ENERGY CONSERVATION AND DEMAND MANAGEMENT PLAN

2024-2029 UPDATE
TOWN OF AURORA

May 1, 2024

Prepared by WALTERFEDY

Table of Contents

Land Acknowledgement

The Town of Aurora acknowledges that the Anishinaabe lands on which we live and work are the traditional and treaty territory of the Chippewas of Georgina Island, as well as many other Nations whose presence here continues to this day. As the closest First Nation community to Aurora, we recognize the special relationship the Chippewas have with the lands and waters of this territory. They are the water protectors and environmental stewards of these lands, and as a municipality we join them in these responsibilities.

We further acknowledge that Aurora is part of the treaty lands of the Mississaugas and Chippewas, recognized through Treaty #13 as well as the Williams Treaties of 1923. A shared understanding of the rich cultural heritage that has existed for centuries, and how our collective past brought us to where we are today, will help us walk together into a better future.

Executive Summary

As greenhouse gas (GHG) emissions continue to rise and contribute to global warming, there has been a growing recognition of the urgent need to mitigate climate change and minimize its adverse impacts. In response to this pressing challenge, various entities, including the Town of Aurora, have taken proactive steps to reduce GHG emissions and mitigate the effects of global warming. In 2019, the Town declared a climate emergency, demonstrating its commitment to addressing climate change.

The 2024 Energy Conservation and Demand Management Plan (ECDMP) update embodies the Town's vision for a sustainable future. It sets ambitious GHG reduction targets for Town operations beyond the five-year cycle, initiating a vision of net-zero emissions by 2050. This plan provides considerations for short, medium, and long term planning initiatives to achieve this goal. For the Town to achieve net-zero emissions, its GHG emissions should be reduced as much as possible, and carbon offsets should be purchased to offset any remaining GHG emissions. To continue the progress towards net-zero emissions by 2050, a medium term target is set under this plan at 50% emission reductions from 2018 by 2035. The energy and GHG emissions plan is centred on Town-owned assets, including emissions from buildings, fleet, corporate solid waste, public lighting and water/wastewater facilities. The energy and emissions plan for the community is assessed under a separate plan, the Town's Community Energy Plan (CEP), which includes an emissions inventory and reduction plan for community buildings, transportation and community waste.

The Town joined the Partners for Climate Protection (PCP) program in 2018, which consists of a five-step Milestone Framework that guides action against climate change. The 2024 ECDMP fulfills the first three PCP Milestones for the first time by expanding emission sources being reported on to include lighting and waste, in addition to buildings, fleet, and water/wastewater stations. Milestones 1 to 3 include Creating a Baseline Emissions Inventory and Forecast, Setting Emissions Reduction Targets, and Developing a Local Action Plan. The remaining Milestones are Implementing the Action Plan and Progress Monitoring and Reporting, which will be fulfilled going forward. By following this framework, municipalities can make informed decisions, engage the community, and contribute significantly to national climate change mitigation efforts. The Town fulfilled PCP Milestones 1 to 3 for its Community emissions in 2022 with the completion of the CEP.

The ECDMP also meets the requirements under the Ontario Regulation 25/23, Broader Public Sector: Energy Reporting and Conservation and Demand Management Plans (O. Reg. 25/23), requiring public agencies such as municipalities to report their buildings' energy consumption and GHG emissions annually. O. Reg. 25/23 also requires these public agencies to develop ECDMPs and update them every five years.

Over the past five years, the Town has made remarkable progress in addressing climate change, driven by a collective determination and innovation. From the Town's previous 2019 ECDMP, which included the planning window from 2019-2023, the Town decreased electricity consumption by 2% and natural gas consumption by 30%. This resulted in an overall reduction in GHG emissions of 20%, surpassing the goal of 16%. Since 2018, the Town acquired new properties (Sports Dome and the Yonge Street properties) which have increased the Town's GHG emissions by 7%, and GHG emissions increased by another 1% from the opening of The Armoury. Any new acquisitions or the construction of new assets increase GHG emissions and erode any Town efforts outlined in this plan. The completed and in-progress projects from the 2019 ECDMP are listed in Table 1.

Table 1: Summary of Measures Implemented During 2019 ECDMP

Status	Measure
Complete	Aurora Community Centre: Installed new condensers and hot water boilers Aurora Community Centre: Low-flow lavatory and shower Aurora Community Centre: Occupancy sensors Aurora Community Centre: Upgraded ice plant motor controls, replaced shell and tube chillers Aurora Cultural Centre: Demand control ventilation Aurora Cultural Centre: Occupancy sensors Aurora Cultural Centre: Programmable thermostat Aurora Family Leisure Complex: Low-flow lavatory and shower Aurora Public Library: Building system optimization - start/stop Aurora Public Library: Demand control ventilation Aurora Public Library: Interior lighting retrofit Aurora Public Library: Occupancy sensors Aurora Public Library: Replace rooftop HVAC Fleet: Developed Green Fleet Action Plan Fleet: Implemented anti-idling initiative Fleet: Incorporated ethanol 10 in all gasoline-fueled vehicles Fleet: Measured vehicle distance traveled and fuel consumed Fleet: Purchased some electric and hybrid-electric assets Fleet: Replaced low tier diesel equipment Stronach Aurora Recreation Complex: Low-flow lavatories and showerheads Stronach Aurora Recreation Complex: Replaced plumbing fixtures in arena change rooms Stronach Aurora Recreation Complex: Replaced pool liner Stronach Aurora Recreation Complex: Replaced screw compressor Town-wide: Implemented a Town-wide energy management system (EMS) Various: Lighting retrofits to LED
In progress	Aurora Family Leisure Complex: Replace humidicon equipment Fleet: Purchased electric ice resurfacer Various: Lighting retrofits to LED

Table 2 summarizes the proposed actions to be undertaken until the next ECDMP update in 2029.

Table 2: Summary of Planned Actions to Undertake in the Short Term Planning Window (2024-2029)

Action	**Reduction in GHG emissions (tCO2e/yr)**
Investigate and implement demand control ventilation	6
Measures to be identified in feasibility studies	134
Remaining lights to LED	-1
Remaining measures from 2019 ECDMP	70
Remaining occupancy sensors to optimize lighting and HVAC use	0.3
Remaining water fixtures to low-flow	1
High efficiency boiler replacement	4
Optimum HVAC scheduling	4
Decarbonize two light-duty vehicles	18
Ice resurfacer vehicle decarbonization	1
Decarbonize 10 pieces of equipment (such as lawn mowers and tractors)	15
BAS upgrade	64
Pool covers at recreation facilities	25

Note that a negative ("-") reduction in GHG emissions indicates that the Town's GHG emissions are anticipated to increase for that measure, although overall energy use would decrease. "Indirect" measures are those which either are not anticipated to result in a direct reduction in GHG emissions, or whose reduction in GHG emissions is difficult to quantify.

The Town is reaching a critical point in achieving a net-zero future. Through the implementation of the 2024 ECDMP, the Town is completing the remaining "quick-win" energy measures that are considered market-ready, higher payback projects as well as lower-cost operational changes and piloting smaller-scale projects. They are

important measures to implement before making a more aggressive jump of switching to low-carbon technologies and renewable energy sources that often require major investment. Outlined in the 2024 ECDMP are crucial feasibility studies required to be completed in the short term to successfully consider newer, more complex technologies in the medium and long term such as infrastructure upgrades and employee training for implementation.

Achieving the carbon reduction goals requires concerted efforts in change management, ensuring seamless transitions towards greener practices. Deep engagement of stakeholders, including working groups with regular touchpoints, will be instrumental in fostering ownership and support. Active tracking of progress is essential to monitor the Town's carbon reduction initiatives' effectiveness and make timely adjustments as required.

Based on the measures identified in Table 2, the estimated cost to implement the draft 2024 ECDMP is approximately $3.97 million (Table 3). Table 3 outlines the estimated costs for the Town and potential sources of funding associated with short term climate action. Each action item identifies a magnitude of scale cost for the full implementation of the measure. Detailed implementation costing will be defined through a business plan and program design stages. The costs outlined below are subject to the Town's regular capital budgeting process. Should Council endorse the 2024 ECDMP, the full scope of planned capital works for the next five-years will be inserted in the Town's next ten-year capital investment plan. The final approval to proceed with each of these noted projects will be subject to funding availability and project approval. Once the Town performs the recommended feasibility studies, identified projects and detailed costing will be included in the 10 year capital planning budget.

Table 3: Cost Summary for the proposed 2024 ECDMP projects

Measure	Description	Short-term cost (0 to 5 years)	Available grant funding
Studies			
Energy Audits (every 5 years)	Perform energy audits for all facilities determine opportunities for energy conservation measures. Complete this every 5 years along with the Building Condition Assessment activity.	$254,500	
Net-Zero Pathway Feasibility Study - Facilities	Perform a facilities feasibility study for the identification of measures to be addressed in a GHG reduction pathway retrofit capital project. Studies will consider the unique objectives and constraints of the building owner and provide a detailed exploration of multiple optimization scenarios to propose different pathways for facilities to reduce their GHG emissions.	$250,000	FCM: GHG reduction pathway retrofit grants
Fleet Electrification Feasibility Study	Investigate the feasibility of fleet electrification based on fleet needs, multi-year investment planning, and assessing infrastructure needs and upgrades.	$250,000	FCM: Municipal fleet electrification
Waste audit and waste reduction strategy	Perform regular waste audits to track GHG emissions from waste. In addition, develop a Waste Reduction Plan to determine strategies to reduce waste-related GHG emissions.	$50,000	FCM: Waste reduction and diversion grants
TOTAL Proposed ECDMP (Studies)		$804,500	
Capital Projects			
Facilities - retrofits	The focus of these measures is on lighting and controls measures, such as demand control ventilation, climate control upgrades, pool covers, and boiler replacement.	$289,019	
Fleet decarbonization	Replace the ice resurfacers with electric options (five ice resurfacers to replace), electrification of two light duty vehicles and 10 pieces of equipment (exact types of vehicles and equipment to be chosen by fleet manager based on which assets are feasible to decarbonize).	$2,850,000	FCM: Municipal fleet electrification
Employee training and capacity building	Train staff on energy efficiency and operation of new technology implemented during facility ECMs. Train staff on operation of new vehicles purchased during fleet decarbonization.	$15,000	
Energy performance monitoring	Monitor each asset's energy consumption to verify that assets are meeting the targets from implementing ECMs.	$7,000	
TOTAL Proposed ECDMP (Capital Projects)		$3,161,019	
TOTAL Proposed ECDMP (Studies and Capital)		$3,965,519	

Table 4 summarizes the baseline (2018) GHG emissions for each asset type, the current state of GHG emissions, and the projected GHG emissions if all the proposed actions are undertaken according to the 2024 ECDMP.

Table 4: Summary of Existing and Projected GHG Emissions From This Plan

	GHG Emissions (tCO2e/yr)					Percent Reduction from Baseline (%)			
Asset type	**2018**	**2022**	**2029**	**2035**	**2050**	**2022**	**2029**	**2035**	**2050**
Buildings	2,857	2,072	2,068	1,293	946	27	28	55	67
Fleet	556	556	507	445	343	-0	9	20	38
Lighting	59	56	123	137	171	5	-110	-133	-192
Solid Waste	416	416	416	374	0	0	0	10	100
Water and Wastewater	1	1	2	2	3	11	-97	-118	-173
Total	3,889	3,100	3,116	2,251	1,463	20	20	42	62

Note that a negative ("-") percent reduction in GHG emissions indicates that the GHG emissions for that asset increased over the indicated time frame. Lighting and Water/Wastewater are projected to have particularly high increases in GHG emissions as they currently do not have planned ECMs with a quantifiable reduction in electricity consumption.

Important to note from Table 4 is that the carbon emission factor of the Ontario grid, also called the emission intensity of the grid, is expected to increase between 2024-2029 and erode some of the Town's emissions reduction progress. An increased intensity means that even though electricity use by the Town decreases during that time, its GHG emissions nevertheless increase. This can be seen when looking at electricity consumed by public lighting and the water/wastewater pump stations. The electricity consumed by these assets is projected to remain constant over the next five years; however, the GHG emissions increase during this time. This also results in relatively constant overall Town GHG emissions from 2022 to 2029, because although the electricity and natural gas consumption is projected to decrease over this period through the plan's implementation, the increase in the electricity grid carbon intensity is projected to offset the progress.

The intent of the 5-year vision of this plan is to foster a more sustainable community by reducing electricity consumption by **8%**, natural gas consumption by **11%**, propane consumption by **100%**, ethanol 10 by **10%**, and biodiesel 5 by **8%**. Despite the projected increase in grid carbon intensity, it is anticipated that a GHG reduction of **20%** from 2018 by 2029 can be achieved, as well as a decrease to the Town's the annual utility costs of **8%**.

Once the Town has established the necessary framework, based on the results of the feasibility studies and waste reduction plan, and take more aggressive actions to reduce their GHG emissions, the GHG emissions are projected to decrease by **42%** by 2035 and **62%** by 2050. This comes close to meeting the target of 50% reduction by 2035 and makes substantial progress towards achieving net-zero by 2050. To realize this vision and contribute meaningfully to global climate mitigation, it is recommended that the Town leverage insights from energy and waste audits and feasibility studies and start accessing available external grants for the implementation of the plans, remain informed about cutting-edge technologies, implement the lowest-carbon alternatives wherever feasible, and consider the purchase of carbon offsets once the Ontario carbon offset market matures. The current plan would fall short of the net-zero target, but advances in technology are quickly evolving, bringing the Town closer to a net-zero future.

1 Background

1.1 Climate Change Overview

GHG emissions have resulted in an increase in temperature and in extreme weather events in southern Ontario. This has caused heat waves, strong winds, and flooding in the Town of Aurora, and these effects are projected to grow more common and more intense if climate change continues to progress. Under the Town's risk and vulnerability assessment performed in the Climate Change Adaptation Plan in 2022, the most likely trend to occur is an increase in temperatures. This is expected to impact several climate and weather parameters between 2021 and 2050:

- Mean summer maximum temperatures are projected to increase by 9%.
- The number of heat waves are projected to increase from 1.2 to 3.6 per year.
- Cooling Degree Days (used for cooling system design and planning) are projected to almost double (increase of 86%).
- Heating Degree Days (used for heating system design and planning) are projected to decrease as winter temperatures are expected to increase, leading to a reduction in extreme cold risks, snow depth, and annual freeze-thaw cycles.
- Precipitation, wind, and low air quality events associated with wildfires are also projected to increase in the future.

These changes impact the Town's GHG emissions, as a projected decrease in heating degree days reduces the facilities' heating load (and accordingly the GHG emissions associated with heating energy use) in winter months, but a corresponding increase in cooling degree days would increase their cooling load.

Changes in winter conditions such as snow depth, and annual freeze-thaw cycles also impact Town fleet operations, with the number of snow and ice events requiring road and sidewalk clearing and re-icing.

1.1.1 Climate Emergency

In October 2019, Town Council joined 457 Canadian municipalities and declared a Climate Emergency and follow the principles from the Global Covenant of Mayors for Climate and Energy (GCOM). Over 13,000 cities are part of this movement as of 2024, and growing. Those cities have established a goal of accelerating ambitious, measurable climate and energy initiatives that lead to an inclusive, low-emission and climate resilient future, helping to meet and exceed the Paris Agreement objectives.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

1.1.2 Blue Dot

The Town joined the Blue Dot movement in 2016. The Blue Dot movement is a campaign based on the idea that everyone in Canada deserves the right to a healthy environment, including clean air and water, and a say in decisions that affect our health and well-being, including:

- The right to breathe clean air;
- The right to drink clean water;
- The right to consume safe food;
- The right to access nature;
- The right to know about pollutants and contaminants released into the local environment; and
- The right to participate in decision-making that will affect the environment.

1.2 Ontario Legislation: O.Reg. 25/23

Ontario Regulation 25/23, Broader Public Sector: Energy Reporting and Conservation and Demand Management Plans (which has replaced Ontario Regulation 507/18) under the Electricity Act requires public agencies, including municipalities, to report on their building energy consumption and greenhouse gas (GHG) emissions annually, and to develop and implement an Energy Conservation and Demand Management Plan (ECDMP), to be updated every five years.

O. Reg. 25/23 also outlines specific items that must be included in the ECDMP. This includes a summary of annual GHG emissions, a description of previous activities and saving estimates for the municipality's previous measures, and the cost and saving estimates for the current and proposed activities and measures.

The Town completed its first ECDMP in 2014. An update was undertaken in 2019 and now its third revision is being performed under the 2024 ECDMP update.

1.3 FCM's Partners for Climate Protection Milestone Framework

The Federation of Canadian Municipalities (FCM) created the Partners for Climate Protection (PCP) to support municipalities with acting against climate change by reducing their emissions. Council committed the Town to joining PCP program in 2018. The programs fills a five step milestone framework for Community and Corporate GHG emissions. The milestones include:

1. Completing a GHG emission inventory and forecast
2. Setting a GHG reduction target
3. Developing a local action plan
4. Implementing the plan, and
5. Monitoring progress and reporting results

The Town has completed Milestones 1, 2, and 3 for the community through the development of Aurora's Community Energy Plan (CEP), endorsed by Council in January 2021. The Town is now working on Milestones 4 and 5, Implementing the Action Plan and ECDMP renewal, and Progress Monitoring and Reporting.

The 2024 ECDMP update fulfills, for the first time, the PCP Milestones 1-3 at the corporate level by including additional assets and utilities in the ECDMP.

1.4 Town of Aurora's Strategic Planning Review

1. **2014 and 2019 Energy and Conservation Demand Management Plans (ECDMP)**

   As required by O. Reg. 25/23, the Town has prepared an ECDMPs in 2014 and updated this document in 2019. These documents provide an overview of the Town's annual GHG emissions, examine the impact of the previous measures undertaken to reduce GHG emissions, and outline proposed measures to reduce GHG emissions in the next five year period.

   The Town's 2014 ECDMP focused on six of the Town's facilities and aimed to reduce their GHG emissions by 10-15% by taking actions such as upgrading lighting fixtures to LED and replacing equipment with more efficient models.

   The 2019 ECDMP broadened the scope to include more facilities, including water/wastewater facilities, fleet, and renewable generation. The 2019 ECDM plan states that the overall goal is to reduce electricity consumption by 10.5% (990,963 kWh), natural gas consumption by 9.7% (119,584 m3), and GHG emissions by 15.9% (514 tCO2e) of the 2018 baseline by the end of 2023. This is expected to require an investment of approximately $628,842. The 2019 ECDMP included an action plan emphasizing the need to implement all in-progress and planned energy conservation measures identified, and to conduct new energy audits of facilities to identify new potential measures for the 2024 ECDMP. Additional strategies are also listed that

include energy efficient retrofits, developing a green fleet plan, implementing life cycle cost purchasing practices, establishing energy efficiency equipment specifications, monitoring savings progress, and improving communication and staff engagement.

2. **2021 Green Fleet Action Plan (GFAP)**

   The Town's GFAP is a plan which outlines the GHG emissions associated with the corporate fleet and presents a series of actions to undertake which are intended to reduce GHG emissions. The 2019 ECDMP set a goal for fleet to reduce their GHG emissions and to create the GFAP. The 2019 ECDMP did not capture all the 2018 fleet fuel data due to fuel dispensing equipment issues, which has been resolved under the 2024 ECDMP. In the long term, the Fleet Division is aligning with York Region's goal of electrifying the corporate fleet to produce zero emissions by 2051.

   The key objectives outlined in the GFAP are:

   - Reducing demand and analyzing data to maximize performance and efficient resource use.
   - Improving maintenance and management practices.
   - Converting to alternative and renewable low carbon fuels.
   - Continuing to provide efficient, cost-effective services with focus on Green Technologies.

   These strategies were incorporated into the fleet recommendations in the 2024 ECDMP to recommend strategies to reduce the Town's fleet GHG emissions in short, medium, and long term planning.

3. **2021 Community Energy Plan (CEP)**

   The Town's 2021 CEP provides strategic direction to 2050 to improve energy efficiency, reduce energy consumption and GHG emissions, and foster a culture of conservation. The CEP focuses on community emissions, while the scope of the ECDMP covers the Town's corporate emissions. The ultimate goal for the Town of Aurora is reducing their greenhouse gas emissions by 80% from 2018 levels by 2050. The Community Energy Plan outlines a series of strategies that achieve a 22% reduction by 2030 from 2018 levels and a 65% reduction by 2050. These put Aurora on a path towards an 80% emissions reduction by 2050. Some of the completed and planned actions from the CEP (particularly actions taken to achieve objectives related to the area of climate change and energy) are relevant to the Town's annual GHG emissions, and planned actions from the CEP were considered while preparing the short, medium, and long term plans to reduce the Town's emissions in the 2024 ECDMP.

4. **Corporate Environmental Action Plan (CEAP) and progress reports**

   The Corporate Environmental Action Plan (CEAP) is a Town plan that captures all the Town's operations' environmental goals developed in 2018. The CEAP serves to protect and enhance the natural environment, promote environmental sustainability, integrity and conservation of resources and create a practice of environmental stewardship within the community. The purpose of the CEAP is to:

   - Protect and enhance the natural environment
   - Be a catalyst for local initiatives that promote environmental sustainability, integrity and conservation of our resources and ecosystem; and,
   - To enhance environmental stewardship within the community

   The 2024 ECDMP meets CEAP Objective C3: "Reduce the Town's greenhouse gas emissions by Town staff and at Town facilities." The CEAP is reported on annually for its progress.

5. **Climate Change Adaptation Plan (CCAP)**

   In the Town of Aurora's Climate Change Adaptation Plan (CCAP), the Town identified adaptation actions to acclimatize to these changing conditions, such as improving flood resilience, performing proactive landscape maintenance to reduce debris hazards, and increasing the cooling capacity of public facilities. In addition to this, the Town is developing strategies to reduce its corporate GHG emissions to decrease its contribution towards climate change.

6. **Town of Aurora Strategic Plan: 2011-2031**

   The Town's Strategic Plan to identifies and assesses growth and development opportunities that ensure the future economic, social and environmental sustainability and health of Aurora. This Strategic Plan emphasizes the development of local assets which capitalize on the many strengths and opportunities in the area. The ECDMP aligns with the Town's strategic goal of "Supporting environmental stewardship and sustainability". This encourages the stewardship of Aurora's natural resources, and promotes and advances green initiatives.

2 Targets

The original target outlined in the Town's 2019 ECDMP aimed to reduce GHG emissions by 16% by 2023 from a 2018 baseline, with no established medium or long-term objectives. However, in 2021, following the introduction of the Town's Community Energy Plan, a comprehensive Town-wide target was established to achieve an 80% reduction in GHG emissions by 2050, using 2018 as the baseline year.

Since 2021, an increasing number of entities, including the Federal Government of Canada, the Intergovernmental Panel on Climate Change (IPCC), the Regional Municipality of York, and numerous municipalities such as the City of Ottawa and the City of Markham, have committed to achieving net-zero emissions. The 2024 ECDMP aligns with these best practices. To accomplish this, the plan set the following GHG emission reduction targets, compared to the 2018 Baseline:

- Short term (2024-2029): 20%
- Medium term (2030-2035): 50%
- Long term (2035-2050): net-zero emissions by the end of 2050

3 Overall Corporate Emissions Analysis

3.1 GHG Emissions Analysis

The GHG emissions analysis is presented in the form of various plots, each representing the contributions to the Town's corporate GHG emissions for the year of 2022. Commentary on the findings of the GHG emissions analysis is provided in Section 3.1.2, and the methodology is presented in Appendix B. Note that "Other" GHG emissions are assets which collectively contribute less than 1% to corporate GHG emissions, including EV charging stations, park lights, traffic lights, water/wastewater stations, ice resurfacers, and roads waste disposal.

3.1.1 GHG Emissions Breakdown

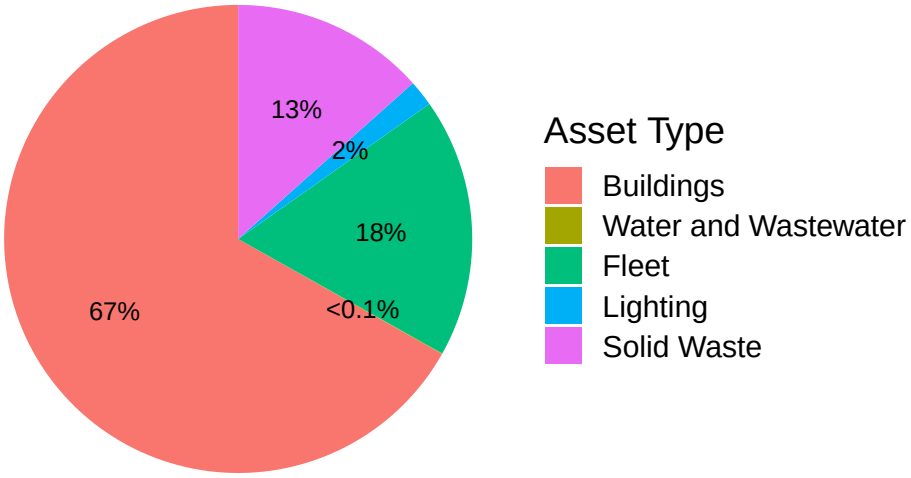

Figure 1: GHG Emissions Baseline by Asset Type.

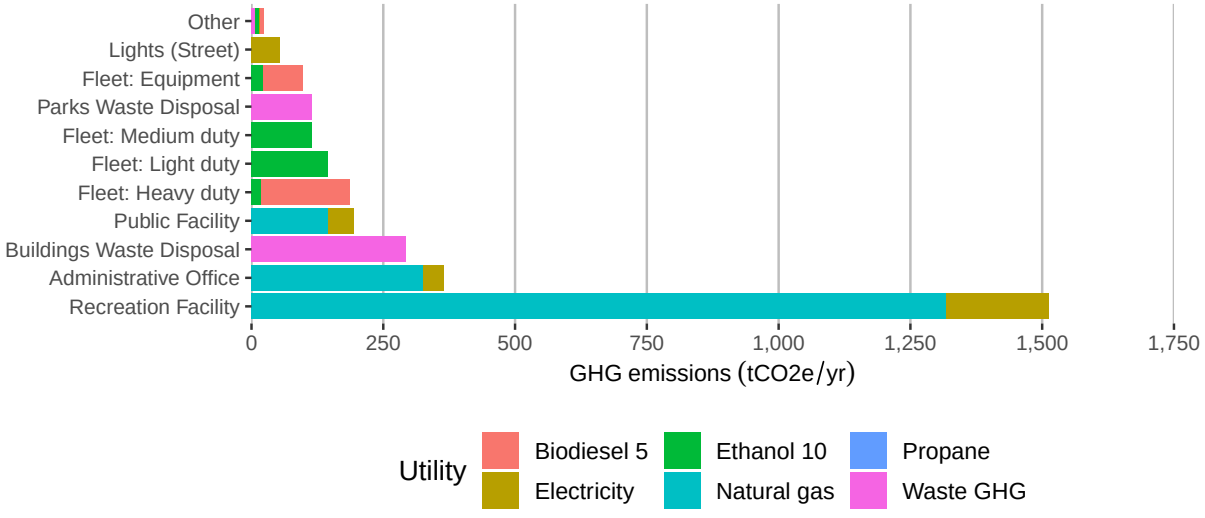

Figure 2: GHG Emissions Baseline by Emission Source.

3.1.2 GHG Emissions Discussion

The following discussion summarizes observations that were made in analyzing the data presented in Section 3.1. The discussion focuses on identifying the most significant contributors to GHG emissions to inform the development of the GHG reduction roadmap scenarios.

- **Asset Type**
  - Buildings have the greatest contribution to GHG emissions, followed by fleet and solid waste. Comparatively, the GHG emissions from lighting and water/wastewater stations is minor. Because of this, the GHG roadmap should prioritize reducing building, fleet, and waste GHG emissions in the short and medium term.
- **Emission Sources**
  - Emission sources refer to the various groups within each asset type. The source is used to break down the buildings sector based on the building's purpose and is used to break down the fleet sector into the vehicle sizes.
  - Indoor 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 from ice resurfacing, water and space heating.
- **Utilities**
  - Natural gas use has the greatest contribution to GHG emissions. Natural gas use is predominately used in buildings. The largest contribution coming from indoor recreation facilities. As such, significantly reducing GHG emissions associated with natural gas use will involve retrofitting multiple buildings, focusing on recreation facilities.
  - Fleet GHG emissions come from a variety of utilities (i.e. fuels). Collectively, these utilities represent the second-greatest contribution to total GHG emissions. As such, significantly reducing corporate GHG emissions will require a reduction in fleet fuel use / fleet asset decarbonization.

3.2 2019-2023 Performance Review

In 2019, the ECDMP considered Town-owned facilities, water/wastewater facilities, and the corporate fleet. The objectives of this plan were to reduce electricity consumption by 10.5%, natural gas by 9.7%, and GHG emissions by 15.9% by 2023. The majority of the measures considered by this plan were the remaining control measures identified by the 2017 energy audits, including LED retrofits, low-flow water fixtures, occupancy sensors, and optimum start/stop ventilation.

Compared to a recalculated baseline, to account for the assets which are new to this plan, it was found that the electricity consumption decreased by 1.8%, which does not meet this goal. However, the natural gas consumption decreased by 30.4% since the 2018 baseline, contributing to an overall decrease of 20.3% in corporate GHG emissions from 2018 to 2022, which meets the overall target from the 2019 ECDMP. Not all items from the 2019 ECDMP have been actioned, as they faced challenges during this time: COVID-19 impacted Town priorities and staff allocation for ECM implementation, and some measures are dependent on first upgrading or installing a Building Automation System (BAS), such as building climate controls and optimization of the start and stop of HVAC equipment.

The recalculated baseline accounts for new assets added since the 2019 ECDMP. Since 2019, the Town has acquired new assets (Aurora Sports Dome and the buildings on Yonge street) and constructed Aurora Town Square, and new GHG emission sources (lighting and solid waste emissions) have been added into the target to comply with the PCP Protocol.

The recalculated baseline GHG emissions and the most recent utility use and GHG emissions data is presented in Table 5. Note that the "current" utility use is taken as the utility use in 2022, as this is the most recent year with complete utility use data available.

Table 5: Utility Use Comparison From Baseline Year

		2018 (Recalculated)		2022		Reduction from baseline		
Utility	**Unit**	**Consumption**	**GHG emissions**	**Consumption**	**GHG emissions**	**Consumption**	**GHG emissions**	**Percentage**
-	-	[unit listed]	[tCO2e/yr]	[unit listed]	[tCO2e/yr]	[unit listed]	[tCO2e/yr]	%
Electricity	[kWh/yr]	11,571,403	347	11,368,706	341	202,697	6	2
Natural gas	[m3/yr]	1,337,896	2,570	930,583	1,788	407,313	782	30
Gasoline	[L/yr]	144,831	334	0	0	144,831	334	-
Ethanol 10	[L/yr]	0	0	136,804	305	-136,804	-305	-
Diesel	[L/yr]	82,185	220	0	0	82,185	220	-
Biodiesel 5	[L/yr]	0	0	96,252	250	-96,252	-250	-
Propane	[L/yr]	705	1	655	1	50	0	7
Waste GHG	[tCO2e/yr]	416	416	416	416	0	0	-
Overall	[tCO2e/yr]		3,889		3,100		788	20

Note that a negative reduction in consumption or GHG emissions indicates that the consumption or GHG emissions increased. Also note that "-" is used to indicate cases where the percent change is not applicable (used for the fleet fuels, which was changed from gasoline and diesel in 2018 to ethanol 10 and biodiesel 5 in 2022)

3.2.1 Historical Utility Use Discussion

The following summarizes observations from the change in GHG emissions. Note that utility use data from 2023 is not included in the analysis because not all data from 2023 was available at the time that this report was written.

- GHG emissions decreased in 2022 compared to 2018.
- There is a slight decrease (1.8%) in the electricity consumption when comparing 2018 and 2022 utility use, and a much larger decrease (30.4%) in the natural gas consumption, with a corresponding decrease in GHG emissions.
- Since 2018, the Town has acquired new properties (Sports Dome and the Yonge Street properties), that have increased the Town's GHG emissions by 7% and the another 1% from the opening of The Armoury. Any new acquisitions or the construction of new assets will increase GHG emissions from the Town directly and erode any Town efforts of reductions.
- In 2022, it appears that certain buildings consumed less natural gas and more electricity, which could contribute to the decreased emissions due to natural gas usage.
- The reduced natural gas consumption in 2022 appears to be a result of reduced space heating. In 2018, approximately 1,300 tCO2e are emitted due to space heating, whereas in 2022, only 1,000 tCO2e are emitted for space heating. This is believed to be primarily the impact of energy conservation measures implemented from the 2019 ECDMP.
- This report is the first report in which the indirect emissions from the Town's solid waste are being estimated and integrated into the plan. Quantifying indirect emissions presents a significant challenge for municipalities, making their inclusion in this plan a noteworthy accomplishment.

This milestone improves the comprehensive nature of this report, and lays the groundwork for identifying strategies to mitigate these emissions in both current and future planning initiatives.

4 Buildings

4.1 Asset Information

The buildings considered under this ECDMP are summarized in Table 6. Central York Fire facilities have been accounted for as a third-party entity and are being excluded from this report at this time, although this can be re-assessed for future reports. Electric Vehicle charging stations are included but considered as a separate end use.

Table 6: Facilities Asset Summary

Type	Building name	Address	Construction	Gross floor area (ft2)
Administrative Office	15165 A Yonge	15165 A Yonge	2000	10,520
	15171 Yonge	15171 Yonge	1991	750
	Aurora Town Hall	100 John West Way	1991	49,280
	Joint Operations Centre	229 Industrial Parkway N	2016	63,152
EV Charging Stations	Electric Vehicle Charging Stations	Varied	2022	-
Public Facility	Aurora Cultural Centre	22 Church Street	1885, 2024	17,500
	Aurora Public Library	15145 Yonge Street	2000	44,375
	Aurora Seniors Centre	90 John West Way	2005	13,934
	McMahon Clubhouse	76 Maple Street	1930, 1970	1,400
	The Armoury	89 Mosley Street	1874, 2018	8,400
	Victoria Hall	27 Mosley Street	1883	900
Recreation Facility	Aurora Community Centre	1 Community Centre Lane	1966, 1996	81,100
	Aurora Family Leisure Complex	135 Industrial Parkway North	1985	61,000
	Aurora Sports Dome	115 Industrial Parkway North	2005, 2018	89,485
	Stronach Aurora Recreation Complex	1400 Wellington Street East	2007	104,000
Solar PV	Solar Photovoltaic Energy	Joint Operations Centre, Aurora Public Library, Aurora Town Hall	Various	-

Note that SARC also has a solar array, but this does not belong to the Town, and it is omitted from this study.

4.2 Historical Utility Use

The Buildings historical utility use is presented in Figure 3.

Figure 3: Buildings Historical Energy Use.

Electricity:

- Electricity use increased from 2015 to 2016 but has largely stayed consistent since then.
- There is a decrease in electricity consumption in 2020, which is likely a factor of reduced energy use due to the COVID-19 pandemic. This was increased in 2021, and electricity use returned to pre-COVID-19 levels in 2022.
- The number of cooling degree days, a measure of cooling demand for facilities, was 8% less in 2022 compared to 2018.

Natural gas:

- Natural gas usage drops significantly in 2020, which is the result of reduced operation due to COVID-19.
- Natural gas usage does not return to pre-pandemic levels, which is thought to be the result of implementing measures to reduce GHG emissions and operational changes.
- In 2022, heating degree days, which measure heating demand for facilities, decreased by 2% compared to 2018. Although the heating demand was reduced in 2022, this alone cannot not explain the reduction in natural gas use observed in 2022.

Solar PV (Photovoltaics):

- The energy generated through each solar PV system has stayed relatively constant. In 2021 to 2022, the Aurora Public Library underwent renovations and the system was disconnected. In addition, in 2022, the PV systems at the Aurora Town Hall had issues with the energy generating tracking meter, but did not impact the energy generation at that site. This decreases the apparent solar energy generated in 2022, although the actual energy generation was likely similar to what it had been in 2021. The library had a similar issue in 2019, only impacting metering and not any generation.

Energy use intensity:

- Table 7 summarizes each building's energy use intensity.
- The Stronarch Aurora Recreation Complex (SARC) consumed the most energy in 2018, and has the second-highest energy use intensity. This is because of the energy consumed to heat the SARC and to operate the ice rinks and pools inside.
- 15171 Yonge have relatively low energy usage, but because it has such a low floor area, it exhibits the highest energy use intensity.
- Three of four indoor recreation facilities have the highest energy consumption in 2022. As mentioned above, this is because of the energy consumed while heating the facilities and operating the ice rinks and pools.

Table 7: Building Energy Use Intensity in 2018 and 2022

Asset	Building type	Gross floor area	Total energy use (2018)	Energy use intensity (2018)	Total energy use (2022)	Energy use intensity (2022)
-	-	[ft2]	[kWh]	[kWh/ft2]	[kWh]	[kWh/ft2]
15171 Yonge	Administrative Office	750	58,000	78	62,000	83
Stronach Aurora Recreation Complex	Recreation Facility	104,000	8,411,000	81	7,777,000	75
Aurora Family Leisure Complex	Recreation Facility	61,000	4,263,000	70	2,508,000	41
Joint Operations Centre	Administrative Office	63,152	2,065,000	33	2,054,000	33
Aurora Public Library	Public Facility	44,375	1,436,000	32	1,378,000	31
Aurora Cultural Centre	Public Facility	17,500	413,000	24	541,000	31
Aurora Seniors Centre	Public Facility	13,934	424,000	30	390,000	28
Aurora Community Centre	Recreation Facility	81,100	4,201,000	52	2,246,000	28
Victoria Hall	Public Facility	900	72,000	80	22,000	24
Aurora Town Hall	Administrative Office	49,280	1,292,000	26	858,000	17
Aurora Sports Dome	Recreation Facility	89,485	861,000	10	1,227,000	14
The Armoury	Public Facility	8,400	109,000	13	106,000	13
15165 A Yonge	Administrative Office	10,520	82,000	8	115,000	11
McMahon Clubhouse	Public Facility	1,400	2,000	1	4,000	3

4.3 Best Practices

A study of best practices employed by other municipalities was referenced in the development of this ECDMP. Some of the best practices which the plan considered, excluding those which have already been implemented by the Town, are listed below:

- **Controls upgrades:** Controls upgrades such as HVAC improvements (demand control ventilation, occupancy sensors, HVAC scheduling, etc.) are often simple measures to implement to reduce energy with a low cost per GHG reduction.
- **Fuel switching:** Many municipalities are switching away from natural gas-fueled heating and implementing more and more electric equipment to reduce GHG emissions. Heat pumps are a popular technology to accomplish this, as in addition to reducing GHG emissions by replacing gas-fired equipment, air-source heat pumps usually have an average COP (Coefficient of Performance, a measure of efficiency) of at least 2.5 (corresponding to 250% efficiency), reducing the amount of energy consumed to maintain the temperature in a space.
- **Recreational facilities:** Recreational facilities often make up a large portion of a municipality's GHG emissions; to address this, many municipalities have measures to reduce the energy consumed by processes within these facilities. For instance, adding pool covers, arena e-ceilings, and implementing cold water flooding within ice rinks are often considered as measures to reduce GHG emissions from recreational facilities. Municipalities are increasingly seeking a whole-building retrofit approach as a way to achieve quicker emission reduction goals, instead of on an individual equipment asset renewal timeframe. Recreational centres, the highest intensity emitting municipal buildings, are being retrofitted to meet net-zero performance goals at the facility level.

4.4 Energy Conservation Measures (ECMs)

4.4.1 Previous ECMs

The following building ECMs were completed under the previous ECDMP between 2019 and 2023, and their status and estimated energy savings are presented in 8.

Table 8: Estimated Annual Energy Savings for Measures Implemented From 2014 to 2023

Status	Building	Measure	Completion Year	Electricity Savings	Natural Gas Savings
-	-	-	-	[kWh]	[m3]
Complete	Aurora Community Centre (ACC)	Interior LED retrofit	2017	172576	-15949
	Aurora Community Centre (ACC)	Arena LED retrofit	2017	6599	0
	Aurora Community Centre (ACC)	Upgraded ice plant motor controls, replaced shell and tube chillers	2017	-	-
	Aurora Community Centre (ACC)	Installed new condensers and hot water boilers	2017	-	-
	Aurora Community Centre (ACC)	Occupancy sensors	2022	10945	-309
	Aurora Community Centre (ACC)	Low-flow lavatory and shower	2022	0	19487
	Aurora Cultural Centre	Occupancy sensors	2023	14536	20685
	Aurora Cultural Centre	Programmable thermostat	2023	26771	2969
	Aurora Cultural Centre	Demand control ventilation	2023	1478	2244
	Aurora Cultural Centre	Exterior lights to LED	2023	2369	0
	Aurora Cultural Centre	Interior LED retrofit	2023	10035	229
	Aurora Family Leisure Complex (AFLC)	LED parking lot lights	2014	-	-
	Aurora Family Leisure Complex (AFLC)	Arena LED retrofit	2019	45000	0
	Aurora Family Leisure Complex (AFLC)	Interior LED retrofit	2019	57624	-3606
	Aurora Family Leisure Complex (AFLC)	Pool LED retrofit	2019	28048	-2211
	Aurora Family Leisure Complex (AFLC)	Low-flow lavatory and shower	2022	0	9867
	Aurora Public Library	Interior lighting retrofit	2018	182784	-2352
	Aurora Public Library	Replace rooftop HVAC	2022	-	-
	Aurora Public Library	Demand control ventilation	2023	-7038	2541
	Aurora Public Library	Occupancy sensors	2023	12447	-281
	Aurora Public Library	Building system optimization - start/stop	2023	3588	3894
	Aurora Public Library	LED exterior lighting retrofit	2024	194520	0
	Aurora Seniors Centre	Interior CFL and T8 to LED retrofit	2021	43041	-2628
	Aurora Town Hall	CFL pot light to LED (floors 1-2)	2023	11729	-2719
	Aurora Town Hall	T8 Light to LED (floors 1-2)	2023	88917	-2719
	Aurora Town Hall (north parking lot)	LED parking lot lights	2014	-	-
	Stronach Aurora Recreation Complex (SARC)	LED parking lot lights	2014	-	-
	Stronach Aurora Recreation Complex (SARC)	Interior LED retrofit	2017	139995	0
	Stronach Aurora Recreation Complex (SARC)	Arena LED retrofit	2017	293599	0
	Stronach Aurora Recreation Complex (SARC)	Pool MH to LED	2017	240416	0
	Stronach Aurora Recreation Complex (SARC)	LED retrofit: exterior	2017	-	-
	Stronach Aurora Recreation Complex (SARC)	Replaced pool liner	2017	-	-
	Stronach Aurora Recreation Complex (SARC)	Low-flow lavatories and showerheads	2018	0	91459
	Stronach Aurora Recreation Complex (SARC)	Replaced plumbing fixtures in arena change rooms	2020	0	45730

Table 8: Estimated Annual Energy Savings for Measures Implemented From 2014 to 2023 *(continued)*

Status	Building	Measure	Completion Year	Electricity Savings	Natural Gas Savings
	Stronach Aurora Recreation Complex (SARC)	Replaced screw compressor	2023	-	-
	Town-wide	Implemented a Town-wide energy management system (EMS)	-	-	-
In progress	Aurora Family Leisure Complex (AFLC)	Replace humidicon equipment	2024	-	-
	Aurora Seniors Centre	Exterior LED retrofit (parking lot)	2024	5790	0
	Aurora Town Hall	LED exterior lighting retrofit (south parking lot)	2024	17957	0
	Aurora Town Hall	CFL pot light to LED (as part of the 3rd floor refresh)	2024	11729	-2719
	Aurora Town Hall	T8 Light to LED (as part of the 3rd floor refresh)	2024	88917	-2719
Planned	Aurora Cultural Centre	Occupancy sensors	TBD	14536	20685
	Aurora Cultural Centre	Programmable thermostat	TBD	26771	2969
	Aurora Family Leisure Complex (AFLC)	Exterior LED retrofit	TBD	21440	0
Canceled - impractical / infeasible / insignificant savings	Aurora Community Centre (ACC)	Replace fan coil units	Canceled	-	-
	Aurora Town Hall	Low-flow lavatory and shower	Canceled	16850	0
	Stronach Aurora Recreation Complex (SARC)	Daylighting	Canceled	-	-
On hold pending feasibility study	Aurora Family Leisure Complex (AFLC)	Arena Low-E ceilings	TBD	125000	0
	Stronach Aurora Recreation Complex (SARC)	Arena Low-E ceilings	TBD	123000	0
Planned - pending Building Automation System upgrades	Aurora Community Centre (ACC)	Building system optimization - start/stop	2024	-10166	10585
	Aurora Family Leisure Complex (AFLC)	Upgrade of climate control	2024	-	-
	Aurora Family Leisure Complex (AFLC)	Demand control ventilation	2024	6862	8383
	Aurora Family Leisure Complex (AFLC)	Building system optimization - start/stop	2024	9655	1645
	Aurora Town Hall	Demand control ventilation	2024	29108	5820
	Aurora Town Hall	Building system optimization - start/stop	2024	9376	2207
	Stronach Aurora Recreation Complex (SARC)	Building system optimization - start/stop	2024	7889	911
Planned at end of life (lifecycle replacement)	Aurora Community Centre (ACC)	Replace compressors	TBD	-	-
	Aurora Community Centre (ACC)	Replace two heating boilers	TBD	-	-
	Aurora Seniors Centre	Low-flow lavatories	TBD	0	1710
	Aurora Town Hall	Replace forced air and gas furnaces	TBD	-	-
	Victoria Hall	Interior LED retrofit	TBD	1313	-104
	Victoria Hall	Low-flow lavatory fixtures	TBD	916	0
	Victoria Hall	Occupancy sensors	TBD	224	0
	Victoria Hall	Programmable thermostat	TBD	76	420

Additional actions undertaken from the 2019 ECDMP are listed below:

- Conducted a life-cycle audit of Town-owned infrastructure and equipment, and assessed opportunities for energy efficiency upgrades: BCAs were completed in 2022, providing a high-level energy assessment, though limited energy conservation measures were provided.
- Implemented a minimum green building standard of LEED Silver for all new town facilities: the Aurora Town Square is meeting a LEED Gold standard (without certification).
- Quarterly staff meeting to discuss building energy performances, best practices, operational changes, innovative technologies, and incentives.
- Explored alternative funding options through Energy Services Company (ESCO) to identify and fund energy efficiency projects.
- Participated in the Enbridge Run it Right incentive program which provided free training to staff on operating changes to reduce natural gas use and incentives for ECMs which were installed in 2021-2022. It is estimated that natural gas use was reduced by 8% at participating facilities.
- Developed the Green Procurement Policy.
- Implemented a Town-wide energy management system (EMS) that tracks energy use, trends, GHG emissions, and building performance. The implementation of life cycle cost purchasing practices was not completed but the development of the Green Procurement Policy was initiated. Staff are looking to develop supporting documents for this process.

Based on the measures which have been implemented, or are in the process of being implemented, the natural gas usage has been considerably reduced since 2018, in part due to the ECMs put in place in that time and the operational changes that occurred through staff education and building operations. In particular, the upgrades at the Aurora Public Library, Aurora Community Centre, and Aurora Family Leisure Complex have decreased the natural gas consumption.

4.4.2 Recommended ECMs

Recommended measures are summarized in Table 9.

Table 9: Recommended Measures and Estimated Impacts (For the Short, Medium, and Long Term)

Facility	Measure	Project cost	Incremental cost	GHG reduction	Utility cost reduction	Cost per GHG reduction	Source
-	-	[$]	[$]	[tCO2e/yr]	[$/yr]	[$/tCO2e]	-
Aurora Community Centre	Arena low-e ceiling, if feasible	73,654	73,654	1	6,896	49,845	Energy Audit
Aurora Community Centre	BAS upgrade	0	0	8	2,115	0	Recommended
Aurora Community Centre	Demand control ventilation	8,489	8,489	1	242	6,500	Energy Audit
Aurora Community Centre	DHW to heat pump	1,000,000	988,000	32	-2,031	31,629	Recommended
Aurora Community Centre	Electrification of dehumidification	400,000	380,000	26	-13,109	15,119	Recommended
Aurora Community Centre	Electrification of ice resurfacing boiler	250,000	250,000	26	-13,109	9,450	Recommended
Aurora Community Centre	HVAC to heat pump	3,000,000	2,880,000	77	-4,945	38,971	Recommended
Aurora Community Centre	Increase roof insulation thickness	4,575,000	4,107,500	5	904	938,334	BCA
Aurora Community Centre	Measures to be identified in feasibility studies	0	0	6	3,395	0	Recommended
Aurora Community Centre	Renewable energy generation	1,687,500	1,687,500	13	59,787	131,718	Recommended
Aurora Cultural Centre	HVAC to heat pump	2,000,000	2,000,000	57	-3,636	35,337	Recommended
Aurora Cultural Centre	Measures to be identified in feasibility studies	0	0	3	1,639	0	Recommended
Aurora Cultural Centre	Renewable energy generation	1,012,500	1,012,500	8	35,872	131,718	Recommended

Table 9: Recommended Measures and Estimated Impacts (For the Short, Medium, and Long Term) *(continued)*

Facility	Measure	Project cost	Incremental cost	GHG reduction	Utility cost reduction	Cost per GHG reduction	Source
Aurora Family Leisure Complex	BAS upgrade	0	0	8	8,377	0	Recommended
Aurora Family Leisure Complex	DHW to heat pump	800,000	800,000	14	-903	56,905	Recommended
Aurora Family Leisure Complex	Electrification of ice resurfacing boiler	250,000	250,000	4	-2,128	58,212	Recommended
Aurora Family Leisure Complex	HVAC to heat pump	6,500,000	5,580,000	63	-4,034	103,513	Recommended
Aurora Family Leisure Complex	Increase roof insulation thickness	4,950,000	3,725,500	4	737	1,244,601	BCA
Aurora Family Leisure Complex	Measures to be identified in feasibility studies	0	0	10	10,852	0	Recommended
Aurora Family Leisure Complex	Pool cover	4,619	4,619	9	22,565	502	Energy Audit
Aurora Family Leisure Complex	Pool heat to heat pump	3,250,000	3,210,000	12	-783	266,744	Recommended
Aurora Family Leisure Complex	Renewable energy generation	1,012,500	1,012,500	8	35,872	131,718	Recommended
Aurora Public Library	BAS upgrade	0	0	3	3,265	0	Recommended
Aurora Public Library	High efficiency boiler replacement	159,124	159,124	4	693	42,555	Energy Audit
Aurora Public Library	HVAC to heat pump	2,000,000	2,000,000	27	-1,750	73,406	Recommended
Aurora Public Library	Measures to be identified in feasibility studies	0	0	3	5,731	0	Recommended
Aurora Seniors Centre	Demand control ventilation	6,866	6,866	4	1,473	1,565	Energy Audit
Aurora Seniors Centre	DHW to heat pump	10,000	5,000	3	-164	3,922	Recommended
Aurora Seniors Centre	HVAC to heat pump	800,000	666,500	29	-1,884	27,282	Recommended
Aurora Seniors Centre	Measures to be identified in feasibility studies	0	0	2	1,329	0	Recommended
Aurora Seniors Centre	Optimum HVAC scheduling	6,492	6,492	4	1,954	1,748	Energy Audit
Aurora Seniors Centre	Remaining exterior lights to LED	2,497	2,497	0	602	19,370	BCA, Energy Audit
Aurora Seniors Centre	Remaining low-flow water fixtures	125	125	0	37	618	Energy Audit
Aurora Seniors Centre	Renewable energy generation	337,500	337,500	3	11,957	131,718	Recommended
Aurora Seniors Centre	VVT or VAV system	13,607	13,607	1	-94	9,281	Energy Audit
Aurora Sports Dome	HVAC electrification	2,000,000	2,000,000	167	-82,984	11,942	Recommended
Aurora Sports Dome	Measures to be identified in feasibility studies	0	0	10	2,887	0	Recommended
Aurora Town Hall	BAS upgrade	0	0	7	4,723	0	Recommended
Aurora Town Hall	HVAC to heat pump	1,500,000	150,000	40	-2,544	37,875	Recommended
Aurora Town Hall	Increase roof insulation thickness	2,025,000	1,325,000	3	465	807,302	BCA
Aurora Town Hall	Measures to be identified in feasibility studies	0	0	4	5,262	0	Recommended
Aurora Town Hall	Occupancy sensor in meeting rooms	18,726	18,726	0	220	68,398	Energy Audit
Aurora Town Hall	Remaining exterior lights to LED	24,343	24,343	1	2,462	46,151	BCA, Energy Audit
Aurora Town Hall	Remaining interior lights to LED	53,056	53,056	-2	11,273	-26,028	BCA, Energy Audit
Aurora Town Hall	Remaining low-flow water fixtures	312	312	0	1,864	781	Energy Audit
Joint Operations Centre	DHW to heat pump	15,000	3,000	20	-1,309	736	Recommended
Joint Operations Centre	HVAC to heat pump	3,000,000	2,400,000	234	-15,054	12,802	Recommended
Joint Operations Centre	Increase roof insulation thickness	3,375,000	2,180,000	15	2,751	227,384	BCA
Joint Operations Centre	Measures to be identified in feasibility studies	0	0	23	8,636	0	Recommended
McMahon Clubhouse	Remaining lights to LED	624	624	-0	40	-86,743	BCA
Stronach Aurora Recreation Complex	BAS upgrade	0	0	38	28,344	0	Recommended
Stronach Aurora Recreation Complex	DHW to heat pump	6,000,000	5,880,000	450	-28,921	13,327	Recommended
Stronach Aurora Recreation Complex	Electrification of dehumidification	400,000	400,000	8	-3,786	52,350	Recommended
Stronach Aurora Recreation Complex	HVAC to heat pump	8,000,000	7,800,000	379	-7,849	21,127	Recommended

Table 9: Recommended Measures and Estimated Impacts (For the Short, Medium, and Long Term) *(continued)*

Facility	Measure	Project cost	Incremental cost	GHG reduction	Utility cost reduction	Cost per GHG reduction	Source
Stronach Aurora Recreation Complex	Increase roof insulation thickness	7,950,000	6,384,000	13	2,447	602,202	BCA
Stronach Aurora Recreation Complex	Measures to be identified in feasibility studies	0	0	74	32,676	0	Recommended
Stronach Aurora Recreation Complex	Pool cover	3,246	3,246	16	10,431	206	Energy Audit
The Armoury	DHW to heat pump	8,000	0	1	-93	5,519	Recommended
The Armoury	HVAC to heat pump	500,000	500,000	17	-1,071	29,997	Recommended
The Armoury	Increase roof insulation thickness	622,500	622,500	1	196	589,650	BCA
Victoria Hall	HVAC to heat pump	45,000	45,000	3	-200	14,422	Recommended
Victoria Hall	Increase roof insulation thickness	150,000	124,000	0	37	759,008	BCA
Victoria Hall	Remaining low-flow water fixtures	499	499	0	69	33,533	Energy Audit
Total		69,801,779	61,082,279	2,001	138,693		

The "Source" column indicates where the ECM data was obtained. "Energy Audit" entries come from the 2017 Energy Audit, "BCA" refers to the 2022 BCAs, and "Recommended" measures are the additional ECMs recommended for consideration. The cost estimates include all anticipated fees of implementing the project, including the design, equipment, installation, and electrical upgrades (where applicable). These costs include a design contingency of 25% and a construction contingency of 10% to account for uncertainty in the cost. Incremental costs are based on costs from the 10 year asset management plan and 2022 BCA, where available.

4.4.3 Measure Descriptions

Arena low-e ceiling

A low-e ceiling can be installed in arenas to block radiant energy from the ceiling structure. This reduces the amount of heat introduced to the arena, lowering the cooling load required to maintain the ice and reducing the energy consumption of the ice plant.

BAS upgrade

Upgrade the building automation system (BAS) to allow for more sophisticated control of the building's HVAC system. Note that in this report, no cost is associated with BAS upgrade measures, as the cost has already been accounted for in the Town's planning.

Boiler replacement

Replace boilers with high efficiency models (95% efficiency).

Daylighting

Add daylighting sensors to spaces with natural light. These sensors can detect how much light is in the space to dim or turn off the lights in the space when they are not needed and save electricity by reducing how often the lights are on.

Demand control ventilation

In demand control ventilation, CO2 sensors can be added to spaces or return ducts to measure the CO2 in a space and determine whether additional outside air is required. This reduces the amount of outside air brought into the building, as unoccupied rooms will not need as much ventilation to maintain comfortable CO2 levels, and reduces the amount of energy which must be used to heat or cool the outside air being introduced to the facility.

Electrification measures

Replace gas-fired equipment with electric equipment. Electricity from the Ontario grid has a lower GHG impact than natural gas and is often more efficient than gas-fired equipment.

Heat pumps

Replace heating system (DHW, boiler, HVAC, etc.) with heat pumps. In these measures, air-source heat pumps are considered, 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 coefficient of performance (COP) of around 2.5 (corresponding to 250% efficiency), and geothermal heat pumps often have an average COP above 3.5.

Increase roof insulation thickness

Increase the insulation thickness in the roof to reduce heat lost to the outside air and decrease the heating load on the facility.

Occupancy sensors

Occupancy sensors can be added to rooms and connected to the HVAC and lighting system to improve HVAC efficiency and reduce the lighting when the room is unoccupied, saving energy in temperature control and in lighting.

Optimum HVAC scheduling

An optimum start/stop program can be integrated with the BAS and use sensors in the building, as well as the occupancy schedule from the BAS, to optimize the HVAC schedule within the building. This program will re-calculate the optimal time to start heating the building to maintain the space set point at the beginning of the day, and the optimal time to switch to a relaxed temperature setpoint at the end of the day, to reduce the amount of energy expended to maintain space conditions in an unoccupied building.

Pool cover

Add a pool cover to the main and therapy pools for use when the pool is unoccupied to reduce heat lost through evaporation. This will reduce the heating load of the pool, as well as the dehumidification load of the pool area, reducing the energy required to operate the pool. Both a standard pool cover and a liquid pool cover can be considered as options in this measure.

Remaining lights to LED

Determine which lights in the facility have not yet been converted to LED, and replace them with LEDs.

Remaining low-flow water fixtures

Determine which water fixtures have not been converted to low-flow, and change to low-flow fixtures.

Renewable energy

Generate renewable energy to reduce GHG emissions by reducing electricity consumption. In this report, the estimated energy generation potential of solar PV at relevant locations is used to estimate the projected reduction in GHG emissions, although alternate renewable energy sources (e.g. solar thermal energy, wind energy, etc.) can also be considered.

Variable Volume and Temperature (VVT) or Variable Air Volume (VAV) systems

Retrofit constant air volume systems with variable volume and temperature (VVT) or variable air volume (VAV) systems. Variable volume systems can modulate the amount of air sent to different zones in the building, decreasing the amount of air which needs to be heated or cooled to reduce the energy used by the building.

4.4.4 Additional Recommendations

In addition to the measures listed, it is recommended that the Town investigate the following actions, listed below. These actions are either not anticipated to result in direct GHG emissions reductions (although many are expected to result in an indirect reduction in GHG emissions), or the reduction in GHG emissions is difficult to quantify.

- **American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Level 3 Energy Audits:** These Energy Audits should be performed alongside the Building Condition Assessments, every five years.
- **Net-zero pathway feasibility study:** Assess the feasibility to support medium-term and long-term projects that reduce energy and GHGs, extend asset life, and reduce cost of ownership for local recreational and cultural facilities. Determine the best approach to achieving near net zero buildings with a study grant. FCM grants should be pursued for the feasibility study portion and any capital projects identified. It is particularly recommended that this is done for recreational facilities.
  - Explore various holistic GHG mitigation strategies / scenarios with a greater level of detail. FCM framework includes multiple stakeholder engagement workshops throughout; this allows stakeholders to provide feedback upfront and have it be considered when making final recommendations.
  - The FCM funds such feasibility studies under the Community Building Retrofit (CBR) program, and is designed for municipal buildings such as these ones.
  - The designs from these studies can be used to provide more accurate estimations of cost and GHG emissions reductions from implementing measures, as well as recommend new measures based on facility operation.
- **Asset renewal consideration for roofs:** Control retrofits are the most economical at the time of asset renewal. Roof upgrades are particularly cost prohibitive due to their high costs. The following measures should be considered at the time of replacement, assessed for feasibility, cost, and incorporated into the design:
  - Increasing roof insulation thickness.
  - Installation of a photovoltaic system, system upgrade, or expansion.

  - Envelope repair and enhancement.
  - White and green roof features.
- **Design**
  - Based on the outcomes of the feasibility studies, engage design consultants to provide a detailed design for each measure.
- **Staff training and capacity building:** Provide energy management training to support staff in their efforts to reduce energy waste and maximize efficiency through building system control strategies and other operational measures, and training required to operate and maintain any new technologies identified in the feasibility study.
- **Building Automation System (BAS) installation and upgrades:** the Town's 10 year capital budget is prioritizing BAS installation and upgrade at the following facilities: ACC, AFLC, SARC, Town Hall and the Library. A building automation system (BAS) is a software program that uses data to automatically adjust building performance. Installing a BAS gives enhanced control over various building systems, including heating, ventilation and air conditioning (HVAC) systems, electrical grids, security systems and much more. They can vary in complexity, depending on the structure and purpose of the building. Smart HVAC controls help limit energy use in unoccupied building areas, detect and diagnose faults, and reduce HVAC usage overall, particularly during times of peak energy demand. After BAS upgrades, planned building control optimization measures from the 2019 ECDMP can be implemented.
- **Prepare for upcoming ECMs:** Steps should also be taken to plan the implementation of the measures set to be implemented shortly after this time frame (e.g. 2030-2034). For instance, the Town should reach out to the staff at Town Hall to discuss the construction required to increase the roof insulation thickness, currently planned for 2031.

4.5 Targets

In the short term, the Town's corporate electricity consumption is projected to be reduced by 8%, which is primarily a result of the measures recommended for the Town's facilities. This corresponds to a decrease of 14% since the 2018 baseline. In the medium term, the electricity consumption will be 1% higher than the baseline, due to the increased implementation of electrification measures in facilities and in fleet. In the long term, electricity use will be 6% higher than in the baseline year, although the corresponding reductions in the utilities with higher emissions factors will reduce the overall GHG emissions.

For natural gas consumption, in the short term, natural gas use should be reduced by 11%, corresponding to a decrease of 40% since the baseline year. In the medium term, the natural gas consumption should be 77% lower than the baseline, and in the long term, it should be 99% lower than the baseline year.

5 Fleet

5.1 Asset Information

The corporate fleet vehicles considered under this ECDMP are summarized in Table 10. A more detailed breakdown is presented in Appendix A. Note that vehicles from the Central York Fire Services are owned by the Town of Newmarket, and thus are not included in this study.

Table 10: Fleet Vehicle Distribution

Department	Equipment	Light duty	Medium duty	Heavy duty
Fleet: Arboretum	2	1	0	0
Fleet: By-Law	0	6	0	0
Fleet: Facilities	10	4	2	0
Fleet: Parks	30	1	12	7
Fleet: Roads	13	7	5	17
Fleet: Water/Wastewater	4	4	3	0

Equipment refers to pieces of equipment such as lawnmowers and tractors.
Light duty vehicles are vehicles with a carrying capacity of 1/2 ton or less.
Medium duty vehicles have a carrying capacity between 1/2 ton and 1 ton.
Heavy duty vehicles have a carrying capacity of 1 ton or more.

5.2 Historical Utility Use

The Fleet historical utility use is presented in Figure 4.

Gasoline, ethanol 10, diesel, and biodiesel 5:

- It is assumed that the fleet consumes gasoline and diesel up until 2020, when the Cleaner Transportation Fuels regulation required a transition to ethanol 10 and biodiesel 5, respectively.
- Gasoline and ethanol 10 consumption remains fairly constant from 2019 to 2022.
- Biodiesel 5 consumption appears to have been gradually increasing from 2020-2022.
- Light duty vehicles are responsible for the largest portion of ethanol 10 consumption, and heavy duty vehicles are responsible for the majority of biodiesel 5 use.
- Note that the "Other" vehicles category refers to fuel consumed from jerry cans, as it is unknown which category of vehicle was served by these cans.

Propane:

- Propane is used for the arena ice resurfacers.
- The overall annual propane use appears to have gradually decreased over the past 5 year period.
- There is a considerable drop in the propane consumption in 2020 and 2021, due to arena closures during COVID-19.

Figure 4: Fleet Historical Energy Use.

5.3 Best Practices

The most common strategies to reduce GHG emissions from the corporate fleet are listed below:

- Fleet electrification (replacing vehicles with electric alternatives where possible) is the most common strategy pursued, as this can significantly reduce the GHG emissions associated with fleet vehicle use.
- In addition to fleet electrification, alternative energy sources (e.g. hydrogen fuel cells and compressed natural gas) are also being considered to reduce fleet GHG emissions.
- Otherwise, various strategies are being implemented to optimize the fleet, for instance:
  - Regular maintenance to improve fuel efficiency
  - Anti-idling policy
  - GPS and route optimization
  - Vehicle sizing to assign vehicles based on need instead of preference, to reduce unnecessary fuel consumption

5.4 Energy Conservation Measures (ECMs)

5.4.1 Previous ECMs

The 2019 ECDMP set a target of reducing fleet GHG emissions by 50% by 2023; however, reliable fuel data was not available at that time. As detailed in the Green Fleet Action Plan (developed as one of the actions recommended by the 2019 ECDMP), the 2019 ECDMP did not capture all fleet fuel data, and the GFAP set a more achievable plan of reducing fleet emissions by 50% by 2028. Actions undertaken from the 2019 ECDMP are listed below:

- Implemented an anti-idling initiative.
- Measured distance traveled and fuel consumed of fleet vehicles at regular intervals to track progress.
- Considered opportunities to upgrade town-owned fleet vehicles to reduce costs and energy consumption.
- Developed a Green Fleet Action Plan.

Additional measures completed in this time include:

- Purchased three hybrid SUVs.
- Re-fitted trucks with LED lights and auxiliary batteries that reduced the need to idle a vehicle for long periods to operate lights and other necessary tools and equipment.
- Replaced lower tier diesel equipment.
- Adopted a biodiesel 5 blend in diesel fuel.
- The Joint Operations Centre (JOC) has also been upgraded with diesel exhaust fluid dispensing equipment to support the new emission control technology in diesels.
- Resizing the Fleet which included disposal of antiquated equipment. (ongoing)
- Implemented driver education program, including anti-idling.
- Incorporated absorbent glass mat (AGM) batteries that do not emit dangerous gasses.
- Increased the use of hot water pressure washing to reduce the dependency on solvent-based parts washers.
- Incorporated ethanol fuel with a 10 percent ethanol blend in all its gasoline-fueled vehicles.
- Incorporated green practices, such as using synthetic oils and extending the time between oil changes.
- Purchased fuel efficient, right-sized vehicles as a standard practice, if commercially available and meet operational needs.
- Replaced the oldest vehicles with cleaner, modern technology by continuing to accelerate the replacement of overdue vehicles through efficient life cycling procedures.
- Installation of electric plugs for truck block heaters where feasible, and developed a policy to ensure they are used by staff to reduce unnecessary vehicle idling.
- Automatic lubrication systems have been installed on all apparatus to extend the life of expensive parts, create less waste, and actually use less grease.

5.4.2 Recommended ECMs

Recommended measures are summarized in Table 11.

Table 11: Recommended Measures and Estimated Impacts (For the Short, Medium, and Long Term)

Fleet Department	Measure	Project cost	Incremental cost	GHG reduction	Utility cost reduction	Cost per GHG reduction	Source
-	-	[$]	[$]	[tCO2e/yr]	[$/yr]	[$/tCO2e]	-
Fleet: Arboretum - Equipment	Equipment decarbonization	240,000	240,000	0	85	766,324	Recommended
Fleet: Arboretum - Light duty	Light vehicle decarbonization	200,000	200,000	0	99	1,203,814	Recommended
Fleet: By-Law - Light duty	Decarbonize two vehicles	400,000	400,000	18	10,874	21,962	Recommended
Fleet: By-Law - Light duty	Light vehicle decarbonization	800,000	655,300	55	32,953	14,495	Recommended
Fleet: Facilities - Ice Resurfacers	Ice resurfacer vehicle decarbonization	1,250,000	222,500	1	282	1,305,073	Recommended
Fleet: Facilities - Light duty	Light vehicle decarbonization	800,000	800,000	10	5,985	79,811	Recommended
Fleet: Parks - Equipment	Decarbonize 10 pieces of equipment	1,200,000	383,400	15	4,103	79,592	Recommended
Fleet: Parks - Equipment	Equipment decarbonization	2,280,000	308,400	44	12,179	51,592	Recommended
Fleet: Parks - Light duty	Light vehicle decarbonization	200,000	200,000	15	8,888	13,436	Recommended
Fleet: Roads - Equipment	Equipment decarbonization	1,560,000	1,560,000	39	13,976	39,813	Recommended
Fleet: Roads - Light duty	Light vehicle decarbonization	1,400,000	1,400,000	37	21,817	38,313	Recommended
Fleet: Water/Wastewater - Equipment	Equipment decarbonization	480,000	480,000	0	160	1,788,845	Recommended
Fleet: Water/Wastewater - Light duty	Light vehicle decarbonization	200,000	58,000	19	11,633	10,265	Recommended
Total		11,010,000	6,907,600	254	123,033		

5.4.3 Measure Descriptions

5.4.4 Additional Recommendations

In addition to the measures listed, it is recommended that the Town investigate the following actions, listed below. These actions are either not anticipated to result in direct GHG emissions reductions (although many are expected to result in an indirect reduction in GHG emissions), or the reduction in GHG emissions is difficult to quantify.

- **Renewable fuel content:** Incorporate fuel with higher blends of renewable content (e.g. biodiesel-20) during the summer months when this is feasible.
- **Continue to implement actions from the Green Fleet Action Plan:** Continue to implement items listed in the GFAP (reduce kilometres travelled by vehicle, perform preventative maintenance on vehicles to improve engine efficiency, etc.).
- **Fleet electrification feasibility study:** Investigate the feasibility of fleet electrification by assessing the corporate electrical capacity. Upgrade electrical services as needed to install additional EV charging stations.
  - Assess the feasibility of the transition to zero-emission vehicles (ZEVs, including battery-electric, plug-in hybrid electric and hydrogen fuel cell vehicles) to significantly reduce GHG emissions associated with fleet in line with the Town's 2035 and 2050 targets emission targets. The study will assess the potential economic, social and other environmental impacts of the transition to ZEVs.
  - Assess and upgrade electrical infrastructure to support the addition of electric vehicles as part of fleet decarbonization. Plan the actions required to upgrade the Town's electric infrastructure to support decarbonization.
  - Assess the available low carbon options for each vehicle being replaced. For equipment and light duty vehicles, there are typically many electric options available for purchase. Electric and hybrid vehicles can effectively reduce GHG emissions, although in some cases there may be issues with the battery life, and this would require building the Town's infrastructure to support charging these vehicles. Another option is hydrogen fuel cell technology; this can also reduce GHG emissions, although care should be taken to ensure that using grey hydrogen (hydrogen produced from natural gas with no carbon capture) as a fuel is avoided where possible.
- **Additional fuel consumption:** Construction Administrators in Engineering and Capital Delivery use their own vehicles to travel between sites, which is not accounted for in this report. It is recommended that this be added to the scope of future reports to provide a more complete understanding of GHG emissions due to corporate activities.

5.5 Targets

Based on selective fleet decarbonization and ethanol 10 and biodiesel 5 consumption will decrease by 10% and 8% in the short term, respectively, compared to the 2018 baseline. Propane use should be nearly eliminated in the short term due to the ice resurfacer vehicle electrification measures currently being implemented.

In the medium term, fleet equipment should be replaced with low-carbon (e.g. electric) alternatives where possible, based on the results of the fleet electrification feasibility study. Ethanol 10 consumption should be decreased by 14%, and biodiesel 5 should be decreased by 31% by 2035. In the long term, the use of these utilities should be decreased as much as possible with existing fleet decarbonization technology. With existing technology, light duty vehicles should be replaced with low carbon alternatives, which is projected to result in an overall decrease in utility use of 52% for ethanol 10, and 31% for biodiesel 5. In the long term, when replacing medium and heavy duty vehicles, low carbon alternatives should also be chosen if available.

By 2050, GHG emission reductions from the fleet measures are estimated to be decreased 40% from the 2018 baseline. In 2050, the ethanol 10 and biodiesel 5 emissions are anticipated to account for roughly 22% of overall GHG emissions. Currently, there is limited technology to electrify medium or heavy duty fleet vehicles, limiting the extent to which these emissions can be reduced. To mitigate this, the Town should seek opportunities to reduce the usage of medium and heavy duty vehicles where possible, and should stay aware of current technology to

replace these vehicles with low-carbon options when possible based on the outcomes of the fleet electrification feasibility study.

6 Solid Waste Sector

6.1 Asset Information

The corporate solid waste sector tracks methane emissions that enter the air directly as waste decomposes at landfills as well as nitrous oxide and non-biogenic carbon dioxide emissions associated with the combustion of solid waste at incineration facilities.

York Region manages and processes the solid waste from the Town. York Region uses two landfill sites with methane gas collection systems and three energy from waste systems.

The Town estimates GHG emissions from its corporate waste based on the amount of solid waste collected from waste bins during the inventory year. This includes waste collected at corporate-owned buildings, as well as parks and public receptacles, and excludes waste collected at residences or local businesses. The composition and quantities of corporate Town waste going to each site is currently unknown and requires a detailed waste audit for more information.

For Town buildings, as well as parks and public receptacles, the annual volume of waste is estimated based on the number and capacity of waste receptacles, approximate fraction that it is filled at pickup, and frequency of pickup times. The expected GHG emissions for this volume of waste are approximated using the calculation methodology specified by the PCP protocol, outlined in Appendix B.

Waste diverted through composting and recycling initiatives are treated as zero emissions based on the PCP Protocol. Currently, corporate solid waste from Town facilities, parks and public receptacles are not diverted (composting nor recycling) due to the high contamination rate in the waste stream.

In 2022, a Dog Waste Diversion Program was implemented as a pilot project to divert dog waste to a facility where it can be repurposed to fuel, and the Town intends to gradually add more receptacles to the program. This initiative supports the reduction of contamination into the park waste receptacles, while also reducing GHG emissions by repurposing dog waste.

6.2 Waste Generation

Table 12: Estimated Solid Waste GHG Emissions Summary (2022)

Waste receptacle type	GHG emissions	Percentage of waste GHG emissions
-	[tCO2e/yr]	[%]
Buildings Waste Disposal	294	71
Parks Waste Disposal	114	28
Roads Waste Disposal	7	2

Waste data prior to 2022 is not available; the annual trends are unknown. Based on the estimated waste generation through consultants with Town staff, the majority of the contribution to corporate solid waste comes from waste disposed of in corporate-owned buildings.

6.3 Best Practices

Many municipalities have incorporated various strategies for waste reduction into their plans. Some of the best practices for waste reduction are listed below, and are incorporated into the recommendations from this plan:

- Perform regular waste audits.
- Develop a Waste Reduction Plan.
- Reduce the use of single-use items.
- Divert corporate solid waste with composting and recycling programs.

- Educate staff to decrease contamination and increase waste diversion to recycling and organics bins.
- Promote a circular economy.
- Commit to net-zero waste by 2050.

6.4 Energy Conservation Measures (ECMs)

6.4.1 Recommended ECMs

There are no quantifiable measures for the waste sector, as it is unsure how much the recommended actions will mitigate waste emissions. The GHG reduction plan results assume a 10% reduction in waste emissions in the medium term, and net-zero waste in the long term.

- Incorporate mandatory green bin and recycling collection at all Town facilities when tendering out the next waste collection contract in 2028.
- Continue expansion and support for the dog waste program at Town parks which reduces contamination of the waste stream at park receptacles, while also reducing GHG emissions by repurposing the dog waste.
- Perform regular waste audits to get a more detailed breakdown of how much waste is generated from corporate activities and where to focus efforts on reducing waste. These audits can also be used to identify new opportunities to reduce waste.
- Develop and implement a Waste Reduction Plan to raise awareness through community education and reduce emissions from corporate waste. The plan might entail the following:
  - Increase focus on reuse activities, possibly through an additional Waste Reuse Plan.
  - Implement community and staff education to increase the amount of waste diverted through recycling and organics programs, and decrease recycling and organics contamination.
  - Work with York Region to improve waste separation processes to improve recovery and reduce the amount of reusable materials which are landfilled or incinerated.
  - Reduce the utilization of single-use items.
  - Where possible, purchase goods which can be upcycled or recycled instead of landfilled.
  - Monitor the industry to remain aware of best practices.
  - Investigate opportunities to promote a circular economy to reduce waste.
  - Explore additional strategies to reduce contamination in recycling and organics bins.
- To reach net-zero GHG emissions, we recommend that the Town strive to achieve net-zero waste by 2050, in alignment with York Region's plan.

6.5 Targets

There are no reduction targets set for the short term, as efforts are focused on gathering reliable waste composition and generation data through a waste audit and the development of a reduction plan. Based on those results, the medium term target is to reduce emissions from corporate waste by 10% by 2035 compared to 2018, and to achieve net-zero waste by 2050.

7 Water and Wastewater

7.1 Asset Information

The water and wastewater sector tracks energy consumption and the corresponding GHG emissions generated by Town-owned municipal water and wastewater infrastructure: lift and pumping stations. Emissions in this sector can be produced directly from the combustion of fuels (e.g. natural gas used in boilers and furnaces) or indirectly from the use of grid electricity or district energy. All infrastructure owned and operated by York Region are excluded from this inventory, as per the PCP Protocol. Currently, fuel consumed by backup generators at these stations is not considered in this report; it is recommended that this fuel consumption is tracked and accounted for in future inventories.

Water and wastewater stations considered under this ECDMP are summarized in Table 13.

Table 13: Water and Wastewater Pumping Station Locations

Station name	Address
Ballymore Lift Station	560 St Johns Sideroad East
Brentwood Lift Station	3 Woodland Hills Boulevard
Elderberry Trail Lift Station	12 Equestrian Drive
Mattamy Phase 4 Lift Station	25 Forest Grove Court
Mattamy Phase 5 Lift Station	39 Bridgepoint Court
Shimvest Phase 1 and 2 Lift Station	90 Scrivener Drive
State Farm Lift Station	24 State Farm Way
Temperance Street Lift Station	15140 Yonge Street
Vandorf Lift Station	385 Vandorf Sideroad
Vandorf Water Booster Station	85 Vandorf Sideroad

7.2 Historical Utility Use

There is very little water/wastewater station data available prior to 2022; this data constitutes a small portion of the overall electricity consumption and it is assumed that the electricity consumed by water/wastewater stations has remained relatively constant.

7.3 Best Practices

Generally, GHG contributions from pumping stations are minor; consequently, few municipalities have undertaken measures for water and wastewater stations. The most common measures considered for pumping stations are measures to add variable frequency drives (VFDs) to the pumps to reduce pump energy use, or upgrade the lighting and HVAC within the corresponding buildings.

7.4 Energy Conservation Measures (ECMs)

7.4.1 Previous ECMs

The 2019 ECDMP stated that electricity consumption for water/wastewater facilities should continue to be monitored and tracked as new facilities were brought online; no additional actions have been taken.

7.4.2 Recommended ECMs

It is recommended that the water and wastewater stations be investigated for opportunities to reduce their energy use (e.g. installing VFDs on the pumps). In addition, it is recommended that the Town investigate methane leakage at pumping stations. This effort should aim to quantify any identified leakage, which can be reported in future iterations of this plan.

7.5 Targets

Due to the critical nature of the pumping stations and minor emissions impact, no significant reduction in GHG emissions is expected for the water/wastewater stations under the 2024 ECDMP. For these facilities, the electricity consumption should be monitored annually to ensure that it does not increase beyond what is expected from population growth, and opportunities for cost-saving energy measures should be investigated.

8 Lighting

8.1 Asset Information

The streetlights and traffic signals sector tracks GHG emissions generated by the use of energy for streetlights, traffic signals and other types of outdoor public lighting, such as park and recreational area lighting. Emissions in this sector are typically produced indirectly from the use of grid electricity.

Public lighting assets represent the electricity use from streetlights, park lights, and traffic lights used by the Town of Aurora. There are 4,800 street lights within the jurisdiction, all of which were retrofitted to LED in 2018.

Parking lots at Town facilities: All town-owned parking lots at major facilities were retrofit to LED lighting between 2014 and 2018. In addition, the Aurora Seniors Centre has a planned rehabilitation project for 2024, and parking lot lighting will be assessed at that time for LED upgrades.

8.2 Historical Utility Use

Energy use from outdoor public lighting was not previously tracked until 2022; this data constitutes a small portion of the overall electricity consumption and it is assumed that the electricity consumed by streetlights, traffic lights, and park lights has remained relatively constant.

8.3 Best Practices

The most common ECM pursued by municipalities to reduce the electricity consumed by public lighting is to switch out the bulbs to LED. Also note that some municipalities have begun to implement solar street lights, where feasible.

As a best practice, energy and emissions data should be sufficiently disaggregated so as to enable comparisons of defined streetlight grids or different lighting types (e.g. park lights, traffic signals, etc.). Reporting energy and emissions data according to defined streetlight grids enables more detailed comparisons based on the average performance of fixtures in a select group of lights (e.g. tonnes CO2e/fixture), and can reveal opportunities to invest in energy efficiency initiatives.

8.4 Energy Conservation Measures (ECMs)

8.4.1 Recommended ECMs

Most of the Town of Aurora's street lights have already been converted to LED, but it is recommended that all remaining street lights, park lights, stadium lights, and traffic lights are retrofitted to LED lights when possible.

8.5 Targets

No significant reduction in GHG emissions is expected for street lighting. The remaining outdoor public lights, such as lights in sports fields, should be retrofitted to LED. Retrofitting these lights to LED could result in significant energy savings from public lighting, and reduce the cost of electricity to operate these lights. The electricity consumption should be monitored to ensure that it does not increase beyond what is expected from population growth.

9 Summary of Recommendations and Implementation Plan

9.1 Project plans

To achieve the Town's goals, a GHG Reduction Plan is developed, and compared to the Business As Usual plan, which is the projected scenario for if no recommended measures are implemented. Where possible, the year of implementation for a measure in the plan was selected based on the end of useful life for the equipment being replaced, obtained from the ten-year asset management plan as well as the most recent BCAs. A communications strategy with more detail on a Steering Committee made up of Town staff to ensure the successful implementation of this ECDMP is presented in Section 9.1.4.

9.1.1 Short Term Plan (2025-2030)

Table 14 outlines the estimated costs for the Town and potential sources of funding associated with short term climate action. Each action item identifies a magnitude of scale cost for the full implementation of the measure. Detailed implementation costing will be defined through a business plan and program design stages. The costs outlined below are subject to the Town's regular capital budgeting process. Should Council endorse the 2024 ECDMP, the full scope of planned capital works for the next five years will be inserted in the Town's next ten-year capital investment plan. The final approval to proceed with each of these noted projects will be subject to funding availability and project approval.

Summary of recommendations:

- Complete remaining measures from 2019 ECDMP.
- ASHRAE Level 3 Energy Audits for all facilities being considered for ECM implementation; these audits should be performed alongside BCAs (every five years).
- GHG Reduction Pathway Feasibility Study for facilities, including an assessment of electric infrastructure, to be used to determine opportunities for net-zero retrofits. The "Study: GHG reduction pathway feasibility" funding opportunity can help cover the costs of these audits.
- Continue to take the actions listed in the Green Fleet Action Plan.
- Perform a fleet electrification feasibility study.
- As vehicles in the corporate fleet reach their end of useful life, replace them with electric alternatives. Consider the "Capital project: Reduce fossil fuel use in fleets" funding opportunity for financial support.
- Perform regular corporate solid waste audits.
- Develop and implement a Waste Reduction Plan. The "Study: Waste reduction and diversion" and "Capital project: Waste reduction and diversion" funding opportunities could help in the development and implementation of this plan.
- Conduct energy efficiency training for staff as required. Training on energy and energy efficiency should be added as part of the Town's onboarding process, and additional training and refreshers can be performed as-needed.
- Implementation and monitoring
  - Implement measures according to the designs agreed upon by design consultants and stakeholders.
  - Currently, the Town has an energy performance system for its facilities, updated and monitored quarterly and reported on annually. All assets under this ECDMP should be included into this energy monitoring and performance system, including fleet, water/wastewater facilities, propane use, waste and public lighting (when feasible). Each asset's energy consumption should be monitored with time and compared against historical data to verify that the assets are meeting the targets from the ECMs which have been implemented.

  - Once the BAS have been upgraded, building conditions and system function should be monitored through the BAS. Through this, it can be verified that building conditions are being maintained as they should, and that no energy is wasted through system inefficiencies (e.g. different HVAC zones fighting each other, no energy is being consumed to heat the building if it is hot outside, etc.).
  - Start tracking fuel consumed by personal vehicles owned by members of the Construction Administrators in Engineering and Capital Delivery department.
  - Track fuel consumed by backup generators at water/wastewater facilities.
- Continue the implementation of the Green Procurement Policy.
- Develop a Sustainable Building Standard to ensure that new facilities are built while considering best practices regarding energy efficiency and reducing GHG emissions.
- Develop a Carbon Offset Policy/Procedure to prepare for the purchase of carbon offsets in the medium and long term.
- Investigate opportunities to reduce energy consumption from the lighting and water/wastewater sectors (i.e. opportunities to convert remaining public lighting to LED).

Table 14: Short Term ECMs to Implement (2024-2029)

Facility	Measure description	Project cost	Incremental cost	GHG reduction	Electricity reduction	Natural gas reduction	Utility cost reduction	Simple payback
-	-	[$]	[$]	[tCO2e/yr]	[kWh/yr]	[m3/yr]	[$/yr]	[yrs]
All facilities	Remaining measures from 2019 ECDMP	0	0	70	525,302	28,304	83,620	-
All facilities	Remaining lights to LED	80,521	80,521	-1	108,851	-2,423	14,376	5.6
All facilities	Remaining water fixtures to low-flow	936	936	1	13,809	105	1,971	0.5
All facilities	Investigate and implement demand control ventilation	15,355	15,355	6	4,910	2,887	1,715	9.0
All facilities	Remaining occupancy sensors	18,726	18,726	0.3	1,256	123	220	>20
Aurora Community Centre	BAS upgrade	0	0	8	4,346	4,230	2,115	-
Aurora Family Leisure Complex	BAS upgrade	0	0	8	51,061	3,451	8,377	-
Aurora Family Leisure Complex	Pool cover	4,619	4,619	9	155,150	2,369	22,565	0.2
Aurora Public Library	BAS upgrade	0	0	3	19,516	1,497	3,265	-
Aurora Public Library	High efficiency boiler replacement	159,124	159,124	4	0	1,946	693	>20
Aurora Seniors Centre	Optimum HVAC scheduling	6,492	6,492	4	9,412	1,786	1,954	3.3
Aurora Town Hall	BAS upgrade	0	0	7	25,432	3,264	4,723	-
Fleet: By-Law - Light duty	Decarbonize two vehicles	400,000	400,000	18	-19,458	0	10,874	>20
Fleet: Facilities - Ice Resurfacers	Ice resurfacer vehicle decarbonization	1,250,000	222,500	1	-1,151	0	282	>20
Fleet: Parks - Equipment	Decarbonize 10 pieces of equipment	1,200,000	383,400	15	-19,296	0	4,103	>20
Stronach Aurora Recreation Complex	BAS upgrade	0	0	38	158,761	17,181	28,344	-
Stronach Aurora Recreation Complex	Pool cover	3,246	3,246	16	55,862	7,330	10,431	0.3
All facilities	Measures to be identified in feasibility studies	0	0	134	353,598	64,323	72,406	-
Total		3,139,018	1,294,918	161	1,349,258	131,267	272,032	

Note that the focus of the short term plan is to implement "quick wins", and to set up the infrastructure required to implement more aggressive measures in the medium and in the long term. In addition, for fleet, the Town needs to improve their electrical infrastructure (i.e. install EV chargers at more locations and perform upgrades to the electrical infrastructure as needed) before they can electrify the fleet. Because of this, there is not projected to be a large decrease in GHG emissions in the short term.

9.1.2 Short Term Implementation Plan

The short term implementation plan is outlined in Table 15.

Table 15: Five-Year Implementation Plan Summary

Action	Description	Lead division/department	Project cost	Cost unit	Funding opportunities	KPIs
Facilities - retrofits and building optimization	The focus of these measures is on lighting and controls measures, such as converting all remaining lights to LED, investigating and implementing demand control ventilation and occupancy sensors, and adding pool covers to the pools. Details of the individual measures, anticipated GHG reduction, and estimated cost are outlined in Section 4.4.	Community Services-Facilities	289,019	$	FCM: GHG impact retrofit and FCM: GHG reduction pathway retrofit grants	Annual energy use (electricity and natural gas consumption)

Table 15: Five-Year Implementation Plan Summary *(continued)*

Action	Description	Lead division/department	Project cost	Cost unit	Funding opportunities	KPIs
Fleet decarbonization	The Town should continue to implement actions according to the Green Fleet Action Plan, and when possible, decarbonize the fleet where possible (e.g. replacing the ice resurfacers with electric ones). Details of the individual measures, anticipated GHG reduction, and estimated cost are outlined in Section 5.4.	OPS-Fleet	2,850,000	$	FCM: Reduce fossil fuel use in fleets	Annual fuel use (ethanol 10 and biodiesel 5 consumption)
Energy audits	Perform energy audits for all facilities being considered for ECM implementation to determine opportunities for net-zero retrofits, determine the feasibility of the ECMs detailed in this report, and generate more detailed design information for feasible ECMs.	Community Services-Facilities	254,500	$		Completion date of each energy audit
Net-Zero Pathway Feasibility Study - Facilities	Perform a facilities feasibility study for the identification of measures to be addressed in a GHG reduction pathway retrofit capital project. Studies will consider the unique objectives and constraints of the building owner (e.g., building condition, capital budgets, equipment renewal cycles, etc.), and provide a detailed exploration of multiple optimization scenarios.	Community Services-Facilities and PDS-Engineering	250,000	$	FCM Study: GHG reduction pathway feasibility	Completion date of each energy audit
Electrical Infrastructure Feasibility Studies	Investigate the feasibility of facility and fleet electrification by assessing the corporate electrical capacity.	OPS-Fleet and PDS-Engineering	250,000	$	FCM Study: Reduce fossil fuel use in fleets	Electrical capacity of main facilities (kW)
Waste audit and waste reduction strategy	Perform regular waste audits to track GHG emissions from waste. In addition, develop a Waste Reduction Plan to determine strategies to reduce waste-related GHG emissions.	PSD-Engineering or OPS-Waste	50,000	$	FCM: Waste reduction and diversion grants	Development of Waste Reduction Plan
Employee training	Train staff on energy efficiency and operation of new technology implemented during facility ECMs. Train fleet staff on operation and maintenance of new vehicles purchased during fleet decarbonization.	Community Services-Facilities, OPS-Fleet, and PDS-Engineering, as needed	15,000	$		Number of employees trained
Energy performance monitoring	Data tracking to monitor and report on the ECDMP emission sources.	PDS-Engineering	7,000	$		Number of assets being monitored
Total			3,965,519	$		

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

In the medium and long term, it is necessary to pursue more aggressive actions to significantly reduce GHG emissions. Using the feasibility studies completed in the short term, the medium and long-term strategies should focus on implementing measures such as HVAC upgrades to heat pumps in facilities and adopting more aggressive fleet decarbonization initiatives. Additionally, other ECMs identified in the Net-Zero Pathway studies should be prioritized for implementation.

If the recommended measures prove insufficient to achieve the Town's GHG reduction targets in the medium and long term, the consideration of carbon offsets is warranted. Carbon offsets involve indirect GHG emissions reductions, often through activities like land restoration or tree planting to enhance global carbon storage. However, it is essential to recognize that carbon offsets do not directly reduce the Town's GHG emissions and should only be used if other measures fall short of meeting the Town's goals. Additionally, it should be noted that as more organizations adopt carbon offsets to address climate change, the cost of purchasing carbon offsets may rise significantly.

Projections suggest that by 2035, the Town may need to allocate approximately $35,000 for carbon offsets to achieve a 50% reduction in GHG emissions, with an estimated annual expenditure of around $110,000 by 2050 to achieve net-zero emissions. These estimates are based on quotes from the Quebec carbon offsets program, which currently prices carbon offsets at $30.05 per tCO2e, projected to increase to $45.10 per tCO2e by 2030, and assuming a general inflation rate of 2.2% beyond 2030.

General implementation plans for the medium and long term are outlined in Tables 16 and 17, respectively. The list of measures listed here in the medium and long term are for the Town's consideration only, and be revised after a detailed project list and project cost is performed through the feasibilities studies being performed in the short term period.

Table 16: Medium Term ECMs (2030-2034) for Future Consideration

Facility	Measure description	GHG reduction	Electricity reduction	Natural gas reduction	Utility cost reduction
-	-	[tCO2e/yr]	[kWh/yr]	[m3/yr]	[$/yr]
Aurora Community Centre	Arena low-e ceiling, if feasible	1	49,255	0	6,896
Various Facilities	DHW to heat pump	496	-920,617	272,521	-31,855
Aurora Community Centre	Electrification of dehumidification	26	-133,980	15,864	-13,109
Various Facilities	Electrification of ice resurfacing boiler	31	-155,729	18,440	-15,237
Fleet	Equipment decarbonization	84	-105,140	0	26,400
Various Facilities	HVAC to heat pump	525	-851,304	286,367	-17,222
Various Facilities	Increase roof insulation thickness	16	0	8,281	2,948
Aurora Family Leisure Complex	Pool heat to heat pump	12	-22,619	6,696	-783
Aurora Seniors Centre	VVT or VAV system	1	-2,722	806	-94
Additional Recommendations	Implementation of plans identified during GHG Reduction Pathways Feasibility Study.	N/A	N/A	N/A	N/A
Additional Recommendations	Implementation of plans identified during fleet electrification feasibility study.	N/A	N/A	N/A	N/A
Additional Recommendations	Continue to take actions listed in the Green Fleet Action Plan	N/A	N/A	N/A	N/A
Additional Recommendations	Perform additional fleet decarbonization where feasible.	N/A	N/A	N/A	N/A
Additional Recommendations	Continue to take the actions determined by the Waste Reduction Plan	42	N/A	N/A	N/A
Additional Recommendations	Energy performance monitoring (annual budget)	N/A	N/A	N/A	N/A
Additional Recommendations	Continually research low carbon electricity generation opportunities and feasibility	N/A	N/A	N/A	N/A
Additional Recommendations	If necessary, purchase carbon offsets in 2035 to meet GHG reduction targets	N/A	N/A	N/A	N/A
Total		865	-1,707,626	496,102	-42,055

Total GHG emission reduction accounts for interactive effects and changes in the electricity grid emissions factor.
Note that "N/A" in columns for utility reduction indicate measures which will not have a direct impact on the utility.

Table 17: Long Term ECMs (2035-2050) for Future Consideration

Facility	Measure description	GHG reduction	Electricity reduction	Natural gas reduction	Utility cost reduction
-	-	[tCO2e/yr]	[kWh/yr]	[m3/yr]	[$/yr]
Various Facilities	DHW to heat pump	24	-45,256	13,397	-1,566
Stronach Aurora Recreation Complex	Electrification of dehumidification	8	-38,695	4,582	-3,786
Aurora Sports Dome	HVAC electrification	167	-848,156	100,428	-82,984
Various Facilities	HVAC to heat pump	401	-744,027	220,247	-25,745
Various Facilities	Increase roof insulation thickness	25	0	12,885	4,588
Fleet	Light vehicle decarbonization	136	-145,602	0	81,374
Various Facilities	Renewable energy generation	31	1,024,920	0	143,489
Additional Recommendations	Implementation of plans identified during GHG Reduction Pathways Feasibility Study.	N/A	N/A	N/A	N/A
Additional Recommendations	Implementation of plans identified during fleet electrification feasibility study.	N/A	N/A	N/A	N/A
Additional Recommendations	Continue to take the actions determined by the Waste Reduction Plan	416	N/A	N/A	N/A
Additional Recommendations	Energy performance monitoring (annual budget)	N/A	N/A	N/A	N/A
Additional Recommendations	Research new technology to identify additional opportunities to reduce GHG emissions	N/A	N/A	N/A	N/A
Additional Recommendations	Maintain a carbon offset budget until a 50% reduction in emissions is achieved (annual budget: $35,000 until 2040)	N/A	N/A	N/A	N/A
Additional Recommendations	If necessary, purchase carbon offsets in 2050 to meet long term (2050) GHG reduction target of net zero GHG emissions (annual budget)	N/A	N/A	N/A	N/A
Total		788	-575,141	295,300	115,369

Total GHG emission reduction accounts for interactive effects and changes in the electricity grid emissions factor.
Note that "N/A" in columns for utility reduction indicate measures which will not have a direct impact on the utility.

9.1.4 Communications Strategy

This Communication Strategy is designed to guide the Town of Aurora in the creation of a Steering Committee which will ensure the successful implementation of the 2024 ECDMP. This committee should meet on a quarterly basis to discuss work in progress and tracking towards the goals established in the ECDM plan. The Steering Committee will be made up of following groups:

- **Energy and Climate Change Analyst**
  - Oversee energy management within all facilities, and act as central resource and contact for energy efficiency matters.
  - Monitor and track energy use in Town of Aurora facilities.
  - Track and support teams to implement ECMs identified in the ECDM plan and otherwise.
  - Facilitate implementation of staff training programs and employee engagement strategies.
- **Water/Wastewater Supervisor**
  - Provide any necessary data to the energy analyst and assist with monitoring and tracking of energy consumption.

  - Request input from Steering Committee Lead on decisions which may have energy impact.
  - Advise Energy and Climate Change Analyst on strategies to reduce energy consumption and GHG emissions and any operating changes that may impact GHG emissions.
  - Lead implementation of Water/Wastewater ECMs.
- **Fleet Supervisor**
  - Provide any necessary data to the energy analyst and assist with monitoring and tracking of energy consumption.
  - Request input from Steering Committee Lead on decisions which may have energy impact.
  - Advise Energy and Climate Change Analyst on strategies to reduce energy consumption and GHG emissions and any operating changes that may impact GHG emissions.
  - Lead implementation of Fleet ECMs.
  - Oversee Green Fleet Action Plan progress and ensure that the Town stays on track to meet their fleet GHG reduction targets.
- **Facilities Manager**
  - Provide any necessary data to the energy analyst and assist with monitoring and tracking of energy consumption.
  - Request input from Steering Committee Lead on decisions which may have energy impact.
  - Advise Energy and Climate Change Analyst on strategies to reduce energy consumption and GHG emissions and any operating changes that may impact GHG emissions.
  - Lead implementation of Facility ECMs.
- **Waste Supervisor**
  - Provide any necessary data to the energy analyst and assist with monitoring and tracking of energy consumption.
  - Request input from Steering Committee Lead on decisions which may have energy impact.
  - Advise Energy and Climate Change Analyst on strategies to reduce energy consumption and GHG emissions and any operating changes that may impact GHG emissions.
  - Lead implementation of Waste ECMs.
  - Oversee the regular conduction of corporate solid waste audits.
  - Assist with development and implementation of Waste Reduction Plan.
  - Oversee the communication and coordination with York Region to reduce waste GHG emissions by improving the landfill and incineration systems.
- **Engineering and Capital Delivery Manager**
  - Request input from Steering Committee Lead on decisions which may have energy impact.
  - Assist Energy and Climate Change Analyst with implementation of ECMs.
  - Assist with development of Town policies to reduce GHG emissions.
- **Corporate Communications Manager**
  - Assist with improving communication of energy efficiency initiatives within the organization.
  - Assist with implementing staff engagement strategies.
- **Finance Manager**
  - Assist with the budgeting process for planned ECMs.

- Lead the application process for accessing external funding.

10 Plan Results

The projected GHG emissions and utility costs for the GHG reduction plan compared to the business-as-usual case are presented below. For the specific year-by-year implementation plan used in scenario development, as well as additional utility use plots, see Appendix C.

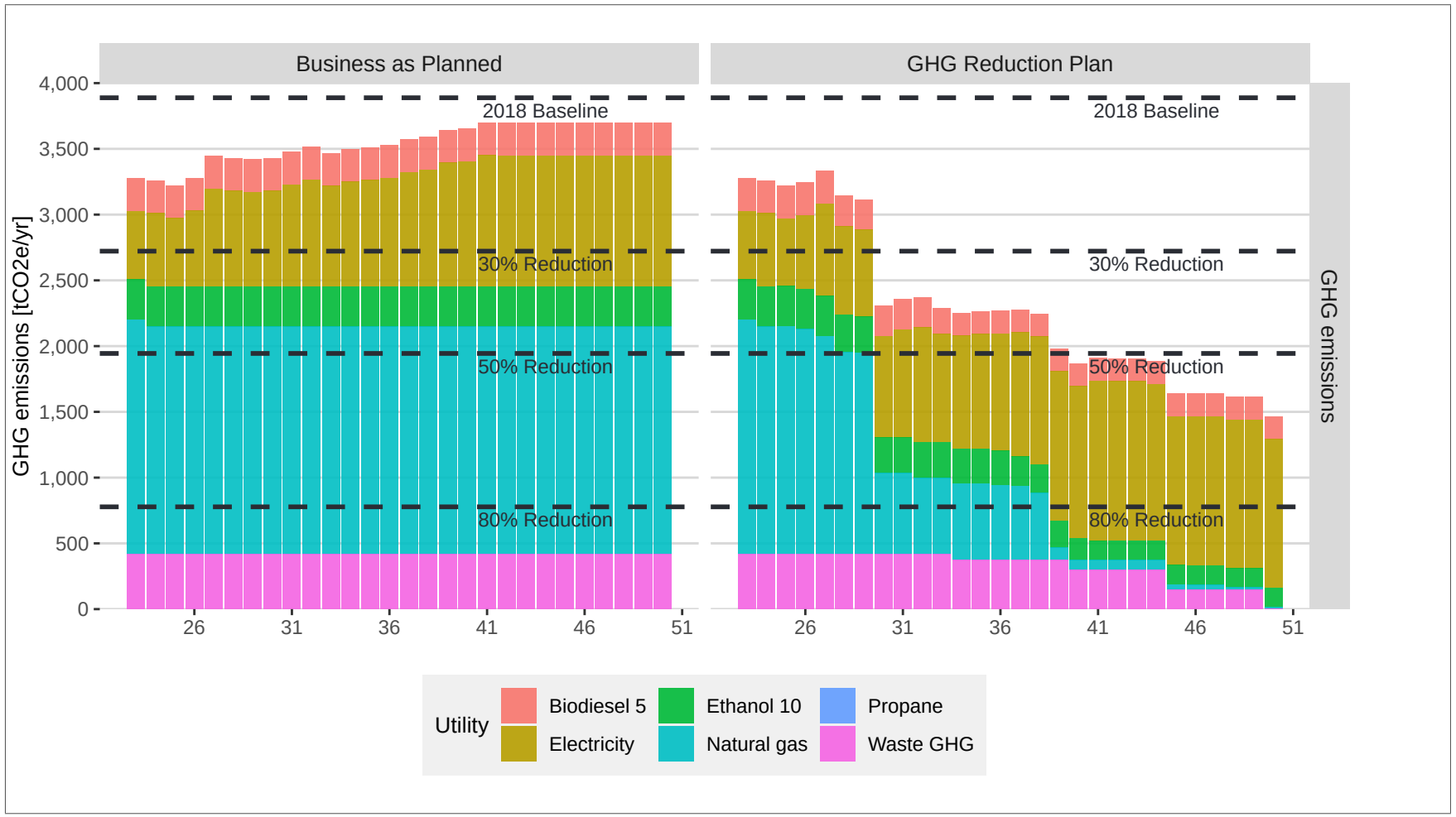

Figure 5: GHG Emissions Projection for Each Scenario

Figure 6: Utility Cost Projection for Each Scenario

10.1 Scenario Discussion

The following results are observed from the scenario analysis:

- The Business as Planned scenario is considered inviable, because it does not take specific action to achieve GHG targets. In 2050, it exhibits annual utility costs roughly $705,856 (17%) 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 is 62%. This is contingent on being able to achieve net-zero waste emissions by 2050.
- 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.
- There is also a projected increase in the electricity grid emissions intensity with time. The electricity emissions factor is still considerably lower than fossil fuel emissions factors, but this phenomenon will still make it more difficult for the Town to meet their GHG reduction targets through electrification ECMs. To counter this, the Town is encouraged to implement energy-efficient and renewable energy technology where possible.
- Remaining ethanol 10 and biodiesel 5 emissions are anticipated to account for roughly 22% of GHG emissions in 2050. Currently, there is limited technology to electrify medium or heavy duty fleet vehicles, limiting the extent to which these emissions can be reduced. To mitigate this, the Town should seek opportunities to reduce the usage of medium and heavy duty vehicles where possible, and should stay aware of current technology to replace these vehicles with low-carbon options when possible.

10.2 Plan Results Summary

Based on the plans identified, the anticipated progress towards reducing GHG emissions is presented in Table 18.

Table 18: Plan Results Summary

Term	GHG Emissions	Utility Cost	Electricity Consumption	Natural Gas Consumption	GHG Emissions Reduction	Cumulative GHG Percent Reduction
-	[tCO2e/yr]	[$/yr]	[kWh/yr]	[m3/yr]	[tCO2e/yr]	[%]
Baseline	3,889	2,307,083	11,571,403	1,337,896	-	-
Current	3,100	2,133,708	11,368,706	930,583	788	20
Short Term Plan	3,116	2,567,271	9,981,362	799,317	-16	20
Medium Term Plan	2,251	2,779,848	11,688,989	303,215	865	42
Long Term Plan	1,463	3,522,832	12,264,129	7,914	788	62

In the short term, the electricity and natural gas consumption are projected to decrease. Note that the stagnating reduction in GHG emissions during the short term is because there is a projected increase in the GHG emissions factor of the electricity grid (shown in Appendix B), which makes it more difficult to decrease GHG emissions. The focus of the short term plan is to establish the infrastructure needed to perform more aggressive measures, as was outlined in more detail in Section 9.1.1.

While this ECDMP outlines comprehensive strategies to reduce the Town's GHG emissions towards net-zero, it is essential to acknowledge the external factors and evolving technologies that may impact the Town's ability to achieve this goal. One significant challenge is the dependence on grid emissions, which are subject to fluctuations and regulatory changes beyond the Town's control. However, various levels of government are targeting net-zero emissions from the grid, which would significantly reduce the Town's remaining GHG emissions in 2050. In addition, advancements in heavy-duty fleet technology, such as hydrogen, compressed natural gas, and improvements to EV technology, could decrease the Town's remaining fleet emissions. The potential for renewable heat generation, such as geothermal or waste heat recovery, has not been fully explored in this plan but holds promise for further emissions reduction. Finally, deeper investigation into renewable energy sources beyond solar PV could provide additional avenues to decrease emissions. As technology evolves, there will be additional opportunities to reduce the Town's GHG emissions and bridge the gap towards net-zero.

ENERGY CONSERVATION AND DEMAND MANAGEMENT PLAN

APPENDICES
TOWN OF AURORA

May 1, 2024

Prepared by WALTERFEDY

Table of Contents

A Appendix A: Additional Fleet Information

The corporate fleet considered under this Energy Conservation and Demand Management Plan are summarized in Table 1. Dashes indicate data that were not available at the time of review.

Table 1: Fleets summary

Category	Department	Vehicle ID	Description	Make and model
Fleet: Equipment	Fleet: Arboretum	Vehicle 27518	275-18: Tractor (Arbortreum)	John Deere X380
	Fleet: Arboretum	Vehicle 299	299: Tractor	John Deere 4320
	Fleet: Facilities	Vehicle 58022	580-22: Lawn Tractor	John Deere X350
	Fleet: Facilities	Vehicle 58122	581-22: Lawn Tractor	John Deere X350
	Fleet: Facilities	Vehicle 588	588: Scissor Lift	SJIII3226
	Fleet: Facilities	Vehicle 589	589: Telescopic Lift	Genie AWP .25s
	Fleet: Facilities	Vehicle 590	590: Ice Resurfacer	Olympia Millenium
	Fleet: Facilities	Vehicle 593	593: Ice Resurfacer	Zamboni 526
	Fleet: Facilities	Vehicle 595	595: Ice Resurfacer	Zamboni 526
	Fleet: Facilities	Vehicle 596	596: Ice Resurfacer	Zamboni 525
	Fleet: Facilities	Vehicle 597	597: Ice Resurfacer	Zamboni 526
	Fleet: Facilities	Vehicle 59920	599-20: John Deer 1575	John Deer 1575
	Fleet: Parks	Vehicle 216	216: Portable Welder	Red-D-Arc D300K
	Fleet: Parks	Vehicle 230	230: Off-Road Utility Vehicle	Kubota RTV 1100
	Fleet: Parks	Vehicle 23522	235-22: Off-Road Utility Vehicle	Kubota RTV 1100
	Fleet: Parks	Vehicle 23821	238-21: Backhoe	John Deere 310 SL / HL Backhoe
	Fleet: Parks	Vehicle 24020	240-20: Tractor	Massey Ferguson 1750MH
	Fleet: Parks	Vehicle 24120	241-20: Tractor	Case Farmall 75A
	Fleet: Parks	Vehicle 241	241: Tractor	John Deere 5225
	Fleet: Parks	Vehicle 242	242: Tractor	John Deere 5115M
	Fleet: Parks	Vehicle 243	243: Line Painter	John Deere F1435
	Fleet: Parks	Vehicle 245	245: Zero Turn Mower	Kubota ZD1211
	Fleet: Parks	Vehicle 246	246: Zero Turn Mower	Kubota ZD1211
	Fleet: Parks	Vehicle 247	247: Zero Turn Mower	Kubota ZD1211R
	Fleet: Parks	Vehicle 248	248: Zero Turn Mower	Kubota ZD1211R
	Fleet: Parks	Vehicle 249	249: Zero Turn Mower	Kubota ZD1211R
	Fleet: Parks	Vehicle 250	250: Zero Turn Mower	Kubota ZD1211R
	Fleet: Parks	Vehicle 251	251: Zero Turn Mower	Kubota ZD1211R
	Fleet: Parks	Vehicle 25219	252-19: Bobcat Mini Excavator	Bobcat E26
	Fleet: Parks	Vehicle 25319	253-19: Bobcat Skid Steer Track Loader	Bobcat T590
	Fleet: Parks	Vehicle 254	254: Articulaling Compact Wheel Loader	John Deere 324J
	Fleet: Parks	Vehicle 25519	255-19: Wide Area Mower	Toro Groundsmaster 5910
	Fleet: Parks	Vehicle 25619	256-19: Wide Area Mower	Toro Groundsmaster 5910
	Fleet: Parks	Vehicle 270	270: Wood Chipper	Bandit Intimidator 12XP
	Fleet: Parks	Vehicle 272	272: Roto Tiller Attachment	Rotodairon / RD150N1VF
	Fleet: Parks	Vehicle 282	282: Snow Plow Attachment	HLA Snow Wing 4200W
	Fleet: Parks	Vehicle 377	377: Greens Mower	Toro Greenmaster 1000
	Fleet: Parks	Vehicle 3966	396-6: 21 inch Rotary Hand Mowers A	Model 22260 Lawn Boy
	Fleet: Parks	Vehicle 396	396: 21 inch Rotary Hand Mowers F	Model 22260 Lawn Boy
	Fleet: Parks	Vehicle 24021	Vehicle 24021	2021 Massey Ferguson
	Fleet: Parks	Vehicle 257	Vehicle 257	John Deere 997 Z TRAK
	Fleet: Parks	Vehicle 261	Vehicle 261	ZD 326RP
	Fleet: Roads	Vehicle 199	199: Forklift	Toyota 8FGCU25
	Fleet: Roads	Vehicle 4021	40-21: Street Sweeper	Pelican
	Fleet: Roads	Vehicle 41	41: Street Sweeper	Elgin Broom Bear
	Fleet: Roads	Vehicle 4419	44-19: Bobcat Skid Steer Loader	Bobcat
	Fleet: Roads	Vehicle 45	45: Front End Loader	Caterpillar 924K
	Fleet: Roads	Vehicle 46	46: Front End Loader	Caterpillar 924K
	Fleet: Roads	Vehicle 50	50: Sidewalk Tractor	John Deere 3720
	Fleet: Roads	Vehicle 5119	51-19: Articulating Trackless Sidewalk Tractor	Trackless MT
	Fleet: Roads	Vehicle 52	52: Sidewalk Tractor	John Deere 3720
	Fleet: Roads	Vehicle 54	54: Steam Jenny	Thompson
	Fleet: Roads	Vehicle 55	55: Portable Air Compressor	Sullair ST185
	Fleet: Roads	Vehicle 7019	70-19: Graco Line Painter /Zone Painter	Graco
	Fleet: Roads	Vehicle 87	87: Asphalt Roller	Caterpillar CB14
	Fleet: Water/Wastewater	Vehicle 110	110: Valve Turner (Electric)	Wachs
	Fleet: Water/Wastewater	Vehicle 112	112: Hydrant Pump	Shindaiwa
	Fleet: Water/Wastewater	Vehicle 56	56: Valve Exercise Trailer	EH Wachs Compact VMT
	Fleet: Water/Wastewater	Vehicle 81	81: Water Pump (Water) 3 inch	Honda WP 30x
Fleet: Heavy duty	Fleet: Parks	Vehicle 20721	207-21: 1 Ton 4x4 Pick-up	Ford F350
	Fleet: Parks	Vehicle 223	223: 3 ton Arborist Truck	Ford F550
	Fleet: Parks	Vehicle 225	225: 2 ton Dump Truck	Ford F450 DRW

Table 1: Fleets summary *(continued)*

Category	Department	Vehicle ID	Description	Make and model
	Fleet: Parks	Vehicle 22621	226-21: 2 Ton Dump Truck	Ford F450 DRW
	Fleet: Parks	Vehicle 227	227: 2 ton Dump Truck	Ford F450 DRW
	Fleet: Parks	Vehicle 22819	228-19: 2 ton Dump Truck	Ford F450 DRW
	Fleet: Parks	Vehicle 229	229: 3 ton Garbage Compactor	Ford F550
	Fleet: Roads	Vehicle 15	15: 2 ton Dump Truck	Ford F450 DRW
	Fleet: Roads	Vehicle 1617	16-17: 3 ton (Sign Truck) Diesel	Super Duty F-550 XL (Sign Truck) Roads
	Fleet: Roads	Vehicle 1721	17-21: 4 Ton Roll Off Truck	Ford F750
	Fleet: Roads	Vehicle 18	18: 1 ton 4x4 Pick-up	Chevrolet 3500 HD
	Fleet: Roads	Vehicle 2421	24-21: 2 Ton Dump Truck	Ford F450 DRW
	Fleet: Roads	Vehicle 2519	25-19: 6 ton Diesel Dump with Sander	Freightliner 108SD
	Fleet: Roads	Vehicle 2623	26-23: 6 ton Diesel Dump with Sander	Freightliner SD
	Fleet: Roads	Vehicle 26	26: 6 ton Diesel Dump with Sander	Freightliner 108SD
	Fleet: Roads	Vehicle 2719	27-19: 6 Ton Diesel Dump with Sander	International HV
	Fleet: Roads	Vehicle 2821	28-21: 6 ton Diesel Dump with Sander	International HV
	Fleet: Roads	Vehicle 28	28: 6 ton Diesel Dump with Sander	Freightliner FM2
	Fleet: Roads	Vehicle 2919	29-19: 6 ton Diesel Dump with Sander (Tandem)	Freightliner 114SD
	Fleet: Roads	Vehicle 30	30: 6 ton Diesel Dump with Sander	International 70S
	Fleet: Roads	Vehicle 3123	31-23: 6 ton Diesel Dump with Sander	Freightliner SD
	Fleet: Roads	Vehicle 32	32: 6 ton Diesel Dump with Sander	Freightliner 108SD
	Fleet: Roads	Vehicle 3422	34: 6 Ton Diesel Multi Purpose Dump (Tandem)	Frieghtliner 114SD
	Fleet: Roads	Vehicle 38	38: 3 ton Dump Truck	Ford F550
Fleet: Light duty	Fleet: Arboretum	Vehicle 297	297: Off-Road Utility Vehicle	Kubota RTV 1100C
	Fleet: By-Law	Vehicle 401	401: 1/4 ton 4x4 Pick-up	Nissan Frontier Crewcab SV
	Fleet: By-Law	Vehicle 402	402: 1/4 ton Pick-up	Nissan Frontier SV
	Fleet: By-Law	Vehicle 40319	403-19: Police Interceptor (Explorer SUV)	Ford Explorer
	Fleet: By-Law	Vehicle 40419	404-19: Police Interceptor (Explorer SUV)	Ford Explorer
	Fleet: By-Law	Vehicle 40518	405-18: Ford Van	Ford Transit
	Fleet: By-Law	Vehicle 40621	406-21: Ford Explorer Hybrid SUV	Ford Explorer
	Fleet: Facilities	Vehicle 50021	500-21: 1/2 ton Pick-up	Ford F150
	Fleet: Facilities	Vehicle 502	502: 1/2 ton Pick-up	Ford F150
	Fleet: Facilities	Vehicle 50321	503-21: 1/2 ton Pick-up	Ford F150
	Fleet: Facilities	Vehicle 504	504: 1/2 ton Pick-up	Chevrolet Silverado
	Fleet: Parks	Vehicle 20121	201-21: Hybrid SUV	Ford Explorer
	Fleet: Roads	Vehicle 1	1: 1/2 ton Pick-up	Ford F150
	Fleet: Roads	Vehicle 13	13: 1/2 ton Pick-up	Ford F150
	Fleet: Roads	Vehicle 2	2: Hybrid SUV	Ford
	Fleet: Roads	Vehicle 23	23: 1/2 ton Pick-up	Chevrolet Silverado
	Fleet: Roads	Vehicle 6	6: 1/2 ton Pick-up	Ford F150
	Fleet: Roads	Vehicle 721	7-21: 1/2 Ton Pick-up	Ford F150
	Fleet: Roads	Vehicle 618	Vehicle 618	2018 Ford F150
	Fleet: Water/Wastewater	Vehicle 10	10: 1/2 ton Pick-up	Ford F150
	Fleet: Water/Wastewater	Vehicle 63	63: 1/4 ton Pick-up	Chevrolet Colorado
	Fleet: Water/Wastewater	Vehicle 8	8: 1/2 ton Supercab Pick-up	Ford F150
	Fleet: Water/Wastewater	Vehicle 9	9: 1/2 ton Supercab Pick-up	Ford F150
Fleet: Medium duty	Fleet: Facilities	Vehicle 50119	501-19: 3/4 ton Cargo Van	Ford Transit
	Fleet: Facilities	Vehicle 505	505: 3/4 ton Cargo Van	Nissan NV2500
	Fleet: Parks	Vehicle 20019	200-19: 3/4 ton Pick-up	Ford F250 (3/4)
	Fleet: Parks	Vehicle 201	201: 3/4 ton Pick-up	Ford F250 (3/4)
	Fleet: Parks	Vehicle 20219	202-19: 3/4 ton Pick-up	Ford F250
	Fleet: Parks	Vehicle 203023	203-23: 3/4 Ton Pick-up	Ford F250 (3/4)
	Fleet: Parks	Vehicle 20422	204-22: 3/4 Ton Pick up 4x4	Ford F250
	Fleet: Parks	Vehicle 204	204: 3/4 ton Pick-up	Chevrolet Silverado
	Fleet: Parks	Vehicle 205	205: 3/4 ton Pick-up	Ford F250
	Fleet: Parks	Vehicle 206	206: 3/4 ton Pickup	Ford F250
	Fleet: Parks	Vehicle 208	208: 3/4 ton Pick-up 4x4	Ford F250
	Fleet: Parks	Vehicle 209	209: 3/4 ton Pick-up 4x4	Ford F250
	Fleet: Parks	Vehicle 21221	212-21: 3/4 Ton Pick-up 4x4 with Lift Gate	Ford F250
	Fleet: Parks	Vehicle 22417	224-17: 3/4 ton Pick-up Crewcab	Dodge Ram 2500
	Fleet: Roads	Vehicle 2221	22-21: 3/4 Ton Pick-up 4x4 with Lift Gate	Ford F250
	Fleet: Roads	Vehicle 2322	23-22: 3/4 Ton Pick-up 4x4	Ford F250
	Fleet: Roads	Vehicle 419	4-19: 3/4 ton Pick-up	Ford F250
	Fleet: Roads	Vehicle 521	5-21: 3/4 Ton Pick-up 4x4 with Lift Gate	Ford F250
	Fleet: Roads	Vehicle 2219	Vehicle 2219	2021 Ford F250
	Fleet: Water/Wastewater	Vehicle 61	61: 3/4 Ton Cargo Van	Nissan NV 2500
	Fleet: Water/Wastewater	Vehicle 62	62: 3/4 Ton Cargo Van	Nissan NV 2500
	Fleet: Water/Wastewater	Vehicle 6420	64-20: 3/4 Ton Cargo Van	Ford Transit 250
Fleet: Other	Fleet: Arboretum	Vehicle 710	Vehicle 710	Arboretum gasoline jerry can

Table 1: Fleets summary *(continued)*

Category	Department	Vehicle ID	Description	Make and model
	Fleet: Arboretum	Vehicle 711	Vehicle 711	Arboretum diesel jerry can
	Fleet: Facilities	Vehicle 706	Vehicle 706	ACC gasoline jerry can
	Fleet: Facilities	Vehicle 707	Vehicle 707	AFLC gasoline jerry can
	Fleet: Facilities	Vehicle 708	Vehicle 708	SARC gasoline jerry can
	Fleet: Facilities	Vehicle 709	Vehicle 709	SC gasoline jerry can
	Fleet: Parks	Vehicle 700	Vehicle 700	Parks gasoline jerry can
	Fleet: Parks	Vehicle 701	Vehicle 701	Parks diesel jerry can
	Fleet: Roads	Vehicle 702	Vehicle 702	Roads gasoline jerry can
	Fleet: Roads	Vehicle 703	Vehicle 703	Roads diesel jerry can
	Fleet: Roads	Vehicle 713	Vehicle 713	Diesel Transfer Tank
	Fleet: Water/Wastewater	Vehicle 704	Vehicle 704	Water gasoline jerry can
	Fleet: Water/Wastewater	Vehicle 705	Vehicle 705	Water diesel jerry can

B Appendix B: Methodology Details

B.1 Methodology

The 2024 ECDMP follows municipal best practices in the development of its energy and GHG emission inventory by following the PCP Protocol while also meeting methodology outlined under the O. Reg. 23/25. To complete the analysis, the following methodology was applied.

1. **Measurement boundary**. The utility use baseline analysis measurement boundary was defined by the following baseline year and assets, and encompasses the utility use of the utilities identified below.
   (a) **GHG emissions baseline year**. The GHG emissions baseline year of the Energy Conservation and Demand Management Plan is as follows.
      - 2018.
   (b) **Asset identification**. The assets considered in the ECDMP are those that are owned by Town of Aurora within the following sectors. The assets are reviewed in greater detail in Sections **??** to **??**.
      - Buildings
      - Fleet (propane use new to 2024 ECDMP)
      - Water and wastewater facilities
      - Lighting (new to 2024 ECDMP)
      - Solid waste (new to 2024 ECDMP)
      - Solar photovoltaic energy
   (c) **Utility identification**. The utilities considered in the Energy Conservation and Demand Management Plan are as follows.
      - Electricity
      - Natural gas
      - Gasoline
      - Ethanol 10 (new to 2024 ECDMP)
      - Diesel
      - Biodiesel 5 (new to 2024 ECDMP)
      - Propane (new to 2024 ECDMP)
2. **Historical utility use**. The historical utility use was provided by the Town and serves as the primary data source for establishing baseline metrics (i.e. baseline GHG emissions and utility costs are calculated by applying assumed factors and rates to the actual measured utility use). The historical utility use data provided was analyzed and summarized in Sections **??** and **??**. Note that the data presented in these sections includes all relevant utility use data received from the Town (i.e. no relevant utility use data that was received was omitted unless explicitly noted). For the corporate fleet's fuel consumption, it is assumed that the fleet consumed gasoline and diesel up until 2020, when the Cleaner Transportation Fuels regulation (O. Reg. 663/20) required a transition to ethanol 10 and biodiesel 5.
3. **GHG emissions analysis**. The baseline GHG emissions were analyzed to understand which assets, asset types, utilities, and sectors have the greatest contributions to yearly GHG emissions. Results are presented in Section **??**.
4. **Waste GHG emission calculation**. GHG emissions due to solid waste are calculated according to the guidelines established by the PCP protocol. The Town does not own a landfill or waste incineration facility, ultimate management of solid waste is the responsibility of York Region. Two of these sites are landfill sites, and the other three are energy from waste centres. It is assumed that 50% of the waste is sent to a landfill site, and the other 50% is sent to a energy from waste centre. The GHG emissions from landfilled waste are calculated as per the PCP protocol, and the methodology is outlined in Appendix B. The PCP protocol does

not provide a methodology to calculate GHG emissions for waste-to-energy centres, so the approach used by the GHG Protocol for municipalities is followed: because the waste is exported for energy generation outside of the boundaries of the Town, these emissions are excluded from this report.

5. **Inclusion and exclusion protocols for GHG sources**. The PCP inclusion and exclusion protocols for each asset are listed below.

- **Facilities**.
  - **Inclusion:** All facilities owned and/or operated by the municipality, including any which are leased to another entity.
- **Fleet**.
  - **Inclusion:** All direct and indirect emissions generated by using motor fuels to operate corporate vehicles and equipment, including on and off-road vehicles owned and/or operated by the municipality.
  - **Exclusion:** If the electricity consumed by a vehicle or piece of equipment cannot be distinguished from electricity consumed by a building, the electricity consumed by these vehicles can be reported with the facility emissions.
  - **Business travel using personal vehicles:** Will be considered in a future ECDMP update.
- **Waste Sector**.
  - **Inclusion:** All GHG emissions generated from the Town's corporate solid waste, including from the following sources: facilities receptacles, park receptacles, and other public receptacles in which the Town directly collects.
  - **Exclusion:** All residential and local business' waste is exclude as they are collected through the Regional Municipality of York's waste system and GHG emissions from those sources are accounted for under the Community-level emissions inventory.
- **Water / Wastewater**.
  - **Inclusion:** All Town-owned water and wastewater pumping stations.
  - **Exclusion:** Emissions from water and wastewater infrastructure owned by a neighbouring municipality or York Region.
- **Public Lighting**.
  - **Inclusion:** All indirect emissions generated from the use of electricity for outdoor lighting, including streetlights, traffic signals, and park lighting owned and/or operated by the municipality.
  - **Exclusion:** Streetlight emissions from streetlights owned by a neighbouring municipality or York Region.

B.2 Analysis Methodology

B.2.1 Scenario Analysis Definitions

The following terms are defined for clarity concerning the scenario analysis.

- **Measure**. An actionable opportunity to reduce utility use or GHG emissions pertaining to a specific asset.
- **Possible measures**. The set of measures that could potentially be implemented for each individual asset.
- **Measure implementation plan**. A plan for measures to be implemented at each asset, consisting of the following details.
  - A set of measures to be implemented and the asset for which each measure is to be implemented.
  - The year during which each measure is to be implemented, for each asset.
- **Scenario**. A possible iteration of a measure implementation plan.
- **GHG reduction roadmap**. The recommended measure implementation plan.

B.2.2 ECM Methodology

Assumptions related to modelling energy conservation measures (ECMs) are listed below.

Buildings:

- Many of the building-specific measure concepts and data, including project cost estimate and utility use impact estimates, were obtained from Energy Audits completed in 2017. These measures were included to provide greater granularity and flexibility in scenario development. Please refer to Energy Audit reports for more detail. Note that for these measures, the cost was taken from the audits, updated to 2024 costs assuming an average inflation rate of 3.2%. For "Remaining" measures, such as "Remaining lights to LED", the retrofits were partially completed (for instance, Town Hall LED retrofits occurred on the first and second floors, and are pending for the third floor), and the cost is halved compared to what was reported in the Energy Audits.
- Some measures were also taken from the 2022 BCAs. Note that energy audits were not completed as part of the BCAs in 2022, so cost and utility reduction information for these measures is assumed as it is in other recommended measures, as detailed in the next point. It is recommended that ASHRAE Level 3 energy audits be performed alongside the next BCAs.
- In addition to measures obtained from the 2017 Energy Audits and 2022 BCAs, additional measures were developed within the scope of this ECDMP with the specific intent of reducing GHG emissions. Such measures typically involved fuel conversion initiatives to reduce fuel utility use and associated GHG emissions. While many measures from the Energy Audits reduce GHG emissions, measures for minimizing GHG emissions were not analyzed in some of the 2017 Energy Audits. For these additional measures, the cost and utility reduction information is assumed based on recent projects done on similar buildings. The cost estimates include all anticipated fees of implementing the project, including the design, equipment, installation, and electrical upgrades (where applicable). These costs include a design contingency of 25% and a construction contingency of 10% to account for uncertainty in the cost. It is recommended that in the next ECDMP update, more accurate costs are taken based on the feasibility studies undertaken over the next five year period.

Fleet:

- Measures were developed within the scope of this ECDMP with the specific intent of reducing GHG emissions. Such measures typically involved fuel conversion initiatives to reduce fuel utility use and associated GHG emissions. The cost and utility reduction information is assumed based on recent projects done.
- Vehicle electrification measures are intended to be done gradually, while replacing vehicles at their end of useful life. This measure represents the completion of fleet electrification.
- Costs were estimated based on the number and size of the vehicles being replaced in each department.

B.2.3 Scenario Analysis Methodology

The scenario analysis was completed according to the following methodology.

1. **Possible measures**. Each asset considered under this Energy Conservation and Demand Management Plan was reviewed and specific measures that could be implemented for each specific asset were identified. This included a review of Energy Audit reports completed by Stantec in 2017, the 2022 BCAs, and the identification of additional measures focused on reducing GHG emissions. Unless otherwise stated, where possible, the year of implementation for each measure corresponds with the year it's set to be replaced, as per the asset management plan. The feasibility of measures was then checked by performing interviews and workshops with staff, which are ongoing. As part of this process, the following were quantified for each possible measure.
    - Project cost estimated to implement the measure. For measures derived from Energy Audit reports completed by Stantec in 2017, project costs were taken from reports but updated to 2024 costs, assuming an average inflation rate of 3.2% based on data reported by Statistics Canada. For additional measures focused on reducing GHG emissions, project costs were approximated based on asset sizes /

quantities. It should be emphasized that project cost estimates presented in this analysis are high-level approximations only. The primary intent of project cost estimates in this analysis is to evaluate scenarios relative to each other. It is recommended that more detailed project cost estimates be completed for project budgeting purposes.

- The measure's expected impact on utility use, GHG emissions and utility costs.

2. **Scenario development**. For the scenario that was identified, a specific measure implementation plan that considers all assets in all sectors was developed. The development of the scenario involved selecting which of the possible measures would be implemented for each asset, and when, to achieve the objectives of that scenario. This process involved iteratively modeling the expected impacts on project costs / utility use / GHG emissions as measures were assigned to each scenario, to assure that the objectives of the scenario were reasonably achieved.
3. **Scenario utility analysis**. A utility analysis was completed for each scenario, in which the yearly utility use for each asset was projected from 2022 to 2050 (i.e. the evaluation period) for all utilities (i.e. Electricity, Natural Gas, Ethanol 10, Biodiesel 5, Propane, and Waste GHG), based on the measure implementation plan specific to each scenario. Also, yearly project costs, GHG emissions and utility costs were projected from 2022 to 2050 based on the yearly utility use projections for each scenario by applying the assumed GHG factors and utility cost rates indicated in Section B.3. All future financial expenditures were projected in current dollar values (i.e. future costs were not adjusted for inflation, and cumulative cost estimates were not discounted back to present value).

B.3 Analysis Assumptions

Assumptions applied throughout the utility baseline and scenario analysis are summarized as follows.

- The GHG emissions factor associated with Ontario's electricity grid was assumed to change over time. Where available, the past values were taken from the National Inventory Report (NIR) for historical emissions factors values. For values that weren't available from the NIR (2022 and beyond), these values were calculated based on projections made by the IESO, inferred from the IESO's *Annual Planning Outlook*, *December 2021*. Figure 1 presents the electricity grid GHG emissions factors assumed over the evaluation period.

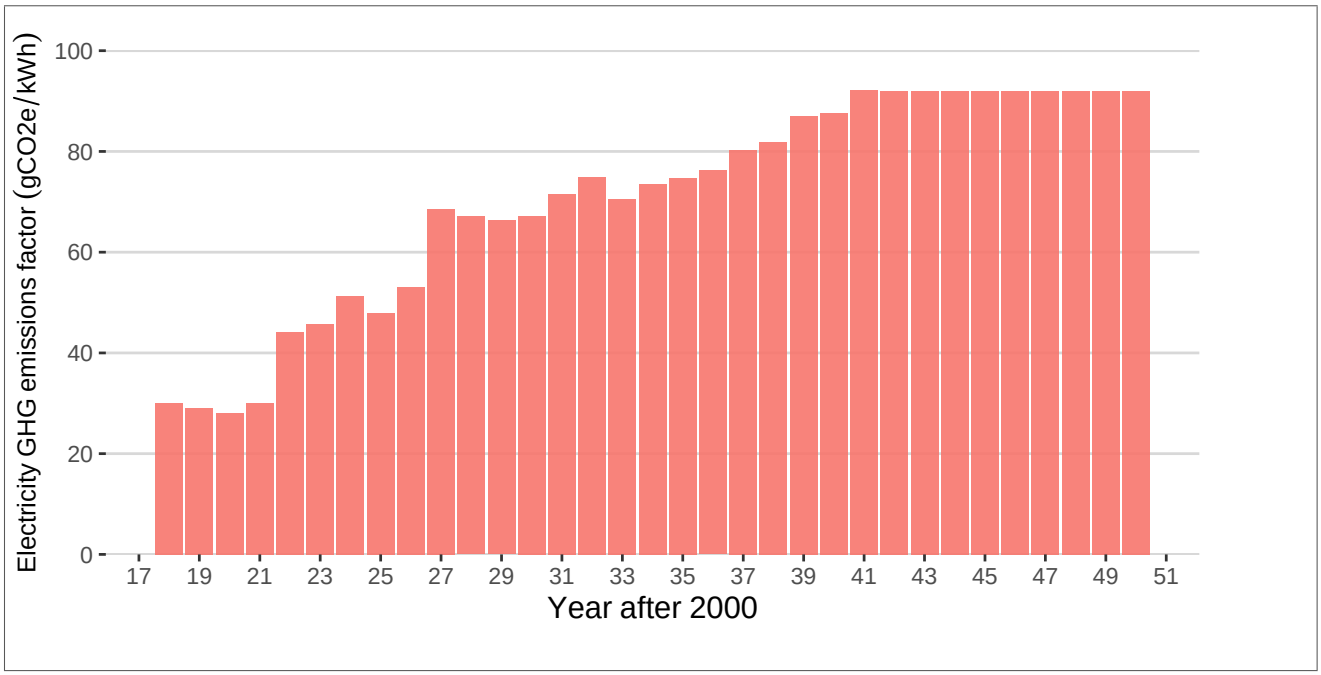

Figure 1: Electricity GHG emissions factor projection (Source: IESO Annual Planning Outlook 2021)

- Other GHG emissions factors were assumed as per Table 2 (source: 2022 National Inventory Report).

Table 2: GHG Emissions Factor Assumptions

Utility	Unit	Value
Electricity	[gCO2e/kWh]	30
Natural gas	[gCO2e/m3]	1921
Propane	[gCO2e/L]	1515
Gasoline	[gCO2e/L]	2307
Ethanol 10	[gCO2e/L]	2227
Diesel	[gCO2e/L]	2680
Biodiesel 5	[gCO2e/L]	2600

- Utility cost rate assumptions for the utility use baseline analysis are as per Table 3. Note that the federal carbon charge is delineated from associated fuel utility costs and accounted for explicitly, for greater granularity. Also note that the values presented are the values taken from 2018. Utility cost rates are typical for industry and were obtained from sources such as IESO, and carbon offset costs were obtained from Bullfrog power. These costs are projected to increase annually with an average inflation rate of 2.2%.

Table 3: Utility Cost Rate Assumptions

Utility	Unit	Value
Electricity	[$/kWh]	0.14
Natural gas	[$/m3]	0.26
Propane	[$/L]	0.6
Gasoline	[$/L]	1.5
Ethanol 10	[$/L]	1.5
Diesel	[$/L]	1.5
Biodiesel 5	[$/L]	1
Waste GHG	[$/tCO2e]	0
Carbon offsets	[$/tCO2e]	30.05
Federal carbon charge	[$/tCO2e]	0

- **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 2 presents the federal carbon charge rates assumed over the evaluation period.

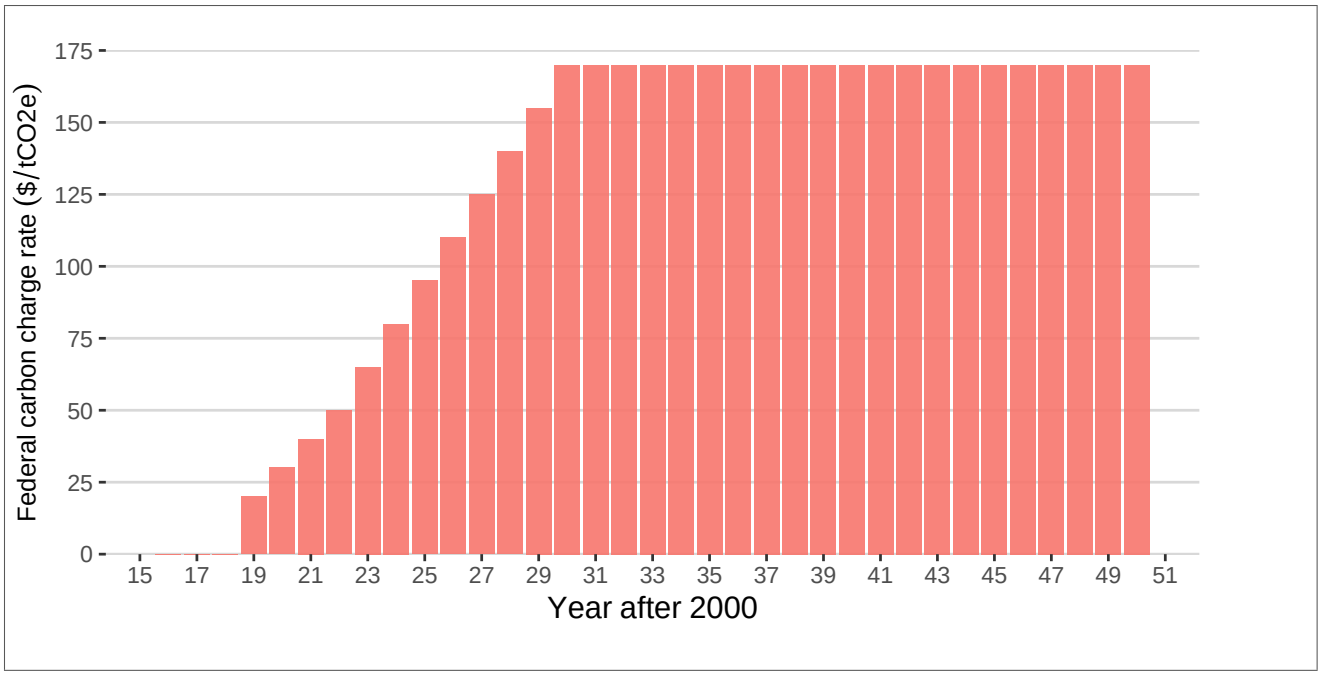

Figure 2: Federal carbon charge projection (Source: Government of Canada (up to 2030); Assumed (After 2030))

B.4 Waste Sector Emissions Calculation Details

The Town of Aurora does not own a landfill or waste incineration facility, and sends its waste to facilities owned by York Region. Two of these sites are landfill sites, and the other three are waste-to-energy centres. It is assumed that 50% of the waste is sent to a landfill site, and the other 50% is sent to a waste-to-energy centre.

The PCP protocol does not provide a methodology to calculate GHG emissions for waste-to-energy centres, so the approach used by the GHG Protocol for Cities is followed - as the waste is exported for energy generation outside of the boundaries of the Town, these emissions are excluded from this report.

For the waste sent to landfill, GHG emissions are calculated as per the PCP protocol, and the methodology is outlined below.

- The annual quantity of solid waste generated by the Town of Aurora is estimated.
  - For each corporate-owned facility, park, and public receptacle, the annual volume of waste is estimated.
  - This is done by measuring the garbage bin capacity and number, how full the bin usually is at pickup, and frequency of garbage pickup.
  - The waste volume is converted to tons by assuming a volume to weight conversion factor of 0.178 tonnes/m3.
  - The total annual mass of corporate waste is obtained by doing this for each corporate-owned waste receptacle and taking the sum.
- The waste composition is assumed as per the general municipal solid waste composition values for North America, provided by the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, and listed in Table 4.
- For each waste category, the degradable organic carbon (DOC) factor is computed by taking taking the sum of the fraction of a waste category present in the waste stream times its DOC. Specific data for the waste composition was not available from the Town, so general numbers from a solid waste composition study are used, as per Table 4.

Table 4: Waste Composition Assumptions

Waste Category	Composition Percentage	Degradable Organic Carbon
Food	0.34	0.15
Paper/Cardboard	0.23	0.40
Wood Products	0.06	0.43
Textiles	0.04	0.24
Plastics and other inerts (glass, metal, etc.)	0.33	0.15

- The quantity of methane generated by the landfilled waste is calculated by multiplying the mass of waste by the DOC, fraction of DOC dissimilated (using the PCP protocol default value of 0.6), fraction of methane in the landfill gas (using the PCP protocol default value of 0.5), and stoichiometric ratio between methane and carbon (16/12).
- From this, the downstream GHG emissions (in tCO2e) can be calculated by multiplying the quantity of methane by 21 (the global warming potential of CH4), (1-OX) (where OX is the oxidation factor, using the PCP protocol default value of 0.1), and (1-f) (where f is the fraction of methane emissions recovered by the landfill gas collection system). f is calculated to be 0.65 based on the default values for a comprehensive landfill gas collection system.

B.5 Utility Use Baseline Recalculation

The 2018 baseline based on the data available from the 2019 ECDMP is presented below:

Table 5: Town of Aurora 2018 Energy Consumption and GHG Emissions Summary as Presented in the 2019 ECDMP

		Administrative Offices	Public Facilities	Indoor Recreation Facilities	Water/ Wastewater Facilities	Fleet	Total
Electricity Consumption	[kWh/yr]	1,299,380	1,220,316	6,761,361	118,358	-	9,399,415
Natural Gas Consumption	[m3/yr]	193,359	119,928	921,252	-	-	1,234,539
GHG Emissions	[tCO2e]	421	279	2,030	5.1	491	3,226

Since 2018, the Town of Aurora has acquired new assets which must be considered in this plan, such as the Aurora Sports Dome and the buildings on Yonge street. Additionally, data for assets (such as some of the street lights and wastewater stations) was not available in 2018, but must be considered to comply with the PCP inclusion protocol.

To establish a fair basis of comparison, if assets did not have utility data available in a given year, it is assumed that the utility consumption in the baseline year was approximately the same as the consumption in the oldest year where utility use data is available. This is accounted for in the adjusted baseline data, presented in in Table 6, as well as the historical utility use trends.

Baseline GHG emissions were calculated by multiplying yearly utility use by the respective GHG emissions factor (see the assumed GHG emissions factors in Table 2). Baseline utility costs were calculated by multiplying yearly utility use by the respective blended utility cost rates (see the assumed utility cost rates in Table 3).

The utility use baseline, for the baseline year of 2018, is summarized in Table 6.

Table 6: Town of Aurora 2018 Adjusted Baseline Energy Consumption and GHG Emissions Summary

Category	Utility	Unit	Value
Utility use	Electricity	[kWh/yr]	11,559,160
	Natural gas	[m3/yr]	1,337,896
	Propane	[L/yr]	705
	Gasoline	[L/yr]	144,831
	Diesel	[L/yr]	82,185
	Waste GHG	[tCO2e/yr]	416
	Carbon offsets	[tCO2e/yr]	0
GHG emissions	Electricity	[tCO2e/yr]	347
	Natural gas	[tCO2e/yr]	2,570
	Propane	[tCO2e/yr]	1
	Gasoline	[tCO2e/yr]	334
	Diesel	[tCO2e/yr]	220
	Waste GHG	[tCO2e/yr]	416
	Carbon offsets	[tCO2e/yr]	0
GHG emissions	Total	[tCO2e/yr]	3,888
Utility cost	Electricity	[$/yr]	1,618,282
	Natural gas	[$/yr]	347,853
	Propane	[$/yr]	423
	Gasoline	[$/yr]	217,247
	Diesel	[$/yr]	123,278
	Waste GHG	[$/yr]	0
	Carbon offsets	[$/yr]	0
	Federal carbon charge	[$/yr]	0
Utility cost	Total	[$/yr]	2,307,083

C Appendix C: Additional Scenario Utility Use Results

C.1 Annual Plans

The annual plans considered in the scenario analysis are outlined in Table 7.

Table 7: Measure Implementation Plans

Plan	Year	Facility	Measure
GHG Reduction Plan	2025	Aurora Seniors Centre	Remaining exterior lights to LED
	2025	Aurora Seniors Centre	Remaining low-flow water fixtures
	2025	Aurora Town Hall	Remaining exterior lights to LED
	2025	Aurora Town Hall	Remaining interior lights to LED
	2025	Aurora Town Hall	Remaining low-flow water fixtures
	2025	McMahon Clubhouse	Remaining lights to LED
	2025	Victoria Hall	Remaining low-flow water fixtures
	2026	Aurora Family Leisure Complex	Pool cover
	2026	Aurora Public Library	High efficiency boiler replacement
	2026	Stronach Aurora Recreation Complex	Pool cover
	2027	Aurora Community Centre	BAS upgrade
	2027	Aurora Family Leisure Complex	BAS upgrade
	2027	Aurora Public Library	BAS upgrade
	2027	Aurora Town Hall	BAS upgrade
	2027	Stronach Aurora Recreation Complex	BAS upgrade
	2028	Aurora Community Centre	Demand control ventilation
	2028	Aurora Community Centre	Measures to be identified in feasibility studies
	2028	Aurora Cultural Centre	Measures to be identified in feasibility studies
	2028	Aurora Family Leisure Complex	Measures to be identified in feasibility studies
	2028	Aurora Public Library	Measures to be identified in feasibility studies
	2028	Aurora Seniors Centre	Demand control ventilation
	2028	Aurora Seniors Centre	Measures to be identified in feasibility studies
	2028	Aurora Sports Dome	Measures to be identified in feasibility studies
	2028	Aurora Town Hall	Measures to be identified in feasibility studies
	2028	Aurora Town Hall	Occupancy sensor in meeting rooms
	2028	Fleet: By-Law - Light duty	Decarbonize two vehicles
	2028	Fleet: Facilities - Ice Resurfacers	Ice resurfacer vehicle decarbonization
	2028	Fleet: Parks - Equipment	Decarbonize 10 pieces of equipment
	2028	Joint Operations Centre	Measures to be identified in feasibility studies
	2028	Stronach Aurora Recreation Complex	Measures to be identified in feasibility studies
	2029	Aurora Seniors Centre	Optimum HVAC scheduling
	2030	Aurora Community Centre	Arena low-e ceiling, if feasible
	2030	Aurora Community Centre	DHW to heat pump
	2030	Aurora Community Centre	HVAC to heat pump
	2030	Aurora Family Leisure Complex	DHW to heat pump
	2030	Aurora Family Leisure Complex	Pool heat to heat pump
	2030	Aurora Seniors Centre	HVAC to heat pump
	2030	Aurora Town Hall	HVAC to heat pump
	2030	Stronach Aurora Recreation Complex	DHW to heat pump
	2030	Stronach Aurora Recreation Complex	HVAC to heat pump
	2030	Stronach Aurora Recreation Complex	Increase roof insulation thickness
	2030	Victoria Hall	Increase roof insulation thickness
	2031	Aurora Town Hall	Increase roof insulation thickness
	2031	Fleet: Arboretum - Equipment	Equipment decarbonization
	2032	Aurora Community Centre	Electrification of ice resurfacing boiler
	2032	Aurora Family Leisure Complex	Electrification of ice resurfacing boiler
	2032	Aurora Seniors Centre	VVT or VAV system
	2032	Fleet: Water/Wastewater - Equipment	Equipment decarbonization
	2033	Fleet: Parks - Equipment	Equipment decarbonization
	2034	Aurora Community Centre	Electrification of dehumidification
	2034	Fleet: Roads - Equipment	Equipment decarbonization
	2036	Fleet: Arboretum - Light duty	Light vehicle decarbonization
	2036	Joint Operations Centre	Increase roof insulation thickness
	2037	Fleet: By-Law - Light duty	Light vehicle decarbonization
	2037	Stronach Aurora Recreation Complex	Electrification of dehumidification
	2038	Aurora Family Leisure Complex	HVAC to heat pump
	2038	Fleet: Facilities - Light duty	Light vehicle decarbonization
	2039	Aurora Sports Dome	HVAC electrification
	2039	Fleet: Parks - Light duty	Light vehicle decarbonization
	2039	Joint Operations Centre	DHW to heat pump
	2039	Joint Operations Centre	HVAC to heat pump

Table 7: Measure Implementation Plans *(continued)*

Plan	Year	Facility	Measure
	2040	Fleet: Roads - Light duty	Light vehicle decarbonization
	2040	The Armoury	DHW to heat pump
	2040	The Armoury	HVAC to heat pump
	2041	Fleet: Water/Wastewater - Light duty	Light vehicle decarbonization
	2044	Aurora Cultural Centre	Renewable energy generation
	2045	Aurora Community Centre	Increase roof insulation thickness
	2045	Aurora Community Centre	Renewable energy generation
	2045	Aurora Cultural Centre	HVAC to heat pump
	2045	Aurora Family Leisure Complex	Increase roof insulation thickness
	2045	Aurora Family Leisure Complex	Renewable energy generation
	2045	Aurora Seniors Centre	DHW to heat pump
	2046	Victoria Hall	HVAC to heat pump
	2048	Aurora Public Library	HVAC to heat pump
	2048	Aurora Seniors Centre	Renewable energy generation
	2048	The Armoury	Increase roof insulation thickness

C.2 Electricity

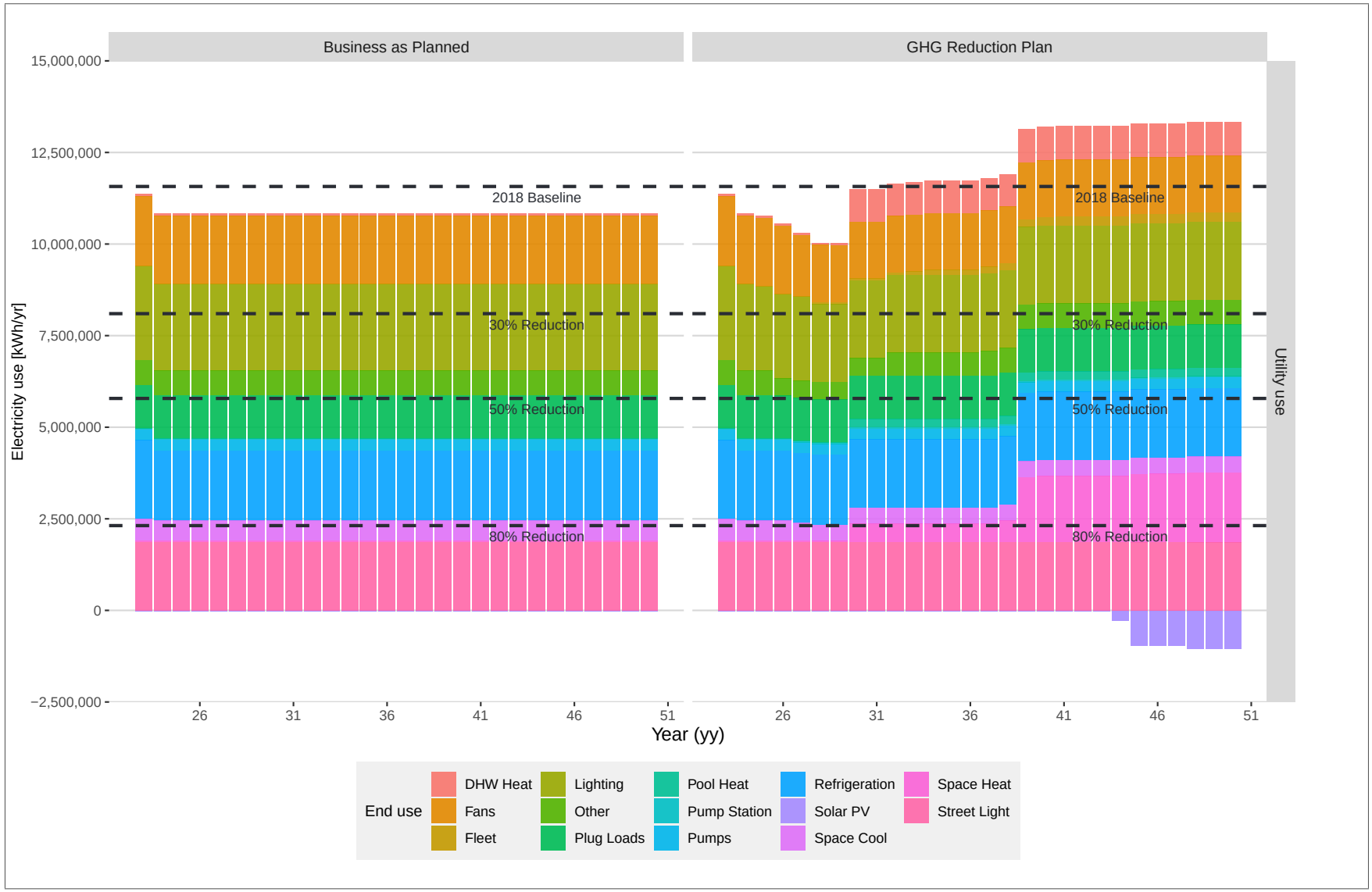

Figure 3: Electricity Utility Use Projection for Each Scenario

C.3 Natural Gas

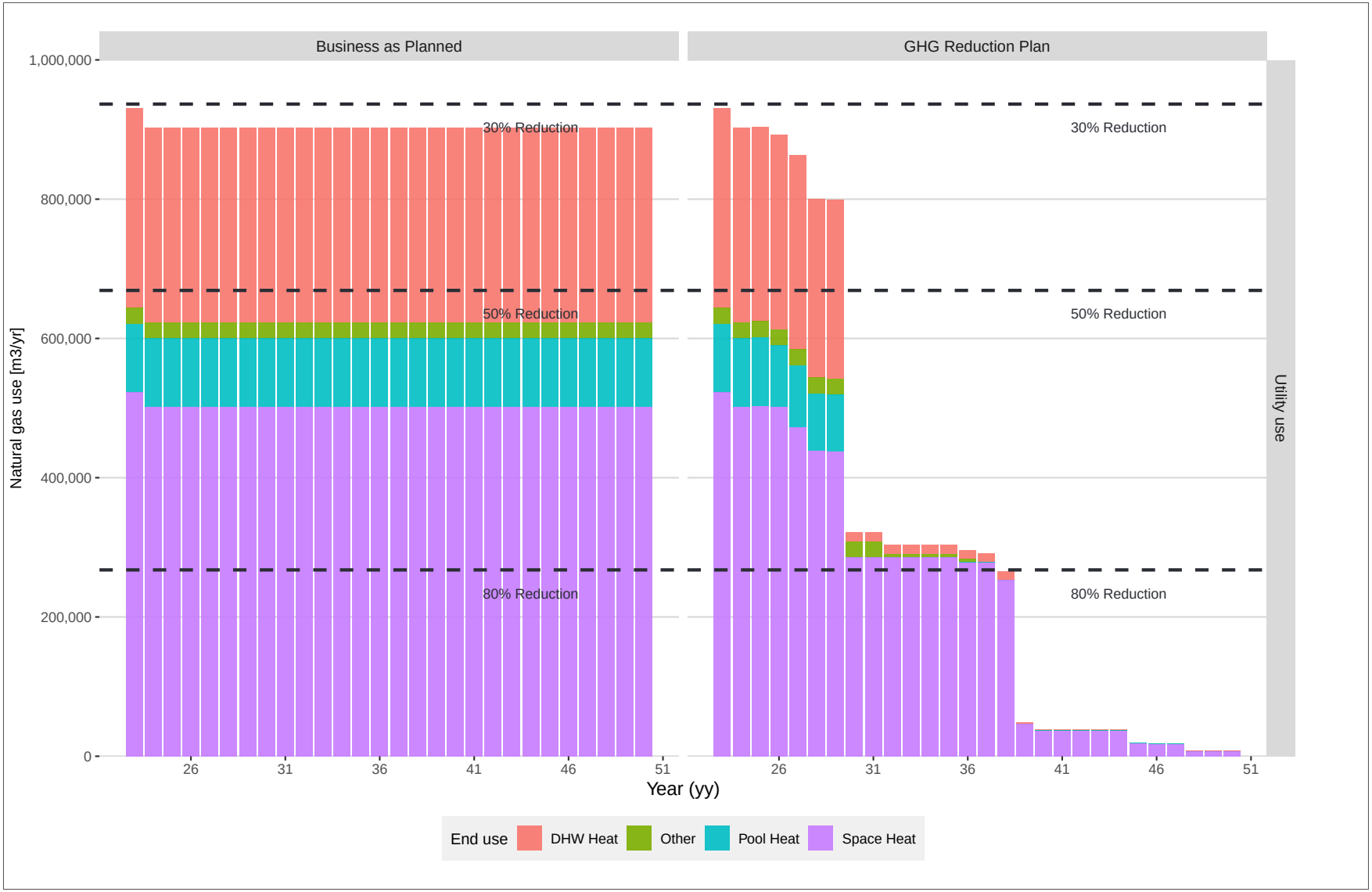

Figure 4: Natural Gas Utility Use Projection for Each Scenario

C.4 Propane

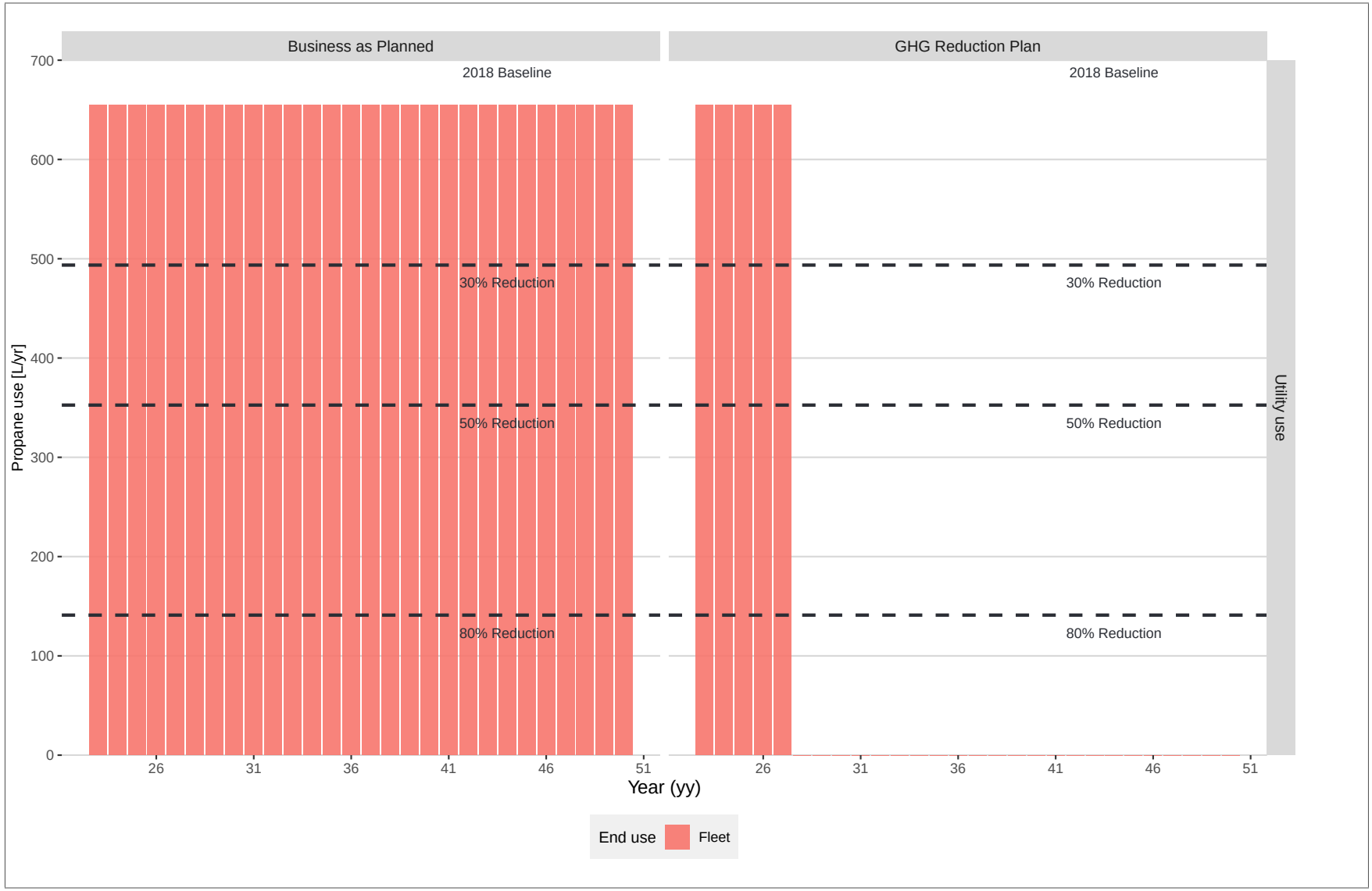

Figure 5: Propane Utility Use Projection for Each Scenario

C.5 Ethanol 10

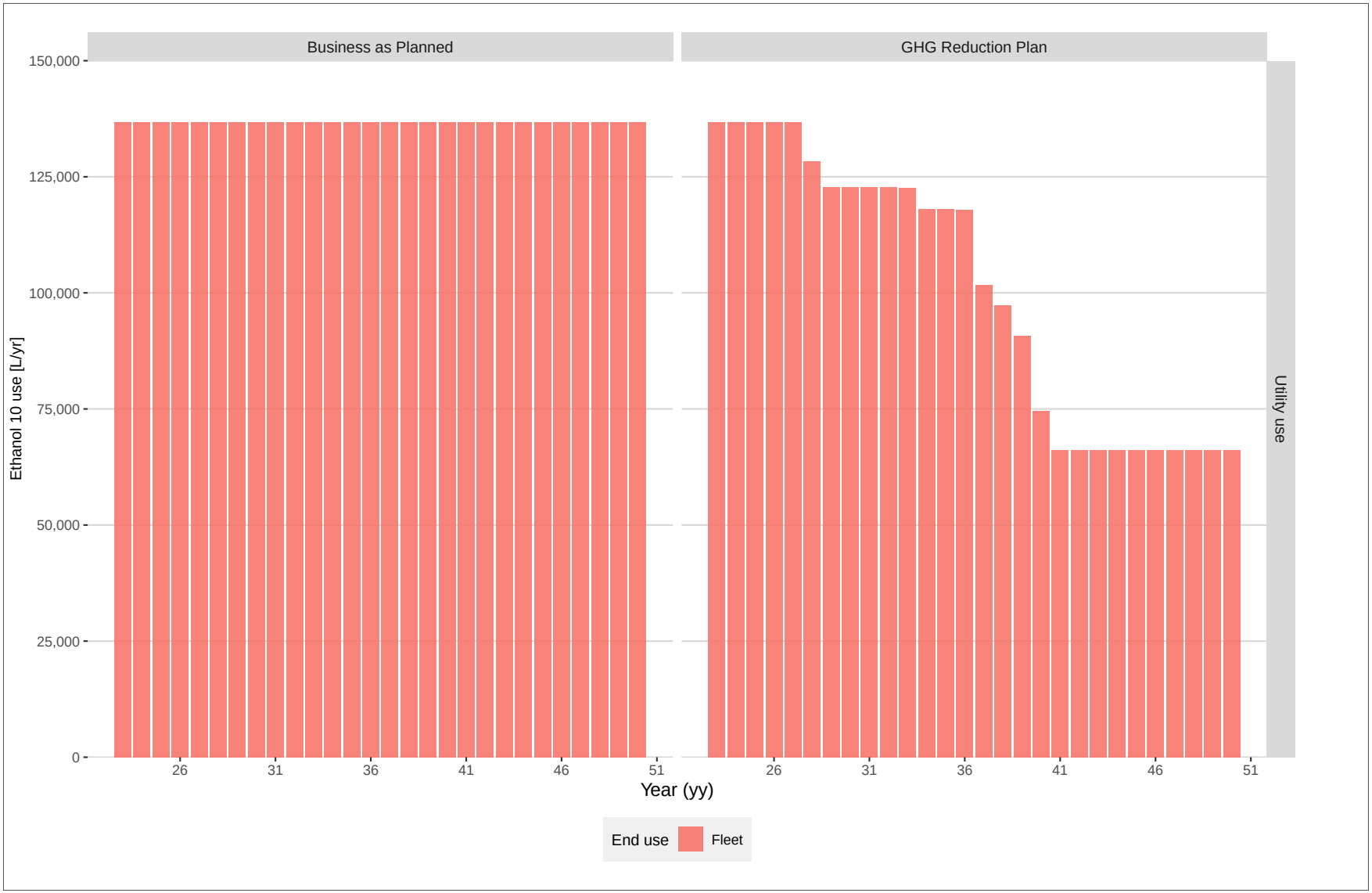

Figure 6: Ethanol 10 Utility Use Projection for Each Scenario

C.6 Biodiesel 5

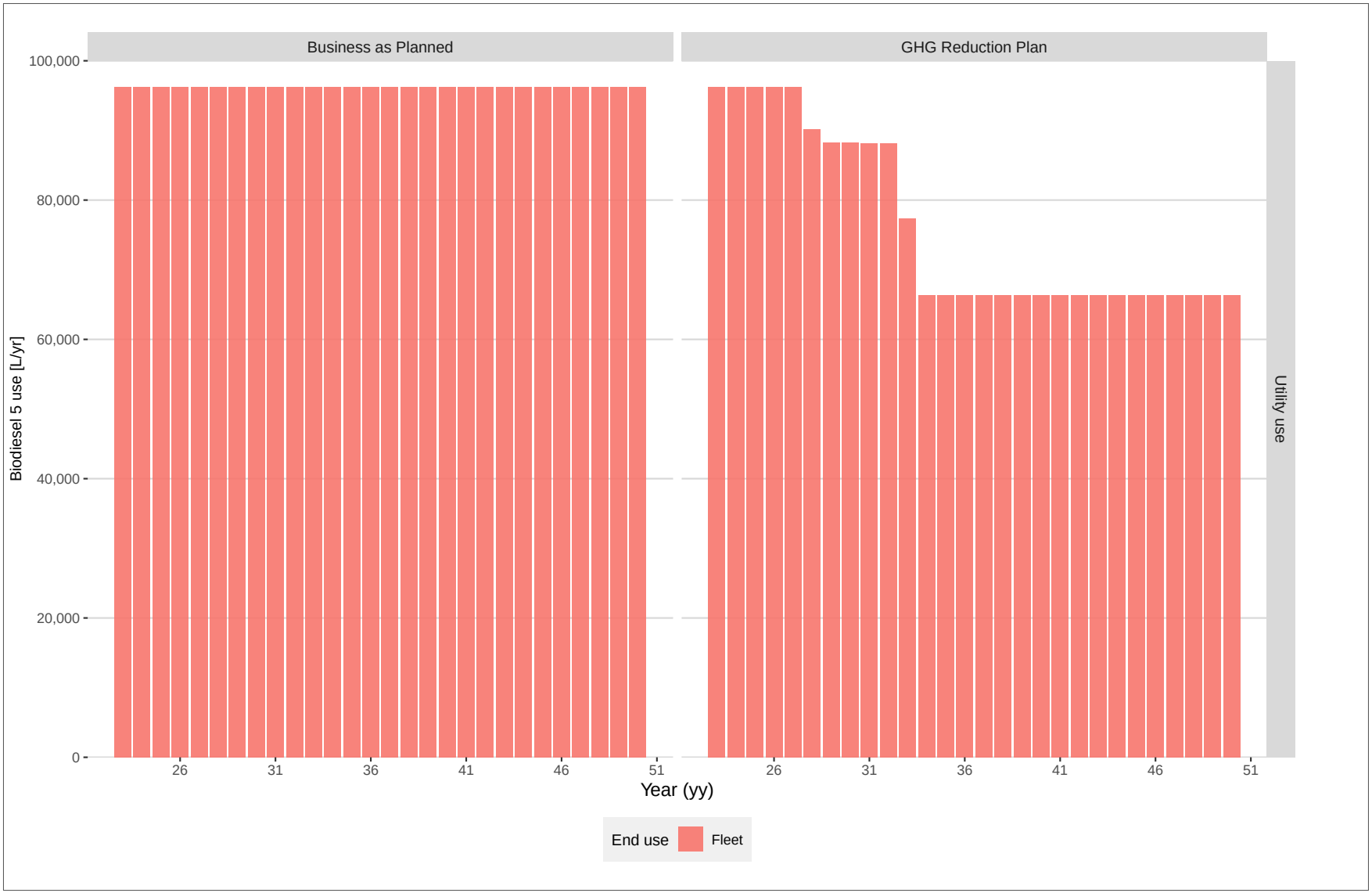

Figure 7: Biodiesel 5 Utility Use Projection for Each Scenario