Metro Transit ZEB Transition 2023 Annual Report

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Metro Transit
a service of the Metropolitan Council

Acronyms

- ZEBTP- Zero Emission Bus Transition Plan
- ZEB – Zero Emission Bus
- BEB – Battery Electric Bus
- KPI – Key Performance Indicator
- MDBCR – Mean Distance Between Chargeable Roadcalls
- EEJ – Equity and Environmental Justice
- GHG – Green House Gas
- CO_2e – Carbon Dioxide equivalent

Agenda

- Zero Emission Bus Transition Plan (ZEBTP) Overview
- 2024 Legislative Session Update
- C Line Battery Electric Bus (BEB) Pilot Overview
- Key Performance Indicators
- Project Updates

Transition Plan Guiding Principles

Technical Viability

Strive to achieve a level of service where ZEBs and diesel buses are referred to as just "buses" rather than by their propulsion type

Technical Viability

Partner with Xcel Energy to assess and upgrade electrical infrastructure for bus operations and maintenance facilities

Equity & Environmental Justice

Implement and prioritize ZEB service reflecting transparent fact-driven community engagement and education

Equity & Environmental Justice

Target ZEB investment in communities where air pollution, racial, and socioeconomic disparities are greatest while also balancing the challenges of new technology

Fiscal Impact

Deploy ZEBs in a fiscally efficient manner in order to maximize use of vehicles and infrastructure

Fiscal Impact

Operate and invest within fiscal means by planning for and optimizing capital and operating expenditures while pursuing new funding streams

Transition Milestones & Vehicle Procurements

- **Vehicle procurement** – measure in percent of purchases over time horizon
  - **Target**: Between 2022 and 2027, at least 20% of Metro Transit 40’ bus replacement purchases will be electric.
- **Community Engagement –** Host public engagement activities at least once per year on ZEBTP progress
- **Performance Measure Reporting –** Update the Council on performance of the ZEB fleet and infrastructure at least once per year
- **Budget Planning –** Update the capital and operating plans annually based on ZEB fleet and infrastructure performance
- **Continuous Improvement –** Strive to not only meet but exceed all ZEBTP milestones and performance measures

Transition Plan Guiding Principles – Key Performance Indicators

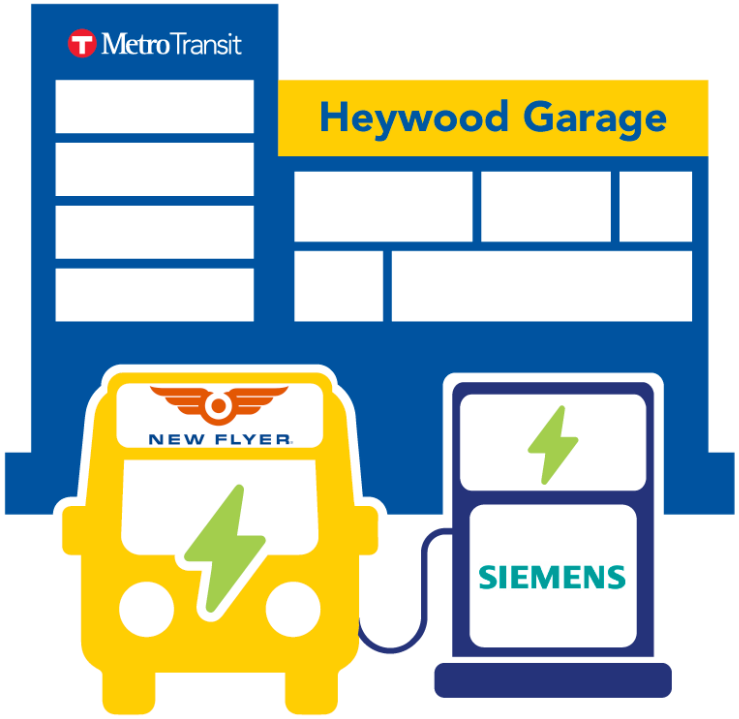
KPI	Guiding Principle		
	Technical Viability	Equity & Environmental Justice	Fiscal Impact
Fleet Mileage	♦		♦
Bus Availability	♦		♦
Bus Reliability	♦	♦	♦
Environmental Impact		♦	
Equity and Environmental Justice (EEJ)		♦	
Energy Cost/Mile	♦		♦
Infrastructure Availability	♦		♦
Infrastructure Reliability	♦	♦	♦

2024 Legislative Session Update

- Must establish a bus procurement transition strategy, so that beginning in 2035, any qualified transit bus purchased for regular route transit service, or special transportation service is a zero emission transit bus
- The Council must also consider methods to maximize GHG reduction, including service expansion, reliability improvements, and other transit service improvements
- Must update our zero emission bus transition plan at least every 3 years, with the next report due on February 15, 2025

C Line Opened June 8, 2019

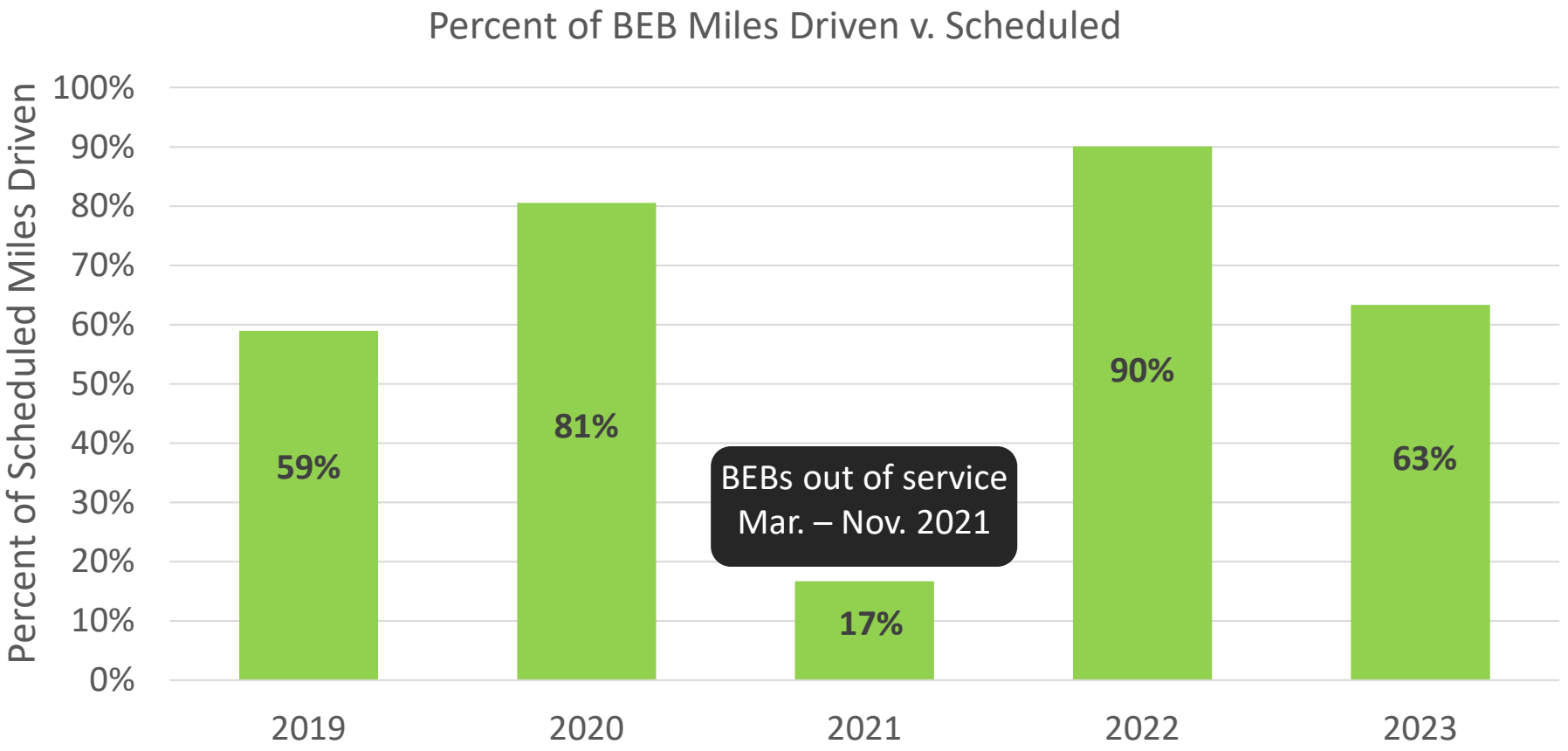
- 8.5 miles from downtown Minneapolis to Brooklyn Center
- 23 stations
- $37 million project cost including new stations and BRT-branded buses
- Initial Battery Electric Bus (BEB) Pilot
  - 2017 FTA Low/No Emission Grant
  - (8) 60-foot 466kWh BEBs
  - (8) 150kW plug-in garage chargers
    - Replaced under warranty in 2021
  - (2) 300kW overhead conductive chargers
    - Retired in 2023



Fleet Mileage

- **What is Being Measured?**
  - The total number of miles driven by BEBs each year
- **How is it Being Measured?**
  - Total odometer miles for the BEBs
- **Why is it Important?**
  - As Metro Transit makes progress towards transitioning its fleet to BEBs, the total number of fleet miles driven by BEBs will increase. Comparing annual vehicle mileage for BEBs will help depict how they perform in our service environment

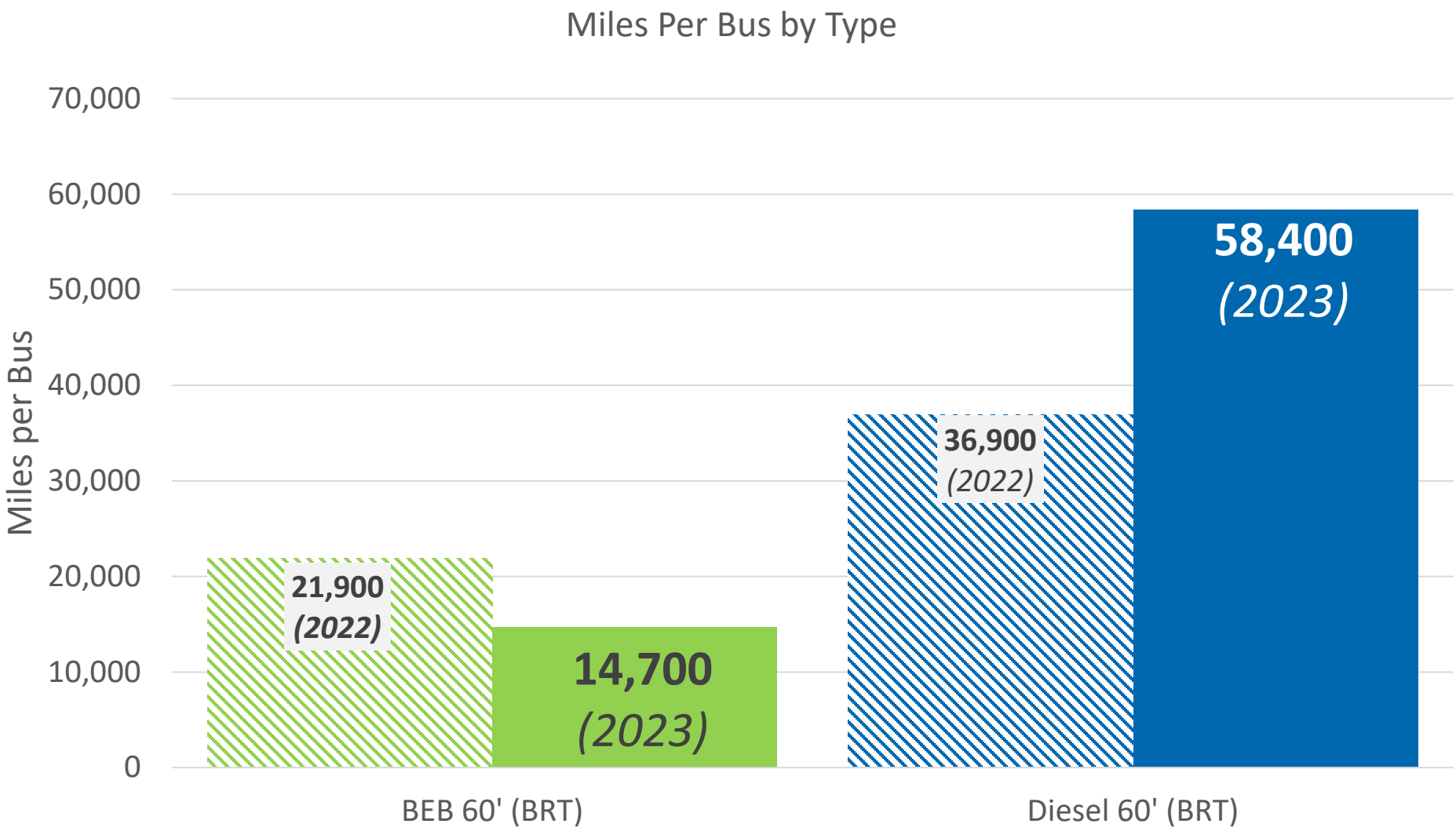
2023 C Line BEBs drove fewer scheduled miles



	2019	2020	2021	2022	2023
Annual C Line BEB Miles*	66,400	162,700	37,800	175,300	117,400
Annual C Line Diesel Miles*	312,600	466,700	625,200	476,900	561,800

** Values rounded to the nearest 100*

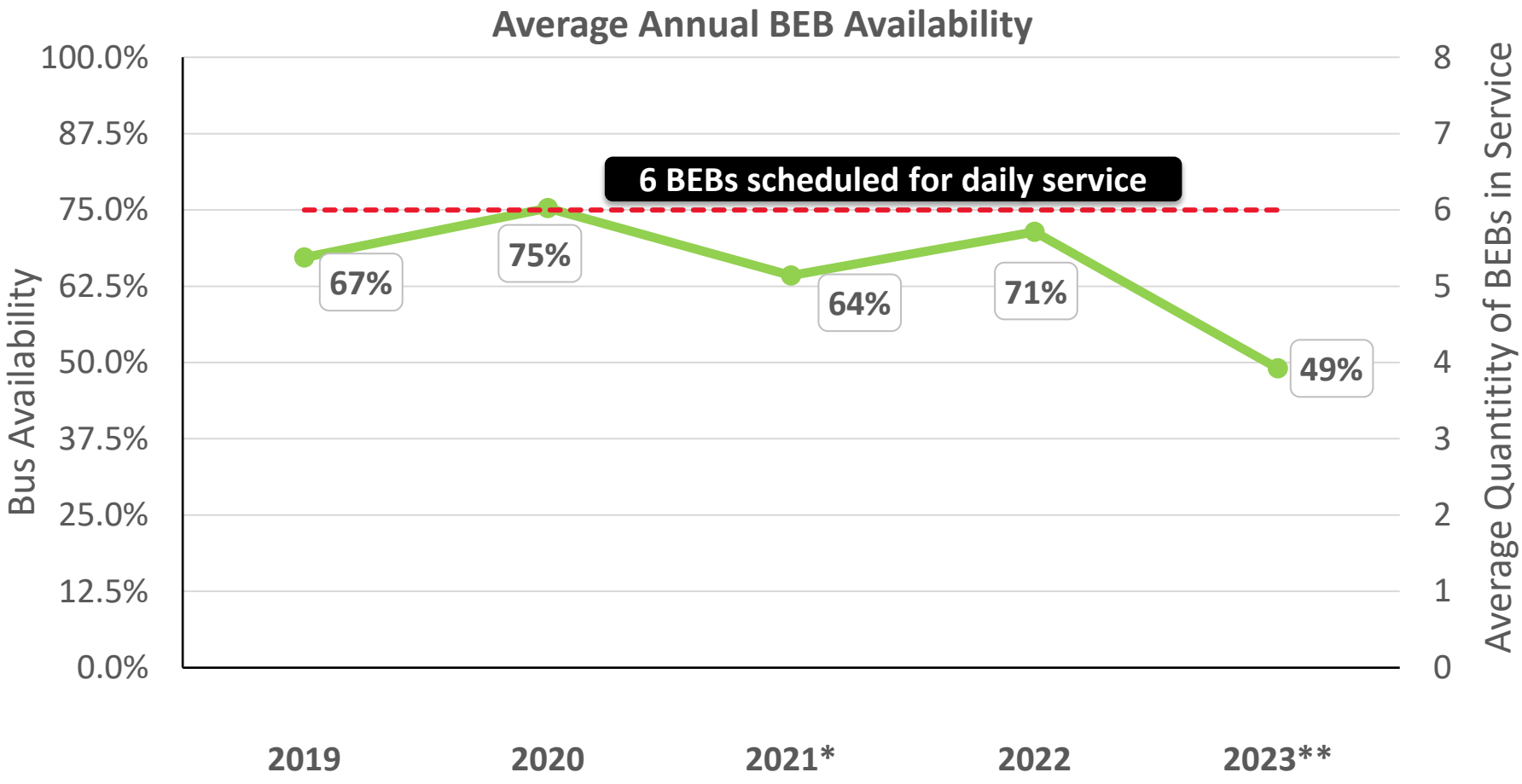
60’ BEBs travel fewer miles than comparable diesel buses



Bus Availability

- **What is Being Measured?**
  - The percent of BEBs available for use in service.
- **How is it Being Measured?**
  - The total number of days each bus is available for use in service divided by the total number of planned service days.
- **Why is it Important?**
  - The **Bus Availability** metric quantifies bus readiness and helps Metro Transit assess product availability to consistently provide reliable service.

BEB availability declined in 2023

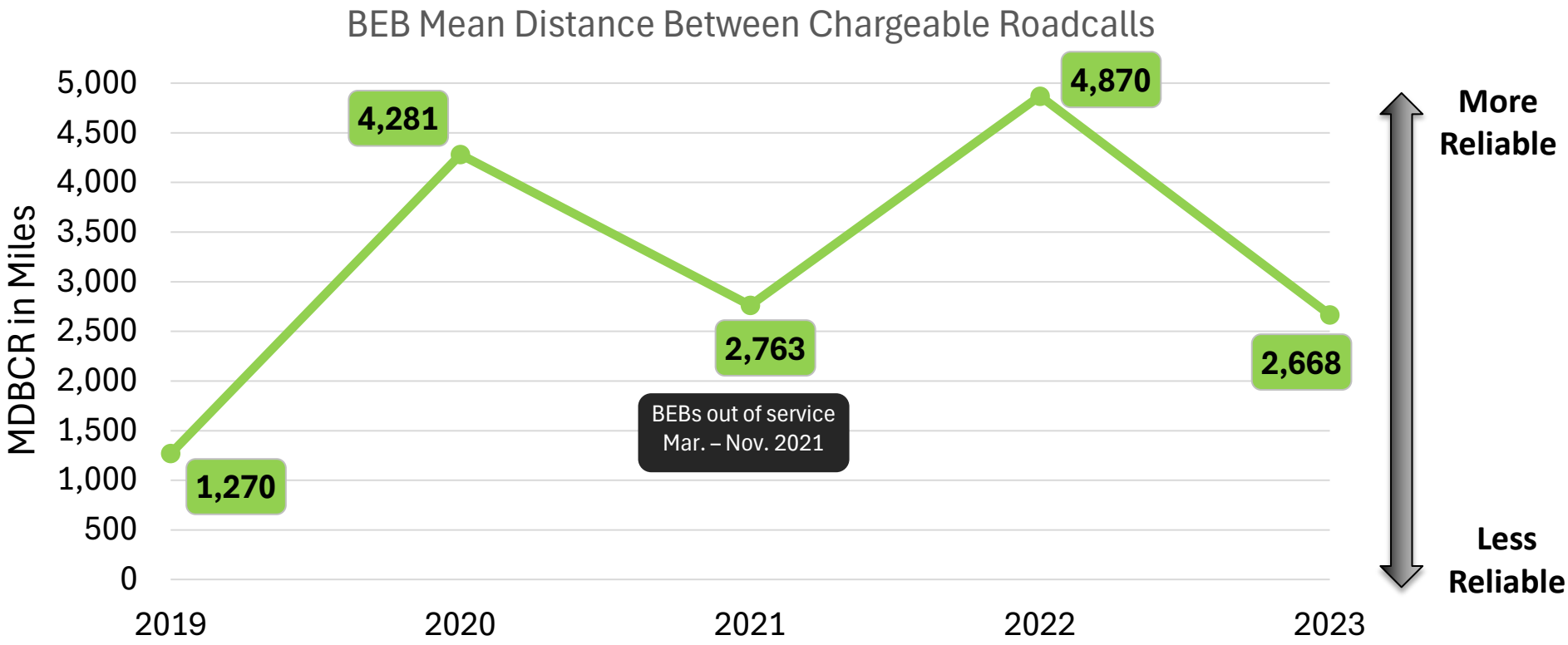


** 2021 metrics measured for the 90 days BEBs were used in revenue service*
*** 2023 metrics impacted by battery cell failures*

Bus Reliability

- **What is Being Measured?**
  - Mean (average) distance between chargeable road calls.
    - Chargeable road calls are defined as instances when a bus requires unplanned maintenance attention while in service.
- **How is it Being Measured?**
  - Number of miles traveled divided by the number of chargeable road calls
- **Why is it Important?**
  - The **Bus Reliability** metric will help Metro Transit evaluate how often a bus breaks down while in service to assess the impact BEBs have on service reliability and customer experience.

BEB reliability declined in 2023



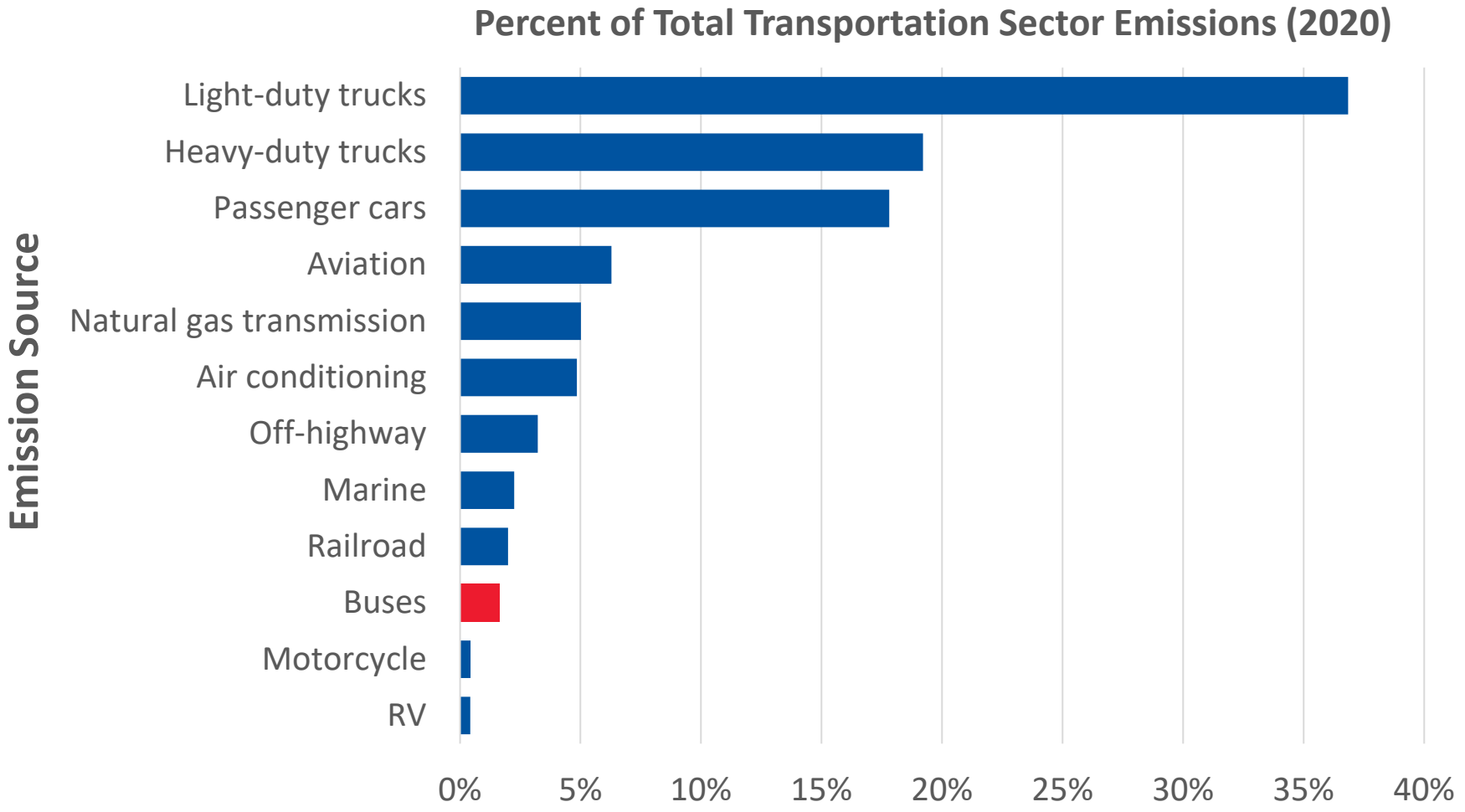
Mean Distance Between Chargeable Roadcalls	2019	2020	2021	2022	2023*
60' BEB BRT Buses	1,270	4,281	2,763	4,870	2,668
60' Diesel BRT Buses	8,247	8,656	5,201	8,862	7,700

** 2023 BEB metrics impacted by battery cell failures and out-of-service on-route chargers*

Environmental Impact

- **What is Being Measured?**
  - Greenhouse gas (GHG) emission reductions compared to a baseline diesel fleet
- **How is it Being Measured?**
  - Well-to-Wheel GHG reductions calculated using the Argonne National Laboratory's 2023 Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) model
- **Why is it Important?**
  - The **Environmental Impact** metric quantifies the impact the transition towards BEBs has on reducing transit vehicle emissions and demonstrates the community benefits that BEBs deliver to the region

Buses contribute less than 2% of Minnesota's transportation greenhouse gas emissions



Source: [2020 Sector Sources of GHG Emissions and Storage](), Minnesota Pollution Control Agency. Accessed May 2023

From 2019 - 2023, BEB deployments have reduced GHG emissions by 430 Metric Tons CO_2e.

This is approximately equivalent to the CO_2 emissions from:

42,200 gallons of diesel consumed

85 homes' electricity use for one year

Conversion Source: EPA Greenhouse Gas Equivalencies Calculator

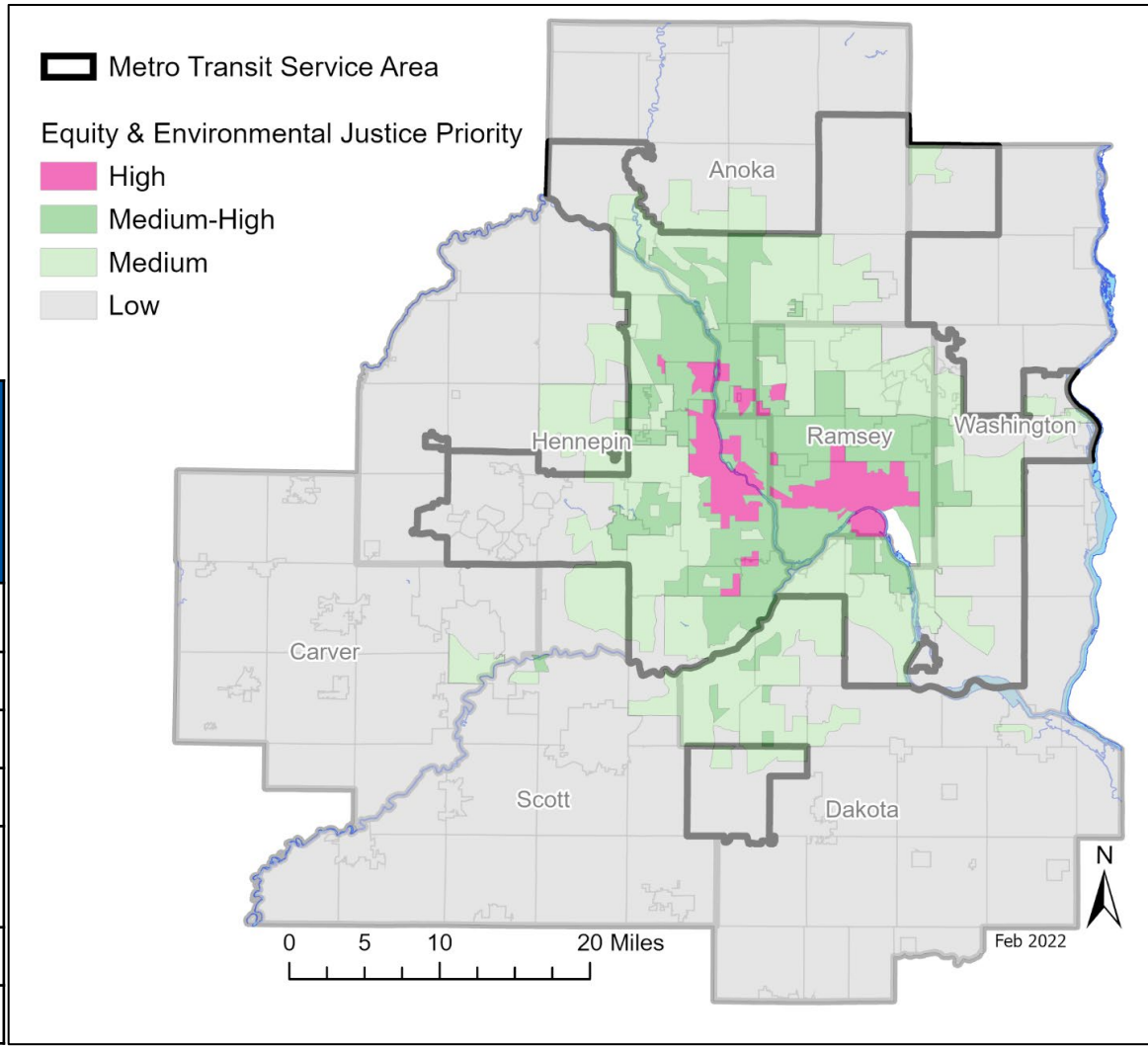
Equity and Environmental Justice (EEJ)

- **What is Being Measured?**
  - Percent of BEB deployments on “High Priority” EEJ service blocks as defined in Section 8.3.2 of Metro Transit’s Zero-Emission Bus Transition Plan (February 2022)
- **How is it Being Measured?**
  - BEB deployments on “High Priority” EEJ service blocks divided by the total number of BEB deployments
- **Why is it Important?**
  - The **Equity and Environmental Justice** metric will help Metro Transit understand the impact BEB deployment prioritization is having in the community based on environmental, racial, and socioeconomic considerations

Equity and Environmental Justice (EEJ)

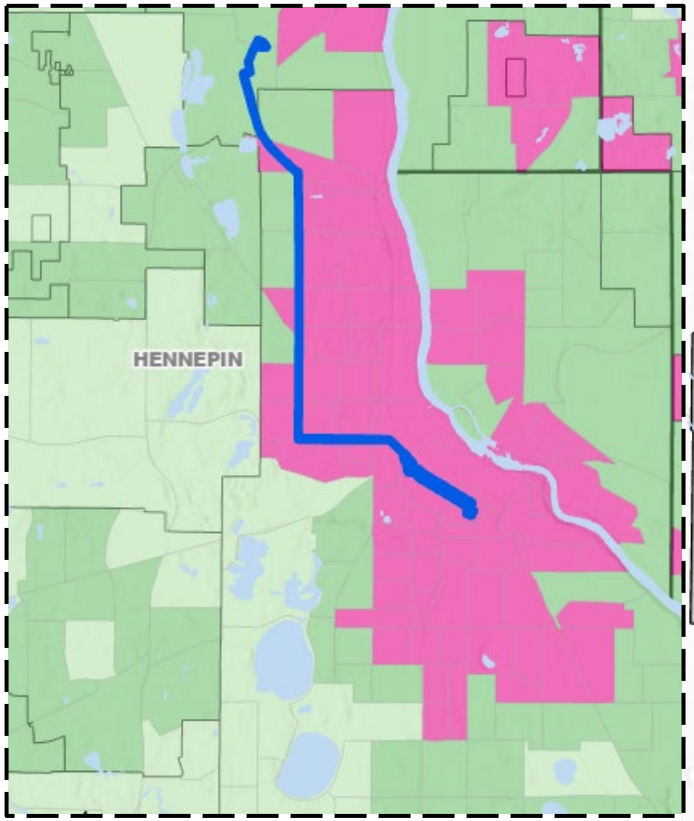
- High Priority service blocks have the greatest portion of bus mileage in High Priority (pink) EEJ Areas

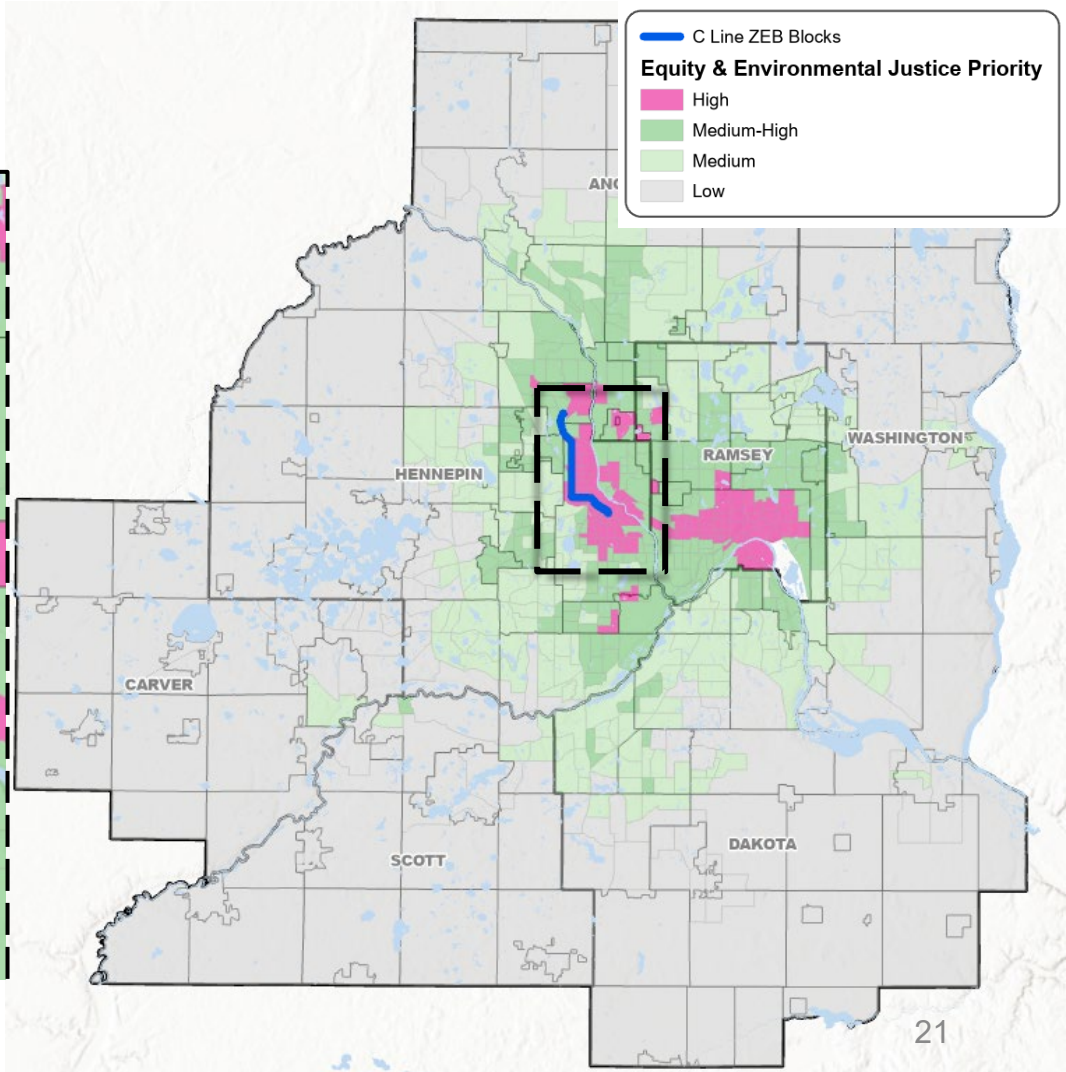
Component	% of Census Tract EEJ Score
Cancer Risk	34%
Population Density	22%
% BIPOC	17%
% Zero Car Household	11%
# of Years Area of Concentrated Poverty	9%
Avg. Land Temperature	4%
% Housing Cost Burdened	3%



In 2023, 100% of BEB deployments were on “High Priority” EEJ blocks

METRO C Line

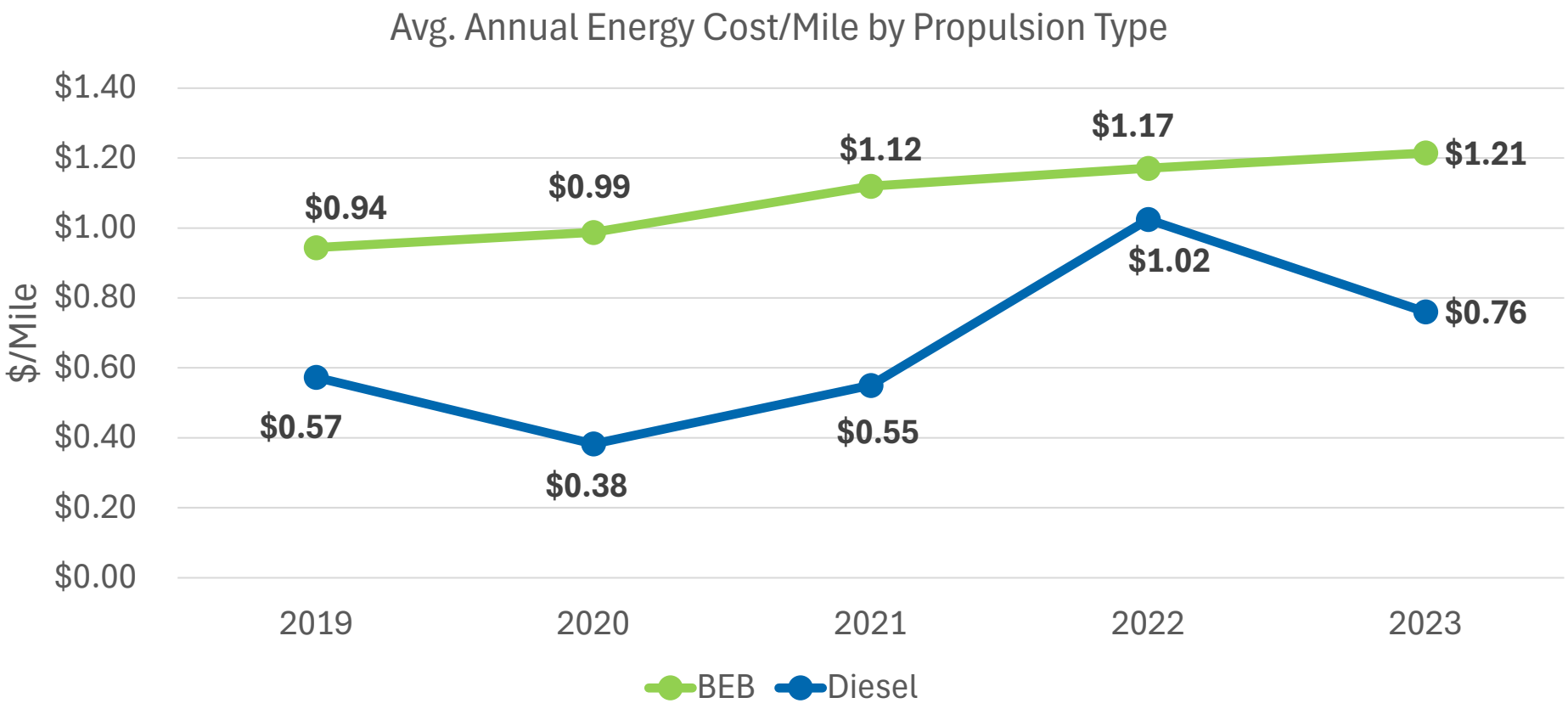




Energy Cost/Mile

- **What is Being Measured?**
  - Energy cost a bus uses to travel one mile inclusive of propulsion energy (diesel or electricity) and diesel fuel for bus auxiliary heat
- **How is it Being Measured?**
  - The total energy cost by vehicle group divided by the total miles traveled by that group
- **Why is it Important?**
  - The **Energy Cost/Mile** metric will help Metro Transit understand the ongoing costs and necessary budget to operate BEBs

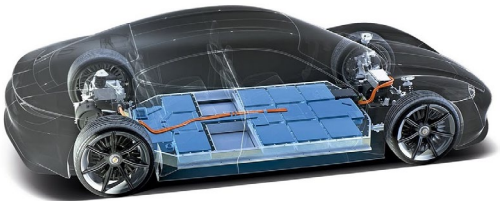
Average energy costs per mile are higher for BEBs than diesel buses

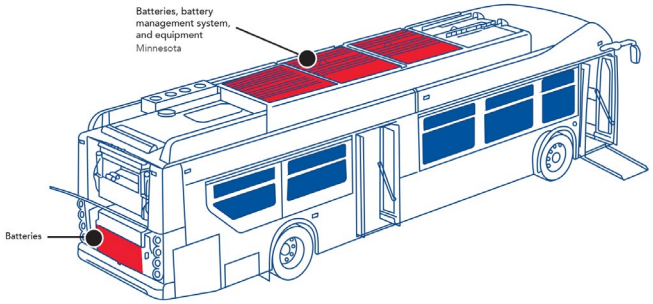


Infrastructure Availability

- **What is Being Measured?**
  - Percent of chargers available to charge a bus for revenue service
- **How is it Being Measured?**
  - Total number of days each charger is available to support deploying buses in revenue service divided by the total number of planned service days
- **Why is it Important?**
  - Historically fuel pump availability was not a concern, however early charger deployments have had lower availability. The **Infrastructure Availability** metric will help Metro Transit assess technology ability to consistently provide reliable service.

BEB batteries are significantly larger than car batteries





Standard Car Battery:

Avg Capacity: 1 kWh

Electric Car Battery:

Avg Capacity: 20-130 kWh

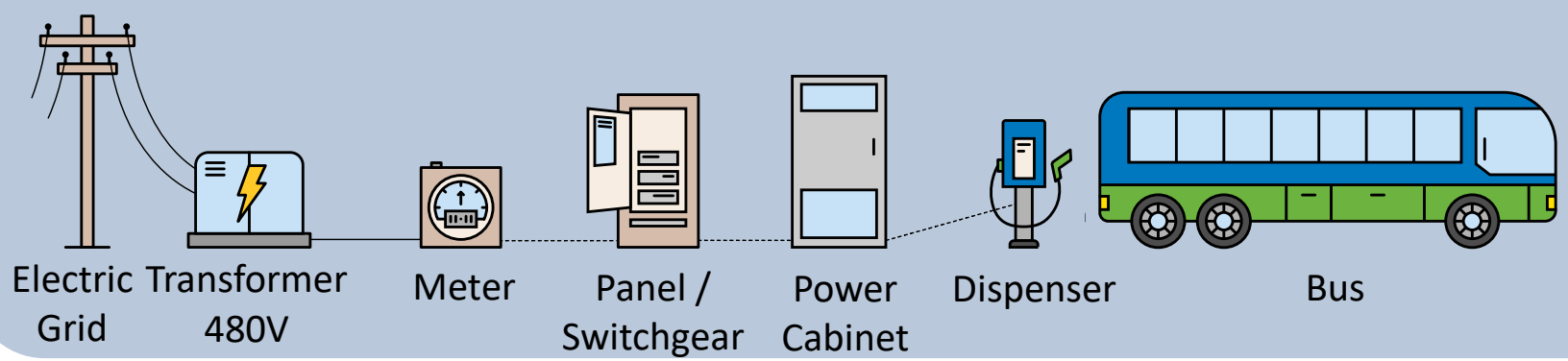
Max Capacity: 212 kWh

BEB Battery:

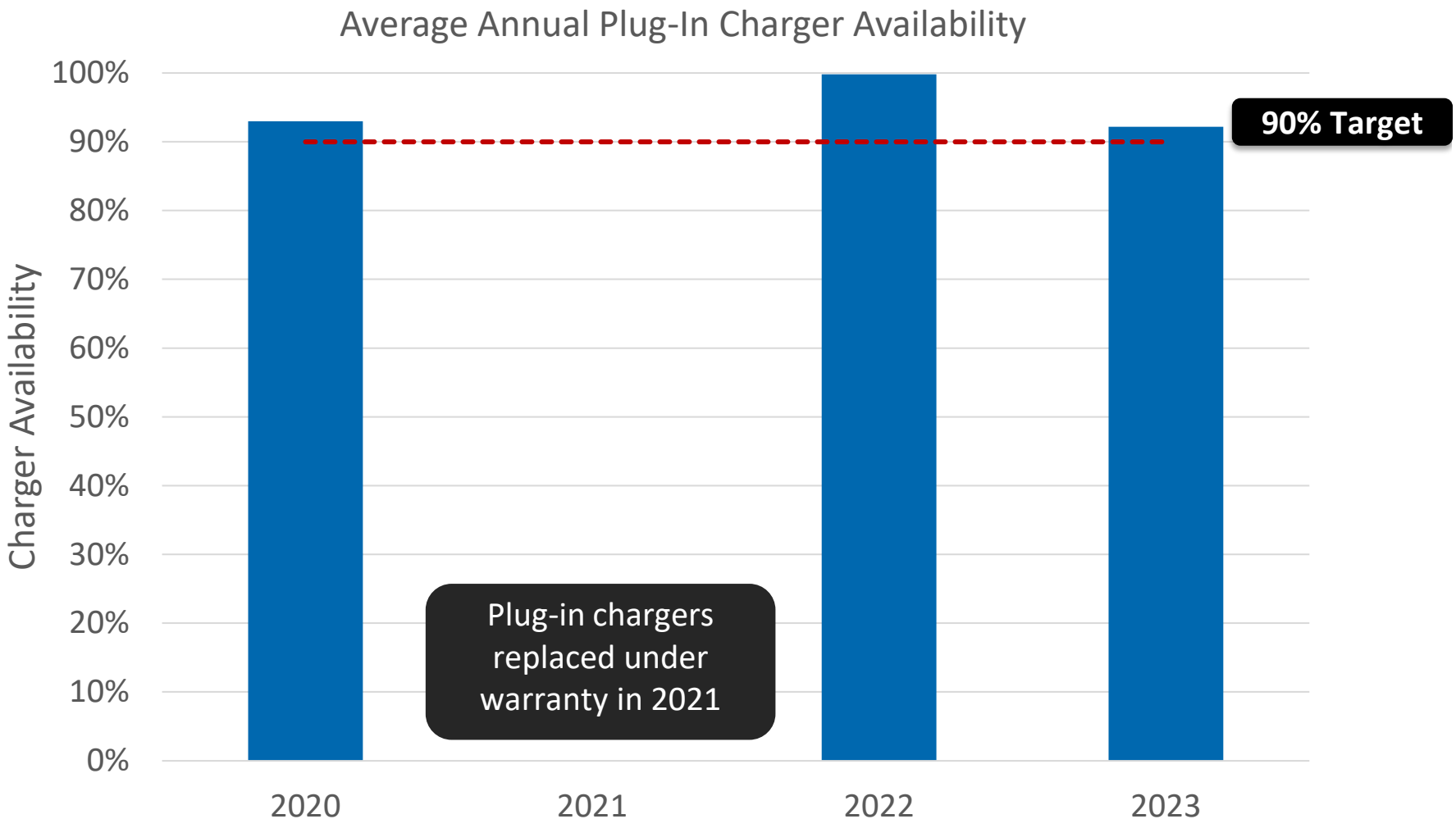
Max Capacity: about 700 kWh

Sources: Stephanie Melancon (LaserAX), Electrek

BEB charging infrastructure



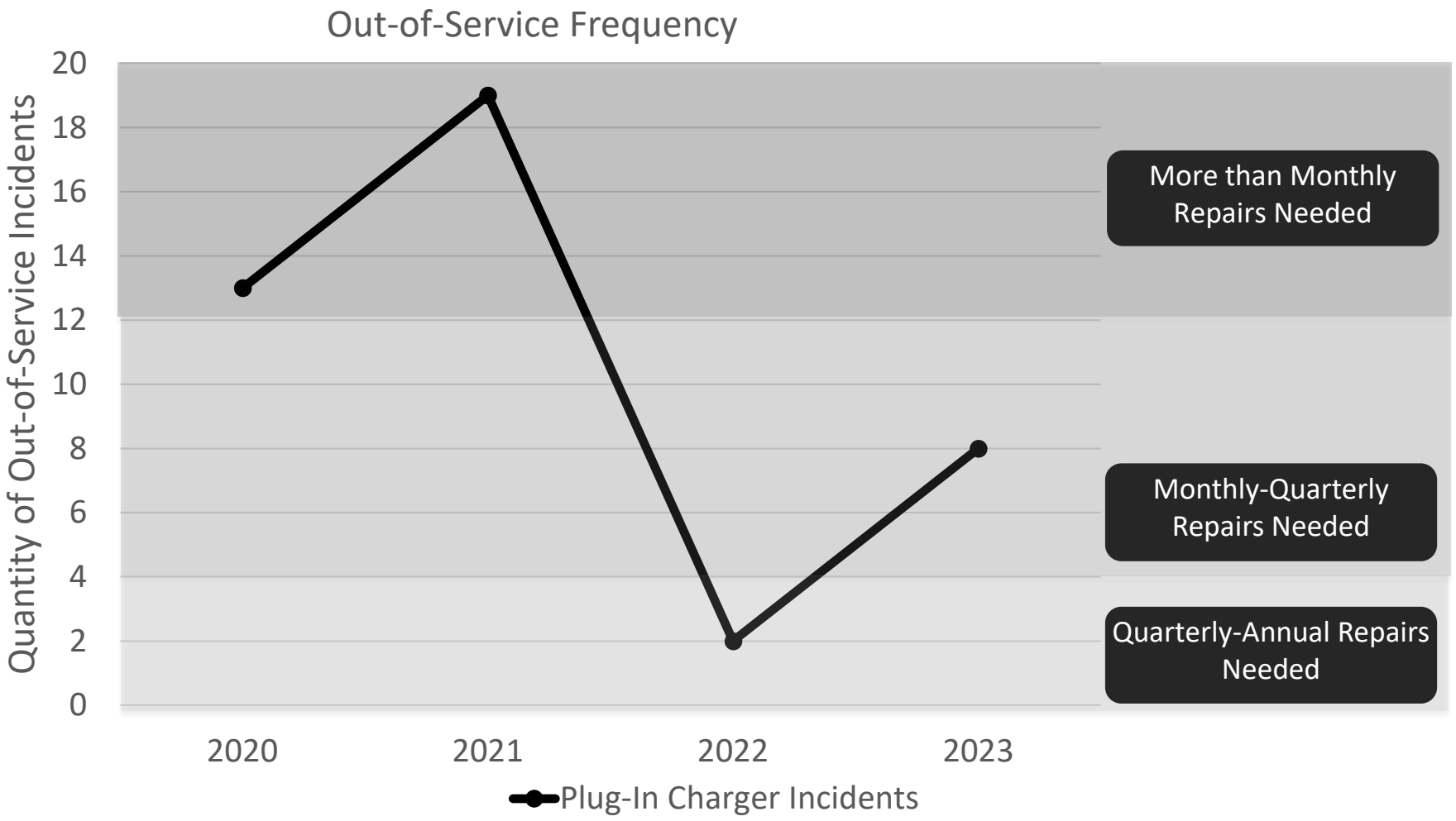
In 2023, plug-in charger availability met operational needs



Infrastructure Reliability

- **What is Being Measured?**
  - The quantity of incidents that take a charger out of service
- **How is it Being Measured?**
  - **Incident Quantity**: Number of incidents that take a charger out of service, not inclusive of preventative maintenance or pre-revenue testing
- **Why is it Important?**
  - The **Infrastructure Reliability** metric will help Metro Transit understand how often chargers must be temporarily removed from service for unplanned maintenance. This will help Metro Transit assess technology ability to consistently provide reliable service.

In 2023, out-of-service incidents occurred on average twice per quarter for garage (plug-in) chargers



Note: Metrics not reported for 2019 while commissioning was ongoing.

Power Disruptions

- Incidents impacting ability to charge at garage in 2023:
  - 1 Power outage lasting less than 2 hours
  - 2 Momentary power disruptions
    - Required all chargers to be reset

Battery-Electric Bus (BEB) KPI Summary

2022 - 2023 Summary

KPI	Battery Electric 2022	Battery Electric 2023
Fleet Mileage*	175,300	117,400
Bus Availability *(% of BEBs Available for Use in Revenue Service)*	71%	49%
Bus Reliability *(Mean Distance Between **Chargeable** Road Calls)*	4,870	2,668
Environmental Impact** *(GHG [CO_2e] Reduction in Metric Tons)*	145	60
Equity and Environmental Justice (EEJ) *(Percent of BEB Deployments on "High Priority" EEJ Blocks)*	100%	100%
Energy Cost/Mile	$1.17 *($1.02 for diesel bus)*	$1.21 *($0.76 for diesel bus)*
Infrastructure Availability *(Average Full Days Available to Charge a Bus for Use in Revenue Service)*	Garage: 99.8%	Garage: 92%
Infrastructure Reliability *(Total incidents that take chargers out of service)*	Garage: 2	Garage: 8

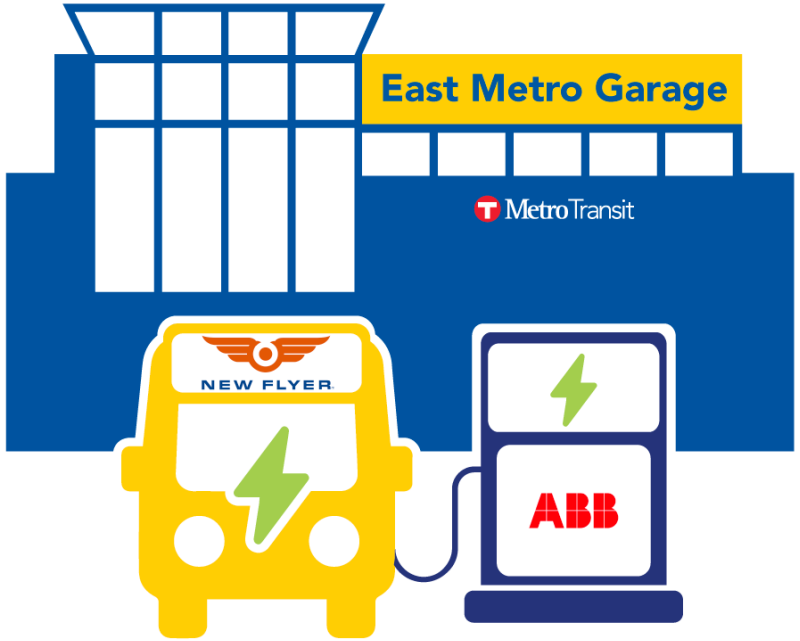
** Rounded to the nearest 100 miles*

*** Rounded to the nearest 5 Metric Tons*

Objectives and Strategies

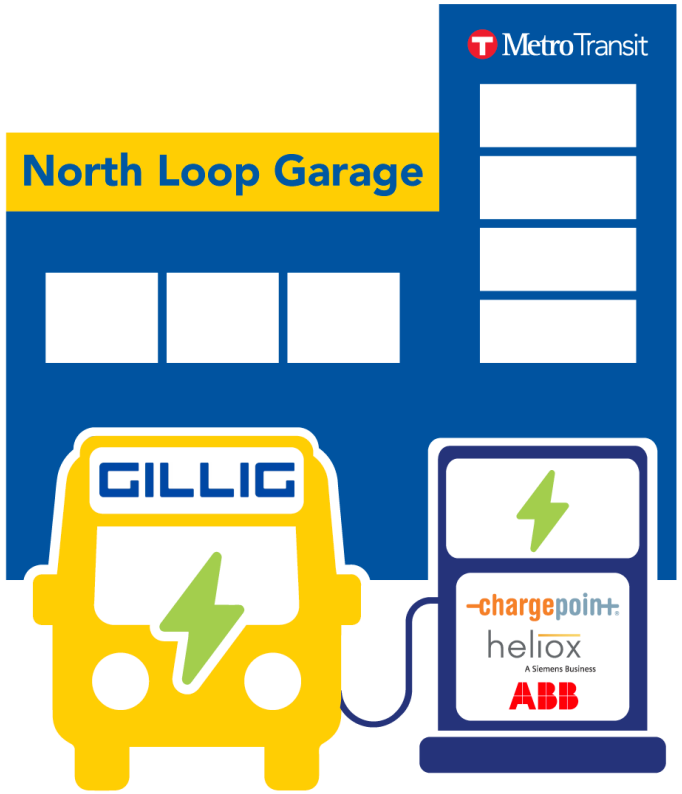
Project Updates: East Metro Garage

- Bus and charger contract executed
  - (5) 60’ New Flyer Electric Buses
  - (4) ABB chargers
- Construction begins June 2024 for new power feeders
- Buses and chargers to enter revenue service in 2025 on METRO Gold Line



Project Updates: North Loop Garage

- Bus and charger purchase
  - (20) 40’ Gillig BEBs
  - (18) plug-in chargers from ABB, Chargepoint, Heliox
  - (4) Heliox mobile chargers for maintenance use
  - Charge Management Software
- Buses and chargers to enter revenue service in 2026 on local service routes



Project Updates: Planned Bus Purchases

Vehicle Type	Purchase Year 2024
40-foot battery electric	20*
40-foot diesel	73
60-foot BRT battery electric	5*
60-foot BRT diesel	20**

**Contract has been executed, procured using State of Washington Cooperative Agreement*

***Contract has been executed, procured using contract 19P321*

Project Updates: 2024 Low/No Grant Application

- Metro Transit is seeking up to $90 million in funding to complete:
  - Facility improvements and electrification readiness upgrades at the East Metro Bus Garage (35) 40’ BEBs for use at East Metro and North Loop Garages primarily for urban service on local routes;
  - Charging system to utilize nearly 2 MW of electric capacity at East Metro Bus Garage;
  - Supporting BEB equipment and workforce development activities.
- FTA selection announcements anticipated by July 10, 2024

Engagement in 2023

- 16 events, tours or speaking engagements
- 10 internal engagement events
- 16 peer exchanges
- 4 industry work groups & committee assignments

❖ Save the Date – Virtual Public Engagement Summit: July 31st 12-1pm

Thank You!

www.metrotransit.org/electric-buses