

Corporate Energy & Emissions Plan (CEEP)

City of Fredericton

March 9, 2021

Prepared for:

City of Fredericton

Prepared by:

Stantec Consulting Ltd.



Fredericton

Table of Contents

EXECUTIVE SUMMARY	1
ABBREVIATIONS.....	XI
1.0 INTRODUCTION	1
1.1 CLIMATE CHANGE IS A PRIORITY	1
1.2 PARTNERS FOR CLIMATE PROTECTION (PCP) PROGRAM	1
2.0 CEEP OBJECTIVE & SCOPE.....	3
2.1 OBJECTIVE	3
2.2 CORPORATE BOUNDARIES AND SCOPE	4
3.0 METHODS.....	7
4.0 CORPORATE ENERGY & GHG EMISSIONS	8
4.1 CURRENT ENERGY & GHG EMISSIONS	8
4.2 HISTORICAL TRENDS	10
4.3 CORPORATE ENERGY AND GHG FORECAST	12
4.3.1 Business as Usual (BAU) Energy and GHG Emissions Forecast	12
4.3.2 Energy Costs	14
4.3.3 Progress Towards 2030 and 2050 Targets	14
5.0 BUILDINGS & FACILITIES.....	19
5.1 BUILDINGS & FACILITIES INITIATIVES.....	21
5.1.1 B1: Develop a Green Building Sustainability Policy.....	21
5.1.2 B2: Complete Building & Facility Utilization Assessments	22
5.1.3 B3: Develop De-Carbonization Plan for Buildings & Facilities.....	22
5.1.4 B4: Implement Energy Audit Recommendations	23
5.1.5 B5: Implement a Building Commissioning Program.....	25
5.1.6 B6: Continue to Develop Alternative Work Strategies and Supportive Policies	25
5.2 SUMMARY OF PROPOSED INITIATIVES	27
6.0 TRANSIT, FLEET & EQUIPMENT	29
6.1 FLEET & EQUIPMENT INITIATIVES.....	32
6.1.1F1: Implement Lean Sigma Six Review of Fleet	

32		
6.1.2	F2: Opportunistically Switch Light Duty Fleet to Hybrid / Electric	32
6.1.3	F3: Monitor Renewable Energy and Fuel Technologies	33
6.1.4	F4: Opportunistically Switch Off-Road and Hand-Held Equipment to Electric	34
6.2	TRANSIT INITIATIVES.....	34
6.2.1	T1: Monitor Cold-Weather City EV Bus Programs.....	34
6.2.2	T2: Complete an On-Demand Transit Feasibility Study & Implement the Recommendations	35
6.3	SUMMARY OF PROPOSED INITIATIVES	36
7.0	SOLID WASTE.....	38
7.1.1	SW1: Develop Solid Waste Management Plan.....	38
7.2	SUMMARY OF PROPOSED INITIATIVES	40
8.0	WATER & WASTEWATER.....	41
8.1	WATER INITIATIVES.....	43
8.1.1	W1: Expand Pilot Remote Water Metering Program to City	43
8.1.2	W2: Implement Pilot GPS AVL Study on Vehicle Fleet Pollution Control.....	43
8.2	POLLUTION CONTROL INITIATIVES	44
8.2.1	P1: Complete a City-Wide Sewer-Shed Study	44
8.2.2	P2: Assess the Feasibility of a Large Solar PV Array	44
8.2.3	P3: Implement Energy Audit Recommendations	44
8.2.4	P4: Assess the Energy and Revenue Potential of the Bio-Materials Generated at the Barker Street PCC.....	45
8.3	SUMMARY OF PROPOSED INITIATIVES	46
9.0	CORPORATE LEADERSHIP	48
9.1.1	C1: Establish Energy & GHG Reduction Targets	48
9.1.2	C2: Establish Role & Hire A Corporate and Community Energy Manager	49
9.1.3	C3: Update Asset Management Plan and Policy	50
9.1.4	C4: Pilot the Use of LCA Tools When Making Capital Purchases	50
9.1.5	C5: Develop A Corporate Energy Savings Policy and Terms of Reference (ToR)	51
9.1.6	C6: Create Sustainable Purchasing Policy	51
9.2	SUMMARY OF PROPOSED INITIATIVES	52
10.0	IMPLEMENTATION & MONITORING.....	55
10.1	CEEP INITIATIVE TIMING	55
10.2	CEEP MANAGEMENT SYSTEM.....	56
10.3	GOVERNANCE AND COLLABORATION	57
10.4	ENERGY & GHG BOUNDARIES.....	58
10.5	ANNUAL DATA COLLECTION & REPORTING.....	58
10.6	EVALUATING FUTURE INITIATIVES.....	59
10.7	MONITORING & REPORTING	59
10.8	RESOURCE & BUDGET PLANNING	61

10.8.1	Financial Resources	61
10.8.2	Staff Resources	61
10.8.3	Funding Opportunities and Risks	61
10.9	COMMUNICATION STRATEGY.....	62
10.9.1	Responsibility	62
10.9.2	Tactics.....	62
10.9.3	Recommendations	63

LIST OF TABLES

Table 1.	List of Assets Included in the CEEP	4
Table 2.	2019 Corporate Energy and GHG Emissions by Category	8
Table 3.	Estimated GHG Emissions By Sector	18
Table 4.	Top GHG Emitting Facilities in 2019	19
Table 5.	Estimated GHG Emission Reductions From Buildings & Facilities.....	20
Table 6.	Summary of Energy Audit Recommendations	24
Table 7.	Summary of Buildings & Facilities Initiatives	27
Table 8.	Fleet & Equipment Energy And GHG Emissions By Department	29
Table 9.	Estimated GHG Emission Reductions From Transit, Fleet & Equipment	31
Table 10.	Summary of Transit, Fleet & Equipment Initiatives	36
Table 11.	Estimated GHG Emission Reductions From Solid Waste.....	39
Table 12.	Summary of Solid Waste Initiatives	40
Table 13.	Estimated GHG Emission Reductions From Water & Wastewater	42
Table 14.	Summary of Energy Audit Recommendations	45
Table 15.	Summary of Water & Pollution Control Initiatives	46
Table 16.	Summary of Corporate Leadership Initiatives.....	52
Table 17.	CEEP Initiative Timing.....	55
Table 18.	City Reporting Sectors	58
Table 19.	Suggested Communication Tactics.....	62
Table 20.	Timing and Responsibility of Suggested Communication Tactics	63

LIST OF FIGURES

Figure 1.	CEEP Operational Profile	3
Figure 2.	GHG Emissions By Source	9
Figure 3.	GHG Emissions by Fuel Type	10
Figure 4.	2004 - 2019 Absolute and Per Capita GHG Emissions Trends	11
Figure 5.	Historical Corporate Energy Consumption (GJ) By Fuel Type	12
Figure 6.	Business as Usual Energy And GHG Emissions Forecast	14
Figure 7.	Forecasted GHG Emission Reductions by CEEP Initiative Category	15
Figure 8.	Forecasted GHG Emissions by Reporting Sector (With RNG / Offsets)	16
Figure 9.	Forecasted Energy Consumption	17
Figure 10.	Forecast of Buildings Energy & GHG Emissions	21
Figure 11.	Vehicle & Equipment GHG Emissions by Department / Unit.....	30
Figure 12.	Forecast of Fleet & Equipment Energy and GHG Emissions	31
Figure 13.	Forecasted Electric Vehicle Global Sales.....	33

Figure 14. Zero Waste Hierarchy	39
Figure 15. Water & Wastewater GHG Emissions By Fuel Type.....	41
Figure 16. Forecast of Water & Wastewater Energy and GHG Emissions	43
Figure 17. The Deming Cycle (Plan-Do-Check-Act)	60

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

Executive Summary

An understanding of climate change and a focus on reduction of greenhouse gas (GHG) emissions has long been a priority for the City of Fredericton (the City) having reported on corporate GHG emissions since 2004. Energy consumption and associated GHG emissions arise as a result of the provision of key services by the City, which include the operation of buildings, fleet, transit, equipment, wastewater treatment, outdoor lighting, and the disposal of solid waste. In 2019, the City's corporate energy consumption and GHG emissions amounted to 182,000 Gigajoules (GJ) and 13,476 tonnes of carbon dioxide equivalent (tCO₂e) – a reduction of 23 percent from the 2004 base reporting year.¹

As important as these energy GHG reduction milestones are, they are not enough to combat the effect that the estimated 3 to 4°C global warming trajectory and the associated impacts that global GHG emissions may have on our global climate system. To substantially reduce the risks and effects of climate change, scientists and policy makers have come to the agreement that global society must stabilize and reduce GHG emissions to levels to limit global temperatures from rising beyond 1.5°C over the next 30 years. This translates to reducing GHG emissions by 50 percent by 2030 and more than 80 percent by 2050. If the current global GHG emissions trajectory continues, scientists estimate that global temperatures could rise by 4 to 6°C this century, resulting in irreversible environmental, social, and climatic changes, and economic losses ranging from 5 to 20 percent of global Gross Domestic Product (GDP) annually.²

As centers of communication, commerce, and culture, municipal government organizations play an important role in the reduction of GHG emissions and the impacts that climate change can have on a community. They have a leadership role that influences their communities beyond their organization's carbon footprint. On this basis, it is recommended in this Corporate Energy & Emissions Plan (CEEP) that the City establish GHG emission reduction targets of 30 percent by 2030, and 80 percent by 2050 (below 2004 levels). The objective of the CEEP is to establish initiatives that build momentum and lay the groundwork for deep energy and GHG emissions reduction actions to be implemented post-2025. The CEEP covers a 5-year horizon from 2020 to 2025, but also considers the actions needed to achieve the 2030 and 2050 targets. The CEEP also meets the ongoing reporting and planning requirements of the Federation of Canadian Municipalities (FCM) Partners for Climate Protection (PCP) Program.

The CEEP GHG emission forecast was based on corporate energy and GHG emissions available for the most current year, 2019, and trends since the 2004 base year as well as anticipated growth to 2050. The identification of initiatives for incorporation into the CEEP was done through a combination of staff engagement, a best-in-class review of other municipalities and input from internal and external subject matter experts.

To achieve the proposed 2030 GHG reduction target, before 2030, the City must:

- Prepare and implement building decarbonization plans for the following buildings and achieve at least a 55 percent reduction in energy consumption (from 2004 levels):

¹ Details on the 2019 GHG inventory and forecast assumptions are included in the 2019 GHG Emissions Inventory Report.

² http://mudancasclimaticas.cptec.inpe.br/~rmclima/pdfs/destaques/sternreview_report_complete.pdf

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

- City Hall
 - Willie O'Ree Place
 - Grant Harvey Centre
 - Lady Beaverbrook Rink
 - St Mary's Depot
 - Two Nations Fire/EOC
 - Fredericton Public Library
 - Regent Depot
 - York Arena
 - York Fire Station
 - Transit Garage
 - Fredericton Police Station
- Implement the recommended energy conservation projects as identified in the recently completed energy audits. For other infrastructure, seek out energy projects to reduce energy and GHG emissions.
 - Implement an ongoing building commissioning and monitoring program to achieve improved energy conservation through optimized operation.
 - Begin the conversion of fleet vehicles to electric and low-carbon fuels.
 - Implement an on-demand transit program that achieves upwards of a 15 percent reduction in energy and emissions.
 - Establish programs that facilitate more accountability and ownership with City staff over cost and fuel management (e.g., departmental carbon planning).
 - Increase vehicle optimization and reduce overall fuel consumption.

The use of Renewable Natural Gas (RNG) and carbon offsets should be deemed as a last resort option as these tools are essentially self-imposed taxes which have no return on investment to the City. It is therefore recommended that the City focus on energy conservation building retrofits and low- or zero-carbon technologies first and to only use RNG or carbon offsets when there are financial, policy or technological barriers (e.g., heritage buildings) to achieving the required GHG reduction targets.

Over the longer term, the achievement of the 2050 energy and GHG reduction target will require the aggressive conversion of all fleet and gas and diesel powered equipment to either electric or renewable fuels, and adjustment of various business models and service levels. It is also assumed that NB Power will continue to green the electrical grid over the next 30 years to which the City can recognize the benefit in reduced GHG emissions from electricity consumption.

Table E-1 presents the short-, medium- and long-term GHG emission reductions based on the estimated potential of the initiatives proposed and with and without the use of RNG and carbon offsets. The table shows that if the City implements the proposed initiatives, it will be on track to achieve the proposed 2030 GHG reduction target; however, to achieve the 2050 GHG reduction target, RNG and offsets would be required in lieu of established low carbon, cost-efficient technologies.

the GHG targets for each reporting sector are presented in Table E-1 and can be used as interim 2030 targets to track progress against.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

Table E-1. City of Fredericton Estimated GHG Emissions Targets By Sector

Reporting Sector	2025	2030	2040	2050
Buildings & Facilities Emissions (tCO ₂ e)	3,464	2,560	1,727	1,679
Lighting & Traffic Signals Emissions (tCO ₂ e)	842	809	745	715
Transit, Fleet & Equipment Emissions (tCO ₂ e)	4,944	4,911	3,655	2,256
Water & Wastewater Emissions (tCO ₂ e)	3,306	3,395	3,559	3,802
Solid Waste Emissions (tCO ₂ e)	152	155	172	163
RNG / Offsets (tCO ₂ e)	-	(733)	(941)	(5,603)
Total GHG Emissions (tCO₂e)	12,708	11,097	8,917	3,013
Change from 2004 Base Year With RNG / Offsets	-28%	-37%	-49%	-83%
Change from 2004 Base Year Without RNG / Offsets	-28%	-33%	-44%	-51%

Notes to Table: 2004 Base Year = 17,549 tCO₂e

The GHG emissions by sector are presented in Figure E-1

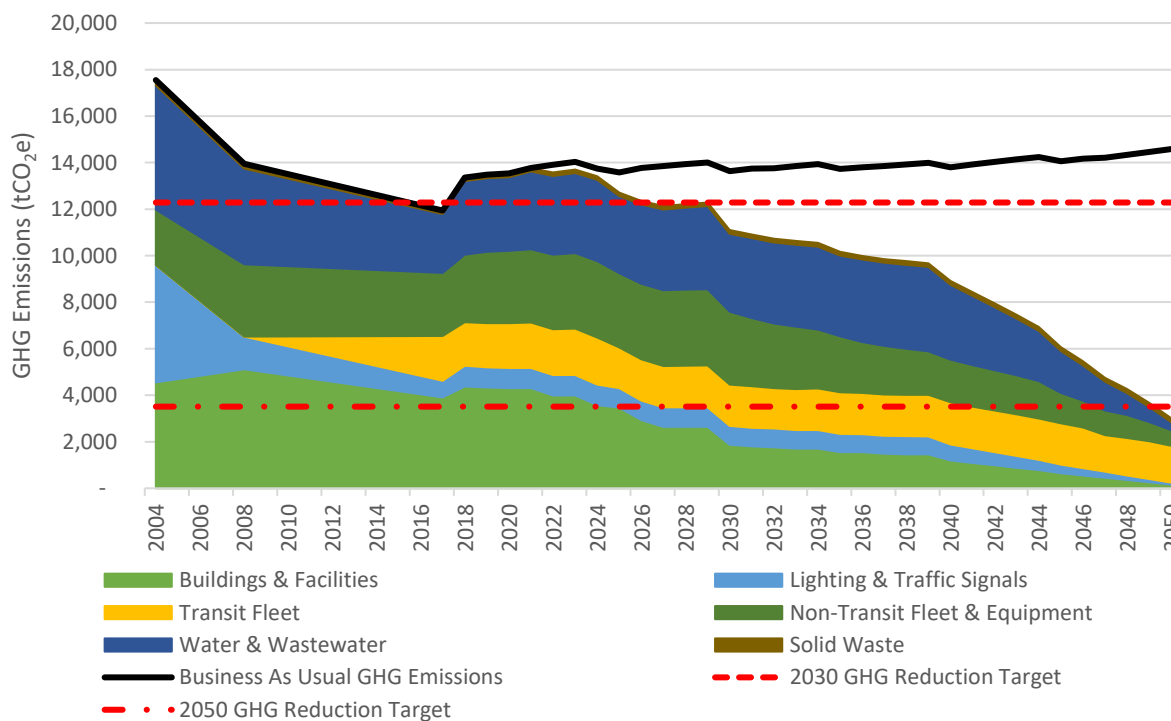


Figure E-1. Forecasted GHG Emissions By Reporting Sector (With RNG & Offsets)

To confidently meet these GHG emission reductions, implementing bold initiatives is not enough, tracking and accountability are required to monitor progress and allow for adjustments to meet unforeseen circumstances. The CEEP provides an organizational structure and framework to support initiative implementation and progress tracking.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

In implementing the CEEP initiatives, framework and organizational structure described in this plan, the City can position itself to achieve the proposed GHG reduction targets. The proposed initiatives are summarized in Table E-2. The following initiatives are proposed to be implemented in the 2021 – 2022 reporting years:

- T2: Complete an On-Demand Transit Feasibility Study & Implement the Recommendations.
- W2: Implement Pilot GPS AVL Study on Vehicle Fleet
- P1: Complete a City-Wide Sewer-shed Study
- B1: Develop a Green Building Sustainability Policy
- B5: Complete a Buildings Utilization Assessment
- P3: Implement Energy Audit Recommendations
- C2: Establish Role & Hire a Corporate and Community Energy Manager
- C3: Update Asset Management Plan and Policy
- C5: Develop a Corporate Energy Savings Policy and Terms of Reference (ToR)
- C6: Update Sustainable Purchasing Policy

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

Table E-2. Summary of Proposed Initiatives

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
Buildings & Facilities							
B1	Develop a Green Building Sustainability Policy	Develop Green Building Policy and technical standards that establishes operational energy performance requirements for when existing facilities undergo major renovations and when new facilities are constructed.	Supportive Initiative	<ul style="list-style-type: none"> Consultant Time (\$5,000) 	Short-term	<ul style="list-style-type: none"> Building Services Corporate Services 	<ul style="list-style-type: none"> Policy and technical standards are completed, approved and integrated into the renewed asset management plan.
B2	Implement Energy Audit Recommendations	Complete recommendations from comprehensive energy audits already recommended by MCW, implement the recommendations, and track the progress of energy audits and projects. Leverage external funding opportunities to implement energy reduction initiatives with longer payback periods.	7-8% Energy Reduction	<ul style="list-style-type: none"> \$1.7M (After Available External Funds). Some of this work will be incorporated in deep retrofit / decarbonization projects Staff Time (1 FTE) 	Medium-term (in tandem with B5 for facilities identified as a deep retrofit priority)	<ul style="list-style-type: none"> Building Services 	<ul style="list-style-type: none"> Building Energy Intensity (GJ/m²) Building GHG Emissions Intensity (tCO₂e/m²) Building Energy Cost Intensity (\$/m²)
B3	Develop De-Carbonization Plan for Buildings & Facilities	Develop a unifying de-carbonization plan for each major City building and facility. De-carbonizing existing buildings will require deep energy retrofits that upgrade or replace equipment and building envelopes (e.g. roof, walls, windows) to achieve large energy and greenhouse gas emission reductions. A decarbonization plan for City Hall has been established, but plans for Regent Depot, St. Mary's Depot, and the Transit Depot Admin Office are required in the short-term.	40-60% Energy Reduction	<ul style="list-style-type: none"> Staff Time (1 FTE) OR Consultant Time (TBD) <p>40% Premium on Retrofit Construction Cost (\$/ft²)</p>	Medium-term	<ul style="list-style-type: none"> Building Services 	<ul style="list-style-type: none"> Building Energy Intensity (GJ/m²) Building GHG Emissions Intensity (tCO₂e/m²) Building Energy Cost Intensity (\$/m²) Develop plans for the top 15 energy consuming buildings and facilities.
B4	Implement a Building Commissioning Program	Prepare and implement an ongoing building commissioning and retro commissioning plan.	Supportive Initiative	<ul style="list-style-type: none"> Staff Time (0.5 FTE) 	Short-term (work is ongoing)	<ul style="list-style-type: none"> Building Services 	<ul style="list-style-type: none"> Building Energy Intensity (GJ/m²) Building GHG Emissions Intensity (tCO₂e/m²) Building Energy Cost Intensity (\$/m²)

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
B5	Complete a Buildings Utilization Assessment	Review service delivery requirements and needs with consideration to facility operational demands with the objectives of identifying operational and service delivery efficiencies. Establish KPI's that relate building / facility energy consumption to operational parameters (e.g., energy consumption (GJ) / operating hour, # of community programs per day by facility, etc.) to better understand what energy and GHG drivers and to identify related reduction / conservation opportunities	Unknown	<ul style="list-style-type: none"> Staff time (0.15 FTE) 	Short-term	<ul style="list-style-type: none"> Building Services, Recreation 	<ul style="list-style-type: none"> Building Energy Intensity (GJ/m²) Building GHG Emissions Intensity (tCO₂e/m²) Building Energy Cost Intensity (\$/m²) Operating Hours Space Utilization Index
B6	Develop Alternative Work Strategies and Supportive Policies	A cost-effective energy and GHG measure that can be deployed is to implement policies that allow for more flexible work environments and disincentivize travel.	Supportive Initiative	<ul style="list-style-type: none"> Staff Time (0.25 FTE) 	Long-term	<ul style="list-style-type: none"> Corporate Services 	<ul style="list-style-type: none"> Policy is completed and approved
Fleet							
F1	Implement Lean Sigma Six Review of Fleet	Implement Lean Sigma Six program review of the fleet, mileage, and fuel usage with the objective of reducing capital, energy, and operational costs.	10-17% for fleet rightsizing and utilization improvements	<ul style="list-style-type: none"> To be determined. 	Medium-term (begin after AVL pilot data is in)	<ul style="list-style-type: none"> Fleet 	<ul style="list-style-type: none"> Review is completed; recommendations are implemented. Unit fuel/km Total L of fuel types used # of vehicles with greater fuel efficiency, hybrid, EV etc.
F2	Opportunistically Switch Light Duty Fleet to Hybrid / Electric	Monitor hybrid police vehicle trial that is underway and apply learnings to other departments with light duty vehicles and trucks when the opportunity arises. For new vehicle and equipment purchases, leverage the purchasing power of the Tri-City Purchasing Agreement and Government of New Brunswick tenders, where feasible.	40-60% per vehicle	<ul style="list-style-type: none"> Assume extra \$3,000 per EV LDV until cost parity is achieved in 2025. LDT EV / Hybrid premiums will likely range from \$8k to \$15k for an indeterminable period of time. 	Pilot is underway Medium-term	<ul style="list-style-type: none"> Fleet 	<ul style="list-style-type: none"> Unit fuel/km Total L of fuel types used # of vehicles with greater fuel efficiency, hybrid, EV etc.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
F3	Monitor Renewable Energy and Fuel Technologies	Monitor the development and implementation of practical research, technologies, and investment in the area of renewable energy and fuels (e.g., B100).	Supportive Initiative	<ul style="list-style-type: none"> Staff time (0.15 FTE) 	Medium-term	<ul style="list-style-type: none"> Fleet Corporate Services 	<ul style="list-style-type: none"> Unit fuel/km Total L of fuel types used # of vehicles with greater fuel efficiency, hybrid, EV etc.
F4	Opportunistically Switch Off-Road and Hand-Held Equipment to Electric	Continue to opportunistically switch off-road and hand-held equipment to electric powered where health and safety and performance is not compromised.	40-60% / Equipment	<ul style="list-style-type: none"> Staff time 	Work underway/ongoing	<ul style="list-style-type: none"> Fleet 	<ul style="list-style-type: none"> Unit fuel/km Total L of fuel types used # of pieces of electric equipment.
Transit							
T1	Monitor Cold-Weather City EV Bus Programs	Monitor other cold weather City electric and hybrid bus initiatives (e.g., the City of Edmonton) to gain insights into the resources required and the lessons learned in order to inform future pilot hybrid / EV transit projects that could be implemented as City buses are replaced.	Supportive Initiative	<ul style="list-style-type: none"> Staff time (0.10 FTE) 	Monitoring (ongoing)	<ul style="list-style-type: none"> Transit 	<ul style="list-style-type: none"> Number of hybrid / EV busses in City Fleet
T2	Complete an On-Demand Transit Feasibility Study & Implement the Recommendations.	Complete an on-demand transit feasibility study to understand how shared, on-demand transit (micro-transit) can successfully complement the fixed-route bus transit system currently in place and result in operational and energy efficiencies.	13%-15% of transit fleet fuel consumption.	<ul style="list-style-type: none"> \$100,000 for study. Implementation costs unknown. 	Medium-term	<ul style="list-style-type: none"> Transit 	<ul style="list-style-type: none"> Completion of Study Transit Ridership Transit Utilization GHG / Transit Rider
Solid Waste							
SW1	Develop Solid Waste Management Plan	Develop a corporate and community solid waste management plan that aligns with the 7R's of zero waste.	Up to 100% of solid waste emissions	<ul style="list-style-type: none"> Staff Time (0.25 FTE) Staff Member / Consultant Salary 	Long-term	<ul style="list-style-type: none"> Engineering 	<ul style="list-style-type: none"> Completion of Initiative tonnes of solid waste / person
Water							
W1	Expand Pilot Remote Water Metering Program	Based on the results of the remote / electronic water metering pilot program, implement the learnings and expand the program to the rest of the City.	10-25% of water fleet emissions	<ul style="list-style-type: none"> To be determined. 	Medium-term	<ul style="list-style-type: none"> Water & Sewer 	<ul style="list-style-type: none"> Unit fuel/km Total L of fuel types used

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
W2	Implement Pilot GPS AVL Study on Vehicle Fleet	Implement a pilot AVL project on the water department fleet with the objective of monitoring the fuel reduction benefit from the Remote Water Metering Program and from changing driver habit programs.	10-17% of water fleet emissions.	<ul style="list-style-type: none"> To be determined. 	Short-term (in 2021 budget)	<ul style="list-style-type: none"> Fleet Water 	<ul style="list-style-type: none"> Unit fuel/km Total L of fuel types used
Pollution Control							
P1	Complete a City-Wide Sewer-shed Study	Complete a City-wide sewer-shed study to find opportunities to reduce infiltration and reduce energy	Supportive Initiative	<ul style="list-style-type: none"> To be determined. 	Short-term (in 2021 budget)	<ul style="list-style-type: none"> Pollution Control 	<ul style="list-style-type: none"> Completion of study & implementation of recommendations Energy Intensity (GJ/m³) Infiltration Rate Renewable energy opportunities are identified and assessed
P2	Assess the Feasibility of a Large Solar PV Array	Complete a more detailed analysis of large solar array to reduce the GHG intensity of energy consumption at the WWTP. Financial viability can be improved by accessing external funding sources (i.e. FCM).	2% Energy Reduction	<ul style="list-style-type: none"> \$0.6M (After Available External Funds) 	Medium-term	<ul style="list-style-type: none"> Pollution Control Building Services 	<ul style="list-style-type: none"> KWh_{ac} produced % of energy demand from renewable energy Energy Intensity (GJ/m³) Operational Energy Costs
P3	Implement Energy Audit Recommendations	Excluding the solar PV recommendations, complete recommendations identified in the comprehensive MCW energy audits, and track the progress of energy audits and projects.	3% Energy Reduction	<ul style="list-style-type: none"> \$1.6M (After Available External Funds) Staff Time (0.5 FTE) 	Short-term	<ul style="list-style-type: none"> Pollution Control Building Services 	<ul style="list-style-type: none"> Energy Intensity (GJ/m³) Operational Energy Costs
P4	Assess the Energy and Revenue Potential of the Bio-Materials Generated at the Barker Street PCC	Engage a Subject Matter Expert (SME) to quantify the potential of bio-material use as fuel and income generating potential from organic material discharged from the Barker Street Pollution Control Centre.	To be Determined	<ul style="list-style-type: none"> To be determined 	Currently underway/ongoing	<ul style="list-style-type: none"> Pollution Control 	<ul style="list-style-type: none"> Energy Savings (GJ) Avoided GHG emissions
Corporate							
C1	Establish Energy and GHG Reduction Targets	Establish corporate energy and GHG emission reduction targets for 2030 and 2050.	Primary Initiative	<ul style="list-style-type: none"> In progress 	In progress	<ul style="list-style-type: none"> Corporate Services 	<ul style="list-style-type: none"> Establishment of Targets

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
C2	Establish Role & Hire a Corporate and Community Energy Manager/ Developing a policy/procedure on implementation	Establish a role within the organization with an adequate level of authority to lead the Corporate and Community Energy and Emission Plans.	Primary Initiative	<ul style="list-style-type: none"> To be determined 	Short-term	<ul style="list-style-type: none"> Corporate Services 	<ul style="list-style-type: none"> Establishment of Role Hiring of Energy Manager
C3	Update Asset Management Plan and Policy	Update Asset Management Policy and associated Plan to include the objective of investing in assets to mitigate and adapt to climate change, as part of asset management planning. An update to the Municipal Plan should also be considered concurrently with the Asset Management Plan as they need to be consistent.	Supportive Initiative	<ul style="list-style-type: none"> Staff Time (0.5 FTE) AND Consultant Time (\$50,000) 	Short-term	<ul style="list-style-type: none"> Corporate Services 	<ul style="list-style-type: none"> Update of Plan and Policy
C4	Pilot the Use of LCA Tools When Making Capital Purchases	Pilot the use of publicly available or low cost LCA tools (e.g., RETScreen) to account for energy and GHG emissions in budget and capital planning and asset management. For example, when considering the need for new municipal facilities or retrofits to existing facilities, a lifecycle analysis will provide information about the amount of energy used over the entire span of a building's life – from planning and design, to construction, through operation, to decommissioning. The LCA should include all of the energy inputs, including those used to create building materials at the outset, and to dispose of them at the end of the building's life.	Supportive Initiative	<ul style="list-style-type: none"> Staff Time / Training in LCA Tools 	Medium-term	<ul style="list-style-type: none"> Legal Finance Procurement Building Services 	<ul style="list-style-type: none"> Policy is completed and approved
C5	Develop A Corporate Energy Savings Policy and Terms of Reference (ToR)	Formalize an energy savings policy and terms of reference that recognizes and makes available any operational budgets saved, as a result of energy conservation and demand initiatives. Savings in budget would be available to any department with	Supportive Initiative	<ul style="list-style-type: none"> Staff Time (0.25 FTE) 	Short-term	<ul style="list-style-type: none"> Finance 	<ul style="list-style-type: none"> Policy is completed and approved

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
C6	Create Sustainable Purchasing Policy	an energy reduction opportunity that meets the requirements of the ToR. Update Sustainable Purchasing Policy to clearly prioritize products and services that reduce / conserve operational energy use and GHG emissions.	Supportive Initiative	<ul style="list-style-type: none"> Staff Time (0.25 FTE) 	Short-term	<ul style="list-style-type: none"> Corporate Services Legal Procurement 	<ul style="list-style-type: none"> Policy is completed and approved
C7	Establish Departmental GHG Accounting & Reporting Program	Develop a methodology to assign energy consumption and GHG emissions to each department.	Supportive Initiative	<ul style="list-style-type: none"> Staff Time (0.25 FTE) 	Short-term	<ul style="list-style-type: none"> Corporate Services 	<ul style="list-style-type: none"> Program is implemented

Table E-3. Timing of Actions

Notation	Timeline
Short-term	Complete by end of 2022
Medium-term	Complete by end of 2024
Long-term	Complete by end of 2026
Ongoing	Work will be ongoing between 2021 and 2026
Work underway	The project has begun

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

Abbreviations

Abbreviation	Full Name
BAS	Building Automation System
BAU	Business as Usual
BCA	Building Conditions Assessment
CAFE	Corporate Average Fuel Economy
CEEP	Corporate Energy and Emissions Plan
CO ₂ e	Carbon Dioxide Equivalent
DHW	Domestic Hot Water
EV	Electric Vehicle
FCM	Federation of Canadian Municipalities
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GJ	Gigajoule
HDV	Heavy Duty Vehicle
HVAC	Heating, Ventilation and Air Conditioning
ICC	Internal Cost of Carbon
I&I	Infiltration & Inundation
LCA	Life Cycle Analysis
LDT	Light Duty Truck
LDV	Light Duty Vehicle
MDV	Medium Duty Vehicle
NRCAN	Natural Resources Canada
PCC	Pollution Control Center
PV	Photovoltaic
RNG	Renewable Natural Gas
VFD	Variable Frequency Drive

1.0 INTRODUCTION

1.1 CLIMATE CHANGE IS A PRIORITY

Climate change has emerged as an unprecedented social, economic, and environmental challenge facing our society today. It poses a serious threat to our quality of life, jobs, and our physical and natural assets. Scientists believe that the human-production of greenhouse gas (GHG) emissions since pre-industrial times has already surpassed the Earth's "carrying capacity" of natural systems and poses significant future risks to human well-being. As such, if we do not reduce our GHG emissions soon, we can expect to be impacted by more severe floods, wind-storms, heat waves, and wildfires which can drag down our economy, erode our social systems, impact our natural resources, and limit our ability to respond and recover. Unless we reduce our GHG emissions drastically – 80 percent by 2050 – scientists believe that we will cause irrevocable harm to our planetary systems as well as our communities.

Addressing climate change and reducing GHG emissions has long been a priority for the City of Fredericton (the City) which it has demonstrated by reporting on corporate GHG emissions since through the Federation of Canadian Municipalities' (FCM) Partners for Climate Protection (PCP) Program. In 2019, the City's corporate energy consumption and GHG emissions amounted to 182,000 Gigajoules (GJ) and 13,476 tonnes of carbon dioxide equivalent (tCO_{2e}) – a reduction of 23 percent from the 2004 base reporting year.³ Despite making progress in reducing GHG emissions, the City, like many communities and organizations, is not on track to meet the scientifically based GHG 2050 reduction targets.

In recognition of this trend, the City is undertaking additional efforts to reduce GHG emissions. This Corporate Energy and Emissions Plan (CEEP) proposes to establish aggressive GHG emission reduction targets of 30 percent by 2030 and 80 percent by 2050 to align with global reduction targets (reductions from 2004 levels).

1.2 PARTNERS FOR CLIMATE PROTECTION (PCP) PROGRAM

The PCP Program is a joint voluntary program between ICLEI-Local Governments for Sustainability (ICLEI) and FCM. It has been designed to empower and support municipalities in their efforts to reduce GHG emissions and take action against climate change. The PCP uses a five-milestone framework to guide municipalities in their efforts to reduce GHG emissions – these milestones are:

- Milestone 1: Create a GHG emissions inventory and forecast
- Milestone 2: Set GHG emission reduction targets
- Milestone 3: Develop a Local Action Plan
- Milestone 4: Implement the Local Action Plan
- Milestone 5: Monitor progress and report results

³ Details on the 2019 GHG inventory and forecast assumptions are included in the 2019 GHG Emissions Inventory Report.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

This CEEP meets the requirements of PCP Milestones 1 through 3. Milestones 4 and 5 call for municipalities to implement the Local Action Plan (LAP) and continue to monitor progress and report on results. The City intends to implement the details set forth in this CEEP and monitor and report on progress over time. Separate reporting submissions for Milestones 4 and 5 will be prepared and filed with the PCP Program as required.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

2.0 CEEP OBJECTIVE & SCOPE

2.1 OBJECTIVE

The development of the CEEP is intended to support the provision of relevant information that makes energy and GHG emissions performance visible to various levels of the City, enabling individuals and departments to plan, prioritize and manage energy and GHG reduction programs in an integrated fashion that aligns with City policies, programs, procedures, standards, practices, regulations, and information. Implementation of the CEEP can lead to long-term financial and productivity improvements through the ongoing monitoring, management, and control of energy and GHG emissions.

Figure 1 presents the elements of the CEEP and the various processes that it can support. It shows that an effective CEEP requires communication, integration, and a commitment to continuous improvement to achieve rapid reductions in energy and GHG emissions and maintain that performance over time.

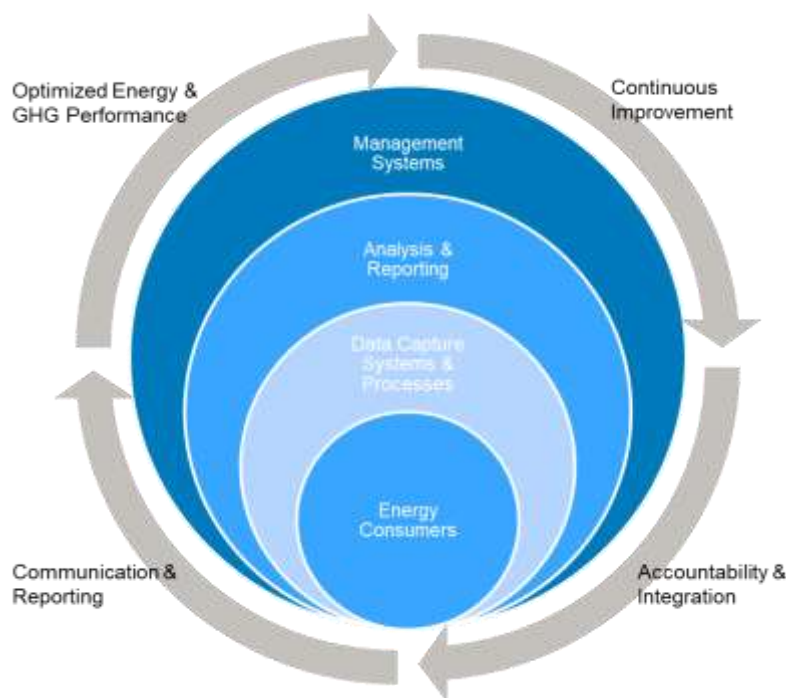


Figure 1. CEEP Operational Profile

This CEEP is a corporate-wide 5-year plan and system that focuses exclusively on energy and GHG emissions resulting from the City’s service delivery to Fredericton residents. It does not include community generated energy or GHG emissions that are outside the geographic boundary of the City.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

2.2 CORPORATE BOUNDARIES AND SCOPE

The City owns and/or operates over \$600 million in assets in the form of buildings, fleet and transit vehicles, equipment and wastewater facilities as well as all supporting infrastructure. The operation of these corporate assets collectively contributes to GHG emissions in the City and provides opportunities for energy conservation and GHG emissions reductions.

Calculating corporate municipal GHG emissions can be complicated because of how City services are delivered and who delivers them (e.g., contractors). To be relevant, GHG inventories must reflect the operations of a City and the way in which it interacts with the community. At the same time, it is important that the GHG inventory conform to international standards for reporting to ensure consistency and comparability with other cities. To this end, the City’s energy and GHG boundary has been set following an “operational control” approach where the City should track energy and GHG emissions of an asset when:

- The City owns or operates the asset, and
- The City is responsible for maintenance and capital upgrades.

Only emissions over which the City has operational control – i.e., the City owns and is responsible for maintenance and capital upgrades of the asset – are included in this CEEP. These assets are summarized in the table below, and do not include GHG emissions from third-party contractors or construction activities. Third party activities could be included in future plans as data availability and tracking improves.

Table 1. List of Assets Included in the CEEP

Buildings & Facilities	Transit and Non-Transit Fleet & Equipment	Pollution Control Facilities	Streetlights & Traffic Signals
Administrative Offices, Service Buildings, & Storage Facilities	Light Duty Vehicles	Pumping Stations	Streetlights
Cultural, Arts, Entertainment & Heritage Facilities	Heavy Duty Vehicles	Wastewater Treatment Facilities	Traffic Signals
Indoor / Outdoor Recreational Centers, Pools, Arenas & Sports Facilities	Off Road Vehicles	Water Treatment Facilities	Recreation Lighting
Fire Stations	Other Equipment (Hand-Held)		
Libraries	Transit Fleet		
Parks & Cemeteries			

While the CEEP focuses on actions to be implemented within the next 5 years, the CEEP energy and GHG emissions forecast considers a longer time horizon from 2020 to 2050. The recommendations made for the first five years integrate relevant planned initiatives and are based on actions identified by City staff using existing and proven technologies. Actions in the medium-term planning horizon (2025-2035), shift momentum towards more

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

aspirational targets. These program components provide the City with an opportunity to slow GHG emissions growth. Initiatives identified in the long-term (2035 and beyond) are of a more transformational nature. These initiatives are based on best available technology to date but recognize that the business case for selecting specific solutions will need to be identified in the coming years. Potential changes to federal and provincial legislation, funding opportunities, as well as technological advances over future decades will help reduce the City's GHG emissions.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

3.0 METHODS

This CEEP was based on corporate energy and GHG emissions available for the most current year, 2019, and trends since 2004 as well as anticipated growth to 2050. The identification of initiatives for incorporation into the CEEP was accomplished through a combination of best-in-class review of other municipalities, staff engagement, and input from internal and external subject matter experts.

Five thematic workshops – focused on buildings and facilities, fleet and equipment, pollution control, transit, and procurement and finance - facilitated sharing of best practices and identification of key initiatives with City staff providing specific guidance and direction on the CEEP components, initiatives, and enabling factors. Discussions were also held with the City's Corporate Energy Partner – MCW - on past actions completed and 7 opportunities. These were completed in July 2020. A review of energy conservation and GHG policies, programs, and initiatives from peer cities and municipalities was also conducted and included an assessment of the following cities and municipalities:

- Canada: Vancouver, North Vancouver, Burlington, Toronto, Edmonton, Calgary
- United States: New York City, Seattle, San Francisco
- Europe: London, United Kingdom
- New Zealand: Auckland

Topics which were covered during the reviews included:

- Actions for energy conservation and GHG emissions
- Energy and GHG reduction targets and performance against targets
- Financing approaches
- Barriers and challenges
- Recommendations

The City reviewed 2 drafts of the CEEP prior to it being finalized.

4.0 CORPORATE ENERGY & GHG EMISSIONS

With GHG emissions contributing to climate change at the forefront of public awareness and policy development, municipal governments are incorporating strategies to both manage the anticipated impacts and reduce their energy consumption and GHG emissions footprint. Many of these efforts have focused on reducing building energy and fleet fuel consumption as these sources are the largest contributors to an organizations' GHG emissions profile.

4.1 CURRENT ENERGY & GHG EMISSIONS

The City owns 40 major facilities, which cover a total area of over 1.38 million square feet (ft²). The City is also responsible for traffic and streetlights, transit, water and wastewater systems, and a fleet of approximately 400 vehicles and equipment to provide public services. These service areas make up the City's corporate energy consumption and GHG emissions and contribute to serving the residents, businesses, and visitors.

In 2019, the City's corporate energy consumption was 182,918 GJ. In terms of GHG emissions, the consumption of fossil fuel powered energy resulted in the estimated release of 13,476 tonnes of carbon dioxide equivalent (tCO₂e). The consumption of energy and associated GHG emissions were the direct result of the provision of key services by the City, which are organized into the following categories.

- **Buildings & Facilities:** The City's building and facilities consume electricity and natural gas to heat, cool, ventilate, and illuminate administrative, police, and fire buildings, park facilities, and community and recreation centers.
- **Transit Buildings & Fleet:** The City owns and operates transit facilities, 28 conventional buses and 5 dial-a-buses. The vehicles consume gasoline and diesel.
- **Water & Wastewater Facilities:** The treatment and movement of water and wastewater is accomplished largely by electrically driven pumps and processes. Diesel fuel is used for backup electricity generation.
- **Non-transit Fleet & Equipment:** The City's fleet includes light, medium and heavy-duty vehicles and hand-held equipment that consume gasoline and diesel.
- **Solid Waste:** Although the City does not own and operate a landfill, the corporate operations generate waste which is sent to the landfill. This waste decomposes in the landfill and results in the release of fugitive methane (CH₄) which is a potent greenhouse gas. The associated landfill has CH₄ collection and utilization which greatly reduces GHGs from solid waste.

Table 2 presents the breakdown of the 2019 energy and GHG emissions by reporting category.

Table 2. 2019 Corporate Energy and GHG Emissions by Category

Reporting Category	Energy (GJ)		GHG Emissions (tCO ₂ e)	
Buildings & Facilities	62,128	34.0%	4,328	32.1%
Streetlighting & Traffic Signals	10,427	5.7%	869	6.4%
Transit Buildings & Fleet	27,545	15.1%	1,901	14.1%
Non-Transit Fleet & Equipment	44,581	24.4%	3,072	22.8%

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

Reporting Category	Energy (GJ)		GHG Emissions (tCO ₂ e)	
Water & Wastewater	38,237	20.9%	3,160	23.4%
Solid Waste	-	0.0%	147	1.1%
Total	182,918	100.0%	13,476	100.0%

For the 2019 reporting year, approximately 32 percent of the City’s corporate GHG emissions came from buildings and other facilities like recreation centers and pools; 37 percent came from transportation related activities which includes corporate service vehicles as well as transit fleet; 23 percent came from the operation of water and wastewater pumping and treatment systems; 6 percent came from the operation of streetlights and traffic signals; and just over 1 percent came from the decomposition of waste at landfills.

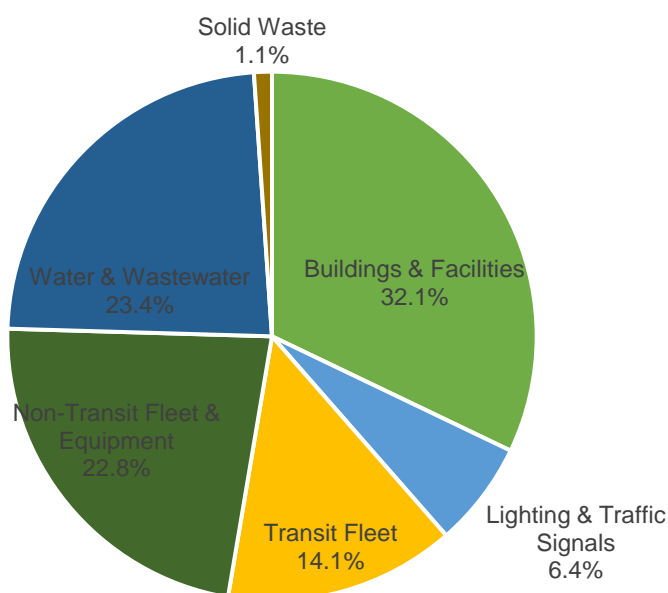


Figure 2. GHG Emissions by Source

More than 50 percent of the City’s corporate GHG emissions come from electricity use in buildings and to power streetlights and vehicles. Natural gas used to heat buildings contributed nearly 10 percent to the total GHG inventory. Diesel, gasoline and propane used in the operation of fleet and equipment accounted for 37 percent of the GHG inventory with diesel contributing the most to the fleet emissions (71 percent) (Figure 3).

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

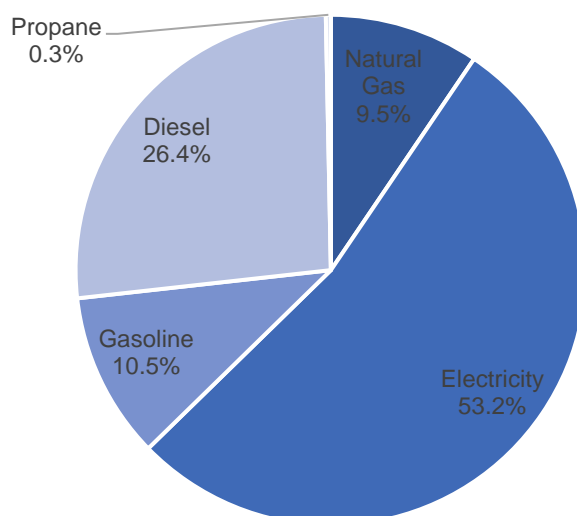


Figure 3. GHG Emissions by Fuel Type

4.2 DEPARTMENTAL ENERGY & GHG EMISSIONS

In terms of department and function, in 2019, the top energy consumers and GHG emitters include Water And Sewer, Recreation, Engineering and Operations, The Transit Department. These departments account for nearly 80% of corporate emissions. This is presented in Table 3.

Table 3. 2019 Energy and GHG Emissions by Department / Function

Department	Energy (GJ)		GHG Emissions (tCO ₂ e)	
Building Inspection (Planning & Development)	721	0.4%	57	0.4%
Building Services Division	1,578	0.9%	111	0.8%
By-Law Enforcement (Safety Dept)	99	0.1%	6	0.0%
Fire Department	7,961	4.3%	538	4.0%
Fleet Division	768	0.4%	45	0.3%
Fredericton Convention Centre	7	0.0%	0	0.0%
Parking Services	1,568	0.9%	126	0.9%
Parks & Trees	6,459	3.5%	433	3.2%
Police Department	11,793	6.4%	780	5.8%
Pollution Control	1,208	0.7%	82	0.6%
Engineering & Operations	33,610	18.3%	2,453	18.2%
Recreation	35,717	19.5%	2,601	19.3%
Safety Services	28	0.0%	2	0.0%
Tourism Department	5,694	3.1%	350	2.6%
Transit Department	30,240	16.5%	2,047	15.2%
Water & Sewer Department	43,704	23.8%	3,529	26.2%

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

Department	Energy (GJ)		GHG Emissions (tCO ₂ e)	
CAO's Office	1,143	0.6%	95	0.7%
Corporate Services	803	0.4%	214	1.6%
HR, Legal & City Clerk	177	0.1%	15	0.1%
Total	183,275	100.0%	13,483	100.0%

4.3 HISTORICAL TRENDS

The City chose 2004 as its base year. Since 2004, the City's population has increased over 30 percent while energy and GHG emissions from corporate operations have decreased 25 and 23 percent, respectively. The relationship between absolute and per capita GHG emissions is illustrated in Figure 4 below.

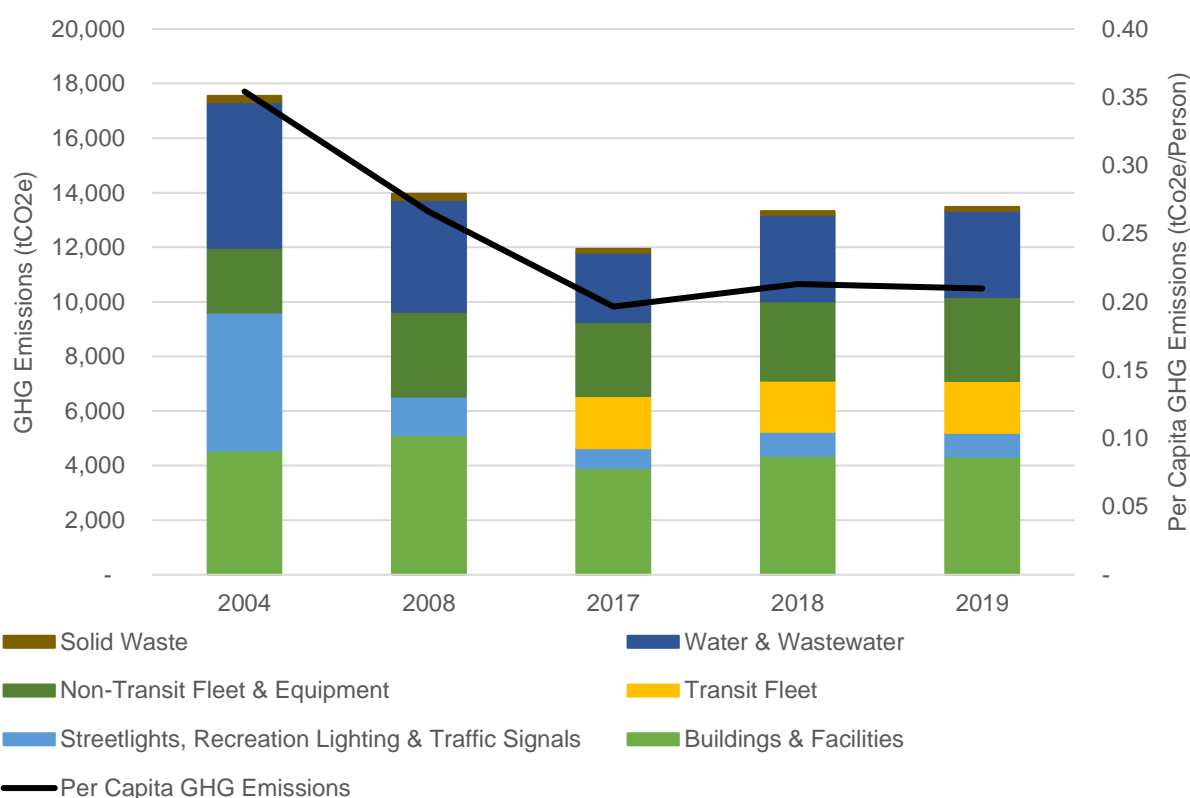


Figure 4. 2004 - 2019 Absolute and Per Capita GHG Emissions Trends

Total energy use for the reporting year was over 182,000 gigajoules (GJ) - a 25 percent increase over the 2004 base year and a 2 percent increase over the 2018 reporting year. Since 2017, energy use has been on a mild incline (Figure 5) with building natural gas use increasing upwards of 15 percent year-over-year and increased diesel and gasoline consumption in transit vehicles, fleet and equipment. These increases in energy use were offset by a decline of electricity consumption in streetlights and buildings.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

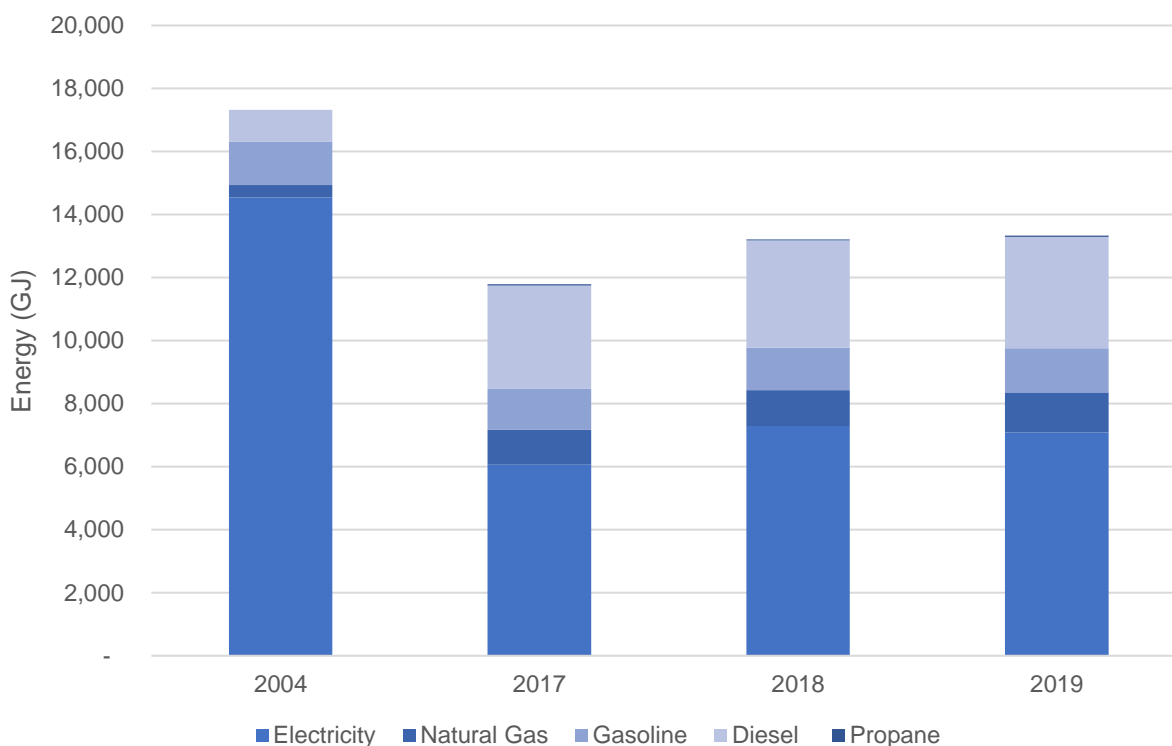


Figure 5. Historical Corporate Energy Consumption (GJ) By Fuel Type

4.4 CORPORATE ENERGY AND GHG FORECAST

4.4.1 Business as Usual (BAU) Energy and GHG Emissions Forecast

A business as usual (BAU) energy and GHG emissions forecast was developed for the CEEP to understand what the City's footprint would look like in 2030 and 2050 as well as examine the potential magnitude of energy and GHG reduction opportunities relative to best practice GHG reduction targets (Figure 5). Assuming the City does not implement any of the energy saving and GHG emissions reduction initiatives recommended in the CEEP, the City's GHG corporate energy and emissions are expected to increase 7 percent by 2050 as a result of increased service levels and demands as the community grows. Accordingly, corporate energy costs in 2019 were \$5.7 million and are expected to nearly double by 2050 should no further conservation and demand reduction actions take place.

The forecast assumes that the City can continue servicing the growing community with existing building assets but will require additional fleet vehicles and equipment. The following assumptions are applied in the forecast:

- Real energy consumption data was available from the City from 2017 to 2019.
- Community population forecast data was available from the City for the years 2016 to 2041. The population was extrapolated out to 2050.
- The existing building stock is expected to be better utilized to support an increasing population and thus no additional buildings beyond those planned or in the process of being built are included.
- Buildings at the following locations will be sold or decommissioned within the next 5 years:

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

- Sutton House
- Whittingham Hall
- Fredericton Playhouse
- Building Services Main Building
- An additional 17 kW of solar array at the Library will supply about 8.5 percent of the library's annual power requirements. This was recognized in 2020.
- Current solar PV systems continue to operate as intended through 2050.
- The City vehicle population would turn-over at a similar rate to the average rate for Canada (every 10 years)
- City diesel and gasoline fuel consumption would increase 1.7 percent and 1.3 percent annually, respectively. This is based on historical trends.
- The City opportunistically converts light duty vehicles and trucks to electric.
- The Transit department will continue to use and purchase diesel buses through to 2050.
- Future wastewater processing, future water storage, and pumping energy usage will increase proportionally to the population growth rate.
- Planned Federal light-duty vehicle, light duty truck, and heavy-duty vehicle fuel efficiency standards will be implemented and fully adopted in vehicles by 2027.
- The Zambonis continue to operate on propane.
- Through the adoption of clean fuel sources, electricity in New Brunswick declines in GHG emissions intensity by 18 percent by 2050.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

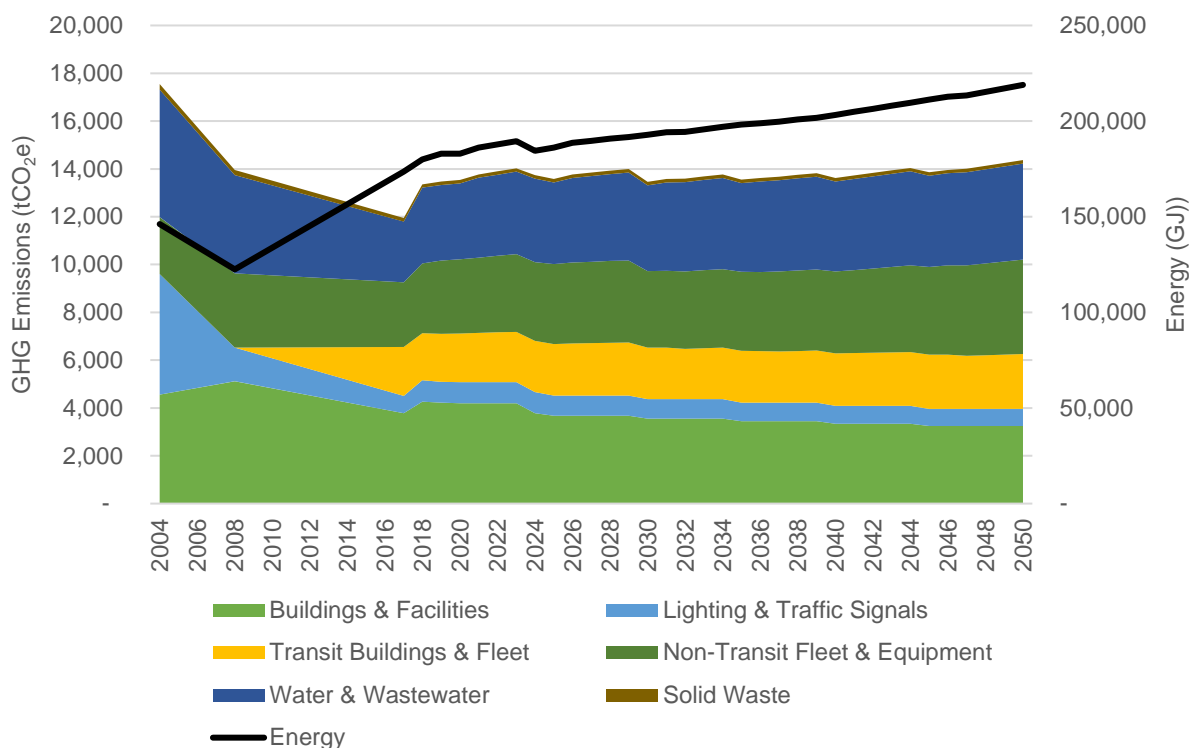


Figure 6. Business as Usual Energy and GHG Emissions Forecast

4.4.2 Energy Costs

It is assumed that electricity and natural gas rates will increase by about 1 percent per year with other fuels like gasoline and diesel increasing by about 2 percent per year. Rising energy costs will negatively impact ongoing operating costs, making energy conservation and demand management even more important to help mitigate these rising costs. Without a dedicated focus on reducing and conserving energy, corporate energy costs are expected to climb to over \$6.9 million by 2030, over \$8.5 million by 2040, and to \$10.5 million by 2050.

4.4.3 Progress Towards 2030 and 2050 Targets

To understand the effect of future energy and GHG savings initiatives as it relates to the 2030 and 2050 GHG reduction targets, the business as usual future scenario was adjusted to reflect the estimated energy and GHG emissions savings if the City were to implement the initiatives proposed in the CEEP. The recommended list of initiatives presented in the following sections could result in a 33 percent reduction by 2030, or a decrease of nearly 5,700 tCO₂e as compared to the 2004 levels (Figure 7). The achievement of the 2030 GHG reduction target will only be realized if the City invests heavily in the decarbonization of its existing facilities, in renewable technologies, and fuel switching projects at the facility, fleet, and equipment level.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

Achievement of the 2050 GHG reduction target will require considerable effort and will require the electrification or the use of biofuels in all non-transit fleet and equipment, the use of renewables, and the procurement of renewable natural gas (RNG) and carbon offsets.

The forecast showing the contribution of each GHG wedge is presented below in Figure 7.

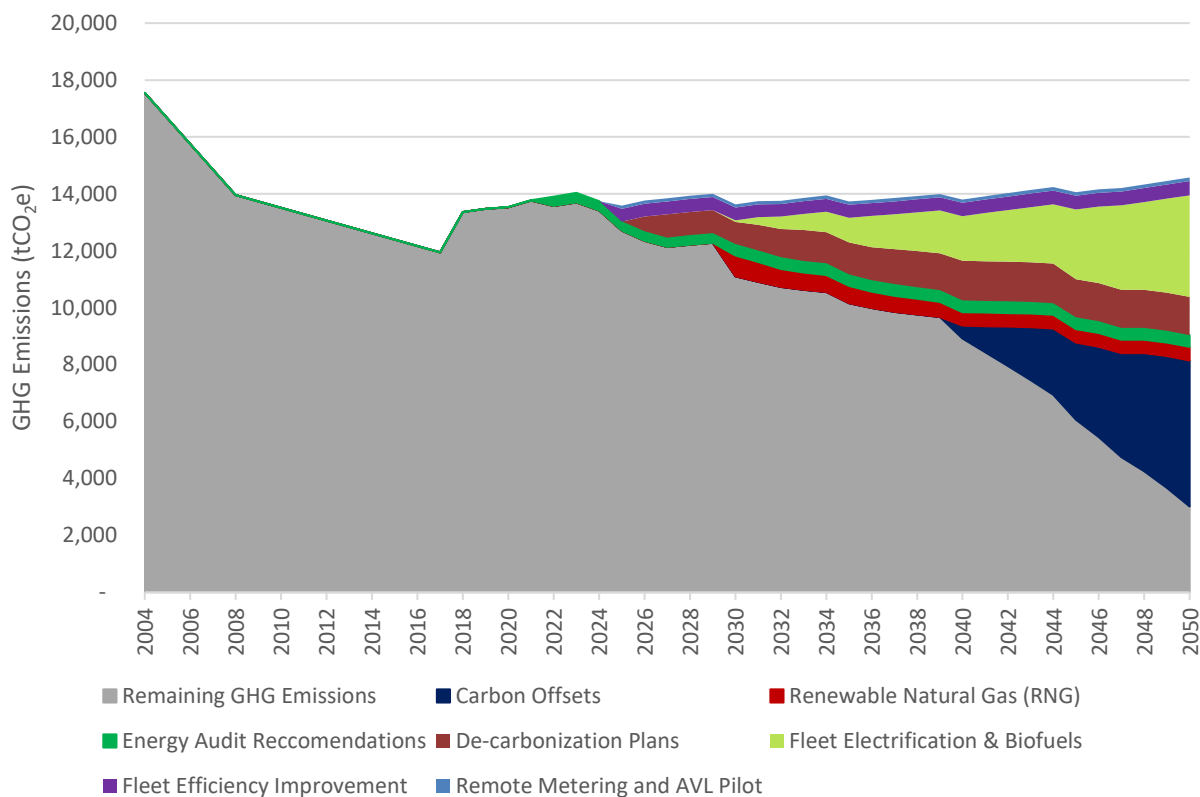


Figure 7. Forecasted GHG Emission Reductions by CEEP Initiative Category

Details of the remaining GHG emissions by sector are presented in Figure 8.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

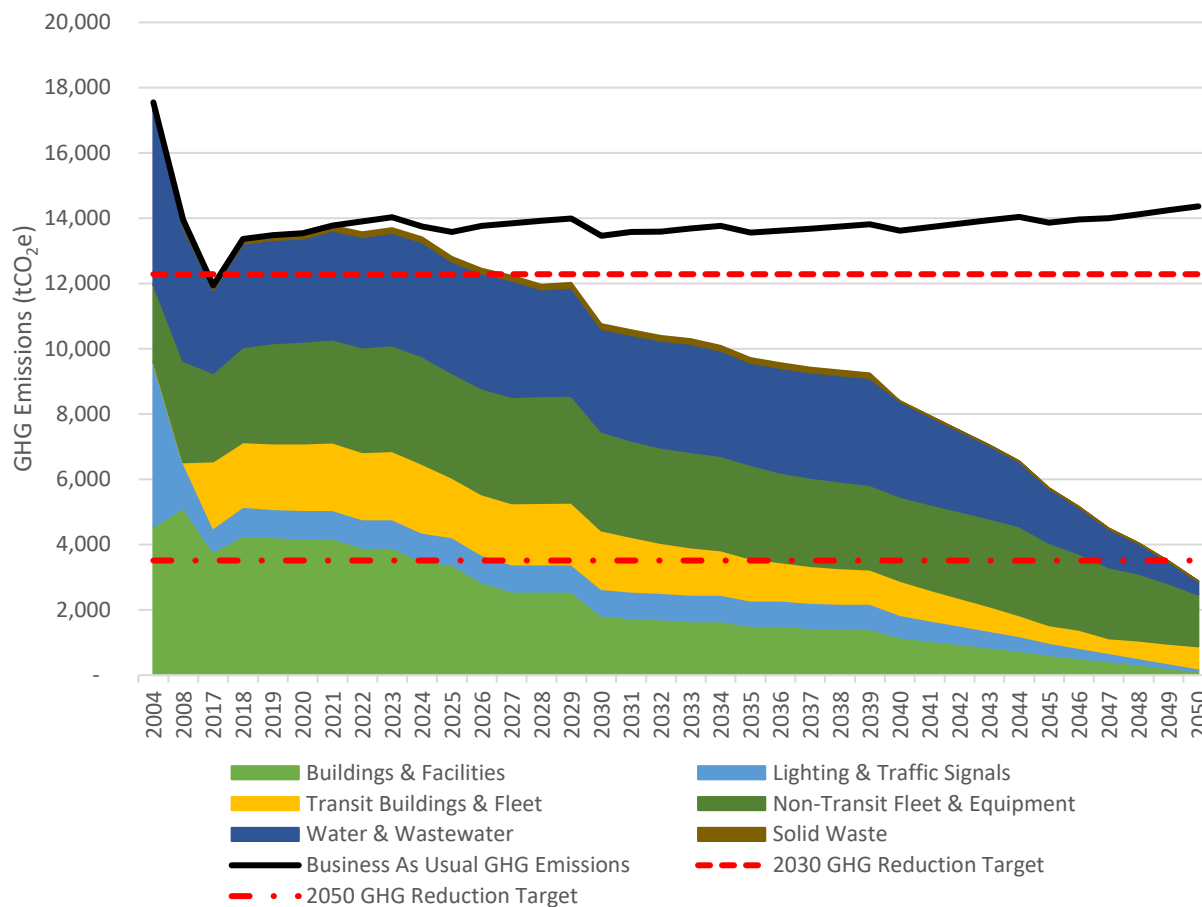


Figure 8. Forecasted GHG Emissions by Reporting Sector (With RNG / Offsets)

The energy forecast is presented in Figure 9. The energy forecast shows that the City can reduce total corporate energy consumption by 10 percent and 26 percent, below 2019 levels, by 2030 and 2050, respectively.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

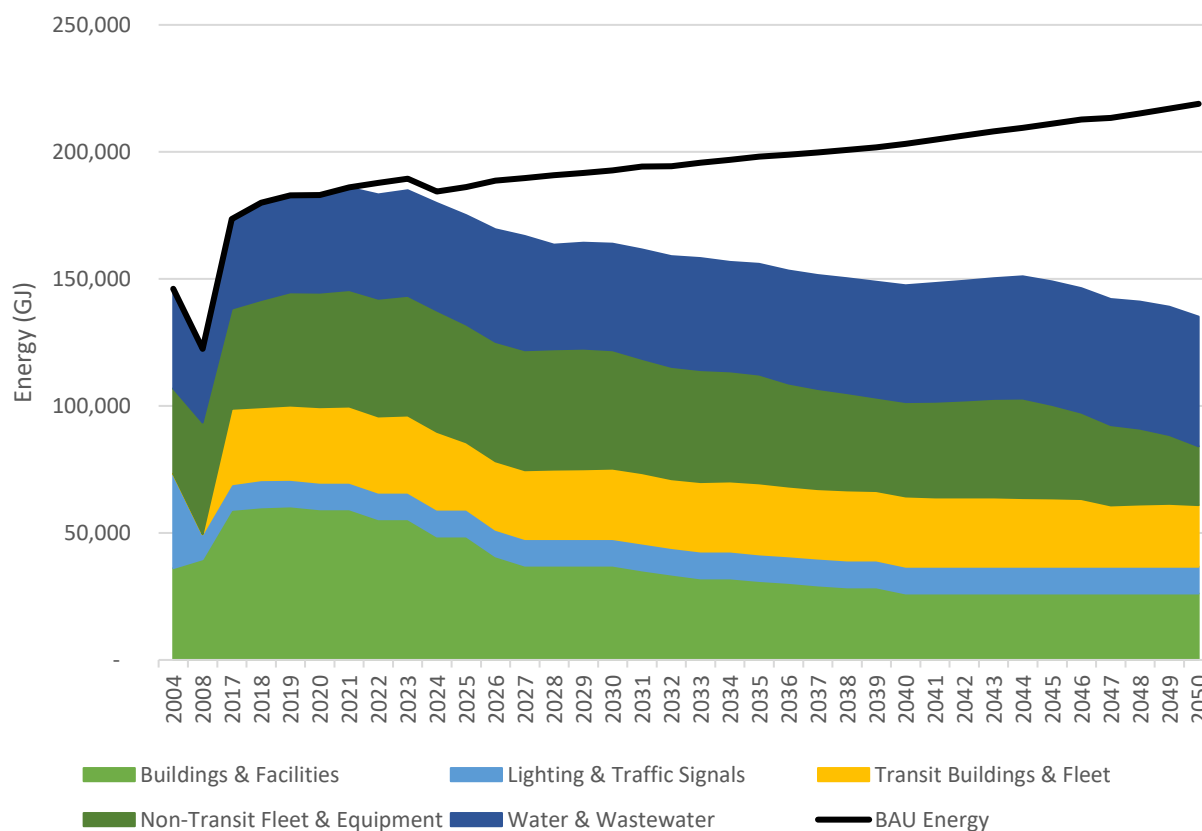


Figure 9. Forecasted Energy Consumption

To achieve the proposed 2030 GHG reduction target, before 2030, the City will need to:

- Prepare and implement building decarbonization plans for the following buildings and achieve at least a 55 percent reduction in energy consumption (below 2004 levels):
 - City Hall
 - Willie O'Ree Place
 - Grant Harvey Centre
 - Lady Beaverbrook Rink
 - St Mary's Depot
 - Two Nations Fire Station/EOC
 - Fredericton Public Library
 - Regent Depot
 - York Arena
 - York Fire Station
 - Transit Garage
 - Fredericton Police Station

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

- Implement the recommended energy conservation projects as identified in the recently completed facility energy audits. For other facilities or infrastructure, seek out energy projects to reduce energy and GHG emissions.
- Implement an ongoing building recommissioning and monitoring program to maintain energy conservation and GHG emissions.
- Begin the conversion of fleet to electric and low-carbon fuels.
- Implement an on-demand transit program.
- Establish programs that facilitate more accountability and ownership over cost and fuel management.
- Increase vehicle utilization and reduce overall fuel consumption.

The use of RNG and carbon offsets should be deemed as a last resort option as these tools are essentially self-imposed taxes which have no return on investment to the City. It is therefore recommended that the City focus on energy conservation building retrofits and low- or zero-carbon technologies first and to only use RNG or carbon offsets when there are policy or technological barriers (e.g., heritage buildings).

Over the longer term, the achievement of the 2050 energy and GHG reduction targets will require the aggressive conversion of all fleet and handheld and off-road equipment to either electric or renewable fuels, and likely adjusting various business models and service levels. It is also assumed that NB Power will green the electrical grid over the next 30 years.

Table 3 presents the CEEP short-, medium- and long-term GHG emission reductions based on the estimated potential of the initiatives proposed. As these values can be used as interim targets to track progress against, the reductions for each reporting sector are presented in Table 3.

Table 4. Estimated GHG Emissions By Sector

Reporting Sector	2025	2030	2040	2050
Buildings & Facilities Emissions (tCO ₂ e)	3,464	2,560	1,727	1,679
Lighting & Traffic Signals Emissions (tCO ₂ e)	842	809	745	715
Transit, Fleet & Equipment Emissions (tCO ₂ e)	4,944	4,911	3,655	2,256
Water & Wastewater Emissions (tCO ₂ e)	3,306	3,395	3,559	3,802
Solid Waste Emissions (tCO ₂ e)	152	155	172	163
RNG / Offsets (tCO ₂ e)	-	(733)	(941)	(5,603)
Total GHG Emissions (tCO₂e)	12,708	11,097	8,917	3,013
Change from 2004 Base Year With RNG / Offsets	-28%	-37%	-49%	-83%
Change from 2004 Base Year Without RNG / Offsets	-28%	-33%	-44%	-51%

Notes to Table: 2004 Base Year = 17,549 tCO₂e

5.0 BUILDINGS & FACILITIES

The City owns or leases over 68 buildings and facilities including administrative and community centers, park facilities, police and fire stations, arenas, garages, and vehicle storage facilities. In 2019, the City’s buildings and facility portfolio accounted for 34 and 32 percent of its energy use and GHG emissions, respectively.

Many of the City’s buildings and facilities are reaching their end of life which presents an opportunity for the City to drastically reduce energy and GHG emissions over the next 50+ years, but also presents a challenge in that going beyond like-for-like replacements will have a significant cost premium that must be planned for.

To achieve the City’s GHG reduction targets, new buildings will need to be ‘net-zero energy ready’ which means they will be highly efficient buildings that can easily accommodate future renewable energy add-ons, such as rooftop solar panels, that will enable them to produce at least as much energy as they consume. Existing buildings and facilities that remain will require deep energy retrofits that radically overhaul the building envelope to reduce energy needs or a complete replacement of the building to a higher energy standard. As part of each building and facility decarbonization plan (Initiative B3), a decision will have to be made regarding whether to redevelop, revitalize, or remove the asset. Along with considering the needs of the City, health and safety, and its residents, the decision must also consider the current and future energy performance, costs, GHG emissions and impact to the City’s GHG emissions base year and forecast. Taking a more holistic and life cycle view of the asset being reviewed, will ensure that the City considers the long-term impacts of each building addition, removal, and replacement option.

These actions will require significant capital investment and an update the City’s Capital Asset Management Plan (CAMP) to address energy conservation, GHG emissions, and the impacts of climate change and to develop long-term de-carbonization plans for each of its buildings and facilities. Having building and facility- specific de-carbonization plans will align the end-of-life rehabilitation initiatives for individual building components (e.g. roof, windows, mechanical equipment, etc.) with the expected updates in the CAMP.

To aggressively reduce GHG emissions by 2050, the City will need to prioritize reducing energy and GHG emissions from its largest GHG contributors. Ten facilities accounted for nearly 30 percent of corporate energy and 29 percent of total GHG emissions. These facilities are presented in Table 4.

Table 5. Top GHG Emitting Facilities in 2019

Building / Facility	2019 Energy (GJ)	Percentage of Total Energy	2019 GHG Emissions (tCO ₂ e)	Percentage of Total GHG Emissions
Willie O'Ree Place	12,855	7.0%	838	6.2%
Grant Harvey Centre	8,708	4.8%	726	5.4%
Barker St WWTP - Blower Building	6,192	3.4%	516	3.8%
Fredericton Playhouse	5,251	2.9%	313	2.3%
Fredericton Police Station	4,496	2.5%	300	2.2%
Lady Beaverbrook Rink	4,049	2.2%	273	2.0%
City Hall	2,663	1.5%	222	1.6%

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

Building / Facility	2019 Energy (GJ)	Percentage of Total Energy	2019 GHG Emissions (tCO ₂ e)	Percentage of Total GHG Emissions
Two Nations Fire / EOC	2,937	1.6%	194	1.4%
St. Mary's Depot	3,105	1.7%	176	1.3%
Barker St WWTP - Operation Building	1,925	1.1%	160	1.2%
Fredericton Public Library	1,742	1.0%	145	1.1%
Total	53,923	29.5%	3,863	28.7%

Maintenance and ongoing-commissioning programs - a process of ongoing monitoring, adjustment, and retrofitting with new technologies like building automation systems upgrades, and energy sub-metering will be key to maintaining energy and GHG reductions. Building Condition Assessments (BCA) and behavioral change programs are also important initiatives that will complement retrofit and building monitoring programs. One of the most cost-effective GHG emissions avoidance measures is to improve existing building utilization rates; therefore, reducing the number of new buildings requiring construction in the future. This will require the development of programs and policies that allow staff to work from home, staff hoteling, and improved space layouts (Initiative B6).

The following is a list of the proposed building and facility initiatives that are discussed in detail in the following sections:

- B1: Develop a Green Building Sustainability Policy
- B2: Complete Buildings Utilization Assessments
- B3: Develop De-Carbonization Plans for Buildings & Facilities
- B4: Implement Energy Audit Recommendations
- B5: Implement a Building continuous commissioning Program
- B6: Develop Alternative Work Strategies and Supportive Policies

With the proposed building and facility initiatives, it is estimated that the City could reduce GHG emissions by 63 percent and 66 percent by 2050 when compared to 2004 and 2019 levels, respectively. This is presented in Table 5.

Table 6. Estimated GHG Emission Reductions From Buildings & Facilities

Year Ended	2025	2030	2040	2050
Business as Usual Forecasted GHG Emissions (tCO ₂ e)	3,780	3,665	3,449	3,348
Emissions Reductions (tCO ₂ e)	316	1,106	1,722	1,669
Remaining GHG Emissions (tCO₂e)	3,464	2,560	1,727	1,679
Change from 2004 Base Year	-24%	-44%	-62%	-63%
Change from 2019 Reporting Year	-30%	-49%	-65%	-66%

Notes to Table:

Base Year GHG emissions: 4,328 tCO₂e

Reduction values and percentages do not include the procurement of RNG and offsets.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

Figure 10 illustrates the progression of GHG emissions reductions over time compared to the forecasted business as usual scenario. It shows that the decarbonization plans and energy retrofits will be the main driver of GHG reductions over time.

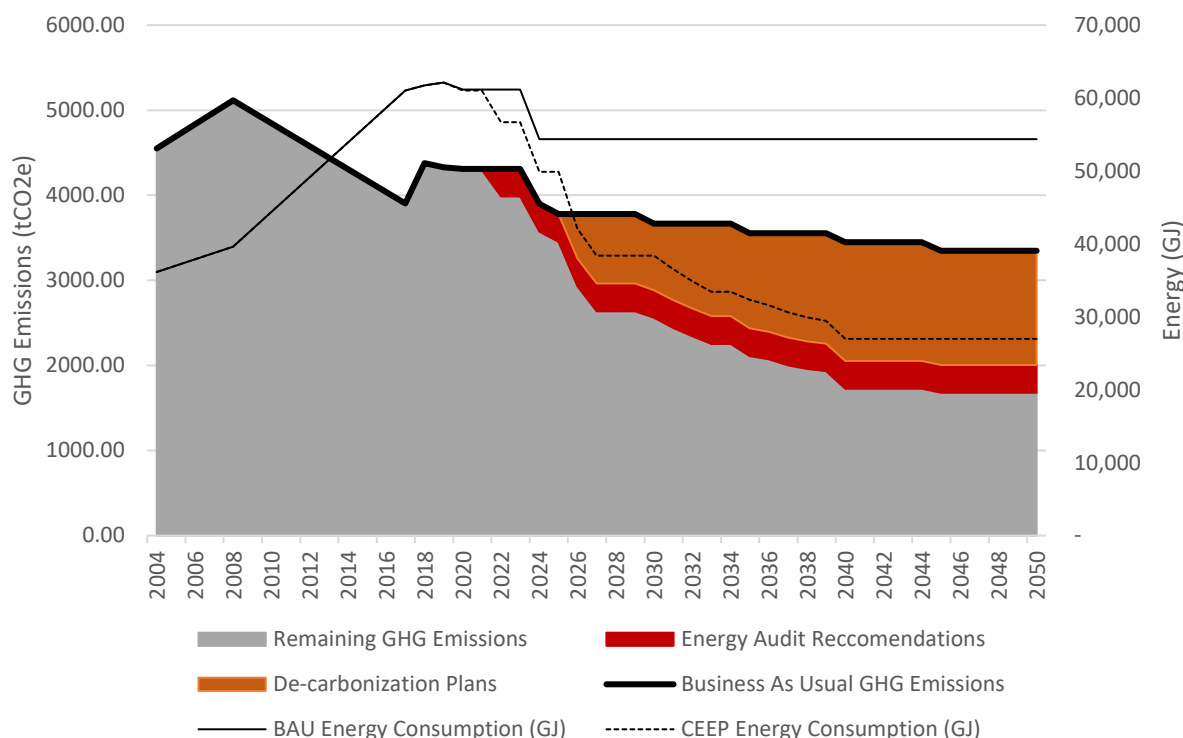


Figure 10. Forecast of Buildings Energy & GHG Emissions

Based on current building technologies available and the forecasted GHG intensity of the electrical grid, the City will need to rely on a combination of RNG and carbon offsets to fully achieve the 2050 GHG emissions reduction target. It is recommended that the City focus on energy conservation building retrofits and low- or zero-carbon technologies first and to treat the use of RNG and carbon offsets as a last resort option - to be used only when there are policy or technological barriers. The challenge to the proposed approach will require a culture spending shift to move away from 'like-for-like' replacements and towards recognizing energy and GHG reduction opportunities on a lifecycle basis. Upfront this will require paying a premium for low- and zero-carbon technologies.

5.1 BUILDINGS & FACILITIES INITIATIVES

5.1.1 B1: Develop a Green Building Sustainability Policy

The City has the opportunity to increase energy efficiency and conservation during the design and construction of new buildings and the deep renovation of existing buildings. It is recommended that the City develop a Green Building Sustainability Policy and associated technical standards to require that all newly constructed and deeply renovated buildings undergo a net-zero and alternative energy evaluation as part of the design process and require

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

that the life cycle cost and return considerations for reducing GHG emissions be presented to Council. A zero-carbon building is a highly energy efficient building that produces renewable energy onsite, or procures, carbon-free renewable energy or high-quality carbon offsets to neutralize the annual carbon emissions associated with building materials and operations.⁴

Supporting the Green Building Sustainability Policy would be the development of technical standards that direct contractors and project staff to focus on specific areas of performance that are important to the City (e.g., energy and water efficiency, waste diversion, sub-metering, etc.). Strong enforcement of technical standards and accountability would limit the number of future retrofits and change orders. It is recommended that the City develop these technical standards, and process with clear lines of accountability for all parties involved with the design, construction, operational management, and major renovation of City buildings.

This is a supportive initiative and would be used to support Initiative B3. No energy or GHG benefit has been estimated for this initiative specifically.

5.1.2 B2: Complete Building & Facility Utilization Assessments

To inform the development of the decarbonization plans for buildings and facilities, it is recommended that the City reassess the suitability of its assets to meet current and long-term needs and demands. A facility utilization and needs assessment is a comprehensive examination of all of the City's major facilities, such as fire stations, maintenance shops and other public buildings and takes into consideration expected life expectancy of the facility, current and projected utilization, changing demographics and trends, and feedback from the community. The objective of the assessment would be to guide future investment in City facilities while meeting community service requirements, realizing operational energy cost savings and reducing GHG emissions, while potentially avoiding unnecessary capital projects. An additional outcome of the assessment would be the development of key performance indicators (KPI) that relate building and facility energy consumption to operational parameters (e.g., energy consumption (GJ) / operating hour, # of community programs per day by facility, etc.). This would enable the City to better understand and track energy and GHG drivers related to facility operation and service levels. If additional buildings are needed, it remains undetermined what form of ownership this will take (i.e. construct new, purchase existing, or lease). In cases where new buildings are leased, the City will need to select spaces that are energy efficient and operate on no-/low-carbon fuel sources and require that the landlord maintain these priorities through the adoption of green leases.

This is a supportive action intended to inform Initiative B3 and provide key metrics to track building and facility performance, thereby supporting Initiatives B5 and B6. No energy or GHG benefit has been estimated for this initiative specifically.

5.1.3 B3: Develop De-Carbonization Plan for Buildings & Facilities

Making significant progress towards the City's GHG targets will require a unifying de-carbonization plan for each City building and facility. De-carbonizing most of the existing buildings will require deep energy retrofits that upgrades or replaces equipment and building envelopes (e.g., roof, walls, windows) to achieve the required large

⁴ <https://www.cagbc.org/zerocarbon>

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

energy and greenhouse gas emission reductions. The objective of deep energy retrofits is to create a building that can be heated and cooled with very little energy. Deep energy retrofits involve at a minimum:

- Replacing the roof if necessary, but minimally adding insulation
- Replacing fenestrations (e.g., doors, windows, louvers, etc.)
- Harnessing sunlight for heat and illumination
- Replacing the heating, ventilation, and air conditioning (HVAC) systems with renewable technologies like ground-source heat pumps

A study conducted by Natural Resources Canada (NRCAN) estimates that deep energy retrofits can achieve upwards of a 60 percent reduction in energy consumption and a similar reduction in GHG emissions.⁵ The building decarbonization plans will require re-thinking of building operations as well as HVAC systems. A significantly reduced building energy demand means smaller mechanical systems and options for cleaner fuel sources. Electrically driven heat-pumps generate significantly fewer GHG emissions than a natural gas boiler or furnace but may cost more to operate. The assessment and use of Solar Photovoltaic (PV) can reduce / eliminate the consumption of grid-based power and could be used to opportunistically support other GHG reductions in the community (e.g., solar PV to power nearby Electric Vehicle (EV) charging station). The final step to de-carbonize City buildings will be to offset any remaining electricity and natural gas consumption through the purchase of RNG or carbon offsets.

The implementation of the decarbonization plans will require a significant capital investment with the deep energy retrofits expected to have upwards of a 40 percent premium on existing renovation costs and that these costs have not been planned for. Over the next 5-years, the City must develop long-term de-carbonization plans for at least the top ten emitting facilities (Table 4).

Having de-carbonization plans will align the end-of-life rehabilitation initiatives for individual building components (e.g., roof, windows, mechanical equipment, etc.) with the City's GHG reduction targets. It is recommended that the de-carbonization plans be based off of up to date building condition assessments, include asset specific GHG intensity (GHGI) targets, and a lifecycle business case assessment that clearly defines capital budget requirements and the offsetting energy cost savings that will be reflected in future operating budgets. In collaboration with finance, a timeline that targets 2040 for all existing buildings and facilities to have had a deep energy retrofit completed is necessary if the City is to achieve its 2050 targets. Initiatives equal to Pollution Control 'P2' Large Solar Array should also be considered for arena properties as the mechanical systems will continue to be energy intensive 100% electric and can only be optimized so much.

It is estimated that this initiative can reduce energy and GHG emissions by 40-60 percent or more if net zero buildings are achieved.

5.1.4 B4: Implement Energy Audit Recommendations

Several building energy audits have been completed. The scope of the audits included reviewing building thermal performance, load distribution, existing equipment and controls schedules, occupancy patterns, lighting, and efficiency systems to identify energy and emission reduction opportunities. The recommendations ranged from

⁵ Natural Resources Canada, 2018. *Retrofitting*, www.nrcan.gc.ca/energy/efficiency/buildings/20707, accessed on Sept 4, 2018.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

lighting system upgrades, Building Automation Systems (BAS) upgrades, the use of insulation and weather-stripping to installing variable speed motors, and the installation of heat recovery systems. The estimated cost, economic savings, simple payback and estimated GHG emissions reductions opportunities by facility are presented in Table 6.

Table 7. Summary of Energy Audit Recommendations

Asset	Estimated Cost	Estimated Annual Energy Savings (GJ)	Estimated Annual Savings	Simple Payback (Years)
Fredericton Convention Centre	\$220,247	1,058	\$40,207	5.5
Garrison Washrooms	\$2,192	2	\$74	29.5
Botanical Gardens Building	\$1,064	11	\$302	3.5
Grant Harvey Centre	\$84,129	1,136	\$33,749	2.5
Kimble Fire Station	\$28,172	55	\$1,289	21.9
Fredericton Public Library	\$259,148	146	\$4,602	56.3
Lady Beaverbrook Rink	\$13,231	19	\$827	16.0
Two Nations Fire Station/EOC	\$49,358	95	\$3,100	15.9
Royal Road Fire Station	\$7,450	-	\$-	0.0
Odell Park Lodge	\$3,088	13	\$452	6.8
Fredericton Police Station	\$147,434	302	\$8,779	16.8
Regent Street Depot	\$10,803	10	\$212	51.0
St Mary's Depot	\$48,798	129	\$2,670	18.3
St Mary's New Transit	\$38,005	292	\$7,374	5.2
Transit Garage	\$21,152	163	\$3,564	5.9
Small Craft Aquatic Centre	\$4,681	21	\$563	8.3
Trail Patrol Building	\$24,245	21	\$557	43.5
Parks & Trees Depot	\$222,979	480	\$4,617	48.3
Willie O'Ree Place	\$73,286	286	\$5,484	13.4
York Arena	\$145,019	382	\$11,732	12.4
York Fire Station	\$18,625	16	\$357	52.2
Fredericton Indoor Pool	\$21,066	49	\$2,337	9.0
St. Mary's Cold Storage	\$12,058	32	\$1,368	8.8
Frederick Square Parking Garage	\$86,025	271	\$10,367	8.3
East End Parking Garage	\$150,742	316	\$15,344	9.8
Total	\$1,692,993	5,306	\$159,925	10.6

The implementation of the energy audit recommendations is estimated to result in both energy cost savings and reasonable payback periods for most. It is recommended the City prioritize the efforts to be undertaken based on the expected energy and cost savings, the payback for the individual measures to be employed, and the availability of City resources to affect the improvement. It is recommended that City continue to seek out funding

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

opportunities and incentives to improve the business case for high GHG reduction actions that have a longer or lower financial return on investment.

It is estimated that this initiative can reduce total building annual energy by 8 to 9 percent.

5.1.5 B5: Implement a Building Commissioning Program

Commissioning verifies that a building has been constructed to its designed specifications. The best time to commission a building is during construction, with special attention being paid to the building envelope. The building envelope influences most aspects of building performance such as energy consumption, occupant comfort and durability over the life of the entire building (50+ years).

Ongoing recommissioning, or retro-commissioning, is the continuous commissioning of a building's various systems over a specified period of time to verify continuous peak performance over its useful life. Ongoing-commissioning and re-commissioning are important because they reduce operating costs, reduce the risk of failures, and inform retrofit opportunities and deep energy retrofit plans. Various pre-and post-implementation commissioning case studies have showed efficiency improvements on the order of 5 percent to 30 percent because of improved operations and maintenance. The studies also showed that the resulting simple payback periods are typically less than 2 years.⁶ Typical commissioning activities include:

- Adjusting reset and set-back temperatures and temperature settings
- Staging/sequencing of boilers, chillers, and air handling units
- Adjusting and repairing dampers and economizers
- Modifying control strategies for standard hours of operation
- Eliminating simultaneous heating and cooling
- Air and water distribution balancing and adjustments
- Verifying controls and control sequencing, including enabling and re-enabling automatic controls for set points, weekends, and holidays

It is recommended that the City schedule the commissioning of buildings on at least a five-year cycle or when the function of a building or facility changes, and that an ongoing-commissioning program be developed, managed, and tracked by the Building Services division in conjunction with the City's asset management system. To limit the impact of occupant behavior on building performance, it is also recommended that the City use change management techniques to help occupants understand and adapt to the defined parameters (i.e., temperature range, light, air flows, etc.) for conditioned spaces.

5.1.6 B6: Continue to Develop Alternative Work Strategies and Supportive Policies

A cost-effective energy and GHG reduction program implements policies that allow for more flexible work environments and dis-incentivizes travel. The City's forecast of office space needs for the corporation estimates that to serve the projected annual year-over-year population growth, staff levels will also need to increase over the same period. Policies that support enhanced staff mobility, hoteling, and improved space layouts, are currently

⁶ Office of Energy Efficiency and Renewable Energy, 2010. *Operations & Maintenance Best Practices: A Guide to Achieving Operational Efficiency*, https://www.energy.gov/sites/prod/files/2013/10/f3/omguide_complete.pdf August 3, 2018.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

being examined and modified as a result of COVID-19 to achieve the same level of functionality and comfort without the need for additional buildings or facilities. These strategies include:

- **Alternative work schedules** which allows employees to vary their hours from day to day or compress more working hours into fewer days.
- **Telecommuting** which enables employees to work from home offices or other alternative spaces.
- **Shared offices and hoteling:** This strategy provides a flexible work environment that allows for better space utilization, in that employees do not have a dedicated office space. This approach can have a significant reduction on greenhouse gas emissions as the strategy can enable the City to avoid adding additional buildings to accommodate increased staff.
- **Virtual meeting rooms and teleconferencing:** The City uses various platforms to facilitate virtual meetings which create the same experience for the user as face-to-face meetings.

Post-COVID-19, it is recommended that the City continue to deploy these strategies as a means to reduce travel related costs (both staff time and reimbursement of fees) and GHG emissions.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

5.2 SUMMARY OF PROPOSED INITIATIVES

A summary of the proposed initiatives is presented in Table 7.

Table 8. Summary of Buildings & Facilities Initiatives

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
Buildings & Facilities							
B1	Develop a Green Building Sustainability Policy	Develop Green Building Policy and technical standards that establishes operational energy performance requirements for when existing facilities undergo major renovations and when new facilities are constructed.	Supportive Initiative	<ul style="list-style-type: none"> • Consultant Time (\$5,000) 	Short-term	<ul style="list-style-type: none"> • Building Services • Corporate Services 	<ul style="list-style-type: none"> • Policy and technical standards are completed, approved and integrated into the renewed asset management plan.
B2	Implement Energy Audit Recommendations	Complete recommendations from comprehensive energy audits already recommended by MCW, implement the recommendations, and track the progress of energy audits and projects. Leverage external funding opportunities to implement energy reduction initiatives with longer payback periods.	7-8% Energy Reduction	<ul style="list-style-type: none"> • \$1.7M (After Available External Funds). Some of this work will be incorporated in deep retrofit / decarbonization projects • Staff Time (1 FTE) 	Medium-term (in tandem with B5 for facilities identified as a deep retrofit priority)	<ul style="list-style-type: none"> • Building Services 	<ul style="list-style-type: none"> • Building Energy Intensity (GJ/m²) • Building GHG Emissions Intensity (tCO₂e/m²) • Building Energy Cost Intensity (\$/m²)
B3	Develop De-Carbonization Plan for Buildings & Facilities	Develop a unifying de-carbonization plan for each major City building and facility. De-carbonizing existing buildings will require deep energy retrofits that upgrade or replace equipment and	40-60% Energy Reduction	<ul style="list-style-type: none"> • Staff Time (1 FTE) OR • Consultant Time (TBD) 	Medium-term	<ul style="list-style-type: none"> • Building Services 	<ul style="list-style-type: none"> • Building Energy Intensity (GJ/m²) • Building GHG Emissions Intensity (tCO₂e/m²)

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
B4	Implement a Building Commissioning Program	<p>building envelopes (e.g. roof, walls, windows) to achieve large energy and greenhouse gas emission reductions. A decarbonization plan for City Hall has been established, but plans for Regent Depot, St. Mary's Depot, and the Transit Depot Admin Office are required in the short-term.</p> <p>Prepare and implement an ongoing building commissioning and retro commissioning plan.</p>	Supportive Initiative	<p>40% Premium on Retrofit Construction Cost (\$/ft²)</p> <ul style="list-style-type: none"> Staff Time (0.5 FTE) 	Short-term (work is ongoing)	<ul style="list-style-type: none"> Building Services 	<ul style="list-style-type: none"> Building Energy Cost Intensity (\$/m²) Develop plans for the top 15 energy consuming buildings and facilities. Building Energy Intensity (GJ/m²) Building GHG Emissions Intensity (tCO₂e/m²) Building Energy Cost Intensity (\$/m²)
B5	Complete a Buildings Utilization Assessment	<p>Review service delivery requirements and needs with consideration to facility operational demands with the objectives of identifying operational and service delivery efficiencies. Establish KPI's that relate building / facility energy consumption to operational parameters (e.g., energy consumption (GJ) / operating hour, # of community programs per day by facility, etc.) to better understand what energy and GHG drivers and to identify related reduction / conservation opportunities</p>	Unknown	<ul style="list-style-type: none"> Staff time (0.15 FTE) 	Short-term	<ul style="list-style-type: none"> Building Services, Recreation 	<ul style="list-style-type: none"> Building Energy Intensity (GJ/m²) Building GHG Emissions Intensity (tCO₂e/m²) Building Energy Cost Intensity (\$/m²) Operating Hours Space Utilization Index
B6	Develop Alternative Work Strategies and Supportive Policies	<p>A cost-effective energy and GHG measure that can be deployed is to implement policies that allow for more flexible work environments and disincentivize travel.</p>	Supportive Initiative	<ul style="list-style-type: none"> Staff Time (0.25 FTE) 	Long-term	<ul style="list-style-type: none"> Corporate Services 	<ul style="list-style-type: none"> Policy is completed and approved

6.0 TRANSIT, FLEET & EQUIPMENT

The City owns and operates nearly 400 light-, medium-, heavy-duty vehicles, transit vehicles and equipment. Both fleet and equipment are powered by gasoline, and diesel which accounted for 39 percent of total energy consumption and 37 percent of GHG emissions in 2019 as detailed in Table 8 and Figure 11. Light duty vehicles and trucks accounted for 27 percent of the fleet and equipment's GHG emissions, with heavy duty vehicles and off-road equipment accounting for the remainder of the GHG emissions (73 percent).

Table 9. Fleet & Equipment Energy And GHG Emissions By Department

Department	Vehicle Count	2019 Energy	Percentage of Total Energy	2019 GHG	Percentage of Total GHG Emissions
Building Inspection	6	175	0.1%	11	0.1%
Building Services Division	15	1,138	0.6%	76	0.6%
By-Law Enforcement	3	99	0.1%	6	0.0%
Fire Department	23	2,672	1.5%	187	1.4%
Fleet Division	21	308	0.2%	20	0.1%
Fredericton Convention Centre	1	7	0.0%	0	0.0%
Parking Services	2	277	0.2%	18	0.1%
Parks And Trees	51	5,382	2.9%	368	2.7%
Police Department	47	7,297	4.0%	480	3.6%
Pollution Control	10	1,208	0.7%	82	0.6%
Public Works	121	19,638	10.7%	1,397	10.4%
Recreation	12	846	0.5%	52	0.4%
Risk And Safety Department	1	28	0.0%	2	0.0%
Tourism Department	1	39	0.0%	3	0.0%
Transit Department	33	27,545	15.1%	1,901	14.1%
Water And Sewer Department	49	5,467	3.0%	369	2.7%
Total	396	72,125	39.4%	4,973	36.9%

Broken down by department / unit, it is estimated that Police, Public Works, and Transit accounted for 76 percent of the total fleet GHG emissions.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

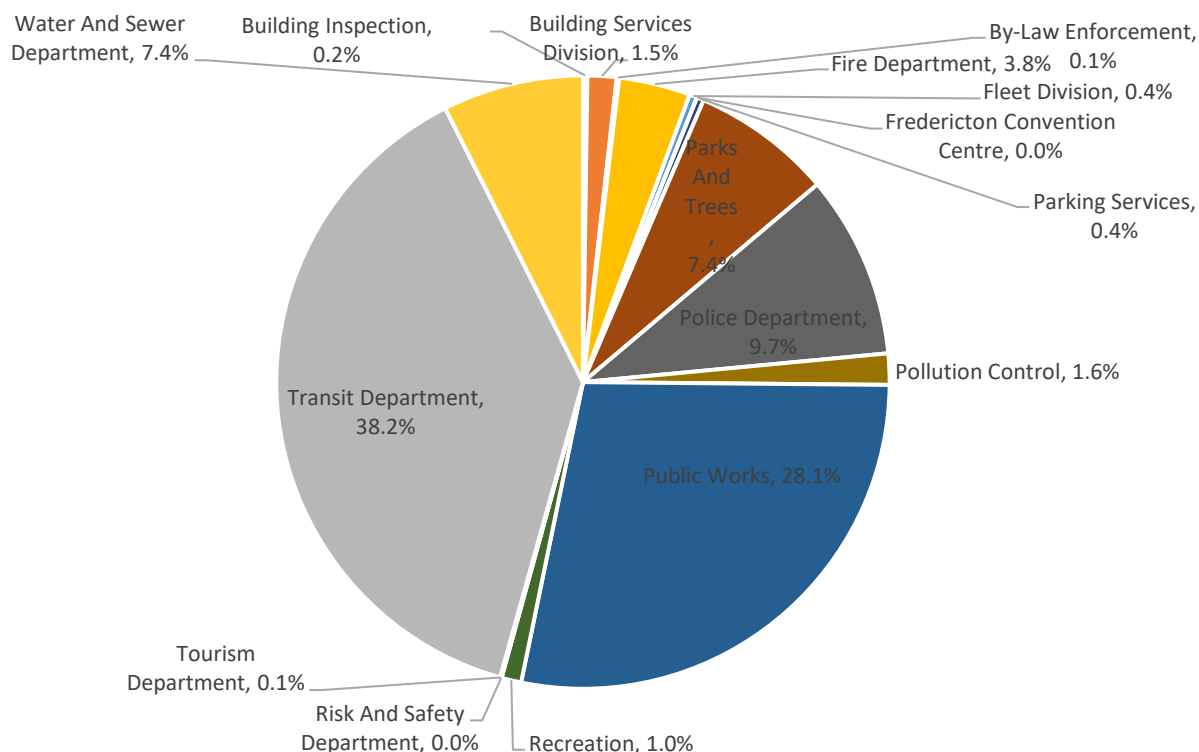


Figure 11. Vehicle & Equipment GHG Emissions by Department / Unit

Transit vehicles, fleet and equipment GHG emissions are the direct result of a wide and varied range of services delivered to the community. As no single measure can eliminate all vehicle and equipment related GHG emissions, a suite of fleet and transit strategies are required which include:

Fleet & Equipment:

- F1: Implement Lean Sigma Six Review of Fleet
- F2: Opportunistically Switch Light Duty Fleet to Hybrid / Electric
- F3: Monitor Renewable Energy and Fuel Technologies
- F4: Opportunistically Switch Off-Road and Hand-Held Equipment to Electric

Transit:

- T1: Monitor Cold-Weather City EV Bus Programs
- T2: Complete an On-Demand Transit Feasibility Study & Implement the Recommendations.

Based on the proposed actions, by 2050 it is estimated that the City can reduce transit, fleet and equipment GHG emissions by 5 percent from the 2004 base year, and 55 percent from the 2019 reporting year (Table 9).

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

Table 10. Estimated GHG Emission Reductions From Transit, Fleet & Equipment

Year Ended	2025	2030	2040	2050
Business as Usual Forecasted GHG Emissions (tCO ₂ e)	5,390	5,413	5,685	6,337
Emissions Reductions (tCO ₂ e)	446	502	2,030	4,080
Remaining GHG Emissions (tCO₂e)	4,944	4,911	3,655	2,256
Change from 2004 Base Year	108%	107%	54%	-5%
Change from 2019 Reporting Year	-1%	-1%	-27%	-55%

Notes to Table:

Base Year GHG emissions: 4,973 tCO₂e

Reduction values and percentages do not include the procurement of offsets.

Figure 12 illustrates the progression of GHG emissions reductions over time compared to the forecasted business as usual scenario. It shows that a focus on fleet efficiency improvements and the adoption of low carbon fuel sources will be the main driver of energy and GHG reductions over time.

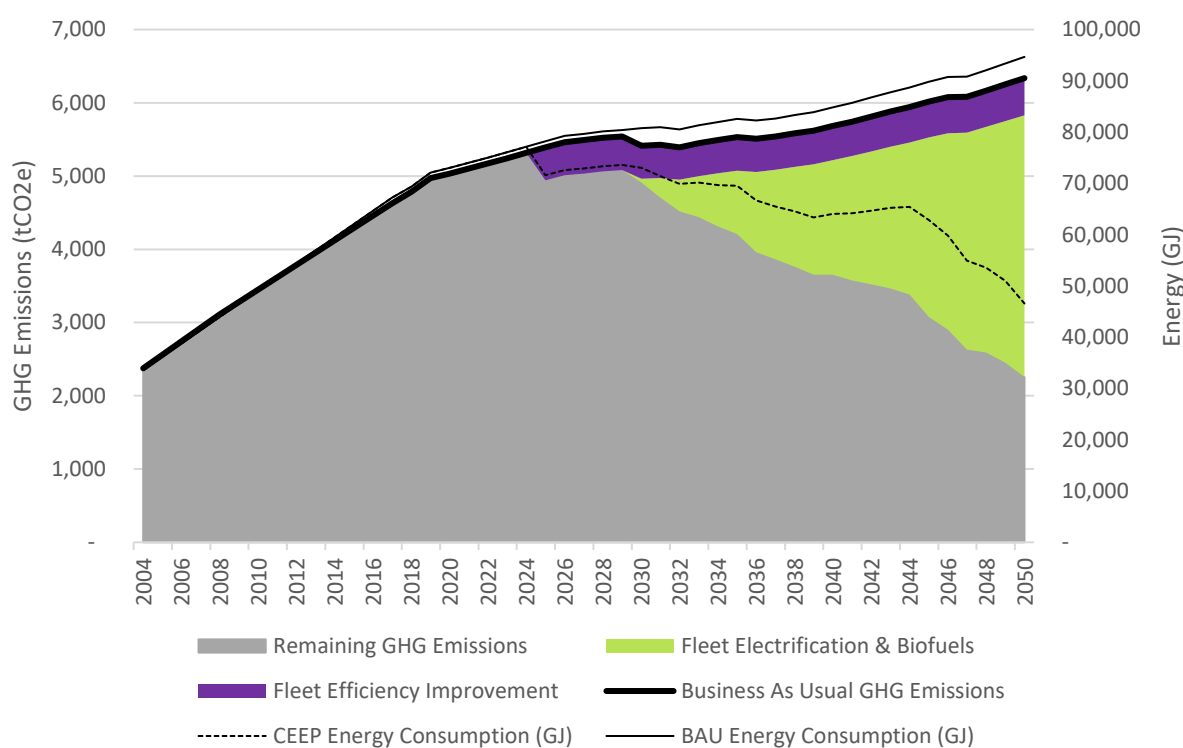


Figure 12. Forecast of Fleet & Equipment Energy and GHG Emissions

To achieve the GHG reduction targets, the City must aggressively electrify the fleet and convert all equipment to electric or renewable fuels. Achievement of the 2050 target will involve converting all emergency and non-emergency light duty vehicles, trucks, and heavy duty equipment to electric or renewable fuels. While many non-essential service vehicles can soon be replaced with electric vehicles that are available on the market, the City's

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

capability to replace emergency vehicles or heavy-duty vehicles with zero emission vehicles will rely upon the advancement of electric vehicle technology and enabling legislation. To meet the 2030 GHG reduction target, it is anticipated that some fuel switching to biofuels will be required at least to reach the 2030 target. R100 is a biofuel replacement for diesel that requires no vehicle modifications and could be a strong candidate for City heavy duty vehicles GHG emissions reduction in the future. High ethanol content gasoline can reduce the GHG emissions of gasoline vehicles when no electric alternative is available in the short-term.

Descriptions of the actions that can lead to the estimated reductions are discussed in the following sections.

6.1 FLEET & EQUIPMENT INITIATIVES

6.1.1 F1: Implement Lean Sigma Six Review of Fleet

This CEEP is proposing that the City reduce GHG emissions by 80 percent below 2004 levels by 2050. Converting this target into action requires the implementation of a Lean Sigma Six Review to optimize, and possibly reduce fleet size, maximize vehicle use, and adjust fleet composition which will result in reduced fuel consumption and GHG emissions. As it relates to fleet, the process typically involves examining existing vehicles, including their purpose, fuel use and emissions, and how other factors like driving techniques can positively and negatively impact fuel consumption, operation and maintenance costs and GHG emissions. This information can then be used to establish a baseline for fuel costs and GHG emissions by vehicle type and class to which the City can then model process changes to identify cost and energy saving opportunities. As part of this process, the City could evaluate its current practices to take advantage of techniques that can result in lower fuel consumption, such as the naturalization of park areas. Naturalization of parks not only reduces the amount of energy-intensive grass mowing areas, thus reducing fuel use, but would also synergistically benefit local air quality and plant biodiversity. Staff time previously used for grass mowing could be switched to establishing and maintaining naturalized areas.

This initiative could result in a 10-17 percent reduction in fleet energy use and GHG emissions.

6.1.2 F2: Opportunistically Switch Light Duty Fleet to Hybrid / Electric

According to Bloomberg New Energy Finance, by 2040, nearly 55 percent of vehicle sales will be electric, and are projected to achieve cost parity to their equivalent gasoline powered vehicle by the early 2020s (Figure 13). It is anticipated that by 2025 light duty electric vehicles (EV) will reach cost parity with their gasoline and diesel counterparts⁷.

The variety and types of electric vehicles available for sale are also expected to expand significantly from the current offering of light-duty vehicles to pick-up trucks and SUVs over the next five years. As the battery life, charge time, cost-parity of electric vehicles have improved significantly, it is now feasible for the City to opportunistically reduce energy and GHG emissions from its light duty vehicle (LDV) fleet by replacing these with electric vehicles. This will not only support corporate needs but will encourage the public to make their own investments in electric vehicle technology as well.

⁷ Bloomberg New Energy Finance, 2018, *Electric Vehicle Outlook 2018*, <https://about.bnef.com/electric-vehicle-outlook/>, accessed August 15, 2018.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

To move forward with this initiative, in the short-term, the City will need to identify a process that incorporates vehicle right-sizing requirements to identify which vehicles can be replaced with electric vehicles. Over the medium-term, it is recommended that the City complete an EV adoption study to identify where fleet can be converted to EV and what EV infrastructure will need to be planned for.

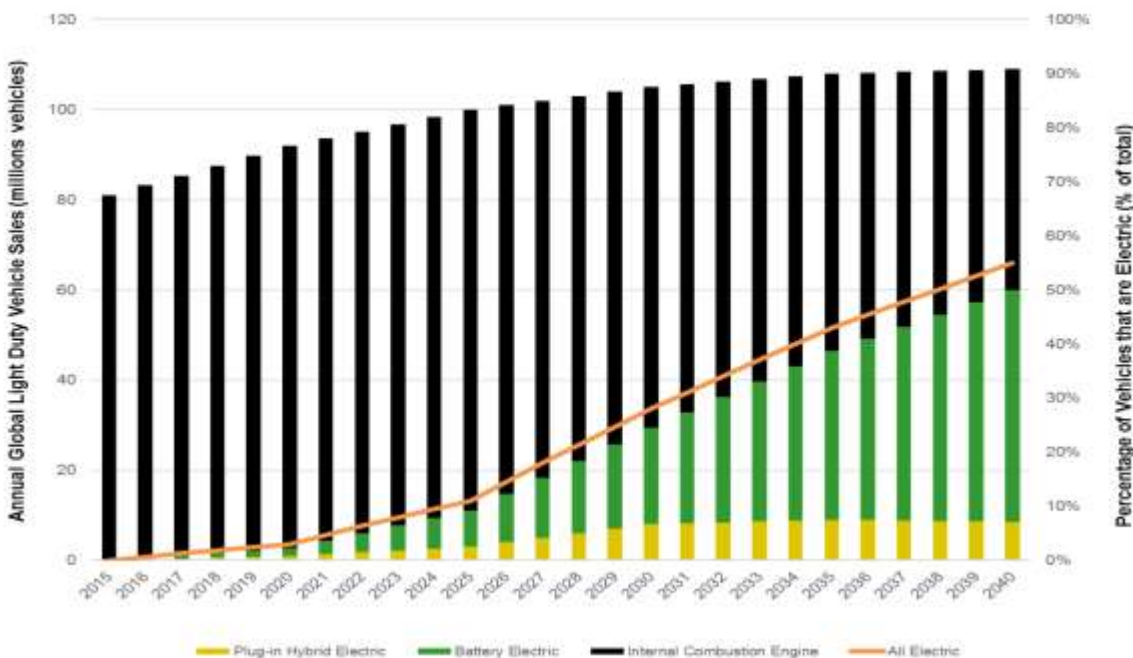


Figure 13. Forecasted Electric Vehicle Global Sales⁸

The corporate fleet is currently capitalized to support the replacement of vehicles on a like-for-like basis and add new vehicles to the fleet based on growth and development of corporate services. It does not support a transition to electrified or low-carbon powered vehicle and equipment fleet which have higher capital costs, require trained staff, and require new fueling infrastructure systems. Some of the costs are offset from reduced fuel and maintenance costs, but additional support is needed in the short term to support the transition. It is recommended that the City consider exploring a three-tiered approach to finance investment in switching to low- no-carbon vehicles using an escalating price of carbon (established Federally), an internal levy and vehicle electrification fund.

Depending on how aggressive the City is with the implementation of the actions within this Initiative, the City could achieve a 40 percent reduction in energy and 80 percent reduction in GHG emissions per vehicle.

6.1.3 F3: Monitor Renewable Energy and Fuel Technologies

It is recommended the City monitor the development and implementation of practical research, technologies, and investment in the area of renewable energy, including energy conservation, efficiency, generation sources (e.g., a mix of expanded sewer heat recovery, waste heat recovered from data centers, thermal energy storage, bio-fuels, hydrogen, or other renewable energy sources), energy storage (e.g. fuel cells), and carbon offset opportunities

⁸ Bloomberg Finance, 2018. *Electric Vehicle Outlook 2018*, <https://about.bnef.com/electric-vehicle-outlook/>.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

ultimately to the benefit of the City. For example, micro-turbine and battery storage may be viable energy conservation and generation opportunities for water and wastewater pumping stations. There may also be opportunities for the City to use bio-materials use as fuel and income generating potential with the amount organic material discharged from the Barker Street Pollution Control Centre. The information should be compiled annually and disseminated to City departments for piloting and to inform departmental energy and GHG plans where feasible.

No energy or GHG benefit has been estimated for this initiative.

6.1.4 F4: Opportunistically Switch Off-Road and Hand-Held Equipment to Electric

The City has been actively piloting new technologies as part of reducing fleet and equipment fuel consumption and GHG emissions. The City should use this experience to consider city-wide approaches to develop a formal strategy to transition small mobile equipment (e.g., mowers and leaf blowers) to electric or zero emissions technologies. It is also recommended that the City investigate pilot projects using electric vehicle and other heavy truck hybrid technologies as they become available and recommend unique opportunities which result in cost effective and reduced fuel consumption and GHG emissions.

No energy or GHG benefit has been estimated for this initiative.

6.2 TRANSIT INITIATIVES

Transit plays a critical role in the Fredericton community. It transports people throughout the community, reduces traffic congestion and therefore GHG emissions by reducing the number of single occupant vehicles, and also supports compact community developments. In 2019, the City accomplished this with 31 diesel buses and support vehicles which collectively account for 15 percent of the City's annual energy usage and 14 percent of its GHG emissions.

6.2.1 T1: Monitor Cold-Weather City EV Bus Programs

The current lifecycle of a transit bus can be up to 18 years which means that transit choices made in 2031 will still have an impact on corporate GHG emissions in 2050. Hybrid and battery electric propulsion technology is currently the desired path for the City because these buses have the potential to reduce transit fleet emissions by upwards of 90 percent over the current diesel models. However, battery electric buses are still in their infancy relative to the adoption of hybrid diesel-electric technology. Exclusive of the infrastructure required to support the vehicle, hybrid and battery electric buses are purchased at a significant premium over conventional diesel buses and in some cases do not perform well in cold weather climates. As general adoption of the technology progresses, it is anticipated that the premium will dissipate, and the cold weather operational concerns be addressed.

It is recommended that the City monitor other cold weather City electric and hybrid bus initiatives (e.g., the City of Edmonton) to gain insights into the resources required and the lessons learned in order to inform future pilot hybrid / EV transit projects that could be implemented as City buses are replaced.

No energy or GHG benefit has been estimated for this initiative.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

6.2.2 T2: Complete an On-Demand Transit Feasibility Study & Implement the Recommendations

On-demand transit is often used where traditional public transit services are lacking, or not cost-effective, to cover the demand areas. In the case of the City, overall ridership utilization is low and is often not cost-effective. In its simplest form, on-demand transit is seen as a combination of regular public transit services (fixed route, fixed schedule) and personalized taxi services (flexible route, flexible schedule) and can help address the first/last mile problem due to the flexible nature of the service. On-demand transit services can reduce the cost of providing transit services and GHG emissions while improving the customer experience by using technology to request a ride. It is recommended that the City complete an on-demand transit feasibility study to understand how shared, on-demand transit can successfully complement the fixed-route bus transit system currently in place and result in operational and energy efficiencies.

It is estimated that the City could achieve a 13 to 15 percent reduction in energy and GHG emissions in Transit fleet from the deployment of an on-demand transit system.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

6.3 SUMMARY OF PROPOSED INITIATIVES

A summary of the proposed initiatives is presented in the following table:

Table 11. Summary of Transit, Fleet & Equipment Initiatives

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
Fleet							
F1	Implement Lean Sigma Six Review of Fleet	Implement Lean Sigma Six program review of the fleet, mileage, and fuel usage with the objective of reducing capital, energy, and operational costs.	10-17% for fleet rightsizing and utilization improvements	<ul style="list-style-type: none"> To be determined. 	Medium-term (begin after AVL pilot data is in)	<ul style="list-style-type: none"> Fleet 	<ul style="list-style-type: none"> Review is completed; recommendations are implemented. Unit fuel/km Total L of fuel types used # of vehicles with greater fuel efficiency, hybrid, EV etc.
F2	Opportunistically Switch Light Duty Fleet to Hybrid / Electric	Monitor hybrid police vehicle trial that is underway and apply learnings to other departments with light duty vehicles and trucks when the opportunity arises. For new vehicle and equipment purchases, leverage the purchasing power of the Tri-City Purchasing Agreement and Government of New Brunswick tenders, where feasible.	40-60% per vehicle	<ul style="list-style-type: none"> Assume extra \$3,000 per EV LDV until cost parity is achieved in 2025. LDT EV / Hybrid premiums will likely range from \$8k to \$15k for an indeterminable period of time. 	Pilot is underway Medium-term	<ul style="list-style-type: none"> Fleet 	<ul style="list-style-type: none"> Unit fuel/km Total L of fuel types used # of vehicles with greater fuel efficiency, hybrid, EV etc.
F3	Monitor Renewable Energy	Monitor the development and implementation of practical research, technologies, and investment in the area of	Supportive Initiative	<ul style="list-style-type: none"> Staff time (0.15 FTE) 	Medium-term	<ul style="list-style-type: none"> Fleet Corporate Services 	<ul style="list-style-type: none"> Unit fuel/km Total L of fuel types used

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
F4	and Fuel Technologies Opportunistically Switch Off-Road and Hand-Held Equipment to Electric	renewable energy and fuels (e.g., B100). Continue to opportunistically switch off-road and hand-held equipment to electric powered where health and safety and performance is not compromised.	40-60% / Equipment	<ul style="list-style-type: none"> Staff time 	Work underway/ongoing	<ul style="list-style-type: none"> Fleet 	<ul style="list-style-type: none"> # of vehicles with greater fuel efficiency, hybrid, EV etc. Unit fuel/km Total L of fuel types used # of pieces of electric equipment.
Transit							
T1	Monitor Cold-Weather City EV Bus Programs	Monitor other cold weather City electric and hybrid bus initiatives (e.g., the City of Edmonton) to gain insights into the resources required and the lessons learned in order to inform future pilot hybrid / EV transit projects that could be implemented as City buses are replaced.	Supportive Initiative	<ul style="list-style-type: none"> Staff time (0.10 FTE) 	Monitoring (ongoing)	<ul style="list-style-type: none"> Transit 	<ul style="list-style-type: none"> Number of hybrid / EV busses in City Fleet
T2	Complete an On-Demand Transit Feasibility Study & Implement the Recommendations.	Complete an on-demand transit feasibility study to understand how shared, on-demand transit (micro-transit) can successfully complement the fixed-route bus transit system currently in place and result in operational and energy efficiencies.	13%-15% of transit fleet fuel consumption.	<ul style="list-style-type: none"> \$100,000 for study. Implementation costs unknown. 	Medium-term	<ul style="list-style-type: none"> Transit 	<ul style="list-style-type: none"> Completion of Study Transit Ridership Transit Utilization GHG / Transit Rider

7.0 SOLID WASTE

Waste does not directly consume energy but when deposited into landfills, it decomposes and releases methane which is a potent GHG. Much of these GHG emissions have been mitigated through the installation of a landfill gas capture system at the landfill which also means the GHG intensity of landfilling organic waste is low. In addition, the extraction and processing of raw materials, the manufacturing, and transportation of these materials prior to disposal also creates GHG emissions. There are other impacts beyond the GHG impacts that waste have which range from land-management (using land to bury waste), air quality impacts because of transporting the waste, managing any contaminated water that comes from the waste, amongst many others. Keeping waste out of the landfill requires a focus on diverting waste to other uses as well as minimizing the amount of waste generated in the first place. To achieve this, a solid waste management plan is proposed that would extend beyond corporate boundaries but to the community as well.

7.1.1 SW1: Develop Solid Waste Management Plan

Reducing the amount of waste created is a critical first step to reduce the burden on local landfills and reduce GHG emissions throughout a product's lifecycle from extraction to disposal. By reducing and eliminating waste, GHG emissions can be avoided not only in the landfill, but through a product's life cycle. This initiative recommends the development of a solid waste management plan that aligns with the 7R's of zero waste (Figure 14):

- **Rethink & Reevaluate** – Current purchasing habits and systems that encourage consumption create much of the waste we need to reduce. The first step is to examine what processes, policies, and actions the City can implement / change immediately to reduce waste.
- **Regulate & Standardize** – Waste suffers from the free rider effect where someone else pays environmentally, economically, or socially, whilst others do not. When City waste is sent to the landfill the waste is buried and left for future generations to contend with. An effective method to addressing this challenge is to implement regional waste reduction initiatives like source waste separation requirements, recycling standards, etc. This will require engagement with the Province, the Regional Solid Waste Commission, and surrounding local governments.
- **Reduce** – Reducing end use waste is very important, but so is reducing waste throughout the supply chain. This means considering the ecological footprint of goods and services by choosing products that last longer, can be repaired, reused, recycled, or sold. It also means prioritizing the purchase of locally grown foods and goods.
- **Reuse** – Wherever possible, use products that retain their value, usefulness, and function. It means using products that have been designed for disassembly and reuse and repairing products when they have broken down.
- **Recycle/Compost/Repurpose** – Many products sold on the market are disposable, but not recyclable/reusable and are meant to be discarded. The solid waste management plan will encourage staff and the community to purchase goods that can be upcycled or recycled and incent the use of diversion systems that allow for the highest and best use of materials, including organics.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

- **Recover** – The current waste systems co-mingle, or mix, waste streams, making it difficult to recover some of the materials thrown out. Change will be required at the Regional Solid Waste Commission and Provincial levels and will require the reexamination of processes to support the separation of waste streams so that as much material is recovered as possible. This will reduce the amount of virgin materials being used in new products.
- **Residuals Management** – The City will need to monitor and track all waste streams, diversion rates, and residual waste to identify new opportunities to reduce residual waste to zero.

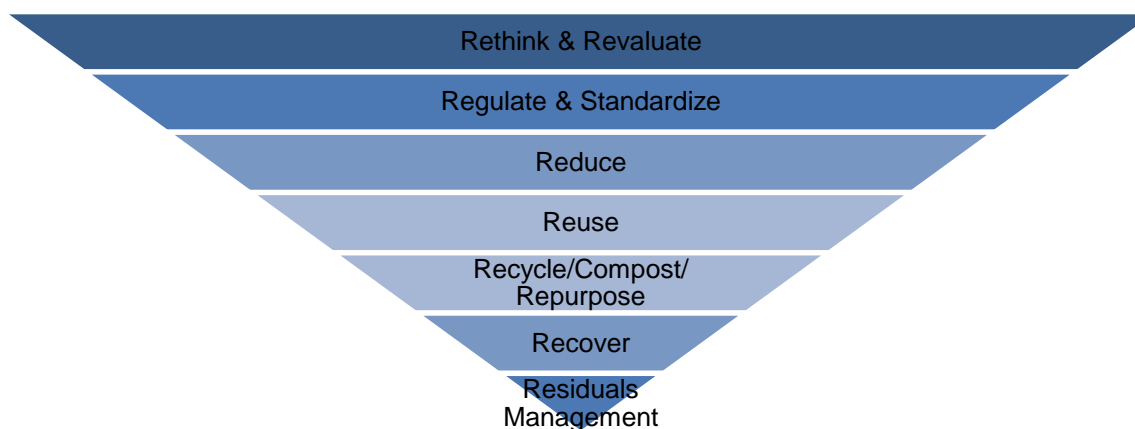


Figure 14. Zero Waste Hierarchy

For this initiative, it is recommended that the City first focus on larger facilities – for example those over 100,000 square feet such as Grant Harvey Centre, Willie O'Ree Place, and Fredericton Convention Centre. Over time, waste diversion rates at smaller facilities could also be examined and strategies put in place to improve performance.

Table 11 presents the forecasted emissions from waste – the expectation is that waste generation will increase as a result of increased staffing requirements. Depending on how aggressive the City is with the implementation of this initiative, the City could negate the projected increase in GHG emissions and possibly eliminate all corporate waste streams and GHG emissions by 2050 (i.e., 163 tCO₂e) as well as reduce community waste and associated GHG emissions.

Table 12. Estimated GHG Emission Reductions From Solid Waste

Year Ended	2025	2030	2040	2050
Business as Usual Forecasted GHG Emissions (tCO ₂ e)	152	155	172	163
Emissions Reductions (tCO ₂ e)	0	0	0	163
Remaining GHG Emissions (tCO₂e)	152	155	172	0
Change from 2004 Base Year	-34%	-33%	-26%	-100%
Change from 2019 Reporting Year	3%	6%	17%	-100%

Notes to Table:

Base Year GHG emissions: 231 tCO₂e. Reduction values and percentages do not include the procurement of RNG and offsets.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

7.2 SUMMARY OF PROPOSED INITIATIVES

A summary of the proposed initiatives is presented in the following table.

Table 13. Summary of Solid Waste Initiatives

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
SW1	Develop Solid Waste Management Plan	Develop a corporate and community solid waste management plan that aligns with the 7R's of zero waste.	Up to 100% of solid waste emissions	<ul style="list-style-type: none"> Staff Time (0.25 FTE) Staff Member / Consultant Salary 	Long-term	Engineering	<ul style="list-style-type: none"> Completion of Initiative tonnes of solid waste / person

8.0 WATER & WASTEWATER

The City is the wholesale supplier of water and wastewater services to the Fredericton community, and is responsible for bulk supply, treatment and storage of drinking water and conveyance and treatment of wastewater. This infrastructure equipment operates 24 hours a day, seven days a week, and accounted for 21 percent of the City's total energy use and 23 percent of 2019 GHG emissions. The bulk of these GHG emissions (89 percent) arise from the consumption of electricity.

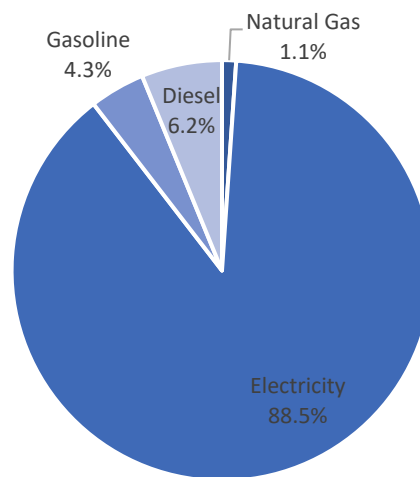


Figure 15. Water & Wastewater GHG Emissions By Fuel Type

The water and wastewater initiatives presented herein leverage existing programs already underway, including the water conservation, sanitary sewer inflow and infiltration reduction, and process energy programs (e.g., opportunistically installing variable frequency drives (VFD) on motors, use solar PV electricity and scheduling water tower filling, to match available solar power). These programs are managed by the Water and Pollution Control divisions.

For this CEEP, the City's energy-related water and wastewater initiatives have been organized into two main categories:

Water:

- W1: Expand Pilot Remote Water Metering Program to City
- W2: Implement Pilot GPS AVL Study on Vehicle Fleet Pollution Control

Pollution Control:

- P1: Complete a City-Wide Sewer-Shed Study
- P2: Assess the Feasibility of a Large Solar PV Array
- P3: Implement Energy Audit Recommendations

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

- P4: Assess the Energy and Revenue Potential of the Bio-Materials Generated at the Barker Street PCC

Based on the proposed actions, it is estimated that the City can reduce water and wastewater related GHG emissions by 21 percent from 2019 levels by 2050. However, when compared to the 2004 base year, the GHG emissions are expected to increase by 65 percent which is the direct result of a growing community. As the bulk of the GHG emissions arise from the consumption of electricity, there is an opportunity to offset those GHG emissions through the investment in renewable infrastructure systems like Solar photovoltaics (PV).

Table 14. Estimated GHG Emission Reductions From Water & Wastewater

Year Ended	2025	2030	2040	2050
Business as Usual Forecasted GHG Emissions (tCO ₂ e)	3,420	3,589	3,758	4,009
Emissions Reductions (tCO ₂ e)	114	193	199	208
Remaining GHG Emissions (tCO₂e)	3,306	3,395	3,559	3,802
Change from 2004 Base Year	39%	43%	50%	60%
Change from 2019 Reporting Year	-34%	-32%	-28%	-24%

Notes to Table:

Base Year GHG emissions: 3,160 tCO₂e

Reduction values and percentages do not include the procurement of RNG and offsets

Figure 16 illustrates the progression of GHG emissions reductions over time compared to the forecasted business as usual scenario.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

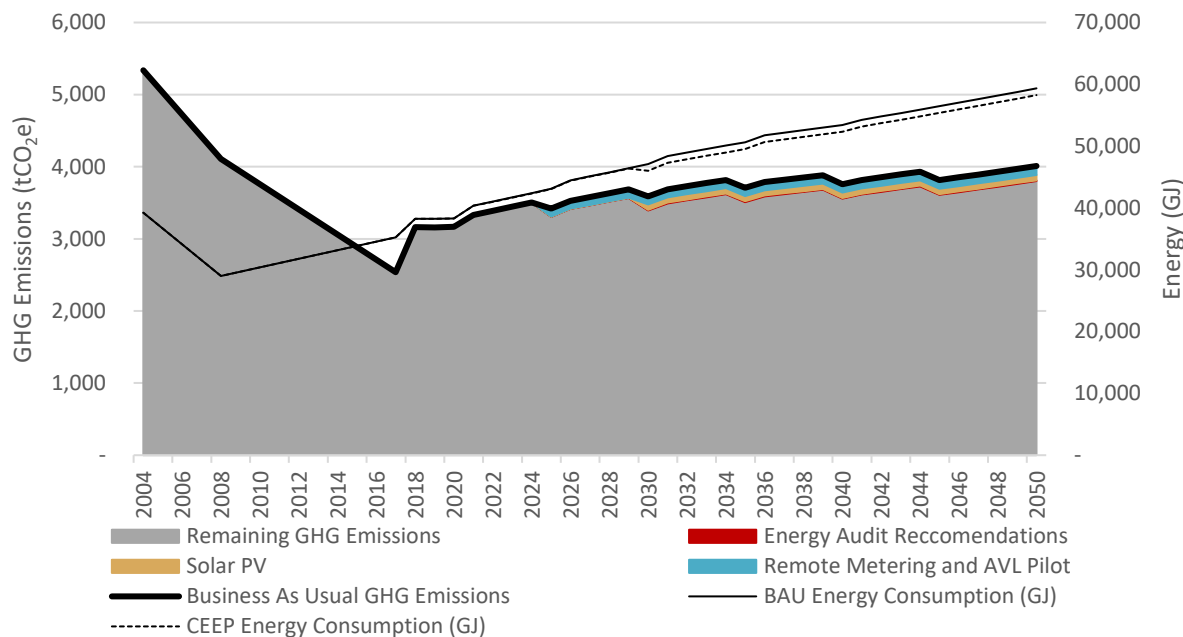


Figure 16. Forecast of Water & Wastewater Energy and GHG Emissions

Descriptions of the actions that can lead to the estimated reductions are discussed in the following sections.

8.1 WATER INITIATIVES

8.1.1 W1: Expand Pilot Remote Water Metering Program to City

Water metering is recognized as a best practice by the Federation of Canadian Municipalities as the practice contributes to achieving water conservation goals, improves billing equity, helps with leak detection and reduction, and support the planning and management of water delivery systems. Like many cities, the water metering program currently in place is a manual and touch-read systems, which require staff to collect data through handheld devices and vehicle units which results in fuel consumption and GHG emissions. A remote water metering program involves the use of advanced metering infrastructure (AMI) that allow automatic collection and transmission of meter data via a regular radio frequency transmission sent directly from each individual meter. With the completion of a successful a pilot remote water metering program in 2019, it is recommended that the City expand the remote water metering program to the rest of the City.

8.1.2 W2: Implement Pilot GPS AVL Study on Vehicle Fleet Pollution Control

Automated vehicle location (AVL) and global positioning systems (GPS) have been widely used by transportation agencies to monitor vehicle locations and operational status. AVL systems are typically comprised of AVL/GPS installed in the vehicle that facilitates data exchanges between vehicles and a central system, and software that enables tracking of vehicle locations throughout a geographic region. Using telematics, route, odometer, and maintenance and operations data, the City can optimize and reduce fleet size, maximize vehicle use, and adjust

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

fleet composition which will result in reduced fuel consumption and GHG emissions. AVL/GPS technology can be used to monitor driving behaviors (e.g., idling, harsh braking, hard acceleration, speeding, engine abuse and fuel consumption) which can be used to inform driver training programs.

It is estimated that the two water initiatives identified can reduce water light duty fleet energy and GHG emissions by up to 50 percent.

8.2 POLLUTION CONTROL INITIATIVES

8.2.1 P1: Complete a City-Wide Sewer-Shed Study

A city-wide sewer-shed study evaluates the current sewer capacity and identifies the pipeline segments which will need capacity improvements to reduce inflow and infiltration (I&I) and increased demands as the population increases. I&I reduction strategies link energy and GHG emissions reductions to water conservation and limiting the inflow and infiltration of rain and groundwater into the City's wastewater systems. By reducing the volume of stormwater in the system, the City consumes less energy for pumping and treatment which results in reduced GHG emissions.

No energy or GHG benefit has been estimated for this initiative.

8.2.2 P2: Assess the Feasibility of a Large Solar PV Array

There exists an opportunity to install a large solar photovoltaic array on an underutilized landscape on lands near the Barker Street Pollution Control Centre (PCC). MCW has estimated that the large field within the site property lines would be an ideal location for a 200 kW solar PV array. As the PCC is equipped with multiple NB Power meters, there is an opportunity to divide this 200 kW array into two (2) separate 100 kW main feeders to comply with the NB Power connected load requirements.

It is estimated that the City could achieve a 2 percent reduction in water and wastewater energy and GHG emissions as a result of this initiative.

8.2.3 P3: Implement Energy Audit Recommendations

Several building energy audits at the PCC buildings and facilities have been completed. The scope of the audits included reviewing building thermal performance, load distribution, existing equipment and controls schedules, occupancy patterns, lighting, and efficiency systems to identify energy and emission reduction opportunities. The recommendations ranged from lighting system upgrades, BAS upgrades, the use of insulation and weather-stripping to installing variable speed motors, and the installation of heat recovery systems. The estimated cost, economic savings, simple payback and estimated GHG emissions reductions opportunities by facility are presented in Table 14.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

Table 15. Summary of Energy Audit Recommendations

Asset	Estimated Cost	Estimated Annual Energy Savings (GJ)	Estimated Annual Savings	Simple Payback (Years)
Barker St WWTP - Administration Building	\$46,709	65	\$1,864	25.1
Barker St WWTP - Operation Building	\$768,765	600	\$19,948	38.5
Barker St WWTP - Blower Building	\$597,328	492	\$9,401	63.5
Barker Street	\$4,015	6	\$1,144	3.5
Total	\$1,416,817	1,163	\$32,357	43.8

These audit recommendations should be considered and prioritized based on paybacks along with the audit results outlined in action B4. It is recommended the City prioritize the efforts to be undertaken based on the expected energy and cost savings, the payback for the individual measure to be employed, and the availability of City resources to affect the improvement. It is recommended that City continue to seek out funding opportunities and incentives to improve the business case for high GHG reduction actions that have a longer or lower financial return on investment.

It is estimated that this initiative can reduce annual energy by 3 percent.

8.2.4 P4: Assess the Energy and Revenue Potential of the Bio-Materials Generated at the Barker Street PCC

The current treatment of wastewater biosolids involves the dewatering and trucking of the materials offsite by a private company for disposal. Although the contractor's fuel use is not included in the corporate energy and GHG emissions, the activity increases GHG emissions in the community. Furthermore, the disposal of the biosolids results in the release of methane (CH₄) a potent GHG emission as a result of decomposition.

As biosolids contain about as much energy as low-grade coal (lignite), there is possibly an opportunity to utilize a waste stream as local fuel source through anaerobic digestion to produce combustible gas or thermal ignition of the solids – i.e., pressure cooking biosolids to produce a combustible coal-type substance. It is recommended that the City engage a Subject Matter Expert (SME) to quantify the potential of bio-material use as fuel and income generating potential with the amount organic material discharged from the PCC. This kind of engagement could be through a master's level University student and be supported in part through ECO-Canada funding grants.

No energy or GHG benefit has been estimated for this initiative.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

8.3 SUMMARY OF PROPOSED INITIATIVES

A summary of the proposed initiatives is presented in the following table.

Table 16. Summary of Water & Pollution Control Initiatives

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
Water							
W1	Expand Pilot Remote Water Metering Program	Based on the results of the remote / electronic water metering pilot program, implement the learnings and expand the program to the rest of the City.	10-25% of water fleet emissions	<ul style="list-style-type: none"> To be determined. 	Medium-term	<ul style="list-style-type: none"> Water & Sewer 	<ul style="list-style-type: none"> Unit fuel/km Total L of fuel types used
W2	Implement Pilot GPS AVL Study on Vehicle Fleet	Implement a pilot AVL project on the water department fleet with the objective of monitoring the fuel reduction benefit from the Remote Water Metering Program and from changing driver habit programs.	10-17% of water fleet emissions.	<ul style="list-style-type: none"> To be determined. 	Short-term (in 2021 budget)	<ul style="list-style-type: none"> Fleet Water 	<ul style="list-style-type: none"> Unit fuel/km Total L of fuel types used
Pollution Control							
P1	Complete a City-Wide Sewer-shed Study	Complete a City-wide sewer-shed study to find opportunities to reduce infiltration and reduce energy	Supportive Initiative	<ul style="list-style-type: none"> To be determined. 	Short-term (in 2021 budget)	<ul style="list-style-type: none"> Pollution Control 	<ul style="list-style-type: none"> Completion of study & implementation of recommendations Energy Intensity (GJ/m³) Infiltration Rate
P2	Assess the Feasibility of a Large Solar PV Array	Complete a more detailed analysis of large solar array to reduce the GHG intensity of energy consumption at the WWTP. Financial viability can be improved	2% Energy Reduction	<ul style="list-style-type: none"> \$0.6M (After Available External Funds) 	Medium-term	<ul style="list-style-type: none"> Pollution Control Building Services 	<ul style="list-style-type: none"> Renewable energy opportunities are identified and assessed KWh_{ac} produced

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
P3	Implement Energy Audit Recommendations	by accessing external funding sources (i.e. FCM). Excluding the solar PV recommendations, complete recommendations identified in the comprehensive MCW energy audits, and track the progress of energy audits and projects.	3% Energy Reduction	<ul style="list-style-type: none"> • \$1.6M (After Available External Funds) • Staff Time (0.5 FTE) 	Short-term	<ul style="list-style-type: none"> • Pollution Control • Building Services 	<ul style="list-style-type: none"> • % of energy demand from renewable energy • Energy Intensity (GJ/m³) • Operational Energy Costs • Energy Intensity (GJ/m³) • Operational Energy Costs
P4	Assess the Energy and Revenue Potential of the Bio-Materials Generated at the Barker Street PCC	Engage a Subject Matter Expert (SME) to quantify the potential of bio-material use as fuel and income generating potential from organic material discharged from the Barker Street Pollution Control Centre.	To be Determined	<ul style="list-style-type: none"> • To be determined 	Currently underway/ongoing	<ul style="list-style-type: none"> • Pollution Control 	<ul style="list-style-type: none"> • Energy Savings (GJ) • Avoided GHG emissions

9.0 CORPORATE LEADERSHIP

As cities contribute to more than 70 percent of global GHG emissions, they have both a responsibility and an opportunity to respond to the causes and impacts of climate change. This CEEP proposes that the City commit to reducing corporate annual GHG emissions, to help manage climate-related risks to the City. By implementing priority actions identified in the climate adaptation plan and developing processes so that all actions are informed by a fuller understanding of through-life social, environmental, and economic costs, risks, and benefits. A better understanding of the suite of sustainability risks and benefits for each asset and service area can enable the City to make smart investments to reduce GHG emissions as much as possible for every dollar invested. The following proposed initiatives align with the proposed commitments and set the foundations for other initiatives identified in the CEEP.

- C1: Establish Energy & GHG Reduction Targets
- C2: Establish Role & Hire A Corporate and Community Energy Manager
- C3: Update Asset Management Plan and Policy
- C4: Pilot the Use of LCA Tools When Making Capital Purchases
- C5: Develop A Corporate Energy Savings Policy and Terms of Reference (ToR)
- C6: Create Sustainable Purchasing Policy
- C7: Establish Departmental GHG Accounting & Reporting Program

These initiatives are presented in the following sections.

9.1.1 C1: Establish Energy & GHG Reduction Targets

As centers of communication, commerce, and culture, municipal government organizations play an important role in the reduction of GHG emissions and the impacts that climate change can have on a community. They have a leadership role that influences their communities beyond their organization's carbon footprint. On this basis, it is recommended in this CEEP that the City establish GHG reduction targets that align with federal commitments as well as the international targets agreed to in the 2015 Paris Climate Agreement. These are as follows:

- 30 percent, below 2004 levels by 2030
- 80 percent, below 2004 levels, by 2050

The establishment of these GHG reduction targets can help galvanize and align the innovative and creative solutions that are required. As part of meeting these GHG reduction targets, it is recommended that the City require key City department, functions or units to develop a 5-year energy and GHG emissions reduction plan for their operational activities, and report on progress annually. This would enable each department, function or unit to directly engage in the CEEP by tracking the energy use and GHG emissions resulting from day to day operations, decision-making, and capital purchases.

This initiative supports all initiatives recommended in this CEEP. No energy or GHG benefit has been estimated.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

9.1.2 C2: Establish Role & Hire A Corporate and Community Energy Manager

The implementation of the proposed initiatives within the corporate and community CEEP will require the establishment of a role for and the onboarding of a Corporate and Community Energy Manager who would oversee and be responsible for supporting the implementation of the proposed energy and GHG reduction initiatives. The Corporate and Community Energy Manager would champion implementation of both the corporate and community CEEP's, including engagement and coordination between departments and stakeholders, monitor progress, quantify energy and GHG reductions achieved, analyze trends, review and share of successes, assist with mitigation of challenges or barriers, and report on progress. The Corporate and Community Energy Manager would also be responsible for leading and coordinating the subsequent updates and refinements of the CEEP to meet the 2030 and 2050 GHG reduction targets.

In the implementation of this initiative, it is imperative that this role be provided an adequate level of authority to implement these cross departmental / function initiatives with direct reporting to the chief administrative officer (CAO). Without adequate authority and support, there is high risk that the recommended initiatives will not be implemented due to changes in political priorities and other internal barriers.

It is recommended that the role of the Corporate and Community Energy Manager, at a minimum, encompass the following responsibilities:

- **Strategy Development and Implementation.** Lead and coordinate the implementation of the City's climate action and sustainability strategies (corporate and community CEEP, adaptation plan, etc.). Consult with internal and external stakeholders, frequently assess climate and sustainability trends, risks, opportunities, and best practices and incorporate necessary aspects into strategic planning documents. Collaborate with leadership to acquire financial and resource commitments and buy-in to support the implementation of the priority initiatives identified in the City's climate action and sustainability strategies.
- **Capacity Development.** Act as climate action champion by providing and embedding sustainability expertise and insights into City departmental strategies and community plans. Assist leadership with the integration of climate action and sustainability into business functions, plans, operations, and internal/external communications. Support the development of internal and external climate action and sustainability programs and programming to advance climate action in the City.
- **Stakeholder Engagement.** Develop stakeholder engagement programs to build cross-functional relationships with internal and external stakeholders around climate action and sustainability to build adaptive capacity and partnerships with community organizations to spread out the climate action effort and responsibility.
- **Reporting, Communications, and Disclosure.** Prepare annual reports on the progress towards the climate action and sustainability targets set out in the corporate and community CEEP's and the climate adaptation plan.
- **Resilience and Innovation.** Work with internal and external stakeholders to implement projects, policies and programs that foster climate action and sustainability improvements that reduce energy, GHG emissions and increase resilience to climate change.

This initiative supports all initiatives recommended in this CEEP. No energy or GHG benefit has been estimated.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

9.1.3 C3: Update Asset Management Plan and Policy

An effective asset management plan and policy should reference the impacts of climate change on asset systems and commit the organization to understanding and managing these risks, as one of several types of risk to assets. Given the nature of the proposed initiatives in this CEEP, it is recommended that the City update its Asset Management Policy and associated Plan to include the objective of investing in and upgrading assets to mitigate and adapt to climate change, as part of asset management planning. The Asset Management Plan should include a corporate risk management framework that outlines a consistent approach to risk identification, classification, prioritization, and management. The risk management framework should identify climate risks as one type of risk to be considered, as well as other types of risk.

It is recommended that the Asset Management Policy and associated Plan be reviewed and updated annually as part of the annual budgeting process and the Policy be reviewed and updated every 5 years. The policy should also require that Building Condition Assessments (BCA) forecast out 30 years to support long-term capital planning.

This initiative supports all initiatives recommended in this CEEP. No energy or GHG benefit has been estimated.

9.1.4 C4: Pilot the Use of LCA Tools When Making Capital Purchases

Like most local governments, the City is often juggling and prioritizing competing financial priorities, which can result in a procurement culture where the lowest bid is often seen as the most viable and best value for taxpayers. The result, however, is a system that defaults to 'like-for-like' replacements, penalizes higher cost energy and GHG emission reduction technologies and best-practices, and does not account for the GHG footprint of the products or services being provided. For example, NRCAN estimates that 20 percent of Canada's GHG emissions are embodied in the construction sector – which are not accounted for in most municipal GHG accounting systems.⁹ To shift the current City culture and narrative, the City will need to begin integrating LCA processes into budget and capital planning, strategic planning, purchasing policies, preventative maintenance plans, environmental management plans, and asset management. The simplest form of integration is using publicly available or low cost LCA tools (e.g., RETScreen) as part of pilot projects to account for energy and GHG emissions in budget and capital planning and asset management. For example, when considering the need for new municipal facilities or retrofits to existing facilities, a lifecycle analysis can provide information about the amount of energy used over the entire span of a building's life – from planning and design, to construction, through operation, to decommissioning. Success from this initiative would mean that LCA measures are incorporated into the initial stages operational and capital project planning, and that options for energy efficiency and conservation are considered, evaluated, and quantified in terms of life cycle, which includes cost, maintenance, and energy and GHG reductions.

This is a supportive initiative and would be used to support Initiatives C3, F1, F2, and B3. No energy or GHG benefit has been estimated for this initiative.

⁹ https://senCanada.ca/content/sen/committee/421/ENEV/reports/ENEV_Buildings_FINAL_e.pdf

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

9.1.5 C5: Develop A Corporate Energy Savings Policy and Terms of Reference (ToR)

When actual utility savings occur from energy reductions projects, future operational budgets are often reduced to reflect this change. However, in many cases the operational costs to maintain the energy reductions are higher than what has been historically required, and the reduction of budget reduces a departments resource capacity to maintain the energy reductions. The proposed initiative would assign the remaining budget to a special projects account (e.g., realized utility savings from an LED retrofit program would be assigned to a financial account for use in the future) for the discretionary use of the department that implemented the energy savings project.

This is a supportive initiative and would be used to support all energy and GHG reduction initiatives presented in this CEEP. No energy or GHG benefit has been estimated for this initiative.

9.1.6 C6: Create Sustainable Purchasing Policy

The City has supported the purchase of environmentally friendly products and services in principle and as set out in its Sustainability Purchasing Policy. However, there is no policy that directly addresses purchasing sustainable products or services that generate positive social, environmental and economic outcomes. Economic, social, and cultural aspects of procurement include ethical and fair-trade practices such as economic and employee equity, worker health and safety, child labor, and community economic development. Environmental aspects include items such as recycled content, renewable versus non-renewable resource inputs, greenhouse gas emissions and embodied energy, other contaminant emissions, energy efficiency, and waste production and reduction. It is recommended that in support of sustainability and climate action across the entire value chain that a Sustainability Purchasing Policy be developed and consider:

- All costs and impacts over the service life (e.g., total cost of ownership and best value)
- The opportunity to collaborate with suppliers to improve sustainability and climate action in the supply chain
- The opportunity to consider procurement alternatives (e.g., used goods, etc.)
- Updating the Sustainability Purchasing Policy every 5 years.

This is a supportive initiative and would be used to support all energy and GHG reduction initiatives presented in this CEEP. No energy or GHG benefit has been estimated for this initiative.

9.1.7 C7: Establish Departmental GHG Accounting & Reporting Program

The tracking of energy consumption and GHG emissions data from fuel and utility bills is valuable for departmental energy-related decision making and should be provided to department directors and managers to support energy conservation and demand management. It is recommended that the larger energy consuming departments (i.e., Engineering and Operations, Recreation, Transit and the Water and Sewer Department) develop a 5-year energy and GHG emissions reduction plans for their operational activities, and report on progress annually. This would enable each department to directly engage in the CEEP by tracking the energy use and GHG emissions resulting from day to day operations, decision-making, and capital purchases.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

9.2 SUMMARY OF PROPOSED INITIATIVES

A summary of the proposed initiatives is presented in the following table.

Table 17. Summary of Corporate Leadership Initiatives

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
Corporate							
C1	Establish Energy and GHG Reduction Targets	Establish corporate energy and GHG emission reduction targets for 2030 and 2050.	Primary Initiative	<ul style="list-style-type: none"> In progress 	In progress	<ul style="list-style-type: none"> Corporate Services 	<ul style="list-style-type: none"> Establishment of Targets
C2	Establish Role & Hire a Corporate and Community Energy Manager/ Developing a policy/procedure on implementation	Establish a role within the organization with an adequate level of authority to lead the Corporate and Community Energy and Emission Plans.	Primary Initiative	<ul style="list-style-type: none"> To be determined 	Short-term	<ul style="list-style-type: none"> Corporate Services 	<ul style="list-style-type: none"> Establishment of Role Hiring of Energy Manager
C3	Update Asset Management Plan and Policy	Update Asset Management Policy and associated Plan to include the objective of investing in assets to mitigate and adapt to climate change, as part of asset management planning. An update to the Municipal Plan should also be considered concurrently with the Asset Management Plan as they need to be consistent.	Supportive Initiative	<ul style="list-style-type: none"> Staff Time (0.5 FTE) AND Consultant Time (\$50,000) 	Short-term	<ul style="list-style-type: none"> Corporate Services 	<ul style="list-style-type: none"> Update of Plan and Policy
C4	Pilot the Use of LCA Tools When Making Capital Purchases	Pilot the use of publicly available or low cost LCA tools (e.g., RETScreen) to account for energy and GHG emissions in budget and capital planning and asset	Supportive Initiative	<ul style="list-style-type: none"> Staff Time / Training in LCA Tools 	Medium-term	<ul style="list-style-type: none"> Legal Finance Procurement Building Services 	<ul style="list-style-type: none"> Policy is completed and approved

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
C5	Develop A Corporate Energy Savings Policy and Terms of Reference (ToR)	<p>management. For example, when considering the need for new municipal facilities or retrofits to existing facilities, a lifecycle analysis will provide information about the amount of energy used over the entire span of a building's life – from planning and design, to construction, through operation, to decommissioning. The LCA should include all of the energy inputs, including those used to create building materials at the outset, and to dispose of them at the end of the building's life.</p> <p>Formalize an energy savings policy and terms of reference that recognizes and makes available any operational budgets saved, as a result of energy conservation and demand initiatives. Savings in budget would be available to any department with an energy reduction opportunity that meets the requirements of the ToR.</p>	Supportive Initiative	<ul style="list-style-type: none"> • Staff Time (0.25 FTE) 	Short-term	<ul style="list-style-type: none"> • Finance 	<ul style="list-style-type: none"> • Policy is completed and approved
C6	Create Sustainable Purchasing Policy	Update Sustainable Purchasing Policy to clearly prioritize products and services that reduce / conserve operational energy use and GHG emissions.	Supportive Initiative	<ul style="list-style-type: none"> • Staff Time (0.25 FTE) 	Short-term	<ul style="list-style-type: none"> • Corporate Services • Legal • Procurement 	<ul style="list-style-type: none"> • Policy is completed and approved
C7	Establish Departmental GHG	Develop a methodology to assign energy consumption and GHG emissions to each department.	Supportive Initiative	<ul style="list-style-type: none"> • Staff Time (0.25 FTE) 	Short-term	<ul style="list-style-type: none"> • Corporate Services 	<ul style="list-style-type: none"> • Program is implemented

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

#	Initiative	Description	Energy Reduction Potential	Estimated Cost	Priority	Responsibility	Indicators
	Accounting & Reporting Program						

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

10.0 IMPLEMENTATION & MONITORING

10.1 CEEP INITIATIVE TIMING

The analysis in this CEEP indicates that there is a pathway for the City to make significant progress towards the proposed 2030 and 2050 GHG emissions reduction targets. This CEEP identifies 25 initiatives which were selected based on their direct energy and GHG reduction potential. Table 17 presents these initiatives and the timing of their implementation over the next five years (2021-2025).

Table 18. CEEP Initiative Timing

Initiative	The Project Has Begun	Complete By End Of 2022	Complete By End Of 2024	Complete By End Of 2026	Work Will Be Ongoing Between 2021 And 2026
C1: Establish Energy And GHG Reduction Targets	X				
F2: Opportunistically Switch Light Duty Fleet to Hybrid / Electric	X				
P4: Assess the Energy and Revenue Potential of the Bio-Materials Generated at the Barker Street PCC					X
T1: Monitor Cold-Weather City EV Bus Programs					X
F4: Opportunistically Switch Off-Road and Hand-Held Equipment to Electric					X
B4: Implement a Building Commissioning Program					X
T2: Complete An On-Demand Transit Feasibility Study & Implement the Recommendations.		X			
W2: Implement Pilot GPS AVL Study on Vehicle Fleet		X			
P1: Complete a City-Wide Sewer-shed Study		X			
B1: Develop a Green Building Sustainability Policy		X			
B5: Complete a Buildings Utilization Assessment		X			
P3: Implement Energy Audit Recommendations		X			
C2: Establish Role & Hire A Corporate And Community Energy Manager		X			
C3: Update Asset Management Plan and Policy		X			
C5: Develop A Corporate Energy Savings Policy and Terms of Reference (ToR)		X			
C6: Create Sustainable Purchasing Policy		X			
C7: Establish Departmental GHG Accounting & Reporting Program		X			

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

F1: Implement Lean Sigma Six Review of Fleet			X	
B2: Implement Energy Audit Recommendations			X	
B3: Develop De-Carbonization Plan for Buildings & Facilities			X	
F3: Monitor Renewable Energy and Fuel Technologies			X	
W1: Expand Pilot Remote Water Metering Program to City			X	
P2: Assess the Feasibility of a Large Solar PV Array			X	
C4: Pilot the Use of LCA Tools When Making Capital Purchases			X	
SW1: Develop Solid Waste Management Plan			X	
B6: Develop Alternative Work Strategies and Supportive Policies				X

The following 10 initiatives are planned to be implemented within the 2021 and 2022 reporting years:

- T2: Complete An On-Demand Transit Feasibility Study & Implement the Recommendations.
- W2: Implement Pilot GPS AVL Study on Vehicle Fleet
- P1: Complete a City-Wide Sewer-shed Study
- B1: Develop a Green Building Sustainability Policy
- B5: Complete a Buildings Utilization Assessment
- P3: Implement Energy Audit Recommendations
- C2: Establish Role & Hire A Corporate And Community Energy Manager
- C3: Update Asset Management Plan and Policy
- C5: Develop A Corporate Energy Savings Policy and Terms of Reference (ToR)
- C6: Create Sustainable Purchasing Policy
- C7: Establish Departmental GHG Accounting & Reporting Program

10.2 CEEP MANAGEMENT SYSTEM

A management system is a tool to facilitate the continuous improvement of a plan. For the CEEP, it ensures that there will be ongoing monitoring, management, and refinement over time. This will keep the CEEP current and ensure it is a living document.

Management systems in general range from simple documents to elaborate IT systems. In the context of the CEEP, the management system is simply a documented delineation of the processes, roles and responsibilities to ensure the CEEP is implemented and its initiatives are actioned and progressed towards the proposed GHG emissions reduction targets. The key focus of a management system is its commitment to continuous improvement. Moving forward, the actions and monitoring requirements developed for the CEEP will be regularly reassessed and refined.

It is recommended that the CEEP should be updated every five years. The following management system framework focuses primarily on the five and ten-year planning horizon. Changes to federal and provincial legislation and regulations, as well as technological advances are anticipated over the next decade that will impact the adoption and implementation of longer-term initiatives. The following are the framework's core elements:

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

- Governance and Collaboration
- Energy / GHG Boundaries
- Data Collection
- Data Analysis
- Evaluating Future Initiatives
- Monitoring & Reporting
- Communication Strategy

10.3 DEPARTMENTAL GHG BUDGETS

The use of GHG budgets can create more accountability and improve the likelihood that the City will achieve the GHG emission reduction targets. The departmental milestone GHG budget years are presented in Table 19 below. Note that these budgets include the use of RNG and offsets to achieve the GHG reduction targets.

Table 19. Department Unit GHG Budgets

Department	2025	2030	2040	2050
Building Inspection (Planning & Development)	55	24	17	13
Building Services Division	94	84	38	28
By-Law Enforcement (Safety Dept)	6	7	2	2
Fire Department	530	403	227	126
Fleet Division	45	23	12	8
Fredericton Convention Centre	0	0	0	0
Parking Services	119	116	95	75
Parks & Trees	425	410	258	97
Police Department	752	643	227	163
Pollution Control	85	81	45	19
Engineering & Operations	2,450	2,280	1,655	221
Recreation	2,367	1,341	988	782
Safety Services	2	2	1	0
Tourism Department	34	30	26	21
Transit Department	1,852	1,799	1,819	1,027
Water & Sewer Department	3,686	3,708	3,345	268
CAO's Office	91	30	27	21
Corporate Services	181	165	169	147
HR, Legal & City Clerk	14	5	4	3

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

10.4 GOVERNANCE AND COLLABORATION

It is recommended that the Corporate and Community Energy Manager be responsible for the CEEP.

As part the CEEP management system, the implemented processes improvements, program implementation and projects will continue to be documented and reviewed annually to update consumption savings. By regularly monitoring and reporting consumption and dollar savings and/or avoidance to each function, department or unit, the outcomes of their participation in energy management initiatives can be demonstrated, and feedback can be obtained for any new ideas. Reporting on the overall energy and GHG emissions inventory, progress towards GHG reduction targets, and CEEP initiatives will be presented to Council through the annual CEEP Report. Along with the preparation of an annual CEEP Report, these activities will be rolled up into an annual CEEP work plan, which will be reviewed with the directors of City departments and reported to Council.

The CEEP should be updated every 5 years with the next update to occur in 2025.

10.5 ENERGY & GHG BOUNDARIES

Calculating corporate municipal GHG emissions can be complicated because of how City services are delivered and by who delivers them (e.g. contractors). To be relevant, GHG inventories must reflect the operations of a City and the way in which it interacts with the community. At the same time, it is important that the GHG inventory conform to international standards for reporting to ensure consistency and comparability with other cities. To this end, the City's energy and GHG boundary has been set following an "operational control" approach where the City should track energy and GHG emissions of an asset when:

- The City owns or operates the asset, and
- The City is responsible for maintenance and capital upgrades.

Table 20. City Reporting Sectors

Reporting Category	Emission Sources
Buildings and Other Facilities	Includes stationary emissions as well as GHG emissions from electricity.
Streetlighting & Traffic Signals	Includes GHG emissions from electricity related to street lighting, and traffic lights, including crosswalk signals, amber flashers, etc.
Transit Fleet	Includes GHG emissions from transit related mobile combustion.
Non-Transit Fleet & Equipment	Includes mobile combustion as well as GHG emissions from electricity for all electric vehicles and other electrified mobile equipment operated by the City.
Water & Wastewater	Includes water and waste pumping and treatment stationary emissions as well as GHG emissions from electricity.
Solid Waste	Includes fugitive emissions from landfills and disposal facilities.
Buildings and Other Facilities	Includes stationary emissions as well as GHG emissions from electricity.

10.6 ANNUAL DATA COLLECTION & REPORTING

To reinforce the concept that energy is a variable cost and to make individuals accountable and empower them to control energy use, the City will need to continue to track and report on energy and GHG emissions annually. This

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

process is already been established internally as the City reports on corporate energy and GHG emissions through the FCM PCP portal.¹⁰ It is recommended that the Energy Manager should develop a system to review on a monthly basis, provide data to department leads on a regular basis

10.7 EVALUATING FUTURE INITIATIVES

The CEEP contains a list of recommended initiatives to be completed over the next 10 years. Implementing the initiatives requires dedicated resources and systems in place to ensure that the policies, programs, and projects recommended are implemented and tracked so the City's proposed GHG emission reduction targets are met. The objective of the CEEP is to dovetail energy conservation, energy demand management, and GHG emissions as part of the City's normal course of business for asset retrofits, renewals, and life cycle replacement projects. Success in this endeavor requires incorporating conservation and demand management options at the initial design stages. In so doing, this ensures that options for improving energy efficiency are considered, evaluated, and quantified in terms of life cycle costing analysis, including cost, maintenance, GHG reductions and other co-benefits that may accrue to the City. When evaluating future initiatives, a City checklist should include the following:

- Project base case
- Energy efficient options
- Project costs (base case vs. energy efficient case)
- Project savings (in terms of energy, maintenance, avoided GHG emissions)
- Maintenance savings
- Financial benefits
- Environmental benefits
- Co-benefits
- Incentives/funding available
- Overall benefits
- Life cycle analysis recommendations

The implementation of the CEEP (the "Plan and Do" components of the cycle) will require the formulation of an annual work plan to define what actions are undertaken annually. To aid in successful implementation, the annual work plan should tie into departmental business plans and budgets to ensure responsibilities and resources are allocated accordingly. Progress will be reported to the following stakeholders as noted below.

10.8 MONITORING & REPORTING

An ongoing feedback loop, known as the Deming Cycle facilitates continuous improvement, and can be used to facilitate the continuous improvement of the CEEP, and ensure that it remains as a living document. The four components of the Deming Cycle, shown below in Figure 17, are "plan, do, check and act." A run through the plan-do-check-act cycle must occur on an annual basis and should coincide with the City's annual budget cycle for planning each year's capital and operating budgets.

¹⁰ <https://pcptool.ca/>

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

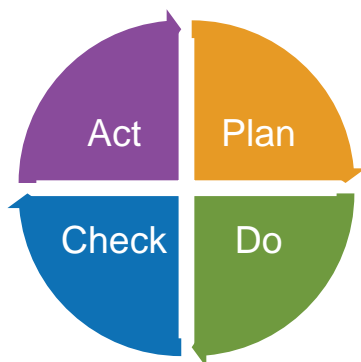


Figure 17. The Deming Cycle (Plan-Do-Check-Act)

A monitoring framework provides the City with a task list of items to track that will help re-assess the effectiveness of the proposed initiatives over time (the “check” components of the cycle). Monitoring includes two components. The first is the monitoring of the proposed initiatives - what is being done, who is doing it, is the activity funded, etc. The second component is the compilation of the energy and GHG emissions inventory to monitor the success of the initiatives. Tracking, measuring, and sharing progress towards the City’s GHG reduction target is essential to maintaining momentum for change. The success of the CEEP will be measured by the results achieved relative to prior reporting years.

On an annual basis, the City will prepare an CEEP report, which at a minimum, will include:

- Current energy and GHG emissions profile in aggregate and broken down by department
- Change in energy and GHG emissions from the prior year and the baseline
- Follow up actions from the prior year’s report.
- A description of the work that has been completed.
- Progress towards the GHG reduction target.
- Identification of any issues or challenges faced in advancing each initiative
- An indication of progress toward achieving each initiative, using the following scale:
 - Not Started – The initiative has not been implemented.
 - On Track – The initiative has been implemented. For various initiatives, progress will be measured through quantitative and qualitative indicators (as identified in the initiatives tables).
 - Outstanding – An issue, barrier and/or challenge is prohibiting the initiative from being implemented.
 - Delayed – The initiative has been delayed or placed on hold.
 - Completed – The initiative has been completed.
- List of new initiatives to address issues, barriers, and challenges.
- Timing and assigned responsibilities of the initiatives.

The initiatives in this CEEP should be evaluated in consultation with the various City departments on an annual basis, as part of the departmental strategic operations planning process. This will be an opportunity to review and prioritize potential strategies based on resources and emerging technological opportunities.

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

10.9 RESOURCE & BUDGET PLANNING

The City's 2019 energy expenditures including electricity, natural gas, diesel, gasoline, and propane was \$5.7 million. It is anticipated over the next 10 years that the average cost of energy will increase by 1-2 percent per year, from which a large portion can be mitigated through the savings achieved by initiatives recommended in the CEEP.

10.9.1 Financial Resources

It is estimated that the recommended initiatives could result an accumulated energy savings of \$67 million in energy costs (or over \$2.1 million per year, on average) if the energy reductions are achieved. The timing of efficiency upgrades and new projects as part of asset upgrades and renewal will continue to be brought forth to Council for approval within the designated budget year.

City staff will need to develop a 10-year spending plan that can be considered in annual municipal budget processes and feed into the City's long-term financial plans. The next update to the City's long-term financial plan will be completed by 2025.

10.9.2 Staff Resources

A number of strategies are intended to embed sustainable energy management and GHG reduction programs into departments, systems and polices which requires time, staff, and the training of staff. While there will be a coordinated level of effort from City operations and various departments, the CEEP requires that a Corporate and Community Energy Manager be hired which will require dedicated budget to support the role's salary as well as a budget to implement actions that benefit various departments, functions or units (e.g., studies). Training facility staff on energy and GHG management practices and concepts builds competencies that enables staff to carry out operations more effectively and efficiently. The City should seek to include energy training concepts for relevant staff, where appropriate.

10.9.3 Funding Opportunities and Risks

Wherever possible, the City should take advantage of funds to speed up the implementation of project initiatives. For example, the City could submit an application to Infrastructure Canada for federal funding under the Community, Culture and Recreation Fund to support the energy projects at the identified community centers under the basis that the retrofits would reduce GHG emissions, but also support using the community centers as 'cooling centers' during heatwaves. The FCM Green Initiative Funds often has grants available to support sustainability and climate action planning efforts and offset low-interest loans to support capital projects that reduce energy and GHG emissions.

As these programs are subject to political changes, the City should proactively plan and incorporate capital and operating costs of the proposed initiatives into future budgets. This will enable the City to take advantage of external funding opportunities when they are available, but not have to rely on these external sources to move forward on initiatives.

It should be noted that regardless of external funding availability, the proposed initiatives will require further business case development, are contingent on future Council approval, and future staff and budget (capital and

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

operating) availability. As part of the implementing the initiatives in this CEEP, the following risks would need to be considered and addressed:

- Increasing capital and operating costs, as well as lower than expected saving and revenues.
- Regulatory barriers and compliance issues that impede the implementation of the initiatives.
- Competing Council and departmental priorities including current operational mandates of impacted services and how mandates have to change to achieve the energy and GHG reductions.

10.10 COMMUNICATION STRATEGY

The overall goal of the communication strategy is to outline tools and techniques to assist the City with ongoing internal communication about the CEEP, including implementation and progress towards targets. The communication strategy is focused on internal communication for city staff and council and is not designed to be public. The key objectives of the strategy are:

- To communicate the presence and importance of the CEEP.
- To share progress towards the proposed GHG reduction targets.
- To motivate multiple audiences about what they can do to reduce the City's energy use and GHG emissions.
- To communicate coming changes in business practices to support the ongoing implementation of the CEEP

10.10.1 Responsibility

Responsibility of the CEEP implementation rests with the Corporate Energy Manager through to delegation of actions to managers and staff.

10.10.2 Tactics

The communications strategy includes a series of strategic tactics (Table 19).

Table 21. Suggested Communication Tactics

Tactic	Description/Rationale
Host quarterly meetings with department leaders	<p>The intent of these meetings is to:</p> <ul style="list-style-type: none"> • Share best practices between departments • Provide status/progress updates on Energy conservation and GHG emission reduction strategies across all departments • Prioritize work • Share funding opportunities • Collaborate on shared initiatives that flow into annual work plans and budgets.
Develop an annual corporate Energy and GHG Emissions Progress Report	<p>The Corporate And Community Energy Manager will gather information from all departments, and report annually on energy and GHG emissions.</p> <p>Ensure the development of a one-page, graphic summary document which can be used to communicate results with a wide range of audiences.</p>
Implement targeted energy skills training	<p>Implement specialized training opportunities as per the CEEP initiatives.</p>
Implement general energy skills training for all staff	<p>Develop (or adopt) a stand-alone webinar that would be suitable for all City staff. The webinar could cover:</p>

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

Tactic	Description/Rationale
Work to integrate key messaging into existing communications	<ul style="list-style-type: none"> The presence of the CEEP The role of all staff members in contributing to energy conservation and GHG emission reductions Easy tips and reminders for every day corporate energy conservation and GHG emission reductions <p>Work alongside the communications department to share tips and reminders about energy conservation and GHG emission reductions with all staff.</p>
Create (and publicize) a “bright lights” program	<p>Create a staff-based program to celebrate success. Suggest working with the Communications and Human Resources departments to develop a staff recognition program. This could include:</p> <ul style="list-style-type: none"> Seeking nominations for staff that have made a difference with energy efficiency Developing short vignettes Circulating stories and photos
Create an annual staff questionnaire	<p>Include a staff questionnaire to survey staff on corporate climate progress and actions.</p>
Ensure open lines of communication	<p>Ensure that staff across the corporation have knowledge of, and access to an CEEP information-sharing portal. This portal might be used to:</p> <ul style="list-style-type: none"> Share innovative ideas Identify areas of concern Provide feedback or solutions
Embed results in performance plans	<p>Consider the inclusion of energy and GHG emission reduction targets in select employee’s performance reviews. This would serve to recognize specific staff for their success in helping to achieve the CLP targets.</p>

10.10.3 Recommendations

The following table includes supporting details for each of the tactics.

Table 22. Timing and Responsibility of Suggested Communication Tactics

Tactic	Audiences	Level of Effort	Timing
Host quarterly CEEP Leadership Meetings	Senior leaders, representing key departments		Quarterly, Ongoing
Share the results of the CEEP Leadership Meetings	Leadership Council		Quarterly, Ongoing
Develop an annual CEEP Report	Council All staff		Annually
Implement targeted energy skills training	Specific, pre-identified staff		End of Year Two
Implement general energy skills training	All staff		End of Year Two
Work to integrate key messaging into existing communications	All staff		End of Year One

CORPORATE ENERGY & EMISSIONS PLAN (CEEP)

City of Fredericton

Tactic	Audiences	Level of Effort				Timing
Create (and publicize) a “Bright Lights” program	All staff	■	■			End of Year One
Ensure open lines of communication	All staff	■	■			End of Year One
Embed results in performance plans	Specific, pre-identified staff	■	■	■		End of Year Three

