Project status update on Energy Evolution: Ottawa's Community Energy Transition Strategy

1. Overview

Energy Evolution is the primary framework and action plan for how Ottawa will mitigate GHG emissions and meet its Council-approved GHG emission reduction targets. It is a multi-phased, community-wide initiative with a vision to transform Ottawa into a thriving city powered by clean, renewable energy through energy conservation and efficiency and local or regional renewable energy.

This status update provides an overview of work done since Council received Energy Evolution Phase 1 in December 2017. It describes Phase 1 and 2, the draft energy and emissions model, proposed list of 20 projects, and next steps to complete Energy Evolution. The final report will be brought forward in Q2 2020 and will include the final energy and emissions model, financial and affordability analysis of the model, descriptions of the proposed projects listed in this report and a proposed spending plan for the 2019 Hydro Ottawa Dividend Surplus.

This document is to be read in conjunction with the report to Standing Committee on Environmental Protection, Water and Waste Management titled "Climate Change Master Plan and the Energy Evolution model" and its supporting documents dated December 2019.

2. Phases 1 and 2

In December 2017, Council received Energy Evolution Phase 1 and directed staff to initiate the recommendations in the report and complete Phase 2 of the Energy Evolution Strategy (ACS2017-PIE-EDP-0048). Phase 1 included renewable energy pathway studies[1] and about 30 short term actions to be completed by 2020.

Phase 2 included analysis of additional energy conservation and efficiency pathway studies. The technical pathway studies examined how various technologies can help achieve long-term GHG targets in Ottawa. The 14 pathways focused on renewable energy, buildings (new and existing), transportation, waste and wastewater, and energy

[1] Pathway studies are focused technical notes describing how a specific energy technology may develop overtime in Ottawa and were used to inform the baseline and the emission scenarios in the model.

storage and demand management[2]. Each pathway was developed by technical experts and considered opportunities and constraints (economic, regulatory, etc.) that could influence uptake.

The results of all pathway studies completed in Phases 1 and 2 were integrated into an energy and emissions model in 2019 (refer to Section 3: Energy and Emissions Model for more information).

To support community action in Phases 1 and 2, the City invested $800K over two years in community-led projects that directly supported the vision of Energy Evolution through the Energy Evolution Catalyst Project program and the Community Energy Innovation Fund. The City also invested $633,000 in Hydro Ottawa Dividend Surplus funds to support Energy Evolution.

Refer to Document 6 for an update on Phase 1 projects, Document 7 for details on the Phase 2 Pathways Studies, Document 8 for the Catalyst Project Program Summary Report, and Document 9 for an update on 2017 Community Energy Innovation Fund projects. More detail on Phases 1 and 2 can be found on the City's website at https://ottawa.ca/en/living-ottawa/environment/climate-change-and-energy/energy-evolution

3. Energy and Emissions Model

City energy systems are highly complex, requiring a sophisticated model to track all the variables and their relationships. Energy Evolution modelling work describes what it would take for Ottawa to reduce emissions by 80% or 100% by 2050 in five key sectors: Land Use and Growth Management, Buildings (New and Existing), Transportation, Waste and Renewable Natural Gas, and Electricity.

How the model was developed

The model was developed using CityInSight, an integrated energy, emissions, and finance modelling tool created by Sustainability Solutions Group (SSG) and whatIf? Technologies (whatIf?). It applies the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GPC) framework, which is an internationally recognized standard. This is the same standard used to complete Ottawa's annual community and corporate GHG inventories. Many cities across Canada, including Calgary, Edmonton,

[2] Seven pathways on renewable energy were completed as part of Phase 1. Seven additional pathways were completed in Phase 2 that focused on energy conservation and efficiency.

Toronto, Guelph and Halifax, have used CityInSight to guide the development of their energy and emission reduction plans[3].

The model was custom built for Ottawa and includes data for population, dwellings, jobs, buildings, transportation, waste, industry, and land use. The model was informed by the best available data at the time through a data collection process led by the City, SSG, and whatIf?.

A representation of the city's energy and emissions was developed for 2016 (the baseline year[4]) to 2050 (target year). This involved calibration of the model with observed data. As an example of this process, the total modelled electricity consumption from each end-use for each building—including heating, cooling, appliances, and others—was adjusted until the sum of all the electricity consumption from the buildings was equal to the total electricity consumption reported by the electricity utility. This process of calibration was applied to each sector within the model. The 2016 baseline inventory includes GHG emissions from buildings, transportation, energy production, and solid and liquid waste. GHG emissions associated with change in land cover and sequestration are not included.

The pathway studies used to develop and inform the model were developed by technical working groups consisting of staff and technical experts. Between 2016 and 2019, Energy Evolution hosted over 30 meetings with more than 180 key stakeholders representing approximately 90 organizations in Ottawa. Inputs from these stakeholders, as well as consultants engaged to provide background information and technical analysis, has been critical in guiding and informing Phase 1 and 2 pathways, the model, and the proposed list of projects.

Key documents used to inform the development of the model include:

- City of Ottawa Official Plan
- Transportation Master Plan
- 2011 Ottawa travel survey data including TRANS model results
- City of Ottawa Green Building Policy for the Construction of Corporate Buildings
- Building data:

[3] http://www.ssg.coop/work/

[4] Although the baseline year of the GHG emission reduction targets is 2012, 2016 was chosen as the baseline of the model in order to be calibrated to align with the 2016 Canadian Census. An extrapolation has been made in order to draw trendlines between 2012 and 2016.

    - City of Ottawa's Municipal Property Assessment Corporation (MPAC) data (2016)
    - Issued Permit Statistics (January 1, 2017 – December 31, 2017)
- Solid Waste data:
    - Institutional, Commercial, and Industrial (ICI) Waste Characterization Report (2007)
    - Residential Curbside Waste Characterization Study Green Bin Program Rollout (2010)
    - Solid Waste Services Division Multi-Unit Waste Characterization Study Quarterly Reports (2010)
    - Curbside waste recycling tonnage
- Hydro Ottawa Strategic Direction 2016-2020

Model results were shared with the technical working groups and an Interdepartmental Working Group that includes representatives from eight departments, Ottawa Public Health, the City Manager's Office and the Mayor's Office.

Limitations and Assumptions

As with any model, there are limitations and assumptions to this exercise. The modelling process gives careful attention to the useful lifetimes of different capital assets, using the concept of stocks and flows. For example, the model tracks the stock of vehicles by type and by vintage; the flow consists of the retirement of vehicles as they reach the end of their life and new vehicles are added to the stock. This consideration is present in each sector within the model for stocks such as buildings, equipment and infrastructure.

The concept of stocks and flows has significant implications for costs within the model. For example, if a natural gas boiler is replaced at the end of its useful lifetime with a heat pump, the cost associated is significantly lower than if the natural gas boiler is replaced prior to the end of its useful life. Different types of equipment turn over more quickly than others. Equipment such as trains for the transit system and industrial boilers will likely be replaced just once between now and 2050. Buildings are likely to last well beyond 2050. Light fixtures will be replaced three to five times. Implementing the policies and actions of the low carbon scenario as soon as possible is critical to avoiding increased costs associated with early replacement, particularly for longer lasting assets.

Some GHG emissions are not accounted for in the model because limited data was available, or emissions were outside of the scope of international protocol. Sectors not included in the model are: aviation, inter-city rail, small equipment, or agriculture. The model also does not factor in: time of use of electricity, natural gas pipe leakage, embodied carbon in materials of buildings or equipment, or carbon sequestration activities. The model may have further limitations in that some of the actions contemplated may have social and political barriers to implementation because they are controversial, in addition to financial, technological, and time constraints. However, it remains useful as a way to prioritize the City's actions so that they will have the greatest effect on reducing GHG emissions. Details on the scope of the protocol and information used to populate the CityInSight model can be found in Document 11 – Data, Methodologies, and Assumptions Manual.

Scenarios

The CityInSight model incorporates and builds on pathway studies and presents three different future GHG emission scenarios compared to a 2016 model baseline year[5]:

- A Business as Planned scenario (BAP scenario)
- An 80% GHG emissions target scenario (80% scenario)
- A 100% GHG emissions target scenario (100% scenario)

These scenarios were developed to better understand what it would take to achieve the 80% or the 100% GHG emissions reduction target. Each scenario explores possible low carbon futures for Ottawa and how the community could change through a set of given actions. The set of actions under the 80% and 100% scenarios were developed with input from staff and stakeholders. Each action represents one possible way to achieve the targets; other options may be explored.

In the context of Energy Evolution, the scenarios and model can be used as a:

- Forecasting tool to understand the implication of decisions and "future proof" a portfolio of activities and proposed actions
- Prioritization tool to determine when, where and how to allocate finite resources
- Testing tool to explore the impact of options and strengthen an existing strategy, innovation initiative or priority
- Oversight tool to add perspective and insight to other planning processes

[5] The baseline year of the GHG emission reduction targets is 2012, 2016 was chosen as the baseline of the model in order to be calibrated to align with the 2016 Canadian Census. An extrapolation has been made in order to draw trendlines between 2012 and 2016.

- Integrative tool to understand the impacts of decisions in highly complex energy systems
- Generative tool to produce innovative ideas, programs, products, and services
- A conversation tool to "talk about the challenges in achieving a low carbon future in a safe and hypothetical way

BAP Scenario

The BAP scenario is designed to illustrate the anticipated energy use and greenhouse gas emissions for Ottawa if no policies, actions or strategies to address energy and emissions beyond those currently anticipated are implemented until 2050. Actions currently underway or planned such as Stage 1 and 2 of the light rail transit network are included in the BAP scenario. The model projects that the BAP scenario will see a decrease in community-wide GHG emissions of 1.5 megatonnes of carbon dioxide equivalent ($MtCO_2e$), or roughly 22%, compared to 2012 to 2050 despite a population growth to about 1.5 million people by 2050.

80% Scenario

The 80% scenario explores the scope and scale of change required if Ottawa is to achieve the current long-term target to reduce community GHG emissions by 80% below 2012 by 2050. This would require reducing emissions by 5.7 $MtCO_2e$ compared to 2012. This would require improved efficiency of existing buildings, higher performance standards for new buildings, fuel switching to electricity heating and vehicles, increases in local renewable energy generation and energy storage, enhanced transit and active transportation, increased organic waste diversion, and energy generated from organic waste streams.

100% Scenario

The 100% scenario explores the scope and scale of change required if Ottawa is to align with the IPCC target to limit global warming to 1.5ºC and reduce emissions by 100% below 2012 by 2050. This represents a gap of 6.8 $MtCO_2e$ compared to 2012. In addition to the 80% scenario, achieving the 100% scenario would require that almost all fossil fuels be phased out, heating and transportation systems to be nearly fully electrified, waste heat and renewable natural gas to be added, and sufficient renewable energy (solar and wind) generation required to meet demand. Since the timing of renewable energy production does not necessarily align with demand, this scenario relies on the grid to balance local electricity production and consumption with grid resources for storage

and supply. It also relies on the province phasing out fossil fuels used to generate electricity.

Figure 1 shows how GHG emission reductions compare in the three scenarios: BAP, 80% and 100%. Actions to 2021 are similar in both the 80% and 100% scenarios. After 2022, the 100% scenario projects more aggressive GHG emission reductions. After 2040, the level of emissions in the 100% scenario remains constant because many of the actions modelled would be complete.

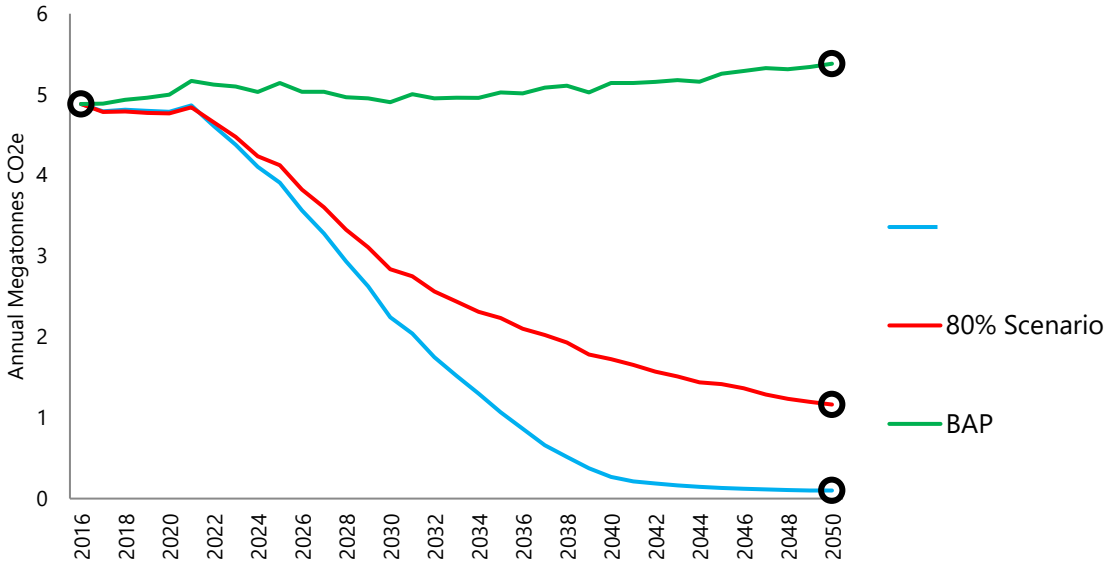

Figure 1: Comparison of GHG emission reductions in three scenarios: BAP, 80% and 100% (2016 – 2050)

Table 1 compares the amount of Mt CO_2e for the three scenarios, relative to Council's 2012 baseline. The change represents the difference between annual emissions in 2012 and projected emissions in 2050 to align with GHG reduction targets.

Table 1: Summary of GHG Emissions Projections for BAP, 80% Scenario and 100% Scenario

Scenario	Description	Carbon Emissions ($MtCO_2e$)		
		2012 (annual)	2050 (annual)	Change
BAP	Aligns with current planned initiatives	6.9	5.4	-1.5
80% scenario	Aligns with Council's current target to reduce GHG emissions 80% by 2050, consistent with the Paris target of limiting global temperature increase to 2ºC.	6.9	1.2	-5.7
100% scenario	Aims to achieve a GHG reduction consistent with the IPCC recommendation of limiting global temperature increase to 1.5ºC.	6.9	0.1	-6.8

Meeting the Targets

Ottawa has made significant investments in recent years in projects that reduce the city's greenhouse gas emissions, notably light rail transit, landfill gas capture and facility improvements. Yet, as outlined in Table 1, under Ottawa's currently planned climate actions, the BAP scenario projects that Ottawa will not reach its 2050 GHG reduction target – there will be a 4.2 $MtCO_2e$ gap in 2050 to reach the 80% Scenario and a 5.3 $MtCO_2e$ gap in 2050 to meet the 100% Scenario.

Figure 2 and Figure 3 demonstrates and Table 2 Figure 3summarizes where community-wide GHG emission reductions are modelled to come from between now and 2050 in five key sectors[6]:

- Land Use and Growth Management (embedded within the four other key sectors)
- Buildings (New and Existing)
- Transportation
- Waste and Renewable Natural Gas
- Electricity

Details on the 44 model actions and their relative GHG emissions reductions are included in Document 10 – Modelling Ottawa's Greenhouse Gas Emissions to 2050: Summary of Results.

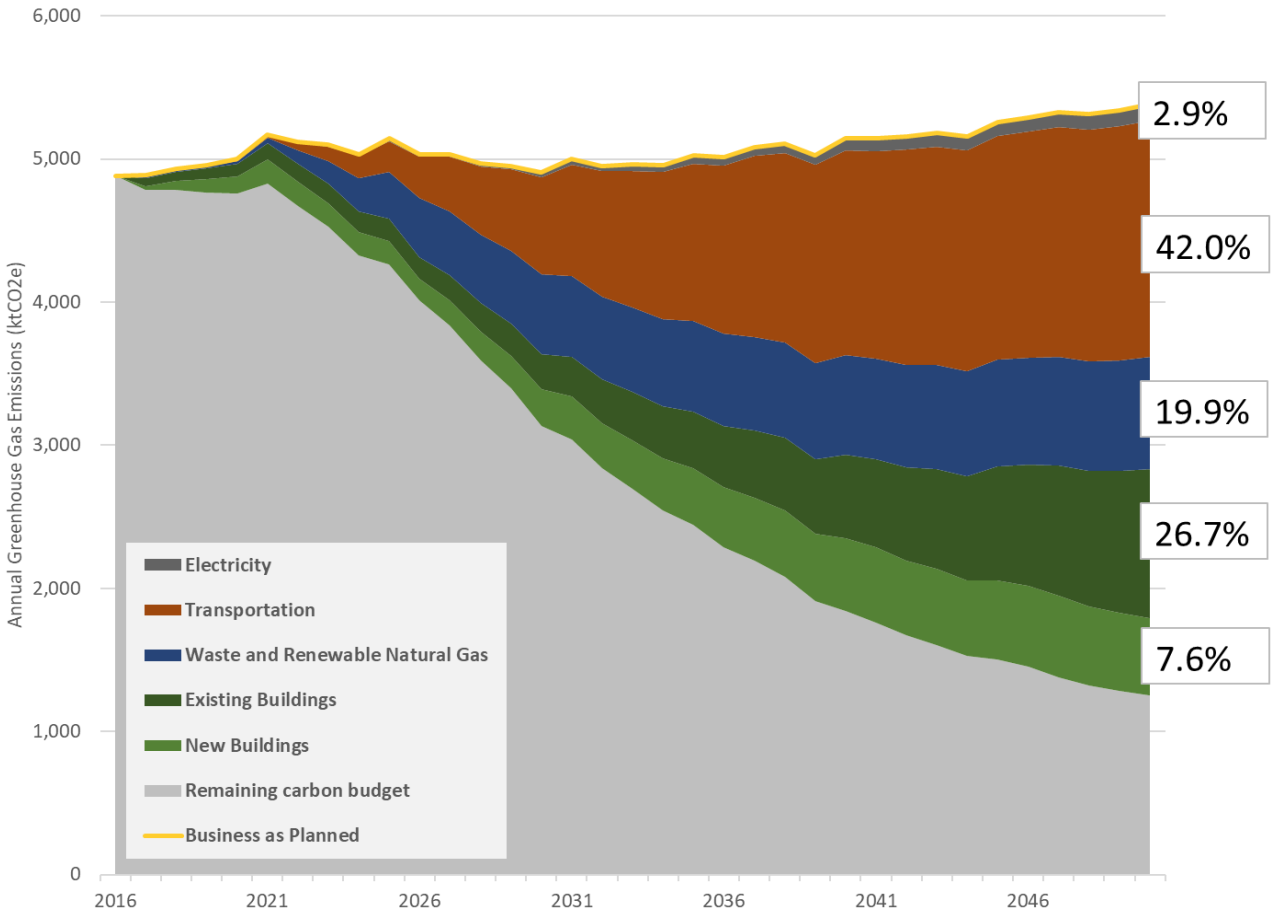

Figure 2: Projected community-wide GHG emissions by sector in the 80% scenario

[6] The GHG reductions are based on community-wide calculations.

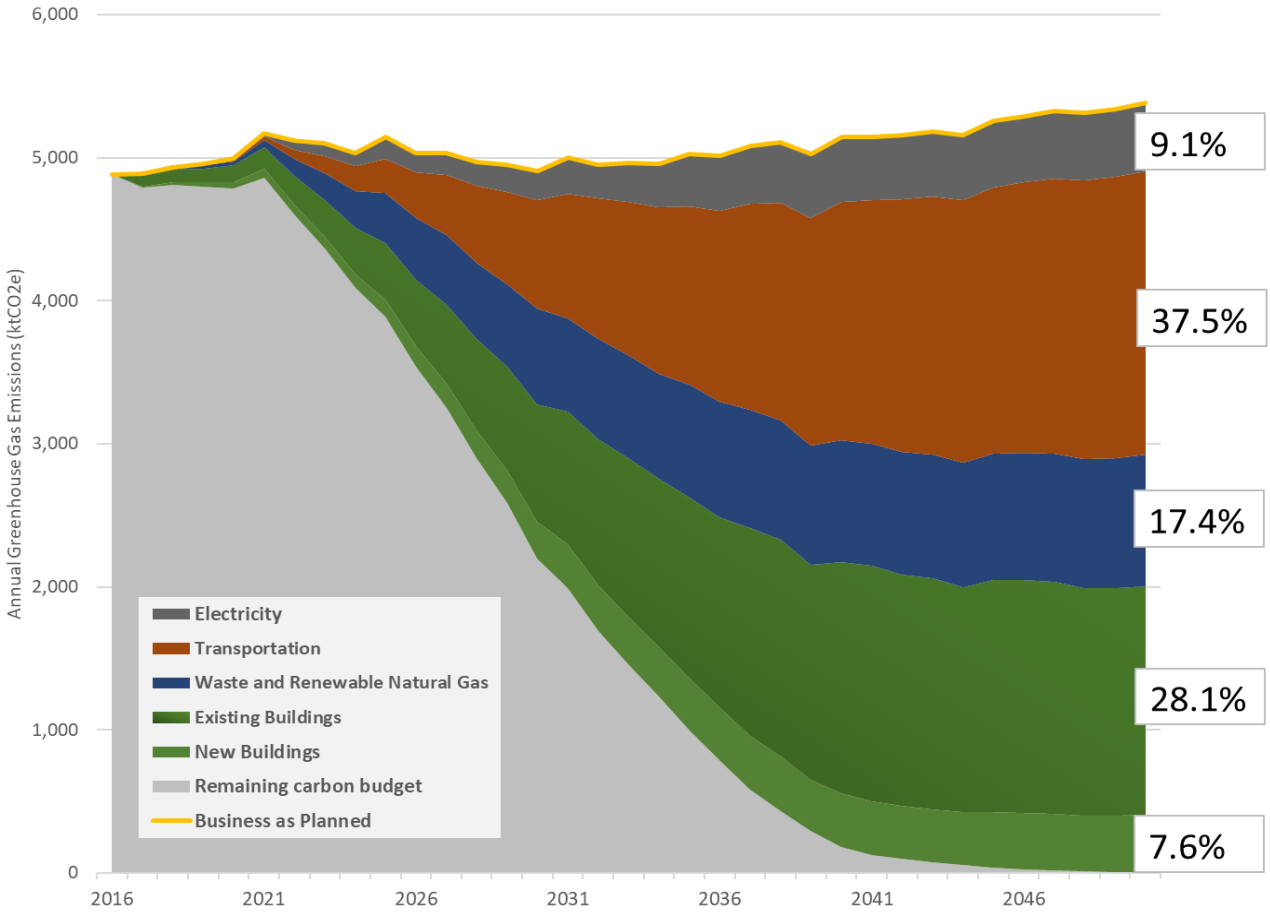

Figure 3: Projected community-wide GHG emissions by sector in the 100% scenario

Table 2: Projected community-wide GHG emissions by sector for the 80% and 100% scenarios

Sector	Percentage (%) of Total Projected GHG Emission Reductions (80% scenario)		Percentage (%) of Total Projected GHG Emission Reductions (100% scenario)	
	2030	**2050**	**2030**	**2050**
Land Use and Growth Management	Imbedded in other actions	Imbedded in other actions	Imbedded in other actions	Imbedded in other actions
Buildings (New and Existing)	24	35	39	37

Sector	Percentage (%) of Total Projected GHG Emission Reductions (80% scenario)		Percentage (%) of Total Projected GHG Emission Reductions (100% scenario)	
	2030	**2050**	**2030**	**2050**
Transportation	41	42	28	37
Waste and Renewable Natural Gas	33	20	25	17
Electricity	2	3	7	9
Total	**100**	**100**	**100**	**100**

Each of the sectors is broken down into proposed key community and municipal model actions. Actions were selected based on the pathway studies, stakeholder consultations and consultant experience in similar modelling exercises[7]. In the model, actions work together cumulatively to achieve either the 80% or 100% scenario targets. The actions are also integrated; if the role of one action is reduced, the impact of such a reduction on all other actions is determined and the model is adjusted until a scenario's targets are again met. For example, a delay in the adoption of electric vehicles would increase the negative impacts of suburban sprawl. An increase in suburban transit investment may be required to compensate for this action. Additional options may be explored as they emerge, for example, as part of the new Official Plan and associated Master Plan updates, changes in legislation or advances in technology.

Table 3 lists the proposed community and municipal action areas by sector.

[7] SSG has completed similar modeling work for Toronto, Edmonton, Victoria, Kingston, Halifax, Peel, Markham, Red Deer, Durham, and Burlington among other municipalities.

Table 3: Proposed Community and municipal actions in the Model by Sector

Land Use and Growth Management

- Spatial distribution

New and Existing Buildings

- Decreased average dwelling size
- Decrease share of single family homes
- New homes net zero carbon
- High efficiency new commercial buildings
- Existing buildings retrofits and electric space and hot water heating
  - Residential
  - commercial
  - municipal
  - Federal
- Industry process improvements
- District energy systems
- Waste heat energy

Transportation

- Increase and improve cycling & walking infrastructure
- Expand and electrify transit
- Electrify municipal fleets, commercial vehicles, autonomous and personal vehicles
- reduce personal vehicle ownership
- Parking management
- Car free zone and EV only zones
- Congestion charges

Waste and Renewable Natural Gas

- Leaf and yard waste diversion and biogas
- Waste Diversion
- Private, non-municipal waste biogas (often farm)
- Power to gas

Electricity

- Increase residential, commercial and utility-scale PV
- Increase local wind and hydro power energy generation
- Increase local energy storage

4. Proposed Projects

Based on the model projections, 20 projects have been identified at a high-level that will accelerate and scale action and investment to achieve the GHG emissions reduction targets. These projects were selected because of the GHG reduction potential or enabling outcomes associated with them and all must be started in the next five years to achieve the GHG emissions reduction targets.

Land Use and Growth Management

- *Integrate energy and climate mitigation priorities in the new Official Plan and supporting master plans*

Buildings

- *Community Building Heating Strategy* to address infrastructure and utility requirements for new ways of heating buildings
- *Residential Retrofit Accelerator Program* to accelerate community residential retrofits through marketing, information and financial mechanisms
- *Commercial Retrofit Accelerator Program* to accelerate community commercial, industrial, and institutional retrofits through marketing, information and financial mechanisms
- *High Performance Development Standard* to improve building design and construction across the community and support an industry-wide transition of new buildings to net zero emissions
- *Municipal Buildings Renovation and Retrofit Program* to achieve higher building energy performance improvements in City owned buildings
- *Update Municipal Green Building Policy* to align with corporate GHG reduction targets

Transportation

- *Personal Vehicles Electrification Strategy* to enable and encourage personal electric vehicle (EV) adoption
- *Commercial Vehicles Electrification Strategy* to enable and encourage commercial electric vehicle (EV) adoption
- *100% zero emissionTransit fleet*

- *Concept transit network* is implemented
- *Transportation Mode Share Framework* to reduce the reliance on personal vehicles in favour of sustainable modes including public transit, walking, cycling and carpooling
- *Update Municipal Green Fleet Plan* considering corporate GHG reduction targets

Waste and Renewable Natural Gas

- *Eliminate Organics from Landfill* to reduce emissions associated with managing waste and enable energy from waste
- Renewable Natural Gas Strategy to supply GHG neutral gas to the community

Electricity

- *Electricity Resource Strategy* to develop local or regional renewable electricity supplies

Private Action

- *Climate Change Education and Outreach program* to engage the public in collective private action to meet long term GHG reduction targets
- *Climate Ambassadors Network* to engage commercial and institutional champions to meet long term GHG reduction targets
- *Advocacy Strategy* to engage with senior levels of government to secure funding, policy changes and/or legislative authority to meet long term GHG reduction targets
- *Fund the Evolution* to review municipal financial mechanisms to support the transition

These projects will be developed in collaboration with internal and external stakeholders. Future staff and budget (operating and capital) pressures will also need to be identified. Of the 20 projects, it is anticipated that approximately half can be advanced using primarily City resources while the other half will require a combination of City and community partner resources. Staff recommend bringing forward further project details and a financial analysis as part of the final report for Energy Evolution in Q2 2020.

5. Next Steps

Staff will continue to work with the Council Sponsor Group, internal staff, stakeholders, and consultants to deliver the final report to the Standing Committee on Environmental Protection, Water and Waste Management in Q2 2020. The final report will include the final energy and emissions model, a financial analysis of the model, descriptions of the proposed projects listed in this report and a proposed spending plan for the 2019 Hydro Ottawa Dividend Surplus.

A financial analysis of capital costs, operational costs/savings, and revenues are required to inform the action and investment necessary to meet the short, mid, and long-term GHG targets. This work will be done with municipal and community sector experts and will be used to inform future annual budget processes, spending plans for the 2018–2022 Term of Council Hydro Ottawa Dividend Surplus, the Long-Term Financial Plan, and capital investments required from other levels of government, the private sector, residents and the broader public sector.

Descriptions of the proposed projects will include roles and responsibilities, timelines, **,** municipal authorities and barriers to implementation, equity and inclusion considerations, and resourcing needs (staff and financial). These will be considered in the development of a proposed spending plan for the 2019 Hydro Ottawa Dividend Surplus.

Ongoing engagement with community partners will be crucial to implementing Energy Evolution. Expanding engagement with broader public, commercial and institutional champions will be essential to achieving community-wide GHG reduction targets. The final modelling work done through Energy Evolution will be shared with stakeholders who have not yet been involved to facilitate an integrated approach across the community and to encourage collaboration amongst various levels of government, utilities, stakeholders, and the broader community.

The website (https://ottawa.ca/en/residents/water-and-environment/climate-change-and-energy) will be kept updated to link relevant documents, including those related to priorities, 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 GHG reduction measures.