TACA 2014 Product and EPA Regulatory Overview

Presented by
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Agenda

- 2014 GHG reduction regulations initiative
- History of rules and technologies
- Who is impacted
- Technology explained
- Natural Gas and it’s future in the market
GHG Reduction and Fuel efficiency Rule

- In August 2011, EPA and NHTSA announced first ever national fuel efficiency and GHG standard standards
- Many/most truck and engine builders ready in 2013
- Chassis, engines, and tires play a role in compliance
- Reduction of GHG = improvement in mpg!

Stated Goal of GHG Proposal

- 20% reduction of CO₂ by 2018
- Cut 500 million barrels of oil
- Cut $34 billion in fuel costs
- Cut CO₂ by 250 million metric tons
Emissions Review and Look to the Future

Review

- Since the 1990’s the emphasis has been the reduction of Particulate Matter (PM) and NOx produced by On-highway engines
- 2002 Introduced Exhaust Gas Recirculation (EGR) for 2.5 Nox
- 2007 Introduced Diesel Particulate filters (DPF), and Diesel Oxidation Catalyst (DOC), and continued EGR for 1.3 Nox
- The emissions journey was often at the expense of fuel economy and a learning curve for fleets and their drivers
- 2010 On-highway engines introduced SCR/DEF by majority of engine builders and emissions are near zero at .20 Nox & .01 PM
- 2014 standard is unchanged for Nox/PM but focuses on reduction of (GHG) and improve fuel efficiency with SCR/DEF technology for all engines
Who is impacted?

- All tractor manufacturer will certify the vehicle for aerodynamics, roof height, weight reduction, tires, idling and speed limiters (3%-15% reduction in GHG by 2014 depending on application of the truck)

- The chassis manufacturer will certify the vehicle for tires only

- The engine manufacturer will certify the engine for NOx, PM and CO₂ (and N₂O and CH₄)
Combination Tractor Simulation

Component Test

Rolling Resistance

Vehicle Speed Limiter (VSL)

Automatic Engine Shutdown (AES)

Controls Settings

Weight Reduction Methods

Aerodynamic Cd

Vehicle Model

Weight Reduction

CO₂ (g/ton*mile)
Tractor Compliance – Engine Features

Controls Settings

Vehicle Speed Limiter (VSL)

- Vehicle credit for speed limit < 65 mph
- Provisions for adjustable and “soft top” limits

Automatic Engine Shutdown (AES)

- Class 8 sleeper cabs only
- Vehicle credit for automatic shutdown within 5 minutes
- Delays allowed under certain conditions (e.g., PTO operation)
Vocational Vehicle Simulation

Component Test

Rolling Resistance

Vehicle Model

CO$_2$ (g/ton*mile)
Engine Standards

- Engines are completely separate from vehicle standards

- Utilize existing regulatory provisions to certify the engine as done today for NOx and PM

- Industry baseline in 2010

- Different standards for:
  - Heavy-duty and Medium-duty Tractor and Vocational engines

- CO₂ Limits: range of 3% in 2014 to 9% total in 2017 over 2010 baseline
  - N₂O and CH₄ Limits
Typical SCR/DEF After treatment configuration

- Selective Catalytic Reduction (SCR) Catalyst
- Decomposition Reactor
- Diesel Exhaust Fluid (DEF) Dosing Valve
- Particulate Filter
Aftertreatment System

Cummins Particulate Filter
- PM Filter
  - ENGINE-OUT
  - TAIL-PIPE OUT
  - PM
  - 0.01

Selective Catalytic Reduction (SCR) Catalyst
- EGR
- ENGINE-OUT
- SCR
- TAIL-PIPE OUT
- NOx
  - 0.2
2013 HD System Architecture

**Improved Heat Retention**

1. More stringent downpipe and added ancillary tubing temperature drop requirements
2. Internal DOC/DPF & SCR insulation
3. External DOC/DPF & SCR body insulation
Diesel Exhaust Fluid (DEF) explained

- Diesel Exhaust Fluid is 32.5% strength urea to 67.5% water solution with high purity requirements.
- It is stored in a separate tank on the truck installed by the OEM.
- **Water purity**: ISO grade 3, produced for example by single distillation, de-ionization, ultra-filtration or reverse osmosis.
- Agricultural grade urea different from Automotive grade urea
The 32.5% wt urea water solution provides the lowest freezing point while also maintaining the solution in constant phase.

- Urea and water freeze together at 11°F so the frozen solution has the same 32.5% wt.
- When thawed, it will remain at the same concentration of urea solution feeding the SCR system.

What happens at different concentrations of Urea:

- Greater concentrations → Urea freezes before water
- Reduced concentrations → Water freezes before Urea
DEF Properties

- Non-toxic and non-flammable.
- Safe to handle and store.
- DEF is non caustic and non toxic.
- The product is slightly alkaline with a pH of approximately 9.0. (same as baking soda)
- Water is considered neutral PH @ 7.0
With extrapolation, the storage viability for DEF stored at constant temp of 86F is over 1 year.

DEF stored @ 95F constant temp is still viable at just over 200 days.

DEF stored at non extreme temperature is not an issue.
How Much DEF Will I Use?

- Approximately 3% DEF consumption

Every 50 gallons of fuel = 1.5 gallon of DEF
On-Board Diagnostics (OBD)

Vehicle System Monitors
- Cooling system
- Vehicle sensors, actuators, switches, malfunction-indicator lamp

Engine Monitors – Emission Thresholds
- Fuel system
- EGR/air handling systems
- Sensors & actuators, lamps, switches …

Aftertreatment Monitors – Emission Thresholds
- Diesel Particulate Filter (DPF)
- Selective Catalytic Reduction (SCR)
- DEF Tank

Service Information Requirements
- Service tools
  - 3rd party
- Ease of repair

MIL Lamp

ECM
- Monitors/algorithms
- Fault recording
2010 Aftertreatment Dash Lamps

- **HEST Lamp**
  - High Exhaust Temperature

- **DPF Lamp**
  - Diesel Particulate Filter

- **Diesel Exhaust Fluid Lamp**
  - Low level warning

- **MIL Lamp**
  - Malfunction Indicator Lamp
  - OBD (On-board Diagnostics)
  - Emissions non-compliance indication
Natural Gas for vocational market

- Gaining traction nationwide
- Infrastructure growing very quickly
- Municipalities are some of the front runners
- Money is available for incremental cost of vehicle & fueling sites
- HP/torque very comparable to Diesel power
- Cost of fuel extremely cheap compared to Diesel
- Uses EGR & 3way catalyst vs. DPF/DOC (no regen)
Summary

- 2014 standards effective in 2014, but most OEM & engine mfg. are ready one year early
- New standards for GHG reduction and improved fuel economy will continue through 2018
- 2013 engines will see OBD, SCR, DEF technology across the board
- **2013 engines will see better fuel economy than 2012**
- 2013 engines see more reliability/uptime due to 6 yrs. aftertreatment experience
- Natural Gas here to stay
Thank you for your time!

Questions?

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