For Action

Green Bus Program Update

Date: July 17, 2025
To: TTC Board
From: Executive Director – Innovation and Sustainability

Summary

The Green Bus Program was first approved by the Board in November 2017 and included the introduction of the latest generation of hybrid-electric buses as a transitional step toward achieving a fully zero-emissions fleet by 2040. The program is aligned with provincial, federal, and international targets for emissions reduction. It is a key action under the City of Toronto's TransformTO Net Zero Strategy, the TTC's 5-Year Corporate Plan, and its Innovation and Sustainability Strategy.

The TTC began its transition to a zero-emissions network with a strong foundation, with more than 50% of ridership already served by electric and emission-free subway and streetcar systems. As of today, approximately 77% of total ridership is on zero- or low-emission vehicles, reflecting the integration of hybrid and battery-electric buses (eBuses) into the fleet. Looking ahead, by 2031, the TTC aims for 50% of its bus fleet to be fully zero-emission.

With the retirement of the last Orion VII Clean Diesel buses in 2024 (remaining buses in the fleet without diesel particulate filters), the TTC has phased out its highest-emitting buses. Since the Green Bus Program was initiated, fleet-wide greenhouse gas (GHG) emissions have been reduced by more than 25% through the procurement of 591 new hybrid-electric buses and 208 eBuses. By the end of Q1 2026, the current order of 340 eBuses will have grown the zero-emission fleet to 400, making the TTC's bus fleet the greenest of large transit systems in North America.

Once our fleet is fully electrified, this transition is expected to avoid approximately 290,000 tonnes of carbon dioxide equivalent and 125 tonnes of criteria air pollutant emissions annually between 2040 and 2050. [1] These emissions reductions are estimated to yield $460 million in avoided social costs of carbon and $2.8 million in

[1] **Criteria air pollutant emissions** are harmful air pollutants regulated for diesel vehicles at the federal level. The criteria air pollutant emissions calculated here include carbon monoxide, nitrogen oxides, particulate matter, sulfur oxides, and volatile organic compounds. Reference Air Pollution – City of Toronto

healthcare costs avoided. This one action will reduce the TTC's direct organization-wide emissions by about 28% by 2030[2].

Due to the timing of funding approvals, bus production lead times, and the need to replace aging buses at the end of their useful life, the next step in the program is to procure 200 hybrid-electric buses for delivery in 2026 through Q1 of 2028 (with contract language to procure additional hybrid buses should there be a need). As a transition technology, these new hybrids are proven reliable, impose no range limitations, and require no electrification infrastructure to be installed in advance. Further, they allow the time needed for the TTC to manage the organizational changes required for large-scale eBus operations.

With the procurement of these hybrid buses, we remain on track to achieve the TransformTO Net Zero target of 2040. Funds totalling $1.2 billion are available in the Approved Capital Budget and Plan, subject to availability and approval of matching funds through intergovernmental grants, to advance electrification over the next five years.

As the TTC advances one of the leading fleet electrification programs in North America, it remains committed to learning and sharing with others. This report includes appendices intended to detail progress, risks, and opportunities in order to further this industry collaboration.

Recommendations

It is recommended that the TTC Board:

1. Receive this report for information.

Financial Summary

2025-2034 Approved Capital Budget and Plan

The 2025-2034 Approved Capital Budget and Plan for the Green Bus Program identifies a need for $4.6 billion in funding over the 10-year period, of which $1.7 billion is funded, as detailed in Table 1 below:

[2] Assuming all over emissions sources remain the same and the bus mileage remains unchanged.

Table 1 – Green Bus Program: 2025-2034 Approved Capital Budget and Plan

2025-2034 Capital Budget & Plan (000's)		2025-2029	2030-2034	10-Year Total
eBus Purchase	**Approved Capital Budget & Plan**	1,054,345	135,904	**1,190,249**
	CIP Unfunded	571,211	1,406,442	**1,977,653**
	Total Capital Investment Plan	1,625,556	1,542,346	**3,167,902**
Charging Systems	**Approved Capital Budget & Plan**	512,357	-	**512,357**
	CIP Unfunded	464,036	473,397	**937,433**
	Total Capital Investment Plan	976,393	473,397	**1,449,790**
Green Bus Program Total	**Approved Capital Budget & Plan**	**1,566,702**	**135,904**	**1,702,606**
	CIP Unfunded	**1,035,246**	**1,879,839**	**2,915,085**
	Total Capital Investment Plan	**2,601,948**	**2,015,743**	**4,617,691**

The $1.7 billion in approved funding includes the remaining funding to deliver 340 eBuses and 248 charge points with Federal funding support through the Zero Emission Transit Fund. The 2025-2034 Approved Capital Budget and Plan included $1.2 billion in required matching City funding to prepare for future bus procurements and intergovernmental grant funding opportunities.

The TTC's transition to a fully electric bus fleet is a long-term investment aimed at reducing emissions and improving financial sustainability. Although eBuses have higher upfront capital and operating investment than diesel and hybrid buses, they are anticipated to offer long-term net savings through:

- Net fuel savings.
- More stable energy pricing.
- Lower maintenance requirements.
- Access to external funding.
- Long-term infrastructure amortization.

While initial capital and operational investments to acquire and prove out this new technology are significant, these are expected to be offset by fuel and maintenance savings by the mid-2040s to early-2050s. Post-transition, operational savings could reach $83 million-$275 million, annually. See Appendix A for more information on methodology. Between 2025 and 2050, the Green Bus Program is projected to avoid approximately $8.6 billion in social costs associated with greenhouse gas emissions and an additional $53 million in health-related costs from improved air quality. These estimates reflect the broader societal benefits of reduced emissions, including avoided climate-related damages and public health impacts.

This analysis is continuously evolving as we gain more insights into transitioning the fleet to electric vehicles. It will be updated as new information becomes available and as advancements occur in procurement strategies, bus technologies, and charging

systems. See Appendix A for additional details on the methodology used for the cost-benefit analysis.

The Executive Director – Finance has reviewed this report and agrees with the financial impact information.

Innovation and Sustainability Matters

The Green Bus Program is essential to the TTC meeting its net-zero commitment. It is a fundamental priority in the TTC's Corporate Plan (Action 3.3.1 Lead the Transition to Net Zero Through the Green Fleet Program) and Innovation and Sustainability Strategy (Action 2.1.2 Eliminate Direct GHG Emissions by Decarbonizing our Fleets).

The TTC's bus fleet generates almost 80% of the TTC's direct and indirect emissions. Therefore, implementing the Green Bus Program is the single most impactful action the TTC can take to reduce its GHG emissions and criteria air pollutant (CAP) emissions. Implementing the Green Bus Program as outlined in this report is anticipated to avoid 5.6 million tonnes of GHG emissions and more than 2,300 tonnes of CAP emissions from 2025 to 2050.

Compared to the 2025 budgeted fleet plan, the 2026 fleet plan, now including the planned procurement of hybrid buses in 2027, is expected to delay further the TTC's achievement of the City of Toronto's target for a 65% reduction in bus fleet emissions (relative to 2008 levels) by approximately two-to-three years, shifting anticipated compliance to 2034-2035. Despite this, the TTC remains on track to meet the broader Sustainable Fleet Target of a 65% reduction in Scope 1 (tailpipe) emissions by 2030, relative to a 1990 baseline, with compliance still anticipated to be achieved between 2029 and 2030.

Equity/Accessibility Matters

Social Equity

Low-income and equity-deserving communities are often located near bus garages and high-traffic corridors, which exposes them disproportionately to diesel exhaust and related health issues (e.g. asthma, cardiovascular disease). Electrifying bus fleets directly reduces local tailpipe emissions, delivering localized air quality improvements to neighbourhoods that historically bear the greatest pollution burden.

Procurement Equity

The most recent hybrid and eBus procurements required contractors to meet two procurement equity requirements during the contract term. The diverse business enterprise requirement obligated vendors to spend 5% of the contract price on supporting, initiating, implementing, and promoting policies and other activities related to diverse business enterprises. The equity hiring requirement obligated vendors to increase hiring of persons from equity-deserving groups or communities. The contract grants the TTC auditing rights to verify that the contractor has fulfilled the requirements. Failure to meet the requirements results in the contractor being required to pay liquidated damages.

Accessibility

All buses are and will be compliant with the Canadian Standards Association D435 standard for accessible transit buses, which outlines requirements for safe transportation for persons with physical disabilities. Additionally, all buses will be compliant with the Accessibility for Ontarians with Disabilities Act, 2005. The TTC strives to exceed the associated requirements outlined and has included the Advisory Committee on Accessible Transit (ACAT) in design reviews of its bus procurements.

The latest accessibility and procurement equity requirements, as well as green procurement provisions, will be incorporated into all eBus vehicle procurements and overhaul programs moving forward.

Decision History

See Appendix B for the key decision history.

Issue Background

The TTC's Green Bus Program aims to transition its bus fleet to zero-emission vehicles by 2040, supporting Toronto's climate goals and improving air quality. The program includes procurement of hybrid and battery-electric (eBus) buses, installation of charging infrastructure, and organizational transformation to support this transition. This program aligns with City objectives through the TransformTO Net Zero Strategy, the TTC's Corporate Plan, and its Innovation and Sustainability Strategy. For details, please refer to Appendix C.

While this report focuses on the accessible-conventional bus fleet, the TTC is also working to transition Wheel-Trans buses and non-revenue vehicles to zero-emission vehicles by 2040.[3]

Comments

1. Pilot Program Insights

The initial pilot of 60 eBuses evaluated three manufacturers, confirming the viability of electric propulsion systems, but revealing manufacturer-specific reliability issues. Lessons learned have informed technical specifications and contract terms for the second-generation fleet of 340 eBuses currently being delivered. For details on evaluation results and performance updates for the pilot fleet, refer to Appendix D.

2. Fleet Procurement Updates

As of June 27, 2025, the TTC has received 148 of 340 second-generation eBuses, with 84 in service. Delivery delays, due to supply chain issues and battery concerns, have pushed project completion to Q1 2026. Mitigation measures include extending the life of older buses, exercising liquidated damages, and requesting a Federal funding extension. Despite setbacks, the fleet has logged more than 297,000 km with a strong

[3] In February 2025, the TTC Board approved the award of a contract for the supply and delivery of five electric paratransit buses to pilot these vehicles for Wheel-Trans service.

Mean Distance Between Failure (MDBF) exceeding 20,000 km, indicating promising early performance. Refer to Appendix E for detailed updates on the eBus Procurement Program and eBus performance to date.

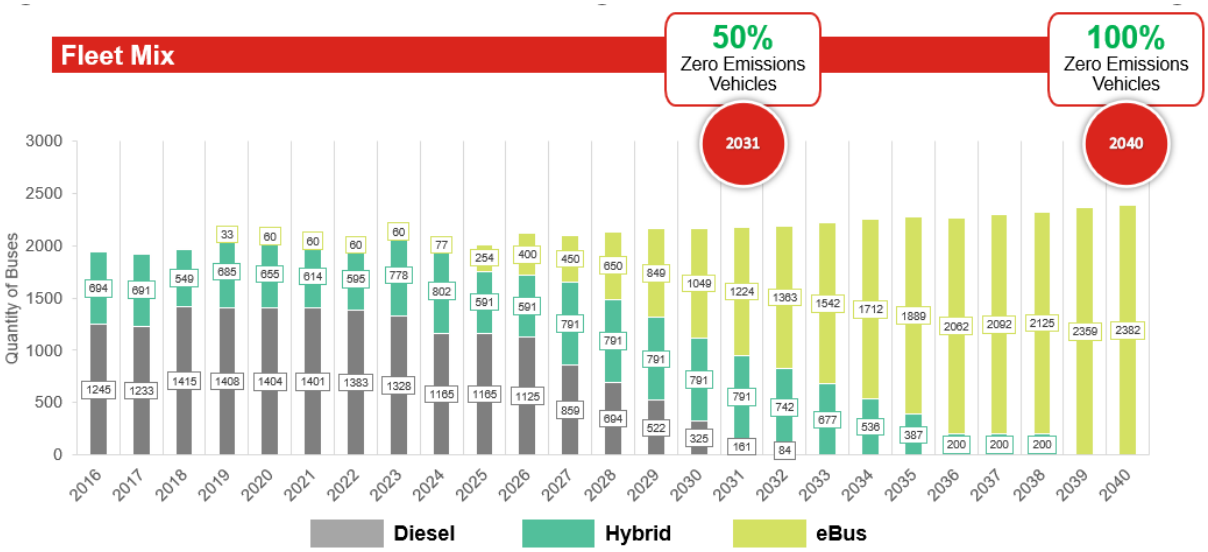
3. Charging Infrastructure Development Updates
The TTC, partnering with PowerON Energy Solutions and Toronto Hydro, is implementing a phased installation of depot-based charging systems. Although the program has encountered initial delays due to technical and commissioning complexities, efforts are underway to accelerate infrastructure deployment and mitigate capacity deficits at key garages. Refer to Appendix F for detailed updates on the Charging Systems Program and Appendix G for more information on the updated integrated delivery schedule.

4. Operational Challenges and Adaptations
eBuses currently have a shorter range (~241 km) than diesel/hybrid buses, requiring adjustments in scheduling, charging operations, and fleet size. Charging infrastructure delays may temporarily limit bus deployment, necessitating storage solutions and delayed diesel bus retirements to maintain service. Workforce training and operational readiness programs are in place to manage these changes. An analysis of eBus service scheduling and its associated impacts on the Bus Transportation workforce is underway. Once this information is available, stakeholder discussions will be arranged. See Appendix H for additional details on operational impacts and considerations of the eBus transition.

5. Business Transformation Efforts
The TTC established the Innovation and Sustainability Group and a dedicated eBus Business Transformation Program to govern the electrification transition, focusing on governance, communication, workforce training, risk management, and operational readiness across departments. See Appendix I for additional details on operational readiness and change management efforts towards the eBus transition.

6. 2026 Bus Fleet Plan and Contingency
Due to funding and production timelines, the TTC proposes a dual-track plan to procure an additional 50 eBuses in 2027, and a one-time hybrid bus purchase of up to 200 units in 2026-2027 (subject to market availability, and with contract language to support the procurement of up to 290 by end of Q1 2028), as a transition technology, to ensure service reliability and allow time for infrastructure and operational readiness improvements. Full electric bus procurement is targeted to begin in 2028, with hybrids retained as a contingency. See Appendix J for additional details on context and needs that support the revised bus fleet plan.

Figure 1 *- Summary of 2026 Bus Fleet Plan*



**Bus numbers are as of end-of-year*

7. Continuous Improvement and Independent Assurance

The TTC continues to strengthen its Green Bus Program through innovation and oversight. The TTC's Capital Projects Assurance Function (CPAF) conducted an independent assurance review through Deloitte LLC between May and June 2025 of the eBus Charging Systems Program and its interdependency with the eBus delivery. The scope of the review was to assess the progress made by the project team on Deloitte's recommendations in the initial 2023 assurance review and to identify remaining gaps, additional corrective actions or mitigations that must be put into place. The project team and the Innovation and Sustainability Group have reviewed and accepted the key findings and the recommended corrective actions. CPAF will continue following up on the remaining recommendations until they are closed. Other key initiatives include battery and energy optimization research, planning for induction charging trials in 2029, a peer review by APTA set for September 2025, and an Auditor General audit planned for 2025-2026. See Appendix K for additional details on program assurance and the plan for continuous improvements.

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Attachments

Appendix A: Cost-Benefit Analysis Methodology
Appendix B: Decision History
Appendix C: Program Alignment with City Mandate and TTC Corporate Plan
Appendix D: eBus Pilot Phase Overview and Update
Appendix E: eBus Procurement Program Update
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Appendix G: Updated Integrated Delivery Schedule
Appendix H: Operational Impacts of eBus Transition
Appendix I: eBus Transformation Program Details
Appendix J: 2026 Bus Fleet Plan
Appendix K: Continuous Improvement and Independent Assurance

Appendix A: Cost Benefit Analysis Methodology

A model was developed with input from internal stakeholders to estimate the environmental (greenhouse gas (GHG) and criteria air pollutant (CAP) emissions) and economic impacts of the 2026 draft bus fleet plan, outlining the planned bus procurements as compared to a 2017 baseline[4] from 2026-2050. The purpose of the model is to quantify the financial implications of transitioning to an electric bus fleet – a necessary action to lower greenhouse gas emissions to mitigate the worst climate impacts and align with the City of Toronto's TransformTO and Sustainable City of Toronto Fleet Plan targets.

The model involved projecting mileage based on the service plan for 2026, followed by an annual growth rate of 1.5% year-over-year until 2050. It also included mileage estimates for each bus model. This estimate is based on historical data, preliminary testing of new eBuses and anticipated battery improvements informed by discussions with manufacturers regarding future generations of buses. Fuel economies and emissions factors were applied to the mileage estimates to assess the environmental impacts. Estimated operational costs include fuel (electricity and diesel) costs, maintenance costs, increased Operator hours required due to block splitting to accommodate the lower range, and the operational costs associated with designing, commissioning and maintaining electric chargers. Estimated capital costs encompass the expenses for bus purchases and charger installation, both of which are based on the fleet plan.

Costs associated with service growth, such as the addition of storage and garage space(s), were not included in this analysis since they are necessary to support the fleet growth independent of bus technology type. Currently, avoided costs beyond fuel expenses are not included in this analysis. These additional avoided costs may include reductions in heating, ventilation, and cooling requirements for bus garages, which are not currently available.

The social cost of carbon assigns a monetary value to the long-term economic damages, such as health impacts, environmental degradation, and damages from climate-induced events, including flooding, associated with the release of each tonne of carbon dioxide equivalent. Applying the Federal Government's estimated social costs of carbon to the projected GHG emissions avoided by electrifying the fleet compared to continuing with the 2017 diesel fleet, estimated to be 5.5 million tonnes of CO2e between 2025 and 2050, translates to $8.6 billion in avoided social costs. These benefits, while not reflected in the TTC's Operating Budget, represent significant value to public health systems, local communities, and all levels of government.

This analysis is continuously evolving as we gain more insights into transitioning the fleet to electric vehicles. It will be updated as new information becomes available and as advancements occur in procurement strategies, bus technologies, and charging systems. Therefore, the results should be viewed as a snapshot in time and are subject to change. However, the preliminary analysis is sufficiently advanced to demonstrate that transitioning to an electric bus fleet will yield significant environmental and

[4] As representative of the 2017 hybrid and diesel fleet composition.

socioeconomic benefits for the community in both the short- and long-term, along with long-term financial advantages for the TTC.

Appendix B: Decision History

February 21, 2017 – The TTC Board directed the TTC CEO to evaluate the merits of electric buses and develop a strategy for the TTC, including consideration of a pilot project.
Decision: New Business Electric Bus Charging

November 13, 2017 – The TTC Board approved the TTC to enter up to three contracts for the supply of 30 eBuses from BYD, New Flyer Industries, and Proterra, as well as up to two contracts for the supply of 230 hybrid buses from Nova Bus and New Flyer.
Decision: Green Bus Technology Plan Decision

June 12, 2018 – The TTC Board approved the procurement of an additional 30 eBuses from BYD, New Flyer Industries, and Proterra. The TTC Board also confirmed the TTC's target for procurement of only zero-emission (fossil fuel-free) bus propulsion technology starting in 2025.
Decision: Green Bus Technology Plan Update

January 27, 2020 – As part of the TTC's 2020-2029 Key Capital Priorities, the TTC Board approved the allocation of $686 million, approximately one-third of the 10-year cost, toward the procurement of 614 buses and $64 million for eBus charging infrastructure.
Decision: TTC's 2020-2029 Key Capital Investment Priorities: Subway Infrastructure and Accelerated Vehicle Procurement

February 25, 2020 – The TTC Board directed TTC staff to report back on potential partnership opportunities to advance the TTC's electric vehicle charging systems and an expedited procurement plan for the 614 funded buses.
Decision: TTC Green Bus Program Update

October 22, 2020 – The TTC Board delegated authority to the TTC CEO to award up to two contracts for the supply and delivery of approximately 300 hybrid buses and directed staff to report back on the first-year results of the eBus Head-to-Head evaluation and a draft agreement with Toronto Hydro and Ontario Power Generation for the delivery of required charging infrastructure for the TTC's target of a zero-emission fleet by 2040.
Decision: TTC Fleet Procurement Strategy and Plan

April 14, 2021 – The TTC Board received the preliminary results of the TTC's eBus Head-to-Head evaluation. The Board delegated authority to the TTC CEO to undertake a public procurement for up to two contracts, each for a total of approximately 300 eBuses, subject to certain conditions, including applying lessons learned from the Head-to-Head evaluation.
Decision: TTC's Green Bus Program: Preliminary Results of TTC's Head-to-Head eBus Evaluation

February 10, 2022 – The TTC Board delegated authority to the CEO to enter into the TTC-PowerON Principal Agreement with PowerON Energy Solutions, subject to an upset limit amount and receipt of further funding for electrification infrastructure.

Decision: Principal Agreement with PowerON Energy Solutions LP to Decarbonize TTC Operations, Fleet, and Facilities

April 14, 2022 – The TTC Board received the final results of the TTC's eBus Head-to-Head evaluation and delegated authority to the TTC CEO to increase the quantity of eBus procurement and infrastructure works, subject to the receipt of new intergovernmental funding.
Decision: TTC's Green Bus Program: Final Results of TTC's Head-to-Head eBus Evaluation

July 14, 2022 – The TTC Board received an update on the Green Bus Program, including the status of eBus procurement.
Decision: Green Bus and Wheel-Trans Green Bus Program Update

Appendix C: Program Alignment with City Mandate and TTC Corporate Plan

A. Alignment with City Objectives

In December 2021, the City Council adopted the TransformTO Net Zero Strategy, which aims to reduce community-wide greenhouse gas (GHG) emissions to net zero by 2040. This City strategy requires the TTC to decarbonize its fleet and facilities, including setting a goal for 50% of the TTC bus fleet to be zero-emission by 2030. The transition to eBuses is crucial for meeting the City's climate action targets as well as improving overall air quality by reducing traffic-related air pollution.

Additionally, the Green Bus Program supports the delivery of several strategic priorities outlined in the City's Corporate Strategic Plan, including Keep Toronto Moving (which commits to transportation options that reduce environmental impacts) and Tackle Climate Change and Build Resilience (which commits to reducing local greenhouse gas emissions). Finally, the Green Bus Program aligns with the C40 Fossil Fuel Free Streets Declaration, which commits to procuring only zero-emission buses from 2025 onward.

A May 2025 study by the University of Toronto found that "the positive impact of electrifying the TTC bus fleet is very dramatic," estimating that with service returning to 100% of 2019 levels and full fleet electrification, there would be an $18-million reduction in annual carbon costs and a $253-million reduction in annual health and mortality costs.[5]

B. Alignment with TTC's Corporate Plan

The Green Bus Program is central to environmental sustainability and innovation, two of the Corporate Plan's four key principles, and is a standalone action under the plan (Action 3.3.1 Lead the Transition to Net Zero Through the Green Fleet Program). The program also directly supports the five strategic directions outlined in its 2024-2028 Corporate Plan:

1. **Build a Future-Ready Workforce:** To equip employees with the skills needed to operate and maintain electric bus technology, the TTC has implemented training programs for Operators and maintenance staff at key garages, including Arrow Road and Eglinton, supporting the TTC's strategic direction to enable its workforce to thrive.
2. **Attract New Riders, Retain Customer Loyalty**: Electric buses offer a quieter, smoother ride and produce no tailpipe emissions, improving the customer experience and contributing to cleaner air. These benefits, along with improved reliability over time due to fewer mechanical components, support the TTC's goals of delivering safe, reliable, and inclusive service.
3. **Place Transit at the Centre of Toronto's Future Mobility**: eBuses are critical to minimizing the TTC's environmental impacts, including improving local air quality, and transitioning to net zero. When the TTC's entire fleet is zero-emission, the TTC estimates that GHG emissions will be reduced by approximately 200,000 tonnes of CO_2 annually.

[5] See Page 23 of Benefits of Transit Investment, Phase 2 Project Final Report to the TTC from the University of Toronto.

4. **Transform and Modernize for a Changing Environment**: The transition to eBuses is a critical component of the TTC's Innovation and Sustainability Strategy, and the TTC is embracing new technology to drive efficiency and enhance employee and customer experience.
5. **Address the Structural Fiscal Imbalance**: In its 2025 Budget, the TTC estimated that eBuses would result in 10-year operating savings of approximately $47 million due to reduced fuel consumption and lower maintenance expenses.

While this report focuses on the accessible-conventional bus fleet, the TTC is also working to transition Wheel-Trans vehicles and non-revenue vehicles to zero-emission vehicles by 2040.[6]

[6] In February 2025, the TTC Board approved the award of a contract for the supply and delivery of five electric paratransit buses to pilot these vehicles for Wheel-Trans service.

Appendix D: eBus Pilot Phase Overview and Update

A. Review of Results

The purpose of the TTC's eBus Head-to-Head evaluation was to assess three types of eBuses in the TTC's operating environment, leverage lessons learned to inform specifications for future procurements and share findings with the broader transit community to support the adoption of zero-emission buses. This was the industry's first long-term, head-to-head comparison of eBus performance.

Based on TTC Board approvals in November 2017 and June 2018, the TTC procured a pilot order of 60 eBuses from three manufacturers: 10 from BYD, 25 from New Flyer, and 25 from Proterra. For the pilot, the TTC retrofitted three garages (Arrow, Eglinton and Mount Dennis) with 60 charge points and supporting charging infrastructure. 25 charge points were installed at Arrow Road, 10 at Eglinton, and 25 at Mount Dennis.

The TTC's first eBus entered service in June 2019. The evaluation was initially scheduled to begin in the first quarter of 2019. However, due to delays in the production and delivery of BYD buses and COVID-19-related delays in commissioning, formal head-to-head testing began in October 2020.

The evaluation tracked dozens of metrics within nine domains: system compatibility, accessibility, customer experience, Operator and maintainer experience, maintainability, charging system performance, vehicle performance, and total lifecycle cost. The TTC presented preliminary results of the evaluation to the Board in April 2021 and final results in April 2022. Refer to the Head-to-Head Evaluation Final Report for detailed evaluation results across all domains and metrics, as well as additional information on technical lessons learned.

At the time of the final report, all 60 eBuses had been in service between one and 2.5 years, had driven more than 2.5 million kilometres, and had reduced GHG emissions by 3.3 million metric tonnes. Only New Flyer had delivered at or above the required performance. In terms of key reliability and availability metrics, New Flyer achieved a Mean Distance Between Failures of 70,000 km and a fleet availability of 95%. In comparison, BYD and Proterra achieved a Mean Distance Between Failures of 35,000 km and 25,000 km, respectively, and an availability of 30% and 95%.[7,8]

An essential finding of the pilot project was that battery-electric propulsion systems were not a significant driver of bus performance. The propulsion systems of the buses were reliable and accounted for less than 4% of the defects experienced. By comparison, body interior and exterior faults accounted for 50% of faults, which are not defects specific to eBus propulsion technology. Consequently, the TTC identified that there were no fundamental issues with eBus technology preventing the transition to a zero-emission bus fleet.

[7] Mean Distance Between Failures is a measure of reliability that reports how far on average a bus can travel before it experiences a mechanical failure that prevents it from completing its trip or takes it out of service.

[8] Bus fleet availability is a measure of how well a bus fleet performs in terms of being available for use when needed. Availability is reported as a percentage and should be as close to 100% as possible.

The pilot generated many technical and commercial lessons learned that informed the TTC's next eBus procurement in 2023. See Table 1 for a summary. The TTC also learned operational lessons, including the range performance of buses, the effect of seasons on range, the management of low state-of-charge buses in service, and the management of battery thermal alerts.

Table 1: Key Lessons Learned from Pilot that Informed the TTC's 2023 eBus Procurement

Type of Lesson Learned	**Key changes incorporated into the 2023 eBus Procurement**
Technical specifications	• Must-have criteria (i.e. a full stainless-steel structure with a minimum of six years of in-service experience, minimum battery capacity, maximum length and height, and charging technology specifications) • Updated commissioning requirements, including requiring buses to pass a 300-km test that mimics in-service conditions and tests all critical systems • IP rated (sealed, fire, corrosion-resistant and maintenance-free) battery enclosure
Commercial/contractual specifications	• Revised milestone payment percentages to incentivize the vendors to commission the buses quickly • Inclusion of reliability and availability performance metrics and battery degradation targets to protect fleet performance, with financial penalties applied if targets are not met

B. 2025 Update on Pilot Fleet Performance against Head-to-Head Evaluation Criteria

As of May 2025, the pilot fleet has accumulated more than five years and six million kilometres of in-service experience. Approximately 45-50% of the 60-bus pilot fleet is available for service. The BYD fleet has shown steady improvement in availability over the past 10 months. New Flyer's pilot bus availability has dropped due to issues with the high-voltage battery enclosure, which the TTC and New Flyer are discussing options for addressing. The availability of Proterra pilot buses has fallen sharply to 30% due to traction motor defects and ongoing supply chain challenges following the company's 2023 bankruptcy. The TTC is collaborating with third-party vendors to source parts for the repair of out-of-service Proterra buses.

Despite these challenges, the TTC continues to gain valuable insights from the pilot fleet. Propulsion-related faults account for only 6% of all system defects but do significantly impact pilot fleet availability, as they represent 38% of the time New Flyer and 22% of the time Proterra eBuses are out of service. The TTC has incorporated lessons learned from battery design and component quality into its second-generation order of 340 eBuses. As eBus technology continues, going forward, the TTC may report

performance of the pilot fleet separately from the performance of the second-generation and future generations of eBuses.

Appendix E: eBus Procurement Program Update

A. Second Generation eBus Order: Delivery, Commissioning and Schedule Update

For the current second-generation eBus order of 340 eBuses, see Table 2 for the delivery and commissioning status by supplier as of June 27, 2025:

Table 2: Second Generation eBus Delivery and Commissioning Update
(As of June 27, 2025)

Supplier	Vehicles ordered	Vehicles delivered	Vehicles commissioned and in service
New Flyer	204	137	83
Nova Bus	136	11	1
Total	340	148	84
Note: New Flyer deliveries are ahead of Nova Bus deliveries due to planned differences in each manufacturer's production schedule.			

Due to supply chain and battery performance issues noted below, the TTC has reevaluated its schedule management approach and added additional schedule contingency.[9] As a result, the completion date for the delivery of the 340 eBuses has been updated to Q1 2026 from Q4 2025.

There have been industry-wide delays in bus deliveries due to the lack of availability of American Seating (AMSECO) passenger seat parts. Bus manufacturers are working with AMSECO to address these issues, such as supporting AMSECO's production, increasing staffing and outsourcing, and are also actively pursuing alternative suppliers.

Further delays have been caused by 93 New Flyer buses experiencing battery fault codes, which affected bus performance and range. The TTC issued a temporary "stop shipment" on October 25, 2024, which ended December 12, 2024, when the root cause and mitigation measures were determined. All buses being produced now have new or retrofitted battery packs to mitigate the issue. All in-service buses have retrofitted battery packs, and the TTC expects retrofitting of the remaining delivered buses to be completed by Q3 2025. To date, retrofits have taken two-to-three days per bus.

To mitigate the impact of bus delivery delays, the TTC has postponed the decommissioning of aging vehicles, some of which are now 16-to-17 years old, and is shifting toward a "fix-on-fail" maintenance approach for these buses. Contingency plans are also being developed to ensure service continuity as the fleet transition progresses.

[9] Based on lessons learned from the hybrid buses procurement program, the TTC had previously added two and three months of additional contingency to the vendors' forecasts for eBus deliveries and commissioning, respectively. The TTC has revised this approach to now add three months of additional contingency for deliveries and four months of additional contingency for commissioning.

In addition, the contracts include a liquidated damages provision for buses delivered beyond the vendors' contractual schedules. The TTC has also requested and was approved for a time extension from the Federal government for the use of federal funding.

B. Second Generation eBus Performance to Date

The second generation of eBuses has performed well to date, with over four months of service and more than 288,000 km accumulated. This new fleet is achieving an operational Mean Distance Between Failure of more than 20,000 km during these first four months. When launching new buses, it is common to initially see higher failure rates due to manufacturing defects, design issues, or early component failures. After these early issues are resolved, failure rates decrease, and performance stabilizes approximately one year after in-service operations begin. Figure 3 shows that this "bathtub curve" pattern of number of defects per kilometre was observed when the TTC launched its hybrid bus fleet. The first three months of service from the second-generation eBus fleet are tracking similarly to date.

Figure 2 - *Second Generation eBus Reliability To Date versus Hybrid Bus Reliability (Number of Defects per Kilometre)*

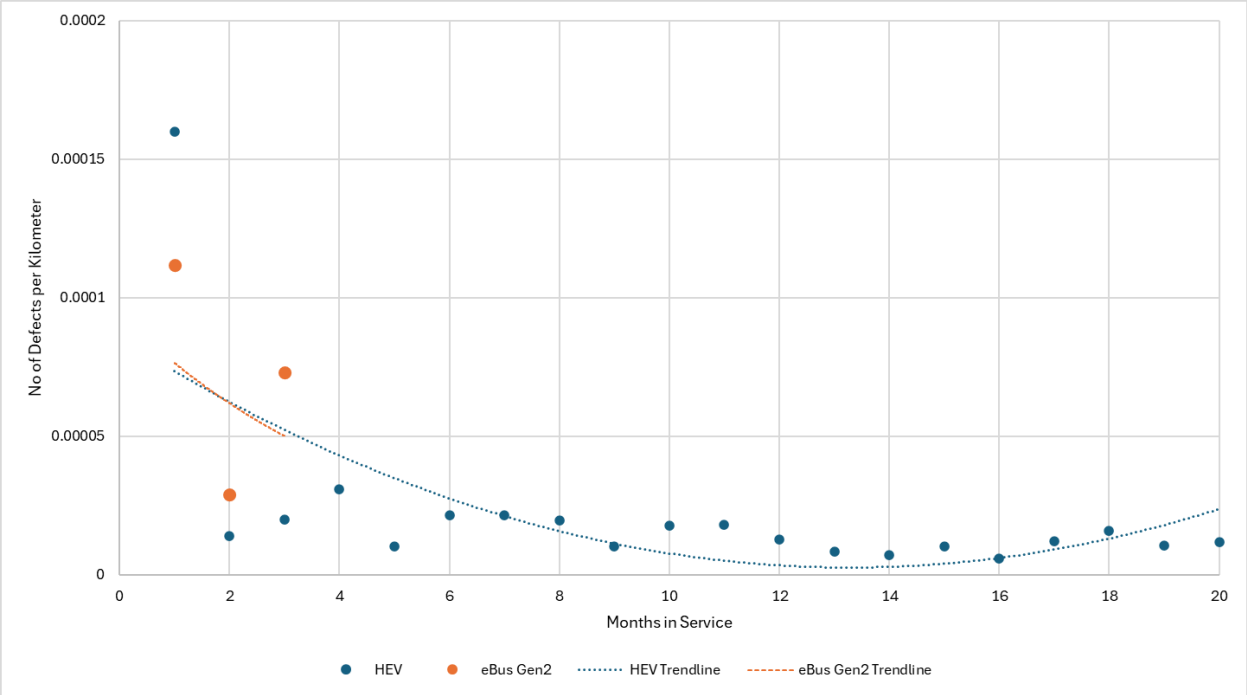
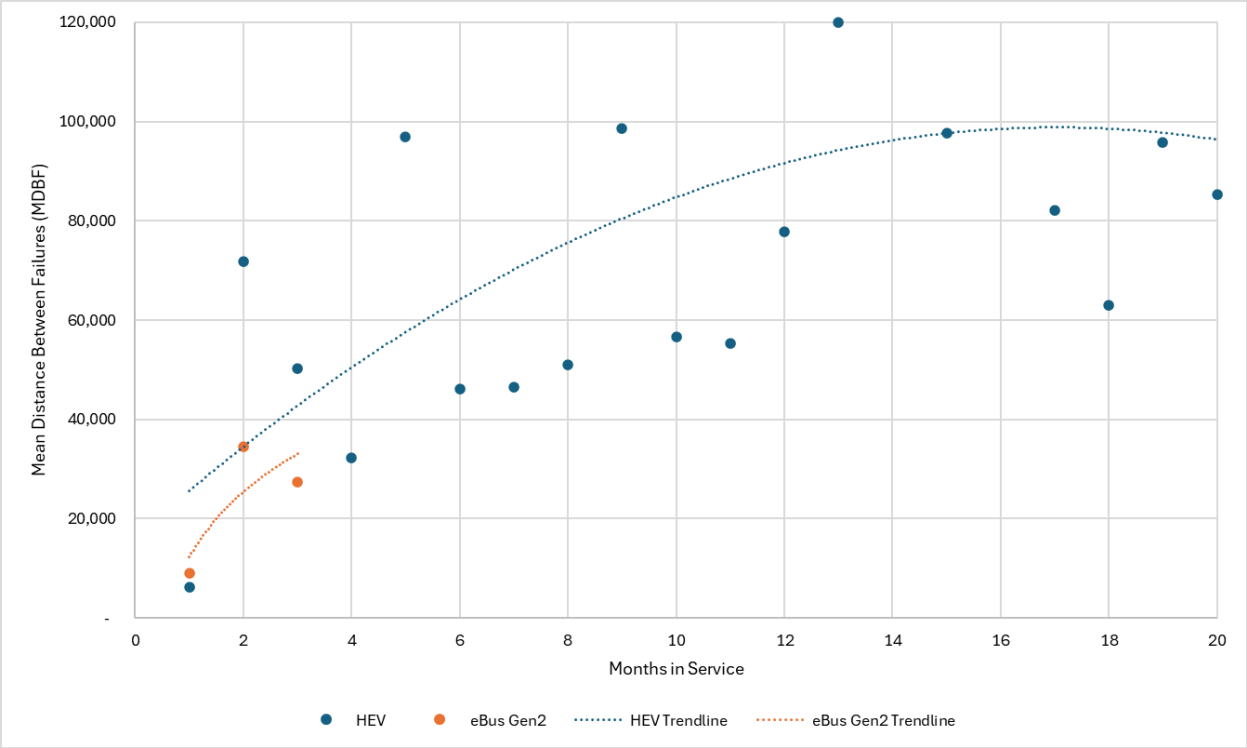


Figure 4 again compares the reliability of the second-generation eBus fleet to date with the pattern observed upon the introduction of the hybrid bus fleet, using Mean Distance Between Failures as the reliability measure. It shows that Mean Distance Between Failure is increasing for the second generation eBus fleet.

Figure 3 *- Second Generation eBus Reliability To Date versus Hybrid Bus Reliability (Mean Distance Between Failures)*



Appendix F: Charging Systems Program Update

A. Program Overview

In 2022, the TTC partnered with PowerON Energy Solutions (PowerON), a subsidiary of Ontario Power Generation, for the design, procurement, installation, commissioning, and maintenance of charging infrastructure such as chargers, battery energy storage systems, and backup generators.

Following the successful completion of the pilot and proof of concept of pantograph chargers, the TTC has progressed with the installation of in-depot charging infrastructure using a phased approach, as outlined in Table 3 below. All eBuses and charging infrastructure with the exception of the pilot BYD buses are specified to the common charging standards for North America, meaning all charge points can be used with the different makes and generations of eBuses.

Table 3: Summary of Charging Systems Implementation Phases

Phase	Scope	Objective	Timing
Pilot/Proof of Concept	60 charge points at three garages and 10 pantograph chargers at Birchmount Garage	Support the pilot and confirm the technical and operational feasibility of pantograph chargers using a centralized power system.	2018 to 2023
Phase 1	Commission 124 charge points at six garages	Installation of charge points to acclimatize the garages to eBus operations, without exceeding the existing power capacity of the sites, where possible.	2022 to 2025
Phase 2a	Commission 124 charge points at two garages	Charging capacity for 50% of the fleet, leaving room to take advantage of technological advancements. This phase requires upgrades to electrical capacity and backup power for emergency use.	2023 to 2026
Phase 2b	Up to 50% electrification at each garage		2026 to 2030
Phase 3	100% electrification at each garage	Charging capacity for 100% of the fleet. This phase will require additional upgrades to electrical capacity and backup power for emergency use.	2028 to 2040

B. Charge Point Commissioning and Schedule Update

Currently, Phase 1 and Phase 2a projects are funded under the Federal Zero-Emission Transit Fund. As of April 1, 2025, 41 of the 248 charge points under Phase 1 and Phase 2a have been commissioned and are in service.

To ensure system resiliency, the commissioning requirements for charge points being installed in Phase 1 and beyond are significantly more rigorous than those used for the pilot phase. Commissioning the first Phase 1 charge points at Eglinton and Birchmount under this new process took longer than anticipated. The TTC has incorporated lessons learned from this experience into the commissioning process for other charge points. Additionally, based on this experience, the TTC has added additional risk-based schedule contingencies into the schedules for other Charging Systems projects.

Table 4 below provides an overview of the Phase 1 and 2a projects, along with the revised end dates:

Table 4: Phase 1 and 2a Charging Projects

Garage (Projects)	# of Charge Points	Current Phase	Previous End Date (as of Nov. 2024)	Revised End Date
Phase 1				
Arrow Road*	10	In-Service	February 2024	February 2024
Eglinton	21	In-Service	November 2024	March 2025
Birchmount	10	In-Service	November 2024	March 2025
Wilson	26	Construction	May 2025	September 2025
Malvern	30	Construction	June 2025	September 2025
McNicoll	27	Construction	July 2025	September 2025
Phase 2a				
Eglinton	56	Construction	July 2025	April 2026
Mount Dennis	68	Construction	October 2025	April 2026
Total	**248**			

* The installation at the Arrow Road Garage is an extension of the pilot program. Most of the critical charging infrastructure (e.g. generators, transformers, battery energy storage systems) required for a Phase 1 project was already installed through the pilot. Therefore, the TTC was able to install 10 additional charge points in a shorter timeframe than other Phase 1 projects.

Based on the revised end dates, there is a risk that during time-limited periods in 2025 and 2026, the charging capacity at McNicoll, Eglinton, and Mount Dennis garages may be insufficient to accommodate the number of eBuses delivered. See “2.4 Updated Integrated Delivery Schedule” for more information on the updated eBus and Charging Systems integrated schedule and deficit mitigation strategies.

Appendix G: Updated Integrated Delivery Schedule

The TTC maintains a multi-year, integrated delivery schedule for eBus deliveries and charging system installations, allowing for concurrent monitoring of their progress. This schedule includes the projected availability of charge points for delivered eBuses, facilitating more effective planning and management. The TTC continuously refines this schedule based on lessons learned from completed work, new information from vendors, and industry-wide developments.

As previously mentioned, the delivery of eBuses has been delayed due to industry-wide supply chain disruptions and battery performance issues. Additionally, the installation of charging systems has experienced setbacks owing to longer-than-expected commissioning times. As highlighted in Section 2.1, the timelines for funding prevented the TTC from establishing a procurement schedule that would meet the six-month minimum lead time required for operationalizing chargers before the delivery of eBuses, which is essential for ensuring operational readiness.

As demonstrated by Figures 5 and 6, the TTC's revised Integrated Delivery Schedule projects charging capacity deficits at three garages during late 2025 and early 2026. These deficits indicate the number of eBuses delivered that the TTC will be unable to charge and put in service due to inadequate charging infrastructure. Consequently, the TTC will not be able to deploy these eBuses into service and will need to store them until the charging capacity issue is resolved. This delay in service deployment will require the TTC to postpone the decommissioning of diesel buses to ensure service levels are maintained.

Figure 4 *- Integrated Schedule: eBuses and Charging Capacity (June 12, 2025)*

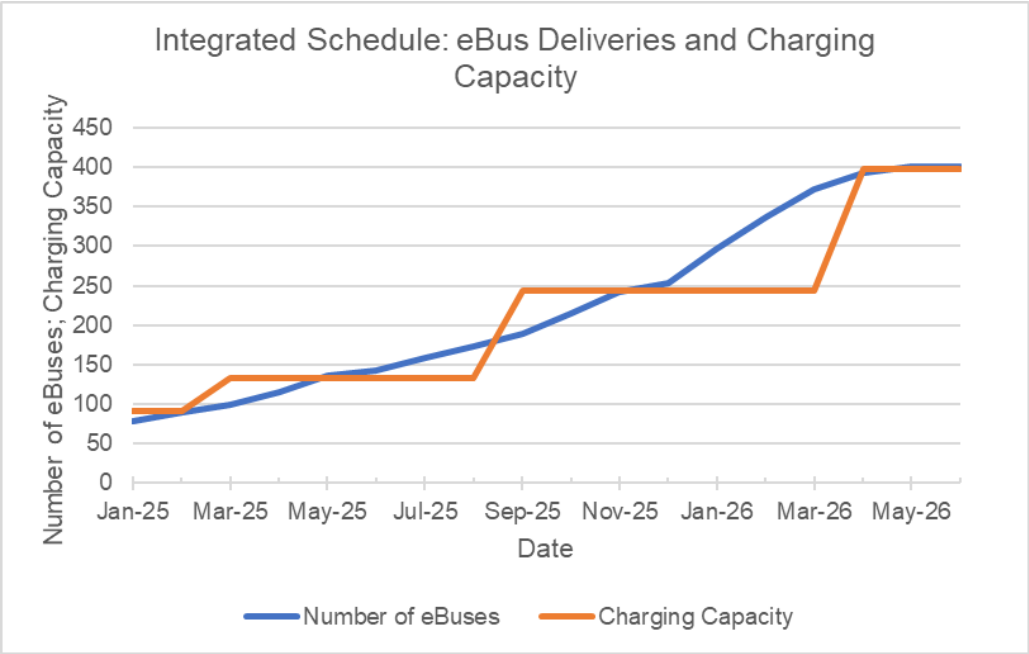
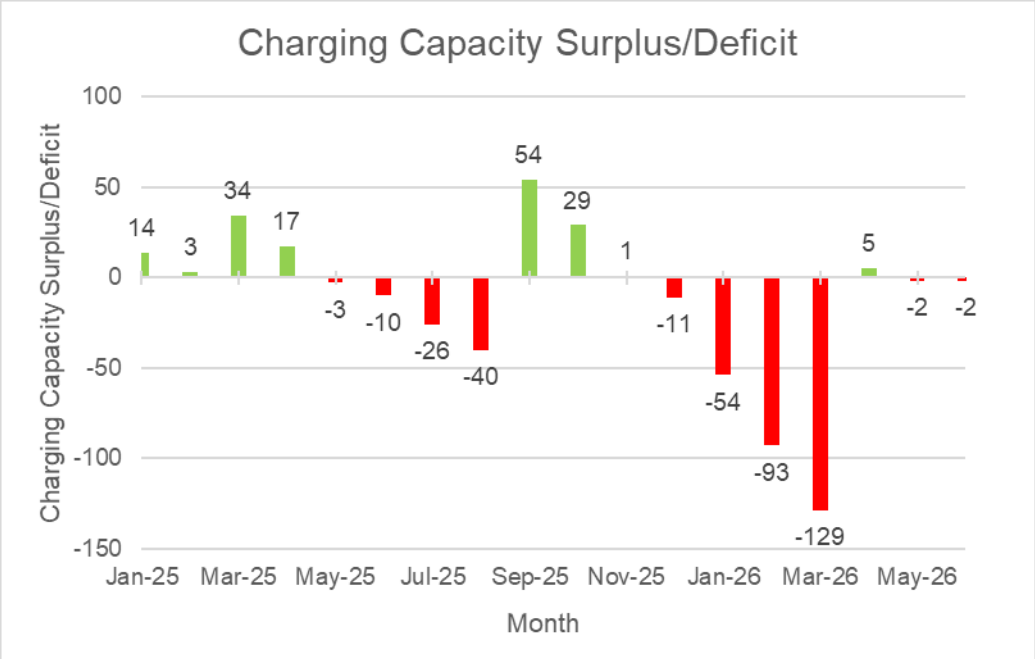


Figure 5 *- Total Charging Capacity Surplus/Deficit (June 12, 2025)*



To address the deficit mentioned above, the TTC is actively exploring opportunities to expedite the installation schedule for charging systems. Mitigation plans have been developed to minimize the impact of charging capacity deficits at the McNicoll, Eglinton, and Mount Dennis garages. Table 5 below outlines the anticipated deficit periods and the corresponding mitigation plans for storage and service at each garage.

Table 5: Anticipated Charging Capacity Deficits

Garage	Anticipated Charging Capacity Deficit	Impact Mitigation Strategies
McNicoll	April - June 2025: 6 July 2025: 11 August 2025: 24	Storing Surplus Buses • Store up to five eBuses that cannot be charged at the affected garage. • Store additional eBuses that cannot be charged across garages, up to five per garage (with the exception of Queensway for plated buses, and, Queensway, Malvern and McNicoll for unplated buses) Maintaining Service Levels • Temporarily delay bus decommissioning to maintain service levels at the garage (included in the 2026 Bus Fleet Plan as part of this report)
Eglinton	January 2026: 26 February 2026: 50 March 2026: 74	Storing Surplus Buses • Store up to five eBuses that cannot be charged at the affected garage. • Store additional eBuses that cannot be charged across garages, up to five per garage (with the exception of Queensway for plated buses, and, Queensway, Malvern and McNicoll for unplated buses) • Consider storing eBuses off-site (e.g. TTC facilities, manufacturer facilities) or delaying delivery. Maintaining Service Levels • Temporarily delay decommissioning to maintain service levels at garages (included in the 2026 Bus Fleet Plan as part of this report)
Mount Dennis	December 2025: 8 January 2026: 26 February 2026: 41 March 2026: 53	

Appendix H: Operational Impacts of eBus Transition

Through the eBus Pilot Phase and the initial operation of the second-generation eBuses, the TTC has gained insight into how the transition to eBuses impacts operations and how these impacts and associated risks can be mitigated.

A. Program Risks and Mitigation Measures

The following organization-level strategies support further risk mitigation to operational impacts:

Business Transformation

While the TTC's initial eBus pilot project primarily focused on assessing the technological feasibility of eBuses, it was implemented with minimal disruption to the TTC's existing organizational structure. Once the pilot successfully demonstrated the viability of eBus technology, the TTC recognized the need for a more co-ordinated and strategic approach to scale up the transition. In response, the TTC established the Innovation and Sustainability Group in 2021. This group was tasked with leading the procurement of eBuses and the development of charging infrastructure, while also serving as a central hub for collaboration across departments to support operational integration.

To further strengthen its capacity for large-scale transformation, the TTC entered into a strategic partnership with PowerON Energy Solutions, a subsidiary of Ontario Power Generation. This partnership focuses on planning, delivering, and managing the electrification infrastructure required to support a fully electric bus fleet.

In October 2024, the TTC launched the eBus Business Transformation Program, a dedicated oversight function designed to manage the complex, cross-functional changes necessary for a successful transition to electric buses. This program introduced a formal governance structure, including both executive-level and working-level committees, composed of representatives from all departments involved in the transition. These committees are responsible for ensuring alignment across the organization and driving progress in several key areas:

- Internal Communication: Facilitating clear and consistent messaging across all levels of the organization to support the adoption of change.
- Workforce Training and Development: Preparing employees for new roles, technologies, and procedures associated with electric bus operations and maintenance.
- Risk Management: Identifying, assessing, and mitigating risks related to the Integrated Delivery Program Schedule, infrastructure deployment, service reliability, and operational readiness.
- Operational Readiness: Ensuring each bus division is equipped and prepared to support electric bus operations, including facility upgrades and staff readiness.
- Service Planning and Reliability: Adapting route planning and scheduling to account for the unique performance characteristics and charging requirements of electric buses.

Phased Technology Adoption and Continuous Learning

A gradual approach to adopting new technologies enables the TTC to accumulate operational insights through experiential learning, proactively implement mitigation measures, and capitalize on ongoing technological advancements – all while minimizing the risk of service disruptions due to unforeseen challenges.

Although risk mitigation measures are largely in place or being planned, the transition remains an iterative process that requires time to implement and refine fully. As with any large-scale transformation, the TTC is navigating a period of adjustment and operational "growing pains" as new systems, technologies, and practices are introduced. Key examples of these challenges include:

- Charging Operations: The time required to charge eBuses currently varies significantly due to differences in charging technology, power limitation at existing garages, personnel practices, and operational usage patterns. This variability necessitates ongoing adjustments to scheduling and depot operations.
- Workforce Ramp-Up and Training: Scaling up the workforce and equipping personnel with the necessary skills to operate and maintain eBuses is a time-intensive process. Comprehensive training programs are being developed and deployed to ensure readiness across all divisions.
- Planning and Scheduling Systems: The TTC is in the process of modernizing its service planning and scheduling systems and processes to support better decision making and service delivery, including electric bus operations. However, integration with existing workflows and legacy systems requires careful planning, configuration, and staff training.

To support this transition, the TTC continues to conduct scenario planning exercises to evaluate various fleet compositions across its garages. These exercises inform schedule optimization and operational readiness, ensuring the TTC is prepared for any potential challenges. Looking ahead to 2040 and beyond, the TTC anticipates that continued technological innovation will further enhance operational capabilities, including:

- Extended vehicle range and battery performance.
- Improved charging infrastructure, including on-route charging trials.
- Advanced energy and yard management systems.
- Increased automation and operational efficiency.

This deliberate, adaptive strategy helps to ensure that the TTC remains well-positioned to integrate emerging technologies while maintaining operational resiliency.

Continuous Improvement and Industry Review

The transition to eBus is an ongoing, adaptive process. Continuous improvement enables our organization to refine operations, respond to emerging challenges, and align with evolving industry standards. This iterative journey is supported by regular performance reviews, scenario testing, and engagement with technological advancements. Key areas of focus include:

- Battery Technology Monitoring: Ongoing evaluation of battery performance and innovation informs procurement and operational planning.
- On-Route Charging Trials: Future planning for targeted testing of on-route charging, particularly for 18.3-metre (60-foot) buses, to address infrastructure and range limitations and support service flexibility.
- Scalable Automation: As the fleet grows, the TTC is exploring automation in yard management and charging co-ordination to enhance efficiency.

B. Additional Operational Impacts and Considerations

1. eBus Range Limitations

The 340-second-generation eBuses currently being delivered are anticipated to have a dispatch range of 241 kilometres, approximately half the operating range of the existing diesel and hybrid fleet (531 kilometres). In their current operating state, eBuses cannot be considered a 1-for-1 replacement of the hybrid and diesel fleet.

The TTC is undertaking scenario planning exercises to understand the scale, processes, and potential resource requirements for actual eBus implementation. These exercises help identify the required schedule adjustments, vehicle requirements, and additional Operator hours necessary to accommodate the eBus range.

As of the May 2025 Service Board Period, there continues to be a number of incompatible eBus service runs at most bus divisions. On average across all bus divisions, 34% of runs are incompatible for eBus operations on weekdays, while weekend service is between 58% to 61% incompatible. However, currently, the eBus makes up a small percentage of the fleet at any of our garages compared to the percentage of incompatible routes, which does not pose an immediate issue to operations due to service incompatibility. As our fleet continues to be electrified and the percentage of eBuses increases at each garage, planning activities, including reblocking and other operational readiness exercises, are currently underway to ensure services can be supported by the current eBus range and charging capabilities.

Additional varying factors must be accounted for in the future eBus-compatible schedules, including:

- Service range variability: The TTC’s first generation of 60 Pilot eBuses has a dispatch range of 180 kilometres, while the new, second-generation eBuses currently offer a range of 241 kilometres. As battery technology advances, each eBus procurement is anticipated to deliver improved service range. Over time, battery degradation is expected to result in an eBus fleet with varying service ranges across vehicles.

- Seasonal impacts: Electric heating is a major energy draw, and eBus batteries are sensitive to temperature fluctuations. In winter, especially when snow and ice are present, battery efficiency and capacity decline, resulting in a reduced available range. While eBuses are still equipped with diesel-fired Webasto heaters to support cabin heating, overall range is still impacted by HVAC demands. To mitigate these effects, the TTC continues to monitor and explore

strategies such as route planning adjustments, on-route charging, and continuous performance monitoring to maintain service reliability during colder months.

Table 6: *eBus Service Scenario Planning Results*

eBus Service Scenario	Additional Estimated Annual Service Hours	Estimated Additional Vehicles	Estimated Additional Crews	Estimated Annual Service Cost
50% at Eglinton	150 (~0.77% increase)	+4 peak vehicles (in service)	0	$0.86M (~0.77% increase)

Work is currently progressing at Malvern Division to gain a deeper understanding of what a 50% eBus scenario would entail for a larger bus division, with the results informing possible projected costs, resource requirements, and potential further scenarios to be developed.

In the short-term transition period, the existing hybrid and diesel fleet can help mitigate and supplement the eBus fleet on longer, eBus-incompatible service blocks.

2. eBus Energy and Charging Limitations

Charging the eBus fleet is currently planned for depot facilities, with on-route charging still under investigation and at least five years from realization. As bus service is dispatched throughout the day, continuous charging is required at each bus garage. For Phase 1 of the Charging Systems Program, which will be installed at seven of eight conventional bus garages, there are facility power load constraints which result in a reduction of the maximum power availability (‘derating’) of the charging systems. This results in significant charging time variability for each vehicle (ranging from three hours up to seven hours), dependent on several changing factors, including:

- Remaining state-of-charge when an eBus returns to the garage.
- Number of eBuses connected to charge points.
- Time-of-day charging occurs.

Energy limitations are further compounded by a charge-point-to-eBus ratio limitation, necessitating shared charge points between eBuses:

- Phase 1: four eBuses to three charge points
- Phase 2: five eBuses to four charge points

The TTC will continue to evaluate the charge-point-to-eBus ratio and mitigate these challenges. Currently, manual modelling is required to optimize charging performance,

which has proven to be time-consuming and insufficient for capturing dispatch requirements. Concurrently, the TTC is actively pursuing advanced technology solutions to modernize its current scheduling processes. Future phases of the Charging Systems Program will integrate load management and smart charging technologies to enhance operational efficiency. Looking ahead, the TTC continues to evaluate on-route charging as a strategic initiative to reduce reliance on depot-based infrastructure. Additionally, increasing the eBus replacement ratio to 1:1.05 from 1:1, as a contingency measure, can potentially provide some operational flexibility in an effort to mitigate program risks, including vehicle and infrastructure limitations, and supporting service reliability throughout the transition.

3. eBus Dispatch Constraints

The current dispatch process for the TTC's existing diesel and hybrid fleet consists of a simple first-in-first-out (FIFO) operation: vehicles return from service, are stacked in order of arrival, and enter the service line. The total service line procedure, which includes fueling, cleaning, and minor inspection, takes approximately 15 minutes until buses are parked in their assigned tracks. Dispatching of service operates under the same FIFO process, where the first block of service is assigned to vehicles parked in sequential order.

In order to mitigate the downstream impacts due to charging limitations described above, eBuses must be dispatched to eBus-compatible service blocks and assigned to chargers to maximize charging capacity. However, this introduces a major change in dispatch operations at each garage, as eBuses must be:

- Serviced and plugged into a charge point with minimal delay.
- Parked on designated charging tracks.
- Parked on designated staging tracks before swapping to a charging track (since there are more vehicles than chargers).
- Sufficiently charged before being dispatched on their compatible service block.

With a larger fleet of buses, this dispatch process, along with charging limitations, will become increasingly complex for the maintenance staff to manage. Without a simple and effective charging process, service delivery risks include vehicle unavailability, inability to meet service requirements, and increased vehicle recovery (towing) charges.

4. Maintenance Workforce Impacts

Although eBus technology may reduce maintenance costs due to the lack of a diesel engine, there is an increasing need to expand the Bus Maintenance workforce to support 24-hour charging and fleet processing. Additional eBus fleet processing activities include manual monitoring of charging status and physically relocating vehicles to chargers. Future technology advancements may improve range and charging capabilities, along with Energy Management System and yard management software, which will iteratively enhance operational effectiveness.

An analysis of eBus service scheduling and its associated impacts on the Bus Transportation workforce is still underway and will be confirmed. Once this information becomes available, stakeholder discussions will be arranged.

5. Ability to Support Closures, Diversions and Emergency Response

While the TTC's eBus fleet supports long-term sustainability goals, current operational constraints limit its effectiveness in certain unplanned scenarios. Specifically, eBuses face challenges in responding to emergency subway closures, route diversions, and other unexpected events due to:

- Charging Requirements: Unlike diesel or hybrid buses, eBuses cannot be quickly refuelled. Their recharging process requires downtime that limits immediate redeployment.

- Range Limitations: Their current battery range restricts flexibility, especially on extended or detoured routes without on-route charging infrastructure.

These limitations are manageable in scheduled service planning but reduce operational agility during emergencies. As a result, diesel and hybrid buses remain essential for ensuring service continuity in high-demand, unpredictable situations.

The TTC continues to monitor advancements in battery technology and charging infrastructure, which will be critical to expanding the role of eBuses in emergency response over time.

Appendix I: eBus Transformation Program Details

The eBus Transformation Program is a cross-functional initiative established to lead and co-ordinate the TTC's transition to a fully electric bus fleet. It serves as the central governance and integration mechanism, ensuring that the electrification of the TTC's bus network is executed in a structured, efficient, and sustainable manner.

Program Governance

- Executive Steering committee comprising the Chiefs and the Executive Director (meeting quarterly).
- Steering Committee comprising Heads (meeting monthly).
- Working group comprising of single-points-of-contact from each key delivery department (meeting weekly).

Areas of Focus

Program Governance and Oversight

- Establishes and manages executive- and working-level governance structures to oversee the planning and implementation of the eBus transition.
- Ensures alignment across departments and facilitates co-ordinated decision-making.

Organizational Change Management and Communication Strategy

- Leads the TTC's internal transformation to support electrification, including workforce engagement, training, and change readiness.
- Collaborating with Corporate Communication teams to develop and implement internal communication strategies that promote staff awareness and adoption.

Program-level Workforce Training Plan

Comprehensive workforce training to ensure the successful integration and operation of eBuses. This training encompasses several key areas:

1) Training Programs
    - Operators: Training programs for drivers include handling eBuses, understanding their unique operational characteristics, and troubleshooting common issues. Additionally, drivers receive training in emergency preparedness, including protocols for addressing battery-related incidents such as fires and breakdowns.
    - Maintenance Staff: Maintenance personnel receive specialized training in the maintenance and repair of eBuses, including high-voltage safety procedures, battery management, and diagnostics for electric propulsion systems.
2) Documentation and Policy Development:
    - Adequate Documentation: Comprehensive documentation is developed to support training programs, including manuals, guidelines, and troubleshooting procedures tailored to eBus technology.
    - Policies and Procedures: Robust policies and procedures are developed to ensure consistency and safety in the operation and maintenance of eBuses.

These policies cover all aspects of eBus handling, from routine maintenance to emergency response.

3) Emergency Preparedness:
    - Safety Protocols: Detailed safety protocols are established to address battery-related incidents. These protocols include steps for handling fires, breakdowns, and other emergencies. Training programs ensure that all staff are familiar with these protocols and can respond effectively in emergency situations.

Program-Level Risks and Issues Management
Program risks and issues register is maintained to provide a program-level view for critical risks and issues that affect multiple parts or parties within the transformation, supporting timely communication and collaboration in risk mitigation.

Division-Specific Operational Readiness Plans
A tailored operational readiness plan is developed for each division to support the integration of eBuses. This plan and schedule include eBus purchase and charging systems delivery milestones, service planning activities, communication tasks, and training for drivers and maintenance employees. Additionally, performance metrics and feedback mechanisms will be implemented to ensure continuous improvement and operational efficiency.

Service Reliability and Route Planning
The TTC has established robust data intake processes to adjust schedules for eBus optimization and operations at a divisional level, as part of the TTC's board period planning processes.

By continuously monitoring division-specific operational readiness based on the availability of eBuses and chargers on a board-to-board period basis, the TTC can optimize schedules as more data becomes available, pending resource availability. These scheduling changes will continue to balance customer service, transit service, and Collective Bargaining Agreement considerations, opportunities, and constraints.

Scenario planning exercises are being conducted at varying degrees of fleet mix and garage locations to understand the challenges, opportunities, processes, and potential resource needs associated with eBus schedule optimization initiatives. The data from these scenarios will also inform downstream planning processes, such as charging analysis, garage operations, financial projections, and more.

Additionally, the TTC is working on procuring a planning and scheduling software tool to develop more efficient service plans and schedules. In the eBus context, this solution could help analyze factors, such as route characteristics and charging considerations, supporting enhanced data-driven decision-making for eBus planning and scheduling.

Appendix J: 2026 Bus Fleet Plan

A. Context and Summary

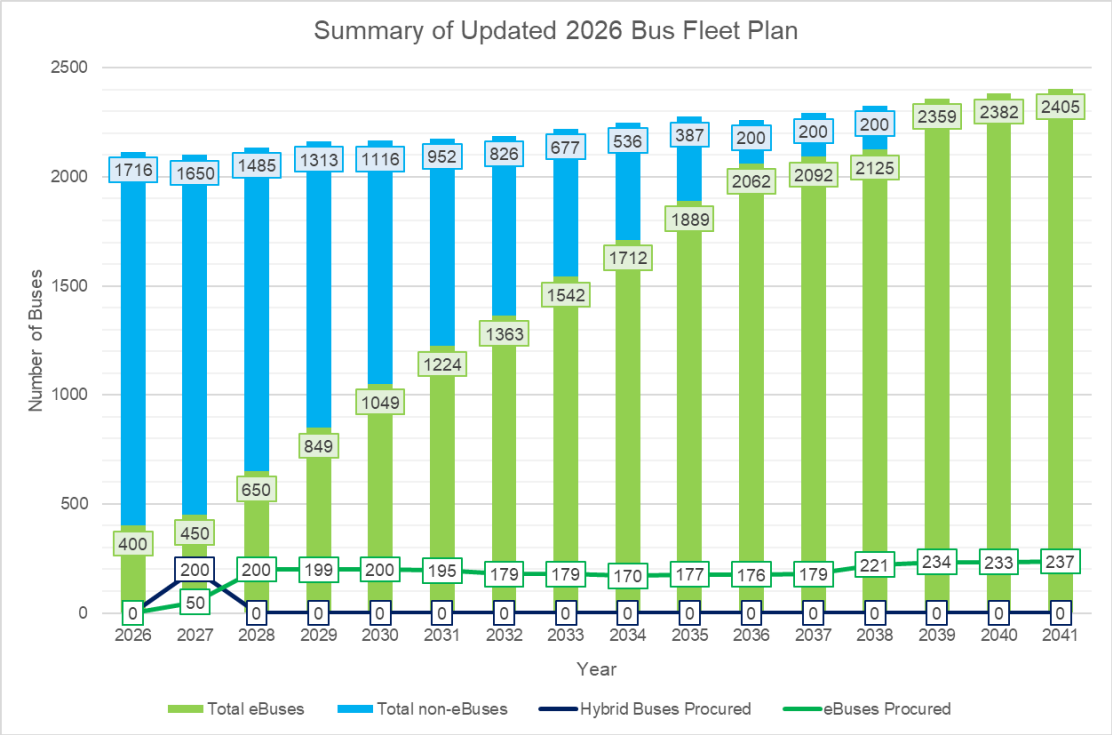
Due to the lack of approved capital funding for eBuses and charging infrastructure, the TTC has been unable to initiate the procurement of new buses and charging points for the 2026 delivery. With the procurement process of eBus and associated charging systems typically requiring approximately two years from initiation to delivery, this delay will result in a shortfall in vehicle availability relative to planned 2026 service levels. To address this, the TTC will need to defer the decommissioning of certain diesel buses, which may impact maintenance costs, emissions targets, and fleet reliability. Additionally, without TTC Board approval of funding and direction to proceed, the TTC risks being unable to procure buses for 2027, which would further affect service continuity and electrification goals.

To accelerate recovery from the vehicle availability shortfall and enable the timely replacement diesel buses, staff are recommending a dual-track procurement strategy that prioritizes eBus acquisition, while incorporating a one-time hybrid bus procurement as a contingency measure.

The resulting 2026 Bus Fleet Plan is summarized as follows:

- 50 eBuses in 2027.
- Up to 200 hybrid buses in 2026 and 2027 (subject to market availability, and with contract language to support the procurement of up to 290 by the end of Q1 2028).
- 100% eBuses from 2028 onwards (with contract language for hybrid buses as a contingency should eBuses prove unreliable).

***Figure 6** - Summary of 2026 Bus Fleet Plan*



** Number of buses as of end-of-year*

B. Continue eBus Procurement

The TTC will continue to prioritize the procurement of eBuses as the core strategy for fleet replacement and decarbonization. Key elements of this approach include:

- Initiating procurement for 2027 deliveries of 50 eBuses, subject to TTC Board approval of the recommendations in this report
- Increasing the eBus replacement ratio to 1:1.05 from 1:1 to account for operational risks, such as:
  - Charging infrastructure constraints.
  - Reblocking and scheduling adjustments.
  - Vehicle reliability and service delivery impacts.
- Investing in supporting infrastructure and systems, including:
  - Charging infrastructure deployment.
  - Energy management systems.
  - Yard management software.
  - Workforce training and operational readiness initiatives.

This approach enables the TTC to scale eBus operations while maintaining service reliability and operational efficiency.

C. Hybrid Bus Procurement (2027) – Contingency Measure

To mitigate the immediate risk of service disruptions due to the missed 2026 procurement cycle, staff recommend a one-time procurement of up to 200 hybrid buses in 2027. This would:

- Enable the timely replacement of end-of-life diesel buses.
- Provide operational flexibility during the eBus transition.
- Allow additional time for infrastructure deployment and business transformation.

Staff will engage manufacturers to confirm market capacity for 2027 deliveries. Current projections suggest that an order of up to 200 hybrid buses is feasible. In addition, the TTC will seek to secure contract options for hybrid buses in 2028 and beyond, to be exercised only if required to maintain safe and reliable service. A decision point is anticipated in Q3 2026.

D. Strategic Alignment

The key benefit of a one-time order of hybrid buses in 2027 is insuring against service disruptions due to aging buses, stemming from the missed procurement year in 2026. The TTC would need to engage manufacturers to confirm that there is market capacity to deliver up to 200 hybrid buses in 2027. As additional insurance, the TTC would also seek to secure contract options for additional hybrid buses in 2028 and beyond, which the TTC would only exercise in the event that additional hybrid buses are required to maintain safe and reliable service.

This approach would also benefit the eBus transition by providing the TTC additional time to install charging infrastructure, continue business transformation, and assess and implement changes required for operational readiness. While the TTC would not be meeting its 2018 target to procure only zero-emission buses starting in 2025 nor its interim target of a 50% zero-emission fleet by 2030, due to the 12-year life of hybrid buses, the TTC would still be able to meet its target of a net-zero fleet by 2040.

E. Garage Capacity Considerations

As the TTC advances its eBus Transformation Program, the temporary increase in fleet size (required to support a greater-than-1:1 replacement ratio during the transition) will place additional pressure on existing garage capacity. It is important to note that the need for a 10th bus garage is not solely a result of the eBus program; rather, it is a long-anticipated requirement driven by broader service growth and operational needs. However, the transition to a fully electric fleet is expected to accelerate this need. Current projections indicate that, without Garage Capacity Enhancements (GCE), the 10th garage could be required as early as 2029. With GCE, the timeline may be extended to around 2043.

Appendix K: Continuous Improvement and Independent Assurance

The TTC's transition to eBuses is guided by a commitment to continuous improvement and industry leadership. Ongoing initiatives include monitoring the evolution of battery technology with our manufacturers and academia, optimization of energy consumption with the National Research Council of Canada, planning of induction charging technology with the Canadian Urban Transit Research and Innovation Consortium, and undergoing the first on-route charging trial planned for 2029. These efforts ensure the TTC remains resilient, responsive, and well-positioned to lead in sustainable transit innovation.

In alignment with the TTC Board's direction to implement independent assurance for major capital projects, the TTC continues to seek independent reviews of the Green Bus Program to identify opportunities for improvement. Deloitte conducted an independent assurance review for the TTC on the eBus charging system and its interdependency with the eBus delivery. The focus of this review was:

- To assess the progress made by the Charging Systems team and the Innovation and Sustainability Group on the recommendations from a 2023 review by Deloitte.
- To identify any gaps, additional corrective actions and necessary mitigations.

The Innovation and Sustainability Group had 37 recommendations to address from the initial review, focused on project management improvement in the areas of schedule, cost, scope, reporting, risks and issues, governance, and interdependencies management. Out of 37 recommendations, 18 are closed/completed, and 19 are in progress.

In summary, Deloitte provided a report to management that outlined:

- Good practices are being followed in the areas of schedule and change management. This includes a preliminary integrated master schedule, the formation of a change management team, improved reporting, and an integrated risk log.
- Deloitte prioritized the remaining 19 recommendations into two priority categories.

- Priority 1 recommendations should be implemented immediately within the next month and include but are not limited to:
  - Maturing the Integrated Master Schedule (IMS), including adding resourcing, pre-construction milestones to the IMS, etc.
  - Updating various logs such as Risk and Issues, Issues and Escalation and Interdependencies log.
  - Updating various plans such as Interdependencies Management, Execution and Staffing Plan.

- Priority 2 recommendations should be implemented within the next one-to-two months and include but are not limited to:

- Reassessing cost impacts on the program once IMS is baselined and include impacts to operating costs based on the forecasted schedule.
- Updating Project Management (PMP) and Benefits Realization Plans to include Change Management, Safety Management Plans and Program benefits.
- Updating KPI framework to include the latest sustainability metrics. Complete implementation of PowerBI to automate project reporting.

The TTC team will continue to integrate lessons learned from this review to mature project management practices across the organization further.

Most recently, the TTC has requested that the American Public Transit Association (APTA) conduct a peer review of its Green Bus Program, expected to begin in September 2025. Next year, the City's Auditor General plans to review the TTC's electric bus program as part of their 2025-2026 audit plan.