Appendix B – Deep Energy Efficiency Retrofit Feasibility Study Summary

In June of 2021 staff applied to The Federation of Canadian Municipalities (FCM) – Green Municipal Fund (GMF) - GHG reduction pathway feasibility studies funding stream and were successful in obtaining $200,000 in funding to begin studies at Appleby Ice Centre, Brant Hills Community Centre, Fire Station 2, and Fire Station 7.

Over the past year City staff from the corporate energy, asset management, project management, and operations teams City staff have been working with DIALOG Design to perform the studies at the above-mentioned facilities.

The studies followed a seven-step process:

1. Site Investigation
2. Calibrated energy modelling of the existing building
3. Design Workshop
4. Measure Level Analysis
5. Reduction pathways and scenario analysis
6. Decision Making Workshop
7. Final Reports

The Design team was asked to prepare four different scenarios as part of Step 5. These scenarios included:

- A 10-year plan that achieves a minimum 50% reduction in on-site GHG reduction emissions vs. current performance and a 20-year plan that achieves a minimum 80% reduction in on site GHG emissions vs current performance.
- A “short-term deep retrofit” scenario: This includes the same GHG reduction measures as scenario 1, except that all measures are implemented in the first two to five years. This pathway could potentially be used for funding applications for future projects if appropriate funding streams become available from senior levels of government.
- A “maximum site potential” scenario: This targets the greatest reduction potential possible, independent of capital considerations
- An “optimized outcome” scenario: This considers cost-per-ton-tCO2e targets, GHG reduction targets and other qualitative and quantitative impacts optimized according to project objectives. This scenario is the best combination of measures identified in the first three scenarios and is the scenario suggest for implementation at each facility.

These studies have been recently completed and we are able to share the results. While the studies contain a vast amount of detail for each of the scenarios, below a

summary of the “Optimized Outcome” scenario for each of the facilities. The recommendations of this scenario will be worked into capital budgets for future implementation.

Appleby Ice Centre

Carbon Reduction Measures Included:

Electric Domestic Hot Water and Ice Resurfacing – Replacement of all 7 natural gas fired boilers with electric boilers and connection to the heat recovery system described in the Ice Plant Upgrade Measures.

Packaged Air Source Heat Pumps and Heat Recovery Ventilators – Changing all rooftop units to air source heat pump rooftop units with hydronic heating to be used as an alternate source of heating for the units which would be fed from the heat recovered from the ice plant along with a backup electric boiler. High efficiency heat recovery ventilators would also be added to the HVAC system to recover all heat available from exhaust air.

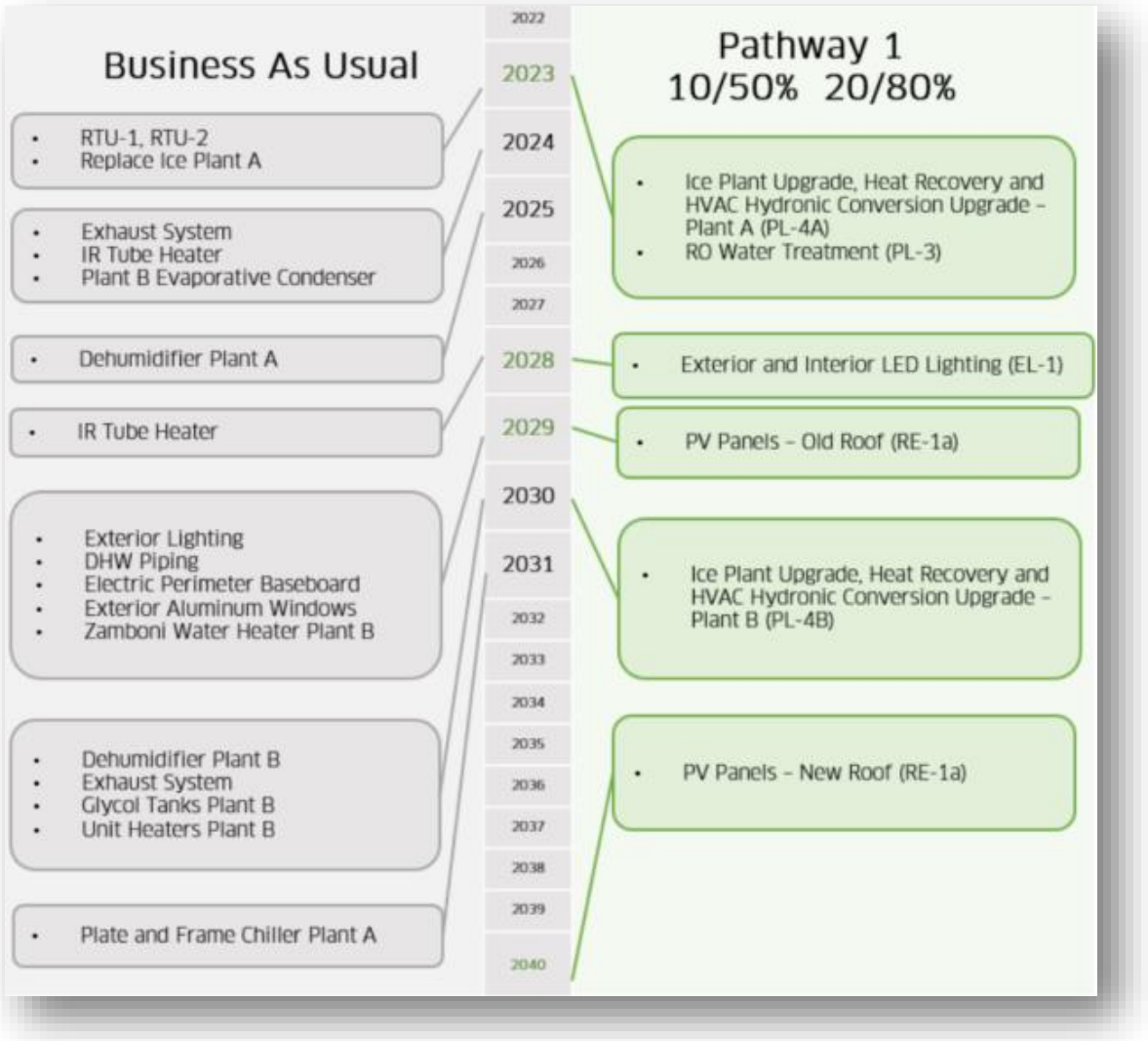
LED Lighting Upgrades – Upgrading the lighting in the newer portion of the building (rinks 3 and 4) to LED lighting.

Ice Plant Upgrades for both Plant A and B – Upgrading plant equipment to more efficient pumps, motors, and compressors. Using equipment compatible with ice plant heat recovery, the introduction of storage tanks, hydronic piping, and pumps to connect the recovered heat with the building hydronic heating loop introduced in the HVAC upgrade described above. Also included would be changing out gas fired bleacher heaters with hydronic unit heaters.

Reverse Osmosis Water Treatment - Using this technology as opposed to chemically treating water used to flood the rinks requires less energy to freeze and bonds to existing ice more easily and remains frozen at a higher temperature.

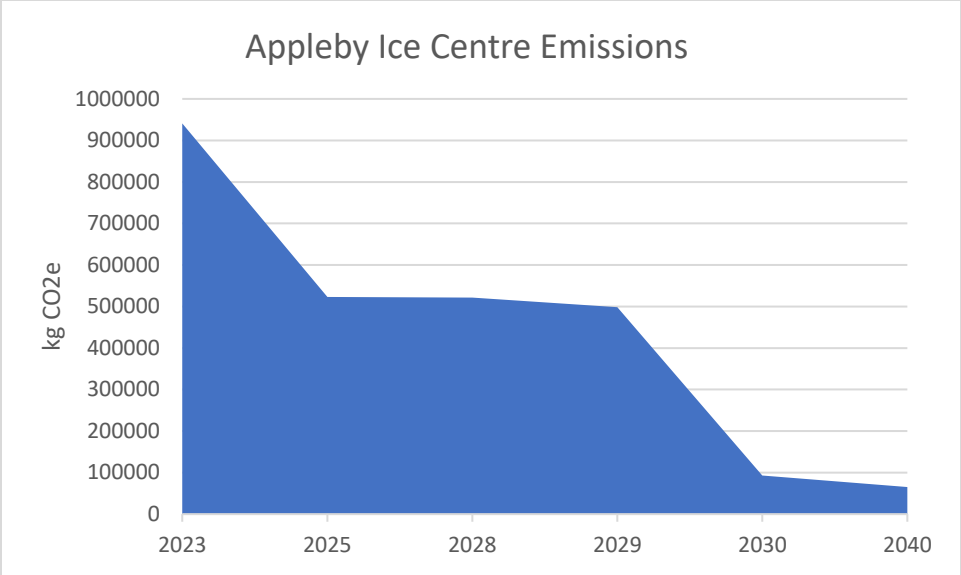
Rooftop Photovoltaic Panels – Installation of three arrays on the building would take place following roof replacements. The total amount of solar installed would be 1,445kW of panels generating approximately 1,680,080kWh of electricity annually.

Timeline for Implementation:



GHG Reduction

The implementation of the above-mentioned projects at the facility will reduce emissions by a total of 93%. Any remaining emissions from the facility at this point could be offset with the purchase of carbon credits or future virtual net metered solar arrays at remote locations.



Capital Cost Implications

Below is a cost in today's dollars of the business-as-usual capital plan implementation vs the optimized. The incremental capital cost of implementing the low carbon pathway is $17,847,845. Over the 30-year term assessed in the study the cost premium for the low carbon pathway is $4,853,682.

	Business as Usual	Low Carbon Optimized Pathway
Capital Cost	$2,972,600	$20,820,085
30-Year Energy Costs	$18,270,973	$12,497,225
30-Year Carbon Costs	$4,555,025	$674,600
Cost premium per ton of avoided GHG	-	$1,055

**Assumed interest rate of 2.2%, discount rate of 3.0%*

Brant Hills Community Centre

Carbon Reduction Measures Included:

Roof Insulation Upgrade – During the next roof replacement at the facility increase the insulation value to R38 and increasing the air tightness of the facility with a fully adhered vapour barrier.

High Performance Glazing and Doors – Because this facility does not have a lot of glazing, the replacement will consist of high performance thermally broken double glazed units which will help to reduce heat loss through the building's envelope.

HVAC Upgrades – Swapping out the existing natural gas fired rooftop units to Air Source Heat Pump Rooftop Units with Heat Recovery and Demand Control Ventilation will provide the greatest single reduction in greenhouse gas of any measure at the facility. The Units will utilize electric resistance backup heat for the extremely cold days where the heat pumps become inefficient.

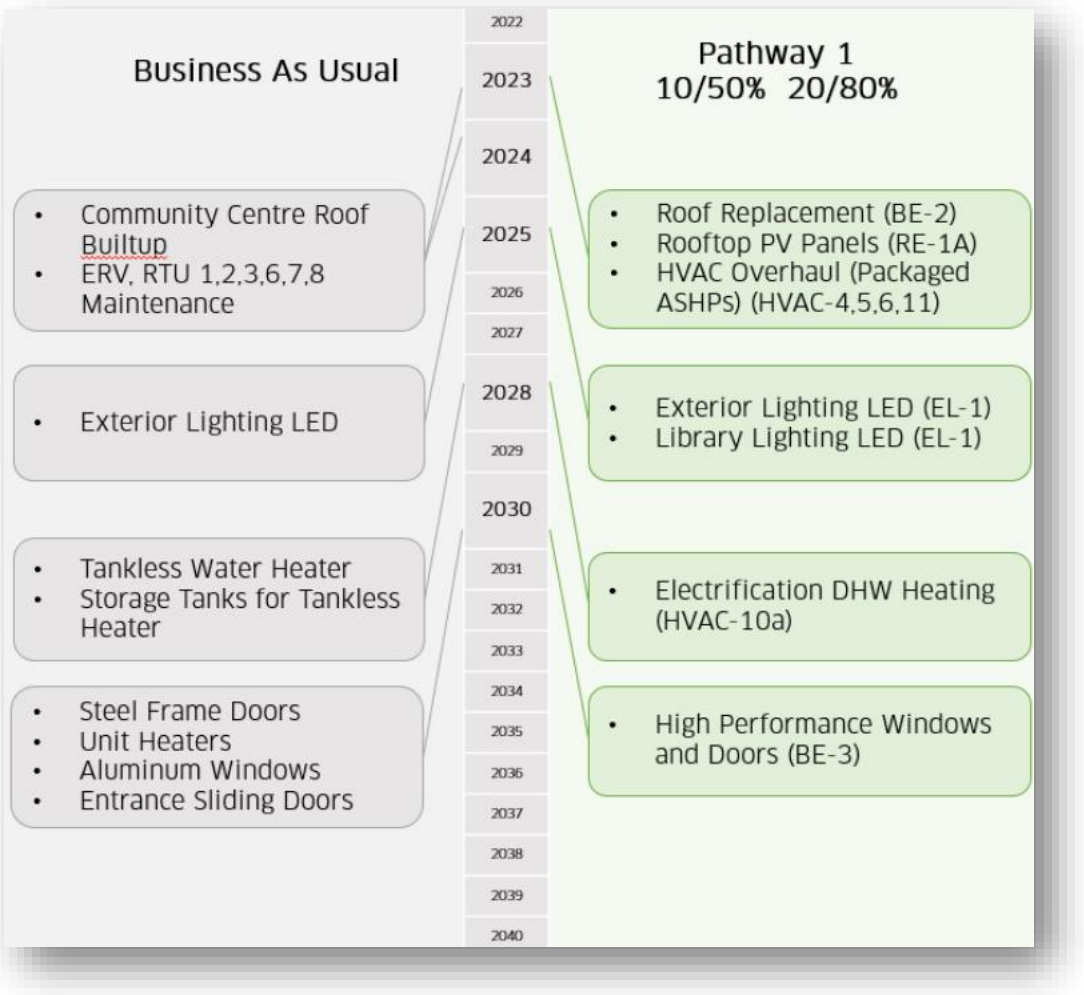
Electric Domestic Hot Water Heater – The existing natural gas fired hot water heaters will be swapped out for electric resistance hot water heaters.

LED Lighting upgrades – The remainder of the lighting inside and outside of the facility that has not already been changed over to LED will be done as part of the regular renewal at the facility.

Rooftop Photovoltaic Panels – A solar array would be installed on the facility with an approximate capacity of 220kW generating 280,000kWh per year.

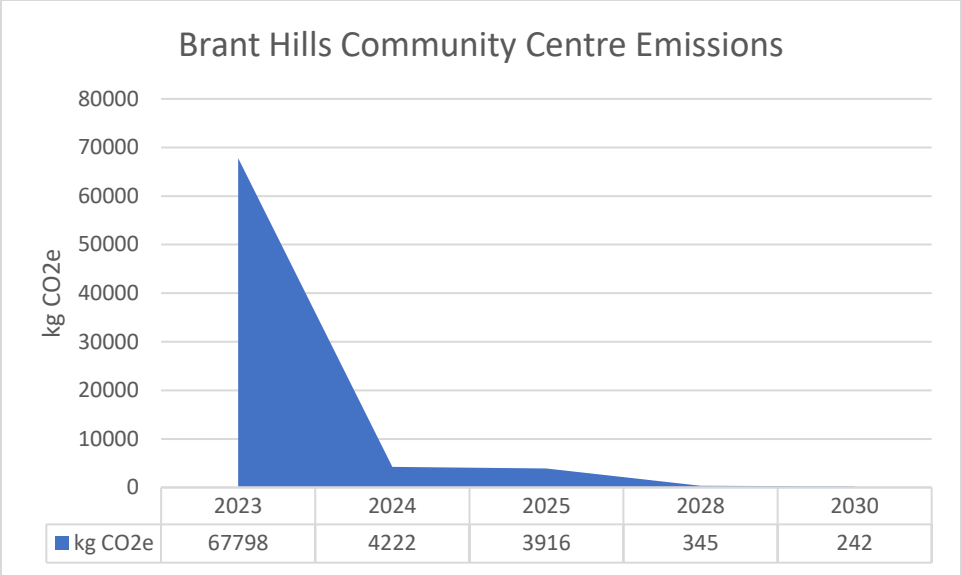
Timeline for Implementation

The timeline for these upgrades generally follows along with the business-as-usual scenario that currently exists in the capital renewal plan.



GHG Reduction

The implementation of the above-mentioned projects at the Community Centre will reduce emissions by a total of 99% bringing the facility to very close to near net carbon neutral. Any remaining emissions from the facility at this point could be offset with the purchase of carbon credits.



Capital Cost Implications

Below is a cost in today's dollars of the business-as-usual capital plan implementation vs the optimized. The incremental capital cost of implementing the low carbon pathway is $3,746,848. Over the 30-year term assessed in the study the cost premium for the low carbon pathway is $1,960,778.

	Business as Usual	Low Carbon Optimized Pathway
Capital Cost	$1,434,700	$5,181,184
30-Year Energy Costs	$1,482,835	$35,520
30-Year Carbon Costs	$321,761	$2,875
Cost premium per ton of avoided GHG	-	$1,900

**Assumed interest rate of 2.2%, discount rate of 3.0%*

Fire Station 2

Carbon Reduction Measures Included:

Roof Insulation Upgrade – Consists of adding more blown in insulation into the attic space of the facility targeting R50.

High Performance Glazing – Replacing old glazing units with high-performance double-glazed units and changing some units from operable to fixed windows in appropriate areas.

Air Sealing – Replacing exterior sealants and weather stripping at all openings.

Automated Exhaust System - Upgrades to the control system of the vehicle exhaust system that currently exists.

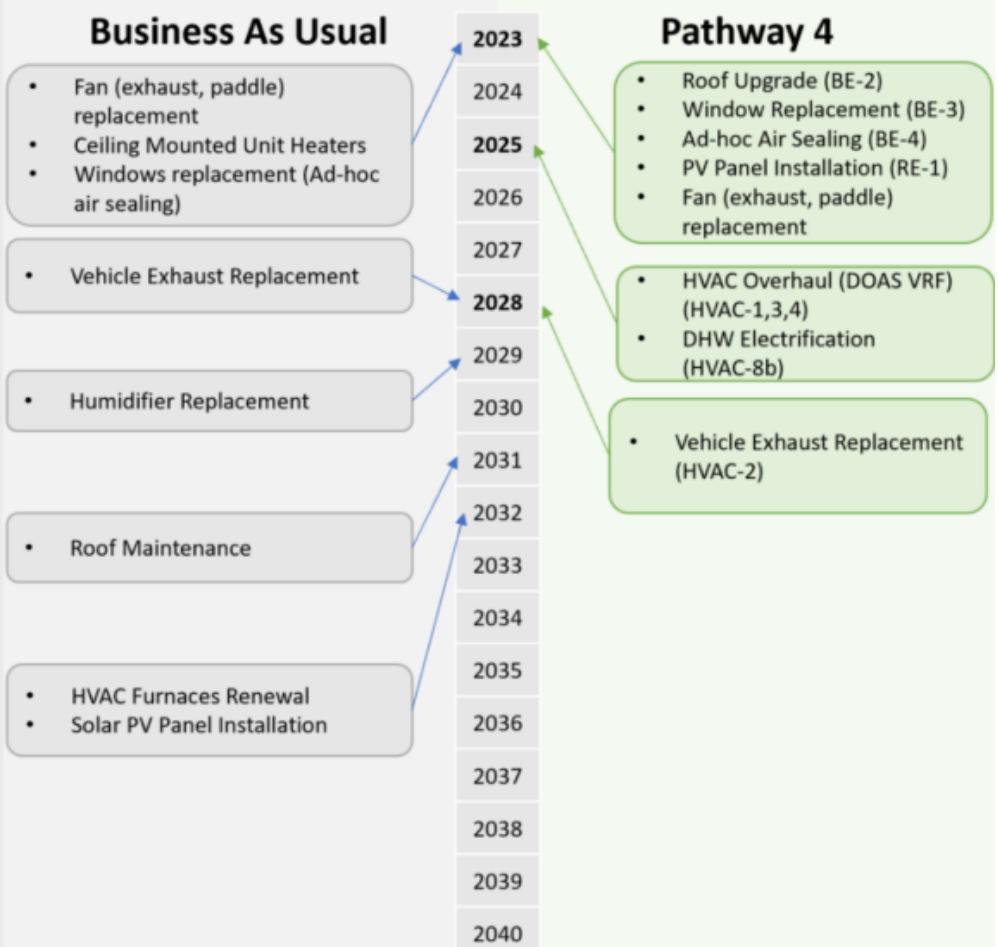
DHW Electrification – Changing out existing natural gas fired domestic hot water heater for an electric unit.

HVAC Upgrade – Replacement of existing gas fired natural gas furnaces with air source heat pumps and electric resistance backup heating. Dedicated outdoor air units with heat recovery would also be installed to provide increased levels of fresh air for the building and allow for heat recovery.

Rooftop Photovoltaic Panels – Installation of a rooftop photovoltaic array.

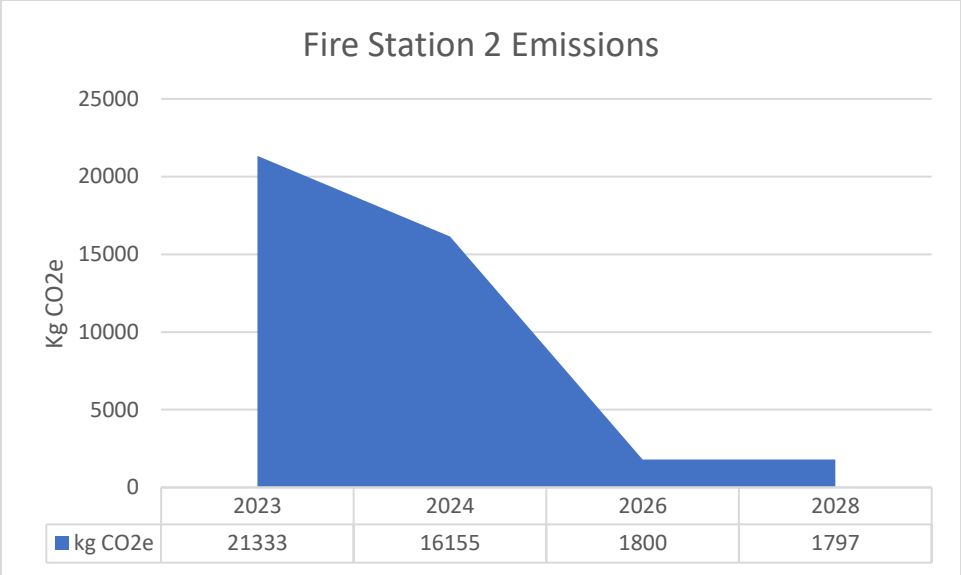
Timeline for Implementation

The timeline for these upgrades is slightly faster than the business-as-usual capital plan, which will maximize the GHG, and cost savings achieved in the retrofits.



GHG Reduction

The implementation of the above-mentioned projects at Fire Station 2 will reduce emissions by a total of 92%. Any remaining emissions from the facility at this point could be offset with the purchase of carbon credits or future virtual net metered solar arrays at remote locations.



Capital Cost Implications

Below is a cost in today's dollars of the business-as-usual capital plan implementation vs the optimized. The incremental capital cost of implementing the low carbon pathway is $864,902. Over the 30-year term assessed in the study the cost premium for the low carbon pathway is $800,507.

	Business as Usual	Low Carbon Optimized Pathway
Capital Cost	$638,176	$1,5033,097
30-Year Energy Costs	$207,936	$195,993
30-Year Carbon Costs	$103,266	$10,749
Cost premium per ton of avoided GHG	-	$1,366

**Assumed interest rate of 2.2%, discount rate of 3.0%*

Fire Station 7

Carbon Reduction Measures Included:

High Performance Glazing – Replacing old glazing units with high-performance double-glazed units and changing some units from operable to fixed windows in appropriate areas.

Air Sealing – Replacing exterior sealants and weather stripping at all openings.

Automated Exhaust System – Upgrades to the control system of the vehicle exhaust system that currently exists.

DHW Electrification – Changing out existing natural gas fired domestic hot water heater for an electric unit.

HVAC Upgrade – Replacement of existing gas fired natural gas furnaces with air source heat pumps and electric resistance backup heating. Dedicated outdoor air units with heat recovery would also be installed to provide increased levels of fresh air for the building and allow for heat recovery.

Rooftop Photovoltaic Panels – Installation of a rooftop photovoltaic array.

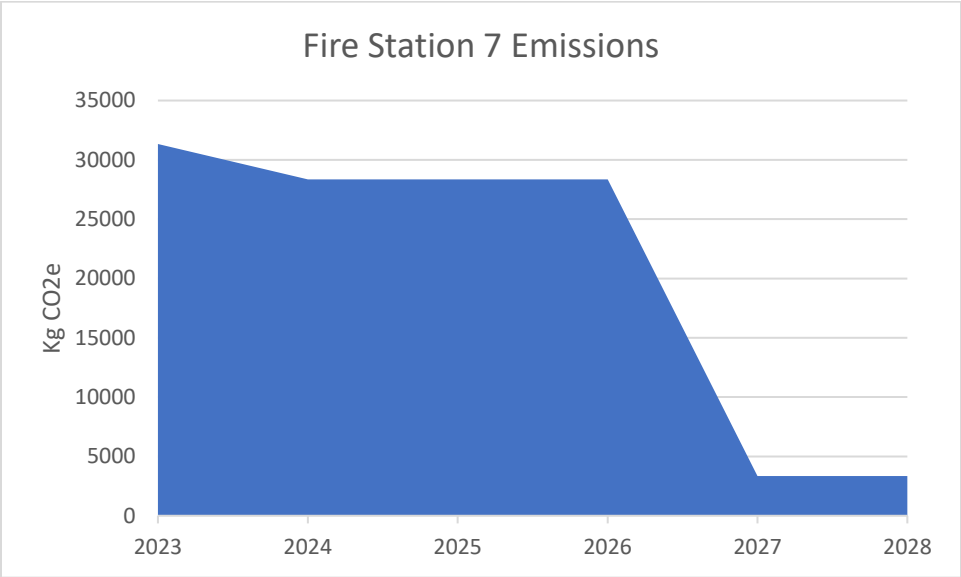
Timeline for Implementation

The timeline for these upgrades is slightly faster than the business-as-usual capital plan, which will maximize the GHG, and cost savings achieved in the retrofits.

GHG Reduction

The implementation of the above-mentioned projects at Fire Station 7 will reduce emissions by a total of 89%. Any remaining emissions from the facility at this point

could be offset with the purchase of carbon credits or future virtual net metered solar arrays at remote locations.



Capital Cost Implications

Below is a cost in today's dollars of the business-as-usual capital plan implementation vs the optimized. The incremental capital cost of implementing the low carbon pathway is $1,306,034. Over the 30-year term assessed in the study the cost premium for the low carbon pathway is $1,020,565.

	Business as Usual	Low Carbon Optimized Pathway
Capital Cost	$272,209	$1,578,243
30-Year Energy Costs	$433,235	$356,703
30-Year Carbon Costs	$144,076	$24,489
Cost premium per ton of avoided GHG	-	$1,215

**Assumed interest rate of 2.2%, discount rate of 3.0%*

Staff recently applied for the federal government's Green and Inclusive Community Building Funding for a deep energy retrofit at Brant Hills Community Centre. If successful, this funding would allow the City to begin a construction project in 2024 to complete the measures in the short term retrofit pathway scenario and convert Brant Hills Community Centre into a net carbon neutral facility.