The Next Regulatory Chapter for Commercial Vehicles

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3 October 2011
Cummins Inc.

Diversified Global Power Leader – Four Complementary Businesses

- World’s largest independent diesel engine manufacturer
- Nearly 900,000 engines in 2010
- Over 60% of sales outside the US
- 40,000+ employees worldwide
May 8, 2007
Commercial Vehicle Industry

CLASS 2
6,001 to 10,000 lb
- Full-size pickup
- Step van
- Walk-in
- Conventional van
- City delivery

CLASS 3
10,001 to 14,000 lb
- Conventional van
- City delivery

CLASS 4
14,001 to 16,000 lb
- Large walk-in

CLASS 5
16,001 to 19,500 lb
- Bucket
- City delivery
- Large walk-in

CLASS 6
19,501 to 26,000 lb
- Beverage
- Single-axle van
- School bus
- Rack

CLASS 7
26,001 to 33,000 lb
- Refuse
- Furniture
- City transit bus
- Medium conventional

CLASS 8
33,001 lb & over
- Dump
- Cement
- Heavy conventional
- COE sleeper
Technology Evolution

- 1990: Aftercooling
- 2000: Electronic Fuel Systems
- 2010: Cooled Exhaust Gas Recirculation
- 2020: Selective Catalytic Reduction

NOx, PM

CO2
Reducing CO₂ Emissions

- Low Carbon Fuels
- Hybrids
- Idle Reduction
- Low Temp Aftertreatment
- Waste Heat Recovery
- High Efficiency Clean Combustion

Reduced CO₂ = Fuel Efficiency
White House Announcements

Rule proposed October 2010 and finalized August 2011
Segmentation

Heavy-duty Pickups and Vans

Combination Tractors
Reuse Existing Engine Protocols

Tractor Duty Cycle (SET Test)

Vocational Duty Cycle (FTP Test)
Diesel Engine Standards

- Separate engine standards
- Utilize existing regulatory provisions to certify the engine as done today for NOx and PM
- Different standards for tractor and vocational engines (HD and MD categories remain)

Standards
- CO₂ Limits: range of 3% in 2014 to 9% total in 2017 over 2010 baseline
- N₂O and CH₄ Limits
Hybrids

Chassis Dyno

Post-Trans Powerpack

Pre-Trans Powerpack

Hybrid Control Module

HCM

Rear Wheel Drive

Transmission

Motor Generator

Internal Combustion Engine
# Vehicle Standards

## Combination Tractors

<table>
<thead>
<tr>
<th></th>
<th>Day Cab</th>
<th>Sleeper Cab</th>
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<tbody>
<tr>
<td><strong>Class 7</strong></td>
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<td><strong>Class 8</strong></td>
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<td><strong>Mid Roof</strong></td>
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<td><strong>High Roof</strong></td>
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- **Low Roof**: Various models are shown, indicating the different types of combination tractors available in the market.
- **Mid Roof**: Some models are shown, indicating mid-roof combination tractors.
- **High Roof**: Various models are shown, indicating the different types of combination tractors available in the market.

## Heavy-duty Pickups and Vans

- Various models of heavy-duty pickups and vans are shown, highlighting their respective features and designs.

## Vocational Vehicles

- A detailed view of a vocational vehicle chassis is provided, showcasing its components and structure.
What does this mean in practice?

- The tractor manufacturer will certify the vehicle for aerodynamics, weight reduction, tires, idling and speed limiters.

- The chassis manufacturer will certify the vehicle for tires.

- The engine manufacturer will certify the engine for NOx, PM and CO₂ (and N₂O₂ and CH₄).
Cummins On-Highway Product Plan

- **SCR is foundation for the future**
  - Reduces NOx to near zero levels required
  - Enables greater efficiency and meeting the new GHG/FE standards

- **Product launch early in 2013**
  - Align with new On-Board Diagnostic (OBD) requirements across all engine platforms
  - Comply with GHG/FE regulation

- **SuperTruck Program lays groundwork**
  - Build on public-private partnerships
  - Improve vehicle freight efficiency by 50%
Summary

- EPA and DOT have developed a sound regulation
  - Numerous stakeholders involved over the last 4 years
  - Regulatory structure builds on existing programs
  - Engine technology development enabled by clarity, certainty

- R&D partnerships and regulations work together
  - First: Near zero emissions standards
  - Next chapter: GHG/FE standards