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RESEARCH PROJECT TITLE

In-Use Fuel Economy and Emission Benefits of Hybrid-Electric School Buses in Iowa

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tech transfer summary

Hybrid-electric school buses may offer lower life-cycle costs, pollutant levels, and fuel consumption than conventional diesel buses.

Objectives

- Compare the in-use fuel economy and operating costs of hybrid-electric school buses (HESBs) versus conventional diesel buses.

Problem Statement

It is much safer and more fuel-efficient to transport children to school in buses than in private vehicles. However, school buses still consume 8.2 million gallons of diesel fuel annually, and transportation costs can be a significant portion of school districts' budgets. Children in diesel-powered school buses may also be exposed to higher levels of particulates and other pollutants than children in cars.

Hybrid-electric school buses have the potential to reduce both pollutant levels and fuel consumption. To encourage manufacturers to develop the technology, Advanced Energy' designed the Hybrid-Electric School Bus Project to create sufficient demand among school districts. Through the project, U.S. school districts have purchased a total of 16 plug-in HESBs that are being tested in 11 states. Two of the HESBs were purchased by Iowa school districts, Nevada and Sigourney.



Hybrid-electric school bus unveiling in Sigourney, Iowa

Research

The Nevada and Sigourney school districts deployed the hybrid buses in January 2008. As a control, each district selected a conventional diesel bus (Nevada in February 2008, Sigourney in November 2008) that operated on a route similar to that of the hybrid bus. Each district recorded odometer readings, in-use fuel economy, and other operational metrics for its hybrid and control buses. Data were recorded through May 2010.

Key Findings

- In Nevada, the average fuel economy was 8.23 mpg for the HESB and 6.35 mpg for the control bus. In Sigourney, the average fuel economy was 8.94 mpg for the HESB and 6.42 mpg for the control bus. The differences were statistically significant for both districts.
- Electrical use for each hybrid bus was also calculated. Using this information and the measured fuel economy, cost per mile to operate each bus was calculated. In Nevada, the HESB averaged \$0.38 per mile, while the control bus averaged \$0.43 per mile. In Sigourney, the HESB averaged \$0.28 per mile, while the control bus averaged \$0.34 per mile. The costs in Sigourney were lower because average diesel costs were lower in that district during the analysis. Maintenance costs were not included.
- As with all new technologies, some problems were noted with the HESBs. Both buses experienced problems with the charging systems which required several fixes. The problem may also have decreased the fuel economy because the bus drivers felt that buses were not fully charged for the afternoon run.



Hybrid-electric school bus in Nevada, Iowa

- Additionally, during periods of maximum electrical use (and minimal engine use) for both HESBs, the idling engine did not provide adequate heat to the bus interior during the winter months. An auxiliary electric heater was used as an attempted solution.
- Although results of an emissions study for this project were inconclusive, other studies for hybrid transit and hybrid-electric school buses have indicated a significant reduction in pollutants from HESBs compared to conventional school buses.

Implementation Benefits

Hybrid-electric school buses, with perhaps lower emissions and life-cycle costs, have the potential to reduce both pollutant levels and fuel consumption.

Implementation Readiness

Although the HESBs experienced an unusual number of maintenance problems that were frustrating for the school districts, the research team believes the problem is generational and can be overcome in future models. Transit buses have utilized both plug-in and conventional hybrid technologies for some time, and it does not appear that those buses have experienced the same challenges as those observed in this study. As a result, it is believed that manufacturers can overcome these initial problems.



Hybrid-electric power train, shown in mirror on floor