

ENERGY CONSERVATION AND DEMAND MANAGEMENT PLAN (2019)

FINAL REPORT

OCTOBER 23, 2019



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Abbreviations

Abbreviation	Full Name
BAS	Building Automation System
BAU	Business As Usual
BREEAM	Building Research Establishment Environmental Assessment Method
BTU	British Thermal Unit
CaGBC	Canada Green Building Council
CAFE	Corporate Average Fuel Economy
CEEQUAL	Civil Engineering Environmental Quality Assessment and Award Scheme
CH ₄	Methane
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalent
DOAS	Dedicated Outdoor Air System
DHW	Domestic Hot Water
ECDM	Energy Conservation and Demand Management
ECM	Energy Conservation Measure
ESCO	Energy Savings Performance Contracting
FTE	Full Time Equivalent
GEA	Green Energy Act
GHG	Greenhouse Gas
GPS	Global Positioning System
GWP	Global Warming Potential
HDV	Heavy Duty Vehicle



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Abbreviation	Full Name
HPS	High Pressure Sodium (refers to a type of lighting fixture)
HVAC	Heating, Ventilation and Air Conditioning
ICC	Internal Cost of Carbon
IPCC	Intergovernmental Panel on Climate Change
ISI	Institute for Sustainable Infrastructure
kWh	Kilowatt Hour
LCA	Life Cycle Analysis
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
LID	Low Impact Development
LDT	Light Duty Truck
LDV	Light Duty Vehicle
PV	Photovoltaic
N ₂ O	Nitrous Oxide
NO _x	Nitrogen Oxides
ORE	Off-Road Equipment
RFID	Radio-Frequency Identification
RIM	Research In Motion, now BlackBerry
REC	Renewable Energy Credit
RNG	Renewable Natural Gas
SO ₂	Sulphur Dioxide
W	Watt



Executive Summary

The phenomenon of climate change and reducing greenhouse gas (GHG) emissions has long been a priority for the City of Waterloo (the City) since the City's first started reporting its emissions in 2011. Since then an annual GHG inventory along with an Energy Conservation and Demand Management (ECDM) Plan published in 2014 has guided the City's commitment to GHG emissions reduction.

In 2018, the City's corporate GHG emissions amounted to 6,230 tonnes of carbon dioxide equivalent (tCO₂e) – a reduction of 23% from the 2011 reporting year, surpassing the City's 2021 GHG reduction target of 6% below 2011 levels. GHGs are emitted by City-owned assets as a direct result of the provision of key services by the City, which include the community and staff use of buildings, fleet, equipment, wastewater treatment, outdoor lighting, solid waste and business travel. The City's GHG emissions are expected to further decline to 5,980 tCO₂e in 2050, a decrease of almost 28% from 2011, as a result of energy and GHG reduction actions already underway at the City and due to actions in place at the Provincial and Federal level.

As important as these GHG reduction milestones are, in order 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 of 50% by 2030 and more than 80% by 2050.¹ 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 result in economic losses ranging from 5% to 20% of global Gross Domestic Product (GDP) annually.²

On this basis, and in alignment with greater community reduction targets set by the entire Region of Waterloo, the City has set its GHG emission reduction targets to be 50% by 2030 and 80% by 2050. The objective of this current update to the City's ECDM Plan is to move the City closer to its GHG emission reduction targets by establishing short-term initiatives that build momentum and lay the groundwork for deeper energy and

¹ https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf

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



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GHG emissions reduction actions to be implemented post-2030. The ECDM Plan also meets the requirements of the Ontario Regulation 507/18 Broader Public Sector: Energy Reporting and Conservation and Demand Management Plans (O. Reg. 507/18, formerly O. Reg. 397/11). The ECDM Plan covers a horizon from 2020 to 2050, in short-term (ending in 2025), medium-term (ending in 2030) and long-term (ending in 2050) planning periods.

Other than the carbon tax on fuels set at a Federal level, there has been little direct cost to the City for emitting GHG emissions to the atmosphere. However, even accounting for fuel savings, the current price of carbon is oftentimes too low to shift the business case away from typical 'like for like' replacements towards low- or no-carbon technologies that have a lower or negative return on investment. To encourage the adoption of low- and no-emission technologies, an internal cost of carbon (ICC) scheme is recommended as part of all capital project assessments.

This ECDM Plan was based on corporate energy and GHG emissions available for the most current year, 2018, and trends since the 2011 base year as well as anticipated growth to 2050. The identification of initiatives for incorporation into the ECDM Plan was done through a combination of staff engagement, formerly completed location-based site visits, a best-in-class review of other municipalities and input from internal and external subject matter experts. The proposed initiatives are summarized in Table E.1.

This ECDM Plan was approved by the City of Waterloo's Corporate Management Team on September 10, 2019.



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Table E.1. Summary of ECDM Plan Initiatives

Number	Sector	Initiative	Action Type
B1	Buildings & Facilities	Green Building Policy Technical Standards	Process
B2	Buildings & Facilities	Energy Projects	Project
B3	Buildings & Facilities	Deep Energy Retrofits	Project
B4	Buildings & Facilities	Ongoing-Commissioning	Program
B5	Buildings & Facilities	Energy Performance Monitoring	Program
B6	Buildings & Facilities	Renewable Energy Sources	Project
F1	Fleet & Equipment	Reduce Light Duty Fleet	Process
F2	Fleet & Equipment	Opportunistically Convert Light Duty Fleet to Electric	Project
F3	Fleet & Equipment	Improve Fleet & Equipment Data Tracking	Program
F4	Fleet & Equipment	Formalize Fleet Management Policy	Process
F5	Fleet & Equipment	Pilot New Technologies	Project
F6	Fleet & Equipment	Driver Education & Awareness	Program
T1	Business Travel	Business Travel Policy	Program
T2	Business Travel	Telecommuting Policy	Program
WW1	Wastewater	Stormwater Management Policy	Process
WW2	Wastewater	Sanitary Sewer Inflow & Infiltration Reduction Program	Process
W1	Solid Waste	Corporate Solid Waste Management Plan	Process
C1	Corporate	Life Cycle Considerations	Process
C2	Corporate	Internal Cost of Carbon (ICC)	Policy
C3	Corporate	Energy Savings Policy	Policy
C4	Corporate	Departmental GHG Accounting & Reporting	Policy

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I.0 Introduction

I.1 Climate Change is a Global Priority

The phenomenon of climate change and reducing greenhouse gas (GHG) emissions has long been a priority for the City of Waterloo (the City) since first reporting on its GHG emissions in 2011. Since then, the City has guided policies and strategies that improve its energy and GHG emissions performance. The result of these actions has been a decline of GHG emissions of 23%, surpassing the City's 2021 GHG reduction target of 6% below 2011 levels. Having made progress in reducing GHG emissions, the City is now evaluating its ability to meet science-based global reduction targets for 2050 and is not alone in this regard.

Climate change has emerged as the next unprecedented social, economic, and environmental challenge facing our society today. It poses a serious threat to global quality of life, jobs, and physical and natural assets. Scientists believe that the human-production of GHG emissions since pre-industrial times have already surpassed the Earth's "carrying capacity" of natural systems and pose significant future risks to human well-being. As such, if GHG emissions are not drastically reduced soon, global cities and communities can expect to be impacted by more floods, windstorms, heat waves, wildfires and other side effects which could negatively impact local and global economies, erode social systems, impact ecosystem functions and the benefits they provide, and limit the ability of cities and communities to respond and recover.³

In recognition of this trend, the City is undertaking additional efforts to reduce GHG emissions and has set more aggressive GHG emission reduction targets of 50% by 2030 and 80% by 2050. This Corporate Energy Conservation & Demand Management (ECDM) Plan serves numerous purposes in that it provides a 5- and 10-year roadmap towards this new GHG target while meeting regulatory requirements.

³ https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf



1.2 Ontario Regulation 507/18

The Ontario Regulation 507/18 Broader Public Sector: Energy Reporting and Conservation and Demand Management Plans (O. Reg. 507/18, formerly O. Reg. 397/11) under the Electricity Act currently requires local governments to report on energy and GHG emissions from owned and operated buildings and to produce ECDM plans which are required to be updated every five years. Local governments are also required to submit annual reports on energy use and GHG emissions to the Ministry of Energy, Northern Development and Mines (the Ministry) as well as publish online and make the annual emissions reports and the ECDM Plan available to the public.

The City prepared its first ECDM Plan in 2014, fulfilling the requirements of O. Reg. 507/18. To meet the requirements of a five-year update in 2019, this document herein is considered to be the current version of the ECDM Plan, and has been updated as required by O. Reg. 507/18 to include all the requirements of the original ECDM Plan, as well as:

- A description of current and proposed measures for conserving and otherwise reducing energy consumption and managing its demand for energy.
- A revised forecast of the expected results of the current and proposed measures.
- A report of the actual results achieved.
- A description of any proposed changes to be made to assist the public agency in reaching any targets it has established or forecasts it has made.

The preparation of this ECDM Plan provided City staff with the opportunity to re-evaluate the status of current corporate emissions, as well as investigate an updated emissions forecast, with and without planned energy and GHG reduction initiatives. The implementation of this ECDM Plan will place the City on a trajectory towards achieving its 2050 GHG reduction target.



1.3 About the City

The City of Waterloo is located within the Region of Waterloo and occupies an area of 64 square kilometers. With a population of 109,185 in 2016, the City is expected to grow 18% by 2030 and, if trends continue, approximately 42% by 2050.

The City owns and operates over \$1,616 million of assets in the form of buildings, fleet vehicles, 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. Some services provided in the area, such as waste collection and disposal and police services are provided by the Region of Waterloo as part of the region's two-tiered municipal government system. The City has been an active member of Sustainable Waterloo Region's Regional Sustainability Initiative to which it reports its annual GHG emissions. As a Bronze Level Pledging Partner through this program, the City has voluntarily committed to reducing its corporate GHG emissions together with over fifty other organizations in the region.





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Although the focus of this ECDM Plan is on corporately owned assets, the City has also made commitments and progress to reducing the GHG emissions in the greater community. While the City's Strategic Plan (2019-2022) sets the tone for the City's vision to be a leader in sustainability, the work that the City has completed with Climate Action Waterloo Region for its community sustainability plan has helped steer the City in the right direction. The City has embarked on numerous energy conservation projects in the community and has committed, collectively with the Region of Waterloo and its partners, to reducing community GHG emissions by 80% below 2011 levels by 2050 which is in alignment with the City's corporate goals.



2.0 Scope

This ECDM Plan is a corporate-wide plan that focuses exclusively on GHG emissions that are directly controlled by the City and does not address community GHG emissions or emissions that are outside the geographic boundary of the City. Although municipal operations form a small subset of overall community GHG emissions, initiatives and assets under local government control may have an indirect impact on community GHG emissions.



The assets which the City has direct control over which are included in this ECDM Plan are summarized in the table below. Although O. Reg. 507/18 does not require that assets beyond buildings and facilities be included in an ECDM Plan, the City has decided to also address energy conservation and GHG emissions reduction in its fleet, outdoor lighting and waste production. The ECDM Plan does not include GHG emissions from third-party contractors or construction activities, but these may be included in future plans as data availability and tracking improves.



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Table 1. List of Assets Included in ECDM

Buildings & Facilities	Fleet & Equipment	Water, Wastewater & Solid Waste Facilities	Outdoor Lighting
Administrative Offices	Light Duty Vehicles	Pumping Stations	Outdoor Lights*
Arts, Entertainment & Heritage Facilities	Heavy Duty Vehicles		
Parks	Off Road Vehicles		
Community Centers & Sports Facilities	Other Equipment		
Cemeteries			
Fire Stations			
Parking Lots			
Libraries			

* Outdoor lighting includes lights on City roads, trails, parks, facilities and parking lots.

The ECDM Plan covers a horizon from 2020 to 2050, in short-term (ending in 2025), medium-term (ending in 2030) and long-term (ending in 2050) planning periods. The recommendations made for the first five years integrate relevant planned initiatives that are based on actions identified by City staff using existing and proven technologies. Actions in the medium-term planning horizon, shift momentum towards more aspirational targets. These program components provide the City with an opportunity to slow GHG emissions growth. Initiatives identified in the long-term are 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.



3.0 Methods

This ECDM Plan was based on corporate energy and GHG emissions available for the most current year, 2018, and trends since the 2011 base year as well as anticipated growth to 2050. The identification of initiatives for incorporation into the ECDM Plan was done through a combination of staff engagement, formerly completed location-based site visits, a best-in-class review of other municipalities and input from internal and external subject matter experts.

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

Two thematic meetings – focused on buildings and facilities, and fleet and equipment - facilitated sharing of best practices and identification of key initiatives with City staff providing specific guidance and direction on the ECDM components, actions, and enabling factors. These were completed in July 2019. Topics which were covered during the reviews included:

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



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A wide range of initiatives were identified by staff during the meetings to which not all were incorporated into the ECDM Plan. These additional initiatives have been included in Appendix A for staff to consider adopt once the foundational actions in this ECDM Plan have been implemented.

City staff reviewed the draft ECDM Plan prior to its finalization.



4.0 2018 Corporate Energy & GHG Emissions

Cities are centers of communication, commerce, and culture. They are also a significant and growing source of energy consumption and GHG emissions. Cities and regional centers have the opportunity to affect considerable change on GHG emissions levels on a global scale as they are responsible for more than 70 percent of global energy related GHG emissions.



4.1 Current Energy & GHG Emissions

In 2018, the City's corporate GHG emissions amounted to 6,230 tonnes of carbon dioxide equivalent (tCO₂e), or 0.06 tCO₂e per person in the community. These GHG emissions were the direct result of the provision of key services by the City, which are organized into the following sectors:

- **Buildings & Facilities:** The City's building and facilities consume electricity and natural gas to heat, cool, ventilate, and illuminate administrative, fire buildings, park facilities, and community and recreation centers.
- **Fleet & Equipment:** The City's fleet vehicles includes light, medium and heavy-duty vehicles for corporate use. All vehicles and equipment consume gasoline and diesel.



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- **Wastewater:** While the Region of Waterloo owns and operates the water supply and sewage treatment systems for the whole region, the City operates multiple sewage pumping stations within its jurisdiction which consume energy and release GHG emissions.
- **Outdoor Lights:** The City operates over 10,000 outdoor lights, decorative and standard cobra head lamps which are powered by electricity. Over 7,800 of the standard cobra head fixtures were converted to LED fixtures as part of the City's street lamp conversion program.
- **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 releases methane (CH₄), a potent greenhouse gas.
- **Personal Vehicle Business Travel:** GHG emissions from City-owned vehicles are covered in the Fleet and Equipment, City employees may also use their personal vehicles for business purposes which results in GHG emissions.
- **Business Air Travel:** The GHG emissions from this sector are those that resulted from aviation gasoline as a result of corporate business travel.

Table 2 below presents the breakdown of the 2018 energy and GHG emissions by sector.

Table 2. 2018 Corporate Energy and GHG Emissions by Category

Sector	Energy (GJ)		GHG Emissions (tCO _{2e})	
Buildings & Facilities	143,681	82.0%	4,256	68.3%
Fleet & Equipment	20,788	11.9%	1,452	23.3%
Wastewater Facilities	1,399	0.8%	8	0.1%
Outdoor Lights	8,467	4.8%	47	0.8%
Solid Waste	-	0.0%	410	6.6%
Personal Vehicle Business Travel	759	0.4%	51	0.8%
Business Air Travel	94	0.1%	6	0.1%
Total	175,187	100.0%	6,230	100.0%



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Buildings and facilities account for nearly 82% of the City's energy usage and 68% of the City's GHG emissions profile. More than 90% of the GHG emissions in facilities result from the consumption of natural gas which has a considerably higher GHG intensity than electricity in Ontario. Diesel, gasoline and small quantities of propane used in the operation of fleet and equipment accounted for 12% and 23% of the City's overall energy and GHG emissions profile. A breakdown of GHG emissions is provided in Figure 1 while a breakdown by energy use in each sector is presented in Figure 2 below.

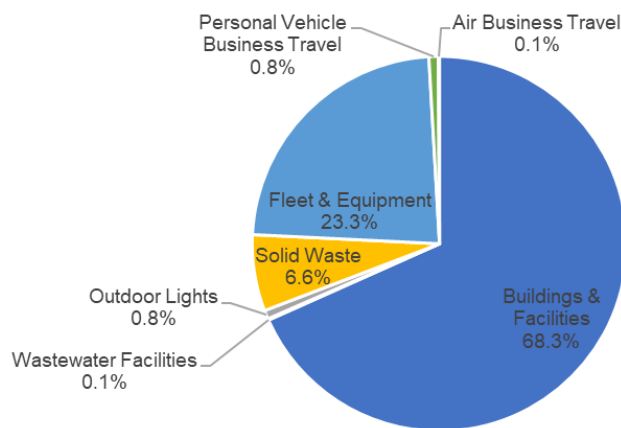


Figure 1. GHG Emissions (tCO₂e) by Sector

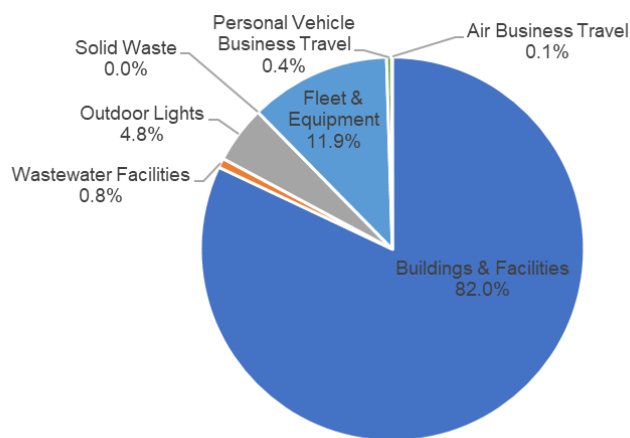


Figure 2. Energy Use (GJ) by Category



4.2 Historical Trends

The City first began tracking corporate GHG emissions in 2011. Since then the City's population has increased 14% while GHG emissions have decreased 23% (Figure 3). On a per capita basis, GHG emissions have decreased 34% since 2011. As with any growing City, the increase in population is often the largest driver of GHG emissions growth due to the increased demand for local services and infrastructure systems. However, the City has avoided a dramatic rise in GHG emissions through the implementation of energy efficiency and reduction actions since 2011, as well as the greening of the provincial electrical grid which currently produces energy largely from renewable and low-carbon sources.

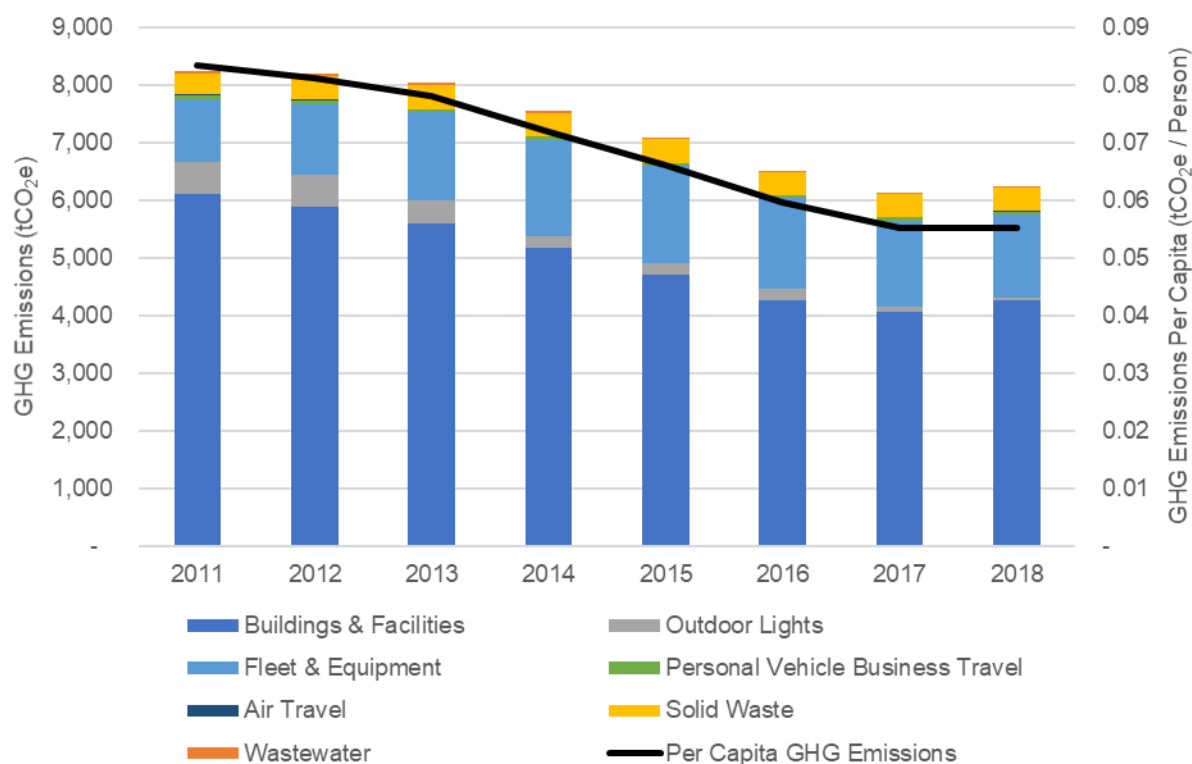


Figure 3. Annual Absolute and Per Capita GHG Emissions



4.3 Past Initiatives

The City's 2014 ECDM Plan was developed based on input provided by staff and an extensive set of energy and water conservation initiatives identified during facility energy audits. While many of the identified conservation actions have been completed, there are those that are in progress and have been carried forward to the current ECDM Plan where feasible. Table 3 presents a summary of these project initiatives and their implementation status.

Table 3. Summary of 2014 ECDM Project Initiatives Status

Action Item	Energy Conservation Opportunity Description	Status
1	Corporate Buildings – Green Building Criteria	Complete
2	Corporate Buildings – Sustainable Energy Policy	In-Progress
3	Corporate Buildings – Energy Project Funding Program	In-Progress
4	Corporate Buildings – Implement Recommendations from Energy & Water Assessments (100 Measures in the next 5 years)	82 Measures Completed / In-Progress
5	Corporate Buildings – Solar Installations	In-Progress
6	Outdoor Lighting – Street Lamp Conversion Program	Complete
7	Outdoor Lighting – Parking Lot Lighting Conversion Program	Complete
8	Corporate Fleet – Anti-Idling Policy	Complete
9	Corporate Fleet – Energy / Fuel Efficient Maintenance Equipment	To-Be-Evaluated in the Future
10	Corporate Fleet – Route Optimization	Future Project for Transportation to Develop
11	Corporate Fleet – Improved Recordkeeping	In-Progress
12	Wastewater – Stormwater Management Policy	In-Progress
13	Wastewater – Sanitary Sewer Inflow and Infiltration Reduction	Not Complete



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Action Item	Energy Conservation Opportunity Description	Status
14	Business Travel – Policy for Efficient Business Travel	Not Complete
15	Business Travel – Telecommuting Policy	Not Complete
16	Business Travel – Carbon Offsetting	Not Complete
17	Other – Environmental Procurement Policy	Policy Not Formalized

4.4 GHG Emissions Forecast to 2050

A model of business as usual (BAU) GHG emissions was developed to project future City emissions through to 2050 to examine the possible magnitude of GHG reduction opportunities (Figure 4). To estimate the future GHG emissions, the City's 2018 energy use was grown proportionally to higher service demand levels as a result of an increasing population and planned structural changes, such as new buildings and facilities, as well as planned GHG reduction initiatives set by the Provincial and the Federal Governments (e.g., vehicle fuel-economy standards).¹ The City's BAU emissions are forecasted to be approximately 5,980 tCO₂e in 2050, a decrease of almost 28% from the 2011 base year which is the direct result of energy and GHG reduction actions already underway at the City and at the Federal level.



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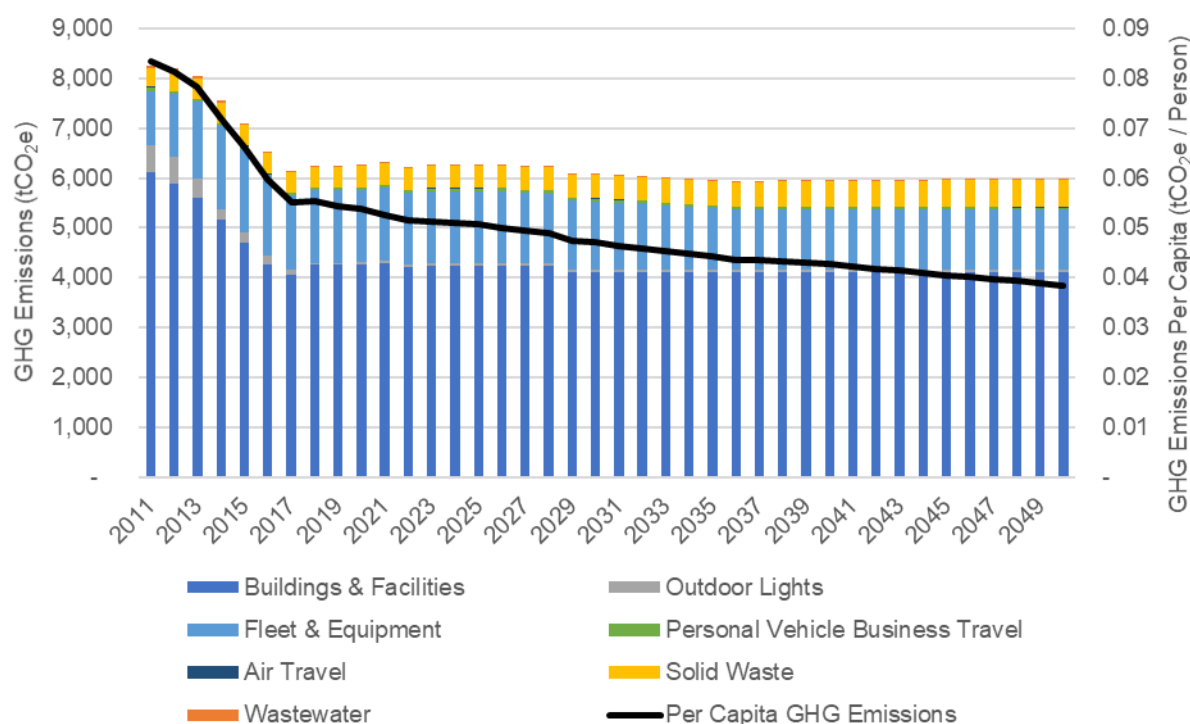


Figure 4. Forecasted GHG Emissions Under a BAU Scenario

4.5 GHG Reduction Targets

The City has committed to reducing its corporate GHG emissions by 80% below 2011 levels by 2050. While this long-term target aligns with global best practices, the City will use an interim 2030 GHG reduction target to help incorporate climate change considerations in planning decisions today. This interim target is set at a 50% reduction below 2011 levels by 2030 and is based on current best practices (Figure 5).

Using today's technologies, to meet either of these GHG reduction targets, the City would need to:

- Renovate the existing building and facility stock to operate at or close to zero-emissions performance.
- Generate and establish long-term renewable natural gas (RNG) contracts to minimize supply risk issues and make up for any shortfalls in meeting net-zero emissions in operations.



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- Switch all large and heavy-duty equipment to biodiesel fuels.
- Adjust various business models and service levels.
- Transition heavy duty fleet and equipment to electric where there are no conflicts with occupation health and safety or other performance requirements, and where technologies have proven to be reliable through pilot studies.
- Reduce the balance of the City's GHG emissions through the purchase of:
 - **Renewable Energy Credit (REC) Certificates** which represent the environmental attributes associated with renewable electricity generated from wind, solar electric, biomass, biogas, small scale hydro, geothermal, etc. Since these renewable energy resources generate very few GHG emissions as they produce energy, they represent an indirect GHG emissions reduction. For every unit of electricity (megawatt hour) generated from a renewable-energy project, a corresponding REC can be created and sold, for corporations like the City to purchase. To use RECs, the City would engage with their utility company to purchase green electricity, at a premium, with the intent of claiming ownership of the RECs to use as an emissions reduction measure. For example, the City of Edmonton, Alberta currently purchases RECs to reduce its GHG emissions from electricity.
 - **Renewable Natural Gas (RNG) Certificates** which is a biogas that has been upgraded to a quality similar to fossil natural gas and having a methane concentration of 90%. RNG provides GHG emissions reductions in comparison to traditional natural gas as it avoids emissions associated with gas extraction, refining, transportation, and storage. To use RNG, the City would engage with its utility company to purchase green natural gas or RNG, at a premium. No onsite changes are required to City facilities or operations. The City of Victoria, British Columbia currently uses RNG to reduce its GHG emissions at various facilities in order to achieve facility-specific GHG emission reduction targets.
 - **Carbon Offsets** which are “created” when a project reduces, removes, or sequesters a measurable amount of GHG emissions that would otherwise have been released to the atmosphere. They generally represent direct, or on-site, GHG emission reductions or removals. For example, the capture and destruction of methane at a landfill gas capture system to generate energy is a direct GHG



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emission reduction and may be considered a carbon offset. Credits from these projects may be purchased from entities that create them in order to offset the City's GHG emissions.

These actions in the short-term are aggressive, capital intensive, and would have significant impact on the City's budgets and service levels. In the long-term, shifts in federal and provincial regulations, industry development, and global prices for energy and carbon could yield opportunities for accomplishing the City's 2050 GHG reduction target.

Other than the Federal carbon tax, there has been little direct cost to the City for emitting GHG emissions to the atmosphere. However, even accounting for fuel savings, the current price of carbon is oftentimes too low to shift the business case away from typical 'like for like' replacements towards low- or no-carbon technologies that have a lower or negative return on investment. To encourage the adoption of low- and no-emission technologies, an internal cost of carbon (ICC) scheme is recommended as part of all capital project assessments.

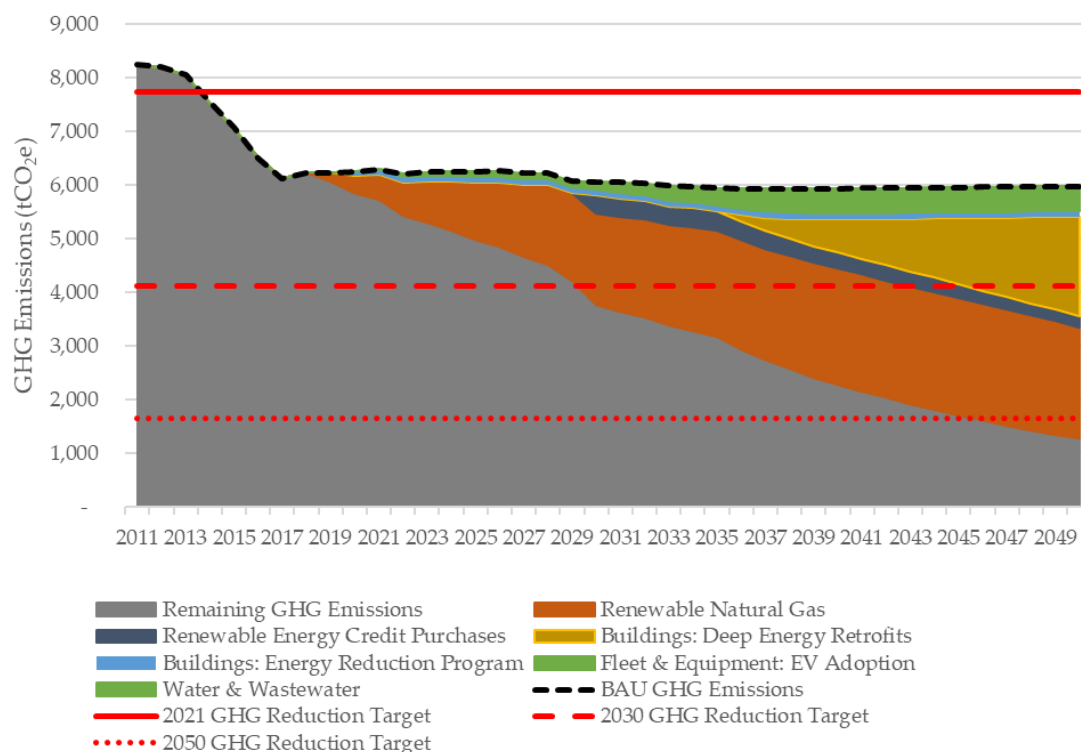


Figure 5. Forecasted BAU GHG Emissions and Impact of Proposed Initiatives



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To build momentum and lay the groundwork for deeper energy and GHG reduction actions to be implemented, a series of short- and medium-term initiatives have been identified in this ECDM Plan. The list of initiatives represents best-practice information collected from similar regional and local governments as well as input from staff and experts. Should the list of initiatives be implemented it is estimated that the City can avoid the release of 4,590 tCO₂e in 2050 – cumulatively, over the next 30 years, this amounts to avoiding over 96,000 tCO₂e if the initiatives presented in this ECDM Plan are implemented over the next 10 years.

The initiatives fall into three main key initiative categories (Table 4):

- **Process** – Improvements or alternatives to current process-based operations that are quicker and more straightforward at a low or no additional cost (e.g., energy tracking, green procurement standards)
- **Program** – Improvements that take longer to implement with moderate costs (e.g., building monitoring program, fleet utilization, etc.)
- **Project** – Capital projects to upgrade equipment and facilities and are usually more costly to implement with detailed planning required (e.g., converting natural gas fired boilers to heat pumps, converting fleet to electric, etc.)

The proposed initiatives are as follows.



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Table 4. Proposed Initiatives

Number	Sector	Initiative	Action Type
B1	Buildings & Facilities	Green Building Policy Technical Standards	Process
B2	Buildings & Facilities	Energy Projects	Project
B3	Buildings & Facilities	Deep Energy Retrofits	Project
B4	Buildings & Facilities	Ongoing-Commissioning	Program
B5	Buildings & Facilities	Energy Performance Monitoring	Program
B6	Buildings & Facilities	Renewable Energy Sources	Project
F1	Fleet & Equipment	Reduce Light Duty Fleet	Process
F2	Fleet & Equipment	Opportunistically Convert Light Duty Fleet to Electric	Project
F3	Fleet & Equipment	Improve Fleet & Equipment Data Tracking	Program
F4	Fleet & Equipment	Formalize Fleet Management Policy	Process
F5	Fleet & Equipment	Pilot New Technologies	Project
F6	Fleet & Equipment	Driver Education & Awareness	Program
T1	Business Travel	Business Travel Policy	Program
T2	Business Travel	Telecommuting Policy	Program
WW1	Wastewater	Stormwater Management Policy	Process
WW2	Wastewater	Sanitary Sewer Inflow & Infiltration Reduction Program	Process
W1	Solid Waste	Corporate Solid Waste Management Plan	Process
C1	Corporate	Life Cycle Considerations	Process
C2	Corporate	Internal Cost of Carbon (ICC)	Policy
C3	Corporate	Energy Savings Policy	Policy
C4	Corporate	Departmental GHG Accounting & Reporting	Policy

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5.0 Buildings & Facilities

The City owns or leases over 60 buildings and facilities including administrative and community centers, park facilities, fire stations, garages and vehicle storage facilities. In 2018, the City's buildings and facility portfolio accounted for 82% of its energy use and 63% of its annual GHG emissions. With an average life cycle of greater than 50 years, many of the City's current building stock will still be operational in 2050.

Green building certifications are an important first step toward reducing GHG emissions from energy consumption but achieving zero-carbon emitting buildings will require more than the current policy of LEED® Silver certification for new buildings. 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 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.



To aggressively reduce building GHG emissions by 2050, the City will need to prioritize reducing energy and GHG emissions from its highest contributors. This includes RIM Park, Waterloo Memorial Recreation Centre, the John M. Harper Library & Stork Family YMCA and the Lexington Service Center which combined account for more than 50% of building GHG emissions (Table 5).



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Table 5. 2018 Building & Facilities Energy and GHG Emissions

Facility	Energy (GJ)	GHG Emissions (tCO ₂ e)	Percent of Total GHG Emissions (%)
RIM Park (Includes RIM Park Ball and Soccer Fields)	37,146	973	22.8%
Waterloo Memorial Recreation Centre	28,029	775	18.2%
John M. Harper District Branch & Stork Family YMCA	11,840	360	8.4%
Lexington Service Centre	11,454	367	8.6%
Albert McCormick Recreation Centre	9,720	266	6.2%
Waterloo City Centre	6391	185	4.3%
Parkview Cemetery	3,382	172	4.0%
Waterloo Library	3981	147	3.4%
Rink In The Park	4441	131	3.1%
Moses Springer Recreation Centre	3,711	107	2.5%
Other Community Centers & Sports Facilities	9,836	336	7.9%
Other Arts, Entertainment & Heritage Facilities	3,155	102	2.4%
Parking Lots & Parkade	2,089	58	1.4%
Fire Stations 1 – 4	5,255	182	4.3%
Parks	2,418	59	1.4%
Other	765	33	0.8%
Sewage Pumping Stations	1,457	12	0.3%
Other Cemeteries	67	3	0.1%
Total	145,138	4,268	100.0%

Notes to Table: To reduce the size of the table, smaller energy consuming and GHG emitting facilities were aggregated according to classification.



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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 minimizing 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 T2).

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

- B1: Green Building Policy Technical Standards
- B2: Energy Projects
- B3: Deep Energy Retrofits
- B4: Ongoing-Commissioning
- B5: Energy Performance Monitoring
- B6: Renewable Energy Sources

Compared to the 2011 base year, the business as usual building GHG emissions are expected to remain relatively stable through to 2050 as many of the building additions and renovations, in terms of square footage, are offset by the planned removal of buildings and facilities (Table 6). With the proposed building and facility initiatives it is estimated that the City can reduce GHG emissions by up to 65% by 2050 and with the purchase of a combination of renewable energy credits (REC) and renewable natural gas (RNG), the City can reduce building and facility GHG emissions by a further 34 percent.



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Table 6. Estimated GHG Emission Reductions From Buildings

Year Ended	2020	2025	2030	2040	2050
Building Business As Usual Forecasted GHG Emissions (tCO₂e)	4,261	4,240	4,106	4,106	4,106
Buildings & Facilities Emissions Reductions (tCO₂e)	90	105	109	724	1,955
Remaining GHG Emissions (tCO₂e)	4,171	4,135	3,997	3,381	2,151
Change from 2011 Base Year	-31.8%	-32.4%	-34.7%	-44.7%	-64.8%

Notes to table: 2011 Base Year = 6,118 tCO₂e

Figure 6 illustrates the progression of GHG emissions reductions over time compared to the forecasted business as usual scenario.

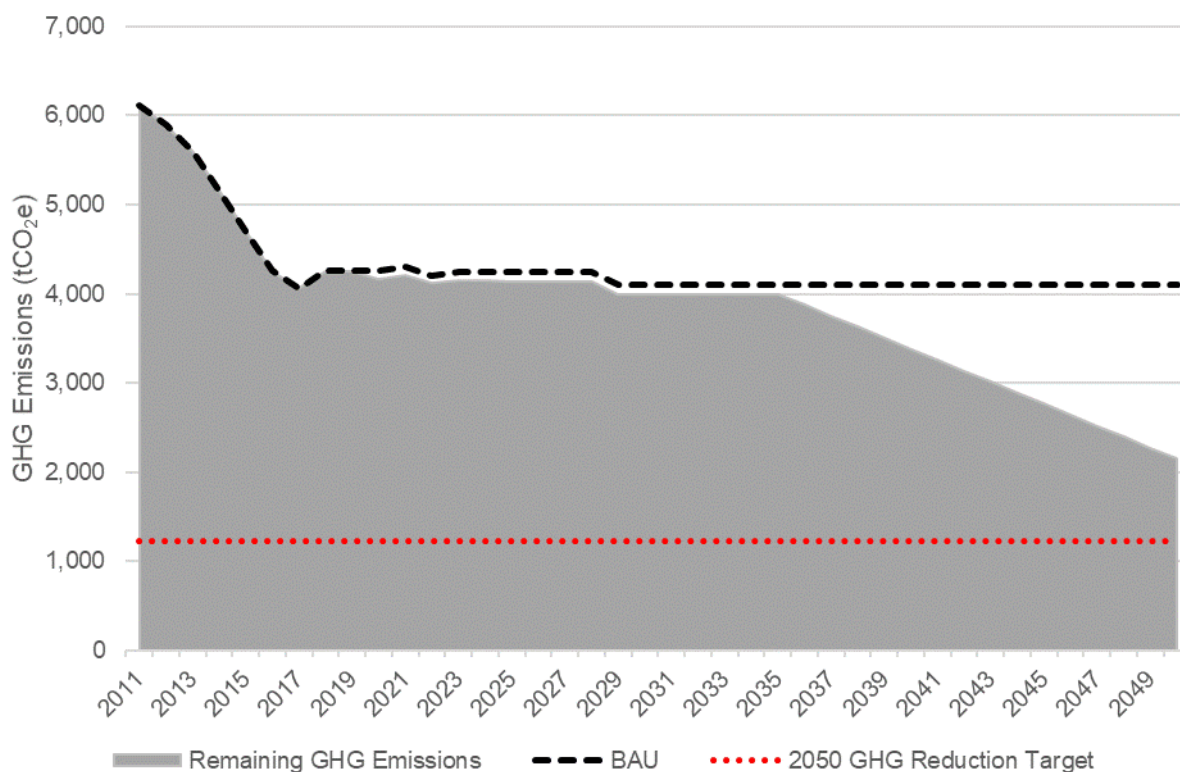


Figure 6. Forecast of Buildings GHG Emissions



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Based on current building technologies available and the current GHG intensity of the electrical grid, the City would need to rely on a combination of RECs, RNG and carbon offsets to 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, RECs 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 life cycle basis which will require paying a premium for low- and zero-carbon technologies.

The implementation of the proposed building initiatives will require the hiring of a full time equivalent (FTE) Corporate Energy Manager. It is recommended that the Corporate Energy Manager focus on identifying energy and GHG reductions in the City's building and facility portfolio which will require coordination with the City's facility operations group, the asset management group and other departments, the development of business cases for high-efficiency and low-carbon technologies, energy reporting and other required tasks. The Corporate Energy Manager would also be responsible for monitoring energy and GHG performance at the facility level for the portfolio and work with building and facility managers to improve energy performance.

BI: Green Building Policy Technical Standards

The City has recently approved a new Green Building Policy which requires that all new buildings achieve a minimum LEED® Silver certification and achieve a minimum 25% energy and GHG efficiency improvement beyond the Ontario Building Code, SB-10 Division 3 (2017). The energy saving benchmark also extends to existing buildings when major renovations, retrofits and rehabilitations occur, and supports the adoption of the principles of the Canadian Green Building Council (CaGBC) Zero Carbon Building Standard. Meeting this requirement for new buildings can be relatively straightforward with a small premium (3.1% as estimated by the City of Toronto⁴), but is likely to be problematic for major renovations of existing building stock due to the nature of the existing design and remaining building materials that can hinder the necessary energy efficiency requirements (e.g., improving the building envelope performance so much so

⁴ <https://www.toronto.ca/wp-content/uploads/2017/11/9875-Zero-Emissions-Buildings-Framework-Report.pdf>



Energy Conservation and Demand Management Plan (2019)

that air infiltration is reduced by 25%). Furthermore, health and safety considerations, like requiring air conditioning in vehicle repair bays, may increase energy consumption and work against the City's Green Building Policy.

It is recommended that the City undertake an energy study on a typical City building that is set to be retrofitted in the future (e.g., a community center) to understand the depth of renovation required and the range of costs that the City may need to plan for. The recommended outcome of this exercise would also be technical standards that direct contractors and project staff to focus on specific areas of performance to achieve the requirements of the City's Green Building Policy. 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. Details on this initiative are presented in Table 7.

Table 7. Green Building Policy Technical Standards Initiative Summary

Initiative	B1: Green Building Policy Technical Standards
Initiative Type	Process
Objective	Energy efficient guidelines and sustainable design principles and specifications are ingrained within all major renovation and new construction projects.
Performance Measures	Completion of the Study, Policy and Technical Standards
GHG Reduction Potential	Not Applicable – this is a supportive action
Responsibility	Facilities
Timeframe	Next 12 – 24 months
Additional Resources Required	1 FTE: Corporate Energy Manager
Additional Budget Requirements	FTE Annual Wage \$40,000 – 50,000 for Study



B2: Energy Projects

Dozens of building energy audits have been completed to which over 80 actions have been implemented since the 2014 ECDM Plan. These energy audits review building thermal performance, load distribution, existing equipment and controls schedules, occupancy patterns, lighting, and efficiency systems to identify energy and emission reduction opportunities. Typical recommendations range from 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. To achieve an estimated 113 tCO₂e annual reduction in GHG emissions, the City will need to implement already identified energy audit recommendations which will also reduce energy use and associated costs. A full list of energy audit recommendations that are either in progress or will be completed in the future is provided in Appendix A.

It is also recommended that the City continue to complete comprehensive energy audits, implement the recommendations, and track the progress of energy audits and projects in the City's asset management system. Importantly, the City must include making appropriate funding or financing available to these projects and be willing to invest in more expensive higher efficiency technologies.

Table 8. Energy Projects Initiative Summary

Initiative	B2: Energy Projects
Initiative Type	Projects
Objective	To undertake equipment and building operations retrofits and improvements so energy efficiency is actioned (i.e., implement all existing energy efficiency opportunities with a pay-back of 7 years or less).
Performance Measures	Energy (GJ) Per Square Foot By Facility Type Energy Cost (\$) Per Square Foot By Facility Type GHG Emissions Per Square Foot By Facility Type Simple Payback
GHG Reduction Potential	1 – 2% of Building GHG Emissions Per Year



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Initiative	B2: Energy Projects
Responsibility	Facilities
Timeframe	Ongoing
Additional Resources Required	1 FTE: Corporate Energy Manager
Additional Budget Requirements	\$3 – \$4 million for energy audits recommendations FTE Annual Wage

B3: Deep Energy Retrofits

Deep energy retrofits simultaneously retrofit or replace equipment and building infrastructure (e.g., roof, walls, windows) to achieve large energy and GHG emission reductions and tend to be informed by building condition assessments and commissioning activities. Deep energy retrofits typically involve:

- Significantly reconfiguring the interior
- Replacing the roof
- Adding or rearranging windows for increased daylight
- Replacing the HVAC systems with renewable technologies like ground-source heat pumps

Natural Resources Canada (NRCAN) estimates that deep energy retrofits can achieve upwards of a 60% reduction in energy consumption which directly translates to a similar reduction in GHG emissions.⁵ A decrease in 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.

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



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It is recommended that as part of planning for deep energy retrofits that the City begin completing building specific deep energy retrofit plans with the objective of implementing the energy retrofit when there are planned rehabilitation and renovation activities and house this information in the City's asset management systems. This would enable the City to forecast and plan for additional capital costs and provide Council with a clear business case as to why the upgrades are occurring and the rationale for not seeking a 'like-for-like' replacement long before the capital is required. Details on this initiative are presented in Table 9.

Table 9. Deep Energy Retrofits Initiative Summary

Initiative	B3: Deep Energy Retrofits
Initiative Type	Projects
Objective	Ensure energy efficiency is prioritized in major building retrofit decisions.
Performance Measures	Energy (GJ) Per Square Foot By Facility Type Energy Cost (\$) Per Square Foot By Facility Type GHG Emissions Per Square Foot By Facility Type Simple Payback
GHG Reduction Potential	40 – 60% Reduction in Building GHG Emissions Per Year
Responsibility	Facilities
Timeframe	2030 Onwards
Additional Resources Required	1 FTE: Corporate Energy Manager
Additional Budget Requirements⁶	\$4 – 25/ft ² FTE Annual Wage
Model Notes	The model assumes that the retrofits would achieve the City's Green Building Policy requirements. The model also assumes that the retrofits would occur over a 15-year period beginning in 2030.

⁶ <https://rmi.org/insight/how-to-calculate-and-present-deep-retrofit-value-a-guide-owners-occupants/>



B4: Ongoing-Commissioning

Commissioning verifies that a building has been constructed to its proper specifications. The best time to commission a building is during design and 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 an entire building. Many oversights, over-design aspects, and coordination items of the M&E system can be caught during the design phase. Construction commissioning can ensure that the design goes as intended, with functional performance testing (FPT) to ensure the sequence of operation runs as intended.

Ongoing commissioning is the continuous commissioning of a building's entire systems over a specified period of time (typically every 1 – 2 years) 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 shown efficiency improvements on the order of 5% to 30% because of improved operations and maintenance. The studies also show that the resulting simple payback periods are typically less than 2 years⁷. 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

⁷ 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



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- Verifying controls and control sequencing, including enabling and re-enabling automatic controls for set points, weekends, and holidays

It is recommended that the commissioning of buildings be scheduled on at least a 5-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 Facilities department 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. Details on this initiative are presented in Table 10.

Table 10. Ongoing-Commissioning Initiative Summary

Initiative	B4: Ongoing-Commissioning
Initiative Type	Program
Objective	To optimize systems and processes to ensure energy efficiency.
Performance Measures	Energy (GJ) Per Square Foot By Facility Type
GHG Reduction Potential	Not Applicable – this is a supportive action
Responsibility	Facilities
Timeframe	Next 12 months
Additional Resources Required	1 FTE: Corporate Energy Manager
Additional Budget Requirements	\$50,000 for Commissioning Plan



B5: Energy Performance Monitoring

Low-energy intensive buildings do not always operate as they were designed resulting in poor energy performance. Annual energy performance reporting, whether through Energy Star Portfolio Manager or a third-party energy management system, can close the gap between predicted and actual energy use. Providing building operators with energy management dashboards will enable them to benchmark their energy performance against prior year data and buildings in the portfolio that are of similar typology to identify underperformers and the need for improvements. Energy performance monitoring can also result in the identification of opportunistic business changes like adjusting how facilities are programmed and managed (e.g., shifting the ice season from the fall to the winter, establishing temperature and environment policies for staff and patrons, closing facilities, etc.).

Details on this initiative are presented in Table 11.

Table 11. Energy Performance Monitoring Initiative Summary

Initiative	B5: Energy Performance Monitoring
Initiative Type	Program
Objective	To provide meaningful benchmarking indicators for all facilities, and to incorporate energy management accountability into daily responsibilities of staff.
Performance Measures	Energy (GJ) Per Square Foot By Facility Type GHG Emissions Per Square Foot By Facility Type Energy Cost Per Square Foot By Facility Type
GHG Reduction Potential	Not Applicable – this is a supportive action
Responsibility	Facilities / Asset Management
Timeframe	System is fully operational by 2022
Additional Resources Required	1 FTE: Corporate Energy Manager
Additional Budget Requirements	Wide Cost Range Depending on City Needs



B6: Renewable Energy Sources

The City has several solar photovoltaic projects in operation. Currently, the total electricity capacity from solar panels at City operations is 12,427 kWh. The City is currently reviewing the implementation of 3 solar photovoltaic installations. As this initiative would replace hydro-based grid generated electricity in Ontario, the GHG reduction potential is low but the energy savings potential is high.

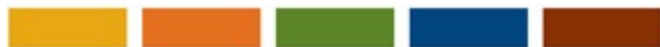


In light of this, the deployment of renewable energy projects would result in reduced energy costs and increases building energy resilience which is a requirement of the City's updated Green Building Policy. Details on this initiative are presented in Table 12.

Table 12. Renewable Energy Sources Initiative Summary

Initiative	B6: Renewable Energy Sources
Initiative Type	Projects
Objective	Reduce fossil-fuel consumption and GHG Emissions.
Performance Measures	kWh of Renewable Energy Generated
GHG Reduction Potential	1 – 3% of Building GHG Emissions Per Year
Responsibility	Operations
Timeframe	Ongoing
Additional Resources Required	Staff Time
Additional Budget Requirements	Project Specific

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6.0 Fleet & Equipment

The City owns nearly 350 light-, medium-, and heavy-duty vehicles that are operated by City departments. Both fleet and equipment are powered by gasoline, and diesel which accounted for 23% of the City's 2018 GHG emissions. Light duty vehicles (LDV) and trucks (LDT) accounted for 43% of the fleet and equipment's GHG emissions, with heavy duty vehicles and off-road equipment accounting for the remainder of the GHG emissions (57%) (Table 13).

Table 13. GHG Emissions by Classification

Classification	GHG Emissions (tCO ₂ e)	Percent
Light Duty Vehicle (LDV)	73	5.0%
Light Duty Truck (LDT)	545	37.5%
Heavy Duty Vehicle (HDV)	556	38.3%
Off-Road Equipment (ORE)	278	19.2%
Total	1,452	100.0%

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 fleet and equipment GHG emissions, a suite of strategies is required which include:

- F1: Reduce Light Duty Fleet
- F2: Convert Light Duty Fleet to Electric
- F3: Improve Fleet & Equipment Data Tracking
- F4: Formalize Fleet Management Policy
- F5: Pilot New Technologies
- F6: Driver Education & Awareness



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Other actions were identified by stakeholders but were too far into the future where the technology or opportunity remains uncertain. For example, autonomous vehicles have potential to reduce congestion, increased road safety and GHG emissions, but conversely could lead to greater traffic congestion and higher GHG emissions as a result of enabling individuals without cars to drive.



Compared to the 2011 base year, fleet and equipment GHG emissions are expected to remain relatively stable by 2050 (Figure 7). The business as usual forecast accounts for the expected changes to the Corporate Average Fuel Economy (CAFE) Standards and tailpipe CO₂ emissions standards for light duty and heavy-duty vehicles starting in 2027. Figure 7 shows that emissions reductions from fleet and equipment will not be sufficient to achieve either the interim or the 2050 GHG reduction target. This is due to a limited number of available low- or no-emission heavy duty vehicle and equipment options currently available for purchase, and many of those that are available do not meet occupational health and safety requirements. Over time as the market conditions in this area improve, it is recommended that the City consider pilot testing of hybrid or fully electric heavy equipment and off-road vehicles prior to purchasing.



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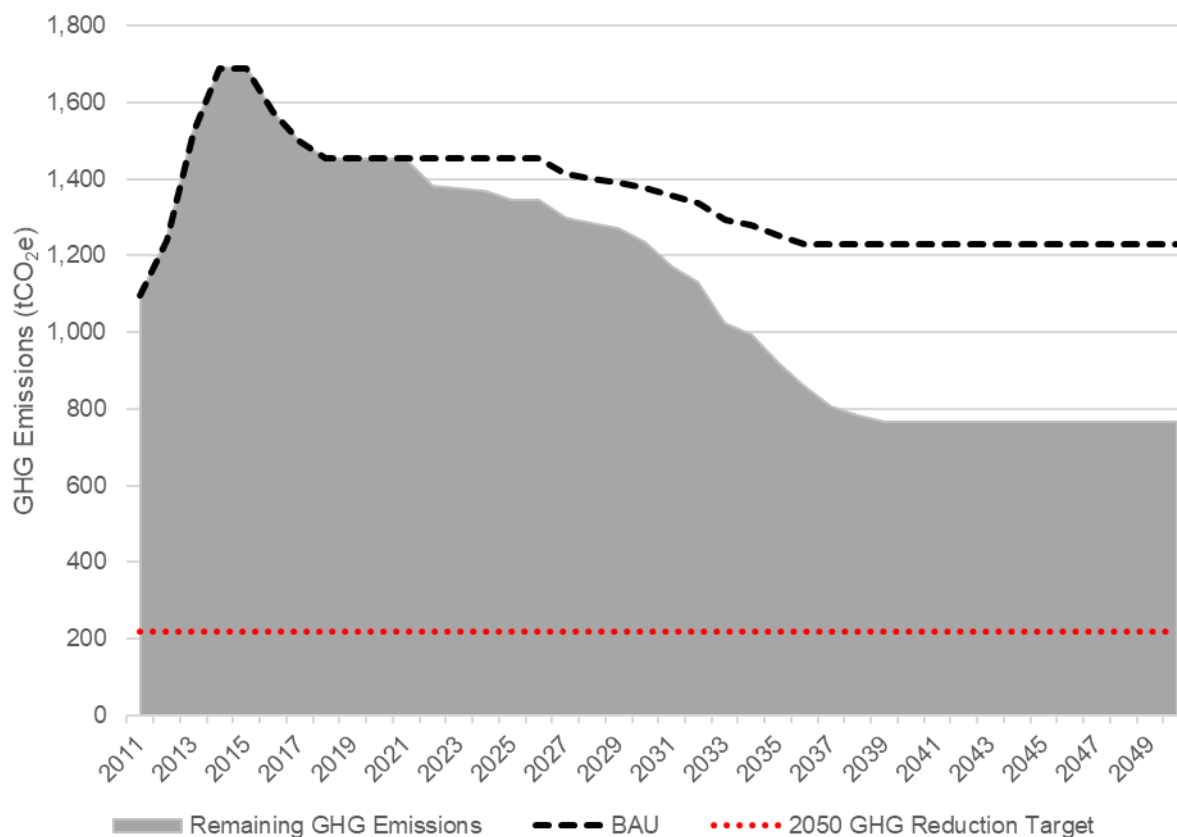


Figure 7. Forecast of Fleet and Equipment GHG Emissions

Based on the proposed actions, it is estimated that fleet can reduce its GHG emissions by 30% by 2050 as a result of fleet optimization, reduction and the conversion of light duty vehicles and trucks to electric (Table 14).

**Table 14. Estimated GHG Emission Reductions From Fleet & Equipment**

Year Ended	2020	2025	2030	2040	2050
Fleet & Equipment Business As Usual Forecasted GHG Emissions (tCO₂e)	1,452	1,452	1,376	1,231	1,231
Fleet & Equipment Emissions Reductions (tCO₂e)	-	106	141	466	466
Remaining GHG Emissions (tCO₂e)	1,452	1,346	1,235	765	765
Change from 2011 Base Year	32.5%	22.9%	12.7%	-30.2%	-30.2%

Notes to table: Fleet & Equipment 2011 Base Year = 1,096 tCO₂e

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

F1: Reduce Light Duty Fleet

Over the past few decades the City's fleet light duty inventory has expanded to include vehicles that are highly specialized, have exceeded their depreciable lifespan, or are no longer suitable for the City's requirements. Many of these light duty vehicles could be removed from service which will directly impact the City's GHG emissions as well as fuel costs. To move forward on this initiative, a fleet utilization study would need to be completed (Initiative F3).

Details on this initiative are presented in Table 15.

**Table 15. Reduce Light Duty Fleet Initiative Summary**

Initiative	F1: Reduce Light Duty Fleet
Initiative Type	Process
Objective	Reduce fleet size, fuel consumed and GHG emissions.
Performance Measures	Number of Light Duty Vehicles Removed From Fleet Economic Savings In Terms of Fuel Reduction
GHG Reduction Potential	10% of Fleet GHG Emissions Per Year
Responsibility	Operations, and Fleet & Procurement Services
Timeframe	Next 3 – 5 years
Additional Resources Required	Staff Time
Additional Budget Requirements	Fleet utilization study, including a sample telematics pilot, can range from \$75,000 and up.

F2: Opportunistically Convert Light Duty Fleet to Electric

According to Bloomberg New Energy Finance, by 2040, nearly 55% of vehicle sales will be electric, and are projected to achieve cost parity to their equivalent gasoline powered vehicle by the early 2020s⁸ (Figure 8). 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 fleet through the purchase and use of 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. Over the medium-term, it is recommended that the City complete an EV adoption study to identify where fleet can be converted to EV, what EV infrastructure will need to be planned for, and to identify funding mechanisms.

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



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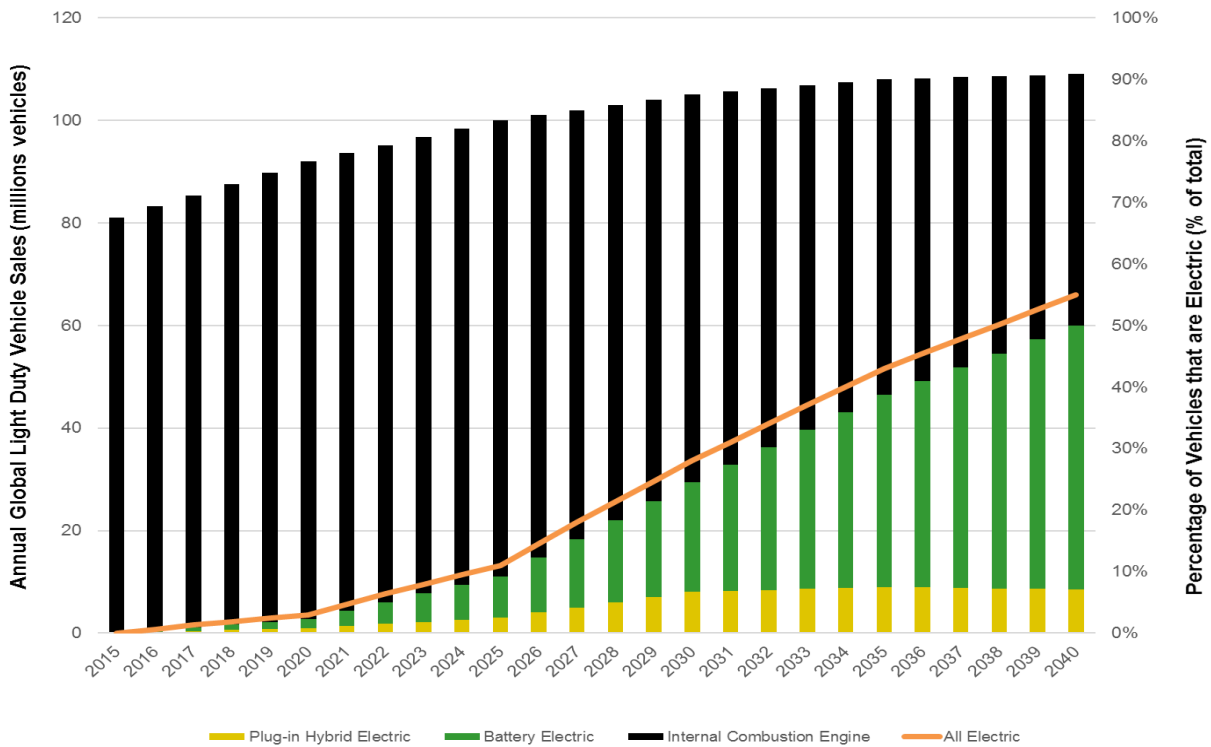


Figure 8. Forecasted Electric Vehicle Global Sales⁹

⁹ Bloomberg Finance, 2018. *Electric Vehicle Outlook 2018*, <https://about.bnef.com/electric-vehicle-outlook/>



Details on this initiative are presented in Table 16.

Table 16. Opportunistically Convert Light Duty Fleet to Electric Initiative Summary

Initiative	F2: Opportunistically Convert Light Duty Fleet to Electric
Initiative Type	Project
Objective	Reduce fuel consumed and GHG emissions.
Performance Measures	Number of EVs Economic Savings In Terms of Fuel Reduction
GHG Reduction Potential	50 – 60% of Fleet GHG Emissions Per Year
Responsibility	Fleet & Procurement Services
Timeframe	Ongoing
Additional Resources Required	Staff Time
Additional Budget Requirements	Assume extra \$3,000 per LDV until cost parity is achieved in 2025. LDT premiums will likely range from \$8k to \$15k for an indeterminable period of time. EV Study: \$40,000 – \$50,000

F3: Improve Fleet & Equipment Data Tracking

Appropriate recordkeeping plays a critical role in managing fleet and equipment. With the appropriate level of fleet data – i.e., fuel consumption by asset, mileage, operating costs, end user, etc., the City can optimize and reduce fleet size, maximize vehicle use, and adjust fleet composition which will result in reduced fuel consumption and GHG emissions. This initiative aims to improve the collection and use of data required by the fleet department (e.g., mileage, fuel use, repair time and repair costs, etc.) to establish an appropriate baseline which would improve decision making, fulfill other fleet management requirements, and establish key performance indicators to which future targets can be set against. With a thorough operational review, and the use of scheduling software, the City could reduce the number of vehicles in the fleet with increased sharing of vehicles. For example, vehicles and equipment spend the



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majority of their time parked. Once the crew and tools are delivered to the job site, vehicles could be used by another crew instead of being parked.

Details on this initiative are presented in Table 17.

Table 17. Improve Fleet & Equipment Data Tracking Initiative Summary

Initiative	F3: Improve Fleet & Equipment Data Tracking
Initiative Type	Program
Objective	To optimize fleet assets, reduce fuel consumption, increase fleet efficiencies, and transition to renewable fuels.
Performance Measures	Number of Fleet Vehicles Vehicle Utilization Rate Fuel Consumption By Vehicle Type
GHG Reduction Potential	Not Applicable – this is a supportive action
Responsibility	Fleet & Procurement Services
Timeframe	KPI's set by 2021
Additional Resources Required	Staff Time
Additional Budget Requirements	None

F4: Formalize Fleet Management Policy

A Fleet Management Policy supports sustainable service delivery through the life cycle management, operation, and replacement of vehicles, equipment and associated components. As it relates to energy and GHG emissions management, it is recommended that the Fleet Management Policy includes guidance on:

- **Procurement Standardization:** Procurement standardization aims to minimize fleet and equipment diversity as much as possible which can lead to economic savings, lower maintenance costs, increased operational efficiency and safety, improved vendor relations, and support the migration to renewable fuels. It is recommended that standardization be focused on purchasing fuel vehicles and equipment



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appropriate for the City's operations, while accounting for life cycle costs, and heavily weighting items that are renewably powered or electric.

- **Life Cycle Costing:** Life cycle costing identifies when vehicle and equipment assets should be replaced to minimize the total cost of ownership to the City. Life cycle analysis also provides optimal timing for replacement, based on anticipated use, and can be used to assign actual asset costs, based on actual use, to end users. It is recommended that the vehicle and equipment life cycle replacement and cost assignment program feed into the City's asset management and financial systems.
- **Vehicle Right Sizing:** Vehicle right sizing assigns vehicles based on identified need rather than driver preference. It is recommended that the policy afford Fleet with the ability to allocate vehicles for staff based on the functional needs required with the objective of rationalizing fleet assets, reducing fuel consumption and increasing fleet efficiencies.

This information can be used to inform the development of a fleet management policy. Details on this initiative are presented in Table 18.

Table 18. Formalize Fleet Management Policy Initiative Summary

Initiative	F4: Formalize Fleet Management Policy
Initiative Type	Process
Objective	To optimize fleet assets, reduce fuel consumption, increase fleet efficiencies.
Performance Measures	Vehicle Utilization Rate Fuel Consumption By Vehicle Type
GHG Reduction Potential	Not Applicable – this is a supportive action
Responsibility	Fleet & Procurement Services and Finance
Timeframe	2021
Additional Resources Required	Staff Time
Additional Budget Requirements	None



F5: Pilot New Technologies

It is recommended that the City continue to investigate pilot projects utilizing 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. For instance, the City should continue using solar panels to run accessory equipment. Other short-term pilot opportunities may include the use of vehicle radio-frequency identification (RFID) technologies to identify equipment and append the details of each fueling transaction to a unique piece of equipment (e.g., passive vehicle fuel rings and wireless nozzle readers). Details on this initiative are presented in Table 19.

Table 19. Pilot New Technologies Initiative Summary

Initiative	F5: Pilot New Technologies
Initiative Type	Projects
Objective	Reduce fossil-fuel consumption and GHG Emissions.
Performance Measures	Number of Pilot Studies Adopted
GHG Reduction Potential	Unknown. Technology Dependent.
Responsibility	Fleet & Procurement Services
Timeframe	Ongoing
Additional Resources Required	Staff Time
Additional Budget Requirements	Unknown. Technology Dependent.



F6: Driver Education & Awareness

It is recommended that the City develop a formal driver education and awareness program that provides drivers with efficient driving techniques that focus on optimal driving behaviors, anti-idling, and educates users on ridesharing and vanpooling. Details on this initiative are presented in Table 20.

Table 20. Driver Education & Awareness Initiative Summary

Initiative	F6: Driver Education & Awareness
Initiative Type	Program
Objective	Reduce fossil-fuel consumption and GHG emissions through improved driver behavior.
Performance Measures	Number of staff attending driver training sessions
GHG Reduction Potential	<1% Per Year
Responsibility	Operations, Human Resources, and Fleet & Procurement Services
Timeframe	2022
Additional Resources Required	Staff Time
Additional Budget Requirements	Unknown

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7.0 Business Travel

Active transportation and other sustainable transportation options, like electric vehicle car share, e-bikes, virtual meetings, and alternative work arrangements, can play a key role in reducing the City's corporate GHG emissions as well as potentially reducing costs associated with employee travel. Two initiatives that can support a reduction in employee travel related GHG emissions are:

- T1: Business Travel Policy
- T2: Telecommuting Policy



T1: Business Travel Policy

The City currently tracks GHG emissions related to business travel by plane and employee personal vehicles. External plane travel and the use of use of personal vehicles for business presently accounts for less than 1% of the City's corporate GHG emissions.

It is recommended that the City develop a Business Travel Policy that would be applicable to all business travel for all staff. It is recommended that the Business Travel Policy:

- Minimize the use of cars for business travel and, where vehicles are necessary, require the use of more fuel-efficient or electric vehicles.
- With respect to air travel, consider adding an additional \$150 per tonne of associated air travel GHG emissions to the cost of flights. For example, a round trip from Toronto to Vancouver would cost an additional \$175. Funds collected from the carbon tax could be used to support GHG reduction initiatives.



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- Expand active transportation programs and facilities for staff to reduce unnecessary vehicle and plane related travel. Active transportation and other sustainable transportation options, like electric vehicle car share, e-bikes, virtual meetings, and alternative work arrangements, can play a key role in the reduction of GHG emissions. The City can expand active transportation programs by providing employee transit programs, access to bikes and electric bikes, and supporting facilities (sheltered bike storage, access to showers, etc.), access to car share vehicles, and through the use of incentives.
- Consider upgrading existing on-site meeting and board rooms so that they can support virtual and in-person meetings which create the same experience for the user as face-to-face meetings. By creating a cultural shift away from in-person meetings, the City can reduce travel related costs (both staff time and reimbursement of fees) and reduce GHG emissions. The City currently does have such facilities and has the potential to expand their existing virtual meeting room space throughout its offices.
- Explore adopting a carbon travel tax. This internalizes the cost of the travel related GHG emissions and assigns it to the department that undertook the travel. An internal carbon travel tax purposely disincentivizes unwarranted business travel.

It is important this the business travel policy align with the recommended Telecommuting Policy (Initiative T2).

Details on this initiative are presented in Table 21.



Table 21. Business Travel Policy Initiative Summary

Initiative	T1: Business Travel Policy
Initiative Type	Program
Objective	Reduce fossil-fuel consumption and GHG emissions through reduced business travel.
Performance Measures	Cost of Business Travel To The City GHG Emissions Per Kilometer Travelled
GHG Reduction Potential	<1% Per Year
Responsibility	Human Resources
Timeframe	Ongoing
Additional Resources Required	Staff Time
Additional Budget Requirements	Staff Time

T2: Telecommuting Policy

An often overlooked and cost-effective energy and GHG reduction opportunity is to implement policies that allow for more flexible work environments and dis-incentivize travel which can include the following:

- **Alternative work schedules:** This allows employees to vary their hours from day to day or compress more working hours into fewer days.
- **Telecommuting:** This enables employees to work from home offices or other alternative spaces. It results in direct GHG emission reductions as little or no office space is needed for these individuals, and indirect GHG emission reductions as these individuals no longer need to commute to and from work.
- **Shared offices and hoteling:** This can provide a flexible work environment that allows for better space utilization, as employees do not have a dedicated office space. This can have a significant reduction on greenhouse gas emissions as the strategy can enable the City to avoid adding additional buildings to accommodate a growing staff population.



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To implement this initiative, it is recommended that the City complete a study to identify and implement suitable alternative work style strategies (e.g., remote work and distributed teams). The City will need to consider the wide range of functionality among staff and will likely need to draft terms to be incorporated into the collective agreement with the union. The City of Edmonton recently prepared a table listing the various alternative work strategies, the primary benefit and outcome drivers, and related IT, space and people tools that are required to support the implementation and management of alternative work strategies.¹⁰ The City could use this resource table as a starting point to explore which options make the most sense. Details on this initiative are presented in Table 22.

Table 22. Telecommuting Policy Initiative Summary

Initiative	T2: Telecommuting Policy
Initiative Type	Program
Objective	Encourage shifting travel behavior from GHG intensive modes to sustainable modes. Provide a leading standard for City facilities as an example to other employers and commercial landlords.
Performance Measures	Avoided GHG emissions
GHG Reduction Potential	Not Applicable - this is a supportive action
Responsibility	Human Resources
Timeframe	2022
Additional Resources Required	Staff Time
Additional Budget Requirements	Approx. \$200,000 (\$1,727 per computer configuration, assumes 20% of City's workforce will participate)

¹⁰ https://www.edmonton.ca/city_government/documents/A1462%20Alternate%20Work%20Strategies%20Att%20II.pdf



8.0 Wastewater

While the pumping of wastewater represents a small fraction of the City's energy use and associated GHG emissions (0.1%), it is important to implement cost-effective actions that can reduce energy and GHG emissions and have several community co-benefits. Two wastewater energy reduction initiatives have been identified for this ECDM Plan:

- WW1: Stormwater Management Policy
- WW2: Sanitary Sewer Inflow & Infiltration Reduction Program

WW1: Stormwater Management Policy

The City plans to update its Stormwater Management Policy and design standards to recognize Low Impact Development (LID) and climate change adaptation technologies. LID technologies accepted as valid stormwater management practices includes the installation of green roofs, rainwater harvesting and bioswales (vegetated open channels designed to mitigate stormwater runoff and remove silt and pollution from runoff water). In addition to reducing and slowing stormwater runoff in the urban environment, green roofs are also effective at reducing energy use as they absorb heat and act as insulators for buildings, thereby reducing the amount of energy needed to heat and cool the building. By lowering the demand for heating and cooling, green roofs help to decrease the production of air pollution and GHG emissions.



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Table 23. Stormwater Management Policy Initiative Summary

Initiative	WW1: Stormwater Management Policy Initiative Summary
Initiative Type	Process
Objective	Reduce stormwater flows and flooding.
Performance Measures	Areas With Bioswales, Green Roofs, etc.
GHG Reduction Potential	<1% of Wastewater GHG Emissions Per Year
Responsibility	Utilities
Timeframe	2021
Additional Resources Required	Staff Time
Additional Budget Requirements	None





WW2: Sanitary Sewer Inflow & Infiltration Reduction Program

About 30 – 40% of the City's treated wastewater is due to wet weather inflow and infiltration which results in higher energy use, GHG emissions, and pumping costs. To reduce the volume of water infiltrating into the system, the City will explore the following strategies:

- Analyze the results of an ongoing inflow and infiltration study being undertaken by the City and determine the appropriate actions to take based on the results.
- Enhance the current City wastewater bylaw to better address illegal connections to the City's wastewater system and to encourage property owners to disconnect sump pumps from the sanitary system to reduce inflow and infiltration.

Although the GHG emissions from wastewater pumping are an immaterial portion of the City's corporate GHG footprint, this initiative can reduce overall utility costs, and contribute to the City's broader sustainability objectives as a result of reduced wet weather infiltration and associated flows.

Table 24. Sanitary Sewer Inflow & Infiltration Reduction Program Initiative Summary

Initiative	WW2: Sanitary Sewer Inflow & Infiltration Reduction Program
Initiative Type	Process
Objective	Reduce infiltration flows and energy usage.
Performance Measures	Energy (GJ) Per m ³ Of Wastewater Pumped Cost (\$) Per m ³ Of Wastewater Pumped Return On Investment
GHG Reduction Potential	<1% Of Wastewater GHG Emissions Per Year
Responsibility	Utilities
Timeframe	2022
Additional Resources Required	Staff Time
Additional Budget Requirements	None

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9.0 Solid Waste

Waste does not directly consume energy but when deposited into landfills, it decomposes and releases methane – a potent GHG. In addition, the extraction and processing of raw materials, the manufacture, and transportation of these materials prior to disposal also create GHG emissions. There are other impacts beyond the GHG emissions that waste has 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 corporate solid waste management plan is proposed.

WI: Corporate Solid Waste Management Plan

Reducing the amount of waste created is a critical first step to reduce the burden on local landfills and reducing GHG emissions throughout a product's life cycle from extraction to disposal. By reducing and eliminating waste, GHG emissions can be avoided not only in the landfill, but through a products life cycle. This initiative recommends the development of a Corporate Solid Waste Management Plan that aligns with the 7R's of zero waste (Figure 9):

- **Rethink & Revalue:** 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, while others do not. When City waste is sent to the landfill the waste is buried and left for future generations to



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contend with. An effective method to addressing this challenge is to implement regional waste reduction initiatives like source waste separation requirements, recycling standards, the development and delivery of employee training and communication materials, etc. This will require engagement with the Region and other local governments.

- **Reduce:** Reducing end use waste is very important, but so is reducing waste throughout the supply chain. This means minimizing 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 and consumption of locally grown foods.
- **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 corporate solid waste management plan will encourage staff 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.
- **Recover:** Working with the Region of Waterloo to improve waste separation processes will improve recovery which will reduce the amount of virgin materials being used in new products. Taking advantage of the full range of green, blue and black bin options at all City facilities will also support this action.
- **Residuals Management:** The City will need to monitor and track all its waste streams, diversion rates, and residual waste to identify new opportunities to reduce residual waste to zero.



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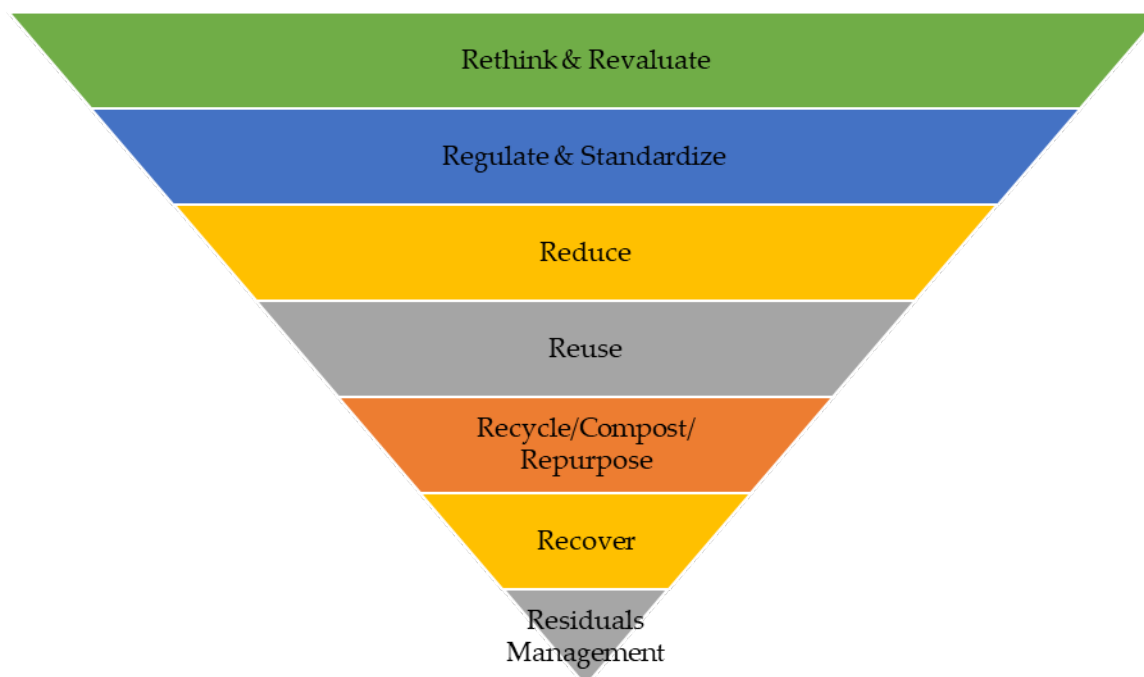


Figure 9. Zero Waste Hierarchy

Table 25. Corporate Solid Waste Management Plan Initiative Summary

Initiative	W1: Corporate Solid Waste Management Plan
Initiative Type	Process
Objective	Reduce solid waste from entering the local landfill.
Performance Measures	Total Waste Sent To Landfill Total Waste Diverted From Landfill
GHG Reduction Potential	6 – 7% Of Solid Waste GHG Emissions Per Year
Responsibility	Utilities
Timeframe	2021
Additional Resources Required	Staff Time
Additional Budget Requirements	None

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10.0 Outdoor Lighting

Outdoor lights accounted for 0.8% of total GHG emissions in 2018. In the 2014 ECDM Plan, the City identified two initiatives to reduce energy and GHG emissions associated with outdoor lighting which have been successfully completed, including the conversion of 7,800 HPS standard cobra head fixtures to LED fixtures. In addition to these completed projects, the City intends to convert the remaining decorative lighting throughout the City to LED lighting, as the technology continues to become less cost prohibitive. Until other new technologies, like adaptive lighting, become more prevalent and consistently demonstrate energy reductions while meeting transportation safety requirements, no further action will be taken to reduce energy from outdoor lights.



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11.0 Corporate

The City has both a responsibility and an opportunity to respond to the causes and impacts of climate change and has recognized this by committing to an 80% reduction in GHG emissions by 2050. The achievement of this important GHG reduction target requires both conservation first actions like those already identified in this ECDM Plan, but also a change in how the City internalizes and prioritizes climate related actions. The following initiatives set these important foundations:

- C1: Life Cycle Considerations
- C2: Internal Cost of Carbon (ICC)
- C3: Energy Savings Policy
- C4: Departmental GHG Accounting & Reporting





CI: Life Cycle Considerations

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% of Canada's GHG emissions are embodied in the construction sector – which are not accounted for in most municipal GHG accounting systems.

To shift the current City culture and narrative, it is recommended that the City integrate LCA processes into budget and capital planning, strategic planning, purchasing policies, preventative maintenance plans, environmental management plans, and asset management. It is also recommended life cycle energy and GHG emissions reduction measures be incorporated as part of the rationale for budget requests, that these measures feed into the annual budgeting process, and that projects be examined in consideration to the total life cycle of the asset. Success means that these 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.

As LCA's can be burdensome, it is recommended that LCA process be first completed for capital projects over \$100,000. This will require a study to develop LCA criteria for different infrastructure types, assess which LCA tools could meet the City's needs, the development of technical guidance, and LCA training for City staff. To follow through on the recommendations of the LCA process, the City will need to expand budgets to allow for additional funds to accommodate premium products that have longer life expectancy and/or less maintenance. Details on this initiative are presented in Table 26.



Table 26. Life Cycle Considerations Initiative Summary

Initiative	C1: Life Cycle Considerations
Initiative Type	Process
Objective	Energy and GHG considerations are taken into budgetary, capital and procurement planning.
Performance Measures	Infrastructure / project specific (e.g., GHGs/km road, GHGs/km track, GHGs/sq. foot)
GHG Reduction Potential	Not Applicable – this is a supportive action
Responsibility	Primary: Operations Secondary: All Departments
Timeframe	2022
Additional Resources Required	Staff Time
Additional Budget Requirements	\$100,000 for Consultant Support

C2: Internal Cost of Carbon (ICC)

Climate change impacts are expected to have serious negative effects on global economic growth and development. In 2005, the UK government commissioned an independent economic review called The Stern Review, which concluded, “the benefits of strong and early action far outweigh the economic costs of not acting.”¹¹ Using results from economic models, the review estimated that if we do not act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global Gross Domestic Product (GDP) annually - potentially as much as 20% of GDP. In contrast, the costs of implementing actions to reduce GHG emissions and mitigate the impacts of climate change could be limited to around 1% of global GDP annually.

¹¹ Nicholas Stern. *The Economics of Climate Change: The Stern Review*. Cambridge University Press, January 2007. http://webarchive.nationalarchives.gov.uk/+http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm



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Although the social and environmental benefits of reducing energy and GHG emissions are well established, their recognition or importance in decision making processes are often under-represented. Applying an internal cost of carbon (ICC) allows organizations to better account for these benefits and is a key component to moving an organization towards its energy and GHG reduction targets. To support many of the proposed initiatives, it is recommended that the City establish an ICC which would be used to calculate the value (expressed as a cost) of GHG emissions associated with decision-making in respect to all City assets and infrastructure.

It is recommended that the City align its policy with the City of Vancouver which establishes the ICC at \$150/tCO_{2e} in 2019 (Appendix B presents the full City of Vancouver policy). Details on this initiative are presented in Table 27.

Table 27. Internal Cost of Carbon (ICC) Initiative Summary

Initiative	C2: Internal Cost of Carbon (ICC)
Initiative Type	Policy
Objective	Account for the true cost of carbon in asset management and procurement decisions.
Performance Measures	GHG Emissions Avoided (tCO _{2e})
GHG Reduction Potential	Not Applicable – this is a supportive action
Responsibility	Facility Design & Management Services (FD&M)
Timeframe	6 months – 1 year
Additional Resources Required	Energy Manager (EM) and Financial Analyst (FA) for FD&M
Additional Budget Requirements	None



C3: Energy Savings Policy

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 City department that implemented the energy savings project. Details on this initiative are presented in Table 28.

Table 28. Energy Savings Policy Initiative Summary

Initiative	C3: Energy Savings Policy
Initiative Type	Policy
Objective	Remove financial disincentives that are a barrier to energy reduction programs.
Performance Measures	Dollars saved
GHG Reduction Potential	Not Applicable – this is a supportive action
Responsibility	Finance
Timeframe	2 – 3 years
Additional Resources Required	Energy Manager (EM) and Financial Analyst (FA) for FD&M
Additional Budget Requirements	None



C4: Departmental GHG Accounting & Reporting

Like many of its peers, the City experiences landlord-tenant split incentives where the Facilities department is responsible for utility consumption of a building, and another department is responsible for delivering programs in the building. As the program delivery organization is not responsible for energy use, it results in a lack of energy accountability and works against the City's efforts to reduce energy consumption and maintain these reductions over time.

To address this accountability issue, it is recommended that each City department develop a 5-year energy and GHG emissions reduction plan for their operational activities, and report on progress annually. This would enable each department to directly engage in the achievement of the City's corporate GHG reduction targets by tracking the energy use and GHG emissions resulting from day to day operations, decision-making, and capital purchases. Implementation of this initiative will require the City to develop a methodology to assign energy consumption and GHG emissions to each department. Details on this initiative are presented in Table 29.

Table 29. Departmental GHG Accounting & Reporting Initiative Summary

Initiative	C4: Departmental GHG Accounting & Reporting
Initiative Type	Policy
Objective	Set energy and GHG accountability at the City department level.
Performance Measures	GHG Emissions By Department
GHG Reduction Potential	Not Applicable – this is a supportive action
Responsibility	Operations Asset Management
Timeframe	Within the next 12 months
Additional Resources Required	Staff Time
Additional Budget Requirements	None



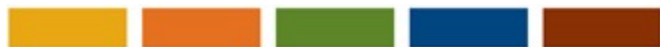
12.0 Monitoring & Implementation

12.1 Governance & Collaboration

The ECDM Plan is championed by Facility Design and Management Services and is governed by a functional team of corporate stakeholders called the Energy Management Committee. The structure of the Energy Management Committee enables for a more direct integration of energy and GHG emissions management in the City's systems while creating the necessary culture of change within the City. Success of the ECDM plan relies on ongoing collaboration and participation across departments and divisions. Staff from all departments are required to use the ECDM Plan as a guide for decision-making, as it contains initiatives that will help bring the City closer toward its 2050 GHG reduction target.

The Energy Management Committee meets quarterly with the following objectives:

- To integrate best practices into daily operations, where feasible, to reduce energy consumption and GHG emissions.
- To recommend the adoption of energy and GHG reduction policies, programs and projects.
- To provide a forum for discussion on energy management strategies that may benefit the City.
- To track and report on the progress of the ECDM Plan initiatives.
- To increase corporate awareness around energy consumption and GHG emissions.
- To provide information for the annual reporting.



12.2 Funding Opportunities & Challenges

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 centres under the basis that the retrofits would reduce GHG emissions, but also support using the community centers as ‘cooling centers’ during heatwaves. This would address the City’s Green Building Policy resilience requirements and support the climate change mitigation and adaption funding requirements set out by Infrastructure Canada. The City should also take advantage of the current rebate programs for electric vehicles.

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.

Over the long term, the City may have to consider moving away from debt financing which can impact its credit rating to other funding models like ESCO (Energy Savings Performance Contracting) models where a third party develops, implements and finances energy conservation measures. The ESCO model is based on provider taking a cut of energy savings which ensures that the City achieves the estimated energy reductions. In exchange for assuming equipment performance risk, the ESCO provider typically earns a double-digit return and requires a long-term contract, typically ranging from 15-20 years.



12.3 Procurement

The City informally supports the purchase of green products in principle but does not have a Green Procurement Policy. The lack of a Green Procurement Policy makes it difficult for staff to enforce sustainable procurement either internally or with vendors. A Green Procurement Policy can help reduce energy use and GHG emissions that result from Regional operations, and the construction of new buildings. The intent of focusing green procurement is to shift spending away from goods and capital assets that have a greater GHG emissions footprint over the products lifespan.



As part of this Policy development, the City will need to deploy a product ranking framework which would allow the City to assess the degree to which environmental and social considerations have been addressed over the life cycle of a good or capital asset. Such a framework is designed to compare, rank and weight purchases based on set on City requirements (e.g., cost, efficiency, etc.) as well as the degree to which the environmental and social impacts of concern have been reduced or eliminated. Each purchase would be assessed against a base case product for which no identifiable efforts have been made to reduce the environmental or social impacts. In the case of capital goods, like buildings, deploy a product ranking framework would incorporate green performance requirements / objectives and performance metrics such as Energy Use Intensity (EUI) and/or Thermal Energy Demand Intensity and/or GHG Emissions Intensity and would undergo an energy and GHG emissions life cycle assessment (LCA) to quantify the energy and GHG emission impact that would be incurred over the life of the asset. These performance targets would be driven by the Green Building Standard and be carried through into contractual requirements, along with associated penalties for non-compliance.



12.4 Sustainable Infrastructure

Numerous infrastructure sustainable rating systems are available to facilitate and assess sustainable practices throughout the various phases of a project's life cycle. Many of these systems, like GreenRoads and CEEQUAL / BREEAM, are infrastructure type specific (transportation, water, and roads) and do not always assess the holistic nature and impacts of a project. Envision, developed by the Institute for Sustainable Infrastructure (ISI), is a comprehensive rating system that assess not only individual project performance, but also how the project contributes to the sustainability of the community it is situated. It includes 5 main categories: Quality of Life, Leadership, Resource Allocation, Natural World and Climate and Risk and 59 credits which specific to the ECDM Plan, requires designers to reduce embodied, construction and operational GHG emissions and energy usage over a project's life cycle. It is recommended that the City consider use of the Envision ISI Framework for certain corporate capital projects where it would be advantageous to evaluate infrastructure sustainability in detail.

12.5 Evaluating Future Initiatives

This ECDM Plan 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 2050 GHG emissions target is met. The objective of the ECDM Plan 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)



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- Maintenance savings
- Financial benefits
- Environmental benefits
- Co-benefits
- Incentives / funding available
- Overall benefits
- Life cycle analysis recommendations

The initiatives in this ECDM Plan 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.

12.6 Reporting

An ongoing feedback loop, known as the Deming Cycle, facilitates continuous improvement, can be used to facilitate the continuous improvement of the ECDM Plan, and ensure that it remains as a living document. The four components of the Deming Cycle, shown below in Figure 10, 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.

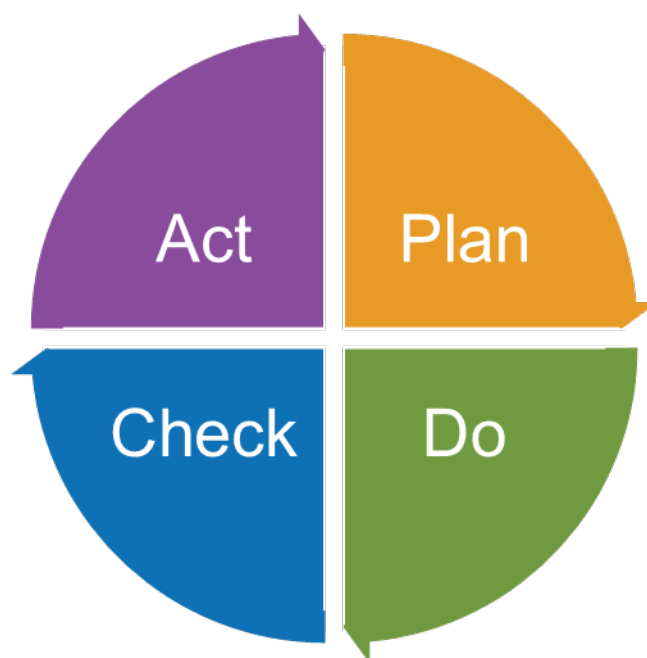


Figure 10. The Deming Cycle (Plan-Do-Check-Act)

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 2050 GHG reduction target is essential to maintaining momentum for change. The success of the ECDM Plan will be measured by the results achieved relative to prior reporting years. Progress will be reported annually to the Ministry of Energy, Northern Development and Mines as noted below.



12.7 Reporting to Ministry of Energy, Northern Development and Mines

The City will continue to report its annual energy use and GHG emissions using the Ministry of Energy, Northern Development and Mines template on an annual basis. The City will also continue to report voluntarily to Sustainable Waterloo Region's Regional Sustainability Initiative. In addition to ongoing monitoring and reporting, the initiatives identified in this ECDM Plan will be frequently examined to ensure that any major developments are integrated. The ECDM Plan will be adaptive by responding to changes in federal and provincial level climate action commitments as they occur.



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Appendix A

Ongoing Initiatives Identified from Buildings Energy Audits

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Appendix A – Ongoing Initiatives Identified from Buildings Energy Audit

Corporate Sector	Facility/Area	Initiative	Current Status
Buildings	404 Wing Rotary	RTU Replacement	Not included in Current Plan
Buildings	404 Wing Rotary	Low-Flow Fixtures	Not included in Current Plan
Buildings	404 Wing Rotary	Duct Cleaning	Not included in Current Plan
Buildings	404 Wing Rotary	Air Balancing & Airflow Reduction	Not included in Current Plan
Buildings	404 Wing Rotary	Economizer Damper and Enthalpy Sensor Readjustment	Not included in Current Plan
Buildings	404 Wing Rotary	RTU Replacement	Not included in Current Plan
Buildings	404 Wing Rotary	DHW Heater	Not included in Current Plan
Buildings	404 Wing Rotary	Demand Control Ventilation	Not included in Current Plan
Buildings	404 Wing Rotary	Occupancy Sensors	Not included in Current Plan
Buildings	404 Wing Rotary	Linear Fluorescent Re-lamping	Not included in Current Plan
Buildings	Adult Recreation Center (ARC)	Demand Control Ventilation	Not included in Current Plan
Buildings	Adult Recreation Center (ARC)	Fluorescent Re-lamping	Not included in Current Plan
Buildings	Adult Recreation Center (ARC)	Low-Flow Fixtures	Not included in Current Plan
Buildings	Adult Recreation Center (ARC)	Duct Cleaning	Not included in Current Plan
Buildings	Adult Recreation Center (ARC)	Air Balancing & Airflow Reduction	Not included in Current Plan
Buildings	Adult Recreation Center (ARC)	Sensor Calibration	Not included in Current Plan
Buildings	Adult Recreation Center (ARC)	Daylight Harvesting	Not included in Current Plan
Buildings	Adult Recreation Center (ARC)	Occupancy Sensors	Not included in Current Plan
Buildings	Albert McCormick	Rooftop Unit Renewal and Demand Control Ventilation	Complete
Buildings	Albert McCormick	Rooftop Unit - Phase 2	Complete
Buildings	Albert McCormick	Dressing Room Ventilation Renewal	Complete
Buildings	Albert McCormick	Building Automation System & Air Quality Sensors	Complete
Buildings	Albert McCormick	Fluorescent Re-lamping	Complete
Buildings	Albert McCormick	Occupancy and Vacancy Sensor	Complete
Buildings	Albert McCormick	Ice Rink Lighting System Renewal	Complete
Buildings	Albert McCormick	Dehumidifier Replacement	Complete
Buildings	Albert McCormick	Plumbing Fixture Replacement	Complete
Buildings	Albert McCormick	Nighttime OA increase in ice pads	Complete
Buildings	Albert McCormick	Snow Melt Pit Renewal	For consideration
Buildings	Albert McCormick	Economizer Damper & Enthalpy Sensor Readjustment	For consideration
Buildings	Albert McCormick	Nighttime OA increase in ice pads	For consideration
Buildings	Albert McCormick	Resurfacing Water Preheat	Included in Current Plan

Appendix A – Ongoing Initiatives Identified from Buildings Energy Audit

Corporate Sector	Facility/Area	Initiative	Current Status
Buildings	Albert McCormick	Consider the introduction of de-stratification fan(s) corresponding to the atrium/entrance area work.	Included in Current Plan
Buildings	Albert McCormick	Air Balancing & Airflow Reduction	Included in Current Plan
Buildings	Albert McCormick	Sensor Calibration	Included in Current Plan
Buildings	Albert McCormick	Exhaust Damper Relocated	Included in Current Plan
Buildings	Albert McCormick	Duct Cleaning	Included in Current Plan
Buildings	Albert McCormick	Solar Photovoltaic Power - FIT Program	Included in Current Plan
Buildings	Albert McCormick	Timer on Snack Bar Hood	Not included in Current Plan
Buildings	Bechtel Park	Natural Gas Fired Heater	Included in Current Plan
Buildings	Bechtel Park	Fluorescent Light Fixture Retrofit	Included in Current Plan
Buildings	Bechtel Park	Duct Cleaning	Included in Current Plan
Buildings	Bechtel Park	Air Balancing & Airflow Reduction	Included in Current Plan
Buildings	Bechtel Park	DHW Heater	Included in Current Plan
Buildings	Bechtel Park	Occupancy Sensors	Included in Current Plan
Buildings	Bechtel Park	Low- Flow Water Fixture	Not included in Current Plan
Buildings	Button Factory	Circulating Pump Replacement	For consideration
Buildings	Button Factory	Potable Water Heating	For consideration
Buildings	Button Factory	Plumbing Fixtures	For consideration
Buildings	Button Factory	Sensor Recalibration	For consideration
Buildings	Button Factory	Controls Recommissioning	For consideration
Buildings	Button Factory	Linear Fluorescent Re-lamping	Included in Current Plan
Buildings	Button Factory	Condensing Boiler	Included in Current Plan
Buildings	Button Factory	Duct Cleaning	Included in Current Plan
Buildings	Button Factory	Hydronic System Cleaning	Included in Current Plan
Buildings	Button Factory	Air Balancing and Airflow Reduction	Not included in Current Plan
Buildings	Carnegie Library	Interior Lighting Renewal	Included in Current Plan
Buildings	Carnegie Library	Exterior Lighting	Included in Current Plan
Buildings	Carnegie Library	Duct Cleaning	Included in Current Plan
Buildings	Carnegie Library	HVAC Renewal	Included in Current Plan
Buildings	Carnegie Library	Envelope Renewal	Included in Current Plan
Buildings	Carnegie Library	Low Flow Water Fixtures	Not included in Current Plan
Buildings	Carnegie Library	Weatherstripping on Exterior Doors	Not included in Current Plan
Buildings	East Bridge Park	Exterior Lighting Replacement	Included in Current Plan

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Corporate Sector	Facility/Area	Initiative	Current Status
Buildings	East Bridge Park	LED Sports Field Lighting	Included in Current Plan
Buildings	East Bridge Park	Remote Operations of Sports Field Lighting	Included in Current Plan
Buildings	Elam Martin	Plumbing Fixture Replacement	For consideration
Buildings	Elam Martin	Interior Lamp Replacement	Included in Current Plan
Buildings	Elam Martin	Interior Lamp Replacement - High Bay Barn	Included in Current Plan
Buildings	Elam Martin	Interior Lamp Retrofit	Included in Current Plan
Buildings	EMS Building	Seal Unused Hose Drying Tower	Complete
Buildings	EMS Building	High Efficiency HVAC/Furnace Renewal	For consideration
Buildings	EMS Building	Low Flow Water Fixtures	For consideration
Buildings	EMS Building	Weatherstripping on Exterior Doors	For consideration
Buildings	EMS Building	Interior Lighting Occupancy Sensors	Included in Current Plan
Buildings	EMS Building	Duct Cleaning	Included in Current Plan
Buildings	Erbsville Community Centre	Condensing Furnaces - Conversion to Gas	Not included in Current Plan
Buildings	Erbsville Community Centre	Daylight Harvesting	Not included in Current Plan
Buildings	Erbsville Community Centre	Low Flow Water Fixtures	Not included in Current Plan
Buildings	Erbsville Community Centre	Duct Cleaning	Not included in Current Plan
Buildings	Erbsville Community Centre	Occupancy Sensor Installation	Not included in Current Plan
Buildings	Fire Station 2	Linear Fluorescent Re-Lamping	Complete
Buildings	Fire Station 2	Exterior Fixture Replacement	For consideration
Buildings	Fire Station 2	Plumbing Fixture Replacement	For consideration
Buildings	Fire station 2	Duct Cleaning	For consideration
Buildings	Fire Station 2	Condensing DHW	For consideration
Buildings	Fire Station 2	Remove Air cooled condensing units, duct mounted evaporator coils and refrigerant piping utilizing R22 refrigerant	Included in Current Plan
Buildings	Fire Station 2	Occupancy Sensors - Board Room etc.	Included in Current Plan
Buildings	Fire Station 3	Plumbing Fixture Replacement	For consideration
Buildings	Fire Station 3	Duct Cleaning	For consideration
Buildings	Fire Station 3	Linear Fluorescent Re-Lamping	Included in Current Plan
Buildings	Fire Station 3	Exterior Fixture Replacement	Included in Current Plan
Buildings	Fire Station 3	Remove Air cooled condensing units, duct mounted evaporator coils and refrigerant piping utilizing R22 refrigerant	Included in Current Plan

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Corporate Sector	Facility/Area	Initiative	Current Status
Buildings	Fire Station 3	Occupancy Sensors	Included in Current Plan
Buildings	Grey Silo	PH -- DHW Renewal	Complete
Buildings	Grey Silo	BAS	Complete
Buildings	Grey Silo	CB – Linear Fluorescent Lamp Replacement	For consideration
Buildings	Grey Silo	MB – Cold Storage Lighting Replacement	For consideration
Buildings	Grey Silo	MB – Linear Fluorescent Lamp Replacement	For consideration
Buildings	Grey Silo	PH – Demand Control Hood Implementation	For consideration
Buildings	Grey Silo	PH -- RTU Renewal	For consideration
Buildings	Grey Silo	PH - Plumbing Fixture	For consideration
Buildings	Grey Silo	MB - Plumbing Fixture	For consideration
Buildings	Grey Silo	Sensor Calibration	For consideration
Buildings	Grey Silo	General - Urinal & Water Closet Renewal	For consideration
Buildings	Grey Silo	Duct Cleaning	For consideration
Buildings	Grey Silo	PH – Halogen Lighting Replacement	Included in Current Plan
Buildings	Grey Silo	CB – Exterior Lighting Replacement	Included in Current Plan
Buildings	Grey Silo	HH – Linear Fluorescent Lamp Replacement	Included in Current Plan
Buildings	Grey Silo	MB – Shop Lighting Replacement	Included in Current Plan
Buildings	Grey Silo	Solar Photovoltaic Power - FIT Program	Not included in Current Plan
Buildings	Grey Silo	PH - Exterior Lighting Replacement	Complete
Buildings	Grey Silo	HH- Aerator Replacement	For consideration
Buildings	Grey Silo	PH - Timber Room Incandescent Lighting Replacement	Included in Current Plan
Buildings	Grey Silo	PH - 25 W Linear Fluorescent Re-Lamping	Included in Current Plan
Buildings	Grey Silo	MB - HVAC Renewal	Included in Current Plan
Buildings	Grey Silo	Solar Photovoltaic Power - Micro fit	Included in Current Plan
Buildings	Hillside Park	Plumbing Fixture Replacement	For consideration
Buildings	Hillside Park	Weatherstripping on Exterior Doors	For consideration
Buildings	Hillside Park	Building Winterization	For consideration
Buildings	Hillside Park	Exterior Lighting Replacement	Included in Current Plan
Buildings	Hillside Park	Interior Lamp Replacement	Included in Current Plan
Buildings	Hillside Park	LED Sports Field Lighting	Included in Current Plan
Buildings	Hillside Park	Remote Operations of Sports Field Lighting	Included in Current Plan
Buildings	Hillside Park	Interior Fixture Re-lamping	Included in Current Plan

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Corporate Sector	Facility/Area	Initiative	Current Status
Buildings	Lexington Park Washrooms & Sports Field	Plumbing Fixture Replacement	For consideration
Buildings	Lexington Park Washrooms & Sports Field	Interior Lamp Replacement	Included in Current Plan
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Building Envelope Assessment	Complete
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Gym and Field House Lighting Retrofit	Complete
Buildings	Manulife Financial Soccer & Sports Complex	Low- Flow Water Fixtures	For consideration
Buildings	Manulife Financial Soccer & Sports Complex	Fluorescent Re-lamping	Included in Current Plan
Buildings	Manulife Financial Soccer & Sports Complex	Make-Up Air Replacement	Included in Current Plan
Buildings	Manulife Financial Soccer & Sports Complex	Roof Top Unit Renewal & DCV	Included in Current Plan
Buildings	Manulife Financial Soccer & Sports Complex	Duct Cleaning	Included in Current Plan
Buildings	Manulife Financial Soccer & Sports Complex	Air Balancing & Airflow Reduction	Included in Current Plan
Buildings	Manulife Financial Soccer & Sports Complex	Occupancy Sensors	Included in Current Plan
Buildings	Manulife Financial Soccer & Sports Complex	LED Sports Field Lighting	Included in Current Plan
Buildings	Manulife Financial Soccer & Sports Complex	Remote Operations of Sports Field Lighting	Included in Current Plan
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Boiler Plant Renewal	Complete
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Rooftop Unit Renewal and Demand Control Ventilation - Base Bid Units 8, 9, 12 & 19	Complete
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Rooftop Unit Renewal and Demand Control Ventilation - Separate Pricing - Units 13, 14, 15, 21 & 22	Complete

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Corporate Sector	Facility/Area	Initiative	Current Status
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Internal Lighting Renewal Except Arena and Field House Areas	Complete
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Arena Areas Lighting Renewal	Complete
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Occupancy and Vacancy Sensors	Complete
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Dehumidification Renewal/Refrigeration Controls	Complete
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Arena Dimmable Lighting	Complete
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Plumbing Fixture Upgrade	For consideration
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Electric Reheat Coil Replacement	For consideration
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Rooftop Unit Renewal - Phase 2 - 16	Included in Current Plan
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Duct Cleaning	Included in Current Plan
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Air Balancing and Airflow Reduction	Included in Current Plan
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Sensor Recalibration	Included in Current Plan
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Economizer Damper and Enthalpy Sensor Readjustment	Included in Current Plan
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Solar Photovoltaic Power - FIT Program	Included in Current Plan
Buildings	Manulife Financial Sportsplex and Healthy Living Centre	Arena Outdoor Air Increase	Not included in Current Plan
Buildings	Moses Springer Community Centre	Occupancy and Vacancy Sensors	Complete
Buildings	Moses Springer Community Centre	Ice Rink Lighting Retrofit	Complete
Buildings	Moses Springer Community Centre	Exterior Lighting Upgrade	Complete
Buildings	Moses Springer Community Centre	Dehumidifier Renewal	Complete
Buildings	Moses Springer Community Centre	Plumbing Fixture Replacement	Complete

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Corporate Sector	Facility/Area	Initiative	Current Status
Buildings	Moses Springer Community Centre	Sensor Recalibration	Included in Current Plan
Buildings	Moses Springer Community Centre	Air Balancing & Airflow Reduction	Included in Current Plan
Buildings	Moses Springer Community Centre	Economizer Damper and Enthalpy Sensor Readjustment	Included in Current Plan
Buildings	Moses Springer Community Centre	Air Quality Sensors in the Ice Rink	Included in Current Plan
Buildings	Moses Springer Community Centre	Demand Control Ventilation	Included in Current Plan
Buildings	Moses Springer Community Centre	Linear Fluorescent Re-Lamping	Included in Current Plan
Buildings	Moses Springer Community Centre	Duct Cleaning	Included in Current Plan
Buildings	Moses Springer Community Centre	Condensing Furnaces	Included in Current Plan
Buildings	Mount Hope Cemetery	Temperature Reduction	Complete
Buildings	Mount Hope Cemetery	Plumbing Fixture Replacement	Complete
Buildings	Mount Hope Cemetery	Weatherstripping on Exterior Doors	Complete
Buildings	Mount Hope Cemetery	Furnace Upgrade	Complete
Buildings	Mount Hope Cemetery	Linear Fluorescent Re-Lamping	Included in Current Plan
Buildings	Our Lady of Lourdes	Exterior Lighting Replacement	Included in Current Plan
Buildings	Parks	Barrel Warehouse Park Lighting	Complete
Buildings	Parks	Lighting Upgrade	Included in Current Plan
Buildings	Parkview Cemetery Administration and Chapel Buildings	High Bay Lighting Replacement	Complete
Buildings	Parkview Cemetery Administration and Chapel Buildings	Chapel -- RTU Replacement	For consideration
Buildings	Parkview Cemetery Administration and Chapel Buildings	Administration -- Demand Control Ventilation	Included in Current Plan
Buildings	Parkview Cemetery Administration and Chapel Buildings	Duct Cleaning	Included in Current Plan
Buildings	Parkview Cemetery Administration and Chapel Buildings	Sensor Calibration	Included in Current Plan
Buildings	Parkview Cemetery Administration and Chapel Buildings	Linear Fluorescent Re-lamping	Included in Current Plan
Buildings	Parkview Cemetery Administration and Chapel Buildings	Exterior Lighting Replacement	Included in Current Plan
Buildings	Parkview Cemetery Administration and Chapel Buildings	Exit Fixture Replacement	Included in Current Plan

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Corporate Sector	Facility/Area	Initiative	Current Status
Buildings	Parkview Cemetery Administration and Chapel Buildings	Furnace Upgrade	Included in Current Plan
Buildings	Parkview Cemetery Administration and Chapel Buildings	Plumbing Fixture Replacement	Included in Current Plan
Buildings	RIM Park Green Lab Solar Shade	Solar Photovoltaic Power - Micro FIT Program	Complete
Buildings	Rink in the Park (Granite Club)	Old Change Room Furnace Renewal	Complete
Buildings	Rink in the Park (Granite Club)	Internal Lighting Renewal	Complete
Buildings	Rink in the Park (Granite Club)	Ventilation System Renewal Non-Curling Lane Areas	For consideration
Buildings	Rink in the Park (Granite Club)	Plumbing Fixture Replacement	For consideration
Buildings	Rink in the Park (Granite Club)	Dehumidification/Make-Up Air Replacement	For consideration
Buildings	Rink in the Park (Granite Club)	Refrigeration Controls	For consideration
Buildings	Rink in the Park (Granite Club)	Economizer Damper and Enthalpy Sensor Readjustment	For consideration
Buildings	Rink in the Park (Granite Club)	Duct Cleaning	For consideration
Buildings	Rink in the Park (Granite Club)	Ice Pad Area Reduction	For consideration
Buildings	Rink in the Park (Granite Club)	Occupancy Sensor Installation	Included in Current Plan
Buildings	Rink in the Park (Granite Club)	Ice Pad Area (Curling Lanes) Packaged Unit Replacement/Dehumidification/Make-Up Air Replacement	Included in Current Plan
Buildings	Rink in the Park (Granite Club)	Programmable Thermostat	Included in Current Plan
Buildings	Rink in the Park (Granite Club)	Air Balancing	Included in Current Plan
Buildings	Rink in the Park (Granite Club)	Demand Control Ventilation	Included in Current Plan
Buildings	Rink in the Park (Granite Club)	Exhaust Fan Operation	Not included in Current Plan
Buildings	Rink in the Park (Granite Club)	Solar Photovoltaic Power - FIT Program	Not included in Current Plan
Buildings	Rink in the Park (Granite Club)	Solar Photovoltaic Power - Microfit - Wall	Not included in Current Plan
Buildings	Service Centre	Main Building - RTU Renewal and DCV Controls	Complete
Buildings	Service Centre	Main Building - Daylight Harvesting	Complete
Buildings	Service Centre	Service Centre Wind/Solar Light	Complete
Buildings	Service Centre	Air Balancing & Airflow Reduction	For consideration
Buildings	Service Centre	Sensor Calibration	For consideration
Buildings	Service Centre	Main Building – MAU Renewal and Variable Frequency Drive	Included in Current Plan
Buildings	Service Centre	Main Building – Condensing DHW Heater	Included in Current Plan
Buildings	Service Centre	Various Buildings - Exterior Lighting Upgrade	Included in Current Plan

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Corporate Sector	Facility/Area	Initiative	Current Status
Buildings	Service Centre	Duct Cleaning	Included in Current Plan
Buildings	Service Centre	Solar Photovoltaic Power - FIT Program	Included in Current Plan
Buildings	Service Centre - Greenhouse	Instantaneous Hot Water Heater	For consideration
Buildings	Service Centre - Greenhouse	Condensing Boiler	Included in Current Plan
Buildings	Service Centre – Greenhouse	Low-Flow Water Fixtures	For consideration
Buildings	Service Centre - Oktoberfest	4 LED Lamps (from old 400 Watt Metal Halide Lamps)	For consideration
Buildings	Service Centre - Oktoberfest	Instantaneous Hot Water Heater	For consideration
Buildings	Service Centre – Oktoberfest	Low-Flow Water Fixtures	For consideration
Buildings	The Canadian Clay and Glass Gallery	Interior Lighting Retrofit	Complete
Buildings	The Canadian Clay and Glass Gallery	HVAC Upgrade	Complete
Buildings	The Canadian Clay and Glass Gallery	Sensor Recalibration	Complete
Buildings	The Canadian Clay and Glass Gallery	Installation of Soft Starter on Primary Equipment	Complete
Buildings	The Canadian Clay and Glass Gallery	Weatherstripping on Exterior Doors	Complete
Buildings	The Canadian Clay and Glass Gallery	Plumbing Upgrade	For consideration
Buildings	The Canadian Clay and Glass Gallery	Exterior Lighting Retrofit	Included in Current Plan
Buildings	The Canadian Clay and Glass Gallery	Duct Cleaning	Included in Current Plan
Buildings	The Canadian Clay and Glass Gallery	Photo Sensor Installation	Not included in Current Plan
Buildings	The Canadian Clay and Glass Gallery	Solar Photovoltaic Power - FIT Program	Not included in Current Plan
Buildings	Uptown Parkade	Lighting Upgrade	Complete
Buildings	Uptown Parkade	Stairwell Revamping	Complete
Buildings	Uptown Parkade	Plumbing Fixture Replacement	For consideration
Buildings	Uptown Parkade	DHW Replacement	Included in Current Plan
Buildings	Uptown Parkade	Snow Melting Boiler	Included in Current Plan
Buildings	Various Sites	Floodrooms - radiant vs. gas fired	For consideration
Buildings	Various Sites	Analyze site for poor power factor	For consideration
Buildings	Veteran's Green	Exterior Lamp Retrofit	Included in Current Plan
Buildings	Waterloo City Centre (City Hall)	Linear Fluorescent Re-lamping	Complete
Buildings	Waterloo City Centre (City Hall)	Lobby Lighting Retrofit	Complete
Buildings	Waterloo City Centre (City Hall)	Centrally Controlled Area Based Lighting	Complete
Buildings	Waterloo City Centre (City Hall)	Council Chamber Lighting Retrofit	Included in Current Plan
Buildings	Waterloo City Centre (City Hall)	Detailed Review of Hydronic System/Recommissioning	Included in Current Plan
Buildings	Waterloo City Centre (City Hall)	Demand Control Ventilation	Included in Current Plan

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Corporate Sector	Facility/Area	Initiative	Current Status
Buildings	Waterloo City Centre (City Hall)	Data Centre Retrofit	Not included in Current Plan
Buildings	Waterloo City Centre (City Hall)	Reheat Coil Controls	Not included in Current Plan
Buildings	Waterloo City Centre (City Hall)	Perimeter Radiator Renewal	Not included in Current Plan
Buildings	Waterloo City Centre (City Hall)	Plumbing Fixture Renewal	Not included in Current Plan
Buildings	Waterloo City Centre (City Hall)	Hydronic Supply Temperature Reset	Not included in Current Plan
Buildings	Waterloo City Centre (City Hall)	Solar Photovoltaic Power - Maintenance	Not included in Current Plan
Buildings	Waterloo Library	Low Flow Water Fixtures	For consideration
Buildings	Waterloo Library	Sensor Calibration	For consideration
Buildings	Waterloo Library	Air Balancing and Airflow Reduction	For consideration
Buildings	Waterloo Library	Weatherstripping on Exterior Doors	For consideration
Buildings	Waterloo Library	Natural Lighting Controls	Included in Current Plan
Buildings	Waterloo Library	Exterior Lighting Upgrade	Included in Current Plan
Buildings	Waterloo Library	Boiler Renewal	Included in Current Plan
Buildings	Waterloo Library	1965 AHU Detailed Review	Included in Current Plan
Buildings	Waterloo Library	1988 AHU Detailed Review	Included in Current Plan
Buildings	Waterloo Library	Duct Cleaning	Included in Current Plan
Buildings	Waterloo Library	Ventilation - Convert dual duct system to single duct.	Not included in Current Plan
Buildings	Waterloo Memorial Recreation Complex	Concession Exhaust Hood Replacement	Complete
Buildings	Waterloo Memorial Recreation Complex	Chiller Replacement	Complete
Buildings	Waterloo Memorial Recreation Complex	Rink Lighting Replacement	Complete
Buildings	Waterloo Memorial Recreation Complex	Track Lighting	Complete
Buildings	Waterloo Memorial Recreation Complex	Plumbing Fixture Upgrades	Complete
Buildings	Waterloo Memorial Recreation Complex	Energy Audit 5.6.3.1 Schedule Adjustment	Complete
Buildings	Waterloo Memorial Recreation Complex	Solar Photovoltaic Power - Microfit	Included in Current Plan
Buildings	Waterloo Memorial Recreation Complex	Pot Light Replacement	Included in Current Plan

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Corporate Sector	Facility/Area	Initiative	Current Status
Buildings	Waterloo Memorial Recreation Complex	Dehumidifier Replacement	Included in Current Plan
Buildings	Waterloo Memorial Recreation Complex	Thermal Ice Storage	Included in Current Plan
Buildings	Waterloo Memorial Recreation Complex	Swirl Pool Cover	Included in Current Plan
Buildings	Waterloo Memorial Recreation Complex	Change Room Air Handling Unit Replacement	Included in Current Plan
Buildings	Waterloo Memorial Recreation Complex	Pool Air Handling Unit Replacement	Included in Current Plan
Buildings	Waterloo Memorial Recreation Complex	Air Balancing and Airflow Reduction	Included in Current Plan
Buildings	Waterloo Memorial Recreation Complex	Sensor Calibration	Included in Current Plan
Buildings	Waterloo Memorial Recreation Complex	Duct Cleaning	Included in Current Plan
Buildings	Waterloo Memorial Recreation Complex	Water Balancing	Included in Current Plan
Buildings	Waterloo Memorial Recreation Complex	Bas Consolidation	Included in Current Plan
Buildings	Waterloo Memorial Recreation Complex	Occupancy Sensors	Included in Current Plan
Buildings	Waterloo Memorial Recreation Complex	Solar Photovoltaic Power - FIT Program - Wall	Not included in Current Plan
Buildings	Waterloo Park	Various - Temperature Reduction	Complete
Buildings	Waterloo Park	Weatherstripping on Exterior Doors	Complete
Buildings	Waterloo Park	Service Centre - High Bay Lighting Replacement	Complete
Buildings	Waterloo Park	Various - Plumbing Fixture Replacement	For consideration
Buildings	Waterloo Park	Various - Interior Lighting Replacement	Included in Current Plan
Buildings	Waterloo Park	Various - Incandescent Lamp Replacement	Included in Current Plan
Buildings	Waterloo Park	Various - Interior Lighting Re-Lamping	Included in Current Plan
Buildings	Waterloo Park	LED Sports Field Lighting	Included in Current Plan
Buildings	Waterloo Park	Various - Furnace Upgrades	Included in Current Plan

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Corporate Sector	Facility/Area	Initiative	Current Status
Buildings	Waterloo Park	Various - Exterior Lighting Replacement	Included in Current Plan
Buildings	Waterloo Park	Lion's Lagoon - Furnace Upgrade	Not included in Current Plan
Buildings	Waterloo Park	Duct Cleaning	Not included in Current Plan
Business Travel	Carbon Offsetting	Where plane travel is required for business, the City will explore the viability of purchasing carbon offsets to mitigate resulting GHG emissions	Included in Current Plan
Business Travel	Carshare Parking Spots	Currently VRTUCAR purchase parking permits from some of the City's supply to locate their vehicles in City parking facilities	Included in Current Plan
Business Travel	Community Carshare	Currently the City is a member of VRTUCAR Car Share	Included in Current Plan
Business Travel	Policy for Efficient Business Travel	Develop a policy to promote more efficient, less carbon-intensive business travel outside the City	Included in Current Plan
Business Travel	Telecommuting Policy	Develop and implement a telecommuting policy for municipal staff that applies to local travel within the City for business purposes	Included in Current Plan
Business Travel	Travelwise Membership	City has a travelwise membership and staff orientation includes a presentation.	Included in Current Plan
Fleet	Anti-Idling Policy	Strengthen existing anti-idling policy for fleet vehicles	Included in Current Plan
Fleet	Effective tracking and monitoring fuel usage	Improve the collection and use of data required by the fleet department to improve decision-making and support the introduction of alternative fuels and vehicles into the City's repertoire	Included in Current Plan
Fleet	Energy / Fuel-efficient Maintenance Equipment	Replace existing maintenance equipment with more energy / fuel-efficient alternatives	Included in Current Plan
Fleet	Route Optimization	Optimize the routes fleet vehicles travel for routine and corrective maintenance activities using AVL technology	Included in Current Plan
Other	Corporate Environmental Initiatives	Implement corporate energy and environmental initiatives and ongoing training to enhance staff awareness	Included in Current Plan
Other	Energy Management Committee	Establish and Energy Management Committee	Complete
Other	Energy Project Funding Program	Establish program to use savings from energy conservation initiatives to fund new ones	Included in Current Plan

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Corporate Sector	Facility/Area	Initiative	Current Status
Other	Environmental Procurement Policy	Enhance the existing environmental procurement policy and integrate environmental purchasing across the corporation	Included in Current Plan
Other	Green Building Criteria	Strengthen existing Green Building Policy; evaluate use of LEED for Existing Buildings and/or BOMA BEST to improve building performance in operations and retrofits	Included in Current Plan
Other	Policies and studies	Re-examine how existing facilities are programmed for better efficiency (e.g., how ice is programmed taken in/out of facilities)	For consideration
Other	Policies and studies	Examine cost recovery opportunities to re-invest in better/ more advanced HVAC, envelope and refrigeration technology	For consideration
Other	Policies and studies	Implement a temperature and environment policy for staff and patrons	For consideration
Other	Policies and studies	Consider closing or seasonally running some facilities	For consideration
Other	Policies and studies	Complete an electric vehicle study	For consideration
Other	Policies and studies	Complete a driver training program	For consideration
Other	Policies and studies	Drop light levels in all public areas / light harvesting where safety is not compromised	For consideration
Other	Policies and studies	Implement employee work from home policy and program	For consideration
Other	Policies and studies	Integrated food services and facility operations needs into the solid waste plan (e.g., share furniture)	For consideration
Other	Policies and studies	Implement employee education and incentive programs to reduce energy consumption	For consideration
Other	Policies and studies	Implement a more robust tree planting policy around buildings and grounds for shade to reduce energy consumption	For consideration
Other	Policies and studies	Source grid electrical supply from lower GHG emitting methods of energy production	For consideration
Other	Policies and studies	Complete a utilization study in facilities to better utilize existing City spaces	For consideration

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Corporate Sector	Facility/Area	Initiative	Current Status
Other	Procedure for Energy Management - Corporate Operations	The purpose of this procedure is to build upon the existing Green Building Policy and outline additional parameters for operations, renovations and new construction in order to further reduce energy and water consumption in corporate assets. It is the intent that this procedure be modified over time based on the changing landscape of energy management.	Included in Current Plan
Other	Sustainable Energy Policy	Develop Policy to encourage ongoing exploration and evaluation of renewable technologies for use / installation at corporate facilities	Included in Current Plan
Other	Waste Diversion	Formulate a more precise method of tracking waste production at Corporate sites and develop a solid waste management policy	Included in Current Plan
Outdoor Lighting	Parking Lot Lighting Conversion Program	Upgrade existing parking lot lights across City owned and operated exterior parking lots and parking structures	Complete
Outdoor Lighting	Street Lamp Conversion Program	Upgrade existing streetlights (approx. 7,000 in total) to more energy efficient fixtures	Complete
Wastewater	Beaver Creek Pumping Station	Internal Temperature Reduction	Complete
Wastewater	Colonial Pumping Station	Internal Temperature Reduction	Complete
Wastewater	Frobisher Pumping Station	Internal Temperature Reduction	Complete
Wastewater	Frobisher Pumping Station	Exterior Lighting Upgrade	Complete
Wastewater	Frobisher Pumping Station	Weatherstripping on Exterior Doors	Complete
Wastewater	Frobisher Pumping Station	Mechanical Louver Re-Adjustment	Complete
Wastewater	Frobisher Pumping Station	Interior Lighting	Complete
Wastewater	Frobisher Pumping Station	Exterior Lighting	Complete
Wastewater	Malabar Pumping Station	Exterior Lighting Upgrade	Complete
Wastewater	Millennium Pumping Station	Internal Temperature Reduction	Complete
Wastewater	Millennium Pumping Station	Exterior Lighting Upgrade	Complete
Wastewater	Millennium Pumping Station	Weatherstripping on Exterior Doors	Complete
Wastewater	Millennium Pumping Station	Mechanical Louver Re-Adjustment	Complete
Wastewater	Millennium Pumping Station	Interior Lighting	Complete
Wastewater	Northlands Pumping Station	Internal Temperature Reduction	Complete
Wastewater	Northlands Pumping Station	External Lighting	Complete

Appendix A – Ongoing Initiatives Identified from Buildings Energy Audit

Corporate Sector	Facility/Area	Initiative	Current Status
Wastewater	Northlands Pumping Station	Weatherstripping on Exterior Doors	Complete
Wastewater	Northlands Pumping Station	Mechanical Louver Re-Adjustment	Complete
Wastewater	Northlands Pumping Station	Interior Lighting Retrofit	Complete
Wastewater	Northlands Pumping Station	Exterior Flood Lighting	Complete
Wastewater	Sanitary Sewer Inflow and Infiltration Reduction	Explore ways to reduce energy use and associated GHG emissions by reducing wet weather flows and energy consumption associated with pumping activities	Included in Current Plan
Wastewater	Stormwater Management Policy	Incorporate LID technologies / techniques such as green roofs, bioswales, rainwater harvesting into the City's stormwater management policy and engineering development manual	Included in Current Plan

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Energy Conservation and Demand Management Plan (2019)

Appendix B

Sample Carbon Pricing Policy

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CARBON PRICE

Effective Date: June 23, 2017

Approved By: MVRD Board

Policy No. GV-015

PURPOSE

To establish a price on Applicable Greenhouse Gas (GHG) Emissions, and to enable the value of those GHG emissions to be incorporated into Life Cycle Cost Analyses for Metro Vancouver projects or initiatives.

The objectives of the *Carbon Price Policy* are to:

- Incorporate consideration of climate change mitigation (i.e., GHG emissions reduction) into options analyses for all Metro Vancouver projects or initiatives; and
- Provide a mechanism to reduce financial risk of increased operating costs associated with rising external carbon taxes over the lifetime of a Metro Vancouver project or initiative.

DEFINITIONS

“Applicable Greenhouse Gas (GHG) Emissions” are GHG emissions associated with Metro Vancouver projects or initiatives, in particular GHG emissions related to energy use and utility processes, and GHG emissions reductions (or avoided GHG emissions) related to ecological carbon storage/sequestration;

“Carbon dioxide equivalent (CO₂e)” is the common metric used to quantify and compare different types of GHG emissions, and is expressed in tonnes;

“Carbon Price” is the total dollar value (including any provincial and federal carbon taxes) assigned by Metro Vancouver to one tonne of CO₂e; and

“Life Cycle Cost Analysis” is the process to establish the net present value of all costs and revenues associated with a Metro Vancouver project or initiative over its expected life.

POLICY

When undertaking options analysis for a Metro Vancouver project or initiative, the Carbon Price will be used to calculate the value (expressed as a cost) of Applicable GHG Emissions associated with each option. This value will be included in the Life Cycle Cost Analysis for each option.

Carbon Price

Metro Vancouver will use a total Carbon Price (inclusive of any applicable external carbon taxes) of \$150 per tonne of CO₂e in Life Cycle Cost Analyses.

BOARD POLICY

Financial Services, in coordination with the Air Quality and Climate Change Division, will develop and annually review a *Carbon Price Schedule*. This *Carbon Price Schedule* will provide the incremental cost per unit of purchased energy (e.g., litres of gasoline, GJ of natural gas), as well as the cost per unit of other Applicable GHGs (e.g., tonne of fugitive methane). The carbon price will be adjusted to account for any changes to provincial and federal carbon taxes, to ensure that the total carbon price per tonne of Applicable GHGs is constant at \$150 per tonne of CO₂e.

Application

This Policy applies to all options analyses that use Life Cycle Cost Analysis for Metro Vancouver projects or initiatives, including (but not limited to):

- Planning, design, procurement, construction, operation, maintenance, and decommissioning (where applicable) of facilities, vehicles, and equipment owned or operated by Metro Vancouver or by third parties on Metro Vancouver's behalf;
- Acquisition of park land, where protection of the land by Metro Vancouver results in quantifiable GHG emissions reductions compared to business as usual; and
- Management of process emissions from Metro Vancouver facilities.

The Carbon Price will be used to calculate the value of Applicable GHG Emissions associated with:

- Energy purchased by Metro Vancouver or by third parties on Metro Vancouver's behalf for the operation of utilities, fleet, and facilities (including natural gas, liquid petroleum products, propane, and electricity);
- Fugitive methane and nitrous oxide emissions released from wastewater treatment processes and municipal solid waste management processes;
- Avoided GHG emissions due to the displacement of fossil fuels with energy recovered from Metro Vancouver facilities;
- Avoided GHG emissions attributable to the protection and/or restoration of park land such as forests and bogs; and
- Other sources related to Metro Vancouver's activities.

CARBON PRICE SCHEDULE

Version 1.0: May 17, 2017

Background

This Carbon Price Schedule provides data and information in support of the implementation of Metro Vancouver's *Carbon Price Policy*.

In accordance with the *Carbon Price Policy*, Financial Services, in coordination with the Air Quality and Climate Change Division, will annually review the Carbon Price Schedule. The incremental costs will be adjusted to account for any changes to external carbon taxes, to ensure that the total Metro Vancouver Carbon Price is constant at \$150 per tonne of CO₂e on applicable emissions.

Carbon Price Schedule

This Carbon Price Schedule provides the incremental cost per tonne of carbon dioxide equivalent emissions (Table 1).

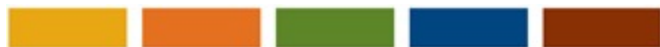
The BC Carbon Tax (currently set at \$30 per tonne CO₂e) is included in the purchase price of fossil fuels within the province. The fuels that are most relevant to Metro Vancouver projects and initiatives are gasoline, natural gas, diesel and propane. The Government of Canada's "Pan-Canadian Framework on Clean Growth and Climate Change" outlines a pathway for an increasing price on carbon¹. This may result in increases to the BC Carbon Tax to \$40 per tonne CO₂e in 2021 and to \$50 per tonne CO₂e in 2022. The Total Metro Vancouver Carbon Price will comprise the sum of the external BC Carbon Tax and an Incremental Metro Vancouver Carbon Price. If the BC Carbon Tax is increased in response to federal carbon price policy, the Incremental Metro Vancouver Carbon Price will be adjusted to maintain the Total Metro Vancouver Carbon Price at \$150 per tonne CO₂e. Table 1 demonstrates this process.

Table 1. Carbon Price for Metro Vancouver, accounting for External Carbon Taxes

Year	Confirmed BC Carbon Tax	Proposed Carbon Price (Pan-Canadian Framework)	Incremental Metro Vancouver Carbon Price for Life Cycle Costs Analysis	TOTAL Metro Vancouver Carbon Price
2017	\$30	-	\$120	\$150
2018	\$30	\$10	\$120	\$150
2019	\$30	\$20	\$120	\$150
2020	\$30	\$30	\$120	\$150
2021	\$30	\$40	\$120	\$150
2022	\$30	\$50	\$120	\$150
Future	\$30	\$50	\$120	\$150

¹ Government of Canada, 2016. "Pan-Canadian Framework on Clean Growth and Climate Change". Available at: <https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework.html>

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End Notes

ⁱ **Business as Usual Model Assumptions / Notes:**

- Real energy consumption and cost data was available from the City from 2011 to 2018.
- City population data was available for the years 2011 and 2016.
- Projected City population data was available for the years 2021 and 2026.
- Buildings and facilities that are either planned, or in the process of being built, have been included in the forecast – these are as follows:
 - Library expansion at Rim Park
 - WMRC Expansion of Pavilion
 - WMRC Expansion of Civic front
 - Minor expansion and upgrade Carnegie Library
 - Storage Place at RIM park
 - Uptown Parking structure expansion
 - New Fire station
 - West Side Mini Operation Centre
- Buildings at the following locations will be sold or decommissioned:
 - 404 Rotary Centre
 - Adult Recreational Centre
 - Rink In The Park (Granite Club)
- It is assumed that the City vehicle population would turn-over at a similar rate to the Canadian population (10 years).
- It is assumed that the 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.
- It is assumed that the Federal government will increase the Renewable Fuel Regulation requirements by 2030 by 5% for gasoline, and 2% for diesel.
- There are no new solar PV installations, and the current solar PV systems continue to operate as intended.
- The fuel mix used to generate electricity in Ontario does not change from what is occurring in the 2018 reporting year.

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