

City of Mississauga  
**Corporate Report**



<p>Date: February 22, 2022</p> <p>To: Chair and Members of General Committee</p>	<p>Originator's files:</p>
<p>From: Geoff Wright, P.Eng, MBA, Commissioner of Transportation and Works</p>	<p>Meeting date: March 9, 2022</p>

## Subject

**MiWay Electrification Feasibility Study**

## Recommendation

That the report to General Committee entitled "MiWay Electrification Feasibility Study" dated February 22, 2022 from the Commissioner of Transportation and Works be received.

## Executive Summary

- The MiWay Electrification Feasibility Study was initiated to assess current zero-emission bus (ZEB) technology, to determine if greenhouse gas (GHG) emission reduction targets could be attained with the change in fleet technology and to identify a garage phasing strategy that would support the conversion of the existing fleet to ZEB.
- MiWay can meet the 2030 and 2050 GHG emission reduction targets with the conversion of its fleet to battery electric buses (BEBs) assuming the first BEBs are introduced to the fleet in 2028 and 66 BEBs are in the fleet prior to 2030.
- To support these BEBs and the fleet electrification plan that assumes all electric buses by 2042, initial facility improvements will require a new West Credit transit garage site be developed as a fully electric facility with an operational opening in 2028.
- Subsequent development of the Malton satellite garage as a fully electric facility is feasible; however, existing property, spatial and power constraints at the main garage at Central Parkway prohibits electrification of the facility and potentially would require a significant number of on-route chargers to support a fully electric fleet, which is not a feasible option due to costs and real estate requirements.
- MiWay will review the longer term garage phasing strategy after completion of the hydrogen fuel cell pilot project to confirm the technology direction for the Malton and Central Parkway garages.
- As MiWay will have had limited to no exposure to BEBs prior to the opening of a new West Credit site, consideration should also be given for an interim electrification

approach to purchase 30 BEBs (24 plus spares) to be housed at the main garage to obtain asset management, operating and maintenance experience with the BEB. To initiate the electrification process, MiWay is requesting \$700,000 through the existing capital budget review process (December 2021 WIP) within Transportation and Works to undertake three studies to support the modifications to the main garage and the development of the new electric garage at the West Credit site. These studies will determine the costs for the detailed design and construction of the modifications to the main garage and the new electric garage at the West Credit site, and support requests for external funding (e.g., Zero Emission Bus Fund, Canada Infrastructure Bank, etc.) and adjustments to the capital plan.

## Background

In 2019, Council approved the Climate Change Action Plan (CCAP) with the action to reduce the City's overall greenhouse gas (GHG) emissions by 40% in 2030 and by 80% in 2050 below 1990 levels. As MiWay's buses are a major contributor to the City's overall GHG emission levels, the need to make a change to the current fleet composition to reduce the emission contribution and assist in achieving the City's targets was identified. The fleet strategy assumed a transition of the existing fleet of diesel buses into diesel-hybrid buses through the replacement program and subsequently to convert the hybrid fleet to zero-emission buses upon confirmation of technology type. To assist in achieving this goal, MiWay initiated the Electrification Feasibility Study in 2020 to better understand the current zero-emission bus technology, the capability of a zero-emission bus fleet to achieve emission reduction targets and the garage infrastructure requirements and phasing strategy to support this new type of fleet while still maintaining operational functionality.

## Comments

### ***A. With BEBs being introduced into the bus fleet in 2028, MiWay can meet both the 2030 and 2050 Climate Change Action Plan GHG emission reduction targets.***

Understanding the direction of the CCAP, MiWay undertook the initiative to begin replacing existing diesel buses with hybrid buses. Of the current fleet of 507 buses, 41 of those buses (approximately 8% of the entire fleet) are hybrid buses. To further expedite the process, MiWay was successful in applying for and receiving Investing in Canada Infrastructure Program (ICIP) funding for the purchase of replacement hybrid buses. MiWay's plan is to fast-track the fleet replacement program with a target fleet composition of 391 hybrid buses (almost 80% of the entire fleet) and 101 diesel buses by the end of 2027. Preliminary calculations undertaken as part of the ICIP submission noted that conversion of MiWay's diesel fleet to hybrid buses, while providing reduction in overall GHG emissions, would not enable MiWay to achieve the GHG emission reduction targets set for 2030 or 2050. Investments would be required in an alternate technology (i.e., zero emission technology) to further reduce GHG emissions from the bus fleet.

At present there are currently two principle technology options available for a zero-emission bus (ZEB), battery electric and fuel cell electric (hydrogen). For the purposes of the Electrification Feasibility Study, the focus was on the battery electric bus (BEB). Multiple transit agencies have either incorporated BEBs into their existing fleet composition or are currently undertaking a pilot project with BEBs, resulting in the availability of data to review the feasibility of BEBs. To assess the extent to which MiWay's fleet could be electrified and the capability of the electric fleet to achieve the GHG emission reduction targets, a proprietary simulation tool, the Battery Optimization Lifecycle Tool (BOLT), was used for the analysis. Multiple scenarios were modelled to evaluate the sensitivity of achieving emission reduction targets to the start year for the purchase of the first BEB.

Modelled results indicated that MiWay's 2030 and 2050 GHG emission reduction targets can be achieved with the following bus assumptions:

- Hybrid buses to be fast-tracked into MiWay's fleet composition between now and 2027;
- The first BEBs will be introduced into the fleet in 2028 with a fleet composition of 14 BEBs, 384 hybrids and 113 diesel buses;
- All subsequent replacement buses and growth buses from 2028 onward will be BEBs;
- Due to constraints associated with the construction of garage facilities to accommodate BEBs, some of the existing diesel and/or hybrid buses will be replaced with BEBs at its mid-life;
- 2030 emission reduction targets can be met in 2029 with an assumed fleet composition of 66 BEBs, 369 hybrids and 76 diesels;
- 2050 emission targets can be met in 2039 with an assumed fleet composition of 547 BEBs and 93 hybrids; and
- Conversion of the entire fleet to BEBs can be completed by 2042.

***B. BEB technology will need to be monitored prior to the purchase of those first BEBs as technology is continually evolving.***

With any type of technology, there are always a multitude of choices. Battery electric buses are no different. There are multiple manufacturers who design the buses in different configurations and sizes often with proprietary changing technology and different specifications such as battery chemistry and sizes, carrying capacities, charging capabilities, and the list continues. Apart from variations in the buses themselves, the type of charging infrastructure can also range from overhead via a pantograph, plug-in (like the electric cars) or even induction through a power transmitter in the ground, as shown in Appendix 1.

Current limitations to the battery size and external factors such as temperature, weather, terrain, etc., lead to unreliability on the delivery of MiWay's service plan due to inconsistencies in the distance that could be covered by a BEB. Pending improvements to battery capacities, there may be a need to purchase additional buses, which in turn would require additional garage space. For example, it is estimated that for every 10 hybrid buses, 13 BEBs will need to be

purchased to maintain the existing service delivery capabilities. If additional buses are not purchased, MiWay will need to substantially change how the buses are scheduled. This has ripple effects on garage operations and employee schedules, which may have implications on labour productivity.

Close monitoring of this evolving technology will be required to ensure maximum operational benefits.

***C. To support the fleet electrification plan and to achieve the 2030 emission reduction targets, the West Credit site will need to be developed to house a fully electric garage facility.***

With the confirmation that the transition plan to a fully electric bus fleet can meet 2030 and 2050 GHG emission reduction targets, the next step of the study focussed on assessing the existing garage facilities to determine infrastructure required to house BEBs and the garage phasing requirements to ensure that both BEBs and existing fleet, whether diesel or hybrid, could be stored and maintained during the transition process while ensuring that operations are maintained.

MiWay currently has two existing garages. The main garage is located at 975 Central Parkway (CPY) and is referred to as the Edward J Dowling Transit (EJDT) facility. Approximately 80% (406 out of 507) of MiWay's fleet is stored at this location. The remaining 20% (101 out of 507) of the fleet is stored at the Malton Satellite Garage (Malton) located at 6780 Professional Court. The City owns an undeveloped parcel of land at 7300 West Credit Avenue (West Credit) which has been set aside for a third transit garage. Each of these sites were reviewed to identify the capabilities to house BEBs and the garage construction/reconstruction requirements to support a fully electric fleet.

To support the fleet electrification schedule, the following garage phasing strategy was assumed:

- Phase 1 (completion by 2028): Construct West Credit as a new fully electric facility;
- Phase 2 (completion by 2033): Demolish and reconstruct Malton as a fully electric facility; and
- Phase 3 (completion by 2050): Install fast chargers at CPY complemented by on-route chargers, as required or implement an alternative energy technology.

***Challenges that may potentially hinder the development of the West Credit facility will need to be addressed.***

The completion of the West Credit electric garage facility by 2028 will be contingent on three main factors: schedule constraints, facility costs and power availability.

Schedule Constraints:

In order to have a new garage facility ready for opening day, the following project elements will need to be completed including an environmental assessment requirement that adheres to the Transit Project Assessment Process (TPAP), a feasibility study, detailed design and construction. These processes may take 5-7 years for completion of the new facility. Any delays will result in an impact on the delivery of the first BEBs to the facility and meeting emission reduction targets in 2030.

Facility Costs:

As the costs to construct facilities to support BEBs are very high, external funding sources will be required to support these initiatives. Adjustments are being requested from existing Transportation and Works capital budgets through the December 2021 WIP process to accommodate funds for the TPAP and the feasibility design study for West Credit. The feasibility design study will identify the costs for the detailed design and construction of the West Credit site at which time external sources of funding will need to be confirmed (e.g., Zero Emissions Bus Fund, etc.).

Power Availability:

A key requirement to support a fully electric facility is a power source and a backup supply. In consultation with Alectra, it was noted that there is available capacity to bring in the required power source to the West Credit site. Engagement with Alectra during the feasibility planning process will be necessary as available capacity cannot be reserved until a design has been confirmed.

If there is a delay to the completion of the West Credit site, MiWay will need a contingency plan to house 66 BEBs at the two existing garages to ensure that the 2030 emission reduction targets are met. Considerations will include storage of 24 BEBs at the annex building at CPY and the remaining 44 BEBs at Malton. These retrofits projects will also require additional capital funds.

***D. The recommended garage phasing strategy for the longer term will allow MiWay to meet 2050 emission reduction targets; however, due to the ever changing technology landscape, the strategy should be reviewed and confirmed following the completion of MiWay's hydrogen pilot project and further improvements to battery technology.***

To meet the 2050 emission reduction targets, the garage phasing strategy recommended the conversion of the Malton Satellite Garage into a fully electric garage while maintaining the facility building at the main garage (CPY) with the electric buses at this garage supported by a few fast chargers on site and a significant number of on-route chargers within the City. This strategy was recommended in light of existing property and power constraints at the main garage (CPY).

Property Constraints:

In order to accommodate the BEBs at the existing garages (CPY and Malton), space is required to support the electrical charging infrastructure, whether vertically (i.e., pantographs above the buses) or horizontally (i.e., chargers placed beside the buses). The existing roof structure at CPY cannot support the chargers on top of the roof, which would require the electric chargers to be placed adjacent to the buses, this can reduce garage storage capacity by a minimum of 25%. Furthermore, fleet numbers will also potentially increase as current battery limitations would require 13 BEBs to replace 10 hybrid buses. If technology does not improve, there may be a future need to consider development of a fourth garage site to house the full BEB fleet.

To minimize bus storage capacity impacts at CPY, a significant number of on-route charging stations supported by fast chargers at the garage is recommended by the study. As each of these stations will require real estate either within the City's existing road right-of-way or on adjacent private properties and are costly, this is not seen as a viable option.

Power Constraints:

MiWay's two existing garages (Malton and CPY) will need an upgrade to the existing power supply as the current supply will not be able to support the electrical charging infrastructure for the BEBs. Alectra noted that spare capacity is available for the Malton site and the required power can be supplied with a system extension to this location. For the main garage (CPY), it would require significant infrastructure upgrades to Alectra's system as the existing transformers are already operating at capacity; however, Alectra has noted that it will not undertake this upgrade unless there are other large-scale residential/commercial developments to justify this major investment in electrical infrastructure.

MiWay will review the longer term garage phasing strategy after completion of the hydrogen fuel cell pilot project to confirm the technology direction for the Malton and CPY garages.

***E. As the first BEB is not required until 2028 to meet 2030 GHG emission reduction targets, an interim electrification approach is being recommended to allow MiWay to test out the battery reliability and performance of the electric buses and provide asset management exposure prior to the completion of the West Credit facility.***

Prior to 2028, MiWay will have no experience with the BEBs in terms of asset management, operations and maintenance. MiWay is recommending that a small number of BEBs be introduced into MiWay's fleet earlier and prior to 2028 to provide MiWay with the opportunity to evaluate the BEBs.

The configuration of the Annex (CX) building at the main garage allows for the opportunity to convert four of the existing parking bays to house a total of 30 BEBs, which includes spare buses. The building itself would require some modifications to accommodate the electrical charging infrastructure. There will be a requirement for additional power to be brought to the site; however, the demand can be accommodated with minimal costs.

In order to house these BEBs at the CX building, a feasibility design study will need to be completed to identify the costs for the detailed design and construction of these improvements. The entire process from feasibility planning to construction completion is estimated to be 3 years, with procurement of the BEBs occurring simultaneously, allowing for the first BEBs to be on site in 2025. Adjustments are being requested from existing Transportation and Works capital budgets through the December 2021 WIP process to accommodate funds for the feasibility design study.

The interim electrification approach will provide MiWay with the opportunity to assess this evolving technology from an operational and maintenance perspective prior to implementation of the fleet electrification plan that commences in 2028.

## Strategic Plan

The MiWay Electrification Feasibility Study supports the Climate Change Action Plan in its vision for the City to be a low carbon and resilient community through leading in green initiatives by reducing greenhouse gas emissions as noted in the City's Strategic Plan. In particular, this study is looking for ways to achieve the goal from the CCAP to:

- Accelerate the adoption of zero emissions vehicles (light and heavy duty); and
- Decrease greenhouse gas emissions from the City's corporate and transit fleet.

## Financial Impact

The MiWay Electrification Feasibility Study provides direction to convert its existing fleet to zero-emission bus (ZEB) technology. A garage phasing strategy that would support the conversion of the existing fleet to ZEB involves the development of a new West Credit garage site and building modifications at the main garage (CX) building.

Funding will be required for the environmental assessment study and the feasibility studies for the West Credit site and modifications to the main garage (CX) building.

1. PN 19246 Transit Electrification Study project is requesting \$700,000 through the 2021 December existing capital budget review process (WIP) within Transportation and Works to complete the following three studies:
  - Transit Project Assessment Process (TPAP) for the West Credit site;
  - Feasibility design study for the West Credit site; and
  - Feasibility design study for building modifications at the main garage (CX building).
2. Detailed design and construction costs associated with the modifications to the main garage (CX building) are not included in the 2022-2031 capital plan and will need to be confirmed through the feasibility design study.

- Detailed design and construction costs for the West Credit site (Transit Meadowvale Satellite and Design Construction Project) are included as unfunded order of magnitude placeholders in the 2022-2031 capital plan until actual costs are confirmed through the feasibility study, which will further support the request for external funding (e.g., Zero Emission Bus Fund, etc.) and adjustments to the capital plan.

## Conclusion

MiWay can meet the 2030 and 2050 GHG emission reduction targets with the conversion of its fleet to BEBs assuming the first BEBs are in the fleet in 2028, and 66 BEBs are in the fleet prior to 2030.

To support these BEBs and the fleet electrification plan that assumes all electric buses by 2042, initial facility improvements will require that the West Credit site be developed as a fully electric facility with an operational opening in 2028. Subsequently, MiWay will review the longer term garage phasing strategy after completion of the hydrogen fuel cell pilot project to confirm the technology direction for the Malton and Central Parkway garages.

As MiWay will have had limited to no exposure to BEBs prior to the opening of the West Credit site, MiWay will be implementing an interim electrification approach to purchase 30 BEBs to be housed at the main garage (CX building) to obtain operating and maintenance experience with the BEB. To initiate the electrification process, MiWay is requesting \$700,000 through December 2021 WIP to undertake three studies to support the modifications to the main garage and the development of the new electric garage at the West Credit site. The feasibility studies will provide the costs for the detailed design and construction of the modifications to the main garage (CX building) and the West Credit site and support requests for external funding (e.g., Zero Emission Bus Fund, etc.) and adjustments to the capital plan.

## Attachments

Appendix 1: Examples of Battery Electric Bus Charging Options



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