Energy Audit

City of Kent Fire Station #1

June 30, 2024

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Executive Summary

Greater Cleveland Partnership has completed an American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Level 2 Energy Audit of the City of Kent Fire Station #1 at 320 S. Depeyster St., Kent, OH 44240. The purpose of this energy audit is to identify cost effective Energy Conservation Measures (ECMs) to reduce energy consumption and greenhouse gas (GHG) emissions.

In the process of completing this audit, Greater Cleveland Partnership analyzed the facility's historical energy usage and completed a site visit to compile a detailed equipment inventory and schedule. From this data, Greater Cleveland Partnership identified ECMs, Operation & Maintenance Measures (OMMs), and Distributed and Renewable Measure (DRM).

SUMMARY OF BASELINE & PROPOSED SAVINGS

Energy	Electricity (kWh)	Natural Gas (therms)	Site EUI	Total GHG Emissions (mtCO2e)
Baseline	334,879	25,684	146.13	385
Proposed	186,931	24,638	122.13	308
Reduction (%)	44.18%	4.07%	16.42%	20%

Proposed Measure	Estimated Measure Cost ($)	Annual Cost Savings ($)	Simple Payback (yrs)	Estimated Energy Savings (kBtu)	Estimated GHG Savings (mtCO2e)	Estimated Electric Savings (kWh)	Estimated Gas Savings (therms)
Addition of Demand Controlled Ventilation (DCV) to HVAC system	10,000	1,044	9.6	71,496	5.72	6,300	500
Lighting Upgrade	28,000	2,213	12.6	85,703	12.24	25,118	-
RTU Zoned Controls	45,000	1,907	>20	50,037	7.15	14,665	-
Replace Natural Gas Packaged RTU	60,000	1,594	>20	90,065	7.95	10,365	547
Solar PV on Bay Roof	167,000 (116,900 after tax incentive)	8,052	14.5	312,198	44.59	91,500	-

Total	310,000	14,810	17.5	609,499	77.65	147,948	1,047

Table 1: Existing Annual Energy Consumption and Proposed Savings

Introduction

Energy auditors from COSE conducted a comprehensive energy assessment on 6/11/24 at City of Kent Fire Station #1 located at 320 S. Depeyster St., Kent, OH. The auditor was Norm Stickney, who was accompanied onsite by Robert Drennan.

The audited building systems included envelope, lighting, cooling, heating, domestic hot water, miscellaneous equipment, and operational/maintenance procedures.

The scope of this audit adheres to the guidelines developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) for a Level 2 audit. As described in ASHRAE's Procedures for Commercial Building Energy Audits, a Level 2 "Energy Survey and Analysis" will identify and provide the savings and cost analyses of all practical energy efficiency measures that meet the owner's/operator's constraints and economic criteria, along with the proposed changes to Operation and Maintenance (O&M) procedures.

A Level 2 audit includes a more detailed survey than a Level 1. Utility analysis is performed based on historical energy bills which may cover consumption data as well as peak demand. It may also provide a listing of potential capital-intensive improvements that require more thorough data collection and engineering analysis. Cost and savings analysis is performed for each measure recommended for implementation. This level of analysis should provide adequate information for the owner/operator to act upon recommendations for most buildings and for most measures.

Facility Description

The City of Kent Fire Station #1 is a Fire Station operated by the Client and has a total floor area of approximately 25,396 sq.ft. The building was built in 2018 and is a 1-story structure. The facility is primarily Fire Station. The building was built in 2018 and is a 1-story structure. The facility is primarily Fire Station. The City of Kent's Main Fire Station serves as a public safety facility and operated as a 24-hour, manned fire house.

BUILDING ENVELOPE

Application	Name	R-Value	Comments
Wall	Metal framing with traditional red brick cladding	R-8	Est. R-Value

Application	Name	R-Value	Comments
Roof	1/3 of the roof area is gabled/sloped metal roofing with the remaining 2/3 roof area being flat, dark black, thermoset/thermoplastic membrane over metal substrate	R-18	Est. R-Value

Application	Name	R-Value	Comments
Window	Doub paned with thermal breaks and slight tint.	R-4	Est. R-Value

Tables: Construction

SPACE HEATING/SPACE COOLING/HVAC/AIR HANDLING (VENTILATION)

Name	Quantity	Location Name
THERMAL SOLUTIONS EV(A,S)0500B**-*A* Boilers	2	Boiler Room
Hot Water Pump (3 hp)	2	Boiler Rom

Name	Quantity	Location Name
TRANE / M# TCD480AE0J2B7NG5 / S# C02C02510 / R-22 / ~2002 Voyager VAV Rooftop Unit	1	Roof

DOMESTIC HOT WATER

Name	Quantity	Location Name
A. O. SMITH BTR-199	2	MER

LIGHTING

Name	Quantity	Location Name	Watts (W)
4 119W T12 4-lamp Magnetic Linear Fluorescent	120	Bay	119
4 89.28W T8 3-lamp Standard Electronic Linear Fluorescent	87	Various	89.28
4' 25/28W T8 3-Lamp, Elect Ballast	60	Various	89.28
4' 25/28W T8 3-Lamp, Elect Ballast	45	Various	89.28
5W 1-lamp LED	10	Various	5
150 WATT LED	10	Exterior	150
6W 1-lamp	25	Various	6

The majority of the general interior fixtures are fluorescent T8 fixtures that have not been upgraded. For the purpose of this report, the number of fixtures were estimated based on the available information. The fixture counts for the facility were estimated. The exterior fixtures have been upgraded to new LED fixtures.

Even though the existing interior fixtures have not been upgraded, the facility does an excellent job of controlling the lighting to reduce energy usage. A number of areas in the facility use occupancy sensors to reduce lighting usage very effectively. Many areas of the facility have limited hours use for the lighting due to occupancy. The truck bay lighting system is T12 fluorescent. These fixtures are not used most of the day. The bay areas have sufficient daylight from the glass doors and the lighting is manually used as needed. It is estimated that these fixtures are used 3 hours a day on the average.

CONTROLS

The HVAC system is controlled by a Trane DDC control system. Access to the system was not available during the audit process. The building is a 24x7 operating building. However, areas of the building are used infrequently or have variable occupancy periods during a day. The facility personnel reported that the occupancy based zone controls in the building had been disable for a long period of time. These sensors and associated VAV boxes in the zones are intended to reduced the HVAC requirement during unoccupied periods.

Currently based on the information provided it is assumed that the building operates as though the building zones are always occupied. These systems being disabled and the lack of ability to easily make program changes may result in longer operation of the equipment during unoccupied or lowly occupied periods.

The facility does an excellent job of controlling the heating system in the equipment bays. The equipment bays are heated by gas fired infrared heating units. The bays are not cooled. The heating in this bay areas is controlled by thermostat that is set to heat only at above approximately 50F. Personnel also manually control the system and it often does not run unless work is required in the bay area.

PLUG LOADS AND MISC LOADS

The report estimated the plug load and miscellaneous loads for the facility. The plug loads are significant due to the nature of the operation and the 24 hour occupancy.

MISC. ENERGY CONSUMING APPLIANCES

Name	Quantity	Energy Source
CHAMPION CENTURIAN II AIR COMPRESSOR	1	ELECTRIC
COMPAIR MAKO BAM 06H	1	ELECTRIC
ICE MAKER MACHINE (COMMERCIAL)	1	ELECTRIC
UNIMAT “UNIMAC 35” – HEAVY DUTY, COMMERCIAL CLOTHS WASHER	1	ELECTRIC
CLOTHES WASHING MACHINE - RESIDENTIAL	1	ELECTRIC
CLOTHES DRYING MACHING - RESIDENTIAL	1	ELECTRIC
OVEN RANGE EXHAUST HOOD (SMALL)	1	ELECTRIC
REFRIGERATOR / FREEZER - RESIDENTIAL	3	ELECTRIC
VULCAN 6-BURNER RANGE TOP WITH 2 OVENS AND SMALL FLAT TOP	1	NAT. GAS
UNDERCABINET DISHWASHER	1	ELECTRIC
VEHICLE BATTERY CHARGING	9	ELECTRIC
AUDIO / VISUAL EQUIPMENT (COUNCIL CHAMBERS)	1	ELECTRIC

NOTE : ESTIMATED COUNTS FROM OBSERVATIONS AT SITE VISIT.

Energy Consumption Analysis

The historical energy usage at the City of Kent Fire Station #1 was analyzed using utility data. This analysis of the building’s energy use from January 2023 to December 2023. The information will be enhanced with the addition of Heating Degree Days (HDD) and Cooling Degree Days (CDD) to account for differences in weather across the reporting period. A summary of the facility’s energy usage and expenses is shown in the table below.

	Electric Usage (kWh)	Electric Total Cost ($)	Total Energy Use (kBtu)	Total Cost ($)	Site EUI (kBtu/SqFt)	Total Cost Per Square Foot ($/SqFt)
2023	767,173.33	67,510.99	4,913,248.4	84,499.25	193.47	3.33
Average	767,173.33	67,510.99	4,913,248.4	84,499.25	193.47	3.33

Table: Energy Usage

ELECTRICITY CONSUMPTION

Electricity at the City of Kent Fire Station #1 is provided by FirstEnergy. The monthly electricity consumption from January 2023 to December 2023 is displayed in the Table and Figure below.

	Electric Usage (kWh)		Electric Usage Cost ($)	
	2023	Average	2023	Average

Jan	53,033.33	53,033.33	4,666.7	4,666.7
Feb	48,473.33	48,473.33	4,265.63	4,265.63
Mar	55,293.33	55,293.33	4,865.47	4,865.47
Apr	51,720	51,720	4,551.13	4,551.13
May	56,893.33	56,893.33	5,006.77	5,006.77
Jun	69,100	69,100	6,081	6,081
Jul	83,406.67	83,406.67	7,339.43	7,339.43
Aug	84,526.67	84,526.67	7,437.93	7,437.93
Sep	69,040	69,040	6,075.7	6,075.7
Oct	70,886.67	70,886.67	6,238.23	6,238.23
Nov	70,600	70,600	6,213	6,213
Dec	54,200	54,200	4,770	4,770
Total	767,173.33	767,173.33	67,510.99	67,510.99

Table: Monthly Electrical Consumption

Electricity Consumption and Degree Days

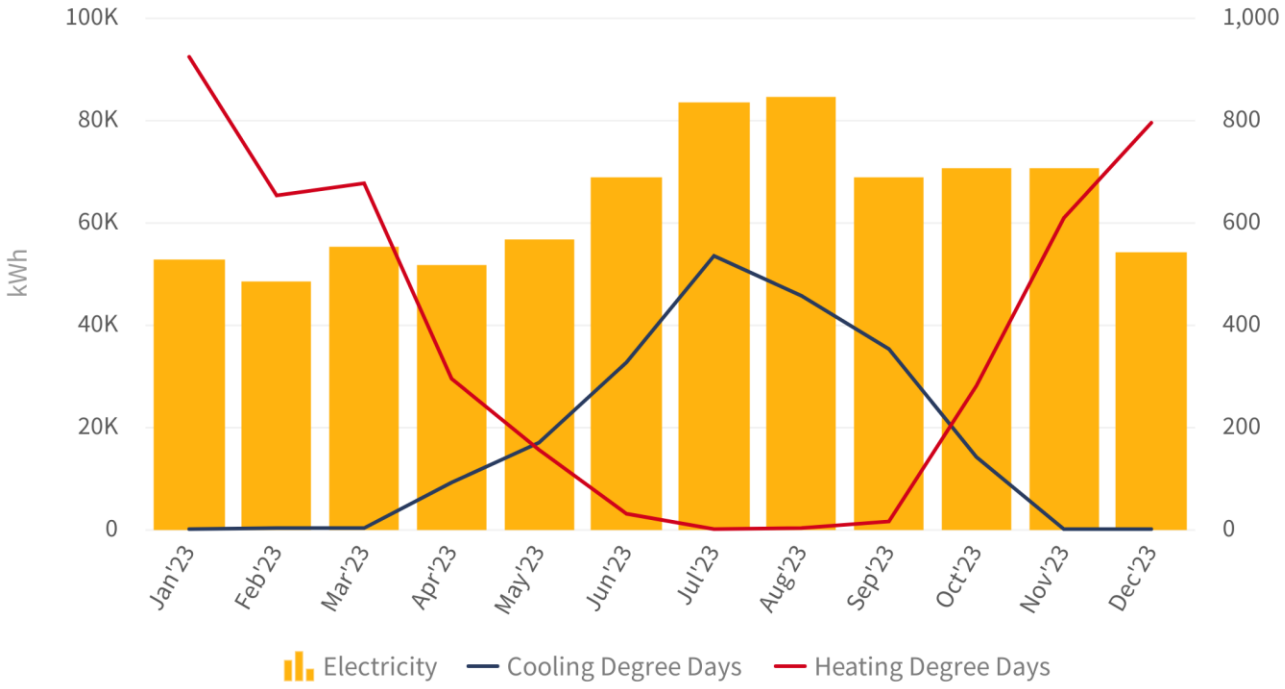

Figure: Average Monthly Electrical Consumption and Monthly Degree Days

NATURAL GAS CONSUMPTION

Natural Gas at the City of Kent Fire Station #1 is provided by Dominion East Ohio.

	Natural Gas Usage (therms)		Natural Gas Usage Cost ($)	
	2023	Average	2023	Average
Jan	3,695.23	3,695.23	2,734.67	2,734.67
Feb	2,794.3	2,794.3	2,067.93	2,067.93
Mar	2,833.8	2,833.8	2,097.33	2,097.33
Apr	1,809.4	1,809.4	1,339.4	1,339.4
May	1,436.9	1,436.9	1,063.13	1,063.13
Jun	1,199.6	1,199.6	887.3	887.3
Jul	1,067.5	1,067.5	790.3	790.3
Aug	1,120.5	1,120.5	829.33	829.33
Sep	898.57	898.57	664.87	664.87
Oct	1,212.73	1,212.73	897	897
Nov	1,951	1,951	1,444	1,444
Dec	2,937	2,937	2,173	2,173
Total	22,956.53	22,956.53	16,988.26	16,988.26

Table: Monthly Natural Gas Consumption

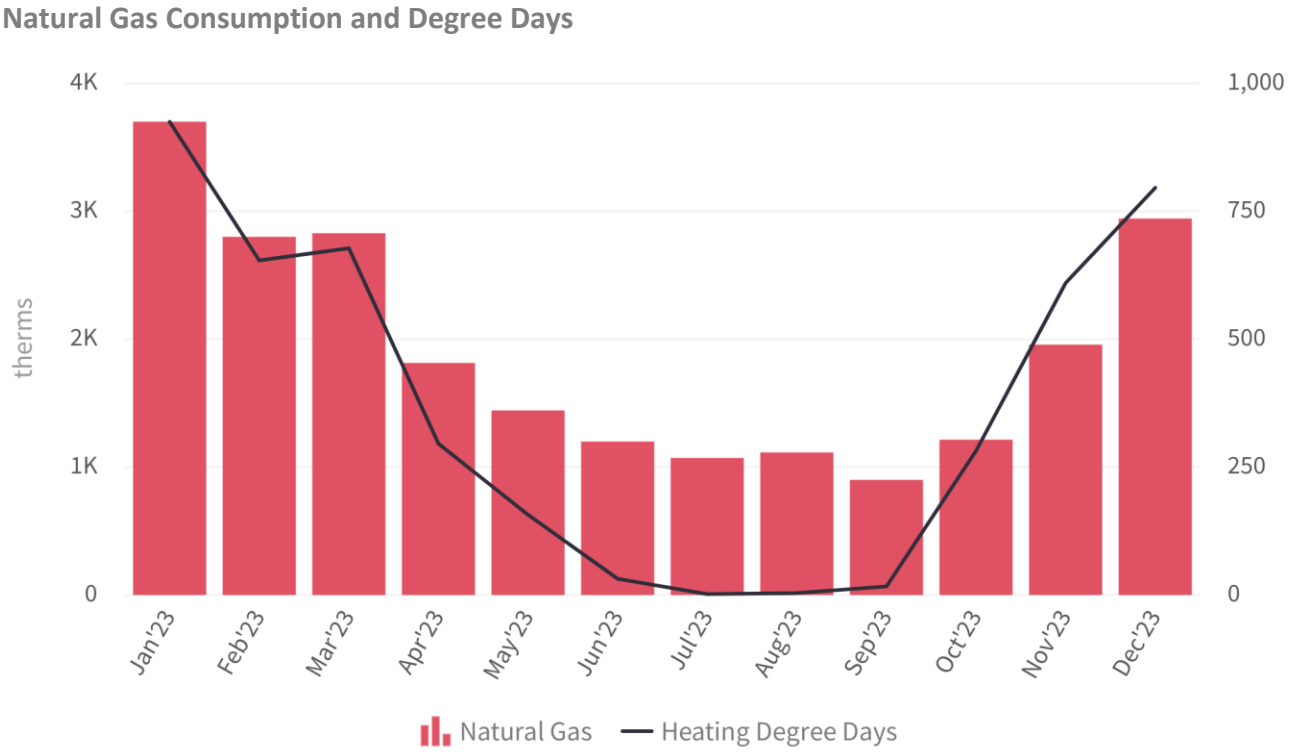

Figure: Monthly Natural Gas Consumption and Monthly Degree Days

UTILITY COSTS AND RATES

The energy cost savings calculations for the proposed ECMs are based on average annual electricity and natural gas costs for the period analyzed. For electricity and natural gas the blended rates will be used to determine the cost savings for ECM analysis.

Electricity Average Blended Rate: $0.088 /kWh

Natural Gas Average Blended Rate: $0.74 /therms

Energy Use Intensity

You are able track building energy efficiency Key Performance Indicators (KPI) such as Energy Use Intensity (EUI). Facility managers can benchmark their facilities against similar types of building throughout the country using the EUI. The Site EUI is calculated by taking the facility's total annual energy usage normalized to kBtu and the square footage of the building. Source EUI considers losses in generation, storage, and distribution of the fuel type.

The table below shows key performance indicators for the facility, including the Energy Use Index EUI and the Energy Cost Index (ECI) based on the utility data provided.

	Site EUI (kBtu/SqFt)	Total Cost Per Square Foot ($/SqFt)
2023	193.47	3.33
Average	193.47	3.33

Table: Normalized KPI

Energy End Use Breakdown

The table below outlines the energy end use breakdown of the City of Kent Fire Station #1 into the end uses outlined by ASHRAE Standard 211/2018. This breakdown was estimated using data provided by the utilities, building operators/occupant interviews, and site visits.

End Use Breakdown by Fuel Type

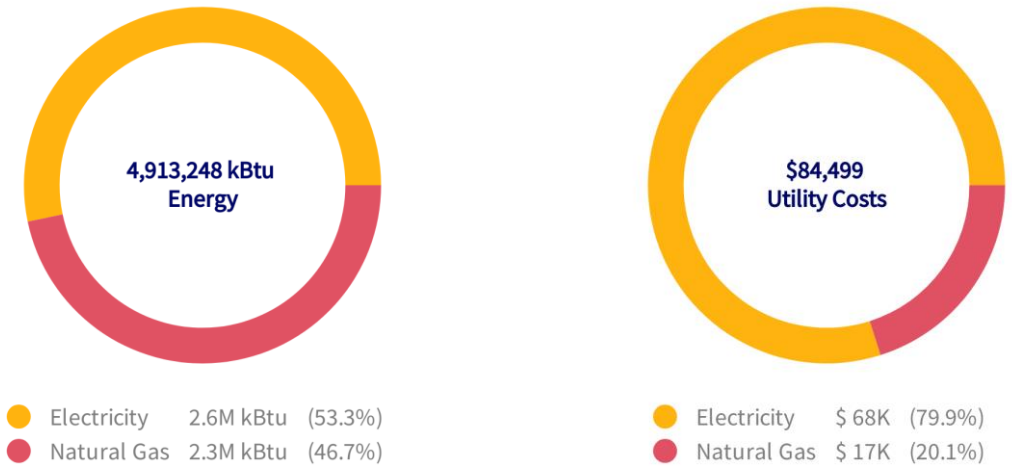

Figure: Energy & Cost End-Use Breakdown by Fuel Type

End Use	Electric Usage (kWh)	Natural Gas Usage(therms)	Total Use (kBtu)	Percentages
Space Heating	0	12,874	1,287,443	34.7%
Space Cooling	104,824	-	357,660	9.7%
Air Distribution	55,673	-	189,957	5%
HW Reheat/DHW/Appliances	0	12,810	1,281,000	34.5%
Lighting	47,844	-	163,245	4.4%
Plug Load	82,500	-	281,490	7.6%
Water Distribution	44,038	-	150,258	4.1%
Total	334,879	25,684	3,711,053	100%
Historical Billing	767,173	22,957	4,913,294	-
Actual	44%	112%	76%	-

Table: Energy End-Use Breakdown

Electricity & Natural Gas End-Use Breakdown

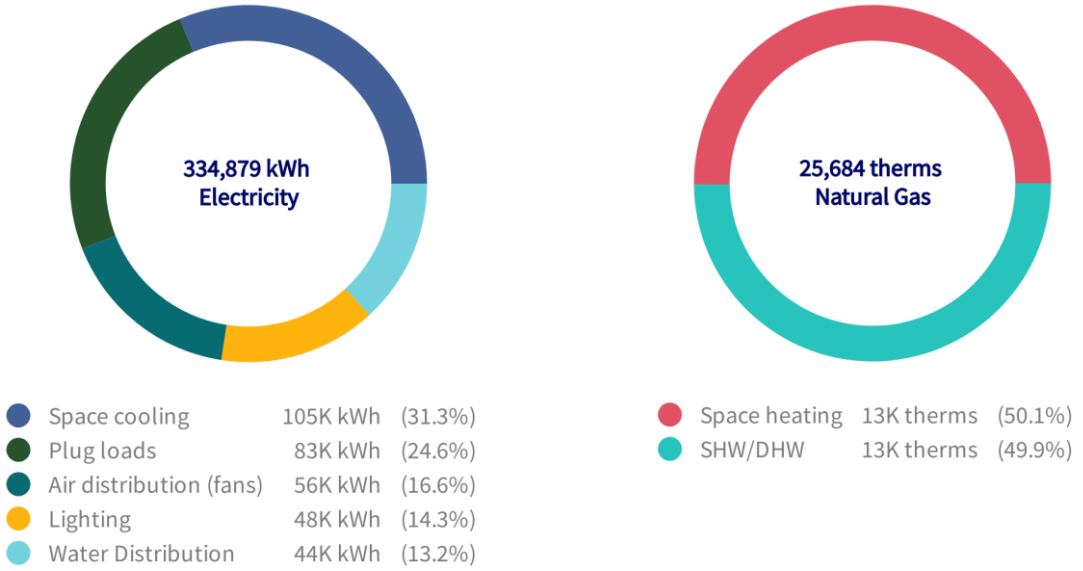

Figure: Electricity End-Use Breakdown and Natural Gas End-Use Breakdown

End Use Breakdown by End Use

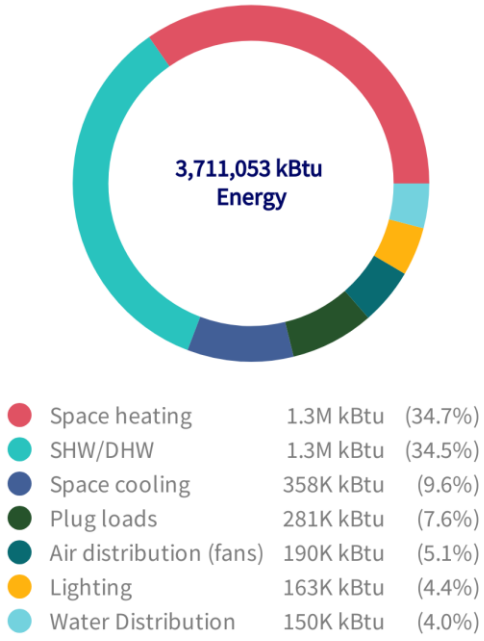

Figure: Total Energy End-Use Breakdown

Summary of Energy Savings

If all ECMs are implemented, the facility can expect to reduce electricity consumption by 44% and natural gas consumption by 4%. This would produce an annual operational savings on the order of 147,948 kWh and 1,047 therms for a combined $14,810 of utility and O&M expenditure reduction. The full implementation cost of these projects is estimated at $310,000, yielding a simple payback of 17.5 yrs. The following table depicts expected savings figures for this facility:

ENERGY SAVINGS BY END USE

End Use	Electricity (kWh)	Electricity Savings (kWh)	Natural Gas (therms)	Natural Gas Savings (therms)	Total Existing Energy Consumption (kBtu)	Total Proposed Energy Consumption (kBtu)	% Reduction
Space Heating	0	-	12,874	546	1,287,443	1,232,843	4.2%
Space Cooling	104,824	25,029	-	-	357,660	272,257	23.9%
Air Distribution	55,673	6,300	-	-	189,957	168,462	11.3%
HW Reheat/DHW/Appliance	0	0	12,810	0	1,281,000	1,281,000	0%
Lighting	47,844	25,118	-	-	163,245	77,543	52.5%
Plug Load (Savings is Attributed to PV Install)	82,500	91,500	-	-	281,490	-30,708	
Water Distribution	44,038	0	-	-	150,258	150,258	0%
Total	334,879	147,948	25,684	1,046	3,711,053	3,101,654	16.4%

Table: Energy Savings Breakdown by Usage

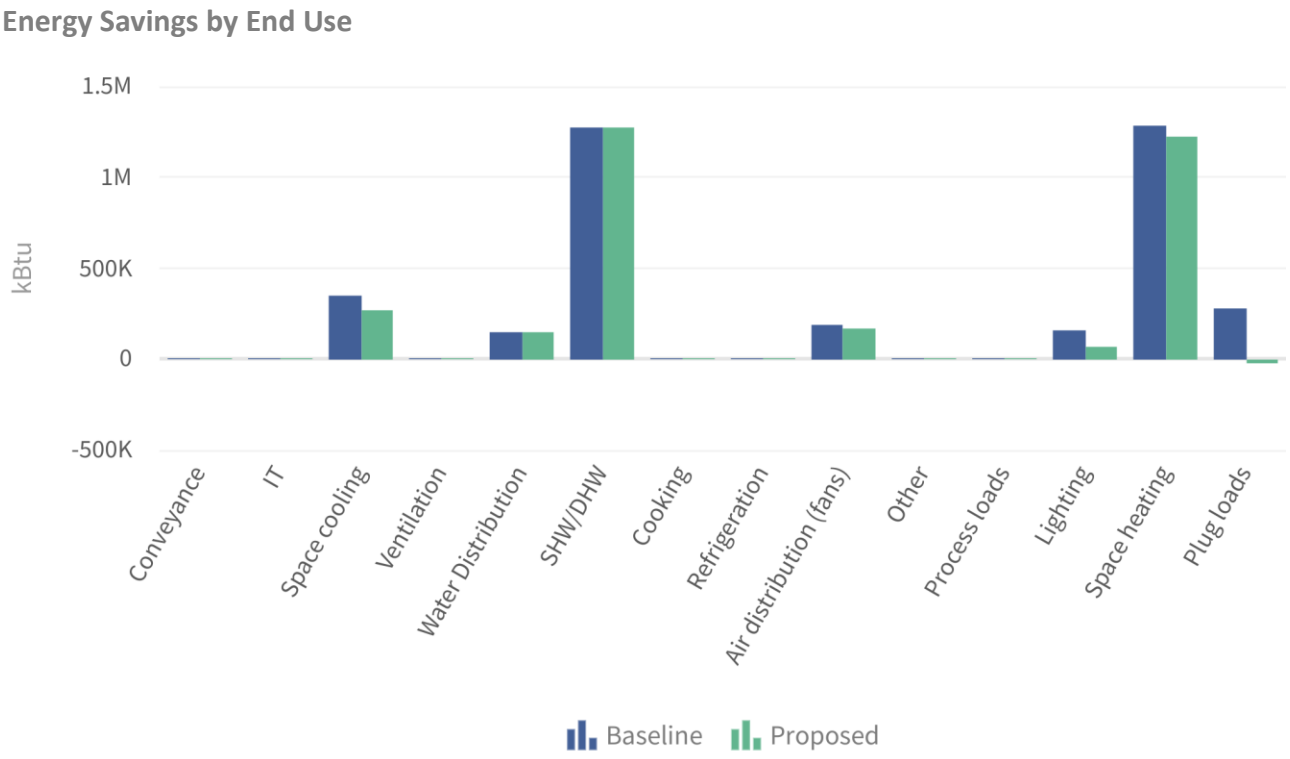

Figure: Energy Saving End-Use by Usage

Key Performance Indicators

Energy	Electricity (kWh)	Natural Gas (therms)	Site EUI	Total GHG Emissions (mtCO2e)
Baseline	334,879	25,684	146.13	385
Proposed	186,931	24,638	122.13	308
Reduction (%)	44.18%	4.07%	16.42%	20%

Table: KPI

Site Energy Use Intensity

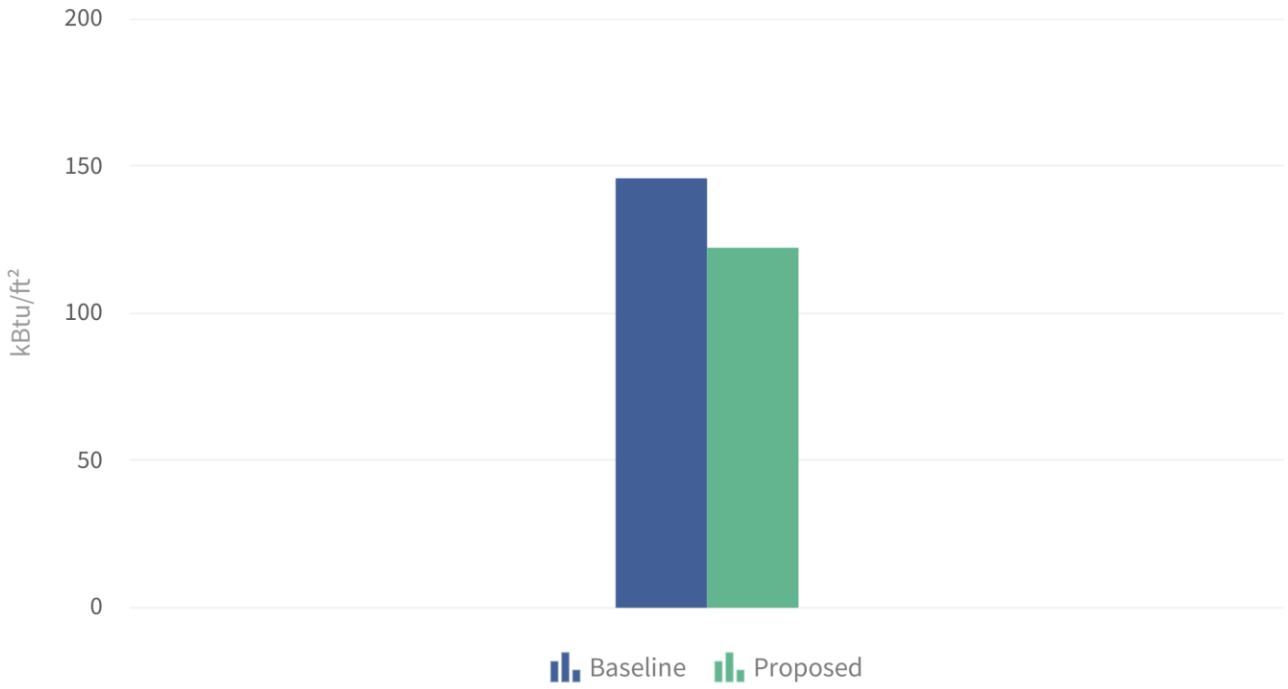

Figure: Site EUI Reduction

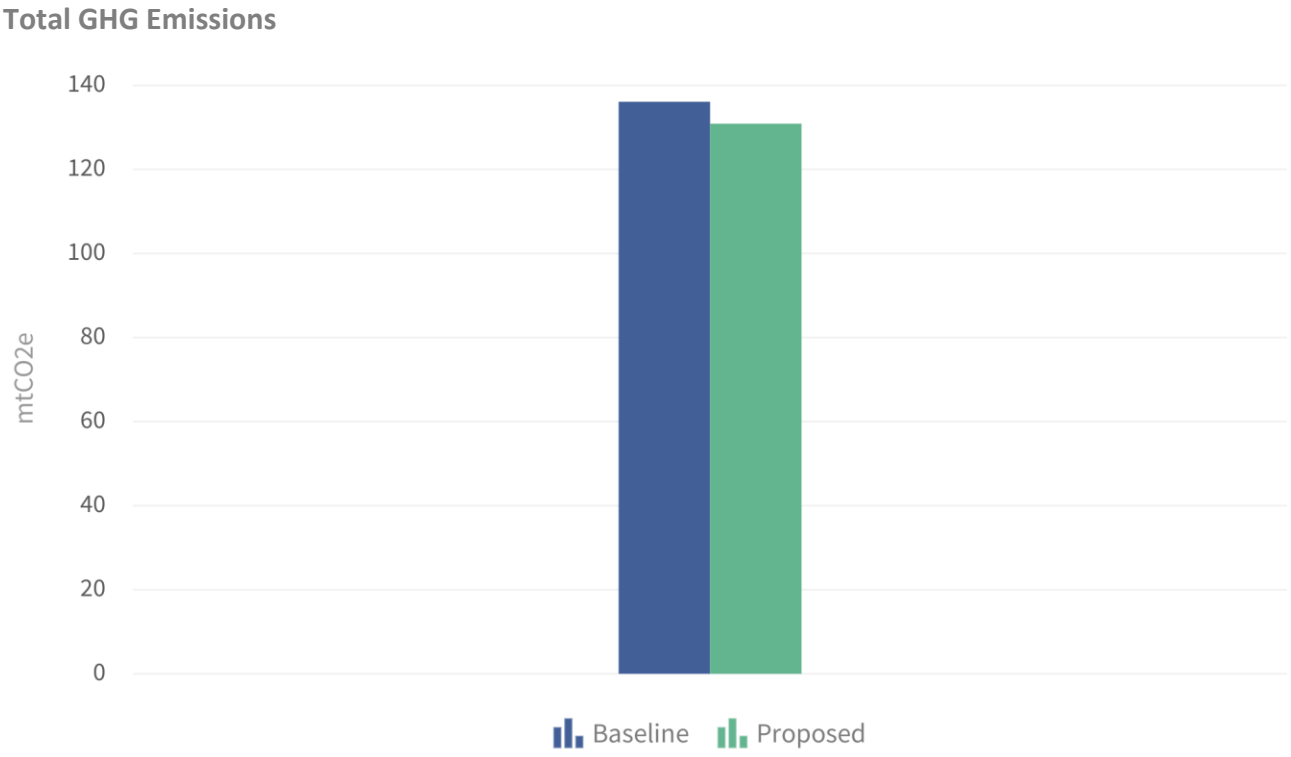

Figure: GHG Reduction

Energy Conservation Measures (ECMs)

Replace Natural Gas Packaged RTU

Replace the existing packaged rooftop air handler with a higher efficiency unit in order to save energy. The exiting unit is from 2003 and approaching the projected life for this type of equipment. The unit has had some recent issues that require the unit to be hand reset by facility personnel to run properly. This project uses degree days to estimate energy consumption of the existing and replacement units. In addition to replacement of the unit it is recommended that the control system be upgraded.

Name	Energy Savings (kBtu)	Electric Savings (kWh)	Natural Gas Savings (therms)	Estimated GHG Savings (mtCO2e)	Effective Useful Life (years)
Replace Natural Gas Packaged RTU	90,065	10,365	547	7.95	-

Total Measure Cost ($)	60,000	ROI (%)	2.7
Annual Cost Savings ($)	1,594	NPV ($)	-45,752
Simple Payback (yrs)	> 20 years		

HVAC Zoned Controls and Controls Upgrade

This measure estimates the energy savings associated with adding new zone controls of HVAC spaces in the facility. These zone controls with vary the cfm requirements based on occupancy in the space. Areas of the facility currently do not have unoccupied control. The occupancy sensors in the building for the HVAC unit have been disabled. The office area, day room on 2nd floor, weight room and council chambers area all areas that have hours of low occupancy. Reducing the airflow based on occupancy can provide reduced heating, cooling and ventilation usage. Areas that are occupied often like the kitchen and sleeping area can be controlled as continuously occupied to avoid comfort concerns.

Name	Energy Savings (kBtu)	Electric Savings (kWh)	Natural Gas Savings (therms)	Estimated GHG Savings (mtCO2e)	Effective Useful Life (years)
RTU Zoned Controls	50,037	14,665	-	7.15	-

Total Measure Cost ($)	45,000	ROI (%)	4.2
Annual Cost Savings ($)	1,907	NPV ($)	-27,952
Simple Payback (yrs)	> 20 years		

Lighting Upgrade

This measure includes an estimate of the existing remaining fluorescent lights in the facility being upgraded to LED systems. The primary lighting in the facility is T8 fluorescent. Many of the fixtures are 25 watt or 28 watt T8 fluorescent. The T8 fixtures in most areas can be retrofit to LED lamps. It suggested that for these areas 12.5 or 13 watt lamps be considered. Retrofit of the T12 fluorescent in the vehicle bays is also included.

Even though the existing fixtures have not been upgraded, the facility does an excellent job of controlling the lighting to reduce energy usage. A number of areas in the facility use occupancy sensors to reduce lighting usage very effectively. Many areas of the facility have limited hours use for the lighting due to occupancy. The truck bay lighting system is T12 fluorescent. These fixtures are not used most of the day. The bay areas have sufficient daylight from the glass doors and the lighting is manually used as needed. It is estimated that these fixtures are used 3 hours a day on the average.

Name	Energy Savings (kBtu)	Electric Savings (kWh)	Natural Gas Savings (therms)	Estimated GHG Savings (mtCO2e)	Effective Useful Life (years)
Lighting Upgrade	85,703	25,118	0	12.24	0

Total Measure Cost ($)	28,000	Simple Payback (yrs)	12.7
Estimated Incentive ($)	0	ROI (%)	31.6
Annual Cost Savings ($)	2,213		

Solar PV on Vehicle Bay Roof

The building's bay roof would be a good candidate for a grid-tied solar PV system. Estimated square footage of the building's usable roof is 7700 square feet. With a typical coverage ratio of 95% and power output of 20 watts per square foot, an 83 kW system is achievable. An 83 kW system will produce around 91,500 kWh per year. PV systems are eligible for accelerated depreciation and a 30% Federal tax credit.

Name	Energy Savings (kBtu)	Electric Savings (kWh)	Natural Gas Savings (therms)	Estimated GHG Savings (mtCO2e)	Effective Useful Life (years)
Solar PV on Bay Roof	312,198	91,500	-	44.59	-

Total Measure Cost ($)	167,000	Simple Payback (yrs)	14.5
Estimated Incentive ($)	50,100	ROI (%)	6.9
Annual Cost Savings ($)	8,052	NPV ($)	-44,894

Addition of Demand Controlled Ventilation (DCV) to HVAC system

This measure assumes a demand control ventilation system with CO2 sensors will be added to an existing HVAC system with fossil fuel heating that previously had no DCV system or ventilation heat recovery equipment installed. The day room on 2nd floor, weight room and council chambers are all areas that have hours of low occupancy that may be good opportunities for demand ventilation. Reducing the OA based on CO2 can provide reduced heating, cooling and ventilation usage. These controls will aid in reducing the require CFM in low occupied zones.

Name	Energy Savings (kBtu)	Electric Savings (kWh)	Natural Gas Savings (therms)	Estimated GHG Savings (mtCO2e)	Effective Useful Life (years)
Addition of Demand Controlled Ventilation (DCV) to HVAC system	71,496	6,300	500	5.72	-

Total Measure Cost ($)	10,000	ROI (%)	10.4
Annual Cost Savings ($)	1,044	NPV ($)	-663
Simple Payback (yrs)	9.6		

Appendix

Lighting Table

Name	Quantity	Location Name	Watts (W)	Control type
4 119W T12 4-lamp Magnetic Linear Fluorescent	120	Bays	119	-
4 89.28W T8 3-lamp Standard Electronic Linear Fluorescent	87	Various	89.28	-
4' 25/28W T8 3-Lamp, Elect Ballast	60	Various	89.28	-
4' 25/28W T8 3-Lamp, Elect Ballast	45	Various	89.28	-
5W 1-lamp LED	10	Various	5	-
150 WATT LED	10	Exterior	150	-
6W 1-lamp	25	Various	6	-

Definitions

AHU	Air Handling Unit	**OAT**	outside air temperature
Btu	British thermal unit	**EUI**	Energy Use Intensity
Btu/h	British thermal unit per hour	**ECI**	Energy Cost Index
CDD	Cooling Degree Days	**W**	watt
DD	Degree Days	**MMBtu**	One million Btu
HDD	Heating Degree Days	**kW**	kilowatt
cfm	cubic feet per minute	**kWh**	kilowatt-hour
CBECS	Commercial Buildings Energy Consumption Survey	**KPI**	key performance indicator
DHW	domestic hot water	**CO2e**	carbon dioxide equivalent
ECM	energy conservation measure	**MBH**	1,000 British thermal unit per hour
gal	gallon	**VFD**	Variable Frequency drive
GHG	greenhouse gas		
gpm	gallons per minute		
FY	fiscal year		
hp	motor horsepower		
AC	air conditioner		
HV	heating and ventilation		
kBtu	1,000 Btu		
COP	coefficient of performance		
EER	energy efficiency ratio		
HW	hot water		
FY	fiscal year		
SF	square feet		