



U.S. Department of Transportation
Federal Transit Administration



Zero-Emission Bus Evaluation Results: Long Beach Transit Battery Electric Buses

Background

This report summarizes the experience and results from a demonstration of a fleet of battery electric buses (BEB) operated by Long Beach Transit (LBT) in southern California as a result of a \$6.7 million grant through FTA's Transit Investments for Greenhouse Gas and Energy Reduction (TIGGER) program to fund an electric bus pilot project. FTA collaborated with the U.S. Department of Energy (DOE) and DOE's National Renewable Energy Laboratory (NREL) to conduct in-service evaluations of advanced technology buses developed under its programs.

Objectives

FTA seeks to provide results from new technologies being adopted by transit agencies. The evaluations selected include fuel cell electric buses (FCEBs) and BEBs from different manufacturers operating in fleets in both cold and hot climates. The purpose of this report is to present the results from NREL's evaluation of 10 BEBs operated by LBT in comparison to a fleet of compressed natural gas (CNG) baseline buses. LBT first began operating its BEBs in March 2017; the focus of the analysis was on the first full year of data, January–December 2018.

Findings and Conclusions

Data from the evaluation focused on the experience of LBT related to fuel economy, miles between roadcalls, and total maintenance cost and propulsion-related maintenance cost per mile for its BEBs and CNG buses.

NREL is collecting data on a conventional fleet of eight Gillig CNG buses of similar age as the primary baseline comparison. LBT operates the BEBs primarily on its Passport route, a free shuttle service. The agency installed 10 plug-in chargers for overnight charging of the BEBs, which is the primary means of charging the buses, and also installed an inductive charging station a stop on the Passport route. A summary of the results for the first year of service is shown in the table below.

LBT worked closely with the BEB manufacturer to identify and solve early issues with the buses. Technical issues noted included those related to battery balancing and degradation, durability of steering/suspension/axles, and validation of the vehicle monitoring and data collection system. General guidance includes dealing with new technologies, training, and planning infrastructure.

Summary of LBT Evaluation Results

Data Item	BEB	CNG
Number of buses	10	8
Total mileage in evaluation period	161,275	315,382
Average monthly mileage per bus	1,344	3,285
Availability (85% is target)	70.9%	89.9%
Fuel economy (kWh/mi or mpgge ^a)	1.82	3.05
Fuel economy (mpdgc ^b)	20.71	3.49
Miles between roadcalls (MBRC)—busc	4,244	15,018
MBRC – ESS only ^c	40,319	—
Total maintenance cost (\$/mi)	0.44	0.54
Maintenance cost – propulsion system only (\$/mi)	0.04	0.16

^aMiles per gasoline gallon equivalent

^bMiles per diesel gallon equivalent

^cMBRC data cumulative through December 2018

Benefits

As with all new technology development, lessons learned during this project could aid other agencies considering BEB technology. One of NREL's goals for advanced technology vehicle evaluation is to document the experience of early adopter transit agencies and share critical lessons learned with the rest of the industry to increase the successful deployment of these vehicles elsewhere in similar service.

Project Information

FTA Report No. 0163

This research project was conducted by Leslie Eudy and Matthew Jeffers of the National Renewable Energy Laboratory (NREL). For more information, contact FTA Project Manager Terrell Williams at (202) 366-0232. All research reports can be found at <https://www.transit.dot.gov/about/research-innovation>.