Heavy-Duty Vehicle Fuel Efficiency Data in the United States

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Executive Summary

The first fuel efficiency and greenhouse gas standards for heavy-duty vehicles in the United States, adopted in 2011, established an approach to testing and regulating these vehicles that is essentially component-based. Capturing additional fuel efficiency opportunities in the next phase of standards will require a more integrated approach, tailored to the wide array of vehicles regulated under the standards. Detailed data on the specifications and use of heavy-duty vehicles will be essential to this undertaking. While implementation of the first phase of the standards will yield useful data on new vehicles, important gaps will remain, and the availability of much of that data to the public is uncertain. For in-use vehicles, despite several important ongoing data collection and analysis efforts, a comprehensive picture of the current heavy-duty stock in the United States is lacking.

Federal agencies (the Department of Energy (DOE), the Environmental Protection Agency (EPA), and the National Highway Traffic Safety Administration (NHTSA)) have a central role in filling the gaps in data on heavy-duty vehicles and making it available to the public. We recommend seven steps to accomplish this:

<u>In implementing the heavy-duty fuel efficiency and greenhouse gas rules in 2013–2014, EPA and NHTSA should:</u>

1. Post all data collected in rule implementation that is not Confidential Business Information on the web in a timely fashion and in a form conducive to analysis.

2. In annual compliance reports for the heavy-duty rule, report on each manufacturer's use of special provisions (e.g., early credits, alternative engine certification, advanced and innovative technology credits), application of credit carry-forward/carry-back, and credit balance.

3. Produce an annual report on trends in heavy-duty vehicle technology, carbon dioxide emissions, and fuel economy.

4. Consolidate analysis and reporting of data on heavy-duty pickups and vans with light-duty reporting.

<u>As part of the second heavy-duty fuel efficiency and GHG rule, EPA and NHTSA should:</u>

5. Expand data collection in the second phase of the program.

<u>In the FY 2015 federal budget process, DOE, EPA, and NHTSA should strive to:</u>

6. Reinstate the Vehicle Inventory and Use Survey.

7. Ensure adequate support for voluntary programs that yield data on heavy-duty vehicle operation.

I. Introduction

The first standards for fuel efficiency and greenhouse gas (GHG) emissions of heavy-duty vehicles in the United States were adopted in 2011 by the National Highway Traffic Safety Administration and the U.S. Environmental Protection Agency. The standards mark a major step toward greater fuel efficiency for trucks and buses. In the next phase of the standards, expected in 2015, the agencies have an opportunity to capture additional savings by pulling a wider array of efficiency technologies into the market and by tailoring the standards more closely to the wide array of covered vehicles and their duty cycles.

Detailed knowledge of the characteristics and usage of U.S. heavy-duty vehicles is essential to designing a sound regulatory program. Moreover, the second phase of the program should be informed by manufacturers' response to the first phase: what vehicle improvements they are making to meet the fuel efficiency targets; how their choices of efficiency technologies relate to vehicle application and duty cycle; and how they are using the flexibility provisions of the program. Finally, it will be necessary to evaluate vehicles' on-road performance, since that will be the real measure of the program's success.

Hence extensive data collection, dissemination, and analysis is essential to further work on the program. More generally, this information is also needed to understand the fuel usage and emissions characteristics of heavy-duty vehicles so that effective mitigation measures can be developed. Table 1 lists several types of data relevant to understanding properties of heavy-duty vehicles and their usage that relate to fuel efficiency.

Section II below discusses data on new engines and vehicles, addressing data collected under the first phase of the rule and the dissemination and shortcomings of that data. The focus in this section is on how data can be used to strengthen the regulatory program. In Section III, we discuss data on vehicles in use, which is also key to regulatory design. In particular, in-use data is necessary for simulation model calibration and validation. Usage characteristics of vehicles, as well as their specifications, will determine appropriate technologies and standards. Data on vehicles in use have applications to vehicle policy beyond standards as well.

Collection of data on heavy-duty vehicles is already underway in connection with rule implementation, agency research, fleet voluntary programs, and private sector activities. This paper compares these ongoing data collection efforts to data needs in order to determine what gaps exist and offers recommendations on how federal agencies could contribute to filling those gaps.

Table 1. Data Relevant to Heavy-Duty Vehicle Fuel Efficiency

Type of Data	Examples	Why Needed?
New Vehicles		
Vehicle specifications	Engine and transmission models, tires, aerodynamic features	Understand configurations of vehicles as spec'ed
Vehicle fuel efficiency	Fuel consumption over relevant drive cycles	Correlate vehicle specifications and technologies with fuel efficiency
Vehicle sales volumes	Sales by vehicle configuration	Determine prevalence of vehicle features and technologies in specific applications
Trends in fuel efficiency, vehicle specs, and technology uptake	EPA fuel economy trends report (currently light-duty only)	Understand features of new vehicle fleet as a whole, rates of technology adoption, trends in engine power
Rule Compliance		
Manufacturer average data	Fuel efficiency by manufacturers and vehicle category	Understand manufacturer-specific issues and market dynamics
Manufacturer use of credits	Credit surpluses and shortfalls; use of off-cycle credits, advanced and innovative technology credits	Calculate savings impacts of flexibilities; identify any unintended consequences
Vehicles in Use		
In-use vehicle operating characteristics	Annual miles traveled, range of operation, typical loading	Determine technology applicability
Typical duty cycles	NREL drive cycle work	Calculate technology payback
In-use fuel efficiency	VIUS, SmartWay data	Calibrate and validate simulation model; evaluate impact of standards

II. Data on New Engines and Vehicles

Model-Level Data

To certify their products under the heavy-duty rule, manufacturers group engines and vehicles into "families" of similar products and test or simulate the performance of representatives of each family. Data to be submitted are the same for the GHG and fuel efficiency rules. Manufacturers must obtain a certificate of conformity for each family of engines or vehicles to be sold. The application for the certificate of conformity requires information on engine or vehicle specifications, as well as on emissions and fuel consumption.

Heavy-duty engine criteria pollutant emissions standards and the corresponding testing and reporting protocols have been in place since model year 1988. These protocols will be applied with little change to the implementation of GHG emissions and fuel efficiency standards for engines. For each model year, EPA posts a spreadsheet showing each engine's specifications, emissions levels, and fuel consumption on the web (EPA 2013a).

For vehicle families, EPA has developed a certification template for GHG emissions and fuel efficiency reporting (EPA 2012a). Among the data required for each family are estimated production volumes and input and output files for running the Greenhouse Gas Emissions Model (GEM), which manufacturers use to calculate emissions and fuel consumption levels for each vehicle configuration. GEM inputs include information on testing and performance of aerodynamic features and tires, add-ons such as anti-idle equipment or speed limiter, and the justification for any Innovative Technology or Advanced Technology Credits claimed. For each family, manufacturers must report emissions results for at least ten configurations in the family, including those members with highest carbon dioxide (CO_2) emissions, lowest CO_2 emissions, and highest projected volumes (EPA 2012a). More detail on information needed to complete the certification template is shown in the table in the appendix.

In the case of heavy-duty pickups and vans, compliance procedures and the data submitted are very similar to what is required of light-duty vehicles.[1]

What's missing?

In general, the data collected by the agencies under the first phase of the rule is the minimum required to demonstrate compliance. As a result, certain information that is central to fuel efficiency is not collected. The standards do not account for the efficiency of all parts of the vehicle and the certified performance does not purport to represent the vehicle's actual fuel consumption. In particular, the rule requires that a vehicle's emissions be certified based not on its actual engine and transmission, but on a standard engine and transmission. Consequently, in certifying a vehicle, manufacturers are not required to identify the engine and transmission sold with the vehicle.[2] This is a hindrance to understanding the vehicle market, to determining actual fuel efficiency, and to moving toward a program based on full-vehicle performance.

A fundamental decision to be made for the second phase of the program is whether to continue to regulate the engine separately from the vehicle. One argument against doing so is that the standards would then provide no incentive to "right-size" the engine for the vehicle. Data on engine-vehicle pairs sold today would be helpful to evaluating the salience of this concern. More generally, a host of information would be required to move to a simulation-based full-vehicle test protocol. Under such a protocol, each system must either be tested to provide inputs to the model ("hardware in the loop") or be described in sufficient detail to permit it to be modeled.

In addition to the incompleteness of specification information, data submitted in the application for certificate of conformity are not sufficient to enable buyers to compare vehicles' fuel efficiency performance in a meaningful way. The certified fuel efficiency level represents performance over a single composite cycle, not over the individual cycle segments (transient operation, 55 miles per hour

[1] As in the case of criteria pollutant emissions, however, heavy-duty pickups and vans with diesel engines have the option to certify using an engine test rather than the chassis test used for gasoline vehicles. In that case, the vehicle will be treated as a vocational vehicle for compliance purposes.

[2] The proposed rule directed manufacturers to "[r]eport the volumes by vehicle configuration, and identify the transmission, axle ratio, and engine in addition to subfamily identifiers" (§1037.250), but the final rule has no such requirement.

steady-state operation, and 65 miles per hour steady-state operation). A buyer with shares of transient and highway driving that differ substantially from the agency weightings cannot compare performance on his own duty cycle based on composite cycle performance alone.

Another fundamental issue is the extent of public access to vehicle data. EPA does not consider emissions data to be Confidential Business Information (CBI), and GEM outputs therefore will not be treated as CBI. Furthermore, EPA has expressed its intention to publish as much non-CBI GHG information as possible for each manufacturer after the end of the model year (EPA 2012b). However, it is not yet clear whether all information from vehicle applications for certificates of conformity will be made available. For example, neither method used by manufacturers to determine coefficient of drag nor efficiency improvement factors attributed to advanced or innovative technologies is among the GEM outputs, and therefore their availability to the public is uncertain at this point. Timeliness of the publication of data is also uncertain. Vehicle certification data was not available on the EPA website as of July 2013, even though 46 model year 2013 vehicle families had been certified by three manufacturers as of January 2013 (Spears and Hicks 2013).

MANUFACTURER COMPLIANCE

Understanding how each manufacturer complies with the rule is also important to further rule development. Manufacturers' product ranges vary substantially, so they are affected differently by rule provisions. Manufacturers' use of flexibility provisions is also key to evaluating the efficacy of those provisions.

Manufacturer compliance requires a demonstration that vehicles or engines produced in each class meet the corresponding standard, on average. Manufacturers must file an End-of-Year Report, due 90 days after the end of the model year (and no later than April 1 of the following calendar year) and, if participating in averaging, banking, and trading (ABT), a Final Report within 270 days after the end of the model year.[3] Aside from providing the certified emission and fuel consumption levels for their products in a single document, these reports will provide family sales volume figures, which are needed to calculate a manufacturer's performance relative to the standard. Manufacturers of heavy-duty pickups and vans, like light-duty manufacturers, must submit a Pre-Model Year Report as well as an End-of-Year Report. Both reports will show: vehicle configurations and their expected or actual production volumes; fleet average performance, based on production volumes; approvals for innovative technologies; and planned use of credits (EPA 2011b).

Each manufacturer must also complete an Averaging, Banking and Trading Report for the model year. These reports include the family-by-family information required to calculate credit status for each vehicle and engine category for that manufacturer, including alternative standards applied and Advanced Technology Benefit Factors. Data on credit trading is required as well (Spears and Hicks

[3] A requirement that all manufacturers submit final reports, whether or not they participate in ABT, was eliminated in technical amendments to the rule (EPA and NHTSA 2013).

2013). Availability of manufacturer End-of-Year and ABT Reports to the public is unknown at this point.[4]

The agencies will create an account of all manufacturers' compliance status at the end of each year. This report will be available to the public and would contain average emissions and fuel efficiency information by class for each manufacturer, as well as manufacturers' credit balances (NHTSA 2013). The importance of having access to manufacturer reports will depend upon the level of detail provided in the agency report and the timing of that report.

New Vehicle Population As a Whole

The information submitted in connection with vehicle certification and manufacturer compliance verification constitutes a rich source of data on heavy-duty vehicles that could permit analysis of a wide range of issues relating to their fuel efficiency. An annual, queryable, and publicly available database including vehicle specifications, technological features, emissions and fuel efficiency performance, and sales would best serve this purpose.[5] NHTSA supplies such a database for light-duty vehicles upon request.

Another very useful agency publication for light-duty vehicles is EPA's annual *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends*. The report provides each manufacturer's average fuel efficiency by vehicle class, showing both test and adjusted (i.e., approximating real-world) fuel economy values. The report also shows trends in vehicle weight, power, and use of technologies, among other parameters.

In the Response to Comments on the proposed heavy-duty rule, the agencies stated that they "will make every effort to publish [a trends] report on a frequent basis. However, until the practical aspects of the implementation of this rule are fully understood and appropriate resource constraints have been satisfied, we cannot commit to publishing such a report on an annual basis" (EPA 2011a). Plans for the content and format of this report have not been announced. Given the vast array of vehicle configurations, careful attention to the format of the report is essential.

To the extent that data from manufacturers' individual applications for certificates of conformity or End-of-Year/Final Reports are unavailable to the public, or the agencies' annual report on compliance is lacking in detail, the trends report becomes all the more critical. If manufacturers have valid CBI concerns about any of this data, then the trends report can provide insights on the issues associated with those data without compromising CBI.

Thus the heavy-duty trends report will serve two essential purposes: first, it will present the agencies' analysis of vehicle, technology, and manufacturer trends as they affect the fuel efficiency and GHG

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[4] For the light-duty Corporate Average Fuel Economy (CAFE) program, NHTSA has historically made available manufacturer pre- and post-model year reports, although at least one manufacturer has claimed such reports are CBI long after the end of the model year.

[5] The utility of the database will be limited I the first phase of the program, however, because the agencies will not be able to match engine and transmission specifications with vehicle specifications.

emissions of the heavy-duty fleet; and second, it is the means of presenting any information not provided in the database or other reports in the most complete form that is consistent with valid CBI concerns.

III. Data on Vehicles in Use

Understanding the usage and performance of the heavy-duty vehicles on the road is essential to both setting informed policy and evaluating the effects of those policies.

Survey Data

There is currently no up-to-data census of the heavy-duty truck population of the United States. The Vehicle Inventory and Use Survey (VIUS), formerly conducted by the Census Bureau at five-year intervals, was discontinued due to budgetary constraints after the 2002 survey. VIUS reported both specifications and operational characteristics of the U.S. truck population. Hence data on truck parameters such as miles traveled, age, on-road fuel efficiency, materials carried, trailer type, and application of efficiency technology is now more than a decade old. It is widely recognized that reinstating the VIUS or similar data collection effort for trucks is important to many stakeholders. (See, for example, EIA 2009.) There have been multiple calls to restart or replace the VIUS and multiple efforts to do so. Most recently, a new VIUS was included in the administration's 2012 DOT budget proposal (DOT 2011).

VIUS data has been a source for federal government publications and analysis of heavy-duty vehicle energy use, such as DOE's *Transportation Energy Data Book* and the National Energy Modeling System (NEMS) of the Energy Information Administration (EIA). In preparing the *2013 Annual Energy Outlook*, EIA supplemented data from the 2002 VIUS with truck registration data from R.L. Polk & Co. (EIA 2013). The Polk data, which EIA used to derive vehicle vintage distribution and scrappage rates, is proprietary and therefore not a substitute for a public database.

The company Frost & Sullivan is conducting a survey of heavy-duty vehicles of model years 2010 and newer as part of a NHTSA contract in support of the development of the second phase of the heavy-duty rule. The survey seeks to gain an understanding of the performance of 2010–2012 (pre-regulation) vehicles and technology penetration in this population (Reinhart 2013). However, this data will describe fleet vehicles only, and it is unclear whether it will be made available to the public.

Valuable heavy-duty data may be generated by other activities as well. Regarding the need for publicly available data on in-use vehicles as part of further program development, EPA stated: "The agencies recognize the need for the inclusion of a broad data set for developing both the test protocols and procedures for whole vehicle testing and modeling and so the agencies will rely upon data made available to it through various in-house and manufacturer run in-use programs. To the extent data may be made available publicly, the agencies will pursue a transparent pathway to data sharing." Further: "The agencies agree that there is a need for sharing heavy-duty emissions and fuel consumption information and therefore will make information publically available under this program" (EPA 2011b). The existence of any efforts along these lines is not apparent to date, however.

DATA FROM VOLUNTARY PROGRAMS

Partners in EPA's SmartWay Program submit data on emissions from their transportation operations. SmartWay partners include thousands of carrier fleets, for which EPA releases annual emissions rates for each of thirteen truck categories. Among the data provided are grams carbon dioxide per mile and grams carbon dioxide per ton-mile for each fleet in each category (EPA 2013b). This data is a potential source of information for: determining the range of fuel efficiency performance for fleets of trucks of a given type; comparing average fuel efficiency performance for vehicles of a given type to the standard for the corresponding regulatory class; and comparing fuel efficiency performance across vehicle types to determine consistency with assumptions underlying the standards. EPA has also posted aggregate data from SmartWay partners on such parameters as average payload, percentage empty miles, and percent capacity volume utilization for each truck type or class (EPA 2013c). While this information provides valuable insights into important fleet parameters, SmartWay partners' trucks cannot be assumed to perform at the same average level as the U.S. truck stock as a whole.

The National Renewable Energy Laboratory (NREL) collects detailed drive cycle data for its Fleet DNA program from participating commercial fleets of various heavy-duty vehicle types. After removing any information identifying the contributor, NREL posts the data electronically for public use to support better understanding of usage patterns of vehicles in a variety of vocations (NREL 2013). The validity of cycles generated from Fleet DNA data depends upon this data being representative of vehicles in use. In the case of Class 8 trucks, the program showed data for only 28 vehicles as of July 2013. The program is relatively new, however, and fleet participation could grow rapidly.

NREL also has developed DRIVE (Drive-Cycle Rapid Investigation, Visualization, and Evaluation), a software tool that generates representative drive cycles from large quantities of on-road vehicle drive cycle data. Having representative drive cycles allows evaluation of technologies to determine their efficacy in reducing fuel consumption and emissions for a given vehicle type in a given application. These resources should prove valuable for developing test cycles, projecting savings from individual technologies, and analyzing the variation of fuel efficiency with changes in test cycle.

IV. Conclusions and Recommendations to Federal Agencies

Extensive data collection is now underway, and more will be done as implementation of the heavy-duty fuel efficiency and greenhouse gas rule progresses. Major gaps remain, however, including data on the powertrains of new vehicles, fuel efficiency performance of actual vehicle configurations sold, and comprehensive survey data on the U.S. vehicle stock. In addition, there is considerable uncertainty regarding the form and extent of data dissemination to the public.

Federal agencies have a central role in filling the gaps in this data and making it available to the public. Seven recommendations for accomplishing this follow. These are divided into three groups, calling for action: 1) during implementation of the first heavy-duty standards, and prior to promulgation of the second phase of the program; 2) in the development of the rule for the second phase of the program; and 3) in the FY 2015 federal budget process. The recommendations in the first

two groups are directed to EPA and NHTSA. The recommendations in the third group are directed to DOE, EPA, and NHTSA.

In implementing the heavy-duty fuel efficiency and greenhouse gas rules in 2013–2014, EPA and NHTSA should:

1. Post all data collected in rule implementation that is not Confidential Business Information on the web in a timely fashion and in a form conducive to analysis.

Starting with the 2013 model year, posted data should include the information in certification applications for engines and vehicles. The data should be made available in a database that is updated frequently so that key properties of engines and vehicles can be referenced as these products enter the market. Sales volumes at the most disaggregate level available should be added to the database as early as possible.

2. In annual compliance reports for the heavy-duty rule, report on each manufacturer's use of special provisions (e.g., early credits, alternative engine certification, advanced and innovative technology credits), application of credit carry-forward/carry-back, and credit balance.

Understanding the details of how manufacturers are complying with the standards, including their use of rule flexibilities, will provide insight into how the rule may be influencing the vehicle market and how rule design might be improved.

3. Produce an annual report on trends in heavy-duty vehicle technology, carbon dioxide emissions, and fuel economy.

An annual heavy-duty vehicle trends report is necessary to track the directions of a rapidly evolving market for fuel efficiency technology. The report should present the agencies' findings regarding the key fuel efficiency trends in the heavy-duty vehicle market with respect to vehicle and engine types, technologies, and manufacturers. Where relevant data on individual models or manufacturers is unavailable in the public online database, the agencies should present that information in the least aggregated form compatible with CBI policy.

4. Consolidate analysis and reporting of data on heavy-duty pickups and vans with light-duty reporting.

These vehicles should be included in the agencies' light-duty databases and in EPA's annual *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends* report.

As part of the second heavy-duty fuel efficiency and GHG rule, EPA and NHTSA should:

5. Expand data collection in the second phase of the program.

Regardless of the structure of the second phase of the program, collect and report actual powertrain specifications of each vehicle. Collect all inputs required for simulation of vehicle fuel efficiency. Require manufacturers to report sufficient fuel efficiency performance data to permit buyers to assess

fuel consumption over customized duty cycles. In particular, provide fuel efficiency results over each discrete test cycle.

In the FY 2015 federal budget process, DOE, EPA, and NHTSA should strive to:

6. Reinstate the Vehicle Inventory and Use Survey.

The agencies should prioritize reinstating the VIUS or developing a new census for vehicles in the 2015 budget. At the same time, they should pursue options to include the survey within existing appropriations by distributing the cost across agencies and programs.

7. Ensure adequate support for voluntary programs that yield data on heavy-duty vehicle operation.

The SmartWay and Fleet DNA Programs are gathering crucial information on duty cycles and fleet performance. Continuing support for these programs and more extensive data sharing will promote informed policymaking for heavy-duty vehicles.

References

[DOT] Department of Transportation. 2011. *Budget Estimates Fiscal Year 2012.* Research and Innovative Technology Administration. Submitted for the Use of the Committees on Appropriations.

[EIA] Energy Information Administration. 2009. *State Energy Data Needs Assessment.* Washington, DC.

———. 2013. *Assumptions to the Annual Energy Outlook 2013.* May. Washington, DC.

[EPA] Environmental Protection Agency. 2011a. Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles: EPA Response to Comments Document for Joint Rulemaking. EPA-420-R-11-004. August.

———. 2011b. "Greenhouse Gas (GHG) Emission Requirements Heavy-Duty Pickup Trucks and Vans." Industry/EPA Workshop Compliance Division Washtenaw Community College, November 3. http://epa.gov/otaq/climate/documents/hd-ghg-2b3-workshop-prestn.pdf

———. 2012a. Heavy-duty Greenhouse Gas Vehicle Certification Template. http://www.epa.gov/otaq/certdat2.htm#cert.

———. 2012b. "Greenhouse Gas (GHG) Emission Requirements for Vocational Vehicles." Presentation. http://epa.gov/otaq/climate/documents/vocational-only-presentation.pdf. August.

———. 2013a. "Engine Certification Data: On-Highway Heavy Duty—Diesel and Gasoline (2012–)." http://www.epa.gov/otaq/certdata.htm.

———. 2013b. "Carrier Performance Rankings." SmartWay Transport Partnership. http://www.epa.gov/smartway/partnership/performance.htm. Accessed July 17, 2013.

———. 2013c. "SmartWay Trends, Indicators, and Partner Statistics (TIPS)." http://www.epa.gov/smartway/tips/archive-tips.htm. Accessed July 17, 2013.

[EPA and NHTSA] Environmental Protection Agency and National Highway Traffic Safety Administration. 2013. "Heavy-Duty Engine and Vehicle, and Nonroad Technical Amendments; Final Rule." Fed. Reg. Vol. 78 No. 116. June 17.

[NHTSA] National Highway Traffic Safety Administration. 2013. Meeting with James Tamm et al.

[NREL] National Renewable Energy Laboratory. 2013. "Fleet DNA: Vehicle Drive Cycle Analysis." http://www.nrel.gov/vehiclesandfuels/fleettest/research_fleet_dna.html. Accessed July 19.

Reinhart, Thomas. 2013. "Phase 2 MD/HD Vehicle Fuel Efficiency Technology Study." Presentation to the June 20, 2013 meeting of the National Research Council Heavy Duty Committee: Assessment of Technologies for Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles, Phase 2. San Antonio, TX: Southwest Research Institute.

Spears, Matthew and Maurice Hicks. 2013. "Medium & Heavy Duty Fuel Efficiency and GHG Emission Standards: Phase 1 Update and Looking Ahead to Phase 2." Presentation to Society of Automotive Engineers meeting, January 31. http://www.sae.org/events/gim/presentations/2013/spears_matthew.pdf.

Appendix: Status of Data Relevant to Heavy-Duty Vehicle Fuel Efficiency

Data Type	Status*	Comments**
New Engines/Engine Families		
Rated power, torque and speed; displacement	2	Engine cert data spreadsheet
Fuel system, aspiration method, emissions control system	2	Engine cert data spreadsheet
Service class	2	Engine cert data spreadsheet
Family Certification Level (FCL)	2	Engine cert data spreadsheet (emissions over SET/FTP)
Sales volume	1	EOY reports; preliminary estimates reported in applications for certificate of conformity
Fuel map	0	Proprietary; however, is/can be collected "invisibly" for agency to use (but not view)
New Vehicles/Vehicle Families		
Cab/roof height/class	2	Application for certificate of conformity (GEM output)
Vehicle speed limit system, idle reduction equipment, weight reduction by component	2	Application for certificate of conformity (GEM output)
Aerodynamics: coefficient of drag	2	Application for certificate of conformity (GEM output)
Tires: coefficient of rolling resistance	2	Application for certificate of conformity (GEM output)
FEL and emissions for projected highest-emissions, lowest-emissions, and highest-volume vehicle in family	2	Application for certificate of conformity (GEM output). NB: Fuel efficiency on separate test cycles (transient, low cruise, and high cruise) not available

* Status: 0 = not collected or unknown; 1 = collected; 2 = collected and publically available

** Where data is available from more than one source, the most accessible source is listed.

Data Type	Status*	Comments**
Aerodynamics: method of determining coefficient of drag	1	Application for certificate of conformity
Tires: model	1	Application for certificate of conformity
Typical applications	1	Application for certificate of conformity
Advanced technology A-to-B information and improvement factor; innovative technology improvement factor	1	Application for certificate of conformity
HFC (refrigerant) info	1	Application for certificate of conformity
Final production volumes (by VIN, vehicle configuration, and subfamily)	1	Manufacturer End-of-Year Report
Engine and transmission models, axle ratio	0	Required in NPRM but not in final rule.
New vehicle fleet summary	0	Goal is a report on trends in heavy-duty fuel efficiency, specifications, and technologies; manufacturer-level performance; and test vs. real world performance
Heavy-duty pickups and vans		
Specifications	1	Application for certificate of conformity
Fuel economy	1	Application for certificate of conformity
Sales volumes by model	1	Estimates required in pre-model year report
Manufacturer compliance		
Manufacturer average performance	2	Agency annual reports
Manufacturer credit status	2	Agency annual reports
Intent to use ABT, Early Credits	1	Application for certificate of conformity
Participation in NHTSA early-credit program	1	Application for certificate of conformity
Innovative and Advanced Tech Credits	1	Manufacturer ABT report

Data Type	Status*	Comments**
Credits traded to another manufacturer	1	Manufacturer ABT report
Vehicles in use		
Total fuel consumption/GHG emissions by vehicle type	2	Current estimates based on 2002 VIUS and proprietary data
Individual fleet performance	2	SmartWay participants report on fuel consumption and emissions performance
Representative cycle data	1	NREL's Fleet DNA project has detailed data for small number of vehicles
Registration data	1	Available for purchase from, e.g., R.L. Polk & Co.
Comprehensive survey data	0	VIUS discontinued after 2002 survey