ACEEE
American Council for an Energy-Efficient Economy

Fact Sheet

Further Fuel Efficiency Gains for Heavy-Duty Vehicles

In 2011, the U.S. Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) adopted standards to reduce the greenhouse gas (GHG) emissions and improve the fuel efficiency of heavy-duty vehicles in model years 2014–2018. These "Phase 1" standards will reduce vehicle fuel consumption by 6 to 24%, depending on vehicle type, in model year 2018. The agencies are now developing the next phase of the program, which will apply to vehicles in later model years. A preliminary exploration of existing and emerging technologies indicates that further reductions of at least 26% are possible, as discussed below. This could lead to additional oil savings of 820,000 barrels per day by 2035.

SAVINGS OPPORTUNITIES BEYOND PHASE 1

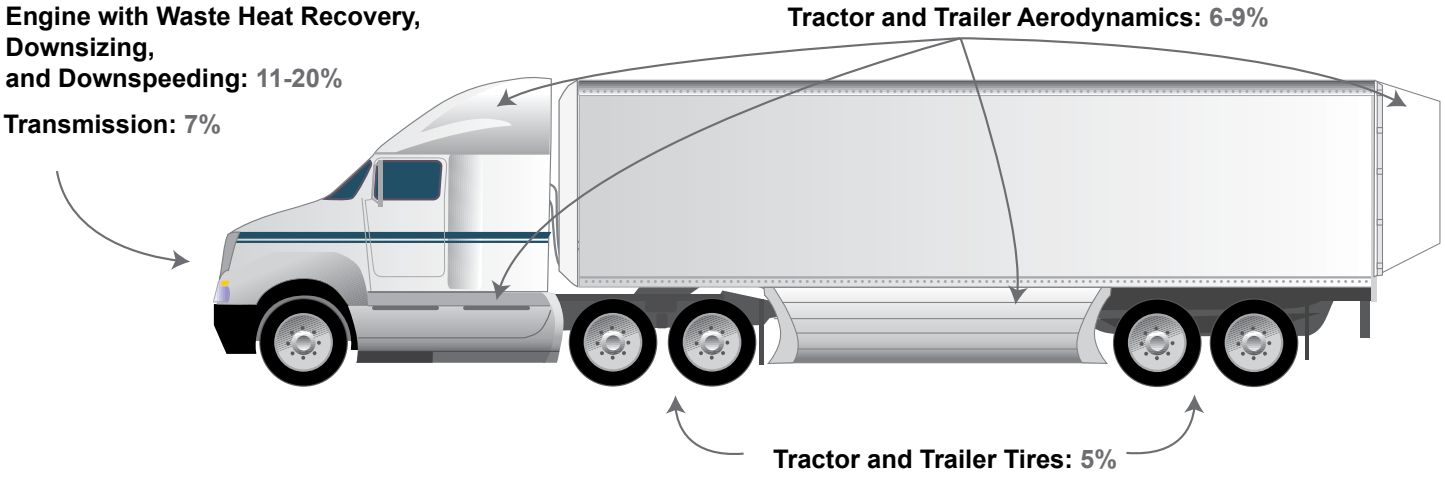
The heavy-duty vehicle standards cover three major categories of commercial vehicles: tractor trucks; heavy-duty pickup trucks and vans; and "vocational vehicles," which are all the remaining vehicle types, including refuse trucks, delivery trucks, utility trucks, and transit buses. Based largely on technologies evaluated by a National Academy of Sciences panel on heavy-duty fuel consumption in 2010 and/or in the 2011 EPA and NHTSA rule, further fuel consumption reduction opportunities beyond Phase 1 are as follows:

Tractor Trucks: 21 to 34%. Engine downsizing and reusing waste heat energy through a "bottoming cycle" will provide large fuel savings for tractor trucks. A bottoming cycle converts heat energy captured from the exhaust gas recirculation (EGR) loop and the exhaust stream into mechanical energy, which is then either fed back to the shaft for mechanical power or converted to electricity and used for electrical loads. Major savings are available from further improvements to aerodynamics and tires, especially on trailers and through the integration of tractor and trailer. Long-haul tractor trucks with box trailers benefit most from drag reduction, but other tractor trucks and trailer types have substantial reduction potential as well. The use of automated manual transmissions and transmission friction reduction will also provide major savings.

Vocational Vehicles: 16 to 31%. Optimized transmissions with more speeds and friction reduction will provide significant fuel savings. Other improvements including electrification of accessories and incremental engine advances will also contribute to fuel savings. The majority of these trucks operate on stop-and-go cycles and hence could benefit greatly from hybridization. We assume 25% penetration of hybrids by 2025.

Heavy-Duty Pickups and Vans: 18 to 22%. Major efficiency gains are available for heavy-duty pickups and vans through incremental engine and transmission improvements and the use of a 42 volt electrical system.

The technologies considered in this assessment are broadly applicable, though not necessarily universally applicable, to the relevant vehicle classes. Almost all



Long-Haul Tractor Trailer Fuel Consumption Reductions Beyond Phase 1 Standards

technologies considered here have a payback period of 3 years or less.[1]

FUEL EFFICIENCY LEVELS ACHIEVABLE IN PHASE 2

The table compares fuel efficiency for selected vehicle types in 2010 to the levels required under the Phase 1 standards and to the levels that could be achieved in Phase 2 based on the technologies discussed above. For new heavy-duty vehicles as a whole, Phase 2 would achieve a 26% fuel consumption reduction beyond that achieved by Phase 1.

FUEL SAVINGS

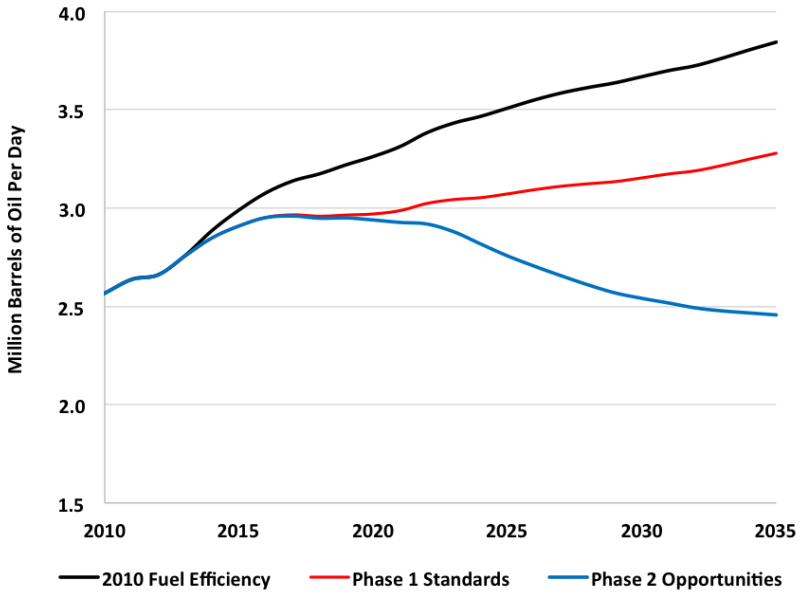
In order to estimate total fuel savings that would result from the Phase 2 fuel efficiency improvements discussed above, we assumed a linear phase-in of those improvements over 6 years, from 2020 through 2025. Where analyses indicated a range of potential fuel efficiency benefits from a given technology, we used the midpoint value. Fuel consumption of new vehicles would then decline by 5% per year on average over this period.

Oil savings would reach 820,000 barrels of oil per day in 2035 beyond the benefits accrued by the Phase 1 standards,[2] as shown in the figure. Tractor trucks would provide the biggest share of these savings, followed by heavy-duty pickup trucks and vans. In this scenario, total heavy-duty fuel consumption would return to 2010 levels by 2029 and continue to fall through 2035, assuming no further efficiency improvements beyond the 2025 model year.

Fuel Efficiency Opportunities for Selected Vehicle Types

Vehicle Type	Fuel Efficiency		
	2010 Level	Phase 1 Standard	Phase 2 Potential
Class 8 Long Haul Tractor Trucks w/ Box Trailers (gallons per 1,000 ton-miles)	9.3	7.1	5.1
Class 7 Regional Haul Tractor Trucks w/ Box Trailers (gallons per 1,000 ton-miles)	13.6	11.8	8.8
Class 8 Vocational Vehicles (gallons per 1,000 ton-miles)	23.2	21.8	16.3
Heavy-Duty Gasoline Pickups and Vans (gallons per 100 miles)	6.5	5.8	4.5
Heavy-Duty Diesel Pickups and Vans (gallons per 100 miles)	7.6	6.4	5.3

Heavy-Duty Vehicle Fuel Consumption With and Without Fuel Efficiency Improvements



CONCLUSION

Further technical analysis is needed to determine appropriate targets for the second phase of the standards and the optimal rate for phasing in new technologies. Additional technologies will become available over the time period discussed here. Far greater tractor-trailer drag reductions appear to be possible that, with the accompanying engine optimization, could bring major further efficiency gains. Full hybrid systems, once costs begin to decline, could achieve higher levels of penetration than assumed in the vocational segment and substantial penetration among heavy-duty pickups and vans. Smaller hybrid systems for long-haul trucks are under development as well. The adoption of such technologies would add substantially to the savings shown here. Thus, the fuel efficiency improvements considered above do not exhaust the full efficiency potential of heavy-duty vehicles in the coming years.

1 Details on the technology packages and the fuel savings calculations below are available at http://aceee.org/transportation/heavy-duty. We did not have sufficient information to calculate a payback period for the diesel package for heavy-duty pick-ups and vans, which was taken from the NAS study.

2 Savings calculated using the U.S. Department of Energy's 2012 VISION model (http://www.transportation.anl.gov/modeling_simulation/VISION). VISION includes heavy-duty pickups and vans with light-duty vehicles, so we calculated their savings separately. Our savings do not include savings from transit buses, as they are not included in the model.