Electric Transit User Group Forum
Meeting Summary

Topic: ZEB Performance

Dates: Sept. 17 and 24, 2024

The Electric Transit User Group (ETUG) regularly gathers to inform the National Renewable Energy Laboratory's (NREL) strategic direction to help address pressing needs associated with electrifying transit fleets, including technical challenges, workforce development, operations and maintenance, procurement, and other hurdles. Information collected through ETUG listening sessions generates key insights that could inform future research, technical assistance needs, and funding opportunities.

The following is a summary of the discussion and key takeaways from the September 2024 sessions on ZEB performance. NREL will use participant input and insights into fleet concerns to help tailor its resources. NREL also plans to continue hosting listening sessions throughout FY25 on various topics to help address ongoing challenges and identify further resource gaps.

Participant Discussion Summary

A summary of information participants shared during the ZEB performance sessions is provided below.

Acceleration and Traction

- **Acceleration:** Initially, some participants faced challenges with the accelerator pedals feeling too aggressive for driver and passenger comfort, but software updates resolved these issues. Participants agreed that electric buses had superior acceleration and hill climbing abilities.
- **Traction:** In winter conditions, battery electric buses (BEBs) performed similarly or better than conventional buses, partly due to the smooth power delivery from electric motors. Traction loss was mitigated by the automatic disabling of regenerative braking when a loss of traction was detected.

Range

- **Cold weather impact:** Using electric heaters in cold weather significantly reduced range, which can cause anxiety for operators accustomed to buses using conventional fuels.
- **Route and energy management:** Participants adjusted their operations by assigning vehicles to routes requiring no more than 60% of the vehicle's nominal range, providing a buffer to account for variability in energy efficiency.
- **Energy consumption:** Participants noted high energy consumption on low-speed, stop-and-go routes, particularly due to HVAC use and limitations in regenerative braking at low speeds.

- **Battery degradation:** Battery performance was better than initially expected, with less degradation over time.

Regenerative Braking and Tires

- **Slippery conditions and hills:** In winter, slippery conditions and hilly routes hindered regenerative braking, reducing the bus's range especially when energy couldn't be recovered by going downhill.
- **Tires:** Stock low-rolling-resistance tires were not suitable for extreme winter conditions, so less-efficient but safer winter tires were needed during these conditions.

Auxiliary Heaters

- **Need for diesel heaters in cold regions:** Participants agreed that diesel-fired auxiliary heaters were necessary for BEBs operating in extremely cold climates since BEBs lack waste heat generation from the engine like conventional buses.

Charging Infrastructure

- **Charging issues:** Participants said charging was often more complicated than just plugging in the vehicle. It required a multistep process, with some participants needing maintenance staff to handle charging due to reliability issues. DC charging systems that share power across multiple ports helped to reduce charging times compared to single-port chargers.
- **Downtime and compatibility:** Participants noted problems with compatibility and charging infrastructure downtime, which could affect operations.

Electric Accessories and Driver Behavior

- **Accessories:** Limited availability of parts for electric accessories (e.g., air compressors and steering systems) posed challenges, as parts suppliers produced them in small volumes.
- **Driver behavior and energy consumption:** Energy consumption and range were strongly influenced by driver behavior, particularly in braking and acceleration. Participants emphasized the need for proper driving techniques to maximize efficiency.

Driver Preferences

- **Comfort and ergonomics:** Participants observed that drivers preferred familiar controls and some had issues with the ergonomics of new BEBs, such as pedal position. Adjustments to the acceleration response and regenerative braking helped improve driver satisfaction.

Hydrogen Fueling Operations

- **Frequent maintenance:** In hydrogen operations, participants reported frequent troubleshooting and repairs of fueling stations and electrolyzers, indicating operational challenges in maintaining infrastructure.

Safety

- **Override systems:** Conventional buses typically allow bus operators to "limp" a vehicle that is experiencing a major fault to a safe location where passengers can exit and the bus can remain until it can be towed. Participants said they are concerned about the lack of such an override system for many faults encountered with ZEBs.

Utility Rates

- **Negotiations with utilities:** Some participants successfully negotiated to reduce or eliminate demand charges for electricity, but others faced difficulties adjusting utility rates to better suit the operational needs of electric fleets.

Key Takeaways

NREL identified the following key takeaways from the ETUG listening sessions on ZEB performance. NREL will seek opportunities to help address these takeaways through the lab's technical assistance offerings.

- Transit vehicle manufacturers (TVMs) could consider adopting appropriate override systems to allow "limping" to a safe location to offload passengers.
- **Phantom energy use may benefit from further study.** In some cases, utility bills for BEB charging showed 50% more energy use than could be explained by the vehicle's in-service energy consumption. A study comparing vehicle energy consumption to utility bills across many fleets could be an important catalyst to increase BEB energy savings and reduce the costs of BEB operation.
- **Basic on-board smart charging functionality is important for all battery electric vehicles.** Participants said there was no way to set basic charging schedules on their BEBs. A simple on-vehicle charge scheduling function could help smaller BEB fleets avoid demand charges without the need for additional charge-management software.
- **Evaluate potential alternate sources of auxiliary heat.** Participants noted that auxiliary cabin heaters are needed even on diesel buses in very cold climates and will likely remain necessary on BEBs, as well. Further research into flexible and efficient auxiliary energy sources for BEBs may yield important takeaways for policymakers and TVMs.