



Strategic Planning for Metro's Transition to Zero Emission Buses

July 20, 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

Challenges to Transitioning to 100% Zero Emissions

1. ZEB Service Requirements: Long term, Metro will need ZE buses that meet/exceed Metro service and operating requirements:
 1. 250+ miles range in CBD duty cycle with 1.4 passenger load factor
 2. Less than 31,000 lbs. curb weight for 40' ZEB
 3. 250+ miles range throughout the 12 year vehicle life
 4. 65mph top speed; ability to sustain 10% grade
2. Facilities and Infrastructure: ZEB program will require up front investment in ZEB charging equipment and related infrastructure.
3. Technology: Known and unknown technology risks with ZEB operation, particularly with battery and propulsion system technologies.
4. Funding: Additional funding needs to be identified for 100% ZEB program.

Impacts to other capital and operating costs, deployment schedule and/or service levels and reliability. May require replacement on greater than 1:1 ratio.

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, including technology assessment, for fleet-wide operation

Key Milestone: ZEB Technology 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

Top Level Procurement Schedule (Bus Only)																												
Current Bus Contracts	FY17				FY18				FY19				FY20				FY21				FY22				FY23			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
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															
CNG 40' Procurement (Group A)	<i>Awarded June 2017</i>				Design, engineering, material sourcing				Delivery 295 Buses				Options (Up to 305 Buses)															
CNG 60' Procurement (Group B)	Solicitation and Award				Design, engineering, material sourcing				Delivery 65 Buses				Options (Up to 335 Buses)															
ZEB 40' Bus Procurement (Group C, MSL)	Solicitation and Award				Design, engineering, material sourcing				Delivery 60 Buses				Options (Up to 40 Buses)															
ZEB 60' Bus Procurement (Group D, MOL)	Solicitation and Award				Design, engineering, material sourcing				Delivery 60' ZEB's 35 Buses				Remaining 60' ZEB Options (Up to 65 Buses)															
New Flyer Low-No Grant (MOL) Five 60' ZEB Contract	Solicitation and Award								Delivery (5 Buses)				<i>Award targeted for Fall 2017</i>															
BYD Five 60' ZEB Contract (MOL) Five 60' ZEB Contract	Solicitation and Award								Delivery (5 Buses)				<i>Awarded March 2017</i>															

ZEB – Phase 1 – Key Program Elements

- 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 for Local and Rapid Lines (160+ lines, 2300 buses)

ZEB Phase 1 - ZEB Master Planning

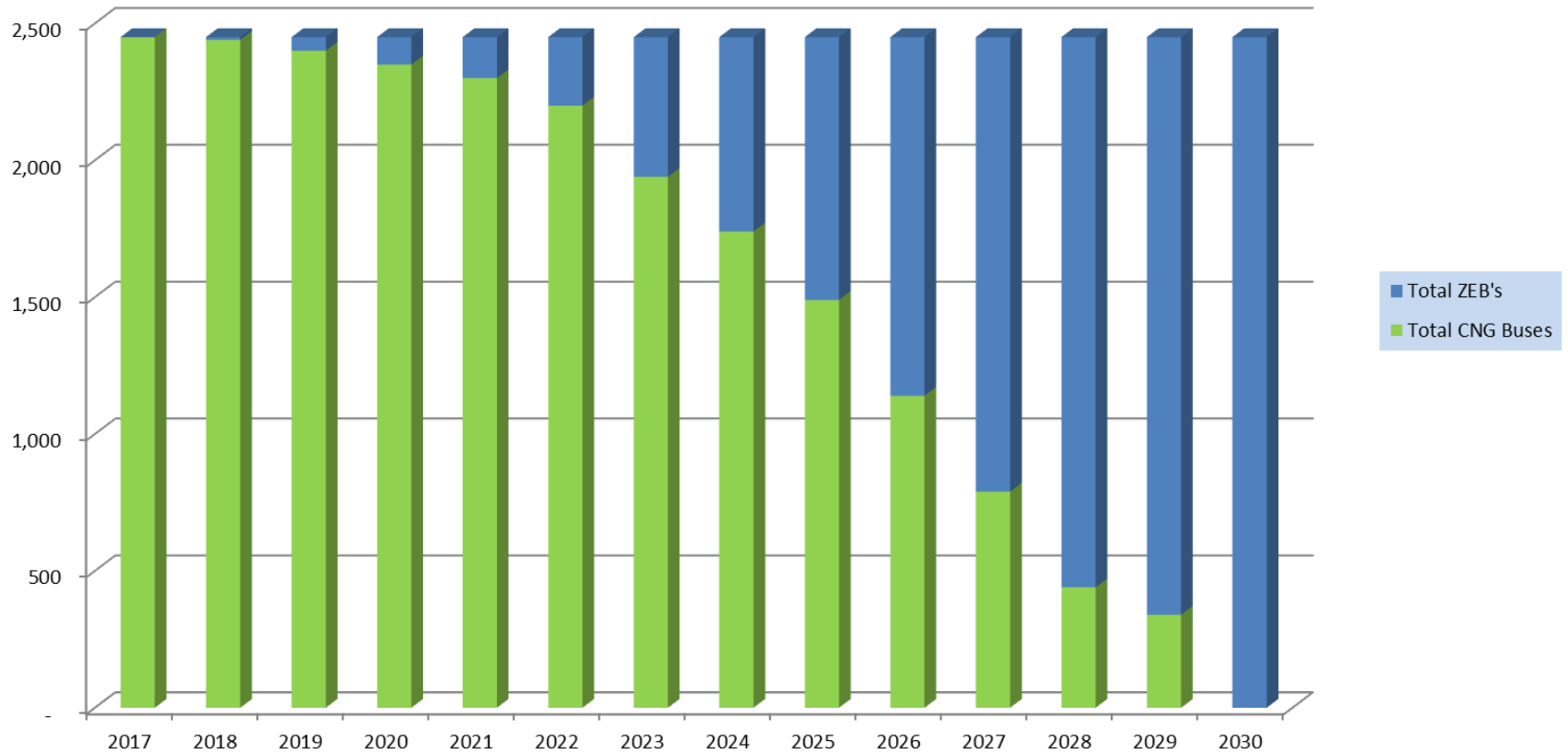
Develop comprehensive plans for deploying ZEB's on Metro Local and Rapid bus routes (i.e. Phase 2 of Metro's ZEB program).

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

Metro's Transition to 100% ZEB

Metro Bus Fleet Transition to Zero Emission Buses (ZEB's)



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.

ZEB – Phase 2 – Key Program Elements

- **Phase 2 - ZEB Program (2020-2030)**
 - **Infrastructure:** Solicit engineering and design services for installing electric charging infrastructure at all Metro bus operating locations.
 - **Utilities:** Coordinate with PUC, SCE and DWP to ensure support for ZEB programs and new power drops. Negotiate ZEB rate structures.
 - **Range:** Phase 2 will require new longer range 40' and 60' ZE buses that are capable of delivering at least 250 miles in Metro service, and meet seating, axle weight and other operating requirements.
 - **Charging:** Optimize operating assignments around overnight depot charging with minimal breaks for midday or opportunity charging.
 - **Procurement:** Strategies and alternate lease structures to help Metro reduce transition costs and mitigate technology and operating risks (e.g. battery leases).
 - **Funding:** Funding source evaluation and trade-offs

