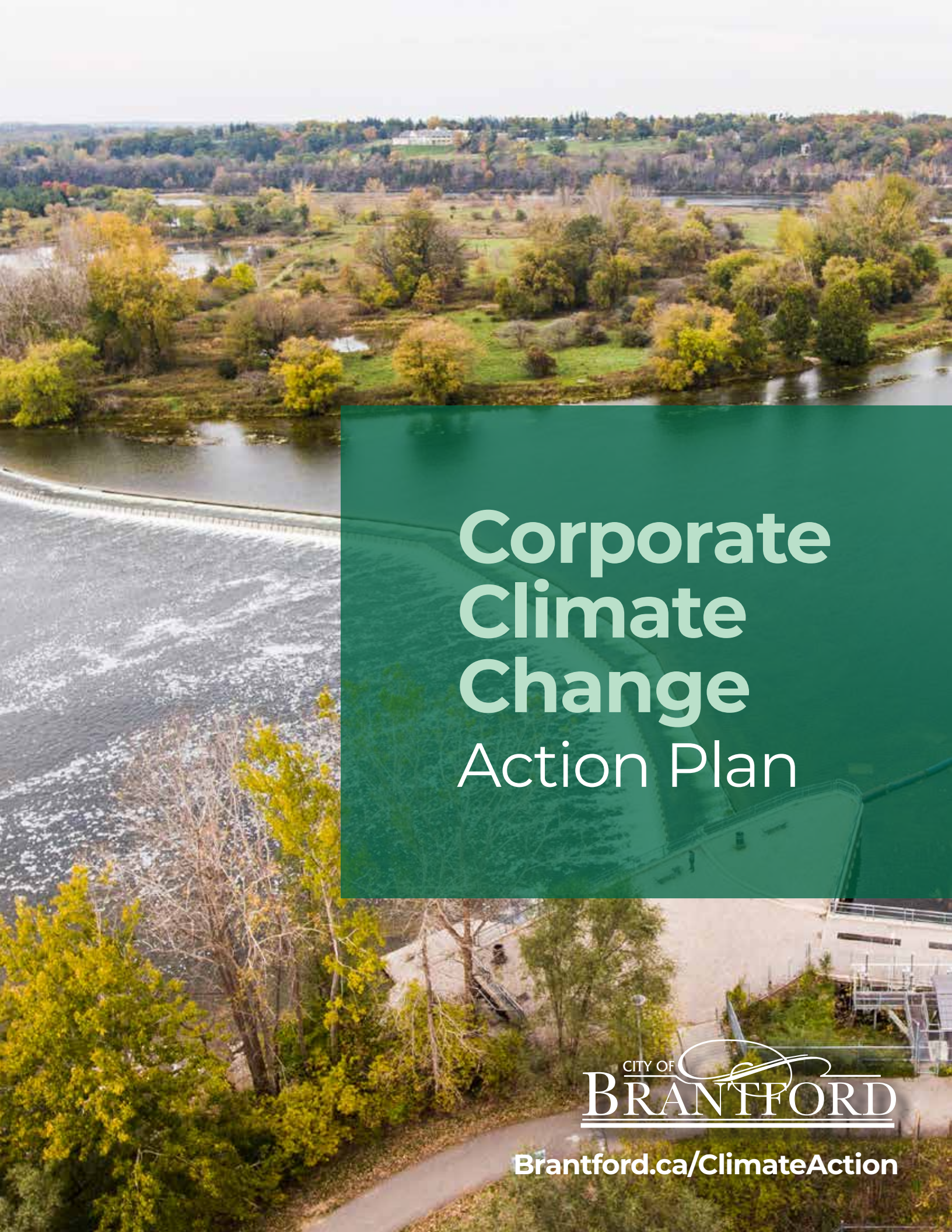


Corporate Climate Change Action Plan

CITY OF BRANTFORD

Brantford.ca/ClimateAction

Table of Contents

SECTION I: CLIMATE CHANGE AT THE CITY OF BRANTFORD 3
1. Introduction 3
2. List of Acronyms and Abbreviations 4
3. Causes and Impacts of Climate Change 5
   3.1 Climate Change in Brantford 6
4. Brantford GHG Emissions Inventory and Forecast 7
   4.1 Current Status of Greenhouse Gases in Brantford 7
   4.1 Projected Emissions for "Business as Usual" Scenario 9

SECTION II: EMISSION REDUCTION TARGETS AND STRATEGY 10
5. Reduction Targets 10
6. Emissions Reduction Ethos 12

SECTION III: CORPORATE EMISSION REDUCTION TOOLS 13
7. Corporate Emissions Reduction Strategy 13
   7.1 Overview of Corporate Action Items 13
   7.2 Priority Actions to 2025 15
   7.3 Fleet 15
   7.4 Buildings 27
   7.5 Water and Wastewater 34
   7.6 Streetlights and Traffic Signals 39
   7.7 Waste 41
   7.8 Corporate Wide 44

SECTION IV: IMPLEMENTATION 48
8. Implementation Overview 48
9. Resources Required 48
   9.1 Leadership 48
   9.2 Dedicated Staff 49
   9.3 Funding Options 50
10. Monitoring and Evaluation 51
   10.1 How to Monitor 51
   10.2 How to Gauge Success 52
11. Plan Revisions 53
   11.1 Corporate Energy Management Plan 54
12. Accountability 54

LIST OF APPENDICES 56
A. Climate Atlas Report for Brantford 56
B Five-year Overview of Costs 58

Section I
CLIMATE CHANGE AT THE CITY OF BRANTFORD

1. Introduction

This document provides a plan for reducing greenhouse gas ("GHG") emissions emitted by The Corporation of the City of Brantford ("Corporation"). This includes any emissions that are produced by any City owned or managed assets including buildings, fleet, water and wastewater treatment facilities, streetlights and traffic signals and emissions from landfill.

The City of Brantford has shown commitment to environmental stewardship and climate action for many years. The City is one of many stewards of the Grand River that runs through the centre of the City that provides drinking water, recreation opportunities, tourism benefits, and is an important wildlife corridor for animals and fish. There are also many large urban forests maintained for recreation, ecosystem benefits and air quality benefits. In 1996, the City joined the Partners in Climate Protection, which is a partner network created to assist municipalities with taking action on climate change. In 2018, the City became involved in the Municipalities for Climate Innovation Project to secure funding for preparing this plan for mitigating the City's impacts on climate change. A community focused climate plan will also be prepared as part of this initiative.

A Climate Change Action Plan ("CCAP") is necessary at this time because of warnings from the global scientific community that our planet is warming at an unnaturally fast pace that will pose significant and irreversible consequences for the planet. This was reflected in the Climate Emergency and Imperative Climate Action declaration ("Climate Emergency Declaration") made by Council in December 2019. The declaration addressed the need for the City of Brantford and all of its citizens to reduce the use of fossil fuels and other sources of greenhouse gas emissions. At both a municipal and global level, the goal is to reach net-zero carbon emissions by 2050 in order to stay below a 1.5°C global temperature increase.

This plan is the first part of the Climate Change Action Plan for Brantford. A community plan will follow that will focus on community sources of emissions and propose emission reduction strategies for personal transportation, homes, businesses, institutions, industry and waste. The Climate Change Action Plan is intended to be a living document that is updated regularly as targets, technology and urgency changes. Both parts of the Climate Change Action Plan should be evaluated alongside the Corporate and Community Greenhouse Gas Emissions Inventory report. The baseline data and most recent report was completed in 2020 based on 2018 data which will be updated regularly to track progress toward the City's emission reduction goals.

This report also incorporates goals and data from the Corporate Energy Management Plan that measures energy use at City facilities and set targets for energy reduction. Recommendations within this plan point to many other City documents that should be updated to include climate change as a criterion for decision making and should work with the Climate Change Action Plan to reach the emission reduction targets outlined herein.

2. List of Acronyms and Abbreviations

°C: Degrees Celsius
Ac: Acre
BAU: Business As Usual
BOMA: Building Owners and Managers Association
CAO: Chief Administrative Officer
CCAP: Climate Change Action Plan
CEMP: Corporate Energy Management Plan
CO_2: Carbon Dioxide
EV: Electric Vehicle
EPC: Energy Performance Contractor
FCM: Federation of Canadian Municipalities
FMS: Facilities Management and Security Department
GHG: Greenhouse Gas
Ha: Hectare
HPS: High Pressure Sodium
IEAP: International Emissions Analysis Protocol
IESO: Independent Electricity System Operator
Kg: Kilogram
Km: Kilometre
kW: Kilowatt
kWh: Kilowatt-hour
L: Litres
LEED: Leadership in Energy and Environmental Design
LED: Light Emitting Diode
m^3: Cubic Metres
mm: Millimetres
RCP: Representative Concentration Pathway
SL/TS: Streetlights/Traffic Signals
Sq.: Square
SUV: Sport Utility Vehicle
T: Tonnes (metric)
W/WW: Water/Wastewater
Yr: Year

3. Causes and Impacts of Climate Change

Climate change is a result of increased greenhouse gas (GHG) emissions (carbon dioxide, methane, nitrous oxide, etc.) trapping heat in the earth's atmosphere. The GHG with the highest concentration in our atmosphere is carbon dioxide (CO_2) and for this reason, greenhouse gases are often simply referred to as carbon emissions. Both terms are used in this report to refer to the greenhouse gases leading to climate change.

The primary source of GHG emissions globally is the burning of fossil fuels (gasoline, oil, natural gas, propane, diesel, coal, etc.), but there are other sources of these gases as well (landfills, livestock, deforestation, etc.). Fossil fuels are the main target of this plan, but it also addresses landfill emissions.

The Paris Climate Agreement signed in 2015 between 195 countries, including Canada, set a target of no more than 2°C increase from pre-industrial levels, and an aspirational target of no more than 1.5°C. The difference between a global temperature increase of 1.5°C and 2°C is significant and global efforts are required to ensure that global temperatures do not increase more than 1.5°C. [1]

Climate change is already causing an increase in global average temperature which has led to visible consequences in global weather patterns and extreme weather events. The average temperature across Canada has already risen 1.7°C and as much as 2.3°C in northern Canada.[2] The work done to reduce greenhouse gas emissions now will determine the extent of the impact for future generations. With careful planning and efforts to reduce GHG emissions globally, the worst outcomes predicted in climate modelling can hopefully be avoided. Climate change has already and will continue to cause melting glaciers and ice caps, rising sea levels, warmer year round temperatures, more extreme weather events (such as floods, hurricanes, droughts, heat waves, wildfires, etc.), millions of climate refugees, bleaching of coral reefs, melting of permafrost and more.

Emission reductions must be made at all levels of government until we live in a carbon neutral world. This means balancing remaining carbon emissions with an equal amount of carbon sinks (trees, wetlands, carbon capture technologies, etc.) until the result is net-zero carbon emissions.

[1] *Intergovernmental Panel on Climate Change. (2018). Global Warming of 1.5°C.*

[2] *Government of Canada. (2019). Canada's Changing Climate Report.*

3.1 Climate Change in Brantford

The impacts of climate change are already visible in Brantford as well. The City is experiencing increasing temperatures, increasing rainfall and more frequent flooding. These impacts will continue to change and increase as estimated in the table below for the years 2050 and 2080. The table shows two scenarios: RCP (representative concentration pathway) 4.5 is a scenario where we reduce GHG emissions starting now and the RCP 8.5 scenario is one where we continue to emit GHGs at the same pace as today. Additional information from the predicted climate change impacts for Brantford can be found in Appendix A.

Table 1: Modelled climate scenarios for the City of Brantford[3]

	2050		2080		Average in 2018
	Reduced Emissions (RCP 4.5)	Current Rate of Emissions (RCP 8.5)	Reduced Emissions (RCP 4.5)	Current Rate of Emissions (RCP 8.5)	
Average annual temperature	9.9°C	10.1°C	10.9°C	12.2°C	7.8°C
Max temperature	36.3°C	37.0°C	37.7°C	39.6°C	33°C
# of very hot days (>30C)	33	36	45	63	10
# of tropical nights (Min temp >20C)	13	15	20	34	3
# of Frost Free Days	185	188	193	211	160
Annual precipitation	910 mm	922 mm	934 mm	947 mm	882 mm
Max 1 day rainfall	42.0 mm	45.4 mm	44.9 mm	53.4 mm	35 mm
# of heavy precipitation days (>10 mm)	29	31	29	31	27

[3] *Prairie Climate Centre. (2018). Climate Atlas of Canada, Municipality: Brantford. Retrieved March 23, 2020 from www.climateatlas.ca.*

4. Brantford GHG Emissions Inventory and Forecast

4.1 Current Status of Greenhouse Gases in Brantford

Corporate greenhouse gas emissions were calculated in 2018 for all municipally owned and operated assets including buildings, fleet, water and wastewater treatment and delivery infrastructure, and street lights/traffic signals. Emissions from the landfill were calculated and included in the community emissions inventory for total emissions production, but will be discussed within both the Corporate and Community Climate Change Action Plans for emission reduction strategies. Emissions were calculated from records of consumption of natural gas, electricity, diesel and gasoline across all departments.

The table below provides a summary of the 2018 corporate emissions. This data is illustrated in the charts below to show the relative emissions from each sector at the City and to show the relative breakdown of the types of fuels that are responsible for the emissions.

Emissions are measured in T of CO_2 eq., which means "metric tonnes of carbon dioxide equivalent". Emissions from burning fossil fuels are not exclusively carbon dioxide; they also contain small amounts of methane and nitrous oxide and trace amounts of other greenhouse gases. Each gas has different strengths as a greenhouse gas, so these are multiplied by the appropriate intensity factor and then converted to the equivalent strength for carbon dioxide and referred to as carbon dioxide equivalent (CO_2 eq.). More information on how this is calculated can be found in the City of Brantford Corporate and Community Greenhouse Gas Emissions 2018 Inventory.

Table 2: Results of 2018 Corporate Greenhouse Gas Emissions Inventory

	Electricity (kWh)	Elec Emiss. (T CO_2 eq)	Natural Gas (m^3)	NG Emiss. (T CO_2 eq)	Total Emiss. (T CO_2 eq)
Buildings	25,148,163	435	33,28,934	6,323	6,758
Streetlights/ Traffic signals	7,591,073	131	-	-	131
Water/Wastewater	18,567,309	321	454,894	864	1,185
	Gas (L)	Gas Emiss. (T CO_2 eq)	Diesel (L)	Diesel Emiss. (T CO_2 eq)	Total Emiss. (T CO_2 eq)
Emerg. Serv. Fleet*	364,756	872	69,004	180	1,053
City Fleet	474,545	1,098	1,670,447	4,683	5,782
Total Corporate Greenhouse Gas Emissions					**14,909**

** Includes Fire, Police and Ambulance*

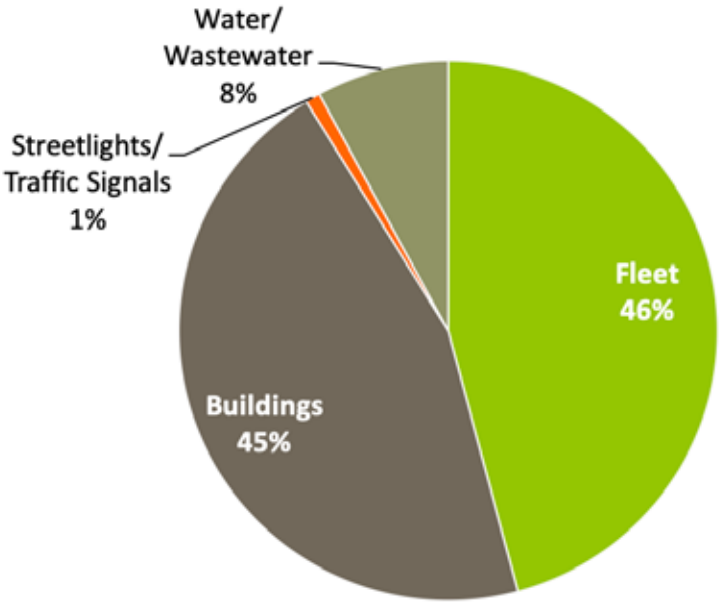


Figure 1: Greenhouse gas emissions for the Corporation of the City of Brantford by usage category

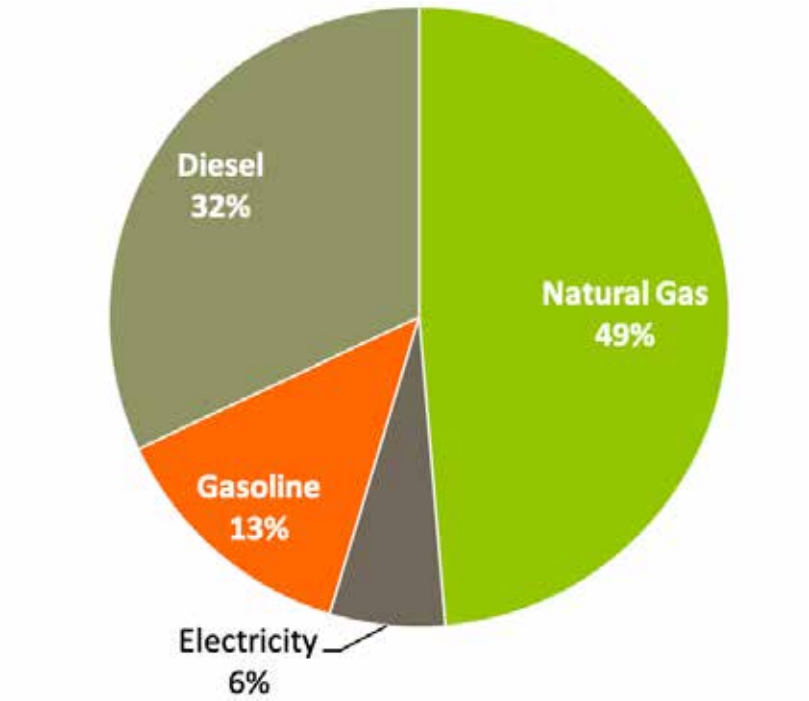


Figure 2: Greenhouse Gas Emissions by fuel type across all assets owned and operated by Corporation of the City of Brantford

4.1 Projected Emissions for "Business as Usual" Scenario

Brantford is a quickly growing city and population estimates indicate that the City could become home to an additional 60,000 people by 2041. If emissions continue to grow relative to city population growth without any mitigating factors, this would be considered the "business as usual" (BAU) approach. In the chart below, the estimated population growth is shown out to 2041 (this is the latest population growth as estimated at this time). Emissions are shown both for the BAU scenario where no mitigation action is taken and also shows the emissions if the reduction targets are met. The wedge between the two lines is the emissions reduction work required to address growth and meet the emission reduction targets in order to stay below the 1.5°C temperature increase limit.

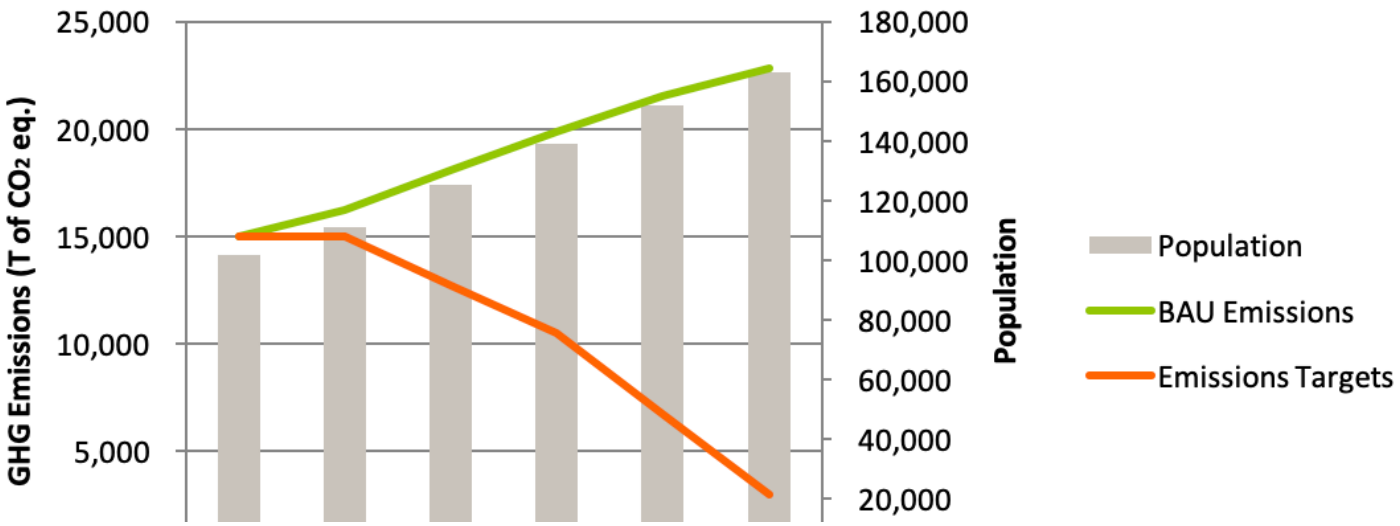


Figure 3: Estimated population growth of Brantford showing expected emissions from business as usual (BAU) approach versus emissions with mitigation efforts to meet defined targets

Section II
EMISSIONS REDUCTION TARGETS AND STRATEGY

5. Reduction Targets

A long term target was set by Council in December 2019 within the Climate Emergency Declaration. Council agreed, in principle, to a municipal target of net-zero carbon emissions by 2050 for both the Corporation and the community. This long term target provides an end goal for the development of the Climate Change Action Plan, but interim targets are necessary to ensure that the City remains on track to reach that long term goal and to provide more tangible targets for City planning in the interim.

The targets identified below have been established by mapping out the emissions reductions possible as a result of the short, medium and long term actions. Educated estimations were made for the emissions reductions for each strategy and are illustrated below. Targets were identified from the consolidation of all of the emissions reductions possible across the Corporation from the proposed actions identified in this report.

.

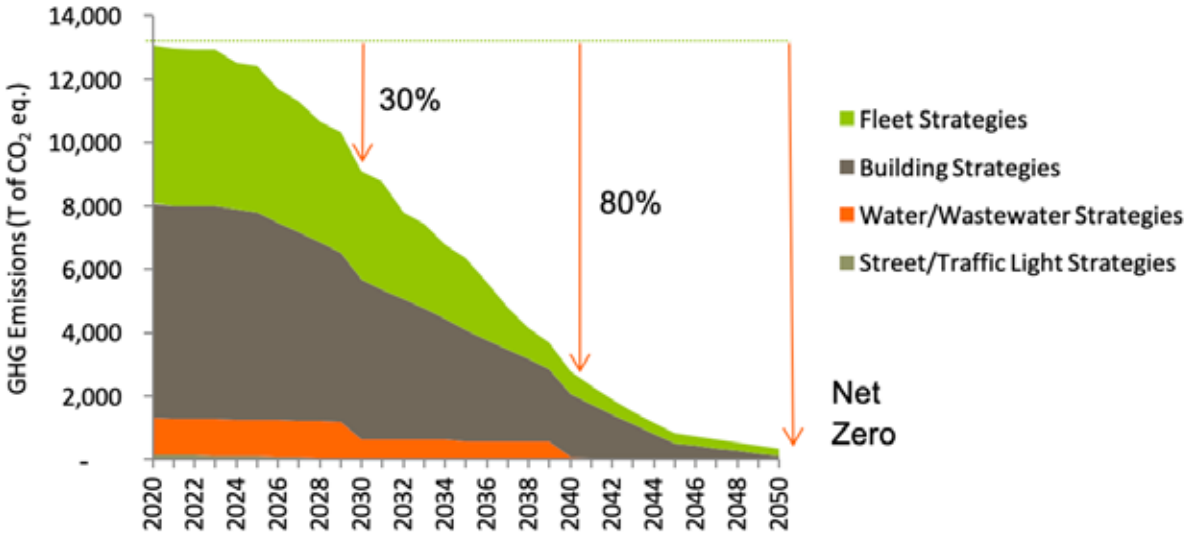


Figure 4: Emission Reduction Strategies to 2050 with Reduction Targets

Emission reduction targets are measured from the 2018 emissions levels explained in detail in the City of Brantford Corporate and Community Emissions 2018 Inventory Report. The figure on next page outlines the target as a percentage reduction from that 2018 level along with the actual volume of GHG emissions targeted for that year.

Interim target years of 2030 and 2040 have been chosen to provide regular and equally spaced targets between now and the end goal of 2050. Ten year timelines allow for the City to feasibly plan the short and medium term goals ahead into strategic plans, capital plans and other policy documents.

The 2030 target is a 30% emissions reduction. This target aligns with the federal government's target for emission reductions across the country of 30% by 2030. The 2040 target is 80% emissions reduction. This is ambitious, but achievable if climate action is prioritized. This interim target will put the City in a good position to reach the next and final goal. The 2050 goal is to target net-zero emissions as outlined in the City's Climate Emergency Declaration. This goal aligns with the IPCC's recommendation to reach net-zero emissions by 2050 in order to avoid average global temperatures rising by more than 1.5°C.

Table 3: City of Brantford Corporate GHG Emission Reduction Goals

2030	2040	2050
30%	80%	100%
Target emissions measurement (T of CO_2 eq)		
9,100	2,610	Net 0

It is important to note that these targets are referring to net emissions, which is calculated by totalling all emissions produced and subtracting all emissions offset through strategies such as absorption from trees and other vegetation, carbon capture technologies, purchasing carbon offsets, producing excess renewable energy generation, etc. This is referred to as net-zero carbon or carbon neutral. This concept is illustrated below.

Figure 5: Net-Zero Carbon Emissions illustrated

6. Emissions Reductions Ethos

Much like the "reduce, reuse, recycle" ethos for waste reduction, the "reduce, improve, switch" ethos for emissions reduction is a guideline for reducing energy consumption and emissions. The order of the steps is intentional. The most effective approach in transitioning to a low-carbon community is to first reduce the amount of energy needed as much as possible through energy conservation (Reduce), then to improve the amount of work being done with that energy by increasing energy efficiency (Improve), and finally to switch to low carbon fuel sources to supply the remaining demand (Switch).

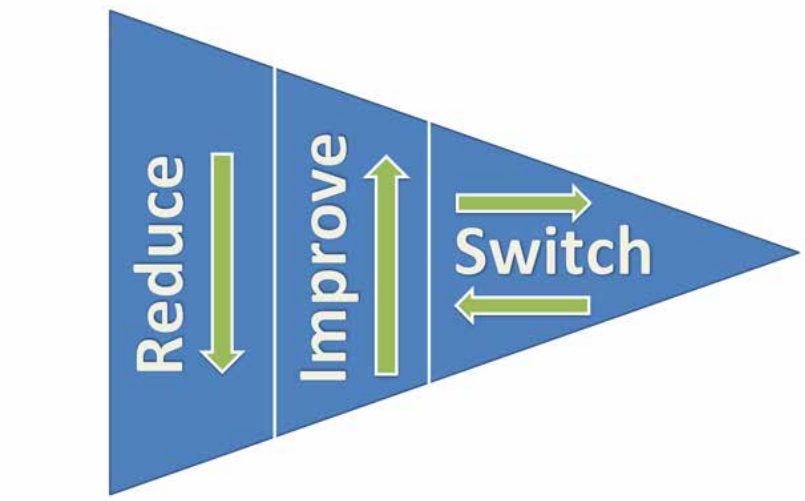


Figure 6: Emissions Reduction Ethos

Reduce → Reduce the amount of energy used daily. This can involve habit changes such as walking somewhere instead of driving or turning off lights when you leave the room. It can also be a product of planning such as route planning for buses to reduce unnecessary kilometres. Energy is also reduced by insulating buildings so internal temperatures are more easily maintained. Reducing energy usage as much as possible first, saves having to address it (and pay for it) in the following two stages.

Improve → Improve the efficiency of the work that is being done to make the required energy have greater effects. Examples of how this can be done are buying more energy efficient appliances, furnaces and boilers, buying more fuel efficient vehicles, or replacing traditional light bulbs with LEDs.

Switch → Switch the source of the remaining energy required to a clean source of energy that doesn't use fossil fuels or produce GHG emissions. Clean energy sources include electricity (depending on the province), solar, geothermal, wind, renewable natural gas, waste heat recovery, etc.

Section III
CORPORATE EMISSION REDUCTION TOOLS

7. Corporate Emissions Reduction Strategy

The emissions reduction strategy presented below is a result of extensive internal consultation with City departments and research on the latest tools and initiatives being undertaken at other municipalities around the world. The plan uses the Reduce, Improve, Switch ethos to identify the order in which strategies are implemented. The main goal of the strategy below is to reduce the overall consumption of fossil fuels and associated GHG emissions through conservation, optimization, and fuel switching.

This strategy will evolve and change over time as technologies, priorities and resources change. For this inaugural version of the Climate Change Action Plan, many of the action items involve creating policies or plans to guide the City through a complex process, such as retrofitting all the municipally owned buildings to be net-zero or to increase waste diversion. Once these policies are established and others have been updated to reflect the emission reduction goals, actions will become more tangible and progress will become more visible. This may result in a slower start with emissions reductions increasing over time. But the City is already working toward these goals in a visible way by transitioning to electric fleet vehicles and installing LED street lights. The City needs to make progress on both strategic plans and physical improvements to both direct and inspire City staff and the community.

Below is an overview of the action items identified as part of this Plan. The rest of the section will elaborate on the details of these tools, what is currently in place and how and when each tool can be implemented.

7.1 Overview of Corporate Action Items

Actions within this report have been broken into the following periods for implementation:

- Short term 2020-2025
- Medium term 2026-2035
- Long term 2036-2050

The tools listed in the table below are consolidated from the sector specific sections that follow. Tables are also presented within the relevant section that details the action items associated with that sector only. For example, all actions associated with fleet emissions reductions are also included in the Fleet specific section of the report.

The table on the next page provides all of the actions identified for the Corporation as a whole to understand the entire scope of the action plan. Actions are organized by priority items first and then by initiation date for tools that will require staff and financial resources within that term. Not every action is proposed to be initiated and completed within the same implementation period. Some of the ongoing work that does not require additional resources, but simply maintained efforts are categorized as long term actions.

Table 4: Corporate Actions for Emissions Reduction

Sector	Action	Initiate	Complete
Short Term Priorities			
Fleet	Convert Light Duty Autos to electric	In progress	2027
Buildings	Green Building Standard	2021	2023
Fleet	Convert Transit Bus Fleet to electric	2021	2038
Buildings	Building Retrofit Strategy	2023	2025
Waste	Initiation of organic waste diversion program	2023	2025
Corporate	Tree Canopy Expansion	In progress	2050
Short Term			
Fleet	Optimizing Fleet (incl. right-sizing and vehicle sharing)	In progress	2022
Streetlights	Convert HPS bulbs to LED	In progress	2030
W/WW	Water conservation programs	In progress	2050
Waste	Waste reduction education and community engagement	In progress	2050
Corporate	Climate Lens Assessment Tool	In progress	2022
Buildings	Energy Efficiency Workplace Training	2021	2022
Fleet	Anti-idling Policy	In progress	2022
Fleet	Prepare Plan for Emergency Services Fleet Emissions Reduction	2021	2022
W/WW	Smart water meters on all municipal buildings	2021	2025
Corporate	Corporate Policy Review	2021	2025
Fleet	Route Planning (incl. Site Planning)	2021	2025
Buildings	Building Operation and Maintenance Standard	2022	2023
Fleet	Energy Efficiency Driver Training Program	2022	2024
W/WW	Wastewater reduction programs	2022	2050
Corporate	Climate Change Adaptation Plan	2023	2025
W/WW	Stormwater reduction programs	2023	2050
Fleet	EV sharing pilot project	2024	2025
Medium Term			
W/WW	Retrofit wastewater treatment plant	2026	2030
Fleet	Convert Light Duty trucks to electric or other low emissions option	2026	2035
Buildings	Retrofit min. 50% of City buildings	2026	2035
Fleet	Convert outstanding equipment to electric where available	2026	2035
SL/TS	Evaluate technological solutions to reduce energy consumption	2030	2035
W/WW	Renewable energy options for treatment plants	2030	2035
Long Term			
W/WW	System Infrastructure improvements	In progress	2050
Buildings	Reimagining the workplace	In progress	2050
SL/TS	Evaluate options for renewable energy electricity sources	2036	2040
W/WW	Retrofit water treatment plant	2036	2040
Fleet	Convert heavy duty fleet to low emissions options where available	2036	2050
Buildings	Retrofit remaining City buildings	2036	2050

Abbreviations: W/WW = water/wastewater, SL/TS = streetlights/traffic signals

7.2 Priority Actions to 2025

Six priority projects have been identified to be the focus of Climate Action at the City of Brantford for the first five year period of this Plan. The action items listed below were selected as priorities because each will have a large impact on emissions output over the long term, require early initiation to reach the desired outcome, and include ideas and technologies that will be long term solutions.

Each of the below strategies are described in more detail in the specified section below, but are highlighted here to emphasize the importance of these actions to the overall Climate Change Action Plan.

1. Transition to EV Light Duty Fleet — Page 22
2. Develop Green Building Standard — Page 32
3. Initiate Transition to EV Transit Buses — Page 27
4. Develop Building Retrofit Strategy — Page 33
5. Initiate Organic Waste Diversion — Page 43
6. Tree Canopy Expansion — Page 46

7.3 Fleet

7.3.1 CURRENT STATUS OF CITY FLEET

The Corporation of the City of Brantford fleet is comprised of more than 450 vehicles at the time of writing this report. The majority are owned by the Corporation for use by various City departments, but both ambulance services and garbage and recycling collection are managed by third parties.

The chart below shows the different uses of the vehicles (incl. the third party vehicles). The Parks department includes golf operations, cemetery maintenance, arena operations, parks and sports field maintenance, forestry, and horticulture, etc. Operational Services includes road maintenance, snow clearing, street cleaning, traffic control, etc. Emergency Services includes Fire, Police and Ambulance.

With such a wide array of vehicles and functions, the Corporate fleet is constantly changing and provides plenty of opportunity for emissions reduction strategies.

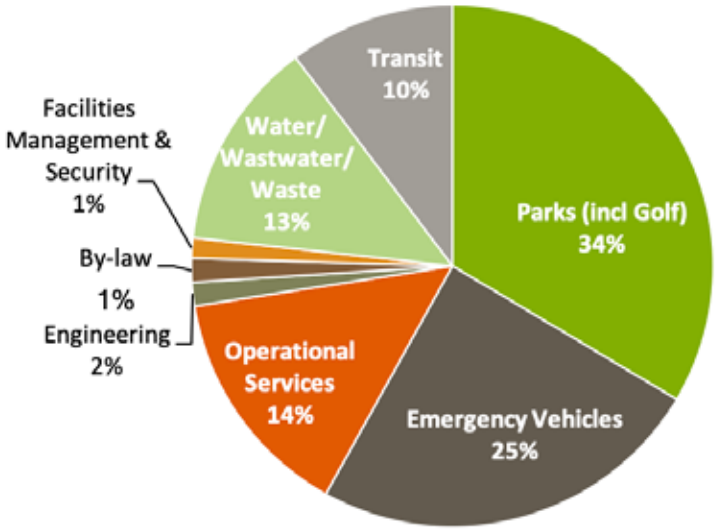


Figure 7: Vehicles per City department

The type of vehicle is also an important factor in determining strategies for emissions reduction. The figure below illustrates the percentage of vehicles by type across the Corporation excluding emergency vehicles. "Light duty auto" includes cars, Sport Utility Vehicles (SUVs) and minivans. "Light duty truck" includes pickup trucks and cargo vans. "Heavy duty" includes any on-road vehicle with a registered gross vehicle weight over 4500 kg such as some pickup trucks, dump trucks, street sweepers, etc. "Bus" includes Lift and Transit buses. "Off-Road" includes tractors, construction equipment, mowers, etc.

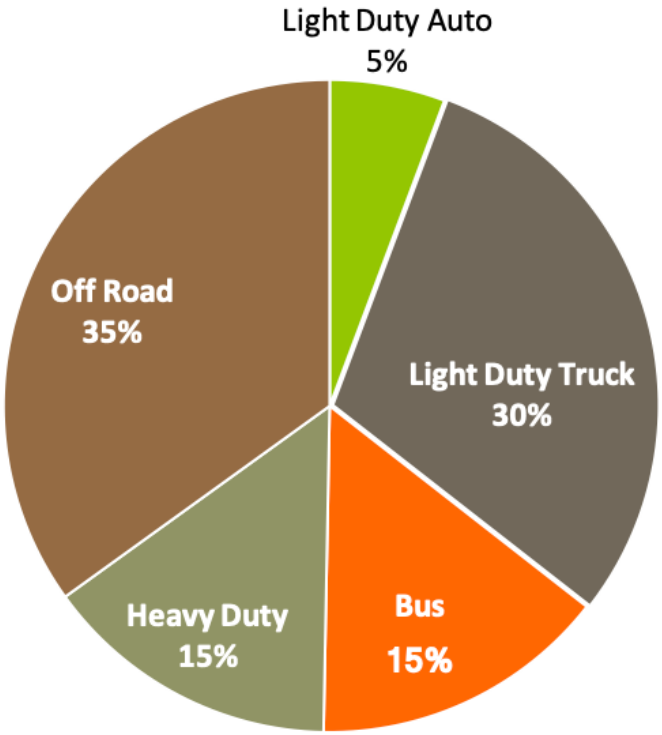


Figure 8: Vehicles by type excluding emergency vehicles

Almost all light duty autos, light duty trucks and Brantford Lift buses run on gasoline and the majority of heavy duty vehicles and Transit buses run on diesel. Off-road vehicles are a mix. The City currently owns two electric light duty auto vehicles.

When targeting emissions reduction in fleet planning, gasoline use and diesel use produce a fairly similar emissions output and both yield much higher emissions than electric vehicles. For this reason, switching away from gasoline and diesel fueled vehicles will be a primary focus of the fleet emissions reduction strategy. See the figure on next page for a comparison of emissions from fuel type equalized to show fuel required for 1 kWh of work.

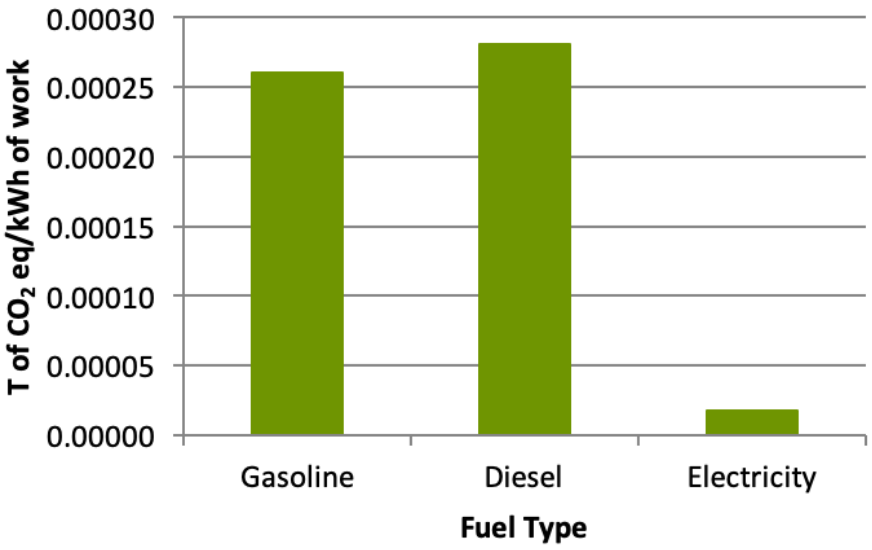


Figure 9: Emissions per kWh of work for fuel options

The above emissions inventory and breakdown includes emergency service vehicles including ambulance, fire and police; however, emergency services are not included as part of the emission reduction strategies provided below. Discussion will be initiated with the emergency services departments in 2021 to establish strategies to reduce emission from emergency vehicles.

The City Fleet is managed by the Fleet Services department includes all vehicles for operational services, transit, specialized buses, parks maintenance, water and wastewater maintenance, waste, other city business, etc., but not emergency vehicles. Corporate Fleet includes all City vehicles and Emergency Services. Police fleet and Fire fleet are managed within their own departments.

7.3.2 EMISSIONS REDUCTION STRATEGIES FOR CITY FLEET

The general strategy for reducing emissions from fleet vehicles follows the principle described in section 6; reduce, improve, switch. Firstly, through planning and other optimization strategies, the City should aim to optimize the fleet by reducing the number of vehicles and fuel consumed. Secondly, the City should improve the efficiency and reduce emissions ratings of the existing vehicles by using smaller vehicles where possible or cleaner emissions systems. Lastly, the City should switch fuel sources to electricity or other lower emission fuels where possible.

Table 5: Emissions Reduction Tools for City Fleet

Tool	Applicable to	Start By	Complete By	Lead Department
Short Term Goals (2020-2025)				
Optimizing Fleet (incl. right-sizing and vehicle sharing)	All depts. with vehicles	In progress	2022	Fleet Services
Convert Light Duty Autos to Electric	All depts. with light duty auto	In progress	2027	Fleet Services
Anti-idling Policy	All depts. with vehicles	In progress	2022	Fleet Services
Work with Emergency Services to prepare plan for Fleet Emissions Reduction	Emergency Services	2021	2022	CAO's office
Convert Transit Bus Fleet to Electric	Transit Services	2021	2038	Transit and Fleet Services
Energy Efficiency Driver Training Program	All depts. with vehicles	2022	2024	Fleet Services
Route Planning (incl. Site Planning)	Public Works	2021	2025	Public Works, Facilities Management & Security
Electric Vehicle Sharing Pilot Project	City Wide	2024	2025	Fleet Services
Medium Term Goals (2026-2035)				
Convert Light Duty Trucks to Electric or other low emissions option where available	Depts. with light duty trucks	2026	2035	Fleet Services
Convert Outstanding Equipment to Electric where available	Depts. with equipment	2026	2035	Fleet Services
Long Term Goals (2036-2050)				
Convert Heavy Duty Fleet to Low Emissions Options where available	Depts. with heavy duty vehicles	2036	2050	Fleet Services

Reducing Fuel Consumption

Fleet Optimization

Fleet optimization takes a high level view of the City wide need for and use of vehicles across departments. This process will look for opportunities to reduce the number of vehicles, size of vehicles and ensure the right size of vehicle is used for the job. The Fleet Services department implemented a process for identifying the appropriate vehicle for the job in 2018 with the use of the "Assessment to Right Size Fleet Vehicles" form. This is completed annually during departmental review with Fleet Services and as vehicle and equipment needs arise. Continued use of this process will help to understand the function, seasonality, and expected mileage of each vehicle to be able to recommend the most appropriate vehicle with the lowest environmental impact and cost for the job. This also allows for a clearer picture of the seasonal use of the vehicles to allow vehicle sharing between departments if there is opportunity to do so.

Fleet optimization provides the opportunity to reduce emissions by replacing light duty autos (cars, SUVs and minivans) and light duty trucks (pick-up trucks, cargo vans) with smaller vehicles that have a viable electric alternative. This has been undertaken by Fleet Services in some cases already through eliminating vehicles with low mileage or replacing SUVs with sedans or large pickup trucks with compact pickup trucks where it is feasible to do so.

Increased vehicle sharing within or between departments can be assessed for all vehicle types and equipment. There may be instances of vehicles that are only used occasionally by multiple departments, especially heavy duty vehicles, where the opportunity for sharing that vehicle type would be appropriate. This reduces the need for a second vehicle of that type, which saves capital costs, maintenance costs and the emissions associated with a second vehicle. Consideration of this type of vehicle sharing is already underway by the Fleet Services department. Examples of this type of approach can be seen between the Parks Services and Golf Operations where equipment is used by Golf Operations during the golf season and used by Parks Services over the winter for snow clearing or other work. Other departments will share specific equipment if it is only needed occasionally, like Operational Services and Environmental Services. Vehicle sharing would be more easily facilitated if fleet vehicles were centrally located or located at more concentrated "hubs" across the City. This type of facilities planning is addressed more in the Route Planning section below.

Fleet Services will continue to watch the market for electric vehicles available and expected to arrive on the market in the near future. It will also be necessary to look for new ways to do the required work where electric options aren't yet available, such as using a new type of vehicle, or other alternatives.

Anti-Idling Policy and Pilot

Vehicle idling often creates unnecessary fuel consumption and emissions. City Fleet vehicle idling should be reduced wherever possible to easily eliminate emissions and fuel consumption that has no benefit. An anti-idling policy is recommended for City vehicles that would limit idling to a certain length of time (i.e. 3 mins) and restrict idling beyond that to certain conditions. Exceptions will be made for conditions that require idling, such as hot or cold outside temperatures that require the vehicle to have the climate control system on, use as a mobile work station, or due to the need to have lights or other equipment that require the vehicle to be running. Even with the exceptions noted, it is expected that an anti-idling policy would reduce fuel consumption and emissions. An anti-idling policy should be implemented along with training for vehicle drivers to explain the purpose and intent of the policy. Fuel and emission savings should be monitored to understand the impact and emissions savings of the reduced idle time which will help lead to the success of the implementation of such a policy. Staff resources dedicated to both driver training and analysis of the fleet's efficiency and performance metrics would benefit this strategy.

Anti-idling technology can also be implemented to control idle time which may be of benefit for vehicles with long operational hours. This type of technology would shut off the engine after a certain number of minutes of idle time. The Fleet Services department is investigating options at this time and plans to pilot this type of technology on Brantford Lift buses in 2021. If this pilot proves successful in reducing idling time and saves fuel costs, emissions and increases the lifetime of the vehicle, this technology can be considered for implementation on other City vehicles.

Energy Efficient Driver Training

Fuel consumption can be reduced simply by adopting fuel efficient driving habits such as reducing speed, maintaining a steady speed, slowing acceleration, coasting to decelerate, etc.

Providing training for City staff that drive fleet vehicles regularly could save fuel costs and emissions. Driver training can be provided by a dedicated internal driver trainer, a contract trainer or can be done independently through online training modules.

Specific vehicle training should be provided for employees that operate vehicles with larger emissions to achieve greater impact, specifically Transit and Lift operators.

Annual refresher courses should be provided to remind drivers of these simple strategies to work toward the City's emissions goals.

Staff resources dedicated to both driver training and analysis of the fleet's efficiency and performance metrics would benefit this strategy.

Route and Site Planning

Route planning for vehicles that use regular routes such as Transit buses, snow plows, garbage trucks, etc. should be reviewed for efficiency. An assessment of the route for distance travelled versus level of service can be undertaken and adjusted where appropriate. This could reduce unnecessary kilometres travelled, fuel consumption and emissions.

Site planning for municipal yards should also consider optimizing route planning for municipal vehicles when identifying locations of satellite yards for refueling, refilling materials, dumping snow, etc. This could again reduce travel distance, fuel consumption and emissions.

Fuel Switching

After the above tools have been implemented to reduce unnecessary mileage, fuel use and number of vehicles, fuel switching can be considered. Fuel switching refers to the use of different sources of energy that have a lower emissions rating. Discussion with Fleet Services identified a strong desire to transition to electricity instead of other alternatives such as natural gas, biofuel, or hydrogen. Aside from hydrogen (which is not widely available enough to be an option at this time), electricity has the lowest emissions rating. Natural gas will reduce the amount of emissions by approximately 30%, but it will not transition the City to zero carbon emissions, therefore it is considered an interim solution and comes with significant up front cost for conversion and fueling stations. Biodiesel is a renewable fuel produced from plant products and can be mixed with traditional diesel to reduce the emissions rating. Currently the City uses a fuel mix for diesel engines of 5% biodiesel and for gasoline engines, 10% ethanol. This is considered an interim solution and comes with some increased fuel and maintenance costs. At this time, the focus will be to convert as much of the fleet as possible to electric vehicles where the technology exists. This area of alternative fuels for vehicles is a rapidly changing market and Fleet Services will continue to watch as the technology develops to determine what can be utilized for the City Fleet to reduce emissions.

Converting Light Duty Autos to Electricity

At this time, the City Fleet is approximately 6% light duty auto vehicles which is 17 vehicles. As noted above, this number does not include vehicles from police or fire. The table below describes the composition of the light duty auto fleet as it exists in Q4 2020.

Table 6: Current City of Brantford Light Duty Fleet

Vehicle Type	Fuel Type	# of vehicles
Sedan	Electricity	2
SUV	Gasoline	10
Minivan	Gasoline	2
Cargo Minivan	Gasoline	3
Total		17

The light duty autos, described in the table above can be switched over to fully electric vehicles or hybrid or electric vehicle alternatives and provide the same level of service. In Canada there are nearly 20 fully electric light duty auto vehicles that fall within the $30,000 to $60,000 price range. This price range includes small cars up to mid-size SUVs with a mileage range of 100 km to 400 km per charge and could directly replace 10 of the gas-powered light duty auto vehicles to bring the light duty auto fleet to 70% electric.

Hybrid options exist for some of the other light duty auto vehicles, such as minivans, but these are not due for replacement until 2027, so Fleet Services will continue to monitor the market for fully electric options. There are alternative vehicle types that are available as electric that could replace cargo vans and possibly some pickup trucks, but more research is required before moving forward with this option.

Capital costs are still higher for electric vehicles than they are for traditional gas powered vehicles, but fuel costs and maintenance costs are lower for electric vehicles. The typical life span of a light duty auto vehicle at the City of Brantford is 7 years. Lifecycle costs have been calculated for two EVs and two gas powered vehicles based on two years of operational data from Fleet Services. Annual fuel and maintenance costs have been equalized to assume an average of 10,000 km of use.

Table 7: Lifecycle costs for electric vs gas light duty autos

Vehicle make/model	Model Year	Vehicle Description	Purchase Cost (2018)	Annual Fuel Costs	Annual Maintenance Costs	Life Cycle Cost (7 year lifecycle)
Nissan Leaf	2018	electric compact car	$38,317	$150	$67	$39,833
Ford Focus	2018	electric compact car	$37,990	$200	$200	$40,790
Hyundai Elantra	2018	gas compact car	$18,100	$950	$300	$26,850
Chevrolet Equinox	2018	gas compact SUV	$22,835	$834	$385	$31,359

Emissions were calculated for both the electric vehicles in the fleet and two of the common gasoline light duty autos for greenhouse gas emission contributions. Fuel efficiency figures were based on city driving statistics. Emissions were calculated based on an approximate average distance driven of 10,000 km/year. As shown in the table, electric vehicles reduce GHG emissions by 99.8%.

Electric vehicles still produce some emissions because the Ontario electricity grid, while a very low emissions output, still produces emissions from the natural gas powered generating stations.

To provide some context for the figures presented below in Table 8, the gas powered vehicles produce approximately 2 tonnes of CO_2 eq. a year which is about the same as 83 bbq propane cylinders[4] or the amount of CO_2 absorbed by 92 mature trees a year.[5] The annual emissions from the electric car can be offset by planting 1 tree every 6 years.

Table 8: GHG emissions for electric vs gas light duty autos

Vehicle make/model	Model Year	Vehicle Description	Fuel Efficiency (L/100 km or Leq/100 km)	Annual Emissions (T of Co2 eq/yr)	Lifecycle emissions (T of Co2 eq/yr)
Nissan Leaf	2018	electric compact car	1.9	0.003	0.023
Ford Focus	2018	electric compact car	2.0	0.003	0.024
Hyundai Elantra	2018	gas compact car	8.3	1.915	13.404
Chevrolet Equinox	2018	gas compact SUV	9.2	2.122	14.857

[4]*Natural Resources Canada. (2020). Greenhouse Gas Equivalencies Calculator. https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/calculator/ghg-calculator.cfm*

[5]*Eastern Ontario Model Forest. (2020). Community Forest Carbon Offset Program. https://www.eomf.on.ca/programs/carbon-offsets*

The conversion to an electric light duty auto fleet is already underway with the two electric sedans already in operation within the Fleet. One of these vehicles is used for Transit Services support and the other vehicle is a staff stand-by vehicle for use by any department on an as-needed basis, but has been in use by the By-law department since April 2020. More staff should be made aware of this electric vehicle availability to reduce emissions from staff travel and become familiar with electric vehicles.

In general Fleet Services has seen good performance results over the first two years of operation of the electric vehicles. It is the recommendation of both the Fleet Services and the Climate Change Officer that the City continues to replace gasoline and diesel powered vehicles with electric vehicles where they are available.

Beyond purchasing the electric vehicles themselves, there are several other considerations that need to be evaluated when transitioning to an electric fleet.

- **Chargers:** With the conversion to electric vehicles, a network of charging infrastructure is needed at City owned facilities to allow for flexible and convenient charging of electric fleet vehicles. Depending on the vehicle type and amount of use, EV recharging may not be required every day, but possibly every 2 or 3 days. Chargers come as Level I, II or III; Level I is slow charging and Level III is fast charging. It is recommended that Level II chargers be installed for fleet vehicles. The cost of installing EV chargers varies depending on the physical work required to install it, but the Level II chargers themselves cost $3500-$5000 for the hardware. This cost can be split between vehicles if there are multiple vehicles sharing a charger.
- **Site Planning:** With electric vehicle use at the City, access to charging needs to be considered if vehicles don't always return to the same location every evening. The City has several yards and vehicle parking locations which adds complexity to vehicle sharing and charging.
- **Networking:** Chargers have the ability to be networked (connected to the internet), so that data on charger availability is visible to staff. This feature also allows the charger to be locked for certain types of use, such as fleet vehicles only between 8:30 am - 4:30 pm for example. It provides the ability to charge fees for battery charging if non-fleet vehicles are permitted to use the chargers.
- **By-law:** Rules around who can use the chargers, hours of use, access fees for chargers, and penalties for non-EVs parking in a charging spot would be required to be established through a municipal By-law.

Due to the rapidly changing market for electric vehicles, availability of vehicles, delivery time of vehicles, and price of vehicles will change significantly over the next several years. For this reason, Fleet Services has prepared a plan for conversion to electric fleet for the next three years based on technology that is available for purchase today.

The table below indicates the vehicles that could be converted to electricity that are due for replacement and have viable electric alternatives. The chart below shows vehicles of all types aside from buses. Two totals are provided; one for all vehicles included in the table and one for only the relevant light duty auto vehicles.

Table 9: Fleet vehicles eligible for replacement with EV for 2021-2023

Vehicle Description	Replace-ment year	Est. Gas Replace-ment Cost	Est. Electric Replace-ment Cost	Add. Funds Req'd	Vehicle Category	Lifetime Emissions Saved (T of CO_2 eq.)
Compact SUV	2021	$35,000	$60,000	$25,000	Light duty auto	13.97
Compact SUV	2021	$35,000	$60,000	$25,000	Light duty auto	13.97
Off Road Utility Vehicle	2021	$25,000	$60,000	$35,000	Off Road	Unknown
Ice Resurfacer	2021	$100,000	$150,000	$50,000	Off Road	Unknown
Ice Resurfacer	2021	$100,000	$150,000	$50,000	Off Road	Unknown
2021 Total All				$185,000		27.94
Total Light Duty Auto				**$50,000**		**27.94**
Compact SUV	2022	$30,000	$60,000	$30,000	Light duty auto	13.97
Compact SUV	2022	$30,000	$60,000	$30,000	Light duty auto	13.97
Cargo Minivan	2022	$40,000	$65,000	$25,000	Light duty auto	22.08
Cargo Minivan	2022	$40,000	$65,000	$25,000	Light duty auto	22.08
Compact Pickup Truck	2022	$40,000	$65,000	$25,000	Light duty truck	22.55
2022 Total All				$135,000		94.65
Total Light Duty Auto				**$110,000**		**72.10**
'21-'23 Total All Vehicles		$570,000	$975,000	$405,000		173.09
Total Light Duty Autos		**$270,000**	**$490,000**	**$220,000**		**127.98**

The previous table plan addresses 8 light duty auto vehicles ready to be converted to EV. There are 2 EVs already in the light duty auto fleet which are due for replacement in 6 years. There remains 7 gas powered light duty autos remaining in the fleet not addressed in the above strategy. These remaining gas powered vehicles are not yet due for replacement and will be analyzed for cost and conversion to EV in 2023 as the market may have changed by that time. The table below summarizes the type of vehicles and replacement year for the light duty auto fleet for those vehicles requiring replacement between 2024 and 2027 which includes the 7 unaddressed gas vehicles and the 2 EV sedans. If the below vehicles are replaced with electric vehicles as they come due for replacement, the light duty auto fleet would be fully electric by 2027.

Table 10: Light duty autos requiring replacement beyond 2023

Vehicle Type	Replacement year	# of vehicles
Compact SUV	2025	1
	2027	3
EV Sedan	2026	2
Minivan	2027	2
Cargo Minivan	2027	1

Fleet Services supports and recommends replacing light duty autos with electric alternatives as they come up for replacement and if funding is available for the additional capital costs. Currently these vehicles have 1-7 years left on their replacement schedule and could be replaced with EVs when the vehicle is due for replacement. If the gas powered vehicles can be reallocated somewhere else within the City to replace a less fuel efficient option, this replacement schedule could be expedited.

By 2023, the EV market may have expanded enough to extend the EV fleet conversion to electric pick-up trucks, minivans and others. This is a market that is rapidly changing and becoming more competitive every year. Fleet Services will continue to monitor this market to ensure they have up to date information with regard to availability of new electric products to replace gasoline and diesel vehicles.

Paired with the Fleet Optimization process that is also underway to better understand the use of the vehicles, there may be instances where an electric car with a daily range of up to 400 km would suffice instead of a more expensive electric SUV or even a gas powered pick-up truck. Fleet Services will consider switching to electric vehicle options wherever possible beyond just replacing existing gas powered cars and SUVs with EV cars and SUVs. Small utility vehicles and small tractors are becoming available as electric and should be considered when available.

.

Converting Transit Buses to Electricity

Transitioning to electric buses will be an important part of the decarbonisation process for the City. Buses (Lift and Transit) make up 15% of the fleet in terms of number of vehicles, but Transit buses alone contribute approximately 40% of total emissions from the City fleet. Switching to electric buses would reduce the emission from the tail pipe but there are still emissions produced through the production of the electricity required to charge the buses. Although it doesn't completely eliminate emissions, it is expected to be a 94% reduction in emissions from diesel Transit buses.

Electric buses not only produce significantly fewer emissions than diesel or hybrid buses, but they are also better for local air quality and street noise. Electric buses are quieter, cleaner and better for the local environment.

There are a several questions that the City needs to ask before converting to electric buses and a feasibility study is the appropriate first step. It will be necessary to understand the different types of electric transit systems and charging infrastructure required to be better able to identify the most appropriate and efficient system for Brantford. Charging electric buses will require a significant amount of electricity and electrical infrastructure at the Transit Service Centre and/or Transit Terminal will need to be evaluated. Transit and Fleet Services plan to begin this feasibility study in 2021.

Charging electric buses can be done either at one location overnight or along the route, depending on the system of electric bus chosen. Route planning and modelling will be required to determine what is best for the Transit system in place in Brantford. This analysis also needs to factor in expected growth of the transit system.

Once the feasibility study is complete and the appropriate charging infrastructure is installed, the City can begin to transition to electric buses. Regardless of the system chosen, the Transit fleet can transition to electric buses gradually as buses are required to be replaced. It is anticipated that the bus fleet could be fully electric by 2038.

7.4 Buildings

7.4.1 CURRENT STATUS OF CITY BUILDINGS

The Corporation of the City of Brantford owns approximately 100 buildings throughout the City that fulfil a wide variety of needs including work, residence, play and utility. These buildings are of various ages, construction types, purposes and states of repair. Because we spend so much time in buildings as a Corporation and a community they become a major source of energy consumption and contribute nearly 46% of all emissions produced by the Corporation.

These buildings are managed by several different departments within the City, making it challenging to establish a consolidated approach to building management. Within the Corporation, buildings are managed by the Facilities Management & Security department for administrative buildings, Farmers' Market and Airport; Community Housing department for subsidized housing; Fire department for fire stations; Public Works Commission for recreation and community centres, water and wastewater buildings, transit, operational services and others. There are also smaller groups of buildings or single buildings with their own management such as the libraries, Police and the Sanderson Centre.

The graph below shows the relative number of buildings per department. The single buildings mentioned above are grouped into the Facilities Management & Security department. Community housing numbers do not reflect the number of units managed but the numbers of buildings owned and operated; many are multi-unit residential buildings. In total, this pie chart represents 96 buildings. It does not include water and wastewater treatment plants which are discussed in a section specific to that use.

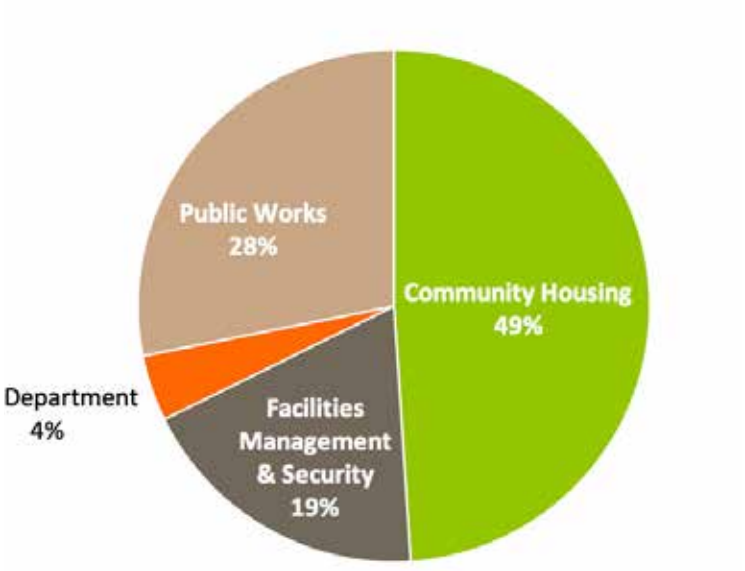


Figure 10: Buildings managed per City Department

The chart below depicts the emissions associated with the buildings by department. Emissions from buildings are a result of electricity and natural gas use. The Public Works Commission has a larger share of the emissions from buildings due to the inclusion of recreation centres that include skating rinks and/or pools. The total GHG emissions represented below is 6,754 T of CO_2 eq. which is the emissions total for those 96 buildings in 2018.

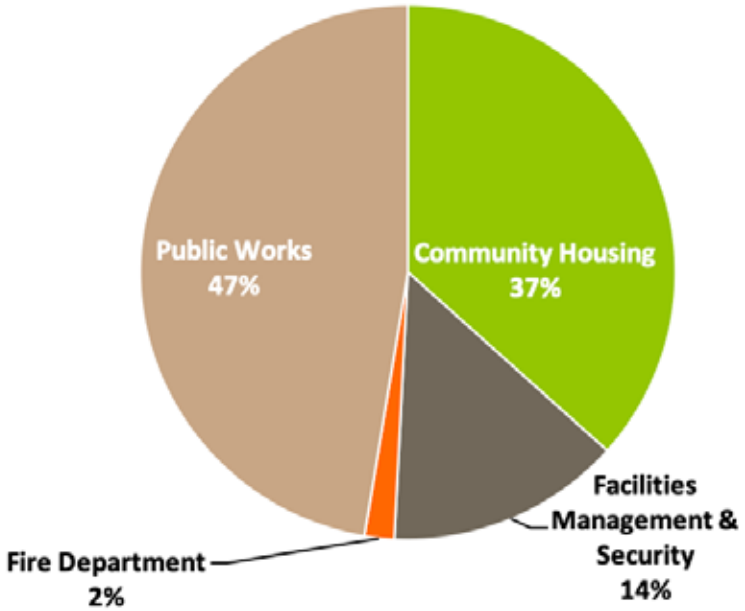


Figure 11: Emissions from buildings per City department

The majority of emissions from buildings are due to the use of natural gas for space heating and water heating. A small percentage is a result of electricity consumption from lighting, space cooling, and other electrical plug loads.

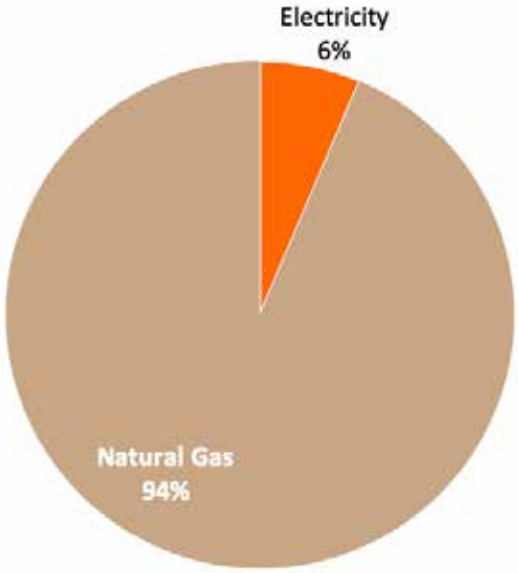


Figure 12: Percentage of emissions from buildings by energy source

As discussed in Section 6, the strategy for emissions reduction is to first lower the demand for energy, then improve energy efficiency and then switch fuel sources. All of these strategies will be important, but to make the biggest impact, there will be a focus on reducing natural gas consumption.

7.4.2 EMISSIONS REDUCTION STRATEGIES FOR CITY BUILDINGS

Considering the wide array of buildings owned and managed by the City, some broad polices are proposed to create consistency in design, operation and energy performance metrics across corporately owned buildings.

Table 11: Emissions Reduction Tools for City Buildings

Tool	Applicable to	Start By	Complete By	Lead Department
Short term goals (2020-2025)				
Reimagining the workplace	All Staff	Ongoing	Ongoing	All
Green Building Standard	New Buildings	2021	2023	Facilities Management and Security (FMS)
Energy Efficiency Workplace Training	All Staff	2021	2022	FMS/Human Resources
Building Operational Standard	All Buildings	2022	2023	FMS
Building Retrofit Strategy	Existing Buildings	2023	2025	FMS/Community Housing
Medium term goals (2026-2035)				
Retrofit min. 50% of City buildings	Existing Buildings	2026	2035	FMS/Community Housing
Long term goals (2036-2050)				
Retrofit remaining City buildings	Existing Buildings	2036	2050	FMS/Community Housing

Building Operations

The operation of a building determines how much energy is used on a day to day basis. Building operators should be aware of the energy draws in each building and where this can be reduced. Without any major retrofits, reducing energy consumption through daily operational practices not only saves energy and emissions, but also saves operational costs.

Reimagining the Workplace

Rethinking the way we use buildings can be a major determinant in how much energy is consumed or how many buildings are required.

The Facilities Management and Security department have updated the Overall Accommodation and Yard Facility Plan to allow for more permanent working from home opportunities. This occurred as a result of the COVID-19 pandemic, but proved to be beneficial for many employees preferring to work from home and for the employer, The Corporation of the City of Brantford. With reduced desk space needed in the administrative buildings, fewer buildings are required, which reduces operational expenses, reduces emissions from the heating and electricity required for the building, and reduces emissions from staff commuting.

This dramatic shift in how people work will have major impacts on offices in the future. Desk sharing or "hot desks" can be utilized for staff that come into the office only occasionally. Utilizing more technological solutions can help staff work more effectively in less time or from different locations. If this strategy is continued, further dramatic cuts to emissions can be made simply by reducing the amount of space required for City administrative purposes.

Taking this high level view of how we work and assessing systems with a climate change and improved efficiency lens may lead to big opportunities to improve. Looking at the systems currently in place and reimagining how work can be done and what role buildings play in that will be a necessary part of the process to reach a low carbon future. It is also an opportunity to examine these systems for functionality and inclusion from multiple viewpoints to ensure we build a future that includes everyone.

Energy Efficiency Workplace Training

As part of a larger culture shift toward greater energy awareness, staff training is recommended for all existing staff and as part of the onboarding process for new staff. This training should include general information on how to reduce energy consumption through simple habits like turning off lights when leaving the room and shutting down computers over the weekend. Training should also include job specific items such as energy training for managing ice rinks or swimming pools. Energy consumption costs the City money in operational expenses and in turn the taxpayer, so it is the responsibility of all staff of the Municipality to be aware of energy consumption and to try to reduce it wherever possible. Online staff training for energy efficiency awareness is also a recommendation within the Corporate Energy Management Plan.

Building Operation and Maintenance Standard

The development of a corporate operation and maintenance standard for buildings would regulate internal controls of buildings for metrics such as temperature during operating hours and non-operating hours, humidity levels, lighting levels, etc. as well as regular preventative maintenance and energy audits. This guideline would improve consistency in operation and maintenance across the corporately owned buildings and ensure that building operation is conducted in an energy efficient manner. Identifying operational controls to be standardized across the City will create a more unified and transparent approach to building operation. This type of standard would reduce energy use and provide guidance to building operators to maintain building conditions at a certain level. A guideline of this type will need to be developed in consultation with all building managers and exceptions will need to be made for specific cases or different types of buildings. This will provide guidance on how to operate an energy efficient building throughout the year and improve awareness of how operational controls contribute to energy consumption and emissions.

Additionally, within this guideline a regular schedule for preventative maintenance should be identified for all buildings and for other work that is required to maintain optimal building performance and efficiency. Regularly scheduled energy audits for each building would be beneficial to ensure the building's equipment is up to date and that the operators are aware of any improvements that could be made to improve energy efficiency and greenhouse gas emissions as well as operational costs.

Ongoing utility bill validation should be undertaken to ensure that billing is correct and to watch for anomalies that could indicate that equipment is malfunctioning or leaking.

Sub-metering of large equipment or buildings should be considered at all buildings and installed where feasible. Sub-metering is the use of energy meters at various locations within a building instead of having just one electricity or gas meter for the entire building. Sub-metering allows for more transparency in energy usage making it easier to identify problems and areas of high energy use that can then be targeted for repair or replacement.

All of the above recommendations, plus any additional information considered important for the efficient operation of the building should be consolidated into one building operational standard to create consistency and transparency across the City's buildings. Annual reporting on suggested metrics can be incorporated as a requirement for comparisons against emissions and efficiency targets.

Building Design and Construction

Municipal Green Building Standard

A municipal Green Building Standard would apply to all new buildings owned by the City of Brantford. This would enact standards for energy efficiency, greenhouse gas emissions and other sustainability metrics when designing new buildings for City use. Many City buildings that are operational today were built 40 to 60 years ago and the users of that building are still living with the building code requirements of that time. With the City of Brantford's goal to be carbon neutral by 2050, buildings need to start being designed in such a way as to make that goal feasible. If buildings are not built to a net-zero or net-zero ready standard now, then major retrofits will be required to bring that building up the emissions standard required by 2050.

The federal and provincial governments also have climate goals and are responsible for the development of building code policy that municipalities must follow. It is anticipated that the building code in Ontario will change to require increasing energy efficiency standards and possibly net-zero carbon ratings at some point in the future. By designing these standards into the buildings now, the City can be prepared for that future change in policy.

Green building standards are used in other municipalities to regulate how buildings are designed, built and operated. These programs require minimum thresholds for efficiency or sustainability items such as lighting, HVAC, construction materials, systems automation, insulation, windows, use of renewable energy, etc. It can also include other sustainability targets such as reducing water consumption, reducing waste, reducing stormwater runoff, etc. Positive impacts include reducing operational energy costs, improving air quality, improving resiliency, and other positive environmental impacts.

Building standards could require that buildings meet one of the existing green building standards that already exist such as LEED, EnerGuide, Energy Star, BOMA Best, Passive House, etc. Alternatively, staff could create a new standard that is designed by the City of Brantford building on best practices in other existing standards.

Renewable energy should be incorporated wherever possible and designed into the building from the planning stages. As costs of this technology continue to decrease, the transfer of energy production from the electrical grid and natural gas system to autonomous energy production will be very desirable. This includes considering the installation of solar panels, geothermal, biomass, etc. on site with the building. The use of renewable energy on site will make these buildings more resilient to future energy cost increases, less predictable weather from climate change and electrical grid uncertainty.

Up-front costs for green buildings are estimated to be about 2% of total project costs and operational costs on average are 8% lower the first year and up to 14% lower over 5 years with a payback of approximately 7 years . For buildings that could still be standing in 60 years, there is a significant savings over the lifetime of the building, as well as significant emissions savings, and potentially water and waste savings.

This type of initiative aligns with Brantford's 2019 Asset Management Strategic Policy. City and Local Boards are working to mitigate contributions to climate change by reducing and setting targets for both greenhouse gas emissions and energy usage, as well as to consider assets' lifecycle costing in the asset management planning process. Therefore initiatives promoting potential savings in emissions, operations, and lifecycle costs are supported through the City's asset management planning.

The development of a corporate green building standard also paves the way for a community green building standard that can encourage increased development of green buildings in the community. This will be a valuable tool in the community focused Climate Change Action Plan. A green building program in Brantford could mean the development of a new market for green building construction, training and jobs as well as improved home comfort, lower energy costs and a reduced emissions future for the residents of Brantford.

The Corporation of the City of Brantford is a vast property owner within the City. The City, as the lawmakers and elected officials of this community, can lead by example in green building technology and inspire the residents and businesses in the City to do the same.

Building Retrofit Strategy

Many of the buildings standing in the City of Brantford today will still be in operation by 2050 when the City has targeted to be at net-zero carbon emissions. The green building standards discussed above will regulate new builds, but there remains a large stock of buildings that use fossil fuels to heat, produce hot water and conduct other work. These buildings will require deep retrofits to reduce their energy consumption and switch to a carbon free energy source.

Retrofitting an existing building instead of decommissioning and building anew is typically more environmentally friendly. Retrofitting avoids production of construction waste from the decommissioned building, reduces the need for new raw materials and avoids GHG emissions from the demolition and construction of the old and new building.

A building retrofit strategy would look at the existing building stock as a whole and determine what buildings will still be in use by 2040 and 2050. For buildings that are planned to be decommissioned before then, retrofitting at this stage could save operational costs and will save emissions, but do not need to be part of the long term strategy.

This strategy would require collaboration between all City departments that are responsible for building management to determine what the lifetime of the buildings are likely to be, and what percentage of buildings need to be retrofitted per year to reach the 2050 target. For example, the City owns approximately 100 buildings and if it is determined that 40% will be decommissioned or sold by 2050, 60% remain that will require retrofits by 2050. That requires that the City retrofit 2% or approximately 2 buildings every year until 2050. These numbers are just an example of what the building retrofit strategy will determine and what the possible outcome could look like.

Building retrofits can be difficult in some circumstances such as heritage buildings or other speciality buildings. For Community Housing, considerations for temporary housing facilities for the residents of the building need to be factored into the strategy.

The strategy can also examine the best approach for retrofitting, whether an energy audit is required in advance to determine the target areas for improvement, or if a larger building energy assessment is required.

[6] *Dodge Data & Analytics. (2018). World Green Building Trends. Downloaded August 10, 2020 from https://www.cagbc.org/cagbcdocs/advocacy/World_Green_Building_Trends_2018_SMR.PDF*

Retrofits will need to look at the building envelope and ensure that it is as energy efficient as possible, looking at windows, doors, insulation and rooves to make sure the building is sealed properly. Internally, equipment needs to be assessed and replaced to exchange natural gas furnaces and hot water tanks to carbon neutral options. Renewable energy should be considered for each building, if solar panels, geothermal or other technologies can be implemented at any of the locations. Retrofits should also consider other sustainability metrics such as water consumption, waste production, and stormwater runoff. Building systems can also make use of automated functions to ensure building temperatures are automatically being turned down at night and weekends (if appropriate), that lights turn off automatically when not in use, etc.

Considering this large undertaking, resources will be required to support the municipality in terms of staffing, financial support and partnership opportunities. One or two dedicated staff members focused on energy reduction at municipal facilities, one for operations and one for capital projects, would be beneficial in order to meet the outcomes of the Climate Change Action Plan. Financial support programs are currently available such as FCM's Green Municipal Fund and Sustainable Affordable Housing that support deep energy retrofits for municipal facilities and additional funding opportunities will be monitored.

It is recommended that the Retrofit strategy be developed after the green building standard document is completed by the City so that the guidance and technology identified in that standard can be used as a framework for the strategy. Similar metrics and technologies should be considered.

The building retrofit strategy should establish medium and long term goals to ensure the City in on track to reach net zero carbon emissions by 2050. This timeline should consider the comparison of multiple energy efficiency upgrades per building versus one deep retrofit improvement. It is recommended that the building retrofit strategy aim to convert 50% of the existing building stock to net-zero emissions or near net-zero by 2035 and the remainder by 2050.

7.5 Water and Wastewater

This section of the report addresses corporate emissions from water and wastewater treatment services, but these emissions can also be viewed as community based because it is a service utilized by every member of the community. Emissions from the treatment of water and wastewater are a direct result of demand for these services. Due to the nature of this service, emission reduction strategies will focus both on management tools and demand reduction tools.

7.5.1 CURRENT STATUS OF WATER AND WASTEWATER

The water and wastewater treatment plants along with pumping stations for water delivery and wastewater removal are large individual users of energy at the City, but this sector makes up only 8% of the Corporate emissions as a whole. Between the two uses, water and wastewater are fairly evenly split in terms of energy consumption and emissions contributions.

Within the water and wastewater departments themselves, the treatment plants are the largest user of energy, making up 85% of the emissions for water and 94% of the emissions for wastewater. Many of the pumping stations are run on electricity only and therefore are not responsible for much of the GHG emissions from these departments.

The City currently runs various water conservation programs to reduce demand for water. There are also ongoing efforts to reduce energy consumption at the treatment plants. These initiatives are discussed in more detail in the following section.

7.5.2 EMISSION REDUCTION TOOLS FOR WATER AND WASTEWATER

Strategies to reduce emissions from water and wastewater will focus on reducing energy consumption at the treatment plants through conservation programs, improved efficiency and fuel switching.

Table 12: Emissions Reduction Tools for Water and Wastewater

Tool	Applicable to	Start By	Complete By	Lead Department
Short term goals (2020-2025)				
Water conservation programs	City wide	In progress	2050	Public Works/ Facilities
Smart water meters on all municipal buildings	City buildings	2021	2025	Public Works/ Facilities/Various
Wastewater reduction programs	City wide	2022	2050	Public Works/ Facilities
Stormwater reduction programs	City wide	2023	2050	Public Works/ Facilities/Various
Medium term goals (2026-2035)				
Retrofit wastewater treatment plant	Wastewater	2026	2030	Public Works
Renewable energy options for treatment plants	Water and Wastewater	2030	2040	Public Works
Long term goals (2036-2050)				
Retrofit water treatment plant	Water	2036	2040	Public Works
System infrastructure improvements	Water and Wastewater	In progress	2050	Public Works

Demand Reduction

The following sections involve many community programs implemented by the City. The programs discussed below also overlap at times because a reduction in water use leads to a reduction in the wastewater production. These initiatives may only result in minor reductions in emissions from the treatment plants for both water and wastewater, but are still essential in the emission planning process to counter the increases expected from City growth.

At this time, it is encouraged that the City implement these reduction practices at City owned facilities to test these practices and demonstrate leadership.

Water Conservation Programs

Water conservation programs are already well underway at the City of Brantford and continued efforts to communicate the need for reduced water consumption are necessary and ongoing. The City of Brantford gets 100% of its drinking water from the Grand River which is a shared resource with all the other communities located along its banks.

The water treatment plant has to treat and process every liter of water that is used and that process consumes energy. Reducing the amount of water drawn from the river, will reduce the energy needed to process it.

There are several programs that are already in place and managed by the City that focus on reducing water demand, such as the water conservation by-law, waterwise gardening and recognition program, and smart water meter installations.

New or expanded programs to reduce water demand could include: incentive program to encourage installation of water saving devices (low flow toilets, low flow shower heads, faucet aerators or washers, rain barrels, etc.), expansion of the water conservation by-law, increased public education campaigns and school education programs.

Within the Municipality, City buildings and services should reduce water wherever possible. Buildings should be designed to reduce water consumption to test technologies and lead by example in this important area. This can be incorporated into the Green Building Standard, Building Operational Guideline and Building Retrofit Strategy.

The community facing programs that focus on water conservation are the responsibility of the Environmental Services department within the Public Works Commission. Water conservation within City owned facilities is the responsibility of the Facilities Management and Security department.

Wastewater Reduction Programs

Emissions from wastewater are similar to emissions from water in that every litre of wastewater created from flushing the toilet or washing the dishes creates wastewater that needs to be treated before it can be sent back into the Grand River. This process uses a significant amount of energy and focusing on conservation programs can help reduce the demand and resulting emissions.

Many of the water conservation programs will have mutual benefit for wastewater processing because if less water is used then less wastewater is created. For example, using a low flow toilet uses less water and also creates less wastewater. Additionally, a community strategy to reduce wastewater, managed through the City's Sewer Use By-law could focus on education programs targeting industrial facilities to look at technological solutions that reduce water use and wastewater production.

At municipal facilities, programs that can be considered for wastewater reduction aside from water conservation include grey water reuse systems. These systems collect water from sinks, dishwashers, etc. (excluding toilets) and reuse it for toilet flushing, irrigation, etc. This saves both water and wastewater. This strategy and other innovative solutions to reduce wastewater can be incorporated into the Green Building Standard, Building Operational Guideline and Building Retrofit Strategy.

The community facing programs that focus on wastewater conservation are the responsibility of the Environmental Services department within the Public Works Commission. Wastewater reduction within City owned facilities is the responsibility of the Facilities Management and Security department.

Stormwater Reduction Programs

Reducing stormwater is both a mitigation strategy to reduce demand for processing and pumping stormwater as well as a critical adaptation strategy to address the increase in stormwater expected as a result of climate change.

Reducing stormwater is a matter of reducing impermeable surfaces and allowing rainwater to infiltrate into the soil instead of flowing along the surface of paved or other hard surfaces. During heavy rain events this can cause the stormwater infrastructure system to become overwhelmed and could lead to flooding.

This can be managed by encouraging property owners, including The Corporation of the City of Brantford, to reduce the amount of hard surfaces on their property. This includes considering smaller parking areas, use of permeable paving, collection and storage of rain water, installation of green roofs, introduction of rain gardens, etc. Protecting wetlands is also a very important tool for stormwater management that has many additional benefits to the community.

Municipal buildings and properties should consider incorporating stormwater reduction elements into their design and function. Policies and guidelines related to stormwater for municipal buildings can be added into the Green Building Standard and Building Retrofit Strategy. Stormwater management practices should also be considered at parks and other types of properties and infrastructure that the City owns and manages.

The community facing programs that focus on stormwater management are the responsibility of the Environmental Services department within the Public Works Commission. Stormwater reduction at City owned properties is the responsibility of the Facilities Management and Security department, and other property managers such as Parks, Fire, Libraries, etc.

Smartwater Meter Installation

The City of Brantford has initiated a program to make smart water meters available to water customer across the community. These smart water meters provide remote meter reading for the City and the customer. This allows for real time water consumption information and data for trend analysis and leak detection. With more data available in real time, customers are better able to reduce water usage, water bills and associated emissions from the water treatment plant.

The City should endeavour to install smart water meters at all City buildings to provide the same benefit to City water billing. This additional source of data will help building managers track water consumption and identify strategies for water reduction. By ensuring City buildings are using this new equipment, the City can better encourage the rest of the community to adopt the smart water meter and learn to use the technology through experience. This strategy can be incorporated in the Building Operation Guideline document also proposed herein.

The community facing programs that focus on smart water meter installation are the responsibility of the Environmental Services department within the Public Works Commission. Smart water meter installation at City facilities will be a collaborative approach between Environmental Services and property managers such as Facilities Management & Security and other building managers such as Parks, Fire, Libraries, etc.

System Efficiencies

System Infrastructure Improvements

The infrastructure to transport water, wastewater and stormwater are all separate piping systems and in various states of repair and age. When these systems leak into the ground or into each other, they reduce the efficiency of the system. Repairing the systems to eliminate leaks will improve the efficiency of the overall system and reduce the demand on the water and wastewater treatment plants.

The City is actively working on repairing underground infrastructure and repairs 2.5 to 5 km of piping a year. This is 1% of the total system annually.

In addition to physical infrastructure improvements, public and staff education on what can and cannot be put into the drain can be increased to improve the efficiency of the system, to reduce clogs and retain the quality of the infrastructure in place.

Building Retrofits

The treatment plants for both water and wastewater are large users of energy. The buildings themselves are both very large in size at approximately 60,000 square feet each. Both contain a lot of specialized equipment required for the treatment process. The water treatment plant processes were retrofitted from 1994 to 2011. The wastewater treatment plant is due for a retrofit and the City is currently developing a plan for a multi-year retrofit program.

As discussed in the Buildings section of this report (Section 7.4) all buildings owned by the City will need to reach net zero carbon emissions by 2050, including the treatment plants. Strategies to accomplish this goal at the treatment plants can include sub-metering of large equipment to have more data and transparency of where energy is being used, equipment energy efficiency upgrades, increasing use of automated systems and fuel switching discussed below. The buildings should be built to follow any Green Building Standard that is adopted by the City in the future.

Fuel Switching

The processes for treating water and wastewater will always require energy so the use of renewable or clean energy at the treatment plants will be essential. Electricity is currently a low emissions source, and can be used to power much of the equipment. Efforts should be made to switch any equipment using natural gas or other fossil fuels to equipment that can run on electricity where it is economically feasible to do so or where supporting resources are available.

Both of the treatment plants are located on large properties that could allow for opportunities to install renewable energy systems including solar, wind and geothermal. As the demand for electricity at the plants increases, the financial case for installing renewable energy improves. Producing electricity on site will protect the City against future electricity price increases and grid availability. The redesign of the buildings should include capacity to install solar panels at some point in the future, if not immediately upon redesign.

The wastewater treatment plant has a unique opportunity to create energy from the biogas that is created as a result of the wastewater treatment process. This biogas could be harnessed to power and heat the treatment plant and associated administrative offices. It is currently used to heat some of the buildings successfully, but this can be expanded to create a zero emissions wastewater treatment plant.

7.6 Streetlights and Traffic Signals

7.6.1 CURRENT STATUS OF STREETLIGHTS AND TRAFFIC SIGNALS

Streetlights and traffic signals are responsible for approximately 1% of emissions from within the Corporation. There are currently 10,000 streetlights and 145 traffic signals in the City of Brantford. All traffic signals have been converted to energy efficient LED lights, and all new streetlights use LED technology.

Streetlights currently installed in the City are either Light Emitting Diodes (LED) or High Pressure Sodium (HPS) bulbs. Streetlights were all HPS bulbs or Metal halide (MH) bulbs at one time and all new installations are required to be LED bulbs. The City is currently in the process of converting all existing streetlights to LEDs. LEDs are approximately 50% more efficient than HPS bulbs and have a much longer lifespan. Converting HPS bulbs to LEDs is the current City standard approach to reducing energy consumption and associated GHG emissions from streetlights and traffic signals.

By the end of 2020, the City will have already converted 25% of the streetlights to LED from HPS. All the traffic signals in the City have already been converted to LED. All new streetlights and traffic signals that get installed in the City are required to be LEDs..

7.6.2 EMISSION REDUCTION TOOLS FOR STREET AND TRAFFIC LIGHTS

Streetlights and traffic signals in the City of Brantford are powered by electricity which is already a relatively low source of emissions, but additional efforts can be made to reduce the amount of energy consumption from this ubiquitous City asset.

Table 13: Emission Reduction Tools for Street Lights and Traffic Signals

Tool	Applicable to	Start By	Complete By	Lead Department
Short term goals (2020-2025)				
Convert HPS bulbs to LED	Streetlights	In progress	2030	Public Works
Medium term goals (2026-2035)				
Evaluate technological solutions to reduce energy consumption	Streetlights and traffic signals	2030	2035	Public Works
Long term goals (2036-2050)				
Evaluate options for renewable energy electricity sources	Streetlights and traffic signals	2036	2040	Public Works

Continue Conversion to LED

The City is already underway with the conversion of HPS bulbs to the lower wattage LEDs which is the primary tool to reduce energy consumption and associated emissions in this category. By the end of 2020, there will still be 75% of street lights that need to be converted to LED. Around the City, there are both 250 W and 100 W HPS bulbs that require replacement with LEDs. The 250 W bulbs will be targeted for replacement first to have the largest impact on energy consumption for both cost and emissions reductions.

The current schedule for this work is to have the 250 W HPS bulbs replaced by 2023 which will then total 40% of all HPS bulbs converted to LED. The remaining 60% of HPS bulbs will be converted over the next 7 years and all street lights will be converted to LED by 2030.

This process can be expedited if additional funds are allocated to purchase and install the LEDs.

Technologies to Reduce Energy Consumption

Once all bulbs are converted to LED, the City can look at technologies available to reduce energy consumption further. One such technology is auto dimming that reduces energy consumption by dimming the street light when there is no vehicular or pedestrian traffic. A test project in Norway has installed auto dimming streetlights that reduce down to 20% brightness when there are no cars and increase to 100% when cars, bikes or pedestrians are detected by radars attached to each lamp post. There are significant energy savings, costs savings and increases in bulb longevity, with an estimated payback of about 4.5 years. At this time, this technology is not allowed in Ontario which is why this strategy is a medium term goal. The City can review policy around auto dimming or other available equivalent technologies at that time.

Renewable Energy Source for Street Lights and Traffic Signals

The City has already begun using technology such as solar cells to replace electricity to power traffic signal flashing beacons and as this technology improves, it may allow for other lights/signals to be powered on site by solar or other renewable and clean energy. Federal and Provincial policy may change to allow for the application of renewable energy produced elsewhere to be applied to the energy used by the streetlights and traffic signals, referred to as virtual net metering. Other creative solutions for powering streetlights and traffic signals from renewable energy may emerge and should be monitored by the Public Works department to understand options for zero emission energy solutions for streetlights and traffic signals.

7.7 Waste

Emissions from waste can be viewed as a corporate source of emissions because the City is responsible for waste management practices or can be viewed as a community source of emissions because the waste is created by the community. For the purposes of emissions reduction planning in the Climate Change Action Plan, it is considered in both emissions reduction strategies. Within the City's emissions inventory, it is considered a source of community emissions.

Many of the strategies noted below will be community facing, but need to be organized and implemented by the City. Waste reduction and emissions strategies will also be discussed in the Community Climate Change Action Plan.

7.7.1 CURRENT STATUS OF WASTE

When emissions from the landfill were inventoried in 2018, the landfill was responsible for approximately 13,050 tonnes of carbon dioxide (equivalent) emissions. This is nearly equivalent to the emissions produced by all other sources of corporate emissions combined. Emissions from the landfill are a significant source of GHG emissions. In Canada, municipal landfills contribute nearly 20% of all methane emissions. [7]

GHG emissions from the landfill are a result of methane being released during the anaerobic digestion of waste materials disposed at the site including organic waste. This means that emissions are created when organic matter decomposes in an environment without oxygen. Additionally, methane is a stronger greenhouse gas than carbon dioxide and has approximately 25 times the warming impact of CO_2.

In Brantford, the landfill has a comprehensive landfill gas collection system that collects the majority of the methane generated and conveys it to a central location where it is combusted (converted to CO_2.) and used to generate electricity. This reduces the strength of the gas and generates a source of electricity that has zero additional emissions and is considered a green source of electricity.

Currently the City participates in the provincial blue box recycling program for diverting paper products and containers and achieves a 20% diversion rate with this program. The City also collects leaf and yard waste for composting and diverts another approx. 13% of waste.

Additional efforts can be undertaken to reduce the amount of waste and associated emissions from the landfill.

7.7.2 EMISSION REDUCTION TOOLS FOR WASTE

Reducing emissions from waste will often overlap with waste reduction strategies in place at the City; the most effective strategy to reduce emissions from the landfill is to reduce the amount of waste going into the landfill. Organic waste (food waste, paper products, plants/wood, etc.) is the primary cause of landfill emissions and this type of waste comes from residential, commercial and industrial sources across the City.

[7] Government of Canada. (2020). Municipal solid waste and greenhouse gases. Retrieved from https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/municipal-solid/greenhouse-gases.html

Table 14: Emissions Reduction Tools for Waste

Tool	Applicable to	Start By	Complete By	Lead Department
Short term goals (2020-2025)				
Waste reduction education and community engagement	City-wide	In progress	Ongoing	Public Works/ Facilities
Initiation of organic waste diversion program	Residential	2023	2025	Public Works
Medium term goals (2026-2035)				
Increase recycling diversion	Residential	In progress	Ongoing	Public Works
Renewable energy options from waste biogas	Waste	In progress	Ongoing	Public Works

Reduce Waste

Waste Reduction Education

Reducing waste produced from City facilities and also in the home, business, office, or factory is an important part of waste management and an important part of the long term strategy to reduce emissions from the landfill. Waste reduction starts with reducing packaging, reusing items, and diverting waste from landfill to either recycle, compost or other.

Waste reduction education can be provided to make the Corporation and the Community more aware of the climate change impacts of waste. Additionally, there are several other environmental impacts associated with waste and landfills that can be addressed by reducing the amount of waste produced such as leachate, odour and land use. Decommissioning and finding a new landfill site is a very expensive and often controversial process.

Waste reduction should be promoted heavily in City facilities to encourage staff and visitors to reduce waste through education on the impacts of waste and providing strategies to make a change. Policies, design choices, or access to waste facilities within City buildings can be improved to reduce waste such as installing hand dryers instead of paper towels, provide more recycling containers, onsite composters, encourage waste reduction from management, technological solutions to reduce use of paper, etc.

Organic Waste Diversion

Organic waste diversion was identified as a City priority in the 2019 Council Priority Exercise within the topic "Green Bin Program and Anaerobic Food and Organic Waste Digester".

Organic waste is a large source of emissions in the landfill and a large portion of residential waste. A waste audit conducted on residential waste in Brantford in 2018 estimated that 36% of waste set out by residents was organic waste and of that portion, 53% was avoidable food waste, meaning still edible or untouched food. This audit does not include waste from commercial or industrial sources, which is estimated to produce 60-70% of the organic waste in the City.

Reducing food waste through increased education and community engagement and options to donate food can help to reduce emissions before they are created. This important step not only reduces emissions from the landfill, but also emissions from the growing, shipping, packaging and resale processes.

Providing a residential organic waste diversion program, such as a municipal green bin collection program, would be a significant step forward in the City's goal to reduce landfill emissions. Once collected, the Council priority directive is to explore the feasibility of building an anaerobic digester which would break down the organic waste faster and collect biogas more efficiently. Alternatively, contracted services for collection and processing can be explored.

As part of the Resource Recovery and Circular Economy Act, 2016, the Province of Ontario released the "Food and Organic Waste Policy Statement" in 2018 which legislated that cities such as Brantford are required to have an organic waste diversion program in place by the end of 2025. This Policy Statement also states a target of 70% reduction in organic waste collected from single-detached dwelling units.

Based on the totals from the waste audit from 2018, if the City of Brantford were able to divert 70% of household organic waste, preliminary calculations estimate that it could reduce landfill emissions by up to 35%.

Investigation into the household organic waste diversion program is underway at the City, but implementation costs continue to be a barrier. Sources of possible funding including the avoided costs for municipal recycling anticipated in 2025 and other additional funding opportunities are being investigated to prepare to make the transition to a green bin collection program in 2025.

Increase Recycling Diversion

Recycling rates in Brantford could continue to be increased through enhanced community engagement and education to inform the public what is and what is not recyclable. The Recycle Coach app and website is a helpful tool that should continue to be promoted to residents to be aware of the acceptable program participation and proper preparation requirements for eligible materials.

In 2024 it is anticipated the recycling program will switch to a producer pays system that will be managed by the producers and first importers of paper and packaging materials within the Province. This change should make recycling programs more consistent across the province and ideally a more effective and efficient system. Recyclable materials accepted may increase as a result of that change, and the City should continue to monitor how those changes affect the waste diversion rates within the City of Brantford.

Renewable Energy Production

Renewable Energy Options from Waste Biogas

The landfill is currently generating electricity from the biogas (majority methane gas) produced within the landfill from the decomposition process. In 2018, the landfill generated enough electricity to power almost 900 Brantford homes (based on Brantford's average residential electricity consumption of 8,444 kWh/yr). This electricity is sold directly into the Ontario electricity grid under a power purchase agreement with the Province.

As the active and retired landfill area expands, new gas collection infrastructure is installed to expand the landfill gas collection system.

The power purchase agreement (renewable energy standard offer program or RESOP) for landfill gas comes to an end in 2030, and at that time the City can investigate how to use that biogas for electricity or other energy generation going forward. If there is an option to direct that energy generation to a City facility and be powered by this zero emissions energy, that may help to reach the net zero carbon emission goal.

An anaerobic digester for organic waste can also contribute biogas that can be converted to electricity or used as a natural gas supplement to reduce GHG emissions.

The City is currently and will continue to explore opportunities to create energy generation from waste.

7.8 Corporate Wide

The tools recommended within this section are those that require cross-departmental efforts and coordination. Three of the four action items listed here are policies or tools that apply to the City as a whole. The fourth, Tree Canopy Expansion, is included here because it does not fall within any of the other categories provided above.

Table 15: Emissions Reduction Tools for Corporate Wide Policy

Tool	Applicable to	Start By	Complete By	Lead Department
Short term goals (2020-2025)				
Climate Lens Assessment	Corporation	2021	Ongoing	CAO's office
Tree Canopy Expansion	Corporation	Ongoing	Ongoing	Public Works
Corporate Policy Review	Corporation	2021	2025	CAO's office
Climate Adaptation Plan	Corporation	2023	2025	CAO's office

Climate Lens Assessment

To facilitate Council in making decisions that align with the Climate Emergency Declaration and the targets set out in this plan, a Climate Lens Assessment process and tool have been developed and are pending Council approval.

The Climate Lens Assessment involves the addition of a new section to the staff report template called "Climate Change and Environmental Implications". Within that section, staff will be asked to quantify the emissions likely to be created as a result of the specific project, event, policy or other proposal before Council. A calculator tool will be available to assist staff in calculating this figure. Where emissions cannot be quantified, qualitative information regarding climate change or environmental impacts can be provided such as proposed strategies to reduce energy, waste, water, stormwater, etc., as well as consideration of climate change adaptation and land use change. Other environmental sustainability metrics such as water consumption, waste production, stormwater impacts and tree canopy impacts will be encouraged to be provided if applicable.

Starting November 2021, this information will be included in each staff report. It will be used to provide additional information to Council as another data point to consider when making decisions for the City of Brantford. There will be no decision recommendations associated with this data to start, but that may develop over time, if Council chooses to do so. At its inception, it will be provided purely for information to aid in Council decision-making and start building an understanding of GHG emissions to frame the climate change conversation and goals. With long term targets identified for emissions reduction, understanding how Council decisions impact that goal will be important to measure as the City moves through the process of becoming carbon neutral.

The climate change and environmental information provided in the staff reports will be consolidated into quarterly summary reports to Council and the public. The quarterly reports will gather up the approved emissions, avoided emissions and other data presented in the previous quarter (three months). Carbon emissions will be compared against the emissions reduction targets set out within this document and the previous year's emission inventory. Annual year end summary reports will also be provided at the end of the fourth quarter to comment on longer-term trends, notable projects and emissions reduction efforts taking place over the past year. This section will not only provide information on the emissions that will be created as a result of Council approved decisions, but celebrate the City's ongoing efforts toward these goals.

Tree Canopy Expansion

Trees are a very important part of both mitigation and adaptation solutions for climate change. They act as a carbon sink to reduce emissions by absorbing CO_2; this can be used to subtract values from the City's GHG emissions. Trees also play a very valuable role in climate change adaptation by storing stormwater, providing shade, lowering ground temperatures, preventing soil erosion, and protecting homes and wildlife from wind and other storm impacts. Trees also have a myriad of wildlife and community benefits outside of climate change including food, habitat, biodiversity, privacy and beauty.

A 2008 motion by Council declared a long term goal of 40% tree canopy coverage. By aligning that goal with the long term emissions reduction goal of net-zero carbon emissions by 2050, these two initiatives can both be strengthened. These can be measured and evaluated in parallel and complementary strategies can be identified.

The land area of the City of Brantford in 2020 is 102.46 sq. km. To reach 40% tree canopy, 41 sq. km of tree coverage is required. It is estimated that the tree canopy coverage is currently around 25% or 26 sq. km; therefore, 15 sq. km is still required to reach this goal. If the target date for the tree canopy goal is 2050, then 30 years remains to reach 40% tree canopy. Each year a 0.5 sq. km (50 ha or 124 ac) area will need to be planted with trees. If it is assumed that trees are planted at a fairly low density of 250 trees per hectare (100 trees per acre), then this commitment will require approximately 12,000 trees to be planted annually at a minimum.

The City currently has a target to plant 500 trees annually, but additional tree planting is also done by volunteer groups and businesses within the City. To increase the tree planting to the level necessary will require increased efforts not only from the Corporation, but from private citizens, community groups, neighbourhood associations, businesses, institutions and many other volunteers and landowners within the City limits. Not all trees will be able to be planted on public lands such as parks or forests, but will also require trees to be planted on private property, such as backyards, commercial properties and institutional areas.

With all the benefits that trees provide, the City must work toward increasing the tree canopy to meet the 40% goal established more than a decade ago. Preservation of existing healthy trees should be emphasized and the removal of trees should require a plan to replace lost trees and ensure they survive for the first several years after being planted.

The carbon absorption value of trees increases with age, so the replacement of a mature tree with a young tree does not have the same carbon sink value and that should be factored in when replacing trees.

The City's Forest Management Plan should be reviewed and updated to ensure the City can meet this 30 year goal and develop partnerships to ensure that this is realistic.

City Policy Review

A thorough review of the relevant Corporate Policies and City Plans should be undertaken to ensure climate change mitigation and adaptation is considered. Policies such as the Corporate Purchasing Policy, City Staff Travel and Expense Policy, Special Events Policy, Strategic Asset Management Policy, Energy Management Policy, Green Fleet Policy, etc. should be reviewed by climate change staff to assess how climate change can be factored into, or will be impacted by, these policies. There are opportunities to have a significant impact if daily policies can be adjusted to consider the impact of these actions on emissions or other sustainability issues.

City plans such as the Official Plan, Transportation Master Plan, Master Servicing Plan, and Downtown Master Plan address emissions mitigation and also factor in climate change adaptation measures when planning for the City's future. For example the Transportation Master Plan identifies measures and programs to encourage multiple occupancy vehicles and setting targets for Active Transportation and transit use as the city grows. Climate change impacts affect the design criteria for portions of the Master Servicing plan such as stormwater management and are addressed in that document.

These documents undergo their regular review process every 10 years (Official Plan) or 5 years (Transportation Master Plan and Master Servicing Plan). A climate change review was provided for the most recent update to the Official Plan, but ongoing review of these plans will be required as best practices for climate change mitigation and adaptation evolve.

A timeline will be developed in 2021 to define a schedule for reviewing internal municipal policy and plans with this climate change lens.

A review of relevant plans and policies is also a recommendation of the CEMP for the 2022-2024 period.

Climate Change Adaptation Plan

The plans discussed within this report are focused on mitigation – ways the City and Community can reduce their impact on climate change by reducing their GHG emission output. The City also needs to understand how Brantford will be impacted by Climate Change. Understanding the impacts of climate change at the local level will help identify the City's vulnerabilities. With this information, the City can begin to adapt and protect itself from the changes expected due to climate change. Climate change impacts are modelled to predict what the City of Brantford will experience in 30, 60, 80 years from now and how the City's strategies for development of infrastructure, City design and programs are developed while considering the changes the City will face in terms of climate. See Section 3.1 for a summary of those predicted impacts for Brantford for 2050 and 2080.

These modelled changes will have very real impacts on the ground when planning for increased temperatures, heat waves, stormwater, and potential flooding. Some examples of how this can impact the local area and the Corporation include:

- Heat warnings and heat waves can be very dangerous for vulnerable populations and those without air conditioning so robust community support policies need to be prepared;
- Reduced rainfall in the summer can threaten access to fresh water and local food production, so emergency plans and contingency plans need to be up to date;
- Precipitation is likely to increase overall with more intense individual precipitation events, so stormwater infrastructure needs to be designed for this future stormwater volume and not for today's stormwater flows.

It is recommended that a Climate Change Adaptation Plan be prepared to provide a long term strategy for adapting City infrastructure and programing to prepare for climate change. A detailed analysis of the likely impacts and the City's vulnerabilities from climate change would be an important first step in this process.

Section IV
IMPLEMENTATION
8. Implementation Overview

The implementation of this plan will require ongoing efforts from all staff members at the City of Brantford as well as Council and the citizens committee focused on climate change issues at the City. This will require the proper resources, funding tools, monitoring and progress reporting to ensure that the climate change mitigation actions described herein are able to function as intended. Regular review and updates will aid in accountability and progress.

The table below outlines the various implementation tools proposed, the timeline or schedule, and the responsible department/position. Additional details on these implementation tools are described in the following sections.

Table 16: Corporate Climate Change Action Plan (CCAP) Implementation Tools

Tool	Schedule	Department/Position Responsible
Add Staffing Resources		
- Climate Change Officer	2020	Facilities Management & Security
- Fleet Driver Trainer	2021	Fleet Services
- Energy Manager, Operations	2021	Facilities Management & Security
- Energy Manager, Projects	2022	Facilities Management & Security
- Fleet Business Improvement Specialist	2022	Fleet Services
Determine Funding Structure	2021	CAO's office
Monitoring		
- Update Emissions Inventory	Annually	Climate Change Officer
- Issue Emissions Inventory Report	Bi-annually	Climate Change Officer
CCAP Progress Reports		
- To Council	Annually	Climate Change Officer
- To ESPAC	Quarterly	Climate Change Officer
Update and Revise CCAP	Every 5 years	Climate Change Officer
Internal Advisory Team Meeting	Annually	Climate Change Officer

9. Resources Required
9.1 Leadership

In order to maintain momentum with this plan and these targets, strong leadership that prioritizes environmental stewardship will be required throughout. The elected council sets priorities for the City and assigns areas of focus for staff. With strong elected leaders that speak up for climate change targets and other environmental initiatives, the City's policy and actions will continue to make progress toward becoming a net-zero community. Internally, executive leadership staff can prioritize environmental awareness and responsibility. Creating a culture of environmental stewardship internally needs to be led from within, not only from senior management, but from any and all environmental champions at the City. Sharing ideas, goals and tips for reducing the City's carbon and environmental footprint can be a very effective tool to create change.

9.2 Dedicated Staff

There are several staff positions that could be added to the City's corporate structure to improve the capacity of the City of Brantford to meet the emissions reduction targets identified herein. These positions are discussed below.

❱ Climate Change and/or Sustainability Officer

It is highly recommended that a permanent dedicated resource be added to focus on environmental, sustainability and climate change issues. The work outlined in this report will require staff time and ongoing monitoring, support, grant seeking, and implementation. Many of the initiatives suggested in this report can be undertaken by a person in this role such as preparation of the Green Building Strategy, Emergency Services Fleet Emission Reduction Strategy, Energy Efficiency Workplace Training, Climate Lens Assessment tool implementation and support, Corporate Policy Review, Climate Adaptation Plan, and others. This role is recommended to be implemented immediately. Creation of this position is also a recommendation outlined in the CEMP for the 2020-2022 period.

❱ Fleet Business Improvement Specialist

A Fleet business improvement specialist would be beneficial to Fleet Services to collect and analyze fleet usage data, to improve fuel efficiency and costs, and reduce GHG emissions. This position could focus on upgrading the Green Fleet Policy to be a more robust plan that looks at specific Key Performance Indicators (KPIs), targets, and strategies for reducing costs and emissions across the City Fleet. Fleet vehicles are responsible for almost half of all Corporate emissions, so a position that focuses on reducing vehicle fuel consumption would be extremely beneficial to the City's emissions reduction goals as well as contributing to operational cost reductions. Fleet Services aims to seek someone for this position in 2022.

❱ Driver Trainer and Compliance Officer

This position would implement the energy efficient driver training program and other driver training requirements as well as enforce practice and procedures after training is complete (e.g. speeding, idling, etc.). Energy efficient driver training can be provided to staff that frequently drive vehicles during the work day to educate on how driving habits and vehicle use and maintenance can impact fuel consumption and emission output. Different vehicle types will require different training techniques to optimize the fuel efficiency of the vehicle. This training should be provided annually to ensure the knowledge is not lost and fuel efficiency is prioritized. Fuel efficiency not only saves emissions, but reducing fuel also
saves operational costs. Fleet Services aims to seek someone for this position in 2021.

❱ Energy Manager, Operations

An Energy Manager, Operations would focus on understanding and monitoring the ongoing energy consumption at City Facilities. This role would aim to find ways to reduce energy consumption, saving emissions and operational expenses across all City buildings. This role is recommended to be implemented in 2021. The creation of this position is also a recommendation with the CEMP for implementation in 2020-2022.

❱ Energy Manager, Projects

An Energy Manager, Projects would focus on new projects and energy retrofit projects for buildings. This position would consider energy management targets, energy efficient technologies and other opportunities to reduce energy consumption, saving emissions and operational expenses at the building design/retrofit phase. This role is recommended to be implemented in 2022.

9.3 Funding Options

Actions recommended within this plan are a combination of current initiatives, expanded initiatives, policy review or creation, and new initiatives. The level of funding required for this work will vary between actions as some are already funded through the regular budget process and work plans, some may be fully incorporated into existing staff roles, and some initiatives will require additional staff or additional funds to implement. Several of the programs suggested within this plan will have long term savings over the lifetime of the project, but may require additional up-front costs.

As this plan is intended to be reviewed and updated every five years, costs for the first five year period have been estimated. The action items proposed to be implemented between 2021 and 2025 are included in Appendix B along with the costs required per year. Actions that are already part of the existing work plan and 10 year capital plan are not included as additional costs. Only those costs that are above and beyond what was previously planned are included. These costs are provided here for additional information only and will be proposed by the identified department as part of the budget process or as an unmet need. At that time, the costs will be fully detailed for each proposal.

Finding sources of funding for these programs is an ongoing requirement and there are several tools the City can implement to fund these initiatives beyond using City budget. The funding options provided below are simply a list of available tools and are not necessarily recommended by way of inclusion in this plan. Financial tools for the ongoing funding of climate change work will need to be determined early on to aid in the implementation of the actions recommended herein.

GRANTS

Grants continue to be an attractive source of funding for environmental initiatives. The urgency to address climate change at all levels of government is increasing and many grant programs are opening up to facilitate this work at the municipal level. Programs like the Federation of Canadian Municipalities' Green Municipal Fund offers grants and loans for various environmental projects often aimed at new and emerging technologies and linked to specific emission reduction targets or other environmental improvement metrics. Funds for studies, pilots and capital projects are available and this program should be closely monitored to understand how the City can make use of this resource. In Ontario, grants programs are also offered from some utility providers such as the Independent Electricity System Operator (IESO) and Enbridge to help customers (including municipalities) reduce their energy consumption. The federal government has programs through Natural Resource Canada and Infrastructure Canada among others, which provide grant programs on occasion to facilitate this transition at the municipal level. Available grants should continue to be monitored and utilized where appropriate to ease the financial burden on the City budget and the taxpayer.

GREEN PROJECTS RESERVE ACCOUNT

A reserve account can be utilized internally at the City to fund energy efficiency, environmental and climate change projects. This could be a dedicated account for City initiatives that is initially funded with budget funds and used to invest in energy savings projects that will pay back into the fund through reduced operational costs or grant funds received. The savings or grants can be fully or partially reinvested into the fund, depending on the level of savings and needs of the department. This type of fund is useful for providing long term, consistent funding for City projects that have a higher capital cost, but a lower lifecycle cost. This type of reserve account is also recommended in the CEMP and exists currently in some capacity as the "Energy Reserve Account" at the City.

ENERGY PERFORMANCE CONTRACTS

Energy performance contracts (EPCs) are contracts between a building owner/operator, in this case The City of Brantford and a private energy service company. An EPC guarantees a certain amount of energy reduction and operational cost

savings for large projects, typically building retrofits and other energy projects such as LED lighting conversion, etc. This third party typically does not require up-front payment, but is paid through operational cost savings. This system incentivizes the EPC to reduce energy consumption and operational costs as much as possible. The initial capital costs of an energy retrofit project will be covered by cost savings generated over the course of the contract, typically 15 to 20 years.

Many municipalities have used EPCs to finance building retrofits and can reduce upfront costs of energy-efficiency retrofits, reduce financial burden on municipal budgets and reduce risk of meeting energy performance targets.

GREEN BONDS

Green bonds are debt securities whose proceeds are earmarked for environmental or climate-related projects. The bonds can be issued by the municipality and should offer a reasonable return on investment to be competitive. There are a few types of green bonds, but most are treasury-style retail bonds with a fixed interest rate and redeemable in full on maturity, usually within 10 to 30 years.[8]

Even though the green bond market is relatively new, in 2019 the Canadian green bond market was worth approximately $6.3 billion.[9] The green bond market is growing quickly with demand consistently exceeding supply in Canada and abroad. There is good opportunity to get involved in this market to assist with financing climate change related projects.

The City of Toronto, City of Ottawa and City of Vancouver, as well as the Province of Ontario and the Province of Quebec, have all used green bonds to fund environmental improvement projects.

10. Monitoring and Evaluation

The success of the enclosed plan requires ongoing monitoring and evaluation to understand if the Corporation is moving in the right direction toward the emission reduction goals. Ongoing monitoring can also help identify what emission reduction programs are working and which programs are not having the desired effect.

The work involved in reducing emissions to net-zero will require ongoing efforts and cannot be left to the end of the target period. This will take regular monitoring, planning, revising and rethinking. Both incremental and drastic emissions reduction strategies may be required at periods throughout the process, and only consistent monitoring can determine what approach is needed to meet the local, federal and global emissions goals.

10.1 How to Monitor

The monitoring of the emissions should replicate and improve upon the 2018 City of Brantford's Greenhouse Gas Emissions Inventory Report published in 2020. This document was prepared in accordance with the Partners in Climate Protection emissions inventory protocol that follows the International Emissions Analysis Protocol (IEAP).

This inventory collects data for all City energy consumption, primarily electricity and natural gas usage from buildings, water and wastewater, and streetlights/traffic signals and diesel and gasoline usage from fleet. Most of this data is also included in the annual Green Energy Act reporting as part of the Corporate Energy Management Plan (CEMP). These inventories are very similar, but the CEMP does not measure data from Community Housing where the Emissions Inventory does.

The emissions should be tracked annually and Emissions Inventory reports will be released bi-annually.

[8] Federation of Canadian Municipalities. (2018). On the money: Financing tools for local climate action.
[9] Ferguson, E. (2020, Aug 31). Kingston still considering green bonds to fund climate projects. Kingston Whig Standard. Retrieved from https://www.thewhig.com/news/local-news/kingston-still-considering-green-bonds-to-fund-climate-change-projects

It is recommended that a dedicated staff member be assigned the responsibility to collect, analyse and report on the energy and emissions data for the City and the Community and to compare these figures against the emissions reduction targets.

The data collection process can be increasingly streamlined, so that staff within relevant departments are aware of the data required to ensure the data collection process is quick and simple year over year. An updated list of municipal assets is also required to ensure that new assets are accounted for and old assets are removed from the inventory.

Up to date emissions inventories can also be useful for estimating improvements proposed for new projects. For example, if a building is being renovated with a particular type of heat pump or other heating technology that is in use elsewhere, real data can be used to estimate the emissions from a new project and a more accurate estimation can be provided to Council in advance.

Additionally, annual reporting will be provided to Council regarding the status of the action items identified in the CCAP. This will be coordinated by climate change staff, with information from the lead department for each action item. This report will look at the action items identified for implementation or ongoing work and provide an update on the status of the item. This reporting process will celebrate successes and provided accountability for departments to ensure the City remains focused on the emissions reduction goals. If additional resources are required to facilitate a goal, annual progress reporting will provide an opportunity to seek that assistance throughout the process. Annual reporting on the progress of targets set out in the CEMP is also recommended to be implemented in the 2020-2022 period, so these two progress reports could be streamlined to share information and results.

Ongoing meteorological metrics, such as temperature, heat events, precipitation, flooding, days without frost, etc., should also be monitored to understand how climate change is already impacting the City and what adaptation measures should be considered.

10.2 How to Gauge Success

Success can be measured in a variety of ways; the most relevant for the purposes of this Plan is the consistent reduction of overall annual GHG emissions. Success will be measured by reaching the GHG targets identified in this Plan and the ultimate goal of net-zero emissions by 2050.

Targets have been identified for 2030, 2040 and 2050, but the interim years are very important to monitor and gauge success annually or bi-annually. If emissions are decreasing at a rate that is on track with the identified emissions, then staff, Council and the community are successfully implementing the Plan.

If the City of Branford and all other jurisdictions around the globe are successful in meeting the climate change goals, then the worst impacts of climate change can be avoided. The City will still see climate change impacts regardless, but if the City has also implemented proper adaptation plans then the community will hopefully be able to cope with the change. Failure will result in more and increased climate extremes and community distress.

Beyond emissions and climate change impacts, success can be measured by looking at The City of Brantford internal culture and engagement in the sustainability and climate change conversation. Climate change work requires efforts from all of us and that will not be possible if the right information, education and training are not provided. Staff need to work together toward this goal on top of all the other work required to keep a growing City running.

Other metrics to be evaluated include specific targets within the individual actions such as recycling participation rate, organic waste diversion rate, water consumption rates, stormwater infiltration rates, etc. These metrics should be identified when developing detailed proposals for the action items within this report to be able to identify what other successes can be pulled from this work, even if emission rates are not dropping. However, if emissions are not dropping, but programs are identified as successful, then the program itself needs to be evaluated for efficacy and relevance in the Climate Change Action Plan.

Through the annual progress reporting process discussed above, success can also be evaluated based on number of initiatives implemented, number of initiatives completed and grants and partnerships identified for supporting these initiatives.

11. Plan Revisions

It is recommended that the Corporate Climate Change Action Plan be updated every 5 years at a minimum. This regular update schedule is proposed to ensure the CCAP is a relevant document that is kept up to date. A five year review is typical for municipal plans of this nature and allows most elected councils to see the plan reviewed within the four year elected term in office. The urgency of climate change action necessitates that this plan be implemented and regularly updated. Regular updates will ensure the following:

- Tools proposed within the Plan are effectively reducing emission as expected
- Emission reductions are on track to reach the targets set-out in this Plan
- Most up-to-date tools are being utilized
- Plan reflects current corporate structure and function
- Review of resources required to implement programs
- Provide more detail to medium and long term recommended actions
- Plan reflects City current Council priorities

Plan revisions should be led by climate change staff with review and support from relevant City departments. Review of the plan should look at the action items outlined for the previous five year period and identify what was completed, what is in progress and what has not yet been initiated. For those programs that are not completed or initiated, it will be important to understand why that is the case and what resources or support are needed to accomplish these goals.

At each five year mark, emissions numbers should be compared to emission reduction targets and discussion on progress toward those targets should be included. If progress is not being made, discussion as to the support and leadership required to move in the right direction should be included.

Discussion with staff and Council can be conducted to understand the level of engagement with the Plan and what can be done to improve this going forward.

Priorities for the next five year period should be identified with specific actionable items and departmental leads.

Community engagement in collaboration with the Community Climate Change Action Plan should be conducted to gauge community support and ambition for the City to prioritize climate change action at City Hall.

11.1 Corporate Energy Management Plan

Many of the strategies, actions items and goals in the Climate Change Action Plan are similarly presented in the City's 2019 Corporate Energy Management Plan (CEMP). This Plan is focused on energy reduction strategies, goals and targets, and also discusses the emissions reduction benefits associated with that. The CEMP is updated every 5 years and will be next updated in 2024. Efficiencies can be found by looking at these two reports in tandem and providing common annual progress reports. The specific actions identified in each Plan are often similar and where they differ, the end result is the same. By reducing fossil fuel energy consumption, GHG emissions are reduced. The CEMP also looks at opportunities to switch fuel sources to clean energy and electricity options. Where goals are common between reports, they are mentioned within this plan, but there will continue to be overlap as the reports evolve and work together to meet the important energy reduction and emissions reduction goals at the City.

12. Accountability

Accountability for the actions outlined in this plan will be crucial for successful implementation and ensuring that emissions reduction targets are met. It is important that all levels of participation are accountable to these goals and that they hold each other accountable for their part in the process. By clearly identifying the role of each participant, and the mandate of that level of participation, progress is more likely to occur.

A. Municipal Government

Within this report, action items have been broken into particular sectors dealing with different functions, fuels, and solutions. These sectors are usually the responsibility of one department, but there is sometimes overlap or cross-departmental responsibility. Accountability has been initiated by identifying a lead department to push initiatives forward and these can be found with the "Emission Reduction Tools" tables within each section of the Corporate Emissions Reduction Strategy.

Annual reporting on the progress of the action items within this plan should be provided to Council and the public. Climate change staff can gather updates from the lead departments on the relevant actions and consolidate these updates into an annual progress report. If progress is not where it expected to be according to the timeline provided herein, the report will provide reasons for this delay and suggestions to correct this delay and/or additional resources required to accomplish the action.

The internal climate change advisory team that was established for the creation of this document will continue to meet annually at a minimum to review strategies, progress and resources. This annual meeting to discuss the Climate Change Action Plan will encourage ongoing progress through the sharing of ideas, strategies and resources. The advisory team can aid in the review of the emissions inventory data, review the indicators of success and the ongoing monitoring and tracking system. Additionally, this team can review the corporate-wide strategies proposed within this Plan that will impact the City as a whole to identify if strategies are effective at the departmental level.

B. Provincial and Federal Government

The Province and the Country both have GHG emission targets that need to be met in order to meet the global targets identified by the IPCC and agreed to in the Paris Climate Agreement. The upper levels of government can aid municipalities with their targets by providing regulatory and financial supports.

Many of the GHGs produced within the City limits are directly influenced by the Provincial or Federal government such as industrial emissions, fuel efficiency standards, building code requirements, etc.

One of the most common strategies proposed herein and across Ontario to reduce emissions is switching fossil fuel use to electricity for both buildings and fleet. Ontario's electricity grid is currently quite low in terms of GHG emissions, but is expected to increase emissions output as natural gas generators are ramped up to meet increasing electricity demand. If the City of Brantford is expected to meet the 2050 targets of net-zero emissions, there needs to be a source of clean electricity available. The Province needs to continue to work towards a clean electricity grid, which means moving away from natural gas power and increasing renewable energy (wind, hydro, solar, biomass, geothermal) and nuclear power outputs.

The Province can also facilitate the transition to net-zero emissions by increasing the requirements for building energy efficiency as part of the Ontario Building Code, allow more renewable energy development, including virtual net metering, increase regulation on emissions from industry and implement higher standards for fuel efficiency.

The Federal government can also support this transition by transitioning away from a fossil fuel based economy, disincentivizing carbon emissions through taxes or other regulation, and improving the market for carbon offset purchasing.

Both levels of government need to continue facilitating climate action by financially supporting Towns and Cities to make these changes through grant programs, technical resources, guidance material and green market growth.

The City of Brantford can continue to put pressure on the upper levels of government to ensure they are providing the support needed to meet these goals and doing the work necessary from their position. Municipalities will contend with a large portion of the costs associated with emission reduction, adaptation and damages caused by climate change. The City is a member of several groups that speak on behalf of municipalities directly to the provincial and federal governments such as Association of Municipalities of Ontario (AMO) and Large Urban Mayors Caucus of Ontario (LUMCO) and Federation of Canadian Municipalities (FCM). The City can continue to emphasize the importance of climate action at all levels of government and the support required to accomplish these goals.

C. Citizen Groups

The Environmental and Sustainability Policy Advisory Committee (ESPAC) is a citizen's Committee of Council. They meet monthly to discuss various environmental and sustainability initiatives that they coordinate in partnership with City staff. They also provide review and comment on Staff reports relating to these issues. ESPAC led the preparation of the Climate Emergency Declaration as well as the grant funding for the preparation of the Climate Change Action Plan. They hold an active interest in the outcomes of these projects and should be aware of the specific actions identified in the CCAP for both corporate and community initiatives. It is recommended climate change staff provide bi-annual (every six months) updates to ESPAC on the progress toward the goals identified within the Plan. Bi-annual updates are also recommended for the goals outlined in the CEMP and these updates can be completed in tandem.

Appendix A
Climate Atlas Report for Brantford

Municipality: Brantford

RCP 8.5: High Carbon climate future
GHG emissions continue to increase at current rates

Variable	Period	1976-2005	2021-2050			2051-2080		
		Mean	Low	Mean	High	Low	Mean	High
Precipitation (mm)	Annual	882	726	915	1111	764	956	1185
Precipitation (mm)	Spring	218	160	236	317	170	252	356
Precipitation (mm)	Summer	234	141	233	332	117	233	384
Precipitation (mm)	Fall	230	134	228	352	145	239	376
Precipitation (mm)	Winter	197	144	218	303	162	233	322
Mean Temperature (°C)	Annual	7.8	8.4	9.9	11.4	10	11.9	14
Mean Temperature (°C)	Spring	6.4	5.9	8.1	10.4	7.4	9.9	12.2
Mean Temperature (°C)	Summer	19.7	20	21.8	23.8	21.4	23.9	26.5
Mean Temperature (°C)	Fall	9.6	9.7	11.7	13.7	11.3	13.6	16.1
Mean Temperature (°C)	Winter	-4.6	-5	-2.1	0.5	-3.5	0.1	3.4
Tropical Nights	Annual	3	5	12	29	13	30	53
Very hot days (+30°C)	Annual	10	14	32	60	26	58	93
Very cold days (-30°C)	Annual	0	0	0	0	0	0	0
Date of Last Spring Frost	Annual	May 5	April 11	April 24	May 10	April 5	April 13	April 29
Date of First Fall Frost	Annual	Oct. 11	Oct. 6	Oct. 21	Nov. 1	Oct. 14	Nov. 1	Nov. 18
Frost-Free Season (days)	Annual	160	153	180	202	172	202	226

RCP 4.5: Low Carbon climate future
GHG emissions much reduced

Variable	Period	1976-2005	2021-2050			2051-2080		
		Mean	Low	Mean	High	Low	Mean	High
Precipitation (mm)	Annual	882	745	924	1120	745	954	1189
Precipitation (mm)	Spring	218	160	236	333	169	250	351
Precipitation (mm)	Summer	234	142	236	350	139	237	374
Precipitation (mm)	Fall	230	149	236	367	154	241	373
Precipitation (mm)	Winter	197	152	217	289	149	226	313
Mean Temperature (°C)	Annual	7.8	8.2	9.7	11.2	8.9	10.7	12.5
Mean Temperature (°C)	Spring	6.4	5.7	8.1	10.5	6.5	8.9	11.3
Mean Temperature (°C)	Summer	19.7	19.7	21.4	22.9	20.2	22.4	24.8
Mean Temperature (°C)	Fall	9.6	9.3	11.3	13.4	10.3	12.3	14.5
Mean Temperature (°C)	Winter	-4.6	-5.6	-2.2	0.7	-4.4	-1.2	1.8
Tropical Nights	Annual	3	3	10	23	6	17	38
Very hot days (+30°C)	Annual	10	11	27	52	15	38	70

Where did this data come from?

Global Climate Models (GCMs) are used to depict how the climate is likely to change in the future. Since no one climate model can be considered correct, it is important to use many GCMs to capture a range of possible conditions. The GCM data we used were obtained from the Pacific Climate Impacts Consortium (PCIC). PCIC collected temperature and precipitation data produced by 12 different models and used advanced statistical techniques to create high-resolution (daily, 10km) versions of the data for all of Canada (for more information visit pacificclimate.org).

What are the RCP 8.5 and RCP 4.5 future climate scenarios?

One of the most important inputs into GCM simulations of the future climate is the expected concentration of greenhouse gases (GHGs; especially carbon dioxide) in the atmosphere as a result of human activity. In the scientific literature these future GHG concentrations are used to calculate Representative Concentration Pathways (RCPs). The High Carbon scenario (RCP8.5) assumes that we continue to emit very large amounts of carbon dioxide from the burning of fossil fuels; the Low Carbon scenario (RCP4.5) assumes that drastic reductions of emissions in the coming decades will stabilize the concentration of GHGs in the atmosphere by the end of this century. We did not use RCP2.6, an even lower emissions scenario.

How are the minimum, mean, and maximum calculated?

We used an ensemble of 12 different GCMs to analyze the future climate. The mean values are the average values of this ensemble over the 1976-2005, 2021-2050 and 2051-2080 periods. The maximum model projection (high) and the minimum model projection (low) are provided to indicate the full range of modelled values.

The Climate Atlas of Canada

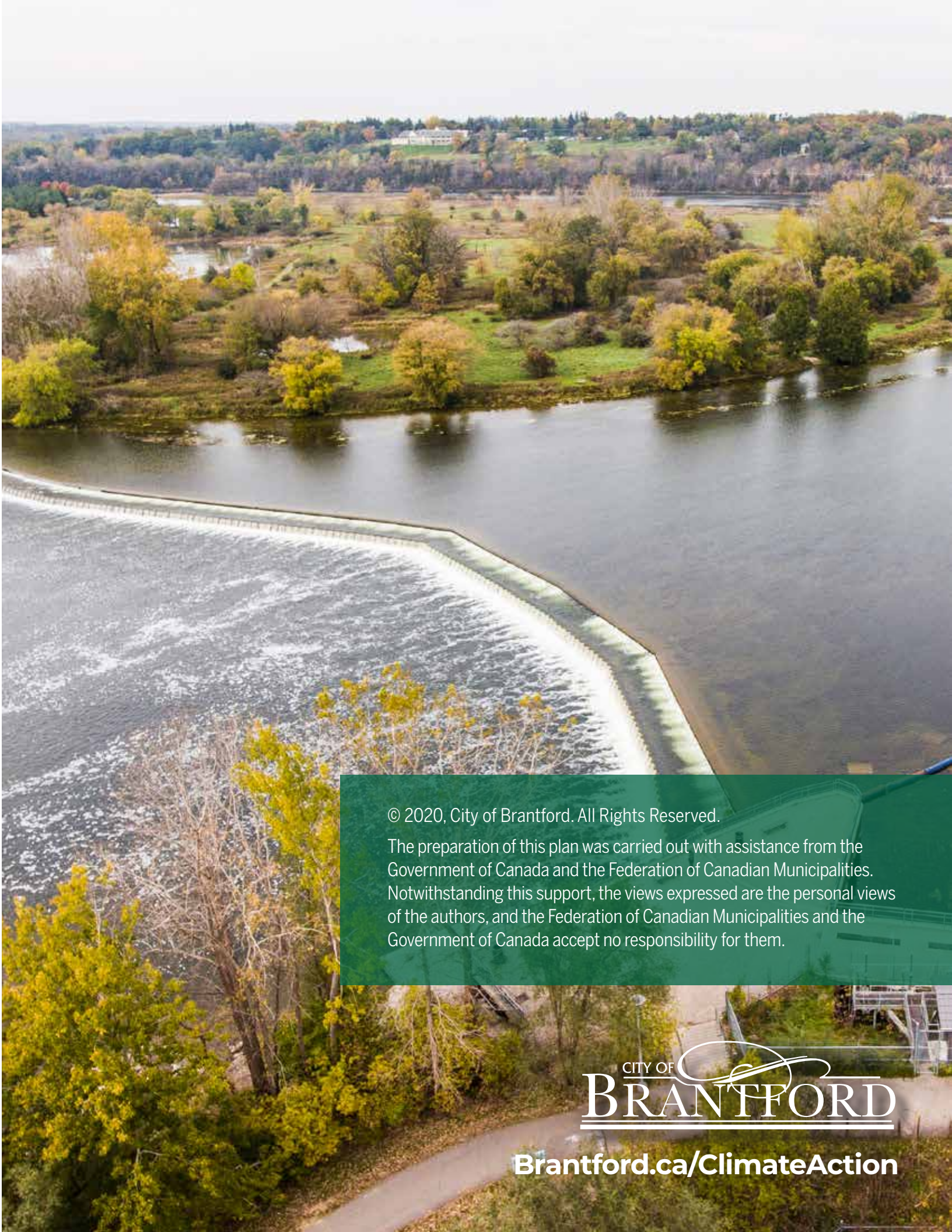
The Climate Atlas of Canada (climateatlas.ca) is an interactive tool for citizens, researchers, businesses, and community and political leaders to learn about climate change in Canada. It combines climate science, mapping and storytelling to bring the global issue of climate change closer to home, and is designed to inspire local, regional, and national action and solutions.

Disclaimer

Appendix B
Five-year Overview of Costs

Appendix B: Climate Change Action Plan Five-Year Capital Costs

Action	Department	Notes	2021	2022	2023	2024	2025	Total
Optimizing Fleet	Fleet and Transit Services	Staff time						
Convert Light Duty Autos to EV	Fleet and Transit Services	Costs for EVs over gas	$50,000	$110,000	$60,000		$30,000	$250,000
Anti-idling Policy	Fleet and Transit Services	Staff time						
Initiate Bus Fleet to Electric	Fleet and Transit Services	Pre-existing work plan						
Energy efficiency driver training	Fleet and Transit Services	Staff time						
Route planning	Fleet and Transit Services	Pre-existing work plan						
EV sharing pilot	Fleet and Transit Services	Staff time						
Reimagining the workplace	Facilities Management & Security	Staff time						
Green Building Standard	Facilities Management & Security	Staff time						
Energy efficiency workplace training	Facilities/Human Resources	Staff time						
Building operational standard	Facilities Management & Security	Staff time						
Building retrofit strategy	Facilities/Community Housing	Staff time						
Smart water meters on all buildings	Public Works (ES)/Facilities	Meter costs	$3,500	$3,500	$3,500	$3,500	$3,500	$17,500
Water Conservation Programs	Public Works (ES)/Facilities	Staff time						
Wastewater reduction programs	Public Works (ES)/Facilities	Staff time						
Stormwater reduction programs	Public Works (ES)/Facilities	Staff time						
W/WW piping system infrastructure improvements	Public Works (ES)	Pre-existing work plan						
Convert HPS bulbs to LED	Public Works (OS)	Pre-existing work plan						
Waste Reduction Education and Community Engagement	Public Works (ES)	Staff time						
Organic waste diversion initiation	Public Works (ES)	Pre-existing work plan						
Emergency Services Fleet Plan	CAO's office	Staff time						
Climate Lens Assessment	CAO's office	Staff time						
Tree Canopy Expansion	Public Works (Parks)	Tree Costs	$30,000	$30,000	$30,000	$30,000	$30,000	$150,000
Corporate Policy Review	CAO's office	Staff time						
Climate Adaptation Plan	CAO's office	Staff time						
Total Project Costs per Year			$83,500	$143,500	$93,500	$33,500	$63,500	$417,500



The preparation of this plan was carried out with assistance from the Government of Canada and the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

CITY OF BRANTFORD

Brantford.ca/ClimateAction