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

- 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

- 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

- 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

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

- 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

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

- 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

<table>
<thead>
<tr>
<th>Measure</th>
<th>Statistic</th>
<th>Value</th>
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<tbody>
<tr>
<td>Length (mi.)</td>
<td>Average</td>
<td>133</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>346</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>11</td>
</tr>
<tr>
<td>Duration (hr.)</td>
<td>Average</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>1- 22</td>
</tr>
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</table>

Example Weekday Blocks
Block
- 12099
- 12030
- 16099
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

<table>
<thead>
<tr>
<th>Item</th>
<th>40-foot buses with auxiliary diesel heater / long-range technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery size, nominal capacity</td>
<td>675 kWh</td>
</tr>
<tr>
<td>Battery size, useable capacity (68% of nominal)</td>
<td>459 kWh</td>
</tr>
<tr>
<td>Average kWh per mile</td>
<td>2.2</td>
</tr>
<tr>
<td>Average range in miles</td>
<td>209</td>
</tr>
<tr>
<td>Worst case kWh per mile</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>Worst case range in miles</strong></td>
<td><strong>131</strong></td>
</tr>
</tbody>
</table>
### 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

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>% of Votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer Risk</td>
<td>34%</td>
</tr>
<tr>
<td>Population Density</td>
<td>22%</td>
</tr>
<tr>
<td>% BIPOC</td>
<td>17%</td>
</tr>
<tr>
<td>% Zero Car Household</td>
<td>11%</td>
</tr>
<tr>
<td># of Years Area of Concentrated Poverty</td>
<td>9%</td>
</tr>
<tr>
<td>Avg. Land Temperature</td>
<td>4%</td>
</tr>
<tr>
<td>% Housing Cost Burdened</td>
<td>3%</td>
</tr>
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</table>
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
- Improved resiliency for when there is a power outage
- Faster (kW) depot charging systems
- Increased production capacity of EVs, batteries, and chargers with a decrease in capital costs
- Operational cost study of EV transit utility rate and demand management
- Better interoperability among different types and makers of EVs, chargers, and software systems
- Hydrogen fuel cell technology advancements
- 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

<table>
<thead>
<tr>
<th>FLEET</th>
<th>DIESEL (BASELINE)</th>
<th>DIESEL HYBRID</th>
<th>FUEL CELL ELECTRIC (FCEL)</th>
<th>BATTERY ELECTRIC (BEB)</th>
<th>LEGACY FUEL CELL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series Grouping</td>
<td>1600</td>
<td>1550</td>
<td>7000</td>
<td>8000</td>
<td>FC</td>
</tr>
<tr>
<td>Technology Type</td>
<td>Diesel</td>
<td>Hybrid</td>
<td>Fuel Cell</td>
<td>Battery</td>
<td>Fuel Cell</td>
</tr>
<tr>
<td>Bus Qty</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>Gillig</td>
<td>Gillig</td>
<td>New Flyer</td>
<td>New Flyer</td>
<td>Van Hool</td>
</tr>
<tr>
<td>Year</td>
<td>2018</td>
<td>2016</td>
<td>2019</td>
<td>2019</td>
<td>2010</td>
</tr>
<tr>
<td>Length</td>
<td>40’</td>
<td>40’</td>
<td>40’</td>
<td>40’</td>
<td>40’</td>
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</table>

**Data Summary (January - June 2021)**

<table>
<thead>
<tr>
<th></th>
<th>120,749</th>
<th>98,189</th>
<th>88,389</th>
<th>54,275</th>
<th>70,859</th>
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<tbody>
<tr>
<td>Fleet Mileage</td>
<td>$1.41</td>
<td>$1.80</td>
<td>$1.97</td>
<td>$2.02</td>
<td>$4.07</td>
</tr>
<tr>
<td>Cost/Mile</td>
<td>$1.37</td>
<td>$1.78</td>
<td>$0.58</td>
<td>$0.69</td>
<td>$4.07</td>
</tr>
<tr>
<td>Cost/Mile (w/ credits)</td>
<td>$1.37</td>
<td>$1.78</td>
<td>$0.58</td>
<td>$0.69</td>
<td>$4.07</td>
</tr>
<tr>
<td>Emissions (CO₂ Metric Tons)</td>
<td>298</td>
<td>182</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fleet Availability</td>
<td>96%</td>
<td>75%</td>
<td>69%</td>
<td>47%</td>
<td>68%</td>
</tr>
<tr>
<td>Reliability (MBCRC)</td>
<td>12,075</td>
<td>4,091</td>
<td>6,314</td>
<td>3,618</td>
<td>2,531</td>
</tr>
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</table>
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.