

NREL Evaluates Performance of Fast-Charge Electric Buses

Highlights in
Research & Development

Initial results indicate significant fuel and emissions savings

In 2014, Foothill Transit in West Covina, California, fully electrified one of the bus routes in its 327-square-mile service area. Today, the transit agency is investigating the feasibility of electrifying additional routes with help from the National Renewable Energy Laboratory (NREL).

Foothill Transit's 100% alternative fuel fleet includes 15 electric buses and 315 compressed natural gas (CNG) buses. NREL is evaluating the in-service performance of the electric buses compared to CNG buses operating on similar routes. Launched in 2015 with support from the California Air Resources Board and the Advanced Vehicle Testing Activity within the U.S. Department of Energy's Vehicle Technologies Office, the study aims to improve understanding of the overall use and effectiveness of fast-charge electric buses and associated charging infrastructure in transit operation.

The on-road portion of the evaluation involves collecting and analyzing vehicle performance data gathered via onboard logging devices. NREL is using the data to evaluate vehicle and component performance—with a focus on energy efficiency, battery and electric motor power profiles, reliability, and maintenance costs—and to conduct detailed drive cycle analyses. Based on the field data, NREL will develop a validated vehicle model using the Future Automotive Systems Technology Simulator, or FASTSim, to help the transit agency identify other routes in its service area that are suitable for electrification. NREL will also analyze the infrastructure requirements and grid-side impacts of the transit agency's two 500 kW charging stations.

Initial results indicate that the electric buses offer significant fuel savings compared to the CNG buses. The average energy efficiency of the electric buses equates to approximately 17.5 miles per diesel gallon equivalent (DGE) while the average fuel economy of the CNG buses equates to about 4.5 miles per DGE.

In addition to the on-road portion of the evaluation, NREL plans to conduct chassis dynamometer testing of the vehicles to determine the fuel economy and emissions impact of the electric bus technology in a controlled setting.

Manufactured by Proterra, the 35-foot EcoRide transit buses in this study are made of light-weight composite materials and are powered with 88 kWh lithium-titanate battery packs.

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References: Prohaska, R.; Eudy, L.; Kelly, K. (2016). "Fast Charge Battery Electric Transit Bus In-Use Fleet Evaluation." Prepared for the IEEE Transportation Electrification Conference, June 27–29, 2016. NREL/CP-5400-66098. Golden, CO: National Renewable Energy Laboratory. <http://www.nrel.gov/docs/fy16osti/66098.pdf>

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Foothill Transit's electric buses can fully charge in less than 10 minutes via two 500 kW fast chargers located midway along the route. The buses are programmed for easy docking—wireless communications govern the speed and stop locations of the buses, and the overhead charger connects without input from the driver.

Photo by Leslie Eudy, NREL 35803

Key Research Results

Achievement

This real-world performance evaluation is designed to enhance understanding of the overall usage and effectiveness of electric buses in transit operation and to provide unbiased technical information to other agencies interested in adding such vehicles to their fleets.

Key Result

Initial results indicate that the electric buses under study offer significant fuel and emissions savings. The final results will help Foothill Transit optimize the energy-saving potential of its transit fleet.

Potential Impact

NREL's performance evaluations help vehicle manufacturers fine-tune their designs and help fleet managers select fuel-efficient, low-emission vehicles that meet their bottom line and operational goals.

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

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