CALIFORNIA HVIP

DEPLOYMENT SPOTLIGHT

ELDORADO NATIONAL AXESS 40' FUEL CELL HYBRID TRANSIT BUS

Photo courtesy of L. Eudy, National Renewable Energy Laboratory (NREL).

PROJECT SUMMARY

Six ElDorado fuel cell electric buses (FCEBs) with BAE Systems' 200-kW hybrid electric propulsion system were deployed through the Stark Area Regional Transit Authority (SARTA) in Stark County, Ohio. Powered by Ballard's FCveloCity-HD6® 150-kW fuel cell, these model year 2016 buses were evaluated for two consecutive one-year periods: January 2018 to January 2019, when the buses were first deployed, and again from January 2019 to January 2020 to understand the longer-term successes and challenges of deploying these FCEBs. SARTA continued to operate the buses after the end of the project.

DUTY CYCLE

Vocation
Public Transit Local

Average Daily Distance
167 miles

Average Daily Speed
19 miles per hour

Maximum Capacity
37 seats

Average Temperature – Summer
77 F

Average Temperature – Winter
46 F

Buses were in service six days a week on two heavily used routes. Each bus drove an average of 2,446 miles monthly.

On days with extreme temperature variations, operators did sometimes switch out their vehicle with another pre-fueled FCEB due to range concerns from increased energy use. This switch occurred in about 8% of the days evaluated.

REFUELING

Refueling Station
Hydrogen 350 bar

Fueling Methodology
Depot Evening 10 minutes per refill

Buses were refueled between 8 pm and 11 pm at SARTA's hydrogen dispensers. The dispensers provided hydrogen at 350-bar pressure, which was compressed on site from delivered liquid hydrogen. Each bus consumed about 31 kg of hydrogen per day.

PERFORMANCE

Energy Efficiency
0.19 kg of hydrogen/mile, 5.26 miles/kg of hydrogen

Miles per Gallon Equivalent
*2018: 5.63 mpdge**
*2019: 4.6 mpdge**

**Certain factors can significantly affect the range and efficiency of electric vehicles, and technology improvements in the hydrogen fuel cell industry are happening quickly. See Recommendations on page 2.*

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FUNDING

This deployment was funded by the Federal Transit Administration's Low or No Emission Grant Program.

TRAINING AND WORKFORCE DEVELOPMENT

Two SARTA maintenance technicians were trained to handle preventative maintenance, general bus repairs, and troubleshooting and repair of propulsion systems.

RECOMMENDATIONS FOR FUTURE DEPLOYMENTS

1. New fuel cell technology will require training and time for technicians and bus operators to feel comfortable with these vehicles. Transit agencies should provide employee training as soon as possible when planning to deploy FCEBs. Transit agencies can obtain training for their employees through the manufacturer or regional training consortia.
2. Piloting FCEBs is critical for transit agencies to gain experience in deploying these vehicles and to overcome challenges. Factors such as ambient temperature, topography, speed, and load play an important role in fuel efficiency. For example, SARTA ultimately used multiple FCEBs during especially cold days due to the increased energy consumption of the heater. Higher fuel economy in more recent model year FCEBs has also been measured since this pilot project.
3. A primary reason that transit agencies may choose to deploy FCEBs over battery-electric buses is range. However, the construction and maintenance of hydrogen stations requires a significantly higher investment and may be cost-prohibitive. Without adequate grant funding to install on-site stations, transit agencies may also look to lease hydrogen stations to offset these infrastructure costs. Transit agencies should use the Transit Agency Infrastructure Planning Tool guide and check out CALSTART's Infrastructure INSITE tool for more information on the zero-emission infrastructure development process, appropriate equipment, and cost and time estimates.

SARTA's hydrogen fueling station courtesy of L. Eudy, NREL.