2024-2029 Corporate Energy Plan Report

City of Richmond Hill

225 East Beaver Creek Road, ON L4B 3P4

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EXECUTIVE SUMMARY

The City of Richmond Hill operates and maintains 60 facilities including community centers, pools, arenas, libraries, and administrative buildings. These facilities consume a significant amount of energy, costing approximately $4.3 million per year and emitting 6,316 tonnes of greenhouse gas (GHG) emissions annually. The City is committed to reducing energy consumption and the associated GHG emissions and costs from its facilities and operations.

Ontario Regulation 25/23 under the *Electricity Act* requires municipalities to report energy consumption and GHG emissions of City facilities annually. It further requires municipalities to develop and publish an energy conservation and demand management plan (Corporate Energy Plan) and update the same every five years.

Richmond Hill developed its first Corporate Energy Plan in 2014, which was updated in 2019. The objective of the Corporate Energy Plan is to manage and reduce municipal energy consumption, related costs and GHG emissions, through energy conservation initiatives and renewable energy systems. The implementation of the 2019 Corporate Energy Plan resulted in approximately 1,899,000 ekWh/year in energy savings, equivalent to $273,000/year in cost avoidance and 128 tonnes/year in GHG emission reduction.

The 2024 update to the City's Corporate Energy Plan represents a major shift in the plan's objective. In the past, the primary focus of the CEP had been on energy conservation and cost avoidance. Moving forward, the focus of the plan is shifting to the reduction of GHG emissions, to align with the Council approved target of net zero GHG emissions for the City of Richmond Hill by 2050. To make progress towards this target, the City will identify and prioritize the implementation of measures that will reduce GHG emissions, energy consumption and cost.

This report, the **2024-2029 Corporate Energy Plan**, outlines the energy conservation and net zero measures the City will undertake over the next five years. This plan has identified a total of 85 measures (51 energy conservation measures and 34 net zero measures) for implementation over the next five years. Once implemented, the measures are expected to provide 8,086,000 ekWh/year in energy savings (i.e., 14.8% of the 2023 total energy consumption of all City facilities), equivalent to $677,000/year in cost avoidance and 930 tonnes in GHG emissions reduction/year (14.7% of all City facilities' 2023 GHG emission). In addition, the plan outlines measures that will promote a culture of energy conservation for staff and residents using City facilities.

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1 Introduction

The City of Richmond Hill understands that energy is a valuable resource and has made commitments to reduce energy consumption and GHG emissions in its Strategic Plan, Official Plan, Environment Strategy, and more recently, in the Community Energy and Emissions Plan (CEEP). This Corporate Energy Plan aligns with this commitment and outlines the energy and greenhouse gas (GHG) reduction strategies and measures that it is undertaking for the 60 facilities it operates and maintains.

City facilities consume a significant amount of energy (electricity and natural gas), costing approximately $4.3 million per year (in 2023) and emitting 6,316 tonnes of GHG emissions per year. The City developed its first five-year (2014-2018) Corporate Energy Plan in July 2014, which was updated in July 2019. These plans led to implementation of several energy conservation projects.

This report, **2024-2029 Corporate Energy Plan**, summarizes the implementation results of the 2019-2023 Corporate Energy Plan (CEP) and outlines the energy conservation, associated costs and GHG emission reduction measures the City will undertake over the next five years.

In addition, this update to the City's Corporate Energy Plan represents a major shift in the plan's objective. In the past, the primary focus of the CEP has been on energy conservation and cost avoidance. Moving forward, the focus of the plan is shifting to the reduction of GHG emissions, to align with the Council approved target of net zero GHG emission for the City of Richmond Hill by 2050. To make progress towards this target, the City will prioritize the implementation of measures that will reduce GHG emissions and energy consumption. This plan also sets progressive energy and GHG emissions targets for new City facilities with over 500 square meters of floor area.

1.1 Legislative Requirements

Originally, the *Green Energy Act*, 2009, O. Reg. 397/11 required public agencies in Ontario, including municipalities, to report their energy use and GHG emissions annually, and to prepare and publish energy conservation and demand management plans (Corporate Energy Plans). The plans required senior management approval and must be updated every five years.

In 2018, the *Green Energy Act*, O. Reg. 397/11 was repealed, and all the requirements for public agencies regarding annual energy use reporting and preparing the corporate energy plans were re-enacted under the *Electricity Act*, O. Reg. 25/23.

2 Energy Conservation Goals, Objectives, and Reduction Target

As previously mentioned, the goal and primary focus of the Corporate Energy Plan is shifting from energy conservation to greenhouse gas emissions reductions to align with the direction set by Council in the Community Energy and Emissions Plan (CEEP). The new target of the Corporate Energy Plan is to achieving net zero emissions from City facilities by 2050. This target will be achieved by moving to low carbon energy sources (i.e., electrification of operations) and continuing to implement energy conservation measures as well as renewable energy systems. This Corporate Energy Plan outlines the actions necessary to achieve the net zero target by 2050.

Corporate Energy Reduction Target

To determine how the City is progressing towards the longer-term net zero GHG emissions target, an interim energy use intensity reduction target has been established. The target is to reduce the average energy use intensity (EUI) of City facilities by 5% over the previous target. Energy use intensity measures the total energy used per square foot of building per year. The new target is to maintain the EUI of City facilities below 39 ekWh/ft^2/year by 2029 (i.e., 5% below the previous CEP's target).

Energy and Greenhouse Gas Emission Targets- New Facilities and Major Retrofits

Richmond Hill currently requires that all new municipal buildings with a floor area over 500 square meters be constructed to meet LEED[1] Silver (or alternative equivalent) certification. To align with the updated CEP target of net zero GHG emissions by 2050, staff have initiated a working group tasked with developing energy and GHG emission targets for new municipal buildings. The working group recommended that all new City facilities over 500 square meters and major facility retrofits meet or exceed the following tiers of the Council-approved Sustainability Metrics Program (SMP)[2]:

- **Achieve SMP "great" tier for energy efficiency metric "IB-12: Building Energy Efficiency, GHG Reduction, and Resilience"** as follows:
    - Office Buildings:
        - Develop a whole-building energy model, and design and construct the building to achieve the following whole building performance metrics:
            - Total Energy Use Intensity (TEUI): 135 kWh/m^2 /year
            - Thermal Energy Demand Intensity (TEDI): 50 kWh/m^2 /year
            - Greenhouse Gas Emissions Intensity (GHGI): 15 kgCO_2e/m^2 /year

[1] Leadership in Energy and Environmental Design (LEED) is the most widely used green building rating system in the world.
[2] The Sustainability Metrics Program (SMP is a scoring system used by the City to encourage developers and builders to implement green development standards to achieve healthy, complete, and sustainable communities.

- All other buildings:
  - Develop a whole-building energy model, and design and construct the building to achieve at least a 25% improvement in energy efficiency over the Ontario Building Code (OBC) SB-10, Division 3 (2017) reference building.
- **Achieve SMP "excellent" tier for metric "IB-10: Solar Readiness"** by generating up to 5% of the building's total energy load from on-site renewable energy sources.

These requirements are in addition to the current requirement to achieve LEED Silver certification for new City facilities. These targets for new City facilities are consistent with the Council-approved Sustainability Metrics Program (SMP), the City's green development standards which establish targets beyond minimum provincial and municipal requirements and promote sustainable development in Richmond Hill. Aligning targets based on the City's SMP demonstrates that the City intends to lead by example in the construction of new, low carbon emitting, energy efficient municipal buildings and facilities.

The estimated incremental construction cost for achieving these targets is approximately 3.1% higher, according to a construction cost analysis conducted by the City of Toronto, published in the 'Zero Emissions Buildings Framework' report[3]. The actual cost premium will be assessed as part of the feasibility work for the next new city building. Although the initial capital construction cost will be higher, part of the incremental cost will be recovered through the energy costs savings provided by the energy efficient building over its life cycle.

The interim performance targets described above, will be replaced in the future with more aggressive targets, as the City moves towards a net zero target. Future energy and GHG performance targets will be informed by an upcoming Corporate Net Zero Strategy that will be developed over the next 5 years.

[3] The City of Toronto Zero Emissions Buildings Emissions Framework (2017).

3 2019-2023 Corporate Energy Plan (CEP) Implementation Results

3.1 Approach

The energy conservation projects implemented as part of the 2019-2023 Corporate Energy Plan were identified through detailed energy audits conducted in 2017 for the City's top 13 energy consuming facilities. Projects with the best return on investment were selected and formed the basis of the 2019 CEP implementation plan. In addition, staff identified additional opportunities to improve energy efficiency through routine projects, such as planned lifecycle (end-of-life) equipment replacement. A total of 62 capital energy conservation projects were recommended for implementation in addition to 16 operational/organization measures.

3.2 Projects Implemented and Results

Capital Energy Projects

From 2019 to 2023, 21 capital energy conservation projects were implemented that resulted in an estimated energy savings of 1,899,300 ekWh/year which represents a reduction of 3.4% in total energy consumption from all City facilities in 2019. This energy savings is equivalent to approximately $272,800/year in cost avoidance and 128 tonnes/year in GHG emissions reduction. Additional 21 capital energy conservation projects are under implementation that, once completed, are expected to provide an additional 1,524,000 ekWh/year in energy savings, equivalent to approximately $164,000/year in cost avoidance and 180 tonnes/year in GHG emissions reduction. Over two thirds of the energy savings and cost avoidance achieved over this period (2019 to 2023) came from proactive energy conservation projects such as indoor LED lights replacements and installation of low-emissivity ceilings over the ice in arenas. The remaining savings/avoidance was achieved from lifecycle replacement projects where the equipment was replaced with more energy efficient options at the end-of-life. Examples of lifecycle replacement projects include heating ventilation & air conditioning (HVAC) system upgrades and heat pump replacements. The implementation of 33 energy conservation projects, identified in the 2019 CEP, could not be started, mainly due to delays caused by the COVID-19 pandemic. These projects have been carried over into the 2024 Corporate Energy Plan and once implemented, they are expected to provide 4,145,000 ekWh/year in energy savings (7.5% of all City facilities' 2019 total energy consumption), $299,000 in cost avoidance and 560 tonnes/year in GHG emission reduction.

To offset the capital cost for implementing these energy conservation projects, staff secured over $200,000 in incentive funding from Provincial programs, managed by local energy distribution companies (IESO, Alectra Utilities and Enbridge Gas Distribution Inc.).

Details on the 2019-2023 Corporate Energy Plan results are provided in Appendix A.

Operational and Organizational Energy Measures

In addition to capital energy projects, several operational and organizational energy measures were planned for implementation over the 2019-2023 CEP period. Operational measures that were implemented include: providing monthly facility energy consumption reports to facility operators/managers and installing wireless energy meters on the refrigeration plant equipment of ice rinks. Similar to the capital projects, some of the operational measures could not be implemented or had to be stopped due to the COVID-19 pandemic. They have been reassessed and considered for implementation over the next CEP period.

4 Energy Consumption, Cost and GHG Emission Analysis

In 2023, the energy consumption from City facilities cost approximately $4.3 million. 60% of the total energy consumed was natural gas and the remaining 40% was electricity (see Table 1 below). Despite this split, electricity accounted for approximately 74% of total energy cost (i.e., $3.2 million), while natural gas accounted for approximately 90% of GHG emissions. Therefore, projects that reduce electricity consumption will result in cost savings while projects that reduce natural gas consumption will help reduce GHG emissions.

It is worth noting that 14 City facilities accounted for approximately 83% of the total energy consumed by all City facilities, and that pools and arenas account for 59% of total energy consumption. As a result, past energy audits and net zero studies have focused on these 14 larger City facilities as well as pools and arenas.

Table 1: 2023 Annual Energy Consumption, Cost and GHG Emissions

	Energy Consumption				Energy Cost		GHG Emissions	
Energy Source	Unit	Annual Quantity	Equivalent kWh	Percent of Total	Annual Cost	Percent of Total	Annual Quantity (tCO_2-eq/yr)	Percent of Total
Electricity	kWh	22,490,640	22,490,640	41.3%	$3,201,546	73.7%	630	10.0%
Natural gas	m^3	3,007,651	31,964,553	58.7%	$1,142,009	26.3%	5,686	90.0%
Total			54,455,194	100%	$4,343,555	100%	6,316	100%

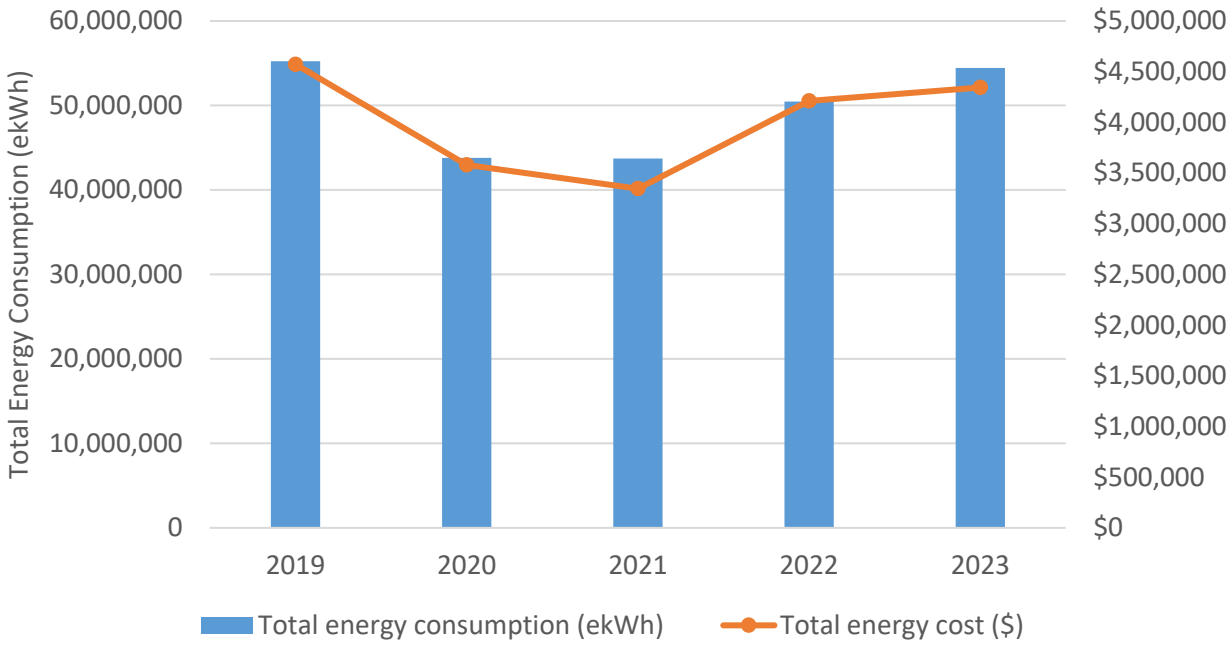
Energy Consumption Trend

Figure 1 shows the energy consumption and cost of City facilities from 2019 to 2023. The decrease in total energy consumption from 2020 to 2022 is due to the COVID pandemic. Consumption started increasing in 2022 as City facilities gradually re-opened after the COVID pandemic.

In 2023, most City facilities had returned to normal operations. Overall, energy consumption decreased by 1.4% in 2023 compared to 2019, mainly due to electricity consumption being 7.2%

lower in 2023 vs 2019. The decrease in consumption is mainly attributed to energy savings achieved from energy conservation projects implemented by the City. This reduction in electrical consumption resulted in a 5% decrease in energy costs when compared to 2019, mainly due to in electricity consumption being lower in 2023.

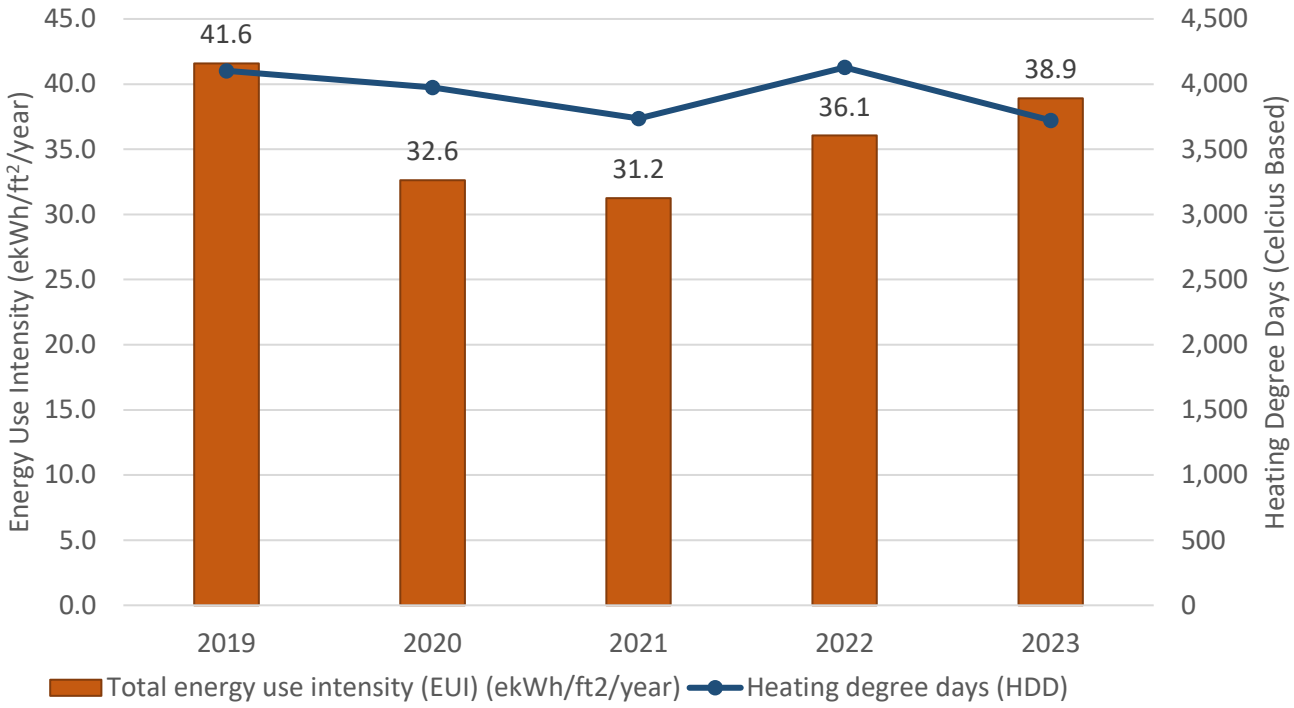
Figure 1: Total Energy Consumption and Cost



Energy Use Intensity Trend

An important indicator of energy performance of City facilities is Energy Use Intensity (EUI), which measures energy consumption per square foot of building space. EUI allows for the comparison between different sized buildings and normalizes increases in consumption resulting from the addition of new facilities. Figure 2 shows the EUI of City facilities from 2019 to 2023 (red bars) and the heating degree-days (HDD) for each year (blue line). Heating degree-days (HDD) is a measurement designed to quantify the demand for energy needed to heat a building. Higher heating degree-days indicate harsher winters when more space heating is required to keep buildings comfortable for occupants and therefore more energy is consumed. As previously mentioned, the decreasing EUI trend in 2020, 2021 and partially in 2022 is attributed mainly to the COVID-19 pandemic, when most City facilities were closed. The decrease in EUI in 2023 (post-COVID year) relative to 2019 (pre-COVID year), is attributed mainly to energy conservation projects implemented by the City and to a slightly milder winter in 2023, which contributed to a 1.4% decrease in energy consumption when compared to 2019.

Figure 2: Energy Use Intensity Trend

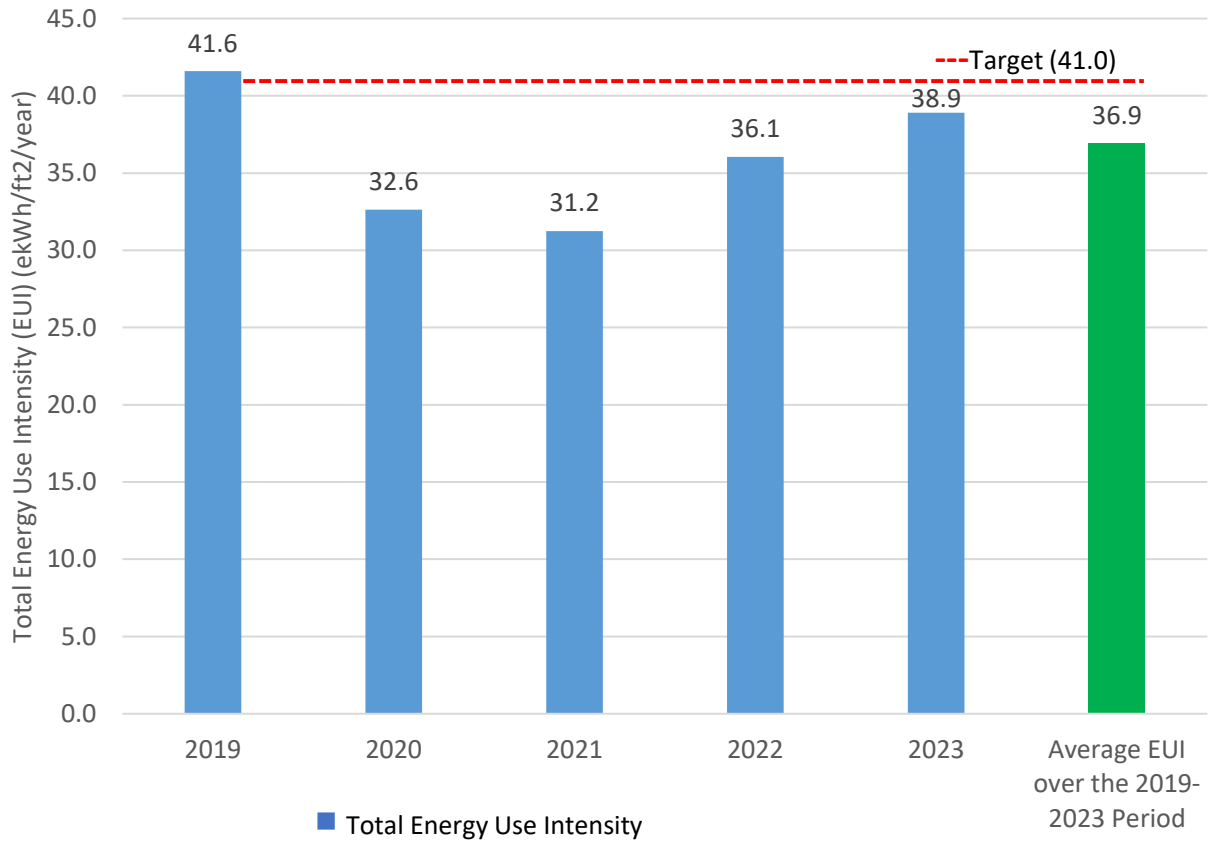


Energy Use Intensity: Actual vs Target

The 2019-2023 Corporate Energy Plan target was to reduce the energy use intensity of City facilities by 5% when compared with the average EUI from the previous five years. The average EUI from 2014-2018 was 43 ekWh/ft^2/year, therefore, the target for the 2019-2023 period was 41 ekWh/ft^2/year (as illustrated by the red dotted line in Figure 3).

The target has been achieved from 2020 to 2023. In addition, the average EUI over these years was 10% lower than the target EUI (see green bar in Figure 3). The lower EUIs is mainly attributed to the COVID-19 pandemic, and energy savings from the implemented energy conservation projects.

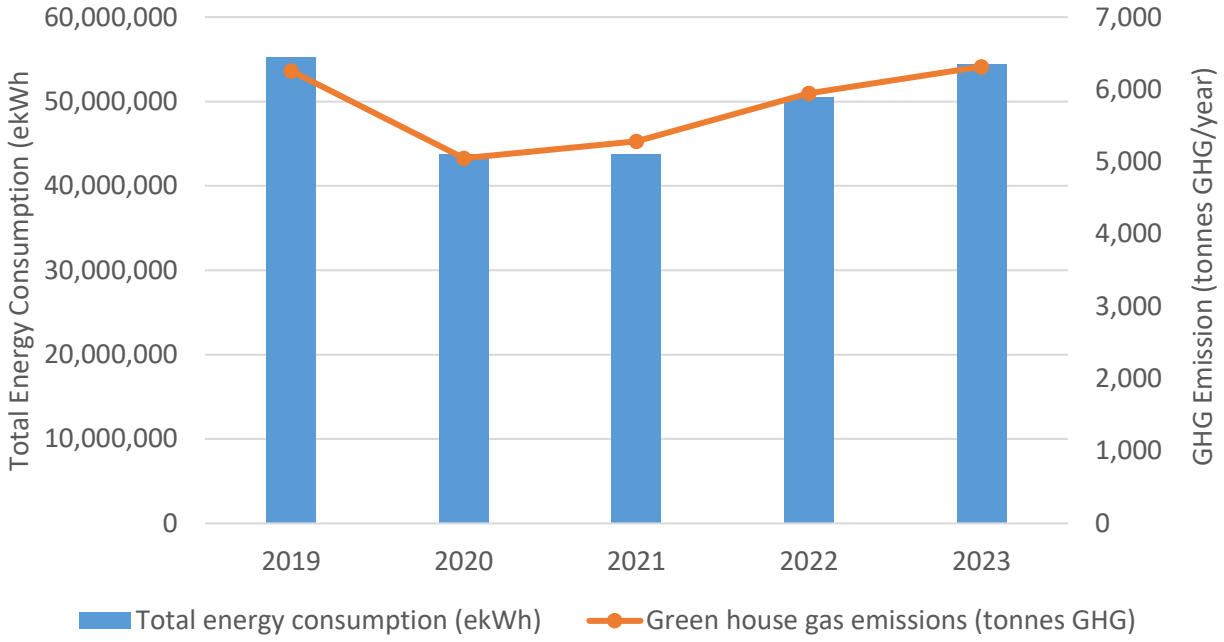
Figure 3: Energy Use Intensity: Target vs Actual



GHG Emission Trend

Figure 4 below shows the GHG emissions trend plotted against the total energy consumption of City facilities from 2019 to 2023. GHG emissions followed the energy consumption trend with emissions decreasing during the COVID-19 pandemic, as City facilities were closed. GHG emissions increased in 2022 and 2023 as facility operations returned to normal.

Figure 4: GHG Emission Trend



5 2024-2029 Corporate Energy Plan Summary

5.1 Approach

The 2024-2029 Corporate Energy Plan was developed in accordance with the requirements of O. Reg. 25/23 under the *Electricity Act*. A planning process was undertaken to develop the plan, which included conducting net zero carbon feasibility studies of five City facilities, and recommissioning studies of nine City facilities. The recommendations from these studies were reviewed and prioritized by staff, and the selected measures have been added to the Implementation Plan for this CEP update. In addition, several measures from previous CEP were reassessed, and recommended for implementation in the next plan period.

A cross-functional team led by staff from the Energy & Waste section of Public Works Operations and supported mainly by staff from the Facility Management Division and the Recreation & Culture Division worked collaboratively on the planning and development of the 2024-2029 Corporate Energy Plan. The team prioritized and selected the measures for implementation over the next CEP period and involved in creating a detailed CEP Implementation Plan with assigned roles, responsibilities, and timelines. The detailed implementation plan for the 2024-2029 Corporate Energy Plan can be found in Appendix B and C (for energy conservation measures and net zero measures, respectively).

Unimplemented Energy Conservation Measures from previous CEP

32 energy conservation projects from previous CEP that could not be implemented were reassessed and added to this CEP update for implementation (see Appendix F). Example projects include the installation of a variable frequency drive on the pool filter pumps at the Richvale Community Centre and Wave Pool; installation of demand control ventilation at the Operations Centre and Central Library; installation of water deaerator at Tom Graham Arena and Ed Sackfield Arena; and recommissioning of City Hall, Operations Center, Central Library, and the Richmond Hill Centre for the Performing Arts (Theatre); etc. Similarly, measures that are under implementation will also be captured in next CEP if the implementation timeline goes beyond the previous plan period, e.g., implementation of measures recommended by recommissioning studies of five ice rink facilities and four community centers and indoor pool facilities.

Replicating Successful Energy Conservation Measures from previous CEP

Energy conservation measures implemented during the previous plan period (2019-2023) that resulted in energy, cost and GHG reductions, were assessed and recommended for replication in other facilities over the next plan period. Examples of successfully implemented projects include LED lighting upgrades in facilities where older lighting remains, and the installation of low-emissivity ceiling over the ice at Tom Graham and Ed Sackfield Arenas. 8 successfully implemented energy conservation projects have been added to Appendix E and incorporated into the CEP Implementation Plan.

Net Zero Studies of Select City Facilities

Net zero carbon feasibility studies were conducted for five City facilities including two indoor swimming pool facilities (Bayview Hill and Centennial Pools), the Richmond Hill Centre for the Performing Arts, Elvis Stojko Arena, and Connor Building. The purpose of the studies was to identify technically and financially feasible GHG emission reduction measures and to develop actionable GHG reduction pathways to get to net zero carbon emissions by 2050. The selection of facilities for these studies was done with the intent to identify net zero measures that can be implemented in similar building archetypes (i.e., in other pools, arenas and administrative buildings).

The recommended capital-intensive low carbon measures (LCM) include energy conservation, fuel switching/electrification (i.e., switching from natural gas to electrical heating) and renewable energy measures (i.e., solar panels). In addition to capital measures, the studies also recommended some operational measures that have good GHG reduction potential and a positive return on investment. The measures were recommended as standalone measures or as counterpart measures to the currently planned like-for-like/business as usual (BAU) measures.

The studies also indicated that the electrical infrastructure for City facilities will need to be upgraded to increase the electrical capacity to implement the recommended electrification measures. A high-level cost estimate for such upgrades has been included in the studies.

Overall, the studies showed that the facilities can achieve the net zero target if all recommended measures are implemented. 80% of the cost of the net zero feasibility studies was covered by the Federation of Canadian Municipalities (FCM) under its Community Building Retrofit (CBR) initiative, administered through Green Municipal Fund (GMF).

Net Zero implementation strategy

City staff recognize that all measures recommended by the net zero studies are needed to get to net zero emissions. However, the City has limited funds and therefore the recommendations must be prioritized for implementation based on their cost and GHG reduction potential.

With this in mind, staff reviewed the results of the net zero studies to prioritize the recommendations over the next 5 years and to determine an appropriate implementation strategy. Given that there are 26 years remaining until the net zero target year (i.e., 2050), staff determined that the most financially sustainable path forward, for the capital-intensive measures (i.e., electrification/fuel switching) is to implement them when existing equipment reaches end of life. This asset management approach reduces wasted investments on assets replaced before their expected end of life and it means that the City will only pay the incremental cost of the low carbon measure over the business-as-usual option.

To assess and prioritize the recommended measures, life cycle costing for each measure was calculated using the Net Present Value (NPV). NPV factors in all the cash outflows and inflows associated with each measure, over the life of that measure/equipment. This includes upfront capital costs, operating and maintenance costs, and carbon tax costs. Measures with positive NPVs represent a positive return on investment, and therefore these measures have been recommended for implementation.

Some fuel switching/electrification measures have a negative NPV. To prioritize which measures with negative NPV the City will implement over the next 5 years, the life cycle cost of the low carbon measures was compared with the life cycle cost of the counterpart 'business as usual' (BAU) measure to calculate the incremental/additional life cycle cost of the low carbon measure (LCM). For example, for space heating, the life cycle cost of electric heating (i.e., air source heat pumps) was compared with the cost of like-for-like replacement of current natural gas fired heating units. Staff prioritized for implementation low carbon measures that:

- Have a lower lifecycle cost than their BAU counterpart (i.e., less negative NPV); or

- Have an incremental/higher life cycle cost of no more than 20% when compared to the corresponding BAU measure.

A total of 34 measures were prioritized for implementation in the next 5 years for the 5 facilities that were studied. Out of these 34 measures, a majority (85%) of measures were energy conservation measures (i.e., 29 measures). In addition, 3 electrification measures and 2 renewable energy measures were prioritized. This allows the City to take a gradual approach to electrification of its buildings so the new technology can be piloted. 15 prioritized net zero measures are recommended for implementation after the next 5 years, when the respective equipment is scheduled to be replaced in the capital plan.

The list of recommended net zero measures that resulted from these studies is presented in Appendix C. The remaining measures that were not prioritized for implementation at this time, based on the above prioritization approach, will be reviewed in the next 5 years. Staff are committed to continuing net zero studies for the remaining facility types (i.e., offices, libraries, and operations center) to inform a corporate net zero strategy.

Net zero Pilot Project at Connor Building

Since many of the recommended net zero measures/equipment (i.e., air source heat pumps) are new to the City, a pilot project is needed to test this new equipment in order to better understand its performance, costs, and maintenance requirements. The Connor Building presented a perfect opportunity for a pilot as this City facility is undergoing a major renovation and expansion to transform it into the City's satellite operations yard. A net zero study was conducted at the Connor Building to identify energy conservation and GHG emission reduction measures with an objective to get the facility to near net zero carbon for operational carbon. The pilot project will implement and test several net zero measures that include air tightness mitigation and replacing all gas-fired equipment with electrical ones. The lessons learned from this pilot project, particularly the actual capital cost, energy, and cost savings, and GHG reduction will be used to prioritize and select similar measures for implementation in other City facilities.

Generic Measures

Some of the energy conservation and low carbon measures recommended for implementation are generic and can be implemented in other similar facilities. For example, the recommendation to replace natural gas fired roof top unit (RTU) with an air source heat pump (ASHP) can be implemented in other pools, arenas, and administrative buildings. A list of generic measures has been developed so it can be considered by project management staff when an existing equipment reaches end-of-life to determine if there is an opportunity to replace the equipment with an energy efficient or low carbon equipment (see Appendix G).

Operational and Organizational Measures

In addition to capital energy conservation and net zero measures, operational and organizational measures have been recommended. Operational measures include maintaining pool and ice rink temperature set points within an optimal range which will reduce energy consumption, costs and GHG emissions.

A key organizational measure is to continue to develop a Corporate Net Zero Strategy to establish a credible path to new zero for existing and new City facilities. The aim is to develop this strategy over the next 5 years.

A list of operational and organizational measures for the 2024 CEP are included in Appendix D.

5.2 Implementation Strategy

Building on the lessons learned from past implementation of energy conservation measures, the following strategies will be used to implement the energy conservation and net zero (decarbonization) measures, recommended by this CEP, over the next five years and beyond:

- **Energy conservation measures** – Continue to focus on implementing energy efficiency measures that have a short payback period. These measures will be implemented proactively even before the equipment reaches end of life. This includes operational measures (i.e., optimizing building HVAC schedules to better align with building operations) and low hanging fruit measures (i.e., retrofitting the remaining inefficient interior lighting to energy efficient LED lighting). This proactive approach will allow the City to reap the savings from such measures early on to help fund the implementation of the capital-intensive measures.
- **Capital intensive projects and net zero electrification measures** – These measures will be implemented when the equipment reaches end of life, by aligning the implementation of such measures with the City's capital replacement plan. This ensures a financially sustainable approach that minimizes replacing equipment before its planned end of life. By choosing this life cycle replacement strategy, the costs to implement these capital-intensive measures is only the incremental cost increase over the business-as-usual planned replacement cost.
- **Bundling of measures during planned major renovations** – To reduce costs and disruption to facilities, several recommended energy conservation and net zero measures will be bundled for implementation during the facility's planned major renovation. Project management staff will be able to reference and consider measures from this plan that can be added into the scope of upcoming major retrofits.

To help drive this implementation strategy, staff from the Facility Management Division and the Energy & Waste section will meet annually, ahead of the Capital Budget submissions, to review the upcoming major renovations and to determine which projects, from the CEP implementation plan, can be bundled and added to the scope of the renovations. The Facility Management Division will then include those selected projects in their annual capital budget requests and seek approval and funding from senior management and from Council.

5.3 Implementation Plan

The 2024-2029 Corporate Energy Plan proposes to implement several capital, operational and organizational energy conservation projects. A detailed Implementation Plan can be found in Appendix B and C of this report (for energy conservation measures and net zero measures, respectively). A brief description for energy conservation and net zero measures in the Implementation Plan is provided in Appendix J.

6 Renewable Energy Systems

The City has implemented a total of 12 renewable energy projects, which includes the installation of solar thermal and photovoltaic (PV) systems as well as ground source heat pumps. The description of renewable energy systems installed by the City is provided in Appendix H.

The installed renewable energy systems demonstrate the City's commitment to become a leader in sustainable energy use. Through the installed renewable energy systems, the City is able to offset the energy purchased from utility companies. This helps reduce the City's corporate energy cost, move towards resilience, and reduce greenhouse gas emissions.

Onsite renewable energy generation will play a significant role in getting to net zero as identified in the net zero studies recently completed. 2 roof top solar PV systems have been recommended for implementation in this plan.

7 Corporate Energy Plan Approval

O. Reg. 25/23, under the *Electricity Act,* requires that the five-year Corporate Energy Plan be approved by the public agency's senior management. Richmond Hill's 2024-2029 Corporate Energy Plan was presented to the City's senior management and was approved.

8 Communication of City's Energy Conservation Initiatives

8.1 Approach

Richmond Hill celebrates its energy achievements corporately, appreciating the efforts of those involved, and encouraging others to also play an active role in energy conservation. The corporate

newsletter, The Connector, as well as the City's corporate and departmental Twitter accounts and departmental newsletters, are utilized to publicize energy achievements. Regular updates on ongoing projects and staff reports are presented to Council and upper management, keeping them informed on energy initiatives.

Staff involved in the implementation of the CEP meet periodically to discuss progress on ongoing energy initiatives. This keeps members informed and gives them the opportunity to bring forth innovative ideas.

Richmond Hill is involved in several external organizations' energy programs, such as Clean Air Council, the Mayors' Megawatt Challenge program, and ClimateWise Building Challenge program. City staff attend webinars and forums, organized by those programs, to stay up to date on new technologies and exchange best practices with other municipalities.

8.2 Reporting to Council

The 2024-2029 Corporate Energy Plan and results of the net zero studies will be presented to Council.

9 Conclusion

The City of Richmond Hill operates and maintains 60 facilities which consume a significant amount of electricity and natural gas that costs $4.3 million annually. As Richmond Hill's population continues to grow, so do City services, infrastructure, and energy needs. Richmond Hill remains committed to managing and reducing energy consumption, costs, and greenhouse gas emissions from its buildings.

The City has prepared a 2024-2029 Corporate Energy Plan as required by Ontario Regulation 25/23, under the *Electricity Act*. The primary objectives of the Corporate Energy Plan are to manage municipal energy consumption, cost, and greenhouse gas emissions. The City will achieve this, through a series of recommended energy conservation and net zero capital projects together with improved operational practices and organizational measures.

The 2024-2029 Corporate Energy Plan has recommended 85 measures for implementation over the next five years (51 energy conservation measures and 34 net zero measures) that, once implemented, are estimated to reduce energy consumption by 8,086,000 ekWh/year, which is approximately 14.8 % of all facilities' total energy consumption in 2023. This equates to a cost avoidance of $677,000/year and a reduction in GHG emissions of 930 tonnes/year (14.7% of all City facilities' 2023 GHG emissions). In addition, this plan sets progressive energy and GHG emissions

targets for new City facilities over 500 square meters of floor area, which align with the City's Sustainability Metrics Program.

As per the requirements of the *Electricity Act*, the 2024-2029 Corporate Energy Plan Summary will be posted on the City's website. Staff have submitted the City facilities' 2022 and 2023 energy consumption and GHG emissions report to the Ministry of Energy.

Appendices

Appendix A: Details of Results from 2019-2023 Corporate Energy Plan Implementation
Appendix B: Energy Conservation Measures Implementation Plan for 2024-2029 Corporate Energy Plan
Appendix C: Net Zero Measures Implementation Plan for 2024-2029 Corporate Energy Plan
Appendix D: Operational and Organizational Measures for 2024-2029 Corporate Energy Plan
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Appendix F: List of Unimplemented Measures from Previous (2019-2023) Corporate Energy Plan
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Appendix I: 2024-2029 Corporate Energy Plan Energy Conservation and Net Zero Measures and Descriptions

Appendix A: Details of Results from 2019-2023 Corporate Energy Plan Implementation

Implementation Status	Project Type (CEP or Life-cycle Driven)	Number of Projects Representing this Status	Estimated Annual Energy Savings (ekWh/year)	Estimated Annual Cost Savings/ Avoidance ($/year)	Estimated Annual GHG Emission Reduction (tonnes/year)	Estimated Capital Cost ($)	Example Projects
Completed	CEP projects	16	1,364,925	$189,395	109	$709,868	Low-e Ceiling in ice rinks, Interior Lighting Retrofit, Occupancy sensors, Pool pump VFD, Low-flow aerators
	Life cycle projects	5	534,420	$83,369	19	NA	Major renovation /HVAC upgrade at Elgin West CC, HVAC upgrade at Elgin Barrow Arena
	Sub-total	**21**	**1,899,345**	**$272,764**	**128**		
In-progress	CEP projects	13	1,348,846	$114,423	174	$241,029	Install Low-flow Aerators, Facility recommissioning (Ice rinks: study phase completed and implementation underway; Community centre & pools: study phase underway since Sept
	Life cycle projects	8	175,574	$49,694	6	NA	MAU replacement at 225 EBC, Mechanical/Electrical Upgrade at Rouge Woods CC
	Sub-total	**21**	**1,524,420**	**$164,116**	**180**		
Implementation not started	CEP projects	33	4,145,062	$299,114	562	$931,847	Optimum start/stop, occupancy sensor, demand control ventilation, arena water deaerator, facility recommissioning of remaining 4 facilities (other than ice rinks and community centre
	Life cycle projects	5	NA	NA	NA	NA	Projects that are in planning/design stage, saving numbers are not available
	Sub-total	**38**	**4,145,062**	**$299,114**	**562**		
Grand Total			**7,568,827**	**$735,995**	**870**	**$1,882,743**	

Incentive received from IESO since 2019 onwards:

Incentive received from IESO for completed energy conservation projects: $200,222

Appendix B: Energy Conservation Measures Implementation Plan for 2024-2029 Corporate Energy Plan

Facility	Energy Conservation Opportunities	Estimated Energy Savings (ekWh/year)	Percent Reduction of 2023 Energy Consumption (Total CRH) (%)	Estimated Annual Cost Avoidance ($/Year)	Estimated Capital Cost ($)	Estimated Payback Period (Year)	Estimated Annual GHG Reduction (tCO_2eq/year)	Implementation Responsibility (Department/ Division)	Implementation Timeline	Measurement & Verification Method to be used to Quantify Energy Savings
Bayview Hill CC	Implement Optimum Start/Stop	121,575	0.2%	$8,611	$8,493	1.0	14.2	FM	2024-2029	Enhanced M&V
Bayview Hill CC	Implement recommendations from recommissioning study	162,751	0.3%	$15,418	$16,418	1.1	17.9	FM and R & C	2024-2029	Enhanced M&V
Bond Lake Arena	Retrofit the lights over the ice to LED	48,370	0.1%	$7,564	$55,500	7.3	1.4	FM	2024-2029	Basic M&V
Bond Lake Arena	Implement Optimum Start/Stop	25,483	0.0%	$1,532	$8,695	5.7	3.3	FM	2024-2029	Enhanced M&V
Bond Lake Arena	Install Occupancy Sensors	7,269	0.0%	$175	$1,545	8.8	1.3	FM	2024-2029	Basic M&V
Bond Lake Arena	Install/Replace BAS, as recommended by Recommissioning study	TBD			$250,000			FM	2024-2029	Enhanced M&V
Bond Lake Arena	Implement recommendations from recommissioning study	57,690	0.1%	$5,843	$10,563	1.8	5.9	FM and R & C	2024-2029	Enhanced M&V
Centennial Pool	Implement Optimum Start/Stop	33,919	0.1%	$1,972	$12,740	6.5	4.6	FM	2024-2029	Enhanced M&V
Centennial Pool	Install Occupancy Sensors	35,856	0.1%	$1,180	$6,179	5.2	6.2	FM	2024-2029	Basic M&V
Centennial Pool	Implement recommendations from recommissioning study	99,334	0.2%	$8,985	$5,958	0.7	11.5	FM and R & C	2024-2029	Enhanced M&V
Central Library	Facility recommissioning	156,503	0.3%	$15,254	$78,956	5.2	13.5	FM	2024-2029	Enhanced M&V
Central Library	Install Occupancy Sensors	43,083	0.1%	$5,347	$19,660	3.7	1.8	FM	2024-2029	Basic M&V
Central Library	Install Demand Control Ventilation	53,404	0.1%	$4,927	$53,363	10.8	3.2	FM	2024-2029	Enhanced M&V
City Hall	Facility recommissioning	166,625	0.3%	$18,978	$98,478	5.2	10.6	FM	2024-2029	Enhanced M&V
City Hall	Implement Optimum Start/Stop	63,684	0.1%	$3,513	$38,421	10.9	9.0	FM	2024-2029	Basic M&V
Ed Sackfield Arena	Install Arena Water Deaerator	240,460	0.4%	$13,858	$75,832	5.5	32.0	FM	2024-2029	Basic M&V
Ed Sackfield Arena	Implement Optimum Start/Stop	33,121	0.1%	$1,266	$10,515	8.3	5.3	FM	2024-2029	Enhanced M&V
Ed Sackfield Arena	Install Occupancy Sensors	2,010	0.0%	$4,098	$10,953	2.7	-5.0	FM	2024-2029	Basic M&V
Ed Sackfield Arena	Implement recommendations from recommissioning study	241,758	0.4%	$22,005	$14,005	0.6	27.8	FM and R & C	2024-2029	Enhanced M&V
Elgin Barrow Arena	Install Arena Low-e Ceiling over the ice	105,960	0.2%	$16,569	$83,000	5.0	3.0	FM	2024-2029	Enhanced M&V
Elgin Barrow Arena	Retrofit the lights over the ice to LED	96,740	0.2%	$15,127	$111,000	7.3	2.7	FM	2024-2029	Basic M&V
Elgin Barrow Arena	Implement Optimum Start/Stop	96,776	0.2%	$4,696	$11,324	2.4	14.0	FM	2024-2029	Enhanced M&V
Elgin Barrow Arena	Implement recommendations from recommissioning study	131,450	0.2%	$11,251	$21,670	1.9	16.1	FM and R & C	2024-2029	Enhanced M&V
Elgin West CC	Implement Optimum Start/Stop	102,377	0.2%	$4,404	$12,942	2.9	16.1	FM	2024-2029	Enhanced M&V
Elgin West CC	Implement recommendations from recommissioning study	133,244	0.2%	$13,626	$11,798	0.9	13.3	FM and R & C	2024-2029	Enhanced M&V
Elvis Stojko Arena	Install Arena Low-e Ceiling over the ice	140,397	0.3%	$21,954	$6,471	0.3	3.9	FM	2024-2029	Enhanced M&V
Elvis Stojko Arena	Retrofit the lights over the ice to LED	48,370	0.1%	$7,564	$55,500	7.3	1.4	FM	2024-2029	Basic M&V
Elvis Stojko Arena	Implement recommendations from recommissioning study	65,931	0.1%	$5,962	$10,563	1.8	7.6	FM and R & C	2024-2029	Enhanced M&V
Operations Centre	Facility recommissioning	265,424	0.5%	$20,528	$105,495	5.1	30.2	FM	2024-2029	Enhanced M&V
Operations Centre	Implement Optimum Start/Stop	837,741	1.5%	$52,162	$16,784	0.3	106.1	FM	2024-2029	Enhanced M&V
Operations Centre	Install Demand Control Ventilation	135,267	0.2%	$16,147	$54,767	3.4	5.7	FM	2024-2029	Enhanced M&V
Performing Art Centre	Facility recommissioning	126,324	0.2%	$10,446	$33,991	3.3	13.2	FM	2024-2029	Enhanced M&V
Performing Art Centre	Implement Optimum Start/Stop	140,469	0.3%	$8,250	$8,898	1.1	18.3	FM	2024-2029	Enhanced M&V
Performing Art Centre	Install Occupancy Sensors	89,386	0.2%	$6,185	$7,724	1.2	10.4	FM	2024-2029	Basic M&V
Performing Art Centre	Install Demand Control Ventilation	349,411	0.6%	$8,274	$89,874	10.9	60.5	FM	2024-2029	Enhance M&V
Richvale CC	Install Filter Pump VFD	123,602	0.2%	$16,315	$30,894	1.9	3.5	FM	2024-2029	Enhanced M&V
Richvale CC	Implement Optimum Start/Stop	28,743	0.1%	$1,955	$13,144	6.7	3.5	FM	2024-2029	Enhanced M&V
Richvale CC	Install Occupancy Sensors	21,626	0.0%	$644	$1,826	2.8	3.8	FM	2024-2029	Basic M&V
Richvale CC	Implement recommendations from recommissioning study	105,479	0.2%	$10,066	$11,004	1.1	11.5	FM and R & C	2024-2029	Enhanced M&V
Tom Graham Arena	Install Arena Water Deaerator	213,306	0.4%	$14,716	$75,832	5.2	24.0	FM	2024-2029	Basic M&V
Tom Graham Arena	Implement Optimum Start/Stop	101,350	0.2%	$4,763	$11,324	2.4	14.5	FM	2024-2029	Enhanced M&V
Tom Graham Arena	Install Occupancy Sensors	12,083	0.0%	$1,030	$8,707	8.4	1.1	FM	2024-2029	Basic M&V
Tom Graham Arena	Install/Replace BAS, as recommended by Recommissioning study	TBD			$250,000			FM	2024-2029	Enhanced M&V
Tom Graham Arena	Implement recommendations from recommissioning study	231,371	0.4%	$21,024	$22,096	1.1	26.7	FM and R & C	2024-2029	Enhanced M&V
Town Hall	Install Occupancy Sensors	12,044	0.0%	$1,441	$6,600	4.6	0.6	FM	2024-2029	Basic M&V
Wave Pool	Facility recommissioning	147,599	0.3%	$12,041	$17,771	1.5	16.2	FM	2024-2029	Enhanced M&V
Wave Pool	Install Filter Pump VFD	150,439	0.3%	$20,008	$33,703	1.7	4.2	FM	2024-2029	Enhanced M&V
Wave Pool	Install Occupancy Sensors	32,874	0.1%	$1,375	$8,145	5.9	5.2	FM	2024-2029	Enhanced M&V
All Facilities with BAS	Align unoccupied period/nightime setback	TBD						FM and R & C	2024-2029	Basic M&V
All Facilities	Implement life cycle projects that have energy saving potential	TBD						FM	2024-2029	Basic/ Enhanced M&V
All Facilities	Retrofit interior lighting to LED for remaining inefficent lights	TBD						FM	2024-2029	Basic M&V
Total:		**5,638,677**	**10.4%**	**$469,052**	**$1,909,120**	**4.1**	**602**			

2023 Total energy consumption of all city facilities (ekWh): 54,455,194

2023 GHG emission of all city facilities (tCO_2e): 6,316

Appendix C: Net Zero Measures Implementation Plan for 2024-2029 Corporate Energy Plan

Facility	Net zero/ Energy Conservation Opportunities	Estimated Energy Savings (ekWh/year)	Reduction of 2023 Energy Consumption (CRH Total) (%)	Estimated Annual Cost Avoidance ($/Year)	Estimated Capital Cost ($)	Estimated Annual GHG Reduction (tCO_2eq/year)	Percent GHG Reduction of 2023 GHG Emission (CRH Total) (%)	Implementation Responsibility (Department/ Division)	Implementation Timeline	Measurement & Verification Method to be used to Quantify Energy Savings	Measure Type
Bayview Hill CC	Pool water temperature optimization (Reduce by 1° F)	20,494	0.04%	$789	$7,500	3.4	0.05%	R & C	2024-2029	Basic M&V	Energy Conservation
Bayview Hill CC	Make up water optimization	102,075	0.19%	$25,424	$9,375	18.7	0.30%	R & C	2024-2029	Basic M&V	Energy Conservation
Bayview Hill CC	Optimize pool space air temperature and humidity	19,372	0.04%	$1,617	$19,250	2.0	0.03%	R & C	2024-2029	Basic M&V	Energy Conservation
Bayview Hill CC	Optimize OA quantities at Pool Dehumidifier	176,894	0.32%	$4,578	$21,313	32.4	0.51%	R & C	2024-2029	Basic M&V	Energy Conservation
Bayview Hill CC	Lighting occupancy and daylight sensors	12,185	0.02%	$3,000	$28,000	-1.5	-0.02%	FM	2024-2029	Basic M&V	Energy Conservation
Bayview Hill CC	Roof top unit (RTU) optimization	11,153	0.02%	$436	$31,815	1.8	0.03%	R & C	2024-2029	Basic M&V	Energy Conservation
Bayview Hill CC	Pool pumping system optimization	134,938	0.25%	$18,356	$31,625	4.1	0.06%	FM	2024-2029	Basic M&V	Energy Conservation
Bayview Hill CC	Demand Control Ventilation through RTUs	185,080	0.34%	$5,062	$101,250	33.6	0.5%	FM	2024-2029	Basic M&V	Energy Conservation
Bayview Hill CC	Automated Pool Cover	153,068	0.28%	$10,399	$210,700	20.0	0.32%	FM	2024-2029	Basic M&V	Energy Conservation
Bayview Hill CC	Solar PV - 178 kW Array	201,262	0.37%	$27,378	$548,240	6.1	0.10%	FM	2024-2029	Basic M&V	Renewable Energy
Centennial Pool	Pool water temperature optimization (Reduce by 1° F)	32,391	0.06%	$1,710	$5,000	5.5	0.09%	R & C	2024-2029	Basic M&V	Energy Conservation
Centennial Pool	Make up water optimization	40,270	0.07%	$11,497	$8,500	7.4	0.12%	R & C	2024-2029	Basic M&V	Energy Conservation
Centennial Pool	Optimize pool space air temperature and humidity	6,149	0.01%	$275	$7,875	1.1	0.02%	R & C	2024-2029	Basic M&V	Energy Conservation
Centennial Pool	Pool pumping system optimization	15,764	0.03%	$2,207	$12,981	0.5	0.01%	FM	2024-2029	Basic M&V	Energy Conservation
Centennial Pool	Lighting occupancy and daylight sensors	5,161	0.01%	$1,377	$22,500	-0.9	-0.01%	FM	2024-2029	Basic M&V	Energy Conservation
Centennial Pool	Demand Control Ventilation through RTUs	50,843	0.09%	$2,349	$25,313	9.2	0.15%	FM	2024-2029	Basic M&V	Energy Conservation
Centennial Pool	Roof top unit (RTU) optimization	14,471	0.0%	$663	$33,469	2.6	0.04%	R & C	2024-2029	Basic M&V	Energy Conservation
Centennial Pool	Automated Pool Cover	77,382	0.14%	$4,116	$150,500	14.2	0.22%	FM	2024-2029	Basic M&V	Energy Conservation
Centennial Pool	Install ASHP domestic hot water heater with back-up EL resistance	75,131	0.14%	-$2,469	$188,125	23.1	0.37%	FM	2024-2029	Basic M&V	Electrification
Centennial Pool	Dehumidifier Upgrade	67,493	0.12%	$3,017	$586,950	12.4	0.20%	FM	2024-2029	Basic M&V	Electrification
Centennial Pool	Solar PV - 197.6 kW Array	223,625	0.41%	$31,308	$608,608	6.8	0.11%	FM	2024-2029	Basic M&V	Renewable Energy
Connor Building	Air Sealing Stage 1	11,035	0.02%	$180	$480	2.0	0.03%	FM	2024-2029	Basic M&V	Energy Conservation
Connor Building	Air Sealing Stage 2	20,594	0.04%	$615	$8,400	4.0	0.06%	FM	2024-2029	Basic M&V	Energy Conservation
Connor Building	Envelope Upgrade - Windows and Doors	8,317	0.02%	$380	$129,853	1.0	0.02%	FM	2024-2029	Basic M&V	Energy Conservation
Connor Building	ERV Ventilation	10,356	0.02%	$351	$19,200	1.9	0.03%	FM	2024-2029	Basic M&V	Energy Conservation
Connor Building	General RTUs to ASHP with Electric Resistance	27,193	0.05%	-$1,150	$52,800	7.0	0.11%	FM	2024-2029	Enhanced M&V	Electrification
Connor Building	Lighting Upgrade to LED	4,788	0.01%	$853	$68,136	0.0	0.00%	FM	2024-2029	Basic M&V	Energy Conservation
Elvis Stojko Arena	Cold water flooding	153,690	0.28%	$9,616	$45,500	25.0	0.40%	FM	2024-2029	Basic M&V	Energy Conservation
Elvis Stojko Arena	HVAC Controls optimization - Scheduling	72,896	0.13%	$4,226	$0	12.0	0.19%	R & C/FM	2024-2029	Basic M&V	Energy Conservation
Elvis Stojko Arena	Ice Plant - DHW preheat Desuperheater	107,115	0.20%	$3,566	$250,088	21.0	0.33%	FM	2024-2029	Basic M&V	Energy Conservation
Elvis Stojko Arena	Lighting controls optimization - Scheduling	36,078	0.07%	$2,910	$0	5.0	0.08%	R & C	2024-2029	Basic M&V	Energy Conservation
Elvis Stojko Arena	Low flow Fixtures	48,154	0.09%	$5,344	$6,240	10.0	0.16%	FM	2024-2029	Basic M&V	Energy Conservation
Performing Arts Centre (Theatre)	HVAC Controls optimization - Scheduling	296,266	0.54%	$21,510	$0	41.0	0.65%	R & C/FM	2024-2029	Basic M&V	Energy Conservation
Performing Arts Centre (Theatre)	Lighting controls optimization - Scheduling	25,684	0.05%	$6,510	$1,300	-2	-0.03%	R & C/FM	2024-2029	Basic M&V	Energy Conservation
	Total:	**2,447,366**	**4.5%**	**$208,000**	**$3,240,886**	**330**	**5.2%**				

2023 Total energy consumption of all city facilities (ekWh): 54,455,194

2023 GHG emission of all city facilities (tCO_2e): 6,316

Appendix D: Operational and Organizational Measures for 2024-2029 Corporate Energy Plan

- **Operational Measures:**

Facility	Energy Conservation Opportunities	Estimated Energy Savings (ekWh/year)	Percent Reduction of 2023 Energy Consumption (CRH Total) (%)	Estimated Annual Cost Avoidance ($/Year)	Estimated Capital Cost ($)	Estimated Payback Period (Year)	Estimated Annual GHG Reduction (tCO_2eq/year)	Percent GHG Reduction of 2023 GHG Emission (CRH Total) (%)	Implementation Responsibility (Department/ Division)	Implementation Timeline
All facilities	Provide energy efficiency awareness training to Facility Operators	This will bring energy efficiency awareness and encourage staff to contribute to City's energy conservation intiatives.							E&W/R&C/FM	2024-2029
Top energy consuming facilities	Provide monthly energy consumption reports for top energy consuming facilities to Facility Supervisors/Managers/Operators	This will help monitor the energy performance of city facilities and take timely action when anomalies are observed.							E&W	2024-2029
Pool Facilities	Continue ensuring that Pools are operated within the following water temperature ranges: - Pleasure/Recreational swimming: 80°F to 85°F	Standardizing water temperature will avoid wastage of energy.							R&C	2024-2029
Ice Rink Facilities	Continue ensuring that Ice Rinks are operated within the following ice surface temperature ranges: - Ice Hockey: 22°F to 24°F - Figure Skating: 24°F to 26°F	Standardizing ice surface temperature will avoid wastage of energy.							R&C	2024-2029

- **Organizational Measures:**

Facility	Energy Conservation Opportunities	Estimated Energy Savings (ekWh/year)	Percent Reduction of 2023 Energy Consumption (CRH Total) (%)	Estimated Annual Cost Avoidance ($/Year)	Estimated Capital Cost ($)	Estimated Payback Period (Year)	Estimated Annual GHG Reduction (tCO_2eq/year)	Percent GHG Reduction of 2023 GHG Emission (CRH Total) (%)	Implementation Responsibility (Department/ Division)	Implementation Timeline
All facilities	Aim to purchase new equipment that is energy efficient and generates low GHG emissions. Include this as a key requirement for the vendor.	This will help to ensure that energy efficiency and net-zero emissions is considered as an important criteria during the purchase of new equipment.							FM	2024-2029
All facilities	Implement generic energy conservation and GHG emission reduction measures during major retrofits and in new buildings.	This will help to ensure that energy efficiency and net zero measures are considered for new builds or major retrofits							E&W/FM	2024-2029
All facilities	Develop a Corporate Net Zero Strategy/Roadmap for existing and new City facilities and set an interim 2035 target.	This will help to set a game plan to decarbonize our existing facilities and establish design standards for our new facilities							FE&W/FM	2024-2029
All facilities	Continue to conduct net zero studies for the remaining facility types that haven't been studied yet	This will help identify actionable net zero measures specific to various facility archetypes							E&W	2024-2029
All facilities	Assess actual energy savings achieved after energy conservation and net zero measures are implemented, using submetering or other M&V methodology	This will help in comparing the actual vs estimated savings and deciding whether or not to replicate this measure in other similar facilities							E&W/FM/R&C	2024-2029
All facilities	Continue working with External Agencies including Local Utility Companies to secure Incentive Funding/Grant for energy conservation projects	This will help offset the capital cost of energy projects and therefore will improve the financial feasibility of projects e.g., payback period							E&W	2024-2029

Appendix E: List of Successfully Implemented Energy Conservation Measures

Energy Conservation Opportunities	Facility	Estimated Energy Savings (ekWh/year)	Percent Reduction of 2023 Energy Consumption (CRH Total) (%)	Estimated Annual Cost Avoidance ($/Year)	Estimated Capital Cost ($)	Estimated Payback Period (Year)	Estimated Annual GHG Reduction (tCO_2eq/year)	Percent GHG Reduction of 2023 GHG Emission (CRH Total) (%)
Install Arena Low-e Ceiling over the ice	Elgin Barrow Arena*	105,960	0.2%	$16,569	$83,000	5.0	3.0	0.05%
	Elvis Stojko Arena	140,397	0.3%	$21,954	$41,500	1.9	3.9	0.06%
Retrofit the lights over the ice to LED	Elgin Barrow Arena	96,740	0.2%	$15,127	$111,000	7.3	2.7	0.04%
	Elvis Stojko Arena	48,370	0.1%	$7,564	$55,500	7.3	1.4	0.02%
	Bond Lake Arena	48,370	0.1%	$7,564	$55,500	7.3	1.4	0.02%
Retrofit interior lighting to LED for remaining inefficent lights	All facilities that have inefficient lighting				TBD			
Align unoccupied period/nightime setback for all facilities that have BAS	All facilities with BAS				TBD			
Implement life cycle projects that have energy saving potential	All facilities				TBD			

*For one pad only, another pad already has a low-e ceiling.

2023 Total energy consumption of all city facilities (ekWh): 54,455,194

2023 GHG emission of all city facilities (tCO_2e): 6,316

Appendix F: List of Unimplemented Measures from Previous (2019-2023) Corporate Energy Plan

Energy Conservation Opportunities	Facility	Estimated Energy Savings (ekWh/year)	Percent Reduction of 2023 Energy Consumption (CRH Total) (%)	Estimated Annual Cost Avoidance ($/Year)	Estimated Capital Cost ($)	Estimated Payback Period (Year)	Estimated Annual GHG Reduction (tCO_2eq/year)	Percent GHG Reduction of 2023 GHG Emission (CRH Total) (%)	Implementation Responsibility (Department/ Division)
Facility recommissioning	City Hall	166,625	0.3%	$18,978	$98,478	5.2	10.6	0.17%	FM
	Operations Centre	265,424	0.5%	$20,528	$105,495	5.1	30.2	0.48%	FM
	Perfoming Art Centre (Theatre)	126,324	0.2%	$10,446	$33,991	3.3	13.2	0.21%	FM
	Central Library	156,503	0.3%	$15,254	$78,956	5.2	13.5	0.21%	FM
	Wave Pool	147,599	0.3%	$12,041	$17,771	1.5	16.2	0.26%	FM
Install Arena Water Deaerator	Tom Graham Arena	213,306	0.4%	$14,716	$75,832	5.2	24.0	0.38%	FM
	Ed Sackfield Arena	240,460	0.4%	$13,858	$75,832	5.5	32.0	0.51%	FM
Install Filter Pump VFD	Richvale CC	123,602	0.2%	$16,315	$30,894	1.9	3.5	0.05%	FM
	Wave Pool	150,439	0.3%	$20,008	$33,703	1.7	4.2	0.07%	FM
Implement Optimum Start/Stop	City Hall	63,684	0.1%	$3,513	$38,421	10.9	9.0	0.14%	FM
	Operations Centre	837,741	1.5%	$52,162	$16,784	0.3	106.1	1.68%	FM
	Perfoming Art Centre (Theatre)	140,469	0.3%	$8,250	$8,898	1.1	18.3	0.29%	FM
	Ed Sackfield Arena	33,121	0.1%	$1,266	$10,515	8.3	5.3	0.08%	FM
	Richvale CC	28,743	0.1%	$1,955	$13,144	6.7	3.5	0.06%	FM
	Centennial Pool	33,919	0.1%	$1,972	$12,740	6.5	4.6	0.07%	FM
	Bayview Hill CC	121,575	0.2%	$8,611	$8,493	1.0	14.2	0.23%	FM
	Elgin West CC	102,377	0.2%	$4,404	$12,942	2.9	16.1	0.25%	FM
	Bond Lake Arena	25,483	0.0%	$1,532	$8,695	5.7	3.3	0.05%	FM
	Tom Graham Arena	101,350	0.2%	$4,763	$11,324	2.4	14.5	0.23%	FM
	Elgin Barrow Arena	96,776	0.2%	$4,696	$11,324	2.4	14.0	0.22%	FM
Install Occupancy Sensors	Town Hall	12,044	0.0%	$1,441	$6,600	4.6	0.63	0.01%	FM
	Performing Art Centre (Theatre)	89,386	0.2%	$6,185	$7,724	1.2	10.37	0.16%	FM
	Central Library	43,083	0.1%	$5,347	$19,660	3.7	1.81	0.03%	FM
	Richvale CC	21,626	0.0%	$644	$1,826	2.8	3.83	0.06%	FM
	Centennial Pool	35,856	0.1%	$1,180	$6,179	5.2	6.18	0.10%	FM
	Wave Pool	32,874	0.1%	$1,375	$8,145	5.9	5.18	0.08%	FM
	Ed Sackfield Arena	2,010	0.0%	$4,098	$10,953	2.7	-5.00	-0.08%	FM
	Bond Lake Arena	7,269	0.0%	$175	$1,545	8.8	1.29	0.02%	FM
	Tom Graham Arena	12,083	0.0%	$1,030	$8,707	8.4	1.09	0.02%	FM
Install Demand Control Ventilation	Performing Art Centre (Theatre)	349,411	0.6%	$8,274	$89,874	10.9	60.50	0.96%	FM
	Operations Centre	135,267	0.2%	$16,147	$54,767	3.4	5.7	0.09%	FM
	Central Library	53,404	0.1%	$4,927	$53,363	10.8	3.2	0.05%	FM
Total:		3,969,833	7.3%	$286,095	$973,574		451	7.1%	

*20% added to the estimated capital cost from 2019 to account for cost escalation.

2023 Total energy consumption of all city facilities (ekWh): 54,455,194

2023 GHG emission of all city facilities (tCO2-e): 6,316

Appendix G: List of Generic Energy Conservation and Net Zero Measures

Net zero/Energy Conservation Opportunities	Facility Types where this Measure can be Implemented	Measure Type	Things to consider for implementation
Lighting occupancy and daylight sensors	All City facilities	Energy conservation	
Roof top unit (RTU) optimization	All City facilities	Energy conservation	
ASHP replacement of fuel fired RTUs	All City facilities	Electrification	Implement at equipment end of life
Solar PV	All City Facilities	Renewable	Assess before implementing
Use of efficient plumbing fixtures & fittings	All City facilities	Energy conservation	Bundle with major renovation, where applicable
Air Sealing/ Air Tightness mitigation	All City facilities	Energy conservation	
Envelope Upgrade - Windows and Doors	All City facilities	Energy conservation	Explore when windors and doors reach end of life
ERV Ventilation	All City facilities	Energy conservation	Implement at equipment end of life
General RTUs to ASHP with Electric Resistance	All City facilities	Electrification	Implement at equipment end of life
Lighting Upgrade to LED	All City facilities	Energy conservation	
HVAC Controls optimization - Scheduling	All City facilities	Energy conservation	
Lighting controls optimization - Scheduling	All City facilities	Energy conservation	Bundle with major renovation or consider implementing a standlone city wide lighting controls optimization project
Cold water flooding	Ice rink facilities	Energy conservation	Investigate and implement. Check with other municipalities in terms of their experiences with its performance and operational matters.
Dehumidifier to electric - end of life replacement	Ice rink facilities	Electrification	Implement at equipment end of life
DHW upgrade to ASHP - Ice Resurfacing	Ice rink facilities	Electrification	
Ice Plant - DHW preheat Desuperheater	Ice rink facilities	Energy conservation	Bundle with major renovation project or even consider implementing as an independent project
Install low-e Ceiling over the ice in ice rinks	Ice rink facilities	Energy conservation	Bundle with over the ice lighting retrofit project
Pool water temperature optimization (Reduce by 1^{o} F)	Pool facilities	Energy conservation	
Make up water optimization	Pool facilities	Energy conservation	
Optimize pool space air temperature and humidity	Pool facilities	Energy conservation	
Optimize OA quantities at Pool Dehumidifier	Pool facilities	Energy conservation	Investigate and implement, if needed
Pool pumping system optimization	Pool facilities	Energy conservation	Investigate and implement, if needed
Pool filtration system optimization	Pool facilities	Energy conservation	Investigate and implement, if needed
Demand Control Ventilation through RTUs	Pool facilities	Energy conservation	Bundle with major renovation, where applicable
ASHP replacement of fuel fired MUAs plus addition of ERV	Pool facilities	Electrification	Implement at equipment end of life
Install ASHP domestic hot water heater with back-up EL resistance	Pool facilities	Electrification	Implement at equipment end of life
Dehumidifier upgrade (electrification)	Pool facilities	Electrification	Implement at equipment end of life
Automated Pool Cover	Pool facilities	Energy conservation	Decide after seeing results from pilot project
Install occupancy sensors	All Facility Types	Energy conservation	
Implement Optimum Start/Stop	All Facility Types	Energy conservation	
Align unoccupied period/nightime setback for all facilities that have BAS	All Facility Types	Energy conservation	
Install VFD on pumps	All Facility Types	Energy conservation	
Install Arena Water Deaerator	Ice Rink Facilities	Energy conservation	
Install Filter Pump VFD	Pool facilities	Energy conservation	

Appendix H: Description of Renewable Energy Systems Installed by the City

Building/Facility	Renewable Energy System Installed	Installation Year	Estimated Energy Generation Capacity
225 EBC	Solar Hot Water	2008	55,658 kWh/year
Bayview Hill Community Centre & Pool	Solar Hot Water	2010	273,055 kWh/year
Bond Lake Arena	Solar Hot Water	2010	80,150 kWh/year
Elgin Barrow Arena	Solar Hot Water	2010	38,688 kWh/year
Richmond Green Sports Complex	Solar PV	2009	5.805 kW
	Wind Mill	2009	1.9kW (Continuous) 2.6 kW (Peak)
Elvis Stojko Arena	Solar PV	2014	5 kW
Shaw House	Solar PV	2010	1.29 kW
Elgin West Community Centre & Pool	Solar Hot Water	2014	111,593 kWh/year
Richmond Hill Centre for the Performing Arts	Ground Source Heat Pump	2009	Heating Capacity: 191 MBH (16 tons) Cooling Capacity: 246 MBH (20.5 tons)
Forster House	Ground Source Heat Pump	2010	Heating Capacity: 82.8 MBH (6.9 tons) Cooling Capacity: 115.3 MBH (9.6 tons)
Eyer Homestead	Ground Source Heat Pump	2011	Heating Capacity: 108 MBH (9 tons) Cooling Capacity: 96.3 MBH (8 tons)

A description of each of the above systems is provided below:

1. Solar Hot Water System at Richmond Hill City Hall

The system was installed in 2008 and the total energy generated in last four years is 222,631.8 equivalent kWh, which is equivalent to 55,658 ekWh/year. The system is used to produce domestic hot water for the building. The technical specification for the system is as follows:

- Collector type: Glazed
- Number of collectors: 12
- Total gross area: 31.2 m^2 (2.6 m^2/collector)
- Estimated system energy output: 84.14 GJ/year (or, 23.37 MWh/year)
- Auxiliary heating system annual efficiency: 70%
- Displaced energy (natural gas): 55,658 ekWh/year[4] (equivalent to 10.2 % of 225 EBC's 2012 natural gas consumption).

[4] A typical 4-person household consumed energy equivalent to 130 GJ in 2007 in Ontario, which is equivalent to 36,110 ekWh (Source: Statistics Canada).

2. Solar Hot Water System at Bayview Hill Community Centre & Pool

A solar hot water system was installed at Bayview Hill Community Centre & Pool in 2010. Pool water is pumped through the filter and then through the solar collectors, where it is heated before it is returned to the pool. The technical specification for the system is as follows:

- Collector type: Glazed flat-plate
- Number of collectors: 73
- Total gross area: 210.24 m^2 (2.88 m^2/collector)
- Total collector design flow rate: 2.43 litres/second
- Estimated system energy output: 590 GJ/year (or, 163,889 ekWh/year)
- Auxiliary heating system annual efficiency: 60%
- Displaced energy (natural gas): 983 GJ/year (or, 273,055 ekWh/year) (equivalent to 11.9 % of Bayview Hill's 2012 natural gas consumption).

3. Solar Hot Water System at Bond Lake Arena

A solar hot water system was installed at Bond Lake Arena in 2010 for preheating the incoming municipal water for the Zamboni room hot water system and for the domestic hot water use (the general change rooms, washrooms, and kitchen). The technical specification for the system is as follows:

- Collector type: Glazed flat-plate
- Number of collectors: 20
- Total gross area: 52 m^2 (2.6 m^2/collector)
- Estimated system energy output[5]: 289 GJ/year (or, 80,150 ekWh/year) (equivalent to 12.2 % of Bond Lake's 2012 natural gas consumption).

4. Solar Hot Water System at Elgin Barrow Arena

A solar hot water system was installed at Elgin Barrow Arena in 2011 for preheating incoming municipal water for the Zamboni room hot water system and for the domestic hot water use (the general change rooms, washrooms, and kitchen). The system also consists of pumping and heat transfer station for a closed loop solar circuit, which incorporates a double-wall heat exchanger for transferring heat to the domestic hot water (DHW) storage tank. The technical specification for the system is as follows:

<u>Solar Collector</u>

- Make/Model: VITOSOL 200-F
- Collector type: Glazed flat-plate
- Number of collectors: 10
- Total surface area: 25.1m^2 (2.51 m^2/collector)
- Total absorber area: 23.2 m^2 (2.32 m^2/collector)

<u>Pumping & heat transfer station</u>

- Make/Model: Solar-Divicon-HX (DN 25)
- Flow meter (setting range): 1to 23 liters/min
- Max. number of Vitosol-F collectors: 18
- Max. number of Vitosol-T tubes: 270
- Estimated system energy output[6]: 139 GJ/year (or, 38,688 ekWh/year) (equivalent to 2.1 % of Elgin Barrow's 2012 natural gas consumption).

[5] Estimated based on average ekWh/ft^2 of collectors at EBC & Bayview Hill and total collector area (ft^2) at Bond Lake Arena.
[6] Estimated based on average ekWh/ft^2 of collectors at EBC & Bayview Hill and total collector area (ft^2) at Elgin Barrow Arena.

5. Solar PV and Windmill at Richmond Green Sports Complex

Renewable energy systems installed at Richmond Green Sports Complex include a solar PV system and a windmill. The technical specification for the systems is as follows:

Solar PV System

- Make/Model: SANYO HIT Power 215N
- Solar Modules: Hybrid of mono-crystalline silicon surrounded by ultra-thin amorphous silicon layers
- Module area: 1.26 m^2/module
- Number of panels (in the array): 27
- Module efficiency: 17.1%
- Cell efficiency: 19.3%
- Maximum system voltage: 600 V
- Inverter: 6 kW
- Rated power: 215 W/panel
- Solar system power rating: 5.805 kW (total from 27 panels)

Windmill System

- Make/Model: Skystream 3.7
- Type: Downwind rotor with stall regulation control
- Tower: Freestanding tapered tubular steel/galvanized finish
- Blades: 3-Fibreglass reinforced composite
- Rotor diameter: 12 ft (3.72 m)
- Rated speed: 50-325 rpm
- Maximum tip speed: 216.5 ft/s (66 m/s)
- Rated capacity: 1.9kW continuous output and 2.6 kW peak

6. Solar PV at Elvis Stojko Arena

The technical specification for the solar PV system installed at Elvis Stojko Arena is as follows:

- Make/Model: FIRST Q SLA 250P
- Solar Modules: Poly-crystalline solar cells (Roof mounted)
- PV system: Off-grid with PV Inverter
- Energy Meter: Inbuilt in the Inverter (Local display: Instantaneous &cumulative)
- Number of panels: 20
- Minimum power rating: 250 W/panel
- Solar system power rating: 5.0 kW (total from 20 panels)

7. Solar PV at Shaw House

The technical specification for the roof mounted solar PV system at Shaw House is as follows:

- Solar Modules: Mono-crystalline solar cells, Aluminum framed
- PV system: Grid Tied with PV Inverter
- Number of panels (in the array): 6 (in a row)

- Module efficiency: >14%
- System operation voltage: 240 VAC
- Minimum power rating: 215 W/panel
- Array power rating: 1.29 kW (total from 6 panels)

8. Solar Hot Water System at Elgin West Community Centre & Pool

A solar hot water system is being installed at Elgin West Community Centre & Pool in 2014. Pool water is pumped through the filter and then through the solar collectors, where it is heated before it is returned to the pool. The technical specification for the system is as follows:

- Make/Model: Buderus SKS 4.0
- Collector type: Glazed flat-plate
- Number of collectors: 30
- Total gross area: 72.4 m^2 (25.96 ft^2/collector)
- Maximum flow rate: 1.07 gpm (0.7 litres/second)
- Estimated system energy output[7]: 402 GJ/year (or, 111,593 ekWh/year) (equivalent to 6.8 % of Elgin West's 2012 natural gas consumption).

9. Ground Source Heat Pump at Richmond Hill Centre for the Performing Arts

The heritage section of the facility is heated and cooled by ground source heat pumps (HP-1 to 6) controlled by the BAS using local room sensors. Heat exchange to and from the heat pumps is from a propylene glycol loop with a pair of main circulator pumps located in the basement mechanical room. Heat supply/rejection to/from the glycol loop is through a series of vertical loop wells located in the west parking lot. A total of 1463 m of geothermal heat exchanger boreholes are installed. The boreholes are 61 m deep and installed on three rows beneath the parking lot at the rear of the theatre.

- Heating Capacity: 191 MBH[8] (16 tons[9])
- Cooling Capacity: 246 MBH (20.5 tons)

Information on annual energy production was not available at the time of plan preparation.

10. Ground Source Heat Pump at Forster House

Heating and cooling is provided from two ground source heat pumps located in the basement. HP-101 feeds the main building. HP-102 is a split heat pump system that feeds the north meeting room. The fan section of this heat pump is located in the attic space above the meeting room. Heat exchange to and from the heat pumps is from a propylene glycol loop with a set of main circulator pumps located in the basement mechanical room. Heat supply/rejection to/from the glycol loop is through an underground horizontal loop located in the park area south of the building.

- Heating Capacity: 82.8 MBH (6.9 tons)
- Cooling Capacity: 115.3 MBH (9.6 tons)

Information on annual energy production was not available at the time of plan preparation.

[7] Estimated based on average ekWh/ft^2 of collectors at EBC and Bayview Hill and total collector area (ft^2) at Elgin West CC.
[8] 1 MBH = 1000 BTU/hour.
[9] 12000 BTU/hour = 1 ton of Refrigeration.

11. Ground Source Heat Pump at Eyer Homestead

Heating and cooling is provided from a ground source heat pump located in the basement storage room. HP-101 feeds, via a controller unit (BC-101), 9 split heat pump fan coil units (FCU-101 to 109) located in various rooms in the basement, ground & second floors.

The heat pump system is backed up from a heating water loop via a heat pump booster unit (BU-101). This heating loop is fed from a wall mount boiler (BLR-1) and feeds heating coils in the discharge ducting of the energy recovery ventilators, the basement radiant floor heating and the domestic hot water tank via an internal heating coil.

- Heating Capacity: 108 MBH (9 tons)
- Cooling Capacity: 96.3 MBH (8 tons)

Information on annual energy production was not available at the time of plan preparation.

Appendix I: 2022 and 2023 Facility Energy Consumption and GHG Emissions Report Submitted to the Province

The report was submitted to the Province.

Appendix J: 2024-2029 Corporate Energy Plan Energy Conservation and Net Zero Measures and Descriptions

Recommended Measures	Description
Implement Optimum Start/Stop	A building optimum start/stop program could be integrated with the Building Automation System (BAS) to determine the optimal start/stop times for the heating, ventilating and air conditioning (HVAC) system based on the occupancy and event schedules set in the BAS. This will save energy by only having the units operate when required; minimizing the time they are active when not needed.
Install Occupancy Sensors	Many of the spaces in the facilities experience varying occupancy levels throughout the day, in particular the program and meeting rooms. Installing occupancy sensors that are tied into the heating, cooling and lighting systems will enable temperature setbacks and turning off of lights when the areas are not in use.
Facility recommissioning	Re-commissioning is the process of analyzing building system operations and returning them to their design or optimum specifications and settings based on current facility needs. Re-commissioning these facilities will lead to energy savings, improved system operations, and improved occupant comfort.
Implement recommendations from recommissioning study	Facility recommissioning studies conducted in a couple of city facilities recommended a bunch of energy conservation measures.
Install/Replace BAS, as recommended by Recommissioning study	Facility recommissoning studies conducted in a couple of city facilities recommended installing a new BAS or replacing the existing BAS to enable the facility operatots to operate the facilities efficiently, aligning with their operational requirements, defined schedules and actual occupancy levels.
Install Demand Control Ventilation	This system utilizes CO_2 sensors located in the air return ducts to control the amount of fresh air brought into the facility to maintain an acceptable level of indoor air quality. This control strategy will save energy by reducing the amount of fresh air that needs to be conditioned.
Energy recovery ventilation (ERV)	This involves installing a ventilation system that enables the recovery of waste heat from exhaust air that can be used to preheat the makeup air.
Align unoccupied period/nightime setback	This involves operating the facility based on operational requirements and aligning with the facility's defined schedules and actual occupancy levels.
Retrofit interior lighting to LED for remaining inefficient lights	Retrofits of interior lights with energy efficient lighting (i.e. LED lights).
Retrofit the lights over the ice to LED	Retrofits of interior lights over the ice with energy efficient lighting (i.e. LED lights). This will not only result in energy savings associated with lighting but also reduce the heating load on refrigeration plant compressors.
Lighting occupancy and daylight sensors	Controlling the operation of lights based on occupancy and through daylight sensors.
Install Arena Low-e Ceiling over the ice	To reduce radiant energy emitted from an arena ceiling onto the ice surface, a low emissivity ceiling will be installed. The low-e ceiling reduces the amount of heat the ice plant has to remove from the ice which in turn reduces the ice plant's electricity consumption and cost.
Install Arena Water Deaerator	A water deaeration system removes air bubbles from the ice resurfacing water. Removing air from water allows for a reduction in the temperature of the water used for ice resurfacing. This results in eliminating the need of energy currently being used to heat water for resurfacing purposes and in reducing the refrigeration load on compressors. In addition, the use of deaerated water makes harder ice, which will reduce the frequency of ice resurfacing.
Ice Plant - DHW preheat Desuperheater	This measure involves recovering the waste heat from refrigeration plant compressors at ice rinks and using it to preheat the domestic hot water. This will help reduce natural gas currently being used for making homestic hot water.
Cold water flooding	This involves installing a device on a cold water line in the ice rink to remove air bubbles from water and using the deaerated water for resurfacing/flooding the ice. This will eliminate the use of energy currently being used to heat the water for resurfacing. In addition, using the deaerated water for flooding reportedly makes the ice harder and reduces the frequency of resurfacing.
Install Filter Pump VFD	Installation of variable frequency drives (VFDs) on pool filter pumps allows the speed of pumps to be reduced to the required levels rather than running at full speed. This significantly reduces the electricity consumed by these pumps.
Make up water optimization	This involves optimizing the use of make up water to the pool by making sure that correct amount of makeup water is added as required by the regulation, based on actual bathers admitted to the pool. Adding correct amount of water will avoid energy wastage that would occur if more than required amount of water is added which would need to be heated.
Optimize pool space air temperature and humidity	This measure involves optimizing the pool space air and humidity by establising the temperatue and humidity setback levels (e.g., allowing the space temperatures setbacks of 4^{o}F above/below setpoint and humidity levels at 60%). This is expected to result in significant energy and GHG emissions savings.
Optimize outside air (OA) quantities at Pool Dehumidifier	This measure involves reducing outside air (OA) flows at Pool dehumidifier to minimum ASHRAE requirements.
Pool water temperature optimization (Reduce by 1^{o} F)	This measure involves optimizing the pool water temperature and ensuring that it is always maintained within the set range. If the temperature is found to be ouside of the set range, try dropping by 1^{o}F at a time until the set range is achieved.

Recommended Measures	Description
Roof top unit (RTU) optimization	This measure involves optimizing RTUs that includes night-time setbacks, economizer mode, OA optimization, and BAS enhancements.
Pool pumping system optimization	This measure involves optimizing the pool pumping system (VFD drives at first, then replace complete pumps at end of life) to achieve minimum required pump flows.
Automated Pool Cover	Installing a cover on the pool would minimize the evaporation, especially during the unoccupied period, such as at night. This would save both water and energy.
Install ASHP domestic hot water heater with back-up EL resistance	This measure involves replacing the natural gas fired domestic hot water heater with an air source heat pump (ASHP) with electric backup.
Dehumidifier Upgrade (electrification)	This measure involves upgrading or replacing the dehumidifier, from natural gas to electricity and includes run-around coil & pool water heat recovery.
Air Sealing	Air infiltration through the building envelope leads to wastage of energy. Applying a sealant will improve air tightness.
Envelope Upgrade - Windows and Doors	This measure involves upgrading the windows and doors with energy efficient alternatives, e.g., replacing a double pane window with a triple pane window.
General RTUs to ASHP with Electric Resistance	This measure involves replacing the natural gas fired roof top units (RTUs) with an air source heat pump (ASHP) with electric backup during the coldest period, as needed.
HVAC Controls optimization - Scheduling	This measure involves optimizing the operation of heating, ventilating and air conditioning (HVAC) system based on actual occupancy and event schedules. This will save energy by only having the units operate when required; minimizing the time they are active when not needed.
Lighting controls optimization - Scheduling	This measure involves optimizing the operation of facility's lighting system based on actual occupancy and event schedules. This will save energy by only having the lights operate when required.
Low flow Fixtures	Low-flow aerators installed on washroom faucets reduce the water flow rate which reduces overall water consumption. This saves energy by reducing the amount of hot water consumed.
Solar PV	This measure involves installing Solar PV systems at the facility for onsite electricity generation. Generating onsite electricity will help the facility conserve energy, free up some connected electrical load of the facility, and reduce facility's greenhouse gas emissions. This measure will help the facility to get to net zero emissions.
Implement life cycle projects that have energy saving potential	This involves replacing the equipment that reaches end of life with energy efficient or low carbon alternatives.