Planning to Charge

Electric truck charging infrastructure and electricity demand in the GTHA

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Chandan Bhardwaj

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The Pembina Institute
#802, 322 – 11 Avenue SW
Calgary, AB T2R 0C5
403-269-3344

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These acknowledgements are part of the start of a journey of several generations. We share them in the spirit of truth, justice and reconciliation, and to contribute to a more equitable and inclusive future for all.

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Executive summary

Charging infrastructure will be essential to support the transition to electric medium- and heavy-duty vehicles (MHDVs). To make effective and forward-looking investments, planners need localized projections of electricity demand, charger needs and associated costs. This study provides the first Canadian estimates of energy demand and charger requirements at both the city and census-block levels that will be needed to support electric MHDVs.

We used anonymized real-world travel data from thousands of Canadian trucks to model charging behaviour and to calculate corresponding energy and infrastructure needs in the Greater Toronto and Hamilton Area (GTHA), Canada's most populous region.

We find that charging infrastructure will need to expand rapidly to support electric vehicle (EV) adoption targets aligned with global and federal climate commitments. By 2030, required chargers total 6,297 in Toronto, 5,703 in Brampton, 3,563 in Mississauga, 5,015 in Hamilton and 929 in Markham. Cumulative investments by municipalities, fleet owners, and charging infrastructure providers across the five cities are estimated at $1.6 billion by 2030.

The impact of electric MHDVs on the electricity grid are modest in the near term. If Toronto meets a 35% EV sales target by 2030, electric trucks would contribute less than 1.5% of today's daily electricity consumption and peak demand.

This analysis also identifies simple strategies that can reduce overall energy consumption and charger costs.

- Staggering electrification across MHDV classes lowers charger needs and can reduce costs by 11% to 54% across Toronto, Brampton, Mississauga, Hamilton and Markham by 2030.
- Deploying chargers strategically at high-traffic sites increases use and yields total cost savings of 15% to 59% across the five cities by 2030.
- Shared charging, when combined with the previous two strategies, further reduces charger costs by 53% to 72% by 2030.
- Managing charging behavior to shift more activity to private depot locations generates additional savings.

The four strategies combined reduce total charger cost by 60% to 75% across the five cities by 2030. The combined strategies could result in total savings of $1.03 billion in the five cities, reducing the cumulative investment of $1.6 billion needed under the default case noted above by about 63%.

1. Introduction

Globally, adoption of electric medium- and heavy-duty vehicles (MHDVs), also known as electric trucks, continues to grow year-over-year, with sales increasing by nearly 80% in 2024.[1] To support this transition, several jurisdictions have introduced sales targets for electric and other zero-emission MHDVs.[2] Canada's 2030 Emissions Reduction Plan, for example, sets a goal for 35% of new MHDV sales to be zero-emission by 2030 and 100% by 2040.[3]

Supporting this shift requires charging infrastructure.[4] Timely planning with localized projections of charging needs, including expected energy demand, number of chargers, and associated costs, is essential for guiding investments.[5]

Most existing literature that estimates charger needs, including most studies conducted globally and the only Canadian study to date,[6] focuses on national or provincial scales. Yet planners such as utilities, municipalities and charging infrastructure developers require more localized projections of charger demand and the resulting impact on the electricity grid.

To address this knowledge gap, we present the first Canadian analysis that estimates charger needs and energy demand at both municipal (city-level) and sub-municipal (census block-level) scales. Using anonymized real-world travel data from thousands of Canadian trucks, we model electric MHDV charging behaviour and estimate the associated charging and energy requirements.

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[1] International Energy Agency, "Global EV Outlook 2025," March 2025. https://www.iea.org/reports/global-ev-outlook-2025

[2] European Commission, "Commission welcomes agreement on strong EU targets to reduce CO2 emissions from new trucks and urban buses, https://ec.europa.eu/commission/presscorner/detail/en/ip_24_287

California Air Resources Board, "Advanced Clean Trucks Fact Sheet." https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks

Government of British Columbia, *Zero-Emission Vehicles Act*, SBC 2019, c. 29. https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/19029#section16

Mehanaz Yakub, "Quebec introduces bill to boost zero-emission truck sales," *Electric Autonomy Canada*, November 2024. https://electricautonomy.ca/policy-regulations/2024-11-27/quebec-bill-for-zero-emission-heavy-duty-truck/

[3] Government of Canada, "2030 Emissions Reduction Plan – Sector-by-sector overview," October 29, 2024. https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/climate-plan-overview/emissions-reduction-2030/sector-overview.html#sector6

[4] A charging port, or charger as it is commonly called, draws electricity from the grid to power the electric trucks and can be installed at a private depot or at a public station.

[5] Chandan Bhardwaj, *Helping Fleets Charge: Barriers and solutions to charging electric medium- and heavy-duty vehicles in Ontario* (Pembina Institute, 2024). https://www.pembina.org/pub/helping-fleets-charge

[6] Natural Resources Canada, "Electric vehicle charging infrastructure for Canada," prepared by Dunsky Energy + Climate (2024). https://natural-resources.canada.ca/energy-efficiency/transportation-energy-efficiency/resource-library/electric-vehicle-charging-infrastructure-canada#a35

We focus on the Greater Toronto and Hamilton Area (GTHA), Canada's most populous region, as a case study. The analysis covers five GTHA cities (Toronto, Brampton, Mississauga, Hamilton and Markham) as well as the region's most populated census blocks (also referred to as postal codes or Forward Sortation Areas, FSAs). For each city, we estimate:

- daily electrical energy consumption in gigawatt-hours (GWh)
- daily estimated peak power demand in megawatts (MW)
- number of required chargers
- cumulative charger-related costs (in billions of dollars)

As a further contribution, we explore strategies to reduce charger needs and costs. We quantify potential near-term savings to 2030 from approaches such as:

- staggering electrification across MHDV classes
- strategic near-term charger deployment
- employing shared charging techniques
- managing charging behaviour

Each strategy is discussed in detail in the Methodology section.

Energy (GWh)

Energy is the total amount of electricity used over a period of time. It accumulates across the day. In this report, daily electrical energy consumption is measured in gigawatt-hours.

Power (MW)

Power is the rate at which electricity is used at a specific moment. It does not accumulate. Daily peak power demand in this report is measured in megawatts and reflects the highest momentary load on the grid.

Why this matters for planning

Energy needs determine how much electricity must be produced. Power needs determine whether local grid equipment can handle periods of high demand. Both are essential for planning charging infrastructure and grid upgrades.

2. Methodology

2.1 Overview

This study builds on the approach used in Natural Resources Canada's (NRCan) 2024 analysis of electric MHDV charging needs.[7] However, our analysis differs from the NRCan study in the following ways.

- **Sub-municipal scope**: The NRCan study provides national and provincial estimates. It also acknowledges that localized estimates of electricity demand are often more useful for utilities and other municipal planners. To address this, our analysis focuses on municipal and sub-municipal regions, scaling down to individual census blocks. We use the five most populous cities in the GTHA as a case study.
- **Real-world truck travel data**: The NRCan study relies on historical province-wide averages of truck travel data such as daily distance travelled. Instead, we use recent real-world truck travel data collected from telematics devices installed on thousands of trucks in the GTHA. The data, purchased from Altitude by Geotab, spans two-month periods in January and July 2023 to capture potential seasonal variation. Altitude by Geotab has roughly 250,000 telematics units installed in light-, medium- and heavy-duty vehicles across Canada. Anonymized real-world truck travel data covers the five most populated municipalities in the GTHA (Brampton, Mississauga, Toronto, Markham and Hamilton) and their census blocks (FSAs). Canada has roughly 1,600 FSAs, including about 500 in Ontario and 95 in Toronto.
- **Staggering electrification across MHDV classes**: The NRCan study assumes uniform electric vehicle sales targets across all MHDV classes. Assumptions about EV sales targets are a key input parameter because they determine daily energy demand and charging needs. However not all MHDV classes are equally ready for electrification. They differ in energy intensity (energy consumed to travel one kilometre), duty cycles and overall market readiness. We discuss differences in electrification potential across MHDV classes in greater detail in our study *Electrifying Fleet Trucks*.[8] In the current study, to reflect differences in EV market readiness across MHDV classes, we examine a scenario where electric MHDV sales are staggered, with higher adoption in lighter classes and lower adoption in heavier ones (section 2.2.2). We then assess whether this staggered adoption could lower overall charger costs.

[7] "Electric vehicle charging infrastructure for Canada."

[8] Chandan Bhardwaj, *Electrifying Fleet Trucks: A case study estimating potential in the GTHA* (Pembina Institute, 2025). https://www.pembina.org/pub/electrifying-fleet-trucks

- **Strategic early charger deployment:** The NRCan study assumes that public chargers are uniformly distributed across highways and major roads. While this may be appropriate over the long term, recent analyses show that freight activity is concentrated in specific zones. In our study, *Locating Charging Stations*, we find that 10% of postal code areas in the GTHA account for half of all truck traffic.[9] Similarly, a 2023 NREL study found that 50% of charging stations meet 90% of charging needs in the U.S.[10] Inspired by the U.S. National Zero-Emission Freight Corridor Strategy, we examine the potential cost savings from initially deploying chargers in the highest-traffic locations.[11]
- **Shared charging**: The NRCan study assumes that each private depot charger serves only one electric MHDV per day. However, multiple emerging shared use charging models allow multiple fleets to use the same chargers, increasing utilization. For example, First Bus, a large bus company in the U.K., operates a peer-to-peer shared charging network in which partner fleets use chargers during the day, while First Bus vehicles charge overnight.[12] In this current study, we quantify the cost savings that could accrue if fleet operators in the GTHA adopt similar shared charging models. Additional shared-charging options will be explored in future work.
- **Managed charging behaviour:** The NRCan study uses default assumptions about electric truck charging behaviour (we list those assumptions in section 2.4).[13] For example, it assumes that Class 8 long-haul rigid trucks rely entirely on public charging. Using telematic data, we find that 40% of Class 8 trucks in the GTHA return to their home FSA at the end of each day, meaning they could use lower-cost private overnight charging. Here, we adjust charging behaviour assumptions based on observed travel patterns to estimate the potential cost reductions.

We estimate four key metrics in this study, with calculations briefly described in the following sections:

- daily energy consumption (section 2.2)
- daily peak power demand (section 2.3)

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[9] Chandan Bhardwaj, *Locating Charging Stations: Identifying zones for early deployment in the GTHA using real-world truck data* (Pembina Institute, 2025), https://www.pembina.org/pub/locating-charging-stations

[10] Brennan Borlaug et al. "Public electric vehicle charging station utilization in the United States," *Transportation Research Part D: Transport and Environment* 114 (2023). https://doi.org/10.1016/j.trd.2022.103564

[11] Chu Kang-Ching et al., *National Zero-Emission Freight Corridor Strategy* (U.S. Joint Office of Energy and Transportation, 2024). https://driveelectric.gov/files/zef-corridor-strategy.pdf

[12] First Bus, "First Bus and Openreach announce powerful new Electric Vehicle charging partnership," media release, January 11, 2024. https://news.firstbus.co.uk/news/first-bus-and-openreach-announce-powerful-new-electric-vehicle-charging-partnership

[13] Charging behaviour refers to the split between overnight depot charging and public charging in meeting an electric truck's energy needs in a typical day.

- number of chargers (section 2.4)
- charger costs (section 2.5)

2.2 Daily energy consumption

Daily energy consumption refers to the total electrical energy required to operate all electric MHDVs in a region on a typical day. It is commonly measured in kilowatt-hours (kWh) for small-scale systems (e.g. a charging station) and in gigawatt-hours (GWh) for large scale systems (e.g. city electricity grid).

Daily energy consumption (E) is calculated as:

$$E = A \times B \times C \times D$$

where:

A = total stock of MHDVs

B = share of MHDVs that are electric in each subsequent year

C = daily distance travelled by each vehicle

D = energy intensity of each vehicle

Each of these four input parameters used to calculate energy demand are discussed next.

2.2.1 Total stock of MHDVs

The first input is the total stock of MHDVs in each municipality and FSA, classified by vehicle class. We purchased this data from Statistics Canada.[14] The MHDV stock data, broken down by vehicle class, are presented in Table 1. Consistent with NRCan (2024), we assume annual growth of 2.1% in vehicle stock.

We use telematics data from Altitude by Geotab to study truck stopping behaviour and understand where vehicles are parked throughout the day.

[14] The vehicle population data for each census block in each city was corroborated with data purchased from the Ontario Ministry of Transportation and from Altitude by Geotab.

Table 1. Number of MHDVs by vehicle class and region (as of June 2025)

Class	Number of MHDVs				
	Toronto	Brampton	Mississauga	Hamilton	Markham
2b	31,597	8,687	11,347	16,149	4,787
3	8,849	2,731	2,943	6,216	1,240
4	2,728	688	846	991	328
5	5,303	981	1,563	1,712	677
6	2,718	1,002	1,096	1,270	284
7	3,442	1,509	1,782	1,564	423
8	16,515	23,105	11,662	11,115	3,250

2.2.2 Share of electric MHDVs

The second input is the share of MHDVs that become electric in each subsequent modelling year. We model two scenarios to demonstrate the significant difference in travel patterns across MHDV classes, and in turn to evaluate potential reductions in electric MHDV-induced energy demand.

- **Policy Reference Scenario:** Electric MHDV adoption is uniform across all MHDV classes. Sales reach 35% electric (or zero-emission) by 2030 and 100% by 2040. This assumption aligns with the NRCan 2024 study.
- **Staggered Scenario:** Electric MHDV adoption varies by vehicle class, reflecting differences in market readiness and ease of electrification.
  - Electric sales in Class 2b, 3 and 4 reach 50% by 2030 and 100% beyond 2036
  - Electric truck sales in Class 5 and 6 reach 10% by 2030 and 100% by 2040
  - Electric truck sales in Class 7 and 8 reach 5% by 2030 and 100% only after 2040

On average, light freight trucks (mostly Class 2b and 3) represent about 63% of commercial MHDV sales, followed by medium trucks (Class 5 and 6) at 30% and heavy trucks at 7%. The Staggered Scenario captures these differences while still meeting the overall 35% sales target by 2030.

2.2.3 Daily driving distance

The third input is daily driving distance or vehicle-kilometres travelled (VKT) by MHDVs. The 2024 NRCan study uses a province-wide average of 70 km per day across Class 3 to 7, which masks regional differences and class-specific duty cycles. Instead, we use recent real-world truck travel data to determine VKT by FSA and vehicle class (Table 2). VKT is held constant to 2040. More detail is available in our study *Electrifying Fleet Trucks*.

Table 2. Average daily VKT across MHDV vehicle class and region

Class	Average daily VKT (km)				
	Toronto	Brampton	Mississauga	Hamilton	Markham
2b	60	74	52	72	64
3	64	102	57	112	64
4	50	77	98	80	125
5	70	84	70	102	79
6	96	89	112	148	120
7	90	102	112	96	91
8	160	280	230	184	118

2.2.4 Vehicle energy intensity

The fourth input is energy intensity per vehicle, measured in kWh/km. This refers to the electrical energy (in kWh) required to travel one additional kilometre. Heavier trucks have roughly twice the energy intensity of lighter trucks. We adopt energy intensity assumptions consistent with the 2024 NRCan study.

Table 3. Energy intensity of electric MHDVs by class

Class	Energy intensity (kWh/km)
2b	0.6
3	0.6
4	0.72
5	0.92
6	0.96
7	1.3
8	1.45

2.3 Daily peak power demand

After estimating daily energy consumption, the next step is to calculate the daily peak power demand from electric MHDVs. Power demand varies hour by hour, so a key input requirement for calculating power demand is the hourly load profile of electric MHDVs. We use charging profiles from a study by Power Advisory, commissioned by the Ontario Energy Board.[15]

Figure 1 shows hourly charging load profiles as a share of total daily energy demand. The X-axis represents the hour of the day, and the Y-axis depicts peak demand (assumed constant over a one-hour period) as a share of total daily energy consumption. Peak charging demand is highest between 1 a.m. and 2 a.m., declines during the day as trucks are on the road, and rises again around 6 p.m. as trucks return to depots and are connected to chargers. Roughly 10% of a truck's daily charging needs are met during the peak hour.

These estimates are consistent with studies in the U.S.[16] We note that these are averages, so individual charging profiles may significantly deviate from this profile.

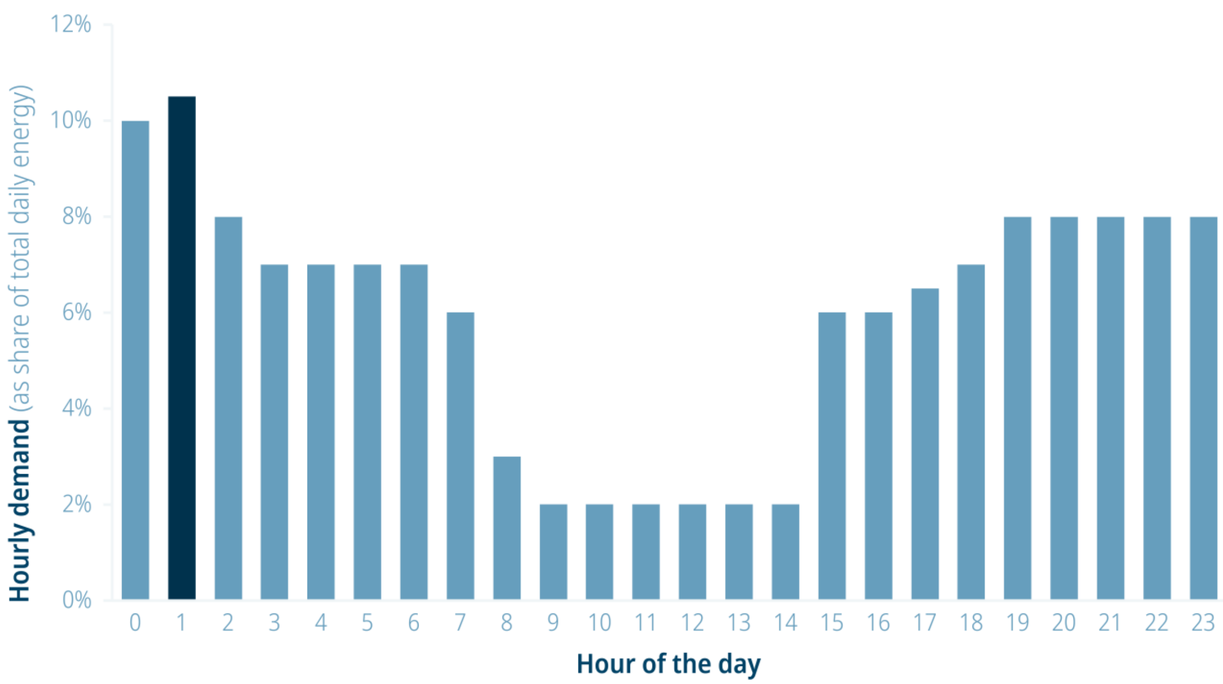

Figure 1. Hourly charging load profiles for electric MHDVs as a share of total daily energy demand

Data source: Power Advisory[17]

[15] Power Advisory, *Electric Delivery Rates for Electric Vehicle Charging*, prepared for the Ontario Energy Board (2023), 6. Available at https://engagewithus.oeb.ca/ev-integration/news_feed/delivery-costs-report

[16] National Laboratory of the Rockies (formerly the National Renewable Energy Laboratory (NREL)), "Fleet DNA: Commercial Fleet Vehicle Operating Data." https://www.nrel.gov/transportation/fleettest-fleet-dna.html

[17] Power Advisory, *Electric Delivery Rates for Electric Vehicle Charging*, prepared for the Ontario Energy Board (2023), 6. Available at https://engagewithus.oeb.ca/ev-integration/news_feed/delivery-costs-report

2.4 Number of chargers

The next step is to calculate the number of chargers required to satisfy the charging demand from the adoption of electric MHDVs.[18] This is estimated by dividing the total share of energy delivered across different charging combinations and charger types, accounting for charger throughput, power levels, and average charging times.

Two common forms of charging are private depot charging and public charging. For both cases, MHDVs are assumed to charge using one of three charger types:

- Slow overnight charger (50 to 100 kW)
- Fast charger (350 kW)
- Ultrafast charger (2 MW)

We assume daily energy demand of a typical electric truck is split across six charging combinations, summarized in Table 4. These default assumptions are aligned with the 2024 NRCan study.

We also consider a scenario where charging behaviour is managed to reduce charging needs. We make two assumptions about the share of private charging under the managed charging scenario.

First, we assume the share of private chargers for Class 2b–6 increases from 86% in the default case to 90% in the managed charging scenario. Real-world truck data shows that 90% of Class 2b–6 truck trips are 160 km or less, which is less than half the range of commercially available electric MHDVs. Since these duty cycles are fully covered, it is reasonable to expect that 90% of charging needs could be met through private charging. Moreover, overnight charging using private chargers can be incentivized using time-of-use electricity pricing. For example, Ontario offers ultra-low electricity rates between 11 p.m. and 5 a.m. Such measures can shift charging demand from public stations to private depot charging and from daytime fast charging (which is expensive) to slower overnight charging.

Second, we assume that 40% of charging needs for Class 8 trucks can be met with private chargers under the managed scenario. Aligned with the 2024 NRCan study, under the default case we assume 100% of Class 8 needs are met by public chargers. However, real-world truck data shows that 40% of Class 8 trucks return to their base daily in the GTHA. For this subset of Class 8 trucks, we assume that their charging needs can be met with private chargers.

[18] One charging station may have multiple charging ports or chargers. In line with NRCan 2024, we assume one charger or charging port is used to charge one vehicle at a time under default conditions. We use charger and charging port interchangeably in this study.

Table 4. Assumed share of energy delivered by private and public chargers by MHDV class and charger type

Class	Private			Public		
	Overnight	Fast	Ultrafast	Overnight	Fast	Ultrafast
Default assumptions, in line with NRCan 2024						
2b–7	72%	13.5%	0.5%	0%	13.5%	0.5%
8	0%	0%	0%	51%	14%	35%
With managed charging						
2b–7	50%	40%	0%	0.5%	0.5%	0%
8	0%	40%	0%	41%	14%	5%

We also quantify potential savings from shared charging strategies. Shared charging allows multiple trucks to use a single charger with managed or restricted access, effectively balancing public and private charging needs. For example, one fleet with a charger may allow a partnering fleet to use it during mutually agreed time slots. By design, shared charging can increase charger utilization (or throughput) rates. We estimate the impact of shared charging on overall charger costs. Under the shared charging scenario, we assume that throughput for both private and public chargers doubles. Assumptions for both the default and shared charging cases are summarized in Table 5.

Table 5. Assumptions for power levels, daily throughput, and share of MHDV charger types

Charging behaviour	Private			Public		
	Overnight	Fast	Ultrafast	Overnight	Fast	Ultrafast
Default assumptions, in line with NRCan 2024 study						
Power (kW)	50	350	2000	100	350	2000
Charging time (h)	8	0.5	0.5	6	0.5	0.5
Charger throughput (vehicles/day)	1	3	3	1.5	6	6
With shared charging and strategic public charger deployment						
Charger throughput (vehicles/day)	2	6	6	3	12	12

2.5 Charging infrastructure costs

Total charger costs are calculated by multiplying the number of chargers by the cost per charger. Costs by charger type are listed in Table 6.

Table 6. Charger costs by charger type

Charger type	Costs in 2025	Costs in 2030
Overnight (50 to 100 kW)	$78,637	$74,604
Fast (350 kW)	$234,129	$225,352
Ultrafast (2 MW)	$645,224	$629,631

3. Results

3.1 Daily energy consumption

Figures 2 to 6 show the incremental energy consumption from electric MHDVs in each municipality from 2025 to 2040 under the Policy Reference Scenario, which assumes uniform EV sales targets across all MHDV classes. Across all cities, energy consumption increases multi-fold over the next 15 years, consistent with increased electric MHDV adoption, as summarized in Table 7.

Table 7. Daily energy consumption from electric MHDVs in selected years

Municipality	Daily energy consumption (GWh)		
	2025	**2030**	**2040**
Toronto	0.05	0.74	6.29
Brampton	0.07	1.10	9.33
Mississauga	0.03	0.50	4.29
Hamilton	0.04	0.59	4.97
Markham	0.01	0.11	0.92

For context, Toronto's total electricity consumption for all end uses in 2024 was more than 24,000 GWh,[19] which translates to an average daily energy consumption of 65.75 GWh. At 0.74 GWh, electric MHDV-induced daily energy consumption in 2030 is estimated to be less than 1.2% of Toronto's current total daily electricity consumption.

Figures 2 to 6 also show how different MHDV classes contribute to total energy consumption. Class 8 trucks contribute the most, as they represent a larger share of the fleet in these cities (about 30%, compared with 10% nationally), travel roughly 50% farther than other classes, and consume twice as much energy per kilometre. In Brampton, Class 8 trucks account for more than 90% of energy consumption because they represent over 70% of trucks in many of the city's FSAs, which also explains why Brampton's energy demand exceeds Toronto's.

[19] Toronto Hydro, "Company Overview," Key facts and figures, December 31, 2024. https://www.torontohydro.com/about-us/company-overview

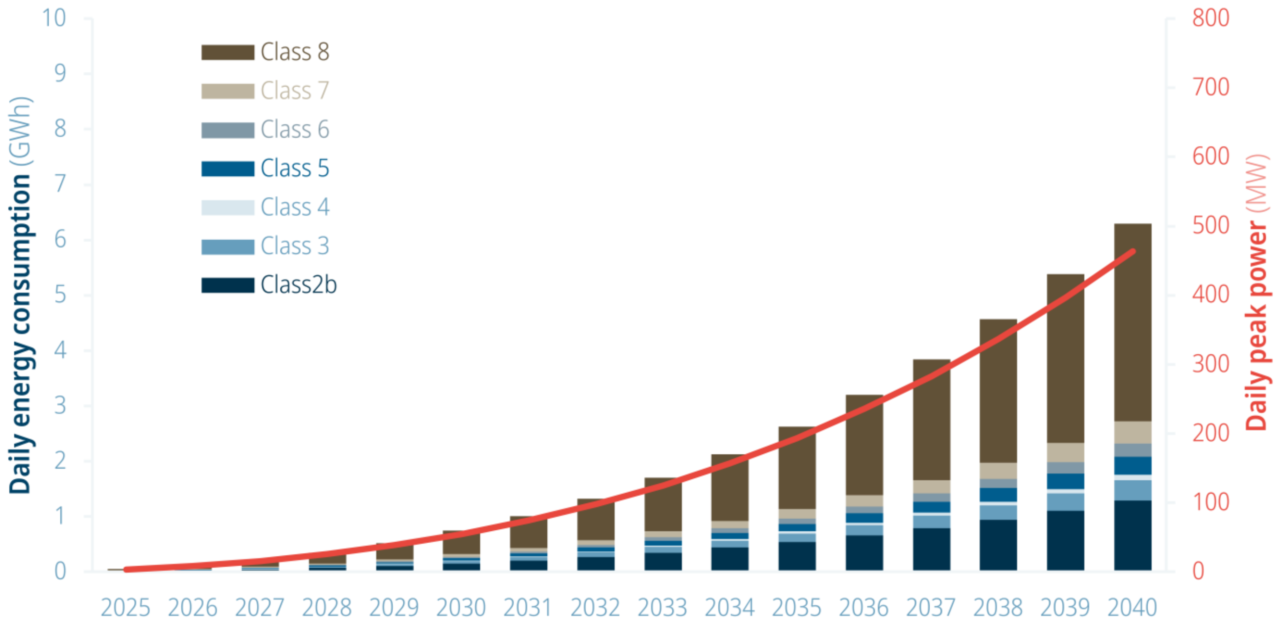

Figure 2. Electric MHDV-induced daily electrical energy consumption and peak power in Toronto

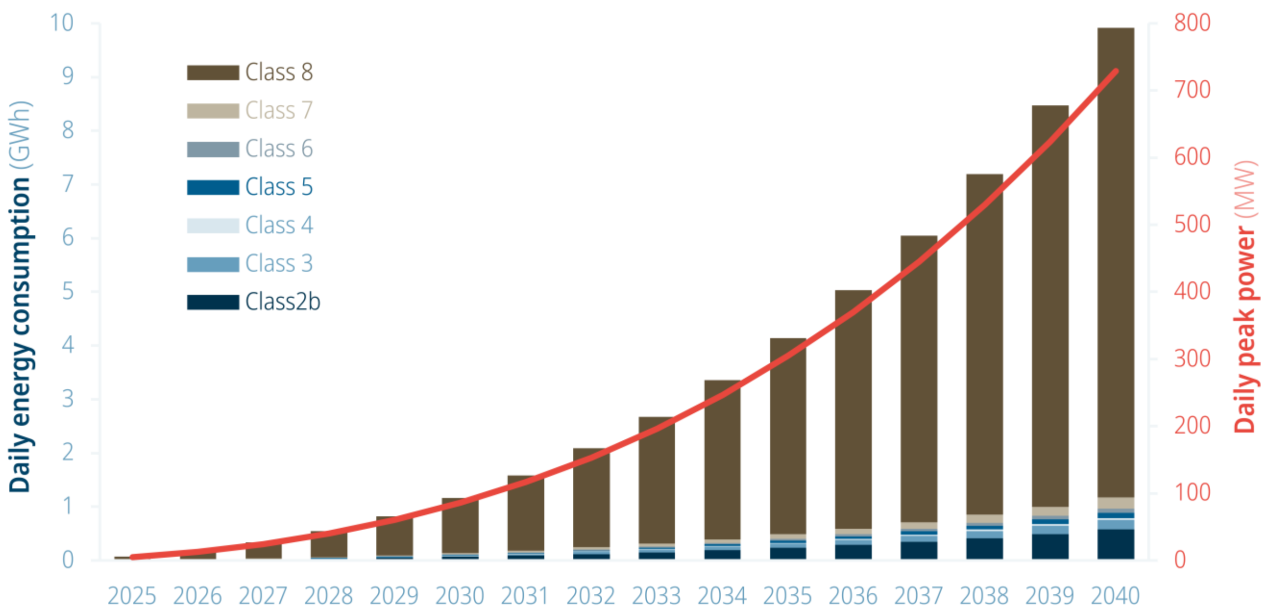

Figure 3. Electric MHDV-induced daily electrical energy consumption and peak power in Brampton

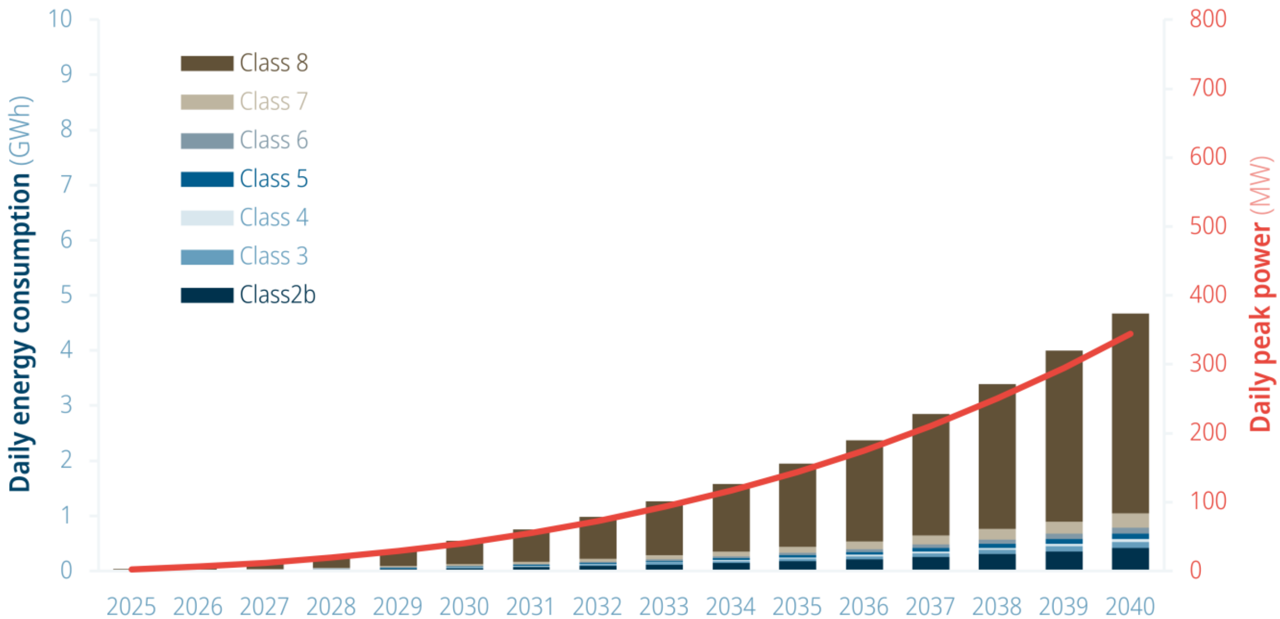

Figure 4. Electric MHDV-induced daily electrical energy consumption and peak power in Mississauga

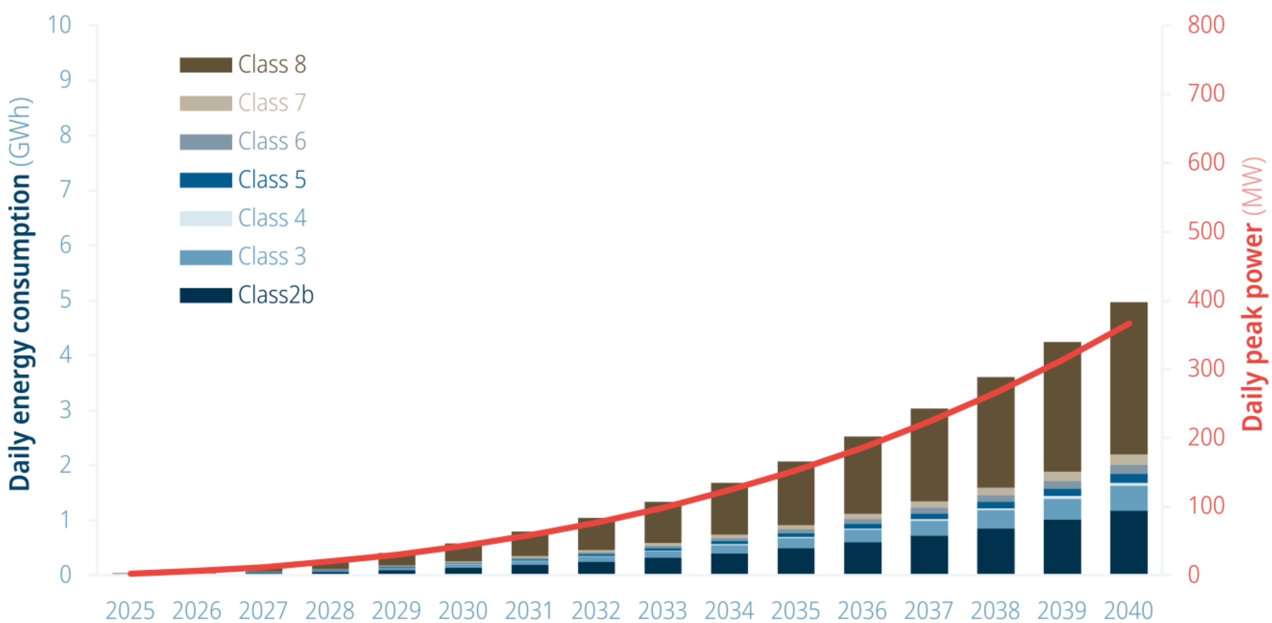

Figure 5. Electric MHDV-induced daily electrical energy consumption and peak power in Hamilton

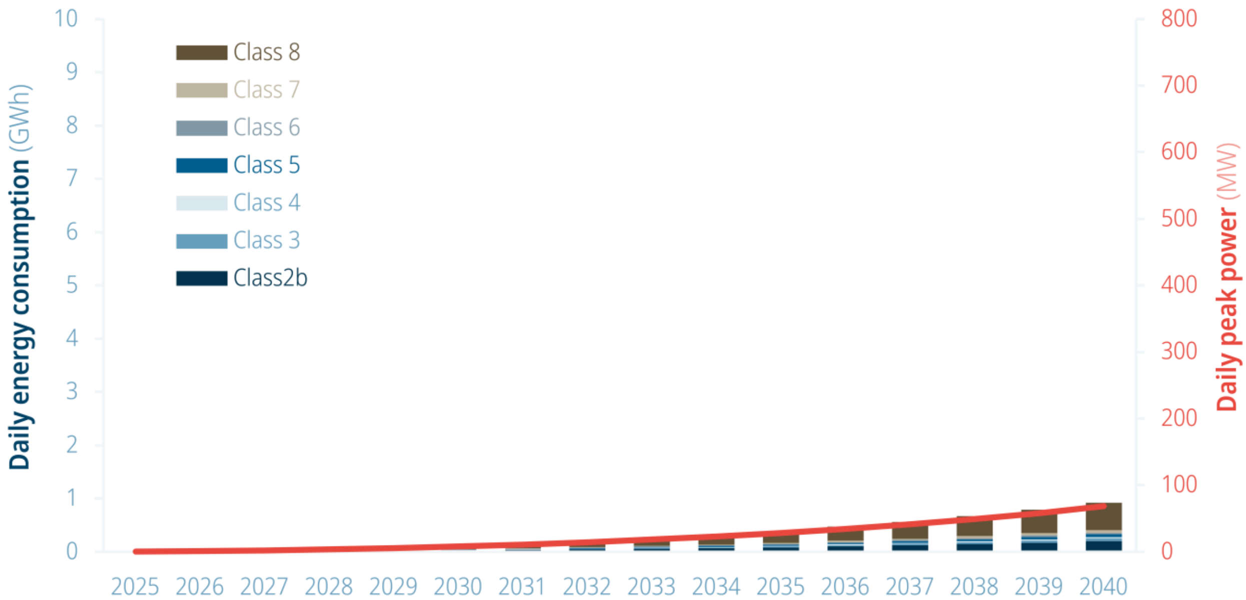

Figure 6. Electric MHDV-induced daily electrical energy consumption and peak power in Markham

3.2 Daily peak power demand

Electric trucks draw instantaneous power from the grid, which varies by hour depending on when the vehicles are charged. Figures 2 to 6 also depict the estimated average daily peak power demand under the Policy Reference Scenario. Peak power rises exponentially in line with energy consumption. Table 8 lists the daily peak power demand in 2030 for each municipality.

Table 8. Daily peak power demand from electric MHDVs in 2030

Municipality	2030 Daily peak power demand (MW)
Toronto	54.70
Brampton	85.97
Mississauga	40.63
Hamilton	43.20
Markham	8.04

For context, Toronto's total daily peak demand for all end uses in 2024 was 4,700MW, with average hourly peaks in May 2025 reaching 6,044 MW.[20] At 54.7 MW, the projected peak power demand from electric trucks in 2030 represents 1.17% of total peak power demand.

[20] Independent Electricity System Operator, "Hourly Zonal Demand Report." https://reports-public.ieso.ca/public/DemandZonal/

Moreover, IESO data show that Toronto's peak demand can fluctuate by more than 25% within a day.[21] For example, on a typical day in May 2025, peak power demand varied between a low of 4,840 MW and a high of 7,109 MW. This suggests that the electricity grid can handle fluctuations of over 2,000 MW in a day. Therefore, an incremental demand increase of less than 1.5% from electric MHDVs is unlikely to cause grid disruptions, particularly in the near term.

3.3 Number of chargers

Figures 7 to 11 show the number of chargers required to support electric MHDV adoption. Chargers are categorized as private or public and by three power levels: overnight, fast and ultrafast.

Currently, there are fewer than 50 chargers in the GTHA that are suitable for electric MHDVs. In Toronto, our estimates show a requirement for 4,621 private overnight chargers and 83 private fast chargers by 2030. To meet the federal 2030 Emissions Reduction Plan targets applied uniformly across all MHDV segments (i.e., Policy Reference Scenario), the city will also need 1,431 public overnight chargers, 97 public fast chargers and 25 public ultrafast chargers by 2030.

The exponential increase in chargers over the years is similar across other GTHA municipalities. By 2030, Brampton will need 5,703 chargers, Mississauga will need 3,563, Hamilton will need 5,015 and Markham will need 929.

Overnight private chargers account for the majority (>70%) of required chargers in Toronto, Hamilton and Markham. The share of overnight chargers is lower in Mississauga at 50% and in Brampton at 30%. These two municipalities have a higher share of Class 8 trucks, which are more likely to rely on overnight public charging. Fast and ultrafast chargers, whether public or private, make up less than 10% of required chargers in all cities and are expected to be used mainly for daytime opportunity charging.

[21] "Hourly Zonal Demand Report."

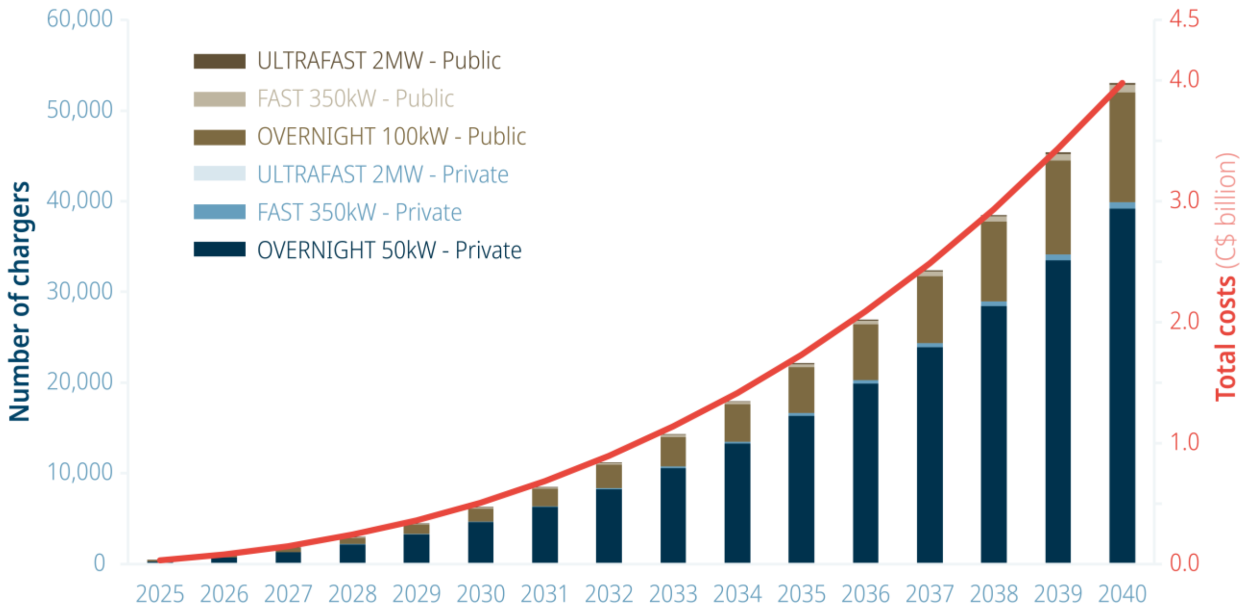

Figure 7. Electric MHDV-induced charger needs and costs in Toronto

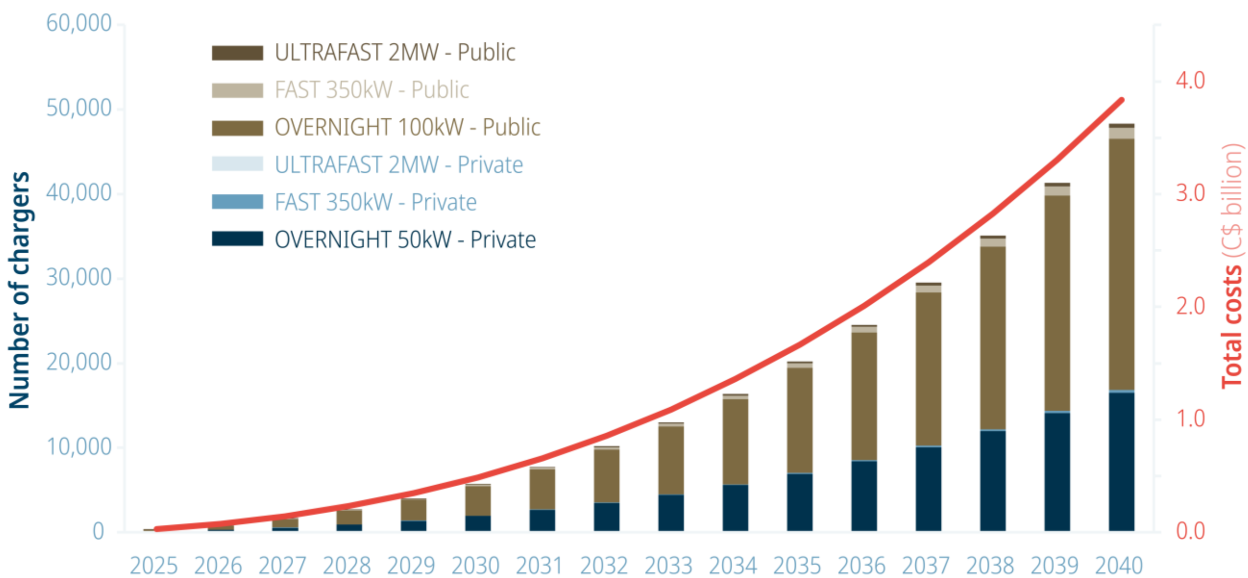

Figure 8. Electric MHDV-induced charger needs and costs in Brampton

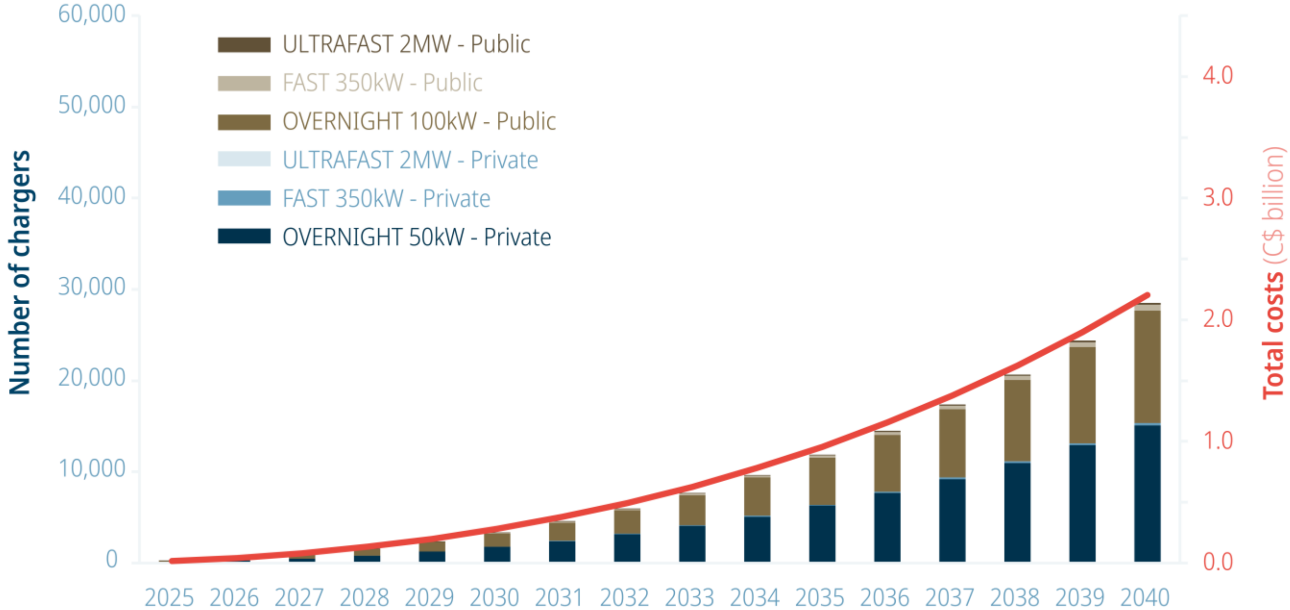

Figure 9. Electric MHDV-induced charger needs and costs in Mississauga

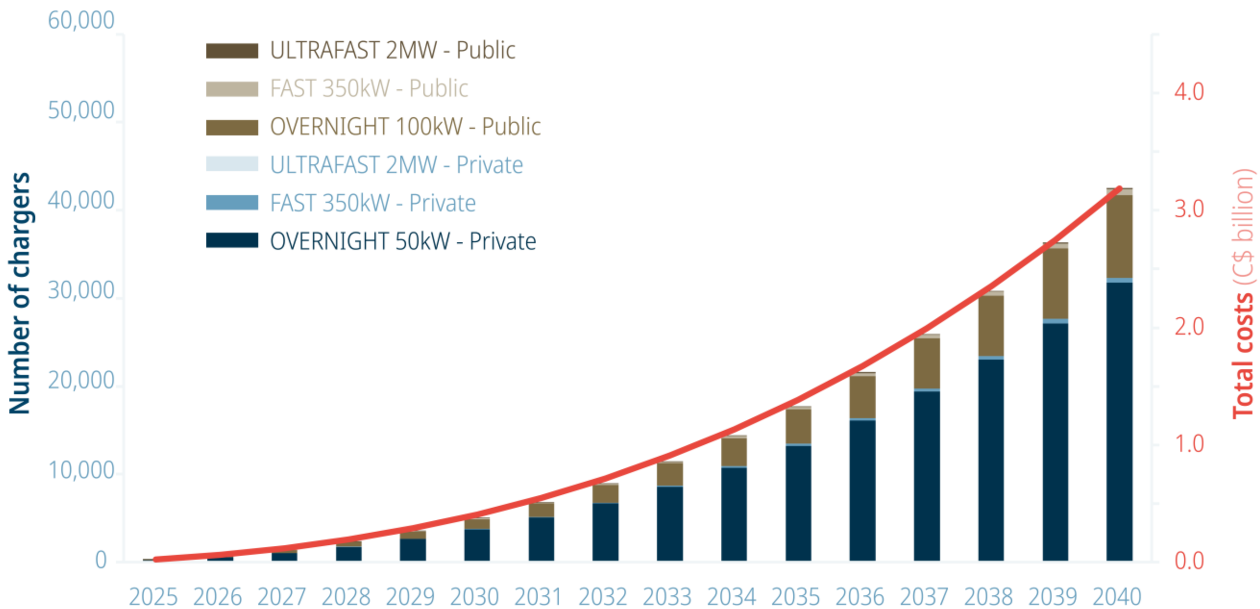

Figure 10. Electric MHDV-induced charger needs and costs in Hamilton

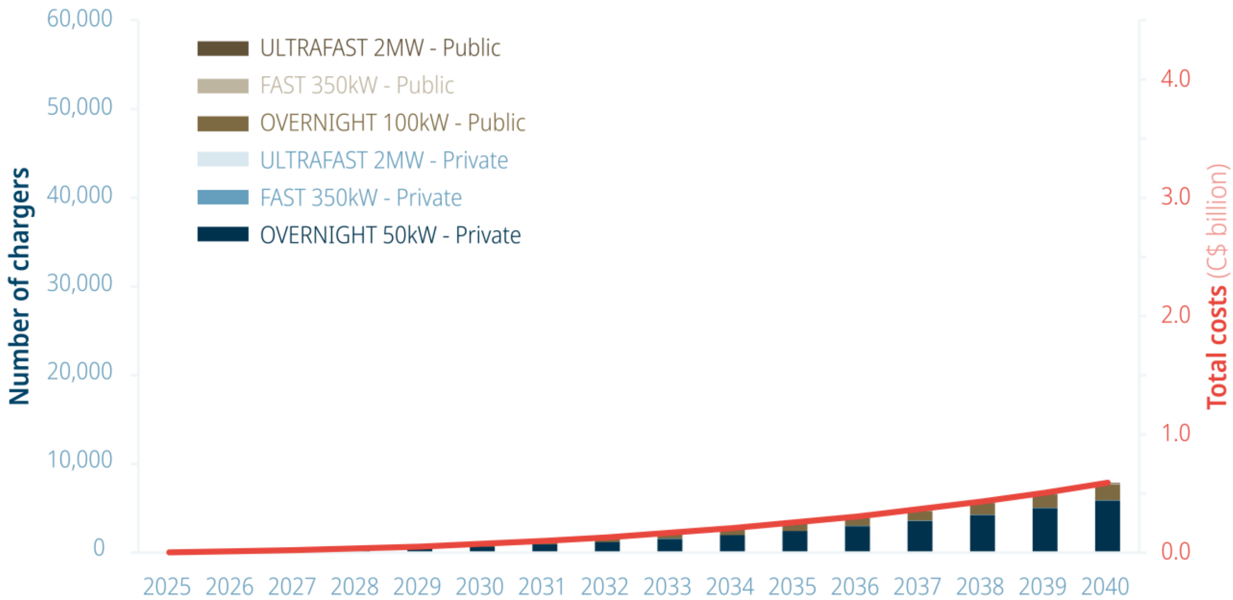

Figure 11. Electric MHDV-induced charger needs and costs in Markham

3.4 Charger costs

Deploying charging infrastructure at the scale needed to support electric MHDV adoption requires significant investments. Figures 7 to 11 (right hand Y-axis) show cumulative costs of charger buildout from 2025 until 2040. These are summarized in Table 9 along with the cost for public chargers only, which account for 25% to 65% of total charger costs (public plus private).

Table 9. Cumulative charging infrastructure costs from electric MHDVs by selected years

	Cumulative charging infrastructure costs ($ billion)		
	Public plus private		Public only
Municipality	**By 2030**	**By 2040**	**By 2030**
Toronto	0.51	3.98	0.14
Brampton	0.49	3.83	0.33
Mississauga	0.28	2.21	0.14
Hamilton	0.41	3.19	0.11
Markham	0.08	0.59	0.02

How these public charger costs will be shared between private and public funding remains uncertain. Under the Zero Emission Vehicle Infrastructure Program, the federal government subsidizes 50% of charger costs. Assuming this split, federal government spending would need to reach $0.37 billion by 2030 across the five GTHA municipalities. The charging infrastructure estimates exclude grid upgrade costs, which are more appropriately assessed by utilities.

3.5 Sub-municipal findings

We also estimate daily energy consumption, daily peak power, charger numbers and costs at the FSA level for all five cities. Tables 10 to 14 summarize results for selected FSAs in 2030. A key finding is that energy consumption and charging demand are concentrated in small number of FSAs. In each municipality, the listed FSAs account for more than 50% of total electric MHDV energy demand and charger needs.

In Mississauga, for example, three FSAs (L4T, L4W, L5C) contribute the bulk of energy demand and charger needs. In Brampton, FSAs L3R and L6C account for more than 60% of energy consumption and charger demand.

This concentration has important implications for city planners and utilities. Planners can adopt a phased approach that prioritizes high-demand FSAs for early charger installation and electrical system upgrades.

Table 10. Estimated results for selected FSAs in Toronto in 2030

Toronto	Daily energy consumption (GWh)	Daily peak power (MW)	# of chargers	Charger costs ($ billion)
TOTAL	**0.74**	**54.70**	**6,257**	**0.51**
M9W	0.126	9.310	836	0.069
M1B	0.043	3.150	563	0.045
M8Z	0.041	3.060	309	0.026
M3J	0.035	1.949	388	0.031
M2J	0.009	0.403	108	0.010
M2N	0.008	0.603	94	0.008
M4S	0.109	7.920	418	0.039
M5H	0.027	1.990	214	0.018
M9C	0.021	1.180	176	0.014
M9L	0.022	1.430	175	0.014

Table 11. Estimated results for selected FSAs in Brampton in 2030

Brampton	Daily energy consumption (GWh)	Daily peak power (MW)	# of chargers	Charger costs ($ billion)
TOTAL	**1.100**	**85.97**	**5,703**	**0.485**
L6P	0.130	9.640	594	0.050
L6R	0.150	10.950	695	0.060
L6T	0.190	13.940	926	0.080
L6Y	0.070	5.500	474	0.040
L7A	0.040	3.500	376	0.030

Table 12. Estimated results for selected FSAs in Mississauga in 2030

Mississauga	Daily energy consumption (GWh)	Daily peak power (MW)	# of chargers	Charger costs ($ billion)
TOTAL	**0.502**	**40.627**	**3,363**	**0.281**
L4T	0.059	4.374	259	0.026
L4W	0.163	12.258	1,074	0.090
L5C	0.042	3.099	238	0.020
L5M	0.018	0.663	187	0.015
L5N	0.049	3.174	353	0.029

Table 13. Estimated results for selected FSAs in Hamilton in 2030

Hamilton	Daily energy consumption (GWh)	Daily peak power (MW)	# of chargers	Charger costs ($ billion)
TOTAL	**0.586**	**43.200**	**5,015**	**0.407**
L0R	0.060	4.140	500	0.040
L8E	0.100	7.290	626	0.050
L8L	0.030	2.130	241	0.020
N0B	0.110	10.230	1,266	0.100
N1R	0.020	1.520	197	0.020

Table 14. Estimated results for selected FSAs in Markham in 2030

Markham	Daily energy consumption (GWh)	Daily peak power (MW)	# of chargers	Charger costs ($ billion)
TOTAL	**0.109**	**8.04**	**929**	**0.075**
L3R	0.050	3.62	376	0.031
L3T	0.010	0.41	120	0.010
L6C	0.025	2.10	184	0.015
L6G	0.015	1.30	133	0.011

4. Strategies for electricity demand and charger cost reduction

Many Canadian and international studies assume uniform EV adoption across all MHDV classes. This simplification tends to overestimate near-term electricity demand and infrastructure needs, because heavier trucks require larger, more expensive chargers, while lighter trucks require less. This section discusses how selected strategies can reduce electricity demand and charger costs and demonstrates how these strategies together can lower near-term demand and costs. The cost savings from applying the strategies together are summarized in Table 15.

Table 15. Potential for charger cost reductions from different strategies

Policy strategies for charger cost reduction*	Toronto	Brampton	Mississauga	Hamilton	Markham
(1) Staggering electrification across MHDV classes	−21%	−54%	−46%	−11%	−18%
(1) + (2) Strategizing early charger deployment	−26%	−59%	−51%	−15%	−22%
(1) + (2) + (3) Employing shared charging	−58%	−72%	−69%	−53%	−56%
(1) + (2) + (3) + (4) Managing charging behaviour	−65%	−75%	−72%	−61%	−63%

* Costs relative to default assumptions under the Policy Reference Scenario.

(1) Staggering electrification across MHDV classes

The previous sections presented charger costs under the Policy Reference Scenario, which assumes uniform EV adoption across all MHDV classes. An alternative approach (the Staggered Scenario) adjusts the targets so they are higher for lighter trucks and lower for heavier trucks.

As shown in Table 15, the Staggered Scenario produces significant cost savings. This occurs because heavier trucks require more powerful (and hence more expensive) chargers. Reducing EV adoption targets for Class 7 and 8 trucks, while increasing targets for lighter classes and maintaining the overall fleet-wide target of 35% sales by 2030, lowers infrastructure needs. Differences in cost savings across cities reflects difference in heavy truck population.

Target adjustments also help reduce overall daily electrical energy consumption. By 2030, the estimated reductions are:

- 46% in Toronto
- 71% in Brampton
- 64% in Mississauga
- 41% in Hamilton
- 46% in Markham

(2) Strategizing early charger deployment

Anonymized vehicle registration data, stop data, trip origins and destination, and truck traffic flow data shows that truck traffic is not uniform but is highly concentrated in a few FSAs. On average, 10% of FSAs account for more than 50% of all truck traffic in a city. Prioritizing these high-traffic FSAs for early charger deployment increases charger utilization and lowers costs.

Strategizing charger deployment reduces costs by an additional 4% to 5%-points beyond savings from adjusting sales targets (Table 15). The savings are even larger when considering only public chargers. Across the five cities, 82% to 86% of public charger costs can be reduced by focusing early deployment in high traffic areas.

(3) Employing shared charging

Shared charging allows multiple electric trucks to charge on the same private (or secure access) charger. This can deliver additional cost reductions of 15% to 30%-points across the cities. By 2030, shared charging, when combined with strategies (1) and (2), raises total savings even further (Table 15).

While the full benefits depend on the willingness of fleet operators to share chargers, the scale of potential savings suggests that governments and city planners should proactively support shared charging opportunities.

(4) Managing charging behaviour

If charging behaviour shifts so that a greater proportion of charging happens overnight at private depots, further cost savings can be achieved. Increasing the share of private depot charging by just 5% reduces total charger costs by 3 to 7 percentage points, in addition to the gains from previous strategies (1), (2) and (3) (Table 15).

The combined strategies result in total savings of $1.03 billion across the five cities.

This analysis provides a high-level view of the potential benefits from managed charging and related cost reduction strategies. A more detailed analysis of managed charging behaviour (also known as demand-side management) is beyond the scope for this paper and will be addressed in a future study.

Photo: iStock.com/RyanJLane

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