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REPORT IN BRIEF

Reducing the Fuel Consumption and Greenhouse Gas Emissions of Medium- and Heavy-Duty Vehicles, Phase Two, First Report

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Medium- and heavy-duty vehicles (MHDVs) such as tractor-trailers, coaches, transit buses and vocational vehicles (e.g., refuse haulers) are used in every sector of the economy. The fuel consumption and greenhouse gas (GHG) emissions of MHDVs have become a focus of legislative and regulatory action in the past few years. The National Highway Traffic Safety Administration (NHTSA) and the U.S. Environmental Protection Agency (EPA) regulate on-road MHDVs to reduce GHG emissions and improve fuel-efficiency. This report provides guidance to NHTSA as it develops a second round (Phase II) of fuel consumption and GHG emission standards for MHDVs. The report's recommendations address the regulation of natural gas vehicles, trailers, and tires, and vehicle certification using modeling and simulation, among other topics.

Background

This report is a follow-on to the National Research Council's (NRC's) 2010 'Phase I report'—*Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles*—which addressed the development of regulations for reducing fuel consumption of MHDVs. The findings and recommendations outlined in the 'Phase I Report' were taken into account in the 'Phase I Rule' jointly published by NHTSA and EPA in 2011 which established a comprehensive Heavy-Duty National Program to reduce GHG emissions and fuel consumption for on-road MHDVs. NHTSA and EPA have since started work on a second round (Phase II) of fuel consumption and GHG emission standards for MHDVs, which is directed at the post-2018 timeframe. To provide guidance on the Phase II Rule, the committee has issued this first report. The committee will issue a final report in 2016, which will cover a broader range of technologies and issues and will address the 2025-2030 timeframe.

Technologies for Reducing Fuel Consumption of Gasoline- and Diesel-Fueled Vehicles

Regarding the potential for technological change in the 2019-2022 time frame, the report does not identify any new combustion or other engine technologies beyond those identified in the NRC's 2010 Phase I Report that would provide significant further fuel consumption reduction during the time frame of the Phase II Rule. However, NHTSA's Phase II Rule should take the current and projected incremental fuel consumption reductions and penetration rates of existing technologies into careful consideration; these incremental reductions and penetration rates should be updated from what was projected in the Phase I Rulemaking. Furthermore, the report recommends that, whenever combinations of technologies are considered, interactions between those technologies should be evaluated for the effect on the projected incremental reductions.

Natural Gas Vehicles

Currently, natural gas engines are well developed although improvements can be pursued in engine efficiency, maintenance costs, and onboard vehicle storage costs. Due to its low carbon content, the greenhouse gas emissions of natural gas are lower than for gasoline or diesel fuel, but this benefit is partially negated by lower efficiency in currently available engines and the higher GHG impact of methane—the main component of unburned natural gas. The GHG impact of methane leakage during gas extraction or other parts of the life cycle could negate the inherent tailpipe CO_2 advantage of natural gas.

In light of these tradeoffs, the report recommends that NHSTA and EPA develop a separate standard for natural gas vehicles to complement those standards already issued for diesel-fueled and gasoline-fueled vehicles. In setting this standard, the agencies should consider the following factors: the maximum feasible capability of natural gas engines to achieve reductions in GHG emissions and fuel consumption, the uncertainties involved with the various engine and storage configurations that use natural gas, the impact of duty cycles on the ability to comply with the vehicle standards, the cost of natural gas vehicle technology, and the rapid growth of the market for natural gas engines and vehicles. This may require additional focused studies.

More studies and data are also needed to determine the well-to-tank GHG emissions of natural gas vehicles, because extraction and leakage emissions of methane are not well quantified. NHTSA, in coordination with EPA, should assemble a best estimate of well-to-tank GHG emissions to be used as a context for long-term rulemakings beyond Phase II.

Citing the possibility of rapid growth of natural gas MHDVs, the report notes the urgency to develop an optimum solution in Phase II Rule standards for natural gas GHG emissions and fuel consumption that will accommodate natural gas without artificially disrupting prevailing commercial transportation business models.

To benefit fully from the GHG reduction and petroleum displacement potential of natural gas, government and the private sector should support further technical improvements in engine efficiency and operating costs, reduction of storage costs, and emission controls. NHTSA and EPA should also evaluate the need for, benefits of, and costs of an in-use natural gas fuel specification for motor vehicle use.

Regulating Trailers

Use of aerodynamic devices on trailers, in particular side skirts, to reduce aerodynamic drag can reduce fuel consumption at highway speed. Yet the majority of both new and in-use van trailers do not use these fuel saving devices. When a trailer is not owned by the tractor owner/operator (who pays for fuel), there is no incentive for the trailer owner to purchase fuel-saving devices.

The report recommends that NHTSA adopt a regulation requiring that all new, 53-foot and longer dry van and refrigerated van trailers meet performance standards that will reduce their impact on fuel consumption and CO_2 emissions. The agencies should also collect actual operating data on fleet use of aerodynamic trailers to help inform the regulation. The report also suggests steps to develop an optimum full-vehicle test procedure.

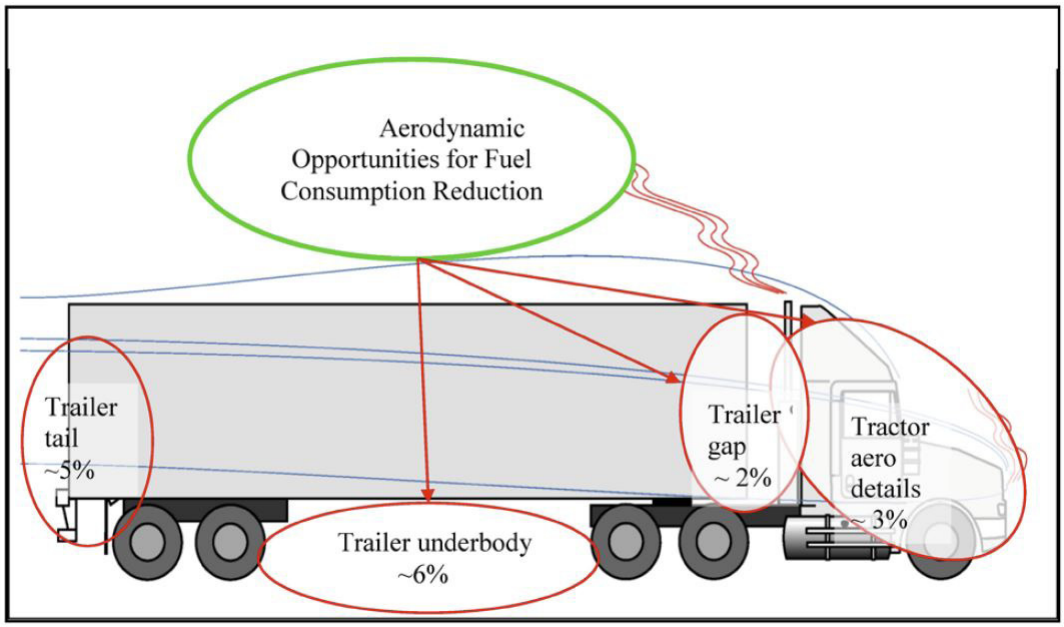

FIGURE: Tractor-trailer combination truck illustrating regions of potential fuel consumption reduction. Source: NRC, 2010.

Additionally, the report recommends the agencies determine whether it is practical and cost effective to regulate other types of trailers such as pups, flatbeds, and container carriers, as doing so could substantially increase overall fuel savings.

Tires

Low rolling resistance tires can reduce fuel consumption and emissions. Many new tractors and most new trailers are equipped with low rolling resistance tires, and manufacturers have also introduced wide base single tires, which feature lower rolling resistance than dual tire sets.

The report recommends that NHTSA further evaluate and quantify the rolling resistance of new tires, especially those sold as replacements. If additional, cost-effective fuel savings can be achieved, NHTSA should adopt a regulation establishing a low rolling resistance performance standard for all new tires designed for tractor and trailer use.

Furthermore, the report urges NHTSA to expeditiously establish and validate the equipment and process of a tire industry laboratory. NHTSA should mandate the use of that laboratory by each tire manufacturer seeking validation of tire rolling resistance coefficients for any tires being offered as candidates in the certification process, just as light duty vehicle tires were validated.

Vehicle Certification Using Modeling and Simulation

The Greenhouse Gas Emissions Model (GEM) was developed for NHTSA's and EPA's Phase I Rule as a simplified method for determining the effects of the vehicle (rather than the engine) on fuel consumption and GHG emissions. It is used for vehicle certification of Class 4 through Class 8 MHDVs. (Lighter vehicles may be certified using a chassis dynamometer.)

The report notes that GEM could be improved to consider synergy between components, the operation or control of components in a most efficient way, and the operation of a smaller component at higher relative load to increase efficiency. A further area for refinement is to consider generic performance maps contained in GEM for major components including the engine and transmission, which do not credit the vehicle manufacturer with the benefits of using a potentially superior engine or transmission.

The report urges NHTSA to investigate allowing the original equipment manufacturers (OEMs) the option to substitute OEM-specific models or code for the fixed models in the current GEM, including substituting a powerpack (engine, aftertreatment, and transmission). These models, whether provided by OEMs or fixed in the code, should be configured to accurately reflect actual operation.

In addition, the report notes that GEM employs a limited set of cycles to challenge the simulated truck and these do not include actual road grades. Being speed-time based, these cycles also do not allow for the faster acceleration of more powerful trucks, or the longer time potentially taken by less powerful trucks, to complete some actual routes. The report recommends reassessing the choice of test cycles/routes or schedules used in GEM to avoid creating designs that are optimized for the test rather than addressing actual performance in the design process.

Regulatory Processes

The report also makes several observations about the current regulatory processes of NHTSA and EPA. Currently, the agencies' standards consider fuel efficiency of the vehicle and tailpipe CO_2 emissions that need to be achieved, on average, by the mix of vehicles sold each year by each manufacturer. Manufacturers are likely to achieve these vehicle standards using a variety of different energy fuels and technologies. The report recommends that NHTSA, in coordination with EPA, should begin to consider the well-to-wheel life-cycle energy consumption and greenhouse emissions associated with different vehicle and energy technologies to ensure future rulemakings best accomplish their overall goals. NHTSA should also conduct an analysis to anticipate and analyze potential unintended consequences of its regulations.

A further issue of importance is the need to collect vehicle data that would permit regulators to evaluate the efficacy of and improve the accuracy of current and future regulations. NHTSA has begun the process of designing surveys and seeking the necessary approvals to allow it to assemble a picture of the MHDVs fleet characteristics. The report recommends that NHTSA should establish a repeatable, reliable survey process to collect private fleet data as soon as possible.

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