



City of Courtenay GHG Reduction Pathway

City of Courtenay | 11 Sites
Courtenay, British Columbia

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We help organizations achieve **energy, climate, and asset renewal objectives** by integrating engineering, energy management and sustainability services.

1. Executive Summary

Introduction

The City of Courtenay (the City) received support from Federation of Canadian Municipalities (FCM) to complete this GHG Emissions Feasibility Study through the Community Buildings Retrofit (CBR) initiative. The City hired Prism Engineering Limited (Prism) to complete this study.

The intent of the study is to develop a greenhouse gas (GHG) emissions reduction plan for 11 city-owned buildings. FCM sets GHG reduction targets for the study that have different timelines from the City of Courtenay’s Corporate Climate Action Strategy targets. The City’s targets were used in the pathway’s development. Achievement of these targets will support the achievement of the FCM’s targets.

	City of Courtenay’s Corporate Climate Action Targets	FCM Study Requirements
GHG Emissions Baseline Year	2007	2024
Target 1:	59% community GHG emission reduction by 2030	50% corporate building GHG emission reduction by 2035
Target 2:	80% community GHG emission reduction by 2050	80% corporate building GHG emission reduction by 2045

Methodology

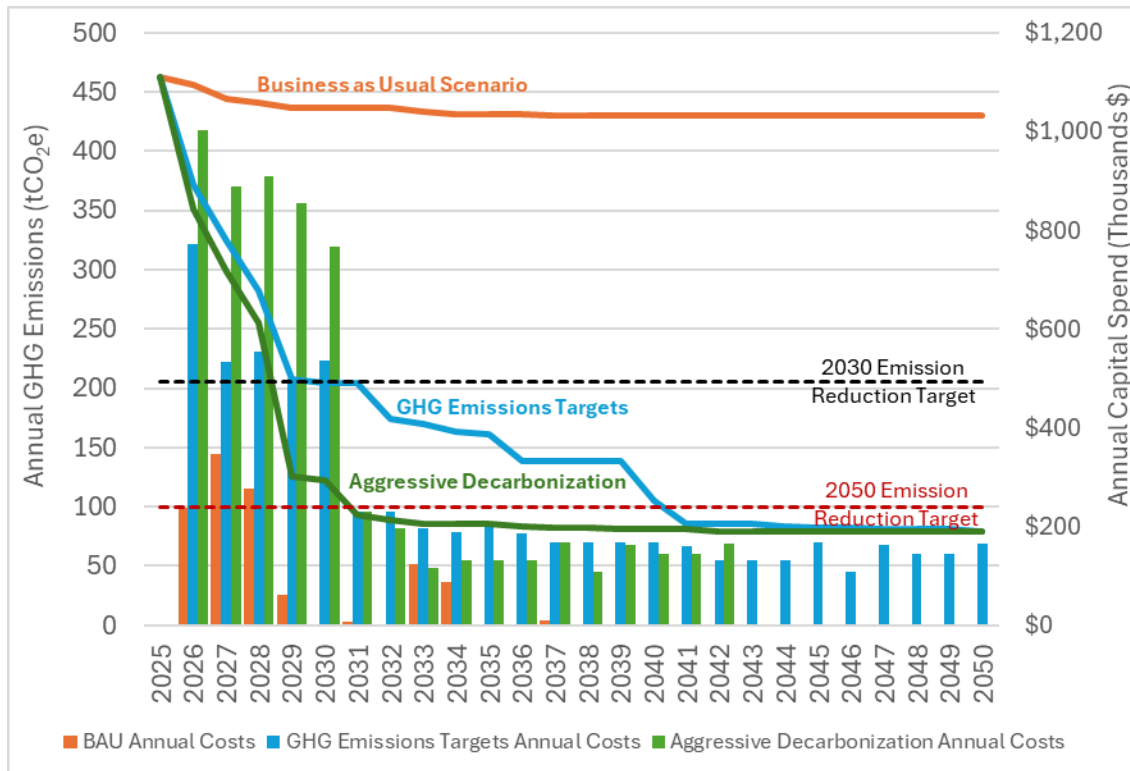
The plan’s development included detailed energy audits of 11 buildings in the City’s portfolio and consultation with City staff through a series of workshops to identify energy and carbon reduction measures for improving operational energy efficiency and reducing GHG emissions.

Prism then modelled three pathway scenarios, each prioritizing identified energy and carbon reduction measures based on unique parameters and prioritization criteria. These pathway scenarios are:

1. **Business-as-Usual:** includes “like-for-similar” replacement of equipment at end of service life and implementation of modest energy efficiency measures identified in the energy audits.
2. **GHG Emissions Targets:** achieves GHG emissions reduction targets while minimizing impacts on the City’s annual budgets and staff capacity.
3. **Aggressive Decarbonization:** maximizes cumulative GHG emissions reductions by prioritizing projects with high fuel saving potential.

Pathway Scenario Results

All three pathways present unique characteristics, advantages, and disadvantages. The figure below shows the GHG emissions reduction profiles and the annual capital expenditures of the three pathways modelled. The table below summarizes the emissions and financial results of each pathway.



	Achieves Targets		Total Cumulative Capital Costs (CAD \$)			Total Cumulative Utility Cost Savings (CAD \$)		
	2030 Target 59% Reduction from 2007 Baseline (206 tCO ₂ e)	2050 Target 80% Reduction from 2007 Baseline (100 tCO ₂ e)	2026	2030	2050	2026	2030	2050
Pathway 1: Business as Usual			\$240k	\$920k	\$1.2M	minimal	minimal	minimal
Pathway 2: GHG Emissions Targets	✓	✓	\$770k	\$2.9M	\$6.3M	\$13k	\$105k	\$997k
Pathway 3: Aggressive Decarbonization	✓	✓	\$1.0M	\$4.4M	\$6.3M	\$10k	\$92k	\$1.5M

Renewable Energy

As part of the detailed energy audits, an opportunity assessment for solar photovoltaic electricity generation was assessed. The energy and emissions impacts, along with the associated capital costs of solar photovoltaic systems, are included in the pathway modelling. In the GHG Emissions Target and Aggressive Decarbonization pathways, the first year of solar PV implementation is modelled to begin after the final decarbonization measure in each pathway. This is to prioritize reducing onsite emissions before reducing grid-based emissions. A summary of the solar photovoltaics analysis is shown below.

	Total Portfolio Analysis Results
Solar PV Annual Electricity Generation <i>Total kWh/year</i>	685,300 kWh
Solar PV Annual Electricity Generation <i>As a percentage of baseline 2024 portfolio electricity consumption</i>	16%
Annual Emissions Avoided from Solar PV Generated Electricity <i>Based on 2024 BC Electricity Grid Emissions Factor (see Appendix A for emissions factor)</i>	7 tCO ₂ e
Annual Electricity Utility Cost Savings <i>Using present day electricity utility costs and BC Hydro expected market value of electricity for surplus electricity generated</i>	\$69 k
Total Estimated Capital Costs	\$1.4 M
Simple Payback Period	20 years

Achieving Net Zero

After implementing the recommended measures, the City of Courtenay will still have approximately 26 tCO₂e of annual emissions remaining at the 11 city-owned buildings in this pathway, associated with electricity consumption and back-up heating sources (e.g. gas-fired radiant tube heaters for backup heating in truck bays, and dual-fuel rooftops that may occasionally require gas-fired heating in extreme cold conditions). An additional 53 tCO₂e remains in the City’s portfolio that are associated with smaller facilities. While further carbon reduction measures have been recommended for these facilities, they are not reflected in the current pathway modelling.

To further reduce emissions, the City can consider installing battery energy storage systems and integrating with renewable energy sources such as solar PV, upgrading building envelopes, and conducting staff behaviour change programs to lower building energy usage. The City can also consider implementing fuel reduction measures on smaller facilities, purchasing carbon credits and offsets, and investing in local ecosystems to enhance local carbon offset production.

Implementation Considerations

Measurement and Verification

Allocating time between projects for proper measurement and validation (M&V) can help to better prioritize and maximize the impact of future initiatives. By tracking performance data, M&V verifies project success and guides planning for future efforts. **Note that if the City pursues Pathway 3: Aggressive Decarbonization, expediting projects will compromise the opportunity to conduct M&V between projects.**

Funding and Incentives

Funding opportunities are continually changing and are commonly available through utility providers (BC Hydro, FortisBC), provincial organizations (CleanBC), and federal organizations (Federation of

Canadian Municipalities). The City of Courtenay can monitor funding opportunities on an ongoing basis as programs periodically change. As funding becomes available, City staff can refer to the results of this pathway study, and the accompanying energy and carbon reduction measure list to identify high priority projects to implement.

Pathway Renewal

Prism recommends that the City consider renewing this pathway plan every 3-5 years. Through time projects will be completed, equipment performance will be improved, and circumstances such as operational needs, funding availability, mandated targets, etc. may change. It is best practice for organizations to update their pathway plans to reflect those changes.

2. Introduction

Project Context

City Climate Action

In **2007**, the City of Courtenay (the City) signed the BC Climate Action Charter, committing to three goals: becoming carbon neutral in municipal operations, measuring and reporting on the community's greenhouse gas (GHG) emissions, and creating a complete, compact, and more energy efficiency community.

In **2009**, the City developed a Corporate Climate Action Strategy (CCAS), detailing a wide range of actions to address GHG emissions. An update to the CCAS was planned for 2025, with the intent to outline the steps to meet climate targets and build on the work completed thus far.

In the **2022** Official Community Plan, a resolution to support the net-zero emissions by 2050 target was approved by City Council, demonstrating the City's commitment to address the climate crisis and support a high quality of life for their community.

Corporate Facilities Energy Management Plan

In **2024**, Prism Engineering Limited (Prism) was hired to complete a GHG emissions reduction pathway study that would support the development of the City's Corporate Facilities Energy Management Plan (CFEMP). In **2025**, the City received support from Federation of Canadian Municipalities (FCM) to complete this GHG Emissions Feasibility Study through the Community Buildings Retrofit (CBR) program.

The intent of the study is to develop a greenhouse gas emissions reduction plan for city-owned buildings and support the update to the Corporate Climate Action Plan by identifying the building upgrades and retrofits required to achieve emission reduction targets.

Project Introduction

The City of Courtenay, in partnership with Prism Engineering, identified eleven facilities within the City's portfolio to be included in an FCM GHG Reduction Pathway Feasibility Study. These sites were selected based on high emissions intensity and building system complexity. In 2024, these sites contributed a combined greenhouse gas emissions total of 409 tCO₂e, representing 89% of a total 462 tCO₂e of the City's portfolio¹.

A summary of the portfolio of buildings included in this study is provided in Table 1.

¹ Emissions are based on the most recent year of natural gas and electricity utility consumption available for each building in the study portfolio, using current emissions intensity factors associated with each energy source. Emissions intensity factors are presented in Appendix A.



Table 1. Summary of Building Portfolio

	Address	Function	Floor Area (sqft)
Lewis Park Recreation Centre & Memorial Pool	489 Old Island Hwy	Lewis Park Recreation Centre, Veterans Memorial Pool, Lewis Park	47,294
Comox Valley Art Gallery	580 Duncan Ave	Art Gallery	10,075
Courtenay & District Museum	207 4 th St	Museum	17,631
Native Sons Hall	360 Cliffe Ave	Multi-use community building	14,585
Fire Hall	650 Cumberland Rd	Fire hall	12,400
City Hall	830 Cliffe Ave	Office spaces, conference rooms	17,438
Vancouver Island Regional Library	300 6 th St	Library, administration offices	12,949
Linc Youth Centre	300 Old Island Hwy	Youth centre, indoor skate park, concession, games room	8,000
Florence Filberg Centre	411 Anderton Ave	Multi-use facility	20,990
Public Works Yard	1000 Piercy Ave	Administration building, truck bays 59 and 60, truck bays 19-34, storage/mechanics building	28,421
Sid Williams Theatre	442 Cliffe Ave	Performing arts centre	14,930

Through the FCM initiative, the intent of the pathway study is to provide information that supports the alignment of City capital plans with the City’s GHG emission reduction goals.

The project consisted of multiple stages with the following deliverables:

- Detailed energy audit reports (ASHRAE L2) that identify energy efficiency and carbon reduction measures for each of the eleven buildings.
- RETScreen building energy models to supplement energy models (as needed), evaluate building envelope measures (where energy and carbon reduction measures were identified), and assess solar photovoltaic (PV) energy generation potential.
- Three workshops with City staff to support energy and carbon reduction measure selection, pathway definitions, and reporting.
- A GHG Emission Reduction Pathway Report, to summarize the study process and results.

Project Objectives

The objectives of the project include:

- Provide the City of Courtenay with building level energy studies to inform a robust 2026 capital plan and an aligned 5-year strategy.
- To conduct a comprehensive building portfolio review and produce a plan that outlines tangible energy and carbon reduction measures, including performance enhancements of heating, refrigeration and refrigeration heat recovery, building controls, domestic hot water (DHW) systems, and envelope.
- To provide the City with multiple pathway scenarios that achieve deep carbon reductions that balances the greatest impact and greatest return for cost as well as allows for consistent capital planning.
- To work with Engineering Services, Recreation, Culture & Community Services, Fire Department, Finance Services and other stakeholders to engage, review and increase buy-in for existing systems efficiency improvements and proposed carbon reduction upgrades.
- To equip the City of Courtenay to continue climate action work beyond the completion of this study.

Greenhouse Gas Emissions Reduction Targets

The Province of British Columbia (BC) has set GHG emissions reduction targets to help fight climate change with the aim of keeping global warming below 1.5°C². The City of Courtenay’s corporate climate action targets sets a community emissions target of 40% below 2007 levels by 2030, and 80% below 2007 levels by 2050, in alignment with targets set out by the Province of BC. The City of Courtenay’s 2022 Official Community Plan commits to meeting these targets and providing the support to achieve them. FCM also sets GHG reduction targets for the study, which closely align with the targets adopted by the City. The City’s targets were used in the pathway’s development. Achievement of these targets will support the achievement of the FCM’s targets.

The corporate climate action and FCM targets are outlined in the following table.

Table 2. City of Courtenay Corporate Climate Action Targets and FCM Study Emissions Reduction Targets

	City of Courtenay’s Corporate Climate Action Targets	FCM Study Requirements
GHG Emissions Baseline Year	2007	2024
Target 1:	59% community GHG emission reduction by 2030	50% corporate building GHG emission reduction by 2035
Target 2:	80% community GHG emission reduction by 2050	80% corporate building GHG emission reduction by 2045

² <https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action>



How this plan was developed

The development of this plan involved the completion of energy and emissions building audits, the review of existing documentation (existing building condition assessments, drawings, past studies, etc.), and consultation with City staff through on-site interviews and workshops to garner staff input and feedback.

Energy and Carbon Audits

Energy and carbon building audits were used to assess building systems and equipment with the aim of developing feasible recommended energy and carbon reduction measures.

As part of the audits, RETScreen models were developed for select sites. Through these models, energy end-use-breakdowns were established, and energy impact of envelope improvement measures and solar photovoltaics (solar PV) potential was assessed.

Workshops

The workshops were used to draw on the City's in-house knowledge, experience and expertise to:

- Inform energy and carbon reduction measure identification and refinement,
- Select key parameters and priorities to include in the pathways modelling, and
- Discuss challenges and opportunities for project implementation.

City staff and building operators were also consulted during site visits so they could lend their knowledge and expertise about the City's buildings and operations. Section 3 provides overviews of the methodology used to develop recommendations, complete pathways modelling and select the recommended pathway.

How to use this plan

This plan and its components can be used in several complimentary ways. While the exact order of project implementation may vary based on equipment performance and longevity, funding availability, changes to City operations from year to year, and other factors, the pathways outlined in this plan can act as a stabilizing force to help guide the City of Courtenay's trajectory towards achieving its targets and priorities.

The pathway results can be shared with City staff, City Council, and the community to help them better understand the actions that the City of Courtenay is taking within their buildings to address climate change mitigation. It can also be used to show how the City has decided to balance various annual and long-term facilities management priorities (such as fiscal responsibility, service continuity, capital project planning, annual budgeting and project planning, emissions reduction, etc.) as they work towards achieving long-term climate action goals.

The pathway energy and carbon reduction measure list and list of equipment past-expected-life can assist in prioritizing and budgeting for projects on an annual basis. Please see Appendix B: Pathway Energy and Carbon Reduction Measure List and Appendix C: Equipment Replacement Timeline for a full overview of these lists.

3. Methodology

Developing Recommended Energy and Carbon Reduction Measures

Energy Audits

Prism Engineering Limited (Prism) conducted energy and carbon audits on the eleven buildings in the City's portfolio.

- *Documentation Review:* technical information and documents were reviewed by the consultant team to gain an understanding of the existing systems and identify existing equipment. Documents reviewed included existing mechanical, electrical, structural, and architectural drawings, building condition assessments, previous energy audits, and equipment documentation.
- *Site Visits and Interviews:* In January 2025, Prism conducted site visits and met with City facilities staff and building operators to collect additional information about existing building systems and equipment.
- *Measure Identification:* Prism used the site visits to conduct a walk-through audit and identify energy and carbon reduction measures according to the Prism 6-Step Approach (Figure 1). The audits focused on mechanical systems (heating, cooling and ventilation systems and controls), electrical systems, and a building envelope review.
- *Energy and Cost Savings Estimates:* Energy and emissions savings and project costs estimates for the identified measures were generated by Prism based on engineering calculations and professional opinion informed by real-world project experience.
- *Equipment Operating Life:* Estimates of mechanical equipment life expectancy are based on manufacturer data, industry standards, and guidelines from organizations such as Institute of Electrical and Electronics Engineers (IEEE), Building Owners and Managers Association of Canada (BOMA Canada), and American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).

Prism's 6-Step Approach

There are many possible approaches for undertaking an energy and carbon focused building retrofit. When developing recommended energy and carbon reduction measures for this plan, Prism applied a six-step methodology to deep carbon retrofits (Figure 1), guided by a philosophy of first **reducing** energy consumption and emissions through system optimization and energy efficiency improvements. This is followed by **avoiding** energy consumption and emissions using heat recovery and reuse strategies, and finally **replacing** equipment with low-carbon electric technologies or renewable energy sources to achieve further emission reductions. The first three steps seek to reduce both energy consumption and carbon while the last three steps are focused primarily on carbon reduction.

Step 1: Focuses on optimizing building systems by eliminating energy waste and improving the functionality of controls. It involves adjusting schedules, equipment sequencing, and building



automation programming to fine-tune mechanical and lighting system operations. Sometimes additional sensors or controls will be added to improve energy monitoring and tracking or to provide additional capacity for system optimization. Measures undertaken at this step are generally low-cost and non-invasive.

Step 2: Aims to improve energy efficiency through equipment upgrades or by redesigning systems to better serve current building needs. Measures undertaken at this step can range from low to high cost depending on the level of redesign required and the type of equipment being replaced. The invasiveness and disruption caused by these measures can vary.

Step 3: Looks for opportunities to recover waste heat from air and water so that it can be used to temper incoming air or water and reduce the building's heating or cooling load. Heat recovery can be used to optimize a single building or can be interlinked with adjacent systems that have differing heating and cooling needs.

Step 4: Is about reducing carbon emissions by switching from fossil fuel-based equipment to Electricity-based equipment. It leverages the low GHG intensity of electricity to reduce carbon and in some cases, such as when switching to heat pumps, can result in significant efficiency gains as well.

Step 5: Seeks to identify way to reduce carbon emissions by adding on-site renewable energy generation or passive means of heating or cooling.

Step 6: The final step considers ways to offset any emissions that remain after all other means of reducing energy and carbon emissions have been taken. This may include purchasing renewable natural gas or renewable energy credits to compensate for any residual emissions from on-site energy use.

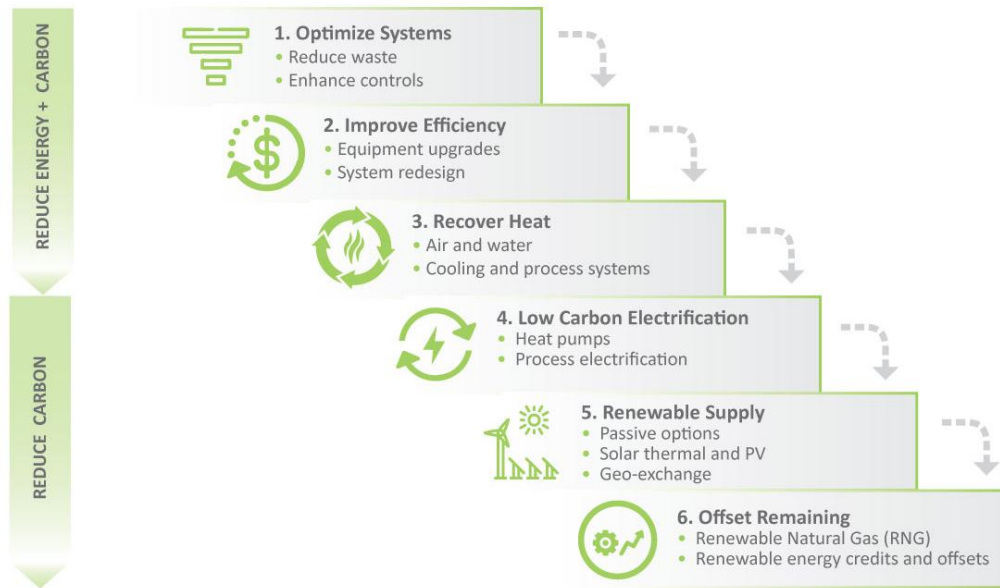


Figure 1. Prism's 6-Step Approach

Modelling Energy and Emissions Pathways

Pathway Model

Prism's pathway model is an excel based tool that can be used to project the GHG emission and financial impacts of different energy and climate resilience pathways. It includes a combination of financial and technical inputs and assumptions. The model calculates the total capital spend and annual emission levels across an entire pathway's timeline, and generates graphical representations and outputs that show the impact of each pathway scenario.

Workshops

Prism facilitated two rounds of workshops during the project:

- Design Workshops – In May 2025, Prism facilitated a workshop to present work to date, discuss measures identified in building audits, and discuss the opportunities and challenges associated with identified measures. Later in May 2025, Prism facilitated a second workshop to identify key considerations and parameters to be included in the City's pathway scenarios. Feedback gathered in these workshops informed measure analysis and pathway modelling.
- Decision Making Workshop – In September 2025, Prism presented portfolio energy analysis results and modelled pathway scenarios to City staff and gathered feedback on the modelled scenarios to inform final presentation in this report, and discuss how the pathway results can be used to inform the City's future capital and climate planning.

4. Portfolio Performance

A breakdown of the City’s building emissions in 2024 are shown in Figure 2. Emissions are shown by site and by energy source.

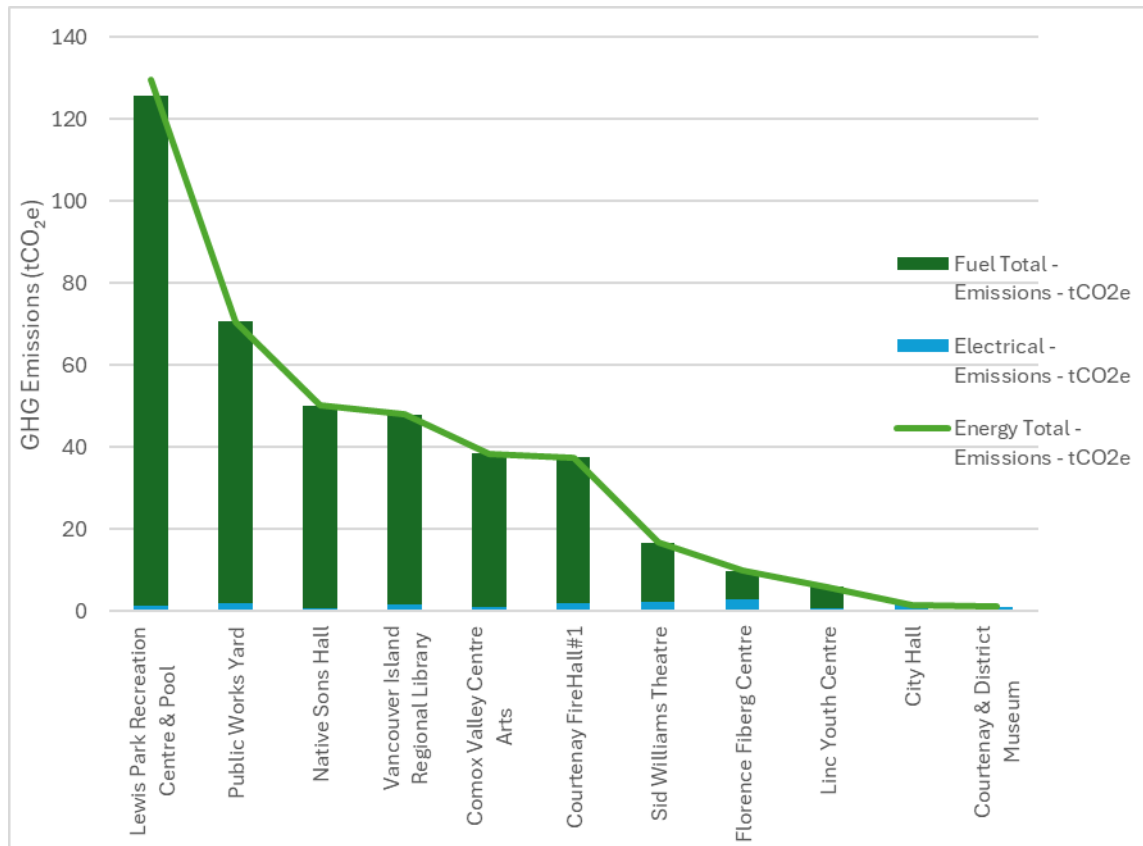


Figure 2. Building Portfolio Summary (2024 Utility Data)

Lewis Park Recreation Centre and Memorial Pool are the highest emitters within the City’s building portfolio. City Hall and the Courtenay & District Museum are fully electric and contribute minimally to overall emissions. A detailed breakdown of each facility’s emissions contribution is provided in Table 3.

Table 3. City of Courtenay Building Performance

	% of 2024 Portfolio Emissions
Lewis Park Recreation Centre & Memorial Pool	28%
Public Works Yard	15%
Native Sons Hall	11%
Vancouver Island Regional Library	10%
Comox Valley Art Gallery	8%
Fire Hall	8%



Sid Williams Theatre	4%
Florence Filberg Centre	2%
Linc Youth Centre	1%
City Hall	>1%
Courtenay & District Museum	>1%
<i>Other Building-Associated Emissions (other smaller sites, street lighting, pump stations)</i>	12%

5. Energy and Carbon Reduction Measures Summary

The following section provides a brief overview of the energy and carbon reduction measures identified for implementation within the detailed audits of the eleven facilities included in the City's portfolio. Appendix B lists all measures included in the pathway. For detailed descriptions, refer to individual building energy audit reports.

Lighting

There is an opportunity to convert the Lewis Park exterior lighting for the three baseball fields, the skate park and the tennis courts to high efficiency LEDs to achieve energy and cost savings. During the summer months, the existing service incurs power factor charges, so the conversion to LED lighting would also assist in lowering power factor costs.

Controls Upgrades

Energy and emissions savings can be achieved by improving the control strategies of existing equipment. Upgrading controls allows for implementation of energy reducing strategies, such as equipment scheduling and temperature setbacks, optimizing equipment sequencing, installing temperature controls, and revising current operations to ensure a more efficient operation.

Recommissioning

Recommissioning for building's HVAC and domestic hot water (DHW) to ensure that the systems are operating as efficiently and effectively as possible. Facilities with building automation systems (BAS), such as the Comox Valley Art Gallery, Lewis Park Recreation Centre, Vancouver Island Regional Library, and Courtenay & District Museum, are well-suited for recommissioning work, and potential opportunities to be explored are presented in detailed audit reports.

HVAC Efficiency Upgrades

This category of measure represents improving energy efficiency of existing HVAC equipment to reduce GHG emissions. Efficiency measures are often considered as interim upgrades to significantly reduce energy and emissions, and make the system ready for future decarbonization upgrade, while managing impact on building users and upfront project costs.

Packaged Rooftop Units

This category of measure represents "like for similar" packaged rooftop units and make up air units. Gas fired ventilation units at end of life can be replaced with dual fuel, fully electric ASHP packaged systems, or variable refrigerant flow (VRF) heat pump systems. By implementing this measure, many facilities can eliminate or drastically reduce fuel consumption.



Heating System Upgrade and Electrification

For facilities with hydronic (hot water) systems, such as the Comox Valley Art Gallery, Native Sons Hall, and Vancouver Island Regional Library, a staged approach to decarbonization of these systems is presented. These measures typically involve the following stages:

- Upgrading existing boilers to condensing efficiency;
- Achieving low-temperature, high efficiency operation of the hydronic system, which may include re-piping and terminal unit upgrades; and
- Installation of an air source heat pump (ASHP).

Truck Bay and Garage Heating Equipment Electrification

Truck bays and garage storage areas located at Public Works Yard and the Firehall utilize gas-fired infrared radiant tube heaters and gas fired unit heaters. Split heat pump systems can be installed to provide most (if not all) heating, with existing gas-fired equipment retained for backup heating or peak heating in case of extreme cold weather events.

Domestic Hot Water Upgrade and Electrification

Domestic hot water is heated by both gas and electric resistance heaters. For the portfolio of buildings, both electric resistance heaters and heat pumps systems are considered to replace gas-fired domestic hot water systems. While electric resistance heaters produce DHW with relatively low emissions, heat pump systems can provide DHW with a coefficient of performance (COP) of ~3.5 or higher. This measure considers the installation of DHW heat pump systems for:

- Electric heaters that serve high DHW use to improve efficiency (limited GHG reductions).
- Gas-fired heaters to significantly reduce GHG emissions and energy use.

Pool Heating Electrification

At the Veterans Memorial Pool, there is an opportunity to upgrade existing gas systems with an air source heat pump to meet the seasonal heating load for maintaining pool temperature. Alternatively, the air source heat pump can be sized to meet both the seasonal heating load and thermal energy required to heat a full pool volume during refill.

Building Envelope

Building envelope upgrade projects reduce the overall energy consumption of the building by reducing the impact of outdoor conditions on the indoor environment. Building envelope upgrades include improving insulation and upgrading windows and doors. Envelope thermal performance is important to the building's overall energy performance and can provide co-benefits of improved climate resilience and occupant comfort. Compared to mechanical system upgrades identified, envelope measures described in individual building reports tend to have weak financial emission reduction performance, and in some cases disruptive to occupants.



Kitchen Stove Electrification

There is an opportunity at Native Sons Hall and the Florence Filberg Centre to replace existing commercial gas stoves with electric equivalents to eliminate gas consumption. This can also lead to energy savings for the kitchen's ventilation and heating systems, as the space no longer requires continuous exhaust fan operation. These measures will assist in reducing the overall fuel consumption of the building.

Solar Photovoltaics

Roof-mounted solar photovoltaics (solar PV) was analyzed for the City's portfolio. A solar PV system displaces the electricity that would typically be provided by the utility and thus results in lower electrical bills from the utility. Given BC's relatively clean (low GHG emissions intensity) electricity supply, solar PV provides limited GHG reduction potential.

6. GHG Reduction Pathway Modelling Results

Overview of the Pathways Modelled

In this study, Prism modelled three pathway scenarios for the City of Courtenay to demonstrate the impact of different project implementation timelines. These pathway scenarios include:

1. Business-as-Usual
2. GHG Emissions Targets
3. Aggressive Decarbonization

Pathway 1: Business as Usual

Pathway 1: Business as Usual, includes “like-for-similar” replacement of equipment at end of service life and implementation of modest energy efficiency measures identified in the energy audits.

The key parameters of this pathway are presented in the table below.

Table 4. Key Parameters for Pathway 1: Business as Usual

Affected Model Element	Implementation Timing
Measures Included in the Pathway	<p>Included:</p> <ul style="list-style-type: none"> • Like-for-similar equipment replacements. Modest efficiency improvements are included to show like-for-similar upgrades of furnaces, boilers, and other gas-fired equipment to high efficiency equivalents. <p>Excluded:</p> <ul style="list-style-type: none"> • Capital-intensive energy measures and low-carbon equipment replacements • Modest (low-cost) energy efficiency and controls measures • All envelope measures • Installation of solar PV
Equipment Renewal and Base Case Costs	<p>Existing equipment end of life is based on equipment installation dates and ASHRAE and BOMA Canada equipment service life recommendations, or on previous building condition assessments completed for the City.</p> <p>Base case costing should be used as estimates only and not fixed prices. In some cases, costs of equipment have been reviewed with suppliers before finalizing cost estimates. Prism Engineering does not guarantee pricing.</p>



	A complete list of equipment scheduled for end-of-life can be seen in Appendix C: Equipment Replacement Timeline
Measure Implementation Timeline – Equipment Upgrades	All measures are implemented as existing equipment comes due for renewal. Note: Where equipment is beyond expected useful service life, measures associated with that equipment or component are distributed across the first 5 years of the pathway, prioritized based on number of years past expected service life. This is to align with capital renewal schedule to the greatest extent possible, while minimizing impacts on the City’s annual budgets and staff capacity. This does not suggest that equipment will last past its expected lifetime.
Measure Implementation – Controls Measures	Excluded from this pathway.

Results

Figure 3 shows the impact of the pathway on annual GHG emissions and capital spending. If the City of Courtenay follows Pathway Scenario 1: Business-as-Usual, the result will be:

- The City will **not** meet their 2030 and 2050 emissions targets.
- The City will reduce portfolio natural gas consumption by 7%.
- The City will reduce annual emissions by 7% (from 462 tCO_{2e} to 430 tCO_{2e}).

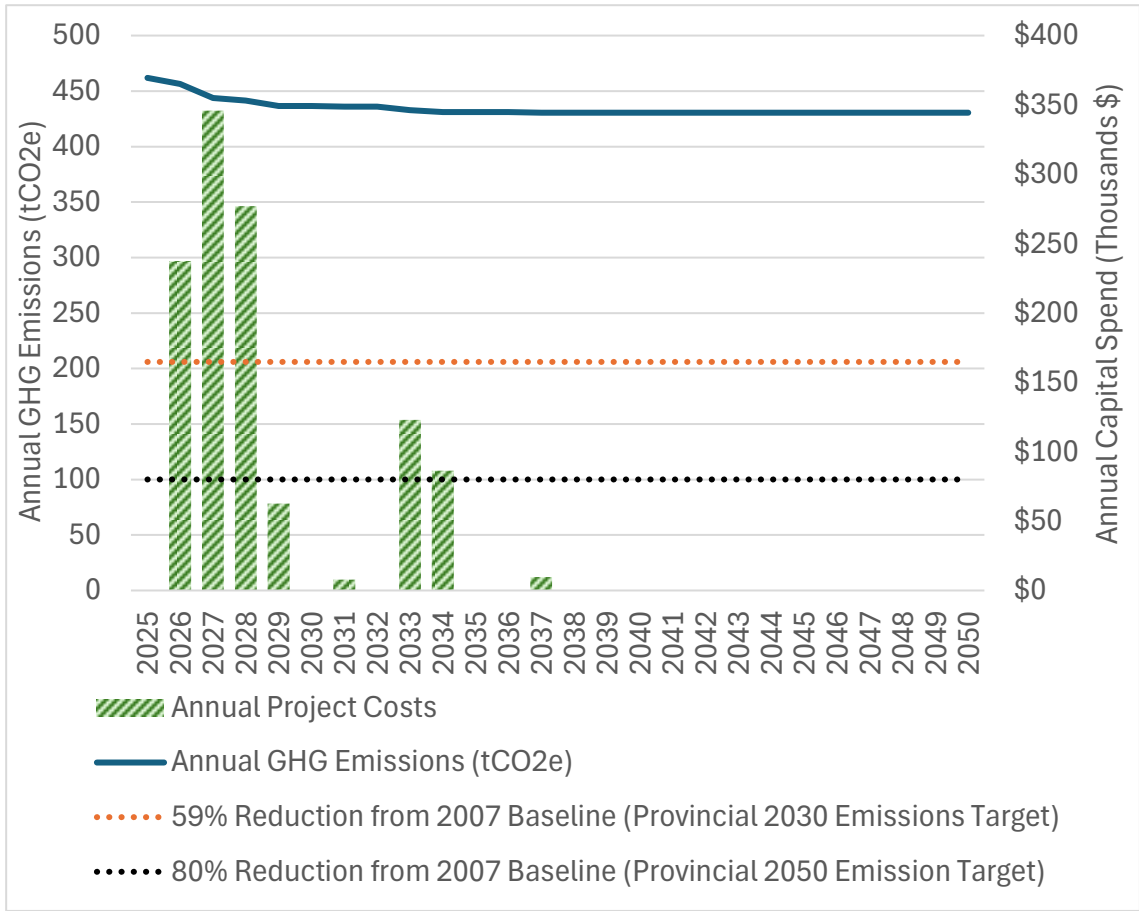


Figure 3. Pathway 1: Business as Usual, Annual GHG Emissions and Project Costs

The estimated project costs for 2026, along with cumulative costs projected through 2030 and 2050, for Pathway Scenario 1: Business as Usual are summarized in Table 5.

Table 5. Pathway 1: Business as Usual, Cumulative Project Costs

	Estimated GHG Reduction Measure Costs	Estimated Base Case Costs	Estimated Incremental Costs (= Measure - Base Case)
2026	N/A	\$240 k	N/A
2026 - 2030	N/A	\$920 k (~\$185 k per year)	N/A
2026 - 2050	N/A	\$1.2 M (~\$46 k per year)	N/A



Pathway 2: GHG Emissions Targets

Pathway 2: GHG Emissions Targets implements measures identified in the energy audits to achieve GHG emissions targets to the greatest extent possible, while minimizing impacts on the City’s annual budgets and staff capacity.

Initial projections indicated a concentration of capital spending between 2026 and 2030, driven by the City’s 2030 emissions reduction targets.

Annual Project Costs (Phased): To maintain consistent annual capital planning, the pathway evenly distributes major capital projects across the pathway timeline. This is achieved by phasing larger projects over time, using an averaged capital distribution across the planned implementation periods. For modelling purposes, six projects have been phased out over time, as seen in Figure 4. Note that feasibility of project phasing will need to be determined by the project team at the time of implementation and be informed by detailed engineering design.

The key parameters of this pathway are presented in the table below.

Table 6. Key Parameters for Pathway 2: GHG Emissions Targets

Affected Model Element	Implementation Timing
Measures Included in the Pathway	<p>Included:</p> <p>Where two alternative measures are proposed in an energy audit, the pathway includes the measure with the greatest fuel reduction potential. Where both alternatives provide the same fuel reduction, the pathway includes the measure with lowest net present value (NPV).</p>
Equipment Renewal and Base Case Costs	<p>Existing equipment end of life is based on previous building condition assessments completed for the City, as well as ASHRAE and BOMA Canada equipment service life recommendations.</p> <p>Base case costing should be used as estimates only and not fixed prices. In some cases, costs of equipment have been reviewed with suppliers before finalizing cost estimates. Prism Engineering does not guarantee pricing.</p> <p>A complete list of equipment scheduled for end-of-life can be seen in Appendix C: Equipment Replacement Timeline.</p>
Measure Implementation Timeline – Equipment Upgrades	<p>Projects that align with planned work for 2026, including roof replacements at Lewis Park Recreation Centre, Comox Valley Art Gallery, and the Fire Hall, as well as a boiler replacement at Native Sons Hall, are placed in 2026.</p> <p>Other equipment upgrade measures are implemented as existing equipment comes due for renewal.</p>

	<p>Some measures may be implemented ahead of the scheduled equipment renewal, but only when necessary to meet emissions targets or to support consistent annual capital planning.</p> <p>Note: Where equipment is beyond expected useful service life, measures associated with that equipment or component are distributed across the first five years of the pathway, prioritized based on number of years past expected service life. This is to align with capital renewal schedule to the greatest extent possible, while minimizing impacts on the City’s annual budgets and staff capacity. This does not suggest that equipment will last past its expected lifetime.</p>
Measure Implementation – Controls Measures	<p>Controls and recommissioning measure implementation aligns with major equipment upgrades, where applicable. Controls upgrades not tied to major equipment are implemented in 2027 and 2028 to maximize impact and energy efficiency.</p>
Measure Implementation – Solar PV Measures	<p>Solar PV installations were planned annually following the final decarbonization measure.</p>

Results

Figure 4 shows the impact of the pathway on annual GHG emissions and capital spending. If the City of Courtenay follows Pathway 2: GHG Emissions Targets Pathway:

- The City will meet the provincial and corporate climate action 2030 and 2050 emissions targets.
- The City will reduce portfolio natural gas consumption by 91%.
- The City will reduce annual emissions by 84% (from 462 tCO₂e to 79 tCO₂e).

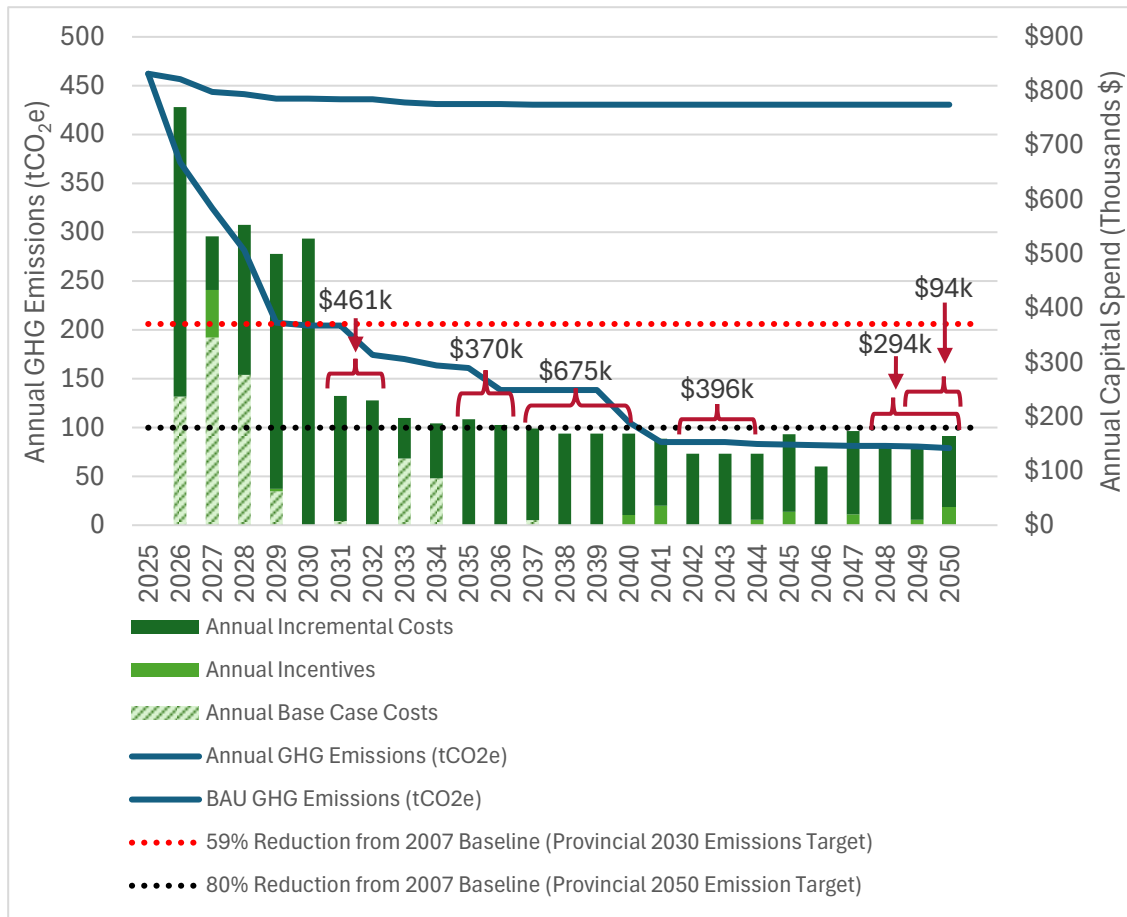


Figure 4. Pathway 2: GHG Emissions Targets, Annual GHG Emissions and Project Costs

The estimated project costs for 2026, along with cumulative costs projected through 2030 and 2050, for Pathway 2: GHG Emissions Targets are summarized in Table 7.

Table 7. Pathway 2: GHG Emissions Targets, Cumulative Project Costs

	Estimated GHG Reduction Measure Costs	Estimated Base Case Costs	Estimated Incremental Costs (= Measure - Base Case)
2026	\$770 k	\$240 k	\$530 k
2026 - 2030	\$2.9 M (~\$570 k per year)	\$920 k (~\$185 k per year)	\$1.9 M
2026 - 2050	\$6.3 M (~\$250 k per year)	\$1.2 M (~\$46 k per year)	\$5.0 M

Pathway 3: Aggressive Decarbonization

Pathway 3: Aggressive Decarbonization includes the same measures included in Pathway 2, but maximizes cumulative GHG emissions reductions over the same period. This is done by expediting high emission saving measures from post-2030 (as per Pathway 2) to the first five years of pathway (2026-2030).

As with Pathway 2, larger projects are phased over time to maintain consistent annual capital spending. Note that feasibility of project phasing will need to be determined by the project team at the time of implementation and be informed by detailed engineering design.

The key parameters of this pathway are presented in the table below.

Table 8. Key Parameters for Pathway 3: Economic Efficiency and Average Annual Spend

Affected Model Element	Implementation Timing
Measures Included in the Pathway	See Table 6. Key Parameters for Pathway 2: GHG Emissions Targets
Equipment Renewal and Base Case Costs	See Table 6. Key Parameters for Pathway 2: GHG Emissions Targets
Measure Implementation – Equipment Upgrades	<p>In general, measures have been implemented according to the same logic as the first pathway scenario, except for measures presented below.</p> <p>See Table 6. Key Parameters for Pathway 2: GHG Emissions Targets for general implementation strategy.</p> <p>See Table 9. Measures Expedited in Pathway 3: Aggressive Decarbonization for measures expedited in this pathway scenario.</p>
Measure Implementation – Controls Measures	See Table 6. Key Parameters for Pathway 2: GHG Emissions Targets

Expedited Measures

Several measures have high fuel-saving potential, but the equipment that the measures would replace have significant lifetime remaining (and therefore are shown post-2030 in the Pathway 2 timeline). To maximize cumulative GHG emissions savings across the pathway, the City could consider expediting a select measures in the Lewis Park Recreation Centre and Comox Valley Art Gallery buildings. These measures are summarized in Table 9.

Table 9. Measures Expedited in Pathway 3: Aggressive Decarbonization

	Fuel Savings (GJ)	Retrofit Cost (\$)	Year of Implementation (Pathway 2)	Year of Implementation (Pathway 3) *
Lewis Park Recreation Centre 5.2 – <i>Install Air Source Heat Pump for Rec Centre Heating</i>	130	\$675,400	2037	2026
Lewis Park Recreation Centre 5.3 – <i>Preheat Domestic Hot Water with Air Source Heat Pump</i>	400	\$63,000	2041	2026
Lewis Park Recreation Centre 6.1.2 – <i>Electrify Pool Heating (Option 2: Air Source Heat Pump for Pool Heating and Full Pool Refill)</i>	615	\$460,500	2031	2030
Comox Valley Art Gallery 5.2 – <i>Upgrade Hydronic Heating System</i>	130	\$187,800	2044	2029
Comox Valley Art Gallery 6.2.1 – <i>Electrify Hydronic Heating System</i>	460	\$370,300	2034	2027

* Years of Implementation for Pathway 3 were selected to support steady capital planning throughout the duration of the pathway.

Results

Figure 5 shows the impact of the pathway on annual GHG emissions and capital spending. If the City of Courtenay follows Pathway 3: Aggressive Decarbonization Pathway:

- The City will achieve the provincial and corporate climate action emission targets in advance of the corresponding target years.
- The City will reduce portfolio natural gas consumption by 91%.
- The City will reduce annual emissions by 84% (from 462 tCO₂e to 79 tCO₂e).

Implementation Considerations

Allocating time between projects for proper measurement and validation (M&V) can help to better prioritize and maximize the impact of future initiatives (for more discussion on M&V, see Section 8). By tracking performance data, M&V verifies project success and guides planning for future efforts. **Note that if the City pursues Pathway 3: Aggressive Decarbonization, expediting projects will compromise the opportunity to conduct M&V between projects.**

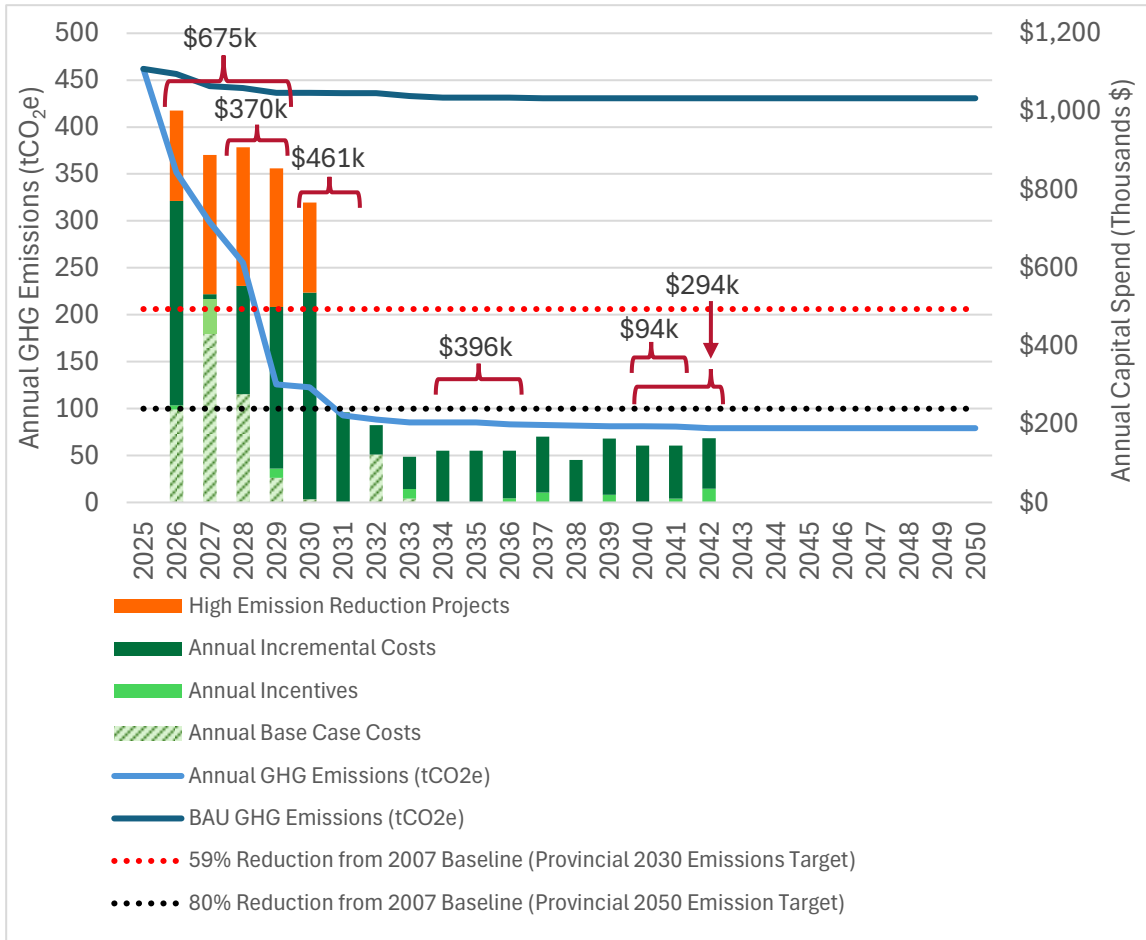


Figure 5. Pathway 3: Aggressive Decarbonization, Annual GHG Emissions and Project Costs

The estimated project costs for 2026, along with cumulative costs projected through 2030 and 2050, for Pathway 3: Aggressive Decarbonization are summarized in Table 10.

Table 10. Pathway 3: Aggressive Decarbonization, Cumulative Project Costs

	Estimated GHG Reduction Measure Costs	Estimated Base Case Costs	Estimated Incremental Costs (= Measure - Base Case)
2026	\$1.0 M	\$240 k	\$760 k
2026 - 2030	\$4.4 M (~\$880 k per year)	\$1.0M (~\$200 k per year)	\$3.4 M
2026 - 2050	\$6.3 M (~\$250 k per year)	\$1.2 M (~\$46 k per year)	\$5.1 M



Renewable Energy Generation

Renewable energy technologies such as the installation of solar PV panels are included in both Pathway 2 and 3. Results for individual buildings are included in each building’s detailed audit reports.

Installation of Solar PV for on-site electricity generation provides minimal emissions reduction because of the low carbon intensity of BC’s electricity grid. However, integrating Battery Energy Storage Systems (BESS) with Solar PV installations may offer energy resilience for facilities. BESS allows electricity generated by the solar panels to be stored and used during power outages or natural disasters, ensuring continued operation when the grid is disrupted.

For each pathway, Solar PV projects are scheduled to follow the final year of implementation for the last decarbonization measure. A summary of Solar PV results are shown in Table 11.

Table 11. Summary of Portfolio Solar PV Analysis

	Total Portfolio Analysis Results
Solar PV Annual Electricity Generation <i>Total kWh/year</i>	685,300 kWh
Solar PV Annual Electricity Generation <i>As a percentage of baseline 2024 portfolio electricity consumption</i>	16%
Annual Emissions Avoided from Solar PV Generated Electricity <i>Based on 2024 BC Electricity Grid Emissions Factor (see Appendix A for emissions factor)</i>	7 tCO ₂ e
Annual Electricity Utility Cost Savings <i>Using present day electricity utility costs and BC Hydro expected market value of electricity for surplus electricity generated</i>	\$69 k
Total Estimated Capital Costs	\$1.4 M
Simple Payback Period	20 years

Summary of Results

Figure 6 shows the GHG emissions reduction profiles, as well as the annual capital spending projections, of the three pathways modelled.

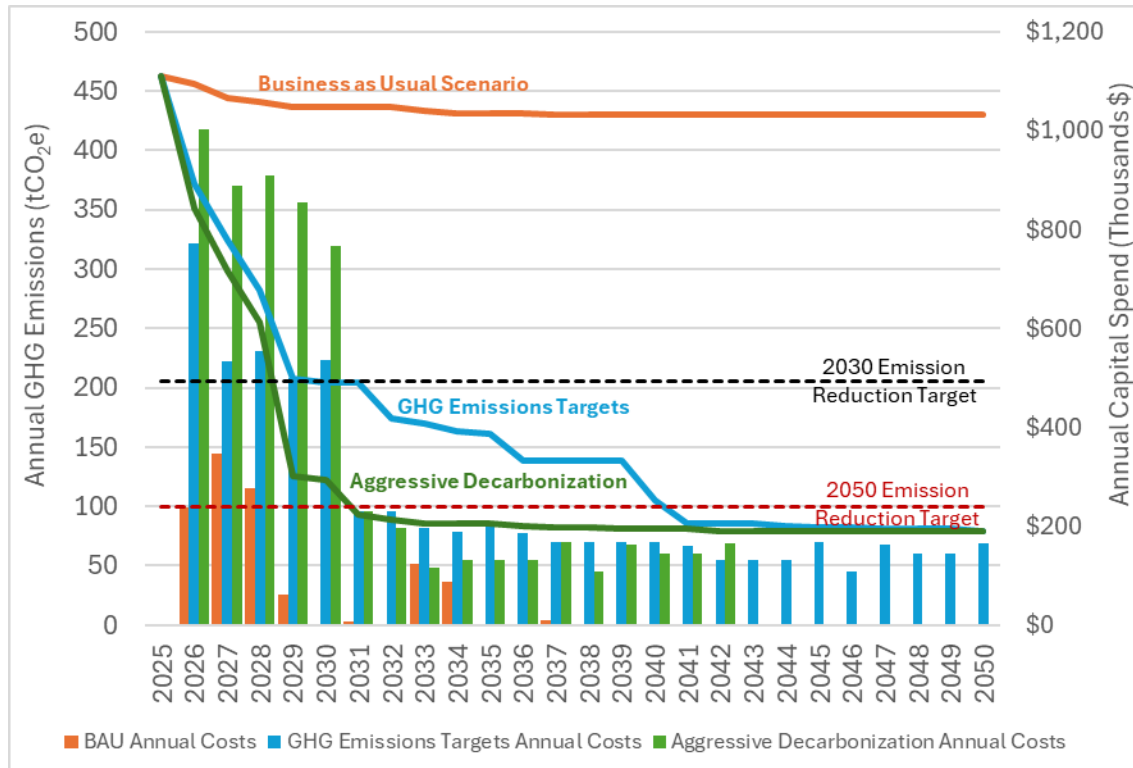


Figure 6. GHG Emission and Capital Spending Profiles of Three Pathways Modelled

The following tables provide a summary of the results for each pathway scenario. Table 12 presents the GHG emissions outcomes, Table 13 outlines the capital cost estimates, and

Table 14 details the cumulative utility cost savings projections.

Table 12. Summary of Pathway GHG Emission Results

	Achieves Targets		Total Annual Emissions (tCO ₂ e)		
	2030 Target 59% Reduction from 2007 Baseline (206 tCO ₂ e)	2050 Target 80% Reduction from 2007 Baseline (100 tCO ₂ e)	2026	2030	2050
Pathway 1: Business as Usual			444	437	431
Pathway 2: GHG Emissions Targets	✓	✓	371	204	79
Pathway 3: Aggressive Decarbonization	✓	✓	352	122	79



Table 13. Summary of Pathway Capital Cost Results

	Total Cumulative Capital Costs (CAD \$)			Total Cumulative Baseline Costs (CAD \$)		
	2026	2030	2050	2026	2030	2050
Pathway 1: Business as Usual	\$240k	\$920k	\$1.2M	\$240k	\$920k	\$1.2M
Pathway 2: GHG Emissions Targets	\$770k	\$2.9M	\$6.3M	\$240k	\$920k	\$1.2M
Pathway 3: Aggressive Decarbonization	\$1.0M	\$4.4M	\$6.3M	\$240k	\$1.0M	\$1.2M

Table 14. Summary of Pathway Operating Cost Results

	Total Cumulative Operating Cost Savings (CAD \$)		
	2026	2030	2050
Pathway 1: Business as Usual	minimal	minimal	minimal
Pathway 2: GHG Emissions Targets	\$13k	\$104k	\$997k
Pathway 3: Aggressive Decarbonization	\$10k	\$92k	\$1.5M

* In 2024, the City of Courtenay incurred approximately \$910,000 in utility costs.

7. Recommendations for Reaching Net Zero

The City of Courtenay will have approximately 26 tCO₂e of annual emissions remaining at these 11 sites after energy and carbon reduction measures have been implemented³. These residual emissions are partly attributed to residual fuel consumption in sites that are costly to fully electrify. There are also some residual emissions from electricity consumption for while BC's Electricity grid is very low carbon it is not yet no carbon. An additional 53 tCO₂e remains in the City's portfolio that are associated with smaller facilities that have been assessed outside this report. While further carbon reduction measures have been identified for these facilities, they are not included in this report or pathway modelling.

The City of Courtenay can further reduce its emissions from existing equipment by battery energy storage systems, and purchasing carbon credits and offsets.

Battery Energy Storage Systems

Renewable energy generation is already part of the City's decarbonization pathway through solar PV installations. There is an opportunity to enhance this approach by integrating Battery Energy Storage Systems (BESS), which can be connected to solar PV to store excess energy and reduce peak demand.

BESS improves the efficiency of renewable energy use by storing electricity when production is high and releasing it when demand increases. This reduces reliance on gas-fired backup systems, which are typically activated during peak periods and are significant sources of emissions.

Integrating Battery Energy Storage Systems (BESS) with Solar PV installations may offer energy resilience for facilities. BESS allows electricity generated by the solar panels to be stored and used during power outages or natural disasters, ensuring continued operation when the grid is disrupted.

Carbon Credits and Offsets

Defining Carbon Credits and Offsets

Carbon credits, offsets, and Renewable Energy Credits (REC's) are alternative financial methods to compensate for GHG emissions emitted and can potentially be used to bring the City to net zero emissions.

Offsets are credits earned by organizations that undertake projects to reduce atmospheric GHG levels either by removing CO₂ from the atmosphere (E.g., planting trees that absorbing CO₂ via photosynthesis) or by reducing the amount of GHG emissions created by a process or product compared to a more traditional/typical process or product (E.g., using wind turbines to create Electricity rather than burning coal or natural gas). The credits, sometimes called "carbon credits" can then be sold to other organizations who are looking to compensate for some, or all, of their

³ Based on Pathway 2 and Pathway 3 Results.



emissions. When an organization purchases enough offsets to compensate for all their emissions, they are considered Carbon Neutral.

A Renewable Energy Certificate (REC) is proof that one megawatt-hour (MWh) of electricity was generated from a renewable source and delivered to the power grid, representing the environmental benefits (zero GHG emissions) of that energy ⁴.

Where to Purchase Carbon Credits and Offsets

Carbon offsets and credits are purchased through brokers, online retailers and trading platforms. The funds are then used to fund GHG emission reduction or sequestration projects elsewhere. The key to the impact of credit and offset purchases are the quality of the product; that is ensuring that the emissions are actually reduced elsewhere. Selecting credits from reputable organisations that comply with international standards should be the first consideration.

The Province of British Columbia has a Carbon Offset Registry⁵. Registry sellers included on the Province's registry go through third-party verification that ensures results are both verifiable and demonstrate measurable progress.

There is an opportunity for the City to invest in local ecosystem restoration projects that could generate its own carbon credits to offset residual emissions from municipal operations. To establish a carbon offset initiative, the Province of British Columbia outlines specific criteria and requirements that must be met. All projects are subject to verification by an accredited validation body to ensure fairness, accuracy, and compliance with provincial legislation⁶. This same verification process applies to projects listed by registry sellers, as indicated above. It is advised to review offset regulatory requirements prior to planning projects or considering investment decisions.

⁴ <https://www.epa.gov/green-power-markets/renewable-energy-certificates-recs>

⁵ <https://carbonregistry.gov.bc.ca/bccarbonregistry/public/bc>

⁶ <https://www2.gov.bc.ca/gov/content/environment/climate-change/industry/offset-projects/develop>

8. Implementation Considerations

Measurement and Validation

Measurement and validation (M&V) is essential for ensuring that energy-saving strategies are delivering the intended results. By tracking performance data and outcomes, organizations can confirm the effectiveness of their projects, identify areas for improvement, and assist in decision for future investments. This process also supports transparency and accountability, helping stakeholders understand the real-world impact of climate and energy programs. Allowing time between projects to conduct M&V will help inform the timing and prioritization of future initiatives, in some cases can inform equipment sizing and design decisions, and help ensure resources are directed where they can have the greatest impact.

Energy Management Systems

Prism also recommends that the City explore Energy Management Information Systems (EMIS) to support measurement and verification (M&V), and to enable technologies that monitor, analyze, and optimize energy use across municipal facilities. A common technology used to monitor energy use across facilities is a Building Automation System (BAS). Adding BAS to the facilities that don't currently have it can help manage and monitor those facilities more effectively. Additionally, adopting ISO 50001 procedures would provide a structured framework for managing energy performance and improving efficiency in alignment with the ISO 50001 Energy Management System standard. Natural Resources Canada (NRCan) currently offers financial assistance to support the compliance or certification of ISO 50001 in commercial and industrial buildings.

Funding

Numerous funding opportunities exist that can support the implementation of energy and carbon reduction measures identified in this study. Funding opportunities are available through utility providers (BC Hydro, FortisBC), provincial organizations (CleanBC), and federal organizations (Federation of Canadian Municipalities).

We recommend that the City of Courtenay monitor funding opportunities on an ongoing basis as programs periodically change. As funding becomes available, City staff can refer to the results of this pathway study, and the accompanying energy and carbon reduction measure list to identify high priority projects to implement.

Pathway Renewal

Prism recommends that the City consider renewing this pathway plan every 3-5 years. Through time projects will be completed and circumstances such as City operational needs, funding availability, mandated targets, etc. may change. It is best practice for organizations to update their pathway plans to reflect those changes. The renewal process can build off the work completed in the creation of this plan. Revisiting and renewing the plan every 3-5 years will help the City maintain its energy and carbon reduction trajectory while allowing for some variation of the plan as circumstances change.

9. Appendices

Appendix A: Pathway Model Inputs and Assumptions

Table 15. Summary of GHG Emission Baselines and Targets

	City of Courtenay’s Community Energy and Emissions Plan	FCM Study Requirements
GHG Emissions Baseline Year	2007	2024
Target 1:	59% GHG emission reduction by 2030	50% corporate building GHG emission reduction by 2035
Target 2:	80% GHG emission reduction by 2050	80% corporate building GHG emission reduction by 2045

Table 16. Electricity and Natural Gas Emissions Factors for Pathway GHG Emissions Analysis

	Emission Factor	Source
Electricity	0.0000099 tonnes/kWh	B.C.’s 2024 Grid Intensity Factors ⁷
Natural Gas	January to June 2024: 0.05022145 tonnes CO ₂ e/GJ	2024 BC Best Practices Methodology for Quantifying GHG Emissions ⁸
	July to December 2024: 0.0497344278 tonnes CO ₂ e/GJ	2024 BC Best Practices Methodology for Quantifying GHG Emissions ⁹

Appendix B: Pathway Energy and Carbon Reduction Measure List

Please see attached.

Appendix C: Equipment Replacement Timeline

Please see attached.

⁷ <https://www2.gov.bc.ca/gov/content/environment/climate-change/industry/reporting/quantify/electriCity>

⁸ https://www2.gov.bc.ca/assets/gov/environment/climate-change/cng/methodology/2024_methodology_for_quantifying_greenhouse_gas_emissions.pdf

⁹ https://www2.gov.bc.ca/assets/gov/environment/climate-change/cng/methodology/2024_methodology_for_quantifying_greenhouse_gas_emissions.pdf

Appendix B: Pathway Energy and Carbon Reduction Measure List

Measure Summary			Energy Summary				Cost Summary			GHG Summary	Implementation Year	
Building	No.	Measure	Demand (kW)	Electrical (kWh)	Fuel (GJ)	Total Energy Cost Savings (\$)	Estimated Retrofit Costs (\$)	Estimated Base Case Cost (\$)	Estimated Incentives (\$)	GHG Reduction CO2-e (Tonnes/year)	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
City Hall	5.1	Revise RTU Operation	0	28,500	0	\$3,200	\$8,600	\$0	\$0	0.3	2027	2027
City Hall	6.1	Install Solar PV	0	45,000	0	\$5,100	\$94,200	\$0	\$10,000	0.4	2048 - 2049	2040 - 2041
Comox Valley Art Gallery	5.1	Recommission HVAC and Domestic Hot Water Systems	0	10,100	52	\$1,300	\$10,000	\$0	\$0	2.6	2026	2026
Comox Valley Art Gallery	5.2	Upgrade Hydronic Heating System	9	3,300	131	\$3,200	\$187,770	\$86,400	\$0	6.3	2034	2027
Comox Valley Art Gallery	6.1	Replace RTU-1 with Heat Pump RTU	-3	-3,000	36	-\$300	\$95,800	\$73,700	\$0	1.7	2026	2026
Comox Valley Art Gallery	6.2.1	Electrify Hydronic Heating System - Air Source Heat Pump	-5	-50,400	460	\$900	\$370,300	\$0	\$0	21.5	2035 - 2036	2028 - 2029
Comox Valley Art Gallery	6.2.2	Electrify Hydronic Heating System - Electric Boiler	-15	-142,700	460	-\$6,800	\$281,100	\$0	\$0	20.6	2035 - 2036	2028 - 2029

Appendix B: Pathway Energy and Carbon Reduction Measure List

Measure Summary			Energy Summary				Cost Summary			GHG Summary	Implementation Year	
Building	No.	Measure	Demand (kW)	Electrical (kWh)	Fuel (GJ)	Total Energy Cost Savings (\$)	Estimated Retrofit Costs (\$)	Estimated Base Case Cost (\$)	Estimated Incentives (\$)	GHG Reduction CO2-e (Tonnes/year)	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
Comox Valley Art Gallery	6.3.1	Electrify Domestic Hot Water - Alternative 1: Install CO2 Heat Pump	0	-3,300	66	\$500	\$23,200	\$9,200	\$0	3.1	2027	2027
Comox Valley Art Gallery	6.3.2	Electrify Domestic Hot Water - Alternative 1: Install Electric Boiler	0	-15,000	66	-\$300	\$16,200	\$9,200	\$0	3.0	2027	2027
Comox Valley Art Gallery	7.1	Install SolarPV Panels	0	22,000	0	\$1,500	\$47,100	\$0	\$10,000	0.2	2045	2037
Courtenay District & Museum	5.2	Install Counter to Align AHU-1 Operation with Actual Occupancy	0	6,600	0	\$700	\$7,700	\$0	\$0	0.1	2028	2028
Courtenay District & Museum	5.3	Control Staff Washrooms Exhaust Fan with Timer	0	400	0	\$0	\$600	\$0	\$0	0.0	2027	2027

Appendix B: Pathway Energy and Carbon Reduction Measure List

Measure Summary			Energy Summary				Cost Summary			GHG Summary	Implementation Year	
Building	No.	Measure	Demand (kW)	Electrical (kWh)	Fuel (GJ)	Total Energy Cost Savings (\$)	Estimated Retrofit Costs (\$)	Estimated Base Case Cost (\$)	Estimated Incentives (\$)	GHG Reduction CO2-e (Tonnes/year)	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
Courtenay District & Museum	6.1	Install Solar PV	0	29,700	0	\$3,100	\$63,600	\$0	\$10,000	0.3	2047	2039
Fire Hall	5.1	Install a Push Button for Gas-Fired Radiant Tube Heaters	0	0	153	\$1,300	\$5,200	\$0	\$0	7.3	2027	2027
Fire Hall	6.1.1	Install Dual-Fuel RTUs	-7	-23,300	304	-\$100	\$166,600	\$103,700	\$49,980	14.3	2026	2026
Fire Hall	6.1.2	Alternative 1: Install Air Source Heat Pump	-20	-29,800	373	-\$500	\$241,600	\$103,700	\$0	17.6	2026	2026
Fire Hall	6.1.3	Alternative 2: Install Centralized VRF	-18	-26,100	373	\$0	\$292,500	\$103,700	\$0	17.6	2026	2026
Fire Hall	6.2	Electrify Domestic Hot Water	0	-12,600	55	-\$900	\$1,000	\$0	\$0	2.5	2029	2029
Fire Hall	6.3	Truck Bay Heating System Upgrade	-1	-5,100	86	\$200	\$100,400	\$0	\$0	4.1	2029	2029
Fire Hall	7.1	Install Solar PV	0	62,000	0	\$7,000	\$121,000	\$0	\$25,000	0.6	2045	2037

Appendix B: Pathway Energy and Carbon Reduction Measure List

Measure Summary			Energy Summary				Cost Summary			GHG Summary	Implementation Year	
Building	No.	Measure	Demand (kW)	Electrical (kWh)	Fuel (GJ)	Total Energy Cost Savings (\$)	Estimated Retrofit Costs (\$)	Estimated Base Case Cost (\$)	Estimated Incentives (\$)	GHG Reduction CO2-e (Tonnes/year)	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
Florence Filberg Centre	5.1	Integrate HVAC Controls with Programmable Thermostats	0	31,500	0	\$2,000	\$125,900	\$0	\$0	0.3	2028	2028
Florence Filberg Centre	6.1	Electrify Domestic Hot Water	-35	-37,700	109	-\$2,900	\$30,400	\$18,305	\$0	4.8	2027	2027
Florence Filberg Centre	6.2	Replace Upstairs Kitchen Stove with Electric Stove	-32	11,300	27	-\$300	\$34,200	\$0	\$0	1.4	2029	2029
Florence Filberg Centre	7.1	Install Solar PV	0	33,800	0	\$2,200	\$66,000	\$0	\$25,000	0.3	2050	2042
Lewis Park Rec Centre	5.1	Decouple Domestic Hot Water Loop	0	0	744	\$6,200	\$15,000	\$0	\$0	35.6	2026	2026
Lewis Park Rec Centre	5.2	Install Air Source Heat Pump	-61	-70,400	676	-\$7,000	\$675,400	\$0	\$19,004	31.7	2037 - 2040	2026 - 2029
Lewis Park Rec Centre	5.3	Preheat DHW with ASHP	0	-52,600	402	-\$2,600	\$63,000	\$0	\$11,245	18.7	2041	2026

Appendix B: Pathway Energy and Carbon Reduction Measure List

Measure Summary			Energy Summary				Cost Summary			GHG Summary	Implementation Year	
Building	No.	Measure	Demand (kW)	Electrical (kWh)	Fuel (GJ)	Total Energy Cost Savings (\$)	Estimated Retrofit Costs (\$)	Estimated Base Case Cost (\$)	Estimated Incentives (\$)	GHG Reduction CO2-e (Tonnes/year)	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
Lewis Park Rec Centre	5.4	Building Envelope Upgrade	0	3,800	0	\$400	\$0	\$0	\$0	0.0	2026	2026
Lewis Park Rec Centre	5.5	Install Solar PV	0	140,700	0	\$15,900	\$294,300	\$0	\$10,000	1.4	2048 - 2050	2040 - 2042
Lewis Park Rec Centre	6.1.1	Electrify Pool Heating (Option 1)	0	-61,300	548	-\$2,100	\$230,300	\$0	\$0	25.6	2031	2031
Lewis Park Rec Centre	6.1.2	Electrify Pool Heating (Option 2)	0	-68,700	614	-\$2,400	\$460,500	\$0	\$0	28.7	2031 - 2032	2030 - 2031
Lewis Park Rec Centre	6.2.1	Alternative 1: CO2 Heat Pump	-3	-2,500	53	\$0	\$55,600	\$9,600	\$0	2.5	2035	2035
Lewis Park Rec Centre	6.2.2	Alternative 2: Electric DHW Heaters	-8	-11,100	53	-\$1,400	\$20,100	\$9,600	\$0	2.4	2035	2035
Lewis Park Rec Centre	7.1	Lewis Park Site Lighting LED Upgrade	56	36,200	0	\$8,300	\$500,000	\$0	\$0	0.4	2030	2030
Lewis Park Rec Centre	7.2	Upgrade Baseboards to Mini-Split Heat Pumps	-2	8,400	0	\$800	\$23,200	\$0	\$0	0.1	2029	2029

Appendix B: Pathway Energy and Carbon Reduction Measure List

Measure Summary			Energy Summary				Cost Summary			GHG Summary	Implementation Year	
Building	No.	Measure	Demand (kW)	Electrical (kWh)	Fuel (GJ)	Total Energy Cost Savings (\$)	Estimated Retrofit Costs (\$)	Estimated Base Case Cost (\$)	Estimated Incentives (\$)	GHG Reduction CO2-e (Tonnes/year)	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
Lewis Park Rec Centre	7.3	Window Upgrade (Salish & Tsolum Building)	0	100	0	\$0	\$15,000	\$0	\$0	0.0	2027	2027
Linc Youth Centre	5.1	Upgrade Rooftop Unit Controls	0	3,100	19	\$600	\$15,000	\$0	\$0	0.9	2027	2027
Linc Youth Centre	6.1.1	Alternative 1: Dual Fuel RTUs	-2	-5,400	70	-\$100	\$181,300	\$122,900	\$54,390	3.3	2033	2033
Linc Youth Centre	6.1.2	Alternative 2: Air Source Heat Pumps	-5	-6,800	87	-\$200	\$197,600	\$122,900	\$0	4.1	2033	2033
Linc Youth Centre	7.1	Install Solar PV	0	49,500	0	\$6,900	\$96,800	\$0	\$25,000	0.6	2041	2033
Native Sons Hall	5.1	Upgrade Kitchen Range and Reduce Ventilation	0	14,100	265	\$3,900	\$22,100	\$0	\$0	12.8	2029	2029
Native Sons Hall	5.2	Upgrade Heating Plant	0	0	317	\$2,800	\$346,500	\$60,000	\$0	15.2	2026	2026
Native Sons Hall	5.3	Insulate Hydronic Piping	0	0	45	\$400	\$8,200	\$0	\$0	2.2	2026	2026

Appendix B: Pathway Energy and Carbon Reduction Measure List

Measure Summary			Energy Summary				Cost Summary			GHG Summary	Implementation Year	
Building	No.	Measure	Demand (kW)	Electrical (kWh)	Fuel (GJ)	Total Energy Cost Savings (\$)	Estimated Retrofit Costs (\$)	Estimated Base Case Cost (\$)	Estimated Incentives (\$)	GHG Reduction CO2-e (Tonnes/year)	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
Native Sons Hall	5.4	Improve Attic Insulation	0	0	31	\$300	\$53,500	\$0	\$0	1.5	2026	2026
Native Sons Hall	6.1	Upgrade DHW Heater	-14	-17,900	92	-\$2,200	\$20,600	\$15,237	\$0	4.2	2028	2028
Native Sons Hall	6.2	Install Hydronic Heating ASHP	-6	-11,900	169	-\$300	\$167,000	\$0	\$4,794	8.0	2029	2029
Native Sons Hall	6.3	Replace Basement Kitchen Gas Stove	0	-1,700	70	\$400	\$11,800	\$0	\$0	3.3	2029	2029
Public Works Yard	5.1	Replace Furnaces with ASHP	-2	-9,800	192	\$500	\$75,500	\$26,060	\$0	9.1	2027	2027
Public Works Yard	5.2	Administration Building - Electrify Domestic Hot Water Heater	-8	-11,100	47	-\$1,300	\$14,500	\$9,200	\$0	2.1	2028	2028
Public Works Yard	6.1	Truck Bays 59 & 60 - Heating System Upgrade	-3	-13,300	259	\$700	\$24,400	\$10,851	\$0	12.3	2029	2029

Appendix B: Pathway Energy and Carbon Reduction Measure List

Measure Summary			Energy Summary				Cost Summary			GHG Summary	Implementation Year	
Building	No.	Measure	Demand (kW)	Electrical (kWh)	Fuel (GJ)	Total Energy Cost Savings (\$)	Estimated Retrofit Costs (\$)	Estimated Base Case Cost (\$)	Estimated Incentives (\$)	GHG Reduction CO2-e (Tonnes/year)	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
Public Works Yard	7.1	Truck Bays 19-34 - Setback Thermostats	0	0	223	\$2,000	\$0	\$0	\$0	10.7	2026	2026
Public Works Yard	7.2	Truck Bays 19-34 - Install Split Air Source Heat Pump	-4	-11,100	192	\$200	\$49,600	\$22,118	\$0	9.1	2029	2029
Public Works Yard	8.1	Stores/Mechanics - Heating System Upgrade	-9	-20,300	369	\$500	\$66,500	\$29,793	\$0	17.5	2029	2029
Public Works Yard	9.1	Install Solar PV	0	205,200	0	\$21,200	\$396,000	\$0	\$10,300	2.0	2042 - 2044	2034 - 2036
Sid Williams Theatre	5.1.2	Install a Variable Flow Dual Fuel RTU	-21	-7,200	227	-\$400	\$293,000	\$238,400	\$87,900	10.8	2027	2027
Sid Williams Theatre	5.1.3	Implement Demand Controlled Ventilation	13	7,200	6	\$1,800	\$1,900	\$0	\$0	0.3	2028	2028
Sid Williams Theatre	5.1.4	Install Zone Temperature Control	0	900	1	\$100	\$18,400	\$0	\$0	0.0	2028	2028
Sid Williams Theatre	5.2.1	Dual Fuel RTU-2 and 3	-4	-5,300	88	-\$100	\$124,500	\$70,620	\$37,350	4.2	2028	2028

Appendix B: Pathway Energy and Carbon Reduction Measure List

Measure Summary			Energy Summary				Cost Summary			GHG Summary	Implementation Year	
Building	No.	Measure	Demand (kW)	Electrical (kWh)	Fuel (GJ)	Total Energy Cost Savings (\$)	Estimated Retrofit Costs (\$)	Estimated Base Case Cost (\$)	Estimated Incentives (\$)	GHG Reduction CO2-e (Tonnes/year)	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
Sid Williams Theatre	5.2.2	Alternative 1: All Electric Heat Pump RTU-2 and 3	-7	-5,700	90	-\$400	\$144,100	\$70,620	\$0	4.3	2028	2028
Sid Williams Theatre	6.1	Install Solar PV	0	45,600	0	\$5,100	\$100,000	\$0	\$10,000	0.5	2047	2039
Vancouver Island Regional Library	5.1	Heating Plant Upgrade	0	0	243	\$2,100	\$65,800	\$56,000	\$0	11.7	2027	2027
Vancouver Island Regional Library	5.2	Replace Condensing Units with Air Source Heat Pump	-13	-41,700	631	-\$100	\$220,700	\$182,013	\$0	29.8	2028	2028
Vancouver Island Regional Library	5.3.1	Alternative 1: CO2 Heat Pump	-5	-2,500	54	-\$200	\$36,400	\$7,960	\$0	2.5	2030	2030
Vancouver Island Regional Library	5.3.2	Alternative 2: Electric DHW Heater	-9	-11,200	54	-\$1,400	\$12,200	\$7,960	\$0	2.5	2030	2030
Vancouver Island Regional Library	6.1	Install Solar PV	0	51,800	0	\$5,800	\$108,300	\$0	\$0	0.5	2046	2038

Red Font: Not included in pathway modelling

Blue Font: Expedited implementation years for Pathway 3: Aggressive Decarbonization

Appendix C: Equipment Replacement Timeline

Measure Summary			Existing Equipment Summary		Expected Replacement Timeline		Implementation Year	
Building	No.	Measure Description	Equipment to be Replaced	Install Year	Recommended Lifetime	Equipment End of Life Year	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
City Hall	5.1	Revise RTU Operation	N/A	N/A	N/A	N/A	2027	2027
City Hall	6.1	Install Solar PV	N/A	N/A	N/A	N/A	2048 - 2049	2040 - 2041
Comox Valley Art Gallery	5.1	Recomission HVAC and Domestic Hot Water Systems	N/A	N/A	N/A	N/A	2026	2026
Comox Valley Art Gallery	5.2	Upgrade Hydronic Heating System	Boiler	2005	30	2035	2034	2027
Comox Valley Art Gallery	6.1	Replace RTU-1 with Heat Pump RTU	RTU	2005	15	2020	2026	2026
Comox Valley Art Gallery	6.2.1	Electrify Hydronic Heating System - Air Source Heat Pump	Boiler	2005	30	2035	2035 - 2036	2028 - 2029
Comox Valley Art Gallery	6.2.2	Electrify Hydronic Heating System - Electric Boiler	Boiler	2005	30	2035	2035 - 2036	2028 - 2029
Comox Valley Art Gallery	6.3.1	Electrify Domestic Hot Water - Alternative 1: Install CO2 Heat Pump	DHW Heater	2005	15	2020	2027	2027
Comox Valley Art Gallery	6.3.2	Electrify Domestic Hot Water - Alternative 1: Install Electric Boiler	DHW Heater	2005	15	2020	2027	2027
Comox Valley Art Gallery	7.1	Install SolarPV Panels	N/A	N/A	N/A	N/A	2045	2037
Courtenay District & Museum	5.1	Baseline Operation: Extended AHU-1 Schedules	N/A	N/A	N/A	N/A	2027	2027
Courtenay District & Museum	5.2	Install Counter to Align AHU-1 Operation with Actual Occupancy	N/A	N/A	N/A	N/A	2028	2028
Courtenay District & Museum	5.3	Control Staff Washrooms Exhaust Fan with Timer	N/A	N/A	N/A	N/A	2027	2027

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Measure Summary			Existing Equipment Summary		Expected Replacement Timeline		Implementation Year	
Building	No.	Measure Description	Equipment to be Replaced	Install Year	Recommended Lifetime	Equipment End of Life Year	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
Courtenay District & Museum	6.1	Install Solar PV	N/A	N/A	N/A	N/A	2047	2039
Fire Hall	5.1	Install a Push Button for Gas-Fired Radiant Tube Heaters	N/A	N/A	N/A	N/A	2027	2027
Fire Hall	6.1.1	Install Dual-Fuel RTUs	RTU	1999	15	2014	2026	2026
Fire Hall	6.1.2	Alternative 1: Install Air Source Heat Pump	RTU	1999	15	2014	2026	2026
Fire Hall	6.1.3	Alternative 2: Install Centralized VRF	RTU	1999	15	2014	2026	2026
Fire Hall	6.2	Electrify Domestic Hot Water	DHW Heater	2016	15	2031	2029	2029
Fire Hall	6.3	Truck Bay Heating System Upgrade	N/A	N/A	N/A	N/A	2029	2029
Fire Hall	7.1	Install Solar PV	N/A	N/A	N/A	N/A	2045	2037
Florence Filberg Centre	5.1	Integrate HVAC Controls with Programmable Thermostats	N/A	N/A	N/A	N/A	2028	2028
Florence Filberg Centre	6.1	Electrify Domestic Hot Water	DHW Heater	2011	15	2026	2027	2027
Florence Filberg Centre	6.2	Replace Upstairs Kitchen Stove with Electric Stove	N/A	N/A	N/A	N/A	2029	2029
Florence Filberg Centre	7.1	Install Solar PV	N/A	N/A	N/A	N/A	2050	2042
Lewis Park Rec Centre	5.1	Decouple Domestic Hot Water Loop	N/A	N/A	N/A	N/A	2026	2026
Lewis Park Rec Centre	5.2	Install Air Source Heat Pump	Furnace	2013	25	2041	2037 - 2040	2026 - 2029
Lewis Park Rec Centre	5.3	Preheat DHW with ASHP	N/A	N/A	N/A	N/A	2041	2026

Appendix C: Equipment Replacement Timeline

Measure Summary			Existing Equipment Summary		Expected Replacement Timeline		Implementation Year	
Building	No.	Measure Description	Equipment to be Replaced	Install Year	Recommended Lifetime	Equipment End of Life Year	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
Lewis Park Rec Centre	5.4	Building Envelope Upgrade	N/A	N/A	N/A	N/A	2026	2026
Lewis Park Rec Centre	5.5	Install Solar PV	N/A	N/A	N/A	N/A	2048 - 2050	2040 - 2042
Lewis Park Rec Centre	6.1.1	Electrify Pool Heating (Option 1)	Condensing Boiler	2017	15	2032	2031	2031
Lewis Park Rec Centre	6.1.2	Electrify Pool Heating (Option 2)	Condensing Boiler	2017	15	2032	2031 - 2032	2030 - 2031
Lewis Park Rec Centre	6.2.1	Alternative 1: CO2 Heat Pump	DHW Heater	2022	15	2037	2035	2035
Lewis Park Rec Centre	6.2.2	Alternative 2: Electric DHW Heaters	DHW Heater	2022	15	2037	2035	2035
Lewis Park Rec Centre	7.1	Lewis Park Site Lighting LED Upgrade	N/A	N/A	N/A	N/A	2030	2030
Lewis Park Rec Centre	7.2	Upgrade Baseboards to Mini-Split Heat Pumps	N/A	N/A	N/A	N/A	2029	2029
Lewis Park Rec Centre	7.3	Window Upgrade (Salish & Tsolum Building)	N/A	N/A	N/A	N/A	2027	2027
Linc Youth Centre	5.1	Upgrade Rooftop Unit Controls	N/A	N/A	N/A	N/A	2027	2027
Linc Youth Centre	6.1.1	Alternative 1: Dual Fuel RTUs	RTU	2018 and 2020	15	2035	2033	2033
Linc Youth Centre	6.1.2	Alternative 2: Air Source Heat Pumps	RTU	2018 and 2020	15	2035	2033	2033
Linc Youth Centre	7.1	Install Solar PV	N/A	N/A	N/A	N/A	2041	2033
Native Sons Hall	5.1	Upgrade Kitchen Range and Reduce Ventilation	Kitchen Range	2010	15	2025	2029	2029

Appendix C: Equipment Replacement Timeline

Measure Summary			Existing Equipment Summary		Expected Replacement Timeline		Implementation Year	
Building	No.	Measure Description	Equipment to be Replaced	Install Year	Recommended Lifetime	Equipment End of Life Year	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
Native Sons Hall	5.2	Upgrade Heating Plant	Boiler	2010	N/A	Planned for replacement in 2025	2026	2026
Native Sons Hall	5.3	Insulate Hydronic Piping	N/A	N/A	N/A	N/A	2026	2026
Native Sons Hall	5.4	Improve Attic Insulation	N/A	N/A	N/A	N/A	2026	2026
Native Sons Hall	6.1	Upgrade DHW Heater	DHW Heater	2010	15	2025	2028	2028
Native Sons Hall	6.2	Install Hydronic Heating ASHP	Boiler	2010	N/A	Planned for replacement in 2025	2029	2029
Native Sons Hall	6.3	Replace Basement Kitchen Gas Stove	N/A	N/A	N/A	N/A	2029	2029
Public Works Yard	5.1	Replace Furnaces with ASHP	Furnace	1985	18	2003	2027	2027
Public Works Yard	5.2	Administration Building - Electrify Domestic Hot Water Heater	DHW Heater	2006	15	2021	2028	2028
Public Works Yard	6.1	Truck Bays 59 & 60 - Heating System Upgrade	Radiant Tube Heaters	2011	25	2036	2029	2029
Public Works Yard	7.1	Truck Bays 19-34 - Setback Thermostats	N/A	N/A	N/A	N/A	2026	2026
Public Works Yard	7.2	Truck Bays 19-34 - Install Split Air Source Heat Pump	Unit Heaters	2018-2021	13	2031	2029	2029
Public Works Yard	8.1	Stores/Mechanics - Heating System Upgrade	Radiant Tube Heaters	2007	25	2032	2029	2029
Public Works Yard	9.1	Install Solar PV	N/A	N/A	N/A	N/A	2042 - 2044	2034 - 2036
Sid Williams Theatre	5.1.2	Install a Variable Flow Dual Fuel RTU	RTU	2000	15	2015	2027	2027

Appendix C: Equipment Replacement Timeline

Measure Summary			Existing Equipment Summary		Expected Replacement Timeline		Implementation Year	
Building	No.	Measure Description	Equipment to be Replaced	Install Year	Recommended Lifetime	Equipment End of Life Year	Replacement Year (Pathway 2: GHG Emissions Target)	Replacement Year (Pathway 3: Aggressive Decarbonization)
Sid Williams Theatre	5.1.3	Implement Demand Controlled Ventilation	N/A	N/A	N/A	N/A	2028	2028
Sid Williams Theatre	5.1.4	Install Zone Temperature Control	N/A	N/A	N/A	N/A	2028	2028
Sid Williams Theatre	5.2.1	Dual Fuel RTU-2 and 3	RTU	2000	15	2015	2028	2028
Sid Williams Theatre	5.2.2	Alternative 1: All Electric Heat Pump RTU-2 and 3	RTU	2000	15	2015	2028	2028
Sid Williams Theatre	6.1	Install Solar PV	N/A	N/A	N/A	N/A	2047	2039
Vancouver Island Regional Library	5.1	Heating Plant Upgrade	Boiler	2001	25	2026	2027	2027
Vancouver Island Regional Library	5.2	Replace Condensing Units with Air Source Heat Pump	Boiler	2001	20	2021	2028	2028
Vancouver Island Regional Library	5.3.1	Alternative 1: CO2 Heat Pump	DHW Heater	2016	15	2031	2030	2030
Vancouver Island Regional Library	5.3.2	Alternative 2: Electric DHW Heater	DHW Heater	2016	15	2031	2030	2030
Vancouver Island Regional Library	6.1	Install Solar PV	N/A	N/A	N/A	N/A	2046	2038

Red Font: Not included in pathway modelling

Blue Font: Expedited implementation years for Pathway 3: Aggressive Decarbonization