12 Muskoka Rd

MacTier, ON P0C 1H0

Climate Action Roadmap

MacTier Public Library

EFFICIENCY ENGINEERING .COM
A Kontrol Technologies Company

Township of Georgian Bay
Muskoka

TOWNSHIP OF
GEORGIAN BAY

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1 The Executive Summary

Efficiency Engineering has performed a comprehensive Net Zero Retrofit Study at the MacTier Public Library, 12 Muskoka Rd, for the Township of Georgian Bay. The Township 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.

This study has been developed in accordance with the Federation of Canadian Municipalities (CFM) Community Building Retrofit (CBR) initiative guidelines which require the following scenarios to be studied:

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

A "business-as-usual" scenario will also be developed to create a 20-year cost baseline for the purposes of comparison.

1.1 Building Overview

The following table summarizes the facility details:

TABLE 1.1.1: FACILITY DETAILS

Building Name:	MacTier Public Library
Client Name:	Township of Georgian Bay
Site Contact:	Jennifer Schnier
Address:	12 Muskoka Rd
	MacTier, ON
	P0C 1H0
Facility Area:	3,500 ft²
Building Type:	Library
Year Constructed:	2008

1.1.1 Existing Building Profile

The MacTier Public Library is a 3,500 ft² facility comprised of the library and office spaces.

Space heating and cooling for the facility is supplied by a packaged ground mounted rooftop unit (RTU). Attached to the RTU is an energy recovery ventilator (ERV) which transfers both sensible and latent heat from the exhaust air stream to the incoming outdoor air stream. The RTU has a heating capacity of 125 MBH and a cooling capacity of 5 tons.

The facility is equipped with a single electric domestic hot water (DHW) heater tank rated at 3000W.

Ventilation to the building is supplied by the RTU at an estimated 1,500 CFM. Ventilation air is tempered by an energy recovery ventilator (ERV) which transfers both sensible and latent heat from the exhaust air stream to the incoming outdoor air stream. The ERV has the ability to move 1,000 CFM of air across the recovery wheel.

Lighting at the facility is provided primarily by a mix of linear T8 fluorescents and LED retrofit lamps. Interior lighting controls consist of wall switches and breakers. Exterior lighting has been upgraded to LED and is controlled via timers.

Water fixtures (toilets and faucets) are standard flow units.

The RTU is controlled through a combination of thermostats and its own internal controls.

1.1.2 Previous Energy Conservation Measures

The facility has previously implemented the following energy conservation measures:

- Installation of LED lighting (with some exceptions)
- Installation of an ERV

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)	% of Total Emissions
Electricity	15,014 kWh	4.3	15,014	0.5	9%
Propane	3,239 l	6.6	23,934	5	91%
Total	**N/A**	**10.9**	**38,948**	**5.5**	**100%**

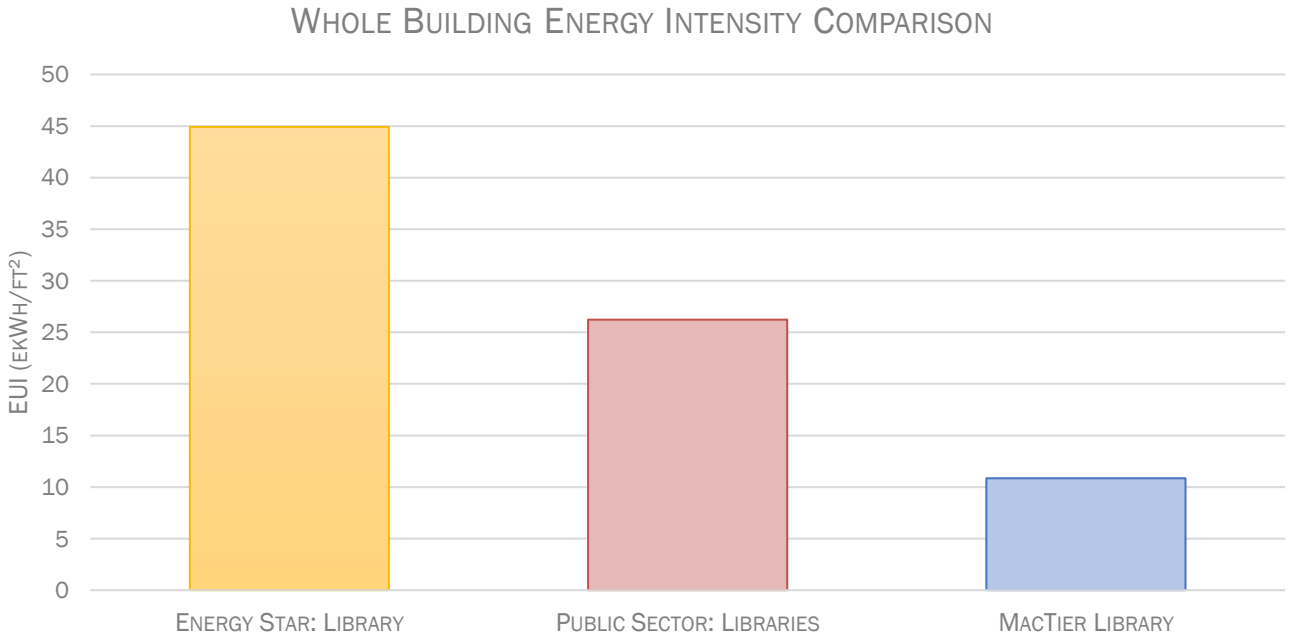
*EUI values presented throughout this report are calculated based on purchased energy and includes electricity provided by the grid, purchased propane etc.

Propane consumption at the facility is responsible for over 91% of GHG emissions at the facility. Propane fired equipment at this facility includes:

- One (1) propane fired rooftop unit used for space heating/cooling & ventilation

Addressing this equipment with a low carbon alternative will be required to achieve either the 50% or 80% GHG reduction target.

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)	Propane (l)	Water (m^3)	GHG Emissions (tCO_2e)	Annual Savings	Project Costs	Cost per tCO_2e	Simple Payback	Capital Payback	NPV	IRR
1	Replace RTU with ASHP RTU & Propane Backup	0	-10,062	3,059	0	4.4	$709	$100,988	$418	142.3	29.0	($37,111)	-3.4%
2	Replace RTU with ASHP RTU & Electric Backup	0	-13,222	3,650	0	5.3	$587	$104,769	$410	178.4	35.0	($43,055)	-5.4%
3	Replace RTU with Electric	0	-18,292	3,650	0	5.1	-$494	$116,432	$709	No Payback	No Payback	($72,389)	No IRR
4	Install Low Flow Washroom Faucets	0	138	0	0	0.0	$29	$600	$1,455	20.4	13.8	($120)	5.0%
5	Replace DHW Heater with Hybrid ASHP Tank Heater	0	122	0	0	0.0	$26	$9,960	$73,648	381.7	44.4	($5,407)	-7.3%
6	Upgrade Lighting to LED	0	1,807	0	0	0.1	$385	$21,902	$14,388	56.8	26.4	($15,603)	-3.6%
7	Install a Building Automation System	0	1,225	194	0	0.3	$443	$47,451	$5,964	107.2	36.6	($40,271)	-8.0%
8	Install Triple Pane Windows	0	116	12	0	0.0	$36	$146,736	$341,412	No Payback	No Payback	($146,158)	No IRR
9	Install EIFS	0	-15	423	0	0.7	$391	$465,165	$35,071	No Payback	No Payback	($458,887)	-21.0%
10	Electrical Service Upgrade	0	0	0	0	0	$0	$105,907	0	No Payback	No Payback	($105,907)	No IRR

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.

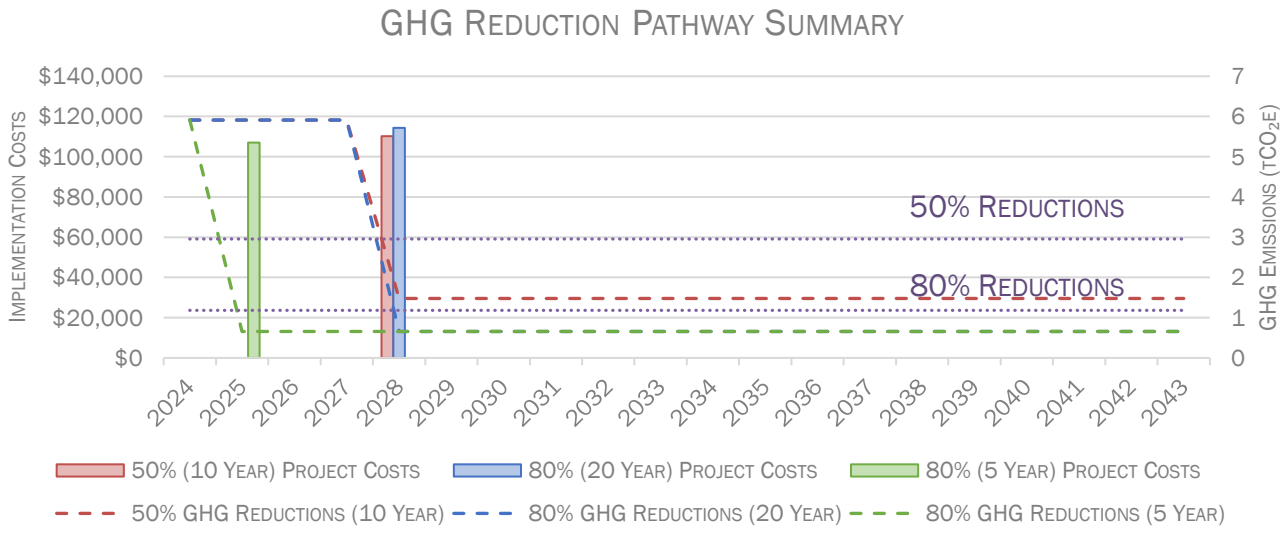
Roadmap 4 – Business-As-Usual

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	Emissions (tCO_2e)	50% Reduction Pathway (10 Year)	80% Reduction Pathway (20 Year)	80% Reduction Pathway (5 Year)
1	Replace RTU with ASHP RTU & Propane Backup	4.4	•		
2	Replace RTU with ASHP RTU & Electric Backup	5.3		•	•
3	Replace RTU with Electric	5.1			
4	Install Low Flow Washroom Faucets	0			
5	Replace DHW Heater with Hybrid ASHP Tank Heater	0			
6	Upgrade Lighting to LED	0.1			
7	Install a Building Automation System	0.3			
8	Install Triple Pane Windows	0			
9	Install EIFS	0.7			
10	Electrical Service Upgrade	0.0		•	•



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 the individual measures. The Scenario Level Analysis accounts for these interactive effects between systems which are not represented in the Measure Level Analysis.

TABLE 1.3.2: REDUCTION PATHWAY SUMMARY OF ENERGY & COSTS

	Reductions				Financials		
GHG Reduction Pathways	**Energy (ekWh)**	**Energy (%)**	**Emissions (tCO_2e)**	**Emissions (%)**	**Annual Savings**	**Project Costs**	**20-Year LC Cost**
50% Reductions (10 Year)	11,627	34%	4.4	75%	$709	$100,988	$171,323
80% Reductions (20 Year)	12,659	37%	5.3	89%	$587	$210,676	$245,319
80% Reductions (5 Year)	12,659	37%	5.3	89%	$587	$210,676	$265,519
Business-As-Usual	$0	0%	$0	0%	$0	$58,594	$113,572

The study compares the costs of implementing multiple options or Pathways against the costs of operating the facility in a "business-as-usual" manner. The Pathways provide options to upgrade HVAC equipment and other energy consuming systems to more efficient options. However, all of the equipment addressed in this study will have to be replaced at some point - if not by more efficient equipment, then by "like-for-like" equipment replacements. By implementing these energy efficiency measures, the "like-for-like" costs are avoided.

Table 1.3.3 presents the financial details of each pathway taking into consideration the incremental costs of implementing energy efficient measures through the GMF program.

TABLE 1.3.3: REDUCTION PATHWAY SUMMARY OF LIFE CYCLE COSTS

	Financials						
Pathway	**Project Costs**	**Potential Grant**	**Avoided Cost**	**Incremental Costs**	**20- Year LC Cost**	**Incremental 20-Year LC Cost**	**Incremental LC Cost per tCO_2e**
50% Reductions in 10 Years	$100,988	$20,198	$58,594	$22,197	$171,323	$57,750	$651
80% Reductions in 20 Years	$210,676	$42,135	$58,594	$109,947	$245,319	$131,747	$1,254
80% Reductions in 5 Years	$210,676	$42,135	$58,594	$109,947	$265,519	$151,947	$1,446
Business-As-Usual	$58,594	$0	$0	$0	$113,572	$0	$0

Limited Liability

This report was prepared by Efficiency Engineering Inc. for the account of the Township of Georgian Bay. 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.

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- Jennifer Schnier, MAES., Director of Sustainability, Township of Georgia Bay

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

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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%

4 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:	MacTier Public Library
Client Name:	Township of Georgian Bay
Site Contact:	Jennifer Schnier
Address:	12 Muskoka Rd
	MacTier, ON
	P0C 1H0
Facility Area:	3,500 ft²
Building Type:	Library
Year Constructed:	2008

4.1 Heating

The building is heated via a single rooftop unit (RTU):

TABLE 4.1.1: HEATING EQUIPMENT DETAILS

Tag ID	Type	Capacity	Efficiency	Condition
RTU1	Propane	125 MBH	80%	Fair

The RTU is original to the building and is approaching its end of service life. Its replacement should be planned and budgeted for.

Ground Mounted RTU

4.2 Cooling

Cooling to the building is provided by onboard DX coils located within the RTU:

TABLE 4.2.1: COOLING EQUIPMENT DETAILS

Tag ID	Comp Type	Capacity	COP	Condition
RTU1	Scroll	5 tons	3.5 (est.)	Fair

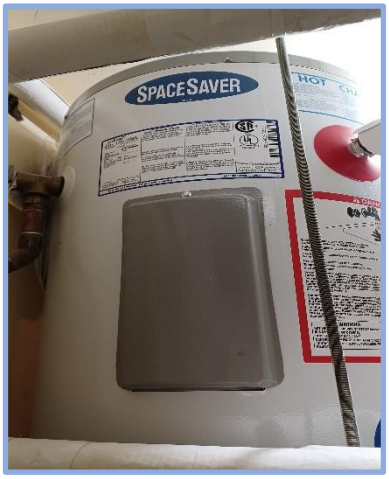
The RTU is original to the building and is approaching its end of service life. Its replacement should be planned and budgeted for.

4.3 Domestic Hot Water

A single electric domestic hot water (DHW) heater tank provides hot water to the facility:

TABLE 4.3.1: DHW EQUIPMENT DETAILS

Tag ID	Boiler Type	Capacity	Efficiency	Condition
DHWHT	Electric	3 kW	100%	Good



Domestic Hot Water Tank

The heater tank stores 19 gallons of hot water until demand 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.

All piping was observed to be properly insulated. The heater tank is estimated to be original to the building and has exceeded its serviceable life. Its replacement should be planned and budgeted for.

4.4 Ventilation

Ventilation is provided to the building via the rooftop unit. Connected to the RTU is an ERV which transfers both sensible and latent heat from the exhaust air stream to the incoming outdoor air stream. The RTU tempers a portion of outdoor air, typically 20% and distributes it to the building.

TABLE 4.4.1: VENTILATION EQUIPMENT DETAILS

Tag ID	Capacity	HP	Airflow	Condition
RTU	125 MBH	1.5	1,500 CFM (est.)	Fair


Building Envelope

The RTU is original to the building and is approaching its end of service life. Its replacement should be planned and budgeted for.

4.5 Building Envelope

The facility was constructed in 2008 with a wood paneled façade. The roof is a wood frame construction with fiberglass insulation and an asphalt shingle finish. 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.

As the building is 16 years old, there has been minimal wear and tear on the envelope. The windows seals were noted to be in good condition and the exterior doors were observed to have weather stripping. The roof was noted to be in overall good condition, although some damage to asphalt shingles was observed.

4.6 Water Fixtures

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

TABLE 4.6.1: WATER FIXTURE DETAILS

Fixture	Flow
Bathroom Faucets:	2.2 GPM
Kitchen Faucets:	2.5 GPM
Toilets:	1.6 GPF

2.2 GPM Washroom Faucet

4.7 Lighting

Lighting in the facility generally consists of T8 fluorescent and LED retrofit lamps. All lighting is controlled by wall switches or circuit breakers.

TABLE 4.7.1: INTERIOR LIGHTING DETAILS

Lamp Type	Wattage	Location
T8 Fluorescent	32 W	Offices, library, entrance vestibule
LED A19	9 W	Mech rm, library

4.7.1 Exterior Lighting

Exterior lighting consists of pot lights located around the building. All exterior lighting is controlled by timers.

TABLE 4.7.2: EXTERIOR LIGHTING DETAILS

Fixture Type	Lamp Type	Wattage
Pot Lights	LED A19	9 W

4.8 Controls

The building is not equipped with a building automation system (BAS). Instead, the rooftop unit (RTU) operates on its own on-board controls which are connected to numerous thermostats inside the building.

4.9 Electrical Service

Within the buildings electrical room is the main disconnect for the facility which is rated at 200A.

No metered demand data was available at the time of this study. The calibrated energy model estimates the facility's peak electrical demand at 6-kW.

The facility's monthly base demand as well as the peak summer and peak winter demand based on the calibrated energy model are as follows:

Average Monthly Base Demand (kW)	Peak Summer Demand (kW)	Peak Winter Demand (kW)
3.5	6.1	3.5

5 The Energy Usage Report

5.1 Utility Meters

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

TABLE 5.1.1: UTILITY METER DETAILS

Utility	Units	Escalation Rate	Marginal Rate ($/Unit)	GHG Emissions (Tonnes/Unit)
Demand	kW	6.0%	N/A	0.000000
Electricity	kW	5.2%	$0.21328	0.000030
Propane	l	5.0%	$0.9334	0.001548
Water	m^3	3.0%	$4.7748	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.

5.2 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.

5.3 Meter Modeling

Daily mean temperatures from Barrie-Oro (WMO ID 71314) were used in creating the baseline models for this facility.

5.3.1 Demand

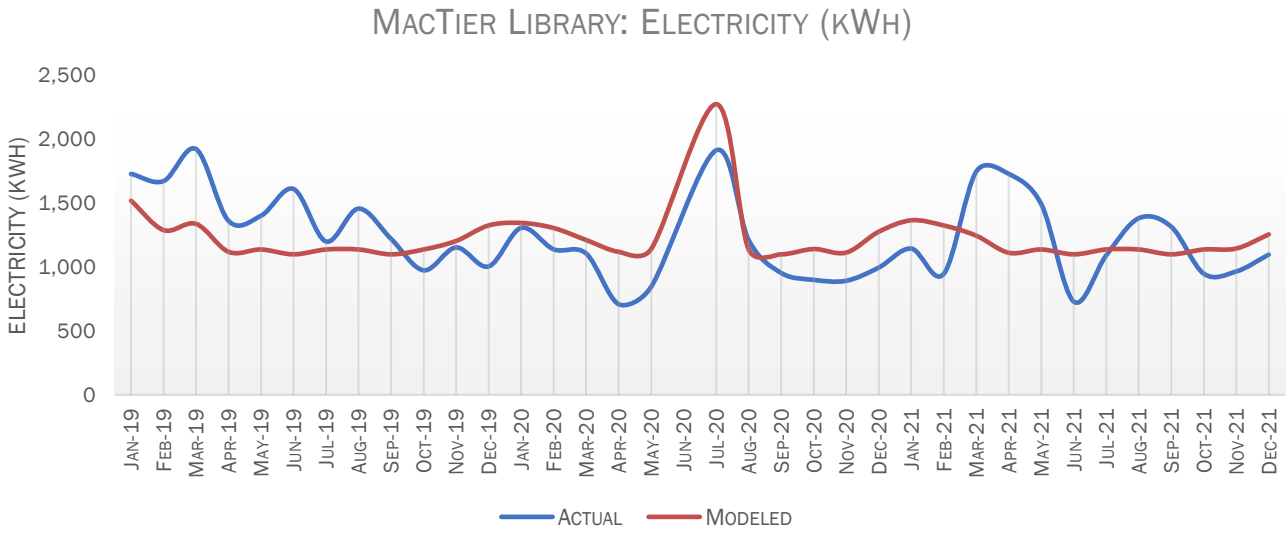
Demand data was not available during the time of this report.

5.3.2 Electricity

Baseline Equation:

Electricity (kWh) = Days x 37.94 + HDD x 1.16.
The underlying regression of this baseline equation is $R^2 = 0.9421$.
HDD (Heating Degree Days) calculated using a balance point of 1°C.
In a typical year, consumption will be 15,014 kWh.

Modeling Graphs:



Rate Structure:

Electricity for this building is provided by Hydro One. It is classified as a General Service account. 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:

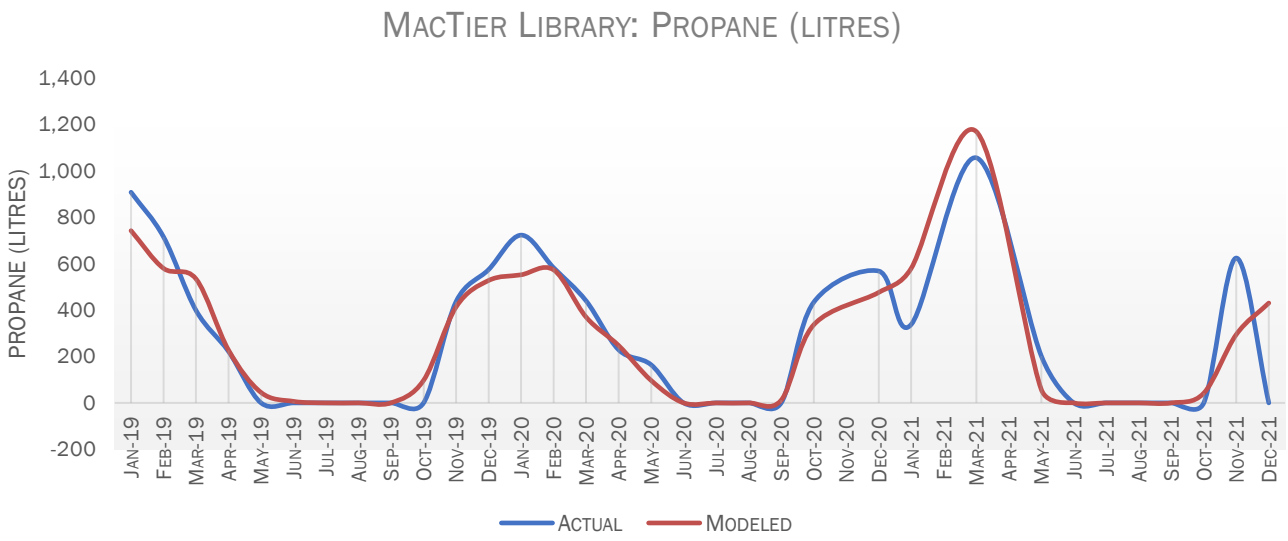
No anomalies or irregularities were noted during the modeling period of this report.

5.3.3 Propane

Baseline Equation:

Propane (litres) = Days x 0 + HDD x 1.24.
The underlying regression of this baseline equation is R^2 = 0.8993.
HDD (Heating Degree Days) calculated using a balance point of 10°C.
In a typical year, consumption will be 3,239 litres.

Modeling Graphs:



Rate Structure:

Propane for the facility is purchased and delivered by the Township's fuel provider,

Comments:

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

5.3.4 Water

Water data was not available during the time of this report.

5.4 Building Energy Performance

The following section provides benchmarking information for the facility.

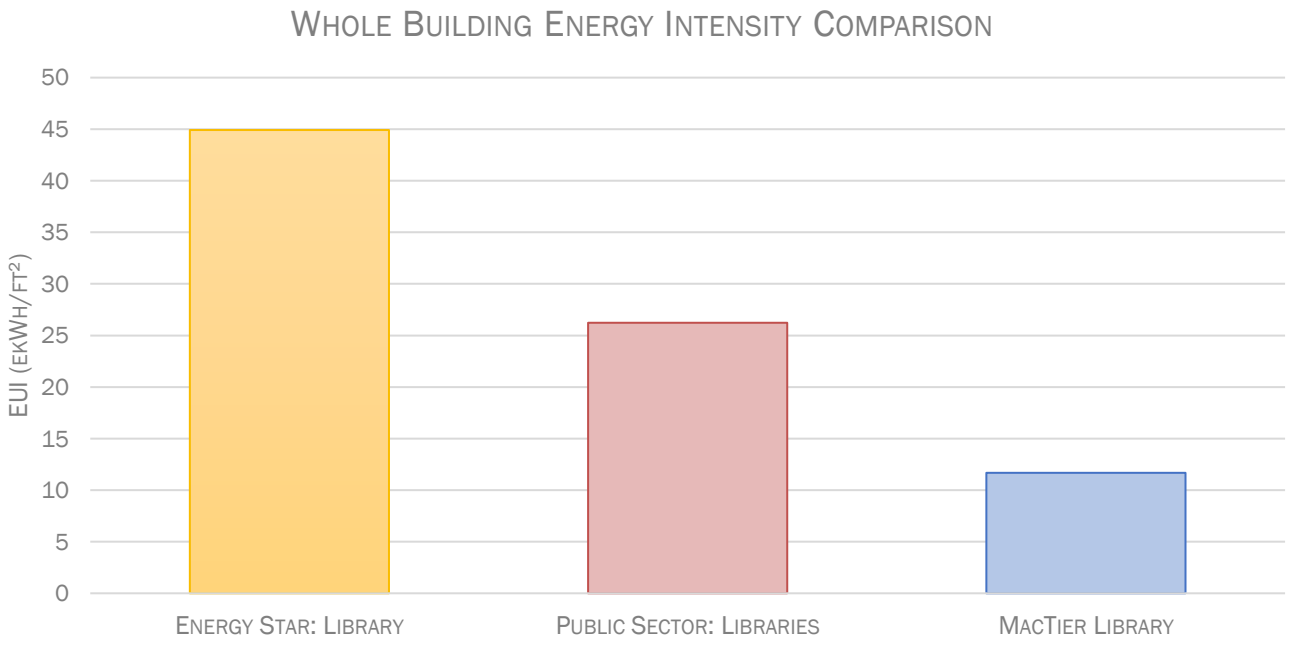
Electricity intensity for the building is 4.3 ekWh/ft² (0.17 GJ/m²). Propane intensity for the building is 7.4 ekWh/ft² (0.45 GJ/m²). Total energy intensity for the building is 11.7 ekWh/ft² (0.45 GJ/m²).

The energy performance of the MacTier Public Library 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
Energy Star: Library	44.9	-76%
Public Sector: Libraries	26.2	-59%
MacTier Library	**11.7**	

*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 the MacTier Public Library is low.

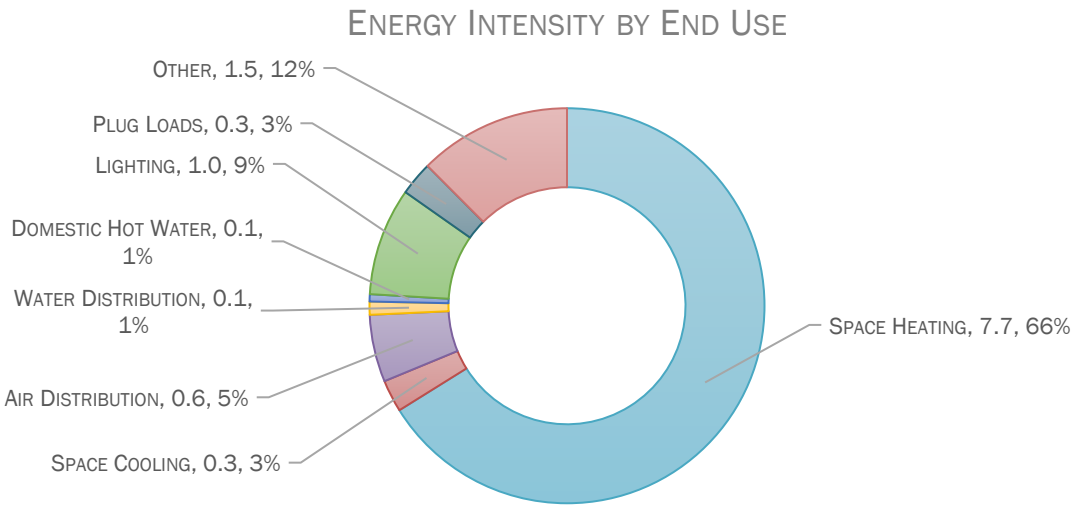
5.5 Energy Breakout by End Use

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:

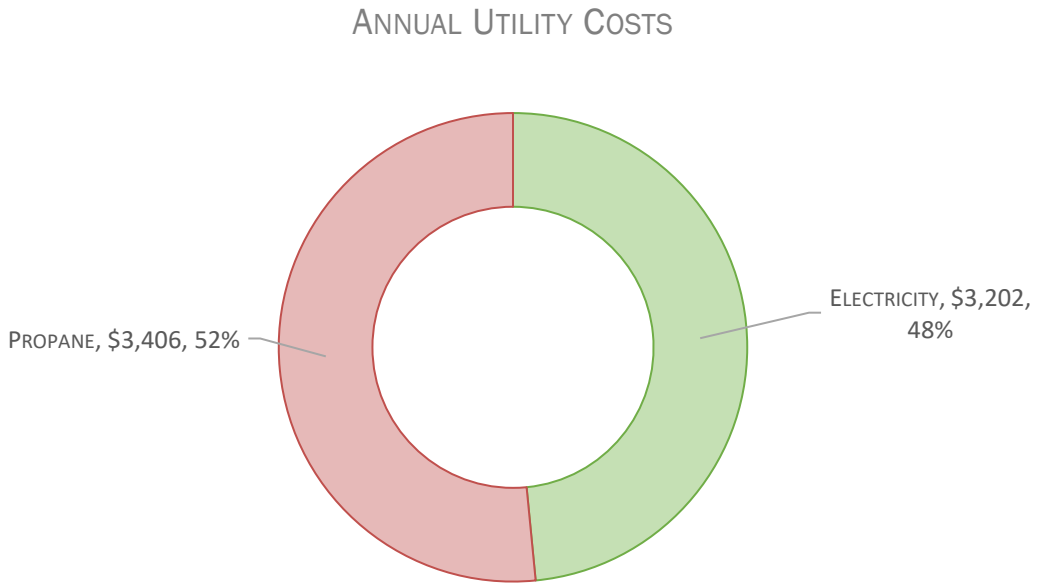
End Use	Electricity (kWh)	Propane (l)	EUI (ekWh/ft²)	GHG Emissions (Tonnes)
Space Heating	1,165	3,649	7.7	5.7
Space Cooling	1,079	0	0.3	0.0
Air Distribution	2,249	0	0.6	0.1
Water Distribution	439	0	0.1	0.0
Domestic Hot Water	245	0	0.1	0.0
Lighting	3,605	0	1.0	0.1
Plug Loads	1,132	0	0.3	0.0
Other	5,101	0	1.5	0.2
Total	**15,014**	**3,649**	**11.7**	**6.1**

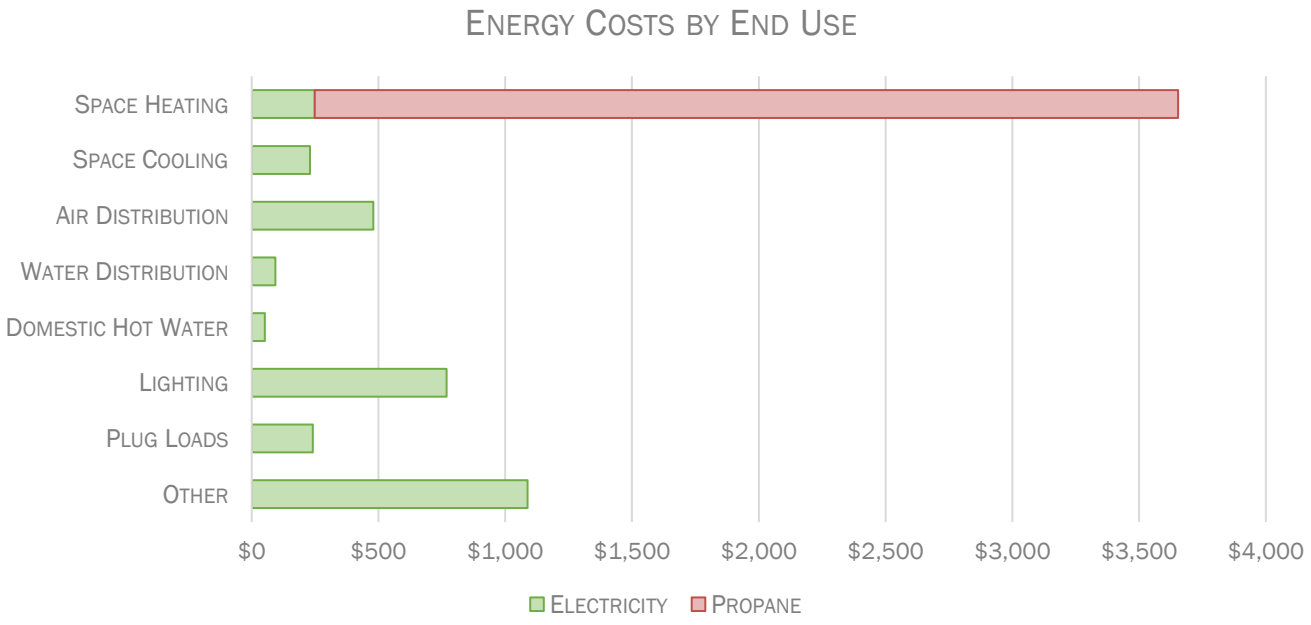
The following chart shows the energy intensity of MacTier Public Library broken out by end use.



5.6 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:





6 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.

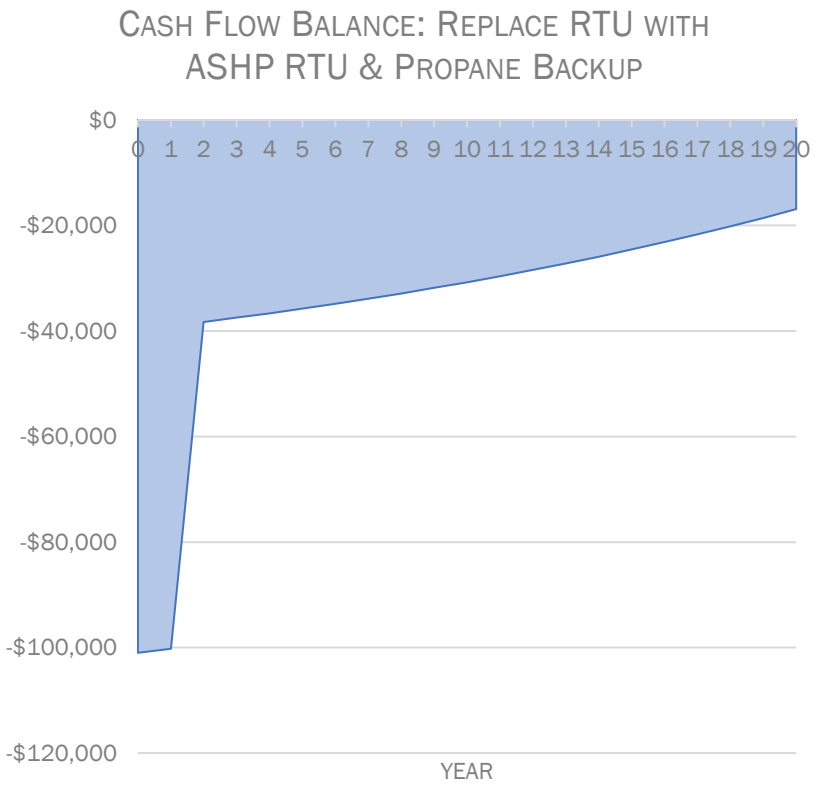
6.1 Opportunity 1: Replace RTU with ASHP RTU & Propane Backup

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: DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	0
Electricity (kWh):	-10,062
Propane (l):	3,059
Water (m^3):	0
Emissions (tCO_2e):	4.4
Financials	
Utility Savings:	$709
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$80,791
Engineering & PM:	$12,119
Contingency:	$8,079
Project Costs:	$100,988
Simple Payback:	142.3
Capital Payback:	29.0
NPV:	-$37,111
IRR:	-3.4%



Existing Conditions

The building is heated via a single rooftop unit (RTU):

Tag ID	Type	Capacity	Efficiency	Condition
RTU1	Propane	125 MBH	80%	Fair

The RTU is original to the building and is approaching its end of service life. Its replacement should be planned and budgeted for.

Retrofit Conditions

This measure includes replacing the existing propane fired rooftop unit with an air source heat pump rooftop unit equipped with propane fired backup heat.

The rooftop unit will be replaced by ASHP rooftop unit sized to the cooling capacity of the existing unit. This minimizes the demand impact of the new equipment and allows for implementation without the need to upgrade the building's electrical service. The 5-ton rooftop unit will be replaced with 5-ton ASHP rooftop unit. Backup heating will be sized to match the existing heating capacity.

Typical Dual Fuel Heat Pump Rooftop Unit

Rather than generating heat, heat pumps primarily operate by transferring heat from one medium (the source) to another (the load). In heating mode, air source heat pumps extract heat from the atmosphere (the source) and transfer it to the occupied space within the building (the load). Since the heat pump is not actually generating the heat, just transferring it, they're able to supply heating energy much more efficiently than propane fired equipment.

As outdoor temperatures drop below the operating envelope of the air source heat pumps, an alternate or backup source of heat must be used. When outdoor temperatures fall below the operating temperature of the units, propane fired backup heating will carry the heating load. Analysis shows that sizing the units based on the above strategy would offset approximately 84% of the propane consumption of the existing rooftop units.

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.

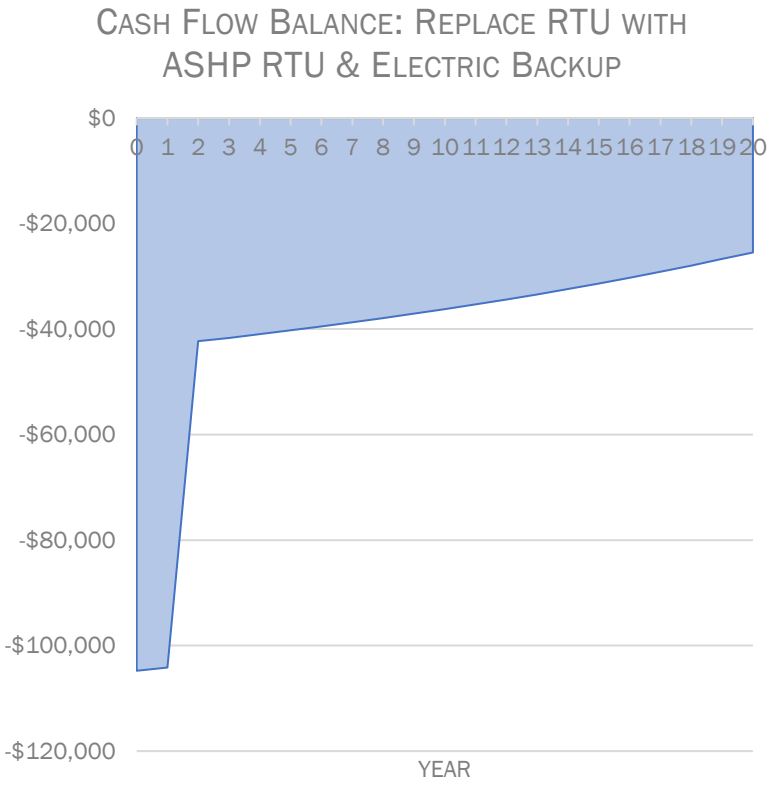
6.2 Opportunity 2: Replace RTU with ASHP RTU & Electric Backup

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 6.2.1: DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	0
Electricity (kWh):	-13,222
Propane (l):	3,650
Water (m^3):	0
Emissions (tCO_2e):	5.3
Financials	
Utility Savings:	$587
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$83,815
Engineering & PM:	$12,572
Contingency:	$8,382
Project Costs:	$104,769
Simple Payback:	178.4
Capital Payback:	35.0
NPV:	-$43,055
IRR:	-5.4%



Existing Conditions

The building is heated via a single rooftop unit (RTU):

Tag ID	Type	Capacity	Efficiency	Condition
RTU1	Propane	125 MBH	80%	Fair

The RTU is original to the building and is approaching its end of service life. Its replacement should be planned and budgeted for.

Retrofit Conditions

This measure includes replacing the existing propane fired rooftop unit with an air source heat pump rooftop unit equipped with electric backup heat.

Typical Dual Fuel Heat Pump Rooftop Unit

The rooftop units will be replaced by ASHP rooftop units sized to the cooling capacity of the existing units. The 5-ton rooftop unit will be replaced with 5-ton ASHP rooftop unit. Backup electric heating will be sized to match the existing heating capacity.

Rather than generating heat, heat pumps primarily operate by transferring heat from one medium (the source) to another (the load). In heating mode, air source heat pumps extract heat from the atmosphere (the source) and transfer it to the occupied space within the building (the load). Since the heat pump is not actually generating the heat, just transferring it, they're able to supply heating energy much more efficiently than propane fired equipment.

As outdoor temperatures drop below the operating envelope of the air source heat pumps, an alternate or backup source of heat must be used. When outdoor temperatures fall below the operating temperature of the units, electric resistance heating will carry the heating load thereby offsetting 100% of the propane consumed by the existing rooftop units.

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.

7 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. Opportunities that fall within this category also are not required to hit GHG reduction targets and/or were asked to be removed from both of the scenarios presented within this report at the request of the client.

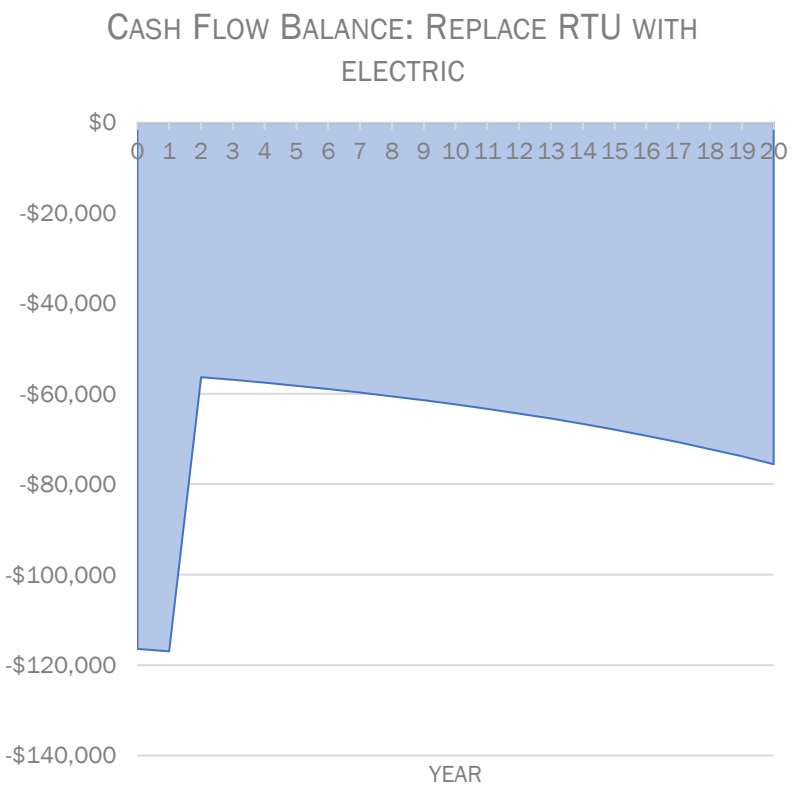
7.1 Opportunity 3: Replace RTU with Electric

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 7.1.1: DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	0
Electricity (kWh):	-18,292
Propane (l):	3,650
Water (m^3):	0
Emissions (tCO_2e):	5.1
Financials	
Utility Savings:	-$494
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$93,145
Engineering & PM:	$13,972
Contingency:	$9,315
Project Costs:	$116,432
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$72,389
IRR:	No IRR



Existing Conditions

The building is heated via a single rooftop unit (RTU):

Tag ID	Type	Capacity	Efficiency	Condition
RTU1	Propane	125 MBH	80%	Fair

The RTU is original to the building and is approaching its end of service life. Its replacement should be planned and budgeted for.

Retrofit Conditions

This measure includes replacing the existing propane fired rooftop unit with a rooftop unit equipped with electric resistance heating & DX cooling. The unit would be sized to the nominal heating & cooling capacities of the existing rooftop units.

The average weight of newer/more efficient rooftop units is typically slightly higher than that for standard rooftop units when comparing similar capacities. .

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

This measure was not at this time due to poorer financial results when compare to either the ASHP RTU with Propane Backup or ASHP RTU with Electric Backup options.

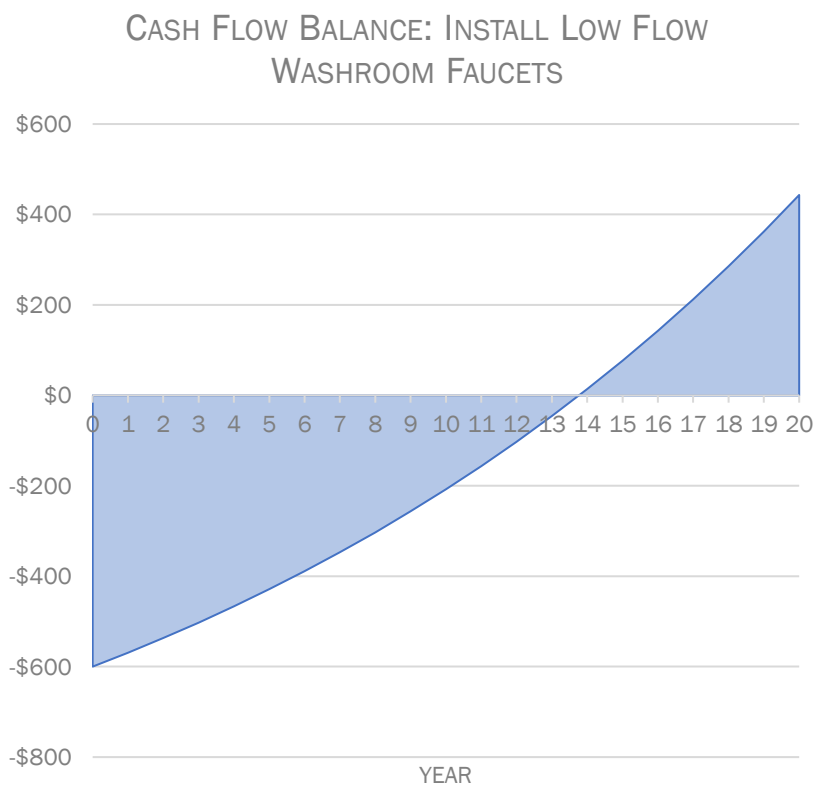
7.2 Opportunity 4: Install Low Flow Washroom Faucets

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 7.2.1: DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	0
Electricity (kWh):	138
Propane (l):	0
Water (m^3):	0
Emissions (tCO_2e):	0
Financials	
Utility Savings:	$29
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$480
Engineering & PM:	$72
Contingency:	$48
Project Costs:	$600
Simple Payback:	20.4
Capital Payback:	13.8
NPV:	-$120
IRR:	5.0%



Existing Conditions

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

WATER FIXTURE DETAILS:

Fixture	Flow
Bathroom Faucets:	2.2 GPM

Retrofit Conditions

We recommend installing new low-flow (0.5 GPM) faucets at the facility. These fixtures perform similarly to standard flow units but consume considerably less water and hot water resulting in significant utility savings and GHG reductions.

While it is possible (and less expensive) to install low flow aerators on the existing fixtures, aerators are easily removed or damaged, resulting in reduced savings.

Only well reviewed products from quality manufacturers should be installed. Quality fixtures will result in greater user satisfaction and reduce the risk of complaints and fixture replacement by occupants.

This measure was not recommended at this time due to its poor financial performance, additionally the GHG emissions savings generated from this measure were not required to hit either the 50% or 80% target.

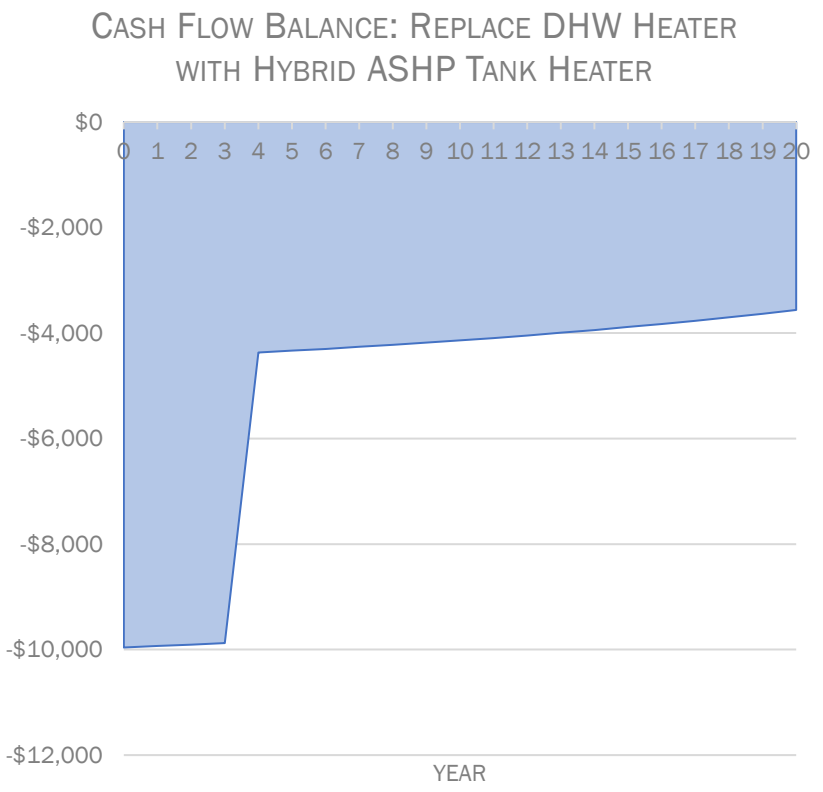
7.3 Opportunity 5: Replace DHW Heater with Hybrid ASHP Tank Heater

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 7.3.1: DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	0
Electricity (kWh):	122
Propane (l):	0
Water (m³):	0
Emissions (tCO_2e):	0.0
Financials	
Utility Savings:	$26
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$7,968
Engineering & PM:	$1,195
Contingency:	$797
Project Costs:	$9,960
Simple Payback:	381.7
Capital Payback:	44.4
NPV:	-$5,407
IRR:	-7.3%



Existing Conditions

A single electric domestic hot water (DHW) heater tank provides hot water to the facility:

DHW EQUIPMENT DETAILS:

Tag ID	Boiler Type	Capacity	Efficiency	Condition
DHWHT	Electric	3 kW	100%	Good

Retrofit Conditions

The existing electric DHW heater can be replaced with residential style “hybrid” ASHP tank heater.

Multiple manufacturers currently offer residential and light commercial hybrid domestic hot water tanks which utilize a combination of an air source heat pump and electric resistance heating. The air source heat pump operates at a low capacity over longer durations of time to slowly increase or maintain tank temperatures. During times of high loads, the electric resistance heater cycles on to carry the peak loads.

Typical Hybrid ASHP/Electric Tank Heater

This measure includes demolition and removal of the existing electric tank heater. A new hybrid tank heater would be installed in the location of the existing equipment.

This measure was not recommended at this time due to its poor financial performance, additionally the GHG emissions savings generated from this measure were not required to hit either the 50% or 80% target.

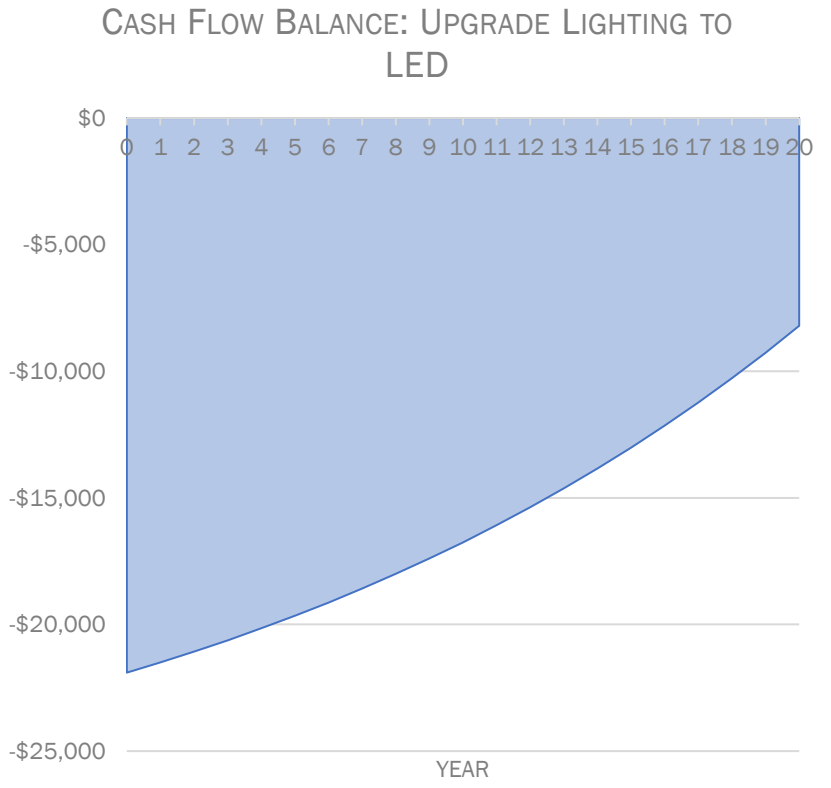
7.4 Opportunity 6: Upgrade Lighting to LED

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 7.4.1: DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	0
Electricity (kWh):	1,807
Propane (l):	0
Water (m^3):	0
Emissions (tCO_2e):	0.1
Financials	
Utility Savings:	$385
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$17,522
Engineering & PM:	$2,628
Contingency:	$1,752
Project Costs:	$21,902
Simple Payback:	56.8
Capital Payback:	26.4
NPV:	-$15,603
IRR:	-3.6%



Existing Conditions

Lighting in the facility generally consists of T8 fluorescent and LED retrofit lamps. All lighting is controlled by wall switches or circuit breakers.

INTERIOR LIGHTING DETAILS:

Lamp Type	Wattage	Location
T8 Fluorescent	32 W	Offices, library, entrance vestibule

Retrofit Conditions

We recommend replacing all interior fluorescent fixtures with equivalent LED fixtures.

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” “flash lights” 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.

This measure was not recommended at this time due to its poor financial performance, additionally the GHG emissions savings generated from this measure were not required to hit either the 50% or 80% target.

However, it is recommended that lamps be retrofitted with LED equivalents as they burn out.

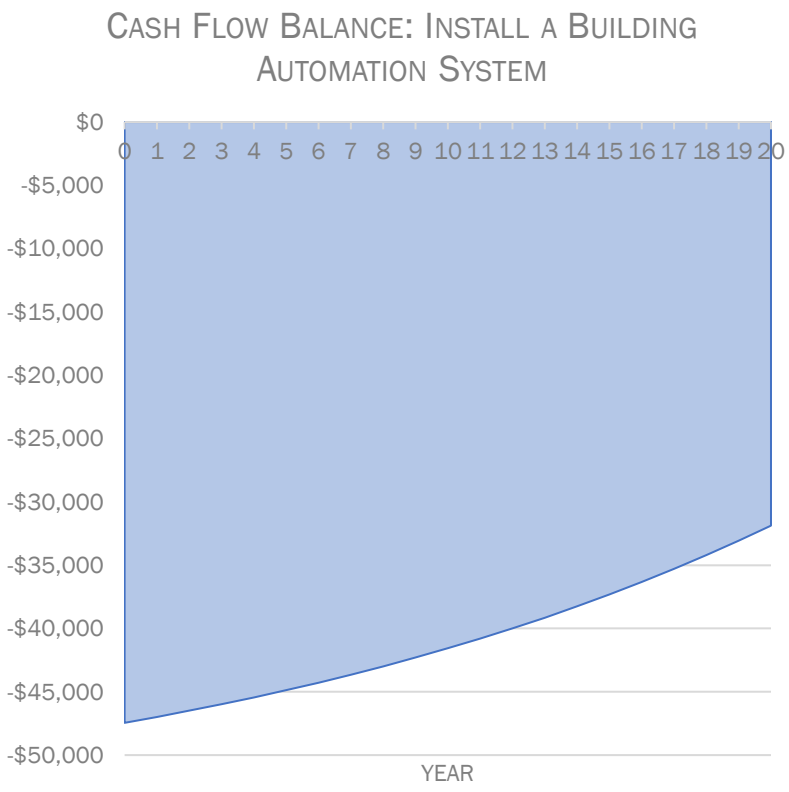
7.5 Opportunity 7: Install a Building Automation System

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 7.5.1: DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	0
Electricity (kWh):	1,225
Propane (l):	194
Water (m^3):	0
Emissions (tCO_2e):	0.3
Financials	
Utility Savings:	$443
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$37,961
Engineering & PM:	$5,694
Contingency:	$3,796
Project Costs:	$47,451
Simple Payback:	107.2
Capital Payback:	36.6
NPV:	-$40,271
IRR:	-8.0%



Existing Conditions

The building is not equipped with a building automation system (BAS). Instead, the rooftop unit (RTU) operates on its own on-board controls which are connected to numerous thermostats inside the building.

Retrofit Conditions

Building automation systems (BAS) can be thought of as computer networks, with miniature computers controlling the important pieces of mechanical equipment within a given facility. These computers talk to each other through the network to enable interaction with one another according to central control logic and to allow central oversight and centrally managed features.

A building automation system (BAS) could be installed at the facility and programmed to operate the major HVAC and lighting systems at the facility. The system would be programmed at the time of installation according to energy-conserving strategies specified by the design engineer.

BAS systems can include many safety and convenience features such as full graphic terminal operation, remote access via internet, dial out/e-mail of alarms, security monitoring, and trending of energy and equipment data. To get all the features of a full BAS system can be quite expensive, however it is possible to start small and expand the control network over time. For the purpose of this study, we are recommending the most cost-effective approach, which is the installation of a BAS system intended to save energy. Further components can be added at a later date.

The cost of a system is closely tied to the number of control "points": physical input and output devices such as temperature sensors and relays. Costing for this measure includes points to enable the BAS to control the following:

- One heating/cooling rooftop unit

The BAS will allow for the following improvements to equipment control:

- Schedule heating and cooling setback temperatures during unoccupied hours
- Schedule ventilation rates to ensure building is not over-ventilated during unoccupied hours
- Turn fans (RTUs & exhaust) off during unoccupied hours (unless called for heating or cooling)
- Lock out cooling during unoccupied hours
- Lock out simultaneous heating and cooling

BAS systems can include many safety and convenience features such as full graphic terminal operation, remote access via phone line, ethernet LANs, WANs, internet, intranet for alarms, security monitoring, and trending of energy and equipment data.

This measure was not recommended at this time due to its poor financial performance, additionally the GHG emissions savings generated from this measure were not required to hit either the 50% or 80% target.

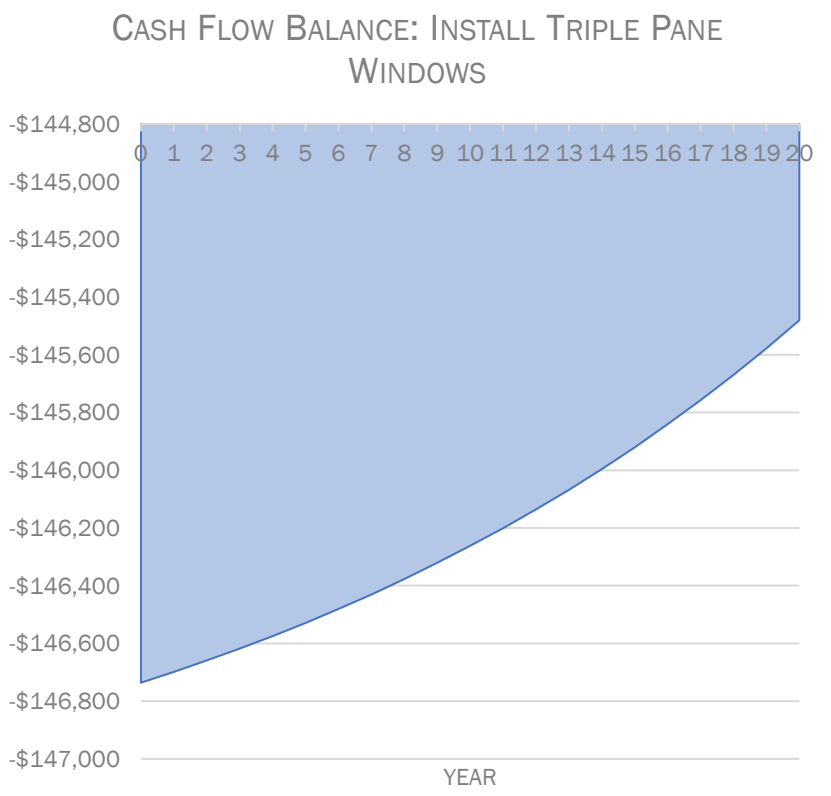
7.6 Opportunity 8: Install Triple Pane Windows

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 7.6.1: DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	0
Electricity (kWh):	116
Propane (l):	12
Water (m³):	0
Emissions (tCO_2e):	0
Financials	
Utility Savings:	$36
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$117,389
Engineering & PM:	$17,608
Contingency:	$11,739
Project Costs:	$146,736
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$146,158
IRR:	No IRR



Existing Conditions

Visual inspection showed that caulking around the windows was in fair condition. The windows are approaching the 16-year mark, and the windows insulation characteristics are not what they used to be.

Retrofit Conditions

We recommend that the windows be replaced with triple glaze, argon filled windows. Window frames should be made of thermally broken aluminum or 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. Specify argon-filled windows with a low-emissivity interior coating to block some of the summer radiant heat gain.

This measure was not recommended at this time due to its poor financial performance, additionally the GHG emissions savings generated from this measure were not required to hit either the 50% or 80% target.

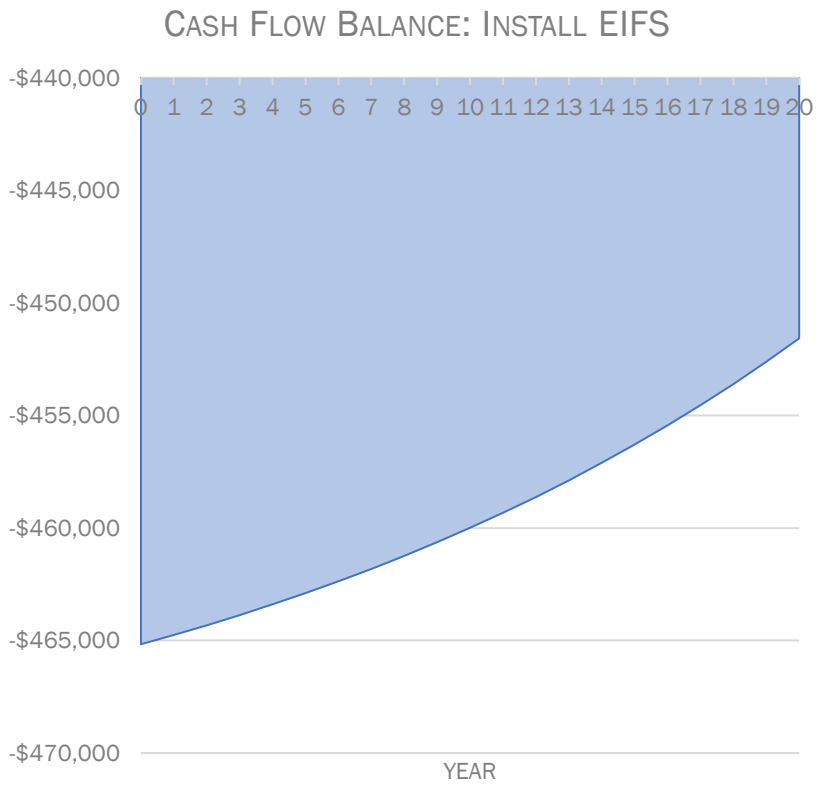
7.7 Opportunity 9: Install EIFS

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 7.7.1: DETAILED FINANCIAL ANALYSIS

Utility Savings	
Demand (kW):	0
Electricity (kWh):	-15
Propane (l):	423
Water (m³):	0
Emissions (tCO_2e):	0.7
Financials	
Utility Savings:	$391
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$372,132
Engineering & PM:	$55,820
Contingency:	$37,213
Project Costs:	$465,165
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$458,887
IRR:	-21.0%



Existing Conditions

The exterior wall structure of the building is a wood paneled façade overtop structural wood framing and wood sheathing. Building drawings were not made available, however due to the age of the building it is estimated that the walls have a total R value of 16. While this is considered an acceptable amount of insulation in the past, it can be improved upon.

Retrofit Conditions

We recommend installing an exterior insulation and finish system (EIFS) on the exterior walls of the building. 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 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 no impact on occupancy comfort or safety.

This measure was not recommended at this time due to its poor financial performance, additionally the GHG emissions savings generated from this measure were not required to hit either the 50% or 80% target.

8 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

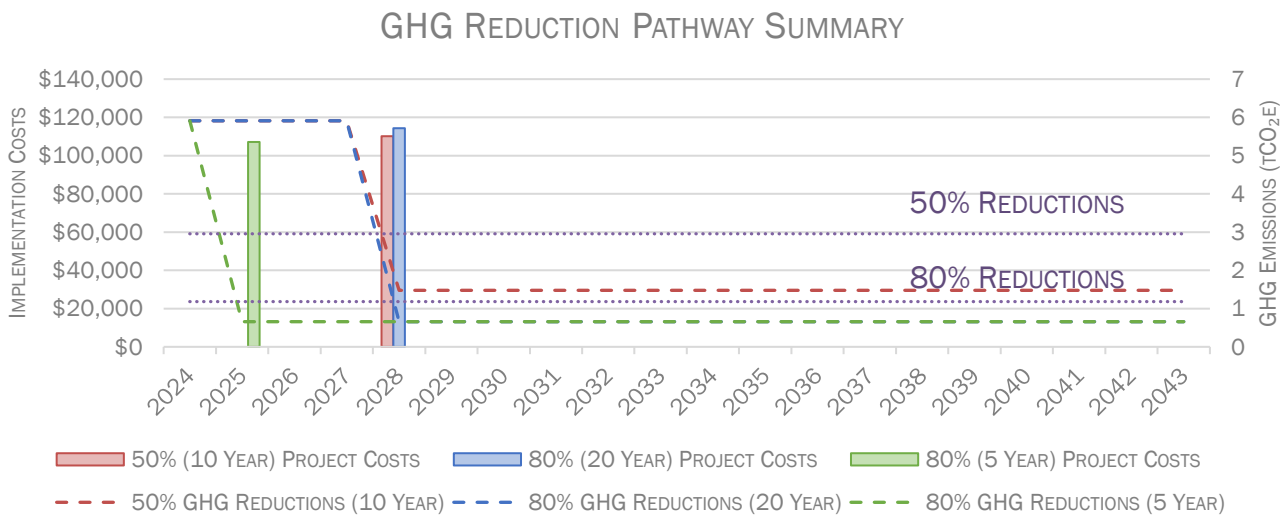
8.1 GHG Reduction Pathway Summary

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

Opp. #	Opportunity	Emissions (tCO_2e)	50% Reduction Pathway (10 Year)	80% Reduction Pathway (20 Year)	80% Reduction Pathway (5 Year)
1	Replace RTU with ASHP RTU & Propane Backup	4.4	•		
2	Replace RTU with ASHP RTU & Electric Backup	5.3		•	•
3	Replace RTU with Electric	5.1			
4	Install Low Flow Washroom Faucets	0			
5	Replace DHW Heater with Hybrid ASHP Tank Heater	0			
6	Upgrade Lighting to LED	0.1			
7	Install a Building Automation System	0.3			
8	Install Triple Pane Windows	0			
9	Install EIFS	0.7			
10	Electrical Service Upgrade	0.0		•	•

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.

	Reductions				Financials		
GHG Reduction Pathways	**Energy (ekWh)**	**Energy (%)**	**Emissions (tCO_2e)**	**Emissions (%)**	**Annual Savings**	**Project Costs**	**20-Year LC Cost**
50% Reductions (10 Year)	11,627	34%	4.4	75%	$709	$100,988	$171,323
80% Reductions (20 Year)	12,659	37%	5.3	89%	$587	$210,676	$245,319
80% Reductions (5 Year)	12,659	37%	5.3	89%	$587	$210,676	$265,519
Business-As-Usual	$0	0%	$0	0%	$0	$58,594	$113,572



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.

Financials							
Pathway	**Project Costs**	**Potential Grant**	**Avoided Cost**	**Incremental Costs**	**20- Year LC Cost**	**Incremental 20-Year LC Cost**	**Incremental LC Cost per tCO_2e**
50% Reductions in 10 Years	$100,988	$20,198	$58,594	$22,197	$171,323	$57,750	$651
80% Reductions in 20 Years	$210,676	$42,135	$58,594	$109,947	$245,319	$131,747	$1,254
80% Reductions in 5 Years	$210,676	$42,135	$58,594	$109,947	$265,519	$151,947	$1,446
Business-As-Usual	$58,594	$0	$0	$0	$113,572	$0	$0

8.2 Demand Impact Summary

A major component of achieving net-zero carbon is fuel switching from propane to a fuel source that emits comparatively less emissions, such as electricity. However, converting most or all of a building's HVAC systems from propane-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.

According to the utility bills, the facility's existing 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)
3.5	6.1	3.5

The site is supplied by a main disconnect for the facility which is rated at 200A. The site has approximately 57 kW of total electrical capacity. The demand impact of each reduction pathway are summarized in the table below.

Pathway	Demand Increase (kW)	Demand Upgrade Costs
50% Reductions in 10 Years	0	$0
80% Reductions in 20 Years	28	$105,907
80% Reductions in 5 Years	28	$105,907

The costs of upgrading electrical distribution to support the implementation of a measure (wiring, conduit, circuit breakers, etc.) are already included in each measure's project costs. 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.

APPENDIX A

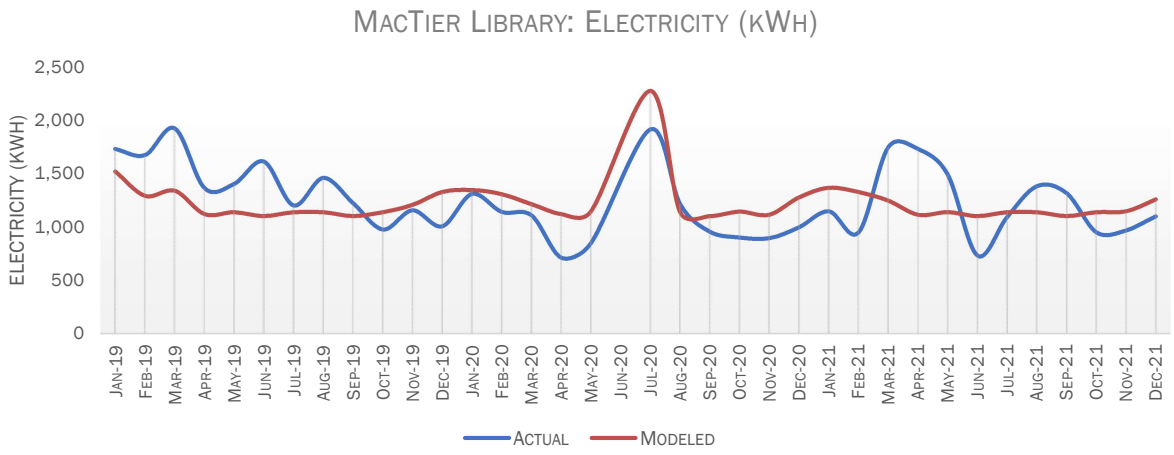
UTILITY BILL ANALYSIS

MacTier Library: Electricity (kWh)

	1	2				
M02	Days	HDD	CDD	IV1	IV2	IV3
Dependent?:	Yes	Yes	No	No	No	No
Balance Point:	N/A	1		N/A	N/A	N/A
Calculated BP:	N/A	1	25	N/A	N/A	N/A
Coefficient:	37.94	1.16	0.00	0.00	0.00	0.00
T-Stat:	18.75	2.11	0.00	0.00	0.00	0.00
Adj R^2:	**0.9421**					

Electricity (kWh) = Days x 37.94 + HDD x 1.16.
The underlying regression of this baseline equation is R^2 = 0.9421.
HDD (Heating Degree Days) calculated using a balance point of 1°C.
CDD (Cooling Degree Days) calculated using a balance point of °C.
In a typical year, consumption will be 15,014 kWh.

M02Base	13,849	13,849
M02Winter	1,165	1,165
M02Summer	0	0
M02Total	15,014	15,014
		1



	Include in Model?	Start Date	Read Date	Electricity (kWh)	IV1	IV2	IV3	Month Allocation
1	Yes	1-Jan-19	31-Jan-19	1,730				Jan-19
2	Yes	1-Feb-19	28-Feb-19	1,674				Feb-19
3	Yes	1-Mar-19	31-Mar-19	1,924				Mar-19
4	Yes	1-Apr-19	30-Apr-19	1,362				Apr-19
5	Yes	1-May-19	31-May-19	1,403				May-19
6	Yes	1-Jun-19	30-Jun-19	1,612				Jun-19
7	Yes	1-Jul-19	31-Jul-19	1,201				Jul-19
8	Yes	1-Aug-19	31-Aug-19	1,458				Aug-19
9	Yes	1-Sep-19	30-Sep-19	1,221				Sep-19
10	Yes	1-Oct-19	31-Oct-19	975				Oct-19
11	Yes	1-Nov-19	30-Nov-19	1,154				Nov-19
12	Yes	1-Dec-19	31-Dec-19	1,005				Dec-19
13	Yes	1-Jan-20	31-Jan-20	1,307				Jan-20
14	Yes	1-Feb-20	29-Feb-20	1,140				Feb-20
15	Yes	1-Mar-20	31-Mar-20	1,107				Mar-20
16	Yes	1-Apr-20	30-Apr-20	709				Apr-20
17	Yes	1-May-20	31-May-20	846				May-20
18	Yes	1-Jun-20	31-Jul-20	1,915				Jul-20
	No	1-Jul-20	31-Jul-20	0				Jul-20
19	Yes	1-Aug-20	31-Aug-20	1,211				Aug-20
20	Yes	1-Sep-20	30-Sep-20	955				Sep-20
21	Yes	1-Oct-20	31-Oct-20	900				Oct-20
22	Yes	1-Nov-20	30-Nov-20	893				Nov-20
23	Yes	1-Dec-20	31-Dec-20	996				Dec-20
24	Yes	1-Jan-21	31-Jan-21	1,145				Jan-21
25	Yes	1-Feb-21	28-Feb-21	947				Feb-21
26	Yes	1-Mar-21	31-Mar-21	1,748				Mar-21
27	Yes	1-Apr-21	30-Apr-21	1,730				Apr-21
28	Yes	1-May-21	31-May-21	1,494				May-21
29	Yes	1-Jun-21	30-Jun-21	731				Jun-21
30	Yes	1-Jul-21	31-Jul-21	1,093				Jul-21
31	Yes	1-Aug-21	31-Aug-21	1,383				Aug-21
32	Yes	1-Sep-21	30-Sep-21	1,316				Sep-21
33	Yes	1-Oct-21	31-Oct-21	948				Oct-21
34	Yes	1-Nov-21	30-Nov-21	966				Nov-21
35	Yes	1-Dec-21	31-Dec-21	1,098				Dec-21

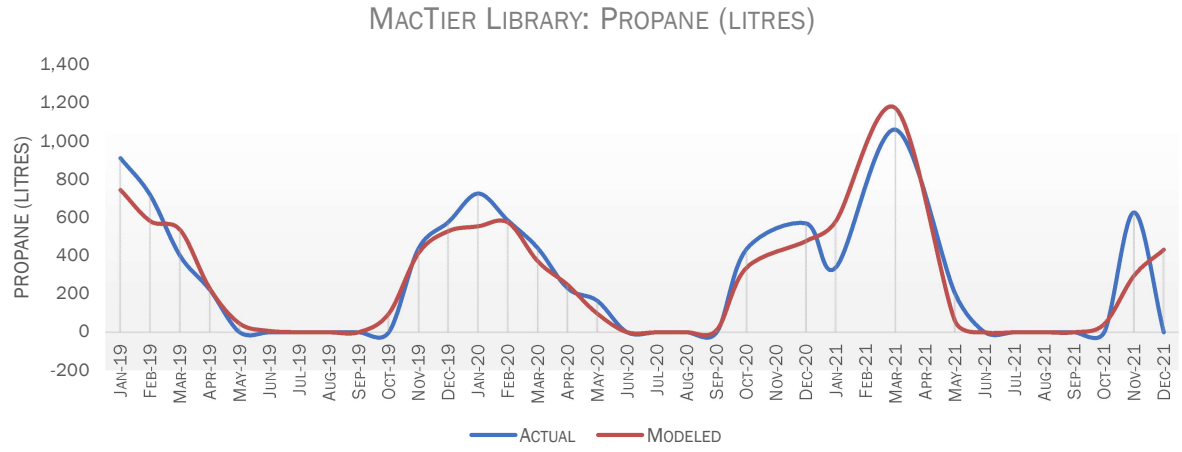
MacTier Library: Propane (litres)

1

M03	Days	HDD	CDD	IV1	IV2	IV3
Dependent?:	No	Yes	No	No	No	No
Balance Point:	N/A	10		N/A	N/A	N/A
Calculated BP:	N/A	1		N/A	N/A	N/A
Coefficient:	0.00	1.24	0.00	0.00	0.00	0.00
T-Stat:	0.00	17.22	0.00	0.00	0.00	0.00
Adj R^2:	**0.8993**					

M03Base	0	0
M03Winter	3,239	3,239
M03Total	3,239	3,239
		100%

Propane (litres) = Days x 0 + HDD x 1.24.
The underlying regression of this baseline equation is R^2 = 0.8993.
HDD (Heating Degree Days) calculated using a balance point of 10°C.
CDD (Cooling Degree Days) calculated using a balance point of °C.
In a typical year, consumption will be 3,239 litres.



	Include in Model?	Start Date	Read Date	Propane (litres)	IV1	IV2	IV3	Month Allocation
	No	1-Jan-18	31-Jan-18	674.9				Jan-18
	No	1-Feb-18	28-Feb-18	509.6				Feb-18
	No	1-Mar-18	31-Mar-18	273.7				Mar-18
	No	1-Apr-18	30-Apr-18	145.2				Apr-18
	No	1-May-18	31-May-18	230.6				May-18
	No	1-Jun-18	30-Jun-18	0.1				Jun-18
	No	1-Jul-18	31-Jul-18	0.1				Jul-18
	No	1-Aug-18	31-Aug-18	0.1				Aug-18
	No	1-Sep-18	30-Sep-18	0.1				Sep-18
	No	1-Oct-18	31-Oct-18	95.0				Oct-18
	No	1-Nov-18	30-Nov-18	273.9				Nov-18
	No	1-Dec-18	31-Dec-18	726.6				Dec-18
1	Yes	1-Jan-19	31-Jan-19	908.0				Jan-19
2	Yes	1-Feb-19	28-Feb-19	715.4				Feb-19
3	Yes	1-Mar-19	31-Mar-19	398.5				Mar-19
4	Yes	1-Apr-19	30-Apr-19	221.7				Apr-19
5	Yes	1-May-19	31-May-19	0.1				May-19
6	Yes	1-Jun-19	30-Jun-19	0.1				Jun-19
7	Yes	1-Jul-19	31-Jul-19	0.1				Jul-19
8	Yes	1-Aug-19	31-Aug-19	0.1				Aug-19
9	Yes	1-Sep-19	30-Sep-19	0.1				Sep-19
10	Yes	1-Oct-19	31-Oct-19	0.1				Oct-19
11	Yes	1-Nov-19	30-Nov-19	436.8				Nov-19
12	Yes	1-Dec-19	31-Dec-19	574.6				Dec-19
13	Yes	1-Jan-20	31-Jan-20	723.2				Jan-20
14	Yes	1-Feb-20	29-Feb-20	582.4				Feb-20
15	Yes	1-Mar-20	31-Mar-20	439.5				Mar-20
16	Yes	1-Apr-20	30-Apr-20	228.9				Apr-20
17	Yes	1-May-20	31-May-20	164.1				May-20
18	Yes	1-Jun-20	30-Jun-20	0.1				Jun-20
19	Yes	1-Jul-20	31-Jul-20	0.1				Jul-20
20	Yes	1-Aug-20	31-Aug-20	0.1				Aug-20
21	Yes	1-Sep-20	30-Sep-20	0.1				Sep-20
22	Yes	1-Oct-20	30-Nov-20	433.5				Oct-20
	No	1-Nov-20	30-Nov-20	433.4				Nov-20
23	Yes	1-Dec-20	31-Dec-20	568.2				Dec-20
24	Yes	1-Jan-21	31-Jan-21	338.3				Jan-21
25	Yes	1-Feb-21	30-Apr-21	1,056.6				Mar-21
	No	1-Mar-21	31-Mar-21	196.3				Mar-21
	No	1-Apr-21	30-Apr-21	0.1				Apr-21
26	Yes	1-May-21	31-May-21	202.9				May-21
27	Yes	1-Jun-21	30-Jun-21	0.1				Jun-21
28	Yes	1-Jul-21	31-Jul-21	0.1				Jul-21
29	Yes	1-Aug-21	31-Aug-21	0.1				Aug-21
30	Yes	1-Sep-21	30-Sep-21	0.1				Sep-21
31	Yes	1-Oct-21	31-Oct-21	0.1				Oct-21
32	Yes	1-Nov-21	30-Nov-21	624.4				Nov-21
33	Yes	1-Dec-21	31-Dec-21	0.1				Dec-21

APPENDIX B

CALCULATIONS

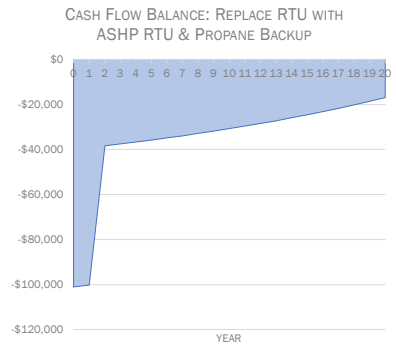
Energy Conservation Measure 3

Opp Cat:	Select
Opp Desc:	
Opp Name:	Replace RTU with ASHP RTU & Propane Backup

Costing Setup	
Engineering & PM:	**15%**
Contingency:	**10%**
Additional Annual Costs:	
Additional Annual Savings:	
Tax Rebate (Capital Projects):	**No**
Avoided Capital Costs:	**$58,594**
Avoided Capital Year:	**2**
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):	-10,062
Natural Gas (litres):	3,059
Water (m³):	0
Natural Gas (m³):	0
():	0
Emissions (Tonnes of CO_2e):	4.4
Financials	
Annual Utility Savings:	$709
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$80,791
Engineering & PM:	$12,119
Contingency:	$8,079
Project Costs:	$100,988
Simple Payback:	142.3
Capital Payback:	29.0
NPV:	-$37,111
IRR:	-3.4%



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

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	57,758	50,755
% Reduction	#DIV/0!	#DIV/0!

Electrical Capacity Impact (Amps): for Ele Service Upgrades			
Base	Summer	Winter	Peak
			7.031936713

	MBH	kW
	5	60	5.85994726

Savings: Replace RTU with ASHP RTU & Propane 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	1						0%
-13	-25	24						0%
-8	-22	37						0%
-3	-19	68						0%
3	-16	153						0%
8	-14	201						0%
13	-11	364						0%
18	-8	506						0%
23	-5	638						0%
28	-3	605						0%
33	0	810						0%
38	3	629						0%
43	6	606						0%
48	9	646						0%
53	11	688						0%
58	14	669						0%
63	17	724						0%
68	20	625						0%
73	23	449						0%
78	25	225						0%
83	28	82						0%
88	31	10						0%
93	34	0						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

End-Use	Existing			Replace RTU with ASHP RTU & Propane Backup			Savings						
	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (kWh)	Propane (L)					
Space Cool	1.1	0.0	1,078.5	1.4	0.0	1,440.0	-362	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	88.3	25,879.2	9.1	14.3	13,241.1	-9,050	3,059					
HP Supp.	0.0	0.0	0.0	0.7	0.0	740.0	-740	0					
Hot Water	0.2	0.0	244.7	0.2	0.0	240.0	5	0					
Vent. Fans	2.2	0.0	2,249.1	2.3	0.0	2,250.0	-1	0					
Pumps & Aux	0.4	0.0	438.8	0.4	0.0	360.0	79	0					
Ext. Usage	0.0	0.0	0.0	0.0	0.0	0.0	0	0					
Misc. Equip	1.1	0.0	1,131.8	1.1	0.0	1,130.0	2	0					
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0					
Area Lights	3.6	0.0	3,604.8	3.6	0.0	3,600.0	5	0					
0	**9**	**88**	**34,627**	**19**	**14**	**23,001**	**-10,062**	**3,059**	**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

84%

General Requirements: Replace RTU with ASHP RTU & Propane Backup

Cost Breakout: Replace RTU with ASHP RTU & Propane 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	5 Ton Nominal c/w Electric Backup	each	Means '23	$30,000	$6,000	$0	Yes	Project	1	$46,056	$9,229	$0	$55,285
111	0	0				Structural Analysis		Each	EE Est	$0	$7,500	$0	Yes	Project	0	$0	$0	$0	$0
112	0	0				Demolition	Demo Existing	Each	Means '23	$0	$2,750	$0	Yes	Project	1	$0	$4,230	$0	$4,230
113	0	0				Craning	Craning - 40 ton truck mounted	Per Day	Means '23	$0	$475	$3,286	Yes	Project	1	$0	$731	$5,054	$5,785
114	0	0				Structural Reinforcement		Each	EE Est.	$5,000	$1,000	$0	Yes	Project	0	$0	$0	$0	$0
115	0	0				Roof Curb		Each	EE Est.	$15,000	$3,000	$0	Yes	Project	0	$0	$0	$0	$0
116	0	0				Controls							Yes	Project		$0	$0	$0	$0
117	0	0				Analog Inputs	Duct Temperature	Each	Means '22	$349	$116	$0	Yes	Project	4	$2,142	$715	$0	$2,857
118	0	0				Analog Outputs	Electric (Not incl. Device)	Each	Means '22	$285	$95	$0	Yes	Project	2	$875	$292	$0	$1,167
119	0	0				Digital Inputs	Current Sensor	Each	Means '22	$326	$109	$0	Yes	Project	2	$1,002	$335	$0	$1,336
120	0	0				Digital Outputs	Start/Stop	Each	Means '22	$255	$85	$0	Yes	Project	2	$783	$261	$0	$1,044
121	0	0				DDC Controller	16 Point Controller	Each	Means '22	$2,456	$819	$0	Yes	Project	1	$3,771	$1,259	$0	$5,030
122	0	0				DDC Front End	Calibration Labour	Point	Means '22	$90	$30	$0	Yes	Project	11	$1,520	$508	$0	$2,027
123	0	0				DDC Front End	Start-up Labour	Point	Means '22	$90	$30	$0	Yes	Project	11	$1,520	$508	$0	$2,027
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	$216	$0	Yes	Project		$0	$0	$0	$0
126	0	0				PVC Conduit	1 1/2" (3x3/0, 4x1/0)	LF	Means '23	$6	$5	$0	Yes	Project		$0	$0	$0	$0
127	0	0				Circuit Breaker - NEMA 1	600V, 200A	Each	Means '23	$1,525	$360	$0	Yes	Project		$0	$0	$0	$0
128	0	0				Pull Box	10"x10"x6" diam	Each	Means '18	$20	$85	$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:	**$57,668**	**$18,069**	**$5,054**	**$80,791**

Escalation Rates: Replace RTU with ASHP RTU & Propane Backup

Year:	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Demand ($/kW):	11.8277	12.5374	13.2896	14.0870	14.9322	15.8281	16.7778	17.7845	18.8516	19.9827	21.1816	22.4525	23.7997	25.2276	26.7413	28.3458	30.0465	31.8493	33.7603	35.7859	37.9330
Electricity ($/kWh):	0.2133	0.2244	0.2360	0.2483	0.2612	0.2748	0.2891	0.3041	0.3199	0.3366	0.3541	0.3725	0.3919	0.4122	0.4337	0.4562	0.4799	0.5049	0.5312	0.5588	0.5878
Natural Gas ($/litres):	0.9334	0.9801	1.0291	1.0805	1.1346	1.1913	1.2508	1.3134	1.3791	1.4480	1.5204	1.5964	1.6763	1.7601	1.8481	1.9405	2.0375	2.1394	2.2463	2.3587	2.4766
Water ($/m³):	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
Natural Gas ($/m³):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
($/):	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

Cash Flow Balance: Replace RTU with ASHP RTU & Propane Backup

	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:	-$100,988	$0	$61,200	$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):		-$2,258	-$2,375	-$2,499	-$2,628	-$2,765	-$2,909	-$3,060	-$3,219	-$3,387	-$3,563	-$3,748	-$3,943	-$4,148	-$4,364	-$4,591	-$4,829	-$5,081	-$5,345	-$5,623	-$5,915
Annual Savings (M03):		$2,998	$3,148	$3,306	$3,471	$3,644	$3,827	$4,018	$4,219	$4,430	$4,651	$4,884	$5,128	$5,384	$5,654	$5,936	$6,233	$6,545	$6,872	$7,216	$7,576
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:	-$100,988	$741	$61,974	$807	$842	$879	$918	$958	$1,000	$1,043	$1,088	$1,136	$1,185	$1,236	$1,290	$1,346	$1,404	$1,464	$1,527	$1,593	$1,661
Cash Balance:	-$100,988	-$100,248	-$38,274	-$37,467	-$36,625	-$35,746	-$34,828	-$33,870	-$32,871	-$31,828	-$30,739	-$29,603	-$28,418	-$27,182	-$25,892	-$24,546	-$23,142	-$21,678	-$20,151	-$18,558	-$16,896
Undepreciated Amount:	-$100,988	-$85,840	-$72,964	-$62,020	-$52,717	-$44,809	-$38,088	-$32,375	-$27,518	-$23,391	-$19,882	-$16,900	-$14,365	-$12,210	-$10,379	-$8,822	-$7,499	-$6,374	-$5,418	-$4,605	-$3,914

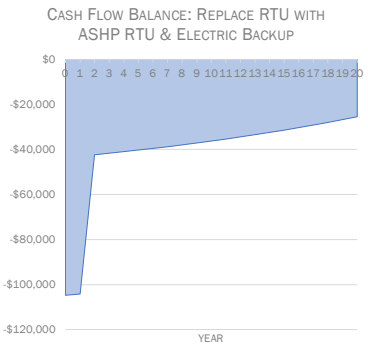
Energy Conservation Measure 4

Opp Cat:	Select
Opp Desc:	
Opp Name:	Replace RTU with ASHP RTU & Electric Backup

Costing Setup	
Engineering & PM:	**15%**
Contingency:	**10%**
Additional Annual Costs:	
Additional Annual Savings:	
Tax Rebate (Capital Projects):	**No**
Avoided Capital Costs:	**$58,594**
Avoided Capital Year:	**2**
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):	-13,222
Natural Gas (litres):	3,650
Water (m³):	0
Natural Gas (m³):	0
():	0
Emissions (Tonnes of CO_2e):	5.3
Financials	
Annual Utility Savings:	$587
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$83,815
Engineering & PM:	$12,572
Contingency:	$8,382
Project Costs:	$104,769
Simple Payback:	178.4
Capital Payback:	35.0
NPV:	-$43,055
IRR:	-5.4%



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

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	56,716	47,144
% Reduction	#DIV/0!	#DIV/0!

Electrical Capacity Impact (Amps): for Ele Service Upgrades			
Base	Summer	Winter	Peak
			35

Savings: Replace RTU with ASHP RTU & Electric Backup

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	1						0%
-13	-25	24						0%
-8	-22	37						0%
-3	-19	68						0%
3	-16	153						0%
8	-14	201						0%
13	-11	364						0%
18	-8	506						0%
23	-5	638						0%
28	-3	605						0%
33	0	810						0%
38	3	629						0%
43	6	606						0%
48	9	646						0%
53	11	688						0%
58	14	669						0%
63	17	724						0%
68	20	625						0%
73	23	449						0%
78	25	225						0%
83	28	82						0%
88	31	10						0%
93	34	0						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

End-Use	Existing			Replace RTU with ASHP RTU & Electric Backup			Savings					
	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (kWh)	Propane (L)				
Space Cool	1.1	0.0	1,078.5	1.4	0.0	1,440.0	-362	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	88.3	25,879.2	9.1	0.0	9,050.0	-9,050	3,650				
HP Supp.	0.0	0.0	0.0	3.9	0.0	3,900.0	-3,900	0				
Hot Water	0.2	0.0	244.7	0.2	0.0	240.0	5	0				
Vent. Fans	2.2	0.0	2,249.1	2.3	0.0	2,250.0	-1	0				
Pumps & Aux	0.4	0.0	438.8	0.4	0.0	360.0	79	0				
Ext. Usage	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Misc. Equip	1.1	0.0	1,131.8	1.1	0.0	1,130.0	2	0				
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Area Lights	3.6	0.0	3,604.8	3.6	0.0	3,600.0	5	0				
0	**9**	**88**	**34,627**	**22**	**0**	**21,970**	**-13,222**	**3,650**	**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: Replace RTU with ASHP RTU & Electric Backup

Cost Breakout: Replace RTU with ASHP RTU & Electric 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	5 Ton Nominal c/w Electric Backup	each	Means '23	$24,000	$6,000	$0	Yes	Project	1	$36,845	$9,229	$0	$46,074
111	0	0				Structural Analysis		Each	EE Est	$0	$7,500	$0	Yes	Project	0	$0	$0	$0	$0
112	0	0				Demolition	Demo Existing	Each	Means '23	$0	$2,750	$0	Yes	Project	1	$0	$4,230	$0	$4,230
113	0	0				Craning	Craning - 40 ton truck mounted	Per Day	Means '23	$0	$475	$3,286	Yes	Project	1	$0	$731	$5,054	$5,785
114	0	0				Structural Reinforcement		Each	EE Est.	$5,000	$1,000	$0	Yes	Project	0	$0	$0	$0	$0
115	0	0				Roof Curb		Each	EE Est.	$15,000	$3,000	$0	Yes	Project	0	$0	$0	$0	$0
116	0	0				Controls							Yes	Project		$0	$0	$0	$0
117	0	0				Analog Inputs	Duct Temperature	Each	Means '22	$349	$116	$0	Yes	Project	4	$2,142	$715	$0	$2,857
118	0	0				Analog Outputs	Electric (Not incl. Device)	Each	Means '22	$285	$95	$0	Yes	Project	2	$875	$292	$0	$1,167
119	0	0				Digital Inputs	Current Sensor	Each	Means '22	$326	$109	$0	Yes	Project	2	$1,002	$335	$0	$1,336
120	0	0				Digital Outputs	Start/Stop	Each	Means '22	$255	$85	$0	Yes	Project	2	$783	$261	$0	$1,044
121	0	0				DDC Controller	16 Point Controller	Each	Means '22	$2,456	$819	$0	Yes	Project	1	$3,771	$1,259	$0	$5,030
122	0	0				DDC Front End	Calibration Labour	Point	Means '22	$90	$30	$0	Yes	Project	11	$1,520	$508	$0	$2,027
123	0	0				DDC Front End	Start-up Labour	Point	Means '22	$90	$30	$0	Yes	Project	11	$1,520	$508	$0	$2,027
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	$216	$0	Yes	Project	6	$4,560	$1,994	$0	$6,553
126	0	0				PVC Conduit	1 1/2" (3x3/0, 4x1/0)	LF	Means '23	$6	$5	$0	Yes	Project	150	$1,382	$1,246	$0	$2,628
127	0	0				Circuit Breaker - NEMA 1	600V, 200A	Each	Means '23	$1,525	$360	$0	Yes	Project	1	$2,341	$554	$0	$2,895
128	0	0				Pull Box	10"x10"x6" diam	Each	Means '18	$20	$85	$0	Yes	Project	1	$30	$130	$0	$160
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:	**$56,769**	**$21,992**	**$5,054**	**$83,815**

Escalation Rates: Replace RTU with ASHP RTU & Electric Backup

Cash Flow Balance: Replace RTU with ASHP RTU & Electric Backup

	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:	-$104,769	$0	$61,200	$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):		-$2,967	-$3,121	-$3,283	-$3,454	-$3,634	-$3,822	-$4,021	-$4,230	-$4,450	-$4,682	-$4,925	-$5,181	-$5,451	-$5,734	-$6,032	-$6,346	-$6,676	-$7,023	-$7,388	-$7,773
Annual Savings (M03):		$3,578	$3,757	$3,944	$4,142	$4,349	$4,566	$4,794	$5,034	$5,286	$5,550	$5,828	$6,119	$6,425	$6,746	$7,084	$7,438	$7,810	$8,200	$8,610	$9,041
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:	-$104,769	$611	$61,836	$661	$688	$715	$744	$773	$804	$836	$868	$902	$938	$974	$1,012	$1,051	$1,092	$1,134	$1,177	$1,222	$1,268
Cash Balance:	-$104,769	-$104,158	-$42,322	-$41,661	-$40,973	-$40,258	-$39,514	-$38,741	-$37,937	-$37,102	-$36,233	-$35,331	-$34,393	-$33,419	-$32,407	-$31,356	-$30,264	-$29,130	-$27,954	-$26,732	-$25,464
Undepreciated Amount:	-$104,769	-$89,054	-$75,696	-$64,341	-$54,690	-$46,487	-$39,514	-$33,587	-$28,549	-$24,266	-$20,626	-$17,532	-$14,903	-$12,667	-$10,767	-$9,152	-$7,779	-$6,612	-$5,620	-$4,777	-$4,061

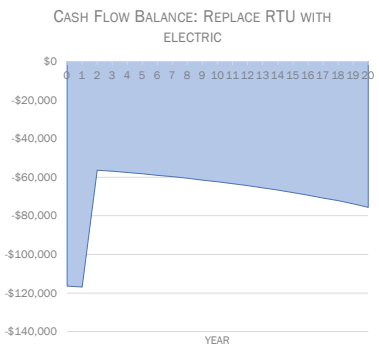
Energy Conservation Measure 2

Opp Cat:	Select
Opp Desc:	
Opp Name:	Replace RTU with electric

Costing Setup	
Engineering & PM:	**15%**
Contingency:	**10%**
Additional Annual Costs:	
Additional Annual Savings:	
Tax Rebate (Capital Projects):	**No**
Avoided Capital Costs:	**$58,594**
Avoided Capital Year:	**2**
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):	-18,292
Natural Gas (litres):	3,650
Water (m³):	0
Natural Gas (m³):	0
():	0
Emissions (Tonnes of CO_2e):	5.1
Financials	
Annual Utility Savings:	-$494
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$93,145
Engineering & PM:	$13,972
Contingency:	$9,315
Project Costs:	$116,432
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$72,389
IRR:	No IRR



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

QC Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	61,791	47,149
% Reduction	#DIV/0!	#DIV/0!

Electrical Capacity Impact (Amps): for Ele Service Upgrades			
Base	Summer	Winter	Peak
			28

Savings: Replace RTU with electric

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	1						0%
-13	-25	24						0%
-8	-22	37						0%
-3	-19	68						0%
3	-16	153						0%
8	-14	201						0%
13	-11	364						0%
18	-8	506						0%
23	-5	638						0%
28	-3	605						0%
33	0	810						0%
38	3	629						0%
43	6	606						0%
48	9	646						0%
53	11	688						0%
58	14	669						0%
63	17	724						0%
68	20	625						0%
73	23	449						0%
78	25	225						0%
83	28	82						0%
88	31	10						0%
93	34	0						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

End-Use	Existing			Replace RTU with electric			Savings						
	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (kWh)	Propane (L)					
Space Cool	1.1	0.0	1,078.5	1.1	0.0	1,090.0	-12	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	88.3	25,879.2	18.3	0.0	18,290.0	-18,290	3,650					
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0	0					
Hot Water	0.2	0.0	244.7	0.2	0.0	240.0	5	0					
Vent. Fans	2.2	0.0	2,249.1	2.3	0.0	2,250.0	-1	0					
Pumps & Aux	0.4	0.0	438.8	0.4	0.0	440.0	-1	0					
Ext. Usage	0.0	0.0	0.0	0.0	0.0	0.0	0	0					
Misc. Equip	1.1	0.0	1,131.8	1.1	0.0	1,130.0	2	0					
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0					
Area Lights	3.6	0.0	3,604.8	3.6	0.0	3,600.0	5	0					
0	**9**	**88**	**34,627**	**27**	**0**	**27,040**	**-18,292**	**3,650**	**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

Equip. Tag	Equip Type	Htg Cap - MBH	Clg Cap - Tons	Date of Install	Renewal Date	Notes
ERV1	ERV	0	0			No heating/cooling
RTU1	Propane RTU	100	6	2005	2025	Propane/DX

Ele Eq - kW 23

General Requirements: Replace RTU with electric

Cost Breakout: Replace RTU with electric

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				Rooftop Unit	6 Tons, 115 MBH	each	Carrier	$14,461	$3,615	$0	Yes	Both	1	$22,201	$5,561	$0	$27,762
111	0	0				Structural Analysis		Each	EE Est	$0	$7,500	$0	Yes	Project	0	$0	$0	$0	$0
112	0	0				Demolition	Demo Existing	Each	Means '23	$0	$2,750	$0	Yes	Both	1	$0	$4,230	$0	$4,230
113	0	0				Craning	Craning - 40 ton truck mounted	Per Day	Means '23	$0	$475	$3,286	Yes	Both	1	$0	$731	$5,054	$5,785
114	0	0				Structural Reinforcement		Each	EE Est.	$5,000	$1,000	$0	Yes	Project	0	$0	$0	$0	$0
115	0	0				Duct Modifications		Each	EE Est.	$15,000	$3,000	$0	Yes	Project	1	$23,028	$4,615	$0	$27,643
116	0	0				Controls							Yes	Project		$0	$0	$0	$0
117	0	0				Analog Inputs	Duct Temperature	Each	Means '22	$349	$116	$0	Yes	Both	4	$2,142	$715	$0	$2,857
118	0	0				Analog Outputs	Electric (Not incl. Device)	Each	Means '22	$285	$95	$0	Yes	Both	2	$875	$292	$0	$1,167
119	0	0				Digital Inputs	Current Sensor	Each	Means '22	$326	$109	$0	Yes	Both	2	$1,002	$335	$0	$1,336
120	0	0				Digital Outputs	Start/Stop	Each	Means '22	$255	$85	$0	Yes	Both	2	$783	$261	$0	$1,044
121	0	0				DDC Controller	16 Point Controller	Each	Means '22	$2,456	$819	$0	Yes	Both	1	$3,771	$1,259	$0	$5,030
122	0	0				DDC Front End	Calibration Labour	Point	Means '22	$90	$30	$0	Yes	Both	11	$1,520	$508	$0	$2,027
123	0	0				DDC Front End	Start-up Labour	Point	Means '22	$90	$30	$0	Yes	Both	11	$1,520	$508	$0	$2,027
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	$216	$0	Yes	Project	6	$4,560	$1,994	$0	$6,553
126	0	0				PVC Conduit	1 1/2" (3x3/0, 4x1/0)	LF	Means '23	$6	$5	$0	Yes	Project	150	$1,382	$1,246	$0	$2,628
127	0	0				Circuit Breaker - NEMA 1	600V, 200A	Each	Means '23	$1,525	$360	$0	Yes	Project	1	$2,341	$554	$0	$2,895
128	0	0				Pull Box	10"x10"x6" diam	Each	Means '18	$20	$85	$0	Yes	Project	1	$30	$130	$0	$160
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:	**$65,153**	**$22,938**	**$5,054**	**$93,145**

Escalation Rates: Replace RTU with electric

Cash Flow Balance: Replace RTU with electric

	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:	-$116,432	$0	$61,200	$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):		-$4,104	-$4,318	-$4,542	-$4,778	-$5,027	-$5,288	-$5,563	-$5,852	-$6,157	-$6,477	-$6,814	-$7,168	-$7,541	-$7,933	-$8,345	-$8,779	-$9,236	-$9,716	-$10,221	-$10,753
Annual Savings (M03):		$3,578	$3,757	$3,944	$4,142	$4,349	$4,566	$4,794	$5,034	$5,286	$5,550	$5,828	$6,119	$6,425	$6,746	$7,084	$7,438	$7,810	$8,200	$8,610	$9,041
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:	-$116,432	-$527	$60,639	-$598	-$637	-$678	-$722	-$769	-$818	-$871	-$927	-$986	-$1,049	-$1,116	-$1,187	-$1,262	-$1,342	-$1,426	-$1,516	-$1,611	-$1,712
Cash Balance:	-$116,432	-$116,958	-$56,319	-$56,917	-$57,553	-$58,232	-$58,954	-$59,722	-$60,541	-$61,411	-$62,338	-$63,324	-$64,373	-$65,489	-$66,676	-$67,938	-$69,279	-$70,706	-$72,222	-$73,833	-$75,545
Undepreciated Amount:	-$116,432	-$98,967	-$84,122	-$71,504	-$60,778	-$51,661	-$43,912	-$37,325	-$31,727	-$26,968	-$22,922	-$19,484	-$16,561	-$14,077	-$11,966	-$10,171	-$8,645	-$7,348	-$6,246	-$5,309	-$4,513

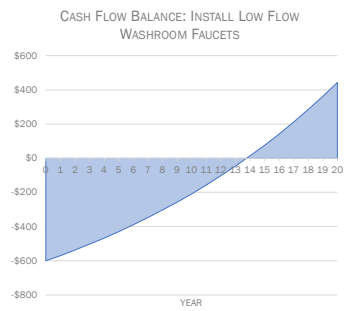
Energy Conservation Measure 5

Opp Cat:	Select
Opp Desc:	
Opp Name:	Install Low Flow Washroom Faucets

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):	138
Natural Gas (litres):	0
Water (m³):	0
Natural Gas (m³):	0
():	0
Emissions (Tonnes of CO_2e):	0.0
Financials	
Annual Utility Savings:	$29
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$480
Engineering & PM:	$72
Contingency:	$48
Project Costs:	$600
Simple Payback:	20.4
Capital Payback:	13.8
NPV:	-$120
IRR:	5.0%



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

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	70,048	70,185
% Reduction	#DIV/0!	#DIV/0!

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

Savings: Install Low Flow Washroom Faucets

			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	1						0%
-13	-25	24						0%
-8	-22	37						0%
-3	-19	68						0%
3	-16	153						0%
8	-14	201						0%
13	-11	364						0%
18	-8	506						0%
23	-5	638						0%
28	-3	605						0%
33	0	810						0%
38	3	629						0%
43	6	606						0%
48	9	646						0%
53	11	688						0%
58	14	669						0%
63	17	724						0%
68	20	625						0%
73	23	449						0%
78	25	225						0%
83	28	82						0%
88	31	10						0%
93	34	0						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

End-Use	Existing			Install Low Flow Washroom Faucets			Savings		Existing				Retrofit		Savings
	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (kWh)	Propane (L)	DHW Htg Cons - kWh	Adj DHW HTG Cons - kWh	Faucet Flow - gpm	% of DHW used in WRs	Adj DHW HTG Cons - kWh	Faucet Flow - gpm	Adj DHW HTG Cons - kWh
Space Cool	1.1	0.0	1,078.5	1.1	0.0	1,078.5	0	0	245	245	2	75%	107	0.5	138
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	88.3	25,879.2	0.0	88.3	25,879.2	0	0							
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0	0							
Hot Water	0.2	0.0	244.7	0.1	0.0	140.3	104	0							
Vent. Fans	2.2	0.0	2,249.1	2.2	0.0	2,249.1	0	0							
Pumps & Aux	0.4	0.0	438.8	0.4	0.0	438.8	0	0							
Ext. Usage	0.0	0.0	0.0	0.0	0.0	0.0	0	0							
Misc. Equip	1.1	0.0	1,131.8	1.1	0.0	1,131.8	0	0							
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0							
Area Lights	3.6	0.0	3,604.8	3.6	0.0	3,604.8	0	0							
0	**9**	**88**	**34,627**	**9**	**88**	**34,523**	**104**	**0**	**245**	**245**	**2**	**1**	**107**	**1**	**138**
Main Meter:	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	M02
Breakout Meter:	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select

General Requirements: Install Low Flow Washroom Faucets

Cost Breakout: Install Low Flow Washroom Faucets

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				Washroom Faucets	0.5 GPM	Eah	Web Search	$125	$31	$0	Yes	Project	2	$384	$96	$0	$480
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:	**$384**	**$96**	**$0**	**$480**

Escalation Rates: Install Low Flow Washroom Faucets

Cash Flow Balance: Install Low Flow Washroom Faucets

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Year:	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**			
Implementation Cost:	-$600	$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):		$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 (M02):		$31	$32	$34	$36	$38	$40	$42	$44	$46	$49	$51	$54	$57	$60	$63	$66	$69	$73	$77	$81	$85	$90	$94
Annual Savings (M03):		$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 (M04):		$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
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
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
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
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
Annual Total:	-$600	$31	$32	$34	$36	$38	$40	$42	$44	$46	$49	$51	$54	$57	$60	$63	$66	$69	$73	$77	$81	$0	$0	$0
Cash Balance:	-$600	-$569	-$537	-$502	-$466	-$429	-$389	-$347	-$303	-$257	-$208	-$157	-$103	-$46	$14	$77	$143	$212	$285	$362	$443	$0	$0	$0
Undepreciated Amount:	-$600	-$510	-$433	-$368	-$313	-$266	-$226	-$192	-$163	-$139	-$118	-$100	-$85	-$73	-$62	-$52	-$45	-$38	-$32	-$27	-$23	$0	$0	$0

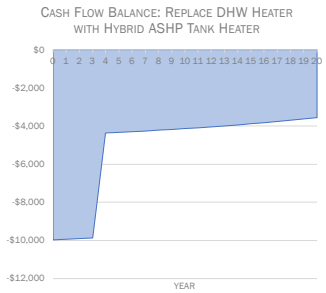
Energy Conservation Measure 6

Opp Cat:	Select
Opp Desc:	
Opp Name:	Replace DHW Heater with Hybrid ASHP Tank Heater

Costing Setup	
Engineering & PM:	**15%**
Contingency:	**10%**
Additional Annual Costs:	
Additional Annual Savings:	
Tax Rebate (Capital Projects):	**No**
Avoided Capital Costs:	**$5,017**
Avoided Capital Year:	**4**
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):	122
Natural Gas (litres):	0
Water (m³):	0
Natural Gas (m³):	0
0:	0
Emissions (Tonnes of CO₂e):	0.0
Financials	
Annual Utility Savings:	$26
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$7,968
Engineering & PM:	$1,195
Contingency:	$797
Project Costs:	$9,960
Simple Payback:	381.7
Capital Payback:	44.4
NPV:	-$5,407
IRR:	-7.3%



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

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	47,982	48,105
% Reduction	#DIV/0!	#DIV/0!

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

Savings: Replace DHW Heater with Hybrid ASHP Tank Heater

			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	1						0%
-13	-25	24						0%
-8	-22	37						0%
-3	-19	68						0%
3	-16	153						0%
8	-14	201						0%
13	-11	364						0%
18	-8	506						0%
23	-5	638						0%
28	-3	605						0%
33	0	810						0%
38	3	629						0%
43	6	606						0%
48	9	646						0%
53	11	688						0%
58	14	669						0%
63	17	724						0%
68	20	625						0%
73	23	449						0%
78	25	225						0%
83	28	82						0%
88	31	10						0%
93	34	0						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

End-Use	Existing			Manual: DHW Heater to ASHP DHW Heater			Savings		Existing		Retrofit					Savings
	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (kWh)	Propane (L)	DHW Htg Cons - kWh	Adj DHW HTG Cons - kWh	Adj DHW Cons - kWh	ASHP Offset	ASHP Avg COP	Electric Backup Htg - kWh	ASHP Cons - kWh	DHW Cons - kWh
Space Cool	1.1	0.0	1,078.5	0.0	0.0	0.0	1,079	0	245	245	245	75%	3.0	61	61	122
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	88.3	25,879.2	0.0	0.0	0.0	0	3,650								
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0	0								
Hot Water	0.2	0.0	244.7	0.0	0.0	0.0	245	0								
Vent. Fans	2.2	0.0	2,249.1	0.0	0.0	0.0	2,249	0								
Pumps & Aux	0.4	0.0	438.8	0.0	0.0	0.0	439	0								
Ext. Usage	0.0	0.0	0.0	0.0	0.0	0.0	0	0								
Misc. Equip	1.1	0.0	1,131.8	0.0	0.0	0.0	1,132	0								
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0								
Area Lights	3.6	0.0	3,604.8	0.0	0.0	0.0	3,605	0								
0	**9**	**88**	**34,627**	**0**	**0**	**0**	**8,748**	**3,650**	**245**	**245**	**245**	**1**	**3**	**61**	**61**	**122**
Main Meter:	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	M02
Breakout Meter:	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select

General Requirements: Replace DHW Heater with Hybrid ASHP Tank Heater

Cost Breakout: Replace DHW Heater with Hybrid ASHP Tank Heater

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	Remove Existing	Each	EE Est	$0	$500	$0	Yes	Both	1	$0	$769	$0	$769
111	0	0				Hybrid Tank Heater	80 Gal 4.5 kW	Each	Web Search	$3,750	$938	$0	Yes	Project	1	$5,757	$1,442	$0	$7,199
112	0	0											Yes	Project		$0	$0	$0	$0
113	0	0				Electric Tank Heater	4.5 kW	Each	Web Search	$1,975	$494	$0	Yes	Avoided	1	$3,032	$759	$0	$3,792
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:	**$5,757**	**$2,211**	**$0**	**$7,968**

Escalation Rates: Replace DHW Heater with Hybrid ASHP Tank Heater

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
Demand ($/kW):	11.8277	12.5374	13.2896	14.0870	14.9322	15.8281	16.7778	17.7845	18.8516	19.9827	21.1816	22.4525	23.7997	25.2276	26.7413	28.3458	30.0465	31.8493	33.7603	35.7859	37.9330	40.2090	42.6216	45.1789	47.8896
Electricity ($/kWh):	0.2133	0.2244	0.2360	0.2483	0.2612	0.2748	0.2891	0.3041	0.3199	0.3366	0.3541	0.3725	0.3919	0.4122	0.4337	0.4562	0.4799	0.5049	0.5312	0.5588	0.5878	0.6184	0.6506	0.6844	0.7200
Natural Gas ($/litres):	0.9334	0.9801	1.0291	1.0805	1.1346	1.1913	1.2508	1.3134	1.3791	1.4480	1.5204	1.5964	1.6763	1.7601	1.8481	1.9405	2.0375	2.1394	2.2463	2.3587	2.4766	2.6004	2.7304	2.8670	3.0103
Water ($/m³):	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
Natural Gas ($/m³):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
($/):	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

Cash Flow Balance: Replace DHW Heater with Hybrid ASHP Tank Heater

	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
Year:	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**				
Implementation Cost:	-$9,960	$0	$0	$0	$5,473	$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	$0	$0	$0	$0
Annual Savings (M02):		$27	$29	$30	$32	$34	$35	$37	$39	$41	$43	$46	$48	$50	$53	$56	$59	$62	$65	$68	$72	$76	$80	$84	$88
Annual Savings (M03):		$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 (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
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
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
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
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
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
Annual Total:	-$9,960	$27	$29	$30	$5,505	$34	$35	$37	$39	$41	$43	$46	$48	$50	$53	$56	$59	$62	$65	$68	$72	$0	$0	$0	$0
Cash Balance:	-$9,960	-$9,933	-$9,904	-$9,873	-$4,369	-$4,335	-$4,300	-$4,262	-$4,223	-$4,182	-$4,139	-$4,093	-$4,045	-$3,995	-$3,942	-$3,886	-$3,827	-$3,765	-$3,700	-$3,632	-$3,560	$0	$0	$0	$0
Undepreciated Amount:	-$9,960	-$8,466	-$7,196	-$6,117	-$5,199	-$4,419	-$3,756	-$3,193	-$2,714	-$2,307	-$1,961	-$1,667	-$1,417	-$1,204	-$1,024	-$870	-$740	-$629	-$534	-$454	-$386	$0	$0	$0	$0

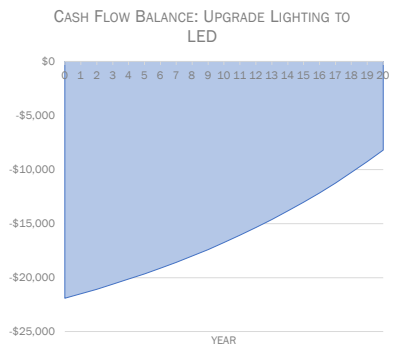
Energy Conservation Measure 8

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

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):	1,807
Natural Gas (litres):	0
Water (m³):	0
Natural Gas (m³):	0
():	0
Emissions (Tonnes of CO_2e):	0.1
Financials	
Annual Utility Savings:	$385
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$17,522
Engineering & PM:	$2,628
Contingency:	$1,752
Project Costs:	$21,902
Simple Payback:	56.8
Capital Payback:	26.4
NPV:	-$15,603
IRR:	-3.6%



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

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	75,705	77,513
% Reduction	#DIV/0!	#DIV/0!

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

Savings: Upgrade Lighting to LED

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	1						0%
-13	-25	24						0%
-8	-22	37						0%
-3	-19	68						0%
3	-16	153						0%
8	-14	201						0%
13	-11	364						0%
18	-8	506						0%
23	-5	638						0%
28	-3	605						0%
33	0	810						0%
38	3	629						0%
43	6	606						0%
48	9	646						0%
53	11	688						0%
58	14	669						0%
63	17	724						0%
68	20	625						0%
73	23	449						0%
78	25	225						0%
83	28	82						0%
88	31	10						0%
93	34	0						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

End-Use	Existing			Upgrade Lighting to LED			Savings		Existing	Retrofit	Savings	
	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (kWh)	Propane (L)	Lighting Cons - kWh	Lighting Cons - kWh	Lighting Cons - kWh	
Space Cool	1.1	0.0	1,078.5	1.0	0.0	963.0	116	0	3,605	1,794	1,811	
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	88.3	25,879.2	0.0	91.7	26,872.8	0	-140				
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Hot Water	0.2	0.0	244.7	0.2	0.0	245.3	-1	0				
Vent. Fans	2.2	0.0	2,249.1	2.2	0.0	2,249.1	0	0				
Pumps & Aux	0.4	0.0	438.8	0.4	0.0	438.7	0	0				
Ext. Usage	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Misc. Equip	1.1	0.0	1,131.8	1.1	0.0	1,131.8	0	0				
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Area Lights	3.6	0.0	3,604.8	1.9	0.0	1,912.4	1,692	0				
0	**9**	**88**	**34,627**	**7**	**92**	**33,813**	**1,807**	**-140**	**3,605**	**1,794**	**1,811**	**0**
Main Meter:	Select	Select	Select	Select	Select	Select	Select	M02	Select	Select	Select	Select	Select
Breakout Meter:	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select

3,605

Building Type	Power Density W/ft2	Retrofit Costs Cost/ft2
Arena	0.78	$ 3.44
Hospital	1.21	$ 5.34
Hotel	1	$ 4.41
Industrial	1.11	$ 4.90
Library	1.18	$ 5.21
Multi-Res Common	0.88	$ 3.88
Muti - Res Suites	0.6	$ 2.65
Office	0.9	$ 3.97
Police/Fire	0.96	$ 4.24
Town Hall	0.92	$ 4.06
University/ schools	0.99	$ 4.37
Wasehouse	0.66	$ 2.91
Extrior	0.13	$ 1.30

General Requirements: Upgrade Lighting to LED

Cost Breakout: Upgrade Lighting to LED

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 Retrofit	LED	per SQFT	EE Database	$1.9	$1.3	$0	Yes	Project	3500	$10,401	$7,121	$0	$17,522
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:	**$10,401**	**$7,121**	**$0**	**$17,522**

Escalation Rates: Upgrade Lighting to LED

Cash Flow Balance: Upgrade Lighting to LED

	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:	-$21,902	$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):		$406	$427	$449	$472	$497	$523	$550	$578	$608	$640	$673	$708	$745	$784	$825	$867	$913	$960	$1,010	$1,062
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:	-$21,902	$406	$427	$449	$472	$497	$523	$550	$578	$608	$640	$673	$708	$745	$784	$825	$867	$913	$960	$1,010	$1,062
Cash Balance:	-$21,902	-$21,497	-$21,070	-$20,621	-$20,149	-$19,652	-$19,130	-$18,580	-$18,002	-$17,394	-$16,754	-$16,080	-$15,372	-$14,627	-$13,843	-$13,019	-$12,151	-$11,239	-$10,279	-$9,269	-$8,206
Undepreciated Amount:	-$21,902	-$18,617	-$15,824	-$13,451	-$11,433	-$9,718	-$8,260	-$7,021	-$5,968	-$5,073	-$4,312	-$3,665	-$3,115	-$2,648	-$2,251	-$1,913	-$1,626	-$1,382	-$1,175	-$999	-$849

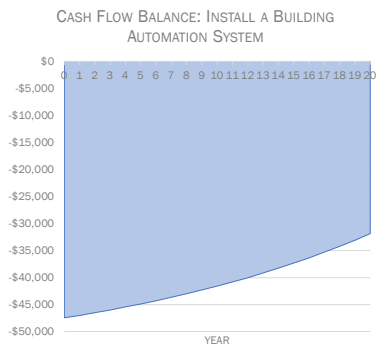
Energy Conservation Measure 7

Opp Cat:	Select
Opp Desc:	
Opp Name:	Install a Building Automation 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):	1,225
Natural Gas (litres):	194
Water (m³):	0
Natural Gas (m³):	0
():	0
Emissions (Tonnes of CO_2e):	0.3
Financials	
Annual Utility Savings:	$443
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$37,961
Engineering & PM:	$5,694
Contingency:	$3,796
Project Costs:	$47,451
Simple Payback:	107.2
Capital Payback:	36.6
NPV:	-$40,271
IRR:	-8.0%



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

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	29,565	30,985
% Reduction	#DIV/0!	#DIV/0!

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

Savings: Install a Building Automation System

Avg Temp (°F)	Avg Temp (°C)	Total Hours	Meter Selection: M02 Base	M02 Summer	M02 Winter	M03 Total	Occupancy: Select	Eff. Profile: Select
-33	-36	0	0	0	0	0		0%
-28	-33	0	0	0	0	0		0%
-23	-30	0	0	0	0	0		0%
-18	-28	1	2	0	1	2		0%
-13	-25	24	38	0	30	43		0%
-8	-22	37	59	0	42	62		0%
-3	-19	68	107	0	66	102		0%
3	-16	153	241	0	129	209		0%
8	-14	201	317	0	142	246		0%
13	-11	364	576	0	209	393		0%
18	-8	506	800	0	222	473		0%
23	-5	638	1,009	0	194	505		0%
28	-3	605	956	0	103	392		0%
33	0	810	1,281	0	28	408		0%
38	3	629	995	0	0	226		0%
43	6	606	958	0	0	131		0%
48	9	646	1,021	0	0	46		0%
53	11	688	1,087	0	0	0		0%
58	14	669	1,057	0	0	0		0%
63	17	724	1,145	0	0	0		0%
68	20	625	987	0	0	0		0%
73	23	449	711	0	0	0		0%
78	25	225	356	0	0	0		0%
83	28	82	130	0	0	0		0%
88	31	10	16	0	0	0		0%
93	34	0	0	0	0	0		0%
98	36	0	0	0	0	0		0%
103	39	0	0	0	0	0		0%
Totals		**8,760**	**13,849**	**0**	**1,165**	**3,239**	**0**	**0**

	Existing: Heating Cons - l	Existing: Cooling Cons - kWh	Existing: Fan Cons - kWh	Retrofit: Heating Cons - l	Retrofit: Cooling Cons - kWh	Retrofit: Fan Cons - kWh	Savings: Heating Cons - l	Savings: Cooling Cons - kWh	Savings: Fan 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			
	2	0	1	2	0	1	0	0	0			
	43	0	33	40	0	30	3	0	3			
	62	0	52	58	0	47	4	0	5			
	102	0	95	96	0	85	6	0	9			
	209	0	214	196	0	192	13	0	21			
	246	0	281	231	0	253	15	0	28			
	393	0	510	370	0	459	24	0	51			
	473	0	707	445	0	637	28	0	71			
	505	0	893	475	0	804	30	0	89			
	392	0	846	368	0	761	24	0	85			
	408	0	1,134	384	0	1,020	24	0	113			
	226	0	880	213	0	792	14	0	88			
	131	0	848	123	0	763	8	0	85			
	46	0	903	44	0	813	3	0	90			
	0	0	962	0	0	866	0	0	96			
	0	0	935	0	0	842	0	0	94			
	0	0	1,013	0	0	912	0	0	101			
	0	0	874	0	0	786	0	0	87			
	0	0	629	0	0	566	0	0	63			
	0	0	315	0	0	284	0	0	32			
	0	0	115	0	0	103	0	0	11			
	0	0	14	0	0	12	0	0	1			
	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	**3,239**	**0**	**12,253**	**3,045**	**0**	**11,028**	**194**	**0**	**1,225**	**0**	**0**	**0**
Main Meter:	Select	Select	Select	Select	Select	Select	Select	M03	M02	M02	Select	Select	Select
Breakout Meter:	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select	Select
					6%	8%	10%						

RTU cfm	2,600
Fan hp (est)	2
Avg Hrs/Day	20
Avg OA Damper	20%
Efs Comb HP	1

General Requirements: Install a Building Automation System

Cost Breakout: Install a Building Automation 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											Yes	Project		$0	$0	$0	$0
111	23	09.23	HVAC	Controls	Analog Inputs-Duct Temperature	Analog Inputs	Duct Temperature	Each	Means '22	$349	$116	$0	Yes	Project	6	$3,212	$1,073	$0	$4,285
112	23	09.23	HVAC	Controls	Analog Outputs-Electric (Not incl. Device)	Analog Outputs	Electric (Not incl. Device)	Each	Means '22	$285	$95	$0	Yes	Project	4	$1,750	$585	$0	$2,335
113	23	09.23	HVAC	Controls	Digital Inputs-Current Sensor	Digital Inputs	Current Sensor	Each	Means '22	$326	$109	$0	Yes	Project	6	$3,005	$1,004	$0	$4,009
114	23	09.23	HVAC	Controls	Digital Outputs-Start/Stop	Digital Outputs	Start/Stop	Each	Means '22	$255	$85	$0	Yes	Project	6	$2,349	$784	$0	$3,133
115	23	09.23	HVAC	Controls	DDC Controller-16 Point Controller	DDC Controller	16 Point Controller	Each	Means '22	$2,456	$819	$0	Yes	Project	2	$7,542	$2,519	$0	$10,060
116	23	09.23	HVAC	Controls	DDC Front End-Colour Graphics Software	DDC Front End	Colour Graphics Software	Each	Means '22	$2,944	$981	$0	Yes	Project	1	$4,519	$1,509	$0	$6,029
117	23	09.23	HVAC	Controls	DDC Front End-Calibration Labour	DDC Front End	Calibration Labour	Point	Means '22	$90	$30	$0	Yes	Project	22	$3,040	$1,015	$0	$4,055
118	23	09.23	HVAC	Controls	DDC Front End-Start-up Labour	DDC Front End	Start-up Labour	Point	Means '22	$90	$30	$0	Yes	Project	22	$3,040	$1,015	$0	$4,055
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
																$28,457	**$9,504**	**$0**	**$37,961**

Escalation Rates: Install a Building Automation System

Year:	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Demand ($/kW):	11.8277	12.5374	13.2896	14.0870	14.9322	15.8281	16.7778	17.7845	18.8516	19.9827	21.1816	22.4525	23.7997	25.2276	26.7413	28.3458	30.0465	31.8493	33.7603	35.7859	37.9330
Electricity ($/kWh):	0.2133	0.2244	0.2360	0.2483	0.2612	0.2748	0.2891	0.3041	0.3199	0.3366	0.3541	0.3725	0.3919	0.4122	0.4337	0.4562	0.4799	0.5049	0.5312	0.5588	0.5878
Natural Gas ($/litres):	0.9334	0.9801	1.0291	1.0805	1.1346	1.1913	1.2508	1.3134	1.3791	1.4480	1.5204	1.5964	1.6763	1.7601	1.8481	1.9405	2.0375	2.1394	2.2463	2.3587	2.4766
Water ($/m³):	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
Natural Gas ($/m³):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
($/):	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

Cash Flow Balance: Install a Building Automation 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:	-$47,451	$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):		$275	$289	$304	$320	$337	$354	$373	$392	$412	$434	$456	$480	$505	$531	$559	$588	$619	$651	$685	$720
Annual Savings (M03):		$190	$200	$210	$221	$232	$243	$255	$268	$281	$295	$310	$326	$342	$359	$377	$396	$416	$437	$458	$481
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:	-$47,451	$465	$489	$514	$541	$568	$597	$628	$660	$694	$729	$767	$806	$847	$891	$936	$984	$1,034	$1,087	$1,143	$1,202
Cash Balance:	-$47,451	-$46,986	-$46,497	-$45,982	-$45,442	-$44,874	-$44,276	-$43,648	-$42,988	-$42,294	-$41,565	-$40,798	-$39,992	-$39,145	-$38,255	-$37,319	-$36,335	-$35,300	-$34,213	-$33,070	-$31,868
Undepreciated Amount:	-$47,451	-$40,334	-$34,284	-$29,141	-$24,770	-$21,054	-$17,896	-$15,212	-$12,930	-$10,991	-$9,342	-$7,941	-$6,750	-$5,737	-$4,877	-$4,145	-$3,523	-$2,995	-$2,546	-$2,164	-$1,839

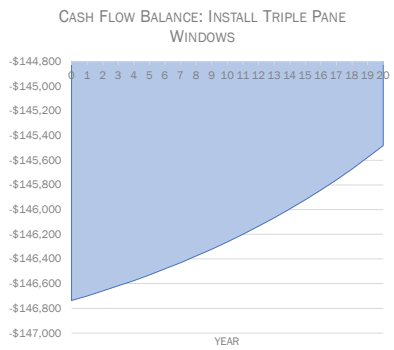
Energy Conservation Measure 1

Opp Cat:	Select
Opp Desc:	
Opp Name:	Install Triple Pane Windows

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):	116
Natural Gas (litres):	12
Water (m³):	0
Natural Gas (m³):	0
():	0
Emissions (Tonnes of CO_2e):	0.0
Financials	
Annual Utility Savings:	$36
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$117,389
Engineering & PM:	$17,608
Contingency:	$11,739
Project Costs:	$146,736
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$146,158
IRR:	No IRR



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

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	68,285	68,413
% Reduction	#DIV/0!	#DIV/0!

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

Savings: Install Triple Pane Windows

			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	1						0%
-13	-25	24						0%
-8	-22	37						0%
-3	-19	68						0%
3	-16	153						0%
8	-14	201						0%
13	-11	364						0%
18	-8	506						0%
23	-5	638						0%
28	-3	605						0%
33	0	810						0%
38	3	629						0%
43	6	606						0%
48	9	646						0%
53	11	688						0%
58	14	669						0%
63	17	724						0%
68	20	625						0%
73	23	449						0%
78	25	225						0%
83	28	82						0%
88	31	10						0%
93	34	0						0%
98	36	0						0%
103	39	0						0%
Totals		**8,760**	**0**	**0**	**0**	**0**	**0**	**0**

End-Use	Existing			Install Triple Pane Windows			Savings					
	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (kWh)	Propane (L)				
Space Cool	1.1	0.0	1,078.5	1.0	0.0	963.0	116	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	88.3	25,879.2	0.0	88.0	25,797.2	0	12				
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Hot Water	0.2	0.0	244.7	0.2	0.0	244.8	0	0				
Vent. Fans	2.2	0.0	2,249.1	2.2	0.0	2,249.1	0	0				
Pumps & Aux	0.4	0.0	438.8	0.4	0.0	438.0	1	0				
Ext. Usage	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Misc. Equip	1.1	0.0	1,131.8	1.1	0.0	1,131.8	0	0				
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0				
Area Lights	3.6	0.0	3,604.8	3.6	0.0	3,604.8	0	0				
0	**9**	**88**	**34,627**	**8**	**88**	**33,466**	**116**	**12**	**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 Triple Pane Windows

Cost Breakout: Install Triple Pane 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				Triple Glazed Windows		per sqft of window area	Pinpoint	$91	$18	$0	Yes	Project	700	$97,792	$19,597	$0	$117,389
111	0	0											Yes	Project		$0	$0	$0	$0
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:	**$97,792**	**$19,597**	**$0**	**$117,389**

Escalation Rates: Install Triple Pane Windows

Year:	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Demand ($/kW):	11.8277	12.5374	13.2896	14.0870	14.9322	15.8281	16.7778	17.7845	18.8516	19.9827	21.1816	22.4525	23.7997	25.2276	26.7413	28.3458	30.0465	31.8493	33.7603	35.7859	37.9330
Electricity ($/kWh):	0.2133	0.2244	0.2360	0.2483	0.2612	0.2748	0.2891	0.3041	0.3199	0.3366	0.3541	0.3725	0.3919	0.4122	0.4337	0.4562	0.4799	0.5049	0.5312	0.5588	0.5878
Natural Gas ($/litres):	0.9334	0.9801	1.0291	1.0805	1.1346	1.1913	1.2508	1.3134	1.3791	1.4480	1.5204	1.5964	1.6763	1.7601	1.8481	1.9405	2.0375	2.1394	2.2463	2.3587	2.4766
Water ($/m³):	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
Natural Gas ($/m³):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
($/):	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: Install Triple Pane 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:	-$146,736	$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):		$26	$27	$29	$30	$32	$34	$35	$37	$39	$41	$43	$46	$48	$50	$53	$56	$59	$62	$65	$68
Annual Savings (M03):		$11	$12	$13	$13	$14	$14	$15	$16	$17	$18	$18	$19	$20	$21	$22	$24	$25	$26	$27	$29
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:	-$146,736	$37	$39	$41	$43	$46	$48	$51	$53	$56	$59	$62	$65	$68	$72	$75	$79	$83	$88	$92	$97
Cash Balance:	-$146,736	-$146,699	-$146,659	-$146,618	-$146,575	-$146,529	-$146,481	-$146,430	-$146,377	-$146,321	-$146,262	-$146,201	-$146,136	-$146,067	-$145,996	-$145,920	-$145,841	-$145,757	-$145,670	-$145,577	-$145,480
Undepreciated Amount:	-$146,736	-$124,726	-$106,017	-$90,114	-$76,597	-$65,108	-$55,341	-$47,040	-$39,984	-$33,987	-$28,889	-$24,555	-$20,872	-$17,741	-$15,080	-$12,818	-$10,895	-$9,261	-$7,872	-$6,691	-$5,687

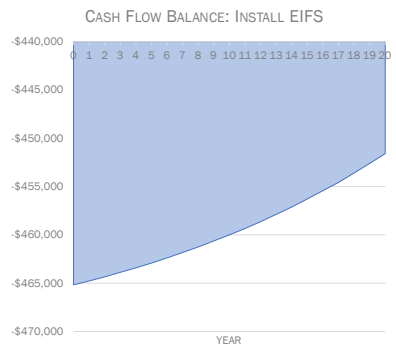
Energy Conservation Measure 9

Opp Cat:	Select
Opp Desc:	
Opp Name:	Install EIFS

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):	-15
Natural Gas (litres):	423
Water (m³):	0
Natural Gas (m³):	0
():	0
Emissions (Tonnes of CO_2e):	0.7
Financials	
Annual Utility Savings:	$391
Add'l Annual Savings:	$0
Add'l Annual Costs:	$0
Incentives:	$0
Materials & Labour:	$372,132
Engineering & PM:	$55,820
Contingency:	$37,213
Project Costs:	$465,165
Simple Payback:	No Payback
Capital Payback:	No Payback
NPV:	-$458,887
IRR:	-21.0%



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

Work Check	Main Meter	Breakout Meter
	Select	Select
Existing	0	0
Savings	66,455	66,862
% Reduction	#DIV/0!	#DIV/0!

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

Savings: Install EIFS

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	1						0%
-13	-25	24						0%
-8	-22	37						0%
-3	-19	68						0%
3	-16	153						0%
8	-14	201						0%
13	-11	364						0%
18	-8	506						0%
23	-5	638						0%
28	-3	605						0%
33	0	810						0%
38	3	629						0%
43	6	606						0%
48	9	646						0%
53	11	688						0%
58	14	669						0%
63	17	724						0%
68	20	625						0%
73	23	449						0%
78	25	225						0%
83	28	82						0%
88	31	10						0%
93	34	0						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)	Propane (MMBTU)	Combined (kWh)	Electricity (MWh)	Propane (MMBTU)	Combined (kWh)	Electricity (kWh)	Propane (L)					
Space Cool	1.1	0.0	1,078.5	1.1	0.0	1,095.2	-17	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	88.3	25,879.2	0.0	78.1	22,881.0	0	423					
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0	0					
Hot Water	0.2	0.0	244.7	0.2	0.0	243.5	1	0					
Vent. Fans	2.2	0.0	2,249.1	2.2	0.0	2,249.1	0	0					
Pumps & Aux	0.4	0.0	438.8	0.4	0.0	438.7	0	0					
Ext. Usage	0.0	0.0	0.0	0.0	0.0	0.0	0	0					
Misc. Equip	1.1	0.0	1,131.8	1.1	0.0	1,131.8	0	0					
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0	0					
Area Lights	3.6	0.0	3,604.8	3.6	0.0	3,604.8	0	0					
0	**9**	**88**	**34,627**	**9**	**78**	**31,644**	**-15**	**423**	**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

Cost Breakout: Install EIFS

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				EIFS	Whole Building	per sqft	MTE Quote	$69	$17		Yes	Project	2800	$297,589	$74,543	$0	$372,132
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:	**$297,589**	**$74,543**	**$0**	**$372,132**

Escalation Rates: Install EIFS

Cash Flow Balance: Install EIFS

	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:	-$465,165	$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):		-$3	-$4	-$4	-$4	-$4	-$4	-$5	-$5	-$5	-$5	-$6	-$6	-$6	-$7	-$7	-$7	-$8	-$8	-$9	-$9
Annual Savings (M03):		$414	$435	$457	$480	$504	$529	$555	$583	$612	$643	$675	$709	$744	$782	$821	$862	$905	$950	$998	$1,047
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:	-$465,165	$411	$432	$453	$476	$500	$525	$551	$578	$607	$638	$669	$703	$738	$775	$814	$854	$897	$942	$989	$1,038
Cash Balance:	-$465,165	-$464,754	-$464,322	-$463,869	-$463,393	-$462,894	-$462,369	-$461,819	-$461,240	-$460,633	-$459,995	-$459,326	-$458,623	-$457,885	-$457,110	-$456,297	-$455,442	-$454,545	-$453,603	-$452,615	-$451,576
Undepreciated Amount:	-$465,165	-$395,390	-$336,082	-$285,669	-$242,819	-$206,396	-$175,437	-$149,121	-$126,753	-$107,740	-$91,579	-$77,842	-$66,166	-$56,241	-$47,805	-$40,634	-$34,539	-$29,358	-$24,954	-$21,211	-$18,030