



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 95811



**ZERO NET ENERGY ASHRAE LEVEL II AUDIT**  
**PONY EXPRESS ELEMENTARY SCHOOL**  
1250 56th Avenue  
Sacramento, California 95831

#### PREPARED BY:

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#### EMG PROJECT #:

136988.19R000-045.268

#### DATE OF REPORT:

September 05, 2019

#### ONSITE DATE:

July 12, 2019



engineering | environmental | capital planning | project management

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## Certification

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EMG has completed an Energy Audit of Pony Express Elementary School located at 1250 56th Avenue in Sacramento, California. EMG visited the site on July 12, 2019.

The assessment was performed at the Client's request using methods and procedures consistent with ASHRAE Level II Energy Audit and using methods and procedures as outlined in EMG's Proposal.

This report has been prepared for and is exclusively for the use and benefit of the Client identified on the cover page of this report. The purpose for which this report shall be used shall be limited to the use as stated in the contract between the client and EMG.

This report, or any of the information contained therein, is not for the use or benefit of, nor may it be relied upon by any other person or entity, for any purpose without the advance written consent of EMG. Any reuse or distribution without such consent shall be at the client's or recipient's sole risk, without liability to EMG.

Estimated installation costs are based on EMG's experience on similar projects and industry standard cost estimating tools including *RS Means and Whitestone CostLab*. In developing the installed costs, EMG also considered the area correction factors for labor rates for Sacramento, California. Since actual installed costs may vary widely for particular installation based on labor & material rates at time of installation, EMG does not guarantee installed cost estimates and shall in no event be liable should actual installed costs vary from the estimated costs herein. We strongly encourage the owner to confirm these cost estimates independently. EMG does not guarantee the costs savings estimated in this report. EMG shall in no event be liable should the actual energy savings vary from the savings estimated herein.

EMG certifies that EMG has no undisclosed interest in the subject property and that EMG's employment and compensation are not contingent upon the findings or estimated costs to remedy any deficiencies due to deferred maintenance and any noted component or system replacements.

Any questions regarding this report should be directed to Kaustubh Anil Chabukswar at 800.733.0660, ext. 7512.

**Prepared by:** Logan Hoshiko  
Energy Auditor  
Project Manager



**Reviewed by:**

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Kaustubh Anil Chabukswar, CEM CRM  
Program Manager

## 1. Executive Summary

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

Bldg #	Structures Assessed	Building Type	EMG Calculated Area (SF)	Estimated Occupancy
1	Administration, K-1 and K-2	School Building	5,832	120-150
2	Multipurpose Room and Kitchen	School Building	5,062	120-150
3	Classrooms 3, 4, 5, 6, and 7	School Building	6,145	120-150
4	Classrooms 8, 9, 10, 11, and 12	School Building	6,145	120-150
5	Portables 13-21	School Building	8,600	140-170
6	4 <sup>th</sup> R	School Building	960	10-20

The study included a review of the building's construction features, historical energy and water consumption and costs, review of the building envelope, HVAC equipment, heat distribution systems, lighting, and the building's operational and maintenance practices.

### 1.1. Energy Conservation Measures

EMG has identified 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> )	\$ 51,851 <i>(In Current Dollars)</i>
Estimated Annual Cost Savings ( <i>Current Dollars Only</i> )	\$18,867 <i>(In Current Dollars)</i>
ECM Effective Payback	2.75 years
Estimated Annual Energy Savings	36.50%
Estimated Annual Energy Utility Cost Savings ( <i>Excluding Water</i> )	39.37%
Estimated Annual Water Cost Saving	3.26%

**Solar Photovoltaic (PV) Screening for PONY EXPRESS ELEMENTARY SCHOOL**

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS		
Estimated Number of Panels	132	
Estimated KW Rating	124	KW
Potential Annual kWh Produced	219,706	kWh
% of Current Electricity Uses	98.8%	
FINANCIAL SUMMARY		
Investment Cost	\$432,600	
Estimated Energy Cost Savings	\$37,370	
Payback without Incentives	11.7	Years
Incentive Payback but without SRECs	6.9	Years
Payback with All Incentives	6.9	Years

**Key Metrics to Benchmark the Subject Property's Energy Usage Profile**

- **Building Site Energy Use Intensity** - The sum of the total site energy use in thousands of Btu per unit of gross building area. Site energy accounts for all energy consumed at the building location only not the energy consumed during generation and transmission of the energy to the site.
- **Building Source Energy Use Intensity** – The sum of the total source energy use in thousands of Btu per unit of gross building area. Source energy is the energy consumed during generation and transmission in supplying the energy to your site.
- **Building Cost Intensity** - This metric is the sum of all energy use costs in dollars per unit of gross building area.
- **Greenhouse Gas Emissions** - Although there are numerous gases that are classified as contributors to the total for Greenhouse Emissions, the scope of this energy audit focuses on carbon dioxide (CO<sub>2</sub>). 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)	22 kBtu/ft <sup>2</sup>
Post ECM Site Energy Use Intensity (EUI)	14 kBtu/ft <sup>2</sup>
SOURCE ENERGY USE INTENSITY (EUI)	RATING
Current Source Energy Use Intensity (EUI)	63 kBtu/ft <sup>2</sup>
Post ECM Source Energy Use Intensity (EUI)	38 kBtu/ft <sup>2</sup>
BUILDING COST INTENSITY (BCI)	RATING
Current Building Cost Intensity	\$0.92/ft <sup>2</sup>
Post ECM Building Cost Intensity	\$0.52/ft <sup>2</sup>

**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	361 MMbtu
Total CO <sub>2</sub> Emissions Reduced	32.51 MtCO <sub>2</sub> /Yr
Total Cars Off the Road (Equivalent)*	6
Total Acres of Pine Trees Planted (Equivalent)*	7

*\*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	988,818 kBtu
Total Annual Energy Savings for Non-Renewable Energy Measures	360,958 kBtu
Total Annual Energy Savings from Renewable Energy Measures	690,316 kBtu
Net Energy Consumption from Grid Post Implementation	0 kBtu
% Energy Reduction (Renewable + Non- Renewable)	100%

**Energy Conservation Measures Screening:**

EMG screens ECMs using two financial methodologies. ECMs which are considered financially viable must meet both criteria.

1. Simple Payback Period –The number of years required for the cumulative value of energy or water cost savings less future non-fuel or non-water costs to equal the investment costs of the building energy or water system, without consideration of discount rates. ECMs with a payback period greater than the Expected Useful Life (EUL) of the project are not typically recommended, as the cost of the project will not be recovered during the lifespan of the equipment. These ECMs are recommended for implementation during future system replacement. At that time, replacement may be evaluated based on the premium cost of installing energy efficient equipment.

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

2. Savings-to-Investment Ratio (SIR) – The savings-to-investment ratio is the ratio of the present value savings to the present value costs of an energy or water conservation measure. The numerator of the ratio is the present value over the estimated useful life (EUL) of net savings in energy or water and non-fuel or non-water operation and maintenance costs attributable to the proposed energy or water conservation measure. The denominator of the ratio is the present value of the net increase in investment and replacement costs less salvage value attributable to the proposed energy or water conservation measure. It is recommended that energy efficiency recommendations should be based on a calculated SIR, with larger SIRs receiving a higher priority. A project is typically only recommended if SIR is greater than or equal to 1.0, unless other factors outweigh the financial benefit.

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



**List of Recommended Energy Conservation Measures For Pony Express Elementary School**

ECM #	Description of ECM	Projected Initial Investment	Estimated Annual Energy Savings		Estimated Annual Water Savings	Estimated Cost Savings	Estimated Annual O&M Savings	Total Estimated Annual Cost Savings	Simple Payback	S.I.R.	Life Cycle Savings	Expected Useful Life (EUL)
			Natural Gas	Electricity								
		\$	Therms	kWh	kgal	\$	\$	\$	Years		\$	Years
<b>No/Low Cost Recommendations</b>												
1	Install Low Flow Faucet Aerators Location: Throughout	\$609	216	0	28	\$460	\$0	\$460	1.32	6.44	\$3,314	10.00
<b>Totals for No/Low Cost Items</b>		<b>\$609</b>	<b>216</b>	<b>0</b>	<b>28</b>	<b>\$460</b>	<b>\$0</b>	<b>\$460</b>	<b>1.32</b>			
<b>Capital Cost Recommendations</b>												
1	Upgrade Building Lighting to LED and Install Automatic Lighting Controls Location: Building Interior And Exterior	\$21,134	0	93,224	0	\$15,716	\$2,151	\$17,867	1.18	10.09	\$192,159	15.00
2	Install Smart Strips In Classrooms & Offices Location : Aproximately 25 Class Rooms	\$1,250	0	6,000	0	\$1,011	\$0	\$1,011	1.24	6.90	\$7,378	10.00
3	Control External Air Leakage In Commercial Buildings Location: Extrior Doors And Windows	\$1,167	360	1,432	0	\$721	\$36	\$757	1.54	7.74	\$7,869	15.00
4	Install Low Flow Tankless Restroom Fixtures Location: Restrooms	\$20,927	0	0	142	\$869	\$0	\$869	24.10	0.50	-\$10,558	15.00
<b>Total For Capital Cost</b>		<b>\$44,478</b>	<b>360</b>	<b>100,656</b>	<b>142</b>	<b>\$18,317</b>	<b>\$2,187</b>	<b>\$20,504</b>	<b>2.17</b>			
	<i>Interactive Savings Discount @ 10%</i>		-58	-10,066	-17	-\$1,878	-\$219	-\$2,096				
	<i>Total Contingency Expenses @ 15%</i>	\$6,763										
<b>Total for Improvements</b>		<b>\$51,851</b>	<b>519</b>	<b>90,590</b>	<b>153</b>	<b>\$16,899</b>	<b>\$1,968</b>	<b>\$18,867</b>	<b>2.75</b>			



## 2. Introduction

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

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

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

### **ENERGY AND WATER USING EQUIPMENT**

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

### **BUILDING ENVELOPE**

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

### **RECOMMENDATIONS FOR ENERGY SAVINGS OPPORTUNITIES**

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

### **ANALYSIS OF ENERGY CONSUMPTION**

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

### **ENERGY AUDIT PROCESS**

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

### **REPORTING**

The EMG Energy Audit Report includes:

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



### 3. Facility Overview and Existing Conditions

#### 3.1. Building Occupancy and Point of Contact

FACILITY SCHEDULE	
Hours of Operations / Week	45
Operational Weeks / Year	38
Estimated Facility Occupancy	830
% of Male Occupants	75

POINT OF CONTACT	
Point of Contact Name	Mark Covington
Point of Contact Title	Senior Project Manager
Point of Contact – Contact Number	916.446.0206

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

**Description:**

Heating is provided by forced air furnaces, and cooling is provided by heat pumps. There is also secondary HVAC system comprised of rooftop packaged units that provide both heating and cooling to the buildings.

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

BUILDING CENTRAL HEATING SYSTEM	
Primary Heating System	Forced Air Furnace
Secondary Heating System	Rooftop Packaged Units
Hydronic Distribution System	N/A
Primary Heating Fuel	Natural Gas
Heating Mode Set-point	70 °F
Heating Mode- Set-back Temperature	62 °F

BUILDING COOLING SYSTEM	
Primary Cooling System	Split Systems
Secondary Cooling System	Package Units
Hydronic Distribution System	N/A
Cooling Mode Set-point	70 °F
Cooling Mode- Set-back Temperature	78 °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 D

## 4. Utility Analysis

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

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

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

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

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

### Utility Rates used for Cost Analysis

ELECTRICITY (BLENDED RATE)	NATURAL GAS	WATER / SEWER
\$0.17 /kWh	\$1.33/therm	\$ 6.13/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.

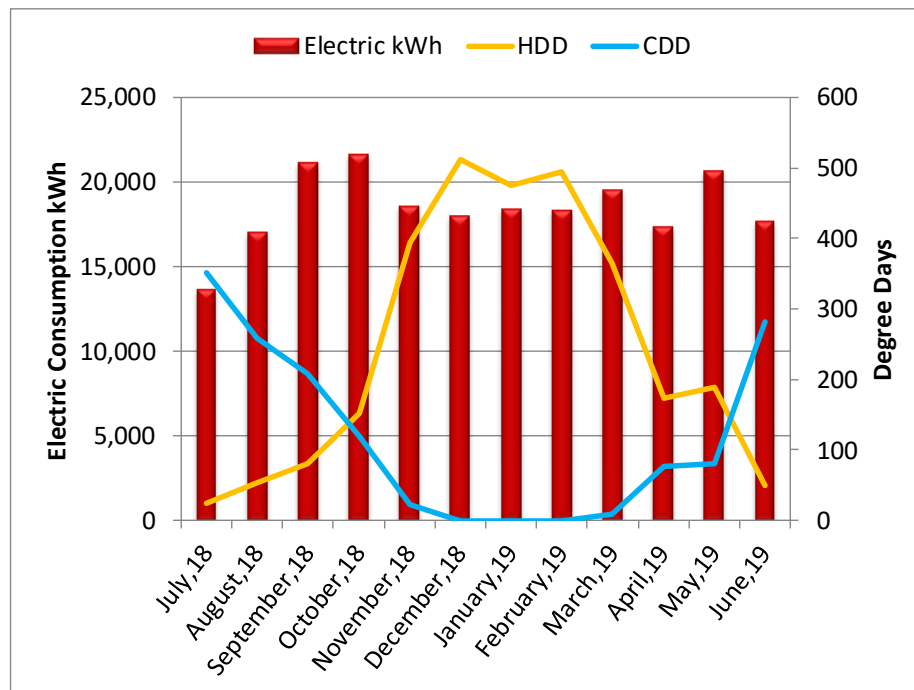
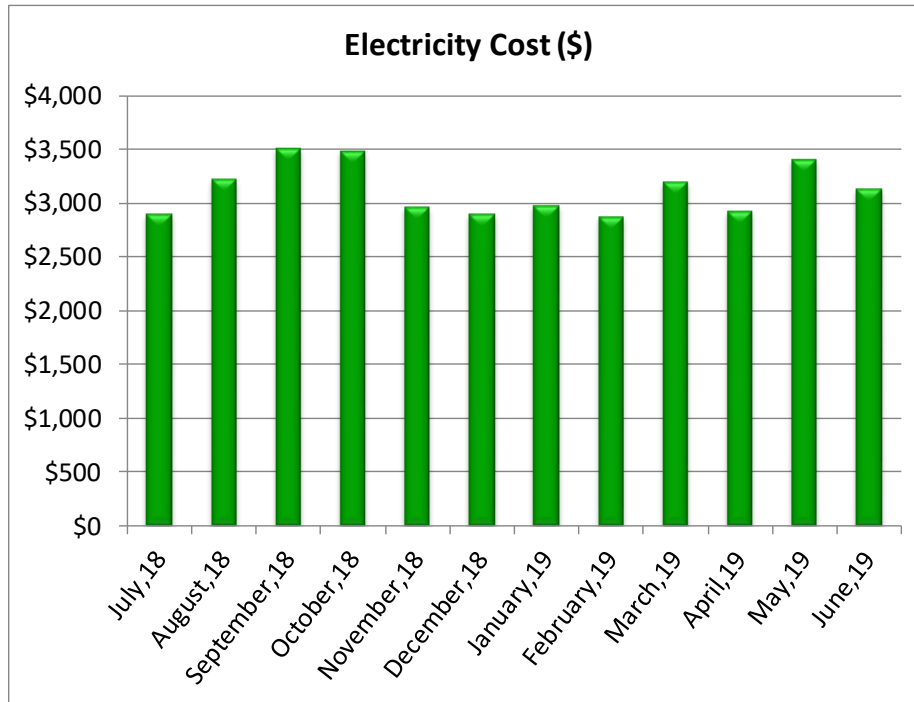
#### 4.1. Electricity

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	13,664	\$0.21	\$2,894
August,18	17,087	\$0.19	\$3,220
September,18	21,177	\$0.17	\$3,503
October,18	21,645	\$0.16	\$3,479
November,18	18,629	\$0.16	\$2,962
December,18	18,016	\$0.16	\$2,903
January,19	18,440	\$0.16	\$2,972
February,19	18,359	\$0.16	\$2,872
March,19	19,559	\$0.16	\$3,200
April,19	17,346	\$0.17	\$2,928
May,19	20,673	\$0.16	\$3,406
June,19	17,677	\$0.18	\$3,131
<b>Total/average</b>	<b>222,270</b>	<b>\$0.17</b>	<b>\$37,471</b>



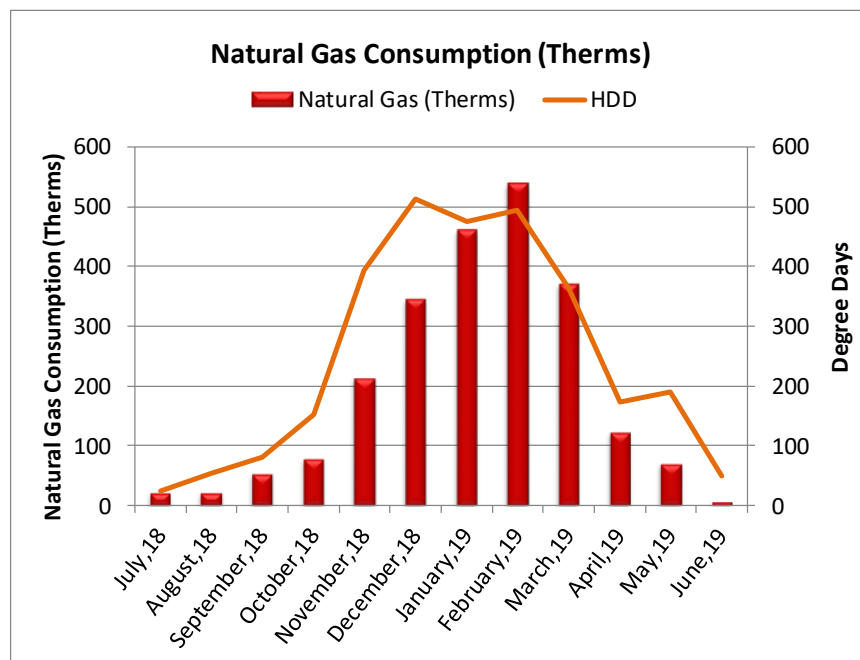
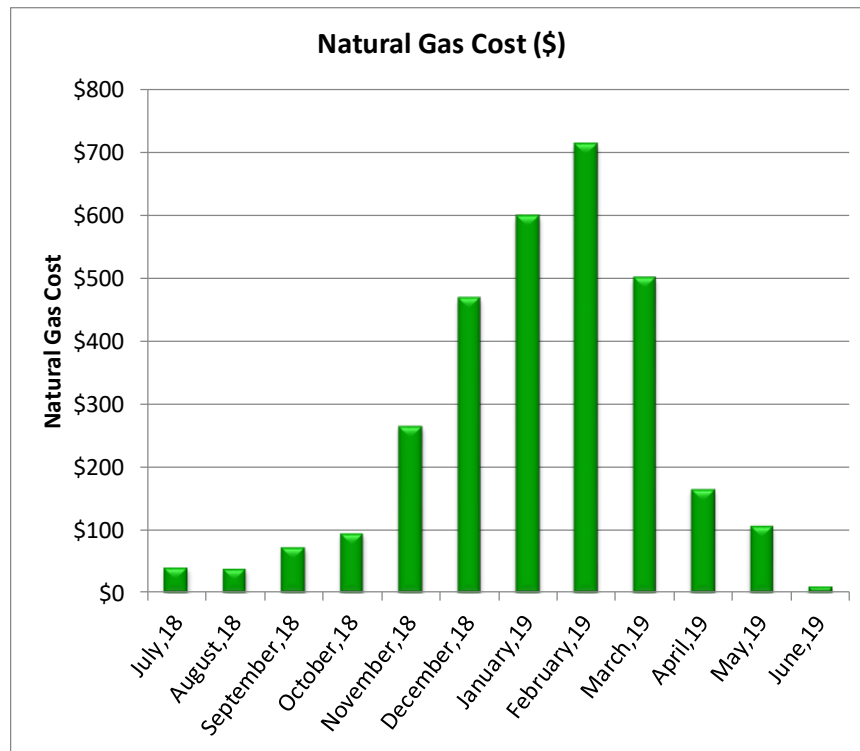
## 4.2. Natural Gas

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	21	\$1.85	\$39
August, 18	23	\$1.67	\$38
September, 18	54	\$1.32	\$72
October, 18	78	\$1.21	\$94
November, 18	213	\$1.24	\$264
December, 18	345	\$1.36	\$469
January, 19	462	\$1.30	\$599
February, 19	538	\$1.33	\$714
March, 19	370	\$1.35	\$501
April, 19	123	\$1.33	\$164
May, 19	71	\$1.49	\$105
June, 19	7	\$1.53	\$10
<b>Total/average</b>	<b>2,304</b>	<b>\$1.33</b>	<b>\$3,071</b>



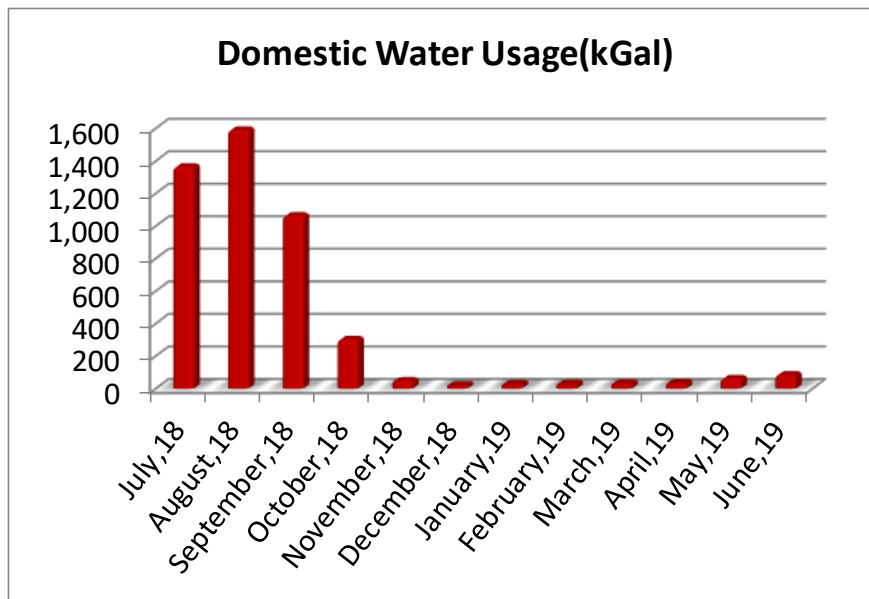
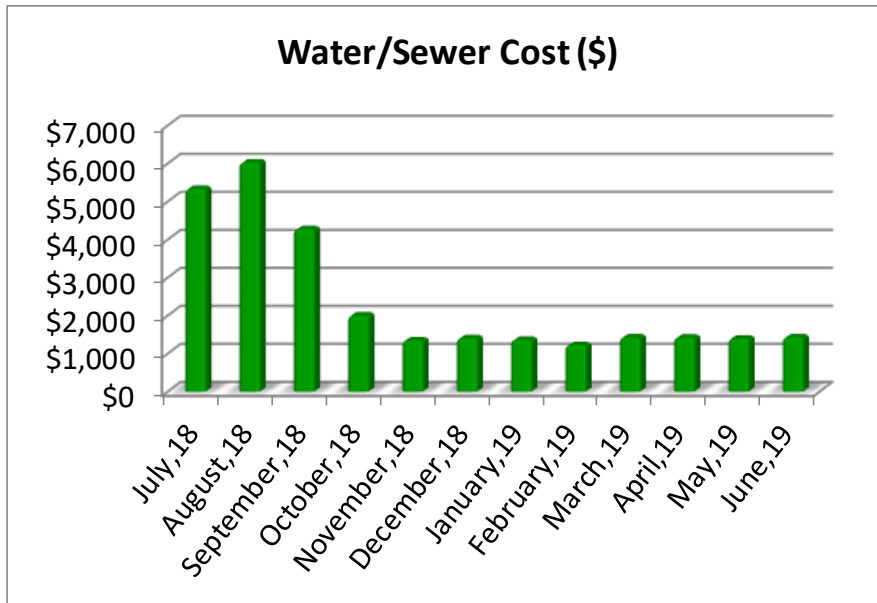
### 4.3. Water and Sewer

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	1,367	\$3.91	\$5,338
August,18	1,593	\$3.79	\$6,035
September,18	1,065	\$4.02	\$4,278
October,18	305	\$6.58	\$2,009
November,18	51	\$26.51	\$1,353
December,18	21	\$67.43	\$1,410
January,19	28	\$48.61	\$1,369
February,19	30	\$41.09	\$1,225
March,19	33	\$43.03	\$1,431
April,19	36	\$39.32	\$1,425
May,19	65	\$21.70	\$1,401
June,19	88	\$16.29	\$1,433
<b>Total/average</b>	<b>4,682</b>	<b>\$6.13</b>	<b>\$28,706</b>





## 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?	<b>Yes</b>
Is the area free from any shading such as trees, buildings, equipment etc throughout the whole day?	<b>Yes</b>
Can the panels be mounted at an incline of roughly 25-45 degrees? (equal to latitude of property)	<b>Yes</b>
Is the property in an area with acceptable average monthly sunlight levels?	<b>Yes</b>
Has the roofing been replaced within the past 3-5 years?	<b>Yes</b>
Is the roof structure sufficient to hold solar panels?	<b>Yes</b>
Is the property located in a state eligible for net metering?	<b>Yes</b>

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

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

- 1) Conducting a preliminary sizing of solar PV panels on the roofs and on the ground and its potential electricity production for its first year of installment using the National Renewable Energy Laboratory (NREL) PV WATTS Version 2 Software.
- 2) Calculate energy and cost savings for the site as a sole proprietor of the system capable of collecting state, local, and federal tax credits and incentives and interconnecting and selling the renewable energy electrical production to the building.

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS	
Estimated Number of Panels	132
Estimated KW Rating	124
Potential Annual kWh Produced	219,706
% of Current Electricity Uses	98.8%
FINANCIAL SUMMARY	
Investment Cost	\$432,600
Estimated Energy Cost Savings	\$37,370
Payback without Incentives	11.7
Incentive Payback but without SRECs	6.9
Payback with All Incentives	6.9

KW

kWh

Years

Years

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 actions. The following is a list of activities that should be performed as part of the routine maintenance program for the property.

### **Building Envelope**

- ✓ Ensure that the building envelope has proper caulking and weather stripping.
- ✓ Patch holes in the building envelope with foam insulation and fire rated caulk around combustion vents
- ✓ Inspect building vents semiannually for bird infestation
- ✓ Inspect windows monthly for damaged panes and failed thermal seals
- ✗ Repair and adjust automatic door closing mechanisms as needed.

### **Heating and Cooling**

- ✗ Pilots lights on furnaces and boilers be turned off in summer
- ✓ All preventive maintenance should be performed on all furnaces and boilers, which would include cleaning of burners and heat exchanger tubes.
- ✓ Ensure that the combustion vents exhaust outside the conditioned space and the vent dampers are functional
- ✓ Ensure that the control valves are functioning properly before start of every season
- ✗ Ensure steam traps are functional before start of each heating season
- ✗ Ensure use of chemical treatment for boiler make up water
- ✗ Ensure boiler outside temperature re-set is set to 55F
- ✗ Ensure use of chemical treatment for Colling tower water to prevent corrosion
- ✓ Ensure the duct work in unconditioned space is un-compromised and well insulated
- ✓ Duct cleaning is recommended every 10 years. This should include sealing of ducts using products similar to 'aero-seal'
- ✗ Ensure use of economizer mode is functional and used
- ✓ Ensure that the outside air dampers actuators are operating correctly
- ✓ Ensure air coils in the AHU and FCA's are pressure washed annually
- ✓ Return vents should remain un-obstructed and be located centrally
- ✓ Temperature settings reduced in unoccupied areas and set points seasonally adjusted.
- ✓ Evaporator coils and condenser coils should be regularly cleaned to improve heat transfer
- ✓ Refrigerant pipes should be insulated with a minimum of ¾" thick Elastomeric Rubber Pipe Insulation
- ✓ Ensure refrigerant pressure is maintained in the condensers
- ✓ Change air filters on return vents seasonally. Use only filters with 'Minimum Efficiency Rating Value'(MERV) of 8

### **Central Domestic Hot Water Heater**

- ✓ Never place gas fired water heaters adjacent to return vents so as to prevent flame roll outs
- ✓ Ensure the circulation system is on timer to reduce the losses through re-circulation
- ✓ Ensure all hot water pipes are insulated with fiberglass insulation at all times
- ✓ Replacement water heater should have Energy Factor (EF)>0.9
- ✓ Tank-type water heaters flushed monthly

### **Lighting Improvements**

- ✓ Utilize bi-level lighting controls in stairwells and hallways.

- ✓ Use LED replacement lamps
- ✓ Clean lighting fixture reflective surfaces and translucent covers.
- ✓ Ensure that timers and/or photocells are operating correctly on exterior lighting
- ✓ Use occupancy sensors for offices and other rooms with infrequent occupancy

***Existing Equipment and Replacements***

- ✓ Ensure that refrigerator and freezer doors close and seal correctly
- ✓ Ensure kitchen and bathroom exhaust outside the building and the internal damper operates properly
- ✓ Ensure that bathroom vents exhaust out
- ✓ Office/ computer equipment either in the “sleep” or “off” mode when not used

## 7. Appendices

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APPENDIX A: Glossary of Terms

APPENDIX B: Mechanical Equipment Inventory

APPENDIX C: Plumbing Equipment Inventory

APPENDIX D: Lighting System Schedule

APPENDIX E: ECM Checklist

APPENDIX F: ECM Calculations

APPENDIX G: Solar PV

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## **APPENDIX A: Glossary of Terms**

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### **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 (CO<sub>2</sub>). 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).



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## **APPENDIX B: Mechanical Equipment Inventory**

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Mechanical Inventory								
Component	Attributes	Location	Location Description	Make	Model	Serial	Capacity	Quantity
Water Heater	30 GAL	Administration, K-1 and K-2 (001)	285-001	Rheem	22V30-30F	RHLN 0205V05310	30 GAL	1
Domestic Circulation Pump	.5 HP	Administration, K-1 and K-2 (001)	285-001	Bell & Gossett			.5 HP	1
Water Heater	10 GAL	Classrooms 8, 9, 10, 11 & 12 (004)	285-004		81VP10S	RH 0204256722	10 GAL	1
Water Heater	80 GAL	Multipurpose Room and Kitchen (002)	285-002	A. O. Smith	DVE 80 917	MA01-0999914-917	80 GAL	1
Domestic Circulation Pump	.5 HP	Multipurpose Room and Kitchen (002)	285-002	Bell & Gossett			.5 HP	1
Domestic Circulation/Booster Pump	20 HP	Site	285-Site	Peerless Pump Company	PLC820AMB20-3T	F08132S	20 HP	1
Exhaust Fan	801 - 2000 CFM	Administration, K-1 and K-2 (001)	285-001-Roof	JennAir	24RV		801 - 2000 CFM	1
Exhaust Fan	251 - 800 CFM	Administration, K-1 and K-2 (001)	285-001-Roof	Greenheck	G-060-D-X		251 - 800 CFM	2
Exhaust Fan	251 - 800 CFM	Classrooms 3, 4, 5, 6 & 7 (003)	285-003-Roof	Greenheck	G-090-DGEX-QD		251 - 800 CFM	2
Exhaust Fan	251 - 800 CFM	Classrooms 8, 9, 10, 11 & 12 (004)	285-004-Roof	Greenheck	G-090-DGEX-QD		251 - 800 CFM	2
Exhaust Fan	1000 CFM	Multipurpose Room and Kitchen (002)	285-002-K001	No tag/plate found	No tag/plate found	No tag/plate found	1000 CFM	1
Exhaust Fan	801 - 2000 CFM	Multipurpose Room and Kitchen (002)	285-002-Roof	JennAir			801 - 2000 CFM	1
Exhaust Fan	251 - 800 CFM	Multipurpose Room and Kitchen (002)	285-002-Roof	Penn Ventilator Company	DX06B		251 - 800 CFM	1
Exhaust Fan	801 - 2000 CFM	Multipurpose Room and Kitchen (002)	285-002-Roof	No tag/plate found	No tag/plate found	No tag/plate found	801 - 2000 CFM	1
Furnace	100 MBH	Administration, K-1 and K-2 (001)	285-001	Carrier	58MXA100-F-1--20	1601A10262	100 MBH	1
Furnace	100 MBH	Administration, K-1 and K-2 (001)	285-001	Carrier	58MXA100-F-1--20	2501A12451	100 MBH	1
Furnace	100 MBH	Administration, K-1 and K-2 (001)	285-001	Carrier	58MXA100-F-1--20	Illegible	100 MBH	1
Furnace	100 MBH	Administration, K-1 and K-2 (001)	285-001	Carrier	58MXA100-F-1--20	2501A12449	100 MBH	1
Furnace	100 MBH	Classrooms 3, 4, 5, 6 & 7 (003)	285-003	Carrier	58MXA100-F-1--20	2501A12420	100 MBH	1
Packaged Terminal Air Conditioner (PTAC)	12,000 BTUH	Classrooms 3, 4, 5, 6 & 7 (003)	285-003-S001	null	null	null	null	1
Furnace	100 MBH	Classrooms 3, 4, 5, 6 & 7 (003)	285-003	Carrier	58MXA100-F-1--20	2401A12470	100 MBH	1
Furnace	100 MBH	Classrooms 3, 4, 5, 6 & 7 (003)	285-003	Carrier	58MXA100-F-1--20	2501A12416	100 MBH	1
Furnace	100 MBH	Classrooms 3, 4, 5, 6 & 7 (003)	285-003	Carrier	58MXA100-F-1--20	2401A12414	100 MBH	1
Furnace	100 MBH	Classrooms 3, 4, 5, 6 & 7 (003)	285-003	Carrier	58MXA100-F-1--20	2501A12419	100 MBH	1
Furnace	100 MBH	Classrooms 8, 9, 10, 11 & 12 (004)	285-004	Carrier	58MXA100-F-1--20	2401A12467	100 MBH	1
Furnace	100 MBH	Classrooms 8, 9, 10, 11 & 12 (004)	285-004	Carrier	58MXA100-F-1--20	2501A12446	100 MBH	1
Furnace	100 MBH	Classrooms 8, 9, 10, 11 & 12 (004)	285-004	Carrier	58MXA100-F-1--20	2401A14433	100 MBH	1
Furnace	100 MBH	Classrooms 8, 9, 10, 11 & 12 (004)	285-004	Carrier	58MXA100-F-1--20	2401A12435	100 MBH	1
Furnace	100 MBH	Classrooms 8, 9, 10, 11 & 12 (004)	285-004	Carrier	58MXA100-F-1--20	2401A12471	100 MBH	1
Heat Pump	4 TON	4th R (P06)	285-P06	Bard	48WH6-A10C	107N890629880	4 TON	1
Packaged Unit (RTU)	5 TON	Administration, K-1 and K-2 (001)	285-001-Roof	Carrier	38TXA060320	2501E18317	5 TON	1
Packaged Unit (RTU)	5 TON	Administration, K-1 and K-2 (001)	285-001-Roof	Carrier	38TXA060320	0202E13339	5 TON	1
Packaged Unit (RTU)	5 TON	Administration, K-1 and K-2 (001)	285-001-Roof	Carrier	38TXA060320	2501E18308	5 TON	1
Packaged Unit (RTU)	5 TON	Administration, K-1 and K-2 (001)	285-001-Roof	Carrier	38TXA060320	5101E10067	5 TON	1
Packaged Unit (RTU)	3 TON	Administration, K-1 and K-2 (001)	285-001-Roof	Carrier	48HJE004G--531	2501G23640	3 TON	1
Packaged Unit (RTU)	5 TON	Classrooms 3, 4, 5, 6 & 7 (003)	285-003-Roof	Carrier	38TXA060320	2501E13997	5 TON	1
Packaged Unit (RTU)	5 TON	Classrooms 3, 4, 5, 6 & 7 (003)	285-003-Roof	Carrier	38TXA060320	2501E13988	5 TON	1
Packaged Unit (RTU)	5 TON	Classrooms 3, 4, 5, 6 & 7 (003)	285-003-Roof	Carrier	38TXA060320	2501E18324	5 TON	1
Packaged Unit (RTU)	5 TON	Classrooms 3, 4, 5, 6 & 7 (003)	285-003-Roof	Carrier	38TXA060320	2501E18329	5 TON	1
Packaged Unit (RTU)	5 TON	Classrooms 3, 4, 5, 6 & 7 (003)	285-003-Roof	Carrier	38TXA060320	2501E18335	5 TON	1
Packaged Unit (RTU)	5 TON	Classrooms 8, 9, 10, 11 & 12 (004)	285-004-Roof	Carrier	38TXA060320	2501E18310	5 TON	1
Packaged Unit (RTU)	5 TON	Classrooms 8, 9, 10, 11 & 12 (004)	285-004-Roof	Carrier	38TXA060320	2501E18311	5 TON	1
Packaged Unit (RTU)	5 TON	Classrooms 8, 9, 10, 11 & 12 (004)	285-004-Roof	Carrier	38TXA060320	2501E13996	5 TON	1
Packaged Unit (RTU)	5 TON	Classrooms 8, 9, 10, 11 & 12 (004)	285-004-Roof	Carrier	38TXA060320	2501E18330	5 TON	1
Packaged Unit (RTU)	5 TON	Classrooms 8, 9, 10, 11 & 12 (004)	285-004-Roof	Carrier	38TXA060320	2501E18327	5 TON	1
Packaged Unit (RTU)	5 TON	Multipurpose Room and Kitchen (002)	285-002-Roof	Carrier	48HJD0060--531--	2501G23483	5 TON	1
Packaged Unit (RTU)	15 TON	Multipurpose Room and Kitchen (002)	285-002-Roof	Carrier	48HGD016A--5--JG	S2301F88662	15 TON	1
Heat Pump	3 TON	Portables 13-21	285-P01	Bard	36WH7-A05C	058F900648765	3 TON	1
Heat Pump	3.5 TON	Portables 13-21	285-Portables 13-21	Bard	WH431-A10CX4XXX		3.5 TON	1

Heat Pump	3 TON	Portables 13-21	285-P02	Bard	36WH7-A05C	058F900648716	3 TON	1
Heat Pump	3.5 TON	Portables 13-21	285-Portables 13-21	Bard	WH431-A1OCX4XXX		3.5 TON	1
Heat Pump	3 TON	Portables 13-21	285-P03	Bard	36WH7-A05C	058F900648751	3 TON	1
Packaged Unit (RTU)	3 TON	Portables 13-21	285-P04	Payne	PY1PNB036090AAAA	0300G10828	3 TON	1
Heat Pump	3.5 TON	Portables 13-21	285-Portables 13-21	Bard	WH431-A05CX4XXB		3.5 TON	1
Packaged Unit (RTU)	3 TON	Portables 13-21	285-P04	Payne	PY1PNB036090AAAA	0400G10544	3 TON	1
Heat Pump	3 TON	Portables 13-21	285-P05	Bard	VA361050		3 TON	1
Air Curtain	1000 CFM	Multipurpose Room and Kitchen (002)	285-002-K001	Mars Air Systems	36C-0	0305PF 36C-L (F3)	1000 CFM	1

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## **APPENDIX C: Plumbing Equipment Inventory**

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Plumbing Schedule									
Building Name	Floor	Space Name	Fixture Type	Rated Flow Rate	Quantity	Control	Comments	Facility Occupancy	% of Male Occupants
Administration, K-1, and K-2	1	S2	Lavatory	2.2	1	Manual		830	50%
Administration, K-1, and K-2	1	C4	Projector	0.5	1	Manual	Projector	420	50%
Administration, K-1, and K-2	1	T1	Lavatory	2.2	1	Manual		420	50%
Administration, K-1, and K-2	1	T2	Toilet	1.6	1	Manual		420	50%
Administration, K-1, and K-2	1	C2	Wifi	0.5	1	Manual		420	50%
Administration, K-1, and K-2	1	J1	Lavatory	2.2	1	Manual	able to identify ter	420	50%
Administration, K-1, and K-2	1	Y2	Lavatory	2.2	1	Manual	Assumed	420	50%
Administration, K-1, and K-2	1	T4	Lavatory	1.5	1.00	Manual		420	50%
Administration, K-1, and K-2	1	Z1	Lavatory	2	1	Manual		420	50%
Administration, K-1, and K-2	1	Y2	Wifi	0.5	1	Manual		420	50%
Administration, K-1, and K-2	1	H1	Tv	0.5	1	Manual		420	50%
Administration, K-1, and K-2	1	T4	Toilet	1.6	1	Manual		420	50%
Administration, K-1, and K-2	1	C3	Lavatory	2.2	1	Manual		420	50%
Administration, K-1, and K-2	1	T1	Toilet	1.6	1	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	1	O4	WiFi	0.5	1	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	1	O7	inking founta	1	1	Manual		420	50%
Classrooms 8, 9, 10, 11, & 12	1	O12	Projector	1	1.00	Manual		420	50%
Classrooms 8, 9, 10, 11, & 12	1	O11	WiFi	1	1.00	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	1	O4	inking founta	1	1	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	1	O6	Lavatory	2	1	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	1	O7	Lavatory	2	1	Manual		420	50%
Classrooms 8, 9, 10, 11, & 12	1	O12	Lavatory	2	1	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	1	O3	inking founta	1	1	Manual	Unable to identify	420	50%
Classrooms 3, 4, 5, 6, & 7	1	O3	Projector	0.5	1	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	0	O5	inking founta	1	1	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	1	O6	WiFi	0.5	1	Manual		420	50%
Classrooms 8, 9, 10, 11, & 12	1	O12	WiFi	1	1.00	Manual		420	50%
Classrooms 8, 9, 10, 11, & 12	1	O11	Lavatory	2	1.00	Manual		420	50%
Classrooms 8, 9, 10, 11, & 12	1	O11	Projector	1	1.00	Manual		420	50%
Classrooms 8, 9, 10, 11, & 12	1	O10	inking founta	1	1.00	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	0	O5	Lavatory	2	1	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	1	O6	Projector	0.5	1	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	1	O3	WiFi	0.5	1	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	1	O4	Lavatory	2	1	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	0	O5	WiFi	0.5	1	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	1	O6	inking founta	1	1	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	1	O3	Lavatory	2	1.00	Manual		420	50%
Classrooms 3, 4, 5, 6, & 7	1	O7	WiFi	0.5	1.00	Manual		420	50%
Classrooms 8, 9, 10, 11, & 12	1	O12	inking founta	1	1.00	Manual	Unable to identify	420	50%

Classrooms 8, 9, 10, 11, & 12	1	O11	inking founta	1	1.00	Manual		420	50%
Classrooms 8, 9, 10, 11, & 12	1	O10	Lavatory	2	1.00	Manual		420	50%
Classrooms 8, 9, 10, 11, & 12	1	O10	WiFi	1	1.00	Manual		420	0.5
Classrooms 8, 9, 10, 11, & 12	1	O10	Projector	1	1.00	Manual		420	0.5
Classrooms 8, 9, 10, 11, & 12	1	O9	Lavatory	2	1.00	Manual		420	0.5
Classrooms 8, 9, 10, 11, & 12	1	O9	inking founta	1	1.00	Manual		420	0.5
Classrooms 8, 9, 10, 11, & 12	1	O9	WiFi	1	1.00	Manual		420	0.5
Classrooms 8, 9, 10, 11, & 12	1	O9	Projector	1	1.00	Manual		420	0.5
Classrooms 8, 9, 10, 11, & 12	1	X8	Lavatory	2	1.00	Manual		420	0.5
Classrooms 8, 9, 10, 11, & 12	1	X8	inking founta	1	1.00	Manual		420	0.5

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## **APPENDIX D: Lighting System Schedule**

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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	Administration, K-1, and K-2	Interior	1	OPEN OFFICE	C2	Administrative	67.5	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	44	Troffer 2'x4'	11	6	10	3,192	4,494
2	Administration, K-1, and K-2	Interior		OFFICE	C5	Administrative	113	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	Troffer 2'x4'	3	6	10	2,280	876
3	Administration, K-1, and K-2	Interior	1	DINING	C3	Administrative	135	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	16	Troffer 2'x4'	4	6	10	3,192	1,634
4	Administration, K-1, and K-2	Interior		STORAGE	S3	Administrative	49.3	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	Troffer 1'x4'	2	6	10	722	92
5	Administration, K-1, and K-2	Interior	1	CONFERENCE	C4	Administrative	93	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	Troffer 2'x4'	3	6	10	2,280	876
6	Administration, K-1, and K-2	Interior	1	LOBBY	H1	Administrative	76.1	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	20	Troffer 2'x4'	5	6	10	6,384	4,086
7	Administration, K-1, and K-2	Interior	1	JANITORIAL	J1	Custodial	24.4	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	Troffer 1'x4'	2	6	10	722	92
8	Administration, K-1, and K-2	Interior	1	OTHER	Z1	Administrative	123.5	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	20	Troffer 2'x4'	5	6	10	2,280	1,459
9	Administration, K-1, and K-2	Interior	1	RESTROOM	T1	Administrative	106.7	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	Troffer 2'x4'	1	6	10	3,192	409
10	Administration, K-1, and K-2	Interior	1	CONFERENCE	CB	Administrative	94	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	Troffer 2'x4'	2	6	10	2,280	584
11	Administration, K-1, and K-2	Interior	1	OTHER	O	Administrative	76.8	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	Troffer 2'x4'	2	6	10	2,280	584
12	Administration, K-1, and K-2	Interior	1	RESTROOM	T4	Administrative	21	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	3,192	204
13	Administration, K-1, and K-2	Interior	1	COMMON	Y2	Instructional	890	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	52	Troffer 2'x4'	13	6	10	6,384	10,623
14	Administration, K-1, and K-2	Interior	1	RESTROOM	T2	Instructional	280	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	3,192	204
15	Administration, K-1, and K-2	Interior	1	STORAGE	S2	Instructional	220	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	722	46
16	Classrooms 3, 4, 5, 6, & 7	Interior	1	COMMON	O3	Instructional	713	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	48	Troffer 2'x4'	12	6	10	3,040	4,669
17	Classrooms 3, 4, 5, 6, & 7	Interior	1	COMMON	O3	Instructional	713	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	3,040	195
18	Classrooms 3, 4, 5, 6, & 7	Interior	1	COMMON	O4	Instructional	819	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	Troffer 2'x4'	9	6	10	3,040	3,502
19	Classrooms 3, 4, 5, 6, & 7	Interior	1	COMMON	O4	Instructional	819	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	3,040	195
20	Classrooms 3, 4, 5, 6, & 7	Interior		COMMON	O5	Instructional	640	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	Troffer 2'x4'	9	6	10	3,040	3,502
21	Classrooms 3, 4, 5, 6, & 7	Interior		COMMON	O5	Instructional	640	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	3,040	195
22	Classrooms 3, 4, 5, 6, & 7	Interior	1	COMMON	O6	Instructional	644	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	Troffer 2'x4'	9	6	10	3,040	3,502
23	Classrooms 3, 4, 5, 6, & 7	Interior	1	COMMON	O6	Instructional	644	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	3,040	195
24	Classrooms 3, 4, 5, 6, & 7	Interior	1	COMMON	O7	Instructional	543	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	Troffer 2'x4'	9	6	10	3,040	3,502
25	Classrooms 3, 4, 5, 6, & 7	Interior	1	COMMON	O7	Instructional	543	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	3,040	195
26	Classrooms 8, 9, 10, 11, & 12	Interior	1	COMMON	O12	Instructional	860	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	Troffer 2'x4'	9	6	10	3,040	3,502
27	Classrooms 8, 9, 10, 11, & 12	Interior	1	COMMON	O12	Instructional	860	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	3,040	195
28	Classrooms 8, 9, 10, 11, & 12	Interior	1	COMMON	O11	Instructional	810	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	Troffer 2'x4'	9	6	10	3,040	3,502
29	Classrooms 8, 9, 10, 11, & 12	Interior	1	COMMON	O11	Instructional	810	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	3,040	195
30	Classrooms 8, 9, 10, 11, & 12	Interior	1	COMMON	O10	Instructional	942	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	Troffer 2'x4'	9	6	10	3,040	3,502
31	Classrooms 8, 9, 10, 11, & 12	Interior	1	COMMON	O10	Instructional	942	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	3,040	195
32	Classrooms 8, 9, 10, 11, & 12	Interior	1	COMMON	O9	Instructional	599	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	Troffer 2'x4'	9	6	10	3,040	3,502
33	Classrooms 8, 9, 10, 11, & 12	Interior	1	COMMON	O9	Instructional	599	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	3,040	195
34	Classrooms 8, 9, 10, 11, & 12	Interior	1	LIBRARY	X8	Instructional	597	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	60	Troffer 2'x4'	15	6	10	2,280	4,378
35	Classrooms 8, 9, 10, 11, & 12	Interior	1	LIBRARY	X8	Instructional	597	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	2,280	146
36	Classrooms 8, 9, 10, 11, & 12	Interior	1	RESTROOM	T3	Custodial	378	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	Troffer 1'x4'	2	6	10	3,192	409
37	Classrooms 8, 9, 10, 11, & 12	Interior	1	WOMENS RR	T2	Custodial	631	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	Troffer 1'x4'	4	6	10	3,192	817
38	Classrooms 8, 9, 10, 11, & 12	Interior	1	MENS RR	T	Custodial	576	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	Troffer 1'x4'	4	6	10	3,192	817
39	Classrooms 8, 9, 10, 11, & 12	Interior	1	ELECTRICAL	BR3	Custodial	369	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	1,596	102
40	Classrooms 8, 9, 10, 11, & 12	Interior	1	STORAGE	S1	Custodial	576	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	Troffer 1'x4'	2	6	10	722	92
41	Classrooms 3, 4, 5, 6, & 7	Interior	1	WOMENS RR	T1	Custodial	518	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	Troffer 1'x4'	4	6	10	3,192	817
42	Classrooms 3, 4, 5, 6, & 7	Interior	1	ELECTRICAL	M1	Custodial	233	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	1,596	102
43	Classrooms 3, 4, 5, 6, & 7	Interior		MENS RR	T	Custodial	425	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	Troffer 1'x4'	4	6	10	3,192	817
44	Classrooms 3, 4, 5, 6, & 7	Interior	1	STORAGE	S1	Custodial	495	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	Troffer 1'x4'	3	6	10	722	139
45	Administration, K-1, and K-2	Interior	1	MENS RR	T5	Custodial	514		Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	3,192	204
46	Administration, K-1, and K-2	Interior	1	ELECTRICAL	M1	Custodial	220	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	1,596	102
47	Multipurpose Room & Kitchen	Interior	1	CAFETERIA	U1	Custodial	706	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	128	Troffer 2'x4'	32	6	20	2,280	9,339
48	Multipurpose Room & Kitchen	Interior	1	KITCHEN	K1	Custodial	860	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	40	Troffer 2'x4'	10	6	10	2,546	3,259
49	Multipurpose Room & Kitchen	Interior	1	JANITORIAL	J1	Custodial	286	1	Light Switch	CFL	CFL - 2 Pin	CFL26	1	Wallpack-Vertical	1	6	6	722	19
50	Multipurpose Room & Kitchen	Interior	1	KITCHEN	K1	Custodial	860	1	Light Switch	CFL	CFL - 2 Pin	CFL26	1	Surface Mount Hor	1	6	6	2,546	66
51	Multipurpose Room & Kitchen	Interior	1	STORAGE	S1	Custodial	495	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	Troffer 1'x4'	2	6	10	722	92
52	Multipurpose Room & Kitchen	Interior	1	RESTROOM	T1	Custodial	925	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 2'x4'	1	6	10	3,192	204
53	Multipurpose Room & Kitchen	Interior	1	STORAGE	D1	Custodial	508	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	20	Troffer 2'x4'	5	6	10	722	462
54	Multipurpose Room & Kitchen	Interior	1	CAFETERIA	U1	Custodial	706	1	Timer	Linear Fluorescent	T8	4' 32W T8	8	Troffer 1'x4'	4	6	10	2,280	584
55	rtables 13, 14, 15, 18, 19, &	Interior	1	COMMON	O13	Instructional	350	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	30	Troffer 2'x4'	15	6	10	6,384	6,129
56	rtables 13, 14, 15, 18, 19, &	Interior	1	COMMON	O14	Instructional	360	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	30	Troffer 2'x4'	15	6	10	6,384	6,129
57	rtables 13, 14, 15, 18, 19, &	Interior	1	COMMON	O15	Instructional	325	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	30	Troffer 2'x4'	15	6	10	6,384	6,129
58	rtables 13, 14, 15, 18, 19, &	Interior	1	COMMON	16	Instructional	927	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	48	Troffer 2'x4'	16	6	10	6,384	9,806
59	rtables 13, 14, 15, 18, 19, &	Interior	1	COMMON	17	Instructional	952	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	48	Troffer 2'x4'	16	6	10	6,384	9,806
60	rtables 13, 14, 15, 18, 19, &	Interior	1	COMMON	18	Instructional	1154	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	48	Troffer 2'x4'	12	6	10	6,384	9,806
61	rtables 13, 14, 15, 18, 19, &	Interior	1	COMMON	19	Instructional	1261	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	48	Troffer 2'x4'	12	6	10	6,384	9,806
62	rtables 13, 14, 15, 18, 19, &	Interior	1	COMMON	20	Instructional	866	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	45	Troffer 2'x4'	15	6	10	6,384	9,193
63	rtables 13, 14, 15, 18, 19, &	Interior	1	COMMON	21	Instructional	1150	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	48	Troffer 2'x4'	16	6	10	6,384	9,806
64	Administration, K-1, and K-2	Interior	1	COMMON	Y1	Instructional	740	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	52	Troffer 2'x4'	13	6	10	6,384	10,623



65	Administration, K-1, and K-2	Interior	1	RESTROOM	T1	Instructional	281	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	3,192	204
66	Administration, K-1, and K-2	Interior	1	STORAGE	S1	Instructional	233	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	Troffer 1'x4'	1	6	10	722	46
67	4th R	Interior	1	COMMON	4th R	Instructional	522	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	48	Troffer 2'x4'	12	6	10	6,384	9,806
68	4th R	Interior	1	EXTERIOR	4th R	Instructional	-	1	Timer	CFL	CFL - 2 Pin	CFL26	4	Sconce-vert	2	6	8	6,384	664
69	4th R	Interior	1	EXTERIOR	4th R	Instructional	-	1	Timer	CFL	CFL - 2 Pin	CFL26	2	Sconce-vert	1	6	10	6,384	332
70	Classrooms 3, 4, 5, 6, & 7	Interior	1	EXTERIOR	Ext	Instructional	-	1	Timer	CFL	CFL - 2 Pin	CFL26	26	Wallpack-Horizontal	13	6	10	6,384	4,316
71	Classrooms 3, 4, 5, 6, & 7	Interior	1	EXTERIOR	Ext	Instructional	-	1	Timer	CFL	CFL - 2 Pin	CFL26	3	Socket-vert	1	6	7	6,384	498
72	Classrooms 8, 9, 10, 11, & 12	Interior	1	EXTERIOR	Ext	Instructional	-	1	Timer	CFL	CFL - 2 Pin	CFL26	11	Socket-hor	11	6	10	6,384	1,826
73	Classrooms 8, 9, 10, 11, & 12	Interior	1	EXTERIOR	Ext	Instructional	-	1	Timer	CFL	CFL - 2 Pin	CFL26	1	Sconce-vert	1	6	10	6,384	166
74	Classrooms 13, 14, 15, 18, 19, & 20	Interior	1	EXTERIOR	Ext	Instructional	-	1	Timer	CFL	CFL - 2 Pin	CFL26	12	Socket-vert	12	6	10	6,384	1,992
75	Classrooms 13, 14, 15, 18, 19, & 20	Interior	1	EXTERIOR	Ext	Instructional	-	1	Timer	CFL	CFL - 2 Pin	CFL26	6	Pendant-Direct	3	6	10	6,384	996
76	Administration, K-1, and K-2	Interior	1	EXTERIOR	Ext	Instructional	-	1	Timer	HID	HPS	HPS200	1	Highbay	1	6	10	6,384	1,277
77	Administration, K-1, and K-2	Interior	1	EXTERIOR	Ext	Instructional	-	1	Timer	CFL	CFL - 2 Pin	CFL13	13	Surface Mount Hor	13	6	10	6,384	1,079
78	Multipurpose Room & Kitchen	Interior	1	EXTERIOR	Exr	Administrative	-	1	Timer	HID	HPS	HPS360	1	Highbay	1	6	15	6,384	2,298
79	Multipurpose Room & Kitchen	Interior	1	EXTERIOR	Exr	Administrative	-	1	Timer	CFL	CFL - 2 Pin	CFL13	3	Socket-vert	3	6	15	6,384	249
80	Multipurpose Room & Kitchen	Interior	1	EXTERIOR	Exr	Administrative	-	1	Timer	CFL	CFL - 2 Pin	CFL13	1	Socket-hor	1	6	8	6,384	83
81	Multipurpose Room & Kitchen	Interior	1	EXTERIOR	Exr	Administrative	-	1	Timer	HID	MH	MH200	1	Socket-vert	1	6	8	6,384	1,277
Totals													1,448	471			305,482	198,007	



Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	Additional Area Description	Existing Control	Control Quantity	Fixture Details					Existing Consumption		ECM	ECM Type	Proposed- Post Retrofit					
									Technology	Sub-Technology	Lamp- Fixture	Fixture Quantity	Total Lamps	Fixture Height	Annual Hours			Existing Annual kWh	Recommended Sensor	LED Lamp Retrofit	Annual Hours of Operation	Proposed Annual kWh	Annual Savings From LED Retrofit
1	Administration, K-1, and K-2	Interior	1	OPEN OFFICE	C2	Administrative	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	11	44	10	3,192	4,494	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,192	2,388	2,107
2	Administration, K-1, and K-2	Interior		OFFICE	C5	Administrative	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	3	12	10	2,280	876	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	465	410
3	Administration, K-1, and K-2	Interior	1	DINING	C3	Administrative	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	4	16	10	3,192	1,634	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,192	868	766
4	Administration, K-1, and K-2	Interior		STORAGE	S3	Administrative	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	2	4	10	722	92	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	722	49	43
5	Administration, K-1, and K-2	Interior	1	CONFERENCE	C4	Administrative	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	3	12	10	2,280	876	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	465	410
6	Administration, K-1, and K-2	Interior	1	LOBBY	H1	Administrative	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	5	20	10	6,384	4,086	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	6,384	2,171	1,915
7	Administration, K-1, and K-2	Interior	1	JANITORIAL	J1	Custodial	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	2	4	10	722	92	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	722	49	43
8	Administration, K-1, and K-2	Interior	1	OTHER	Z1	Administrative	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	5	20	10	2,280	1,459	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	775	684
9	Administration, K-1, and K-2	Interior	1	RESTROOM	T1	Administrative	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	1	4	10	3,192	409	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,192	217	192
10	Administration, K-1, and K-2	Interior	1	CONFERENCE	CB	Administrative	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	2	8	10	2,280	584	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	310	274
11	Administration, K-1, and K-2	Interior	1	OTHER	O	Administrative	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	2	8	10	2,280	584	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	310	274
13	Administration, K-1, and K-2	Interior	1	COMMON	Y2	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	13	52	10	6,384	10,623	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	6,384	5,643	4,980
15	Administration, K-1, and K-2	Interior	1	STORAGE	S2	Instructional	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	1	2	10	722	46	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	722	25	22
17	Classrooms 3, 4, 5, 6, & 7	Interior	1	COMMON	O3	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	1	2	10	3,040	195	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,040	103	91
19	Classrooms 3, 4, 5, 6, & 7	Interior	1	COMMON	O4	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	1	2	10	3,040	195	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,040	103	91
21	Classrooms 3, 4, 5, 6, & 7	Interior		COMMON	O5	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	1	2	10	3,040	195	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,040	103	91
22	Classrooms 3, 4, 5, 6, & 7	Interior	1	COMMON	O6	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	9	36	10	3,040	3,502	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,040	1,860	1,642
24	Classrooms 3, 4, 5, 6, & 7	Interior	1	COMMON	O7	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	9	36	10	3,040	3,502	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,040	1,860	1,642
25	Classrooms 3, 4, 5, 6, & 7	Interior	1	COMMON	O7	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	1	2	10	3,040	195	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,040	103	91
26	Classrooms 8, 9, 10, 11, & 12	Interior	1	COMMON	O12	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	9	36	10	3,040	3,502	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,040	1,860	1,642
27	Classrooms 8, 9, 10, 11, & 12	Interior	1	COMMON	O12	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	1	2	10	3,040	195	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,040	103	91
28	Classrooms 8, 9, 10, 11, & 12	Interior	1	COMMON	O11	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	9	36	10	3,040	3,502	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,040	1,860	1,642
32	Classrooms 8, 9, 10, 11, & 12	Interior	1	COMMON	O9	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	9	36	10	3,040	3,502	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,040	1,860	1,642
33	Classrooms 8, 9, 10, 11, & 12	Interior	1	COMMON	O9	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	1	2	10	3,040	195	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,040	103	91
34	Classrooms 8, 9, 10, 11, & 12	Interior	1	LIBRARY	X8	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	15	60	10	2,280	4,378	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	2,326	2,052
35	Classrooms 8, 9, 10, 11, & 12	Interior	1	LIBRARY	X8	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	1	2	10	2,280	146	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	78	68
36	Classrooms 8, 9, 10, 11, & 12	Interior	1	RESTROOM	T3	Custodial	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	2	4	10	3,192	409	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,192	217	192
37	Classrooms 8, 9, 10, 11, & 12	Interior	1	WOMENS RR	T2	Custodial	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	4	8	10	3,192	817	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,192	434	383
38	Classrooms 8, 9, 10, 11, & 12	Interior	1	MENS RR	T	Custodial	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	4	8	10	3,192	817	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,192	434	383
39	Classrooms 8, 9, 10, 11, & 12	Interior	1	ELECTRICAL	BR3	Custodial	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	1	2	10	1,596	102	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,596	54	48
40	Classrooms 8, 9, 10, 11, & 12	Interior	1	STORAGE	S1	Custodial	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	2	4	10	722	92	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	722	49	43
41	Classrooms 3, 4, 5, 6, & 7	Interior	1	WOMENS RR	T1	Custodial	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	4	8	10	3,192	817	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,192	434	383
42	Classrooms 3, 4, 5, 6, & 7	Interior	1	ELECTRICAL	M1	Custodial	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	1	2	10	1,596	102	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,596	54	48
45	Administration, K-1, and K-2	Interior	1	MENS RR	T5	Custodial	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	1	2	10	3,192	204	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,192	109	96
48	Multipurpose Room & Kitchen	Interior	1	KITCHEN	K1	Custodial	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	10	40	10	2,546	3,259	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,546	1,731	1,528
49	Multipurpose Room & Kitchen	Interior	1	JANITORIAL	J1	Custodial	Light Switch	1	CFL	CFL - 2 Pin	CFL26; Wallpack-Vertical	1	1	6	722	19	ECM	RB - Replace Bulb	Retain Existing Controls	4 Pin-LED10	722	7	12
50	Multipurpose Room & Kitchen	Interior	1	KITCHEN	K1	Custodial	Light Switch	1	CFL	CFL - 2 Pin	CFL26; Surface Mount Hor	1	1	6	2,546	66	ECM	RB - Replace Bulb	Retain Existing Controls	4 Pin-LED10	2,546	25	41
51	Multipurpose Room & Kitchen	Interior	1	STORAGE	S1	Custodial	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	2	4	10	722	92	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	722	49	43
52	Multipurpose Room & Kitchen	Interior	1	RESTROOM	T1	Custodial	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	1	2	10	3,192	204	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,192	109	96
53	Multipurpose Room & Kitchen	Interior	1	STORAGE	D1	Custodial	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	5	20	10	722	462	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	722	245	217
54	Multipurpose Room & Kitchen	Interior	1	CAFETERIA	U1	Custodial	Timer	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	4	8	10	2,280	584	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,280	310	274
55	Tables 13, 14, 15, 18, 19, & 20	Interior	1	COMMON	O13	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	15	30	10	6,384	6,129	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	6,384	3,256	2,873
56	Tables 13, 14, 15, 18, 19, & 20	Interior	1	COMMON	O14	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	15	30	10	6,384	6,129	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	6,384	3,256	2,873
58	Tables 13, 14, 15, 18, 19, & 20	Interior	1	COMMON	16	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	16	48	10	6,384	9,806	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	6,384	5,209	4,596
60	Tables 13, 14, 15, 18, 19, & 20	Interior	1	COMMON	18	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	12	48	10	6,384	9,806	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	6,384	5,209	4,596
62	Tables 13, 14, 15, 18, 19, & 20	Interior	1	COMMON	20	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	15	45	10	6,384	9,193	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	6,384	4,884	4,309
64	Administration, K-1, and K-2	Interior	1	COMMON	Y1	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Troffer 2'x4'	13	52	10	6,384	10,623	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	6,384	5,643	4,980
65	Administration, K-1, and K-2	Interior	1	RESTROOM	T1	Instructional	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	1	2	10	3,192	204	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	3,192	109	96
66	Administration, K-1, and K-2	Interior	1	STORAGE	S1	Instructional	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Troffer 1'x4'	1	2	10	722	46	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	722	25	22
67	4th R	Interior	1	COMMON	4th R	Instructional	Light Switch	2	Linear Fluorescent	T8	4' 32W T8												

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## **APPENDIX E: ECM Checklist**

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NA	In Place	Evaluate	ECM Description
✓			Add Reflective Coating To Exterior Windows
✓			Replace External Windows
✓			Upgrade Insulation
		✓	Control External Air Leakage In Commercial Buildings
✓			Install Reflective Insulation Between Radiators And External Wall
✓			Replace Existing Motors With High Efficiency Motors
✓			Install On-Demand Ventilation on Air Handlers
	✓		Reduce HVAC Hours of Operation
✓			Install Variable Frequency Drives (VFD)
✓			Install Outside Air Temperature Reset Controls For Hot Water Boilers
✓			Install Chilled Water Reset Control
	✓		Install Timers On Exhaust Fans
	✓		Install Energy Savers on Vending, Snack Machines
✓			Install Building Energy Management System and Replace Terminal Units
✓			Re-Commission The Building & Its Control Systems
✓			Replace Inefficient Heating Plant
✓			Replace Inefficient Cooling Plant
	✓		Replace Existing Air Conditioners with Energy Star Air Conditioners
✓			Replace Unit Electric Heaters with Natural Gas Fired Unit Heaters
✓			Convert From Gas Pilot to Electronic Ignition for Boilers
✓			Insulate Hot Water Pipes
	✓		Insulate Refrigerant Lines
	✓		Insulate Hot Surfaces And Tanks
	✓		Insulate Air Ducts
✓			Replace Defective Steam Traps
✓			Upgrade Electric Heating System To Heat Pumps
	✓		Replace Inefficient Furnace System
✓			Replace Rooftop Package Unit
✓			Install Energy Recovery Wheel on Air Handling Unit
	✓		Replace Existing Water Heater With New Energy Efficient Units
		✓	Replace Incandescent/Halogen Lamps With Energy Efficient Lamps
		✓	Upgrade Inefficient Linear Fluorescent Lamps And Fixtures
✓			Upgrade EXIT SIGNS With LED EXIT Signs
	✓		Bilevel and Tandem Linear Fluorescent Lighting ECM
		✓	Replace High Intensity Discharge (HID) Lamps With Energy 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

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## **APPENDIX F: ECM Calculations**

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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
<b>Upgrade Lighting to LED</b>		296	470	1,447	93,224	\$15,848.05	\$2,151.07
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	13	84	6,909	6,909	\$1,174	\$237
CFL	CFL - 4 Pin	0	0	0	0	\$0	\$0
CFL	CFL - Screw-in	0	0	0	0	\$0	\$0
Circiline	T9	0	0	0	0	\$0	\$0
Incan/H/MR	H	0	0	0	0	\$0	\$0
Incan/H/MR	Incan	0	0	0	0	\$0	\$0
Incan/H/MR	MR	0	0	0	0	\$0	\$0
HID	HPS	2	2	2	1,532	\$260	\$96
HID	MH	0	0	0	0	\$0	\$0
HID	MV	0	0	0	0	\$0	\$0
HID	QL	0	0	0	0	\$0	\$0
Linear Fluorescent	T8	65	405	405	84,783	\$14,413	\$1,818
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
<b>Proposed Controls</b>		<b>No. of Controls</b>				<b>No. of Controls</b>	
Photo Sensor		0		Ceiling Mounted		0	
Wall Mounted		0					
<b>Initial Investment</b>		<b>Equipment Rentals</b>					
Material Cost		\$7,728.36		Scissor Lift 26' - Interior Spaces		\$370.00	
Labor Cost		\$13,036.10		Bucket Truck - Exterior Spaces		\$0.00	
Local Electric Rate:		\$0.17 /kWh		Estimated Annual Energy Savings:		93,224	
Hourly Labor Rate For Electrician:		\$72.05		Estimated Annual Energy Cost Savings:		\$15,848	
Budgeted Initial Investment:		\$21,134		Estimated Annual O&M Cost Savings:		\$2,151	
Estimated Return on Investment: <i>(Including O&amp;M Savings)</i>		1.17 Years		Estimated Annual Cost Savings:		\$17,999	

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UIC	Install Low Flow Tankless Restroom Fixtures	
EAP4	Location: Restrooms	
<b>ECM FOR DETERMINING WATER SAVINGS IN COMMERCIAL PROPERTIES</b>		
Number of Males	<input type="text" value="210"/>	
Number of Females	<input type="text" value="210"/>	
Number of Occupied Days Per Week (Max 7)	<input type="text" value="5"/>	
Number of Occupied Weeks/Year (Max 52)	<input type="text" value="38"/>	
Number of Urinals To Be Retrofitted	<input type="text" value="8"/>	
Number of Water Closets To Be Retrofitted	<input type="text" value="17"/>	
No. of Water Closets With Separate Flush Tank <i>(Typical Residential Type)</i>	<input type="text" value="0"/>	
<b>Estimated Restroom Usage/Individual/Day</b>	<input type="text" value="2"/> (Select)	
<i>Default is 4 Uses/Day For Residential/Office</i>		
<b>Urinal Water Savings</b>		
Do you Want To Make Any Changes To The Urinals?	<input type="text" value="Yes"/>	
Estimated Existing Use of Urinal/Day/Man	<input type="text" value="80%"/>	
Existing Gallons Per Flush Ratings For Urinal Flushes	<input type="text" value="1.00"/>	GPF
Proposed Urinal	<input type="text" value="0.125 GPF -Wall Mount"/>	
GPF of Proposed Urinal Flush Valve**	<input type="text" value="0.125"/>	GPF
<i>** (1992 EpACT Energy Act Mandates 1.0GPF Max on Urinals)</i>		
Estimated Annual Water Savings From Urinal	<input type="text" value="55.86"/>	kGal
<b>Water Closet Water Savings</b>		
<b>Tankless Water Closets</b>		
Do The Water Closet Need To Be Retrofitted?	(Select) <input type="text" value="Yes"/>	
Existing Gallons Per Flush Ratings For Water Closet Flushes	<input type="text" value="1.60"/>	GPF
Are The Existing Water Closet Being Replaced?	(Select) <input type="text" value="No"/>	
<i>(If No; Then Only The Flush Valve Would Be Replaced With Dual Flush Retrofit Kit)</i>		
No. of Tankless Water Closets	<input type="text" value="17"/>	
GPF of Proposed Dual Flush- Water Closet Valve*	<input type="text" value="1.60"/>	GPF
<i>*(Federal Law Requires All Flushes Not To Exceed 1.6 GPF)</i>		
	<input type="text" value="0.48"/>	GPF
<i>Solid Waste (20%)</i>		
<i>Liquid Waste (80%)</i>		
Estimated Annual Water Savings From Male Users	<input type="text" value="14.30"/>	kGal
Estimated Annual Water Savings From Female Users	<input type="text" value="71.50"/>	kGal
Total Water Savings From Water Closets	<input type="text" value="85.80"/>	kGal
<b>Water &amp; Cost Saving Calculations</b>		
<b>Water Savings Calculation</b>		
Water Savings By The Use of Low Flow Water Closet Flush Valves/Yr	<input type="text" value="85.80"/>	kGal
Water Savings By The Use of Low Flow Urinal Flush Valves/ Yr	<input type="text" value="55.86"/>	kGal
Total Annual Water Savings in kGal	<input type="text" value="141.66"/>	kGal
<b>Cost Savings Calculations</b>		
Enter Water Tariff Rate (\$/1000Gal)	<input type="text" value="\$6.13"/>	\$\$
Estimated Cost Savings From Water	<input type="text" value="\$869"/>	\$\$
<b>Estimated Cost of Retrofit</b>		
Cost For Replacing Existing Urinal Fixture With A Low Flow Fixture	<input type="text" value="\$10,403"/>	\$\$
<i>(Includes Labor)</i>		
Cost For Replacing Existing Flush Valves With Low Flow - Dual Flush Valves (\$80 Per Unit)	<input type="text" value="\$10,524"/>	\$\$
<i>(Includes Labor)</i>		
<i>(Up For Liquid Waste And Down For Solid Waste)</i>		
Estimated Total Cost For Retrofit	<input type="text" value="\$20,927"/>	\$\$
Simple Pay Back Period	<input type="text" value="24.10"/>	Yrs
<b>Type of Recommendation</b>	<input type="text" value="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: \$20,927      Simple Payback Period: 24.10 Yrs  
Annual Cost Savings: \$869

<i>UIC</i>	<b>Install Low Flow Faucet Aerators</b>		
<b>EAP2-b</b>	Location: Throughout		
Property Type:	<b>Commercial</b>	Estimated No. of Operational Weeks	<b>38</b>
		Number of Occupied Days/Week (Max 7)	<b>5</b>
<b>KITCHEN FAUCETS</b>		<b>BATHROOM FAUCETS</b>	
Number of Occupants Affected By Retrofit	<b>0</b>	Number of Occupants Affected by Retrofit	<b>317</b>
Do You Want To Replace Kitchen Faucets Aerators	<b>No</b> (Select)	Do You Want To Replace Bathroom Faucets Aerators	<b>Yes</b> (Select)
Total Number of Faucet Aerators To Be Replaced	<b>0</b>	Total Number of Faucet Aerators To Be Replaced	<b>40</b>
Total Number of Faucets To Be Replaced:	<b>0</b>	Total Number of Faucets To Be Replaced:	<b>0</b>
GPM of Existing Faucet Aerators	<b>-</b> GPM	GPM of Existing Faucet Aerators	<b>1.71</b> GPM
GPM of Proposed Faucet Aerator	<b>-</b> GPM	GPM of Proposed Faucet Aerator	<b>0.5</b> GPM
Estimated Number of Uses Per Day	<b>4</b>	Estimated Number of Uses Per Day	<b>4</b>
Annual Water Savings From Installing Low Flow Aerators:		<b>27.99</b> kGal	
<b>WATER &amp; ENERGY SAVING CALCULATION</b>		<b>COST SAVING CALCULATION</b>	
Select Type of Water Heater Fuel:	<b>Natural Gas</b> (Select)	Property Location in United States	<b>North Central Localities</b>
Energy Factor of Domestic Hot Water Heater:	<b>0.55</b> EF	Heating Fuel Tariff	<b>\$1.33</b> \$/Therm
Hot Water Discharge Temperature at Faucet	<b>110.00</b> °F	Water Tariff (\$/1000 Gal)	<b>\$6.13</b> \$/kGal
Equivalent Heating Fuel Savings: <small>Savings Discounted by 15% to Account For Cold Water Use</small>	<b>216</b> Therms	Annual Cost Savings In Form of Water	<b>\$172</b> \$
Annual Water Savings	<b>27.99</b> kGal	Annual Energy Savings From Water Heater	<b>\$288</b> \$
<b>COST BENEFIT ANALYSIS</b>			
Estimated Total Annual Cost Savings	<b>\$460</b> \$\$	Estimated Total Installation Cost	<b>\$609</b> \$\$
Simple Payback Period	<b>1.32</b> Years	Type of Recommendation	<b>No/Low Cost ECM Recommendation</b>

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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: \$609      Estimated Annual Cost Savings: \$460      Simple Payback Period (Yrs): 1.32



<b>UIC</b>	<b>Control External Air Leakage In Commercial Buildings</b>		
<b>EAE4A</b>	<b>Location: Exrior Doors and Windows</b>		
<b>ENTER EXISTING CONDITION</b>			
Insert Existing Estimated Air Change Rate/Hr (ACH 1): <small>(Existing Air Changes Per Hour, 3 is very leaky and 0.35 ideal)</small>	<input type="text" value="0.80"/>	Cubic Feet/Min (CFM 1):	<input type="text" value="1,178"/>
Insert Proposed Estimated Air Change Rate/Hr (ACH 2):	<input type="text" value="0.52"/>	Cubic Feet/Min (CFM 2):	<input type="text" value="766"/>
Estimated Space Volume Under Consideration	<input type="text" value="88,354"/>	Cu.Ft	
<b>WINTER</b>		<b>SUMMER</b>	
Select Type of Heating Fuel	<input type="text" value="Natural Gas"/> (Select)	Is The Building Cooled?	<input type="text" value="Yes"/>
Estimated Annual Heating Plant Efficiency	<input type="text" value="88.00"/> %	Estimated Annual Cooling Plant Efficiency	<input type="text" value="10.50"/> EER
Annual Heating Degree Days(HDD):	<input type="text" value="2,963"/>	Annual Cooling Degree Days(CDD):	<input type="text" value="1,407"/>
Estimated Total Annual Input Heating Energy Savings	<input type="text" value="360"/> Therms	Estimated Total Annual Input Cooling Energy Savings	<input type="text" value="1,432"/> kWh
Cost/Unit of Heating Fuel:	<input type="text" value="\$1.33"/> \$/Therm	Cost/Unit For Electricity	<input type="text" value="\$0.17"/> \$\$
Estimated Annual Heating Cost Savings	<input type="text" value="\$480"/> \$\$	Estimated Annual Cooling Cost Savings	<input type="text" value="\$241"/> \$\$
<b>Cost Analysis</b>			
Install Flush Mounted, Vinyl Door Sweeps ?	<input type="text" value="Yes"/>	Total Length of Door Sweeps to Be Installed: <small>(3.5' Standard Width Door)</small>	<input type="text" value="64"/> LF
Install Window Air Conditioner Covers For Winter:	<input type="text" value="No"/>	Number of Air Conditioner Covers To Be Installed: <small>(Covers would meet HUD Chapter-12 Energy Conservation Compliance Section 329C)</small>	<input type="text" value="0"/>
<b>Estimated Annual O&amp;M Savings</b>	<input type="text" value="\$36"/>	Estimated Length of Joints To Be Re-Caulked: <small>(Includes Demolition and Re-Caulking)</small>	<input type="text" value="0"/> LF
Total Estimated Annual Cost Savings	<input type="text" value="\$757"/>	Total Cost For Controlling Air Leakage	<input type="text" value="\$1,167"/>
Simple Pay Back Period	<input type="text" value="1.54"/> Yrs	<i>Type of Recommendation</i>	<input type="text" value="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 0.35 per hour. In order to ensure proper thermal isolation of the property, EMG recommends ensuring that the weather-stripping and caulking of all external doors and windows remains intact. Its also recommended that door sweeps be installed under all the doors opening into conditioned space. Any visible cracks between the window frame and wall should be plugged by caulking.  
 In case of building with window airconditioners, EMG recommends use of interior/exterior window airconditioner covers so as to prevent cold air drafts into the conditioned space during the winter so as to save on heating costs.

**SUMMARY:**  
 Initial Investment: \$1,167      Simple Pay Back Perio: 1.54 Yrs  
 Annual Energy Cost Savings: \$757

<i>UIC</i>	<b>Install Smart Strips In Classrooms &amp; Offices</b>	
<b>EAC11</b>	<b>Location : Aproximately 25 class rooms</b>	
Step: 1	Total Number of Rooms	25
Step: 2	No. of Smart Strips Required	25
Step: 3	Cost per Smart Strip	\$50
Step:4	Total Installation Costs	\$1,250
Step:5	Total Energy Savings	6,000 kWh
Step:6	Electric Rate:	\$0.17 \$/kWh
Step:7	Total Cost Savings	\$1,011
Step:8	Simple Pay Back Period	1.24 Years
<i>Type of Recommendation</i>	Capital Cost ECM Recommendation	

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## APPENDIX G: Solar PV

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<b>UIC</b>	<b>Install Fixed Tilt Solar Photovoltaic System</b>
<b>EAR-2</b>	<b>Details: Install 124kW PV Systems on top of three buildings</b>

Select State: **Northern California**      Electric Rate: **\$0.17** \$/KWH      Annual Electric Consumption: **222,270** 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	
												30%	\$0.02	\$0		
1	Building 1	1	41	41	129	90,312	90,312	\$15,263	\$141,750	9.3	\$0	\$42,525	\$1,987	\$0	5.2	
2	Building 2	1	59	59	3	92,024	92,024	\$15,552	\$206,850	13.3	\$0	\$62,055	\$2,025	\$0	8.0	
3	Building 3	1	24	24	1	37,370	37,370	\$6,316	\$84,000	13.3	\$0	\$25,200	\$822	\$0	8.0	
4				0	0		0	\$0	\$0		\$0	\$0	\$0	\$0		
5				0	0		0	\$0	\$0		\$0	\$0	\$0	\$0		
6				0	0		0	\$0	\$0		\$0	\$0	\$0	\$0		
7				0	0		0	\$0	\$0		\$0	\$0	\$0	\$0		
8				0	0		0	\$0	\$0		\$0	\$0	\$0	\$0		
9				0	0		0	\$0	\$0		\$0	\$0	\$0	\$0		
10				0	0		0	\$0	\$0		\$0	\$0	\$0	\$0		
		<b>3</b>		<b>124</b>	<b>132</b>	<b>219,706.0</b>	<b>219,706</b>	<b>\$37,130</b>	<b>\$432,600</b>	<b>11.65</b>	<b>\$0</b>	<b>\$129,780</b>	<b>\$4,834</b>	<b>\$0</b>	<b>6.85</b>	

Solar Rooftop Photovoltaic Analysis	
Total Number of Roofs	3
Estimated Number of Panels	132
Estimated KW Rating	124 KW
Potential Annual KWh Produced	219,706 KWh
% of Current Electricity Load	98.8%

Financial Analysis	
Investment Cost	\$432,600
Estimated Energy Cost Savings	\$37,130
Potential Rebates	\$129,780
Potential Annual Incentives	\$4,834
Payback without Incentives	11.7 years
Incentive Payback but without SRECS	6.9 years
Payback with All Incentives	6.9 years



Caution: Photovoltaic system performance predictions calculated by PVWatts® include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by PVWatts® inputs. For example, PV modules with better performance are not differentiated within PVWatts® from lesser performing modules. Both NREL and private companies provide more sophisticated PV modeling tools (such as the System Advisor Model at <https://sam.nrel.gov>) that allow for more precise and complex modeling of PV systems.

The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.

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The energy output range is based on analysis of 30 years of historical weather data for nearby , and is intended to provide an indication of the possible interannual variability in generation for a Fixed (open rack) PV system at this location.

## RESULTS

# 63,062 kWh/Year\*

System output may range from 61,599 to 64,349 kWh per year near this location.

Month	Solar Radiation ( kWh / m <sup>2</sup> / day )	AC Energy ( kWh )	Value ( \$ )
January	2.91	2,868	502
February	4.30	3,680	644
March	5.67	5,366	939
April	6.64	6,004	1,051
May	7.47	6,719	1,176
June	8.11	6,989	1,223
July	8.14	7,122	1,246
August	7.81	6,861	1,201
September	6.97	5,895	1,032
October	5.59	5,033	881
November	3.96	3,623	634
December	2.97	2,903	508
<b>Annual</b>	<b>5.88</b>	<b>63,063</b>	<b>\$ 11,037</b>

### Location and Station Identification

Requested Location	1250 56th Avenue
Weather Data Source	Lat, Lon: 38.49, -121.5 1.0 mi
Latitude	38.49° N
Longitude	121.5° W

### PV System Specifications (Residential)

DC System Size	40.5 kW
Module Type	Standard
Array Type	Fixed (roof mount)
Array Tilt	20°
Array Azimuth	180°
System Losses	14.08%
Inverter Efficiency	96%
DC to AC Size Ratio	1.2

### Economics

Average Retail Electricity Rate	0.175 \$/kWh
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### Performance Metrics

Capacity Factor	17.8%
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The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.

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The energy output range is based on analysis of 30 years of historical weather data for nearby , and is intended to provide an indication of the possible interannual variability in generation for a Fixed (open rack) PV system at this location.

## RESULTS

# 92,024 kWh/Year\*

System output may range from 89,889 to 93,902 kWh per year near this location.

Month	Solar Radiation ( kWh / m <sup>2</sup> / day )	AC Energy ( kWh )	Value ( \$ )
January	2.91	4,184	732
February	4.30	5,370	940
March	5.67	7,830	1,370
April	6.64	8,761	1,533
May	7.47	9,805	1,716
June	8.11	10,198	1,785
July	8.14	10,393	1,819
August	7.81	10,013	1,752
September	6.97	8,603	1,505
October	5.59	7,344	1,285
November	3.96	5,287	925
December	2.97	4,237	741
<b>Annual</b>	<b>5.88</b>	<b>92,025</b>	<b>\$ 16,103</b>

### Location and Station Identification

Requested Location	1250 56th Avenue
Weather Data Source	Lat, Lon: 38.49, -121.5 1.0 mi
Latitude	38.49° N
Longitude	121.5° W

### PV System Specifications (Residential)

DC System Size	59.1 kW
Module Type	Standard
Array Type	Fixed (roof mount)
Array Tilt	20°
Array Azimuth	180°
System Losses	14.08%
Inverter Efficiency	96%
DC to AC Size Ratio	1.2

### Economics

Average Retail Electricity Rate	0.175 \$/kWh
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### Performance Metrics

Capacity Factor	17.8%
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The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.

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The energy output range is based on analysis of 30 years of historical weather data for nearby , and is intended to provide an indication of the possible interannual variability in generation for a Fixed (open rack) PV system at this location.

## RESULTS

# 37,370 kWh/Year\*

System output may range from 36,503 to 38,133 kWh per year near this location.

Month	Solar Radiation ( kWh / m <sup>2</sup> / day )	AC Energy ( kWh )	Value ( \$ )
January	2.91	1,699	297
February	4.30	2,181	382
March	5.67	3,180	556
April	6.64	3,558	623
May	7.47	3,982	697
June	8.11	4,141	725
July	8.14	4,220	739
August	7.81	4,066	712
September	6.97	3,493	611
October	5.59	2,982	522
November	3.96	2,147	376
December	2.97	1,720	301
<b>Annual</b>	<b>5.88</b>	<b>37,369</b>	<b>\$ 6,541</b>

### Location and Station Identification

Requested Location	1250 56th Avenue
Weather Data Source	Lat, Lon: 38.49, -121.5 1.0 mi
Latitude	38.49° N
Longitude	121.5° W

### PV System Specifications (Residential)

DC System Size	24.0 kW
Module Type	Standard
Array Type	Fixed (roof mount)
Array Tilt	20°
Array Azimuth	180°
System Losses	14.08%
Inverter Efficiency	96%
DC to AC Size Ratio	1.2

### Economics

Average Retail Electricity Rate	0.175 \$/kWh
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### Performance Metrics

Capacity Factor	17.8%
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