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IE11.17 - Attachment 1

CITY OF TORONTO ELECTRIC VEHICLE STRATEGY

Supporting the City in Achieving its TransformTO Transportation Goals

December 9, 2019

TORONTO

City of Toronto Electric Vehicle Strategy

Supporting the City in achieving its TransformTO transportation goals.

SUBMITTED TO:

City of Toronto
Environment & Energy Division
toronto.ca

PREPARED BY:

Dunsky Energy Consulting
50 Ste-Catherine St. West, suite 420
Montreal, QC, H2X 3V4

(514) 504 9030 | info@dunsky.com
www.dunsky.com

With the support of Chris Tyrrell and Brendan McEwen

About Dunsky

Dunsky provides strategic analysis and counsel in the areas of energy efficiency, renewable energy and clean mobility. We support our clients – governments, utilities and others across North America – by assessing opportunities (technical, economic, market); designing strategies (programs, plans, policies); and evaluating performance (with a view to continuous improvement).

Dunsky's 30+ experts are wholly dedicated to helping our clients accelerate the clean energy transition.

EXECUTIVE SUMMARY

The City of Toronto's Electric Vehicle Strategy ("EV Strategy") identifies a range of actions to help the City achieve its 2050 goal of having all transportation powered by zero carbon energy sources. This is one of the key goals identified in TransformTO, the City's climate action strategy. The EV Strategy is one of many initiatives informing Toronto's approach to sustainable transportation. It focuses on activities for passenger light duty vehicle electrification (i.e. personal vehicles, which include cars, vans, trucks and SUVs, for personal and shared use), which represented 30% of the City's GHG emissions in 2017. Meanwhile, the City has a wide range of other transportation and land use policies, programs, and infrastructure initiatives that are either underway or planned to increase the use of more sustainable transportation modes (e.g. walking, cycling, or public transit).

By using an electric drivetrain, EVs eliminate tailpipe emissions, which can lead to a number of benefits for the City and its residents and businesses:

- **Reducing GHG emissions**: Local GHG emissions for EVs are much lower than those of gasoline vehicles. A 2018 study using Ontario's average grid electricity determined that EVs can release as little as 4% of the CO_{2eq} emissions of a gasoline vehicle;
- **Improving resident health**: Air quality improvements, noise pollution reduction, and a reduction in the urban heat island effect are three key benefits of transportation electrification;
- **Strengthening the local economy**: As EVs cost less to operate and maintain, EV owners will have more disposable income for non-transportation needs (once the total cost of ownership reaches parity with gasoline vehicles); EVs can help support the optimal use of electricity generation by leveraging vehicle-grid integration technologies; and new business and job opportunities can present itself through growth in the clean-tech sector.

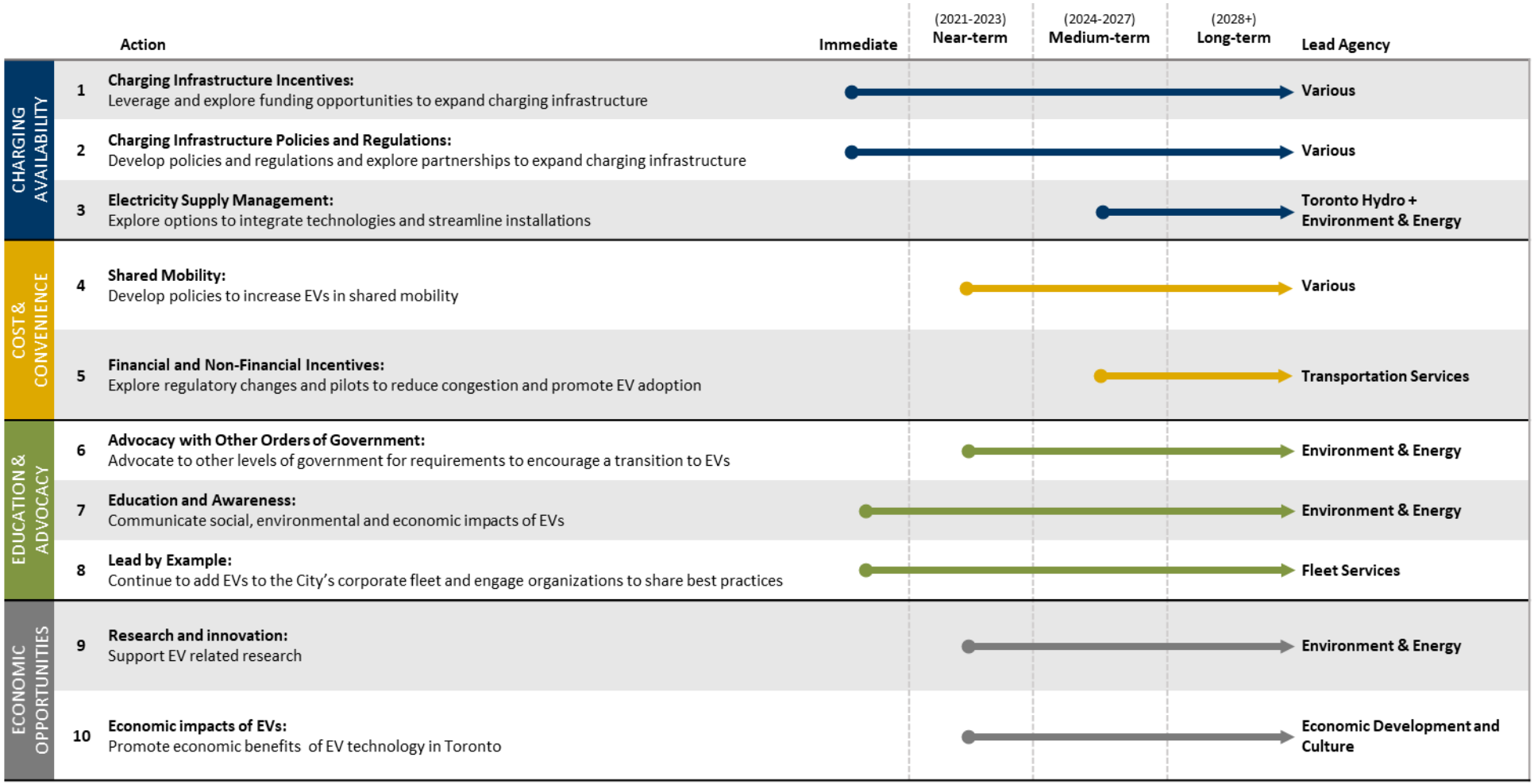
The EV Strategy's ultimate objective is having 100% of light-duty vehicles being zero emitting by 2050. To monitor progress towards this goal, a pathway was developed to understand if the City is on track:

- By **2025, 5%** of registered personal vehicles are EVs;
- By **2030, 20%** of registered personal vehicles are EVs; and
- By **2040, 80%** of registered personal vehicles are EVs.

While developing the EV Strategy's actions, we relied on:

- Municipal best practices and the existing electric mobility landscape in Toronto identified in the Electric Mobility Strategy Assessment Phase Report;
- Engagement with over 100 targeted stakeholders representing a range of industry groups;
- Broad citywide community engagement through public consultation and an online survey, the latter receiving approximately 750 responses; and
- The qualitative and quantitative evaluation of actions.

The Strategy outlines 10 actions, segmented among four areas of opportunity, which the City can pursue to enable the EV market. A summary of the implementation roadmap, outlining the actions, along with their start times and lead agencies, is presented on the following page.


Action
Immediate
(2021-2023) Near-term
(2024-2027) Medium-term
(2028+) Long-term
Lead Agency
CHARGING AVAILABILITY
1 Charging Infrastructure Incentives: Leverage and explore funding opportunities to expand charging infrastructure
Various
2 Charging Infrastructure Policies and Regulations: Develop policies and regulations and explore partnerships to expand charging infrastructure
Various
3 Electricity Supply Management: Explore options to integrate technologies and streamline installations
Toronto Hydro + Environment & Energy
COST & CONVENIENCE
4 Shared Mobility: Develop policies to increase EVs in shared mobility
Various
5 Financial and Non-Financial Incentives: Explore regulatory changes and pilots to reduce congestion and promote EV adoption
Transportation Services
EDUCATION & ADVOCACY
6 Advocacy with Other Orders of Government: Advocate to other levels of government for requirements to encourage a transition to EVs
Environment & Energy
7 Education and Awareness: Communicate social, environmental and economic impacts of EVs
Environment & Energy
8 Lead by Example: Continue to add EVs to the City's corporate fleet and engage organizations to share best practices
Fleet Services
ECONOMIC OPPORTUNITIES
9 Research and innovation: Support EV related research
Environment & Energy
10 Economic impacts of EVs: Promote economic benefits of EV technology in Toronto
Economic Development and Culture

Within this report, each action is described in more detail, featuring an overview of the activities to be performed, key outcomes and benefits, the lead and supporting stakeholders, next steps, and expected costs to the City.

Key performance indicators were also defined, to allow for the monitoring of progress towards the overall objectives of the strategy:

- **General**: GHG emission reductions and EVs as a proportion of light-duty vehicles;
- **Health**: local air quality improvement and noise reduction;
- **Equity**: public charging access, EV ownership ratio, and shared mobility availability;
- **Economic**: number of businesses, number of jobs, and investment in the industry; and
- **Public engagement**: breadth, quality, and persuasiveness of the engagements.

By pursuing the recommended actions, the City of Toronto will be well positioned to meets its ultimate goal of 100% of transportation using zero carbon energy sources by 2050. While 2050 is a long-term target, the long lead time required to transition the vehicle market to EVs requires that actions and activities be pursued today to allow a realistic chance of meeting the City's objectives. During our stakeholder consultations, we interacted with a highly engaged group with strong commitments to advancing the EV market. By putting in place the necessary supports, the City can work with these partners to electrify its transportation network.

TABLE OF CONTENTS

ACRONYMS

AC: alternating current

BEV: battery electric vehicle

CO_{2eq}: carbon dioxide equivalent (equates the impact of a group of greenhouse gases to the impact of CO_2)

CVPA: car share vehicle parking area

DCFC: direct current fast charger

EV: electric vehicle (includes both BEV and PHEV)

EVAFIDI: Electric Vehicle and Alternative Fuel Infrastructure Deployment Initiative

EVWG: Electric Vehicle Working Group (Toronto)

FCEV: hydrogen fuel cell electric vehicle

GHG: greenhouse gas

HELP: Home Energy Loan Program

HEV: hybrid electric vehicle

HOV: high occupancy vehicle

ICE: internal combustion engine

KPI: Key Performance Indicators

kW: kilowatt

kWh: kilowatt hour

LEV: low-emission vehicle (includes electric and hydrogen fuel cell electric vehicles; synonymous with ZEV)

NRCan: Natural Resources Canada

MURB: multi-unit residential building

PHEV: plug-in hybrid electric vehicle

PTC: private transportation company

TGS: Toronto Green Standard

TPA: Toronto Parking Authority

TTC: Toronto Transit Commission

ZEV: zero-emission vehicle (includes electric and hydrogen fuel cell electric vehicles; synonymous with LEV)

ZEVIP: Zero-Emission Vehicle Infrastructure Program

INTRODUCTION

The City of Toronto's Electric Vehicle Strategy ("Strategy") identifies actions to help the City achieve its TransformTO goal of having 100% of transportation use low-carbon energy sources by 2050. These activities will have a material impact on reducing greenhouse gas (GHG) emissions and providing additional co-benefits in the city.

It is important to note that this Strategy is just one document informing Toronto's approach to sustainability transportation. In general, when seeking to reduce emissions, other mobility options are preferred to personal vehicle use (see Figure 1). This Strategy focuses on activities for **light duty vehicle electrification** (i.e. personal vehicles, which include cars, vans, trucks and SUVs, for personal and shared use). The following opportunities are outside of scope for this Strategy: medium and heavy-duty commercial vehicles, transit, non-road vehicles, and hydrogen fuel cell vehicles (which the City will continue to monitor to determine when it is appropriate to add in a future iteration of this Strategy). The City is concurrently pursuing opportunities to prioritize other means of mobility, including walking, cycling, the electrification of transit, and other opportunities to reduce personal vehicle usage.[1]

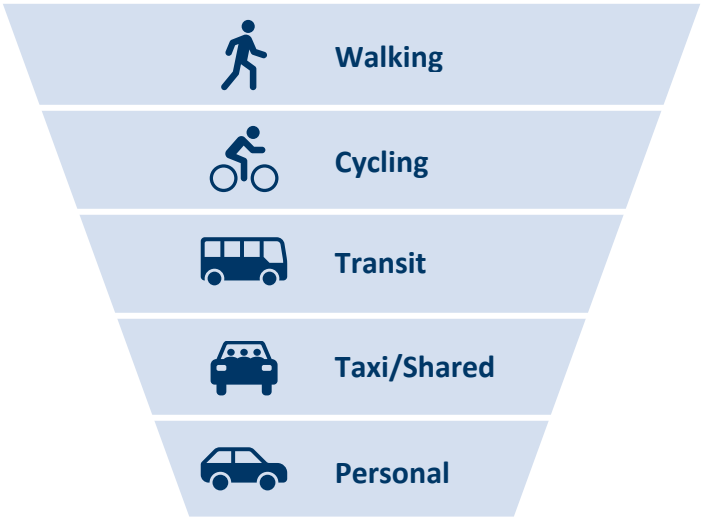


Figure 1: The mobility pyramid emphasizes multimodal mobility before personal vehicle dependency.

This Strategy's actions are based on:

- Municipal best practices and the existing electric mobility landscape in Toronto identified in the Electric Mobility Strategy Assessment Phase Report;[2]
- A review of other municipal electric mobility strategies;
- The qualitative and quantitative evaluation of actions, including the use of our EVA model;[3]
- Engagement with targeted stakeholders; and
- Broad citywide community engagement through public consultation and an online survey.

[1] The mandate to prioritize walking and cycling was established when the City Council adopted *Power to Live Green: Toronto's Sustainable Energy Strategy*, which can be accessed at: http://www.toronto.ca/legdocs/mmis/2009/cc/decisions/2009-11-30-cc42-dd.htm

[2] The Assessment Phase Report can be accessed at: https://www.toronto.ca/wp-content/uploads/2019/05/9685-EMS-Assessment-Phase-Final-Project-Report.pdf

[3] Dunsky's Electric Vehicle Adoption Model (EVA) provided forecasts of long-term EV adoption in Toronto and supported the evaluation of the relative impact of vehicle and charging infrastructure incentive programs.

TORONTO'S VISION FOR 2050

TransformTO is Toronto's Climate Action Strategy to reduce GHG emissions. In October 2019, City Council strengthened TransfromTO's commitment to 100% by 2050, while creating a low-carbon future for Toronto that is healthy, equitable and prosperous. City Council has also directed staff to explore the feasibility of actions that could achieve net zero by 2040. Currently, more than one quarter of GHG emissions in the City come from passenger vehicles (see Figure 2).

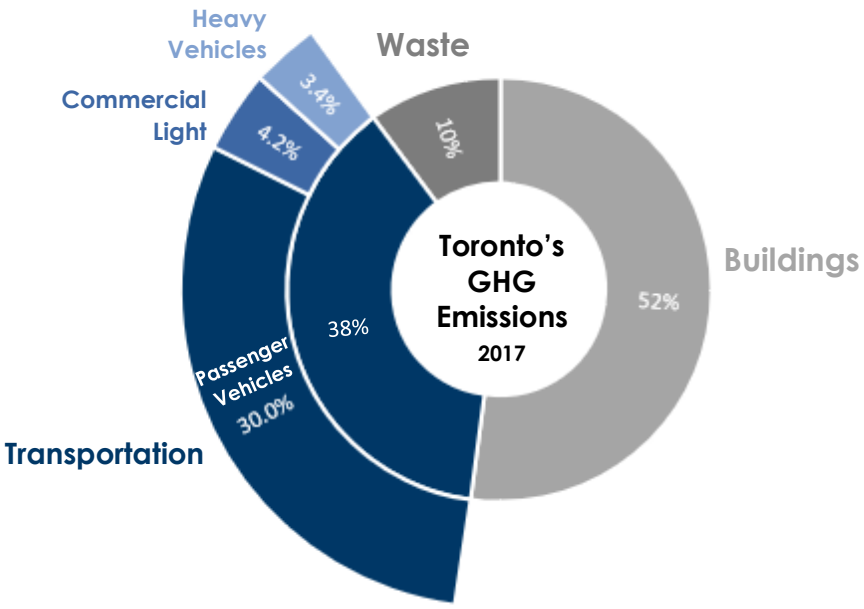


Figure 2: Current breakdown by sector of GHG emissions in Toronto.

To address emissions in the transportation sector, by 2050, the City's goal is to have:

1. 100% of transportation use zero carbon energy; and
2. 75% of trips under 5 km be walked or biked.

To achieve the first goal, by 2050, all passenger vehicles will need to be zero emitting. The actions in the Strategy provide a path to achieving this goal.

DEFINING ELECTRIC MOBILITY

Two elements need to be defined when discussing electric mobility for personal vehicles:

1. **Electric Vehicles (EVs)**: This evolving vehicle technology offers an opportunity to reduce GHG emissions in the transportation sector; and

2. **Charging Infrastructure**: This provides the energy source required to charge EVs. While GHGs from electricity generation will influence GHG reduction goals, current electricity-related emissions for Toronto are very low due to the low carbon electric grid.[4]

These concepts are explained in further detail in the following pages. In addition, **benefits** and potential **equitable access** concerns that may arise from strategic actions are touched on below.

[4] While we expect the electricity grid's carbon intensity to be reduced over time due to other initiatives, the process of moving towards a cleaner grid is outside of the scope of this Strategy.

ELECTRIC VEHICLES (EV)

Low emission vehicles (LEVs) are classified as those which do not rely on gasoline as their primary fuel source (see Figure 3).

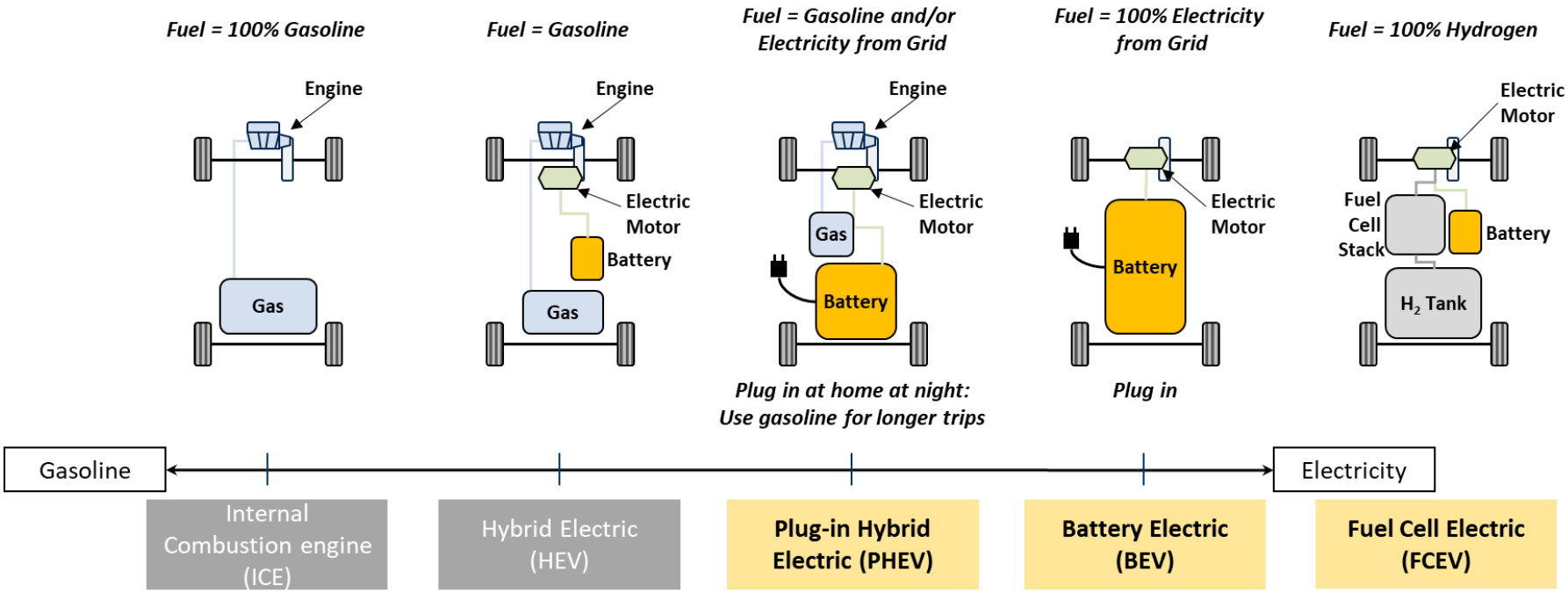


Figure 3: Low emission vehicles (LEV) are those which do not rely on gasoline as their primary fuel source (i.e. PHEVs, BEVs, and FCEVs).[5]

While FCEVs are included in the definition of LEVs, the technology and required infrastructure is at a much earlier stage of maturity compared to EVs (including PHEVs and BEVs). As such, this Strategy will focus on increasing the ratio of passenger vehicles which are PHEVs and BEVs. Toronto's current proportion of registered EVs is 60% BEVs and 40% PHEVs.[6]

[5] Adapted from an image created by the Electric Power Research Institute.

[6] Data request fulfilled by the Ministry of Transportation Ontario (June 2019).

CHARGING INFRASTRUCTURE

For PHEVs and BEVs, there are three common types of charging infrastructure, each with benefits and drawbacks (see Table 1).

Table 1: PHEVs and BEVs have three common types of charging infrastructure.[7]

	Level 1 (AC)	Level 2 (AC)	DCFC
Typical Output	1.5 kW (120 Volts)	7.2 kW (240 Volts)	50 kW – 350 kW (400 to 800 Volts)
Range Added per Hour (approximate)	8 km	40 km	300+ km
Equipment and installation costs	$150 - $1,500[8]	$5,000 - $10,000	$50,000 - $200,000
Typical use locations	Some homes, workplaces, public spaces	Homes, workplaces, public spaces	Major corridors, public spaces
Used by	BEV and PHEV	BEV and PHEV	Primarily BEVs

Government support is typically targeted towards the installation of Level 2 and direct current fast charger (DCFC) infrastructure, due to their faster charging and higher cost. Regardless, all three types have their place in enabling EVs.

BENEFITS AND EQUITY CONSIDERATIONS

By using an electric drivetrain, EVs eliminate tailpipe emissions. Compared to ICE vehicles, this can lead to a number of benefits, including:

- **Reducing GHG emissions**: EVs reduce emissions in two ways. First, electric motors are more energy efficient, resulting in less energy being needed to travel an equivalent distance to an ICE vehicle. Second, the energy used for EVs (i.e. electricity) has a lower carbon intensity per unit of energy than gasoline or diesel. Ontario's predominantly clean electric grid, which is supplied by approximately 94% of nuclear or renewable sources of energy,[9] results in much lower lifecycle GHG emissions for EVs than for ICE vehicles. A 2018 study using Ontario's average grid electricity determined that BEVs released only 4% of the CO_{2eq} emissions of an ICE vehicle, while PHEVs released between 5% and 37% of the emissions (depending on the proportion of total kilometres travelled using electric power).[10]

[7] Adapted from Electric Mobility Strategy Assessment Phase Report.

[8] While a standard 120 V AC outlet can be used, an EV driver will need to provide their own portable charging infrastructure to make the connection possible. Alternatively, Level 1 charging can refer to a permanently affixed 120 Volt charging station that can be used by EVs without requiring additional equipment.

[9] Ontario Energy Board (2018). Ontario's System-Wide Electricity Supply Mix: 2018 Data. Accessed at: https://www.oeb.ca/sites/default/files/2018-supply-mix-data.pdf

[10] Azadeh Maroufmashat and Michael Fowler (2018). *Policy Considerations for Zero-Emission Vehicle Infrastructure Incentives: Case Study in Canada.* Figure 4. Accessed at: https://www.mdpi.com/2032-6653/9/3/38/pdf

- **Improving resident health**: Three primary pathways exist to improve health:

    - *Air quality improvements* are made by reducing the localized emission of air pollutants;
    - *Reduced noise pollution* due to the relatively silent electrical drivetrain; and
    - *Reduction in the urban heat island effect* (lowering peak summer temperatures), as EVs emit only 20% of the heat emitted by ICE vehicles.[11]

- **Strengthening the local economy**: Three primary benefits exist to strengthen the economy:

    - *EVs cost less to operate and maintain* than ICE vehicles. Once the total cost of ownership of an EV reaches parity with ICE vehicles, EV owners will have more disposable income for non-transportation needs;

    - *EVs can help support the optimal use of electricity generation* by leveraging vehicle-grid integration technologies. This can help reduce net electricity system costs in Ontario, benefiting all residents; and

    - *Signal growth in the clean-tech sector*. A strong commitment to transportation electrification will signal that Toronto is a prime destination for innovative businesses.[12]

Challenges will accompany these benefits as the City transitions to new technology. For example, while economic opportunities exist, the transition to a new technology without sufficient training support may result in job losses among specific groups (e.g. mechanics).

The City plays a key role in promoting **equitable access** and affordability for electric transportation options. A key consideration in developing the Strategy was how to promote equity. A focus was placed on these considerations during the stakeholder workshops, public engagement session, and public survey. This allowed equity to be factored into the design and selection of the actions in the Strategy.

An opportunity for equitable access to e-mobility

With the TTC incorporating e-buses into its fleet, there is an opportunity to prioritize bus routing to promote access among targeted neighbourhoods. While outside of the scope of this Strategy, the TTC has been receptive to the idea of integrating an equity lens in their routing selection criteria. A potential approach is to use the socio-economically vulnerable neighbourhoods mapping exercise, from the Electric Mobility Strategy Assessment Phase report, as a factor in routing decision-making.

To help improve equitable access, this strategy recommends multiple actions which benefit equity considerations.[13] Though early adopters of EVs have predominantly held a higher socio-economic status, the short and long-term benefits of vehicle electrification will be felt by all (e.g. cleaner air, potential for lower electricity rates through improved grid utilization). As the technology matures, prices

[11] Li et al. (2015). *Hidden Benefits of Electric Vehicles for Addressing Climate Change*. Accessed at: https://www.nature.com/articles/srep09213

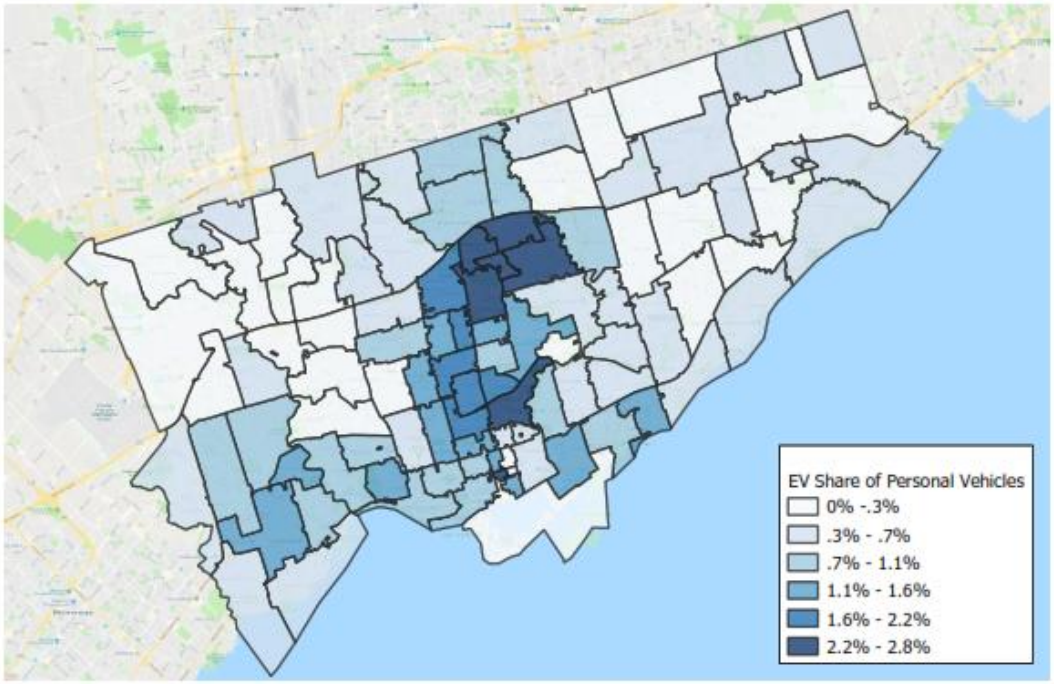
[12] Pollution Probe and Delphi Group (2018). *City of Toronto Electric Mobility Strategy Assessment Phase*.

[13] Refer to Table 2 for the specific actions with a greater impact on equity.

reach parity with ICE vehicles, a second-hand EV market develops, EVs are integrated into car share fleets, and charging infrastructure becomes more prevalent, the distribution of EV usage will become more accessible.

TORONTO'S CURRENT EV LANDSCAPE

To meet long-term goals, significant EV uptake is required in Toronto. Currently, approximately 0.6% of vehicles registered in the City are EVs.[14] Figure 4 depicts the portion of personal vehicles that are registered in the City's various postal code areas. At most, EVs make up 2.8% of registered vehicles in any given postal code area. There are also currently very few public EV charging stations across the city, as shown in Figure 5.



Source: Google Maps, City of Toronto, Statistics Canada
Map created: 20-June-2019 by David Baumann, Dunsky Energy Consulting

Figure 4: Current share of personal vehicles in Toronto that are EVs.

[14] Or approximately 6,300 EVs.

Data request fulfilled by the Ministry of Transportation Ontario (November 2018).

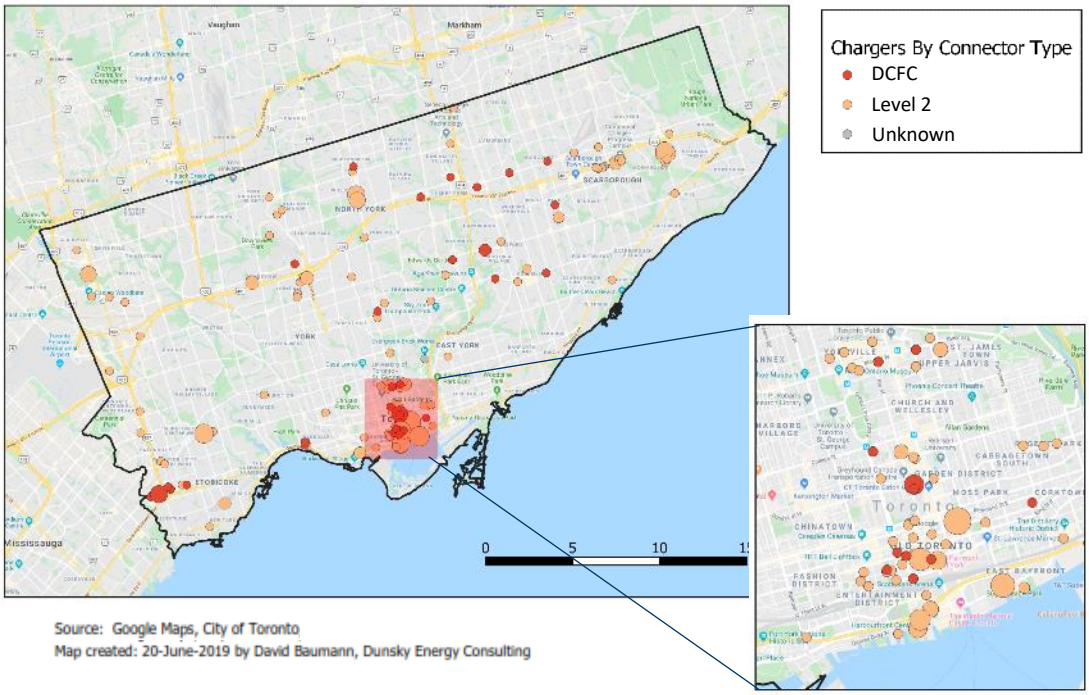


Figure 5: Current DCFC and Level 2 public charging infrastructure in Toronto.

The Assessment Phase Report also included a demographic study, including a mapping of socio-economic vulnerability.[15] This analysis can be used to support equity considerations (e.g. as an input of the development of targeted neighbourhoods).

CURRENT INITIATIVES

Many current initiatives, outside of TransformTO, are underway in the City that will have an impact on EV uptake. While developing this Strategy, the following initiatives were reviewed in order to build on existing initiatives and to ensure alignment between the strategy and other initiatives:

City's EV initiatives, studies, standards, and programs:

- **Residential On-street EV Charging Station Pilot**: A pilot project that will install on-street public charging infrastructure in residential permit parking areas. Current plans call for 13 stations at 7 locations that may include electrical and streetlight poles. Led by Toronto Hydro and Transportation Services.
- **Downtown On-street EV Charging Station Pilot**: A pilot project that will install on-street public charging infrastructure in Toronto's downtown core. Current plans call for 3 stations at 2 locations. Led by Toronto Hydro and Transportation Services.
- **Parking Garage Charge Station Pilot Project**: A pilot project that will install charging infrastructure in Toronto Parking Authority (TPA) operated parking facilities. Led by Toronto Hydro and TPA.

[15] Pollution Probe and Delphi Group (2018). *City of Toronto Electric Mobility Strategy Assessment Phase*.

- **Toronto Green Standard**: The Toronto Green Standard (TGS) outlines sustainable design requirements for new private and city-owned developments. The TGS includes mandatory (Tier 1) and voluntary (Tiers 2 – 4) guidelines. They include standards for charging infrastructure including mandatory requirements for the installation of charging infrastructure and EV-capable parking spots in new developments. Led by City Planning.
- **Home Energy Loan Program (HELP):** Toronto City Council recently approved changes to HELP, which can now fund EV charging infrastructure along with a broad range of energy efficiency and renewable energy measures.
- **Sustainable Fleets Plan**: The City's Sustainable Fleets Plan outlines Fleet Services objectives to addressing climate mitigation and adaptation with strategies for transitioning to sustainable, climate resilient, low-carbon operations. One of the objectives is to transition 45% of the City's fleet to low-carbon vehicles by 2030, as established by TransformTO. Led by Fleet Services.
- **Toronto Hydro's EV Charging Infrastructure Strategy**: Toronto Hydro is continually examining the impacts of EV charging on the grid and accommodating within its infrastructure planning activities.
- **Vehicles-for-Hire Bylaw Review**: The Vehicle-for-Hire By-law provides regulations for taxicabs, limousines and private transportation companies such as Lyft and Uber. The City is exploring an emissions reduction incentive program and/or low-emission standards and targets for the entire vehicle-for-hire industry, in keeping with TransformTO's transportation goals.
- **Waterfront Toronto**: An initiative involving the federal, provincial and City governments to renew Toronto's waterfront. The initiative requires all buildings governed by Toronto Waterfront to meet minimum green building requirements, which include minimum requirements for charging infrastructure (i.e. 2% of parking spaces require L2 charging infrastructure, with the remaining spaces being EV-ready).

<u>City's complementary work on electrification and active transportation:</u>

- **Toronto Official Plan**: The Toronto Official Plan is a policy document outlining how the City grows and evolves over time. It contains a broad range of policy regarding transportation, land use, built form, public realm, and sustainability.
- **Toronto Walking Strategy**: The Toronto Walking Strategy, adopted in 2009, is a "52-action blueprint for making Toronto a great walking city".
- **Cycling Network 10 Year Plan**: The plan identifies over 500 kilometres of new cycling infrastructure over a 10 year period (2016-2025).
- **Green Bus Technology Plan and Ridership Growth Strategy**: Toronto Transit Commission's (TTC's) Green Bus Technology Plan includes commitments to only procure zero-emission buses by 2025 and to completely transition to a zero-emission fleet by 2040. TTC's Ridership Growth Strategy outlines initiatives over a five year period (2018-2022) to grow ridership by making transit faster, more reliable, more comfortable and more convenient.
- **Freight and Goods Movement Strategy**: Transportation Services Division is developing a strategy for the efficient and effective movement of goods in the city.

- **Micro-mobility (e-scooters)**: City Council requested staff develop a program to enable the oversight and management of e-scooters on City roadways, with the goal of ensuring a safe and accessible transportation network during a proposed 5-year Provincial pilot project. Currently, e-scooters are prohibited on city/public roads, bike lanes, and municipal sidewalks. Led by Transportation Services, Municipal Licensing and Standards, the Medical Officer of Health, and the TPA.
- **Automated Vehicles Tactical Plan**: Developed by the Automated Vehicles Interdivisional Working Group, comprising 30 City Divisions, the Automated Vehicle (AV) Tactical Plan outlines how the City should prepare to ensure that Toronto is well placed to both maximize opportunities and mitigate impacts arising from the arrival of AVs in the City.
- **Actions to Reduce Traffic-Related Air Pollution (TRAP)**: Human health impacts associated with TRAP are most pronounced for those living near busy roads and highways. Toronto's Medical Officer of Health and Deputy City Manager have recommended actions to pursue the reduction of TRAP.

The City will continue to monitor, participate in working groups and provide input to these initiatives, in addition to policies and regulations developed by other orders of government. At the federal and provincial levels, other EV focused initiatives are also underway which may impact the Strategy:

- **Federal Government infrastructure funding**: The Electric Vehicle and Alternative Fuel Infrastructure Deployment Initiative (EVAFIDI) and Zero Emission Vehicle Infrastructure Program (ZEVIP) programs are respectively providing funding for fast charging infrastructure along highway corridors, and for charging infrastructure in multi-unit residential buildings (MURB), workplaces, public charging (including curbside charging) and for fleet vehicles. Under both programs, Natural Resources Canada (NRCan) provides up to 50% of eligible project costs.
- **Federal new EV incentive**: The Federal Government is providing point of sale incentives of up to $5,000 for consumers who buy or lease eligible EVs. Eligible vehicles include those with six seats or less where the base model is less than $45,000, or those with seven or more seats where the base model is less than $55,000.
- **Tax write-off**: To support business adoption, the Federal Government's Budget 2019 proposed a 100 percent write-off for EVs. Eligible vehicles include BEVs and PHEVs. The 100 percent write off will be limited to $55,000 plus sales tax per vehicle. In addition, vehicles that receive the federal new EV incentive are ineligible for the write-off.
- **Zero-emission Vehicle Target**: The federal government has set a target that 100% of vehicle sales be zero-emission vehicles by 2040 – in other words, all sales will be zero-emission vehicles.
- **Right to Charge in MURBs**: Changes in 2018 to provincial regulations made it easier for condominium corporations and owners to obtain approval to install charging infrastructure. The amendments eliminated the need for a vote of condo owners, and provided a process for individual owners to request and obtain the required information to install their own systems.
- **Carbon pricing:** Pricing carbon emissions (e.g. carbon levies or cap and trade programs) influence the relative costs of transportation options including EVs and fossil-fuel-based vehicles. Currently, Ontario is subject to the federal government's carbon pricing backstop.

Activities and initiatives, which have a more direct impact on the Strategy and its proposed actions, are highlighted in the *Opportunities and Actions* section which follows.

DEVELOPING THE STRATEGY

We developed this Strategy by building upon previous undertakings by the City, reviewing federal best practice reports on EV strategies and frameworks, reviewing other cities EV strategies, and extensive stakeholder engagement with city officials, targeted stakeholders, and the general public.

PREVIOUS CITY EFFORTS

This strategy builds off the Electric Mobility Strategy Framework and the Electric Mobility Strategy Assessment Phase Report previously conducted by the city.

The Strategy Framework outlined the goals, objectives, areas of alignment and areas of opportunity to be incorporated into the final strategy. The framework was the result of collaboration between the Environment & Energy Division and the Electric Vehicle Work Group (EVWG). It incorporated feedback from external stakeholders received during a consultation held in May 2018. The consultation session included academic experts, EV owners, and representatives from numerous non-profits and community organizations working on EV promotion in Toronto.

The Electric Mobility Assessment Phase Report was the culmination of a process to outline the considerations to incorporate into the strategy, while also establishing a baseline that subsequent actions and strategies could be assessed against. The objectives of the Assessment Phase were to:

- Conduct a comprehensive review of the state of electric mobility in Toronto,
- Identify barriers, opportunities, and best practices with regard to electric mobility,
- Identify and preliminarily engage key stakeholders who may be willing to contribute to the development of the subsequent strategy, and
- Summarize and present findings in a project report.

As part of the Electric Mobility Assessment Phase, an additional stakeholder consultation event was held in November 2018.

STRATEGY DEVELOPMENT

Our approach to developing the Strategy featured two phases. First, determine the art of the possible. Using research conducted during the Assessment Phase, complemented with our team's expertise in electric mobility, and a review of best practices in other municipalities, a long list of potential actions and initiatives was created. Next, based on the stakeholder engagement session, public consultation, our Electric Vehicle Adoption (EVA) model, and a qualitative assessment of overall impact, we refined the set of strategic actions to a subset of key activities. The stakeholder consultation and engagement activities also ensured that the Strategy reflects their input and feedback, while beginning to secure the necessary buy-in required for success. Critical to success will be building partnerships with external stakeholders to implement initiatives, to identify risks and roadblocks, and to find workable solutions.

For each of the shortlisted actions, the key challenges or barriers addressed by the action, as well as the overarching area of opportunity, were identified. This mapping of the strategy elements is critical to ensure that there are no actions that do not ultimately support the strategy's objectives.

STAKEHOLDER CONSULTATION

During the development of the strategy, three stakeholder engagement sessions were held – two by invite only with City staff and EV experts (in May and June 2019) and one open to the general public (in June 2019) – as well as a city-wide online survey. Over a hundred stakeholders representing a broad range of industry groups participated in the workshops, including automakers and manufacturers, EV charging infrastructure suppliers, EV technology companies, municipal, provincial and federal government, NGOs, oil & gas, electricity system operators, building owners/property managers and developers, educators, and business/economic groups. Appendix A further outlines the types of stakeholders that contributed to these sessions.

Stakeholder Engagement Workshops

During both stakeholder workshops, the primary objective was to solicit feedback on prioritizing actions, while also identifying areas of opportunity, roadblocks, or key considerations for implementation. Due in large part to the high-level of engagement from stakeholders, these objectives were met. In addition:

- The large number of participants indicates that there is high interest in EVs;
- Participants' diverse backgrounds provided a variety of opinions and perspectives to inform the Strategy design and implementation plan; and
- Stakeholders were eager to continue collaborating to influence the Strategy's direction and support its implementation.

In addition, important feedback from the workshops included:

1. The City should lead by implementing its own actions while also advocating and/or supporting other levels of government to implement actions;
2. Equity remains a significant concern for the Strategy, however, opportunities exist to provide benefits for all (e.g. cleaner air). In general, the City should prioritize transitioning away from a reliance on personal vehicles, while electrifying those that remain when all other modes of transportation have been exhausted;
3. Educating stakeholders and the public remains key;
4. The Strategy will require both short- and long-term initiatives.
5. Key performance indicators would be helpful at both the action and Strategy levels.

This feedback has been incorporated in the development of the Strategy.

Public Engagement

The objective of the public engagement workshop was also to solicit feedback to prioritize actions, while providing an opportunity for the public to contribute to the Strategy's final design and identify gaps or potentially inequitable social or health outcomes. More than twenty-five citizens participated in a 1.5-hour workshop. Other than input on the strategic actions, key takeaways from this session included:

1. Residents who have no access to a private overnight parking space (e.g. garage orphans), or who live in high-rises (also referred to as Multi-Unit Residential Buildings, or MURBs), are experiencing difficulty in accessing and / or installing charging infrastructure. Residents shared ideas to resolve these barriers, including allowing front-yard parking permits for those who install charging infrastructure, creating an on-street charging hub in neighbourhoods with high concentrations of MURBs, or allowing residents to extend electric wiring from their properties to the street to allow for on-street charging;[16]
2. Opportunities exist to educate citizens;
3. Partnerships will help spread awareness.

In addition, the public survey received approximately 750 responses by individuals who either live or work in Toronto. The survey asked respondents to prioritize the actions in each area of opportunity, while also flagging actions for which they perceived equity concerns. For each area of opportunity, survey respondents identified the following actions as having the highest priority:

- **Incentives for residential housing**: Explore providing financial incentives (rebates, tax incentives) to support the installation of EV charging infrastructure in homes, apartments and condominiums;
- **Advocate for rebates**: Advocate for provincial / federal policies that encourage a transition to EVs (including rebates for new and used EVs);
- **Corporate fleet**: Convert the City's corporate vehicle fleet to EVs; and
- **Related industries**: Prioritize investments and technical assistance to attract EV-related industries / businesses.

Across the areas of opportunity, respondents noted that improving charging availability would have the greatest impact. The workshop and survey results helped to prioritize the Strategy's actions.

MODELLING

High-level modelling of consumer EV adoption was conducted to help inform the Strategy. Using Dunsky's Electric Vehicle Adoption (EVA) model, the relative impact on consumer adoption of EVs due to various levers (e.g. financial incentives, charging infrastructure deployment) were investigated. These results were presented at stakeholder sessions to help inform and guide discussions.

[16] While an idea was shared on extending electric wiring, it should be noted that this would introduce potential safety and liability issues.

Our approach for using EVA to forecast EV adoption included:

1. Market Characterization and Research: Segmented the market into vehicle classes and collected key data on fleet size and annual sales, as well as other general market data such as electricity and fuel prices, charging infrastructure availability, home charging access, etc.
2. Model Calibration: Using historical input data, the model was benchmarked to historical adoption and calibrated to capture local market characteristics. The calibrated model was used in developing future-looking projections.
3. Baseline: Forecasted uptake under business-as-usual scenario to understand the natural market demand for EVs and to serve as a benchmark for comparing the impact actions.
4. Scenario Analysis: Assessed the impact of the Strategy's initiatives on market demand.

EV STRATEGY INTERIM GOALS

To accomplish the TransformTO goal of 100% zero emission transportation by 2050, 100% of personal vehicles will need to be zero-emissions vehicles, currently EVs are the only mass technology to achieve this. Currently, less than 1% of vehicles in Toronto are EVs.[17] With 2050 being three decades away, interim objectives will help the City understand if it is on track to meet their goal. Interim goals for EV adoption should include:

- By **2025, 5%** of registered personal vehicles are EVs;
- By **2030, 20%** of registered personal vehicles are EVs;
- By **2040, 80%** of registered personal vehicles are EVs; and
- By **2050, 100%** of registered personal vehicles are EVs.

These goals are based on Dunsky's EVA model and federal EV sales targets (see Figure 6). Conversion to share of registered vehicle targets was done using the sales goals and average age of vehicles, assuming an 11-year average vehicle age.[18] Sales goals were developed to proportionally align to federal targets.[19] We assumed more aggressive goals for the City than those of the Federal Government.[20] This ratio of sales is consistent with the current ratio of registered vehicles; at the end of 2018, the City had a greater portion of vehicles as EVs (0.6%)[21] than the portion across Canada (0.4%).[22]

[17] Data request fulfilled by the Ministry of Transportation Ontario (June 2019).

[18] IHS Markit report found that average age of vehicles in the US is 11.8 years. To accommodate for harsher weather conditions in Canada, which tend to reduce vehicle lifespan, we assumed an average vehicle age of 11 years. Accessed at: https://news.ihsmarkit.com/press-release/automotive/average-age-cars-and-light-trucks-us-rises-again-2019-118-years-ihs-markit-

[19] City sales goals are 15% of vehicle sales are EVs in 2025, 45% of sales in 2030, and 100% of sales in 2040.

[20] Federal sales targets are 10% sales in 2025, 30% sales in 2030, and 100% sales by 2040.

[21] Data request fulfilled by the Ministry of Transportation Ontario (November 2018).

[22] Electric Mobility Canada Sales Report (2018).

StatsCan Vehicle Registration (Vehicles weighing less than 4,500 kilograms) (2018).

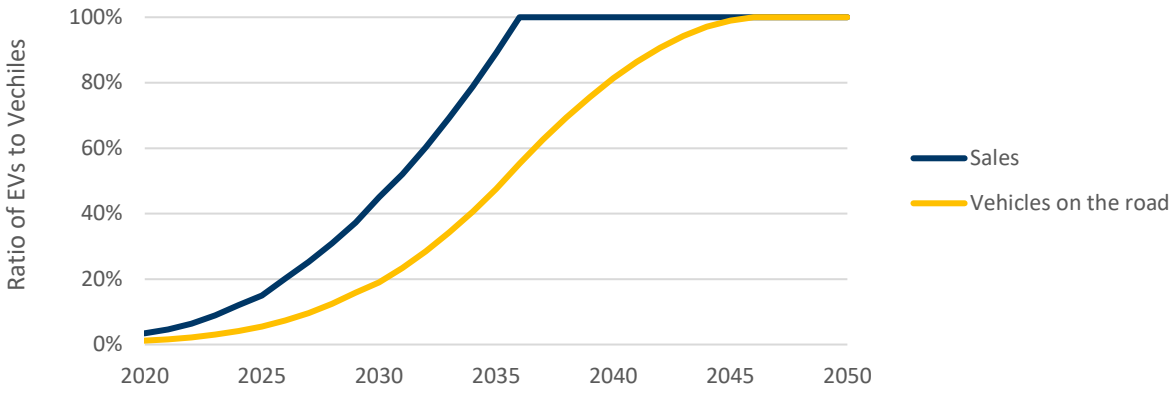


Figure 6: Targeted portion of vehicle sales and total vehicles that are EVs.

Sufficient public charging infrastructure is required to support the achievement of these goals and ensure there is sufficient charging capacity to support a growing EV population. While a significant portion of charging is typically done at home overnight, public charging infrastructure provides additional flexibility for EV drivers covering longer distances and provides an alternative for those without access to charging at home. Numerous studies have emphasized the importance of public charging infrastructure and assessed the overall need for charging infrastructure as a function of the size of the EV population.[23, 24]

Based on Dunsky's EV Adoption model and extensive research on optimal EV-to-charge port ratios, interim objectives for total public charging infrastructure deployment in the City include:

- **DCFC**:
  - By **2025, 220 DCFC ports** are installed in public locations; and
  - By **2030, 650 DCFC ports are** installed in public locations.

- **Level 2**:
  - By **2025, 3,000 Level 2 ports** are installed in public locations; and
  - By **2030, 10,000 Level 2 ports** are installed in public locations.[25]

[23] The International Council on Clean Transportation (2017). *Emerging best practices for electric vehicle charging infrastructure*. https://theicct.org/publications/emerging-best-practices-electric-vehicle-charging-infrastructure

[24] National Renewable Energy Lab (2017). *National Plug-in Electric Vehicle Infrastructure Analysis*. https://www.nrel.gov/docs/fy17osti/69031.pdf

[25] These estimates are based on Dunsky's EV Adoption model, which incorporates research into optimal EV-to-charge port ratios. While near-term infrastructure planning often focuses on a need to establish geographic coverage, the capacity of the infrastructure must increase as the EV population grows over time to avoid congestion.

The resulting EV-to-charge port ratios are that by 2025, there will be 270 EVs to DCFC port and 20 EVs to L2 port; whereas by 2030, the ratios will have increased to 330 EVs to DCFC port and 22 EVs to L2 port.

It is important to note that these ratios are aligned to the estimated needs in other metropolitan areas in the United States, where the average ratios in 2025 across 50 such areas is estimated as 256 EVs to DCFC port and 15 EVs to L2 port; or when comparing with specific metropolitan areas that are predicted to have a similar number of EVs as the City of Toronto, such as Chicago (234 EVs to DCFC port and 17 EVs to L2 port) or Sacramento (345 EVs to DCFC port and 17 EVs to L2 port).

These goals are the total estimated level of public charging infrastructure required to accommodate the targeted vehicle uptake in 2025 and 2030. As these estimates are city-wide requirements, it is important to note that a portion of this infrastructure will be satisfied by private investment. Currently, approximately 75 DCFC ports and 600 Level 2 ports are publicly accessible in the City.[26] Interim goals beyond 2030 are not provided, as advances in technology and the success of other TransformTO initiatives aiming to reduce reliance on personal vehicles will influence the requirement for charging infrastructure.

PUBLIC CHARGING DEPLOYMENT

To support the achievement of the interim goals, the City should enable the deployment of public charging infrastructure. While specific activities are discussed in Action 2, Activity 4, two strategies that have been used by other municipalities are outlined below.

1. Identifying **high-priority areas for public charging infrastructure** supports the equitable deployment of the infrastructure. Typical criteria to identify these areas include:

    - Equitable access to public charging (e.g. fewer existing public charging stations based on density per square kilometer);
    - Access to amenities such as washrooms, Wi-Fi, green space, shelter (most important for DCFC);
    - Proximity to businesses (e.g. grocery stores, other retail, cafes);
    - Limited access to frequent transit and bike routes;
    - Higher proportions of MURBs and garage orphans;
    - Many large businesses with employees commuting long distances;
    - Residents who have higher average vehicle miles travelled;
    - Close to destinations that people tend to travel longer distances to access (e.g. recreation sites, event venues);
    - Areas identified by residents as benefiting from infrastructure;[27] and
    - Sufficient electrical grid capacity (most important for DCFC).

2. Options exist for the City to **establish a preferred approach to rolling out public charging infrastructure**, including:

    - City supported deployment areas:

        - **Comprehensive city-wide network**: No specific locational focus, but prioritizing installations based on targeted area identification;

The International Council on Clean Transportation (2019). *Quantifying the electric vehicle charging infrastructure gap across U.S. markets*. Page 33. https://theicct.org/sites/default/files/publications/US_charging_Gap_20190124.pdf

[26] Data provided by the City of Toronto based on public EV chargers within the City (June 2019).

[27] New York City provides an online tool that lets residents inform planners as they site 100 level 2 charging stations across the city. See more at: https://nycdotprojects.info/project/curbside-level-2-electric-vehicle-charging

- **Targeted network in underserved areas**: Focus on targeted areas, with a special lens on those that are underserved; or

- **Municipal property only**: Focus on areas under the City's control (e.g. parks, TTC stations, municipal parking, community centres).

- Preferred type of charging infrastructure:

  - **Level 2**: Curbside Level 2 charging is the most direct substitute for residential charging for garage orphans (i.e. those who lack a private parking space on their property), as it provides the convenience of overnight charging.[28] However, to support overnight charging, this approach requires a 1-to-1 ratio of EVs to charge ports. Curbside installations can be more complex and expensive than those in off-street parking areas.

  - **DCFC**: The deployment of DCFC charging hubs most closely resembles the usage profile that most vehicle owners are used to, that of ICE vehicles. For those with BEVs with sufficient range, a fast-charging station can be used on a weekly or longer basis to fuel up.

[28] The City of Montreal, working with charging solutions provider AddEnergie, has built a Level 2 charging network.

CHALLENGES

In order to develop strategic actions that will support the achievement of a transition to 100% zero-emission vehicles by 2050, it is important to understand the key barriers limiting EV uptake. There are a few main barriers impacting uptake in Toronto (see Figure 7).

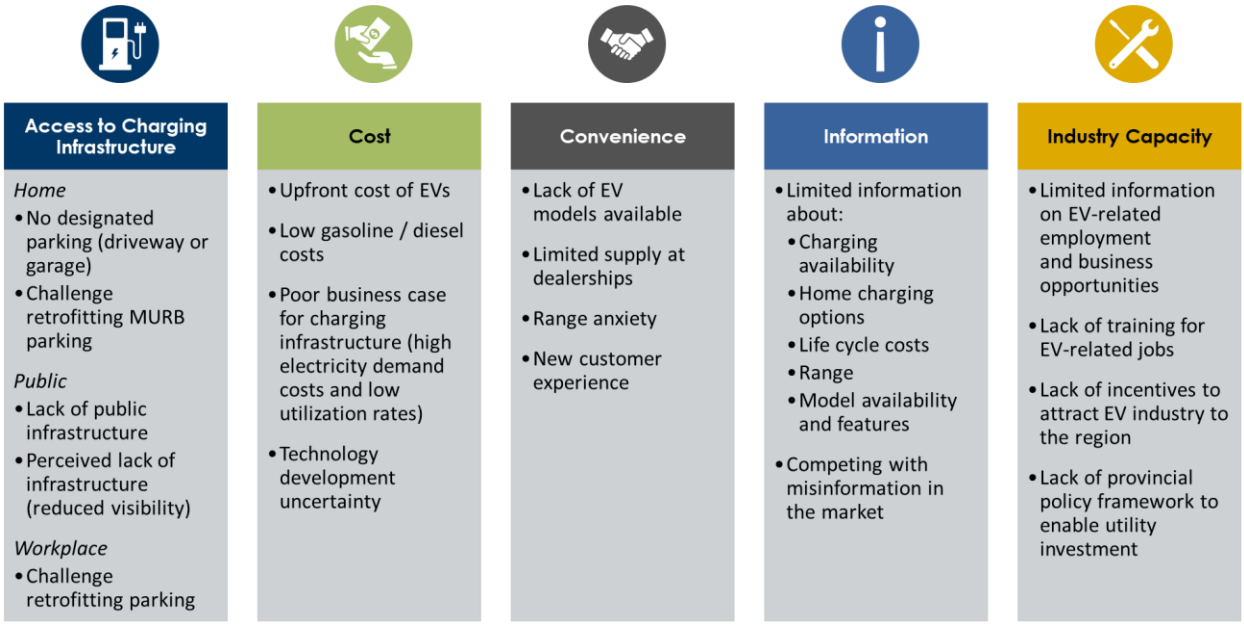


Figure 7: Primary barriers to EV adoption.

Limited access to charging infrastructure is a barrier to adoption. While most EV users charge at home (80 – 90%),[29] the City has a large portion of MURB residents, without access to a garage or driveway, who do not have this option. Outside of the home, a lack of public charging infrastructure can limit uptake and the ability to undertake long-distance travel. This lack of infrastructure can be due to either a limited number of chargers or due to reliability issues with existing chargers. Both real and perceived lack of public charging contributes to range anxiety.

Cost is another significant barrier. A higher upfront cost and the relatively longer-term payback due to the low cost of gasoline and diesel (relative to other parts of the world) creates a longer return on investment period when compared to ICE vehicles. For those installing public charging infrastructure, the high peaks in electricity usage required to fast charge an EV result in higher electricity demand and infrastructure costs, which can make it difficult to create a strong business case for installing infrastructure. As technology is changing quickly, additional financial risk can be borne by EV buyers and charging infrastructure investors. EV resale value risks being diminished due to newer technology hitting the market, while charging infrastructure risks becoming outdated.

[29] Bruce Power, Plug'n' Drive, Pollution Probe, University of Waterloo (2016). *Accelerating the Deployment of Plug-In Electric Vehicles in Canada and Ontario*. Page 19. Accessed at: https://www.plugndrive.ca/wp-content/uploads/2017/07/160159_ElectricVehicleReport_R001.pdf

Convenience concerns are also limiting uptake. Limited availability of existing models at dealerships, and a lack of variety between models, can make it difficult for consumers to find their EV. Consumer demand continues to shift towards larger vehicles (e.g. SUVs, trucks, minivans), for which EV models are currently limited. Adding range anxiety to the mix, the concern that the EV will run out of energy, creates another barrier to adoption. Finally, customers are used to ICE vehicles; refuelling their vehicle in a few minutes at gas stations across Toronto and the Greater Toronto Area (GTA). EV owners must adapt to new customer experiences when fuelling their vehicles, either doing so at home, at work, or at public stations (which will require longer charging times).

Limited information or misinformation about EVs, their charging options, and total lifecycle costs can lead consumers to inappropriately weigh the cost and benefits.

Limited industry capacity can negatively impact the benefits the City could reap from transitioning to the new technology (e.g. new employment and business opportunities). One avenue for charging infrastructure deployment, utility supported and funded, remains inhibited due to the lack of a provincial policy framework.

Finally, as an overarching consideration, significant swings in the support provided by other levels of government for vehicle electrification present many challenges for the City. The City cannot transform the personal vehicle market on its own. It will take consistent, dedicated partners in the Greater Toronto Area and at higher levels of government working together in order to achieve a transition to 100% zero-emission vehicles by 2050.

Opportunities and actions exist that can mitigate these barriers.

OPPORTUNITIES AND ACTIONS

Four areas of opportunity were used to group the specific actions in the Strategy (see Figure 8).

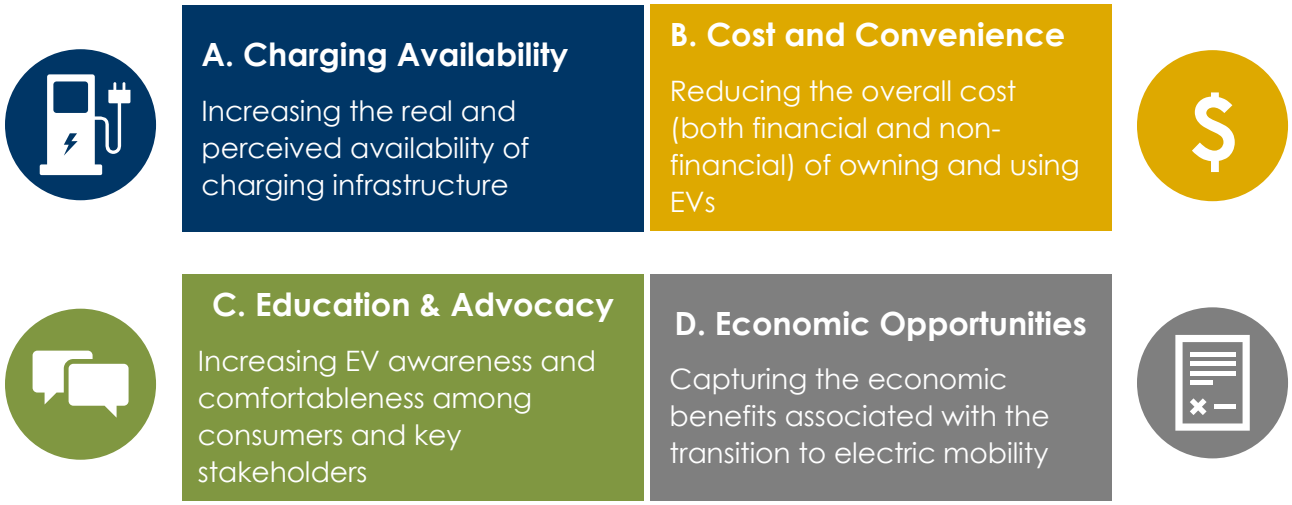


Figure 8: The Strategy is segmented among four broad areas of action.

Actions were selected for each area of opportunity based on their ability to progress the EV market, while taking into consideration the cost and effort placed upon the City. To determine the most appropriate actions for the Strategy, a long list of actions was prioritized based on their impact (e.g. EV adoption, GHG emission reduction, health, equity, and economic development) and feasibility (e.g. ease of implementation, regulatory barriers, resources required, political support, time to implement).

In addition, a qualitatively evaluation of the potential impact for each shortlisted action was undertaken for four key benefits:

1. **GHG**: The reduction of GHG emissions by displacing ICE vehicles with EVs;
2. **Health**: The improvement of public health outcomes;
3. **Economy**: The capture of the economic benefits associated with the EV transition; and
4. **Equity**: The assurance that all residents partake in and experience the benefits of EVs.

The impacts were informed by stakeholder and public consultation, Dunsky's EVA modelling, and desktop research. In the following table, actions are ranked *relative to each other* in terms of their benefit – e.g. actions with the potential to reduce greater amounts of GHGs will be ranked higher than actions will less reduction potential.

Table 2: Impact of the Strategy's actions on key benefit streams.

Action	GHG	Health	Economy	Equity
A. Charging Availability				
1. Leverage and explore funding opportunities to expand charging infrastructure				
2. Develop policies and regulations and explore partnerships to expand charging infrastructure				
3. Explore options to integrate technologies and streamline installations				
B. Cost and Convenience				
4. Develop policies to increase EVs in shared mobility				
5. Explore regulatory changes and pilots to reduce congestion and promote EV adoption				
C. Education and Advocacy				
6. Advocate to other levels of government for requirements to encourage a transition to EVs				
7. Communicate social, environmental and economic impacts of EVs				
8. Continue to add EVs to the City's corporate fleet and engage organizations to share best practices				
D. Economic Opportunities				
9. Support EV related research				
10. Promote economic impact of EV technology in Toronto				

High Impact Medium Impact Mild Impact Minimal Impact

IMPLEMENTATION ROADMAP

The implementation roadmap for all the Strategy's actions, broken out by area of opportunity, including the key activities for each action, is presented on the next page. Following the roadmap, dedicated sections for each area of opportunity contain the overarching objective, a general description, areas of alignment with other initiatives, and the relevant actions. Each action includes a description of the:

- **Challenge**: What the action is aiming to address;
- **Activities**: Description of the activities that should be performed;
- **Outcomes**: Targeted objectives specific to the action;
- **Key Performance Indicators (KPIs)**: Tracking indicators specific to the action;
- **Barriers Addressed**: Overarching barriers addressed by the action;
- **Benefits**: Key benefits resulting from the action;
- **Next Steps**: Activities to progress the action;
- **Lead**: Stakeholder accountable for the action;
- **Support**: Stakeholders who can support implementation of the action; and
- **Resources**: Expected costs are divided into Set-Up Cost which includes the City investment required to plan the activity (including staff resources), and Implementation Cost which includes the necessary community level of investment required to accomplish the activity, and based on a four-point scale:

$: $0 - $100,000 **$$**: $100,000 - $1,000,000 **$$$**: $1,000,000 - $10,000,000 **$$$$**: $10,000,000+

		Action	Immediate	(2021-2023) Near-term	(2024-2027) Medium-term	(2028+) Long-term	Lead Agency
CHARGING AVAILABILITY	1	**Charging Infrastructure Incentives:** Leverage and explore funding opportunities to expand charging infrastructure 1. Explore the feasibility or providing incentives for charging infrastructure 2. Expand financing options for charging infrastructure installation on private property 3. Explore quantifying and monetizing GHG reductions from charging infrastructure via carbon offset credits					**Various** *Environment & Energy* *EED + Social Dev.* *Environment & Energy*
	2	**Charging Infrastructure Policies and Regulations:** Develop policies and regulations and explore partnerships to expand charging infrastructure 1. Support Toronto Green Standards for new developments 2. Home and Workplace: Explore regulatory opportunities or programs for charging at existing homes and workplaces 3. Lead by Example: Develop a workplace EV charging program for the City 4. Public: Enable EV charging deployment through guidance and partnerships 5. Lead by Example: Make municipal charging infrastructure publicly available					**Various** *City Planning* *Environment & Energy* *Environment & Energy* *Project Management Office* *Transportation Services + TPA* *Fleet Services*
	3	**Electricity Supply Management:** Explore options to integrate technologies and streamline installations 1. Explore integrating technologies (investments in enabling renewable energy and grid optimization)					**Toronto Hydro + Environment & Energy**
COST & CONVENIENCE	4	**Shared Mobility:** Develop policies to increase EVs in shared mobility 1. Encourage vehicle-for-hire companies to increase EVs in their fleet 2. Support electric carsharing, especially in targeted neighbourhoods 3. Explore piloting electric micro-mobility					**Various** *MLS* *EED* *TPA + Transportation Services*
	5	**Financial and Non-Financial Incentives:** Explore regulatory changes and pilots to reduce congestion and promote EV adoption 1. Explore establishing a pilot LEV or ZEV zone 2. Explore reducing any future road tolls or congestion charges for EVs					**Transportation Services**
EDUCATION & ADVOCACY	6	**Advocacy with Other Orders of Government:** Advocate to other levels of government for requirements to encourage a transition to EVs 1. Advocate for EV ready parking in residential new construction 2. Advocate for policies that support a transition to EVs					**Environment & Energy**
	7	**Education and Awareness:** Communicate social, environmental and economic impacts of EVs 1. Develop education and outreach initiatives 2. Create an EV Community Champions network					**Environment & Energy**
	8	**Lead by Example:** Continue to add EVs to the City's corporate fleet and engage organizations to share best practices 1. Continue to convert City's corporate fleet to low-emission vehicles 2. Develop a joint City EV charging infrastructure procurement strategy					**Fleet Services**
ECONOMIC OPPORTUNITIES	9	**Research and innovation:** Support EV related research 1. Support post-secondary institution and private sector EV research 2. Explore opportunities to avoid waste and support end-of-life reuse					**Environment & Energy**
	10	**Economic impacts of EVs:** Promote economic benefits of EV technology in Toronto 1. Support efforts to host EV industry events 2. Help attract EV-related industries and businesses					**Economic Development and Culture**

A. CHARGING AVAILABILITY

OBJECTIVE: Increase the proportion of consumers willing and able to use EVs relative to fossil-fuel-based vehicles by improving the real and perceived availability of EV charging infrastructure.

Adequate access to charging infrastructure is a key barrier to EV adoption. While most charging occurs at home, many residents do not have reliable access to home charging infrastructure. Some residents lack access to designated parking areas (e.g. driveways, garages) where they can reliably charge. Others, including those living in MURBs with designated parking areas (e.g. in parking garages or surface lots), do not have access to charging infrastructure and are faced with barriers to install it.

Outside the home, a lack of reliable public charging infrastructure can limit long-distance travel, making an EV an impractical choice for some. Additionally, the perceived lack of public charging infrastructure can contribute to range anxiety, which makes consumers less likely to switch to EVs. In Toronto, approximately 570,000 people drive a personal vehicle to work every day.[30] Public charging infrastructure can alleviate commuters' concerns they will get stranded away from home.

Workplace charging can also play an important role in supporting EV adoption. The infrastructure provides a reliable alternative to home and public charging. The associated barriers to installation are similar to those faced by MURBs, with existing parking infrastructure not designed with charging infrastructure in mind.

Post-deployment, maintenance and operation of charging infrastructure is critical to enable use. Infrastructure should remain in good working order, chargers should not be blocked when not in use, and EV-designated parking spots should be enforced. As charging infrastructure grows across the City, it will be important to discourage abandonment and ensure that out-of-order infrastructure is quickly put back into service. Usage fees can help to recover operating costs while encouraging users to vacate a charging station once they have sufficient charge.

Finally, for all actions increasing charging infrastructure, it is important that signage be visible and easily recognizable to ensure that residents know the infrastructure is available.

Actions to improve charging availability include:

1. Leverage and explore funding opportunities to expand charging infrastructure
2. Develop policies and regulations and explore partnerships to expand charging infrastructure
3. Explore options to integrate technologies and streamline installations

Pilot projects, new construction design requirements, and federal government funding programs are currently supporting the improvement of charging availability.

[30] Statistics Canada, 2016 Census of Population, Statistics Canada Catalogue no. 98-400-X2016334.

Areas of Alignment	
	Residential On-street EV Charging Station Pilot: A pilot project that will install on-street public charging infrastructure in residential permit parking areas. Current plans call for 13 stations at 7 locations that may include electrical and streetlight poles. Led by Toronto Hydro and Transportation Services.
	Downtown On-street EV Charging Station Pilot: A pilot project that will install on-street public charging infrastructure in Toronto's downtown core. Current plans call for 3 stations at 2 locations. Led by Toronto Hydro and Transportation Services.
	Parking Garage Charge Station Pilot Project: A pilot project that will install charging infrastructure in TPA operated parking facilities. Led by Toronto Hydro and TPA.
	Toronto Green Standard: The TGS outlines sustainable design requirements for new private and city-owned developments. The TGS includes mandatory (Tier 1) and voluntary (Tiers 2 – 4) guidelines. They include standards for charging infrastructure including mandatory requirements for the installation of charging infrastructure and EV-capable parking spots in new developments. Led by City Planning.
	Home Energy Loan Program (HELP): City Council recently approved changes to HELP, which can now fund EV charging infrastructure along with a broad range of energy efficiency and renewable energy measures.
	Right to Charge in MURBs: Changes in 2018 to provincial regulations made it easier for condo corporations and condo owners to obtain approval to install charging infrastructure.[31] The amendments eliminated the need for a vote of condo owners, and provided a process for individual owners to request and obtain the required information to install their own systems.
	Federal Government Funding: The EVAFIDI and ZEVIP programs are respectively providing funding for fast charging infrastructure along highway corridors, and for charging infrastructure in MURBs, workplaces, public charging (including curbside charging) and for fleet vehicles.

A note on personal data collection and privacy:

Many public charging stations require users to create an account in order to use the station. In these cases, driver's personal data is collected through an account that driver voluntarily establishes with the charging station network provider. While typically, if the charging station owner is different from the station network provider, the owner will not receive any personal data, it could be possible for the owner to obtain such data. In these cases, the station owner could potentially identify specific users.

Municipalities value the privacy of their residents. As such, it is important that the City reasonably ensure that any personally identifiable information is de-identified at the source, and that the public is aware of what data is being gathered and used when they charge an EV at a City-owned station. The collection of personal information should be limited to the amount necessary for the primary purpose identified. Alternatively, the City can work with third parties to own the infrastructure in order to avoid concerns related to the collection of personal data by the City.

[31] Ontario Regulation 48/01 under the Condominium Act, 1998, S.O. 1998, c.19. Sections 24.2 to 24.7. Accessed at: https://www.ontario.ca/laws/regulation/010048

ACTION 1:

Leverage and explore funding opportunities to expand charging infrastructure

Barriers Addressed

The Challenge

The upfront cost of installing charging infrastructure can act as a barrier to deployment. Home and building owners, workplaces, and businesses would benefit from incentives (i.e. to lower the cost of installation) or financing (i.e. to allow for the repayment of the upfront cost over a longer period).

For those installing public charging infrastructure, the high peaks in electricity usage required to fast charge an EV result in higher electricity demand and infrastructure costs, which can make it difficult to create a strong business case for installing infrastructure. An additional source of revenue, outside of the fee for EV owners to use the charging infrastructure, would benefit installers.

Benefits

- Greater access to charging infrastructure will reduce range anxiety and increase adoption
- The creation of an alternate revenue source for charging infrastructure
- Underserved communities can be prioritized to address equity concerns

Activity #1

Explore the feasibility of providing incentives for charging infrastructure

The City should explore options for providing incentives in home, public, workplace and fleet settings. Each segment has its own set of benefits and challenges.

1. **Home**: Most EV charging occurs at home (with Level 1 or Level 2 infrastructure). Not all residents will benefit from incentives for home charging (i.e. some residents who are garage orphans, lacking a private parking space on their property). Other residents may need more funding (i.e. existing MURBs typically require greater cost to install charging infrastructure).
2. **Public**: Charging curbside (i.e. on-street) or in parking areas at publicly or privately owned destinations. Typical infrastructure is Level 2 or DCFC. Increased access to public infrastructure reduces reliance on home and/or workplace charging.
3. **Workplace**: Shared charging for employee parking areas. Can be open to public use, but typically dedicated to employees.
4. **Fleet**: Charging infrastructure for corporate or delivery fleets, typically used in support of an organization's operations and activities. Can be open to public use **where feasible** or dedicated to the fleet.

Incentives could take the form of rebates or tax incentives. Rebates will likely be reliant on third-party funding, which the City should actively solicit.

Lead

- Environment & Energy Division

Support

- Corporate Finance

Resources

Set Up Cost: N/A

No additional funds required (covered with current resources)

Implementation Cost: $$-$$$$

Will depend on approach taken and third-party funding received.

Activity #2	Lead
Expand financing options for charging infrastructure installation on private property Toronto homeowners and building owners can get low-interest loans from the City to cover the cost of targeted improvements to their homes and buildings. The Home Energy Loan Program (HELP) and High-Rise Retrofit Improvement Support Program (Hi-RIS) respectively support single family and multifamily property improvements (e.g. installing energy efficiency, renewable energy, water conservation, and other defined measures). City Council recently approved the inclusion of EV charging stations (Level 2) in these programs. While at a minimum, the City should continue to support EV charging infrastructure as an eligible improvement under these programs, there are also opportunities to: • Expand the eligibility of participants for EV charging infrastructure financing outside of the residential sector; • Dedicate additional funds to financing EV charging improvements; or • Increase marketing efforts to have more residents knowledgeable and participating in these programs.	• Environment and Energy • Social Development and Financial Administration **Support** • N/A **Resources** Set Up Cost: N/A No additional funds required (covered with current resources) Implementation Cost: N/A To be reflected in a separate staff report.
Activity #3	**Lead**
Explore quantifying and monetizing GHG reductions from charging infrastructure via carbon offset credits Explore the potential for City assets to be used to generate carbon offset credits and allocate revenues from the sale of credits to be re-invested in actions that: • Expand the network of charging infrastructure; • Reduce the cost of EV ownership through financial incentives; or • Educate or inform consumers of the benefits of EVs.	• Environment & Energy Division **Support** • The Atmospheric Fund **Resources** Set Up / Implementation Cost: N/A No additional funds required (covered with current resources)

Outcomes	
Short-term: • Cost barrier is reduced for charging infrastructure installation	
KPIs	**Next Steps**
• Number of charger installations (Level 2 and DCFC) supported by secured funding for each segment • Number of charger installations (Level 2) supported by each financing program	• Explore the feasibility of an incentive program and report back with options. • Prepare a plan for charging infrastructure for funding support (e.g. prioritized list of city- and privately-owned sites for charging installations) • Apply for funding support (e.g. federal ZEVIP) • Research other opportunities for third-party funding • Work with partners to support pilots and leverage outcomes • Market existing financing programs and their recent measure eligibility changes • Explore other opportunities to support charging infrastructure through financing • Determine the impact of Federal regulations and the City's policy on carbon credits in this context

ACTION 2:

Develop policies and regulations and explore partnerships to expand charging infrastructure

Barriers Addressed

The Challenge

Demand for charging infrastructure will increase as residents move towards EV ownership. If **new buildings** continue to be designed without charging in mind, a gap between availability and demand will continue to grow. Retrofitting existing structures presents challenges, including high costs, lack of adequate space and/or electrical infrastructure, and split incentives between owners and tenants. Setting up infrastructure during the initial design can mitigate these barriers, at a reduced cost.

Most of Toronto's **existing buildings** (e.g. homes, workplaces) will be around far into the future. As such, it is also important to support the development of charging infrastructure in the existing building stock.

Residents without access to home or workplace charging will rely on **public charging** infrastructure to make EVs a viable option. Public infrastructure will support EV adoption as it reduces range anxiety and increases the ability to travel further from home. Challenges exist to the development of public charging infrastructure. Among them, attracting public and/or private investment requires a viable business model, but charging infrastructure can have high upfront costs and low utilization rates. Private investment in public charging infrastructure has been limited to date and is likely to rely on significant financial support from governments and/or utilities in the near- to mid-term.

Benefits

- Greater access and availability of charging infrastructure for all
- Greater deployment of charging infrastructure in homes, MURBs, and workplaces
- Encourage City employees to transition to EVs
- Encourage other workplaces to install infrastructure

Activity #1

Support Toronto Green Standards for new developments

The TGS are the City's sustainable design requirements for new private and city-owned developments. Tier 1 performance measures are mandatory and require charging units in:

- 20% of parking spaces in Mid to High-rise and Commercial buildings; and
- 25% of parking spaces in City-Owned facilities.

In addition, 100% of parking spaces must be designed EV capable (i.e. must be designed to allow for future installation). Opportunities exist to further TGS' support by:

1. **Mandating 100% EV ready** to require parking spaces to feature a complete electrical circuit terminating in an electrical outlet for the purpose of EV charging. To classify as EV ready, charging

Lead

- City Planning

Support

- Toronto Hydro
- Property Developers
- Electrical Safety Authority

Resources

Set Up / Implementation Cost: $

Does not include providing incentives or financing to support developers with achieving TGS requirements

units are not required to be installed in the parking spots. This update will simplify and reduce the cost of future charging infrastructure installation. 2. **Amending Low-Rise Residential building** (i.e. 4 storeys or less with a minimum of 5 dwelling units) requirements to mandate EV ready charging infrastructure for parking spaces. 3. **Supporting developers** in achieving the TGS requirements (e.g. educate on technical options available, or develop guides, case studies). Increased awareness of load management technologies can support meeting a 100% EV ready requirement without a significant increase in cost.[32]	
Activity #2	**Leads**
Home and Workplace: Explore regulatory opportunities or programs for charging at existing homes and workplaces The City should explore approaches to support the installation of charging infrastructure in existing buildings. These approaches need to consider the unique challenges of installing charging infrastructure in existing structures, while also preserving housing affordability. A review of the City's legal authority to require minimum levels of charging infrastructure would also be beneficial. An initial step will be further, more targeted, consultations with homeowners, multifamily building owners, workplace owners, contractors, property managers, and charging infrastructure suppliers to understand the opportunities for increasing charging availability in the existing building stock. With a clear understanding of these opportunities, the City will consider appropriate approaches to support charging infrastructure development in workplaces. For residential buildings, the barriers and opportunities will vary by segment: 1. **Existing Single Family Homes** with access to a private parking space primarily face a financial hurdle to install infrastructure. 2. **Existing MURBs** with private parking spaces can face substantially greater financial, physical, and administrative barriers to install charging infrastructure. 3. **Garage Orphans**, lacking a private parking space on their property, face greater barriers; this leads them to be reliant on public or workplace charging infrastructure. With a clearer understanding of the barriers and opportunities, the City can consider appropriate policies to support charging infrastructure development. In addition, exploring how to increase	• Environment & Energy Division **Support** • Toronto Building • Transportation Services • Municipal Licensing and Standards • Social Development and Financial Administration • City Planning • Toronto Hydro **Resources** Set Up / Implementation Cost: N/A No additional funds required because work is exploratory in nature. City divisions will consider as part of ongoing policy reviews and report through the appropriate committee.

[32] The City of Richmond (BC) commissioned a costing analysis to assess the impact of different requirements. The analysis concluded that, by employing load management technologies, the 100% requirement can be met without a significant increase in cost compared to a building providing charging in 20% of parking stalls. The study can be accessed at: http://udi.bc.ca/wp-content/uploads/2017/06/Final-Report-r004-EV-Requirements-20170404.pdf

signage and wayfinding for charging stations to help residents find chargers. Finally, one consistent concern that was heard from the public was around lack of access to home charging. Some ideas that were shared repeatedly were to explore the option for allowing front-yard parking permits to support home charging or create neighbourhood charging hubs. These types of options should be further explored.	
Activity #3	**Lead**
Lead by Example: Develop a workplace EV charging program for the City The City should lead by example through the establishment of a workplace charging program that will provide charging infrastructure for a percentage of the City's workforce that commutes via personal vehicle. Developing a workplace charging program will also provide a valuable learning opportunity for the City to understand the opportunities and challenges for expanding workplace charger availability. For example, in support of this initiative, the City could develop a policy manual for workplace charging and hold short information sessions for interested employees regarding proper usage and etiquette of charging infrastructure. To support other workplaces, the City should explore making internally developed materials publicly available (e.g. policy manual for workplace charging, information session presentations) and also provide workshops or learning opportunities to residents and local workplaces.	• Project Management Office (Corporate Real Estate Management) **Support** • Fleet Services • Environment and Energy • Information and Technology **Resources** Set Up Cost: $ Implementation Cost: $$ - $$$ Will depend on who is responsible for the installation and associated cost of the charging infrastructure. For example, a deployment of 200 Level 2 stations for employees could require roughly $500k to $1M, assuming 50% funding from ZEVIP.
Activity #4	Lead
Public: Enable EV charging deployment through guidance and partnerships The City should undertake the following four sub-actions to increase public infrastructure: 1. **Identify high-priority areas for public charging infrastructure.** The City is to identify high-priority areas for public charging infrastructure. This research is necessary to identify where charging infrastructure is most valuable, most needed, and not detrimental to other land uses or the electric grid. This activity will be very important to guide the installation of public charging infrastructure. It should be noted that it is not an easy undertaking; significant time and resources will be required. 2. **Explore partnerships** with other entities to install public charging infrastructure. The City should look for ways to partner with other entities to leverage private investment to deploy public charging infrastructure. Significant interest was shown by	• On-street: Transportation Services • Off-street: Toronto Parking Authority • Environment & Energy Division **Support** • Toronto Hydro • Private businesses • Information and Technology **Resources** Set Up Cost: $ Implementation Cost: $$ - $$$$ Will depend on approach taken and third-party funding received. Identifying high priority areas alone

the private sector to work with the City during the development of this Strategy's stakeholder engagement workshops; 3. **Establish a preferred approach to roll out** public charging infrastructure. In collaboration with partners, an approach should be agreed upon for the roll-out of public charging infrastructure. Ultimately, the approach selected should include a combination of Level 2 and DCFC infrastructure. 4. **Reduce barriers** to the installation of public charging infrastructure. The City is to prioritize reducing barriers within its control to deploying public charging infrastructure. Barriers may include access to public rights-of-way and rules regarding use of public lands. For example, the City could explore: • Allowing and/or prioritizing public charging infrastructure in public rights-of-way; • Adopting single-side parking on alternate-side parking streets to facilitate charging infrastructure installation; • Converting roadside lamps to charging ports; [33] • Allowing overnight charging in underutilized lots (e.g. parks, community centres, churches, TTC lots); or • Allowing reserved parking for charging in residential neighbourhoods.	will require a budget near the lower end of the range. When including City supported deployment, this value can grow significantly. For example, attaining the interim target of 220 public DCFC ports by 2025 could require between $3M and $6M assuming a 75% contribution from the federal government and other partners.
Activity #5	**Lead**
Lead by Example: Make municipal charging infrastructure publicly available Explore the opportunity to offer the City's private charging infrastructure for public use during times of non-use (e.g. at night when employees are at home). When exploring this opportunity, it will be important to understand potential liability concerns with granting access to the public. Opportunities for access may exist for various City groups, including Fleet Services, TTC, and the Toronto Parking Authority. It is likely that the barriers facing each group, and even within each group, will vary depending on the location and type of charging infrastructure.	• Fleet Services **Support** • Toronto Parking Authority • Corporate Real Estate Management **Resources** Set Up Cost: $ Implementation Cost: N/A
Outcomes	
Short-term: • Streamlined processes for EV installation • Improved technical knowledge among developers • Better understanding of the opportunities and challenges to installing charging infrastructure in existing buildings • City employees have improved access to workplace charging infrastructure • Installation of additional public charging infrastructure	

[33] This may be costly in practice. The City has few streetlight poles that are located on curbside, and the practice of boring under sidewalks to access the lights can result in very high cost. Also, lighting circuits do not necessarily have sufficient electrical capacity for a significant number of charging points.

- Process to identify high-priority areas for public charging
- Understanding of whether the City can make publicly available its private charging infrastructure

Medium term:

- Future proof the market
- Increased demand for EV charging infrastructure
- Implementation of a suite of policies to support charging infrastructure in existing buildings
- Further installation of public charging infrastructure in targeted areas
- More private parties installing and operating public charging infrastructure

KPIs	Next Steps
• For buildings under TGS: percent of parking spaces with charging units; and percent of parking spaces that are EV ready • Percent of residential parking spaces with access to charging infrastructure (determined via survey of residents) • Percentage of existing workplaces constructed pre TGS v3 (May 1, 2018) with new charging infrastructure • Proportion of City employee vehicles that are EVs • Number of public charging stations and ports (segmented by Level 2 and DCFC) • Number of City private chargers made available to the public	• Continue outreach efforts to developers to understand existing barriers to implementing TGS • Develop resources to support developers where gaps exist • Amend TGS EV charging requirements to include low-rise residential buildings • Conduct consultations with homeowners, building owners, property managers, contractors, and charging infrastructure suppliers • Develop policies to support the installation of charging infrastructure in existing residential buildings • Conduct consultations with workplace owners, contractors, property managers, and charging infrastructure suppliers • Develop policies to install charging infrastructure at existing workplaces • Consult City employees to assess current and future demand for workplace EV charging • Develop and implement plan to provide workplace charging to City employees • Spread knowledge and lessons learned • Identify high priority public charging areas • Explore potential partnerships to support development of public charging infrastructure • Apply for funding (e.g. ZEVIP) and secure match funding • Explore the barriers and challenges with making private charging infrastructure available • Launch a pilot to understand the real-world implications of making infrastructure public • Monitor and evaluate the pilot

ACTION 3:

Explore options to integrate technologies and streamline installations

Barriers Addressed

The Challenge

EVs present interesting new challenges and opportunities for the electric grid. They can result in significant new load as adoption increases. However, opportunities exist to mitigate these impacts by integrating charging installations with local renewable energy technologies or technologies that communicate with the grid (e.g. smart charging can be used to shift loads and provide grid flexibility). EV batteries can serve as an energy source, providing additional flexibility to the grid if bidirectional chargers are in place.

While there is already a mechanism that notifies Toronto Hydro of charging infrastructure requirements for large new developments at the site plan and rezoning application phase of the development application process, Toronto Hydro is exploring opportunities to receive notification from the Electrical Safety Authority when residential chargers are installed on a one-off basis.

Benefits

- Greater flexibility for the installation of charging infrastructure
- Greater emission reduction potential
- Better planning of infrastructure installations with respect to the electrical grid
- Less expensive charging infrastructure installation due to better planning

Activity #1

Explore integrating technologies (investments in enabling renewable energy and grid optimization)

Accommodate the integration of technologies including EVs, their charging infrastructure, and renewable generation into the electrical grid. Initial steps include:

1. Investigate battery storage to enable fast EV charging infrastructure;
2. Track EV charging using meter data to assess impact on distribution grid and optimize upgrades;
3. Investigate power quality impacts on grid due to vehicle charging; and
4. Investigate vehicle grid bidirectional charging impact.

Lead

- Toronto Hydro
- Environment & Energy Division

Support

- The Atmospheric Fund

Resources

Set Up Cost: $

Implementation Cost: $$

Outcomes

Short-term:

- Investigate impacts of EV charging infrastructure on the distribution grid ahead of broader adoption

Medium term:

- Allow the grid to accommodate more rapid uptake of EV adoption

KPIs

- Number of pilot projects or investigations underway

Next Steps

- Form partnerships to launch pilots for integrating technologies
- Monitor and evaluate the pilot results

B. COST AND CONVENIENCE

OBJECTIVE: Increase the percentage of residents with affordable, convenient access to EVs through financial and non-financial incentives.

Consumers consider many factors when making vehicle choices, including costs, convenience, environmental impact, and customer experience. For consumer-owned EVs, the upfront costs are an often-cited barrier to adoption. Incentives that reduce this cost or reduce costs elsewhere (e.g. charging rates, parking fees, tolls) can help reduce this barrier. Additionally, incentives that make EVs a more convenient option relative to ICE vehicles (e.g. preferential access to high occupancy vehicle [HOV] lanes) can also nudge consumers towards selecting EVs.

Actions to improve cost and convenience include:

4. Develop policies to increase EVs in shared mobility
5. Explore policies and pilots to reduce congestion and promote EV adoption

Areas of Alignment	**Vehicles-for-Hire**: The Vehicle-for-Hire By-law provides regulations for taxicabs, limousines and private transportation companies such as Lyft and Uber. The City is exploring an emissions reduction incentive program and/or low-emission standards and targets for the entire vehicle-for-hire industry, in keeping with TransformTO's transportation goals.
	New EV incentive: The Federal Government is providing point of sale incentives of up to $5,000 for consumers who buy or lease eligible EVs.[34] Eligible vehicles include those with 6 seats or less where the base model is less than $45,000, or those with 7 or more seats where the base model is less than $55,000.
	Used EV incentive: Plug'n'Drive, in collaboration with Clean Air Partnership, is offering a used EV incentive of $1,000 for a BEV or PHEV with a resale sticker price below $50,000.[35] To qualify for the incentive, purchases must attend an EV 101 seminar, take an EV test drive, purchase a used EV, and claim their incentive.
	Tax write-off: To support business adoption, the Federal Government's Budget 2019 proposed a 100 percent write-off for EVs. Eligible vehicles include BEVs and PHEVs. The 100 percent write off will be limited to $55,000 plus sales tax. Vehicles that receive the EV incentive are ineligible for the write-off.

[34] More information on the Federal incentive is available at: https://www.tc.gc.ca/en/services/road/innovative-technologies/zero-emission-vehicles.html

[35] The incentive is available until the funding is exhausted. For more information, visit: https://www.plugndrive.ca/used-electric-vehicles/

ACTION 4:

Develop policies to increase EVs in shared mobility

Barriers Addressed

The Challenge

With the higher upfront cost of EVs (relative to ICE vehicles), not all residents will be able to choose an EV as their next vehicle. However, other opportunities exist for residents to use EVs for their transportation needs.

Many people in Toronto use **for-hire vehicles** (e.g. taxis, limousines, or private transportation companies [PTCs; e.g. Lyft, Uber]) to meet their transportation needs. **Some research suggests** that these vehicles typically travel more kilometres and can have non-conventional use patterns relative to personal vehicles, which makes charging a more unique challenge. On the other hand, due to higher vehicle utilization the carbon and health benefits of EV adoption in for-hire vehicles are much greater on a per vehicle basis. Transitioning these vehicles to EVs will help provide residents with the option of using electric mobility options.

To facilitate access to EVs for all, the City can also support opportunities for EV use via **car sharing** (i.e. short-term car rental services) to provide more equitable access to the technology. Car-sharing services often need special assistance in electrifying – most notable is obtaining consistent access to EV charging infrastructure. Return-to-home fleets (i.e. car share services where the vehicle has a designated parking spot) are easier to electrify, but these services are reluctant to build and manage charging infrastructure. For free-floating fleets (i.e. car share services where the vehicle is driven point-to-point and may park in non-designated spots), the barrier is only magnified.

Benefits

- Greater access to EVs
- Greater EV visibility, resulting in increased awareness and comfortableness
- More equitable access to EVs for personal mobility
- Greater access to e-mobility solutions for all residents

Activity #1

Encourage vehicle-for-hire companies to increase EVs in their fleet

The City should explore ways to encourage vehicles-for-hire to electrify. The City could transition the industry via:

- **Regulations.** The City could explore modifying the Vehicle-for-Hire By-law to gradually require vehicles-for-hire to electrify. Any changes to the By-law would reflect the availability of charging stations in the City and involve stakeholder and industry consultations.
- **Incentives.** The City could explore providing incentives to encourage vehicles-for-hire to electrify. For example, the City may explore the ability to offer discounted licensing fees to for-hire EVs.

Lead

- Municipal Licensing and Standards

Support

- Environment & Energy Division
- The Atmospheric Fund

Resources

Set Up Cost: $

Implementation Cost: $$

Will depend on the level of support provided through incentives and charging infrastructure.

Informational resources developed for vehicles-for-hire may also support and encourage their electrification.	
Activity #2	**Lead**
Support electric car sharing, especially in targeted neighbourhoods In partnership with car-sharing companies, the City should explore the opportunity to support the expansion of EV car share fleets, especially in targeted neighbourhoods. Ideas to explore to facilitate a transition to EVs include: • Requiring some portion of public charging infrastructure in targeted neighbourhoods to be designated for car-sharing services (e.g. an on-street public Level 2 charging station with two ports could designate one port for car-sharing services) • Designating on-street car share vehicle parking areas (CVPA) for EVs; • Temporarily waiving or reducing car share permitting fees for EVs; or • Prioritize the issuance of permits for CVPAs for EVs Charging infrastructure access for car-sharing services will likely be a primary concern for establishing EVs in their fleets.	• Environment & Energy Division **Support** • Transportation Services • Toronto Hydro • Toronto Parking Authority • The Atmospheric Fund • Car-sharing companies **Resources** Set Up Cost: $ Implementation Cost: $ - $$ Will depend on the level of support provided through incentives and charging infrastructure.
Activity #3	**Lead**
Explore piloting electric micro-mobility The City could review piloting a city service for shared pedal assist e-bikes through the Toronto Parking Authority, ensuring it complements bike sharing, public transit and Vision Zero safety for active travel modes. While such programs expand opportunities for electric mobility and alternatives to driving, it is important to research and monitor impacts on safety, affordability, public health, and the environment. A pilot project approach would allow the city to evaluate the potential benefits (e.g. enabling last kilometer needs, reducing time for short trips, providing options for all demographics, and encouraging residents to be more physically active) while also reviewing the challenges (e.g. concerns about safety risks for riders and the public, sidewalk and cycling path litter and obstructions, diversion of trips from active and less polluting modes [i.e. walking, cycling and public transit], e-waste, and emissions from collecting, recharging and re-distributing fleets) associated with electric micro-mobility.	• Toronto Parking Authority • Transportation Services **Support** • Toronto Public Health **Resources** Set Up Cost: TBD Implementation Cost: TBD Piloting options and the resourcing requirements of each will be reflected in a separate staff report.

Outcomes	
Short-term: • Report outlining pilot project options and an improved understanding of benefits and challenges of providing pedal assist e-bikes in the City **Medium-term:** • Increase in number of EVs in for-hire fleets • Residents have greater access to EVs through car-sharing services • Residents have easy access to safe, affordable and sustainable micro-mobility options	
KPIs	**Next Steps**
• Proportion of for-hire and PTC vehicles that are EVs • Number of car sharing EVs available in targeted neighbourhoods • Proportion of EVs in car-sharing fleets • Proportion of trips using pedal assist electric bikes, while also tracking proportion of trips from walking, cycling, public transit, and car trips	• Explore opportunities to support vehicles-for-hire in transitioning to EVs • Initiate partnerships with interested car sharing companies to explore opportunities • Provide input on provincial government initiatives, policies and legislation allowing for electric micro-mobility and pilot projects • Conduct research, review pilot project options, and monitor impacts on bike sharing and pedal assist e-bike sharing

ACTION 5:

Explore regulatory changes and pilots to reduce congestion and promote EV adoption

Barriers Addressed

The Challenge

To facilitate the transition to 100% LEVs, additional non-financial incentives for EV drivers may be important to accelerate adoption. For example, LEV or ZEV zones – areas that only allow access to certain types of vehicles – can provide a significant and highly visible benefit to EV drivers. In addition, operating incentives can decrease EV ownership costs leading to more consumers switching to EVs.

Benefits

- Local emission reduction and resident health improvement
- Lowering owner fees will improve the economics of purchasing an EV

Activities

Activity #1: Explore establishing a pilot LEV or ZEV zone

The City can explore the establishment of a LEV or ZEV zone. A pilot project would be beneficial in determining the potential impacts of these zones, best practices, and lessons learned for future electrification.

When establishing a zone, access and equity will be an important consideration that should be included as part of the pilot project.

Activity #2: Explore reducing any future road tolls or congestion charges for EVs

In the longer term, if road tolls or congestion charges are implemented by the City, consider reducing or exempting EVs from their payment. As these types of charges are not currently imposed by the City, the development of a statement of intent would be sufficient until such a time that these types of charges are implemented. The City could also explore exempting deliveries made by EVs from regulations which restrict vehicle activities (e.g. Noise Bylaw).

Lead

- Transportation Services

Support

- Environment & Energy Division
- Waterfront Toronto
- City Planning
- Toronto Public Health (to provide health and health equity research and evidence for Activity #1)

Resources

Set Up Cost: $ - $$

Costs are assumed only for the exploration, not the piloting and further implementation.

Outcomes	
Short-term: • Create a cross-divisional working group to explore the feasibility of LEV or ZEV pilot project • Explore developing a statement of intent to reduce or exempt EVs from future toll or congestion charges **Medium term:** • Launch a LEV or ZEV pilot project	
KPIs	**Next Steps**
• Number of pilot projects for LEV or ZEV zones • Statement of intent exempting EVs from future toll or congestion charges finalized	• Create a working group to explore the feasibility of a LEV or ZEV pilot project • Form a working group to explore developing a statement of intent exempting EVs from future toll or congestion charges

C. EDUCATION AND ADVOCACY

OBJECTIVE: Increase the awareness and acceptance of EVs and charging infrastructure among all Torontonians and key stakeholders (e.g. architects, builders, landlords, building owners, politicians).

EV adoption can be inhibited by a lack of information as well as misinformation (e.g. knowledge of charging availability, knowledge of home charging options, range anxiety, lifecycle costs, model availability, and model features). Consumers may not have enough awareness, confidence, or understanding of EVs to be comfortable deciding to switch. Addressing these knowledge gaps can reduce the barrier to EV adoption.

In addition, other levels of government can be influential in providing incentives and requirements to support EV and charging infrastructure adoption. The City can help by advocating for such support.

Actions to improve education and advocacy include:

6. Advocate to other levels of government for requirements to encourage a transition to EVs
7. Communicate social, environmental, and economic impacts of EVs
8. Continue to add EVs to the City's corporate fleet and engage organizations to share best practices

Areas of Alignment	
	Sustainable Fleets Plan. The City's Sustainable Fleets Plan outlines Fleet Services objectives to addressing climate mitigation and adaptation with strategies for transitioning to sustainable, climate resilient, low-carbon operations. One of the objectives is to transition 45% of the City's fleet to low-carbon vehicles by 2030, as established by TransformTO.
	Green Bus Technology Plan and Ridership Growth Strategy. TTC's Green Bus Technology Plan includes commitments to only procure zero-emission buses by 2025 and to completely transition to a zero-emission fleet by 2040. TTC's Ridership Growth Strategy outlines initiatives over five years (2018-2022) to grow ridership by making transit faster, more reliable, more comfortable and more convenient.

ACTION 6:

Advocate to other levels of government for requirements to encourage a transition to EVs

Barriers Addressed

The Challenge

Requirements and incentives provided by the Provincial and Federal governments can play a large role in advancing the EV market in the City. For example, provincially, the Ontario Building Code was recently amended to no longer require new residential construction to be EV ready. While concerns were raised that the requirement adds construction costs, the costs to install the required infrastructure during initial construction are substantially less than those required to retrofit pre-existing homes.

Incentives which reduce upfront EV costs lead to more consumers switching to EVs. Typically, such incentives are provided by Provincial or Federal governments. ZEV policies that mandate an increasing percentage of EV sales in a region can promote greater availability of EVs, but require a large catchment area to be effective (i.e. larger than just the City).

Benefits

- Reduces overall cost of adding charging infrastructure in homes
- Decrease EV costs for residents
- Improve accessibility to EVs

Activities

Activity #1: Advocate for EV ready parking in residential new construction

As the City enforces the Ontario Building Code for new residential construction, the City should advocate to the Province to re-require EV readiness for new residential construction. EV ready requires parking spaces to feature a complete electrical circuit terminating in an electrical outlet for the purpose of EV charging.

Activity #2: Advocate for policies that support a transition to EVs

Advocate for Provincial and Federal policies to encourage the transition to EVs. Opportunities exist at both levels of government for rebates for new and used vehicles, to establish a ZEV policy or mandate,[36] or to maintain existing benefits for EV drivers (e.g. HOV lane access on provincial highways).

Lead

- Environment & Energy Division

Support

- The Atmospheric Fund
- Toronto Building (to provide support on Activity #1)
-

Resources

Set Up Cost: $ - $$

Implementation Cost: N/A

[36] In Canada, British Columbia and Quebec have established ZEV mandates. British Columbia has mandated that 100% of new cars are to be ZEV by 2040, while Quebec has created a credit system mandating manufacturers to earn ZEV credits equal to 22% of light duty vehicle sales and leases by 2025.

Outcomes	
Short-term: • The provincial and federal governments continue to enable a shift to EVs through policies and incentives **Medium term:** • The provincial government amends the Ontario Building Code to require residential new construction to be EV ready	
KPIs	**Next Steps**
• Interactions with the provincial government on this topic • Amendment of the Ontario Building Code	• Develop a work plan for exploring policy opportunities related to potential modifications to the Ontario Building Code and EV enabling activities • Form a working group to determine the priority of preferred actions by the provincial and federal governments • Advocate for governments to pursue EV enabling activities or policies

ACTION 7:

Communicate social, environmental and economic impacts of EVs

Barriers Addressed

The Challenge

Many consumers and businesses are unaware, misinformed and/or uncomfortable with EVs, charging infrastructure, incentive programs, and other important information supporting consumer adoption of EVs. On the other hand, there are also many who residents are interested in actively promoting a transition to EVs. An organized network of residents, supported and engaged by the City, would help provide an avenue for engagement.

Benefits

- Improved knowledge and interest of EVs
- Engaged residents have a City-supported method to make an impact on EV adoption in the City

Activities

Activity #1: Develop education and outreach initiatives

The City should pursue a number of different education and outreach initiatives, including:

1.1. Hosting a website that acts as centralized information hub;

1.2. Developing and/or promoting existing toolkits for targeted stakeholder segments:

- *Architects and developers*: Include information on ensuring new construction is EV ready;
- *Building operators, condominium boards, landlords and employers*: Include information on installing and maintaining charging infrastructure; and
- *Vehicle dealerships and sales staff*: Include information on EV benefits to simplify sales process;

1.3. The City to explore the creation of a resident-led public charging initiative to identify new locations for public charging infrastructure. This should include on-street charging. This initiative will help site new public charging across Toronto.

1.4. Promoting existing rebates for new and used EV purchases to ensure consumers are aware of these programs;

1.5. Leveraging affiliate agencies and corporations to partner and promote EV and charging information;

1.6. Exploring partnerships with non-governmental organizations or others to implement education and outreach initiatives; and

1.7. Developing standard signage requirements for EV charging infrastructure, to improve visibility and simplify the process for EV owners who are using a charging station at a new location.

When designing the education packages, information on both the benefits and challenges of vehicle electrification should be

Lead

- Environment & Energy Division

Support

- Information and Technology
- Toronto Parking Authority
- Fleet Services
- Plug'n'Drive
- Community EV Groups
- Developers and Building Operators

Resources

Set Up Cost: $

Implementation Cost: $$

discussed. For example, as EVs are quieter vehicles, there may be new risks associated with pedestrian safety. Such challenges can be explored by the City to determine whether education and outreach are sufficient to mitigate the risk, or if further actions are required. **Activity #2: Create an EV Community Champions network** Live Green Toronto develops programs and provides resources to engage the community to accelerate the reduction of GHG emissions. They actively engage residents in Toronto to support the City's initiatives. Creating an EV Community Champions network would help further engage residents in implementing the Strategy's actions. Initially, neighbourhoods that have high rates of EV adoption can be a preferred focus area for this activity.	

Outcomes

Short-term:

- Informational toolkits and online materials are easily accessible for interested stakeholders
- An EV Community Champions network is launched in specific neighbourhoods

Medium term:

- Stakeholder segments are better informed about EVs and their charging infrastructure
- Expand the EV Community Champions network to the rest of the City

KPIs	Next Steps
• Number of consumers reached • Average feedback rating of materials/events • Number of members of the EV Community Champions network • Number of events held by the network	• Review available information to determine gaps and leverage existing content (e.g. Plug'n'Drive resources) • As required, develop new toolkits and online materials • Determine appropriate neighbourhoods to launch the EV Community Champions network • Launch the network

ACTION 8:

Continue to add EVs to the City's corporate fleet and engage organizations to share best practices

Barriers Addressed

The Challenge

One way to increase EV adoption is through increased EV visibility. As consumers see more EVs on Toronto's roads and highways, they will become more aware and comfortable with EVs.

TransformTO set the goal of transitioning 45% of the City's fleet to low-carbon vehicles by 2030, and 100% by 2042. A significant part of the City's fleet are on-road light-duty vehicles. The City currently operates approximately 2,000 cars, pickup trucks, vans and SUVs. The City is **continuing to add EVs** to its corporate fleet as part of its Sustainable Fleets Plan.

Benefits

- Reduced GHG and pollutant emissions
- Increased EV visibility, resulting in increased general awareness and comfortableness
- Decreased long-term maintenance and operation costs for the City

Activities

Activity #1: Continue to convert City's corporate fleet to low-emission vehicles

As part of the Sustainable Fleets Plan, the City will continue converting their fleets to low-emission vehicles including EVs. The plan will consider the current state of EV technology and determine which vehicles can be feasibly transitioned in the near future without compromising service quality. Barriers to the further electrification of light-duty vehicles (e.g. access to charging infrastructure, range limits) should be identified and solutions proposed to address these challenges. A key barrier to explore is the cost of developing charging infrastructure at the City's corporate sites.

In addition, the City should conduct outreach to the private sector, community organizations, and neighbouring jurisdictions to share lessons learned and best practices associated with fleet electrification.

Lead

- Fleet Services

Support

- Environment & Energy Division

Resources

Set Up / Implementation Cost: $$

Activity #2: Develop a joint City EV charging infrastructure procurement strategy

A standardized City-wide electric vehicle charging infrastructure technical requirements would simplify procurement processes and streamline activities. Opportunities currently exist to harmonize standards by:

- Identifying technical requirements for internal and public facing charging infrastructure; and
- Standardizing signage, installation standards, guidelines, and policies.

Outcomes

Short-term:

- Continuing the process to replace the City's passenger vehicles with EVs
- Study of replacement options for City's medium- and heavy-duty fleet vehicles

Medium term:

- Replacement of City's remaining light-duty fleet (e.g. pickup trucks, vans and SUVs)
- Replacement of City's medium- and heavy-duty fleet vehicles

KPIs	Next Steps
• Percent of City fleet that are EVs • Percent of fleet vehicle kilometres travelled powered by electricity	• Sustainable Fleets Plan will be presented in fall 2019

D. ECONOMIC OPPORTUNITIES

OBJECTIVE: Capture the economic benefits associated with the transition to EVs by supporting local innovation on vehicles and vehicle-related infrastructure.

The transition to EVs will create new economic opportunities. Capitalizing on these opportunities can spur economic growth and generate new, high-paying jobs within the City. As jurisdictions around the world are actively participating in the EV transition, the City will need to proactively pursue opportunities to realize these benefits locally.

Actions to improve economic opportunities include:

9. Support EV related research
10. Promote economic benefits of EV technology in Toronto

Areas of Alignment	**City of Toronto's Department of Employment & Social Services.** The department provides employment support, financial benefits and social support to Toronto residents. Staff can help residents find jobs or training needed to find work. Their vision is to strengthen the social and economic well-being of residents in their communities.
	Toronto Global. The organization is a pan-regional investment attraction agency representing Toronto and surrounding municipalities. It receives funding from the regions it represents including Toronto.

ACTION 9:

Support EV related research

Barriers Addressed

The Challenge

Innovative post-secondary and private sector research can be a key driver for attracting investment and creating high-paying jobs in Toronto. A strong network of active research can help create and attract businesses, entrepreneurs, and others participating in the emerging EV ecosystem, as well as serve as a potent magnet for EV R&D investment. It can help cultivate the educated and skilled workforce that the EV industry demands.

One specific research related topic is the circular economy, which aims to optimize resource use by moving from the current linear take-make-dispose process to one focusing on product longevity, reuse, and repair. Such a focus would benefit EVs by providing use for their components after the vehicle is no longer operational.

Benefits

- Increased EV-related R&D investment in Toronto
- Larger skilled EV workforce
- Increased EV-related businesses in Toronto
- New uses for EV batteries to extend their useful life beyond that of the vehicle

Activity #1

Support post-secondary institution and private sector EV research

The City should support world class, innovative EV research in Toronto's post-secondary institutions and private sector through:

1. Providing direct funding or in-kind support;
2. Providing timely and high-quality data for research projects;
3. Providing access to transportation and planning professionals to help inform and guide research; or
4. Incorporating research outcomes into pilot projects for real-world testing and verification.

Ongoing research tends to attract funding and support for more research as research clusters have strong advantages for fostering collaboration and innovation. The City should focus its support for EV-related research in a way that will help leverage and attract support from other sources, while also supporting the City's own needs in the electric mobility landscape. Some potential research topics that could be addressed include:

- Optimization of charging infrastructure distribution, siting and capacity
- Development of innovative customer interfaces for locating charging stations and making payments
- Vehicle grid integration opportunities, including smart charging and vehicle-to-grid
- Optimization of EV fleet logistics and charging, including for shared mobility applications.

Lead

- Environment & Energy Division

Support

- The Atmospheric Fund
- Information and Technology
- Universities
- Colleges
- Private sector

Resources

Set Up Cost: $

Implementation Cost: $-$$

Activity #2	Lead
Explore opportunities to avoid waste and support end-of-life reuse The City can support research opportunities for new uses for EV batteries and components after the effective useful vehicle life. Support towards these types of opportunities, or access to municipal resources (e.g. EV batteries after decommissioning vehicles) could benefit the private sector or academics in this space. Research may lead to new market opportunities for battery recycling and the development of pathways for second life applications of EV batteries.	• Environment and Energy Division **Support** • Fleet Services • Private sector • Academics **Resources** Set Up Cost: $ Implementation Cost: N/A

Outcomes	
Short-term: • More EV-related research is conducted in Toronto **Medium term:** • More EV-related research conducted in Toronto is recognized nationally and globally • More funding and support for EV-related research is attracted to Toronto	
KPIs	**Next Steps**
• Number of EV-related research projects hosted within Toronto's post-secondary institutions • Number of EV-related research projects funded or supported by the City	• Hold targeted consultations with post-secondary institutions and the private sector to determine best way to support EV-related research • Secure funding to support research • Enter into partnership agreements with researchers

ACTION 10:

Promote economic impact of EV technology in Toronto

Barriers Addressed

The Challenge

Cities across North America are competing to attract new businesses. The EV market, and its related businesses, are expected to see growth as the transition to LEV adoption progresses. The City should provide support to attract new EV businesses to ensure that Toronto stays at the centre of this growth.

In addition, industry conferences are a key opportunity to bring EV experts, entrepreneurs and investors to Toronto. Besides the direct economic benefits, the conferences will provide a low-barrier opportunity for residents to engage with the industry and will provide the city an opportunity to showcase its forward-thinking EV policies. To successfully host such conferences or forums, financial and logistical support is required from different stakeholders.

Benefits

- More EV-related businesses and jobs in Toronto
- Host industry leading events to expand local knowledge of EVs and their opportunities

Activities

Activity #1: Support efforts to host EV industry events

The City can support efforts to host EV industry conferences, events and forums in Toronto by providing, when they fit existing Divisional programs and funding mechanisms, support in such areas as venues, funding and staff technical support as well as by partnering with event organizers in their bidding and planning. Such events could be used to discuss the current state and long-term evolution of the EV market and associated policies. In addition, the conference could look at EVs place in the regional automobile industry, workforce expansion, and the role of regional and local economic development organizations in supporting this industry. Depending on the topics covered, the City could play a role to encourage local businesses to participate.

Activity #2: Help attract EV-related industries and businesses

The City can aid EV-related businesses to establish themselves in Toronto by supporting investment or providing general business development assistance. This is a unique opportunity, with Ontario well positioned as the centre of the Canadian automobile industry. The range of support activities will vary depending on the type of enterprises, whether they be a manufacturing facility, or a small start-up. Mentoring, training, and guidance in navigating the processes to establish a business in Toronto will be helpful for businesses and entrepreneurs.

The City can also support efforts by external investment agencies, such as Toronto Global, to attract the EV industry.

Lead

- Economic Development and Culture

Support

- Environment & Energy Division
- Enterprise Toronto
- Toronto Global

Resources

Set Up Cost: N/A

No additional funds required (covered with current resources)

Implementation Cost: $

Outcomes	
Short-term: • More EV focused events are held in the City • More EV-related businesses are attracted to Toronto **Long-term:** • Toronto is known as a North American hub for EV-centric idea generation and policy	
KPIs	**Next Steps**
• Number of EV events supported • Number of EV-related businesses supported	• Determine partnership opportunities • Determine appropriate levels of support for events • Market the City as a location where EV-related businesses can thrive • Support EV-related industry in establishing itself in Toronto

STRATEGY KEY PERFORMANCE INDICATORS

Progress towards the overall objectives of the Strategy will be important to monitor. While KPIs have been defined at the action level (to gauge progress in addressing barriers to adoption), they should also be defined for the Strategy (to gauge progress in achieving outcomes). For the Strategy, the following can be tracked:[37]

General	**GHG emissions**: As more Torontonians adopt EVs over ICE vehicles, GHG emissions from personal vehicles will decrease. As part of its commitment to address climate change and inform the development of its climate strategy and policy, the City annually reports citywide GHG emissions by sector including personal vehicles.
	EVs: As the Strategy increases EV adoption, and other City strategies and initiatives decrease personal vehicle usage, the proportion of EVs relative to ICE vehicles registered in Toronto will increase. Relevant targets are outlined in this Strategy's " *EV Strategy* Interim " section.
Health	**Local air quality**: Air pollutants from passenger vehicles impact local air quality. As EVs displace ICE vehicles, local air quality will improve. This should result in a direct improvement in Toronto's Air Quality Health Index over time.
	Noise: EVs are much quieter than ICE vehicles. As EVs displace ICE vehicles, traffic noise levels will decline. The City regularly commissions environmental noise studies (the most recent one in 2017). These studies should show a declining percentage of residents exposed to road traffic noises above recommended levels over time.
Equity	**Public charging access:** As public charging infrastructure becomes more prevalent in Toronto, it will be important to ensure vulnerable neighbourhoods are not left out. The proportion of public charging stations and ports in vulnerable neighbourhoods should be tracked. There should not be an expectation of equal distribution among all neighbourhoods, but of an equitable distribution as the transition towards LEVs progresses.
	EV Ownership: Over time, an equitable transition to electric mobility should provide *all* Toronto residents the opportunity to own an EV. Thus, the proportion of EVs to ICE vehicles registered in vulnerable neighbourhoods should be measured and compared to the City's overall proportion.
	Shared Mobility: As shared mobility services (e.g. taxis, ridesharing, car-sharing) begin to offer EV options, it will be important that vulnerable neighbourhoods benefit. The proportion of shared mobility trips completed by EVs in vulnerable neighbourhoods should be tracked. Again, the expectation should not be of equal distribution, but of an equitable one.

[37] For many of these KPIs, while we acknowledge that there may be issues in determining causation, these indicators can help track progress of the overall Strategy.

Economic	**Businesses:** If Toronto is successful in attracting and fostering EV-industry investment, the number of EV-related businesses located in the city will grow. This should be reflected in the data collected by Toronto's annual employment survey.
	Jobs: If Toronto is successful in attracting and fostering EV-industry investment, the number of EV-related jobs in the city will grow. This should be reflected in the data collected by Toronto's annual employment survey.
	Investment: If Toronto is successful in attracting and fostering EV-industry investment, the number of EV-related investment in the city will grow. Toronto does not collect granular data on investment in the City. Accordingly, this metric may require a more qualitative approach (e.g. the amount of EV-related investment Toronto Global reports having helped facilitate).
Public Engagement	**Breadth:** Public engagement should reach as many residents as possible. This will be reflected in the number of people attending EV outreach events and/or accessing EV-related informational materials or websites.
	Quality: Public engagement should increase residents' knowledge. Through general surveying of Toronto residents, the city can track the percent of people indicating they are knowledgeable about EVs and the percent indicating they are knowledgeable about EV charging locations.
	Persuasiveness: Public engagement should help convince people to pursue electric mobility. Through general surveys of Toronto residents, the percent of people indicating they would purchase an EV can be tracked.

NEXT STEPS

The City should undertake the following steps to implement the Strategy:

- **Secure approval by City Council**: City Council needs to approve the strategy that will be pursued.

- **Convene working groups with key stakeholders to support implementation**: Where appropriate, expand the role of the EV Working Group to oversee industry-specific groups designed to focus on how to effectively implement actions. These targeted working groups would, ideally, include 8-10 champions from specific industries that can:

    - Frame issues;
    - Identify roadblocks and what is needed to implement the specific action(s);
    - Help smooth implementation for industry; and
    - Support EV adoption.[38]

    Potential topics for discussion among these groups include:

    - Public charging infrastructure deployment;
    - MURB charging infrastructure deployment;
    - Training and job growth (e.g. in-demand skills);
    - Equity; and
    - Regional partners.

- **Begin implementing new actions**: In order to meet 2025 interim targets, it will be important to promptly begin working on those actions not already in progress.

[38] Stakeholders who participated in the workshops to support the development of this Strategy showed interest and enthusiasm in pursuing ongoing collaboration with the City to help shape and implement the actions.

APPENDICES

APPENDIX A: STAKEHOLDERS ENGAGED

The following City divisions and external organizations were engaged during the development of this Strategy. The views and opinions expressed in this document are not necessarily representative of the views of individual participants or the organizations they represent.

City of Toronto and Electric Vehicle Working Group

- City Planning
- Economic Development and Culture
- Environment & Energy Division
- Exhibition Place
- Facilities management
- Fleet Services
- Geospatial Data Integration & Access
- Parks, Forestry & Recreation
- The Atmospheric Fund
- Toronto Employment and Social Services
- Toronto Hydro
- Toronto Parking Authority
- Toronto Public Health
- Toronto Public Library
- Toronto Zoo
- Tower & Neighbourhood Revitalization Unit
- Transportation Services
- Toronto Transit Commission
- Solid Waste Management Services
- Waterfront Toronto

External Organizations

- Academics
- Automakers
- Automotive Industry
- Community Organizations
- Economic Organizations
- Electricity System Stakeholders
- EV Technology Companies
- Government – Non-Municipal
- Neighbouring Municipal Jurisdictions
- NGOs / Advocacy Groups
- Oil & Gas Sector
- Property Developers / Managers
- School Boards

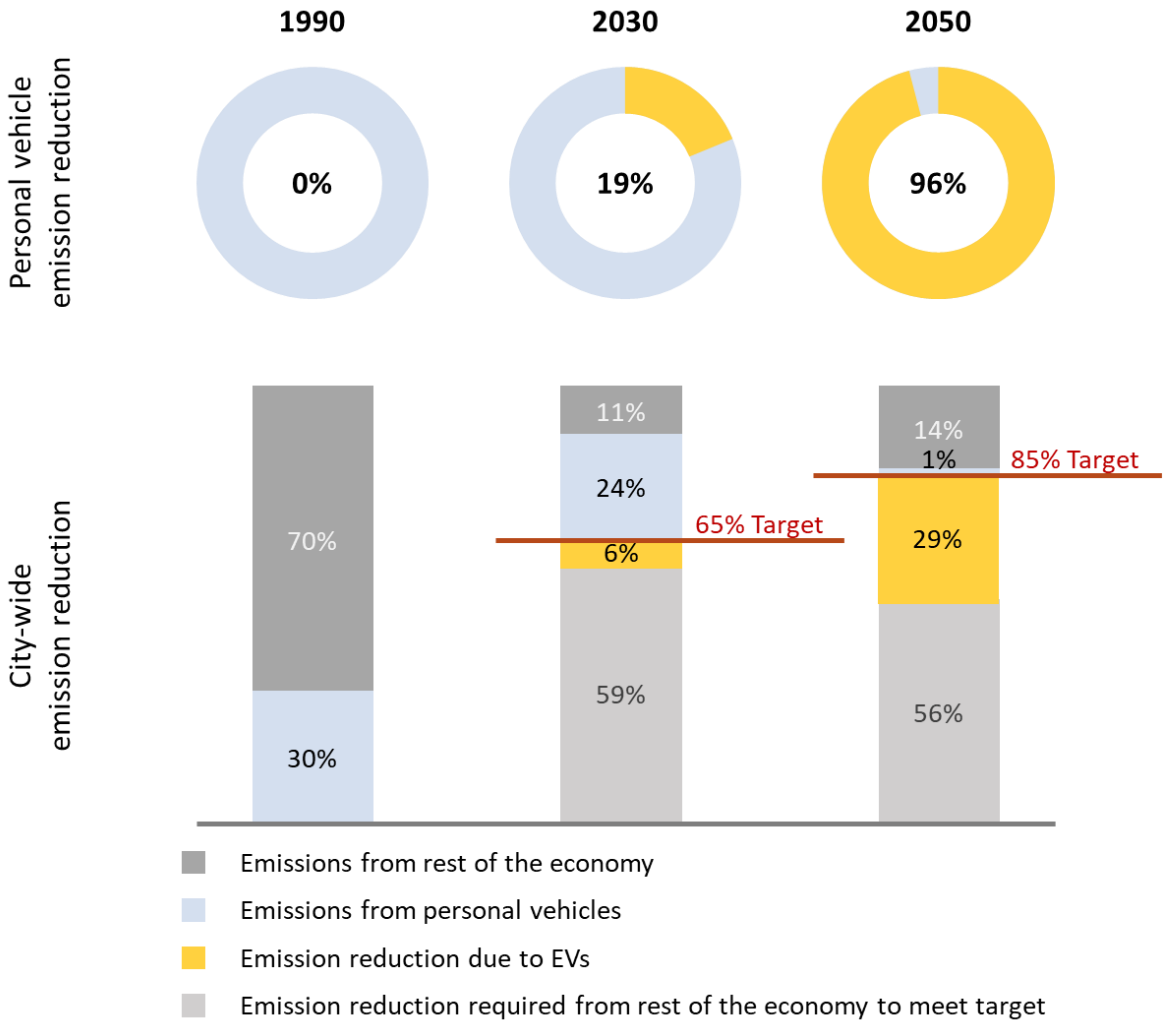
APPENDIX B: GHG EMISSION REDUCTIONS

The Strategy ultimately aims to support TransformTO's GHG emission reduction objectives. As such, we conducted a high-level, simplified analysis to estimate the emission reduction impact of meeting the Strategy's targets of 20% electrification by 2030, and 100% by 2050.

Accomplishing the EV Strategy's goal of electrifying 100% of registered personal vehicles in Toronto by 2050 will reduce Toronto's *city-wide* emissions by approximately 29% compared to levels in 1990. This reduction is because approximately 30% of Toronto's emissions are attributable to personal vehicles, and when all personal vehicles become electric, nearly all of their emissions (approximately 96%) will be reduced.[39] Therefore, fully electrifying personal vehicles will nearly completely eliminate emissions from this segment. This will have a significant role in meeting the overall TransformTO emission reduction targets (i.e. 80% by 2050).

In 2030, achieving the Strategy's goal of electrifying 20% of personal vehicles will reduce emissions from personal vehicles by approximately 19%, reducing economy-wide emissions by 6%. Because this reduction in personal vehicle emissions is lower than the average reduction needed to meet TransformTO's target (i.e. 65% by 2030), greater reductions will be required from the rest of the economy if the target is to be achieved.

[39] Personal vehicle emissions are not reduced 100% because this analysis assumes Toronto's electricity grid remains static with approximately 4% of electricity coming from emitting sources. This in turn means the electricity consumed by EVs will create a non-negligible level of GHG emissions.



The above analysis assumes a number of factors remain constant, including the number of personal vehicle kilometres driven in Toronto and the emissions from Ontario's electrical grid, while also assuming that all EVs are BEVs. Shifting to other mobility solutions and a continued reduction of grid emissions over time can further reduce the emissions associated with personal vehicles.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