



Resilient Richmond Hill

Richmond Hill's Path to a Low-Carbon Future

DRAFT Community Energy & Emissions Plan

Prepared by SSG and the City of Richmond Hill

Contributors

Many people and organizations contributed to the development of the Resilient Richmond Hill Net-Zero Strategy, including numerous community members, the executive leadership team and City staff, without whose support this plan would not have been possible. Acknowledgement also goes to the Ontario Ministry of Energy's Municipal Energy Plan program that provided a grant for this project.

A number of stakeholders lent their expertise to the plan, including York Region, the Toronto and Region Conservation Authority, utilities, local business and environmental organizations, partner agencies, and representatives from the development industry. We also want to thank the 650 residents who shared their ideas with the City of Richmond Hill and Sustainability Solutions Group, the 40 residents who participated in the creation of a collaborative vision board for Richmond Hill, a community art piece, online surveys, and a crowdsourced map.

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Project funding support provided by the Government of Ontario

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Executive Summary: A Resilient City is Richmond Hill's Future

Richmond Hill's Path to a Low-Carbon Future outlines actions and opportunities for Richmond Hill to reap the benefits of a resilient city. Also known as the City's Community Energy and Emissions Plan (CEEP), this strategy was developed to improve resiliency by identifying actions to reduce our community's greenhouse gas (GHG) emissions, conserve energy, and explore related economic opportunities.

The next decade is critical for limiting global warming to 1.5°C and preventing catastrophic climate change. As reflected in the Council-endorsed Resilient Richmond Hill Climate Change Framework, local communities must adapt to the impacts of climate change and, conversely, take responsibility for mitigating their own contributions to climate change.

By 2050, this plan will help transform Richmond Hill into a thriving, resilient, low-carbon community with a diversified and strong local economy. Thanks to the leadership of the City and the efforts of residents and businesses, Richmond Hill will have done its part to reduce GHG emissions to mitigate catastrophic climate change and, in the process, boosted renewable energy and zero-carbon construction. To achieve this goal, it must take ambitious and concrete action to mitigate GHG emissions and foster prosperous green industries. This document lays out a Low-Carbon Strategy that details how Richmond Hill can accomplish this goal while reducing its GHG emissions to net-zero.

NET-ZERO GHG EMISSIONS

BY 2050

Net zero signifies that, by the year 2050, Richmond Hill will have reduced its GHG emissions as much as possible and will not be emitting more than it is offsetting.

This low-carbon strategy is community driven. The entire Richmond Hill community is invited to take part in its transformation. To implement this strategy and become a low-carbon city, the City of Richmond Hill must work together with residents, businesses, and all levels of government. Together, they can achieve the 29 Program Specific Sub-Target(s) outlined in this plan. The Low-Carbon Strategy details seven program areas to help Richmond Hill achieve its emissions reduction target of net-zero GHG emissions. Achieving the targets in this plan does leave a small carbon gap that will need to be

addressed in future iterations of this plan or offset through other means. Offsetting is the reduction of emissions in one place to compensate for emissions in another location.

Table E1. Net-Zero Program areas and respective GHG reductions in 2050

Program Area	Proportion (%) of Community GHG Reductions
Transportation Transformation	40%
Efficient Buildings	30%
Smart, Renewable Energy	6%
Towards Zero Waste	9%
Compact Community	5%
Municipal Leadership	2%
Natural Heritage	1%
Carbon Gap	7%

The seven program areas are further broken down into 29 Program area specific Sub-targets that detail how Richmond Hill will be transformed into a resilient, low-carbon city. The Sub-targets are:

Table E2. Matrix of Low Carbon Actions

Transportation Transformation	Energy Efficient Buildings	Smart, Renewable	Towards Zero Waste	Compact Community	Municipal Leadership	Natural Heritage
65% active transportation mode share	Net-zero energy Residential	Rooftop Solar	Anaerobic Digestion and water conservation	Development along Yonge Street corridor	Net-zero Municipal Buildings	Land-use based restoration planting targets
E-bike and car share	Net-Zero energy non-residential	Energy Storage	100% methane recovery	Promote Intensification	Electric Municipal Fleet	Natural Heritage Strategy
Zero-emission ownership vehicle targets	Retrofit existing residential	District Energy		Car free zones in Richmond Hill Centre	Education Plan	
Electrify transit	Retrofit existing non-residential	Ground mount solar				
Expand subway	Green Roofs	Wind generation				

Transportation Transformation	Energy Efficient Buildings	Smart, Renewable	Towards Zero Waste	Compact Community	Municipal Leadership	Natural Heritage
Expand VIVA	Increase efficiency of Industrial	Renewable Natural Gas and Hydrogen				
Areas with Zero-emission vehicle exclusivity						

Dollars that would be spent normally in Richmond Hill (Business-as-Planned (BAP) Spending) by the whole community (residents, businesses, all levels of government, etc.) is in the range of \$2 billion per year, or \$67 billion over the 2020-2050 scenario period. The incremental investments required to realize the Net-Zero Scenario (NZS) presented in this analysis total \$8.4 billion (2016 dollars) over the 2020-2050 period, or an average of about \$250 million per year, implying the NZS requires an increase in investment on the order of 10-13%. Further analysis of these figures is provided in the financial analysis component of this report.

From 2032 forward annual savings and revenue begin to increase as energy improvements turn into savings. By 2050, cumulative net benefits reach \$12.3 billion and are still growing. Most actions save and/or generate more money than they cost, as does the plan as a whole.

Transitioning to a low- or zero-carbon economy is expected to create new avenues for employment and economic development in Richmond Hill. Commonly used employment metrics suggest that when \$1 million dollars is invested in...¹

...building retrofits, it is expected to generate **9 person-years** of employment.

...community-scale energy systems, it is expected to generate **8 person-years** of employment.

...new vehicles, it is expected to generate **3 person-years** of employment.

Supplementary Information: Technical Paper

The Low-Carbon Strategy is a summary of the effort to transition to a low-carbon future. A technical report provides more details on all of the analysis that backed up the information contained in this plan. That report is available on the Resilient Richmond Hill website.

¹ For an introduction to the way investments in energy efficiency and renewables create jobs, see “How does energy efficiency create jobs?”, ACEEE fact sheet accessed at <https://www.aceee.org/files/pdf/fact-sheet/ee-job-creation.pdf>. Canadian input/output multipliers are at : <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610059401>

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Introduction

The Challenge

The climate is changing, primarily due to human activity. Rapid and steep emissions reductions are needed to limit warming. Every sector of society will innovate, creating new jobs and employment. Ensuring that the transition is equitable and sustainable will ensure no one is left behind. The time is now.

In 2018, the Intergovernmental Panel on Climate Change (IPCC), the world's leading scientific body on climate change, released a report titled *Global Warming of 1.5°C*. The report indicated that the risks of climate change can be substantially reduced by limiting warming to 1.5°C above pre-industrial levels. However, if current annual greenhouse gas (GHG) emissions trends continue, we have a window of opportunity of less than 10 years for the planet to remain below 1.5 degrees of warming.²

The impacts of climate change are being felt across the globe and in every part of Canada, with a measurably increasing impact on economic performance. A recent study indicated that weather-related disaster costs have increased to five to six percent of GDP. In 2016, an extreme-weather and slow-GDP-growth year, weather-related disaster costs were equivalent to a third of Canada's GDP growth.³

Canada's House of Commons declared a climate emergency in June 2019,⁴ joining France, Ireland, the United Kingdom, and Portugal. Major cities around the world, including New York, London, Sydney, and Paris, have all declared climate emergencies, as have 439 Canadian municipalities. Richmond Hill has recognized the urgency of climate change and has made a commitment to taking climate action.

We are now at a pivotal moment in human history. The next ten years will determine whether or not society can successfully address climate change.

² The remaining global carbon budget for having a 66% chance of limiting warming to 1.5 degrees is 420 GtCO₂e. Global annual GHG emissions are approximately 42 MtC20e. (IPCC, 2018: Summary for Policymakers. In: *Global Warming of 1.5°C*. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.)

³ Canadian Institute for Climate Choices. (2020). *Tip of the iceberg; Navigating the known and unknown costs of climate change*. <https://climatechoices.ca/wp-content/uploads/2020/12/Tip-of-the-Iceberg- -CoCC -Institute -Full.pdf>

⁴ See

The Opportunity

Climate change is spurring fundamental shifts in every sector of the economy, highlighted by an energy transition away from fossil fuels to renewable energy. This strategy positions Richmond Hill to embrace the opportunities resulting from the energy transition.

In 2017, the Task Force on Climate-Related Financial Disclosures (TCFD) proposed a framework for reporting on “transition risks” resulting from the impacts of climate change and societies’ efforts to address climate change.⁵ Transition risks highlight the risks of investments that are made without considering the policies and activities that society needs to meaningfully address climate change. Governments are advancing their efforts to address climate change, as highlighted by recent announcements of net-zero targets by Canada,⁶ China,⁷ Japan,⁸ South Korea,⁹ and the European Union,¹⁰ and by ambitious GHG targets set by Canadian cities, such as Toronto,¹¹ Halifax,¹² Ottawa,¹³ and Edmonton.¹⁴ York Region has followed suit and targeted net-zero GHG emissions in the York Region Draft Climate Change Action Plan (CCAP).¹⁵ Nearby Markham has already adopted the same target in its CEEP.¹⁶

One mechanism for evaluating transition risks is to develop scenarios that reflect different futures, which is the methodology used to develop a Low-Carbon Strategy for Richmond Hill.¹⁷ On the flip side, transition risks also represent opportunities for jurisdictions and enterprises which are proactive and engage early. Opportunities include building a more resilient community, creating new economic development opportunities, reducing health risks, and building a more appealing community.

⁵ Task Force on Climate-related Financial Disclosures. (2017). Recommendations of the Task Force on Climate-related Financial Disclosures.

⁶ Government of Canada. (2020). *Net-zero emissions by 2050*. <https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/net-zero-emissions-2050.html>

⁷ Bloomberg. (2020). *China beat the U.S. to a zero-carbon emissions climate pledge*. <https://www.bloomberg.com/news/articles/2020-09-22/china-beat-the-u-s-to-a-zero-carbon-emissions-climate-pledge>

⁸ UN News. (2020). Climate action: UN chief encouraged by Japan’s 2050 net zero pledge. *UN News*. <https://news.un.org/en/story/2020/10/1076132>

⁹ Cha, S. (2020, October 28). South Korea’s Moon targets carbon neutrality by 2050. *Reuters*. <https://www.reuters.com/article/us-southkora-environment-greennewdeal-idUSKBN27D1DU>

¹⁰ European Commission. (2016). *2050 long-term strategy*. https://ec.europa.eu/clima/policies/strategies/2050_en

¹¹ Rider, D. (2019). *City of Toronto aiming to be carbon neutral by 2050 or earlier* | *The Star*. https://www.thestar.com/news/city_hall/2019/09/26/city-of-toronto-aiming-to-be-carbon-neutral-by-2050-or-earlier.html

¹² Halifax Regional Municipality. (n.d.). *HalifACT: Acting on climate together*. Retrieved December 4, 2020, from <https://www.halifax.ca/about-halifax/energy-environment/halifact-2050-acting-climate-together>

¹³ City of Ottawa. (2019, June 24). *Energy evolution*. <https://ottawa.ca/en/living-ottawa/environment/climate-change-and-energy/energy-evolution>

¹⁴ City of Edmonton. (2020). *Edmonton’s energy transition* (Edmonton, Alberta, Canada). The City of Edmonton. https://www.edmonton.ca/city_government/environmental_stewardship/energy-transition.aspx

¹⁵ “Vision 2051” 2019. York Region. Retrieved from: “<https://www.york.ca/wps/wcm/connect/yorkpublic/a6d9d1ce-0813-4376-a593-daccf2b7fd6e/vision+2051.pdf?MOD=AJPERES&CVID=mulIVE5>”

¹⁶ “Municipal Energy Plan” 2018. City of Markham. Retrieved from: <https://www.markham.ca/wps/portal/home/about/sustainability/energy/municipal-energy-plan/01-municipal-energy-plan>

¹⁷ Task Force on Climate-Related Financial Disclosure. (2017). *The use of scenario analysis in disclosure of climate-related risks and opportunities*. <https://assets.bbhub.io/company/sites/60/2020/10/FINAL-TCFD-Technical-Supplement-062917.pdf>

Preface: COVID-19 Recovery

COVID-19, which became a factor during the development of this plan, has shown how an external factor can change our everyday lives. COVID-19 has given room for pause and a reflection on priorities. During this period, Canadians have altered their daily and yearly plans, which has resulted in reduced fossil fuel consumption from activities such as driving and flying. The decline in emissions resulting from the current COVID-19 pandemic, however, is projected to lie between just 4% (low estimate) and 7% (high estimate) in 2020 relative to 2019 levels.¹⁸

The pandemic has demonstrated that community leaders and residents are able to act and change habits quickly in a time of a crisis. As social distancing, lockdown, and telework became the norm, people relied less on cars and more on services and amenities closer to home. They turned to walking and cycling to get around, local businesses to conduct their errands, and parks and greenspaces to maintain a sense of community. As people spent more time at home, domestic comfort and energy and water costs became a more prominent concern, sparking a desire to renovate and renew homes. Such renovations offer the opportunity to upgrade old technologies and retrofit buildings with more efficient designs and materials.

The need to ensure more equitable access to transit, infrastructure, and technology also became more pronounced during the pandemic, as those hit hardest by the pandemic tend to live or work in underserved communities. Many governments, including the Canadian government, are strategizing how economic recovery packages can be used to “build back better” and support an equitable transition to a zero-carbon society. Municipalities are also looking at rapid interventions to protect populations from further health outbreaks and enable residents to enjoy their cities by increasing active transportation opportunities, accessibility to public green space, and supporting local business.

¹⁸ Le Quéré, C., Jackson, R.B., Jones, M.W. et al. Temporary reduction in daily global CO₂ GHG emissions during the COVID-19 forced confinement. *Nat. Clim. Chang.* (2020). <https://doi.org/10.1038/s41558-020-0797-x>

Climate change in Richmond Hill



Illustrating The effects of Climate Change in Ontario (2019).¹⁹

Climate modelling completed for York Region and Richmond Hill predicts that, if present trends continue, the City can expect to experience the following by 2050:²⁰

- › **An annual mean temperature that is 2.7 to 3.6°C higher than current levels, bringing warmer summers and winters.**
- › **A longer growing season by as much as 30 days for both the spring and fall.**
- › **A 59+ mm increase in annual average rainfall, with more precipitation occurring in the winter months.**
- › **More than twice as many days above 30°C (26 days a year, versus the current average of 12) and several days that exceed 40°C annually.**
- › **More frequent heavy rainfall, hail, freezing rain, and snow storms.**
- › **A 33% increase in the intensity of extreme storms.**

Climate change poses considerable risk to the well-being, economic potential, and evolution of the city. Examples of threats include the destruction of infrastructure, privately owned buildings, and resources from severe weather events; delays in business supply chains; reduced reliability of transit and commuting in general, health risks, including the geographic expansion of infectious diseases, and an increase in extreme weather events.

¹⁹ "Ontario plans to do an assessment on the impact of climate change. 2019. CBC. "<https://www.cbc.ca/news/canada/toronto/ont-climate-assessment-1.5351577>

²⁰ York Region Climate Futures. 2016.

Climate scientists have already documented a host of impacts from climate change, including droughts, flooding, sea level rise, more frequent and destructive storms, global ecosystem decline, loss of biodiversity, food and water scarcity, and increased disease. Their models project that climate-driven impacts could become catastrophic without rapid, deep cuts in future emissions.²¹

No municipal government, or any organization for that matter, can address climate change on its own. Making a significant dent in the reduction of global GHG emissions will be the result of cumulative small steps and bold, broad-scale measures. Richmond Hill recognizes the need to work with other levels of government, agencies, the community, businesses and stakeholders to do our part in reducing GHG emissions.

²¹ “Recalibrating climate prospects” Environmental Research Letters. Lovins et al. 2019. Retrieved from: <https://iopscience.iop.org/article/10.1088/1748-9326/ab55ab>

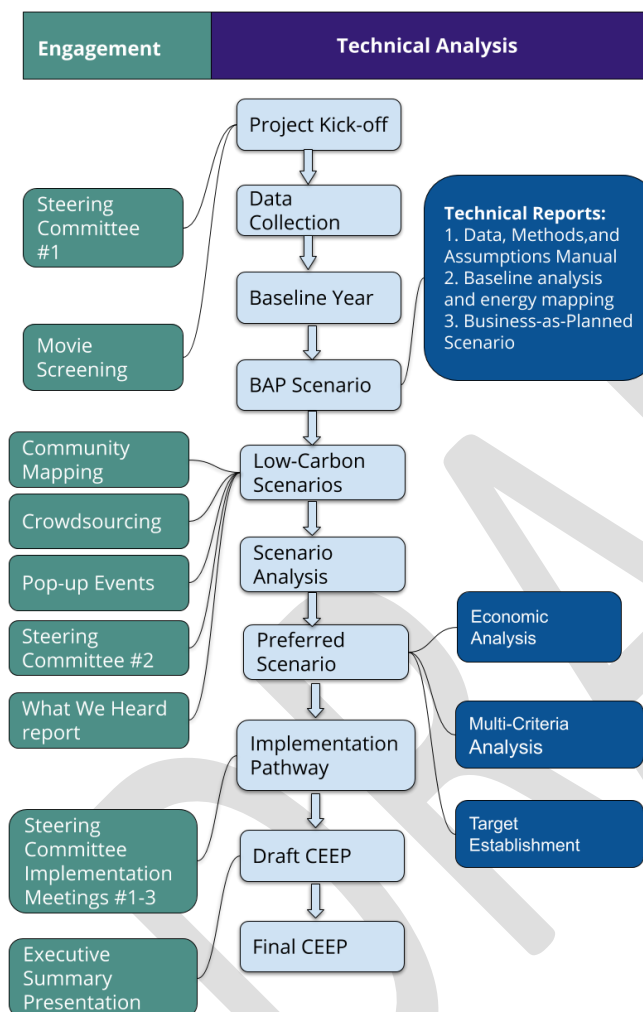
Terms and Acronyms

BAP: Business-as-Planned Scenario
 CAFÉ: Corporate Average Fuel Economy
 CEEP: Community Energy and Emissions Plan
 DE: District energy
 EPA: Environmental Protection Agency
 EV: Electric vehicle
 FCM: Federation of Canadian Municipalities
 GHG: Greenhouse gas
 GJ: Gigajoule
 HDV: High-density vehicle
 HELP: Home Energy Loan Program
 ICI: Institutional, commercial, and industrial
 IESO: Independent Electricity System Operator
 IPCC: Intergovernmental Panel on Climate Change
 J: Joule
 kWh: Kilowatt hour
 ktCO₂e: Kilotonnes carbon dioxide equivalent
 MTSA: Major Transit Station Area
 MW: Megawatt
 NEB: National Energy Board
 O&M: Operations and maintenance
 OPO: Ontario Planning Outlook
 PACE: Property Assessed Clean Energy
 PJ: Petajoule
 PV: Photovoltaics
 RNG: Renewable natural gas
 ROPEC: Robert O. Pickard Environmental Centre
 SCC: Social cost of carbon
 tCO₂e: Tonnes carbon dioxide equivalent
 TGS: Toronto Green Standard
 TJ: Terajoule
 UNFCCC: UN Framework Convention on Climate Change
 VKT: Vehicle kilometres travelled
 WWTP: Wastewater Treatment Plant

How This Plan Was Created

The Resilient Richmond Hill Path to a Low-Carbon Future (Low-Carbon Strategy) is a community energy and emissions plan (CEEP). It was developed over a two-year period starting in 2019.

Figure 1: Engagement process and technical analysis flow for developing the Low-Carbon Strategy



This Low-Carbon Strategy details a pathway for Richmond Hill to reduce its net GHG emissions to zero through a range of low-carbon actions (policies and programs to reduce emissions). The process of identifying the low-carbon actions and GHG emissions target in the plan involved three steps:

1. A technical analysis by SSG and the City;
2. Community engagement to capture residents' vision for the future and to crowdsource ideas for low-carbon actions; and
3. The creation of an emissions reduction target for Richmond Hill in consultation with key stakeholders.

The process, as shown in Figure 1 to the left, began with a kick-off meeting between staff and SSG to schedule the delivery of key milestones related to the technical analysis: a baseline energy analysis, a Business-as-Planned Scenario (BAP), and a Low-Carbon Scenario.

As technical analysis continued, the City informed citizens about the concepts, structures, and strategies to mitigate climate change and led a process to identify a vision for “Resilient Richmond Hill”. Regular reporting through the steering committees shared highlights from community feedback, as well as insights from the technical analysis of the city’s energy and emissions profile. A “Technical Advisory Committee” represented internal staff and policy makers and an “External Advisory Committee” represented major stakeholders within the community.

2014

Business as Planned in Richmond Hill

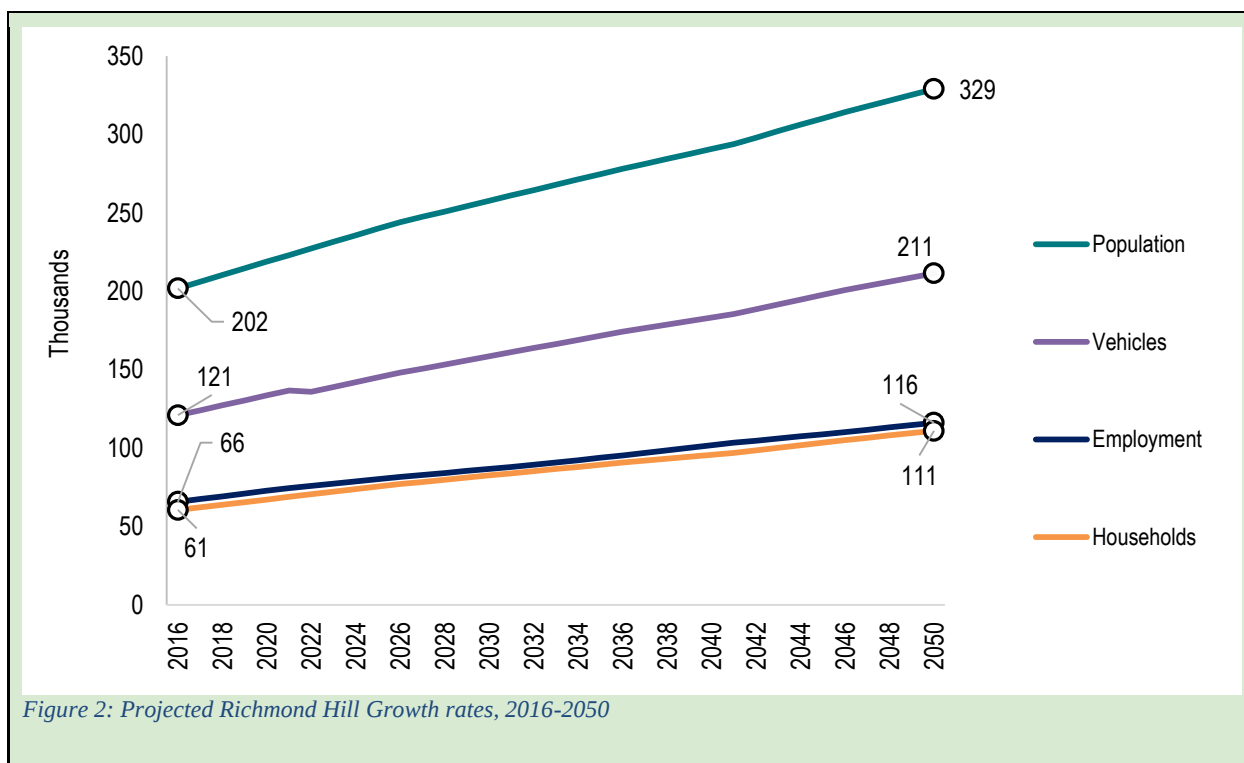
As described above, the technical analysis of the CEEP began with collecting baseline data of Richmond Hill’s energy consumption and GHG emissions. Then, a series of assumptions about the city’s future growth and mobility patterns was used to develop future scenarios. The Business-as-Planned (BAP) Scenario represents a forecast of energy consumption and GHG emissions in the city if current practice unfolds.

Under the BAP scenario, energy consumption is projected to increase by 26% and GHG emissions are projected to increase by 8% by 2050. Richmond Hill be unable able to meet any climate targets in the next critical 30 years.

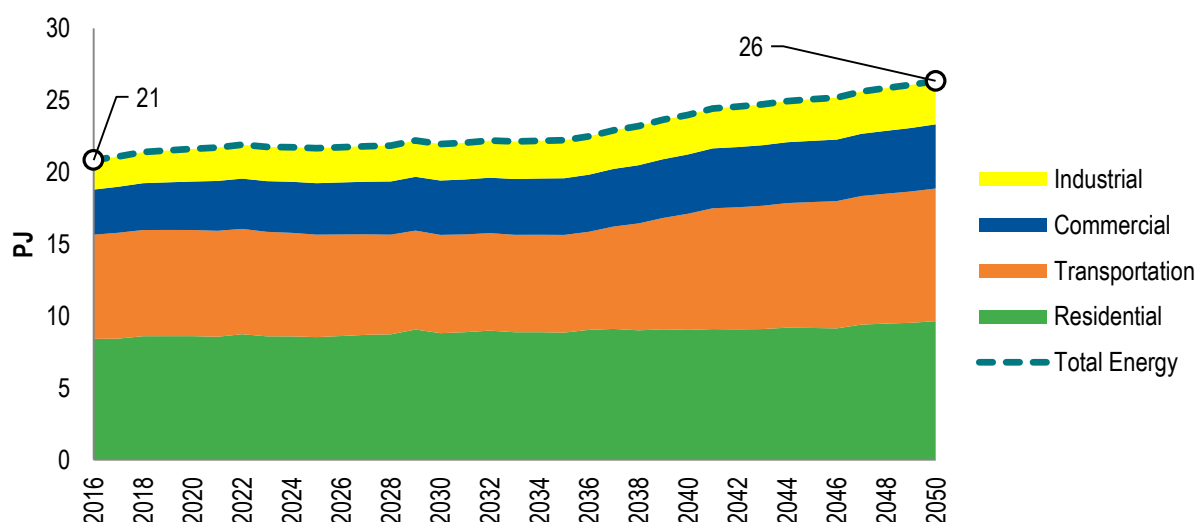
Growth in Richmond Hill

Demographics are an important driver of energy consumption and, therefore, GHG emissions. The Richmond Hill population is steeply increasing and is projected to be 63% greater in 2050 compared to 2016.²² Construction of employment centres and housing, as well as other sources of emissions, will follow suit.

²² This is based on current City projections and will be updated as a part of the Regional Municipal Comprehensive Review and The City’s own Official Plan Update, both of which are underway.



The BAP scenario reflects assumptions on how residents will live and move around, how businesses operate, and how energy is consumed over the next 30 years. The two largest sources of energy in the community today and in the future are gasoline and natural gas, both of which emit GHGs. The BAP assumptions about these sectors reflect the city's historic pattern of growth as a suburban community, where residents primarily commute to other municipalities for work and are likely to drive personal vehicles to get there.



By fuel source in the BAP, the main sources of GHG emissions are natural gas, gasoline, and diesel, which add up to almost 1 MtCO₂e in 2050. These fuel sources are used for space heating in buildings and transportation.

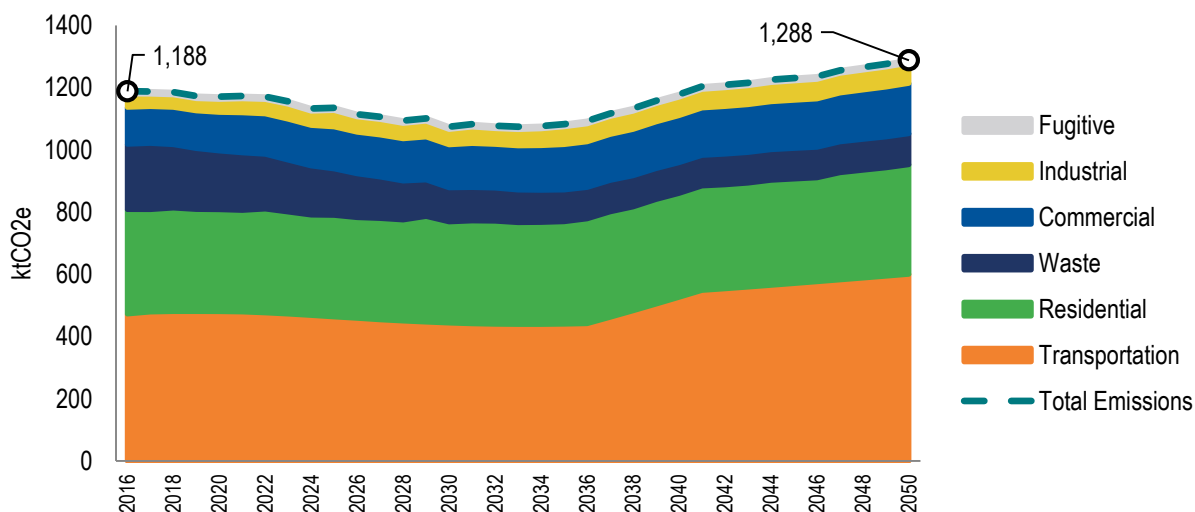


Figure 4: Community GHG emissions, BAP Scenario, 2016-2050.

Opportunities to reduce GHG emissions identified from the baseline year (2016) and BAP analysis include:

1. Implementing a GHG standard for new construction to decouple GHG emissions from growth in the residential and non-residential building stock;
2. Implementing deep energy retrofits for the existing building stock;
3. Switching to electric heating and water systems, from those powered by natural gas; and
4. Facilitating the rapid uptake of electric vehicles.

These four actions alone can decrease community emissions by nearly 500 ktCO₂e, or a 45%, by 2050.

The Target

NET-ZERO GHG EMISSIONS

BY 2050

Net zero signifies that, by the year 2050, Richmond Hill will have reduced its GHG emissions as much as possible and will not be emitting more than it is offsetting.

Arriving at our target

Developing and agreeing on a GHG emissions target was a critical component of the engagement process. Low-carbon actions were identified through community input from a crowdsourcing survey and workshops were used to determine actions and a level of ambition for the city. The team identified options for a low-carbon pathway that align with the latest science and the targets of neighbouring jurisdictions, including targets proposed for York Region.

Informed by this process, a low-carbon pathway to achieve net-zero GHG emissions by 2050 was presented in an interim report to Council in December 2020 as the basis for drafting this plan.

Vision: Richmond Hill as a Resilient and Low-Carbon City

By 2050, Richmond Hill will be a thriving, resilient, low-carbon community with a diversified and strong economy. Thanks to the leadership of the City and the efforts of residents and businesses, Richmond Hill will have done its part to reduce GHG emissions to mitigate catastrophic climate change and, in the process, boosted renewable energy and zero-carbon construction.

In 2050, the vision for a low-carbon city includes rooftop gardens and bioretention gardens/LIDs across the city and more trees everywhere. The air is cleaner and everyone is healthier. Those who own a car have an electric one that doesn't emit any pollution. On many days, people don't use their cars at all. All essentials are a short walk away, there's more bike paths than ever, and the subway shuttles residents downtown within minutes. Everything—the lights, heating and air conditioning, computers, public buses—is powered by electricity generated from renewable sources like hydro, wind, and solar.

This Low-Carbon Strategy envisions an alternative to a business-as-planned (BAP) scenario. In the BAP future, Richmond Hill would continue to see rising GHG emissions, fossil fuel consumption, and greater infrastructure costs associated with a growing city and population. In contrast, this low-carbon strategy envisions a future in which the City has taken a bold approach to successfully balance economic needs with investment in climate action. In the low carbon future, Richmond Hill would be a world-class city that fosters an innovative, prosperous green economy alongside a healthy urban environment in which residents can reach key amenities within a 15-minute walk, bike ride, or transit trip.

This low-carbon strategy is community driven. The entire Richmond Hill community is invited to take part in its transformation. To implement this strategy and become a low-carbon city, the City of Richmond Hill must work together with residents, businesses, and all levels of government. Together, they can achieve the 29 climate targets outlined in this plan.

The Net-Zero Pathway

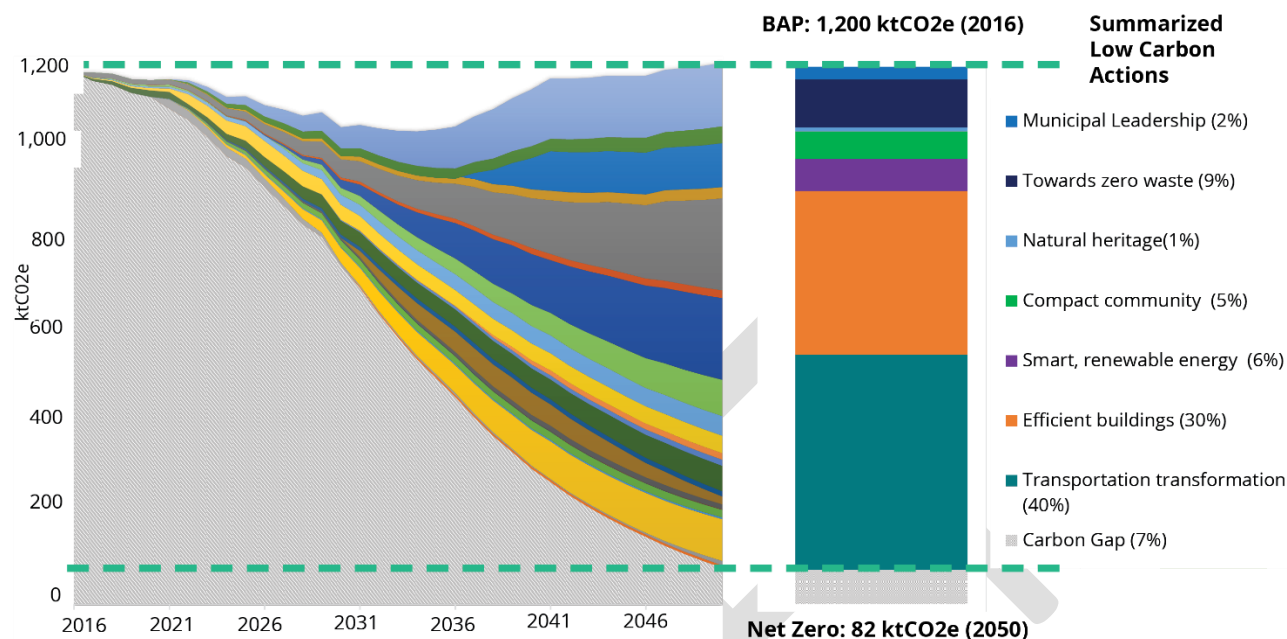


Figure 5: Summarized low-carbon actions for Richmond Hill

Figure 5 illustrates the impacts of actions in the Net-Zero Scenario on GHG emissions. On the left side of figure 5, emissions reductions from each action are represented by different colours, while remaining GHG emissions are represented by the hatched grey area. On the right side, the reductions are grouped by their program areas. In the Net-Zero Scenario, GHG emissions in Richmond Hill are 93% below 2050 levels in the BAP Scenario

A Note on Scenario Modelling

The modelling process sheds light on the impacts of low-carbon actions, as well as how they relate to and impact one another. Twenty-nine sub-targets were modelled in the Net-Zero Scenario. Each action was modelled with assumptions and parameters, which are explained in detail in the Technical Report that accompanies this strategy.

In brief, each action was modelled in two steps. First, assumptions for each of the actions were modelled to quantify the emissions reduction impact against the BAP scenario. Then, the model was used to develop the Net-zero Scenario, wherein all actions were modelled together to capture interactions between the actions. Scenario modelling and low-carbon planning is an iterative process where actions to reduce energy demand are modelled before actions that increase efficiency or involve switching to low-carbon fuels. For example, actions that increase walking and cycling are considered before those that involve switching to electric vehicles.

What We Need To Do

In order to achieve net-zero emissions by 2050, Richmond Hill must take action on seven program areas that have the largest and most transformational effect on the city's emissions. These are detailed in Table 1 and ordered by largest areas of impact.

Table 1: Program areas for a low-carbon future

Program Area	Proportion (%) of Community GHG Reductions	Selected Sub-Targets
Transportation Transformation	40%	65% of trips within the city are done by transit, walking, and cycling. 100% of new vehicle sales are EVs by 2040
Efficient Buildings	30%	80% of buildings are retrofit for energy efficiency, and switch to electric heat pumps and electric water heating.
Smart, Renewable Energy	6%	- Rooftop solar is incorporated on 50% of buildings by 2050. 50MW of ground-mount solar and 50MW of wind generated-energy are added to the grid by 2050.
Towards Zero Waste	9%	95% of organic waste is sent to an anaerobic digester.
Compact Community	5%	90% of new development occurs along Yonge Street, HWY 7, or selected infill areas.
Municipal Leadership	2%	- All municipal buildings are zero-emissions. - The corporate fleet is electrified.
Natural Heritage	1%	Complete implementation of the Urban Forest Management Plan

The following outlines the sub-targets and priority actions for each program area. The sub-targets bring some granularity to the Net-Zero Target. These visionary sub-targets define the vision and future state for each area of action and set the direction for the actions to be taken. The full list of actions in each program area is discussed in the Implementation Strategies section.

Program Area 1: Transportation Transformation

Theme	Program Specific Sub-Target(s)	Short Term Priorities
Increase/improve cycling and walking infrastructure	1. 65% of trips within the city are completed by walking and cycling and transit use by 2050. Walking and cycling take the majority of trips up to 2km and 5km respectively.	1.1 Develop levels-of-service standards for active transport users in MTSAs and prioritize them over vehicle standards. 1.2 Formalize a complete street standard for all streets in Richmond Hill, starting with MTSAs.
Add e-bikes and car shares to Richmond Hill	2. Facilitate e-bike and car share services to achieve 25% of trips that are 10km or under by 2050.	
Electrify personal vehicles	3. Establish aspirational targets for zero-emission vehicles to make up 10% of light-duty vehicles sales per year by 2025, 30% by 2030, and 100% by 2040.	1.3 Develop a regional EV charging network. 1.4 Investigate bylaw and other policy options to limit heavy diesel vehicles in MTSAs.
Electrify transit 100% by 2040	4. Electrify 100% of the transit service by 2030.	
Expand transit	5. Target expansion of the Yonge subway line beyond Richmond Hill Centre. 6. Build out the BRT/ViVA network by 2040.	
Low-carbon heavy vehicles	7. By 2030, MTSAs in the city permit light-electric vehicles only, and, by 2040, mostly electric or hydrogen heavy trucks in the city.	

Through increased active transportation, the sub-sector targets highlight how Richmond Hill residents can reduce energy demand and GHG emissions by simply choosing to walk or cycle, and how the City can help make that option more attractive to them.

Work in this program area begins by reducing the number of vehicles in the city, the number of kilometres driven, and the percentage of vehicle trips completed by solo drivers. Active transport and improvised transit infrastructure further shifts trips away from vehicles. The implementation of complete streets city-wide, along with level-of-service guidelines, will enable pedestrians and cyclists to travel freely through the compact city. Shared mobility services, such as bike shares, electric bicycles, and electric car sharing, also help reduce transport emissions.

In order for the city to meet its targets, convenient and affordable alternatives to private vehicles must be available to residents and workers, while also placing restrictions on vehicle movement. In addition to rapid transit and active transport options, services such as car-share, car rental, and ride hailing will be available and accessible by 2050. Services that provide active assistance to travelers in finding the best alternatives, along with ways to assure affordability of using these services, will contribute significantly to this objective.

Quality of life and the city's natural systems will improve as a result of decarbonization of the energy system and, in particular, transportation. A resilient and low-carbon Richmond Hill will have quieter roads,

improved air quality, and reduced toxins and petrochemicals in stormwater runoff. This section describes the interventions for most vehicles that operate in the city today.

Private and Commercial Vehicles

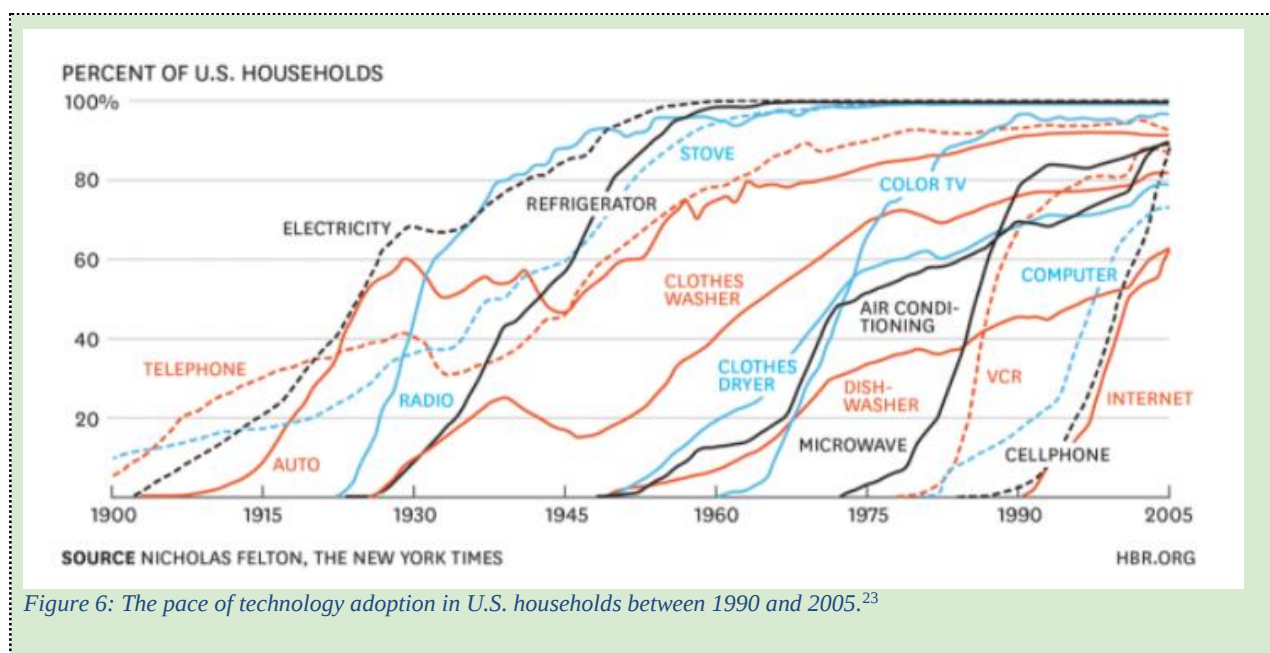
Transportation is the largest source of GHG emissions in Richmond Hill, representing 40% of the community total. Achieving the net-zero target requires a transformative shift to zero-carbon transportation and a fundamental change in how citizens move around the city. This transformation of the transportation system includes fuel-switching personal vehicles from gasoline and diesel fuel to electric, with a parallel shift occurring with heavy vehicle technologies. Heavy vehicles will also have to transfer their cargo to lighter vehicles for delivery completion in the MTSAs.

Transit

Transit service will be more robust and accessible for all citizens of Richmond Hill while also being powered by electricity. Many transit authorities across the world are actively adding more battery powered buses, with leaders suggesting that 100% of their rolling stock will be electrified by 2050 at the latest. Benefits include reduced noise in the city and savings for the authority in fuel expenditures and maintenance. York Region Transit will employ battery electric buses across its expanded rapid-transit network in the city. The City will also benefit from the TTC subway opening in Richmond Hill Centre and advocate for expansion to beyond that.

Technology Adoption Rates

The most dramatic energy shifts in the net-zero strategy are in electric vehicles and the use of heat-pumps resulting in a near-complete elimination of gasoline, diesel fuel, and natural gas use. The strategy assumes the technologies are ubiquitous and that internal combustion engines are effectively eliminated by 2040. Although this timeline may appear to be aggressive, it is consistent with the adoption rates seen for numerous other technologies during the past century, including the automobile itself. Technology adoption rates have also accelerated in recent decades due to the globalization of markets and a more interconnected society in general.



Program Area 2: Efficient Buildings

Theme	Program Specific Sub-Target(s)	Short Term Priorities
New buildings	8. Construct 90% of new residential buildings to meet net-zero energy standards after 2030, and with electric water and space heating. 9. Construct 100% of new non-residential buildings requiring that:²⁴ - Water heating be electric, and - Space heating demand be met by heat pumps.	2.1 Update sustainability metrics to align with net-zero GHG standards or passive house construction. 2.2 Adopt a net-zero building standard that includes specifications for rooftop solar.
Existing buildings	10. Retrofit 80% of existing residential buildings to Passive House energy standards by 2050, including: - Retrofitting buildings with electric space and water heating, and - Switching all existing residential buildings to heat pumps. 11. Retrofit 90% of existing non-residential buildings to net-zero energy standards, including switching to electric space and water heating, as well as heat pumps, by 2050.	2.3 Pilot a Bulk Retrofit Program for an older housing block with multiple parcels. Convert single-detached housing to multi-family as a possibility. 2.4 Implement Property Assessed Clean Energy PACE programs to finance/deliver building retrofits, including heat pumps and solar PV, for different sectors/building types²⁵.
Green roofs	12. Add green roofs, where appropriate, to all new buildings and retrofitted buildings as retrofits occur.	

²³ *The Pace of Technology Adoption is Speeding Up*. September 25, 2019. Harvard Business Review. <https://hbr.org/2013/11/the-pace-of-technology-adoption-is-speeding-up>

²⁴ The Toronto Green Standard progressively improves building energy performance on a graduated timeline towards 2050. Learn more here: <https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/toronto-green-standard/>

²⁵ Two notable PACE programs in Ontario are Toronto's "HELP" and "Hi-RES" financing programs. Learn more at: Home Energy Loan Program – City of Toronto

Theme	Program Specific Sub-Target(s)	Short Term Priorities
Industrial processes	13. Increase efficiency of industrial buildings by 50% by 2030.	

Interventions to make buildings efficient consider both existing and new buildings. Reducing energy demand is the building block of all the actions. Switching away from fossil fuels for space and water heating is also required. This program area is related to the rooftop solar generation and district energy targets described in Program Area 3: Smart, Renewable Energy. Existing, new, and net-zero buildings will be discussed in this section.

Existing Buildings

Building renewal will play a central role in meeting the City's climate target. Nearly all buildings in existence today need to be retrofitted to improve their thermal performance and to fuel switch to electricity for space and water heating. Through this transformation, zero-emissions buildings will become the norm in 2050. Meeting this goal will require a standard energy goal (i.e. Canada Green Building Council's Zero Carbon Building Standard).²⁶ In addition, retrofits must be accessible, financially affordable, and rapid in order for the targets to be met. The City must provide leadership and collaborate with a range of community partners to scale up this effort; it is expected that the majority of investments will come from the private sector and building owners. Strategies to enable retrofits across Richmond Hill are identified in the Implementation Strategies section.

New Buildings

New buildings will be highly efficient and use renewable energy in order to meet the Net-Zero Target. Richmond Hill anticipates a high rate of growth over the next 30 years; if more new buildings that meet net-zero GHG targets are built today, fewer buildings will require retrofits later.

Through the City's Sustainability Metrics initiative, a framework to improve building performance and the local environment near the site is required and voluntarily requested to move to higher performance. Through the points-based system, new buildings are pushed to meet energy performance standards such as LEED Buildings. New approaches to building performance will enhance building envelope design and construction; improve efficiencies for mechanical systems, appliances and lighting; and stimulate intelligent building management systems.

The actions in this strategy require engagement and partnerships, as the City cannot implement them alone. The Region, construction and development industries, and the Province of Ontario are among the key partners. The City will advocate for progressively more stringent energy efficiency requirements for new builds and retrofits, particularly for new multi-family developments.

Net-Zero Buildings

A net-zero building can refer to either a *net-zero energy* or *net-zero emissions* building. Both measurements are important and often work side-by-side. A net-zero energy building is one that primarily

²⁶ Zero Carbon Buildings: Information. N.d. CaGBC. Retrieved from: https://www.cagbc.org/CAGBC/Zero_Carbon/The_CaGBC_Zero_Carbon_Building_Program.aspx

reduces energy consumption as much as possible through site orientation, envelope (building wall) thickness, efficient appliances, and heat saving windows and doors. These measures prepare the building for solar PV generation. A net-zero emissions building, or “Zero-Carbon Building”, goes a step further by eliminating fossil fuel power used for space heating and water heating, which is often serviced by natural gas in Richmond Hill.

Arguably, zero-carbon buildings are a better target measurement when considering climate change. The key components of a zero-carbon building are:

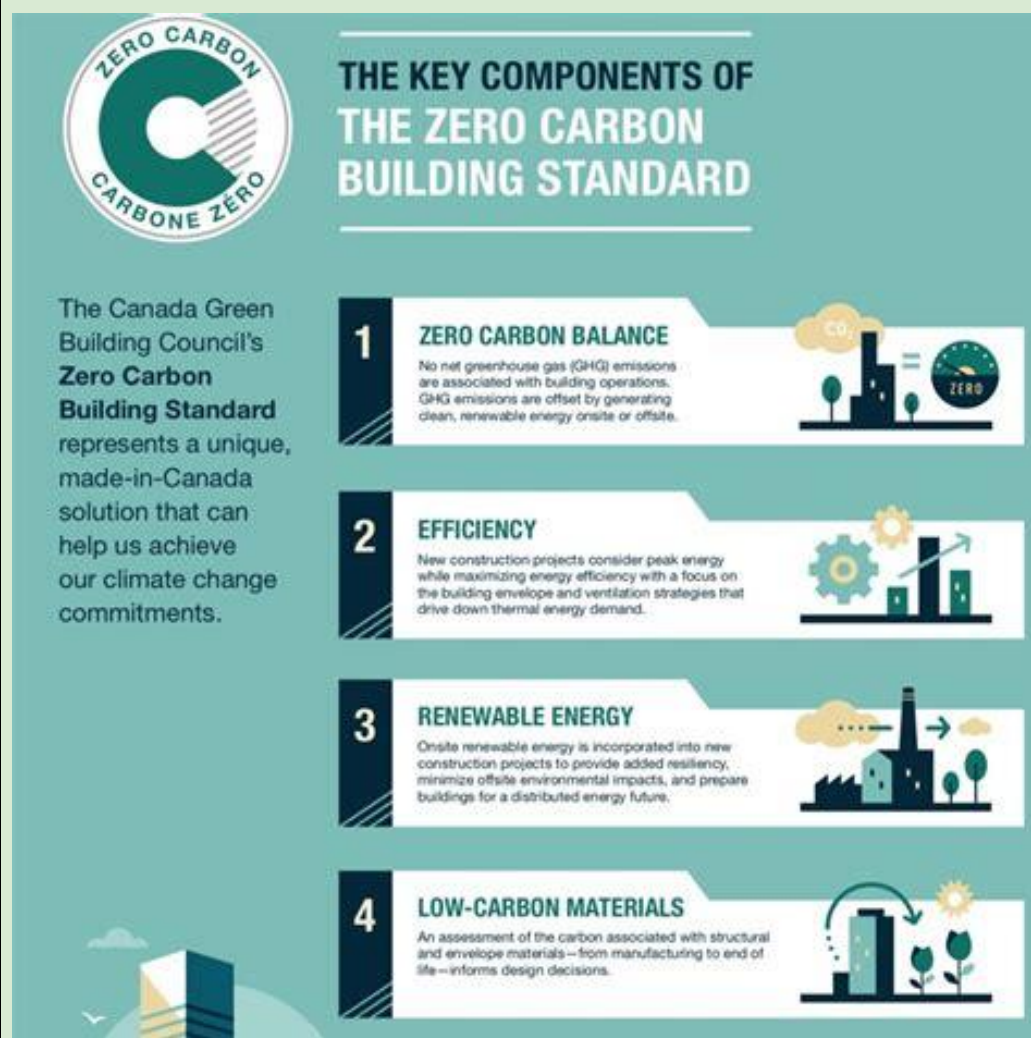


Figure 7: Principles of the Zero Carbon Building Standard, Canada Green Building Council, 2019.

Program Area 3: Smart, Renewable Energy

Theme	Program Specific Sub-Target(s)	Short Term Priorities
Increased rooftop solar electricity generation	14. 50% of buildings in Richmond Hill have rooftop solar by 2050 and that generation accounts for 50% of their energy demand.	3.1 Work with neighbouring municipalities to develop a renewable energy cooperative.
Renewable energy storage	15. Install energy storage to optimize the use of renewable energy. ²⁷	3.2. Invest in opportunities for solar PV on parking lots and on large buildings
District energy	16. Install district energy system by 2030, with 100% of energy from low-carbon sources.	3.3. Create a by-law requiring new builds to be district energy ready.
Community/ground solar	17. Install 150 MW of solar energy from 2020 to 2050, or an average of 5 MW/year, including 14 MW on city parking lots.	3.4 Develop investment opportunities for battery storage and/or microgrids.
Community/wind power	18. Access/support the development of 50 MW of wind capacity outside of the city by 2050.	
Renewable natural gas/hydrogen	19. Meet remaining natural gas demand in the system, after electrification and fuel switching, with renewable natural gas and hydrogen.	

Smart and renewable energy serves many purposes in the low-carbon future. There will be more electricity demand to power electric vehicles and homes, including for space and water heating. At the same time, the city must use almost no fossil fuels. This program area delineates a strategy to enable the city to switch to other sources of energy. Community generation, district energy, and renewable heating are key things that can be done to help achieve this transition.

Smart and Renewable Electricity Through Community Generation

Renewable energy is critical in facilitating the growth of carbon-free energy consumption. Generation from rooftop solar PV, ground solar PV, and wind reduce carbon intensity from electricity.²⁸

The generation of large amounts of local renewable energy has four major purposes:

1. To respond to the growing demand for electrification that will occur naturally through population growth and anticipated growth of electric vehicles;
2. To respond to further efforts towards electrification of space heating through, primarily via heat-pumps;

²⁷ Curtailment essentially refers to the loss of renewable energy potential when the energy is not directly being used. The energy is “turned off” or dumped because it has no use. Energy storage enables greater use of renewable energy by saving it for a different time, thus reducing curtailment. Read more: <https://physicsworld.com/a/curtailment-losing-green-power/>

²⁸ The Ontario Energy Grid is anticipated to increase in carbon intensity after 2030, reflecting increased use of natural gas peaker plants to meet peak demand periods. This can mitigate the goals of Net-zero strategy. Carbon intensity is taken from: Ontario Annual Planning Outlook 2020. IESO

3. To provide enough clean energy to displace the projected Ontario grid GHG emissions; and
4. To create economic development pathways through keeping energy dollars within the community (dollars re-invested)²⁹ and new ventures, including green-hydrogen development.³⁰

This program also anticipates the need for energy storage and smart consumption of energy.

District Energy Heating in Richmond Hill

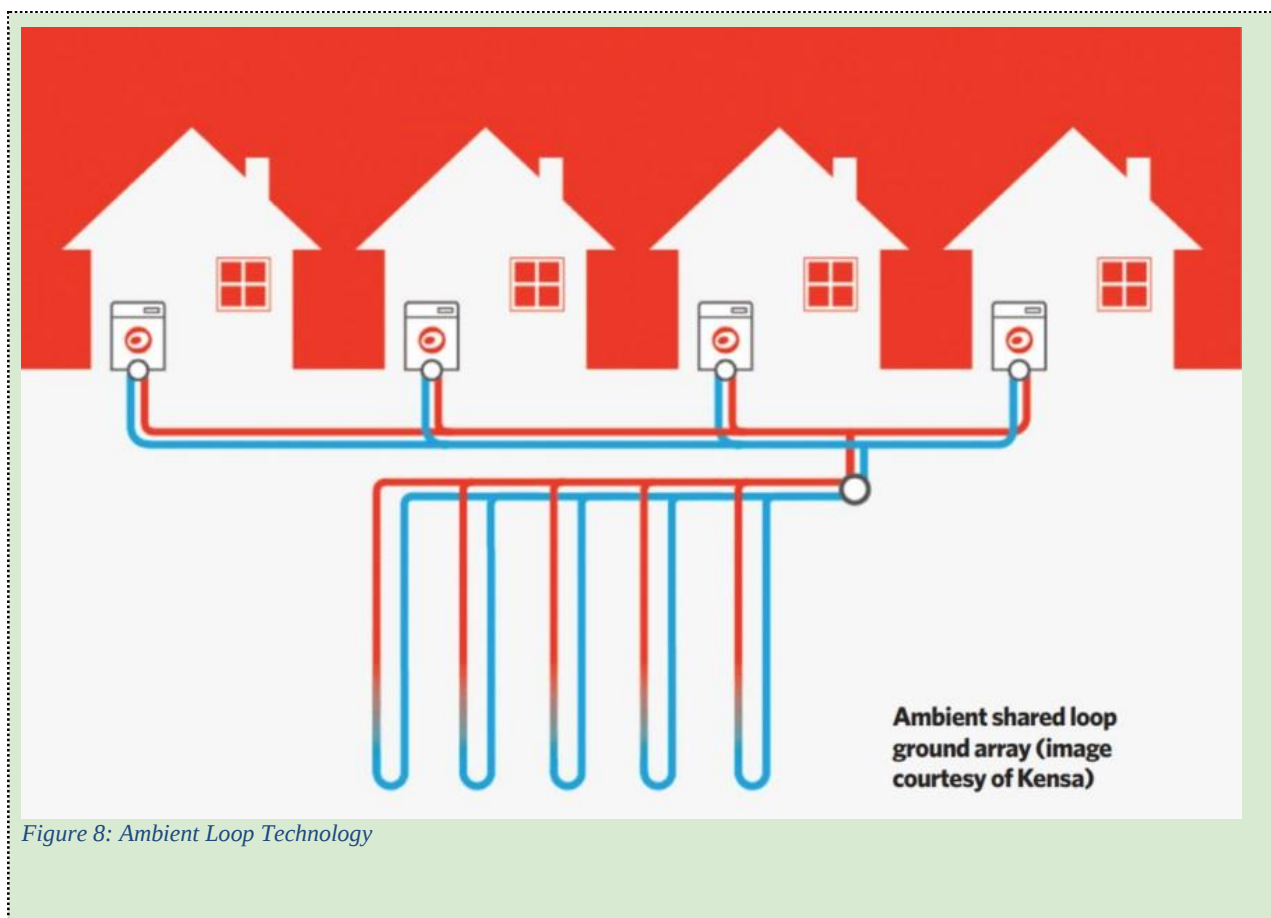
Canada is home to some of the most innovative district energy and heating systems in the world, as exemplified by Toronto's Deep Lake Water Cooling System and systems across Canada which recycle waste heat rather than generation from combusting materials. Richmond Hill could build on this work by introducing a district energy low-carbon ambient heating loops system for Richmond Hill Centre (technology explained below). District energy can complement many different low-carbon actions in the low-carbon future. In dense areas, district energy systems can take advantage of heat that would otherwise be wasted, improve resiliency in the event of grid outages, and reduce peak demand for heating during colder periods.

Ambient Loop District Energy

The initial design envisions a thermal grid consisting of a network of water pipes that circulate heat energy across the building, site, and neighbourhood levels. These pipe loops can transfer energy to one another through "heat exchangers" or devices that enable heat to cross into a new pipe without losing energy. This ambient-loop system interfaces well in dense, mixed-use environments that have different heating requirements. The system also interfaces well with heat-pump technology, which can facilitate heat transfer by accepting or rejecting additional heating load requirements.

²⁹ A large proportion of energy dollars spent primarily on gasoline, fuel oil, and natural gas leaves the Richmond Hill Boundary and cannot be re-invested into community ventures.

³⁰ Green Hydrogen is a hydrogen generated through renewable energy and is a promising fuel source due to its portability and function for space-heating as well as in transportation that requires higher loads (freight vehicles, cargo ships, and airplanes)



Renewable Natural Gas and Hydrogen

Warming and powering buildings without fossil fuels is an ambitious, but necessary, strategy: eliminating natural gas use for space heating, water heating, and appliances is essential for Richmond Hill's net-zero target. To some degree, the city will have to switch to renewable natural gas (RNG) and hydrogen. Under the Low-Carbon Strategy, RNG and hydrogen will be produced locally, where possible, before being procured over the grid/pipeline. RNG is typically generated through anaerobic digestion or landfill gas capture, is carbon neutral, and can be blended with existing natural gas infrastructure easily. (See Program Area 8: Towards Zero Waste for more information.) The analysis for this strategy assumed that only green hydrogen energy, which is produced through electrolysis (using electricity to create hydrogen from water) and fueled through clean energy, is used.

Hydrogen has a small role in this plan, but it could have larger impacts on the energy system in the future. Hydrogen can be used for industrial processes but can also be blended with the natural gas distribution network. However, hydrogen must be distributed in natural gas distribution networks at concentrations of an estimated 5-15% of total volume.³¹ Otherwise, it can damage infrastructure. Hydrogen can also be a primary fuel for freight and heavy vehicles, but this use is embedded in the analysis of electric vehicles.

³¹M. W. Melaina, O. Antonia, and M. Penev (2013). *Blending Hydrogen into Natural Gas Pipeline Networks: A Review of Key Issues*
<https://www.nrel.gov/docs/fy13osti/51995.pdf>

Program Area 4: Towards Zero Waste

Theme	Program Specific Sub-Target(s)	Short Term Priorities
Waste and Wastewater	20. Divert 95% of organic waste to anaerobic digestion and Reduce water consumption to achieve a 25% reduction in water/wastewater consumption (behaviour change, leak detection system, greywater reuse).	4.1 Add organic waste collection to multi-family and commercial buildings. 4.2 Identify a site for anaerobic digestion of wastewater and organic waste.
Create biogas from wastewater treatment	21. Increase methane recovery to approximately 100% by 2050 at Duffin Creek Water Pollution Control Plant.	

The most effective way to reduce GHGs from waste is to reduce the waste generated in the first place, which also avoids the costs of landfilling and composting. Opportunities to reduce organic waste and GHGs include changing consumer and business behaviours, as well as better design and planning. Scaling up collection of organic waste ensures it has a useful end use. Capturing that methane and using that renewable natural gas has many co-benefits to the low-carbon pathway.

Waste to Energy

After waste diversion, several interventions to capture emissions and convert them to useful energy round out the net-zero pathway. When separated out from the start, food waste can be converted into a clean energy source through a process called anaerobic digestion; this process breaks down organic material biologically, just like a stomach breaks down food, creating biogas (or renewable fuel). Richmond Hill will partner with York Region and Durham Region to consider a large-scale anaerobic digester for organic solid waste and wastewater collected at wastewater treatment plants.

Once the biogas and RNG is extracted, it can be used to fuel a variety of different end uses in the city, including powering heavy vehicles or heating homes in the transition period to zero carbon sources. The dehydrated waste can also be used as a source of rich compost for gardening or local food production.

Zero Waste Stores

Canada has banned the use of single-use plastics in the country by 2021.³² Richmond Hill also has a three-point plan to encourage the reduction of single-use plastics within its community. In order to reduce plastic waste, many businesses across Canada are encouraging a movement back to how we used to shop. This means making everyday purchases by bringing your own containers or choosing unwrapped items.

Zero waste stores are an effective way to begin the movement in reducing plastic waste in our households and can spark a greater transition among larger grocery chains. As the business idea gets more traction in

³²“Zero Plastic Waste.” 2020. Government of Canada. Retrieved from: <https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/zero-plastic-waste/canada-action.html>

communities, Richmond Hill can help support such initiatives as a first step towards more waste diversion.



Figure 9: Zero waste groceries³³

³³ "Zero waste lifestyle - cereals and muesli in glass without packaging" by markus spiske is licensed under CC BY 2.0

Program Area 5: A Compact Community

Theme	Program Specific Sub-Target(s)	Short Term Priorities
Compact land use and denser housing	22. Ensure 90% of new development takes place along Yonge Street, Highway 7 and identified Infill Areas.	5.1 Adopt a target of 90% infill development for new homes and non-residential buildings.
	23. Promote multi-residential housing development.	
Car-free zones	24. Add Car-Free Zones to Richmond Hill Centre by 2030.	

The Low-Carbon Strategy requires the development of compact communities, which are inherently low-carbon because they require less energy to power buildings and transport. Compact communities are characterized by more infill development, higher density, and mixed-use buildings that use less energy, and prioritizes walking and cycling.

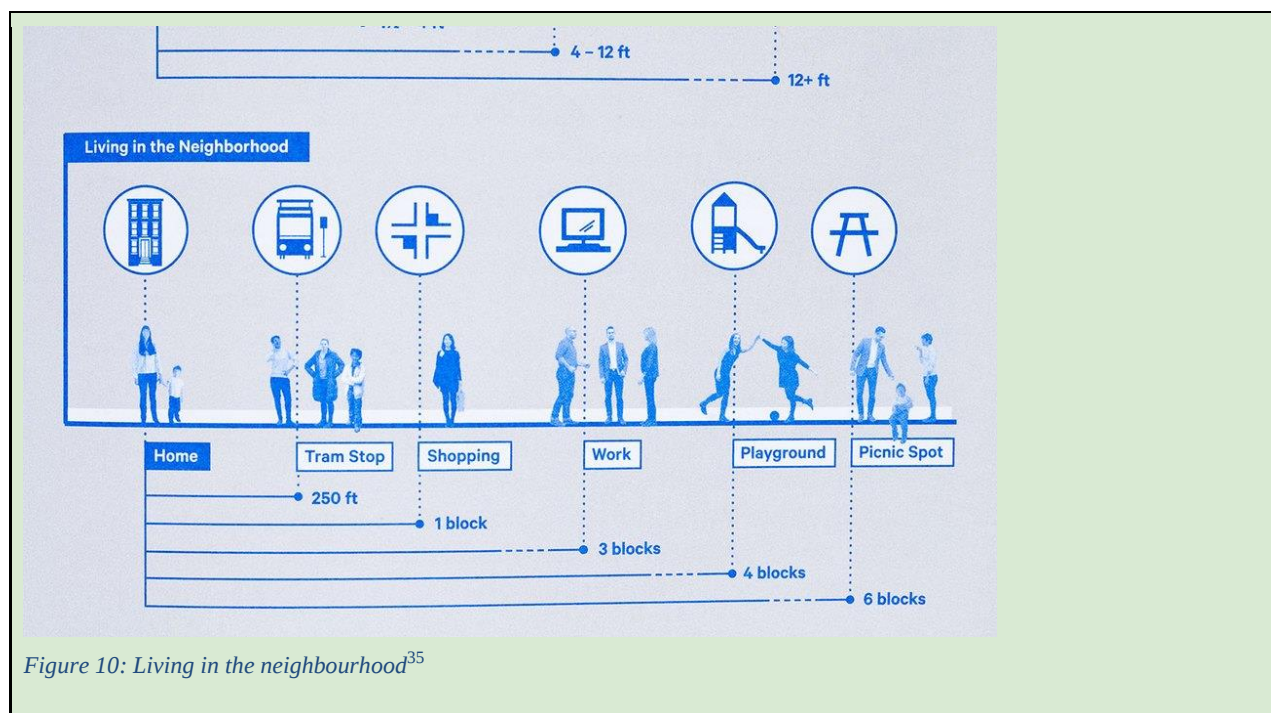
Geographically, Richmond Hill is a small city covering approximately 100km² and has an opportunity to create better access to jobs, services, and recreation through intensification and infill where appropriate. Richmond Hill can accommodate population growth by promoting more compact forms of housing, secondary suites, and mixed-use developments that support transit viability and live-work buildings.

Richmond Hill will become a city of neighbourhoods by developing 15-minute districts along Yonge Street and the City's southern border. 15-minute districts are areas where residents can access their daily needs within a 15-minute travel time by walking, rolling, biking or transit. Many areas of Richmond Hill will still be car-accessible, but the incentive and infrastructure to choose alternative forms will be attractive and available city-wide. Richmond Hill Centre will incrementally limit car travel as it develops over time and will increase car-free sections by 2030.

Walkable cities are more resilient because they are accessible and low carbon

While the term “15-minute districts” is a relatively new term with origins in Paris, France³⁴, the principle of living near core amenities of everyday life has been entrenched in community planning efforts for the past 30 years. Approaches such as Smart Growth, Transit-Oriented Development, and Compact Communities focus on enabling residents to quickly reach amenities like grocery stores, restaurants, work, the gym, libraries, and parks. This action perhaps has the greatest co-benefits amongst all climate mitigation strategies, as it results in increased accessibility for those who cannot drive (elderly, youth, new immigrants), increased ability to participate in the economy and workplaces, quieter streets that de-prioritize vehicle movement, better air quality, better connections to neighbours and society. The walkability matrix visualizes life in Richmond Hill Centre under this vision.

³⁴ Paris: 15-minute city plan. <https://www.theguardian.com/world/2020/feb/07/paris-mayor-unveils-15-minute-city-plan-in-re-election-campaign>



Program Area 6: Municipal Leadership

Theme	Program Specific Sub-Target(s)	Short Term Priorities
Zero-emissions municipal buildings	25. All municipal buildings are net-zero carbon by 2030 and all future buildings meet this standard by 2030.	6.1 Adopt a “Climate Lens” for city decision-making.
Zero-emissions municipal fleet	26. Convert municipal fleet to 100% electric by 2040.	6.2 Develop a Green Bond program to finance low-carbon initiatives.
Climate education	27. A sustainability education plan is launched by the city to reduce GHG emissions and energy consumption, particularly those related to transportation and home-based work.	6.3 Adopt a zero-emissions standard for municipal buildings.
		6.4 Develop an engagement program to inform and gather input on zero-emissions building standards from the local construction and development community.
		6.5 Advocate to upper levels of government for new/implemented legislative/regulatory tools to aid the City in implementing this plan.

³⁵ Terra Nova: The world after oil, cars, and suburbs. 2013. Eric Sanderson. Retrieved from: <http://newyork.thecityatlas.org/lifestyle/book-review-terra-nova-world-oil-cars-suburbs/>

The City can take leadership on climate action by adopting new technologies, making strategic investments, and creating pilot programs. This section describes priorities for the City to transform its own processes.

The City has already taken on GHG reduction and energy savings measures for municipal operations. In 2019, the City's updated Corporate Energy Plan identified projects and energy management activities to improve energy efficiency and reduce emissions for the 2019-2023 period.

Under the Net-Zero Pathway, the City's capital inventory and investments would be transformed. The City's fleet would be completely powered by zero carbon by 2040, and buildings would be net-zero by 2030. The City will also lead the efforts on educational campaigns to reduce water and energy consumption. Tree planting efforts and carbon sequestration will also be led by the city as discussed under Program Area 7.

Climate change will be embedded in City decision-making through the use of a "Climate Lens". This lens will be used to evaluate all City decisions on investments and planning in alignment with GHG targets.

Program Area 7: Natural Heritage

Theme	Program Specific Sub-Target(s)	Short Term Priorities
Increase carbon sequestration	28. Complete implementation of the Urban Forest Management Plan 29. Develop and implement a Natural Heritage Strategy to increase the quality, connectivity, integrity, and diversity of the natural heritage system	7.1 Develop land-use based tree canopy targets for the city. 7.2 Continue to restore Elgin Mills Greenway. 7.3 Continue restoration and tree-planting in David Dunlap Observatory Park. 7.4 Develop a Natural Heritage Strategy

Richmond Hill's natural heritage and greenspace are an asset that improves livability. The City will improve and enhance this asset by prioritizing development in the city core and encouraging growth within the built-up areas. The City will also maintain and enhance open space through parks and undeveloped areas, which act as carbon "sinks" to reduce community emissions.

The City has begun to restore natural areas of the Elgin Mills Greenway as well as the park restoration project at David Dunlap Observatory. The City will plant approximately 300,000 additional trees in the city by 2050, resulting in an additional 8 ktCO₂e reduction by 2050.

David Dunlap Restoration

The City has prioritized the reforestation of the David Dunlap Observatory Park. The Toronto and Region Conservation Authority (TRCA) and the City of Richmond Hill established a partnership to develop a baseline analysis and a restoration plan for the park. Informed by the Council approved DDO Master Plan and guided by the DDO Conservation Management Plan, the David Dunlap Observatory Study Area Natural Feature Baseline Assessment and Prioritization Report submitted by the TRCA in September 2017 identifies a series of projects and phases to achieve the following objectives:

- Wetland restoration;
- Invasive species removal/management;
- Creation of new woodland communities;
- Improvement of hydrologic function; and
- Creation of new habitat features.



Investing in the Low-Carbon City

Key Numbers compared to the Business-as-Planned*

Energy Consumption in 2050:

34 GJ/capita

(55% decline)

Total additional investment*:

\$8.4 billion

Net benefit of zero-carbon investments:

\$1 billion

New person years of employment, 2020-2050

64,000

Cumulative value of avoided climate damage, 2020-2050:

\$12.3 billion

*2016 Dollars

Investment Summary

Capital investments to fund actions in the Low-Carbon Strategy will be incurred by residents, businesses, the City, utilities, and other levels of government. The incremental investments required to realize the Net-Zero Pathway presented in this analysis total \$8.4 billion (2016 dollars) over the 2020-2050 period, or an average of about \$250 million per year. These investments represent opportunities for existing and future businesses.

The amount that would be spent normally on the activities outlined in this Strategy (i.e. buying a new car or retrofitting buildings) in Richmond Hill (BAP Spending) by government, residents and businesses is in the range of \$2 billion per year, or \$67 billion over the 2020-2050 scenario period. Under the Net-Zero Scenario, the increase in investment to make those activities low carbon would be on the order of 10-13%.

In the early years of transition, capital investments are greater than the savings and revenues generated. During this time, the City and other stakeholders must invest dollars into replacing old equipment, incorporating new technologies, and building or upgrading infrastructure when opportunities arise. From 2032 forward, however, annual savings and revenue begin to increase as energy improvements turn into savings. By 2040, the cumulative benefits outweigh the costs of the programs. By 2050, cumulative net benefits reach \$12.3 billion (\$2016) and are still growing.

Present Value Analysis

The figure below demonstrates the present value analysis for the strategy where a 3% discount value is applied. Present value analysis states that the value of money in the future will be less than it is today. In the net-zero pathway, most actions save and/or generate more money than they cost, as does the plan as a whole.

The figure below reveals the major financial components of the plan, including investments, operations and maintenance (O&M) savings, fuel and electricity cost savings, GHG emission cost savings, and revenue from local energy generation. After discounting, approximately \$5.5 billion (2016 dollars) is spent and approximately \$6.6 billion (2016 dollars) is returned, for a net gain of nearly \$1.2 billion

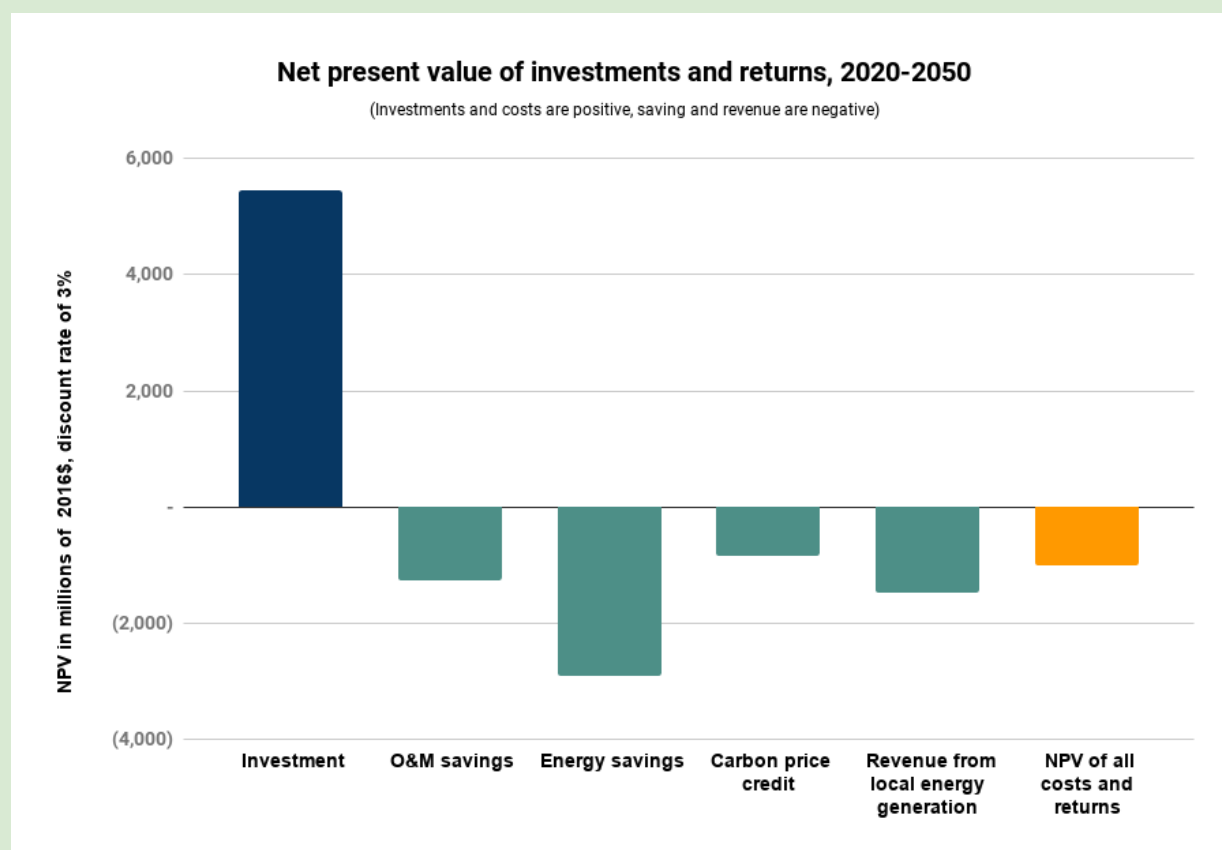


Figure 12: Net present values (NPV), and costs and savings components of the Low-Carbon Scenario. NOTE: Investments and costs appear above the \$0 cost threshold line. Savings and revenue appear below the \$0 cost threshold line.

Transitioning to a low- or zero-carbon economy is expected to create new avenues for employment and economic development in Richmond Hill. Sectors expected to benefit from additional investment include businesses involved in retrofit activities, renewable energy installation and maintenance, as well as transit service operations. Investments in renewable energy and building retrofits will provide opportunities for tradespeople, equipment suppliers, contractors, and associated engineering, legal, and financial services – many of which are part of innovation industries and the knowledge economy. The analysis indicates that these investments will generate new employment locally. The methodology uses employment multipliers to illustrate the effect of projected investments in the Low-Carbon Strategy on person-years of employment over and above the jobs associated with the BAP Scenario.

Commonly used employment metrics suggest that when \$1 million dollars is invested in...³⁶

...**building retrofits**, it is expected to generate **9 person-years** of employment.
Retrofits.

...**community-scale energy systems**, it is expected to generate **8 person-years** of employment.

...**new vehicles**, it is expected to generate **3 person-years** of employment.

Investments for Net Zero Can Generate Jobs in Richmond Hill

Many investments into the Low-Carbon Strategy will have direct benefits for Richmond Hill. The strategy is projected to add over 68,000 person-years of employment, or an average of 2,000 person years of employment per year. These do not necessarily represent new jobs, as some jobs may be displaced or eliminated each year, but they represent new employment opportunities within the city including investment and growth in green industries, knowledge and innovation.

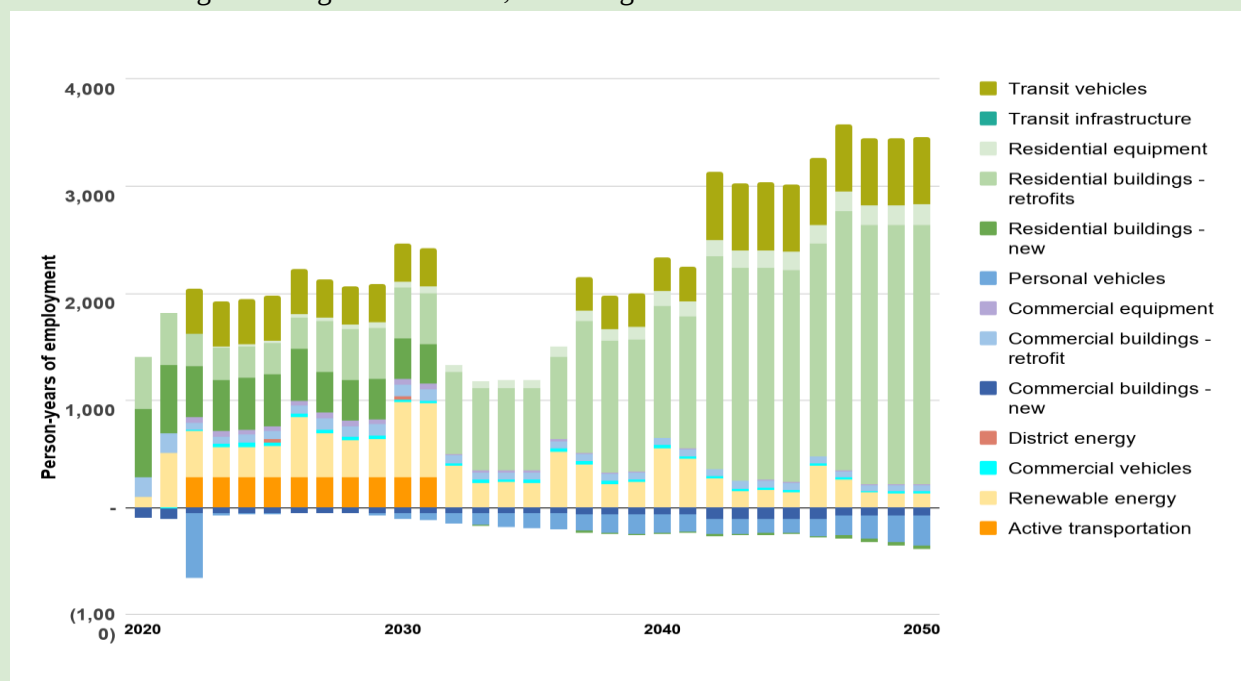


Figure 13: Additional person-years of employment associated with Low-Carbon Strategy, relative to BAP, 2020-2050.

Cost-Effectiveness of Programs

Program areas that are cost effective will reduce operating costs, create savings, and have an overall net payback over time. Up-front capital investments in the community include retrofitting building stock, adding new sources of renewable energy, electric vehicles, district energy, and electric heating. Operational

³⁶ For an introduction to the way investments in energy efficiency and renewables create jobs, see “How does energy efficiency create jobs?”, ACEEE fact sheet accessed at <https://www.aceee.org/files/pdf/fact-sheet/ee-job-creation.pdf>. Canadian input/output multipliers are at : <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610059401>

savings include reductions in natural gas, gasoline, electricity, and other energy consumption costs. The cost of avoiding carbon reflects activities that switch fuels to non-carbon based or reduce consumption. Revenues include the sales of energy and transit / mobility service sales.

The costs and savings modelled in this plan represent the combined total of investments and savings that would be incurred by the City, York Region, community partners / stakeholders, and residents. For example, deep energy retrofits require initial capital investment but also generate long term annual savings in fuel and electricity costs. However, in this analysis, the cost of the retrofits and any related incentives or loan programs to finance those measures are not yet allocated to any specific party because many of these programs could be executed in a number of different ways.

Table 2 below shows the net cost of each program and the net cost per tonne of CO₂e reduced.³⁷ Over the long run, the programs pay for themselves; the aggressive targets for building retrofits and renewables result in net costs, but these are more than offset by the net benefits of the land use, transportation and municipal facilities investments.

Table 2: Cost Effectiveness of Programs and Overall Net-Zero Strategy (net present value)

Program	Program Total Net Cost (Revenue) (millions of \$)	GHG reduction, \$/tonne
Efficient Buildings	876	123
Land Use & Low Carbon Transport	(3,884)	(462)
Renewables	251	187
Municipal Actions & Leadership	(146)	(203)
Waste	0	0
Total³⁸	(2,902)	(155)

Who Pays and Who Benefits?

The City is a leader in implementing and financing the initiatives of this plan; however, the success of the Low-Carbon Strategy hinges on business and community cooperation, in addition to continued support from the provincial and federal governments.

Financing the Low-Carbon Strategy, as well as the savings and revenue generated, hinges on five principles:

³⁷ Since the completion of this plan, the Federal Government announced plans to increase the carbon tax to \$170/tonne by 2030, which would further increase carbon savings. "Putting a price on pollution." 2020. Federal Government of Canada. [Putting a price on pollution - Canada.ca](https://www150.ca.ca/putting-a-price-on-pollution)

³⁸ Note also that the total net present value of the program in this table -- \$2.9 billion -- is much higher than the \$1 billion NPV of the program over the 2020-2050 period. This is due to the energy savings, carbon credits and revenue that continues to accumulate after 2050 as the result of capital investments made in the 2020-2050 period.

- **Innovation:** The plan considers many new technologies that are being developed and refined across the world, while adopting new technologies not yet used in abundance in the city. In the near and long term, innovation will be a key to the successful transition to a low-carbon future.
- **Collaboration:** The community and businesses will take the lead from the City by taking advantage of programs, when made available, as well as growing opportunities. The community will also be involved in designing implementation programs to ensure it suits the Richmond Hill context. Policy decisions by the City will require consultation to ensure that appropriate incentives and regulations are followed.
- **Leading by Example:** The City will take rapid and decisive action to reduce GHG emissions. Regulations and standards will be adopted earlier than the community, and the City will strive to achieve net-zero well before the community in 2050.
- **Strategic Investment:** Sectors where more GHG reductions can occur per dollar spent will be prioritized whenever possible. The investment opportunities will be shared by stakeholders and community at large through the full variety of financing options available.

Implementation Strategies

The community will implement several additional strategies to effectively reduce energy consumption and eliminate fossil fuel use. This section details those supporting strategies while signaling the need to incorporate a regular process of review and updates.

The supporting strategies are tailored to Richmond Hill's building stock, transportation network, energy infrastructure, and waste system. **Although the City is uniquely positioned to lead many actions, implementation of the strategies will require resources from and partnerships with many stakeholders including, but not limited to Enbridge, Alectra Hydro Utilities, York Region, the Richmond Hill Board of Trade, the province, and the federal government.**

The strategies are ordered first by program areas, then by timing with near-term (0-5 years) first, followed by mid-term (5-10 years) and then long-term (10-30 years). The near-term strategies build on policies and practices in effect in Richmond Hill today or fill in gaps where the City and community can begin efforts to specifically reduce GHGs. The priority actions that have been identified are all near-term. The actions were shaped by stakeholder deliberations, including the use of "Multi-Criteria Analysis," where stakeholders measured and weighed actions against community priorities.

Mid-term strategies are more likely to be new or substantially redesigned versions of existing policies and practices requiring more time to design and implement. Both near and mid-term strategies create the framework and foundation for long-term strategies. Long-term strategies may also consider further developed technologies or rely on increased investment potential that can be cultivated in the near and mid-terms.

The distribution of roles and responsibilities, costs, and savings are expected to be shared amongst the community. The principles identified in the previous section are identified in the strategy charts below to indicate how these elements will likely be allocated.

Measurement of Co-benefits

The Low-Carbon Strategy prioritizes supporting strategies that occur in the short and medium term in order to maximize potential to mitigate climate change as early as possible and ensure that the City is on a path to meet net-zero GHG emissions.

Many of these strategies will be implemented simultaneously in order to maximize their GHG reduction potential and the associated co-benefits.

Table 3: Co-benefit quantification scales.

Indicator	N/A	Low	Medium	High
GHG emissions	Enables GHG emissions.	>5 ktCO ₂ e by 2050	5 to 20 ktCO ₂ e reduction by 2050	<20 ktCO ₂ e by 2050
Equity	No discernible effect.	Without intervention,	This action is more	This action has a high

Indicator	N/A	Low	Medium	High
		this action may favor certain groups or create a greater disparity between higher and lower income groups	likely to be implemented in the community fairly, but existing powerful groups may still be at an advantage.	likelihood of being implemented fairly and equitably.
Employment	Enables employment or has no discernible effect.	Unlikely to generate major employment opportunities, but can facilitate induced employment. 0-5 person years of employment per \$1 million invested.	Investment in the sector/action will generate direct person years of employment, but is unlikely to create new local industries. 5-10 person years of employment per \$1 million invested.	Investment has greater potential for long-term employment, new industries set-up, and spin-off industries. <10 person years of employment per \$1 million invested.
Cost effectiveness	This program may not have a direct cost	This program will need incentives, loans, or grants in order to be completed.	This action has the ability to break even, especially if paired with a more attractive investment type.	This action will be a driver of total cost effectiveness of the entire program area.

Detailed Implementation Tables

Program Area 1: Transportation Transformation

Implementation Action	Resources required	Key partners	Target year to initiate	GHG impact (2050)	Equity impact	Employment impact	Cost effectiveness	Funding Principle(s)	Primary funding source(s)
1.1 Develop levels-of-service standards for active transport users in MTSAs and prioritize them over vehicle standards.	Technical analysis: Shift process and design to prioritize active transport and transit use. Consulting Budget: \$100,000.	Smart Commute Richmond Hill City Staff	2021	Low	High	Medium	Medium	Leading by example.	Development fees City infrastructure budget
1.2 Formalize a complete street standard for all streets in Richmond Hill, starting with MTSAs.	Updated levels-of-service standards for pedestrians, cyclists, and transit users.	City Staff Richmond Hill businesses	2035	Low	Medium	High	Medium	Leading by example.	City/transportation budget
1.3 Develop an EV charging network.	Technical Analysis: Development of an EV strategy. Consulting Budget: \$50-100,000.	Offices/employment centres in Richmond Hill. Recreation centres/libraries	2022	High	Low	Medium	Medium	Collaboration.	Community businesses Incentive program from City Higher levels of government Development community
1.4 Investigate bylaw and other policy options to limit heavy diesel vehicles in MTSAs.	Coordination and approval from York Region. Policies and regulations to limit diesel vehicles. Technology: hydrogen fuel cell. Heavy-duty charging stations.	Large industries operating in Richmond Hill York Region Hydrogen fuel companies	2040	High	N/A	Low	Medium	Leading by Example Collaboration	Infrastructure Canada Fueling stations City/sustainability budget (incentives)

Implementation Action	Resources required	Key partners	Target year to initiate	GHG impact (2050)	Equity impact	Employment impact	Cost effectiveness	Funding Principle(s)	Primary funding source(s)
	Identify locations for transfer hub for heavy vehicles to unload and transfer through light vehicles								
1.5 Implement bikeshare system.	Technical analysis: Systems installed with most density of population and services. Infrastructure for bikeshare systems.	Smart Commute Richmond Hill Business community City Staff	2029	Low	Medium-High	Low-Medium	High	Leading by Example Collaboration	City/transportation budget Business community Infrastructure Canada
1.6 Implement infrastructure changes to promote active transport.	Technical analysis: To update Active Transportation Plan. Renewal and update of bikeshare systems and electric car share.	City Staff Smart Commute Richmond Hill Local business community	2030	Low	High	High	High	Leading by Example	City/transportation budget Business community Auto/insurance groups
1.7 Repurpose rights of way (Yonge Street)	Implementation steps of the City's TMP related to Active Transportation. Implementation of levels-of-service standards for pedestrians, cyclists, and transit users.	City Staff Richmond Hill businesses	2035	Low	High	High	Medium	Leading by Example	City/transportation budget
1.8 Issue a joint RFP alongside large companies and York Region to replace current fleets with electric vehicles	Technical analysis; Fleet replacement schedules for City and partners. Technical analysis: Length of amortization rate. Loan from senior levels of government. Charging network across the city and	City Staff Neighbouring municipalities/York Region EV producers Large fleet operators: taxi, rideshare, delivery services, waste management	2030	High	N/A	Low	Medium	Collaboration	Infrastructure Canada York Region and municipalities Business community in region Utilities

Implementation Action	Resources required	Key partners	Target year to initiate	GHG impact (2050)	Equity impact	Employment impact	Cost effectiveness	Funding Principle(s)	Primary funding source(s)
	in buildings.	Infrastructure Canada							
1.9 Require EV charging stations in new developments.	Update to Zoning By-law and design guidelines. An incentive program to commence the installation of chargers.	City Staff Strata corporations Non-residential building owners (office, commercial)	2026	N/A	Medium	Medium	High	Leading by Example Strategically Invest	Development community (capital) City/sustainability budget (incentives)
1.10 Implement EV zones for commercial vehicles.	Legal review of bylaw options Road right-of-way changes. Light electric vehicle stock. Identified locations for transfer hub for heavy vehicles to unload and transfer through light vehicles	Business community in Richmond Hill	2030	Low	Low	Medium	Medium	Leading by Example	City budget Funding from business community York Region
1.11 Advocate to Extend TTC subway to beyond Richmond Hill Centre. Rapidway expansion for BRT service in Southern Richmond Hill.	Continued Transit Oriented Development along Yonge Street. Road dedications for transit service. Shift in levels of service planning away from vehicles to active and transit service.	York Region Transit Development community City Staff	2025	Medium	High	High	Medium	Collaboration	Development community York Region Transit City/transportation budget (capital) Infrastructure Canada Residents (user fees)

Program Area 2: Efficient Buildings

Implementation Action	Resources required	Key partners	Target year to initiate	GHG impact (2050)	Equity impact	Employment impact	Cost effectiveness	Funding Principle(s)	Primary funding source(s)
2.1 Update Sustainability Metrics to align with net-zero GHG standards.	Technical analysis: developing and integrating a stepped approach for net-zero GHG buildings. Consulting program and budget	City Staff Canada Green Building Council Technical Support: cities which have implemented efficiency standards Urban Development Institute Leading/progressive cities: Toronto, Vancouver, Whitby	2030	Medium	Low-medium	Medium	High	Leading by Example	Development community Municipal funding
2.2. Adopt a net-zero building standard that includes specifications for rooftop solar.	Zoning regulation updates. Funding for incentive programs.	Canada Renewable Energy Association Utilities Development community	2025	Low-medium	Medium	High	High	Leading by Example	Development community Incentive programs from City/Region Loans from City/Region
2.3 Pilot a Bulk Retrofit Program for an older housing block with multiple parcels. Promote conversion of housing to multi-family. Target social or low-income housing.	Building owners willing to participate in pilot program. Funding for program: \$1-5 million. Rezoning approval. Architects/designers willing to provide a scalable design.	Construction/renovation industry Canada Green Building Council/Passive House Institute Canada Utilities	2025	Low	Medium	Low	Medium	Strategically Invest Equity	FCM funding for program start-up Grant program from City and Region budget Suppliers of low-carbon technology (heat pumps, solar PV, electric hot water heaters)
2.4 Implement Property Assessed Clean Energy (PACE) programs to finance/deliver building retrofits, including heat pumps and solar PV, for different sectors/building	Comprehension of legislative authority. Supply chain analysis of heat pumps and solar PV.	Construction/renovation industry Businesses/banks Utility Companies	2021	N/A	Medium	High	Low	Strategically Invest Equity	Incentive programs from City/Region FCM funding for program start-up

Implementation Action	Resources required	Key partners	Target year to initiate	GHG impact (2050)	Equity impact	Employment impact	Cost effectiveness	Funding Principle(s)	Primary funding source(s)
types.		York Region							
2.5 Require new multi-residential developments to have a green roof, then move to single detached housing where appropriate.	Feasibility study on rooftop structures and ability to support landscaping. Update to Zoning By-law/Sustainability Metrics. Addition to PACE financing or incentive programs.	Landscape architects Leaders from other cities: Toronto, Vancouver, etc. City Staff	2030	Low	Low	Low	High	Leading by Example	FCM (start-up/feasibility) Development communities Strata organizations
2.6 Publish energy performance and GHG emissions reduction updates on different neighbourhoods.	Monitoring plan that updates GHG inventory regularly Data from utility companies in the City Buildings data and demographics	City Staff	2030	N/A	Low	Low	Low	Leading by Example	City/sustainability budget (capital)
2.7 Increased funding mechanisms for efficient, zero-emissions homes.		Construction industry Federal/provincial governments	2030					Strategically Invest	Business community Construction/trades industry Tax incentives/ PACE financing Infrastructure Canada Utilities
2.8 Adopt benchmarking, rating, and disclosure policies for large buildings.	Technical study: Energy consumption and GHG emissions of large buildings. Climate Lens Framework	Business community	2040	N/A	N/A	N/A	Low	Leading by Example	FCM (capital/project start-up) Business community Contracting/construction industry

Program Area 3: Smart & Renewable Energy

Implementation Action	Resources required	Key partners	Target year to initiate	GHG impact (2050)	Equity impact	Employment impact	Cost effectiveness	Financing Principle(s)	Primary funding source(s)
3.1 Work with neighbouring municipalities to develop a renewable energy cooperative.	Funding for first renewable energy project. Technical analysis: detailed review of renewable energy resources in Richmond Hill.	Utilities Business community in Richmond Hill Neighbouring municipalities York Region Canada Renewable Energy Association	2025	Low	Low	Medium	Medium	Leading by Example	Community/business partners Community Bond Program
3.2 Invest in opportunities for solar PV on parking lots and on large buildings	Coordination with businesses in the city. Pilot program funding.	Canada Renewable Energy Association Utilities Park-and-ride lots (Region-owned)	2025	Medium	Low	High	High	Collaboration	Community Bond Program Utilities Infrastructure Canada
3.3 District energy in Richmond Hill Centre: Zoning Updates to make buildings DE ready	Technical analysis: feasibility study on district energy.	Development community District energy operators/construction agencies Strata organizations	2021	Low	Low	Medium	High	Leading by Example	Development community City budget/sustainability budget (incentives)
3.4 Identify and deploy a pilot microgrid	Technical analysis: develop appropriate site for microgrid given electric demand and appropriate locations for storage. Investment capital to deploy grid. Strong partnership with utilities.	Utilities Business community in Richmond Hill Neighbouring municipalities York Region Canada Renewable Energy Association	2025	N/A	N/A	Low-Medium	High	Leading by Example Collaboration	Federation of Canadian Municipalities (FCM; study funding) City/sustainability budget (capital) Utilities (capital) Business community (capital)

Implementation Action	Resources required	Key partners	Target year to initiate	GHG impact (2050)	Equity impact	Employment impact	Cost effectiveness	Financing Principle(s)	Primary funding source(s)
3.5 Expand district energy system: as Richmond Hill Centre and the Key Development Areas grow, require connection to district energy	Zoning update to require district energy connection. Feasibility study for growth of consumption.	Development community District energy operators/Markham District Energy Strata organizations	2025	Low	Low	Medium	High	Collaboration	Development community District energy operators
3.6 Deploy 5MW of wind and solar energy annually	Land available to deploy renewable energy. A corporation, entity, or co-operative to fund and deploy the system. Connection to microgrid or electrical grid. Energy storage capability.	Utilities Business community in Richmond Hill Neighbouring municipalities York Region Canada Renewable Energy Association	2025	Low-medium	Low	High	High	Innovation	Utility companies Community bond programs Business community
3.8 Renewable natural gas and hydrogen procurement.	Technical study: understand and update data on natural gas consumption in the city, and RNG/Hydrogen capacity in the region. Distribution network that can accommodate RNG either directly or by blending with natural gas.	Utilities Business community in Richmond Hill Neighbouring municipalities York Region Canada Biogas Association Hydrogen fuel organizations	2030	High	Low	Low	Low-Medium	Collaboration	Residents (Purchase fees) Utility companies Infrastructure Canada

Program Area 4: Towards Zero Waste

Implementation Action	Resources required	Key partners	Target year to initiate	GHG impact (2050)	Equity impact	Employment impact	Cost effectiveness	Funding Principle(s)	Primary funding source(s)
4.1 Add organic waste collection to multi-residential and commercial buildings.	Technical Analysis: Funding and budget for collection. Partners to divert organic waste to the digester.	Waste Management Companies Strata Organizations Multi-family residents	2030	Medium	Medium	Medium	Low	Leading by Example	Waste collection services City budgets
4.2 Identify site for anaerobic digester for wastewater and organic waste.	Technical Analysis: Funding and budget for collection. Partners to divert organic waste to the digester. Technical Analysis: Developing RNG and implementing it.	York Region Waste Management Organizations Utilities	2025	Medium	Low-Medium	Medium	Low	Collaboration Innovation	Regional Budget Waste management organizations Strata organizations
4.3 Scale up capacity of regional anaerobic waste digester.	Strong organic waste collection program. Partnership to use biogas/ RNG. Land capacity for larger digester.	York Region/Durham Region Utilities Canadian Biogas Association	2039	High	N/A	Low-Medium	High	Collaboration Innovation	Infrastructure Canada York Region/Durham Region Utilities

Program Area 5: A Compact Community

Implementation Action	Resources required	Key partners	Target year to initiate	GHG impact (2050)	Equity impact	Employment impact	Cost effectiveness	Funding Principle	Primary funding source(s)
5.1 Only permit new residential development within the current built boundary of Richmond Hill.	Official Plan update.	City Staff Development community	2025	Medium	Low	Medium	High	Leading by Example	Municipal funding
5.Promote multi-residential development.	Update Official Plan to set dwelling-type targets. Provide incentives and/or disincentives through fees to promote multi-residential development and help limit single-detached housing development	City Staff Development community	2026	Low	Medium	Low	High	Leading by Example	Development community
5.3 Car Free zones in Richmond Hill Centre.	Infrastructure investment in limiting car travel. Behaviour change program and communications. Completion of RH Centre Master Plan.	City Staff Development community Businesses in community	2030	Low-Medium	Medium	Medium	High	Innovation	City budget Development community

Program Area 6: Municipal Leadership

Implementation Action	Resources required	Key partners	Target year to initiate	GHG impact (2050)	Equity impact	Employment impact	Cost effectiveness	Funding Principle(s)	Primary funding source(s)
6.1 Adopt a “Climate Lens” for city decision-making.	Staff training, templates for Climate Lens review.	City Council City Staff	2021	N/A	Medium	N/A	N/A	Leading by Example	City Budgets
6.2 Community Bond Program.	Account set-up and targets for funding. Technical analysis: determination of preliminary projects and funding requirements.	City Staff Community businesses	2022	N/A	Medium	N/A	High	Leading by Example	Community Organizations, Residents, and Businesses Undetermined external funders Federation of Canadian Municipalities
6.3 Adopt a Zero-Emissions Standard for municipal buildings (current and new).	Technician analysis on existing building stock and cost to retrofit.	York Region FCM Canada Green Building Council/Passive House Institute	2025	Low	Low	Medium	High	Leading by Example	City Budgets FCM
6.4 Develop an engagement program for the community	Staff training and time Recommended products to reduce water and energy consumptions	City Staff York Region Alectra	2021	Low	Low	Low	High	Leading by Example	City Budgets for staff Alectra/ Utility companies
6.5 Advocate to upper levels of government for new/implemented legislative/regulatory tools to	Staff time	City Council City Staff	2022	Low	N/A	N/A	High	Leading by Example	City Budgets

Implementation Action	Resources required	Key partners	Target year to initiate	GHG impact (2050)	Equity impact	Employment impact	Cost effectiveness	Funding Principle(s)	Primary funding source(s)
aid the City in implementing this plan.									
6.6 Engage with utility companies to deploy more renewable energy with their partnership	Land on which to deploy renewables.	Alectra Enbridge District energy providers	2026	Medium	N/A	High	High	Leading by Example Collaboration	Utility companies Community bond programs
6.7 Require MTSA updates and other neighbourhood level planning activities to have an energy plan component	Community Energy Manager. Template to review land-use decisions and their effect on GHGs.	City Staff	2026	Medium	High	Low	High	Leading by Example	City budgets
6.8 Develop an energy storage plan	Technical study: understand renewable energy capacity currently and in future to determine how much capacity can be saved through storage. Consulting fee: \$100,000.	York Region Canada Renewable Energy Association Tesla/storage companies/technology companies	2035	N/A	Low	N/A	Medium	Leading by Example	Business community Infrastructure Canada City Budget / Sustainability Budget (Grants) FCM (Start-up study costs)
6.9 Require a GHG impact study for transportation infrastructure	Capital planning framework for the Transportation Department for next 25 years. Climate Lens with metrics	City Staff Clean Air Partnership/FCM resources	2030	N/A	N/A	N/A	N/A	Leading by Example	FCM (study costs/ start-up costs) Transportation Planning Department (budget)

Program Area 7: Natural Heritage

Implementation Action	Resources required	Key partners	Target year to initiate	GHG impact (2050)	Equity impact	Employment impact	Cost effectiveness	Funding Principle(s)	Primary funding source(s)
7.1 Develop land-use based tree canopy targets for the city.	Technical analysis on large gaps of tree cover. Completion of projects at David Dunlap Observatory and Elgin Mills Greenway. Arborists/ environmental technicians	York Region Forestry Department Developers City Staff	2021	Low	High	Medium	Low	Leading by Example	City budget York Region funding Development community
7.2 Continue to Restore Elgin Mills Greenway	Arborists/ environmental technicians	City Staff Toronto and Region Conservation Authority	2025	Low	Medium	Medium	Low	Leading by Example	City Budget
7.3 Continue restoration and tree-planting in David Dunlap Observatory Park Site	David Dunlap Observatory Master Plan schedule and tasks Arborists/ environmental technicians	City Staff Toronto and Region Conservation Authority	2035	Low	Medium	Medium	Low	Collaboration	City Budget
7.4 Develop a Natural Heritage Strategy	Staff Time \$200,000 for consulting fees	York Region Toronto and Region Conservation Authority	2030	Low	Low	Low	Low	Leading by Example	City Budget

Glossary

Term:	Definition:
Air pollution	Degradation of air quality with negative effects on human health or the natural or built environment due to the introduction, by natural processes or human activity, into the atmosphere of substances (gases, aerosols) which have a direct (primary pollutants) or indirect (secondary pollutants) harmful effect.
Carbon dioxide	A naturally occurring gas, CO2 is also a by-product of burning fossil fuels (such as oil, gas, and coal), burning biomass, land-use changes, and industrial processes (e.g. cement production). It is the principal anthropogenic 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 (GWP) of 1.
Carbon price	The price for avoided or released carbon dioxide (CO2) or CO2-equivalent emissions. This may refer to the rate of a carbon tax or the price of emission permits. In many models that are used to assess the economic costs of mitigation, carbon prices are used as a proxy to represent the level of effort in mitigation policies.
Carbon sequestration	The process of storing carbon in a carbon sink. This is more likely to be in natural lands, forested areas, and soils at the moment. The future may permit carbon sequestration technology.
Climate change	Climate change refers to a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or land use. Note that the Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as: “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.” The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition and climate variability attributable to natural causes.
Decarbonization	The process by which countries, individuals, or other entities aim to achieve zero fossil carbon existence. Typically refers to a reduction of the carbon emissions associated with electricity, industry and transport.
Energy security	The goal of a given country, or the global community as a whole, to maintain an adequate, stable and predictable energy supply. Measures encompass safeguarding the sufficiency of energy resources to meet national energy demand at competitive and stable prices and the resilience of the energy supply; enabling development and deployment of technologies; building sufficient infrastructure to generate, store and transmit energy supplies; and ensuring enforceable contracts of delivery.
Equality	A principle that ascribes equal worth to all human beings, including equal opportunities, rights, and obligations, irrespective of origins.
Equity	Equity is the principle of fairness in burden sharing and is a basis for understanding how the impacts and responses to climate change, including costs and benefits, are distributed in and by society in more or less equal ways. It is often aligned with ideas of equality, fairness, and justice, and applied with respect to equity in the responsibility for, and distribution of, climate impacts

Term:	Definition:
	and policies across society, generations, and gender, and in the sense of who participates and controls the processes of decision-making. Intergenerational equity. Equity between generations that acknowledges that the effects of past and present emissions, vulnerabilities and policies impose costs and benefits for people in the future and of different age groups.
Feasibility	The degree to which climate goals and response options are considered possible and/or desirable. Feasibility depends on geophysical, ecological, technological, economic, social, and institutional conditions for change. Conditions underpinning feasibility are dynamic, spatially variable, and may vary between different groups.
Fossil fuels	Carbon-based fuels from fossil hydrocarbon deposits, including coal, oil, and natural gas.
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 (CO2), nitrous oxide (N2O), methane (CH4), and ozone (O3) are the primary GHGs in the Earth’s atmosphere. Moreover, there are a number of entirely manmade GHGs in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Beside CO2, N2O, and CH4, the Kyoto Protocol deals with the GHGs sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).
Methane (CH4)	One of the six greenhouse gases (GHGs) to be mitigated under the Kyoto Protocol, methane is the major component of natural gas and associated with all hydrocarbon fuels.
Mitigation measures	In climate policy, mitigation measures are technologies, processes, or practices that contribute to mitigation, such as renewable energy technologies, waste minimization processes, and commuting by public transport.
Net-zero emissions	Net-zero emissions are achieved when anthropogenic emissions of greenhouse gases into 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 chosen to compare emissions of different gases (such as global warming potential or global temperature change potential, as well as the chosen time horizon).
Net-zero energy	Refers to a community-scale system or aspect of the built environment (i.e. a neighbourhood or a building) that produces as much energy as it consumes.
Offsetting	Offsetting is the reduction of emissions in one place to compensate for emissions in another location.
Paris Agreement	The Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) was adopted on 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, 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.

Term:	Definition:
Pathways	The temporal evolution of natural and/or human systems towards 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.
PACE	A financing tool that provides access to long-term financing for energy efficiency, water conservation, renewable energy, and resiliency measures for owners and developers of residential, commercial, industrial, institutional, and multifamily properties. PACE programs can stimulate private investment and become self-supporting without the ongoing need for funding from provincial or local governments
Person years (Employment)	A unit of measurement for the amount of work done by an individual throughout the entire year, expressed in the number of hours. The person-year takes the number of hours worked by an individual during the week and multiplies it by 52.
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. Scenarios are neither predictions nor forecasts, but are used to provide a view of the implications of developments and actions.
Well-being	A state of existence that fulfils various human needs, including material living conditions and quality of life, as well as the ability to pursue one’s goals, to thrive, and feel satisfied with one’s life.