INTERROGATORY RESPONSE - ED-1

1

EXHIBIT REFERENCE:

Exhibit 8 ,Tab 9, Schedule 1, UPDATED, May 5, 2020

SUBJECT AREA: Loss Factor

Preamble:

Hydro Ottawa's Conservation and Demand Management Annual Reports for 2006 and 2007 describe a project relating to Distribution Loss Reduction as follows:

Description:

The Distribution Loss Reduction Program is a broad network based initiative to drive greater efficiencies within the distribution grid. This program will identify opportunities for system enhancements. Next steps will be to complete the engineering analysis and feasibility studies. Items to be addressed may include the following:

Power Factor Correction - A power factor assessment will be completed which will identify locations for the installation of power factor correction capacitor banks.

Voltage Conversion - Voltage upgrades can save up to 90% of the losses associated with a feeder as higher voltages and lower current results in lower losses. This study will ascertain the locations and value of voltage conversions.

Power System Load Balancing - This program is designed to ascertain where load shifting can occur to improve system efficiency. It is estimated that approximately 5% - 10% of system losses could be saved.

Voltage Profile Management - Changing voltage profiles at the distribution station level can result in a peak reduction at the controllable distribution stations.

Line Loss Reductions - Replacement of conductors can reduce line losses. An evaluation of where such opportunities exist may be undertaken.

Target users

The results of this program will positively impact all of Hydro Ottawa's customers. Benefits

Reducing electricity distribution system delivery losses will have a number of positive impacts including reducing system demand, relieving network capacity to accommodate growth and reducing the requirement for new generating capacity in the Province. Costs associated with distribution system delivery losses are recovered through electricity distribution charges. Reductions in these costs will therefore benefit all customers

Question:

a) Please provide the final cost and the expected savings in terms of distribution loss reductions (kWh) and the value of those reductions ($) for the above project and each component.

b) Please file the studies, evaluations, and reports completed in the above project.

c) Has Hydro Ottawa undertaken other focused distribution loss reduction work since the project described above?

d) Would Hydro Ottawa consider conducting a similar project seeing as considerable time has passed since 2006?

e) Is Hydro Ottawa able to estimate the cost of doing so and the estimated value of loss reductions?

f) Would regulatory approval for this be required in this proceeding

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RESPONSE:

a) Please refer to part (b) below. Hydro Ottawa acknowledges the report provided in part (b) does not include costs details and dollar values of the loss reductions for the associated projects.

b) Please refer to Attachment ED-1(A): H4-3-1 Distribution Loss Update, which was originally submitted in Hydro Ottawa's 2012 distribution application.[1] In the Approved Settlement Agreement to that proceeding, the parties agreed the outstanding directive to reduce distribution losses had been addressed in Exhibit H4-3-1.[2]

c) Hydro Ottawa has not undertaken any focused distribution loss reduction work since the projects described in Attachment ED-1(A) and above. However, please see the response to interrogatory ED-3 regarding Hydro Ottawa's overarching approach to address system losses.

d) Hydro Ottawa does not have any plans for a project focused on distribution loss reduction as part of this Application. Hydro Ottawa's target Key Performance Indicator ("KPI") metric for distribution system losses is ≤ 4.0%. As demonstrated below in Table A, losses have remained below the target over the 2014-2019 period.

[1] Hydro Ottawa Limited, *2012 Electricity Distribution Rates - Cost of Service*, EB-2011-0054 (June 17, 2011).
[2] Ontario Energy Board, *Decision and Rate Order*, EB-2011-0054 (February 25, 2016), Appendix A, pages 7 and 8.

Table A – Hydro Ottawa System Losses

	2014	2015	2016	2017	2018	2019
Losses %[3]	2.76%	3.25%	2.98%	2.97%	3.22%	3.02%

As noted in section 4.1.4.3 of Exhibit 2-4-3: Distribution System Plan, Hydro Ottawa records and monitors annual system losses aiming to maintain losses within acceptable levels.

e) Hydro Ottawa has not estimated the costs of any future focused loss reduction projects, or the estimated dollar value of loss reductions.

f) OEB approval would be required as part of this Application for any focused distribution loss reduction projects above Hydro Ottawa's materiality threshold.

[3] This does not include Wholesale kWh in its calculation.

DISTRIBUTION LOSSES UPDATE

Hydro Ottawa Limited ("Hydro Ottawa") filed a *Plan to Reduce Line Losses by 5%* (the "Plan") on July 11, 2006 (EB-2005-0381). A copy is included with Exhibit H1-4-3 as Attachment AL. The Plan outlined a number of initiatives Hydro Ottawa intended to implement in order to reduce distribution losses. In its *2008 Electricity Distribution Rate Application* (EB-2007-0713), Hydro Ottawa provided an update on this loss reduction program. The following summarizes the progress made during the last three years within the various components of the Plan.

1.0 VOLTAGE PROFILE MANAGEMENT SYSTEM

Changing the voltage profile on the distribution system can result in reduced load demand and therefore reduced losses. This type of operation is commonly termed Conservation Voltage Reduction ("CVR"). Various papers on this subject indicate that for every 1% drop in voltage one can expect 0.5% to 1.5% load reduction, depending on the load characteristics of the feeder. There are a number of systems on the market that can be used to accomplish such voltage reduction.

Hydro Ottawa undertook a pilot project for the installation of an automatic voltage control system, called AdaptiVolt™, to regulate the voltage at a suburban 44/8.32 kV distribution station that has transformers with under load tap changers ("ULTCs"). This system reduces the distribution voltage at the substation by a small percentage, while ensuring that the voltage seen by customers remains within Canadian Standards Association voltage limits throughout the feeder length. It does this by monitoring the end of line voltage. The AdaptiVolt system was installed at Centrepointe substation in 2006. Over a test period of 45 days the load reduction was measured using a third party testing protocol. Based on this, a forecast annual reduction in load of 3.7 GWh was determined. From this load reduction, the estimated reduction in system losses would be 130 MWh. Unfortunately, the AdaptiVolt system complicated the operation of the distribution system

by introducing complexities during switching operations to the point that its use was terminated. The cost of implementing the AdaptiVolt system at several other Hydro Ottawa stations that are equipped with ULTCs was also deemed to be uneconomic.

Hydro Ottawa plans to investigate and pilot alternative means of reducing distribution voltage, while maintaining flexibility in system operations. Pilot projects are currently planned to be deployed in 2015, and beyond.

2.0 SYSTEM OPTIMIZATION

This initiative aims at identifying opportunities to improve the delivery efficiency of the overall distribution system. Line losses in the system are influenced by the amount of load supplied on a feeder. By reconfiguring the state of the distribution system to change how particular loads are supplied, it may be possible to reduce total system demand and energy losses. Conceptually, if certain feeders in the system are heavily loaded, and others have lighter loading, then if some of the load can be transferred off of the heavily loaded lines onto the lightly loaded feeders, then the system losses will be reduced. This type of load transfer often can be achieved simply by changing which switches in the system are the “Normally Open Points”. It is important to note that the optimal system configuration for reducing system losses may not be the optimal configuration in terms of operating reliability considerations. In such cases a utility may have to assess whether reducing system losses is more important than improving reliability of supply to its customers.

Balancing the load on 3 phase circuits may also reduce the losses on a feeder. If it is feasible to change which phase a load is connected to and allow the current on each of the phases to be more uniform, then system losses will be lowered.

System optimization can practicably only be studied utilizing a Distribution System Analysis software package. Such software allows utilities to create models of the

circuits, station transformers, distribution transformers, distribution switches, and customer loads for each of its distinct distribution networks. The software can then analyze the flow of current along the circuits, as well as the voltage at each point in the system under various loading conditions. The program will calculate the energy and demand losses for a given system configuration. Most system analysis programs also offer optimizing modules that can identify the optimal system configuration to achieve the lowest system losses, or other objectives such as optimal voltage levels.

In 2006 a consultant was retained by Hydro Ottawa to perform a study for parts of the Nepean, and Kanata distribution systems. Their report indicated that for the Nepean system, loss savings in the order of 600 kW, or about 0.3%, could be achieved by changing open points. For Kanata the reduction was only 83 kW.

Leveraging the information stored in Hydro Ottawa's Geographic Information System ("GIS"), the system analysis software vendor was retained to develop a tool to extract all of the information required to build the network models directly from the GIS database. This eliminates the need to maintain two separate systems and ensures that the network model is kept up to date with GIS revisions. The initial development of this tool was completed in late 2010. Some additional software updates will be required to enable full functionality of the Switching Optimization Module ("SOM"). The SOM will be used to assist in determining the optimum circuit configuration to minimize losses; the required updates are anticipated to be completed in Q4 2011. With the completed solution Hydro Ottawa plans to move forward with further loss reduction studies both to confirm the results of the earlier work, and to examine potential reductions for the parts of our overall distribution system that previously weren't modeled. Initial studies and analysis are expected to be completed in 2012.

3.0 VOLTAGE CONVERSION

Within the core area of Ottawa the two prevalent distribution voltages are 4.16 kV and 13.2 kV. In the suburban areas the most common voltages are 8.32 kV and 27.6 kV. If Hydro Ottawa were to undertake voltage conversion to increase the distribution voltage from either 4 kV to 13.2 kV or 8 kV to 27.6 kV, the line losses are expected to be reduced by about 90%. In addition, both the no-load and load losses associated with distribution transformers would be reduced substantially. This is because today's transformers are considerably more efficient than the units that were installed 20-30 years ago. Other loss savings will accrue with the removal of 13.2 kV to 4 kV station transformers from the system.

Hydro Ottawa does not expect that the loss savings alone will justify the costs of the voltage conversion program; however, by retiring distribution station equipment that is nearing its end of life, Hydro Ottawa will forego the costs of replacement of this equipment and the ongoing operation and maintenance costs.

Since the last update to the *Plan to Reduce Line Losses by 5%*, voltage conversion was completed in 2007 in the Sunnyside and Winding Way areas. From the conversion of 6.3 MW of load, a reduction in distribution losses of 1,100 MWh was estimated.

Conversion work in the Uplands 8 kV area will be completed in 2011, and the Kilborn 4kV area is expected to be completed in 2012. In these two areas conversion of about 8 MW of load will result in a distribution loss reduction of approximately 1,500 MWh.

Hydro Ottawa continues to review business cases for potential conversion areas to determine whether to proceed with additional conversion projects. The Woodroffe 4 kV business case was found to be positive and work to convert this territory to operate at 13 kV is planned to start in 2013. In addition, the conversion of 8 kV in South Nepean is planned across several projects scheduled from 2012-2015.

4.0 POWER FACTOR CORRECTION

Capacitors can be used to improve power factor on a feeder and this may result in reduced line losses. By providing reactive power at the end of a feeder, capacitors reduce the reactive current flow and therefore the losses; however, capacitors also increase the voltage at the point in the system that they are installed. This increase in voltage at the end of a feeder may result in an increased delivered power, which can lead to an increase in losses. If the overall goal is to reduce system losses, then it may become necessary to lower the voltage at the feeder source, i.e. the distribution station.

Hydro Ottawa had planned on installing two banks of capacitors on one of its 27.6 kV systems that has relatively long feeders. Both fixed and switched capacitor installations were contemplated to provide a greater degree of voltage control for varying load levels. Due to work protection concerns, the project was put on hold, pending specific operating procedures being developed by Hydro Ottawa.

5.0 TRANSFORMER LOSS EVALUATION AND LOADING PRACTICES

A consultant's report containing a review of the loss evaluation formula in Hydro Ottawa's distribution transformer specifications and the life cycle costs associated with various transformer-loading schemes was received in 2007. Hydro Ottawa plans to leverage newly available Smart Meter data in concert with the consultant's findings to assess and if necessary develop a revised loss formula by the end of 2012.

6.0 TRANSFORMER REPLACEMENT AND REMOVAL

Whenever replacement of a distribution transformer is required, Hydro Ottawa ensures that excess transformation is removed. This increases the utilization of transformation capacity on the remaining transformer(s) reducing the ratio of power delivered to losses.

7.0 CONSERVATION AND DEMAND MANAGEMENT ("CDM")

Hydro Ottawa's CDM programs for 2007, 2008, 2009 and 2010 have been very successful, resulting in a reduction in energy use of 373 GWhs and corresponding reduction in losses.

8.0 UPDATING RECORDS FOR STREET LIGHT AND UNMETERED SCATTERED LOAD

Streetlight records have been updated as a part of the implementation of the GIS system. As a result, more accurate information on kWh consumption for streetlights has resulted in a reduction in non-technical losses.

9.0 DRY CORE TRANSFORMER LOSSES

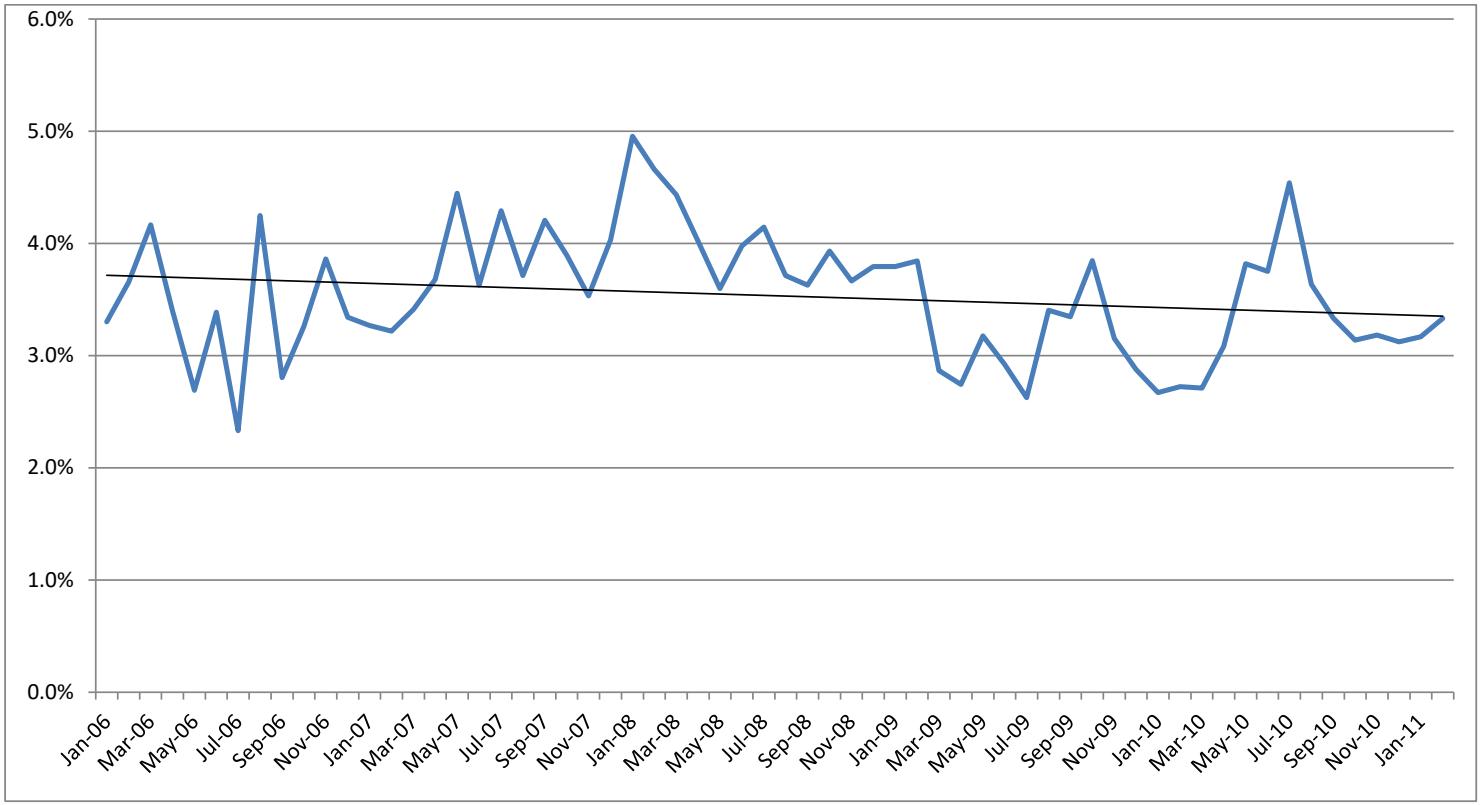
Dry Core transformer losses are now being recorded as part of Hydro Ottawa's sales. In 2010 this resulted in a reduction in reported losses of 3,079 MWh.

10.0 CONCLUSION

Hydro Ottawa continues to look for ways to reduce both technical and non-technical losses from its distribution system. Figure 1 shows the rolling 12 month average of Hydro Ottawa's losses as a percentage of purchases since January 2006. Although monthly loss factors can vary significantly, the overall trend is a decline in losses indicating that the *Plan to Reduce Line Losses by 5%* is having a positive impact.

Hydro Ottawa Limited
EB-2011-0054
Exhibit H1
Tab 4
Schedule 3
Filed: 2011-06-17

Figure 1 – 12 Month Rolling Average Loss Factor



INTERROGATORY RESPONSE - ED-2

2

EXHIBIT REFERENCE:

Exhibit 8 ,Tab 9, Schedule 1, UPDATED, May 5, 2020

SUBJECT AREA: Loss Factor

Question:

a) How does Hydro Ottawa's rate of distribution system energy losses compare to other leading LDCs inside and outside of Ontario?

b) How does Hydro Ottawa compare to other LDCs in terms of its efforts to reduce distribution system energy losses? In what ways is or isn't Hydro Ottawa a leader in this regard?

RESPONSE:

a) In the process of completing the comparison for system losses, Hydro Ottawa has noted an error in the loss factors presented in section 4.1.4.3 of Exhibit 2-4-3: Distribution System Plan. Accordingly, Table 4.21 has been revised below.

Table 4.21 – AS ORIGINALLY SUBMITTED - System Losses

KPI	Target	2014	2015	2016	2017	2018
Losses %	≤ 4.00%	2.71%	3.32%	3.04%	2.97%	3.20%

Table 4.21 – AS REVISED - System Losses

KPI	Target	2014	2015	2016	2017	2018
Losses %	≤ 4.00%	2.71%	3.21%	2.95%	2.97%	3.20%

To compare with other Local Distribution Companies ("LDCs") in Ontario, Hydro Ottawa has used the information provided in the OEB's Yearbook of Electricity Distributors for 2014-2018 to compare the percentage of distribution system energy losses (as outlined in Table A). The same group of utilities were used for the Peer Group as described in Attachment 1-1-12(C): Electricity Utility Scorecard. The percentage of losses has been derived in the same method used in section 2.1.5.3 of OEB's annual Reporting and Record Keeping Requirements ("RRRs") – that is, by dividing the Total Distribution Losses (kWh) by the Total kWh Purchased.

Table A – Percentage of Distribution Losses - Comparison of Ontario LDCs

	2014	2015	2016	2017	2018
Hydro Ottawa	2.71%	3.21%	2.95%	2.97%	3.20%
Peer Group Average	3.46%	3.55%	3.42%	3.37%	3.43%
Ontario Average	4.09%	3.84%	3.97%	3.82%	3.80%

From 2014-2018, Hydro Ottawa's percentage of distribution losses has remained lower than the Peer Group Average and Ontario Average, as well as lower than Hydro Ottawa's KPI target of ≤ 4.0%.

Hydro Ottawa was not able to locate any studies completed by Ontario LDCs or information detailed in other OEB proceedings in regards to distribution system losses for utilities outside of the province of Ontario.

b) Hydro Ottawa is not aware of the efforts taken by other Ontario LDCs in regards to reducing system losses. Hydro Ottawa believes that the steps taken as described in part (a) of the response to interrogatory ED-3 have led to continued distribution loss percentages below the Peer Group and Ontario Averages.

Table B below provides information on the loss factor for secondary metered customers < 5000 kW for the peer group LDCs in comparison to Hydro Ottawa's 2021 proposed

loss factor.[1] It is recognized that there are many factors contributing to an LDC's loss factor, some of which are not in its control. Hydro Ottawa's placement on this table is a reflection of the work that has been done in recent years to keep distribution losses low.

Table B – Peer Group Distribution Loss Factors for Secondary Metered Customers < 5000 kW[2]

Electricity Distributor	Loss Factor
Toronto Hydro-Electric System Limited	1.0295
EnWin Utilities Ltd.	1.0311
London Hydro Inc.	1.0315
Hydro Ottawa Limited	1.0338[3]
Kitchener-Wilmot Hydro Inc.	1.0350
Waterloo North Hydro Inc.	1.0362
Alectra Utilities Corporation	1.0369
Burlington Hydro Inc.	1.0373
Oakville Hydro Electricity Distribution Inc.	1.0376
Thunder Bay Hydro Electricity Distribution Inc. (Synergy North)	1.0394
Elexicon Energy Inc. (Veridian Rate Zone)	1.0482
Hydro One Networks Inc.	1.057[4]

[1] Hydro Ottawa's proposed loss factor for secondary metered customers is based upon that which was approved by the OEB as part of the utility's Custom IR Year 5 update. *See* Hydro Ottawa Limited, *2020 Electricity Distribution Rate Application*, EB-2019-0046 (August 12, 2019).
[2] The source for this information is the set of respective 2020 Rate Orders issued by the OEB to the applicable distributors.
[3] This represents the 2021 Loss Factor that Hydro Ottawa is proposing and is subject to OEB approval.
[4] This loss factor corresponds to Hydro One Networks' Residential - UR Rate Class.

INTERROGATORY RESPONSE - ED-3

3

EXHIBIT REFERENCE:

Exhibit 8 ,Tab 9, Schedule 1, UPDATED, May 5, 2020

SUBJECT AREA: Loss Factor

Preamble:

Hydro Ottawa's Conservation and Demand Management Annual Reports for 2006 and 2007 describe a project relating to Distribution Loss Reduction.

Question:

a) What are the most important steps that Hydro Ottawa has taken in the past 20 years to reduce distribution system energy losses?

b) Where does Hydro Ottawa believe the greatest opportunities are to make additional reductions in distribution losses in the next 20 years?

c) Does Hydro Ottawa quantify and consider the potential value of distribution loss reductions for different options when procuring equipment (e.g. transformers) and deciding on the details of demand-driven capital projects (e.g. the type and sizing of conductors)? If yes, please explain how and provide documentation detailing the methodology used.

d) If Hydro Ottawa is considering the value to its customers of distribution loss reductions for planning purposes, how does it calculate the dollar value ($) of said loss reductions (kWh)? Is the value calculated based only on the HOEP or on all-in cost of electricity (e.g. including the GA)?

e) Please list and describe the operational measures that Hydro Ottawa takes to cost-effectively reduce distribution losses.

f) Please provide a table listing the technically available measures to cost-effectively reduce distribution losses and describe for each the respective responsibilities of Hydro Ottawa, the IESO, and Hydro One.

RESPONSE:

a) Over the last 20 years, the steps Hydro Ottawa has taken to reduce distribution losses include the following:

- Voltage conversion;
- Upgrading conductors;
- Load balancing; and
- Ensuring transformer purchase specifications balance fault current and losses.

b) Hydro Ottawa believes the greatest opportunities to make additional reductions in distribution losses include the same steps taken over the previous 20 years:

- Voltage conversion;
- Upgrading conductors;
- Load balancing; and
- Ensuring transformer purchase specifications balance fault current and losses.

c) Hydro Ottawa designs and procures equipment based on distribution system needs, right-sizing the equipment to balance technical requirements (e.g. system loading and voltage drop) and cost. Hydro Ottawa does not quantify distribution loss reductions when procuring equipment, but does consider them. This includes comparing vendor

substation power transformer losses during evaluation and requiring that Hydro Ottawa transformers meet or exceed Canadian Standards Association ("CSA") 802.94 (Maximum Losses for All Transformers).

Hydro Ottawa designs and procures equipment owned by the utility for demand-driven projects based on right-sizing for customer technical requirements (e.g. loading). Hydro Ottawa does not specify customer-owned equipment which is governed by the Electrical Safety Authority; however, Hydro Ottawa does charge customers for all unmetered transformer losses, per section 2.5.5.5 of the utility's Conditions of Service (Transformer Loss Charge).

d) If Hydro Ottawa is considering the value to its customers of distribution loss reductions for planning purposes, the utility would calculate the dollar savings based on kWh basis using the cost of electricity, including Global Adjustment. Hydro Ottawa acknowledges that the most significant savings are achieved in the long-term with isolated short-term savings as well.

e) Please see part (a) above.

f) Please see part (a) above.

INTERROGATORY RESPONSE - ED-4

4

EXHIBIT REFERENCE:

Exhibit 8, Tab 9, Schedule 1, UPDATED, May 5, 2020, p. 2

SUBJECT AREA: Loss Factor

a) Please complete the below table.

Value of Ottawa's Distribution System Energy Losses - Historic						
	2015	2016	2017	2018	2019	Total
Electricity Purchases (MWh)	7,622,794	7,600,820	7,410,784	7,612,656	7,466,403	
Electricity Sales (MWh)	7,374,808	7,374,415	7,190,875	7,367,818	7,240,881	
Losses (MWh)	247,987	226,405	219,909	244,838	225,521	
Losses %	3.25%	2.98%	2.97%	3.22%	3.02%	
All-In Cost of Electricity in Ottawa ($/Mwh) – Annual Average						
Cost of Losses ($)						

b) Does Hydro Ottawa anticipate the value of losses on its system to be materially higher or lower over the next five years?

c) Please complete the following table:

GHG's from Ottawa's Forecast Distribution System Energy Losses						
	2021	2022	2023	2024	2025	Total
Forecast Losses (MWh)[1]						
Carbon Intensity of Electricity[2] (CO2e/MWh)						
GHGs (CO2e)						

d) Is Hydro Ottawa willing to review its operational measures, investment planning, and other practices to consider whether it could be taking additional measures to cost-effectively reduce the energy losses occurring in its distribution system?

RESPONSE:

a) Table A has been completed, per the interrogatory request.

Table A – Value of Hydro Ottawa's Distribution System Energy Losses - Historic

	2015	2016	2017	2018	2019	Total
Electricity Purchases (MWh)	7,622,794	7,600,820	7,410,784	7,612,656	7,466,403	37,713,457
Electricity Sales (MWh)	7,374,808	7,374,415	7,190,875	7,367,818	7,240,881	36,548,797
Losses (MWh)	247,987	226,405	219,909	244,838	225,521	1,164,660
Losses %	3.25%	2.98%	2.97%	3.22%	3.02%	
All-In Cost of Electricity in Ottawa ($/Mwh) – Annual Average	$101.48	$113.69	$105.56	$99.76	$107.63	
Cost of Losses ($'000s)	**$25,166**	**$25,739**	**$23,214**	**$24,425**	**$24,273**	**$122,817**

To calculate the all-in cost of electricity in Ottawa ($/MWh), Hydro Ottawa has included

[1] If no better numbers are available, the losses from 2019 or the average over 2015 to 2019 could be used for the purpose of this row of this response.
[2] Please base this figure on the IESO's January 2020 Annual Planning Outlook - http://www.ieso.ca/-/media/Files/IESO/Document-Library/planning-forecasts/apo/Annual-Planning-Outlook-Jan2020.pdf?la=en; See also the data tables at http://www.ieso.ca/-/media/Files/IESO/Document-Library/planning-forecasts/apo/Annual-Planning-Outlook-Data-Tables-Jan2020.xlsx?la=en.

Uniform System of Account ("USofA") Account 4705 - Power Purchased and USofA Account 4707 - Charges - Global Adjustment.

b) Hydro Ottawa does not anticipate the value of losses to be materially different over the next five years.

c) Table B has been completed, per the interrogatory request.[3]

Table B – GHGs from Ottawa's Forecast Distribution System Energy Losses

	2021	2022	2023	2024	2025	Total
Forecast Losses (MWh)	232,932	232,932	232,932	232,932	232,932	1,164,660
Carbon Intensity of Electricity (CO2e/MWh)	0.03	0.04	0.06	0.06	0.07	
GHGs (CO2e)	6,988	9,317	13,976	13,976	16,305	60,562

The forecast losses are based on the average losses from 2015-2019.

The Carbon Intensity of Electricity was calculated using data from the IESO's *Annual Planning Outlook* – namely, the data tables corresponding to Figure 2: Reference Case - Energy Demand (TWh) and Figure 32: Electricity Sector GHG Emissions, Historical and Forecast (Megatonnes CO2e).[4]

[3] Hydro Ottawa notes that it has fulfilled this information request, given the nexus with the relevant matter of system losses and the use of a data set that is within the utility's possession and is thus readily accessible. This approach stands in contrast to Hydro Ottawa's approach with respect to parts (e), (f), and (g) of interrogatory ED-11, in which the utility was requested to complete a similar information request pertaining to GHG emissions associated with electricity use in the City of Ottawa. In this latter instance, no clear connection has been established with any matter that is directly relevant to this proceeding, while several of the critical data sets for purposes of responding are either not within the utility's possession or are ones which would require significant time to review and analyze.

[4] These data sets are available at the following website: http://www.ieso.ca/-/media/Files/IESO/Document-Library/planning-forecasts/apo/Annual-Planning-Outlook-Data-Tables-Jan2020.xlsx?la=en.

Table C identifies the inputs for the calculated Carbon Intensity of Electricity (CO2e/MWh) for Table B above.

Table C – Inputs for Carbon Intensity of Electricity Forecast

	2021	2022	2023	2024	2025
Reference Case (Megatonnes CO2e)	4,800,000	5,300,000	8,100,000	8,300,000	10,700,000
Reference Case - Total Ontario Energy Demand (MWh)	145,810,000	146,430,000	147,050,000	149,060,000	150,600,000
Megatonnes CO2e / MWh	0.03	0.04	0.06	0.06	0.07

d) As part of the utility's Asset Management processes, Hydro Ottawa does review its operational measures, investment planning, and other practices to consider whether it could be taking additional measures to cost-effectively reduce the energy losses occurring on its distribution system.

INTERROGATORY RESPONSE - ED-5

5

EXHIBIT REFERENCE:

Cost Allocation Model, Sheet O2 Monthly Fixed Charge Min & Max

SUBJECT AREA: Fixed and Variable Charges

Preamble: The above reference includes the following information:

Output sheet showing minimum and maximum level for Monthly Fixed Charge

	1	2	3	4	6	7	8	9
Summary	Residential	GS <50	GS 50 to 1,499 kW	GS 1,500 to 4,999 kW	Large Use	Street Light	Sentinel	Unmetered Scattered Load
Customer Unit Cost per month - Avoided Cost	$4.23	$6.25	$26.46	$67.13	$13.28	$0.07	$1.85	$0.05
Customer Unit Cost per month - Directly Related	$7.68	$10.73	$44.75	$117.09	$70.72	$0.18	$3.77	$0.13
Customer Unit Cost per month - Minimum System with PLCC Adjustment	$16.61	$21.15	$78.85	$402.12	$516.80	$8.19	$14.67	$8.70
Existing Approved Fixed Charge	$27.79	$19.32	$200.00	$4,193.93	$15,231.32	$0.91	$3.17	$5.09

Question:

a) Does Hydro Ottawa agree that shifting costs for commercial and industrial customers from fixed charges to variable charges would incentivize positive customer behaviour such as shifting load off the peak, installing distributed energy, and implementing energy

efficiency? Please explain.

b) Does Hydro Ottawa agree that setting the fixed monthly charges for commercial and industrial customers at the level of avoided cost would represent a shift of costs from fixed charges to variable charges?

c) Does Hydro Ottawa agree with Board Staff that setting fixed monthly charges at the level of avoided costs has benefits, including that avoided costs "are easiest to determine, are subject to minimal judgment and thus more accurate"?[1]

d) Would Hydro Ottawa agree to set its commercial and industrial fixed monthly charges to equal avoided costs going forward? If not, would Hydro Ottawa agree to study and consider this issue for potential implementation in its next annual rate application?

e) Could the City of Ottawa ask Hydro Ottawa through a unanimous shareholder resolution (or otherwise) to set commercial and industrial fixed monthly charges to equal avoided costs, subject of course to OEB approval (e.g. in an effort to incentivize more conservation to help meet its GHG reduction targets)? If not, please explain why not.

f) Please confirm that the balance between fixed and variable charges does not and should not impact Hydro Ottawa being made whole for its revenue requirement. Please explain.

g) Please confirm that Hydro Ottawa has proposed fixed monthly charges for commercial and industrial customers that is above the maximum level.

h) Please explain why Hydro Ottawa is proposing fixed monthly charges for commercial and industrial customers that are above the maximum level. Please include a detailed

[1] EB-2007-0667, Board Staff Discussion Paper: On the implications arising from a review of the electricity distributors' cost allocation filings, June 28, 2007, pp. 26-27.
60 Ibid

breakdown quantifying and explaining for each rate class the difference between the proposed fixed charges and the maximum fixed charges.

i) Please provide the methodology, calculations, and any underlying documentation showing how Hydro Ottawa calculates the fixed monthly charge for its commercial and industrial customers.

j) Please provide the percent difference between the proposed monthly fixed charge for commercial and industrial customers and the Board minimum and maximum figures (i.e. Customer Unit Cost per month - Avoided Cost; Customer Unit Cost per month - Directly Related; and Customer Unit Cost per month - Minimum System with PLCC Adjustment). Please calculate the percentage based on an average weighted by the number of customers in each class.

k) For the most recent year available, please provide the number of customers in each of the commercial and industrial rate classes.

l) Please complete the following table calculating the total annual amount of fixed charges by customer class (actual and forecast). If we have missed relevant commercial or industrial customer classes, please add them to the table:

Total Fixed Charges Collected by Custer Classes ($)

	GS <50	GS 50 to 1,499 kW	GS 1,500 to 4,999 kW	Large Use	Street Light	Sentinel	Unmetered Scattered Load	Total
2018 (actual)								
2019 (actual)								
2020 (forecast)								
2021 (forecast)								
2021-2025 (forecast)								

RESPONSE:

a) The establishment of fixed and variable rates by customer class must be based on the principle of cost causality. The fixed portion of the rate represents the cost of establishing and maintaining the customer connection and of providing sufficient load in the network to serve the customer's requirements. The OEB has agreed that the delivery system operated by a Local Distribution Company ("LDC") is largely fixed in nature for residential customers,[2] and the OEB's ongoing consultation to review commercial and industrial rates[3] reflects a potential change in philosophy for non-residential customers as well. It is therefore important that each customer's fixed rate captures the cost of that customer's place in the network. Reducing the fixed charge for a customer class runs the risk of not recovering that cost and obliging the non-commercial classes to contribute the difference, which is counter to economic regulation principles.

b) Please see the response to part (a) above. Distribution system costs by nature are significantly fixed. Avoidable cost does not adequately capture the cost of the customer connection since it considers a relatively minor portion of the cost to operate. For example, the avoidable cost ceiling generated by the cost allocation model for the residential customer class falls considerably short of the current fixed monthly residential rate of $27.79. Using avoidable cost as a proxy for fixed cost runs the real risk of generating a revenue shortfall or of requiring other rate classes to make up the difference.

c) Hydro Ottawa notes that the date of the OEB Staff discussion paper referenced is June 28, 2007, and suggests that recent OEB Staff policy on reports such as Residential Rate Design[4] and Commercial and Industrial Rate Design[5] demonstrate a potential change of

[2] Ontario Energy Board, *Fixing Distribution Rates - Rate Redesign Backgrounder* (April 6, 2015), Available at https://www.oeb.ca/oeb/_Documents/EB-2012-0410/OEB_Distribution_Rate_Design_Backgrounder_20150406.pdf
[3] Ontario Energy Board, *Rate Design for Commercial and Industrial Electricity Customers,* EB-2015-0043 (February 21, 2019).
[4] Ontario Energy Board, *A New Distribution Rate Design for Residential Electricity Customers,* EB-2012-0410 (April 2, 2015).

position. Please refer to the response to part (b) above for a discussion of Hydro Ottawa's position on using avoidable cost as a proxy for fixed cost. In any event, Hydro Ottawa would not agree that avoidable costs are subject to minimal judgment and therefore easy to determine or defend.

d) Hydro Ottawa would not agree to either request. Please refer to the response to part (b) above for a discussion of the merits of this approach in the utility's view. As noted in the response to part (b), the OEB is currently consulting on industrial and commercial rate design. Hydro Ottawa is participating in that process and awaiting its outcome.

e) As a preface to its response, Hydro Ottawa wishes to clarify the corporate governance structure of the utility. As explained in Exhibit 1-4-1: Corporate Structure and Governance, the sole shareholder of Hydro Ottawa is the utility's parent company, Hydro Ottawa Holding Inc. ("Holding Company"). The shareholder agreement governing the relationship between the Holding Company and Hydro Ottawa is included in this Application as Attachment 1-4-1(B): Shareholder Declaration - Hydro Ottawa Limited. What's more, the sole shareholder of the Holding Company is the City of Ottawa. The shareholder agreement governing the relationship between the City of Ottawa and the Holding Company is included in this Application as Attachment 1-4-1(A): Shareholder Declaration - Hydro Ottawa Holding Inc.

To the best of its knowledge, Hydro Ottawa is not aware of any provisions in either Shareholder Declaration that would necessarily or inherently preclude or restrict the course of action contemplated in the interrogatory. However, it is not the proper purview of the utility to speculate or comment upon the likelihood or the appropriateness of either shareholder directing such action by way of a formal resolution.

[5] Ontario Energy Board, *Rate Design for Commercial and Industrial Electricity Customers,* EB-2015-0043 (February 21, 2019).

f) The existence of any variable portion of the rate structure creates the risk of a revenue shortfall should consumption or demand fall short of forecast levels. Therefore, Hydro Ottawa is at risk for a revenue shortfall should shifts in demand occur within a rate term.

g) Hydro Ottawa confirms that some proposed fixed monthly charges for some commercial and industrial customers are above the ceiling. Please see the response to part (b) above for a discussion of the difference between fixed and avoidable costs. In addition, please note that the OEB Chapter 2 Filing Requirements state the following: "If a distributor's current fixed charge for any non-residential class is higher than the calculated ceiling, there is no requirement to lower the fixed charge to the ceiling."[6]

h) Please see the responses to parts (a), (b), (c), and (d) above. Hydro Ottawa sets and maintains the fixed portion of its rates with the objective of recovering the cost of the customer's position in the network while maintaining the fixed/variable ratio.

Hydro Ottawa would need to conduct a detailed study to quantify differences between the modeled ceiling and current rate structures. Such a study has not been conducted and is not being contemplated at this time.

i) Please see Attachment 7-1-1(B): Hydro Ottawa Cost Allocation Report for a discussion of the rate design methodology used by Hydro Ottawa. The fixed portion of the rate is established based on historical values and forecast customer connections, and follows the guiding principle to maintain the current fixed/variable ratio as closely as possible. In addition, please note that the OEB Chapter 2 Filing Requirements state the following: "If a distributor's current fixed charge for any non-residential class is higher than the calculated ceiling, there is no requirement to lower the fixed charge to the ceiling."[7]

[6] Ontario Energy Board, *Chapter 2 Filing Requirements For Electricity Distribution Rate Applications - 2018 Edition for 2019 Rate Applications* (updated July 12, 2018; addended July 15, 2019), page 50.
[7] *Ibid*..

j) Listed below are percentage differences between the proposed monthly fixed charge for commercial and industrial customers and the OEB Cost Allocation model ceilings. The calculation uses the average forecast number of customers in 2021. The result of the calculation is the following average ratios for the commercial and industrial rate classes:

- Customer Unit Cost per month - Avoided Cost - 92%
- Customer Unit Cost per month - Directly Related - 86%
- Customer Unit Cost per month - Minimum System with PLCC Adjustment - 28%

k) Please see Table A for the number of customers in each of the commercial and industrial rate classes as of December 31, 2019. Please refer to UPDATED Exhibit 3-1-2: Accuracy of Load Forecast and Variance Analyses, Table 9, for the average number of customers by class by year.

Table A – Customer Count for Commercial and Industrial Rate Classes - as of December 31, 2019 (Year End)

	GS<50	GS 50 to 1,499kW	GS 1,500 to 4,999kW	Large Use	Street Lighting	Sentinel Lights	USL	Standby	Total
2019	25,080	3,148	68	11	61,363	57	3,321	2	92,760

l) Please see Table B below for fixed charges by customer class. Note that all rate classes have been included.

Table B – Fixed Charges by Customer Class ($'000s)

	Residential	GS <50	GS 50 to 1,499 kW	GS 1,500 to 4,999 kW	Large Use	Street Light	Sentinel	Unmetered Scattered Load	Standby	Total
2018 A	$74,847	$5,536	$7,706	$3,386	$2,278	$607	$2	$199	$3	$94,564
2019 A	$90,538	$5,749	$7,654	$3,396	$2,011	$647	$2	$203	$3	$110,203
2020 F	$104,308	$5,787	$8,179	$3,825	$2,011	$606	$2	$224	$4	$124,944
2021 F	$116,124	$6,280	$7,488	$3,422	$2,011	$716	$3	$223	$6	$136,272
2021 -2025 F	$649,213	$35,458	$40,292	$17,812	$10,371	$4,148	$18	$1,307	$32	$758,651

INTERROGATORY RESPONSE - ED-6

6

EXHIBIT REFERENCE:

Exhibit 1, Tab 1, Schedule 5, UPDATED, p. 8-14

SUBJECT AREA: Integrated Resource Planning

Question:

a) Please describe the processes at Hydro Ottawa to implement Integrated Resource Planning, with a particular focus on the consideration of non-wires solutions to system needs. Please file any internal documentation outlining said processes.

b) How does Hydro Ottawa ensure that non-wires options are identified and considered early enough in the planning process to ensure that they can be implemented in lieu of supply-side solutions where cost effective?

c) How does Hydro Ottawa calculate the net costs/benefits of non-wires solutions when comparing them to supply-side option? Please include all kinds of distributed energy resources in your answer, including energy efficiency, demand response, storage, and distributed generation. Please include a description of how avoided energy costs (e.g. the value of future energy savings from energy efficiency) are considered when comparing wires and non-wires solutions.

d) Does Hydro Ottawa always study potential non-wires solutions to system needs in its capital planning processes? If not, please explain the screening criteria that Hydro Ottawa uses to determine whether an assessment of non-wires solutions is warranted.

e) Does Hydro Ottawa agree that it is appropriate in certain circumstances for an LDC to procure or contract for distributed energy resources where doing so would be a more cost-effective alternative in comparison to a traditional supply-wide investment?

f) Does Hydro Ottawa agree that it is appropriate for it to earn a return if it is able to avoid a capital investment in wires or transformers through distributed energy resources such as energy efficiency, demand response, or storage?

g) Does Hydro Ottawa agree that it is important to give LDCs an incentive to adopt non-wires solutions to system needs where those solutions are more cost-effective?

h) Does Hydro Ottawa agree that the difference between the financial returns from wires and non-wires solutions creates a disincentive to implement non-wires solutions?

i) Has Hydro Ottawa sought approval to earn a return for avoiding a capital investment in wires or transformers through distributed energy resources such as energy efficiency, demand response, or storage?

j) How does Hydro Ottawa believe a financial return should be calculated for avoiding a capital investment in traditional supply-side infrastructure through distributed energy resources such as energy efficiency, demand response, or storage?

RESPONSE:

a) Hydro Ottawa participates in the process for Integrated Regional Resource Planning that is administered by the IESO, pursuant to Section 8 of the OEB's *Distribution System Code*.[1]

[1] For an overview of the regional planning process, please see the IESO's website: http://www.ieso.ca/en/Get-Involved/Regional-Planning/About-Regional-Planning/Overview.

b) Hydro Ottawa ensures that non-wires options can be identified and considered early enough in the planning process by bringing attention to future potential capacity constraints and the required needs as early as possible in the regional planning process.

c) The IESO calculates the net costs/benefits of non-wires solutions when comparing them to supply-side options. Hydro Ottawa is not involved in this process.

d) Yes, Hydro Ottawa studies non-wire alternatives in its capital planning process, specifically through the IRRP process with the IESO.

e) Hydro Ottawa evaluates all potential alternatives for capital investment, including non-wires solutions, and strives to balance cost versus performance when renewing or installing additional infrastructure. Hydro Ottawa also endeavours to improve safety, reliability, and financial performance, while holding overall existing performance steady.

f) Hydro Ottawa observes that Section 4.1 of the OEB's Conservation and Demand Management Requirement Guidelines for Electricity Distributors already permits distributors to seek distribution rate funding for various activities (e.g. conservation and demand management programs, demand response programs, energy storage programs, and programs reducing distribution losses) for the purpose of deferring the capital investment for specific distribution infrastructure.

With respect to commenting on the possibility or desirability of the OEB establishing additional mechanisms to allow a distributor to earn a rate of return if it is able to avoid a "wires" capital investment through distributed energy resources ("DERs"), Hydro Ottawa believes that it is more appropriate to offer such commentary in the context of an OEB generic hearing or policy consultation. The utility observes, for example, that there is an ongoing OEB policy consultation regarding Utility Remuneration and Responding to Distributed Energy Resources.[2] Hydro Ottawa does not wish to pre-empt or prejudice

[2] EB-2018-0287 and EB-2018-0288.

that consultation by offering policy-related comments in the context of the current proceeding, which is focused exclusively on determining the justness and reasonableness of the utility's proposed rates and charges for the 2021-2025 rate term.

g) Please see the second paragraph in the response to part (f) above.

h) Please see the second paragraph in the response to part (f) above.

i) Hydro Ottawa has not previously filed an application under Section 4.1 of the OEB's Conservation and Demand Management Requirement Guidelines for Electricity Distributors seeking approval to earn a return for avoiding a capital investment in wires or transformers through DERs. To confirm, the utility is not seeking such approval by way of this Application.

j) In step with the second paragraph in its response to part (f) above, Hydro Ottawa does not believe it is appropriate or relevant in the context of this proceeding to comment or speculate on such subject matter as the appropriate calculation for a financial return associated with avoiding a capital investment in traditional supply-side infrastructure through DERs.

INTERROGATORY RESPONSE - ED-7

7

EXHIBIT REFERENCE:

Exhibit 1, Tab 1, Schedule 5, UPDATED, p. 8-14

SUBJECT AREA: Integrated Resource Planning

Question:

a) Of the capital spending identified in the application, please identify which items are candidates for considering whether the need could be addressed most cost-effectively with distribution energy resources or non-wires solutions? For each, please describe the need addressed by the project and the cost of the supply-side solution.

b) Does Hydro Ottawa anticipate that the drop in electricity demand from COVID-19 will defer the need for some of the capital investments outlined in its application? If yes, would this potentially create a window to consider or reconsider non-wires solutions?

c) If Hydro Ottawa determines before the end of 2025 that a certain capital investment could be addressed more cost effectively through a non-wires solution, what regulatory steps would be required to implement that non-wires solution instead? Please consider a scenario where the non-wires solution is less expensive up-front and a scenario where the non-wires solution is more expensive up-front but is more cost-effective overall (e.g. due to future avoided energy costs).

d) Is Hydro Ottawa proposing to spend on any distributed energy resources (including energy efficiency, storage, etc.) to avoid more costly supply-side investments? If yes, please provide details and cite references to the evidence.

RESPONSE:

a) Hydro Ottawa has not identified any item that would be a candidate for consideration as to whether the need could be addressed most cost-effectively with distributed energy resources or non-wires solutions.

b) The possibility that COVID-19 might reduce or defer the need is unknown at this point. Please see the response to interrogatory SEC-1 for additional information on how Hydro Ottawa is assessing the impacts of COVID-19 on its business and operations.

c) Hydro Ottawa is interpreting the question as (i) assuming that the utility would be the owner of the non-wires solution and (ii) inquiring into the regulatory action that would be required on the utility's part to implement the solution.

If the non-wires solution is an embedded generation facility, Hydro Ottawa would be required to undertake a connection impact assessment, in accordance with Section 6.2A of the OEB's *Distribution System Code*. In addition, the utility would need to establish a net metering billing arrangement for the generation facility's account, in accordance with Ontario's net metering regulation (O. Reg. 541/05: Net Metering).

With respect to the prospect of developing an embedded generation facility as a non-wires solution in lieu of a capital investment, Hydro Ottawa would be restricted to owning and operating a renewable energy generation facility that does not exceed 10 megawatts or other such capacity as may be prescribed by regulation, consistent with Section 71(3) of the *Ontario Energy Board Act, 1998.*

If the non-wires solution is an energy storage facility, Hydro Ottawa is not aware of any regulatory requirement that would need to be fulfilled.

If the non-wires solution is intended to avoid or defer capital investment for specific

distribution infrastructure, and if Hydro Ottawa wishes to seek distribution rate funding for the solution, then the utility would be required to submit an application to the OEB for approval in accordance with Section 4.1 of the OEB's Conservation and Demand Management Requirement Guidelines for Electricity Distributors.

d) No, Hydro Ottawa's capital expenditure plan does not include any distributed energy resources to avoid supply-side investments.

INTERROGATORY RESPONSE - ED-8

8

EXHIBIT REFERENCE:

Exhibit 1, Tab, Schedule 5, UPDATED p. 8-14

SUBJECT AREA: Integrated Resource Planning

Preamble: These questions relate to the planned investments described in Exhibit 1, Tab 1, Schedule 5, UPDATED, p. 14, tables 6 and 7.

Question:

a) For each investment, please quantify and describe the need to be addressed.

b) For each investment, please discuss (i) the possibility that COVID-19 might reduce or defer the need and (ii) whether this may provide additional time to consider or implement non-wires solutions.

c) For each investment, describe the efforts taken so far to consider distributed energy resources as a potentially more cost-effective alternative. Please expressly address (i) energy efficiency and (ii) a combination of options, such as energy efficiency coupled with storage. Please file any analysis or related documentation that Hydro Ottawa has prepared in this regard.

d) For each investment to be made by HONI in relation to Ottawa, please describe whether and how HONI and Hydro Ottawa have or will be working together to consider non-wires alternatives.

RESPONSE:

a) The needs assessment methodology implemented in the Integrated Regional Resource Plan ("IRRP") is described in Section 6.1 of the IRRP report. Please see Attachment PP-11(A): Ottawa Sub-Region 2020 IRRP for a copy of the report.

b) Factors such as capacity, reliability, and end-of-life asset replacement are taken into consideration in the identification of electricity needs in the Greater Ottawa area. A single quantity for each need was not assigned in the IRRP since all factors need to be considered.

The possibility that COVID-19 might reduce or defer the need is unknown at this point. Please see the response to the interrogatory SEC-1 for additional information on how Hydro Ottawa is assessing the impacts of COVID-19 on its business and operations.

c) The efforts taken to consider distributed energy resources as potentially more cost-effective alternatives are described in the IRRP report, Section 7.1.1- Consideration of Non-Wires Options.

d) Hydro Ottawa will continue to participate in the IRRP process in collaboration with the IESO and Hydro One Networks to develop a plan that integrates a variety of resource options to address the electricity needs of the region.

INTERROGATORY RESPONSE - ED-9

9

EXHIBIT REFERENCE:

Exhibit 1, Tab 1, Schedule 5, UPDATED, p. 8-14

SUBJECT AREA: Integrated Resource Planning

Preamble:

During the OEB's Distributed Energy Resources process, Mike Fletcher, Project Manager, Building Engineering and Energy Management for the City of Ottawa made these comments relating to integrated resource planning, and a lost opportunity to examine a non-wires alternative:

> 13 That was the case in south Nepean. Basically we ran
> 14 out of time to look at non-wire solutions. Nobody's fault,
> 15 really, but it would be nice not to have that reoccur in,
> 16 you know, in everybody's interest.[1]

Questions:

a) Please describe the above-referenced situation in South Nepean and why the time ran out to look at non-wires solutions.

b) Please describe what lessons have been learned from this situation and what, if anything, Hydro Ottawa commits to do differently in the future.

[1] EB-2018-0287/0288 Distributed Energy Resources and Remuneration, Transcript, Stakeholder Conference, September 19, 2019, p. 42.

c) Will Hydro Ottawa commit in its interrogatory response to review this situation further and determine what other changes are needed to avoid running out of time to look at non-wires solutions?

RESPONSE:

a) The situation in question pertains to the Cambrian Municipal Transformer Station ("MTS"), which was previously known as the South Nepean MTS. Hydro Ottawa received approval from the OEB to proceed with construction of the Cambrian MTS, as part of the OEB's Decision and Order on Hydro Ottawa and Hydro One Networks' ("HONI") joint application under Section 92 of the OEB Act for leave to construct the Power South Nepean Project.[2]

The Section 92 application was supported by rigorous, objective evidence that demonstrated how the Power South Nepean Project was the most cost-effective solution to address the identified supply capacity need in the South Nepean area of the City of Ottawa. A key component of the evidence in support of the project need was a copy of the IESO's Ottawa Area Integrated Regional Resource Plan ("IRRP"), dated April 2015, and the Greater Ottawa Regional Infrastructure Plan ("RIP"), dated December 2015. Both reports confirmed the need for additional supply capacity in the South Nepean area to address the forecast demand.

In addition, the evidence in support of need included a copy of the IESO's "Handoff Letter" issued in April 2016 to Hydro Ottawa and HONI. This letter directed the initiation of a transmission project to supply growing demand in South Nepean, in accordance with the needs identified in the 2015 Ottawa Area IRRP and RIP.

The following findings in the IESO's Handoff Letter are particularly germane to this interrogatory response:

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[2] Ontario Energy Board, *Decision and Order*, EB-2019-0077 (October 17, 2019).

> *"Additional conservation, local generation, and transmission and distribution expansion were considered as means of increasing supply capacity in South Nepean. Given the near-term timing of the need for additional supply, in order for a solution to be feasible it must provide firm capacity in about five years, and be able to meet the total capacity need of over 60 MW by the end of the forecast period.*
>
> *In order to rely entirely on conservation initiatives to provide additional capacity, more than four times the currently targeted level would need to be achieved. In terms of local generation, the magnitude of generation which would need to be connected to the distribution system in order to offset the need for additional station capacity is significantly higher than the historical uptake in the area. In addition, a distribution station like Fallowfield DS is not capable of absorbing a large amount of generation due to equipment rating limitations such as short circuit and thermal limits. New transmission connected generation in the area would not address the station limitation.*
>
> *Based on the timeline and magnitude of the need for additional supply capacity in South Nepean, it is clear that it will not be feasible to address the need through additional conservation and local generation. Therefore, a new supply station and connection line are recommended for the South Nepean area."*[3]

A key point of emphasis in the IESO's Handoff Letter is that the construction of the Cambrian MTS was not only beneficial and necessary for purposes of fulfilling the required *timeline* to meet the supply capacity need in the South Nepean area, it was also an appropriate solution in the context of the *magnitude* of the need.

b) Consistent with Hydro Ottawa's responses to various parts of interrogatory ED-6, the utility remains committed to evaluating all potential alternatives for capital investment,

[3] Independent Electricity System Operator, Near-term Transmission Project Hand-off Letter to Hydro One and Hydro Ottawa (April 25, 2016), page 5. A copy of this letter was included as Exhibit B, Tab 3, Schedule 1, Attachment 3 in the Leave to Construct application for the Power South Nepean Project (EB-2019-0077).

studying non-wires solutions in its capital planning process, and ensuring that non-wires options can be identified and considered as early as possible in the planning process.

c) In its Decision and Order on Hydro Ottawa and HONI's joint Leave to Construct application seeking approval for the Power South Nepean Project, the OEB issued the following finding:

> *"As part of the OEB's required consideration of prices, the OEB is satisfied that the applicants have established the need for the project, a need that has been confirmed by the IESO. The Project is in conformance with the IESO's 2015 Ottawa Area IRRP and in keeping with the IESO's assessment of the growing electricity demand of customers to be served by the Project...*
>
> *[T]he IRRP process considered whether the need could be addressed through additional CDM or local generation, and determined that immediate needs could not be met by either of these alternatives."*[4]

In addition, the OEB noted that no evidence had been placed on the record contradicting the conclusions of the IESO with respect to the Project need.[5]

Based upon the conclusions reached by both the IESO and the OEB in their respective capacities, Hydro Ottawa does not believe that any additional review of the need, or the evidence in support of the need, for Cambrian MTS is required.

As a final point of observation, Hydro Ottawa observes that it is actively evaluating and pursuing non-wires solutions to meet capacity and reliability needs in specific areas of its service territory. For example, in the Kanata North area, solutions include area-specific demand reduction programs. Please see section 8.1.4 of Exhibit 2-4-3: Distribution System Plan for further details. In addition, in March 2020 the IESO released an updated IRRP for the Ottawa Area. There is extensive discussion and evaluation of the potential

[4] Ontario Energy Board, *Decision and Order*, EB-2019-0077 (October 17, 2019), pages 6-7.
[5] *Ibid*, page 7.

role of non-wires solutions in Hydro Ottawa's service territory throughout that document. For a copy of this updated IRRP, please see Attachment PP-11(A): Ottawa Sub-Region 2020 IRRP.

INTERROGATORY RESPONSE - ED-10

10

EXHIBIT REFERENCE:

Exhibit 1, Tab 1, Schedule 5, UPDATED, p. 8-14

SUBJECT AREA: Integrated Resource Planning

Preamble:

During the OEB's Distributed Energy Resources process, Mike Fletcher, Project Manager, Building Engineering and Energy Management for the City of Ottawa made these comments relating to the possibility of decommissioning a 130 kV line.

> 11 So going into Orleans, one option would involve
> 12 decommissioning a 130 kV line, and again that's a
> 13 municipality that likes intensification, we put our hand up
> 14 for that option and when I made comments to the IESO, I
> 15 said, well, that is a big vote in favour of that. I don't
> 16 know how we are going to go on to weigh the factors, but
> 17 you know, as a municipality, costs of running a
> 18 municipality go do if we can intensify.

Questions:

a) What role has Hydro Ottawa taken in support of the possibility of decommissioning this line?

b) How would Hydro Ottawa and the IESO calculate the value of decommissioning this line such that the land can be used for other purposes?

RESPONSE:

a) Load in Orleans continues to grow in the form of intensification and new subdivisions, as described in Exhibit 2-4-3: Distribution System Plan, section 7.2.5.3. In order to support the long-term growth of Orleans and improve reliability performance, Hydro Ottawa has supported the refurbishment option of Bilberry TS, as outlined in the IESO's latest Integrated Regional Resource Plan for the Ottawa Area sub-region.[1]

b) Hydro Ottawa is not involved in the value calculations of decommissioning transmission lines.

[1] For a copy of the latest IRRP plan, please see Attachment PP-11(A): Ottawa Sub-Region 2020 IRRP.

INTERROGATORY RESPONSE - ED-11

11

EXHIBIT REFERENCE:

Exhibit 1, Tab 1, Schedule 9, UPDATED, May 5, 2020, Page 19

SUBJECT AREA: Climate Change

Questions:

a) Please file a copy of Ottawa's Climate Change Action Plan and its declaration regarding a climate crisis.

b) Please confirm Ottawa's GHG reduction targets.

c) Please provide Ottawa's planned reductions in GHGs from electricity to meet its overall GHG targets.

d) What are Hydro Ottawa's roles and responsibilities in relation to Ottawa's Climate Change Action Plan and related climate change policies?

e) Please provide the information used in the Climate Change Action Plan modelling of the "business as usual" scenario for electricity use, electricity carbon intensity, and GHG's arising from electricity use.

Ottawa's Electricity Demand and GHGs Per Climate Planning Documents					
	2020	2021	…	2049	2050
Annual Electricity Demand (kWh)					
Carbon Intensity of Electricity (CO2e/kWh)					
GHGs from Electricity Use (CO2e)					

f) If it differs from the above, please provide the information used in Ottawa's "Modelling Ottawa's Greenhouse Gas Emissions to 2050"[1] for electricity use, electricity carbon intensity, and GHG's arising from electricity use.

Ottawa's Electricity Demand and GHGs Per Climate Planning Documents					
	2020	2021	…	2049	2050
Annual Electricity Demand (kWh)					
Carbon Intensity of Electricity (CO2e/kWh)					
GHGs from Electricity Use (CO2e)					

g) According to the IESO's January 2020 Annual Planning Outlook[2], the carbon intensity of electricity is forecast to increase significantly between now and 2040 under the reference case. Please calculate the impact of this increase on the GHG emissions arising from Ottawa's electricity usage in the following table:

Ottawa's Carbon Emissions from Electricity – Impact of Increased Carbon Intensity					
	2020	2021	…	2040	Total
Annual Electricity Demand – Ottawa (kWh)					
Scenario 1 – Carbon Intensity Remains at 2019 Levels					
Carbon Intensity of Electricity (CO2e/kWh) -					
GHGs from Electricity Use (CO2e)					
Scenario 2 – Cabron Intensity Increases per IESO Annual Planning Outlook Reference Case					
Carbon Intensity of Electricity (CO2e/kWh) -					
GHGs from Electricity Use (CO2e)					
Percent Difference in GHG Levels Between Scenario 1 and 2					

[1] https://app05.ottawa.ca/sirepub/cache/2/ovrfoz1xumuuxu3z2a2wevdp/628023050820201238227 66.PDF

[2] http://www.ieso.ca/-/media/Files/IESO/Document-Library/planning-forecasts/apo/Annual-Planning-Outlook-Jan2020.pdf?la=en; see also the data tables at http://www.ieso.ca/-/media/Files/IESO/Document-Library/planning-forecasts/apo/Annual-Planning-Outlook-Data-Tables-Jan2020.xlsx?la=en .

h) Please confirm that the forecast increase in carbon intensity of electricity is due to forecast increases in gas-fired electricity generation.

i) Has Hydro Ottawa provided the City of Ottawa with an updated forecast of GHG emissions arising from electricity use in the City as a result the forecast increases in gas-fired electricity generation? If yes, when was that provided?

For each of the above, please make assumptions as necessary and state all assumptions. If the calculations are a challenge, please answer the question on a best-efforts basis and with any caveats as necessary. If certain parts of the answer cannot be estimated, please explain why and complete as much of the answer as possible. If an answer cannot be provided for the complete period, please provide an answer for as far into the future as feasible. If Ottawa's electricity demand cannot be forecast beyond 2025, please assume that demand remains at 2025 levels.

RESPONSE:

a) Please see Attachment ED-11(A): City of Ottawa Climate Change Master Plan. This document was approved by Ottawa City Council on January 29, 2020. Please also see Attachment ED-11(B): City of Ottawa Declaration of Climate Emergency. This resolution was approved by City Council on April 24, 2019.

b) As per the aforementioned *Climate Change Master Plan*, the City of Ottawa has adopted formal "community" and "corporate" greenhouse gas ("GHG") reduction targets. "Community" emissions refer to all emissions generated within the City of Ottawa's geographical boundaries, while "corporate" emissions refer to emissions from the City of Ottawa's own operations (e.g. facilities, fleet, etc.). Both sets of GHG reduction targets are relative to 2012 baseline emission levels.

Ottawa's community GHG emission reduction targets are as follows:

- 43% by 2025
- 68% by 2030
- 96% by 2040
- 100% by 2050

Ottawa's corporate GHG emission reduction targets are as follows:

- 30% by 2025
- 50% by 2030
- 100% by 2040

For additional information, please see the City of Ottawa's website.[3]

c) According to the draft modelling that the City of Ottawa has performed in support of its renewable energy strategy initiative known as "Energy Evolution," reductions in GHG emissions from the electricity sector are expected to represent 7% of total projected GHG emission reductions by 2030, and 9% of total projected emission reductions by 2050.[4]

d) Hydro Ottawa has been actively engaged in the development and implementation of the City of Ottawa's Energy Evolution initiative since its inception in 2015. In addition, the utility is in the early stages of collaboration with the City on specific priorities identified in the *Climate Change Master Plan*.

Examples of the substantive participation that Hydro Ottawa has maintained in Energy Evolution and related City of Ottawa renewable energy and climate change activities over the past five years include, but are not limited to, the following:

[3] https://ottawa.ca/en/planning-development-and-construction/official-plan-and-master-plans/climate-change-master-plan.

[4] https://ottawa.ca/en/living-ottawa/environment/climate-change-and-energy/energy-evolution.

- Sounding Board: Hydro Ottawa executives and senior managers have been active members of this group of stakeholders that was convened by City staff to help define a vision, approach, and process for the preparation of options and recommendations to support achievement of Energy Evolution's core objectives.

- Working Groups: City staff established eight stakeholder working groups to facilitate discussion and action on specific aspects of Energy Evolution (Vision, Communication and Engagement, New Buildings, Existing Buildings, Transportation, Energy Supply and Distribution, Funding, Governance). Hydro Ottawa senior management and staff have participated in several of these working groups.

  In addition, in 2018 the City formed a dedicated External Advisory Working Group to provide guidance and feedback on the development of the second phase work under Energy Evolution. Hydro Ottawa has likewise been represented on this group.

- Stakeholder Workshops and Meetings: Hydro Ottawa executives, senior management, and subject matter experts have participated in the numerous workshops and meetings held by City staff to secure input from stakeholders on a range of issues related to the design and implementation of Energy Evolution. These meetings have included workshops organized by City staff to gather feedback from stakeholder experts on how specific energy technologies may be developed in Ottawa and what specific projects and initiatives may be actionable within targeted timeframes.

  In addition to attending and participating in City-led meetings, Hydro Ottawa has also provided opportunities for City staff to directly engage the utility's own stakeholders and customers. For example, Hydro Ottawa provided City staff with

a platform to discuss Energy Evolution at one of the utility's annual forums with Key Account customers.

- Catalyst Project: City Council's 2017 budget included funding to support catalyst projects under the auspices of Energy Evolution that will increase energy conservation, energy efficiency, and renewable energy in Ottawa. Hydro Ottawa secured funding from this program for a project entitled "Supplemental Use of Electric Water Heating for Environmental and Cost Reduction." This project involved the piloting of a proof of concept solution using clean, efficient electricity to supplement the use of natural gas boilers for space heating. Based upon results, the City is assessing various opportunities and scenarios for using electricity to reduce GHG emissions and energy costs at municipal facilities.

- Use of Surplus Dividend from Hydro Ottawa: In 2016, City Council adopted a new policy governing the receipt of dividends from Hydro Ottawa.[5] The scope of the amended dividend policy applies to regulated net income only. The policy mandates that annual dividends will be the larger of (i) 60% of the net income of Hydro Ottawa Limited, or (ii) $20 million.

  In December 2017, City Council passed a motion stipulating that any surplus in the dividend received from Hydro Ottawa in 2018 (i.e. any amount above the threshold established in the 2016 dividend policy) would be allocated such that 2/3 of the amount be directed towards road resurfacing and that 1/3 be directed towards energy efficiency programs. For 2018, this resulted in an extra $633,000 being available for projects and programs in support of Energy Evolution.

  In April 2019, City Council passed a motion declaring a climate emergency for purposes of naming, framing, and deepening the City's commitment to protecting

[5] The City of Ottawa is the sole shareholder of Hydro Ottawa Holding Inc., the parent company of Hydro Ottawa Limited. For additional information on Hydro Ottawa's corporate governance and structure, please see Exhibit 1-4-1 in this Application.

its economy, ecosystems, and community from climate change. As part of the motion, City Council directed City staff to report back within the 2019 calendar year on a spending plan for any surplus dividend from Hydro Ottawa that would help reduce community and corporate GHG emissions beyond the scope of Ottawa's climate targets while also saving money.

In January 2020, as part of its motion adopting new community and corporate GHG emission reduction targets, City Council directed City Staff to propose a spending plan for the 2019 Hydro Ottawa Dividend Surplus once the value of the dividend surplus is known.

- Phase 1 Projects: City Council formally received Phase 1 of Energy Evolution in December 2017. Phase 1 focused primarily on renewable energy generation opportunities and included a three-year action plan with over 30 initiatives that are targeted for completion in partnership with community stakeholders. Hydro Ottawa and its affiliates were identified as preferred partners for four of these action items (i.e. in relation to virtual net metering, construction of a solar park at a municipal waste facility, discussion of options for facilitating grid connections for renewable resources, and expansion of rebate programs for heat pumps).

  In addition, Hydro Ottawa provided strategic and technical advice to City staff in 2017, in support of the City's applications to the Government of Ontario's Municipal GHG Challenge Fund.[6] The City was seeking funding for energy retrofits and upgrades at various municipal facilities, consistent with the policy direction set forth in Energy Evolution. In April 2018, the government announced five funding awards for the City of Ottawa, four of which involved facility projects whose applications had been informed by Hydro Ottawa's support.

[6] The Municipal GHG Challenge Fund was administered under the auspices of the previous Government of Ontario's *Climate Change Action Plan*, with the goal of supporting community-led action on climate change.

- Phase 2 Projects: In conjunction with its receipt and approval of Phase 1, City Council formally directed City staff to initiate plans for Phase 2, with a focus on reducing energy use in the building and transportation sectors. Over the course of 2018 and 2019, Hydro Ottawa representatives provided input to City staff on the development of the pathway studies set to govern Phase 2 activity on buildings, transportation, demand side management and energy storage, and energy from waste.

  In June 2019, Hydro Ottawa attended a series of meetings hosted by City staff to share the results of modelling that was conducted based upon the technical analysis set forth in the pathway studies. The results spoke to what steps will be required in order for the City to achieve its 2050 GHG emission reduction targets.

  At present, City staff is preparing its final strategy and action plan for Phase 2, which is scheduled to be presented to City Council for approval later in 2020.

Finally, with respect to how Hydro Ottawa is integrating Energy Evolution into its system planning, please see section 1.10.3 of Exhibit 2-4-3: Distribution System Plan.

e) Information related to the GHG modelling that was performed by the City of Ottawa to inform its *Climate Change Master Plan* is appended as Attachment ED-11(C): Ottawa GHG Emissions to 2050 - Draft Modelling Results. In addition, Attachment ED-11(D): Data, Methods & Assumptions Manual - City of Ottawa Community Energy Strategy is a copy of the manual prepared for the City to illustrate the modeling approach used to provide energy and emissions benchmarks and projections.

Hydro Ottawa does not have access to any other sources of information from the City that would enable the utility to complete the data request made by Environmental Defence. Moreover, Hydro Ottawa respectfully submits that Environmental Defence has not established a clear connection between the requested data and the limited scope of

the current proceeding, which is the review of the utility's proposed rates and charges for the 2021-2025 term.

f) Please see the response to part (e) above.

g) Calculating the impact of the expected increase in province-wide electricity sector GHG emissions through 2040 on the GHG emissions arising from Ottawa's electricity usage would entail significant effort on Hydro Ottawa's part. Within the limited timeframe available for responding to interrogatories, the utility is not able to commit the staff resources necessary to perform these calculations. Moreover, Hydro Ottawa respectfully submits that Environmental Defence has not established a clear connection between the requested data and the limited scope of the current proceeding, which is the review of the utility's proposed rates and charges for the 2021-2025 term. The utility therefore declines to provide the information.

h) Hydro Ottawa confirms that in the *Annual Planning Outlook* released in January 2020, the IESO states the following: "Electricity sector emissions are forecast to increase to 11 megatonnes CO_2e by 2030, still well below 2005 levels. This expected increase is due to reduced nuclear production and increasing demand, resulting in increased production from gas-fired generation."[7]

i) No, Hydro Ottawa has not provided the City of Ottawa with an updated forecast of GHG emissions arising from electricity use in the City as a result of the forecast increases in gas-fired electricity generation.

[7] Independent Electricity System Operator, *Annual Planning Outlook* (January 2020), page 32.

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).

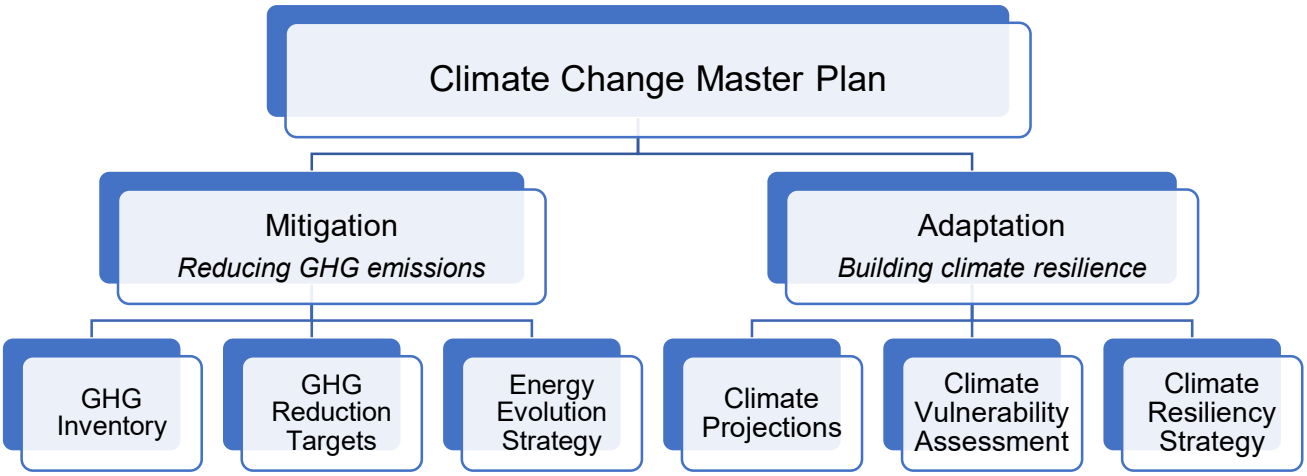

Figure 1: Ottawa's Climate Change Framework

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.

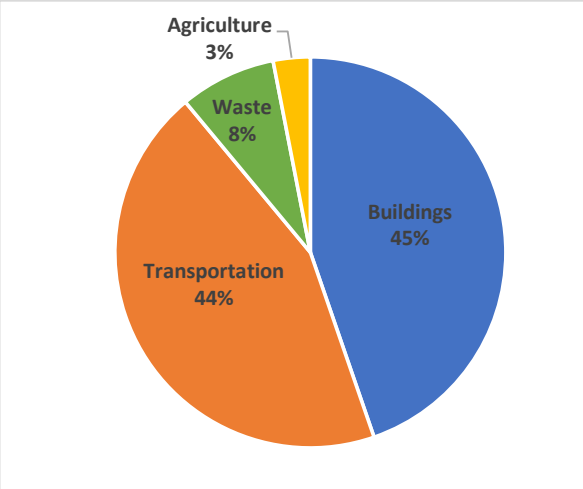

Figure 3: Community GHG Emissions by Sector (2018)

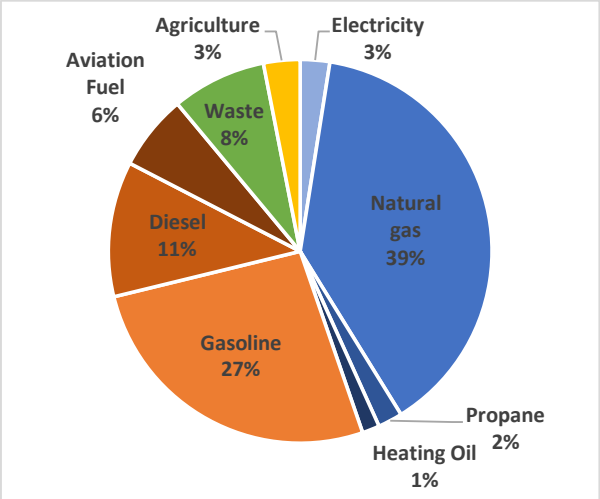

Figure 4: Community GHG Emissions by Source (2018)

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.

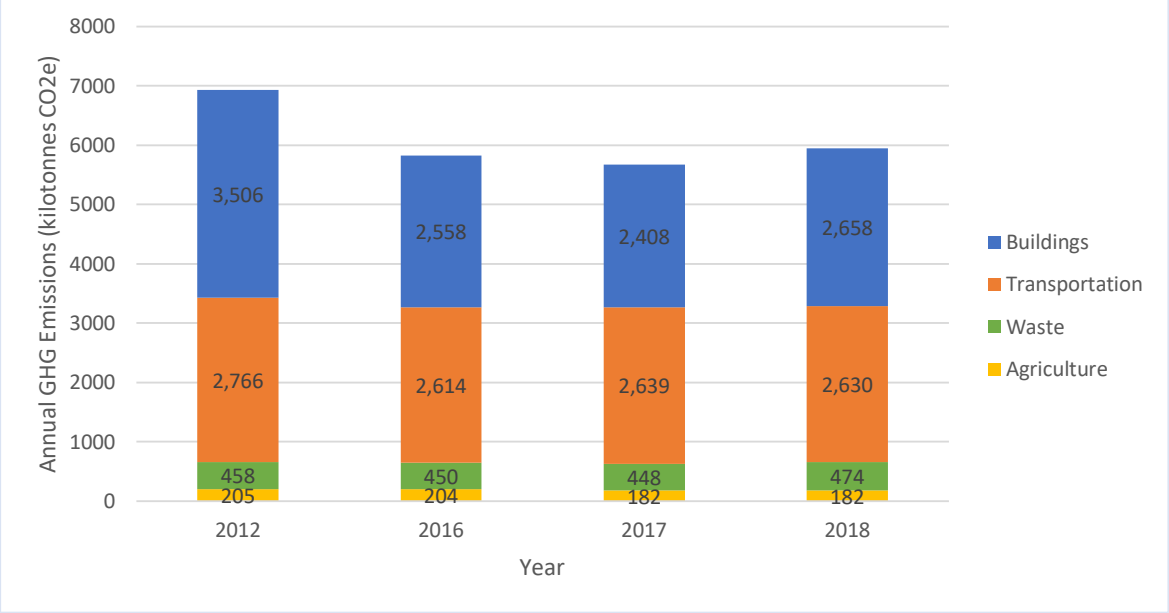

Figure 5: Annual Community GHG Emissions by Sector Since 2012

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]

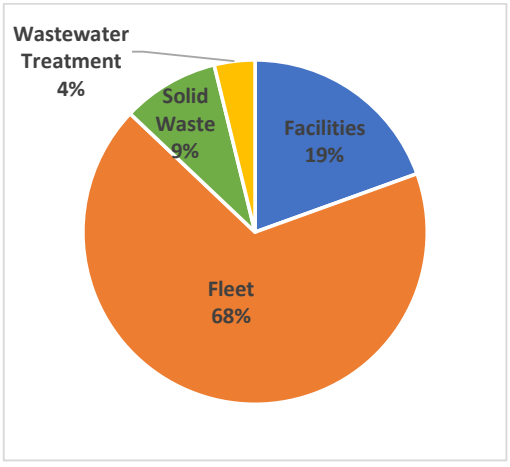

Figure 6: Corporate GHG Emissions by Sector (2018)

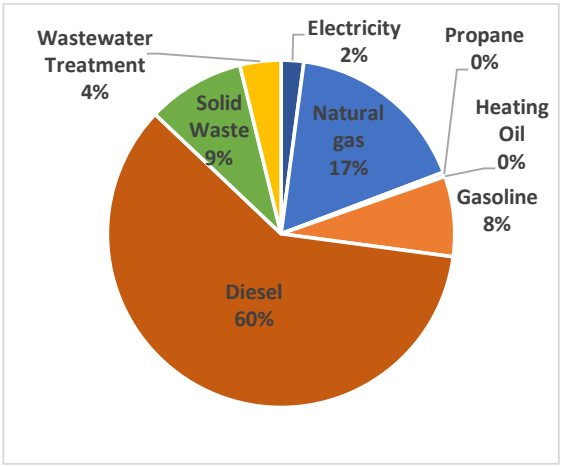

Figure 7: Corporate GHG Emissions by Source (2018)

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.

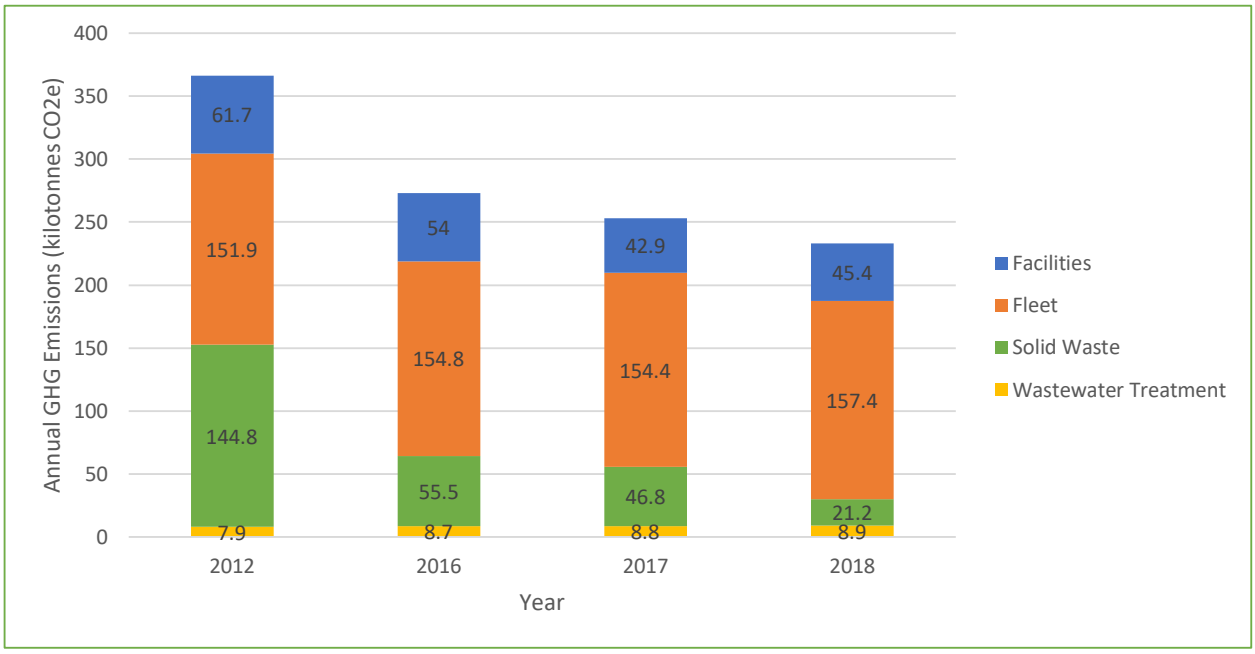

Figure 8: Annual Corporate GHG Emissions by Sector Since 2012

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).

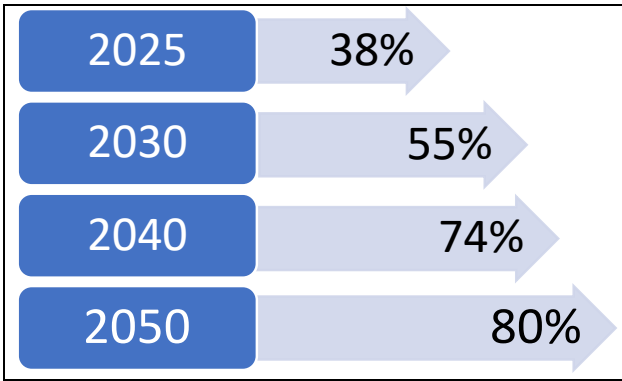

Figure 9: Short, mid and long-term community targets to reach 80 per cent by 2050 targets

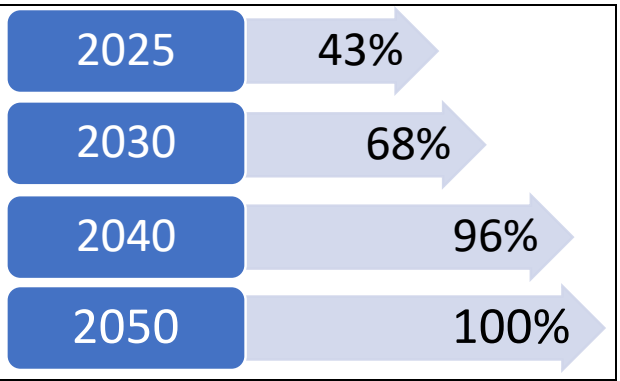

Figure 10: Short, mid and long-term community targets to reach 100 per cent by 2050 target

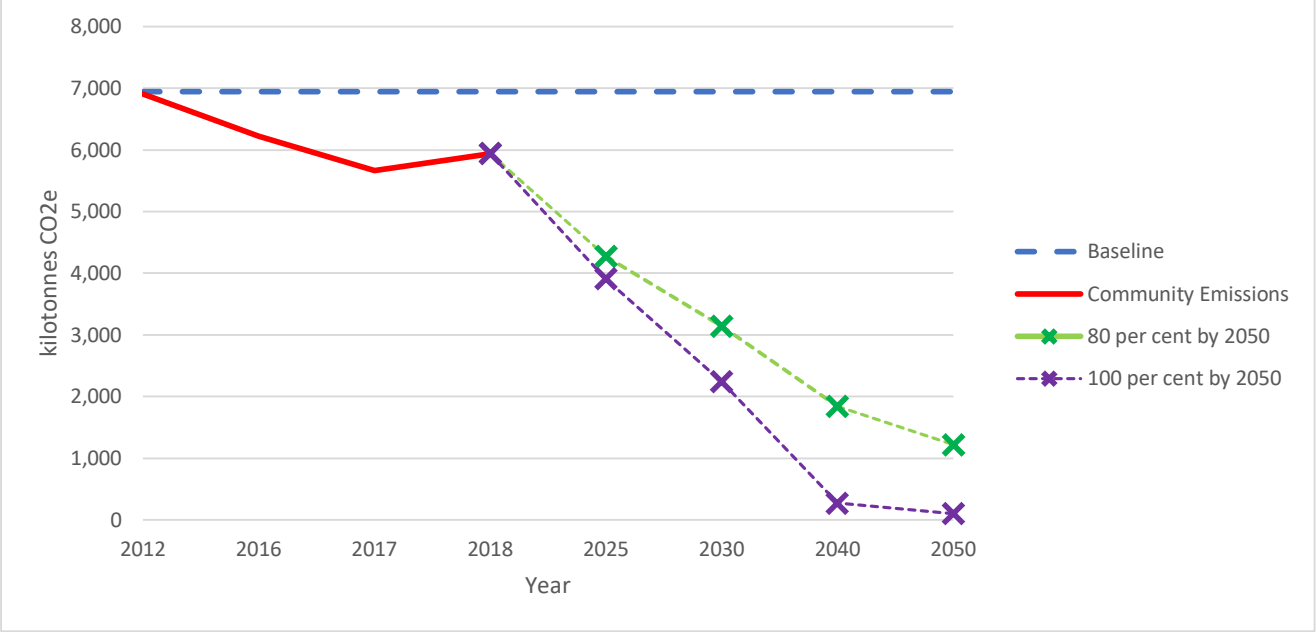

Figure 11: Progress towards achieving community GHG emission reduction targets

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.

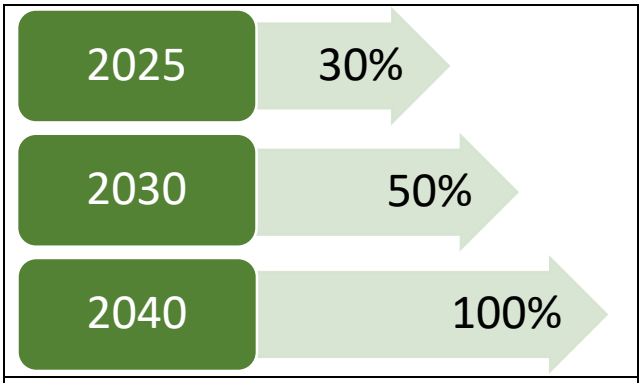

Figure 12: Short, mid and long-term corporate targets to reach 100 per cent by 2040 target

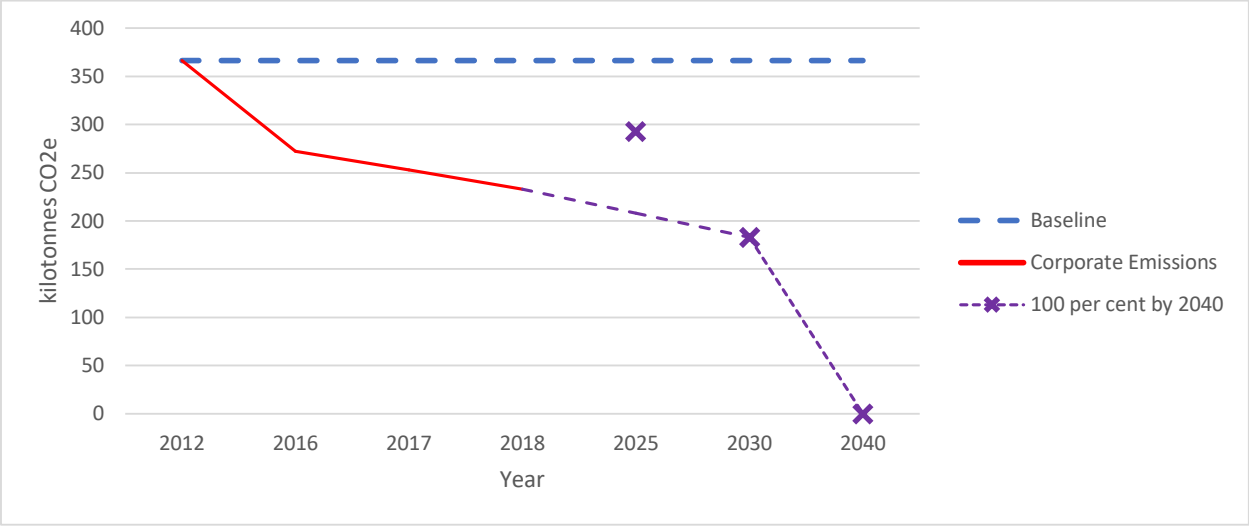

Figure 13: Progress towards achieving corporate GHG reduction targets

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
[ii] Carrington, D. (2019) Climate Crisis: 11,000 scientists warn of 'untold suffering', *The Guardian*, 5 Nov. https://www.theguardian.com/environment/2019/nov/05/climate-crisis-11000-scientists-warn-of-untold-suffering
[iii] UNFCC. The Paris Agreement. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
[iv] 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
[v] Ibid
[vi] Climate Atlas of Canada. July 10, 2019. https://climateatlas.ca/report_v2/grid/299
[vii] Insurance Bureau of Canada
[viii] Carbon Disclosure Project. https://www.cdp.net/en/research/global-reports/cities-at-risk
[ix] Federation of Canadian Municipalities. https://fcm.ca/en/focus-areas/climate-and-sustainability
[x] UNFCC. The Paris Agreement. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
[xi] UNFCC. Paris Agreement – Status of Ratification. Viewed July 31 2019. https://unfccc.int/process/the-paris-agreement/status-of-ratification
[xii] World Resources Institute. Half a Degree and a World Apart: The Difference in Climate Impacts Between 1.5ºC and 2ºC of Warming. October 07 2018. https://www.wri.org/blog/2018/10/half-degree-and-world-apart-difference-climate-impacts-between-15-c-and-2-c-warming
[xiii] 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
[xiv] Climate Emergency Declaration. Climate emergency declarations in 901 jurisdictions and local governments cover 200 million citizens. July 31 2019. https://climateemergencydeclaration.org/climate-emergency-declarations-cover-15-million-citizens/
[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

STANDING COMMITTEE ON ENVIRONMENTAL PROTECTION, WATER AND WASTE MANAGEMENT

REPORT 2
24 APRIL 2019

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COMITÉ PERMANENT DE LA PROTECTION DE L'ENVIRONNEMENT, DE L'EAU ET DE LA GESTION DES DÉCHETS

RAPPORT 2
LE 24 AVRIL 2019

3. CITY OF OTTAWA – DECLARATION OF CLIMATE EMERGENCY

VILLE D'OTTAWA – DÉCLARATION SUR L'URGENCE CLIMATIQUE

COMMITTEE RECOMMENDATIONS

That Council:

1. **Officially declare a climate emergency for the purposes of naming, framing, and deepening our commitment to protecting our economy, our eco systems, and our community from climate change;**

2. **Establish a Council Sponsors Group comprised of representatives from the Standing Committee on Environmental Protection, Water and Waste Management, Planning Committee, Transportation Committee, Transit Commission, the Ottawa Board of Health and the Councillor Liaison of the Environmental Stewardship Advisory Committee;**

3. **Direct City staff to include the following in the review and update of the Air Quality and Climate Change Management Plan (AQCCMP):**

    a) **An analysis of how the AQCCMP's long term target to reduce GHG emissions 80% below 2012 levels by 2050 compares to the IPCC's targets for limiting global warming to 1.5 ºC**

    b) **Midterm (2030) corporate and community GHG emission reduction targets**

    c) **Climate Change mitigation and adaptation priorities for next five years (2019-2024) to embed climate change considerations across all elements of City business;**

4. Direct City staff to include the following in the Energy Evolution Final Report:

a) Status update of Energy Evolution Phase 1 actions

b) New concrete actions and resource implications (staff and financial) to achieve GHG emission reduction targets

c) Use an equity and inclusion lens in the prioritization of actions

d) Funding and savings options for the City when implementing emission reductions;

5. Direct City staff to report back, within the 2019 calendar year, on a spending plan for the Hydro Ottawa Dividends Surplus that would help reduce community and corporate GHG emissions beyond the scope of the City's current climate targets while also saving money;

6. Direct City staff to complete a vulnerability assessment and develop a climate resiliency strategy to reduce the impacts of a changing climate;

7. Recognize climate change as a strategic priority in the City's strategic plan and accompanying budget directions for the remaining Term of Council; and

8. Work with senior levels of government to accelerate ambition and action to meet the urgency of climate change and provide additional resources for municipalities and the public to reduce their GHG emissions and build resiliency to climate impacts.

STANDING COMMITTEE ON ENVIRONMENTAL PROTECTION, WATER AND WASTE MANAGEMENT

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COMITÉ PERMANENT DE LA PROTECTION DE L'ENVIRONNEMENT, DE L'EAU ET DE LA GESTION DES DÉCHETS

REPORT 2
24 APRIL 2019

RAPPORT 2
LE 24 AVRIL 2019

RECOMMANDATIONS DU COMITÉ

Que le Conseil :

1. **déclare officiellement une urgence climatique afin de nommer, d'encadrer et d'intensifier notre engagement à protéger notre économie, nos écosystèmes et nos communautés des changements climatiques;**

2. **établisse un groupe de parrains du Conseil composé de représentants du Comité permanent de la protection de l'environnement, de l'eau et de la gestion des déchets, du Comité de l'urbanisme, du Comité des transports, de la Commission du transport en commun, du Conseil de santé d'Ottawa et du conseiller de liaison du Comité consultatif sur la gérance environnementale;**

3. **demande au personnel de la Ville d'inclure les éléments suivants dans la révision et la mise à jour du Plan de gestion de la qualité de l'air et des changements climatiques (PGQACC) :**

    a) **une analyse permettant de comparer les objectifs à long terme du PGQACC visant à réduire les émissions de GES de 80 % sous les niveaux de 2012 d'ici 2050 avec les objectifs du GIEC visant à limiter le réchauffement planétaire à 1,5 °C;**

    b) **les objectifs communautaires et municipaux de réduction des émissions de GES à moyen terme (2030);**

    c) **les priorités d'adaptation aux changements climatiques et d'atténuation de leurs effets pour les cinq prochaines années (2019-2024) afin d'ancrer les considérations relatives aux changements climatiques dans tous les éléments des activités de la Ville;**

4. demande au personnel de la Ville d'inclure les éléments suivants dans le rapport final sur le projet Évolution énergétique :

a) compte rendu sur les mesures prises durant la phase 1 de la stratégie Évolution énergétique;

b) nouvelles mesures concrètes et incidence sur les ressources (humaines et financières) pour atteindre les objectifs de réduction des émissions de GES;

c) l'emploi d'une optique d'équité et d'inclusion dans l'établissement des mesures prioritaires;

d) les options de financement et d'économies qui s'offriront à la Ville lorsqu'elle mettra en œuvre les réductions des émissions.

5. demande au personnel de la Ville de présenter un rapport, au cours de l'année civile 2019, sur un plan de dépenses pour les excédents de dividendes d'Hydro Ottawa qui aideraient à réduire les émissions communautaires et municipales de GES au-delà des objectifs actuels de la Ville en matière de climat tout en économisant de l'argent;

6. demande au personnel de la Ville de remplir une évaluation de la vulnérabilité et de mettre en place une stratégie de résilience face aux changements climatiques afin d'en limiter les effets;

7. reconnaisse les changements climatiques comme une priorité stratégique dans le Plan stratégique de la Ville et dans les lignes directrices du budget pour les prochaines années du mandat du Conseil;

8. travaille avec les instances supérieures pour nourrir son ambition et précipiter les mesures visant à répondre à l'urgence des

changements climatiques et à fournir des ressources supplémentaires aux municipalités et au public pour les aider à réduire leurs émissions de GES et à bâtir leur résilience envers les effets du climat.

DOCUMENTATION / DOCUMENTATION

1. Councillor S. Menard's report dated 5 April 2019.
(ACS2019-CCS-ENV-0005)

   Rapport du Conseiller S. Menard, daté le 5 avril 2019.
(ACS2019-CCS-ENV-0005)

2. Extract of Draft Minute, 16 April 2019.

   Extrait de l'ébauche du procès-verbal, le 16 avril 2019.

STANDING COMMITTEE ON ENVIRONMENTAL PROTECTION, WATER AND WASTE MANAGEMENT

REPORT 2
24 APRIL 2019

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COMITÉ PERMANENT DE LA PROTECTION DE L'ENVIRONNEMENT, DE L'EAU ET DE LA GESTION DES DÉCHETS

RAPPORT 2
LE 24 AVRIL 2019

Report to
Rapport au :

Standing Committee on Environmental Protection, Water and Waste Management
Comité permanent de la protection de l'environnement, de l'eau et de la gestion des déchets
16 April 2019 / 16 avril 2019

and Council
et au Conseil
24 April 2019 / 24 avril 2019

Submitted on April 5, 2019
Soumis le 5 avril 2019

Submitted by
Soumis par :
Councillor / Conseiller Shawn Menard,
Capital Ward / Quartier Capitale (17)

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Personne ressource :
Councillor / Conseiller Shawn Menard, Capital Ward / Quartier Capitale (17)
(613) 580-2487 Shawn.Menard@ottawa.ca

Ward: CITY WIDE / À L'ÉCHELLE DE LA VILLE

File Number: ACS2019-CCS-ENV-0005

SUBJECT: CITY OF OTTAWA – DECLARATION OF CLIMATE EMERGENCY

OBJET: VILLE D'OTTAWA – DÉCLARATION SUR L'URGENCE CLIMATIQUE

REPORT RECOMMENDATIONS

STANDING COMMITTEE ON ENVIRONMENTAL PROTECTION, WATER AND WASTE MANAGEMENT

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COMITÉ PERMANENT DE LA PROTECTION DE L'ENVIRONNEMENT, DE L'EAU ET DE LA GESTION DES DÉCHETS

REPORT 2
24 APRIL 2019

RAPPORT 2
LE 24 AVRIL 2019

That the Standing Committee on Environmental Protection, Water and Waste Management recommend Council:

1. **Officially declare a climate emergency for the purposes of naming, framing, and deepening our commitment to protecting our economy, our eco systems, and our community from climate change;**

2. **Establish a Council Sponsors Group comprised of representatives from the Standing Committee on Environmental Protection, Water and Waste Management, Planning Committee, Transportation Committee, Transit Commission, the Ottawa Board of Health and the Councillor Liaison of the Environmental Stewardship Advisory Committee;**

3. **Direct City staff to include the following in the review and update of the Air Quality and Climate Change Management Plan (AQCCMP):**

    a) **An analysis of how the AQCCMP's long term target to reduce GHG emissions 80% below 2012 levels by 2050 compares to the IPCC's targets for limiting global warming to 1.5 ºC**

    b) **Midterm (2030) corporate and community GHG emission reduction targets**

    c) **Climate Change mitigation and adaptation priorities for next five years (2019-2024) to embed climate change considerations across all elements of City business;**

4. **Direct City staff to include the following in the Energy Evolution Final Report:**

    a) **Status update of Energy Evolution Phase 1 actions**

    b) **New concrete actions and resource implications (staff and financial) to achieve GHG emission reduction targets**

c) Use an equity and inclusion lens in the prioritization of actions

d) Funding and savings options for the City when implementing emission reductions;

5. Direct City staff to report back, within the 2019 calendar year, on a spending plan for the Hydro Ottawa Dividends Surplus that would help reduce community and corporate GHG emissions beyond the scope of the City's current climate targets while also saving money;

6. Direct City staff to complete a vulnerability assessment and develop a climate resiliency strategy to reduce the impacts of a changing climate;

7. Recognize climate change as a strategic priority in the City's strategic plan and accompanying budget directions for the remaining Term of Council; and

8. Work with senior levels of government to accelerate ambition and action to meet the urgency of climate change and provide additional resources for municipalities and the public to reduce their GHG emissions and build resiliency to climate impacts.

RECOMMANDATIONS DU RAPPORT

Que le Comité permanent de la protection de l'environnement, de l'eau et de la gestion des déchets recommande au Conseil de :

1. déclarer officiellement une urgence climatique afin de nommer, d'encadrer et d'intensifier notre engagement à protéger notre économie, nos écosystèmes et nos communautés des changements climatiques;

2. établir un groupe de parrains du Conseil composé de représentants du Comité permanent de la protection de l'environnement, de l'eau et de la

gestion des déchets, du Comité de l'urbanisme, du Comité des transports, de la Commission du transport en commun, du Conseil de santé d'Ottawa et du conseiller de liaison du Comité consultatif sur la gérance environnementale;

3. demander au personnel de la Ville d'inclure les éléments suivants dans la révision et la mise à jour du Plan de gestion de la qualité de l'air et des changements climatiques (PGQACC) :

- **a) une analyse permettant de comparer les objectifs à long terme du PGQACC visant à réduire les émissions de GES de 80 % sous les niveaux de 2012 d'ici 2050 avec les objectifs du GIEC visant à limiter le réchauffement planétaire à 1,5 °C;**
- **b) les objectifs communautaires et municipaux de réduction des émissions de GES à moyen terme (2030);**
- **c) les priorités d'adaptation aux changements climatiques et d'atténuation de leurs effets pour les cinq prochaines années (2019-2024) afin d'ancrer les considérations relatives aux changements climatiques dans tous les éléments des activités de la Ville;**

4. demander au personnel de la Ville d'inclure les éléments suivants dans le rapport final sur le projet Évolution énergétique :

- **a) compte rendu sur les mesures prises durant la phase 1 de la stratégie Évolution énergétique;**
- **b) nouvelles mesures concrètes et incidence sur les ressources (humaines et financières) pour atteindre les objectifs de réduction des émissions de GES;**
- **c) l'emploi d'une optique d'équité et d'inclusion dans l'établissement des mesures prioritaires;**
- **d) les options de financement et d'économies qui s'offriront à la Ville lorsqu'elle mettra en œuvre les réductions des émissions.**

5. demander au personnel de la Ville de présenter un rapport, au cours de l'année civile 2019, sur un plan de dépenses pour les excédents de

dividendes d'Hydro Ottawa qui aideraient à réduire les émissions communautaires et municipales de GES au-delà des objectifs actuels de la Ville en matière de climat tout en économisant de l'argent;

6. **demander au personnel de la Ville de remplir une évaluation de la vulnérabilité et de mettre en place une stratégie de résilience face aux changements climatiques afin d'en limiter les effets;**

7. **reconnaître les changements climatiques comme une priorité stratégique dans le Plan stratégique de la Ville et dans les lignes directrices du budget pour les prochaines années du mandat du Conseil;**

8. **travailler avec les instances supérieures pour nourrir son ambition et précipiter les mesures visant à répondre à l'urgence des changements climatiques et à fournir des ressources supplémentaires aux municipalités et au public pour les aider à réduire leurs émissions de GES et à bâtir leur résilience envers les effets du climat.**

BACKGROUND

The Intergovernmental Panel on Climate Change warns that a reduction of global carbon emissions of 45 per cent from 2010 levels to reach net zero emissions by 2050 is necessary to keep the Earth "compatible with human civilization." That means making sure global warming is kept to an increase of 1.5 C. The world is currently on track for more than 3ºC of warming based on policies currently in place, and Ottawa and Canada are no exception to this international trend.

While Ottawa's community carbon pollution levels decreased an average of 2.75% per year from 2012 to 2016, the bulk of these reductions came from the phase out of coal fired power plants. In order to maintain its trajectory, the City will need to identify substantial new avenues for corporate and community emission reductions. The released federal budget offers opportunities in this respect, providing $350M for grants and loans to municipal governments for energy efficiency in large public buildings, community and demonstration projects; $300M through FCM to finance home energy efficiency upgrades, and $300M to improve energy efficiency in affordable housing.

This motion is being proposed to position Ottawa as a world-class green capital city, and leader in the transition to a low-carbon economy. More specifically it will accelerate the scope and timeframe of the City's climate change initiatives, coordinate greenhouse gas reduction targets with long-range IPCC projections, and explore options for better integrating actions within existing City structures. The motion aligns with a number of internal efforts including the 5-year update of the AQCCMP and the final report for Energy Evolution, Ottawa's Community Energy Transition Strategy to come later in 2019, staff initiatives on climate resilience and adaptation, and the motion passed at March 6th Council to report annually on community and corporate GHG emissions.

Moved by Councillor S. Menard:

WHEREAS Climate change is currently contributing to billions of dollars in property and infrastructure damage worldwide, stressing local and international economies;

AND WHEREAS, Climate change is currently jeopardizing the health and survival of many species and other natural environments worldwide, stressing local and international eco systems;

AND WHEREAS Climate change is currently harming human populations through rising sea levels and other extraordinary phenomena like intense wildfires worldwide, extreme heat events, and more variable and unpredictable droughts and heavy rains, stressing local and international communities;

AND WHEREAS recent international research has indicated a need for massive reduction in carbon emissions in the next 11 years to avoid further and devastating economic, ecological, and societal loss;

AND WHEREAS the City of Ottawa Emergency Management Plan defines emergency as "any situation that constitutes a danger of major proportions that could result in serious harm to persons or substantial damage to property that is caused by natural, technological or human-caused hazards, whether intentional or otherwise."

THEREFORE BE IT RESOLVED THAT the Standing Committee on Environmental Protection, Water and Waste Management recommend Council:

1. **Officially declare a climate emergency for the purposes of naming, framing, and deepening our commitment to protecting our economy, our eco systems, and our community from climate change;**

2. **Establish a Council Sponsors Group comprised of representatives from the Standing Committees on Environmental Protection, Water and Waste Management, Planning Committee, Transportation Committee, Transit Commission, the Ottawa Board of Health and the Councillor Liaison of the Environment Stewardship Advisory Committee;**

3. **Direct City staff to include the following in the review and update of the AQCCMP:**
   a) **An analysis of how the AQCCMP's long term target to reduce GHG emissions 80% below 2012 levels by 2050 compares to the IPCC's targets for limiting global warming to 1.5 ºC**
   b) **Midterm (2030) corporate and community GHG emission reduction targets**
   c) **Climate Change mitigation and adaptation priorities for next five years (2019-2024) to embed climate change considerations across all elements of City business;**

4. **Direct City staff to include the following in the Energy Evolution Final Report:**
   a) **Status update of Energy Evolution Phase 1 actions**
   b) **New concrete actions and resource implications (staff and financial) to achieve GHG emission reduction targets**
   c) **Use an equity and inclusion lens in the prioritization of actions**
   d) **Funding and savings options for the City when implementing emission reductions;**

5. **Direct City staff to report back, within the 2019 calendar year, on a spending plan for the Hydro Ottawa Dividends Surplus that would help reduce community and corporate GHG emissions beyond the scope of the City's current climate targets while also saving money;**

6. **Direct City staff to complete a vulnerability assessment and develop a climate resiliency strategy to reduce the impacts of a changing climate;**

7. **Recognize climate change as a strategic priority in the City's strategic plan and accompanying budget directions for the remaining Term of Council; and**

8. **Work with senior levels of government to accelerate ambition and action to meet the urgency of climate change and provide additional resources for municipalities and the public to reduce their GHG emissions and build resiliency to climate impacts.**

DISCUSSION

Comments provided by the Mover of the Motion

A growing list of cities, districts and counties across the world representing over 15 million people collectively have recently declared or officially acknowledged the existence of a global climate emergency, including Los Angeles, Oakland, London, Montreal, and most recently, Vancouver, Halifax, Kingston, Hamilton, and Richmond, and over 300 communities in Quebec. A recent report commissioned by Environment and Climate Change Canada, called Canada's Changing Climate Report, warned that on average, Canada is warming at twice the rate of the rest of the world. The direct effects of this phenomena include an increase of precipitation across the country though summer rainfall may decrease; warmer and more acidic oceans; and more frequent and more intense hot temperatures.

Locally, recent Ottawa weather related events including the tornados in the fall of 2018 and severe flooding in spring of 2017 underscore the gravity of the situation and the need for urgent action. As we know from the field of public health, climate change

shocks and stresses do not affect all groups in our community equally. Frontline communities, those that have been affected by systemic vulnerabilities and inequities, are often at greater risk and have the fewest resources to respond and adapt. The City's Equity and Inclusion lens offers a pro-active approach to respond to problems and prioritize solutions in a changing climate.

RURAL IMPLICATIONS

Comments provided by the Mover of the Motion

The effects of climate change can have devastating effects in rural areas with resource or tourism-based economies that are directly dependant on natural weather systems. Farmers are challenged with shortened or unpredictable growing seasons, while increasing temperatures impact the maple syrup industry as well as summer tourism. According to NRCAN[1], in Canada, the rate of projected climate change is expected to be 10 to 100 times faster than the ability of trees to migrate, resulting in impacts on forest health and productivity.

CONSULTATION

Community groups including Ecology Ottawa and the Community Associations for Environmental Sustainability have provided input for this motion, which will be publicized in advance of the Environment Committee meeting.

This report was also circulated to City staff in several Departments and their comments are reflected below:

The Climate Change and Resiliency Unit has reviewed the Climate Emergency report. In order to deliver on the report recommendations, staff propose the following timelines:

- Establish a Council Sponsors Group by the end of May 2019 to provide guidance on the Review and Update of the Air Quality and Climate Change Management Plan (AQCCMP) and the Energy Evolution Final Report

[1] https://www.nrcan.gc.ca/forests/climate-change/forest-change/17778

- Bring forward the Review and Update of the AQCCMP, including new recommendations, by the end of 2019 to allow time to:
    - Compare the City's current AQCCMP targets with IPCC's targets
    - Ensure current and revised Energy Evolution modeling work informs new AQCCMP targets and priorities
    - Align the AQCCMP's priorities for the next five years (2019-2024) with current City initiatives, including draft policy recommendations within the Official Plan
- Bring forward Energy Evolution including new recommendations by the end of 2019
- Bring forward a spending plan for the Hydro Ottawa Dividend Surplus in conjunction with Energy Evolution by the end of 2019
- Use the Regional Climate Projections developed in partnership with the National Capital Commission (estimated completion by the end of 2019) to develop a Vulnerability Assessment and initiate the Climate Resiliency Strategy (estimated by the end of 2020)

To implement the measures in this report that are above and beyond what was approved as part of the 2019 budget, PIED requires additional funding in the amount of $250,000 to finance a combination of consulting support to add additional analysis to work we are already doing, and funds to support an additional temporary FTE to assist with the increased scope of work.

Development of the climate resiliency strategy and all implementation work associated with the AQCCMP and Energy Evolution will require additional funding and staff resources. These will be identified in advance of the 2020 budget.

Additional comments on the Recommendations

With respect to recommendation 1, should Council officially declare a climate emergency, as described in this report, the Municipal Emergency Plan would not be triggered as the climate change emergency is an evolving situation over an extended

period of time that would not constitute an emergency as intended by the Emergency Management and Civil Protection Act, R.S.O. 1990, c. E. 9 (EMCPA). The City's current Municipal Emergency Plan takes into account and plans for serious and imminent harm caused by forces of nature, like spring flooding, tornados, and earthquakes.

With respect to recommendation 7, given that this Term of Council has yet to finalize its strategic priorities, staff suggest that climate change be considered for inclusion as a strategic priority when the City's Strategic Plan is brought forward to Council for decision. Additionally, to avoid pre-committing future budgets, any accompanying budget implications would be brought forward to Council as part of its regular budget process.

With respect to Recommendation 2, the City Clerk's office will work with Planning, Infrastructure and Economic Development Department to circulate for expressions of interest from Members of the relevant Committees with a view to bringing a Motion to Council prior to the end of May, 2019 to confirm the Sponsors' group membership

COMMENTS BY THE WARD COUNCILLOR(S)

This report is City-wide in nature.

ADVISORY COMMITTEE(S) COMMENTS

No Advisory Committees were consulted in the preparation of this report. The 2018-2022 Environmental Stewardship Advisory Committee has not yet met this term, but its members will be provided a copy of the final report. Individual comments may be received by the Committee at its meeting of 16 April 2019.

LEGAL IMPLICATIONS

There are no legal impediments to Committee and Council's approval of the Report's recommendations.

RISK MANAGEMENT IMPLICATIONS

No specific Risk Management Implications have been identified in this Motion. Staff will be available at Committee, or at Council, if clarification is required.

ASSET MANAGEMENT IMPLICATIONS

There are no direct asset management implications with the recommendations of this report.

FINANCIAL IMPLICATIONS

One-time funding in the amount of $250,000 is required to implement the recommended measures. Through the 2019 budget process, Council directed the use of surplus Hydro Ottawa dividends be directed towards energy efficiency initiatives. Subject to the availability of surplus dividend funds, a new capital account will be established with budget authority of $250,000, funded with dividend revenues.

Development of the climate resiliency strategy and all implementation work associated with the AQCCMP and Energy Evolution will require additional funding and staff resources. These will be identified in advance of the 2020 budget.

ACCESSIBILITY IMPACTS

No specific Accessibility Impacts have been identified. Staff will be available at Committee, or at Council, if clarification is required.

TERM OF COUNCIL PRIORITIES

Recommendation 7 Speaks to Term of Council priorities. As noted in the staff comment above, Council has yet to finalize its strategic priorities for the 2018-2022 Term.

DISPOSITION

Staff will take direction from Council, as appropriate.

Document 10 - Modelling Ottawa's Greenhouse Gas Emissions to 2050: Draft Results

#	Description	2016 Baseline: Start of Modelling	2050 Business As Planned	2020-2030 Model Outputs 80% and 100% Target Scenarios	2030-2050 Model Outputs 80% Target Scenario	2030 - 2050 Model Outputs 100% Target Scenario
	Description			Actions are common to 80% and 100% except as noted.		
	Demographics					
	Population	969,318	Preliminary Growth Projections, dated August 22, 2019 with linear extrapolation after 2046. Revised projections will be incorporated into future models.	1,200,449	1,509,358	1,509,358
	Background employment	565,955	Preliminary Growth Projections, dated August 22, 2019 with linear extrapolation after 2046. Revised projections will be incorporated into future models.	750,727	954,765	954,765
	LAND USE					
1	Dwelling units	385,074	2046 (Official Plan limit) New: 236,696 Existing: 359,377	New: 126,312 Existing: 370,581	New: 274,611 Existing: 357,738	New: 274,611 Existing: 357,738
2	Non-residential floor space (sum)	23,697,909	2046 (Official Plan limit) New: 17,453,027 Existing: 19,936,373	New: 11,909,833 Existing: 20,282,103	New: 20,735,100 Existing: 19,723,201	New: 20,735,100 Existing: 19,723,201
3	Spatial distribution	50% greenfield development, 50% infill	Current official plan until 2031 and a similar plan thereafter	90% of new development is in transit access zones or adjacent to existing or new LRT, BRT after 2025.	90% of new development is in transit access zones or adjacent to existing or new LRT, BRT after 2025.	90% of new development is in transit access zones or adjacent to existing or new LRT, BRT after 2025.
	BUILDINGS					
	New buildings					
4	Dwelling size	Single-detached: 264m2 Semi-detached: 160m2 Rows: 150m2 Apartments: 110m2	2016 dwelling sizes maintained	The average dwelling size is 10% smaller relative to 2016	The average dwelling size is 20% percent smaller in 2050 compared to 2016	Decrease the average new dwelling size by 20% relative to 2016
5	Housing mix	Single-detached: 45% Semi-detached: 7% Rows: 21% Apartments: 27%	Allocation to dwelling types based on Scenario T2 DN Hybrid, 2019-07-23 provided by City of Ottawa Research and Forecasting with linear extrapolation after 2046 Type shares of new dwelling units by 2046: Single-detached: 36% Semi-detached: 5% Rows: 33% Apartments: 26%	New dwelling unit single share is at 28% at 2030	Share of new single family homes decreased by 40% from 2016 by 2050	New dwelling unit single share is 24%*
6	Efficiency of new homes	2012 Building Code	10% improvement every 5 years for new construction	N/A - superseded by "Net Zero Homes"	N/A - superseded by "Net Zero Homes"	N/A - superseded by "Net Zero Homes"
7	Net zero homes	N/a	2016 efficiencies held constant	100% of new construction is net zero energy after 2030	100% of new construction is net zero energy after 2030	Hold 2030 Target
8	New commercial buildings	2012 Building Code	10% improvement every 5 years for new construction	All buildings built to a high performance building standard similar to what exists in Toronto and Vancouver by 2030	The 2030 measure is carried on	Passive house for new commercial and retail*

Note:
* denotes model outputs that change between the 80% to 100% target scenarios

Document 10 - Modelling Ottawa's Greenhouse Gas Emissions to 2050: Draft Results

#	Description	2016 Baseline: Start of Modelling	2050 Business As Planned	2020-2030 Model Outputs 80% and 100% Target Scenarios	2030-2050 Model Outputs 80% Target Scenario	2030 - 2050 Model Outputs 100% Target Scenario
	Existing buildings					
9	Retrofit older homes (pre-1980)	N/A, estimated 1% annual renovation rate	No additional retrofits	Scale up rate of retrofits to 16% of all dwellings by 2030; achieve thermal savings of 60%; electrical savings of 50%	Scale up rate of retrofits to 98% of all dwellings by 2050; achieve thermal savings of 60%; electrical savings of 50%	Scale up rate of retrofits to 98% of all dwellings by 2040; achieve thermal savings of 70%; electrical savings of 30%*
10	Retrofit newer homes (post-1980)	N/A, estimated 1% annual renovation rate	No additional retrofits	Scale up rate of retrofits to 16% of all dwellings by 2030; achieve thermal savings of 60%; electrical savings of 50%	Scale up rate of retrofits to 98% of all dwellings by 2050; achieve thermal savings of 50%; electrical savings of 40%	Scale up rate of retrofits to 98% of all dwellings by 2040; achieve thermal savings of 70%; electrical savings of 30%*
11	Retrofits for small commercial and office buildings	N/A, estimated 1% annual renovation rate	No additional retrofits	Scale up rate of retrofits to 16% of all buildings by 2030; achieve thermal savings of 50%; electrical savings of 40%	Scale up rate of retrofits to 98% of all buildings by 2050; achieve thermal savings of 50%; electrical savings of 40%	Scale up rate of retrofits to 98% of all buildings by 2040; achieve thermal savings of 60%; electrical savings of 30%*
12	Retrofits for commercial, office and industrial buildings	N/A, estimated 1% annual renovation rate	No additional retrofits	16% of the existing building stock is retrofit by 2030 with average savings of 50%	95% of the existing building stock is retrofit by 2050 with average savings of 50%	95% of the existing building stock is retrofit by 2040; achieve thermal savings of 60%; electrical savings of 20%*
13	Municipal buildings retrofits	N/A	Current efficiencies held constant	16% of existing municipal buildings are retrofit to net zero emissions by 2030	99% of existing municipal buildings are retrofit to net zero emissions by 2040	99% of existing municipal buildings are retrofit to net zero emissions by 2040
14	Federal building retrofits	N/A	15% savings for both heating and cooling for 50% of the buildings by 2030 and 15% for the remaining buildings by 2050.	50% savings for both heating and cooling for 50% of buildings over 5000 m2 by 2030	Same results for remaining 50% of buildings by 2050	Same results for remaining 50% of buildings by 2050
	Industry					
15	Industry process improvements	4,877 TJ	Hold process efficiency constant	Increase efficiency by 22.5% by 2030	Increase efficiency by 75% by 2050	Increase efficiency by 75% by 2050
	Building Equipment					
17	Low-rise residential heat pumps in existing buildings	0 Heat pumps, 21,522 TJ natural gas consumption	Fuel share from 2016 maintained until 2050	34,377 heat pumps installed by 2030 Air: 67% Ground: 33%*	150,491 heat pumps installed by 2050 Air: 50% Ground: 15%	424,281 heat pumps installed by 2050 Air: 74% Ground 26%*
	Low-rise residential heat pumps in new buildings				89,145 heat pumps installed by 2050 Air: 50% Ground: 15%	
18	Apartments heat pumps in existing buildings	0 heat pumps, 3, 678 TJ natural gas consumption	Fuel share from 2016 maintained until 2050	9,782 heat pumps installed by 2030 Air: 67% Ground: 33%*	67,669 heat pumps installed by 2050 Air: 50% Ground: 15%	159,300 heat pumps installed by 2050 Air: 74% Ground 26%*
	Apartments heat pumps in new buildings				21,948 heat pumps installed by 2050 Air: 50% Ground: 15%	
19	Commercial heat pumps in existing buildings	0 heat pumps, 18, 327 TJ of natural gas consumption	Fuel share from 2016 maintained until 2050	9% of floor space by 2030	31.0% of floor space	71% floor space by 2050*
20	Commercial heat pumps in new buildings				15.0% of floor space	
21	Electric water heaters in residential and commercial buildings	Unmodeled item	Unmodeled item	Shares for new residential water heaters will be 60% on demand electric and 40% heat pumps by 2030	The 2030 target is the floor on a go-forward basis	75% of non-residential floor space is served by electric water heating by 2040*

Note:
* denotes model outputs that change between the 80% to 100% target scenarios

Document 10 - Modelling Ottawa's Greenhouse Gas Emissions to 2050: Draft Results

#	Description	2016 Baseline: Start of Modelling	2050 Business As Planned	2020-2030 Model Outputs 80% and 100% Target Scenarios	2030-2050 Model Outputs 80% Target Scenario	2030 - 2050 Model Outputs 100% Target Scenario
	District energy and other heating					
22	District energy system	1673 TJ	Existing 2016 DE capacity is held constant through to 2050	2,465 homes served by expanded DE by 2030 5,647,669 m2 non-residential floor space served by expanded DE by 2030	80% of existing commercial buildings; 80% of apartments; 15% of residential buildings; 100% of the system low carbon (geothermal) 31,434 homes served by DE by 2050 10,962,135 m2 non-residential floor space served by DE by 2050	80% of existing commercial buildings; 80% of apartments; 15% of residential buildings; 100% of the system low carbon (geothermal) 31,434 homes served by DE by 2050 10,962,135 m2 non-residential floor space served by DE by 2050
	Federal district energy systems	1,673 TJ	No changes	Federal DE systems switched to geothermal by 2040 1,445,134 m2 floor space served by federal DE by 2030	Federal DE systems switched to geothermal by 2040 Floor space value from 2030 becomes the minimium value	Federal DE systems switched to geothermal by 2040
16	Waste heat	Not significantly employed	Not significantly employed	100% Scenario Only: 700 TJ of waste heat displaces fossil gas	Waste heat was not considered in the 80% Scenario	1600 TJ of waste heat displaces fossil gas by 2050*
	ELECTRICITY AND DEMAND					
	Solar energy					
24	Residential PV	72 KW	Capacity provided by Hydro One and Hydro Ottawa; no additional capacity added	120 MW by 2030 capacity factor = 15%	320 MW by 2050 capacity factor = 15%	320 MW by 2040 capacity factor = 15%
25	Commercial PV	584 KW	Capacity provided by Hydro One and Hydro Ottawa; no additional capacity added	278 MW by 2030 capacity factor = 15%	740 MW by 2050 capacity factor = 15%	740 MW by 2040 capacity factor = 15%
26	Utility-scale PV	N/A	Capacity provided by Hydro One and Hydro Ottawa; no additional capacity added	233 MW by 2030 capacity factor = 15%	233 MW by 2050 capacity factor = 15%*	233 MW by 2040 capacity factor = 15%*
	Waterpower					
27	Hydropower	6,780 TJ / 260 MW	No additional capacity added	18 MW by 2030 capacity factor = 70%	36 MW by 2050 capacity factor = 70%	36 MW by 2040 capacity factor = 70%
	Wind					
28	Wind	N/A	Existing 2016 capacity is held constant through to 2050	100 MW by 2030 capacity factor = 30%	394 MW by 2050 capacity factor = 30%	4084 MW by 2040 Capacity Factor = 30%*
	Energy storage					
29	Increase energy storage	N/A	No additional storage	73 MW storage by 2030 sufficient storage to reduce curtailment of renewable generation from 15% to 10%	180 MW storage by 2050 sufficient storage to reduce curtailment of renewable generation from 15% to 10%	180 MW storage by 2050 sufficient storage to reduce curtailment of renewable generation from 15% to 10%

Note:
* denotes model outputs that change between the 80% to 100% target scenarios

Document 10 - Modelling Ottawa's Greenhouse Gas Emissions to 2050: Draft Results

#	Description	2016 Baseline: Start of Modelling	2050 Business As Planned	2020-2030 Model Outputs 80% and 100% Target Scenarios	2030-2050 Model Outputs 80% Target Scenario	2030 - 2050 Model Outputs 100% Target Scenario
	TRANSPORTATION					
	Transit					
30	Expand transit	12% internal trips, 11% outbound trips, 25% inbound trips	Completion of the Confederation & Trillium Line - Phase 1 and 2	The frequency of light rail transit (LRT) is increased to every 1.5 min in the core area at rush hour Bus rapid transit (BRT) speeds increase by 20% in dedicated bus lanes (currently every 5 minutes at peak times), and every 7.5 minutes for off-peak frequency (currently every 15 minutes for off-peak). Expanded transit to reflect "Concept Transit Network" rather than "Affordable Transit Network"	The frequency of light rail transit (LRT) is increased to every 1.5 min in the core area at rush hour Bus rapid transit (BRT) speeds increase by 20% in dedicated bus lanes (currently every 5 minutes at peak times), and every 7.5 minutes for off-peak frequency (currently every 15 minutes for off-peak). Expanded transit to reflect "Concept Transit Network" rather than "Affordable Transit Network"	The frequency of light rail transit (LRT) is increased to every 1.5 min in the core area at rush hour Bus rapid transit (BRT) speeds increase by 20% in dedicated bus lanes (currently every 5 minutes at peak times), and every 7.5 minutes for off-peak frequency (currently every 15 minutes for off-peak). Expanded transit to reflect "Concept Transit Network" rather than "Affordable Transit Network"
31	Electrify transit	N/A	100% electric by 2050	100% electric by 2030	Transit stays electric	Transit stays electric
	Active					
32	Increase/improve cycling & walking infrastructure	12% internal trips, 11% outbound trips, 25% inbound trips 24-hr mode shares Auto: 73.80% Transit: 12.20% Walk: 10.10% Bike: 3.80%	Active mode shares by O-D zones in 2011 and 2031 model data 24-hr mode shares by 2050 Auto; 68.10% Transit: 16.50% Walk: 11.70% Bike: 3.70%	Mode shift to 50% of the walking and cycling potential away from vehicles and driving. Use 2km for walking and 5km for cycling. **Under defined transportation zones** 24-hr mode shares by 2030 Auto: 57.8% Transit: 21.1% Walk: 13.2% Bike: 7.9%	Mode shift to 50% of the walking and cycling potential away from vehicles and driving. Use 2km for walking and 5km for cycling. **Under defined transportation zones** 24-hr mode shares by 2050 Auto: 56.1% Transit: 22.4% Walk: 10.3% Bike: 11.2%	Mode shift to 50% of the walking and cycling potential away from vehicles and driving. Use 2km for walking and 5km for cycling. **Under defined transportation zones** 24-hr mode shares by 2050 Auto: 56.1% Transit: 22.4% Walk: 10.3% Bike: 11.2%
33	Car free zone	N/A	None	Byward market and downtown Ottawa are car free; Wellington St - Rideau St, Sparks St, Bank St, University of Ottawa campus by 2030	Byward market and downtown Ottawa are car free; Wellington St - Rideau St, Sparks St, Bank St, University of Ottawa campus by 2030	Byward market and downtown Ottawa are car free; Wellington St - Rideau St, Sparks St, Bank St, University of Ottawa campus by 2030
34	Congestion charge	N/A	None	Congestion charge of $20 applied to the downtown core between 6:00 am and 10:00 am on weekdays by 2030	Congestion charge of $20 applied to the downtown core between 6:00 am and 10:00 am on weekdays by 2030	Congestion charge of $20 applied to the downtown core between 6:00 am and 10:00 am on weekdays.
	Electric Vehicles					
35	Zero emission municipal fleets	Some transition had started	None	Municipal fleet is 60% zero emission by 2030	Municipal fleet is 100% zero emission by 2040	Municipal fleet is 100% zero emission by 2040
36	Electrify personal vehicles	150 Electric Vehicles (EV)	Vehicle fuel consumption rates reflect the implementation of the U.S. Corporate Average Fuel Economy (CAFE) Fuel Standard for Light-Duty Vehicles. 25,463 EVs (3.5%) in personal use vehicle stock by 2035, 46,403 EVs (5.5%) in personal use vehicle stock by 2050. 4.2% of new personal use vehicles are EVs by 2035	EVs comprise 90% of new vehicle sales after 2030	The 2030 target is the floor value on a go forward basis	2040: EVs comprise 100% of new vehicle sales*
37	Autonomous vehicles (AV)	N/A	No AVs	Personal vehicle ownership declines by 16% by 2030; VKT per capita increases by 116%; AVs are electric only	Personal vehicle ownership declines by 50% by 2050; VKT per capita increases by 150%; AVs are electric only	Same as 80% scenario

Note:
* denotes model outputs that change between the 80% to 100% target scenarios

Document 10 - Modelling Ottawa's Greenhouse Gas Emissions to 2050: Draft Results

#	Description	2016 Baseline: Start of Modelling	2050 Business As Planned	2020-2030 Model Outputs 80% and 100% Target Scenarios	2030-2050 Model Outputs 80% Target Scenario	2030 - 2050 Model Outputs 100% Target Scenario
38	Parking management	$1.50 - 3.00 / Hour	No change	No off-street parking within 500m of LRT	50% reduction in Centretown; on-street parking fares are doubled during peak hours by 2050; VKT reduction of 15% in relevant zones	Same as 80% scenario
39	Electrify commercial vehicles	N/A	Phase 1 and Phase 2 of EPA HDV Fuel Standards for Medium- and Heavy-Duty Vehicles.	40% of heavy trucks are zero emissions by 2030	100% of heavy trucks are zero emissions by 2040	100% of heavy trucks are zero emission by 2040
40	EV only zones	NA	None	**100% Scenario only:** EVs only inside the area bounded by Bronson Avenue, Catherine Street, and Queen Elizabeth Drive (Rideau Canal) by 2028. (This is the area to which the congestion charge is applied.)	An EV only zone not considered in the 80% Scenario	EVs only inside the area bounded by Bronson Avenue, Catherine Street, and Queen Elizabeth Drive (Rideau Canal) by 2028. (This is the area to which the congestion charge is applied.)
	WASTE AND RENEWABLE NATURAL GAS (RNG)					
	Waste					
41	Leaf and yard waste	NA	NA	All yard and leaf waste goes to compost	All leaf and yard waste goes to compost	All leaf and yard waste gasified after 2030, displaces fossil gas
	Wastewater Generation from RNG			Systems operaterated to reduce electrcity charges and avoid natural gas consumption	Systems operaterated to reduce electrcity charges and avoid natural gas consumption	At 2040 all biogas goes to RNG except for power supply failures
42	Waste diversion	2016 residential waste diversion: Paper: 78% Organics and yard: 58% Plastic/metal/glass: 65%	Existing diversion rate unchanged	98% organics diverted by 2024 Diversion rates by 2030: Paper: 78% Plastic/metal/glass: 40% Route all of organic waste to anaerobic digester	Achieve residential Ottawa waste diversion targets by 2042, increase paper diversion to 100% Non-res targets: Paper: 100% Plastic/metal/glass: 50% Route all of organic waste to anaerobic digester Anaerobic digester gas and landfill gas are used as RNG and displace natural gas use	Achieve residential Ottawa waste diversion targets by 2042, increase paper diversion to 100% Non-res targets: Paper: 100% Plastic/metal/glass: 50% Route all of organic waste to anaerobic digester Anaerobic digester gas and landfill gas are used as RNG and displace natural gas use
	Biogas					
43	Private, non-municipal waste biogas (often farm)	Three farm set-ups in Ottawa	No additional capacity added or changes considered	3 MW until 2030	Biogas to RNG after 2030 with production at 6 MW	Biogas to RNG after 2030 with production at 6 MW
	Power to gas			**100% Scenario Only:**		
44	Power to gas	Not currently happening in Ottawa	Not considered as a Business As Planned measure	2030: 865 TJ hydrogen produced at 70% efficiency, half of waste heat is used. Produced hydrogen is injected into natural gas pipelines. Hydrogen can displace up to 15% of natural gas by volume. Hydrogen production is limited to the amount of natural gas in use in this scenario	Power to gas was not considered in the 80% Scenario	2040 and onwards: 95 TJ hydrogen produced at 80% efficiency, half of waste heat is used. At 2030, although its not modelled, power to methane will be considered as a way to maintain gas production.

Note:
* denotes model outputs that change between the 80% to 100% target scenarios

CITY OF OTTAWA
COMMUNITY ENERGY TRANSITION PLAN 2018

Data, Methods & Assumptions Manual

PREPARED BY:

SSG SUSTAINABILITY SOLUTIONS GROUP
whatIf?

Contents

Summary

The Data, Methods and Assumptions (DMA) manual has been created for the City of Ottawa to illustrate the modeling approach used to provide energy and emissions benchmarks and projections. The DMA will also provide a summary of the data and assumptions being used as the foundation for the energy and emissions modeling. This allows for the elements of the modelling to be fully transparent, as well as lay a foundation for the scope of data required for future modelling efforts that the City can build upon.

Accounting and Reporting Principles

The Global Protocol for Community-Wide GHGs (GPC) is based on the following principles in order to represent a fair and true account of emissions:

- Relevance: The reported GHG emissions shall appropriately reflect emissions occurring as a result of activities and consumption within the Town boundary. The inventory will also serve the decision-making needs of the Town, taking into consideration relevant local, subnational, and national regulations. Relevance applies when selecting data sources, and determining and prioritizing data collection improvements.
- Completeness: All emissions sources within the inventory boundary shall be accounted for. Any exclusions of sources shall be justified and explained.
- Consistency: Emissions calculations shall be consistent in approach, boundary, and methodology.
- Transparency: Activity data, emissions sources, emissions factors and accounting methodologies require adequate documentation and disclosure to enable verification.
- Accuracy: The calculation of GHG emissions should not systematically overstate or understate actual GHG emissions. Accuracy should be sufficient enough to give decision makers and the public reasonable assurance of the integrity of the reported information. Uncertainties in the quantification process should be reduced to the extent possible and practical.

Assessment Boundary

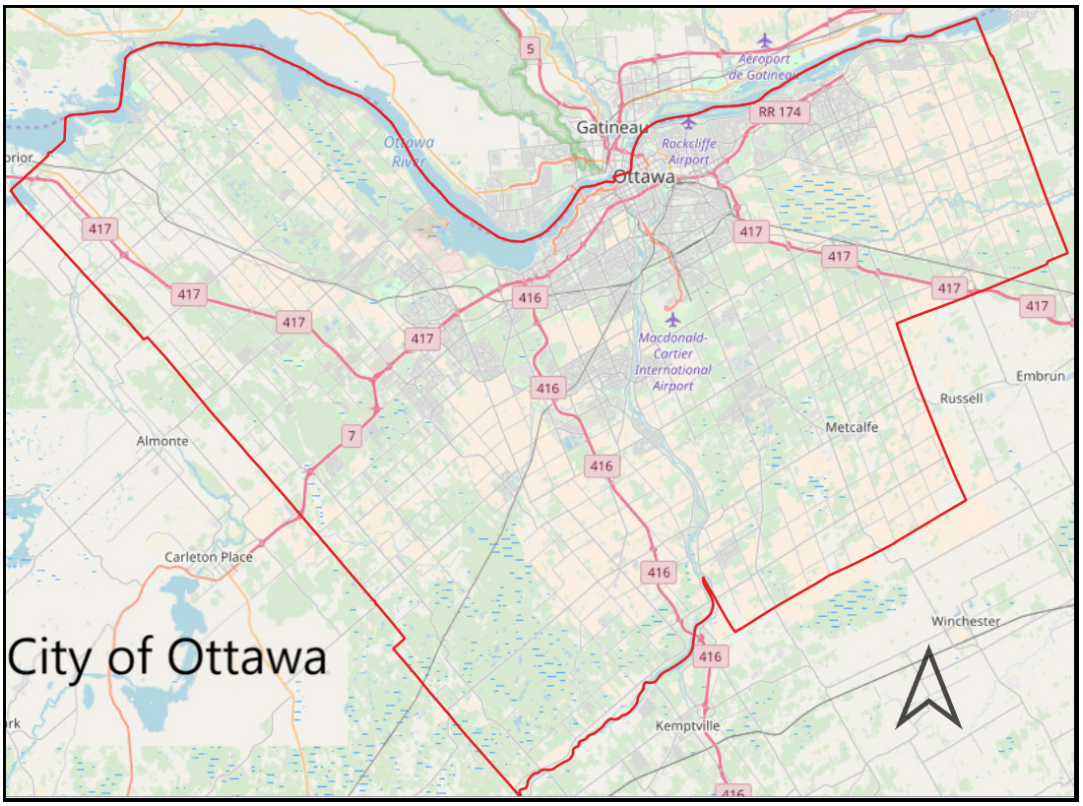

Figure 1. Municipal Boundary of Ottawa.

Assessment Time Frame

The energy and emissions modelling for this project considers the time frame of 2016 (baseline year) to 2050 (target year). The 2016 census is used to establish the baseline year, which is also based on as much observed data as possible in order to provide an accurate and consistent information snapshot.

Assessment Scope

The inventory will include Scopes 1 and 2, and some aspects of Scope 3. Refer to Appendix 1 for a list of GHG emission sources by Scope that are included.

Table 1. GPC scope definitions.

Scope	Definition
1	All GHG emissions from sources located within the Town boundary.
2	All GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the Town boundary.
3	All other GHG emissions that occur outside the Town boundary as a result of activities taking place within the Town boundary.

Emissions Factors

Table 2. Emissions Factors for Ottawa Baseline and Future Scenarios.

Category	Description	Comment
Natural gas	49 kg CO2e/GJ	Environment and Climate Change Canada. National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada. Part 2. Tables A6-1 and A6-2, Emission Factors for Natural Gas.
Electricity	2016: CO2: 28.9 g/kWh CH4: 0.007 g/kWh N2O: 0.001 g/kWh 2050: CO2: 37.4 g/kWh CH4: 0.009 g/kWh N2O: 0.001 g/kWh	National Energy Board. (2016). Canada's Energy Future 2016. Government of Canada. Retrieved from https://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2016pt/nrgyftrs_rprt-2016-eng.pdf
Gasoline	g/L CO2: 2316 CH4: 0.32 N2O: 0.66	Environment and Climate Change Canada. National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada. Part 2. Table A6–12 Emission Factors for Energy Mobile Combustion Sources
Diesel	g/L CO2: 2690.00 CH4: 0.07 N2O: 0.21	Environment and Climate Change Canada. National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada. Part 2. Table A6–12 Emission Factors for Energy Mobile Combustion Sources
Fuel oil	Residential g/L CO2: 2560 CH4: 0.026 N2O: 0.006 Commercial g/L CO2: 2753 CH4: 0.026 N2O: 0.031 Industrial g/L CO2: 2753 CH4: 0.006 N2O: 0.031	Environment and Climate Change Canada. National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada. Part 2. Table A6–4 Emission Factors for Refined Petroleum Products

Category	Description	Comment
Propane	g/L Transport CO2: 1515.00 CH4: 0.64 N2O: 0.03 Residential CO2: 1515.00 CH4 : 0.027 N2O: 0.108 All other sectors CO2: 1515.00 CH4: 0.024 N2O: 0.108	Environment and Climate Change Canada. National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada. Part 2. Table A6–3 Emission Factors for Natural Gas Liquids Table A6–12 Emission Factors for Energy Mobile Combustion Sources
Waste	Landfill emissions are calculated from first order decay of degradable organic carbon deposited in landfill. Derived emission factor in 2016 = 0.015 kg CH4/ tonne solid waste (assuming 70% recovery of landfill methane); 0.050 kg CH4/tonne solid waste not accounting for recovery.	Landfill emissions: IPCC Guidelines Vol 5. Ch 3, Equation 3.1
Wastewater	CH4: 0.48 kg CH4/kg BOD N2O: 3.2 g / (person * year) from advanced treatment 0.005 g /g N from wastewater discharge	CH4 wastewater: IPCC Guidelines Vol 5. Ch 6, Tables 6.2 and 6.3; MCF value for anaerobic digester N2O from advanced treatment: IPCC Guidelines Vol 5. Ch 6, Box 6.1 N2O from wastewater discharge: IPCC Guidelines Vol 5. Ch 6, Section 6.3.1.2

Modelling Tool

The modelling for the 2016 baseline year and BAP scenario out to 2050 were completed using CityInSight, an integrated energy, emissions and finance model developed by Sustainability Solutions Group (SSG) and whatIf? Technologies Inc. (whatIf?). It is an integrated, multi-fuel, multi-sector, spatially-disaggregated energy systems, emissions and finance model for cities. The model enables bottom-up accounting for energy supply and demand, including renewable resources, conventional fuels, energy consuming technology stocks (e.g. vehicles, appliances, dwellings, buildings) and all intermediate energy flows (e.g. electricity and heat).

Table 3. Characteristics of CityInSight.

Characteristic	Rationale
Integrated	CityInSight is designed to model and account for all sectors that relate to energy and emissions at a city scale while capturing the relationships between sectors. The demand for energy services is modelled independently of the fuels and technologies that provide the energy services. This decoupling enables exploration of fuel switching scenarios. Physically feasible scenarios are established when energy demand and supply are balanced.
Scenario-based	Once calibrated with historical data, CityInSight enables the creation of scenarios to explore different possible futures. Each scenario can consist of either one or a combination of policies, actions and strategies. Historical calibration ensures that scenario projections are rooted in observed data.
Spatial	The configuration of the built environment determines the ability of people to walk and cycle to their destinations, accessibility to transit, feasibility of district energy and other aspects. CityInSight therefore includes a full spatial dimension that can include as many zones - the smallest areas of geographic analysis - as are deemed appropriate. The spatial component to the model can be integrated with City GIS systems, land-use projections and transportation modelling.
GHG reporting framework	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC Protocol).
Economic impacts	CityInSight has the ability to incorporate a financial analysis of costs related to energy (expenditures on energy) and emissions (carbon pricing, social cost of carbon), as well as operating and capital costs for policies, strategies and actions. It supports the generation of marginal abatement curves to illustrate the cost and/or savings of policies, strategies and actions.

Energy and GHG emissions are derived from a series of connected stock and flow models, evolving on the basis of current and future geographic and technology decisions/assumptions (e.g. EV penetration rates). The model accounts for physical flows (i.e. energy use, new vehicles by technology, vehicle kilometres travelled) as determined by stocks (buildings, vehicles, heating equipment, etc).

CityInSight incorporates and adapts concepts from the system dynamics approach to complex systems analysis. For any given year within its time horizon, CityInSight traces the flows and transformations of energy from sources through energy currencies (e.g. gasoline, electricity, hydrogen) to end uses (e.g. personal vehicle use, space heating) to energy costs and to GHG emissions. An energy balance is achieved by accounting for efficiencies, conservation rates, trade, and losses at each stage in the journey from source to end use.

Model Structure

The major components of the model, and the first level of modelled relationships (influences), are represented by the blue arrows in Figure 2. Additional relationships may be modelled by modifying inputs and assumptions, specified directly by users, or in an automated fashion by code or scripts running "on top of" the base model structure. Feedback relationships are also possible, such as increasing the adoption rate of non-emitting vehicles in order to meet a particular GHG emissions constraint.

The model is spatially explicit. All buildings and transportation activities are tracked within a discrete number of geographic zones, or zone system, specific to the city. This enables consideration of the impact of land-use patterns and urban form on energy use and emissions production from a baseline year to future points in the study horizon. CityInSight's GIS outputs can be integrated with city mapping and GIS systems.

Stocks and flows

For any given year, various factors shape the picture of energy and emissions flows, including: the population and the energy services it requires; non-residential buildings; energy production and trade; the deployed technologies which deliver energy services (service technologies); and the deployed technologies which transform energy sources to energy carriers (harvesting technologies). The model makes an explicit mathematical relationship between these factors - some contextual and some part of the energy consuming or producing infrastructure - and the energy flow picture.

Some factors are modelled as stocks - counts of similar things, classified by various properties. For example, population is modelled as a stock of people classified by age and gender. Population change over time is projected by accounting for: the natural aging process, inflows (births, immigration) and outflows (deaths, emigration). The fleet of personal use vehicles, an example of a service technology, is modelled as a stock of vehicles classified by size, engine type and model year - with a similarly-classified fuel consumption intensity. As with population, projecting change in the vehicle stock involves aging vehicles and accounting for major inflows (new vehicle sales) and major outflows (vehicle discards). This stock-turnover approach is applied to other service technologies (e.g. furnaces, water heaters) and also harvesting technologies (e.g. electricity generating capacity).

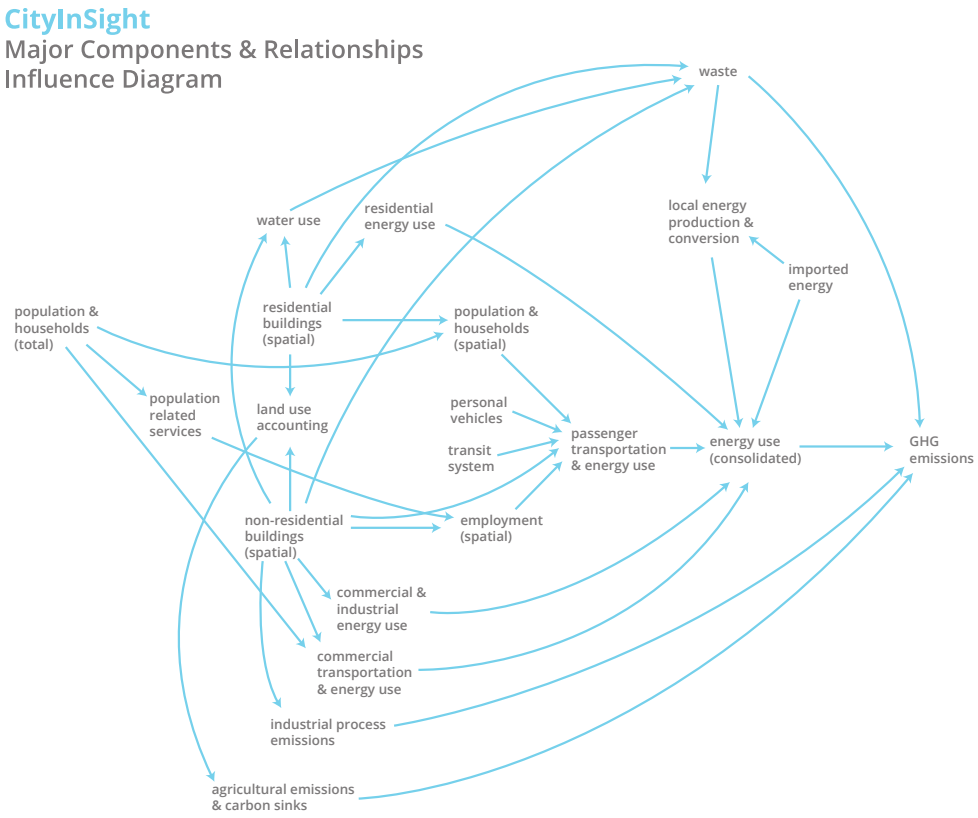

Figure 2. Representation of CityInSight's structure.

Sub-models

Population and demographics

City-wide population is modelled using the standard population cohort-survival method, disaggregated by single year of age and gender. It accounts for various components of change: births, deaths, immigration and emigration. The age structured population is important for analysis of demographic trends, generational differences and implications for shifting energy use patterns. Population in CityInSight drives residential waste generation and generates demand for community services such as education and health care.

Residential buildings

Residential buildings are spatially located and classified using a detailed set of 30+ building archetypes capturing footprint, height and type (single, double, row, apt. high, apt. low), in addition to year of construction. This archetype classification enables a "box" model of buildings to estimate building surface area and the thermal conduction through the building walls. Coupled with thermal envelope performance and degree-days the model calculates space conditioning energy demand independent of any particular space heating or cooling technology and fuel.

Energy service demand then drives stock levels of key service technologies (heating systems, air conditioners, water heaters). These stocks are modelled with a stock-turnover approach capturing equipment age, retirements, and additions - exposing opportunities for efficiency gains and fuel switching, but also simulating the rate limits to new technology adoption and the effects of lock in.

Residential building archetypes are also characterized by number of contained dwelling units, allowing the model to capture the energy effects of shared walls as well as the urban form and transportation implications of population density.

In addition to energy service demand, residential buildings produce demand for water and generate wastewater.

Non-residential buildings

Non-residential buildings are spatially located and classified by a detailed use/purpose-based set of 50+ archetypes, and the floorspace of these non-residential building archetypes can vary by location. Non-residential floorspace produces waste and demand for energy and water, and also provides an anchor point for locating employment of various types.

Spatial population and employment

City-wide population is made spatial by assignment to dwellings, using assumptions about persons-per-unit by dwelling type. Spatial employment is projected via two separate mechanisms: population-related services and employment, which is assigned to corresponding building floorspace (e.g. teachers to school floorspace); and floorspace-driven employment (e.g. retail employees per square metre).

Passenger Transportation

The model includes a spatially explicit passenger transportation sub-model that responds to or accounts for changes in land use, transit infrastructure, vehicle technology, travel behavior and other factors. Trips are divided into four types (home-work, home-school, home-other, and non-home-based), each produced and attracted by different combinations of spatial drivers (population, employment, classrooms, non-residential floorspace).

Trips are distributed - that is, trip volumes are specified for each zone of origin and zone of destination pair. For each origin-destination pair trips are shared over walk/bike (for trips within the walkable distance threshold), public transit (for trips whose origin and destination are serviced by transit) and automobile. Following the mode share step, along with a network-based distance matrix, a projection of total personal vehicles kilometres travelled (VKT) is produced. The energy use and emissions associated with personal vehicles is calculated by assigning VKT to a stock-turnover personal vehicle model. All internal and external passenger trips are accounted for and available for reporting according to various geographic conventions.

Waste

Households and non-residential buildings generate solid waste and wastewater, and the model traces various pathways to disposal, compost and sludge including those which capture energy from incineration and recovered gas. Emissions accounting is performed throughout the waste sub-model, which follows the recommended methodology for solid waste and wastewater emissions calculations in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.[1] Landfill methane emissions calculations in CityInSight use the First Order Decay (FOD) method in which models the release of methane through the decomposition of organic carbon over time. Emissions from biological treatment processes such as composting and anaerobic digestion are calculated from emissions factors applied to the amount of waste treated and a methane recovery rate. Methane emissions from wastewater are calculated from emissions factors applied to the biochemical oxygen demand (BOD) in the wastewater influent. Nitrous oxide emissions from wastewater come from process emissions within the treatment plant and indirect emissions from the wastewater effluent. Process emissions are calculated from a population-based emission factor and the population served. Indirect emissions are calculated from the estimated nitrogen concentration in the wastewater effluent.

Energy flow and local energy production

Energy produced from local, primary sources (e.g. solar, wind) is modelled alongside energy converted from imported fuels (e.g. electricity generation, district energy, CHP). As with the transportation sub-model, the district energy supply model has an explicit spatial dimension and represents areas - collections of zones - served by district energy networks.

Finance and employment

Energy related financial flows and employment impacts—while not shown explicitly in Figure 2—are captured through an additional layer of model logic. Calculated financial flows include the capital, operating and maintenance cost of energy consuming stocks and energy producing stocks, including fuel costs. Employment related to the construction of new buildings, retrofit activities and energy infrastructure is modelled.

1 Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). (2006). IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme,Published: IGES, Japan.

Modelling Process

1. Data request & collection

A detailed data request was compiled and issued to the City of Ottawa. Data was collected from various sources by the City, SSG and whatIf?. Assumptions were identified to supplement any gaps in observed data. The data and assumptions were applied in modelling per the process described below.

2. Setting up the model

Zone system

The modelling tool (CityInSight) is spatially explicit, that is, population, employment and residential and non-residential floorspace, which drives stationary energy demand, are allocated and tracked spatially within the model's zone system. The passenger transportation sub-model, which drives transportation energy demand, also operates within the same zone system.

The City of Ottawa uses a pre-existing transportation zone system extensively for planning projections and analysis. The population, employment and floorspace projections, as well as baseline and projected transportation modelling results, were completed and provided by the City of Ottawa at the transportation zone level. As such, the transportation zone system for the City of Ottawa was adopted as CityInSight's zone system, the primary spatial unit of analysis.

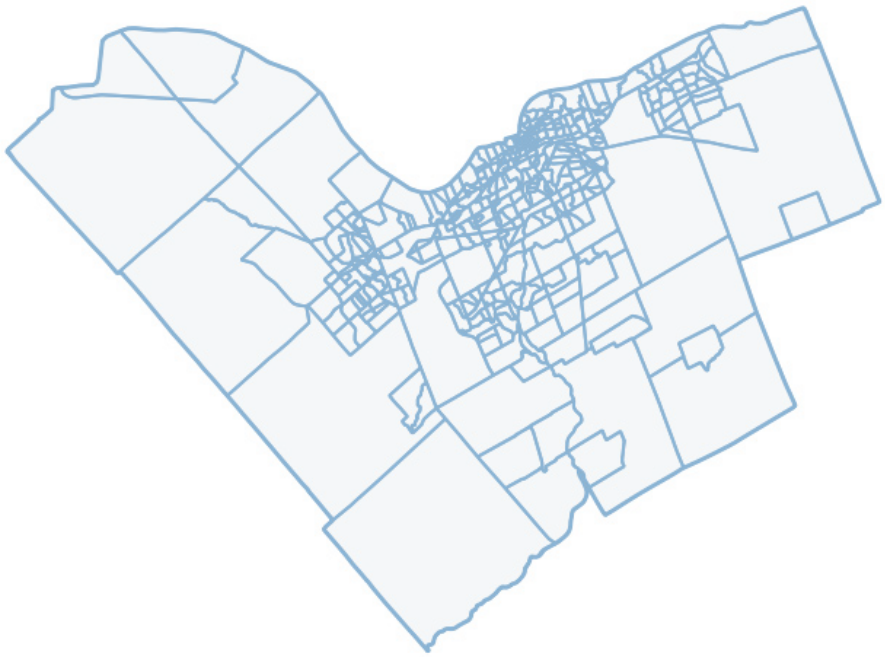

Figure 3. Transportation zones for City of Ottawa (2011).

Buildings

Buildings data, including building type, building footprint area, number of storeys, total floorspace area, number of units, and year built was sourced from the City of Ottawa's Municipal Property Assessment Corporation (MPAC) data for 2016. Using the spatial attributes of the MPAC data, buildings were allocated to specific zones, based on the zone system for the City of Ottawa.

Subsequently, buildings were classified using a detailed set of buildings archetypes; 30+ archetypes for residential, and 50+ archetypes for non-residential (see Appendix 2). These archetypes capture footprint, height and type (eg. single family home, semi-attached home etc.), enabling the creation of a "box" model of buildings, and an estimation of surface area for all buildings.

Residential buildings

The model multiplies the residential building surface area by an estimated thermal conductance (heat flow per unit surface area per degree day) and the number of degree days to derive the energy transferred out of the building during winter months and into the building during summer summer months. The energy transferred through the building envelope, the solar gain through the building windows, and the heat gains from equipment inside the building constitute the space conditioning load to be provided by the heat systems and the air conditioning. The initial thermal conductance estimate is a provincial average by dwelling type from the Canadian Energy System Simulator (CanESS). This initial estimate is adjusted through the calibration process as the modelled energy consumption in the residential sector is forced to track on observed residential fuel consumption in the baseline year.

Non-residential buildings

For non-residential buildings, the model calculates the space conditioning load as it does for residential buildings with one distinction, the thermal conductance parameter for non-residential buildings is based on floor space area instead of surface area. CanESS provides the initial estimate of the non-residential thermal conductance by building sector. This estimate is then adjusted to match the space heating energy use intensity for building types in the Ontario Broader Public Sector data set.

Starting values for output energy intensities and equipment efficiencies for other residential and non-residential end uses are also provincial averages from CanESS. All parameter estimates are further adjusted during the calibration process. The calibration target for non-residential building energy use is the observed commercial and industrial fuel consumption in the baseline year.

Using assumptions for thermal envelope performance for each building type, the model calculates total energy demand for all buildings, independent of any space heating or cooling technology and fuel.

Population and employment

Population and employment data was sourced directly from the City, and spatially allocated to residential (population) and non-residential (employment) buildings. Population and employment is allocated spatially primarily to enable indicators to be derived from the model, such as emissions per household, and to drive the BAP energy and emissions projections (buildings, transportation, waste).

Population for 2016 was spatially allocated to residential buildings using initial assumptions about persons-per-unit (PPU) by dwelling type. These initial PPUs are then adjusted so that total population in the model (which is driven by the number of residential units by type multiplied by PPU by type) matches the total population from census data.

Employment for 2016 was spatially allocated to non-residential buildings using initial assumptions for two main categories: population-related services and employment, allocated to corresponding building floorspace (e.g. teachers to school floorspace); and floorspace-driven employment (e.g. retail employees per square metre). Similarly to population, these initial ratios are adjusted within the model so that the total employment derived by the model matches total employment from census data.

Transportation

The model includes a spatially explicit passenger transportation sub-model that responds to changes in land use, transit infrastructure, vehicle technology, travel behavior change and other factors. Trips are divided into four types (home-work, home-school, home-other, and non-home-based), each produced and attracted by different combination of spatial drivers (population, employment, classrooms, non-residential floorspace). Trips volumes are distributed as pairs for each zone of origin and zone of destination. For each origin-destination pair, trips are shared over walk/bike (for trips within the walkable distance threshold), public transit (for trips whose origin and destination are serviced by transit) and automobile. Total personal vehicles kilometres travelled (VKT) is produced when modelling mode shares and distances. The energy use and emissions associated with personal vehicles is calculated by assigning VKT to model of personal vehicle ownership. The City of Ottawa Transportation Planning group provided several data sets to support the calibration of the transportation sub-model:

- 2011 Ottawa travel survey data - provided initial trip mode shares by origin/destination pair and trip purpose
- 2011 TRANS model results - provided initial trip distribution by trip purpose over origin/destination pairs
- 2011 origin/destination network distance matrix
- MTO vehicle registration data

The GPC induced activity approach is used to account for emissions. All internal trips (trips within Ottawa's boundary) are accounted for, as well as half of the trips that terminate or originate within the Town's boundary. This approach allows Ottawa to better understand its impact on the peripheries and the region. Figure 4 shows sample trips within a municipality.

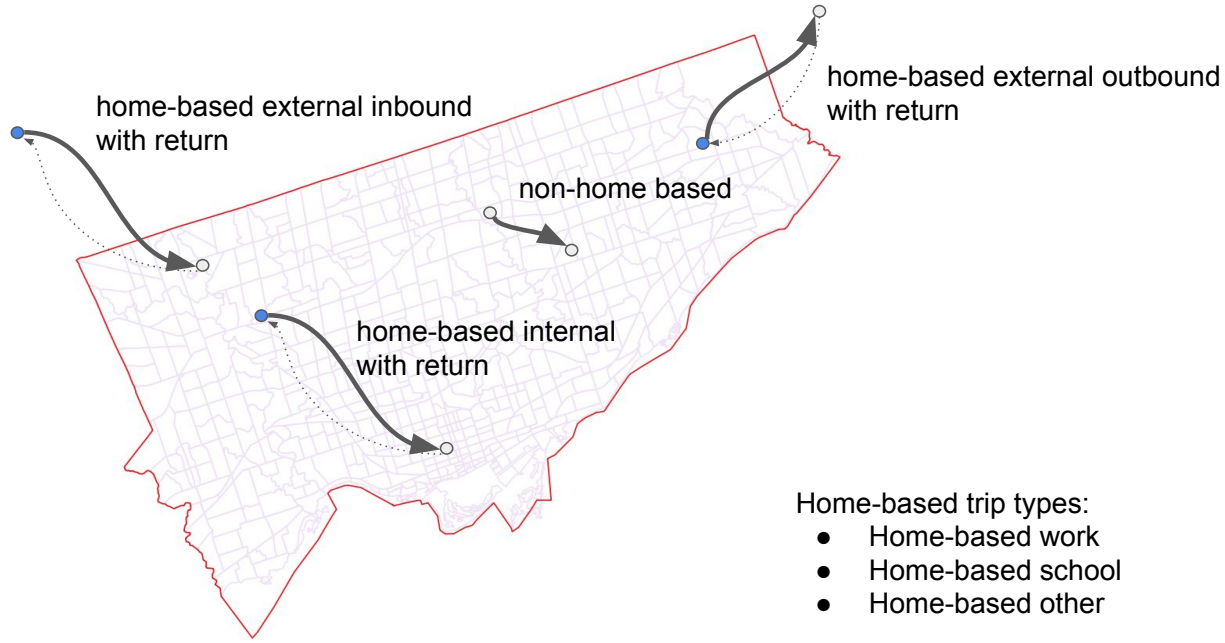

Figure 4. Conceptual diagram of trip categories.

Waste

Solid waste stream composition and routing data (landfill, composting, recycling) was sourced from the City of Ottawa reports for the years 2012, 2015, and 2016 for the Trail Road Waste Facility. The base carbon content in the landfill was estimated based on waste production data going back to 1971. 1971-2012 waste inputs into landfills is sourced from the Ottawa LandGEM model. 2013-2015 waste inputs into landfills is estimated from the 2016 per capita waste generation and Ottawa population in 2013-2015 for residential wase, the 2016 ICI waste per unit floor space and pre-2016 non-residential floor space for ICI waste. Total methane emissions were estimated using the first order decay model, with the methane generation constant and methane correction factor set to default, as recommended by and based on values from IPCC Guidelines for landfill emissions. Data on methane removed via recovery/flaring was sourced from data provided by The City of Ottawa, and Ottawa Research and Forecasting Centre for R.O. Pickard Environment Centre (Wastewater)

Model Calibration

Buildings calibration

Total buildings energy demand, derived from the buildings box model, was then calibrated against 2016 observed utility data for electricity and natural gas, provided by Ottawa Hydro / Hydro One, and Enbridge Gas respectively. In the calibration process, fuel shares are adjusted to meet the ratio of electricity to natural gas energy use in a given sector. Then the thermal conductance for residential building space conditioning and output energy use intensities for non-residential buildings and non-space conditioning residential end uses are adjusted until the model estimate of electricity and natural gas use matches the observed data.

Transportation calibration

Unlike utility-reported stationary energy consumption totals (e.g. electricity, natural gas) transportation fuel sales data is not a preferred control total for municipal transportation activity and energy analysis, due to the uncertainty of estimating point of fuel consumption based on retail point of fuel purchase. Therefore, calibration of the passenger transportation model was anchored with the household survey informing the spatial travel demand model and the results compared for reasonableness against indicators such as average annual VKT per vehicle. For medium-heavy duty commercial vehicle transportation, the diesel fuel sales for Ottawa were used as a control total - along with an assumed retail/non-retail ratio - due to the absence of other data sources for local commercial transportation activity.

The modelled stock of personal vehicles (by size, fuel type, efficiency, vintage) was informed by CANSIM and Natural Resources Canada's Demand and Policy Analysis Division. The total number of personal use and corporate vehicles is proportional to the projected number of households in the BAP.

The transit vehicle fleet, and its respective VKT and fuel consumption was modelled on data provided by Ottawa 's transit provider, OC Transpo.

Scenario Analysis

Creating a Baseline Scenario

After completion of model calibration, a baseline energy and emissions profile is generated for 2016.

Business-as-planned Scenario

The business-as-planned (BAP) scenario is a projection over the time period from 2017 to 2050. It is designed to illustrate the anticipated energy use and greenhouse gas emissions for the City of Ottawa if no additional policies, actions or strategies to address energy and emissions are implemented between 2017-2050, other than those currently underway or planned.

Note that a scenario, as it is applied in this context, is an internally consistent view of what the future might turn out to be—not a forecast, but one possible future outcome. As such, the BAP scenario projection is one of many possible views of the future; in this case, one that assumes that no additional policies, actions or strategies to address energy and emissions, other than those currently underway or planned, are implemented between 2017-2050.

The BAP process

The BAP scenario was established through developing assumptions as follows:

- Incorporating existing quantitative projections directly into the model when available. This included:
    a. From the City:
        - Population and employment projections by zone;
    b. From other technical sources:
        - Ontario building code and new building energy performance standards
        - Electricity grid emissions factor
        - Climate projections for heating/cooling degree days
        - Vehicle efficiency standards
        - Electric vehicle uptake projections
- Where quantitative projections were not carried through to 2050 (eg. completed to 2031), the projected trend was extrapolated to 2050.
- Where specific quantitative projections were not available, projections were derived using proxy or related data, and continuing with the existing trend; this included:
    - Building floorspace projections, derived using the population and employment projections and allocating new dwellings based on existing persons per unit (for residential), and floorspace (m2) per employee/job (for non-residential space).
    - Waste projections, derived using population projections and applying existing waste productions rates (tonnes waste/person).

The BAP methodology and assumptions for the major model components are summarized. Further details and sources of data can be found in BAP data & assumptions.

Population, employment and buildings

The BAP energy and emissions profile was generated through:

- Applying the population and employment projections into the future, provided by the City;
- Identifying new residential floorspace (households/dwellings) to house the projected population; this is derived by allocating new dwellings based on the existing persons per unit;
- Identifying new non-residential floorspace to accommodate projected employment; this is derived by allocating new non-residential floorspace according to gross floor area per employee/ job.
- New residential and non-residential floorspace is spatially allocated according to existing and projected growth/land-use plans.

Buildings performance

New construction: No policy for new construction was found when reviewing City of Ottawa policies and data, however building efficiencies are anticipated to increase with future technologies. Modelling for all new construction assumes a 10% improvement every 5 years.

Existing buildings: The efficiency of the existing building stock was assumed to remain unchanged; efficiency was held constant from 2016-2050.

Climate projections

To account for the influence of projected climate change, energy use was adjusted according to the number of heating and cooling degree days. Projections are created using "Statistically Downscaled Climate Scenarios," developed by the Pacific Climate Impacts Consortium and applied to the Ottawa Region . (Figure 5).

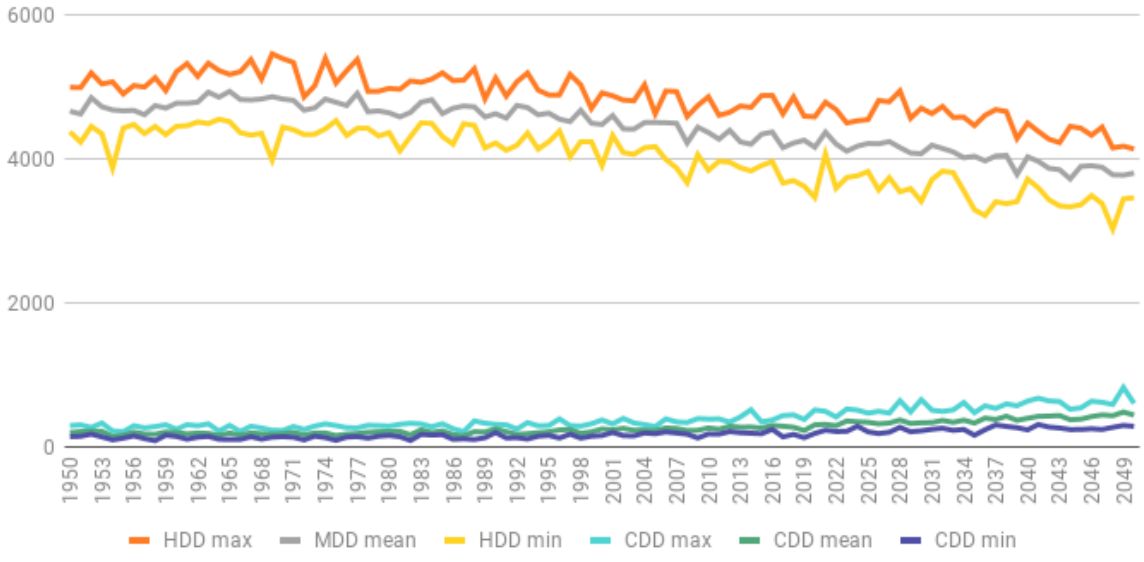

Figure 5. Projected heating and cooling degree days, 2011-2050.

The projection indicates a decrease in heating degree days (HDD), and an increase in cooling degree days (CDD) as the climate continues to warm towards 2050. A decrease in the number of heating degree days (the number of degrees that a day's average temperature is below 18o Celsius, at which buildings need to be heated) results in a reduction in the amount of energy required for space heating. This increase is partially offset by an increase in the number of cooling days (the temperature at which buildings start to use air conditioning for cooling), which results in an increase in energy use.

Grid emissions

For the BAP scenario, the electricity generation input variables were set on the basis of a combination of NEB's Energy Future 2016 projected electricity generation capacity for Ontario, and IESO capacity factors that specify the planned deployment of that capacity. This scenario assumes: the Pickering generation units are decommissioned between 2022 and 2024, while refurbishments of the remaining nuclear facilities mostly occurs in the 2020s; wind, solar and natural gas increases in capacity from 2016 to 2025; from 2016 onwards there is a slight increase in carbon intensity as nuclear loses some of its share; and, post 2035 fossil fuel based electricity generation (natural gas) is maintained at 2035 levels, and all increases in capacity, required due to increases in demand, is non-fossil fuel based, resulting in a constant carbon intensity post 2035 (Figure 6). The resulting Ontario grid carbon intensity closely aligns with the emission and generation projection of Outlook B presented in the 2016 IESO Ontario Planning Outlook (OPO).

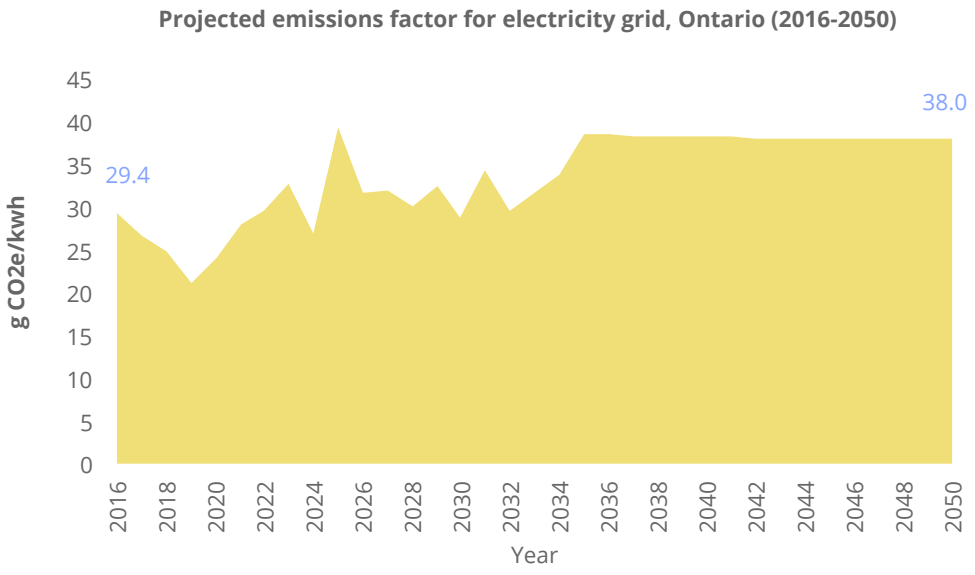

Figure 6. Projected emissions factor for Ontario's electricity grid, 2016-2050.

Transportation

Transportation projections for vehicle stocks, distance travelled, and fuel consumption are derived from calibrated baseline model parameters, BAP household projections, BAP buildings projections, and explicit assumptions about the introduction of electric vehicles and changes to vehicle fuel efficiency standards.

For vehicle stocks, the BAP assumes the introduction of electric vehicles. Original projections in the Ontario Climate Plan (2017) are not considered as programs to encourage EV use are currently on hold by the Ontario government. For modelling purposes, an assumption of 2-3% of market share by 2040 is used and held constant to 2050, mirroring other provinces without robust EV policies & programs as shown in the Canada's Electric Vehicle Policy Report Card (2016. Axsen, Goldberg, Melton (Simon Fraser University)). The total number of personal use and corporate vehicles is proportional to the projected number of households in the BAP.

Vehicle distances travelled projections are driven by buildings projections. The number and location of dwellings and non-residential buildings over time in the BAP drive the total number of internal and external person trips. Person trips are converted to vehicle trips using the baseline vehicle occupancy. Vehicle distance travelled is calculated from vehicle trips using the baseline distances between zones and average external trip distances.

Vehicle fuel consumption rates in the BAP are set to reflect the implementation of the U.S. Corporate Average Fuel Economy (CAFE) fuel standard for light duty vehicles and phase 1 and phase 2 of EPA HDV fuel standards for medium and heavy duty vehicles.

Waste

Emissions projections for waste are derived using projected population growth and existing rates of waste produced per capita. For 2016, solid waste diversion was calculated at 47% in line with Ontario Rates; this rate was held constant to 2050 and applied to additional waste generated over the period. The projection assumes no reduction in the rates of per capita waste production and no improvement in treatment facilities.

Financial

Energy cost intensities were derived from two sources: National Energy Board Energy Futures 2016 projections- reference case (electricity, natural gas, fuel oil, gasoline and diesel oil); and, a Fuels Technical Report prepared for the Government of Ontario (propane). The National Energy Board projections extend until 2040; these were extrapolated to 2050. The energy cost intensities are applied to energy consumption by fuel, derived by the model as described above, to determine total annual energy and per household costs.

Table 4. Energy costs projections, 2016 & 2050.

Energy costs ($/MJ)		2016	2050	% +/- (2016-2050)
Residential	Natural_Gas	$0.009	$0.010	17%
Residential	Electricity	$0.042	$0.048	14%
Residential	FuelOil	$0.029	$0.037	28%
Commercial	Natural_Gas	$0.006	$0.008	23%
Commercial	Electricity	$0.035	$0.042	20%
Commercial	FuelOil	$0.025	$0.034	33%
Commercial	Propane	$0.015	$0.018	26%
Industrial	Natural_Gas	$0.006	$0.007	27%
Industrial	Electricity	$0.032	$0.039	20%
Industrial	Diesel	$0.016	$0.024	54%
Industrial	FuelOil	$0.016	$0.024	54%
Industrial	Propane	$0.019	$0.027	41%
Vehicles	Natural_Gas	$0.009	$0.010	17%
Vehicles	Electricity	$0.042	$0.048	14%
Vehicles	Gasoline	$0.036	$0.049	36%
Vehicles	Diesel	$0.035	$0.048	39%

BAP Data and Assumptions

Data/Assumption		Source	Summary approach/methodology
DEMOGRAPHICS			
Population & employment			
Population & employment	Population: 969,318 (2016) 1,200,449 (2031) 1,509,358 (2050) Employment: 565,955 (2016) 750,727 (2031) 954,765 (2050)	2016 census data City of Ottawa; population & employment projections for 2023 and 2031 by zone. 2023 and 2031 TZ Projection Revised May 2016 .xlsx	Population and employment projections by zone to 2050 are applied and spatially allocated in the model. 2016 population number includes estimated census undercount. Post 2031 projections and spatial allocation were not available from the City. The population and employment trends for 2023-2031 are extrapolated to get totals for 2050. Spatial allocation of post 2031 population and employment are distributed according to similar patterns of growth exhibited between 2023-2031.

Data/Assumption		Source	Summary approach/methodology
BUILDINGS			
New buildings growth			
Building growth projections	Job density and vacancy rate assumptions Vacancy adjusted (sqft/job) Commercial 327 (8.9% weighted avg of 10.5% office and 4.2% retail) Industrial 853 (6.6%) Institutional 400 Base (sqft/job) Commercial 300 Industrial 800 Institutional 400	City of Ottawa Research and Forecasting	Buildings floorspace (res & non-res) by zone to 2050 was derived using population and employment projections provided by the City. New residential floorspace is derived by allocating new dwellings based on the existing persons per unit. New dwellings by type are allocated to zones: - if zone already has dwellings, the existing dwelling type share is used for new builds - if zone does not have dwellings, existing dwelling type share from nearby zones is used for new builds - if population in a zone is projected to decrease, dwellings are removed - Greenfield vs. infill designation is based on the Neptis Foundation GIS data New non-residential floorspace is derived by allocating the floorspace according to gross floor area per employee/job. New non-residential floorspace by type is allocated to zones - if zone already has employment, the existing employment sector shares are used along gross floor area per employee - if zone does not have employment, the employment shares from nearby zones are used along with gross floor area per employee - if employment in a zone decreases, non-residential buildings are removed

Data/Assumption		Source	Summary approach/methodology
New buildings energy performance			
Residential	New construction 10% more efficient every 5 years starting in 2018.	Adapted from Report by Environmental Commissioner of Ontario. Conservation: Let's Get Serious 2015-2016	The Let's Get Serious report forecasts a building energy performance of 13% every 5 years. For the purpose of the Ottawa BAP Scenario, a slightly more conservative 10% energy improvement every 5 years is used.
Multi-residential	New construction 10% more efficient every 5 years starting in 2018.		
Commercial & Institutional	New construction 10% more efficient every 5 years starting in 2018.		
Industrial	New construction 10% more efficient every 5 years starting in 2018.		
Existing buildings energy performance			
Residential	Existing building stock efficiency unchanged; efficiency held constant from 2016-2050.		Baseline efficiencies for each building type are derived in the model through calibration with observed data; for existing buildings, no improvements in efficiency are applied.
Multi-residential			
Commercial & Institutional			
Industrial			
End use			
Space heating	Fuel shares for end use unchanged; held from 2016-2050.	Canadian Energy Systems Analysis Research. Canadian Energy System Simulator. http://www.cesarnet.ca/research/caness-model	Within the model, the starting point for fuel shares by end use is an Ontario average value for the given building type, which comes from CanESS. From there, the fuel shares are calibrated to track on observed natural gas and electricity use. Once calibrated, end use shares are held constant through the BAP.
Water heating			
Space cooling			

Data/Assumption		Source	Summary approach/methodology
Projected climate impacts			
Heating & cooling degree days	Heating degree days (HDD) decrease and cooling degree days (CDD) increase from 2016-2050.	Statistically Downscaled Climate Scenarios (2018). Pacific Climate Impacts Consortium. https://www.pacificclimate.org/data/statistically-downscaled-climate-scenarios	Average HDD and CDD values across all models for Ottawa in the RCP4.5 scenario is used
Grid electricity emissions			
Grid electricity emissions factor	2016: 50.8 gCO2e/kWh 2050: 76.4 gCO2e/kwh 2016: CO2: 28.9 g/kWh CH4: 0.007 g/kWh N2O: 0.001 g/kWh 2050: CO2: 37.4 g/kWh CH4: 0.009 g/kWh N2O: 0.001 g/kWh IESO ONT Planning Outlook: 2016: 32.06 gCO2e/kWh 2035: 35.81 gCO2e/kwh	National Energy Board. (2016). Canada's Energy Future 2016. Government of Canada. Retrieved from https://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2016pt/nrgyftrs_rprt-2016-eng.pdf 2016 Ontario Planning Outlook - IESO http://www.ieso.ca/sector-participants/planning-and-forecasting/ontario-planning-outlook	Electricity generation input variables are sourced from CanESS and are set on the basis of a combination of NEB's Energy Future 2016 projected electricity generation capacity for Ontario, and IESO capacity factors that specify the planned deployment of that capacity. IESO emissions factors are derived from forecast emissions from Outlook B divided by forecasted demand (which appears to be total generation) for Outlook B. See Grid Emissions Factors sheet for comparison of two sources. If IESO forecast are used, variation in 2036-2050 from CanESS data will be applied to 2035 IESO to extend forecast. Also, splits between CO2,CH4,and N2O from CanESS will be used.

Data/Assumption		Source	Summary approach/methodology
ENERGY GENERATION			
Local energy generation			
Solar PV	2016 solar generation: 700 GWh	Historical solar PV generation provided by Hydro One and Hydro Ottawa	Generation was derived assuming solar capacity is available 8760 hr/year and using a capacity factor of 0.15, which was based on the assumed solar capacity factor in the Ottawa 2012 Energy and Emissions report, page 13. Solar capacity in 2016 is held constant to 2050.
District Energy	2016 DE thermal supply: 872 (TJ) 2016 DE cooling supply: 435 TJ	Reported rates from University of Ottawa DE system, and 4 Federal Systems within the city	Existing DE capacity in 2016 is held constant through 2050

Data/Assumption		Source	Summary approach/methodology
TRANSPORTATION			
Transit			
Expansion of transit	Transit mode shares by O-D zones in 2011 & 2031 model data; mode shares constant post 2031	Ottawa transportation model data for 2011 and 2031	It is assumed the modelled 2031 trips by mode reflects planned transit expansion
Electric vehicle transit fleet	Transit fleet is electrified by 2050.	Transit fleet is electrified as vehicles come to end of life beginning in 2030.	
Active			
Cycling & walking infrastructure	Active mode shares by O-D zones in 2011 & 2031 model data; mode shares constant post 2031	Ottawa transportation model data for 2011 and 2031	It is assumed the modelled 2031 trips by mode reflects planned cycling and pedestrian infrastructure expansion
Private & commercial vehicles			
Vehicle kilometers travelled	No data from City or other transportation agencies. Derived by the model.		VKT projections are driven by buildings projections. The number and location of dwellings and non-residential buildings over time in the BAP drive the total number of internal and external person trips. Person trips are converted to vehicle trips using the baseline vehicle occupancy. VKT is calculated from vehicle trips using the baseline distances between zones and average external trip distances.
Vehicle fuel efficiencies	Vehicle fuel consumption rates reflect the implementation of the U.S. Corporate Average Fuel Economy (CAFE) Fuel Standard for Light-Duty Vehicles, and Phase 1 and Phase 2 of EPA HDV Fuel Standards for Medium- and Heavy-Duty Vehicles.	EPA. (2012). EPA and NHTSA set standards to reduce GHGs and improve fuel economy for model years 2017-2025 cars and light trucks. https://www3.epa.gov/otaq/climate/documents/420f12050.pdf http://www.nhtsa.gov/fuel-economy	Fuel efficiency standards are applied to all new vehicle stocks starting in 2016.
Vehicle share	Personal vehicle stock share changes, commercial stock does not, between 2016-2050.	CANSIM and Natural Resources Canada's Demand and Policy Analysis Division.	The total number of personal use and corporate vehicles is proportional to the projected number of households in the BAP.
Electric vehicles	2-3% of Market Share in 2040	Canada's Electric Vehicle Policy Report Card 2016. Axsen, Goldberg, Melton (Simon Fraser University)	The BAP will use a similar market share to other provinces who lack distinct policy to support EV (prairies) as established by the Canada's Electric Vehicle Policy Report Card 2016.

Data/Assumption		Source	Summary approach/methodology
WASTE			
Waste generation	Existing per capita waste generation rates unchanged.	City of Ottawa Reports prepared by Dillon Consulting for TRAIL waste facility Ontario Rates provided by Resource Productivity & Recovery Authority (2015 Rates) https://www.rpra.ca/wp-content/uploads/2015-Waste-Diversion-Rates.pdf	Waste generation per capita held constant form 2016-2050.
Waste diversion	Existing waste diversion rates unchanged.		Waste diversion rates held constant form 2016-2050.
Waste treatment	Existing waste treatment processes unchanged.		No change in waste treatment processes assumed 2016-2050.
Wastewater	Existing waste treatment processes unchanged.	City of Ottawa, Ottawa research and Forecasting	No change in wastewater treatment processes assumed 2016-2050.

FINANCIAL			
Energy costs	Energy intensity costs by fuel increase incrementally between 2016-2050 per projections.	National Energy Board. (2016). Canada's Energy Future 2016. Government of Canada. Retrieved from https://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2016pt/nrgyftrs_rprt-2016-eng.pdf Government of Ontario. (2016). Fuels Technical Report. https://www.ontario.ca/document/fuels-technical-report	NEB projections extend until 2040; extrapolated to 2050. Energy cost intensities are applied to energy consumption by fuel, derived by the model, to determine total annual energy and per household costs.

Pathways Analysis: Policies, Actions and Strategies

Throughout the CityInSight accounting framework there are input variables - for user assumptions and projections - which collectively comprise an interface to controlling the physical trajectory of the urban energy system and resultant emissions. Different settings for these inputs can be interpreted as alternative behaviours of various actors or institutions in the energy system (e.g. households, various levels of government, industry, etc). This interface can be directly set or controlled by the model user, to create "what if" type scenarios. The modelling platform upon which CityInSight is built allows for a "higher layer" of logic to operate at this physical-behavioural interface, in effect enabling a flexible mix-and-match approach to behavioral models which connect to the same constraining physical model. CityInSight is able to explore a wide variety of policies, actions and strategies. The resolution of CityInSight enables the user to apply scenarios to specific neighbourhoods, technologies, building or vehicle types or eras, and configurations of the built environment.

Methodology

1. Develop and order a list of potential actions developed during the Pathway Studies (Phase 1 and 2) and evaluated from the perspective of staff and consultant experience.

2. Identify the technological potential of each action (or group of actions) to reduce energy and emissions by quantifying actions:
   - » If the action or strategy specifically incorporates a projection or target; or,
   - » If there is a stated intention or goal, review best practices and literature to quantify the goal;
   - » Identify any actions that are either overlapping and/or include dependencies on other actions;

3. Translate the actions into quantified assumptions over time;

4. Apply the assumptions to relevant sectors in the model to develop the 80% and 100% scenarios (i.e. apply the technological potential of the actions to the model);

5. Analyze results of the low carbon scenarios;

6. If the target is not achieved, Identify variables to scale up and provide a rationale for doing so;

7. Iteratively adjust variables to identify a pathway for the 80% and 100% scenarios;

8. Develop marginal abatement curve for the 80% and 100% scenarios;

9. Define criteria to evaluate low carbon scenario (i.e identify criteria for multi-criteria analysis)

10. Prioritize actions of low carbon scenario through multi-criteria analysis (along with other criteria e.g. health, prosperity, etc.);

11. Revise scenario to reflect prioritisation for final low carbon scenario, removing and scaling the level of ambition of actions according to the evaluation results.

Sensitivity Analysis

The BAP scenario illustrates the projected emissions for the City of Ottawa built upon the assumptions as described in this report. In that light, the BAP reflects what is anticipated to occur in the future if the actions/assumptions as described are implemented.

Sensitivity analysis involves the process of adjusting certain selected variables within the model in order to identify variables that have the most significant impact on the model outcomes of a scenario. It is not a process of "scenario analysis", as the variables tested do not represent internationally consistent scenarios. The approach to sensitivity analysis is to adjust those variables that were identified as having a higher potential to "move the curve", (ie. the factors that appear to be contributing significantly to the BAP scenario), in order to be better informed about the implications of future options.

The process used applies a judgement-based "one-at-a-time" exploration of variables within a scenario. The results should not be viewed as an evaluation of fully considered alternative futures, rather, it is an exploration revealing how a selected output (i.e. emissions) responds to changes in selected inputs (e.g. # residential units).

Variables and Results

Sensitivity analysis was applied to the BAP scenario. Several variables were identified for sensitivity analysis; the assumptions and results of each are described in Table 13, and depicted in Figures 40 & 41. The impact , expressed in GJ for energy and kt CO2e for emissions, shows the absolute difference relative to the BAP in 2050.

Discussion

For energy, changes in BAP assumptions for heating degree days (HDD) and building energy performance have the most significant impact on BAP energy consumption. Those variables with the least impact include changes in VKT and the uptake of electric vehicles.

Similarly for emissions, changes in BAP assumptions for HDD and building energy performance have the most significant impact on the BAP emissions trajectory, as does the grid electricity emissions factor. Variables with a lesser impact include changes in VKT, the uptake of electric vehicles, and changes in solid waste diversion rates.

Population and employment assumptions also play a role in both energy and emissions outcomes of the BAP; an increase in population and employment of 10% by 2050 results in a 7.5% increase in energy and 8.5% increase in emissions; a decrease of 10% in population and employment by 2050 results in a 8.9% and 8.4% decrease in energy and emissions respectively.

Notwithstanding the above however; the assumptions for heating degree days appear to be muting the impact of a growing population on energy and emissions in the BAP. For sensitivity, if it is assumed that HDD are constant over the time period (i.e. the climate does not change, and winters do not become warmer), and the population projections used in the BAP are not adjusted (as described above), the results indicate an increase in energy (+15.6%) and emissions (+18.9%); the impact of population growth becomes much more apparent.

Changes in the grid electricity emissions factor (EF) has an important influence for emissions. There is only a minor shift towards electricity in the BAP; by 2050, approximately two thirds of energy consumption remains fossil fuel based (predominantly natural gas), resulting in over 80% of emissions. As such, large changes in the grid emissions factor assumption in the BAP scenario results in somewhat minor changes in emissions; an increase and decrease of 7.1% and 6.8% respectively. However, this would not be the case for a scenario that represented a large shift towards electricity (eg. in a low carbon scenario). It will be fundamental, in that type of scenario, for the EF of new capacity to remain low, or the electrification approach will be at risk from a greenhouse gas emissions perspective.

The BAP assumes that all new construction, in all building sectors, will be 15% more efficient every 5 years starting in 2018, which is based on The Atmospheric Fund (TAF) analysis indicating that by 2017, the Ontario Building Code (OBC) will be the equivalent of the Toronto Green Standards (TGS) v2 Tier 1 with a 5-year lag. For sensitivity, the performance improvement was decreased to represent a lower achievement in performance of OBC. Results indicate that if OBC building energy performance requirements do not follow those in TGS, building energy and emissions will increase by 12.1% and 12.7% respectively (for 5% improvement), and 7.0% and 7.0% (for 10% improvement). The City should therefore not rely solely on the expected improvements in OBC to decrease energy and emissions in new buildings; the City will need to focus on adopting more aggressive energy performance requirements in the buildings sector.

Appendix 1: GPC Emissions Scope Table

Reasons for exclusions

N/A	Not Applicable, or not included in scope
ID	Insufficient Data
NR	No Relevance, or limited activities identified
Other	Reason provided in other comments

GPC ref No.	Scope	GHG Emissions Source	Inclusion	Reason for exclusion (if applicable)
I		**STATIONARY ENERGY SOURCES**		
I.1		Residential buildings		
I.1.1	1	Emissions from fuel combustion within the city boundary	Yes	
I.1.2	2	Emissions from grid-supplied energy consumed within the city boundary	Yes	
I.1.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes	
I.2		Commercial and institutional buildings/facilities		
I.2.1	1	Emissions from fuel combustion within the city boundary	Yes	
I.2.2	2	Emissions from grid-supplied energy consumed within the city boundary	Yes	
I.2.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes	
I.3		Manufacturing industry and construction		
I.3.1	1	Emissions from fuel combustion within the city boundary	Yes	
I.3.2	2	Emissions from grid-supplied energy consumed within the city boundary	Yes	
I.3.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes	
I.4		Energy industries		
I.4.1	1	Emissions from energy used in power plant auxiliary operations within the city boundary	Yes	
I.4.2	2	Emissions from grid-supplied energy consumed in power plant auxiliary operations within the city boundary	Yes	
I.4.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption in power plant auxiliary operations	Yes	
I.4.4	1	Emissions from energy generation supplied to the grid	Yes	
I.5		Agriculture, forestry and fishing activities		
I.5.1	1	Emissions from fuel combustion within the city boundary	Yes	
I.5.2	2	Emissions from grid-supplied energy consumed within the city boundary	Yes	
I.5.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes	

I.6		Non-specified sources		
I.6.1	1	Emissions from fuel combustion within the city boundary	No	NR
I.6.2	2	Emissions from grid-supplied energy consumed within the city boundary	No	NR
I.6.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	No	NR
I.7		Fugitive emissions from mining, processing, storage, and transportation of coal		
I.7.1	1	Emissions from fugitive emissions within the city boundary	No	NR
I.8		Fugitive emissions from oil and natural gas systems		
I.8.1	1	Emissions from fugitive emissions within the city boundary	Yes	
II		**TRANSPORTATION**		
II.1		On-road transportation		
II.1.1	1	Emissions from fuel combustion for on-road transportation occurring within the city boundary	Yes	
II.1.2	2	Emissions from grid-supplied energy consumed within the city boundary for on-road transportation	Yes	
II.1.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	Yes	
II.2		Railways		
II.2.1	1	Emissions from fuel combustion for railway transportation occurring within the city boundary	Other (Partial)	
II.2.2	2	Emissions from grid-supplied energy consumed within the city boundary for railways	Other (Partial)	
II.2.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	No	NR
II.3		Water-borne navigation		
II.3.1	1	Emissions from fuel combustion for waterborne navigation occurring within the city boundary	No	N/A
II.3.2	2	Emissions from grid-supplied energy consumed within the city boundary for waterborne navigation	No	N/A
II.3.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	No	N/A
II.4		Aviation		
II.4.1	1	Emissions from fuel combustion for aviation occurring within the city boundary	No	N/A
II.4.2	2	Emissions from grid-supplied energy consumed within the city boundary for aviation	No	N/A
II.4.3	3	Emissions from portion of transboundary journeys occurring outside the city boundary, and transmission and distribution losses from grid-supplied energy consumption	No	N/A
II.5		Off-road		
II.5.1	1	Emissions from fuel combustion for off-road transportation occurring within the city boundary	No	NR
II.5.2	2	Emissions from grid-supplied energy consumed within the city boundary for off-road transportation	No	NR

III		**WASTE**		
III.1		Solid waste disposal		
III.1.1	1	Emissions from solid waste generated within the city boundary and disposed in landfills or open dumps within the city boundary	Yes	
III.1.2	3	Emissions from solid waste generated within the city boundary but disposed in landfills or open dumps outside the city boundary	No	N/A
III.1.3	1	Emissions from waste generated outside the city boundary and disposed in landfills or open dumps within the city boundary	No	N/A
III.2		Biological treatment of waste		
III.2.1	1	Emissions from solid waste generated within the city boundary that is treated biologically within the city boundary	Yes	
III.2.2	3	Emissions from solid waste generated within the city boundary but treated biologically outside of the city boundary	No	N/A
III.2.3	1	Emissions from waste generated outside the city boundary but treated biologically within the city boundary	No	N/A
III.3		Incineration and open burning		
III.3.1	1	Emissions from solid waste generated and treated within the city boundary	No	N/A
III.3.2	3	Emissions from solid waste generated within the city boundary but treated outside of the city boundary	No	N/A
III.3.3	1	Emissions from waste generated outside the city boundary but treated within the city boundary	No	N/A
III.4		Wastewater treatment and discharge		
III.4.1	1	Emissions from wastewater generated and treated within the city boundary	Yes	
III.4.2	3	Emissions from wastewater generated within the city boundary but treated outside of the city boundary	No	NR
III.4.3	1	Emissions from wastewater generated outside the city boundary	No	N/A
IV		**INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)**		
IV.1	1	Emissions from industrial processes occurring within the city boundary	No	ID
IV.2	1	Emissions from product use occurring within the city boundary	No	ID
V		**AGRICULTURE, FORESTRY AND LAND USE (AFOLU)**		
V.1	1	Emissions from livestock within the city boundary	No	NR
V.2	1	Emissions from land within the city boundary	No	NR
V.3	1	Emissions from aggregate sources and non-CO2 emission sources on land within the city boundary	No	NR
VI		**OTHER SCOPE 3**		
VI.1	3	Other Scope 3	No	N/A

Appendix 2: Building Types

Residential Buildings (Dwellings)	Non-Residential Buildings	
Single_detached_1Storey_tiny	college_university	religious_institution
Single_detached_2Storey_tiny	school	surface_infrastructure
Single_detached_3Storey_tiny	retirement_or_nursing_home	energy_utility
Single_detached_1Storey_small	special_care_home	water_pumping_or_treatment_station
Single_detached_2Storey_small	hospital	industrial_generic
Single_detached_3Storey_small	municipal_building	food_processing_plants
Single_detached_1Storey_medium	fire_station	textile_manufacturing_plants
Single_detached_2Storey_medium	penal_institution	furniture_manufacturing_plants
Single_detached_3Storey_medium	police_station	refineries_all_types
Single_detached_1Storey_large	military_base_or_camp	chemical_manufacturing_plants
Single_detached_2Storey_large	transit_terminal_or_station	printing_and_publishing_plants
Single_detached_3Storey_large	airport	fabricated_metal_product_plants
Double_detached_1Storey_small	parking	manufacturing_plants_miscellaneous_processing_plants
Double_detached_2Storey_small	hotel_motel_inn	asphalt_manufacturing_plants
Double_detached_3Storey_small	greenhouse	concrete_manufacturing_plants
Double_detached_1Storey_large	greenspace	industrial_farm
Double_detached_2Storey_large	recreation	barn
Double_detached_3Storey_large	community_centre	
Row_house_1Storey_small	golf_course	
Row_house_2Storey_small	museums_art_gallery	
Row_house_3Storey_small	retail	
Row_house_1Storey_large	vehicle_and_heavy_equiptment_service	
Row_house_2Storey_large	warehouse_retail	
Row_house_3Storey_large	restaurant	
Apartment_1To4Storey_small	commercial_retail	
Apartment_1To4Storey_large	commercial	
Apartment_5To14Storey_small	commercial_residential	
Apartment_5To14Storey_large	retail_residential	
Apartment_15To24Storey_small	warehouse_commercial	
Apartment_15To24Storey_large	warehouse	
Apartment_25AndUpStorey_small		
Apartment_25AndUpStorey_large		
inMultiUseBldg		

SSG SUSTAINABILITY SOLUTIONS GROUP

whatIf?

INTERROGATORY RESPONSE - ED-12

12

EXHIBIT REFERENCE:

Reference: Exhibit 1, Tab 1, Schedule 5, UPDATED, p. 8-14; Exhibit 1, Tab 1, Schedule 9, UPDATED, May 5, 2020, Page 19

SUBJECT AREA: CDM

Questions:

a) What are the total avoided energy costs that have been achieved though Hydro Ottawa's CDM programs to date?

b) What are the total net benefits (calculated per the TRC) that have been achieved through Hydro Ottawa's CDM programs to date?

c) What was the TRC benefit-cost ratio for Hydro Ottawa's CDM programs for the latest year of data available for (i) residential customers and (ii) commercial / industrial customers. Please indicate the year of data provided.

d) Is Hydro Ottawa prevented by the OEB rules or other rules to implement a non-wires alternative to a capital project that involves an energy efficiency program? If yes, please identify the rules and provide excerpts.

e) Is Hydro Ottawa prevented by the OEB rules or other rules from filing an application with the OEB seeking approval of an energy efficiency program akin to the applications filed by gas utilities for their DSM programs? If yes, please identify the rules and provide excerpts.

f) Could the City of Ottawa ask Hydro Ottawa through a unanimous shareholder resolution (or otherwise) to apply to the OEB for approval of an energy efficiency program to be funded via distribution rates (e.g. as part of its efforts to meet its GHG reduction targets)? If not, please explain why not.

g) Aside from any regulatory questions, does Hydro Ottawa believe it could develop an energy efficiency program that would save more for consumers (via avoided future energy costs) than it cost (via administration and the incremental costs of the efficiency measures)?

h) If Hydro Ottawa were to propose an energy efficiency program, what areas would it focus on?

i) If Hydro Ottawa were to finance the cost of an energy efficiency program to ensure the benefits (avoided energy costs) match the costs over time, what, approximately, is the lowest interest it could obtain to do so?

RESPONSE:

a) The most recent data available to Hydro Ottawa that is consistent with the utility's understanding and interpretation of "avoided energy costs" is found within the Cost Effectiveness ("CE") Tool completed by the IESO and provided to Hydro Ottawa in March 2018. The CE Tool summarizes the utility's performance in the delivery of CDM programming within the CFF framework (as originally scheduled to be in effect for the 2015-2020 period). The Levelized Costs ("LC") from the "Summary CE Results tab" found within the CE Tool are provided below in Table A.

Table A – Summary of Levelized Costs for Hydro Ottawa CDM Programs

Sector	Program	Program Year	Levelized Cost ($/kWh)	Levelized Cost ($/kW)
Business	All Programs	All Program Years	0.028	152.44
Consumer	All Programs	All Program Years	0.030	179.41
Total	All Programs	All Program Years	0.029	161.51

Note that this calculation includes actual CFF savings achievements from 2015-2017, as well as projections for 2018-2020 based on Hydro Ottawa's approved CDM Plan at the time this tool was populated by the IESO. This is the most recent version of the CE Tool that has been provided to Hydro Ottawa following the centralization of CDM programs, per the Ministerial directive issued in March 2019.

Definitions of the LC test are as follows:

Levelized Unit Energy Cost Cost-Effectiveness Test (LC) - done in terms of both peak demand ($/kW) and energy ($/kWh) savings.	A cost effectiveness test that normalizes the costs incurred by the program administrator per unit of energy or demand reduced.

b) The most recent data available to Hydro Ottawa that calculates Total Resource Cost ("TRC") Benefits is also contained in the CE Tool completed by the IESO and provided to Hydro Ottawa in March 2018, as described in the response to part (a) above. Within the CE Tool, total net benefits for all programs and all program years are presented in Table B.

Table B – Total Net TRC Benefits

Program	Program Year	Total Resource Cost Test
		Net Benefits
All Programs	**All Program Years**	**61,889,121**

Note that this calculation includes actual CFF savings achievements from 2015-2017, as well as projections for 2018-2020 based on Hydro Ottawa's approved CDM Plan at the time the CE Tool was populated by the IESO.

c) The most recent data available that Hydro Ottawa can provide is once again contained in the CE Tool completed by the IESO and provided to Hydro Ottawa in March 2018. This is the most recent version of the tool that IESO provided to the utility following the centralization of CDM programs. In the CE Tool, TRC benefits/cost ratio by sector can be calculated using achieved results from program year 2017. This has been provided in Table C.

Table C – Hydro Ottawa's TRC Benefit-Cost Ratio

PROGRAM YEAR 2017	
Sector	**TRC Ratio**
Business	0.96
Consumer	6.30
Hydro Ottawa - Pilot	0.60
Grand Total	**2.07**

d) No, Hydro Ottawa is not prevented by the OEB rules or other rules to implement a non-wires alternative to a capital project that involves an energy efficiency program. Under current rules, as outlined in the OEB's Conservation and Demand Management Requirements Guidelines for Electricity Distributors, Hydro Ottawa "may apply to the Board for funding through distribution rates to pursue various activities such as CDM programs, demand response programs, energy storage programs and programs reducing distribution losses for the purpose of deferring the capital investment for

specific distribution infrastructure."[1] In addition, Hydro Ottawa is permitted to seek approval from the IESO under the Interim Framework for the delivery of an energy efficiency program in a manner set forth by the IESO, pursuant to the Ministerial directive published on April 4, 2019.[2]

For a more comprehensive explanation, please see the response to interrogatory OEB-134 part (c)(v).

e) Please see the response to part (d) above.

f) Please see the response to interrogatory ED-5 part (e).

g) Yes, Hydro Ottawa believes that electricity conservation can be a cost-effective alternative to other electricity resources. The utility ensures that conservation is evaluated as a potential option during the system planning process. Any program proposed to the OEB or IESO would need to meet cost-effectiveness thresholds in order to be considered.

h) Any energy efficiency program for which Hydro Ottawa would seek approval would need to address a specific customer or distribution system need in the Ottawa region.

i) If Hydro Ottawa were to finance the cost of an energy efficiency program, the cost of capital would be considered the same as the utility's weighted average cost of capital ("WACC"), as shown in UPDATED Attachment 5-1-1(A): Appendix 2-OA - Capital Structure and Cost of Capital. This is summarized in Table D below.

[1] Ontario Energy Board, *Conservation and Demand Management Requirements Guidelines for Electricity Distributors*, EB-2014-0278 (December 19, 2014), page 4.
[2] https://www.ontario.ca/page/ministers-directive-order-council-3792019.

1

Table D – Forecast WACC

Year	Hydro Ottawa WACC (%)
2021	5.54
2022	5.64
2023	5.74
2024	5.80
2025	5.96

2

INTERROGATORY RESPONSE - ED-13

13

EXHIBIT REFERENCE:

Exhibit 1, Tab 1, Schedule 9, UPDATED, May 5, 2020, Page 19

SUBJECT AREA: CDM

Preamble:

An expert report filed in EB-2016-0004 by Dr. Stanley Reitsma, P. Eng., outlined significant benefits to the electricity system in reducing peak demand.[1] See page 5 to 13. For example, Dr. Reitsma concludes:

> "Though geothermal relies on electricity as an input (to power the pump), geothermal system actually reduces electricity demand in the summer, and increases it in the winter, relative to traditional methods of heating and cooling (heating with fossil fuels and cooling with traditional AC systems). For Ontario, a summer peaking jurisdiction, a greater reliance on geothermal would reduce peaking power needs and also reduce surplus baseload generation. Coincidentally, the load profile of a geo system is similar to the production profiles of Ontario wind energy facilities."[2]

> "For the cooling of buildings, Geo HP's use about half the electricity to operate compared to air source heat pumps and AC systems, and, geo's electrical demand doesn't spike as it gets hot outside, since the ground loop temperature remains relatively unchanged. They can reduce the "heat wave" electricity system demand spikes by up to 75%."[3]

[1] Dr. Stanley Reitsma, P. Eng., *Ontario's Low Carbon Future: Geothermal Heat Pumps*, March 21, 2016 (http://www.rds.oeb.ca/HPECMWebDrawer/Record/521626/File/document).
[2] *Ibid*. p. 5.
[3] *Ibid*. p. 6.

Questions:

a) Does Hydro Ottawa agree with the comments in the above-referenced report regarding the benefits that geothermal systems can provide to the electricity system, including a reduction of peak demand? Please explain.

b) Does Hydro Ottawa agree that the expansion of geothermal systems would reduce peak demand on Hydro Ottawa's system, on which distribution system capacity is based?

c) Does Hydro Ottawa agree that geothermal systems have the capacity to provide important benefits to the electricity distribution system, especially in comparison to traditional baseboard heating?

d) Does Hydro Ottawa agree that the benefits of geothermal systems are not reflected in the distribution costs paid by residential consumers because those charges do not vary based on coincident peak demand?

e) Does Hydro Ottawa agree that increases in heat pumps would assist the City of Ottawa in achieving its GHG reduction targets?

f) Would Hydro Ottawa agree to study the possibility of offering customers with geothermal systems a reduction in their distribution charges that would approximately reflect the benefits those customers provide to the distribution system? Assume the overall rate structure would continue to make Hydro Ottawa whole for its revenue requirement.

g) Could the City of Ottawa ask Hydro Ottawa through a unanimous shareholder resolution (or otherwise) to apply to the OEB for approval of a rate structure that provides a discount to customers with geothermal systems to reflect the benefits those customers provide to the distribution system? If not, please explain why not. Assume the rate structure would continue to make Hydro Ottawa whole for its revenue requirement.

h) Please provide Hydro Ottawa's best information on the number and proportion of its customers with (i) electrical, (ii) natural gas, (iii) propane, (iv) oil, (v) wood, and (vi) other kind of space heating.

RESPONSE:

a) Hydro Ottawa is constrained in its ability to comment on the excerpt that is quoted from the above-referenced report. The utility was not a participant in the EB-2016-0004 generic hearing, which was initiated to consider cost recovery mechanisms for expanding natural gas service to Ontario communities not served by natural gas. Hydro Ottawa does not have a pre-existing opinion on the above-referenced report, its author, or the author's expertise. The utility has not reviewed this report in depth and will be limited in its ability to do so within the timelines and context of this immediate proceeding related to the utility's 2021-2025 Custom IR application.

What's more, several of the statements in the quotation are province-wide in their scope (e.g. Ontario as a summer-peaking jurisdiction and the production profiles of Ontario's wind energy facilities). The inference is that these statements, and the excerpt more generally, are intended to apply to the province-wide bulk power system. In its capacity as an electricity distributor, Hydro Ottawa would defer to the expertise of an entity such as the IESO regarding the potential benefits of a certain resource to the province-wide electricity system.

b) Hydro Ottawa has not formally conducted any internal studies on the expansion of geothermal systems within the utility's service territory and customer base. It is therefore challenging to comment on whether such expansion would reduce peak demand on the utility's distribution system.

c) Similar to the response to part (b) above, in the absence of any formal internal studies it is challenging for Hydro Ottawa to comment on the capacity of geothermal systems to

provide important benefits to the electricity distribution system, including in comparison to traditional baseboard heating.

d) Hydro Ottawa does not believe that it would be appropriate to respond to this question in the context of this proceeding, which is limited to review of the utility's proposed rates and charges for 2021-2025. The nature of this question is such that it is more suited to examination through an OEB generic hearing or policy consultation.

e) Hydro Ottawa acknowledges that, as part of the extensive technical analysis of clean energy resource options that the City of Ottawa has conducted under the auspices of its "Energy Evolution" initiative, it has been determined that heat pumps can help reduce greenhouse gas ("GHG") emissions in Ottawa. The City has commissioned dedicated studies – known as "Pathway Studies" – that examine different technologies which could help achieve its GHG reduction targets. One of these Pathway Studies focused on the potential for uptake of heat pumps to provide for heating and cooling in the built environment.[4] Under three different uptake scenarios, the study finds that heat pumps would help reduce GHG emissions in Ottawa.

f) This question appears to assume that offering customers with geothermal systems a reduction in their distribution charges would be compatible with established OEB rate-making principles and rate-setting options. Hydro Ottawa is reluctant to commit to any course of action that makes presumptions or speculations in this regard. It is Hydro Ottawa's view that this question engages subject matter (e.g. utility rate design, rate-setting, and revenue requirement) that is more appropriately suited to examination through an OEB generic hearing or policy consultation, such as the active consultations on Utility Remuneration and Responding to Distributed Energy Resources (EB-2018-0287/EB-2018-0288).

g) Please see the response to interrogatory ED-5 part (e).

[4] Leidos Canada Inc., *Pathway Study on Heat Pumps in Ottawa* (October 17, 2017). Available at: https://docs.google.com/document/d/1NymjBxG8RFa3MBPVyi-BYEGvemwWmfSbnAVEUxC1mdE/edit.

h) Hydro Ottawa does not maintain, or have access to, any data with regards to the heating types used by our customers. There are no obligations for customers to share or disclose such information to Hydro Ottawa.

INTERROGATORY RESPONSE - ED -14

14

EXHIBIT REFERENCE:

Exhibit 1, Tab 1, Schedule 9, UPDATED, p. 19

SUBJECT AREA: CDM

Question(s):

a) Please confirm that 39% of Ottawa's greenhouse gas emissions are from the consumption of natural gas (per Ottawa's Climate Change Action Plan).

b) Please describe potential roles that Hydro Ottawa could play in relation to the implementation of electric heat pumps as an alternative to natural gas heating.

c) How many new homes and businesses are forecast to be built in Hydro Ottawa's coverage area in the next 10 years? If available, please provide an annual breakdown.

d) How many new customers does Hydro Ottawa expect to hook up in the next 10 years? If available, please provide an annual breakdown.

e) What assistance could Hydro Ottawa provide to developers to promote the installation of electric heat pumps instead of natural gas furnaces in new construction?

f) Would Hydro Ottawa benefit from regulatory changes in order to play a greater role in promoting the expansion of electric heat pumps in lieu of natural gas? If yes, what are those potential changes?

g) Please comment on the report by Ralph Torrie estimating that electricity demand could decline if all heating was converted to electric heat pumps and energy retrofits were

increased:
https://www.corporateknights.com/channels/built-environment/recovering-stronger-building-low-carbon-future-green-renovation-wave-15875463/.

RESPONSE:

a) Hydro Ottawa confirms that, according to the City of Ottawa's *Climate Change Master Plan*, the use of natural gas represented 39% of Ottawa's greenhouse gas ("GHG") emissions by source type in 2018.[1]

b) Examples of the potential roles which Hydro Ottawa could play include collaboration with the City of Ottawa in the pending implementation of its "Energy Evolution" initiative, with an eye towards understanding how best to support increased demand for lower-carbon heating systems for both new developments and building retrofits. In addition, Hydro Ottawa could engage with other utilities, low-carbon technology suppliers, and all levels of government to support and promote the development of incentive programs for lower-carbon alternatives to heating, such as electric heat pumps. In this regard, the utility notes that it sought to support uptake within its customer base of the former Green Ontario Fund's rebate programs for various low-carbon and energy efficiency solutions, including ground-source and air-source heat pumps.[2] Hydro Ottawa lent support by taking such actions as adding information and links to the Green Ontario Fund on the utility's Save on Energy "Incentives and Rebates" webpage and through social media outreach.

c) Based on projections adopted by Ottawa City Council in December 2019 for the City's new *Official Plan*, approximately 80,000 new dwellings are forecasted to be developed from 2021-2031. (For purposes of this response, Hydro Ottawa is utilizing 2021-2031 to define "the next 10 years," seeing as the City of Ottawa's forecast stretches from 2018-2046, with specific data only provided for the intervals of 2021, 2026, 2031, 2036,

[1] Attachment ED-11(A): City of Ottawa Climate Change Master Plan, page 11.
[2] https://news.ontario.ca/ene/en/2017/12/helping-families-save-money-and-fight-climate-change-at-home.html.

and 2041). A projection for businesses is unavailable.[3]

d) UPDATED Exhibit 3-1-1: Load Forecast includes a forecast of the number of Hydro Ottawa customers by class for the 2021-2025 period (see Table 3).

For the 2026-2030 period, Hydro Ottawa has not conducted a forecast of the number of customers by class.

e) Hydro Ottawa has provided assistance to developers and building owners to inform the decisions they make around energy efficiency technologies such as electric heat pumps versus natural gas in several ways. Examples in this regard include the following:

- Administering the High Performance New Construction Program (which was funded by the Independent Electricity System Operator ["IESO"]) and providing incentives to developers/building owners for energy modelling and for constructing more efficient buildings;[4] and

- Promoting and supporting Enbridge Gas Distribution's Savings by Design Program, which provides design support and funding incentives for efficient building components.

In addition, Exhibit 4-1-6: Conservation and Demand Management outlines the different activities Hydro Ottawa intends to carry out over the 2021-2025 period in order to remain a trusted advisor to its customers in the emerging smart energy future through its Conservation and Demand Management team. This future includes a growing array of electricity generation, electricity storage, demand management, and Smart Grid

[3] City of Ottawa Planning, Infrastructure and Economic Development Department, *Growth Projections for the New Official Plan: Methods and Assumptions for Population, Housing and Employment 2018 to 2046* (November 2019), page 46, Appendix 6. Available at: https://engage.ottawa.ca/8204/widgets/36458/documents/33928.
[4] This program was cancelled effective April 1, 2019, pursuant to a Ministerial Directive instructing the IESO to discontinue the Conservation First Framework and establish an Interim Framework for conservation and demand management programming.

technologies and alternatives.

f) Hydro Ottawa respectfully declines to answer. In the context of a proceeding limited to review of the utility's proposed rates and charges for a five-year Custom IR term, Hydro Ottawa does not believe it is appropriate or relevant to opine or speculate on preferred or possible regulatory changes that would facilitate the utility's involvement in the promotion of a specific technology or resource.

g) Hydro Ottawa is constrained in its ability to comment on the above-referenced report. Hydro Ottawa does not have a pre-existing opinion on the report, its author, or the author's expertise. The utility has not reviewed this report in depth and will be limited in its ability to do so within the timelines and context of the current proceeding. In addition, no information or explanation has been provided by Environmental Defence to establish a clear linkage between this report and the scope and substance of Hydro Ottawa's Application. Accordingly, the utility respectfully declines to comment.

INTERROGATORY RESPONSE - ED-15

15

EXHIBIT REFERENCE:

Exhibit 1, Tab 1, Schedule 9, UPDATED, p. 19

SUBJECT AREA: Electric Vehicles

Question(s):

a) How many electric vehicle charging stations are installed by Hydro Ottawa customers now and how many are forecast for each year from 2021 to 2025? Please provide a high-end and low-end estimate.

b) Is Hydro Ottawa confident that it is making all the investments needed to facilitate increases in electric vehicles and electric vehicle charging stations even if its high-end forecasts come to fruition?

c) Have any Hydro Ottawa customers been unable to install an electric vehicle charging station (e.g. a level 3 station) due to constraints on Hydro Ottawa's distribution system? If yes, how many customers each year?

d) Have any Hydro Ottawa customers been *delayed* in installing an electric vehicle charging station (e.g. a level 3 station) due to constraints on Hydro Ottawa's distribution system? If yes, how many customers each year?

e) Is it Hydro Ottawa's goal that all customers will be able to install and use electric vehicle charging stations if they wish to do so? If not, please detail Hydro Ottawa's targets in this regard.

f) Is it Hydro Ottawa's goal that all customers will be able to install and use electric vehicle charging stations *without delay of more than one month* if they wish to do so? If not, please detail Hydro Ottawa's targets in this regard.

g) Please list and describe the investments that Hydro Ottawa intends to make over 2021-2025 to ensure readiness for electric vehicles.

h) Please list and describe the ways in which Hydro Ottawa is *currently* able to use the battery in electric vehicles as a distributed energy resource to provide a service that benefits the distribution system.

i) Please list and describe the ways in which it is possible to use the battery in electric vehicles as a distributed energy resource to provide a service that benefits the distribution system, *focusing only on those which Hydro Ottawa is not yet capable of undertaking*.

j) Is Hydro Ottawa able to capitalize on the storage capacity of electric vehicles to reduce distribution system costs by: (i) communicating directly with charging stations to reduce load during peak periods, (ii) communicating directly with charging stations to allow power to be drawn from batteries during peak periods, (iii) drawing energy from car batteries connected to charging stations during peak periods, and (iv) communicating directly with charging stations to ensure energy is drawn from the LDC's system at the optimal times? If not, please explain what additional steps Hydro Ottawa is willing to commit to take to explore and implement these things.

k) Is Hydro Ottawa willing to offer customers special rates to encourage the expansion of electric vehicles?

l) Is Hydro Ottawa willing to further explore steps it can take to speed up the implementation of charging stations in hard-to-service locations, such as for on-street parking in the City of Ottawa?

m) Could the City of Ottawa ask Hydro Ottawa through a unanimous shareholder resolution (or otherwise) to apply to the OEB for approval of programs intended to encourage the expansion of electric vehicles? If not, please explain why not.

RESPONSE:

a) Hydro Ottawa does not have any data on how many electric vehicle ("EV") charging stations are installed by Hydro Ottawa customers now or how many are forecast for each year from 2021-2025, as there are no requirements for customers to report the installation to the utility.

b) Hydro Ottawa takes into consideration the potential impact of EVs and the associated requirement for charging as part of the planning process. Please see section 8.1.6.4 Electric Vehicles in the Exhibit 2-4-3: Distribution System Plan.

c) No Hydro Ottawa customers have been unable to install an EV charging station (e.g. a Level 3 station) due to constraints on the utility's distribution system.

d) No Hydro Ottawa customers have been *delayed* in installing an EV charging station (e.g. a level 3 station) due to constraints on the utility's distribution system.

e) Hydro Ottawa builds into planning assumptions and specifications the ability to allow all forecasted customers to install and use EV charging stations if they wish to do so. For example, please see pages 286-287 of Exhibit 2-4-3: Distribution System Plan for a discussion of how the utility has increased the standard size of transformer for installation in residential neighbourhoods, so as to provide higher capacity for future EV penetration.

f) Please see the response to part (e) above.

g) Hydro Ottawa builds into planning assumptions and specifications which are used to plan projects the forecasted system requirements for EV chargers and as such, all projects are associated with ensuring the readiness for EVs.

h) There are no ways in which Hydro Ottawa is *currently* able to use the battery in EVs as a distributed energy resource to provide a service that benefits the distribution system.

i) EVs and their associated support equipment are complex electronic devices that are capable of many ancillary functions that could theoretically be used to support the distribution system through the use of the battery. A fulsome description of all possible functionality is likely outside the scope of this document. However, looking only at the basic functions of the EV charging system, the following functions could be controlled to provide a benefit to the distribution system:

- Charging time;
- Charging duration;
- Peak charging power; and
- Average power consumption.

In order to access these functions, Hydro Ottawa would need to develop new standards, as well as adopt technologies such as those described in the response to interrogatory DRC-6.

j) Hydro Ottawa is currently not able to capitalize on the storage capacity of EVs to reduce distribution system costs by: (i) communicating directly with charging stations to reduce load during peak periods; (ii) communicating directly with charging stations to allow power to be drawn from batteries during peak periods; (iii) drawing energy from car batteries connected to charging stations during peak periods; and (iv) communicating directly with charging stations to ensure energy is drawn from the utility's system at the optimal times. Hydro Ottawa reviews and prioritizes initiatives such as those listed above within the Smart Energy Steering Committee where projects and proposals are scored

and discussed for validity. Projects proceed when they have financial and customer benefits and are in alignment with Hydro Ottawa's vision.

k) This question appears to assume that offering customers special rates so as to encourage the expansion of EVs would be compatible with established OEB rate-making principles and rate-setting options. Hydro Ottawa is reluctant to commit to any course of action that makes presumptions or speculations in this regard. It is Hydro Ottawa's view that this question engages subject matter (e.g. utility rate design, rate-setting, and revenue requirement) that is more appropriately suited to examination through an OEB generic hearing or policy consultation, such as the active consultations on Utility Remuneration and Responding to Distributed Energy Resources (EB-2018-0287/EB-2018-0288).

l) Hydro Ottawa is willing to further explore steps it can take in order to help facilitate the implementation of charging stations in all locations across its service territory, including, but not limited to, hard-to-service locations and on-street parking. In the past two years, Hydro Ottawa has pursued federal innovation funding (through Natural Resources Canada) for the development and deployment of EV supply equipment ("EVSE") specifically targeted for hard-to-service locations. While this project ultimately did not go forward, Hydro Ottawa did gain a more fulsome understanding of the potential solutions and available vendors and partners. Furthermore, through the MiGen program, Hydro Ottawa intends to continue to develop and explore technologies for facilitating and enabling behind-the-meter resources including EVSE.

m) Please see the response to interrogatory ED-5 part (e).

INTERROGATORY RESPONSE - ED-16

16

EXHIBIT REFERENCE:

Exhibit 1, Tab 1, Schedule 9, UPDATED, May 5, 2020, Page 19

SUBJECT AREA: Distribution System Plan

a) Please discuss the possibility of installing solar PV in some of Hydro Ottawa's larger distribution corridors (e.g. as part of the City of Ottawa's efforts to meet its GHG reduction targets). Please include a table itemizing potential obstacles and next steps that would be needed to explore solutions to those obstacles.

b) What approvals, if any, would Hydro Ottawa require from the OEB to allow a third party to install solar PV in its distribution corridor?

c) What approvals, if any, would Hydro Ottawa require from the OEB to (i) install solar PV in its distribution corridor as an unregulated investment not funded in rate base, and (ii) install solar PV in its distribution corridor as a cost-effective non-wires solution to a distribution-system need?

d) For each of Hydro Ottawa's five largest distribution corridors (by land area), please discuss whether and what distribution system upgrades would be required for the installation of solar PV in the corridor. Please make and state assumptions as necessary regarding matters such as the size and type of installation. Please discuss approximate ballpark cost of the kinds of upgrades that might be necessary, if any. Please also discuss who would be responsible for paying for those.

RESPONSE:

a) Hydro Ottawa does not own any distribution corridors. Hydro Ottawa's distribution lines are typically within the public road allowance or on easements. Major utility corridors in Ottawa are used and owned by Hydro One Networks. Hydro Ottawa easements on privately-owned lands are not large enough to accommodate solar PV installations. In addition, Hydro Ottawa does not have authorization to install solar PV installations on those easements. Therefore, amendments to the easement agreements would be required for such installation.

b) Please see the response to part (a) above.

c) Please see the response to part (a) above.

d) Please see the response to part (a) above.

INTERROGATORY RESPONSE - ED-17

17

EXHIBIT REFERENCE:

Exhibit 1, Tab 1, Schedule 9, UPDATED, May 5, 2020, Page 19

SUBJECT AREA: Distribution System Plan

a) Please discuss three examples of electrification projects (e.g. heat pumps, EV chargers) hitting the capacity limit of a feeder line and the prospective installer of such equipment being shown an estimate by Hydro Ottawa to expand the feeder line, after which the project was no longer pursued.

b) How many times in the past 5 years has Hydro Ottawa indicated to its customer or the prospective installer of an electrification project that the project would require an increase in the capacity of a feeder line for which the customer/proponent would be partially or fully responsible? If an exact number is not known, please provide a best estimate.

c) If a new load customer (e.g. home or business) seeks to connect to Hydro Ottawa's system, but that load cannot be accommodated because of the capacity limit of the feeder, what steps does Hydro Ottawa take to resolve (or avoid) this situation? Would the feeder be upgraded? Who would pay for said work?

d) If an existing customer seeks to install an electrification project (e.g. large heat pump or electric vehicle charger), but that load cannot be accommodated because of the capacity limit of the feeder, what steps does Hydro Ottawa take to resolve (or avoid) this situation? Would the feeder be upgraded? Who would pay for said work?

e) Please compare Hydro Ottawa's responses to (c) and (d) with the practices in place across the river in Gatineau, Quebec.

RESPONSE:

a) Hydro Ottawa does not currently track customer-requested projects which are not pursued by the proponent based on costs for System Expansion (i.e. capacity constraints).

b) Hydro Ottawa does not track customer-requested projects by their specific driver. However, regardless of the source of proposed load increases, the requesting party is responsible for the System Expansion costs necessary for connection, which are subject to an Economic Evaluation.

c) The following options are considered when a new customer seeks to connect to Hydro Ottawa's distribution system, but the proposed load cannot be accommodated because of feeder capacity limits:

i. Load Transfers – If only one lie-along feeder is available for the new customer, transfer an existing customer supplied from the same feeder to an alternate supply, where feasible, with sufficient load to offset the new addition.
ii. Feeder Capacity Increase – Where feasible, upgrade existing constraints on feeder capacity to allow customer connection (e.g. conductor/cable size upgrade).
iii. System Expansion – Extend an existing/new feeder with capacity to the customer's premise.

With respect to cost responsibilities, please see the response to part (b) above. Alignment with planned and documented Hydro Ottawa projects is also considered. If the scope required for connection partially or fully aligns with internal plans, Hydro Ottawa will enter a cost-sharing arrangement with the customer.

d) Electrification projects add new loads to the distribution system; therefore, they are subject to the same processes described in the response to part (c) above.

e) Hydro Ottawa is not familiar with the connection processes utilized by Hydro-Québec Distribution and is therefore not able to respond.