Reducing Commercial Vehicle Fuel Consumption

Workshop on Cleaner and More Efficient Commercial Vehicles
Bangalore, India
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Cummins Inc.

Diversified Global Power Leader – Four Complementary Businesses

- World’s largest independent diesel engine manufacturer
- Over 1 million engines built in 2011
- Customers in over 190 countries and territories
Cummins in India

Largest diesel engine manufacturer
- In India since 1962
- Over 1 million engines in operation
- Over 11,000 employees
- 2011 combined sales of $2.3 billion

Entities:
- Cummins India Ltd.
- Cummins Research & Technology India Ltd.
- Cummins Generator Technologies India Ltd.
- Cummins Technologies India Ltd.
- Tata Cummins Ltd.
- KPIT Cummins Infosystems Ltd.
- Fleetguard Filters Pvt. Ltd.
- Valvoline Cummins Ltd.
Meeting Emissions Standards

Filtration and Diesel Exhaust Fluid

Aftertreatment System

Electronic Controls

Combustion Technology

Fuel Systems

Turbochargers
Commercial Vehicle Regulations

Status of Greenhouse Gas and Fuel Consumption Regulations

- **Canada**
  - 2014 (proposal)

- **United States**
  - 2014

- **Europe**
  - Under Discussion

- **Korea**
  - Under Discussion

- **Japan**
  - 2015

- **China**
  - 2012

- **Mexico**
  - Under Discussion
Vehicle and Application Complexity
Separate Engine and Vehicle Standards
Addressing the Engine Directly

100% Fuel

100% Power

100% CO₂
Engine Improvement Opportunities

Hybrids achieve reductions through modifying *engine* operation.

Reference: TIAX presentation “Technologies to Improve Fuel Efficiency of Heavy Duty Trucks”
Certainty for Technology Development

- Base Engine
- Waste Heat Recovery
- Aftertreatment
- Hybrids

Reduced $\text{CO}_2 = \text{Fuel Efficiency}$
Hybrid and Waste Heat Recovery

![Graph showing fuel economy benefit and duty cycle for hybrid and waste heat recovery systems. The graph illustrates that hybrid systems are more beneficial in scenarios with frequent start/stop cycles, while waste heat recovery systems are more beneficial in scenarios with seldom start/stop cycles.](image)
Hybrids

Rear Wheel Drive
Transmission
Motor Generator
Internal Combustion Engine

Hybrid Control Module
HCM
Waste Heat Recovery

Pump → Working Fluid – Closed Cycle

Boiler / Superheater → Exhaust / EGR

Power Turbine / Expander → Additional Power

Condenser → Waste Heat

Waste Heat → Condenser

Waste Heat → Power Turbine / Expander

Waste Heat → Boiler / Superheater

Waste Heat → Exhaust / EGR
Path to Fuel Consumption Improvements

- **Criteria emissions**
  - Stable legislation and clear implementation timeline
  - Infrastructure (fuel, urea)
  - Full enforcement

- **Fuel consumption**
  - Separate engine and vehicle standards
  - Lead-time, clarity and certainty for technology development

Level Playing Field