NREL & DOE Activities: Update

HTUF 2009
Fleet Experience and Needs Session

Kevin Walkowicz
National Renewable Energy Laboratory
Advanced Vehicle Testing Activity

October 28, 2009
NREL/PR-540-46995
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%**

<table>
<thead>
<tr>
<th></th>
<th>HTUF4</th>
<th>OCTA Bus</th>
<th>NYCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE (mpg)</td>
<td>10.45</td>
<td>9.36</td>
<td>6.75</td>
</tr>
<tr>
<td>Diesel FE (mpg)</td>
<td>11.36</td>
<td>9.52</td>
<td>7.34</td>
</tr>
<tr>
<td>Energy Content Adj</td>
<td>11.66</td>
<td>6.08</td>
<td></td>
</tr>
<tr>
<td>Advantage</td>
<td>-2.6%</td>
<td>-1.7%</td>
<td>+20.7%</td>
</tr>
</tbody>
</table>
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
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