500 Water St

Peterborough, ON K9H 3M4

Climate Action Roadmap

500 Water Street

EFFICIENCY ENGINEERING .COM
A Kontrol Technologies Company

peterborough

EE Project #: 22-198

March 2025

Table of Contents

TABLE OF CONTENTS 2

LIST OF ABBREVIATIONS 3

1 THE EXECUTIVE SUMMARY 4

1.1 Building Overview 4
1.2 Master List of Measures 8
1.3 GHG Reduction Pathways 9

2 METHODOLOGY 11

3 THE EXISTING BUILDING PROFILE 14

3.1 Heating 14
3.2 Cooling 15
3.3 Domestic Hot Water 16
3.4 Ventilation 16
3.5 Building Envelope 17
3.6 Water Fixtures 17
3.7 Lighting 18
3.8 Controls 18
3.9 Electrical Service 19

4 THE ENERGY USAGE REPORT 20

4.1 Utility Meters 20
4.2 Utility Rate Structures 20
4.3 Meter Modeling 22
4.4 Building Energy Performance 25
4.5 Energy Breakout by End Use 26
4.6 Utility Costs 27

5 MEASURE LEVEL ANALYSIS 28

5.1 Opportunity 1: Upgrade to LED Fixtures 29
5.2 Opportunity 2: Install ASHP RTU w/ Gas Backup 31
5.3 Opportunity 3: Heating Boilers: Install ASHP w/ Gas Backup and Connect to DHW Loop 33
5.4 Opportunity 4: Install High Efficiency Windows 35
5.5 Opportunity 5: Increase Roof Insulation 37
5.6 Opportunity 6: Install EIFS System 39
5.7 Opportunity 7: Install a 37-kW Rooftop Solar PV System 41
5.8 Opportunity 8: Install a 173-kW Solar PV Canopy over East Parking Area 43

6 OTHER MEASURES CONSIDERED 45

6.1 Opportunity 9: Install ASHP RTU w/ Elec Backup 45
6.2 Opportunity 10: Heating Boilers: Install ASHP w/ Elec Backup and Connect to DHW Loop 47
6.3 Opportunity 11: Increase Roof Insulation Using Glavel 49

7 SCENARIO LEVEL ANALYSIS 51

7.1 GHG Reduction Pathway Summary 51
7.2 Demand Impact Summary 54

APPENDIX A. ENERGY MODEL OUTPUT REPORTS ..... A

APPENDIX B. SCHEMATICS ..... B

APPENDIX C. CALCULATIONS C

APPENDIX D. FLOORPLANS ..... D

List of Abbreviations

AC – Air Conditioner
AHU – Air Handling Unit
ASHP – Air Source Heat Pump
ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers
BAU – Business as Usual
CDD – Cooling Degree Days
CEM – Certified Energy Manager
CFL – Compact Fluorescent Lamp
DHW – Domestic Hot Water
ECM – Energy Conservation Measure
EIFS – Exterior Insulation and Finishing System
ERV – Energy Recovery Ventilator
EUI - Energy Use Intensity
GA - Global Adjustment
GHG - Green House Gases
GSHP - Ground Source Heat Pump
HDD – Heating Degree Days
HOEP - Hourly Ontario Energy Price
HPS – High Pressure Sodium
HRU - Heat Recovery Unit
HVAC – Heating Ventilation and Air Conditioning.
IAQ - Air Quality and Comfort
IRR – Internal Rate of Return
kW - Kilowatt
kWh – Kilowatt Hour
kVA – Kilovolt Ampere
KPI – Key Performance Indicator
LCC - Life Cycle Cost
LCCA – Life Cycle Cost Analysis
LDC – Local Distribution Company
LED – Light Emitting Diode
MARR – Minimum Acceptable Rate of Return
MW – Megawatt
NPV – Net Present Value
RTU – Rooftop Unit
RSMeans – Cost Data Base
WMO ID – World Meteorological Organization Identification

1 The Executive Summary

Efficiency Engineering has performed a comprehensive Net Zero Retrofit Study at 500 Water Street for the City of Peterborough. The City has set aggressive greenhouse gas reduction targets. The purpose of this study is to catalogue the existing energy consuming systems at the building, analyze energy usage within the facility and provide recommendations on how to significantly reduce GHG emissions while improving the energy and water efficiency of the facility.

1.1 Building Overview

The following table summarizes the facility details:

TABLE 1.1.1: FACILITY DETAILS

Building Name:	500 Water St
Address:	500 Water St
	Peterborough, ON K9H 3M4
Facility Area:	34,528 Sq.Ft.
Building Type:	Police Station
Year Constructed:	1967
Number of Stories:	2

1.1.1 Existing Building Profile

500 Water Street is a 34,528 ft^2 police station comprised of offices, exercise rooms, locker rooms, laboratories and holding cells.

Space heating is provided by two (2) natural gas fired cast iron sectional boilers, both rated at 1785 MBH. These gas boilers serve hydronic glycol coils in the central air handlers, reheat coils in duct work and some perimeter heating radiators.

Cooling for the facility is supplied mostly by two (2) electric condensing units, which are both rated at 45 tons. These two remote electric condensing units serve the buildings air handling units. A single rooftop unit serving the basement is equipped with an electric DX cooling coil and there are several electric AC units on the roof which serve single rooms (i.e. server rooms).

Ventilation is provided through the two hydronic air handling units and a single natural gas fired rooftop unit. Air handling units each provide 14,000 CFM of fresh air while the single rooftop unit provides 6,400 CFM. Energy recovery ventilators are present and help to recapture sensible and latent heat leaving the building. This captured heat is used to preheat incoming ventilation air which is then supplied to the building through the two (2) air handling units and single rooftop unit.

The facility is equipped with a single natural gas fired domestic hot water (DHW) heater rated at 200 MBH, with the ability to hold 80 US gallons of hot water. In addition, a single hot water storage tank is also present which has a volume of 180 US gallons.

Lighting in the facility generally consists of T8 fluorescent and compact fluorescents (CFLs). All lighting is controlled by wall switches or circuit breakers. Exterior lighting has been upgraded to LED.

Water fixtures (toilets, shower heads, faucets, etc.) are low flow units.

All major systems, including boilers, the domestic hot water heater tank, air handling units, VAV boxes and pumps are controlled through a building automation system (BAS). The City has remote access to the buildings BAS.

1.1.2 Previous Energy Conservation Measures

500 Water Street was constructed in 1967 and over the years has made energy efficiency a priority. Energy efficient design components include:

- Low flow water fixtures
- Installation of ERVs supplying air handling units and rooftop unit
- Installation of VFDs on applicable pumps
- Installation of VFDs on applicable fans
- A single hydraulic elevator
- All systems are controlled through a building wide BAS, allowing for proper scheduling and setbacks for equipment
- A high efficiency DHW heater tank

Limited Liability

This report was prepared by Efficiency Engineering Inc. for the account of the City of Peterborough. The material in it reflects our best judgment in light of the information available to us at the time of preparation. Without express written permission, any use which a third-party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Efficiency Engineering Inc. accepts no responsibility for damages, if any, suffered by any third-party as a result of decisions made or actions based on this report.

Acknowledgements

Assistance from the City of Peterborough was provided by:

- Ailan McKenzie, OAA – Senior Project Manager
- James Byrne – Climate Change Project Manager

Report prepared by Graeme St.Clair, C.Tech., LEED AP

Efficiency Engineering Inc.
73 Water St N, Unit 500
Cambridge, ON N1R 7L6

1.1.3 Existing Energy & GHG Emissions

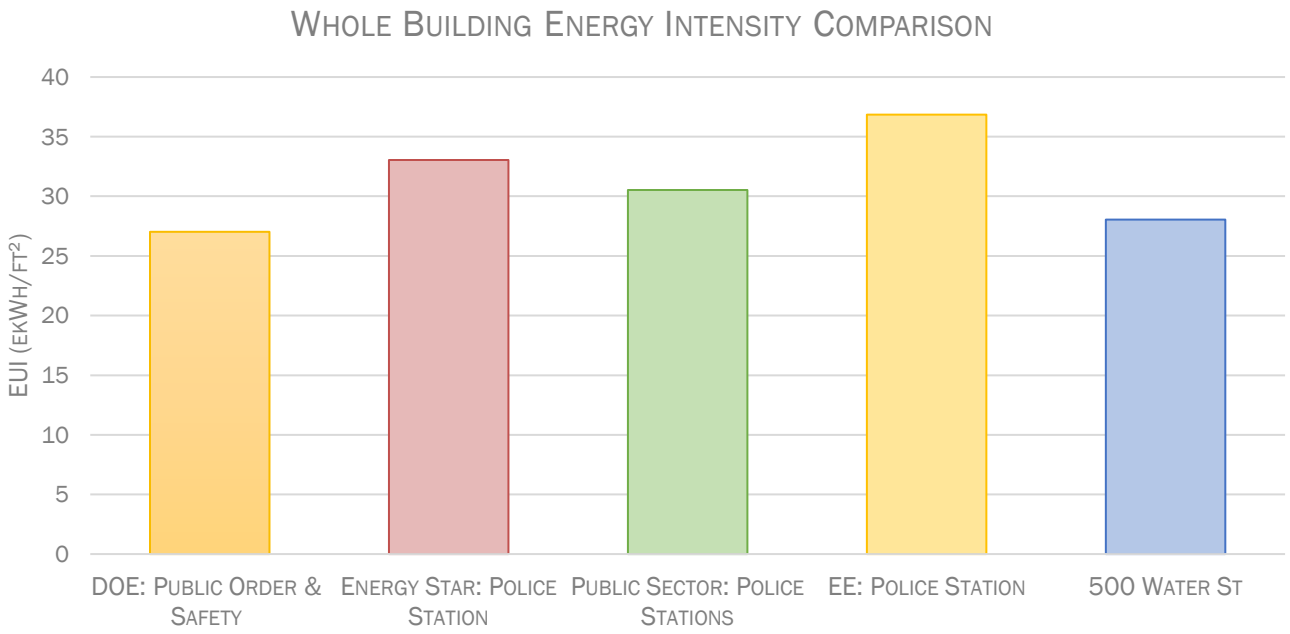
The facility's existing energy consumption and GHG emissions are summarized as follows:

TABLE 1.1.2: EXISTING ENERGY KPI DETAILS

Utility	Consumption	EUI* (ekWh/ft²)	Total Energy (ekWh)	Emissions (tCO2e)	Total Cost ($)
Electricity	571,770 kWh	16.6	571,770	16	$74,902
Natural Gas	38,430 m^3	11.5	396,600	74	$15,618
Total	**N/A**	**30.4**	**968,370**	**90**	**$90,520**

*EUI values presented throughout this report are calculated based on purchased energy and includes electricity provided by the grid, purchased natural gas etc.

The following benchmarking graph displays the comparative energy performance of the buildings studied as a part of this project.



1.2 Master List of Measures

Opp. #	Opportunity	Demand (kW)	Electricity (kWh)	Nat Gas (m^3)	Water (m^3)	GHG Emissions (tCO_2e)	Annual Savings	Project Costs	Cost per tCO_2e	Simple Payback	Capital Payback	NPV	IRR
1	Upgrade to LED Fixtures	200	69,090	-4,628	0	-7.0	$12,741	$115,690	$1,231	9.1	1.4	$172,543	34.8%
2	Install ASHP RTU w/ Gas Backup	-45	-6,560	997	0	1.7	-$923	$355,814	$4,783	No Payback	No Payback	($166,602)	No IRR
3	Install ASHP Boilers w/ Gas Backup & Connect to DHW Loop	-1,387	-165,780	34,965	0	62.9	-$22,077	$1,407,438	$1,089	No Payback	No Payback	($1,370,682)	No IRR
4	Install High Efficiency Windows	0	-3,740	3,765	0	7.2	$1,040	$1,764,202	$5,458	No Payback	No Payback	($782,559)	-9.7%
5	Install EIFS System	0	-2,720	3,734	0	7.1	$1,161	$1,107,953	$7,631	954.3	79.1	($1,089,317)	-20.0%
6	Increase Roof Insulation	0	-510	758	0	1.5	$241	$1,095,450	$8,025	No Payback	No Payback	($232,786)	-11.9%
7	Install 37kW Roof Mounted Solar PV System	133	46,051	0	0	1.3	$7,432	$140,848	$683	19.0	12.9	($17,603)	5.9%
8	Install 173kW Solar PV Canopy over Parking Structure	779	216,404	0	0	6.1	$36,532	$1,871,559	$10,431	51.2	24.5	($1,264,054)	-2.7%

1.3 GHG Reduction Pathways

The GHG Reduction Pathways tie together all aspects of the audit, providing an implementation plan which considers energy savings and the results of the financial analysis as well as the need for capital renewal and budgeting.

This study analyzes four potential roadmaps for decarbonization. Generally speaking, the Roadmaps progress from less complex measures with lower installation costs to more complex and more efficient solutions with the understanding that more expensive equipment may provide lower operating costs.

Roadmap 1 – Minimum Performance: 50% GHG Reductions over 10 Years

This includes a group of energy reduction measures that will achieve a 50% reduction in GHGs over the following 10 years. This will generally include the lowest cost measures available to achieve this target.

Roadmap 2 – Minimum Performance: 80% Reductions over 20 Years

This includes a group of energy reduction measures that will achieve an 80% reduction in GHGs over the following 20 years. This will generally require the inclusion of the most aggressive GHG reduction measures, regardless of cost.

Roadmap 3 – Aggressive Performance: 80% Reductions over 5 Years

This roadmap will include the same suite of measures that Roadmap 2 includes, but with a more accelerated timeline of 5 years.

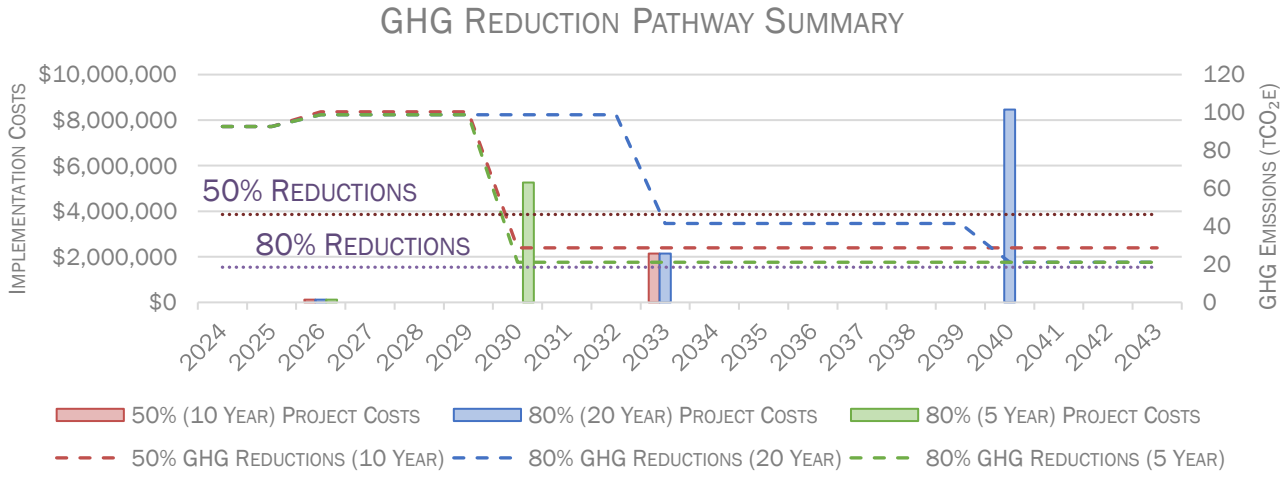
Roadmap 4 – Business-As-Usual

The Business-As-Usual Roadmap will include the project costs associated with replacing the equipment with like-for-like equivalents. This will provide a cost baseline for the other roadmaps to understand how much additional capital is required to implement the more energy efficient options.

Bundling measures into these pathways often results in interactive effects between systems. As a result, the total GHG reduction for a particular Roadmap will typically differ from the sum of the GHG reductions from individual measures. The Scenario Level Analysis accounts for these interactive effects between systems which are not represented in the Measure Level Analysis.

TABLE 1.3.1: SUMMARY OF SCENARIO LEVEL ANALYSIS

Opp. #	Opportunity	Year of Implementation	50% Reduction Pathway	80% Reduction Pathway
1	Lighting: Upgrade to LED	2026	•	•
2	Install ASHP RTU w/ Gas Backup	2033	•	•
3	Install ASHP Boilers w/Gas Backup & Connect to DHW Loop	2033	•	•
4	Install High Efficiency Windows	2040		•
5	Increase Roof Insulation	2040		•
6	Install EIFS System	2040		•
7	Install 37kW Roof Mounted Solar PV System	2040		•
8	Install 173kW Solar PV Canopy over Parking Structure	2040		•



2 Methodology

Efficiency Engineering utilizes a rigorous and standardized approach for all of our energy audits. We utilized a comprehensive "form based" data collection process to ensure all relevant data is collected during our site visits. Utility bills are collected and analyzed to ASHRAE14-2002 standards. Savings for each Opportunity are calculated based on sound engineering principles and always related back to actual consumptions. Costing utilizes a combination of MEANS standard costing tools, vendor quotes and our experience in design and project management.

Utility Bill Analysis

The purpose of performing a detailed utility bill analysis on the building is to:

- Normalize the consumption or demand for billing period, heating degree days (HDD), Cooling Degree Days (CDD) and any other independent variables.
- Calculate the energy use for benchmarking (comparison to typical buildings).
- Break out the consumption into weather dependent and weather independent portions.
- Calculate the heating and cooling balance point temperatures.
- Look for anomalies that may indicate heating plant efficiency, accuracy of the building automation system, building use, etc.
- Look for changes in the consumption over a period of time.
- Look for billing errors (over-billing) that may be recouped from the utility.

The utility meters have been modeled using standard modeling calculations. The utility data received has been correlated with actual weather data from the nearest weather station to produce a "best fit" equation using linear regression. The data has been normalized for billing periods, HDD, CDD as well as up to three user-defined variables. The heating and cooling balance point temperatures are adjusted to your specific building to properly model each utility.

The Modeling process creates an equation that allows us to calculate the consumption for any given period. A typical equation is as follows:

Consumption (kWh) = Days x 5,000 + HDD (13°C) x 50 + CDD (14°C) x 100
Regression (R^2 Value) = 0.92

Heating Degree Days (HDD) and Cooling Degree Days (CDD) are relative measurements of outdoor air temperature used as an index for heating and cooling energy requirements. Heating/cooling degree days are the number of degrees that the daily average temperature falls below or rises above a given balance point temperature. Coefficients are the constants in the baseline models. They are the values that are multiplied by the independent variables to get the model results, and are determined during the baseline model process. The Regression value indicates how well the actual bills match the equation, with 1.0 being a perfect fit. Typical year data (Environment Canada) is used to calculate the consumption for an average year. This consumption is used in all of the savings calculations.

Savings Methodology

Savings for opportunities are calculated using rigorous scientific modeling tools to ensure accuracy. The first step in the savings calculations is to find the existing consumption(s) of the equipment, based on equipment nameplate data, operating parameters, logged data (when available) and modeling from the utility bill analysis. The next step is to calculate the retrofit consumption once the opportunity is implemented. The savings are simply the difference between the two.

The calculation method varies depending on the Opportunity. For weather dependent savings, we would typically use a modified bin method from our own proprietary software. The underlying data used for creating the modified bins is ASHRAE WYEC (Weather Year for Energy Calculations). This ensures that the savings are based on a typical year, not an abnormally warm or abnormally cold year. When appropriate, we use other well-accepted methods such as eQUEST whole-building simulation.

Savings calculations for a particular Opportunity assume that other Opportunities listed ahead of it have been implemented. For example, if Opportunity 1 recommends upgrading to a better technology and Opportunity 2 recommends reducing lighting hours, the savings for Opportunity 2 will be based on the lighting upgrade recommended in Opportunity 1. This ensures that savings are not "double counted".

Certain Opportunities have additional annual savings or costs, such as an increase or decrease in annual maintenance. The Annual Savings noted in the financial analysis tables throughout the report includes the energy savings as well as these additional annual savings or costs.

Cost Estimates

Cost estimates are calculated based on our experience, industry standards and market conditions. Market conditions can vary significantly between the writing of this report and the actual implementation of the recommendations.

PWGSC (Public Works and Government Services Canada) has defined classes of cost estimation for building construction or renovation. We provide Class C Cost Estimates as standard, however in many instances (especially with lighting opportunities) our work is closer to Class B.

TABLE 1.3.1: CLASSES OF COST ESTIMATES

Class D	Rule of thumb costing to get an order of magnitude – for study approval.
Class C	Measured quantities based on preliminary design – for project approval.
Class B	Measured quantities based on detailed engineering sizing calculations
Class A	Measured quantities based on design drawings

The Project Cost shown in the Financial Analysis tables throughout the report includes materials and labour and contingency as well as engineering and or third-party project management where appropriate. Costing does not include any applicable taxes.

Financial Analysis

The following Financial Factors are taken into account in the life cycle costing analysis presented throughout this report. The table lists the actual values used in the calculations.

Financial Factors

- Real Dollars: Monetary units of constant purchasing power.
- Real MARR: $MARR_R$, the minimum acceptable rate of return when cash flows are expressed in real dollars.
- Actual Dollars: Monetary units at the time of payment.
- Actual MARR: $MARR_A$, The minimum acceptable rate of return for actual dollar cash flows. It is the real MARR adjusted upwards for inflation. (Also called discount rate)
- Net Present Value (NPV): Total value of all cash streams discounted to present day dollars, or Net Present Value.
- Internal Rate of Return (IRR): The IRR represents the annualized (year over year) Return on Investment (ROI) an Opportunity is expected to generate. For example, if an investment provides 10% each year over 5 years, a $1 investment turns into 1 x $(1+10\%)^5$ = $1.61. The IRR is 10%, the average annual ROI is 10% and the ROI over the five-year period is 61%.
- Inflation: The rate of increase in average prices of goods and services over a one-year period; Also, the rate year period of decrease in purchasing power of money over a one-year period
- Escalation Rate: The rate of increase in utility costs due to a combination of factors including inflation, supply, demand, environmental and political effects.
- Simple Payback: Determines the financial payback or the time taken for the cash flows from a capital investment project to equal the cash outflows. The payback is represented in years and provides a timeframe for when initial costs will be recovered
- Capital Payback: provides the time required to recover capital investment in years, while taking into consideration factors such as the time value of money and life cycle costing

TABLE 1.3.2: FINANCIAL FACTORS

$MARR_R$:	5.0%
Inflation:	2.20%
$MARR_A$:	7.31%
Interest Rate (APR):	1.9%

3 The Existing Building Profile

The following section highlights the main building details and examines each energy-consuming system, including all HVAC system, lighting, building envelope, etc. The facility details are as follows:

TABLE 3.1: FACILITY DETAILS

Building Name:	500 Water St
Client Name:	City of Peterborough
Site Contact:	Ailan McKenzie
Address:	500 Water St
	Peterborough, ON
	K9H 3M4
Facility Area:	34,528 Sq.Ft.
Building Type:	Police Station
Year Constructed:	1967
Number of Stories:	2 plus basement

3.1 Heating

The building is heated via a central boiler plant that serves hydronic coils in air handling units, reheat coils in VAV boxes and perimeter baseboards. The boiler plant consists of two natural gas fired DeDietrich boilers:

Central Heating Boilers

TABLE 3.1.1: HEATING EQUIPMENT DETAILS

Tag ID	Type	Capacity	Efficiency	Condition
B-1	Cast Iron Sectional	1785 MBH	80%	Good
B-2	Cast Iron Sectional	1785 MBH	80%	Good

The hot water generated by the central plant is circulated throughout the building using two sets of pumps, with both sets of pumps operating in a primary/standby configuration. The central plant uses a straight through piping configuration with small circulation pumps for the boilers. The pump details are as follows:

TABLE 3.1.2: HOT WATER LOOP PUMP DETAILS

Tag ID	HP	Flow Distribution	Function	Condition
P-1A	2	Variable	Main Distribution	Fair

Tag ID	HP	Flow Distribution	Function	Condition
P-1B	2	Variable	Main Distribution	Fair
P-2A	3	Variable	Main Distribution	Fair
P-2B	3	Variable	Main Distribution	Fair
P-3	2	Constant	Boiler Circulation	Fair
P-4	2	Constant	Boiler Circulation	Fair
P-6	2	Variable	Main Distribution	Fair
P-7	1.5	Variable	Main Distribution	Fair
P-8	1.5	Variable	Main Distribution	Fair

All piping was observed to be properly insulated. The boiler plant was retrofitted in 2010 and is still in good operating condition. There is no need to plan or budget for the replacement of any equipment at this time.

3.2 Cooling

The building is cooled via roof mounted electric condensing units which serve both the buildings air handlers. The building's rooftop unit has an internal electric condensing unit. Several small electrical condensing units located on the roof serve the building's data rooms.

Remote Condensing Unit

TABLE 3.2.1: COOLING EQUIPMENT DETAILS

Tag ID	Chiller Type	Fuel Type	Capacity	COP	Condition
CU-1	Scroll	Electric	45 tons	3.5	Fair
CU-2	Scroll	Electric	45 tons	3.5	Fair
CU-3 (RTU)	Scroll	Electric	15 Tons	3	Fair
CU-4	Scroll	Electric	1,000 BTU	3	Fair
CU-5	Scroll	Electric	1,000 BTU	3	Fair
CU-6	Scroll	Electric	1.5 Ton	3	Poor
CU-7	Scroll	Electric	1.5 Ton	3	Poor

Most of the condensing units appear to be newer and are in good overall condition. Except for condensing units 6 and 7, which appear to be slightly older than the others, there is no need to plan or budget for the replacement of any equipment at this time.

3.3 Domestic Hot Water

A dedicated natural gas fired domestic hot water heater tank provides domestic hot water (DHW) for the building:

Domestic Hot Water Tank

TABLE 3.3.1: DHW EQUIPMENT DETAILS

Tag ID	Boiler Type	Fuel Type	Capacity	Efficiency	Condition
DHWHT	Condensing	Natural Gas	200 MBH	90%	Fair

A 180-gallon tank stores the hot water until demand for DHW is called. The water temperature in the tank is kept at 60°C (140°F) but cooled to about 50°C (120°F) using a mixing valve before heading to the building.

Small recirculation pumps are used to ensure hot water is available to occupants on demand.

TABLE 3.3.2: DHW LOOP PUMP DETAILS

Tag ID	HP	Flow Distribution	Function	Condition
P-5	1/12	Constant	DHW Recirculation	Fair
P-9	0.5	Constant	DHW Recirculation	Good
P-10	3/4	Constant	DHW Recirculation	Fair

All piping was observed to be properly insulated. The heater tank was installed in 2014 and is still in good condition. There is no need to plan or budget for the replacement of any equipment at this time.


Air Handling Unit

3.4 Ventilation

Ventilation is provided to the building via two Haakon air handling units (AHUs) and a single natural gas fired Aaon rooftop unit (RTU). These units temper a percentage of outdoor air, typically 20%, and distribute it to the building. Exhaust fans in these units help remove air from the building and send it to the buildings ERVs (energy recovery ventilators). ERVs help capture sensible and latent heat from the exhaust air stream and use it to preheat incoming outdoor air.

TABLE 3.4.1: VENTILATION EQUIPMENT DETAILS

Tag ID	Capacity	HP	Airflow	Condition
AHU-1	N/A	20	14,000 CFM	Fair
AHU-2	N/A	20	14,000 CFM	Fair
RTU-1	480 MBH	7.5	6,400 CFM	Fair

Tag ID	Capacity	HP	Airflow	Condition
ERV-1	N/A	3	4,200 CFM	Good
ERV-2	N/A	3	4,200 CFM	Good
ERV-3	N/A	0.5	2,500 CFM	Fair

The AHUs are 10 years old while the RTU is 16 years old. The ERVs serving these units are the same age. There is no need to plan or budget for the replacement of any equipment at this time.

3.5 Building Envelope

The facility was constructed in 1967 with a grey brick façade. The roof is built-up of tar and asphalt shingles. Windows are generally double glazed with an air fill. Front entrance doors are mostly glass with aluminum frames. Services doors around the building are generally metal with hollow cores.

Building Envelope

As the building is nearly 60 years old, there has been some wear and tear on the envelope. However, the City has been proactive with replacement of envelope components. New windows were installed in 2016. The roof is also new, having been installed in 2023 and was noted to be in good condition. EIFS panels have also been installed around the second floor of the building. Exterior doors were observed to have weather stripping for the most part.

3.6 Water Fixtures

Water fixtures in the facility were generally observed to be low flow.

TABLE 3.6.1: WATER FIXTURE DETAILS

Fixture	Flow
Bathroom Faucets:	0.5 GPM
Kitchen Faucets:	1.5 GPM
Toilets:	1.6 GPF
Shower Heads:	1.5 GPM

3.7 Lighting

3.7.1 Interior Lighting

Lighting in the facility generally consists of T8 fluorescent and compact fluorescents (CFLs). All lighting is controlled by wall switches or circuit breakers.

TABLE 3.7.1: INTERIOR LIGHTING DETAILS

Lamp Type	Wattage	Location
T8 Fluorescent	32 W	Corridors, offices, mechanical rooms, storage rooms, locker rooms, gym, cells
CFL Pins	21 W	Lobby, washrooms, cells, locker room
Halogen	50 W	Meeting rooms

3.7.2 Exterior Lighting

Exterior lighting consist of wall packs along the exterior walls of the building. All exterior lighting is controlled by photocells.

TABLE 3.7.2: EXTERIOR LIGHTING DETAILS

Fixture Type	Lamp Type	Wattage
Wall Packs	LED	40 W

3.8 Controls

The building is equipped with a MACH System (Reliable Controls) building automation system (BAS). The BAS controls all major HVAC equipment at the facility including the central boiler plant, air handling units, ERVs and rooftop unit. Schedules for specific pieces of equipment vary by area served. A review of the BAS schedules showed that operating schedules for all units follows that of occupancy which in the case of the police station is 24/7.

3.9 Electrical Service

The site is serviced by a pad mounted step-down transformer located within the building. The transformer cannot be accessed. This supplies the main disconnect for the facility which is rated at 1000A.

Reviewing the facilities electrical bills the monthly base demand as well as the peak summer and peak winter demands are as follows:

Average Monthly Base Demand (kW)	Peak Summer Demand (kW)	Peak Winter Demand (kW)
98.5	125	82

4 The Energy Usage Report

4.1 Utility Meters

The following utility meters were modeled as part of this report:

TABLE 4.1.1: UTILITY METER DETAILS

Utility	Meter Number	Units	Escalation Rate	Marginal Rate ($/Unit)	GHG Emissions (Tonnes/Unit)
Demand	89141	kW	6.0%	$10.5034	0.000000
Electricity	89141	kW	5.2%	$0.1310	0.000028
Natural Gas	N/A	m^3	5.0%	$0.4064	0.001932
Water	N/A	m^3	3.0%	$3.3400	0.000000

These utility meters and account numbers can be used to cross-reference reports in *the Appendices*.

The "Effective Marginal Rate" is an average of the base marginal rates plus additional charges that the Utility Providers charge per unit of consumption or demand. This number is used in calculations to determine the utility cost savings of individual measures.

4.2 Utility Rate Structures

The following charges apply to this facility through the utility bills:

Energy Consumption Charges: typically billed monthly per unit of energy used by the building. Such charges may include customer charges, energy charges and other miscellaneous charges. These charges may vary from month to month.

Electric Demand Charges: determined by the maximum power demand in kilowatts that a building requires each month. The demand charge is based on the "peak demand" that the building required during the billing cycle. The peak demand is typically set during a period varying from 15 minutes to one hour. This can mean that very short periods of high energy demand during the billing cycle can result higher demand charges.

Regulatory Charges: the costs of administering the wholesale electricity system and maintaining the reliability of the provincial grid and include costs associated with funding Ontario Power Authority conservation and renewable energy programs.

Distribution Charges: delivering electricity from electricity generating stations across the province to your LDC, then to your facility. This includes the costs to build and maintain the transmission and distribution lines, towers and poles and operate provincial and local electricity systems.

A portion of these charges are fixed and do not change from month to month. Others are variable and increase or decrease depending on the amount of electricity used.

Power Factor Charges: "Power Factor" is the ratio of real power (kilowatt) to apparent power (kilovolt-ampere, kVA) for any given load and time. It is a measure of how much of the power being delivered to the facility is actually performing work.

Power factors for resistive loads, such as lighting and electrical heating are (ideally) 1.0, meaning that all power being supplied is performing work. Electric motors (used for pumps, fans, elevators etc.) are inductive loads which have a power factor of less than 1.0. A motor with a power factor of 0.85 effectively uses only 85% of the power being delivered.

A low power factor affects the utilization of the installed capacity of the electrical system. Additional charges for having a low or less-than-optimum power factor are often structured as additional demand charges or can be per kilovolt-ampere reactive (KVAR) charges.

Time-of-use Rates: Time-of-use rate structures use varying rates for energy costs based on the time of day. The rates are typically associated with peak, off-peak and mid-peak periods. Prices can vary based on the time of day, day of the week, or season. They are higher during peak periods and lower during off-peak periods. Since time of use rates are designed to encourage energy conservation during peak periods, load shifting strategies used in the energy model can result in significant energy cost savings.

Global Adjustment Charges: Consumers who pay the Hourly Ontario Energy Price (HOEP), or have signed a retail contract, will see their electricity bills also include a line for the Global Adjustment. This charge accounts for the differences between the market price and the rates paid to regulated and contracted generators and for conservation and demand management programs. The charge shows on bills in different ways, depending on the type of customer:

1. Class B Consumers: those with a peak demand over 50kW and under 5MW
2. Class A Consumers: those with an average hourly peak demand of 3MW or higher

Other Charges: Utilities often charge additional taxes and surcharges based on local regulations and/or programs, such as energy conservation and low-income assistance programs. Additionally, there can also be fuel adjustment charges, which are related to the cost of resource energy to the utility. Often this charge is an additional multiplier that is applied to the energy charge and will vary monthly based on fuel cost fluctuations.

4.3 Meter Modeling

Daily mean temperatures from Peterborough A (WMO ID 71436) were used in creating the baseline models for this facility.

4.3.1 Demand

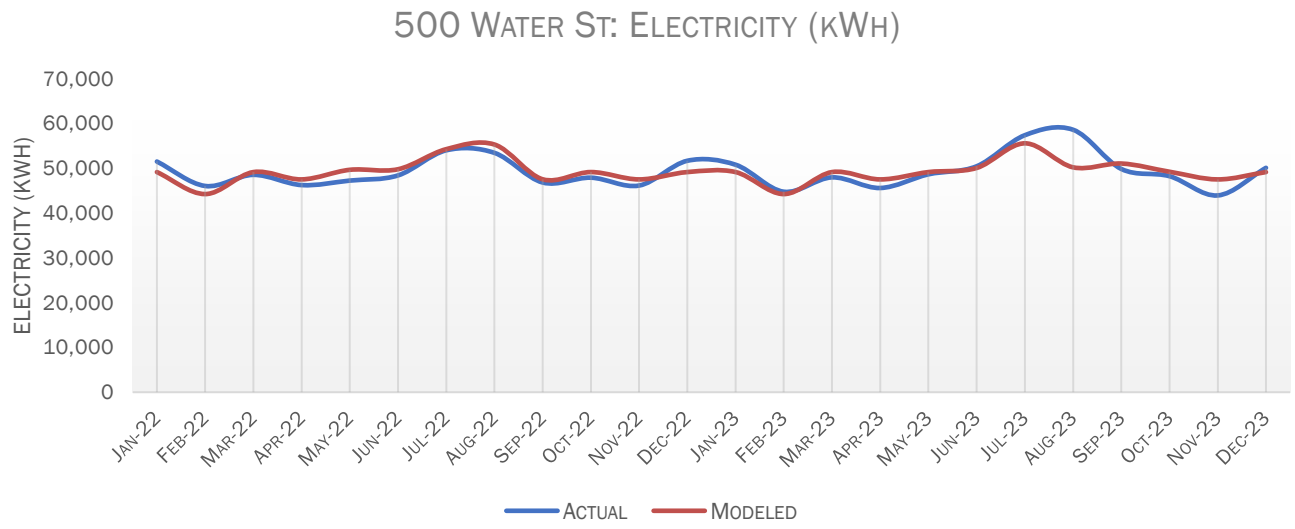
Limited demand data was made available. Data provided (3 months' worth) was not enough to provide a true reflection of the building's electrical demand across an entire year.

4.3.2 Electricity

Baseline Equation:

Electricity (kWh) = Days x 1638.57 + CDD x 241.24.
The underlying regression of this baseline equation is $R^2 = 0.9975$.
CDD (Cooling Degree Days) calculated using a balance point of 20°C.
In a typical year, consumption will be 638,625 kWh.

Modeling Graphs:



Rate Structure:

Electricity for this building is provided by Alectra. It is classified as a General Service account with a monthly demand of between 50 and 999 kW. This is a "Standard Rate" structure which charges electricity based on the Hourly Ontario Energy Price (HOEP) and Global Adjustment (GA). Both of these rates change from month-to-month as they are based on real-time market conditions. Regulatory Charges are also added to this cost on a per kWh basis.

Comments:

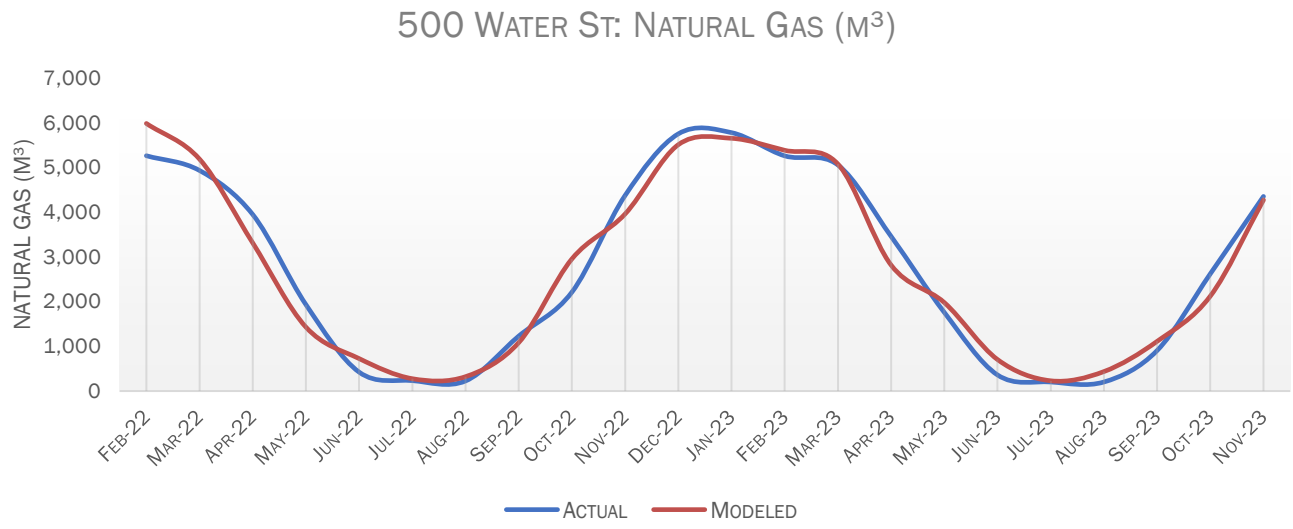
No anomalies or irregularities were noted during the modeling period of this report.

4.3.3 Natural Gas

Baseline Equation:

Natural Gas (m^3) = Days x 4.06 + HDD x 8.18.
The underlying regression of this baseline equation is R^2 = 0.9866.
HDD (Heating Degree Days) calculated using a balance point of 19°C.
In a typical year, consumption will be 38,794 m^3.

Modeling Graphs:



Rate Structure:

Natural Gas for this building is provided by Enbridge/Union Gas. It is classified as a Commercial M2 (Southern Ontario) account. It is a "Block Rate" structure which charges set monthly rates for gas consumed, storage and adjustments and variable delivery charges based on "blocks" of gas consumption. For example, the Delivery portion of charges for gas consumed up to 1,000 cubic meters might be 3.7 ¢/m^3 while gas consumed between 7,000 and 20,000 cubic meters might have a Delivery charge of 3.4¢/m^3.

Comments:

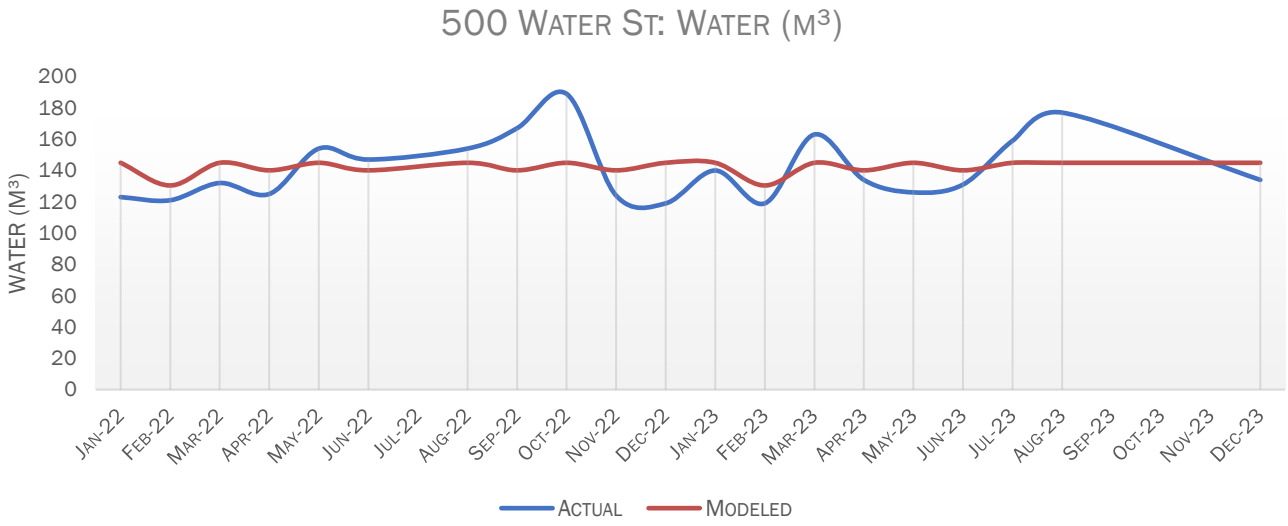
No anomalies or irregularities were noted during the modeling period of this report.

4.3.4 Water

Baseline Equation:

Water (m^3) = Days x 4.83.
The underlying regression of this baseline equation is R^2 = 0.9818.
In a typical year, consumption will be 1,763 m^3.

Modeling Graphs:



Rate Structure:

Water for this building is provided by the City of Peterborough. It is classified as a Commercial account. Billing for this account includes a flat daily rate (based on meter size) as well as both water consumed, and the associated wastewater produced. If the building uses 100 cubic meters of water in a given month, it is billed the daily service rate (based on meter size) as well as for the 100 m^3 of water and for 100m^3 of waste water.

Comments:

There were significant spikes in water consumption during the month of July 2022 as well as September to November of 2023. A long-standing shower leak was the cause of the spikes in consumption during 2022. The roof was replaced in 2023 and due to the nature of the construction additional water was used to complete the project. These points of high consumption have been removed from the utility analysis as they are deemed to be outliers.

4.4 Building Energy Performance

The following section provides benchmarking information for the facility.

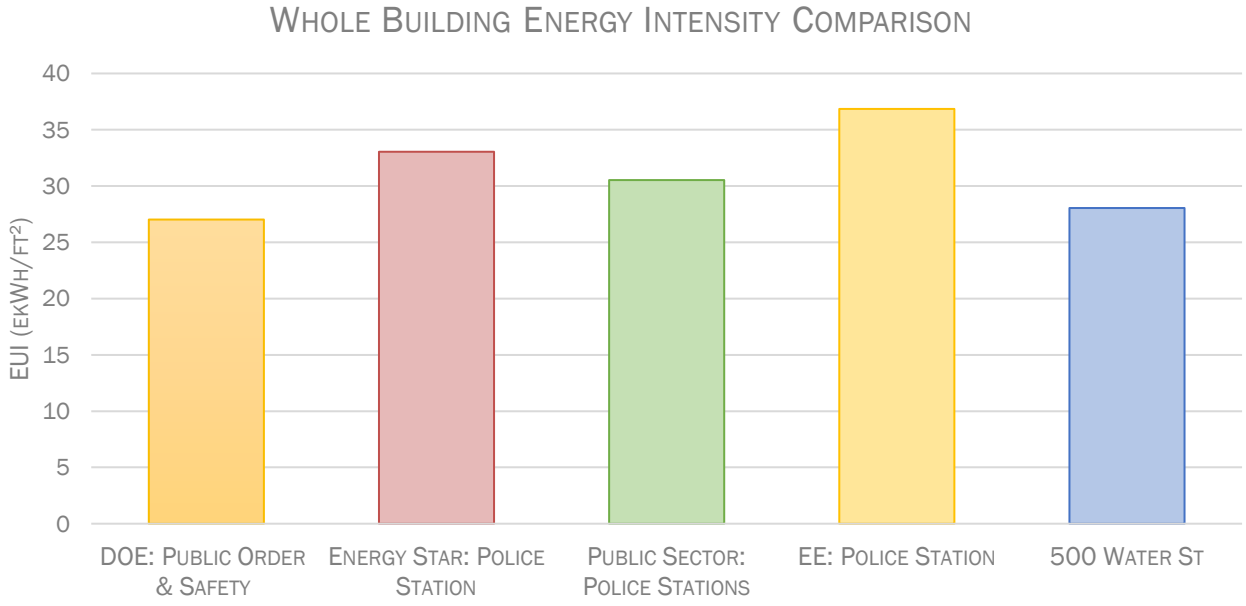
Electricity intensity for the building is 16.6 ekWh/ft² (0.64 GJ/m²). Natural Gas intensity for the building is 11.5 ekWh/ft² (0.44 GJ/m²). Total energy intensity for the building is 28 ekWh/ft² (1.09 GJ/m²).

The energy performance of 500 Water St is compared to buildings of similar usage or size from multiple benchmarking databases including Energy Star, Department of Energy (DOE), Ontario Broader Public Sector buildings and a database of energy use intensities maintained by Efficiency Engineering:

Benchmark	EUI	% Variance
DOE: Public Order & Safety	27.0	4%
Energy Star: Police Station	33.0	-15%
Public Sector: Police Stations	30.5	-8%
EE: Police Station	36.8	-24%
500 Water St	**28.0**	

*A positive variance indicates that the facility EUI is xx% higher than the stated benchmark. A negative variance indicates that this facility's EUI is below the indicated benchmark, consuming less energy per unit of area.

A comparison of the total energy intensity of the facility with buildings of a similar type and characteristics are shown in the chart below.



Compared to other buildings of a similar type, the overall energy intensity at 500 Water St is comparable.

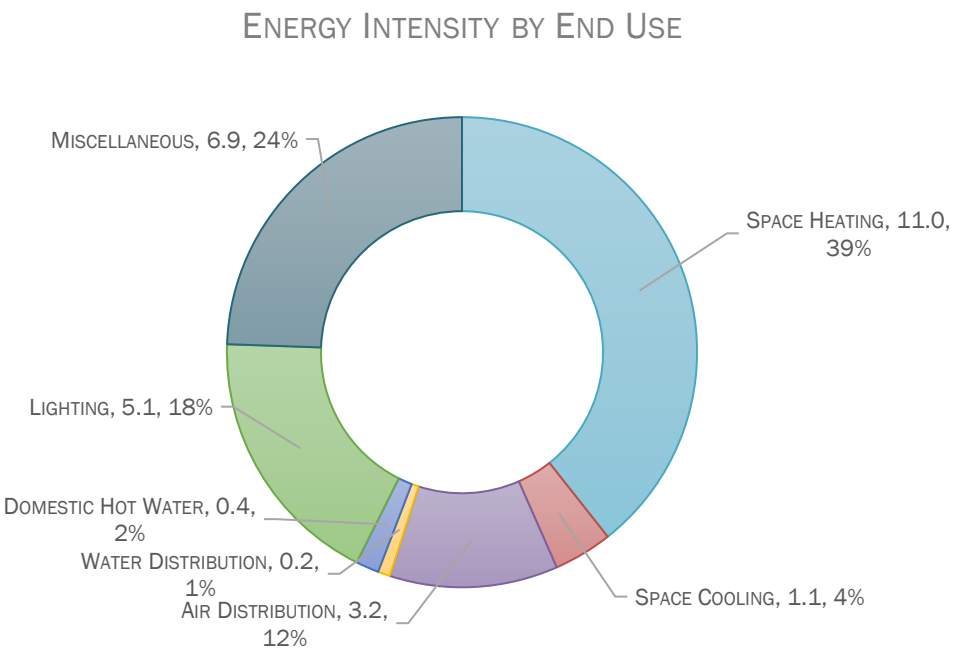
4.5 Energy Breakout by End Use

Energy consumption by end use for the facility has been calculated based on the building's overall energy consumption, calibrated energy models, nameplate information, schedules and estimated cycle times for equipment.

The end use energy breakdown for this facility is:

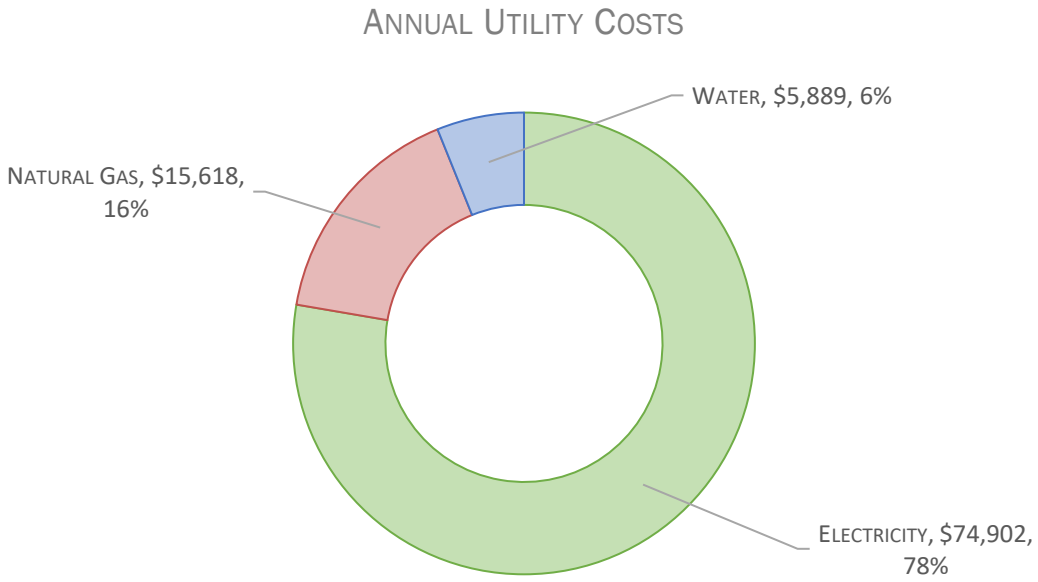
End Use	Electricity (kWh)	Natural Gas (m^3)	EUI (ekWh/ft^2)	GHG Emissions (Tonnes)
Space Heating	0	36,934	11.0	71.4
Space Cooling	39,140	0	1.1	1.1
Air Distribution	112,110	0	3.2	3.1
Water Distribution	7,990	0	0.2	0.2
Domestic Hot Water	0	1,497	0.4	2.9
Lighting	175,690	0	5.1	4.9
Miscellaneous	236,840	0	6.9	6.6
Total	**571,770**	**38,430**	**28.0**	**90.3**

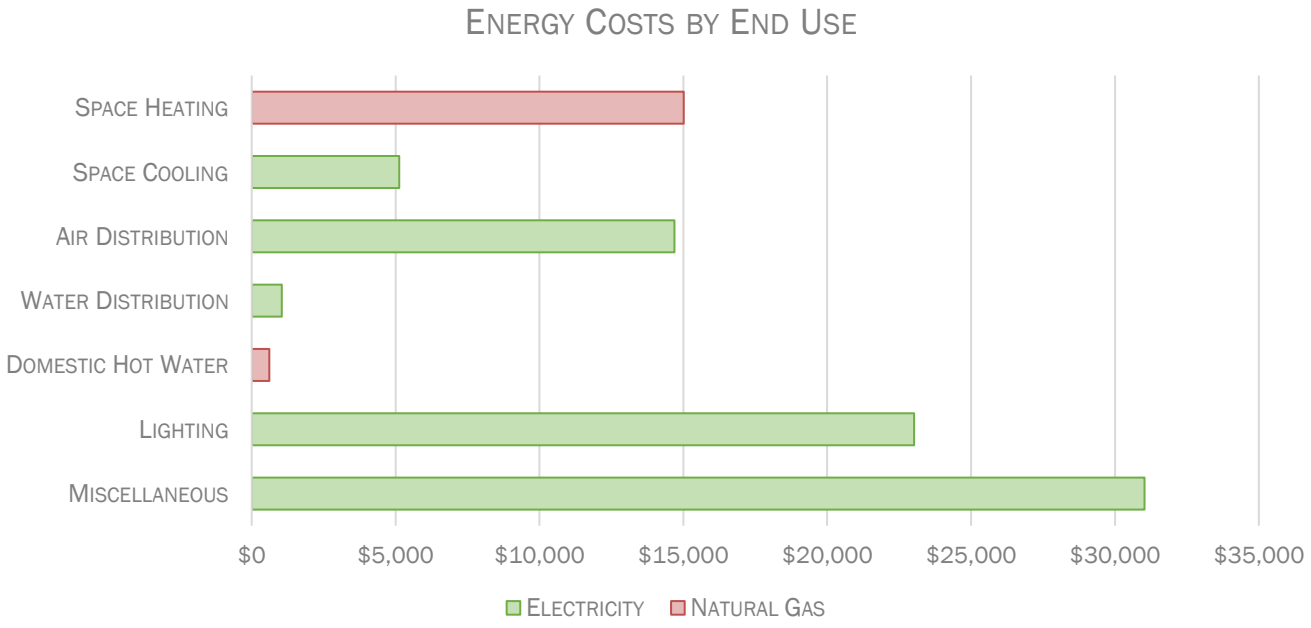
The following chart shows the energy intensity of 500 Water St broken out by end use.



4.6 Utility Costs

In a Typical Model Year, the building would expect to spend the following at the current utility rates. Energy costs by end use are:





5 Measure Level Analysis

The Measure Level Analysis quantifies the energy savings and implementation costs for each Opportunity (or "Measure"). As Opportunities are organized into Roadmaps, interactive effects will occur. As such, the total GHG emissions reductions may differ between the sum of the individual measures and the total for the Roadmap. Individual Opportunities may be included in multiple roadmaps.

The financial analyses for the Opportunities listed in the following section includes a Life Cycle Cost Analysis or LCCA. The LCCA provides a more detailed analysis over the lifespan of the measure and includes the following items:

- **Inflation Rate:** An annual inflation rate is included for future avoided costs and additional annual maintenance costs/savings.
- **Discount Rate:** The rate used to approximate the present-day value of future costs/savings.
- **Utility Escalation Rate:** Utility costs escalate year after year. This value increases the energy savings/costs accordingly over the 20-year period. These escalation rates can be found in Table 5.1.1.
- **Operational Costs:** Implementing some measures will require additional annual maintenance (for example, chemical treatment for a new boiler plant), while others require less annual maintenance (such as longer lasting LED lighting).
- **Avoided Costs:** If some pieces of equipment are due for replacement in the coming years, then by implementing related energy efficiency measures as a part of this project, you are avoiding the future costs associated with the replacement of this equipment.

The results of the LCCA are summarized in a single value: the Capital Payback. Where a simple payback will give you a general idea of how an Opportunity will perform economically (using first year utility savings and the upfront implementation costs), the Capital Payback identifies at what point along the 20-year LCCA the Opportunity recoups its initial investment, taking all of the above into consideration.

Further details are located in the Appendices of this report.

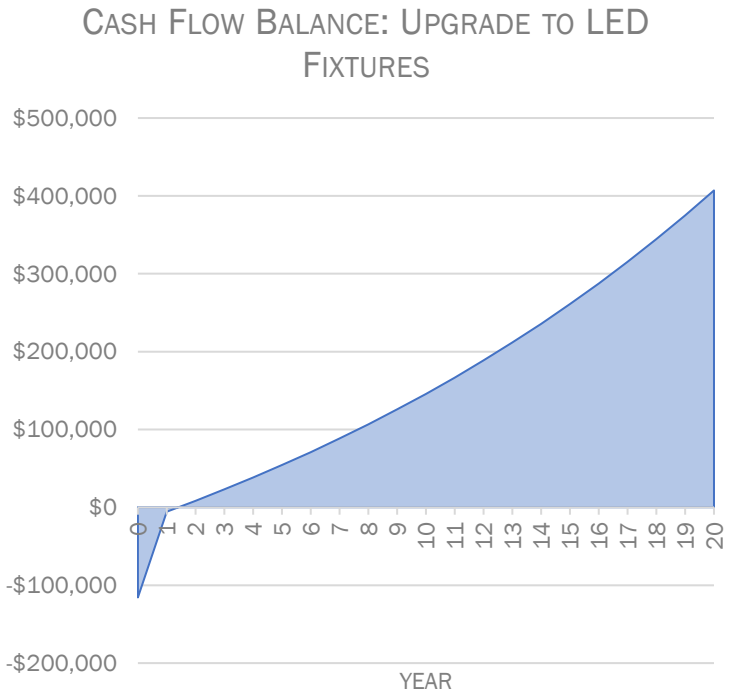
5.1 Opportunity 1: Upgrade to LED Fixtures

The Detailed Financial Analysis

Using the Financial Factors listed in this report, this project results in the following Annual Utility Savings, Simple Payback and Net Present Value:

Table 5.1.1: Opportunity 1 Detailed Financial Analysis

Utility Savings	
Demand (kW):	200
Electricity (kWh):	69,090
Natural Gas (m³):	-4,628
Water (m³):	0
Emissions (tCO_2e):	-7.0
Financials	
Utility Savings:	$9,275
Add'l Annual Savings:	$3,466
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$92,552
Engineering & PM:	$13,883
Contingency:	$9,255
Project Costs:	$115,690
Simple Payback:	9.1
Capital Payback:	1.4
NPV:	$172,543
IRR:	34.8%



Existing Conditions

Lighting in the facility generally consists of T8 fluorescent and compact fluorescents (CFLs). All lighting is controlled by wall switches or circuit breakers.

Table 5.1.2: Interior Lighting Details

Lamp Type	Wattage	Location
T8 Fluorescent	32 W	Corridors, offices, mechanical rooms, storage rooms, locker rooms, gym, cells
CFL Pins	21 W	Lobby, washrooms, cells, locker room
Halogen	50 W	Meeting rooms

Retrofit Conditions

We recommend replacing all interior linear fluorescent T8, CFL and metal halide fixtures with LED equivalents.

Savings for this measure were calculated with the assumption of a 1 for 1 replacement. Many LED fixtures now have occupancy sensors integral to the fixture.

Advantages of LED include:

- Instant "ON/OFF"
- Work well with occupancy sensors/photocells/lighting control systems
- Dimmable
- Long Life (50,000-100,000+ hours)
- Reduced Maintenance Costs
- Good Colour Rendering (>80 CRI)
- Typical Colour Temperatures Availability from 2700K up to 5000K
- Many fixtures have option for Integrated Occupancy Sensors
- Better Uniformity of light across playing surface
- Ability to cycle lights "ON/OFF" "flashlights" with no effect to system life

In addition to the upfront energy savings, LEDs true savings lie in the reduced maintenance costs associated with lamp and ballast life. Typical LED fixtures are rated for 50,000 - 100,000+ hours as opposed to the 15,000 - 24,000 hour average lamp life for High Intensity Discharge (HID) or the 20,000 – 36,000 hour average lamp life for linear fluorescent lamps. Care should be taken in selecting a quality LED fixture which meets the needs of the application while being supported by a reputable company guaranteeing a lengthy warranty. LED fixtures should be either Design Lighting Consortium (DLC) listed or Energy Star Certified.

It should be noted that there are negative savings for natural gas associated with this measure. This is because LEDs do not give off heat while turned on. This impacts the buildings heating system negatively as it will have to work harder to maintain space temperatures.

This energy conservation measures (ECM) may have a negative GHG impact on its own, however, when this measure is packaged with other ECMs in the scenario level analysis the negative GHG impact for this measure will disappear. This is due to the recommendations for the heating systems being put forward (i.e., ASHP with Gas Backup or ASHP with Electric Backup) which are fuel conversion measures. The negative natural gas savings then becomes a reduction in the electrical savings for this measure, and as a result will no longer have a negative GHG emission impact.

This measure will have some impact on operations and maintenance at the facility as the LED lighting will last much longer than traditional T8 and CFL lighting. Maintenance savings has been accounted for in the annual additional savings row.

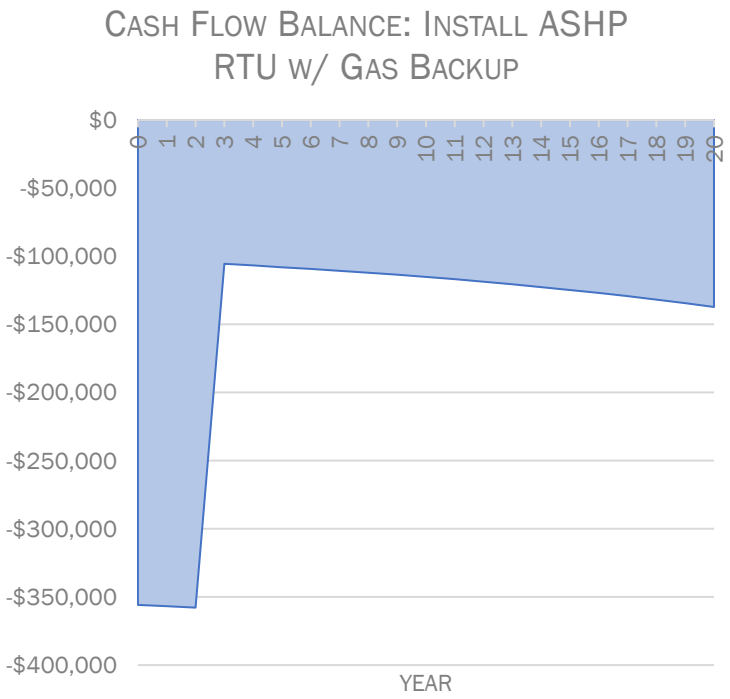
5.2 Opportunity 2: Install ASHP RTU w/ Gas Backup

The Detailed Financial Analysis

Using the Financial Factors listed in this report, this project results in the following Annual Utility Savings, Simple Payback and Net Present Value:

Table 5.2.1: Opportunity 2 Detailed Financial Analysis

Utility Savings	
Demand (kW):	-45
Electricity (kWh):	-6,560
Natural Gas (m^3):	997
Water (m^3):	0
Emissions (tCO_2e):	1.7
Financials	
Utility Savings:	-$923
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$284,651
Engineering & PM:	$42,698
Contingency:	$28,465
Project Costs:	$355,814
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$166,602
IRR:	No IRR



Existing Conditions

Heating, cooling and ventilation are provided to the buildings ground floor via a single Aaon rooftop unit (RTU). This unit tempers a percentage of outdoor air, typically 20%, and distributes it to the building.

Table 5.2.2: Ventilation Equipment Details

Tag ID	Htg Capacity	Clg Capacity	HP	Airflow	Condition
RTU-1	480 MBH	15 Tons	7.5	6,400 CFM	Fair

Retrofit Conditions

This measure includes replacing the existing gas fired rooftop unit with air source heat pump rooftop unit equipped with gas fired backup heat. The unit would be sized to the nominal cooling capacity of the existing rooftop units.

As an example, a 10-ton (nominal) cooling rooftop unit would be replaced by a 10-ton (nominal) ASHP rooftop unit. The ASHP for this unit would supply (nominally) 10-tons of heating and cooling. The gas fired backup would be sized to provide the full heating capacity of the existing unit. This provides significant natural gas savings and GHG reductions for the facility without significantly impacting the electrical demand on the facility.

Weight is always a consideration when replacing rooftop equipment. ASHP rooftop units are available from multiple manufacturers. Weights will vary by capacity, manufacturer, size and model. The exact weight of the replacement rooftop units will not be known until the project is designed, tendered and products selected.

The average weight of ASHP rooftop units is typically slightly higher than that for standard rooftop units when comparing similar compressor capacities. To account for potential structural issues, costing for this measure includes increased allowances for structural evaluations of the roof structure and increased costs for structural reinforcement which may be required.

This measure will have no measurable impact on operations and maintenance at the facility.

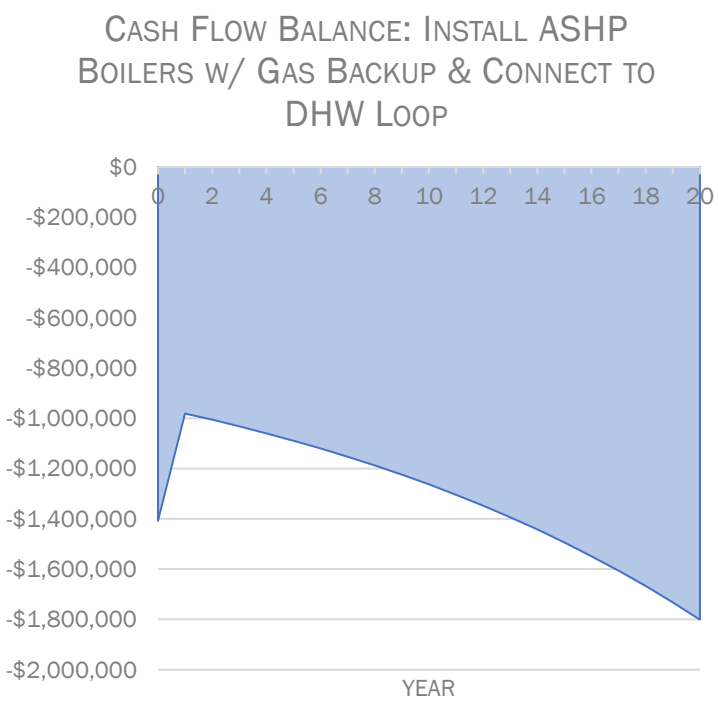
5.3 Opportunity 3: Heating Boilers: Install ASHP w/ Gas Backup and Connect to DHW Loop

The Detailed Financial Analysis

Using the Financial Factors listed in this report, this project results in the following Annual Utility Savings, Simple Payback and Net Present Value:

Table 5.3.1: Opportunity 3 Detailed Financial Analysis

Utility Savings	
Demand (kW):	-1,387
Electricity (kWh):	-165,780
Natural Gas (m^3):	34,965
Water (m^3):	0
Emissions (tCO_2e):	62.9
Financials	
Utility Savings:	-$22,077
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$1,125,951
Engineering & PM:	$168,893
Contingency:	$112,595
Project Costs:	$1,407,438
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$1,370,682
IRR:	No IRR



Existing Conditions

The building is heated via a natural gas fired central boiler plant that serves hydronic coils in air handling units, reheat coils in VAV boxes and perimeter baseboards. The boiler plant consists of two DeDietrich boilers:

TABLE 5.3.2: HEATING EQUIPMENT DETAILS

Tag ID	Type	Capacity	Efficiency	Condition
B-1	Cast Iron Sectional	1785 MBH	80%	Good
B-2	Cast Iron Sectional	1785 MBH	80%	Good

Retrofit Conditions

Both existing gas fired cast iron sectional boilers and their associated venting would be removed. In their place two (2) 1,000 MBH gas fired condensing boilers will be installed and will serve as heating backup.

Additionally, the domestic hot water loop would be added to the central heating loop. A connection point already exists for this, but it is not currently in use. DHW would be heated by the central ASHPs during regular operation. However, in times of extreme cold, where heat pump operation is not possible or during the cooling season when the ASHPs are in cooling mode, a backup electric heater tank will be installed to provide DHW to the building.

Hot water heating will be provided by a hybrid ASHP system with gas fired backup. One (1) new 1080 MBH air source heat pumps would be installed outdoors.

The air source heat pump will operate during most of the year, when outdoor temperatures allow for adequate output capacity. The ASHPs have been sized to cover the heating load down to around -10°C. During the peak of the heating season, when outdoor temperatures are colder, the natural gas condensing boiler will provide capacity and redundancy for the system.

Analysis shows that the ASHP will offset approximately 91% of the existing plants' natural gas consumption.

This measure will have no measurable impact on operations and maintenance at the facility.

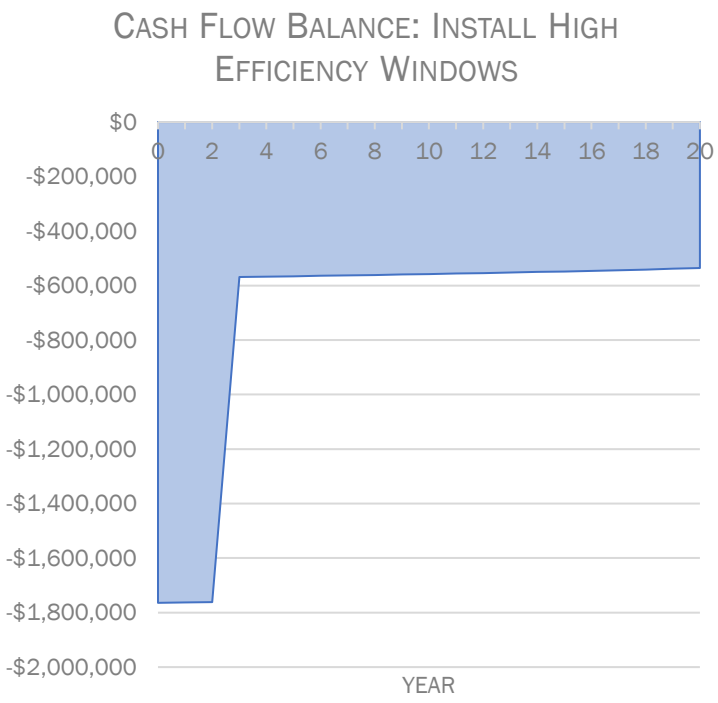
5.4 Opportunity 4: Install High Efficiency Windows

The Detailed Financial Analysis

Using the Financial Factors listed in this report, this project results in the following Annual Utility Savings, Simple Payback and Net Present Value:

TABLE 5.4.1: OPPORTUNITY 4 DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	0
Electricity (kWh):	-3,740
Natural Gas (m^3):	3,765
Water (m^3):	0
Emissions (tCO_2e):	7.2
Financials	
Utility Savings:	$1,040
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$1,411,361
Engineering & PM:	$211,704
Contingency:	$141,136
Project Costs:	$1,764,202
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$782,559
IRR:	-9.7%



Existing Conditions

The facility was constructed in 1967 with a grey brick façade. The roof is built-up of tar and gravel. Windows are generally double glazed with an air fill. The City has been proactive with replacement of envelope components. New windows were installed in 2016.

Retrofit Conditions

Although the windows are fairly new, we recommend that the windows be replaced with triple glaze, argon filled windows. Window frames should be made of thermally broken fibreglass. Existing operable windows should be replaced with operable windows. Newer windows will have a higher R-value (better insulating characteristics), and will also have tighter frames resulting in less infiltration. Savings generated for this measure were based on the installation of windows with an

R value of 4. Specify argon-filled windows with a low-emissivity interior coating to block some of the summer radiant heat gain.

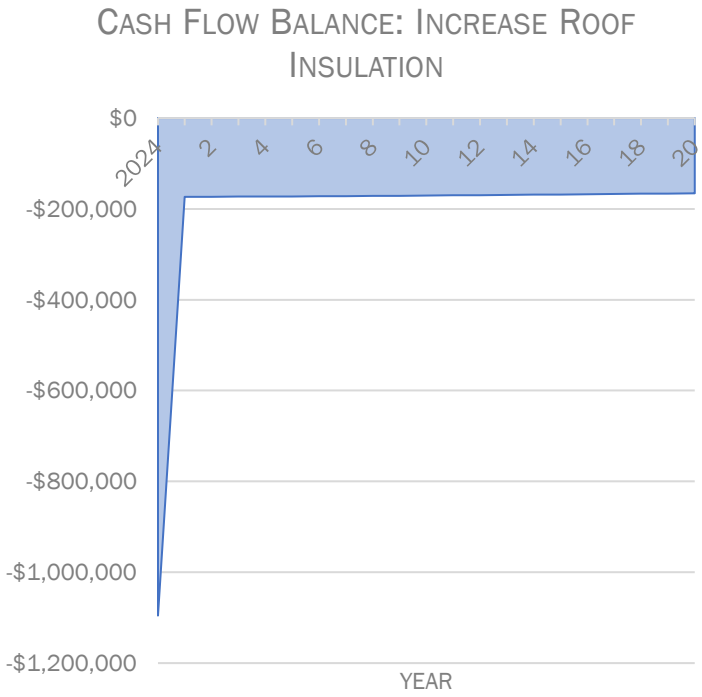
5.5 Opportunity 5: Increase Roof Insulation

The Detailed Financial Analysis

Using the Financial Factors listed in this report, this project results in the following Annual Utility Savings, Simple Payback and Net Present Value:

TABLE 5.5.1: OPPORTUNITY 5 DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	0
Electricity (kWh):	-510
Natural Gas (m³):	758
Water (m³):	0
():	0
():	0
Emissions (tCO_2e):	1.5
Financials	
Utility Savings:	$241
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$1,095,450
Engineering & PM:	$0
Contingency:	$0
Project Costs:	$1,095,450
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$232,786
IRR:	-11.9%



Existing Conditions

The exterior roof structure of the building is a built-up type with a membrane and shingle finish. Based on the building drawings provided it was determined that the roof had a total R-value (a measure of an exterior surface's ability to resist the transfer of heat) of 20. While this was considered an acceptable amount of insulation at the time of the building's construction, R20 is considered fairly poor by today's standard. The roof was recently replaced in 2023 however, the insulation could be improved upon.

Retrofit Conditions

We recommend replacing the existing roof and increasing the roof insulation when it has reached its end-of-life expectancy. New insulation can either be batt or foam board, but the overall thickness of the insulation needs to be taken into consideration when examining the existing roofs parapet and HVAC equipment. For this measure, we have recommended installing an additional 2 inches of insulation which brings the total R value of the roof to 30.

This new roof will be installed and maintained by a qualified contractor. No additional staff training is required. This measure will have no measurable impact on operations and maintenance costs at the facility but will have a positive impact on occupancy comfort.

Other sources of insulation, such as Glavel, were examined during the development of this energy conservation measure and have been included in the Other Measures Considered section.

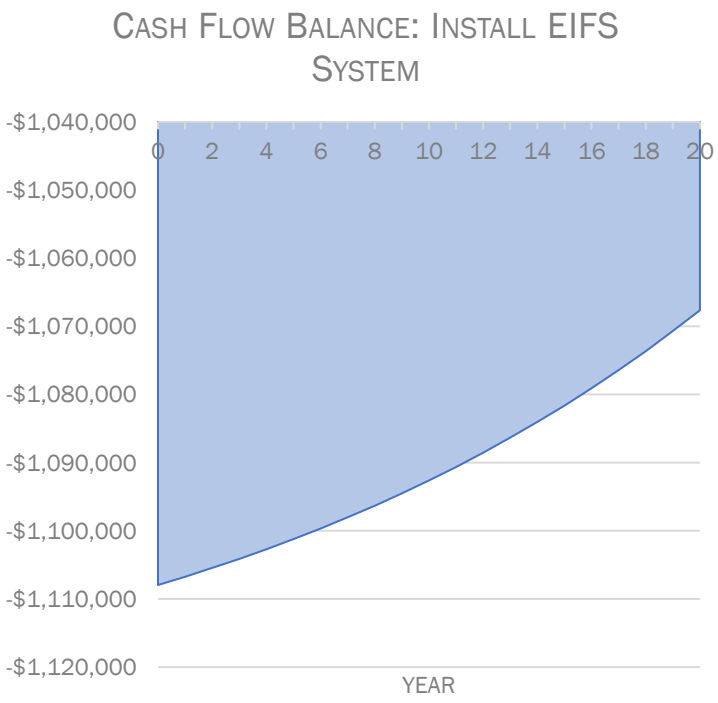
5.6 Opportunity 6: Install EIFS System

The Detailed Financial Analysis

Using the Financial Factors listed in this report, this project results in the following Annual Utility Savings, Simple Payback and Net Present Value:

TABLE 5.6.1: OPPORTUNITY 6 DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	0
Electricity (kWh):	-2,720
Natural Gas (m^3):	3,734
Water (m^3):	0
Emissions (tCO_2e):	7.1
Financials	
Utility Savings:	$1,161
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$886,362
Engineering & PM:	$132,954
Contingency:	$88,636
Project Costs:	$1,107,953
Simple Payback:	954.3
Capital Payback:	79.06
NPV:	-$1,089,317
IRR:	-20.0%



Existing Conditions

The facility was constructed in 1967 with a grey brick façade.

As the building is nearly 60 years old, there has been some wear and tear on the envelope. However, the City has been proactive with replacement of envelope components. EIFS panels have also been installed around the second floor of the building.

Retrofit Conditions

We recommend installing an exterior insulation and finish system (EIFS) over top the buildings grey brick wall sections. An EIFS system typically contains about 4 inches of rigid insulation. One inch of rigid insulation provides an average R-value of 5 and a total of R20 in addition to the existing insulation. The insulation will be protected by an exterior veneer.

This EIFS system would be installed and maintained by a qualified contractor. No additional staff training is required. This measure will have no measurable impact on operations and maintenance costs at the facility but will have a positive impact on occupancy comfort.

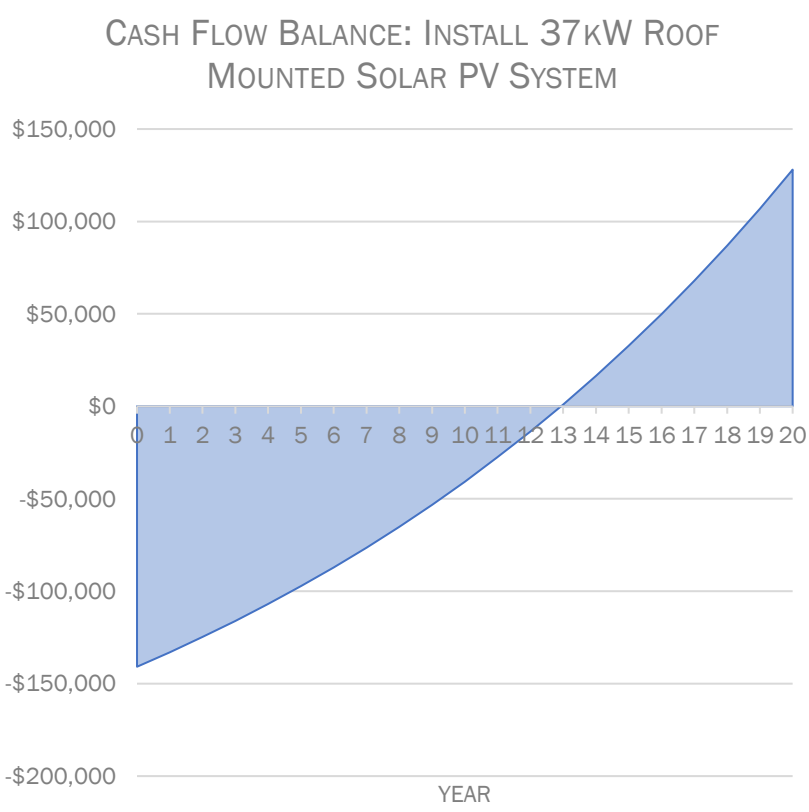
5.7 Opportunity 7: Install a 37-kW Rooftop Solar PV System

The Detailed Financial Analysis

Using the Financial Factors listed in this report, this project results in the following Annual Utility Savings, Simple Payback and Net Present Value:

Table 5.7.1: Opportunity 7 Detailed Financial Analysis

Utility Savings	
Demand (kW):	133
Electricity (kWh):	46,051
Natural Gas (m^3):	0
Water (m^3):	0
Emissions (tCO_2e):	2.3
Financials	
Utility Savings:	$7,432
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$128,044
Engineering & PM:	$0
Contingency:	$12,804
Project Costs:	$140,848
Simple Payback:	19.0
Capital Payback:	12.9
NPV:	-$17,603
IRR:	5.9%



Existing Conditions

All electricity consumption for the facility is currently supplied by the local LDC.

Retrofit Conditions

We recommend installing a 37kW photovoltaic (PV) system on the roof. PV panels convert solar energy directly into electricity. The electricity can then be coupled to the building's electrical distribution, where it can be used within the building or sold back to the utility (with a net-metering agreement). This building has a lot of room on the roof to accommodate a PV system. Additionally, clear exposures to eastern, southern, and western skies will help maximize the electricity production of the PV system.

A 37kW system will provide about 46,051kWh of electricity per year. This accounts for approximately 8% of the building's total annual electricity consumption. With net metering, the electricity that is produced by the PV system is used by the building, but any additional electricity not used can be exported to the grid for credit.

This measure will have some impact on operations and maintenance at the facility as snow might need to be cleared off panels during the winter months.

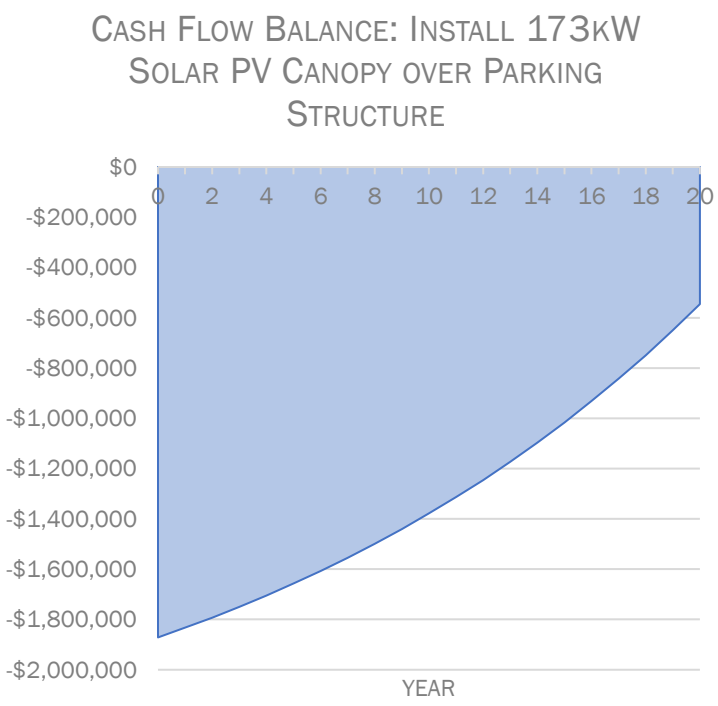
5.8 Opportunity 8: Install a 173-kW Solar PV Canopy over East Parking Area

The Detailed Financial Analysis

Using the Financial Factors listed in this report, this project results in the following Annual Utility Savings, Simple Payback and Net Present Value:

Table 5.8.1: Opportunity 8 Detailed Financial Analysis

Utility Savings	
Demand (kW):	779
Electricity (kWh):	216,404
Natural Gas (m³):	0
Water (m³):	0
Emissions (tCO_2e):	6.1
Financials	
Utility Savings:	$36,532
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$1,497,247
Engineering & PM:	$224,587
Contingency:	$149,725
Project Costs:	$1,871,559
Simple Payback:	51.2
Capital Payback:	24.5
NPV:	-$1,264,054
IRR:	-2.7%



Existing Conditions

All electricity consumption for the facility is currently supplied by the local LDC.

Retrofit Conditions

Further to the east of the building, past the parking structure is an additional parking lot which could support a sizable solar PV canopy system. A canopy mounted solar PV system is an effective alternative for a roof mounted system; however, canopy systems are significantly more expensive to install.

Photovoltaic (PV) solar panels convert solar energy directly into electricity. The electricity can then be coupled to the building's electrical distribution, where it can be used within the building or sold

back to the utility (with a net-metering agreement). Clear exposures to eastern, southern, and western skies will help maximize the electricity production of the PV system.

Solar Canopy Location

Analysis shows that there is adequate space in the east parking lot for a solar PV system of approximately 173-kW.

A 173-kW system will provide about 216,404kWh of electricity per year. This accounts for approximately 38% of the building's total annual electricity consumption. With net metering, the electricity that is produced by the PV system is used by the building, but any additional electricity not used can be exported to the grid for credit.

This measure will have some impact on operations and maintenance at the facility as snow might need to be cleared off panels during the winter months.

6 Other Measures Considered

The following Opportunities were also considered during the process of the audit; however, were not pursued due to implementation restrictions, poor financial results or other logistical challenges when viewed at a high level.

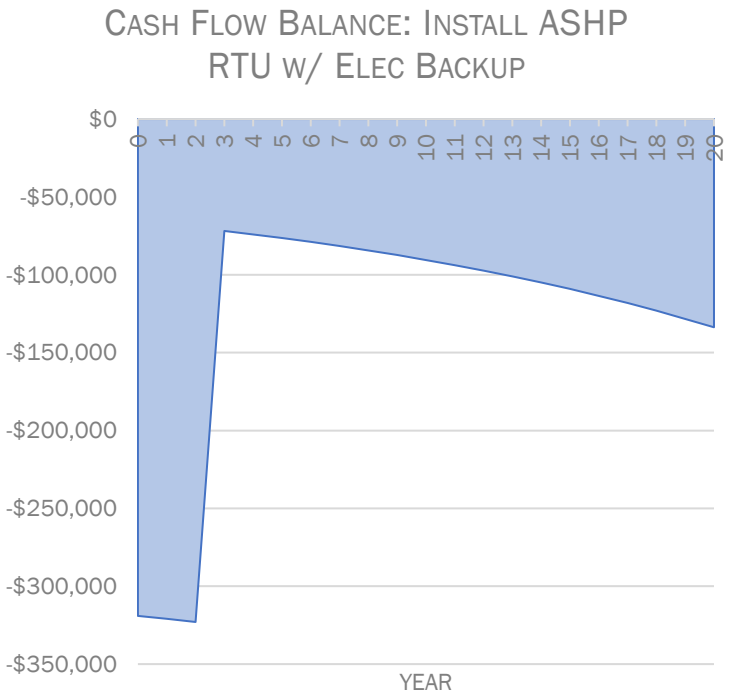
6.1 Opportunity 9: Install ASHP RTU w/ Elec Backup

The Detailed Financial Analysis

Using the Financial Factors listed in this report, this project results in the following Annual Utility Savings, Simple Payback and Net Present Value:

TABLE 6.1.1: OPPORTUNITY 9 DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	-103
Electricity (kWh):	-10,180
Natural Gas (m³):	1,519
Water (m³):	0
Emissions (tCO_2e):	2.6
Financials	
Utility Savings:	-$1,799
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$255,236
Engineering & PM:	$38,285
Contingency:	$25,524
Project Costs:	$319,046
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$144,990
IRR:	No IRR



Existing Conditions

Heating, cooling and ventilation is provided to the buildings ground floor via a single gas fired Aaon rooftop unit (RTU). This unit temper a percentage of outdoor air, typically 20%, and distribute it to the building.

TABLE 6.1.2: VENTILATION EQUIPMENT DETAILS

Tag ID	Htg Capacity	Clg Capacity	HP	Airflow	Condition
RTU-1	480 MBH	15 Tons	7.5	6,400 CFM	Fair

Retrofit Conditions

This measure includes replacing the existing gas fired rooftop units with an air source heat pump rooftop unit equipped with electric backup heat. Each unit would be sized to the nominal cooling capacity of the existing rooftop units.

As an example, a 10-ton (nominal) cooling rooftop unit would be replaced by a 10-ton (nominal) ASHP rooftop unit. The ASHP for this unit would supply (nominally) 10-tons of heating and cooling. The electric backup would be sized to provide the full heating capacity of the existing unit, eliminating natural gas consumption from the rooftop unit.

The average weight of ASHP rooftop units is typically slightly higher than that for standard rooftop units when comparing similar compressor capacities. To account for potential structural issues, costing for this measure includes increased allowances for structural evaluations of the roof structure and increased costs for structural reinforcement which may be required.

Costs also include the installation of new electrical feeds from the rooftop units to their respective electrical panels.

This measure will require an electrical service upgrade for the building.

This measure was not selected at this time as it is likely to increase the electrical demand on the building more significantly than the “Install ASHP RTU w/ Gas Backup” option. Also, opting for the natural gas backup option provides building resiliency which should be considered paramount for a building of this type.

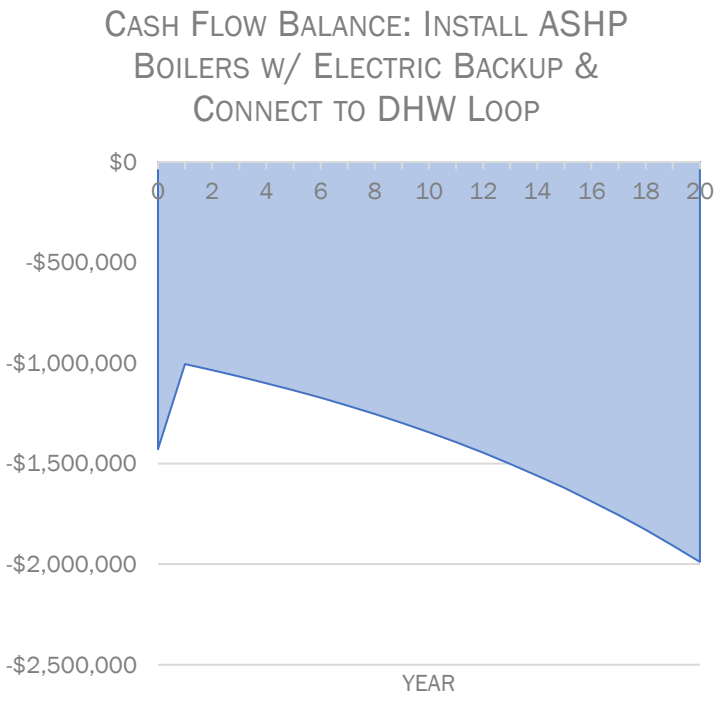
6.2 Opportunity 10: Heating Boilers: Install ASHP w/ Elec Backup and Connect to DHW Loop

The Detailed Financial Analysis

Using the Financial Factors listed in this report, this project results in the following Annual Utility Savings, Simple Payback and Net Present Value:

Table 6.2.1: Opportunity 10 Detailed Financial Analysis

Utility Savings	
Demand (kW):	-1,585
Electricity (kWh):	-194,240
Natural Gas (m^3):	38,153
Water (m^3):	0
Emissions (tCO_2e):	68.3
Financials	
Utility Savings:	-$26,585
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$1,141,908
Engineering & PM:	$171,286
Contingency:	$114,191
Project Costs:	$1,427,384
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$1,467,138
IRR:	No IRR



Existing Conditions

The building is heated via a natural gas fired central boiler plant that serves hydronic coils in air handling units, reheat coils in VAV boxes and perimeter baseboards. The boiler plant consists of two DeDietrich boilers:

Table 6.2.2: Heating Equipment Details

Tag ID	Type	Capacity	Efficiency	Condition
B-1	Cast Iron Sectional	1785 MBH	80%	Good

Tag ID	Type	Capacity	Efficiency	Condition
B-2	Cast Iron Sectional	1785 MBH	80%	Good

Retrofit Conditions

Both existing gas fired cast iron sectional boilers and their associated venting would be removed. In their place two (2) 300kW electric boilers will be installed and will serve as heating backup.

Hot water heating will be provided by a hybrid ASHP system with electric backup. One (1) new 1080 MBH air source heat pumps would be installed outdoors. New electric boilers would be installed for backup during times of peak heating.

Additionally, the domestic hot water loop would be added to the central heating loop. A connection point already exists for this, but it is not currently in use. DHW would be heated by the central ASHPs during regular operation. However, in times of extreme cold, where heat pump operation is not possible or during the cooling season when the ASHPs are in cooling mode, a backup heater tank will be installed to provide DHW to the building.

The air source heat pump will operate during most of the year, when outdoor temperatures allow for adequate output capacity. The ASHPs have been sized to cover the heating load down to around -10°C. During the peak of the heating season, when outdoor temperatures are colder, the electric boiler will provide capacity and redundancy for the system.

Analysis shows that the ASHP will offset approximately 99% of the existing facilities natural gas consumption.

This measure was not selected at this time as it is likely to increase the electrical demand on the building more significantly than the “Heating Boilers: Install ASHP w/ Gas Backup and Connect to DHW Loop” option. Also, opting for the natural gas backup option provides building resiliency which should be considered paramount for a building of this type.

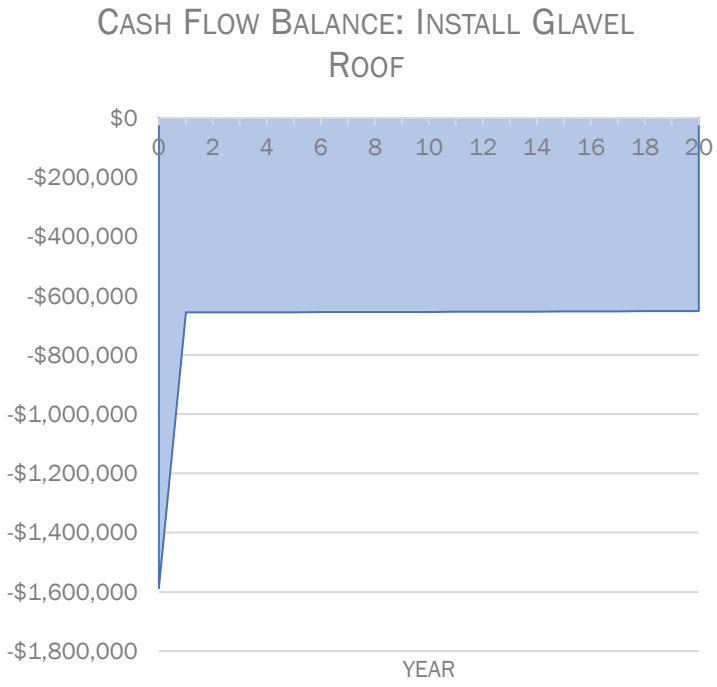
6.3 Opportunity 11: Increase Roof Insulation Using Glavel

The Detailed Financial Analysis

Using the Financial Factors listed in this report, this project results in the following Annual Utility Savings, Simple Payback and Net Present Value:

TABLE 6.3.1: OPPORTUNITY 11 DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	0
Electricity (kWh):	-1,710
Natural Gas (m³):	937
Water (m³):	0
Emissions (tCO_2e):	1.8
Financials	
Utility Savings:	$157
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$1,270,091
Engineering & PM:	$190,514
Contingency:	$127,009
Project Costs:	$1,587,613
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$717,635
IRR:	-24.1%



Existing Conditions

The exterior roof structure of the building is a built-up type with a membrane and shingle finish. Based on the building drawings provided it was determined that the roof had a total R-value (a measure of an exterior surface's ability to resist the transfer of heat) of 20. While this was considered an acceptable amount of insulation at the time of the building's construction, R20 is considered fairly poor by today's standard. The roof was recently replaced in 2023 however, the insulation could be improved upon.

Retrofit Conditions

We recommend replacing the existing roof and increasing the roof insulation when it has reached its end-of-life expectancy.

Currently on the market is a product called Glavel, which is a foam glass gravel that is lightweight and has insulating properties of R1.7 per compacted inch.

Because the existing roof has around 8" of parapet, Glavel can be spread over top the existing buildings roof structure. With 6" of compressed Glavel the roofs overall R value would increase by 10. Something will need to keep the foam glass gravel weighted down, as it is too lightweight on its own and could fall from the building's rooftop. Glavel has been used in conjunction with natural vegetation to create a green roof. Costs and savings for this ECM assumed that the Glavel would be used in conjunction with natural vegetation.

If this roof construction is to be pursued, work around lifting the HVAC units to the new roof height will need to be done.

This new roof will be installed and maintained by a qualified contractor. No additional staff training is required. This measure will have no measurable impact on operations and maintenance costs at the facility and will have a positive impact on occupancy comfort.

This measure was not selected as it is more costly than increasing the roof using more traditional methods and only provides 0.3 tonnes more of GHG reductions than its counterpart.

7 Scenario Level Analysis

As per the funding guidelines set out by the Green Municipal Fund, the measures presented in this study will be grouped in the following GHG reduction target pathways:

- 50% GHG reductions in 10 years
- 80% GHG reductions in 20 years
- 80% GHG reductions in 5 years

7.1 GHG Reduction Pathway Summary

The following table summarizes which measures are included in each pathway.

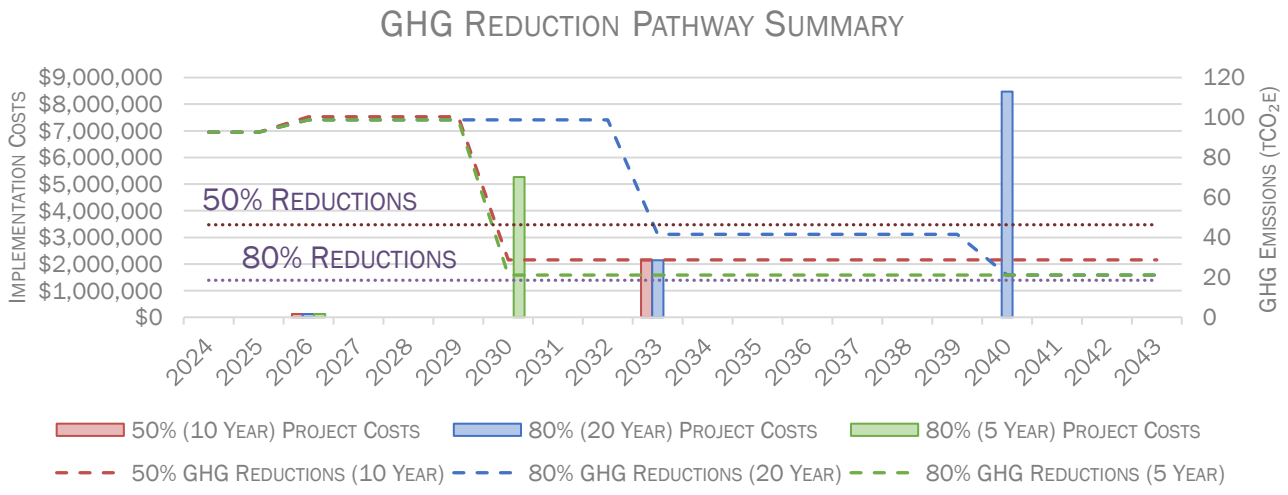
TABLE 7.1.1: SUMMARY OF SCENARIO LEVEL ANALYSIS

Opp. #	Opportunity	Year of Implementation	50% Reduction Pathway	80% Reduction Pathway
1	Lighting: Upgrade to LED	2026	•	•
2	Install ASHP RTU w/ Gas Backup	2033	•	•
3	Install ASHP Boilers w/Gas Backup & Connect to DHW Loop	2033	•	•
4	Install High Efficiency Windows	2040		•
5	Increase Roof Insulation	2040		•
6	Install EIFS System	2040		•
7	Install 37kW Roof Mounted Solar PV System	2040		•
8	Install 133kW Solar PV Canopy over Parking Structure	2040		•

Bundling measures into pathways, or scenarios, often results in interactive effects between systems. As a result, the total GHG reduction for a particular Roadmap will typically differ from the sum of the GHG reductions from individual measures. The Scenario Level Analysis accounts for these interactive effects between systems which are not represented in the Measure Level Analysis.

TABLE 7.1.2: PROJECT ROADMAP ENERGY, EMISSION & FINANCIAL OVERVIEW

GHG Reduction Pathways	Energy (ekWh)	Energy (%)	Emissions (tCO_2e)	Emissions (%)	Annual Savings	Project Costs	20-Year LC Costs
Business-As-Usual	N/A	N/A	N/A	N/A	N/A	$2,791,337	$4,094,501
50% Reductions (10 Year)	247,330	26%	63.9	71%	-$10,258	$1,878,942	$2,911,405
80% Reductions (20 Year)	516,772	53%	71.5	79%	$36,147	$7,858,954	$5,097,224
80% Reductions (5 Year)	516,772	53%	71.5	79%	$36,147	$7,858,954	$6,358,941



Another aspect of this analysis is considering the costs associated with a "business-as-usual" approach. This study is offering upgrade options to HVAC equipment and other energy consuming systems to reduce overall GHG emissions. However, all of the equipment addressed in this study will have to be replaced at some point, if not by more efficiency equipment, then by "like-for-like" equipment replacements. By implementing these energy efficiency measures, the "like-for-like" costs are avoided.

The table below shows the financial details of each pathway taking into consideration the incremental costs of implementing energy efficient measures through the GMF program.

TABLE 7.1.3: PATHWAY LIFE CYCLE COSTING OVERVIEW

Pathway	Project Costs	Potential Grant	Avoided Cost	Incremental Costs	20-Year LC Costs	Incremental LC Cost	Incremental LC Cost per Tonne CO_2e
Business-As-Usual	$2,791,337	N/A	N/A	N/A	$4,094,501	N/A	N/A
50% Reductions in 10 Years	$1,878,942	$300,631	$772,515	$805,796	$2,911,405	($1,183,095)	($926)
80% Reductions in 20 Years	$7,858,954	$1,257,433	$2,791,337	$3,810,184	$5,097,224	$1,002,723	$701
80% Reductions in 5 Years	$7,858,954	$1,257,433	$2,791,337	$3,810,184	$6,358,941	$2,264,440	$1,584

7.2 Demand Impact Summary

A major component of achieving net-zero carbon is fuel switching from natural gas to a fuel source that emits comparatively less emissions, such as electricity. However, converting most or all of a building's HVAC systems from gas-fired equipment to electrical can have a significant impact on the building's electrical demand. If the building is unable to support the sudden increase in electrical demand as a result of implementing fuel-switching measures, then further investment into bolstering the building's existing electrical capacity may be necessary.

Reviewing the facilities electrical bills, the monthly base demand as well as the peak summer and peak winter demands are as follows:

Average Monthly Base Demand (kW)	Peak Summer Demand (kW)	Peak Winter Demand (kW)
98.5	125	82

The site is serviced by a pad mounted step-down transformer located within the building. The transformer cannot be accessed. This supplies the main disconnect for the facility which is rated at 1000A. The site has an estimated 257kW of total electrical capacity, with an estimated remaining capacity of 80kW. The demand impact of each reduction pathway are summarized in the table below.

Pathway	Demand Increase (kW)	Extra Capacity Required (kW)	Demand Upgrade Costs
50% Reductions in 10 Years	74	0	$0
80% Reductions in 20 Years	74	0	$0
80% Reductions in 5 Years	74	0	$0

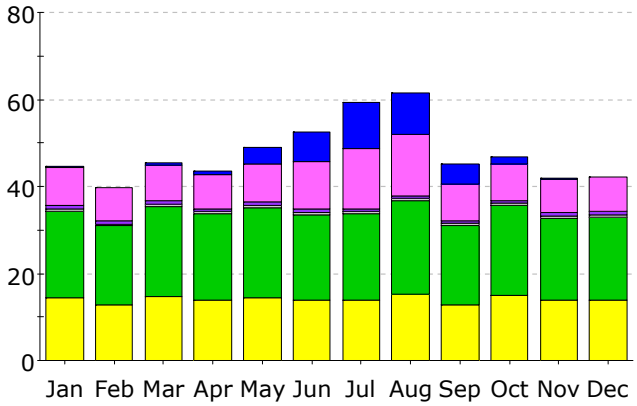
The costs of upgrading electrical distribution to support the implementation of a measure (wiring, conduit, circuit breakers, etc.) are already included in each roadmap. However, if the demand impact of implementing several measures exceeds the building's installed capacity, then further electrical costs will be required. These upgrades are typically done by the utility by local distribution company (LDC) and costs are passed onto the building owner. These costs are already included in the total project costs listed in the financial tables above.

The existing capacity should be sufficient to accommodate the recommended ECMs at the facility.

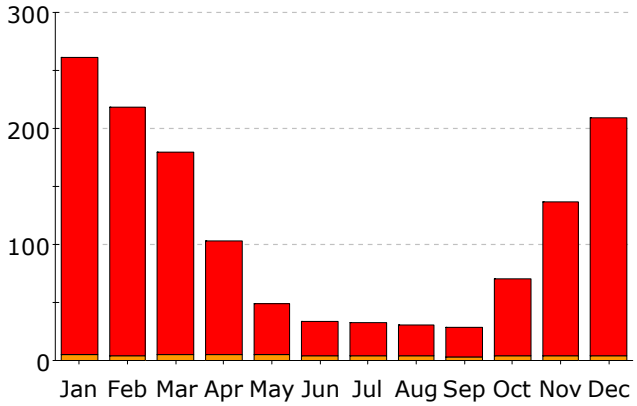
APPENDIX A

ENERGY MODEL OUTPUT REPORTS

(x000) **Electric Consumption (kWh)**



(x000,000) **Gas Consumption (Btu)**



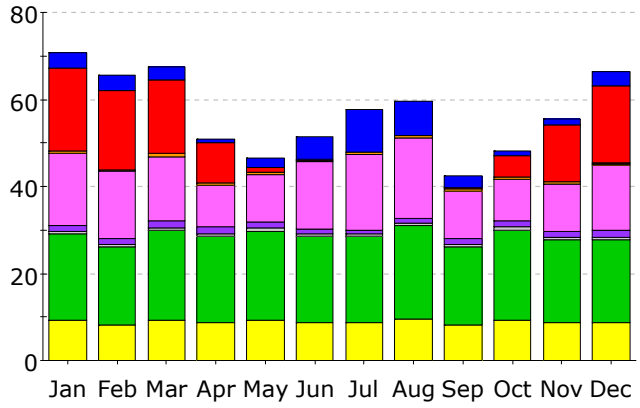
Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	0.15	0.08	0.28	0.74	3.78	6.95	10.59	9.64	4.48	1.85	0.49	0.12	39.14
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	8.79	7.58	8.29	7.81	8.84	10.87	13.75	13.93	8.54	8.24	7.53	7.93	112.11
Pumps & Aux.	0.72	0.65	0.74	0.68	0.67	0.62	0.62	0.68	0.57	0.69	0.67	0.69	7.99
Ext. Usage	0.57	0.51	0.60	0.57	0.60	0.57	0.57	0.62	0.51	0.60	0.54	0.54	6.80
Misc. Equip.	19.86	17.97	20.66	19.77	20.66	19.75	19.87	21.44	18.19	20.66	18.96	19.07	236.84
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	14.52	12.92	14.75	13.94	14.49	13.82	13.85	15.18	12.76	14.90	13.80	13.95	168.89
Total	44.62	39.71	45.31	43.51	49.04	52.58	59.26	61.49	45.05	46.93	41.99	42.31	571.78

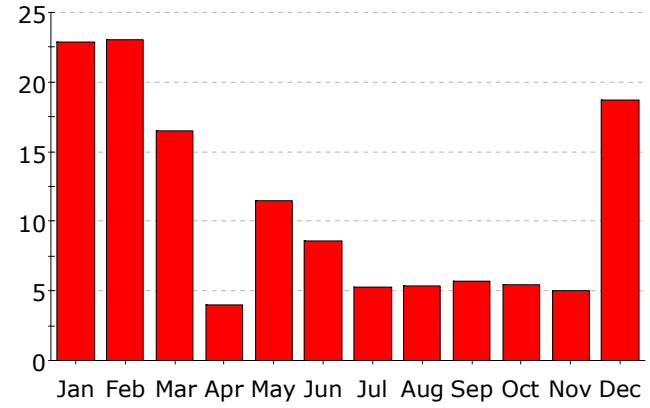
Gas Consumption (Btu x000,000)

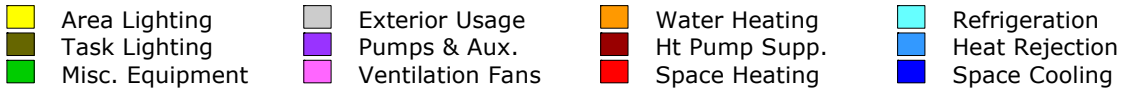
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	256.1	214.3	174.4	98.5	43.8	29.1	28.7	26.7	25.2	66.1	132.4	205.3	1,300.5
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	4.9	4.6	5.3	4.9	4.8	4.3	4.0	4.1	3.5	4.1	4.0	4.4	52.7
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	261.0	218.8	179.7	103.5	48.6	33.3	32.7	30.8	28.6	70.2	136.5	209.6	1,353.3

(x000) **Electric Consumption (kWh)**



(x000,000) **Gas Consumption (Btu)**





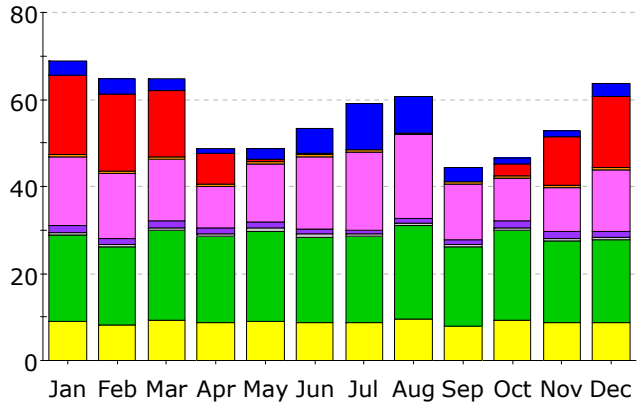
Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	3.44	3.60	2.95	1.01	1.96	5.15	9.87	7.89	2.73	1.13	1.58	3.30	44.61
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	19.17	18.06	16.94	9.13	1.24	0.19	0.05	0.02	0.28	4.78	13.06	17.84	100.78
HP Supp.	0.01	0.01	0.01	0.00	-	-	-	-	-	-	0.01	0.01	0.04
Hot Water	0.56	0.52	0.60	0.57	0.55	0.49	0.46	0.47	0.40	0.47	0.46	0.50	6.06
Vent. Fans	16.38	15.41	14.78	9.67	10.78	15.43	17.45	18.44	11.11	9.53	10.84	14.94	164.77
Pumps & Aux.	1.53	1.38	1.59	1.51	1.49	1.16	0.75	1.05	1.18	1.56	1.45	1.46	16.10
Ext. Usage	0.57	0.51	0.60	0.57	0.60	0.57	0.57	0.62	0.51	0.60	0.54	0.54	6.80
Misc. Equip.	19.86	17.97	20.66	19.77	20.66	19.75	19.87	21.44	18.19	20.66	18.96	19.07	236.84
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	9.14	8.14	9.29	8.78	9.13	8.71	8.73	9.56	8.04	9.39	8.70	8.79	106.40
Total	70.65	65.60	67.40	51.02	46.41	51.45	57.76	59.50	42.44	48.11	55.61	66.44	682.40

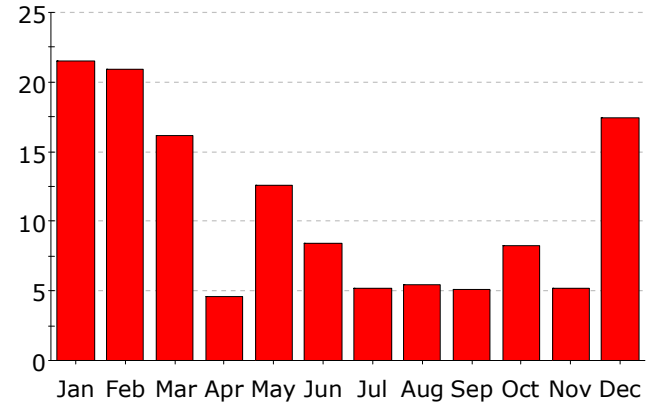
Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	22.87	23.03	16.48	3.96	11.50	8.56	5.24	5.39	5.69	5.42	5.03	18.67	131.84
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	22.87	23.03	16.48	3.96	11.50	8.56	5.24	5.39	5.69	5.42	5.03	18.67	131.84

(x000) **Electric Consumption (kWh)**



(x000,000) **Gas Consumption (Btu)**



Electric Consumption (kWh x000)

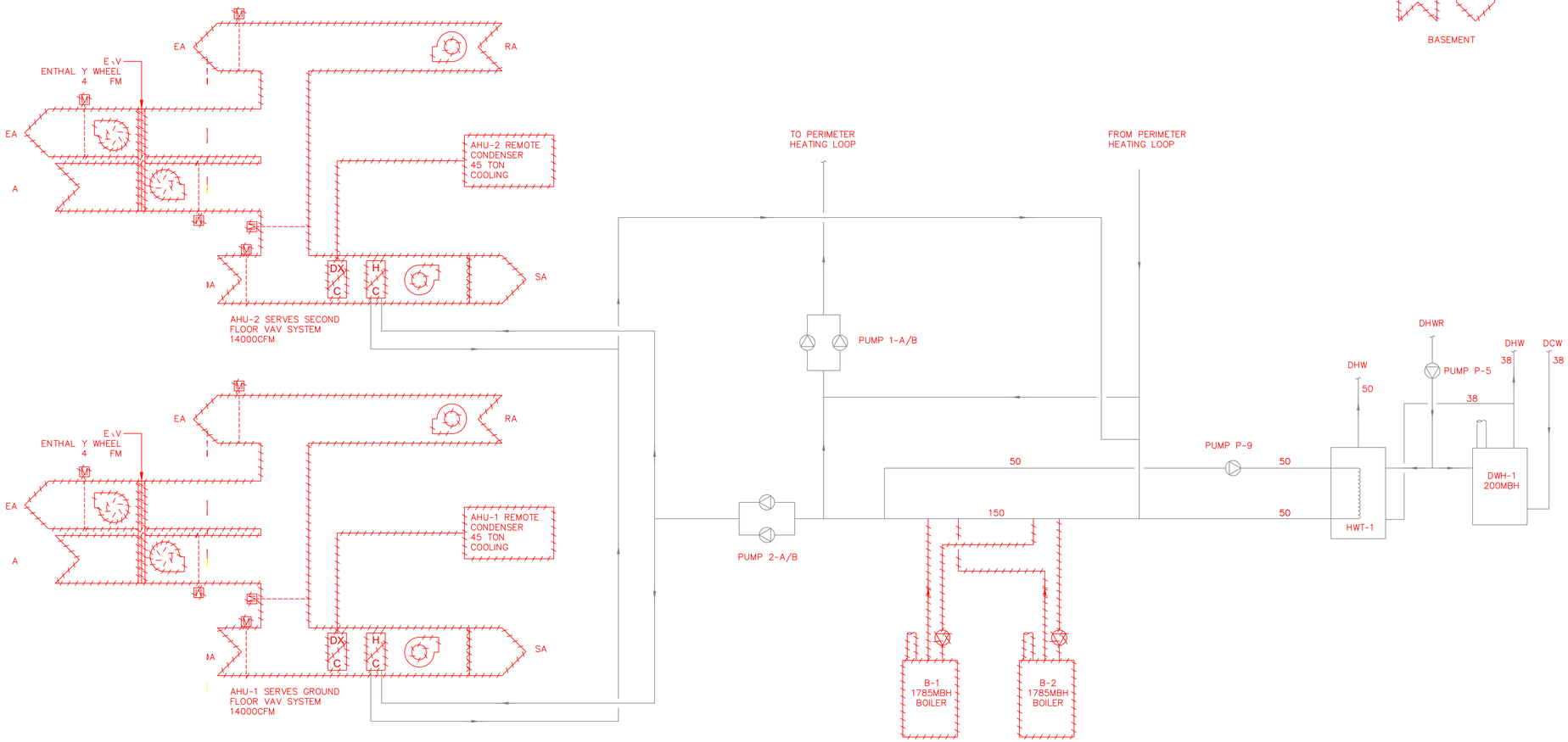
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	3.38	3.59	2.81	0.91	2.35	5.72	10.42	8.46	3.15	1.12	1.40	2.94	46.25
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	18.18	17.53	15.14	7.11	0.53	0.19	0.08	0.02	0.08	2.78	11.19	16.43	89.26
HP Supp.	0.01	0.01	0.01	0.00	-	-	-	-	-	0.00	0.01	0.01	0.05
Hot Water	0.56	0.52	0.60	0.57	0.55	0.49	0.46	0.47	0.40	0.47	0.46	0.50	6.06
Vent. Fans	15.82	15.15	14.08	9.41	13.36	16.74	18.09	19.24	12.79	9.92	10.14	13.99	168.73
Pumps & Aux.	1.53	1.38	1.59	1.51	1.49	1.16	0.75	1.05	1.18	1.56	1.45	1.46	16.10
Ext. Usage	0.57	0.51	0.60	0.57	0.60	0.57	0.57	0.62	0.51	0.60	0.54	0.54	6.80
Misc. Equip.	19.86	17.97	20.66	19.77	20.66	19.75	19.87	21.44	18.19	20.66	18.96	19.07	236.84
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	9.05	8.08	9.23	8.73	9.09	8.66	8.69	9.51	7.98	9.31	8.61	8.70	105.64
Total	68.96	64.74	64.72	48.58	48.63	53.28	58.93	60.81	44.28	46.41	52.76	63.63	675.73

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	21.48	20.89	16.14	4.63	12.58	8.46	5.16	5.47	5.09	8.21	5.18	17.47	130.76
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	21.48	20.89	16.14	4.63	12.58	8.46	5.16	5.47	5.09	8.21	5.18	17.47	130.76

APPENDIX B

SCHEMATICS



1 M-1A MECHANICAL SCHEMATICS DEMOLITION

NTS

NLE THE ⟍WI E E IFIE ALL IMEN I N A⟍E IN MILLIMETE⟍

NOTES:

SEAL:

PRELIMINARY
NOT FOR CONSTRUCTION

ORIENTATION:

The contractor shall check and verify all dimensions and report any errors or omissions to the consultant before commencing or proceeding with work.

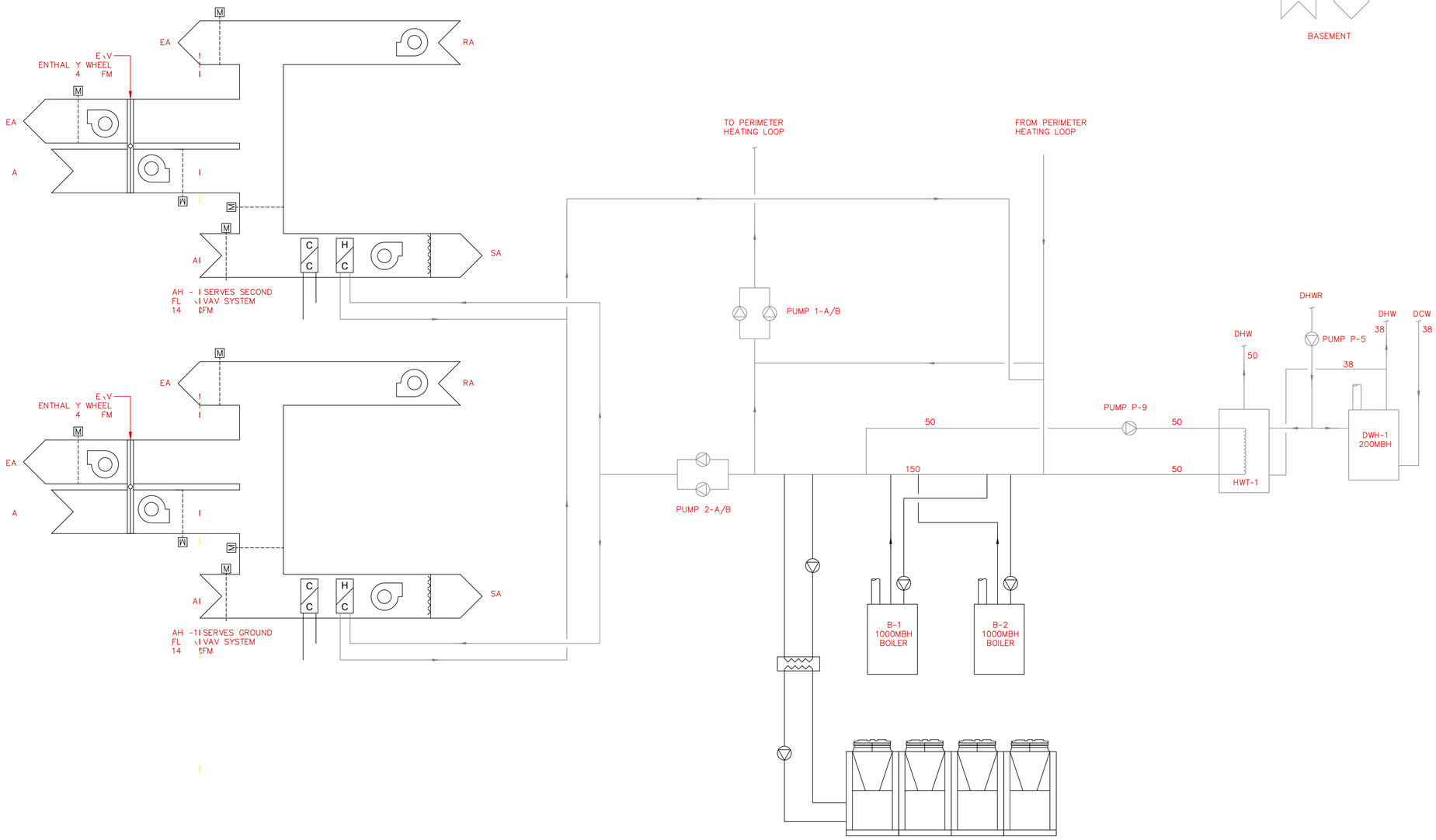
Do not scale this drawing.

NO.	ISSUANCE	DATE	BY
01	----	----	----

EFFICIENCY ENGINEERING
A Kontrol Technologies Company

JOB NAME: PETERBOROUGH NET ZERO - POLICE SERVICES
ADDRESS: 500 WATER ST
PETERBOROUGH, ON K9H 3M4
DWN: JG
CHK: AR
DWG TITLE: MECHANICAL SCHEMATICS DEMOLITION
DATE: 01/10/2025
JOB NO.: 22-198
DWG NO.: M-1A
ARCH: D
SCALE: AS SHOWN

2/24/2025 3:05 PM



1 M-1B MECHANICAL SCHEMATICS DEMOLITION

NTS

NLE THE WI E E IFIE ALL IMEN I N A E IN MILLIMETE

NOTES:

SEAL:

PRELIMINARY
NOT FOR CONSTRUCTION

ORIENTATION:

The contractor shall check and verify all dimensions and report any errors or omissions to the consultant before commencing or proceeding with work.

Do not scale this drawing.

NO.	ISSUANCE	DATE	BY
	---- ----	----	----
	---- ----	----	----
	---- ----	----	----
	---- ----	----	----
	---- ----	----	----
01	----	----	----

EFFICIENCY ENGINEERING
A Kontrol Technologies Company

JOB NAME: PETERBOROUGH NET ZERO - POLICE SERVICES

ADDRESS: 500 WATER ST
PETERBOROUGH, ON K9H 3M4

DWN: JG

CHK: AR

DWG TITLE: MECHANICAL SCHEMATICS
RETROFIT

DATE: 01/10/2025

SCALE: AS SHOWN

JOB NO. 22-198

DWG NO. M-1B

ARCH D

2/24/2025 3:05 PM

APPENDIX C

CALCULATIONS

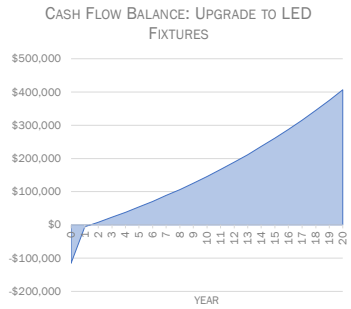
Energy Conservation Measure 1

Opp Cat:	Lighting
Opp Desc:	Upgrade to LED Fixtures
Opp Name:	Upgrade to LED Fixtures

Costing Setup	
Engineering & PM:	**15%**
Contingency:	**10%**
Additional Annual Costs:	
Additional Annual Savings:	**$3,466**
Tax Rebate (Capital Projects):	**No**
Avoided Capital Costs:	**$94,865.80**
Avoided Capital Year:	**1**
Financial Analysis Term (years):	**20**

Incentive Work Area			
Rate	Qty	Total	Comments
		$0	
		$0	
		$0	
		$0	
		$0	
Total:		**$0**	

Utility Savings	
Demand (kW):	200
Electricity (kWh):	69,090
Natural Gas (m³):	-4,628
Water (m³):	0
():	0
():	0
Emissions (Tonnes of CO_2e):	-7.0
Financials	
Annual Utility Savings:	$9,275
Add'l Annual Savings:	$3,466
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$92,552
Engineering & PM:	$13,883
Contingency:	$9,255
Project Costs:	$115,690
Simple Payback:	9.1
Capital Payback:	1.4
NPV:	$172,543
IRR:	34.8%



Write-ups	
Existing:	This facility is
Retrofit:	We recommend

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	1,883,341	1,948,003
% Reduction	#DIV/0!	#DIV/0!

Electrical Capacity Impact (Amps): for Ele Service Upgrades			
Base	Summer	Winter	Peak

Savings: Upgrade to LED Fixtures

Avg Temp (°F)	Avg Temp (°C)	Total Hours	Meter Selection				Occupancy	Eff. Profile
			Select	Select	Select	Select	Select	Select
-33	-36	0						0%
-28	-33	0						0%
-23	-30	0						0%
-18	-28	0						0%
-13	-25	1						0%
-8	-22	21						0%
-3	-19	80						0%
3	-16	127						0%
8	-14	169						0%
13	-11	290						0%
18	-8	423						0%
23	-5	460						0%
28	-3	537						0%
33	0	776						0%
38	3	719						0%
43	6	651						0%
48	9	677						0%
53	11	786						0%
58	14	773						0%
63	17	678						0%
68	20	639						0%
73	23	523						0%
78	25	296						0%
83	28	108						0%
88	31	26						0%
93	34	1						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

End-Use	Existing			Upgrade to LED Lighting			Savings		From Ltg SS			
	Electricity (MWh)	Natural Gas (MMBTU)	Combined (kWh)	Electricity (MWh)	Natural Gas (MMBTU)	Combined (kWh)	Electricity (kWh)	Natural Gas (m3)	Dem Savings. (kW)			
Space Cool	39.1	0.0	39,140.0	36.0	0.0	35,990.0	3,150	0	200			
Heat Reject.	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Refrigeration	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Space Heat	0.0	1,300.5	381,154.7	0.0	1,463.4	428,898.0	0	-4,625				
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Hot Water	0.0	52.7	15,445.5	0.0	52.8	15,474.8	0	-3				
Vent. Fans	112.1	0.0	112,110.0	108.7	0.0	108,650.0	3,460	0				
Pumps & Aux	8.0	0.0	7,990.0	8.0	0.0	8,000.0	-10	0				
Ext. Usage	6.8	0.0	6,800.0	6.8	0.0	6,800.0	0	0				
Misc. Equip	236.8	0.0	236,840.0	236.8	0.0	236,840.0	0	0				
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Area Lights	168.9	0.0	168,890.0	106.4	0.0	106,400.0	62,490	0				
0	**572**	**1,353**	**968,370**	**467**	**1,516**	**911,063**	**69,090**	**-4,628**	**200**	**0**	**0**	**0**
Main Meter:	Select	Select	Select	Select	Select	Select	Select	M02	M03	M01	Select	Select	Select
Breakout Meter:	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select

82% of LED Costs are Like For Like

General Requirements: Upgrade to LED Fixtures

Cost Breakout: Upgrade to LED Fixtures

Row	Division #	Section #	Division	Section	Item Description	Item	Description	Units	Source	Unit Costs			Gen Req?	Avoided Cost/ Project Cost	Qty	Material	Labour	Equipment	Total
										Materials	Labour	Equipment							
110	0	0											Yes	Project		$0	$0	$0	$0
111	0	0				Lighting Like for Like Costs				$75,893	$18,973		No	Avoided	1	$75,893	$18,973	$0	$94,866
112	0	0											Yes	Project		$0	$0	$0	$0
113	0	0											Yes	Project		$0	$0	$0	$0
114	0	0											Yes	Project		$0	$0	$0	$0
115	0	0											Yes	Project		$0	$0	$0	$0
116	0	0											Yes	Project		$0	$0	$0	$0
117	0	0											Yes	Project		$0	$0	$0	$0
118	0	0											Yes	Project		$0	$0	$0	$0
119	0	0											Yes	Project		$0	$0	$0	$0
120	0	0											Yes	Project		$0	$0	$0	$0
121	0	0											Yes	Project		$0	$0	$0	$0
122	0	0											Yes	Project		$0	$0	$0	$0
123	0	0											Yes	Project		$0	$0	$0	$0
124	0	0											Yes	Project		$0	$0	$0	$0
125	0	0											Yes	Project		$0	$0	$0	$0
126	0	0											Yes	Project		$0	$0	$0	$0
127	0	0											Yes	Project		$0	$0	$0	$0
128	0	0											Yes	Project		$0	$0	$0	$0
129	0	0											Yes	Project		$0	$0	$0	$0
130	0	0											Yes	Project		$0	$0	$0	$0
131	0	0											Yes	Project		$0	$0	$0	$0
132	0	0											Yes	Project		$0	$0	$0	$0
133	0	0											Yes	Project		$0	$0	$0	$0
134	0	0											Yes	Project		$0	$0	$0	$0
135	0	0											Yes	Project		$0	$0	$0	$0
136	0	0											Yes	Project		$0	$0	$0	$0
137	0	0											Yes	Project		$0	$0	$0	$0
138	0	0											Yes	Project		$0	$0	$0	$0
139	0	0											Yes	Project		$0	$0	$0	$0
140	0	0											Yes	Project		$0	$0	$0	$0
141	0	0											Yes	Project		$0	$0	$0	$0
142	0	0											Yes	Project		$0	$0	$0	$0
143	0	0											Yes	Project		$0	$0	$0	$0
144	0	0											Yes	Project		$0	$0	$0	$0
145	0	0											Yes	Project		$0	$0	$0	$0
146	0	0											Yes	Project		$0	$0	$0	$0
147	0	0											Yes	Project		$0	$0	$0	$0
															Totals:	**$0**	**$0**	**$0**	**$0**

Escalation Rates: Upgrade to LED Fixtures

Year:	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Demand ($/kW):	10.5034	11.1336	11.8016	12.5097	13.2603	14.0559	14.8993	15.7932	16.7408	17.7453	18.8100	19.9386	21.1349	22.4030	23.7472	25.1720	26.6823	28.2833	29.9803	31.7791	33.6858
Electricity ($/kWh):	0.1310	0.1378	0.1450	0.1525	0.1604	0.1688	0.1776	0.1868	0.1965	0.2067	0.2175	0.2288	0.2407	0.2532	0.2664	0.2802	0.2948	0.3101	0.3263	0.3432	0.3611
Natural Gas ($/m³):	0.4066	0.4270	0.4486	0.4712	0.4950	0.5200	0.5463	0.5740	0.6030	0.6335	0.6655	0.6991	0.7344	0.7714	0.8103	0.8512	0.8941	0.9391	0.9864	1.0360	1.0881
Water ($/m³):	3.3400	3.4402	3.5434	3.6497	3.7592	3.8720	3.9881	4.1078	4.2310	4.3579	4.4887	4.6233	4.7620	4.9049	5.0520	5.2036	5.3597	5.5205	5.6861	5.8567	6.0324
($/):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
($/):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GHG Emissions (tCO_2e):	0.000031	0.000043	0.000047	0.000054	0.000071	0.000072	0.000075	0.000069	0.000077	0.000083	0.000079	0.000079	0.000079	0.000077	0.000081	0.000082	0.000087	0.000088	0.000093	0.000093	0.000093

Cash Flow Balance: Upgrade to LED Fixtures

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Implementation Cost:	-$115,690	$96,953	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M01):		$2,231	$2,365	$2,507	$2,657	$2,817	$2,986	$3,165	$3,355	$3,556	$3,770	$3,996	$4,235	$4,490	$4,759	$5,044	$5,347	$5,668	$6,008	$6,369	$6,751
Annual Savings (M02):		$9,521	$10,017	$10,537	$11,085	$11,662	$12,268	$12,906	$13,577	$14,283	$15,026	$15,807	$16,629	$17,494	$18,404	$19,361	$20,368	$21,427	$22,541	$23,713	$24,946
Annual Savings (M03):		-$1,976	-$2,076	-$2,181	-$2,291	-$2,407	-$2,528	-$2,656	-$2,791	-$2,932	-$3,080	-$3,235	-$3,399	-$3,570	-$3,750	-$3,939	-$4,138	-$4,346	-$4,565	-$4,795	-$5,036
Annual Savings (M04):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M05):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M06):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Incentives:	$0																				
Add'l Annual Costs:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Add'l Annual Savings:		$3,542	$3,620	$3,700	$3,781	$3,864	$3,949	$4,036	$4,125	$4,216	$4,309	$4,403	$4,500	$4,599	$4,700	$4,804	$4,910	$5,018	$5,128	$5,241	$5,356
Tax Rebate:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Total:	-$115,690	$110,271	$13,926	$14,563	$15,233	$15,936	$16,675	$17,451	$18,266	$19,123	$20,024	$20,971	$21,966	$23,013	$24,113	$25,270	$26,486	$27,766	$29,112	$30,527	$32,017
Cash Balance:	-$115,690	-$5,419	$8,507	$23,070	$38,303	$54,240	$70,915	$88,366	$106,632	$125,756	$145,780	$166,751	$188,717	$211,730	$235,843	$261,113	$287,599	$315,365	$344,477	$375,005	$407,021
Undepreciated Amount:	-$115,690	-$98,337	-$83,586	-$71,048	-$60,391	-$51,332	-$43,632	-$37,088	-$31,524	-$26,796	-$22,776	-$19,360	-$16,456	-$13,988	-$11,889	-$10,106	-$8,590	-$7,302	-$6,206	-$5,275	-$4,484

Energy Conservation Measure 3

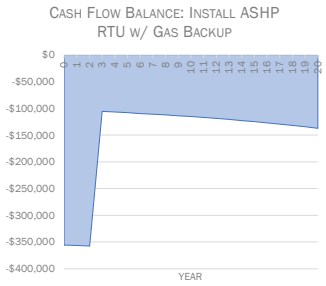
Opp Cat:	Select
Opp Desc:	
Opp Name:	Install ASHP RTU w/ Gas Backup

Costing Setup	
Engineering & PM:	**15%**
Contingency:	**10%**
Additional Annual Costs:	
Additional Annual Savings:	
Tax Rebate (Capital Projects):	**No**
Avoided Capital Costs:	**$237,294**
Avoided Capital Year:	**3**
Financial Analysis Term (years):	**20**

SIZED TO HTG LOAD*

Incentive Work Area			
Rate	Qty	Total	Comments
		$0	
		$0	
		$0	
		$0	
		$0	
Total:		**$0**	

Utility Savings	
Demand (kW):	-45
Electricity (kWh):	-6,560
Natural Gas (m³):	997
Water (m³):	0
():	0
():	0
Emissions (Tonnes of CO_2e):	1.7
Financials	
Annual Utility Savings:	-$923
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$284,651
Engineering & PM:	$42,698
Contingency:	$28,465
Project Costs:	$355,814
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$166,602
IRR:	No IRR



Write-ups	
Existing:	#N/A
Retrofit:	#N/A

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	1,941,966	1,936,358
% Reduction	#DIV/0!	#DIV/0!

Electrical Capacity Impact (Amps): for Ele Service Upgrades			
Base	Summer	Winter	Peak

Savings: Install ASHP RTU w/ Gas Backup

			Meter Selection				Occupancy	Eff. Profile
Avg Temp (°F)	Avg Temp (°C)	Total Hours	Select	Select	Select	Select	Select	Select
-33	-36	0						0%
-28	-33	0						0%
-23	-30	0						0%
-18	-28	0						0%
-13	-25	1						0%
-8	-22	21						0%
-3	-19	80						0%
3	-16	127						0%
8	-14	169						0%
13	-11	290						0%
18	-8	423						0%
23	-5	460						0%
28	-3	537						0%
33	0	776						0%
38	3	719						0%
43	6	651						0%
48	9	677						0%
53	11	786						0%
58	14	773						0%
63	17	678						0%
68	20	639						0%
73	23	523						0%
78	25	296						0%
83	28	108						0%
88	31	26						0%
93	34	1						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

End-Use	Existing			Install ASHP RTU w/ Gas Backup			Savings		Month	Demand kW (from Model)	Base Model Dem (kW)	Demand Savings (kW)	Demand Impact (kW)
	Electricity (MWh)	Natural Gas (MMBTU)	Combined (kWh)	Electricity (MWh)	Natural Gas (MMBTU)	Combined (kWh)	Electricity (kWh)	Natural Gas (m3)					
Space Cool	39.1	0.0	39,140.0	40.0	0.0	40,020.0	-880	0	1	219	219	0	
Heat Reject.	0.0	0.0	0.0	0.0	0.0	0.0	0	0	2	220	213	-7	
Refrigeration	0.0	0.0	0.0	0.0	0.0	0.0	0	0	3	181	173	-8	
Space Heat	0.0	1,300.5	381,154.7	5.4	1,265.4	376,217.5	-5,350	997	4	177	177	0	
HP Supp.	0.0	0.0	0.0	0.4	0.0	350.0	-350	0	5	197	196	-1	
Hot Water	0.0	52.7	15,445.5	0.0	52.7	15,445.5	0	0	6	219	219	0	
Vent. Fans	112.1	0.0	112,110.0	112.1	0.0	112,110.0	0	0	7	259	258	0	
Pumps & Aux	8.0	0.0	7,990.0	8.0	0.0	7,970.0	20	0	8	252	251	-1	
Ext. Usage	6.8	0.0	6,800.0	6.8	0.0	6,800.0	0	0	9	215	214	-1	
Misc. Equip	236.8	0.0	236,840.0	236.8	0.0	236,840.0	0	0	10	186	184	-2	
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0	11	201	187	-14	14
Area Lights	168.9	0.0	168,890.0	168.9	0.0	168,890.0	0	0	12	217	206	-11	
0	**572**	**1,353**	**968,370**	**578**	**1,318**	**964,643**	**-6,560**	**997**	**78**	**2,542**	**2,498**	**-45**	**14**
Main Meter:	Select	Select	Select	Select	Select	Select	Select	M02	M03	Select	Select	Select	M01	Select
Breakout Meter:	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select

General Requirements: Install ASHP RTU w/ Gas Backup

Cost Breakout: Install ASHP RTU w/ Gas Backup

Row	Division #	Section #	Division	Section	Item Description	Item	Description	Units	Source	Unit Costs			Gen Req?	Avoided Cost/ Project Cost	Qty	Material	Labour	Equipment	Total
										Materials	Labour	Equipment							
110	0	0				ASHP RTU	15 Ton Nominal c/w Gas Backup	each	Means '23	$102,000.00	$15,300.00	$0	Yes	Project	1	$154,958	$21,530	$0	$176,489
111	0	0				Structural Analysis		Each	EE Est	$0.00	$7,500.00	$0	Yes	Both	1	$0	$10,554	$0	$10,554
112	0	0				DeMeans '23ition	Demo Existing	Each	Means '23	$0.00	$2,750.00	$0	Yes	Both	1	$0	$3,870	$0	$3,870
113	0	0				Craning	Craning - 40 ton truck mounted	Per Day	Means '23	$0.00	$475.44	$3,286	Yes	Both	1	$0	$669	$4,624	$5,293
114	0	0				Structural Reinforcement		Each	EE Est.	$10,000.00	$2,000.00	$0	Yes	Both	1	$15,192	$2,814	$0	$18,006
115	0	0				Roof Curb		Each	EE Est.	$25,000.00	$5,000.00	$0	Yes	Both	1	$37,980	$7,036	$0	$45,016
116	0	0				Controls							Yes	Both		$0	$0	$0	$0
117	0	0				Analog Inputs	Duct Temperature	Each	Means '22	$348.75	$116.25	$0	Yes	Both	4	$2,119	$654	$0	$2,774
118	0	0				Analog Outputs	Electric (Not incl. Device)	Each	Means '22	$285.00	$95.00	$0	Yes	Both	2	$866	$267	$0	$1,133
119	0	0				Digital Inputs	Current Sensor	Each	Means '22	$326.25	$108.75	$0	Yes	Both	2	$991	$306	$0	$1,297
120	0	0				Digital Outputs	Start/Stop	Each	Means '22	$255.00	$85.00	$0	Yes	Both	2	$775	$239	$0	$1,014
121	0	0				DDC Controller	16 Point Controller	Each	Means '22	$2,456.25	$818.75	$0	Yes	Both	1	$3,732	$1,152	$0	$4,884
122	0	0				DDC Front End	Calibration Labour	Point	Means '22	$90.00	$30.00	$0	Yes	Both	11	$1,504	$464	$0	$1,968
123	0	0				DDC Front End	Start-up Labour	Point	Means '22	$90.00	$30.00	$0	Yes	Both	11	$1,504	$464	$0	$1,968
124	0	0				Electrical							Yes	Project		$0	$0	$0	$0
125	0	0				Cu-XHHW	#3/0, 1 Wire, 200A, 166kW	100 LF	Means '23	$495.00	$216.00	$0	Yes	Project	6	$4,512	$1,824	$0	$6,336
126	0	0				Circuit Breaker	Enclosed, 100 Amp	each	Means '23				Yes	Project	1	$0	$0	$0	$0
127	0	0				Conduit	2" PVC	LF	Means '23	$8.80	$9.00	$0	Yes	Project	150	$2,005	$1,900	$0	$3,905
128	0	0				Pull Box	10"x10"	Each	Means '23	$23.50	$77.00	$0	Yes	Project	1	$36	$108	$0	$144
129	0	0											Yes	Project		$0	$0	$0	$0
130	0	0				Rooftop Unit - Multizone	15 ton cooling, 360 MBH heating	Each	Means '25	$74,000.00	$3,925.00		Yes	Avoided	1	$112,421	$5,523	$0	$117,944
131	0	0											Yes	Project		$0	$0	$0	$0
132	0	0											Yes	Project		$0	$0	$0	$0
133	0	0											Yes	Project		$0	$0	$0	$0
134	0	0											Yes	Project		$0	$0	$0	$0
135	0	0											Yes	Project		$0	$0	$0	$0
136	0	0											Yes	Project		$0	$0	$0	$0
137	0	0											Yes	Project		$0	$0	$0	$0
138	0	0											Yes	Project		$0	$0	$0	$0
139	0	0											Yes	Project		$0	$0	$0	$0
140	0	0											Yes	Project		$0	$0	$0	$0
141	0	0											Yes	Project		$0	$0	$0	$0
142	0	0											Yes	Project		$0	$0	$0	$0
143	0	0											Yes	Project		$0	$0	$0	$0
144	0	0											Yes	Project		$0	$0	$0	$0
145	0	0											Yes	Project		$0	$0	$0	$0
146	0	0											Yes	Project		$0	$0	$0	$0
147	0	0											Yes	Project		$0	$0	$0	$0
															Totals:	**$226,174**	**$53,853**	**$4,624**	**$284,651**

Escalation Rates: Install ASHP RTU w/ Gas Backup

Year:	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Demand ($/kW):	10.5034	11.1336	11.8016	12.5097	13.2603	14.0559	14.8993	15.7932	16.7408	17.7453	18.8100	19.9386	21.1349	22.4030	23.7472	25.1720	26.6823	28.2833	29.9803	31.7791	33.6858	35.7070
Electricity ($/kWh):	0.1310	0.1378	0.1450	0.1525	0.1604	0.1688	0.1776	0.1868	0.1965	0.2067	0.2175	0.2288	0.2407	0.2532	0.2664	0.2802	0.2948	0.3101	0.3263	0.3432	0.3611	0.3798
Natural Gas ($/m³):	0.4066	0.4270	0.4486	0.4712	0.4950	0.5200	0.5463	0.5740	0.6030	0.6335	0.6655	0.6991	0.7344	0.7714	0.8103	0.8512	0.8941	0.9391	0.9864	1.0360	1.0881	1.1429
Water ($/m³):	3.3400	3.4402	3.5434	3.6497	3.7592	3.8720	3.9881	4.1078	4.2310	4.3579	4.4887	4.6233	4.7620	4.9049	5.0520	5.2036	5.3597	5.5205	5.6861	5.8567	6.0324	6.2134
($/):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
($/):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GHG Emissions (tCO2e):	0.000031	0.000043	0.000047	0.000054	0.000071	0.000072	0.000075	0.000069	0.000077	0.000083	0.000079	0.000079	0.000079	0.000077	0.000081	0.000082	0.000087	0.000088	0.000093	0.000093	0.000093	0.000093

Cash Flow Balance: Install ASHP RTU w/ Gas Backup

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Year:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Implementation Cost:	-$355,814	$0	$0	$253,302	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M01):		-$497	-$526	-$558	-$591	-$627	-$665	-$704	-$747	-$791	-$839	-$889	-$943	-$999	-$1,059	-$1,123	-$1,190	-$1,261	-$1,337	-$1,417	-$1,502	-$1,593
Annual Savings (M02):		-$904	-$951	-$1,001	-$1,053	-$1,107	-$1,165	-$1,225	-$1,289	-$1,356	-$1,427	-$1,501	-$1,579	-$1,661	-$1,747	-$1,838	-$1,934	-$2,034	-$2,140	-$2,252	-$2,369	-$2,492
Annual Savings (M03):		$426	$447	$470	$493	$518	$544	$572	$601	$631	$663	$697	$732	$769	$808	$848	$891	$936	$983	$1,032	$1,084	$1,139
Annual Savings (M04):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M05):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M06):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Incentives:	$0																					
Add'l Annual Costs:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Add'l Annual Savings:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Rebate:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Total:	-$355,814	-$975	-$1,030	$252,214	-$1,151	-$1,216	-$1,285	-$1,358	-$1,435	-$1,516	-$1,602	-$1,693	-$1,790	-$1,891	-$1,999	-$2,113	-$2,233	-$2,360	-$2,494	-$2,636	-$2,787	$0
Cash Balance:	-$355,814	-$356,789	-$357,819	-$105,606	-$106,756	-$107,972	-$109,257	-$110,615	-$112,050	-$113,566	-$115,168	-$116,862	-$118,652	-$120,543	-$122,542	-$124,655	-$126,887	-$129,247	-$131,742	-$134,378	-$137,165	$0
Undepreciated Amount:	-$355,814	-$302,442	-$257,076	-$218,514	-$185,737	-$157,877	-$134,195	-$114,066	-$96,956	-$82,413	-$70,051	-$59,543	-$50,612	-$43,020	-$36,567	-$31,082	-$26,420	-$22,457	-$19,088	-$16,225	-$13,791	$0

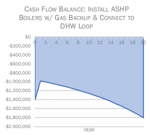
Energy Conservation Measure 7

Opp Cat:	Select
Opp Desc:	
Opp Name:	Install ASHP Boilers w/ Gas Backup & Connect to DHW Loop

Costing Setup	
Engineering & PM:	15%
Contingency:	10%
Additional Annual Costs:	
Additional Annual Savings:	
Tax Rebate (Capital Projects):	No
Avoided Capital Costs:	$440,355
Avoided Capital Year:	1
Financial Analysis Term (years):	20

Incentive Work Area			
Rate	Qty	Total	Comments
		$0	
		$0	
		$0	
		$0	
		$0	
Total:		$0	

Utility Savings	
Demand (kW):	-1,387
Electricity (kWh):	-165,780
Natural Gas (m³):	34,965
Water (m³):	0
():	0
():	0
Emissions (Tonnes of CO_2e):	62.9
Financials	
Annual Utility Savings:	-$22,077
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$1,125,951
Engineering & PM:	$168,893
Contingency:	$112,595
Project Costs:	$1,407,438
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$1,370,682
IRR:	No IRR



Write-ups	
Existing:	#N/A
Retrofit:	#N/A

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	#DIV/0!	#DIV/0!
% Reduction	#DIV/0!	#DIV/0!

Electrical Capacity Impact (Amps): for Ele Service Upgrades			
Base	Summer	Winter	Peak

Resize Boilers to 1000 MBH
COP Profiles taken from Durham

34528
690560
690.56

Savings: Install ASHP Boilers w/ Gas Backup & Connect to DHW Loop

			Meter Selection			eQUEST W.E.(m3	QUEST Base (m3)	Eff. Profile
Avg Temp (°F)	Avg Temp (°C)	Total Hours	Select	M03 Winter	Select	Select	Select	Vertical Coiltube
-33	-36	0		0		0	0	83%
-28	-33	0		0		0	0	83%
-23	-30	0		0		0	0	83%
-18	-28	0		0		0	0	83%
-13	-25	1		21		7	0	83%
-8	-22	21		294		100	4	83%
-3	-19	80		1,042		379	14	83%
3	-16	127		1,526		599	22	83%
8	-14	169		1,874		797	29	83%
13	-11	290		2,946		1,370	49	82%
18	-8	423		3,902		2,002	72	82%
23	-5	460		3,804		2,174	79	82%
28	-3	537		3,935		2,540	92	82%
33	0	776		4,953		3,672	133	82%
38	3	719		3,908		3,402	123	82%
43	6	651		2,923		3,081	111	81%
48	9	677		2,397		3,202	116	81%
53	11	786		2,040		3,720	134	81%
58	14	773		1,273		3,656	132	81%
63	17	678		475		3,207	116	81%
68	20	639		0		3,026	109	81%
73	23	523		0		0	89	81%
78	25	296		0		0	51	81%
83	28	108		0		0	18	81%
88	31	26		0		0	4	81%
93	34	1		0		0	0	81%
98	36	0		0		0	0	81%
103	39	0		0		0	0	81%
Totals		8,760	0	37,313	0	36,934	1,497	23
							38,430	
							91%	

End-Use	Existing Electricity (MWh)	Existing Natural Gas (MMBTU)	Existing Combined (kWh)	Heating Boilers: Install an ASHP w/ Gas Backup Boil Electricity (MWh)	Natural Gas (MMBTU)	Combined (kWh)	Savings Electricity (kWh)	Savings Natural Gas (m3)
Space Cool	39.1	0.0	39,140.0	45.9	0.0	45,900.0	-6,760	0
Heat Reject.	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Refrigeration	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Space Heat	0.0	1,300.5	381,154.7	90.1	121.7	125,764.1	-90,090	33,469
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Hot Water	0.0	52.7	15,445.5	6.1	0.0	6,050.0	-6,050	1,496
Vent. Fans	112.1	0.0	112,110.0	167.0	0.0	166,980.0	-54,870	0
Pumps & Aux	8.0	0.0	7,990.0	16.0	0.0	16,000.0	-8,010	0
Ext. Usage	6.8	0.0	6,800.0	6.8	0.0	6,800.0	0	0
Misc. Equip	236.8	0.0	236,840.0	236.8	0.0	236,840.0	0	0
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Area Lights	168.9	0.0	168,890.0	168.9	0.0	168,890.0	0	0
0	572	1,353	968,370	738	122	773,224	-165,780	34,965
Main Meter: Select	Select	Select	Select	Select	Select	Select	M02	M03
Breakout Meter: Select	Select	Select	Select	Select	Select	Select	Select	Select

Air Source Heat Pump Boiler Calcs

Existing: Previous Savings (m3)	Existing: Boiler Heating Cons (m3)	Existing: Htg Output (Mbtu)	Retrofit: ASHP COP	ASHP Capacity - MBH	Potential ASHP Capacity (Mbtu)	Actual ASHP Capacity (Mbtu)	Backup Htg Required Mbtu	ASHP Cons - kWh	Nat Gas Backup Cons m3	Savings: Boiler Gas Cons - m3	ASHP Cons - kWh	ASHP Boiler Dem - KW	ASHP Boiler Dem - KW
	0	0					0		0	0	0	100%	-211
	0	0					0		0	0	0	100%	-211
	0	0					0		0	0	0	50%	-105
	0	0					0		0	0	0	30%	-63
	7	215					215		6	1	0	20%	-42
	112	3,265					3,265		93	19	0	0%	0
	427	12,464					12,464		354	73	0	0%	0
	680	19,794					19,794		562	118	0	0%	0
	912	26,500					26,500		752	159	0	20%	-42
	1,577	45,768	2.0	540	156,399	45,768	0	6,705	0	1,577	-6,705	30%	-63
	2,266	65,617	2.3	630	266,503	65,617		8,240		2,266	-8,240	50%	-105
	2,432	70,304	2.7	720	330,875	70,304		7,725		2,432	-7,725	100%	-211
	2,821	81,402	3.0	810	434,850	81,402		7,950		2,821	-7,950		
	4,070	117,219	3.3	900	698,465	117,219		10,303		4,070	-10,303		
	3,782	108,724	3.7	990	711,798	108,724		8,688		3,782	-8,688		
	3,454	99,090	4.0	1,080	703,331	99,090		7,258		3,454	-7,258		
	3,636	104,112	4.0	1,080	730,836	104,112		7,626		3,636	-7,626		
	4,299	122,884	4.0	1,080	849,109	122,884		9,001		4,299	-9,001		
	4,320	123,234	4.0	1,080	834,473	123,234		9,027		4,320	-9,027		
	3,890	110,986	4.0	1,080	732,028	110,986		8,130		3,890	-8,130		
	3,731	106,445	4.0	1,080	690,647	106,445		7,797		3,731	-7,797		
	0	0	4.0	1,080	565,129	0		0		0	0		
	0	0	4.0	1,080	320,013	0		0		0	0		
	0	0	4.0	1,080	116,528	0		0		0	0		
	0	0	4.0	1,080	27,829	0		0		0	0		
	0	0	4.0	1,080	1,076	0		0		0	0		
	0	0	4.0	1,080	0	0		0		0	0		
	0	0	4.0	1,080	0	0		0		0	0		
0	42,416	1,218,024	69	18,630	8,169,888	1,155,785	62,238	98,450	1,767	40,649	-98,450	5	-1,055
Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select
Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select

Air Source Heat Pump DHW Calcs

Existing: Previous Savings (m3)	Existing: DHW Heating Cons (m3)	Existing: Htg Output (Mbtu)	Retrofit: ASHP COP	ASHP Capacity - MBH	Potential ASHP Capacity (Mbtu)	Actual ASHP Capacity (Mbtu)	Backup Htg Required Mbtu	ASHP Cons - kWh	Elec Backup Cons. (kWh)	Savings: DHWHT Gas Cons - m3	ASHP Cons - kWh	Elec Backup Cons. (kWh)
	0	0	0.0	0	0		0		0	0	0	0
	0	0	0.0	0	0		0		0	0	0	0
	0	0	0.0	0	0		0		0	0	0	0
	0	0	0.0	0	0		0		0	0	0	0
	0	8	0.0	0	0		8		2	0	0	-2
	4	115	0.0	0	0		115		34	4	0	-34
	15	436	0.0	0	0		436		128	15	0	-128
	24	688	1.5	0	0		688		202	24	0	-202
	31	915	1.7	0	0		915		268	31	0	-268
	54	1,569	1.9	540	156,399	1,569	0	242	0	54	-242	0
	79	2,288	2.1	630	266,503	2,288	0	319	0	79	-319	0
	86	2,481	2.3	720	330,875	2,481	0	316	0	86	-316	0
	100	2,893	2.5	810	434,850	2,893	0	339	0	100	-339	0
	145	4,174	2.7	900	698,465	4,174	0	453	0	145	-453	0
	134	3,859	2.9	990	711,798	3,859	0	390	0	134	-390	0
	122	3,489	3.2	1,080	703,331	3,489	0	319	0	122	-319	0
	126	3,619	3.5	1,080	730,836	3,619	0	303	0	126	-303	0
	147	4,196	3.8	1,080	849,109	4,196	0	324	0	147	-324	0
	144	4,116	4.1	1,080	834,473	4,116	0	294	0	144	-294	0
	127	3,611	4.1	1,080	732,028	3,611	0	258	0	127	-258	0
	119	3,407	4.1	1,080	690,647	3,407	3,407	0	998	119	0	-998
	98	2,788	4.1	1,080	565,129	2,788	2,788	0	817	98	0	-817
	55	1,579	4.1	1,080	320,013	1,579	1,579	0	462	55	0	-462
	20	575	4.1	1,080	116,528	575	575	0	168	20	0	-168
	5	137	4.1	1,080	27,829	137	137	0	40	5	0	-40
	0	5	4.1	1,080	1,076	5	5	0	2	0	0	-2
	0	0	4.1	1,080	0	0	0	0	0	0	0	0
	0	0	4.1	1,080	0	0	0	0	0	0	0	0
0	1,636	46,946	69	18,630	8,169,888	44,784	10,652	3,557	3,121	1,636	-3,557	-3,121
Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select
Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select

Month	Demand kW (from Model)	Base Model Dem (kW)	Demand Savings (kW)	Demand Impact (kW)		M03 Winter	MBTU	
1	352	219	-133			0	0	#DIV/0!
2	349	213	-137			0	0	#DIV/0!
3	350	173	-177	177		0	0	#DIV/0!
4	347	177	-170			0	0	#DIV/0!
5	298	196	-102			21	610	436
6	273	219	-55			294	8,602	408
7	289	258	-31			1,042	30,394	380
8	283	251	-32			1,526	44,449	351
9	303	214	-89			1,874	54,466	323
10	337	184	-152			2,946	85,473	295
11	350	187	-162			3,902	113,004	267
12	355	206	-148			3,804	109,952	239
						3,935	113,538	211
						4,953	142,656	184
						3,908	112,343	156
						2,923	83,870	129
						2,397	68,634	101
						2,040	58,309	74
						1,273	36,321	47
						475	13,551	20
						0	0	0
						0	0	0
						0	0	0
						0	0	0
						0	0	0
						0	0	0
						0	0	#DIV/0!
						0	0	#DIV/0!
78	3,885	2,498	-1,387	177	0	37,313	1,076,172	#DIV/0!
Select	Select	Select	M01	Select	Select	Select	Select	Select
Select	Select	Select	Select	Select	Select	Select	Select	Select

AERMEC			
Nominal Capacity - MBH	1,080		
Nominal COP	3		
Nominal kW	105	211	
V	208		
Amps	293		
Qty	1	1 HP at 1080MBH would cover the 90 Tons of cooling of the condensing units	
Total Capacity - MBH	1,080		
Total Amps	293		
		60kW	60
HX Size (GPM)	0		

General Requirements: Install ASHP Boilers w/ Gas Backup & Connect to DHW Loop

Cost Breakout: Install ASHP Boilers w/ Gas Backup & Connect to DHW Loop

Row	Division #	Section #	Division	Section	Item Description	Item	Description	Units	Source	Unit Costs			Gen Req?	Avoided Cost/ Project Cost	Qty	Material	Labour	Equipment	Total
										Materials	Labour	Equipment							
110	0	0				Demolition	Condensing Unit	Each	Means '25		$5,850.00		Yes	Both	2	$0	$16,464	$0	$16,464
111	0	0				Structural Analysis		Each	EE Est	$0.00	$6,500.00	$0	Yes	Both	1	$0	$9,147	$0	$9,147
112	0	0											Yes	Project		$0	$0	$0	$0
113	0	0				Aermec ASHP	1080 MBH	Each	HTS	$315,000.00	$63,000.00	$0	Yes	Project	1	$478,548	$88,654	$0	$567,202
114	0	0											Yes	Project		$0	$0	$0	$0
115	0	0				Close coupled Pump	3", 5 hp, to 225 gpm	Each	Means '22	$4,075.00	$560.00	$0	Yes	Project	2	$12,381	$1,576	$0	$13,958
116	0	0				Plate & Frame	200 gpm	Each	Means '23	$42,500.00	$1,775.00	$0	Yes	Project	1	$64,566	$2,498	$0	$67,064
117	0	0											Yes	Project		$0	$0	$0	$0
118	0	0				ASHP Electrical							Yes	Project		$0	$0	$0	$0
119	0	0				Cu-XHHW	#300, 1 Wire, 285A, 237kW	100 LF	Means '23	$945.00	$284.00	$0	Yes	Both	10	$14,356	$3,996	$0	$18,353
120	0	0				PVC Conduit	2 1/2" (3x400, 4x300)	LF	Means '23	$12.80	$10.80	$0	Yes	Both	250	$4,861	$3,799	$0	$8,661
121	0	0				Circuit Breaker - NEMA 1	600V, 200A	Each	Means '23	$1,525.00	$310.00	$0	Yes	Both	1	$2,317	$436	$0	$2,753
122	0	0				Pull Box	10"x10"x6" diam	Each	Means '23	$19.60	$84.50	$0	Yes	Both	1	$30	$119	$0	$149
123	0	0											Yes	Project		$0	$0	$0	$0
124	0	0				Pump Electrical							Yes	Project		$0	$0	$0	$0
125	0	0				Cu-XHHW	#8, 1 Wire, 50A, 42kW	100 LF	Means '23	$53.00	$68.00	$0	Yes	Project	8	$644	$766	$0	$1,410
126	0	0				PVC Conduit	3/4" (3x#6,4x#6)	LF	Means '23	$2.77	$6.00	$0	Yes	Project	200	$842	$1,689	$0	$2,530
127	0	0				Circuit Breaker - NEMA 1	600V, 30A	Each	Means '23	$535.00	$168.00	$0	Yes	Project	2	$1,626	$473	$0	$2,098
128	0	0				Pull Box	10"x10"x6" diam	Each	Means '23	$19.60	$84.50	$0	Yes	Project	2	$60	$238	$0	$297
129	0	0											Yes	Project		$0	$0	$0	$0
130	0	0				Piping to/from HX & ASHP							Yes	Project		$0	$0	$0	$0
131	0	0				Sched 40 Pipe	4" Welded	Lin. Ft.	Means '23	$64.50	$29.00	$2	Yes	Project	250	$24,497	$10,202	$563	$35,262
132	0	0				Fibreglass Pipe Insul. w/serv jacket	4" Pipe, 2" Ins	Lin. Ft.	Means '23	$10.40	$7.25	$0	Yes	Project	322	$5,087	$3,285	$0	$8,373
133	0	0				90 º Elbow	4" Welded	Each	Means '23	$54.00	$201.00	$12	Yes	Project	14	$1,149	$3,960	$244	$5,353
134	0	0				Tee	4" Welded	Each	Means '23	$148.00	$400.00	$12	Yes	Project	2	$450	$1,126	$35	$1,610
135	0	0				Ball Valve	4" Flanged	Each	Means '23	$2,050.00	$335.00	$0	Yes	Project	8	$24,915	$3,771	$0	$28,686
136	0	0				Check Valve - Steel	4" Flanged	Each	Means '23	$1,625.00	$335.00	$0	Yes	Project		$0	$0	$0	$0
137	0	0											Yes	Project		$0	$0	$0	$0
138	0	0				Controls							Yes	Project		$0	$0	$0	$0
139	0	0				Analog Inputs	Water Temperature	Each	Means '22	$705.00	$235.00	$0	Yes	Both	6	$6,426	$1,984	$0	$8,410
140	0	0				Analog Outputs	Electric (Not incl. Device)	Each	Means '22	$285.00	$95.00	$0	Yes	Both	2	$866	$267	$0	$1,133
141	0	0				Digital Inputs	Current Sensor	Each	Means '22	$326.25	$108.75	$0	Yes	Both	10	$4,956	$1,530	$0	$6,487
142	0	0				Digital Outputs	Start/Stop	Each	Means '22	$255.00	$85.00	$0	Yes	Both	10	$3,874	$1,196	$0	$5,070
143	0	0				DDC Front End	Start-up Labour	Point	Means '22	$90.00	$30.00	$0	Yes	Both	28	$3,828	$1,182	$0	$5,010
144	0	0				DDC Programming	Time Program	Point	Means '22	$5.14	$1.71	$0	Yes	Both	28	$219	$67	$0	$286
145	0	0											Yes	Both		$0	$0	$0	$0
146	0	0				Boilers	Condensing	Each	Means '25	$23,700.00	$5,150.00	$0	Yes	Project	2	$72,010	$14,494	$0	$86,504
147	0	0				Pumps	0.5 hp	Each	Means '25	$950.00	$345.00	$0	Yes	Both	2	$2,886	$971	$0	$3,857
148	0	0				Tank Heat Exchanger	55 GPM	Each	Means '25	$44,700.00	$2,925.00	$0	Yes	Project	1	$67,908	$4,116	$0	$72,024
149	0	0				Piping	2"	Lin Ft	Means '25	$19.85	$17.35	$0	Yes	Both	50	$1,508	$1,221	$0	$2,729
150	0	0				Insulation	2"	Lin Ft	Means '25	$10.40	$7.25	$0	Yes	Both	50	$790	$510	$0	$1,300
151	0	0				Elec HW Heater Tank	60kW	Each	Means '25	$83,000.00	$1,925.00		Yes	Project	1	$126,094	$2,709	$0	$128,802
152	26	05.19.90	Electrical	Wire	Cu-XHHW-#4, 1 Wire, 85A, 71kW	Cu-XHHW	#4, 1 Wire, 85A, 71kW	100 LF	Means '18	$79	$88	$0	Yes	Project	1	$120	$124	$0	$244
153	26	05.33.13	Electrical	Conduit	PVC Conduit-1/2" (3x#8,4x#10)	PVC Conduit	1/2" (3x#8,4x#10)	LF	Means '18	$1	$2	$0	Yes	Project	100	$135	$345	$0	$480
154	26	05.33.18	Electrical	Pull Boxes	Pull Box-10"x10"x6" diam	Pull Box	10"x10"x6" diam	Each	Means '18	$20	$85	$0	Yes	Project	1	$30	$119	$0	$149
155	26	24	Electrical	Switchboards	Switchboard-200A, 600V Breaker	Switchboard	200A, 600V	Each	Means '18	$2,975	$775	$0	Yes	Project	1	$4,520	$1,091	$0	$5,610
156	0	0				Tank Demolition		Each	Means '25		$80		Yes	Project	1	$0	$112	$0	$112
157	0	0				Boiler Demolition		Each	Means '25		$2,975.00		Yes	Both	2	$0	$8,373	$0	$8,373
158	0	0				Cooling Coils		Each	Means '25	$4,875.00	$1,200.00	$0	Yes	Avoided	2	$14,812	$3,377	$0	$18,189
159	0	0				Heating Coils		Each	Means '25	$4,875	$1,200		Yes	Avoided	2	$14,812	$3,377	$0	$18,189
160	0	0											Yes	Project		$0	$0	$0	$0
161	0	0				Cast Iron Section Boilers	2000 MBH	Each	Means '25	$37,200.00	$6,500.00	$0	Yes	Avoided	2	$113,028	$18,294	$0	$131,322
162	0	0				HW Heater Tank	200 MBH	Each	Web Estimate 25'	$20,000	$5,000		Yes	Avoided	1	$30,384	$7,036	$0	$37,420
163	0	0											Yes	Project		$0	$0	$0	$0
164	0	0				Condensing Units, Air Cooled	50 Tons	Each	Means'25	$22,900	$9,750		Yes	Avoided	2	$69,579	$27,440	$0	$97,020
																$932,499	**$192,610**	**$842**	**$1,125,951**

Escalation Rates: Install ASHP Boilers w/ Gas Backup & Connect to DHW Loop

Year:	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Demand ($/kW):	10.5034	11.1336	11.8016	12.5097	13.2603	14.0559	14.8993	15.7932	16.7408	17.7453	18.8100	19.9386	21.1349	22.4030	23.7472	25.1720	26.6823	28.2833	29.9803	31.7791	33.6858	35.7070	37.8494	40.1204	42.5276	45.0792	47.7840
Electricity ($/kWh):	0.1310	0.1378	0.1450	0.1525	0.1604	0.1688	0.1776	0.1868	0.1965	0.2067	0.2175	0.2288	0.2407	0.2532	0.2664	0.2802	0.2948	0.3101	0.3263	0.3432	0.3611	0.3798	0.3996	0.4204	0.4422	0.4652	0.4894
Natural Gas ($/m³):	0.4066	0.4270	0.4486	0.4712	0.4950	0.5200	0.5463	0.5740	0.6030	0.6335	0.6655	0.6991	0.7344	0.7714	0.8103	0.8512	0.8941	0.9391	0.9864	1.0360	1.0881	1.1429	1.2004	1.2607	1.3241	1.3906	1.4605
Water ($/m³):	3.3400	3.4402	3.5434	3.6497	3.7592	3.8720	3.9881	4.1078	4.2310	4.3579	4.4887	4.6233	4.7620	4.9049	5.0520	5.2036	5.3597	5.5205	5.6861	5.8567	6.0324	6.2134	6.3998	6.5918	6.7895	6.9932	7.2030
($/):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
($/):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GHG Emissions (tCO2e):	0.000031	0.000043	0.000047	0.000054	0.000071	0.000072	0.000075	0.000069	0.000077	0.000083	0.000079	0.000079	0.000079	0.000077	0.000081	0.000082	0.000087	0.000088	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093

Year:	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076
Demand ($/kW):	50.6510	53.6901	56.9115	60.3262	63.9458	67.7825	71.8495	76.1604	80.7300	85.5738	90.7083	96.1508	101.9198	108.0350	114.5171	121.3881	128.6714	136.3917	144.5752	153.2497	162.4447	172.1914	182.5229	193.4742	205.0827	217.3877
Electricity ($/kWh):	0.5149	0.5416	0.5698	0.5994	0.6306	0.6634	0.6979	0.7342	0.7724	0.8125	0.8548	0.8992	0.9460	0.9952	1.0469	1.1014	1.1586	1.2189	1.2823	1.3489	1.4191	1.4929	1.5705	1.6522	1.7381	1.8285
Natural Gas ($/m³):	1.5338	1.6108	1.6917	1.7766	1.8658	1.9594	2.0577	2.1609	2.2693	2.3831	2.5025	2.6280	2.7597	2.8980	3.0433	3.1958	3.3559	3.5240	3.7005	3.8859	4.0805	4.2849	4.4994	4.7247	4.9613	5.2097
Water ($/m³):	7.4191	7.6417	7.8709	8.1071	8.3503	8.6008	8.8588	9.1246	9.3983	9.6802	9.9707	10.2698	10.5779	10.8952	11.2221	11.5587	11.9055	12.2627	12.6305	13.0094	13.3997	13.8017	14.2158	14.6422	15.0815	15.5340
($/):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
($/):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GHG Emissions (tCO2e):	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093												

Cash Flow Balance: Install ASHP Boilers w/ Gas Backup & Connect to DHW Loop

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Year:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20						
Implementation Cost:	-$1,407,438	$450,043	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M01):		-$15,443	-$16,370	-$17,352	-$18,393	-$19,497	-$20,667	-$21,907	-$23,221	-$24,614	-$26,091	-$27,657	-$29,316	-$31,075	-$32,940	-$34,916	-$37,011	-$39,232	-$41,586	-$44,081	-$46,726	-$49,529	-$52,501	-$55,651	-$58,990	-$62,529	-$66,281
Annual Savings (M02):		-$22,846	-$24,034	-$25,284	-$26,599	-$27,982	-$29,437	-$30,968	-$32,578	-$34,272	-$36,055	-$37,929	-$39,902	-$41,977	-$44,159	-$46,456	-$48,871	-$51,413	-$54,086	-$56,899	-$59,857	-$62,970	-$66,244	-$69,689	-$73,313	-$77,125	-$81,136
Annual Savings (M03):		$14,931	$15,684	$16,476	$17,308	$18,183	$19,103	$20,070	$21,084	$22,150	$23,269	$24,444	$25,678	$26,973	$28,333	$29,762	$31,261	$32,836	$34,489	$36,225	$38,048	$39,961	$41,971	$44,081	$46,296	$48,623	$51,065
Annual Savings (M04):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M05):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M06):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Incentives:	$0																										
Add'l Annual Costs:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Add'l Annual Savings:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Rebate:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Total:	-$1,407,438	$426,685	-$24,720	-$26,160	-$27,684	-$29,296	-$31,001	-$32,805	-$34,715	-$36,737	-$38,877	-$41,142	-$43,540	-$46,079	-$48,766	-$51,610	-$54,621	-$57,809	-$61,183	-$64,755	-$68,536	$0	$0	$0	$0	$0	$0
Cash Balance:	-$1,407,438	-$980,753	-$1,005,473	-$1,031,634	-$1,059,318	-$1,088,614	-$1,119,615	-$1,152,420	-$1,187,135	-$1,223,872	-$1,262,749	-$1,303,891	-$1,347,431	-$1,393,509	-$1,442,275	-$1,493,886	-$1,548,507	-$1,606,316	-$1,667,499	-$1,732,254	-$1,800,789	$0	$0	$0	$0	$0	$0
Undepreciated Amount:	-$1,407,438	-$1,196,322	-$1,016,874	-$864,343	-$734,691	-$624,488	-$530,815	-$451,192	-$383,514	-$325,987	-$277,089	-$235,525	-$200,196	-$170,167	-$144,642	-$122,946	-$104,504	-$88,828	-$75,504	-$64,178	-$54,552	$0	$0	$0	$0	$0	$0

	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Year:																										
Implementation Cost:	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M01):	-$70,258	-$74,474	-$78,942	-$83,678	-$88,699	-$94,021	-$99,662	-$105,642	-$111,981	-$118,699	-$125,821	-$133,371	-$141,373	-$149,855	-$158,847	-$168,377	-$178,480	-$189,189	-$200,540	-$212,573	-$225,327	-$238,847	-$253,177	-$268,368	-$284,470	-$301,538
Annual Savings (M02):	-$85,355	-$89,793	-$94,463	-$99,375	-$104,542	-$109,978	-$115,697	-$121,713	-$128,043	-$134,701	-$141,705	-$149,074	-$156,826	-$164,981	-$173,560	-$182,585	-$192,079	-$202,067	-$212,575	-$223,629	-$235,257	-$247,491	-$260,360	-$273,899	-$288,142	-$303,125
Annual Savings (M03):	$53,630	$56,323	$59,151	$62,120	$65,237	$68,511	$71,948	$75,557	$79,346	$83,325	$87,502	$91,889	$96,495	$101,331	$106,409	$111,741	$117,340	$123,218	$129,391	$135,872	$142,677	$149,822	$157,324	$165,202	$173,474	$182,159
Annual Savings (M04):	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M05):	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M06):	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Incentives:																										
Add'l Annual Costs:	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Add'l Annual Savings:	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Rebate:	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Total:	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Cash Balance:	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Undepreciated Amount:	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

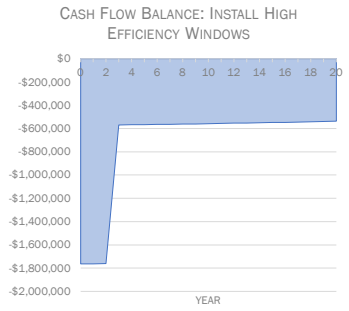
Energy Conservation Measure 10

Opp Cat:	Select
Opp Desc:	
Opp Name:	Install High Efficiency Windows

Costing Setup	
Engineering & PM:	**15%**
Contingency:	**10%**
Additional Annual Costs:	
Additional Annual Savings:	
Tax Rebate (Capital Projects):	**No**
Avoided Capital Costs:	**$1,117,093**
Avoided Capital Year:	**3**
Financial Analysis Term (years):	**20**

Incentive Work Area			
Rate	Qty	Total	Comments
		$0	
		$0	
		$0	
		$0	
		$0	
Total:		**$0**	

Utility Savings	
Demand (kW):	0
Electricity (kWh):	-3,740
Natural Gas (m³):	3,765
Water (m³):	0
():	0
():	0
Emissions (Tonnes of CO_2e):	7.2
Financials	
Annual Utility Savings:	$1,040
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$1,411,361
Engineering & PM:	$211,704
Contingency:	$141,136
Project Costs:	$1,764,202
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$782,559
IRR:	-9.7%



Write-ups	
Existing:	#N/A
Retrofit:	#N/A

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	1,905,339	1,905,364
% Reduction	#DIV/0!	#DIV/0!

Electrical Capacity Impact (Amps): for Ele Service Upgrades			
Base	Summer	Winter	Peak

RE RE	%80 RM	
2038	2035	3

Savings: Install High Efficiency Windows

Avg Temp (°F)	Avg Temp (°C)	Total Hours	Meter Selection				Occupancy	Eff. Profile
			Select	Select	Select	Select	Select	Select
-33	-36	0						0%
-28	-33	0						0%
-23	-30	0						0%
-18	-28	0						0%
-13	-25	1						0%
-8	-22	21						0%
-3	-19	80						0%
3	-16	127						0%
8	-14	169						0%
13	-11	290						0%
18	-8	423						0%
23	-5	460						0%
28	-3	537						0%
33	0	776						0%
38	3	719						0%
43	6	651						0%
48	9	677						0%
53	11	786						0%
58	14	773						0%
63	17	678						0%
68	20	639						0%
73	23	523						0%
78	25	296						0%
83	28	108						0%
88	31	26						0%
93	34	1						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

End-Use	Existing			Install High Efficiency Windows			Savings					
	Electricity (MWh)	Natural Gas (MMBTU)	Combined (kWh)	Electricity (MWh)	Natural Gas (MMBTU)	Combined (kWh)	Electricity (kWh)	Natural Gas (m3)				
Space Cool	39.1	0.0	39,140.0	41.7	0.0	41,730.0	-2,590	0				
Heat Reject.	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Refrigeration	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Space Heat	0.0	1,300.5	381,154.7	0.0	1,162.9	340,826.5	0	3,907				
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Hot Water	0.0	52.7	15,445.5	0.0	57.7	16,910.9	0	-142				
Vent. Fans	112.1	0.0	112,110.0	114.5	0.0	114,470.0	-2,360	0				
Pumps & Aux	8.0	0.0	7,990.0	8.0	0.0	7,980.0	10	0				
Ext. Usage	6.8	0.0	6,800.0	6.8	0.0	6,800.0	0	0				
Misc. Equip	236.8	0.0	236,840.0	236.8	0.0	236,840.0	0	0				
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Area Lights	168.9	0.0	168,890.0	167.7	0.0	167,690.0	1,200	0				
0	**572**	**1,353**	**968,370**	**576**	**1,221**	**933,247**	**-3,740**	**3,765**	**0**	**0**	**0**	**0**
Main Meter:	Select	Select	Select	Select	Select	Select	Select	M02	M03	Select	Select	Select	Select
Breakout Meter:	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select

General Requirements: Install High Efficiency Windows

Cost Breakout: Install High Efficiency Windows

Row	Division #	Section #	Division	Section	Item Description	Item	Description	Units	Source	Unit Costs			Gen Req?	Avoided Cost/ Project Cost	Qty	Material	Labour	Equipment	Total
										Materials	Labour	Equipment							
110	0	0				High Efficiency Windows	Installation and Repairs	Per m2	Costing Consultant Interpolated	$1,069,171			No	Project	1	$1,069,171	$0	$0	$1,069,171
111	0	0											No	Project		$0	$0	$0	$0
112	0	0							Design Contingency		$213,829		No	Project	1	$0	$213,829	$0	$213,829
113	0	0							Construction Contingency		$128,362		No	Project	1	$0	$128,362	$0	$128,362
114	0	0											No	Project		$0	$0	$0	$0
115	0	0											No	Project		$0	$0	$0	$0
116	0	0				Double Pane Windows	Installation and Repairs	Per m2	Costing Consultant Interpolated	$846,249			No	Avoided	1	$846,249	$0	$0	$846,249
117	0	0											No	Project		$0	$0	$0	$0
118	0	0							Design Contingency		$169,246		No	Avoided	1	$0	$169,246	$0	$169,246
119	0	0							Construction Contingency		$101,598		No	Avoided	1	$0	$101,598	$0	$101,598
120	0	0											Yes	Project		$0	$0	$0	$0
121	0	0											Yes	Project		$0	$0	$0	$0
122	0	0											Yes	Project		$0	$0	$0	$0
123	0	0											Yes	Project		$0	$0	$0	$0
124	0	0											Yes	Project		$0	$0	$0	$0
125	0	0											Yes	Project		$0	$0	$0	$0
126	0	0											Yes	Project		$0	$0	$0	$0
127	0	0											Yes	Project		$0	$0	$0	$0
128	0	0											Yes	Project		$0	$0	$0	$0
129	0	0											Yes	Project		$0	$0	$0	$0
130	0	0											Yes	Project		$0	$0	$0	$0
131	0	0											Yes	Project		$0	$0	$0	$0
132	0	0											Yes	Project		$0	$0	$0	$0
133	0	0											Yes	Project		$0	$0	$0	$0
134	0	0											Yes	Project		$0	$0	$0	$0
135	0	0											Yes	Project		$0	$0	$0	$0
136	0	0											Yes	Project		$0	$0	$0	$0
137	0	0											Yes	Project		$0	$0	$0	$0
138	0	0											Yes	Project		$0	$0	$0	$0
139	0	0											Yes	Project		$0	$0	$0	$0
140	0	0											Yes	Project		$0	$0	$0	$0
141	0	0											Yes	Project		$0	$0	$0	$0
142	0	0											Yes	Project		$0	$0	$0	$0
143	0	0											Yes	Project		$0	$0	$0	$0
144	0	0											Yes	Project		$0	$0	$0	$0
145	0	0											Yes	Project		$0	$0	$0	$0
146	0	0											Yes	Project		$0	$0	$0	$0
147	0	0											Yes	Project		$0	$0	$0	$0
															Totals:	**$1,069,171**	**$342,191**	**$0**	**$1,411,361**

Escalation Rates: Install High Efficiency Windows

Cash Flow Balance: Install High Efficiency Windows

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year:	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Implementation Cost:	-$1,764,202	$0	$0	$1,192,455	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M01):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M02):		-$515	-$542	-$570	-$600	-$631	-$664	-$699	-$735	-$773	-$813	-$856	-$900	-$947	-$996	-$1,048	-$1,103	-$1,160	-$1,220	-$1,284	-$1,350
Annual Savings (M03):		$1,608	$1,689	$1,774	$1,864	$1,958	$2,057	$2,161	$2,270	$2,385	$2,506	$2,632	$2,765	$2,904	$3,051	$3,205	$3,366	$3,536	$3,714	$3,901	$4,097
Annual Savings (M04):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M05):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M06):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Incentives:	$0																				
Add'l Annual Costs:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Add'l Annual Savings:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Rebate:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Total:	-$1,764,202	$1,092	$1,147	$1,193,658	$1,264	$1,327	$1,393	$1,462	$1,535	$1,612	$1,692	$1,776	$1,865	$1,957	$2,055	$2,157	$2,264	$2,376	$2,493	$2,617	$2,746
Cash Balance:	-$1,764,202	-$1,763,110	-$1,761,963	-$568,305	-$567,041	-$565,714	-$564,322	-$562,859	-$561,324	-$559,712	-$558,020	-$556,244	-$554,379	-$552,422	-$550,367	-$548,210	-$545,947	-$543,571	-$541,078	-$538,461	-$535,715
Undepreciated Amount:	-$1,764,202	-$1,499,572	-$1,274,636	-$1,083,440	-$920,924	-$782,786	-$665,368	-$565,563	-$480,728	-$408,619	-$347,326	-$295,227	-$250,943	-$213,302	-$181,306	-$154,110	-$130,994	-$111,345	-$94,643	-$80,447	-$68,380

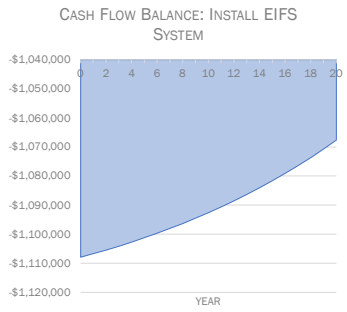
Energy Conservation Measure 2

Opp Cat:	Space_Heating
Opp Desc:	Install EIFS System
Opp Name:	Install EIFS System

Costing Setup	
Engineering & PM:	**15%**
Contingency:	**10%**
Additional Annual Costs:	
Additional Annual Savings:	
Tax Rebate (Capital Projects):	**No**
Avoided Capital Costs:	**$0**
Avoided Capital Year:	
Financial Analysis Term (years):	**20**

Incentive Work Area			
Rate	Qty	Total	Comments
		$0	
		$0	
		$0	
		$0	
		$0	
Total:		**$0**	

Utility Savings	
Demand (kW):	0
Electricity (kWh):	-2,720
Natural Gas (m³):	3,734
Water (m³):	0
():	0
():	0
Emissions (Tonnes of CO_2e):	7.1
Financials	
Annual Utility Savings:	$1,161
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$886,362
Engineering & PM:	$132,954
Contingency:	$88,636
Project Costs:	$1,107,953
Simple Payback:	954.3
Capital Payback:	79.06
NPV:	-$1,089,317
IRR:	-20.0%



Write-ups	
Existing:	The exterior wall
Retrofit:	We recommend

QC Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	1,904,641	1,905,655
% Reduction	#DIV/0!	#DIV/0!

Electrical Capacity Impact (Amps): for Ele Service Upgrades			
Base	Summer	Winter	Peak

Savings: Install EIFS System

Avg Temp (°F)	Avg Temp (°C)	Total Hours	Meter Selection				Occupancy	Eff. Profile
			Select	Select	Select	Select	Select	Select
-33	-36	0						0%
-28	-33	0						0%
-23	-30	0						0%
-18	-28	0						0%
-13	-25	1						0%
-8	-22	21						0%
-3	-19	80						0%
3	-16	127						0%
8	-14	169						0%
13	-11	290						0%
18	-8	423						0%
23	-5	460						0%
28	-3	537						0%
33	0	776						0%
38	3	719						0%
43	6	651						0%
48	9	677						0%
53	11	786						0%
58	14	773						0%
63	17	678						0%
68	20	639						0%
73	23	523						0%
78	25	296						0%
83	28	108						0%
88	31	26						0%
93	34	1						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

End-Use	**Existing**			**Install EIFS**			**Savings**					
	Electricity (MWh)	**Natural Gas (MMBTU)**	**Combined (kWh)**	**Electricity (MWh)**	**Natural Gas (MMBTU)**	**Combined (kWh)**	**Electricity (kWh)**	**Natural Gas (m3)**				
Space Cool	39.1	0.0	39,140.0	40.7	0.0	40,660.0	-1,520	0				
Heat Reject.	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Refrigeration	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Space Heat	0.0	1,300.5	381,154.7	0.0	1,169.0	342,614.3	0	3,734				
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Hot Water	0.0	52.7	15,445.5	0.0	52.7	15,445.5	0	0				
Vent. Fans	112.1	0.0	112,110.0	113.3	0.0	113,330.0	-1,220	0				
Pumps & Aux	8.0	0.0	7,990.0	8.0	0.0	7,970.0	20	0				
Ext. Usage	6.8	0.0	6,800.0	6.8	0.0	6,800.0	0	0				
Misc. Equip	236.8	0.0	236,840.0	236.8	0.0	236,840.0	0	0				
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Area Lights	168.9	0.0	168,890.0	168.9	0.0	168,890.0	0	0				
0	**572**	**1,353**	**968,370**	**574**	**1,222**	**932,550**	**-2,720**	**3,734**	**0**	**0**	**0**	**0**
Main Meter:	Select	Select	Select	Select	Select	Select	Select	M02	M03	Select	Select	Select	Select
Breakout Meter:	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select

General Requirements: Install EIFS System

Cost Breakout: Install EIFS System

Row	Division #	Section #	Division	Section	Item Description	Item	Description	Units	Source	Unit Costs			Gen Req?	Avoided Cost/ Project Cost	Qty	Material	Labour	Equipment	Total
										Materials	Labour	Equipment							
110	0	0				EIFS	Whole Building	per m2	Costing Consultant Interpolated 2025	$671,454			No	Project	1.00	$671,454	$0	$0	$671,454
111	0	0											Yes	Project		$0	$0	$0	$0
112	0	0							Design Contingency 2025		$134,317		No	Project	1	$0	$134,317	$0	$134,317
113	0	0							Construction Contingency 2025		$80,590		No	Project	1	$0	$80,590	$0	$80,590
114	0	0											Yes	Project		$0	$0	$0	$0
115	0	0											Yes	Project		$0	$0	$0	$0
116	0	0											Yes	Project		$0	$0	$0	$0
117	0	0											Yes	Project		$0	$0	$0	$0
118	0	0											Yes	Project		$0	$0	$0	$0
119	0	0											Yes	Project		$0	$0	$0	$0
120	0	0											Yes	Project		$0	$0	$0	$0
121	0	0											Yes	Project		$0	$0	$0	$0
122	0	0											Yes	Project		$0	$0	$0	$0
123	0	0											Yes	Project		$0	$0	$0	$0
124	0	0											Yes	Project		$0	$0	$0	$0
125	0	0											Yes	Project		$0	$0	$0	$0
126	0	0											Yes	Project		$0	$0	$0	$0
127	0	0											Yes	Project		$0	$0	$0	$0
128	0	0											Yes	Project		$0	$0	$0	$0
129	0	0											Yes	Project		$0	$0	$0	$0
130	0	0											Yes	Project		$0	$0	$0	$0
131	0	0											Yes	Project		$0	$0	$0	$0
132	0	0											Yes	Project		$0	$0	$0	$0
133	0	0											Yes	Project		$0	$0	$0	$0
134	0	0											Yes	Project		$0	$0	$0	$0
135	0	0											Yes	Project		$0	$0	$0	$0
136	0	0											Yes	Project		$0	$0	$0	$0
137	0	0											Yes	Project		$0	$0	$0	$0
138	0	0											Yes	Project		$0	$0	$0	$0
139	0	0											Yes	Project		$0	$0	$0	$0
140	0	0											Yes	Project		$0	$0	$0	$0
141	0	0											Yes	Project		$0	$0	$0	$0
142	0	0											Yes	Project		$0	$0	$0	$0
143	0	0											Yes	Project		$0	$0	$0	$0
144	0	0											Yes	Project		$0	$0	$0	$0
145	0	0											Yes	Project		$0	$0	$0	$0
146	0	0											Yes	Project		$0	$0	$0	$0
147	0	0											Yes	Project		$0	$0	$0	$0
															Totals:	**$671,454**	**$214,908**	**$0**	**$886,362**

Escalation Rates: Install EIFS System

Cash Flow Balance: Install EIFS System

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year:	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Implementation Cost:	-$1,107,953	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M01):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M02):		-$375	-$394	-$415	-$436	-$459	-$483	-$508	-$535	-$562	-$592	-$622	-$655	-$689	-$725	-$762	-$802	-$844	-$887	-$934	-$982
Annual Savings (M03):		$1,594	$1,675	$1,759	$1,848	$1,942	$2,040	$2,143	$2,251	$2,365	$2,485	$2,610	$2,742	$2,880	$3,025	$3,178	$3,338	$3,506	$3,683	$3,868	$4,063
Annual Savings (M04):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M05):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M06):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Incentives:	$0																				
Add'l Annual Costs:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Add'l Annual Savings:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Rebate:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Total:	-$1,107,953	$1,220	$1,280	$1,345	$1,412	$1,483	$1,557	$1,635	$1,717	$1,803	$1,893	$1,988	$2,087	$2,192	$2,301	$2,416	$2,536	$2,663	$2,795	$2,935	$3,081
Cash Balance:	-$1,107,953	-$1,106,733	-$1,105,453	-$1,104,108	-$1,102,696	-$1,101,214	-$1,099,657	-$1,098,022	-$1,096,305	-$1,094,502	-$1,092,609	-$1,090,621	-$1,088,534	-$1,086,342	-$1,084,041	-$1,081,625	-$1,079,089	-$1,076,427	-$1,073,631	-$1,070,697	-$1,067,616
Undepreciated Amount:	-$1,107,953	-$941,760	-$800,496	-$680,421	-$578,358	-$491,604	-$417,864	-$355,184	-$301,907	-$256,621	-$218,128	-$185,408	-$157,597	-$133,958	-$113,864	-$96,784	-$82,267	-$69,927	-$59,438	-$50,522	-$42,944

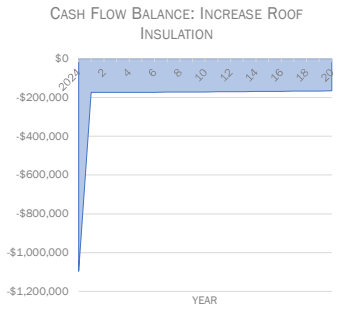
Energy Conservation Measure 9

Opp Cat:	Select
Opp Desc:	
Opp Name:	Increase Roof Insulation

Costing Setup	
Engineering & PM:	**15%**
Contingency:	**10%**
Additional Annual Costs:	
Additional Annual Savings:	
Tax Rebate (Capital Projects):	**No**
Avoided Capital Costs:	**$901,729**
Avoided Capital Year:	**1**
Financial Analysis Term (years):	**20**

Incentive Work Area			
Rate	Qty	Total	Comments
		$0	
		$0	
		$0	
		$0	
		$0	
Total:		**$0**	

Utility Savings	
Demand (kW):	0
Electricity (kWh):	-510
Natural Gas (m³):	758
Water (m³):	0
():	0
():	0
Emissions (Tonnes of CO_2e):	1.5
Financials	
Annual Utility Savings:	$241
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$1,095,450
Engineering & PM:	$0
Contingency:	$0
Project Costs:	$1,095,450
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$232,786
IRR:	-11.9%



Write-ups	
Existing:	#N/A
Retrofit:	#N/A

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	1,933,249	1,933,497
% Reduction	#DIV/0!	#DIV/0!

Electrical Capacity Impact (Amps): for Ele Service Upgrades			
Base	Summer	Winter	Peak

Savings: Increase Roof Insulation

Avg Temp (°F)	Avg Temp (°C)	Total Hours	Meter Selection				Occupancy	Eff. Profile
			Select	Select	Select	Select	Select	Select
-33	-36	0						0%
-28	-33	0						0%
-23	-30	0						0%
-18	-28	0						0%
-13	-25	1						0%
-8	-22	21						0%
-3	-19	80						0%
3	-16	127						0%
8	-14	169						0%
13	-11	290						0%
18	-8	423						0%
23	-5	460						0%
28	-3	537						0%
33	0	776						0%
38	3	719						0%
43	6	651						0%
48	9	677						0%
53	11	786						0%
58	14	773						0%
63	17	678						0%
68	20	639						0%
73	23	523						0%
78	25	296						0%
83	28	108						0%
88	31	26						0%
93	34	1						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

End-Use	**Existing**			**Increase Roof Insulation**			**Savings**						
	Electricity (MWh)	**Natural Gas (MMBTU)**	**Combined (kWh)**	**Electricity (MWh)**	**Natural Gas (MMBTU)**	**Combined (kWh)**	**Electricity (kWh)**	**Natural Gas (m3)**					
Space Cool	39.1	0.0	39,140.0	39.4	0.0	39,410.0	-270	0					
Heat Reject.	0.0	0.0	0.0	0.0	0.0	0.0	0	0					
Refrigeration	0.0	0.0	0.0	0.0	0.0	0.0	0	0					
Space Heat	0.0	1,300.5	381,154.7	0.0	1,273.8	373,329.4	0	758					
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0	0					
Hot Water	0.0	52.7	15,445.5	0.0	52.7	15,445.5	0	0					
Vent. Fans	112.1	0.0	112,110.0	112.4	0.0	112,350.0	-240	0					
Pumps & Aux	8.0	0.0	7,990.0	8.0	0.0	7,990.0	0	0					
Ext. Usage	6.8	0.0	6,800.0	6.8	0.0	6,800.0	0	0					
Misc. Equip	236.8	0.0	236,840.0	236.8	0.0	236,840.0	0	0					
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0					
Area Lights	168.9	0.0	168,890.0	168.9	0.0	168,890.0	0	0					
0	**572**	**1,353**	**968,370**	**572**	**1,327**	**961,055**	**-510**	**758**	**0**	**0**	**0**	**0**
Main Meter:	Select	Select	Select	Select	Select	Select	Select	M02	M03	Select	Select	Select	Select
Breakout Meter:	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select

General Requirements: Increase Roof Insulation

Cost Breakout: Increase Roof Insulation

Row	Division #	Section #	Division	Section	Item Description	Item	Description	Units	Source	Unit Costs			Gen Req?	Avoided Cost/ Project Cost	Qty	Material	Labour	Equipment	Total
										Materials	Labour	Equipment							
110	0	0				Arch	Subtotal 1		AW Hooker	$934,918	$0		No	Project	1	$934,918	$0	$0	$934,918
111	0	0											No	Project		$0	$0	$0	$0
112	0	0					Subtotal 2		AW Hooker	$160,532	$0		No	Project	1	$160,532	$0	$0	$160,532
113	0	0											No	Project		$0	$0	$0	$0
114	0	0											Yes	Project		$0	$0	$0	$0
115	0	0				Arch	Subtotal 1		AW Hooker	$767,997	$0		No	Avoided	1	$767,997	$0	$0	$767,997
116	0	0											No	Project		$0	$0	$0	$0
117	0	0					Subtotal 2		AW Hooker	$133,732	$0		No	Avoided	1	$133,732	$0	$0	$133,732
118	0	0											No	Project		$0	$0	$0	$0
119	0	0											Yes	Project		$0	$0	$0	$0
120	0	0											Yes	Project		$0	$0	$0	$0
121	0	0											Yes	Project		$0	$0	$0	$0
122	0	0											Yes	Project		$0	$0	$0	$0
123	0	0											Yes	Project		$0	$0	$0	$0
124	0	0											Yes	Project		$0	$0	$0	$0
125	0	0											Yes	Project		$0	$0	$0	$0
126	0	0											Yes	Project		$0	$0	$0	$0
127	0	0											Yes	Project		$0	$0	$0	$0
128	0	0											Yes	Project		$0	$0	$0	$0
129	0	0											Yes	Project		$0	$0	$0	$0
130	0	0											Yes	Project		$0	$0	$0	$0
131	0	0											Yes	Project		$0	$0	$0	$0
132	0	0											Yes	Project		$0	$0	$0	$0
133	0	0											Yes	Project		$0	$0	$0	$0
134	0	0											Yes	Project		$0	$0	$0	$0
135	0	0											Yes	Project		$0	$0	$0	$0
136	0	0											Yes	Project		$0	$0	$0	$0
137	0	0											Yes	Project		$0	$0	$0	$0
138	0	0											Yes	Project		$0	$0	$0	$0
139	0	0											Yes	Project		$0	$0	$0	$0
140	0	0											Yes	Project		$0	$0	$0	$0
141	0	0											Yes	Project		$0	$0	$0	$0
142	0	0											Yes	Project		$0	$0	$0	$0
143	0	0											Yes	Project		$0	$0	$0	$0
144	0	0											Yes	Project		$0	$0	$0	$0
145	0	0											Yes	Project		$0	$0	$0	$0
146	0	0											Yes	Project		$0	$0	$0	$0
147	0	0											Yes	Project		$0	$0	$0	$0
															Totals:	**$1,095,450**	**$0**	**$0**	**$1,095,450**

Escalation Rates: Increase Roof Insulation

Cash Flow Balance: Increase Roof Insulation

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year:	**2024**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Implementation Cost:	-$1,095,450	$921,567	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M01):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M02):		-$70	-$74	-$78	-$82	-$86	-$91	-$95	-$100	-$105	-$111	-$117	-$123	-$129	-$136	-$143	-$150	-$158	-$166	-$175	-$184
Annual Savings (M03):		$324	$340	$357	$375	$394	$414	$435	$457	$480	$505	$530	$557	$585	$614	$645	$678	$712	$748	$785	$825
Annual Savings (M04):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M05):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M06):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Incentives:	$0																				
Add'l Annual Costs:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Add'l Annual Savings:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Rebate:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Total:	-$1,095,450	$921,820	$266	$279	$293	$308	$324	$340	$357	$375	$394	$413	$434	$456	$478	$502	$527	$554	$581	$610	$641
Cash Balance:	-$1,095,450	-$173,630	-$173,364	-$173,084	-$172,791	-$172,482	-$172,159	-$171,819	-$171,462	-$171,087	-$170,694	-$170,280	-$169,846	-$169,391	-$168,912	-$168,410	-$167,883	-$167,329	-$166,747	-$166,137	-$165,496
Undepreciated Amount:	$0	-$931,133	-$791,463	-$672,743	-$571,832	-$486,057	-$413,148	-$351,176	-$298,500	-$253,725	-$215,666	-$183,316	-$155,819	-$132,446	-$112,579	-$95,692	-$81,338	-$69,138	-$58,767	-$49,952	-$42,459

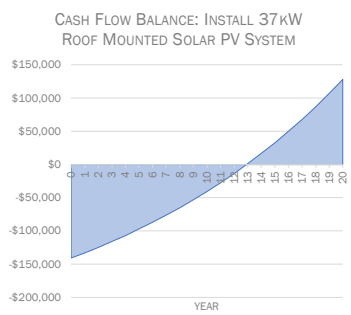
Energy Conservation Measure 14

Opp Cat:	Select
Opp Desc:	
Opp Name:	Install 37kW Roof Mounted Solar PV System

Costing Setup	
Engineering & PM:	**0%**
Contingency:	**10%**
Additional Annual Costs:	
Additional Annual Savings:	
Tax Rebate (Capital Projects):	**No**
Avoided Capital Costs:	**$0**
Avoided Capital Year:	
Financial Analysis Term (years):	**20**

Incentive Work Area			
Rate	Qty	Total	Comments
		$0	
		$0	
		$0	
		$0	
		$0	
Total:		**$0**	

Utility Savings	
Demand (kW):	133
Electricity (kWh):	46,051
Natural Gas (m³):	0
Water (m³):	0
():	0
():	0
Emissions (Tonnes of CO_2e):	1.3
Financials	
Annual Utility Savings:	$7,432
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$128,044
Engineering & PM:	$0
Contingency:	$12,804
Project Costs:	$140,848
Simple Payback:	19.0
Capital Payback:	12.9
NPV:	-$17,603
IRR:	5.9%



Write-ups	
Existing:	#N/A
Retrofit:	#N/A

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	82	46,266
% Reduction	#DIV/0!	#DIV/0!

Electrical Capacity Impact (Amps): for Ele Service Upgrades			
Base	Summer	Winter	Peak

Savings: Install 37kW Roof Mounted Solar PV System

			Meter Selection				Occupancy	Eff. Profile
Avg Temp (°F)	Avg Temp (°C)	Total Hours	Select	Select	Select	Select	Select	Select
-33	-36	0						0%
-28	-33	0						0%
-23	-30	0						0%
-18	-28	0						0%
-13	-25	1						0%
-8	-22	21						0%
-3	-19	80						0%
3	-16	127						0%
8	-14	169						0%
13	-11	290						0%
18	-8	423						0%
23	-5	460						0%
28	-3	537						0%
33	0	776						0%
38	3	719						0%
43	6	651						0%
48	9	677						0%
53	11	786						0%
58	14	773						0%
63	17	678						0%
68	20	639						0%
73	23	523						0%
78	25	296						0%
83	28	108						0%
88	31	26						0%
93	34	1						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

From RETScreen

Electricity (kWh)	Month	%	Estimated Dem (kW)										
46,051	1	10%	4										
	2	10%	4										
	3	20%	7										
	4	30%	11										
	5	40%	15										
	6	50%	19										
	7	50%	19										
	8	50%	19										
	9	40%	15										
	10	30%	11										
	11	20%	7										
	12	10%	4										
46,051	**78**	**4**	**133**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Main Meter:	M02	Select	M01	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select
Breakout Meter:	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select

General Requirements: Install 37kW Roof Mounted Solar PV System

Cost Breakout: Install 37kW Roof Mounted Solar PV System

Row	Division #	Section #	Division	Section	Item Description	Item	Description	Units	Source	Unit Costs			Gen Req?	Avoided Cost/ Project Cost	Qty	Material	Labour	Equipment	Total
										Materials	Labour	Equipment							
110	0	0				Solar PV Panels	New panels	per W	Quote	$2	$1		No	Project	37000	$62,900	$37,000	$0	$99,900
111	0	0											Yes	Project		$0	$0	$0	$0
112	0	0				Structural Evaluations		Each	EE Est		$20,000		Yes	Project	1	$0	$28,144	$0	$28,144
113	0	0											Yes	Project		$0	$0	$0	$0
114	0	0											Yes	Project		$0	$0	$0	$0
115	0	0											Yes	Project		$0	$0	$0	$0
116	0	0											Yes	Project		$0	$0	$0	$0
117	0	0											Yes	Project		$0	$0	$0	$0
118	0	0											Yes	Project		$0	$0	$0	$0
119	0	0											Yes	Project		$0	$0	$0	$0
120	0	0											Yes	Project		$0	$0	$0	$0
121	0	0											Yes	Project		$0	$0	$0	$0
122	0	0											Yes	Project		$0	$0	$0	$0
123	0	0											Yes	Project		$0	$0	$0	$0
124	0	0											Yes	Project		$0	$0	$0	$0
125	0	0											Yes	Project		$0	$0	$0	$0
126	0	0											Yes	Project		$0	$0	$0	$0
127	0	0											Yes	Project		$0	$0	$0	$0
128	0	0											Yes	Project		$0	$0	$0	$0
129	0	0											Yes	Project		$0	$0	$0	$0
130	0	0											Yes	Project		$0	$0	$0	$0
131	0	0											Yes	Project		$0	$0	$0	$0
132	0	0											Yes	Project		$0	$0	$0	$0
133	0	0											Yes	Project		$0	$0	$0	$0
134	0	0											Yes	Project		$0	$0	$0	$0
135	0	0											Yes	Project		$0	$0	$0	$0
136	0	0											Yes	Project		$0	$0	$0	$0
137	0	0											Yes	Project		$0	$0	$0	$0
138	0	0											Yes	Project		$0	$0	$0	$0
139	0	0											Yes	Project		$0	$0	$0	$0
140	0	0											Yes	Project		$0	$0	$0	$0
141	0	0											Yes	Project		$0	$0	$0	$0
142	0	0											Yes	Project		$0	$0	$0	$0
143	0	0											Yes	Project		$0	$0	$0	$0
144	0	0											Yes	Project		$0	$0	$0	$0
145	0	0											Yes	Project		$0	$0	$0	$0
146	0	0											Yes	Project		$0	$0	$0	$0
147	0	0											Yes	Project		$0	$0	$0	$0
															Totals:	**$62,900**	**$65,144**	**$0**	**$128,044**

Escalation Rates: Install 37kW Roof Mounted Solar PV System

Cash Flow Balance: Install 37kW Roof Mounted Solar PV System

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year:	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Implementation Cost:	-$140,848	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M01):		$1,483	$1,572	$1,666	$1,766	$1,872	$1,985	$2,104	$2,230	$2,364	$2,505	$2,656	$2,815	$2,984	$3,163	$3,353	$3,554	$3,767	$3,993	$4,233	$4,487
Annual Savings (M02):		$6,346	$6,676	$7,024	$7,389	$7,773	$8,177	$8,602	$9,050	$9,520	$10,015	$10,536	$11,084	$11,660	$12,267	$12,905	$13,576	$14,282	$15,024	$15,806	$16,627
Annual Savings (M03):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M04):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M05):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M06):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Incentives:	$0																				
Add'l Annual Costs:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Add'l Annual Savings:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Rebate:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Total:	-$140,848	$7,829	$8,248	$8,690	$9,155	$9,645	$10,162	$10,706	$11,280	$11,884	$12,521	$13,192	$13,899	$14,645	$15,430	$16,258	$17,130	$18,049	$19,018	$20,039	$21,114
Cash Balance:	-$140,848	-$133,019	-$124,771	-$116,081	-$106,926	-$97,280	-$87,119	-$76,413	-$65,133	-$53,249	-$40,728	-$27,536	-$13,637	$1,008	$16,438	$32,695	$49,825	$67,874	$86,892	$106,930	$128,044
Undepreciated Amount:	-$140,848	-$119,721	-$101,763	-$86,499	-$73,524	-$62,495	-$53,121	-$45,153	-$38,380	-$32,623	-$27,729	-$23,570	-$20,035	-$17,029	-$14,475	-$12,304	-$10,458	-$8,889	-$7,556	-$6,423	-$5,459

Site reference conditions

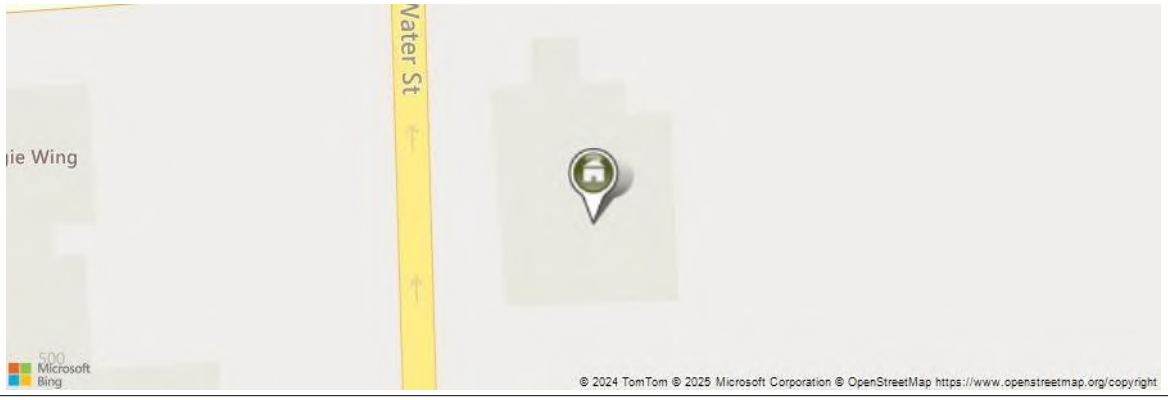
Climate data location: Canada - Ontario - Peterborough A

Facility location: Canada - ON - Peterborough

Legend

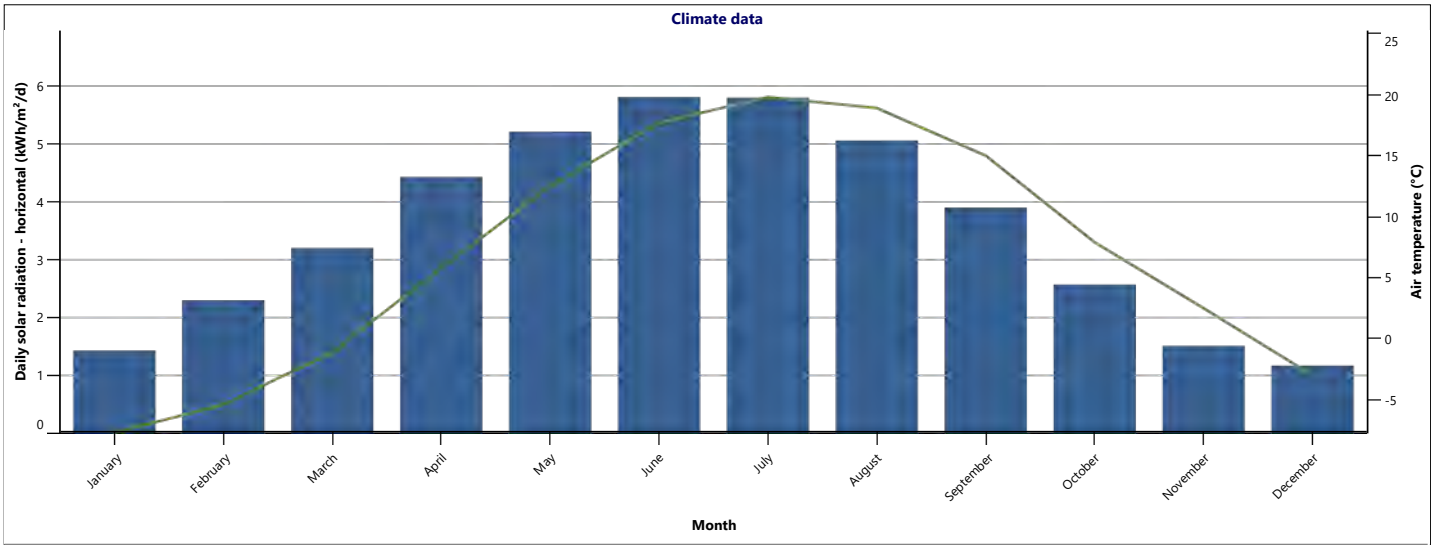
Facility location

Climate data location



	Unit	Climate data location	Facility location	Source
Latitude		44.2	44.3	
Longitude		-78.4	-78.3	
Climate zone		6A - Cold - Humid		Ground+NASA
Elevation	m	191	206	Ground – Map
Heating design temperature	°C	-20.4		Ground
Cooling design temperature	°C	28.1		Ground
Earth temperature amplitude	°C	22.3		NASA

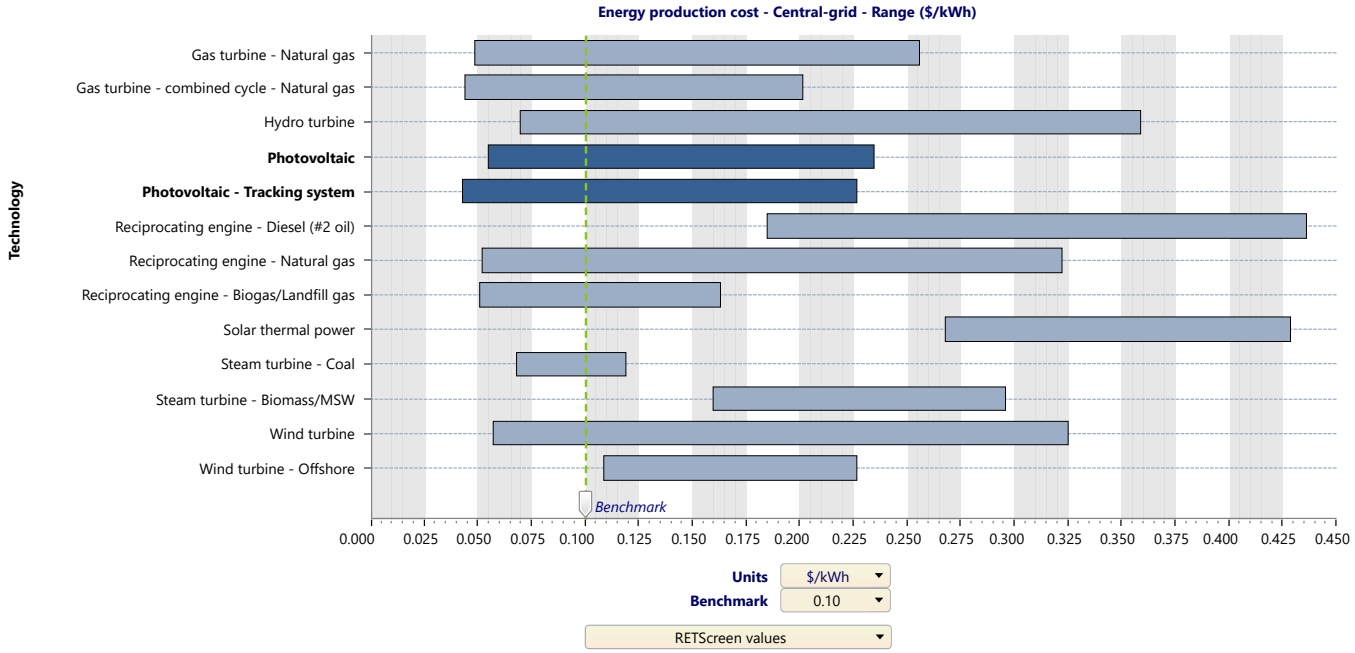
Month	Air temperature	Relative humidity	Precipitation	Daily solar radiation - horizontal	Atmospheric pressure	Wind speed	Earth temperature	Heating degree-days 18 °C	Cooling degree-days 10 °C
	°C	%	mm	kWh/m²/d	kPa	m/s	°C	°C-d	°C-d
January	-7.7	74.5%	44.64	1.42	99.1	3.4	-6.4	797	0
February	-5.4	71.9%	36.96	2.29	99.1	3.2	-5.8	655	0
March	-1.1	69.3%	45.26	3.19	99.1	3.4	-1.0	592	0
April	5.8	65.1%	57.30	4.42	99.0	3.3	5.3	366	0
May	12.5	71.1%	65.41	5.20	99.0	3.0	11.5	171	78
June	17.7	76.2%	66.30	5.80	98.9	2.5	17.4	9	231
July	19.8	76.0%	63.86	5.79	99.0	2.5	21.0	0	304
August	18.9	79.4%	59.83	5.05	99.1	2.1	20.6	0	276
September	15.0	81.4%	69.30	3.89	99.2	2.3	16.1	90	150
October	7.9	79.1%	64.17	2.56	99.2	2.7	9.1	313	0
November	2.5	79.2%	63.30	1.50	99.2	3.0	2.8	465	0
December	-3.0	79.0%	52.70	1.16	99.1	3.2	-3.2	651	0
Annual	**7.0**	**75.2%**	**689.03**	**3.53**	**99.1**	**2.9**	**7.4**	**4,109**	**1,038**
Source	Ground	Ground	NASA	NASA	NASA	Ground	NASA	Ground	Ground
Measured at					m	10	0		



Facility information

Facility type	Power plant
Type	Photovoltaic
Description	Rooftop Solar PV
Prepared for	City of Peterborough
Prepared by	Efficiency Engineering
Facility name	Peterborough Police Services
Address	500 Water St
City/Municipality	Peterborough
Province/State	ON
Country	Canada

Benchmark - Power plants



Units	$/kWh
Benchmark	0.10
	RETScreen values

Note: Typical cost values in Canadian $ as of January 1, 2022.
Purchasing power parity (Exchange rate) approximately 1.25 CAD = 1 USD.

Power plant - Rooftop Solar PV - Photovoltaic

- **Fuels & schedules**
  - Electricity and fuels
- **Technology**
  - Power
    - Photovoltaic
- **Summary**
  - Include system?
  - Comparison

Photovoltaic

Description: Photovoltaic

Note:

Level: Level 1 | Level 2

Options: eLearning | RETScreen Connect

Photovoltaic - Level 2

Resource assessment

Solar tracking mode		Fixed
Slope	°	15
Azimuth	°	0

Show data

Month	Daily solar radiation - horizontal kWh/m²/d	Daily solar radiation - tilted kWh/m²/d	Electricity export rate $/kWh	Electricity exported to grid kWh
January	1.42	1.90	0.10	2,120.396
February	2.29	2.85	0.10	2,815.725
March	3.19	3.60	0.10	3,848.578
April	4.42	4.69	0.10	4,688.633
May	5.20	5.29	0.10	5,302.072
June	5.80	5.80	0.10	5,487.580
July	5.79	5.84	0.10	5,653.003
August	5.05	5.26	0.10	5,126.102
September	3.89	4.30	0.10	4,146.734
October	2.56	3.06	0.10	3,177.709
November	1.50	1.92	0.10	1,990.802
December	1.16	1.54	0.10	1,694.110
Annual	**3.53**	**3.84**	**0.10**	**46,051.443**

Annual solar radiation - horizontal	MWh/m²	1.29
Annual solar radiation - tilted	MWh/m²	1.40

Photovoltaic

Type		mono-Si
Power capacity	kW	36.9
Manufacturer		Canadian Solar
Model		mono-Si - CS6X-300M - MaxPower
Number of units		123
Efficiency	%	15.63%
Nominal operating cell temperature	°C	45
Temperature coefficient	% / °C	0.4%
Solar collector area	m²	236
Bifacial cell adjustment factor	%	5%
Miscellaneous losses	%	5%

Inverter

Efficiency	%	95%
Capacity	kW	40
Miscellaneous losses	%	5%

Summary

Capacity factor	%	14.2%
Initial costs	$/kW	
	$	
O&M costs (savings)	$/kW-year	
	$	
Electricity export rate		Electricity export rate - annual
	$/kWh	0.10
Electricity exported to grid	kWh	46,051
Electricity export revenue	$	4,605

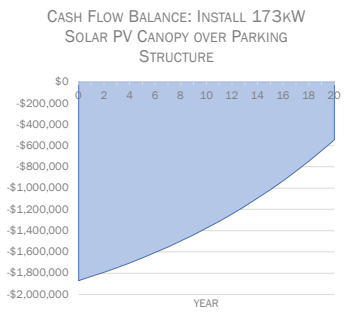
Energy Conservation Measure 13

Opp Cat:	Select
Opp Desc:	
Opp Name:	Install 173kW Solar PV Canopy over Parking Structure

Costing Setup	
Engineering & PM:	**15%**
Contingency:	**10%**
Additional Annual Costs:	
Additional Annual Savings:	
Tax Rebate (Capital Projects):	**No**
Avoided Capital Costs:	**$0**
Avoided Capital Year:	**5**
Financial Analysis Term (years):	**20**

Incentive Work Area			
Rate	Qty	Total	Comments
		$0	
		$0	
		$0	
		$0	
		$0	
Total:		**$0**	

Utility Savings	
Demand (kW):	779
Electricity (kWh):	216,404
Natural Gas (m³):	0
Water (m³):	0
():	0
():	0
Emissions (Tonnes of CO_2e):	6.1
Financials	
Annual Utility Savings:	$36,532
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$1,497,247
Engineering & PM:	$224,587
Contingency:	$149,725
Project Costs:	$1,871,559
Simple Payback:	51.2
Capital Payback:	24.5
NPV:	-$1,264,054
IRR:	-2.7%



Write-ups	
Existing:	#N/A
Retrofit:	#N/A

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	82	217,265
% Reduction	#DIV/0!	#DIV/0!

Electrical Capacity Impact (Amps): for Ele Service Upgrades			
Base	Summer	Winter	Peak

Savings: Install 173kW Solar PV Canopy over Parking Structure

			Meter Selection				Occupancy	Eff. Profile
Avg Temp (°F)	Avg Temp (°C)	Total Hours	Select	Select	Select	Select	Select	Select
-33	-36	0						0%
-28	-33	0						0%
-23	-30	0						0%
-18	-28	0						0%
-13	-25	1						0%
-8	-22	21						0%
-3	-19	80						0%
3	-16	127						0%
8	-14	169						0%
13	-11	290						0%
18	-8	423						0%
23	-5	460						0%
28	-3	537						0%
33	0	776						0%
38	3	719						0%
43	6	651						0%
48	9	677						0%
53	11	786						0%
58	14	773						0%
63	17	678						0%
68	20	639						0%
73	23	523						0%
78	25	296						0%
83	28	108						0%
88	31	26						0%
93	34	1						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

From RETScreen

Electricity (kWh)	Month	%	Estimated Dem (kW)									
216,404	1	10%	22									
	2	10%	22									
	3	20%	43									
	4	30%	65									
	5	40%	87									
	6	50%	108									
	7	50%	108									
	8	50%	108									
	9	40%	87									
	10	30%	65									
	11	20%	43									
	12	10%	22									
216,404	**78**	**4**	**779**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Main Meter:	M02	Select	Select	M01	Select	Select	Select	Select	Select	Select	Select	Select
Breakout Meter:	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select

38%

General Requirements: Install 173kW Solar PV Canopy over Parking Structure

Cost Breakout: Install 173kW Solar PV Canopy over Parking Structure

Row	Division #	Section #	Division	Section	Item Description	Item	Description	Units	Source	Unit Costs			Gen Req?	Avoided Cost/ Project Cost	Qty	Material	Labour	Equipment	Total
										Materials	Labour	Equipment							
110	0	0				Solar PV Panels	New panels	per W	Quote	$2	$1		No	Project	216404	$367,887	$216,404	$0	$584,291
111	0	0				Solar PV Canopy Strucutre	Canopy Structure, Asphalt tie ins, repaving of certain areas	Per m2		$500	$50		Yes	Project	1100	$835,560	$77,396	$0	$912,956
112	0	0				Canopy Structure		Per m2	AW Hooking Costing Estimate 2024	$860			No	Project		$0	$0	$0	$0
113	0	0				Re-paving of parking lot		Per m2	AW Hooking Costing Estimate 2024	$860			No	Both		$0	$0	$0	$0
114	0	0				New Asphalt tie in			AW Hooking Costing Estimate 2024	$10,000			No	Project		$0	$0	$0	$0
115	0	0											Yes	Project		$0	$0	$0	$0
116	0	0											Yes	Project		$0	$0	$0	$0
117	0	0											Yes	Project		$0	$0	$0	$0
118	0	0											Yes	Project		$0	$0	$0	$0
119	0	0											Yes	Project		$0	$0	$0	$0
120	0	0											Yes	Project		$0	$0	$0	$0
121	0	0											Yes	Project		$0	$0	$0	$0
122	0	0											Yes	Project		$0	$0	$0	$0
123	0	0											Yes	Project		$0	$0	$0	$0
124	0	0											Yes	Project		$0	$0	$0	$0
125	0	0											Yes	Project		$0	$0	$0	$0
126	0	0											Yes	Project		$0	$0	$0	$0
127	0	0											Yes	Project		$0	$0	$0	$0
128	0	0											Yes	Project		$0	$0	$0	$0
129	0	0											Yes	Project		$0	$0	$0	$0
130	0	0											Yes	Project		$0	$0	$0	$0
131	0	0											Yes	Project		$0	$0	$0	$0
132	0	0											Yes	Project		$0	$0	$0	$0
133	0	0											Yes	Project		$0	$0	$0	$0
134	0	0											Yes	Project		$0	$0	$0	$0
135	0	0											Yes	Project		$0	$0	$0	$0
136	0	0											Yes	Project		$0	$0	$0	$0
137	0	0											Yes	Project		$0	$0	$0	$0
138	0	0											Yes	Project		$0	$0	$0	$0
139	0	0											Yes	Project		$0	$0	$0	$0
140	0	0											Yes	Project		$0	$0	$0	$0
141	0	0											Yes	Project		$0	$0	$0	$0
142	0	0											Yes	Project		$0	$0	$0	$0
143	0	0											Yes	Project		$0	$0	$0	$0
144	0	0											Yes	Project		$0	$0	$0	$0
145	0	0											Yes	Project		$0	$0	$0	$0
146	0	0											Yes	Project		$0	$0	$0	$0
147	0	0											Yes	Project		$0	$0	$0	$0
															Totals:	**$1,203,447**	**$293,800**	**$0**	**$1,497,247**

Escalation Rates: Install 173kW Solar PV Canopy over Parking Structure

Cash Flow Balance: Install 173kW Solar PV Canopy over Parking Structure

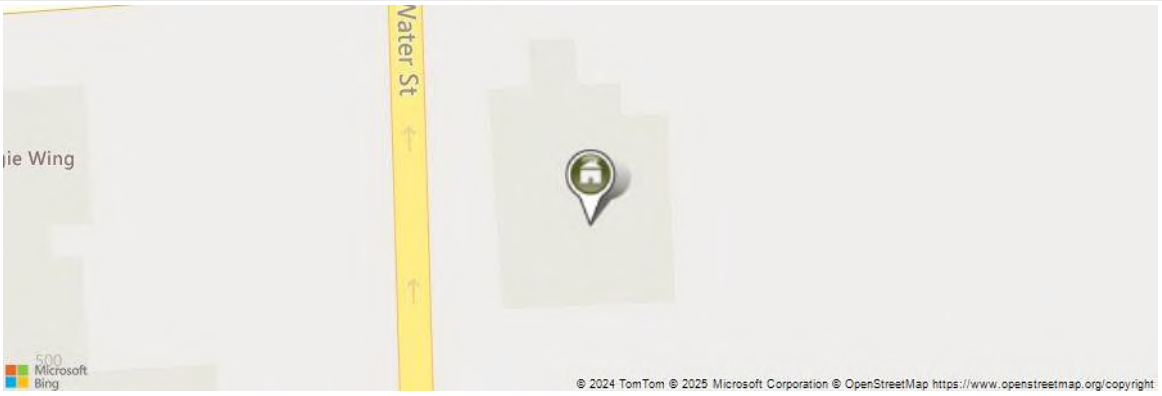
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year:	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Implementation Cost:	-$1,871,559	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M01):		$8,674	$9,194	$9,746	$10,330	$10,950	$11,607	$12,304	$13,042	$13,825	$14,654	$15,533	$16,465	$17,453	$18,500	$19,610	$20,787	$22,034	$23,356	$24,758	$26,243
Annual Savings (M02):		$29,823	$31,374	$33,005	$34,722	$36,527	$38,427	$40,425	$42,527	$44,738	$47,065	$49,512	$52,087	$54,795	$57,644	$60,642	$63,795	$67,113	$70,602	$74,274	$78,136
Annual Savings (M03):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M04):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M05):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Savings (M06):		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Incentives:	$0																				
Add'l Annual Costs:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Add'l Annual Savings:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Rebate:		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual Total:	-$1,871,559	$38,497	$40,568	$42,751	$45,052	$47,477	$50,034	$52,728	$55,569	$58,563	$61,719	$65,045	$68,552	$72,248	$76,145	$80,252	$84,582	$89,147	$93,959	$99,031	$104,379
Cash Balance:	-$1,871,559	-$1,833,062	-$1,792,494	-$1,749,743	-$1,704,691	-$1,657,213	-$1,607,179	-$1,554,451	-$1,498,882	-$1,440,319	-$1,378,601	-$1,313,556	-$1,245,004	-$1,172,756	-$1,096,611	-$1,016,359	-$931,776	-$842,630	-$748,671	-$649,639	-$545,260
Undepreciated Amount:	-$1,871,559	-$1,590,825	-$1,352,201	-$1,149,371	-$976,965	-$830,420	-$705,857	-$599,979	-$509,982	-$433,485	-$368,462	-$313,193	-$266,214	-$226,282	-$192,339	-$163,489	-$138,965	-$118,120	-$100,402	-$85,342	-$72,541

Site reference conditions

Climate data location: Canada - Ontario - Peterborough A

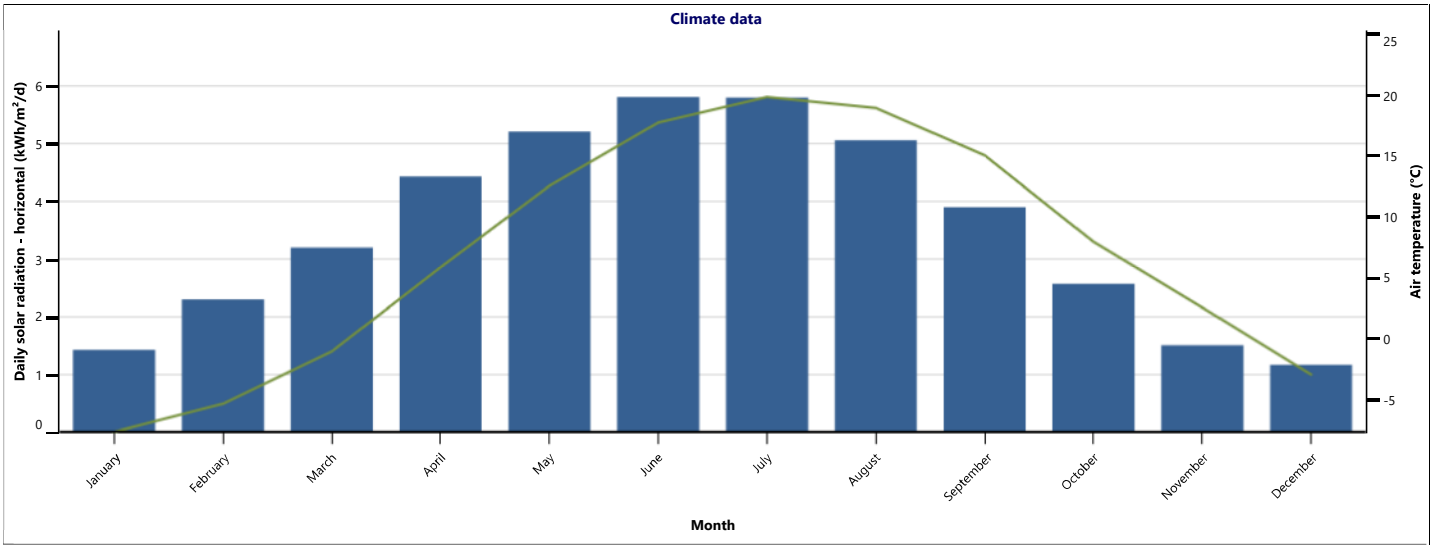
Facility location: Canada - ON - Peterborough

Legend
Facility location
Climate data location



	Unit	Climate data location	Facility location	Source
Latitude		44.2	44.3	
Longitude		-78.4	-78.3	
Climate zone		6A - Cold - Humid		Ground+NASA
Elevation	m	191	206	Ground – Map
Heating design temperature	°C	-20.4		Ground
Cooling design temperature	°C	28.1		Ground
Earth temperature amplitude	°C	22.3		NASA

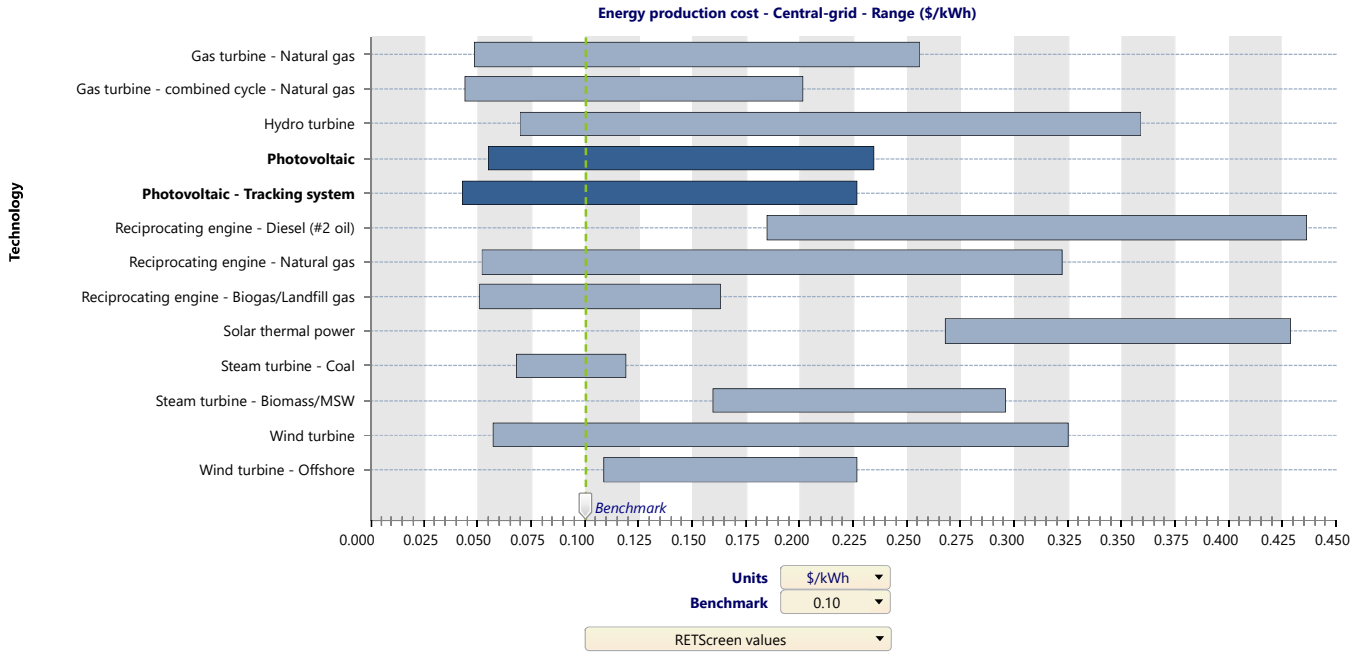
Month	Air temperature	Relative humidity	Precipitation	Daily solar radiation - horizontal	Atmospheric pressure	Wind speed	Earth temperature	Heating degree-days 18 °C	Cooling degree-days 10 °C
	°C	%	mm	kWh/m²/d	kPa	m/s	°C	°C-d	°C-d
January	-7.7	74.5%	44.64	1.42	99.1	3.4	-6.4	797	0
February	-5.4	71.9%	36.96	2.29	99.1	3.2	-5.8	655	0
March	-1.1	69.3%	45.26	3.19	99.1	3.4	-1.0	592	0
April	5.8	65.1%	57.30	4.42	99.0	3.3	5.3	366	0
May	12.5	71.1%	65.41	5.20	99.0	3.0	11.5	171	78
June	17.7	76.2%	66.30	5.80	98.9	2.5	17.4	9	231
July	19.8	76.0%	63.86	5.79	99.0	2.5	21.0	0	304
August	18.9	79.4%	59.83	5.05	99.1	2.1	20.6	0	276
September	15.0	81.4%	69.30	3.89	99.2	2.3	16.1	90	150
October	7.9	79.1%	64.17	2.56	99.2	2.7	9.1	313	0
November	2.5	79.2%	63.30	1.50	99.2	3.0	2.8	465	0
December	-3.0	79.0%	52.70	1.16	99.1	3.2	-3.2	651	0
Annual	**7.0**	**75.2%**	**689.03**	**3.53**	**99.1**	**2.9**	**7.4**	**4,109**	**1,038**
Source	Ground	Ground	NASA	NASA	NASA	Ground	NASA	Ground	Ground
Measured at					m	10	0		



Facility information

Facility type	Power plant
Type	Photovoltaic
Description	Solar PV Canopy
Prepared for	City of Peterborough
Prepared by	Efficiency Engineering
Facility name	Peterborough Police Services
Address	500 Water St
City/Municipality	Peterborough
Province/State	ON
Country	Canada

Benchmark - Power plants



Units	$/kWh
Benchmark	0.10

RETScreen values

Note: Typical cost values in Canadian $ as of January 1, 2022.
Purchasing power parity (Exchange rate) approximately 1.25 CAD = 1 USD.

Power plant - Solar PV Canopy - Photovoltaic

- **Fuels & schedules**
  - Electricity and fuels
- **Technology**
  - Power
    - Photovoltaic
- **Summary**
  - Include system?
  - Comparison

Photovoltaic

Description: Photovoltaic

Note:

Level: Level 1 | Level 2

Options: eLearning | RETScreen Connect

Photovoltaic - Level 2

Resource assessment

Solar tracking mode		Fixed
Slope	°	15
Azimuth	°	0

Show data

Photovoltaic

Type		mono-Si
Power capacity	kW	173.4
Manufacturer		Canadian Solar
Model		mono-Si - CS6X-300M - MaxPower
Number of units		578
Efficiency	%	15.63%
Nominal operating cell temperature	°C	45
Temperature coefficient	% / °C	0.4%
Solar collector area	m²	1,109
Bifacial cell adjustment factor	%	5%
Miscellaneous losses	%	5%

Inverter

Efficiency	%	95%
Capacity	kW	40
Miscellaneous losses	%	5%

Summary

Capacity factor	%	14.2%
Initial costs	$/kW	
	$	
O&M costs (savings)	$/kW-year	
	$	
Electricity export rate		Electricity export rate - annual
	$/kWh	0.10
Electricity exported to grid	kWh	216,404
Electricity export revenue	$	21,640

APPENDIX D

FLOORPLANS