Medium & Heavy Duty Fuel Efficiency and GHG Emission Standards:

Phase 1 Summary and Looking Ahead to Phase 2

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NHTSA Background

• The National Highway Traffic Safety Administration (NHTSA)
  – Agency within the Department of Transportation
  – Responsible for on road vehicle safety and fuel economy standards

• Authority and direction for fuel economy standards from Congress
  – Energy Policy and Conservation Act (EPCA) of 1975

• Fuel Efficiency Related Standards
  – Corporate Average Fuel Economy standards for passenger cars, light trucks and medium-duty passenger vehicles
  – Fuel Efficiency standards for medium- and heavy-duty on road vehicles
  – Some content on light duty vehicle fuel economy labels
  – Consumer information for alternative fuel vehicle
    • Badging
    • Fuel compartment labeling
    • Owner’s manual information on the capability and benefits of using alternative fuels.
Mission of OTAQ

• Address Pollution from All Transportation Sources
  – Vehicles, Engines, Fuels

• All Emissions
  – Conventional (urban smog) and CO$_2$ and other greenhouse gases (climate protection)

• Operate the National Vehicle and Fuel Emissions Lab
  – Ann Arbor, MI
  – Conduct official government certification and fuel consumption testing
  – Test procedure development and technology evaluation

• Utilize a combination of approaches to fulfill mission
  – Mandatory performance-based standards
  – Partnership incentive-based programs
Topics

- Medium & Heavy Duty Fuel Efficiency and GHG Emission Standards:
  - MDHD Energy Use & Emissions
  - Phase 1
    - Regulatory overview
  - Phase 2
    - NHTSA research
    - EPA research
  - Other
    - NAS study

Phase 1
- Model Years 2014-2018/19

Phase 2
- Beyond Model Year 2018+
Transportation Related Energy Use in 2010

Source: Annual Energy Outlook 2012 (U.S. Energy Information Administration)
MD/HD Sector Emissions in 2010

Transportation Related Greenhouse Gas Emissions (Tg CO2eq) in 2010

- Light-Duty Vehicles: 62%
- Heavy-Duty Trucks and Buses: 23%
- Aircraft: 8%
- Ships and Boats: 3%
- Rail: 3%
- Other (Motorcycles, Pipelines, Lubricants): 2%

MD/HD Phase 1 – Highlights

- First ever Medium- & Heavy-Duty Standards
- Will reduce fuel consumption, CO2 emissions, and operating costs for thousands of businesses
- Allows manufacturers to produce a single fleet of vehicles to meet requirement

- 530 million barrels less oil
- 270 MMT lower GHGs
- $50 billion in fuel savings
- $49 billion in net benefits
Phase 1 – Timing

- NHTSA standards are mandatory beginning in MY 2016
  - Voluntary early compliance MY 2014 & 2015

- EPA standards are mandatory beginning in MY 2014

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Phase 1 – Vehicles Covered

- All on-highway vehicles that are not regulated by CAFE standards.
- Certain small businesses will not be covered in initial phase.

CLASS 2b
8,501 to 10,000 lb

CLASS 1
6,000 lb & less

CLASS 3
10,001 to 14,000 lb

CLASS 4
14,001 to 16,000 lb

CLASS 5
16,001 to 19,500 lb

CLASS 6
19,501 to 28,000 lb

CLASS 7
26,601 to 30,000 lb

CLASS 8
33,001 lb & over

RV’s

NHTSA
www.nhtsa.gov
Phase 1 – Overview

• Divides diverse MD/HD vehicle sector into 4 distinct categories
  – Combination Tractors
  – Heavy-duty (HD) pickups and vans
  – Vocational vehicles (other trucks, buses, ambulances, etc.)
  – Engines
Phase 1 – Regulation

- NHTSA regulates fuel consumption.
  - Fuel consumption is calculated based on CO2.

- EPA regulates CO2, N2O, CH4 and HFCs.

- Both agencies offer manufacturers flexibilities including credit Averaging, Banking and Trading (ABT), among other provisions.
Class 7/8 Line Haul Tractors

- Engine standards met through same procedures as for criteria pollutants
- Tractor standards met through GEM compliance model

Technologies:
- Aerodynamic Profiles and Fairings
- Reduced rolling resistance tires
- Weight reduction
- Vehicle speed limiter
- Reduction in extended idle operation

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Final 2017 Standards (% reductions)

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Heavy-Duty Pickups & Vans

- Same basic test procedure as for light-duty vehicles
- Compliance assessed on “corporate average” basis
- Attribute = payload + towing
- Additional reduction of 2% achieved in the GHG program through A/C HFC leakage reductions

\[ \text{CO}_2 \text{ (gram/mile) and Fuel Efficiency (gal/100 miles)} \]

- \[ .75 \times (\text{Payload capacity} + 500 \text{ lb if 4wd}) + .25 \text{ towing capacity} \]

New vehicles today:
- 10% gasoline vehicles
- 15% diesel vehicles
Vocational Vehicles

• **Problem:** the wide range of vocational vehicle applications means that there are few common avenues for CO₂ and fuel consumption reductions

• **Solution:**
  – Focus on reduced tire rolling resistance and engine improvements
  – Aerodynamic drag reduction technologies are of limited value

• Allows for hybrid powertrain as a means for compliance

• The final CO₂ and fuel consumption standards will achieve reductions from 6% to 9%, depending on the size of the truck
Medium & Heavy Duty Fuel Efficiency and GHG Emission Standards:

PHASE 2
Phase 2 – Rulemaking Objectives

• Full rulemaking process consistent with applicable law with notice and opportunity for public review and comment.
• May include:
  – Regulating trailers, vocational vehicle second stage manufacturers
  – Considering additional and new technologies
  – Considering refining test procedures and the GEM vehicle simulation compliance model
  – Updating technology, economic and environmental assessments
  – Considering more stringent standards and timing
  – Considering updating flexibilities
Phase 2 – NHTSA FE Technology Research

- MD/HD Technology Study
  - Multi-year study of fuel-efficiency technologies for medium- and heavy-duty vehicles (Classes 2b-8) in the years prior to and in the Phase 2 timeframe
  - Research and survey examine sectors not regulated in Phase 1: Trailers and second-stage complete vehicles
    - Main contractor: Southwest Research Institute (SwRI)
      - Subcontractors:
        - Cost analysis: Tetra Tech, Inc. (formerly TIAX LLC)
        - Market data gathering: Frost & Sullivan
Phase 2 – NHTSA FE Technology Research

• Project Approach:
  – Conduct market research on MD-HD fuel efficiency improving technology adoption on current model year vehicles to augment baseline information
  – Use simulation modeling (GT Power, GT Drive, and Raptor) to estimate technologies that will be used for compliance with Phase 1 standards in MY 2018
  – Evaluate the effectiveness of technologies that could be used in Phase 2 using simulation modeling.
  – Evaluate the cost of technologies in the Phase 2 timeframe
Phase 2 – NHTSA FE Research Engine Technologies

- Engine down speeding (reduced cruise RPM, requires transmission tech.)
- Low Friction Engine Oil
- Engine Friction Reduction
- Fuel System Improvements
- Stop / start
- Improved SCR Conversion
- Reduced Aftertreatment Backpressure
- Turbo Efficiency Improvement - No Cost
- Air handling Improvement
- Mechanical Turbocompound
- Electric Turbocompound

- Engine Technologies
- Adv. Bottoming Cycle
- Active Controlled Combustion
- Coolant Pump
- Engine Oil & Fuel Pumps
- Substitute Electric Fans for Engine Driven Fans
- Variable Valve Timing
- Cylinder Deactivation
- Stoich GDI
- Lean Burn GDI w/ SCR
- GDI + EGR
- Engine Down sizing
- Down sizing & boosted vs. NA

**NHTSA**

[Logo]
Phase 2 – NHTSA FE Research Vehicle & Trailer Technologies

- Aero Bin III Tractor features will be baseline 2019, trailer will be added cost
- Aero Bin IV and V
- Include trailer Cd and Crr in rule
- Aero on regional haul
- Improved 2b & 3 Aerodynamics
- Improved Transmissions (more gears, higher ratio spread, shift points)
- AMT vs. Manual
- Dual Clutch vs. Manual
- Low Rolling Resistance Tires
- Single Wide Tires
- Automatic Tire Pressure Control
- Weight Reduction
- 6X2 Tractors or Clutched 6X4
- Chassis friction reduction & improved lube
- Speed limiters
- Mild hybrid
- Full Hybrid
- Plug-in Hybrid
- Full EV
- Automatic Engine Shutdown
- Diesel APU
- Battery APU
- Fuel Fired Heater
- Driver Management Features
- Driver Coaching Features
- Air Conditioner Compressor Improvements
- A/C Reduced Reheat
- Cab Insulation to Reduce A/C
- Air Compressor Improvements
- Hydraulic Pump Improvements
- Fan Power Demand Reduction
- Thermal Storage for A/C
- Shore Power
Phase 2 – NHTSA FE Research on Vehicle Drive Cycles

• Class 2b and 3
  – EPA FTP-75 City cycle
  – EPA HWFET Highway cycle
  – EPA US06
  – EPA SC03

• Class 4 – 8
  – GEM ARB Transient
  – GEM 55 MPH cruise
  – GEM 65 MPH cruise
  – One or two vocational cycles
  – Bus
  – Long haul cycles with grades for tractor-trailer only
Phase 2 – NHTSA Safety Research

- Comprehensive analysis on the need for crash worthiness standards on Class 7 and 8 property carrying commercial motor vehicles involved in interstate commerce, including an evaluation of the need for roof strength, pillar strength, air bags, and frontal and back wall standards.
  - Study prescribed by of the Moving Ahead for Progress in the 21st Century Act (MAP-21)

- Heavy Vehicle Safety:
  - Evaluate heavy truck safety data to identify the frequency, types, severities, and sources of driver injury.
  - Examining European, Japanese, and North American heavy vehicle crashworthiness standards.
  - Evaluate injury countermeasures to estimate injury mitigation potential.
  - An industry coalition of OEMs will advise regarding safety countermeasures.
  - Contractor: University of Michigan Transportation Research Institute
Phase 2 – EPA GHG Research

• Test procedure development and GEM refinement and validation studies
  – Refine and evaluate aerodynamic and powertrain test procedure approaches
  – Attempt to refine GEM to simulate actual powertrain
  – Compare test procedure and GEM results
  – Validate GEM over 120+ vehicle variant tests
  – Assess different Phase 2 combinations of certification testing and simulation

  – Program sponsor: EPA

  – EPA developing GEM refinements in-house and with contractor support
    • Main testing contractor: Southwest Research Institute (SwRI)
Later Phase – National Academies of Science Study (#2)

• Required by Energy Independence and Security Act of 2007

• Sponsored by NHTSA

• NAS MD/HD Study #1
  – Issued in 2010: “Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles”

• NAS MD/HD Study #2
  – Initiating in 2013
  – Final report expected in 2016
  – Will inform future considerations beyond Phase 2
Elements of the NAS Study #2

- Review and contrast the 2010 study with the MY 2014-2018 final rule
- Identify potential implications of, gaps in and opportunities to improve the regulatory process
- Update estimates in the 2010 study including technology cost, effectiveness, and barriers to commercial deployment
- Explore regulatory options for trailers
- Include consideration of recreational vehicles
- Contrast U.S. regulatory approach to those of other countries
- Provide baseline information on the MD/HD truck fleet, including combination tractors and trailers
For More Information

• EPA’s rulemaking documents and implementation information can be found at www.epa.gov/otaq/climate/regs-heavy-duty.htm

• NHTSA’s rulemaking documents can be found at www.nhtsa.gov/fuel-economy

• See Federal Register 76 FR 57106, September 15, 2011

• See Code of Federal Regulations, 40 CFR Parts 1036, 1037, 1065, 1066; and 49 CFR Parts 523, 534, 535