STEPS Workshop
Achieving Targets for 2030
Technology & Fuels for Trucks

Jennifer Rumsey
Vice President of Engineering
Engine Business - Cummins Inc.

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Cummins’ Products are Everywhere

- The world’s largest independent manufacturer of diesel engines
- Diesel & natural gas products 2.8 – 95L displacement
- Global manufacturing and support
- Over 1,200 OEM customers
- Powering more types of equipment in more markets than any other engine company
Evolution of Diesel Technology

- Aftercooling
- Cooled Exhaust Gas Recirculation
- Gas Recirculation
- Electronic, High pressure Fuel Systems
- Wall-Flow Particulate Filter
- Selective Catalytic Reduction
- CO₂ and Fuel Efficiency

Stability of regulatory framework and long-term vision of future standards were critical to success.

Fuel sulfur:
- 500 ppm → 15 ppm

Key Engine and Powertrain Technologies

- Combustion & Fuel Systems
- Air Handling & EGR
- Aftertreatment (AT)
- Electronic Controls
- Transmission Integration
- Energy Recovery

System Integration
Looking Ahead: Technologies

- SuperTruck averaged a 75% improvement in fuel economy over 2009 baseline truck
- Engine is significant contributor
  - GHG Phase 1 HD engine ~10% improved from 2009 baseline
  - Up to 15% CO₂ improvement over 2017 tractor engine standard possible in GHG Phase 2
Reducing CO$_2$
Waste Heat Recovery Technology

4-5% Fuel Consumption Benefit

Beyond SuperTruck

- 4th generation design
- Improvements for packaging, cost, reliability
- End-user testing planned for late 2015
- Production possible by ~2020
Long Term Approach to Electrification

- Lower Operating Cost
- Increased Functionality
- Range Extended
- EV Battery
- PlugIn Hybrid
- High Voltage Hybrid
- Low Voltage Hybrid
- Electric Hybrid
- Start/Stop

Lower Initial Cost

Lower Operating Cost
GHG Penalty at Low Tailpipe NOx

**Diesel**

- More work needed to identify a robust 0.02 g/hp*hr diesel solution
- Potential path to ~0.1 g/hp*hr with minimal CO₂ penalty
- New technology will help, but needs development

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**Improving Current Conventional Diesel**

**New Diesel Technologies**

- BTE Improvements
- New Catalysts and Reductants
- Thermal Management
GHG Penalty at Low Tailpipe NOx

- Path to 0.02 g/hp*hr with natural gas with small CO₂ penalty

**Diesel Natural Gas***

**Current Technology**
- Stoichiometric EGR w/TWC

**New Nat Gas Technologies**
- Closed Crankcase Breather
- BTE Improvements
- Close Coupled AT
- More EGR
- Advanced TWC

* Includes methane emissions as equivalent CO₂
Innovation You Can Depend On

- 您可信赖的创新
- L’innovation
- Sur Laquelle Vous Pouvez Compter
- 期待に答える技術革新
- Innovación En La Que Usted Puede
- Confiar
- 신뢰할 수 있는 혁신
- Inovação Que Você Pode Confiar
- नवायुक्ति जिस पर आप निर्भर कर सकें