CITY OF VAUGHAN

EXTRACT FROM COUNCIL MEETING MINUTES OF SEPTEMBER 24, 2024

Item 1, Report No. 27 of the Committee of the Whole, which was adopted without amendment by the Council of the City of Vaughan on September 24, 2024.

1. PROPOSED 2024 MUNICIPAL ENERGY PLAN

The Committee of the Whole recommends that consideration of this matter be deferred to a future Committee of the Whole (Working Session) meeting.

Recommendations

1. That the Proposed 2024 Municipal Energy Plan be endorsed;
2. That staff be directed to implement the actions contained within the Plan; and
3. That staff be directed to work with Communications, Marketing and Engagement to promote the Plan

Committee of the Whole (1) Report

DATE: Tuesday, September 10, 2024 **WARD(S):** ALL

TITLE: PROPOSED 2024 MUNICIPAL ENERGY PLAN

FROM:
Haiqing Xu, Deputy City Manager, Planning and Growth Management

ACTION: DECISION

Purpose

To seek Council endorsement of the Proposed 2024 Municipal Energy Plan.

Report Highlights

- Staff was directed to update the 2016 Municipal Energy Plan.
- The City has set targets to limit greenhouse gas (GHG) emissions to 2-3 tonnes per person by 2030 and achieve net-zero emissions by 2050 at the latest.
- The Proposed 2024 Municipal Energy Plan (the Plan) provides strategies and actions, informed by engagement, to reach the City's climate goals.
- Plan implementation is projected to create a net return of over $6 billion and the equivalent of an annual average of 2,285 additional full-time jobs across Vaughan by 2050.
- Plan implementation can reduce the risk of cancer and other illnesses and improve mental health in Vaughan.
- The Plan includes a carbon budget tool that would integrate GHG emissions with City decision-making and make Vaughan a leader in climate action.
- City staff is actively pursuing many other forms of climate action.

Recommendations

1. That the Proposed 2024 Municipal Energy Plan be endorsed;
2. That staff be directed to implement the actions contained within the Plan; and

3. That staff be directed to work with Communications, Marketing and Engagement to promote the Plan

Background

Vaughan is already experiencing the impacts of climate change, including temperature rise, significant flooding, heatwaves, and decreased air quality

The mean temperature in Vaughan increased by more than 1°C between 1950 and 2022. Vaughan has experienced significant flooding, numerous heat waves, and air quality issues from forest fires in other parts of the province. These climate hazards are projected to increase in severity over the coming years and decades. More extreme weather events will accompany these changes, including more intense rain and snowfall events, flash floods, high winds, and hurricanes.

Based on the current trajectory, climate change will continue to impact Vaughan with projected increases in precipitation, drought, and temperature

Data from the Climate Atlas of Canada predicts an increase in yearly precipitation and heavy rain days which could lead to floods. As well, the precipitation increases are expected in the winter and spring, which could lead to more mixed precipitation events due to temperatures hovering around 0ºC. Meanwhile, summer precipitation is slated to decrease which could lead to drought. By 2050, mean annual temperature is projected to rise by another 2ºC, and the number of extremely hot days (greater than 30°C) are expected to increase from 57 in 2013 to 97 days. Additionally, by 2050, average heatwave length is expected to double to 6 days, compared to 2013, increasing the risk of adverse health impacts, environmental concerns, and crop failures.

In June 2019, Mayor and Members of Council unanimously passed a Members' Resolution to declare a climate emergency in Vaughan

The Climate Change Emergency Declaration was made in response to the Intergovernmental Panel on Climate Change's (IPCC) warning of the intensifying climate emergency. It recognizes the IPCC's assessment that urgent and transformative action needs to occur between now and 2030 to limit the average global temperature increase to 1.5°C, with aggressive actions required to meet net-zero emissions by 2050. The stated purpose of the declaration is to name and deepen Vaughan's commitment to protect the economy, environment, and community from the impacts of climate change.

The City set the targets of reaching 2 to 3 tonnes of greenhouse gas (GHG) emissions per person by 2030 and net-zero emissions by 2050

To meet these goals, Vaughan will need to eliminate 0.86 megatonnes of CO2 equivalent emissions (MtCO2e) by 2030 and 2.6 MtCO2e by 2050. Of these totals, most emissions will come from energy consumption in buildings with the stock of residential

buildings emitting more than commercial and institutional buildings, and Vaughan's industrial buildings emitting the least. The transportation sector is projected to be the second largest GHG emitter over this time frame followed by the waste sector.

It is projected that most community GHG emissions will come from natural gas consumption followed by grid-powered electricity use, diesel, and lastly, gasoline. Natural gas will make up the largest portion of emissions due to its use in buildings. Gasoline based emissions are projected to steadily decline as electric vehicles become more commonly utilized.

The Climate Change Emergency Declaration underlined the importance of updating the 2016 Municipal Energy Plan (MEP) to meet the City's climate targets

Vaughan's MEP is a strategic planning document and action framework that outlines how the City and community can increase energy efficiency, reduce GHG emissions and limit economic risks associated with transitioning to a low-carbon community.

Sustainability Solutions Group (SSG) was retained to update the 2016 MEP and provide official plan policy recommendations through the Municipal Energy Plan Revision (MEPR)

SSG provided the necessary project management, data analysis, and technical expertise to undertake the MEPR process in collaboration with Policy Planning and Special Programs staff. In addition to updating the City's 2016 MEP to reach Vaughan's climate goals, SSG was tasked with providing climate change and sustainability policy recommendations for the City's Official Plan Review to ensure integration between the two processes.

The MEPR was well-integrated with the Vaughan Official Plan Review (OPR)

The City's Official Plan and Municipal Energy Plan are linked, with both influencing key aspects of one another. The MEPR was designed to be well-integrated with the OPR process. As such, SSG reviewed OPR deliverables such as the Climate Change Adaptation and Resiliency Framework and other background papers, as well as forecast data for integration with the MEPR. SSG reviewed the OPR Policy Directions Report and provided policy recommendations to be considered in the updated Official Plan. In addition, community feedback received through the OPR process on climate change and sustainability matters has been closely considered as part of the MEPR as detailed later in this report.

The MEPR was rooted in extensive data collection, analysis and modelling

Staff coordinated with internal City departments, as well as York Region, Alectra, Enbridge, the Municipal Property Assessment Corporation, and Kalibrate Group to

collect the necessary data for the subsequent modelling and analysis. This included data related to demographics and economics, buildings and properties, land use, energy, transportation, wastewater, solid waste, industrial processes, agriculture, water and forestry.

Analysis was undertaken to model and understand recent and planned energy use and emissions in Vaughan

The baseline inventory was developed using the best available data to illuminate the nature of recent energy-use and the resulting community GHG emission patterns and sources. The business-as-planned scenario was then modelled using data, policy information, and informed assumptions. This scenario illustrates the City's expected emissions levels if Vaughan continues with current policies and practices and assumes no additional policy or climate action intervention.

The MEPR was guided by engagement with internal and external technical experts

A technical advisory committee (TAC) was formed at the onset of the project that included representation from many City departments, Vaughan Public Libraries, Toronto and Region Conservation Authority, York Region, Enbridge, and Alectra. Engagement efforts included intensive workshops, circulation of deliverables and additional meetings as necessary. TAC members received information on the MEPR process and climate action planning, and provided input into the modelling assumptions, low-carbon actions, and Implementation Framework.

The public was engaged through a project survey and contest, interactive public workshops, pop-up booths, and a project webpage and email

An online survey was launched to identify opportunities and challenges in updating and implementing the Plan. Two interactive community workshops were held to gain insights into what actions the City and its community members should take to increase energy efficiency, reduce emissions, and mitigate climate change. The survey was incentivized by a contest to win 3-month fitness memberships and single-use activity passes provided by Vaughan's Recreation staff.

Engagement also included pop-up booths at Vaughan's Concerts in the Park event series where Environmental Sustainability staff raised community awareness about the MEPR, provided themed art activities for children, and answered questions and received feedback about climate change and sustainability. Community members were directed to the project webpage: vaughan.ca/MEP to learn more and to submit feedback to mep@vaughan.ca. Engagement efforts were designed, promoted and advertised in

collaboration with Communications, Marketing and Engagement staff to maximize both reach and effectiveness.

The public provided insights into what the City can do to support climate action
The following recommendations were commonly heard through engagement:

- Leverage and expand financial, employment, and transit support for all.
- Adopt an equity lens to ensure climate actions are developed to support equity-seeking and vulnerable community members.
- Encourage sustainable building design, mixed-use and compact development and invest in active transportation.
- Work to raise the community's awareness of climate change and climate actions by providing education on these topics.

More information is available in the ancillary Engagement Plan and Summary Report included as Attachment 4.

The MEPR integrated relevant community feedback from intensive engagement efforts undertaken as part of the OPR
Given the interrelatedness of the two processes, the MEPR was designed to piggyback on OPR engagement efforts to create efficiencies, eliminate redundancy, and reduce community engagement fatigue. The OPR process included intensive community engagement including several meetings, workshops, webinars and events. Relevant feedback collected is summarized as follows:

- Explore opportunities to lower energy consumption in both industry and buildings, including the use of alternative energy sources like solar.
- Support initiatives that allow for energy savings and emissions reductions.
- Increase preparedness for climate emergencies to build resiliency.
- Invest in electric vehicle and electric bicycle infrastructure.
- Improve waste management and recycling policies and practices.
- Continue to address and plan for a changing climate.

Building industry feedback was collected through the review process and engagement efforts from other City projects
The Project Team held a workshop with BILD – York Chapter to inform members of the building industry about the project and provide the opportunity to share insights on the low-carbon actions and options for implementing those actions. The review process also integrated valuable feedback on climate change and sustainability matters gathered

through several workshops with BILD – York Chapter undertaken as part of 2023 Sustainability Metrics Program update process and the ongoing Vaughan OPR process.

Previous Reports/Authority

Related Council materials can be accessed via the following links:

Member's Resolution, June 4, 2019 – Council passed a Member's Resolution to declare a climate emergency and lists actions for climate change mitigation and adaptation.

Council meeting extract, March 22, 2016 – A presentation of the draft 2016 MEP was brought to Working Session and comments were incorporated into the final 2016 MEP.

Analysis and Options

The 2024 Proposed Municipal Energy Plan (the Plan) identifies key actions the City and community can take to reach Vaughan's climate goals

The Plan, included as Attachment 1, consists of the main document, implementation framework and accompanying carbon budget tool. The Plan sets a pathway to reduce per-capita GHG emissions by approximately half by 2030, and to reach the target of net-zero GHG emissions by 2050, while respecting the needs of those who live, work and play in Vaughan. The Plan also considers the role of the City in driving and supporting action, and identifies how citizens, businesses and stakeholders can participate in transitioning Vaughan to a low-carbon community.

The Plan will implement the following priorities previously set by Council in Green Directions Vaughan, the community sustainability plan:

- Goal 1, Objective 1.2: To promote the reduction of community greenhouse gas emissions in the City of Vaughan.
- Goal 2, Objective 2.1: To ensure a climate resilient City and build capacity for local action on climate change.
- Goal 2, Objective 2.3: To create a city with sustainable built form that is compact, resilient and designed to promote citizen health.

A carbon budget is an important tool to consider GHG emissions in decision-making processes and meet climate targets

In 2017, the C40 Cities Climate Leadership Group (C40) published a report in which they assessed the contribution of the C40 cities to the COP21 Paris Agreement's aspirations of limiting global temperature rise to 1.5 or well below 2.0 degrees Celsius. For each city, the report identified GHG emissions reduction pathways and potential actions to achieve these pathways. These city-specific pathways were referred to as

carbon budgets and were an effective way to communicate the urgency of the required emission reductions and became a tool for incorporating GHG emissions into their decision-making processes.

Carbon budgets are driven by emission limits or targets. A ceiling on carbon emissions is established with reference to scientific targets and modelling, and strategies for staying within that ceiling or budget are then developed. A carbon budget is both a mechanism for setting a target and a management system for embedding the consideration of GHG emissions throughout an organization. A carbon budget allows municipalities to make decisions to avoid significant GHG emissions before they are committed to. This proactive approach represents a shift in traditional municipal climate change planning which typically entails trying to mitigate GHG emissions associated with initiatives and projects after they are already operational.

Adopting a carbon budget would make the City a leader in Canadian municipal climate action

In adopting a carbon budget, Vaughan would join a short list of Canadian municipalities taking the lead on this form of climate action. To date, Calgary, Durham, Edmonton, Halifax, Montreal and Whitby have implemented some form of a carbon budget. The City of Toronto is currently working to do the same. Globally, the City of Oslo was the first municipality to adopt a carbon budget having done so in 2017.

The Plan includes a cumulative carbon budget that is broken down into an annual carbon budget

The cumulative carbon budget represents the cumulative emissions for Vaughan between now and 2050. It seeks to align the city's total emissions with its fair share of the remaining global carbon budget that limits warming to 1.5°C.

The annual carbon budget is based on the targeted GHG emissions for a particular year. It is aligned with the cumulative carbon budget and would be integrated with Vaughan's financial budgeting process.

Vaughan will miss its climate goals if it continues on its business-as-planned (BAP) pathway

The BAP pathway shows that although emissions per person are expected to decrease significantly under current policies and practices, increased population and employment in Vaughan will outstrip per person emissions. If the City is to continue along a BAP pathway, overall emissions will decrease by only 23% by 2050, relative to the 2016 baseline. This means further action beyond a BAP pathway must be taken to reach net-zero emissions by 2050.

Vaughan's climate goals are largely attainable under the low-carbon pathway presented in the Plan

The low-carbon pathway is a projected future state in which the amount of carbon emissions is significantly reduced compared to a BAP pathway to mitigate the effects of climate change. This scenario can be achieved through a combination of measures such as increasing the use of clean energy sources, improving energy efficiency, and reducing overall fossil fuel consumption. Implementing Vaughan's low-carbon pathway would reduce per person GHG emissions to 3.3 tonnes per person by 2030 and 0.3 tonnes per person by 2050.

These figures are slightly above the targets of 2 to 3 tCO2e per person by 2030 and net-zero emissions by 2050. This projected gap stems from only including in the low-carbon pathway what is feasible in Vaughan. For example, in the modelling, it is not assumed that everyone will retire gas-powered vehicles within a certain time frame because of the burden it would have on individuals with low or fixed incomes. The pathway also considers that renewable energy sources within Vaughan are limited. In the low-carbon scenario, renewable energy is placed on rooftops and parking lots. However, no ground-based wind and solar farms are located within Vaughan due to the city's rapid urbanization and the importance of leaving natural areas intact.

In both cases, these challenges have the potential to diminish through external factors. Future Provincial and Federal electric vehicle subsidies and rebates could help to speed up the retiring of gas-powered vehicles. Meanwhile, the expansion of power purchase agreements can help to increase the supply of clean electricity to Vaughan's grid.

Vaughan can take action in six key areas to reach its climate goals

Most of Vaughan's emissions are produced by the buildings, transportation and waste sectors. Action in the following areas, or low-carbon pillars, can reduce emissions and implement the Plan's low-carbon pathway: (1) retrofitting buildings; (2) building net-zero new construction; (3) generating renewable energy; (4) reducing vehicle emissions; (5) increasing active transportation and transit use; and (6) reducing waste emissions.

Implementing the Plan can lead to reduced risk of cancer and cardiovascular, endocrine, respiratory, cardiopulmonary, and mental health illnesses in Vaughan

Combusting fossil fuels for energy use releases air pollutants and can create ground-level ozone. These pollutants are breathed in during regular daily activities and can negatively impact human health. Retrofitting existing buildings can also reduce indoor air pollutants, reduce mold and dampness, and improve the thermal comfort of

buildings. These changes can lead to improvements in human health by reducing the risk of several diseases.

The expansion of Vaughan's active transportation network can also lead to positive health outcomes for its residents. Evidence shows increased active transportation and routine physical exercise can lead to improvements in mental health. Increased walking and biking are significant ways to improve a community's physical health.

The local economy would also benefit from implementing the low-carbon scenario. Retrofitting buildings, installing renewable energy, and expanding the construction of active transportation networks all help to create jobs that can be held locally. Decreased utility and fuel costs can also reduce household and business costs, which offsets capital investments in low-carbon assets over time.

In addition to the Plan, the City is actively pursuing additional forms of climate action

- Under Green Directions Vaughan (GDV), milestones are being tracked for the sustainability actions within the GDV. To date, 30 actions are complete, 35 actions are in progress and five actions have not yet begun. In December 2023, data was collected from City departments and York Region to update the 24 quantitative indicators outlined in the GDV.
- Vaughan is an active participant in the Mayors' Megawatt Challenge, a network of municipalities that take part in benchmarking and assessment reports, and energy and water reporting. The initiative also has energy efficiency challenges such as the Community Centre Challenge and Town Hall Challenge.
- The Climate Change Adaptation and Resilience Framework (CCARF) was finalized in August 2022. A Vulnerability and Risk Assessment was completed as a component of the CCARF. Both the assessment and the CCARF provided recommendations for the Official Plan Review.
- A Local Improvement Charges Study to enable energy efficiency retrofits in private buildings was completed and approved by Council. Staff is exploring implementation options for a City-managed energy retrofit program.
- In May 2022, Council approved the updated Sustainability Metrics Program (SMP) which features threshold scores and minimum sustainability performance levels that must be achieved for new developments in Vaughan. The SMP and threshold performance levels are aligned with partner municipalities to ensure a level playing field and streamlined process for all development across the cities of Richmond Hill, Markham, Brampton, and Vaughan.

- In collaboration with the ClimateWise Business Network, Vaughan has improved compliance with and reporting to Ontario Regulation 506/18, Energy and Water Reporting and Benchmarking (EWRB) in the commercial sector.
- In 2022, the City was presented with the Mayor's Energy Challenge Advocate Award for demonstrating climate leadership by conducting a survey with commercial building owners, developing intelligence on the sector as well as awareness of the EWRB program, and also including participation in the EWRB as a reporting metric in Vaughan's Climate Emergency Declaration.
- The City continues to implement the Sustainable Neighborhood Action Program (SNAP) in the Thornhill area in partnership with the Toronto and Region Conservation Authority (TRCA) and local resident groups. In June 2023, the City and the TRCA entered into a new Service Level Agreement to continue implementation of the climate resiliency projects identified in the Action Plan.
- Climate resiliency is becoming an increasingly strong component of work in the Parks, Forestry and Horticulture department. Environmental Sustainability staff provided comment on the recently published Urban Forest Management Plan and sit on the Greenspace Strategic Plan Technical Advisory Committee. Our two departments partnered on a tree planting event in 2023 and will do so again on two more tree planting events in the fall of 2024.

Meeting Vaughan's climate goals requires action from the City, the public, the building community and other stakeholders

The Plan presents specific actions to be undertaken by the community, in addition to those to be undertaken by the City, that consider feedback received to-date. Policy Planning and Special Programs staff will work with Communications, Marketing and Engagement and other departments to further promote, educate, and implement these actions in collaboration with members of the public, the building industry, and other stakeholders.

A net return of over $6 billion across Vaughan by 2050 is projected to be generated by implementing the Proposed 2024 MEP

This expected net return for the low-carbon pathway is larger than the business-as-planned scenario. It is based on revenue generation, and savings in operations, maintenance, and energy costs. Financial modelling was completed by SSG as part of their work on the MEPR.

The equivalent average of 2,285 additional full-time jobs would be created annually between 2024 and 2050 in the low-carbon scenario

This is modelled as 59,423 person-years of employment above what would be created in the business-as-planned scenario. Retrofitting buildings, installing renewable energy, building net-zero new construction, increasing transit use and expanding the construction of active transportation networks all help to create local job opportunities.

Financial Impact

Funding for Plan implementation is available through the Ministry of Energy and other mechanisms

Environmental Sustainability staff can apply for $25,000 in funding available through the Provincial Municipal Energy Plan program. The Plan's Implementation Framework provides high level guidance for the funding mechanisms and amounts necessary to support the six key actions. The Implementation Framework also details funding opportunities and potential stakeholders, collaborators and partners who will take on some of the financial obligations. Staff will continue to assess the financial impacts of Plan implementation and report back as necessary.

The carbon budget would be integrated with the City's financial budgeting and decision-making processes

If adopted and successfully implemented, all capital budget project line items would include a column indicating the anticipated GHG emissions that would be considered when deciding whether or not to pursue a particular capital project.

Broader Regional Impacts/Considerations

The MEPR aligns the City with York Region's climate targets as detailed in the Region's Climate Change Action Plan, and more specifically with York Region's goal of achieving net-zero emissions by 2050. Further, York Region's Priority Action Areas of resilient communities and infrastructure, low-carbon living, and supporting an equitable transition also align with details within the six low-carbon pillars in the MEPR. Effective climate action is also consistent with York Region's Official Plan and its report entitled "Renewing York Region's Vision: Strong, Caring, Safe Communities".

Vaughan would become part of a growing trend of Canadian municipalities pursuing innovative climate action in the form of a carbon budget. Staff can share this accomplishment and encourage others to take part through our continued role in the Joint York Region and Local Municipal Climate Change Meeting Group, and the Clean Air Council's Energy Managers Community of Practice Working Group, and Roundtable.

Operational Impact

Effective climate leadership will require action across all City departments

Staff from various City departments were engaged throughout the MEPR and on the Implementation Framework and carbon budget, as many actions involve internal departments. Staff were circulated on deliverables for comment and were made aware of their roles. Further, implementation of the carbon budget will provide an additional layer of information and analysis to capital budget decisions and long-term decision making in the City. Policy Planning and Special Programs staff will train other departments on the implementation tools and provide support.

Conclusion

Council endorsement of the Proposed 2024 Municipal Energy Plan (the Plan) is necessary to reach the City's climate goals, create a low-carbon economy and resilient city, and mitigate the climate crisis. Implementation of the Plan is projected to create a net return of over $6 billion across Vaughan and an average of 2,285 full-time jobs will be created annually above the business-as-planned scenario by 2050. Implementation can also reduce the risk of cancer and other illnesses and improve mental health in Vaughan.

Integration of the carbon budget in City decision-making processes will not only help the City accurately and accountably track its progress in reaching its climate targets but will also make Vaughan a role model in municipal sustainability. Limiting the worst effects of climate change is still possible if Vaughan continues to demonstrate leadership, and join and inspire others in pursuing bold climate action.

For more information, please contact Will Baigent, Energy and Climate Change Specialist at ext. 3789.

Attachments

1. City of Vaughan Municipal Energy Plan Revision, Sustainable Solutions Group, June 2024.
2. City of Vaughan Carbon Budget, Sustainable Solutions Group, June 2024.
3. City of Vaughan Municipal Energy Plan Presentation, Sustainable Solutions Group, June 2024.
4. City of Vaughan Municipal Energy Plan Ancillary Report: Engagement Plan and Summary, Sustainable Solutions Group, June 2024.

Prepared by

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Attachment 1

City of Vaughan's 2024 Municipal Energy Plan

June 2024

VAUGHAN

Presented to:

Vaughan Municipal Energy Plan Revision Project Team

Presented by:

Sustainability Solutions Group (SSG)

Designed by SSG

June 2024

VAUGHAN

SSG

Acknowledgments

Land Acknowledgement

We respectfully acknowledge that the City of Vaughan is situated in the Territory and Treaty 13 lands of the Mississaugas of the Credit First Nation. We also recognize the traditional territory of the Huron-Wendat and the Haudenosaunee. The City of Vaughan is currently home to many First Nations, Métis, and Inuit people today. As representatives of the people of the City of Vaughan, we are grateful to have the opportunity to work and live in this territory.

Project Team Acknowledgement

City of Vaughan, Policy Planning and Special Programs Project Team

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Fausto Filipetto, Senior Manager

We also acknowledge many members of the community and City of Vaughan staff for their input, guidance, and support.

Ancillary Reports

- **Ancillary Report:** Vaughan's Current Practices for Decreasing Community Energy Use and Emissions
- **Ancillary Report:** Data, Methods and Assumptions Manual
- **Ancillary Report:** Financial Analysis
- **Ancillary Report:** Engagement Plan and Engagement Summary

Contents

Abbreviations

BAU: Business-as-usual scenario

BAP: Business-as-planned scenario

CDD: Cooling Degree Day

EV: Electric Vehicle

GHG: Greenhouse Gas

GJ: Gigajoule

HDD: Heating Degree Day

IPCC: Intergovernmental Panel on Climate Change

kWh: Kilowatt-hour

$ktCO_2e$: Kilotonnes of Carbon Dioxide Equivalents

MEP: Municipal Energy Plan (2016 and 2023)

MEPR: Municipal Energy Plan Revision

$MtCO_2e$: Megatonnes of Carbon Dioxide Equivalents

MW: Megawatt

OPR: Official Plan Review

O&M: Operations and Maintenance

PJ: Petajoule

PPA: Power Purchase Agreements

PV: Photovoltaic

RNG: Renewable Natural Gas

tCO_2e: Tonnes of Carbon Dioxide Equivalents

UNFCCC: United Nations Framework Convention on Climate Change

A glossary of terms can be found in Appendix B.

Units

GHG emissions

1 $MtCO_2e$ = 1,000,000 tCO_2e

One megatonne of carbon dioxide equivalents ($MtCO_2e$) is equal to one million tonnes of carbon dioxide equivalents (tCO_2e).

Energy

1 MJ = 0.0001 GJ

1 TJ = 1,000 GJ

1 PJ = 1,000,000 GJ

1 GJ = 278 kWh

1 MWh = 1,000 kWh

1 GWh = 1,000,000 kWh

Disclaimer

Reasonable skill, care, and diligence have been exercised to assess the information acquired during the preparation of this analysis, but no guarantees or warranties are made regarding the accuracy or completeness of this information. This document, the information it contains, the information and basis on which it relies, and the associated factors are subject to changes that are beyond the control of the author. The information provided by others is believed to be accurate but has not been verified.

This analysis includes strategic-level estimates for the City of Vaughan that should not be relied upon for project-level implementation without verification. The authors do not accept responsibility for the use of this analysis for any purpose other than that stated above or for any third-party use, in whole or in part, of the contents of this document. The suggestions in this plan apply to the City of Vaughan and cannot be applied to other jurisdictions without the appropriate analysis. Any use by the City of Vaughan, its sub-consultants, or any third party, or any reliance on or decisions based on this document, are the responsibility of the user or third party.

Message from Mayor Steven Del Duca

Over the past decade, the City of Vaughan has demonstrated strong leadership in the fight against climate change, and the updated Municipal Energy Plan will continue to guide our efforts. It plots a path toward a greener future and provides recommendations that will allow our city to reduce greenhouse gas emissions, while also generating a positive economic return and thousands of jobs – it's a win-win.

The plan includes an implementation framework that outlines the actions we need to take in six key areas to reach our goals. It's ambitious but achievable. We need to do our part to ensure we're building a brighter, cleaner Vaughan for future generations. We will continue working with residents, businesses, industry professionals and other levels of government to achieve this.

I want to thank all the City staff who contributed to this report. Your hard work is evident on every single page, and we are grateful for your efforts.

Thank you for all you do.

Sincerely,

Steven Del Duca

Mayor

Key Insights

The 2024 Municipal Energy Plan (MEP) provides guidance and recommendations for the City of Vaughan (City) to reach its greenhouse gas emissions reduction targets and build a low-carbon economy and resilient city. The MEP is rooted in the local context and work already underway through current programs and initiatives, and accounts for projected population growth. This plan will enable the City to take a leadership role in addressing climate change and promoting a sustainable future for its community. The entire Vaughan community, as well as regional, provincial, and federal organizations, will have to collaborate to implement the plan and make it a success.

1

Vaughan can reach net-zero emissions by 2050 with actions in six key sectors.

The City has set a target to reach 2-3 tonnes of greenhouse gas emissions per capita by 2030 and net-zero emissions by 2050 at the latest. Six low-carbon pillars, or areas of action, can contribute to reducing emissions in these sectors:

- Retrofitting existing buildings,
- Building net-zero new construction,
- Generating renewable energy,
- Reducing vehicle emissions,
- Increasing active transportation and transit use, and
- Reducing waste emissions.

2

The Implementation Framework outlines key actions the City can take to get the plan off the ground.

The City's Ancillary Report: Implementation Framework report outlines the actions required for each low-carbon pillar. Using the Implementation Framework, the City can begin planning how to implement actions over the next five years.

3

Low-carbon actions will make Vaughan wealthier.

The cumulative, incremental expenditures and undiscounted savings of a low-carbon actions have a capital investment of $11 billion, and the savings, avoided cost of carbon, and revenue have a total of $11.42 billion. After discounting at 3%, the capital investments have a net present value of $7.67 billion across various sectors in the community. These investments are offset by the cost savings related to avoided energy, carbon pricing, maintenance and operations, and increased revenue generation. This means that implementing the low-carbon pathway will yield a net return (financial return) of $6.37 billion across the community.

4

This plan will generate thousands of jobs.

Implementing the MEP will also generate job growth in Vaughan. Specifically, more than 59,423 person-years of employment are expected to be created between 2024 and 2050. This is equal to an annual average of 2,285 full-time-equivalent jobs above the jobs that would be created in the business-as-planned scenario.

5

Climate action can transform Vaughan into a more equitable place to live.

In the context of climate planning, equity refers to the fairness and justice in the distribution of resources and opportunities to ensure that climate change does not disproportionately impact or increase the vulnerability of community members. To prioritize equity, the project team engaged with and incorporated the perspectives of interested and affected communities in developing climate actions and implementation policies that can contribute to increased equity in Vaughan.

Introduction

A Time for Action

The planet is heating up. Our natural, economic, and social systems are suffering. In 2022, the Intergovernmental Panel on Climate Change (IPCC) provided a dire warning about the impact global climate change will have on people and our planet. The Panel urged governments to take action to limit global warming to 1.5 degrees Celsius (°C) above pre-industrial levels. Reaching this target will allow humanity to avoid the most harmful impacts of climate change. However, it will require unprecedented changes to global energy systems, including vast changes to buildings, land use, transportation, and waste systems.

Limiting the most catastrophic impacts of climate change is still possible, if we act now.[1] Local governments and communities can continue being catalysts for change, using their local expertise, commitment to community, and place-based action to reduce emissions.

Vaughan's Response

Vaughan has set a target to reach 2-3 tonnes of greenhouse gas emissions per capita by 2030 and net-zero emissions by 2050 at the latest. To meet these targets, Vaughan will need to eliminate 0.86 megatonnes of CO_2 equivalent emissions ($MtCO_2e$) by 2030 and 2.6 $MtCO_2e$ by 2050.

In June 2019, in response to the IPCC's 2018 assessment and intensifying climate emergency, Vaughan City Council endorsed a City of Vaughan Climate Emergency Declaration. The Declaration recognizes the IPCC's assessment that urgent and transformative action needs to occur between now and 2030 to limit the average global temperature increase to 1.5°C, with aggressive actions required to meet the target of net-zero emissions by 2050.

The Municipal Energy Plan Revision (MEPR), the process undertaken to update the 2016 Municipal Energy Plan (MEP) with a 2024 MEP, is a directive resulting from the Declaration and the 2018-2022 Council's "Environmental Stewardship" strategic priority which included the directive to build a low-carbon economy and resilient city. The 2024 MEP measures the size of the challenge in Vaughan and provides guidance and recommendations for the City to reach its greenhouse gas (GHG) emissions reduction targets. It is rooted in Vaughan's unique local context, including the work already being done through the City's planning efforts and current programs and initiatives, and accounts for the population and job growth expected in the community.

[1] Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte et al.]. (2021). Climate Change 2021: The Physical Science Basis. Cambridge University Press, Cambridge, United Kingdom. In Press.

What Is a Climate Emergency Declaration?

A climate emergency declaration is used by governments to signal the dire and urgent need to respond to the climate crisis. As of 2024, climate emergencies have been declared by 2,356 jurisdictions in 40 countries, representing over one billion citizens.[2]

Climate Action Opportunities in a Growing City

For the past 35 years, Vaughan has been one of Canada's fastest-growing municipalities. This trend is expected to continue until at least the 2051 planning horizon (Figure 1). With this transformation comes challenges but also great opportunities for climate action as the residential, commercial, industrial, and transportation sectors shift their energy use. Transit-supported intensification and higher-density mixed-use forms of development are planned to accommodate future growth. Prioritizing the development of higher-density mixed-use developments within close proximity to transit nodes or corridors supports more walkable and bikeable neighbourhoods and decreases reliance on cars. Many new buildings will need to be built to accommodate population and job growth, offering the opportunity to build with emissions reductions and energy efficiency in mind.

[2] Climate Emergency Declaration. (2024). "Climate Emergency Declarations in 549 Councils Cover 65 Million Citizens - Climate Emergency Declaration." Climate Emergency Declaration. Accessed May 2024. https://climateemergencydeclaration.org/climate-emergency-declarations-cover-15-million-citizens/.

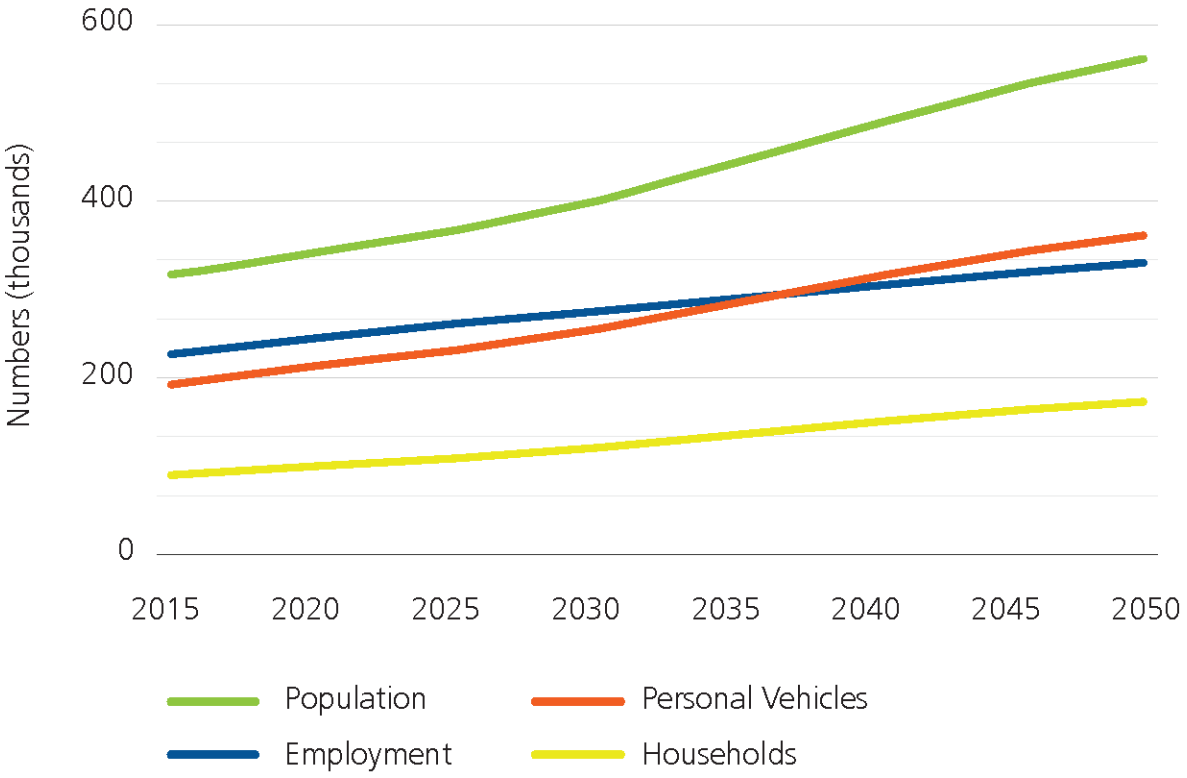


Figure 1. Projected population, personal vehicles, number of households, and employment (in full-time equivalent person-years) from 2016-2050.

Vaughan's Official Plan Review

The City is conducting a comprehensive Official Plan Review (OPR) for Vaughan, which will establish updated planning decisions for the city's growth and protection of existing neighbourhood characteristics, to contribute to Vaughan's environmental integrity and provide different transportation options. The OPR is being conducted to better meet the needs of current and future citizens, workers, and visitors, and to conform with new provincial policies and plans such as the Planning Act, A Place to Grow: Growth Plan for the Greater Golden Horseshoe, and the Greenbelt Plan.

The timeline and goals of the OPR overlap with those of the MEPR. Thus, the OPR offers an opportunity to develop policies to support the updated MEP. The OPR is guided by principles such as environmental sustainability, social responsibility, and economic development to plan for complete communities and guide the city's growth for the next 30 years and beyond. As part of the MEPR, current and proposed Official Plan policies were reviewed to assess whether they align with the emissions reduction target, and recommendations were made to increase alignment where necessary.

What are complete communities?

Complete communities prioritize transit-oriented and mixed-use development practices, which aim to establish neighbourhoods where residents can live, work, and conveniently access essential amenities without the need to travel extensively.

The Climate Change Experience in Vaughan

Vaughan is already experiencing the impacts of climate change. The mean temperature in Vaughan increased by more than 1°C between 1950 and 2022.[3] The city has experienced significant flooding,[4] numerous heat waves, and air quality issues from forest fires in other parts of the province. These climate hazards are projected to increase in severity over the coming years and decades. More extreme weather events will accompany these changes, including more intense rain and snowfall events, flash floods, high winds, and stronger hurricanes.

Residents' experiences with climate change also impact energy use trends. For example, an increase in extreme heat events and the number of cooling degree days[5] (CDDs) and heating degree days[6] (HDDs) in a year is an indicator of the heating and cooling demand of buildings (known as thermal conditioning), which directly influences energy consumption and therefore GHG emissions. While HDDs are declining and will continue to decline in Vaughan due to warming weather, CDDs will continue to increase as hot days and nights encourage a greater use of air conditioning (Figure 2).

[3] Climate Atlas of Canada. (2020). Municipality Toronto. Annual Mean Temperature (RCP 8.5). Accessed May 2024: https://climateatlas.ca/data/city/458/annual_meantemp_null_85/line

[4] Global News. (August 9, 2011). Heavy rain causes flooding in Vaughan. https://globalnews.ca/news/142991/heavy-rain-causes-flooding-in-vaughan/

[5] CDDs are used to provide an indication of the amount of air conditioning required to maintain comfortable indoor conditions. Over the selected measurement timeframe (e.g. monthly, annually etc) when the daily outdoor temperatures exceed the temperature threshold of 18°C, the CDDs are accumulated. A larger number of CDD means that there is a greater need for air conditioning.

[6] HDDs are used to provide an estimate of the amount of heating required to maintain a comfortable indoor conditions. Over the selected measurement timeframe (e.g. monthly, annually etc) when the daily outdoor temperature is less than the temperature threshold of 18°C, the HDDs are accumulated. A larger number of HDD means that there is a greater need for heating.

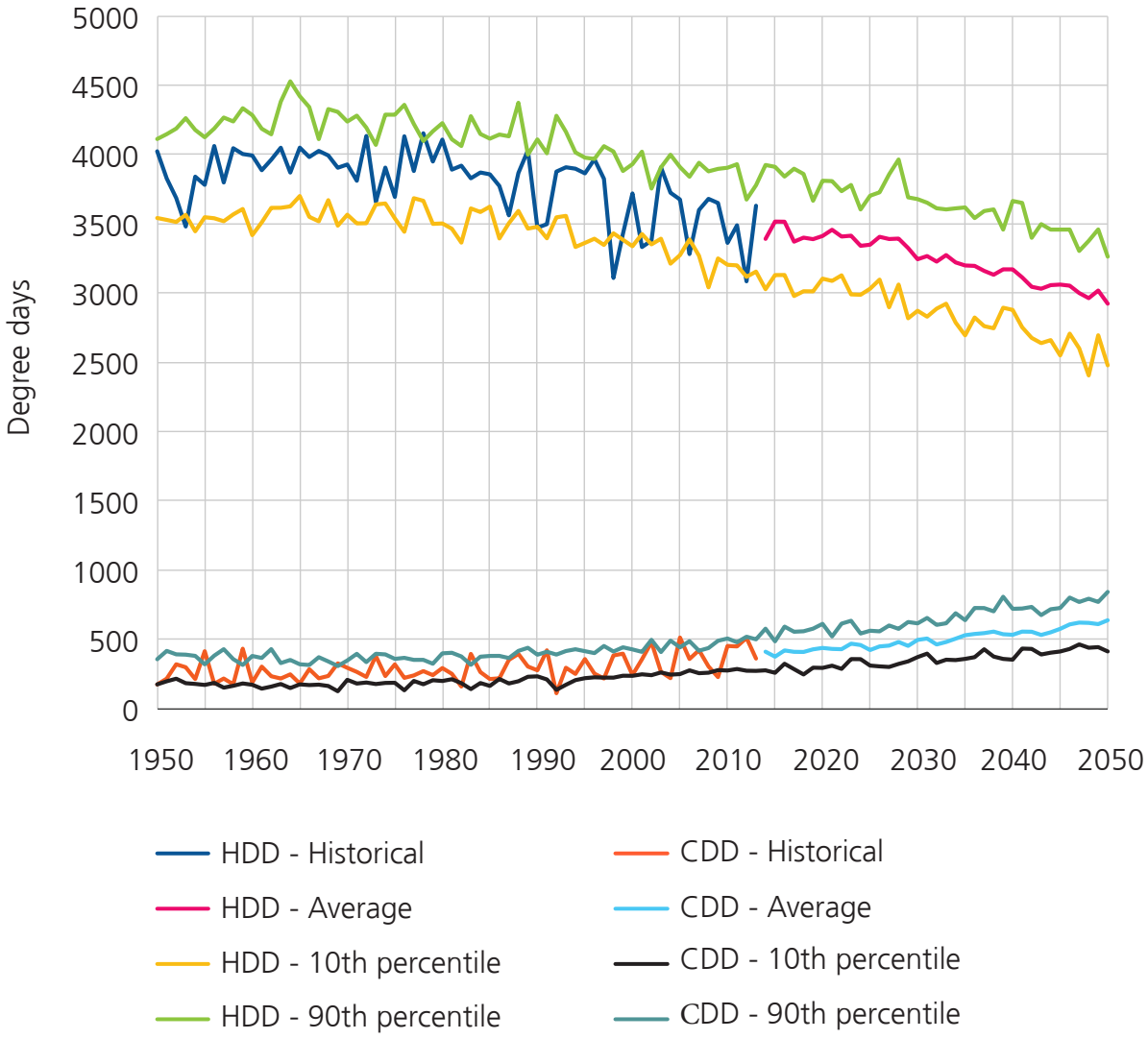


Figure 2. Heating degree days and cooling degree days for Vaughan, projected out to 2050 (IPCC AR5 RCP 8.5).[7] *Historical data are shown until 2013. The projection is an average of the results of several models. Ten and ninety percentiles of the results from these simulations are also included.*

Based on the current global trajectory, climate change in Vaughan is far from over. Yearly precipitation is expected to increase from a historical average of 793 mm (1976 - 2005) to 845 mm by 2050 (IPCC AR5 RCP 8.5).[8] This increase may not seem large, but a predicted increase in heavy rain days could lead to floods. As well, the precipitation increases are expected in the winter and spring, which could lead to more mixed precipitation (e.g., hail, slush) events due to temperatures hovering around 0°C. By 2050, mean annual temperature

[7] Climate Atlas of Canada. (2020). Toronto Municipality. Heating Degree Days (RCP 8.5) and Cooling Degree Days (RCP 8.5). Accessed May 2024: https://climateatlas.ca/data/city/458/hdd_2030_85/line; https://climateatlas.ca/data/city/458/cooldd_2030_85/line

[8] Climate Atlas of Canada.(2020). Toronto Municipality. Annual Precipitation (RCP 8.5). Accessed May 2024: https://climateatlas.ca/data/city/458/annual_precip_2030_85/line

is projected to rise by another 2°C, and the number of extremely hot days (greater than 30°C) are expected to increase from an average of 12 days per year to an average of 30 days per year. Additionally, by 2050, average heatwave length is expected to double to 11 days, compared to 2013, increasing the risk of adverse health impacts, environmental concerns, and crop failures.

Demonstrating Commitment

Besides the MEPR, the City has taken other steps to address climate change in the community. The City released its first MEP in 2016 and provided Vaughan with an emissions reduction action plan aligned with the City's participation in the Partners for Climate Protection program, a national program for municipalities focused on reducing emissions. The MEP 2016 replaced the City's climate change action plan, and aligned with Green Directions Vaughan, and the Community Sustainability Plan.

The City has also addressed climate change across many of its plans and operational decisions. The City's current Official Plan has a goal dedicated to establishing Vaughan as a green and sustainable community, which involves minimizing energy use and encouraging the use of alternative transportation options. Many of Vaughan's secondary plans carry this work forward, including the Vaughan Metropolitan Centre Secondary Plan which addresses creating a mixed-use, higher-density community and a more walkable and bikeable neighbourhood.

The City is also developing a new Transportation Master Plan and has established the plan's guiding principles. The Vaughan Transportation Plan will include a multi-modal approach to moving Vaughan's citizens, and support the reduction of environmental impacts and transportation-related GHG emissions.

Additionally, the City has a Corporate Energy Management Plan. This plan includes proposed conservation and energy efficiency measures, cost and savings estimates, an implementation plan, and energy consumption and GHG emissions reduction targets. The City reports annually on metrics set out in the plan and on energy use in municipally owned and operated facilities via a public report.

This list is not exhaustive. To learn more about the City's current practices aimed at decreasing energy use and emissions across the community, please see Ancillary Report: Data, Methods and Assumptions Manual and the Ancillary Report: Current Practices for Decreasing Community Energy Use and Emissions.

The MEPR is a comprehensive revision of the 2016 MEP, and will ultimately replace it with the 2024 MEP, to align with the increased expectations for reducing emissions as outlined in city-wide plans and with plans, including the OPR, that have been updated since the MEP was first created. The updated MEP provides guidance and recommendations for Vaughan to reach its GHG emissions reduction targets, and build a low-carbon economy and resilient city. It is rooted in the local context and work already being completed through current programs and initiatives.

Vaughan's Sustainability Metrics Program

Updated in 2022, Vaughan's Sustainability Metrics Program (SMP) guides and measures how well new development performs in terms of sustainability by providing a menu of metrics (called the Sustainability Metrics and Thresholds) that applicants can apply to their development application. These metrics support reducing emissions in buildings, increasing active transportation and transit use and reducing transportation emissions, increasing waste diversion and infrastructure, and generating renewable energy. Additionally, the metrics support the development of community well-being and natural heritage.

As of Q1 2023, the updated set of Sustainability Metrics and Thresholds will be implemented for all development in Vaughan. Development located within Intensification Areas will be required to meet the applicable Silver Threshold Scores, and applications located elsewhere in the city will be required to meet the applicable Bronze Threshold Scores. Following the launch of the program, the City staff will examine requiring higher Threshold Scores and integrating climate change performance to advance the success of the SMP.

Community Input

As part of the MEPR, members of the community members, City staff, members of the Building Industry and Land Development Association (BILD) - York Chapter, and other interested and affected parties were engaged through a series of engagement events. The City invited the broader public to participate in two workshops to learn more about the MEPR and share feedback. Participants provided insights on what they felt should be included in the plan and how they felt the plan could and should be implemented in the community. A community survey was also conducted to identify opportunities and challenges for implementing the plan. Additionally, the City held a workshop with BILD – York Chapter to inform key members of the building industry about the project, and to provide them with an opportunity to share their insights on the low-carbon actions and potential options for implementing those actions.

Staff and stakeholders met with the project team in a series of workshops to learn about the MEP development process and climate action planning. They also provided feedback on the modelling assumptions, low-carbon actions, and Implementation Framework.

What We Heard

SSG and the City's Project Management team gathered feedback from 79 members of the public, including representatives from the construction, building, and consulting industries, community members, non-profit organizations, and equity-denied community members. Engagement participants shared their perspectives on climate action and lived experiences with climate change, opportunities and barriers, and different supports to assist community members in implementing climate actions. SSG used a thematic analysis to analyse the qualitative feedback received from the engagement process. This was completed to share common patterns among the feedback, and provides a compressed analysis of key concerns, challenges and opportunities expressed by different stakeholder groups. The following recommendations were developed based on the thematic analysis, and were used to inform the MEP:

1. The City should leverage and expand financial, employment, and transit support for all community members, with priority given to equity-denied and vulnerable community members.
2. The City should adopt an equity lens to ensure climate actions are developed to support equity-seeking and vulnerable community members. This includes directly working with equity-seeking and vulnerable community members throughout projects to address potential co-harms and enhance co-benefits.
3. The City should encourage mixed-use and compact development to enhance access to community amenities and facilitate less travel. In addition, the City should invest in active transportation infrastructure to encourage walking and cycling between destinations.
4. The City should work to raise the community's awareness of climate change and climate actions by providing education on these topics. The City should recruit community champions and encourage greater participation in climate planning events.

Informed by this input, the MEP is designed to streamline the implementation of the GHG reduction measures identified in this document and to maximize co-benefits. Our Ancillary Report: Engagement Plan and Summary provides a thematic analysis of all the feedback gathered from engagement with interested and affected parties.


EARTH HOUR
CHANGE
CHANGE
CLIMATE
CHANGE

Energy and Emissions in Vaughan

The city's current energy use and associated emissions (the baseline), and the potential energy use and emissions trajectory resulting from demographic changes and changes in practices, policies, and legislation is used to understand the size of Vaughan's challenge to reach the community's net-zero target by 2050 (the business-as-usual and business-as-planned scenarios).

A low-carbon scenario identifies actions that are locally viable and can reduce the current expected emissions by decreasing energy use and moving to low-carbon energy sources.

What is Scenario Modelling?

Scenario modelling examines potential energy and emissions trajectories based on observed historical data; assumptions about the impact of current policies, regulations, legislation, and practices (e.g., the federal electric vehicle target); and assumptions about future conditions (e.g., population growth, the types of housing people will live in).

As scenario models tend to examine complex issues impacted by multiple, interdependent, and unpredictable factors, they do not attempt to predict the future. Rather, these models are explorative. They are also transparent about the assumptions that are made, and about the factors that could change the modelled outcomes. Therefore, scenario models provide an internally consistent view of the future that is plausible.

The CityInSight model was used for Vaughan's energy-use and emissions scenarios. The model is a stocks and flows model, meaning it tracks energy-using assets and their associated emissions over time and space based on observed historical data, locally provided demographic projections, and relevant policies. Refer to the Ancillary Report: Data, Methods, and Assumptions Manual for more information about the model and the assumptions.

Baseline Energy Use and Emissions

A quantitative assessment of Vaughan's baseline energy use and resulting emissions was completed for 2016. The 2016 baseline year was used due to the availability of robust census data and other community data. Based on observed data—including utility data, transportation and fuel use data, and waste data—Vaughan's baseline energy use was estimated to be 51 million gigajoules (GJ). The resulting emissions in 2016 were estimated to be nearly 2.7 megatonnes of carbon dioxide equivalents ($MtCO_2e$). Based on Vaughan's 2016 population, this is 161 GJ of energy use per capita (or per person) and 8.4 tonnes of carbon dioxide equivalents (tCO_2e) per capita.

Vaughan's per capita GHG emissions in the 2016 baseline year (8.4 tCO_2e) were significantly below the average Canadian per capita GHG emissions (18.6 tCO_2e)[9] but significantly higher than the community's 2030 target of 2-3 tCO_2e per capita (Figure 3). Based on the business-as-usual scenario the 2024 per capita emissions were projected to be 7.4 tCO_2e per capita.

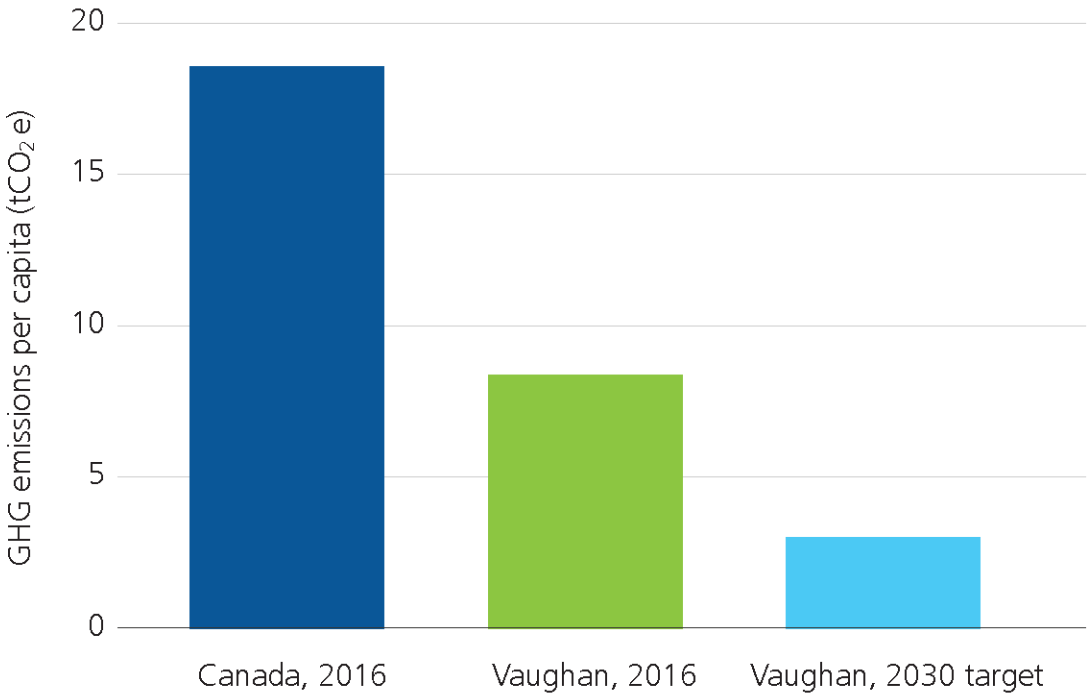


Figure 3. Per capita emissions comparisons.

[9] Statistics Canada. (2016). Greenhouse gas emissions in Canada. Table 38-10-0097-01. Accessed May 2024: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3810009701

Business-As-Planned Energy Use and Emissions

A business-as-usual (BAU) scenario was also developed for Vaughan in CityInSight, an energy-use and emissions scenario model. This scenario illustrates expected energy use and emissions in Vaughan if the City, other levels of government, and other sectors do not implement the energy and emissions-reducing measures they have committed to. In this scenario, energy use is projected to increase from the baseline by 13% by 2050 from 51 to 58 million GJ. Emissions are expected to increase by 11% by 2050 from nearly 2.7 to 3 $MtCO_2e$ (equivalent to 2,662,140 $ktCO_2e$ and 3,019,132 $ktCO_2e$).

To further understand the size of the challenge to reach Vaughan's 2050 net-zero target, a business-as-planned (BAP) scenario was developed to provide insights into future emissions resulting from current policy decisions and practices within the community.

The BAP scenario estimates the energy use and resulting emissions in Vaughan between the baseline year (2016) and net-zero target year (2050). The scenario is based on projects and initiatives that are underway or approved with dedicated funding, and legislation and regulations at the provincial and federal levels. For example, a BAP scenario accounts for planned changes in transportation infrastructure and expected shifts in mode share, the percentage of trips made using different types of transportation, resulting from infrastructure additions. It also includes projected increases in the grid emissions factor of electricity based on current provincial policy and an increase in electric vehicle uptake based on the federal light-duty electric vehicle target.

In the BAP scenario, energy use is expected to decrease from the baseline by 16% by 2050 (from 51 to 43 million GJ). Emissions are expected to decrease by 30% from nearly 2.7 to 1.9 $MtCO_2e$ (equivalent to 2,662,140 $ktCO_2e$ and 1,944,812 $ktCO_2e$) (Figure 4). Because the population in Vaughan is expected to grow at a rapid rate, per capita emissions are expected to decrease by 58% (from 8.4 to 3.5 tCO_2e).

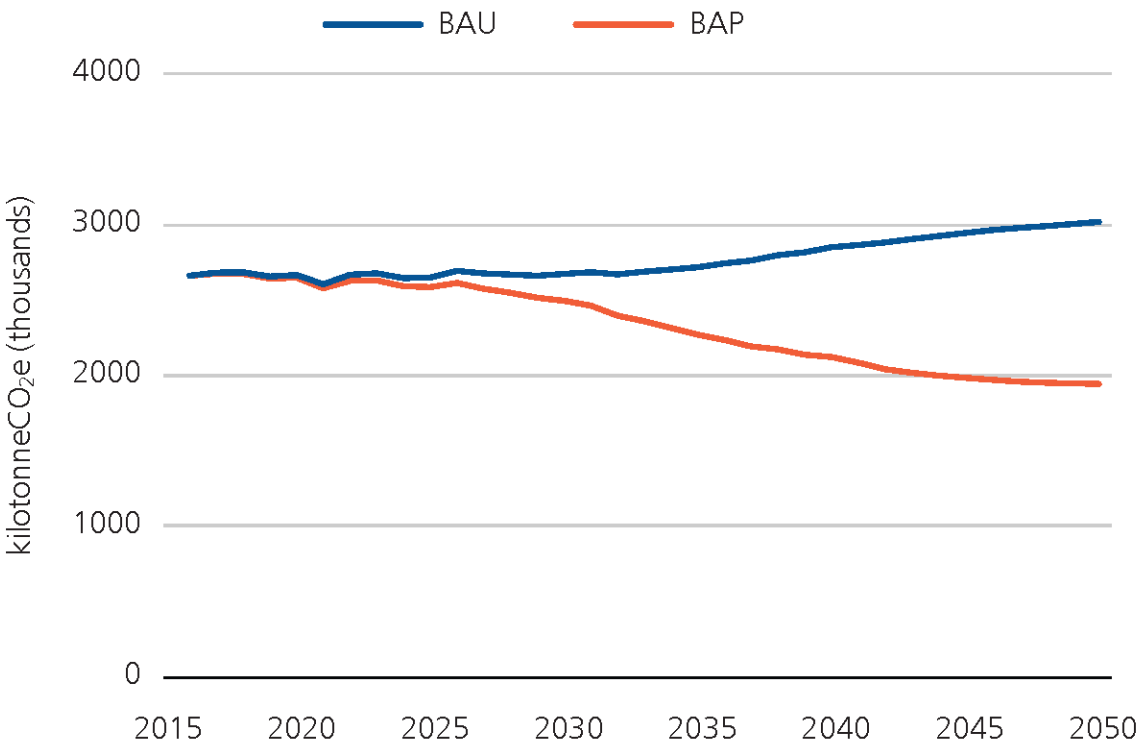


Figure 4. A comparison between 2016 baseline emissions, 2050 business-as-planned emissions, and 2050 business-as-usual emissions in Vaughan.

The BAP scenario predicts that, by 2050, buildings will have produced most of the projected emissions in Vaughan (Figure 5). Of the total community emissions, 35% are projected to come from residential buildings, 24% from commercial and institutional buildings, and just over 6% from industrial buildings. Emissions from transportation would make up nearly a quarter of community emissions, while emissions from waste would make up over 5%.

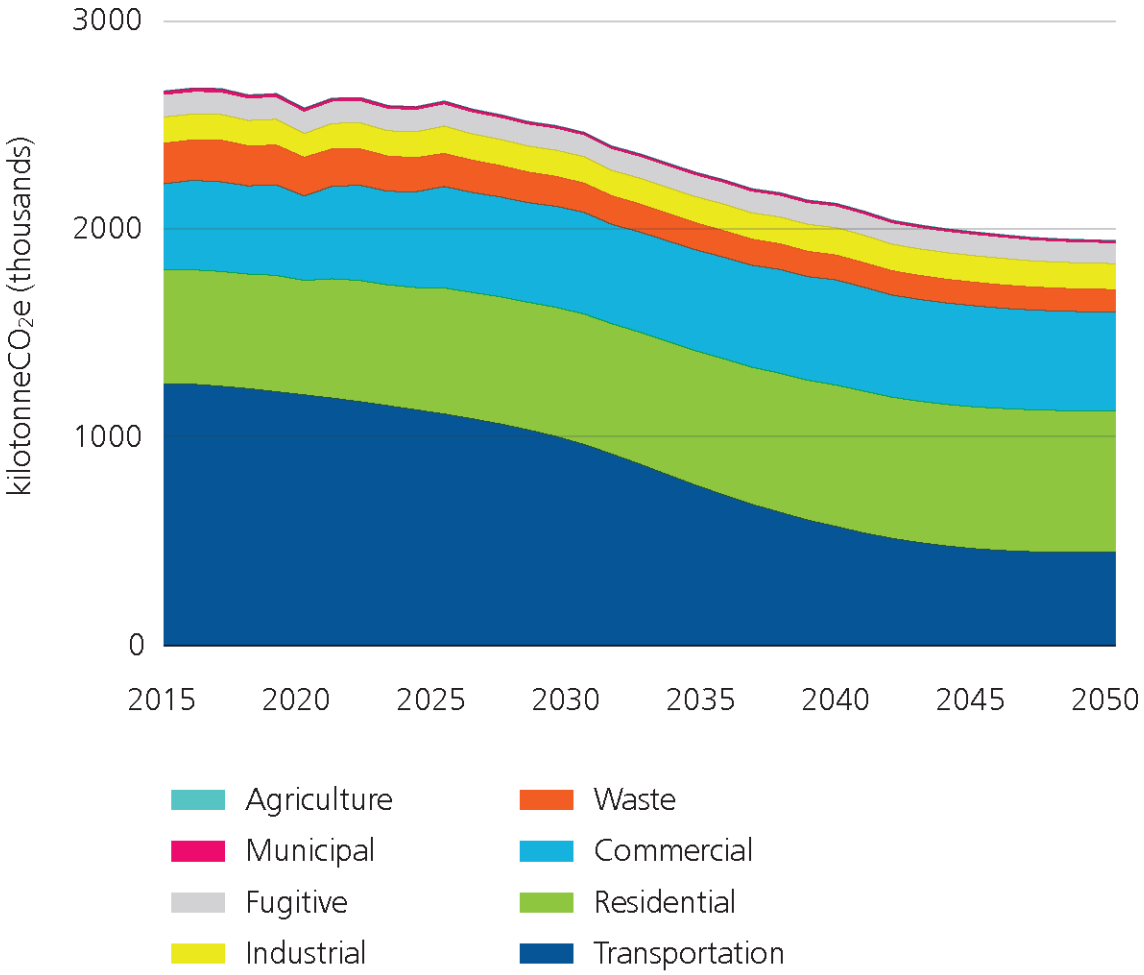


Figure 5. Projected emissions by sector between 2016 and 2050 in the business-as-planned scenario in Vaughan.

Regarding projected energy sources in 2050, natural gas is expected to make up 42% of community emissions, mostly due to its use in buildings (Figure 6). Electricity use from the grid would make up over a quarter of emissions, also largely due to its use in buildings but also in power electric vehicles. Diesel is projected to make up 14% of emissions, from its use in medium- and heavy-duty vehicles, while gasoline would make up less than 2% of emissions as it is displaced by electric vehicles. Non-energy emissions, which include waste and fugitive emissions,[10] would make up nearly 11% of community emissions.

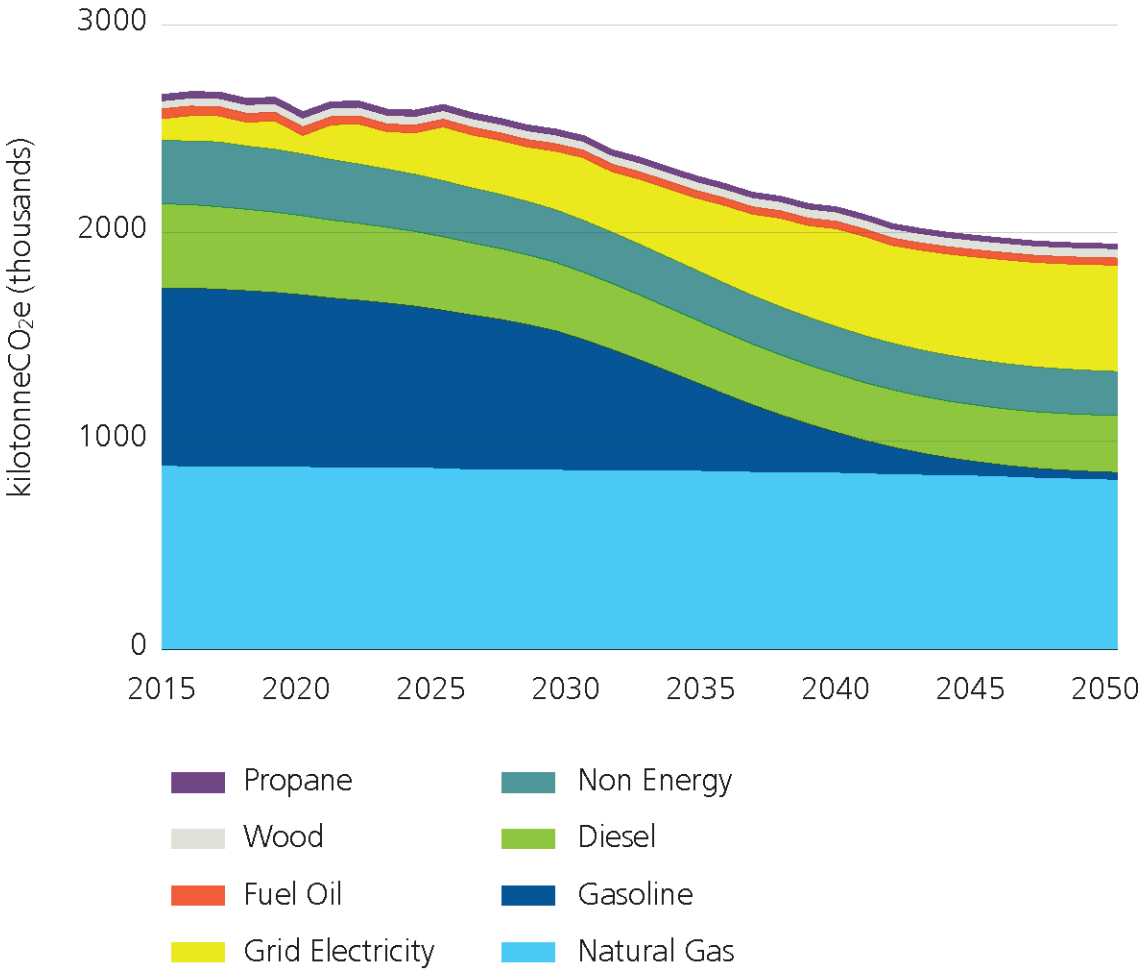


Figure 6. Emissions by fuel type between 2016 and 2050 in the business-as-planned scenario in Vaughan.

[10] Fugitive emissions are the accidental greenhouse gas emissions released from equipment, storage tanks, pipelines, or other sources.

While overall emissions reductions show that there is a modest decrease between 2016 and 2050, this does not reflect all the work being done within the community to decrease emissions. Over the course of the BAP scenario, per capita emissions are projected to decrease by over half, from 8.4 to 3.5 tCO_2e per person (Figure 7).

The overall emissions trajectory shows that although emissions per person are expected to decrease significantly under current policies and practices, increased population and employment in Vaughan will outstrip per capita emissions resulting in an overall increase in emissions. This means further action must be taken to meet net-zero emissions by 2050.

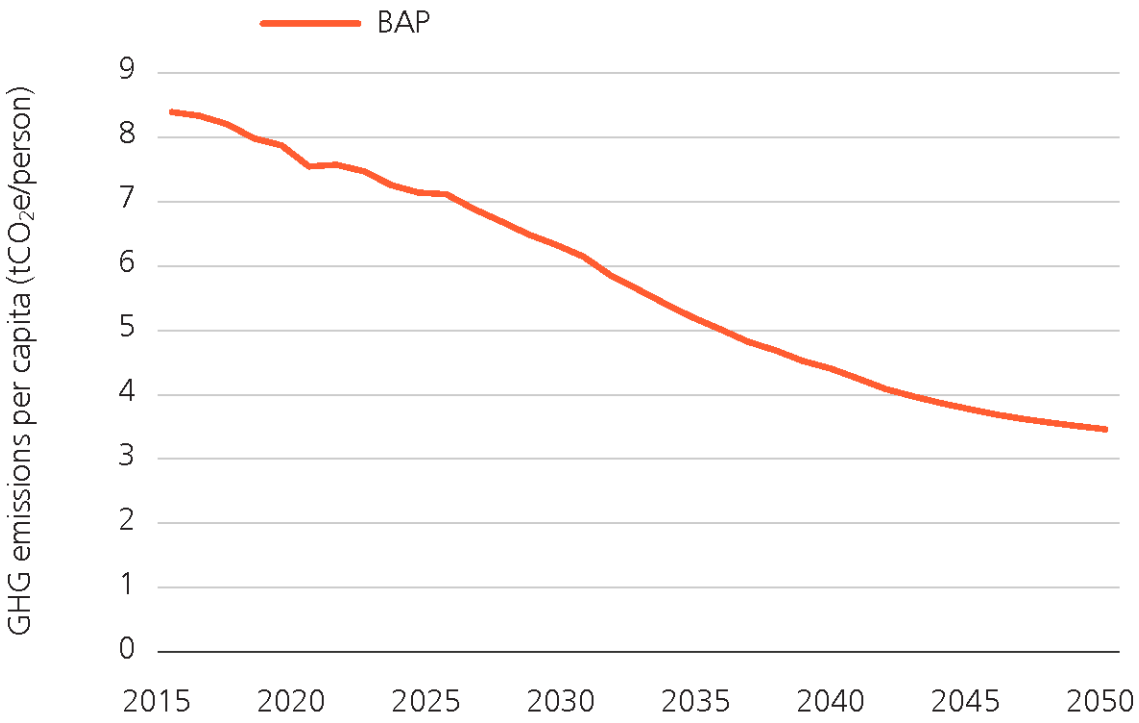


Figure 7. Per capita emissions trajectory in the business-as-planned scenario in Vaughan.

Imagining a Low-Carbon Vaughan

The BAP scenario makes Vaughan's efforts to reduce community GHG emissions obvious, especially when compared to the BAU scenario. It also highlights where additional work is needed to reach the net-zero target in Vaughan—specifically, action is required in the buildings, transportation, and waste sectors to achieve this goal.

Six low-carbon pillars, or areas of action, can contribute to reducing emissions in these sectors include: building retrofits and net-zero new construction for the buildings sector, generating renewable energy for both the buildings and transportation sectors, reducing vehicle emissions and increasing active transportation and transit use in the transportation sector, and reducing waste emissions.

What Is the Difference Between a BAP Scenario and Low-Carbon Scenario?

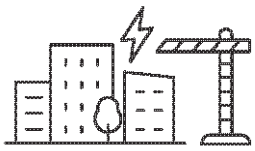
A **BAP scenario** for carbon emissions reductions is a projection of the City's expected emissions levels if it continues with its current policies and practices, and assumes no additional policy or climate action intervention. This scenario serves as a benchmark, or starting point, against which the City can measure the effectiveness of its emissions reduction efforts. It includes projections for energy consumption, emissions from transportation and industrial processes, and other sources of carbon emissions. The projections are based on locally available data including utility use records, transportation data, demographic data, and population and employment change forecasts. The BAP scenario also considers local, provincial, and federal policies, such as the federal electric vehicle target. This scenario essentially describes the size of the emissions reduction challenge the City faces, and can be used to set emissions reduction targets and track progress toward achieving them.

A **low-carbon scenario** is a projected future state in which the amount of carbon emissions is reduced to mitigate the effects of climate change. This scenario can be achieved through a combination of measures such as increasing the use of clean energy sources, improving energy efficiency, and reducing overall fossil fuel consumption. A low-carbon scenario helps evaluate the effectiveness of different policy options for reducing emissions and informing decisions about how to achieve a low-carbon future.

Vaughan's Low-Carbon Pillars

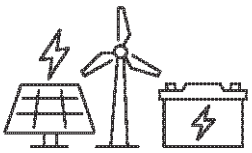
Retrofitting Buildings

In 2016, energy use in buildings accounted for nearly half of GHG emissions in Vaughan. Building emissions result from heating, cooling, and lighting spaces, and running appliances and equipment. These emissions come from all types of buildings in the community, including homes, schools, offices, stores, and industrial spaces. To make buildings more efficient, they can be retrofitted by replacing windows and doors, increasing insulation, replacing weatherstripping, and replacing inefficient heating systems with more efficient technologies such as heat pumps. In turn, these retrofitted buildings use less energy overall, whether the energy comes from a renewable source or not. This decreases emissions from the baseline and the amount of renewables required later to meet community needs.



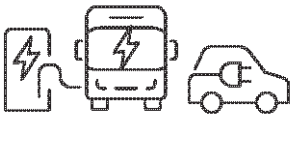
Building Net-Zero New Construction

Buildings and the systems within them, such as heating and cooling systems, are long-lasting assets. However, they can also be significant sources of GHG emissions depending on how efficient they are and what types of energy they use to operate. A net-zero building is one that is designed and constructed in an energy efficient way. For example, a net-zero energy building is one in which the energy demand is met by on-site (or near-site) renewable energy, and a net-zero energy ready building is designed and constructed in the same manner as a net-zero energy building but does not yet have on-site renewable energy. Constructing new buildings that do not meet net-zero standards creates an emissions burden now that will last well into the future unless costly retrofits are completed to meet the GHG reduction target before the buildings' systems are due to be renewed. Net-zero buildings eliminate that burden throughout the building's lifecycle, right from the beginning. The upfront capital cost of more efficient construction is typically more than offset by utility savings over time.



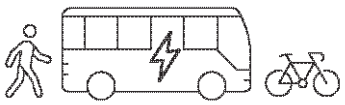
Generating Renewable Energy

Renewable energy systems ensure that our buildings and transportation sectors can operate emissions-free. Currently, in Vaughan, a mix of natural gas, electricity (most of it not emissions-free), gasoline, and diesel power day-to-day activities. By 2050, electricity will largely replace gasoline as more people adopt electric vehicles for personal use. Natural gas and electricity will still play large roles in powering the community but need to be replaced by renewable energy sources such as wind, solar, and renewable natural gas to reduce emissions. As technologies and consumer products evolve, new energy sources such as green hydrogen may also come online. While the cost of renewables is decreasing year-over-year, efficiency measures such as retrofitting buildings and building net-zero construction will still contribute to their viability for widespread use.



Reducing Vehicle Emissions

Vehicle emissions result from travel in personal and commercial fleet vehicles, the movement of goods, and mass transportation such as transit. Emissions from vehicles are expected to decrease drastically in the business-as-planned scenario from 2016 to 2050 (from 1.2 to less than 0.5 $MtCO_2e$), mostly due to an increased uptake in electric vehicles, SUVs, and small trucks in line with federal policy. Electric vehicles are emissions-free if they are charged using infrastructure connected to renewable (e.g., solar, wind) energy sources. However, even if they are emitting, their motors are significantly more efficient than those of gasoline and diesel vehicles, decreasing the amount of energy they require to operate. New technologies are also being refined for medium- and heavy-duty vehicles to become non-emitting, but no target date for their uptake is currently outlined at the federal level.



Increasing Active Transportation and Transit Use

Active transportation (e.g., cycling, walking) and transit (e.g., bus) use can help reduce transportation emissions when single-occupancy vehicle trips. Well-thought-out active transportation and transit networks and supportive programming, operations, and maintenance can help decrease congestion, promote active and healthy lifestyles, and complement urban intensification and mixed-use developments while decreasing emissions. The City continues to develop and expand active transportation and transit networks in Vaughan while the community experiences rapid population growth and urbanization that requires attention to transportation modes within, and in and out of, the community. The City of Vaughan and York Region share responsibility for municipal services within Vaughan, with York Region managing transit use. Thus, expanding transit in Vaughan will require collaboration and alignment with York Region's policies.

Reducing Waste Emissions

Waste releases emissions, mostly methane, over time as it decomposes. Vaughan has a plan in place to significantly divert waste in the coming years. However, even as per capita waste decreases, the growing population means overall waste will continue to increase. With a strong residential diversion program in place, the City is positioned to turn its attention to the non-residential sector in Vaughan to decrease waste going to landfills.

Vaughan's Low-Carbon Pathway

A low-carbon pathway offers a strategic approach to reduce GHG emissions by identifying a series of actions that aim to minimize carbon-intensive activities. The objective of a low-carbon pathway is to achieve substantial emissions reductions within a specified timeframe, while also mitigating the impacts of climate change and promoting a more resilient future.

Vaughan's low-carbon pathway shows what actions need to be taken, over what timeframe, and in what sequence to balance the priorities of reducing GHG emissions, financial and technological feasibility, and maximizing co-benefits while minimizing co-harms. The pathway was built through community engagement and energy and emissions modelling.

The resulting low-carbon pathway reaches nearly net-zero emissions by 2050 (Figure 8 and Figure 9). This scenario projects that the transportation sector will still produce emissions due to the replacement of heavy trucks only starting in 2035 when low emissions options are expected to be widely available. However, the scenario does not assume that trucks will be retired before the end of their lifecycle, so some will be replaced with low-emission vehicles after 2050. In the buildings sector, small amounts of emissions are expected to remain from natural gas as current projected renewable natural gas (RNG) is maximized and buildings and processes that are difficult to convert to other energy sources will still remain and exceed the total availability of RNG. It is likely that new technologies, and potentially even new fuel sources, will address these remaining emissions before 2050. Additionally, the scenario projects that the waste sector will also continue to produce emissions. Emissions decreases in this sector are largely due to diversion efforts. However, because Vaughan does not operate the landfills where remaining waste is deposited, it does not have the authority to capture methane, resulting in the continued emissions in the sector.

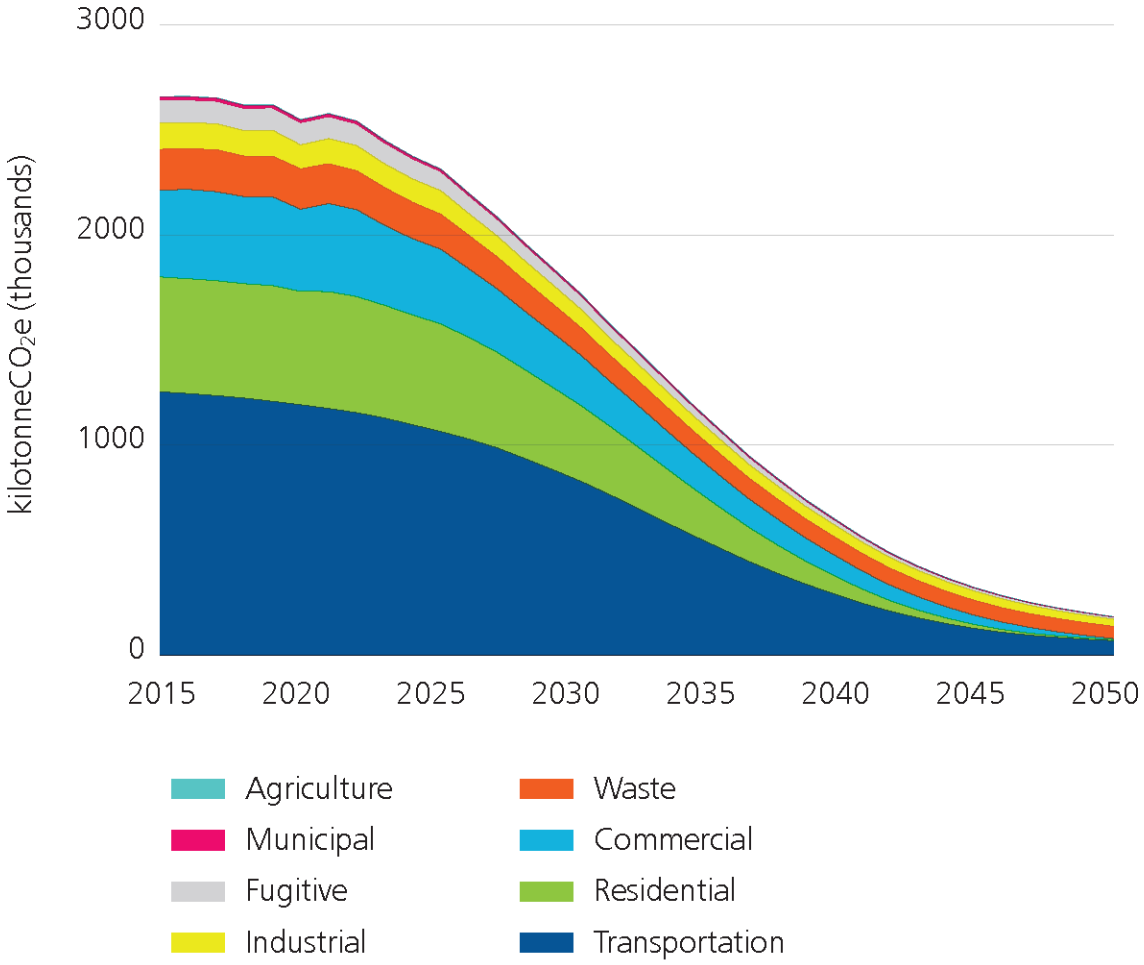


Figure 8. Projected emissions by sector between 2016 and 2050 in the low-carbon scenario in Vaughan.

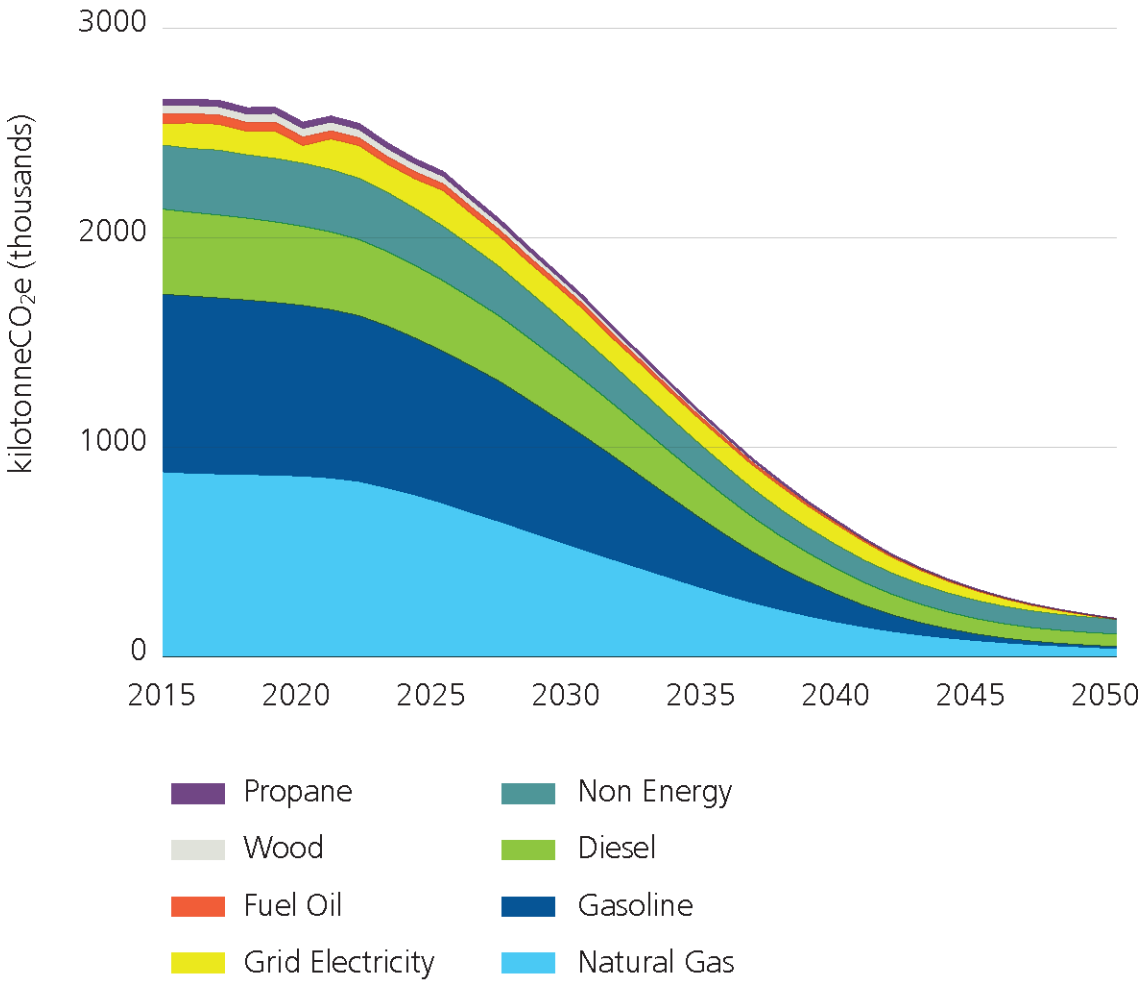


Figure 9. Projected emissions by fuel type between 2016 and 2050 in the low-carbon scenario in Vaughan.

The low-carbon scenario reduces per capita GHG emissions to 3.3 tonnes per person by 2030 and 0.3 tonnes per person by 2050 (Figure 10). These figures are slightly above the targets of 2-3 tCO_2e per capita by 2030 and net-zero emissions by 2050. This is largely because the low-carbon scenario assumes some gas vehicles will have a lifespan past 2050. Additionally, the need for natural gas in some buildings is beyond the expected RNG supply, although this could change over time.

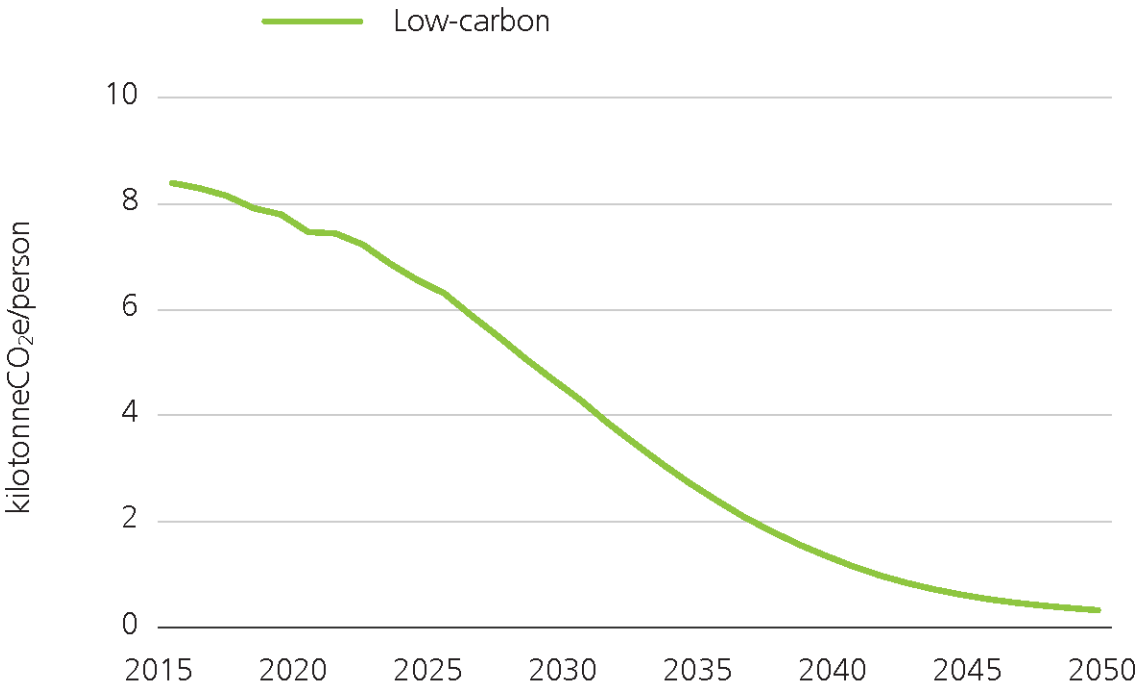


Figure 10. Projected emissions per capita between 2018 and 2050 in the low-carbon scenario in Vaughan.

The low-carbon scenario is ambitious, but it focuses heavily on what is feasible in Vaughan. For example:

- Vehicles are not retired early because of the burden it would have on individuals with low or fixed incomes. Most municipalities do not offer incentives on low emissions vehicles because they cannot guarantee the emissions savings will stay in their jurisdiction. Thus, any requirement to have a low-emissions vehicle through regulations, or the phase out of gas stations, etc. can have a negative impact on equity.
- Renewable energy sources within Vaughan are limited. In the low-carbon scenario, renewable energy is placed on rooftops and on parking lots. However, following consultation with City staff and the community, no ground-based (wind and solar) farms are located within Vaughan due to the city's rapid urbanization and the importance of leaving natural areas intact. Instead, power purchase agreements are identified as a potential solution for clean electricity.

Power Purchase Agreements

A power purchase agreement (PPA) is an agreement between a seller (the owner of renewable energy infrastructure, which could be a private business, the utility, the City, a cooperative of residents, or another third party) and the buyer (the City, utility, or ratepayer). The agreement often aims to increase the availability of renewable energy in an area where renewable energy assets cannot be built at the required scale or price. A PPA can be beneficial for both the seller, who receives incentives for generating renewable energy, and the buyer, who can purchase renewable energy at a lower rate than is possible through other arrangements.

- Waste diversion is prioritized over methane capture at landfills. This is because the City of Vaughan and York Region have committed to increasing diversion rates. Diverting waste at the source (e.g., households, businesses) through purchasing less, reusing, and recycling can decrease the burden at the end of a product lifecycle. The City does not operate landfills and uses shared landfills for residential waste, while commercial and institutional entities find their own private waste disposal sources. Thus, it is challenging for the City to have influence over what happens at the landfill.
- Ambient geothermal district energy is an option for increasing local energy generation. This will need to be further explored during the secondary planning stages of development. Vaughan is rapidly urbanizing and new blocks of land are being developed, presenting an opportunity to develop highly efficient shared heating and cooling systems for buildings in newly developing areas where there is high density and/or mixed building uses that require a high demand for heating and cooling.

Geothermal District Energy Systems

Ambient geothermal district energy systems include heat pumps in individual buildings and underground pipes that circulate water. Heat is exchanged via the ambient loop that connects all the buildings within the system. Ambient geothermal systems are very efficient because they operate at temperatures similar to the ground temperature, whether heating or cooling is required. Because of this, little energy is lost to the surrounding ground and little insulation is required to prevent loss. As well, the same pipe system can simultaneously provide heating and cooling, creating system efficiencies. Companies in Vaughan are exploring the viability of offering ambient geothermal systems in future markets.

Co-Benefits of a Low-Carbon Vaughan

The low-carbon scenario offers Vaughan more than just a net-zero future; it provides a suite of co-benefits associated with improved health outcomes, prosperity, opportunities for equity enhancement, and climate resilience. The IPCC defines co-benefits as "the positive effects that a policy or measure aimed at one objective might have on other objectives, irrespective of the net effect on overall social welfare. Co-benefits are often subject to uncertainty and depend on local circumstances and implementation practices, among other factors."[11] Not all co-benefits are equal. One set of criteria by which to assess the co-benefits of initiatives and actions to reduce GHG emissions follows:[12]

- **Synergies:** Many low-carbon actions have multiple socio-economic benefits, including improving transit, energy efficiency, and compact urban design.
- **Costs:** The cost of early action is generally lower than that of later action, particularly because delayed action involves ongoing investments in infrastructure, activities, and utilities (e.g., renewable energy infrastructure, transit, energy efficiency) that are higher emitting than low-carbon solutions.
- **Urgency:** Some actions are associated with a higher degree of urgency to avoid loss of inertia on action already taken, lock-in effects,[13] irreversible outcomes, or deferred costs that become even more elevated due to deferment. Some low-carbon actions require time to realize their effects, making immediate implementation paramount.
- **Longevity:** Related to urgency, the longevity of investment decisions locks society into their effects for decades, if not centuries.
- **Distribution effects:** Low-carbon actions have different impacts on different population subsets including income groups, generations (including future generations), and ethnicities.

[11] Intergovernmental Panel on Climate Change. (2014). Annex II: Glossary [Agard, J., et al.] Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1762.

[12] Adapted from: Fay, Marianne; Hallegatte, Stephane; Vogt-Schilb, Adrien; Rozenberg, Julie; Narloch, Ulf; Kerr, Tom. 2015. Decarbonizing Development: Three Steps to a Zero-Carbon Future. Climate Change and Development;. © Washington, DC: World Bank. http://hdl.handle.net/10986/21842

[13] Lock-in effect refers to the implementation of a strategy or action (e.g., building upgrades, land use) that improves performance of an object or activity in the short term but is prohibitive to future change. As an example, where quick building retrofits are undertaken, no additional improvements in the equipment installed can be expected over the course of its lifetime without considerable additional expense. In this way, lower energy reduction levels can be locked in for a long period.

Air Quality and Health Benefits

Combusting fossil fuels for energy use releases air pollutants (e.g., sulphur dioxide, nitrogen oxides [NOx], particulate matter, carbon monoxide [CO], volatile organic compounds [VOC]) and can create ground-level ozone. These pollutants impact human health as they are breathed in during regular daily activities. For example, air pollution from traffic is linked to neurological disorders, bronchitis, asthma, and other respiratory illnesses. Often, low-income residents experience the impacts of air pollution to a greater extent compared to other residents, due to proximity to pollution sites, lack of indoor air filtration, and comorbidities. While a quantitative assessment of impact has not been conducted for Vaughan, in nearby Toronto, Toronto Public Health estimates that air pollution causes 1,300 premature deaths and 3,550 hospitalizations for heart and lung disease in that city each year.[14] A U.S.-based study of light-duty vehicle electrification in large metropolitan areas estimated that the health cost savings of eliminating fine particulate matter emissions from tailpipe pollution is between US$0.02 and US$0.12 per mile.[15] These health cost savings, when compared to those associated with a conventional vehicle, present a clear case for electrification in urban areas.

Indoors, natural gas stoves and fireplaces are shown to contribute to negative health impacts, especially for children.[16] Replacing these with electric units over time can further decrease negative health outcomes and associated human and financial costs.

Retrofitting existing buildings can also reduce indoor air pollutants (i.e., NOx, CO, and VOCs), reduce mold and dampness, and improve the thermal comfort of buildings. These changes can lead to health benefits such as reduced risk of cancer and cardiovascular, endocrine, respiratory, and cardiopulmonary illnesses.[17,18] Evidence also suggests that these improvements contribute to better mental health outcomes.[19]

By 2050, the low-carbon scenario projects a significant reduction in local fossil fuel combustion compared to the BAP scenario as vehicles and buildings are moved away from using fossil fuels, primarily from switching vehicles and building heating systems to electric sources.

[14] City of Toronto. (2017). Avoiding the TRAP: Traffic-Related Air Pollution in Toronto and Options for Reducing Exposure. Technical Report. https://www.toronto.ca/legdocs/mmis/2017/pe/bgrd/backgroundfile-108667.pdf

[15] Choma, E. F., Evans, J. S., Hammitt, J. K., Gómez-Ibáñez, J. A., & Spengler, J. D. (2020). Assessing the health impacts of electric vehicles through air pollution in the United States. Environment International, 144, 106015.

[16] Seals, B. & Karasner, A. (2020). Gas Stoves: Health and Air Quality Impacts and Solutions. https://rmi.org/insight/gas-stoves-pollution-health

[17] Wu, F., Jacobs, D., Mitchell, C., Miller, D., & Karol, M. H. (2007). Improving Indoor Environmental Quality for Public Health: Impediments and Policy Recommendations. Environmental Health Perspectives, 115(6), 953–957. https://doi.org/10.1289/ehp.8986.

[18] Barton, A., Basham M., Foy C., Buckingham, K., & Somerville, M., on behalf of the Torbay Healthy Housing Group. (2007). The Watcombe Housing Study: the short term effect of improving housing conditions on the health of residents. Journal of Epidemiol Community Health, 61(9), 771e7.

[19] Bonnefoy, X. (2007). Inadequate housing and health: An overview. International Journal of Environment and Pollution, 30(3/4), 411. doi: 10.1504/IJEP.2007.014819

Active Transportation and Health Benefits

Vaughan is already planning to expand its active transportation network. Doing so using the most climate positive scenario identified by the City will not only lead to the greatest GHG reduction benefit but also to the greatest health outcomes for its residents. Evidence shows increased active transportation and routine physical exercise can lead to improvements in mental health.[20] A study of 828 workers in Portland, Oregon, found that those who travel by car or transit in heavily congested areas are less happy with their commutes than their counterparts who walk or bike.[21] Increasing walking and biking is one of the most significant ways to improve a community's public physical health. Health benefits from routine physical exercise include reductions in rates of diabetes, cancer, and heart-related illnesses.[22]

Equity

In the low-carbon scenario, increased equity is possible but not guaranteed. Equity is a broad term that encompasses fairness for many different demographics across many different situations, so the low-carbon scenario can only contribute to, not create, equity. In the context of climate planning, equity refers to the fairness and justice in the distribution of resources and opportunities to ensure that climate change does not disproportionately impact or increase the vulnerability of different population groups. The MEPR prioritized equity by engaging with and incorporating the perspectives of interested and affected communities in the development of climate actions and implementation policies. Some areas where the low-carbon scenario can contribute to equity are intergenerational equity, income inequality, global equity, and climate resilience.

Intergenerational Equity

As the impacts of climate change increase in frequency, duration, and severity, younger generations, and generations yet to be born, are and will be increasingly affected by the impacts of, and shoulder the responsibility for, reducing emissions generated by systems created by older and past generations. Addressing emissions in the short-term decreases that inequitable burden.

[20] Sampasa Kanyinga, H., Colman, I., Hamilton, H. A., & Chaput, J. P. (2020). Outdoor physical activity, compliance with the physical activity, screen time, and sleep duration recommendations, and excess weight among adolescents. Obesity Science & Practice, 6(2), 196–206.

[21] Smith, O. (March 1, 2017). "Commute Well-Being Differences by Mode: Evidence from Portland, Oregon, USA." Journal of Transport & Health, 4, 246–54. https://doi.org/10.1016/j.jth.2016.08.005.

[22] Canadian Society for Exercise Physiology. (2019). Canadian 24-Hour Movement Guidelines. Canadian Society for Exercise Physiology. https://csepguidelines.ca/

Income Inequality

We often hear that it is "expensive to be poor," and that is true in the low-carbon transition unless an effort is made to decrease the financial burden for individuals and families living on low incomes. For example, as the transition from fossil fuels to cleaner energy sources progresses, individuals still using fossil fuels will feel the impact of covering the fixed costs of those systems in the prices they pay for energy. In addition, those still using fossil fuels will be increasingly impacted by the rising carbon tax. If a person cannot transition due to the upfront cost, it could mean an increase in their ongoing costs. However, if individuals and families living on a low income are supported to make their homes and vehicles more efficient and transition away from fossil fuels, they could gain utility and fuel savings. The City and other levels of government must play a role in this and ensure that support is accessible for low-income earners. For example, instant rebates and other time-of-purchase financial supports may be more useful than post-purchase rebates.

Access to transit and active transportation can also increase equity. For individuals who do not own a vehicle, especially those who cannot own a vehicle due to cost, access to transit and active transportation increases the ability to get to services, appointments, activities, and employment. This is only possible if robust transit and active transportation networks are connected to both areas within the community where lower-income earners reside and to areas with employment opportunities and services.

Individuals living on low and fixed incomes are also more vulnerable to climate risks than wealthier individuals due to factors such as higher rates of comorbidities; limited access to transportation to flee during climate-related events; lack of air conditioning during heat-related events; and a lack of money for alternative accommodations, to prepare for climate-related events, or to repair or restore their dwellings after an event.

Global Equity

Globally, climate change is currently having a disproportionate impact on poorer nations, which experience more climate-related events and resulting mortality rates than wealthier nations. At the same time, many of these disproportionately impacted countries have contributed less than their wealthier counterparts to the increased use of fossil fuels that have led to the current climate crisis. Led by C40 Cities Climate Leadership Group (C40), many cities, including Vaughan, have set GHG reduction targets that acknowledge that cities in wealthier countries must act more rapidly to reduce emissions than cities struggling with widespread poverty.

Climate Resilience

Some actions that support reducing emissions can also increase a city's capacity to adapt to climate change impacts. Some of the key resilience co-benefits associated with Vaughan's low-carbon scenario include:

- Safer buildings during extreme weather events (e.g., flooding, extreme heat/cold) due to older buildings being retrofitted;
- Decreased impacts of power outages due to homes being fitted with renewable energy and storage systems;
- Decreased impacts of power outages on homes that are connected to district energy systems;
- Decreased stress on water and wastewater systems due to retrofits and more stringent efficiency standards for new buildings; and
- Increased back-up power from electric vehicles.

Economic Prosperity

The local economy will benefit from implementing the low-carbon scenario. Retrofitting buildings, installing renewable energy, and expanding the construction of active transportation networks all help to create jobs that can be held locally. Decreased utility and fuel costs can also reduce household and business costs, which offsets capital investments in low-carbon assets over time. All of these factors can be built into an economic strategy to encourage residents to buy locally to ensure more money stays within the community.


EXIT
Thornhill Room
2024 Earth Hour
VAUGHAN TOGETHER FOR A GREENER FUTURE
City Hall
MAPLE
CORTELLUCCI
2024 Earth Hour
York Hill
P.E.S.
TAKEACT
CLIMAT
IS RE
"We are diverse
we are one"
St Agnes of Assisi
selected works from the
corporate art collection

Capturing an Economic Opportunity

Transitioning to a low-carbon economy will require investments in all community sectors from residents, businesses, institutions, the City of Vaughan, and other levels of government. The investments need to begin now and continue out to 2050. While the need for capital is high, the paybacks of the investments are higher, especially if they happen in the short term. The cumulative, undiscounted incremental expenditures and savings, have a capital investment of $11 billion, and savings, avoided cost of carbon, and revenue have a total of $11.42 billion.

After discounting at 3%[23], the capital investments in the low carbon actions have a net present value of $7.67 billion, and the savings, avoided cost of carbon, and revenue have a total return of $ 6.37 billion by the end of 2050.

This expected net return is based on revenue generation (valued at $726 million) and savings in operations and maintenance ($171 million), energy costs ($10.5 billion), and carbon taxes ($2.6 billion), all at a 3% discount rate. The overall investment across the community amounts to $7.5 billion (Figure 11, next page).

[23]< The discount rate is the baseline growth value an investor places on their investment dollar. An investor considers a project to be financially beneficial if it generates a real rate of return equal to or greater than their discount rate. 3% is the social discount rate recommended by the Treasury Board of Canada. A social discount rate is recommended for instances where a regulatory proposal primarily affects private consumption of goods and services, and a regulatory proposal's impacts occur over the long term (50 years or more).

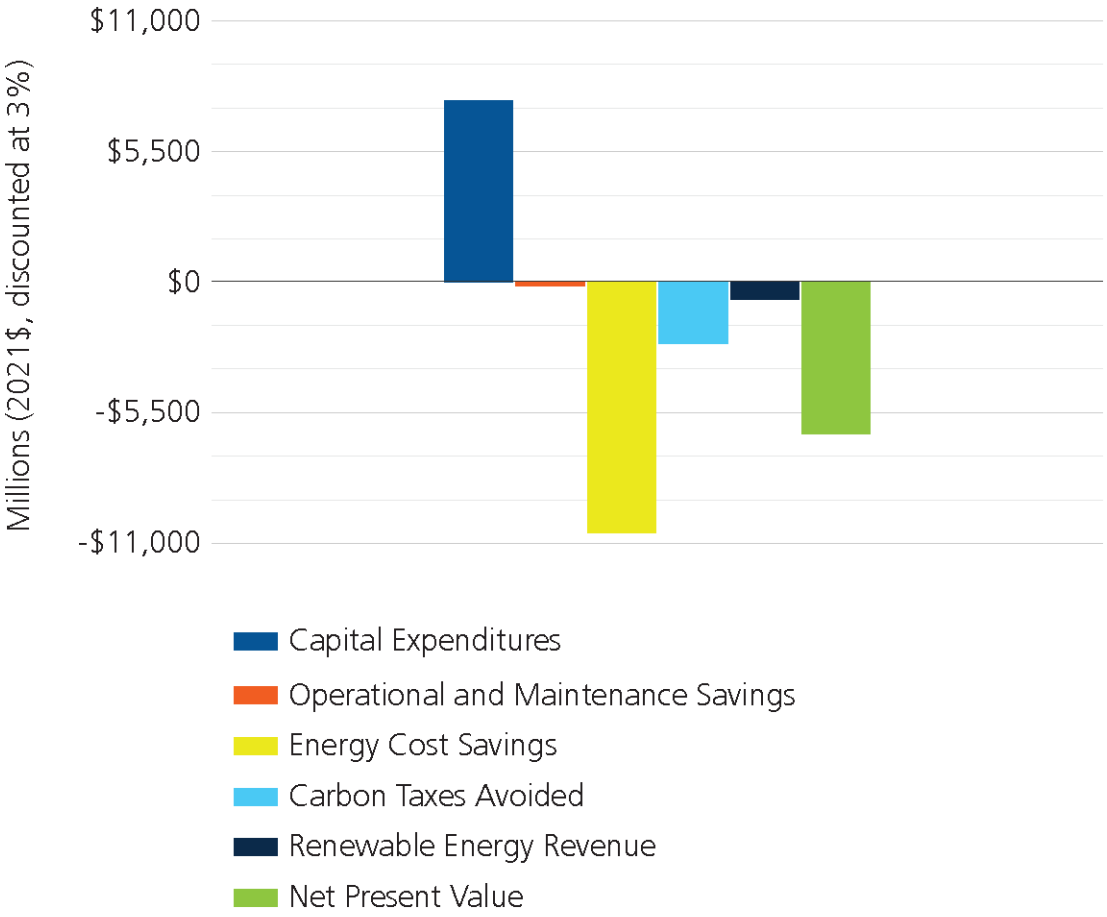


Figure 11. Projected net investments and returns between 2024 and 2050 resulting from the low-carbon scenario.

Transitioning to a low- or zero-carbon economy is expected to impact labour markets in four main ways: additional jobs will be created in emerging sectors, some employment will be shifted (e.g., from fossil fuels to renewables), certain jobs will be reduced or eliminated, and many existing jobs will be transformed and redefined. Specifically, more than 59,423 person-years of employment between 2024 and 2050. This equates to an average of 2,285 full-time equivalent jobs annually across all sectors. These jobs are primarily created by expanding transit, investing in residential retrofits, and investing in commercial and industrial retrofits

The financial analysis is developed at the low-carbon pathway level, meaning it represents total costs across the community and does not allocate costs or savings specifically to the municipality or other sectors or investors, although it does assign costs to current asset owners. Actual costs to the municipality are dependent on third-party funding available for actions the municipality will take directly (e.g., in its own buildings and fleets) and the degree to which the municipal government chooses to invest in certain actions and incentivize other sectors. Implementing the MEP requires investigating all financial tools available to the

municipal government and other community stakeholders including individuals, businesses, and other levels of government. The financial analysis does not include incentives and rebates currently available to residents and businesses through local, provincial, and federal programs.

Financial Scenario Limitations

The financial scenario is a current best-guess estimated cost of implementing the MEP, but it is very sensitive to change. For example, if a new technology is introduced that causes individuals to make currently unexpected changes to reduce emissions, this might change the scenario's financials.

The financial scenario is also sensitive to changes in energy prices. As seen in recent years, energy prices can fluctuate widely based on global events such as pandemics and wars. These events cannot be reliably predicted, but could greatly impact the financial scenario. For example, if the change in natural gas prices were to increase while electricity prices remained stable, or vice versa, the price of the scenario would change drastically and may push individuals and governments to make different choices about energy sources.

To achieve the emissions reductions targets, all of the MEP actions need to be implemented. When other funding from other levels of government have already been considered or applied, it makes sense for the City to intervene and provide financial support for actions that do not have a payback that is attractive to individual residents or businesses. When there is a clear and timely financial payback for community members, the City's role is to educate and support using non-financial mechanisms. The MEP Implementation Framework provides initial recommendations on how the City can use both financial and non-financial mechanisms to support its residents and community sectors to take action.

For a more detailed financial analysis, please review the Ancillary Report: Financial Analysis.

Starting the Journey to Net-Zero Emissions

New Choices on the Horizon

Enbridge is piloting hybrid heating programs and incentives. The current program involves an incentive for residents to install an electric air-source heat pump in their home while keeping their natural gas furnace as a secondary heating source. Residents can switch between the two systems, via controls, to maximize savings or GHG reductions. A preliminary assessment shows that this program reduces but does not eliminate GHGs. In the future, the hybrid system could eliminate household GHGs if the availability of affordable RNG increases. This could lead to a decrease in costs for households to transition to clean energy, given that they would be keeping a current heating source. However, depending on when RNG availability increases, it could shift when emissions reductions are achieved. Regardless, building retrofits that decrease energy needs, while increasing efficiency and the comfort of the home, are still recommended.

The MEP is an ambitious plan that spans every sector of the community to achieve net-zero emissions by 2050. It relies on a whole-city approach in which staff members and departments advance the MEP's objectives and targets to meet the City's long-term target. While climate action is essential, not all the required changes can happen at once. Over the next year, the City can take the following key steps to set the foundation that will ensure climate action remains a priority for it and the broader community.

1

Adopt a carbon budget

A global carbon budget is the maximum amount of GHG emissions that can be emitted world-wide without increasing the global average temperature above 1.5°C. Increasingly, municipalities across Canada are adopting a municipal carbon budget. A carbon budget is a tool to transform municipal GHG emission targets into funded and measurable actions across the city. As such, a carbon budget is a management system to align the City's plans and expenditures (operating and capital) with its GHG reduction targets. Implementing a carbon budget will support the City of Vaughan and the community in:

- Achieving the GHG emissions reduction targets by implementing a new management system that integrates GHG emissions impacts into City decision-making processes;
- Aligning expenditures and investments with GHG targets and building capacity and expertise across the organization; and
- Providing transparent accountability by publishing an Annual Carbon Budget Report and a GHG Inventory.

2

Dedicate staff to manage the MEP implementation

Implementing the MEP will require a concerted effort by city staff and departments. Dedicating staff to oversee coordinating the MEP's implementation will ensure the City is on track to meet its interim 2030 reduction goal, while planning ahead to create future programs that will ensure net-zero emissions by 2050. It is recommended that the City, dedicate one staff member to oversee the implementation of the MEP's Implementation Framework, and develop an annual work plan identifying activities, budgets and schedules to achieve each implementation action. In addition, establishing a cross-departmental working group of City staff to:

- Discuss the allocation of the Implementation Framework into departmental work plans;
- Identify internal operational and capital funding opportunities for each implementation mechanism;
- Determine the City's role in each action and identify internal lead departments;
- Adaptively respond to changes in implementation mechanisms, external funding opportunities, and technological developments; and
- Engage external project leads, sponsors, and supports.

3

Apply an equity lens

Applying an equity lens assessment to climate change mitigation and resilience projects and programs is a first step to ensure that intergenerational equity, income inequality, global equity, and climate resilience are considered in policies, programs, and initiatives. This action can be further enhanced through continued collaboration and information sharing about climate change with community grassroots organizations and nonprofit organizations in a way that builds trust with the City.

As these foundational pieces are put into place, the City can plan how to operationalize the implementation actions outlined in Appendix A: Implementation Framework over the next five years. But climate action is not just about the actions the community takes today; it is also about the legacy it leaves for future generations. Committing to meaningful actions in the fight against climate change is required, and this plan represents an important step in that direction. With collaboration and a shared sense of purpose, the City of Vaughan can achieve its net-zero emissions by 2050 target.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2024 Earth Hour
St. Gabriel
C.E.S.
2024 Earth Hour
Glenn Gould
P.E.S.

Appendix A: Implementation Framework

Context

The purpose of the following short-term Implementation Framework (Framework) is to actively guide progress on the low-carbon pathway outlined in the 2024 MEP between 2024 and 2030.

The direction of the low-carbon pathway is driven by the target of net-zero emissions by 2050. However, the specific strategies to achieve this target is influenced by several factors, including:

- Input from the Municipal Energy Plan Revision (MEPR) Project Advisory Committee,
- Input from the community via community workshops and survey responses,
- Input from the development and construction industry via a sector specific workshop,
- Research on best practices,
- Consultant experience from other projects.

Partnerships are critical to the success of the MEP. Although this Framework outlines City-led initiatives, the City will need to leverage resources and leadership from various community partners, including industry, businesses, utilities, and institutions. Additionally, securing funding, resources, and enabling policies from higher levels of government and municipal partners will be vital in achieving the targets set by the MEP.

How the Guide is Organized

The Framework is divided into the following three sections:

Section 1: Governance and Administration details the governance structures and administrative processes required to successfully implement the low-carbon pillars.

Section 2: Low-Carbon Pillars details the actions across the six focus areas identified in the MEP. It is important to note that actions within each focus area are interconnected and mutually reinforce one another, as there is considerable overlap between the programs, initiatives, policies, and infrastructure recommendations. These six focus areas are:

1. Retrofitting buildings;
2. Building net-zero new construction;
3. Generating renewable energy;
4. Reducing vehicle emissions;
5. Increasing active transportation and transit use; and
6. Reducing waste emissions.

Section 3: Funding Opportunities provides a summary of potential funding opportunities the City and community members can access to fund the actions.

Key Definitions

Each low-carbon pillar is divided into the Action Overview and Detailed Sub-Actions. The Action Overview section details the action, the 2050 modelled low carbon targets, the GHG impact, and the modelled investment. The Detailed Sub-Actions provides a description of the implementation mechanism, the internal impact, the city's role, the implementation timeframe, and tracking metrics. Due to the overlap in interested and affected parties[24], a summary of these has been provided for each low-carbon pillar.

Action Overview

Action: The title of the action that helps achieve the Low-Carbon Pillar in the MEP's low-carbon pathway.

2050 Modelled Low Carbon Target: A description of the low-carbon pathway's 2050 modelled target related to the action.

Total Modelled Investment: The estimated funding required across all sectors between 2024 and 2030 to implement the actions. The investment does not include the savings from avoided carbon tax, energy savings, operation and maintenance, and revenue generation. The investment costs can be provided by a variety of sources, such as funding opportunities identified in the Section 3. This is a high-level estimate that may change with further study and action refinement.

Detailed Sub-Actions

Sub-Action: A brief description of the programs, initiatives, policies, and infrastructure required to implement each action. These are further expanded upon in the table below.

MECHANISM	DEFINITION
Policy	A policy developed by the Municipality, and approved by Council.
Program	An ongoing effort by the Municipality, with staff and financing to support the effort.
Initiative	A study or project, undertaken by the Municipality, private sector, not-for-profit sector, or other sectors, individually or collaboratively, with a specific focus, that is implemented for a set time period.
Infrastructure	Investment in physical infrastructure by the municipality or private sector, not-for-profit sector, or other sectors, individually or collaboratively.
Advocacy	An activity undertaken by the Municipality that demonstrates leadership and/or feasibility to the community.
Education	An activity undertaken by the Municipality to raise awareness and increase knowledge within the community.

Internal Impact: Summarizes the anticipated internal impacts of each sub-action. These

[24] Organizations that have a vested interest in these actions and should be engaged and/or informed during implementation.

include resources to initiate the action; internal communications and engagement fees; and anticipated costs to be incurred by the City to implement City-led initiatives, such as consulting fees to complete feasibility studies. This is an initial estimate, subject to change as additional investments may be necessary following further study and refinement of actions. In addition, many of the initial steps of the actions are to investigate opportunities and begin planning for specific implementation mechanisms. As opportunities are investigated, the City will better understand what additional investments need to be made into programs, which can be integrated into the City's annual budget review process.

Project Lead, Sponsors, and Support: Highlights the City's role as either the project lead, project sponsor, or project support.

- **Project Lead:** Organization responsible for executing and overseeing the sub-action from initiation to completion. The project lead's primary role is to manage project activities, resources, and risks. They act as the central point of communication for the action.
- **Project Sponsor:** Organization required to champion the action. They will need to be engaged to ensure the action is implemented, and may be responsible for providing funding.
- **Project Support:** Organization with a range of roles and functions that assist the project lead and the project sponsor in various aspects of the action.

Tracking Metrics: The method and measurement unit for measuring the impact of the action taken. All metrics should be analyzed on an annual basis for those actions that are being actively implemented.

Section 1: Governance and Administration

This first section of Vaughan's Implementation Framework focuses on building internal capacity to efficiently implement the actions associated with the Low-Carbon Pillars. The City's Climate Change team within the Policy Planning and Special Programs department will be responsible for overseeing and planning the implementation of the 2024 MEP. The Governance and Administration actions lay out the important first steps to determine the City's level of involvement for each action and lead departments, launching the monitoring and evaluation framework, and engaging community members.

Action A: Incorporate climate change mitigation into all corporate decision-making and planning in current and future processes

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	TRACKING METRIC(S)
A.1 Initiative: Provide training and workshops to City staff on climate change mitigation and adaptation.	Staff time	Percent of staff completed training
A.2 Policy: Develop carbon budget to integrate climate mitigation into the City's budgeting process, and require that administrative/staff reports to Council include an assessment of greenhouse gas emission impacts.	Staff time	Carbon budget is adopted by Council in 2024 Corporate carbon budget is implemented in 2026 Community carbon budget is implemented in 2028

Action B: Develop and implement a community wide education campaign on climate mitigation

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	TRACKING METRIC(S)
B.1 Initiative: Define climate vulnerable populations in alignment with the City of Vaughan's Diversity, Equity and Inclusion Strategy, and with support from the Anti-Hate, Diversity, and Inclusion Advisory Committee.	Staff time	Climate vulnerable populations defined and identified Published in Diversity, Inclusion, and Equity materials
B.2 Education: Publish a toolkit and/or guidance for private businesses and organizations to follow based on the City's GHG reduction experience.	Staff time	Toolkit published
B.3 Initiative: Develop a communications strategy for the implementation of MEP that includes a baseline assessment of community member's climate change knowledge and identifies education needs.	Staff time	Communications reach

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	TRACKING METRIC(S)
B.4 Education: Develop proactive education and information campaigns with partners that the public trusts and who can distribute information (libraries, non-profits, businesses, radio stations, etc.). Identify partners who can assist the City in engaging with vulnerable populations (Action B.1).	Staff time	Number of partners engaged Communications reach

Action C: Monitor and report on climate change mitigation

How will the City monitor progress?

Monitoring and evaluating the City's progress towards its GHG emission targets and Framework will allow the City to adaptively manage the plan and respond to advancements in technology and resources. GHG emission targets can be tracked by completing an annual GHG inventory in accordance with the GHG Protocol for Community-Scale (GPC) GHG Inventories and updating the modelling for the baseline and three scenarios (BAU, BAP, and low-carbon) during the 5-year update of the MEP. Completing an annual GHG inventory and disclosing to the Carbon Disclosure Project (CDP) will provide insights into the progress made towards achieving the 2030 GHG targets. As the largest disclosure program, the CDP offers a standardized and transparent approach for all sectors to measure and manage their climate action. The 5-year MEP update provides a more detailed means to track GHG emissions reductions and projections, and will allow the City to identify additional actions to reach the net-zero emissions by 2050 target. The Implementation Framework identifies six actions to monitor the MEP progress. In addition, the carbon budget (Action A.3) will be an important tool for the City to monitor the GHG impacts of corporate capital and operating projects.

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	TRACKING METRIC(S)
C.1 Program: Establish a cross-departmental working group of City staff to:[25] • Discuss the allocation of the Implementation Framework into departmental work plans; • Identify internal operational and capital funding opportunities for each implementation mechanism; • Determine the City's role in each action and identify internal lead departments; • Adaptively respond to changes in implementation mechanisms, external funding opportunities, and technological developments; and • Engage external project leads, sponsors, and supports.	Staff time	Working group participants identified Working group convened Quarterly meetings hosted
C.2 Program: Dedicate one staff member to oversee the implementation of the MEP's Implementation Framework, and develop an annual work plan identifying activities, budgets and schedules to achieve each implementation action.	1 FTE salary and compensation benefits	Annual workplan developed and reviewed
C.3 Program: Track, update, and share annual progress on the MEP's implementation. The annual progress reporting can include reporting on the progress of the Implementation Framework's tracking metrics, investigating opportunities to update implementation actions in response to changes in technology and resources.	Staff time	Implementation report complete
C.4 Program: Complete an annual GHG inventory according to the GPC GHG Inventories, and submit annual reporting to the CDP.	Staff time Consulting fees for annual GHG emissions inventory (if used): $10,000 - $20,000 per inventory	Annual GHG inventory completed Annual CDP submission completed

[25] Once the cross-departmental working group is established, the City can either invite community members (including youth) to attend quarterly meetings or develop an MEP Community Working Group. Community participation will be key to building partnerships and identifying project champions.

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	TRACKING METRIC(S)
C.5 Program: Assign staff person to track and manage funding applications for monitoring and reporting.	Staff time	Number of annual funding applications submitted
C.6 Initiative: Review and update MEP every five years.	Staff time $50,000 in modelling fees, plus additional consulting fees to develop Plan and Framework	MEP update completed

Section 2: Low-Carbon Pillars

Section 2 is designed to generate momentum for Vaughan's low-carbon pillars by identifying actions and supporting sub-actions to decrease emissions. The Framework is designed to be a living document, as circumstances evolve (e.g., community champions are identified, funding becomes available, technologies change), the Implementation Framework should be updated to reflect new opportunities and advancements.

Pillar 1: Retrofitting Buildings

Building emissions result from heating, cooling, and lighting spaces, and running appliances and equipment. These emissions come from all types of buildings in the community, including homes, schools, offices, stores, and industrial spaces. The most cost-effective approach is to first maximize energy efficiency before incorporating renewable energy sources or fuel switching. This approach improves energy efficiency in homes and buildings, reduces energy costs, and enables significant emissions reductions as the power grid becomes cleaner. To make buildings more efficient, they can be retrofitted by replacing windows and doors, increasing insulation, replacing weather stripping, and replacing inefficient heating systems with more efficient technologies such as heat pumps or hybrid heating systems. In turn, these retrofitted buildings use less energy overall, whether the energy comes from a renewable source or not. This decreases emissions from the baseline and the amount of renewable energy required later to meet community needs. The following interested and affected parties have been identified to support the implementation of the retrofitting buildings actions:

- Alectra Utilities
- Enbridge Gas
- TransPower Utility Contractors
- Local developers (e.g., Building Industry and Land Development [BILD] York Region Chapter)
- Local construction companies (e.g., Residential Construction Council of Ontario [RESCON] can be a resource for beginning engagement with local construction companies)
- Post-secondary education institutions
- Ontario Landlords Association
- Local manufacturers and trades associations
- Canada Green Building Council
- Ontario Government
- Canada-Ontario Housing Benefit (COHB)
- Housing Services Corporation
- Clean Air Partnership
- The Atmospheric Fund

- Toronto and Region Conservation Authority (TRCA)
- At-risk and affordable housing groups (e.g., Local Diversity and Immigration Partnership Council)
- Vaughan Chamber of Commerce

Building On Success: The City's Decarbonization Efforts

The City of Vaughan has already successfully implemented several initiatives to support the decarbonization of existing buildings. These include:

1. Collaborating with the Toronto and Region Conservation Authority (TRCA) to implement a Sustainable Neighbourhood Action Program (SNAP) in a neighbourhood in Thornhill. Council approved the Thornhill SNAP Action Plan in September 2021, which included a Residential Retrofit Program.
2. Conducting an outreach study with commercial building owners to raise awareness of the Government of Ontario's Reporting of Energy Consumption and Water Use Regulation, which requires commercial buildings to annually report on energy-use.
3. The City of Vaughan's Corporate Energy Management Plan outlines proposed conservation and energy efficiency measures, cost and savings estimates, an implementation plan, and energy consumptions and GHG emissions reduction targets for municipally owned and operated facilities.

Action 1.1 Develop retrofit program for residential and ICI buildings

What is a deep retrofit?

A deep retrofit program is designed to improve the energy efficiency of a building and as a result improve building quality. These programs are designed to overhaul all systems of the building, such as replacing existing HVAC systems with electric heat pumps, replacing the roof, and maximizing solar gain through reconfiguring windows. A deep retrofit typically reduces a building's energy consumption by 50% or more. Further reductions in energy consumption can be achieved through minor retrofits such as insulation improvements and installation of LEDs.

However, retrofitting buildings one by one will not suffice to meet Vaughan's targets, and bulk retrofits will be required to retrofit several housing units at one time. Energiesprong, a Dutch public-private partnership, has pioneered a semi-industrialized net-zero energy retrofit package and applied this approach to approximately 5,000 low- and mid-rise multifamily retrofits, with roughly another 100,000 units of multifamily demand aggregated across Europe. Similar projects are underway in Edmonton, and the City of Seattle has developed an Energy Efficiency as a Service (EEaS) contract mechanism to transform deep retrofits into power purchase agreements. Conducting a feasibility study through a pilot bulk retrofit program can help tailor and refine the approach to suit Vaughan's local conditions.

Action 1.1 Overview

ACTION 1.1 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	All residential, and institutional, commercial and industrial (ICI) buildings are retrofitted to achieve a 50% reduction in thermal energy and 10% reduction in electrical savings using the following schedule: • By 2040, 70% of the existing buildings are retrofitted; and • By 2050, 100% of the existing buildings are retrofitted.
MODELLED INVESTMENT (2024 -2030):	Residential: $14 million ICI: $29.5 million Note: retrofitting building performance and fuel switching investments were modelled together.

Detailed Sub-Actions

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
Residential Buildings			
1.1.1 Program: Implement the Home Energy Retrofit (similar to a Property Assessed Clean Energy [PACE]) program based on the recommendations of the Local Improvement Charges (LIC) study.	Staff time Consulting firm fees to develop a Home Energy Retrofit feasibility study (if used): approx. $130,000	Project Lead	Home Energy Retrofit program implemented
1.1.2 Program: Using the City of Vaughan Study Report for a Home Energy Retrofit Program conduct feasibility study to investigate an incentive program to conduct bulk energy retrofits and provide larger incentives for lower-income housing dwellers and individuals earning less than 80% of the average household income. Note: Integrate with Action 1.1.1	Staff time Consulting firm fees to develop feasibility study (if used): approx. $130,000	Project Lead	Feasibility study completed
1.1.3 Initiative/Program: Investigate opportunity to expand the SNAP to another neighbourhood across Vaughan and implement Residential Retrofit Program in low-income housing and vulnerable populations. Note: integrate with Actions 1.1.1 and 1.1.2.	Staff time	Project Lead Note: include the TRCA as a co-lead or project sponsor.	SNAP program expanded
1.1.4 Program/Initiative: Investigate additional financing opportunities for residents to make retrofits and potentially stack with the City of Vaughan's Home Energy Retrofit Program.	Staff time	Project Lead	Research completed
1.1.5 Education: Clearly communicate and promote existing programs and incentive stacking opportunities that residents can take advantage of through federal, provincial, regional, utility, and other local government programs.	Staff time Internal digital communications fees	Project Lead	Number of education techniques used Number of people reached through education efforts

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
1.1.6 Education: Educate residents on the opportunities and pathways to reach net-zero based on their home. This includes building awareness of the different types of energy retrofits that can be completed in their homes, the benefits of energy retrofits and heat pumps, qualified energy auditors and local contractors that can conduct energy retrofits. Note: integrate with Action 1.1.5	Staff time Internal digital communications fees	Project Lead	Number of education techniques used Number of people reached through education efforts
1.1.7 Advocacy: Advocate the Provincial and Federal government, construction industry, and local post-secondary education institutions, including trades schools to develop a labour and training strategy to meet building retrofit targets.	Staff time	Project Support Note: potential project leads include the CAP and TAF.	Advocacy completed
ICI Buildings			
1.1.8 Program: Investigate opportunity to develop a Commercial Property Assessed Clean Energy (C-PACE) program or expand the Home Energy Retrofit Program to include ICI buildings. Note: Integrate with Action 1.1.1	Staff time Consulting firm fees to develop a Commercial Energy Retrofit feasibility study (if used): approx. $130,000	Project Lead	Home Energy Retrofit program implemented

Action 1.2 Implement retrofit schedule for municipal buildings as identified in the Corporate Energy Management Plan

Action 1.2 Overview

ACTION 1.2 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	All municipal buildings are retrofitted to achieve the long-term goal of eliminating GHG emissions associated with building operations by 2050 using the following schedule: • By 2024, building energy consumption is reduced by 9%, and natural gas consumption is reduced by 10%, relative to the 2017 levels; and • By 2030, building energy consumption is reduced by 14%, and natural gas consumption is reduced by 37%, relative to the 2017 levels.
MODELLED INVESTMENT (2024 -2030):	Not modelled

Detailed Sub-Actions

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
1.2.1 Policy: Undertake review of Corporate Energy Management Plan to develop strategy for achieving net-zero emissions and provide guidance on investments for all departments. Consider integrating into the City's Asset Management Plan so replacements and cost estimates reflect energy reduction needs. Note: the corporate carbon budget (Action A.2) provides a decision-making tool to analyze corporate capital and operations investments based on an annual GHG surplus or deficit.	Staff time Consulting firm fees to complete review of the Corporate Energy Management Plan (if used): approx. $130,000	Project Lead	Number of buildings retrofitted

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
1.2.2 Program: Implement a revolving energy fund that directs cost savings generated from retrofits to future low-carbon investments. Revolving funds, or Green Revolving Funds (GRF), provide a unique opportunity to pay forward the success of efficiency projects into future projects. A green revolving fund finances projects by tracking utility savings, fuel savings, or other cost savings associated with efficiency upgrades, and paying those savings back into a common fund. GRFs should reduce resource consumption or reduce emissions, and produce savings from operations.	Staff time Capital and operating funding to launch GRF	Project Lead	GRF launched Number of projects financed through GRF

Action 1.3 Develop retrofit program for electric heat pumps and water heaters for all residential and non-residential buildings

Action 1.3 Overview

ACTION 1.3 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	By 2050, all residential and non-residential buildings are retrofitted with electric heat pumps and water heaters using the following schedule: • By 2040, 70% of the existing buildings are retrofitted; and • By 2050, 100% of the existing buildings are retrofitted.
MODELLED INVESTMENT (2024 -2030):	Residential: $14 million ICI: $29.5 million Note: retrofitting building performance and fuel switching were investments were modelled together.

Detailed Sub-Actions

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
1.3.1 Program: Identify eligible households and implement a targeted program for installing hybrid heating, heat pumps, and electric water heaters in lower-income or at-risk households (e.g., senior centers, support housing), alongside measures that increase efficiency. For example, explore a program to connect heat pump manufacturers and installers with lower-income households to discount the incentive of the heat pump at the time of purchase.[26]	Staff time	Project Lead Potential Project Support: York Region	List of eligible households identified Partnerships established (i.e., manufacturers, installers, or private funders) to fund program The annual number of heat pumps and electric water heaters installed at lower income or at-risk houses
1.3.2 Program: Develop an interim program to support hybrid heating systems for residents. A hybrid heating system is comprised of an electric heat pump with smart controls and a natural gas furnace.	Staff time	Project Lead Potential Project Support: York Region	Program launched Number of hybrid heating systems installed
1.3.3 Program: Develop fuel-switching programs for all buildings. A fuel switching program that includes the installation of hybrid heating, air or ground-source heat pumps, and electric water heaters can be combined with building retrofits, or carried out as a separate program. This program will increase energy efficiency in homes and buildings, decrease energy costs, and enable deep emissions reductions as the grid becomes cleaner. The installation and maintenance of heat pumps creates local jobs and stimulates local businesses.	Staff Time	Project Lead Potential Project Support: York Region	Number of heat pumps and electric water heaters installed Number of building with heat pumps and electric water heaters

[26] Programs supporting eligible homes that meet income qualification requirements provide rebate coverage based on the number of people living in the home and the income level, for example the CleanBC program provides up to 95% of the upgrade costs. The approximate installation cost for a residential heat pump ranges from $15,000 to $32,000, if following a similar rebate coverage based on number of people living in the home and income level the program should anticipate to cover up to 95% of the eligible installation costs.

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
1.3.4 Education/Initiative: Develop and implement a communications and engagement plan to educate the community about the benefits and feasibility of hybrid heating, electric heat pumps and water heaters, and federal, provincial, and regional rebates and grant programs. For example, engagement events and campaigns can include open houses hosted at locations with electric heat pumps and water heaters, speaker-series and educational webinars, and social media campaigns.	Staff time Communications fees	Project Lead	Communication and engagement plan developed and implemented Number of campaigns developed and number of engagement events hosted Number of community members reached (e.g., website visits, social media campaign reach)

Pillar 2: Building Net-Zero New Construction

Planning for net-zero homes is essential in the coming decade, but there are advantages to taking action earlier. With expected significant growth in Vaughan, encouraging net-zero new construction now will result in fewer buildings contributing to GHG emissions in the community and reduce the need for future retrofits. Choices made today regarding buildings and building systems will have a lasting impact on emissions for decades to come, either increasing or decreasing the burden on future generations. Increasing the proportion of net-zero builds over time will also help prepare the workforce for industry-wide changes by 2030. The following interested and affected parties have been identified to support the implementation of the net-zero construction:

- Alectra Utilities
- Enbridge Gas
- TransPower Utility Contractors
- Local developers (e.g., Building Industry and Land Development [BILD] York Region Chapter)
- Local construction companies (e.g., Residential Construction Council of Ontario [RESCON] can be a resource for beginning engagement with local construction companies)
- Post-secondary education institutions
- Ontario Landlords Association
- Local manufacturers and trades associations
- Canada Green Building Council
- Ontario Government

- Canada-Ontario Housing Benefit (COHB)
- Housing Services Corporation
- Clean Air Partnership
- The Atmospheric Fund
- Toronto and Region Conservation Authority (TRCA)
- At-risk and affordable housing groups (e.g., Local Diversity and Immigration Partnership Council)
- Vaughan Chamber of Commerce

Building On Success: The City's Sustainability Metrics Program

Vaughan has implemented a Sustainability Metrics Program (SMP) as part of the development application review process. The SMP provides developers with a menu of Sustainability Metrics and Thresholds. Currently, development applications in Vaughan, such as Site Plans, Draft Plans of Subdivision, and Block Plans, are required to meet a minimum threshold score based on sustainability actions in mobility and transportation, energy efficiency, green space, and occupant well-being.

The SMP's IB-12: Building Energy Efficiency, Greenhouse Gas Reduction, and Resilience metric promotes buildings that are designed to be energy-efficient with reduced operating costs and greenhouse gas emissions associated with building operations, while improving the thermal comfort of occupants and enhancing building resilience. To achieve an excellent or exceptional level of performance, buildings must be constructed to near-net zero emissions or achieve Canadian Home Builders Association's Net Zero Homes or Passive House certification.

Discussions with the building sector throughout the project revealed a need for clear regulations, policies, and by-laws that would impact the sector, as well as transparent and advanced communications whenever possible. The City's low-carbon pathway aligns with the Sustainability Metrics Program, however early adoption of Net Zero Energy Ready (NZER) and Net Zero Energy (NZE) building performance can be promoted through additional developer incentives, such as development charge rebates.

Action 2.1 All new residential construction is net-zero ready in accordance with the CHBA Net Zero Home Labelling Program or Passive House Standards, and all new ICI buildings are built to achieve net-zero by 2050

Action 2.1 Overview

ACTION 2.1 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	By 2050, all new residential buildings are designed and constructed in accordance with the CHBA Net Zero Energy Labelling Program or Passive House Canada. By 2050, all new commercial and industrial buildings achieve a 50% energy improvement, and office and retail buildings achieve a Greenhouse Gas Intensity (GHGI) target of 15 kgCO2/m2/year by 2030, and 5 kgCO2/m2/year by 2050.
MODELLED INVESTMENT (2024 -2030):	Residential: $3.86 million ICI: $149.7 million

Detailed Sub-Actions

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
2.1.1 Program: Investigate and implement an incentive program to encourage the adoption of the SMP higher energy performance standards.	Staff time	Project Lead Potential project supports: City of Brampton, Town of Richmondhill, City of Markham, York Region, and The Atmospheric Fund	Incentives study completed Incentive program funded and implemented for energy performance standards The number of development applications approved using the higher performance standards in the SMP
2.1.2 Education: Educate developers, planners, and builders on the SMP and opportunities to achieve higher performance standards.	Staff time Internal communications fees	Project Lead	Education materials developed Number of developers, planners, and builders engaged

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
2.1.3 Advocacy: Identify organizations to advocate for training and micro-credential programs for skilled tradespeople to increase their knowledge and skills around efficient building practices.	Staff time	Project Lead	At least one project sponsor, support, or partnership identified Increase number of training and micro-credential programs available regarding efficient building practices

Action 2.2 All new municipal construction is net-zero ready and Passive House certified

Detailed Sub-Actions

ACTION 2.2 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	As of 2023, all new municipal buildings are designed and constructed to achieve NZER, and by 2030, all new municipal buildings are designed and constructed to achieve Passive House certification.
MODELLED INVESTMENT (2024 -2030):	Not modelled

Detailed Sub-Actions

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
2.2.1 Policy: Adopt a policy that commits the City to constructing all new municipal facilities to meet NZER and Passive House standards. Note: the corporate carbon budget (Action A.2) provides a decision-making tool to analyze corporate capital and operations investments based on an annual GHG surplus or deficit.	Staff time	Project Lead	Policy is adopted

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
2.2.2 Initiative/Education: Conduct public engagement to share progress on the City's new net-zero construction, host public demonstrations, and share information on the results.	Staff time Internal communications fees	Project Lead	Number of communication actions completed Number of community members reached (e.g., website visits, social media campaign reach)

Pillar 3: Generating Renewable Energy

Renewable energy generation plays a significant role in reducing GHG emissions. Coupling renewable energy generation with energy efficiency improvements will offset some of the challenges with meeting the current energy demands with renewable energy. Since Vaughan does not have local community-scale renewable energy generation, in order to meet the renewable energy targets Vaughan will need to:

1. Implement supportive programs, policy frameworks, external funding, and labour and training strategies to facilitate large-scale rooftop solar PV installations, similar to building retrofits.
2. Promote large-scale ground-mount solar photovoltaics (PV) installations in parking lots. A community-scale funding model could be explored, where community members who invest in the project distribute the costs of installation, operation, and maintenance, ensuring the generation of low-emission energy.
3. Conduct feasibility studies to explore the installation of district energy systems in new high-density and mixed-use neighbourhoods. This will provide an energy-efficient solution for heating buildings in these areas.

Immediate efforts are needed to establish programs for new builds and make rooftop solar PV an attractive option for retrofits. New build installations could be coupled with developer incentives for NZER and NZE buildings under the SMP. Additionally, by implementing solar PV installations on municipal buildings, the City can demonstrate its commitment to renewable energy and provide transparency on feasibility, cost, and outcomes. The following interested and affected parties have been identified to support the implementation of the generating renewable energy actions:

- Alectra Utilities
- Enbridge Gas
- TransPower Utility Contractors
- Local developers (e.g., Building Industry and Land Development [BILD] York Region Chapter)
- Local construction companies (e.g., Residential Construction Council of Ontario

[RESCON] can be a resource for beginning engagement with local construction companies)

- Post-secondary education institutions (e.g., Ontario Tech University, Durham College Geothermal Field and Energy Innovation Centre, Trent University)
- Ontario Landlords Association
- Local manufacturers and trades association
- Canada Green Building Council
- Ontario Government
- Windfall Ecology Centre
- Canada-Ontario Housing Benefit (COHB)
- Housing Services Corporation
- Clean Air Partnership
- The Atmospheric Fund
- At-risk and affordable housing groups (e.g., Local Diversity and Immigration Partnership Council)

Action 3.1 Increase local renewable energy generation through installing rooftop solar photovoltaics and ground-mount solar photovoltaics

Action 3.1 Overview

ACTION 3.1 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	By 2050, Vaughan will increase renewable energy generation by achieving the following installation capacities: • 23 MW capacity installed using greenfield solar farms; • 1970 MW capacity installed on available rooftops; and • Ground mount PV installed in 50% of existing parking lots.
MODELLED INVESTMENT (2024 -2030):	$20.42 million

Detailed Sub-Actions

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
3.1.1 Infrastructure: Develop plan for community-scale solar farms on greenfield sites and ground mount solar in existing parking lots. Determine how the municipality can best contribute to the development of local solar farms and installation in existing parking lots (e.g. as an investor, providing land in-kind or at reduced cost, acting as a promoter).	Staff time	Project Lead	Plan completed First solar farm installed First ground mount PV installed
3.1.2 Program/Initiative: Create an inventory of all programs, funding, and support mechanisms available to building owners in Vaughan to add solar PVs to rooftop and parking lots and analyze opportunities and gaps.	Staff time	Project Lead	Inventory of opportunities and gaps completed Inventory is used to support the implementation of Actions 3.1.3 and 3.1.5
3.1.3 Education: Educate building owners on programs, funding, and support mechanisms available to install solar PVs, and of the feasibility of these installations in Vaughan.	Staff time Internal communications fees	Project lead	Number of education programs completed on an annual basis Number of building owners engaged with on an annual basis
3.1.4 Program: Investigate funding and financing tools (i.e., the Home Energy Retrofit Program) to add rooftop solar PVs to residential and ICI buildings. Determine the City's role and identify required partners.	Staff time Potential feasibility study fees are identified in Action 1.1.1[27]	Project Lead	Financing and funding tools investigated Tools presented to Council and City's role identified

[27] The FCM grant provides up to $175,000 in eligible costs for municipalities to assess options for a local home-energy upgrade financing program.

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
3.1.5 Program/Infrastructure: Undertake study of existing municipal building assets to determine solar PV potential and use as a pilot to install solar PVs. Note: the City of Vaughan participated in the Feed-In-Tariff (FIT) program and identified buildings for solar installations, Action 3.1.5 builds on the work completed as part of the FIT.	Staff time Consulting firm fees to develop costing study and plan (if used): approx. $75,000 - $150,000	Project Lead	FIT program results reviewed Feasibility study completed First solar PV installed
3.1.6 Policy/Initiative: Complete a study to determine the areas throughout the City that are best suitable for a district energy, and wastewater heat recovery. Based on study, investigate partnership with private sector firm to develop district energy system in one new high-density and mixed-use neighbourhood.	Staff time Consulting firm fees to develop feasibility study: $60,000[28]	Project Lead	Study completed Private sector partner identified

Pillar 4: Reducing Vehicle Emissions

To meet or exceed Federal targets of achieving 100% electric sales for personal and light-duty vehicles by 2035, the City needs to develop and implement a strategy to transition to low-emission vehicles. For example, the lack of electric vehicle charging infrastructure remains a significant barrier to local EV adoption. Establishing a local charging network that involves multiple partners is crucial to encourage wider adoption of electric vehicles. Immediate actions are required to ensure that the necessary infrastructure is in place to support the rapid growth of EVs as prices decrease, supply increases, and the Federal target deadline approaches. The following interested and affected parties have been identified to support the implementation of the reducing vehicle emissions actions:

- York Region Transit
- Toronto Transit Commission
- Metrolinx
- Brampton Transit
- Community members
- Local businesses and institutions
- Local dealerships
- Ontario Trucking Association

[28] The FCM provides up to $175,000 for municipalities to assess energy recovery or district energy.

- Ontario Government
- Durham Region
- Post-secondary institutions
- Electric Vehicle Society
- Plug'n Drive
- Electric Mobility Canada
- Non-profit organizations
- The Atmospheric Fund
- Clean Air Partnership
- Electric Vehicle Society

Building On Success: The City's Actions To Reduce Vehicle Emissions

The City of Vaughan has already successfully implemented several initiatives to reduce vehicle emissions. These include:

1. The City has installed electric vehicle charging stations at multiple City buildings and is seeking grants to further expand charging infrastructure;
2. The City is developing an EV Strategy to identify potential locations for charging stations, explore funding opportunities, and address technical requirements;
3. The Sustainable Metrics Program includes low-emission vehicle parking spots; and
4. The City's MoveSmart Mobility Management Study does indicate that a Heavy Traffic and Truck Routing Plan will be completed in 2026 to manage heavy vehicle and truck transport traffic throughout the community.
5. In addition, in 2019 the York Region Council approved the procurement of six electric buses. The pilot will be used to assess the technology and evaluate requirements to further electricity the York Region Transit.

Action 4.1 Advocate for the electrification of regional transit systems

Action 4.1 Overview

ACTION 4.1 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	Starting in 2030, all new transit asset purchases are zero emissions and all transit vehicles are electric by 2040.
MODELLED INVESTMENT (2024 -2030):	Not modelled

Detailed Sub-Action

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
4.1.1 Advocacy: Host regular meetings with all transit operators within York Region to discuss their electrification strategies and advocate for meeting the MEP targets for transit electrification.	Staff time	Project Lead (advocacy) Project Co-Leads (implementation): York Region, Toronto Transit Commission, Metrolinx, and Brampton Transit	York Region engaged through advocacy program Regular meetings hosted (quarterly, or annually) Number of transit vehicles electrified on an annual basis

Action 4.2 Electrify municipal fleet as per the Green Fleet Strategy

Action 4.2 Overview

ACTION 4.2 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	Beginning in 2024, all new light and medium duty vehicles and equipment purchases are electric, and beginning in 2030, all new heavy-duty vehicle and equipment purchases are electric.
MODELLED INVESTMENT (2024 -2030):	$2.25 million

Detailed Sub-Action

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
4.2.1. Program: Implement the City of Vaughan's Green Fleet Strategy as per the timeline and targets.	Staff time	Project Lead	Number of fleet vehicles electrified

Action 4.3 Electrify personal and commercial vehicles

Action 4.3 Overview

ACTION 4.3 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	Beginning in 2024, all new light and medium duty vehicles and equipment purchases are electric, and beginning in 2030, all new heavy-duty vehicle and equipment purchases are electric.
MODELLED INVESTMENT (2024 -2030):	$178.66 million

Detailed Sub-Actions

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
4.3.1 Program/Policy: Investigate incentives for the Sustainability Metrics Program to encourage all residential and commercial buildings and parking lots are equipped with electric vehicle charging stations.	Staff time	Project Lead	Incentives study completed Number of new development with EV charging
4.3.2 Program/Initiative: Create an inventory of all programs, funding, and support mechanisms available for in-home electric vehicle infrastructure installations and purchases.	Staff time	Project Lead Project Support: Clean Air Partnership	Inventory complete
4.3.3 Education: Educate community members about the feasibility of purchasing electric vehicles in Vaughan.	Staff time Internal communications fees	Project Lead	Number of community members reached (e.g., website visits, social media campaign reach)

Action 4.4: Electrify commercial vehicles

Action 4.4 Overview

ACTION 4.4 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	Beginning in 2024, all new light and medium duty vehicles and equipment purchases are electric, and beginning in 2030, all new heavy-duty vehicle and equipment purchases are electric.
MODELLED INVESTMENT (2024 -2030):	$175.02 million

Detailed Sub-Actions

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
4.4.1 Policy: Support the development of refuelling stations for zero emissions medium- and heavy-duty vehicles through investigating and developing zoning ordinances.	Staff time	Project Lead	Zoning ordinance implemented
4.4.2 Initiative: Identify partners to collaborate on annual research on industry trends for the deployment of green hydrogen and electric vehicle infrastructure in the ICI sector.	Staff time	Project Lead Project Sponsor and Support: TBC based on partner identification	ICI partners identified Annual research on industry trends completed
4.4.3 Education: Educate commercial vehicle owners annually on industry trends for the deployment of green hydrogen and electric vehicle infrastructure.	Staff time Internal communications fees	Project Lead	Annual communication reach to ICI sector on industry trends update

Pillar 5: Increasing Active Transportation and Transit Use

Efforts to increase transit use, walking, and cycling are crucial for reducing transportation emissions and offer additional benefits for health and community well-being. The City plays a leading role in implementing programs and initiatives that support transit and active transportation, contributing to a more inclusive and less car-dependent community. As a local municipality, Vaughan is not directly responsible for delivering transit services, however, the City provides guidance on transit planning matters to transit agencies such as York Region Transit (YRT), the Toronto Transit Commission (TTC), Metrolinx, and Brampton Transit. Similar

to the electrification of transit systems, the City will need to advocate that its partners expand transit services in the Region. The following interested and affected parties have been identified to support the implementation of the active transportation and transit expansion actions:

- York Region Transit
- Toronto Transit Commission
- Metrolinx
- BILD York Region
- RESCON
- Ontario Traffic Council
- Local businesses
- Landlords
- Post-secondary institutions
- Non-profit organizations
- The Atmospheric Fund
- Clean Air Partnership

Building On Success: The City's Actions To Increase Active Transportation

The City already has several projects underway to increase active transportation use, these include:

1. The Vaughan Transportation Plan (2023), with guiding principles to reduce environmental impacts and monitor transportation-related GHG emissions as a key indicator of progress. The Plan adopts a multi-modal approach to support residents in increasing their active transportation use.
2. Pedestrian and Bicycle Master Plan (2020), which provided 75 recommendations to enhance safety, infrastructure, connectivity, and awareness for pedestrian and bicycle travel. A key outcome of this plan is the formalization of the Active Transportation Implementation Framework, which integrates pedestrian and cycling facilities into all capital and development projects.
3. The MoveSmart Mobility Management Strategy, which identifies short-term projects and programs to enhance safety and promote sustainable mobility.
4. The Parking Strategy, which considers opportunities for bike-sharing.
5. The Sustainability Metrics program assigns points to new developments that incorporate traffic calming measures on residential and non-residential streets, provide pedestrian connectivity to schools, proximity to transit routes, proximity to bikeways, and include bicycle parking on-site. Additionally, all new developments undergo reviews to ensure the inclusion of pedestrian and cycling facilities, trails, and transportation demand management measures during the development application process.

Action 5.1 Advocate for transit expansion

Action 5.1 Overview

ACTION 5.1 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	By 2050, travel within the city of a distance less than 5km is completed by using transit (10% of travel), walking (16%), and biking (2%). Travel between 5 and 15 km is completed using transit (10%), and biking (2%). Travel that is greater than 15km in distance is completed using transit (25%).
MODELLED INVESTMENT (2024 -2030):	$205.85 million

Detailed Sub-Actions

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
5.1.1 Program: Advocate York Region to undertake a pilot for free transit by determining populations to offer free transit and time frames in which to offer free transit. The City will need to determine roles in providing free transit (e.g. advocacy, financing, education, campaign, feasibility assessment).	Staff time	Project Lead (advocacy)	York Region engaged through advocacy program Pilot launched Transit ridership
5.1.2 Program: Advocate York Region to undertake study to increase frequency of transit across the Region.	Staff time	Project Lead (advocacy)	York Region engaged through advocacy program Study completed Transit ridership
5.1.3 Education: Use education, advocacy and promotional support to increase the number of employers that offer commute option programs and subsidized transit passes for their employees.	Staff time	Project Lead	Communications reach Employer participation

Action 5.2 Increase active transportation

Action 5.2 Overview

ACTION 5.2 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	By 2050, travel less than 5km is completed using transit (10%), walking (16%), biking (2%), travel between 5 and 15 km is completed using transit (10%), biking (2%), and travel greater than 15 km is completed using transit (25%).
MODELLED INVESTMENT (2024 -2030):	Not modelled

Detailed Sub-Actions

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
5.2.1 Infrastructure: Fully implement the infrastructure outlined in the City of Vaughan's Pedestrian and Bicycle Master Plan, and MoveSmart Mobility Management Strategy.	Staff time Capital funding as identified in Master Plan and Mobility Management Strategy	Project Lead	Number of projects completed annually Mode share
5.2.2 Program/Policy: Complete Parking Strategy, and implement initiatives to increase bike share opportunities.	Staff time Capital funding required	Project Lead	Parking Strategy adopted Mode share
5.2.3 Initiative: Investigate incentives to encourage developers to implement traffic calming measures, pedestrian connectivity, and proximity to multi-modal networks in the SMP.	Staff time Incentives funding required	Project Lead	Study completed Number of developments achieving Silver or higher threshold in active transportation and transit
5.2.4 Education: Promote active transportation and educate residents on the benefits. Promote new routes and trails and programs and initiatives.	Staff time	Project Lead	Communications

5.3 Decrease vehicle kilometers travelled

Action 5.3 Overview

ACTION 5.3 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	By 2030, light duty VKT decreases 10% beyond decreases from mode share changes, and medium and heavy-duty VKT decrease by 5%.
MODELLED INVESTMENT (2024 -2030):	Not modelled

Detailed Sub-Actions

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
5.3.1 Education: Complete annual commuter survey for City staff to track home-to-work trips and calculate the GHG emission reductions and additional co-benefits as a result of hybrid work schedules.	Staff time	Project Lead	Annual commuter survey completed and GHG emissions calculated
5.3.2 Education/Advocacy: Using the results from 5.2.1, develop education and promotion campaigns to highlight the annual GHG emissions saved by the City and other co-benefits tracked in the survey as a way to promote other businesses to continue or adopt hybrid remote policies.	Staff time	Project Lead	Communications reach Number of businesses engaged

Pillar 6: Reducing Waste Emissions

Forty-seven percent of respondents in the community survey reported difficulty in reducing their household waste. One mechanism to address this issue is to increase education and awareness regarding waste diversion and reduction opportunities. These efforts can include social media campaigns, outreach events, newsletter updates, and educational programs that focus on recycling and composting (e.g., providing education stickers for household bins). In addition, the City will need to support and take a leading role in working with the York Region Environment Department and other community partners to implement additional programs and initiatives.[29]

The following interested and affected parties have been identified to support the implementation of waste initiatives:

- Local businesses
- York Region
- Local municipalities
- Non-profit organizations
- National Zero Waste Council
- Canadian Circular Cities and Regions Initiatives
- Vaughan Chamber of Commerce (for engaging with small businesses)
- Toronto Region Conservation Authority (TRCA)

[29]< The top initiatives and programs selected among survey respondents were community reuse centers, increased support for reuse programs, and a green procurement strategy.

Building On Success: The City's Actions To Reduce Waste

Vaughan already offers residential recycling and composting programs and has also adopted York Region's SM4RT Living Plan. This Plan includes a long-term waste reduction goal to decrease and recycle an additional bag of garbage per week per household by 2031, as well as to reduce food waste through changes in purchasing and consumption habits. In addition, York Region provides drop-off centers for garbage, recycling, yard waste, electronics, and other items

Action 6.1 Increase residential and ICI diversion rates and decrease per capita waste across all sectors

Action 6.1 Overview

ACTION 6.1 OVERVIEW	
2050 MODELLED LOW CARBON TARGET:	By 2031, the residential sector diversion rates increase by 15% over the business-as-planned (BAP) rates.[30] The ICI sector diversion recycling rates increase by 50% by 2030 and 75% by 2050, and the organics rates increase to 50% by 2030 and 90% by 2050. The waste per capita decreases by 20% by 2031 and 30% by 2050.
MODELLED INVESTMENT (2024 -2030):	Not modelled

Detailed Sub-Actions

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
6.1.1. Program: Work with community partners to support reuse programming and events that encourage repairing products, or donation events.	Staff time	Project Support Potential Project Leads: York Region, TRCA, and Vaughan Libraries	Number of community partners contacted Number of annual programming and events

[30] The BAP 2031 rate is to achieve a reduction of one bag of garbage per week per household.

IMPLEMENTATION MECHANISM	INTERNAL IMPACT	CITY'S ROLE	TRACKING METRIC(S)
6.1.2 Education: Educate residents and local businesses on waste diversion and reduction opportunities, including organic and recycling.	Staff time	Project Lead Potential Project Leads: York Region, TRCA, and Vaughan Libraries	Number of education campaigns Communications reach
6.1.3 Program/Initiative: Convene a circular economy roundtable to investigate the creation of circular economy initiatives. The Green Municipal Fund provides a seven-step model for developing such an initiative.	Staff time	Project Lead Potential project sponsors include: York Region, TRCA, and Vaughan Libraries	Roundtable created Seven-step model followed to identify a circular economy community initiative

Section 3: Funding Opportunities

The MEP's financial analysis (Ancillary Report: Financial Analysis) estimates the total funding required across all sectors in the community to implement the actions and meet the modelled low-carbon pathway. The Implementation Framework includes estimates of the investment costs across all sectors for each action, however the investments are not solely borne by the City. One of the key roles of the City will be to apply for funding and grant opportunities to fund either City-led initiatives or further fund community initiatives. There are several financial tools that can be used at the municipal level to facilitate climate action, including:

1. Federation of Canadian Municipalities (FCM): The FCM is an advocacy group that offers grants and loans for municipal projects related to climate mitigation, resilience, and environmental projects.
2. Incentive Programs: Incentives programs provide building owners with non-repayable sums of money (directly or as a rebate) to purchase efficient appliances and products, or to perform energy audits or retrofitting.
3. Revolving Loan Funds: Revolving funds, or green revolving funds and community revolving funds, provide a unique opportunity to pay for future projects using the savings achieved through efficiency improvements.

Investigating all financial tools available to the City will be critical, as capital costs or upfront investments are considered a primary barrier to climate action. The following section provides a summary of potential funding opportunities available to the City and community members to implement the MEP's Implementation Framework.

Funding Opportunities: Retrofitting and New Construction

SOURCE	FUNDING OPPORTUNITIES
Government of Canada	• Greener Homes Loans Program: As of 2024 the program is not accepting new applicants, however, low to median income homeowners who were heating their homes with oil and have already installed a heat pump as part of the Canada Greener Homes Grant on or after January 1st, 2023, may be eligible for up to $5,000 in additional grant funding under the Oil to Heat Pump Affordability (OHPA) program. • Deep Retrofit Accelerator Initiative: Provides funding to organizations that help building owners in the development of deep retrofits in commercial, institutional, and mid- or high-rise multi-unit residential buildings. • Greener Neighbourhoods Pilot Program:Provides funding to pilot the Energiespring aggregated deep energy retrofit model in low-rise housing. • Implementation Readiness Fund: Provides funding for activities and investments that increase the readiness to deploy GHG emissions reduction projects and remove barriers to low-carbon technology adoption and 2030 climate mitigation action. • Oil to Heat Pump Affordability (OHPA) program: Provides funding for low to median income homeowners. • Low Carbon Economy Fund: Provides between $1 million up to $25 million in funding for eligible municipal project expenditures.
Ontario Government	• Save on Energy Program: Supports residents in lower energy use during peak times.
Municipal Government	• Revolving Loan Funds provide an opportunity for municipalities to pay for future projects using savings achieved through energy efficiency improvements.

SOURCE	FUNDING OPPORTUNITIES
Federation of Canadian Municipalities (FCM)	• Green Municipal Fund: Provides funding for local governments and non-profit organizations to retrofit public buildings to improve energy performance. • Community Efficiency Financing Program: Provides funding for low-rise residential properties, such as PACE.[31] • Feasibility Study: Provides funding to conduct feasibility studies to assess options for a local home-energy upgrade financing program. • Capital Program: Provides a loan or credit enhancement for local home-energy upgrade financing program. • Pilot Project: Provides funding for retrofitting or new construction of sustainable affordable housing.
Canada Infrastructure Bank	• Building Retrofits Initiative: Provides financing for energy retrofits projects, the program is available to both public sector and private sector.
Private investments	• Private investments include investments from individual homeowners and business owners to complete building retrofits, and private sector financing into retrofit programs such as the PACE programs.

Funding Opportunities: Renewable Energy

SOURCE	FUNDING OPPORTUNITIES
Government of Canada	• Greener Homes Loans Program: As of 2024 the program is not accepting new applicants, however, low to median income homeowners who were heating their homes with oil and have already installed a heat pump as part of the Canada Greener Homes Grant on or after January 1st, 2023, may be eligible for up to $5,000 in additional grant funding under the Oil to Heat Pump Affordability (OHPA) program. • Low Carbon Economy Fund: Provides funding for non-profit organizations, Indigenous recipients, and public sector to implement projects that deploy proven, low-carbon technologies. • Canadian Renewable and Conservation Expenses (open to businesses): Provides guidance on clean energy generation and energy conservation project development activities, the cost of which qualifies as Canadian renewable and conservation expense (CRCE) or businesses. • Investment Tax Credit (beginning in 2023 this refundable incentive will cover up to 30% of the capital cost investment).
Ontario Government	• Net-metering program: Supports residents and municipalities to fund renewable energy programs.

[31] PACE programming can be financed through the municipality, private investment or a third party such as a Community Revolving Loan Fund, or Local Improvement Charge (LIC).

SOURCE	FUNDING OPPORTUNITIES
Municipal Government	• Revolving Loan Funds provide an opportunity for municipalities to pay for future projects using savings achieved through energy efficiency improvements.
Federation of Canadian Municipalities (FCM)	• Feasibility Study: Provides up to $175,000 to assess energy recovery or district energy. • Community Efficiency Financing Program: Provides funding for low-rise residential properties, such as PACE.
Canada Infrastructure Bank	• Clean Power Initiative: Provides financing for renewable, district energy systems, energy storage, etc., projects.
Private investments	• Private investments include investments from individual homeowners and business owners to complete solar installations, and private sector financing could be explored for PACE programs.

Funding Opportunities: Transportation

SOURCE	FUNDING OPPORTUNITIES
Government of Canada	• Zero Emission Vehicle Infrastructure Program: Provides funding for the deployment of electric vehicle (EV) chargers and hydrogen refuelling stations. • Incentives for Zero Emission Vehicles Program: Provides point-of-sale incentives for eligible consumers (subject to funding availability) who buy or lease an eligible zero emission vehicles. • Active Transportation Fund: Provides funding to support the expansion and enhancement of active transportation infrastructure. • Zero Emission Transit Fund: Provides planning and capital funding for zero emission transit programs.
Federation of Canadian Municipalities (FCM)	• Green Municipal Fund: Provides funding support for studies, capital projects, and pilot projects related to transit electrification and expansion. • Green Municipal Fund: Provides funding support for studies, capital projects, and pilot projects related to transportation networks and commuting. • FCM GMF Pilot Project: provides up to $500,000 in funding to reduce fossil fuel use in municipal fleets.
Other funding sources	• The Atmospheric Fund's EV Station Fund provides organizations with rebates of up to 50% of EV charging station installation cost.
Private investments	• Private investments include investments from community members and businesses to purchase electric vehicles and charging infrastructure.

Funding Opportunities: Waste

SOURCE	FUNDING OPPORTUNITIES
Government of Canada	• Innovative Solutions Canada: Provides funding streams related to the circular economy, research, and technology development. • Low Carbon Economy Challenge: Federal cost share program to implement low-carbon technologies that align with Canada's net-zero emissions by 2050 goal. • Smart Cities Challenge: Provides funding for municipalities, local or regional governments, and Indigenous communities to adopt smart cities approaches. • Strategic Innovation Fund: Provides investments to all economic sectors to support the Canadian innovation network.
Federation of Canadian Municipalities (FCM)	• Circular Cities and Regions Initiative: Provides support, guidance, and peer-to-peer exchange to support local governments in circular economy initiatives.

Appendix B: Glossary

Air-source heat pump: A building heating technology that transfers heat from the outside air to heat or cool a building using a refrigeration system and process.

Baseline: The starting year for energy or emissions projections.

Building envelope: A building envelope is any building component (e.g., windows, doors, insulation) that physically separates the interior and exterior of a building and shields the inside space from elements such as heat, cold, and precipitation.

Carbon budget: This term refers to three concepts: (1) an assessment of carbon-cycle sources and sinks on a global level through the synthesis of evidence for fossil-fuel and cement emissions, land-use change emissions, ocean and land CO_2 sinks, and the resulting atmospheric CO_2 growth rate. This is referred to as the global carbon budget; (2) the estimated cumulative amount of global carbon dioxide emissions that is predicted to limit global surface temperature to a given level above a reference period, taking into account global surface temperature contributions of other greenhouse gases and climate forcers; and (3) the distribution of the carbon budget defined under (2) to the regional, national, or sub-national level based on considerations of equity, costs, or efficiency.

Clean energy: Energy derived from renewable, zero-emissions sources.

Climate adaptation: Any initiative or action in response to actual or projected climate change impacts which reduce the effects of climate change on built, natural, and social systems.

Climate mitigation: Any policy, regulation, infrastructure, or other project-based measures that contributes to the reduction of greenhouse gas concentrations in the atmosphere.

Carbon dioxide (CO_2): A naturally occurring gas and a by-product of burning fossil fuels (e.g., oil, gas, coal), of burning biomass, of land-use changes, and of industrial processes (e.g., cement production). CO_2 is the principal anthropogenic greenhouse gas (GHG) that affects the Earth's radiative balance. It is the reference gas against which other GHGs are measured and therefore has a global warming potential of one.

Carbon dioxide equivalent (**CO_2e):** A standardized measurement of greenhouse gases based on the warming potential of given gases compared with carbon dioxide.

Co-benefits: Benefits that are additional to the primary objective of the climate plan. In this case, the primary objectives are energy efficiency and emissions reductions, and co-benefits include job creation, enhanced equity, and better air and water quality.

Cooling degree days: The number of degrees that a day's average temperature is above 18°C, requiring cooling.

Decarbonization: The process by which countries, individuals, or other entities aim to achieve a zero-fossil-carbon existence. Typically refers to a reduction of the carbon emissions associated with electricity, industry, and transport.

Deep building retrofits: A whole-building analysis and construction process minimizing

building energy use by 50% or more compared to the baseline energy use.

Density: A measurement of the population per unit area.

District energy systems: A network of hot and cold water pipes that are used to heat and cool connected buildings more efficiently than if each building had its own heating/cooling systems.

Energy efficiency: Using less energy to perform the same task.

Greenhouse gas (GHG): Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and ozone (O_3) are the primary GHGs in the Earth's atmosphere. Moreover, there are several entirely human-made GHGs in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Besides CO_2, N_2O, and CH_4, the Kyoto Protocol deals with the GHGs sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).

Green hydrogen: Hydrogen generated by surplus renewable electricity using electrolysis, which can then be combusted.

Ground-source heat pump: A building heating technology that transfers heat stored in the earth at a somewhat stable temperature into a building when it requires heating, and transfers heat out of a building into the ground when it needs cooling. Also referred to as a geothermal heat pump.

Heating degree days: Number of degrees that a day's average temperature is below 18°C, requiring heating.

Intensification: Refers to land-use intensification and describes developing an area at a higher building density (units/sq km) than currently exists through development, redevelopment, infill, building expansion, and building conversion.

Lock-in: A situation in which the future development of a system—including infrastructure, technologies, investments, institutions, and behavioural norms—is determined or constrained ("locked in") by historic developments.

Low emissions: A term used to comparatively describe technologies and processes that produce much fewer greenhouse gas emissions than current conventional technologies and processes. There is no standard threshold for low emissions.

Net-zero emissions: Net-zero emissions are achieved when human-caused emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period. Where multiple greenhouse gases are involved, the quantification of net-zero emissions depends on the climate metric (e.g., global warming potential, global temperature change potential) chosen to compare emissions of different gases, as well as

on the time horizon chosen.

Paris Agreement: The Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) was adopted in December 2015, in Paris, France, at the 21st session of the Conference of the Parties (COP) to the UNFCCC. The agreement, adopted by 196 Parties to the UNFCCC, entered into force on 4 November 2016 and as of May 2018, it had 195 Signatories and was ratified by 177 Parties. One of the goals of the Paris Agreement is "Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change." Additionally, the Agreement aims to strengthen the ability of countries to deal with the impacts of climate change.

Pathway: The temporal evolution of natural and/or human systems toward a future state. Pathway concepts range from sets of quantitative and qualitative scenarios or narratives of potential futures to solution-oriented decision-making processes to achieve desirable societal goals. Pathway approaches typically focus on biophysical, techno-economic, and/or socio-behavioural trajectories and involve various dynamics, goals, and actors across different scales.

Renewable energy: Energy that is derived from a source that is not depleted when used or is regularly replenished, such as wind or solar energy. Renewable energy is commonly used interchangeably with "clean energy" and is understood to be derived from zero- or low-emissions energy sources.

Renewable natural gas: Methane captured from bacterial decomposition of sewage, manure, waste, plant crops, or other organic waste products. It can be used as a natural gas replacement.

Scenario: A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships. Note that scenarios are neither predictions nor forecasts, but are used to provide a view of the potential implications of developments and actions.

Solar farm: A large-scale or centralized solar installation where photovoltaic panels are used to harvest the sun's energy. Solar farms are typically connected to the electricity grid, and energy from the farm is delivered to consumers as part of that system.

Solar photovoltaic technologies: Technologies that produce electricity from solar radiation.

Wind farm: A large-scale or centralized group of wind turbines that are used to harvest the energy from wind. Wind farms are typically connected to the electricity grid, and energy from wind farms is delivered to consumers as part of that system.


VAUGHAN

Attachment 2

City of Vaughan Carbon Budget

Recommendations for Implementing a Carbon Budget and Framework

VAUGHAN SSG

Table of Contents

Disclaimer

This report was prepared in June 2024 to introduce the carbon budget concept and provide recommendations for how it can be implemented into a framework for the City of Vaughan.

Reasonable skill, care, and diligence have been exercised to assess the information acquired during the preparation of this analysis, but no guarantees or warranties are made regarding the accuracy or completeness of this information. This document, the information it contains, the information and basis on which it relies, and the associated factors are subject to changes that are beyond the control of the authors. The information provided by others is believed to be accurate but has not been verified.

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Executive Summary

In 2019, the City's Mayor and the members of the City Council unanimously passed a Member's Resolution to declare a climate emergency in the City of Vaughan. The carbon budget responds to this declaration by providing the City with a systematic way to reduce greenhouse gas (GHG) emissions, ensure policies and programs do not lock in further emissions, and maximize social and financial opportunities resulting from the energy transition.

A carbon budget is a tool to transform municipal GHG emission targets into funded and measurable actions across the city. As such, a carbon budget is a management system to align the City's plans and expenditures (operating and capital) with its GHG reduction targets. This document provides guidance on establishing a carbon budget and management framework for the City of Vaughan (the City) that aligns with the low-carbon scenario set out in the Municipal Energy Plan (MEP). The recommended implementation will support the City of Vaughan and the community in:

- Achieving the GHG emissions reduction targets by implementing a new management system that integrates GHG emissions impacts into City decision-making processes;
- Aligning expenditures and investments with GHG targets and building capacity and expertise across the organization; and
- Providing transparent accountability by publishing an Annual Carbon Budget Report and a GHG Inventory.

Context

In 2019, the Mayor and the members of the City Council unanimously passed a Member's Resolution to declare a climate emergency in the City of Vaughan (the City). This declaration reaffirmed the City's commitment to climate action and directed that Vaughan staff continue the planned update of the MEP. The updated 2024 MEP established a low-carbon scenario to achieve the City's climate target of reaching 2–3 tonnes of GHG emissions per capita by 2030 and net-zero emissions by 2050, at the latest. Vaughan's target aligns with the C40 Cities Climate Leadership Group (C40)[1] approach of Convergence and Contraction. The C40 and the International Panel on Climate Change (IPCC) recommend, by 2030, all cities converge on a maximum emissions rate of 2.9 tonnes carbon dioxide equivalent (tCO2e) per person,[2] and from 2030 onwards, cities reduce their emissions to net zero by 2050.[3]

> "Human activity has already caused 1.2°C of warming since pre-industrial times. The time lag between emitting GHGs and their effect on climate means that we are guaranteed some additional warming. Without an immediate, large-scale reduction in GHG emissions, it will be impossible to limit global heating to 1.5°C." – C40[4]

The MEP's Implementation Framework provides a concise and comprehensive guide (zero to five years) that enables the City to efficiently transition from climate planning to climate action. Achieving the City's GHG targets will require a whole-city approach that is as much about change management as it is about technical solutions.

Implementing a carbon budget is one of the first policies the City can undertake to achieve the Governance and Administration action of incorporating climate change mitigation into all corporate decision-making and planning processes (as outlined in the MEP's Implementation Framework). When implemented, the carbon budget framework is a tool to incorporate climate considerations into the City's decision-making processes, ensuring accountability is distributed across the organization rather than concentrated within a single department.

This report details the process for setting the City's annual carbon budget for 2025 to 2030 and provides the recommended framework for the City to implement the carbon budget throughout its capital and operating decision-making processes.

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[1] C40 is a group of 96 cities representing one twelfth of the world's population and one quarter of the global economy.

[2] During the first iteration of C40's carbon budget, cities are required to converge their per capita emissions rate of 3.2 tonnes per person by 2030 and decrease until 2050 when the per capita emissions rates for all cities would need to reach 0 tonnes per capita. However, as of 2020, the recommended per capita emissions are 2.9 tCO2e per capita by 2030.

[3] Arup et al., "How Cities Will Get the Job Done," Deadline 2020: How Cities Will Get the Job Done, 2016, https://www.c40.org/wp-content/uploads/2021/07/Deadline_2020.pdf.

[4] "C40 Knowledge Community," n.d., https://www.c40knowledgehub.org/s/article/1-5-C-Cities-the-why-what-and-how-of-urban-climate-leadership?language=en_US.

Understanding the Carbon Budget

A carbon budget uses two dimensions to mainstream accountability and action across all municipal departments, both of which are adapted to the local context and scale. The first dimension provides the mechanism for setting the cumulative and annual carbon emissions limit (such as a target), and the second dimension establishes a management framework for embedding GHG emissions decisions throughout the organization.

Carbon budget frameworks can be implemented at different scales, from a corporate-level scope focusing on emissions municipalities have direct control over to a community-wide scope that encompasses all emissions within the municipal boundaries. Some municipalities choose to implement the climate budget framework rather than the carbon budget framework.

The carbon budget concept and its use as a management framework is fairly new. Since 2017, municipalities around the world have started to implement the carbon budget framework. However, there is no correct method or standardized approach to operationalize the carbon budget. In Canada, the first municipal carbon budget framework was introduced in Edmonton, Alberta, in 2021, with the first carbon budget report released in 2022.

What is a Carbon Budget?

In 2017, C40 published a report assessing the C40 cities' contribution to the UN Climate Change Conference (COP21) Paris Agreement's target of limiting climate change to 1.5°C to 2.0°C.[5] The report highlights the use of carbon budgets as a communication tool to represent how much carbon the world had left to emit before exceeding the desired global temperature increases. Oslo, Norway, is one of the cities turning the Paris Agreement into action. Its climate budget gave rise to the creation of city-specific carbon budgets, which are used as tools to incorporate GHG emissions reductions into municipal decision-making processes and to communicate the urgency of these required reductions by placing them at the forefront of the financial budgeting process (Figure 1, next page).

[5] Anne Hidalgo and Mark Watts, "C40 Annual Report 2017," 2017, https://www.c40.org/wp-content/uploads/2024/01/C40-2017-Annual-Report-ORIGINAL_compressed.pdf.

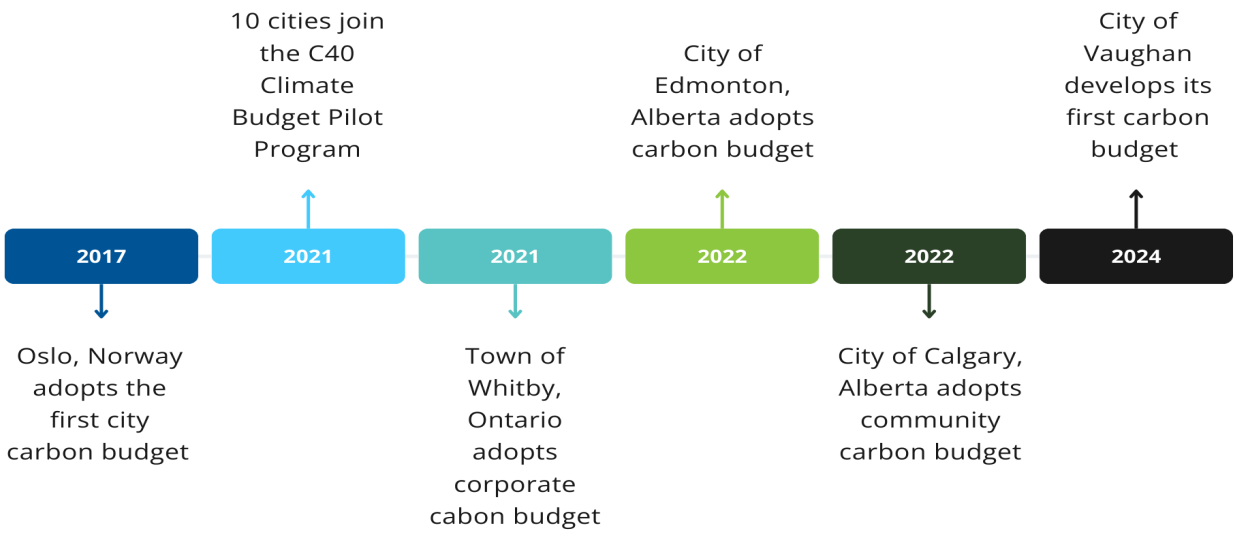


Figure 1. Key carbon budget implementation milestones.

Oslo: The First City Carbon Budget Approach

Oslo, Norway, is one of the most energy-efficient cities in the world. With a population of just under 700,000 and a virtually carbon-free hydroelectricity-based electric grid, Oslo's per capita emissions rate is 1.2 tCO2e/person —one of the lowest in the world. Over half the city's emissions are produced by road transport and another 25% are from the city's waste incineration and energy supply facilities.

In 2017, Oslo pioneered the carbon budget (referred to as the "climate budget" by the City of Oslo) and began using it in local government climate mitigation planning. Despite the city's anticipated population growth throughout the next decade, Oslo is pursuing a climate budget that would reduce emissions by 90% by 2030 (or 95% relative to the 1990 levels).

Oslo's Department of Environment and Transport (the City's climate agency) oversees the City's climate action programs; however, the responsibility and management of the climate budget resides in the financial services department. In addition, using the climate budget as the first chapter of the financial budget created an effective strategy to bring the climate budget and lens to all financial decisions and priorities. The progress is reported on the same three-year timeframe as the financial reporting and an online climate barometer is used to track real-time reductions using 14 indicators.

Oslo's success spurred the development of climate and carbon budgets across multiple regions. Since 2021, C40 has been working with cities to pilot the development and implementation of climate budgets. Led by the City of Oslo, the pilot includes Barcelona, Berlin, Los Angeles, Milan, Montreal, Mumbai, Stockholm, Paris, Rio de Janeiro, and Tshwane.[6]

[6] "C40 Knowledge Community." n.d. Www.c40knowledgehub.org. https://www.c40knowledgehub.org/s/article/Climate-budgets-why-your-city-needs-one?language=en_US.

HOW DO MUNICIPALITIES SET A CARBON BUDGET?

The first step in developing a corporate and community carbon budget is identifying the cumulative emissions that can be released within a timeframe in order to stay within the IPCC and C40's target to limit global warming to 1.5°C. The limit on emissions can be calculated on an annual basis or as a cumulative total between the baseline year (in Vaughan's case, 2016) and the net-zero target year. This approach underscores the importance of establishing a viable low-carbon scenario in which annual emissions are continually reduced over time to ensure compliance within the cumulative limits.

Carbon budgeting is driven by emission limits, which are comparable to spending limits in a financial budget. The key difference between a carbon budget and a financial budget is that financial budgets can be adjusted to reflect growing demands and increasing populations, whereas a carbon budget is fixed. Similar to financial planning on a fixed income, a carbon budget is balanced when GHG emissions ("expenditures") are at or below the target. When applied to capital and operating expenditures, the carbon budget is an additional tool that decision-makers can use during the approval process because it explains the emissions surplus or deficit caused by a project.

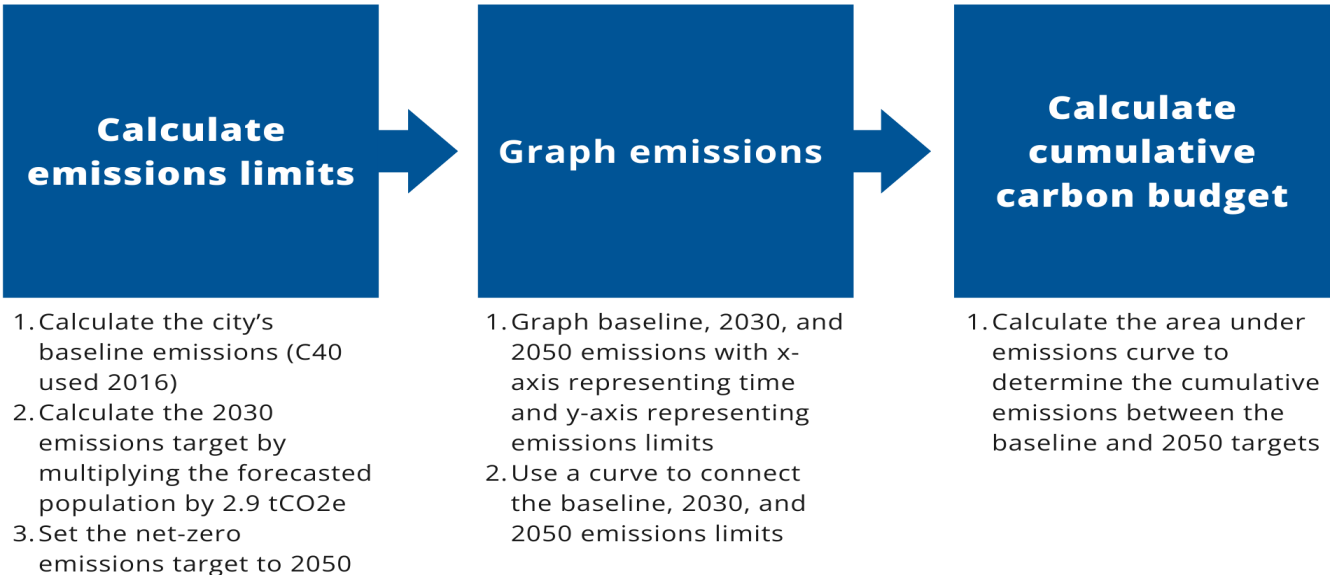


Figure 2. C40 approach for calculating fair-share city carbon budgets.

Setting Emission Limits: The C40's Convergence and Contraction Methodology

C40 used a three-step approach to identify emission limits for its member cities. The methodology can be used for cities who are not C40 member cities, such as Vaughan, to develop fair-share distributions of the global carbon budgets. The following section outlines how the C40 developed a carbon budget and city-specific carbon budgets.

Step 1: Calculating the global carbon budgets

In 2016, the C40 determined the global carbon budget to stay within 1.5°C and 2°C of warming. Based on data from the IPCC and a 66% chance of limiting global temperature rises to 1.5°C and 2°C, the global carbon budgets are 387 gigatons of CO2e (GtCO2e) and 1,037 GtCO2e, respectively.

Step 2: Calculating a city's fair-portion of the global carbon budget

Using the Convergence and Contraction approach, C40 allocated a fair-share portion of the global carbon budget to each member city. This approach assigns cities to one of four groups depending on whether they have high or light emissions and high or low gross domestic product (GDP). Those with high emissions and high GDP are required to reduce their emissions fastest, while cities with low emissions and low GDP are permitted to increase their emissions until 2030.

Figure 2 (previous page) summarizes the C40 approach for calculating the fair-share portion of the global carbon budget for each member city.

Step 3: Comparing the C40 carbon budget to the global carbon budget

To ensure that the Vaughan's carbon budget was realistic relative to current patterns, it was compared to the global budget identified in Step 1. Based on C40 methodologies, C40 cities were granted a total of 22 GtCO2e, or 6% of the remaining global budget. In 2016, the C40 cities emitted a total of 2.5 GtCO2e, or 5% of the total global emissions for that year. These similar proportions suggest that assigning this portion of the total remaining global carbon budget to cities who are not C40 member cities would result in a fair-share distribution of the global carbon budget.

What is a Carbon Budget Framework?

With a carbon emissions limit established, the second mechanism is to develop a multi-year framework that allows the carbon budget to be operationalized alongside more conventional and familiar fiscal budgets.

At the beginning of the budget cycle, project proposals requesting capital and operational budgets will include estimated GHG emissions that would result from the project. Using the estimated project-level GHG emissions, City staff and leadership are able to compare the total emissions to the carbon budget in order to strategize how to stay within the budget. Once projects are underway or completed, consistent monitoring and reporting using carbon accounting methods track the carbon budget status.

WHAT IS CARBON ACCOUNTING?

Carbon accounting is the process of quantifying the number of GHGs produced directly or indirectly by an organization's activities within a set of boundaries, providing the organization with a better understanding of their climate impacts. The project-level GHG emissions are typically reported in the form of a GHG inventory that provides a snapshot of energy use and associated emissions over a given period of time.

In the context of the carbon budget framework, GHG inventories can be evaluated against the total carbon budget at the end of each budget cycle to determine if the City has stayed within or exceeded its allocated budget.

WHY IMPLEMENT A CARBON BUDGET FRAMEWORK?

Proactive GHG Emissions Management

The carbon budget framework will allow Vaughan to make decisions to avoid significant emissions before committing to the GHG emitting initiatives. This transitions Vaughan away from the current GHG management processes, which focus on mitigating GHG emissions associated with initiatives after they have been committed to and are in operation.

Managing Cumulative Emissions to Ensure Emissions Trajectories Are Decreased

The carbon budget framework aligns with the science of climate change—it is the cumulative emissions to the atmosphere that will determine the extent of climate change. The carbon budget framework recognizes that cumulative emissions will determine the extent of global warming, and it reflects this by setting a limit on the cumulative emissions between the present and the target year.

Tying Into Financial Accounting

The carbon budget framework is comparable to Vaughan's capital and operating financial management, and the familiarity provides simplicity and allows for easy implementation across all the City's municipal departments. By setting an emissions ceiling and devising strategies to adhere to this limit, carbon budgeting is analogous to financial planning while specifically addressing emissions management.

Providing Accountability to the Climate Actions

The carbon budget framework provides a direct link between decision-making and Vaughan's climate targets identified in the MEP, ensuring there is accountability for meeting these climate targets.

Transparent Reporting and Monitoring

When combined with effective emissions monitoring, the framework provides the mechanism to consistently report on progress towards reaching climate targets on a year-to-year basis while ensuring the transparency and feedback needed to make periodic adjustments to the emissions budget.

How Does the Framework Overcome Challenges of Climate Action?

These characteristics (outlined above) will allow Vaughan to overcome three key challenges commonly associated with climate planning.

1. Mobilization: Typically, climate action plans are implemented by a sustainability or climate team, which is small relative to the scale of the climate challenge; however, the carbon budget provides a framework to engage the entire municipal staff and local organizations and businesses. This mainstreams climate action across all departments and community

organizations, making it easier to mobilize action.

2. Alignment: Achieving GHG targets requires organizational transformation; however, historically, municipalities have had minimal linkages between capital and operating projects and climate targets. This presents a temporal disconnect between the decisions being made today and the net-zero target in 2050. While only six years away, the 2030 target is still outside the consideration of many municipal projects. The carbon budget's annual reporting brings the climate target in alignment with the standard decision-making timeframe of governments.
3. Inertia: Decarbonization actions and policies require transformative changes across all sectors; however, it is the municipal government's role to provide community services. This creates a system of business-as-usual that can be at odds with climate goals. The carbon budget provides guidance to municipalities to manage this risk, from the perspective of their operations and from the perspective of the community. Without this guidance, governments and communities are prone to making or enabling investments that will need to be undone or retrofitted in the future, imposing heavy financial costs due to retrofits and limiting the opportunity to invest in other climate projects in the future.

HOW DOES THE CARBON BUDGET DIFFER FROM OTHER MUNICIPAL ACCOUNTABILITY TOOLS?

Municipalities have access to a host of tools and resources to integrate climate considerations into their decision-making process to promote sustainability and mitigate climate change impacts.

Climate Lens

A climate lens is a strategic approach used to evaluate the potential climate impacts of policies, projects, and decisions, and how they contribute to or detract from the municipality's climate objectives. Municipalities can incorporate a climate lens through dedicated sections in staff reports to council or by integrating climate change considerations into municipal plans. A climate lens can be qualitative or quantitative, whereas the carbon budget framework provides a mechanism for quantifying climate impacts. The two tools can be integrated together within municipal processes for better accountability and to reduce the risk of missed emissions reduction opportunities.

Climate Budget

Similar to the carbon budget, the climate budget integrates GHG emissions into budget deliberations. However, where the carbon budget sets a cap on cumulative emissions, with each department estimating emissions for their projects and operations, the climate budget focuses on funding actions that will result in significant GHG reductions. However, by not considering the overall emissions impact, there is a higher likelihood of missing opportunities for reduction.

Task Force on Climate-Related Financial Disclosures (TCFD)

The TCFD provides a framework for organizations to disclose their climate-related financial risks and opportunities. The TCFD core recommendations focus on governance, strategy, risk management, and metrics and targets through the phases of "maturity", "getting started", "evolving", and "highly integrated".

Following the TCFD's disbandment in November 2023, the International Sustainability Standards Board (ISSB) has assumed the TCFD's responsibility of monitoring climate-related disclosures. On June 26, 2023, the ISSB released its first two IFRS Sustainability Disclosure Standards.

1. IFRS S1 General Requirements for Disclosure of Sustainability-Related Financial Information lays out the general requirements for disclosing sustainability-related financial information.
2. IFRS S2 Climate-Related Disclosures focuses on climate-related disclosures.

Both standards fully incorporate the TCFD recommendations.

The Process

In partnership with the Norwegian municipalities of Oslo, Hamer, and Trondheim, the C40 has developed a four-step manual to guide municipalities in preparing and implementing a carbon budget.[7] The following section summarizes how the four steps were adapted to Vaughan's context.

STEP 1: SETTING THE STAGE FOR THE CARBON BUDGET

The first step prepares the municipality to develop and implement the carbon budget by adopting political resolutions to support the carbon budget, setting emission targets, and identifying champions. The preliminary work for Vaughan's carbon budget was undertaken during the review of the MEP and included the following steps:

1. The City adopted a Science-Based Target to reduce emissions to between 2 and 3 tonnes per capita by 2030 and achieve net-zero emissions by 2050, at the latest.
2. The MEP's Implementation Framework identified the carbon budget as a key action to achieve Vaughan's climate targets.
3. The Environmental Sustainability department engaged with representatives from the City's Finance department to begin the process of preparing the carbon budget as part of the City's budgeting process.

STEP 2: CALCULATING THE GREENHOUSE GAS EMISSION IMPACTS

The second step involves developing the baseline GHG emission, modelling emission trajectories, and setting the emissions limit. The MEP review modelled the baseline emissions (2016) and developed three scenarios: business-as-usual (BAU), business-as-planned (BAP), and low-carbon. Through the review process, the MEP's low-carbon scenario was selected as the preferred pathway to achieve the City's GHG emissions targets.

Vaughan's cumulative and annual emissions limits for the carbon budget were developed using the C40 Convergence and Contraction methodology, and they align with the trajectories from the low-carbon scenario (See Section 3: Vaughan's Emissions Limits).

STEP 3: CREATING THE CARBON BUDGET MANAGEMENT FRAMEWORK

The third step involves preparing the carbon budget's management framework. The framework uses the climate targets, baseline emissions and emissions trajectories, and roles and responsibilities for integrating the carbon budget into the City's financial budgeting processes.

Carbon budget frameworks can be implemented at different scales, from a corporate-level scope focusing on emissions municipalities have direct control over to a community-wide scope that encompasses all emissions within the municipal boundaries. Some municipalities choose to implement the climate budget framework rather than the carbon budget framework. Table 1 (next page) summarizes the different approaches.

[7] "C40 Knowledge Community," n.d., https://www.c40knowledgehub.org/s/article/Manual-for-climate-budgets-as-a-governance-tool?language=en_US.

Table 1. Strategies for implementing carbon budgets.

APPROACH	DESCRIPTION	EXAMPLES
Corporate operations	A carbon budget is established for corporate operations. The carbon budget can be annual or aligned with multi-year capital or operating budgets. The carbon budget can also be scaled down to individual departments or divisions.	Town of Whitby, Ontario, Canada Regional Municipality of Durham, Ontario, Canada
Climate action plan	A carbon budget is calculated based on the City's initiatives and programs in the climate action plan only.	City of Oslo, Norway City of Saskatoon, Saskatchewan, Canada City of Montreal, Quebec, Canada
City operations and policies	A carbon budget is identified for the community, and investments, expenditures, policies, and programs by the City are tracked against that carbon budget.	City of Edmonton, Alberta, Canada
Comprehensive community	A carbon budget is identified for the community. Expenditures and policies by the City, households, businesses and other organizations in the community are tracked against the carbon budget.	City of Calgary, Alberta, Canada United Kingdom (national-level framework)

STEP 4: REPORTING AND EVALUATION

The fourth and final step involves reporting the GHG impacts of the City's projects and evaluating the carbon budget on an annual basis.

Recommendations for Vaughan's corporate carbon budget reporting is detailed in Section 4: Vaughan's Carbon Budget Management Framework.

Vaughan's Emissions Limits

Moving from the MEP's BAP scenario[8] to the low-carbon scenario will require a new approach to integrating GHG reductions into the City's decision-making processes. The City will need to control and influence certain decisions within the community, but many decisions that influence GHG emissions will be outside the City's control or input. As such, the City's phased approach focuses on first establishing a corporate carbon budget to address capital and operating expenditures. Once the management framework is implemented and the City is familiar with conducting carbon budgeting for municipal decision-making processes, the community actions can be incorporated into the carbon budgeting process.

This report provides the corporate and community-wide emissions limits, the management framework for implementing the corporate carbon budget, and preliminary guidance for implementing a community-wide carbon budget. The corporate carbon budget's emission limits were calculated using a proportion of the municipal emissions from the total community emissions for each year. During the 2016 baseline, the municipality's emissions accounted for approximately 0.6% of the total community emissions. Assuming this proportion stays the same in the short term, the carbon budgets for corporate operations were calculated as 0.6% of the community emissions limits.

Vaughan's Cumulative Emissions

Vaughan's cumulative emissions were identified using the MEP's low-carbon scenario. As illustrated in Figure 3 (next page), Vaughan's low-carbon scenario is very different from the BAP scenario, which will see emissions decrease by only 23% by 2050, relative to the 2016 baseline. The low-carbon scenario reduces per capita GHG emissions to 3.3 tonnes per person by 2030 and to 0.3 tonnes per person by 2050.

[8] The BAP scenario models the energy use and resulting emissions in Vaughan based on initiatives that are underway or approved with dedicated funding and legislations and regulations at the provincial and federal levels.

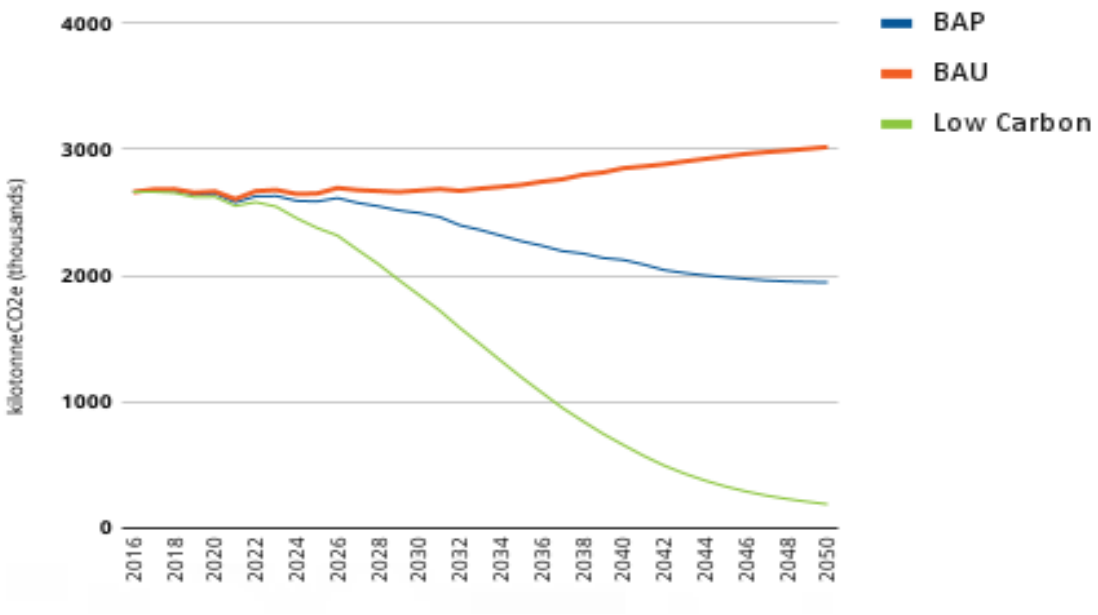


Figure 3. Emissions trajectory of the low-carbon scenario recommended in the Municipal Energy Plan versus emissions trajectory in the business-as-planned and business-as-usual scenarios.

While Vaughan's climate targets are within the recommended C40 per capita convergence of 2.9 tCO2e, the low-carbon scenario results in 2030 emissions above the C40 cities' target. As a result, there is a gap between the fair-share carbon budget and the low-carbon scenario. However, climate action is not a static process. As circumstances evolve (e.g., community champions are identified, funding becomes available, technologies change), additional GHG reduction measures can be added to reflect these new opportunities and further reduce GHG emissions to meet the fair-share carbon budget. Table 2 (below) summarizes the low-carbon scenario's cumulative emissions.

Table 2. Vaughan's community-wide and corporate cumulative emissions between the baseline, implementation year, and 2050.

	CUMULATIVE EMISSIONS BETWEEN BASELINE YEAR (2016) AND NET-ZERO TARGET (2050)	CUMULATIVE EMISSIONS BETWEEN IMPLEMENTATION YEAR (2024) AND NET-ZERO TARGET (2050)
Community-wide emissions	54 MtCO2e	30 MtCO2e
Corporate emissions	0.324 MtCO2e	0.18 MtCO2e

Vaughan's Annual Carbon Budget

The annual carbon budgets for Vaughan were calculated to guide decision-making during the remaining two years of the 2023–2026 and the entire four years of the 2027–2030 financial budgeting periods. The assumption is that the carbon budget would be used starting in 2025, meaning that the allowable community-wide emissions limits between implementing the carbon budget and 2030 are equal to 12.79 MtCO2e. Table 3 summarizes the annual corporate and community-wide carbon budgets between 2025 and 2030.

Table 3. Vaughan's corporate and community-wide annual carbon budgets from 2025 to 2030.

BUDGETING YEAR	2025	2026	2027	2028	2029	2030
Community-wide carbon budget (MtCO2e)	2.38	2.32	2.20	2.09	1.96	1.84
Corporate carbon budget (MtCO2e)9	0.014	0.014	0.013	0.012	0.012	0.011

[9] During the 2016 baseline, the City's emissions accounted for approximately 0.6% of the total community emissions. Assuming this proportion stays the same in the short term, the carbon budgets for corporate operations were calculated as 0.6% of the community-wide carbon budget.

Vaughan's Carbon Budget Management Framework

The management framework for Vaughan's corporate carbon budget is designed to be implemented through a phased approach, with a long-term goal to incorporate a community carbon budget framework. The management framework has been designed to meet the following carbon accounting objectives:

1. Implement a mechanism to manage carbon emissions from municipal operations and assets.
2. Align operating and capital budgets, processes, decisions, and priorities with the carbon budget.
3. Highlight trade-offs and synergies for financial and GHG decisions.
4. Track municipal initiatives, actions, and policies and the impact on the broader community's carbon budget.
5. Provide an accountability framework.
6. Enable transparent reporting.
7. Build carbon literacy in the municipal government.

The carbon budget framework will be an integral part of Vaughan's ongoing operational and capital budgeting processes under the MEP. The City will begin implementation with a corporate-level carbon budget framework focusing on high-investment capital projects, which will be expanded to include all corporate emissions. As the city staff gains expertise in the process, the City will reassess its resources and capacity to introduce a community-wide carbon budget framework within the next five years.

Establishing the Framework

In 2017, Council endorsed the Financial Sustainability Guiding Principles, which represent responsible fiscal management and provide a conceptual approach to decision-making to address short-term and long-term financial impacts. The carbon budget is the third pillar of Vaughan's budget, alongside the capital budget and the operating budget.

Figure 4 (next page) summarizes how the carbon budget framework supports Vaughan's Financial Sustainability Guiding Principles.

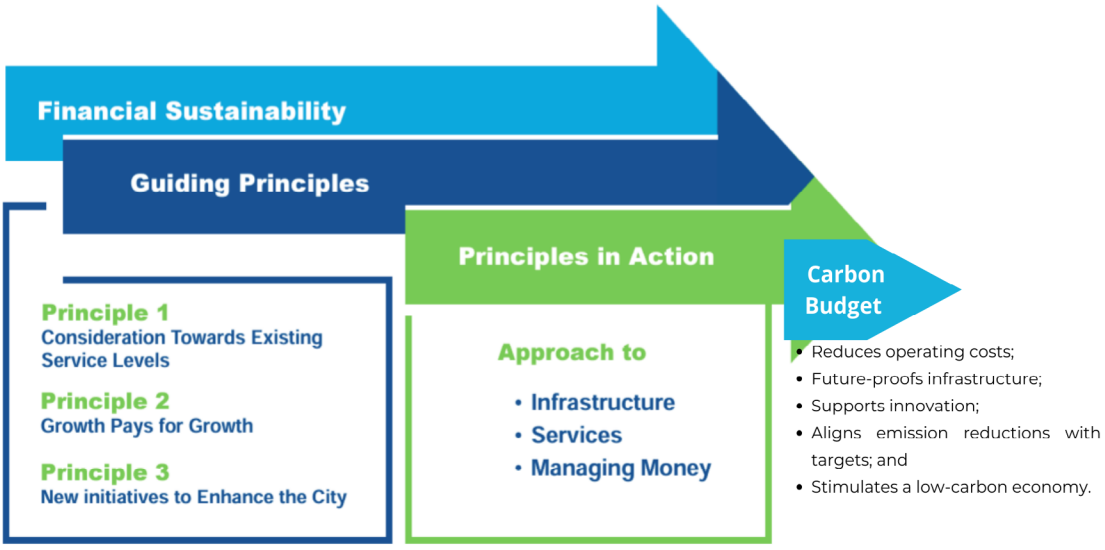


Figure 4. Integration between the City's Financial Sustainability Guiding Principles and the carbon budget outcomes (image adapted from the City of Vaughan's 2024 Budget and the 2025–2026 Financial Plan).

THE CONCEPT

The corporate carbon budget quantifies emissions derived from three distinct streams: capital projects, operating expenditures, and policies that impact the broader community. Once the carbon budget is expanded to include community-wide emissions limits, it will quantify emissions derived from GHG reduction projects by external organizations. Table 4 summarizes the four carbon budget streams.

Table 4. The four carbon budget framework streams.

STREAM	DESCRIPTION
Capital	Analysis of the GHG impact of proposed capital investments by Vaughan. The GHG quantification will be conducted by the Policy Planning and Special Programs department and used to prioritize capital expenditures through the financial budgeting process.
Operating	Analysis of the GHG impact of operating expenditures by Vaughan. Since many operating expenditures relate to personnel or other ongoing expenses, their GHG impact will be less significant than that of capital expenditures. The impact of Vaughan's investment portfolio could be included in this stream.
Policy	Analysis of the GHG impact of transportation, land use, industry, energy, and buildings policies implemented by Vaughan, resulting in GHG emissions from community activities.
External	The external stream is a mechanism for other organizations, including other levels of government, businesses, public sector organizations (schools, health authorities), non-profits, to register GHG emission reduction efforts as part of Vaughan's overall carbon budget.

TOOLS AND RESOURCES

Six tools and resources support the implementation of Vaughan's carbon budget and management framework:

1. Carbon Budget Strategy (this report provides the basis for the strategy): The document that guides the implementation of the carbon budget for Vaughan, including identifying timelines and roles and responsibilities.
2. GHG Calculator for Municipal Projects Tool: Prepared by SSG, the GHG Calculator is a Microsoft Add-On Excel Tool used for calculating the project-level GHG impact of the projects and policies and compiling the total GHG impact to determine the carbon surplus and deficit.
3. Aggregation Worksheet: A document that aggregates all the GHG impacts of projects and policies using the output from the GHG Calculator for Municipal Projects Tool. This worksheet can be used to compare the annual GHG emissions against the annual carbon budget.
4. GHG Actions Form (and Climate Lens): A form that departments can fill out to describe the GHG impact of the projects. Since Vaughan does not currently have a climate lens, it is recommended the City develop both a climate lens and GHG Actions From.
5. Carbon Budget Report: An annual report that compares the annual carbon budget against the carbon budget target and describes progress and challenges.
6. Annual GHG Inventory: An annual inventory of the previous year's GHG emissions.

GOVERNANCE FRAMEWORK

Implementing the carbon budget will require the continuation of existing roles, as well as the creation of new or revised roles and responsibilities, as outlined in Table 5 (next page). It is recommended that the Environmental Sustainability team within the Policy Planning and Special Programs department lead the implementation of the carbon budget. However, a new line of communication needs to be established between the Environmental Sustainability team and Finance staff, as the Finance department should have in-depth knowledge of the carbon budget process and its integration with the financial planning process. During the first two years of implementation, the departments will need to collaborate closely to build capacity across the organization to fully implement the corporate carbon budget tools. This process will include:

- Training staff for specific responsibilities and steps;
- Training for existing staff to bolster capacity to complete GHG quantification
- Updating internal documents to include GHG quantification reporting (e.g., climate lens) and an Annual Carbon Budget Report;
- Establishing liaisons between the Environmental Sustainability Team and the Finance department; and
- Updating online resources and corporate-wide tools.

Table 5. Key responsibilities in administering the carbon budget's management framework.

GROUP	RESPONSIBILITIES AND APPLICABLE TOOLS	RESOURCES
City of Vaughan Council	Carbon Budget Report • Review and approve annual carbon budget.	Briefing on the overall carbon budget framework and how to interpret the carbon budget reports in decision-making processes.
Committee of a Whole	Carbon Budget Report • Review, assess, and advise Council and Senior Leadership Team on annual report.	Briefing on the overall carbon budget framework and how to interpret the carbon budget reports in decision-making processes.
Senior Leadership Team (SLT)	Supporting the carbon budget implementation • Champion the carbon budget by providing leadership; • Coordinate with the Environmental Sustainability Team; • Act as an administrative resource for programs/departments; • Provide transparency on the progress to the organization and the community; • Evaluate the impact of GHG reduction decisions on other municipal priorities (e.g., job growth, economic growth, stability, etc.); and • Evaluate the financial implications at the corporate level. Carbon Budget Report • Review and present the report with the Finance Department and Environmental Sustainability Team to the Committee of a Whole/Council and • If required, support the preparation of the Carbon Budget Report.	Briefing on the overall carbon budget framework and how to interpret the carbon budget reports in decision-making processes.

GROUP	RESPONSIBILITIES AND APPLICABLE TOOLS	RESOURCES
Finance Department	Implementation Support • Ensure processes under the management framework remain aligned with the business planning and budgeting processes and the municipality's financial framework, long-term financial outlook, policies, procedures, and requirements; • Evaluate the impact of GHG reduction decisions on other municipal priorities (e.g., job growth, economic growth, stability, etc.); • Evaluate the financial implications at the corporate level; and • Liaise with the Environmental Sustainability Team to support implementation of the carbon budget and management framework. GHG Actions Form and Climate Lens • Update project budget forms with recommended GHG Actions Form and climate lens form. Carbon Budget Report • Support the Environmental Sustainability Team in preparing the Annual Carbon Budget Report; and • Integrate the Annual Carbon Budget Report into the annual Budget and Financial Plan.	Training on carbon budget framework and all its tools for calculations and reporting.

GROUP	RESPONSIBILITIES AND APPLICABLE TOOLS	RESOURCES
Environmental Sustainability Team	Implementation Support • If necessary, propose additional actions to achieve the carbon budget based on available funding, longer-term asset/financial strategies, and current year and proposed forecasts; • Support the Finance department in analyzing the impact of GHG reduction decisions on other municipal priorities (e.g., job growth, economic growth, stability, etc.); • Coordinate/facilitate the assessment of cross-program or multi-program initiatives; and • Provide training, resources, and support to all staff involved in the carbon-budgeting process. Carbon Budget Strategy • Prepare Carbon Budget Strategy; • Review annually and provide necessary updates; • Communicate policy updates to the Finance Team; • Support the Finance department in preparing the GHG Actions and climate lens forms; and • Lead implementation of the carbon budget and management framework. GHG Quantification Tool • Complete project-level GHG quantification on behalf of each department; • Beginning in 2027, support each department in completing GHG quantification and review project-level GHG quantification on behalf of each department; and • Compile project-level GHG quantification into an Aggregation Worksheet to determine the carbon surplus and deficit.	Training on carbon budget framework and all its tools for calculations and reporting.

GROUP	RESPONSIBILITIES AND APPLICABLE TOOLS	RESOURCES
Managers	Implementation Support • Implement Council-approved actions and directions. GHG Quantification Tool • Beginning in 2027, quantify GHG impacts of program initiatives and projects and submit to the Environmental Sustainability Team for review. GHG Actions Form and Climate Lens • Complete climate lens section and submit to the Environmental Sustainability Team for quantification; and • With support from the Environmental Sustainability Team update the GHG Actions Form with the results of the GHG quantification.	Briefing on carbon budget framework. Training on all its tools for project-level calculations.
Departmental Staff/ Program Leads	GHG Quantification Tool • Beginning in 2027, quantify GHG impacts of program initiatives and projects and submit to the Environmental Sustainability Team for review. GHG Actions Form and Climate Lens • Complete climate lens section and submit to the Environmental Sustainability Team for quantification; and • With support from the Environmental Sustainability Team update the GHG Actions Form with the results of the GHG quantification.	Briefing on carbon budget framework. Training on all its tools for project-level calculations.

IMPLEMENTING THE CARBON BUDGET INTO VAUGHAN'S FINANCIAL PLANNING PROCESSES

Implementing the City's carbon budget and framework required four distinct GHG quantification activities:

1. Annual Carbon Budget: Quantification and establishment of the carbon budget. The annual carbon budget limits have been prepared in this report, however, the Environmental Sustainability Team will be responsible for reviewing and updating annually.
2. Project-Level GHG Quantification: The project manager(s) within the Environmental Sustainability Team uses (use) the GHG Calculator for Municipal Projects to calculate project-level GHG emissions of capital and operating expenditures (Appendix A). The

project manager(s) within the Environmental Sustainability Team compiles (compile) all the project-level GHG quantification results into an Aggregation Worksheet to compare against the annual carbon budget target (e.g., emissions limits).

3. Carbon Budget Report: The Environmental Sustainability Team and the Finance Team co-develop the Carbon Budget Report using the outputs from the GHG quantification and aggregation. The Carbon Budget Report is presented alongside the capital and operating budgets as a forward-looking perspective of GHG emissions. The Carbon Budget Report identifies whether a carbon surplus or deficit will be achieved based on the approved projects, and adjustments to or cancellation of proposals can be made to stay within the financial and carbon budget limits during municipal budget deliberation.
4. Annual GHG Inventory: The project manager(s) within the Environmental Sustainability Team prepares (prepare) the annual community-wide GHG inventory to illustrate how Vaughan performed against its carbon budget and emission reduction targets.

The following section details how each carbon budget step and tool is integrated into the City's existing financial planning processes (Figure 5). The City's corporate carbon budgeting framework is a management system approach designed to incorporate GHG emission targets into capital and operating expenditures using five key outputs:

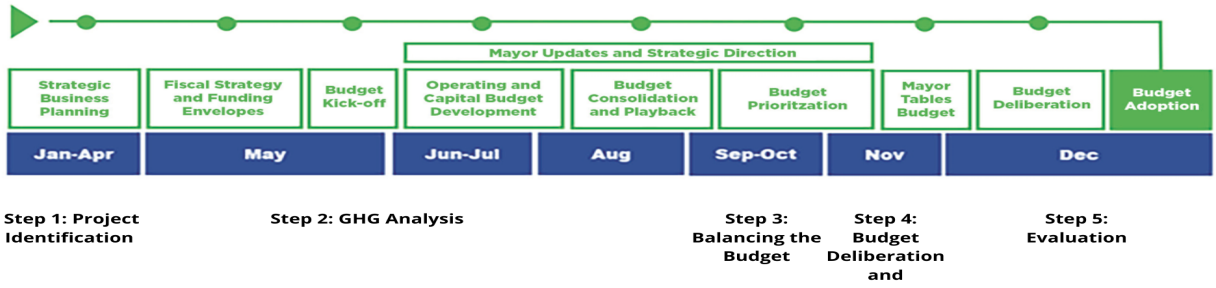


Figure 5. Implementation of the carbon budget management framework into the City of Vaughan's annual budget process (image adapted from the City of Vaughan's 2024 Budget and 2025–2026 Financial Plan).

STEP 1: PROJECT IDENTIFICATION

Overview

Timeframe	• January to April
Leads	• Departmental managers and staff
Carbon Budget Tools	• Climate lens
Outputs	• Each department identifies the GHG emission impact resulting from the project in the climate lens • Departmental project lists are compiled and submitted to the Environmental Sustainability Team for GHG quantification

Description

From January to April, each department completes their annual strategic business planning to identify projects and plans that support the City's Master Plans, Studies, and Capital Plans. During this phase, departments will compile a list of potential projects and policies to submit

to the Environmental Sustainability Team for GHG quantification. In addition, the Environmental Sustainability Team will be responsible for notifying departments of the MEP Implementation Framework's projects that are related to their department's work plan.

For each project, apply the climate lens to identify if there will be any resulting GHG emissions impacts. While not all project proposals will have emissions impacts, this step reduces the risk of missing out on opportunities for emissions reductions and ensures that projects with a GHG impact will be quantified during Step 2.

STEP 2: GHG ANALYSIS

Overview

Timeframe	• May to July
Leads	• Environmental Sustainability Team • Finance department (support)
Carbon Budget Tools	• GHG Quantification Tool • GHG Action Form (and Climate Lens)
Outputs	• Project-level GHG quantification is completed for each department • Climate lens is updated to include GHG quantification, using the GHG Action Form

Description

Key elements of the carbon budgeting process are the quantification of GHG impacts and the completion of an analysis to determine whether there is a surplus or deficit. These processes will be integrated into the City's operating and budget development process between May and July.

Project-Level GHG Quantification

For projects with GHG emissions impacts identified in the climate lens, the Environmental Sustainability Team will be responsible for quantifying the project-level GHG emissions expected to be eliminated or added, relative to the business-as-usual scenario. Depending on the project size and complexity, different tools may be used as long as the tool adheres to standard GHG accounting methodologies. Analysis results are summarized into a GHG Action Form (similar to a budget request form) and submitted to the finance department. Figure 6 (next page) illustrates a decision tree that can guide which protocol or method to use.

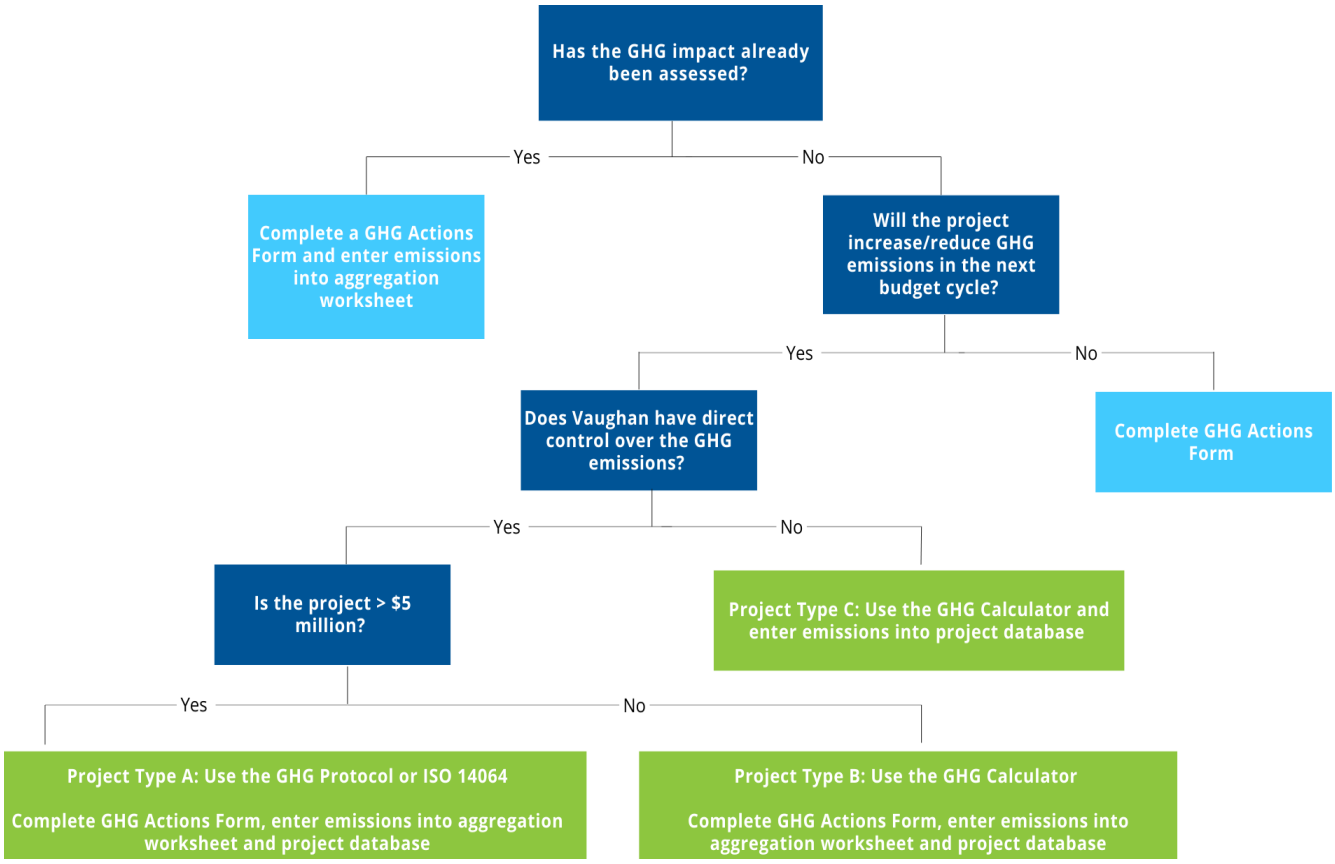


Figure 6. Carbon accounting decision tree for GHG projects (adapted from the City of Edmonton).

As the City gains experience with quantification, the decision tree would likely evolve. The review by the Environmental Sustainability Team is a quality-control step prior to submitting results into the aggregation worksheet or project database. For major projects that require investments above a certain threshold (e.g. above $5 million), a higher level of scrutiny is applied using third-party standardized approaches or standards (such as the International Organization for Standardization 14064 or GHG Protocol); however, other projects apply a simpler approach through the GHG Calculator for Municipal Projects Tool.

As the Environmental Sustainability Team builds internal capacity and familiarizes themselves with the GHG quantification procedures, they will be responsible for training other departmental staff and program leads in the procedures. It is recommended that each department complete the project-level GHG quantification beginning of the 2028 budget cycle. At this stage, the Environmental Sustainability Team will be responsible for acting as a quality-control by reviewing each GHG quantification and aggregating all project-level quantifications into the Aggregation Worksheet. This transition aligns with the full implementation of the carbon budget across the municipal portfolio, which will allow the Environmental Sustainability Team to allocate their resources towards compiling all the project-level GHG emissions into a spreadsheet for analysis and preparing the Annual Carbon Budget Report.

Aggregating the GHG Quantifications

Similar to financial budgets, the aggregated total is evaluated in comparison with the allocated budget to determine whether the City will be in a deficit or surplus for the budget cycle. Using the project-level GHG quantification results, the Environmental Sustainability Team will compile the GHG quantification results into a spreadsheet (e.g., Aggregation Worksheet). The preliminary

budget will be reviewed with the Finance department.

STEP 3: BALANCING THE BUDGET

Overview

Timeframe	• September to October
Leads	• Senior Leadership Team
Carbon Budget Tools	• Aggregation Worksheet • Annual Carbon Budget Report
Outputs	• Preliminary carbon budget is reviewed and the budget is balanced based on the City's ranking framework, Council priorities, and GHG impacts

Description

The Environmental Sustainability Team and Finance departments present the results of the preliminary carbon budget to inform the Senior Leadership Team of the GHG surplus or deficit. The preliminary budget will undergo the formal budgeting process, including a presentation to Council, a public hearing, and ultimately, a decision by Council.

GHG reductions would be one of the criteria in the priority-based process—other criteria would depend on the City's priorities, like fiscal responsibility and service-level commitments. Criteria weighting can be determined by policy, stakeholder engagement, or Council direction. In a deficit situation, trade-offs between criteria will see some projects adjusted, redesigned, or deferred to ensure that the City remains within its carbon and fiscal budget allocations.

At the end of the budget deliberation process, which typically takes place from September to October each year, a final budget will be approved by Council for implementation.

STEP 4: BUDGET DELIBERATION AND EXECUTION

Overview

Timeframe	• September to October
Leads	• Environmental Sustainability Team • Finance department (support) • Committee of a Whole, Mayor, and Members of Council (reviewers and approvers)
Carbon Budget Tools	• Carbon Budget Report
Outputs	• A Carbon Budget Report is prepared and presented to the City's Committee of a Whole and Council

Description

The City will present the Annual Carbon Budget Report of the proposed projects to the Committee of a Whole, the Mayor's Table, and Council. The results feed into the City's budget deliberation in November, which includes presentations to the Mayor and Members of Council.

STEP 5: EVALUATION

Overview

Timeframe	• Ongoing
Leads	• Environmental Sustainability Team
Carbon Budget Tools	• Annual Carbon Budget Report • GHG Inventory Tool
Outputs	• An annual GHG inventory is compiled

Description

Following approval, funds are allocated according to the approved budget and City staff executes planned activities and projects. Deviations from a planned budget may occur due to a number of factors, such as unexpected funding shortfalls, unforeseen expenses, policy adjustments, and external factors. It is important for department heads and project managers to monitor and adjust accordingly.

Reporting is a key component of the carbon budgeting process. The Annual Carbon Budget Report and the GHG Inventory Report describe whether the municipality is in a surplus or deficit position and provide accountability for Council and the public.

As actions are implemented, their impacts on GHG emissions are evaluated and tracked annually, either through direct measurement of energy or emissions or via key performance indicators. Annual GHG inventories help assess whether emissions are within the carbon budget, the magnitude of any carbon deficit, and the effectiveness of implemented actions. Like the financial budgeting process, supplemental adjustments are made annually based on continuous reporting and evaluation.

Integrating the Community Carbon Budget

Several municipalities have elected to initially implement a carbon budget solely for municipal operations, with the intention of expanding to the broader community emissions in subsequent phases. However, due to the City of Vaughan's 2030 target of 2–3 tCO2e per capita, it is recommended that the City expand the carbon budget to include community emissions in Q1, 2027. As identified in Figure 6, external emissions that the City does not have a direct control over the GHG emissions would not be quantified using the GHG Calculator. However, these emissions would be tracked and reported using the Annual Carbon Budget and project database.

The annual community-wide GHG inventory will track community progress towards the 2030 target; to support tracking, the City would need to build or purchase a tool that allows other entities to report on their emissions reduction projects so they can be tracked in the Annual Carbon Budget Report. For example, the Climate Smart[10] software enables businesses to measure, reduce, and report on their corporate carbon footprint by providing training and resources, and Kausal[11] provides community collaboration software to track progress. The City of Vaughan could adopt a similar program to allow local entities to self-report their GHG emissions,

[10] Information on the Climate Smart program is available here: https://commercial.bmo.com/en/ca/we-can-help/climate-smart/.

[11] Information on Kausal is available here: https://kausal.tech/solutions/collaborate

which would reduce the resourcing requirements of city staff, as the GHG quantification would be completed through the self-reporting software.

Next Steps

Where possible, carbon budget framework timelines should align with financial accounting timelines to ensure clarity and continuity.

- The first priority is to establish a carbon budget strategy with roles, responsibilities, and timelines, thereby formalizing the incorporation of a GHG management framework that aligns organizational decision-making with GHG targets.
- The City will need to develop the GHG Actions Form and climate lens, to prepare for the first carbon budget workflow in the 2025 budget.
- The City will build resources, tools, and staff capacity to ensure that the organization as a whole (and project managers in particular) is equipped and ready to undertake its first carbon budget workflow for inclusion in the 2025 budget.
- In the short term, the City needs to focus on quantifying the impacts of actions that result in high corporate investments. Actions in this category include that lock-in patterns of GHG emissions (i.e., road construction) are irreversible (i.e., building codes) or result in higher costs if action is delayed (i.e., deployment of retrofits). GHG emissions for some actions with these characteristics are already being quantified because they involve federal investments.
- Following this effort, the next target is to deliver a full Carbon Budget Report for corporate emissions in the 2027 financial budgeting period.
- Within the next five years, with the knowledge and experience gained from the corporate framework, the City will expand the carbon budget framework to capture emissions from the community to align with Vaughan's corporate and community GHG emissions targets.

Figure 7 (next page) summarizes the recommended implementation phases, and the following sections detail the concept, governance framework, roles and responsibilities, and implementation steps for incorporating carbon budgeting into Vaughan's existing financial processes.

YEAR 1 Q3 - Q4, 2024	YEAR 2 Q1 - Q4, 2025	YEAR 3 Q1 - Q4, 2026	YEAR 4 Q1 - Q4, 2027	2028 - 2030
Formally adopt annual carbon budgets and management framework, and establish the Carbon Budget Strategy Complete GHG quantification training Pilot carbon budget workflow for one major capital project Update relevant financial documents to include climate lens and GHG quantification results, and prepare template for annual Carbon Budget Report Identify departments to participate in Year 2 pilot	Pilot carbon budget management framework's workflow into multiple departments for at least one project per department It is recommended to pilot with Corporate Fleet and Facilities Management	Incorporate carbon budget management framework into annual budgeting process for all capital and operating projects Update the the annual "Budget Book" to include the Carbon Budget Report as part of the Budget Summary Section Complete GHG quantification training for all departmental; Project Managers Begin exploring implementation of community-wide carbon budget	Departmental staff are responsible for completing project-level GHG quantification Carbon budget management framework is integrated into all capital and operating projects Pilot community carbon budget is launched	Continue full implementation and reporting for corporate and community carbon budget management frameworks

Figure 7. Recommended implementation phases.

The corporate carbon budget will further enhance the implementation of the MEP and will highlight Vaughan as a leader in climate action. The organizational change process will require staff time, support, training, and new processes to be efficiently implemented; however, implementing the carbon budget will also produce the following benefits:

- Simplicity: Aligns with financial systems, providing a familiar approach to planning used in local governments;
- Temporal Scope: Provides a multi-year framework for tracking GHG emissions over all aspects of corporate capital, operating, and policy decisions, and it can be further applied to community activities;
- Alignment: Integrates into the existing capital and operating decision-making frameworks of a local government, allowing investments, costs, and benefits to be assessed over multiple years;
- Accountability: Allocates climate action across all municipal departments, while at the same time allowing managers to manage their team's share of the budget and to identify priorities for action that fit best with their team's mission and objectives; and
- Transparency: When combined with emissions monitoring (as identified in Vaughan's MEP), it provides a transparent framework to measure progress towards the climate targets.

This structured approach ensures that Vaughan's strategies for reducing GHG emissions are integrated seamlessly with financial planning, enhancing the effectiveness and accountability of the City's climate actions.

Appendix A: Greenhouse Gas Quantification Manual

GHG Quantification Resources

It is recommended the City uses the SSG GHG Calculator for Municipal Projects for projects with a budget of less than $5 million (Table 1A). For projects with a budget exceeding $5 million, the City should explore using the GHG Protocol or ISO 14064.

Table 1A. Recommended quantification tool.

DOCUMENT	USE CASE	GUIDANCE
SSG (2023). GHG Calculator for Municipal Projects	Designed for typical municipal projects and policies. Useful for quick, preliminary GHG quantifications.	Microsoft Office Add-in for Excel. Estimates project GHG emissions with formulas and emission factors embedded within the tool.

Protocols

The Greenhouse Gas Protocol (GHG Protocol), the internationally accepted GHG accounting and reporting standards and tools, outlines six principles for project-level GHG quantification:

1. Relevance: The data and GHG quantification procedures most appropriate to the project should be selected. The levels of accuracy and uncertainty associated with the quantification process should reflect the intended use of the data and the objectives of the project.
2. Completeness: All relevant GHG emissions and removals should be included, along with information to support criteria and procedures.
3. Consistency: All data, methods, criteria, and assumptions should be applied consistently to ensure meaningful comparisons between the baseline and the project scenario.
4. Accuracy: Estimates and calculations should be unbiased, and uncertainties should be reduced as far as practical. Calculations should be conducted in a manner that minimizes uncertainty.
5. Transparency: All assumptions, methods, calculations, and associated uncertainties should be explained to allow the intended users to make decisions with reasonable confidence.
6. Conservativeness: Where there are uncertainties, the values used to quantify GHG emissions should err on the side of underestimating potential reductions.

Actions Categories

As the City gains experience with quantification, it is expected that the decision-making process regarding GHG impacts will evolve. It is recommended that during early implementation, the Environmental Sustainability Team's project manager(s) leads (lead) the project-level GHG emissions on behalf of departmental managers, staff, and program leads. As internal capacity builds and the corporate carbon budget expands to include all capital and operating projects, the quantification process will transition to be completed by each departmental manager, staff, and/or program lead. At this point, the Environmental Sustainability Team's project manager would act as a quality-control step prior to submitting the results to the project's climate lens

and Annual Carbon Budget Report. For major projects, a third-party verification could also be beneficial.

Boundary

The boundary defines the scope of the GHG analysis and is the geographic boundary of the city of Vaughan, unless otherwise specified. GHG emissions will be reported according to the accounting framework for cities (Figure 1A and Table 1B), which includes:

- Direct Emissions: Emissions or removals from GHG sources or sinks that are owned or controlled by the City. At the GHG inventory level, direct emissions are also commonly referenced as Scope 1 emissions, such as emissions from in-boundary transportation and stationary fuel combustion.
- Indirect Emissions: Emissions or removals that are of consequence to the project but occur at GHG sources or sinks not owned or controlled by the City. For example, reduced electricity consumption might be considered a secondary effect in some infrastructure projects. Indirect emissions can include Scope 2 emissions as well as some Scope 3 emissions, as defined under the GHG Protocol, such as emissions from grid-supplied energy, transmission and distribution, and out-of-boundary transportation.

Table 1B. Emissions scope definitions.

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

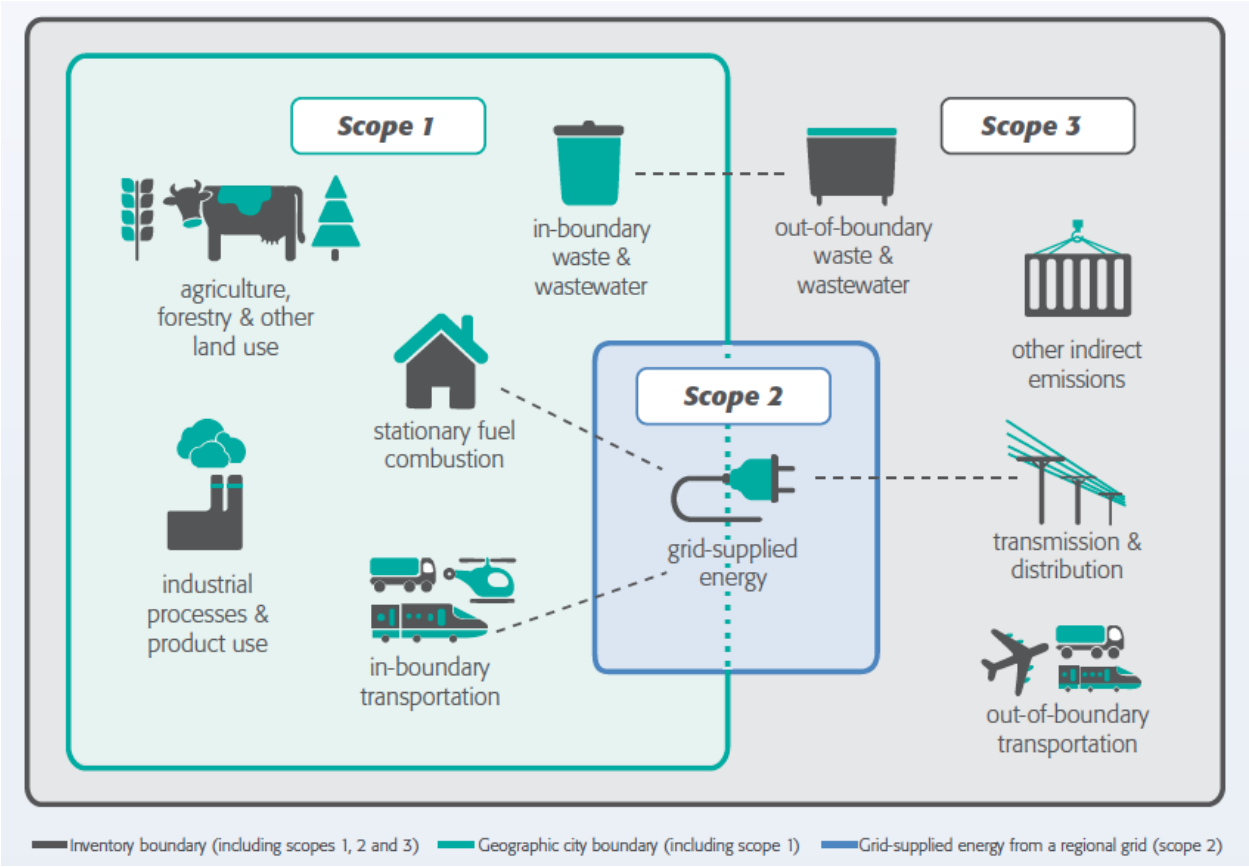


Figure 1A. Illustration of scope for a city's GHG calculation.

Greenhouse Gases

Mitigation assessments will consider the same greenhouse gases tracked through Canada's National Inventory Report. Specific gases can be excluded if deemed insignificant and appropriately rationalized through the assessment report. Emissions must be converted into CO2 equivalent (CO2e) using the Global Warming Potentials (GWP) identified in the most up-to-date version of Canada's National Inventory Report and reported in tonnes (t), kilotonnes (kt), or megatonnes (Mt):

- The GWP of CO2 = 1
- The GWP of CH4 = 28
- The GWP of NOC = 325

For projects that result in reductions or releases of CH4, Chartered Professional Accountants' (CPA) guidance on accounting for the short-term impacts should be reported:

- GWP (100 year) of 28 based on the IPCC's Fifth Assessment Report;
- GWP (20 year) of 85 based on the IPCC's Fifth Assessment Report and to match the more risk-relevant time horizon of 20 years; and
- Further, where relevant, hydrochlorofluorocarbons (HCFCs) should also be included, for example, if they are being used as refrigerants.

The Basic Formula

The quantification strategies are designed to provide GHG estimates for a source or activity because of an expenditure or action taken by the City of Vaughan. The general equation for emissions quantification is as follows:

GHG emissions = [source metric] x [emissions factors] x [GWP]

This calculation is used when:

- The source metric is the unit of measure of the source of emissions. For example, in the case of transportation, the source metric is vehicle kilometres travelled. For building energy use, it is the energy intensity or energy consumption per square metre of building space;
- The emissions factor is the rate at which emissions are generated per unit of source metric. In the case of a vehicle, it is kgCO2 per kilometre travelled; and/or
- The GWP is the factor that converts different greenhouse gasses to their carbon dioxide equivalent.

GHG Emissions Reductions

There are three types of GHG reduction categories (Table 1C). Reductions are calculated by subtracting GHG emissions resulting from a low-carbon action from GHG emissions in a reference or BAU case. For example, in order to identify the impact of the purchase of an electric car, GHG emissions resulting from the electric carbon are subtracted from GHG emissions created with a gasoline car, with the gasoline car representing the reference case. The general equation for GHG reduction quantifications is as follows:

GHG Reduction = [reference case] - [low-carbon case]

This calculation is used when:

- GHG reduction is the GHG emissions avoided as a result of the action taken or policy implemented;
- Reference case is the calculation of GHG emissions if current practice continues; and
- Low-carbon case is the calculation of GHG emissions when the action or policy is implemented.

Table 1C. Types of GHG emissions reductions.

REDUCTION CATEGORIES	DESCRIPTION
Avoided GHG emissions	The activity that generates the emissions is avoided. For example, a vehicular trip is replaced by a transit trip or a walking trip, avoiding the GHG emissions resulting from that vehicle.
Fewer created GHG emissions	The same activity is undertaken but with a strategy that generates fewer GHG emissions. For example, a more energy efficient vehicle is used or a more energy efficient boiler is installed.
Sequestration of emissions	Carbon emissions are embedded in a structure that can hold the emissions, preventing them from being released into the atmosphere. Planting trees is an example of biological sequestration. Carbon capture and storage injects emissions underground, an example of physical sequestration.

Appendix B: GHG Actions Form

The following is a recommended Climate Lens and GHG Actions Form:

Project Number:		
Project Name:		
Proposed by:		
Department:		
Estimated Project Planning and Design Phase Timing:	Start:	End:
Estimated Project Execution Phase Timing:	Start:	End:
Estimated Operational Date		

Climate Lens:

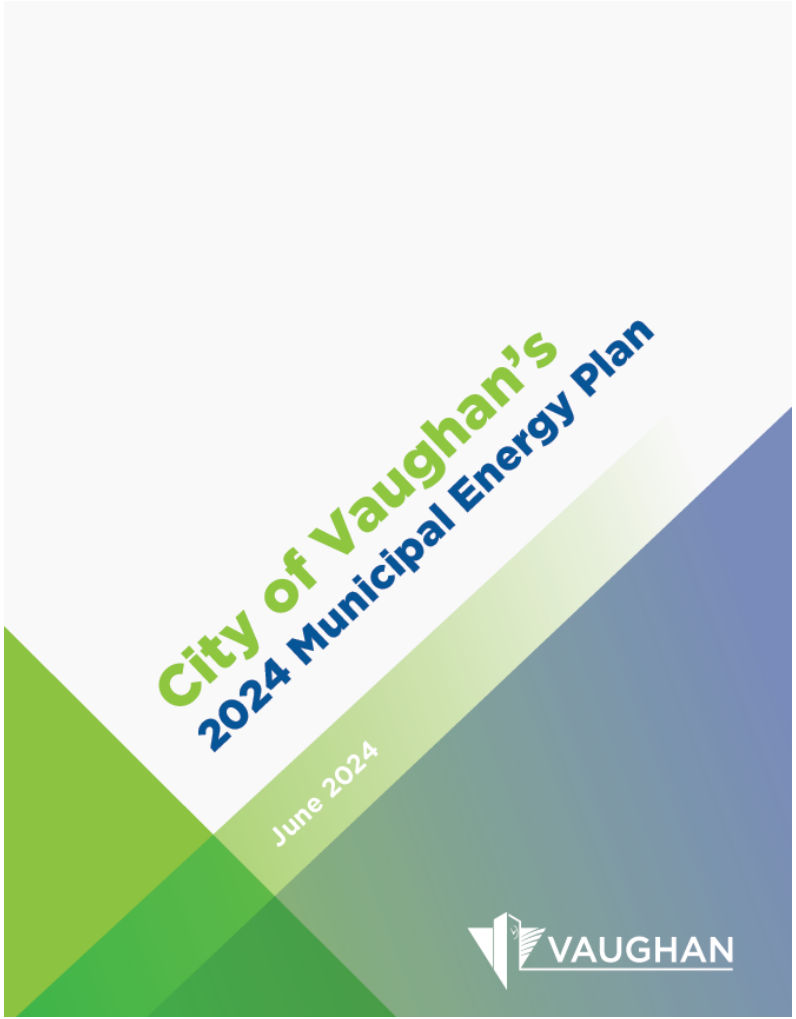
- Does this proposal move the City of Vaughan closer to its emissions reduction targets in line with Municipal Energy Plan (2024)?

Carbon Budget:

	2025	2026	2027	2028	2029	2030
Projected Energy Use						
Projected Emissions						

Description of GHG Impacts

Attachment 3



City of Vaughan

Municipal Energy Plan (2024)

SSG

Vaughan's Climate Target

Vaughan has set a target to reach 2-3 tonnes of GHG per capita by 2030 and net-zero emissions by 2050 at the latest.

To meet these targets, **Vaughan will need to eliminate 0.86 MtCO2e by 2030 and 2.6 MtCO2e by 2050**.

Target Setting Best Practices

Cities Climate Leadership Group (C40) and the International Panel on Climate Change recommend, by 2030, all cities converge on a maximum emissions rate of 2.9 tCO2/person and from 2030 onwards, cities reduce their emissions to net zero by 2050.

The Municipal Energy Plan Includes

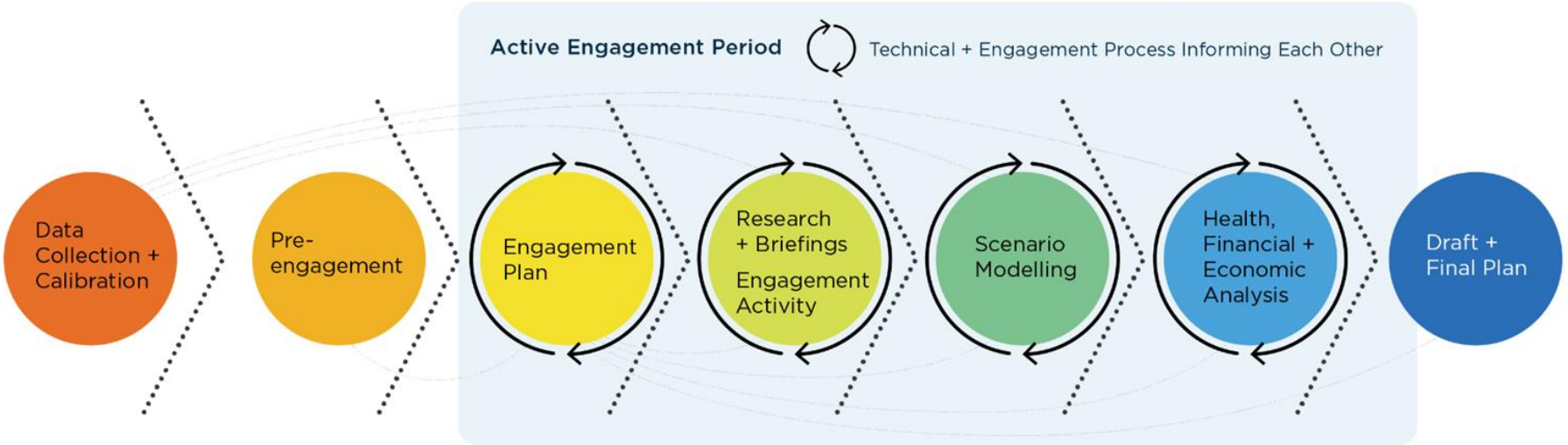
New **GHG emission reduction targets** for 2030 and 2050.

A **low carbon pathway** to reduce emissions in 6 sectors.

A set of comprehensive **actions** to:

- Meet these new GHG emission reduction targets.
- Prepare and build resilience for the changing climate.

The Engagement and Technical Process



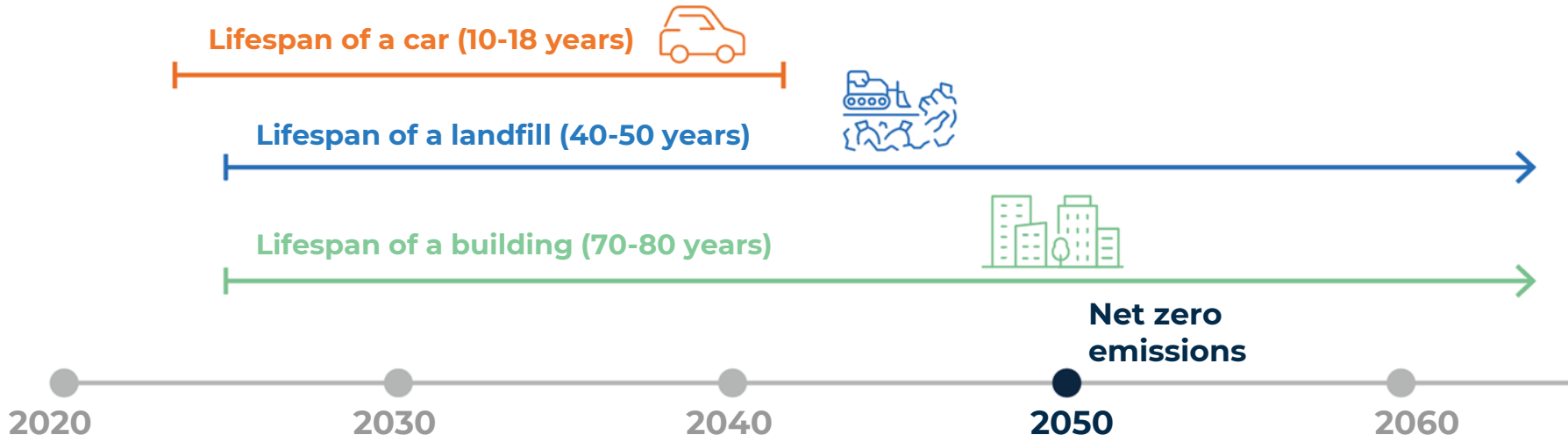
Climate Change and Vaughan

Energy and Emissions

Why Now?

There is **clear global consensus** that there is no time to waste in taking action on climate change.

Infrastructure built now can lock-in patterns of high energy use and emissions for decades to come.



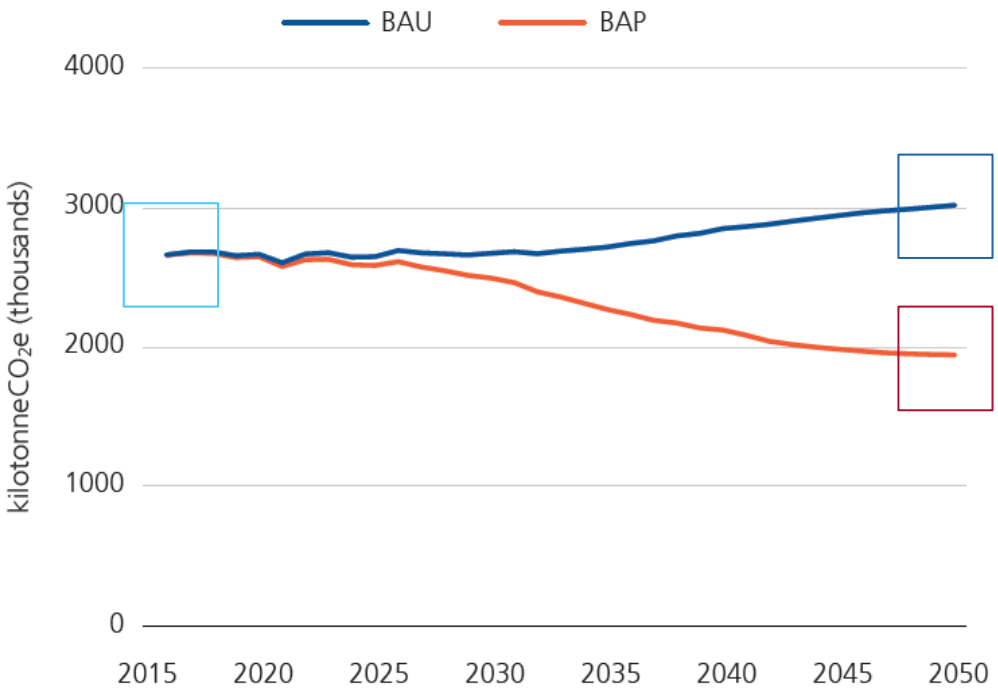
Current State: the Business-as-Usual and Business-as-Planned Emissions

The 2016 baseline is our starting point:

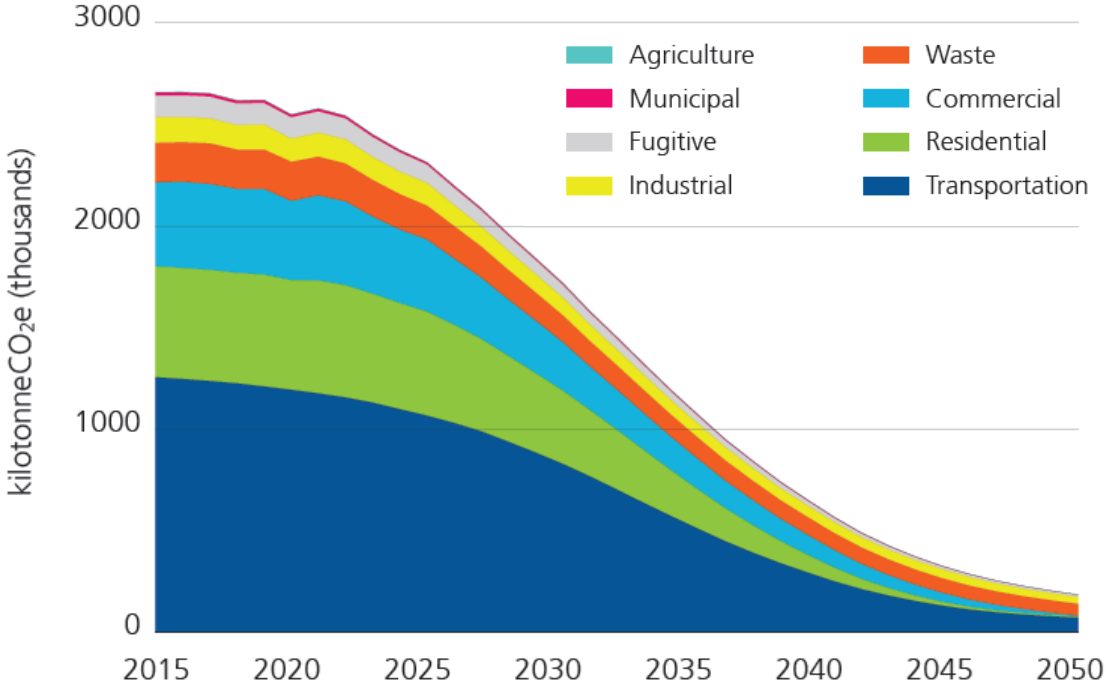
- 2.6 MtCO2e and 8.4 tCO2e/capita

The 2050 projected emissions:

- BAU: 3.2 MtCO2e and 5.38 tCO2e/capita
- BAP: 1.94 MtCO2e and 3.47 tCO2e/capita



Future State: The Low-Carbon Pathway

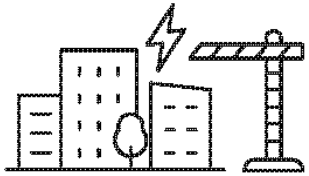


Vaughan's low-carbon pathway achieves a **93% reduction in GHG emissions.**

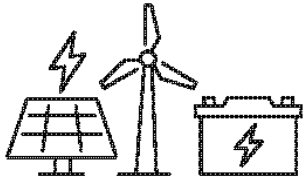
In 2050, the low-carbon pathway produces **0.18 MtCO2e or 0.33 tCO2e/capita.**

Vaughan's Low Carbon Pillars

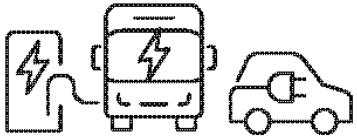
Retrofitting Buildings



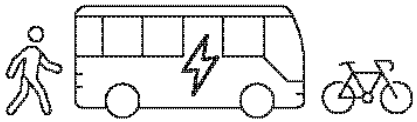
Building Net-Zero
New Construction



Generating
Renewable Energy



Reducing Vehicle
Emissions



Increasing Active
Transportation and
Transit Use

Reducing Waste
Emissions

The Climate Opportunity

Vaughan’s Next Steps

Systematic Change

Action 1: Adopt a Carbon Budget

- Systematic way to reduce GHG emissions, ensure policies and programs do not lock in further emissions, and maximize social and financial opportunities resulting from the energy transition

Action 2: Dedicate staff and convene a working group

- Dedicate one staff member to oversee the implementation of the MEP's Implementation Framework and establish a cross-departmental working group

Action 3: Apply an equity lens

- The first step to ensure that intergenerational equity, income inequality, global equity, and climate resilience are considered in policies, programs, and initiatives

Thank you!

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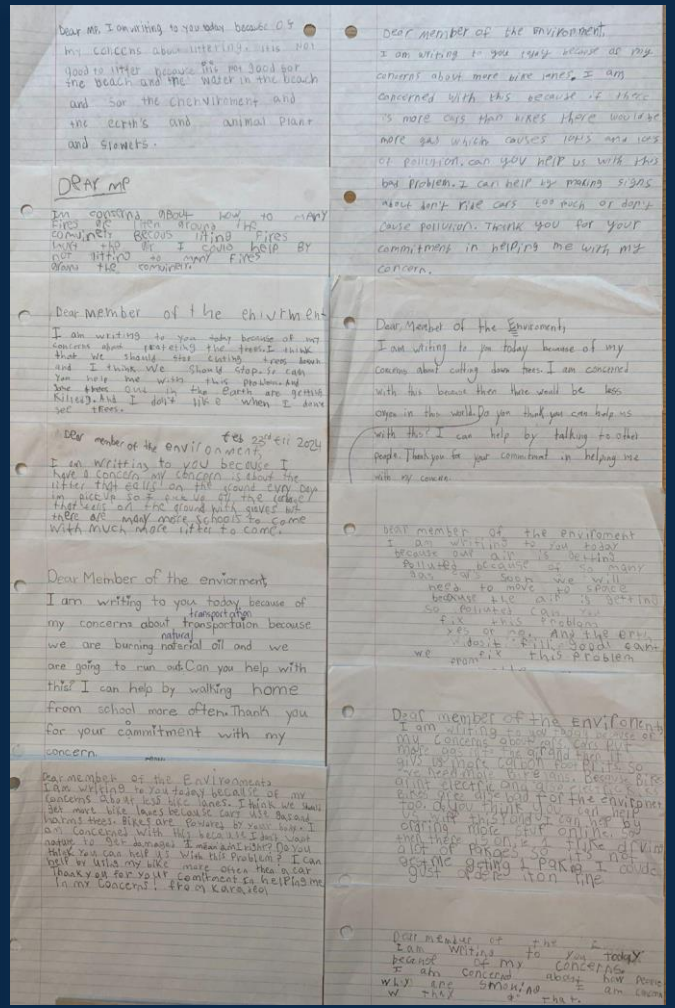

Attachment 4

City of Vaughan Municipal Energy Plan

Ancillary Report: Engagement Plan and Summary

VAUGHAN SSG

Table of Contents

Executive Summary

Background

Engagement is best understood as a process that involves the public in shared decision-making or influence over decision-making. Meaningful engagement is critical to building mutual understanding, providing information and data, and strengthening weak or poor relationships.

This Engagement Plan was used for the City of Vaughan's Municipal Energy Plan Review (MEPR) to ensure that interested and affected parties (either internal or external) received opportunities to inform and provide feedback to create the best possible updated Municipal Energy Plan (MEP). The Engagement Plan provided the framework outlining the engagement objectives and techniques, and roles and responsibilities used for the MEPR. Successfully delivering the Engagement Plan helped to establish community support for the implementation of the MEP through its completion.

This Engagement Summary report was finalized in May 2024 to summarize the feedback we received during the active engagement period.

Key Results

Based on the thematic analysis of the engagement sessions, the following recommendations and considerations were used to inform the MEP:

1. The City should leverage and expand financial, employment, and transit support for all community members, with priority given to equity-denied[1] and vulnerable community members.
2. The City should adopt an equity lens[2] to ensure climate actions are developed to support equity-denied and vulnerable community members. This includes directly working with equity-denied and vulnerable community members throughout projects to address potential co-harms and enhance co-benefits.
3. The City should encourage mixed-use and compact development to enhance access to community amenities and facilitate less travel. In addition, the City should invest in active transportation infrastructure to encourage walking and cycling between destinations.
4. The City should work to raise the community's awareness of climate change and climate actions by providing education on these topics. The City should recruit community champions and encourage greater participation in climate planning events.

[1] Equity-denied groups are those who identify barriers to equal access, opportunities and resources due to disadvantage and/or discrimination.

[2] An equity lens is a tool to analyze the impact of the design and implementation of policies, practices, and programs on historically excluded and/or marginalized individuals and groups.

Engagement Plan Background

This Engagement Plan was used for the City of Vaughan's Municipal Energy Plan Review (MEPR) to ensure that interested and affected parties (either internal or external) received opportunities to inform and provide feedback to create the best possible updated Municipal Energy Plan (MEP). The Engagement Plan provided the framework outlining the engagement objectives and techniques, and roles and responsibilities used for the MEPR. Successfully delivering the Engagement Plan helped to establish community support for the implementation of the MEP through its completion. Outcomes are the results, often measured by a change in state. They are intangible and measured qualitatively.

Supporting Strategic Documentation

The MEP builds on the City of Vaughan's previous initiatives, including the 2017 Municipal Energy Plan, 2019 Green Directions Vaughan Plan, and Sustainability Metrics Program. The MEPR informed the Official Plan Review that the City conducted to update the Vaughan Official Plan to guide the city's growth and development to the year 2051.

To develop a plan and modelling method for the MEP, SSG compiled and reviewed strategic documents, planning initiatives, and climate modelling for the City of Vaughan, as well as for York Region and other nearby municipalities. Examples, principles, and approaches were drawn from Vaughan's previous initiatives and current plans, policies, and strategic documents. This increased the MEP's alignment with these other initiatives, and helped to integrate all of these different but related initiatives, ultimately improving all their chances of success.

What Is Being Decided and Who Decides?

All projects have decision statements that cover the scope of the project and clearly identify who is making the final decisions related to the project. For this project, the decision-makers are the Vaughan City Council.

There is room for shaping the recommended updated MEP that will go before Council in fall 2024. Opportunities for public engagement were provided at various stages of the project, under defined conditions (outlined in this plan), to influence the plan that goes to Council for adoption.

Vaughan's MEPR Decision Statement

By September 2024, the Vaughan City Council will approve an updated Municipal Energy Plan.

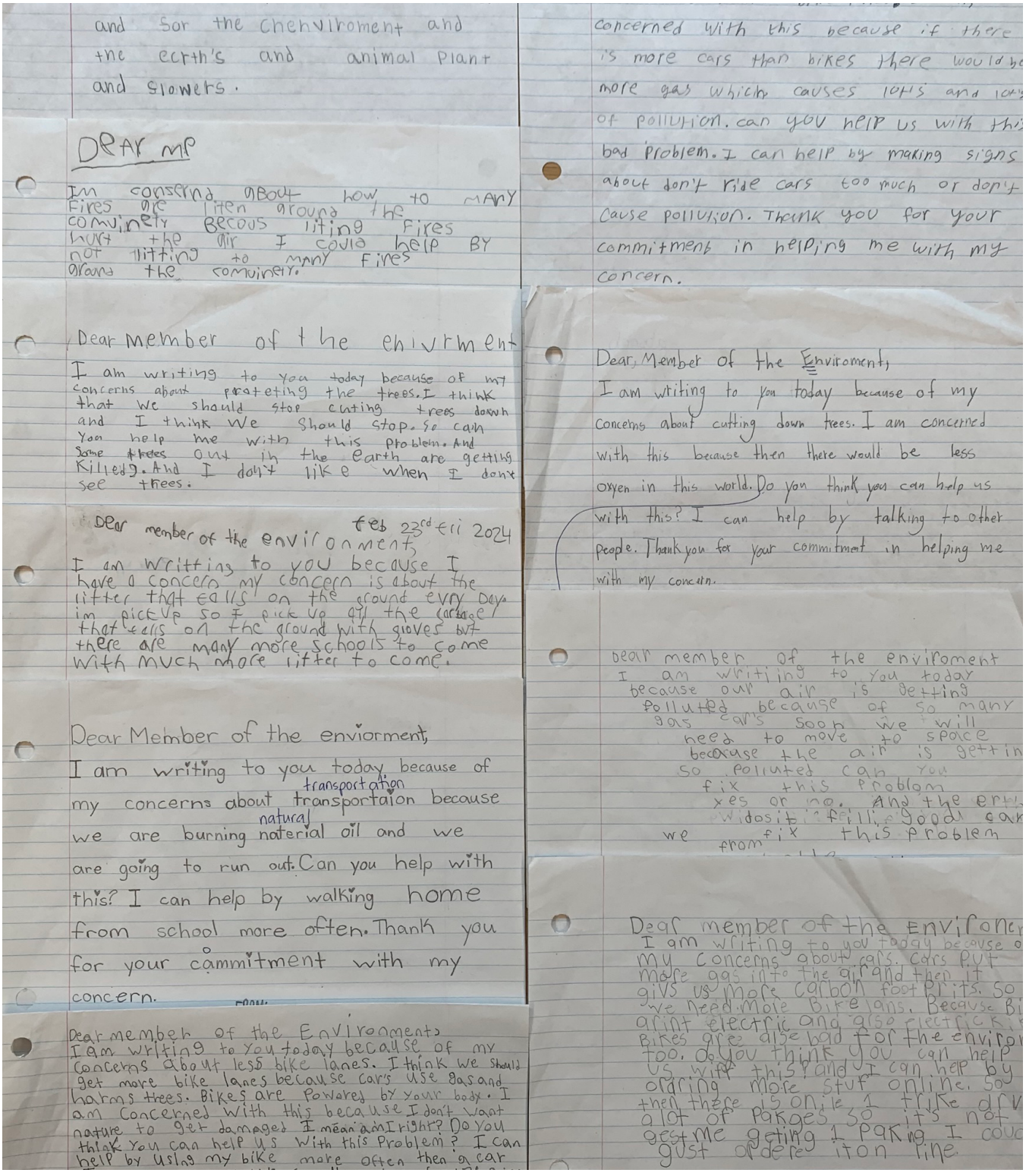

Figure 1. Grade 2 and 3 students from Kleinburg Public School use their knowledge gained from a unit on air quality and their passion for the environment in some letters to Vaughan's Environmental Sustainability staff.

Engagement Plan

What is an engagement plan? Engagement is best understood as shared decision-making or influence over decision-making. The Engagement Plan is the framework that will ensure key internal and external interested and affected parties are given opportunities to inform and provide feedback to create the best possible updated MEP. This process helped establish community support for the implementation of the MEP through to its completion.

Engagement is applied like a "dial," increasing or decreasing influence where appropriate, at different stages of a project; this plan outlines the level of influence the varying interested and affected parties have throughout the creation of the MEP. The levels of influence of each interested and affected party is determined using the International Association of Public Participation (IAP2) Spectrum of Public Participation (Appendix A), and are stated in the engagement objectives.

Givens

What is the engagement scope? Not all aspects of a project, such as "givens," are within the engagement scope. Givens are facts that are not negotiable; therefore, they are outside the scope of engagement. As such, interested and affected parties do not have room to influence these parts of the project. The givens for this engagement included the following:

- Climate change is real and driven by human activity.
- The City of Vaughan will approve an updated Municipal Energy Plan to provide a low-carbon transition strategy for the city.
- The City of Vaughan is completing an Official Plan Review to update the policy framework to guide the physical, social, environmental and economic development of the city's communities. The Official Plan was informed by the MEPR.

Guiding Principles

Guiding principles are designed to ensure that engagement activities help inform the MEPR by identifying and considering the impacts of the engagement techniques on interested and affected parties. This includes taking into account equity considerations for vulnerable or equity-denied communities. The following principles guided the design and execution of all engagement activities for this project:

- Engagement conversations will be values-based;
- Engagement meeting formats will be guided by interested or affected parties' preferences. Pre-engagement interviewees indicated a preference for virtual engagement so they could join from anywhere. Online engagement opportunities will be interactive and designed to consider varying technology skill levels;
- The project team will involve key interested or affected parties in information collection to demonstrate process integrity and build credibility for the MEPR;
- Background information and engagement opportunities (e.g., times, dates, online venues) will be communicated in a reasonable time prior to engagement;

- Interested or affected parties will have opportunities to provide input and will be informed on how their feedback will shape the final MEP; and
- Concerns and aspirations will be discussed in order to formulate options for consideration.

Interested and Affected Parties

The community refers to any individual, group of individuals, organizations, or political entity within or connected to Vaughan. Similarly, interested and affected parties are any person, group of individuals, or organization interested in or affected by the MEPR.

Interested and affected parties engaged can be grouped into four categories: government/ public organizations, businesses and economic organizations, non-profit and community groups, and the community.

In addition to providing feedback opportunities to the public during key planning process phases, the project team engaged stakeholders through the following three groups:

- The Steering Committee, consisting of City staff and project staff;
- The Community Workshops, attended by community representatives from various sectors, including youth, equity-denied community members, and individuals with lived-experience; and
- The York Region Building Industry and Land Development Association (BILD), consisting of representatives from the development and construction industry.

First Nations (Rights Holders)

Indigenous engagement in Canada is governed by the "duty to consult" as ruled by the Supreme Court of Canada. Indigenous Peoples are rights holders and not stakeholders. This means governments have a duty to engage in meaningful consultation whenever there is reason to believe that their policies or actions, directly or indirectly, may infringe upon actual or claimed Indigenous interests, rights, or title. SSG recognizes that the creation of the MEP falls under this duty.

Engagement Objectives

The following are the main objectives of this Engagement Plan described according to the IAP2 Spectrum of Engagement of inform, consult, involve, or collaborate (see Appendix A).

Engagement objectives are strategic and describe why we are engaging. They outline the purpose (not technique) of the plan, define what is successful and meaningful engagement, and are clear about the level of influence participants have. The engagement objectives were designed based on information available in the project proposal and pre-engagement summary, as well as the feedback provided by City staff.

Engagement techniques (e.g., workshops, focus groups, surveys) are tactical and describe how we're engaging. The techniques are linked with the engagement objectives to show how they achieve those objectives.

The outputs and outcomes drive the techniques selected to achieve the objectives.

- Outcomes are the results, often measured by a change in state. They are intangible and

measured qualitatively.

- Outputs are the actions, activities, or items that contribute to achieving the outcome. They are tangible and can be measured quantitatively.

Communications

The engagement's overall success depends on comprehensive communications and education efforts. While SSG can do extensive work identifying the interested and affected parties, the City is ultimately responsible for developing and publishing content in line with the project milestones. For example, SSG will prepare the survey content and provide recommendations for survey deployment, while the City's communications team will develop the back-end logistics to host the survey, deploy the survey on the project schedule, and develop and publish promotion content (e.g., social media channels, direct emails to interested and affected parties).

Pre-engagement interviewees expressed the need for the City to communicate regularly with stakeholders and the broader public, to communicate via multiple platforms to enhance reach and accessibility, and to complete a stakeholder analysis to ensure communication strategies reach underrepresented and/or vulnerable community members. These interviewees recommended the following communications tools:

- Signage and billboards;
- Well maintained project website;
- Email notifications and newsletters;
- City Councillor announcements;
- Phone, text, and online chat options;
- Social media; and
- Gamification of surveys.

Engagement Phases and Techniques

The engagement's timeline was integrated with the project's modelling activities. Between the stages of modelling, engagement input was gathered; and when the modelled results are completed, results will be presented. In addition, the engagement techniques were designed to provide a transparent engagement process, as defined during the pre-engagement interviews and survey. Interviewees identified the following approaches for ensuring such transparency:

- Provide interested and affected parties with clear communication on how their feedback will be implemented into the Plan;
- Provide regular updates to the community, including during the implementation of the MEPR;
- Provide accessibility options for all engagement events. If in-person events are hosted, locations should be considered based on availability of accessible transportation or an online session should be hosted to increase accessibility;
- Provide clear, concise communication of the technical modelling process used in the MEPR development, and focus broader public engagement on prioritization of climate actions

and opportunities; and

- Convey the potential benefits of climate action for the community throughout the engagement process in clear, accessible language.

The following section details the engagement objectives, techniques, outcomes, and outputs for the three engagement phases.

ENGAGEMENT PHASE 1: PRE-ENGAGEMENT INTERVIEWS AND ENGAGEMENT DESIGN

How Objectives Were Achieved

OBJECTIVE	INTERESTED AND AFFECTED PARTY(IES)	OUTCOME(S)	OUTPUT(S)	ENGAGEMENT TECHNIQUES TO ACHIEVE OBJECTIVE
Objective 1: To inform community members, including youth and vulnerable communities, of the MEPR process including specific targets and actions required to achieve net-zero emissions.	All	A diverse representation of Vaughan's community members understand how to engage with the project, and are motivated to participate.	A list of community members and organizations who wish to participate in the engagement process and their contact information (ongoing intake for the project's duration) A list of underrepresented and vulnerable community members to invite to the process Information shared through the City's communications channels, newsletters, and advertising A list of MEPR champions and interested residents who want regular communications	Regular project updates and ongoing communications
Objective 2: To involve community members in learning about their preferred ways to be engaged in the MEPR.	All	Effective methods are identified to ensure meaningful engagement during the Active Engagement Phases	A series of pre-engagement interviews with representatives of different sectors of Vaughan Pre-engagement summary report with recommendations for the engagement plan An Engagement Plan reflecting the community's needs for engagement	The pre-engagement interview process Engagement Plan

Roles and Responsibilities for Pre-engagement

TECHNIQUE	SSG	CITY OF VAUGHAN	OBJECTIVES
Pre-engagement Interviews and Summary Report	Conducted interviews of individuals identified by City staff (30-minute to 1-hour phone or video call) Analyzed interviews	Identified and invited participants	2

TECHNIQUE	SSG	CITY OF VAUGHAN	OBJECTIVES
Engagement Plan	Prepared draft Engagement Plan	Refined and approved the Engagement Plan	All
Ongoing Communications + List of Interested or Affected Parties	Advised City of Vaughan staff on groups to include based on the pre-engagement interview process Advised City staff on project updates to communicate on the project website and through communications channels Prepared engagement materials (e.g., presentations, virtual engagement platforms) Identified interested and affected parties for stakeholder lists	Compiled communications list of interested groups and individuals, and provided opportunities for members of the public to join the list Provided regular project updates distributed through the City's communications channels, newsletters, and advertising Provided communication approaches that consider Vaughan's linguistic diversity, accessible language, and those with disabilities Prepared communications materials (e.g., social media and website content)	1

PHASE 2: ACTIVE ENGAGEMENT PERIOD

How Objectives Were Achieved

OBJECTIVE	INTERESTED AND AFFECTED PARTY(IES)	OUTCOME(S)	OUTPUT(S)	ENGAGEMENT TECHNIQUES TO ACHIEVE OBJECTIVE
Objective 3: To consult diverse community members in documenting their lived-experiences with climate change, the Plan's vision and objectives, and their preferred approach to climate action in Vaughan.	Community members, including York Region BILD	Community members have: A common understanding of the project approach to the MEPR; Clarity on how public input shapes the final plan and future opportunities for engagement; A shared understanding and sense of excitement of community opportunities and challenges on the MEPR process; and A shared understanding of community criteria for the MEPR	Identification of community concerns and opportunities for implementing the MEPR Identification of opportunities for collaboration and partnerships, monitoring, and reporting for implementation Deployment of community survey through the City's communications channels	Community Workshop 1: Inventory, Context, and BAU Results Community Workshop 2: Targets and Actions York Region BILD Workshop: Targets and Actions Community Survey: Climate Actions

OBJECTIVE	INTERESTED AND AFFECTED PARTY(IES)	OUTCOME(S)	OUTPUT(S)	ENGAGEMENT TECHNIQUES TO ACHIEVE OBJECTIVE
Objective 4: To involve the Staff Steering Committee members in documenting their approach to climate action in Vaughan, their local climate change concerns, and challenges and opportunities for the climate resilience plan.	City of Vaughan Staff Steering Committee	City staff have a shared understanding of how their feedback shaped the final MEPR City staff support the MEPR implementation City staff are interested in the MEPR process and excited for its implementation	Delivery of five staff steering committee workshops at key phases of the project	Staff Steering Committee Workshop 1: The Process Staff Steering Committee Workshop 2: Inventory and Context Staff Steering Committee Workshop 3: BAU Results Staff Steering Committee Workshop 4: Targets and Actions Staff Steering Committee Workshop 5: Draft Plan
Objective 5: To inform interested and affected parties how their feedback and participation shaped the plan.	All	Community members understand how their feedback shaped the plan and find the process acceptable	"What We Heard" updates provided at key points of the project Engagement Plan and Summary report prepared for the final MEPR	Engagement Plan and Summary

Roles and Responsibilities for Active engagement

TECHNIQUE	SSG	CITY OF VAUGHAN	OBJECTIVES
Community Workshop 1: Inventory, Context, and BAU Results Community Workshop 2: Targets and Actions York Region BILD Workshop: Targets and Actions	Prepared presentations for each workshop, highlighting key updates, deliverables, and results Facilitated workshops to understand opportunities and challenges of climate actions in the local context and future emissions profile Responded to questions about the modelling process, assumptions development, and implementation framework Provided digital framework/exercise tools Analyzed feedback	Promoted workshops via the City's social media channels, newsletters, and media outlets Co-ordinated meeting timing and hosting Reviewed presentation materials prior to the workshops Responded to questions about the City's role and jurisdiction	3

TECHNIQUE	SSG	CITY OF VAUGHAN	OBJECTIVES
Community Survey: Climate Actions	Prepared survey design Prepared advice on survey deployment Analyzed responses	Reviewed draft survey based on SSG's advice, and provided feedback on survey design Provided logistical support Sent survey to external interested and affected parties Provided ongoing marketing and communications via the City's social media channels, newsletters, and media outlets Provided incentive to encourage survey participation	3
Staff Steering Committee Workshop 1: The Process Staff Steering Committee Workshop 2: Inventory and Context Staff Steering Committee Workshop 3: BAU Results Staff Steering Committee Workshop 4: Targets and Actions Staff Steering Committee Workshop 5: Draft Plan	Prepared presentations for each workshop, highlighting key updates, deliverables, and results Facilitated workshops to understand opportunities and challenges of climate actions in the local context and future emissions profile Responded to questions about the modelling process, assumptions development, and implementation framework Provided digital framework/exercise tools Analyzed feedback	Recruited committee members Coordinated meeting timing and hosting Reviewed presentation materials prior to the workshops Responded to questions about the City's role and jurisdiction	4
Engagement Plan and Summary	Analyzed feedback from all engagement activities Wrote Ancillary Report: Engagement Plan and Summary	Reviewed Ancillary Report: Engagement Plan and Summary	5

PHASE 3: FINAL MUNICIPAL ENERGY PLAN AND PRESENTATION

How Objectives Were Achieved

OBJECTIVE	INTERESTED AND AFFECTED PARTY(IES)	OUTCOME(S)	OUTPUT(S)	ENGAGEMENT TECHNIQUES TO ACHIEVE OBJECTIVE
Objective 6: To inform City staff, Vaughan City Council, (City Council) and interested groups of the MEPR process.	All	City staff and City Council have an understanding of the MEPR, opportunities, and concerns.	Approval of the final MEPR by Council	Presentation to City Council

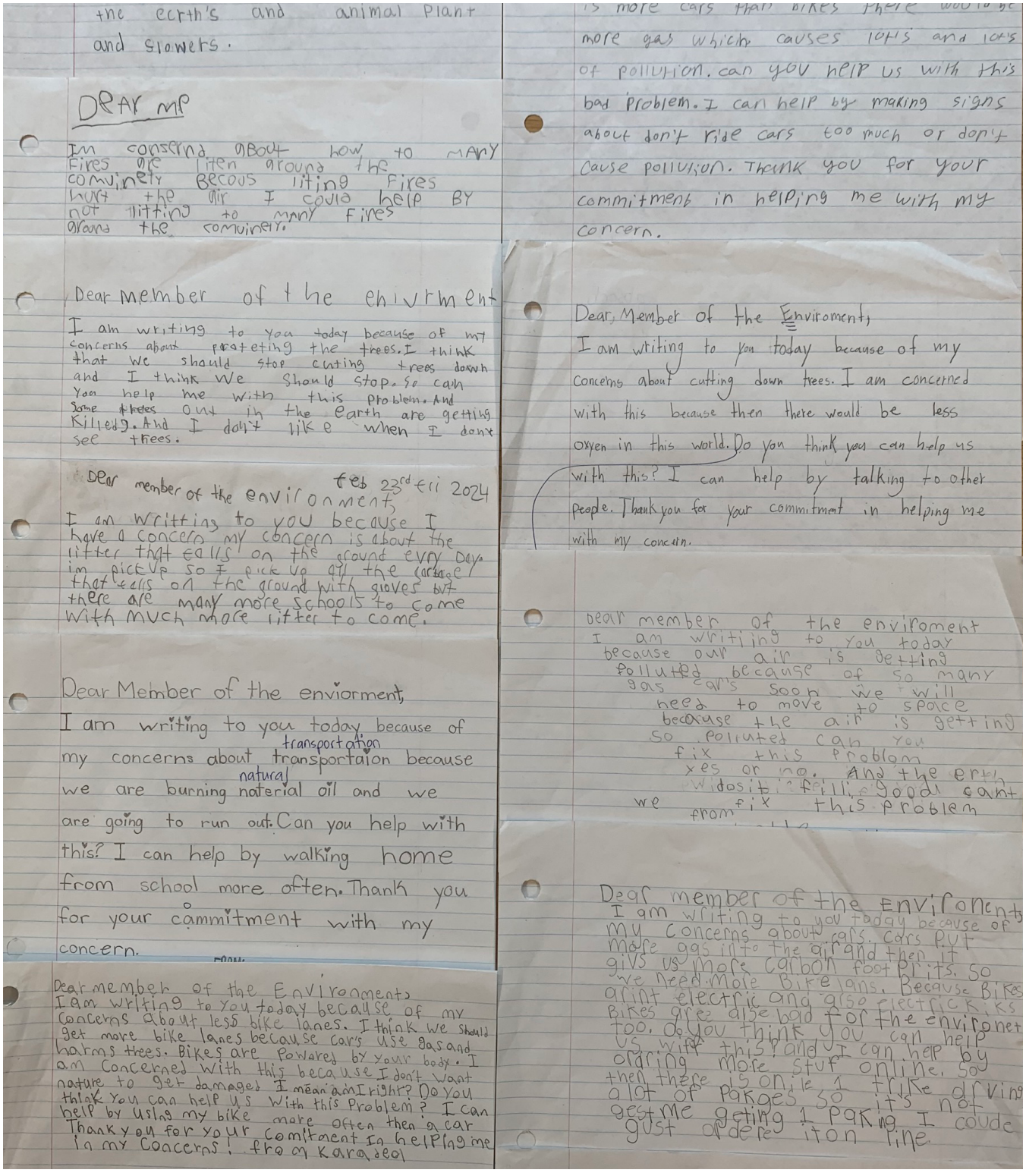

Figure 2. Grade 2 and 3 students from Kleinburg Public School use their knowledge gained from a unit on air quality and their passion for the environment in some letters to Vaughan's Environmental Sustainability staff.

What We Heard

Who We Heard From

SSG and the City's Project Management team gathered feedback from 79 members of the public, including representatives from the construction, building, and consulting industries, community members, non-profit organizations, and equity-denied community members. Engagement participants shared their perspectives on climate action and lived experiences with climate change, opportunities and barriers, and different supports to assist community members in implementing climate actions. SSG used a thematic analysis to analyse the qualitative feedback received from the engagement process. This was completed to share common patterns among the feedback, and provides a compressed analysis of key concerns, challenges and opportunities expressed by different stakeholder groups.

COMMUNITY WORKSHOPS

In June and July 2022, SSG and City staff hosted two virtual workshops open to all community members in Vaughan. The City promoted the workshops via social media, newsletters, and media outlets and through direct email contacts. A total of ten individuals attended the two workshops. The workshops were designed to engage community members on their climate concerns, and gain feedback on what they saw as opportunities and barriers for implementing the proposed climate actions.

YORK REGION BILD WORKSHOP

In September 2022, SSG and City staff hosted one workshop with representatives from York Region BILD. Six representatives from the building, construction, and consulting industries attended the workshop. The workshop was designed to engage representatives from the developer and construction industries on their climate concerns, and gain feedback on what they saw as opportunities and barriers to implementing the proposed climate actions in their industry.

COMMUNITY SURVEY

In June 2022, SSG and the City released a community survey to ask community members for feedback on the implementation approaches and support needed within the community to implement climate actions. Fifty-three community members responded to the survey.

Participants were asked six key identifier questions to determine that participants represented diverse groups of residents, and to encourage participation from under-represented communities. The identifiers included: if they lived or worked in Vaughan, the neighbourhood they lived in, their age, their gender identity, their household income, and self-identification in groups. The key findings are summarized below.

Age ranges with the highest participation were 35-44 years old, 56-64 years old, and 25-24 years old; these groups made up 25%, 23%, and 18%, respectively, of the community members. The age range with the lowest participation was under 18 years old; no survey participants identified being in this age group.

A household income of $100,000 or greater had the highest participation (55%), and the

second- and-third highest participation were from household incomes of $60,001-$80,000 (5%) and $40,001-$60,000 (5%). The lowest participation was from household incomes of $20,000 or less; this group only made up 1% of community members. Twenty-five percent of survey respondents selected "prefer not to disclose."

Forty-four percent of respondents identified as a woman; 41% identified as a man; 2% identified as non-binary, gender fluid, or gender non-conforming; and 2% identified as a transgender woman. Ten percent of survey respondents selected "prefer not to disclose."

For the self-identification of groups, 39% of survey respondents identified as someone who was born outside of Canada, 18% said English was not their first language, and 13% identified as Indigenous, First Nations, Métis, or Inuit.

What We Heard

KEY INSIGHTS

In the community engagement sessions, we commonly heard the following recommendations and considerations which were used to inform the MEPR.

The City should leverage and expand financial, employment, and transit support for all community members, with priority given to equity-denied and vulnerable community members.

The City should adopt an equity lens to ensure climate actions are developed to support equity-denied and vulnerable community members. This includes directly working with equity-denied and vulnerable community members throughout projects to address potential co-harms and enhance co-benefits.

The City should encourage mixed-use and compact development to enhance access to community amenities and facilitate less travel. In addition, the City should invest in active transportation infrastructure to encourage walking and cycling between destinations.

The City should work to raise the community's awareness of climate change and climate actions by providing education on these topics. The City should recruit community champions and encourage greater participation in climate planning events.

THEMATIC ANALYSIS

The following is a summary of our quantitative and qualitative analysis of interested and affected parties' feedback from all engagement techniques.

Transportation

Seventy-seven percent of survey respondents indicated their primary mode of transportation is a personal vehicle. Biking, public transit, walking, and passengers in a vehicle or ride-sharing made up the remaining 11%, 5%, 5%, and 2%, respectively. Most respondents selected that the City's main transportation priority should be to increase electric vehicle (EV) use, active transportation, and transit use equally.

Electric Vehicles

Sixty percent of survey respondents selected that they would be interested in purchasing or leasing an EV in the next five years, and 27% are not interested. The biggest barriers for purchasing an EV were identified as (since question respondents could select multiple options, the percentages may not add up to 100%):

1. Purchase cost (selected by 51% question respondents);
2. Lack of availability of public charging stations (37%); and
3. Lack of EVs available to purchase locally (28%).

Similar feedback was received during the community workshops, with participants indicating a need for Vaughan to increase availability of charging stations.

> *"I would like to see Vaughan install more electric stations according to the increase of electric transportation." - Community Workshop 1 participant*

Public Transportation

Sixty-four percent of respondents do not take public transit at all. Twenty-two percent take public transit occasionally (twice per month or less); 6% take it seasonally in the warmer months; 6% take it sometimes (one to two times per week); and the remaining 4% take it regularly (multiple times per week).

The respondents who do not currently take public transportation regularly indicated that the following tactics would encourage them to use transit in the future (since question respondents could select multiple options, the percentages may not add up to 100%):

1. More direct routes (selected by 44% of question respondents);
2. More frequent service (38%);
3. Transit stops closer to their origin or destination (30%); and
4. Lower transit fares (17%)

Thirty-eight percent of question respondents are not interested in taking public transportation.

Active Transportation

Thirty-eight percent of survey respondents do not ride a bike to commute, but do ride a bike for creation or leisure; 24% do not ride a bike; and 18% ride a bike to commute regularly. The remaining respondents either ride sometimes (10%), seasonally (4%), or occasionally (4%).

Those who do not ride their bikes indicated that the following would encourage them to start biking (since question respondents could select multiple options, the percentages may not add up to 100%):

1. An increase in separated and protected bike lanes (selected by 60% of question respondents);
2. Better protection against bike theft, such as more secure bike parking facilities and policy-supported bike identification and return services (27%); and
3. A bike share program (18%).

Twenty-four percent of question respondents selected that they are not interested in riding a bike for commuting.

General Transportation Feedback

The following is a summary of our thematic analysis of the general transportation-related feedback we received through written survey responses and workshop discussions.

- Encourage the creation of dense development and complete neighbourhoods to reduce

the need for travel with vehicles.

- Incentivize low-carbon or zero-emission transportation through rebates and rewards. For example, rewards should be provided for students who commute to school using a bike.
- Enhance safe and direct connections between bike paths and routes, including separated barriers between bike lanes and vehicle lanes.
- Consider equity in planning decisions and respect the individual's right to choose the transportation options that best suit their needs and desires.
- The adoption of electric vehicles needs to consider end-of-life recycling options for vehicle batteries.

In addition, participants raised several concerns about the City's role in climate change planning and electric vehicles as a viable technology. These concerns could be addressed through enhanced education and outreach programs to increase community knowledge on climate change.

Renewable Energy

Most (71%) survey respondents were in full support of increasing renewable energy supply.

The 29% of survey respondents that were unsure, or may support increasing renewable energy supply, were asked what would increase their support. These respondents selected that they may support an increase in renewable energy supply with more information about the (since question respondents could select multiple options, the percentages may not add up to 100%):

1. Personal and household financial impacts (selected by 19% of question respondents);
2. Technology (16%); and
3. Benefits and trade-offs (14%).

Rooftop Solar Installations

Thirty-nine percent of survey respondents said they were unsure if they would consider installing rooftop solar or another energy source on their property in the next five years. Twenty-eight percent indicated that they are interested, while 23% are not interested in installing solar or another renewable energy source in the next five years. Nine percent do not own their property.

The top five supports needed for respondents to install rooftop solar are (since question respondents could select multiple options, the percentages may not add up to 100%):

1. Partial financial support, in which a proportion of the system's cost is covered by a utility, government, or non-profit organization (selected by 60% of question respondents);
2. Education about the technology and how well it may work (41%);
3. Financing support, such as a loan (34%);
4. A list of recommended professionals and contractors (32%); and
5. Full financial support, in which the total cost of the system is covered by another party such as a utility, government, or non-profit (32%).

General Renewable Energy Feedback

The following is a summary of our thematic analysis of the general renewable energy-related feedback we received through written survey responses and workshop discussions.

- Encourage personal renewable energy systems to feed back into the system.
- Require that all new buildings be built with geothermal energy and/or solar energy.
- The upfront capital costs to install solar panels is prohibitive for many homeowners and businesses.
- Encourage installation of solar or renewable energy on commercial roofs and municipal buildings.
- Enhance support for lower-income households.

Waste Reduction

Forty-one percent of survey respondents said it was somewhat difficult for them to reduce their household waste. Twenty-one percent selected that it is somewhat easy, and 20% selected that it was neither easy nor difficult, to reduce their household waste. Ten percent selected that it is very easy, and 6% selected that it is very difficult, to reduce their household waste. The top supports needed for respondents to reduce their household waste are (since question respondents could select multiple options, the percentages may not add up to 100%):

1. Community reuse centers, where unused items are accepted and redistributed back into the community (selected by 66% of question respondents);
2. Increased support for reuse programs, such as programs or events that encourage repairing products, or donation events for community organizations (49%);
3. A green procurement strategy, such as a policy to guide businesses and homeowners when acquiring new materials, supplies, and services (39%);
4. Increased financial incentives for recycling and composting (39%); and
5. Increased waste supporting education (30%).

General Waste Feedback

The following is a summary of our thematic analysis of the general waste-related feedback we received through written survey responses and workshop discussions.

- Establish a single-use plastic ban and associated incentives for businesses that ban single-use plastics early;
- Develop enhanced curbside recycling programs such as monthly electronics pick-up.
- Invest in circular economy principles, and encourage small businesses to transition their practices in line with the circular economy principles.

Energy Efficiency Improvements

Survey respondents expressed a general interest in making energy efficiency improvements to their property. Only 7% of respondents identified that they are not interested in making any improvements, and another 7% identified that they would need the support of their landlords to complete the retrofits.

Of the remaining 47 respondents who selected specific energy efficiency improvements, the top potential projects include:

1. Installing more efficient windows and/or doors to prevent the loss of heated or cooled air (selected by 61% of question respondents);

2. Improving the insulation to prevent the loss of heated or cooled air (57%); and
3. Replacing older appliances with more efficient options (44%).

The top categories of supports that participants would need to make energy efficiency improvements are:

1. Full financial support, where the full cost of the upgrades is covered by another party (selected by 44% of question respondents);
2. Financing support, such as a loan (44%); and
3. Information about how to make energy efficiency improvements by themselves (40%).

General Building Efficiency Feedback

The following is a summary of our thematic analysis of the general building efficiency-related feedback we received through written survey responses and workshop discussions.

- Update by-laws to include efficiency standards.
- Ban or tax indoor natural gas stoves.
- Enhance development standards to require mandatory energy efficiency standards in new buildings.
- Enhance incentives and subsidies by collaborating with regional, provincial, and federal governments.

Education and Equity

Education and equity were common themes among survey responses and workshop participants. Sixty-nine percent of survey respondents selected that they would support the City developing education and job training to support workers in transitioning to employment in new industries supporting the net-zero emissions target. In addition, workshop participants said they would like to see the City increase education for climate action and how each action affects businesses, and to encourage more participation among community members in workshops.

Next Steps

The feedback from the engagement techniques helped the City understand the community's priorities and needs, and enabled the City staff and SSG to develop a MEP that can be successfully implemented across the community. As noted in the survey and focus group analyses, ongoing and continued engagement will be important during the implementation of the MEP. To ensure this is achieved, the Implementation Framework has been designed with multiple advocacy and education actions to ensure community members stay informed and to build awareness.

Appendix A: IAP2 Public Participation Spectrum

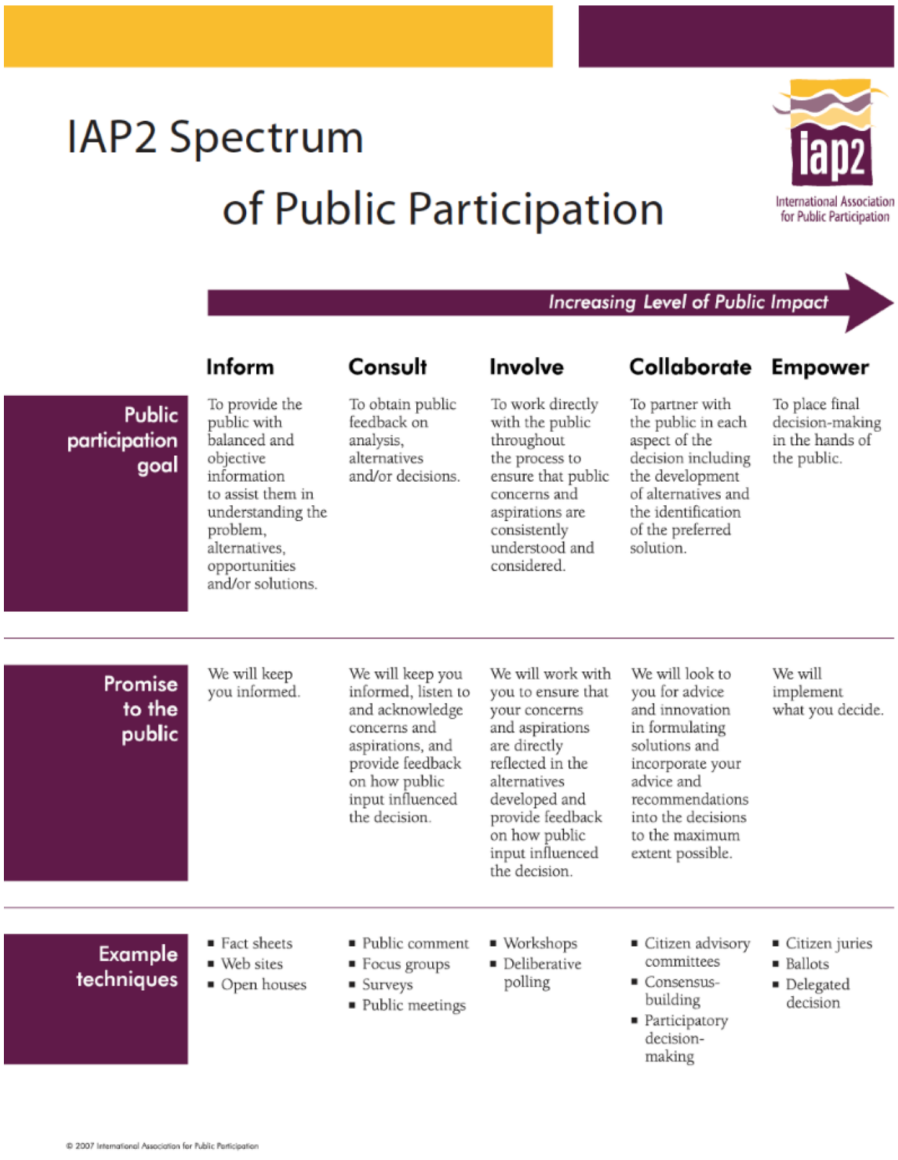

Figure 1A. Summary of the IAP2 Public Participation Spectrum (source: International Association for Public Participation).