Heavy-Duty Automotive Trends and Outlook

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Cummins Inc.

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Net gain of 200,000 people per day!
Growing Need for Resources

*In 15 years...*

- **30%** MORE ENERGY
- **55%** MORE MATERIAL EXTRACTION
- **40%** MORE FRESH WATER
- **50%** MORE FOOD

Source: KPMG “Future State 2030”
Environmental & Economic Megatrends

Economic Driving Forces
- Population Growth
- Urbanization
- Wealth

Eco-enablers
- Energy and Fuel
- Material Resources
- Water
- Food

Increases in economic forces strain natural resources
Material resources enable economic forces to grow
Global sustainability depends on successfully managing the interactions

Environmental Impacts – Realized Or Avoided
Ecosystem Decline  Climate Change  Deforestation

Source: KPMG Expect the Unexpected: Building business value in a changing world
Cummins Legacy and Core Values

“…we believe that our survival in the very long run is as dependent upon responsible citizenship in our communities and in the society, as it is in responsible technological, financial and production performance.”

-- J. Irwin Miller
Former Chairman and CEO
1972
Cummins Global Presence

- 190+ Countries and territories
- 1919 Founded & headquartered in Columbus, Indiana
- 55,000 Employees worldwide
- 154 Fortune 500 rank
- 4 Business units & global power leader
- 6 continents
Cummins and the Environment

“WE DEMAND THAT EVERYTHING WE DO LEADS TO A CLEANER, HEALTHIER AND SAFER ENVIRONMENT”

- Set environmental direction for the company everywhere we have an impact
- Integrate environmental impact into business decisions and processes
- Drive compliance and accountability to environmental requirements
- Inspire individual employee environmental responsibility
Envolve Cummins
Making people's lives better.

70% of the environmental impacts of a product are determined in the design phase.

88% of Cummins' water use is from raw material extraction.

74% of Cummins' waste comes from raw materials and processing.

99% of Cummins' GHG footprint from products in use.

85% less energy used by remanufacturing.

Reducing our carbon footprint.
Using fewer natural resources.
Partnering to solve complex problems.
**Envolve Cummins Priorities**

**FOCUS**

- Reducing our carbon footprint.
  - New product fuel efficiency • facility GHG reduction • renewable energy • products-in-use fuel efficiency • logistics • remanufacturing

- Using fewer natural resources.
  - Water reduction and neutrality • increased recycling • zero disposal • materials efficiency • packaging • advanced manufacturing

- Partnering to solve complex problems.
  - Supplier and community collaboration • new technologies • metals and water availability • ngo’s • governments
Customers and Environmental Success

**Rio Tinto - Customer Improvements**
- Fuel Use: 4%, 10M Liters Annually
- CO₂/Yr: 27,000 MT
- Savings: $14.2M Annually

<table>
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<th>Actual</th>
<th>Goal</th>
<th>Cumulative</th>
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<td></td>
<td>million gallons</td>
<td>million USD</td>
<td>million metric tons (MMT)</td>
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Equivalent cars off the road for a year by 2020
Major Heavy-Duty Automotive Trends

- Emissions Reductions
- Compliance & Enforcement
- Future of Fuels
- GHG / Fuel Efficiency Standards
- Data & Connectivity
Emissions Reductions

LOWER NOx

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<th>Year</th>
<th>NOx / NOx+HC (g/HP-hr)</th>
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<tr>
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500 PPM Sulfur Diesel Fuel

15 PPM ULSD Diesel Fuel

Target: 90% further reduction in NOx
Emission Reductions
GLOBAL HEAVY-DUTY ON-HIGHWAY REGULATIONS
Emission Reductions
DIVERSE COMMERCIAL VEHICLE APPLICATIONS
Compliance and Enforcement

IN-USE TESTING

“Rolling Coal” is tampering

Light-duty chassis-dyno testing (lab)

Heavy-duty in-use testing (PEMS)

Light-duty in-use testing (PEMS)
Compliance and Enforcement

ENGINE AND ELECTRONICS GROWTH

Sensors

Actuators

Pressure

Temperature

Position

Chemical

Exhaust Aftertreatment

Exhaust Aftertreatment
Data and Connectivity

DRIVER ASSIST / PLATOONING

Daimler autonomous platoon demo March 2016
Greenhouse Gas & Fuel Economy

COMMERCIAL VEHICLE APPROACH

- **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
Greenhouse Gas & Fuel Economy

STAKEHOLDER COLLABORATION

The Art Of The Possible

May 21, 2010
August 9, 2011
2013

75% Fuel economy improvement
Greenhouse Gas & Fuel Economy
WASTE HEAT RECOVERY
Greenhouse Gas & Fuel Economy
WASTE HEAT RECOVERY
Future of Fuels
CURRENT VIABILITY

California air regulators readopt fuel standard to fight climate change
The Power to be Part of the Solution

Fueled by 54,000 employees and meaningful public policy and stakeholder engagement.