The Corporation of the Town of Milton

Report To:	Council
From:	Tony D'Alessandro, Director, Transit Services
Date:	April 15, 2024
Report No:	COMS-003-24
Subject:	Zero-Emission Bus Feasibility Strategy and Fleet Transition Plan
Recommendation:	**THAT the Zero-Emission Bus Feasibility Strategy and Fleet Transition Plan be received.**

EXECUTIVE SUMMARY

- The Zero-Emission Bus Feasibility Strategy and Fleet Transition Plan (referred to herein as "ZEB Feasibility Strategy") assesses the viability of implementing battery-electric technology for transit fleet.

- The strategy was funded in part by a grant from Infrastructure Canada's Zero Emission Transit Fund (ZETF) – Planning Stream. Completion of the strategy is a prerequisite for future funding opportunities through ZETF – Capital Stream.

- Given its transformative potential, staff have identified four (4) strategic objectives that underpin the ZEB Feasibility Strategy:

    1. To support climate responsiveness in alignment with sustainability goals
    2. To foster a state-of-readiness for zero-emission technology
    3. To align adoption with Transit Operations Facility development
    4. To develop a customer-centred plan that preserves service reliability

- The Transit Operations Facility is a catalyst for transit service growth and a prerequisite for the large-scale adoption of battery-electric technology.

- A pragmatic and measured Fleet Transition Plan that integrates the procurement of both diesel and battery-electric buses is recommended in the short term (initial 5 years) for the following reasons:

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- Leverages current assets to maintain service predictability/reliability while gaining experience with battery-electric technology
- Spreads out battery-electric capital investments
- Maximizes the return on investment of the current fleet

- There is evidence of a gradual, market-shift in the production of buses from diesel to battery-electric. As a result, it is important to undertake planning efforts through this study to prepare for the prospect of such a market-transition.

- Subject to the Transit Operations Facility timing and associated funding commitments, the ZEB Feasibility Study forecasts a 100% battery-electric fleet composition by 2040.

- Over the study period to 2040 (cumulative), the adoption of battery electric buses (BEBs) in Milton would reduce GHG emissions by approximately 76,900 tonnes

- The acquisition of a BEB will incur an additional $1.093M capital cost per unit (includes vehicle charging equipment) compared to a diesel equivalent.

- Excluding asset replacement contributions, the cost of operating a BEB will achieve an estimated average savings of $27,000 per unit, per year, attributed to fuel and maintenance savings of BEBs compared to diesel buses. However, increased asset replacement costs of BEBs and charging infrastructure would put future pressure on tax levy-funded contributions to replacement reserves in the amount of approximately $63,796 per unit.

- This report is for information purposes only. Recommendations for next steps will come to Council for discussion as part of the Transit Service Plan and Master Plan Update report, scheduled for Q2/Q3 this year.

REPORT

Background

Bus technology improvements over the last several years have contributed to making transit services more efficient, reliable, responsive and user-friendly. The transition from internal combustion engines (ICEs) to battery-electric buses (BEBs) and/or other propulsion alternatives, will further transform how services are delivered in the future. In anticipation, staff have been keeping abreast of advancements toward zero-emission bus technology through industry working groups and committees, and sharing best practices from projects that are currently underway at other transit systems. The development of a ZEB Feasibility Strategy became an integral next step to further the understanding of technical, environmental and economic implications for adopting zero-emission technologies in the Milton context.

Through the Metrolinx Transit Procurement Initiative (TPI), the Town retained the HDR consulting firm to undertake the ZEB Feasibility Strategy (CORS-073-22). The Town was successful in acquiring a grant from the Infrastructure Canada Zero Emission Transit Fund (ZETF – Planning Stream, funding up to 80% of the cost of the study. The completion of a ZEB Feasibility Strategy is a prerequisite for future funding opportunities through the ZETF – Capital Stream and/or low interest financing through the Canada Infrastructure Bank (CIB) for the acquisition of BEBs and associated charging infrastructure. Staff are also evaluating prospective funding opportunities through the Federal Permanent Public Transit Funding Program.

At present, there are two (2) principal technology options available for ZEB: 1) Battery-electric and 2) Fuel-cell electric (hydrogen). The ZEB Feasibility Strategy focuses on the adoption of BEBs, as there are currently limited options for fuel-cell electric buses and hydrogen sourcing. Additionally, multiple transit systems have either incorporated BEBs into their existing fleet complement, or are presently undertaking BEB demonstration projects. These actions result in further ubiquity of performance data to support feasibility assumptions and analysis.

The purpose of the ZEB Feasibility Strategy is to assess the viability of implementing battery-electric technology for transit fleet, including operational and technical considerations, as well as the development of a fleet transition roadmap. The study's scope of work is summarized on Appendix 1.

Given the transformative potential of zero-emission technology, staff have identified four (4) strategic objectives that underpin the ZEB Feasibility Strategy:

1. To support climate responsiveness in alignment with sustainability goals

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2. To foster a state-of-readiness for zero-emission technology
3. To align adoption with Transit Operations Facility development
4. To develop a customer-centred plan that preserves service reliability

More details about these objectives can be found on Appendix 2.

It is important to note that Transit Division staff are also involved with related projects that are occurring in parallel to the ZEB Feasibility Strategy (Table 1).

Table 1. Concurrent Projects (Work in Progress)

Project	Description
5-Year Transit Service Plan and Master Plan Update	Assesses current family of services and their delivery approach, service standards/triggers, service improvements, growth
Diesel-to-BEB Conversion (Repower) Pilot Project	Mid-life, diesel-to-battery-electric conversion of a 12-metre conventional bus; charger
Review of Diesel Bus Asset Useful Life	Evaluates opportunities to extend asset life of a diesel bus, where practicable

This work will provide further guidance to facilitate the adoption of BEBs (when considered) as part of the management of transit fleet assets as they relate to service growth.

Discussion

The ZEB Feasibility Strategy (with accompanying technical appendices) is included as Appendix 3 to this report. The study uses a comprehensive approach that considers operational requirements, market conditions, utilities, infrastructure demands and associated capital and operating costs for the prospective implementation of BEBs in the Milton context. Table 2 provides a summary of study components and inputs.

Discussion

Table 2. ZEB Feasibility Strategy – Study Components and Inputs

Topic	Description
System-Level Planning	• Environmental scan of BEB technology to understand availability and fueling options that are currently in the marketplace • Energy consumption analysis using Milton Transit scheduling data and other contextual variables (e.g. traffic, vehicle speed limits, topography, distance travelled, duty cycles, etc.) • Energy profile, identifying charging, refueling and facility requirements[1] for various modelling scenarios
Operational Planning and Deployment Strategy	• Fleet and infrastructure implementation plan that supports innovative and effective ZEB deployments and future operations. • Informed by optimal route selection, service design, and procurement needs
Financial Planning	• Preliminary capital and operating cost estimates, including anticipated lifecycle cost comparison encompassing fuel and maintenance costs
Capacity to Implement Technology	• Assessment of Town's current resources, skills and training required for the deployment and operation of BEB fleet • Risk management plan that details mitigation strategies upon assessment of potential technological, operational and system-wide risks
Environmental Benefits	• Lifecycle assessment of environmental benefits associated with BEB transition, including estimates of GHG emissions reduction, noise reduction, and non-GHG pollutant reduction

[1] For modelling purposes, a Transit Garage Facility was assumed to be located at the Civic Operations Centre (5670 Regional Rd 25, Milton, ON) and operational by 2027. Fleet forecast schedules are subject to change.

Discussion

The ZEB Feasibility Strategy uses the HDR's Zero+ Model to develop a BEB energy profile with current Milton Transit service data to confirm technical feasibility, fleet charging strategies and associated infrastructure typologies. This analysis feeds into operational and infrastructure requirements that support phasing considerations for capital programs upon potential BEB adoption, including procurement coordination, timing and servicing.

Underpinned by the strategic objective previously highlighted, a pragmatic and measured Fleet Transition Plan that integrates the procurement of both diesel and battery-electric buses, is recommended in the short term (initial 5 years) for the following reasons:

- Leverages current assets to maintain service predictability/reliability while gaining experience with battery-electric technology
- Spreads out battery-electric capital investments over a longer timeframe
- Maximizes the return on investment in the current fleet

GHG Emissions Analysis

The ZEB Feasibility Study quantified GHG impacts based on estimates of diesel fuel and electricity usage by conventional transit buses to 2040. Using rate assumptions from the Canadian National Inventory Report (2023) and GHG^{+PLUS} guidance modules, the adoption of BEBs in the Milton context would reduce GHG emissions by approximately 76,900 tonnes over the study period. This reduction is due to the dramatically lower operating emissions of BEBs relative to diesel buses.

Table 3. Total GHG Emissions (CO_2 in Tonnes), Diesel (baseline) and BEB (transition)

	Total GHG Emissions (2023-2040)
Diesel (baseline, do nothing scenario)	120,466
BEB (transition scenario)	43,505
GHG Emission Reduction	**76,961**

Next Steps

The ZEB Feasibility Strategy assesses the viability of implementing battery-electric technology for transit fleet. This report is for information purposes only. Recommendations for next steps will come to Council for consideration as part of the Transit Service Plan and Master Plan Update report, scheduled for Q2/Q3 this year.

Financial Impact

A cost analysis addressing the adoption of BEB fleet and associated infrastructure was completed in the ZEB Feasibility Strategy. Financial modelling was developed using 2023 dollars and does not factor inflation or any expected reduction in costs associated with demand pricing. Per unit cost assumptions from the financial analysis were used to compare upfront capital costs of a baseline diesel bus to a BEB, provided in Table 4.

Table 4: Capital Cost Comparison of 12 Metre Conventional Diesel Bus and BEB (2023$)

Cost Components	Baseline Scenario Diesel Bus	BEB Transition Scenario Battery-Electric Bus	Variance (Per Bus Unit)
Vehicle			
Bus Acquisition	$915,024	$1,909,686	$994,662
Mid Life Refurbishment	$120,000	$7,000	-$113,000
SubTotal of Vehicle Costs	**$1,035,024**	**$1,916,686**	**$881,662**
Charging Equipment*			
Plug-In Depot Charger Cabinet (150 kW)	$0	$154,097	$154,097
Plug-In Depot Charger Wall-Mounted Dispenser	$0	$25,265	$25,265
Plug-In Depot Charger Overhead Reel Dispenser	$0	$32,158	$32,158
SubTotal of Charging Equipment Costs	**$0**	**$211,520**	$211,520
Total Capital Cost	**$1,035,024**	**$2,128,206**	**$1,093,182**

*Excludes major infrastrucre and utility upgrades

Additionally, Table 5 illustrates the estimated annual operating cost comparison between a diesel bus and a BEB.

Table 5: Annual Operating Cost Comparison of 12 Metre Conventional Diesel Bus and BEB (2023$)

Cost Components	Diesel Bus	Battery-Electric Bus	Variance
Service Delivery			
Operations, Administration, Training*	$326,794	$317,253	-$9,541
Vehicle Maintenance + Fuel (diesel, gas, carbon levy)	$99,843	$49,620	-$50,223
Electricity	$0	$26,502	$26,502
Charging Equipment			
Charger-Related Maintenance	$0	$5,959	$5,959
SubTotal of Service Delivery + Charging Equipment Costs	**$426,637**	**$399,334**	**-$27,303**
Contribution to Reserve - Asset Replacement			
Vehicle (12-year life)	$86,252	$159,724	$73,472
Charging Equipment (12-year life)	$0	$17,627	$17,627
SubTotal of Contribution to Reserve Costs	**$86,252**	**$177,351**	**$91,099**
Total Annual Operating Cost	**$512,889**	**$576,685**	**$63,796**

*Based on average annual operating hours per vehicle, 2021 CUTA Statistics

Financial Impact

The transition plan presented through the ZEB Feasibility Strategy would result in an estimated incremental capital cost of $64.0 million over the period 2023-2050 with an estimated incremental impact on the operating budget of $81.4 million over that same time period.

Although the Transit Service Plan and Master Plan Update will better inform the timing of the spending, this suggests a required average capital investment of $2.4 million per year as well as pressure on the operating budget of $3.0 million per year. As the cost of electrification has not yet been reflected in the Town's fiscal impact studies or budget forecast, this pressure on the operating budget is in addition to the property tax increases that were forecasted as part of the 2024 budget process.

Funding requirements will be further reviewed as part of the recommendations of the Transit Service Plan and Master Plan Update and through the development of the annual budget but can be expected to include a combination of grant funding, development charges, Town source reserves and property taxes.

Respectfully submitted,

Kristene Scott
Commissioner, Community Services

For questions, please contact: Tony D'Alessandro, MCIP, RPP Director, Transit Services Phone: Ext. 2548

Attachments

Appendix 1. Scope of Work Summary
Appendix 2. Strategic Objectives
Appendix 3. Zero-Emission Bus Feasibility Strategy and Fleet Transition Plan – HDR Report

Approved by CAO

Andrew M. Siltala
Chief Administrative Officer

Recognition of Traditional Lands

The Town of Milton resides on the Treaty Lands and Territory of the Mississaugas of the Credit First Nation. We also recognize the traditional territory of the Huron-Wendat and Haudenosaunee people. The Town of Milton shares this land and the responsibility for the water, food and resources. We stand as allies with the First Nations as stewards of these lands.