



Zero-Emission Bus Program Update

Transit Commission
January 27, 2023



Purpose of Today's Discussion

1. Approve budget authority for the ZEB Program in the amount of \$425 million
 - \$350 million from the Infrastructure Canada (INFC) grant and
 - \$75 million drawdown on the Canada Infrastructure Bank (CIB) credit facility
2. Approve a budget adjustment to transfer funding from the existing 2022 approved Bus Replacement budget to the ZEB Program Budget
3. Direct the GM, Transit Services to request the City's share of the ZEB funding requirements and CIB financing amount as part of the annual budget process for ZEB bus procurement in 2024 and 2025
4. Approve the creation of a ZEB Program Reserve to facilitate repayment of the CIB loan and replacement batteries from accrued savings (required by the CIB loan agreement)

Background

April 2019: Council declares climate emergency

- Directs staff to establish new 2030 midterm corporate and community GHG emissions reduction targets
- Directs staff to review and update long-term GHG emissions targets
- Directs staff to identify concrete actions and resource implications to achieve new targets

January 2020: Council approves Climate Change Master Plan

- Commits to reducing 100% of City's corporate GHG emissions by 2040
- OC Transpo fleet identified as a major contributor of City's corporate GHG emissions

June 2021: Council approves purchase of zero-emission buses for all future transit bus fleet needs, provided they meet operational needs and subject to financial agreements

Adoption of electric bus technology

- Transit agencies across Canada and around the world are transitioning their fleets to include electric buses
- Ottawa is a member of the North American eBus Experience Group, a working group with representatives from over 30 transit agencies in Canada and the United States focused on adoption of electric buses
- Members include New York City, Toronto, Montreal, Boston, Chicago, Vancouver, Edmonton, Association du Transport urbain du Québec and Metrolinx
- Transit agencies and manufacturers are shifting towards electric vehicles
- As the industry transitions, price of e-buses may drop and availability is expected to increase
- As manufacturers shift focus, it may become increasingly difficult to procure diesel-powered buses

Worldwide adoption of electric bus technology

(Cont'd)

Examples of strong battery-electric bus adoption:

- Montreal, Quebec – 43
- Moscow, Russia – 1,000
- Copenhagen, Denmark – 160
- Paris, France – 400
- London, England – 1,041 (total of two transit agencies)
- Bogota, Colombia – 1,485
- Shenzhen, China – 16,359

Oversight by the Auditor General

July 2021: Council moves to amend the Auditor General's workplan to add an agile audit of ZEB Program conducted in sprints

February 2022: Sprint 1 – Technology and Performance

September 2022: Sprint 2 – Procurement of E-buses

February 17, 2023: Sprint 3 – Financing



Review of energy sources and technology

Leading up to 2021, City staff engaged with experts from several organizations to develop the recommendations for the Zero Emission Bus Program

Included studies on technology alternatives, energy supply and financing options and findings shared from studies in other Canadian cities, such as Winnipeg

The following sources of energy and technologies were examined and were not recommended:

- Hybrid-electric, Compressed Natural Gas, and Renewable Natural Gas buses were not recommended as they were not zero-emission and do not meet the Council policy direction, also not eligible for federal funding
- Trolley buses (with overhead wires) were not recommended because of the high cost of buses and overhead infrastructure
- Hydrogen fuel cells were not recommended because of the high cost of buses and high cost of production or transportation of hydrogen

A red and green electric bus is shown from a front-quarter perspective. The bus features a large windshield with a digital display at the top that reads "Going electric!". The side of the bus is green with a white and red graphic of a stylized wave or path. The text "100% electric" is repeated along the side. The number "2103" is visible on the side near the front. The front of the bus has a red bumper and a headlight. The word "transpo" is visible on the front bumper area. The bus is parked on a paved surface.

Transformation to ZEB

Current conventional fleet composition



2005-06 New Flyer D40I

- 95 in fleet
- Phased out by end of 2025



2008-11 New Flyer D60/61LF

- 356 in fleet
- Phased out by end of 2026



2019-21 Nova LFS

- 249 in fleet
- Remain through 2036



2012 ADL E500

- 73 in fleet
- Phased out by end of 2026



2022 New Flyer XE40 E-bus

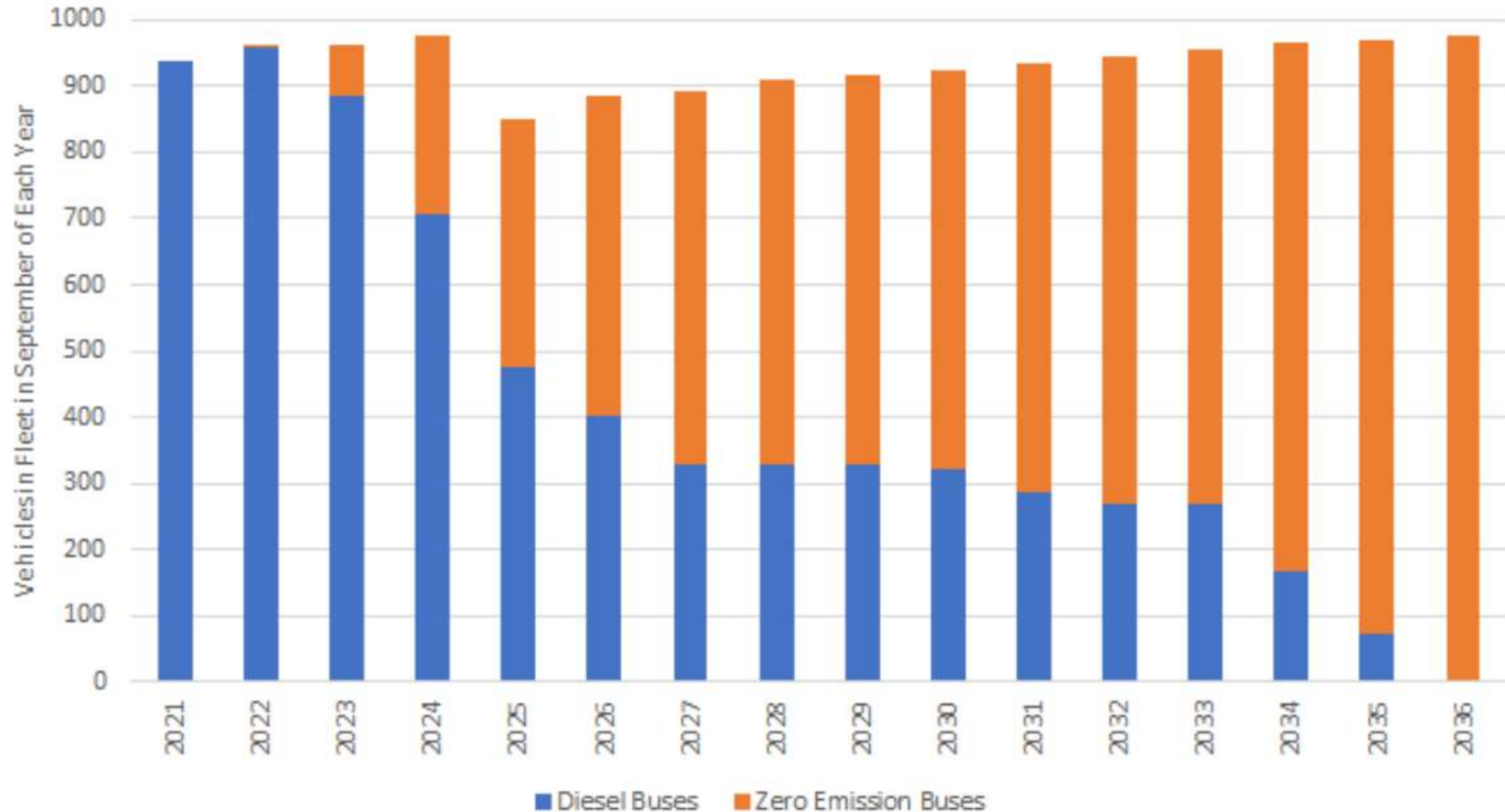
- Four in fleet
- Gradual additions to fleet



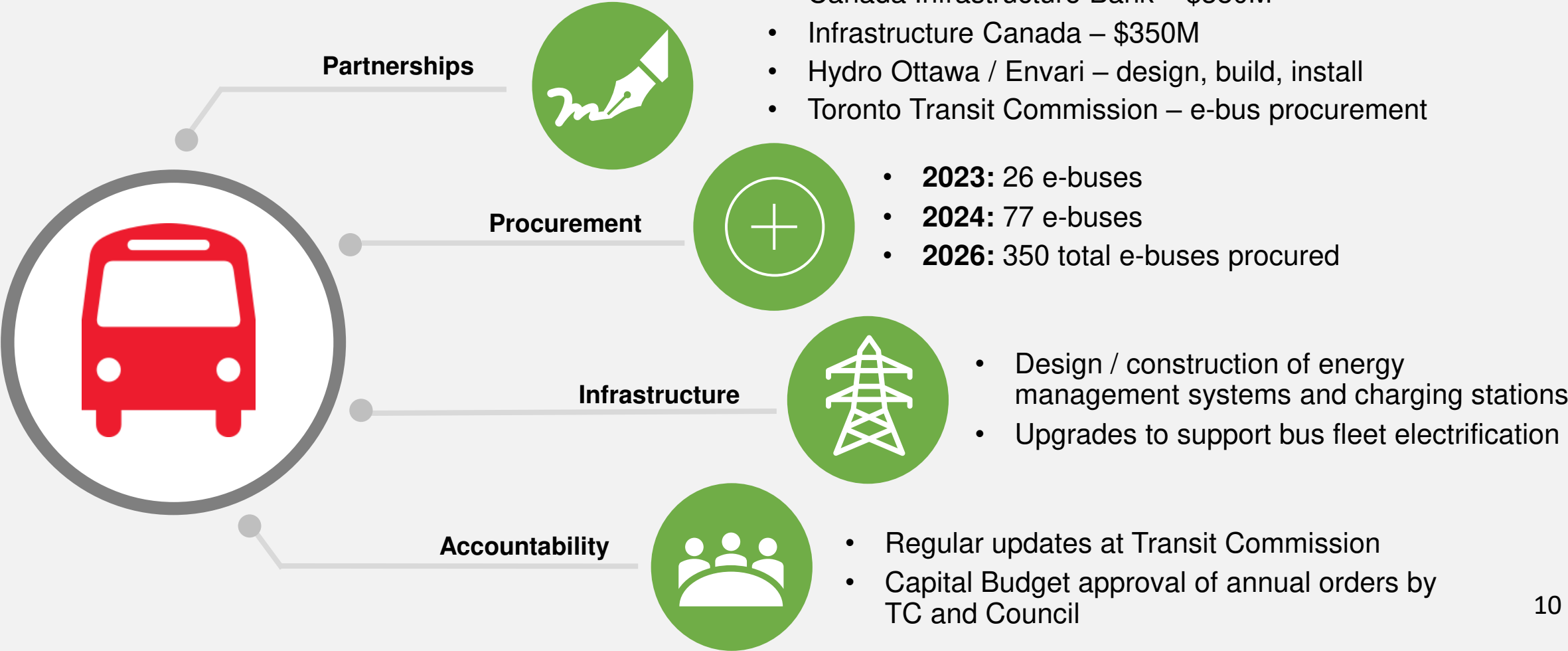
2015-19 ADL MMC, E527, G531, J523

- 78 in fleet
- Remain through 2030

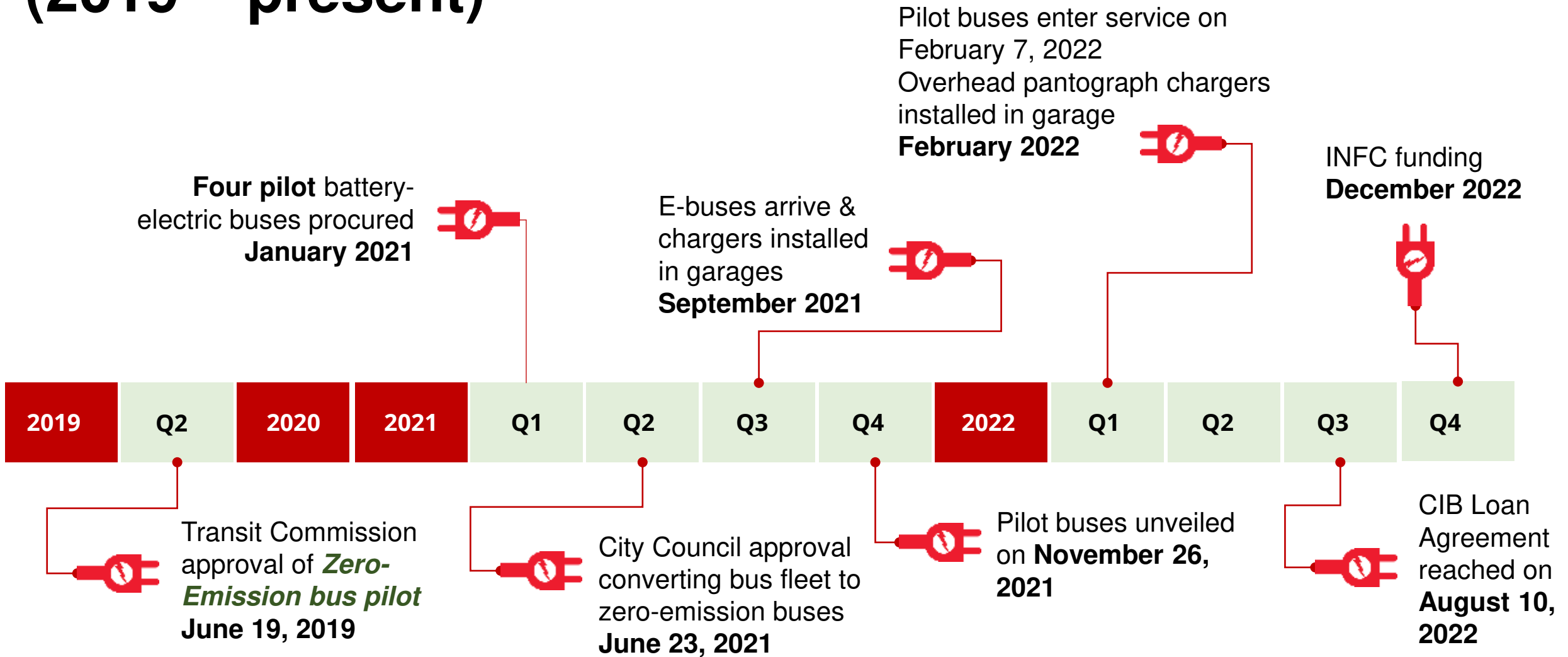
Projected Fleet Transition – 2021 estimates



Zero-emission Bus Program



Overview: key program milestones (2019 – present)





Electric Bus Specifications

- New Flyer XE40
- 40' buses
- Long Range – 280-350 km range
- In-depot charging
- 36 seats
- Diesel auxiliary heater for winter weather
- Acoustic Vehicle Alerting System (AVAS)

Charger Specifications

Over-head

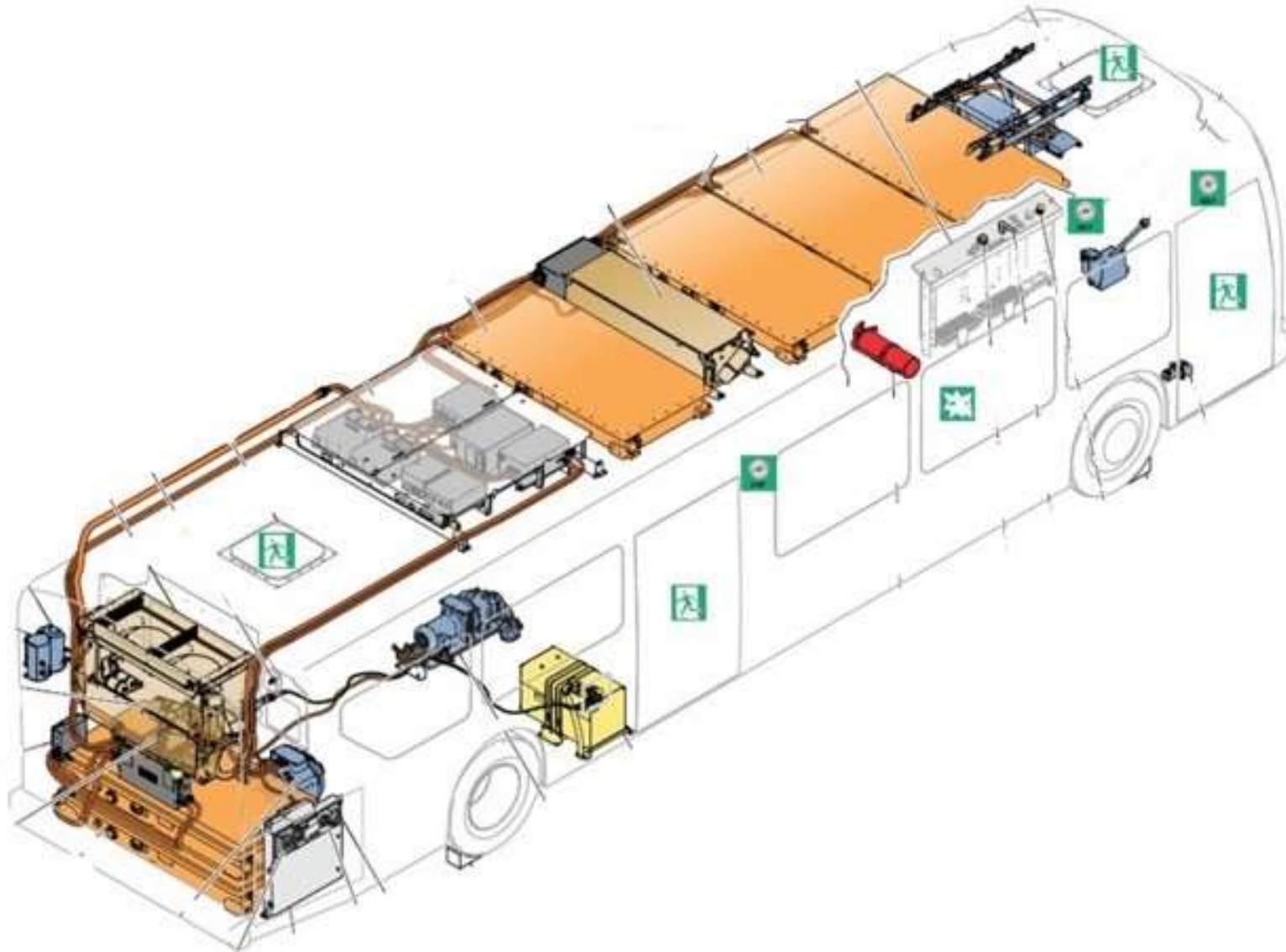
- 2 Siemens Overhead Pantograph (in-depot 150 kwh)

Plug-in (pilot program only)

- 3 ABB plug-in charger (in-depot 150 kwh)
- 1 Siemens Plug-in (in-depot 150 kwh)









Electric 40-foot bus power and engine system



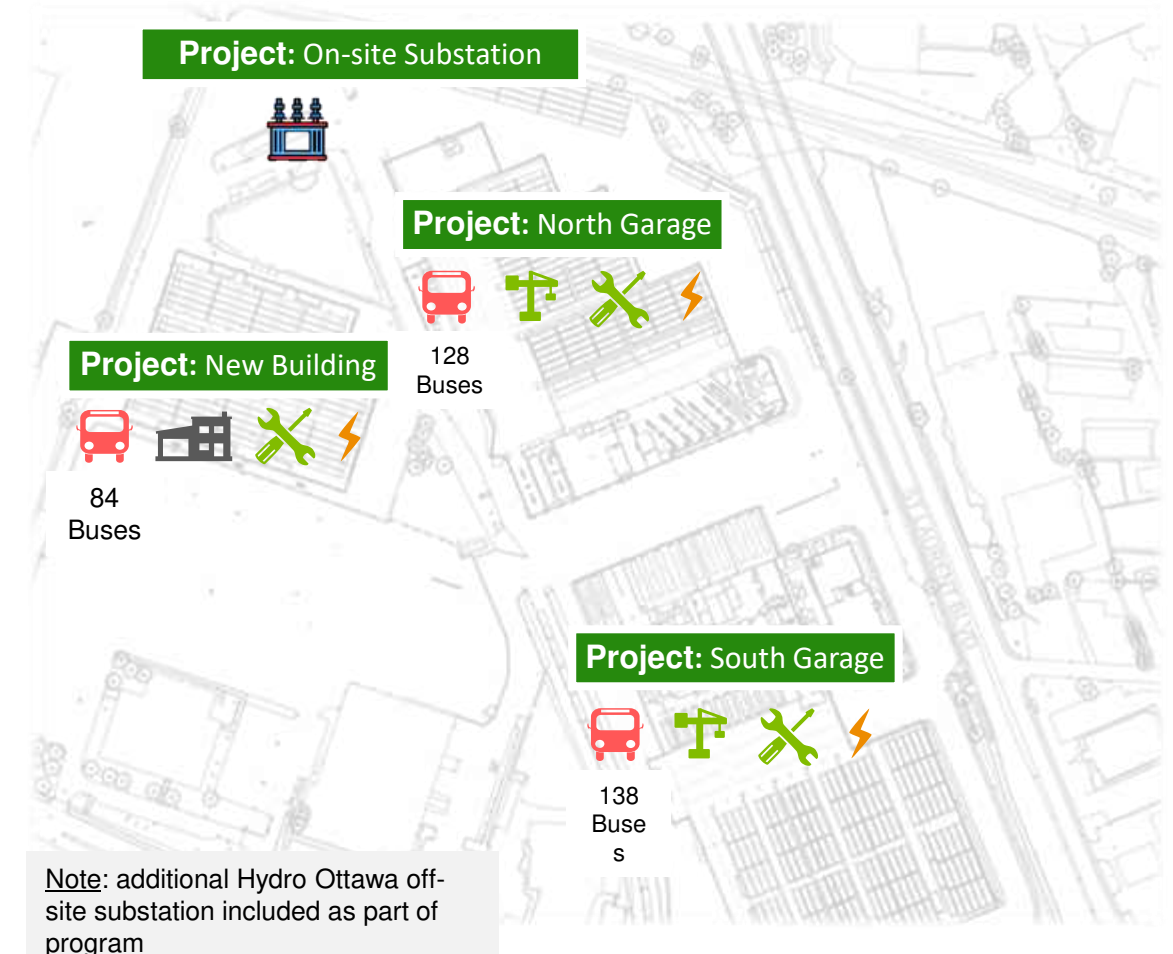
Facilities Upgrades and Power Supply Redundancy

Key consideration

- 350 bus program
- Structural (new build / fit up / upgrades) + electrical / charging equipment work expected at all sites within the Depot
- Hydro Ottawa is expected to provide two circuits to feed the site
- Natural gas fired generators to provide emergency backup power

	Bus Acquisition (ZEBs)
	New Indoor Parking Building
	Structural Upgrades
	Building Fit-up
	Electrical Infrastructure, Charging Equipment and related Civil Works
	Hydro Ottawa On-site Substation (transformer, generators, switchgears, etc.)

Indicative Site Layout: St-Laurent Depot, 350 Bus Program

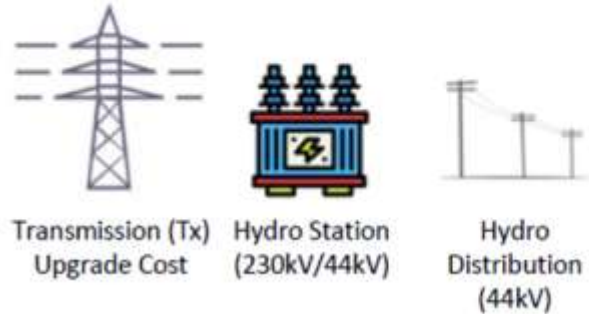


ZEB Program Electrical Infrastructure

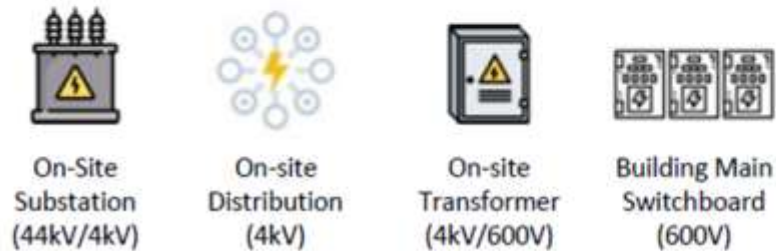
Working with our local utility company Hydro Ottawa for all electrical infrastructure

- Design
- Procure
- Build

Grid and Substation Elements (Hydro Ottawa)



On-Site Electrical Elements (Electrical and Power Distribution)



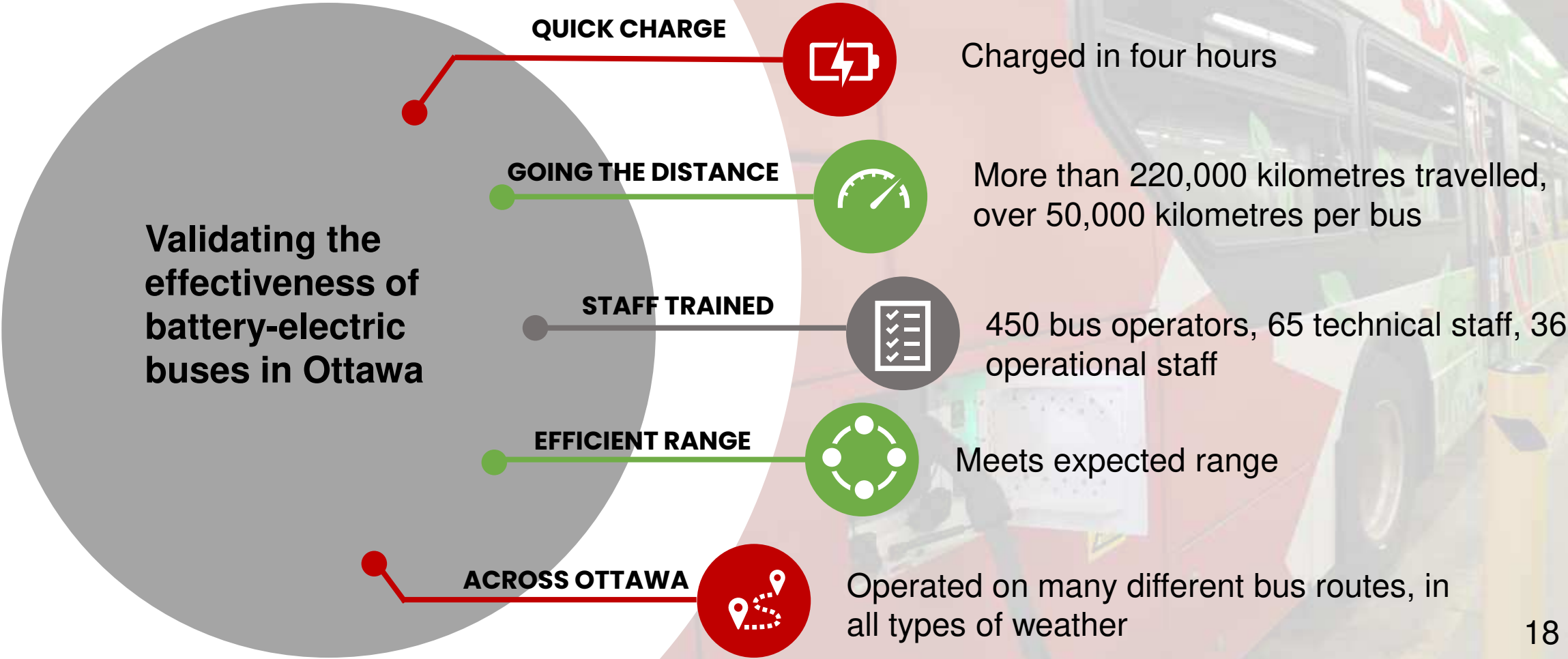
On-Site eBus Charging Equipment



Pilot Results



ZEB Pilot Update: E-buses put to the test in Ottawa



Focus on Reliability and Performance

✓ Performance

- Range of 280 to 350 km
- Meets or exceeds expected range from the manufacturer

✓ Reliability

- The E-Bus Mean Distance Between Failure (MDBF)* is currently **12,422 km**
- Slightly above fleet wide average MDBF of **11,236 km**

* Definition: Mean distance between failure (**MDBF**) is an industry standard measure of reliability that expresses the average distance travelled by a bus before a service disruption due to a mechanical defect. A higher MDBF indicates greater reliability.

Next Steps



Cost of ZEB Program

Capital Expenditure	Cost Estimate (in millions \$)
ZEB Bus Acquisition (350 buses)	653
Charging Infrastructure Costs	214
Transition Costs	107
Total	974

- Increase in costs from June 2021 estimates:
 - Existing facilities can accommodate 350 ZEBs but need additional upgrades
 - Structural upgrades and fit-up of maintenance facilities
 - Covered parking
 - Additional advisory and project management costs
 - Cost escalations since 2021

Sources of Funding

City's contribution is aligned with LRFP planned spending on bus replacement cost for diesel buses:

Funding Source	Amount (in millions \$)	Estimated % Share of Funding
CIB Loan	289	29%
INFC Funding Grant (ZETF)	350	36%
City Funding from GHG Capital Envelope (per LRFP \$348.1 million planned)	335	35%
Total Funding	974	100%

Canada Infrastructure Bank

- **August 2022:** \$380M loan agreement executed.
 - Value based on estimated difference between diesel bus and ZEBs
 - 80% of savings repay loan and pays for battery replacement
 - 20% retained by City
 - Drawdowns will be aligned with each bus purchase
- 15-year loan to match the life of the asset at 1% interest rate repaid from savings
- Loan is only to be repaid if actual savings are achieved, the risk of achieving ZEB savings is borne by CIB:
 - ZEB useful life, maintenance costs and energy efficiency
 - ZEB battery replacement frequency and cost
- City bears the risk of average mileage and electricity price

Infrastructure Canada – Zero Emission Transit Fund (ZETF)

- The ZETF is a \$2.75B federal program to support procurement of 5,000 zero-emission transit and school buses for Canadian municipalities
- **June 2021:** approval from Commission and Council to purchase zero-emission buses for all future transit bus fleet needs
- **November 2021:** Expression of interest submitted to Infrastructure Canada for ZETF funding
- **April 2022:** City submits application for \$500M in funding for 450 ZEBs, charging infrastructure and transition costs
- **December 2022:** INFC approved \$350M in funding with end date of March 2026

Cost Neutrality/Savings

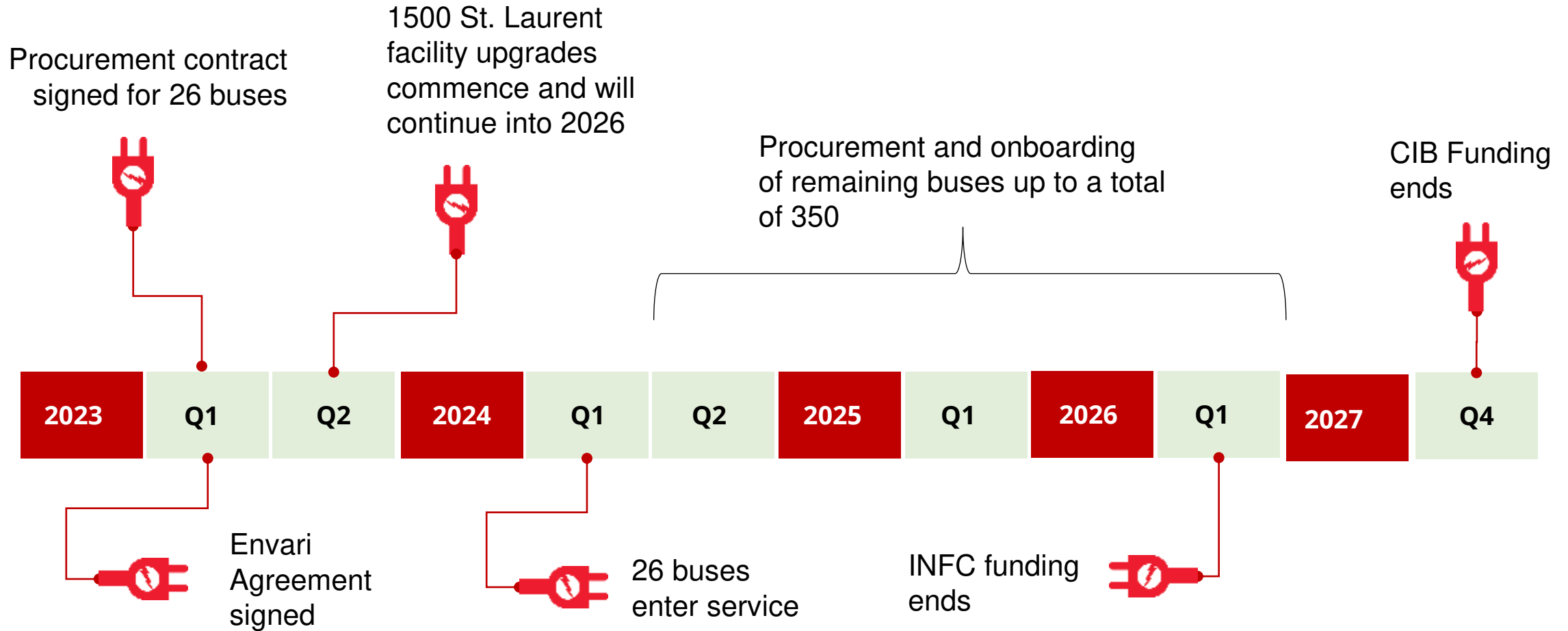
- The ZEB Program is estimated to be cost neutral for the City
- The City is contributing per the LRFP; savings will pay for the loan, price difference between diesel buses and ZEBs, interest and battery replacements

(Savings) / Cost	Amount (in millions \$)
CIB Loan	289
CIB Loan Financing Charge (1%)	28
ZEB Ongoing Costs (15 years):	
Maintenance Costs	254
Energy Costs	144
Battery Replacement	91
GHG Buses Ongoing Costs (15 years):	
Maintenance Costs	(525)
Fuel Costs	(332)
Engine Overhaul	(29)
Net Savings	(80)

Risks of further delay

- ZEBF funding only available until March 2026, important to move quickly to maximise funding availability
- Shortened timeframe of 2023 -2026 due to circumstances beyond the City's control
- Other municipalities will also receive ZETF funding and advancing their ZEB procurement at the same time as Ottawa
- Limited supply and high demand for ZEB could impact availability and cost
- Delays would require additional investment in maintaining aging diesel vehicles scheduled for replacement
- Impact on reliability due to higher maintenance requirements for aging vehicles

Key program milestones – 2023-2027





Questions?