

**Board Report**

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**File #:** 2024-0470, **File Type:** Informational Report**Agenda Number:** 31.

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**OPERATIONS, SAFETY, AND CUSTOMER EXPERIENCE COMMITTEE  
SEPTEMBER 19, 2024****SUBJECT: ZERO EMISSION BUS (ZEB) PROGRAM UPDATE****ACTION: RECEIVE AND FILE****RECOMMENDATION**

RECEIVE AND FILE status report on the ZEB Program in response to Motion 31.1.

**ISSUE**

At its April 2024 meeting, the Board approved Motion 31.1 (Attachment A) by Directors Yaroslavsky, Bass, Krekorian, Dupont-Walker, and Solis, which reaffirmed its commitment to transitioning Metro's bus fleet to zero-emission by 2030. The Motion directed staff to report back to the Board at its September 2024 meeting with a more detailed plan to deliver a 100% zero-emission bus fleet. Staff has prepared a more detailed plan that also ensures Metro's ability to continue providing reliable bus service, including availability of operations and maintenance funding to support the full seven million annualized revenue service hours as planned through the NextGen Bus Plan.

**BACKGROUND**

In July 2017, the Board approved Motion 50 by Directors Bonin, Garcetti, Najarian, Hahn, and Solis (Attachment B), which endorsed a ZEB Strategic Plan to transition Metro's entire bus fleet to zero-emissions by 2030. This was contingent on cost and performance equivalence with Compressed Natural Gas (CNG) buses and continued advancements in charging infrastructure. In 2018, the California Air Resources Board (CARB)'s Innovative Clean Transit (ICT) regulation mandated that all transit agencies in the state operate zero-emission fleets by 2040. In addition, ICT ZEB purchase requirements for large transit agencies require 25% of bus purchases to be zero emissions by 2023, 50% by 2026, and 100% by 2029. Metro has met all state-mandated program requirements a decade earlier than the ICT mandate of 2029. In September 2019, Metro awarded its final option for CNG buses and committed to having 100% zero emissions in all future procurements. Furthermore, since October 2020, Metro has powered its bus fleet with 100% Renewable Natural Gas.

Since the Board endorsed the ZEB Strategic Plan, Metro prepared a ZEB Program Master Plan in 2022 and a Master Plan Update in 2023. In 2021, Metro electrified the G Line, which has accumulated more than five million miles of zero-emission service, the most miles by any public transit agency in the U.S., however, it is experiencing chronic reliability issues. The electrification of

the J Line is also underway, with both the Harbor Gateway Transit Center scheduled for completion, and civil construction at Division 9 and the El Monte Transit Center to begin this fall. Metro expects to release a Progressive Design Build (PDB) solicitation for Divisions 18 & 7 in the second quarter of FY25. In April 2024, Metro released the largest solicitation for ZEBs in U.S. history, with a base order of 260 battery electric buses (BEBs) and 20 hydrogen fuel cell electric buses (FCEBs), with options to purchase up to 1,160 ZEBs. In July 2024, Metro increased the solicitation option amounts, allowing purchases of up to 1,980 ZEBs and requesting that Original Equipment Manufacturers (OEMs) propose an alternative base order quantity. Proposals are due in September.

Despite progress, the U.S. ZEB industry has neither evolved nor matured to the extent necessary to meet the complete fleet transition by the 2030 goal. In the April 2024 ZEB Program Update (Attachment C), staff identified several challenges (e.g., program cost and funding, technology performance, grid capacity, and U.S. supply chain constraints), which demonstrate that cost and performance parity with CNG buses has yet to materialize and that technology advancements are not projected to meet the necessary thresholds for the 2030 goal. Over the last six months, New Jersey Transit, Houston Metro, CapMetro Austin, and Seattle’s Sound Transit have announced scaling back their 2030 ZEB goal given the state of the industry - in some instances, they have elected to order more diesel buses.

**DISCUSSION**

Plan to Deliver 100% ZEB Fleet

Staff have prepared a ZEB Program Project Map (Attachment D), which illustrates electrification project sites, and a ZEB Program Division Electrification Detailed Schedule (Attachment E), which outlines the program phasing sequence inclusive of milestones for division electrification. The division electrification schedule details anticipated timelines for project phases, including Requests for Proposals (RFPs), design, and construction.

The Detailed Schedule anticipates that in 2030, five bus Divisions (9, 18, 7, 5, and 13) will be electrified, as will opportunity charging sites (also known as on-route charging) to support battery electric operations of the North San Fernando Valley (NSFV) Transit Improvements Project, North Hollywood to Pasadena Bus Rapid Transit (BRT), J Line, and the Vermont Transit Corridor BRT. Staff also anticipates that by 2030, Metro’s bus fleet will surpass 30% zero emissions. The table below illustrates milestones by year through the completion of the transition.

<b>Division and Fleet Electrification Milestones</b>		
<b>Year</b>	<b>Number of Divisions Electrified</b>	<b>Fleet of Zero Emission Buses (# / %)</b>
2028	3	256/12%
2030	5	647/30%
2032	7	1,175/55%
2034	9	1,709/80%

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2035	10	2,130/100%
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Attachment F outlines Metro’s approach to ZEB program project delivery as well as discusses Unsolicited Proposals received and the agency’s evaluation of Charging-as-a-Service to date.

*Utility Capacity Upgrades*

In addition to the weak manufacturing pipeline, the availability of existing utility power and needed capacity upgrades are major schedule risks for delivering the ZEB program on time. Studies conducted by the California Independent System Operator have shown that the entire California electric grid is undersized by two to three Terawatts and not ready to support a large-scale adoption of zero-emission vehicles.

A key lesson learned from the electrification work to date is that Metro will require substantial utility capacity upgrades at its divisions and opportunity charging sites. This was derived from insights from advancing designs at Division 9 and 18, as well as developing conceptual designs for the remaining divisions, in addition to the advanced coordination with Southern California Edison (SCE) and (LADWP). Metro has submitted service requests to SCE for Division 9, and staff anticipates making service requests for 18 and 7 once each division reaches an 85% level of design, which is expected in Q2 and Q4 FY26. SCE has already reserved 6 Megavolt-Ampere (MVA) for Division 18. However, they cannot proceed with upgrades until Metro advances design to a better-defined scope in FY26.

Firm utility service requests require detailed project information, such as charging equipment power output and the number of charging positions at each site, which Metro will not know until upgrades reach a more advanced level of design (typically 85%). While Metro has delivered power need forecasts to both SCE and LADWP, including worst-case and charge management scenarios, firm calculations cannot be provided until the charging equipment is specified and nameplate power ratings are available. Fortunately, additional charge management scenario analysis suggests that capacity upgrades may be less extensive than previously anticipated, reducing utility capacity scope and timelines.

However, in the near term, Metro is preparing several service requests to LADWP for sites that will support the NSFV, North Hollywood to Pasadena BRT, and North Hollywood Transit Center redevelopment projects. While preliminary, these requests will be based on worst-case power needs, will allow LADWP to evaluate existing grid capacity, and result in developing collaborative strategies that ensure timely/cost-effective upgrades. The charging equipment will be purchased under a new procurement, although nameplate information is currently unavailable. Staff have prepared Attachment G which describes ongoing utility coordination activities in more detail.

*Schedule Phasing Constraints*

In addition to utility capacity upgrades, the Division electrification phasing schedule is driven by two main constraints: 1) A bus operations disruption mitigation strategy and 2) Olympics and Paralympic Games contingency fleet acquisition.

Metro cannot undertake construction activities at divisions without robust mitigation strategies that ensure Metro’s ability to continue providing reliable bus service. This includes the availability of operations and maintenance funding to support the total seven million annualized service hours as planned through the NextGen Bus Plan. Division electrification work will require the transfer of buses and service delivery to other divisions and facilities during construction. To achieve the transition as soon as possible but not later than 2035, Metro must move up to approximately 475 buses per month to other locations, which places enormous strain on bus operations groups and presents yet-to-be-quantified program costs.

At present, Metro has space to transfer up to 170 buses. However, available space will decrease dramatically when construction of the new Rail Operations Control and Bus Operations Control Centers begins at Division 10. The disruption to bus operations and strain on bus storage space extends over a longer period with the updated schedule but with reduced severity of those impacts and reduced risk related to construction. However, construction and utility assumptions for each division are less aggressive in the updated schedule, reducing the risk of delays and cost overruns.

The need to accommodate the incoming Olympic and Paralympic Games contingency fleet, currently anticipated at 2,700 buses in addition to Metro’s fleet of 2,100 may provide an opportunity to coordinate with the fleet transition. As contingency fleet buses arrive, Metro has requested federal funds to invest in property, upgrade facilities, and retain staff to store, exercise, and maintain contingency fleet buses that may arrive prior to 2028. While this may impact near-term fleet movements, in the long term, property leases and investments to support the Games contingency fleet may be retained to support later phases of the ZEB transition and increase space availability. The updated assumptions shift much of the bus displacement strain to after 2028. This allows better opportunities to extend the utility of the temporary storage facilities needed for the contingency fleet while reducing the scale of the off-site storage required during this period.

Program Cost and Funding

The most recent program estimate prepared in the Master Plan Update indicated a total capital cost of \$4.73 billion through 2030 to replace buses and build charging infrastructure for the zero-emission transition. This is nearly double the cost if Metro replaced its fleet with CNG buses and upgraded the existing CNG fueling infrastructure. The table below compares the capital cost estimates for CNG and ZEB to replace the bus fleet and upgrade fueling infrastructure.

Capital Cost Estimate to Replace Bus Fleet and Upgrade Fueling Infrastructure			
	CNG/RNG	ZEB (2035)	ZEB (2030)
Total Program Cos	\$2.60 billion	\$4.57 billion	\$4.73 billion
Average Annual Cost	\$260 million	\$381 million	\$675 million

In the past eleven years, Metro has annually budgeted an average of \$169.9 million for bus acquisitions, bus facilities improvements, and bus maintenance/state of good repair (SGR). However, transitioning the entire fleet and all ten divisions to zero emission no later than 2035 will require nearly three times that average annual investment. In April 2024, Metro’s Early Intervention Team

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(EIT), an interdepartmental working group of subject matter experts from across the agency, recommended updating the program estimate with soft costs, utility capacity upgrades, and other costs not included in previous estimates. Staff will update the estimate in 2025, accounting for recently added program elements, which includes the FCEB pilot project. Staff are now working to prepare updated program cost estimates.

Since the Board approved the March 2021 ZEB Rollout Plan (Attachment H), Metro has maintained a funding strategy for the ZEB conversion as part of the agency's overall financial forecast. This strategy includes a combination of revenue streams, primarily sourced from Proposition A and Proposition C. Additionally, the strategy leverages substantial funding from various state and federal programs, including the Transit and Intercity Rail Capital Program (TIRCP), Regional Improvement Program (RIP), Urbanized Area Formula Funding Program (Section 5307), Congestion Mitigation and Air Quality (CMAQ), Surface Transportation Block Grant (STBG), and the Transportation Development Act (TDA), among others.

As detailed below, Metro has developed a comprehensive funding plan to facilitate the ZEB conversion scenario, utilizing the agency's available eligible revenues to fund the project's current anticipated costs:

- Local funding sources comprise of 47.6 percent of the funding plan, consisting mainly of Proposition C (\$1.7 billion or 38.7 percent of the total) and TDA (\$239.1 million or 5.5 percent)
- Federal funding sources contribute 34.4% to the funding plan, primarily from STBG (\$669.4 million or 15.3 percent), Section 5307 (\$317.6 million of 7.3 percent), and CMAQ (\$240 million or 5.5 percent)
- State funding sources comprise 18.1% of the funding plan, primarily from RIP (\$400.6 million, or 9.2 percent) and TIRCP (\$331.8 million, or 7.6 percent).

A significant portion of the funding relies on operations-eligible financing through Proposition C and TDA. As a result, the funding plan will need to compete with Metro's annual operating budget. The revenue projections heavily depend on borrowed capital, with approximately 15% of the total funding anticipated from debt issuances.

While these funding sources have not yet all been secured, Metro will prioritize them along with other Board-approved projects and programs to cover the necessary ZEB program costs. Although Metro's current revenue forecasts are sufficient to cover the costs of the ZEB conversion (as estimated herein), reallocating funds from other Metro projects may need to be considered if the economic situation changes or costs increase further. Metro will continue to update the funding plan to reflect grant awards, adopted budgets, contract awards, new grant opportunities, and the ongoing reprogramming of Metro funds as part of the Metro systemwide financial forecast. In addition, Metro will continue to evaluate proposals regarding public-private partnerships (P3) and include them in the funding plan for consideration if they provide demonstrable financial benefits to Metro.

Metro has secured \$1.052 billion in state and federal funding for the program. Staff have attached to this report an overview of all ZEB Program Grant Awards and Funding Allocations, Amounts, and Uses (Attachment I).

Since April 2024, staff have secured \$276.9 million in funding from state and federal sources. Metro has recently requested \$261 million through the California State Transportation Agency (CALSTA) Transit and Intercity Rail Capital Program for Division 7 buses and charging equipment. Staff expect a decision on TIRCP in October 2024.

### *Grants and Legislative Strategy*

Metro has taken an all-hands approach to securing state and federal grant funds for the ZEB program. Departments across the agency, including Federal/State Policy and Programming, Government Relations, Community Relations, Sustainability Policy, the Office of Strategic Innovation, Program Management, the Office of the Chief Executive Officer, and Operations, continuously collaborate to develop as well as support grant applications. This includes preparing applications, pursuing grants through new/non-traditional sources (e.g., U.S. Environmental Protection Agency's Climate Pollution Reduction Grant program), including appropriate program costs in Olympic and Paralympic cost estimates and funding requests, accessing Measure M project funds, and garnering local support for proposed projects. Metro has also sought and received vital support from climate advocacy groups like the Los Angeles County Electric Truck and Bus Coalition (LACETBC). In July 2024, Metro hosted a tour for the LACETBC of Division 8 and the G Line to discuss the challenges of the zero-emission transition and opportunities for collaboration. Strengthening partnerships with organizations like LACETBC will better position Metro to secure future grants, as they can support our grant applications and advocate for new and continued funding programs at the state and federal levels.

Metro's Government Relations team is working on several fronts to increase Metro's competitiveness in state and federal grant opportunities related to ZEB procurement and infrastructure deployment. Regarding the federal government, Metro was a national leader in ensuring the Bipartisan Infrastructure Law (P.L. 117-58) dramatically increased federal funding for ZEBs and related infrastructure needs. Specifically, the new federal infrastructure law provides \$5 billion to help transportation agencies, such as Metro, transition to low or zero-emission buses and purchase charging infrastructure.

Following the adoption of the Bipartisan Infrastructure Law, Metro has been working closely with the Biden Administration to address various challenges facing domestic zero-emission bus manufacturing firms. These efforts have included Metro CEO Stephanie Wiggins participating in a White House Roundtable on Clean Bus Manufacturing held on February 7, 2024, to discuss how our agency is taking steps to leverage the upcoming 2028 Olympic/Paralympic Games to ensure our agency can provide the "cleanest" mobility plan for a major sporting event. Prior to this meeting, Metro's CEO had held in-depth conversations on zero-emission bus procurement matters at the White House with the then-Senior Advisor to the President, Infrastructure Coordinator Mitch Landrieu, and later with Samantha Silverberg, Deputy Assistant to the President for Infrastructure Implementation.

In addition to working with White House officials and the U.S. Department of Transportation (USDOT) to explain Metro's plans related to zero-emission buses, the agency has been in regular contact with members of the Los Angeles County Congressional Delegation to build support for our federal grants seeking funding for zero-emission and near-zero emission buses. As a result of strong grant applications and robust support from our federal delegation across Los Angeles County, in 2022, FTA awarded the nation's second-largest Low or No Emission (LoNo) grant to our agency in the amount of \$104 million for zero-emission buses and related infrastructure for our agency's Bus Divisions 9 and 18. In July 2024, Metro was awarded another LoNo grant for \$77.5 million -the nation's second-largest award for zero-emission buses and related infrastructure at Division 7.

At the state level, Metro's legislative program has focused efforts on climate and infrastructure issues by working with the California Legislature, Governor Newsom, as well as the LA County delegation to advocate for the passage of proposals that support the state's climate change goals, transportation projects, and workforce development. In 2024, Metro's state legislative program included goals to ensure the state continues to secure, protect, and fully fund the major transportation programs; support legislative initiatives aimed at increasing funding for LA County transportation projects and initiatives; maximize funding for transportation projects and programs through implementation of the state's cap and trade program; and coordinate with our local and state partners to incorporate the region's needs in emerging climate change and sustainability programs. Government Relations staff have worked with the state to support the development and implementation of Metro's ZEB program.

While funding for many state and federal grant programs has increased dramatically since the COVID-19 health crisis, these infusions are set to expire in the coming years. The massive infusions for grant programs that fund transit, bus acquisitions, construction of fueling infrastructure, and other solutions that address climate change authorized by the Infrastructure Investment and Jobs Act (H.R. 3684) and the Bipartisan Infrastructure Law (P.L. 117-58) will expire in 2026 and 2027 respectively. Without congressional action to extend funding, programs will return to their pre-COVID funding levels, which will be insufficient to support the scale and pace of the transition occurring across the U.S. Likewise, California Senate Bill (SB) 125, authorized the newly created Zero Emission Transit Capital Program (ZETCP), which will also disburse funds through FY27-28. However, Metro continues to advocate for additional funding beyond what is currently planned to meet the agency's zero-emission and climate goals.

### Hydrogen Fuel Cell Electric Bus (FCEB)

The December 2023 Master Plan Update modeled Metro's existing service block mileages against multiple rates of BEB technology improvements. The model suggested with current technology improvement rates, BEB technology cannot meet 9 - 27% of Metro's service blocks in 2030, and 1 - 8% cannot be met in 2035 or 2040. Even by introducing opportunity charging, most of these blocks cannot be achieved with anticipated improvements in BEB technology. Metro will evaluate FCEBs, which offer ranges comparable to CNG, and bring zero-emission service for uncompleted service blocks. Other benefits FCEBs provide include a fueling time comparable to CNG's (6-10 minutes per bus) and avoiding expensive utility capacity upgrades.

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Metro will purchase 20 FCEBs in the open solicitation's base order. Staff have prepared a preliminary feasibility study to evaluate the placement of hydrogen fueling infrastructure and deployment of FCEBs on bus lines. Staff identified Divisions 8 and 15, contracted service Division 97, and the Marilla Lot, a Metro-owned property near Division 8, as candidate locations to place hydrogen fueling infrastructure. Staff have advanced the feasibility study to more detailed site-level evaluations of the shortlist. Attachment J provides more detail on the preliminary Hydrogen Fueling Infrastructure Feasibility Study.

## **EQUITY PLATFORM**

No changes in equity impacts are expected that were noted in the previously submitted board reports associated with the ZEB program. Bus purchases fall under FTA's Transit Vehicle Manufacturers (TVM) program, and DEOD does not set contract goals on TVM procurements. PLA is only applicable on construction contracts that have a construction-related value in excess of \$2.5 million.

Metro's programmatic transition to a ZEB fleet, as well as modifying facilities, will ensure that Equity Focus Communities see the benefits of reduced noise and greenhouse gas emissions in their communities as the divisions are being transitioned. Metro's ZEBs will operate on routes restructured through the NextGen transit service plan. Five of Metro's ten directly-operated bus Divisions are within an Equity Focus Community (EFC). Seven Divisions are located within a state-classified Disadvantaged Community (DAC) according to the California Environmental Protection Agency and as established in California Senate Bill 535.

The first phase of Metro's ZEB transition will reduce noise and pollution in EFCs. Division 9, the first bus division to be electrified, is located within an EFC, and 59% of the communities served are designated EFCs. Prioritizing electrification of the J Line will also bring environmental benefits to some of the region's most densely populated, congested, and polluted communities, many of which are EFCs. Divisions 18 and 7, the subsequent two divisions to be electrified, serve 70% and 52% EFCs, respectively.

An emissions model was designed to quantify the vehicle tailpipe and lifecycle GHG emission reductions that can be achieved through transitioning to a ZEB fleet. Tailpipe emissions, especially particulate matter (PM) and nitrogen oxides (NOx), pose immediate health risks, including chronic bronchitis, asthma, and increased risks for individuals with heart conditions. Though CNG/RNG buses emit less overall emissions compared to gasoline-powered vehicles, they still emit low levels of criteria pollutants, including significant amounts of carbon monoxide (CO), which can lead to poisoning if inhaled. The model results show that in the County of Los Angeles, the transition to a ZEB fleet will eliminate 86% of harmful tailpipe gases, including CO, NOx, and volatile organic compounds (VOCs), compared to keeping a CNG fleet (fueled with renewable natural gas) from now to 2050. The transition will also help remove 41% of PM10 and 53% of PM2.5. Metro's current fleet profile would generate 13,798 metric tons of lifecycle emissions without the transition. The lifecycle emission reduction depends on the power grid being transitioned to use 100% renewable power. When assuming the grid will gradually transition to 100% renewable generation, transitioning the entire bus fleet by 2035 would yield negative Greenhouse gas (GHG) emissions (-1 metric ton of



CO<sub>2</sub>e), meaning it eliminates the lifecycle GHG emissions and removes carbon from the atmosphere.

Considering Metro's 5.2 million BEB service miles to date, this reflects the reduction of 104.98 metric tons of tailpipe CO, 0.68 metric tons of NO<sub>x</sub>, 2.4 metric tons of VOCs, 0.55 metric tons of PM<sub>10</sub>, and 0.09 metric tons of PM<sub>2.5</sub>. However, the lifetime greenhouse gas emissions of operating BEBs increased by 5,514 metric tons of CO<sub>2</sub>e compared to RNG. This is due to the power mix of the electric grid.

Transitioning to a ZEB fleet offers significant public health benefits, especially for those most impacted by transportation emissions. People of color and low-income households are more likely to live near busy roads and face higher exposure to air pollutants, resulting in increased health risks. These demographics also represent a significant portion of Metro ridership. The lifecycle emissions model estimates public health savings of approximately \$223 million between 2025 and 2050 due to the public health benefits of zero-emission buses.

### **IMPLEMENTATION OF STRATEGIC PLAN GOALS**

This update supports Goal #3 to enhance communities and lives through mobility and access to opportunity and Goal #4 to transform LA County through regional collaboration and national leadership.

### **NEXT STEPS**

Staff will continue executing the plan to transition Metro's bus fleet to zero emissions, and Operations will return to the board in January 2025 and quarterly thereafter, as requested in Motion 31.1. In addition, Operations will prepare the preliminary utility service requests to LADWP for the NSFV, North Hollywood Transit Center redevelopment, and North Hollywood to Pasadena BRT projects. Operations will also aggressively pursue state and federal grant opportunities through collaboration with internal and external stakeholders, as well as advocate for an extension of grant programs that will expire soon. Lastly, Operations will advance the FCEB fueling infrastructure feasibility study, perform market analysis, and evaluate delivery models.

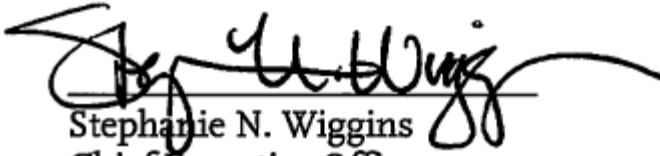
### **ATTACHMENTS**

- Attachment A - Board Motion 31.1 Related to Item 31: Zero Emission Bus Program Update
- Attachment B - Board Motion 50 Strategic Plan for Metro's Transition to Zero Emission Buses
- Attachment C - April 2024 ZEB Program Update
- Attachment D - ZEB Program Projects Map
- Attachment E - ZEB Program Division Electrification Detailed Schedule
- Attachment F - Project Delivery, Unsolicited Proposals, and Charging-as-a-Service
- Attachment G - Ongoing Utility Coordination Activities
- Attachment H - March 2021 ZEB Rollout Plan
- Attachment I - ZEB Program Grant Awards and Funding Allocations, Amounts, and Uses
- Attachment J - Summary of Hydrogen Fueling Infrastructure Feasibility Study

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Chief Executive Officer

**Board Report**

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**File #:** 2024-0275, **File Type:** Motion / Motion Response**Agenda Number:** 31.1

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**REVISED**  
**REGULAR BOARD MEETING**  
**APRIL 25, 2024**

**Motion by:****DIRECTORS YAROSLAVSKY, BASS, KREKORIAN, DUPONT-WALKER, SOLIS**

Related to Item 31: Zero-Emission Bus Program Update

As transportation planner, designer, builder, and operator for the country's most populous county, Metro has an important role in the fight against climate change and in meeting global, state and local greenhouse gas reduction targets. A major part of Metro's role in fighting climate change is its Zero Emission Bus program.

The California Air Resources Board (CARB) proposed the Innovative Clean Transit (ICT) regulation in 2018 that required all transit agencies in the state to transition to all Zero Emission fleets by 2040.

In response, LA Metro has created a comprehensive Zero Emission Bus Program Master Plan which outlines the path to a complete transition to zero emission buses by 2030. The Board took action to endorse this aggressive goal, recognizing the need to act urgently against the climate crisis, improve air quality locally, and leverage Metro to advance the Zero Emissions Bus industry nationwide.

The Master Plan, updated in May 2023, builds off of the Metro CARB Innovative Clean Transit rollout plan, which evaluates service schedules, power needs, proposed technological advancements, bus production, and market conditions to determine the best path to a full fleet transition of Metro's fixed-route fleet by 2030.

According to Metro, and despite the significant progress made to date, staff is of the opinion that the Zero Emission Bus industry is evolving slower than previously anticipated and not mature enough to promote full fleet transition by the 2030 goal, particularly due to Zero Emission Bus costs, performance, and utility infrastructure.

Program challenges identified by Metro include costs, performance, grid capacity, supply chain and utilities' lead times, and market availability. As a result, according to Metro, shifting the program implementation from 2030 to no later than 2035 will help mitigate these challenges by allowing grid capacity to develop and technology to mature. There are also concerns about how attaining the 2030 goal would affect the overall Operations budget.

At the same time, the urgency of both the air quality and climate crises continue, which both disproportionately impact the health and well-being of Equity Focused Communities here locally and beyond. Additionally, Metro has substantial control to move more quickly to ensure that charging infrastructure is installed, regardless of the timing of delivery of new battery-electric buses. Changing a target of this significance cannot be undertaken lightly and must be thoroughly examined so a thoughtful public discourse can occur and solutions that can address the obstacles come forward. For these reasons, accepting a 2035 goal is premature at this time.

Metro has the responsibility to lead the region in mobile source GHG reduction - not only in its own fleet but by incentivizing Angelenos to get out of their cars and onto transit. Every dollar invested here will have a triple net benefit. Therefore, Metro should do everything in its power to strive for a 100% ZEB fleet by 2030. Each year that passes delays us in delivering the benefits of a fully zero emission fleet.

**SUBJECT: ZERO EMISSION BUSES MOTION**

**RECOMMENDATION**

APPROVE Motion by Yaroslavsky, Bass, Krekorian, Dupont-Walker, and Solis that the Board direct the Chief Executive Officer to:

- A. Report back to the September Operations Committee on a more detailed and updated plan to deliver a 100% Zero Emissions bus fleet as soon as is possible and fiscally responsible; with interim milestones and metrics for both rolling stock and electric vehicle infrastructure installation that reflect an ambitious and actionable schedule; The report back should include a timeline for the submission of relevant service requests to Southern California Edison and Los Angeles Department of Water & Power. The ZEB conversion schedule should ensure Metro's ability to continue providing reliable bus service, including availability of operations and maintenance funding to support the full 7 million annualized revenue service hours as planned through the NextGen Bus Plan.
- B. Provide quarterly reports beginning in January 2025 to the Operations Committee on progress towards accomplishing that plan, including status of grant applications;
- C. Present a list of alternative funding scenarios from what has been presented to date for zero emission bus fueling infrastructure deployment. The alternative scenarios should take into consideration all flexible capital dollars, including from Measures R and M, Propositions A and C, grants and any other revenues. The alternative scenarios should separate funding and timeline considerations between zero emission fueling infrastructure and rolling stock, focusing strictly on infrastructure deployment, and should provide the board options for moving near term funding from other capital projects to ZEB infrastructure projects where near term changes will not affect project delivery timelines for existing projects. It should also include a report back on any relevant Public Private Partnership opportunities, such as "charging as a service", or unsolicited proposals Metro has received thus far that could support lowering costs to Metro for the transition;
- D. ~~Issue a Request for Information to minimize Metro's capital outlay related to zero emission bus~~

~~procurements and infrastructure deployment;~~

- E. Develop a legislative and administrative advocacy strategy that supports increasing Metro's competitiveness in state and federal grant opportunities related to zero emission bus procurement and infrastructure deployment; and
  
- F. Present additional detail on the hydrogen bus procurement process including safety plans, sourcing strategies that protect public health, and justification for specific and narrow use cases where hydrogen buses are proposed to be deployed.



Metro

## Board Report

File #: 2017-0524, File Type: Motion / Motion Response

Agenda Number: 50

**REVISED**  
**REGULAR BOARD MEETING**  
**JULY 27, 2017**

Motion by:

**DIRECTORS BONIN, GARCETTI, NAJARIAN, HAHN and SOLIS**  
**AS AMENDED BY SOLIS, KUEHL and BARGER**

**FRIENDLY AMENDMENT BY FASANA**

July 27, 2017

**Strategic Plan for Metro's Transition to Zero Emission Buses**

LA Metro has developed a comprehensive plan to deliver a complete transition to zero emission electric buses by 2030. The transition plan is contingent on two primary factors: continuous advancements in electric bus technology (which must increase range, reduce bus weights, reduce charging times, extend battery life cycles), as well as a drop in prices as the technology develops.

As electric bus technology continues to advance, our electric grid is becoming cleaner by gradually eliminating coal from our energy portfolio and replacing it with renewable sources. A full transition to electric buses coupled with renewable energy sources promises mobility with significantly lower environmental impacts from this form of transportation.

In order to maintain our bus fleet in a state of good repair, Metro plans to continue replacing its aging bus fleet at approximately 200 buses per year. With firm local hiring requirements in Metro bus procurement, routine bus procurement presents a recurring opportunity that bolsters our local labor force in perpetuity.

In 2012, Metro's U.S. Employment Plan resulted in the award of an \$890 million contract to Kinkisharyo, a factory in Los Angeles County, and 404 quality railcar manufacturing jobs. Similarly, Metro can leverage recurring bus replacements to bolster labor throughout Los Angeles County

Metro plans to spend nearly one billion dollars on bus procurements in the next ten years. That level of investment, coupled with a transition to all electric buses, presents an opportunity for LA County to demonstrate leadership on combating climate change, and can make Los Angeles the central marketplace for new electric bus technology: a County rich with quality manufacturing jobs rooted in technologies that provide mobility, sustain a healthy environment and create career paths in clean

energy technologies.

**SUBJECT: MOTION BY BONIN, GARCETTI, NAJARIAN, HAHN  
AND SOLIS AS AMENDED BY SOLIS, KUEHL AND  
BARGER**

**RECOMMENDATION**

WE THEREFORE MOVE that the Board:

- A. ENDORSE the Strategic Plan for Metro's Transition to Zero Emission Buses;
- B. DIRECT the CEO to create a zero emission bus infrastructure working group comprised of Metro staff, federal and state regulators and local utility companies to track market availability and to cultivate ongoing collaboration among stakeholders. The working group will monitor market rates for emerging zero emission bus technology to support Metro's 2030 transition plan:
  - 1. Working group to report to the Board annually with the latest technology innovations to support the cost/benefit analysis of fleet conversion
  - 2. MTA to host an industry forum to solicit innovative solutions to delivering the 2030 plan;
- C. AMEND the Metro federal legislative plan to advocate for local jobs as a critical factor in the evaluation criteria of MTA procurements; and
- D. DEVELOP an equity threshold consistent with Title VI regulations for priority deployment of electric buses in underserved communities.

FURTHER MOVE that the Board direct staff to:

- A. As part of establishing a working group:
  - 1. EXPAND the invitation to regional air quality regulators (e.g. South Coast Air Quality Management District), the American Public Transportation Association and California Transit;
  - 2. EXAMINE and TRACK vehicle technology and performance, energy production and pricing, infrastructure needs and life-cycle analysis and creative funding opportunities.
- B. COORDINATE with the County of Los Angeles to explore opportunities to develop a countywide incentive structure to promote and attract more companies to manufacture, assemble and produce zero-emission transit vehicles and related technologies and infrastructure in Los Angeles County;
- C. Widely PROMOTE and ENCOURAGE municipal transit agencies/operators to participate in the established process by which to co-procure ("piggyback procurement" provisions) zero-

emission transit vehicles;

- D. ENSURE that MTA maintains the flexibility to explore the best available technologies that contributes to zero-emissions and/or net-negative emissions in the Los Angeles County public transit sector.

**FRIENDLY AMENDMENT BY FASANA** that staff report back to the board with a timeline and any commitments by parties before we undertake our next bus purchase and answers to the following questions:

- A. Will electric buses and their batteries deliver the guaranteed range and service?
- B. Can municipal and electric utilities timely invest in the grid in order to power electric buses?
- C. Which strategies will maximize Metro's ability to receive cap and trade credits?
- D. How and when can charging infrastructure be deployed at our bus divisions? More importantly, how will such infrastructure be paid for?
- E. Why is Metro's role critical for the adoption of low NOX engines in the trucking industry? What assurances do we have that this will take place when Metro has operated cleaner engines since the 1990s without adoption of these technologies by the trucking industry?
- F. What are the resiliency impacts to our service if electricity or natural gas service is disrupted? What is our back-up plan?
- G. Metro can intervene in regulatory proceedings at the California Public Utilities Commission for investor owned utilities regarding transportation electrification and equivalent natural gas proceedings as appropriate. Metro needs to assess the current regulatory schedule for such proceedings, develop advocacy position, and indicate that our adoption of electrification may be affected if electric transportation infrastructure is funded by shareholders, recovered through rates, and implemented on a timely basis.
- H. Conversely, how will Metro undertake the capital investments directly? Foothill Transit has intervened in the active proceeding. Antelope Valley and other providers are engaged. Metro needs to be more actively engaged and needs to report back to our Board on what is at stake. In SCE's service area, demand charges make the operating costs of electric buses more costly than natural gas vehicles. Are we working to influence changes to the rate schedules?
- I. Can RNG be adopted without direct Metro involvement by substituting RNG for natural gas purchased out of state? We should participate in any state framework that could create linkages between Metro's adoption of RNG and RNG implementation by the trucking industry.





## Board Report

**File #:** 2023-0766, **File Type:** Informational Report

**Agenda Number:** 31.

### OPERATIONS, SAFETY, AND CUSTOMER EXPERIENCE COMMITTEE APRIL 18, 2024

**SUBJECT: ZERO-EMISSION BUS PROGRAM UPDATE**

**ACTION: RECEIVE AND FILE**

#### **RECOMMENDATION**

RECEIVE AND FILE status report on the Zero-Emission Bus (ZEB) Program.

#### **ISSUE**

In 2018, The California Air Resources Board's (CARB) Innovative Clean Transit (ICT) regulation mandated that all transit agencies in the state operate all-zero emission fleets by 2040. In addition, ICT ZEB purchase requirements for large transit agencies require 25% of bus purchases to be zero-emission beginning in 2023, 50% beginning in 2026, and 100% beginning in 2029.

In July 2017, Metro's Board of Directors approved Motion #50 by Directors Bonin, Garcetti, Najarian, Hahn, and Solis (Attachment A), which endorsed a ZEB Strategic Plan (SP) to transition the entire bus fleet to ZE by 2030, contingent on envisioned cost and performance equivalence with compressed natural gas (CNG) buses and continued advancements in charging infrastructure. As a result, Metro is the largest transit agency in the State with the largest investment in transition from CNG to ZE. The Motion has enabled Metro to meet all of the ICT ZEB purchase requirements 10 years ahead of schedule.

However, cost and performance parity have yet to materialize, and it is not projected to reach it for the foreseeable future. Furthermore, the recent pandemic adversely impacted the financial viability and competitiveness of the US clean bus manufacturing market. This, and other factors, recently led an OEM to announce plans to close its US manufacturing facility in 2025, another OEM to file for bankruptcy relief, and another OEM to close its manufacturing facility in Southern California - all within the last 12 months. The US now finds itself with just two major OEMs that can compete for Metro bus procurements.

#### **BACKGROUND**

Since the Board's actions in 2017, Metro has embarked on the most extensive ZEB transition program in the U.S. In 2018, Metro initiated the development of a comprehensive plan of action to guide the ZE transition. The "2022 Zero-Emission Bus Program Master Plan" was developed with

service analysis, design criteria, and action-ready requests for proposals (RFPs) to begin the transition of Metro's fleet to ZEBs.

To date, Metro has made significant progress in transitioning to ZEB service.

- Metro's G (Orange) Line bus rapid transit (BRT) initiated 100% ZE service at the start of 2021. To date, these vehicles have accumulated over three million miles of ZE service, the most miles by any public transit agency in the country.
- Conversion of Metro's J (Silver) Line BRT is underway and is anticipated to be completed by mid-2025.
  - Harbor Gateway opportunity charger installation work: 3 chargers installed out of 8 chargers.
  - El Monte Transit Center opportunity chargers & Division 9 Full electrification: Bids are due 04/05/2024.
- Division 18 & Division 7 Full electrification: RFP will be released in July with award planned for January 2025
- Metro is initiating a pilot program of approximately 20 buses to explore hydrogen fuel cell bus technology and the application in LA County's service environment.

#### Procurements:

- In September 2019, Metro awarded its final option for CNG buses and committed to all future procurements being ZE - a decade earlier than the ICT ZEB deadline of 2029.
- A total of 145 BEBs have been ordered, one of the most significant BEB procurements to date in California and among the three most significant in the country. Currently, 50 BEBs have been delivered, with the remaining 95 scheduled to be delivered between March and September 2024. Metro is projected to have the most BEBs in active service in the U.S upon delivery of these buses.
- In January 2023, the Metro Board authorized the solicitation of a Request for Proposal (RFP) of 260 additional BEBs and associated charging infrastructure, with up to four options of 200 BEBs each. The RFP will be released by May 2024.

#### Workforce Development:

- Metro has made significant investments in workforce development, developing a manufacturing careers policy and implemented advanced training for operators and maintainers specific to BEB technology.

#### Funding & Grant Applications:

- Metro has aggressively pursued all available ZEB-related federal and state grant funding, having applied for approximately \$741 million and successfully secured \$446 million to-date, inclusive of \$155 million in local funding, including one of the largest Low-Emission/No-Emission (LoNo) grants in this federal program's history (\$104.1 million awarded in 2022).
- Securing grant funding is challenging as the main criteria for all ZE grants is demonstrating GHG reductions. As Metro operates highly clean buses fueled with Renewable CNG, it is disadvantaged against agencies who have not pursued cleaner options and are still operating diesel buses.

- The grants will pay for Zero Emission Buses, charging infrastructure, and workforce development.
- In the last 12 months Metro has applied for numerous grants including: FTA -LoNo, SCAG-CMAQ/STBG/CRP, and EPA-CPRG.
- Scheduling project delivery is critical to ensure it aligns with grant draw-down requirements.

While aggressive program achievements and collaboration with relevant international and national organizations have incentivized the market to make investments in battery technology, energy management, and motor efficiencies, transit bus OEMs continue to leave the U.S. market including Nova Bus, Proterra, and ENC. Additionally, despite the progress made to date, significant challenges remain as the ZEB industry is still evolving and not sufficiently mature to allow for full implementation without risk to service. Key issues include cost and funding, vehicle performance, early obsolescence, utility lead times, and supply chain issues. Each is discussed below.

## **DISCUSSION**

### **ZEB Costs and Funding**

BEB cost and technical parity with CNG buses have not materialized. For example, per current contract prices from the states of California and Washington, the cost of a BEB 40-footer is almost double that of a CNG 40-foot bus. For 60-footers, the cost differential is 70.1% more. ZEBs are more expensive than CNG buses, and the new infrastructure required to support ZEBs requires a large initial capital investment.

The following are the areas of note regarding cost comparisons between ZEB and CNG buses:

- Capital Costs
  - This cost differential for ZEBs has dropped slower than initially expected.
  - The capital costs for installing BEB charging infrastructure at the depots and on-route charging are approximately \$600 million to \$800 million higher than the periodic cost of replacing CNG infrastructure.
  - Although Metro has successfully obtained more than \$400 million in additional grant funding for the ZEB program, more must be obtained or other Metro capital programs re-scheduled in order to complete the full transition to ZEB operation.
- Operating Costs
  - Costs to maintain and operate ZEBs are still being evaluated. From initial deployments, savings in maintenance costs have only now begun to be realized in some agencies. However, energy costs have not remained stable.
  - Costs to maintain and operate charging infrastructure can be higher than conventional CNG storage and fueling infrastructure, although many agencies are mitigating cost increases through external vendor contracts and extended warranties on the charging equipment, covered under capital expenditures.
  - Costs associated with charge management are still being developed; however, these costs will also be new costs over that of the CNG legacy fleet.

### BEB Performance Challenges

- Range - Current BEBs have an operable range of 150-160 miles (dependent on a myriad of factors, such as seasonal fluctuations in energy usage, operator driving habits, route topography, general traffic speeds, etc.). Metro's updated service modeling analysis estimated future BEB battery capacities, and derived energy consumption rates to project the service blocks that can be completed by a single BEB on a single charge. Currently, 64% of Metro's 1,800 service blocks are within 150 miles. The model projected that up to 27% of the service blocks could not be completed with a fully charged battery pack by BEBs Metro will have purchased by 2030. In comparison, this situation is reduced to only 8% non-completion with BEB technology Metro expects to acquire between 2030 and 2035.
- Reliability - The industry is still gaining experience in integrating new technologies into existing systems. Metro continues to experience integration issues between new and existing battery systems and interfaces between the bus and charging infrastructure, leading to premature failures of components. Recent reports suggest that this continues to be an industry-wide problem and not unique to Metro's operation. Extending the transition period will allow technology to mature, improving fleet availability and reducing the time and resources required to maintain the fleet in a State of Good Repair (SGR).
- Maintainability - While the industry has focused primarily on ensuring ZEBs can perform as CNG counterparts, less effort has been made to develop diagnostic information and tools for on-site technicians to expeditiously investigate and repair failures. Because the technology is relatively new and rapidly evolving, agencies must resort to relying on OEM suppliers' subject matter experts who are remotely located to investigate and mitigate failures, leading to longer out of service times. Metro has taken on additional consulting staff to address these issues and recently received a \$5 million training grant for workforce development. The recent LoNo grant from the federal government can also be used to improve operator and maintenance staff training. Additionally, Metro's work to establish a Center for Transportation Excellence for advanced transportation technology is also designed to address these issues by incentivizing suppliers to locate their technical staff in Southern California.
- Operability - BEBs are relatively less user-friendly to operate compared to Metro's legacy fleet. As such, operators of BEBs need to be more intentional with driving. For example, operators will need to consider regenerative braking, HVAC usage, and buses' state of charge. Additional training and experience are needed to ensure the operators' familiarity with correct procedures to avoid creating faulty conditions.
- Obsolescence - As technology advances, parts, models, and other seemingly new equipment are rapidly becoming replaced - and in some cases, obsolete - as vendors continue to evolve their products and respond to market needs. As a result, vendors have less incentive to support early technology than their newest offerings.

### Utility, Infrastructure, and Supply Chain Challenges

- Long lead times for grid upgrades - According to discussions with relevant staff of the electric utilities serving Metro's bus divisions, the project time that the utilities need to perform service studies, develop engineering and design documents, as well as add the necessary construction contractor time, is a core factor in achieving the transition at each division. It was identified that a minimum of four to five years is required to complete utility upgrades. Furthermore, should substation or transmission infrastructure upgrades be needed, the project time could be up to seven years.
- Grid capacity - Studies conducted by the California Independent System Operator (CAISO) have shown that the entirety of the California electrical grid is undersized by 2-3 terawatts (TW) and not ready to support a large-scale adoption of ZE vehicles. Additionally, more refined surveys of the divisions have revealed that the available grid capacity to serve some of its divisions may be less than the assumed minimum of five additional megawatts needed for each division. These challenges will require added efforts in the planning and design processes to mitigate and may result in schedule impacts.

Market availability - Supply chain issues and constraints are currently impacting the timelines to deliver ZEBs and their supporting infrastructure. These issues are worse for FCEBs than for BEBs, as the market is still not mature enough to support Metro's goals. Only two OEMs produce FCEBs, and only 4% of all ZEBs (procured or in operation) are FCEBs.

### Considerations

Metro's bus fleet contributes only 0.2% of LA County transport emissions.

Over the last year, Metro has continued to engage with SCE and DWP. Specifically, Metro is taking advantage of the SCE Charge Ready Program and Chair Bass and Director Yaroslavsky's offices have facilitated meetings with DWP and Metro staff to improve communication and understanding of Metro's future utility needs.

### *APTA Bus Task Force*

Labor market tumult, hyperinflation in material and component prices, commodity shortages, hardships by many parts suppliers, and the significant increase in the cost of capital, have undermined the financial health of the bus OEMs. Preserving, protecting, and nurturing a highly competitive US bus manufacturing market and the capacity to transition to zero-emission buses are essential. In October 2023, APTA created a Bus Manufacturing Task Force to recommend immediate actions that can support a more competitive and stable bus manufacturing capacity in the US.

### *State and Regional Collaboration*

- Working with Los Angeles County Municipal Operators Association (LACMOA) in developing a ZEB joint procurement. This procurement will allow LA Metro and LACMOA to purchase hydrogen fuel cell buses, battery electric buses, opportunity chargers, and depot chargers.
- LA Metro and LACMOA are considering potential combined procurement for as many as 300 BEBs and fuel cell electric buses (FCEB) and for more than 1,300 ZEBs over the next seven

years. Vehicle and charging equipment specifications were distributed to municipal operators for review and feedback in March.

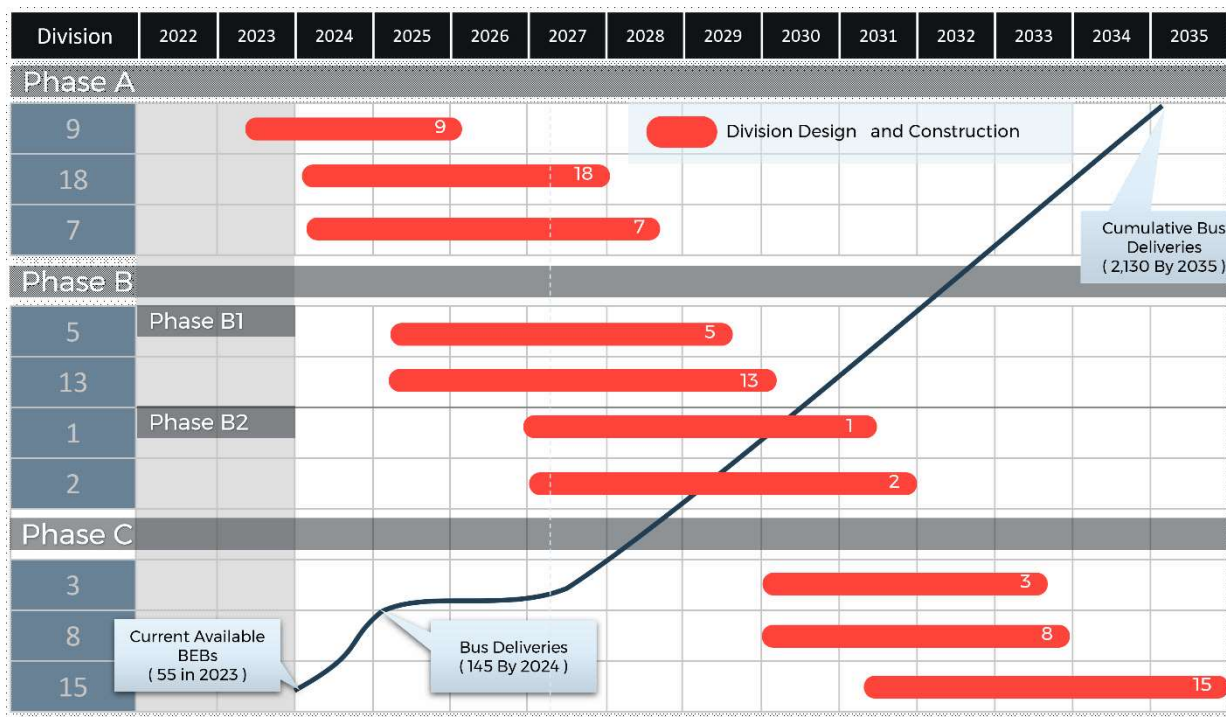
### Current ZEB Conversion Schedule

The following updated phasing timeline for the continuation of the ZEB program is designed to maximize the potential gains from BEB technology growth while accommodating the extended timeline required for utility coordination.

- Phase 1 includes Divisions 7, 9, and 18, which are all serviced by SCE. Combining them in one phase allows for potential time savings with the related utility coordination and upgrades, particularly considering that such work has already commenced for Divisions 9 and 18.
- Phase 2 will focus on divisions serviced by LADWP, with most service blocks within 150 miles, which are divisions with service less dependent on on-route changing facilities. Phase 2 is further divided into two sub-phases as Divisions 1 and 2 have been identified with site-related constraints.
  - Phase 2A: D5 & D13
  - Phase 2B: D1 & D2
- Phase 3 includes Divisions 3, 8, and 15, where more of the bus network's longer service blocks are currently deployed, indicating the more extensive need for power and on-route chargers. Grouping them in the last phase will also benefit the most from potential advancement in BEB technology and range.

Moreover, the optimized infrastructure phasing schedule is consistent with the new bus procurement and charger installation schedules, SGR planning, and the staff's capacity to receive and make ready the new BEB and associated systems for service.

The following Gantt chart shows the phasing and transition schedule, by bus division, as well as the new BEB deliveries schedule based on updated procurement timelines: However, staff continues to explore other opportunities to advance ZEB conversion, including hydrogen.



**DETERMINATION OF SAFETY IMPACT**

This update has no impact on safety.

**EQUITY PLATFORM**

No changes in equity-associated impacts are expected in the previously submitted board reports associated with the ZEB transition program. Maintaining service reliability and operability with the proposed program extension, as noted above, will allow Metro to continue to provide transit service for travelers throughout Los Angeles County with the fewest mobility options. BEBs will operate on routes restructured through the NextGen transit service plan. Seven out of the 10 Metro directly-operated bus divisions are located within a state-classified disadvantaged community (DAC) according to the California Environmental Protection Agency and in the established California Senate Bill 535. A DAC is defined as a community located in one of the top 25% highest-scoring census tracts identified by the CalEnviroScreen health screening tool. At least 50% of the communities serviced by lines from each division are DACs.

**IMPLEMENTATION OF STRATEGIC PLAN GOALS**

This update supports Goal #3 (enhance communities and lives through mobility and access to opportunity) and Goal #4 (Transform LA County through regional collaboration and national leadership). The revised implementation schedule also fulfills Metro’s ZEB Strategic Plan goals in a manner consistent with considerations that minimize cost and operational risks to Metro’s existing capital and operation plans.

**NEXT STEPS**

Staff will continue to proceed with a competitively negotiated solicitation for acquiring new ZEBs and supporting charging and fueling infrastructure, forecast to be released by May 2024.

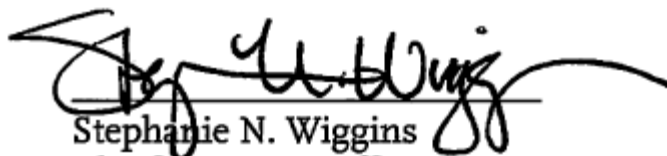
**ATTACHMENTS**

Attachment A - Board Motion 50 Strategic Plan for Metro's Transition to Zero Emission Buses

Prepared by: Jesus Montes, Senior Executive Officer, Vehicle Engineering & Acquisitions, (213) 418-3277

Matthew Dake, Deputy Chief Operations Officer, Vehicle Maintenance & Engineering, (213) 922-4061

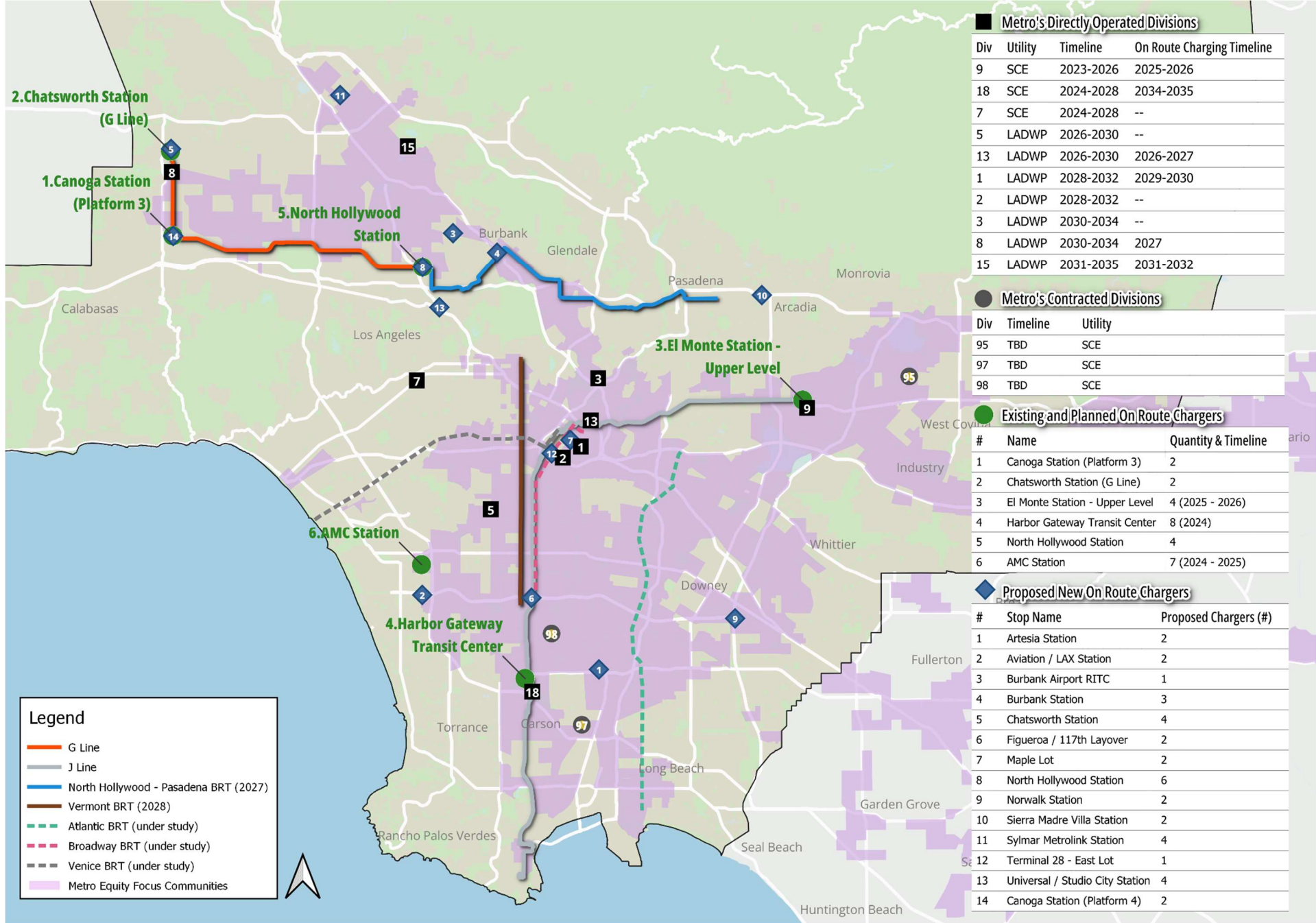
Reviewed by: Conan Cheung, Chief Operations Officer, (213) 418-3034



Stephanie N. Wiggins  
Chief Executive Officer



**ATTACHMENT D**





## PROJECT DELIVERY, UNSOLICITED PROPOSALS, AND CHARGING AS A SERVICE

### *Program Project Delivery to Date*

To date, Metro has employed two delivery methods for its ZEB projects. For example, division 9, El Monte Transit Center, and Harbor Gateway Transit Center were pursued as Design Bid Build (DBB). In contrast, Divisions 18 and 7 will be pursued through a Progressive Design Build (PDB) delivery method. In the former approach, Metro designs the project to 100%, while in the latter, Metro benefits from early contractor involvement during the design phase. Metro continues to evaluate the costs, benefits, opportunities, and challenges of traditional and alternative delivery methods in the remaining seven divisions. Metro also continues to consider other alternative delivery methods, including Design Build, Operate Maintain (DBOM), Progressive Design Build, Operate and Maintain (PDBOM), and Charging-as-a-Service (CaaS). Discussion of DBOM and CaaS will continue in the Cost and Funding section of this report.

As noted previously, Metro released a regional procurement to purchase up to 1,980 ZEBs. For local and municipal operators who wish to participate, Metro will assign option bus quantities based on local and municipal operator needs. Operators do not need to commit to a quantity until after the procurement award. The assignability of options approach preserves flexibility and reduces the administrative burden on Metro and participating municipal operators. Metro expects to release another bus procurement no later than 2029 for the remainder as well as any additional buses for local and municipal operators, unlocking the latest zero-emission technology advancements and potentially limiting exposure risk to a single fleet type.

### *Unsolicited Proposals*

In 2019, Metro received two unsolicited proposals related to the ZEB program: one from Proterra for a Bus-as-a-Service (BaaS) delivery approach and one from Amply (now bp Pulse) for a Charging-as-a-Service (CaaS) delivery approach. Each proposal offered Metro potential opportunities to spread capital expenditures over the life of the project and transfer risk to a private partner in exchange for long-term asset performance. The proposal review team recommended Metro advance toward an alternative delivery approach for Phase II of the ZEB program. In June 2021, the CEO directed the Office of Strategic Innovation (OSI) to proceed with a business case and assess alternative program delivery approaches to assist with achieving Metro's goals.

### *Charging-as-a-Service and Other Alternative Delivery Methods*

In January 2022, Metro retained a financial advisor to initiate an evaluation of program delivery options. Following qualitative analysis and market soundings, Metro developed a conceptual project scope comprised of Divisions 3, 5, 13, and 15, as well as evaluated three "as-a-service" delivery approaches in the preliminary business case:

- **CaaS with energy management:** Includes facility upgrades, charging infrastructure, distributed energy resources, management systems, and operations/maintenance of the charging infrastructure. A project developer would commit to the timely delivery of the assets as well as the infrastructure's ongoing performance and availability.
- **CaaS with Vehicle Delivery Only:** This includes all scope elements from Option 1, as well as the acquisition and on-time delivery of the buses.
- **BaaS:** Includes all scope elements from Option 2, as well as maintenance and long-term performance of the buses.

The inclusion of buses in the project bundle introduces a significant cost increase compared to the base CaaS approach. Financing buses, primarily through private instruments, would likely introduce a high cost of capital over the life of the project. Given that the U.S. bus market is limited and technology is still developing, the market's appetite to bear vehicle performance risk beyond standard warranties remains untested. However, Metro bears the sole risk of vehicles not meeting its performance needs under Metro's current bus acquisition approach.

The assessment concluded that due to the uncertainty surrounding several factors, not least the performance of buses and charging equipment, a progressive contracting approach, like CaaS, PDB, or Progressive DBOM, could enable several benefits, including:

- **Collaboration:** Early contractor involvement could allow Metro to collaborate with the private sector to better understand the risks related to costs as well as technical constraints regarding the transition to ZEB, test assumptions, and validate the project's commercial/financial feasibility. This iterative process would allow Metro to refine the project scope and schedule with the private partner as new information and analysis are completed while maintaining control over the overall project outcome.
- **Global Private Sector Expertise:** Metro will benefit from private sector expertise and innovation in optimal technology to deliver the ZEB transition and provide opportunities for improved outcomes through early involvement in the design of solutions. In 2022, 66,000 BEBs were sold worldwide, but only 2,000 were sold in the U.S. While the U.S. lags behind Asia and Europe in BEB deployments, there is vast international experience available in the marketplace that can deliver tangible benefits to Metro.
- **Pricing Risk:** The better a contractor understands a risk, the more likely it is to price that risk efficiently. Early contractor involvement may help drive more efficient pricing for project activities and reduce contingencies for shared/transferrable risk opportunities.

- **Project Schedule and Concurrent Activities:** Early contractor involvement with these alternative delivery strategies will enable Metro to accelerate project development as well as allow various planning, procurement, environmental, permitting, and development activities to occur concurrently using early work packages (e.g., utility capacity upgrades).

Metro staff continue to evaluate the cost and benefit of alternative delivery methods, including the extent to which Metro may require access to financing to deliver the latter phases of the program, as well as operations/maintenance support to ensure high levels of performance of charging equipment. While alternative delivery approaches may help Metro manage the cost of the transition through risk transfer and spreading costs over the asset lifecycle, lessons learned from Metro's existing ZEB projects and contracted bus service will be crucial to understanding the potential total cost of the transition as a benchmark.

**ONGOING UTILITY COORDINATION ACTIVITIES**

While it is premature to submit preliminary service requests for the divisions in the LADWP service territory, staff provided updated load demand forecasts to LADWP's Distribution Planning team in July. The estimates presented three indicative scenarios that describe future electrified division power needs:

- Unregulated scenario, which does not account for charge management and represents the maximum anticipated site load
- Minimum scenario, which accounts for charge management and represents the lowest possible utility limit for viable operation
- Efficient scenario, which accounts for charge management and represents the least monthly utility cost to Metro.

LADWP staff are reviewing the latest power forecasts.

Staff will continue to closely coordinate with LADWP to identify opportunities to accelerate upgrade timelines, mitigate capacity needs, and minimize the cost of upgrades. Regarding the latter, staff have advocated for LADWP to develop a Charge Ready Transport (CRT)-like incentive program (currently operated by SCE), which covers some of the costs of utility capacity upgrades and charging equipment. Metro has enrolled in SCE's CRT program and expects that the program will deliver \$12.6 million in incentives for Division 9 and El Monte Transit Center alone.

Furthermore, Metro is engaged with LADWP across all departments and levels as working groups negotiate terms for a Master Utility Cooperative Agreement (MUCA). Staff expect the MUCA to be executed in June 2025 and that it will support Metro's efforts to convert the bus fleet to zero-emissions.

Staff are also collaborating with the Los Angeles Mayor's Office, the Los Angeles Cleantech Incubator (LACI), LADWP, SCE, and other local stakeholders to prioritize site planning and grid interconnection for transportation electrification initiatives that support the 2028 Olympic and Paralympic Games. This work is ongoing under the Games Energy Council (GEC) Mobility Electrification Working Group. While many sites and their respective needs remain to be determined, the regional approach will ensure that needs, synergies, and actions support collective efforts and deliver legacy infrastructure.

**Board Report**

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**File #:** 2020-0636, **File Type:** Plan**Agenda Number:** 41.

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**EXECUTIVE MANAGEMENT COMMITTEE  
MARCH 18, 2021****SUBJECT: ZERO EMISSION BUS ROLLOUT PLAN****ACTION: APPROVE RECOMMENDATION****RECOMMENDATION**

APPROVE Zero Emission Bus Rollout Plan for submittal to California Air Resources Board (CARB).

**ISSUE**

CARB's Innovative Clean Transit (ICT) Regulation requires all public agencies in the State of California to submit a Zero Emission Rollout Plan, approved by the agency's governing body, describing the agency's strategy to transition to 100% zero emission bus operation by 2040.

**BACKGROUND**

In December 2018, the California Air Resources Board (CARB) approved the Innovative Clean Transit (ICT) Regulation which requires all public transit agencies in the state to transition from conventional buses (compressed natural gas, diesel, etc.) to ZEBs (battery-electric or fuel cell electric) by 2040. The regulation requires a progressive increase of an agency's new bus purchases to be ZEBs based on their fleet size.

To ensure that each agency has a strategy to comply with the 2040 requirement, the ICT regulation requires each agency to submit a ZEB Rollout Plan (Rollout Plan) before purchase requirements take effect. The Rollout Plan is considered a living document and is meant to guide the implementation of ZEB fleets and help transit agencies work through many of the potential challenges and explore solutions.

As a "Large Transit Agency", as defined by the CARB ICT regulation, Metro was originally required to submit a Board-approved Rollout Plan by July 1, 2020. However, due to the severe impact the COVID-19 pandemic to agencies' operations, budgets, and schedules, CARB staff has permitted larger transit bus agencies to request an extension. Metro requested an extension on June 29, 2020 to submit the Rollout Plan by December 31, 2020. CARB granted the extension on June 30th, 2020. Due to resource impacts with COVID, Metro requested another extension on October 22, 2020 to submit the Rollout Plan by March 31, 2021. CARB granted the extension on October 27, 2020.

**DISCUSSION**

### California Air Resources Board (CARB) Zero Emission Bus Rollout Plan

Pursuant to the CARB ICT Regulation, Metro's Rollout Plan (Attachment A) describes the plan to meet CARB's 2040 ZEB goals. Since Metro's goal is to transition by approximately 2030, Metro's Rollout Plan is more aggressive than the ICT Rule's schedule and thus complies with the CARB ICT regulation.

### Zero Emission Bus Program Master Plan

The ICT Regulation Rollout Plan is derived the Metro's ZE Master Plan. The key difference is that the ICT Regulation specifies a generic format and level of information to be provided by all California transit bus agencies. Metro's ZE Master Plan is customized for Metro's Operations.

The Rollout Plan (Plan) is based on pre-COVID-19 pandemic operations. While no change to Metro's goal of transitioning to a 100% ZEB bus fleet by 2030 fleet is recommended at this time, staff is investigating potential impacts that changes to revenue, ridership, and service levels may have to the Plan and the Board's 2030 goal.

In parallel:

- Staff continues to refine development of layover charging locations in preparation for additional modeling of battery bus performance with on-route charging options, including for the Pasadena-North Hollywood Bus Rapid Transit Project.
- Staff continues to coordinate with Southern California Edison's (SCE) as they work to electrify the Silver Line. SCE's method of service (MOS) study preliminary analyses is anticipated to be complete by September 2020. This study will inform Metro on strategies to electrify Division 9 and El Monte Station, including considerations for energy storage and siting.

Should staff identify any issues that will result in material changes to the Plan or schedule, Metro will inform the Board and CARB as required by the ICT regulations.

### **DETERMINATION OF SAFETY IMPACT**

This recommendation will have a positive impact on system safety, service quality, and system reliability for our customers.

### **FINANCIAL IMPACT**

Adoption of the Rollout Plan would have no additional financial impact to the agency. Financial impact is consistent with previous Master Plan updates.

### **IMPLEMENTATION OF STRATEGIC PLAN GOALS**

This item supports the following Strategic Goals: 1) Provide high-quality mobility options that enable people to spend less time traveling and 2) Provide responsive, accountable, and trustworthy governance within the Metro organization.



**ALTERNATIVES CONSIDERED**

Staff could request another extension, but such an action would likely not be approved by CARB.

**NEXT STEPS**


If this action is approved, staff will submit the Rollout Plan to CARB by March 31, 2021 as directed.

**ATTACHMENTS**

Attachment A - Metro's Rollout Plan

Prepared by: Marc Manning, Sr. Director, Vehicle Engineering & Acquisition, (213) 922-5871  
Jesus Montes, Sr. Executive Officer, Vehicle Engineering & Acquisition, (213)  
418-3277

Reviewed by: James T. Gallagher, Chief Operations Officer, (213) 418-3108



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Phillip A. Washington  
Chief Executive Officer

**ZEB Program Grant Awards and Funding Allocations, Amounts, and Uses (August 2024)**

LINE	GRANT TYPE	GRANT AMOUNT	PURPOSE
1	\$ 17,096,000	STIP-RIP	Buses
2	\$ 17,915,334	CRP	Buses
3	\$ 25,507,000	SCCP	Buses
4	\$ 40,749,000	STIP-RIP	Buses
5	\$ 5,000,000	FTA	Buses
6	\$ 56,400,000	AHSC	Buses
7	\$ 200,633,000	STIP-RIP	Buses
8	\$ 39,098,039	LCTOP (FY19-20)	Charging Infrastructure
9	\$ 52,157,339	LCTOP (FY22-23)	Charging Infrastructure
10	\$ 38,189,000	CRRSAA-STIP	Charging Infrastructure
11	\$ 500,000	STIP-RIP	Charging Infrastructure
12	\$ 24,000,000	CRP	Charging Infrastructure
13	\$ 19,132,000	STIP-RIP	Buses & Charging Infrastructure
14	\$ 159,100,000	TIRCP	Buses & Charging Infrastructure
15	\$ 104,160,000	FTA LoNo	Buses, Charging Infrastructure & Workforce Development
16	\$ 77,536,675	FTA LoNo	Buses, Charging Infrastructure & Workforce Development
17	\$ 175,364,000	SB125 (ZETCP)	Buses & Charging Infrastructure

**TOTAL**    \$    **1,052,537,387**

**Summary of the Hydrogen Fueling Infrastructure Feasibility Study**

The December 2023 Master Plan Update modeled Metro’s existing service block mileages against multiple rates of BEB technology improvements. The model suggested with current technology improvement rates, BEB technology cannot meet 9 – 27% of Metro’s service blocks in 2030, and 1 – 8% cannot be met in 2035 or 2040. Even by introducing opportunity charging, most of these blocks cannot be achieved with anticipated improvements in BEB technology. Metro will evaluate FCEBs, which offer ranges comparable to CNG, and bring zero-emission service for uncompleted service blocks. Other benefits FCEBs provide include a fueling time comparable to CNG's (6-10 minutes per bus) and avoiding expensive utility capacity upgrades.

Metro will purchase 20 FCEBs in the open solicitation’s base order. Staff have prepared a preliminary feasibility study to evaluate the placement of hydrogen fueling infrastructure and deployment of FCEBs on bus lines. Staff also established four criteria to assess all directly operated and contracted divisions, as well as identified a short list of suitable locations for implementation. The four criteria and their respective components included:

- Space constraints
  - Available space in the bus yard to accommodate hydrogen fueling infrastructure
  - Number of bus parking spaces that would be displaced
  - Impact on yard circulation
- Service block profile
  - Divisions with the most significant number of service blocks over 200 miles
  - Blocks that a BEB cannot complete with a 2028 forecasted range
- Development plans
  - Avoid interference with ongoing or planned division electrification activities
- Equity Focus Communities (EFC)
  - Location within and the number of EFCs potentially served by FCEBs

Divisions 8 and 15, as well as the Marilla Lot, a Metro-owned property near Division 8, received the highest scores based on the evaluation criteria. All three locations appear to have the space to accommodate FCEB fueling infrastructure, and none would experience a significant loss of bus parking spaces. Divisions 8 and 15 each have more than 40 service blocks with distances over 200 miles, and no major development or construction is planned for either location, except Division 15, which may receive resiliency charging infrastructure in 2026. Neither division is located within an EFC, and 27% and 34% of the communities served by Divisions 8 and 15 are EFCs, respectively.

While Metro's two contracted divisions (95 and 97) did not score as highly, Division 97 received a medium score, which warrants further consideration. Transitioning Metro's contracted divisions to zero-emissions may be more feasible and cost-effective if they operate FCEBs instead of BEBs. This is due to the unique characteristics of each site, contract term lengths, and the cost to upgrade facilities. However, Metro continues to evaluate the available pathways for transitioning contracted divisions.

Staff have advanced the feasibility study to more detailed site-level evaluations of the shortlist (Divisions 8, 15, the Marilla Lot, and Division 97). Staff are also collaborating with the Federal/State Policy and Programming team to identify grant funding sources for the FCEBs and fueling infrastructure.

### *Safety Considerations*

FCEB technology necessitates specific safety measures due to the properties of hydrogen as a fuel source. These measures include adequate safety setbacks for hydrogen storage tanks, emergency shutdown (ESD) mushroom-style buttons throughout the station, comprehensive gas detection systems to monitor for leaks, Ultraviolet and Infrared-Flame (UV and IR) detectors, as well as fire-rated barriers to protect facilities in the event of a fire and to reduce the required safety setbacks.

While similar safety precautions are taken with Compressed Natural Gas (CNG) fueling and buses, the transition to FCEBs introduces unique challenges. Colorless/odorless Hydrogen requires more sensitive and specialized leak detection systems than those used for CNG, which typically rely on odor cues for initial leak identification. Agencies already operating CNG facilities can adapt much of their existing infrastructure (e.g., gas handling systems) but must enhance their leak detection technology to manage hydrogen safely. Additionally, transitioning to FCEB facilities involves accommodating the high pressures and low temperatures specific to hydrogen storage, alongside electrical safety measures for managing on-board high-voltage batteries, such as those in BEBs.

Several agencies within California, including the Alameda-Contra Costa Transit District (AC Transit), Sunline Transit Agency, and the Orange County Transportation Authority (OCTA), operate FCEBs. During previous conversations with Metro staff, staff at these agencies have not reported any unique safety incidents related to FCEBs and infrastructure.

### *Sourcing Strategies*

While FCEBs have zero tailpipe emissions, upstream emissions vary depending on the hydrogen production method. The two primary methods for generating hydrogen fuel

are steam methane reformation (SMR) and water electrolysis. Both are typically conducted off-site at a central production plant but can be done on-site at the bus facility, producing gaseous hydrogen (GH<sub>2</sub>). SMR, a process that extracts hydrogen atoms from natural gas, is predominantly used by hydrogen suppliers at a large scale. Electrolysis, a process utilizing electricity to separate hydrogen atoms from water, generates no on-site emissions.

The hydrogen gas produced via these methods is categorized as gray, blue, or green, each signifying a different degree of upstream emissions. It is crucial to acknowledge the actual advantages and drawbacks will depend on Metro's specific design and contract. The table below summarizes several considerations for each hydrogen type and provides on-site and off-site hydrogen generation considerations:


### Hydrogen Fuel Types

Gray (SMR)	Blue (SMR)	Green (Electrolysis)
<ul style="list-style-type: none"> <li>• Produced via natural gas SMR, resulting in CO<sub>2</sub> emissions that are released into the atmosphere.</li> <li>• Currently, the most prevalent hydrogen production method in the U.S. is approximately 95% of current hydrogen production.</li> <li>• Largest emission profile compared to blue and green hydrogen.</li> <li>• Requires a supply of natural gas to the site if produced on-site.</li> </ul>	<ul style="list-style-type: none"> <li>• Produced via natural gas SMR, CO<sub>2</sub> is captured and stored using carbon capture storage (CCS) technology.</li> <li>• CCS is not 100% efficient, resulting in residual emissions.</li> <li>• Mostly done on a large scale at a central plant.</li> </ul>	<ul style="list-style-type: none"> <li>• Produced via electrolysis.</li> <li>• Requires a significant amount of water and power.</li> <li>• Does not emit CO<sub>2</sub> during electrolysis; however, the total upstream emissions are contingent upon the electric grid mix. Emissions can be negligible if powered entirely by renewable sources, such as solar or wind.</li> <li>• Currently, hydrogen is the most expensive compared to gray and blue.</li> </ul>

Green hydrogen, though limited, is available locally. At least one site in Ontario produces green hydrogen, and several other producers plan to enter the local market in the coming years. In 2021, Metro received an unsolicited proposal for a two-year

Hydrogen-as-a-Service Pilot Program to design, install, implement, perform operations/maintenance on FCEB fueling infrastructure, supply FCEBs, and supply liquid hydrogen to fuel the vehicles. The proposal offered a green hydrogen fuel option, albeit at a cost premium to gray hydrogen. Given the limited local supply, green hydrogen currently sells for a 30-50% price premium compared to gray hydrogen. FCEBs powered by green hydrogen generate up to 16 times fewer metric tons of CO<sub>2</sub>e greenhouse gas emissions compared to gray or blue hydrogen.

In July 2024, California Hydrogen Hub ARCHES, a statewide public-private partnership to create a sustainable statewide clean hydrogen hub, was awarded \$1.2 billion from the U.S. Department of Energy. ARCHES priorities include renewable and clean (green) hydrogen, focusing efforts on communities with the largest pollution burden, as well as creating an economically sustainable, expanding renewable hydrogen market. Metro will benefit from this partnership as it will increase the local supply of green hydrogen and drive down the long-term cost compared to gray and blue hydrogen.



# Zero Emission Bus (ZEB) Program Update Motion 31.1 Response

VEHICLE ENGINEERING & ACQUISITION



Metro®

Operations, Safety, and Customer Experience Committee

September 19, 2024

# Program Updates Since April 2024



- Released regional procurement to purchase up to 1,980 ZEBs, the largest ZEB order in U.S. history.
- Awarded \$77.5 million from FTA LoNo grant program.
  - **\$1.052 billion in state and federal funds secured to date.**
- Submitted updated power needs for (7) LADWP divisions. Preparing service requests for SFV opportunity charging sites.
- Civil work has begun for Division 9 electrification.
- First five chargers at Harbor Gateway Transit Center have been commissioned.

## Fund Sources Secured Since April 2024

Fund Source	Amount (\$)	Use
Low or No Emission Grant (FTA)	\$77.5 million	Div 7 Buses and chargers and workforce development
Carbon Reduction Program	\$24 million	Div 18 chargers
Zero Emission Transit Capital Program (SB125)	\$175 million	Buses and chargers



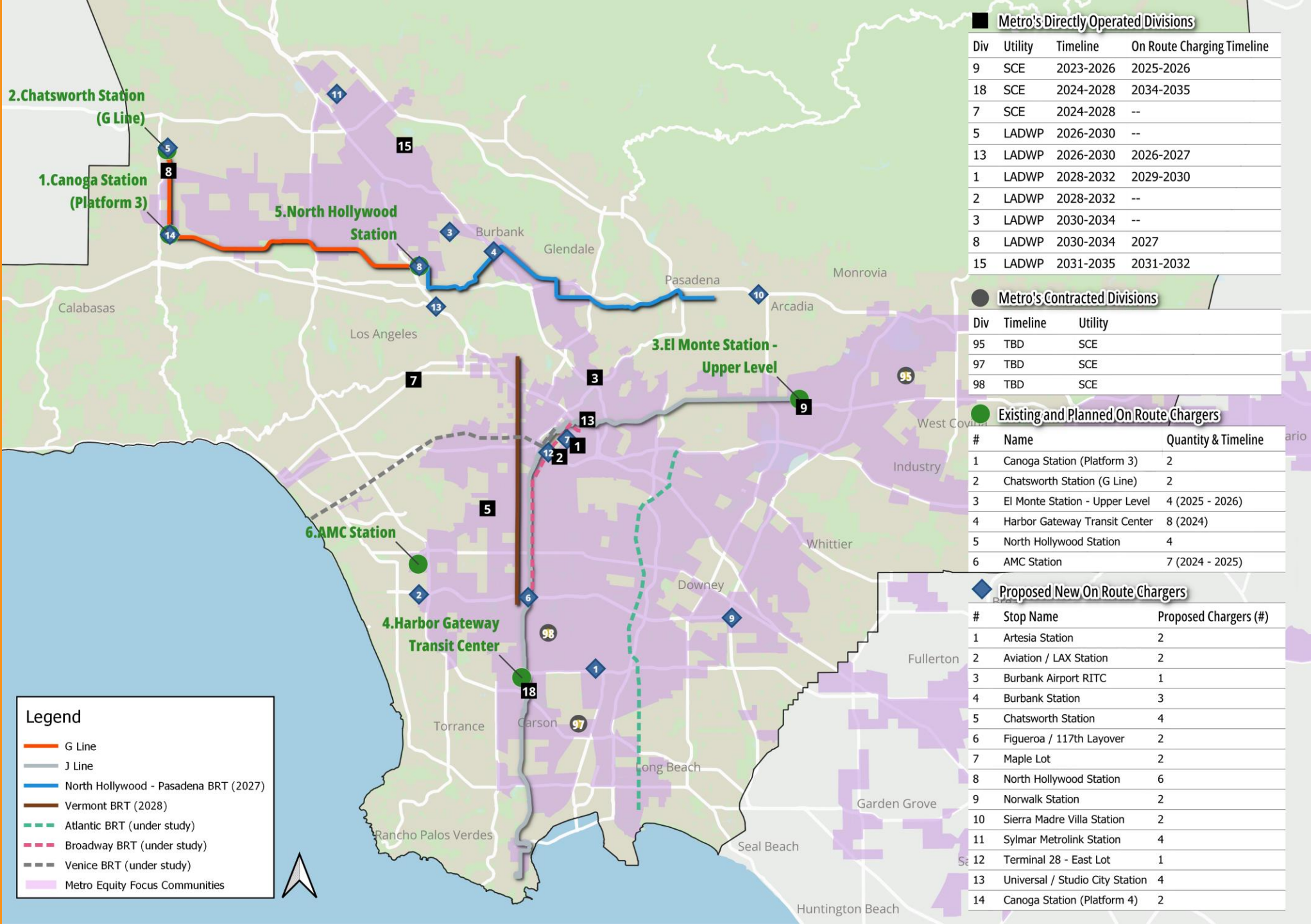
**Metro**

## State and Federal Funding Strategy

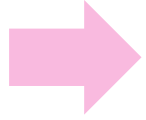
- Working on several fronts to increase competitiveness:
  - Addressing issues in U.S. bus manufacturing industry
  - White House Roundtable on Clean Bus Manufacturing
- All-hands approach to securing state and federal funds.
- Continuously seek new grant opportunities and garner local support for projects.
- Seek vital support from and strengthen partnerships with climate advocacy groups.
- Advocate for extension of IIJA / BIL funding infusions.



# ZEB Program Projects Map

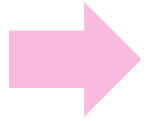


# Transition Schedule



## Project Milestones by FIFA World Cup (2026)

- Fleet of 145 BEBs in operation
- J Line, Division 9 & El Monte Transit Center electrified
- AMC Station electrified
- Divisions 18 & 7 under construction



## Project Milestones by Olympic & Paralympic Games

- Division 18 electrified & Division 7 nearing completion
- North San Fernando Valley TIP & North Hollywood to Pasadena BRT electrified
- First buses from regional procurement begin to arrive.
- Solicitation for Divisions 5 & 13 and 1 & 2 will have been released.

## Schedule Phasing Constraints

- Utility capacity upgrades
- Bus operations disruption mitigation
- Olympic and Paralympic Games contingency fleet acquisition



Photo: First charging session at HGTC

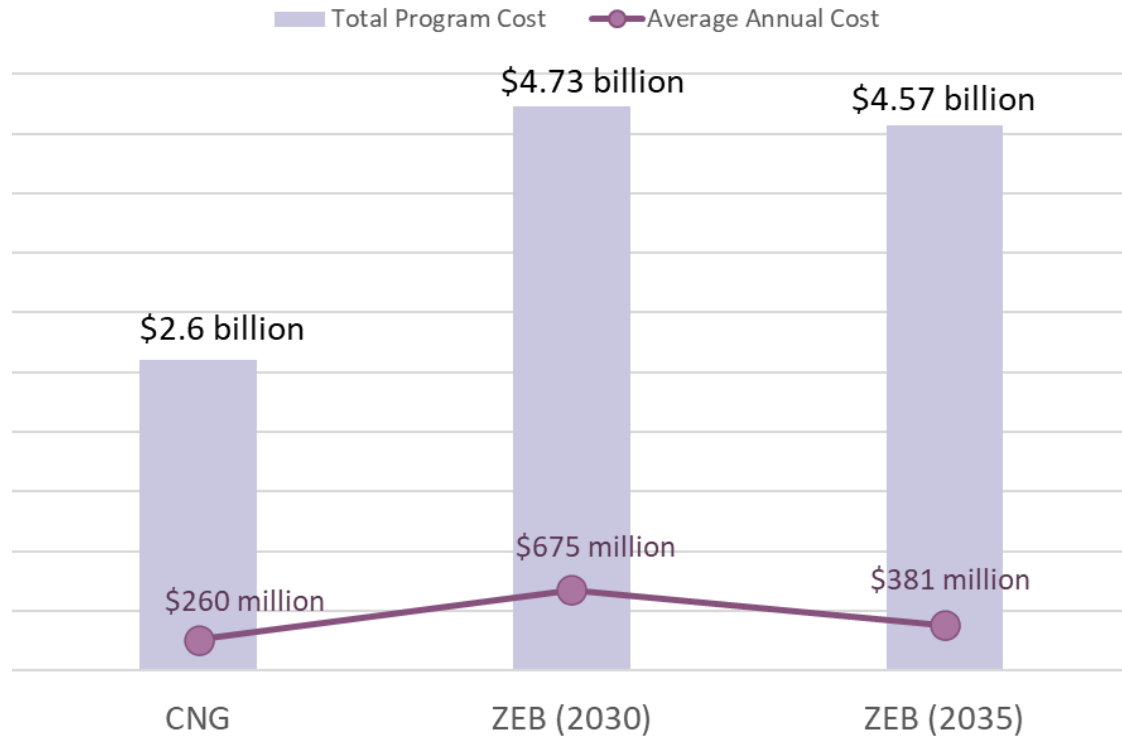


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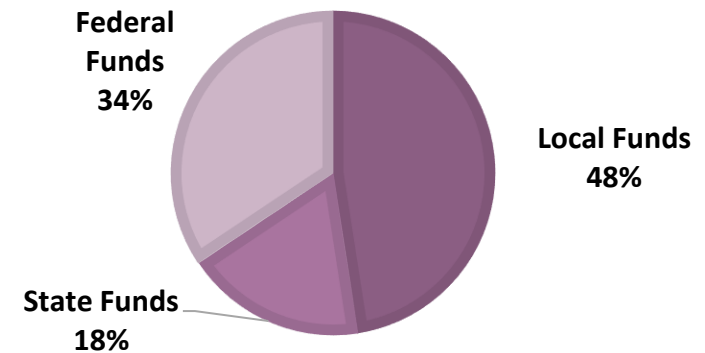
# Program Cost and Funding



## Estimated Capital Costs (RNG v. ZEB)

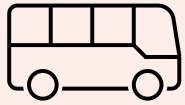
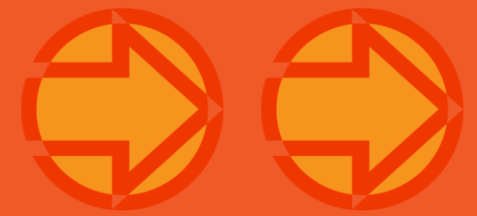


## Funding Plan



- Local funds consist largely of Prop C and TDA. As a result, program will compete with annual operating budget.
- Revenue projections are heavily on borrowed capital; ~15% of total funding from debt issuances.
- Current revenue forecasts sufficient to deliver program, but reallocating funds from other projects may be needed if economic situation changes or costs increase.
- Continue to evaluate Charging-as-a-Service and other P3 approaches.

# Hydrogen Fuel Cell Electric Buses (FCEBs)



- At current rate of technology improvement, up to 8% of Metro's 2035 / 2040 service blocks cannot be served by BEBs.
- Hydrogen FCEBs, which offer range and fueling time comparable to RNG, will be evaluated to meet long service blocks.
- Staff have identified Divisions 8 and 15, contracted service Division 97, and the Marilla Lot, a Metro-owned property near Division 8, as short-list locations for hydrogen fueling infrastructure.
- FCEBs have zero tailpipe emissions. Upstream emissions depend on fuel production method.
- For the 20-bus pilot, Metro intends to use green hydrogen, pending available and reliable local supply to support bus operation.

THANK YOU

