



Zero Emission Bus Transition Plan

Committee of the Whole
Information Item
January 5, 2022

Agenda

- Overview of legislative requirements
- Guiding Principles
- Update on community engagement
- Peer agency interviews and lessons learned
- Methodology establishing policies and guidance
- Results and recommendations
- Risks and strategies
- Milestones and performance measures
- Proposed Action and timeline

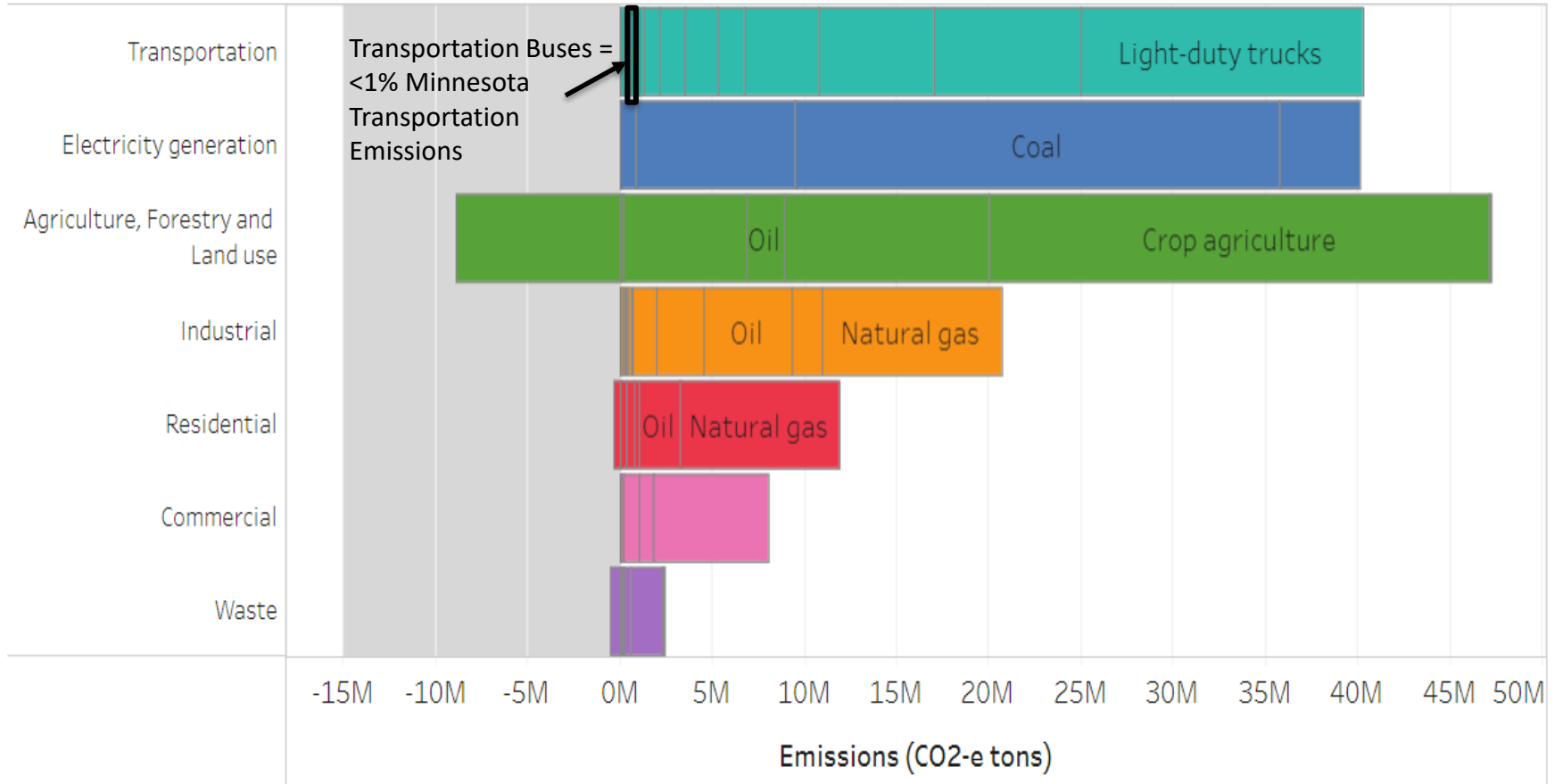
ZEBTP Statutory Requirements

- The Council must develop and maintain a zero-emission and electric transit vehicle transition plan
- The Council must complete the initial plan by February 15, 2022, and revise the plan at least once every five years
- At a minimum, the plan must:
 1. establish implementation policies and guidance;
 2. set transition milestones or performance measures, or both, which may include vehicle procurement goals over the transition period;
 3. identify barriers, constraints, and risks, and determine objectives and strategies to address the issues identified;
 4. consider findings and best practices from other transit agencies;
 5. analyze zero-emission and electric transit vehicle technology impacts, including cold weather operation and emerging technologies;
 6. consider opportunities to prioritize the deployment of zero-emissions vehicles in areas with poor air quality;
 7. provide detailed estimates of implementation costs; and
 8. summarize updates to the plan from the most recent version. (Updates required at least every 5 years)

Metro Transit Mission & Service Excellence

- **Mission:** We at Metro Transit deliver environmentally sustainable transportation choices that link people, jobs and community conveniently, consistently and safely.
- **Service Excellence:** We go beyond the expectations of our customers to deliver convenient, comfortable and reliable service; we don't accept today's best as tomorrow's limitations.

Sources of GHG Emissions and Storage in Minnesota



Source: [Climate change in Minnesota: Greenhouse gas emissions data](#), Minnesota Pollution Control Agency, 2018

Guiding Principles & Supporting Actions



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

Engagement Events

- External
 - Stakeholder Summits - November 3 & 4
 - Drive Electric Minnesota Keynote - December 9
 - Neighborhood Organizations
 - Completed - St. Anthony Park, Fort Road Federation, Marcy-Holmes, Northside Residential Redevelopment Council, Sustain St. Paul
 - Scheduled –Stevens Square, Powderhorn Park, Phillips West
 - Orange Line Opening Celebration at Lake Street Station
- Internal
 - Bus operator and maintenance outreach at each garage
 - Metro Transit monthly manager's meeting

Survey Results

- 300+ survey responses
 - 89% respondents rated transition to zero-emission as important or very important.
- How should Metro Transit prioritize ZEB deployment:
 - Areas with highest air quality concerns
 - High ridership routes
 - Population density
- Other factors or characteristics Metro Transit should consider:
 - Noise
 - Emissions/air pollution
 - Access
 - Elderly
 - Food deserts

Survey Results

- Survey results inform Equity and Environmental Justice prioritization
- Environmental factors and population characteristics ranking
 1. Cancer Risk
 2. Population Density
 3. % BIPOC
 4. % Zero-car Households
 5. # Years Areas Concentrated Poverty
 6. Land Temperature
 7. % Housing Cost Burdened

Learning from Our Peers

- Expect the unexpected
- Plan for longer ZEB/charger repair times
- Start ZEB process early; implementation takes much longer than a diesel bus
- Meet early and often with your electric utility
- Consistent range allows for reliable operation through all seasons; plan for bad weather days
- Develop strong contractual language; including performance metrics
- When conducting an equity analysis, consider impacts to service reliability with emerging technologies

Peer Agency Comparison

	Metro Transit Minneapolis-Saint Paul, Minnesota	Foothill Transit Greater Los Angeles, California		King County Metro King County, Washington		Chicago Transit Authority (CTA) Chicago, Illinois	Toronto Transit Commission (TTC) Toronto, Ontario
Total Bus Fleet	910	347		1,391		1,861	2,096
Type of ZEB	BEB	BEB	FCEB	Electric Trolleybus	BEB	BEB	BEB
Year of First In-Service ZEB	2019	2010	2022/2023	1940	2015	2014	2019
ZEBs in Service (Dec. 2021)	8	34	0	174	51	11	60
ZEBs on Order or Programmed	100	0	33	0	250	90	300
Programmed Time Horizon	2022-2027	2021-2024		2025-2028		2020-2027	2023-2025
Total ZEBs Identified	108 (12% of bus fleet)	67 (19% of bus fleet)		475 (34% of bus fleet)		101 (5.4% of bus fleet)	360 (17% of bus fleet)
Current ZEB Transition Goal		100% zero-emissions by 2040 Set by CARB		100% zero-emissions powered by renewable energy by 2035 Set by King County Metro		100% zero-emissions by 2040 Set by City of Chicago	100% zero-emissions by 2040 Set by TTC
Year Goal Established	2022	2019		2020		2019	2017

- Information provided from peer agency interviews and email correspondence
- BEB=Battery Electric Bus; FCEB=Fuel Cell Electric Bus
- CARB=California Air Resources Board


Methodology for Establishing Policies and Guidance

- 4-Step Sequential filtering of August 2021 service schedules

1. Garage Suitability & Xcel Power Analysis



2. Sufficient Vehicle Battery Capacity Including in Cold Weather



3. Equity Prioritization



4. Fiscal Efficiency Prioritization

Garage Analysis

- Garage electrification will occur in tiers based on:



Current and future
electrical supply



Garage capacity and space
for charging infrastructure



Land/facility ownership

Xcel Electrical Capacity Analysis

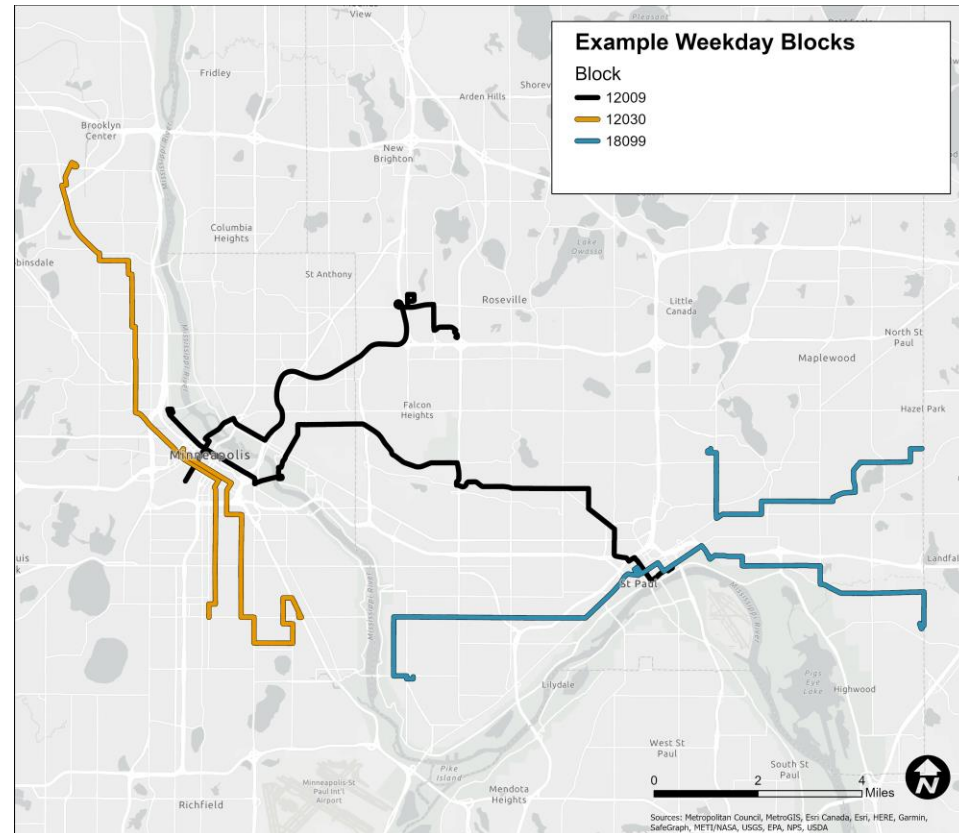
Tier	Garage Facility	Xcel Energy Timeline Horizon to Add Power	Construction & Installation Timeline	Xcel + Metro Transit Project Duration
Tier 1 (start in 2022)	Minneapolis Bus Garage (MBG)	First Half Ready	1-1.5 Years	1 – 1.5 Years
	East Metro Garage	1.5 – 2 Years	1.5 – 2 Years	3 – 3.5 Years
Tier 2 (start TBD)	Nicollet Garage	2 Years	1.5 – 2 Years	3.5 – 4 Years
	Heywood Garage			
Tier 3 (start TBD)	Martin J Ruter Garage	5 Years	1.5 – 2 Years	6.5 – 7 Years
	South Garage	No upgrades recommended without long-term lease		

- Variation in Xcel Energy timelines based on if utility lines are overhead (2 years) or underground (5 years)

Analysis Overview

- **Goal:**
 - Develop methodology that can be applied to future schedules for deploying ZEBs
- **Block-Level Analysis:**
 - Series of bus trips combined and assigned to a single vehicle for operation
 - What one bus does in a day
 - May have multiple operators
 - May cover multiple routes
 - 1,189 total blocks
 - Weekday: 672
 - Saturday: 293
 - Sunday: 224

Measure	Statistic	Value
Length (mi.)	Average	133
	Max	346
	Min	11
Duration (hr.)	Average	11
	Range	1- 22



Vehicle & Service Analysis

- **Usable Battery Capacity:**
 - Plan for worst-case (winter) fuel efficiency
 - Plan for reserve to protect battery health and get home in unforeseen conditions
 - Plan for battery degradation over life of vehicle

- **Service Analysis:**
 - Based on Aug. 2021 schedules
 - Approximately half of blocks are technically viable
 - Approximately one third of service hours and miles are technically viable

Item	40-foot buses with auxiliary diesel heater / long-range technology
Battery size, nominal capacity	675 kWh
Battery size, useable capacity (68% of nominal)	459 kWh
Average kWh per mile	2.2
Average range in miles	209
Worst case kWh per mile	3.5
Worst case range in miles	131

Equity and Environmental Justice Analysis

Equity & Environmental Justice Priority Areas (% of Top Choice Votes)

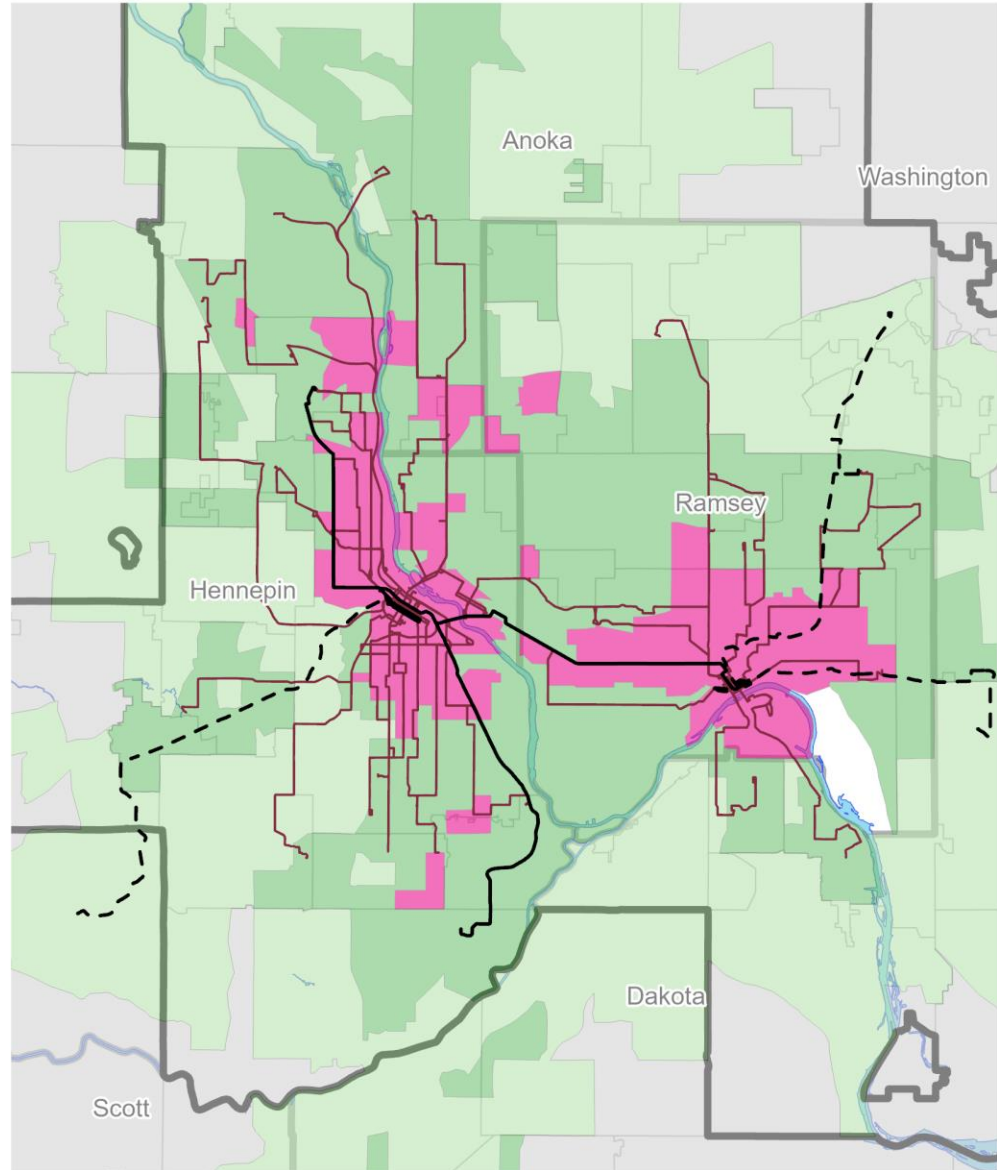
- Metro Transit Service Area
- Existing Dedicated Electric Fleet
- Future Dedicated Electric Fleet
- Top 675 kWh Blocks (August '21 Pick)

Equity & Environmental Justice Priority

- High
- Medium-High
- Medium
- Low



Characteristic	% of Votes
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%



Barriers, Constraints, Risks

- Electrical Grid Capacity
 - Increasing and competing demands of power from the grid
- Large infrastructure projects can adversely impact garage operations
- Manufacturer and supply chain capacity to meet increasing demand
- Manufacturer ability to meet performance necessary to deliver reliable service
- Long term changes in level of service and peak vehicle requirements
 - Covid-19 impacts
 - Operator shortage
- Speed of innovation
 - Technology obsolescence and minimum life requirements

Objectives and Strategies

- Evaluate multiple charger and bus manufacturers in smaller orders before proceeding to larger orders
- Identify learning objectives for each project
- Maximum concurrent work at two garages to manage disruption to operations
- Ensure project timelines align with Xcel Energy timelines for planning, engineering, construction of power supply
- Pair ZEB projects with development of other areas of the business including software tools, workforce development, etc.

Necessary Industry Advancements



Increased battery capacity



Operational cost study of EV transit utility rate and demand management



Improved resiliency for when there is a power outage



Better interoperability among different types and makers of EVs, chargers, and software systems



Faster (kW) depot charging systems



Hydrogen fuel cell technology advancements



Increased production capacity of EVs, batteries, and chargers with a decrease in capital costs



Improved reliability and reduced fiscal impact of on route charging

Milestone Setting Recommendations

- **Requirement:** set transition milestones or performance measures, or both, which may include vehicle procurement goals over the transition period
- **Approach:**
 1. Milestones are set in five year increments aligned with plan updates
 - a. Short Term: 2022-2027
 - b. Medium Term: 2028-2032
 - c. Long Term: 2033 and beyond
 2. Performance measures are used to analyze progress against the milestones, inform plan updates, and drive decision making for future procurements
 3. *Targets* are set for short term milestones for each update
 4. *Projections* are identified for medium term milestones starting with 2027 plan update

Performance Measures

- **Fleet Mileage** – how many miles vehicles are driven annually
- **Bus Availability** - % of calendar year ready for service
- **Infrastructure Availability** - % of calendar year infrastructure available for use
- **Bus Reliability** – mean distance between road calls
- **Charger Reliability** – warranty ticket volume
- **Cost/mile** – energy cost per mile driven
- **Environmental Impact** – emissions reduction

Peer Agency Performance Measure Example

AC Transit 5x5

FLEET	DIESEL (BASELINE)	DIESEL HYBRID	FUEL CELL ELECTRIC (FCEB)	BATTERY ELECTRIC (BEB)	LEGACY FUEL CELL
Series Grouping	1600	1550	7000	8000	FC
Technology Type	Diesel	Hybrid	Fuel Cell	Battery	Fuel Cell
Bus Qty	5	5	5	5	5
Manufacturer	Gillig	Gillig	New Flyer	New Flyer	Van Hool
Year	2018	2016	2019	2019	2010
Length	40'	40'	40'	40'	40'
Data Summary (January - June 2021)					
Fleet Mileage	120,749	98,189	88,389	54,275	70,859
Cost/Mile	\$1.41	\$1.80	\$1.97	\$2.02	\$4.07
Cost/Mile (w/ credits)	\$1.37	\$1.78	\$0.58	\$0.69	\$4.07
Emissions (CO ₂ Metric Tons)	298	182	0	0	0
Fleet Availability	96%	75%	69%	47%	68%
Reliability (MBCRC)	12,075	4,091	6,314	3,618	2,531

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.
 - **Projection:** Between 2028 and 2032, the percentage of Metro Transit bus procurements that are zero emission will be driven by key performance indicators and available budgetary resources.
- **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

Council Timeline & Proposed Action

- January 5 – Committee of the Whole Information Item
- January 24 – Transportation Committee Business Item
- February 9 – Full Council Business Item
- February 15 – Submit ZEBTP to MN legislature
- **Proposed Action BI 2022-05:** That the Metropolitan Council adopt the Zero Emission Bus Transition Plan for submittal to the MN State Legislature as required by Minnesota Statute 473.3927.