HD GHG Vehicle Baselines

APRIL 23, 2018

Overview

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Timeline of HD GHG Phase 1 and 2

- November 2010 - Notice of Proposed Rulemaking for Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles

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

- June 2015 – Notice of Proposed Rulemaking for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2

- 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 CO_2 emissions
- On the other hand, it takes 1,000 pound weight reduction on tractors to reduce the fuel consumption and CO_2 emissions by approximately 1% based on simulations conducted in Phase 2 GEM
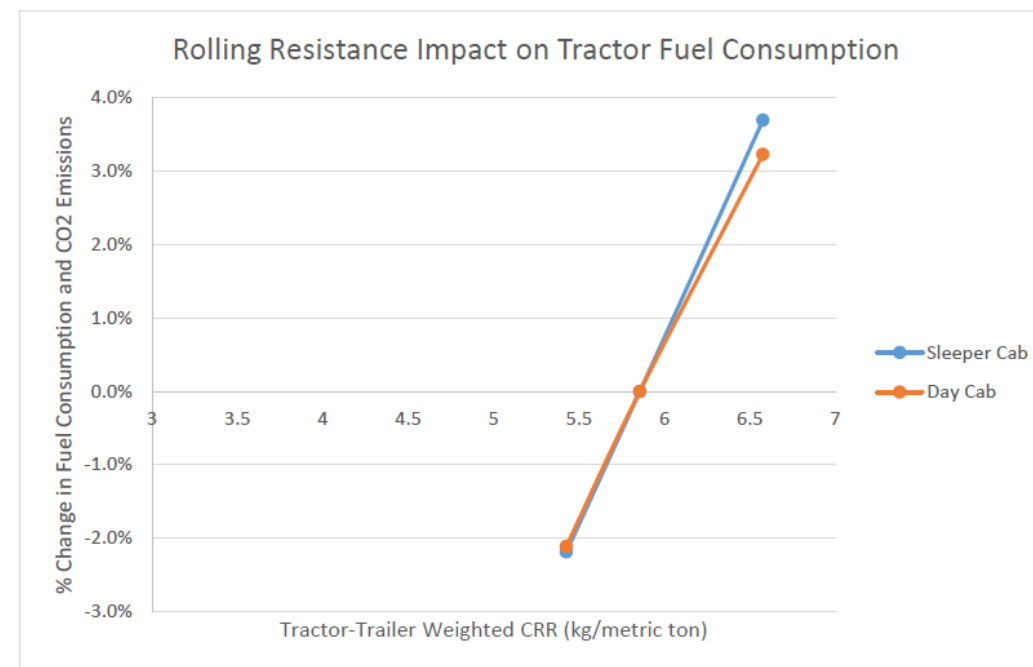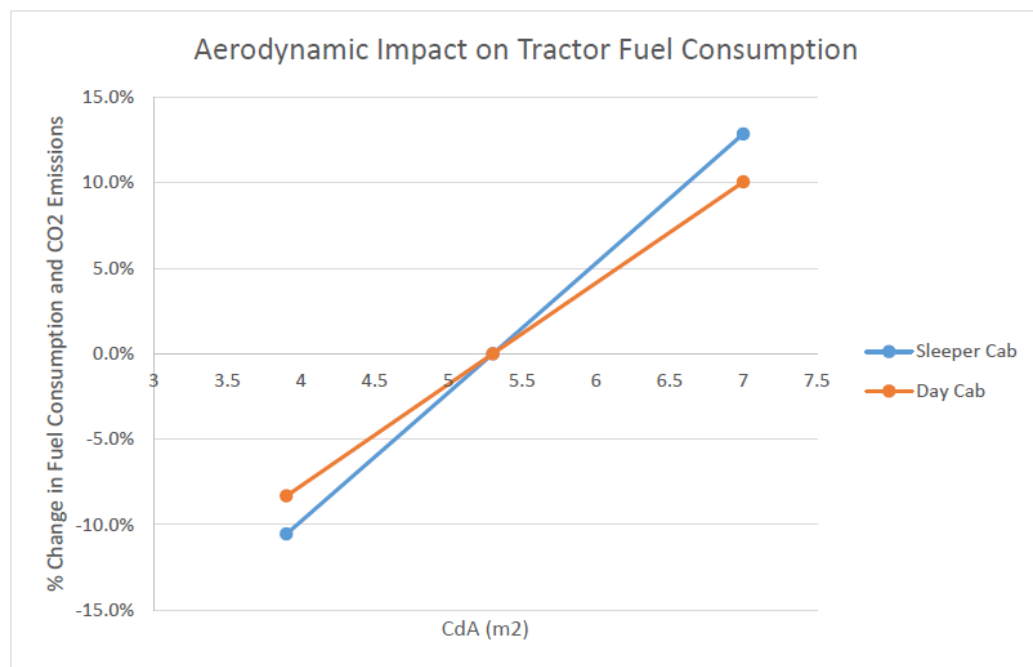

Figure 2-23 Aerodynamic Impact on Tractor CO_2 Emissions based on Phase 2 GEM Simulations

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.
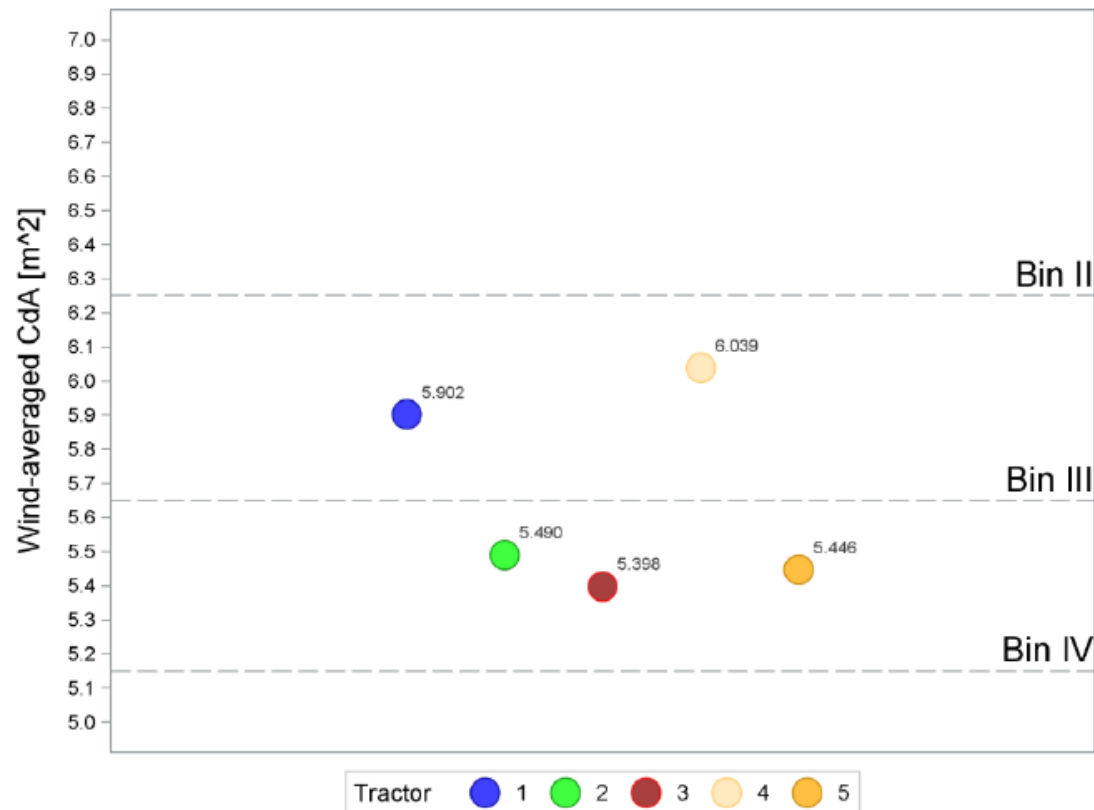
Phase 2 Aerodynamic Test Results

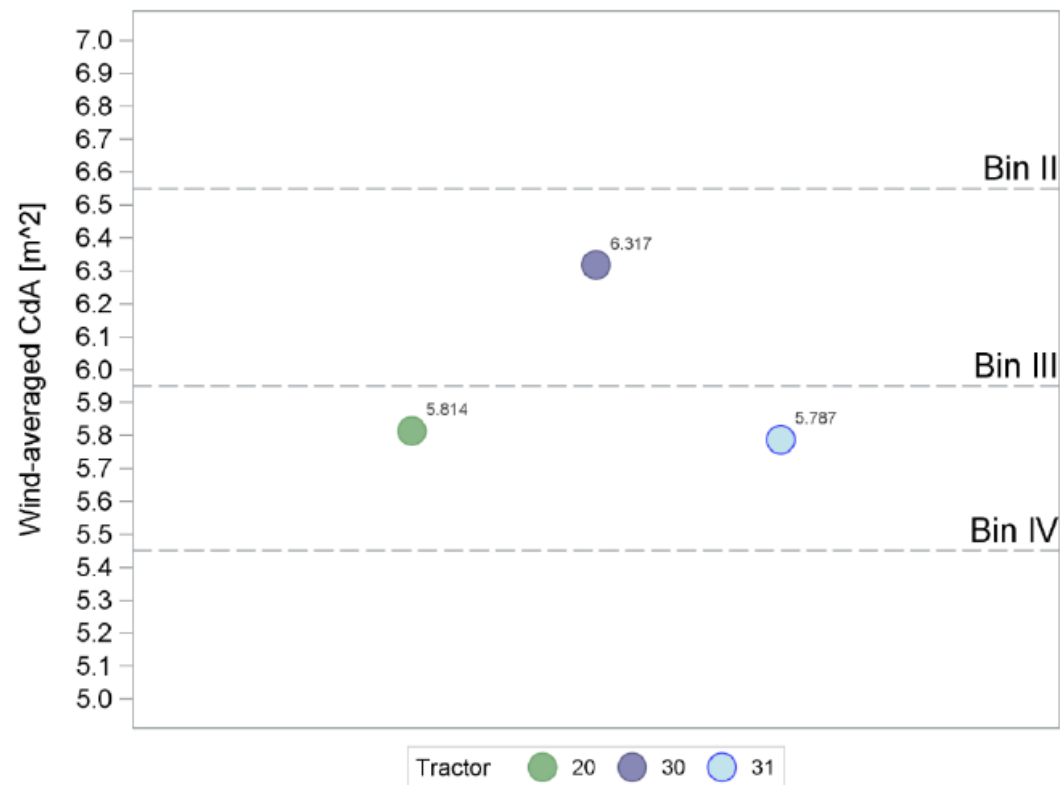Figure 3-17 High Roof Sleeper Cab Phase 2 Results and Bin Boundaries

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.
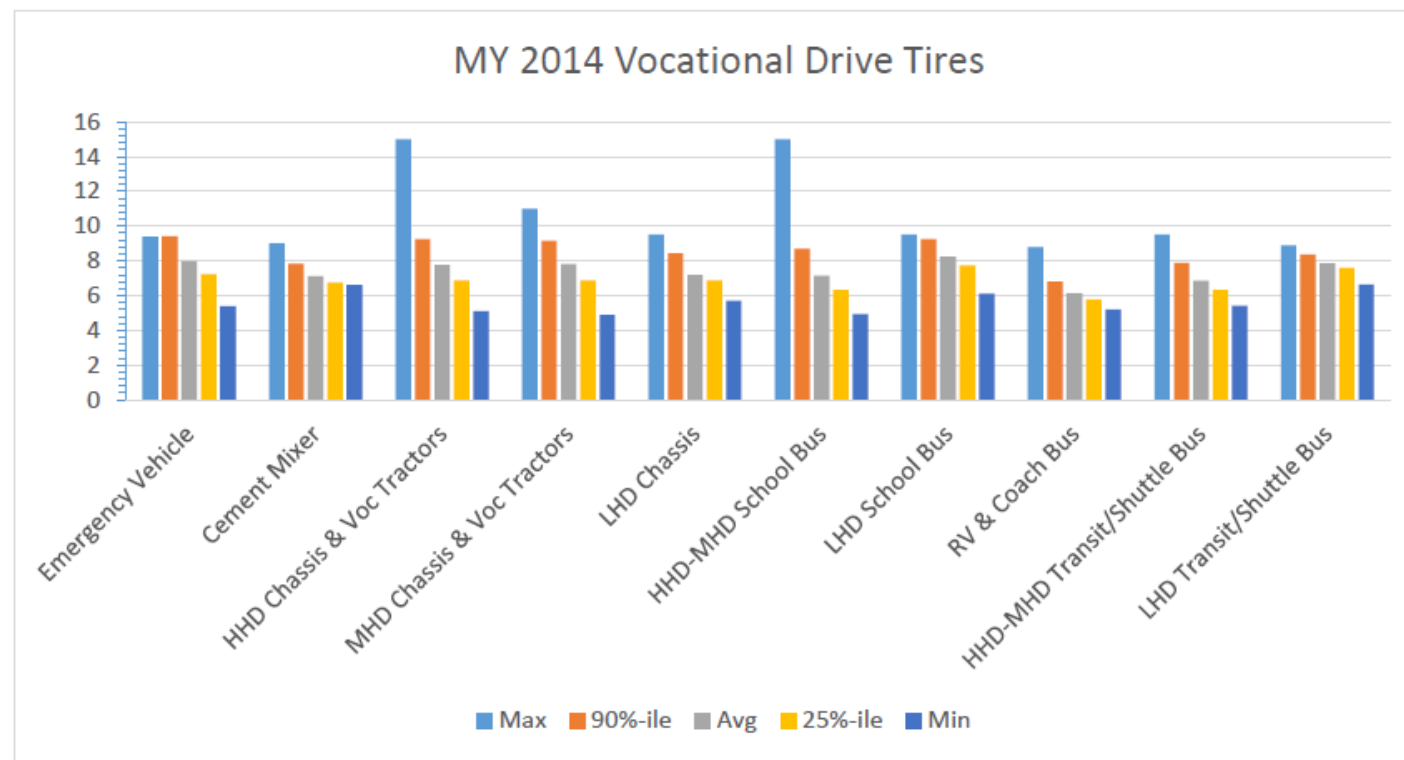

Figure 2-54 Vocational Drive Tire CRR Data Summary

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 where then created using GEM and a 1.05 multiplier to account for effect of transient operation on fueling consumption

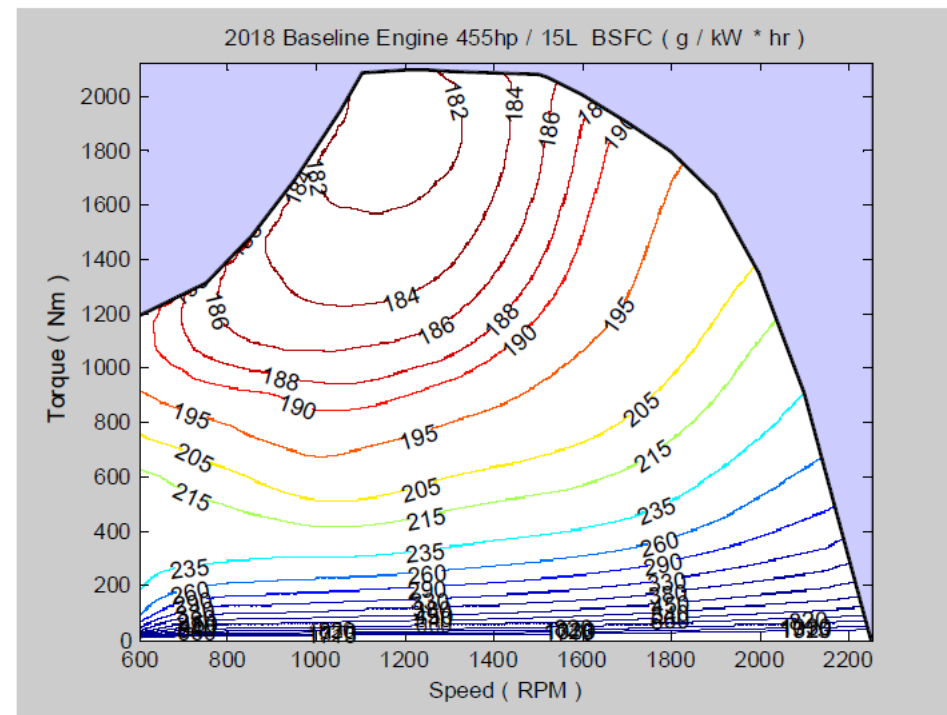- Three tractor baseline engines were created to cover all ten subcategories (350 HP, 455 HP, and 600 HP)

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?