Overview

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Timeline of HD GHG Phase 1 and 2


- September 2011 - Final Rule for Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles


- October 2016 - Final Rule for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2
HD Vehicle Baselines

• All of our baselines go through Notice and Comment and we actively seek additional information to develop appropriate baselines

• For each subcategory of vehicles, EPA developed a theoretical vehicle configuration to determine the baseline
  ◦ 10 Tractor subcategories: such as Class 8 high roof sleeper cab, Class 7 low roof day cab, etc.
  ◦ 18 Vocational subcategories: such as Class 2b-5 Regional with gasoline engine, Class 6-7 Urban, Class 8 Multi-purpose with diesel engine, etc.
  ◦ 7 Trailer subcategories: such as Long van full aero, Long van, partial aero, non-box, etc.

• A baseline tractor configuration included the GEM inputs listed on the next slide, whereas the baselines for vocational vehicles and trailers included a subset of the GEM inputs
GEM Tractor Inputs

- Coefficient of Drag
- Steer Tire Rolling Resistance
- Drive Tire Rolling Resistance
- Vehicle Speed Limiter
- Vehicle Weight Reduction
- Extended Idle Reduction

- Engine Data
  - Torque Curve
  - Motoring Curve
  - Fuel Maps

- Transmission Data
  - Gear Ratios
  - Power Loss Map

- Tire Size

- Axle Data
  - Configuration (4x2, 6x4, etc)
  - Ratio
  - Power Loss Map(s)

- Neutral-Idle
- Accessory Load
- Tire Pressure System

HD GHG Phase 1 Inputs in Green
Accuracy of the Baseline Values

The necessary accuracy of a baseline value is dependent on the value’s effect on the vehicle’s overall performance

- Aerodynamics and tire rolling resistance have a significant impact on CO₂ emissions
- On the other hand, it takes 1,000 pound weight reduction on tractors to reduce the fuel consumption and CO₂ emissions by approximately 1% based on simulations conducted in Phase 2 GEM

Figure 2-23 Aerodynamic Impact on Tractor CO₂ Emissions based on Phase 2 GEM Simulations

Figure 2-24 Impact of the Coefficient of Rolling Resistance (CRR) on Fuel Consumption based on Phase 2
HD GHG Phase 1 Vehicle Baselines

• The Phase 1 baseline represented our best estimate of the average vehicle in the market in 2010

• Coefficient of drag baseline
  • Based on coastdown testing of 8 tractors and information on the number of tractors meeting EPA’s voluntary Smartway standards
  • For High-Roof Tractors the baseline was set at Bin II (7.1-7.9 m²)

• Tire rolling resistance
  • Conducted tire rolling resistance testing of 156 tires
  • For all tractor subcategories the baseline was set by sales weighted the top three tire manufacturers

• Automatic Engine Shutdown:
  • 0% due to the requirement that they could not be overwritten (had to be locked) and this was not available in the market at that time.

• Vehicle Speed Limiters: EPA did not consider this technology in setting the standards because of the complexity of the impact on logistics and whether this would require additional trucks on the road.

• Weight reduction: EPA did not have data to determine the penetration of weight reduction components and the impact is VERY small, so we set the baseline to zero penetration.
HD GHG Phase 2 Vehicle Baselines

• For each subcategory of vehicles, EPA developed a theoretical vehicle configuration that represented an average 2017 MY vehicle that met the Phase 1 standards.
  • In general, where there were corresponding parameters in the Phase 1 program, we used the same values used to determine the Phase 1 2017 MY standards.
  • Where there were not equivalent Phase 1 parameters, we conducted research using industry information, including Confidential Business Information, to develop a representative baseline.

• Additional information for each vehicle segment can be found in the preamble to the final rule and in the Final Regulatory Impact Analysis
Aerodynamic Test Procedures

• Test procedures have a direct impact on the aerodynamic coefficient of drag area (CdA)
  ◦ Coastdown testing, wind tunnel measurements, and computational fluid dynamic modeling of the aerodynamic performance from each method produces a different CdA for a given vehicle
  ◦ The wind speed and direction also impact the CdA value
  ◦ The accounting of non-aero losses also can impact CdA values determined through coastdown testing
  ◦ The final baseline aero performance could not be determined until a primary aerodynamic test method was selected and the associated test procedure details were final

• EPA conducted aero testing for both Phase 1 and Phase 2 to both establish a baseline and to develop and refine aero test procedures

• Aero testing of a typical tractor from each of the manufacturers was conducted to establish the aero bin values

• The technologies on the tractors helped differentiate between Bin III and Bin IV. For example, Bin III includes “SmartWay” technologies such as fuel tank fairings as chassis fairings.
Phase 2 Aerodynamic Test Results

Figure 3-17 High Roof Sleeper Cab Phase 2 Results and Bin Boundaries

Figure 3-18 High Roof Day Cab Phase 2 Results and Bin Boundaries
Aerodynamic Baseline

• The baseline aerodynamic CdA value is a combination of adoption rates of aerodynamic bins and the CdA level that represents a specific bin

• The baseline CdA value is different for each type of tractor subcategory (low/mid/high roof, sleeper/day cab) due to the operational needs of various types of tractors and the degree of aero development taken on by the manufacturers
  ◦ For example, high roof sleeper cabs typically are used on the highway and typically pull a box trailers so this subcategory leads the aero development of tractors

• The Phase 2 aero baseline consisted of the adoption rates of each bin used to determine the Phase 1 MY 2017 standards and the revised CdA level of each bin using the Phase 2 aero test procedures
Tire Rolling Resistance

- We selected the ISO 28580 test procedure for determining rolling resistance
  - The rolling resistance levels differ from the values using SAE J1269
- There is a large variation in the performance of tires used in the market today
- The Phase 2 baseline was determined using the adoption rates of the tire rolling resistance levels used to determine the Phase 1 2017 MY standards.
Engine Baseline

• Created using proprietary data from manufacturers, primarily from steady-state operating points

• Fuel maps were fine tuned to align with Phase 1 2017 MY FTP and RMC engine standards

• The transient cycle average maps were then created using GEM and a 1.05 multiplier to account for the effect of transient operation on fueling consumption

• Three tractor baseline engines were created to cover all ten subcategories (350 HP, 455 HP, and 600 HP)

Figure 2-18 2018 Baseline Engine Fuel Map used in GEM for a 455 Hp Rating
Automatic Engine Shutdown Baseline

• Based on the certification data, no manufacturers were using the tamper-proof AESS in Phase 1.

• Therefore, the Phase 2 AESS baseline was developed based on market adoption rate information from the North American Council on Freight Efficiency (NACFE) Confidence Report and comments we received from the Phase 2 NPRM
  ◦ NACFE found that 96% of trucks had an adjustable AESS and 9% of trucks had an APU
  ◦ Our baseline included 9% APU with adjustable AESS and 87% with only an adjustable AESS
Questions?