



## Board Report

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**SYSTEM SAFETY, SECURITY AND OPERATIONS COMMITTEE  
EXECUTIVE MANAGEMENT COMMITTEE  
OCTOBER 20, 2016**

**SUBJECT: ZERO EMISSION BUS PLANS**

**ACTION: RECEIVE AND FILE**

**RECOMMENDATION**

RECEIVE AND FILE status report on Metro's Zero Emission Bus Plans.

**ISSUE**

At the April 2016 Metro Board of Directors Meeting, Metro's CEO was asked to provide a status report on Metro's initial plans for Zero Emission Buses and to provide a comprehensive plan to further reduce greenhouse gas emissions by gradually transitioning to a zero emission bus fleet.

**DISCUSSION**

Metro's current plan for Zero Emission Buses (ZEB's) and reducing Greenhouse Gas Emissions (GHG) include new engine and fuel deployment and ZEB (electric bus) operational testing. Our approach consists of the following projects and activities:

1. Purchase five (5) New Flyer all-electric articulated buses with depot and en-route chargers for deployment on Metro's Orange Line with expected delivery in late 2017.
2. Purchase five (5) BYD all-electric articulated buses with depot chargers, also for use on Metro's Orange Line, with expected delivery in late 2017.
3. Purchase additional zero emission buses under RFP OP28167 for delivery between FY18 and FY22.
4. Expand use of Low NOx "Near Zero" CNG engines and Renewable Natural Gas (RCNG) for all new bus purchases and for mid-life engine repowers starting in FY18.

Given the rapid growth in ZEB technology and the strong possibility that today's technology may be dated in a couple of years, the first two ZEB projects will be used to gain first-hand experience with two prominent ZEB approaches, i.e. en-route charging and depot charging; and with operational

testing of the newest ZEB long range battery technology.

For additional ZEB's that may be purchased between FY18 and FY22, Metro will need to consider that costs and operational capabilities of ZEB technologies are maturing rapidly. ZEB's that are available today (in 2016) are more expensive to buy and to operate. ZEB's currently impose operational compromises such as limited operating range and battery charging requirements that need to be tested in a larger scale than previously. While Metro does plan to gradually build up Metro's ZEB fleet over the next 3-5 years, this assumes successful operational testing and experience; and that ZEB technologies continue to evolve. Assuming that occurs, Metro would expect to accelerate the rate that ZEB's are brought into Metro's bus fleet in the future.

The more immediate term strategy for air quality improvement is to consider purchasing "Near Zero" Cummins-Westport Low NOx ISL-G engines and renewable natural gas (RCNG) fuel for both new and repowered CNG buses. According to the fleet emission modeling done by Metro's technical consultant, this approach will have significant regional air quality benefits, including reducing NOx emissions for Metro's bus fleet by an additional 90%, and greenhouse gas emissions by an additional 80% below current fleet emission levels. This is the most cost effective approach that provides immediate emission and regional air quality benefits.

Low NOx engines were certified by CARB and EPA in 2015. The Low NOx engines may be run using existing operations infrastructure, and are commercially available today. It is anticipated that the majority of Metro's CNG powered bus fleet will be retrofit with Low NOx engines by 2026.

The attached report from Ramboll/Environ outlines different technology options for Metro to comply with pending CARB ZEB rules. The report provides a high-level cost assessments and emission impacts for several technology options, including battery electric buses, fuel cell buses, and Low NOx "Near Zero" CNG engines. Since the draft report was first released in February 2016, it has been updated and revised based on input from CARB staff and ZEB industry suppliers. As shown in Table 1, the expanded use of Low NOx CNG engines and renewable natural gas appear to be the most impactful strategies. This approach will have the greatest potential for emission reductions for our region at the lowest cost.

As compared to Electric Buses with Depot & En-route charging, Low NOx & RCNG offers:

- Approximately the same reduction in NOx (2.72 vs. 2.83 million tons)
- Approximately 39% greater reductions in GHG (11.4 vs. 8.2 million tons)
- At approximately half the increased costs from the baseline (\$173M vs. \$376.1M)

**TABLE 1**  
**ESTIMATED COSTS FOR EMISSION REDUCTION OPTIONS 2015 - 2055**

| Comparison to Baseline CNG            | LNOx & RCNG     | Electric Buses |                           | Fuel Cell Buses |                      |
|---------------------------------------|-----------------|----------------|---------------------------|-----------------|----------------------|
|                                       |                 | Depot Charging | Depot & En-Route Charging | H2 from Methane | H2 from Electrolysis |
| Increased Cost (NPV \$ Million)       | <b>\$173.0</b>  | \$767.8        | \$376.1                   | \$1,379.3       | \$1,680.2            |
| GHG Reductions (million tons)         | <b>11.4</b>     | 8.2            | 8.2                       | 3.3             | 6.7                  |
| In-Basin NOx Reduction (million tons) | <b>2.72</b>     | 2.83           | 2.84                      | 0.07            | 2.50                 |
| <b>Cost Effectiveness</b>             |                 |                |                           |                 |                      |
| \$/Ton Reduction of GHG               | <b>\$15.19</b>  | \$93.71        | \$45.69                   | \$419.43        | \$249.84             |
| \$/Ton Reduction of NOx               | <b>\$63,530</b> | \$271,638      | \$132,667                 | \$20,247,155    | \$670,849            |

Source: Ramboll/Environ, October 2016

## **FINANCIAL IMPACT**

Staff and consultants will continue to refine our comprehensive cost analysis that encompasses the total life-cycle cost for ZEB implementation. Details of the cost elements include, but are not limited to the necessary infrastructure changes, operation and maintenance costs (including staff training), engine repower mileage impacts, and short term capital cost impacts. Metro expects to pursue a number of competitive federal, state and local grant funding opportunities. Specific funding sources may include FTA “Lo-No” grants, Measure R and a “Buy Back” credit from BYD for the trade-in of Metro’s original BYD 40’ buses.

The recommended bus procurement program, including zero emission buses is expected to be made under RFP OP28167, Forty and Sixty Foot Low Floor CNG or Zero Emission Buses. Funding for these projects will be identified when this contract is awarded. Currently the RFP is an active procurement and in a blackout period. Specific quantities and types of ZE buses to be purchased under RFP OP28167 are to be determined based on Metro’s operational needs, and these ZE buses may be a combination of 40’ and 60’ buses. Each of these ZEB projects will be subject to Metro Board approval and funding availability.

## **NEXT STEPS**

Staff will return to the Board with award recommendations for purchasing new CNG and zero emission buses in early 2017. This will include recommendations for quantities and types of zero

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emission buses that are best suited for Metro's operational needs, reflect best performance in field tests, and that fit within Metro's available funding.

**ATTACHMENTS**

Attachment A - Board Motion April 28, 2016

Attachment B - Staff Responses to Board Requests for ZEB Plans

Attachment C - Updated Ramboll/Environ Report September 29, 2016

Attachment D - List of Transit Properties Running ZEB's

Attachment E - Identified ZEB Suppliers

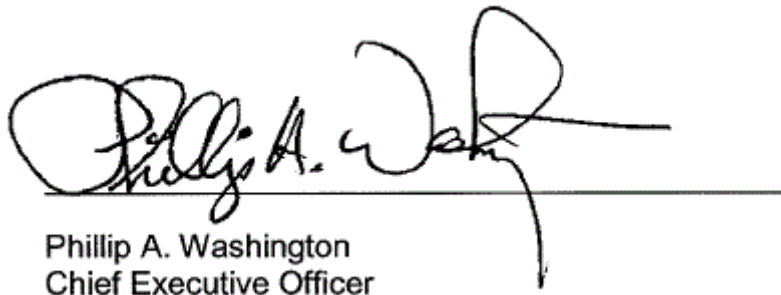
Attachment F - Noise Level Comparison of Conventional Buses and ZEB's

Attachment G - Metro Routes Most Suitable for ZEB Operation

Attachment H - Summary of ZEB Funding Opportunities

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