Strategic Planning for Metro’s Transition to Zero Emission Buses

October 2017
Requirements and Guidelines/Guiding Principles

- Continue to replace Aging Bus Fleet (~200 Buses per Year)
- Upgrade current CNG buses to “Near Zero” Low NOx engines
- Maintain existing bus fleet in a “State of Good Repair”
- Improve Service Quality and Reliability
- Transition Metro Orange Line (MOL) to Zero Emission by 2020
- Transition Metro Silver Line (MSL) to Zero Emission by ~ 2021
- Goal of 100% Zero Emission Bus Fleet by 2030
1. **ZEB Service Requirements:** Long term, Metro needs ZE buses that meet/exceed Metro service and operating requirements:
   - 250+ miles range in CBD duty cycle with 1.4 passenger load factor
   - Meet/exceed range requirements throughout 12 year vehicle life
   - Minimum 38 passenger seats for 40’ bus; 56 passenger seats for 60’ bus
   - Less than 31,000 lbs curb weight for 40’ ZEB
   - Ability to reach/sustain a top speed of 65 mph, and to sustain 15 mph on a 10% grade
   - (Impacts to capital and operating costs, service operation; may require replacement of CNG buses on greater than 1:1 ratio)

2. **Facilities and Infrastructure:** ZEB’s require an upfront investment in ZEB charging equipment and related infrastructure upgrades ahead of ZEB program start-up
   - (Impacts to ZEB deployment schedule; key pacing item)

3. **Technology:** Numerous known, and potentially many unknown, risks to ZEB operation, particularly with battery and propulsion system technologies.
   - (Impacts to capital and operating costs, fleet/service reliability; implement risk mitigation strategies where practical)

4. **Funding:** Additional funding needs to be identified to support an expanded ZEB program. Current funding programmed for CNG bus replacement is not sufficient for ZEB buses nor related infrastructure.
Strategic Approach – Two Phase Plan

Phase 1:
- Award ZEB contracts for MOL and MSL based on service proven products, with a high-probability of success, and minimal impact to service.
- Upgrade to Near Zero CNG engines and RCNG
- Evaluate and mitigate issues that could potentially impact service & operation.
- Develop ZEB Master Plan for fleet-wide operation

Key Milestone: ZEB Technology Re-Assessment (2019-2020)
- “Go/No-Go” decision milestone on expanding use of ZEB fleet-wide at Metro in 2019-2020 (i.e. determine whether to move into Phase 2).

Phase 2:
- Continue assessment of ZEB technologies.
- Take measured steps toward full implementation of 100% zero emission bus fleet for use throughout Metro’s operating region.
## Current Bus Contracts

### VEHICLE ENGINEERING & ACQUISITION

#### Top Level Procurement Schedule (Bus Only)

<table>
<thead>
<tr>
<th>Current Bus Contracts</th>
<th>FY17</th>
<th>FY18</th>
<th>FY19</th>
<th>FY20</th>
<th>FY21</th>
<th>FY22</th>
<th>FY23</th>
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#### ZEB Implementation Phase:

- **Phase 1** (MOL & MSL Electrification) & ZEB Technology Assessment
- **Phase 2** - ZEB Re-Assessment and Expansion of ZEB Program to Rapid and Local Lines

<table>
<thead>
<tr>
<th>CNG 40' Procurement (Group A)</th>
<th>Soliciation and Award</th>
<th>Design, engineering, material sourcing</th>
<th>Delivery 295 Buses</th>
<th>Options (Up to 305 Buses)</th>
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<tbody>
<tr>
<td>CNG 60' Procurement (Group B)</td>
<td>Soliciation and Award</td>
<td>Design, engineering, material sourcing</td>
<td>Delivery 95 Buses</td>
<td>Options (Up to 305 Buses)</td>
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<thead>
<tr>
<th>ZEB 40' Bus Procurement (Group C, MSL)</th>
<th>Soliciation and Award</th>
<th>Design, engineering, material sourcing</th>
<th>Delivery 40' ZEB’s 60 Buses</th>
<th>Remaining 40' ZEB Options (Up to 40 Buses)</th>
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<tr>
<th>ZEB 60' Bus Procurement (Group D, MOL)</th>
<th>Soliciation and Award</th>
<th>Design, engineering, material sourcing</th>
<th>Delivery 60' ZEB’s 35 Buses</th>
<th>Remaining 60' ZEB Options (Up to 65 Buses)</th>
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| New Flyer Low-No (MOL) Five 60' ZEB Contract | Soliciation and Award | Delivery (5 Buses) |
| BYD Five 60' ZEB Contract (MOL) Five 60' ZEB Contract | Soliciation and Award | Delivery (5 Buses) |
Phase 1 ZEB (2017-2020)
- Upgrade CNG fleet to Low NOx engines and RCNG
- Continue to operate and maintain CNG fleet in “State of Good Repair”
- Start MOL and MSL operation using limited range ZE battery electric buses and “En-Route” charging
  - Install opportunity charging on the ROW of BRT Lines (901, 910, 950)
  - Continuous daily operation (no breaks for midday charging)
  - Maximize use of mature ZEB technologies that are commercially available, “Off-the-shelf” hardware
- By 2020, Open Metro Orange Line BRT (45 x 60’ ZE buses)
- By 2021, Open Metro Silver Line BRT (60 x 40’ ZE buses)
- Develop “Master Plan” for fleet wide ZEB implementation, and establish ZEB investment priorities and goals Local and Rapid Lines (160+ lines, 2300 buses)
Metro Orange Line ZEB Program
Metro Orange Line

Metro Orange Line & Station
Metro Orange Line Extension & Station
Metro Rapid Line & Stop
Metro Red Line & Station
MetroLink & Amtrak
Parking
Proposed Parking
Overcrossing

DEC 2009 Subject to Change

1-2 Chargers
2-3 Chargers
3-4 Chargers
Div 8 Chatsworth (Shop chargers)
Metro Silver Line ZEB Program
Metro Silver Line

- 29 mile ROW
- Longer distances (1-5 miles) between stations
- Mostly HOT lane operation with 65 mph top speed
- Use of 60 x 40' ZEB’s on this corridor.
- Potential opportunity charging locations in El Monte, Harbor Transit Center, and Carson (D18)
Develop comprehensive plans for rolling out ZEB’s to Metro Local and Rapid bus routes (i.e. Phase 2 of Metro’s ZEB program).

Master plan elements include:

- Life-Cycle and Technology Configurations, Costs
- Utilities and Infrastructure Requirements
- Operating Considerations
- Material Sourcing Strategies and End of Life Recycling/Reuse
- ZEB Program Funding
ZEB – Phase 2
CARB’s goal is that by 2040 only ZEB’s are in service. LA Metro’s 2030 ZEB plan would be ten years ahead of CARB goals.
Phase 2 - ZEB Program (2020-2030)

- **Infrastructure:** Procure engineering and design services related to installing electric charging infrastructure for all Metro bus operating locations.
- **Utilities:** Coordinate with PUC, SCE and DWP to ensure support for ZEB programs, new power drops. Negotiate ZEB rate structures.
- **Range:** Phase 2 requires use of longer range 40’ and 60’ ZE buses that are capable of delivering at least 250 miles in Metro service, and also meet seating, axle weight and other operating requirements.
- **Charging:** Optimize operating assignments around overnight depot charging and minimal breaks for midday or opportunity charging.
- **Contract Financing:** Review use of procurement strategies and alternate lease structures for that may help Metro reduce transition costs and mitigate technology and operating risks (e.g. battery leases).