



CORPORATE ENERGY CONSERVATION AND DEMAND MANAGEMENT PLAN

2024-2029

CITY OF BRAMPTON



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Version History

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For revisions between versions, please see errata table in Appendix E.

For more information, please contact the City's Energy Management team at energy@brampton.ca.

Executive Summary

As the urgency of global warming intensifies due to greenhouse gas (GHG) emissions, there is a growing emphasis on mitigating climate change to minimize its adverse effects. In response to this issue, in June 2019, the City of Brampton voted unanimously to declare a climate emergency, and has taken action to curb its GHG emissions. This Energy Conservation and Demand Management Plan (ECDMP) provides an overview of the City's current emissions and outlines a strategy to diminish its corporate contribution to GHG emissions. The goal is to achieve a reduction of 40-45% in emissions by 2030 (compared to a 2010 baseline) and ultimately attain net zero emissions by 2050. This is aligned with the federal targets to achieve a 40-45% reduction in GHG emissions by 2030 (compared to 2005 levels), and net zero by 2050.

This ECDMP recommends a set of strategies which comprise a Net Zero GHG Emission Reduction Roadmap. In the short term, the Net Zero Roadmap focuses on low-capital measures which the potential for sizable reductions in GHG emissions. In the medium and long term, the focus of this roadmap is on more capital-intensive measures with a potential for significant reductions in GHG emissions. The key strategies for the short, medium, and long term are presented below.

These strategies are aligned with the state of good repair for the City of Brampton, as where possible, the measure implementation timeline was chosen to match the end of useful life for any equipment which will be replaced by implementing this measure.

Short Term (2024-2029)

In the short term, the key strategies in the Net Zero GHG Emission Reduction Roadmap are:

- Lighting upgrades.
- Heating, ventilation, and air conditioning (HVAC) system optimization measures.
- Complete net zero retrofits at Susan Fennell Sportsplex and Earnscliffe Recreation Centre (in planning stage).
- Additional deep retrofit studies to identify additional opportunities to reduce GHG emissions.

Table 1 summarizes the proposed actions to be undertaken as part of the 2024-2029 ECDMP, and the corresponding GHG and cost savings.

Table 1: Summary of planned actions to undertake in the short term (2024-2029)

Facility	Action	Reduction in GHG emissions (tCO ₂ e/yr)	Utility cost savings (\$/yr)
Corporate Facilities (FOM)	New building	-296	-314,949
	Lighting upgrades	40	139,527
	HVAC system optimization	103	43,541
	Equipment electrification	56	-16,597
	Upgrades to heat pump	223	1,953
	Additional process upgrades	9	14,536
Fire Facilities	Lighting upgrades	3	10,561
	HVAC system optimization	15	4,302
Library Facilities	Lighting upgrades	4	15,063
	HVAC system optimization	26	7,147
Parks Facilities	Lighting upgrades	3	6,172
	HVAC system optimization	21	4,614
Recreation Facilities	Ongoing construction	0	0
	Building decommission	1	1,704
	Lighting upgrades	98	222,975
	HVAC system optimization	1,008	131,577
	Equipment electrification	165	-31,028
	Upgrades to heat pump	687	78,457
	Envelope upgrades	143	33,553
	Solar PV	248	396,106

Table 1: Summary of planned actions to undertake in the short term (2024-2029) (*continued*)

Facility	Action	Reduction in GHG emissions (tCO ₂ e/yr)	Utility cost savings (\$/yr)
	Additional process upgrades	482	185,150
	Purchasing carbon offsets	3,150	-77,264
Transit Facilities	Lighting upgrades	12	44,685
	HVAC system optimization	177	51,729
	Purchasing carbon offsets	4,754	-116,618

Note that a negative ("-") reduction in GHG emissions indicates that the City's GHG emissions are anticipated to increase for that measure, although overall energy use would decrease. Also note that the measures associated with the net zero retrofits are being accounted for in the recreation measures.

The 5-year vision of this plan would entail a reduction in electricity consumption of **6%** and natural gas consumption of **8%**. To achieve the target of a 40-45% reduction in GHG emissions by 2030, it is recommended that the City of Brampton purchase carbon offsets for the four largest contributors to GHG emissions, the Brampton Transit Yard Sandalwood Facility, the Brampton Transit Yard 185 Clark Blvd, the Gore Meadows Community Centre, and the Susan Fennel Sportsplex. This will offset 7240 tCO₂e/yr, and will result in a cumulative GHG reduction of **41%** from 2010 by 2029. The recommended measures are also anticipated to decrease the annual utility costs by \$1,553,237, or **8%**.

Medium Term (2030-2035) and Long Term (2035-2050)

In the medium and long term, the key strategies in the Net Zero GHG Emission Reduction Roadmap are:

- HVAC equipment to heat pumps.
- Domestic hot water heaters to heat pumps.
- Installation of solar PV (photovoltaic) arrays.
- Replace gas-fired equipment with electric equipment.
- Develop a policy to ensure that new builds are designed to have net zero or near net zero emissions (similar to the City of Toronto's Zero Emissions Buildings Framework) to avoid a significant increase in the City's GHG portfolio when new buildings are constructed.

Based on the recommendations in this net zero pathway, the City can decrease their GHG emissions by about **97%** without purchasing carbon offsets. Once the effects of offsets to meet its goals are factored in, the City of Brampton's GHG emissions are projected to decrease by **68%** by 2035 and **100%** by 2050. Carbon offsets are employed only as a last resort to offset remaining GHGs which cannot be fully eliminated in order to meet the City's goal of net zero by 2050. Additionally, it should be noted that as more organizations adopt carbon offsets to meet their GHG reduction targets, the cost of purchasing carbon offsets may increase. The quantity of carbon offsets required in 2050 could change depending on the electricity grid intensity at that time.

Progress Summary

Figure 1 summarizes the City's current emissions (in blue) and projected progress (green) in decreasing their GHG emissions, per the Net Zero GHG Emission Reduction Roadmap.

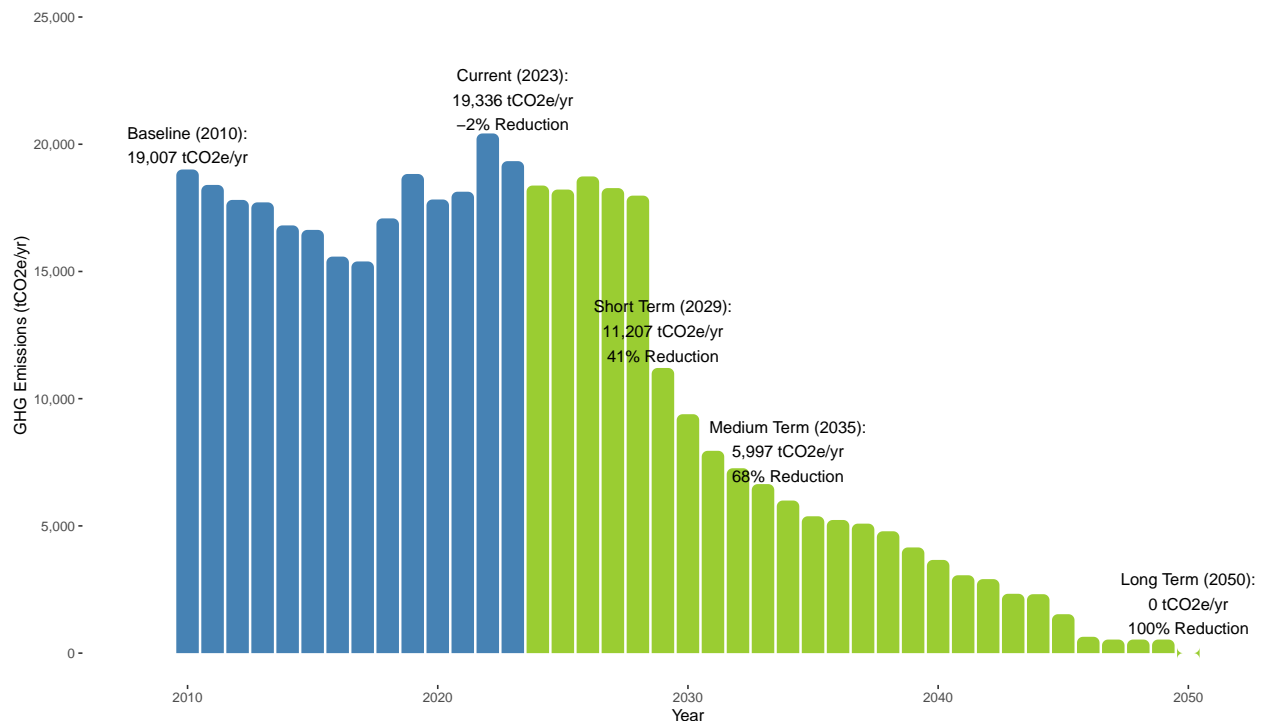


Figure 1: Projected reduction in GHG emissions at the end of each term.

To ensure that the City of Brampton is staying on track to meet their goals, it is recommended that the City continuously monitor and analyze utility use data for their facilities. The City is currently using Ameresco's AssetPlanner for Utility Data Management and annual BPS reporting to track utility use data. When the City implements measures at any facility, the utility consumption at that facility should be analyzed to ensure that the projected utility and savings are being achieved. This will allow the City of Brampton to investigate if the measure does not result in the savings that they expect, and take action as needed to stay on track with their GHG reduction targets.

Funding Opportunities

To support the implementation of short, medium, and long term strategies, the City of Brampton can leverage initiatives such as the Clean Fuel Regulations (CFR) credits and carbon trading schemes to secure financial resources for retrofitting projects and the purchase of carbon offsets. By participating in these programs, the City can generate revenue or reduce costs associated with GHG reduction measures. Furthermore, federal, provincial, and municipal funding programs offer grants and incentives for energy conservation projects and the adoption of renewable energy systems. For instance, in the short term, programs such as Enbridge's Retrofits & Custom Projects Rebate can be used to offset the costs of HVAC optimization projects. In the medium and long term, the Federation of Canadian Municipalities Green Municipal Fund offers several programs to offset the costs of energy conservation projects, such as the GHG Reduction Pathway Retrofit program. These funding strategies will play a crucial role in enabling the City to achieve its ambitious GHG reduction targets by alleviating the financial burden of implementing energy efficiency measures, renewable energy installations, and other capital-intensive projects. By proactively seeking and utilizing these funding opportunities, the City of Brampton can accelerate its transition towards a sustainable and resilient future.

Notice to the Ontario Ministry of Energy, Northern Development and Mines

To: The Ontario Ministry of Energy, Northern Development and Mines

I hereby confirm the approval of the City of Brampton Energy Conservation and Demand Management Plan (ECDMP) on behalf of the City of Brampton's Corporate Leadership Team (CLT). This plan, in compliance with Ontario Regulation 25/23, will guide the City's energy conservation and demand management efforts over the period of 2024-2029 and will be revised periodically, as necessary.

Signed,



Peter Pilateris
Commissioner, Public Works and Engineering
City of Brampton

June 26, 2024

Date

Acknowledgements

We extend our sincerest appreciation to the team involved in the development of this plan for their expertise and contributions. Special recognition goes to:

1. Project Lead: Rajbalinder Ghatoura
2. Energy Management Team
3. Sectional Manager: Kanagasabai Balakanthan
4. Divisional Head: Rajkaran Chhina

We express our gratitude to all stakeholders and department representatives who have provided their insights and expertise including Building Design and Construction, Environmental Planning, Fire, Facilities Operations & Maintenance, Recreation and Transit.

We also thank the consulting team at WalterFedy Group Inc for their efforts in the development of the Corporate Energy Conservation & Demand Management Plan.

1 Introductions

1.1 What is an ECDMP?

Ontario Regulation 25/23 (which has replaced O.Reg. 507/18) is a regulation which requires public agencies, such as municipalities, to annually report their greenhouse gas (GHG) emissions and to develop an energy conservation and demand management plan (ECDMP). The ECDMP should include a summary of the public agency's GHG emissions, a description of previous conservation measures undertaken, proposed measures to undertake over the course of the current plan, and the estimated savings for these measures. A more detailed breakdown of the requirements for the O.Reg 25/23 ECDMP is presented below:

- A summary of the annual GHG emissions for each of the public agency's prescribed operations.
- Proposed activities and energy conservation measures that the public agency can undertake to save energy and reduce GHG emissions.
- Cost and energy saving estimates for the proposed measures.
- A description of renewable energy generated by the public agency, and the annual amount of energy produced, including:
 - the ground source energy utilized by ground source heat pump technology operated by the public agency,
 - the solar energy utilized by thermal air technology or thermal water technology operated by the public agency, and
 - the proposed plan, if any, to operate heat pump technology, thermal air technology or thermal water technology.
- The estimated length of time the public agency's current and proposed activities and measures will be in place.
- A confirmation that the energy conservation and demand management plan has been approved by the public agency's senior management.

1.2 Vision, Goals, and Objectives

Vision

The City of Brampton's vision is to create a sustainable and resilient community that thrives in harmony with its environment. The City aspires to be leaders in sustainability, embracing innovative solutions to mitigate climate change and enhance the well-being of current and future generations.

Goals

The City of Brampton has two targets for reducing its GHG emissions:

1. **GHG Reduction:** The City is committed to significantly reducing its GHG emissions to mitigate the impacts of climate change. The City of Brampton's short-term goal is to achieve a 40-45% reduction in GHG emissions by 2030, compared to baseline levels from 2010. This reduction aligns with international targets and highlights the City's dedication to combatting global warming.
2. **Net Zero Emissions:** Building on the short-term goal, the City of Brampton aims to achieve net zero GHG emissions by 2050. This goal reflects the City's recognition of the need to transition to a carbon-neutral society and their commitment to leading by example in the fight against climate change.

Objectives

- **Short Term (2024-2029)**

1. **Implement Energy Efficiency Measures:** Complete lighting upgrades at 75% of City facilities, and optimize HVAC systems at 55% of City facilities by 2029. This should decrease the City's electricity and natural gas consumption by 5% each, which is aligned with the City's commitment to reducing GHG emissions and operating costs. To achieve this, leverage existing budget allocations, and seek additional funding from federal, provincial, and external programs (such as Enbridge's Retrofits & Custom Projects Rebate).
 2. **Continue to Conduct Deep Retrofit Studies:** Complete 10 net zero retrofit studies for large facilities by 2029. These studies will identify additional opportunities to reduce GHG emissions, and can be completed through combined efforts between internal staff and external consultants.
 3. **Develop a Comprehensive Plan:** Develop a comprehensive GHG reduction plan by 2029. This plan should encompass all departments and account for corporate emissions, transit, the fire department, etc. This plan can be completed through collaboration by internal staff, and will enable enhanced co-ordination between its departments to ensure that energy conservation and GHG reduction initiatives can be implemented as effectively as possible.
- **Medium Term (2030-2035)**
 1. **Implement Energy Efficiency Measures:** Complete all remaining lighting upgrades and HVAC system optimization measures by 2035. This should decrease the City's electricity consumption by 2% and natural gas consumption by 4%, which is aligned with the City's commitment to reducing GHG emissions and operating costs. To achieve this, leverage existing budget allocations, and seek additional funding from federal, provincial, and external programs.
 2. **Begin Upgrading Equipment to Heat Pumps:** Upgrade domestic hot water (DHW) heaters to heat pumps at 25% of facilities with gas-fired DHW systems. This is expected to decrease the City's natural gas use by about 2%, and contribute to the City's progress towards reducing its GHG emissions. To achieve these equipment upgrades, leverage existing budget allocations, and seek additional funding from federal and provincial programs (e.g. the Federation of Canadian Municipalities Community Buildings Retrofit Initiative).
 - **Long Term (2035-2050)**
 1. **Complete Equipment Electrification:** Convert all gas-fired equipment to electric equipment, such as heat pumps, that it is feasible to convert. This will reduce the City's natural gas consumption to less than 5% of the baseline natural gas consumption, and significantly decrease the City of Brampton's GHG emissions. To achieve these equipment upgrades, leverage existing budget allocations, and seek additional funding from federal and provincial programs.
 2. **Solar PV:** install solar PV arrays where possible to offset roughly 15% of the City's electricity consumption by 2050. This will offset the City's utility costs and GHG emissions due to electricity. To achieve this, seek funding from federal and provincial programs.

1.3 Benefits

An ECDMP offers numerous benefits to both municipalities and their communities. By implementing energy conservation measures (ECMs) and optimizing energy use, the City of Brampton can significantly reduce its energy consumption and operating costs. This leads to direct financial savings, allowing the City to reallocate funds to other critical priorities such as infrastructure improvements, community services, and environmental initiatives. Additionally, ECMs contribute to the reduction of GHG emissions, mitigating the impacts of climate change and promoting environmental sustainability. By demonstrating leadership in energy conservation, the City can inspire and mobilize its communities to adopt sustainable practices, fostering a culture of environmental stewardship and resilience.

Tangible benefits include the direct financial savings from reduced energy consumption and operating costs. These savings can be reinvested in other critical areas, enhancing the overall quality of life for residents. Furthermore, energy conservation measures often result in improved comfort, health, and productivity of municipal

buildings and facilities, benefiting both employees and residents. The intangible benefits include fostering a culture of sustainability and resilience within the community, as well as enhancing the City's reputation as a leader in environmental stewardship.

An ECDMP also opens up various opportunities for the City of Brampton. For instance, by achieving energy and GHG emission reductions, the City can benefit from carbon offset credits (also called Clean Fuel Regulations credits, or CFR credits), which can be sold or traded in carbon markets to generate additional revenue. Participation in carbon trading schemes provides financial incentives for further reducing emissions. Additionally, the strategic approach outlined in an ECDMP can make the City eligible for various federal, provincial, and municipal funding programs designed to support energy efficiency and sustainability initiatives. These funding programs can provide grants, low-interest loans, or rebates, further reducing the financial burden of implementing ECMs.

Additionally, an ECDMP enhances the reliability and resilience of municipal infrastructure and services. By reducing energy demand and peak loads, the City of Brampton can mitigate the risk of energy supply disruptions and enhance energy security. This is particularly crucial during extreme weather events, such as heat waves or ice storms, or emergencies when reliable access to energy is essential for public safety and well-being. Overall, an ECDMP not only delivers tangible economic and environmental benefits but also strengthens the resilience and sustainability of municipalities and their communities in the face of evolving energy challenges.

The approaches which can be taken to address some of these energy challenges are presented in Table 2.

Table 2: Energy challenges facing municipalities and proposed approaches

Energy Challenge	Description	Approach
Increasing Energy Costs	Rising energy prices can strain municipal budgets, making it essential to implement ECMs that enhance energy efficiency and reduce overall consumption.	Invest in energy-efficient technologies such as LED lighting, high-efficiency HVAC systems, and building automation systems. Additionally, perform regular energy audits to identify and rectify inefficiencies.
Aging Infrastructure	Outdated and inefficient infrastructure can lead to higher energy consumption and increased maintenance costs.	Upgrade and retrofit municipal buildings and facilities with modern, energy-efficient systems and materials. Utilize smart grid technology to enhance energy distribution and management.
Energy Supply Disruptions	Extreme weather events, such as heat waves and ice storms, and other emergencies can disrupt energy supply, affecting the reliability of municipal services.	Implement energy conservation measures to reduce energy peak demand and reduce the risk of energy supply disruptions. Develop and implement an energy resilience plan that includes backup power solutions like battery storage systems and microgrids. Enhance grid reliability by incorporating distributed energy resources.
Peak Energy Demand	High energy demand during peak times can lead to increased costs and strain on the energy grid.	Decrease energy use through the implementation of energy conservation measures to decrease the peak energy demand from different facilities and reduce the strain on the energy grid.

2 Context

2.1 Climate Change and Action

Climate change poses a significant threat to the stability and well-being of our planet and its inhabitants. At its core, climate change is driven by the accumulation of GHGs in the Earth's atmosphere, leading to a gradual increase in global temperatures — a phenomenon commonly referred to as global warming. The consequences of global warming are wide-ranging and severe, and include rising sea levels, more frequent and intense extreme weather events, disruptions to ecosystems and biodiversity, shifts in agricultural productivity, and threats to human health and livelihoods. In light of these profound impacts, it is crucial to take urgent action to mitigate climate change by reducing GHG emissions.

2.2 City of Brampton Background and Previous Plan (2019-2024)

The City of Brampton recognizes the importance of mitigating climate change, and has taken action to reduce its GHG emissions. The City has several plans which highlight its commitment to reducing its contribution to climate change, outlined below.

- **2019 Conservation and Demand Management Plan**

As per O.Reg. 507/18, the City of Brampton released a Conservation and Demand Management (CDM) Plan in 2019. This energy and emissions management plan focused on GHG emissions from corporate buildings, including administrative offices, cultural facilities, indoor recreational facilities, community centres, fire stations, parking garages, public libraries, and storage facilities. The plan noted that from 2014 to 2019, 50 energy conservation projects had been undertaken, including building automation systems (BAS), renewable technology, and energy management training, which decreased the City's 2017 GHG emissions by 13% compared to a 2010 baseline year.

The focuses of the 2019 to 2024 CDM Plan are listed below:

- **Deep retrofit studies for zero-carbon facilities:** 8 deep retrofit studies have been completed from 2019 to 2024.
- **Implementation of BAS:**
 - * Developed individual Virtual Servers and Virtual Local Area network (VLAN) for each major BAS system to avoid communication conflicts.
 - * Upgraded ten sites for Johnson Controls graphics to the new online Mobile User-Interface (MUI) graphics.
 - * Updated all BAS applications to the most recent versions.
 - * Migrated control applications to increase the cyber security of BAS systems.
 - * Created and configured two new BAS servers to host new Desigo CC BAS applications to allow greater control of HVAC equipment with tighter security.
- **Conservation and efficiency projects (i.e. investigate better refrigerant management practices)**
- **Operational savings and employee awareness training plan**
- **Set point policy**
- **EV charging station infrastructure**
- **Minimize energy and emissions in new facilities**

Table 3 lists the energy conservation measures and anticipated utility saving which were implemented during the 2019 to 2024 ECDMP.

Table 3: Estimated annual energy savings for measures completed during the 2019-2024 ECDMP

Buildings	Measure	Completion Year	Electricity Savings [kWh/yr]	GHG Reduction [tCO ₂ e/yr]
-	-	-	-	-
Civic Centre	Library Lighting Retrofit to LED	2019	31,267	0.938
Memorial Arena	Retrofit Lighting to LED (Wallpacks)	2019	2,260	0.068
South Fletchers	Retrofit Lighting to LED	2019	322,526	9.676
Terry Miller and Ellen Mitchell	Retrofit Lighting to LED	2019	58,622	1.759
Brampton Soccer Centre	Retrofit Lighting to LED	2020	157,046	4.397
Earnscliffe, Century Gardens, and Brampton Curling Club	Ice Rink CIMCO system	2021	187,150	5.24
Sandalwood Transit	Retrofit Lighting to LED	2021	171,170	4.793
Cassie Campbell Recreation Centre	Ice rink controller upgrade	2022	151,164	4.5
Clark Transit, Earnscliffe, and Century Gardens	Retrofit Lighting to LED	2022	331,232	9.274
Jim Archdekin Recreation Centre and Brampton Curling Club	Retrofit Lighting to LED	2023	44,116	1.5

- **Net zero retrofit reports**

As part of the 2019 CDM, the City of Brampton performed net zero retrofit studies for the following facilities:

- Century Gardens Recreation Centre
- Earnscliffe Recreation Centre
- City Hall West Tower
- Susan Fennel Sportsplex
- Chinguacousy Wellness Centre
- Cassie Campbell Community Centre
- Save Max Sports Centre
- Terry Miller Recreation Centre

In addition, the City of Brampton has developed the plans presented Table 4, which will be incorporated into this ECDMP.

Table 4: City of Brampton existing plans

Plan	Description	Objectives	Strategies	Alignment with ECDMP
2020 Community Energy and Emissions Reduction Plan	The Community Energy and Emissions Reduction Plan (CEERP) is a community-focused plan presenting a strategy to achieve a clean, sustainable, and resilient energy future.	<ul style="list-style-type: none"> - Reduce community-wide energy end use by at least 50% by 2041 - Reduce community-wide emissions by at least 50% by 2041 - Establish a pathway to reduce emissions by 80% by 2050 	Energy efficiency programs, low carbon alternatives to reduce the GHG emissions from various sectors, and considering renewable energy when possible.	The CEERP presents strategies for the City of Brampton to reduce community emissions alongside the corporate emission strategies in the ECDMP to reduce its overall carbon footprint.
2020 Brampton Grow Green Environmental Master Plan	The Brampton Grow Green Environmental Master Plan has been the catalyst for many plans, policies, and projects to improve environmental performance. This includes, but is not limited to, the: <ul style="list-style-type: none"> - Transportation Master Plan - Natural Heritage and Environmental Management Strategy - Let Connect: Active Transportation Master Plan 	These plans will lay out the path for the City of Brampton to progress towards its GHG emission reduction targets.	Key actions in the plan: develop a Grow Green recognition program, to develop and implement a Sustainable Fleet Strategy, to complete a Network Electrification Feasibility Analysis for Brampton Transit, and to develop and implement a Climate Change Adaptation Plan. In the wake of this plan, two full network feasibility studies have been completed and used to complete the ZEB (zero emission bus) strategy to reduce GHG emissions due to public transit.	The plans developed through the Grow Green Master Plan have helped to guide the City of Brampton's progress and set up the framework to help the City to achieve its GHG reduction targets.
Brampton 2040 Vision	The Brampton 2040 Vision is meant to guide the development of the City of Brampton.	Visions to improve the City of Brampton <ul style="list-style-type: none"> - Sustainability and the Environment - Jobs and Living Centres - Neighbourhoods - Transportation and Connectivity - Social Matters and Housing - Health - Arts and Culture 	Within the Sustainability and the Environment vision, the City of Brampton has completed several actions to achieve that vision. First is the "Institute for Sustainable Brampton", where the City has founded a public-private facilitator for local environmental progress. In addition, Brampton has created "Brampton Eco-Park" by constituting the green park network into one designated municipal park and nature reserve. Finally, the "Brampton Trees Project" has planted one million trees in the public and semi-public realm of the City of Brampton to enhance its green canopy.	The strategies in this plan have improved the City of Brampton's sustainability and greenspace to help reduce its contributions to climate change.
Sustainable Fleet Strategy	The City of Brampton developed a Sustainable Fleet Strategy for its Corporate Fleet, Fire and Emergency Services Fleet, and non-revenue Transit Fleet.	Reduce fleet GHG emissions by 50% by 2040 and 80% by 2050, compared to 2016 levels.	Best management practices (such as light-weighting, driver eco-training, and route optimization), fuel switching (incorporating higher blends of ethanol and biodiesel into fuels), and a gradual transition to low-carbon options such as battery-electric vehicles.	The Sustainable Fleet Strategy proposes best practices for the City to reduce its transit-related GHG emissions, to help the City reduce the GHG emissions included in its corporate portfolio.
2023 Zero Emission Bus Strategy	In the wake of the 2020 Brampton Grow Green Environmental Master Plan, the City of Brampton worked with CUTRIC in 2023 to develop a Zero Emission Bus (ZEB) Strategy. All plans developed within the City of Brampton should align with this strategy, including this ECDMP.	Achieve net zero public transit by 2041.	This plan assessed the feasibility of various bus decarbonization strategies, and recommended a mixed green fleet solution, which entails a mix of battery electric buses and fuel cell electric buses. For fuel cell electric buses, the fleet can use grey hydrogen supplies in the immediate future, and shift towards the use of green hydrogen supplies by 2041. The implementation strategy from this plan would allow the City of Brampton to achieve net zero public transit by 2041.	As a larger portion of the fleet is electrified, there will be a need for more electric bus charging stations, which will increase the City's electrical consumption. As the City considers retrofits for its facilities, it should ensure that transit facilities have the necessary electrical capacity to support electric bus charging stations as well as any additional electric equipment being added as part of the retrofit.

2.3 Provincial and Federal

There have also been provincial and federal actions taken to decrease GHG emissions. The government of Ontario's GHG reduction goal is to achieve a 30% reduction in GHG emissions by 2030 (compared to 2005 levels)¹. The Canadian federal government has updated its targets to aim to achieve a 40-45% reduction in GHG emissions by 2030 (compared to 2005 levels), and net zero by 2050². Both of these reduction targets include GHG emissions from several sources, including residential, commercial, and transportation emissions.

In addition to O.Reg 25/23, Ontario has established some regulations towards its goal of reducing GHG emissions. For instance, in 2020, Ontario released the Cleaner Transportation Fuels regulation (O.Reg. 663/20), which requires that fuel suppliers blend renewable content into gasoline and diesel. Ontario has also amended the Oil, Gas, and Salt Resources Act to allow for the designation of carbon storage projects. In addition to this, Ontario has been working towards building retrofits and employee training to reduce the GHG emissions from their operations.

As Canada aims to meet its emissions goals, the Government of Canada has developed a 2030 Emissions Reduction Plan (ERP). The government has released the first of three progress reports on the ERP, under the Canadian Net-Zero Emissions Accountability Act. To date, the Canadian government has established various funding opportunities to encourage homeowners to improve the energy efficiency of their homes through retrofits and upgrades. In addition, the government has established regulations to reduce emissions from the oil and gas sector and has funded programs to meet the increasing demand for clean electricity. Going forwards, the government of Canada aims to develop a national net zero by 2050 buildings strategy, continue to support communities to upgrade their homes and buildings, and enhance support for the deployment of renewable energy technologies to support grid decarbonization.

¹<https://www.ontario.ca/laws/statute/18c13#BK4>

²<https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/net-zero-emissions-2050.html>

3 Brampton Corporate Emissions

3.1 Facilities

Buildings and assets

The building types considered under this Corporate Energy Conservation and Demand Management Plan are summarized in Table 5. Building types with (FOM) next to them are buildings which are managed by the Facilities, Operations and Maintenance division. Note that the scope of this plan includes corporate-owned buildings, and excludes buildings which are currently being leased out to another entity. Also note that the scope of this plan is operational GHG emissions, and does not account for embedded carbon. A more detailed breakdown of the buildings included in this plan is presented in Appendix A.

Table 5: Buildings summary

Building Sector	Number of Buildings
Corporate Facilities (FOM)	47
Fire Facilities	15
Library Facilities	4
Parks Facilities	29
Recreation Facilities	63
Transit Facilities	7
Works Operations Facilities (FOM)	11

The street lights asset belongs to the Works Operations division, and the EV chargers belong to FOM. The average operating hours for all facilities are 89 hours a week, or around 12.7 hours a day. All fire and some transit properties are in operation 24/7, every day of the year. Some Works Operations assets also operate 24/7.

In addition to buildings, this plan accounts for energy consumed by street lights and by city-owned electric vehicle (EV) chargers. Public lighting includes street lights and "other" lights, which includes additional public lighting sources such as park lights, parking lot lights, and traffic lights. EV chargers in this scope include electric bus chargers at transit stations as well as all public EV charging stations located at City of Brampton facilities. The scope of this plan does not include transportation emissions or community emissions.

Renewable energy

In addition to this, the City of Brampton generates renewable energy through solar PV systems, geothermal heating and cooling loads, and solar thermal energy. A detailed overview of the City's annual solar PV generation is presented in Section 3.2. It is estimated that the City's annual geothermal heating and cooling loads are roughly 11,120 kWh, and that the City's annual solar thermal energy production is roughly 27,000 ekWh.

An analysis of the portfolio utility use and GHG emissions is presented in the following sections.



3.2 Historical Data

3.2.1 Electricity historical utility use data

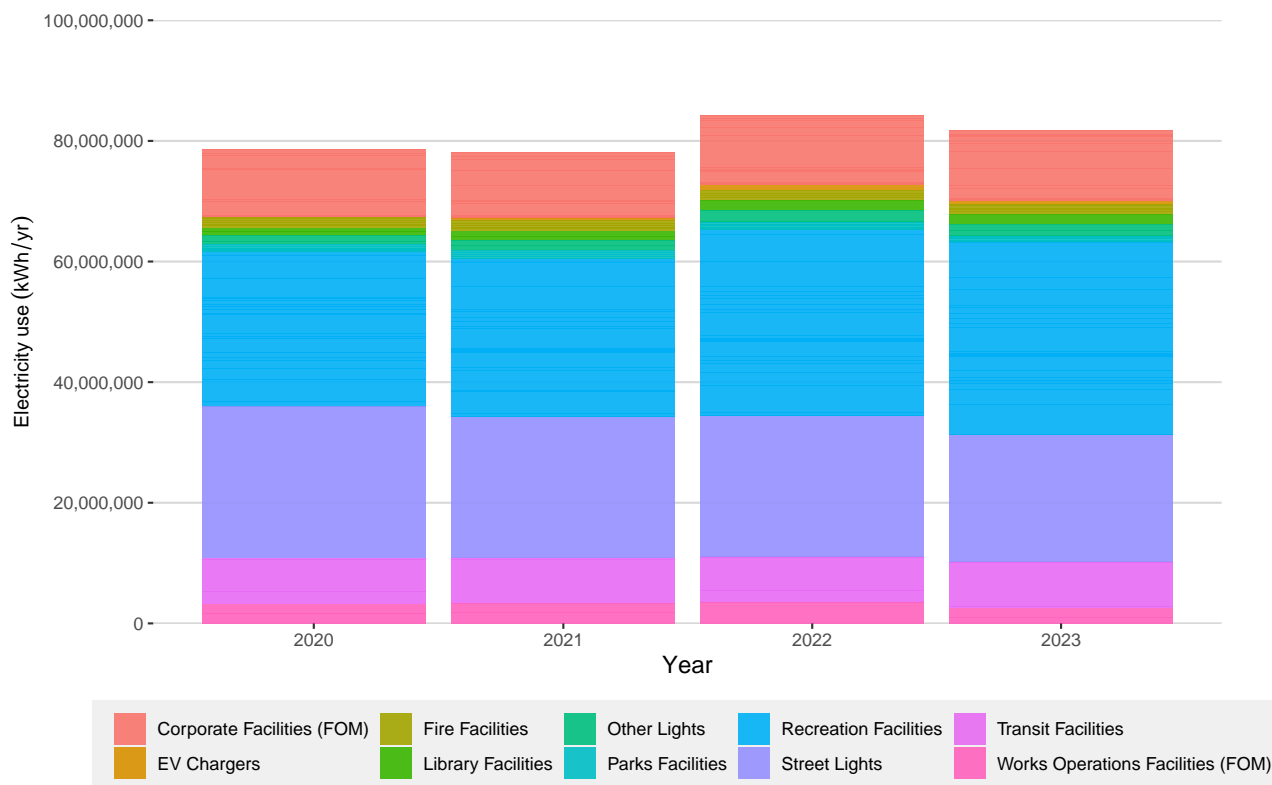


Figure 2: Electricity historical utility use data of all assets

Electricity.

- Electricity use has remained relatively constant from 2020 to 2023.
- The electricity consumption in 2020 and 2021 is lower than it is in 2022 and 2023, which is likely the result of reduced operation due to the COVID-19 pandemic.
- There is a decrease in electricity consumption from 2022 to 2023, which could be the result of implementing energy savings measures at City facilities.

3.2.2 Natural gas historical utility use data

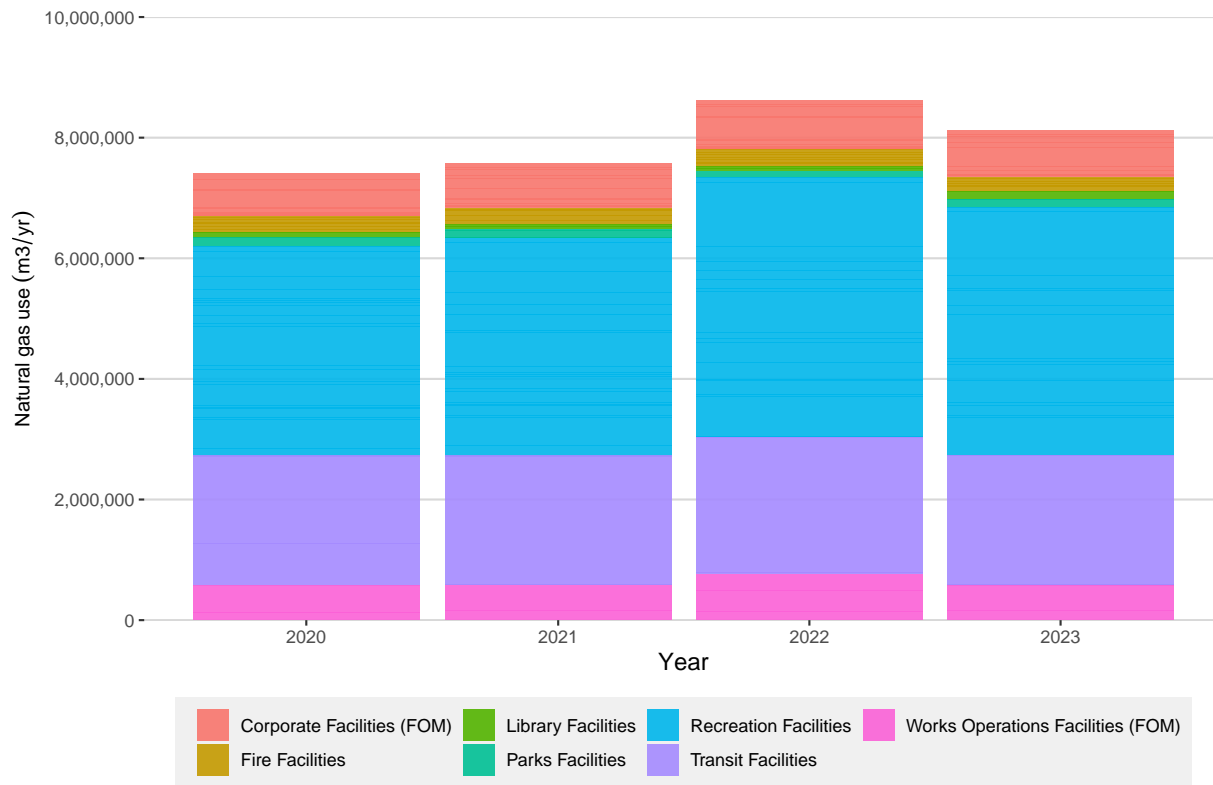


Figure 3: Natural gas historical utility use data of all assets

Natural gas.

- Natural gas consumption is fairly consistent from 2020 to 2023.
- The natural gas consumption in 2020 and 2021 is visibly lower than it is in 2022 and 2023, which is likely the result of reduced operation due to the COVID-19 pandemic.
- There is a decrease in natural gas use from 2022 to 2023, which could be the result of implementing energy savings measures at City facilities.

3.2.3 Solar PV generation data

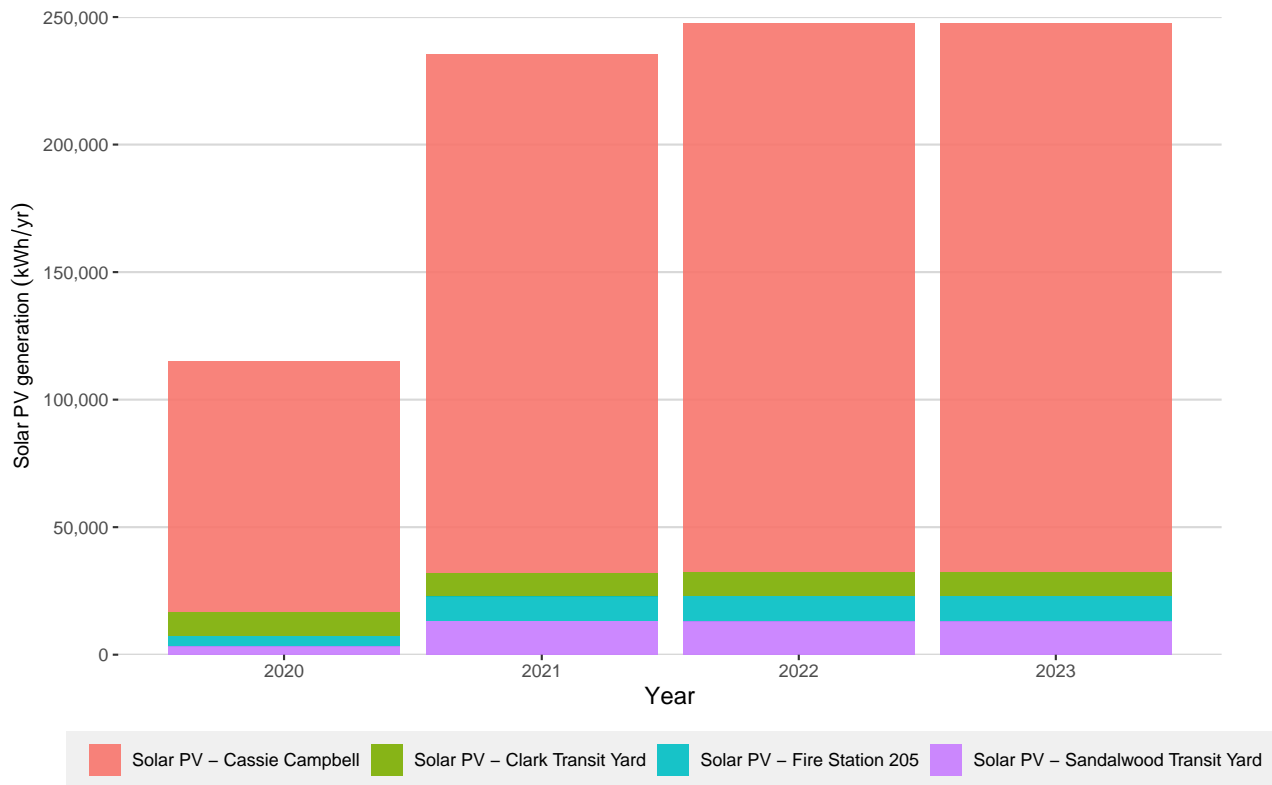


Figure 4: Solar PV generation data of all assets

Solar PV.

- Although the solar PV generation in 2021 is significantly higher than solar generation in 2020, solar generation stays relatively consistent from 2021 to 2023.
- Four facilities generate metered electricity from solar energy, but the solar PV array at the Cassie Campbell Community Centre is responsible for the vast majority of solar generation.
- In addition to these facilities, there is a solar PV system at Save Max Sports Centre which is currently a net-metering system, although no data on solar PV generation is available for this facility.

3.2.4 GHG emissions historical data

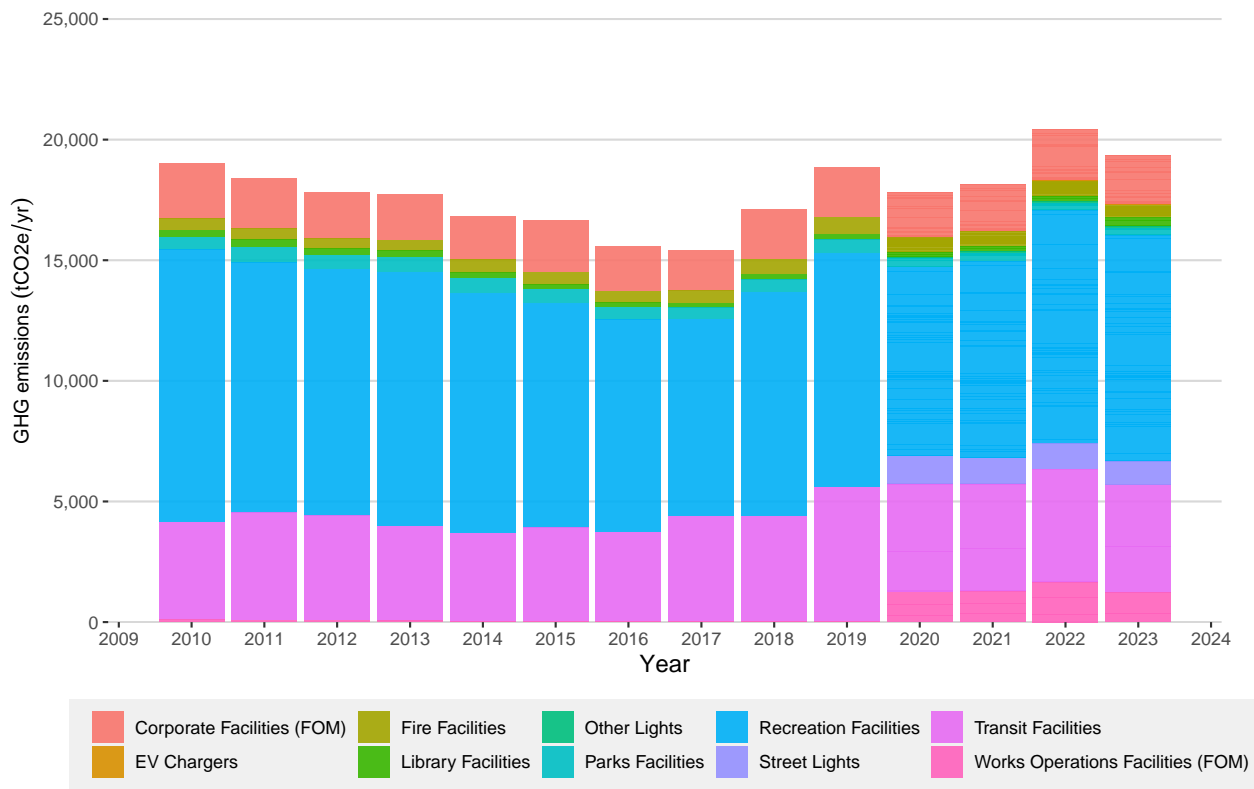


Figure 5: GHG emissions historical data of buildings

GHG emissions.

- Figure 5 shows a steady decrease in GHG emissions from 2010 to 2017.
- GHG emissions increased from 2018 to 2022, and decreased slightly in 2023.
- Most decreases in the City's GHG emissions are likely the result of implementing energy conservation measures such as lighting retrofits, BAS systems, and renewable technology.
- New buildings have come online over time, such as the A & M Fire Apparatus Building and the Springdale Library. This would increase the City's GHG emissions, as there are more buildings contributing to the City's energy use.
- The Ontario electricity grid emissions factor has varied with time, impacting the City's GHG emissions. The grid emissions factor gradually decreased from 2010 to 2017, and increased from 2018 to 2023. Because electricity accounts for a relatively low portion of the City's GHG emissions compared to natural gas, this impact is relatively small, and the majority of the City's decrease in GHG emissions from 2010 to 2017 is due to the implementation of measures to reduce GHG emissions.

3.2.5 GHG emissions by sector

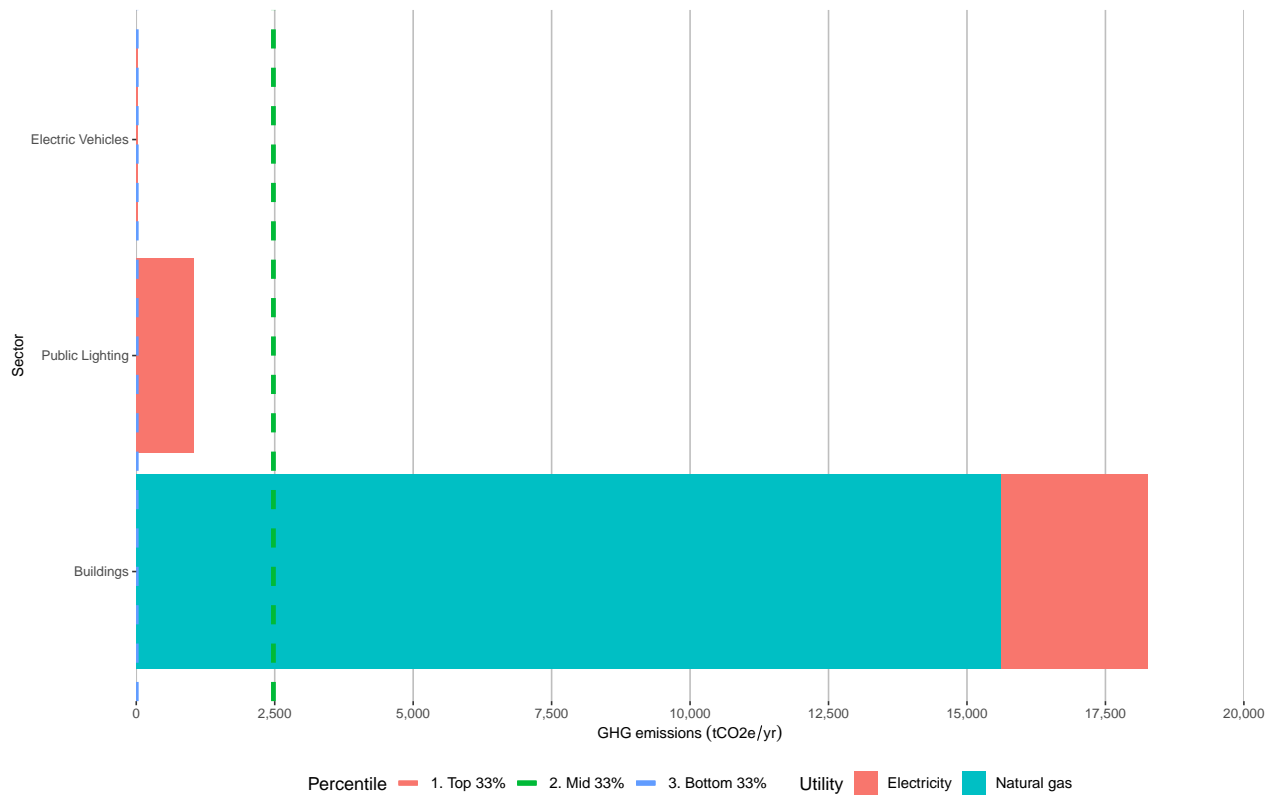


Figure 6: Current GHG emissions: Contributions by sector

Sectors.

- Buildings have the greatest contribution to GHG emissions. Comparatively, the GHG emissions due to public lighting and EV charging stations is minor.
- Because emissions from corporate buildings account for roughly 90% of the City's corporate GHG emissions, the GHG roadmap should prioritize reducing building GHG emissions.

3.2.6 GHG emissions by asset type

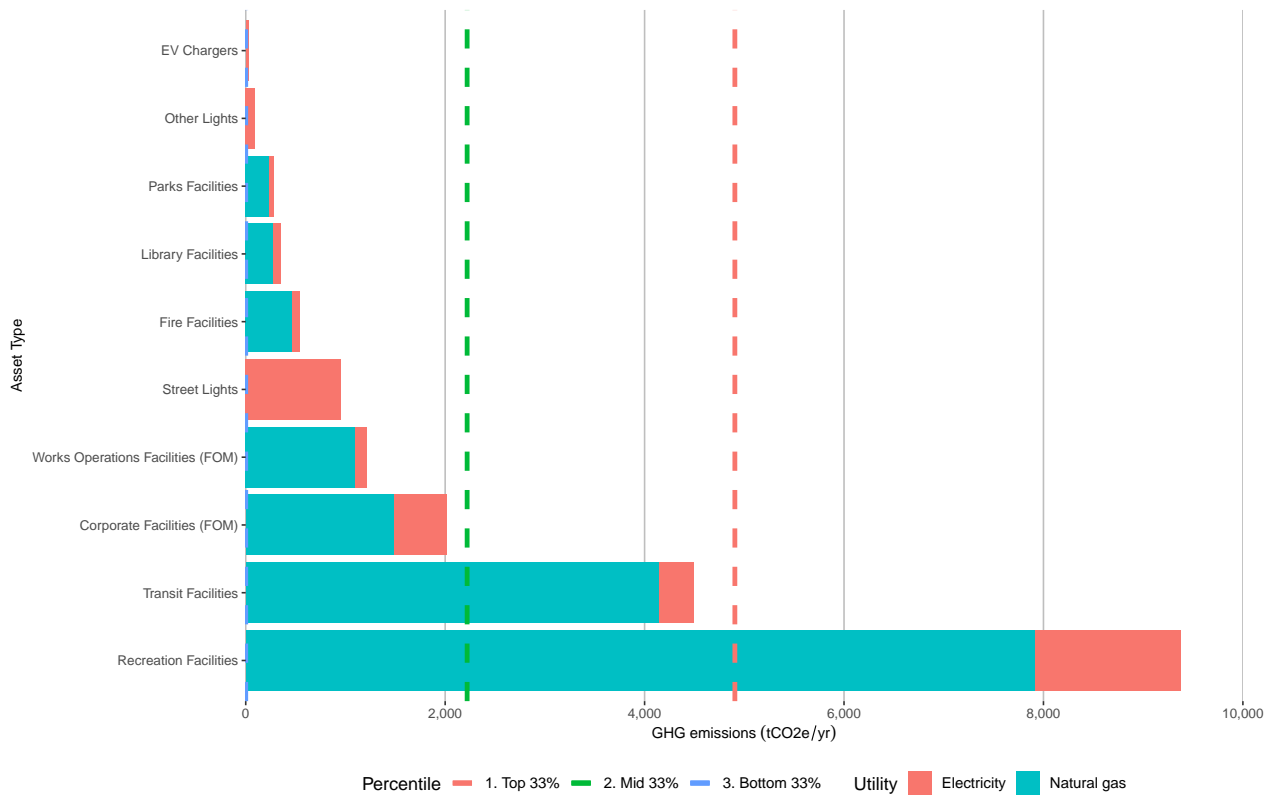


Figure 7: Current GHG emissions: Contributions by asset type

Types.

- Types refer to the various asset types within each sector. The type is used to break down the buildings sector based on the building's purpose.
- Recreation facilities (which have arenas and pools) have the greatest contributions to GHG emissions among the building types. Most of their GHG emissions are due to natural gas consumption.
- The arenas use significant quantities of natural gas due to ice resurfacing water heating, and greater domestic hot water loads (e.g. showers), in addition to space heating.
- The pools use significant quantities of natural gas due to pool water heating, and greater domestic hot water loads (e.g. showers), in addition to space heating.

3.2.7 GHG emissions by utility

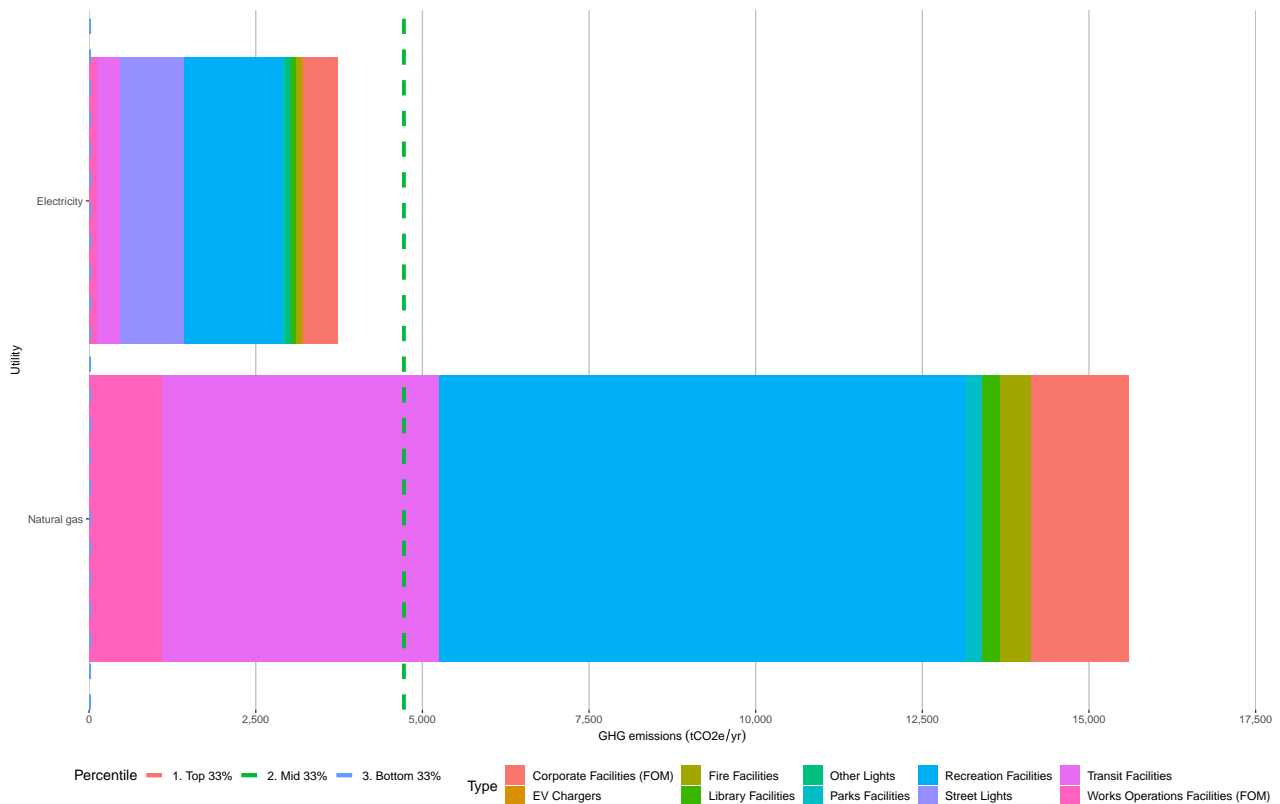


Figure 8: Current GHG emissions: Contributions by utility

Utilities.

- Natural gas use has the greatest contribution to GHG emissions. The natural gas use is divided among almost all of the individual buildings, with the largest contribution coming from indoor recreation facilities. As such, significantly reducing GHG emissions associated with natural gas use will necessarily involve retrofitting multiple buildings, focusing on recreation facilities.
- Electricity is the second greatest-contributing utility to GHG emissions in buildings. While electricity in Ontario has relatively low GHG-emissions intensity (due to hydro and nuclear plants producing most of the province's electricity), limiting electricity use would be beneficial for the GHG reduction roadmap. Possible strategies include building retrofits that reduce electricity use and solar PV electricity generation.

End uses.

- End uses are operational aspects which are primarily used to break down electricity and natural gas use within buildings to a greater level of granularity.
- The most significant end use contributions to corporate GHG emissions are space heat and DHW heat.
- Ambitious GHG emissions reduction targets (e.g. >50% reduction) will require significantly reducing natural gas use associated with space heat and DHW heat.

3.2.8 GHG emissions by asset

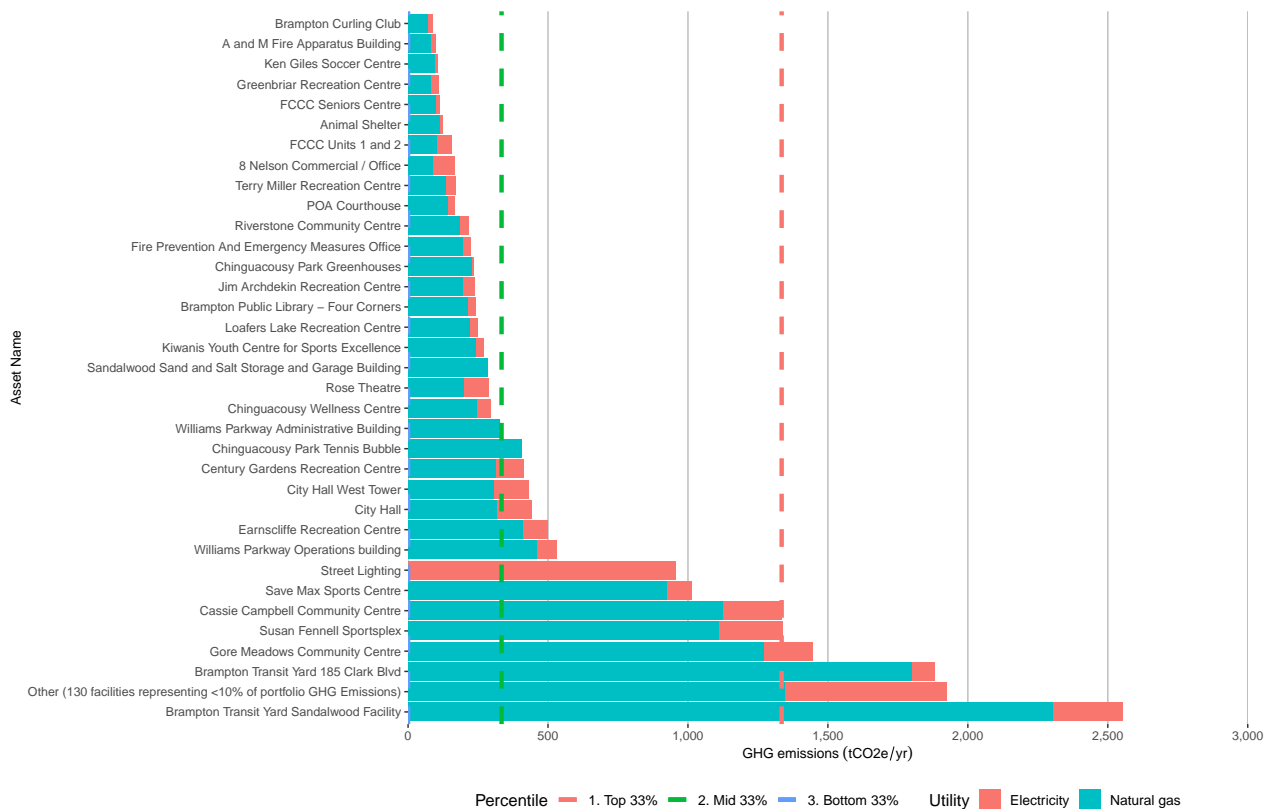


Figure 9: Current GHG emissions: Contributions by individual assets

Assets.

- **Contributions to corporate GHG emissions**

- Table 6 summarizes each asset's contribution to corporate GHG emissions. Note that this table only lists assets which contributed at least 0.5% of the GHG emissions in the City's portfolio.
- >33% of corporate GHG emissions are due to the 4 greatest-contributing assets.
- >67% of corporate GHG emissions are due to the 13 greatest-contributing assets.
- Ambitious GHG emissions reduction targets (e.g. >50% reduction) cannot likely be achieved without significantly reducing GHG emissions in the assets representing the top 33% and 67%. It would be recommended to focus efforts on retrofitting most, or all, of these facilities to reduce GHG emissions.
- **Energy use intensity**
 - Table 7 summarizes each building's energy use intensity.
 - Many of the buildings with the highest energy use intensity are not the buildings with the highest annual energy use, but exhibit a high energy use for a relatively small floor area.
 - It is recommended that buildings with high energy use intensity be investigated to determine the source of the high energy consumption (i.e. whether the meters for these buildings are tied to additional energy use consumption, or whether additional measures should be pursued to improve the efficiency of these facilities).

Table 6: Asset-specific contributions to corporate GHG emissions for top-emitting assets (>0.5% of corporate emissions) in 2023

Asset	Gross floor area	Priority	GHG emissions	GHG emissions	Cumulative GHG emissions
-	[ft ²]	-	[tCO ₂ e/yr]	[%]	[%]
Brampton Transit Yard Sandalwood Facility	443,269	1. High	2,553.6	13.2	13.2
Brampton Transit Yard 185 Clark Blvd	144,164	1. High	1,880.4	9.7	22.9
Gore Meadows Community Centre	137,527	1. High	1,444.7	7.5	30.4
Susan Fennell Sportsplex	173,546	1. High	1,338.2	6.9	37.3
Cassie Campbell Community Centre	242,238	2. Med	1,334.4	6.9	44.2
Save Max Sports Centre	153,044	2. Med	1,012.1	5.2	49.5
Street Lighting	NA	2. Med	955.5	4.9	54.4
Williams Parkway Operations building	82,452	2. Med	532.8	2.8	57.2
Earnscliffe Recreation Centre	91,637	2. Med	499.2	2.6	59.7
City Hall	196,316	2. Med	442.5	2.3	62.0
City Hall West Tower	188,924	2. Med	432.4	2.2	64.3
Century Gardens Recreation Centre	114,904	2. Med	412.8	2.1	66.4
Chinguacousy Park Tennis Bubble	42,228	2. Med	405.9	2.1	68.5
Williams Parkway Administrative Building	38,499	3. Low	327.4	1.7	70.2
Chinguacousy Wellness Centre	43,188	3. Low	294.1	1.5	71.7
Rose Theatre	65,324	3. Low	287.0	1.5	73.2
Sandalwood Sand and Salt Storage and Garage Building	41,506	3. Low	285.3	1.5	74.7
Kiwanis Youth Centre for Sports Excellence	43,961	3. Low	270.1	1.4	76.1
Loafers Lake Recreation Centre	34,340	3. Low	249.7	1.3	77.4
Brampton Public Library - Four Corners	38,939	3. Low	240.5	1.2	78.6
Jim Archdekin Recreation Centre	45,919	3. Low	236.1	1.2	79.8
Chinguacousy Park Greenhouses	12,886	3. Low	234.5	1.2	81.0
Fire Prevention And Emergency Measures Office	64,363	3. Low	225.5	1.2	82.2
Riverstone Community Centre	33,653	3. Low	217.4	1.1	83.3
POA Courthouse	46,012	3. Low	168.9	0.9	84.2
Terry Miller Recreation Centre	60,344	3. Low	168.6	0.9	85.1
8 Nelson Commercial / Office	82,774	3. Low	164.5	0.9	85.9
FCCC Units 1 and 2	32,514	3. Low	157.6	0.8	86.7
Animal Shelter	8,916	3. Low	124.7	0.6	87.4
FCCC Seniors Centre	27,499	3. Low	112.2	0.6	88.0
Greenbriar Recreation Centre	43,528	3. Low	109.2	0.6	88.5
Ken Giles Soccer Centre	28,907	3. Low	105.3	0.5	89.1
A and M Fire Apparatus Building	46,642	3. Low	98.2	0.5	89.6

Table 7: Building energy use intensity for the 50 buildings with the highest energy use intensity in 2023

Asset	Building type	Gross floor area [ft2]	Total energy use [kWh]	Energy use intensity [kWh/ft2]
-	-	-	-	-
Chinguacousy Park Mini Golf and Snack Bar	Recreation Facilities	2,796	574,000	205.3
Sandalwood Works Administration Building	Works Operations Facilities (FOM)	8,019	1,044,000	130.2
Mount Pleasant Clock Tower and W.R.	Corporate Facilities (FOM)	440	49,000	112.2
Chinguacousy Park Greenhouses	Parks Facilities	12,886	1,438,000	111.6
Animal Shelter	Corporate Facilities (FOM)	8,916	896,000	100.5
Brampton Trinity Common Terminal	Transit Facilities	919	80,000	87.1
Andrew Mccandless Park - Comfort Station And Skateboard Park	Parks Facilities	1,367	116,000	85.0
Brampton Transit Yard 185 Clark Blvd	Transit Facilities	144,164	11,682,000	81.0
Gore Meadows Community Centre	Recreation Facilities	137,527	10,814,000	78.6
Creditview Park Fieldhouse	Parks Facilities	4,444	319,000	71.8
Chinguacousy Park Outdoor Skating Rink Building	Recreation Facilities	3,218	224,000	69.7
Susan Fennell Sportsplex	Recreation Facilities	173,546	11,109,000	64.0
COB Parking lot (Former BCC Terminal)	Corporate Facilities (FOM)	1,368	82,000	59.7
Peel Village Maintenance	Recreation Facilities	1,646	96,000	58.5
Chinguacousy Wellness Centre	Recreation Facilities	43,188	2,451,000	56.7
FCCC Park Maintenance Warehouse	Corporate Facilities (FOM)	4,392	243,000	55.3
FCCC Units 1 and 2	Corporate Facilities (FOM)	32,514	1,787,000	55.0
Loafers Lake Recreation Centre	Recreation Facilities	34,340	1,878,000	54.7
Chinguacousy Park Tennis Bubble	Recreation Facilities	42,228	2,231,000	52.8
Riverstone Community Centre	Recreation Facilities	33,653	1,744,000	51.8
Williams Parkway Operations building	Works Operations Facilities (FOM)	82,452	4,155,000	50.4
Bramalea Transit Terminal (new)	Transit Facilities	9,359	448,000	47.9
FCCC Lawn Bowling	Recreation Facilities	6,415	302,000	47.0
Williams Parkway Administrative Building	Works Operations Facilities (FOM)	38,499	1,803,000	46.8
Rose Theatre	Recreation Facilities	65,324	3,046,000	46.6
Brampton Public Library - Four Corners	Library Facilities	38,939	1,797,000	46.2
Save Max Sports Centre	Recreation Facilities	153,044	7,037,000	46.0
Earnscliffe Recreation Centre	Recreation Facilities	91,637	4,191,000	45.7
Cassie Campbell Community Centre	Recreation Facilities	242,238	10,785,000	44.5
Kiwanis Youth Centre for Sports Excellence	Recreation Facilities	43,961	1,937,000	44.1
Norton Place Park Community Centre and Depot	Corporate Facilities (FOM)	12,001	523,000	43.6
County Court Pavillion	Parks Facilities	1,228	53,000	43.3
Jim Archdekin Recreation Centre	Recreation Facilities	45,919	1,955,000	42.6
Animal Services Administration Building (By-Law Enfo. Williams Parkway Administration)	Corporate Facilities (FOM)	6,379	272,000	42.6
Brampton Transit Yard Sandalwood Facility	Transit Facilities	443,269	18,151,000	40.9
Gateway Transit Terminal Building A	Transit Facilities	4,834	194,000	40.1
Valleybrook Field House	Parks Facilities	560	22,000	39.9
Fire Life Safety Centre	Recreation Facilities	10,415	401,000	38.5
Fire Station 206	Fire Facilities	6,448	245,000	38.0
Sandalwood Sand and Salt Storage and Garage Building	Works Operations Facilities (FOM)	41,506	1,568,000	37.8
Fire Station 204	Fire Facilities	10,161	379,000	37.3
Chinguacousy Park Curling Club	Recreation Facilities	35,900	1,229,000	34.2
Century Gardens Recreation Centre	Recreation Facilities	114,904	3,895,000	33.9
Ellen Mitchell Recreation Centre	Recreation Facilities	14,178	472,000	33.3
FCCC Dorm F-Sports Equipment Storage	Recreation Facilities	7,525	248,000	33.0
Teramoto Park Parks Depot	Parks Facilities	8,530	272,000	31.8
FCCC Seniors Centre	Recreation Facilities	27,499	871,000	31.7
Fire Station 207 Duggan Park Fieldhouse	Fire Facilities	9,398	296,000	31.5
Former Fire Station 201	Fire Facilities	12,488	393,000	31.4
Fire Station 208	Fire Facilities	6,345	195,000	30.8

3.2.9 GHG emissions Sankey diagram

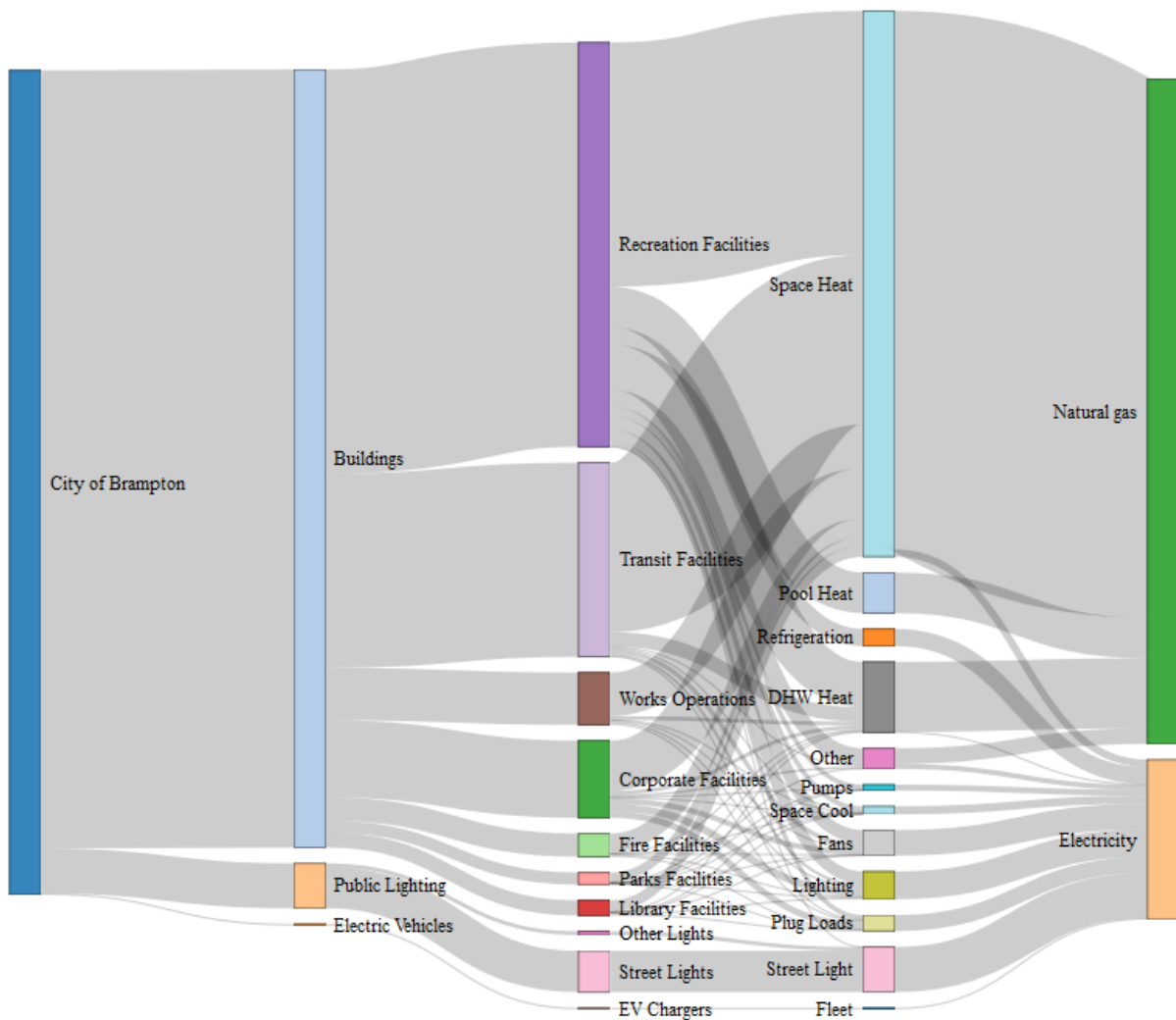


Figure 10: 2023 GHG emissions contributions by corporation, sector, type, end use, and utility (in the same order from left to right)

The Sankey diagram provides a visual representation of the relative GHG emission contributions from each of the City's sectors, asset types, end uses, and utilities. The bar corresponding to each item in a category (i.e. Natural gas compared to Electricity) shows the proportion of GHG emission contributions resulting from each item. In addition, the transition from one category to the next shows the breakdown of GHG emissions from the category on the left (i.e. the thick line between Recreation Facilities and Space Heat indicates that a large portion of the GHG emissions from the Recreation facilities is the result of energy used to provide space heating).

3.3 Change from baseline year

The change between the baseline and the most recent utility use and GHG emissions data is presented in Table 8. The current utility use is taken as the utility use in 2023, as this is the most recent year with complete utility use data available. 2010 is used as the baseline year. Note that a negative ("-") reduction in GHG emissions indicates that the GHG emissions increased over that time frame.

In addition, the current "equivalent" emissions are presented in Table 8. The equivalent emissions represent the GHG emissions from the buildings and assets which contributed to the baseline GHG emissions. The equivalent emissions exclude the GHG emissions from buildings which were constructed after 2010, and exclude assets (such as street lights and EV chargers) which were not accounted for in the baseline GHG emissions. These assets are excluded because by adding additional assets in the GHG emissions comparison, these additional assets cause the current GHG emissions to appear high when compared to the baseline GHG emissions, despite the efforts made by the City of Brampton to decrease their GHG emissions. There are 152 facilities included in the City of Brampton's portfolio in 2010, and 195 facilities included in the City's portfolio today. The purpose of calculating equivalent emissions is to better understand the impact of the energy conservation measures undertaken since the baseline year.

Table 8: GHG emissions comparison from baseline year

Sector	Baseline (2010)	GHG emissions	GHG emissions	Current (2023)		Current equivalent emissions		
	GHG emissions			GHG reduction	Percent reduction	GHG emissions	GHG reduction	Percent reduction
-	[tCO2e/yr]	[tCO2e/yr]	[tCO2e/yr]	[tCO2e/yr]	[%]	[tCO2e/yr]	[tCO2e/yr]	[%]
Recreation Facilities	11,296	9,375	1,921	17.0		7,416	3,880	34.3
Transit Facilities	4,061	4,499	-437	-10.8		4,490	-429	-10.6
Corporate Facilities (FOM)	2,283	2,013	270	11.8		1,507	777	34.0
Parks Facilities	500	277	222	44.5		259	240	48.1
Fire Facilities	482	538	-56	-11.6		352	129	26.9
Library Facilities	278	351	-72	-26.0		309	-31	-11.1
Works Operations Facilities (FOM)	107	1,212	-1,105	-1,036.4		0	107	100.0
EV Chargers	0	29	-29	-		0	0	-
Public Lighting	0	1,042	-1,042	-		0	0	-
Overall	19,007	19,336	-329	-1.7		14,333	4,674	24.6

Change from baseline year.

- In Table 8, the overall GHG emissions appear to have increased 1.7% from 2010 to 2023.
- The "Current equivalent emissions" section considers the change in GHG emissions without accounting for the City's newer assets, to highlight the energy savings from the measures the City has implemented. In this comparison, the City's equivalent GHG emissions are 24.6% lower than the 2010 baseline, even with a higher GHG emissions factor for electricity than the factor in the baseline year, which highlights the impact of the measures the City has undertaken to reduce GHG emissions.
- The difference in the apparent and equivalent GHG emissions emphasizes the challenge to reduce GHG emissions while the City grows.

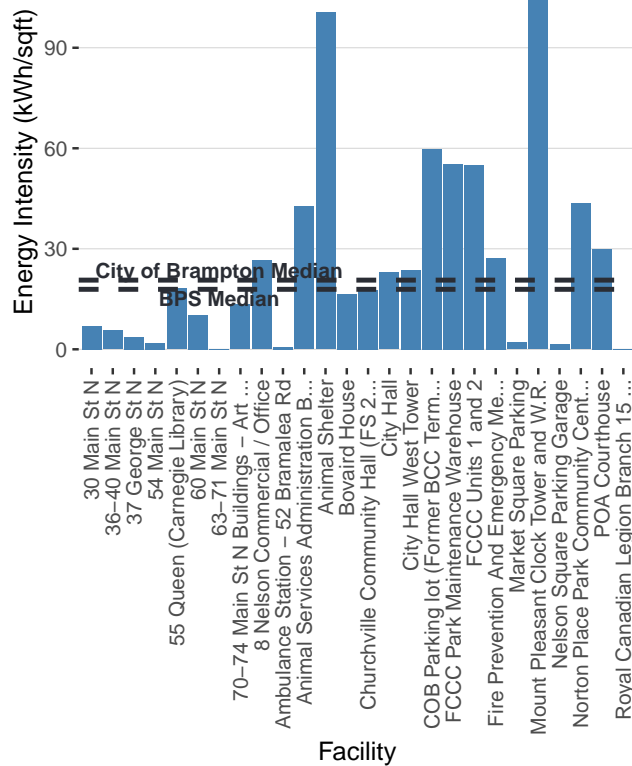
3.4 Benchmarking

The City's facilities were benchmarked against broader public sector (BPS) municipality buildings to compare their energy performance, as another means of evaluating the City's facility energy use. The BPS median energy intensity was used instead of the mean to reduce the data skew from outliers in BPS data. The energy intensity for each building is plotted against the BPS median in Figures 11 and 12 below.

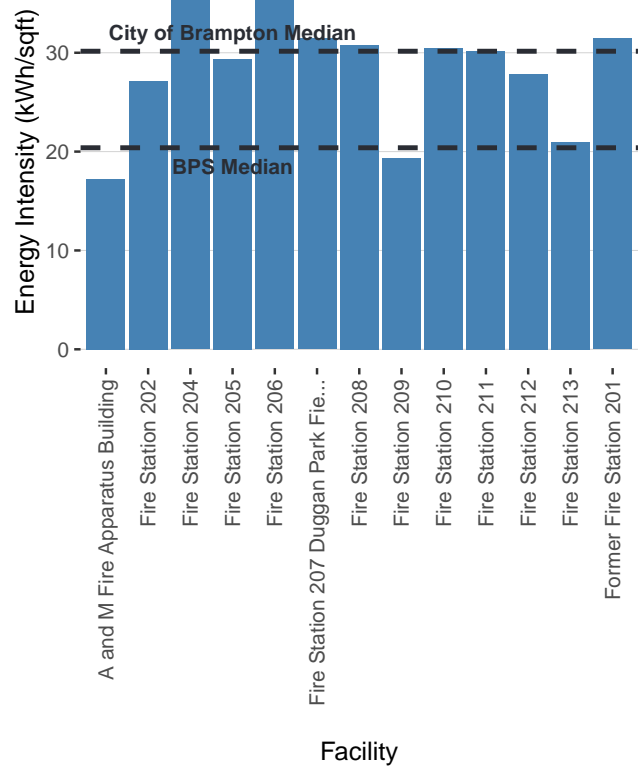
These figures demonstrate that most of the City's facility types did not perform well when compared to BPS facilities. Among the City of Brampton's facility types, most of the Corporate, Recreation, and Parks buildings performed well compared to BPS facilities, although a few outliers increased the City's median energy intensity.



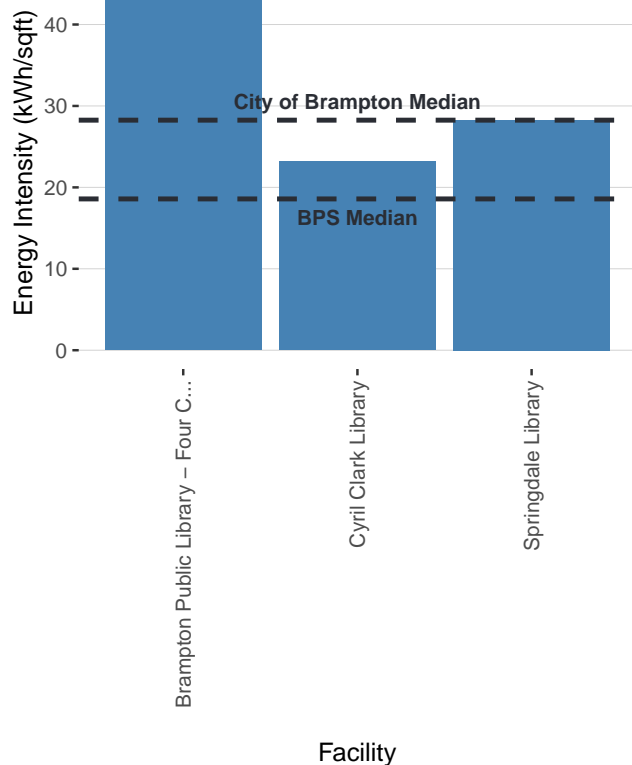
Corporate Facilities (FOM)



Fire Facilities



Library Facilities



Parks Facilities

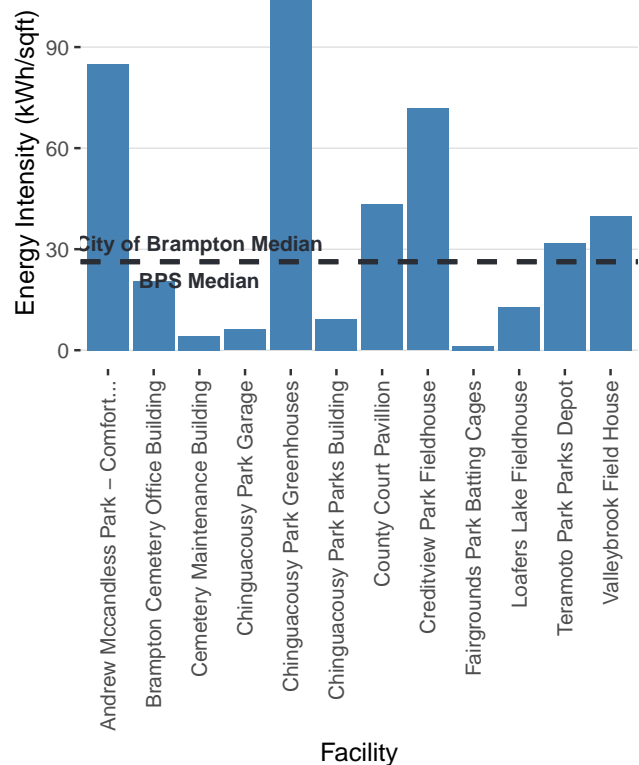
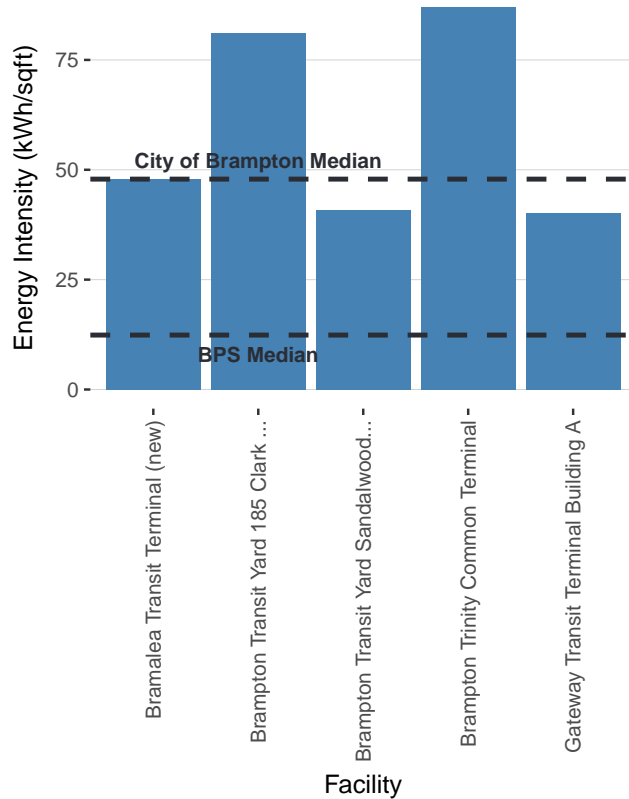
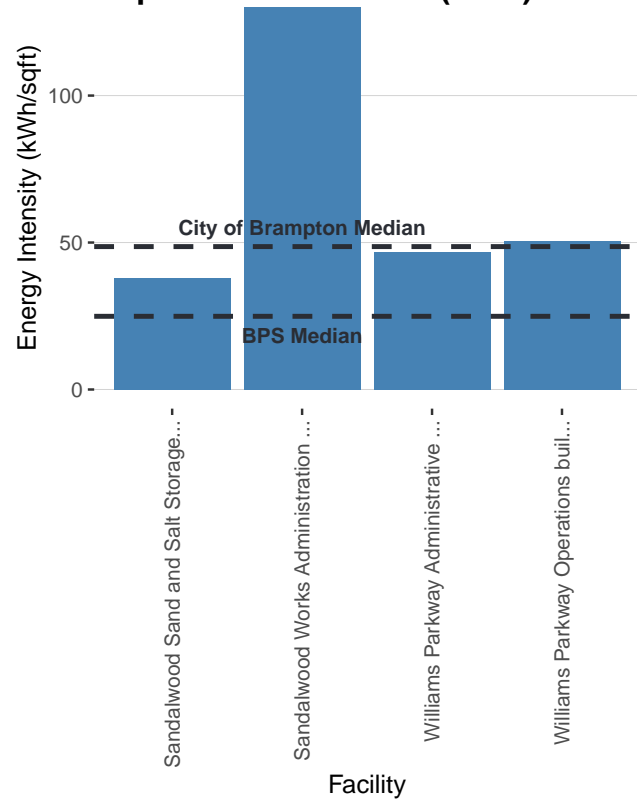


Figure 11: City of Brampton benchmarking against BPS facilities (1)

Transit Facilities



Works Operations Facilities (FOM)



Recreation Facilities

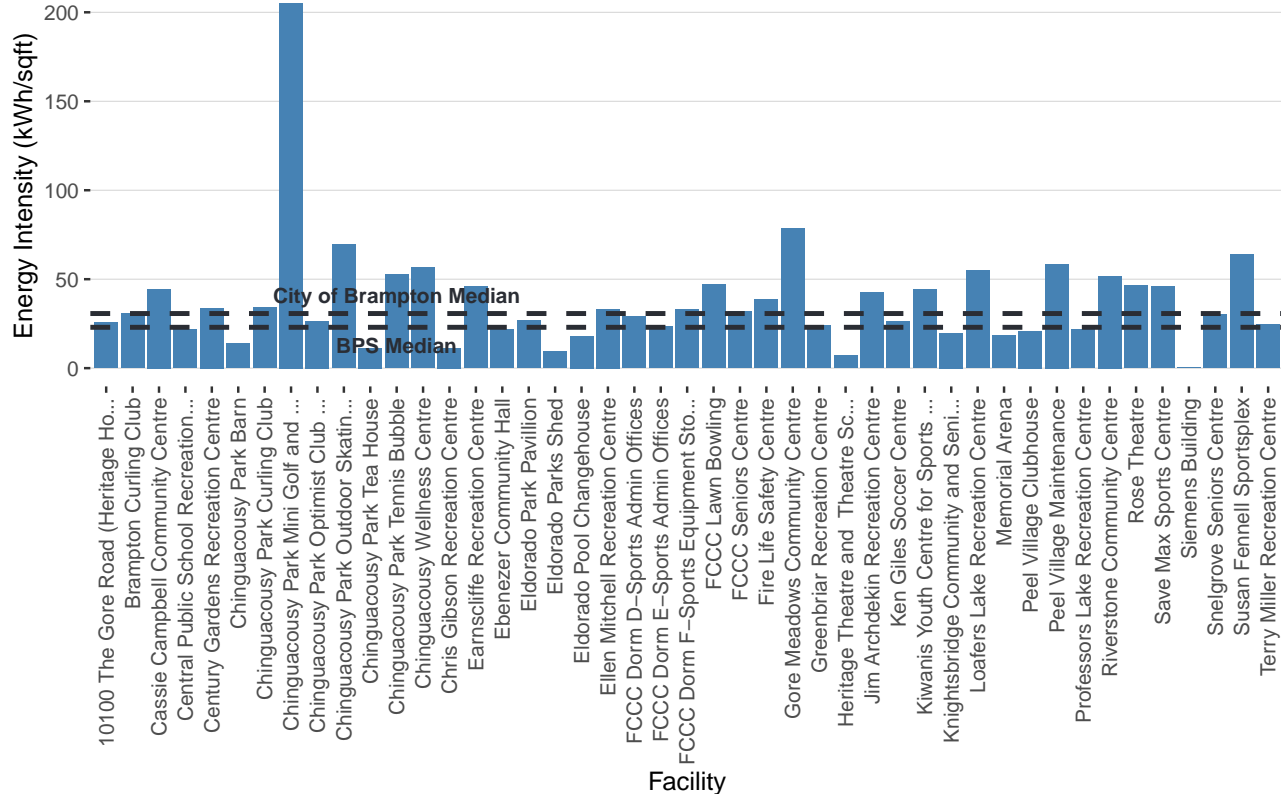


Figure 12: City of Brampton benchmarking against BPS facilities (2)

4 2024-2029 Plan (40-45% Reduction by 2030)

4.1 Methodology

The implementation plans for the short, medium, and long term were developed and analyzed according to the following methodology.

1. **Recommended measures.** Each asset considered under this Corporate Energy Conservation and Demand Management Plan was reviewed and measures that could be implemented for each specific asset were identified. Best practices from existing municipalities were identified in Appendix C and used to guide measure recommendations. Where possible, measures were identified using the deep retrofit studies undertaken for certain assets. For assets where those studies were not available, general measures were recommended based on building operation and the priorities identified in Section 3. The savings and costs associated with these measures were estimated based on detailed measures modelled for buildings of similar sizes and functions. Note that these measure recommendations are high-level and may not reflect actual building conditions; a detailed feasibility study would be recommended before pursuing any measures.
2. **Plan identification.** In this plan, two main scenarios are considered: the Business as Planned scenario, and the Net Zero GHG Emission Reduction Roadmap. The Business as Planned scenario is presented as a benchmarking tool to observe the change in utilities and GHG emissions if no energy conservation measures (ECMs) are undertaken. The Net Zero GHG Emission Reduction Roadmap is the recommended plan to meet the City's GHG emission goals by implementing various ECMs, and is broken down into short term (2024-2029; Section 4), and medium and long term (2030-2035 and 2035-2050; Section 5) plans.
3. **Plan development.** In the development of the Net Zero GHG Emission Reduction Roadmap, the recommended measures are implemented in various years to reduce the City's GHG emissions. The year of implementation was obtained from deep retrofit plans or State of Good Repair documentation where possible, and otherwise chosen based on the age of the building and complexity of the measure (i.e. low capital cost measures such as controls measures and lighting retrofits were recommended to be undertaken over a shorter time frame than high capital cost measures such as HVAC retrofits). In addition, carbon offsets are recommended to be purchased when needed to meet the City of Brampton's climate change targets.
4. **Model.** To review the annual utility usage and impact of each measure, a streamlined modelling process was used, following WalterFedy's Rquest approach. This approach was used to simulate individual measure impacts, as well as the planned scenario outcome, and accounts for interactive effects between measures. WalterFedy uses the Rquest approach for several types of studies, and has used this approach to project future utility use for asset portfolios as part of the development of multiple ECDMPs.
5. **Scenario utility analysis.** A utility analysis was completed for each scenario, in which the yearly utility use for each asset was projected from 2023 to 2050 (i.e. the evaluation period) for all utilities (i.e. electricity and natural gas), based on the measure implementation plan specific to each scenario. Also, yearly GHG emissions and utility costs were projected from 2023 to 2050 based on the yearly utility use projections for each scenario by applying the assumed GHG factors and utility cost rates indicated below.
 - **GHG emissions factors for electricity.** The GHG emissions factor associated with Ontario's electricity grid was assumed to change over time. The projected emissions factor was taken from the IESO 2022 Planning Outlook for the short term projections (until 2029), and from the Low Carbon Economy Fund (LCEF) numbers (obtained from ECCC's 2022 *Reference Case GHG Emissions*) for the 2030-2050 projections. Figure 13 presents the electricity grid GHG emissions factors assumed over the evaluation period.

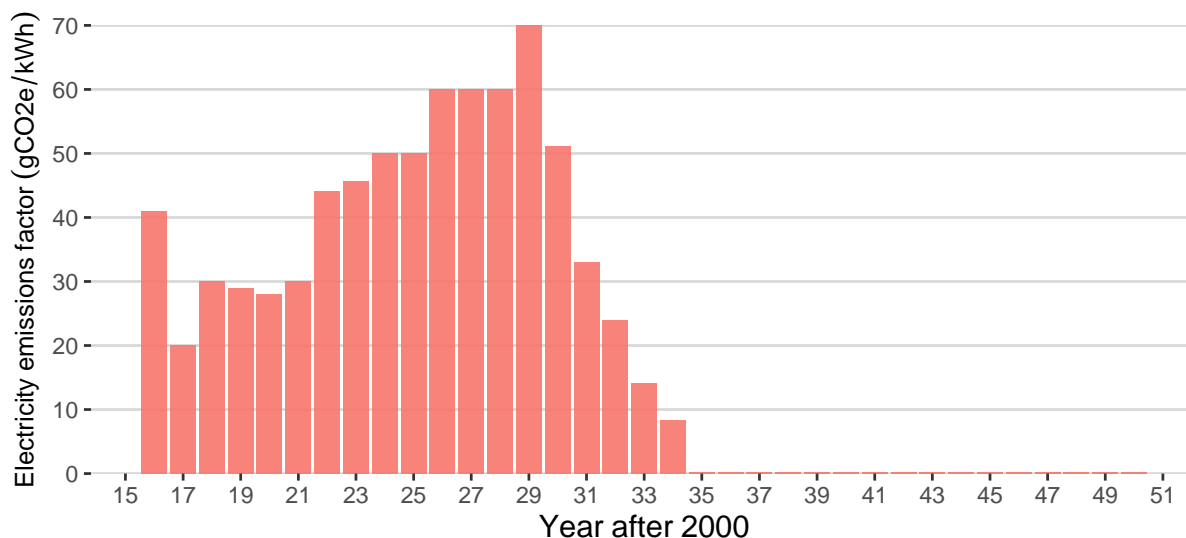


Figure 13: Electricity GHG emissions factor assumptions (from IESO's 2022 Planning Outlook (short term) and ECCC's 2022 Reference Case GHG Emissions (long term))

- **GHG emissions factors for other utilities.** All other GHG emissions factors assumptions were as per Table 9, based on the emission factor in 2023.

Table 9: GHG emissions factor assumptions

Utility	Unit	Value
Electricity	[gCO ₂ e/kWh]	46
Natural gas	[gCO ₂ e/m ³]	1921

- **Utility cost rates for federal carbon charge.** The federal carbon charge was assumed to change over time, based on existing legislation. In this analysis, the federal carbon charge is applied to all GHG emissions associated with scope 1 GHG emissions (GHG emissions due to direct fuel combustion). Figure 14 presents the federal carbon charge rates assumed over the evaluation period.

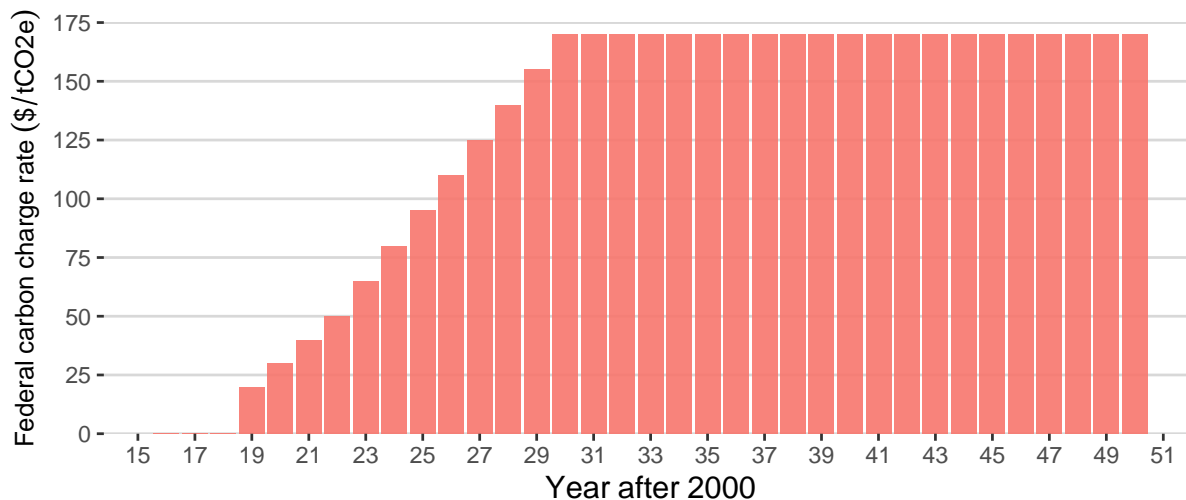


Figure 14: Federal carbon charge projection (Source: Government of Canada (up to 2030); Assumed (After 2030))

- **Utility cost rates for other utilities.** All other utility cost rate assumptions in 2023 were as per Table 10, assuming a general inflation rate of 2.2%.

Table 10: Utility cost rate assumptions

Utility	Unit	Value
GHG emissions	[\$/tCO ₂ e]	50
Electricity	[\$/kWh]	0.14
Natural gas	[\$/m ³]	0.26
Carbon offsets	[\$/tCO ₂ e]	24

6. **Additional recommendations.** In addition to the quantifiable measures presented in Sections 4.2 and 5.1, additional recommendations are listed. These recommendations are anticipated to have unquantifiable or indirect utility use savings, but are anticipated to help the City of Brampton to achieve their climate change targets.

4.2 Recommended Measures and Implementation Plans

A five year summarized project plan to reduce GHG emissions is outlined in Table 16. A detailed breakdown of this plan, including estimated project costs, is presented in Appendix B.1.

Table 11: Short term ECMs to implement (2024-2029)

Year	Facility	Measure	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)
2024	Susan Fennell Sportsplex	AHU replacement	617	-1,000,790	367,701	425
	Susan Fennell Sportsplex	Arena lighting controls	18	197,276	0	28,226
	Multiple Facilities	Arena nighttime setback implementation	12	135,146	0	19,337
	Susan Fennell Sportsplex	Basic lighting controls	10	115,270	0	16,493
	Multiple Facilities	Control sequence optimization (HVAC schedules)	20	16,779	9,517	6,118
	Multiple Facilities	Control sequence optimization (temperature and humidity)	36	3,771	18,546	7,784
	Siemens Building	Decommission	1	11,912	0	1,704
	Terry Miller Recreation Centre	Dehumidifier retrofit	3	-24,350	2,883	-2,358
	Chinguacousy Wellness Centre	Demand control ventilation through RTUs	21	16,752	9,954	6,285
	Cassie Campbell Community Centre	Exterior LED lighting upgrade	7	73,751	0	10,552
	Susan Fennell Sportsplex	Exterior lighting retrofit to LED	22	247,008	0	35,342
	Terry Miller Recreation Centre	Exterior wall insulation upgrade	3	0	1,442	563
	Multiple Facilities	Floating head pressure controls implementation	14	150,794	0	21,576
	Susan Fennell Sportsplex	Ground source heat loop	437	-225,231	237,958	60,717
	Susan Fennell Sportsplex	Ice resurfacer replacement	5	-14,269	3,036	-856
	Terry Miller Recreation Centre	Ice thickness optimization	0	0	262	102
	Multiple Facilities	Interior lighting retrofit to LED	5	147,729	-4,116	19,530
	Multiple Facilities	Laser ice levelling implementation	5	30,749	1,173	4,857
	Century Gardens Recreation Centre	Lighting controls	0	11,767	-328	1,556
	Century Gardens Recreation Centre	Lighting fixture upgrade	6	163,063	-4,543	21,557
	Chinguacousy Wellness Centre	Lighting occupancy and daylight sensors	4	39,514	0	5,654
	Susan Fennell Sportsplex	Low flow water fixtures	23	0	12,086	4,720
	Chinguacousy Wellness Centre	Make up water optimization	4	-2	1,919	749
	Chinguacousy Wellness Centre	Optimize pool air space temperature and humidity	12	21,082	5,481	5,157
	Chinguacousy Wellness Centre	Optimize ventilation rate through dehumidifier unit	1	9,413	0	1,347
	Multiple Facilities	Pool heat recovery and MUW controls	97	0	50,736	19,817
	Chinguacousy Wellness Centre	Pool pumping system optimization	5	53,128	0	7,602
	Susan Fennell Sportsplex	Radiant heating conversion	25	-88,514	17,165	-5,960
	Terry Miller Recreation Centre	REALice	13	0	6,814	2,662
	Terry Miller Recreation Centre	Reduce flood water use	4	0	1,835	717
	Terry Miller Recreation Centre	Refrigeration plant heat recovery	102	412,724	34,067	72,358
	Terry Miller Recreation Centre	Replace ventilation and AC units	1	6,923	0	991
	Century Gardens Recreation Centre	Roof assembly upgrade	15	1,138	7,522	3,101
	Terry Miller Recreation Centre	Rooftop Solar PV	30	331,391	0	47,415
	Chinguacousy Wellness Centre	RTU optimization	28	17,074	13,818	7,840
	Chinguacousy Wellness Centre	Solar PV	21	234,593	0	33,566
	Balmoral Recreation Centre	Undergoing construction	0	0	0	0
	Terry Miller Recreation Centre	Window upgrade	2	0	1,017	397
2025	Terry Miller Recreation Centre	Boiler plant replacement with electric boiler	14	-30,105	8,912	-827
	Susan Fennell Sportsplex	Chiller replacement - CO ₂	0	1,386	0	198
	Susan Fennell Sportsplex	Heat pump replacement	7	78,852	0	11,282
	Susan Fennell Sportsplex	Ice rink flooding	56	-103,378	33,904	-1,549

Table 11: Short term ECMs to implement (2024-2029) (continued)

Year	Facility	Measure	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)
	Multiple Facilities	Lighting upgrade	3	56,576	-1,072	7,677
	City Hall West Tower	Plug load reduction	9	101,593	0	14,536
	Earnscliffe Recreation Centre	Radiant heater upgrade	1	-5,341	632	-517
	City Hall West Tower	Re-commissioning measures	25	0	12,866	5,025
	Susan Fennell Sportsplex	Solar PV	47	523,848	0	74,952
	Century Gardens Recreation Centre	Solar PV rooftop	105	1,172,964	0	167,828
	Susan Fennell Sportsplex	Solar thermal pool heat	12	0	6,155	2,404
	Terry Miller Recreation Centre	Spectator heating to electric	12	0	6,290	2,457
	Terry Miller Recreation Centre	Ventilation operation	16	0	8,387	3,276
2026	City Hall West Tower	Enhanced occupant-based controls	12	0	6,433	2,513
	Earnscliffe Recreation Centre	HVAC equipment upgrade (dehumidification - arena)	3	33,257	0	4,758
	Cassie Campbell Community Centre	HVAC re-commissioning	83	78,360	39,776	26,747
	Save Max Sports Centre	HVAC recommissioning	52	80,773	23,517	20,742
	Multiple Facilities	HVAC system optimization	51	120,903	21,113	25,545
	City Hall West Tower	Lighting - full fixture replacement	14	377,383	-10,514	49,889
	Multiple Facilities	Lighting upgrade	11	305,325	-8,502	40,365
	Save Max Sports Centre	Roof upgrade to high performance	73	19,701	36,955	17,253
	Century Gardens Recreation Centre	Wall assembly upgrade	16	14,936	7,402	5,028
2027	Cassie Campbell Community Centre	Cold water flooding	38	0	19,742	7,711
	Cassie Campbell Community Centre	DHW conversion	46	-333,476	39,486	-32,291
	Earnscliffe Recreation Centre	DHW equipment upgrade (ground source heat pump)	3	-4,128	1,711	78
	City Hall West Tower	Electric humidification	31	-223,296	26,440	-21,622
	Cassie Campbell Community Centre	Electrical service upgrade	0	0	0	0
	City Hall West Tower	Heat pump DHW heaters	6	-11,909	3,525	-327
	Earnscliffe Recreation Centre	HVAC equipment upgrade (dehumidification - pool)	62	-34	32,044	12,511
	Earnscliffe Recreation Centre	HVAC equipment upgrade (ground source heat pump)	240	-339,550	140,719	6,380
	Multiple Facilities	HVAC system optimization	26	15,784	12,939	7,312
	Cassie Campbell Community Centre	Ice resurfacer conversion	1	-7,411	878	-718
	Earnscliffe Recreation Centre	Lighting controls	0	8,316	-232	1,099
	Multiple Facilities	Lighting upgrade	8	218,988	-6,044	28,973
	Multiple Facilities	Low-flow shower fixtures	52	0	27,338	10,677
	Earnscliffe Recreation Centre	Plumbing fixture upgrade	2	0	1,076	420
	Earnscliffe Recreation Centre	Roof assembly upgrade	8	0	4,272	1,669
	Cassie Campbell Community Centre	Roof upgrade to high performance	20	0	10,529	4,112
	Earnscliffe Recreation Centre	Solar PV rooftop	45	505,627	0	72,345
	Earnscliffe Recreation Centre	Wall assembly upgrade	6	0	3,289	1,285
	Earnscliffe Recreation Centre	Window assembly upgrade	1	0	370	145
2028	Save Max Sports Centre	Cafe fryer electrification	11	-77,018	9,120	-7,458
	City Hall West Tower	Central ground-source heat pumps	176	-248,390	102,940	4,667
	Multiple Facilities	Cold water flooding	14	0	7,389	2,886
	City Hall West Tower	DOAS and air-source VRF	42	-86,936	25,735	-2,387
	Save Max Sports Centre	Energy Star appliances	1	9,850	0	1,409
	City Hall West Tower	Heat recovery chiller with electric boiler	25	0	12,866	5,025
	Century Gardens Recreation Centre	HVAC equipment upgrade (dehumidification - arena)	3	37,588	0	5,378
	Multiple Facilities	HVAC system optimization	74	57,554	35,845	22,236
	Multiple Facilities	Lighting upgrade	23	541,343	-13,084	72,343
2029	Multiple Facilities	Cold water flooding	11	0	5,622	2,196
	Save Max Sports Centre	Electrical service upgrade	0	0	0	0
	Multiple Facilities	HVAC system optimization	270	304,116	126,328	92,854
	Multiple Facilities	Ice resurfacer conversion	0	-1,369	162	-133
	Multiple Facilities	Lighting upgrade	30	750,083	-19,448	99,727
	Multiple Facilities	Purchasing carbon offsets	7,905	0	0	-193,882

Table 11: Short term ECMs to implement (2024-2029) (continued)

Year	Facility	Measure	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)
Short Term	Total	(Accounts for interactive effects and changes in the electricity grid emissions factor)	7,169	5,037,246	629,594	836,897

Descriptions of key measures are listed below.

Electrification measures

Replace gas-fired equipment with electric equipment. Electric equipment is often more efficient than gas-fired equipment, depending on the scenario. In addition, electricity from the Ontario grid has a lower GHG impact than natural gas, and switching from gas-fired to electric equipment will often significantly decrease the GHG emissions from that equipment.

Heat pump measures

General measure to represent replacing the heating system (DHW, boiler, HVAC, etc.) with heat pumps. In these measures, air-source heat pumps are considered unless stated otherwise, but each building can be surveyed to check whether a geothermal heat pump would be a suitable alternative. As with the general electrification measures, if the original equipment is gas-fired, the switch to electric equipment can reduce GHG emissions. Additionally, heat pumps are a high efficiency alternative to most existing heating systems, as air-source heat pumps typically have an average COP of around 2.5 (corresponding to 250% efficiency), and geothermal heat pumps often have an average COP above 3.5.

HVAC system optimization

General measure to represent various HVAC upgrades to reduce the heating load. This measure represents a budget to be put aside to optimize the HVAC system, and could include recommissioning measures or HVAC controls upgrades. The most effective controls upgrades will vary depending on the facility, but could include items such as setpoint temperature setbacks, BAS systems, HVAC system scheduling, and demand control ventilation.

Lighting upgrade

General measure to represent upgrading building lighting to reduce the energy consumed by light fixtures. This could include lighting retrofits to LED or upgrading the lighting controls in a building. Depending on which lighting controls are feasible in a facility, this could include daylighting, occupancy sensors, or other opportunities to save on lighting energy.

Solar PV

Implement solar PV arrays to generate renewable energy, to reduce GHG emissions by reducing electricity consumption. Note that solar PV systems were sized based on the gross floor area and may not be suitable in all locations; a feasibility study is recommended to determine whether solar PV would be suitable at each location.

4.3 Projected Utility Use and GHG Emissions Based On the Plan

The projected utility use, GHG emissions, and utility costs for the proposed scenarios are presented below.

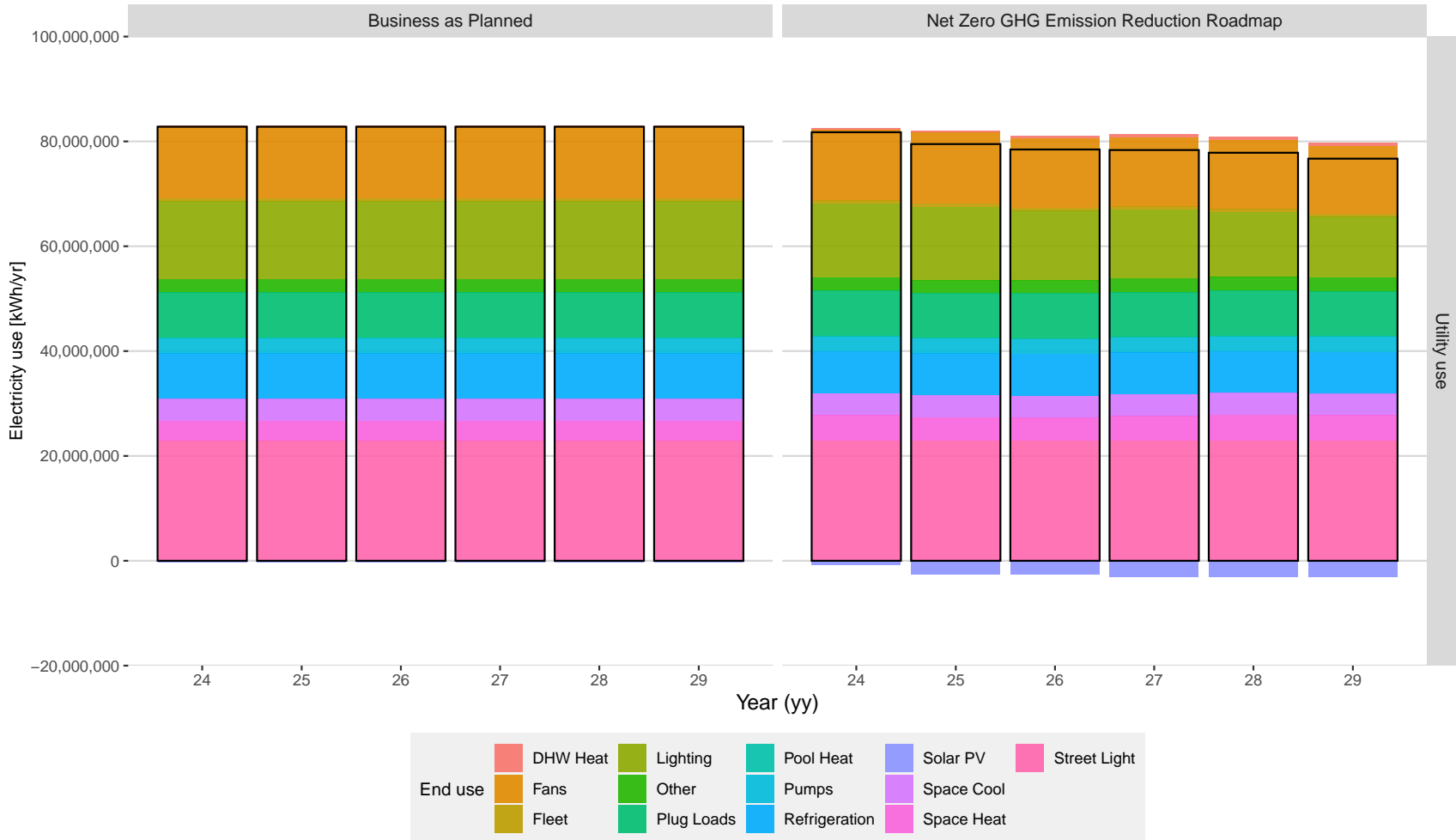


Figure 15: Electricity utility use projection for each scenario

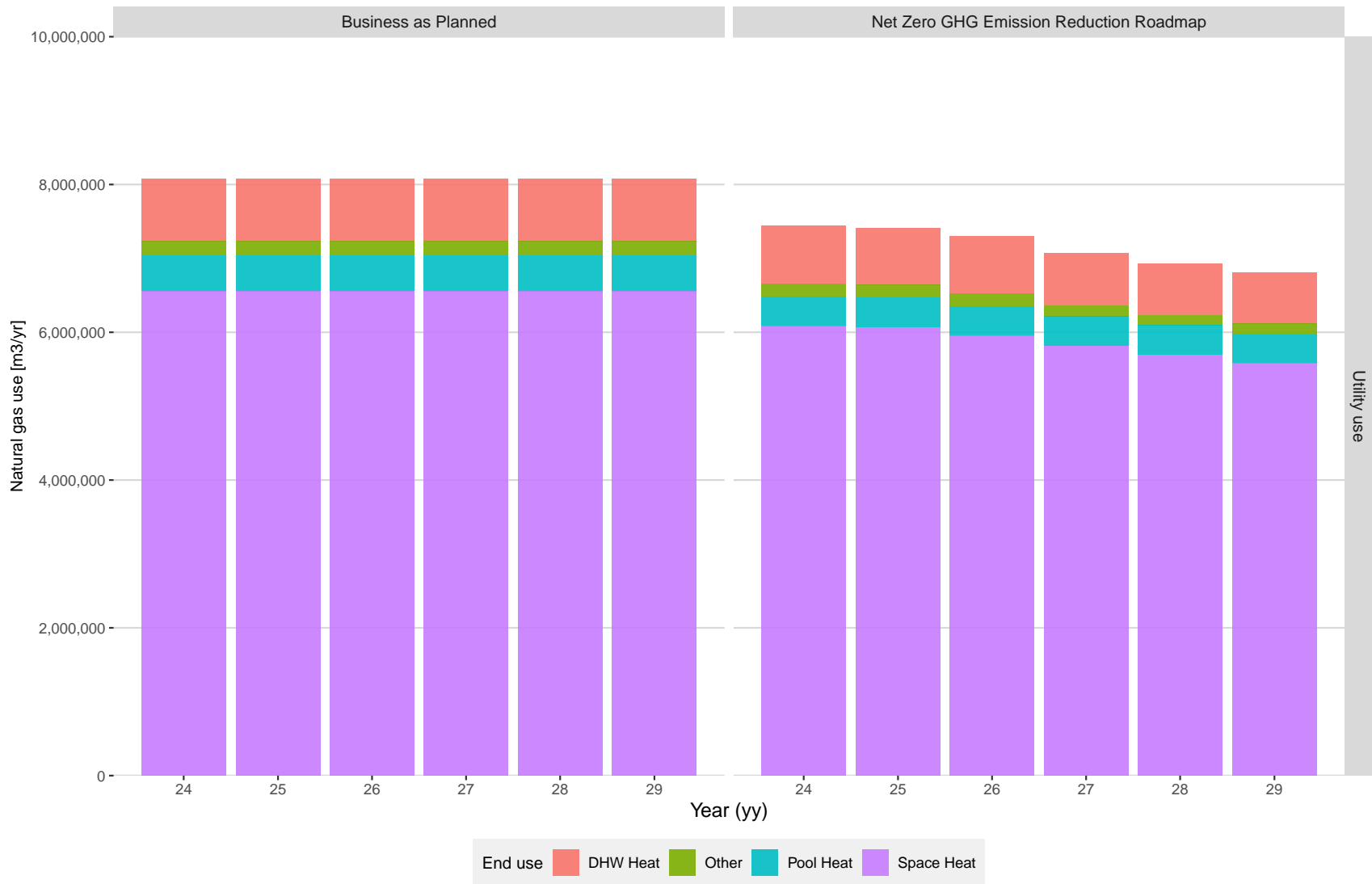


Figure 16: Natural gas utility use projection for each scenario

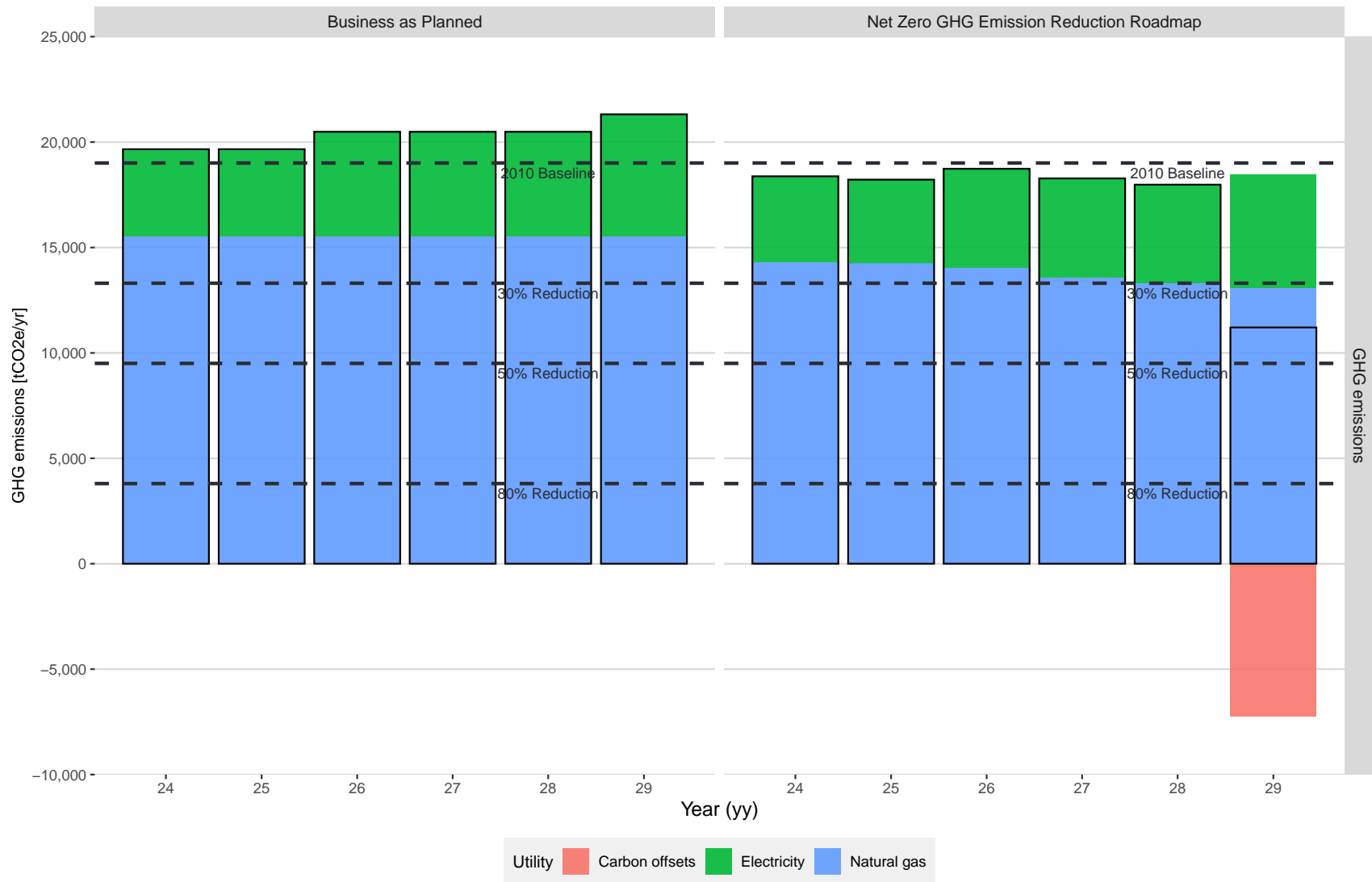


Figure 17: GHG emissions projection for each scenario

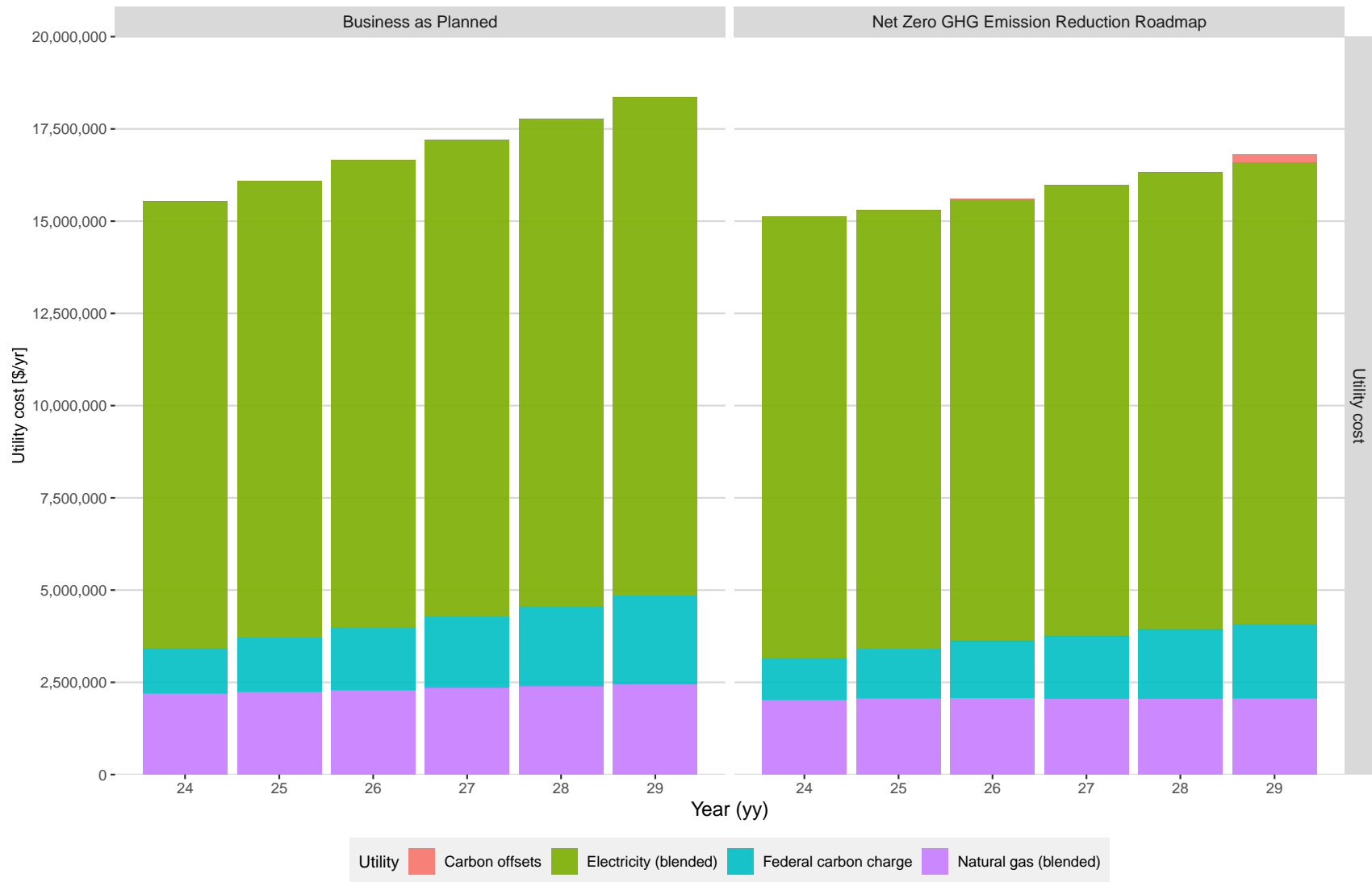


Figure 18: Utility cost projection for each scenario

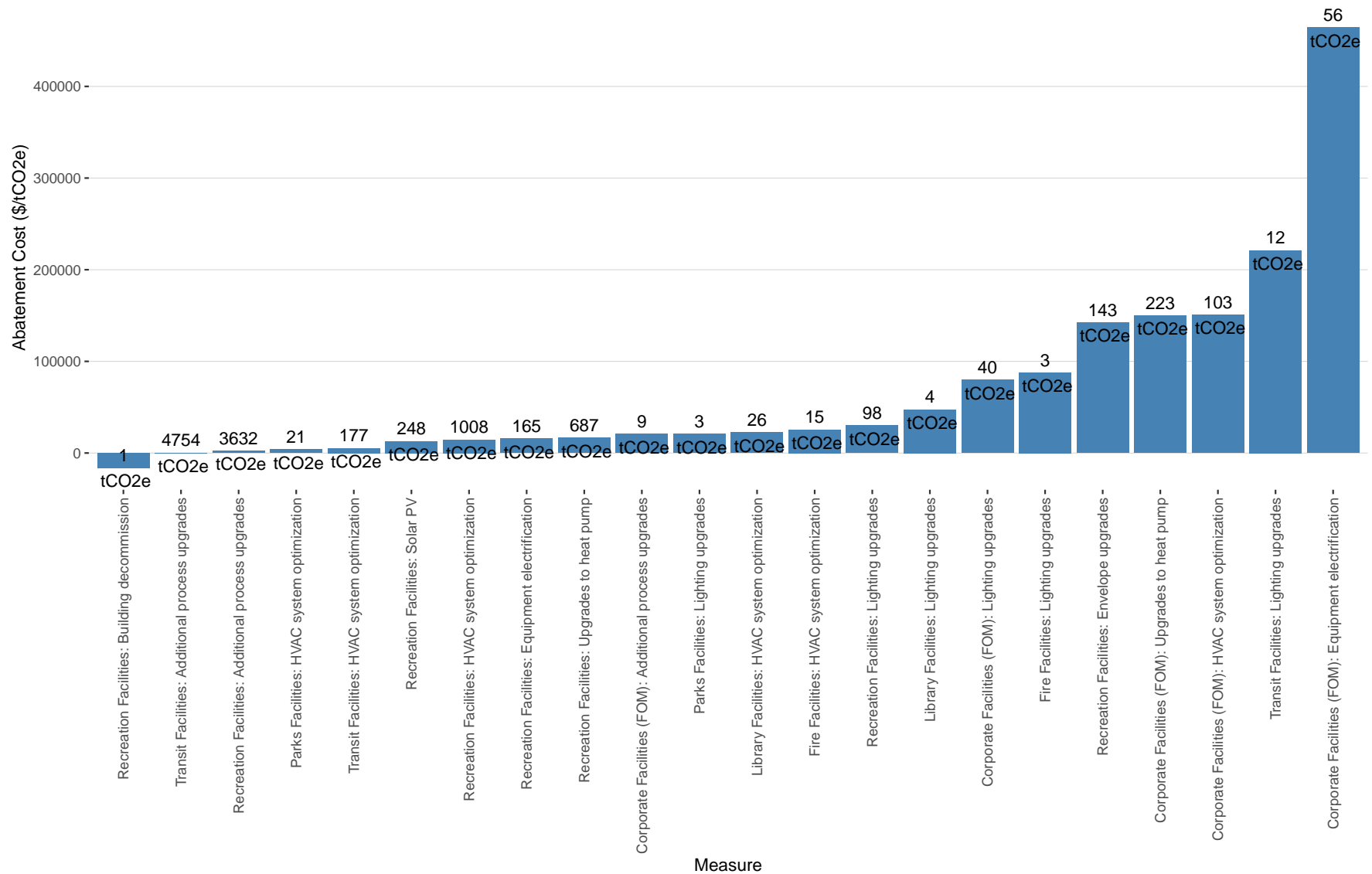


Figure 19: Marginal abatement cost curve for measure groupings. Note that the labels over each bar represent the annual abated emissions for each measure.

4.3.1 Scenario discussion

The following results are observed from the scenario analysis:

- In the short term, it is anticipated that by implementing low-hanging fruit measures (i.e. lighting retrofit, controls upgrades, and HVAC system optimization) as well as select heat pump upgrades, the City will be able to decrease their GHG emissions by roughly 3% compared to the 2010 baseline.
- Due to the GHG emissions being added by new additions to the City's portfolio, this would not be sufficient to meet the City of Brampton's target of a 40-45% reduction in GHG emissions by 2030.
- To meet their GHG reduction target, in addition to implementing the specified measures, it is recommended that the City purchase carbon offsets for their 4 assets which have the highest contribution to GHG emissions (currently projected to be the two Transit Yards, Gore Meadows Community Centre, and Cassie Campbell Community Centre).
- By purchasing these carbon offsets, the City will be able to reduce their GHG emissions by 43% from 2023, for a total GHG reduction of 41% compared to the baseline.
- Note that carbon offsets refer to an indirect reduction in GHG emissions, often linked to activities such as land restoration or planting trees to increase global carbon storage. Carbon offsets do not directly reduce the City of Brampton's GHG emissions and should only be employed when measure implementation does not decrease the GHG emissions enough to meet the City of Brampton's goals. In addition, carbon offset costs are estimated based on the current inflation rate, but as more organizations use carbon offsets to meet their climate change goals, the price to purchase carbon offsets could increase significantly.

The following key performance indicators (KPIs) should be used to evaluate the performance of the measures:

- **Electricity consumption:** For measures which are anticipated to decrease electricity consumption, such as lighting upgrades, the KPI is the corresponding reduction in electricity consumption. This should be tracked to ensure that the electricity savings are tracking with the projected savings for that measure.
- **Natural gas consumption:** For measures which are anticipated to decrease natural consumption, such as HVAC system optimization, the KPI is the corresponding reduction in natural gas consumption. The impact on natural gas consumption should be tracked to verify that the natural gas savings are tracking with the projected savings for that measure.

4.3.2 Triple Bottom Line Business Case

The Triple Bottom Line approach is a framework that encourages organizations to focus on social, environmental, and financial performance (also called the 3 Ps: people, planet, and profit). This approach ensures that business strategies are sustainable and beneficial for all stakeholders. Below is a business case for the proposed plan, incorporating Triple Bottom Line principles.

Social Impact (People):

- **Community Engagement:** This plan will engage local communities through consultations and participatory planning processes, ensuring that their needs and concerns are addressed.
- **Employment Opportunities:** The implementation of this job will create new job opportunities, both during the construction phase and in ongoing operations.
- **Health and Well-being:** This plan aims to improve quality of life by reducing pollution and providing access to cleaner energy, leading to better health outcomes for community members.

Environmental Impact (Planet):

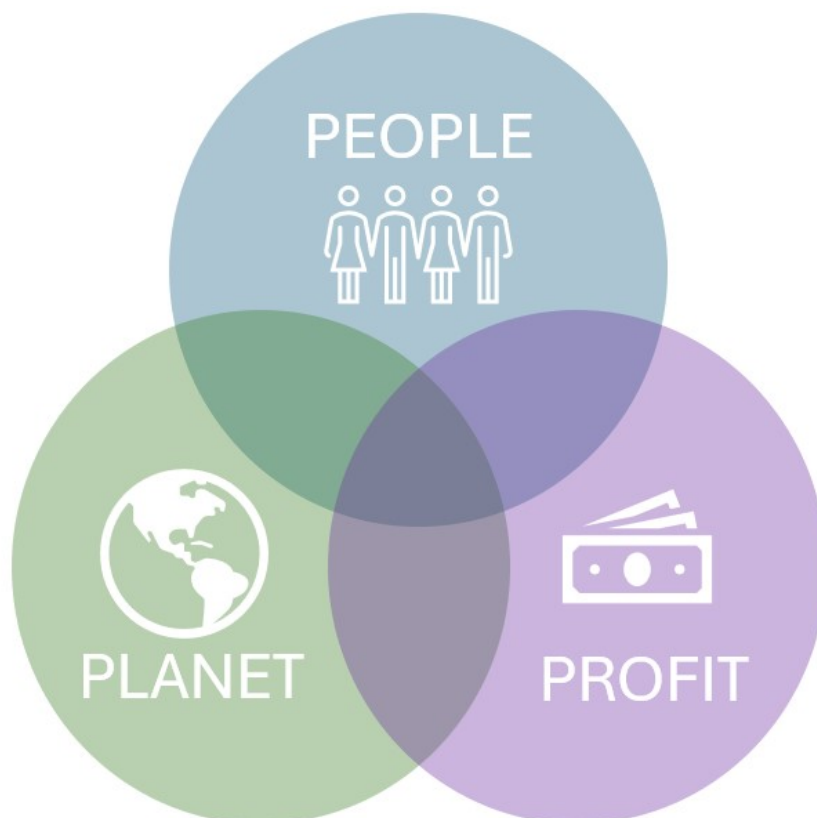
- **GHG Emissions Reduction:** This plan will significantly reduce greenhouse gas emissions by implementing energy-efficient technologies and renewable energy sources.
- **Resource Efficiency:** By optimizing energy use, this plan will minimize wasteful use of energy and reduce the use of non-renewable fuels such as natural gas.

- **Pollution Reduction:** By reducing the amount of fossil fuels burned, this plan will reduce air pollution, ensuring a cleaner environment.

Financial Impact (Profit):

- **Cost Savings:** Energy efficiency measures and renewable energy adoption will lead to significant cost savings on utility bills.
- **Funding Opportunities:** The plan can leverage various funding programs, such as carbon credits, federal and provincial grants, and other financial incentives.

By adopting the Triple Bottom Line approach, the plan ensures a balanced and sustainable strategy that benefits society, the environment, and the economy. This holistic perspective will not only contribute to the overall success of the plan but also promote long-term sustainability and resilience.



4.4 Additional Recommendations (Non-Quantifiable)

Additional recommendations to consider in the next five years are listed below.

- Continue to perform deep retrofit studies for high-emitting facilities, particularly the three facilities listed below. These deep retrofit studies should identify additional measures which can be undertaken to reduce GHG emissions from these facilities. Note that recommendations made for the Transit Yard facilities should align with Transit's ZEB Strategy retrofit work.
 - Brampton Transit Yard Sandalwood Facility
 - Brampton Transit Yard 185 Clark Blvd
 - Gore Meadows Community Centre
- Perform feasibility studies for measures before implementing them, to ensure that recommended measures are feasible and to get a more detailed estimate on the measure cost and projected savings.
- Investigate the feasibility of additional measures at recreation facilities:
 - Implementation of pool covers: adding pool covers when the pools are unoccupied to reduce evaporation and energy use to heat pool water.
 - Pool water temperature optimization: optimize pool water temperature to reduce pool heating energy use.
 - Ice resurfacing water temperature optimization: the ice resurfacing water temperature at Century Gardens Recreation Centre was observed to be 130F, and has opportunity to be lowered to 100-110F, as many operators have noted no detrimental effects to the ice surface at this temperature. Investigate ice resurfacing water temperatures at ice rinks and lower the temperature if possible to reduce the water heating energy use as well as the refrigeration plant energy use.
- Incorporate embedded carbon calculations and life cycle analysis into the City's budgeting, planning, and asset management. The City plans to obtain a template to quantify embedded carbon to use as part of the pathway to net zero.
- Develop an overall GHG reduction plan for the City of Brampton.
 - This plan should capture a comprehensive overview all GHG emissions, including corporate GHG emissions, transit-related GHG emissions, fire department GHG emissions, and GHG emissions due to solid waste.
 - As part of the transit GHG emissions, a program should be put into place to estimate the GHG emissions associated with the commute to work for all City employees.
 - The goal of this plan is to ensure that all departments can align their goals and coordinate GHG reduction efforts to lower costs and improve efficiency as much as possible, while capturing a comprehensive overview of the City's GHG emissions.
- Investigate opportunities to implement district energy, particularly in locations where new buildings are planned for construction in concentrated clusters (e.g. Heritage Heights community).
- Develop a plan to support electrical upgrades. As part of this plan, perform studies to investigate the electrical feasibility of proposed electrification measures and investigate grid resiliency. Upgrade electrical service where necessary to support electrification measures to reduce GHG emissions.
- Evolve the sophistication of the GHG emissions accounting model in future plans by accounting for additional emissions from contracted or other indirect services which result in GHG emissions. This could include, but is not limited to:
 - Accounting for fuel consumed by the City's fleet vehicles in the next ECDMP.
 - Metering electricity and fuel consumption at the City's wastewater stations.
 - Performing corporate solid waste audits to estimate downstream GHG emissions from waste collected at corporate-owned facilities.

- Implementing a tool to track the estimated GHG emissions generated from City employees commuting to work.
- Implementing a tool to track the fuel consumed by contracted services in the City (e.g. snow removal services).

5 Net Zero Emissions by 2050 Plan

5.1 Recommended Measures and Implementation Plans

Using the methodology outlined in Section 4.1, medium and long term plans for the City of Brampton are outlined below.

5.1.1 Medium term plan (2030-2035)

A five year project plan to reduce GHG emissions in the medium term (2030-2035) is outlined in Table 17. A detailed breakdown of this plan, including estimated project costs, is presented in Appendix B.2.

Table 12: Medium term ECMs to implement (2030-2035)

Year	Facility	Measure	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)
2030	Cassie Campbell Community Centre	Arena dehumidification	75	-545,912	64,640	-52,862
	Cassie Campbell Community Centre	Boiler conversion to ground source heat pump	433	-612,821	253,970	11,515
	Multiple Facilities	Cold water flooding	14	0	7,200	2,812
	Century Gardens Recreation Centre	DHW equipment upgrade (ground source heat pump)	8	-11,816	4,897	222
	Multiple Facilities	DHW to heat pump	1	-1,312	388	-36
	Save Max Sports Centre	Electrification of current ventilation unit for the dome	215	-1,556,573	184,311	-150,725
	Century Gardens Recreation Centre	Energy recovery ventilator (changerooms)	12	34,745	4,569	6,756
	Save Max Sports Centre	Gas heat pump pretreat of dome outside air	40	0	20,637	8,061
	Cassie Campbell Community Centre	Geothermal infrastructure	0	0	0	0
	Century Gardens Recreation Centre	HVAC equipment upgrade (dehumidification - pool)	68	-37	35,501	13,861
	Century Gardens Recreation Centre	HVAC equipment upgrade (ground source heat pump)	209	-295,394	122,420	5,550
	Multiple Facilities	HVAC system optimization	342	575,677	151,112	141,390
	Multiple Facilities	Ice resurfacer conversion	0	-1,167	138	-113
	Multiple Facilities	Lighting upgrade	9	169,522	-3,168	23,019
	Cassie Campbell Community Centre	RTU-03 ground source heat pump conversion	19	-27,005	11,192	507
	Cassie Campbell Community Centre	RTU-04-18 ground source heat pump conversion	613	-867,430	359,488	16,298
	Save Max Sports Centre	VRF pretreat of dome outside air	114	-238,350	70,557	-6,545
	Save Max Sports Centre	VRF space conditioning of the dome	70	-145,929	43,198	-4,007
2031	Save Max Sports Centre	B1 and B2 upgrade to ground source heat pump	103	-145,929	60,477	2,742
	Save Max Sports Centre	B3 upgrade to ground source heat pump	103	-146,392	60,669	2,751
	Multiple Facilities	DHW to heat pump	7	-15,355	4,545	-422
	Save Max Sports Centre	Geothermal infrastructure	0	0	0	0
	Multiple Facilities	HVAC system optimization	80	56,516	39,258	23,420
	Multiple Facilities	Ice resurfacer conversion	0	-1,470	174	-143
	Multiple Facilities	Lighting upgrade	16	457,020	-12,718	60,421
	Save Max Sports Centre	MUA upgrade to ground source heat pump	441	-624,019	258,611	11,725
	Save Max Sports Centre	Pavilion DHW upgrade to air source heat pump	9	-19,457	5,760	-534
	Save Max Sports Centre	Pavilion furnace upgrade to air source heat pump	12	-25,943	7,680	-712
	Save Max Sports Centre	Redesign changeroom HVAC	10	0	5,279	2,062
	Save Max Sports Centre	RTU upgrade to ground source heat pump	40	-56,750	23,519	1,066
2032	Multiple Facilities	DHW to heat pump	15	-32,012	9,476	-879
	Multiple Facilities	HVAC system optimization	178	269,594	80,108	69,863
	City Hall West Tower	Opaque wall upgrade	2	0	1,287	503

Table 12: Medium term ECMs to implement (2030-2035) (continued)

Year	Facility	Measure	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)
	City Hall West Tower	Roof upgrade	1	0	643	251
	Multiple Facilities	Solar PV	26	284,700	0	40,735
	Save Max Sports Centre	Unit heaters conversion	10	-68,911	8,160	-6,673
	Cassie Campbell Community Centre	Windows and doors to high performance	49	0	25,737	10,053
2033	Multiple Facilities	DHW to heat pump	6	-13,373	3,958	-368
	Century Gardens Recreation Centre	Plumbing fixture upgrade	2	0	892	349
	FCCC Dorm D-Sports Admin Offices	Solar PV	1	11,388	0	1,629
2034	Chinguacousy Wellness Centre	Active power management system	5	52,356	0	7,491
	Chinguacousy Wellness Centre	Air source heat pump boilers	56	-117,597	34,811	-3,229
	Chinguacousy Wellness Centre	Air source heat pump domestic hot water heater	53	-111,193	32,916	-3,053
	Chinguacousy Wellness Centre	Air source heat pump replacement of fuel fired RTUS	79	-165,569	49,012	-4,546
	Multiple Facilities	DHW to heat pump	103	-215,299	63,733	-5,913
	Chinguacousy Wellness Centre	Energy recovery ventilator unit	6	0	3,361	1,313
	Multiple Facilities	Solar PV	3	34,164	0	4,888
	Cassie Campbell Community Centre	Solar PV canopy	181	2,015,676	0	288,403
	Cassie Campbell Community Centre	Solar PV rooftop	65	725,416	0	103,792
Medium Term	Total	(Accounts for interactive effects and changes in the electricity grid emissions factor)	5,211	608,228	1,347,686	622,623

5.1.2 Long term plan (2035-2050)

A project plan to reduce GHG emissions in the long term (2035-2050) is outlined in Table 18. A detailed breakdown of this plan, including estimated project costs, is presented in Appendix B.3.

Table 13: Long term ECMs to implement (2035-2050)

Year	Facility	Measure	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)
2035	Multiple Facilities	DHW to heat pump	184	-384,175	113,724	-10,548
	Bovaird House	HVAC to heat pump	7	-15,092	4,468	-414
	Chris Gibson Recreation Centre	Pool heat to heat pump	7	-15,475	4,581	-425
2036	Multiple Facilities	DHW to heat pump	40	-82,425	24,400	-2,263
	Multiple Facilities	HVAC to heat pump	76	-158,727	46,987	-4,359
	Multiple Facilities	Pool heat to heat pump	302	-631,178	186,841	-17,331
	10100 The Gore Road (Heritage House-Dougherty / Johnson Farm)	Solar PV	1	11,388	0	1,629
2037	Multiple Facilities	DHW to heat pump	12	-25,215	7,464	-692
	Multiple Facilities	HVAC to heat pump	83	-174,356	51,613	-4,788
	Jim Archdekin Recreation Centre	Pool heat to heat pump	28	-57,710	17,083	-1,585
	Multiple Facilities	Solar PV	5	56,940	0	8,145
	City Hall West Tower	Spandrel upgrade	2	0	1,287	503
	Chinguacousy Wellness Centre	VRV system to replace VVT	19	-39,099	11,574	-1,074
	Century Gardens Recreation Centre	Window assembly upgrade	1	0	384	150
	City Hall West Tower	Window upgrade - step 3	25	0	12,866	5,025
2038	Multiple Facilities	DHW to heat pump	188	-393,395	116,453	-10,802
	Multiple Facilities	Equipment electrification	14	-99,483	11,780	-9,633
	Cassie Campbell Community Centre	Existing solar PV ownership transition	18	204,984	0	29,329
	Multiple Facilities	HVAC to heat pump	105	-219,875	65,087	-6,037
	Multiple Facilities	Pool heat to heat pump	105	-219,004	64,830	-6,013
	Century Gardens Recreation Centre	Radiant heater upgrade	1	-6,634	786	-642
	Multiple Facilities	Solar PV	23	261,924	0	37,477
2039	Bramalea Transit Terminal (new)	DHW to heat pump	2	-5,304	1,570	-146

Table 13: Long term ECMs to implement (2035-2050) (continued)

Year	Facility	Measure	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)
2040	Chris Gibson Recreation Centre	Equipment electrification	1	-10,411	1,233	-1,008
	Multiple Facilities	HVAC to heat pump	580	-1,210,983	358,475	-33,251
	Multiple Facilities	DHW to heat pump	53	-110,026	32,570	-3,021
	Multiple Facilities	Equipment electrification	16	-113,230	13,407	-10,965
	Multiple Facilities	HVAC to heat pump	1,669	-3,483,626	1,031,224	-95,656
2041	Multiple Facilities	Solar PV	58	649,116	0	92,875
	Multiple Facilities	DHW to heat pump	345	-720,773	213,363	-19,792
	Memorial Arena	Equipment electrification	9	-68,017	8,054	-6,586
	Multiple Facilities	HVAC to heat pump	454	-947,892	280,595	-26,028
	Multiple Facilities	Solar PV	73	819,936	0	117,317
2042	Springdale Library	DHW to heat pump	0	-799	237	-22
	Multiple Facilities	HVAC to heat pump	139	-290,684	86,048	-7,982
	Chinguacousy Wellness Centre	Pool filtration system optimization	2	13,858	407	2,142
	Multiple Facilities	Solar PV	42	466,908	0	66,805
	Multiple Facilities	HVAC to heat pump	2,306	-4,814,526	1,425,196	-132,202
2043	Multiple Facilities	Solar PV	124	1,389,336	0	198,786
	Rose Theatre	DHW to heat pump	13	-27,760	8,217	-762
	Multiple Facilities	Solar PV	8	91,104	0	13,036
	Chinguacousy Wellness Centre	Solar PV additional array	87	967,980	0	138,499
	Chinguacousy Wellness Centre	Use of efficient plumbing fixtures and fittings	19	0	9,957	3,889
2045	Jim Archdekin Recreation Centre	DHW to heat pump	4	-9,220	2,729	-253
	Multiple Facilities	HVAC to heat pump	727	-1,517,943	449,342	-41,681
	Multiple Facilities	Solar PV	82	922,428	0	131,982
	Cassie Campbell Community Centre	Wall upgrade to high performance	10	0	5,264	2,056
	FCCC Dorm D-Sports Admin Offices	DHW to heat pump	2	-3,732	1,105	-102
2046	Multiple Facilities	HVAC to heat pump	1,313	-2,740,097	811,123	-75,241
	Multiple Facilities	Solar PV	8	91,104	0	13,034
	Save Max Sports Centre	Windows and doors upgrade to high performance	112	19,701	57,593	25,314
	Multiple Facilities	DHW to heat pump	15	-31,454	9,311	-863
	Multiple Facilities	HVAC to heat pump	79	-165,631	49,030	-4,548
2047	Multiple Facilities	Solar PV	41	455,520	0	65,176
	Save Max Sports Centre	Solar PV canopy	-5	-56,750	0	-8,120
	Save Max Sports Centre	Solar PV rooftop	-5	-56,750	0	-8,120
	Multiple Facilities	Solar PV	119	1,332,396	0	190,640
	Springdale Library	Solar PV	6	68,328	0	9,776
2050	Multiple Facilities	Purchasing carbon offsets	14,761	0	0	-362,061
Long Term	Total	(Accounts for interactive effects and changes in the electricity grid emissions factor)	5,997	-8,870,459	5,157,457	237,800

5.2 Projected Utility Use and GHG Emissions Based On the Plan

The projected utility use, GHG emissions, and utility costs for the proposed scenarios are presented below.

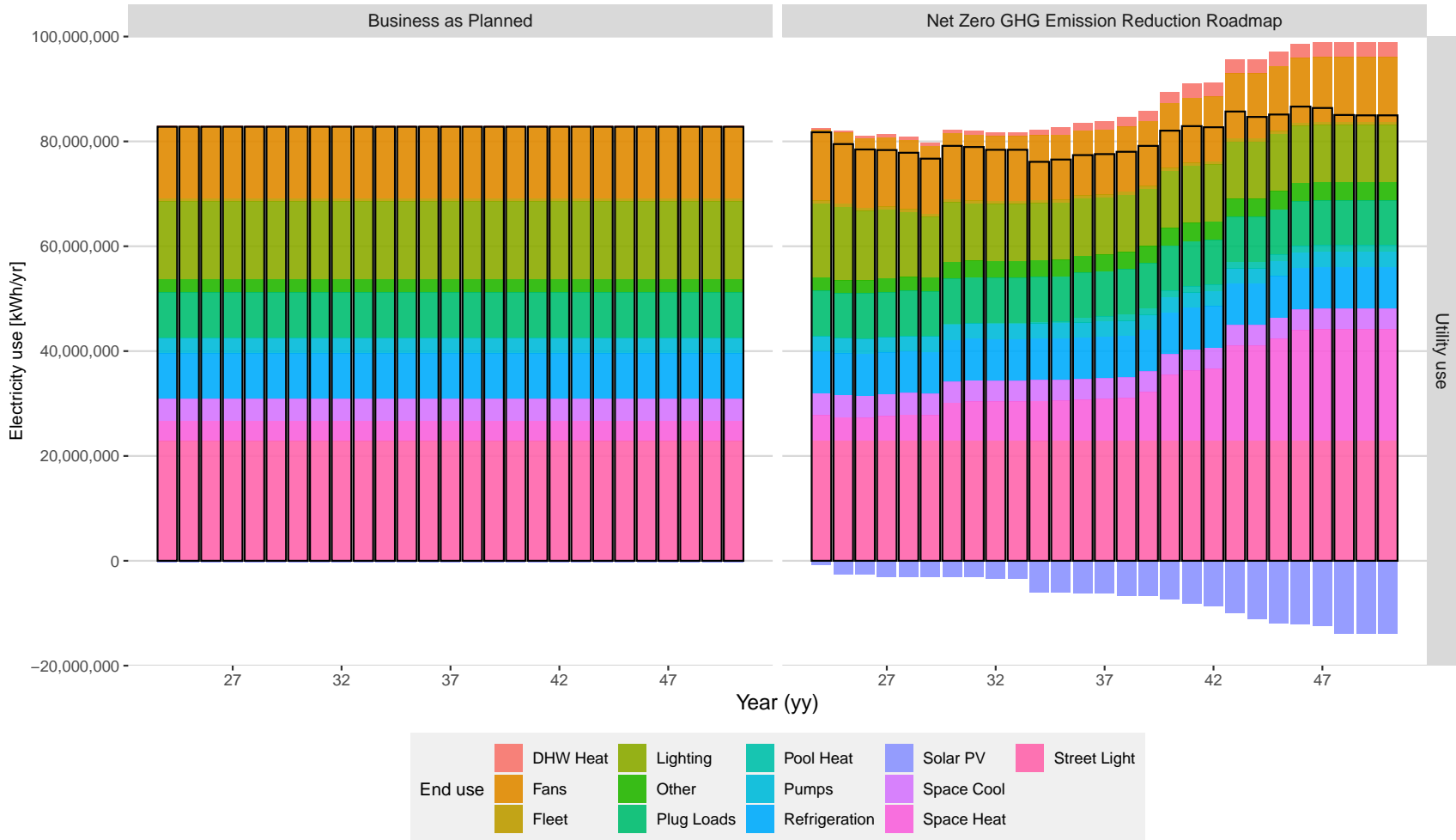


Figure 20: Electricity utility use projection for each scenario

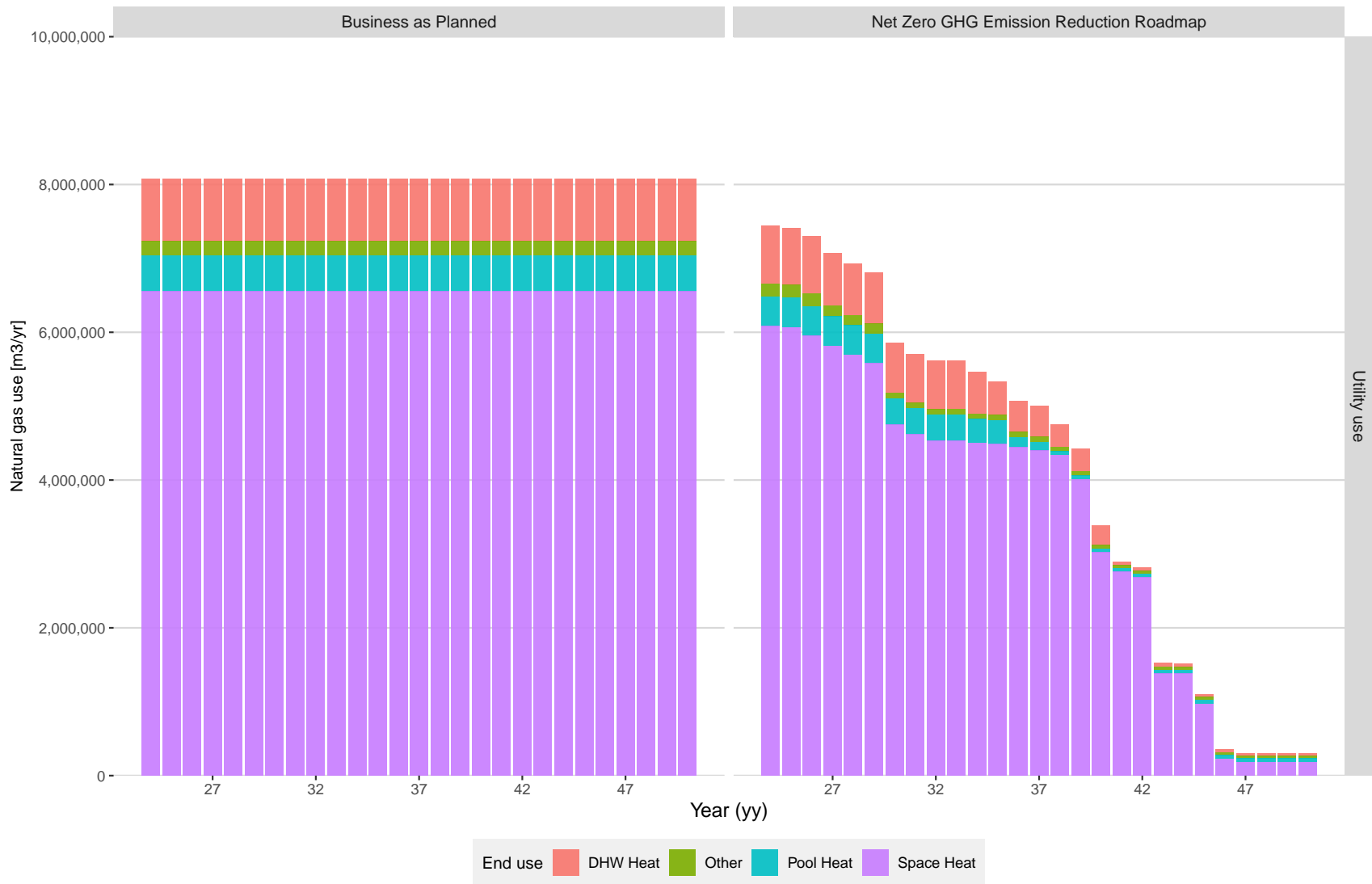


Figure 21: Natural gas utility use projection for each scenario

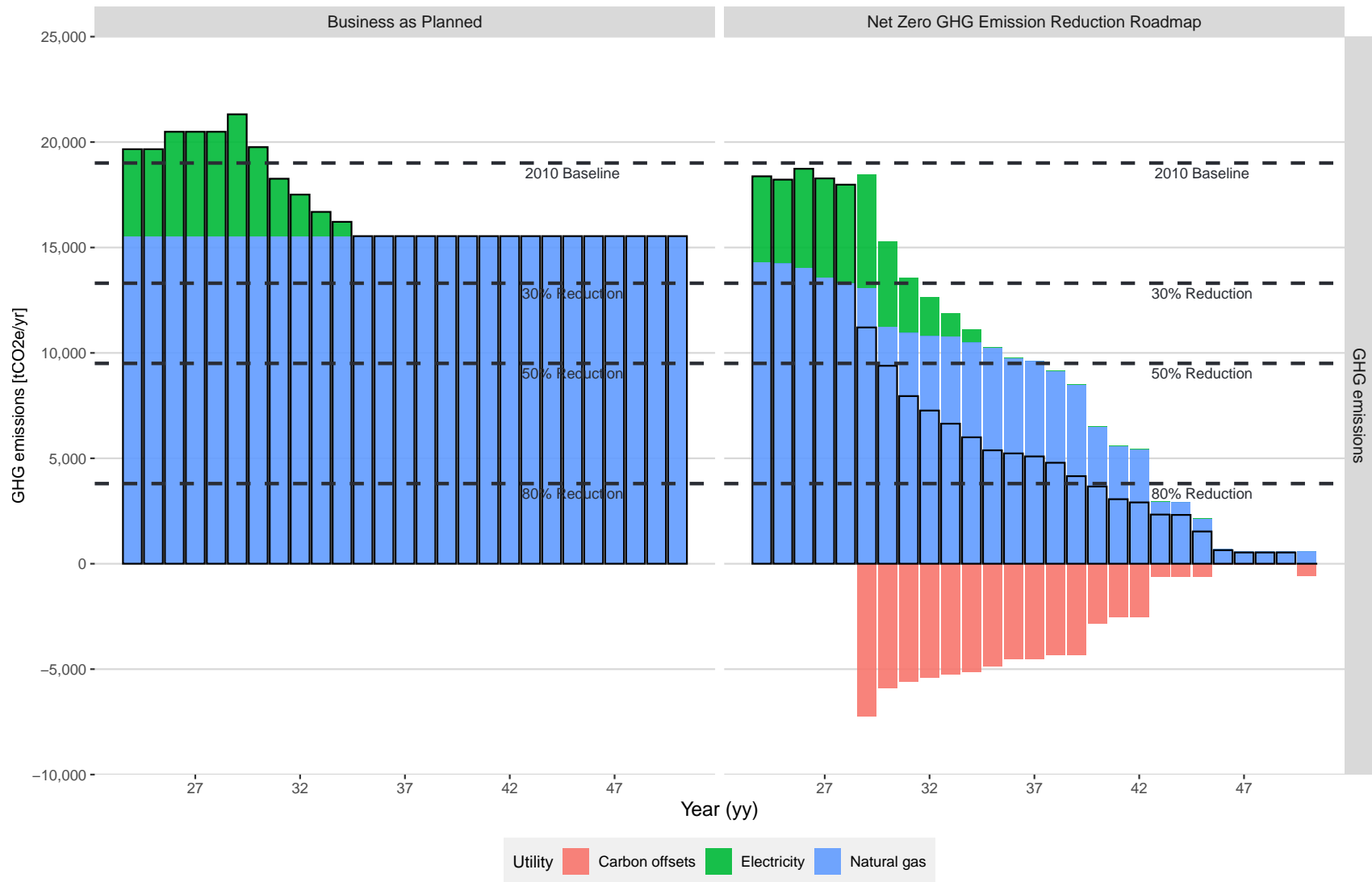


Figure 22: GHG emissions projection for each scenario

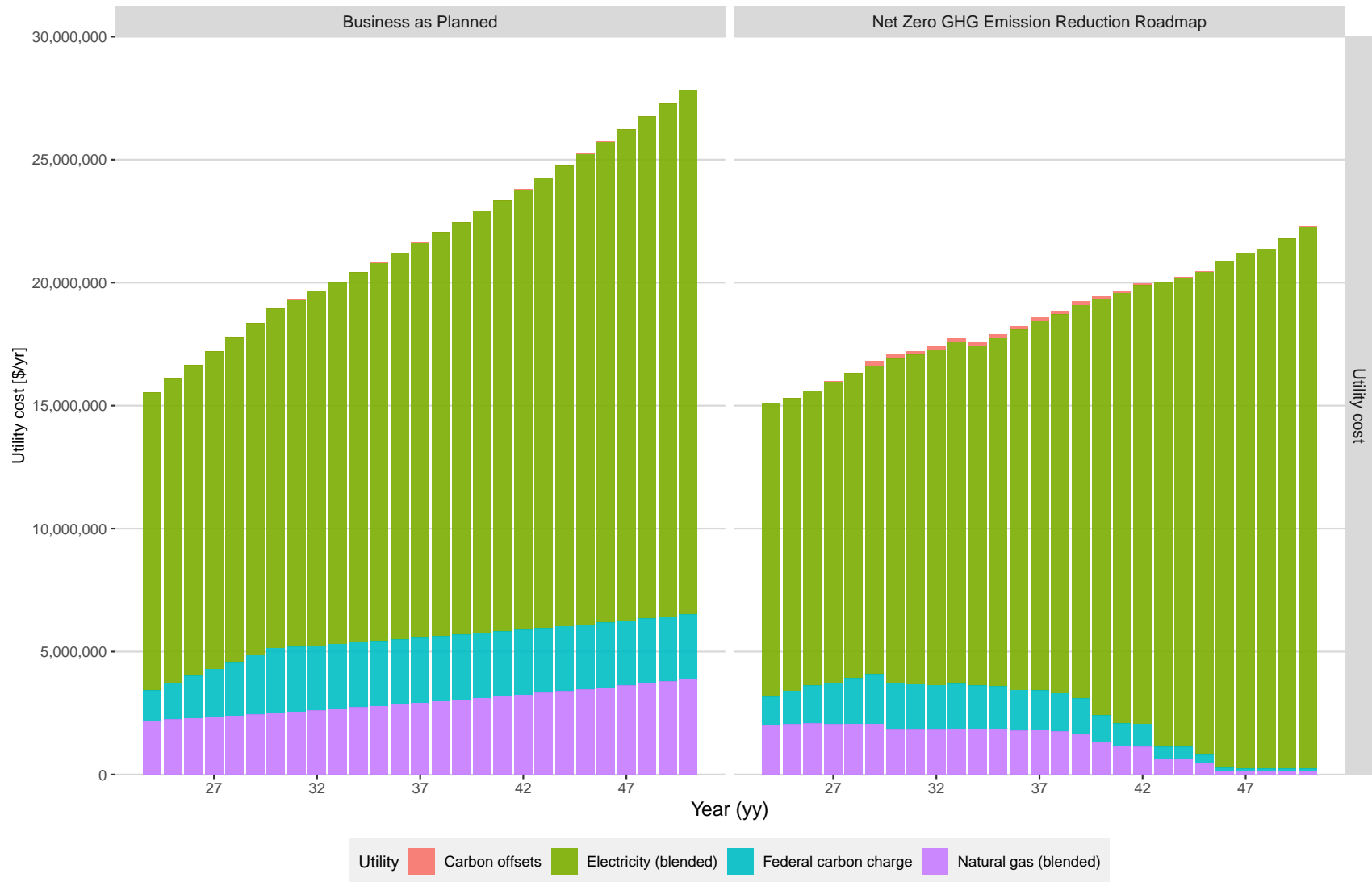


Figure 23: Utility cost projection for each scenario

5.2.1 Scenario discussion

The following results are observed from the scenario analysis:

- The Business as Planned scenario is considered inviable, because it involves taking no specific action to achieving GHG targets. In 2050, the Business as Planned scenario also exhibits annual utility costs roughly \$5,513,124 (20%) higher than those in the GHG reduction pathway, due to the greater energy use and due to the federal carbon charge.
- The maximum GHG emissions that can be achieved by pursuing the ECMs outlined previously, without carbon offsets, is roughly 97%.
- By purchasing carbon offsets, net zero GHG emissions can be attained. Carbon offsets are employed only as a last resort to offset remaining GHGs which cannot be fully eliminated, as carbon offsets do not directly reduce the City's GHG emissions and should only be used if other measures fall short of meeting the City's goals. Additionally, it should be noted that as more organizations adopt carbon offsets to meet their GHG reduction targets, the cost of purchasing carbon offsets may rise significantly.
- Most of the significant reductions in GHG emissions are a result of measures taken in the medium and long term to reduce the consumption of fossil fuels through process electrification. The electrical grid emissions factor is projected to decrease with time as multiple levels of government push for net zero emissions from the electricity grid, and using electric equipment where possible can significantly decrease the City's GHG emissions.

The following key performance indicators (KPIs) should be used to evaluate the performance of the measures:

- **Electricity consumption:** In addition to tracking the electricity use to verify the savings from implementing measures, the electricity consumption should be tracked as one of the KPIs for fuel-switching measures, such as heat pump upgrades. This is to ensure that the electric equipment is operating at the desired efficiency, and any deviation in the electricity consumption can be investigated.
- **Natural gas consumption:** For fuel-switching measures, such as heat pump upgrades, the main KPI is the reduction in natural gas consumption at the facilities where electric equipment is being implemented.
- **Solar PV generation:** For solar PV measures, the KPI is the electricity generated by the solar PV system.

5.3 Additional Recommendations (Non-Quantifiable)

Additional recommendations to consider are listed below.

- Investigate renewable energy.
 - Investigate additional opportunities to implement renewable energy technology (e.g. additional locations for solar PV or geothermal systems, solar thermal heating, solar canopies, etc.).
 - Using more renewable energy will enable the City of Brampton to reduce the remaining GHG emissions from electricity consumption, which are expected to increase as the grid emissions factor gets higher.
 - While investigating renewable energy, the City is also encouraged to investigate the feasibility of battery storage systems.
- Implement additional ECMs identified through deep retrofit studies.
- Develop a policy to ensure that new builds are designed to minimize GHG emissions as much as possible (near net zero emissions), similar to the City of Toronto's Zero Emissions Buildings Framework.
- Continuously investigate new technology for consideration in new measures to reduce pre-offset GHG emissions as much as possible.

6 Conclusions

Based on the plans identified, the anticipated progress towards reducing GHG emissions is presented in Table 14.

Table 14: Plan Results Summary

Term	GHG Emissions	Utility Cost	GHG Emissions Reduction	Additional Reduction (Compared to Baseline)	Cumulative GHG Percent Reduction
-	[tCO ₂ e/yr]	[\$/yr]	[tCO ₂ e/yr]	[%]	[%]
Baseline	19,007	-	-	-	-
Current	19,336	15,116,689	-329	-2	-2
Short Term Plan	11,207	16,797,653	8,129	43	41
Medium Term Plan	5,997	17,568,335	5,211	27	68
Long Term Plan	0	22,307,815	5,997	32	100

Currently, the City of Brampton's emissions show a slight increase relative to the 2010 baseline as a result of new buildings coming online. However, when not including emissions from new builds and new acquisitions, the City of Brampton has decreased their GHG emissions by 25%, showcasing the City's progress toward its climate change objectives while also acknowledging the challenge of emission reduction amid municipal growth.

In the short term, recommended measures — primarily comprising low-capital initiatives such as lighting retrofits and controls upgrades — are expected to yield a 3% reduction in GHG emissions compared to the 2010 baseline. To meet the City's short-term target of a 40-45% reduction by 2030, it may be necessary to purchase carbon offsets for the four assets which have the highest contribution to GHG emissions.

Looking ahead to the long term, implementation of the recommended measures is projected to decrease the City of Brampton's GHG emissions by 97% compared to baseline levels. This reduction is primarily attributed to electrification and heat pump initiatives aimed at curbing buildings' natural gas consumption and enhancing HVAC system efficiency. While carbon offsets may be needed to offset the remaining GHG emissions and achieve net zero status, the City is encouraged to continuously explore new technologies for additional emission reduction opportunities.

A Appendix A: Detailed Asset List

A detailed list of the buildings considered under this Corporate Energy Conservation and Demand Management Plan are summarized in Table 5. Dashes indicate data that were not available at the time of review.

Table 15: Buildings in the scope of this plan

Type	Building name	Address	Construction	Gross floor area (ft2)
Corporate Facilities (FOM)	10981 Torbram Road House	10981 Torbram Road	1965	3,336
	14 Nelson St W	14 Nelson Street West	1959	-
	16 George St (Brampton Safe City)	16 George St	-	-
	175 Sandalwood Parkway West	175 Sandalwood Parkway West	1991	153,770
	1B Knightsbridge Rd	1B Knightsbridge Rd	1971	7,199
	20 Nelson St W	20 Nelson St W	1973	26,510
	24 Queen	24 Queen St. E.	-	1,610
	2591 Bovaird Dr West	2591 Bovaird Dr West	1870	3,000
	30 Main St N	30 Main St N	1900	3,460
	36-40 Main St N	36-40 Main St N	1917	5,600
	37 George St N	37 George St N	1974	34,995
	42 Main Street North	42 Main Street North	1937	1,307
	46 Main Street North	46 Main Street North	1937	1,979
	54 Main St N	54 Main St N	1920	4,500
	55 Queen (Carnegie Library)	55 Queen St E	1900	8,348
	60 Main St N	60 Main St N	1917	7,700
	63-71 Main St N	63-71 Main St N	1922	4,241
	70-74 Main St N Buildings - Art Gallery	70-74 Main St N	1942	9,163
	76-78 Main St N Building - Brampton Downtown Development Corporation	76 Main St N	1922	3,550
	8 Nelson Commercial / Office	8 Nelson St. W	1990	82,774
	9 Hansen Road South	9 Hansen Road South	1967	8,229
	Alderlea	40 Elizabeth St S	1867	11,794
	Ambulance Station - 52 Bramalea Rd	52 Bramalea Rd	1950	3,950
	Andrew McCandless Plank House	1985 Bovaird Dr W	1840	807
	Animal Services Administration Building (By-Law Enfo. Williams Parkway Administration)	485 Chrysler Dr	1999	6,379
	Animal Shelter	475 Chrysler Dr	1998	8,916
	Bovaird House	563 Bovaird Dr E	1852	4,714
	Churchville Community Hall (FS 217 Volunteer)	7752 Churchville Rd	1970	962
	City Hall	2 Wellington St W	1990	196,316
	City Hall Parking	2 Wellington St W	1990	154,771
	City Hall West Tower	41 George	2014	188,924
	City Hall West Tower Parking	41 George	2014	183,458
	COB Parking lot (Former BCC Terminal)	200 Clark Blvd	1998	1,368
	Department of National Defence	2 Chapel St	1854	6,241
	FCCC Administrative Building	8990 McLaughlin Rd	1936	15,009
	FCCC Park Maintenance Warehouse	8890 McLaughlin Rd	1960	4,392
	FCCC Units 1 and 2	8850 McLaughlin Rd Units 1 and 2	2005	32,514
	Fire Prevention And Emergency Measures Office	129 Glidden Rd	1974	64,363
	Market Square Parking	1 Theatre Lane	1997	224,739
	Mount Pleasant Clock Tower and W.R.	100 Commuter Drive	2011	440
	Nelson Square Parking Garage	2 Diplock Lane	1991	99,089
	Norton Place Park Community Centre and Depot	170 Clark Blvd	2014	12,001
	Peel Ice and Fuel building - ORDC property	64 Nelson St W	-	600
	POA Courthouse	5 Ray Lawson Blvd	2004	46,012
	POA Courthouse Parking	5 Ray Lawson Blvd	2004	12,476
	Royal Canadian Legion Branch 15 (Centennial Recreation Centre)	80 Mary St	1967	7,657
	Williams Parkway Fire Campus	425 Chrysler Drive	2022	68,835
Fire Facilities	A and M Fire Apparatus Building	52 Rutherford Rd	2017	46,642
	Fire Station 202	280 Bramalea Rd	1984	8,355

Table 15: Buildings in the scope of this plan (*continued*)

Type	Building name	Address	Construction	Gross floor area (ft2)
	Fire Station 203 Training Tower	425 Chrysler Dr	2010	6,218
	Fire Station 204	657 Queen St W	1976	10,161
	Fire Station 205	95 Sandalwood Pkwy E	1978	8,239
	Fire Station 206	7880 Hurontario St	1984	6,448
	Fire Station 207 Duggan Park Fieldhouse	75 Vodden St E	1987	9,398
	Fire Station 208	120 Fernforest Dr	1994	6,345
	Fire Station 209	2691 Sandalwood Parkway East	2003	9,377
	Fire Station 210	10530 Creditview Rd	2003	9,126
	Fire Station 211	10775 The Gore Road	2014	13,750
	Fire Station 212	8220 Mississauga Road	2011	11,068
	Fire Station 213	4075 Ebenezer Rd	2003	9,608
	Fire Station 214	917 and 927 Bouvaird Drive West	2023	10,900
	Former Fire Station 201	8 Rutherford Rd S	1963	12,488
Library Facilities	Brampton Public Library - Four Corners	65 Queen St. E.	1973	38,939
	Cyril Clark Library	20 Loafers Lake Lane	1985	26,442
	Mount Pleasant Library	100 Commuter Drive	2011	22,000
	Springdale Library	10705 Bramalea Rd	2018	28,910
Parks Facilities	Andrew Mccandless Park - Comfort Station And Skateboard Park	450 Elbern Markell Dr.	2015	1,367
	Batsman Park Comfort Station	389 Father Tobin Road	2013	2,142
	Brampton Cemetery Office Building	10 Wilson Ave	1910	750
	Cemetery Maintenance Building	10 Wilson Ave	2014	2,470
	Century Gardens Fieldhouse	340 Vodden St E	2010	373
	Chinguacousy Park Central Electrical Metering Room	9050 Bramalea Rd	2010	77
	Chinguacousy Park Garage	9050 Bramalea Rd	1985	2,625
	Chinguacousy Park Greenhouses	9050 Bramalea Rd	1974	12,886
	Chinguacousy Park NE Electrical Metering Room	9050 Bramalea Rd	2010	91
	Chinguacousy Park NW Electrical Metering Room	9050 Bramalea Rd	2010	169
	Chinguacousy Park Parks Building	9050 Bramalea Rd	1970	3,185
	Chinguacousy Park SE Electrical Metering Room	9050 Bramalea Rd	2010	173
	Chinguacousy Park Snow Making Pump House	9050 Bramalea Rd	2010	674
	Chinguacousy Park Splash Pad Building	9050 Bramalea Rd	2011	84
	Chinguacousy Park Tennis and Baseball Storage	9050 Bramalea Rd	1995	613
	Chinguacousy Wellness Centre Fieldhouse	995 Peter Robertson Blvd	1998	249
	County Court Pavillion	95 County Court Blvd	1990	1,228
	Creditview Park Fieldhouse	10490 Creditview Rd	2008	4,444
	Ellen Street Parks Garage	16 Alexander St	1950	898
	Fairgrounds Park Batting Cages	61 Elliot St	2003	1,181
	Fred Kline Park Building	9445 McLaughlin Road N	1990	756
	Gage Park Bandstand	45 Main St S	1950	920
	Loafers Lake Fieldhouse	30 Loafers Lake Lane	1985	500
	Mount Chinguacousy Electrical Bunker - Hilltop Electrical Room	9050 Bramalea Rd	2010	91
	Mount Chinguacousy Garage (Tubing Storage Shed)	9050 Bramalea Rd	2010	973
	Sesquicentennial Park Sportsfield House	11367 Bramalea Rd	2008	4,438
	Teramoto Park Comfort Station	9020 Chinguacousy Road	2012	1,410
	Teramoto Park Parks Depot	45 Davis Elm Drive	2012	8,530
	Valleybrook Field House	North side of Centre St. N and Williams Pkwy E	1990	560
Recreation Facilities	10100 The Gore Road (Heritage House-Dougherty / Johnson Farm)	10100 The Gore Road	1852	4,980
	Avondale Day Care	55 Avondale Blvd	1964	6,928
	Balmoral Recreation Centre	225 Balmoral Dr	1964	17,439
	Brampton Curling Club	46 McMurchy Ave	1955	26,007
	Brampton Tennis Club	38 Union Street	2023	933
	Cassie Campbell Community Centre	1050 Sandalwood Parkway West	2008	242,238

Table 15: Buildings in the scope of this plan (*continued*)

Type	Building name	Address	Construction	Gross floor area (ft ²)
	Cassie Campbell Electrical Bunker	1050 Sandalwood Parkway West	2008	150
	Central Public School Recreation Centre	24 Alexander St	1916	25,930
	Century Gardens Lawnbowling	340 Vodden St E	1979	3,279
	Century Gardens Recreation Centre	340 Vodden St E	1973	114,904
	Chingaucousy Park Changeroom Terry Fox Fieldhouse	9050 Bramalea Rd	2016	4,820
	Chinguacousy Park Barn	9050 Bramalea Rd	1890	10,000
	Chinguacousy Park Curling Club	9050 Bramalea Rd	1973	35,900
	Chinguacousy Park Mini Golf and Snack Bar	9050 Bramalea Rd	1978	2,796
	Chinguacousy Park Optimist Club and Ski Chalet	9050 Bramalea Rd	2012	19,602
	Chinguacousy Park Outdoor Skating Rink Building	9050 Bramalea Rd	2016	3,218
	Chinguacousy Park Paddle Boat Pavilion	9050 Bramalea Rd	2012	2,396
	Chinguacousy Park Tea House	9050 Bramalea Rd	1920	3,607
	Chinguacousy Park Tennis Bubble	9050 Bramalea Rd	2011	42,228
	Chinguacousy Park Track and Field Stadium	9050 Bramalea Rd	2011	320
	Chinguacousy Wellness Centre	995 Peter Robertson Blvd	1998	43,188
	Chris Gibson Recreation Centre	125 McLaughlin Rd N	1985	57,598
	Earnscliffe Recreation Centre	44 Eastbourne Dr	1971	91,637
	Ebenezer Community Hall	4494 Ebenezer Rd	1892	2,218
	Eldorado Park Pavillion	8520 Creditview Rd	2003	1,271
	Eldorado Parks Shed	8520 Creditview Rd	1980	881
	Eldorado Pool Changehouse	8520 Creditview Rd	1980	848
	Ellen Mitchell Recreation Centre	922 North Park Dr	1985	14,178
	Fairgrounds Park Snack Bar and Washrooms	61 Elliot St	1997	860
	FCCC Dorm D-Sports Admin Offices	8950 McLaughlin Rd	1960	7,516
	FCCC Dorm E-Sports Admin Offices	8930 McLaughlin Rd	1960	7,523
	FCCC Dorm F-Sports Equipment Storage	8970 McLaughlin Rd	1960	7,525
	FCCC Lawn Bowling	8910 McLaughlin Rd	2011	6,415
	FCCC Seniors Centre	8870 McLaughlin Rd	2006	27,499
	Fire Life Safety Centre	225 Central Park Dr	2003	10,415
	Gage Park Mechanical	45 Main St S	1990	2,000
	Gore Meadows Community Centre	10150 The Gore Rd	2013	137,527
	Gore Meadows Outdoor Arena	10150 The Gore Rd	2019	20,707
	Greenbriar Recreation Centre	1100 Central Park Dr	1974	43,528
	Heritage Theatre and Theatre School	80-86 Main St N	1922	9,518
	Howden Recreation Centre	150 Howden Blvd	1974	22,400
	Huttonville Community Centre	2322 Embleton Rd	1974	10,637
	James F. McCurry Victoria Park - Soccer Stadium	20 Victoria Crescent	2015	125
	- Bleachers / Score Box			
	James F. McCurry Victoria Park - Soccer Stadium	20 Victoria Crescent	2015	3,714
	- Fieldhouse			
	Jim Archdekin Recreation Centre	292 Conestoga Dr	1988	45,919
	Ken Giles Soccer Centre	370 Bartley Bull Pkwy	1974	28,907
	Kiwanis Youth Centre for Sports Excellence	247 McMurphy Ave S	1971	43,961
	Knightsbridge Community and Seniors Centre	1A Knightsbridge Rd	1979	6,391
	Loafers Lake Recreation Centre	30 Loafers Lake Lane	1980	34,340
	Memorial Arena	69 Elliot St	1949	33,128
	Mount Pleasant Recreation Centre	100 Commuter Drive	2011	7,516
	Peel Village Clubhouse	29A Hartford Trail	1988	2,820
	Peel Village Maintenance	29A Hartford Trail	1988	1,646
	Peel Village Pumphouse (2019)	29A Hartford Trail	2019	66
	Professors Lake Recreation Centre	1660 North Park Dr	1981	10,953
	Riverstone Community Centre	195 Don Minaker Dr	1990	33,653
	Rose Theatre	1 Theatre Lane	2006	65,324
	Save Max Sports Centre	1495 Sandalwood Pkwy East	2007	153,044
	Save Max Sports Centre - Pavilion Building and Turf	1495 Sandalwood Pkwy East	-	-
	Siemens Building	2719 Bovaird Dr	1975	37,500
	Snelgrove Seniors Centre	11692 Hurontario	1990	6,755
	Susan Fennell Sportsplex	500 Ray Lawson Blvd	1996	173,546

Table 15: Buildings in the scope of this plan (*continued*)

Type	Building name	Address	Construction	Gross floor area (ft2)
	Terry Miller Recreation Centre	1295 Williams Pkwy	1979	60,344
Transit Facilities	Bramalea Transit Terminal (new)	160 Central Park Way	2010	9,359
	Brampton Downtown Terminal	8 Nelson St W	1990	2,219
	Brampton Transit Yard 185 Clark Blvd	185 Clark Blvd	1979	144,164
	Brampton Transit Yard Sandalwood Facility	130 Sandalwood Pkwy W	2008	443,269
	Brampton Trinity Common Terminal	164 Great Lakes Dr	1999	919
	Gateway Transit Terminal Building A	501 Main St South	2012	4,834
	Gateway Transit Terminal Lunchroom Building B	501 Main St South	2012	1,568
Works Operations Facilities (FOM)	Sandalwood Fabric Building	120 Sandalwood Pkwy W	2011	1,915
	Sandalwood Pole Barn Phase-2	120 Sandalwood Pkwy W	2011	32,000
	Sandalwood Pole Barn Phase-3	120 Sandalwood Pkwy W	2011	11,700
	Sandalwood Sand and Salt Storage and Garage Building	120 Sandalwood Pkwy W	2011	41,506
	Sandalwood Works Administration Building	120 Sandalwood Pkwy W	2011	8,019
	Sandalwood Yard Storage Bays Building	120 Sandalwood Pkwy W	2011	4,424
	Williams Parkway Administrative Building	1975 Williams Parkway East	2014	38,499
	Williams Parkway Operations building	1975 Williams Parkway East	2014	82,452
	Williams Parkway Sand Salt Storage Building	1975 Williams Parkway East	2014	63,560
	Williams Parkway South Storage Shed	1945 Williams Pkwy E	1980	2,000
	Williams Parkway Truck Wash Building	1975 Williams Parkway East	2014	4,795

B Appendix B: Plan Detailed Information

B.1 Short Term Plan

The detailed five year implementation plan to reduce GHG emissions is outlined in Table 16. Note that project costs were taken from deep retrofit studies where available, and otherwise estimated based on the size of each building.

Table 16: Short term ECMs to implement (2024-2029)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2024	175 Sandalwood Parkway West	New building	0	-296.2	-2,040,000	-	-314,949	0
2024	Balmoral Recreation Centre	Undergoing construction	0	0.0	0	59,055.0	0	0
2024	Cassie Campbell Community Centre	Exterior LED lighting upgrade	203,520	6.6	73,751	0.0	10,552	2,035
2024	Cassie Campbell Community Centre	Interior lighting retrofit to LED	1,260,000	5.2	142,906	-3,981.5	18,892	12,600
2024	Century Gardens Recreation Centre	Arena nighttime setback implementation	3,500	2.4	26,529	0.0	3,796	0
2024	Century Gardens Recreation Centre	Control sequence optimization (HVAC schedules)	3,500	9.1	12,397	4,176.6	3,405	0
2024	Century Gardens Recreation Centre	Control sequence optimization (temperature and humidity)	3,500	11.1	3,771	5,596.6	2,726	0
2024	Century Gardens Recreation Centre	Floating head pressure controls implementation	19,800	9.7	108,608	0.0	15,540	0
2024	Century Gardens Recreation Centre	Laser ice levelling implementation	3,500	1.7	9,704	435.0	1,558	0
2024	Century Gardens Recreation Centre	Lighting controls	20,700	0.4	11,767	-327.8	1,556	0
2024	Century Gardens Recreation Centre	Lighting fixture upgrade	17,700	5.9	163,063	-4,543.1	21,557	177
2024	Century Gardens Recreation Centre	Pool heat recovery and MUW controls	19,000	65.6	0	34,172.0	13,347	190
2024	Century Gardens Recreation Centre	Roof assembly upgrade	470,000	14.6	1,138	7,522.5	3,101	0
2024	Chinguacousy Wellness Centre	Demand control ventilation through RTUs	47,600	20.6	16,752	9,953.6	6,285	0
2024	Chinguacousy Wellness Centre	Lighting occupancy and daylight sensors	29,406	3.5	39,514	0.0	5,654	-294
2024	Chinguacousy Wellness Centre	Make up water optimization	7,000	3.7	-2	1,918.6	749	70
2024	Chinguacousy Wellness Centre	Optimize pool air space temperature and humidity	14,000	12.4	21,082	5,481.4	5,157	0
2024	Chinguacousy Wellness Centre	Optimize ventilation rate through dehumidifier unit	7,000	0.8	9,413	0.0	1,347	0
2024	Chinguacousy Wellness Centre	Pool pumping system optimization	22,785	4.8	53,128	0.0	7,602	0
2024	Chinguacousy Wellness Centre	RTU optimization	22,960	28.1	17,074	13,817.8	7,840	0
2024	Chinguacousy Wellness Centre	Solar PV	544,880	21.0	234,593	0.0	33,566	-5,449
2024	Earnscliffe Recreation Centre	Arena nighttime setback implementation	3,500	9.7	108,617	0.0	15,541	0
2024	Earnscliffe Recreation Centre	Control sequence optimization (HVAC schedules)	3,500	10.7	4,382	5,340.3	2,713	0

Table 16: Short term ECMs to implement (2024-2029) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO2e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m3/yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2024	Earnscliffe Recreation Centre	Control sequence optimization (temperature and humidity)	3,500	24.9	0	12,949.0	5,058	0
2024	Earnscliffe Recreation Centre	Floating head pressure controls implementation	19,800	3.8	42,186	0.0	6,036	0
2024	Earnscliffe Recreation Centre	Laser ice levelling implementation	3,500	3.3	21,045	738.1	3,299	0
2024	Earnscliffe Recreation Centre	Pool heat recovery and MUW controls	19,000	31.8	0	16,564.2	6,470	190
2024	Siemens Building	Decommission	0	1.1	11,912	0.0	1,704	0
2024	Susan Fennell Sportsplex	AHU replacement	9,875,791	616.7	-1,000,790	367,700.9	425	0
2024	Susan Fennell Sportsplex	Arena lighting controls	159,583	17.7	197,276	0.0	28,226	0
2024	Susan Fennell Sportsplex	Basic lighting controls	125,673	10.3	115,270	0.0	16,493	0
2024	Susan Fennell Sportsplex	Exterior lighting retrofit to LED	225,614	22.1	247,008	0.0	35,342	2,256
2024	Susan Fennell Sportsplex	Ground source heat loop	4,457,320	436.9	-225,231	237,957.5	60,717	0
2024	Susan Fennell Sportsplex	Ice resurfacers replacement	556,000	4.6	-14,269	3,035.9	-856	0
2024	Susan Fennell Sportsplex	Interior lighting retrofit to LED	112,327	0.2	4,823	-134.4	638	1,123
2024	Susan Fennell Sportsplex	Low flow water fixtures	203,729	23.2	0	12,085.6	4,720	0
2024	Susan Fennell Sportsplex	Radiant heating conversion	202,361	25.0	-88,514	17,164.7	-5,960	0
2024	Terry Miller Recreation Centre	Dehumidifier retrofit	179,500	3.4	-24,350	2,883.2	-2,358	0
2024	Terry Miller Recreation Centre	Exterior wall insulation upgrade	113,999	2.8	0	1,441.5	563	0
2024	Terry Miller Recreation Centre	Ice thickness optimization	2,500	0.5	0	262.1	102	0
2024	Terry Miller Recreation Centre	REALice	40,250	13.1	0	6,814.4	2,662	0
2024	Terry Miller Recreation Centre	Reduce flood water use	1,000	3.5	0	1,834.6	717	0
2024	Terry Miller Recreation Centre	Refrigeration plant heat recovery	650,000	102.4	412,724	34,066.6	72,358	0
2024	Terry Miller Recreation Centre	Replace ventilation and AC units	190,000	0.6	6,923	0.0	991	0
2024	Terry Miller Recreation Centre	Rooftop Solar PV	501,120	29.7	331,391	0.0	47,415	-5,011
2024	Terry Miller Recreation Centre	Window upgrade	187,275	2.0	0	1,016.9	397	0
2025	10100 The Gore Road (Heritage House-Dougherty / Johnson Farm)	Lighting upgrade	29,880	0.1	2,993	-83.4	396	299
2025	30 Main St N	Lighting upgrade	20,760	0.1	1,425	0.0	204	208
2025	36-40 Main St N	Lighting upgrade	33,600	0.2	1,930	0.0	276	336
2025	54 Main St N	Lighting upgrade	27,000	0.0	197	0.0	28	270
2025	55 Queen (Carnegie Library)	Lighting upgrade	50,088	0.3	8,777	-244.5	1,160	501
2025	60 Main St N	Lighting upgrade	46,200	0.2	4,279	-119.2	566	462
2025	Andrew Mccandless Park - Comfort Station And Skateboard Park	Lighting upgrade	8,202	0.6	6,152	0.0	880	82
2025	Bovaird House	Lighting upgrade	28,284	0.1	2,286	-63.7	302	283
2025	Brampton Cemetery Office Building	Lighting upgrade	4,500	0.0	299	0.0	43	45
2025	Central Public School Recreation Centre	Lighting upgrade	155,580	0.7	20,127	-560.7	2,661	1,556
2025	Century Gardens Recreation Centre	Solar PV rooftop	1,950,000	105.1	1,172,964	0.0	167,828	-19,500
2025	Chinguacousy Park Tea House	Lighting upgrade	21,642	0.1	1,010	0.0	145	216
2025	City Hall West Tower	Plug load reduction	339,000	9.1	101,593	0.0	14,536	0
2025	City Hall West Tower	Re-commissioning measures	62,000	24.7	0	12,866.4	5,025	0
2025	Earnscliffe Recreation Centre	Radiant heater upgrade	32,400	0.7	-5,341	632.4	-517	0
2025	Ebenezer Community Hall	Lighting upgrade	13,308	0.3	2,970	0.0	425	133
2025	Heritage Theatre and Theatre School	Lighting upgrade	57,108	0.4	4,131	0.0	591	571

Table 16: Short term ECMs to implement (2024-2029) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO2e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m3/yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2025	Susan Fennell Sportsplex	Chiller replacement - CO2	6,099,516	0.1	1,386	0.0	198	0
2025	Susan Fennell Sportsplex	Heat pump replacement	4,180,594	7.1	78,852	0.0	11,282	0
2025	Susan Fennell Sportsplex	Ice rink flooding	812,040	55.9	-103,378	33,903.6	-1,549	0
2025	Susan Fennell Sportsplex	Solar PV	3,875,942	46.9	523,848	0.0	74,952	-38,759
2025	Susan Fennell Sportsplex	Solar thermal pool heat	899,386	11.8	0	6,154.6	2,404	-13,491
2025	Terry Miller Recreation Centre	Boiler plant replacement with electric boiler	257,128	14.4	-30,105	8,911.8	-827	0
2025	Terry Miller Recreation Centre	Spectator heating to electric	60,000	12.1	0	6,290.2	2,457	0
2025	Terry Miller Recreation Centre	Ventilation operation	23,500	16.1	0	8,386.9	3,276	0
2026	10100 The Gore Road (Heritage House-Dougherty / Johnson Farm)	HVAC system optimization	49,800	1.7	1,266	821.6	502	0
2026	14 Nelson St W	Lighting upgrade	60,000	0.5	14,635	-407.7	1,935	600
2026	55 Queen (Carnegie Library)	HVAC system optimization	83,480	1.2	3,711	444.3	705	0
2026	60 Main St N	HVAC system optimization	77,000	0.7	1,809	257.4	359	0
2026	70-74 Main St N Buildings - Art Gallery	Lighting upgrade	54,978	0.0	1,165	-32.4	154	550
2026	Ambulance Station - 52 Bramalea Rd	Lighting upgrade	23,700	0.0	164	0.0	23	237
2026	Bovaird House	HVAC system optimization	47,140	0.9	966	446.7	313	0
2026	Brampton Curling Club	Lighting upgrade	156,042	0.7	20,726	-577.4	2,740	1,560
2026	Cassie Campbell Community Centre	HVAC re-commissioning	120,000	83.4	78,360	39,775.5	26,747	0
2026	Central Public School Recreation Centre	HVAC system optimization	259,300	6.3	10,948	2,779.8	2,652	0
2026	Century Gardens Recreation Centre	Wall assembly upgrade	629,000	15.6	14,936	7,401.7	5,028	0
2026	Chinguacousy Park Barn	HVAC system optimization	100,000	2.3	0	1,216.8	475	0
2026	City Hall	HVAC system optimization	1,963,160	38.3	102,203	15,146.7	20,539	0
2026	City Hall	Lighting upgrade	1,177,896	8.7	241,716	-6,734.4	31,954	11,779
2026	City Hall West Tower	Enhanced occupant-based controls	12,367,000	12.4	0	6,433.2	2,513	0
2026	City Hall West Tower	Lighting - full fixture replacement	745,000	13.6	377,383	-	49,889	7,450
2026	Earnscliffe Recreation Centre	HVAC equipment upgrade (dehumidification - arena)	173,000	3.0	33,257	0.0	4,758	0
2026	FCCC Dorm D-Sports Admin Offices	Lighting upgrade	45,096	0.2	6,381	-177.8	844	451
2026	FCCC Dorm E-Sports Admin Offices	Lighting upgrade	45,138	0.2	4,641	-129.3	613	451
2026	FCCC Dorm F-Sports Equipment Storage	Lighting upgrade	45,150	0.1	2,082	-58.0	275	452
2026	FCCC Park Maintenance Warehouse	Lighting upgrade	26,352	0.1	4,112	-114.6	544	264
2026	Memorial Arena	Lighting upgrade	198,768	0.4	9,703	-270.3	1,283	1,988
2026	Save Max Sports Centre	HVAC recommissioning	111,600	52.4	80,773	23,516.9	20,742	0
2026	Save Max Sports Centre	Roof upgrade to high performance	9,555,266	72.8	19,701	36,955.2	17,253	0
2027	14 Nelson St W	HVAC system optimization	100,000	4.0	6,188	1,779.0	1,580	0
2027	70-74 Main St N Buildings - Art Gallery	HVAC system optimization	91,630	1.9	492	948.2	441	0
2027	Brampton Curling Club	HVAC system optimization	260,070	4.0	1,243	2,035.7	973	0
2027	Brampton Public Library - Four Corners	Lighting upgrade	233,634	2.7	76,215	-2,123.4	10,075	2,336
2027	Cassie Campbell Community Centre	Cold water flooding	54,000	37.9	0	19,741.5	7,711	0

Table 16: Short term ECMs to implement (2024-2029) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO2e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m3/yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2027	Cassie Campbell Community Centre	DHW conversion	923,400	46.0	-333,476	39,486.2	-32,291	0
2027	Cassie Campbell Community Centre	Electrical service upgrade	3,274,223	0.0	0	0.0	0	0
2027	Cassie Campbell Community Centre	Ice resurfacer conversion	258,000	1.0	-7,411	877.5	-718	1,290
2027	Cassie Campbell Community Centre	Low-flow shower fixtures	30,600	7.3	0	3,820.9	1,492	0
2027	Cassie Campbell Community Centre	Roof upgrade to high performance	8,504,899	20.2	0	10,528.8	4,112	0
2027	Chinguacousy Park Curling Club	Lighting upgrade	215,400	1.8	50,641	-1,410.9	6,695	2,154
2027	Chinguacousy Park Greenhouses	Lighting upgrade	77,316	0.5	14,947	-416.4	1,976	773
2027	Chinguacousy Park Parks Building	Lighting upgrade	19,110	0.1	1,558	0.0	223	191
2027	Churchville Community Hall (FS 217 Volunteer)	Lighting upgrade	5,772	0.0	416	0.0	60	58
2027	City Hall West Tower	Electric humidification	12,241,000	30.8	-223,296	26,440.0	-21,622	0
2027	City Hall West Tower	Heat pump DHW heaters	181,000	5.7	-11,909	3,525.3	-327	0
2027	Earnscliffe Recreation Centre	DHW equipment upgrade (ground source heat pump)	1,140,000	2.9	-4,128	1,710.9	78	0
2027	Earnscliffe Recreation Centre	HVAC equipment upgrade (dehumidification - pool)	281,000	61.6	-34	32,044.2	12,511	0
2027	Earnscliffe Recreation Centre	HVAC equipment upgrade (ground source heat pump)	2,530,000	239.9	-339,550	140,719.2	6,380	0
2027	Earnscliffe Recreation Centre	Lighting controls	75,000	0.3	8,316	-231.7	1,099	0
2027	Earnscliffe Recreation Centre	Plumbing fixture upgrade	41,000	2.1	0	1,076.0	420	0
2027	Earnscliffe Recreation Centre	Roof assembly upgrade	675,000	8.2	0	4,272.2	1,669	0
2027	Earnscliffe Recreation Centre	Solar PV rooftop	1,150,000	45.3	505,627	0.0	72,345	-11,500
2027	Earnscliffe Recreation Centre	Wall assembly upgrade	503,000	6.3	0	3,289.2	1,285	0
2027	Earnscliffe Recreation Centre	Window assembly upgrade	309,000	0.7	0	370.5	145	0
2027	FCCC Dorm D-Sports Admin Offices	HVAC system optimization	75,160	2.7	2,698	1,270.2	882	0
2027	FCCC Dorm E-Sports Admin Offices	HVAC system optimization	75,230	2.2	1,962	1,066.0	697	0
2027	FCCC Dorm F-Sports Equipment Storage	HVAC system optimization	75,250	3.8	881	1,956.3	890	0
2027	FCCC Park Maintenance Warehouse	HVAC system optimization	43,920	3.4	1,738	1,706.9	915	0
2027	Greenbriar Recreation Centre	Lighting upgrade	261,168	1.1	30,095	-838.5	3,979	2,612
2027	Ken Giles Soccer Centre	Lighting upgrade	173,442	0.8	20,866	-581.3	2,758	1,734
2027	Kiwanis Youth Centre for Sports Excellence	Lighting upgrade	263,766	0.9	24,180	-673.7	3,197	2,638
2027	Memorial Arena	HVAC system optimization	331,280	4.2	582	2,177.0	934	0
2027	Royal Canadian Legion Branch 15 (Centennial Recreation Centre)	Lighting upgrade	45,942	0.0	70	0.0	10	459
2027	Save Max Sports Centre	Low-flow shower fixtures	11,400	45.2	0	23,516.9	9,185	0
2028	175 Sandalwood Parkway West	Lighting upgrade	922,620	0.0	0	0.0	0	9,226
2028	37 George St N	HVAC system optimization	349,950	2.1	0	1,098.4	429	0
2028	8 Nelson Commercial / Office	Lighting upgrade	496,644	5.4	150,730	-4,199.4	19,926	4,966
2028	Brampton Curling Club	Cold water flooding	54,000	8.0	0	4,180.4	1,633	0
2028	Brampton Public Library - Four Corners	HVAC system optimization	389,390	20.4	10,161	10,125.5	5,409	0
2028	Brampton Transit Yard 185 Clark Blvd	Lighting upgrade	864,984	3.0	82,772	-2,306.1	10,942	8,650

Table 16: Short term ECMs to implement (2024-2029) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO2e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m3/yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2028	Century Gardens Recreation Centre	HVAC equipment upgrade (dehumidification - arena)	173,000	3.4	37,588	0.0	5,378	0
2028	Chinguacousy Park Curling Club	Cold water flooding	54,000	4.5	0	2,358.6	921	0
2028	Chinguacousy Park Curling Club	HVAC system optimization	359,000	2.5	3,038	1,148.5	883	0
2028	Chinguacousy Park Greenhouses	HVAC system optimization	128,860	21.0	2,790	10,791.7	4,614	0
2028	Chinguacousy Park Mini Golf and Snack Bar	Lighting upgrade	16,776	3.2	35,451	0.0	5,072	168
2028	Chinguacousy Park Outdoor Skating Rink Building	Cold water flooding	54,000	1.6	0	849.6	332	0
2028	Chris Gibson Recreation Centre	Lighting upgrade	345,588	0.4	12,462	-347.2	1,647	3,456
2028	City Hall West Tower	Central ground-source heat pumps	15,656,000	175.5	-248,390	102,939.7	4,667	0
2028	City Hall West Tower	DOAS and air-source VRF	17,582,000	41.6	-86,936	25,734.9	-2,387	0
2028	City Hall West Tower	Heat recovery chiller with electric boiler	13,312,000	24.7	0	12,866.4	5,025	0
2028	County Court Pavillion	Lighting upgrade	7,368	0.3	2,817	0.0	403	74
2028	Cyril Clark Library	Lighting upgrade	158,652	1.4	37,732	-1,051.2	4,988	1,587
2028	Eldorado Parks Shed	Lighting upgrade	5,286	0.0	519	0.0	74	53
2028	Eldorado Pool Changehouse	Lighting upgrade	5,088	0.1	945	0.0	135	51
2028	Ellen Mitchell Recreation Centre	Lighting upgrade	85,068	0.2	5,662	-157.7	748	851
2028	Fire Station 202	Lighting upgrade	50,130	0.3	7,901	-220.1	1,045	501
2028	Fire Station 204	Lighting upgrade	60,966	0.6	15,579	-434.0	2,059	610
2028	Fire Station 205	Lighting upgrade	49,434	0.4	11,331	-315.7	1,498	494
2028	Fire Station 206	Lighting upgrade	38,688	0.3	8,739	-243.5	1,155	387
2028	Fire Station 207 Duggan Park Fieldhouse	Lighting upgrade	56,388	0.4	10,965	-305.5	1,450	564
2028	Greenbriar Recreation Centre	HVAC system optimization	435,280	4.7	1,806	2,381.5	1,189	0
2028	Jim Archdekin Recreation Centre	Lighting upgrade	275,514	1.1	30,322	-844.8	4,009	2,755
2028	Ken Giles Soccer Centre	HVAC system optimization	289,070	9.4	11,350	4,367.0	3,330	0
2028	Kiwanis Youth Centre for Sports Excellence	HVAC system optimization	439,610	13.9	28,409	5,932.0	6,382	0
2028	Knightsbridge Community and Seniors Centre	Lighting upgrade	38,346	0.2	4,223	-117.6	558	383
2028	Loafers Lake Fieldhouse	Lighting upgrade	3,000	0.0	340	0.0	49	30
2028	Loafers Lake Recreation Centre	Lighting upgrade	206,040	1.0	27,042	-753.4	3,575	2,060
2028	Nelson Square Parking Garage	Lighting upgrade	594,534	0.9	9,712	0.0	1,390	5,945
2028	Peel Village Maintenance	Lighting upgrade	9,876	0.5	5,943	0.0	850	99
2028	Professors Lake Recreation Centre	Lighting upgrade	65,718	1.3	14,816	0.0	2,120	657
2028	Riverstone Community Centre	Lighting upgrade	201,918	2.3	64,157	-1,787.5	8,481	2,019
2028	Save Max Sports Centre	Cafe fryer electrification	12,000	10.6	-77,018	9,119.5	-7,458	0
2028	Save Max Sports Centre	Energy Star appliances	80,352	0.9	9,850	0.0	1,409	0
2028	Valleybrook Field House	Lighting upgrade	3,360	0.1	1,183	0.0	169	34
2029	175 Sandalwood Parkway West	HVAC system optimization	1,537,700	0.0	0	0.0	0	0
2029	8 Nelson Commercial / Office	HVAC system optimization	827,740	13.6	63,732	4,105.5	10,722	0
2029	Animal Services Administration Building (By-Law Enfo. Williams Parkway Administration)	Lighting upgrade	38,274	0.5	14,409	-401.4	1,905	383
2029	Animal Shelter	Lighting upgrade	53,496	0.9	24,598	-685.3	3,252	535
2029	Brampton Curling Club	Ice resurfacer conversion	258,000	0.1	-875	103.6	-85	1,290
2029	Brampton Transit Yard 185 Clark Blvd	HVAC system optimization	1,441,640	176.7	126,473	86,108.9	51,729	0
2029	Brampton Transit Yard 185 Clark Blvd	Purchasing carbon offsets	0	1,959.5	0	0.0	-48,062	0

Table 16: Short term ECMs to implement (2024-2029) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2029	Brampton Transit Yard Sandalwood Facility	Lighting upgrade	2,659,614	9.1	252,792	-7,043.0	33,419	26,596
2029	Brampton Transit Yard Sandalwood Facility	Purchasing carbon offsets	0	2,795.0	0	0.0	-68,556	0
2029	Brampton Trinity Common Terminal	Lighting upgrade	5,514	0.1	2,451	-68.3	324	55
2029	Cassie Campbell Community Centre	Purchasing carbon offsets	0	1,536.8	0	0.0	-37,694	0
2029	Chinguacousy Park Curling Club	Ice resurfacers conversion	258,000	0.1	-494	58.5	-48	1,290
2029	Chris Gibson Recreation Centre	Cold water flooding	54,000	1.4	0	731.8	286	0
2029	Chris Gibson Recreation Centre	HVAC system optimization	575,980	4.7	8,939	2,005.3	2,062	0
2029	COB Parking lot (Former BCC Terminal)	Lighting upgrade	8,208	0.5	5,047	0.0	722	82
2029	Creditview Park Fieldhouse	Lighting upgrade	26,664	1.5	16,899	0.0	2,418	267
2029	Cyril Clark Library	HVAC system optimization	264,420	5.5	5,030	2,605.8	1,738	0
2029	Eldorado Park Pavillion	Lighting upgrade	7,626	0.2	2,098	0.0	300	76
2029	Ellen Mitchell Recreation Centre	HVAC system optimization	141,780	3.4	6,652	1,470.0	1,526	0
2029	Fairgrounds Park Batting Cages	Lighting upgrade	7,086	0.0	80	0.0	11	71
2029	FCCC Seniors Centre	Lighting upgrade	164,994	1.1	29,691	-827.2	3,925	1,650
2029	FCCC Units 1 and 2	Lighting upgrade	195,084	3.9	107,626	-2,998.5	14,228	1,951
2029	Fire Life Safety Centre	Lighting upgrade	62,490	0.4	10,118	-281.9	1,338	625
2029	Fire Station 202	HVAC system optimization	83,550	2.6	1,499	1,270.5	711	0
2029	Fire Station 204	HVAC system optimization	101,610	3.9	2,956	1,910.0	1,169	0
2029	Fire Station 205	HVAC system optimization	82,390	2.3	2,150	1,094.5	735	0
2029	Fire Station 206	HVAC system optimization	64,480	2.8	1,658	1,355.1	766	0
2029	Fire Station 207 Duggan Park Fieldhouse	HVAC system optimization	93,980	3.3	2,080	1,596.5	921	0
2029	Fire Station 208	Lighting upgrade	38,070	0.3	8,182	-228.0	1,082	381
2029	Fire Station 210	Lighting upgrade	54,756	0.4	10,846	-302.2	1,434	548
2029	Fire Station 213	Lighting upgrade	57,648	0.2	6,341	-176.7	838	576
2029	Gore Meadows Community Centre	Purchasing carbon offsets	0	1,613.3	0	0.0	-39,570	0
2029	Greenbriar Recreation Centre	Cold water flooding	54,000	9.4	0	4,890.6	1,910	0
2029	Jim Archdekin Recreation Centre	HVAC system optimization	459,190	16.3	21,751	7,478.2	6,033	0
2029	Knightsbridge Community and Seniors Centre	HVAC system optimization	63,910	1.5	2,297	656.1	585	0
2029	Loafers Lake Recreation Centre	HVAC system optimization	343,400	13.1	31,772	5,352.3	6,636	0
2029	Market Square Parking	Lighting upgrade	1,348,434	2.5	27,932	0.0	3,997	13,484
2029	Peel Village Clubhouse	HVAC system optimization	28,200	1.0	0	514.1	201	0
2029	POA Courthouse	Lighting upgrade	276,072	1.9	52,967	-1,475.7	7,002	2,761
2029	Riverstone Community Centre	HVAC system optimization	336,530	19.3	27,127	8,805.1	7,320	0
2029	Rose Theatre	Lighting upgrade	391,944	6.2	171,644	-4,782.1	22,691	3,919
2029	Save Max Sports Centre	Electrical service upgrade	3,040,800	0.0	0	0.0	0	0
2029	Snelgrove Seniors Centre	Lighting upgrade	40,530	0.2	6,362	-177.3	841	405
Short Term	Total	(Accounts for interactive effects and changes in the electricity grid emissions factor)	171,767,631	7,169.1	5,037,246	629,594.3	836,897	72,190

B.2 Medium Term Plan

The detailed medium term implementation plan to reduce GHG emissions is outlined in Table 17. Note that project costs were taken from deep retrofit studies where available, and otherwise estimated based on the size of each building.

Table 17: Medium term ECMs to implement (2030-2034)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2030	10100 The Gore Road (Heritage House-Dougherty / Johnson Farm)	DHW to heat pump	10,000	1.2	-2,414	714.5	-66	0
2030	175 Sandalwood Parkway West	DHW to heat pump	10,000	0.0	0	0.0	0	0
2030	Animal Services Administration Building (By-Law Enfo. Williams Parkway Administration)	HVAC system optimization	63,790	2.3	6,092	931.2	1,235	0
2030	Animal Shelter	HVAC system optimization	89,160	11.2	10,401	5,356.7	3,580	0
2030	Bovaird House	DHW to heat pump	10,000	0.6	-1,312	388.5	-36	0
2030	Bramalea Transit Terminal (new)	Lighting upgrade	56,154	0.4	11,072	-308.5	1,464	562
2030	Brampton Transit Yard Sandalwood Facility	HVAC system optimization	4,432,690	246.4	386,258	110,252.4	98,329	0
2030	Brampton Trinity Common Terminal	HVAC system optimization	9,190	0.8	3,746	232.6	627	0
2030	Cassie Campbell Community Centre	Arena dehumidification	884,925	75.3	-545,912	64,640.4	-52,862	0
2030	Cassie Campbell Community Centre	Boiler conversion to ground source heat pump	2,279,644	433.0	-612,821	253,970.3	11,515	0
2030	Cassie Campbell Community Centre	Geothermal infrastructure	5,636,588	0.0	0	0.0	0	0
2030	Cassie Campbell Community Centre	RTU-03 ground source heat pump conversion	1,750,613	19.1	-27,005	11,191.6	507	0
2030	Cassie Campbell Community Centre	RTU-04-18 ground source heat pump conversion	5,944,388	612.9	-867,430	359,487.5	16,298	0
2030	Century Gardens Recreation Centre	DHW equipment upgrade (ground source heat pump)	1,140,000	8.3	-11,816	4,896.8	222	0
2030	Century Gardens Recreation Centre	Energy recovery ventilator (changerooms)	158,000	11.9	34,745	4,569.4	6,756	-1,580
2030	Century Gardens Recreation Centre	HVAC equipment upgrade (dehumidification - pool)	281,000	68.2	-37	35,500.6	13,861	0
2030	Century Gardens Recreation Centre	HVAC equipment upgrade (ground source heat pump)	2,530,000	208.7	-295,394	122,419.5	5,550	0
2030	Chinguacousy Park Optimist Club and Ski Chalet	Lighting upgrade	117,612	2.9	32,084	0.0	4,591	1,176
2030	Chris Gibson Recreation Centre	Ice resurfacers conversion	258,000	0.0	-143	17.0	-14	1,290
2030	FCCC Lawn Bowling	Lighting upgrade	38,490	0.3	7,058	-196.6	933	385
2030	FCCC Seniors Centre	HVAC system optimization	274,990	10.0	16,150	4,476.3	4,059	0
2030	FCCC Units 1 and 2	HVAC system optimization	325,140	13.4	45,507	4,857.4	8,408	0
2030	Fire Life Safety Centre	HVAC system optimization	104,150	5.2	4,278	2,484.9	1,583	0
2030	Fire Station 208	HVAC system optimization	63,450	2.0	1,552	971.5	602	0
2030	Fire Station 209	HVAC system optimization	93,770	3.0	0	1,583.7	619	0
2030	Fire Station 210	HVAC system optimization	91,260	3.0	2,058	1,455.5	863	0
2030	Fire Station 212	Lighting upgrade	66,408	0.6	16,333	-455.0	2,159	664
2030	Fire Station 213	HVAC system optimization	96,080	2.4	1,203	1,186.9	636	0

Table 17: Medium term ECMs to implement (2030-2034) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2030	Gateway Transit Terminal Building A	Lighting upgrade	29,004	0.6	6,283	0.0	899	290
2030	Greenbriar Recreation Centre	Ice resurfacer conversion	258,000	0.1	-1,024	121.2	-99	1,290
2030	Jim Archdekin Recreation Centre	Cold water flooding	54,000	5.2	0	2,729.1	1,066	0
2030	Memorial Arena	Cold water flooding	54,000	8.6	0	4,470.7	1,746	0
2030	Mount Pleasant Clock Tower and W.R.	Lighting upgrade	2,640	0.3	3,048	0.0	436	26
2030	POA Courthouse	HVAC system optimization	460,120	15.0	22,396	6,761.7	5,845	0
2030	Rose Theatre	HVAC system optimization	653,240	24.7	72,575	9,449.3	14,075	0
2030	Sandalwood Works Administration Building	Lighting upgrade	48,114	2.9	79,264	-2,208.4	10,479	481
2030	Save Max Sports Centre	Electrification of current ventilation unit for the dome	1,058,063	214.6	-1,556,573	184,310.8	-150,725	0
2030	Save Max Sports Centre	Gas heat pump pretreat of dome outside air	1,211,963	39.6	0	20,637.3	8,061	-24,239
2030	Save Max Sports Centre	VRF pretreat of dome outside air	1,115,775	114.2	-238,350	70,556.5	-6,545	-11,158
2030	Save Max Sports Centre	VRF space conditioning of the dome	1,125,394	69.9	-145,929	43,197.8	-4,007	-11,254
2030	Snelgrove Seniors Centre	HVAC system optimization	67,550	2.4	3,461	1,112.0	929	0
2030	Teramoto Park Parks Depot	Lighting upgrade	51,180	1.3	14,380	0.0	2,058	512
2031	55 Queen (Carnegie Library)	DHW to heat pump	10,000	0.6	-1,305	386.4	-36	0
2031	60 Main St N	DHW to heat pump	10,000	0.4	-756	223.8	-21	0
2031	A and M Fire Apparatus Building	Lighting upgrade	279,852	1.2	34,444	-959.6	4,553	2,799
2031	Bramalea Transit Terminal (new)	HVAC system optimization	93,590	5.0	16,918	1,805.4	3,126	0
2031	Cemetery Maintenance Building	Lighting upgrade	14,820	0.0	546	0.0	78	148
2031	Central Public School Recreation Centre	DHW to heat pump	20,000	4.7	-9,719	2,876.9	-267	0
2031	Chinguacousy Park Barn	DHW to heat pump	10,000	1.7	-3,575	1,058.2	-98	0
2031	Chinguacousy Park Tennis Bubble	HVAC system optimization	422,280	37.3	0	19,437.6	7,592	0
2031	FCCC Lawn Bowling	HVAC system optimization	64,150	4.0	2,984	1,925.7	1,179	0
2031	Fire Station 211	Lighting upgrade	82,500	0.6	15,408	-429.3	2,037	825
2031	Fire Station 212	HVAC system optimization	110,680	2.6	3,099	1,224.3	922	0
2031	Gore Meadows Community Centre	Lighting upgrade	825,162	5.5	153,576	-4,278.7	20,302	8,252
2031	Jim Archdekin Recreation Centre	Ice resurfacer conversion	258,000	0.1	-534	63.3	-52	1,290
2031	Memorial Arena	Ice resurfacer conversion	258,000	0.1	-936	110.8	-91	1,290
2031	Norton Place Park Community Centre and Depot	Lighting upgrade	72,006	0.5	14,906	-415.3	1,970	720
2031	Sandalwood Sand and Salt Storage and Garage Building	HVAC system optimization	415,060	26.2	0	13,661.7	5,336	0
2031	Sandalwood Works Administration Building	HVAC system optimization	80,190	5.3	33,515	1,203.0	5,265	0
2031	Save Max Sports Centre	B1 and B2 upgrade to ground source heat pump	1,510,144	103.1	-145,929	60,477.0	2,742	0
2031	Save Max Sports Centre	B3 upgrade to ground source heat pump	836,831	103.4	-146,392	60,669.0	2,751	0
2031	Save Max Sports Centre	Geothermal infrastructure	3,135,713	0.0	0	0.0	0	0
2031	Save Max Sports Centre	MUA upgrade to ground source heat pump	3,491,606	440.9	-624,019	258,611.1	11,725	0

Table 17: Medium term ECMs to implement (2030-2034) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO2e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m3/yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2031	Save Max Sports Centre	Pavilion DHW upgrade to air source heat pump	15,390	9.3	-19,457	5,759.7	-534	0
2031	Save Max Sports Centre	Pavilion furnace upgrade to air source heat pump	30,780	12.4	-25,943	7,679.6	-712	0
2031	Save Max Sports Centre	Redesign changeroom HVAC	596,363	10.1	0	5,279.3	2,062	0
2031	Save Max Sports Centre	RTU upgrade to ground source heat pump	2,702,869	40.1	-56,750	23,518.8	1,066	0
2031	Springdale Library	Lighting upgrade	173,460	3.4	94,279	-2,626.7	12,463	1,735
2031	Williams Parkway Administrative Building	Lighting upgrade	230,994	0.0	402	-11.2	53	2,310
2031	Williams Parkway Operations building	Lighting upgrade	494,712	5.2	143,459	-3,996.9	18,965	4,947
2032	70-74 Main St N Buildings - Art Gallery	DHW to heat pump	10,000	1.3	-2,785	824.6	-76	0
2032	A and M Fire Apparatus Building	HVAC system optimization	466,420	8.1	6,535	3,927.8	2,469	0
2032	Brampton Curling Club	DHW to heat pump	30,000	6.8	-14,123	4,180.7	-388	0
2032	Cassie Campbell Community Centre	Windows and doors to high performance	7,579,575	49.4	0	25,737.1	10,053	0
2032	Chinguacousy Park Outdoor Skating Rink Building	HVAC system optimization	32,180	3.8	0	1,954.0	763	0
2032	City Hall West Tower	Opaque wall upgrade	12,454,000	2.5	0	1,286.6	503	0
2032	City Hall West Tower	Roof upgrade	12,332,000	1.2	0	643.3	251	0
2032	Ellen Mitchell Recreation Centre	Solar PV	225,000	5.1	56,940	0.0	8,147	-2,250
2032	Fire Station 211	HVAC system optimization	137,500	4.6	2,923	2,235.8	1,292	0
2032	Gore Meadows Community Centre	HVAC system optimization	1,375,270	75.8	180,437	31,051.6	37,945	0
2032	Jim Archdekin Recreation Centre	Solar PV	900,000	20.4	227,760	0.0	32,588	-9,000
2032	Memorial Arena	DHW to heat pump	30,000	7.2	-15,104	4,471.1	-415	0
2032	Norton Place Park Community Centre and Depot	HVAC system optimization	120,010	6.5	6,302	3,071.7	2,102	0
2032	Save Max Sports Centre	Unit heaters conversion	105,806	9.5	-68,911	8,159.6	-6,673	0
2032	Springdale Library	HVAC system optimization	289,100	1.6	12,569	272.1	1,905	0
2032	Williams Parkway Administrative Building	HVAC system optimization	384,990	30.1	170	15,670.3	6,145	0
2032	Williams Parkway Operations building	HVAC system optimization	824,520	47.6	60,658	21,924.3	17,242	0
2033	14 Nelson St W	DHW to heat pump	10,000	2.5	-5,226	1,547.0	-144	0
2033	Century Gardens Recreation Centre	Plumbing fixture upgrade	41,000	1.7	0	892.3	349	0
2033	FCCC Dorm D-Sports Admin Offices	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2033	FCCC Dorm E-Sports Admin Offices	DHW to heat pump	10,000	1.5	-3,132	927.0	-86	0
2033	FCCC Park Maintenance Warehouse	DHW to heat pump	10,000	2.4	-5,015	1,484.4	-138	0
2034	37 George St N	DHW to heat pump	10,000	1.5	-3,227	955.2	-89	0
2034	Bramalea Transit Terminal (new)	Solar PV	90,000	2.0	22,776	0.0	3,259	-900
2034	Brampton Public Library - Four Corners	DHW to heat pump	15,000	14.3	-29,746	8,805.5	-817	0
2034	Cassie Campbell Community Centre	Solar PV canopy	13,620,150	180.6	2,015,676	0.0	288,403	-136,202
2034	Cassie Campbell Community Centre	Solar PV rooftop	3,065,496	65.0	725,416	0.0	103,792	-30,655
2034	Chinguacousy Park Curling Club	DHW to heat pump	30,000	3.8	-7,968	2,358.8	-219	0
2034	Chinguacousy Park Greenhouses	DHW to heat pump	10,000	15.2	-31,704	9,384.9	-871	0
2034	Chinguacousy Wellness Centre	Active power management system	130,000	4.7	52,356	0.0	7,491	0
2034	Chinguacousy Wellness Centre	Air source heat pump boilers	628,800	56.3	-117,597	34,811.1	-3,229	0
2034	Chinguacousy Wellness Centre	Air source heat pump domestic hot water heater	276,575	53.3	-111,193	32,915.5	-3,053	0

Table 17: Medium term ECMs to implement (2030-2034) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2034	Chinguacousy Wellness Centre	Air source heat pump replacement of fuel fired RTUS	587,100	79.3	-165,569	49,011.9	-4,546	0
2034	Chinguacousy Wellness Centre	Energy recovery ventilator unit	96,000	6.5	0	3,361.0	1,313	-960
2034	Fire Station 206	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2034	Greenbriar Recreation Centre	DHW to heat pump	60,000	7.9	-16,522	4,890.9	-454	0
2034	Ken Giles Soccer Centre	DHW to heat pump	20,000	7.3	-15,268	4,519.6	-419	0
2034	Kiwanis Youth Centre for Sports Excellence	DHW to heat pump	60,000	53.1	-110,864	32,818.0	-3,044	0
Medium Term	Total	(Accounts for interactive effects and changes in the electricity grid emissions factor)	105,406,179	5,210.6	608,228	1,347,686.2	622,623	-198,106

B.3 Long Term Plan

The detailed long term implementation plan to reduce GHG emissions is outlined in Table 18. Note that project costs were taken from deep retrofit studies where available, and otherwise estimated based on the size of each building.

Table 18: Long term ECMs to implement (2035-2050)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2035	10100 The Gore Road (Heritage House-Dougherty / Johnson Farm)	HVAC to heat pump	251,259	13.3	-27,757	8,216.5	-762	0
2035	Bovaird House	HVAC to heat pump	239,077	7.2	-15,092	4,467.5	-414	0
2035	Brampton Transit Yard 185 Clark Blvd	DHW to heat pump	50,000	121.2	-252,967	74,883.3	-6,946	0
2035	Chris Gibson Recreation Centre	DHW to heat pump	90,000	1.2	-2,472	731.9	-68	0
2035	Chris Gibson Recreation Centre	Pool heat to heat pump	4,000,000	7.4	-15,475	4,580.9	-425	0
2035	Cyril Clark Library	DHW to heat pump	15,000	3.7	-7,655	2,266.1	-210	0
2035	Fire Station 202	DHW to heat pump	20,000	1.8	-3,732	1,104.9	-102	0
2035	Fire Station 204	DHW to heat pump	40,000	2.7	-5,611	1,661.0	-154	0
2035	Fire Station 205	DHW to heat pump	20,000	1.5	-3,215	951.8	-88	0
2035	Fire Station 207 Duggan Park Fieldhouse	DHW to heat pump	20,000	2.2	-4,690	1,388.4	-129	0
2035	Knightsbridge Community and Seniors Centre	DHW to heat pump	10,000	1.1	-2,294	679.1	-63	0
2035	Loafers Lake Recreation Centre	DHW to heat pump	60,000	47.9	-100,029	29,610.6	-2,747	0
2035	Peel Village Clubhouse	DHW to heat pump	10,000	0.7	-1,510	447.1	-41	0
2036	10100 The Gore Road (Heritage House-Dougherty / Johnson Farm)	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2036	55 Queen (Carnegie Library)	HVAC to heat pump	237,797	7.2	-15,011	4,443.6	-412	0
2036	60 Main St N	HVAC to heat pump	137,755	4.2	-8,696	2,574.2	-239	0
2036	8 Nelson Commercial / Office	DHW to heat pump	15,000	5.8	-12,061	3,570.3	-331	0
2036	Central Public School Recreation Centre	HVAC to heat pump	879,757	45.0	-93,912	27,799.9	-2,579	0
2036	Chinguacousy Park Barn	HVAC to heat pump	372,120	19.7	-41,108	12,168.8	-1,129	0
2036	City Hall	DHW to heat pump	25,000	21.3	-44,497	13,172.1	-1,222	0
2036	Ellen Mitchell Recreation Centre	Pool heat to heat pump	4,000,000	13.7	-28,530	8,445.3	-783	0
2036	Gore Meadows Community Centre	Pool heat to heat pump	4,000,000	288.7	-602,648	178,396.0	-16,548	0
2036	Riverstone Community Centre	DHW to heat pump	20,000	12.4	-25,867	7,657.2	-710	0
2037	36-40 Main St N	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2037	54 Main St N	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2037	55 Queen (Carnegie Library)	Solar PV	45,000	1.0	11,388	0.0	1,629	-450

Table 18: Long term ECMs to implement (2035-2050) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2037	60 Main St N	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2037	70-74 Main St N Buildings - Art Gallery	HVAC to heat pump	507,448	15.3	-32,033	9,482.4	-880	0
2037	Animal Services Administration Building (By-Law Enfo. Williams Parkway Administration)	DHW to heat pump	10,000	1.3	-2,736	809.8	-75	0
2037	Animal Shelter	DHW to heat pump	10,000	7.5	-15,737	4,658.4	-432	0
2037	Bovaird House	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2037	Brampton Curling Club	HVAC to heat pump	1,022,759	32.9	-68,773	20,358.2	-1,888	0
2037	Century Gardens Recreation Centre	Window assembly upgrade	765,000	0.7	0	384.4	150	0
2037	Chinguacousy Wellness Centre	VRV system to replace VVT	191,400	18.7	-39,099	11,574.2	-1,074	0
2037	City Hall West Tower	Spandrel upgrade	13,078,000	2.5	0	1,286.6	503	0
2037	City Hall West Tower	Window upgrade - step 3	20,375,000	24.7	0	12,866.4	5,025	0
2037	Fire Station 208	DHW to heat pump	20,000	1.4	-2,854	844.9	-78	0
2037	Jim Archdekin Recreation Centre	Pool heat to heat pump	4,000,000	27.6	-57,710	17,083.4	-1,585	0
2037	Memorial Arena	HVAC to heat pump	1,093,796	35.2	-73,550	21,772.2	-2,020	0
2037	Snelgrove Seniors Centre	DHW to heat pump	10,000	1.9	-3,888	1,150.8	-107	0
2038	14 Nelson St W	HVAC to heat pump	952,074	28.8	-60,101	17,791.0	-1,650	0
2038	70-74 Main St N Buildings - Art Gallery	Solar PV	90,000	2.0	22,776	0.0	3,259	-900
2038	Brampton Curling Club	Equipment electrification	500,000	8.8	-63,600	7,530.7	-6,158	0
2038	Brampton Curling Club	Solar PV	225,000	5.1	56,940	0.0	8,147	-2,250
2038	Brampton Transit Yard Sandalwood Facility	DHW to heat pump	50,000	155.2	-323,895	95,879.4	-8,894	0
2038	Cassie Campbell Community Centre	Existing solar PV ownership transition	0	18.4	204,984	0.0	29,329	-8,100
2038	Central Public School Recreation Centre	Solar PV	225,000	5.1	56,940	0.0	8,147	-2,250
2038	Century Gardens Recreation Centre	Radiant heater upgrade	32,400	0.9	-6,634	785.5	-642	0
2038	Chinguacousy Park Barn	Solar PV	90,000	2.0	22,776	0.0	3,259	-900
2038	Chinguacousy Park Curling Club	Equipment electrification	500,000	4.9	-35,883	4,248.8	-3,475	0
2038	FCCC Dorm E-Sports Admin Offices	HVAC to heat pump	326,009	17.3	-36,014	10,661.0	-989	0
2038	FCCC Dorm F-Sports Equipment Storage	HVAC to heat pump	598,283	31.7	-66,093	19,564.7	-1,815	0
2038	FCCC Park Maintenance Warehouse	HVAC to heat pump	913,525	27.6	-57,667	17,070.6	-1,583	0
2038	FCCC Seniors Centre	DHW to heat pump	20,000	7.5	-15,650	4,632.8	-430	0
2038	FCCC Units 1 and 2	DHW to heat pump	10,000	6.8	-14,270	4,224.2	-392	0
2038	Fire Life Safety Centre	DHW to heat pump	10,000	3.5	-7,300	2,161.0	-200	0
2038	Fire Station 209	DHW to heat pump	20,000	2.2	-4,653	1,377.3	-128	0
2038	Fire Station 210	DHW to heat pump	20,000	2.0	-4,276	1,265.8	-117	0
2038	Fire Station 213	DHW to heat pump	20,000	1.7	-3,487	1,032.2	-96	0
2038	Heritage Theatre and Theatre School	Solar PV	90,000	2.0	22,776	0.0	3,259	-900
2038	Kiwanis Youth Centre for Sports Excellence	Pool heat to heat pump	4,000,000	55.2	-115,128	34,080.2	-3,161	0
2038	Loafers Lake Recreation Centre	Pool heat to heat pump	4,000,000	49.8	-103,876	30,749.5	-2,852	0
2038	Memorial Arena	Solar PV	315,000	7.1	79,716	0.0	11,406	-3,150
2038	POA Courthouse	DHW to heat pump	10,000	9.5	-19,864	5,880.2	-545	0
2039	37 George St N	HVAC to heat pump	587,846	17.8	-37,108	10,984.8	-1,019	0
2039	Bramalea Transit Terminal (new)	DHW to heat pump	10,000	2.5	-5,304	1,570.1	-146	0
2039	Brampton Public Library - Four Corners	HVAC to heat pump	5,419,064	163.9	-342,083	101,263.5	-9,393	0
2039	Chinguacousy Park Curling Club	HVAC to heat pump	577,043	18.6	-38,802	11,486.2	-1,065	0
2039	Chinguacousy Park Greenhouses	HVAC to heat pump	5,775,612	174.7	-364,591	107,926.1	-10,011	0
2039	Chris Gibson Recreation Centre	Equipment electrification	500,000	1.4	-10,411	1,232.8	-1,008	0
2039	Greenbriar Recreation Centre	HVAC to heat pump	1,196,511	38.5	-80,457	23,816.8	-2,209	0
2039	Ken Giles Soccer Centre	HVAC to heat pump	1,382,078	70.7	-147,534	43,673.0	-4,051	0

Table 18: Long term ECMs to implement (2035-2050) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO2e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m3/yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2039	Kiwanis Youth Centre for Sports Excellence	HVAC to heat pump	3,551,074	96.0	-200,408	59,324.8	-5,503	0
2040	175 Sandalwood Parkway West	HVAC to heat pump	2,907,475	0.0	0	0.0	0	0
2040	37 George St N	Solar PV	315,000	7.1	79,716	0.0	11,406	-3,150
2040	Brampton Transit Yard 185 Clark Blvd	HVAC to heat pump	26,333,953	1,393.6	-2,909,119	861,157.7	-79,881	0
2040	Chinguacousy Park Curling Club	Solar PV	360,000	8.2	91,104	0.0	13,035	-3,600
2040	Chinguacousy Park Tennis Bubble	DHW to heat pump	20,000	27.4	-57,103	16,903.6	-1,568	0
2040	Chris Gibson Recreation Centre	HVAC to heat pump	769,419	32.5	-67,747	20,054.6	-1,860	0
2040	City Hall	Solar PV	1,800,000	40.8	455,520	0.0	65,176	-18,000
2040	Cyril Clark Library	HVAC to heat pump	1,394,583	42.2	-88,034	26,059.9	-2,417	0
2040	FCCC Dorm E-Sports Admin Offices	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2040	FCCC Dorm F-Sports Equipment Storage	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2040	FCCC Lawn Bowling	DHW to heat pump	10,000	2.7	-5,657	1,674.6	-155	0
2040	Fire Station 202	HVAC to heat pump	679,962	20.6	-42,923	12,706.1	-1,179	0
2040	Fire Station 204	HVAC to heat pump	1,022,232	30.9	-64,529	19,102.0	-1,772	0
2040	Fire Station 205	HVAC to heat pump	585,778	17.7	-36,978	10,946.2	-1,015	0
2040	Fire Station 207 Duggan Park Fieldhouse	HVAC to heat pump	854,445	25.8	-53,938	15,966.6	-1,481	0
2040	Fire Station 212	DHW to heat pump	40,000	1.7	-3,597	1,064.7	-99	0
2040	Greenbriar Recreation Centre	Equipment electrification	500,000	10.3	-74,404	8,810.1	-7,205	0
2040	Jim Archdekin Recreation Centre	Equipment electrification	500,000	5.4	-38,826	4,597.3	-3,760	0
2040	Knightsbridge Community and Seniors Centre	HVAC to heat pump	207,652	10.6	-22,166	6,561.7	-609	0
2040	Loafers Lake Recreation Centre	HVAC to heat pump	3,204,021	86.6	-180,822	53,526.9	-4,965	0
2040	Peel Village Clubhouse	HVAC to heat pump	157,237	8.3	-17,370	5,141.9	-477	0
2040	Sandalwood Sand and Salt Storage and Garage Building	DHW to heat pump	20,000	19.2	-40,135	11,880.7	-1,102	0
2040	Sandalwood Works Administration Building	DHW to heat pump	10,000	1.7	-3,534	1,046.2	-97	0
2041	8 Nelson Commercial / Office	HVAC to heat pump	2,197,234	66.4	-138,702	41,058.7	-3,809	0
2041	A and M Fire Apparatus Building	DHW to heat pump	80,000	5.5	-11,539	3,415.8	-317	0
2041	Brampton Public Library - Four Corners	Solar PV	765,000	17.3	193,596	0.0	27,700	-7,650
2041	Chinguacousy Park Greenhouses	Solar PV	225,000	5.1	56,940	0.0	8,147	-2,250
2041	Chinguacousy Park Outdoor Skating Rink Building	DHW to heat pump	30,000	1.4	-2,870	849.6	-79	0
2041	Chris Gibson Recreation Centre	Solar PV	540,000	12.2	136,656	0.0	19,553	-5,400
2041	City Hall	HVAC to heat pump	8,106,318	245.1	-511,718	151,478.9	-14,051	0
2041	Cyril Clark Library	Solar PV	225,000	5.1	56,940	0.0	8,147	-2,250
2041	Fire Station 211	DHW to heat pump	40,000	3.1	-6,568	1,944.3	-180	0
2041	Gore Meadows Community Centre	DHW to heat pump	120,000	278.0	-580,328	171,788.8	-15,935	0
2041	Greenbriar Recreation Centre	Solar PV	855,000	19.4	216,372	0.0	30,959	-8,550
2041	Ken Giles Soccer Centre	Solar PV	585,000	13.3	148,044	0.0	21,182	-5,850
2041	Memorial Arena	Equipment electrification	500,000	9.4	-68,017	8,053.8	-6,586	0
2041	Norton Place Park Community Centre and Depot	DHW to heat pump	10,000	4.3	-9,024	2,671.3	-248	0
2041	Riverstone Community Centre	HVAC to heat pump	2,692,782	142.5	-297,472	88,057.8	-8,168	0
2041	Royal Canadian Legion Branch 15 (Centennial Recreation Centre)	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2041	Williams Parkway Administrative Building	DHW to heat pump	20,000	22.1	-46,036	13,627.4	-1,264	0
2041	Williams Parkway Operations building	DHW to heat pump	20,000	30.9	-64,408	19,066.2	-1,769	0
2042	Animal Services Administration Building (By-Law Enfo. Williams Parkway Administration)	HVAC to heat pump	498,389	15.1	-31,461	9,313.2	-864	0
2042	Animal Shelter	HVAC to heat pump	2,866,857	86.7	-180,973	53,571.6	-4,969	0
2042	Brampton Trinity Common Terminal	HVAC to heat pump	124,511	3.8	-7,860	2,326.7	-216	0
2042	Chinguacousy Wellness Centre	Pool filtration system optimization	108,300	2.0	13,858	406.7	2,142	0
2042	Fire Station 202	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2042	Fire Station 204	Solar PV	90,000	2.0	22,776	0.0	3,259	-900

Table 18: Long term ECMs to implement (2035-2050) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO2e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m3/yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2042	Fire Station 205	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2042	Fire Station 208	HVAC to heat pump	519,953	15.7	-32,823	9,716.1	-901	0
2042	Kiwanis Youth Centre for Sports Excellence	Solar PV	855,000	19.4	216,372	0.0	30,959	-8,550
2042	Knightsbridge Community and Seniors Centre	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2042	Loafers Lake Recreation Centre	Solar PV	675,000	15.3	170,820	0.0	24,441	-6,750
2042	Professors Lake Recreation Centre	Solar PV	90,000	2.0	22,776	0.0	3,259	-900
2042	Snelgrove Seniors Centre	HVAC to heat pump	351,920	18.0	-37,567	11,120.5	-1,032	0
2042	Springdale Library	DHW to heat pump	15,000	0.4	-799	236.6	-22	0
2043	8 Nelson Commercial / Office	Solar PV	1,350,000	30.6	341,640	0.0	48,882	-13,500
2043	Animal Services Administration Building (By-Law Enfo. Williams Parkway Administration)	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2043	Brampton Transit Yard Sandalwood Facility	HVAC to heat pump	33,717,575	1,784.4	-3,724,790	1,102,612.6	-102,279	0
2043	FCCC Seniors Centre	HVAC to heat pump	1,416,682	72.4	-151,228	44,766.5	-4,153	0
2043	FCCC Units 1 and 2	HVAC to heat pump	2,599,618	78.6	-164,103	48,577.8	-4,506	0
2043	Fire Life Safety Centre	HVAC to heat pump	759,938	40.2	-83,951	24,851.0	-2,305	0
2043	Fire Station 207 Duggan Park Fieldhouse	Solar PV	90,000	2.0	22,776	0.0	3,259	-900
2043	Fire Station 208	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2043	Fire Station 209	HVAC to heat pump	847,601	25.6	-53,506	15,838.7	-1,469	0
2043	Fire Station 210	HVAC to heat pump	778,970	23.6	-49,173	14,556.2	-1,350	0
2043	Fire Station 213	HVAC to heat pump	635,208	19.2	-40,098	11,869.8	-1,101	0
2043	Market Square Parking	Solar PV	2,250,000	51.0	569,400	0.0	81,470	-22,500
2043	Nelson Square Parking Garage	Solar PV	990,000	22.4	250,536	0.0	35,847	-9,900
2043	POA Courthouse	HVAC to heat pump	3,618,798	109.4	-228,440	67,622.8	-6,273	0
2043	Riverstone Community Centre	Solar PV	675,000	15.3	170,820	0.0	24,441	-6,750
2043	Rose Theatre	HVAC to heat pump	2,889,800	152.9	-319,237	94,500.6	-8,766	0
2043	Snelgrove Seniors Centre	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2044	Animal Shelter	Solar PV	180,000	4.1	45,552	0.0	6,518	-1,800
2044	Chinguacousy Wellness Centre	Solar PV additional array	4,590,000	86.7	967,980	0.0	138,499	-45,900
2044	Chinguacousy Wellness Centre	Use of efficient plumbing fixtures and fittings	100,450	19.1	0	9,957.2	3,889	0
2044	Fire Station 209	Solar PV	90,000	2.0	22,776	0.0	3,259	-900
2044	Fire Station 210	Solar PV	90,000	2.0	22,776	0.0	3,259	-900
2044	Rose Theatre	DHW to heat pump	30,000	13.3	-27,760	8,217.4	-762	0
2045	Cassie Campbell Community Centre	Wall upgrade to high performance	2,429,696	10.1	0	5,264.4	2,056	0
2045	Chinguacousy Park Tennis Bubble	HVAC to heat pump	3,561,624	314.6	-656,683	194,391.4	-18,032	0
2045	FCCC Lawn Bowling	HVAC to heat pump	588,915	31.2	-65,058	19,258.4	-1,786	0
2045	FCCC Seniors Centre	Solar PV	540,000	12.2	136,656	0.0	19,553	-5,400
2045	FCCC Units 1 and 2	Solar PV	630,000	14.3	159,432	0.0	22,812	-6,300
2045	Fire Life Safety Centre	Solar PV	90,000	2.0	22,776	0.0	3,259	-900
2045	Fire Station 212	HVAC to heat pump	655,246	19.8	-41,363	12,244.3	-1,136	0
2045	Fire Station 212	Solar PV	90,000	2.0	22,776	0.0	3,259	-900
2045	Fire Station 213	Solar PV	90,000	2.0	22,776	0.0	3,259	-900
2045	Jim Archdekin Recreation Centre	DHW to heat pump	90,000	4.4	-9,220	2,729.3	-253	0
2045	Jim Archdekin Recreation Centre	HVAC to heat pump	2,869,347	121.0	-252,646	74,788.3	-6,937	0
2045	POA Courthouse	Solar PV	900,000	20.4	227,760	0.0	32,588	-9,000
2045	Rose Theatre	Solar PV	1,305,000	29.6	330,252	0.0	47,252	-13,050
2045	Sandalwood Sand and Salt Storage and Garage Building	HVAC to heat pump	4,178,053	221.1	-461,551	136,628.3	-12,674	0
2045	Sandalwood Works Administration Building	HVAC to heat pump	367,900	19.5	-40,642	12,030.8	-1,116	0
2046	A and M Fire Apparatus Building	HVAC to heat pump	2,102,116	63.6	-132,698	39,281.2	-3,644	0
2046	Chinguacousy Park Optimist Club and Ski Chalet	Solar PV	180,000	4.1	45,552	0.0	6,518	-1,800
2046	Chinguacousy Park Outdoor Skating Rink Building	HVAC to heat pump	597,580	31.6	-66,015	19,541.7	-1,813	0
2046	FCCC Dorm D-Sports Admin Offices	DHW to heat pump	10,000	1.8	-3,732	1,104.6	-102	0
2046	FCCC Dorm D-Sports Admin Offices	HVAC to heat pump	388,465	20.6	-42,914	12,703.4	-1,178	0
2046	FCCC Lawn Bowling	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2046	Fire Station 211	HVAC to heat pump	1,196,567	36.2	-75,534	22,359.7	-2,074	0

Table 18: Long term ECMs to implement (2035-2050) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO2e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m3/yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2046	Gateway Transit Terminal Building A	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2046	Gore Meadows Community Centre	HVAC to heat pump	18,588,425	502.6	-1,049,055	310,541.2	-28,806	0
2046	Norton Place Park Community Centre and Depot	HVAC to heat pump	1,643,950	49.7	-103,776	30,719.7	-2,850	0
2046	Sandalwood Works Administration Building	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2046	Save Max Sports Centre	Windows and doors upgrade to high performance	2,143,058	112.4	19,701	57,592.5	25,314	0
2046	Teramoto Park Parks Depot	Solar PV	45,000	1.0	11,388	0.0	1,629	-450
2046	Williams Parkway Administrative Building	HVAC to heat pump	4,792,316	253.6	-529,409	156,715.6	-14,537	0
2046	Williams Parkway Operations building	HVAC to heat pump	6,704,933	354.8	-740,696	219,260.8	-20,339	0
2047	Bramalea Transit Terminal (new)	HVAC to heat pump	966,253	29.2	-60,996	18,055.9	-1,675	0
2047	Chinguacousy Park Tennis Bubble	Solar PV	855,000	19.4	216,372	0.0	30,959	-8,550
2047	Ellen Mitchell Recreation Centre	DHW to heat pump	30,000	13.2	-27,473	8,132.5	-754	0
2047	Ellen Mitchell Recreation Centre	HVAC to heat pump	879,983	23.8	-49,663	14,701.1	-1,364	0
2047	Fire Station 206	DHW to heat pump	20,000	1.9	-3,981	1,178.4	-109	0
2047	Fire Station 206	HVAC to heat pump	725,207	21.9	-45,779	13,551.6	-1,257	0
2047	Fire Station 211	Solar PV	135,000	3.1	34,164	0.0	4,888	-1,350
2047	Sandalwood Sand and Salt Storage and Garage Building	Solar PV	810,000	18.4	204,984	0.0	29,329	-8,100
2047	Save Max Sports Centre	Solar PV canopy	19,776,150	-5.1	-56,750	0.0	-8,120	-197,762
2047	Save Max Sports Centre	Solar PV rooftop	4,185,118	-5.1	-56,750	0.0	-8,120	-41,851
2047	Springdale Library	HVAC to heat pump	145,632	4.4	-9,193	2,721.4	-252	0
2048	Gore Meadows Community Centre	Solar PV	2,745,000	62.2	694,668	0.0	99,393	-27,450
2048	Norton Place Park Community Centre and Depot	Solar PV	90,000	2.0	22,776	0.0	3,259	-900
2048	Williams Parkway Administrative Building	Solar PV	765,000	17.3	193,596	0.0	27,700	-7,650
2048	Williams Parkway Operations building	Solar PV	1,665,000	37.8	421,356	0.0	60,288	-16,650
2049	Springdale Library	Solar PV	270,000	6.1	68,328	0.0	9,776	-2,700
2050	10100 The Gore Road (Heritage House-Dougherty / Johnson Farm)	Purchasing carbon offsets	0	20.2	0	0.0	-496	0
2050	14 Nelson St W	Purchasing carbon offsets	0	52.1	0	0.0	-1,279	0
2050	175 Sandalwood Parkway West	Purchasing carbon offsets	0	0.0	0	0.0	0	0
2050	30 Main St N	Purchasing carbon offsets	0	2.3	0	0.0	-56	0
2050	36-40 Main St N	Purchasing carbon offsets	0	2.8	0	0.0	-69	0
2050	37 George St N	Purchasing carbon offsets	0	22.9	0	0.0	-563	0
2050	54 Main St N	Purchasing carbon offsets	0	1.3	0	0.0	-32	0
2050	55 Queen (Carnegie Library)	Purchasing carbon offsets	0	18.3	0	0.0	-448	0
2050	60 Main St N	Purchasing carbon offsets	0	9.8	0	0.0	-239	0
2050	63-71 Main St N	Purchasing carbon offsets	0	0.0	0	0.0	-1	0
2050	70-74 Main St N Buildings - Art Gallery	Purchasing carbon offsets	0	21.0	0	0.0	-515	0
2050	8 Nelson Commercial / Office	Purchasing carbon offsets	0	240.1	0	0.0	-5,889	0
2050	A and M Fire Apparatus Building	Purchasing carbon offsets	0	113.7	0	0.0	-2,788	0
2050	Ambulance Station - 52 Bramalea Rd	Purchasing carbon offsets	0	0.2	0	0.0	-6	0
2050	Andrew McCandless Park - Comfort Station And Skateboard Park	Purchasing carbon offsets	0	10.4	0	0.0	-255	0
2050	Animal Services Administration Building (By-Law Enfo. Williams Parkway Administration)	Purchasing carbon offsets	0	34.2	0	0.0	-839	0

Table 18: Long term ECMs to implement (2035-2050) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO2e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m3/yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2050	Animal Shelter	Purchasing carbon offsets	0	137.0	0	0.0	-3,362	0
2050	Bovaird House	Purchasing carbon offsets	0	11.7	0	0.0	-286	0
2050	Bramalea Transit Terminal (new)	Purchasing carbon offsets	0	59.3	0	0.0	-1,454	0
2050	Brampton Cemetery Office Building	Purchasing carbon offsets	0	2.3	0	0.0	-56	0
2050	Brampton Curling Club	Purchasing carbon offsets	0	107.0	0	0.0	-2,624	0
2050	Brampton Public Library - Four Corners	Purchasing carbon offsets	0	268.3	0	0.0	-6,582	0
2050	Brampton Trinity Common Terminal	Purchasing carbon offsets	0	9.6	0	0.0	-236	0
2050	Cemetery Maintenance Building	Purchasing carbon offsets	0	0.9	0	0.0	-23	0
2050	Central Public School Recreation Centre	Purchasing carbon offsets	0	80.7	0	0.0	-1,979	0
2050	Century Gardens Recreation Centre	Purchasing carbon offsets	0	508.2	0	0.0	-12,464	0
2050	Chinguacousy Park Barn	Purchasing carbon offsets	0	25.4	0	0.0	-623	0
2050	Chinguacousy Park Curling Club	Purchasing carbon offsets	0	130.1	0	0.0	-3,192	0
2050	Chinguacousy Park Garage	Purchasing carbon offsets	0	3.0	0	0.0	-72	0
2050	Chinguacousy Park Greenhouses	Purchasing carbon offsets	0	243.2	0	0.0	-5,965	0
2050	Chinguacousy Park Mini Golf and Snack Bar	Purchasing carbon offsets	0	51.4	0	0.0	-1,261	0
2050	Chinguacousy Park Optimist Club and Ski Chalet	Purchasing carbon offsets	0	46.5	0	0.0	-1,142	0
2050	Chinguacousy Park Outdoor Skating Rink Building	Purchasing carbon offsets	0	40.8	0	0.0	-1,001	0
2050	Chinguacousy Park Parks Building	Purchasing carbon offsets	0	2.6	0	0.0	-65	0
2050	Chinguacousy Park Tea House	Purchasing carbon offsets	0	4.7	0	0.0	-116	0
2050	Chinguacousy Park Tennis Bubble	Purchasing carbon offsets	0	405.9	0	0.0	-9,956	0
2050	Chinguacousy Wellness Centre	Purchasing carbon offsets	0	343.0	0	0.0	-8,413	0
2050	Chris Gibson Recreation Centre	Purchasing carbon offsets	0	84.9	0	0.0	-2,082	0
2050	Churchville Community Hall (FS 217 Volunteer)	Purchasing carbon offsets	0	2.5	0	0.0	-62	0
2050	City Hall	Purchasing carbon offsets	0	563.8	0	0.0	-13,829	0
2050	City Hall West Tower	Purchasing carbon offsets	0	555.1	0	0.0	-13,615	0
2050	COB Parking lot (Former BCC Terminal)	Purchasing carbon offsets	0	7.3	0	0.0	-180	0
2050	County Court Pavillion	Purchasing carbon offsets	0	4.8	0	0.0	-117	0
2050	Creditview Park Fieldhouse	Purchasing carbon offsets	0	28.6	0	0.0	-702	0
2050	Cyril Clark Library	Purchasing carbon offsets	0	82.6	0	0.0	-2,026	0
2050	Earnscliffe Recreation Centre	Purchasing carbon offsets	0	584.1	0	0.0	-14,326	0
2050	Ebenezer Community Hall	Purchasing carbon offsets	0	4.3	0	0.0	-106	0
2050	Eldorado Park Pavillion	Purchasing carbon offsets	0	3.0	0	0.0	-75	0
2050	Eldorado Parks Shed	Purchasing carbon offsets	0	0.8	0	0.0	-18	0

Table 18: Long term ECMs to implement (2035-2050) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO ₂ e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m ³ /yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2050	Eldorado Pool Changehouse	Purchasing carbon offsets	0	1.4	0	0.0	-34	0
2050	Electric Bus Charging Stations	Purchasing carbon offsets	0	44.2	0	0.0	-1,083	0
2050	Electric Vehicle Charging Stations	Purchasing carbon offsets	0	12.9	0	0.0	-318	0
2050	Ellen Mitchell Recreation Centre	Purchasing carbon offsets	0	72.8	0	0.0	-1,785	0
2050	Fairgrounds Park Batting Cages	Purchasing carbon offsets	0	0.1	0	0.0	-3	0
2050	FCCC Dorm D-Sports Admin Offices	Purchasing carbon offsets	0	33.1	0	0.0	-811	0
2050	FCCC Dorm E-Sports Admin Offices	Purchasing carbon offsets	0	27.0	0	0.0	-663	0
2050	FCCC Dorm F-Sports Equipment Storage	Purchasing carbon offsets	0	43.0	0	0.0	-1,054	0
2050	FCCC Lawn Bowling	Purchasing carbon offsets	0	47.4	0	0.0	-1,164	0
2050	FCCC Park Maintenance Warehouse	Purchasing carbon offsets	0	39.9	0	0.0	-978	0
2050	FCCC Seniors Centre	Purchasing carbon offsets	0	127.1	0	0.0	-3,118	0
2050	FCCC Units 1 and 2	Purchasing carbon offsets	0	211.6	0	0.0	-5,191	0
2050	Fire Life Safety Centre	Purchasing carbon offsets	0	62.3	0	0.0	-1,527	0
2050	Fire Station 202	Purchasing carbon offsets	0	33.8	0	0.0	-829	0
2050	Fire Station 204	Purchasing carbon offsets	0	54.2	0	0.0	-1,329	0
2050	Fire Station 205	Purchasing carbon offsets	0	33.3	0	0.0	-816	0
2050	Fire Station 206	Purchasing carbon offsets	0	36.3	0	0.0	-891	0
2050	Fire Station 207 Duggan Park Fieldhouse	Purchasing carbon offsets	0	43.4	0	0.0	-1,065	0
2050	Fire Station 208	Purchasing carbon offsets	0	27.8	0	0.0	-682	0
2050	Fire Station 209	Purchasing carbon offsets	0	33.1	0	0.0	-811	0
2050	Fire Station 210	Purchasing carbon offsets	0	40.4	0	0.0	-990	0
2050	Fire Station 211	Purchasing carbon offsets	0	60.8	0	0.0	-1,492	0
2050	Fire Station 212	Purchasing carbon offsets	0	40.6	0	0.0	-995	0
2050	Fire Station 213	Purchasing carbon offsets	0	30.6	0	0.0	-751	0
2050	Former Fire Station 201	Purchasing carbon offsets	0	60.5	0	0.0	-1,484	0
2050	Gateway Transit Terminal Building A	Purchasing carbon offsets	0	17.3	0	0.0	-426	0
2050	Greenbriar Recreation Centre	Purchasing carbon offsets	0	135.6	0	0.0	-3,327	0
2050	Heritage Theatre and Theatre School	Purchasing carbon offsets	0	6.0	0	0.0	-147	0
2050	Jim Archdekin Recreation Centre	Purchasing carbon offsets	0	274.6	0	0.0	-6,735	0
2050	Ken Giles Soccer Centre	Purchasing carbon offsets	0	115.7	0	0.0	-2,839	0
2050	Kiwanis Youth Centre for Sports Excellence	Purchasing carbon offsets	0	296.6	0	0.0	-7,276	0
2050	Knightsbridge Community and Seniors Centre	Purchasing carbon offsets	0	18.5	0	0.0	-454	0
2050	Loafers Lake Fieldhouse	Purchasing carbon offsets	0	0.6	0	0.0	-14	0

Table 18: Long term ECMs to implement (2035-2050) (continued)

Year	Facility	Measure	Project cost (\$)	GHG reduction (tCO2e/yr)	Electricity reduction (kWh/yr)	Natural gas reduction (m3/yr)	Utility cost reduction (\$/yr)	Operating cost reduction (\$/yr)
2050	Loafers Lake Recreation Centre	Purchasing carbon offsets	0	279.4	0	0.0	-6,852	0
2050	Market Square Parking	Purchasing carbon offsets	0	40.5	0	0.0	-994	0
2050	Memorial Arena	Purchasing carbon offsets	0	92.1	0	0.0	-2,258	0
2050	Mount Pleasant Clock Tower and W.R.	Purchasing carbon offsets	0	4.4	0	0.0	-108	0
2050	Nelson Square Parking Garage	Purchasing carbon offsets	0	14.1	0	0.0	-346	0
2050	Norton Place Park Community Centre and Depot	Purchasing carbon offsets	0	79.4	0	0.0	-1,948	0
2050	Park Lighting	Purchasing carbon offsets	0	7.6	0	0.0	-187	0
2050	Parking Lot Lighting	Purchasing carbon offsets	0	4.9	0	0.0	-121	0
2050	Peel Village Clubhouse	Purchasing carbon offsets	0	10.7	0	0.0	-263	0
2050	Peel Village Maintenance	Purchasing carbon offsets	0	8.6	0	0.0	-211	0
2050	POA Courthouse	Purchasing carbon offsets	0	195.4	0	0.0	-4,794	0
2050	Professors Lake Recreation Centre	Purchasing carbon offsets	0	21.5	0	0.0	-527	0
2050	Recreation Lighting	Purchasing carbon offsets	0	74.1	0	0.0	-1,818	0
2050	Riverstone Community Centre	Purchasing carbon offsets	0	249.6	0	0.0	-6,121	0
2050	Rose Theatre	Purchasing carbon offsets	0	373.1	0	0.0	-9,151	0
2050	Royal Canadian Legion Branch 15 (Centennial Recreation Centre)	Purchasing carbon offsets	0	0.1	0	0.0	-2	0
2050	Sandalwood Sand and Salt Storage and Garage Building	Purchasing carbon offsets	0	285.3	0	0.0	-6,997	0
2050	Sandalwood Works Administration Building	Purchasing carbon offsets	0	106.3	0	0.0	-2,607	0
2050	Save Max Sports Centre	Purchasing carbon offsets	0	1,098.6	0	0.0	-26,946	0
2050	Snelgrove Seniors Centre	Purchasing carbon offsets	0	30.5	0	0.0	-749	0
2050	Springdale Library	Purchasing carbon offsets	0	76.1	0	0.0	-1,866	0
2050	Street Lighting	Purchasing carbon offsets	0	1,873.3	0	0.0	-45,949	0
2050	Susan Fennell Sportsplex	Purchasing carbon offsets	0	1,558.4	0	0.0	-38,223	0
2050	Teramoto Park Parks Depot	Purchasing carbon offsets	0	24.3	0	0.0	-597	0
2050	Terry Miller Recreation Centre	Purchasing carbon offsets	0	201.0	0	0.0	-4,930	0
2050	Traffic Lighting	Purchasing carbon offsets	0	81.3	0	0.0	-1,994	0
2050	Transit Station Lighting	Purchasing carbon offsets	0	0.7	0	0.0	-17	0
2050	Valleybrook Field House	Purchasing carbon offsets	0	2.0	0	0.0	-49	0
2050	Williams Parkway Administrative Building	Purchasing carbon offsets	0	327.6	0	0.0	-8,036	0
2050	Williams Parkway Operations building	Purchasing carbon offsets	0	604.7	0	0.0	-14,833	0
Long Term	Total	(Accounts for interactive effects and changes in the electricity grid emissions factor)	301,861,880	5,996.7	-8,870,459	5,157,456.6	237,800	-555,063

B.4 2050 Facility Utility Use

The projected utility use for each facility in 2050 is presented in Table 19. Note that the change in utility use columns indicate the difference from 2023 to 2024; i.e. a positive change indicates an increase in utility use, and a negative change indicates a decrease from 2023 to 2050.

Table 19: Projected utility use for all facilities in 2050

Facility	Projected Electricity Use (kWh/yr)	Projected Natural Gas Use (m3/yr)	Projected GHG Emissions (tCO2e/yr)	Change in Electricity Use (kWh/yr)	Change in Natural Gas Use (m3/yr)	Change in GHG Emissions (tCO2e/yr)
10100 The Gore Road (Heritage House-Dougherty / Johnson Farm)	46,212.2	0.0	0.0	12,001.2	-8,931.0	-18.7
14 Nelson St W	206,990.8	0.0	0.0	39,733.8	-19,338.0	-44.8
175 Sandalwood Parkway West	1,982,290.6	0.0	0.4	1,982,290.6	0.0	0.4
30 Main St N	21,649.8	114.0	0.2	-1,425.2	0.0	-1.1
36-40 Main St N	17,930.9	0.0	0.0	-13,318.1	0.0	-1.4
37 George St N	-43,091.4	0.0	0.0	-43,091.4	-11,940.0	-22.9
54 Main St N	-8,388.5	522.0	1.0	-11,585.5	0.0	-0.1
55 Queen (Carnegie Library)	91,988.2	0.0	0.0	-8,316.8	-4,830.0	-13.8
60 Main St N	40,369.1	0.0	0.0	-8,530.9	-2,798.0	-7.6
63-71 Main St N	452.0	0.0	0.0	0.0	0.0	-0.0
70-74 Main St N Buildings - Art Gallery	20,592.0	0.0	0.0	7,281.0	-10,307.0	-20.4
8 Nelson Commercial / Office	1,316,186.3	0.0	0.3	-406,439.7	-44,629.0	-164.2
A and M Fire Apparatus Building	446,181.4	0.0	0.1	92,906.4	-42,697.0	-98.1
Ambulance Station - 52 Bramalea Rd	2,493.8	0.0	0.0	-164.2	0.0	-0.1
Andrew McCandless Park - Comfort Station And Skateboard Park	110,051.1	0.0	0.0	-6,151.9	0.0	-5.3
Animal Services Administration Building (By-Law Enfo. Williams Parkway Administration)	165,054.5	0.0	0.0	382.5	-10,123.0	-26.9
Animal Shelter	381,265.9	0.0	0.1	100,146.9	-58,230.0	-124.6
Bovaird House	26,569.0	0.0	0.0	449.0	-4,856.0	-10.5
Bramalea Transit Terminal (new)	251,223.3	0.0	0.1	10,372.3	-19,626.0	-48.7
Brampton Cemetery Office Building	5,355.6	926.0	1.8	-299.4	0.0	-0.3
Brampton Curling Club	469,941.9	2,192.7	4.3	55,415.9	-34,161.3	-84.5
Brampton Public Library - Four Corners	699,229.2	0.0	0.1	64,108.2	-110,069.0	-240.3
Brampton Transit Yard 185 Clark Blvd	4,469,488.8	0.0	0.9	2,668,963.8	-936,041.0	-1,879.5
Brampton Transit Yard Sandalwood Facility	8,557,535.7	0.0	1.7	3,058,598.7	-	-2,551.9
Brampton Trinity Common Terminal	54,410.4	202.3	0.4	1,084.4	1,198,492.0	-6.9
Cassie Campbell Community Centre	3,062,638.5	32,594.3	63.2	-1,547,238.5	-2,326.7	-1,271.2
Cemetery Maintenance Building	9,771.8	0.0	0.0	-546.2	0.0	-0.5
Central Public School Recreation Centre	237,950.5	594.1	1.2	7,930.5	-30,676.9	-69.4
Century Gardens Recreation Centre	769,793.2	1,737.7	3.5	-1,402,085.8	-161,488.3	-409.3
Chinguacousy Park Barn	17,796.3	0.0	0.0	17,796.3	-13,227.0	-25.4

Table 19: Projected utility use for all facilities in 2050 (continued)

Facility	Projected Electricity Use (kWh/yr)	Projected Natural Gas Use (m3/yr)	Projected GHG Emissions (tCO2e/yr)	Change in Electricity Use (kWh/yr)	Change in Natural Gas Use (m3/yr)	Change in GHG Emissions (tCO2e/yr)
Chinguacousy Park Curling Club	947,117.0	1,237.2	2.6	-65,697.0	-19,273.8	-83.1
Chinguacousy Park Garage	0.0	1,536.0	3.0	0.0	0.0	0.0
Chinguacousy Park Greenhouses	485,719.3	0.0	0.1	286,427.3	-117,311.0	-234.4
Chinguacousy Park Mini Golf and Snack Bar	538,519.8	0.0	0.1	-35,451.2	0.0	-26.1
Chinguacousy Park Optimist Club and Ski Chalet	441,820.9	0.0	0.1	-77,636.1	0.0	-23.7
Chinguacousy Park Outdoor Skating Rink Building	60,849.1	424.9	0.8	60,849.1	-20,816.1	-40.0
Chinguacousy Park Parks Building	27,876.7	0.0	0.0	-1,558.3	0.0	-1.3
Chinguacousy Park Tea House	27,613.7	1,134.0	2.2	-1,010.3	0.0	-1.3
Chinguacousy Park Tennis Bubble	431,751.0	0.0	0.1	431,751.0	-211,295.0	-405.8
Chinguacousy Wellness Centre	22,973.7	4,578.0	8.8	-1,091,085.3	-122,020.0	-285.3
Chris Gibson Recreation Centre	291,945.9	382.7	0.8	-68,903.1	-26,966.3	-68.2
Churchville Community Hall (FS 217 Volunteer)	5,628.0	1,039.0	2.0	-416.0	0.0	-0.3
City Hall	2,490,826.6	0.0	0.5	-271,641.4	-164,651.0	-442.0
City Hall West Tower	2,799,272.5	15,233.9	29.8	5,188.5	-143,406.1	-402.6
COB Parking lot (Former BCC Terminal)	76,673.5	0.0	0.0	-5,047.5	0.0	-3.7
County Court Pavillion	50,393.9	0.0	0.0	-2,817.1	0.0	-2.4
Creditview Park Fieldhouse	302,308.8	0.0	0.1	-16,899.2	0.0	-14.5
Cyril Clark Library	304,811.6	0.0	0.1	-9,619.4	-28,326.0	-68.7
Earncliffe Recreation Centre	1,456,781.5	53,534.0	103.1	-476,582.5	-160,325.0	-396.0
Ebenezer Community Hall	45,122.6	0.0	0.0	-2,970.4	0.0	-2.2
Eldorado Park Pavillion	31,863.4	0.0	0.0	-2,097.6	0.0	-1.5
Eldorado Parks Shed	7,883.1	0.0	0.0	-518.9	0.0	-0.4
Eldorado Pool Changehouse	14,347.5	0.0	0.0	-944.5	0.0	-0.7
Electric Bus Charging Stations	492,791.0	0.0	0.1	0.0	0.0	-22.4
Electric Vehicle Charging Stations	144,520.3	0.0	0.0	0.0	0.0	-6.6
Ellen Mitchell Recreation Centre	173,464.5	0.0	0.0	31,925.5	-31,279.0	-66.5
Fairgrounds Park Batting Cages	1,430.1	0.0	0.0	-79.9	0.0	-0.1
FCCC Dorm D-Sports Admin Offices	95,349.5	0.0	0.0	22,428.5	-13,808.0	-29.8
FCCC Dorm E-Sports Admin Offices	70,984.0	0.0	0.0	17,947.0	-11,588.0	-24.7
FCCC Dorm F-Sports Equipment Storage	69,109.2	1,701.3	3.3	45,309.2	-19,564.7	-38.7
FCCC Lawn Bowling	124,041.9	0.0	0.0	43,376.9	-20,933.0	-43.9
FCCC Park Maintenance Warehouse	98,403.5	0.0	0.0	51,413.5	-18,555.0	-37.8
FCCC Seniors Centre	311,097.2	956.8	1.9	-28,225.8	-49,399.2	-110.3
FCCC Units 1 and 2	1,088,529.6	0.0	0.2	-141,484.4	-52,802.0	-157.4
Fire Life Safety Centre	162,180.5	0.0	0.0	46,540.5	-27,012.0	-57.1
Fire Station 202	103,285.3	0.0	0.0	22,244.3	-13,811.0	-30.2
Fire Station 204	183,479.2	0.0	0.0	23,697.2	-20,763.0	-47.2
Fire Station 205	128,800.9	0.0	0.0	12,586.9	-11,898.0	-28.1
Fire Station 206	113,767.9	0.0	0.0	24,137.9	-14,730.0	-32.4

Table 19: Projected utility use for all facilities in 2050 (continued)

Facility	Projected Electricity Use (kWh/yr)	Projected Natural Gas Use (m3/yr)	Projected GHG Emissions (tCO2e/yr)	Change in Electricity Use (kWh/yr)	Change in Natural Gas Use (m3/yr)	Change in GHG Emissions (tCO2e/yr)
Fire Station 207 Duggan	130,801.2	0.0	0.0	18,342.2	-17,355.0	-38.5
Park Fieldhouse						
Fire Station 208	95,883.4	0.0	0.0	11,965.4	-10,561.0	-24.1
Fire Station 209	30,032.1	0.0	0.0	30,032.1	-17,216.0	-33.1
Fire Station 210	125,013.9	0.0	0.0	13,770.9	-15,822.0	-35.5
Fire Station 211	181,392.3	0.0	0.0	23,359.3	-24,304.0	-53.9
Fire Station 212	167,517.5	0.0	0.0	-0.5	-13,309.0	-33.2
Fire Station 213	74,829.3	0.0	0.0	9,792.3	-12,902.0	-27.7
Former Fire Station 201	118,060.0	25,997.0	50.0	0.0	0.0	-5.4
Gateway Transit Terminal Building A	175,946.1	0.0	0.0	-17,670.9	0.0	-8.8
Gore Meadows Community Centre	4,950,850.5	0.0	1.0	1,111,462.5	-660,726.0	-1,443.7
Greenbriar Recreation Centre	511,276.0	2,565.3	5.0	-90,632.0	-39,964.7	-104.2
Heritage Theatre and Theatre School	39,981.6	0.0	0.0	-26,907.4	0.0	-3.0
Jim Archdekin Recreation Centre	929,318.0	1,427.2	2.9	51,273.0	-100,563.8	-233.1
Ken Giles Soccer Centre	208,021.5	933.4	1.8	-30,442.5	-48,192.6	-103.4
Kiwanis Youth Centre for Sports Excellence	743,952.5	0.0	0.1	139,447.5	-126,223.0	-270.0
Knightsbridge Community and Seniors Centre	52,953.0	140.2	0.3	4,694.0	-7,240.8	-16.1
Loafers Lake Fieldhouse	6,077.3	0.0	0.0	-339.7	0.0	-0.3
Loafers Lake Recreation Centre	815,360.7	0.0	0.2	139,302.7	-113,887.0	-249.5
Market Square Parking	-145,096.2	0.0	0.0	-597,332.2	0.0	-20.7
Memorial Arena	246,659.5	2,345.0	4.6	52,598.5	-36,534.0	-79.0
Mount Pleasant Clock Tower and W.R.	46,304.7	0.0	0.0	-3,048.3	0.0	-2.2
Nelson Square Parking Garage	-103,013.5	0.0	0.0	-260,247.5	0.0	-7.2
Norton Place Park Community Centre and Depot	230,050.7	0.0	0.0	59,701.7	-33,391.0	-71.9
Park Lighting	85,289.0	0.0	0.0	0.0	0.0	-3.9
Parking Lot Lighting	54,860.0	0.0	0.0	0.0	0.0	-2.5
Peel Village Clubhouse	17,143.6	0.0	0.0	17,143.6	-5,589.0	-10.7
Peel Village Maintenance	90,281.7	0.0	0.0	-5,943.3	0.0	-4.4
POA Courthouse	532,162.9	0.0	0.1	-73,174.1	-73,503.0	-168.8
Professors Lake Recreation Centre	202,289.8	0.0	0.0	-37,592.2	0.0	-10.9
Recreation Lighting	827,411.0	0.0	0.2	0.0	0.0	-37.6
Riverstone Community Centre	770,144.6	0.0	0.2	36,925.6	-95,715.0	-217.2
Rose Theatre	1,716,794.3	0.0	0.3	-244,856.7	-102,718.0	-286.6
Royal Canadian Legion Branch 15 (Centennial Recreation Centre)	-10,325.9	0.0	0.0	-11,457.9	0.0	-0.1
Sandalwood Sand and Salt Storage and Garage Building	250,550.2	0.0	0.1	250,550.2	-148,509.0	-285.2
Sandalwood Works Administration Building	828,534.6	0.0	0.2	-77,340.4	-13,077.0	-66.4
Save Max Sports Centre	3,433,596.9	48,847.8	94.5	1,463,314.9	-431,128.2	-917.6
Siemens Building	1.2	0.0	0.0	-11,911.8	0.0	-0.5
Snelgrove Seniors Centre	89,738.7	237.7	0.5	17,025.7	-12,271.3	-26.9
Springdale Library	627,539.1	0.0	0.1	-158,116.9	-2,958.0	-41.5
Street Lighting	20,907,804.0	0.0	4.2	0.0	0.0	-951.3
Susan Fennell Sportsplex	4,823,768.6	81,637.4	157.8	-190,600.4	-495,702.6	-1,180.4

Table 19: Projected utility use for all facilities in 2050 (*continued*)

Facility	Projected Electricity Use (kWh/yr)	Projected Natural Gas Use (m3/yr)	Projected GHG Emissions (tCO2e/yr)	Change in Electricity Use (kWh/yr)	Change in Natural Gas Use (m3/yr)	Change in GHG Emissions (tCO2e/yr)
Teramoto Park Parks Depot	245,859.7	0.0	0.0	-25,768.3	0.0	-12.4
Terry Miller Recreation Centre	27,409.4	18,816.1	36.2	-709,670.6	-51,429.9	-132.5
Traffic Lighting	907,117.0	0.0	0.2	0.0	0.0	-41.3
Transit Station Lighting	7,940.0	0.0	0.0	0.0	0.0	-0.4
Valleybrook Field House	21,165.8	0.0	0.0	-1,183.2	0.0	-1.0
Williams Parkway Administrative Building	332,972.0	0.0	0.1	328,373.0	-170,343.0	-327.4
Williams Parkway Operations building	1,757,247.2	0.0	0.4	117,720.2	-238,327.0	-532.4

B.5 Overall Plan Impact and Budget

Based on the plans identified, the anticipated progress towards reducing GHG emissions and corresponding budget is presented in Table 20.

Table 20: Plan Results Summary

Term	Project Cost	Utility Cost	GHG Emissions	GHG Emissions Reduction	Cumulative GHG Percent Reduction
-	[\$]	[\$/yr]	[tCO2e/yr]	[tCO2e/yr]	[%]
Baseline	-	-	19,007	-	-
Current	-	15,116,689	19,336	-329	-2
Short Term Plan	171,767,631	16,797,653	11,207	8,129	41
Medium Term Plan	105,406,179	17,568,335	5,997	5,211	68
Long Term Plan	301,861,880	22,307,815	0	5,997	100

C Appendix C: Best Practices Among Existing Municipalities

To identify best practices in GHG emission reduction strategies, the strategies implemented by other Ontario municipalities are reviewed. These strategies, as well as some strategies implemented by other municipalities in Canada and worldwide, are presented below.

C.1 Best practices among Ontario municipalities

C.1.1 City of Toronto

The City of Toronto has recently updated their climate change goal and aims to achieve net zero emissions by 2040. Notable projects include:

- **Increased building performance:**
 - LED lighting upgrades
 - HVAC upgrades
 - DHW heater upgrade to electric
 - BAS upgrades
 - Biomass boiler centre
- **Renewable energy technologies:**
 - Solar PV
 - Solar thermal DHW heating
 - Solar thermal air technology
 - Geo-exchange for building heating
 - Solar PV with storage
 - Biogas
 - Deep lake water cooling

These projects have aided the City of Toronto to make progress towards its goals. For instance, between 2014 and 2018, the City of Toronto operated 95 solar PV systems, and generated an average of approximately 3,600,000 kWh each year. Additionally, HVAC upgrades and LED retrofitting have contributed to a reduction in the natural gas consumption of Toronto's long-term care homes and performing arts theatres by 10% and 11%, respectively, from 2014 to 2018.

C.1.2 Region of Peel

The Region of Peel's Corporate Energy Conservation and Demand Management Plan commits to achieving GHG emissions of 45% by 2030 and 80% by 2050 compared to 2010 levels. Notable projects include:

- **Incentivized natural gas conservation projects**
- **Increased energy efficiency:**
 - LED lighting upgrades
 - HVAC retrofits (e.g. heat pumps)
 - Envelope improvements
- **Renewable energy technologies:**
 - Combined heat & power generation
 - Micro hydro turbine

- Solar PV
- Solar DHW heating

Peel has performed several lighting retrofit projects, as well as incentivised natural gas conservation (e.g. DHW heater electrification), which has contributed to a decrease in its electricity consumption by 9.7% and its natural gas consumption by 1.9% from 2014 to 2019. As of 2017, their GHG emissions were reduced by 40% compared to 2010 levels. In addition, through renewable energy projects - the most effective of which are combined heat & power generation and solar DHW heating - the Region of Peel has generated 21,280 MWh of electricity and offset 95,974 m³ of natural gas.

Due to the higher GHG emissions intensity of natural gas, the reduction in energy consumption does not decrease GHG emissions as much as it could have if there were a larger reduction in natural gas consumption. To address this, in the 2019 ECDMP, there is an increased focus on natural gas conservation measures, such as HVAC upgrades and envelope upgrades to reduce the natural gas consumed for space heating.

C.1.3 Region of Durham

The Region of Durham's goal is to achieve a reduction in GHG emissions of 20% by 2025, 40% by 2030, and 100% by 2045, compared to 2019 levels. Notable projects include:

- **Energy conservation in buildings:**
 - LED lighting upgrades
 - Building Condition Assessments to identify opportunities for GHG emissions reduction
- **Renewable energy technologies:**
 - Solar PV
 - Biogas

The Region of Durham has not seen a significant decrease in GHG emissions, but has completed several assessments to identify new projects with opportunities to decrease GHG emissions.

C.1.4 City of Ottawa

The City of Ottawa has set goals to reduce emissions from City operations by 30% by 2025, 50% by 2030, and 100% by 2040 compared to a 2012 baseline. The City has also set goals to decrease community emissions by 45% by 2025, 68% by 2030, 96% by 2040, and 100% by 2050. Notable projects include:

- **Energy conservation in buildings:**
 - LED lighting upgrades
 - Integration of building automation systems
 - HVAC improvements
 - Occupancy control for lighting and environmental systems
 - Pool covers on swimming pools to reduce evaporation
- **Renewable energy technologies:**
 - Solar PV
 - Alternative energy sources for transit
 - Renewable natural gas

As of 2020, the City of Ottawa's corporate GHG emissions had decreased by 36% compared to 2012 emissions. The City attributes a significant portion of this to the efficiencies made at their Trail Road Waste Facility, where they implemented a landfill gas capture system with 90% efficiency.

The City has identified sectors with an anticipated increase in emissions, such as their Trail Road Waste Facility emissions, and are endeavouring to account for this in their emissions reduction planning. Also, the City of Ottawa noted that, despite their greater-than-planned reduction in corporate GHG emissions, the overall city emissions (including community emissions) have only decreased by 14% since 2012. It is more difficult to reduce GHG emissions associated with community action, but the City has implemented a framework intended to support the municipality as needed to assist them in meeting the climate goals.

C.1.5 City of Mississauga

The City of Mississauga is currently aiming to reduce GHG emissions by 40% by 2030 and 80% by 2050, compared to a 1990 baseline. Notable projects include:

- **Energy conservation in recreational facilities:**
 - Pool heat recovery
 - Ice plant energy upgrades
 - Pool dehumidification energy upgrades
- **Energy conservation in buildings:**
 - Lighting upgrades (including LED retrofits, occupancy controls, and daylighting)
 - Energy management information system
 - Controls upgrades
 - Electrical upgrades to reduce distribution wastage
- **Renewable energy technologies:**
 - Solar PV
 - Solar DHW heating
 - Solar lighting

From 2014 to 2018, the City implemented measures such as lighting and control upgrades and saw a decrease in GHG emissions of 8.1%. In the current ECDMP, recreational facilities (such as pools and ice rinks) were identified as a large source of GHG emissions, and many of the actions focus on conserving energy in these facilities.

C.1.6 Town of Caledon

The Town of Caledon aims to achieve a reduction in corporate emissions of 24% from 2017 to 2024, and achieve net zero emissions by 2050. Notable projects include:

- **Retrofit, renewal, and GHG reduction:**
 - Equipment asset management
 - Whole systems approach to scoping projects
 - Commissioning and performance verification
 - Thermal energy conservation
 - Lighting conservation
 - Renewable energy strategy
- **Facility operations and maintenance:**
 - Preventative maintenance
 - Scheduling and set point optimization
 - Building automation systems
- **Purchasing, procurements, and standards:**

- Corporate green building standard update
- Corporate energy revolving fund
- Energy procurement
- Energy incentives
- **Fleet retrofit, replacement, and GHG reduction:**
 - Develop Green Fleet and Fuel Reduction Strategy
 - Identify low-carbon fleet fuel conversion options
 - Expand EV charging station network

From 2012-2018, the Town of Caledon implemented 140 energy conservation measures, including LED retrofits, and managed to reduce facility energy consumption by 12.6% compared to 2012 levels.

C.1.7 City of Markham

The City of Markham's current goal stated in their 2019 Corporate Energy Management Plan is to achieve 5% energy reduction from 2019-2024, to progress towards achieving net zero emissions by 2050. A list of ongoing projects is presented below:

- **Energy and environmental management policies:**
 - Municipal Energy Plan
 - Monarch friendly city
 - Battle of Buildings
 - Textile recycling
- **Energy conservation measures:**
 - Markham district energy
 - Develop and implement BAS
 - Install Combined heat and power at Angus Glen Community Centre
 - Design all new buildings to LEED Silver standard
 - Solar PV energy

Markham implemented several ECMs from 2014-2019, developing corporate BAS design standards, increasing their solar portfolio, and converting 50% of streetlights and 100% of arena lights to LEDs. This resulted in 8% facility energy reductions and 29% street lighting energy reductions from 2014-2018. As of 2019, the City of Markham had reduced their corporate GHG emissions per resident by 14% compared to 2012.

C.1.8 York Region

York Region's plan, with respect to a 2014 baseline, is to allow for a 4% increase in GHG emissions as it invests in infrastructure to support future population growth, with targets of a 16% reduction in emissions by 2030 and a 60% reduction by 2051. Some of York Region's main projects include:

- **Energy conservation to reduce demand:**
 - Deep energy retrofit of existing buildings
 - Development of a Sustainable Buildings Policy to conserve energy in new buildings
 - Water and wastewater facility energy conservation
 - Adaptive streetlight technologies
- **Switching to renewable energy and low-emission fuel alternatives to aim for net zero carbon:**
 - Solar PV and micro-hydro turbines

- Wind powered systems
- Renewable natural gas
- Electrification of the corporate fleet

As of 2019, York Region had not seen significant reductions in its GHG emissions, as it is balancing population growth against GHG reduction targets. That being said, the Region has planned to undertake projects to allow it to reduce GHG emissions by 60% by 2051, even accounting for population growth.

C.1.9 Halton Region

Halton Region's current plan is a 5% reduction in GHG emissions in most sectors from 2019 to 2023, with a 10% reduction in GHG emissions related to the energy consumed to light street lights. Notable projects include:

- **Reduce energy consumption and greenhouse gas emissions:**
 - Lighting retrofit
 - Building control upgrades
 - Building envelope upgrades
 - Wastewater treatment plant optimization
 - Artificial intelligence software for distribution system
 - Alternative mixing for digesters
- **Recover energy from operations:**
 - Combined heat and power (CHP) for biogas energy recovery at wastewater treatment plants
 - SSO digestion facilities
- **Shift away from fossil fuel-based energy:**
 - Solar PV systems
 - Solar thermal energy

From 2014 to 2018, Halton Region implemented several ECMs, including lighting, control, and mechanical retrofits, street lighting conversion to LED, and water treatment plant improvements. These ECMs led to a 2% decrease in GHG emissions over that time frame, despite the simultaneous growth in the region. That being said, the growth of Halton Region poses a challenge to the Region's ability to make significant progress in reducing its GHG emissions, as a 2% decrease is only a slight improvement.

C.2 Best practices among additional municipalities

C.2.1 City of Vancouver

In the City of Vancouver's Strategic Energy Management Plan, they outline a framework to achieve net zero GHG emissions by 2050. Notable projects include:

- **Reduce natural gas consumption and overall energy intensity:**
 - HVAC upgrades to heat pumps
 - Lighting upgrades
 - Controls upgrades
- **Renewable energy technologies:**
 - Solar PV
 - Solar DHW heating
 - Wind

- Geothermal heat pumps
- Waste as an energy resource

To date, Vancouver has reduced their emissions in municipal buildings by more than 25%. In addition, as of 2020, 67% of Vancouver's corporate fleet is fully electric. Vancouver has also approved strategies to ensure that all new buildings are low carbon, and is restricting single-use items.

C.2.2 Global municipalities

A brief overview of the climate strategies in other municipalities worldwide is provided below:

- **New York: Energy Management Program:** Focuses on renewable energy sources, reduced energy consumption through LED lighting retrofits, and the installation of electric vehicle charging stations to reduce transport emissions.
- **Madrid: Road Map to Climate Neutrality by 2050:** Targets high energy intensity centres, new transportation technologies, and electrification of heating systems.
- **Germany: MasterPlan 100% Climate Protection:** Focuses on energy savings and use of renewable energy sources and increased efficiency in mobility and transport sector.
- **Melbourne: Climate Change Mitigation strategy by 2050:** Emphasizes the priorities to be on 100% renewable, zero emissions buildings, zero emissions transport, and on reduction of impact of waste.

C.3 Recommendations

Based on actions being undertaken by other municipalities, some commitments that the City could consider adopting for its updated ECDMP are listed below:

- **Energy conservation measures:** Most municipalities have listed lighting and control upgrades as a measure to reduce energy consumption, and the City of Brampton is encouraged to complete their lighting and control upgrades to achieve the full benefits of LED lighting and to reduce unnecessary energy consumption. In addition, many municipalities have listed HVAC improvements and envelope upgrades among the measures which they are implementing. These measures can significantly reduce GHG emissions due to space heating. As space heating is the end use with the most GHG emissions in the City of Brampton, we recommend considering these measures in the upcoming ECDMP.
- **Heat pumps:** Heat pumps are a frequently investigated energy conservation measure as they are several times more efficient than gas-fired space heating, and mitigate the emissions associated with natural gas consumption. Space heating is commonly the largest source of GHG emissions, and replacing gas-fired heaters with heat pumps can significantly decrease GHG emissions. The City of Toronto has identified geothermal heat pumps as a technology of choice, as the heat from the ground can heat buildings year-round. However, in cases where ground-source heat pumps are not practical, air-source heat pumps with backup are also very promising options to reduce the GHG emissions associated with space heating.
- **Renewable energy:** Many municipalities are considering solar energy (solar PV and solar thermal) as a source of renewable energy. The City of Brampton has implemented solar PV, solar thermal, and geothermal systems in multiple locations, and it is recommended that the City continue to investigate the feasibility of these technologies at additional locations.
- **Measures focused on recreational facilities:** In Mississauga, recreational facilities contributed to a significant portion of the City's GHG emissions. To mitigate this, several measures - for instance, pool heat recovery, and energy upgrades for the ice plants and pool dehumidification - focus on reducing GHG emissions from recreational facilities. Recreation facilities are the largest contributor to the City of Brampton's GHG emissions, which indicates that the emissions from recreational facilities must be addressed for the City to be able to meet its targets.

C.4 Frameworks

Frameworks for measuring and benchmarking success in GHG emission reduction are identified below:

- **ICLEI – Local Governments for Sustainability:**
 - Provides tools and resources to help local governments to measure and manage GHG emissions and develop action plans
 - Connects governments at the local, regional, national and global levels
 - Partners for Climate Protection Framework:
 - * 5-Milestone framework with resources to aid users in progressing towards their goals to meet emissions targets
 - * Milestones: Create an inventory, Set a target, Develop a plan, Implement the plan, Monitor the impact and advance the commitment
- **Global Covenant of Mayors for Climate & Energy:**
 - International alliance of cities and local governments with a standardized approach to measuring, reporting, and verifying GHG emissions
 - Offers support and more financial opportunities to fund measure implementation
 - In this reporting framework, all emission sources from stationary energy, transportation, and waste must be reported, and GHG emissions from industrial processes, agriculture, and forestry should also be reported.
- **The Carbon Disclosure Project (CDP):**
 - A global disclosure system for companies, cities, states, and regions to report their GHG emissions, as well as other environmental impacts
 - Evaluates response to help to identify gaps and areas of opportunity
 - Provides access to a range of additional services and tailored capacity building and support

C.5 PCP Milestone Framework

The milestones in the PCP Milestone framework are presented below:

1. **Milestone 1: Creating an Inventory.** A GHG emissions inventory can help you track and anticipate emissions, energy use and energy spending as well as measure your progress over time. Having a forecast also allows you to project future emissions based on assumptions about population, economic growth, fuel mix and technological change.
2. **Milestone 2: Setting a Target.** A GHG emissions reduction target sets the tone and direction for your emission reduction efforts. Targets should be achievable, while also inspiring ambitious action. We encourage you to adopt two targets: one for municipally owned operations and another for community-wide emissions.
3. **Milestone 3: Developing a Plan.** A local climate action plan outlines how your municipality will achieve its emissions reduction target through municipal operations and/or community-based initiatives. Stakeholder engagement is critical to your plan's development, and a feeling of joint ownership of the plan by both municipal staff and the community can help ensure its long-term success.
4. **Milestone 4: Implementing a Plan.** After your municipality has completed a greenhouse gas emissions inventory and forecast, set emissions reduction targets and created a local climate action plan, the focus must turn to implementing your plan. Once your plan is integrated and linked to your municipal budgeting process, elected officials and climate staff can make decisions based on short-term and long-term needs.

5. **Milestone 5: Monitoring the impact.** Monitoring helps you determine whether your initiatives are working and whether you'll meet your target. Use data you've collected to evaluate and adjust your activities. You can also use reporting to connect with stakeholders and funders to solidify support for future initiatives.

The PCP protocol specifies that this should be performed for buildings, fleet, streetlights, water/wastewater facilities, and emissions due to solid waste. Through ECDMPs, The City of Brampton has completed all milestones at the corporate level for buildings and streetlights, and continuously updates Milestones 3-5 for these asset types.

D Appendix D: Communications Strategy

D.1 Communication Strategy to Align City Processes with the Net Zero Emissions Goal

D.1.1 Internal Communication Strategy

Promote Strategies and Initiatives within the Organization and Council

Objective: Ensure that all city employees and council members are informed, engaged, and motivated towards the Net Zero Emissions goal.

Actions:

1. **Regular Updates and Briefings:**

- **Monthly Newsletters:** Distribute newsletters highlighting progress, success stories, upcoming projects, and key achievements related to the Net Zero Emissions goal.
- **Quarterly Briefings:** Hold briefings for department heads and council members to provide detailed updates on the ECDMP (Energy Conservation and Demand Management Plan) implementation.

2. **Training and Workshops:**

- **Sustainability Workshops:** Organize workshops on sustainable practices, energy efficiency measures, and the importance of reducing GHG emissions.
- **Departmental Training:** Conduct specific training sessions for departments on how they can contribute to the Net Zero goal.

3. **Internal Campaigns:**

- **Green Champions Program:** Identify and train 'Green Champions' within each department to advocate for energy conservation and sustainable practices.
- **Recognition Programs:** Implement programs to recognize and reward departments or individuals who make significant contributions towards the Net Zero goal.

D.1.2 Public Communication Strategy

Engage the Public, Raise Awareness, and Build Community Support

Objective: Engage the public, raise awareness, and build community support for the City's Net Zero Emissions initiatives.

Actions:

1. **Public Awareness Campaigns:**

- **Media Outreach:** Utilize local media, including newspapers, radio, and TV, to communicate the City's commitment and progress towards the Net Zero goal.
- **Social Media Campaigns:** Regularly post updates, educational content, and interactive elements (e.g., polls, Q&A sessions) on social media platforms.

2. **Community Engagement:**

- **Public Workshops and Town Halls:** Host workshops and town hall meetings to discuss the ECDMP, gather public input, and address any concerns or questions.
- **Educational Programs:** Collaborate with local schools and community groups to create educational programs about sustainability and energy conservation.

3. Informational Materials:

- **Brochures and Flyers:** Distribute printed materials detailing the City's Net Zero initiatives, benefits, and ways the public can contribute.
- **Website and Online Portal:** Maintain a dedicated section on the City's website with detailed information, progress reports, and resources related to the ECDMP.

D.2 Aligning Procurement Guidelines and Policies

D.2.1 Update and Align the City's Procurement Guidelines and Policies

Objective: Update and align the City's procurement guidelines and policies to support the use of low carbon products, technologies, and measures to reduce GHG emissions.

Actions:

1. Review and Update Procurement Policies:

- **Low Carbon Criteria:** Incorporate low carbon and sustainability criteria into the procurement process, prioritizing products and services that have a lower environmental impact.
- **Life Cycle Cost Analysis:** Require life cycle cost analysis for procurement decisions to ensure long-term savings and sustainability.

2. Supplier Engagement:

- **Sustainable Supplier Program:** Develop a program to engage and incentivize suppliers who demonstrate a commitment to sustainability and provide low carbon products or services.
- **Supplier Workshops:** Host workshops for suppliers to educate them on the City's sustainability goals and procurement requirements.

3. Pilot Projects:

- **Demonstration Projects:** Implement pilot projects to test and showcase low carbon technologies and sustainable procurement practices.
- **Case Studies and Reports:** Document and share case studies of successful implementations to build a business case for sustainable procurement.

D.3 Monitoring and Reporting

D.3.1 Ensure Transparency, Accountability, and Continuous Improvement

Objective: Ensure transparency, accountability, and continuous improvement in the City's efforts to achieve the Net Zero Emissions goal.

Actions:

1. Progress Reporting:

- **Annual Reports:** Publish an annual report detailing the City's progress towards the Net Zero Emissions goal, including key metrics, achievements, and challenges.
- **Dashboard:** Develop an online dashboard to provide real-time updates on key performance indicators related to energy conservation and GHG reductions.
- **Analysis:** Ensure that collected data is analyzed to verify that all completed actions have had the anticipated impact on the City's GHG emissions.

2. Feedback Mechanisms:

- **Surveys and Feedback Forms:** Regularly solicit feedback from city employees, council members, and the public to identify areas for improvement.
- **Public Meetings:** Hold periodic public meetings to present progress reports and gather feedback from the community.

3. **Continuous Improvement:**

- **Benchmarking:** Regularly benchmark the City's performance against other municipalities and best practices in sustainability.
- **Adjust Strategies:** Use the feedback and benchmarking results to adjust strategies and improve the effectiveness of the ECDMP.

D.4 Key Stakeholders

Key stakeholders in the development of this plan are identified below.

1. **City Council:**

- Responsibilities:
 - Approve funding and resources for implementing energy efficiency measures.
 - Provide policy support and direction for the ECDMP.

2. **City Manager/Chief Administrative Officer (CAO):**

- Responsibilities:
 - Oversee the overall implementation of the ECDMP.
 - Ensure alignment of the plan with the city's strategic goals and objectives.
 - Allocate resources and coordinate efforts across departments.

3. **Director of Sustainability/Environmental Services:**

- Responsibilities:
 - Lead the development and implementation of the ECDMP.
 - Coordinate with various departments to identify energy conservation opportunities.
 - Monitor progress and report on key performance indicators related to GHG reduction targets.

4. **Facilities Management Departments (Including Fire, Recreation, and Transit):**

- Responsibilities:
 - Identify energy efficiency opportunities in municipal buildings and facilities.
 - Implement energy conservation measures (ECMs) and oversee their maintenance.
 - Provide data on energy consumption for monitoring and reporting purposes.

5. **Finance Department:**

- Responsibilities:
 - Provide financial support and budget allocations for implementing ECMs.
 - Analyze the financial feasibility of proposed energy projects.
 - Track expenditures and cost savings associated with energy conservation initiatives.

6. **Public Works Department:**

- **Responsibilities:**
 - Identify opportunities for improving energy efficiency in municipal infrastructure.
 - Implement measures to reduce energy consumption in street lighting and traffic signals.
 - Coordinate with utilities for energy management and optimization.

7. Community Engagement Coordinator:

- **Responsibilities:**
 - Engage with residents, businesses, and community groups to raise awareness about energy conservation and GHG reduction.
 - Facilitate public consultations and feedback sessions on the ECDMP.
 - Mobilize community support for energy efficiency initiatives and behavior change campaigns.

8. Energy Service Providers (Utilities):

- **Responsibilities:**
 - Provide energy consumption data and utility usage information to the city.
 - Collaborate with the city to implement demand-side management programs and incentives.
 - Support the integration of renewable energy sources into the city's energy infrastructure.

9. External Partners (NGOs, Industry Associations):

- **Responsibilities:**
 - Provide technical expertise and best practices for energy management and sustainability.
 - Assist in securing funding opportunities and grants for energy projects.
 - Facilitate knowledge sharing and capacity building through workshops and training sessions.

10. Steering Committee:

- **Responsibilities:**
 - Provide strategic guidance and oversight for the implementation of the ECDMP.
 - Review progress reports and make recommendations for adjustments to the plan.
 - Resolve any barriers or challenges encountered during implementation.

11. Technical Working Groups:

- **Responsibilities:**
 - Contribute specialized knowledge and expertise in areas such as building design, HVAC systems, renewable energy technologies, etc.
 - Assist in the development of technical specifications and performance metrics for energy projects.
 - Conduct feasibility studies and pilot tests for new energy efficiency measures.

A Appendix E: List of Errata - Version 1.1

Table 21: List of Errata in Version 1.1

Page #	Previously (V 1.0)	Revised To (V 1.1)
11	Table 3 GHG reduction units were kg CO ₂ e/yr	Table 3 GHG reduction units converted to tCO ₂ e/yr
11	Table 3 included column of natural gas savings	Removed natural gas savings from Table 3 (all 0 m ³ /yr)