CLIMATE CHANGE MASTER PLAN

DRAFT – December 2, 2019

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Executive Summary

The Climate Change Master Plan is a framework for how Ottawa will mitigate and adapt to climate change over the next three decades. The vision of the Climate Change Master Plan is to take unprecedented, collective action that transitions Ottawa to a clean, renewable and resilient city by 2050. It sets guiding principles, goals, greenhouse gas (GHG) emission reduction targets, and priority actions for the next five years (2020-2025).

Worldwide, climate scientists agree that fast rising global temperatures have created a climate crisis. In 2018, the Intergovernmental Panel on Climate Change (IPCC) released The Special Report on Global Warming of 1.5°C providing the scientific evidence for the need to limit global warming to 1.5ºC. The IPCC states that this is possible but "would require rapid, far-reaching and unprecedented changes in all aspects of society"[i]. To align with the IPCC, Ottawa would need to set targets to reduce emissions by 68% by 2030 and 100% by 2050.

As identified by the IPCC, significant action and investment is required in the next 10 years to avoid catastrophic impacts. The next five years are critical to putting Ottawa on the path to meet GHG emission targets and prepare for future climate conditions. The Climate Change Master Plan identifies a total of eight priority actions for the next five years (2020-2025) that can be embedded into City business.

1. Implement Energy Evolution: Ottawa's Community Energy Transition Strategy
2. Undertake a climate vulnerability assessment and develop a Climate Resiliency Strategy
3. Apply a climate lens to the new Official Plan and its supporting documents
4. Apply a climate lens to asset management and capital projects
5. Explore community and corporate carbon budgets
6. Explore options for carbon sequestration methods and the role of green infrastructure
7. Encourage private action through education, incentives, and municipal support
8. Develop a governance framework to build corporate and community capacity, align priorities, and share accountability in tackling climate change.

Staff will provide an annual status update on the Climate Change Master Plan, including the results of the annual GHG inventories and the five-year priorities. A full review and update of the Climate Change Master Plan, including the guiding principles, goals, GHG emission reduction targets, and priority actions, will be completed in five years (2025).

1. Introduction

Around the world, cities are experiencing escalating and accelerated changes due to a significantly warming planet caused by human activity. Worldwide, climate scientists agree that the fast-rising global temperature has created a climate crisis.[ii]

In 2016, the Paris Agreement entered into force, an historic agreement with the aim to keep the increase of global temperatures below 2°C above pre-industrial levels and to strive to limit global temperature increase even further to 1.5°C.[iii] In 2018, the Intergovernmental Panel on Climate Change (IPCC) released The Special Report on Global Warming of 1.5°C, stating that 2°C does not go far enough and provides the scientific evidence on the need to limit global warming to 1.5ºC.[iv] Scientists estimate that global warming is likely to reach 1.5ºC as early as 2030. Limiting global warming to 1.5ºC is possible, but it will "require rapid, far reaching and unprecedented changes in all aspects of society".[v]

Ottawa is not immune to the global climate crisis and its impacts. In April 2019, Environment and Climate Change Canada released Canada's Changing Climate Report stating that Canada is warming at twice the rate of the rest of the world and projects that the effects of warming will intensify in the future. The latest data from Climate Atlas of Canada indicates that over the coming decades, Ottawa will experience considerably wetter springs and winters, much warmer winters, and an increase in summer days over 30ºC.[vi] Extreme weather events such as heat waves, floods, high winds and ice storms will become more unpredictable. These changing patterns in our climate will have significant and direct impacts on our health and safety, our infrastructure, our local economy and our environment. In 2018 alone, insured damage from severe weather across Canada reached $2 billion, and it is estimated that climate change could cost Canada $21 to $43 billion per year by 2050.[vii]

While the current climate trends are alarming, there is reason for hope. At the local and global level, we collectively have the power to make decisions and take actions that will protect our climate and our city. The good news is that the technological solutions, skills and knowledge already exist to transition away from fossil fuels to clean, renewable energy sources. The bad news is we don't have the luxury of time and business-as-usual is no longer an option. It will take accelerated and unprecedented community-wide action and investment to limit global warming to 1.5ºC.

On April 24, 2019, Ottawa City Council declared a climate emergency, joining a growing global movement calling for urgent action to avert the climate crisis. The next five years are critical for monumental change.

Let's get started.

2. Ottawa's Climate Change Framework

The Climate Change Master Plan is a framework for how Ottawa will mitigate and adapt to climate change over the next three decades. Mitigation means reducing or preventing greenhouse gas (GHG) emissions that lead to global warming. Adaptation means responding to the impacts of climate change and becoming more resilient for the future.

In keeping with the latest IPCC reports, the vision of the Climate Change Master Plan is to take unprecedented, collective action to transition Ottawa to a clean, renewable, resilient city by 2050. It is guided by the principles that:

- Everyone has a responsibility to manage energy consumption and to mitigate risks.
- Collaboration is needed amongst various levels of government, utilities, stakeholders, and the broader community to effect change and develop joint solutions.
- Municipal leadership is needed to ensure an integrated and comprehensive approach across the corporation and the community.
- Coordination is needed amongst all long-term municipal plans, including land use, transportation, and infrastructure master plans, the Comprehensive Asset Management program, and the long-range financial plan to ensure a strategic, harmonized approach.
- Equity and inclusion considerations must be incorporated into all decision-making processes.

To become a renewable and resilient city, Ottawa will:

***Mitigate** climate change by:*

1. Making a sustained transition away from a dependence on fossil fuels
2. Reducing energy use through conservation and efficiency
3. Increasing the supply of renewable energy through local and regional production
4. Reducing greenhouse gas emissions from non-fossil fuel sources
5. Improving carbon capture storage and sequestration

***Adapt** to climate change and protect people and property by:*

1. Reducing the risks to public health and ensuring public safety, including vulnerable populations
2. Increasing infrastructure resiliency
3. Increasing resiliency of buildings
4. Protecting and enhancing the natural environment
5. Incorporating Incident Management System (IMS) principles in emergency management
6. Promoting public preparedness

The Climate Change Master Plan provides the framework for actions that address both mitigation and adaptation (Figure 1).

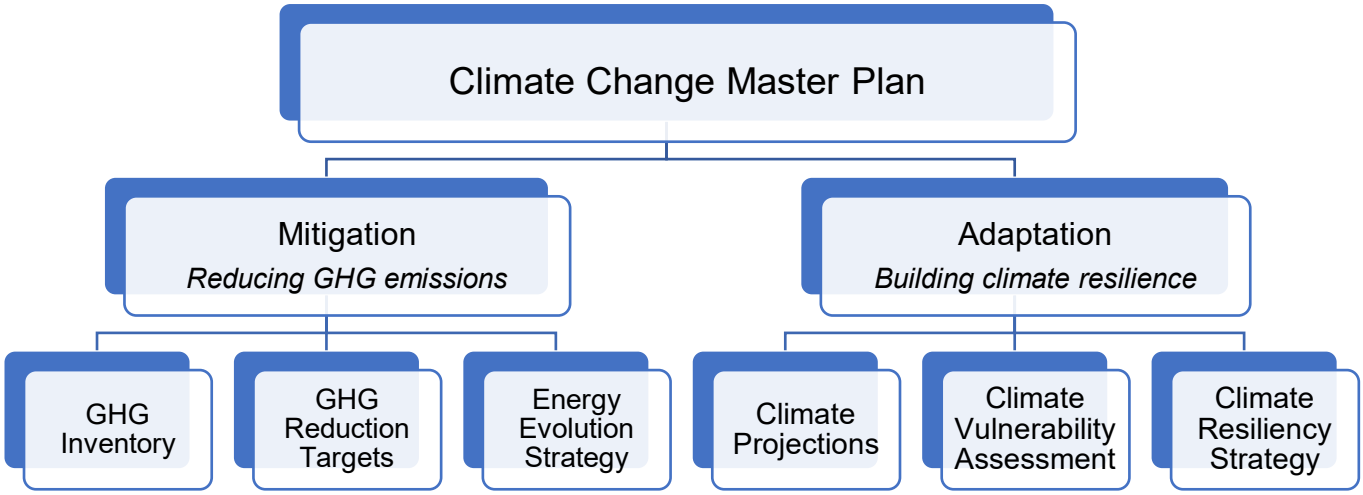

Figure 1: Ottawa's Climate Change Framework

Over the past few years, emphasis has been placed on initiatives that mitigate the climate crisis, including:

- Setting GHG reduction targets
- Undertaking annual GHG emission inventories
- Significant emission-reducing projects such as the Light Rail Transit, landfill gas improvements, streetlight conversion and facility improvements to reduce energy consumption
- Developing Energy Evolution: Ottawa's Community Energy Transition Strategy

Energy Evolution provides a model and actions to mitigate GHG emissions to meet our GHG emission reduction targets. Developed in collaboration with more than one hundred public and private stakeholders, it is a community-wide initiative with a vision to transform Ottawa into a thriving city powered by clean, renewable energy.

The need to increase efforts to understand and build resiliency to climate change has become more apparent and work has started on climate projections, a vulnerability assessment and a Climate Resiliency Strategy. Key climate adaptation projects to-date include the Combined Sewage Storage Tunnel, flood risk management, and ongoing public health outreach and emergency preparedness and response.

The Climate Change Master Plan is not intended to be a standalone document. Coordination is needed amongst all long-term municipal plans so that the Climate Change Master Plan informs or influences numerous other City initiatives including, but not limited to:

- *Official Plan and associated Master Plans*: The Official Plan provides a vision for the future growth of the city and a policy framework to guide the city's physical development, with an aim for Ottawa to grow to be the most liveable mid-sized city in North America.

It is coordinated with the reviews and updates of the Transportation Master Plan, the Infrastructure Master Plan, the Parks and Greenspace Master Plan, and the Development Charges By-Law.

- *Comprehensive Asset Management (CAM)*: Asset Management is an integrated business approach involving the different disciplines of planning, finance, engineering, maintenance, and operations to effectively manage existing and new infrastructure through their lifecycle. The City maintains nearly $42 billion in existing infrastructure and works to ensure safe and sustainable services are delivered to our communities in a cost-effective way.
- *Long Range Financial Plan (LRFP):* The Long-Term Financial Plan provides a framework for longer-term financial decision-making, including strategies and key actions to facilitate multi-year, integrated, strategic decision-making.
- *Urban Forest Management Plan (UFMP):* Ottawa's urban forest includes all trees and their habitat public and private property within the city's urban area boundary. The UFMP is intended to provide the strategic and technical guidance required to achieve urban forest sustainability in Ottawa over the coming decades.
- *Solid Waste Master Plan*: The municipal Solid Waste Master Plan is intended to provide the overall framework, direction, and goals for solid waste management, diversion and reduction policy over the short-, medium- and longer-term horizon.
- *Operational Plans and Polices:* These include the Energy Conservation and Demand Management Plan, the Municipal Green Fleet Plan, the Green Building Policy, the Corporate Electric Vehicle Charging Station Policy, and the Municipal Emergency Plan among others.

The Role of Municipalities

In the next 30 years, some 70 million people will move to urban areas every single year. By 2050, two-thirds of the global population will live in cities[viii]. The Federation of Canadian Municipalities estimates that cities influence roughly half of Canada's greenhouse gas emissions and own approximately 60% of the public infrastructure that supports our economy and quality of life.[ix] Municipalities have an essential role in local solutions to reduce emissions and prepare for climate impacts.

As a local authority with powers handed down by the Province, municipalities have direct control over a range of services that touch people's everyday lives and affect how energy is consumed. This includes housing, transportation planning and public transit, water and sewer infrastructure, and waste management. Municipalities control where and how growth will occur through the designation of land use and in the development and enforcement of zoning by-laws. Building construction is also controlled through site plan control measures, urban design guidelines and Building Code enforcement.

In carrying out its municipal duties, the City partners with several associated agencies, including Conservation Authorities, utility companies, the National Capital Commission, Ottawa Community Housing Corporation, as well as other levels of government and the private sector throughout the National Capital region.

In addition to its regulatory powers, the City also plays a key role in bringing community stakeholders together to facilitate discussions and foster collaboration in planning and strategizing integrated approaches to achieve long term energy sustainability goals and build local resiliency. Through education and civic engagement, the City can explain the benefits and promote action towards a long-term sustainable future.

Despite the important role that municipalities play in mobilizing forces toward a low carbon resilient future, there are limitations on the extent of power that can be exerted by local government. This is due in part to the limit on financial resources available to municipalities and jurisdictional barriers. Ottawa's ability to mitigate and adapt to climate change is therefore contingent upon senior levels of government, stakeholders and partners to commit to action within their specific jurisdictions (i.e. utilities, housing, development industry, etc.).

3. Global, National, and Local Climate Initiatives

At all levels of government, we are seeing a call for action. Three key events have been highlighted below; Figure 2 provides a chronological list of initiatives.

a) The Paris Agreement

The Paris Agreement is a landmark agreement within the United Nations Framework Convention on Climate Change (UNFCC). Its aim is to keep the increase of global temperatures below 2°C above pre-industrial levels and to strive to limit global temperature increase even further to 1.5°C.[x] It entered into force on November 4, 2016 and to date has been adopted by over 190 countries and ratified by 185 Parties of the UNFCC, including Canada.[xi]

b) IPCC Special Report

In October 2018, the IPCC released The Special Report on Global Warming of 1.5ºC as a follow-up to the Paris Agreement. The report explored what the impacts would be if global temperatures increased 1.5ºC above pre-industrial levels and what climate impacts could be avoided by limiting global warming to 1.5ºC compared to 2ºC. Scientists project that some of the global impacts of a 2ºC warming scenario versus a 1.5ºC warming scenario are:

- Almost three times as many people exposed to severe heat at least once every five years
- Higher risk to human heath, including heat-related morbidity and mortality in urban areas
- Twice as many vertebrates and plants species will be lost
- Three times as many insects will lose at least half their range
- Greater rise in sea levels and up to 79 million people exposed to flooding
- Greater economic losses, particularly with middle income countries[xii]

The IPCC report noted that some of these impacts are already being felt today, and that limiting global warming to 1.5ºC would “require rapid, far-reaching and unprecedented changes in all aspects of society”.[xiii]

c) Declaration of Climate Emergency

Since the IPCC report came out in 2018, over 900 (and counting) cities and jurisdictions around the world have declared a climate emergency, representing more than 200 million citizens.[xiv] In Canada, over 440 municipal and regional governments have declared a climate emergency including Vancouver, Toronto, Kingston, Halifax, and over 390 Quebec Councils (including Montreal). On April 24, 2019, Ottawa City Council joined the global movement for action by declaring a climate emergency. The Canadian House of Commons declared a national climate emergency later in June 2019 and in July 2019, the Assembly of First Nations, representing 634 First Nation communities across Canada declared a global climate emergency. In November 2019, 11,000 climate scientists from 153 nations a endorsed the declaration of a climate emergency. While the details of individual climate emergency declarations vary, one element remains constant – the commitment to take the urgent action required to avert the climate crisis.

Figure 2: Global, National and Local Climate Initiatives, 2014-2019

4. Mitigation

Mitigation means reducing or preventing GHG emissions that lead to global warming. Every day people make choices that impact our GHG emissions including where we live and work, how we heat and cool our homes and businesses, how we travel around the city, and how we dispose of waste.

GHG Emissions

The City tracks community and corporate GHG emissions through annual GHG inventories. Inventories provide a snapshot of energy use and emissions, as well as their driving factors. The most recent inventory results are for the 2017 and 2018 calendar years. For a detailed summary of the results, refer to Annex A.

Community GHG inventories track emissions associated with activities within the geographic boundary of Ottawa and are broken down into four sectors: buildings, transportation, waste (solid waste and wastewater treatment), and agriculture. In 2018, 90 per cent of Ottawa's emissions came from the stationary energy and transportation sectors. Within those sectors, the combustion of natural gas and gasoline accounted for 83 per cent of emissions.

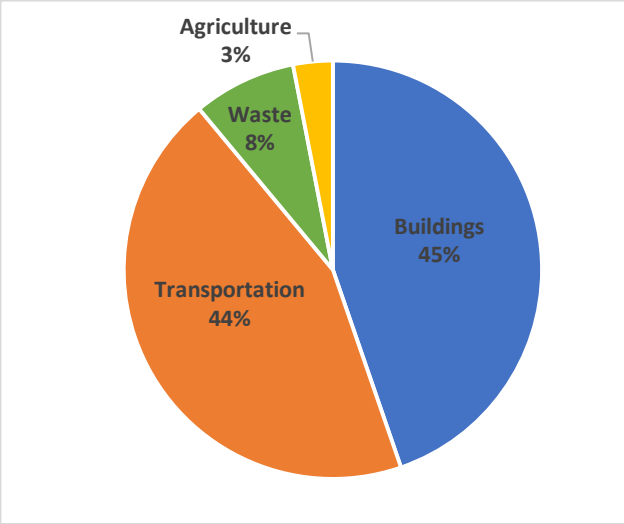

Figure 3: Community GHG Emissions by Sector (2018)

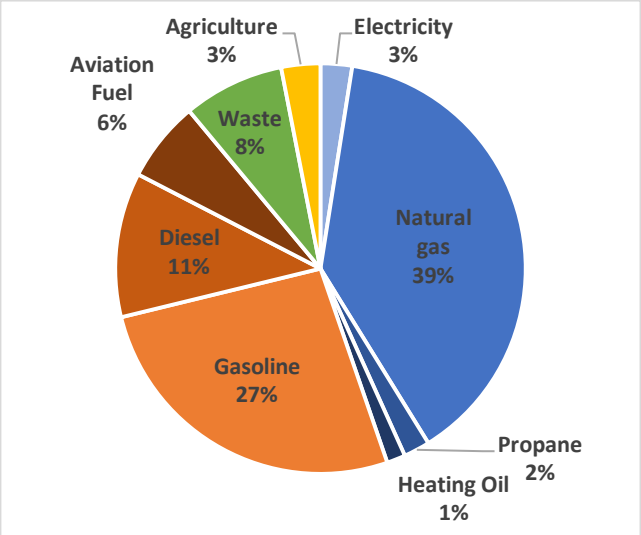

Figure 4: Community GHG Emissions by Source (2018)

Since 2012, community emissions have declined by 14 per cent. This decrease in emissions can be primarily attributable to the phase out of Ontario's coal plants, a reduction in GHG emissions associated with electricity generation and a decrease in electricity consumption. It is not anticipated that we will continue to see the emission benefits of the phase out of coal much longer. If Ottawa is going to meet its GHG reduction targets, significant action and investment will need to be made to transition off fossil fuels to renewable energy sources.

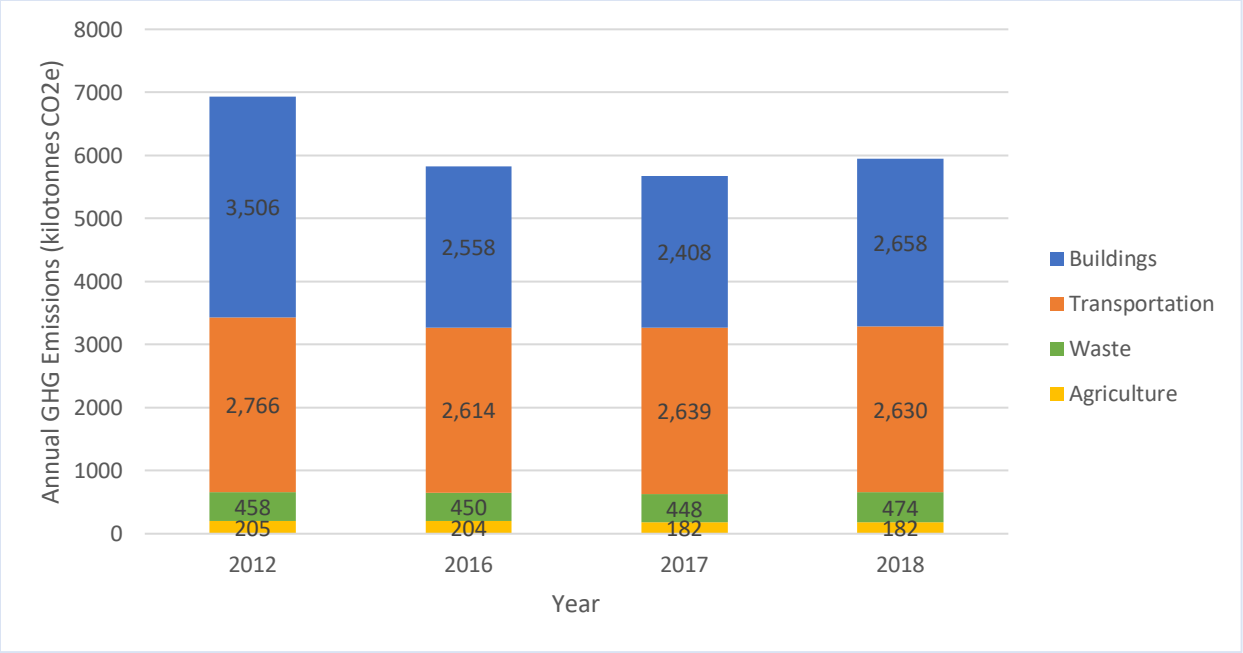

Figure 5: Annual Community GHG Emissions by Sector Since 2012

Corporate GHG emission inventories track emissions from municipal operations within four sectors: fleet, facilities, solid waste, and wastewater. Corporate inventories are generally considered to be more accurate than community inventories as municipalities have direct control over their emissions and have access to reliable, observed data. In 2018, corporate emissions represented roughly 4 per cent of all emissions generated in Ottawa. However, the Federation of Canadian Municipalities estimates that municipalities have influence over roughly half of Canada's emissions.[xv]

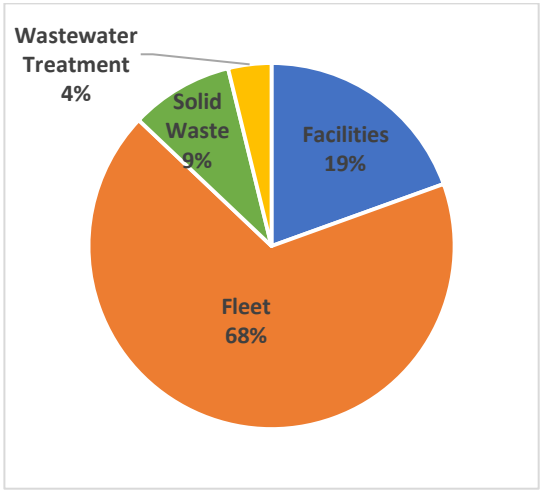

Figure 6: Corporate GHG Emissions by Sector (2018)

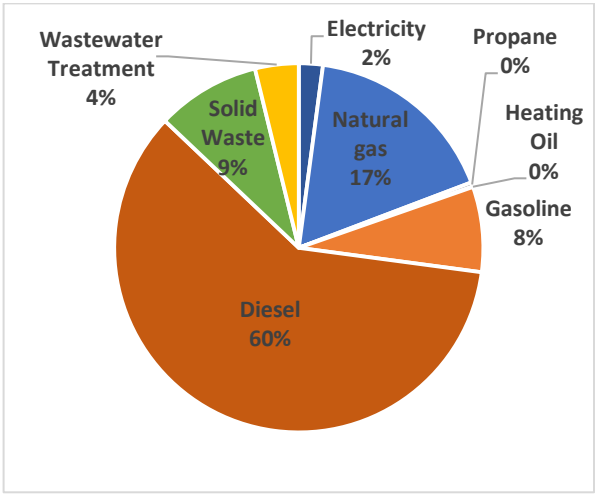

Figure 7: Corporate GHG Emissions by Source (2018)

Since 2012, corporate emissions have declined by 36 per cent. The significant reduction in emissions can be attributed to the efficiencies made at the Trail Road Waste Facility, where a 90 per cent landfill gas collection efficiency rate is being observed due to the landfill gas capture system.

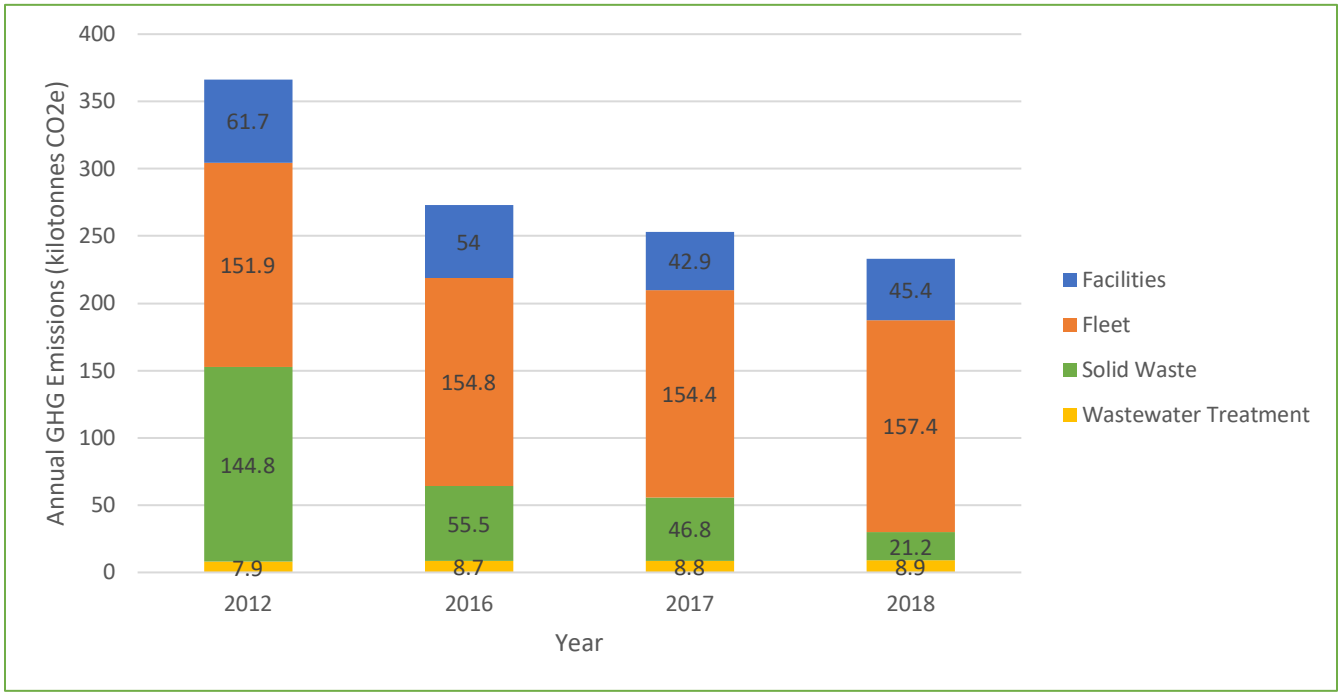

Figure 8: Annual Corporate GHG Emissions by Sector Since 2012

Current GHG Emission Reduction Targets

Ottawa currently has three GHG reduction targets based on a 2012 baseline:

- A short-term target to reduce community emissions by 12 per cent by 2024;
- A short-term target to reduce corporate emissions by 20 per cent by 2024; and
- A long-term target to reduce community emissions by 80 per cent by 2050.

The results from the 2018 GHG inventories indicate that the community and the City are currently exceeding their short-term targets, reducing emissions by 14 per cent and 36 per cent, respectively, since 2012. Annual GHG inventories will be used to monitor community and corporate emissions and track progress towards short and long-term targets.

Proposed Community GHG Reduction Targets

All three of Ottawa's current GHG emissions reduction targets were set prior to the Paris Agreement coming into force or the subsequent release of the IPCC's Special Report on Global Warming of 1.5°C. The long-term target to reduce community emissions by 80 per cent by 2050 is roughly equivalent to limiting global average temperature increase to 2°C per the Paris Agreement. A new long-term a commitment to reduce community emissions 100 per cent by

2050 would be required to align with the IPCC target to limit global average temperature increase to 1.5°C. New short and mid term targets would also be required.

Figure 9 identifies short and mid-term targets to meet the 80 per cent by 2050 target and are based on the integrated modelling scenario work developed through Energy Evolution (refer to Priority Action #1 "Implement Energy Evolution: Ottawa's Community Energy Transition Strategy" under Section 6 to learn more).

Figure 10 identifies short and mid-term targets to achieve 100 per cent reductions by 2050 target and are based off the global carbon budget for the IPCC's 1.5°C global warming scenario (i.e. the total amount of emissions that we have left to spend on the planet before global temperatures increase by 1.5°C).

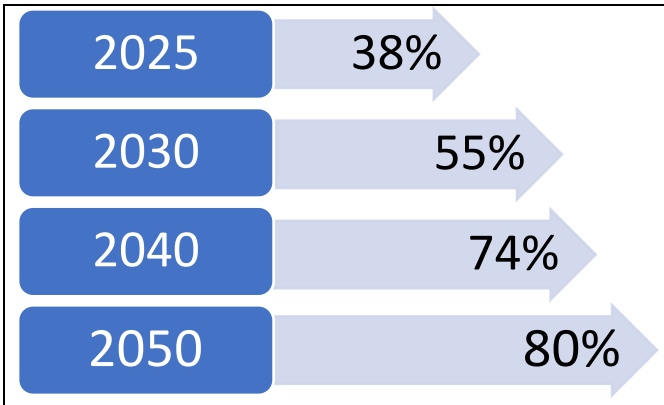

Figure 9: Short, mid and long-term community targets to reach 80 per cent by 2050 targets

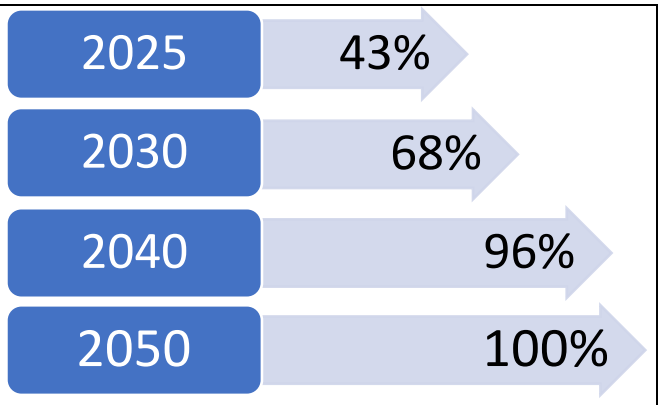

Figure 10: Short, mid and long-term community targets to reach 100 per cent by 2050 target

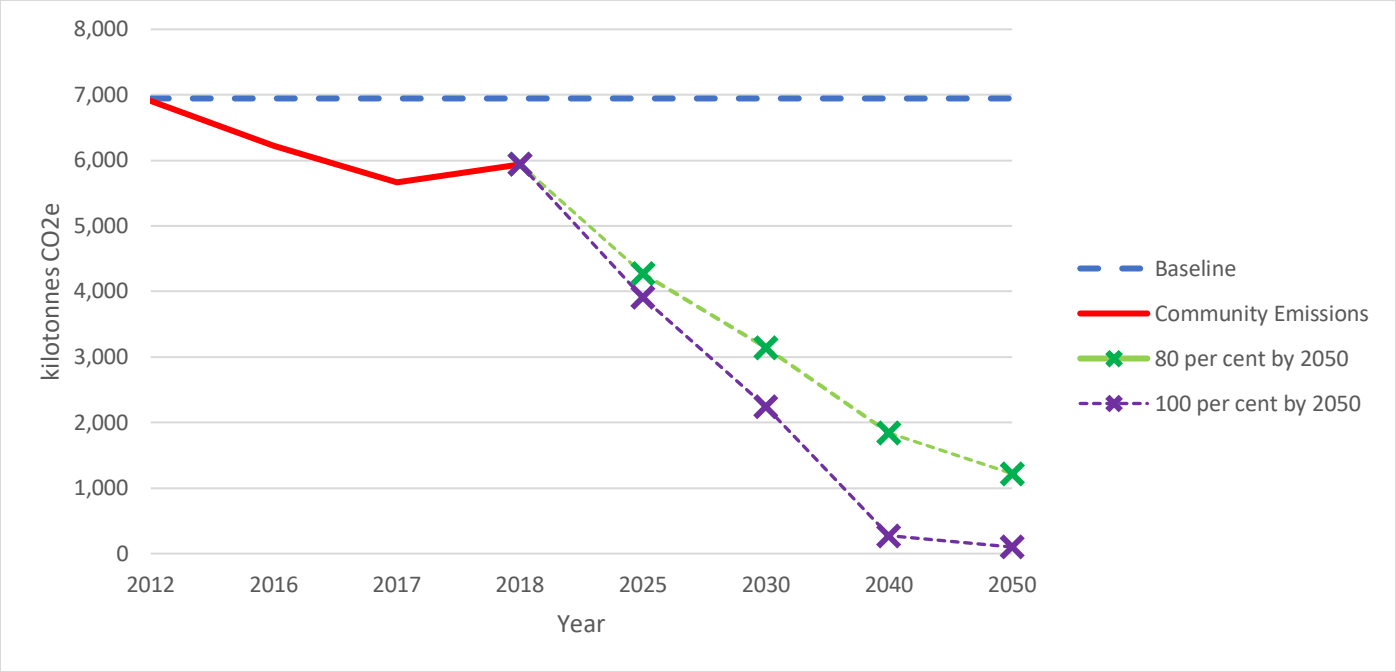

Figure 11: Progress towards achieving community GHG emission reduction targets

Proposed Corporate GHG Reduction Targets

While corporate emissions from City operations were a small percentage of overall GHG emissions in Ottawa in 2018 (5%), leading by example is critical to set the pace, spur innovation, and catalyze community action. In order to help limit global warming to 1.5°C, the corporation could strive to reduce corporate emissions by 100 per cent by 2040, 10 years earlier than the community. Figure 12 identifies short and mid term targets for the City to meet the 100 per cent by 2040 target. The good news is under this scenario, the City has already achieved the short-term target and can focus on meeting the 2030 target. However, the City needs to consider anticipated emissions increases in certain sectors. For example, starting in 2021 it is expected that the City will observe an increase in Trail Road Waste Facility emissions as a result of Provincial regulatory requirements. The City is required by the Province to recirculate leachate in order to reduce the contaminating lifespan of the landfill in the future, which will accelerate GHG emissions. These considerations must be taken into account when tracking progress towards meeting the corporate targets. For further details on the GHG inventories, refer to Annex A.

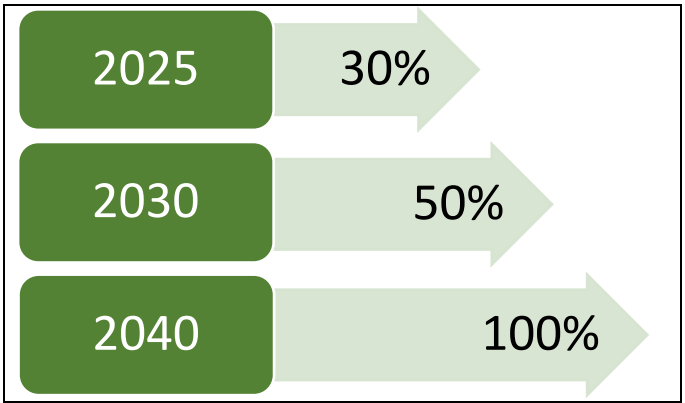

Figure 12: Short, mid and long-term corporate targets to reach 100 per cent by 2040 target

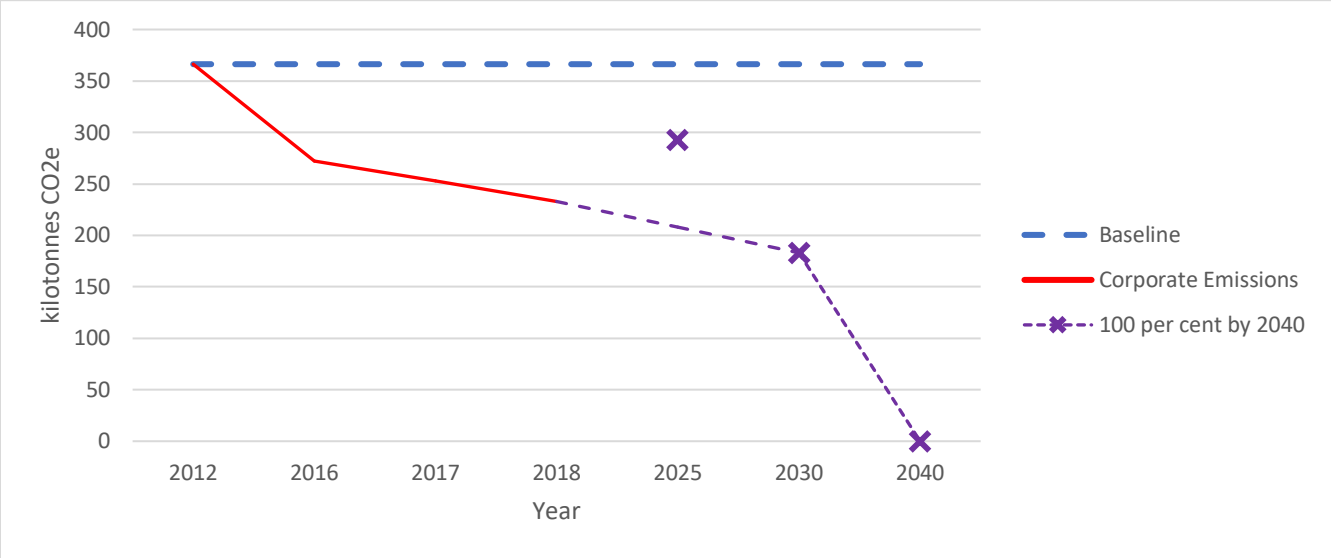

Figure 13: Progress towards achieving corporate GHG reduction targets

Corporate Actions

In the last five years, the City has invested in a number of initiatives to mitigate climate change. By far the biggest investment is the light rail transit (LRT) system. It is also the single biggest action to reduce emissions within the City's fleet in its history. Key corporate actions to reduce emissions are highlighted below. For a full list, refer to Annex B.

a) Investments in Light Rail Transit (LRT) and Electric Buses

The City and senior levels of government have invested billions of dollars into the creation of a LRT system in Ottawa. The first phase of LRT was completed in 2019, replacing a 12.5 km stretch of bus rapid transit and introducing 34 low-carbon electric powered trains. The second phase of LRT is scheduled to be completed in 2025 and will introduce 44 km of new rail to the LRT system. The benefits of an LRT system in Ottawa will be a significant reduction in corporate fleet emissions, improvements to air quality, and a quicker way to get around the city. In addition

to LRT, the City is investing $6 million into electric buses and charging infrastructure, targeting having the first electric buses running as early as 2021.

b) Landfill Gas Improvements at City's Trail Road Waste Facility

In 2018, the Trail Road Waste Facility constructed a Landfill Gas Perimeter Collection System and installed temporary collection wells in active waste cells to capture landfill gas generated as waste degrades. This was done in order to meet regulatory requirements to manage off-site odours and migration through the ground and resulted in the co-benefit of significant emission reductions at the landfill. The Trail Road Waste Facility is continually trying to evolve operating gas conditions at the landfill to meet compliance obligations with the Ministry of Environment, Conservation, and Parks.

c) Energy Conservation and Demand Management

Since 2015, the City has made great strides in the implementation of capital projects to reduce energy consumption and the environmental impact of City facilities. 62% of streetlights (35,700 of 58,000) have been converted to LED lights, producing an energy savings of 64%. Heating and ventilation improvements have been completed at the City's Water Purification Plants resulting in a combined estimated annual electricity savings of almost 35,000 kWh. $50,000 was invested into 25 splash pads with the highest water consumption levels, resulting in a 22% reduction in water use and annual savings of $147,000. The development of a Building Automation System (BAS) Integration platform has allowed for a greater degree of control of energy use and avoided unnecessary energy use and utility costs. Conservation initiatives created an estimated cumulative annual utility savings of approximately 5.9 million kWh of electricity, 297,909 m^3 of natural gas and 48,662 m^3 of water.

5. Adaptation and Resiliency

Climate change adaptation and resiliency refers to actions to reduce the harmful impacts of climate change today and become more resilient for the future. This includes preparing for incremental changes in temperature and precipitation, which can lead to a change in the likelihood of events such as heat waves, floods, storms, drought, and wildfires and.

Climate projections

Ottawa is experiencing warmer, wetter, and more unpredictable weather. On average, summers are getting hotter and winters less cold. While total annual precipitation has increased on average, precipitation varies greatly both in terms of where and when it falls.

Recently released data from the Climate Atlas of Canada predicts that Ottawa will continue to get much warmer, with significant increases in extreme heat events, more frost-free days, and wetter springs and winters (Figure 14). A warmer climate can lead to more variable and unpredictable precipitation (droughts or heavy rains) and other extreme weather such as ice storms, droughts or high winds.

Change	1976-2005 Mean	2051-2080 Low	2051-2080 Mean	2051-2080 High
Typical hottest summer day	33.7 °C	35.6 °C	38.6 °C	42.4 °C
Typical coldest winter day	-29.5 °C	-26.1 °C	-21.0 °C	-15.6 °C
Number of +30 °C days per year	14	33	57	81
Number of +20 °C nights per year	5	18	35	55
Number of below-zero days per year	152	89	111	131
Annual precipitation	886 mm	811 mm	978 mm	1166 mm
Frost-free season (days)	160	173	203	235

Figure 14: Future climate projections for Ottawa – high carbon scenario (Source: Climate Atlas of Canada, March 2019)

To better understand how the city's climate could change, the City, in partnership with the National Capital Commission, is working with climate scientists to develop more detailed climate projections for the National Capital Region. This work will forecast changes in temperature, precipitation, wind, and extreme weather events (where feasible) to 2100. The report is

expected to be available in early 2020. This work will inform a Vulnerability Assessment and a Climate Resiliency strategy (refer to Priority Action #2 “Undertake a climate vulnerability assessment and develop of Climate Resiliency Strategy” under Section 6 to learn more).

The impacts of a changing climate

Climate change impacts our health and safety, our infrastructure, our economy and our environment. The impacts of climate change to our health will be increasingly felt through extreme heat and cold events, increased risk of vector-borne diseases, reduced air quality from forest fires, and disruption and displacement from floods. And while climate change will impact everyone, our individual abilities to deal with those impacts will vary and disproportionately affect our more vulnerable populations. In terms of infrastructure, our roads, buildings, pipes and other built structures were not necessarily designed to withstand projected future climate conditions such as high temperatures, high winds and freeze-thaw cycles. Climate change will also affect our economy and natural environment. Agricultural practices, for example, will need to change in response to more unpredictable water availability (droughts or heavy rains), shifting seasons and new challenges such as pests and invasive species.

Corporate actions

In the last five years, the City has invested in a number of initiatives to adapt to the impacts of climate change and become a more resilient city. Key corporate actions to adapt to climate change are highlighted below. For a complete list, refer to Annex B.

a) Public Health and Emergency Preparedness

The City and many service providers continue to support vulnerable populations and reduce illness and deaths associated with extreme heat and cold, as well as helping people recover from other extreme climate events. Ongoing education and outreach increases awareness of climate change risks (including emerging health concerns such as West Nile Virus and Lyme Disease) and advises on actions they can take to protect themselves and be personally prepared.

b) Flood Risk Management

The City is updating floodplain mapping and community flood risk profiles to better understand and reduce potential risks from both riverine and urban (basement or overland) flooding. This work enhances the City’s ability to prepare for and respond to flooding. It guides future development and informs flood mitigation efforts such as improved planning and design of infrastructure.

c) Combined Sewage Storage Tunnel (CSST)

A signature project of the Ottawa River Action Plan, the CSST will reduce the frequency of combined sewage overflows to the Ottawa River, add redundancy to downtown sewer system, and reduce risk of basement flooding in Glebe and Centretown. The CSST was designed to accommodate a greater storage volume to prepare for higher rainfall intensity anticipated as a result of climate change. It will reduce the volume of combined sewage overflow to the Ottawa River by up to 43,000 m^3 (18 Olympic-sized swimming pools), reduce frequency of overflow

events from approximately 28 to two, and reduce the risk of basement flooding for 7,000 residential and 150 non-residential properties.

d) Urban Forest Management Plan:

Putting Down Roots for the Future is a 20-year strategic Urban Forest Management Plan (UFMP) for the City of Ottawa. This plan was approved by Ottawa City Council in June 2017 and has 26 recommendations for growing Ottawa's urban forest and making it healthier, more diverse, and resilient. The UFMP is intended to provide the strategic and technical guidance required to achieve urban forest sustainability in Ottawa over the coming decades. This is a crucial companion piece to other climate change efforts since it recognizes the carbon sequestration value and broader ecosystem services of Ottawa's urban forest.

e) Building Resilience of Residents

The City provides a series of grants to residents to help them prepare for the impacts of a changing climate, including backwater valves and back-up power for sump pumps to reduce the risks of flooding. Agricultural grants are also available to support farmers to adapt to drought conditions and build economic resiliency to climate change.

6. Priorities for the next five years (2020-2025)

As identified by the IPCC, significant action and investment is required in the next 10 years to achieve the GHG emission targets and to build resilience in Ottawa. The next five years are critical to putting Ottawa on the path to meet GHG emission targets and prepare for future climate conditions. The Climate Change Master Plan identifies eight priority actions for the next five years (2020-2025) that can be embedded in City business. They are:

1. Implement Energy Evolution: Ottawa's Community Energy Transition Strategy
2. Undertake a climate vulnerability assessment and develop a Climate Resiliency Strategy
3. Apply a climate lens to the new Official Plan and supporting documents
4. Apply a climate lens to asset management and capital projects
5. Explore the feasibility of setting corporate carbon budgets, including piloting them within a small portion of the organization
6. Explore options for carbon sequestration methods and the role of green infrastructure
7. Encourage private action through education, direct and indirect incentives, municipal support, and advocacy for support of individuals and private organizations by senior levels of government.
8. Develop a governance framework to build corporate and community capacity, align priorities, and share accountability in tackling climate change.

The first three priorities are already underway and have started either because of Council direction or government legislation. The last five priorities have been identified as critical areas to be explored and developed in the short-term in order to achieve the long-term vision. Descriptions of each priority including the details of the action, key outcomes, corporate and community partners, timelines, and resource requirements are outlined below. Existing and new budget requirements have been identified; securing this funding will be critical to their success.

Priority #1	**Implement Energy Evolution: Ottawa's Community Energy Transition Strategy**
Description:	Energy Evolution is the primary framework and action plan for how Ottawa will mitigate GHG emissions and meet our GHG emission reduction targets. It is a community-wide initiative with a vision to transform Ottawa into a thriving city powered by clean, renewable energy. The final report for Energy Evolution includes: • A Business As Planned (BAP) scenario that demonstrates the impact on our emissions if we do not alter our policies and actions. • Integrated models that demonstrate how cumulative policies and actions can achieve our GHG emission reduction targets of 80 per cent by 2050 or 100 per cent by 2050. • Assessment of co-benefits and co-harms associated with actions to reduce GHG emissions. • Corporate and Community Carbon Budget • Actions to reduce GHGs and/or generate clean, renewable energy in new buildings, existing buildings, transportation, waste and biogas, and electricity, and generate clean, renewable energy • Funding requirements Energy Evolution will use annual GHG inventories to assess how we are tracking towards corporate and community GHG reduction targets.
Measures of Success:	• Sustained community and corporate leadership, action and investment to transition off fossil fuels to renewable energy sources in line with GHG emission targets • Annual community GHG emission reductions commensurate with those required to meet our GHG emission reduction targets • A significant, consistent level of investment to fund the long-term action plan, as well as policies and regulations demonstrably showing realization of targets
Responsible Department(s):	• Led by the Planning, Infrastructure, and Economic Development Department • Supported by Public Works and Environmental Services; Recreation, Cultural, and Facility Services; Transportation Services, Community and Social Services; and Innovative Client Services Departments

Key Community Partners:	• Federal and provincial governments • Development industry • Institutions and academia • Non-profit sector • Utilities • Private sector • Residents
Estimated Project Milestones:	• Q2 2020: Completion of the final report for Energy Evolution, including priority projects for the next five years (2020 – 2025) based on the models which integrates the cumulative effects from a suite of proposed actions • 2020 and beyond: Implement action plan (details in the Energy Evolution Final Report)
Resources:	• Existing funding from departments leading GHG reduction initiatives (ex. $6M for new e-buses) • New budget pressures will be identified as part of the annual municipal budget process • Funding from other levels of government and agencies such as the Federation of Canadian Municipalities. • Hydro Ottawa Dividend Surplus are to be allocated annually to energy efficiency projects for the 2018-2022 term of Council. • Funding from other sources will be explored as opportunities arise, as well as reinvestment of savings achieved into new opportunities. • Two temporary staff have been hired for 2019/2020.

Priority #2	**Undertake a climate vulnerability assessment and develop a Climate Resiliency Strategy**
Description:	Through the climate emergency declaration, Council directed staff to complete a vulnerability assessment and develop a climate resiliency strategy to reduce the impacts of a changing climate. Ottawa is predicted to become much warmer over the coming decades with more variable precipitation and more unpredictable events.[xvi] To better understand how the city's climate will change, the City of Ottawa, in partnership with the National Capital Commission, is working with climate scientists to develop more detailed climate projections for the National Capital Region. This work will provide an analysis of future climate conditions to 2100 for temperature, precipitation, wind, and extreme weather events (as feasible). A climate vulnerability assessment will use the climate projections to identify climate risks from a range of climate hazards (such as heat waves, flooding and other storms). It will examine impacts on health and safety, infrastructure, the economy and the environment. It will identify where the city is vulnerable, who will be affected and how, and what the anticipated impacts will be. The climate vulnerability assessment will guide the development of a climate resiliency strategy. The aim of a long-term climate resiliency strategy is to mitigate climate risks and impacts, and to build the capacity of social, economic, and environmental systems to adapt and thrive under evolving climate conditions. The strategy will be developed in close coordination with internal and external stakeholders to align and integrate with programs such as hazard mitigation, health vulnerability plan and comprehensive asset management. A supporting action plan will identify priority actions and funding requirements including ways to integrate climate resiliency in existing City procedures.
Measures of Success:	• Clear understanding of how Ottawa's weather will change in the coming decades and consistent climate information for use across departments • Clear understanding of vulnerabilities and risks • Priority projects and initiatives identified for City and external funding opportunities

Responsible Department(s):	• Led by the Planning, Infrastructure, and Economic Development Department • Supported by Emergency and Protective Services, Ottawa Public Health, Public Works and Environmental Services, Community and Social Services, Recreation, Cultural and Facility Services, and Transportation Services Departments
Key Community Partners:	• National Capital Commission • Ville de Gatineau • Environment and Climate Change Canada • Public Services and Procurement Canada • Ministry of Environment, Conservation and Parks • Conservation Authorities • Hydro Ottawa and other regional partners
Estimated Project Milestones:	• Early 2020: Complete climate projections • End of 2020: Complete a vulnerability assessment • 2020-2021: Develop a Climate Resiliency Strategy and supporting action plan
Resources:	• Existing budget of $260,000 accounted for to complete the climate projections and undertake a climate vulnerability assessment and Climate Resiliency Strategy • Future budget considerations for the action plan starting in 2021

Priority #3:	**Apply a climate lens to the new Official Plan and supporting documents**
Description:	The Official Plan provides a vision for the future growth of the city and a policy framework to guide the city's physical development, with an aim for Ottawa to grow to be the most liveable mid-sized city in North America. It will be coordinated with the reviews of the Transportation Master Plan, the Infrastructure Master Plan, the Parks and Greenspace Master Plan, and the Development Charges By-Law. Incorporating climate change policies into the Official Plan is critical to achieving overall climate change objectives since decisions made today will have lasting impacts for the future. Embedding climate and energy resiliency is one of the five Big Moves identified in the Official Plan. Policy directions that lead to a reduction in greenhouse gas emissions and a more resilient future are therefore critical if the City is to achieve climate change goals and targets. Energy systems are an integral part of nearly every aspect of residents' daily lives. This includes everything from heating and cooling peoples' homes, to fuelling vehicle and transit systems, to waste and landfills. How we plan our city will shape Ottawa over the next century. Official Plan policies must work towards a transition from fossil fuels to renewable energy sources and reducing emissions in the city's building, transportation, and waste sectors. Ottawa must also adapt and become resilient to the impacts of climate change. Building climate resiliency means taking forward-looking decisions that make Ottawa's communities, infrastructure and environment less vulnerable to future climate conditions and more capable of recovering from extreme events. The Official Plan must strengthen policy directions that mitigate extreme heat, protect people and property from flooding, and build resilience in our communities, infrastructure and natural environment.
Measures of Success:	• Integration of climate and energy priorities into the Official Plan, Transportation, Infrastructure and Parks and Greenspace master plans, and other supporting policy documents and plans • Strengthened policies that reduce the impacts from heat, flooding and extreme events • Reduced corporate and community carbon emissions across a range of sectors (i.e. buildings, transportation, waste, etc.) • Clear standards for low carbon and climate resilient buildings (e.g. High Performance Development Standards) • Other tools to implement these policies (for example via supporting Master Plans, development review procedures, standards and guidelines, and incentives)
Responsible Department(s):	• Official Plan and Infrastructure Master Plan – Led by Planning, Infrastructure, and Economic Development and Ottawa Public Health • Transportation Master Plan – Led by Transportation Services

Key Community Partners:	• Development industry • Utilities • Housing authorities • Conservation authorities • Federal and Provincial government • Private sector • Non-Government Organizations
Estimated Project Milestones:	• December 2019: New Official Plan Preliminary Policy Directions • October 2020 – May 2021: Draft Official Plan tabled and consultations • June 2021 – September 2021: Joint Planning & Agriculture and Rural Affairs Committees and Council adoption of Official Plan • September 2021 – January 2022: Circulation to Ministry of Municipal Affairs and Housing and adoption of Official Plan
Resources:	• No additional resources required.

Priority #4	**Apply a climate lens to asset management and capital projects**
Description:	Development and application of a climate lens to embed climate change considerations into the management of existing assets, the design of new capital projects and current City asset management policies and practices. The Comprehensive Asset Management (CAM) program guides the management of the City's $42 billion worth of assets including buildings, roads and pathways, fleet, water and wastewater infrastructure, and parks and greenspace. Recent provincial regulations (O. Reg 588/17) require municipalities to commit to considering climate change – both greenhouse gas mitigation and adaptation - in asset management planning. The project will also better position the City to respond to external funding opportunities and meet eligibility requirements for infrastructure funding (e.g. federal Climate Lens). A safe, liveable city needs well-functioning infrastructure that supports community services for decades. Applying a climate lens lets us address key questions: How vulnerable are the City's existing assets to a changing climate? How can we ensure that current and future infrastructure performs in projected climate conditions? From a mitigation perspective, a key question that we can address is: How can we retrofit our existing infrastructure and design future capital projects to meet our greenhouse gas emission targets? Risk management and asset resiliency are core principles of asset management. Further integrating climate considerations into CAM will enable climate change to be considered alongside additional challenges such as aging infrastructure, growth and limited resources. Parallel Climate Change Master Plan projects in Energy Evolution and Climate Resiliency will provide key inputs in terms of actions to meet our greenhouse gas targets and key vulnerabilities to projected climate conditions.
Measures of Success:	• Comprehensive Asset Management Policy reflects commitment to consider climate change in its asset management systems and processes • Asset Management Plans in 2021 for core infrastructure and in 2023 for other infrastructure • Staff with capacity to assess GHG emissions and climate impacts and develop mitigation and adaptation strategies
Responsible Department(s):	• Led by Planning, Infrastructure and Economic Development Department

Key Community Partners:	• Ministry of Infrastructure
Estimated Project Milestones:	• 2021: Update Comprehensive Asset Management Policy • 2021: Asset Management Plans for core infrastructure services • 2021/2022: Identify practical ways to integrate climate resilience into the suite of asset management tools • 2022/2023: Identify practical ways to integrate GHG emissions reductions into the suite of asset management tools • 2023: Integrate climate change considerations in Asset Management Plans for other infrastructure services.
Resources:	• Infrastructure Services will lead the development of the Service Based Asset Management Plans and will commit to consider climate change as part of their overall development • Priority projects will continue to be identified through Energy Evolution • The climate projections, vulnerability assessment and climate resiliency strategy will be used to inform detailed risk assessments and identification of gaps • A dedicated Standing Offer list for expertise in climate change mitigation and adaptation for major service areas to be developed

Priority #5	**Explore the feasibility of setting corporate carbon budgets, including piloting them in a small portion of the organization**
Description:	In order to prevent dangerous levels of global warming, scientists have determined that there is a finite amount of carbon dioxide that can be emitted into the atmosphere. This is considered to be the global carbon budget. The latest science data indicates that in order to limit global warming to 1.5ºC, the world has a strict global carbon budget of 420 gigatonnes of carbon dioxide equivalent (CO_2e). Around the world, more and more cities are adopting or exploring the implementation of a carbon budget to support projects that reduce GHG emissions and can be applied to both city-wide and corporate emissions. Oslo was one of the first cities to adopt a carbon budget in 2016. In Canada, cities such as Vancouver and Edmonton are exploring what a carbon budget could look like for them. Developing a carbon budget for Ottawa would involve establishing a local emissions budget and making decisions about how we "spend" our corporate GHG budget within that context. For a carbon budget in Ottawa to be successful, an implementation and monitoring framework would be required. Corporately, a carbon budget could be embedded within the financial budgetary framework, as has been done in Oslo.
Measures of Success:	• Development of a carbon budget implementation and monitoring framework. • The carbon budget and the annual financial budget process work in tandem to determine which projects will be funded.
Responsible Department(s):	• Led by the Planning, Infrastructure and Economic Development Department • Supported by Ottawa Public Health; Public Works and Environmental Services; Transportation Services; Recreation, Cultural and Facility Services; Innovative Client Services and Community and Social Services Departments.
Key Community Partners:	• To be determined
Estimated Project Milestones:	• 2020: Quantify community and corporate carbon budgets • 2020: Develop community and corporate carbon budget project charter, governance structure and implementation frameworks

	• 2020: Pilot a corporate carbon budget with Planning, Infrastructure and Economic Development Department and Ottawa Public Health
Resources:	• Existing resources under Energy Evolution are being used to develop the community and corporate carbon budgets • Future staffing needs for implementing a carbon budget should be considered in departmental work plans starting in 2020/2021 • If a carbon budget is established, future budgets could be impacted

Priority #6	**Explore options for carbon sequestration methods and the role of green infrastructure**
Description:	Carbon sequestration is the process through which forestry, agricultural, and wetlands practices capture carbon dioxide caused by activities such as burning fossil fuels and stores it away over the long-term. It does not replace the need for unprecedented action to mitigate climate change and transition off fossil fuels; rather, it complements it. The value of carbon sequestration was identified in both the City's Urban Forest Management Plan and the Significant Woodlands Policy. Additionally, understanding and quantifying the climate benefits of trees, forests and wetlands will support the justification for the active management of the City's forests and wetlands. To help better understand the potential for carbon sequestration in Ottawa, a number of initiatives should be undertaken within the next couple of years. These include: • Inventorying forests as carbon sinks • Monitoring and evaluating changes in carbon in agricultural soils • Mapping wetlands as functioning carbon sinks • Exploring carbon market options
Measures of Success:	• Completion of a natural features carbon inventory that includes inventorying carbon in forests, wetlands, and agricultural soils. • Increased carbon sequestration to complement GHG reduction targets
Responsible Department(s):	• Forests – Led by Planning, Infrastructure, and Economic Development; supported by Public Works and Environmental Services Department • Wetlands and agricultural soils – Led by Planning, Infrastructure, and Economic Development
Key Community Partners:	• National Capital Commission • Agriculture Canada • Ontario Ministry of Agriculture, Food, and Rural Affairs • Ministry of Natural Resources and Forestry • Local Conservation Authorities • Carleton University / University of Ottawa
Estimated Project Milestones:	• 2020: Develop Terms of Reference for Natural Features Inventories • 2020-2022: Undertake and Complete the Natural Features Inventories • 2020: Undertake Carbon Market Options Analysis

Resources:	• To be determined.

Priority #7	**Encourage private action through education, direct and indirect incentives, municipal support, and advocacy for support of individuals and private organizations by senior levels of government**
Description:	To achieve substantial GHG reductions, significant action and investment is required across the corporation and the community. Approximately 95% of community wide emissions are under the direct control of other community players including the federal and provincial governments, utilities, large energy consumers and employers, small businesses, non-profit organizations, and residents. Private action will range from individual choices (e.g. shifting from personal vehicles to transit or active transportation) to investment (e.g. high-performance new buildings, retrofits, electric vehicles and renewable energy generation). Support from senior levels of government and the private sector will be required to approach the level of effort and investment required. Similarly, building resilience to future climate conditions requires actions by individuals, businesses, organizations and governments. Private action can range from investments in property (e.g flood protection or shade), adequate insurance, new business opportunities (e.g. alternative energy or adapted agriculture) and strengthened social networks (e.g. collective response during extreme events). To mobilize action across all sectors, the City of Ottawa can play a leadership and coordinating role in: • Climate education: helping people understand the causes and implications of climate change, the actions we can take now to both reduce emissions and build resilience against a changing climate, and the benefits in doing so • Leveraging other resources where feasible • Communicating what resources are available • Recommending, advocating for and promoting incentives to catalyze action (ex. Community Energy Innovation Fund, home protection grants, etc.) • Assessing municipal tools to support action (ex. High Performance Building Standards, Local Improvement Charges, Community Improvement Plans, etc.) • Setting policies and procedures that facilitate a shift to low carbon and resilient future (e.g. through the Official Plan)
Measures of Success:	All measures will be dependent on the focus of private action. Examples are provided below. • Overall decrease in community wide GHG emissions tracked through annual GHG inventories

	• Increased uptake in GHG reduction and climate resiliency programs (e.g. increased transit and/or active transportation programs, EV purchase programs, EV charging infrastructure programs, deep energy programs, home protection programs, etc.) • Number of top energy consumers and employers reached through communication strategy • Number of people reached through education • Number of people or groups incentivized to take action • Number of people/groups receiving municipal support
Responsible Department(s):	• Led by the Planning, Infrastructure, and Economic Development Department • Support to be determined
Key Community Partners:	• Federal and provincial governments • Utilities • Large energy consumers and employers • Small businesses • Non profit organizations • Residents

Estimated Project Milestones:	Details on private action will be brought forward as part of the annual Climate Change Master Plan update. Aspects that will be included are:
	• Communication and Outreach
	  ○ 2020: Identify communications and outreach opportunities, gaps, and needs and develop core materials
	  ○ 2020: Launch an education and outreach strategy
	  ○ 2020/2021: Work with partners to implement the communications and outreach strategy
	• Incentives:
	  ○ 2020: Identify and assess incentives to catalyze action across key GHG reduction and community resilience areas
	  ○ 2020 and beyond: Continue to work with municipalities across the country to advocate for support from senior levels of government
	• Municipal support:
	  ○ 2020: Identify and assess municipal tools to catalyze action across key GHG reduction and community resilience areas
	•

Resources:	• New temporary staff and consulting services will be funded through the Hydro Ottawa Dividend Surplus • Additional budget requests will be identified for the 2021 budget, if required.

Priority #8	**Develop a governance framework to build corporate and community capacity to tackle climate change**
Description:	Transitioning to a clean, renewable and resilient city will require broad and deep participation in mitigation and adaptation efforts. Through Energy Evolution, the City has identified a comprehensive and ambitious strategy to reduce GHG emissions. Following the development of local climate projections, the City will undertake a vulnerability assessment and develop a climate resiliency strategy to help adapt to the current and future changes of our climate. Major stakeholders in the National Capital Region including the Federal Government, the National Capital Commission, City of Gatineau, Hydro Ottawa, and institutions such as universities also have strategies underway to address climate change. However, there is currently no forum in which large or leading organizations can come together to coordinate efforts, align priorities, and mobilize the broader community. This priority will explore governance approaches to support and encourage collaboration over the course of what will be a profound transition.
Measures of Success:	• A diverse, influential and impactful governance structure is established based on common vision, goals, and priorities • Coordinated implementation of climate mitigation and adaptation actions • Scaling up of community wide projects, programs, or policies resulting in observable increase in action to reduce GHG emissions (ex. community wide EV charging network, retrofit program, etc.) or to increase resiliency • Organizations and residents that would not otherwise be influenced are mobilized and motivated to take action • Governance structure is appropriately resourced and staffed to support a community wide transition and maintain relevance
Responsible Department(s):	• Led by the Planning, Infrastructure, and Economic Development Department • Supported by Innovative Client Services Department

Key Community Partners:	• Large, leading, influential and/or impactful organizations including
	  ○ Low Carbon Cities Canada (LC3)
	  ○ Federal government and crown corporations
	  ○ Utilities
	  ○ Large energy consumers and employers
	  ○ Non profit and community organizations

Estimated Project Milestones:	• 2020: Staff evaluate different governance approaches • 2020: Identify large, leading, influential and impactful organizations interested in climate change governance discussions • 2020: Present options to interested participants • 2020: Establish a diverse, influential and impactful governance structure based on common vision, goals, and priorities • 2020-2025: Implement priorities
Resources:	• Existing resources will be allocated to evaluate governance options in 2020 • Funding options will be explored with potential partners in 2020 • Budget requests will be identified in the 2021 budget, if required

7. Reporting

Over the next five years, the City will work with elected officials, municipal departments and community partners to move forward with the priority actions outlined in the Climate Change Master Plan. Staff will bring reports to relevant Committees on the five-year priority projects, as required.

In addition to individual project reports, staff will provide an annual status update on the climate change framework that includes:

- Annual GHG community and corporate inventories
- An assessment of how Ottawa is tracking towards community and corporate targets
- An update on the Climate Change Master Plan priorities
- Recommendations, as required, to advance the Climate Change Master Plan priorities
- New budget pressures, if required

A full review and update of the Climate Change Master Plan, including the guiding principles, goals, GHG emission reduction targets, and priority actions will be completed in five years (2025). Simultaneously, Energy Evolution and the Climate Resiliency Strategy will be reviewed to see if the three documents can be merged into one standalone document.

The website will be updated to link relevant documents as they are approved. Where possible, data (including the results of the GHG inventories) will be made available through the City's Open Data Catalogue to ensure transparency of information and to assist the public in undertaking their own climate change actions and emission tracking.

8. Conclusion

We can celebrate that city-wide GHG emissions have declined 14 per cent below 2012 levels, but incremental changes to reduce emissions within buildings, transportation, waste, and agricultural sectors will not position Ottawa to meet short, mid or long-term GHG reduction targets.

It will require collaboration from the broader community to effect change and develop joint solutions. It will require municipal leadership to ensure an integrated and comprehensive approach across the corporation and the community. And it will require unprecedented action, investment, and change from all levels of government areas to make it happen.

The Climate Change Master Plan sets the framework for success. Building on the latest climate science and practice, it outlines the priorities for the next five years needed to support the municipality, residents and businesses in taking action to meet our emission targets and prepare for future climate conditions.

Let's work together to make Ottawa a clean, renewable and resilient city by 2050.

Annexes

Annex A – Results of 2017 and 2018 Community and Corporate GHG Inventories

Annex B – List of Corporate Actions

Endnotes

[i] IPCC Press Release. Summary for Policymakers of IPCC Special Report on Global Warming of 1.5ºC approved by governments. October 8, 2018. https://www.ipcc.ch/site/assets/uploads/2018/11/pr_181008_P48_spm_en.pdf
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[xv] Federation of Canadian Municipalities. Climate and Sustainability. https://fcm.ca/en/focus-areas/climate-and-sustainability
[xvi] Climate Atlas of Canada. July 10, 2019. https://climateatlas.ca/report_v2/grid/299