	Roof	00A Classrooms	1
Packaged Unit (RTU)	Aaon	Illegible	Illegible	4 TON	Roof	00A Classrooms	1
Packaged Unit (RTU)	AAON, Inc.	RK-06-3-EO-222	200308-AKGE50340	6 TON	Roof	00C Classrooms	1
Packaged Unit (RTU)	Aaon	RK-05-3-EO-222	200308-AKGD50335	5 TON	Roof	00B Administration & Classrooms	1
Packaged Unit (RTU)	Aaon	Illegible	Illegible	5 TON	Roof	00A Classrooms	1
Packaged Unit (RTU)	Aaon	Illegible	Illegible	4 TON	Roof	00A Classrooms	1
Packaged Unit (RTU)	Aaon	RK-06-3-EO-222	Illegible	6 TON	00B Classrooms	00B Administration & Classrooms	1
Packaged Unit (RTU)	Aaon	RK-04-3-EO-222	Illegible	6 TON	Roof	00B Administration & Classrooms	1
Packaged Unit (RTU)	Aaon	Illegible	Illegible	4 TON	Roof	00A Classrooms	1
Packaged Unit (RTU)	Aaon	Illegible	Illegible	5 TON	Roof	00A Classrooms	1
Packaged Unit (RTU)	Aaon	RK-06-3-EO-222	Illegible	6 TON	Roof	00B Administration & Classrooms	1
Packaged Unit (RTU)	Aaon	RK-05-3-EO-222	200308-AKGD50317	5 TON	Roof	00B Administration & Classrooms	1
Packaged Unit (RTU)	Aaon	Illegible	Illegible	4 TON	Roof	00A Classrooms	1
Packaged Unit (RTU)	Aaon	RK-04-0-EO-222	200308-AK6050620	4 TON	Roof	00A Classrooms	1
Packaged Unit (RTU)	Aaon	RK-04-3-EO-222	200306-AKGC60333	4 TON	Roof	00B Administration & Classrooms	1
Packaged Unit (RTU)	Aaon	RK-05-3-EO-222	200308-AKGD50	5 TON	Roof	00B Administration & Classrooms	1
Packaged Unit (RTU)	Aaon	Illegible	Illegible	5 TON	Roof	00A Classrooms	1
Water Heater	Rheem	ES50-12-G-1	CS0208RR1107E01019	50 GAL	00B Classrooms	00B Administration & Classrooms	1
Water Heater	Rheem	EGSP15	0400300745	15 GAL	Janitor closet	00G Classrooms	1
Water Heater	National US	No tag/plate found	No tag/plate found	15 GAL	Utility closet	00B Administration & Classrooms	0
Water Heater	No tag/plate found	No tag/plate found	No tag/plate found	15 GAL	Janitor closet-001	00A Classrooms	0
Water Heater	State Industries, Inc.	P661OMSKO	E00304718	6 GAL	Utility closet	P02 Restrooms	0

APPENDIX C:

Lighting System Schedule



Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	Additional Area Description	LUX	Control Quantity	Existing Control	Lamp Details				Fixture Details				Existing Consumption	
										Technology	Sub-Technology	Lamp Type	Total Lamps	Fixture Type	Fixture Quantity	24x7 Fixture Count	Fixture Height	Annual Hours	Existing Annual kWh
1	E	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 4 Pin	CFL42	18	Surface Mount Can	18	0	8	2,220	1,678
2	E	Exterior		HALLWAY	Exterior		-	1	Timer	HID	HPS	HP5400	3	Wallpack-Horizontal	3	0	8	2,220	2,664
3	E	Interior		CLASSROOM	I-26A		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	33	2x4 Prism Troffer	11	0	8	1,480	1,563
4	E	Interior		CLASSROOM	I-26A		-	4	Light Switch	Linear Fluorescent	T8	2' 18W T8	9	2x2 Prism Troffer	3	0	8	1,480	240
5	E	Interior		CLASSROOM	I-26A		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	1,480	189
6	E	Interior		CLASSROOM	I-26A		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	1,480	189
7	E	Interior		CLASSROOM	I-26A		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	1,480	189
8	E	Interior		CLASSROOM	I26-B		-	3	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	33	2x4 Prism Troffer	11	0	8	1,480	1,563
9	E	Interior		CLASSROOM	I26-B		-	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	1,480	189
10	E	Interior		MECHANICAL	I-25		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	6	0	8	1,554	597
11	E	Interior		CLASSROOM	I26-B		-	3	Light Switch	Linear Fluorescent	T8	2' 18W T8	9	2x4 Prism Troffer	3	0	8	1,480	240
12	E	Interior		MECHANICAL	I-25		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	6	0	8	1,554	597
13	E	Interior		MECHANICAL	I-25		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	66	Industrial	33	0	8	1,554	3,282
14	E	Interior		MECHANICAL	I-25		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	1,554	99
15	E	Interior		CLASSROOM	I-24A		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	30	2x4 Prism Troffer	15	0	8	1,480	1,421
16	E	Interior		CLASSROOM	I-24A		-	4	Light Switch	Linear Fluorescent	T8	2' 18W T8	12	2x2 Prism Troffer	4	0	8	1,480	320
17	E	Interior		CLASSROOM	I-24A		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	1,480	189
18	E	Interior		CLASSROOM	I-24A		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	1,480	95
19	E	Interior		CLASSROOM	I-24 B		-	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	40	2x4 Prism Troffer	10	0	8	1,480	1,894
20	E	Interior		CLASSROOM	I-24 B		-	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	1,480	95
21	E	Interior		CLASSROOM	I-23		-	5	Light Switch	Linear Fluorescent	T8	4' 32W T8	80	2x4 Prism Troffer	20	0	8	1,480	3,789
22	E	Interior		CLASSROOM	I-23		-	5	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	1,480	189
23	E	Interior		CLASSROOM	I-23		-	5	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	2	0	8	1,480	95
24	E	Interior		CLASSROOM	I-23		-	5	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	1,480	95
25	E	Interior		MECHANICAL	Electrical panel room		-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	26	2x4 Prism Troffer	13	0	8	703	585
26	E	Interior		MECHANICAL	Electrical panel room		-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	10	2x4 Prism Troffer	5	0	8	703	225
27	E	Interior		RESTROOM	All gender restroom		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	2,220	284
28	E	Interior		RESTROOM	All gender restroom		-	1	Light Switch	Linear Fluorescent	T8	18" 15W T8	1	Strip Fixture	1	0	8	2,220	33
29	E	Interior		CLASSROOM	I-22		-	2	Light Switch	Linear Fluorescent	T8	18" 15W T8	60	2x4 Prism Troffer	20	0	8	1,480	1,332
30	F	Exterior		HALLWAY	Exterior		-	1	Timer	HID	HPS	HP5400	2	Wallpack-Horizontal	2	0	16	2,220	1,776
31	F	Exterior		HALLWAY	Exterior		-	1	Timer	HID	HPS	HP51000	1	Wallpack-Horizontal	1	0	22	2,220	2,220
32	F	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 4 Pin	CFL42	10	Surface Mount Can	10	0	8	2,220	932
33	F	Interior		CAFETERIA	Multi purpose		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	201	2x4 Prism Troffer	67	0	8	2,220	14,279
34	F	Interior		AUDITORIUM	2006		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	8	2,220	568
35	F	Interior		KITCHEN	Kitchen		-	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	8	1,850	474
36	F	Interior		KITCHEN	Kitchen		-	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	8	1,850	118
37	F	Interior		KITCHEN	Kitchen		-	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	20	1x4 Prism Troffer	10	0	8	1,850	1,184
38	F	Interior		KITCHEN	Kitchen		-	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	32	1x4 Prism Troffer	16	0	8	1,850	1,894
39	F	Interior		KITCHEN	Kitchen		-	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	8	1,850	237
40	F	Interior		KITCHEN	Kitchen		-	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	1,850	118
41	F	Interior		KITCHEN	Kitchen		-	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	1,850	237
42	F	Interior		CAFETERIA	Teacher's Lounge		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	8	2,220	568
43	F	Interior		ESTROOM - PRIVAT	All gender restroom		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	925	59
44	F	Interior		CAFETERIA	I-27		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	10	2x4 Prism Troffer	5	0	8	2,220	710
45	F	Interior		MECHANICAL	C001		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	20	1x4 Prism Troffer	10	0	8	703	450
46	F	Interior		STORAGE	S011		-	1	Light Switch	Incan/H/MR	Incan	I100-Globe	1	Can-Surf Mount	1	0	8	740	74
47	F	Interior		AUDITORIUM	Stage		-	1	Light Switch	Incan/H/MR	Incan	I100-Globe	2	Can-Surf Mount	2	0	16	740	148
48	C	Interior		CLASSROOM	H-21		-	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	54	Industrial	27	0	8	1,480	2,557
49	C	Interior		CLASSROOM	H-21		-	3	Light Switch	CFL	CFL - 2 Pin	CFL13	9	Recessed Can-hor6"	9	0	8	1,480	173
50	C	Interior		CLASSROOM	H-20		-	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	54	Industrial	27	0	8	1,480	2,557
51	C	Interior		CLASSROOM	H-20		-	3	Light Switch	CFL	CFL - 2 Pin	CFL13	9	Recessed Can-hor6"	9	0	8	1,480	173
52	C	Interior		CLASSROOM	H-18		-	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	54	Industrial	27	0	8	1,480	2,557
53	C	Interior		CLASSROOM	H-18		-	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	3	0	8	1,480	284
54	C	Interior		CLASSROOM	H-18		-	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	8	1,480	379
55	C	Interior		CLASSROOM	H-18		-	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Indirect Troffer	4	0	8	1,480	379
56	C	Interior		CLASSROOM	H-19		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	54	Industrial	27	0	8	1,480	2,557
57	C	Interior		CLASSROOM	H-19		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	3	0	8	1,480	284
58	C	Interior		CLASSROOM	H-19		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Indirect Troffer	4	0	8	1,480	379
59	C	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 4 Pin	CFL42	11	Surface Mount Can	11	0	8	2,220	1,026
60	D	Interior		GYMNASIUM	Gym		-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	100	2x4 Prism Troffer	25	0	18	2,220	7,104
61	D	Interior		LOCKER ROOM	Girls locker room		-	4		Linear Fluorescent	T8	4' 32W T8	240	2x4 Prism Troffer	120	0	8	2,220	17,050
62	D	Interior		STORAGE	S012		-	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	703	90



Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	Additional Area Description	LUX	Control Quantity	Existing Control	Lamp Details				Fixture Details				Existing Consumption	
										Technology	Sub-Technology	Lamp Type	Total Lamps	Fixture Type	Fixture Quantity	24x7 Fixture Count	Fixture Height	Annual Hours	Existing Annual kWh
63	D	Interior		STORAGE	Hallway		-	3	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	6	0	8	703	270
64	D	Interior		STORAGE	H022		-	3	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	3	0	8	703	135
65	D	Interior		STORAGE	Coach office		-	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	703	90
66	D	Interior		STORAGE	T011		-	2	Wall-Mounted Sensor	Linear Fluorescent	T8	18" 15W T8	4	2x4 Prism Troffer	4	0	8	703	42
67	D	Interior		STORAGE	PE office		-	1	Wall-Mounted Sensor	Linear Fluorescent	T8	18" 15W T8	2	2x4 Prism Troffer	2	0	8	703	21
68	D	Interior		GYMNASIUM	V020		-	2	Light Switch	Linear Fluorescent	T8	18" 15W T8	24	2x4 Prism Troffer	6	0	22	2,220	799
69	D	Interior		GYMNASIUM	M021		-	1	Light Switch	Linear Fluorescent	T8	18" 15W T8	4	2x4 Prism Troffer	2	0	8	2,220	133
70	D	Exterior		HALLWAY	Exterior		-	1	Timer	HID	HPS	HP5400	2	Wallpack-Horizontal	2	0	8	2,220	1,776
71	D	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 4 Pin	CFL42	6	Surface Mount Can	6	0	8	2,220	559
72	E	Interior		RESTROOM	Boys		-	1	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	8	2,220	568
73	C	Interior		RESTROOM	Girls		-	1	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	8	2,220	142
74	B	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 4 Pin	CFL42	107	Surface Mount Can	107	0	8	2,220	9,977
75	B	Exterior		HALLWAY	Exterior		-	1	Timer	HID	HPS	HP5150	2	Wallpack-Horizontal	2	0	8	2,220	666
76	B	Interior		CLASSROOM	205		-	10	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	360	Industrial	180	0	8	1,480	17,050
77	B	Interior		CLASSROOM	204		-	6	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	288	Industrial	144	0	8	1,480	13,640
78	B	Interior		RESTROOM	T005		-	4		Linear Fluorescent	T8	4' 32W T8	40	1x4 Prism Troffer	20	0	8	2,220	2,842
79	B	Interior		RESTROOM	All gender		-	3	Wall-Mounted Sensor	Linear Fluorescent	T8	18" 15W T8	6	1x4 Prism Troffer	3	0	8	2,220	200
80	A	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 4 Pin	CFL42	18	Surface Mount Can	18	0	8	2,220	1,678
81	B	Exterior		HALLWAY	Exterior		-	1	Timer	HID	MH	MH100	6	Wallpack-Horizontal	6	0	8	2,220	1,332
82	P02	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 2 Pin	CFL13	2	Wallpack-Vertical	2	0	8	2,220	58
83	P02	Interior		ESTROOM - PRIVAT	Men staff		-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	8	925	237
84	P02	Interior		ESTROOM - PRIVAT	Staff		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	925	59
85	P01	Interior		OFFICE	P-2		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	72	2x4 Prism Troffer	24	0	8	2,220	5,115
86	P01	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 2 Pin	CFL13	2	Wallpack-Vertical	2	0	8	2,220	58
87	P03	Interior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 2 Pin	CFL13	1	Wallpack-Vertical	1	0	8	703	9
88	P03	Interior		OFFICE	P-3		-	12	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	2x4 Prism Troffer	12	0	8	2,220	2,557
89	P03	Interior		OFFICE	P-3		-	12	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	2	0	8	2,220	426
90	P03	Interior		OFFICE	P-3		-	12	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	2	0	8	2,220	426
91	P03	Interior		OFFICE	P-3		-	12	Light Switch	Linear Fluorescent	T8	4' 32W T8	3	2x4 Prism Troffer	1	0	8	2,220	213
92	P03	Interior		OFFICE	P-3		-	12	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	2	0	8	2,220	426
93	P03	Interior		OFFICE	P-3		-	12	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	2	0	8	2,220	142
94	P01	Exterior		HALLWAY	Exterior		-	1	Timer	HID	MH	MH250	1	Wallpack-Horizontal	1	0	8	2,220	555
95	D	Exterior		HALLWAY	Exterior		-	1	Timer	HID	MH	MH100	7	Wallpack-Horizontal	7	0	8	2,220	1,554
96	Site	Exterior		HALLWAY	Exterior		-	1	Timer	HID	MH	MH400	2	Pole Post Top	2	0	8	2,220	1,776
97	B	Exterior		HALLWAY	Exterior		-	1	Timer	HID	MH	MH400	2	Wallpack-Horizontal	2	0	8	2,220	1,776
98	B	Exterior		HALLWAY	Exterior		-	1	Timer	HID	HPS	HP51000	1	Wallpack-Horizontal	1	0	8	2,220	2,220
99	G	Exterior		HALLWAY	Exterior		-	1	Timer	CFL	CFL - 4 Pin	CFL42	6	Surface Mount Can	6	0	8	2,220	559
100	G	Interior		STORAGE	5009		-	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	1	Strip Fixture	1	0	8	6,216	199
101	G	Interior		CLASSROOM	0027		-	3	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	96	Industrial	32	0	8	1,480	4,547
102	G	Interior		CLASSROOM	0027		-	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	3	0	8	1,480	284
103	G	Interior		ESTROOM - PRIVAT	T005		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	2,220	142
104	G	Interior		CLASSROOM	028		-	1	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	108	Industrial	36	0	8	2,220	7,672
105	G	Interior		CLASSROOM	028		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	3	0	8	2,220	426
106	G	Interior		ESTROOM - PRIVAT	T001		-	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	925	59
107	G	Interior		STORAGE	J002		-	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	1	Strip Fixture	1	0	8	703	22
108	G	Interior		CLASSROOM	029		-	3	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	96	Industrial	32	0	8	1,480	4,547
109	G	Interior		CLASSROOM	029		-	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	3	0	8	1,480	284
110	B	Interior		CLASSROOM	17		-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	6	0	8	1,480	568
111	B	Interior		CLASSROOM	17		-	2	Light Switch	Incan/H/MR	Incan	I100-Globe	12	Gooseneck	12	0	8	1,480	1,776
112	B	Interior		STORAGE	013		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	1	Strip Fixture	1	0	8	555	18
113	B	Interior		STORAGE	S012		-	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	Strip Fixture	4	0	8	703	180
114	A	Interior		CLASSROOM	4		-	8	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	288	2x4 Prism Troffer	144	0	8	1,480	13,640
115	A	Interior		CLASSROOM	11		-	1	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	48	2x4 Prism Troffer	24	0	8	1,480	2,273
116	A	Interior		LIBRARY	Library		-	3	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	90	2x4 Prism Troffer	30	0	8	2,220	6,394
117	A	Interior		STORAGE	13		-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	22	2x4 Prism Troffer	11	0	8	703	495
118	B	Interior		OFFICE	Office		-	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	20	2x4 Prism Troffer	10	0	8	2,220	1,421
119	B	Interior		OFFICE	C003		-	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	Industrial	4	0	8	2,220	568
120	B	Interior		OFFICE	Office hallway		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	8	2,220	568
121	B	Interior		OFFICE	H017		-	3	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	Industrial	3	0	8	2,220	426
122	B	Interior		OFFICE	H017		-	3	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	8	2,220	142
123	B	Interior		OFFICE	H017		-	3	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	2,220	284
124	B	Interior		OFFICE	H017		-	3	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	8	2,220	568



										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
125	B	Interior		OFFICE	C015		-	3	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	36	2x4 Prism Troffer	18	0	8	2,220	2,557
126	B	Interior		OFFICE	Assistant principal		-	2	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	16	Industrial	8	0	8	2,220	1,137
127	B	Interior		RESTROOM - PRIVAT	T014		-	2	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	8	925	237
128	B	Interior		OFFICE	C013		-	3	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	6	0	8	2,220	852
129	B	Interior		CAFETERIA	F019		-	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	24	Industrial	12	0	8	2,220	1,705
130	B	Interior		OFFICE	C021		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	2,220	284
131	B	Interior		OFFICE	Z010		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	8	2,220	568
132	G	Interior		OFFICE	C004		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Prism Troffer	2	0	8	2,220	284
133	Site	Exterior		HALLWAY	Exterior		-	1	Timer	HID	MH	MH400	3	Pole Post Top	3	0	8	2,220	2,664
Totals													3,496		1,671			233,581	215,400



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							
1	E	Exterior		HALLWAY	Exterior		Timer	1	CFL	CFL - 4 Pin	CF42; Surface Mount Can	18	18	8	2,220	1,678			Photo Sensor				kWh							
2	E	Exterior		HALLWAY	Exterior		Timer	1	HID	HPS	HP5400; Wallpack-Horizontal	3	3	8	2,220	2,664	ECM	RF - Replace Entire Fixture	Photo Sensor	30W LED Wall Pack	2,220	200	2,464							
3	E	Interior		CLASSROOM	I-26A		Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	11	33	8	1,480	1,563	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	830	733							
4	E	Interior		CLASSROOM	I-26A		Light Switch	4	Linear Fluorescent	T8	2' 18W T8; 2x2 Prism Troffer	3	9	8	1,480	240	ECM	RB - Replace Bulb	Ceiling Mounted	2' 8W LED T8	1,480	107	133							
5	E	Interior		CLASSROOM	I-26A		Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	1,480	189	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	101	89							
6	E	Interior		CLASSROOM	I-26A		Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	1,480	189	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	101	89							
7	E	Interior		CLASSROOM	I-26A		Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	1,480	189	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	101	89							
8	E	Interior		CLASSROOM	I-26-B		Ceiling-Mounted Sensor	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	11	33	8	1,480	1,563	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	830	733							
9	E	Interior		CLASSROOM	I-26-B		Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	1,480	189	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	101	89							
10	E	Interior		MECHANICAL	I-25		Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	6	12	8	1,554	597	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,554	317	280							
11	E	Interior		CLASSROOM	I-26-B		Light Switch	3	Linear Fluorescent	T8	2' 18W T8; 2x4 Prism Troffer	3	9	8	1,480	240	ECM	RB - Replace Bulb	Retain Existing Controls	2' 8W LED T8	1,480	107	133							
13	E	Interior		MECHANICAL	I-25-B		Light Switch	4	Linear Fluorescent	T8	4' 32W T8; Industrial	33	66	8	1,554	3,282	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,554	1,744	1,538							
15	E	Interior		CLASSROOM	I-24A		Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	15	30	8	1,480	1,421	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	755	666							
17	E	Interior		CLASSROOM	I-24A		Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	1,480	189	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	101	89							
19	E	Interior		CLASSROOM	I-24 B		Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	10	40	8	1,480	1,894	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	1,006	888							
21	E	Interior		CLASSROOM	I-23		Light Switch	5	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	20	80	8	1,480	3,789	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	2,013	1,776							
22	E	Interior		CLASSROOM	I-23		Light Switch	5	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	1,480	189	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	101	89							
24	E	Interior		CLASSROOM	I-23		Light Switch	5	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	8	1,480	95	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	50	44							
25	E	Interior		MECHANICAL	Electrical panel room		Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	13	26	8	703	585	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	703	311	274							
26	E	Interior		MECHANICAL	Electrical panel room		Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	5	10	8	703	225	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	703	120	105							
27	E	Interior		RESTROOM	All gender restroom		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	2,220	284	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	151	133							
28	E	Interior		RESTROOM	All gender restroom		Light Switch	1	Linear Fluorescent	T8	18" 15W T8; Strip Fixture	1	1	8	2,220	33	ECM	RB - Replace Bulb	Wall Mounted	18" 8W LED T8	2,220	18	16							
32	F	Exterior		HALLWAY	Exterior		Timer	1	CFL	CFL - 4 Pin	CF42; Surface Mount Can	10	10	8	2,220	932			Photo Sensor											
33	F	Interior		CAFETERIA	Multi purpose		Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	67	201	8	2,220	14,279	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	2,220	7,586	6,693							
34	F	Interior		AUDITORIUM	2006		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	8	8	2,220	568	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	302	266							
35	F	Interior		KITCHEN	Kitchen		Light Switch	6	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	8	1,850	474	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,850	252	222							
36	F	Interior		KITCHEN	Kitchen		Light Switch	6	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	8	1,850	118	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,850	63	56							
37	F	Interior		KITCHEN	Kitchen		Light Switch	6	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	10	20	8	1,850	1,184	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,850	629	555							
38	F	Interior		KITCHEN	Kitchen		Light Switch	6	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	16	32	8	1,850	1,894	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,850	1,006	888							
39	F	Interior		KITCHEN	Kitchen		Light Switch	6	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	2	8	1,850	237	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,850	126	111							
40	F	Interior		KITCHEN	Kitchen		Light Switch	6	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	8	1,850	118	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,850	63	56							
41	F	Interior		KITCHEN	Kitchen		Light Switch	6	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	1,850	237	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,850	126	111							
42	F	Interior		CAFETERIA	Teacher's Lounge		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	8	8	2,220	568	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,220	302	266							
45	F	Interior		MECHANICAL	C001		Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	10	20	8	703	450	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	703	239	211							
48	C	Interior		CLASSROOM	H-21		Light Switch	3	Linear Fluorescent	T8	4' 32W T8; Industrial	27	54	8	1,480	2,557	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	1,359	1,199							
49	C	Interior		CLASSROOM	H-21		Light Switch	3	CFL	CFL - 2 Pin	CF113; Recessed Can-hor*	9	9	8	1,480	173			Ceiling Mounted											
50	C	Interior		CLASSROOM	H-20		Light Switch	3	Linear Fluorescent	T8	4' 32W T8; Industrial	27	54	8	1,480	2,557	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	1,359	1,199							
51	C	Interior		CLASSROOM	H-20		Light Switch	3	CFL	CFL - 2 Pin	CF113; Recessed Can-hor*	9	9	8	1,480	173			Ceiling Mounted											
52	C	Interior		CLASSROOM	H-18		Light Switch	3	Linear Fluorescent	T8	4' 32W T8; Industrial	27	54	8	1,480	2,557	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	1,359	1,199							
53	C	Interior		CLASSROOM	H-18		Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	3	6	8	1,480	284	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	151	133							
54	C	Interior		CLASSROOM	H-18		Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	8	8	1,480	379	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	201	178							
55	C	Interior		CLASSROOM	H-18		Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	4	8	8	1,480	379	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	201	178							
56	C	Interior		CLASSROOM	H-19		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Industrial	27	54	8	1,480	2,557	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	1,359	1,199							
58	C	Interior		CLASSROOM	H-19		Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	4	8	8	1,480	379	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	1,480	201	178							
60	D	Interior		GYMNASIUM	Gym		Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Indirect Troffer	25	50	18	2,220	7,104	ECM	RB - Replace Bulb	Ceiling Mounted	4' 17W LED T8	2,220	3,174	3,390							
62	D	Interior		STORAGE	5012		Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	703	90	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	703	48	42							
64	D	Interior		STORAGE	H022		Wall-Mounted Sensor	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	3	6	8	703	135	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	703	72	63							
65	D	Interior		STORAGE	Coach office		Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	4	8	703	90	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	703	48	42							
66	D	Interior		STORAGE	T011		Wall-Mounted Sensor	2	Linear Fluorescent	T8	18" 15W T8; 2x4 Prism Troffer	4	4	8	703	42	ECM	RB - Replace Bulb	Retain Existing Controls	18" 8W LED T8	703	22	20							
67	D	Interior		STORAGE	PE office		Wall-Mounted Sensor	1	Linear Fluorescent	T8	18" 15W T8; 2x4 Prism Troffer	2	2	8	703	21	ECM	RB - Replace Bulb	Retain Existing Controls	18" 8W LED T8	703	11	10							
68	D	Interior		GYMNASIUM	V020		Light Switch	2	Linear Fluorescent	T8	18" 15W T8; 2x4 Prism Troffer	6	24	22	2,220	799	ECM	RB - Replace Bulb	Ceiling Mounted	18" 8W LED T8	2,220	426	373							
69	D	Interior		GYMNASIUM	M021		Light Switch	1	Linear Fluorescent	T8	18" 15W T8; 2x4 Prism Troffer	2	4	8	2,220	133	ECM	RB - Replace Bulb	Ceiling Mounted	18" 8W LED T8	2,220	71	62							
70	D	Exterior		HALLWAY	Exterior		Timer	1	HID	HPS	HP5400; Wallpack-Horizontal	2	2	8	2,220	1,776	ECM	RF - Replace Entire Fixture	Photo Sensor	30W LED Wall Pack	2,220	133	1,643							
72	E	Interior		RESTROOM	Boys		Ceiling-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4																		

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
✓			Bi-level and Tandem Linear Fluorescent Lighting ECM
		✓	Replace High Intensity Discharge (HID) Lamps With Energy Efficient Lamps
✓			Replace Existing Refrigerator(s) With Energy Star Certified Refrigerator(s)
✓			Replace Existing Freezers With High Efficiency Freezers
	✓		Install Low Flow Shower Heads
		✓	Install Low Flow Faucet Aerators
✓			Install Low Flow Restroom Flush Tank Toilets
		✓	Install Low Flow Tankless Restroom Fixtures

APPENDIX E: ECM Calculations

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

	No. of ECMs	No. of Fixtures	No. of Lamps	KWh Saved	Energy Cost Saving	O & M Savings
Upgrade Lighting to LED	296	1,472	3,297	100,742	\$15,004.52	\$5,284.94

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
Circuline	T9	0	0	0	0	\$0	\$0
Incan/H/MR	H	0	0	0	0	\$0	\$0
Incan/H/MR	Incan	3	15	15	1,678	\$250	\$178
Incan/H/MR	MR	0	0	0	0	\$0	\$0
HID	HPS	6	11	11	9,835	\$1,465	\$286
HID	MH	6	21	21	6,880	\$1,025	\$477
HID	MV	0	0	0	0	\$0	\$0
HID	QL	0	0	0	0	\$0	\$0
Linear Fluorescent	T8	106	1,425	1,425	82,349	\$12,265	\$4,344
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	12	Ceiling Mounted	162
Wall Mounted	96		

Initial Investment		Equipment Rentals	
Material Cost	\$44,085.13	Scissor Lift 26' - Interior Space:	\$445.00
Labor Cost	\$78,486.22	Bucket Truck - Exterior Spaces	\$650.00
Local Electric Rate:	\$0.17 \$/kWh	Estimated Annual Energy Savings:	100,742
Hourly Labor Rate For Electrician:	\$72.40	Estimated Annual Energy Cost Savings:	\$15,005
Budgeted Initial Investment:	\$123,666	Estimated Annual O&M Cost Savings:	\$5,285
Estimated Return on Investment: (Including O&M Savings)	6.10 Years	Estimated Annual Cost Savings:	\$20,289

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UIC		Control External Air Leakage In Commercial Buildings	
EAE4A		Location: Exterior Doors	
ENTER EXISTING CONDITION			
Insert Existing Estimated Air Change Rate/Hr (ACH 1): <small>(Existing Air Changes Per Hour, 3 is very leaky and 0.35 ideal)</small>	0.50	Cubic Feet/Min (CFM 1):	2,314
Insert Proposed Estimated Air Change Rate/Hr (ACH 2):	0.35	Cubic Feet/Min (CFM 2):	1,620
Estimated Space Volume Under Consideration	277,672.00	Cu.Ft	
WINTER		SUMMER	
Select Type of Heating Fuel	Natural Gas (Select)	Is The Building Cooled?	Yes
Estimated Annual Heating Plant Efficiency	75.00 %	Estimated Annual Cooling Plant Efficiency	8.00 EER
Annual Heating Degree Days(HDD):	2,963	Annual Cooling Degree Days(CDD):	1,407
Estimated Total Annual Input Heating Energy Savings	711 Therms	Estimated Total Annual Input Cooling Energy Savings	3,165 kWh
Cost/Unit of Heating Fuel:	\$1.23 \$/Therm	Cost/Unit For Electricity	\$0.15 \$\$
Estimated Annual Heating Cost Savings	\$877 \$\$	Estimated Annual Cooling Cost Savings	\$471 \$\$
Cost Analysis			
Install Flush Mounted, Vinyl Door Sweeps ?	Yes	Total Length of Door Sweeps to Be Installed: <small>(3.5' Standard Width Door)</small>	393 LF
Install Window Air Conditioner Covers For Winter:	Yes	Number of Air Conditioner Covers To Be Installed: <small>(Covers would meet HUD Chapter-12 Energy Conservation Compliance Section 329C)</small>	0
Estimated Annual O&M Savings	\$67	Estimated Length of Joints To Be Re-Caulked: <small>(Includes Demolition and Re-Caulking)</small>	0 LF
Total Estimated Annual Cost Savings	\$1,416	Total Cost For Controlling Air Leakage	\$7,168
Simple Pay Back Period	5.06 Yrs	Type of Recommendation	Capital Cost ECM Recommendation

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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 0.25 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:	\$7,168	Simple Pay Back Period	5.06 Yrs
Annual Energy Cost Savings	\$1,416		

UIC	Install Low Flow Tankless Restroom Fixtures	
EAP4	Location: Restrooms	
ECM FOR DETERMINING WATER SAVINGS IN COMMERCIAL PROPERTIES		
Number of Males	508	
Number of Females	508	
Number of Occupied Days Per Week (Max 7)	5	
Number of Occupied Weeks/Year (Max 52)	38	
Number of Urinals To Be Retrofitted	17	
Number of Water Closets To Be Retrofitted	38	
No. of Water Closets With Separate Flush Tank <i>(Typical Residential Type)</i>	1	
Estimated Restroom Usage/Individual/Day <i>Default is 4 Uses/Day For Residential/Office</i>	4	(Select)
Urinal Water Savings		
Do you Want To Make Any Changes To The Urinals?	No	
Estimated Existing Use of Urinal/Day/Man	80%	
Existing Gallons Per Flush Ratings For Urinal Flushes	1.00	GPF
Proposed Urinal	0.125 GPF -Wall Mount	
GPF of Proposed Urinal Flush Valve**	0.125	GPF
<small>** (1992 EpACT Energy Act Mandates 1.0GPF Max on Urinals)</small>		
Estimated Annual Water Savings From Urinal	0.00	kGal
Water Closet Water Savings		
Tankless Water Closets		
Do The Water Closet Need To Be Retrofitted?	(Select) Yes	
Existing Gallons Per Flush Ratings For Water Closet Flushes	1.60	GPF
Are The Existing Water Closet Being Replaced?	(Select) No	
<small>(If No, Then Only The Flush Valve Would Be Replaced With Dual Flush Retrofit Kit)</small>		
No. of Tankless Water Closets	37	
GPF of Proposed Dual Flush- Water Closet Valve*	1.60	GPF
<small>* (Federal Law Requires All Flushes Not To Exceed 1.6 GPF)</small>		
	0.48	GPF
<small>Solid Waste (20%) Liquid Waste (80%)</small>		
Estimated Annual Water Savings From Male Users	345.93	kGal
Estimated Annual Water Savings From Female Users	345.93	kGal
Total Water Savings From Water Closets	691.86	kGal
Water & Cost Saving Calculations		
Water Savings Calculation		
Water Savings By The Use of Low Flow Water Closet Flush Valves/Yr	691.86	kgal
Water Savings By The Use of Low Flow Urinal Flush Valves/ Yr	0.00	kgal
Total Annual Water Savings in kgal	691.86	kgal
Cost Savings Calculations		
Enter Water Tariff Rate (\$/1000Gal)	\$4.43	\$\$
Estimated Cost Savings From Water	\$3,065	\$\$
Estimated Cost of Retrofit		
Cost For Replacing Existing Urinal Fixture With A Low Flow Fixture	\$0	\$(Includes Labor)
Cost For Replacing Existing Flush Valves With Low Flow - Dual Flush Valves (\$80 Per Unit)	\$23,524	\$(Includes Labor)
<small>(Up For Liquid Waste And Down For Solid Waste)</small>		
Estimated Total Cost For Retrofit	\$23,524	\$\$
Simple Pay Back Period	7.68	Yrs
Type of Recommendation	Capital Cost ECM Recommendation	

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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:	\$23,524	Simple Payback Period:	7.68 Yrs
Annual Cost Savings:	\$3,065		

UIC	Upgrade Electric Heating System To Heat Pumps				
EAH11-A	Location: Portable Classrooms				
ASHRAE Climatic Zone:	Zone-3	Portable Classrooms	Specify Location Here	Specify Location Here	Specify Location Here
Select Existing Heating System Type	Heat Pump - Split System	PTAC	PTAC	PTAC	PTAC
Number of Existing Systems:	4 Qty				
Output Capacity of Heating System/Unit:	36,000.00 btuh				
Output Capacity of Heating System:	36,000 Btuh	0 Btuh	0 Btuh	0 Btuh	
Existing COP of Heating System:	3.00 COP				
Estimated Annual Heating Hours:	1,464 Hrs				
Auxiliary Heating In Heatpumps:					
Cooling Capacity of Each System:	36,000 Btuh				
Existing EER of Cooling System:	8.00 EER				
Estimated Annual Cooling Hours:	680 Hrs				
Install Programmable Thermostats With Heatpumps:	Yes	Yes	Yes	Yes	
Current Energy Consumption From Cooling:	12,240 kWh	0 kWh	0 kWh	0 kWh	
Current Energy Consumption From Heating:	16,476 kWh	0 kWh	0 kWh	0 kWh	
Total Existing Electric Consumption:	28,716 kWh	0 kWh	0 kWh	0 kWh	
Proposed System					
Heat pump Type	Air-Source Split Heat Pump System	Air-Source PTHP System	Water-Source System	Water-Source System	
Proposed Number of Systems:	4 Qty	1 Qty	2 Qty		
Proposed Heat pump Capacity:	36,000 Btuh	- Btuh	- Btuh	- Btuh	
Proposed COP:	3.85 COP	- COP	- COP	- COP	
Proposed Emergency Heat Rating:	10.55 kW	0.00 kW	0.00 kW	0.00 kW	
Proposed Energy Consumption From Cooling:	6,267 kWh	0 kWh	0 kWh	0 kWh	
Proposed Energy Consumption From Heating:	13,079 kWh	0 kWh	0 kWh	0 kWh	
Total Proposed Electric Consumption:	19,345 kWh	0 kWh	0 kWh	0 kWh	
Total Electric Savings:	9,371 kWh	0 kWh	0 kWh	0 kWh	
Total Cost For Replacement:	\$12,558.29	\$0.00	\$0.00	\$0.00	
Annual Energy Cost Savings:	\$1,396	\$0	\$0	\$0	
Individual Simple Payback	9.00 Yrs	- Yrs	- Yrs	- Yrs	
Total Initial Investment:	\$12,558.29	Total Annual Electric Savings		9,371 kWh	
Total Annual Cost Savings	\$1,395.75	Overall Simple Payback Period:		9.00 Yrs	

UIC	Re-Commission The Building & Its Control Systems	
EAC10	Location: Throughout	
Enter the Total Area of The Facility	138,740	SqFt
Select the Type of Heating Fuel:	Natural Gas	(Select)
Estimated Annual Heating Fuel Consumption:	18,195	Therms
Is the Property Cooled?	Yes	(Select)
Estimated Annual Electrical Energy Consumed For Cooling:	25,000	kWh
Estimated Energy Savings From Re-Commissioning on Building Systems:	15%	(Select)
Estimated Heating Energy Saving Post Re-Commissioning:	2,729	Therms
Estimated Cooling Energy Saving Post Re-Commissioning:	3,750	kWh
Average Heating Fuel Rate Paid By The Property:	\$1.23	\$/Therm
Average Electrical Rate Paid By The Property:	\$0.15	\$/kWh
Annual Energy Cost Savings:	\$3,925	\$
Estimated Cost For Re-Commissioning The Facility: (LBNL 2009 Report on Building Commissioning)	\$62,124	\$
Simple Payback Period:	15.83	Yrs
Type of Recommendation	Capital Cost ECM Recommendation	

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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:	\$62,124	Simple Payback:	15.83	Years
Energy Cost Savings:	\$3,925			

UIC		Upgrade Insulation			
EAE3B		Location: Attic/Ceiling Throughout			
ENTER EXISTING CONDITION					
Property Zone	Surface Under Consideration	Min. R-Value	Existing Net Effective R-Value: (Sq.Ft deg F/btu)		
Zone-3	Ceiling/Attic	R-30			13
Source: 2009 IECC For Residential Bldgs		"-" Not Specified			
Enter Total Surface Area Under Consideration:		138,740 Sq.Ft	Proposed Net Effective R-Value: (Sq.Ft deg F/btu)		30
ENTER CLIMATIC & SYSTEM DATA					
Annual Cooling Degree Days (CDD):		1,407	Estimated Annual Cooling Plant Efficiency (EER):		8.00 EER
Annual Heating Degree Days (HDD):		2,963	Estimated Annual Heating Plant Efficiency: %		76.00 %
WINTER			SUMMER		
Select Type of Heating Fuel	Natural Gas (Select)	Is the Property Cooled ?		Yes (Select)	
Annual Conduction Losses From Existing Insulation	783,022 kBtu	Annual Conduction Losses From Existing Insulation		371,823 kBtu	
Annual Conduction Losses From Proposed Insulation	328,869 kBtu	Annual Conduction Losses From Proposed Insulation		156,166 kBtu	
Savings In Conduction Losses After Adding Insulation	454,153 kBtu	Savings In Conduction Losses After Adding Insulation		215,657 kBtu	
Estimated Total Annual Input Heating Energy Savings	5,976 Therms	Estimated Total Annual Input Cooling Energy Savings		26,957 kWh	
Cost of Heating Fuel/Unit:	\$1.23 \$/Therm	Cost of Electricity/Unit		\$0.15 \$/kWh	
Annual Heating Cost Savings	\$7,371 \$\$	Annual Cooling Cost Savings		\$4,015 \$\$	
COST ANALYSIS					
Estimated O&M Savings	\$0.00 \$\$	Estimated Cost To Add Insulation/Sqft		\$1.70	
Total Estimated Annual Cost Savings	\$11,386 \$\$	Estimated Total Installation Cost		\$352,033 \$\$	
Simple Pay Back Period	30.92 Years	Type of Recommendation		Capital Cost ECM Recommendation	

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UIC	Replace Inefficient Furnace and Air Conditioning System			
EAH12-A	Location: Throughout			
Estimated Annual Cooling Hours:	976	Hrs	Estimated Annual Heating Hours:	1,464 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:	3		No. of Furnaces To Be Replaced:	3
Input the Btu/Hr of the air conditioner:	60,000		Input the MBH Rating of the Furnace:	75 MBH
Input Existing EER of the Air Conditioner:	9.00		Input Existing AFUE for the Furnace:	76% %
Estimated Current Annual Energy Consumption For Cooling: <small>(For All Units)</small>	19,520	kWh	Estimated Annual Current Energy Consumption For Heating: <small>(For All Units)</small>	3,294 Therms
Proposed Cooling System		Proposed Heating System		
Input the Btu/Hr of the Proposed Air Conditioner:	60,000	Btuh	Proposed Furnace:	Gas Fired -75MBH
Input EER of the Proposed Air Conditioner:	10.00		Input AFUE for the Proposed Furnace:	95%
Estimated Annual Energy Consumption With New AC's <small>(For One Unit)</small>	5,856	kWh	Estimated Annual Energy Consumption With New Furnace <small>(For One Unit)</small>	878 Therms
Energy & Cost Savings From New Cooling System		Energy & Cost Savings From New Heating System		
Estimated Annual Energy Savings From New Cooling System: <small>(Total)</small>	1,952	kWh	Estimated Annual Energy Consumptions From New Heating System: <small>(Total)</small>	2,635 Therms
Average Electric Rate:	\$0.15	\$/kWh	Average Heating Fuel Cost For New Furnace:	\$1.23 \$/Therm
Estimated Annual Cost Savings From Cooling:	\$291		Estimated Annual Cost Savings From Heating:	\$813 \$\$
Estimated Cost of New Condensing Unit: <small>(Material + Installation+Labor)</small>	\$13,350		Estimated Cost of New Furnace Unit: <small>(Material + Installation+Labor)</small>	\$1,302 \$\$
Estimated Cost of New Evaporator Coils In Furnace: <small>(Material + Installation+Labor)</small>	\$3,435		Estimated Total Cost of New Furnace Unit: <small>(Material + Installation+Labor)</small>	\$3,905 \$\$
Total Estimated Installed Cost For A New Air Conditioning System Setup + New High Efficiency Furnace : <small>(Includes Location Factor)</small>		\$30,881 \$\$		
Estimated Total Energy Cost Savings From New HVAC System:	\$1,103	\$\$	Estimated O&M Savings:	\$55
Estimated Simple Pay Back Period:			26.66	Years
Type of Recommendation		Capital Cost ECM Recommendation		

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UIC		Replace External Windows	
EAE2		Location: Throughout	
ENTER EXISTING CONDITIONS			
Existing and Proposed Window Properties		Existing & Proposed Air Leakage Through Windows	
Total Sq.Ft window area:	8,592 sq.ft	Insert Existing Estimated Air Change Rate/Hr (ACH 1):	0.75
Approximate number of windows:	716	(Existing Air Changes Per Hour, 1.5 is very leaky and 0.35 ideal)	
Total existing window area:	8,592 Sq.Ft	Insert Proposed Estimated Air Change Rate/Hr (ACH 2):	0.53
Select The Existing Window Type	Metal Frame & Single Glazing (Select)	Estimated Space Volume Under Consideration	277,672.00 Cu. Ft
Existing U-value of window: (1/R)	1.31 Btu/ ft ² ·F·h		
ASHRAE Climatic Zone	Zone-3		
New U-value with Double pane Low E window: (1/R)	0.35 Btu/ ft ² ·F·h	Is the Property Cooled ?	Yes (Select)
AHRAE 90.1 Recommended Value			
WINTER		SUMMER	
Select Type of Heating Fuel	Natural Gas (Select)	Select Type of Cooling Fuel:	Electric (Default)
Net heating plant & distribution system efficiency:	76.00 %	Cooling Plant Efficiency (EER):	7.00 EER
Annual Heating Hours:	2,963 HDD	Annual Cooling Hours:	1,407 CDD
Estimated Total Annual Input Heating Energy Savings By Replacing Windows	77.18 Therms	Annual Total Input Cooling Fuel Savings During Summer Season By Replacing Windows	39,790 kWh
Estimated Total Annual Input Heating Energy Savings Achieved By Controlling Air Leakage Through Windows	1,052 Therms	Estimated Total Annual Input Cooling Energy Savings Achieved By Controlling Air Leakage Through Windows	5,425 kWh
Estimated Total Input Heating Fuel Savings From Replacing Windows	1,129 Therms	Estimated Total Input Cooling Fuel Savings From Replacing Windows	45,215 kWh
ENERGY & COST ANALYSIS			
Insert Cost of Heating Fuel:	\$1.23 \$/Therm	Annual Heating Cost Savings:	\$1,393.15 \$\$
Insert Cost of Cooling Fuel:	\$0.15 \$/kWh	Annual Cooling Cost Savings:	\$6,734.50 \$\$
Total Annual Cost Savings	\$8,209	Total Annual Cost Savings From Heating & Cooling:	\$8,128 \$\$
Cost of window upgrade:	\$587,772	Estimated Annual O&M Savings	\$81 \$
Simple payback:	71.60 Yrs	Type of Recommendation	Capital Cost ECM Recommendation

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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:	\$587,772	Simple Payback	71.60 Yrs
Annual Energy Cost Savings:	\$8,209		

UIC		Install Low Flow Faucet Aerators	
EAP2-b	Location: Restrooms and Classrooms		
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	1,016	Number of Occupants Affected by Retrofit	1,016
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	19	Total Number of Faucet Aerators To Be Replaced	49
Total Number of Faucets To Be Replaced:	0	Total Number of Faucets To Be Replaced:	0
GPM of Existing Faucet Aerators	2.2 GPM	GPM of Existing Faucet Aerators	2.2 GPM
GPM of Proposed Faucet Aerator	1.5 GPM	GPM of Proposed Faucet Aerator	0.5 GPM
Estimated Number of Uses Per Day	2	Estimated Number of Uses Per Day	4
Annual Water Savings From Installing Low Flow Aerators:		151.96	kGal
WATER & ENERGY SAVING CALCULATION		COST SAVING CALCULATION	
Select Type of Water Heater Fuel:	Electric (Select)	Property Location in United States	North Central Localities
Energy Factor of Domestic Hot Water Heater:	0.76 EF	Heating Fuel Tariff	\$0.15 \$/kWh
Hot Water Discharge Temperature at Faucet	110.00 °F	Water Tariff (\$/1000 Gal)	\$4.43 \$/kGal
Equivalent Heating Fuel Savings:	24,926 kWh	Annual Cost Savings In Form of Water	\$673 \$
<small>Savings Discounted by 15% to Account For Cold Water Use</small>		Annual Energy Savings From Water Heater	\$3,713 \$
Annual Water Savings	151.96 kGal		
COST BENEFIT ANALYSIS			
Estimated Total Annual Cost Savings	\$4,385 \$\$	Estimated Total Installation Cost	\$1,036 \$\$
Simple Payback Period	0.24 Years	Type of Recommendation	Capital Cost ECM Recommendation

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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: \$1,036 Estimated Annual Cost Savings: \$4,385 Simple Payback Period (Yrs): 0.24

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:		567,414		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	156.70	157	497	241,375	241,375	\$35,950	\$548,450	15.3	\$0	\$164,535	\$5,310	\$0	9.2																												
2	Building 2	1	76	76	240	116,297	116,297	\$17,321	\$264,250	15.3	\$0	\$79,275	\$2,559	\$0	9.2																												
3	Building 3	1	17	17	53	25,570	25,570	\$3,808	\$58,100	15.3	\$0	\$17,430	\$563	\$0	9.2																												
4	Building 4	1	14	14	43	20,795	20,795	\$3,097	\$47,250	15.3	\$0	\$14,175	\$457	\$0	9.2																												
5	Building 5	1	24	24	76	36,661	36,661	\$5,460	\$83,300	15.3	\$0	\$24,990	\$807	\$0	9.2																												
6	Building 6	1	23	23	73	35,582	35,582	\$5,300	\$80,850	15.3	\$0	\$24,255	\$783	\$0	9.2																												
7	Building 7	1	20	20	63	30,653	30,653	\$4,565	\$69,650	15.3	\$0	\$20,895	\$674	\$0	9.2																												
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																													
		7		329	1,045	506,933.0	506,933	\$75,503	\$1,151,850	15.26	\$0	\$345,555	\$11,153	\$0	9.20																												
<table><tr><th colspan="2">Solar Rooftop Photovoltaic Analysis</th></tr><tr><td>Total Number of Roofs</td><td>7</td></tr><tr><td>Estimated Number of Panels</td><td>1,045</td></tr><tr><td>Estimated KW Rating</td><td>329</td></tr><tr><td>Potential Annual KWh Produced</td><td>506,933</td></tr><tr><td>% of Current Electricity Load</td><td>89.3%</td></tr></table> <table><tr><th colspan="2">Financial Analysis</th></tr><tr><td>Investment Cost</td><td>\$1,151,850</td></tr><tr><td>Estimated Energy Cost Savings</td><td>\$75,503</td></tr><tr><td>Potential Rebates</td><td>\$345,555</td></tr><tr><td>Potential Annual Incentives</td><td>\$11,153</td></tr><tr><td>Payback without Incentives</td><td>15.3</td></tr><tr><td>Incentive Payback but without SRECS</td><td>9.2</td></tr><tr><td>Payback with All Incentives</td><td>9.2</td></tr></table>																Solar Rooftop Photovoltaic Analysis		Total Number of Roofs	7	Estimated Number of Panels	1,045	Estimated KW Rating	329	Potential Annual KWh Produced	506,933	% of Current Electricity Load	89.3%	Financial Analysis		Investment Cost	\$1,151,850	Estimated Energy Cost Savings	\$75,503	Potential Rebates	\$345,555	Potential Annual Incentives	\$11,153	Payback without Incentives	15.3	Incentive Payback but without SRECS	9.2	Payback with All Incentives	9.2
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