TRANSIT ASSET MANAGEMENT

Spring 2023 Discussion Forum

TAM Considerations for Zero-Emission Bus Fleets

U.S. Department of Transportation
Federal Transit Administration

Overview

The Federal Transit Administration (FTA) Transit Asset Management (TAM) Program organizes biannual discussion forums to support professional capacity building for transit agency staff. Discussion forums bring together a small group of transit professionals to engage virtually on topics that go beyond the requirements in the TAM Rule (49 CFR 625).

The Spring 2023 Discussion Forum focused on TAM considerations for zero-emission bus (ZEB) fleets. Participants were transit agency staff who manage transit assets or otherwise contribute to fleet management planning and related practices. The goals of this discussion forum were to:

1. Promote peer-to-peer education and collaboration around effective practices in the planning, acquisition, and management of ZEBs;
2. Support transit agencies in updating TAM-related practices for ZEBs, e.g., around investment prioritization, fleet sizing, life cycle planning, risk management, and reporting; and
3. Understand the state of the practice in transitioning to ZEBs, and identify resources used and any gaps in resources or technical assistance.

This document highlights the main successes and challenges in transitioning to ZEBs as described by participants and summarizes perspectives shared during the facilitated discussion.

ZERO-EMISSION BUS

Zero-emission buses (ZEBs) are buses that emit no tailpipe emissions. There are currently two types of ZEBs available:

- **Battery-electric buses (BEBs)** are powered by a battery, which can be recharged through plug-in charging, overhead conductive (pantograph) charging, or wireless inductive charging using floor-mounted pads.
- **Fuel cell electric buses (FCEBs)** are powered through electricity created from onboard hydrogen, which can be refueled at a central location.

Participants

Name	Agency	City and State
Bruce Abanathie	Santa Clara Valley Transportation Authority (VTA)	San Jose, CA
A. Graham Curtis	Connecticut DOT Bureau of Public Transportation	Newington, CT
Tom Dietz	Salem Area Mass Transit District - Cherriots	Salem, OR
Kyle Meehan	CitiBus	Watertown, NY
Chris Payton	ABQ Ride	Albuquerque, NM
Jorge Pubillones	Atlanta-Region Transit Link Authority (ATL)	Atlanta, GA
Chris Ward	Transit Authority of River City (TARC)	Louisville, KY

Successes and Challenges

Participants provided short introductions to their agencies and experiences with ZEBs. They identified several agency-specific success and challenges in deploying ZEBs. Areas of success for some agencies were challenges for other agencies.

Identified Successes

- **Securing funding** to procure ZEBs and supporting infrastructure, including through Federal programs like the Low-No Bus Program, Bus and Bus Facilities Program, and the Congestion Mitigation and Air Quality Improvement (CMAQ) Program.
- **Obtaining stakeholder buy-in,** including support from agency executives, board members, elected officials, and environmentally conscious community members.

- **Organizing transition planning**, including through procurement and implementation plans and by creating teams for project planning, design, and delivery.
- **Forming partnerships** with transportation consultants, bus manufacturers, and local utility companies.
- **Conducting block planning** and identifying feasible routes for battery-electric buses considering range limitations.

Identified Challenges

- **Planning around supply chain delays**, which impact the availability of both vehicles and components and can interfere with fleet conversion. For example, one agency faced ZEB lead times ranging from 18 to 28 months.
- **Overcoming upfront vehicle costs,** including to procure sufficient ZEBs to fulfill the same service requirements as diesel buses.
- **Planning for winter weather** operations amidst uncertainty in how extreme cold temperature will affect ZEB reliability and driving range, which factors into fleet makeup and sizing.
- **Adapting bus facilities**, including overcoming costs to upgrade facilities and the electric grid, reconfiguring bus yards and working within existing physical constraints, and balancing competing needs for space.
- **Staffing and workforce development** to support fleet transition planning, bus maintenance, and bus operation. High driver and mechanic vacancy may impact service levels, and maintaining and driving ZEBs requires additional staff skillsets (e.g., using regenerative braking to maximize driving range).
- **Other challenges or areas of uncertainty**: planning for a constantly evolving technology, securing local government buy-in, confirming block/route feasibility and weighing the need for on-route charging, safety management planning (e.g., first responder training), scheduling charging to minimize electricity cost, and performance monitoring and evaluation.

Summary of Discussion

Q1: How did your agency plan for ZEBs?

In planning for ZEBs, many agencies considered **route feasibility** and whether a ZEB would have sufficient range to complete the route.[1] One agency conducted initial range planning but learned it was hard to determine actual range until receiving and operating the buses. For example, they found that range decreased in the winter, with up to 35 percent of energy going towards bus heating. On the other hand, range benefits from regenerative braking exceeded their expectations, particularly on urban routes.

To address the challenge of range planning, another agency recommended **conducting a pilot** with a small fleet of ZEBs and adapting over time. Ultimately, this agency adopted FCEBs for their longer blocks and BEBs for shorter blocks.

Participants described other approaches to initial planning and scoping for ZEBs. One agency centered their planning around **existing bus facilities**. They obtained a consultant to develop partial and full electrifications plans for buses in each facility and conducted a pilot with a small number of BEBs. Ultimately, they prioritized BEBs for facilities that had sufficient electrical grid capacity along with feasible routes within the BEBs' driving range.

Another agency initially focused their planning and grant applications on their **most heavily traveled corridor** and longest route to maximize the impact of electrification. Further in the process, they obtained a consultant to confirm route feasibility.

Finally, the importance of **partnerships** was a common theme across agencies. Several agencies worked with consultants to understand the technologies and check route feasibility. One agency highlighted their local electric utility as a valuable resource in conducting and paying for necessary electrical upgrades and also identified the bus manufacturer as a helpful partner.

[1] Actual driving range in miles may vary from stated manufacturer range depending on several factors, such as route terrain, weather conditions, passenger loads, heating and air conditioning needs, and whether drivers are trained to maximize energy recaptured from regenerative braking.

Q2: How did your agency adapt once ZEBs were deployed?

Several agencies alluded to a **learn-as-you-go** approach in which they start with a smaller fleet of ZEBs and adapt processes as needed.

Some participants described efforts to **reconfigure bus facilities**. One agency is looking into building a new satellite charging facility to minimize density on the electric grid and allow more space between parked BEBs as a fire protection measure. Another agency has applied for grant funding to expand their facility footprint to accommodate multiple types of fueling and charging infrastructure.

One agency asked for a waiver on the **spare ratio policy,** which limits the number of spare vehicles to include in a Federal funding application. The participant explained that the right spare ratio for ZEBs is unclear, and ZEBs are costly for agencies to acquire.

Q3: What does your agency need to transition more effectively to ZEBs?

Participants expressed desire for more **peer learning opportunities** to better understand how other agencies are approaching the ZEB transition. One participant asked that FTA help facilitate this connection and collaboration among agencies. Developing and distributing **best practices**—especially in training operators for ZEBs—would also be helpful.

Participants also reiterated the importance of updating the **spare ratio policy** for BEBs and FCEBs and the need for more **maintenance staff**. One participant emphasized that they have funding for ZEB training but don't have personnel to train.

Related Resources

Grant Programs

- FTA Low or No Emission Vehicle Program
  - https://www.transit.dot.gov/lowno
- FTA Buses and Bus Facilities Program
  - https://www.transit.dot.gov/bus-program
- DOT / DOE technical assistance
  - https://www.transit.dot.gov/funding/grants/low-and-no-emission-vehicle-federal-technical-assistance

Reference Documents

- Guidebook for Deploying Zero-Emission Transit Buses
  - https://nap.nationalacademies.org/catalog/25842/guidebook-for-deploying-zero-emission-transit-buses
- Rural Electric Mobility Toolkit
  - https://www.transportation.gov/rural/ev/toolkit
- Urban Electric Mobility Toolkit
  - https://www.transportation.gov/urban-e-mobility-toolkit

Tools and Calculators

- FTA Transit Bus Electrification Tool
  - https://www.transit.dot.gov/regulations-and-programs/environmental-programs/fta-transit-bus-electrification-tool
- FTA Transit Greenhouse Gas Emissions Estimator
  - https://www.transit.dot.gov/regulations-and-guidance/environmental-programs/ftas-transit-greenhouse-gas-emissions-estimator