Sustainable Electric Technologies For MD/HD Trucks And Buses

Compare hydrogen fuel cell and battery electric trucks and buses across a variety of applications including short haul drayage, medium-duty urban, vocational, and long haul.

WHAT IS THE NEED?

The California Sustainable Freight Action Plan includes goals of deploying over 100,000 zero emission vehicles (ZEV)/equipment, maximizing near-zero freight vehicles, and improving freight system efficiency 25 percent by 2030. In addition, the California Air Resources Board (CARB) is considering a ZEV truck mandate.

ZEV or near-ZEV trucks will be powered by either batteries or fuel cells. The choice of ZEV vehicle technology will depend on a variety of considerations and will vary by application. Understanding the benefits and barriers associated with each technology will be critical to ensuring that sustainable freight goals are met in a viable, cost effective manner. In order to meet the 2040 GHG reduction goals, most of the fuel for the freight vehicles must come from sustainable energy sources. The research team will evaluate how realistic it is to have most of the freight vehicles powered by sustainable energy.

In the case of the battery electric option, the key issues are the range of the vehicles and the cycle life and cost of batteries suitable for the Medium Duty/Heavy Duty (MD/HD) applications. The battery charging infrastructure will also be important. Much of the infrastructure can be at terminals for the urban trucks and buses. The intercity infrastructure can be associated with that expected to be developed for light-duty electric vehicles.

In the case of the hydrogen fuel cell option, the key issues are the characteristics of the technologies for storing large quantities of hydrogen onboard the trucks and buses and the infrastructure needed to provide refueling of the vehicles. Hydrogen refueling at urban terminals will be important particularly in the near term. The cost ($/kg) and distribution of the hydrogen and the cost and location of the infrastructure for intercity refueling will be critically important.
WHAT ARE WE DOING?

Using the results of the technology/vehicle studies and projected use requirements for the various MD/HD vehicles and applications, the attractiveness (performance, cost, utility) of battery powered and hydrogen fuel cell vehicles will be compared and the prospects for their marketability assessed relative to other options available to new truck purchasers. The cost and availability of convenient refueling infrastructure will be a critical factor in the decisions of new truck/bus purchasers so that the projection of the refueling infrastructure will be an important element of the proposed study.

The tasks to be undertaken in the study are listed below.

1. Projection of the characteristics of heavy-duty batteries for use in buses and trucks for 2020-2040.
2. Projection of the characteristics of heavy-duty fuel cell systems for use in buses and trucks for 2020-2040.
3. Projection of the characteristics of hydrogen energy storage for buses and trucks for 2020-2040.
4. Projections of the cost of buses and various MD/HD trucks having specified ranges using batteries and fuel cells.
5. Determination of the linkage between sustainability, driveline technology, and economics for each MD/HD vehicle type/class/application.
6. Determination of the design and operational characteristics of battery charging and hydrogen refueling infrastructure for urban terminals and intercity stations.
7. Estimation of the ownership costs of buses and various MD/HD trucks meeting user requirements.
8. Projection of the markets and prospects for the sale of battery powered and hydrogen fuel cell buses and trucks for 2020-2040.

WHAT IS OUR GOAL?

The goals are to project how battery electric and fuel cell technologies will be introduced into the MD/HD vehicle markets and to identify which markets will be most suitable for each of technologies and what factors (technical, economic, operational) will be most critical to their successful introduction.

The research team will also assess the extent to which renewable energy sources can be used to power the freight vehicles using batteries and fuel cells in the various markets.

The results of the study will be summarized in the final report.

WHAT IS THE BENEFIT?

It is generally assumed that the markets for battery electric and hydrogen fuel cell light-duty vehicles will grow steadily in the 2020-2040 time period. There is considerably more uncertainty in the growth of markets for battery and hydrogen fuel cell powered MD/HD vehicles. This is especially true of the HD vehicle in the long haul markets.

This project is intended to clarify these uncertainties and to identify the factors that will be most critical in attaining steady growth in the markets for electrified MD/HD vehicles. The research results will be of value to CARB as they develop mandates for sales of various truck classes in support of the California Sustainable Freight Action Plan for 2030 and beyond.

The California Department of Transportation (Caltrans) operates fleets of various classes of trucks. This study will provide guidance to the operating and purchasing groups at Caltrans as they integrate advanced vehicle/trucks utilizing the electrification technologies in their fleet and refueling/charging facilities.

WHAT IS THE PROGRESS TO DATE?

This project began in mid-December 2018. The researchers are updating the characteristics of the key technologies associated with the electrified bus and truck powertrains and have begun to prepare EXCEL spreadsheets to calculate the performance and economics of MD/HD vehicles in the various class (4-8).
IMAGES

Picture 1: A Fuel-cell Transit Bus

Picture 2: A Battery-electric Bus

Picture 3: A Fuel-cell Powered Heavy-duty Truck

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