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Metropolitan Transportation
Authority
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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.

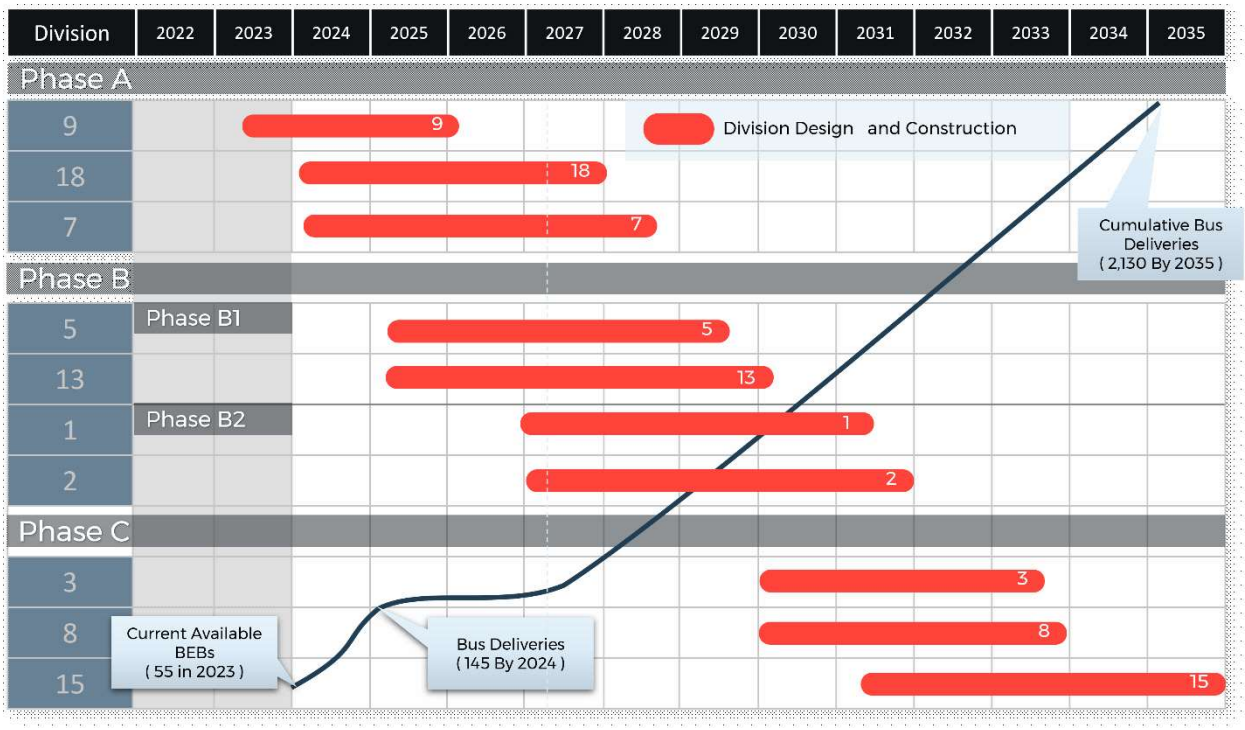
Current ZEB Conversion Schedule

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

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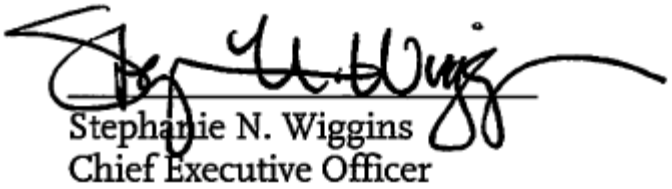

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