LEVEL II ENERGY AUDIT

A Bureau Veritas Group Company

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

DLR GROUP
1050 20th Street, Suite 250
Sacramento, California 95968

ZERO NET ENERGY ASHRAE LEVEL II AUDIT

A.M. WINN PUBLIC WALDORF

3351 Explorer Drive
Sacramento, California 95827

PREPARED BY:
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EMG PROJECT #:

136988.19R000-068.268

DATE OF REPORT:

October 28, 2019

ONSITE DATE:

September 26, 2019

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Certification

EMG has completed an Energy Audit of A.M. Winn Public Waldorf located at 3351 Explorer Drive in Sacramento, California. EMG visited the site on September 26, 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:

Rashad Alnial
Energy Auditor
Project Manager

Reviewed by:

Al Diefert
Technical Report Reviewer
For
Kaustubh Anil Chabukswar, CEM CRM
Program Manager

1. Executive Summary

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

Bldg #	Structures Assessed	Building Type	EMG Calculated Area (SF)	Estimated Occupancy
1	001	Multipurpose	4976	47
2	002, 1-2 & Office	Classroom & Office	5503	52
3	003, 3-7	Classroom	6107	58
4	004, 8-12	Classroom	6162	58
5	P01, 13-16	Classroom	3840	36
6	P02, 17 A&B	Classroom	1920	18
7	P03, 18-21	Classroom	1920	18
8	P05, 22-23	Classroom	1920	18
9	P06, 42-26	Classroom	3200	31
10	P07, HS	Classroom	1440	14

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 two 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.

<u>Summary of Financial Information for Recommended Non-Renewable Energy Conservation Measures</u>

ITEM	ESTIMATE
Net Initial ECM Investment *(Current Dollars Only)*	$ 4,990 *(In Current Dollars)*
Estimated Annual Cost Savings *(Current Dollars Only)*	$1,873 *(In Current Dollars)*
ECM Effective Payback	2.66 years
Estimated Annual Energy Savings	4.62%
Estimated Annual Energy Utility Cost Savings *(Excluding Water)*	3.75%
Estimated Annual Water Cost Saving	0.00%

Solar Photovoltaic (PV) Screening for PROP N

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS		
Estimated Number of Panels	417	
Estimated KW Rating	131	KW
Potential Annual kWh Produced	198,394	kWh
% of Current Electricity Uses	85.0%	
FINANCIAL SUMMARY		
Investment Cost	$459,550	
Estimated Energy Cost Savings	$33,727	
Payback without Incentives	13.6	Years
Incentive Payback but without SRECs	8.2	Years
Payback with All Incentives	8.2	Years

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

- Building Site Energy Use Intensity - The sum of the total site energy use in thousands of Btu per unit of gross building area. Site energy accounts for all energy consumed at the building location only not the energy consumed during generation and transmission of the energy to the site.
- Building Source Energy Use Intensity – The sum of the total source energy use in thousands of Btu per unit of gross building area. Source energy is the energy consumed during generation and transmission in supplying the energy to your site.
- Building Cost Intensity - This metric is the sum of all energy use costs in dollars per unit of gross building area.
- Greenhouse Gas Emissions - Although there are numerous gases that are classified as contributors to the total for Greenhouse Emissions, the scope of this energy audit focuses on carbon dioxide (CO_2). Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement).

SITE ENERGY USE INTENSITY (EUI)	RATING
Current Site Energy Use Intensity (EUI)	37 kBtu/ft^2
Post ECM Site Energy Use Intensity (EUI)	35 kBtu/ft^2
SOURCE ENERGY USE INTENSITY (EUI)	**RATING**
Current Source Energy Use Intensity (EUI)	82 kBtu/ft^2
Post ECM Source Energy Use Intensity (EUI)	79 kBtu/ft^2
BUILDING COST INTENSITY (BCI)	**RATING**
Current Building Cost Intensity	$1.18/ft^2
Post ECM Building Cost Intensity	$1.13/ft^2

Summary of the Greenhouse Gas Reductions from Recommended Non-Renewable Energy Conservation Measures

The following table provides a summary of the projected Greenhouse Gas Emissions reductions as a result of the recommended Energy Conservation Measures:

GREENHOUSE GAS EMISSIONS REDUCTION	
Estimated Annual Thermal Energy Reduction	72 MMbtu
Total CO_2 Emissions Reduced	4.93 MtCO_2/Yr

GREENHOUSE GAS EMISSIONS REDUCTION	
Total Cars Off the Road (Equivalent)*	1
Total Acres of Pine Trees Planted (Equivalent)*	1

**Equivalent reductions per DOE emissions calculation algorithms*

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

ZERO NET ENERGY ANALYSIS	
Building Annual Net Energy Consumption	1,567,389 kBtu
Total Annual Energy Savings for Non-Renewable Energy Measures	72,347 kBtu
Total Annual Energy Savings from Renewable Energy Measures	478,342 kBtu
Net Energy Consumption from Grid Post Implementation	1,016,700 kBtu
% Energy Reduction (Renewable + Non- Renewable)	35%

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 A.M. Winn Public Waldorf

ECM #	Description of ECM	Projected Initial Investment	Estimated Annual Energy Savings		Estimated Annual Water Savings	Estimated Cost Savings	Estimated Annual O&M Savings	Total Estimated Annual Cost Savings	Simple Payback	S.I.R.	Life Cycle Savings	Expected Useful Life (EUL)
			Natural Gas	Electricity								
		$	Therms	kWh	kgal	$	$	$	Years		$	Years
No/Low Cost Recommendations												
1	Install Energy Savers on Vending, Snack Machines Location:Throughout	$446	0	3,220	0	$551	$0	$551	0.81	10.53	$4,253	10.00
Totals for No/Low Cost Items		**$446**	**0**	**3,220**	**0**	**$551**	**$0**	**$551**	**0.81**			
Capital Cost Recommendations												
1	Install Timers On Exhaust Fans Location:Throughout	$3,893	524	4,991	0	$1,530	$0	$1,530	2.54	4.69	$14,376	15.00
Total For Capital Cost		**$3,893**	**524**	**4,991**	**0**	**$1,530**	**$0**	**$1,530**	**2.54**			
	Interactive Savings Discount @ 10%		-52	-821	0	-$208	$0	-$208				
	Total Contingency Expenses @ 15%	$651										
Total for Improvements		**$4,990**	**471**	**7,390**	**0**	**$1,873**	**$0**	**$1,873**	**2.66**			

In addition to the above measures, EMG has identified the following measure(s) but has not recommended as they fail to meet the above-mentioned financial criteria of SIR>1.0. Thus, EMG has classified the measure(s) as recommended for consideration.

List of Recommended For Consideration Energy Conservation Measures For A.M. Winn Public Waldorf

ECM #	Description of ECM	Initial Investment	Annual Energy Savings		Annual Water Savings	Cost Savings	Estimated Annual O&M Savings	Total Estimated Annual Cost Savings	Payback	S.I.R.	Life Cycle Savings	Expected Useful Life (EUL)
		$	Natural Gas	Electricity	kgal	$	$	$	Years		$	Years
1	Install Low Flow Tankless Restroom Fixtures Location: Throughout	$34,024	0	0	284	$2,218	$0	$2,218	15.34	0.78	-$7,551	15.00
Total for Improvements		**$34,024**	**0**	**0**	**284**	**$2,218**	**$0**	**$2,218**	**15.34**			

2. Introduction

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

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

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

ENERGY AND WATER USING EQUIPMENT

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

BUILDING ENVELOPE

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

RECOMMENDATIONS FOR ENERGY SAVINGS OPPORTUNITIES

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

ANALYSIS OF ENERGY CONSUMPTION

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

ENERGY AUDIT PROCESS

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

REPORTING

The EMG Energy Audit Report includes:

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

3. Facility Overview and Existing Conditions

3.1. Building Occupancy and Point of Contact

FACILITY SCHEDULE	
Hours of Operations / Week	35
Operational Weeks / Year	36
Estimated Facility Occupancy	350
% of Male Occupants	175

POINT OF CONTACT	
Point of Contact Name	Darin Lanz
Point of Contact Title	Plant Manager
Point of Contact – Contact Number	916-254-9586

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

Description:

Heating is provided by a Forced Air Furnace systems and Cooling is provided by Split Systems

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	NA
Hydronic Distribution System	NA
Primary Heating Fuel	Natural gas
Heating Mode Set-point	69 °F
Heating Mode- Set-back Temperature	53 °F

BUILDING COOLING SYSTEM	
Primary Cooling System	Split Systems
Secondary Cooling System	None
Hydronic Distribution System	NA

BUILDING COOLING SYSTEM	
Cooling Mode Set-point	68°F
Cooling Mode- Set-back Temperature	93 °F

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

DOMESTIC HOT WATER SYSTEM	
Primary Domestic Water Fuel	Natural Gas

3.3. Lighting

<u>Description</u>:

Both the interior and exterior lighting in the school buildings are primarily LED. As such, no evaluation of the lighting system for energy efficiency has been performed and a lighting schedule is not included.

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	$1.29/therm	$ 7.80/kGal

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

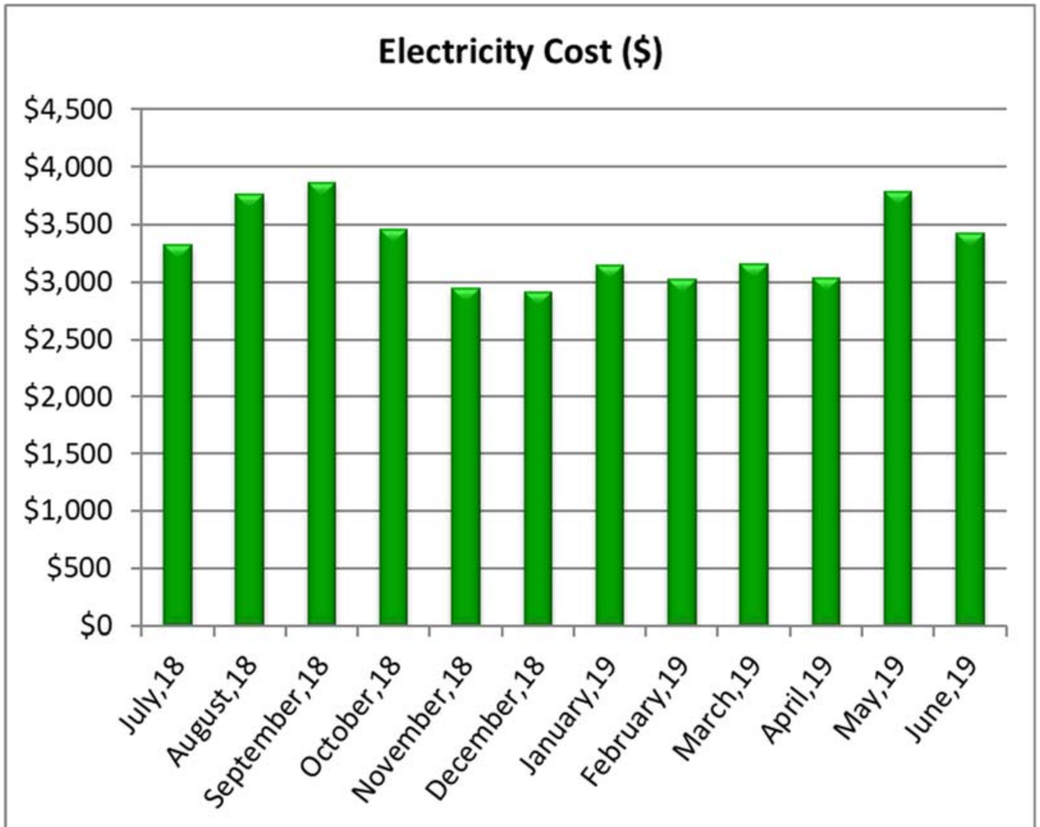
4.1. Electricity

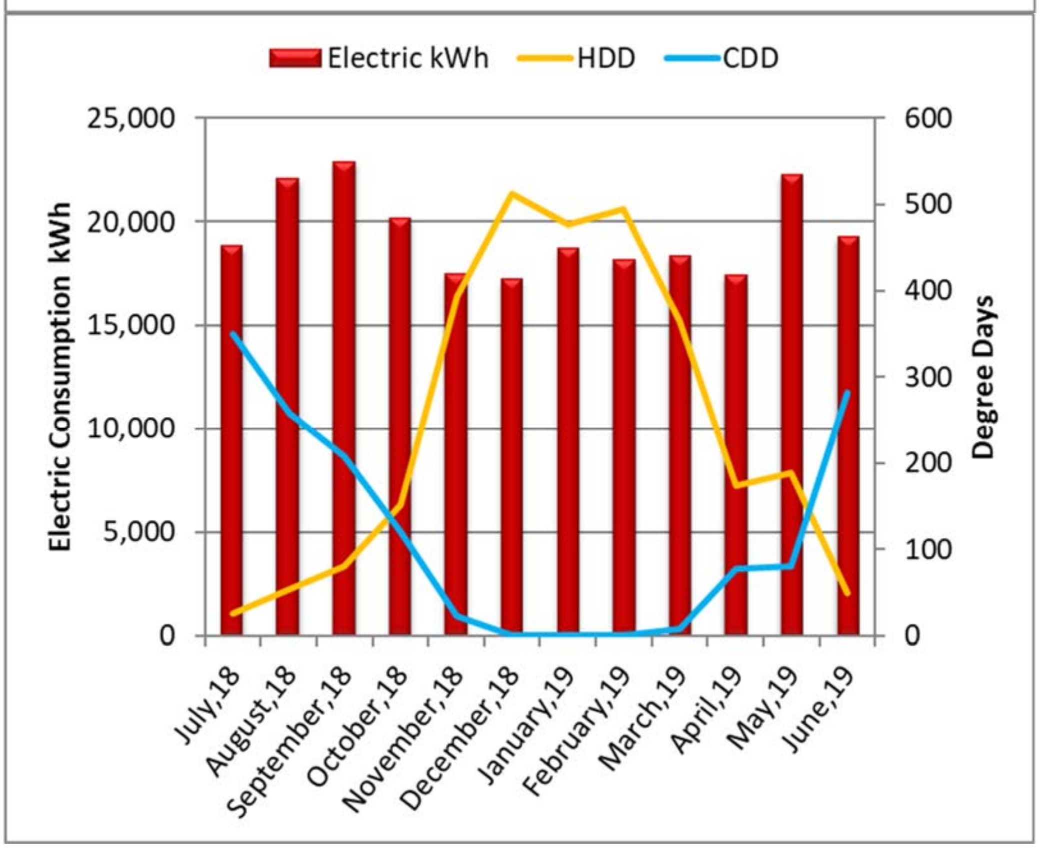
PGE satisfies the electricity requirements for the facility. The primary end uses for electric utility compromises of lighting, cooling, office/school equipment, and appliances in the break room.

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

Electric Consumption and Cost Data

BILLING MONTH	CONSUMPTION (KWH)	UNIT COST/KWH	TOTAL COST
July,18	18,916	$0.18	$3,338
August,18	22,092	$0.17	$3,765
September,18	22,909	$0.17	$3,864
October,18	20,198	$0.17	$3,472
November,18	17,537	$0.17	$2,958
December,18	17,276	$0.17	$2,926
January,19	18,787	$0.17	$3,157
February,19	18,203	$0.17	$3,034
March,19	18,395	$0.17	$3,161
April,19	17,497	$0.17	$3,045
May,19	22,330	$0.17	$3,787
June,19	19,327	$0.18	$3,437
Total/average	**233,467**	**$0.17**	**$39,943**


Electricity Cost ($)
$4,500
$4,000
$3,500
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19


Electric kWh
HDD
CDD
Electric Consumption kWh
Degree Days
25,000
20,000
15,000
10,000
5,000
0
600
500
400
300
200
100
0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

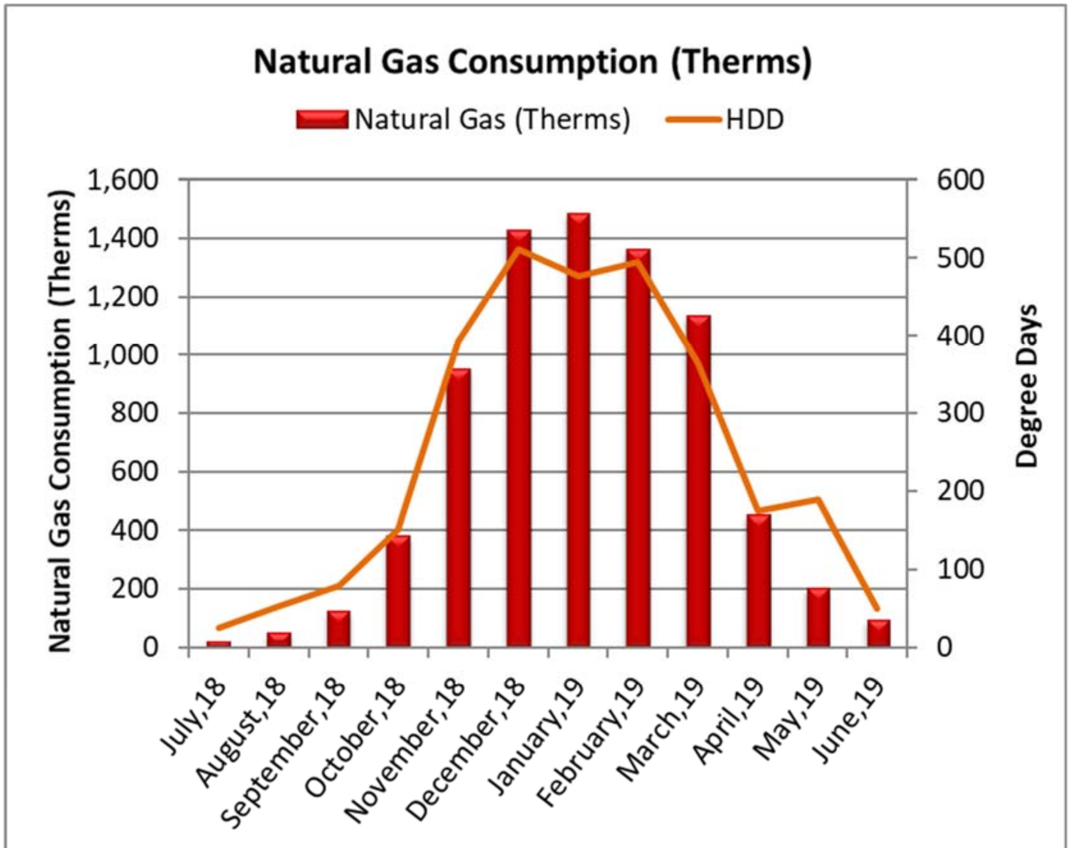
4.2. Natural Gas

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	22	$2.39	$53
August,18	50	$1.61	$81
September,18	125	$1.22	$153
October,18	383	$1.11	$425
November,18	952	$1.17	$1,116
December,18	1,431	$1.36	$1,947
January,19	1,488	$1.29	$1,912
February,19	1,364	$1.31	$1,792
March,19	1,136	$1.33	$1,507
April,19	455	$1.23	$559
May,19	205	$1.33	$273
June,19	97	$1.44	$139
Total/average	**7,708**	**$1.29**	**$9,957**


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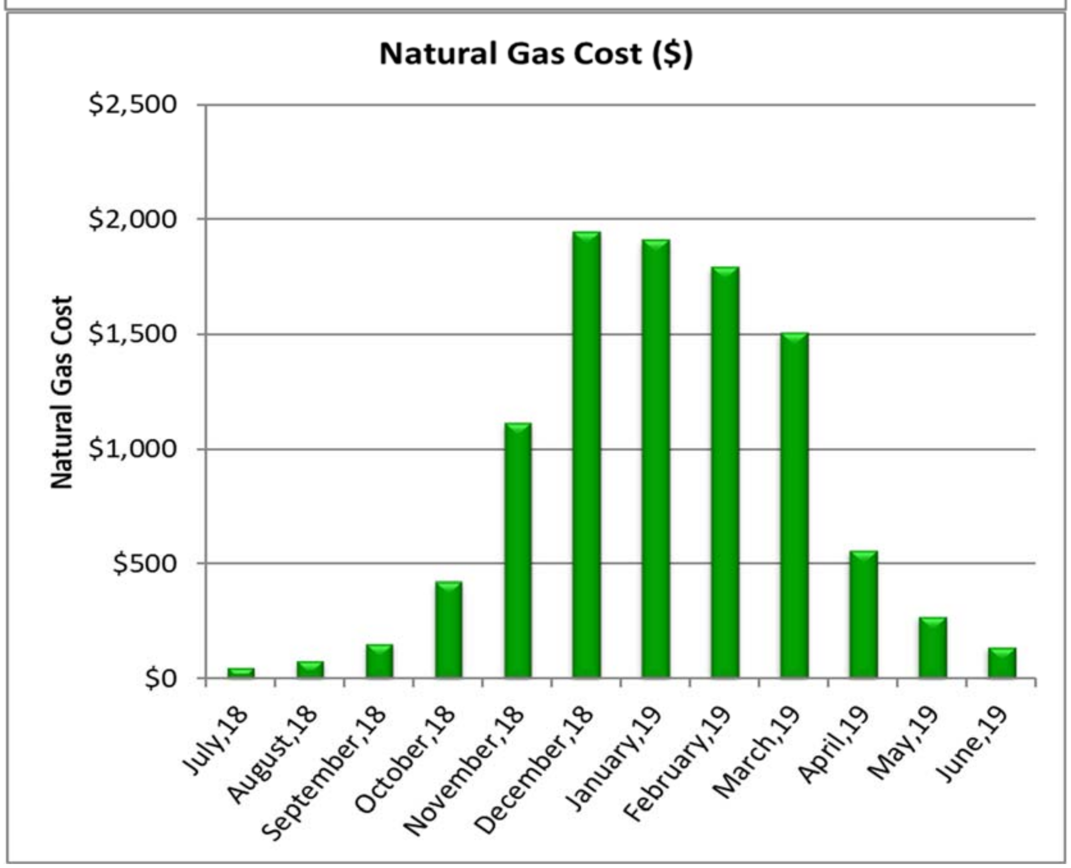
December,18
January,19
February,19
March,19
April,19
May,19
June,19

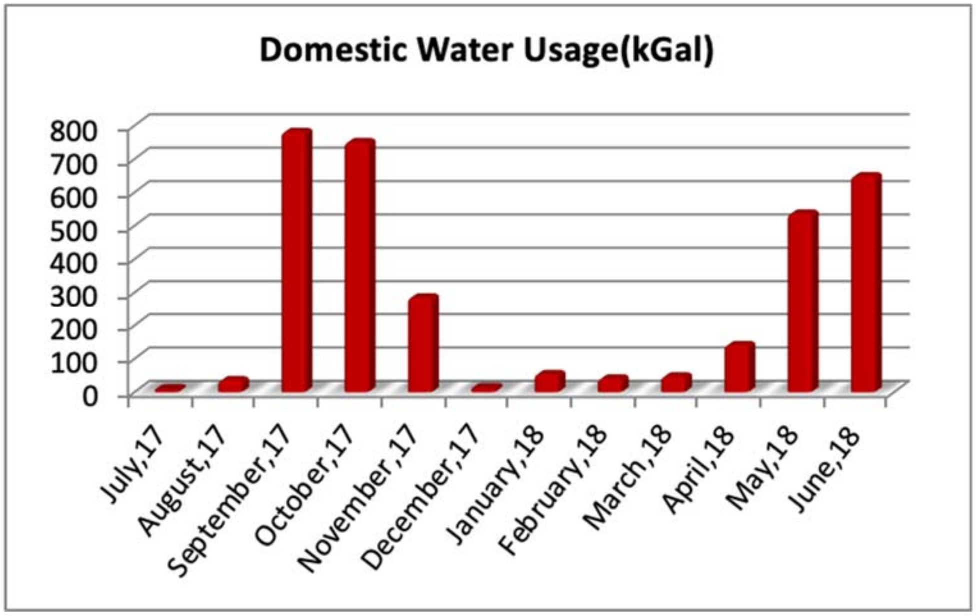

Natural Gas Cost ($)
Natural Gas Cost
$2,500
$2,000
$1,500
$1,000
$500
$0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

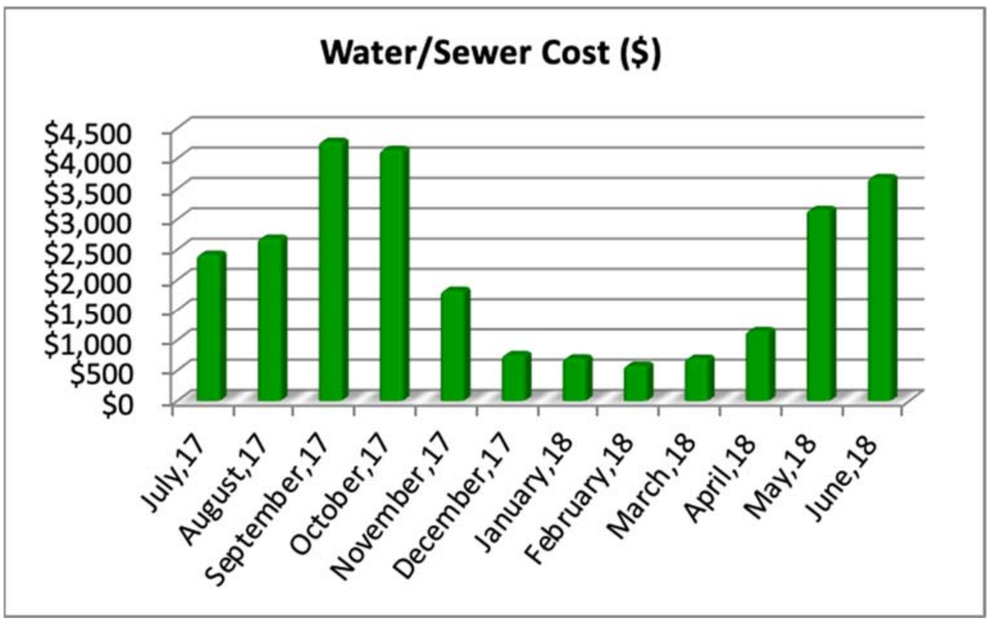
4.3. Water and Sewer

The City of Sacramento satisfies the water requirements for the facility. The primary end use of water is the plumbing fixtures such as staff showers, water closets, and lavatories. The table below provides the twelve continuous months' worth of consumption and cost for water in kGal for the facility.

Water and Sewer Consumption and Cost Data

BILLING MONTH	CONSUMPTION (KGAL)	UNIT COST/KGAL	TOTAL COST
July,17	8.2762	$2,421	$2,421
August, 17	35.922	$2,686	$2,686
September, 17	781.5394	$4,281	$4,281
October, 17	750.8887	$4,147	$4,147
November, 17	285.4794	$1,827	$1,827
December, 17	13.0836	$761	$761
January,18	54.5804	$704	$704
February, 18	41.2899	$585	$585
March, 18	47.5648	$700	$700
April, 18	141.1881	$1,155	$1,155
May, 18	536.7376	$3,158	$3,158
June, 18	648.6506	$3,683	$3,683


Domestic Water Usage(kGal)
800
700
600
500
400
300
200
100
0
July,17
August,17
September,17
October,17
November,17
December,17
January,18
February,18
March,18
April,18
May,18
June,18


Water/Sewer Cost ($)
$4,500
$4,000
$3,500
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$0
July,17
August,17
September,17
October,17
November,17
December,17
January,18
February,18
March,18
April,18
May,18
June,18

5. Renewable Energy Discussions

5.1. Rooftop Solar Photovoltaic Feasibility

Solar Energy Feasibility

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

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

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

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

A solar feasibility analysis of the XXX 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	417	
Estimated KW Rating	131	KW
Potential Annual kWh Produced	198,394	kWh
% of Current Electricity Uses	85%	
FINANCIAL SUMMARY		
Investment Cost	$459,550	
Estimated Energy Cost Savings	$33,727	
Payback without Incentives	13.6	Years
Incentive Payback but without SRECs	8.2	Years
Payback with All Incentives	8.2	Years

A photovoltaic array is a linked collection of photovoltaic modules, which are in turn made of multiple interconnected solar cells. The cells convert solar energy into direct current. Modules of cells are linked together to form an array. Most PV arrays use an inverter to convert the DC power produced by the modules into alternating current that can connect to existing AC infrastructure to power lights, motors, and other loads.

Cost of production has fallen years with increasing demand and through production and technological advances. The cost dropped from $8–10/watt in 1996 to $4–7/watt in 2006. The market is diversifying with new types of panels suited to unique installation methods including stick on sheets and PV spray coating. The solar PV cost used in the analysis was set at $7.0/Watt which includes design, construction, administration, and installation and maintenance cost throughout the life of the solar panels.

One breakthrough for PV is “Net Metering”. When more PV electric power is generated than is consumed on site, the electric service meter reverses to “sell” the excess power directly back onto the power grid. The economics of PV for commercial industrial installations become attractive when coupled with incentives from Federal and state agencies, as well utility companies.

A kilowatt-hour costing $0.15 might be valued at $0.30 when produced by PV and sent to the grid. The economics of PV for commercial industrial installations become attractive when coupled with incentives from Federal and state agencies, as well utility companies.
The low payback period is highly dependent on the marketing potential of selling Solar Renewable Certificates to electricity generated providers who are under state regulations to contain a certain percentage of their electricity generation derived from renewable energy such as wind and solar.
Solar facilities are encouraged to sell their SRECs on the market (either spot market or through long-term contracts). Utilities may use SRECs for compliance under the state RPS for the year in which they are generated. Utilities may purchase up to 10% more SRECs than they require for compliance and "bank" those surplus SRECs for compliance during the following two years. Any SRECs pricing can range from $300 - $450/MWh and can be sold across state borders to other utility providers looking to purchase SRECs. EMG has selected to use the market value of $300/MWh minus 5% administrative fee in the analysis.
A number of states and corresponding electrical utility supplier are required under regulation to have a certain percentage of its electricity be produced by solar energy. To offset that they allow other utility companies to buy Renewable Energy Credits (REC) credit off their customers and facilities that produce their own solar energy. Typically, the national market, the utility market is $400 per MWh to Utility Suppliers for not meeting this standard percentage so these REC credits are sold for $350 per MWH. (1 REC credit = 1 MWH).
State charges these utility companies to meet their state compliance of 0.2% of the entire electricity consumption from solar energy by 2022 (from.005% in 2008 aggregated up to 0.2% by 2022). The REC credits correspond to these percentages as they aggregate each year.

6. Operations and Maintenance Plan

The quality of the maintenance and the operation of the facility's energy systems have a direct effect on its overall energy efficiency. Energy-efficiency needs to be a consideration when implementing facility modifications, equipment replacements, and general corrective actions. The following is a list of activities that should be performed as part of the routine maintenance program for the property.

Building Envelope

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

Heating and Cooling

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

Central Domestic Hot Water Heater

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

Lighting Improvements

- ✓ Utilize bi-level lighting controls in stairwells and hallways.
- ✓ Use LED replacement lamps

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

Existing Equipment and Replacements

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

7. Appendices

APPENDIX A: Glossary of Terms

APPENDIX B: Mechanical Equipment Inventory

APPENDIX C: ECM Checklist

APPENDIX D: ECM Calculations

APPENDIX E: Solar PV

APPENDIX A:
Glossary of Terms

Glossary of Terms and Acronyms

ECM – Energy Conservation Measures are projects recommended to reduce energy consumption. These can be No/Low cost items implemented as part of routine maintenance or Capital Cost items to be implemented as a capital improvement project.

Initial Investment – The estimated cost of implementing an ECM project. Estimates typically are based on R.S. Means Construction cost data and Industry Standards.

Annual Energy Savings – The reduction in energy consumption attributable to the implementation of a particular ECM. These savings values do not include the interactive effects of other ECMs.

Cost Savings – The expected reduction in utility or energy costs achieved through the corresponding reduction in energy consumption by implementation of an ECM.

Simple Payback Period –The number of years required for the cumulative value of energy or water cost savings less future non-fuel or non-water costs to equal the investment costs of the building energy or water system, without consideration of discount rates.

EUL – Expected Useful Life is the estimated lifespan of a typical piece of equipment based on industry accepted standards.

RUL – Remaining Useful Life is the EUL minus the effective age of the equipment and reflects the estimated number of operating years remaining for the item.

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

Life Cycle Cost - The sum of the present values of (a) **I**nvestment costs, less salvage values at the end of the study period; (b) Non-fuel operation and maintenance costs: (c) Replacement costs less salvage costs of replaced building systems; and (d) Energy and/or water costs.

Life Cycle Savings – The sum of the estimated annual cost savings over the EUL of the recommended ECM, expressed in present value dollars.

Building Site Energy Use Intensity - The sum of the total site energy use in thousands of Btu per unit of gross building area. Site energy accounts for all energy consumed at the building location only not the energy consumed during generation and transmission of the energy to the site.

Building Source Energy Use Intensity – The sum of the total source energy use in thousands of Btu per unit of gross building area. Source energy is the energy consumed during generation and transmission in supplying the energy to your site.

Building Cost Intensity - This metric is the sum of all energy use costs in dollars per unit of gross building area.

Greenhouse Gas Emissions - Although there are numerous gases that are classified as contributors to the total for Greenhouse Emissions, the scope of this energy audit focuses on carbon dioxide (CO_2). Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement).

APPENDIX B:
Mechanical Equipment Inventory

Mechanical Inventory					
System	Make	Model	Serial Number	Location	Location- Floor
Condensing Unit/Heat Pump	Carrier	38CKC060570	3003E14182	A.M. Winn Public Waldorf / 003 Classrooms 3-7	Roof
Condensing Unit/Heat Pump	Carrier	38CKC060570	3003E14194	A.M. Winn Public Waldorf / 003 Classrooms 3-7	Roof
Condensing Unit/Heat Pump	Carrier	38CKC060570	3003E14183	A.M. Winn Public Waldorf / 003 Classrooms 3-7	Roof
Condensing Unit/Heat Pump	Carrier	38CKC060570	3003E14188	A.M. Winn Public Waldorf / 003 Classrooms 3-7	Roof
Condensing Unit/Heat Pump	Carrier	38CKC060570	3003E14160	A.M. Winn Public Waldorf / 002 Classrooms 1-2 & Office	Roof
Condensing Unit/Heat Pump	Carrier	38CKC060570	3003E14184	A.M. Winn Public Waldorf / 004 Classrooms 8-12	Roof
Condensing Unit/Heat Pump	Carrier	38CKC060570	3003E14196	A.M. Winn Public Waldorf / 004 Classrooms 8-12	Roof
Condensing Unit/Heat Pump	Carrier	38CKC060570	3003E14173	A.M. Winn Public Waldorf / 004 Classrooms 8-12	Roof
Condensing Unit/Heat Pump	Carrier	38CKC030520	2703E08534	A.M. Winn Public Waldorf / 003 Classrooms 3-7	Roof
Condensing Unit/Heat Pump	Carrier	38CKC060570	3003EI4174	A.M. Winn Public Waldorf / 002 Classrooms 1-2 & Office	Roof
Condensing Unit/Heat Pump	Carrier	3BCKC030520	2703E08554	A.M. Winn Public Waldorf / 003 Classrooms 3-7	Roof
Condensing Unit/Heat Pump	Carrier	38CKC060570	3003E14186	A.M. Winn Public Waldorf / 004 Classrooms 8-12	Roof
Condensing Unit/Heat Pump	Carrier	38CKC060570	3003E14185	A.M. Winn Public Waldorf / 004 Classrooms 8-12	Roof
Condensing Unit/Heat Pump	Carrier	38ARZ008---501--	2903G4005	A.M. Winn Public Waldorf / 002 Classrooms 1-2 & Office	Roof
Exhaust Fan	JennAir	241 CK C	No tag/plate found	A.M. Winn Public Waldorf / 001 Multipurpose	Roof
Exhaust Fan	No tag/plate found	No tag/plate found	No tag/plate found	A.M. Winn Public Waldorf / 001 Multipurpose	Roof
Exhaust Fan	JennAir	91 CR ACU	No tag/plate found	A.M. Winn Public Waldorf / 002 Classrooms 1-2 & Office	Roof
Exhaust Fan	No tag/plate found	No tag/plate found	No tag/plate found	A.M. Winn Public Waldorf / 001 Multipurpose	Roof
Exhaust Fan	No tag/plate found	No tag/plate found	No tag/plate found	A.M. Winn Public Waldorf / 001 Multipurpose	Roof
Exhaust Fan	Greenheck	GB-091-4-X	05610914	A.M. Winn Public Waldorf / 003 Classrooms 3-7	Roof
Exhaust Fan	Greenheck	GR-091-4-X	05610913	A.M. Winn Public Waldorf / 003 Classrooms 3-7	Roof
Exhaust Fan	Greenheck	GB-071-6-X	05610856	A.M. Winn Public Waldorf / 002 Classrooms 1-2 & Office	Roof
Exhaust Fan	Greenheck	GB-071-6-X	05810859	A.M. Winn Public Waldorf / 004 Classrooms 8-12	Roof
Exhaust Fan	Greenheck	GB-P71-6-X	05610860	A.M. Winn Public Waldorf / 002 Classrooms 1-2 & Office	Roof
Furnace	Carrier	ZI58DLX110---10122	S2603A42829	A.M. Winn Public Waldorf / 004 Classrooms 8-12	O011
Furnace	Carrier	ZI58DLX110---10122	S2603A42823	A.M. Winn Public Waldorf / 002 Classrooms 1-2 & Office	Y001
Furnace	Carrier	ZI58DLX110---10122	S2603A42826	A.M. Winn Public Waldorf / 003 Classrooms 3-7	O007
Furnace	Carrier	ZI58DLX110---10122	S2603A42828	A.M. Winn Public Waldorf / 004 Classrooms 8-12	O009
Furnace	Carrier	ZI58DLX110---10122	S2603A4284p	A.M. Winn Public Waldorf / 002 Classrooms 1-2 & Office	Y002
Furnace	Carrier	ZI58DLX110---10122	S2603A42833	A.M. Winn Public Waldorf / 004 Classrooms 8-12	O010
Furnace	Carrier	ZI58DLX110---10122	S2603A42839	A.M. Winn Public Waldorf / 004 Classrooms 8-12	O012
Furnace	Carrier	ZI58DLX110---10122	S2603A42838	A.M. Winn Public Waldorf / 004 Classrooms 8-12	O008
Furnace	Carrier	58DLX45. 10112	4502A33037	A.M. Winn Public Waldorf / 003 Classrooms 3-7	O003
Furnace	Carrier	58DLX45. 10112	1403A26126	A.M. Winn Public Waldorf / 003 Classrooms 3-7	O003
Furnace	Carrier	ZI58DLX110---10122	S2803A43784	A.M. Winn Public Waldorf / 003 Classrooms 3-7	O004
Furnace	Carrier	ZI58DLX110---10122	S2603A42842	A.M. Winn Public Waldorf / 003 Classrooms 3-7	O005
Furnace	Carrier	ZI58DLX110---10122	S2603A42841	A.M. Winn Public Waldorf / 003 Classrooms 3-7	O006
Heat Pump	Bard Manufacturing Company	Illegible	Illegible	A.M. Winn Public Waldorf / P05 Portable Classroom 22-23	Room 22
Heat Pump	Bard Manufacturing Company	36WH7-A05C	058N890628956	A.M. Winn Public Waldorf / P04 Portable Classrooms 18-21	Room 18
Heat Pump	Sun Mfg	HVA36105C	D901189B	A.M. Winn Public Waldorf / P05 Portable Classroom 22-23	Room 23
Heat Pump	Bard Manufacturing Company	WH431-A0ZCX4XXB	176L981277072-02	A.M. Winn Public Waldorf / P02 Portable Classrooms 17A-17B	Room 17A
Heat Pump	Bard Manufacturing Company	WH361-A00XX4XXX	125F981234812-02	A.M. Winn Public Waldorf / P04 Portable Classrooms 18-21	Room 21
Heat Pump	Bard Manufacturing Company	WH431-A0ZCX4XXB	176L981277481-02	A.M. Winn Public Waldorf / P02 Portable Classrooms 17A-17B	Room 17B
Heat Pump	Bard Manufacturing Company	WH361-800XX4XXX	125K001504474-01	A.M. Winn Public Waldorf / P07 HS	P07
Heat Pump	Bard Manufacturing Company	WH361-A00XX4XXX	125F981234810-02	A.M. Winn Public Waldorf / P04 Portable Classrooms 18-21	Room 19
Heat Pump	Bard Manufacturing Company	WH361-800XX4XXX	125J001491119-01	A.M. Winn Public Waldorf / P07 HS	P07
Heat Pump	Bard Manufacturing Company	Illegible	Illegible	A.M. Winn Public Waldorf / P04 Portable Classrooms 18-21	Room 21
Heat Pump	Bard Manufacturing Company	WG422-ANBVX4XXX	253H031818621-1	A.M. Winn Public Waldorf / P01 Portable Classrooms 13-16	Room 13
Heat Pump	Bard Manufacturing Company	WG422-ANBVX4XXX	253H031818623-1	A.M. Winn Public Waldorf / P01 Portable Classrooms 13-16	Room 15
Heat Pump	Bard Manufacturing Company	WG422-ANBVX4XXX	253H031818633-1	A.M. Winn Public Waldorf / P06 Portable Classrooms 24-26	Room 25
Heat Pump	Bard Manufacturing Company	WG422-ANBVX4XXX	253HO31818622-1	A.M. Winn Public Waldorf / P01 Portable Classrooms 13-16	Room 14
Heat Pump	Bard Manufacturing Company	WG422-ANBVX4XXX	253H031818653-1	A.M. Winn Public Waldorf / P06 Portable Classrooms 24-26	Room 24
Heat Pump	Bard Manufacturing Company	WG421-ANBVX4XXX	126J011651903-1	A.M. Winn Public Waldorf / P01 Portable Classrooms 13-16	Room 16
Heat Pump	Bard Manufacturing Company	WG481-ANBVX4XXX	253H031818691-1	A.M. Winn Public Waldorf / P06 Portable Classrooms 24-26	Room 26
Packaged Unit		No access to unit		A.M. Winn Public Waldorf / 001 Multipurpose	Grounds
Packaged Unit	Inaccessible	Inaccessible	Inaccessible	A.M. Winn Public Waldorf / 001 Multipurpose	Building exterior

APPENDIX C:
ECM Checklist

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

APPENDIX D:
ECM Calculations

UIC	Install Energy Savers on Vending, Snack Machines
EAC8	Location:Throughout

No. of Vending Machines:	2	Qty	No. of Beverage Cooling Machines:	0	Qty
No. of Snack Machines	0	Qty			

Vending Machines (Cold Beverage Vending Machines)		
Estimated Annual kWh Consumption of Vending Machine:	3,500	kWh
Estimated Annual kWh of Vending Machine With VendMiser:	1,890	kWh
Total annual kWh savings:	1,610	kWh
Total Annual kWh Savings for All Vending Machines:	3,220	kWh
Beverage Cooling Machines		
Estimated Annual kWh Consumption of Beverage Cooling Machine:	2,300	kWh
Estimated Annual kWh of Cooling Machine With CoolerMiser:	1,610	kWh
Total Annual kWh savings:	690	kWh
Total Annual kWh Savings For All Cooling Machines:	0	kWh
Snack Vending Machines		
Estimated Annual kWh Consumption of Individual Snack Machine:	874	kWh
Estimated Annual kWh of Individual Snack Machines With VendMiser:	367	kWh
Total Annual kWh savings:	507	kWh
Total Annual kWh Savings For All Snack Vending Machines:	0	kWh
Cost Analysis		
Total estimated annual kWh savings withEnergy Misers:	3,220	kWh
Cost/kWh:	$0.17	$/kWh
Estimated Cost of Vendmiser/ Vending Machine:	$223	
Estimated Cost of Coolermiser/ Beverage Cooling Machine:	$213	
Estimated Cost of Vendmiser/ Snack Machine:	$137	
Estimated total installed cost of all VendMisers:	$446	
Estimated Total Annual Electricity Savings Using VendingMisers:	$551	
Simple Payback:	0.81	years
Type of Recommendation	No/Low Cost ECM Recommendation	

ECM DESCRIPTION:

Vending machines are usually designed to operate all day round irrespective of the occupancy level in the office. This means that the vending machines operate for more that 12 hours a day when not required in case of commercial establishments.

EMG recommends installing vend misers on the vending machines, which will automatically reduce the run time of these machines during weekends and unoccupied hours. There are two types of vend misers; one has a timer in it, which is programmed to turn off or tune down the vending machines after the office hours and bring it back up an hour before the office opens. The other is a motion sensor based system that tunes down the machines upon detecting no-occupancy for a pre-programmed duration of time. In the case of vending machines storing chilled products, the vend miser does not turn off the machine entirely, but reduces the operating time of the compressor, such that the machine maintains the products at a minimum tolerable temperature

Summary:

Initial Investment:	$446	Simple Payback:	0.81
Energy Cost Savings:	$551		

UIC	Install Timers On Exhaust Fans
EAC7A	Location:Throughout

Type of Exhaust Fan: Rooftop Exhaust Fans

EXISTING CONDITION

No. of Timers to Be Installed:	11	Qty	HP of Individual Fan Motor:	0.17	HP
No. of Exhaust Fans:	11		Total kW:	1.40	kW
Existing Daily Hours of Operation/Exhaust Fan:	7.00	Hrs/Day	Annual kWh For All Fans:	3,564	kWh

PROPOSED CONDITION

New Daily Hours With Timers/Exhaust Fan:	0.94	Hrs/Day	New Annual kWh For All Fans:	478	kWh
Type of Heating Fuel:	Natural Gas		Is The Property Cooled?	Yes	

Only For Apt. Bathroom Exhaust Fans			Only For Roof Top Exhaust Fans- Commerical Spaces		
CFM for Individual Bathroom Exhaust Fans *(For bathrooms<100Sqft)*	90	CFM	No. of Water Closets In Building	21	
			No. of Urinals In Building	11	
Total Exhuast CFM From All Fans	990	CFM	Total CFM for All Restroom Exhaust	1,600	CFM
Annual Heating Energy Savings	0	kbtu	Annual Heating Energy Savings	41,896	kbtu
Annual Cooling Energy Savings	0	kbtu	Annual Cooling Energy Savings	20,948	kbtu

Energy & Cost Savings

Estimated Annual Heating Plant Efficiency	80.00	%	Estimated Annual Cooling Plant Efficiency	11.00	EER
Annual Heating Energy Savings	524	Therms	Annual Cooling Energy Savings	1,904	kWh
Annual Electric Fan Motor Savings	3,086	kWh			

COST ANALYSIS

Electric Rate:	**$0.17**	$/kWh	Total Annual Electric Savings	4,991	kWh
Material Cost For Timers:	$1,862	$	Total Annual Non Electric Savings	524	Therms
Total Cost for Installing Timers	$3,893	$	Annual Cost savings:	$1,530	$
Simple Payback:	2.54	Yrs			

Type of Recommendation Capital Cost ECM Recommendation

ECM DESCRIPTION:

Exhaust fans are generally used in areas with high concentrations of pollutants generated from occupants' activities. These exhaust requirements are rarely continuous, and the fans should operate only as needed. Continuous operations of bathroom exhaust fans results in exhausting conditioned air out. This causes low pressures in the conditioned space, which is filled up by infiltrated air from unconditioned spaces. Air infiltration leads to increase loads on heating and cooling system increasing the energy consumed to condition the space. In addition to this the fan motor is also consumes energy to operate, though insignificant as compared to the HVAC losses. In case of the residential properties with individual exhaust fans in the bathrooms, EMG recommends installing timer switches on each bathroom fan to control the fan operations. Bathroom fans are essential to exhaust out the excess humidity and odor control. The timer switch will limit the operation time to 20 mins.

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

Summary:

Initial Investment:	$1,862	Simple Payback:	2.54	Years
Energy Cost Savings:	$1,530			

UIC	Install Low Flow Tankless Restroom Fixtures
EAP4	Location: Throughout

ECM FOR DETERMINING WATER SAVINGS IN COMMERCIAL PROPERTIES

Number of Males	175	
Number of Females	175	
Number of Occupied Days Per Week (Max 7)	5	
Number of Occupied Weeks/Year (Max 52)	36	
Number of Urinals To Be Retrofitted	11	
Number of Water Closets To Be Retrofitted	21	
No. of Water Closets With Separate Flush Tank *(Typical Residential Type)*	4	
Estimated Restroom Usage/Individual/Day *Default is 4 Uses/Day For Residential/Office*	5	(Select)

Urinal Water Savings

Do you Want To Make Any Changes To The Urinals?	Yes	
Estimated Existing Use of Urinal/Day/Man	80%	
Existing Gallons Per Flush Ratings For Urinal Flushes	1.00	GPF
Proposed Urinal	0.125 GPF -Wall Mount	
GPF of Proposed Urinal Flush Valve** ***(1992 EpACT Energy Act Mandates 1.0GPF Max on Urinals)*	0.125	GPF
Estimated Annual Water Savings From Urinal	110.25	kGal

Water Closet Water Savings

Tankless Water Closets

Do The Water Closet Need To Be Retrofitted?	*(Select)*	Yes	
Existing Gallons Per Flush Ratings For Water Closet Flushes		1.60	GPF
Are The Existing Water Closet Being Replaced? *(If No; Then Only The Flush Valve Would Be Replaced With Dual Flush Retrofit Kit)*	*(Select)*	Yes	
No. of Tankless Water Closets		17	
GPF of Proposed Dual Flush- Water Closet Valve*	*Solid Waste(20%)*	1.60	GPF
**(Federal Law Requires All Flushes Not To Exceed 1.6 GPF)*	*Liquid Waste(80%)*	0.45	GPF
Estimated Annual Water Savings From Male Users		28.98	kGal
Estimated Annual Water Savings From Female Users		144.90	kGal
Total Water Savings From Water Closets		173.88	kGal

Water & Cost Saving Calculations

Water Savings Calculation

Water Savings By The Use of Low Flow Water Closet Flush Valves/Yr	173.88	kgal
Water Savings By The Use of Low Flow Urinal Flush Valves/ Yr	110.25	kgal
Total Annual Water Savings in kgal	284.13	kgal

Cost Savings Calculations

Enter Water Tariff Rate ($/1000Gal)	$7.80	$$
Estimated Cost Savings From Water	$2,218	$$

Estimated Cost of Retrofit

Cost For Replacing Existing Urinal Fixture With A Low Flow Fixture	$14,304 *(Includes Labor)*	$$
Cost For Replacing Existing Water Closet With A New Water Closet And- Dual Flush Valves *(Up For Liquid Waste And Down For Solid Waste)*	$19,720 *(Includes Labor)*	$$
Estimated Total Cost For Retrofit	$34,024	$$
Simple Pay Back Period	15.34	Yrs
Type of Recommendation	Capital Cost ECM Recommendation	

ECM EXPLANATION:

The highest water utilization at any home/office occurs in the restrooms. It is estimated that on an average a normal human being uses the restroom at least four times a day. Keeping with the global water conservation objectives, federal law prohibits use of any new water closet flushes over 1.6 GPF. At the same time the '1992 EpACT' mandates all new Urinals to have a maximum 1.0 GPF flush valves on urinals.

EMG recommends replacing all urinals above 1.0 GPF with a new 0.5 GPF or lesser urinals. At the same time EMG also recommends replacing all the water closets having a GPF rating of 1.6 and over with low flow water closet fixtures equipped with dual flush valves.

In case the property doesn't wish to replace the entire water closet fixtures, EMG recommends retrofitting all the tankless water closet flush fixtures with new dual flush fixtures that would result in a 30% water savings per flush for liquid wastes, while retaining the same flush rate for solid wastes.

SUMMARY:

Initial Investment:	$34,024	Simple Payback Period:	15.34 Yrs
Annual Cost Savings:	$2,218		

APPENDIX E:
Solar PV

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

Select State: Northern California | **Electric Rate:** **$0.17** $/KWH | Annual Electric Consumption: 233,467 KWh

Roof No.	Description	Number of Roofs	DC System Size Per Roof	PV System Sizing For All Roofs	Estimated Number of 315 Watt PV Panels:	Total Estimated Annual Electricity Generated/ Roof	Total Estimated Electricity Generated (All Roofs)	Total Cost Savings	Installation Cost: ($3.5/Watt)	Simple Pay Back Period without Incentives	One Time Potential Utility or State Incentives	One Time Potential Federal Incentives	Annual Potential Incentives and Rebates		Simple Pay Back Period with All Incentives
			kW	kW		kWh	kWh			Yrs		Dept. of Treasury Renewable Grant (30%)	Federal REPI Incentive	Solar Renewable Certificates (SRECS)- (~$0/MWH)	Years
												30%	$0.02	$0	
1	Building 1	1	35.40	35	112	53,489	53,489	$9,093	$123,900	13.6	$0	$37,170	$1,177	$0	8.2
2	Building 2	1	22	22	69	32,789	32,789	$5,574	$75,950	13.6	$0	$22,785	$721	$0	8.2
3	Building 3	1	21	21	68	32,335	32,335	$5,497	$74,900	13.6	$0	$22,470	$711	$0	8.2
4	Building 4	1	19	19	60	28,407	28,407	$4,829	$65,800	13.6	$0	$19,740	$625	$0	8.2
5	Building 5	1	25	25	78	37,322	37,322	$6,345	$86,450	13.6	$0	$25,935	$821	$0	8.2
6	Building 6	1	9	9	30	14,052	14,052	$2,389	$32,550	13.6	$0	$9,765	$309	$0	8.2
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	
		6		**131**	**417**	**198,394.0**	**198,394**	**$33,727**	**$459,550**	**13.63**	**$0**	**$137,865**	**$4,365**	**$0**	**8.24**

Solar Rooftop Photovoltaic Analysis		
Total Number of Roofs	6	
Estimated Number of Panels	417	
Estimated KW Rating	131	KW
Potential Annual KWh Produced	198,394	KWh
% of Current Electricity Load	85.0%	

Financial Analysis		
Investment Cost	$459,550	
Estimated Energy Cost Savings	$33,727	
Potential Rebates	$137,865	
Potential Annual Incentives	$4,365	
Payback without Incentives	13.6	years
Incentive Payback but without SRECS	8.2	years
Payback with All Incentives	8.2	years