California Energy Commission
Public Interest Energy Research (PIER) Program
TRANSPORTATION ENERGY RESEARCH

Heavy-Duty Vehicle Emissions and Fuel Consumption Improvement

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Fact Sheet

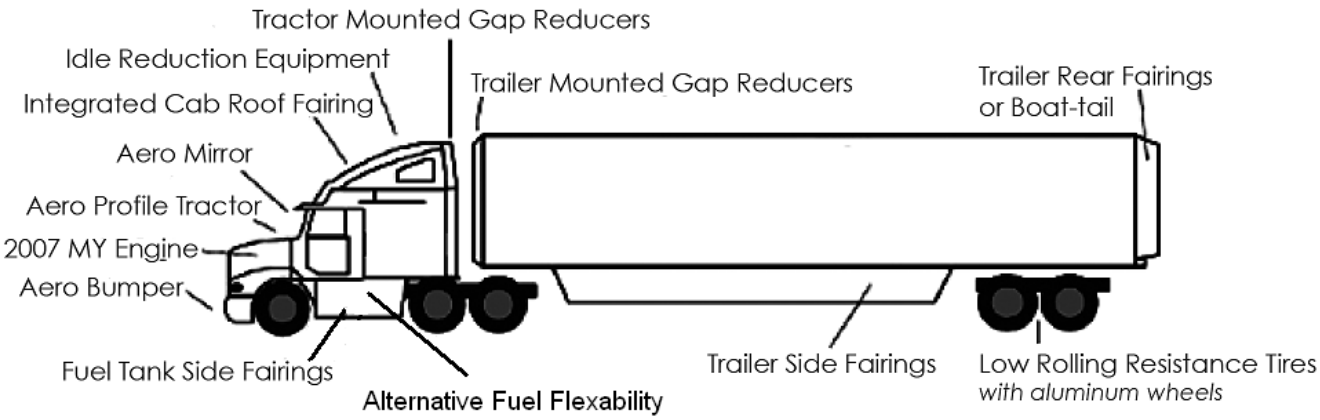

Illustration of a heavy-duty tractor-trailer modified to meet the SmartWay™ Equipment Standards for lower fuel consumption per mile and enhanced environmental performance.
Image Credit: NESCCAF. 2009. *Reducing Heavy-Duty Long Haul Combination Truck Fuel Consumption and CO_2 Emissions*

The Issue

Heavy-duty trucks are an important category to evaluate when looking for emissions reductions and fuel consumption savings in the transportation sector. Worldwide, diesel fuel consumption accounts for about 8 percent of total energy consumption. Trucking also accounts for 60 percent of freight energy use in the U.S.

In the U.S., diesel trucks emit approximately 7 percent of greenhouse gas emissions, 20 percent of ozone forming pollutants, and up to 50 percent of particulate matter in urban areas. Among medium- and heavy- duty trucks, Class 8 trucks are the largest carbon dioxide emitters and fuel users, consuming two-thirds of all truck fuel or 1.57 million barrels per day.

Project Description

The purpose of this research was to evaluate the combination of vehicle platforms and technologies that would result in the largest real-world emissions reductions and fuel consumption improvements. Northeast States Center for a Clean Air Future, Southwest Research Institute, and the Steering Committee selected a Kenworth T-600 Class 8 tractor, a Volvo D13 engine and an Eaton Fuller 10-speed manual transmission as the study's representative baseline vehicle.

The project also tested a Caterpillar C15 engine certified to 2007 U.S. Environmental Protection Agency heavy-duty, on-highway emissions standards with four fuels: standard petroleum-based certification fuel, a soy-based B5 biodiesel blend, a soy-based B20 biodiesel blend, and a

renewable diesel B100 fuel called NExBTL provided by Neste Oil. Performance was measured in the forms of power and torque, fuel consumption, carbon dioxide emissions, and regulated emissions for all test fuels.

PIER Program Objectives and Anticipated Benefits for California

Reduced heavy-duty vehicle emissions and improved fuel consumption will provide the following benefits:

- Promote alternative fuel blending with gasoline and diesel in the near- and mid-term.
- Stimulate innovation through the development of a low carbon fuel standard.
- Verify the performance and environmental attributes of advanced diesel biofuels.
- Reduce greenhouse gas emissions.

Final Results

Research results found that substantial improvements could be made to truck efficiency through a variety of existing and emerging technologies, including engine improvements, transmission enhancements, better aerodynamics, and changes in systems logistics. The simulation modeling included 13 packages other than the baseline package. The test cycle used in this study was based on the California Heavy-Duty Diesel Truck Drive Cycle.

The study finds that fuel consumption for new tractor-trailers could be lowered by 20 percent starting in 2012 and by as much as 50 percent beginning in 2017 while providing net savings over the life of the vehicle. Also, fuel cost savings far outweigh the additional technology costs for 12 of the 13 advanced technology packages over a 15-year period. Estimated lifetime net savings are between $30,000 and $42,000 for vehicles achieving carbon dioxide and fuel consumption reductions of up to 50 percent.

The engine met all 2007 emissions requirements on all 4 test fuels. The soy-based biodiesel blends provide slight improvements in carbon monoxide emissions but also have a slight penalty for hydrocarbon, oxides of nitrogen, and carbon dioxide emissions. As with the benefits, the penalty generally grows from the soy-based B5 biodiesel blend to the soy-based B20 biodiesel blend. The renewable B100 provides a carbon dioxide advantage over standard diesel, unlike the soy-based fuels. This fuel has a small hydrocarbon penalty, similar in magnitude to the soy-based blends.

Project Specifics

Agreement Number: 500-06-043
Recipient: California Air Resources Board
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