



U.S. Department of Transportation
Federal Transit Administration



Zero-Emission Bus Evaluation Results: Stark Area Regional Transit Authority Fuel Cell Electric Bus

Background

This report summarizes the experience and results from a demonstration of five fuel cell electric buses (FCEBs) operated by Stark Area Regional Transit Authority (SARTA). SARTA, based in Canton, Ohio, has been operating a fleet of FCEBs built by ElDorado National-California with a BAE Systems electric propulsion system and a Ballard fuel cell. FTA is collaborating with the U.S. Department of Energy (DOE) and DOE's National Renewable Energy Laboratory to conduct in-service evaluations of advanced technology buses developed under its programs. This report presents evaluation results for the FCEB in comparison to baseline buses in similar service. The focus of the analysis is on the most recent year of service from February 2018 through January 2019. SARTA is collaborating with CALSTART to analyze the acceptance of the technology within the agency. CALSTART conducted surveys of the operators and maintenance technicians at SARTA. The survey analysis results are presented in the report.

Objectives

The objectives of the research effort are to evaluate zero-emission buses (ZEBs) funded under the various FTA programs, compare ZEB performance to baseline conventional buses in similar service, and disseminate results to the transit industry and other stakeholders. Key performance metrics tracked for the buses include fuel/energy efficiency, availability, reliability, operational cost, and customer acceptance.

Findings and Conclusions

The FCEB averaged 4.99 kg of hydrogen per mile, average fuel economy was 20% higher than CNG fuel economy, overall availability of the fuel cell system was 94%, and maintenance cost was the same as that of CNG buses.

During the evaluation period of the report—February 2018 through January 2019—the FCEBs accumulated more than 130,000 miles. The report compares the FCEB to that of a fleet of four CNG (compressed natural gas) buses. Overall, the FCEB averaged 4.99 kg of hydrogen per mile, which equates to 5.63 miles per diesel gallon equivalent (mpdge). The average fuel economy of the FCEB is 20% higher than the CNG fuel economy of 4.59 mpdge. During the data period, the FCEB had an overall availability of 68% compared to 76% for SARTA's CNG buses. Most unavailable days for the FCEBs were due to general bus issues, followed by preventive maintenance. The overall availability of the fuel cell system was 94%. The maintenance cost for the FCEBs was essentially the same as that of

the CNG buses. The systems with the highest percentage of maintenance costs for the FCEBs and CNG buses were the same. Propulsion-related maintenance costs were highest, followed by preventive maintenance costs and cab, body, and accessories.

Customer acceptance assessment showed that drivers and technicians rated the buses as good overall, and their opinions improved on most metrics over time, indicating that more experience with the buses led to better perception of them. The FCEBs were rated either the same or better than conventional buses on initial launch, acceleration, coasting/deceleration, and braking behavior, and rated best for noise levels. Respondents expressed that the productivity of the FCEBs was worse than that of the conventional buses, had issues with reaching higher speeds, and had issues with heating and cooling inside the buses.

Benefits

This report documents the performance of FCEBs that can meet the needs of U.S. transit agencies. These evaluations have proved useful for a variety of groups including transit operators considering the technology for future procurements, manufacturers needing to understand the status of the technology for transit applications, and government agencies making policy decisions or determining future research needs.

Project Information

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This research project was conducted by Leslie Eudy and Matthew Post of the National Renewable Energy Laboratory (FCEB performance and cost evaluation) and by Steve Sokolsky and Jonathan Norris of CALSTART (customer acceptance evaluation). For more information, contact FTA Project Manager Terrell Williams at (202) 366-0232, Terrell.Williams@dot.gov. All research reports can be found at <https://www.transit.dot.gov/about/research-innovation>.