“To the Tailpipe and Beyond”

John Wall
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ITS-Davis Asilomar 2015
Current and Proposed HD GHG Standards

Class 8 High Roof Sleeper Tractor

- Phase 1 Veh. Std. Scaled to Phase 2
- Phase 2 Veh. Std.
- Ph2 Vehicle + Ph2 Trailer

- ST Total Improvements on 2010 Reference
- 50% from 1990

SuperTruck

“50 in 30”
Current and Proposed HD GHG Standards

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- Phase 1 Veh. Std. Scaled to Phase 2
- Phase 2 Veh. Std.
- Ph2 Vehicle + Ph2 Trailer

- ST Total Improvements on 2010 Reference
- 50% from 1990
- 80% from 1990

SuperTruck

- “50 in 30”
- “80 in 50”
System Partitioning

- **Fuels**
  - Reduced carbon intensity
  - Bio Diesel, CNG, LNG

- **Engines**
  - Brake Thermal Efficiency improvements

- **Vehicles**
  - Tires
  - Aerodynamics
  - Weight
  - Speed / Idle Controls

- **Fleets / Operators**
  - Deployment of Low GHG vehicles
  - Logistics, Driver training & aids

- **Highways / Infrastructure**
  - Highway Construction / Congestion
  - Speed limits
  - Increased GVWs, LCVs
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- **Hybrids / Waste Heat Recovery**

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Evolution of WHR System Design
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Renewable Hydrocarbon Fuels

- **Ethanol** (via sugar fermentation from corn, sugar cane, switchgrass / cellulose, ... = “gasoline”

- **Bio-derived diesel**
  - Vegetable oil (soy, canola / rapeseed, jatropha, ...)
  - Transesterification to Fatty Acid Methyl Ester (FAME)
  - Molecule generally heavier than average diesel
  - Quality is crucial -- glycerin impurity is a filter killer; hygroscopic

- **Bio-produced diesel**
  - Amyris: Genetically engineered yeast produce diesel-range hydrocarbon from sugar (farnesene derivatives)
  - DOE Bioenergy Research Centers – e.g., LBNL/JBEI
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Cummins Corporate Sustainability Initiative

CO2 Avoidance Goal for Products In-Use

Partner with customers to improve efficiency of our products in-use, reaching by 2020 an annual reduction rate of 3.5 million metric tonnes (MMT) of CO$_2$ thereby saving customers 350 million gallons of fuel.
Products In-Use Scope

**Cummins Engines in Production**
- Running improvements on engines in production
- Accompanied by aftermarket retrofit

**Equipment Manufacturers**
- Ensure vehicles and machines are optimized for fuel efficiency with Cummins engines

**End User Customers**
- Utilize Cummins tools and Six-Sigma to further improve efficiency of the equipment as it is being used by customers
Cummins PowerSpec Tool for Engine Parameter / Vehicle Optimization

- Tailor engine calibration for efficiency and performance for each individual customer application
- Match vehicle gearing, transmission, axle ratio, tires with engine settings such as idle time, load-based speed control and road speed governing.
- Performance reviewed with customers to ensure efficiency and productivity objectives are met.
Cummins PowerSpec Tool for Engine Parameter / Vehicle Optimization

- Tailor engine calibration for efficiency and performance for each individual customer application.

Since 2005, Cummins has used Six Sigma to help fleet customers save:

- $1 billion,
- 90 million gallons of fuel, and
- avoid 1 million metric tons of CO₂
Rio Tinto Australia
Cummins teamed with Rio Tinto, Komatsu and General Electric

Annual fuel savings over $16 million
Annual CO₂ avoidance 40,000 metric tons
Examples of Global Fuel Efficiency / CO₂ Initiatives

New engine calibration for 2.3% improvement in fuel economy and avoiding over 300,000 MT of CO₂ in 2014

Using PowerSpec vehicle/engine parameter optimization tool to improve efficiency of customers’ trucks on average 5%

Optimized Euro V ISX15 engine for a 7% fuel economy improvement

Collaborating with Komatsu to improve efficiency of their excavator (5%) and forestry (3%) machines

Working with AngloAmerican to improve mine truck efficiency by analyzing operation and duty cycle; Targeting 6% to 7%

Developed a driver selectable Economy-Performance Balance switch for 8% to 9% improvement in truck fuel consumption

Lowered engine speed projects at 5 mines result in a 3% to 6% improvement in fuel economy

Partnered with Komatsu & GE to improve efficiency of mine trucks 6 to 7% without any loss of productivity using 6-Sigma

Worked with NACCO Material Handling (Yale & Hyster) to improve efficiency of forklifts and container handlers they produce avoiding 28,000 MT of CO₂

Modified engine installation in Daewoo buses for a projected 2,000 MT reduction in CO₂

Refined engine installation for a improvement 3% in LiuGong excavators

Launched a global PowerSpec tool for 3.5% to 5% efficiency improvement for trucks

Using PowerSpec vehicle/engine parameter optimization tool to improve efficiency of customers’ trucks on average 5%
Examples of Global Fuel Efficiency / \(\text{CO}_2\) Initiatives

These are voluntary efforts with specific customers.

What policies can be put in place to drive this type of improvement more generally into the market?
Nerdy factoid of the day … (:D)

HOW BIG IS A TON OF CO$_2$?
4.2

Tractor

Trailers

Full!
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- **Automation**

- **Cummins**
For example: Driver Assist / Platooning

How will freight transport rebalance across modes?
How do other considerations, like vehicle cooling and differential fuel consumption depending on placement in the platoon, affect implementation?
The Correct Answer is: “All of the Above”
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