TOWNSHIP OF ESQUIMALT

BUILDING RETROFIT STUDY

PUBLIC WORKS BUILDING, 601 CANTEEN RD

JANUARY 2026

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TOWNSHIP OF ESQUIMALT

PROJECT NO.: CA0051294.1761
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1 EXECUTIVE SUMMARY

ENERGY AND GHG ANALYSIS

The Public Works Building is a single storey facility consisting of a maintenance garage, woodwork shop, metal shop, storage sheds, washrooms, changerooms and offices. The area is reported to be 1,150 m^2. The site used approximately 225,000 ekWh of energy at a cost of $23,600, for an energy intensity of 18.2 ekWh/ft^2.

The current GHG emissions are approximately 17.2 tCO2e, which is less than the 2010 baseline of 22 but slightly higher than the 2023 baseline of 16. The emissions are low when compared to other municipal buildings such as the Recreation Centre.

ENERGY CONSERVATION AND GHG REDUCTION MEASURES

We identified a number of measures; these have been split up into the following categories:

— Energy Conservation measures

— Capital Measures

— GHG Emissions Reduction Strategies

The following table summarizes the potential energy conservation measures.

MEASURE		POTENTIAL SAVINGS			COST/PAYBACK	
#	ENERGY CONSERVATION MEASURE	Energy (ekWh[1]/Yr)	Utility Cost ($/Yr)	Emissions Reduction (tCO_2e /Yr)	Opinion Of Cost	Simple Payback (years)
Energy Conservation Measures						
6.1	LED Lighting Retrofit	15,000	$1,620	0.2	$20,000	12
6.2	Install Programable Thermostats	40,000	$2,700	4	$10,000	3.7
6.3	Install Overhead Door to Heater Interlock	4,100	$130	0.8	$2,000	15
	ECM Totals (Rounded)	**59,000**	**$4,450**	**5**	**$32,000**	**7.2**
Capital Measures						
7.1	PV Panels	75,000	$8,100	1	$185,000	23
7.2	Building Envelope – Window Replacement	3,300	$350	0.05	$438,000	NA
Capital Measures Totals (Rounded)		**78,300**	**$8,450**	**1.05**	**$623,000**	**NA**
GHG Reduction Measures						
8.1	Replace Natural Gas Heaters with Electric	13,600	-$2,500	9.3	$20,000	NA

[1] ekWh – equivalent kilowatt hour

The total potential savings will not equal the simple addition of the individual values. The "integrated" totals represent an estimate of the combined savings.

Cost savings are based on historic utility rates. Future utility rates are on the rise in many jurisdictions. Higher utility rates result in higher, more attractive cost savings from energy conservation.

To realize the benefits outlined in this report, the measures identified must be implemented. We have recommended a next step for each measure. Depending on the size, complexity, and volume of projects, you may need to prepare engineering designs and/or specifications, develop bid documents for competitive quotes, manage construction review and/or contract administration, commission systems, verify installation as intended, train operators on system changes, measure performance improvement, and analyze/prepare/administer incentive applications and associated reporting. WSP can provide the expertise and services that will lead to successful implementation of energy conservation measures.

2 INTRODUCTION

2.1 AUTHORIZATION

This report was prepared at the request of Steve Knoke, Director, Parks and Recreation Services at the Township of Esquimalt, in accordance with our proposal dated February 28, 2025.

2.2 BACKGROUND

Esquimalt Council has made climate action a strategic priority, declared a climate emergency, and set ambitious targets to reduce corporate greenhouse gas emissions (GHGs) by 45% from 2010 levels by 2030, and to becoming a 100% renewable energy community by 2050. Recently, Council resolved to complete a **GHG Reduction Building Feasibility Study** that would meet Federation of Canadian Municipalities (FCM) goals to identify a sequence of GHG reduction measures to reduce GHG emissions for community buildings by at least 50% within 10 years and by at least 80% (i.e. near net-zero GHG emissions) within 20 years from 2023 (the base year), while managing capital costs and reducing operating costs.

The completion of the Retrofit Feasibility Study would ultimately enable the municipality to integrate reductions in GHG emissions and energy use into longer-term asset management plans for managing the municipal buildings and attain future FCM funding to complete innovative capital projects.

The Township of Esquimalt contracted WSP to conduct Building Retrofit Studies on a portfolio of 5 buildings, with the primary focus on the two largest energy consumers and GHGs emitters.

- **Esquimalt Recreation Centre** (527 Fraser Street): Built in 1973. Gross floor area = 4828. Heated with gas. A community recreation facility with an aquatics centre, weight room, gymnasium, and multi-purpose spaces.
- **Archie Browning Sports Centre** (1151 Esquimalt Road): Built in 1960. Gross floor area = 6050 m^2. Heated with gas. This facility includes an ice arena, a six-sheet curling rink, lounge areas, and Esquimalt Parks and Recreation administrative offices.
- **Municipal Hall** (1229 Esquimalt Road): Built in 2002. Gross floor area = 935 m^2.Heated with gas and electric heat pump. The Hall, a three-storey building includes a council chamber, administrative offices, and satellite police offices.
- **Public Works** building (601 Canteen Road) Built in 1996. Gross floor area = 1150 square metres. Heated with gas. Home to Esquimalt’s public works staff and the municipal fleet, including administration offices, mechanics shop, and stores.
- **Parks Nursery** building (1100 Craigflower Road) Built in 1979. Gross floor area = 223 m^2. Heated with gas. Home to Esquimalt’s parks staff, including administrative offices, meeting /lunchroom and storage.

This report focuses on the **Public Works Building, 601 Canteen Road**.

2.3 OPINION OF COSTS

The opinions of probable costs presented in this report should be considered preliminary budgets. They are intended to be sufficient for making educated investment decisions and obtaining preliminary project approval. Significant projects will typically require further investigation and design to accurately determine construction budgets and timing. Unless noted otherwise, we have assumed that all the measures identified in our report will be implemented as a single project. Actual costs may be higher if projects are implemented individually. Costs do not include HST.

For each option where an incentive may be available, we have included an estimate of the potential eligible incentive value, less the anticipated cost of incentive administration. You would need to apply for incentives before proceeding with any work. Incentive programs periodically change. The values presented are based on the program in effect at the time of our investigation. The incentives considered are described below.

2.4 PROJECT SAVINGS

Savings were developed using tabulated data, energy handbooks, the ASHRAE Handbook, weather data, WSP's previous project experience, supplier data sheets, and background information gathered during the site visits, as well as mechanical, electrical, and architectural plans provided by the clients. Equipment operation was based on schedules and control sequences provided by the client during the site visit.

Savings were calculated using the latest rates provided by the energy suppliers.

2.5 UTILITY RATE

The utility rates used throughout this project to assess the savings from implementing energy conservation and decarbonization measures were the current rates published by the supplier. The rates used are summarized in the table below.

Table 2-1 Summary Utility Savings Rates

Electricity	BC Hydro: Medium General Service Rate 1500 Consumption rate = $0.1080/kWh, Demand rate = $6.03/kW
Natural Gas	FORTIS BC: Large Commercial Rate Total rate (Supply, Delivery, Storage & transport) = $8.80/GJ
Water	City of Victoria Rate = $5.30 /100 ft3, or $1.87 /m3

2.6 INCENTIVES

The Federation of Canadian Municipalities (FCM) Community Buildings Retrofit (CBR) initiative helps to optimize the energy performance and reduce greenhouse gas (GHG) emissions of community buildings owned by municipalities and not-for-profit organizations. The CBR initiative is administered through FCM's Green Municipal Fund (GMF).

FCM's Community Buildings Retrofit initiative is a $167 million initiative that was made possible through a federal government contribution of $950 million in its 2019 budget. Applicants can stack CBR funding with funding from other programs, including programs available through provincial and territorial governments.

Grants for GHG reduction pathway feasibility studies help to integrate energy and GHG reductions into longer- term plans for managing community buildings. These studies will enable municipalities to identify a sequence of GHG reduction measures—the "GHG reduction pathway"—that will help to reduce GHG emissions for community buildings by at least 50% within 10 years and by at least 80% (i.e. near net-zero GHG emissions) within 20 years while managing capital costs and reducing operating costs. For a full list of eligibility requirements for the CBR initiative and GHG reduction pathway feasibility studies, see the application guide.

2.7 EMISSION ENERGY & CONVERSIONS FACTORS

The emission energy factors and conversion factors used in this report comes from NRCan and are summarized below:

Table 2-2 Emission Energy Factors and Conversions Factors

ENERGY	EMISSION FACTOR (TCO2/EKWH)	EMISSION FACTOR (TCO2E/GWH)	CONVERSION FACTOR
Electricity	0.000014	14.0	
Natural Gas	0.000185995	185.995	0.05167 tCO2/GJ

Updated projections for the future emissions factors for electricity were published in December 2025. The projected factors for British Columbia are listed below.

Table 2-3 Projected Emission Energy Factors for Electricity

YEAR	REGION	EMISSION FACTOR (TCO2E/GWH)*
2025	British Columbia	5.8
2026	British Columbia	7.2
2027	British Columbia	7.7
2028	British Columbia	8.2
2029	British Columbia	8.5
2030	British Columbia	5.7
2031	British Columbia	5.8
2032	British Columbia	5.4
2033	British Columbia	6.5
2034	British Columbia	7.4
2035	British Columbia	2.2

** Excluding Biomass and RNG CO2 emissions*

See ECCC Data Catalogue

3 BUILDING DESCRIPTION

GENERAL DESCRIPTION

Esquimalt Public Works Building or Esquimalt Public Works Yard is a single-story structure with varied uses, located in Esquimalt, British Columbia. Built in 1996, the building has an area of approximately 12,375 ft^2 (1,150 m^2) and is comprised of a large maintenance garage, woodwork shop, metal shop, storage sheds as well as offices and changerooms.

Table 3-1 General description of the Esquimalt Public Works Yard

Name and Address	Public Works / Public Works Yard Building – 601 Canteen Road, Esquimalt, BC V9A 3R2
Gross Floor Area	1,150 m2
Year Constructed	1996
Number of Levels	1 Storey, Large maintenance garage, Woodwork shop, Metal shop, Storage sheds, Washrooms, change rooms, offices
Cladding	The exterior walls are metal siding with some exposed concrete walls.
Parking	surface
Current Occupancy (%)	Full
Building Usage	Maintenance functions

Figure 3-1 Aerial View

GENERAL SCHEDULES

The schedules for the Public Works building were retrieved from the documentation received and the site visit.

Table 3-2 Summary of Schedules

	ON	OFF	DAYS/WK	WK/YR
Staff Occupancy	7:00	17:00	6	52
Public Hours	8:00	17:00	6	52
Lighting	7:00	20:30	6	52

3.1 BUILDING ENVELOPE

The structure is steel-framed with corrugated metal roof decking supported by open web steel joists, beams and columns. The ground floor is a cast-in-place concrete slab-on-grade. There is a vehicle service pit in the mechanical workshop which extends below grade. The building's foundation consists of concrete strip and spread footings.

Walls
The exterior walls are primarily clad in painted prefinished metal siding. There are also small areas with exposed concrete walls. Sealant is installed at cladding transitions and at window and door perimeters.

The cladding is designed as a face-sealed system, meaning that the walls do not include drainage cavities or other means of expelling water which penetrates the outer surface. With this type of system, the outer surface is intended to be watertight.

Windows
There are aluminum-framed glazing systems with double-glazed insulating glass units (IGUs) at all elevations of the building, generally installed in a window-wall or strip configuration.

Roof
The roofs are covered with pre-finished standing seam sloped metal roofing. The roofs drain into prefinished metal gutters and downspouts that discharge into the below-grade drainage system.

Doors
There is an entrance door which consists of a painted single swing steel door in a steel frame. Exit doors are generally painted single or double-swing steel doors set in steel frames. Some exit doors have inset glazing units.

Overhead doors at the mechanics shop and workspace areas are a combination of standard-height and double-height insulated metal roll up doors. These doors are chain-driven, with some operated automatically.

3.2 ELECTRICAL INFRASTRUCTURE

Electricity is supplied underground to the main electrical room that is located on the south side of the building. The main electrical room contains the following equipment:

- Main switchboard with the main disconnect switch (rated at 800A, 120/208V), and various sized secondary switches for distribution to the panels.
- Distribution panels labelled A, M and E, each rated 225A, 120/208V
- House meter located in a locked cabinet

Electricity is distributed throughout the facility via additional distribution panels located in corridors and service areas. We noted panels labelled B, C, D and H (each rated 225A, 120/208V) located in the various corridors.

The outbuilding/garage located to the north of the operations building also contained a distribution panel, labelled F, rated at 100A, with service fed from the main electrical room. Where seen, the wiring is copper.

3.3 HVAC SYSTEMS

Office Spaces
Conditioned air is distributed throughout the occupied floor spaces by a simple air handling unit with electric duct heater, and four split-system heat pumps. These units are further described as follows:

- Air handling unit (AHU1) located in the east corridor ceiling space, serving the lunchroom area. This unit is a simple fan with electric duct heater (no cooling). The unit appears to be original, 1996.
- Two split system heat pumps serve the east office area via 3 wall-mounted head units, connected to two condensers located on the exterior wall on the east side of the building. These units were manufactured by Carrier, have an approximate cooling capacity of 3 tons each, operate on R410A refrigerant, and were manufactured in 2019.
- A split system heat pump serves the west office area (Yard Office) via a fan coil unit manufactured by Accutemp located in the central ceiling space with distribution ductwork provided to the surrounding office spaces, and connected to a condenser located in the landscaped area on the west side of the building. This condenser unit was manufactured by Dakine, has an approximate cooling capacity of 2 tons, operates on R410A refrigerant, and was manufactured in 2012.
- A split system heat pump serves the computer server room via a wall-mounted head unit, connected to a condenser located in the landscaped area on the west side of the building. This unit was manufactured by Mitsubishi (Mr. Slim model), has an approximate cooling capacity of 1 ton, operates on R410A refrigerant, and was manufactured in about 2007 (based on serial number).

Supplemental heating in occupied spaces (offices and corridors) is provided by electric baseboards.

Service Bays
Service bays are equipped with gas-fired ceiling-hung radiant heaters; two in the wood shop and metal shop, four in the mechanic's shop. The stores warehouse space is also equipped with a gas-fired ceiling-hung radiant heater. Smaller service areas are equipped with ceiling-hung electric unit heaters.

Heating systems are controlled by local thermostats. No central building automation system is provided.

Exhaust Fans
Exhaust fans include small ventilation fans serving service rooms, storage rooms, and washrooms. Ceiling hung circulation fans were also noted in larger service areas.

The facility is equipped with a variety of specialized ventilation/exhaust systems:
- Metal shop and wood shop have specialty ventilation fans and dust extractor fans
- Mechanics shop has one large ventilation fan and two vehicle exhaust extraction fans manufactured by PolymoVent
- Stores warehouse storage space has a large ventilation fan.

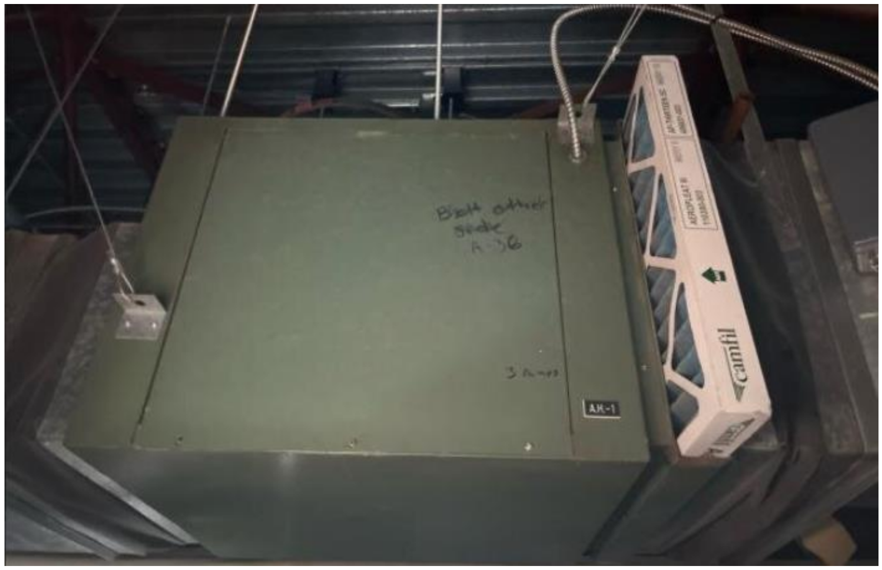


Figure 3-2 AH-1

3.4 DOMESTIC HOT WATER

Domestic hot water is generated from one domestic hot water electric heater tank, manufactured by John Wood (model E80TEM) in 2022, with a rated heating capacity of 4500W. There is also a second smaller electric heater tank located in the mechanics shop above the bathroom ceiling.

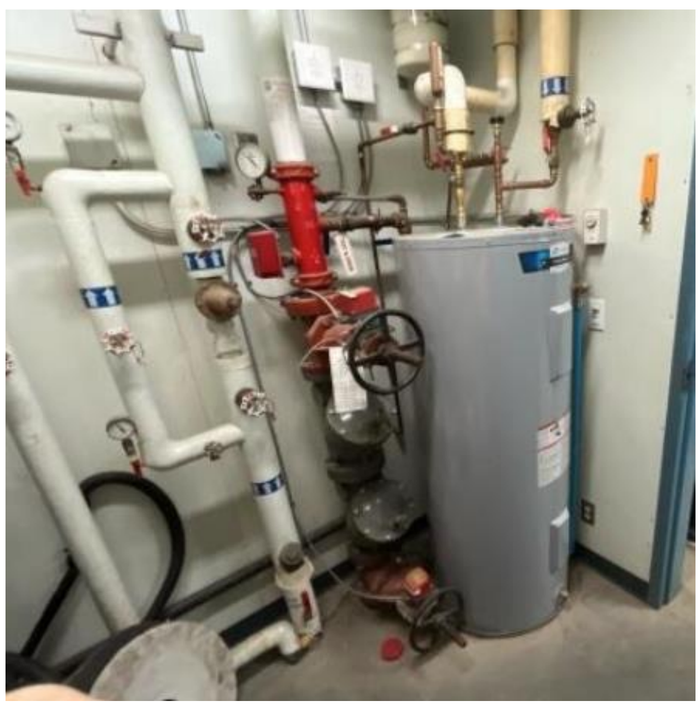


Figure 3-3 Domestic Hot Water System

3.5 LIGHTING

Interior Lighting

- Occupied areas (offices and smaller rooms), typically ceiling mounted fixtures with 2 lamp, 4ft long fluorescent T8 lamps.
- One office and the women's washroom have been upgraded to LED panel fixtures.
- Service bays/workshop areas, typically, ceiling-hung fixtures with 2 lamp, 4 ft long fluorescent lamps (combination of T5 lamps and some T8 lamps).
- The mechanics shop area had additional wall-mounted fluorescent fixtures with T8 lamps.

Exterior Lighting

- seven wall-mounted LED fixtures illuminating walking areas and roadways around the building
- five ceiling-mounted fixtures installed at roof overhangs above overhead doors and entrance doors
- ten galvanized metal lamp posts with LED fixtures to illuminate the operations yard,
    - two were equipped with two lamps each, the other eight posts had a single lamp each.

3.6 PLUG LOADS

As a maintenance facility, there is significant machine shop equipment. Additionally, there is some office equipment and there are small kitchen appliances.

4 EXISTING ENERGY PERFORMANCE

4.1 EXISTING ENERGY PERFORMANCE AND GHG EMISSIONS

4.1.1 ANNUAL UTILITY USAGE AND COSTS

The Public Works Building is supplied with energy and water from these sources:

- Electricity from BC Hydro
- Natural gas from Fortis BC
- Water from the City of Victoria

The utility usage and costs are summarized below. A baseline period of approximately May 2024 through April 2025 was selected to match the baseline of the other facilities.

Table 4-1 Baseline Data (May 2024 – April 2025)

Utility	Consumption		Equivalent Consumption		% of total energy	Rate		Cost	Energy Use Intensity (ekWh/ft^2)
Electricity Consumption	143,467	kWh	143,467	kWh	64%	0.1080	$/kWh	$15,494	11.59
Electricity Demand	460	kW				6.03	$/kW/mo	$2,774	
Natural Gas	294	GJ	81,767	ekWh	36%	8.80	$/GJ	$2,590	6.61
Water	1,477	m^3				1.87	$/m3	$2,764	
Total Equiv. Energy Consumption			**225,234**	**ekWh**	**100%**	**Total Cost**		**$23,623**	**18.20**

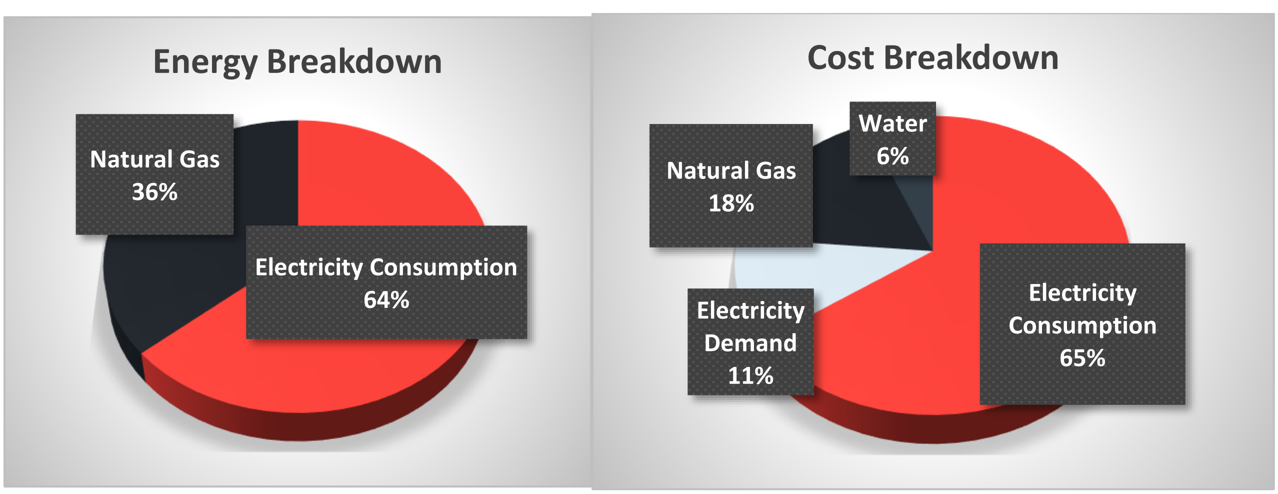


Figure 4-1 Utility Cost and Energy Usage Breakdown

The monthly energy usage shows a typical heating profile where the usage is high in the winter and low in the summer. There is no visible cooling, which is expected. This indicates that a large part of the energy consumption is for heating – both electricity and natural gas. Natural gas consumption is less than electricity but still significant.

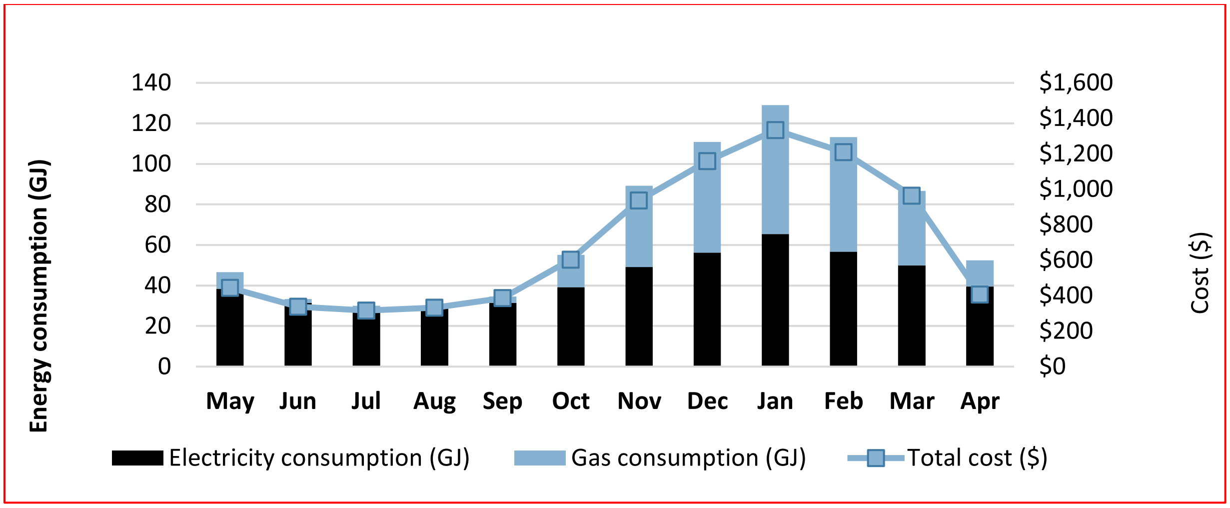


Figure 4-2 Monthly Energy Consumption and Cost

4.1.2 ANNUAL GHGS

The annual GHG emissions for the Public Works Building during the baseline period are summarized below. Most of the emissions come from natural gas consumption even though it is a smaller portion of the energy usage. The overall GHG emissions are very low.

Table 4-2 4-3 GHG Emissions Data (May 2024 – April 2025)

Utility	Consumption		GHG emissions (tons)	% of total GHG emissions	GHG emissions Intensity (kg CO_2e/ft^2)
Electricity	143,467	kWh	2	12%	0.16
Natural Gas	294	GJ	15	88%	1.23
Total			**17**	**100%**	**1.39**

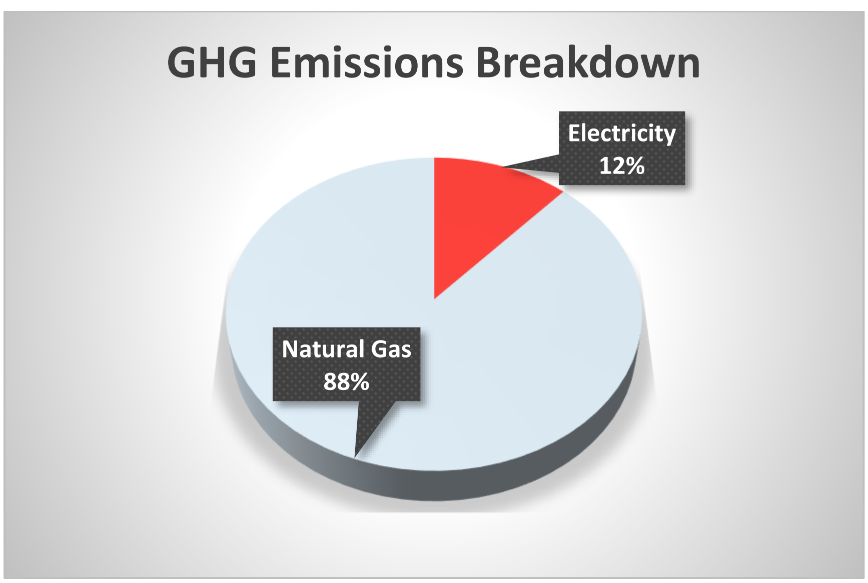


Figure 4-3 GHG Emissions Breakdown

4.1.3 ELECTRICITY

Electricity consumption at the Public Works Building was assessed starting from December 2022. The consumption has been consistent over the years, for the most part. The baseline was selected as May 2024 to April 2025 to match the other facilities. The usage clearly shows a significant baseload but also electric heating. This is expected as the building has electric heating.

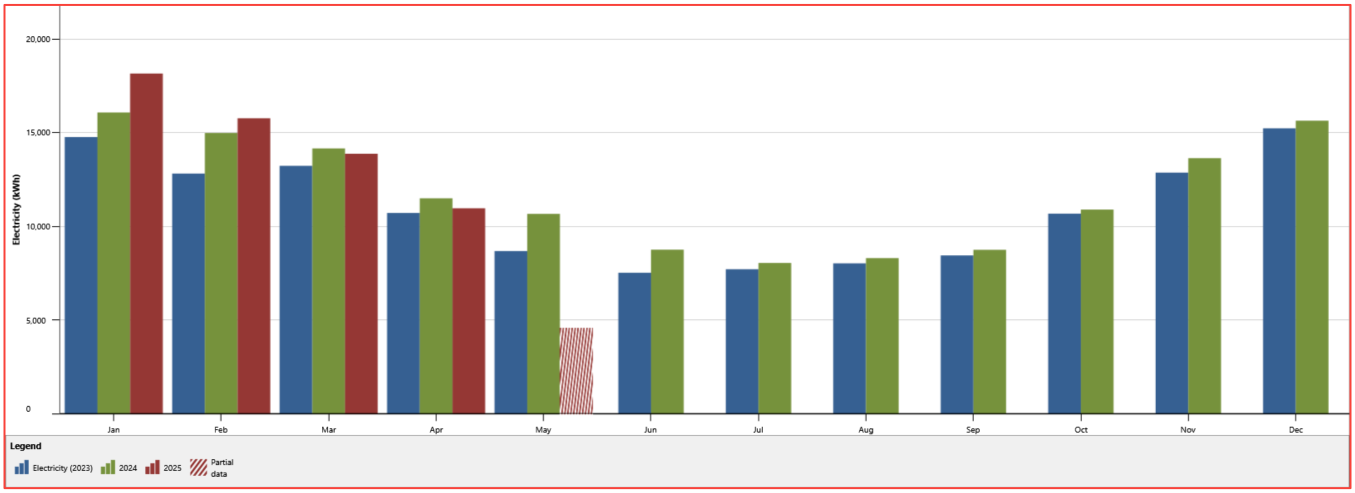


Figure 4-4 Monthly Electricity Consumption January 2023 to April 2025

The Public Works Building consumed around 143,500 kWh of electricity in the baseline, at a cost of $18,300. Monthly electrical demand varies from a low of 22 kW (summer) to a peak of 62 kW (winter).

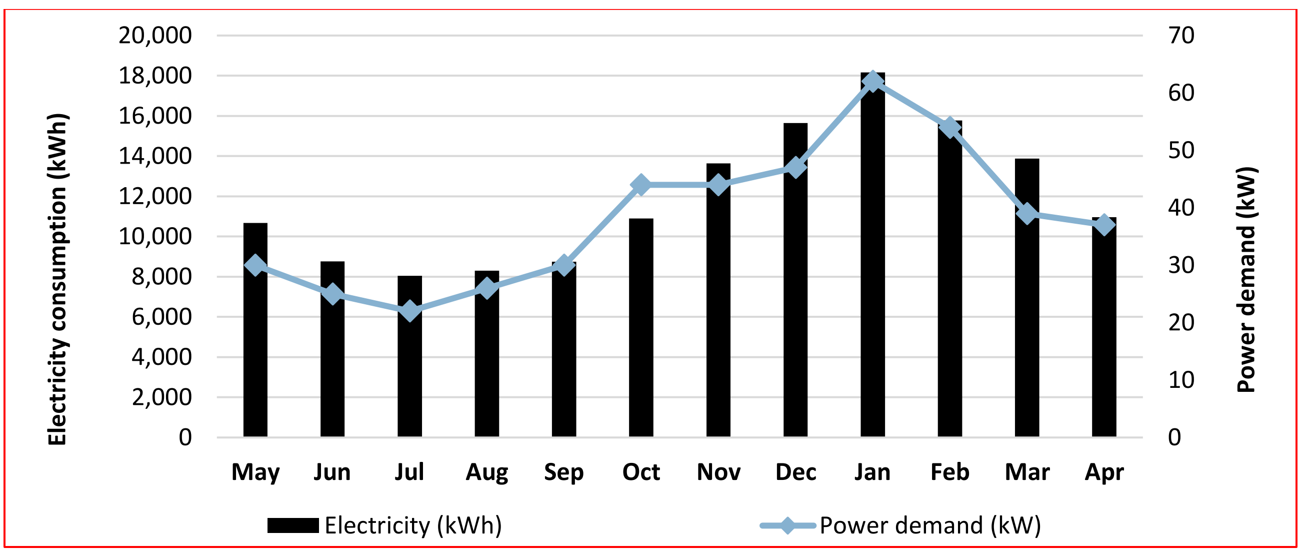


Figure 4-5 Monthly Electricity Consumption and Demand

The electricity consumption correlates very well with heating degree days with a balance point of 11°C. The electricity consumption does not correlate with cooling degree days, which is expected as there is no significant cooling on site.

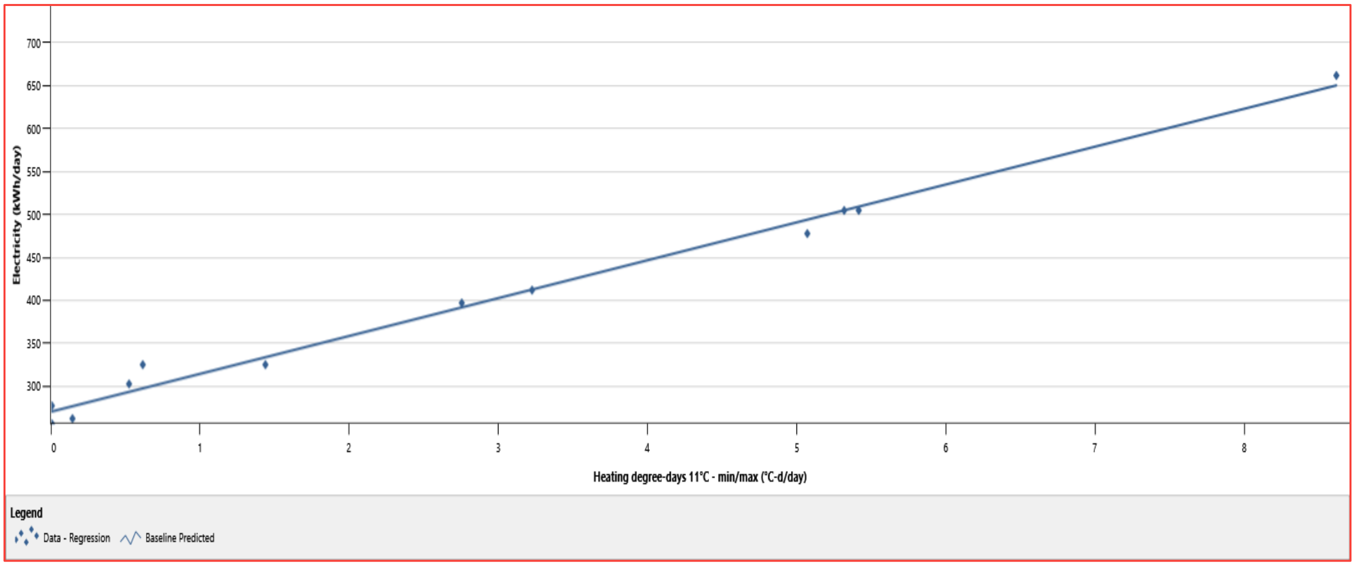
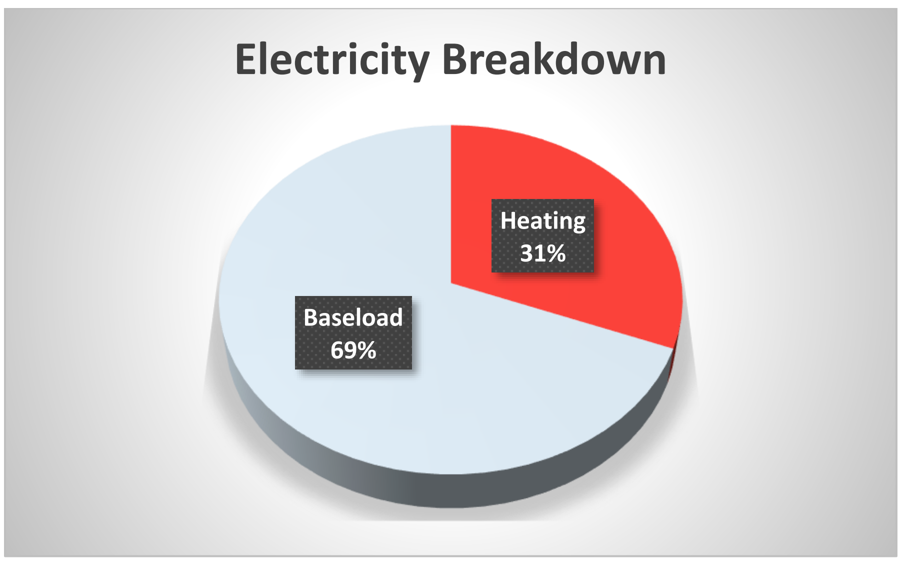


Figure 4-6 Electricity Consumption vs Heating Degree Days

The regression indicates that the majority of the consumption is baseload but with a significant amount of electric heating.



Equation

Data table	Electricity consumption - 6199933
Dependent variable (Y)	Electricity (kWh)
Independent variable (x)	Heating degree-days 11°C - min/max (°C-d)
Method	Daily
Weighted	Yes

Regression results

$Y = 44.0567*x+270.5943$

$R^2 = 0.9891$

Figure 4-7 Electricity Regression Breakdown

Interval Data

Hourly meter interval data was obtained from BC Hydro and analyzed. Data was only available from January 1 to June 6, 2025. When the data is graphed on a weekly basis, there is a high baseload and daily profile. This indicates that equipment is operating long hours and during unoccupied hours. Electricity is used for heating, so after hours usage is expected. But there may be room for improvement.

Figure 4-8 Electricity Interval Data Week Starting April 6, 2025

Heatmap

The interval data was also graphed as a heatmap, where all of interval data is displayed. The top right shows the beginning, Jan 1, ending in the bottom right with June 6. The days of the week run along the bottom.

Darker squares indicate higher consumption; lighter squares indicate lower consumption. The graph shows a light daily pattern, indicating that there is some scheduling but also a lot of variation in use. The building uses a lot of energy at night and during unoccupied hours. There may be opportunities for scheduling equipment. The usage is higher in the winter months which is expected.

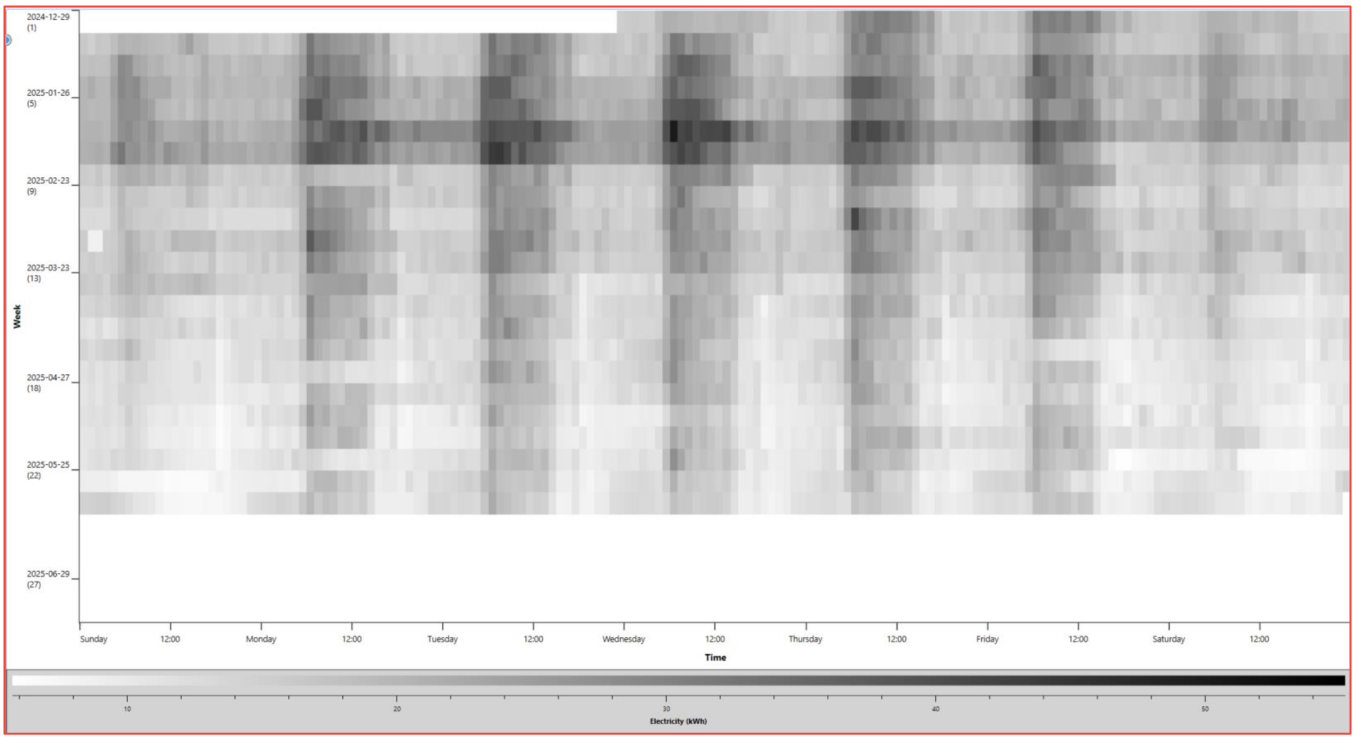


Figure 4-9 Heatmap of Electricity Interval Data January to June 2025

An example of clear daily scheduling of equipment is seen in the Esquimalt Recreation Centre heatmap. Dark and light bands indicate operation of equipment.

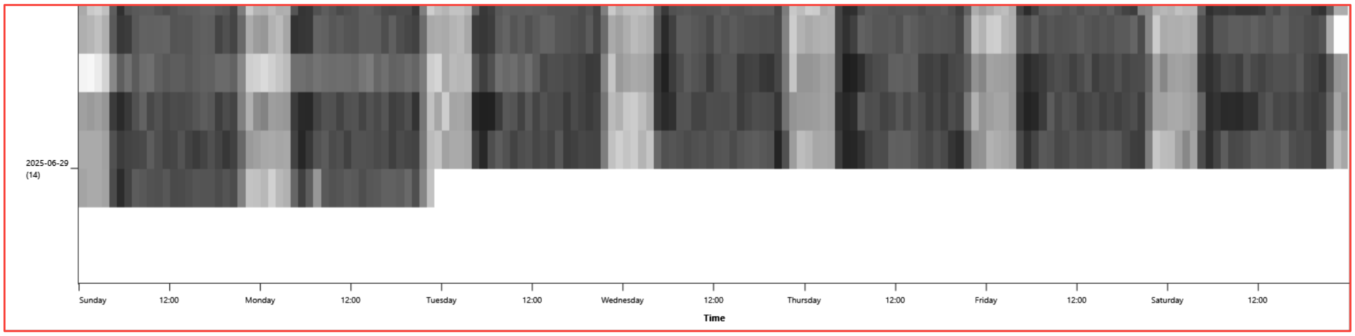


Figure 4-10 Example Recreation Centre Heatmap of Electricity Interval Data

4.1.4 NATURAL GAS

Natural gas consumption at the Public Works Building was assessed starting from December 2022. The baseline was selected as May 2024 to April 2025 to match the other facilities. The facility consumed less than 300 GJ of natural gas at a cost of $2,600. The usage is mainly in the cold months, with very little consumption in summer.

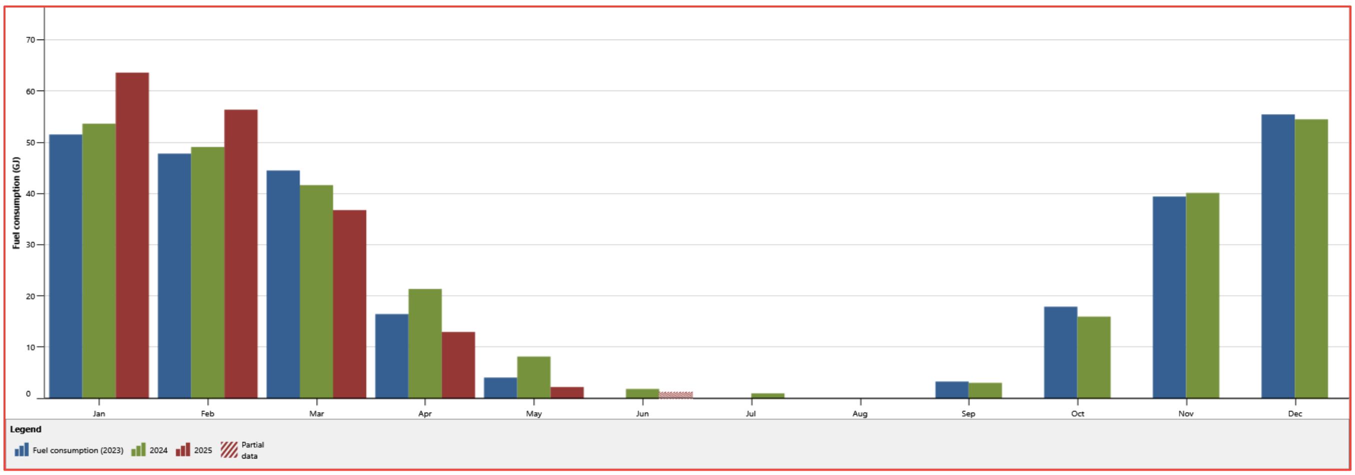


Figure 4-11 Monthly Natural Gas Consumption January 2023 to May 2025

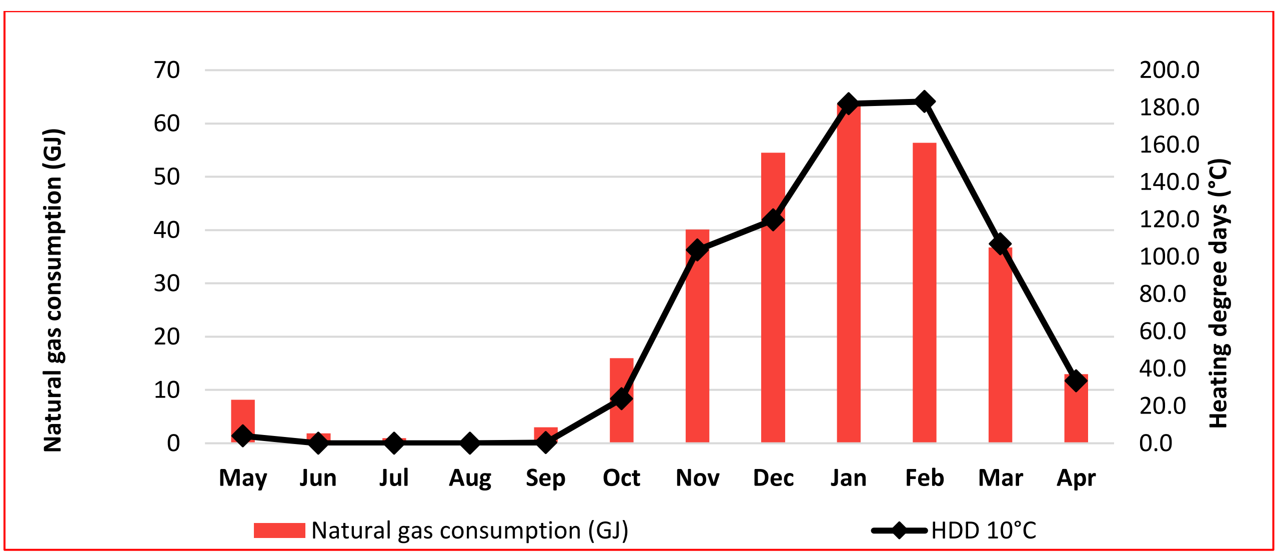


Figure 4-12 Baseline Natural Gas Consumption and HDD

The usage has an excellent correlation with heating degree days at a balance point of 10°C.

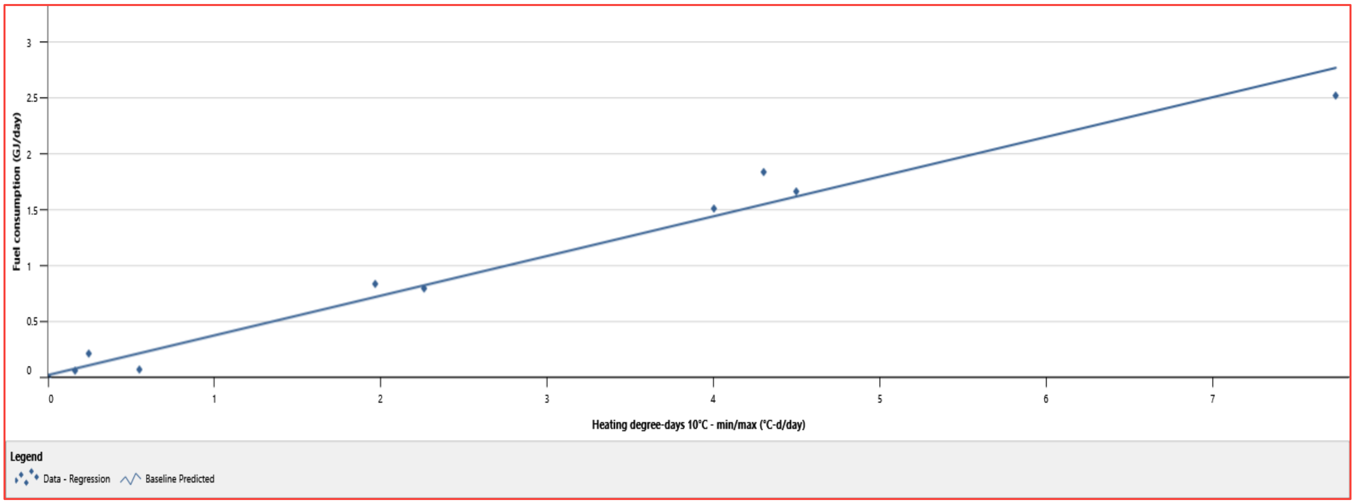
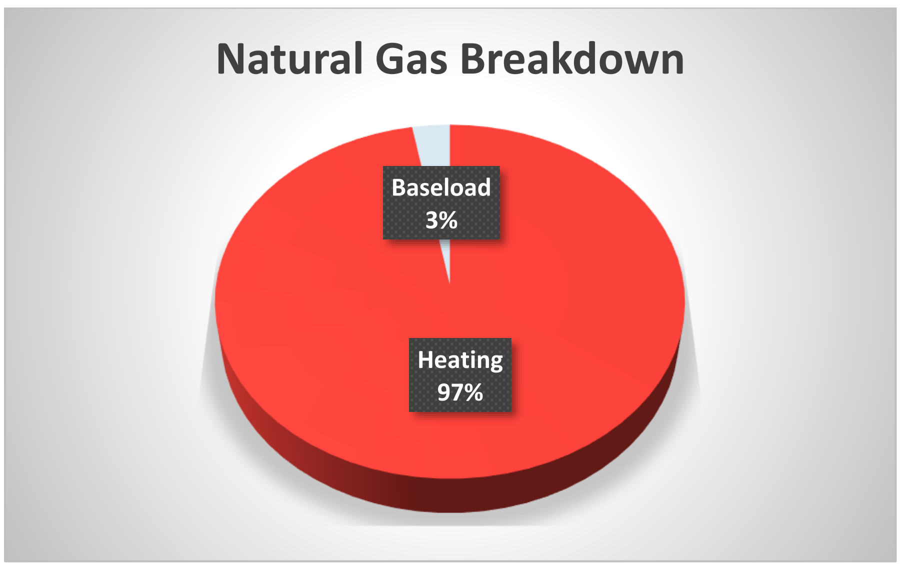


Figure 4-13 Natural Gas Consumption vs HDD

The results of the regression analysis indicate that is only 3% baseload and 97% heating.



Equation

Data table	Natural gas - SKT187747
Dependent variable (Y)	Fuel consumption (GJ)
Independent variable (x)	Heating degree-days 10°C - min/max (°C-d)
Method	Daily
Weighted	Yes

Regression results

$Y = 0.3552*x+0.0207$

$R^2 = 0.9749$

Figure 4-14 Natural Gas Regression Breakdown

4.1.5 WATER

Water consumed at the building is provided by the City of Victoria through a local distribution network. There are 2 water meters associated with this address, meter A-60030983 and A-10814209, but only the first has data. Water is only invoiced 3 times per year, generally every 120 days.

The annual water consumption (from calendarized data) is 1,477 m^3 at a cost of \$2,764. With total floor area of 1,150 m^2, this total annual water consumption amounts to a water use intensity of 1.28 m^3/m^2 and water cost index of \$2.4/m^2. Water consumption does not correlate with degree days or weather. This is expected, water is consumed by domestic water fixtures such as sinks, toilets, faucets, etc.

4.2 ENERGY PERFORMANCE BENCHMARKING

For context, we looked to compare the building's energy use intensity (EUI) with the 2019 Survey of Commercial and Institutional Energy Use for works buildings but data was not available. Comparing to public works sites in our database found a benchmark of 37 ekWh/ft^2. The EUI of Public Works Building compares well to this average which indicates that the energy usage of this site is good.

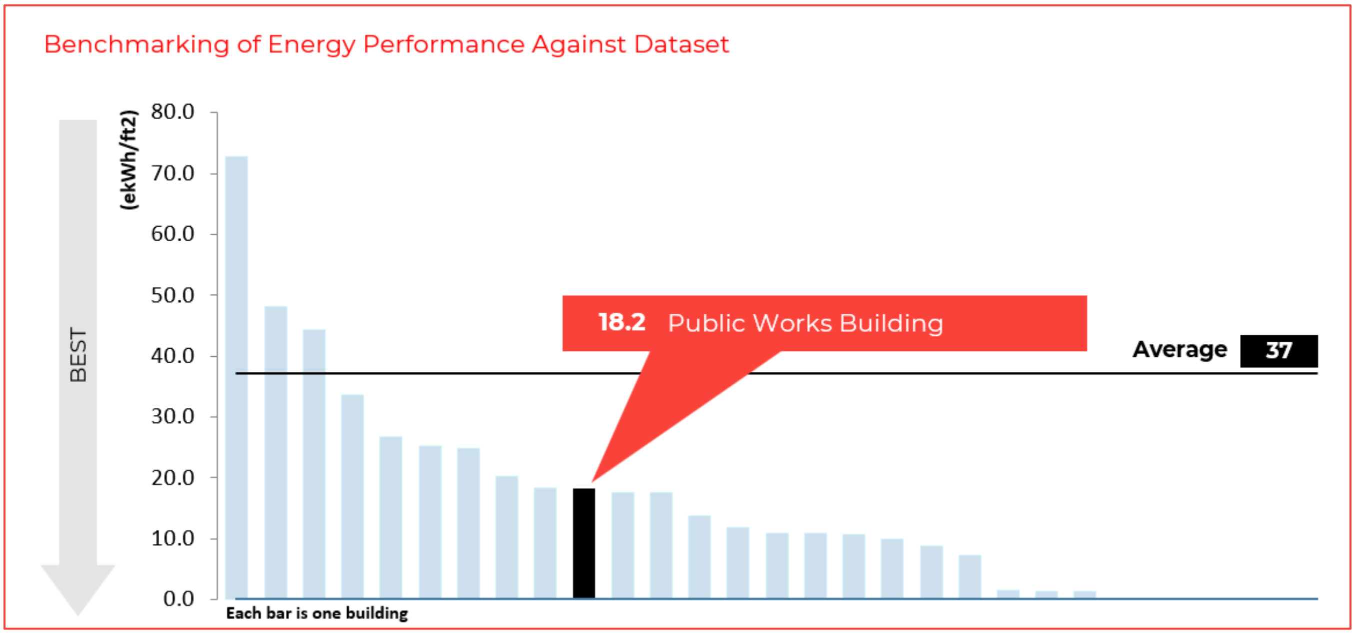


Figure 4-15 Benchmark of Works Buildings

4.3 END-USE-BREAKDOWN

The following table and graph show the estimated energy end-use breakdown for the facility.

Table 4-4 4–5 Energy End Use Breakdown

Section	Energy (kWh)	%
Space heating	137,392	61.1%
Lights	60,444	26.9%
Mechanical equipment	13,457	6.0%
Space cooling	10,608	4.7%
Hot water	2,977	1.3%
Total	224,878	

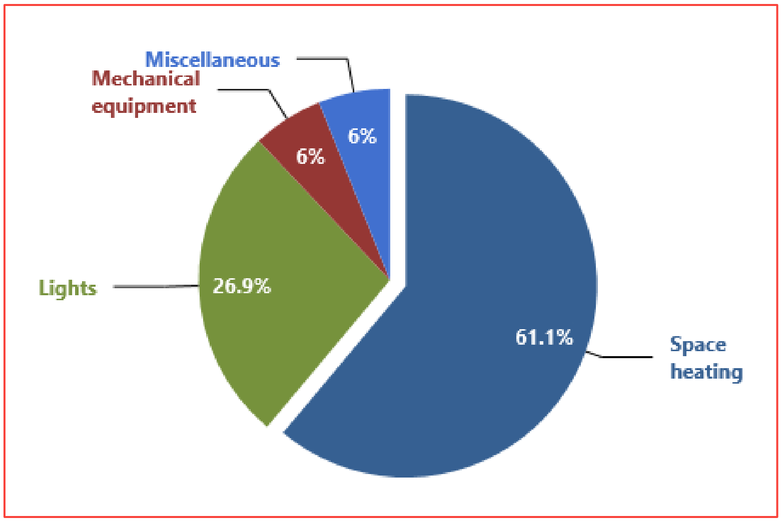


Figure 4-16 End Use Breakdown

5 KEY FINDINGS

The key findings of the Building Retrofit Study are captured below. The findings from our investigation have been divided into the following categories:

1. Operational Energy Conservation Measures

   Operational energy reduction strategies that do not require extensive equipment replacement but instead optimize existing systems for efficient operation.

2. Capital Measures

   Retrofit opportunities that require a capital investment.

3. GHG Reduction Strategies

   Strategies that will reduce carbon or GHG emissions.

6 ENERGY CONSERVATION MEASURES

6.1 LED LIGHTING RETROFIT

6.1.1 OPPORTUNITY

Interior Lighting
The office areas, service bays and workshops have ceiling or wall mounted fluorescent fixtures with T8 lamps, or in some cases T5 lamps.

The exterior lighting has been converted to LEDs.

Figure 6-1 Sample Lighting Fixtures

6.1.2 SCOPE OF MEASURE

It is recommended that the interior lighting be converted to LEDs.

Table 6-1 LED Lighting Retrofit

ENERGY SAVINGS	% ENERGY SAVINGS	COST SAVINGS	GHG SAVINGS	% GHG SAVINGS	OPINION OF COST	SIMPLE PAYBACK
15,000 ekWh/yr	7%	$1,620 /yr	0.2 tCO2e	1%	$20,000	12 years

6.2 INSTALL PROGRAMMABLE THERMOSTATS

6.2.1 OPPORTUNITY

Currently, there is no BAS or remote control for the HVAC equipment in the main building and the workshops. Since the site is typically only occupied during business hours and on weekends, it would be efficient to have a night setback of the temperature settings.

6.2.2 SCOPE OF MEASURE

It is recommended to install programable thermostats for the office areas and workshops. This would maintain the usual setpoints when the space is occupied but reduce to lower heating (higher cooling) setpoints during unoccupied hours.

Table 6-2 Install Programmable Thermostats

ENERGY SAVINGS	% ENERGY SAVINGS	COST SAVINGS	GHG SAVINGS	% GHG SAVINGS	OPINION OF COST	SIMPLE PAYBACK
40,000 ekWh/yr	18%	$2,700 /yr	4 tCO2e	24%	$10,000	3.7 years

6.3 INSTALL OVERHEAD DOOR TO HEATER INTERLOCK

6.3.1 OPPORTUNITY

Currently, the staff leave the overhead doors open often, when the weather is mild or not too cold. This is fine except that the heaters continue to operate.

6.3.2 SCOPE OF MEASURE

It is recommended to install interlocks between the overhead doors and the heaters. The heaters will automatically shut off when the overhead doors are open, saving heat.

Table 6-3 Install Overhead Door to Heater Interlock

ENERGY SAVINGS	% ENERGY SAVINGS	COST SAVINGS	GHG SAVINGS	% GHG SAVINGS	OPINION OF COST	SIMPLE PAYBACK
4,100 ekWh/yr	2%	$130 /yr	0.8 tCO2e	5%	$2,000	15 years

7 CAPITAL MEASURES

The following are retrofit opportunities that require major capital investment.

7.1 PV PANELS

7.1.1 OPPORTUNITY

The roof area of the various buildings is not shaded or obstructed by other structures.

7.1.2 SCOPE OF MEASURE

Installing PV panels on the roof areas would provide clean electricity for the site. The roof area could accommodate approximately 80 kW of PV panels. Calculations are based simulated model using Helioscope software.

Figure 7-1 Potential PV Panel Layout

Table 7-1 PV Panels

ENERGY SAVINGS	% ENERGY SAVINGS	COST SAVINGS	GHG SAVINGS	% GHG SAVINGS	OPINION OF COST	SIMPLE PAYBACK
75,000 ekWh/yr	50%	$8,100 /yr	1.0 tCO2e	6%	$185,000	23 years

7.2 BUILDING ENVELOPE – WINDOW REPLACEMENT

7.2.1 OPPORTUNITY

The current windows are likely non-thermally broken and understood to not provide the same level of thermal performance as modern windows. No replacements to date were reported. There are aluminum-framed glazing systems with double-glazed insulating glass units (IGUs) at all elevations of the building, generally installed in a window-wall or strip configuration.

The windows are about 29 years old (installed c.1996). This type of aluminum-framed window system generally has service life of about 45 to 50 years. Since these older-style aluminum-framed windows generally do not provide a level of service that would be considered acceptable by modern standards, eventual replacement of the windows with a more thermally efficient system is considered as part of on-going maintenance.

7.2.2 SCOPE OF MEASURE

The windows or IGUs will eventually fail over time as moisture gets past the perimeter seals and fogs up the units. It is recommended to replace these with upgraded window assembly units as these approach the end of their useful life, around 2041.

An example of an upgraded window assembly could include a low E coating applied on surface #2, argon filled IGU, non metallic spacing and a 19mm thermal break.

Table 7-2 Building Envelope – Window Replacement

ENERGY SAVINGS	% ENERGY SAVINGS	COST SAVINGS	GHG SAVINGS	% GHG SAVINGS	OPINION OF COST	SIMPLE PAYBACK
3,300 ekWh/yr	1%	$350 /yr	0.05 tCO2e	0.3%	$483,000	NA

8 GHG REDUCTION STRATEGIES

Esquimalt Council has made climate action a strategic priority, declared a climate emergency, and set ambitious targets to reduce corporate greenhouse gas emissions (GHGs).

As part of this report, it is required to develop and evaluate the following six GHG reduction pathway scenarios:

1) Short-term retrofit (5 years) – Achieving a 45% GHG reduction from **2010** levels.
2) Medium-term retrofit (10 years) – Achieving a 50% GHG reduction from **2023** levels.
3) Long-term retrofit (20 years) – Achieving an 80% GHG reduction from **2023** levels (near net-zero).
4) Short-term deep retrofit (5 years) – Achieving a 50% GHG reduction from **2023** levels.
5) Maximum site potential – Identifying the greatest possible GHG reductions, regardless of cost.
6) Optimized outcome – Balanced approach of aggressive GHG reduction with asset management objectives.

From the **2010** Energy Audit report, the GHG emissions were **23** tCO2e. From the utility data, the **2023** GHG emissions were **16.3** tCO2e. The most current GHG emissions were **17.2** tCO2e.

Given the very low emissions in the baseline years, all scenarios require substantial reductions.

The vast majority of the GHG emissions (98%) come from natural gas consuming equipment. Substantial reductions can only be achieved by measures that reduce or eliminate this equipment.

Table 8-1 List of Natural Gas Consuming Equipment

SYSTEM ID	DESCRIPTION
Unit Heaters	Service bays natural gas-fired heaters; two in the wood shop and metal shop, four in the mechanic's shop, and in the stores warehouse

8.1 REPLACE NATURAL GAS HEATERS WITH ELECTRIC

8.1.1 OPPORTUNITY

The service bays are heated by natural gas fired radiant heaters. These are controlled by local thermostats.

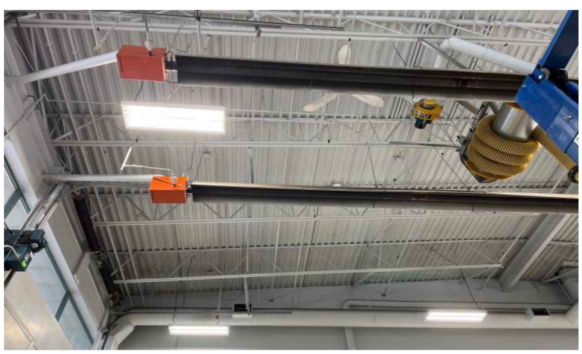


Figure 8-1 Natural Gas Fired Radiant Heaters

8.1.2 SCOPE OF MEASURE

It is recommended to replace these with electric heaters. This will save energy and reduce GHG emissions.

Table 8-2 Replace Natural Gas Heaters with Electric

ENERGY SAVINGS	% ENERGY SAVINGS	COST SAVINGS	GHG SAVINGS	% GHG SAVINGS	OPINION OF COST	SIMPLE PAYBACK
13,600 ekWh/yr	6%	-$2,500 /yr	9.3 tCO2e	54%	$20,000	NA

8.2 SUMMARY OF GHG REDUCTION MEASURES

Since the GHG emissions baselines (2010 and 2023) are very low, there is little benefit in reviewing the 6 individual scenarios. Using the various measures already described, the following pathway to low GHG emissions is outlined below.

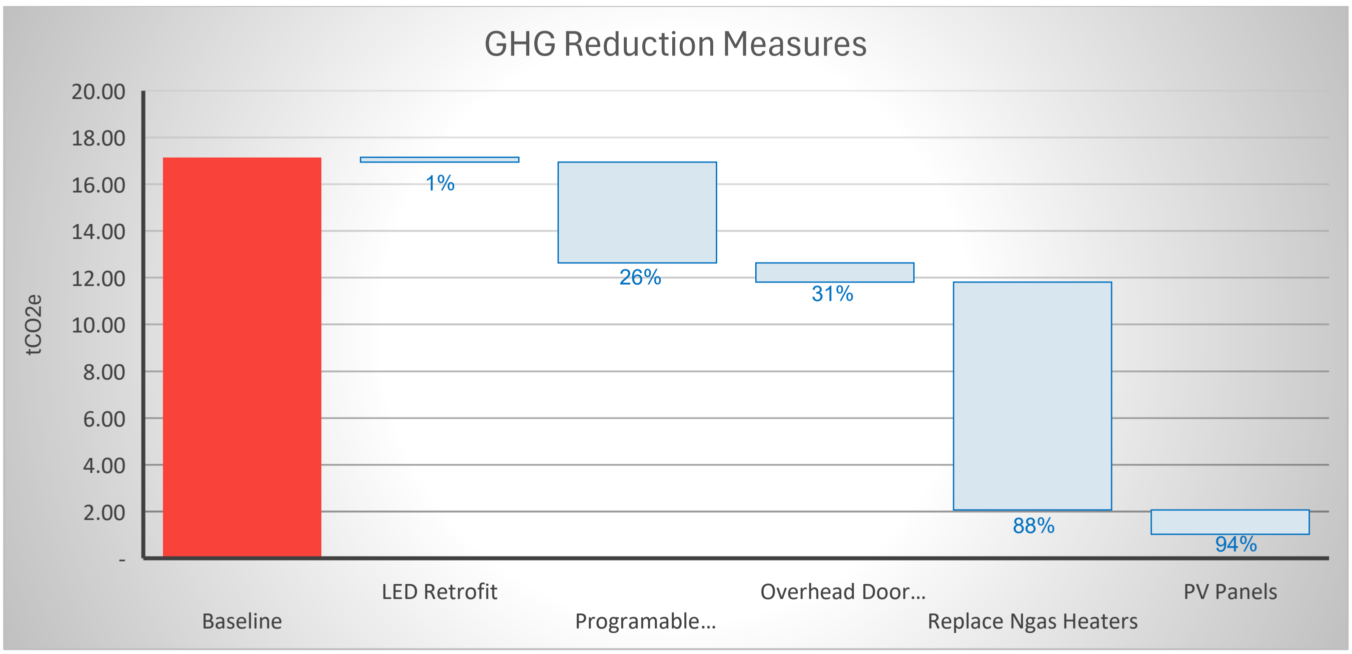


Figure 8-2 GHG Reduction Pathway

Table 8-3 Measures Summary and Implementation Year

MEASURE	YEAR OF IMPLEMENTATION
LED Lighting Retrofit	2026
Install Programable Thermostats	2026
Install Overhead Door Heater Interlock	2026
Replace Natural Gas Unit Heaters with Electric	2030
Install PV Panels	2033

Pathways

Since the GHG emissions baselines (2010 and 2023) are very low, there is little benefit in reviewing the 6 individual scenarios. The following pathway to low GHG emissions is outlined below

- ***Business As Usual Pathway.*** This is a reference case reflecting the planned (or already completed) energy-related capital renewal projects planned for this building.

- ***GHG Reduction Pathway.*** This Pathway features a combination of the BAU as well as GHG reduction measures. The GHG emissions reductions in this pathway are achieved over the life-cycle performance of 20 years.

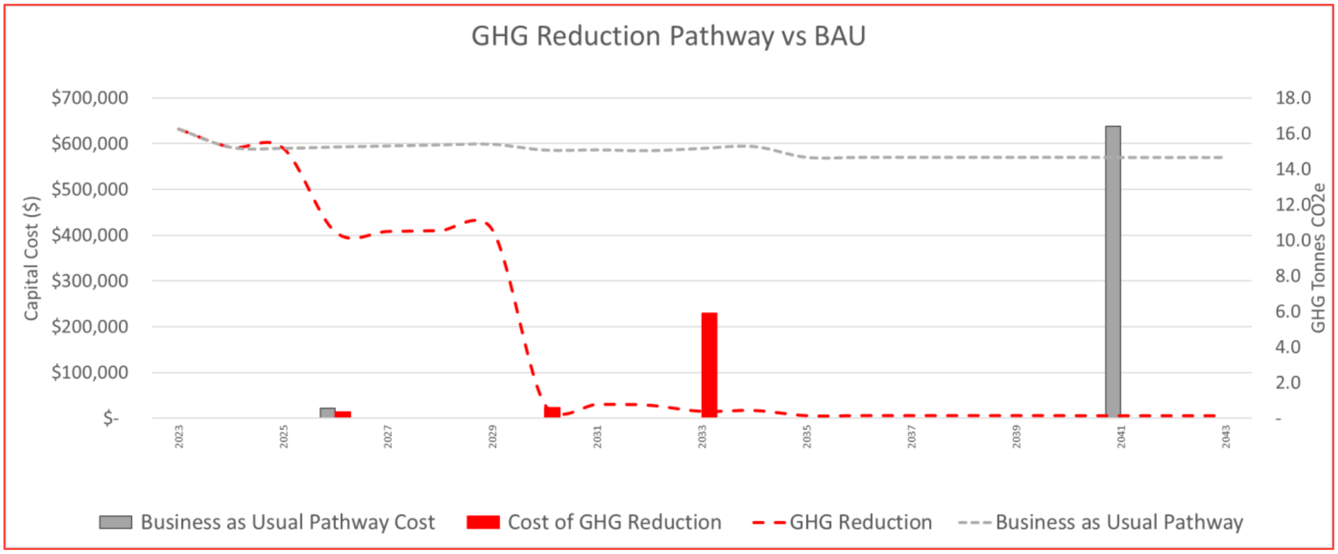


Figure 8-3 GHG Reduction Pathway vs BAU

Incremental Life-Cycle Cost (ILCC) is used as the financial metric in this analysis because it captures the greater financial impact over the design option's lifespan as opposed to capital cost or simple payback analysis alone.
Key ILCC parameters include:

- First/capital costs of measures
- 20-year study period, with construction starting in 2026;
- Utility costs, with appropriate escalation rates;
- System service life estimates and associated replacement over the study period
- Standard inflation rates and discount rates

Key assumptions for the LCC analysis include:

- Residual costs of equipment (i.e., equipment service lives longer and shorter than 20 years will result in a linearly-depreciated residual value at the end of the study period);
- The 20-year study starts in 2025 and lasts until 2044 (inclusive). All values in 2025 dollars will be escalated using the rates summarized in the table below.

Figure 8-2 illustrates the projected greenhouse gas (GHG) reduction pathway relative to the Business-as-Usual (BAU) scenario over the study period. The BAU pathway reflects continued operation with conventional energy systems and deferred capital reinvestment, resulting in steadily increasing lifecycle costs and persistently high GHG emissions over time. In contrast, the GHG reduction pathway demonstrates a stepwise decline in emissions associated with the implementation of energy efficiency and low-carbon capital renewal measures.

The stepped nature of the GHG reduction curve reflects the timing of major retrofit interventions, where discrete project packages deliver significant emissions reductions at specific points in the study period rather than a continuous decline. Correspondingly, the cost of GHG reduction shows intermittent capital expenditures, represented by vertical bars, aligned with major retrofit years. While these investments result in short-term cost increases relative to BAU, the long-term effect is a substantial reduction in emissions coupled with avoided future capital and operating costs associated with legacy equipment replacement under the BAU scenario.

Notably, the BAU pathway incurs a large capital cost toward the end of the study period due to the replacement of aging systems with like-for-like equipment. This reinforces the finding that deferring action does not avoid cost but rather shifts it to a later date without delivering emissions benefits.

GHG reduction pathway reduces the emissions in this facility by 98% (reducing 16 Tonnes of CO_2e).

Table 8-4 LCC Assumptions

Rate Name	Value (%)
Energy Inflation (ENER)	2.00%
Long Term Construction Costs (Capital Costs) Escalation (LTCC)	2.00%
Operations and Maintenance Escalation (O&M)	2.00%
Discount Rate (DISC)	2.00%

- An ***incremental*** LCC analysis as opposed to a ***comparative*** LCC analysis is provided. The difference is that the absolute LCC of the options is not calculated, just the differences in LCC between them; the result will be similar and just as useful for decision-making.
- As discussed above, the Pathway is compared to the life-cycle cost of taking all energy-related capital renewal items identified and executing them as a single construction project. Though this approach is not reflective of how the capital plan proposes execution of the work, it offers a fair comparison of the various programs of work compared to the baseline.

9 TIMELINE

Based on the building condition assessment and discussions with staff, the following timeline is expected for business-as-usual measures.

Table 9-1 Time for Business-as-Usual Measures

MEASURE	YEAR OF IMPLEMENTATION
LED Lighting Retrofit	2026
Building Envelope – Window Replacement	2041

The following timeline for measures is proposed for decarbonization measures.

Table 9-2 Time for Decarbonization Measures

MEASURE	YEAR OF IMPLEMENTATION
Install Programable Thermostats	2026
Install Overhead Door Heater Interlock	2026
Replace Natural Gas Unit Heaters with Electric	2030
Install PV Panels	2033

10 REJECTED MEASURES

10.1 BUILDING ENVELOPE

10.1.1 DOOR UPGRADES

The overhead doors are currently a large contributor to the heat loss noted in the building. However, based on reports from the facility manager, these doors remain open during working hours. Before thinking about replacement of components, it is recommended to keep these doors closed when not in use or install interlocks with the heating as well as ensuring the weatherstripping is intact. This would result in more immediate improvements and would be much less costly than replacement.

10.1.2 ROOF UPGRADES

The existing roofing assembly appeared in serviceable condition during our review and is expected to remain in service beyond the report term. Given the assumed assembly of the roofing, and the current operations of the building, replacing the roofing with an improved assembly is unlikely to yield thermal paybacks. As such, the associated costs of replacement would not be economical at this time.

10.1.3 WALL UPGRADES

Consideration could be given to improving the current metal cladding assembly and over cladding the concrete walls with an exterior insulated metal panel. This would require relocation of the windows to align with the new cladding system. Similarly, completing this work and maintaining the current building operations would provide minimal cost savings.

11 RECOMMENDATIONS

11.1 SUMMARY OF SAVINGS

Due to the interactive nature of building systems, it is difficult to determine the total savings with precision. However we estimate that the results of implementing the energy conservation measures outlined in this report would be as follows.

- You will save about 59,100 ekWh of annual energy consumption (26%);
- You will save about $4,450 in annual energy cost (19%);
- It will cost you about $32,000 (HST/GST not included) to implement the measures;
- The simple payback will be over 7 years overall;
- The building's EUI will drop to about 15.5 ekWh/ft2/year;

11.2 NEXT STEPS

This report presents measures that can reduce energy use at your building. To realize the benefits outlined in this report, the measures identified must be implemented. Our description of each measure includes our recommendation on how to proceed.

We recommend the following next steps:

1. **Review the proposed measures** listed in section 6;
2. **Decide which measures to implement** and your implementation timeline;
3. **Select your incentive program enrolment strategy**. The preferred incentive program for this property will depend on the measures you choose to implement, and the timeline for implementation.
4. **Decide how implementation will be managed** (and engage support, if desired);
5. **Implement operational measures** that are quick or low-cost. Plan to verify that measures are completed and that the expected benefit is achieved;
6. **Implement retrofit measures, or add them to your capital plan** if they cannot be completed in the current capital year. Develop a formal scope of work and request quotes for more detailed or costly measures. You may need to prepare engineering designs and/or specifications, develop bid documents for competitive quotes, manage construction review and/or contract administration, commission systems, verify installation as intended, train operators on system changes, and measure performance improvement;
7. **Train operators** on system changes and update building documentation; and
8. **Measure performance improvement** and verify measures are completed as planned.

WSP can provide the expertise and services that will lead to successful completion of any or all of these operational and retrofit measures.

We trust this report meets your needs and would be pleased to discuss our findings further with you at your convenience. We would also very much like to help you implement these measures and look forward to taking these next steps with you.

APPENDIX

A METHODOLOGY

APPENDIX A

METHODOLOGY

Work completed for this assessment included:

1 Preliminary System Review: We performed this review prior to visiting the site using existing mechanical, electrical, and structural drawings and report. We review past equipment maintenance, repair, and replacement details;

2 Facility Walkthrough: Our team was on site to assess the current condition of equipment and associated components;

3 Fossil-fuelled asset : We developmented an asset inventory profile including model and serial numbers, age, installation date, capacities, dimensions, photographs, etc;

4 Identification : We Identified key issues relevant to project scope related to the state of current fossil-fuelled assets;

5 Analysis: We performed various calculations to estimate both the potential of electrification and implementation costs associated with potential fuel switching measures; and

6 Reporting: We summarized our findings and the recommended next steps in this report.

APPENDIX

B MEASUREMENT AND VERIFICATION OPTIONS

APPENDIX B

MEASUREMENT AND VERIFICATION OPTIONS

For each measure presented in this report, we recommend a measurement and verification approach based on the International Performance Measurement and Verification Protocol (IPMVP): Concepts and Options for Determining Energy and Water Savings. The Protocol defines techniques for reviewing and confirming savings in various situations. The following is an excerpt from the Protocol which outlines the four primary M&V options available:

OPTION A. PARTIALLY MEASURED RETROFIT ISOLATION: Savings are determined by partial field measurement of the energy use of the system(s) to which an ECM was applied; separate from the energy use of the rest of the facility. Measurements may be either short-term or continuous. Partial measurement means that some but not all parameter(s) may be stipulated, if the total impact of possible stipulation error(s) is not significant to the resultant savings. Careful review of ECM design and installation will ensure that stipulated values fairly represent the probable actual value. Stipulations should be shown in the M&V Plan along with analysis of the significance of the error they may introduce.

OPTION B. RETROFIT ISOLATION: Savings are determined by field measurement of the energy use of the systems to which the ECM was applied; separate from the energy use of the rest of the facility. Short-term or continuous measurements are taken throughout the post-retrofit period.

OPTION C. WHOLE FACILITY: Savings are determined by measuring energy use at the whole facility level. Short-term or continuous measurements are taken throughout the post-retrofit period.

OPTION D. CALIBRATED SIMULATION: Savings are determined through simulation of the energy use of components or the whole facility. Simulation routines must be demonstrated to adequately model actual energy performance measured in the facility. This option usually requires considerable skill in calibrated simulation.

APPENDIX

C LIMITATIONS

APPENDIX

LIMITATIONS

WSP Canada Inc. is the “Consultant” referenced throughout this document.

- The scope of our work and related responsibilities related to our work are defined in our project authorization (“Conditions of Assignment”).
- Any user accepts that decisions made, or actions taken based upon interpretation of our work are the responsibility of only the parties directly involved in the decisions or actions.
- No party other than the Client shall rely on the Consultant’s work without the express written consent of the Consultant, and then only to the extent of the specific terms in that consent. Any use which a third party makes of this work, or any reliance on or decisions made based on it, are the responsibility of such third parties. Any third party user of this report specifically denies any right to any claims, whether in contract, tort and/or any other cause of action in law, against the Consultant (including Sub-Consultants, their officers, agents and employees).The work reflects the Consultant’s best judgement in light of the information reviewed by them at the time of preparation. It is not a certification of compliance with past or present regulations. Unless otherwise agreed in writing by the Consultant, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity; it is written to be read in its entirety.
- Only the specific information identified has been reviewed. No physical or destructive testing and no design calculations have been performed unless specifically recorded. Conditions existing but not recorded were not apparent given the level of study undertaken. Only conditions actually seen during examination of representative samples can be said to have been appraised and comments on the balance of the conditions are assumptions based upon extrapolation. Therefore, this work does not eliminate uncertainty regarding the potential for existing or future costs, hazards or losses in connection with a property. We can perform further investigation on items of concern if so required.
- The Consultant is not responsible for, or obligated to identify, mistakes or insufficiencies in the information obtained from the various sources, or to verify the accuracy of the information.
- No statements by the Consultant are given as or shall be interpreted as opinions for legal, environmental or health findings. The Consultant is not investigating or providing advice about pollutants, contaminants or hazardous materials.
- The Client and other users of this report expressly deny any right to any claim against the Consultant, including claims arising from personal injury related to pollutants, contaminants or hazardous materials, including but not limited to asbestos, mould, mildew or other fungus.
- Budget figures are our opinion of a probable current dollar value of the work and are provided for approximate budget purposes only. Accurate figures can only be obtained by establishing a scope of work and receiving quotes from suitable contractors.
- Time frames given for undertaking work represent our opinion of when to budget for the work. Failure of the item, or the optimum repair/replacement process, may vary from our estimate.