OC Transpo Zero Emission Bus (ZEB) Program

Pilot Performance and Evaluation

Engineering Findings

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Acronyms and Definitions

ABB	Electric Charger Vendor
AVAS	Acoustic Vehicle Alerting System
BEB	Battery Electric Bus
BTAC	Bus Technical Advisory Committee
Code 4	Defects that will cause a bus to be taken out of service
Code 5	Defects that trigger a maintenance action when they return from service
E-Bus	Electric Bus
GHG	Green House Gas
HVAC	Heating, Ventilation and Air Conditioning
kgCO2e	Kilogram of carbon dioxide equivalent
KPI	Key Performance Indicator
kWh	Kilowatthour a unit of energy used by an electrical device during a given period
MDBF	Mean Distance Between Failure
NF	New Flyer
NMC	Nickel Manganese Cobalt, the chemistry of the lithium high voltage battery packs
NOVA LFS	NOVA Low Floor Series diesel bus
NRC	National Research Council
OEM	Original Equipment Manufacturer
OPTA	Ontario Public Transit Association
Orange County Bus Cycle	A chassis dynamometer test for heavy-duty vehicles. It has been developed by the West Virginia University (WVU), based on the driving patterns of urban transit buses in the Los Angeles, California area.
PDI	Pre-Delivery Inspection
SB	Service Bulletin

Siemens	Electric Charger Vendor
SOC	State of Charge
XE40	A battery-electric transit bus from New Flyer's Xcelsior line
ZEB	Zero Emission Bus

1. EXECUTIVE SUMMARY

The Zero Emission Bus (ZEB) Pilot Program has shown that Battery Electric Buses (BEB) can operate in service, as an alterative to diesel buses.

The New Flyer XE40 electric buses, with XALT Lithium NMC batteries with a capacity of 525 kWh, have met or surpassed the range and efficiency data provided by New Flyer. Revenue service routes longer than 10 hours and driving distances over 200 km have been performed on a regular basis.

Diesel savings at the time of this report were over 100,000 Litres for the 4-bus fleet. These diesel savings resulted in a Greenhouse Gas (GHG) reduction of over 280,000 kgCO_2e. If battery technology improves there is an expectation that the auxiliary diesel heater may no longer be required for the winter months and diesel savings and GHG reductions will increase.

The Electric Buses (E-Buses) began arriving in September 2021, and a Pre-Delivery Inspection (PDI) was completed by December 2021 for all buses. Charging infrastructure commissioning was completed in conjunction with the PDI process. Upon completion of PDI, a series of tests began to determine the baseline capabilities of the E-Bus:

- Range Testing;
- Inclement Weather Testing; and,
- Hill Testing.

The E-Buses performed well in testing, and further information is available in the report.

Training, documentation, and infrastructure were all reviewed and updated in preparation for the rollout of the E-Buses. A lane in the South Garage of 1500 St. Laurent Boulevard was outfitted with pantograph and plug-in chargers, and a maintenance bay was renovated to prepare for E-Bus maintenance. At the writing of this report, training has been provided to the following groups:

- 520 bus operators;
- 20 mechanics, 65 garage attendants, and 8 body shop mechanics; and,
- 36 operations and support staff.

Training will continue to ramp up as the electrification of the fleet grows.

In February 2022 the E-Buses began revenue service. Key Performance Indicators (KPI) were gathered including:

- Mean Distance Between Failure (MDBF);
- Availability (E-Buses and Charger Infrastructure);
- Mileage;
- Efficiency; and,
- Diesel Savings and GHG Emission Reductions.

The KPI’s have shown favourable results and will be continuously monitored throughout the life of the E-Buses. A more detailed breakdown of each KPI is available in the report.

2. INTRODUCTION

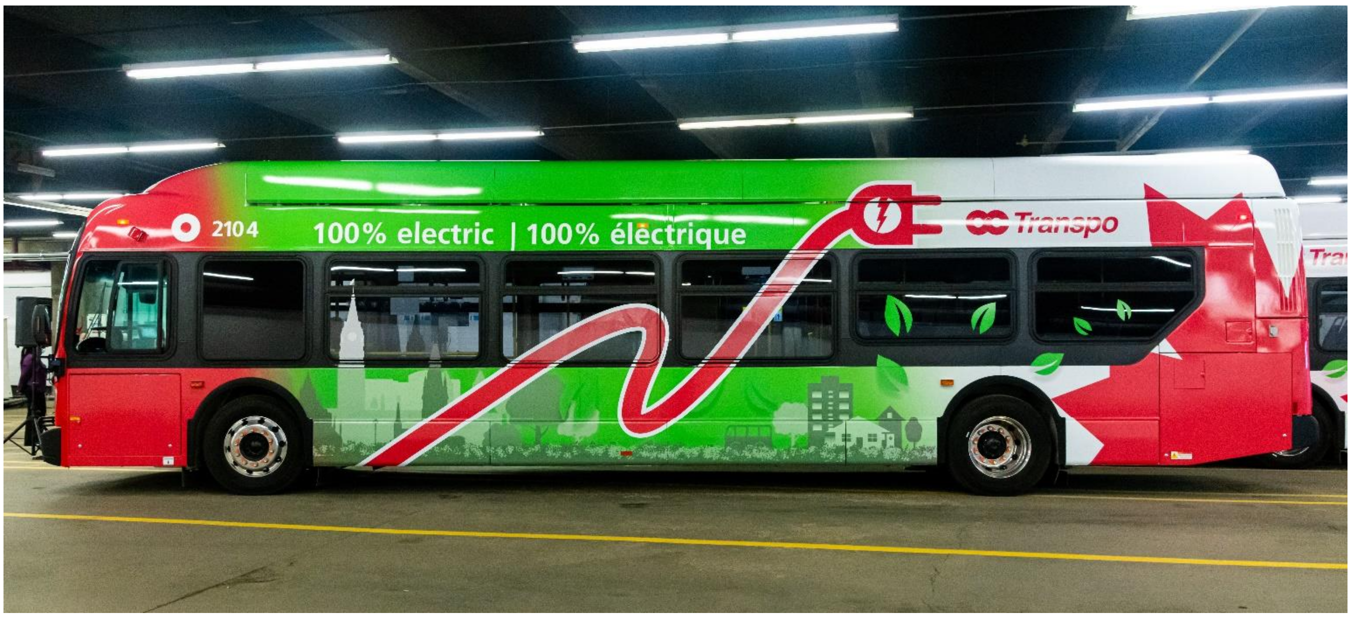
The ZEB Pilot Project was an initiative that began in 2019 as part of the City of Ottawa's plan to be zero emission by 2030. The pilot fleet consists of 4 New Flyer XE40 electric buses, with Generation III fully enclosed battery boxes and a capacity of 525 kWh. The buses began to arrive in Ottawa on September 17, 2021 and were placed in revenue service February 7, 2022.

In preparation for the arrival of the E-Buses, modifications to one of our indoor garage lanes was completed to provide charging infrastructure. This included the installation of plug-in chargers and overhead pantograph chargers to test each technology option. One of our maintenance bays was also modified for the E-Buses to provide roof access for preventative maintenance tasks.

High voltage clothing and tooling was procured and provided to maintenance staff. An ongoing series of New Flyer-led and component Original Equipment Manufacturer (OEM) led training sessions, as well as hands-on training with New Flyer technicians, have provided a groundwork for maintaining this new fleet of electric buses.

A review of all maintenance documentation and procedures at OC Transpo was performed before the E-Buses arrived. This is an ongoing process as we continue to transform our fleet from diesel to electric buses.

As part of the ZEB Pilot Project, a plan to monitor and evaluate KPIs on the electric bus was established under the *SB-1393: Controlled Engineering Testing and an E-Bus Performance Evaluation* document. As part of an audit from the Office of the Auditor General, *Sprint 1 – Technology and Performance*, additional KPI's were identified and added to our testing plan.



3. MDBF

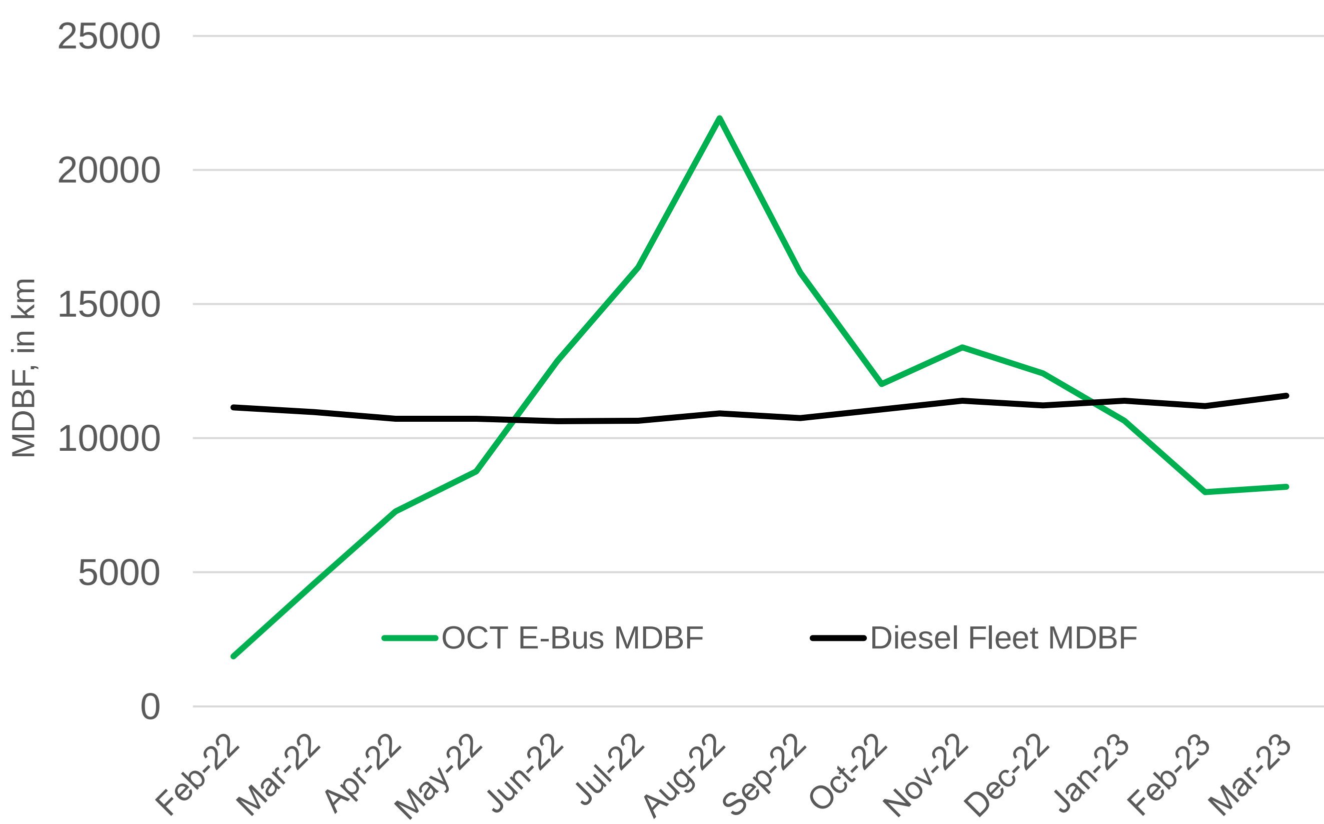
Mean Distance Between Failure, or MDBF, is an industry standard metric used to evaluate the performance of conventional and electric buses. It is a measure of the number of failures which place a bus out of service compared to in-service mileage. This measurement is not calculated the same across the transit industry. The Ontario Public Transit Association (OPTA) has been working to create a standardized calculation that can be used across the industry. Currently at OC Transpo we calculate MDBF using our own criteria, which will be explained below in *Section 3.1: OC Transpo MDBF*.

3.1 OC Transpo MDBF

OC Transpo calculates MDBF as anything that takes a bus out of service (with some exceptions). These incidents are assigned a Code 4 designation and are evaluated by our reliability team to determine if they are added to our MDBF calculation. If a bus is taken out of service and no fault was found, that still counts towards the MDBF of the bus as it disrupted service.

Figure 1 below shows the average MDBF of the 4 E-Buses from the beginning of their in-service date. Included is our total diesel bus fleet MDBF data as a comparison.

Figure 1: OCT E-Bus MDBF Comparison to total Diesel Fleet, in km



The E-Bus MDBF continued to climb as more kilometers were put on the fleet. However, with such a small sample size, any failures will result in a dramatic dip in the MDBF. The dip from

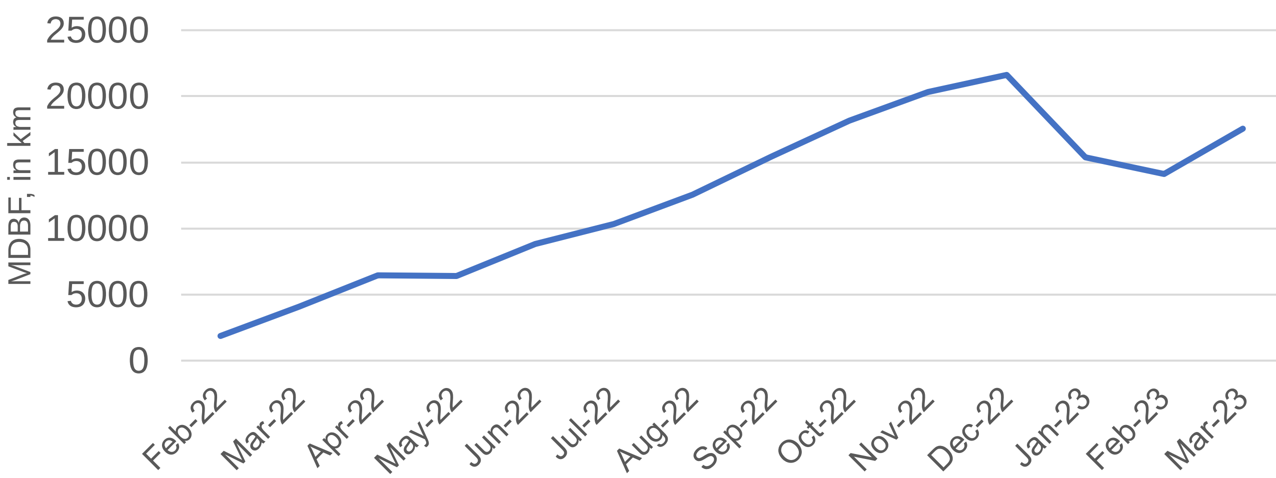
September 2022 is predominantly from “No Fault Found” heating issues, which we are working with our training and maintenance departments and New Flyer to correct.

3.2 OEM & Manufacturer MDBF

To determine the reliability of the E-Bus compared to other transit agencies, OC Transpo has also calculated an MDBF for bus specific failures; where a manufacturer’s component has failed or resulted in a work order, replacement of parts and/or loss of revenue service to troubleshoot the failure mode. These considerations for what will count as a recordable incident have been determined by OPTA and are part of a larger initiative to allow transit agencies to compare the performance of their fleets to other organizations.

Figure 2 shows the OEM MDBF for our E-Buses.

Figure 2: OEM MDBF, in km

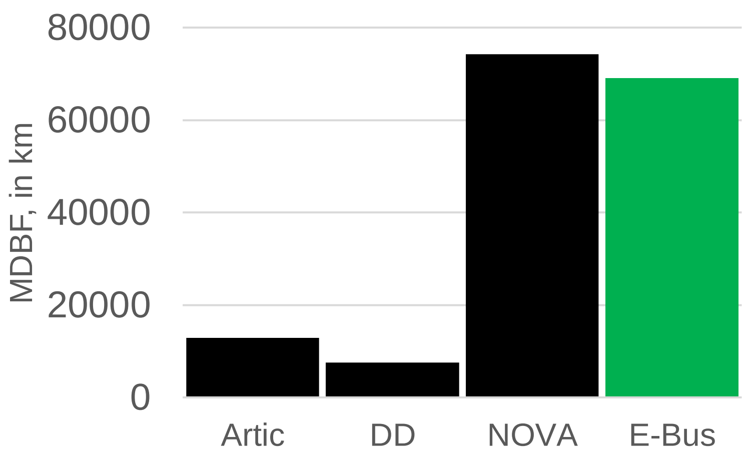


3.3 Propulsion MDBF Comparison

With the transition to a new propulsion technology, a review of all propulsion defects between our conventional diesel bus fleets and the 4 E-Buses was performed.

Figure 3 shows the propulsion specific MDBF of all our fleets. The NOVA Low Floor Series (LFS) Diesel is our newest and most reliable diesel fleet, and the E-Bus has shown to be as reliable.

Figure 3: Propulsion MDBF Comparison, in km



4. CODE 4 & 5 DEFECTS

Code 4/5 Defects are identified during operations or circle checks. These defects will cause a bus to be taken out of service (Code 4) or trigger a maintenance action when they return from service (Code 5). Code 4 failures affect the MDBF of a bus (as shown above in Section 3) and are vetted by our reliability team to determine their validity.

Table 1 identifies all the Code 4 defects on the E-Bus fleet since it went into revenue service.

Table 1: Code 4 Failures

Bus ID	Date	Description
2104	23-Feb-22	Stop System Alarm
2103	07-Mar-22	CS Suspension Sensor Failure
2103	12-Mar-22	CS Suspension Sensor Failure (repeater)
2101	21-Mar-22	Loose Connector causing HV Code
2102	04-May-22	CAN Communication Error (Connectors)
2101	06-May-22	Critical Low Coolant (Connectors)
2103	24-May-22	HV Codes (diagnosed as loose connector)
2102	19-Jun-22	Loose HV Cable
2103	18-Aug-22	HV Interlock Alarm (Connectors)
2102	16-Sep-22	Seat Defect
2104	23-Sep-22	Wheels Rubbing
2101	06-Oct-22	Operator Not Trained
2103	17-Oct-22	No Heat
2102	18-Oct-22	No Heat
2104	09-Nov-22	No Heat
2102	06-Dec-22	Low Diesel Fuel
2101	19-Dec-22	No Heat and Not Charged
2104	12-Jan-23	HV Codes
2103	13-Jan-23	Traction Control Off
2103	23-Jan-23	Brake Wear Indicator
2103	31-Jan-23	Low Fuel and No Heat
2104	03-Feb-23	Air Leak
2102	14-Feb-23	No Heat, “Dog Tracking on Highway”
2102	15-Feb-23	No Heat
2102	16-Feb-23	No Heat
2104	24-Feb-23	No Heat
2102	25-Feb-23	Low Battery SOC
2101	27-Feb-23	HV Lights on Dash
2102	28-Feb-23	Encoder Fault on Dash
2101	03-Mar-23	Loss of Power
2104	04-Mar-23	ABS Alarm

5. AVAILABILITY

5.1 Service Availability

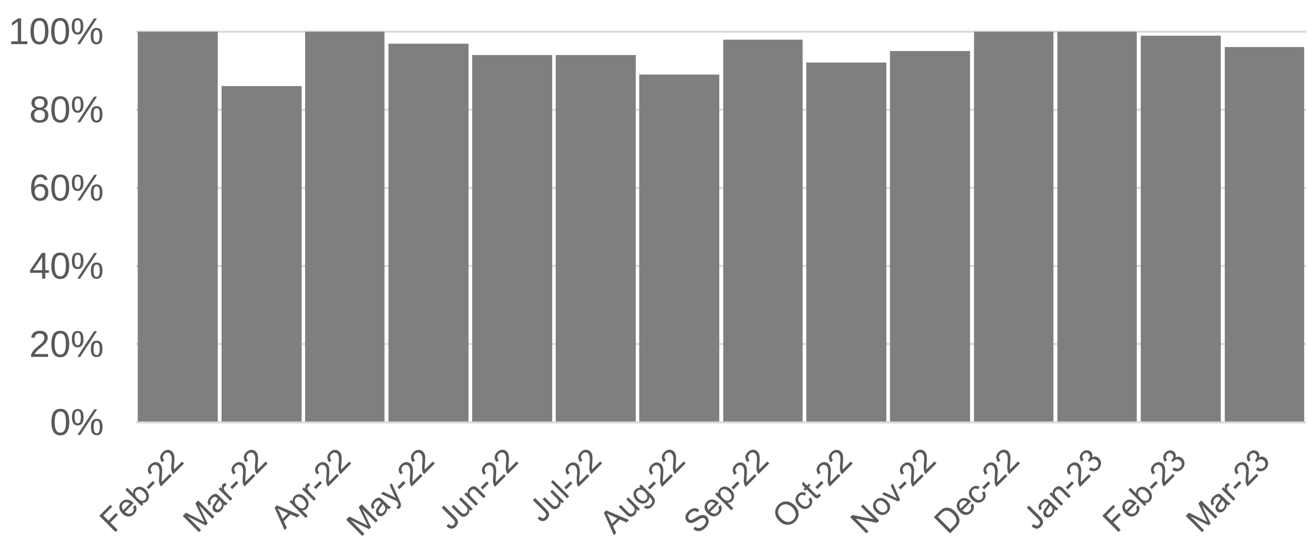
Availability is another important metric for transit operations as it reflects the total available buses for service each day. The E-Bus program began revenue service on February 7, 2022, with one bus. Later that same week a second bus was put in service, with a third the week after. The fourth bus remained in testing until May 2022, as it being used for range testing and training.

The target availability of the E-Bus fleet is 75% (3 out of 4 buses). This excludes Q1 2022 when the buses were still being phased in and the E-Bus fleet have achieved an availability of 78%.

5.2 Charger Availability

All 4 plug-in chargers have been available since September 2021. The 2 overhead pantographs have been in service since February 2022. Figure 4 shows the availability of the charging infrastructure. The overhead pantographs have been the major factor contributing to the dips in availability. We have been working closely with our vendor to improve the reliability of the overhead pantographs, with most of the component failures being related to the power cabinet and not the overhead infrastructure. OC Transpo expects an availability of 95%.

<u>Figure 4</u>: Charger Availability



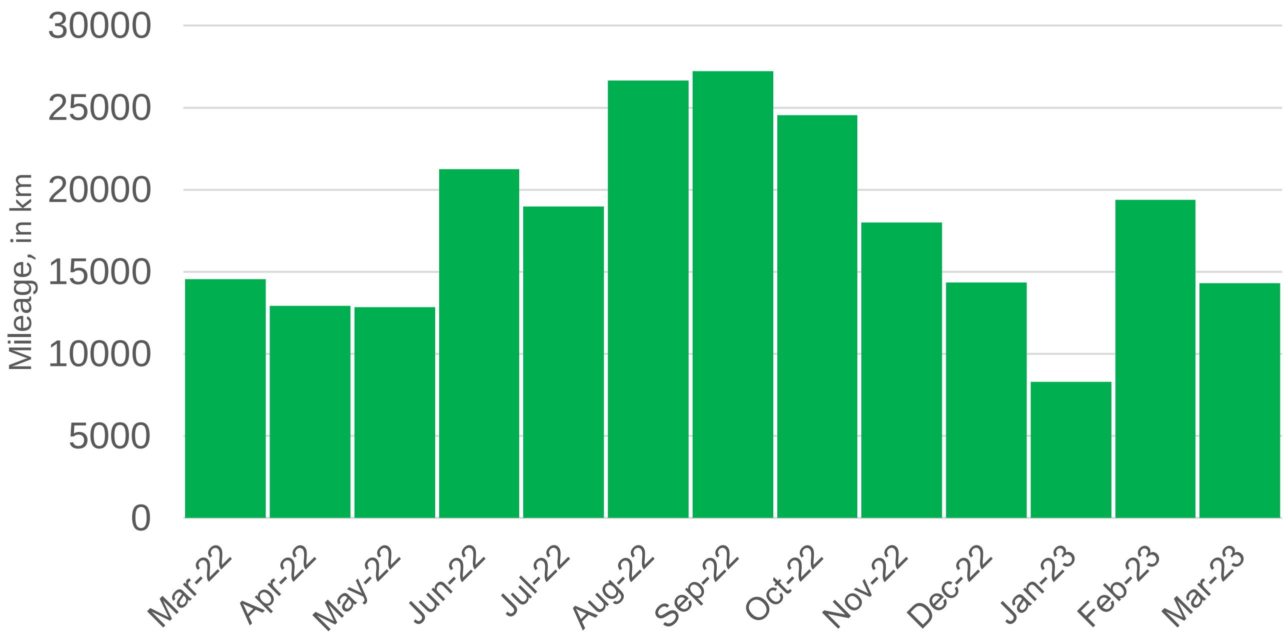
6. MILEAGE

E-Bus mileage has been closely monitored since the buses went into service in February of 2022. It is important, as part of future bus procurement, that mileage needs to hit certain milestones to meet operational needs.

6.1 Monthly Mileage Breakdown

Figure 5 shows the cumulative E-Bus mileage per month for the fleet. It has been challenging getting all four E-Buses out in service on a regular basis due to operator training and seasonal booking changes, however we have been able to reach our internal mileage targets on a regular basis. It should be noted for December 2022 and January 2023, buses were parked over the holiday break due to a special holiday schedule. OC Transpo has set a monthly target of 18500 km for the total E-Bus fleet which will match our operational requirements for E-Bus mileage.

Figure 5: E-Bus Monthly Mileage, in km



6.2 Effective Range

As part of the procurement of the E-Buses, New Flyer provided an expected range chart for the XE40. Their range data was calculated using modelling based on the Orange County Duty Cycle with a 23-passenger load and an average urban driving speed.

To prove this data, OCT evaluated the transit network and identified a route with similar speed, stops, and elevation conditions of the Orange County Duty Cycle. Additionally, 23 simulated passengers were installed using water containers and the route was performed at a wide range of temperatures. Table 2 shows the data comparison between New Flyer's estimates and OCT's testing data.

The expected ranges provided by New Flyer were found to be very close to our tested data.

Note: The New Flyer data was provided with an effective battery usage of 90%. OCT runs with an effective battery usage of 75% so the OCT data has been linearly extrapolated to 90%.

Table 2: New Flyer Range Testing

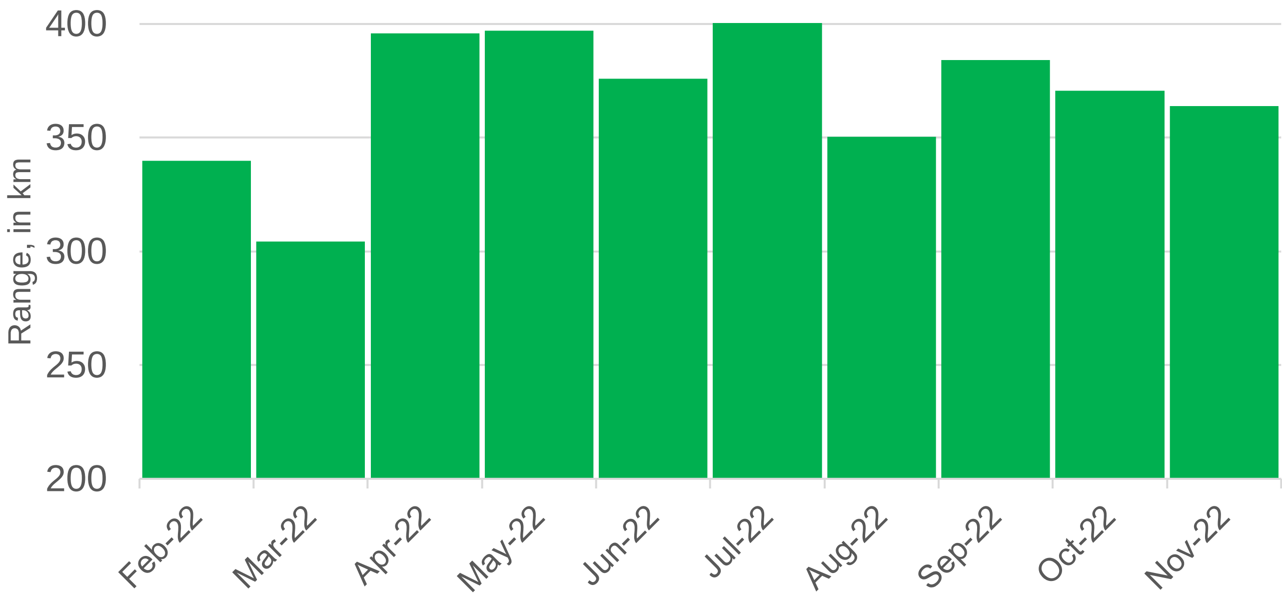
Temperature & Range Performance Testing		
Temp (°C)	New Flyer Expected Range (km)**	OCT Tested Range (km)
40*	315	
30	342	391
25	357	391
15	322	300
5	262	280
-5	363	365
-15	360	345
-26	316	314
-40*	239	

*Temperature was not reached to test
**Beginning of Life range

Figure 6 shows the effective maximum range of the E-Bus each month based on trip data extrapolated to 75% battery usage. The variations between months are a combination of factors including Heating, Ventilation and Air Conditioning (HVAC) usage and weather conditions. Winter months require additional heating for both the cabin (supplemented by the auxiliary diesel heater) and the batteries, and summer months require cooling.

As outlined in the graph below, more energy is consumed during winter months, which limits the range compared to the summer. In September the temperature drops to the range where the electric heater begins operating more frequently and you can see the dip in effective range. OC Transpo's required minimum range is 250 km.

Figure 6: E-Bus Effective Range



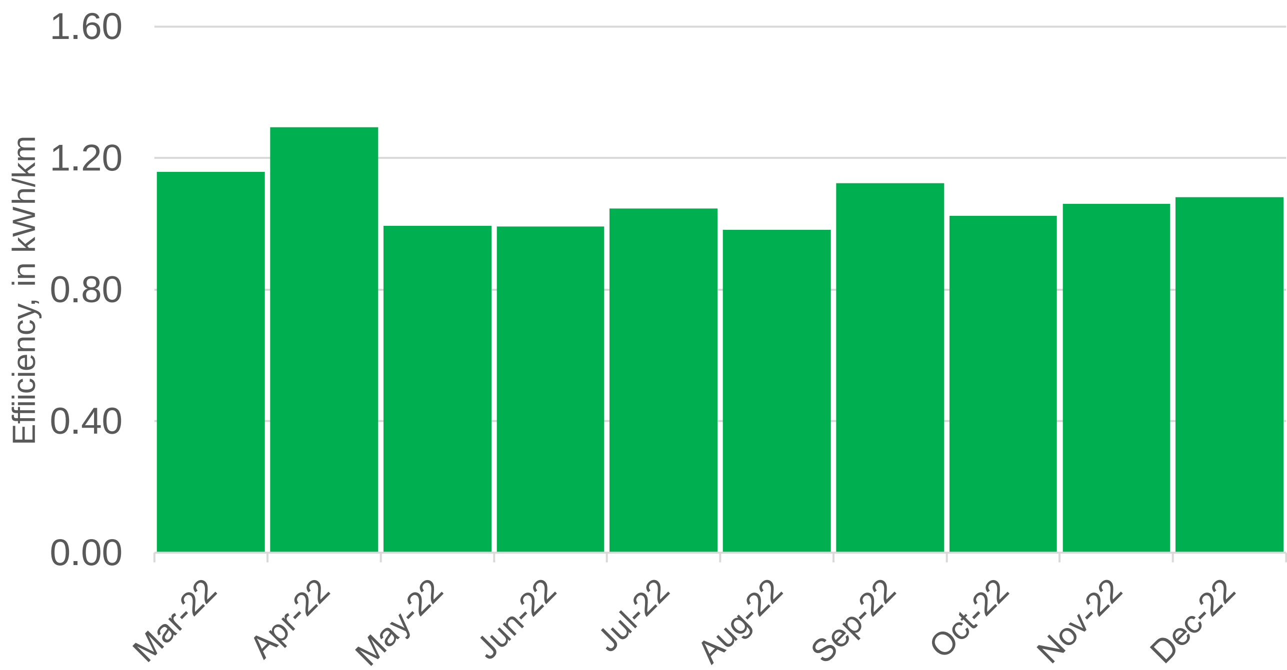
7. ENERGY CONSUMPTION

Many factors will affect the energy consumption of the E-Bus. As mentioned in previous sections, HVAC usage and weather conditions will affect total energy used during a run. High voltage accessories (battery heating/cooling), low voltage accessories (compressors, fans, pumps), as well as regenerative braking, passenger load, and driving behaviours, all play a factor in the overall energy efficiency.

7.1 Energy Efficiency

The total energy efficiency helps our planning department determine which routes are available, and what blocks of work in the future need to be reassessed to accommodate the new limitations of an electric fleet. Figure 7 shows the energy efficiency of the E-Buses month-to-month, using the formula of total energy used (kWh) over kilometers driven (km). New Flyer estimated the efficiency of the E-Buses to be 1.4 kWh/km, which has been shown to be a conservative estimate to this point.

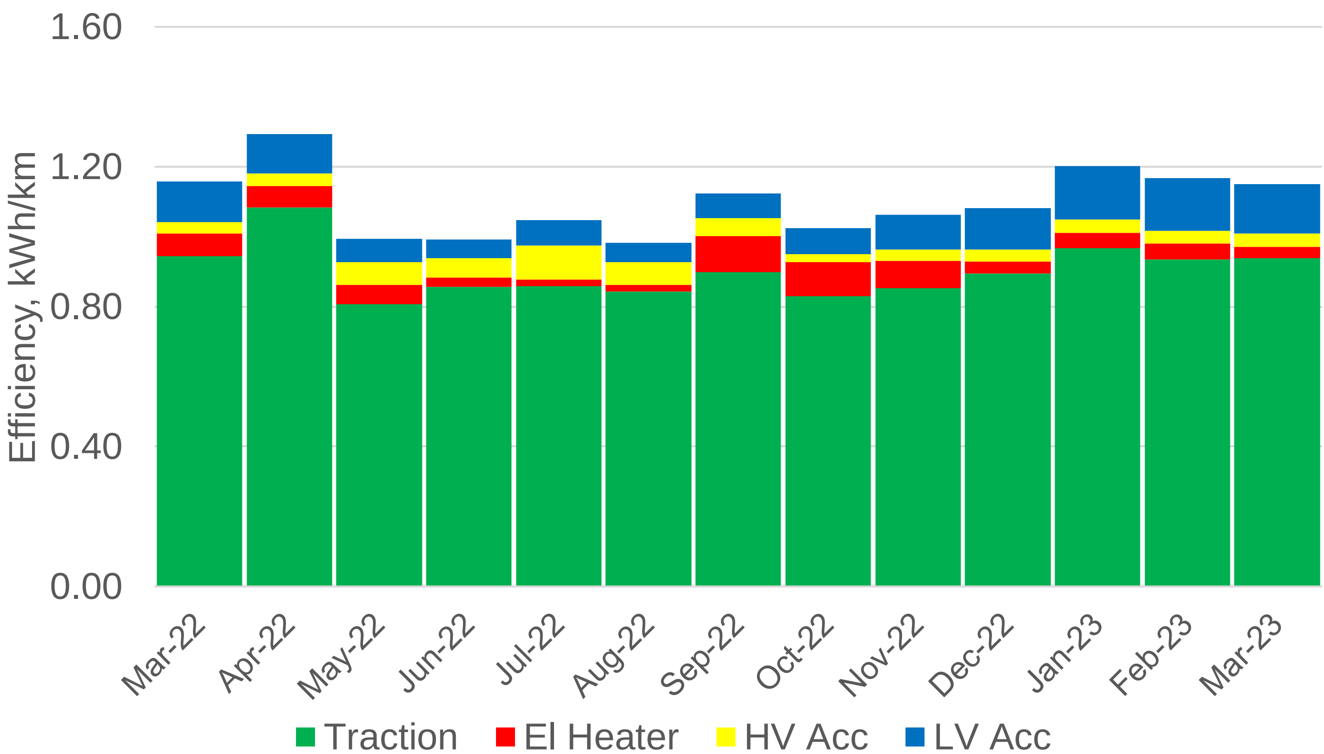
Figure 7: E-Bus Energy Efficiency



7.2 Energy Distribution

Figure 8 shows the monthly energy distribution of the E-Bus electrical systems. The electrical heater is the main heating source in the spring and fall months. As the temperature drops in the winter the auxiliary diesel heater takes over with the electric heater as a backup. The High Voltage (HV) accessories appear to use more power in the summer months to keep the batteries at their optimum operating temperature.

Figure 8: E-Bus Energy Distribution



7.4 Diesel Savings

The E-Buses have used 92% less diesel compared to our most efficient diesel fleet, the NOVA LFS. As the summer season arrives, the diesel heaters are no longer in use and savings are higher. During the colder months, diesel savings are offset slightly by the auxiliary diesel heater. The 4 E-Buses have saved OC Transpo over 100,000 L of diesel fuel, based on E-Bus mileage and comparing against our most efficient diesel fleet, the NOVA LFS.

7.5 GHG Emission Reductions

The 4 E-Buses have saved over 280,000 kgCO_2e. A kWh of electricity in Ontario generates 0.025 kgCO_2e in greenhouse gas emissions, compared to 2.7 kgCO_2e per litre of diesel. In the summer months when the diesel heater is not in use, the E-Buses reduce greenhouse gas emissions by 97%.

8. BATTERY & CHARGER ANALYSIS

As part of the ZEB Pilot Project, multiple vendors and charger types were acquired to test which products would best suit our needs. The two types of chargers are plug-in and overhead pantograph. ABB and Siemens were chosen as the two vendors, with ABB supplying three (3) plug-in chargers and Siemens supplying two (2) overhead pantographs and one (1) plug-in chargers. All chargers are set to supply a maximum of 150kw.

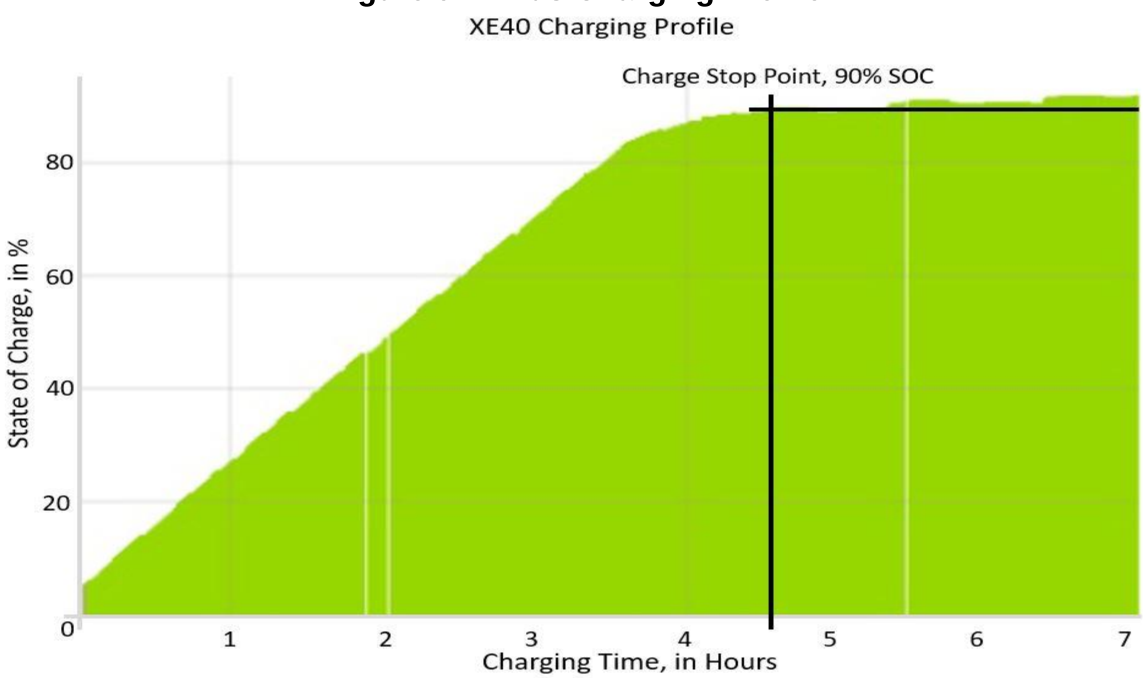
8.1 Bus State of Charge (SOC) Data

The SOC of a bus indicates the remaining available energy for the trip. It includes propulsion, HVAC, and all other accessories (lights, air pressure, cameras, etc.). We have set the maximum available SOC for the buses at 90%. This setpoint was chosen to extend the life of the batteries and for charging time efficiency. We have also set our minimum available SOC at 15%. This setpoint allows the bus to return to the garage from anywhere in the city without the concern of running out of charge.

It is important to not overcharge or undercharge the batteries, as this will prematurely degrade the battery cells. OC Transpo has administrative barriers to prevent overcharging (setpoints on the bus-side that prevent charging over 90% SOC) and undercharging (audible alarms on the bus once it gets below 12% SOC).

Figure 9 below shows a typical charging cycle, in this case from March 17, 2022, before we implemented the 90% charge stop point. The charging rate is very linear throughout the charging cycle until it reaches 85% and then a ‘trickle charge’ mode is enabled to protect the batteries. This ‘trickle charge’ mode ramps down current but continues to charge the bus. Above 90% SOC, it is time-prohibitive to continue charging as a 1% increase in SOC can take up to 1 hour, compared to 1% every 4 minutes prior to the ‘trickle charge’ mode.

Figure 9: E-Bus Charging Profile



9. CONTROLLED ENGINEERING TESTING

OC Transpo performs a Pre-Delivery Inspection (PDI) on all revenue service vehicles that are procured. Additional to the PDI, the E-Bus was tested to ensure it could meet all the weather and demand conditions it would experience in service here in Ottawa. The National Research Council (NRC) was consulted to provide their expertise and experience with electric vehicles to augment our testing and identify any gaps.

9.1 Block Testing

Block testing was designed to answer 3 major questions.

1) Can the E-buses perform our current blocks of work, or will they need modification?
2) Can the E-buses complete the blocks at maximum capacity?
3) Will the E-Bus meet the range expectations provided by the manufacturer?

9.1.1 Can the E-buses perform our current blocks of work that our conventional buses do, or will they need modification?

The original block range limit was set at 200 km as our testing began in the winter months. The E-Bus easily handled that range. At the beginning of testing, each block was accompanied by an OC engineering employee to monitor data for each route (temperature, distance travelled, SOC used). As testing progressed, and there was no question the buses could handle all the blocks assigned in the booking, we relied on New Flyer 360 Connect data (manufacturer supplied analytical data).

In the spring and summer, the range limit was set to 250 km. Again, the E-Bus had no issues handling that range. The current limiting factor for putting E-Buses on longer blocks is the operator changes. A 300+ km block of work may require up to 3 or 4 operators to complete, and at this time we have not trained all our operators on E-Buses. If the Relief operator was not E-Bus trained, a bus change would be required and would disrupt service.

9.1.2 Can the E-buses complete the blocks at maximum capacity?

To help get the answer for this question, the NRC provided water containers (Figure 10 below) to simulate up to 56 passengers (3800kg). The testing was completed in 3 stages:

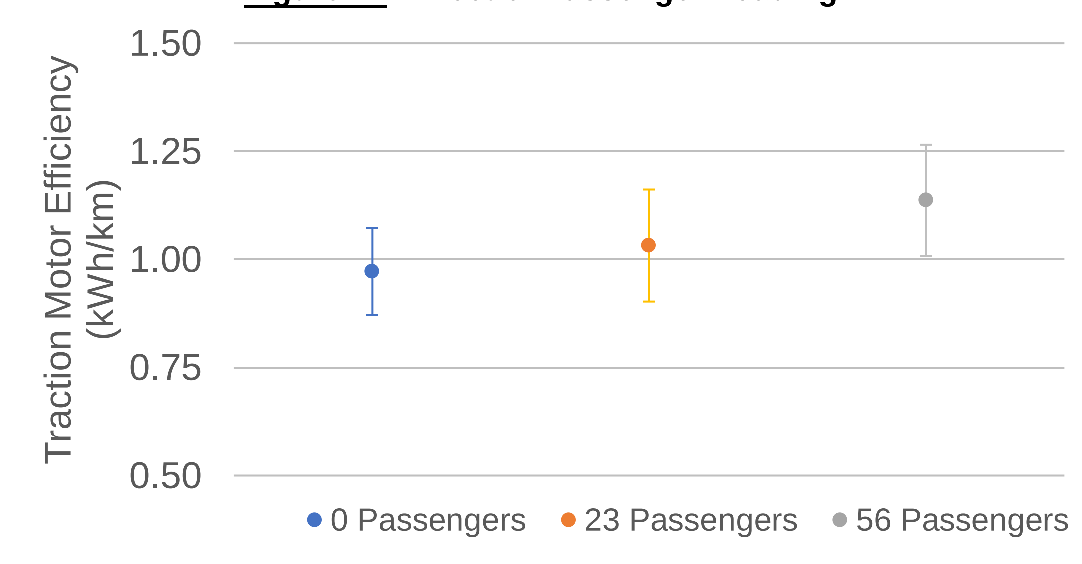
1. 0 passengers;
2. 23 passengers; and
3. 56 passengers.

Overall, it was found that additional passengers can increase demand on the traction motor by up to 15%.

Figure 10: Water Containers

Figure 11 shows the average traction motor efficiency in kWh/km for 3 different passenger loads, to eliminate environmental factors. The traction motor is the biggest consumer of energy on the E-Bus, and a 15% increase at maximum capacity is something to consider. OC Transpo will continue to monitor to see how passenger loading affects efficiency.

<u>Figure 11</u>: Effect of Passenger Loading



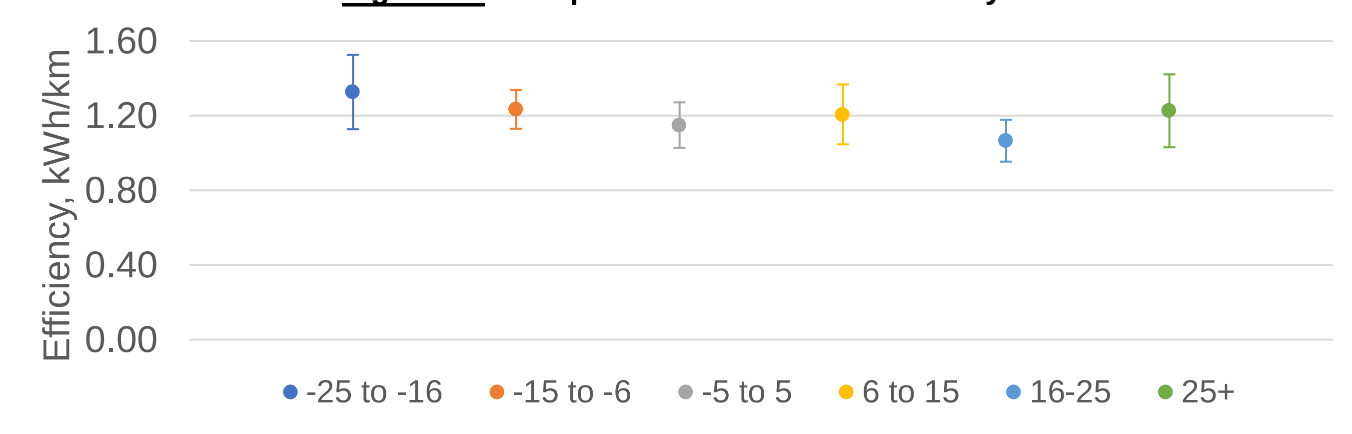
9.1.3 Will the E-Bus meet the range expectations provided by the manufacturer?

The E-Buses have met or exceeded the range expectations set by the manufacturer, and more detail was provided in Section 6.2.

9.2 Temperature and Road Conditions

Two major factors that affect the range of the electric buses are temperature and road conditions.

Figure 12: Temperature Effect on Efficiency



During the winter months, an auxiliary diesel heater provides temperature control for the passenger cabin. The auxiliary diesel heater begins to run when the ambient temperature drops below 5°C. If the temperature in the passenger cabin drops below the HVAC setpoint, the electric heater comes on to provide additional heating. Temperature conditions can reduce the efficiency of the E-Bus by as much as 24%, but the E-Buses still meet minimum distance requirements.

In the spring and fall seasons, the average temperatures are in the 5°C to 15°C range and the electric heater is the only source of heating, so overall electrical efficiency and range is reduced.

If the road conditions are poor and traction is not dependable, the regenerative braking will automatically be disabled and traditional braking will occur instead. This can eliminate up to 50% of additional energy regeneration depending on the length of the run and the road conditions. This can reduce overall efficiency by up to 10%.

OC Transpo has provided range charts to our control room for summer and winter temperatures, as well as road conditions for the winter (>7cm snowfall). These charts will be updated annually based on the previous year's efficiency calculations and will allow operators to extend beyond their allocated blocks of work to get more mileage out of the E-Buses.

9.3 Hill Testing

On April 14, 2022, we performed a hill test in 3 areas of the city. The data was collected by dataloggers (a device that captures all the signals on the bus) and was provided to the NRC for analysis.

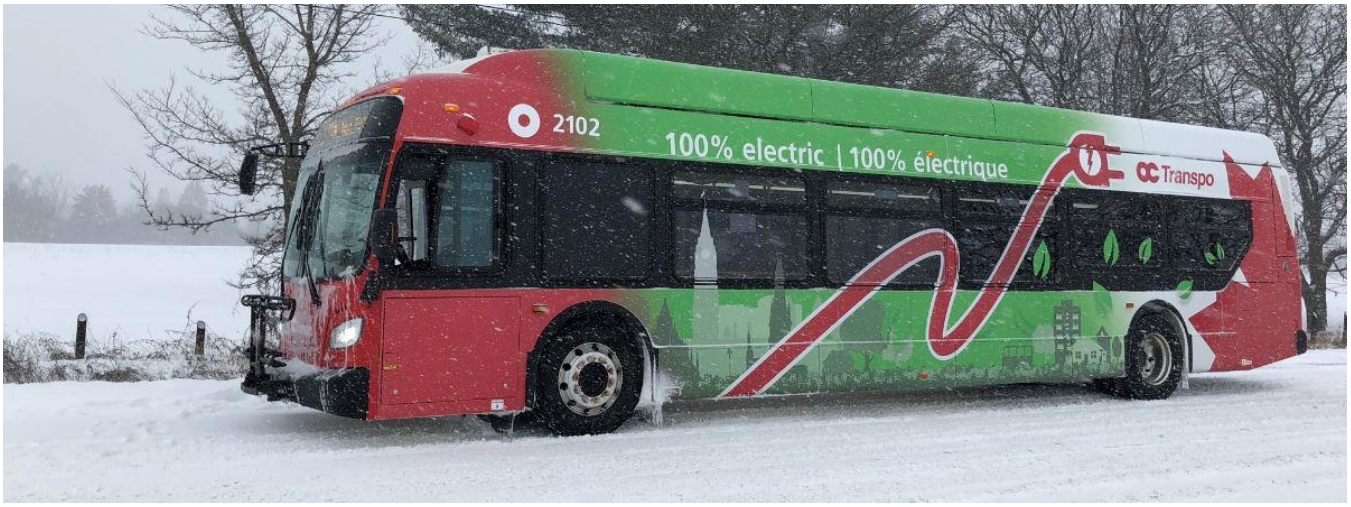
Table 3: Hill Testing Data

	Vanier (A)	Orleans (B)	Gloucester (C)
Elevation Change (m)	624	548	306
Grade (%)	18 ± 0.73	19 ± 1.21	14 ± 0.76
Efficiency (kWh/km)	1.29	1.80	1.22

To summarize, the energy draw related to hill climbing showed upwards of 50% increase in traction motor demand, but due to the limited number of hilly areas in the city, OC Transpo believes there will not be a reduced range concern for the E-Buses.

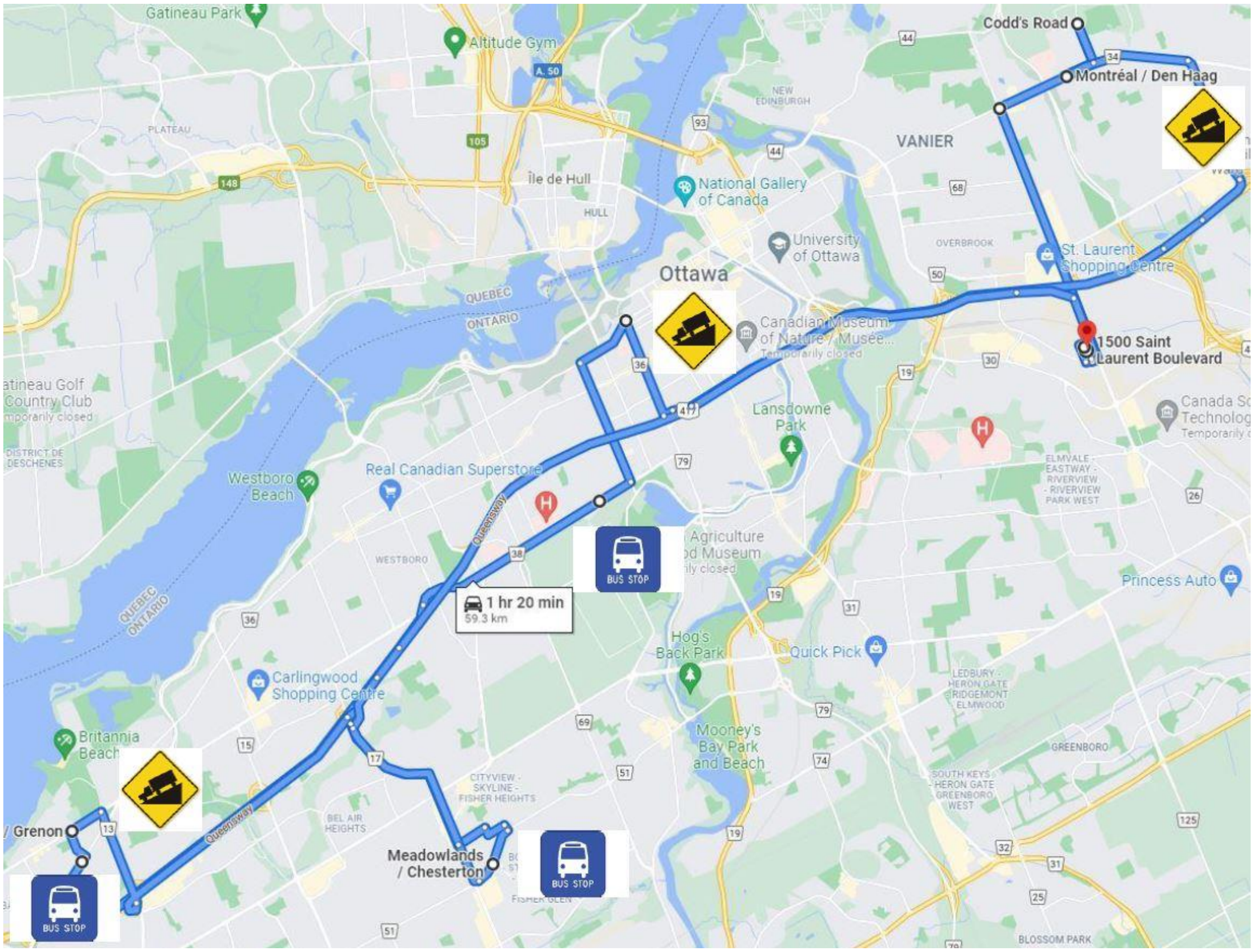
9.4 Inclement Weather Testing

A route was created to determine the capabilities of the E-Bus during inclement weather conditions. 3 hills and 3 bus stops (closed during the winter) were chosen for our testing. On January 17, 2022, a major snowstorm (47.8cm snow accumulation) hit the city and we performed our test.



The routes the test was performed on had limited plowing and no road salt or sand. We performed stop-starts on all the identified hills and bus stops and the E-Bus never got stuck. Figure 13 shows the route performed and the areas tested.

<u>Figure 13</u>: Inclement Weather Testing Roadmap



9.5 Battery and Charger Testing

Battery and charger testing was completed to ensure all chargers could charge a bus from low charge (5% SOC) to full charge (90% SOC). To get all the E-Buses to 5% SOC, we had operators run the buses on the road until it they reached 10% SOC and then they were brought back to the garage and drawn down to 5% SOC using low voltage accessories. All 4 E-Buses were brought down to 5% SOC to ensure there were no operational issues.

10. OPERATOR EXPERIENCE

During testing, 36 operators were surveyed to compare the operational parameters of the E-Bus to our latest diesel fleet, the NOVA LFS. The survey choices were “Dissatisfied”, “Neither Satisfied or Dissatisfied”, or “Satisfied”. Overall satisfaction was rated on a scale of “Very Negative” to “Very Positive”.

<u>Table 4:</u> Operator Survey Results

	Noise Level	Ergonomics	Visibility / Sightlines	Ride Comfort	Acceleration	Steering / Maneuverability	Braking	HVAC
Satisfied	78%	64%	69%	72%	36%	67%	89%	64%
Neutral	19%	22%	17%	28%	44%	14%	8%	25%
Dissatisfied	3%	10%	14%	0%	17%	19%	3%	6%

The operators were also asked for their overall satisfaction with the E-Buses, which was rated on a different scale than the operational parameters.

<u>Table 5</u>: Overall Satisfaction

	Overall Satisfaction
Very Positive	39%
Positive	61%
Neutral	0%
Negative	0%
Very Negative	0%

Overall satisfaction was high. The main complaint from our operators was that the 18-inch steering wheel was identified as too small. There have been ongoing trials with steering wheel used on other bus fleets to increase the size to 20 inches. There is also a trial to replace the current rear-view side mirrors, as our operator community has expressed their dislike for the current configuration and have requested the setup from one of our existing fleets as they are more comfortable with that format.

Acceleration and maneuverability were rated the lowest by our operators; however, it is comparable to other buses in our fleets, so no action has been taken.

11. ACCESSIBILITY

The following is an excerpt from a legislative report on the funding for the E-Buses which details the accessibility considerations taken with the E-Buses:

> Accessibility has been integral to the procurement process for zero-emission vehicles. Staff have considered the concerns expressed by the Accessibility Advisory Committee and other accessibility stakeholders about the low levels of noise produced by electric vehicles and the increased risk this poses to pedestrians, particularly those who are blind or partially sighted.
>
> Staff mitigated this risk by outfitting the City’s first four pilot battery-electric buses with an Acoustic Vehicle Alerting System (AVAS). This technology emits a sound from an exterior speaker at the front of the bus, which is intended to mimic that of an internal combustion engine. The sound is generated when the bus is idling, and when it is moving at 32 km/hour or less (for example, when it is leaving or approaching a bus stop or intersection).
>
> In addition, the battery-electric buses included the same accessibility features as the fleet's newer bus models, including allocated spaces for customers using mobility devices equipped with “theatre-style” flip-down seats, an additional visual next-stop-announcement sign mounted at the rear entrance, and interior and exterior speakers with improved sound quality.
>
> Once the pilot buses entered service in early 2022, two orientation sessions were coordinated by OC Transpo staff to familiarize accessibility stakeholders with the buses’ sound-emission technology and other accessibility features. Representatives of the Accessibility Advisory Committee, Canadian National Institute for the Blind (CNIB), Alliance for the Equality of Blind Canadians, Canadian Council of the Blind, Vision Loss Rehabilitation Canada, CNIB Guide Dogs and the City's Accessibility Office participated in the 1.5-hour sessions, which included testing the sound-emission technology on-street in different locations and under different scenarios.
>
> The feedback from participants was positive. They indicated that the sound generated by the bus’s sound emission system was clearly audible, distinct, and was useful to customers in identifying that a bus was passing or approaching a stop or intersection. In addition, stakeholders were supportive of the existing on-board accessibility features.
>
> Based on the feedback received, OC Transpo will:
>
> - Equip all future zero-emission buses with the equivalent AVAS technology;
> - Ensure consistent sound (where possible) and volume of sound emission across all zero-emission buses;
> - Continue to equip all new battery-electric buses with the same on-board accessibility features; and,
> - Monitor new developments in legislation, regulations and emerging technology in sound-emission.

OC Transpo will also continue to monitor and respond to feedback from accessibility stakeholders and customers.