Making Transportation and Goods Movement Leaner, Cleaner & Greener

August 8, 2011  San Antonio, TX

Allen Schaeffer, Executive Director
We appreciate the chance to Sponsor this Luncheon

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- Cummins Inc
- Daimler
- Delphi Diesel Systems
- Donaldson Co.
- Dow Automotive
- Deere & Company
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- Honeywell
- Johnson Matthey
- Mazda North American Operations
- Navistar
- Volvo/Mack Trucks- Powertrain
- Volkswagen of America

Allied Members

- Association of Diesel Specialists
- Western States Petroleum Association
Agenda

- Big Picture Energy Policy
- Focus on transportation fuels, basics on diesel fuel and technology;
- Diesel, energy efficiency and the clean energy future
- What you can do....
- But first... a word about our technology display
Uses of Diesel Power
Overview

- Diesel is the most efficient internal combustion engine and energy-dense liquid fuel.
- Coupled with its proven performance, reliability, durability, that’s why it plays the predominant role today in many key sectors of the economy.
- Transformation to low-emissions, its renewable fuel readiness and hybrid capabilities assure clean diesel a place in the clean energy future.
- There are many policy options available to accelerate gains in energy efficiency.
Big Picture

Energy Considerations in Transportation
Diesel makes up 21% of refined petroleum products.
DOE Projection of US Oil Consumption

Projection Oil Consumption by Vehicle Type
Presuming 75% Reduction in Light-Duty Oil Consumption*

Million Barrels per Day in 2050

Oil Consumed (Million Barrels per Day)

Cars
Light Trucks
Heavy Trucks

*Light duty oil consumption reduction from AEO 2007 reference case modeled via increased fuel economy and shifts to flex-fuel, hybrid-electric, and plug-in hybrid-electric vehicles.
Options for Transportation Energy Savings are straightforward...

- **Vehicles**
  - Make them more efficient
  - Encourage *use* of more efficient vehicles (incentives or removal of barriers)

- **Fuels**
  - Different, lower carbon, renewable

- **Operation**
  - Improve efficiency and productivity, reduce driving, limit idling
Transportation Fuels for the future

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- Biodiesel (1st Gen)
- Ethanol
- Natural Gas
- Hybrid
- E-10
- Diesel Hybrid
- Direct injection Gasoline
- EV range extender
- E-85
- Renewable Diesel
- Hydrogen
- Fuel Cell
- Electric Vehicle

- 2000
- 2020 ?
## Comparing fuel attributes

<table>
<thead>
<tr>
<th></th>
<th>Gasoline</th>
<th>Diesel</th>
<th>Ethanol</th>
<th>Biodiesel</th>
<th>LPG</th>
<th>CNG</th>
<th>Hydrogen</th>
<th>Electricity</th>
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<tbody>
<tr>
<td><strong>Energy Content</strong></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Relative to Gasoline</td>
<td>1</td>
<td>+10%</td>
<td>-35%</td>
<td>+9%</td>
<td>-28%</td>
<td>-70%</td>
<td>-75%</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Vehicle Fuel Economy</strong></td>
<td>1 (conventional)</td>
<td></td>
<td>-3% (E10)</td>
<td>+23%</td>
<td>-20%</td>
<td>-5%</td>
<td>N/A</td>
<td>17%-35%</td>
</tr>
<tr>
<td><strong>Relative to Gasoline</strong></td>
<td>25%-30%</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(hybrid)</td>
<td></td>
<td></td>
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<tr>
<td><strong>Fuel Availability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All vehicle classes</td>
<td>Widely available</td>
<td></td>
<td>Widely available</td>
<td>Regional availability</td>
<td>Limited: most accessible alternative fuel</td>
<td>Limited</td>
<td>Minimal most for private use</td>
<td>Available: Upgrades Eventually Needed</td>
</tr>
<tr>
<td>Most vehicle classes</td>
<td>Widely available</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vehicle Availability</strong></td>
<td>All vehicle classes</td>
<td></td>
<td>All vehicles: 10% blends Limited -(E85)</td>
<td>All vehicles: 5% blends Limited -(20%)</td>
<td>No OEM Conversions Available</td>
<td>Limited</td>
<td>None</td>
<td>Limited: Hybrids in some classes</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td>Existing</td>
<td></td>
<td>Existing for 10% blends</td>
<td>Limited</td>
<td>Limited</td>
<td>Limited</td>
<td>None</td>
<td>Minimal</td>
</tr>
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Energy Density of Fuels
Normalized to Diesel Fuel

Source: US DOE, EERE
Clean Diesel is Part of a Sustainable Energy Strategy

- **Efficiency:** Most fuel efficient internal combustion engine
- **Low-Emissions:** New, near zero emissions technology addresses past emissions concerns
- **Capability:** of hybridization and renewable fuel compatible
- **Availability:** Fueling and maintenance infrastructure well-established
- **Affordability:** Cost competitive in total cost of operations
- **Solutions** available for modernizing and upgrading existing engines – diesel retrofits among most cost-effective air quality solutions
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Policy Issues and Impacts

What policies and developments will impact fuel cost, availability, composition, environmental impacts in the years ahead: cars and medium and heavy-duty trucks
New Rules drive Fuel Economy for cars and light trucks

- New Fuel economy Proposal
  - Cars -- 5% a year improvement each year 2017-2025
  - Light Trucks - 3.5% improvement/year 2017-2020; then 5% annually to the 54.5 mpg standard.
  - 2021 reg. review
Things have changed.....
From your grandfathers diesel . . .
To tomorrow's generation of clean diesel: Chevy Cruise, VW Passat, Mazda-3, & Nissan Titan (coming soon)
Demand for more fuel efficient vehicles likely to increase diesel cars in US

Analyst: Chevy Cruze could break U.S. diesel barrier
July 13, 2011
The diesel Cruze -- GM sells it with a 2.0-liter turbo diesel outside the U.S. -- can get about a real-world 50 mpg on the highway. That should put it at 50 to 55 mpg in the test the government uses for its fuel-economy rules -- about a direct hit on the 52.6 mpg industry average the feds are considering by 2025.

Diesel craze sends carmakers scurrying for deisel engines in India
Daily News and Analysis, July 19, 2011

Diesels poised, again, to win hearts in America
July 27, 2011
Chrysler CEO sees higher gas mileage mainly from improved gasoline and diesel engines
(August 3, 2011)

"If one-third of all vehicles in the USA were already clean diesel vehicles today, we would be saving 1.4 million barrels of oil every day. "That is equivalent to the amount of oil we currently import from Saudi Arabia."
- U.S. Transportation Secretary Ray LaHood (May 24, 2011)
And if diesels were to make up 15% of the fleet, the US would use 17B gallons LESS FUEL over their useful lives.

**US Light Duty Diesel Fuel and CO2 Savings – 6 model years**

- 15% of US Fleet
- 413M bbls saved
- 17B gallons saved
- 205M tonnes of CO2 saved

Based on 2007 LD vehicle sales with confirmed diesel programs. Analysis assumes 2010-2015 vehicle sales over their entire useful life savings over the average 2007 vehicles with announced diesel options.
Things are not always as they seem..
Which vehicle saves more energy?

*Toyota Prius*  
Gasoline Hybrid

*GMC heavy-duty*  
Diesel Pick up
From 2003-2007, diesel pickup trucks outsold the hybrids 2.5-1.
The Energy Savings and CO2 Benefits From Consumers who bought Diesel instead of gasoline is significant

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<tbody>
<tr>
<td>Well-to-wheel CO₂ - Tonnes</td>
<td>59.3M</td>
<td>1.6M</td>
</tr>
<tr>
<td>Federal excise taxes paid (FHTF)</td>
<td>$2.6B</td>
<td>$26M</td>
</tr>
<tr>
<td>Real $ fuel savings to consumers</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>USA</strong></td>
<td>$4.6B</td>
<td>$179M</td>
</tr>
<tr>
<td><strong>CA</strong></td>
<td>$420M</td>
<td>$48M</td>
</tr>
<tr>
<td><strong>FL</strong></td>
<td>$222M</td>
<td>$9M</td>
</tr>
<tr>
<td><strong>NY</strong></td>
<td>$80M</td>
<td>$8M</td>
</tr>
<tr>
<td><strong>TX</strong></td>
<td>$590M</td>
<td>$8M</td>
</tr>
</tbody>
</table>

Imported crude oil – expressed in days

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<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Days import protection</td>
<td>11</td>
<td>0.28</td>
</tr>
<tr>
<td>OPEC imports</td>
<td>25</td>
<td>0.63</td>
</tr>
<tr>
<td>Venezuela imports</td>
<td>119</td>
<td>3</td>
</tr>
<tr>
<td>Saudi Arabia imports</td>
<td>92</td>
<td>2</td>
</tr>
<tr>
<td>Algeria imports</td>
<td>127</td>
<td>3</td>
</tr>
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</table>
Using renewable diesel fuel in that diesel pickup truck gives even greater benefits

Source: California Energy Commission, June 2007
The Past – Present – Future of Clean Diesel

Clean Diesel Greenhouse Gas Reduction Potential

<table>
<thead>
<tr>
<th></th>
<th>CO₂ emissions [g/mi]</th>
</tr>
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<tbody>
<tr>
<td>Gasoline PFI*</td>
<td>476</td>
</tr>
<tr>
<td>eHybrid</td>
<td>322</td>
</tr>
<tr>
<td>eHyb. TC</td>
<td>256*</td>
</tr>
<tr>
<td>Diesel</td>
<td>405</td>
</tr>
<tr>
<td>Diesel B20</td>
<td>334</td>
</tr>
<tr>
<td>with Hybrid</td>
<td>230</td>
</tr>
<tr>
<td>eHybrid</td>
<td>184*</td>
</tr>
<tr>
<td>Base Diesel B20 Fuel</td>
<td>289</td>
</tr>
<tr>
<td>Plug-in Hybrid elec.</td>
<td>340</td>
</tr>
<tr>
<td>Well to wheel</td>
<td></td>
</tr>
</tbody>
</table>

Source: EIA report based on GREET model

Significant Potential in Greenhouse Gas reduction expected from Clean Diesel

*estimated based on Bosch internal simulations
Evolution of commercial trucks

1950?

Diesel powers over 90 percent of all commercial trucks

1980

2010
Commercial Trucks and Buses to meet new Federal fuel efficiency and GHG goals

- **Medium-Heavy duty trucks** – Use about 22 billion gallons of diesel fuel a year.
- **First-ever rules on fuel economy for medium and heavy-duty trucks and buses** -- August 9.

- Engine efficiency increases;
- Hybrid powertrains;
- Vehicle efficiency improvements (tires, aerodynamics, etc.)
Fuel Consumption Reduction Potential with Super Truck Technologies - Long Haul Trucking

Typical Long Haul ...

- 46,000 Payload (lbs)
- 23 Payload (tons)
- 150,000 Miles/year
- 6.0 Miles/gallon
- 0.26 Gallons/ton/mile
- 25,000 Gallons/truck/year
- $100,000 Fuel cost per year *

Super Truck diesel engine ...

- +20% Improved fuel efficiency
- 5000 Gallons saved/year
- 56 Fewer tons CO₂ per year
- $20,000 Fuel savings per year *

* Assumes $4/gallon

5.6 Billion Gallons Fuel
63 Million Tons CO₂

- Engine Only
- One Model Year
- 5 Years
- 225,000 Trucks
There are many fuel saving strategies:

- 70% reduction in Idling
- 12-16% savings speed and shifting
- Downsize 24’ to 20’
- 1K weight reduction and engine downsizing diesel
Idle reduction = low hanging fruit

- Reduce heavy-duty truck idling
  - Argonne National Laboratory estimates that more than 650,000 long-haul heavy-duty trucks idle during required rest stops.
  - As the trucks idle during those rest periods, they use more than 685 million gallons of fuel per year. At a price of roughly $3 per gallon, that wasted diesel fuel translates into almost $2 billion annually.
  - Verified Technologies available to heat/cool/power
Expanded Use of Renewable fuels can enhance diesel benefits

- Displaces petroleum, from domestic plant and biomass sources
- Renewable Fuel Standard mandates 1 billion gallon market in 2012
- Quality and consistency of fuels critical to success
- Manufacturers warranties cover 5% up to 20% blends
Technology choices have consequences: Diesel vs. natural gas; biodiesel

- **Public Transit bus fleets, “Diesel vs. Natural gas”**
  - Pressure to move away from diesel to CNG to demonstrate “greener choice.” (Emissions virtually the same for today’s clean diesel and natural gas.)
  - CNG bus/infrastructure costs reduced operating and capital funds available for regular fleet turnover, maintenance, expanded service routes
  - **Result:** Overall fleet age increases, emissions, costs increase

- **Lessons learned:** Acquisition of perceived “greener” technology/fuels can have unintended consequences, undermine core services—consider all factors

- **Biodiesel Mandates**
  - Fuel performance, vehicle capabilities/costs
Concluding thoughts
Choices for Reducing Transportation-related Petroleum Consumption & GHG Emissions

- Expand the use of existing energy-efficient technologies
- Invest in new alternative technologies and fuels
- Reduce the number of vehicle miles traveled
- Improve efficiency of energy intensive sectors -- goods movement
- Use lower carbon fuels
What you can do…

- Lead by example
  - Create a mindset and use the bully pulpit
  - Little things can add up to big savings (LEED)
    - Government fleets benefit from modernization and efficiency, idle reduction programs
    - Influence/reward choices --contract/project specifications for fuel savings, efficiency gains, Technology and Fuel choices
  - Provide incentives focused on results not preference/favorite technology/choices
    - SmartWay
What you can do . . .

- Recognize that for Fuel and technology choices ....no silver bullets, just silver pellets – no one best fuel for everything
- A balancing act.... near-term Improvements in existing engines, fuels and technologies are critical– steady progress. Success of some alternative fuels and technologies can be uncertain, long-term.
- Smart policies can avoid unintended consequences
  - Biodiesel
  - Public Transit
About Diesel

- Diesel power’s inherent energy efficiency coupled with new environmental performance position it as a competitive future technology.
- Diesel + Hybrid + Renewable fuel = big gains in efficiency, lower CO2
- For some sectors/modes of transportation, no alternatives to diesel power on the horizon today.
Thank you!

- See it for yourself --Visit our technology display here and Booth/tractor and truck display in the Exhibit Hall
- Resources and Assistance
  - Presentation will be available on the Diesel Technology Forum website [www.dieselforum.org](http://www.dieselforum.org)
  - Other tools and resources for state policymakers

Thank you please contact us
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