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

PREPARED BY:
EMG / A Bureau Veritas Company
10461 Mill Run Circle, Suite 1100
Owings Mills, Maryland 21117
800.733.0660

www.emgcorp.com

EMG CONTACT:
Kaustubh Anil Chabukswar
Program Manager
800.733.0660 x7512
kachabukswar@emgcorp.com

EMG PROJECT #:

136988.19R000-092.268

DATE OF REPORT:

November 26, 2019

ONSITE DATE:

September 11, 2019

ZERO NET ENERGY ASHRAE LEVEL II AUDIT

EDWARD KELLY PRESCHOOL

3340 Bradshaw Road

Sacramento, CA 95827

TABLE OF CONTENTS

Certification

EMG has completed an Energy Audit of Edward Kelly Preschool located at 3340 Bradshaw Road in Sacramento, CA. EMG visited the site on September 11, 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, CA. Since actual installed costs may vary widely for particular installation based on labor & material rates at time of installation, EMG does not guarantee installed cost estimates and shall in no event be liable should actual installed costs vary from the estimated costs herein. We strongly encourage the owner to confirm these cost estimates independently. EMG does not guarantee the costs savings estimated in this report. EMG shall in no event be liable should the actual energy savings vary from the savings estimated herein.

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

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

Prepared by: Henry Guo
Energy Auditor
Project Manager

Reviewed by: 

Kaustubh Anil Chabukswar, CEM CRM
Program Manager

1. Executive Summary

The purpose of this Energy Audit is to provide Sacramento City Unified School District and Edward Kelly Preschool 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	Edward Kelly Preschool	School	3,456	100

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

1.1. Energy Conservation Measures

EMG has identified three Energy Conservation Measures (ECMs) for this property. The savings for each measure is calculated using standard engineering methods followed in the industry, and detailed calculations for ECM are provided in Appendix for reference. A 10% discount in energy savings was applied to account for the interactive effects amongst the ECMs. In addition to the consideration of the interactive effects, EMG has applied a 15% contingency to the implementation costs to account for potential cost overruns during the implementation of the ECMs.

The following table summarizes the recommended ECMs in terms of description, investment cost, energy consumption reduction, and cost savings.

Summary of Financial Information for Recommended Non-Renewable Energy Conservation Measures

ITEM	ESTIMATE
Net Initial ECM Investment *(Current Dollars Only)*	$5,721 *(In Current Dollars)*
Estimated Annual Cost Savings *(Current Dollars Only)*	$1,371 *(In Current Dollars)*
ECM Effective Payback	4.17 years
Estimated Annual Energy Savings	33.21%
Estimated Annual Energy Utility Cost Savings *(Excluding Water)*	46.28%
Estimated Annual Water Cost Saving	0.00%

Solar Photovoltaic (PV) Screening for EDWARD KELLY PRESCHOOL

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS		
Estimated Number of Panels	72	
Estimated KW Rating	23	KW
Potential Annual kWh Produced	34,149	kWh
% of Current Electricity Uses	411.5%	
FINANCIAL SUMMARY		
Investment Cost	$79,100	
Estimated Energy Cost Savings	$5,976	
Payback without Incentives	13.2	Years
Incentive Payback but without SRECs	8.0	Years
Payback with All Incentives	8.0	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)	31 kBtu/ft^2
Post ECM Site Energy Use Intensity (EUI)	21 kBtu/ft^2
SOURCE ENERGY USE INTENSITY (EUI)	**RATING**
Current Source Energy Use Intensity (EUI)	51 kBtu/ft^2
Post ECM Source Energy Use Intensity (EUI)	27 kBtu/ft^2
BUILDING COST INTENSITY (BCI)	**RATING**
Current Building Cost Intensity	$0.71/ft^2
Post ECM Building Cost Intensity	$0.38/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	36 MMbtu
Total CO_2 Emissions Reduced	2.73 $MtCO_2$/Yr
Total Cars Off the Road (Equivalent)*	0
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	107,016 kBtu
Total Annual Energy Savings for Non-Renewable Energy Measures	35,538 kBtu
Total Annual Energy Savings from Renewable Energy Measures	116,516 kBtu
Total Annual Energy Savings	152,054 kBtu
Net Energy Consumption from Grid Post Implementation	-45,038 kBtu
% Energy Reduction (Annual Energy-Net Energy) / (Annual Energy)	142%

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 Edward Kelly Preschool

ECM #	Description of ECM	Projected Initial Investment	Estimated Annual Energy Savings		Estimated Annual Water Savings	Estimated Cost Savings	Estimated Annual O&M Savings	Total Estimated Annual Cost Savings	Simple Payback	S.I.R.	Life Cycle Savings	Expected Useful Life (EUL)
			Natural Gas	Electricity								
		$	Therms	kWh	kgal	$	$	$	Years		$	Years
Capital Cost Recommendations												
1	Upgrade Building Lighting to LED and Install Automatic Lighting Controls Location: Building Interior And Exterior	$2,570	0	4,303	0	$675	$258	$934	2.75	4.34	$8,577	15.00
2	Reduce HVAC Hours of Operation Location: Implement Programmable Thermostat Settings	$412	107	1,655	0	$416	$0	$416	0.99	12.04	$4,550	15.00
3	Control External Air Leakage In Commercial Buildings Location: Extrior Doors	$1,993	70	405	0	$165	$8	$174	11.47	1.04	$81	15.00
Total For Capital Cost		**$4,975**	**178**	**6,364**	**0**	**$1,256**	**$267**	**$1,523**	**3.27**			
	Interactive Savings Discount @ 10%		-18	-636	0	-$126	-$27	-$152				
	Total Contingency Expenses @ 15%	$746										
Total for Improvements		**$5,721**	**160**	**5,727**	**0**	**$1,131**	**$240**	**$1,371**	**4.17**			

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 Edward Kelly Preschool

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	Upgrade Insulation Location: Attic/Ceiling Throughout	$9,027	158	847	0	$362	$0	$362	24.94	0.70	-$2,723	25.00
2	Replace Inefficient Furnace and Air Conditioning System Location: Throughout	$10,294	120	1,074	1	$342	$17	$360	28.62	0.50	-$4,943	20.00
3	Replace External Windows Location: Throughout	$27,090	119	3,831	0	$774	$8	$782	34.64	0.50	-$13,474	25.00
Total for Improvements		**$9,027**	**158**	**847**	**0**	**$362**	**$0**	**$362**	**24.94**			

2. Introduction

The purpose of this Energy Audit is to provide Edward Kelly Preschool 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.

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Energy and Water Using Equipment

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

Building Envelope

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

Recommendations for Energy Savings Opportunities

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

Analysis of Energy Consumption

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

Energy Audit Process

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

Reporting

The EMG Energy Audit Report includes:

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

3. Facility Overview and Existing Conditions

3.1. Building Occupancy and Point of Contact

FACILITY SCHEDULE	
Hours of Operations / Week	50
Operational Weeks / Year	38
Estimated Facility Occupancy	100
% of Male Occupants	50%

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

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

Description:

A furnace unit located in the Entry room provides heating for the building and a condensing unit located outside the building provides cooling.

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	-
Hydronic Distribution System	Not Applicable
Primary Heating Fuel	Natural Gas
Heating Mode Set-point	68 °F
Heating Mode- Set-back Temperature	65 °F

BUILDING COOLING SYSTEM	
Primary Cooling System	Split Systems
Secondary Cooling System	None

Hydronic Distribution System	Not Applicable
Cooling Mode Set-point	68 °F
Cooling Mode- Set-back Temperature	74 °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	Electricity

3.3. Lighting

Description:

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

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

4. Utility Analysis

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

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

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

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

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

Utility Rates used for Cost Analysis

ELECTRICITY (BLENDED RATE)	NATURAL GAS	WATER / SEWER
$0.157 /kWh	$1.45/therm	$0.23/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.

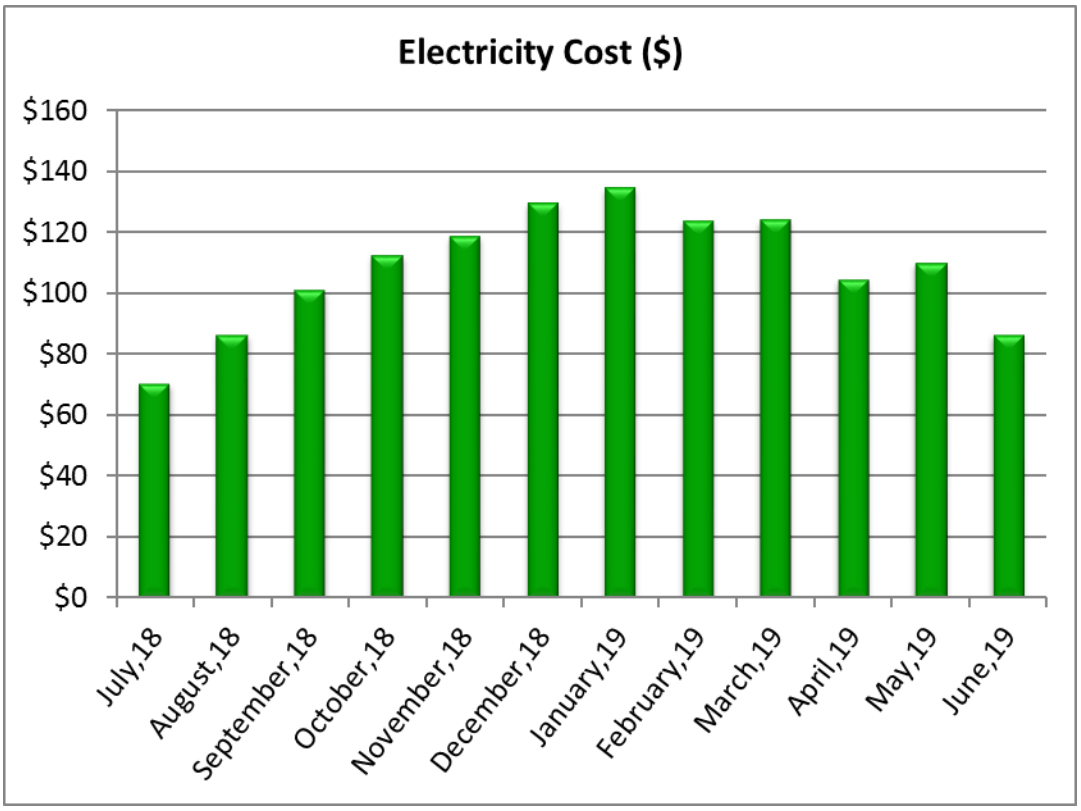
4.1. Electricity

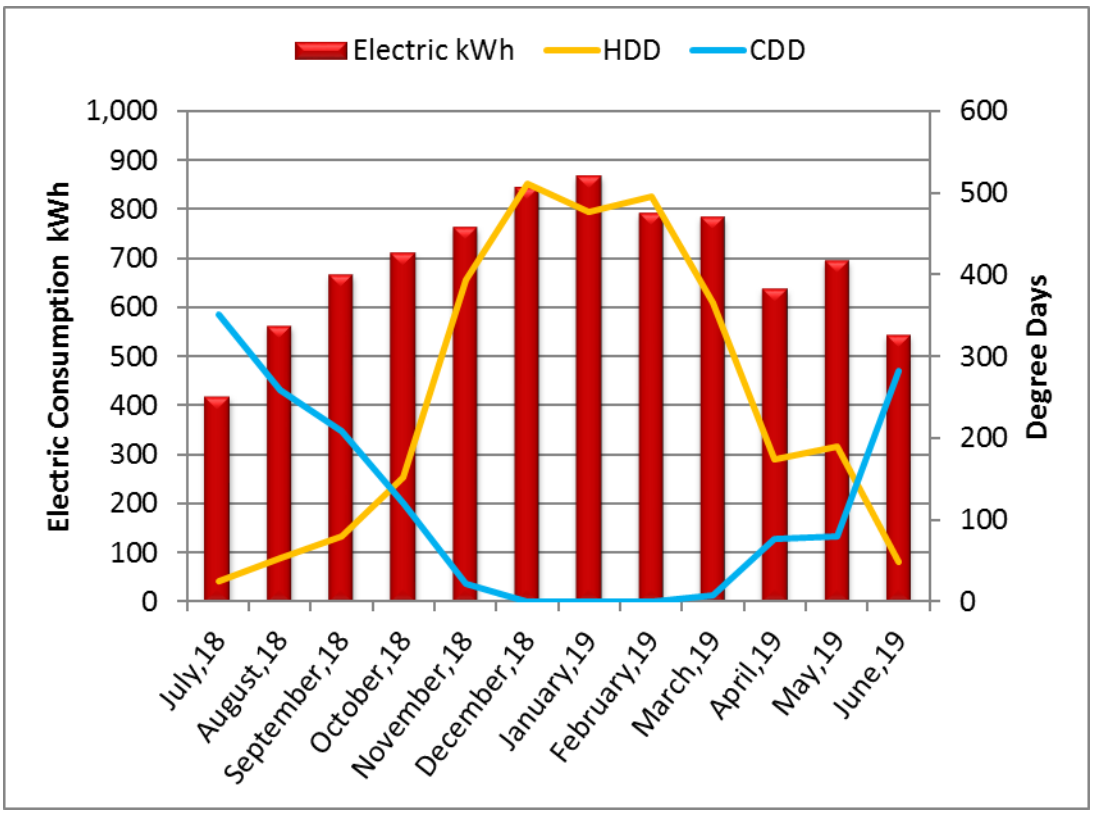
PGE satisfies the electricity requirements for the facility. The primary end uses for electric utility compromises of lighting, cooling, office/school equipment, and appliances in the break room.

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	419	$0.17	$70
August,18	563	$0.15	$87
September,18	669	$0.15	$101
October,18	712	$0.16	$112
November,18	764	$0.16	$119
December,18	845	$0.15	$130
January,19	870	$0.15	$135
February,19	794	$0.16	$124
March,19	785	$0.16	$124
April,19	638	$0.16	$105
May,19	697	$0.16	$110
June,19	544	$0.16	$86
Total/average	**8,299**	**$0.16**	**$1,302**


Electricity Cost ($)
$160
$140
$120
$100
$80
$60
$40
$20
$0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19


Electric kWh
HDD
CDD
Electric Consumption kWh
Degree Days
1,000
900
800
700
600
500
400
300
200
100
0
600
500
400
300
200
100
0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

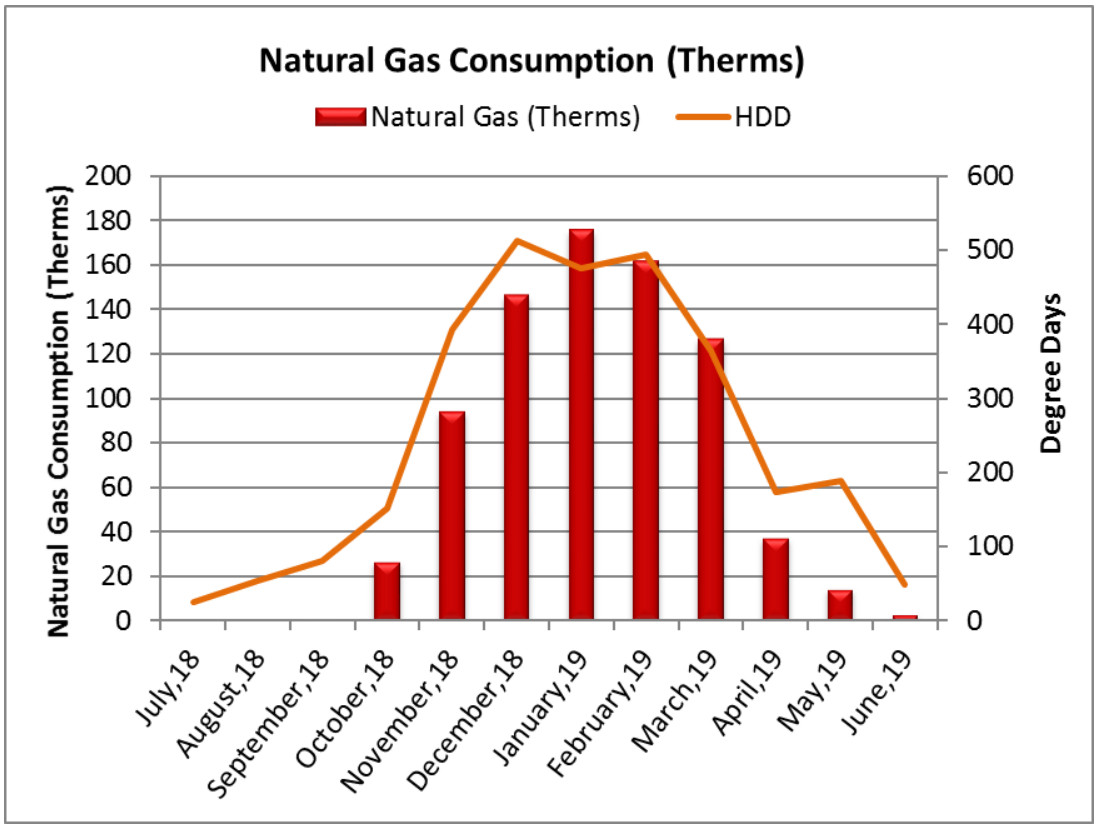
4.2. Natural Gas

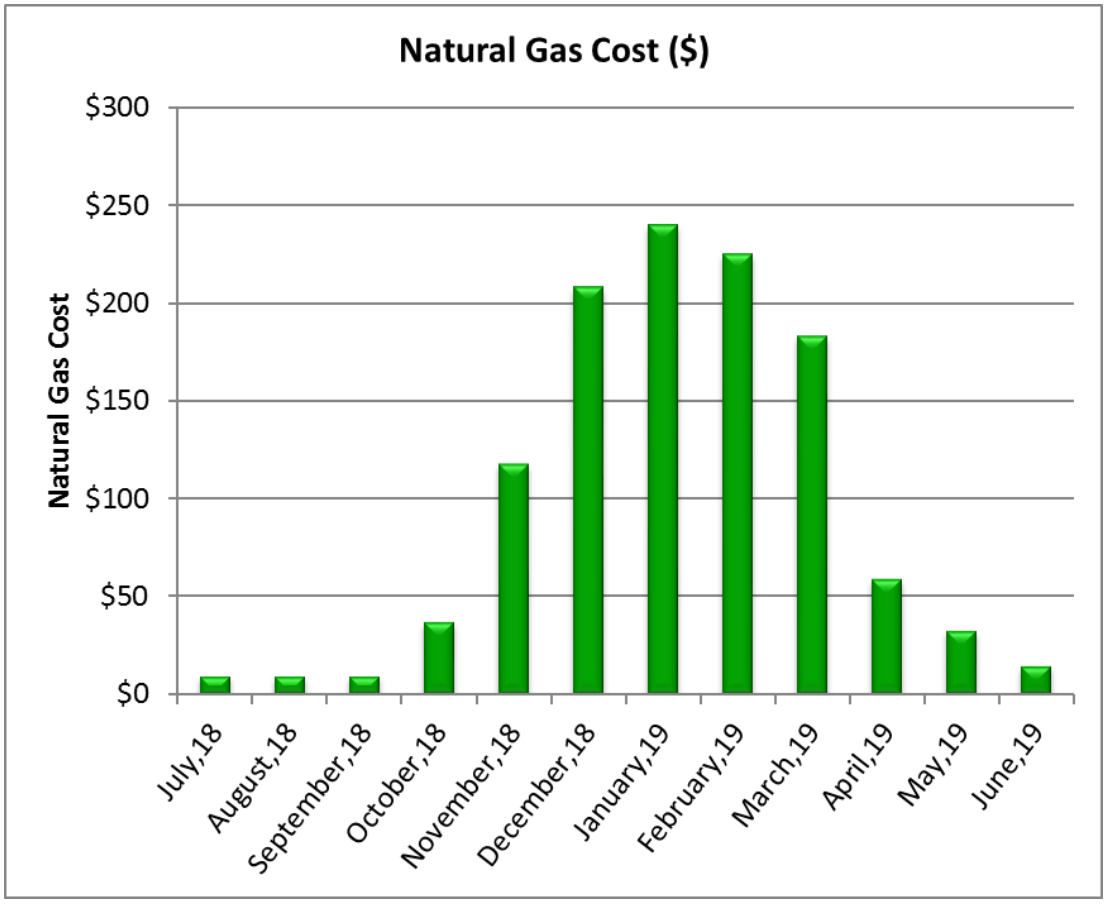
Spurr Gas satisfies the natural gas requirements of the facility. The primary end use of natural gas is for building heating, domestic water heating, and cooking in the cafeteria.

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	0	0	$9
August,18	0	0	$9
September,18	1	$12.34	$9
October,18	27	$1.37	$37
November,18	94	$1.25	$118
December,18	146	$1.42	$208
January,19	176	$1.36	$240
February,19	162	$1.39	$225
March,19	127	$1.44	$183
April,19	37	$1.57	$58
May,19	14	$2.26	$32
June,19	3	$5.24	$14
Total/average	**787**	**$1.45**	**$1,141**


Natural Gas Consumption (Therms)
Natural Gas (Therms)
HDD
Natural Gas Consumption (Therms)
Degree Days
200
180
160
140
120
100
80
60
40
20
0
600
500
400
300
200
100
0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

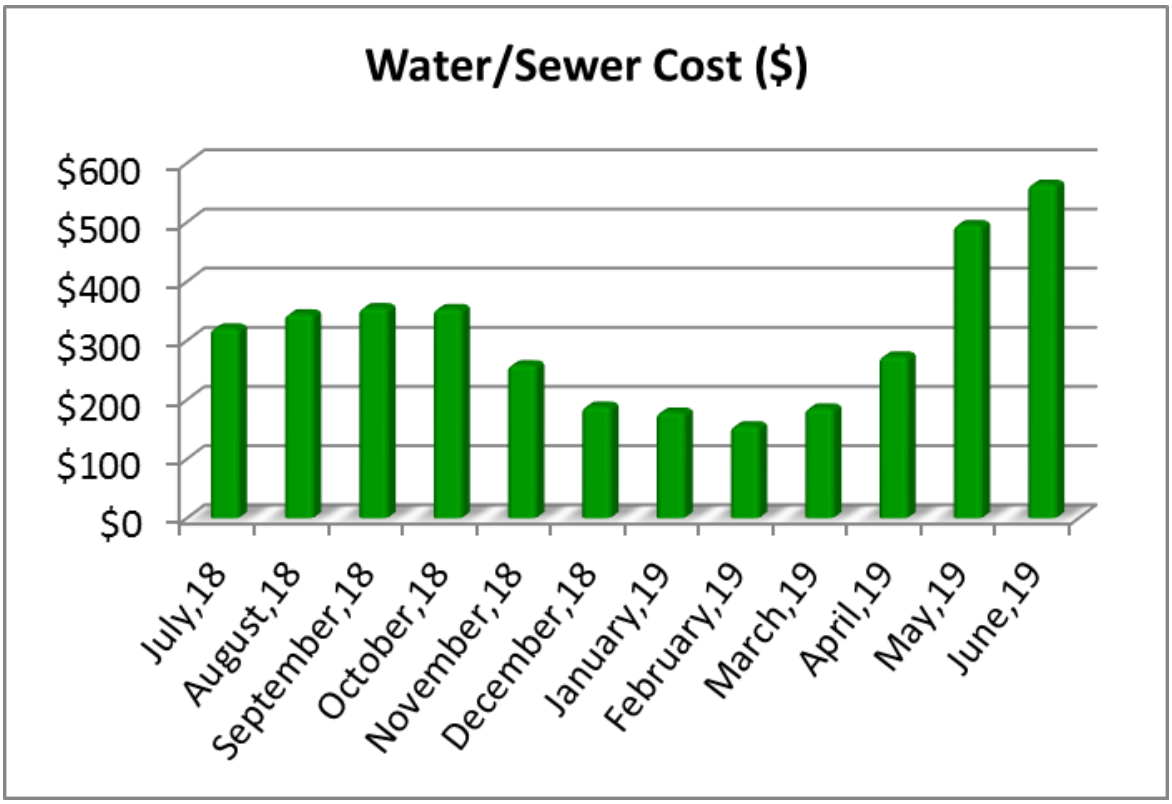

Natural Gas Cost ($)
Natural Gas Cost
$300
$250
$200
$150
$100
$50
$0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

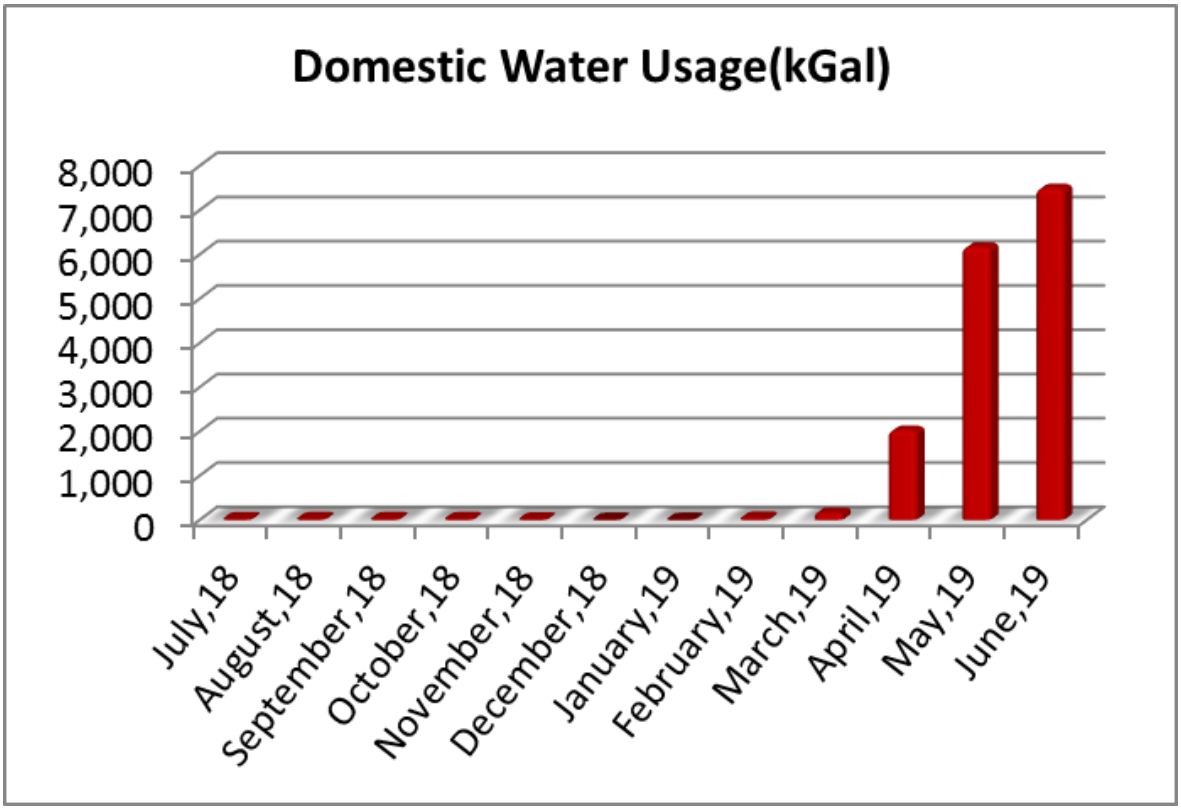
4.3. Water and Sewer

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

Water and Sewer Consumption and Cost Data

BILLING MONTH	CONSUMPTION (KGAL)	UNIT COST/KGAL	TOTAL COST
July,18	29	$10.99	$321
August,18	35	$9.91	$345
September,18	35	$10.04	$356
October,18	33	$10.58	$354
November,18	18	$14.79	$259
December,18	4	$52.73	$189
January,19	2	$118.75	$179
February,19	51	$3.08	$156
March,19	164	$1.14	$186
April,19	2,030	$0.13	$274
May,19	6,171	$0.08	$496
June,19	7,497	$0.08	$564
Total/average	**16,069**	**$0.23**	**$3,680**


Water/Sewer Cost ($)
$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


Domestic Water Usage(kGal)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

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?	**Needs to be analyzed**
Is the property located in a state eligible for net metering?	**Yes**

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

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

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

2) Calculate energy and cost savings for the site as a sole proprietor of the system capable of collecting state, local, and federal tax credits and incentives and interconnecting and selling the renewable energy electrical production to the building.

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS		
Estimated Number of Panels	72	
Estimated KW Rating	23	KW
Potential Annual kWh Produced	34,149	kWh
% of Current Electricity Uses	411.5%	
FINANCIAL SUMMARY		
Investment Cost	$79,100	
Estimated Energy Cost Savings	$5,976	
Payback without Incentives	13.2	Years
Incentive Payback but without SRECs	8.0	Years
Payback with All Incentives	8.0	Years

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

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

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

A kilowatt-hour costing $0.15 might be valued at $0.30 when produced by PV and sent to the grid. The economics of PV for commercial industrial installations become attractive when coupled with incentives from Federal and state agencies, as well utility companies.

The low payback period is highly dependent on the marketing potential of selling Solar Renewable Certificates to electricity generated providers who are under state regulations to contain a certain percentage of their electricity generation derived from renewable energy such as wind and solar.

Solar facilities are encouraged to sell their SRECs on the market (either spot market or through long-term contracts). Utilities may use SRECs for compliance under the state RPS for the year in which they are generated. Utilities may purchase up to 10% more SRECs than they require for compliance and "bank" those surplus SRECs for compliance during the following two years. Any SRECs pricing can range from $300 - $450/MWh and can be sold across state borders to other utility providers looking to purchase SRECs. EMG has selected to use the market value of $300/MWh minus 5% administrative fee in the analysis.

A number of states and corresponding electrical utility supplier are required under regulation to have a certain percentage of its electricity be produced by solar energy. To offset that they allow other utility companies to buy Renewable Energy Credits (REC) credit off their customers and facilities that produce their own solar energy. Typically, the national market, the utility market is $400 per MWh to Utility Suppliers for not meeting this standard percentage so these REC credits are sold for $350 per MWH. (1 REC credit = 1 MWH).

State charges these utility companies to meet their state compliance of 0.2% of the entire electricity consumption from solar energy by 2022 (from.005% in 2008 aggregated up to 0.2% by 2022). The REC credits correspond to these percentages as they aggregate each year.

6. Operations and Maintenance Plan

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

Building Envelope

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

Heating and Cooling

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

Central Domestic Hot Water Heater

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

Lighting Improvements

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

Existing Equipment and Replacements

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

7. Appendices

APPENDIX A: Glossary of Terms

APPENDIX B: Mechanical Equipment Inventory

APPENDIX C: Lighting System Schedule

APPENDIX D: ECM Checklist

APPENDIX E: ECM Calculations

APPENDIX F: Solar PV

APPENDIX A:
Glossary of Terms

Glossary of Terms and Acronyms

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

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

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

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

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

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

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

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

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

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

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

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

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

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

APPENDIX B:
Mechanical Equipment Inventory

Mechanical Inventory							
System	Make	Model	Serial Number	Input Capacity	Room Number	Space Served	Quantity
Condensing Unit/Heat Pump	Ruud	RA1460AJ1NA	W261756008	5 TON	Building exterior	Edward Kelly Preschool	1
Furnace	Carrier	58MXA080-F-1--16	4502A14192	80 MBH	Classrooms	Edward Kelly Preschool	1
Water Heater	Sears Electric	153.10388	H68 57645	16 - 29 GAL	Kitchen	Edward Kelly Preschool	1

APPENDIX C:
Lighting System Schedule

										Lamp Details				Fixture Details				Existing Consumption	
Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	Additional Area Description	LUX	Control Quantity	Existing Control	Technology	Sub-Technology	Lamp Type	Total Lamps	Fixture Type	Fixture Quantity	24x7 Fixture Count	Fixture Height	Annual Hours	Existing Annual kWh
1	Edward Kelly Preschool	Interior		HALLWAY	H1		-	1	Light Switch	Incan/H/MR	Incan	I15-Globe	1	Pendant-Direct	1	0	8	2,100	32
2	Edward Kelly Preschool	Interior		CLASSROOM	O1		115	2	Light Switch	Linear Fluorescent	T12	8' 75W T12	16	1x4 Prism Troffer	8	0	8	2,100	2,520
3	Edward Kelly Preschool	Interior		STORAGE	S1		-	2	Light Switch	Incan/H/MR	Incan	I75-A19	2	Vanity-Direct	2	0	8	665	100
4	Edward Kelly Preschool	Interior		KITCHEN	K1		95	1	Light Switch	Linear Fluorescent	T12	8' 75W T12	4	1x4 Prism Troffer	2	0	8	1,750	525
5	Edward Kelly Preschool	Interior		RESTROOM	T2		110	1	Light Switch	Incan/H/MR	Incan	I75-A19	1	Vanity-Direct	1	0	8	2,100	158
6	Edward Kelly Preschool	Interior		CLASSROOM	Ext		-	1	Timer	LED	-	-	6	Wallpack-Horizontal	6	0	8	2,100	-
7	Edward Kelly Preschool	Interior		CLASSROOM	Ext		-	1	Timer	HID	HPS	HPS1000	1	Wallpack-Horizontal	1	0	8	2,100	2,100
8	Edward Kelly Preschool	Interior		RESTROOM	T1		-	1	Light Switch	Incan/H/MR	Incan	I75-A19	1	Vanity-Direct	1	0	8	2,100	158
9	Edward Kelly Preschool	Interior		CLASSROOM	Ext		-	1	Timer	Incan/H/MR	Incan	I150-Flood	2	Track Lighting	1	0	8	2,100	630
	Totals												34		23			17,115	6,221

									Fixture Details						Existing Consumption				Proposed- Post Retrofit				
Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	Additional Area Description	Existing Control	Control Quantity	Technology	Sub-Technology	Lamp- Fixture	Fixture Quantity	Total Lamps	Fixture Height	Annual Hours	Existing Annual kWh	ECM	ECM Type	Recommended Sensor	LED Lamp Retrofit	Annual Hours of Operation	Proposed Annual kWh	Annual Savings From LED Retrofit
																							kWh
1	Edward Kelly Preschool	Interior		HALLWAY	H1		Light Switch	1	Incan/H/MR	Incan	I15-Globe; Pendant-Direct	1	1	8	2,100	32	ECM	RB - Replace Bulb	Wall Mounted	11W LED A19	1,785	20	12
2	Edward Kelly Preschool	Interior		CLASSROOM	O1		Light Switch	2	Linear Fluorescent	T12	8' 75W T12; 1x4 Prism Troffer	8	16	8	2,100	2,520	ECM	RB - Replace Bulb	Ceiling Mounted	8' 40W LED T8	1,785	1,142	1,378
3	Edward Kelly Preschool	Interior		STORAGE	S1		Light Switch	2	Incan/H/MR	Incan	I75-A19; Vanity-Direct	2	2	8	665	100	ECM	RB - Replace Bulb	Wall Mounted	11W LED A19	565	12	87
4	Edward Kelly Preschool	Interior		KITCHEN	K1		Light Switch	1	Linear Fluorescent	T12	8' 75W T12; 1x4 Prism Troffer	2	4	8	1,750	525	ECM	RB - Replace Bulb	Ceiling Mounted	8' 40W LED T8	1,488	238	287
5	Edward Kelly Preschool	Interior		RESTROOM	T2		Light Switch	1	Incan/H/MR	Incan	I75-A19; Vanity-Direct	1	1	8	2,100	158	ECM	RB - Replace Bulb	Wall Mounted	11W LED A19	1,785	20	138
6	Edward Kelly Preschool	Interior		CLASSROOM	Ext		Timer	1	LED	-		6	6	8	2,100				Retain Existing Controls				
7	Edward Kelly Preschool	Interior		CLASSROOM	Ext		Timer	1	HID	HPS	HPS1000; Wallpack-Horizontal	1	1	8	2,100	2,100	ECM	RF - Replace Entire Fixture	Retain Existing Controls	200W LED Wall Pack	2,100	420	1,680
8	Edward Kelly Preschool	Interior		RESTROOM	T1		Light Switch	1	Incan/H/MR	Incan	I75-A19; Vanity-Direct	1	1	8	2,100	158	ECM	RB - Replace Bulb	Wall Mounted	11W LED A19	1,785	20	138
9	Edward Kelly Preschool	Interior		CLASSROOM	Ext		Timer	1	Incan/H/MR	Incan	I150-Flood; Track Lighting	1	2	8	2,100	630	ECM	RB - Replace Bulb	Retain Existing Controls	11W LED A19	2,100	46	584
	Totals												34									1,918	4,303

APPENDIX D:
ECM Checklist

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

APPENDIX E:
ECM Calculations

UIC	Reduce HVAC Hours of Operation
EAC3	Location: Implement Programmable thermostat settings

No of Programmable Thermostats To Be Installed : 2 Qty.

Select Type of Programmable Thermostat Recommended: 7-Day Programmable Thermostat *(Select)*
(Selection Based on Type of Property)

Heating Load Calculation

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

Estimated Current Annual Energy Consumption For Winter Heating: 608 Therms

	Weekdays	Weekends
Day Time Set Back Hours	6.00	10.00
Night Time Set Back Hours	8.00	10.00
Hours Without Set Back	10.00	4.00

Typical Indoor Temp	69.00	°F
Temp Set Point With Set Back During Day Time	60.00	°F
Temp Set Point With Set Back During Night Time	60.00	°F
Average Heating Set Point	63.11	°F
Savings Per Degree Set Back For Heating Season *(Industry Standard, 2004)*	3%	
Estimated Annual Heating Energy Consumption	60,800	kBtu
Estimated New Annual Heating Energy Consumption	50,051	kBtu
Estimated Annual Heating Energy Savings	107	Therms

Cooling Load Calculation

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

Estimated Current Annual Energy Consumption For Summer Cooling: 3,511 kWh

	Weekdays	Weekends
Day Time Set Back Hours	6.00	10.00
Night Time Set Back Hours	8.00	10.00
Hours Without Set Back	10.00	4.00

Typical Indoor Temp	73.00	°F
Temp Set Point With Set Back During Day Time	85.00	°F
Temp Set Point With Set Back During Night Time	85.00	°F
Average Cooling Set Point	80.86	°F
Savings Per Degree Set Back For Cooling Season *(Industry Standard, 2004)*	6%	
Estimated Annual Cooling Energy Consumption	11,980	kBtu
Estimated New Annual Cooling Energy Consumption	6,332	kbtu
Estimated Annual Cooling Energy Savings	1,655	kWh

Cost Analysis

Average Annual Cost of Heating Fuel:	$1.45	$/Therm
Average Annual Cost of Electricity:	$0.16	$/kWh
Estimated Annual Heating Cost Savings:	$156	$$
Estimated Annual Cooling Cost Savings:	$260	$$

Estimated Installation Cost Per Thermostats: *(Includes Material, Labor & Installation Costs)*	$138	$$
Total Estimated Cost For All Programmable Thermostats	$412	$$
Total Estimated Cost Savings From All Programmable Thermostats	$416	
Estimated Simple Pay Back Period	0.99	Yrs

Type of Recommendation: No/Low Cost ECM Recommendation

ECM DESCRIPTION:

Turning off energy-consuming systems when they are not needed is the most basic energy conservation technique. When a building is occupied intermittently, energy savings can be realized by minimizing the time the heating or cooling system is operated when the building is closed. Building control algorithms should be implemented to delay startup until the last moment and to shut down as early as possible.

Because of the thermal inertia of both the building structure and its heating and cooling equipment, preheat or precool time is almost always required to raise or lower the space temperature to the desired level before the occupants return. This start-up time depends on the outdoor environment, the thermal response of the building, and the thermal performance of the space conditioning equipment. Similarly, the thermal inertia of the building maintains the indoor temperature at a comfortable level for a short period of time after the equipment is shut off. It allows the system to be turned off before the end of an occupied period. An optimum start/stop control accounts for these factors.

SUMMARY

Initial Investment:	$412	Simple Payback Period:	0.99 Yrs
Annual Energy Cost Savings	$416		

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

	No. of ECMs	No. of Fixtures	No. of Lamps	KWh Saved	Energy Cost Saving	O & M Savings
Upgrade Lighting to LED	296	17	28	4,303	$675.33	$258.44

Existing Technology	Sub-Technology	No. of ECMs	No. of Fixtures	No. of Lamps	KWh Saved	Energy Cost Saving	O & M Savings
CFL	CFL - 2 Pin	0	0	0	0	$0	$0
CFL	CFL - 4 Pin	0	0	0	0	$0	$0
CFL	CFL - Screw-in	0	0	0	0	$0	$0
Circiline	T9	0	0	0	0	$0	$0
Incan/H/MR	H	0	0	0	0	$0	$0
Incan/H/MR	Incan	5	6	6	959	$150	$182
Incan/H/MR	MR	0	0	0	0	$0	$0
HID	HPS	1	1	1	1,680	$264	$18
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	0	0	0	0	$0	$0
Linear Fluorescent	T12	2	10	10	1,665	$261	$59
Linear Fluorescent	T8 U	0	0	0	0	$0	$0
Linear Fluorescent	T12 U	0	0	0	0	$0	$0
Linear Fluorescent	T5	0	0	0	0	$0	$0
Linear Fluorescent	T6	0	0	0	0	$0	$0
Linear Fluorescent	T10	0	0	0	0	$0	$0

Proposed Controls	No. of Controls		No. of Controls
Photo Sensor	0	Ceiling Mounted	3
Wall Mounted	5		

Initial Investment			**Equipment Rentals**	
Material Cost	$1,297.20		Scissor Lift 26' - Interior Spaces	$0.00
Labor Cost	$1,272.82		Bucket Truck - Exterior Spaces	$0.00
Local Electric Rate:	$0.17	$/kWh	Estimated Annual Energy Savings:	4,303
Hourly Labor Rate For Electrician:	$72.40		Estimated Annual Energy Cost Savings:	$675
Budgeted Initial Investment:	$2,570		Estimated Annual O&M Cost Savings:	$258
Estimated Return on Investment: *(Including O&M Savings)*	2.75	Years	Estimated Annual Cost Savings:	$934

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

ENTER EXISTING CONDITION

Insert Existing Estimated Air Change Rate/Hr (ACH 1): *(Existing Air Changes Per Hour, 3 is very leaky and 0.35 ideal)*	0.50	Cubic Feet/Min (CFM 1):	259
Insert Proposed Estimated Air Change Rate/Hr (ACH 2):	0.35	Cubic Feet/Min (CFM 2):	181
Estimated Space Volume Under Consideration	31,104.00 Cu.Ft		

WINTER			SUMMER		
Select Type of Heating Fuel	Natural Gas (Select)		Is The Building Cooled?	Yes	
Estimated Annual Heating Plant Efficiency	85.00	%	Estimated Annual Cooling Plant Efficiency	7.00	EER
Annual Heating Degree Days(HDD):	2,963		Annual Cooling Degree Days(CDD):	1,407	
Estimated Total Annual Input Heating Energy Savings	70	Therms	Estimated Total Annual Input Cooling Energy Savings	405	kWh
Cost/Unit of Heating Fuel:	$1.45	$/Therm	Cost/Unit For Electricity	$0.16	$$
Estimated Annual Heating Cost Savings	$102	$$	Estimated Annual Cooling Cost Savings	$64	$$

Cost Analysis

Install Flush Mounted, Vinyl Door Sweeps ?	Yes	Total Length of Door Sweeps to Be Installed: *(3.5' Standard Width Door)*	60 LF
Install Window Air Conditioner Covers For Winter:	Yes	Number of Air Conditioner Covers To Be Installed: *(Covers would meet HUD Chapter-12 Energ Conservation Compliance Section 329C)*	2
Estimated Annual O&M Savings	$8	Estimated Length of Joints To Be Re-Caulked: *(Includes Demolition and Re-Caulking)*	200 LF
Total Estimated Annual Cost Savings	$174	Total Cost For Controlling Air Leakage	$1,993
Simple Pay Back Period	11.47 Yrs	*Type of Recommendation*	Capital Cost ECM Recommendation

ECM DESCRIPTION:

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

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

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

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

SUMMARY:

Initial Investment:	$1,993	Simple Pay Back Perio	11.47 Yrs
Annual Energy Cost Savings	$174		

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

ENTER EXISTING CONDITION

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

Source: 2009 IECC For Residential Bldgs

"-" Not Specified

Enter Total Surface Area Under Consideration: 3,456 Sq.Ft

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

Proposed Net Effective R-Value: (Sq.Ft deg F/btu) 35

ENTER CLIMATIC & SYSTEM DATA

Annual Cooling Degree Days (CDD): 1,407

Annual Heating Degree Days (HDD): 2,963

Estimated Annual Cooling Plant Efficiency (EER): 7.00 EER

Estimated Annual Heating Plant Efficiency: % 79.00 %

WINTER

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

Annual Conduction Losses From Existing Insulation: 19,505 kBtu

Annual Conduction Losses From Proposed Insulation: 7,022 kBtu

Savings In Conduction Losses After Adding Insulation: 12,483 kBtu

Estimated Total Annual Input Heating Energy Savings: 158 Therms

Cost of Heating Fuel/Unit: $1.45 $/Therm

Annual Heating Cost Savings: $229 $$

SUMMER

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

Annual Conduction Losses From Existing Insulation: 9,262 Kbtu

Annual Conduction Losses From Proposed Insulation: 3,334 kBtu

Savings In Conduction Losses After Adding Insulation: 5,928 kBtu

Estimated Total Annual Input Cooling Energy Savings: 847 kWh

Cost of Electricity/Unit: $0.16 $/kWh

Annual Cooling Cost Savings: $133 $$

COST ANALYSIS

Estimated O&M Savings: $0.00 $$

Total Estimated Annual Cost Savings: $362 $$

Simple Pay Back Period: 24.94 Years

Estimated Cost To Add Insulation/Sqft: $1.75

Estimated Total Installation Cost: $9,027 $$

Type of Recommendation: Capital Cost ECM Recommendation

UIC	Replace Inefficient Furnace and Air Conditioning System
EAH12-A	Location: Throughout

Estimated Annual Cooling Hours:	680	Hrs	Estimated Annual Heating Hours:	950	Hrs
Are The Condensing Units Being Replaced	Yes		Replace Furnace? Yes	Heating Fuel: Natural Gas	
Existing Cooling System			**Existing Heating System**		
No. of Cooling Plants To Be Replaced:	1		No. of Furnaces To Be Replaced:	1	
Input the Btu/Hr of the air conditioner:	60,000		Input the MBH Rating of the Furnace:	80	MBH
Input Existing EER of the Air Conditioner:	9.12		Input Existing AFUE for the Furnace:	80%	%
Estimated Current Annual Energy Consumption For Cooling: *(For All Units)*	4,474	kWh	Estimated Annual Current Energy Consumption For Heating: *(For All Units)*	760	Therms
Proposed Cooling System			**Proposed Heating System**		
Input the Btu/Hr of the Proposed Air Conditioner:	60,000	Btuh	Proposed Furnace:	Gas Fired -75MBH	
Input EER of the Proposed Air Conditioner:	12.00		Input AFUE for the Proposed Furnace:	95%	
Estimated Annual Energy Consumption With New AC's *(For One Unit)*	3,400	kWh	Estimated Annual Energy Consumption With New Furnace *(For One Unit)*	640	Therms
Energy & Cost Savings From New Cooling System			**Energy & Cost Savings From New Heating System**		
Estimated Annual Energy Savings From New Cooling System: *(Total)*	1,074	kWh	Estimated Annual Energy Consumptions From New Heating System: *(Total)*	640	Therms
Average Electric Rate:	$0.16	$/kWh	Average Heating Fuel Cost For New Furnace:	$1.45	$/Therm
Estimated Annual Cost Savings From Cooling:	$168		Estimated Annual Cost Savings From Heating:	$174	$$
Estimated Cost of New Condensing Unit: *(Material + Installation+Labor)*	$4,450		Estimated Cost of New Furnace Unit: *(Material + Installation+Labor)*	$1,302	$$
Estimated Cost of New Evaporator Coils In Furnace: *(Material + Installation+Labor)*	$1,145		Estimated Total Cost of New Furnace Unit: *(Material + Installation+Labor)*	$1,302	$$

Total Estimated Installed Cost For A New Air Conditioning System Setup + New High Efficiency Furnace : *(Includes Location Factor)*			$10,294	$$	
Estimated Total Energy Cost Savings From New HVAC System:	$342	$$	Estimated O&M Savings: $17	Total Annual Savings:	$360 $$
Estimated Simple Pay Back Period:			28.62	Years	
Type of Recommendation	Capital Cost ECM Recommendation				

UIC	Replace External Windows
EAE2	Location: Throughout

ENTER EXISTING CONDITIONS

Existing and Proposed Window Properties

Total Sq.Ft window area:	696	sq.ft
Approximate number of windows:	33	
Total existing window area:	696	Sq.Ft
Select The Existing Window Type	Metal Frame & Single Glazing	*(Select)*
Existing U-value of window: (1/R)	1.31	Btu/ ft²·°F·h
ASHRAE Climatic Zone	Zone-3	
New U-value with Double pane Low E window: (1/R)	0.35	Btu/ ft²·°F·h
AHRAE 90.1 Recommended Value		

Existing & Proposed Air Leakage Through Windows

Insert Existing Estimated Air Change Rate/Hr (ACH 1):	0.75	
(Existing Air Changes Per Hour, 1.5 is very leaky and 0.35 ideal)		
Insert Proposed Estimated Air Change Rate/Hr (ACH 2):	0.53	
Estimated Space Volume Under Consideration	31,089.00	Cu. Ft
Is the Property Cooled ?	Yes	*(Select)*

WINTER

Select Type of Heating Fuel	Natural Gas	*(Select)*
Net heating plant & distribution system efficiency:	79.00	%
Annual Heating Hours:	2,963	HDD
Estimated Total Annual Input Heating Energy Savings By Replacing Windows	6.01	Therms
Estimated Total Annual Input Heating Energy Savings Achieved By Controlling Air Leakage Through Windows	113	Therms
Estimated Total Input Heating Fuel Savings From Replacing Windows	119	Therms

SUMMER

Select Type of Cooling Fuel:	Electric	*(Default)*
Cooling Plant Efficiency **(EER)**:	7.00	**EER**
Annual Cooling Hours:	1,407	CDD
Annual Total Input Cooling Fuel Savings During Summer Season By Replacing Windows	3,223	kWh
Estimated Total Annual Input Cooling Energy Savings Achieved By Controlling Air Leakage Through Windows	607	kWh
Estimated Total Input Cooling Fuel Savings From Replacing Windows	3,831	kWh

ENERGY & COST ANALYSIS

Insert Cost of Heating Fuel:	$1.45	$/Therm	Annual Heating Cost Savings:	$173.06	$$
Insert Cost of Cooling Fuel:	$0.16	$/kWh	Annual Cooling Cost Savings:	$601.14	$$
Total Annual Cost Savings	$782		Total Annual Cost Savings From Heating & Cooling:	$774	$$
Cost of window upgrade:	$27,090		Estimated Annual O&M Savings	$8	$
Simple payback:	34.64	**Yrs**	*Type of Recommendation*	Capital Cost ECM Recommendation	

ECM DESCRIPTION:

Windows play a major role in the energy use and comfort of an interior space. In the winter, heat in a room is lost when cold outside air infiltrates around the edges of windows. Heat also can be lost by conduction directly through the pane, even if the window fits tightly. Windows with insulated panes, such as those filled with Argon address this issue, while proper caulking and sealant address the infiltration issue. The cold drafts and the chilly windowpane make the room uncomfortable. Windows also can help to heat a room by letting the sun's rays enter. While this solar radiation is beneficial in the winter, it can be a major source of discomfort in hot, summer climates. Energy Star rated windows with Low-E glazing are designed to keep the solar heat gain minimized during the summer months. Choosing a replacement window that fits properly has the desired U-value, and proper glazing characteristics is critical to energy conservation through window upgrades.

Summary:

Initial Investment:	$27,090	Simple Payback	34.64 Yrs
Annual Energy Cost Savings:	$782		

APPENDIX F:
Solar PV

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

Select State: Northern California **Electric Rate:** **$0.18** $/KWH Annual Electric Consumption: 8,299 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	12.10	12	38	18,283	18,283	$3,200	$42,350	13.2	$0	$12,705	$402	$0	8.0
2	Building 2	1	11	11	33	15,866	15,866	$2,777	$36,750	13.2	$0	$11,025	$349	$0	8.0
3				0	0		0	$0	$0		$0	$0	$0	$0	
4				0	0		0	$0	$0		$0	$0	$0	$0	
5				0	0		0	$0	$0		$0	$0	$0	$0	
		2		**23**	**72**	**34,149.0**	**34,149**	**$5,976**	**$79,100**	**13.24**	**$0**	**$23,730**	**$751**	**$0**	**8.01**

Solar Rooftop Photovoltaic Analysis		
Total Number of Roofs	2	
Estimated Number of Panels	72	
Estimated KW Rating	23	KW
Potential Annual KWh Produced	34,149	KWh
% of Current Electricity Load	411.5%	

Financial Analysis		
Investment Cost	$79,100	
Estimated Energy Cost Savings	$5,976	
Potential Rebates	$23,730	
Potential Annual Incentives	$751	
Payback without Incentives	13.2	years
Incentive Payback but without SRECS	8.0	years
Payback with All Incentives	8.0	years