NAFTA Heavy Duty Engine and Aftertreatment Technology: Status and Outlook

2006 DEER Conference Luncheon Address
Glenn Lysinger
August 24, 2006
Agenda

- DOE/Detroit Diesel Collaboration
- EPA 2007 Readiness
- EPA 2010 Emissions
  - AdBlue Infrastructure and Compliance
Technology & Products that Continue to Benefit the Environment

Fuel Economy
- Supplier of the most fuel efficient diesel engines for various applications within the United States for nearly 20 years.
- Engines that help our customers reduce diesel fuel consumption in America by 2.5 million gallons per day.

Emissions
- Detroit Diesel meets the highest clean air standards for today and is a leader in developing clean burning diesel engines for the future.
- 2007 Detroit Diesel engines will emit 70% less pollutants than they did in 1998 – helping to preserve the clean air that Americans breathe.

Hybrid Technologies
- Detroit Diesel and Freightliner are working together to develop diesel hybrid electric engines that will:
  - Improve fuel economy
  - Reduce emissions
- Development of hybrid technologies is gaining momentum and will lead to high quality jobs and industry growth.

Celebrating 20+ Years of DOE & DDC Collaboration
Heavy-Duty Thermal Efficiency Trend

- **DOE-DDC Technology Demonstration**
- **NZ-50+**
- **Impact on Commercial Technology**
- **Heavy Truck Project NZ-50**
- **Without DOE Assistance**

Graph showing the trend of brake thermal efficiency over calendar years from 1960 to 2020.
2004 vs. 2007 DDC Fuel Economy Comparison

Testing showed EPA07 engine to be within 1% of the EPA04 engine. All runs were within 2% variance. This test was a preliminary look at EPA07 vs. EPA04 Fuel Economy.

Includes
50% less NOx
90% less PM
Active Regen
EPA 2007 Readiness
### Status Customer Demonstration Program

**Series 60**

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- **36 Trucks delivered to end users**

8 million equivalent miles of reliability growth on dynamometer and actual truck tests through July 2006.
EPA 2010 Emissions
AdBlue Infrastructure and Compliance
Global Emissions Regulations

Global heavy-duty emissions regulations are approaching near-zero and present an opportunity for some common technologies to be utilized for global synergy

*Euro 6 and post-Japan 2005 Regulations yet to be Finalized
Heavy-Duty Engine Technology Evolution

2002 / 2004
- Single actuator electronic unit injection system
- Variable geometry turbocharger / Asymmetric turbocharger (MBE 4000, 900)
- Cooled EGR
- Combustion system optimized for EGR

2007
- Dual actuator electronic unit injection system
- Diesel particulate filter system with active regeneration
- Increased rates of cooled EGR
- Combustion system optimization with enabling fuel system and EGR
- New electronics with model-based controls, engine manufacturers diagnostics
- Variable geometry turbocharger / 2-stage turbocharger (MBE 900)
- Closed crankcase breather

2010
- Advanced combustion enabled by sub-system technologies
- PM and NOx aftertreatment
- On-board diagnostics
**DCX Vision for Global Emissions Control in Trucks and Medium and Heavy Duty Engines**

Production experience with several emissions control technologies within the DC family (e.g. EGR in U.S., SCR in Europe) lays a strong foundation for a global solution.  

2012 is the earliest opportunity for this global synergy to be implemented; Possibility of earlier implementation via pre-fulfillment of Euro 6.
Low Emissions Combustion, DPF and AdBlue
SCR Integrated on a Vehicle Test-bed

Example System Integration
Installation for Long Sleeper Cabs

2010 Technology Vehicle at
the DEER 2006 Vehicle Display
Engine-out and Tailpipe-out NOx

- Engine-out
- Cold FTP Cycle
- Hot FTP Cycle
- Tailpipe-out

Cumulative NOx (g/hp-hr)

Time (s)

EPA 2010 Emissions Regulations
Urea Infrastructure at Distributors and Dealers

- **Urea infrastructure**
  Ensure that drivers will find SCR-quality urea wherever they need it.

- **Market study on urea consumption.** By 2015 there consumption is projected to be 400 million gallons per year for all sectors of commercial vehicles.

- **EPA 2010 heavy-duty engine manufacturers reviewing what the Automotive Alliance plans are for infrastructure for this technology for light duty vehicles.**

- **Stakeholders include urea producers, distributors and retailers**

- **Freightliner dealerships and affiliated fuel truck stops will carry urea**
Freightliner LLC Sales & Service Network

Freightliner, Sterling & Western Star Brands, DDC Distributors & TA Service Point Locations
Urea Compliance Guidance from EPA

- **Urea Compliance** - Ensure that vehicles will meet the standards
  - Drivers will not drive with empty urea tanks
    - Vehicle standards may not be exceeded due to lack of urea.
    - Audible & visible alarms when urea is running low are needed
    - No-start mechanisms are to be used as last resort.
    - Detect if fluids other than urea are used. Urea Sensor vs. NOx Sensors are developed, but require much reliability growth testing before introduction to series production.
EPA10 SCR
Urea Compliance Strategy (Proposed)

- **Urea tank > 10% full**: No lamps lit
- **< 10% full**: AdBlue lamp lit solid
- **< 5% full**: AdBlue lamp flashing
- **Range < 1 fuel fill**: AdBlue lamp flashing, Check engine lamp lit solid, Light engine derate
- **Urea tank empty**: AdBlue lamp flashing, Check engine lamp lit solid, Additional measures
Thank You