

Project Startup: Evaluating Coca-Cola's Class 8 Hybrid-Electric Delivery Trucks

Although the largest trucks—Class 8, with a gross vehicle weight rating (GVWR) above 33,000 lb—make up only 1% of the U.S. highway vehicle fleet, they are responsible for almost 20% of highway petroleum consumption.¹ Improving the efficiency of Class 8 trucks through strategies such as alternative fuels and hybridization is a high-impact way to reduce petroleum consumption and associated emissions.

The National Renewable Energy Laboratory's (NREL's) Fleet Test and Evaluation Team is evaluating the 12-month, in-service performance of five Class 8 diesel hybrid-electric delivery trucks and five comparable conventional diesel trucks operated by Coca-Cola Refreshments in Miami/South Dade County, Florida. In addition, the tailpipe emissions and fuel economies of one hybrid and one diesel truck have been evaluated on a chassis dynamometer at NREL's Renewable Fuels and Lubricants (ReFUEL) Laboratory.

One goal of this project is to provide a consistent comparison of fuel economy and operating costs between the hybrids and the diesel trucks. Another goal is to help Coca-Cola select delivery routes for their hybrids that maximize the fuel-saving and environmental benefits of hybrid technology. This document introduces the Coca-Cola evaluation project. Final results will be available in summer 2011.

Advanced Vehicle Testing

This project is part of a series of evaluations performed by NREL's Fleet Test and Evaluation Team for the U.S. Department of Energy's Advanced Vehicle Testing Activity (AVTA). AVTA bridges the gap between research and development and the commercial availability of advanced vehicle technologies that reduce petroleum use and improve air quality in the United States. The main objective of AVTA projects is to provide comprehensive, unbiased evaluations of advanced vehicle technologies in commercial use. Data are collected and analyzed for operation, maintenance, performance, costs, and emissions characteristics of advanced-technology fleets and comparable conventional-technology fleets operating at the same site. AVTA evaluations enable fleet owners and operators to make informed vehicle-purchasing decisions.

PIX 17947

PIX 17949



Coca-Cola Refreshments operates hybrid-electric and conventional diesel delivery trucks from its Miami/South Dade depot.

Credit: Patrick Curran, NREL

Coca-Cola's Hybrid-Electric Delivery Trucks

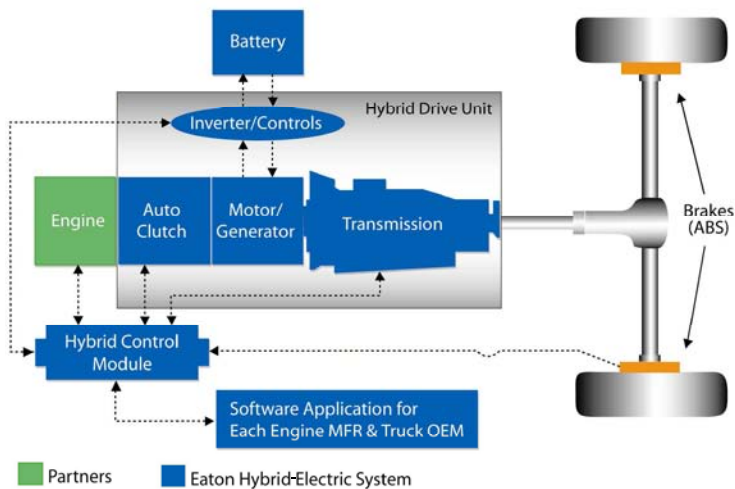
As part of its commitment to environmental responsibility, Coca-Cola operates over 600 hybrid-electric delivery trucks throughout the United States and Canada.² The efforts to build this fleet originated in 2001, when Coca-Cola began working with its suppliers to develop, test, and produce hybrid trucks that would meet its delivery needs. By the end of 2008, Coca-Cola had deployed 142 hybrid 12-bay box trucks (33,000 lb GVWR) in North American cities. In 2009, the company rolled out larger hybrid trucks (55,000 lb GVCW) for its bulk-delivery applications.

The large hybrid trucks—the subjects of this evaluation—are equipped with a parallel hybrid system manufactured by Eaton Corp. The system includes a synchronous brushless, permanent magnet motor (26-kW continuous power, 44-kW peak power); regenerative braking; and lithium-ion batteries that provide 340 volts direct current and 1.8 kWh of energy storage. Torque from the electric motor augments torque from the vehicle's engine, which can improve fuel economy and performance. Energy that is normally lost during braking is captured, stored in the batteries, and used to power the electric motor. This system has been shown to improve fuel economy and reduce emissions in other truck applications.³

¹ Calculated from statistics in the *Transportation Energy Data Book*, Edition 29, Oak Ridge National Laboratory, 2010 (<http://cta.ornl.gov/data>).

² As of the end of 2009.

³ For example, see *United Parcel Service Evaluates Hybrid Electric Delivery Vans*, National Renewable Energy Laboratory, 2010 (www.nrel.gov/docs/fy10osti/47327.pdf).



Coca-Cola's hybrid-electric delivery trucks use Eaton's parallel hybrid system. Courtesy of Eaton Corp.

In-Service Testing in Miami/South Dade County

NREL is evaluating the five hybrid and five diesel trucks from May 2010 to May 2011 as the trucks serve their Miami/South Dade delivery area. Delivery routes for this area are assigned on a first-come, first-served basis, so all trucks have an equal, random chance to be used on any route. Initial data collected using global positioning system (GPS) data loggers show that the trucks average 45 miles of driving per day at an average speed of 21 mph, with 1.3 stops per mile. The average weight of a truck and trailer loaded with products is 42,800 lb.

The following information will be evaluated during the study to enable comparison of the hybrid and diesel truck fuel economies and operating costs:

- Vehicle fueling data from the fuel provider, the engine control module, and data loggers
- Vehicle mileage data from driver logs, the engine control module, and data loggers
- Vehicle maintenance data from service reports.

Test Vehicle Specifications

	Hybrid Electric	Conventional Diesel
Chassis manufacturer/model	Kenworth T370	Freightliner M2106
Chassis model year	2010	2009
Engine manufacturer/model	PACCAR PX-6 280	Cummins ISC-285
Engine model year	2009	2008
Engine emissions certifications	EPA 2007, CARB 2008 (Clean Idle)	EPA 2007, CARB 2008 (Clean Idle)
Engine ratings		
Maximum horsepower	280 hp @ 2,300 rpm	285 hp @ 2,000 rpm
Maximum torque	660 lb-ft @ 1,600 rpm	800 lb-ft @ 1,300 rpm
Fuel capacity	56 gal	80 gal
Transmission manufacturer/model	Eaton Fuller UltraShift automatic	Eaton Fuller T-14607 seven-speed manual
Curb weight	11,600 lb	11,140 lb
Gross vehicle weight rating	34,700 lb	34,700 lb
Retarder/regenerative braking	Regenerative braking	None
Advanced emission-control equipment	Diesel particulate filter	Diesel particulate filter
Cabin air conditioning	Yes	Yes

Chassis Dynamometer Testing at the ReFUEL Laboratory

In August 2010, one hybrid (from Coca-Cola's Denver fleet) and one diesel truck (from its Omaha fleet) underwent chassis dynamometer testing at NREL's ReFUEL Laboratory in Golden, Colorado. Initial data collected from the Miami/South Dade trucks using GPS data loggers were used to choose the dynamometer drive cycles, which included the West Virginia University City (WVU CITY), Composite International Truck Local Cycle and Commuter (CILCC), and Heavy Heavy-Duty Diesel Truck (HHDDT) cycles. Fuel economy and emissions of nitrogen oxides, carbon monoxide, hydrocarbons, and carbon dioxide were measured for each truck. The results are being analyzed and will be published.

To track the progress of the Coca-Cola hybrid truck evaluation project, visit the AVTA (www.eere.energy.gov/vehiclesandfuels/avta) and Fleet Test and Evaluation (www.nrel.gov/vehiclesandfuels/fleettest) Web sites. Interim and final project reports will be posted on these sites as they are published.

U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

EERE Information Center

1-877-EERE-INFO (1-877-337-3463)

www.eere.energy.gov/informationcenter

Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post consumer waste.

Prepared by the National Renewable Energy Laboratory (NREL). NREL is a national laboratory of the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy. NREL is operated by the Alliance for Sustainable Energy, LLC

DOE/GO-102011-3172 • March 2011