# Emerging Trends in Technology Discussion Paper

## Brampton Mobility Plan

Revised January 2025

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# 1 Introduction

The City of Brampton is embarking on the development of the Brampton Mobility Plan (BMP)as an update of the City's 2015 Transportation Master Plan (2015TMP). This new plan will embrace the Brampton 2040 Vision and its framework of green spaces, diversified centres, enhanced transit, and revitalized neighbourhoods. The transformation of Brampton from a 'suburban community' to a 'big city' will explicitly reflect principles of sustainability, livability, diversity, and health.

In February 2021, City Council endorsed a set of guiding principles to direct the development of a new, more sustainable Brampton Mobility Plan:

1. Enhance mobility and travel options for people and goods
2. Advance multi-modal transportation equity
3. Integrate transportation and land use planning
4. Protect public health and safety
5. Improve environmental sustainability
6. Leverage technology
7. Emphasize community engagement and collaboration

This discussion paper presents a review of emerging trends in technology and innovation in mobility and that are expected to change how people travel and the City's role in becoming a connected city that is innovative, inclusive, and bold. The paper will also provide a background review on emerging technologies, recommendations for pilot programs, and potential requirements for policies, infrastructure, and services.

# 2 New Mobility Technologies

Technological advancements are disrupting business models across all industries, including transportation, urban planning and city-building practices. These advancements in technology combined with emerging social megatrends – including declining rates of automobile ownership, rise of shared mobility services, and the advancement of connected and automated vehicle technology – are defining transportation in cities today and tomorrow.

The challenge for the City of Brampton will be to proactively guide the new mobility paradigm towards positive changes that provide equitable opportunity and accessibility for all Brampton residents and workers. The City has made progress towards this goal by revitalizing its downtown through the award-winning Brampton Innovation District. The innovation district is fostering an entrepreneurial ecosystem as a hub for startups, entrepreneurs, and corporations in Canada's Innovation Corridor, offering resources, mentorship, and networking to support tech-enabled businesses and "New Mobility" startups.

"New Mobility" or future mobility refers to new technologies and business models that are changing transportation systems. These including new services, modes, electrification of existing modes, micromobility devices, connected wireless technology that enables

communications between vehicles and infrastructure, and advancements in vehicle automation.[1] New Mobility may refer to solutions that leverage Autonomous, Connected, Electrified, and Shared (ACES) technologies and the data collected and generated to enable effective services.

The new mobility technologies reviewed in this paper include:

- Shared Mobility
- Micro-mobility
- Connected and Autonomous Vehicles
- Electric Vehicles
- Mobility as a Service (MaaS)

## 2.1 Shared Mobility

### 2.1.1 Description

Society of Automotive Engineers defines **Shared Mobility** as "the shared use of a vehicle, motorcycle, scooter, bicycle, or other travel mode… [that] provides users with short-term access to one of these modes of travel as they are needed"[2]. The shared aspect of mobility can be the vehicle (or scooter, bicycle, etc.) or the trip itself (as in sharing a ride with another person). Shared mobility is also an umbrella term for Shared Micro-mobility and On-Demand Microtransit as described below:

- **Shared Micro-mobility** refers to the shared use of vehicle/device that is low speed, light weight and is part of a shared fleet. This typically includes fleets of shared bikes, electric bicycles (e-bikes), and electric scooters (e-scooters) among other shared micro-mobility devices. (See **Section 2.2** for Micro-mobility.)
- **On-Demand Microtransit** (ODMT) is transit provided based on routes and scheduling determined by passenger demand using smartphones or web applications to request rides. The service design is based on community needs and based on the existing local context of municipalities.

Shared services are typically provided at hubs or docking stations, where fleets of shared vehicles and/or devices are available to users and transfer between modes/devices can be accommodated. Examples of shared mobility services include **Communauto,** a car-sharing system that was launched in Montréal in1995 and has since expanded outside of Québec to cities in Ontario, Calgary, Edmonton, Halifax, and Paris (France), and **Bike Share Toronto**, a bicycle-sharing system launched in 2011 that is now managed by the Toronto Parking Authority.

1 The Conference Board of Canada. Governing Disruption, Toward Canada's New Mobility Future. Issue Briefing, May 18, 2023.
2 SAE International https://www.sae.org/shared-mobility/

### 2.1.2 Benefits

Some of the key benefits or advantages of shared mobility are described below.

#### Increases flexibility and convenience of trip making

Shared mobility services can enable more multimodal trips by removing concerns around theft of a parked personal mobility device and the need to bring a personalized device on the trip. It provides connectivity to higher order transit that may be further away and can enable people to make more trips that they may not have made previously. Most notably, shared mobility users showed significant increases in physical activity since starting to use shared modes to replace short ride-hailing trips.

#### Complements public transit use and decreases personal vehicle ownership

The Transit and Micro-mobility study[3] by the Shared-Use Mobility Center (SUMC) showed that instead of competing for the same user, public transit and shared modes complement one another by serving different trip types, or by acting as a replacement when one mode is unavailable. In the same study by the SUMC, three groups of users were surveyed: those who have never used a shared mode (aside from public transit), those who have used a shared mode before, and those who have used a shared mode for both discretionary and non-discretionary travel within the last three months (called “supersharers”). Among these three groups, the last group was found to have significantly lower household vehicle ownership and also spent less on transportation on a net basis. ODMT can also be used as a first/last mile solution to provide curb-to-stop connection, especially those that may experience accessibility challenges.

### 2.1.3 Risks and Mitigation Strategies

#### Right-of-Way (ROW) Considerations and Lack of Multimodal Integration

Shared micro-mobility systems require space to park devices between uses, including any docking systems that may be required. Increased competing interests for public road right-of-way space will make it challenging to integrate shared micro-mobility options with other complementary modes required for complete trip making.

To mitigate these concerns, municipalities can design complete streets, which enables safe use and supports mobility for all modes within the right-of-way and consult NACTO’s guidance, Curb Appeal (2017), for curbside management in a transit-focused approach. Along with this, the city can explore Mobility hubs to consolidate first/last-mile trips. This can be complemented by Mobility-as-a-Service (MaaS) alternatives, further described in **Section 2.5,** that integrate mobility services from start to finish, with payment and information through a single platform.

#### Equity, Inclusiveness, and Accessibility

Shared mobility has the potential to improve quality of life for low-income and vulnerable populations who generally have a higher reliance on public transit. Despite these services being

[3] National Academies of Sciences, Engineering, and Medicine 2021. *Transit and Micromobility*. Washington, DC: The National Academies Press. https://doi.org/10.17226/26386.

relatively low-cost, low-income or minority populations may still have difficulty accessing these services due to cost barriers or lack of access to internet/mobile phones.

To ensure that shared mobility is accessible and inclusive, municipalities can explore tax credits, subsidies, and pilot programs that encourage and make shared mobility mainstream. To minimize digital barriers, municipalities can explore providing digital trip information through screens or kiosks at shared mobility stations, along with support through non-digital means such as a call center for microtransit or ride-hailing services.

## 2.2 Micro-mobility

### 2.2.1 Description

Micro-mobility, a term often used in conjunction with shared mobility, typically refers to a vehicle or device that is low speed (under 50 km/h), light weight (less than 45 kilograms) and personally owned. Micro-mobility devices are sized to transport individuals and sometimes one or two additional passengers, in a smaller form than a motor vehicle while providing a flexible mode for first and last mile pedestrian and freight travel.

In recent years, there has been many types of electrified personal mobility devices that have come to a widespread commercial market in Canada and internationally. Micro-mobility is an emerging umbrella term to capture all types of personal mobility devices that include non-motorized devices such as bicycles, cargo bicycles, skateboards, and kick scooters. New types and permutations of micro-mobility devices with electric motors continue to be developed, such as electric bikes (e-bikes), electric scooters (e-scooters), and electric skateboards (e-skateboards).

E-bikes have become very popular, outselling electric cars in the US market in 2021[4]. E-bikes provide a convenient mobility option as the electric motor helps propel the device and can help make cycling hilly terrain or longer distances less of a barrier. Electric-assist bicycles are do not require a licence to operate, are more affordable than car ownership and the risks of using an e-bikes is considered similar to a traditional bicycle[5].

In November 2019, Ontario announced a pilot project where municipalities can enact a by-law to allow e- scooters in municipal rights of way. In April 2023, the City of Brampton launched a 2-year pilot for shared micro-mobility services to support the City's multi-modal needs through a fleet of shared, small and environmentally friendly devices. Through this pilot, up to 750 e-scooters will be deployed by three service providers. The e-scooters will provide residents with an alternative mode to connect to neighbourhoods, services, businesses, and transit in Brampton.

[4] https://www.bloomberg.com/news/articles/2022-01-21/u-s-e-bike-sales-outpaced-electric-cars-in-2021?leadSource=uverify%20wall
[5] https://www.sciencedirect.com/science/article/pii/S0967070X22002475?via%3Dihub

Currently, the Province of Ontario regulates some micro-mobility devices as outlined in **Table 2-1**. There are opportunities for an updated tiered e-bike classification to account for speed differences (upwards of 45 km/h[6]) from various pedal assistance technologies.

**Table 2-1. Micro-mobility Regulations by Province of Ontario**

| Requirements (Maximums) | E-bike | E-scooter |
|---|---|---|
| Maximum Speed | 32 km/h | 24 km/h |
| Maximum Weight | 120 kg | 45 kg |
| Maximum Power Output | 500 watts | 500 watts |

Cargo bicycles have opened up opportunities to replace a motor vehicle trip with a cargo bicycle trip. These include grocery trips, travelling with children or another adult, and even options to replace work vehicles[7]. Electric-assist motors enables more people of different abilities to be able to comfortably propel and maneuver these larger and heavier bicycles. In April 2021, MTO released regulations for a Cargo Power-Assisted Bicycles pilot project for a 5-year period[8]. Through this pilot regulation, municipalities must enact a municipal by-law to permit the use of cargo e-bikes within the community.

### 2.2.2 Benefits

For the most part, benefits for shared mobility also apply to micro-mobility. Micro-mobility **complements public transit**, particularly for "first and last mile" connections, and **increases flexibility and convenience** of using sustainable mode choices.

### 2.2.3 Risks and Mitigation Strategies

The risks and mitigation strategies presented for shared mobility also apply to micro-mobility. Additional risks are described below.

#### Appropriate Facilities

Micro-mobility devices present many considerations and challenges to our current transportation system. Due to top speeds of some devices, it may be unclear where within the road right-of-way (ROW) these devices should operate. For example, e-scooters and e-bikes are regulated to maximum speeds (see **Table 2-1)** up to 32 km/h that suggest these devices are most appropriate on facilities where cyclists are permitted. In the City of Brampton's e-scooter pilot program, e-scooters are permitted on roads with a posted speed limit of 50 km/h or less, bicycle lanes and multi-use paths. E-scooters are not permitted on Brampton's sidewalks.

As micro-mobility devices gain popularity, municipalities are facing challenges in the lack of facilities where people feel comfortable using their micro-mobility device. Similar to the challenges for cycling, on-road facilities are perceived to be unsafe or uncomfortable (such as painted bike lanes directly next to high-speed car traffic without sufficient separation). As a result, many people using e-scooters and other electric devices choose to use the sidewalk

[6] https://www.peopleforbikes.org/electric-bikes/policies-and-laws
[7] https://www.larryvsharry.com/en/blog/cyclo-plombier
[8] https://www.ontario.ca/laws/regulation/210141

even when they are aware it is not permitted. Building appropriate facilities, such as physically separated bikeways, will be integral for supporting the use of micro-mobility devices. This may require a review of the Brampton Active Transportation Master Plan with micro-mobility devices, particularly electric devices, in mind.

#### Safety, Production Standards, and Operating Regulation/Oversight

Regulation and industrial standards for micro-mobility are still developing, which results in variations in speed between vehicles of the same class and lack of awareness of regulations among recreational or inexperienced users.

International standards are being drafted through institutions such as Society of Automotive Engineers International which provided standards to define the weight, width, top speed, and power source of six types of micro-mobility vehicles though these standards vary by institution.

Pilot study results and policies developed by the Province of Ontario can be adapted by municipalities for micro-mobility operation.

## 2.3 Connected and Automated Vehicles

### 2.3.1 Description

Automated vehicles (AVs), also called autonomous vehicles, use technology to automate aspects of the driving system by either operating vehicle features or the entire driving process. SAE International defines six levels of automation for AVs, which range from 0 (“No Automation”) to 5 (“Full Automation”). Levels 0-2 require a driver to monitor the driving environment whereas Levels 4-5 require no human intervention and can be considered fully “driverless” vehicles.

Many experts in the industry believe that AVs must be connected to advance their deployment and access the full benefits of driverless technology[9], and often refer to Connected Vehicles (CVs) when discussing AVs (or vice-versa). CV technology allows vehicles to communicate with infrastructure (vehicle-to-infrastructure, V2I), with each other (vehicle-to-vehicle, V2V), or with “everything” (vehicle-to-everything, V2X) including with other modes such as pedestrians and cyclists. Connected and Automated Vehicles (CAVs) are jointly discussed in this paper.

Policymakers have opportunities to shape the impact of CAV within their jurisdiction. Some concerns with CAVs include the level of regulation, liability implications, safety standards, and methods to encourage adoption through infrastructure improvements, financial incentives, or dedicated highway lanes. Many of the policy-making concerns are at the provincial level and fall outside municipal jurisdiction. To ensure that CAV implementation is consistent across regional boundaries, there is a need to develop regional policies/standards. Potential applications of

[9] Eno Center for Transportation. (2017). *Adopting and Adapting: States and Automated Vehicle Policy.* Washington, DC: Eno Center for Transportation.

CAVs in the transport network have been widely explored in academia for car-sharing, ride-hailing, private ownership, goods movement, and public transit.

### 2.3.2 Benefits

#### Improved road safety

Collisions result in vehicle damage, personal injury, and lives lost. It is estimated that human error is responsible in over 90% of collisions[10] and removing the human element of driving through CAVs, many collisions could be prevented. Issues such as distracted driving or driving under influence may be eliminated with CAVs.

#### Decreased congestion

CAVs have the potential to reduce traffic delay by 1) by reducing vehicle collisions and 2) enhancing vehicle throughput in the transport network through connected technology (through co-operative driving). Additionally, a decrease in total vehicle-kilometers-travelled (VKT) due to CAV proliferation could lead to a further decrease in congestion, but it is inconclusive whether an increase or decrease in total VKT will actually occur.

#### Improved goods movement and use of road space

V2V technology will allow for platooning or “co-operative driving” (safely grouping vehicles closely by communicating with one another) of vehicles with low headway through speed harmonization. This could be highly beneficial for the trucking industry where CAVs can travel to depots off major highways and human drivers can complete the final delivery leading directly to better utilization of freeways. CAVs also have the potential to reduce traffic delay by decreasing the number of vehicle collisions and enhancing vehicle throughput in the transport network through co-operative driving.

#### Increased fuel efficiency and land use pattern shifts

CAVs are more fuel efficient because of their ability to communicate their maneuvers with each other, which can reduce sudden braking, and because they are anticipated to be electric vehicles (EVs), which generate fewer emissions throughout their lifecycle. CAV technology is anticipated to significantly reduce parking needs in city centers, which can be freed for other uses and increase density but could also perpetuate existing land use patterns such as urban sprawl.

### 2.3.3 Risks and Mitigation Strategies

#### CAV Transition

As CAVs increase in prominence on the road network, existing roadway infrastructure may be unable to handle operations for both CAV and non-CAV users and road users may lack familiarity with CAVs during and after the CAV transition. Facilitation of the transition to an automated future will involve participation from the government at all levels.

[10] Maddox, J. (2012). *Improving driving safety through automation, congressional robotics caucus*. National Highway Traffic Safety Administration.

#### Economic Disruption

CAVs may eliminate the need to employ humans for tasks such as truck drivers, taxicab drivers, municipal bus drivers, etc. Additionally, revenues from parking charges are a source of steady income for many municipalities. By making parking less essential, CAVs may reduce or eliminate this revenue stream.

To mitigate the economic risk associated with CAVs, lost revenues from parking could be offset through the CAV benefits described above and replaced by opportunities for taxation through a VKT tax or a luxury tax associated with private CAV ownership. New employment opportunities will also come with the innovation and by supporting a transportation innovation plan and coordination with higher levels of government, municipalities can share and leverage any lessons learned.

#### Increase in Urban Sprawl and VKT

CAVs could lead to more urban sprawl as commuters may be more willing to travel further to their workplace if they are able to gain utility during the commute time to complete other tasks (sleeping, working, reading, entertainment, etc.).

Municipalities can mitigate the risk of urban sprawl by providing zoning regulations and exploring road/distance/congestion pricing schemes and making other sustainable modes more attractive.

Where CAVs are adopted as personal, privately-owned vehicles, this may introduce “ghost vehicles” where empty CAVs are circulating on the road network after dropping off passengers resulting in an increase of vehicles on the road and vehicle-kilometres travelled (VKT). Municipalities should plan for and promote alternatives to CAV ownership – such as shared mobility services or pricing strategies to discourage trips by ghost vehicles.

## 2.4 Electric Vehicles

### 2.4.1 Description

Electrification in mobility aims to replace fossil fuels used for internal combustion engines (ICE) with electricity stored in batteries or hydrogen to power vehicles. Transportation is the highest contributor of greenhouse gas (GHG) emissions across all industries. Electrification has many potential benefits but also many barriers to widespread adoption.

Municipal service providers, goods movement companies, and transit agencies are considering a transition to electric fleets. Electric fleets require operators to change their current processes to allow for different fueling times, off-peak charging, and spare vehicles. Key design and operational strategies will depend on the vehicle design, fleet size, charging frequency, charging speed, and suitability for the specific use case. Increased investments to accommodate electric demand should also be considered.

### 2.4.2 Benefits

#### User cost savings

Lifetime ownership costs of popular electric vehicles (EVs) are estimated to be $7,500 to $13,000 lower compared to top-rated internal combustion engine vehicles of similar class according to a Montana study conducted in October 2020[11]. Purchasing a used EV between 5 and 7 years old resulting in even greater cost savings, at two to three times more on a percentage basis.

#### Allowing for updated energy sources

Electric vehicles typically use batteries or hydrogen fuel cells to power the vehicle, but future systems can be adapted to other energy sources and can be continuously upgraded with future technological improvements.

#### Reduction in GHG emissions

The Montana study[13] also indicated an EV would reduce carbon-based GHG emissions by an estimated 4,096 pounds (1,850 kg) per year. It is important to note that although EVs do not directly create emissions, the method used to generate the electricity and the level of energy consumption on a life cycle basis must also be considered.

### 2.4.3 Risks and Mitigation Strategies

#### Power Infrastructure Gap

Existing power grids are not equipped to support widespread EV adoption and can result in potential challenges with power infrastructure supply meeting demand. To help mitigate the power infrastructure gap, municipalities can develop a city-wide electrification plan that examines the ability of the existing grid to meet EV demand, prioritizes investment in EV infrastructure, and provides policies to support EV adoption.

#### Availability of Charging Infrastructure

The limited availability of charging infrastructure deters widespread EV adoption and makes it infeasible for EV owners to take longer trips beyond the range of their vehicles if charging stations are not available at intermediate points. A network of direct current fast charging (DCFC) stations, which can provide 80% power in 20-30 minutes, is needed. However, a DCFC station costs more to install and costs more for the consumer.

Municipalities can identify key nodes in its jurisdiction that warrant DCFC charging and support implementation. Municipalities should also collaborate regionally to ensure that longer-distance trips are feasible through the provision of charging infrastructure to support cross-boundary trips.

[11] Merkel, J. (2020). How to design electric vehicle charging infrastructure by coordinating with utilities and managing electric demand. Missoula, MT. HDR Inc.

#### Weather Impacts on Vehicle Performance

In cold weather, EVs are less efficient and have lower vehicle ranges compared to internal combustion engine vehicles because batteries are more resistant to charging and are poorer at holding their charge. This results in the user needing to charge more often. Cold weather impacts may be less noticeable to city drivers making shorter-distance trips. As EV technology continues to advance, EV efficiency in cold climates will continue to improve.

#### Adoption Cost Barriers

While the costs of producing EVs and the cost of operating heavy-duty/transit EVs have been decreasing, upfront investment on a per-vehicle cost basis is higher for EVs than conventional vehicles. Many states and provinces offer incentives for individuals and industries to adopt EVs and municipalities can promote those rebates and programs through a city-wide electrification plan.

## 2.5 Mobility-as-a-Service

### 2.5.1 Description

Mobility-as-a-Service (MaaS) is a term to describe the integration of various transport services into a single application for on-demand mobility service. Although some interpretations and descriptions vary, MaaS is intended to improve the consumer mobility experience by integrating information, payment, services, and policies. MaaS is often used as a blanket statement to cover a variety of mobility services, including shared mobility services (bike share, e-scooter share, car share), ride-hailing services (e.g., traditional taxi service, Uber, Lyft, DiDi in China); ride-sharing services (e.g., Lyft Line, UberPOOL), and transit.

The ideal MaaS concept “integrates different mobility services and provides one-stop access through a common interface”.[12] Multiple mobility programs, such as bike sharing, e-scooters, and carsharing services, must first be established in order for MaaS to effectively integrate these services into one platform.

### 2.5.2 Benefits

#### Capacity optimization within the transport network.

MaaS can improve network efficiency by optimizing capacity to meet demand. In peak periods, excess demand could be directed to under-utilized modes or routes.

#### Better intermodal connectivity and trip planning

As multiple transport services are connected through a single platform, information can be easily accessed. Integration of ticketing and payment contributes to a seamless use of multiple modes and increases the number of intermodal trips. For transit agencies, MaaS presents an opportunity to reach a previously inaccessible market and increase their market share.

[12] Karlsson, I.C.M., et al. (2019). Development and implementation of Mobility-as-a-Service – A qualitative study of barriers and enabling factors. Transportation Research Part A: Policy and Practice, Volume 131, 2020, Pages 283-295.

#### Environment and health benefits

MaaS has the potential to decrease private vehicle use and ownership, resulting in air quality improvements, noise reduction, improvements to the landscape and urban realm, and increased physical activity as users shift towards more active modes such as walking and biking.

### 2.5.3 Risks and Mitigation Strategies

#### Infrastructure Barriers

MaaS relies heavily on available transport and communications infrastructure. Municipalities may need to upgrade transportation infrastructure or operations to provide reliable service and users will need to have good connections to communications infrastructure to access real-time information.

#### Data and Regulation

To deliver an integrated system, data between private and public sectors must be shared rapidly and frequently. It may be challenging to standardize and anonymize mobility data to meet privacy regulations while encouraging innovation.

Municipalities should create regulations that support mobility data privacy. Open mobility standards, such as the General Transit Feed Specification (GTFS), can be useful for widely adopting mobility data standards. This can be further supported by prioritizing Mobility-as-a-Service as a foundation of open data standards.

#### Digital Exclusion and Accessibility

As more services are moved online, some equity-seeking groups in the community may be excluded, including disabled and elderly populations. Groups that may benefit the most from MaaS may face access barriers due to digital exclusion or cost factors.

Municipalities can investigate alternative methods to offer MaaS, such as providing a telephone service to minimize digital barriers that prevent segments of the population from accessing MaaS benefits. This could be offered in tandem with a smartphone application. Introducing a “mobility bill of rights”, which would establish minimum standards for service, can be beneficial to mitigate against issues where services are inconsistent across different populations. Government subsidies could also minimize cost barriers.

# 3 Policies

## 3.1 Provincial Policies

### 3.1.1 Metrolinx 2041 Regional Transportation Plan

The Metrolinx 2041 Regional Transportation Plan (RTP) is centered on a common vision for the Greater Toronto and Hamilton Area (GTHA) and emphasizes a system that provides safe, convenient, and reliable connections and supports a high quality of life, a prosperous and competitive economy, and a protected environment.

Relevant priority actions relating to future mobility in the 2041 RTP plan include:

- **Strategy 5: Prepare for an uncertain future**
  - Develop a regional framework for on-demand and shared mobility;
  - Develop a region-wide plan for autonomous mobility;
  - Coordinate across the region to improve climate resiliency of the transportation system;
  - Proactively prepare for a future with low-carbon mobility options;
  - Develop a regional transportation big data strategy; and
  - Develop a strategy for innovation in mobility.

### 3.1.2 Greater Golden Horseshoe Transportation Plan

In 2022, the Ontario Ministry of Transportation (MTO) published a long-term transportation plan for the Greater Golden Horseshoe (GGH) region to support prosperity and quality of life to the 2051 horizon year.

To achieve the vision for 2051, many actions were identified for improvements to infrastructure, services, and policies. The following key areas include actions that are most relevant to new mobility and emerging technology:

- Improve the transit user experience with a more integrated region-wide transit network, including advancing use of smart phone applications and integrating fare payment and trip planning.
- Improve access to and availability of transit services, including supporting the use of on-demand microtransit
- Support the development and effective implementation of Mobility-as-a-Service technologies, including investigating MaaS solutions in the GGH and beyond
- Leverage electric, connected and automated vehicle technologies and other emerging mobility technologies.

### 3.1.3 CAV Readiness Plan

In March 2020, MTO released its CAV Readiness Plan[13] for the Greater Toronto and Hamilton Area (GTHA). The plan has five focus areas: Infrastructure Readiness, Operational Readiness, Institutional Readiness, Public Levers, and Pilots. Specifically, the readiness guidelines are aimed at establishing the first four to enable pilot-testing in urban and rural areas.

The outcome of this plan was the identification of five program areas, which were:

1. CAV Development Streams. Task forces to identify CAV impacts and how to address specific needs such as accessibility;
2. Development of CAV Modelling Tools. Develop a system dynamics model and simulation model updates to existing long-term transportation planning analysis tools.
3. Pilot Projects Program Management. Managing pilot projects to gather data and evaluate CAV and infrastructure, test designs and identify regulatory needs in a coordinated approach to reduce agencies' cost and time.
4. Data Needs and Management Plan. Defining needs for data standards and creating a data management plan and a data-sharing model.
5. Development of a Regional Mobility Platform Strategy. Developing an integrated strategy for fare, trip planning, and both private and public services through a region-wide approach for shared mobility.

## 3.2 Peel Region Policies

### 3.2.1 Peel Region Long Range Transportation Plan (2019)

The Region of Peel Long Range Transportation Plan (LRTP) directs the planning of transportation infrastructure in accordance with the Growth Plan for the Greater Golden Horseshoe. The Sustainable Transportation Strategy and the Goods Movement Strategic Plan are components of the LRTP that explored CAVs in goods movement and new technologies to support carpooling, ridesharing, and transit. The LRTP unifies these three component studies to support the transportation system through key actions. Relevant actions include:

- **Leverage shared mobility to achieve Peel's 50% sustainable mode share targets.** The plan includes cycling, walking, carpooling, public transit, and alternatives to travel (i.e., telework) as sustainable modes and notes that an increase in sustainable mode share in Brampton from 37% to 48% is required to support the Regional target.
- **Undertake CAV corridor pilot project.** CAV technologies are a tool that can enhance vehicular mobility and goods movement. Peel Region will help foster industry innovation through a CAV corridor pilot project that will identify a pilot corridor, deploy CAV technology, and install CAV infrastructure.
- **Adapt to Advancements in the E-Commerce Shift.** Assess current e-commerce trends and plan for policies and network efficiencies to adapt to shifting retail market.

[13] Ministry of Transportation for Ontario. (2020). CAV Readiness Plan Final Report. Toronto, ON. Ministry of Transportation for Ontario.

### 3.2.2 Region of Peel Sustainable Transportation Strategy (2016)

The Sustainable Transportation Strategy identifies the Region's role in supporting sustainable transportation options through the following:

- Working with Smart Commute (a transportation management organization) and member workplaces to promoting sustainable transportation options for commuting.
- Encouraging the use of new mobility technology in sustainable transportation modes and new business strategies.

### 3.2.3 Region of Peel Goods Movement Strategic Plan (2017)

The Goods Movement Strategic Plan promotes programs that achieve current and long-term goals for a sustainable, multi-modal, and integrated goods movement system in Peel Region through actions that include:

- Identify a CAV Pilot Corridor that will assess freight operations and install CAV infrastructure to improve the efficiency of goods movement.
- Pursue Fuel Efficiency Initiatives and support businesses in accessing funding to reduce GHG impacts in transportation through alternative fuel sources.

## 3.3 City of Brampton Policies

### 3.3.1 Brampton Plan (2023)

The Brampton Plan outlines how the City will employ an integrated mobility network to improve accessible and sustainable transportation throughout Brampton, which includes encouraging shared mobility, enhanced mobility, and locating amenities closer together. Policy actions that support current and emerging technologies include:

- **Shared Mobility**
  Bikeshare and carshare programs and fleets will encouraged within Centres and be incorporated among green development practices in Employment Areas.

- **Micro-mobility**
  The City will consider the challenges and opportunities to arise from micro-mobility and consider shared micro-mobility standards to protect sidewalks, entrances, and rights-of-ways from being blocked by shared devices.

  Along with walking and cycling, micro-mobility will be emphasized for short trips within Centres and along Boulevards.

  To improve transportation affordability, the City will consider public ownership of shared micro-mobility as an extension of the transit network, rebates for micro-mobility devices for low-income individuals, and refurbishment and redistribution programs

- **Electric Vehicles**
  The City will encourage the provision electric vehicle charging spaces in parking lots and incorporate within City buildings and facilities. The City may set Zoning By-law standards for minimum requirements.

  A network electrification feasibility analysis for Brampton Transit fleet will be undertaken to support the transition of Brampton's transit fleet to zero-emissions operation by 2040.

### 3.3.2 Brampton Active Transportation Master Plan (2019)

The goal of the Active Transportation Master Plan (ATMP) is to support an integrated transportation network that encourages active transportation choices. While the plan discusses strategies that improve pedestrian cycling and walking amenities, next steps to incorporate emerging technologies are not identified.

# 4 New Mobility Initiatives

This section describes ongoing new mobility initiatives in the City of Brampton and other local municipalities in the Greater Toronto Area.

## 4.1 Electric Bus Integration Trial and Zero Tailpipe-Emission Buse Study (City of Brampton)

Brampton Transit participated in an electric bus demonstration and integration trial which brought charger and bus manufacturers, multiple levels of government, and funding partners together to implement electric buses in Brampton in 2021. This project was part of the largest single global deployment of standardized and fully interoperable battery electric buses (BEBs) and high-powered overhead on-route charging systems[14]. Brampton's deployment allows for depot and on-road charging options which increases daily travel ranges.

The Canadian Urban Transit Research & Innovation Consortium (CUTRIC) has also received government funding to carry out a study to assess the feasibility of using zero tailpipe-emission buses (ZEBs) on Brampton Transit's route network[15].

## 4.2 Shared Micro-mobility Study (City of Mississauga)

A micro-mobility study was initiated to explore creating a system of shared bikes, electric bicycles (e-bikes), or electric scooters (e-scooters) as a recommended action item of the City of Mississauga's Transportation Master Plan. Micro-mobility devices are alternatives to vehicles

[14] City of Brampton (2021). *Brampton's Milestone Electric Buses Will Be on the Roads.* Media Release. https://www.brampton.ca/EN/City-Hall/News/Pages/Media-Release.aspx/912.
[15] Brampton Media Release: CUTRIC receives $175K investment for Brampton Transit from Government of Canada and FCM Retrieved from https://www.brampton.ca/en/city-hall/news/pages/media-release.aspx/1086

that are both lightweight and low emission while providing opportunities for users to connect to the broader transportation system in Mississauga.

As an initial step in 2021, the City updated by-laws to regulate the use of personal e-scooters within Mississauga. This interim e-scooter strategy will help garner community feedback on e-scooters and help inform the potential of shared micro-mobility systems within Mississauga.

## 4.3 Autonomous Transit

Two autonomous shuttle pilots were completed in Durham Region and the City of Toronto. Both trials were undertaken using vehicles contracted by the company Local Motors, however, as of January 2022, Local Motors ceased operations.

### 4.3.1 Durham Region Transit

The Whitby Autonomous Vehicle Electric (WAVE) shuttle pilot was the first autonomous shuttle integrated with existing transit services in Canada[16]. The pilot replaced an existing 6 km loop route operated by Durham Region Transit connecting Whitby GO Transit station and the Port Whitby neighborhood. The study was concluded as of February 2022 and results are being compiled on the technological capabilities and limitations, weather, accessibility, insurance, and policy surrounding autonomous vehicle integration into public transportation.

The project was funded in part by the Government of Ontario through the Autonomous Vehicle Innovation Network, led by the Ontario Centre of Innovation. Other funding and support were provided by local, national, and international partners including SmartCone Technologies, Region of Durham, Durham Region Transit, Town of Whitby, Metrolinx, Nokia Canada, Ontario Tech University and Durham College.

During the pilot, the WAVE vehicle was involved in a collision in December 2021. Police investigations confirmed the incident occurred while the vehicle was in manual mode and that the hazard mitigation safety systems used in autonomous modes were not engaged at the time.

### 4.3.2 City of Toronto

The West Rouge Automated Shuttle Trial was a collaboration between the City of Toronto, Toronto Transit Commission (TTC), and Metrolinx. The goal was to test a low-speed, electric, automated shuttle vehicle connected Rouge Hill GO Station to destinations in the West Rouge community in southeast Scarborough. The shuttle operated in mixed traffic on both local and arterial roads in a variety of weather conditions including rain and snow. The West Rouge community was chosen as the preferred location and coverage area for the trail because the route filled an unmet need in the transit system, the route accommodated technological limitations of the anticipated shuttle technology, and the route possessed preferred location characteristics, including avoidance of school zones.

The trial concluded without offering service to the public; however, the two months of on-road testing allowed the City and its partners to gather valuable data. This included automated

[16] https://connectwhitby.ca/ridethewave

vehicle technology operations, operating requirements compared to conventional transit vehicles, and current limitations of the technology.

## 4.4 Transportation Innovation Zones (City of Toronto)

The Cit of Toronto established a Transportation Innovation Zone (TIZ) at the Exhibition Place grounds in 2020. The TIZ provides a testing ground for emerging transportation technologies prior to implementation, foster economic development, and provide knowledge sharing across the region. To date, three Transportation Innovation Challenges have been issued by the City to invite organizations to test and demonstrate new technologies at the TIZ.

The TIZ provides public transparency on how transportation trials are selected and monitored in Toronto, provides opportunities to interact with technologies, and supports local development. For participants of the Transportation Innovation Challenges, the TIZ provides a real-world environment for testing, access to partners in industry, academia, and staff from the City of Toronto, and opportunities to connect with external investors.

All trials take place at the TIZ and involve applicants testing their solutions and monitoring, evaluating, and collecting data. The current initiative is a Parking Sensor and Curbside Vehicle Detection challenge to help inform parking strategy and other related policy initiatives to support a future City-wide Parking Strategy.

## 4.5 Logistics Innovation Zone (Brampton)

Brampton is poised for a transformative leap as a global hub of logistics and mobility innovation with the establishment of a Logistics Innovation Zone (LIZ) that builds on its strong foundation in manufacturing, transportation, and logistics. Anchored by the CN Intermodal facility, Canada’s largest rail intermodal terminal handling nearly 60% of CN’s system-wide intermodal business, Brampton plays a pivotal role in Ontario’s supply chain network, reinforcing its strategic importance and alignment with Brampton 2040 Vision.

Key components of the first phase of the LIZ include assessing emerging logistics technologies for innovation and sustainability and evaluating infrastructure needs like 5G and autonomous vehicle integration. The LIZ will also establish criteria for pilot projects that showcase sustainable logistics practices and design a process to integrate and monitor these projects for future expansion.

The second phase of the LIZ highlights tangible goals such as evolving pilot projects by structuring their implementation and evaluation, fostering the practical application of innovative logistics technologies, and establishing a robust feedback system to ensure iterative improvements and alignment with the zone's zero-emissions vision.

Building on the success of earlier phases, the third and final phase will integrate renewable energy, smart building technologies, and dedicated spaces for technological advancement, while ensuring the Centre's design embodies sustainability and cutting-edge innovation.

# 5 Recommendations and Next Steps

Recommended new mobility technologies for consideration by the City of Brampton is presented in this section. Recommendations are based on the review of technologies, policies, and ongoing initiatives.

## 5.1 Recommendations

Recommended next steps for further exploration by the City of Brampton are described below.

### 5.1.1 Shared Mobility and Micro-mobility

Shared mobility and micro-mobility can help grow active transportation mode share and support the long-term cycling network by providing accessible and convenient options that will introduce new users to sustainable modes. Providing micro-mobility programs to increase mode choice should be investigated through collaboration and partnerships with micro-mobility operators, transit agencies, and other community groups (e.g., Bike Brampton).

High-density areas, such as designated growth areas and transit hubs, are strong candidate locations for shared micro-mobility programs. One example opportunity to introduce a shared micro-mobility program in Brampton is a pilot program at Sheridan College – Davis Campus where hubs are located at popular student pick up and drop off points on campus and in the surrounding community. Expansion of the shared micro-mobility program to more areas of Brampton could be further explored based on the results of the pilot program.

To integrate micro-mobility into the transit network, Brampton can review options for racks or storage on buses and identify options that would expand the ability to accommodate additional types and models of micro-mobility devices (e.g., e-bikes, e-scooters).

Next steps and timelines to implement shared mobility and micro-mobility in Brampton are outlined in **Table 5-1**.

**Table 5-1. Next Steps and Timelines for Shared Mobility and Micro-mobility**

| Next Steps | Timeline |
|---|---|
| Continue to investigate collaboration opportunities between micro-mobility operators (e.g., such as Scooty, Lime, and Bird), transit agencies (e.g, Brampton Transit, GO Transit), and other relevant stakeholders (e.g, Bike Brampton and the Brampton Cycling Advisory Committee). | Near term (<5 years) |
| Continue to engage in regular discussion with other municipalities and levels of government, with the aim of identifying emerging modes and opportunities in Brampton to achieve transportation objectives. | Short term (5-10 years) |
| Apply data collected from the e-scooter pilot program to develop a policy for new mobility, including shared mobility and micro-mobility. | Near term (<5 years) |
| Leverage micro-mobility more widely as a first- and last-mile connection for transit through micro-mobility/mobility hub concepts. | Medium to long term (10+ years) |

### 5.1.2 Autonomous Transit

Potential applications of autonomous transit in the City of Brampton include the following:

- Connecting newly developing areas (such as Heritage Heights) with major transit/transportation nodes to integrate and provide new mobility from the start.
- Supplementing fixed route services in low density communities to be timed to meet with GO Train arrivals/departures (such as Mount Pleasant GO).
- Serving low demand large industrial areas (such as the Airport Intermodal Area and Highway 410 and Steeles) to improve productivity of transit resources.
- Serving low demand areas during the off-peak periods or on weekends

Next steps and timelines to implement shared autonomous transit vehicles in Brampton are outlined in **Table 5-2.**

**Table 5-2. Next Steps and Timelines for Autonomous Transit**

| Opportunity | Timeline |
|---|---|
| Establish pilot program that uses autonomous transit vehicles to serve community routes that connect to major transit hubs or stations. | Near term (<5 years) |
| Participate and contribute to conversations with advisory committees on implementation standards and roadway design to provide Brampton-specific perspectives for new standards. | Short term (5-10 years) |
| Support development of GTHA-wide design, operations and standards for CAV and the required connected infrastructure to support them, ensuring that the City is well positioned for these newer modes. | Medium to long term (10+ years) |

### 5.1.3 Electric Vehicles

The largest barrier to EVs is the lack of charging infrastructure and/or supporting infrastructure required to deliver increased electric power demand. EV for private use, goods movement, and municipal fleet are all areas to be further explored and supported.

There is a strong need for government action to meet the federal zero-emission vehicle (ZEV) mandate, which requires 100% ZEV sales by 2035. Closing the electric vehicle charging infrastructure gap is critical, with an additional 40,000 public ports needed annually from 2025 to 2040, beyond the 30,000 currently available or planned in Canada.

To support the federal zero-emission vehicle (ZEV) sales mandate, the Canadian Vehicle Manufacturers' Association recommends a national plan for widespread, reliable public charging infrastructure and regulated requirements for its distribution and reliability. Additionally, they urge updates to the Canadian Electrical Code for EV readiness and coordination with utilities to ensure sufficient clean, affordable electricity and grid capacity.

Next steps and timelines to implement EVs in Brampton are outlined in **Table 5-3**.

**Table 5-3. Next Steps and Timelines for EVs**

| Opportunity | Timeline |
|---|---|
| Propose requirements for new developments to include EV charging or the connections for future installation. . | Short term (5-10 years) |
| Support EV charging retrofit programs as existing developments may not currently have the necessary infrastructure for installation. Look into opportunities for EV charging streetlights in residential or urban areas | Short term (5-10 years) |
| Advocate for improvements to the electric power system to increase clean electricity generation to meet future electricity demand from electric vehicles (cars, trucks, buses). | Short term (5-10 years) |
| Conduct a study to guide transition to electric municipal fleet. | Short term (5-10 years) |
| Advocate for the Federal Government to support the expansion of EV infrastructure in Brampton. | Short term (5-10 years) |
| Coordinate with other municipalities and agencies to identify and install charging infrastructure to support long-distance travel. | Medium to long term (10+ years) |
| Support electric fleet transition in the goods movement industry | Medium to long term (10+ years) |

### 5.1.4 Mobility-as-a-Service

As described in Section 2.5, MaaS integrates multiple mobility services and provides one-stop access through a common interface. At this time, existing trip planning and fare payment tools address mobility by a single service provider. However, additional mobility services first need to be established in Brampton (and adjacent areas in the GTHA) in order for a MaaS application to effectively integrate trip planning across all multiple travel modes.

Better transit integration between agencies across the GTHA would benefit all cross-boundary transit travel. Metrolinx should develop a strategy to improve integration across the GTHA, with Brampton being an active participant in the process.

## 5.2 Resource Gaps

The City of Brampton will also need to address resource gaps to successfully bring emerging technologies online:

- **Capital and Operating Funding:** The exploration of emerging technologies and delivery of new mobility projects will require both capital and operational funding. Funding sources such as the Smart Cities challenge by Infrastructure Canada should be explored to fund studies and pilot programs to establish proof of concept.
- **Staffing, Resourcing and Talent:** Knowledgeable and specialized staff will be critical to successfully implement frameworks to support new mobility in Brampton. Staff should be educated on emerging technologies and monitor for opportunities to integrate these in the planning process. In the longer term, the City may need staff with specialized skills (e.g., data science, artificial intelligence, advanced transportation systems) to plan, implement and manage new mobility programs.