

NREL & DOE Activities: Update



HTUF 2009

**Fleet Experience and
Needs Session**

Kevin Walkowicz

**National Renewable Energy
Laboratory
Advanced Vehicle Testing Activity**

October 28, 2009

MD & HD Hybrid Fleet Testing at NREL



- **Funded Through DOE's Vehicle Technology Program**
- **Goals/Objectives:**
 - Real-world feedback: new technology vs conventional (under same conditions)
 - 6-12 month, on-road evaluations
 - Obtain and analyze data:
 - Operating cost/mile
 - Fuel economy
 - Maintenance costs
 - Warranty issues
 - Reliability (miles between failure)
 - Implementation issues from a fleet's perspective
 - Duty cycle analysis
 - Subsystem performance
 - Provide data to help fleets, manufacturers and other R&D organizations who might be considering similar technology
 - Publish data
 - Acquire data for vehicle modeling activities
 - Identifies additional barriers to energy efficient vehicles

Recent Projects: Fed Ex (DOE, CALSTART, SCAQMD)

- Azure HEV Delivery Vehicles

- Status:** Dyno testing and on-road evaluation - April 2009 thru April 2010
- Technology:** Azure Gen I gasoline HEV in Southern CA vs conventional diesels
- Data:** Interim report in late 2009, Final report in mid 2010; Include both on-road and chassis dyno data
- Results:**



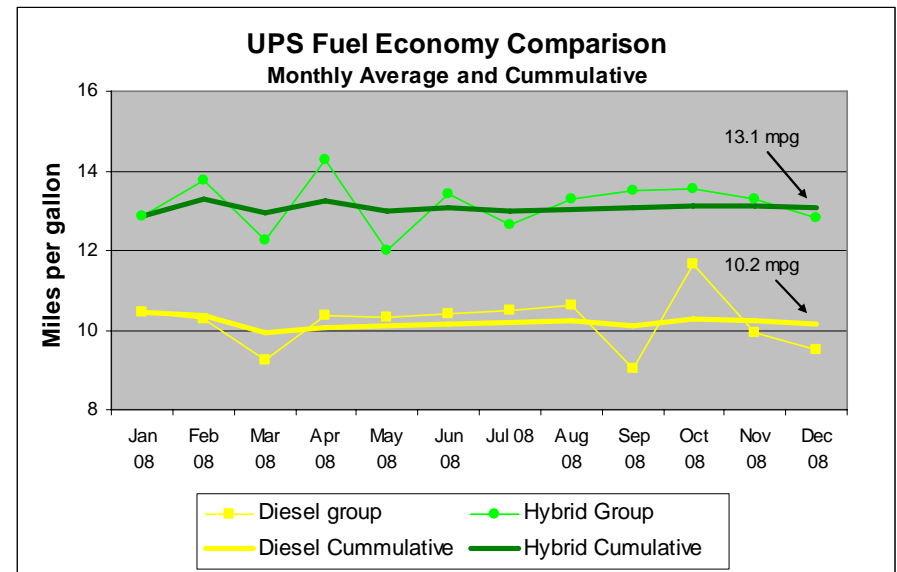
Chassis Dyno Data:

- MPG: -2 to +20 % improvement in MPG (dge) (gasoline engine vs diesel)
- Emission Reductions:
 - Much cleaner!
 - NOx = 75-89%
 - PM = 99.9%

Drive Cycle	gHEV FE (mpg)	gHEV Diesel Equivalent FE (mpg)	Diesel FE (mpg)	Energy Content Adj GHEV Advantage
HTUF4	10.45	11.36	11.66	-2.6%
OCTA Bus	8.61	9.36	9.52	-1.7%
NYCC	6.75	7.34	6.08	+20.7%

Recent Projects: UPS

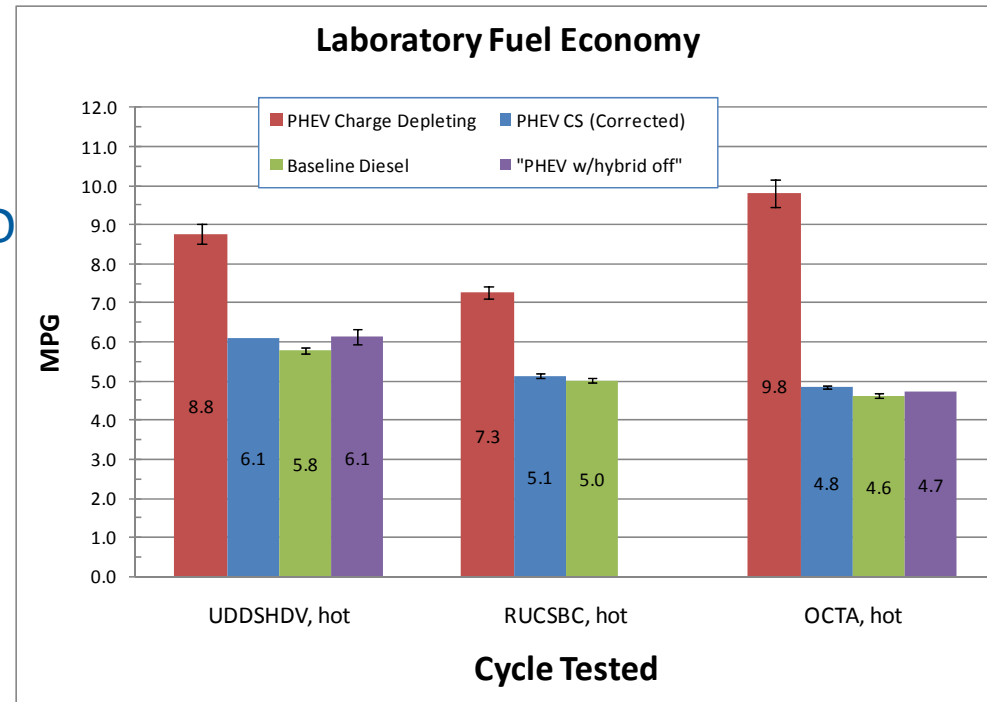
- Eaton Hybrid Delivery Vehicles
 - **Status:** Dyno testing and on-road evaluation began in 2008. Now complete.
 - **Technology:** Gen I diesel HEV in-use in Phoenix, AZ vs conventional diesels
 - **Data:** Final report in Nov 2009 will include on-road eval + chassis dyno data
 - **Results:**
 - 29% on-road fuel economy improvement for hybrids
 - 31-37% improvement in-lab (CILCC/CBD/WVU City)
 - Diesel = \$0.53 per mile operating costs
 - Hybrid = \$0.43 per mile operating costs



Recent Projects:

PHEV School Bus

- PHEV School Bus / Enova-IC Corp
 - **Status:** Dyno testing and on-road evaluation completed for 4 sites (Austin, Napa, Wake County NC, Manatee FL)
 - **Technology:** Diesel Plug-In HEV (Enova charge-depleting) school buses in-use in various locations
 - **Data:** Final report in Dec 2009
 - **Results:**
 - 44-113% improvement in CD
 - But...3-39 miles possible in CD
 - Slight improvement in CS
 - On-road MPG:
 - 6.5-7.1 mpg diesels
 - 8.0-9.1 mpg hybrids
 - Good reliability and low maintenance costs



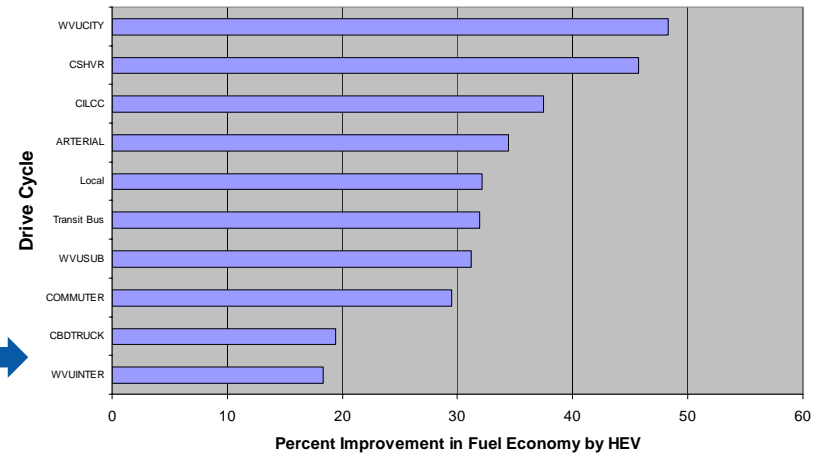
FY10 Planned Projects: More Hybrids!

- Recently announced DOE funded grants (still under negotiation):
 - Navistar: Expanded, next-gen PHEV school bus
 - SCAQMD: 378 trucks and shuttle buses with Eaton
 - Navistar: 400 EV Delivery Trucks
 - Smith Electric: ~100 Transit Connect EV and 'Newton' MD trucks

- FY10 Evaluations and Interests (being planned now thru DOE's Vehicle Technologies Program):
 - Class 7-8 HEV
 - Day Cab HEV tractors
 - Lithium battery buses - various locations, in-depth battery data
 - Next generation, improved HEV systems for MD Package Delivery
 - Plug In Hybrid Trucks
 - Hydraulic Hybrids

Key Findings & Considerations

- Business Case and Payback?
 - Duty Cycle drives fuel use and % improvement
 - The 'most urban' route not always best place for HEV's and other advanced technology vehicles
 - Fuel Price Driven



- Green Initiatives?
 - CO2 Credits / Cap & Trade
- Future of Hybrids – Market Penetration?
 - Depends on Fuel Prices, hardware costs (battery costs), incentives

For More DOE / NREL MD&HD Hybrid Info

Lee Slezak

U.S. Dept of Energy

Vehicle Technology Analysis & Evaluation Program Manager

Vehicle Technologies Program

Lee.slezak@ee.doe.gov

202-586-2335

Kevin Walkowicz

National Renewable Energy Laboratory

Advanced Vehicle Testing Activity Team Lead

kevin.walkowicz@nrel.gov

phone: 303.275.4492