**Comments to EPA Science Advisory Board**
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**May 31, 2018**

The American Council for an Energy-Efficient Economy (ACEEE) has worked on the technical aspects of EPA's greenhouse gas emissions standards for light- and heavy-duty vehicles for over a decade. We have identified many scientific and technical deficiencies in EPA's recent work to roll back these standards, and we find most of the issues raised in the May 18 SAB Work Group (WG) memo to be valid and substantial. Those issues, as well as other serious deficiencies, threaten to further undermine the role of science in EPA policymaking and ultimately erode environmental protection for the people of United States. Our comments are not comprehensive but highlight some specific points of concern and provide additional technical information. All citations are to the May 18 WG memo unless otherwise indicated.

**Final determination on light-duty greenhouse gas standards**

The WG memo posed several questions related to the April 2018 final determination and related materials that we believe are vital to understanding the justification, if any, for revisiting the standards. EPA's response (p. C-5) offers no substantive answers to those questions.

*Vehicle sales and safety impacts*

The WG notes (p. B-26) that EPA cites a figure of 1.3 million fewer vehicles sold as a result of the standards. This figure appears in the comments of the Alliance of Automobile Manufacturers on EPA's reconsideration of the final determination, which in turn reference the Trinity-NERA study (Attachment 6 to the Alliance's comments). However, the Trinity-NERA study's analysis of the sales impacts of the standards is not reasonable. It assumes that the standards' effect on sales is determined entirely by the incremental price of more-efficient vehicles (Trinity-NERA p.19) and thus ignores the fuel savings achieved with added efficiency and the effect of those savings on consumer purchase decisions. We note that this same issue arises in the macroeconomic analysis of the standards in the Indiana University study by Carley et al. (2017) cited in the WG memo (p. B-26). This and other shortcomings of the Indiana University study are addressed in a recent Synapse Energy Economics report.[1] The Synapse report finds increases in vehicle sales as well as positive impacts on macroeconomic indicators including GDP and employment in all years as a result of the standards.

EPA's unsupported suggestions of negative sales impacts of the standards are particularly troubling in view of their link to safety concerns, as reflected in the following "key question" for SAB review identified in the WG memo (p. B-23): "Would requirements for more fuel efficient

[1] "Cleaner Cars and Job Creation," Synapse Energy Economics, Inc. March 2018. http://www.synapse-energy.com/project/cleaner-cars-and-job-creation.

new vehicles lead to longer retention of older less fuel efficient vehicles and, if so, would this significantly affect projected emission reductions and have effects on crash-related safety?" Because fleet turnover is closely tied to vehicle sales, this question highlights the importance of rejecting ill-founded claims of negative sales impacts from the standards.

Agency estimates of the standards' effect on vehicle fatalities also depend on the value they choose for the rebound effect, because an increase in driving due to better fuel economy means increased crash exposure. The WG memo notes that "EPA raised the issue of rebound effect based solely on public comment but did not offer any assessment of this issue" (p. B-26). EPA's assumption of 10% rebound in the past several light-duty regulatory analyses is consistent with the current literature and should not be changed arbitrarily.

*2015 National Research Council report*

As the WG states, the 2015 National Research Council (NRC) study on light-duty vehicle fuel economy found EPA's technical work for the 2012 rulemaking on MY 2017-2025 standards to be "thorough and of high caliber as a whole" and commented favorably on several of EPA's methods to determine technology costs and benefits (p. B-22). The WG also noted that, contrary to the Administrator's assertion in the April 2018 final determination that electric vehicles sales would be needed to meet the standards, the NRC "indicated that a variety of approaches could be employed to meet the requirements for the 2025 model year" (p. B-19). However, the WG also observes that the NRC study "focused on mid-sized cars and did not account for the rapid growth of the light truck fleet." I was a member of the NRC committee and carried out the same pathway analysis for a full-sized pickup truck after the report was released. The analysis shows that the truck also could meet the 2025 target without electrification, at a cost that was even closer to the agency cost projection than in the case of a mid-sized car (Attachment 1, Pathways to the 2025 CAFE Target for a Standard Pickup). Furthermore, neither the NRC cost estimate nor my pickup estimate reflects cost reductions from the use of the various credits available to manufacturers under the standards.

The WG also correctly notes that "the NRC found that the EPA did not take full account of the range of technology options available to manufacturers that would enable compliance with the standards" (p. C-6). The conservativeness of the EPA technology assessment has been confirmed by lower cost or higher effectiveness values for several technologies considered by EPA, and also by the appearance of additional efficiency technologies in the market within the past three years. (See e.g. Attachment 2, ACEEE's comments on EPA's reconsideration of the final determination.)

*Stability of regulatory requirements*

The WG notes (p. B-26) that while EPA acknowledges the importance of regulatory certainty and lead time, it is reopening standards that would take effect within a few model years. EPA's claim in the April 2018 final determination that "industry cannot effectively plan for compliance with the current MY 2022-2025 GHG standards until it knows the outcome of the upcoming

NHTSA rulemaking for MY 2022-2025 CAFE standards" is disingenuous, given that NHTSA's augural standards have been place since 2012. In contrast to the April 2018 final determination, the initial final determination of January 2017 showed deference to the need for regulatory certainty and lead time:

> In [the administrator's] view, the current record, including the current state of technology and the pace of technology development and implementation, could support a proposal, and potentially an ultimate decision, to adopt more stringent standards for MY2022-2025. However, she also recognizes that regulatory certainty and consequent stability is important, and that it is important not to disrupt the industry's long-term planning.

Indeed, ACEEE's investigation of agency models used for the Draft Technical Assessment Report (TAR) analysis showed that the current MY 2022-2025 standards are well below the level that achieves maximum net benefit. These results are documented in Attachment 3, Addendum to ACEEE comments on Draft TAR.

*Upcoming NPRM*

As discussed in ACEEE's comments on EPA's reconsideration of the final determination (Attachment 2), EPA's work for the Draft TAR in 2015 was much more complete and sound than that of NHTSA, and EPA staff expertise and tools in the technical areas relevant to this program are generally much stronger. Consequently it is especially important that the SAB insist that any analysis supporting the upcoming proposal be reviewed according to standards set for EPA scientific and technical work, whether that analysis is supplied by EPA or by NHTSA.

ACEEE and others plan to look in detail at the agencies' modeling for the proposal, including both vehicle simulation and compliance modeling. It is our understanding that agency models have undergone substantial changes from the versions made available to the public when the Draft TAR was issued. In March, the Natural Resources Defense Council and other groups requested the updated models and related information from EPA and NHTSA but have received no information on the models from either agency to date. The SAB should support the robust review of the NPRM by requesting that EPA ensure all relevant models and model-related information are made publicly available in a timely fashion and that the comment period for the NPRM is long enough to allow for thorough review of the modeling, as well as other aspects of the proposal.

**Repeal of glider standards**

Many public comments on the proposed repeal of heavy-duty standards for gliders have rightly focused on the unacceptable increases in criteria pollution emissions and implications for human health. The increases in energy consumption and greenhouse gas emissions are also substantial, however. Glider sales increased dramatically in 2015 to 10,000 vehicles, or 5% of all

tractor sales, and there is a potential for further increases if gliders become an established way for manufacturers of tractors and engines to circumvent current emissions requirements. If glider standards are repealed, these vehicles will also skirt any responsibility to comply with the Phase 1 and 2 fuel efficiency and greenhouse gas standards and thus will not need to adopt efficiency technologies for any part of the vehicle. Consequently, whatever the percentage of tractor sales represented by gliders, that same percentage of fuel savings from the Phase 1 and 2 heavy-duty standards will be in jeopardy as a result of the repeal. For example, at 5% of tractor sales, gliders would result in additional fuel consumption of up to 21,000 barrels of oil per day in 2035. (See Attachment 4, ACEEE comments on proposed glider repeal.)

**Conclusion**

Given the extreme deficiencies in EPA's work in support of the April 2018 final determination and the proposed glider repeal, as well as the major consequences that would follow from these EPA actions, we believe it is essential that the SAB review both actions as recommended by the WG. Moreover, when EPA proposes a light-duty vehicle greenhouse gas emissions rule and/or finalize the glider standards repeal, the SAB should review the analysis offered in support of those rules as well.

In the case of the light-duty rule in particular, the SAB review should include any analysis completed or referenced by NHTSA upon which the EPA proposal relies, directly or indirectly. It would be unacceptable for EPA to circumvent its standards for science by outsourcing analysis to another agency, which not only has statutory responsibilities different from EPA's but also may have different norms and requirements for the treatment of scientific and technical analysis.

Attachment 1

Pathways to the 2025 CAFE Target for a Standard Pickup
(T. Langer)

**Pathways to the 2025 CAFE Target for a Standard Pickup**

The 2015 National Research Council (NRC) report **Cost, Effectiveness, and Deployment of Fuel Economy Technologies for Light-Duty Vehicles** presents in Chapter 8 a sample set of technology pathways for a midsize car (I4 engine) to reach its 2025 fuel economy target. The report compares the cost of reaching the target using three different sets of technology effectiveness and cost estimates: 1) NHTSA estimates from the 2017-2025 rule, 2) the lower cost/higher effectiveness (more optimistic) estimates from the NRC report, and 3) the higher cost/lower effectiveness (less optimistic) estimates from the NRC report. To complement that analysis, we present here a comparable analysis for a full-size pickup truck (V8 engine). In keeping with the NRC committee estimates, cost shown are direct manufacturing costs only.

In the NRC report, the purpose of the pathways was to provide a comparison of the agencies' and the committee's technology effectiveness and cost estimates in the aggregate for technology packages reaching the 2025 target. The resulting cost figures should not be taken as estimates of the cost of complying with the fuel economy standard, because they do not reflect the various flexibilities of the program, such as availability of off-cycle credits or the ability to average fuel economy across vehicles. See the NRC report (pp.271-280) for a more complete discussion of the meaning and limitations of the pathways presented there, which apply to our V8 example as well.

Considerations and results of the V8 pathway are as follows:

*2008 Baseline Vehicle* The pickup in this example weighs 5,500 lbs. and has a footprint of 66 sq. ft. (and hence CAFE target of 33.4 mpg in 2025). It begins with a combined city/highway fuel economy of 20 mpg (lab), which was the average full-size pickup fuel economy in 2008.[1] The truck has an 8-cylinder overhead valve (OHV) engine. OHV is assumed here because a light truck with V8 OHV engine was one of the three engine/vehicle combinations for which the NRC committee developed technology effectiveness and cost numbers (the others being I4 DOHC midsize car and V6 DOHC large car). We assume that the baseline engine has fixed valve timing, but employs cylinder deactivation, reflecting the fact that V8 OHV pickup engines in 2008 were dominated by the GM engines featuring cylinder deactivation. These same trucks had 4-speed transmissions, so that is assumed for the baseline vehicle as well. Assumptions regarding technology in the baseline vehicle are important, because they determine what additional technologies are available to reach the 2025 fuel economy target.

*Approach* Generally, we add technologies to the baseline vehicle in order of decreasing cost-effectiveness (defined as cost per percent fuel consumption reduction). However, within a technology category (e.g. engine technologies), we apply individual technologies in the order set out in NHTSA's decision trees (see NHTSA FRIA for the 2017-2025 rule), so that any technology prerequisites were met and effectiveness numbers properly reflected overlaps in

[1] EPA's 2008 Fuel Economy Trends report lists 16 mpg as average adjusted FE for large pickups; so the unadjusted value was approximately 20 mpg.

technology benefits. Synergies between engine and transmission technologies are also reflected in the effectiveness values used for transmission technologies.

*Results* The three pathways are summarized below and presented in detail in the Appendix tables.

- Using the NHTSA effectiveness and cost estimates, a pathway including a 50% downsized, turbocharged engine with cooled EGR (24 bar BMEP) and 10% mass reduction allows the pickup to reach the 2025 target fuel economy of 33.4 mpg. No electrification is required.
- With NRC's more optimistic estimates (higher effectiveness and lower cost), a very similar pathway to the previous one reaches the target. This pathway is 14% more expensive than the pathway using NHTSA estimates.
- The less optimistic NRC estimates lead to a pathway with 56% downsizing, cooled EGR level 2 (27 bar), and start-stop (the only application of electrification in any of the pathways described here). This pathway has a cost 30% more than the pathway using NHTSA estimates.[2]

Table 1 summarizes the costs of the three pathways. The corresponding findings from the NRC report for a midsize car are shown for purposes of comparison.

*Table 1: Illustrative Incremental Direct Manufacturing Costs for 2017-2025 for Two Example Vehicles (2010 dollars)*

| Source of Estimates | Standard Pickup Truck with V8 engine | NRC % above NHTSA Estimates | Midsize Car with I4 Engine* | NRC % above NHTSA Estimates |
|---|---|---|---|---|
| NHTSA | $2,038 | NA | $1,060 | NA |
| NRC More Optimistic | $2,324 | 14.0% | $1,181 | 11.4% |
| NRC Less Optimistic | $2,640 | 29.5% | $1,658 | 56.4% |

* From NRC report, Table 8.5

Figure 1 shows incremental cost vs. incremental fuel savings for the three pickup pathways.

[2] An alternative pathway that comes within 0.1 mpg of reaching the 2025 target omits CEGR2 (downsizing only 50% and remaining at 24 bar) and start-stop, substituting the next increment of mass reduction, to 15%. This pathway costs $3,350, or 64.4% more than the pathway that uses the NHTSA estimates.

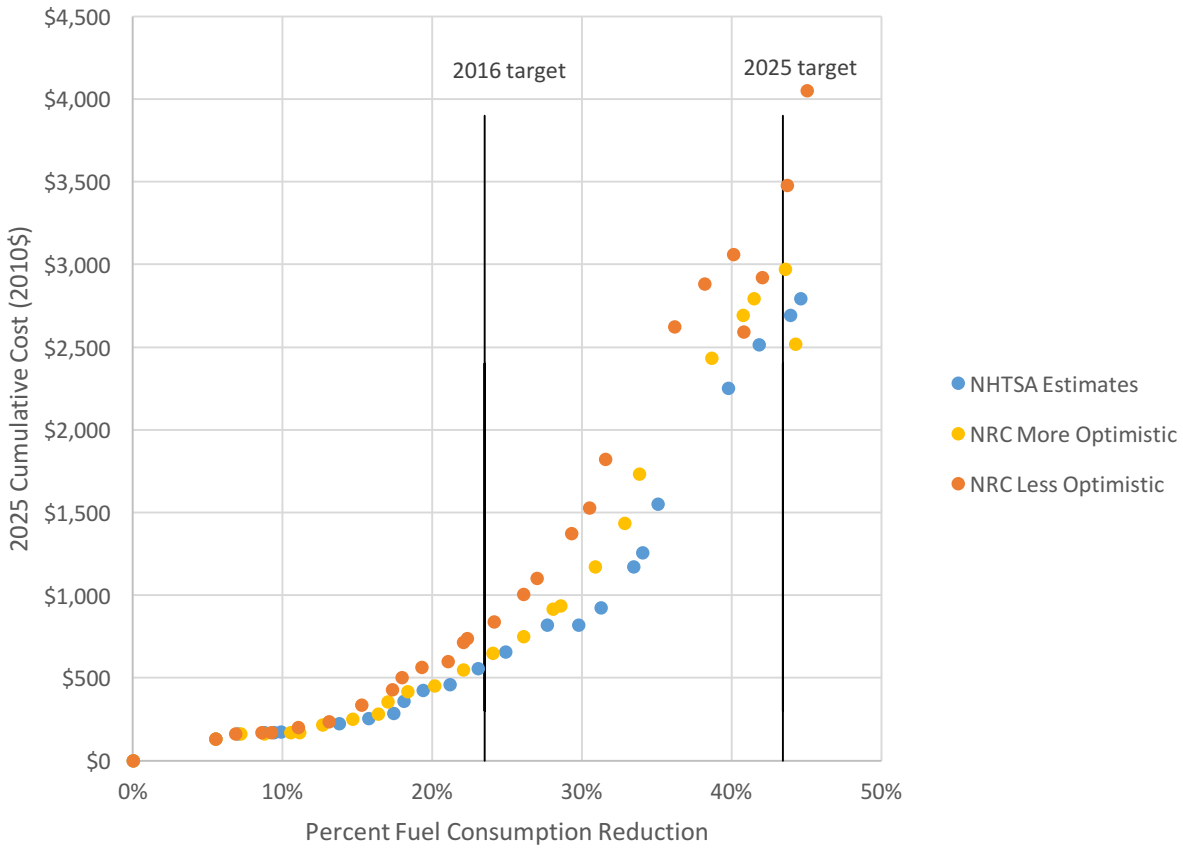


*Figure 1: Pathway example for standard pickup truck with V8 OHV SI engine comparing three estimates of technology effectiveness and cost*

**Attachment: 2025 Technology Pathways for Three Sets of Cost and Effectiveness Estimates for a Light Truck**

Footprint 66 sq ft, Weight 5,500 lbs.

*Table A1: Pathway Using NHTSA Effectiveness and Cost Estimates*

| | Possible Technologies | NHTSA % FC Reduction | FC Reduction Multiplier | Cumulative FC Reduction Multiplier | Fuel Consumption Gal per 100 mi | Unadjusted Combined MPG | 2025 NHTSA Cost Estimate | 2025 Cost per % FC Reduction |
|---|---|---|---|---|---|---|---|---|
| | Null Vehicle | | 1.000 | 1.000 | 5.291 | 18.9 | | |
| 2008 Baseline Vehicle | Cylinder Deactivation DEACO | 5.5 | 0.945 | 0.945 | 5.000 | 20.0 | $133 | $24.18 |
| | 6 Speed Automatic Transmission 6 SP AT with Improved Internals IATC | 1.6 | 0.984 | 0.930 | 4.920 | 20.3 | $31 | $19.38 |
| | Low Rolling Resistance Tires - ROLL1 | 1.9 | 0.981 | 0.912 | 4.827 | 20.7 | $5 | $2.63 |
| | Low Friction Lubricants -LUB1 | 0.7 | 0.993 | 0.906 | 4.793 | 20.9 | $3 | $4.29 |
| | Mass Reduction - MR1 (0-1.5%) (-82.5 lbs) | 0.5 | 0.995 | 0.901 | 4.769 | 21.0 | $4 | $8.00 |
| | 8 Speed Automatic Transmission - 8 SP AT | 4.3 | 0.957 | 0.863 | 4.564 | 21.9 | $47 | $10.93 |
| 2012 Compliance 22.3 mpg | Aero Drag Reduction - AERO1 | 2.3 | 0.977 | 0.843 | 4.459 | 22.4 | $33 | $14.35 |
| | Low Rolling Resistance Tires - ROLL2 | 2 | 0.980 | 0.826 | 4.370 | 22.9 | $31 | $15.50 |
| | Electric Power Steering - EPS | 0.8 | 0.992 | 0.819 | 4.335 | 23.1 | $74 | $92.50 |
| | Improved Accessories - IAAC1 | 1.6 | 0.984 | 0.806 | 4.265 | 23.4 | $64 | $40.00 |
| | Improved Accessories - IACC2 | 2.2 | 0.978 | 0.788 | 4.171 | 24.0 | $37 | $16.82 |
| | Engine Friction Reduction - EFR1 | 2.4 | 0.976 | 0.769 | 4.071 | 24.6 | $95 | $39.58 |
| 2016 Compliance 24.7 mpg | Aero Drag Reduction - AERO2 | 2.4 | 0.976 | 0.751 | 3.974 | 25.2 | $100 | $41.67 |
| | High Efficiency Transmission HETRANS | 3.7 | 0.963 | 0.723 | 3.827 | 26.1 | $163 | $44.05 |
| | Shift Optimizer SHFTOPT | 2.9 | 0.971 | 0.702 | 3.716 | 26.9 | $0 | $0.00 |
| | Mass Reduction - MR2 (1.5-7.5%) (-70 lbs = 123 lbs-53 lbs)* | 2.1 | 0.979 | 0.688 | 3.638 | 27.5 | $106 | $50.48 |
| | Variable valve actuation - CCP+DVVL VVA | 3.2 | 0.968 | 0.666 | 3.521 | 28.4 | $248 | $77.50 |
| | Mass Reduction - MR3 (7.5-10%)* | 0.9 | 0.991 | 0.660 | 3.489 | 28.7 | $84 | $93.33 |
| | Stoichiometric Gasoline Direct Injection SGDI (Required for TRBDS) | 1.5 | 0.985 | 0.650 | 3.437 | 29.1 | $296 | $197.33 |
| | Turbocharging & Downsizing - 1 TRBDS1 33% DS 18 bar BMEP | 7.3 | 0.927 | 0.602 | 3.186 | 31.4 | $700 | $95.89 |

| | Possible Technologies | NHTSA % FC Reduction | FC Reduction Multiplier | Cumulative FC Reduction Multiplier | Fuel Consumption Gal per 100 mi | Unadjusted Combined MPG | 2025 NHTSA Cost Estimate | 2025 Cost per % FC Reduction |
|---|---|---|---|---|---|---|---|---|
| | Turbocharging & Downsizing - 2 TRBDS2 50% DS 24 bar BMEP | 3.4 | 0.966 | 0.582 | 3.078 | 32.5 | $261 | $76.76 |
| 2025 Compliance 33.4 mpg | Cooled EGR - 1 CEGR1 50% DS 24 bar BMEP | 3.6 | 0.964 | 0.561 | 2.967 | 33.7 | $180 | $50.00 |
| | Low Friction Lub - 2 & Engine Friction Red - 2 LUB2_EFR2 | 1.2 | 0.988 | 0.554 | 2.931 | 34.1 | $99 | $82.50 |
| | Mass Reduction - MR4 (10-15%)* | 2.6 | 0.974 | 0.540 | 2.855 | 35.0 | $239 | $91.92 |
| | Cooled EGR - 2 CEGR2 56% DS 27 bar BMEP | 1.2 | 0.988 | 0.533 | 2.821 | 35.4 | -$453 | -$377.50 |
| | Mass Reduction - MR5 (15-20%)* | 2.6 | 0.974 | 0.519 | 2.748 | 36.4 | $336 | $129.23 |
| | Stop-Start - SS | 2.1 | 0.979 | 0.508 | 2.690 | 37.2 | $279 | $132.86 |
| | Relative to Null Vehicle | 49.2% | 0.508 | | | | $3,195 | $64.99 |
| | | | | | | | | |
| | Null Vehicle - 2008 MY Vehicle | | | | | | $133 | |
| | | | | | | | | |
| | 2008 MY Vehicle - 2016 MY | 14.7% | 0.853 | | | | $524 | |
| | | | | | | | | |
| | 2017 MY- 2025 MY | 23.6% | 0.764 | | | | $2,038 | $86.29 |

*The mass reduction effectiveness numbers in the table above are from the NRC report at p.411, which cites the NHTSA RIA. However, the effectiveness numbers shown in the RIA at p.478 differ slightly from these values.

*Table A2: Pathway Using NRC High Effectiveness and Low Cost Estimates ("NRC More Optimistic")*

| | Possible Technologies | NRC High % FC Reduction | FC Reduction Multiplier | Cumulative FC Reduction Multiplier | Fuel Consumption Gal per 100 mi | Unadjusted Combined MPG | 2025 NRC Low Cost Estimate | 2025 Cost per % FC Reduction |
|---|---|---|---|---|---|---|---|---|
| | Null Vehicle | | 1.000 | 1.000 | 5.291 | 18.9 | | |
| 2008 Baseline Vehicle | Cylinder Deactivation - DEACO | 5.5 | 0.945 | 0.945 | 5.000 | 20.0 | $133 | $24.18 |
| | 6 Speed Automatic Transmission 6 SP AT with Improved Internals - IATC | 1.8 | 0.982 | 0.928 | 4.910 | 20.4 | $31 | $17.22 |
| | Mass Reduction - MR1 (0-5%) | 1.69 | 0.983 | 0.912 | 4.827 | 20.7 | $0 | $0.00 |
| | Low Rolling Resistance Tires - ROLL1 | 1.9 | 0.981 | 0.895 | 4.735 | 21.1 | $5 | $2.63 |
| | Low Friction Lubricants - LUB1 | 0.7 | 0.993 | 0.889 | 4.702 | 21.3 | $3 | $4.29 |
| | 8 Speed Automatic Transmission - 8 SP AT | 1.7 | 0.983 | 0.874 | 4.622 | 21.6 | $47 | $27.65 |
| | Aero Drag Reduction - AERO1 | 2.3 | 0.977 | 0.854 | 4.516 | 22.1 | $33 | $14.35 |
| 2012 Compliance 22.3 mpg | Low Rolling Resistance Tires - ROLL2 | 2 | 0.980 | 0.836 | 4.426 | 22.6 | $31 | $15.50 |
| | Electric Power Steering - EPS | 0.8 | 0.992 | 0.830 | 4.390 | 22.8 | $74 | $92.50 |
| | Improved Accessories - IAAC1 | 1.6 | 0.984 | 0.816 | 4.320 | 23.1 | $60 | $37.50 |
| | Improved Accessories - IACC2 | 2.2 | 0.978 | 0.799 | 4.225 | 23.7 | $37 | $16.82 |
| | Engine Friction Reduction - EFR1 | 2.4 | 0.976 | 0.779 | 4.124 | 24.3 | $95 | $39.58 |
| 2016 Compliance 24.7 mpg | Aero Drag Reduction - AERO2 | 2.5 | 0.975 | 0.760 | 4.020 | 24.9 | $100 | $40.00 |
| | High Efficiency Transmission HETRANS, Level 1 | 2.7 | 0.973 | 0.739 | 3.912 | 25.6 | $102 | $37.78 |
| | High Efficiency Transmission HETRANS, Level 2 | 2.7 | 0.973 | 0.719 | 3.806 | 26.3 | $165 | $61.11 |
| | Shift Optimizer - SHFTOPT | 0.7 | 0.993 | 0.714 | 3.780 | 26.5 | $22 | $31.43 |
| | Variable valve actuation - CCP+DVVL VVA | 3.2 | 0.968 | 0.691 | 3.659 | 27.3 | $235 | $73.44 |
| | Mass Reduction - MR2 (5-10%) | 2.9 | 0.972 | 0.672 | 3.554 | 28.1 | $264 | $92.63 |

| | Possible Technologies | NRC High % FC Reduction | FC Reduction Multiplier | Cumulative FC Reduction Multiplier | Fuel Consumption Gal per 100 mi | Unadjusted Combined MPG | 2025 NRC Low Cost Estimate | 2025 Cost per % FC Reduction |
|---|---|---|---|---|---|---|---|---|
| | Stoichiometric Gasoline Direct Injection SGDI (Required for TRBDS) | 1.5 | 0.985 | 0.662 | 3.501 | 28.6 | $296 | $197.33 |
| | Turbocharging & Downsizing - 1 TRBDS1 33% DS 18 bar BMEP | 7.3 | 0.927 | 0.613 | 3.245 | 30.8 | $700 | $95.89 |
| | Turbocharging & Downsizing - 2 TRBDS2 50% DS 24 bar BMEP | 3.4 | 0.966 | 0.593 | 3.135 | 31.9 | $261 | $76.76 |
| | Low Friction Lub - 2 & Engine Friction Red - LUB2_EFR2 | 1.2 | 0.988 | 0.585 | 3.098 | 32.3 | $99 | $82.50 |
| 2025 Compliance 33.4 mpg | Cooled EGR - 1 CEGR1 50% DS 24 bar BMEP | 3.6 | 0.964 | 0.564 | 2.986 | 33.5 | $180 | $50.00 |
| | Cooled EGR - 2 CEGR2 56% DS 27 bar BMEP | 1.2 | 0.988 | 0.558 | 2.950 | 33.9 | -$453 | -$377.50 |
| | Stop-Start - SS | 2.1 | 0.979 | 0.546 | 2.888 | 34.6 | $279 | $132.86 |
| | Mass Reduction - MR3 (10-15%) | 2.4 | 0.977 | 0.533 | 2.820 | 35.5 | $487 | $207.23 |
| | Mass Reduction - MR4 (15-20%) | 2.4 | 0.976 | 0.520 | 2.752 | 36.3 | $866 | $359.34 |
| | Mass Reduction - MR5 (20-25%) | 2.5 | 0.975 | 0.507 | 2.685 | 37.2 | $1,807 | $734.55 |
| | Relative to Null Vehicle | 45.4% | 0.546 | | | | $5,959 | $131.22 |
| | Null Vehicle - 2008 MY Vehicle | | | | | | $133 | |
| | 2008 MY Vehicle - 2016 MY | 17.5% | 0.825 | | | | $516 | |
| | 2017 MY- 2025 MY | 27.6% | 0.724 | | | | $2,324 | $84.25 |

*Table A3: Pathway Using NRC Low Effectiveness and High Cost Estimates ("NRC Less Optimistic")*

| | Possible Technologies | NRC Low % FC Reduction | FC Reduction Multiplier | Cumulative FC Reduction Multiplier | Fuel Consumption Gal per 100 mi | Unadjusted Combined MPG | 2025 NRC High Cost Estimate | 2025 Cost per % FC Reduction |
|---|---|---|---|---|---|---|---|---|
| | Null Vehicle | | 1.000 | 1.000 | 5.291 | 18.9 | | |
| 2008 Baseline Vehicle | Cylinder Deactivation - DEACO | 5.5 | 0.945 | 0.945 | 5.000 | 20.0 | $133 | $24.18 |
| | 6 Speed Automatic Transmission 6 SP AT with Improved Internals IATC | 1.4 | 0.986 | 0.932 | 4.930 | 20.3 | $31 | $22.14 |
| | Low Rolling Resistance Tires - ROLL1 | 1.9 | 0.981 | 0.914 | 4.836 | 20.7 | $5 | $2.63 |
| | Low Friction Lubricants - LUB1 | 0.7 | 0.993 | 0.908 | 4.802 | 20.8 | $3 | $4.29 |
| | Low Rolling Resistance Tires - ROLL2 | 2 | 0.980 | 0.890 | 4.706 | 21.2 | $31 | $15.50 |
| | Aero Drag Reduction - AERO1 | 2.3 | 0.977 | 0.869 | 4.598 | 21.7 | $33 | $14.35 |
| 2012 Compliance 22.3 mpg | Aero Drag Reduction - AERO2 | 2.5 | 0.975 | 0.847 | 4.483 | 22.3 | $100 | $40.00 |
| | Engine Friction Reduction - EFR1 | 2.4 | 0.976 | 0.827 | 4.376 | 22.9 | $95 | $39.58 |
| | Electric Power Steering - EPS | 0.8 | 0.992 | 0.820 | 4.341 | 23.0 | $74 | $92.50 |
| | Improved Accessories - IACC1 | 1.6 | 0.984 | 0.807 | 4.271 | 23.4 | $60 | $37.50 |
| | Improved Accessories - IAAC2 | 2.2 | 0.978 | 0.789 | 4.177 | 23.9 | $37 | $16.82 |
| | 8 Speed Automatic Transmission 8 SP AT | 1.3 | 0.987 | 0.779 | 4.123 | 24.3 | $115 | $88.46 |
| | Shift Optimizer - SHFTOPT | 0.3 | 0.997 | 0.777 | 4.111 | 24.3 | $22 | $73.33 |
| 2016 Compliance 24.7 mpg | High Efficiency Transmission HETRANS, Level 1 | 2.3 | 0.977 | 0.759 | 4.016 | 24.9 | $102 | $44.35 |
| | High Efficiency Transmission HETRANS, Level 2 | 2.6 | 0.974 | 0.739 | 3.912 | 25.6 | $165 | $63.46 |
| | Low Friction Lub - 2 & Engine Friction Red – LUB2_EFR2 | 1.2 | 0.988 | 0.730 | 3.865 | 25.9 | $99 | $82.50 |
| | Variable valve actuation – VVA (CCP+DVVL) | 3.2 | 0.968 | 0.707 | 3.741 | 26.7 | 271 | $84.69 |

| | Possible Technologies | NRC Low % FC Reduction | FC Reduction Multiplier | Cumulative FC Reduction Multiplier | Fuel Consumption Gal per 100 mi | Unadjusted Combined MPG | 2025 NRC High Cost Estimate | 2025 Cost per % FC Reduction |
|---|---|---|---|---|---|---|---|---|
| | Mass Reduction - 1<br>MR1 (0-5%) | 1.69 | 0.983 | 0.695 | 3.678 | 27.2 | $151 | $89.35 |
| | Stoichiometric Gasoline Direct Injection<br>SGDI (Required for TRBDS) | 1.5 | 0.985 | 0.685 | 3.623 | 27.6 | $296 | $197.33 |
| | Turbocharging & Downsizing - 1<br>TRBDS1 33% DS 18 bar BMEP | 6.8 | 0.932 | 0.638 | 3.376 | 29.6 | $800 | $117.65 |
| | Turbocharging & Downsizing - 2<br>TRBDS2 50% DS 24 bar BMEP | 3.1 | 0.969 | 0.618 | 3.272 | 30.6 | $260 | $83.87 |
| | Cooled EGR - 1<br>CEGR1 50% DS 24 bar BMEP | 3.1 | 0.969 | 0.599 | 3.170 | 31.5 | $180 | $58.06 |
| | Cooled EGR - 2<br>CEGR2 56% DS 27 bar BMEP | 1.2 | 0.988 | 0.592 | 3.132 | 31.9 | -$469 | -$390.83 |
| | Stop-Start - SS | 2.1 | 0.979 | 0.580 | 3.066 | 32.6 | $329 | $156.67 |
| 2025 Compliance 33.4 mpg | Mass Reduction - MR2 (5-10%) | 2.9 | 0.972 | 0.563 | 2.979 | 33.6 | $558 | $195.79 |
| | Mass Reduction - MR3 (10-15%) | 2.4 | 0.977 | 0.550 | 2.909 | 34.4 | $570 | $242.55 |
| | Mass Reduction - MR4 (15-20%) | 2.4 | 0.976 | 0.537 | 2.839 | 35.2 | $1,064 | $441.49 |
| | Mass Reduction - MR5 (20-25%) | 2.5 | 0.975 | 0.523 | 2.769 | 36.1 | $1,947 | $791.46 |
| | Relative to Null Vehicle | 47.7% | 0.523 | | | | $7,062 | $148.16 |
| | Null Vehicle - 2008 MY Vehicle | | | | | | $133 | |
| | 2008 MY Vehicle - 2016 MY | 27.5% | 0.725 | | | | $708 | |
| | 2017 MY- 2025 MY | 15.4% | 0.846 | | | | $2,640 | |

Attachment 2

ACEEE's comments on EPA's reconsideration of the final determination

# Comments of the American Council for an Energy-Efficient Economy on EPA's Reconsideration of the Final Determination of the Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022–2025 Light-Duty Vehicles and the Appropriateness of Model Year 2021 Greenhouse Gas Standards

Docket ID Number EPA-HQ-OAR-2015-0827

October 5, 2017

## Introduction

The American Council for an Energy-Efficient Economy (ACEEE) advances energy efficiency policies, programs, and technologies through research and outreach. ACEEE strongly supported the fuel economy and greenhouse gas (GHG) emissions standards adopted in 2012 for model years (MY) 2017–2025, as well as EPA's determination earlier this year that the standards for MY 2022–2025 remain appropriate.

These comments respond to the "Request for Comment on Reconsideration of the Final Determination of the Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022–2025 Light-Duty Vehicles; Request for Comment on Model Year 2021 Greenhouse Gas Emissions Standards" by the National Highway Traffic Safety Administration (NHTSA) and the Environmental Protection Agency (EPA) (EPA and NHTSA 2017).

The basis for the January 2017 Final Determination (FD) was sound, and consequently ACEEE does not support its reconsideration. In particular, the analysis presented in the draft Technical Assessment Report (TAR) released in 2016 provides very strong technical evidence that the MY 2022–2025 standards remain achievable and cost effective (EPA, NHTSA, and CARB 2016).

In the current Request for Comment (RFC), EPA states that "the agency is primarily interested in comments relevant to the reconsideration of the Final Determination, rather than the Technical Assessment Report (TAR), which is not being reopened for comment in this document." Hence the draft TAR remains the primary analytical basis for any further Mid-Term Evaluation (MTE) decisions (EPA, NHTSA, and ARB 2016).[1] Based on the TAR, public comments on the TAR, and

[1] The MY 2017–2025 rulemaking specifies that the TAR is to serve this purpose: "EPA, NHTSA and CARB will jointly prepare a draft Technical Assessment Report (TAR) to inform EPA's determination on the appropriateness of the GHG standards and to inform NHTSA's rulemaking for the CAFE standards for MY 2022–2025. The TAR will examine the same issues and underlying analyses and projections considered in the original rulemaking, including technical and other analyses and projections relevant to each agency's authority to set standards as well as any relevant new issues that may present themselves" (FR, 62784).

the subsequent Proposed Determination (PD) and accompanying materials, EPA stated the following in the FD:

> In [the administrator's] view, the current record, including the current state of technology and the pace of technology development and implementation, could support a proposal, and potentially an ultimate decision, to adopt more stringent standards for MY2022-2025. However, she also recognizes that regulatory certainty and consequent stability is important, and that it is important not to disrupt the industry's long-term planning (EPA 2017a).

ACEEE agrees with EPA's conclusion that the evidence indicates that more stringent standards are achievable. Any reconsideration of the Final Determination would need to evaluate thoroughly the appropriateness of strengthening the existing standards.

Should EPA pursue the reconsideration, ACEEE has a number of concerns and comments related to the process as follows.

## Required Factors

EPA regulations cite eight factors that the agency must consider in making its determination. These are listed below, followed by our comments regarding new information and considerations beyond those discussed in prior comments to the docket.

<u>The availability and effectiveness of technology, and the appropriate lead time for introduction of technology</u>

As reflected in EPA's Final Determination, suppliers and manufacturers have continued to introduce new or improved automotive efficiency technologies that are not fully reflected in the draft TAR analysis. For example, Mazda, which already achieves the highest fleet fuel economy in the U.S., recently announced it would commercialize a homogeneous charge compression ignition engine within two years (Mazda 2016, Estrada 2017), and Delphi reported its Dynamic Skip Fire cylinder deactivation technology is ready for production (Birch 2017).

For the Draft TAR, EPA considered only six-, seven-, and eight-speed automatic transmissions. Multiple manufactures had already adopted or announced plans to adopt nine- and ten-speed automatics in time for the proposed or final determinations, but were excluded from EPA's analysis. In December 2016, Chevrolet announced that ten of its models would be available with a new nine-speed automatic by the end of MY 2017 (Truett 2016). At the time of the Draft TAR release, Ford and GM had announced deployment of a jointly developed 10-speed automatic in MY 2017, and Honda was road testing 10-speed automatics, which are now deployed in the 2018 Odyssey (Brooke 2017b; Brooke 2017c).

In its analyses for the MTE, EPA also makes conservative effectiveness or cost assumptions for a variety of efficiency technologies. New 48-volt mild hybrid systems are being deployed quickly

by Volkswagen, Audi, Mercedes-Benz, and Volvo (Frost 2017, Atiyeh 2017). Suppliers state these systems enable a range of effective fuel economy improvements, from 10% to nearly 20%, rather than EPA's estimate of 7%-9.5%. EPA also assumes a cost of $806, while suppliers state costs ranging from $500-$1500. Table 1 shows a sampling of information recently offered by suppliers and manufacturers regarding new or improved technologies. These developments provide further evidence of the conservative nature of EPA's analysis in the MTE, reinforcing the feasibility of the existing standards and of the multiple options manufacturers have to achieve them.

<u>The cost on the producers or purchasers of new motor vehicles or new motor vehicle engines</u>

In many cases, manufacturers and suppliers have provided information on technology cost and/or effectiveness that serves to update assumptions in the TAR or the PD. Table 1 provides several examples.

Table 1. Recent supplier statements on technology effectiveness and/or cost

| **Technologies not considered in TAR, PD, or FD analysis** | | | | |
|---|---|---|---|---|
| **Technology** | **Description** | **Effectiveness** | | |
| HCCI engine | Mazda, for MY 2019 | 20–30% FE[2] | | |
| 9-speed AT | 2017 Chevrolet Malibu | 3% over 2016 model with eight-speed automatic[3] | | |
| 10-speed AT | Honda Odyssey | 6% FE over outgoing 6-speed[4] | | |
| 10-speed AT | Ford F-150 3.5L V6 | 1 mpg over 6-speed (approx. 10% FE)[5] | | |
| Variable-compression-ratio ICE | Nissan TDS w/VCR | 27% FE compared to outgoing 3.5L V6[6] | | |
| **Technologies considered in TAR, PD, or FD analysis, but with conservative effectiveness or cost assumptions** | | | | |
| **Technology** | **Description** | **Effectiveness** | **Cost** | **EPA assumptions** |
| 48-volt mild hybrid | Valeo | 12% FE | $500[7] | 7.0–9.5% GHG; $580 (TAR, reaffirmed in PD[8]) |
| 48-volt mild hybrid | Continental | 25% FE[9] | | |
| 48-volt mild hybrid | Delphi | 10–15% FE | $1,000[10] | |
| 48-volt + cylinder deactivation | Delphi | >15% FE; 19% City FE | $1,500[10] | |
| Cylinder deactivation | Delphi-Tula Dynamic Skip Fire | 10–20% FE, $CO_2$ up to 20%[11] | $350 (4-cyl)[10] | 5.3%, $115[12] |
| **Other technologies or advancements relevant to future analysis** | | | | |
| **Technology** | **Description** | **Effectiveness** | **Cost** | |
| Lightweight doors | Magna | 42.5% weight reduction of doors | $2.59 per pound[13] | |
| Lightweight CFRP subframe | Magna, Ford | 200 lb for equivalent part | $20 per pound[14] | |
| Carbon-fiber composites | | | 16x the price of steel[15] | |

[2] Mazda 2017
[3] Chevrolet 2016
[4] Brooke 2017b
[5] Brooke 2017c
[6] Kendall 2016
[7] Brooke 2017a
[8] EPA 2017a
[9] Bolduc 2017
[10] Zoia 2017
[11] Delphi 2016
[12] EPA and NHTSA 2016
[13] Buchholz 2017
[14] Brooke 2017d
[15] Schweinsberg 2017c

This information points to lower costs and/or higher effectiveness for several technologies, relative to information used in the MTE.

The feasibility and practicability of the standards

The standards set out to 2025 were fundamentally conservative in that they could be met entirely with well-known technologies, as the agencies demonstrated in detail in the rulemaking. However those technologies have evolved and new technologies have emerged since the standards were adopted, as discussed above and as reflected in EPA's lower estimates of the cost of compliance in the draft TAR and the FD.

Furthermore, as an analysis by the International Council on Clean Transportation (ICCT) has demonstrated, even these more recent EPA analyses present an outdated account of the state of technology (Lutsey et al. 2017). Compared to draft TAR, current data on many technologies' cost and effectiveness are substantially more favorable than EPA estimates.

Volvo, a company that previously has chosen to pay CAFE fines and buy credits from other manufacturers in lieu of improving performance, announced that its entire fleet will be available with an electrified drivetrain option starting in 2019 (Gibbs 2017). With 48-volt mild hybrid being both more effective and cheaper than EPA assumed, manufacturers adopting the technology (including Volvo, VW, Daimler, and others) are likely to greatly improve their fuel economy and emissions performance.

The auto industry cited a Novation Analytics report (Novation 2015) extensively in its comments on the draft TAR. While the industry has continued to claim that the Novation analysis supports its concerns about EPA's demonstration of the appropriateness of the MY 2022-2025 standards (Hartrick 2016), EPA explained fundamental flaws in the Novation analysis in detail in the technical support document for the PD (EPA 2016d). Where EPA found that Novation's critique warranted further analysis (relating to variations in technology effectiveness based on performance specifications and the need for quality control checks on the powertrain efficiency of vehicles in the compliance packages), it undertook that analysis and applied the results in the PD.

The feasibility and practicability of the standards have been amply demonstrated by the agencies, and new information that has emerged since the TAR further justifies that conclusion.

The impact of the standards on reduction of emissions, oil conservation, energy security, and fuel savings by consumers

The vehicle standards are among the most significant steps the United States can take to lower GHG emissions and fuel consumption. In table ES-3 of the PD, EPA shows savings from the MY 2022–2025 standards of 537 MMT $CO_2$ and 1.2 billion barrels of oil over the life of vehicles of those model years; the standards reduce the vehicles' lifetime fuel consumption and GHG emissions by 12%.

The benefits of the standards to consumers far outweigh their costs. Even with the lower gas price projections used for the draft TAR, net savings to consumers remain large.

The impact of the standards on the automobile industry

Considerable evidence indicates that the standards will have a positive impact on the automobile industry. For example, ACEEE's 2012 analysis with the Blue-Green Alliance found that, in addition to 50,000 jobs in the auto industry itself, the standards would generate an estimated 570,000 jobs economy-wide by 2030 (Busch et al. 2012). A more recent study found that the standards have already created 288,000 American jobs in 48 states (Lipman et al. 2017). In its September 6th testimony to EPA, the Motor & Equipment Manufacturers Association (MEMA) claimed a 23% increase in automotive supplier employment since 2012—an increase of 171,000 jobs—and attributed these gains in part to the development of technologies that will help manufacturers comply with the standards (MEMA 2017a; MEMA 2017b).

Despite this evidence, auto industry sources continue to claim that the standards jeopardize vehicle sales and jobs. A Center for Automotive Research (CAR) study (McAlinden 2016) purported to demonstrate the standards' potentially large negative impacts on vehicles sales and jobs, but it contained multiple fallacies, as discussed in Kodjak (2017) and Martinez (2017). EPA found that merely replacing CAR's overblown and unsubstantiated technology cost assumptions with the agency's detailed and up-to-date cost estimates changes the results of the CAR analysis, yielding increases in vehicle sales, auto jobs, and national employment due to the standards (Charmley 2017).

Another analysis commissioned by the auto industry and conducted at Indiana University (IU) found that the standards would produce gains in GDP, income, and total jobs in the mid-to-long term (Carley et al. 2017). For example, the IU study projects net increases in total jobs ranging from 50,000 to 500,000 by 2035, depending on assumptions regarding technology costs and consumer behavior, among other factors. The IU report does find near-term negative economic impacts, however.

These negative impacts may be due to shortcomings in the macroeconomic modeling. In particular, as the study acknowledges, IU's REMI modeling does not reflect consumers' valuation of fuel economy in vehicle purchase decisions and thus would inappropriately project losses in vehicle sales based on the higher purchase prices of more fuel-efficient vehicles. This is likely reflected in the less favorable employment impacts in geographic regions where automotive manufacturing is concentrated, e.g. the northern Midwest. Moreover, the REMI modeling does not appear to reflect the financing of vehicles, even though, according to IU, cars loans and leases account for 70% of new vehicle purchases. Failure to account for vehicle financing would produce unrealistic, negative cash flows in the early years of the analysis, which may account for the near-term negative economic impacts. We believe these aspects of

the IU study would require further investigation if EPA were to take this study into account in the MTE.

*Vehicle sales*

Recognizing that its macroeconomic modeling does not properly capture the standards' effects on vehicle sales, IU constructs a total cost of ownership (TCO) model to incorporate the full range of cost and savings resulting from the purchase of a vehicle with added fuel-saving technologies. IU presents results of the TCO model for a "2012 perspective," intended to reflect assumptions used by the agencies in the 2012 rule for MY 2017-2025, and for several "2016 perspectives," reflecting alternative data and assumptions. IU's primary finding is that, while the standards produced a strong sales increase after the first few years in the 2012 perspective, adjusting the assumptions reversed the outcome: the standards substantially *reduced* vehicle sales in most 2016 perspectives.

In order to better understand the IU results, ACEEE created a TCO model using information provided in the IU report.[16] This allowed us to clarify several points. First, IU uses the NHTSA's estimates of "required" fuel economy values and the accompanying technology costs, instead of NHTSA's "achieved" values. NHTSA's use of "required" values follows from statutory constraints on how they determine appropriate levels for the standards; but "achieved" values are the correct choice for determining the standards' real-world impacts, as IU seeks to do. We found that using "achieved" values produced more favorable vehicle sales results. In addition, there is no indication that IU applied NHTSA's assumption that costs of new technologies decline over time (through "learning") after MY 2025; incorporating learning would increase sales as well. We note that IU applies a 7% discount rate for fuel savings, whereas OMB guidance suggests using both 3% and 7%, though this choice has only a minor effect on the results. IU's 2012 perspective otherwise appears reasonable.

To create its 2016 perspectives, IU makes a variety of changes to the TCO inputs and assumptions, almost none of which could be accurately described as update to reflect new data or new consensus. Using more-recent fuel price projections is certainly appropriate. However, several of the changes to inputs for the 2016 perspectives, such as alternative assumptions regarding consumer valuation of fuel savings or NHTSA's projections of vehicle miles traveled from the TAR, reflect ongoing uncertainties or lack of consensus. Conveying the impression that the adjustments reflected in the 2016 perspectives represent an improved understanding of the factors affecting the standards' impacts on sales, as the IU report has done, is highly misleading. IU's figure ES.2 illustrates the problem. All 2016 perspectives in this figure show negative sales results.

[16] ACEEE's model reproduces IU's results very closely for cars. Our results for trucks differed somewhat from IU's, but we discuss only car results here.

IU's treatment of technology costs in particular warrants discussion. Assuming that the cost of technology will be bounded by NRC's high and low costs is misguided for several reasons. The NRC committee stated:

> It is important to note that these calculations did not include full CAFE/GHG program flexibilities so are not intended to be an estimate of actual compliance costs. In this example, technologies were applied to achieve the CAFE targets without consideration of other vehicles in a manufacturer's fleet and without consideration of credits. The results for other vehicle classifications may vary considerably from this example (NRC 2015).

Moreover, the NRC committee accepted many of the agencies' technology cost estimates from the rule, and these should be updated to reflect the agencies' latest estimates. Finally, the NRC discussed several emerging technologies that did not appear in the agencies' compliance packages for the rule but could create new compliance pathways. In the meantime, some of those very technologies have appeared on the market, as discussed above.

To create a more objective, but conservative, 2016 perspective, we used ACEEE's TCO with updated fuel prices, NHTSA's estimated achieved fuel economy values and technology costs in the rule, and the assumptions of four years' consumer valuation of fuel savings and 4% discount rate. We omit the ZEV mandate, because here we are interested specifically in the impacts of the federal program. Figure 1 shows three perspectives from IU's original figure ES.2, with this additional perspective (2016 ACEEE). Unlike IU's 2016 perspectives, the 2016 ACEEE perspective shows positive, though reduced, sales impacts from the standards.

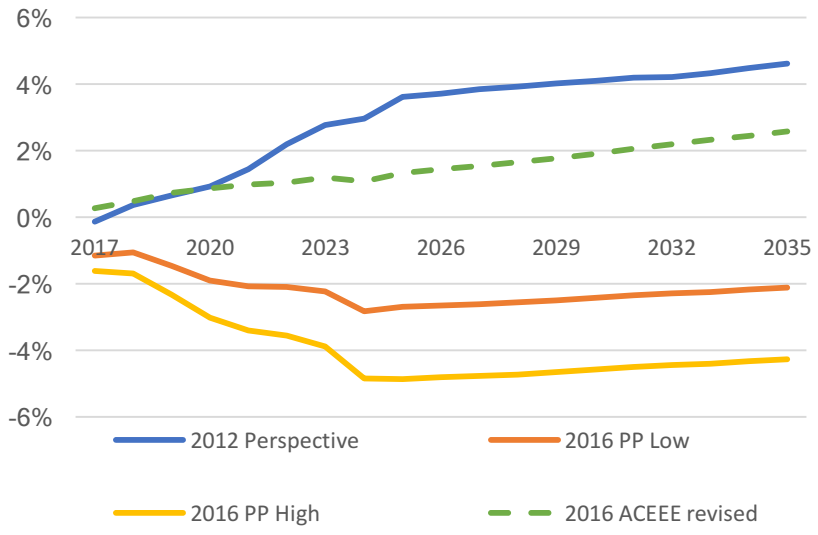


Figure 1. Estimated percentage change in car sales in various scenarios

While the TCO analyses reflect many uncertainties, we conclude that it is incorrect to say that new information available since the adoption of the MY 2017-2025 standards shifts the outlook for vehicle sales impacts of the standards from positive to negative.

*Global competitiveness*

A key consideration not discussed in the studies referenced above is the need for manufacturers producing vehicles for the US market to also meet requirements in other parts of the world. If standards in other major markets are more rigorous than those in the United States, companies, including domestic manufacturers with a strong US focus, are likely to be at a disadvantage in competing in the foreign markets while also producing less-efficient vehicles in the United States. To remain competitive, all manufacturers will need to continue investing in advanced technology, and both the manufacturers and the country will benefit most from that investment in an environment of steady advances in emissions and fuel economy requirements in the United States.

<u>The impacts of the standards on automobile safety</u>

Understanding of the relationship between vehicle GHG and fuel economy standards and safety has improved greatly in recent years, due to extensive research (NRC 2015). The advent of size-based standards in MY 2011 has gone far to mitigate concerns. Parties surfacing on occasion to raise the specter of the standards' negative safety impacts seem ill informed on the current state of knowledge. For example, in recent testimony before EPA on the MTE, CEI cited multiple safety studies and articles from the 1990s purporting to confirm fuel economy's adverse safety implications, but cited no recent studies (Kazman 2017).

<u>The impact of the greenhouse gas emission standards on the Corporate Average Fuel Economy standards and a national harmonized program</u>

(No comment at this time.)

<u>The impact of the standards on other relevant factors. (40 CFR 86.1818-12(h)(1))</u>

(No comment at this time.)

## Other Relevant Factors

In the RFC, EPA lists several additional "relevant factors." Those factors are a small fraction of the full set of considerations relevant to setting and reviewing GHG standards for vehicles. While the required factors discussed above are indeed distinguished from the many other relevant considerations in that they are identified in the 2017–2025 rule, the additional factors listed have no such special status, and any new action taken in the midterm review based on

these factors to the detriment of EPA's obligations under the Clean Air Act or to the required factors would be unjustified.

EPA does not explain the other factors listed in the RFC, and it is not always clear what they mean. Where the meaning of the factors listed is clear, they are largely not new at all, but rather are issues that have been discussed in earlier EPA documents relating to the 2017–2025 rule and/or in comments on those documents. These factors and our comments on them are as follows.

<u>The impact of the standards on compliance with other air quality standards</u>

(No comment at this time.)

<u>The extent to which consumers value fuel savings from greater efficiency of vehicles</u>

(No comment at this time.)

<u>The ability for OEMs to incorporate fuel-saving technologies, including those with "negative costs," absent the standards</u>

The meaning of this factor in the RFC is not clear, but we note that NHTSA used similar language in the draft TAR:

> The default assumption in the [Volpe] model is that manufacturers will treat all technologies that pay for themselves within the first three years of ownership (through reduced expenditures on fuel) as if the cost of that technology were negative. This holds true up to the point at which the manufacturer achieves compliance with the standard – after which the manufacturer treats all technologies that pay for themselves within the first year of ownership as having a negative effective cost (EPA and NHTSA 2017, 12–10).

This assumption reflects the understanding that manufacturers are more likely to adopt efficiency technologies, including those with fairly short payback periods, when subject to binding standards. Several reasons have been identified for the fact that they often fail to incorporate such technologies absent the standards, as discussed at length in the FRM. Some commenters have maintained this behavior indicates that the technologies in question must compromise other vehicle properties, but extensive EPA research has found that this is rarely the case (Helfand et al. 2015).

<u>The distributional consequences on households</u>

EPA responded in the Proposed Determination and in its response to comments for the final determination that fuel economy improvements are progressive and reduce expenditures for all income groups (EPA 2016c, EPA 2017b). A report cited by EPA shows using historic data that

all income quintiles benefit from improved fuel economy. Highest quintile households realize the greatest net savings, but the lowest-income quintile sees the greatest relative benefit. Fuel economy improvements since 1980 have saved 4.7% of annual income, or over $500, for households in the lowest income quintile. Highest income quintile households realized a savings of $1,500, which is a much smaller portion (0.9%) of household income (Greene 2010, Welch 2016).

The appropriate reference fleet

(No comment at this time.)

The impact of the standards on advanced fuels technology, including but not limited to the potential for high-octane blends

The standards through MY 2025 are feasible with the octane levels of regular fuel today. High-octane fuel blends, including those made by increasing the ethanol content in gasoline, present opportunities for further improvements in efficiency. However, based on comments delivered at EPA's September 5, 2017 hearing in Washington, DC on the Midterm Evaluation, even those advocating higher-octane blends are not necessarily recommending a mandate for higher fuel octane. Benefits from the optional use of higher-octane fuels are not guaranteed, because modern vehicles are able to run on lower-octane fuels at the expense of performance and fuel economy. Many consumers will choose cheaper, lower-octane fuel if given the option.

The availability of realistic technological concepts for improving efficiency in automobiles that consumers demand, as well as any indirect impacts on emissions

Consumer demand for a given technology is not always apparent from its uptake in the market. In its response to the PD, Toyota voiced concern that the agency hasn't appropriately accounted for low fuel prices potentially shifting consumer preference to vehicles or powertrain types that make compliance more challenging. Yet consumers are frequently driven away from more-efficient powertrains because they are available only in packages with a cost far greater than that of the technology. Manufacturers regularly package fuel-saving technology with other features or higher trim levels that the consumer may not desire or cannot afford, thus discouraging adoption of already mature fuel-saving technology. For example, the 2016 Toyota Highlander Hybrid was available only in the $49,500 Limited or $52,200 Limited Premium trims (US News 2016) that come with features such as Blu-ray players, premium audio, and heated and ventilated seats. For 2017, the Highlander Hybrid is available in the $36,270 LE trim (Toyota 2017). This pricing change may explain why Toyota has realized a 197.1% increase in Highlander Hybrid sales through August 2017 compared to the same period of 2016. Sales of all Highlander models have increased by only 21.3% (Schweinsberg 2017a; Schweinsberg 2017b). As another example, Chevrolet's 2017 Silverado 1500 pickup with eAssist mild-hybrid system is available in some states as a $500 option, but only in packages that include under-bed cargo lights, remote start, and power seats, which add significantly to price (GM 2017).

*Off-cycle technologies*

The reference to "realistic technological concepts" having "indirect impacts on emissions" in this factor could be a reference to off-cycle technologies. The auto industry continues to request easier access to credits for such technologies. In the PD, EPA affirmed that the MY 2022-2025 standards are appropriate with the off-cycle credit provisions currently in place. Moreover, any relaxation of the off-cycle credit program's requirements could undermine the credibility and effectiveness of the standards overall.

In our comments on the draft TAR, ACEEE noted that off-cycle credits must be based on a credible technical demonstration of real-world benefits. EPA responded partly by stating that it "is not proposing to make changes to the off-cycle credits program as part of the Midterm Evaluation, as there is no reason within the scope of the MTE to revisit these provisions" (EPA 2016d). The agency also stated:

> EPA agrees […] that off-cycle credits must continue to be based on data demonstrating the real-world benefits of the off-cycle technology per the regulations that are currently in place. By ensuring that the credits are based on demonstrated real-world benefits, which we believe the current off-cycle regulatory framework does, EPA ensures that emissions reductions associated with the standards are maintained. The existing credits process in place today ensures that credits are legitimate and maintains the integrity of the program (EPA 2016d, A-104).

However, EPA did not respond to our comment that the MY 2017-2025 rule prohibits credits for "technologies which provide those improvements by indirect means […] or may provide benefit to other vehicles on the road more than for themselves." This prohibition is appropriate, given that the standards are based on an approach focused on a vehicle's performance as measured in specified, repeatable conditions.

We urge that, in considering whether to grant credits for off-cycle technologies, EPA continue to observe the following principles:

- The purpose of off-cycle credits is to bring into the market new technologies that reduce emissions and fuel consumption.
- Award of off-cycle credits must be based on a credible technical demonstration that the technology will provide benefits in the real world.
- A technology used as a basis for the standard is not eligible for off-cycle credits.
- A technology may receive off-cycle credits based only emissions reductions in the vehicle in which the technology is installed.

<u>The advantages or deficiencies in EPA's past approaches to forecasting and projecting automobile technologies, including but not limited to baseline projections for compliance costs, technology penetration rates, technology performance, etc.</u>

EPA's staff expertise and facilities at the National Vehicle and Fuel Emissions Laboratory in Ann Arbor have been absolutely critical to the development of these standards. EPA has done the tear-down analyses to estimate the costs of new technologies, benchmarked recent implementations of engine and transmission technologies to assess their fuel efficiency performance, and developed and made freely available to the public a vehicle simulation tool (ALPHA) to model the benefits of technology packages.

The most recent NRC fuel economy committee, which included leading automotive engineers, found that the agencies' analysis in developing the 2017–2025 standards was "thorough and of high caliber on the whole." The committee also noted the high value of EPA's teardown studies to estimate technology costs, stating that "the added cost is well justified because it produces more reliable assessments" (NRC 2015).

EPA has carried out a vast number of technical projects in support of its work on automotive standards and has routinely published its analyses in engineering journals and subjected its models to rigorous peer review. It has been responsive to critiques arising from those reviews and from formal comment processes, as in the case of the Novation Analytics critique cited above.

By requesting comments on "[t]he advantages or deficiencies in EPA's past approaches" as well as "[t]he use of alternative methodologies and modeling systems" (discussed below), the RFC suggests the possibility of a diminished role for EPA, and/or the analytical approaches it has developed, in the technology assessments for setting vehicle standards. Such a shift would be inappropriate and would detract from the integrity of EPA's regulatory processes and the standards program. EPA and NHTSA have distinct statutory obligations to regulate vehicles' GHG emissions and fuel economy, respectively, that impose differing constraints on their analyses. While the agencies have agreed to harmonize the two programs to the extent possible, EPA must exercise its independent judgment regarding the matters under its jurisdiction.

Furthermore, any reduction in EPA's role in the technical analysis for the standards would necessitate greater reliance on NHTSA's analysis, which would greatly reduce the robustness and transparency of the technical basis for the standards. As ACEEE noted in its TAR comments, much of NHTSA's work for the TAR was deficient:

> Given the complexity of technology effectiveness and cost estimation in the TAR, and its importance to the MTE, it is essential that the agencies' findings be presented in a transparent fashion. Hence it is unacceptable that NHTSA does not provide effectiveness estimates explicitly in the TAR. NHTSA's approach to the modeling of technologies was problematic as well, in that it relied upon a simulation model that requires a license and work done on proprietary, and in some cases outdated, engine maps to determine technology fuel consumption benefits (ACEEE 2016a).

A 2010 report from the US Government Accountability Office (GAO) describes the unequal partnership between EPA and NHTSA on the analysis of vehicle standards. GAO notes EPA's far greater experience and investment in automotive technology analyses and states:

> By comparison [to NHTSA], EPA has been able to develop and maintain automotive engineering expertise. This expertise has proved helpful in setting GHG emissions standards for automobiles. For example, EPA has been home to the National Vehicle and Fuel Emissions Laboratory since 1971, and in the early 1990s, it expanded its activities to conduct research and development of technologies used to reduce emissions, which are often marketed and licensed to the automobile industry. Although NHTSA brings safety expertise to CAFE standards, which has been a concern with raising CAFE standards in the past, the agency's primary mission and expertise is in vehicle safety, not vehicle power train design and the impact of vehicle emissions on the environment. Thus NHTSA cannot be expected to have the same level of in-house expertise related to vehicle power train design and environmental issues as EPA (GAO 2010, 23-24).

Automotive technology is a rapidly evolving field with enormous environmental and economic implications for the nation. Accordingly, EPA must continually update and improve its information and analysis tools in this area, as it has done in the past. It is essential that EPA maintain and invest in its vast capabilities in automotive analysis, rather than allow them to stagnate.

<u>The impact of the standards on consumer behavior, including but not limited to consumer purchasing behavior and consumer automobile usage behavior (e.g., impacts on rebound, fleet turnover, consumer welfare effects, etc.)</u>

As discussed in our comments on the PD (ACEEE 2016c), the average price of a new vehicle in real dollars has remained essentially flat for nearly 10 years. Yet auto interests continue to argue that the standards will make vehicles unaffordable to many Americans. For example, the National Automobile Dealers Association stated that the average price of a new car has increased 57% since 1996 while average household income has increased only 21% (Welch 2017). This is an apples-to-oranges comparison. As in an earlier comparison by the Alliance of Automobile Manufacturers (AAM 2016), vehicle price increase appears to be given in terms of nominal dollars, while income growth is in real dollars.[17] When appropriately adjusted for inflation, average vehicle price (cars and trucks combined) has increased only 10% over this

[17] In addition, AAM cites KBB transaction prices, which does not include applied consumer incentives or rebates (AAM 2016). Our statements are based on transaction price, which includes concessions, discounts, and rebates. Consumer incentives can be significant, especially for pickup trucks. On October 5, 2017 for zip code 20001, GMC is offering up to $12,000 in discounts on its 2017 Sierra 1500 4WD Crew Cab, Ford is offering $6,550 in discounts on its 2017 F-150 XLT with 2.7L V6 Ecoboost, and RAM is offering $13,311 in discounts on its 2017 RAM 1500 models. Screen clippings of these offers are attached to these comments.

period, and this increase is due in part to an increase in truck sales share.[18] The inflation-adjusted price of cars alone actually declined 10% on average over this period.

Any relevant information in light of newly available information

In the final rule for MY 2017–2025, EPA committed to a midterm evaluation to review the MY 2022–2025 standards using updated information. Analysis conducted since the adoption of the final rule has confirmed the fundamental soundness of the agencies' approach. Predictably, new technologies have emerged since that time, with the likely result that compliance with the standards will be less expensive than projected in the rulemaking. EPA's TAR analysis confirms this, and additional technology gains not reflected in the TAR analysis will reduce compliance costs further. The primary factor that has emerged to work against the cost effectiveness of the standards is the reduction in gasoline prices. The gasoline prices used in the TAR, which are from the Energy Information Administration's Annual Energy Outlook (AEO) 2015, are roughly a dollar per gallon lower through 2025 than projected by AEO 2012 Early Release, which was the source of fuel prices in the rule. As demonstrated in the TAR, the impact of those price reductions, while significant, does not alter the conclusion that the standards through 2025 are highly cost effective.

Since the TAR, EIA has released AEO 2017, which further reduces fuel price projections by 4-18% per year between 2025 and 2040. Weighting these price reductions by expected annual miles of travel by a MY 2025 vehicle, the reduction in discounted fuel costs over the life of the vehicle would be about 6%. At the same time, a recent assessment of technology availability and cost conducted by the ICCT indicates a reduction of 34-40% in the cost of compliance in MY 2025 relative to EPA's analyses for the midterm review (Lutsey et al. 2017). This reduction more than offsets the reduction in projected benefits due to the AEO 2017 fuel price projections. Furthermore, preliminary EIA modeling indicates gasoline price projections will rise again slightly in AEO 2018 (EIA 2017). Hence an update to the TAR, PD, and FD analyses can be expected to show further improvement to the cost effectiveness of the MY 2022-2025 standards.

In addition to the "new factors" discussed above, EPA requested comment on the following topic:

The use of alternative methodologies and modeling systems to assess both analytical inputs and the standards, including but not limited to the Department of Energy's (DOE's) Argonne National Laboratory's Autonomie full vehicle simulation tool and DOT's CAFE Compliance and Effects Model.

[18] In our response to the PD, we discussed average vehicle prices limited to years where light truck price data was available. For these comments, and to include light trucks back to 1996, we use DOE VTO Fact of the Week #988, "Average Price of a New Light Vehicle, 1970-2016."

Replacing EPA's methodologies and modeling systems with NHTSA's will detract from the quality and integrity of the standards programs. As noted in the draft TAR:

> [T]he EPA GHG and NHTSA CAFE assessments were done largely independently. These independent analyses were done in part to recognize differences in the agencies' statutory authorities and to reflect independent choices regarding some of the modeling inputs used at this initial stage of our evaluation. The agencies believe that independent and parallel analyses can provide complementary results (EPA et al. 2016, ES-6).

Apart from the agencies' responsibility to conduct independent, complementary analyses using tools appropriate to their respective obligations, the notion that Autonomie is objectively superior to EPA's ALPHA model, or DOT's Volpe model to EPA's OMEGA model, is counter to ACEEE's experience and understanding. At a minimum, inputs to the models used for DOT's analysis have reflected in several instances long-outdated assumptions, inadequate documentation, or opaque results. Moreover, it would be unreasonable to move EPA from purpose-built tools to modeling platforms developed by other entities in the midst of the MTE, and after the primary technical document (i.e., the draft TAR) has been completed.

Furthermore, unlike EPA's ALPHA simulation tool, Autonomie requires users to purchase a license, at considerable cost. ACEEE requested a quote for a single license of MATLAB (December 2, 2015) and was quoted $1,659 for one year of access or $4,846 to purchase it outright. While open-source alternatives to MATLAB exist, Autonomie also requires Simulink and Stateflow, which have no open-source alternatives. For Simulink and Stateflow, a single license is $3,250 each; combined with the MATLAB purchase, the minimum cost to run Autonomie is more than $8,150 (MathWorks 2017a; MathWorks 2017b).

## Reopening MY 2021 Standards

EPA notes that NHTSA may reevaluate model year 2021 standards and that, "in the interest of harmonization between the GHG and CAFE programs," EPA also is requesting comment on whether the model year 2021 standards are appropriate.

The impetus for EPA to reopen the 2021 standards is unclear. In NHTSA EIS comments regarding MY 2021 standards, the automakers' trade groups focused entirely on "harmonization" issues:

> Due to the unfulfilled commitment from the 2012 joint EPA-NHTSA final rule that was touted as creating a truly harmonized set of CAFE and GHG standards, reexamination of MY 2021 requirements is appropriate and NHTSA should consider whether any provisions developed to address harmonization should be applied (AAM and AGA 2017).

The record does not support granting the automakers' requests in their petition, as discussed in ACEEE et al. (2017). In any case, the harmonization requests reference CAFE program changes only, not changes to EPA's GHG program.

Weakening MY 2021 standards would be both inappropriate and unwarranted. Many vehicles of all types already meet future standards. In the 2016 *Trends Report*, EPA notes that, because overall manufacturer compliance is determined on a production-weighted average footprint and $CO_2$ emissions, in future years, only about 50% of manufacturers' vehicles will need to meet or exceed the standard. Table 2 shows that 17% of MY 2016 vehicles already meet or exceed the 2020 standard, and 3.5% meet or exceed the 2025 standard, based on performance over the test cycle. When off-cycle credits are taken into account, over 20% of all MY 2016 vehicles meet or exceed the 2020 standard (Charmley 2017). Even popular SUVs are comfortably meeting future standards. For example, the 2017 Honda CRV all-wheel-drive model meets its 2022 target (Charmley 2017). With an increasing number of models meeting future standards, manufacturers are demonstrating their ability to make the necessary improvements in their product lineups.

Table 2. Number of MY 2016 vehicles that meet or exceed future standards

| Future standard MY | Number of MY 2016 vehicles | Source |
|---|---|---|
| 2020 | 17% | 2016 EPA *Trends Report* |
| 2025 | 3.5% | 2016 EPA *Trends Report* |

Figure 2 shows that the majority of vehicles meeting the MY 2020 standard are conventional gasoline vehicles. Comparing this to the MY 2012 vehicles, where the majority of vehicles meeting the 2020 standard were hybrids, indicates the industry's improvement capabilities.

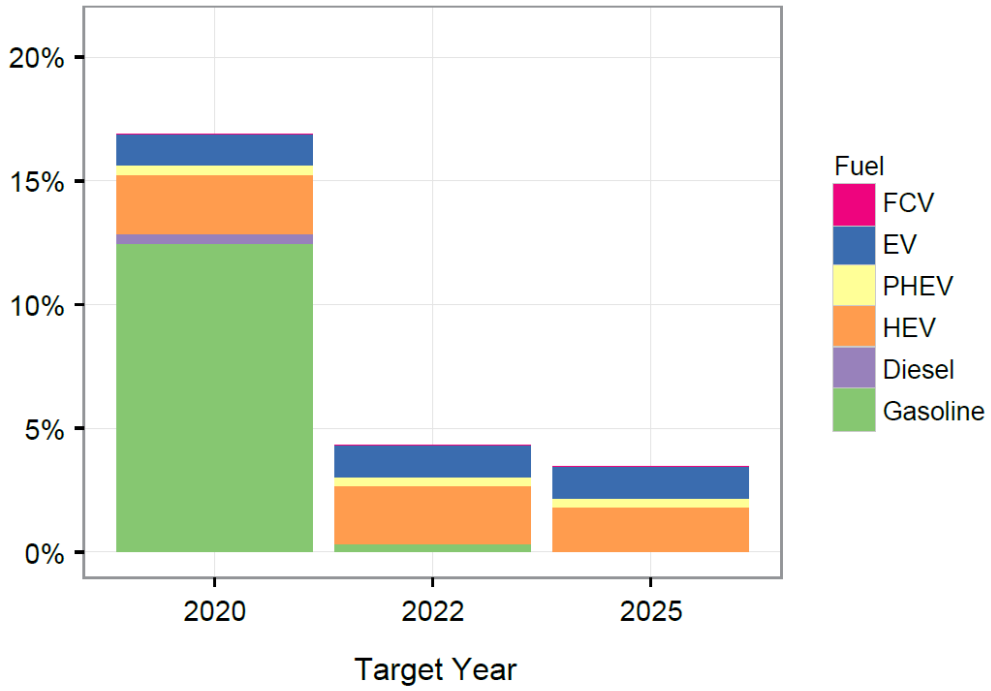


Figure 2. MY 2016 vehicle production that meets or exceeds future $CO_2$ emission targets (EPA 2016b)

Likewise, ICCT recently reported that the 2018 Camry, a very high-volume vehicle, meets its MY 2022 standard on 2-cycle alone. When including off-cycle and A/C credits, the 2018 Camry nearly meets its MY 2024 standard (German 2017).

In addition to producing many conventional vehicles that meet their footprint targets several years into the future, manufacturers have accrued numerous credits that will facilitate their compliance with the standards through at least MY 2021. ACEEE modeled a variety of fleet compliance pathways for future model years by considering the GHG credit provisions. We used EPA's 2015 model year *Manufacturer Performance Report* (EPA 2016a) for fleet performance in MY 2012–2015 and a Novation Analytics report for forecasts of the use of various flexibilities (off-cycle, A/C efficiency, A/C leakage) (Novation 2016).

By overcomplying with the standards in MY 2012–2015, the industry banked more than 285 million metric tons of GHG credits (EPA 2016b). We found that, as a result, the industry would be able to comply through model year 2021 by reducing 2-cycle emissions only 2% per year after MY 2016 and spending down banked credits, while using flexibilities as projected in the draft TAR and the Novation MY 2016 Baseline Study (Novation 2016).[19] This rate of emissions reduction is slower than the improvement achieved between 2012 and 2015 (2.5% per year on average), and it is not credible that industry requires relief from this standard.

[19] MY 2016 flexibility projections are from the Novation MY 2016 Baseline Study. Projected use of flexibilities for MY 2017-2020 are interpolated from Novation's MY 2016 values and MY 2021 values from TAR table 12.7 (cars) and 12.8 (light trucks).

*Light truck targets*

Although the agencies have provided no explanation of why they may consider reopening the MY 2021 standards, some external accounts have drawn attention to the relatively large jump in truck $CO_2$ targets from 2020 to 2021 (Briggs 2017). The increment, however, follows years of minimal reductions in the truck emissions targets at the large end of the footprint spectrum. These minimal reductions were adopted with the understanding that later targets would partially compensate for this early leniency in MY 2021 and beyond. ACEEE expressed concern about this approach in our comments on the proposed rule:

> The small improvements required of large trucks in 2017-2020, followed by a larger improvement in 2021 is of particular concern given the agencies' plan to conduct a midterm evaluation. This situation raises the possibility that the more significant improvements proposed for large trucks in the period 2021-2025 will never be realized, because manufacturers may allow technology development for these vehicles to stagnate in the early years of the rule and use this to influence the outcome of the midterm evaluation (ACEEE 2012).

EPA dismissed this concern, stating in part that "if there are cost effective technologies that have not yet been applied, the manufacturer will implement them in advance in order to earn credits for the 5%/yr period…" (EPA 2012, 2–103). Yet the agencies demonstrated the existence of exactly such "cost effective technologies that have not yet been applied" in producing compliance pathways in the TAR. Both agencies showed that large pickup trucks could meet their emissions targets in 2021; in fact, tables 12.3 and 12.4 in the draft TAR showed light trucks overcomplying in both MY 2021 and MY 2025, offsetting shortfalls in compliance for cars in both years. Hence we do not believe that large trucks' alleged difficulty in meeting MY 2021 targets provides a legitimate reason to reopen MY 2021 standards.

*Loss in savings if standards are held flat at 2020 levels*

ACEEE estimated emissions in various scenarios using Argonne National Laboratory's VISION model (2016 version). Savings from the MY 2022-2025 standards (discussed earlier) were determined by comparing a scenario representing the standards to a scenario in which the standard is held flat at MY 2021 levels. Similarly, we determine the savings from MY 2021-2025 by comparing them to a scenario in which the standard is held flat at MY 2020 levels. Table 3 shows that over the lifetime of the affected vehicles, savings from the MY 2021-2025 standards account for an additional 56% of $CO_2$ emissions and oil use over the MY 2022-2025 standards.

Table 3. Loss in lifetime savings in GHG emissions and oil use relative to existing standards

| Scenario | Affected Model Years | GHG emissions (MMT) | Oil (billion barrels) |
|---|---|---|---|
| Flat at MY 2020 | 2021–2025 | 890 | 1.75 |
| Flat at MY 2021 | 2022–2025 | 571 | 1.12 |

Losses due to these scenarios should also be viewed in terms of annual losses in savings due to weakened emissions standards in all future years, not just the model years nominally covered by the standards. Holding the standards flat at model year 2020 would result in an annual loss of savings of 476 million barrels oil and 226 MMT GHG in 2035 alone, and holding flat at MY 2021 would result in a loss of 354 million barrels and 168 MMT GHG, respectively. Comparing the two scenarios, figure 3 shows that holding the standards flat at MY 2020 would lead to an additional 58 MMT of $CO_2$ emissions in 2035. Similarly, we find that holding the standards flat at MY 2020 levels would increase oil consumption by an additional 0.3 MBD in 2035, or nearly 122 million barrels. Table 4 shows the annual emissions increase associated with keeping the standards flat at model years 2020 and 2021, compared to maintaining the current MY 2022-2025 standards.

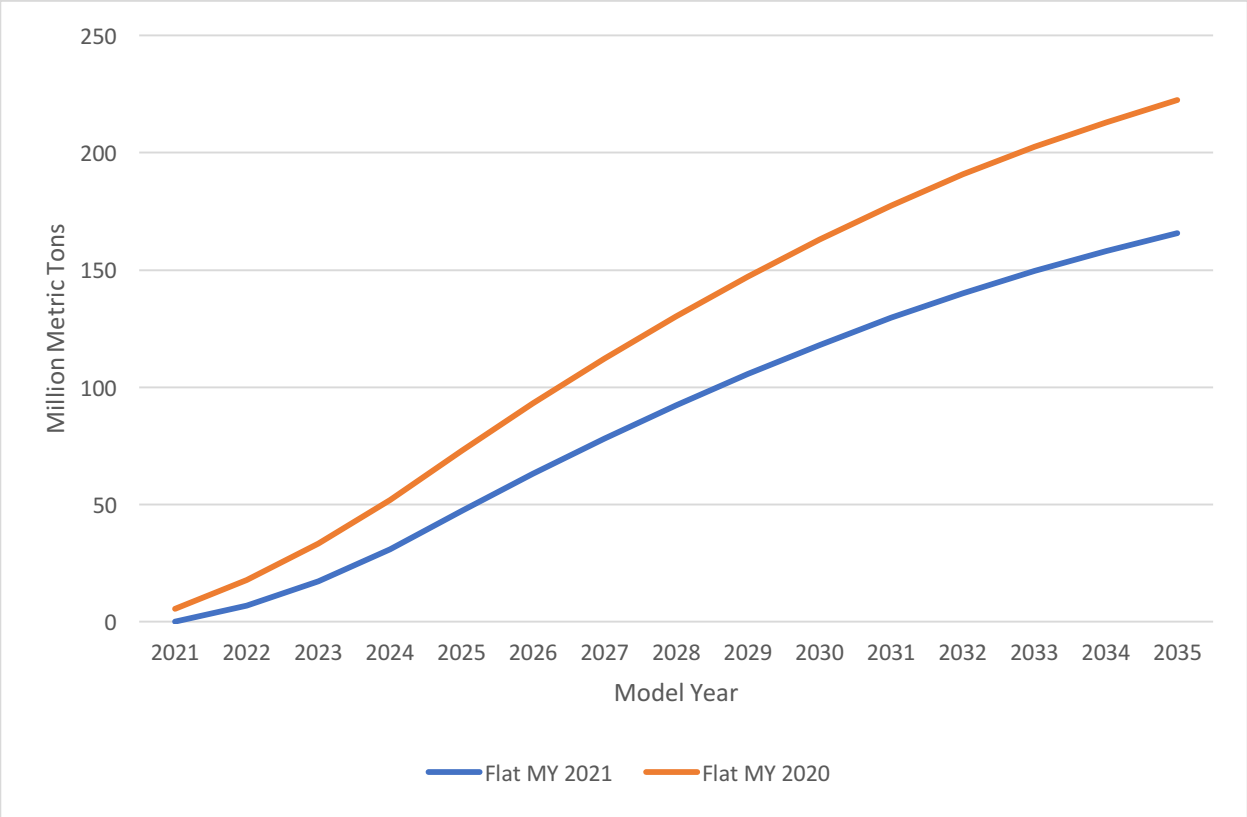


Figure 3. Additional $CO_2$ emissions each year if the standards are kept flat after MY 2020 vs. after MY 2021

Table 4. Annual loss in savings, GHG emissions relative to the standards (million metric tons)

| Scenario | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|
| Flat at 2020 | 73 | 164 | 226 | 263 | 282 | 285 |
| Flat at 2021 | 47 | 119 | 168 | 198 | 213 | 216 |

The central aim of EPA standards is to address emissions, yet these changes would result in a large loss of avoided emissions. As discussed above, there is no evidence that such changes are justified.

## Conclusion

In light of the considerations discussed above and the large volume of evidence produced elsewhere in the midterm evaluation process, ACEEE believes that the light-duty GHG standards for MY 2021–2025 remain appropriate. We urge EPA to finalize standards through 2025 that are at least as strong as those now in place and begin looking forward to the next phase in creating an efficient and sustainable transportation future.

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# Attachment 3

# Addendum to ACEEE comments on Draft TAR

**Addendum to ACEEE Comments to the Environmental Protection Agency and the National Highway Traffic Safety Administration on the Technical Assessment Report; Docket ID No. EPA-HQ-OAR- 2015-0827 and/or Docket No. NHTSA-2016-0068**

November 17, 2016

In our comments of September 26, 2016, ACEEE drew certain conclusions regarding NHTSA's compliance scenario from running the Volpe model. As noted in footnotes 8 and 13 of those comments, we used the "Standard Setting" Volpe settings for this purpose in two cases in which the "Real World" settings would have been more appropriate. This addendum is to revise our comments based on model runs using the correct (i.e. Real World) settings. We note that ACEEE's comments on NHTSA's pickup truck technology utilization in 2025 remain unchanged, because in that case we referenced results based on the Real World settings in our original comments.

**Power-to-Weight Ratio**

In discussing the consequences of NHTSA's allowing vehicle "performance" to increase in its compliance scenario modeling, we stated (p. 9 of ACEEE TAR comments) that the average power-to-weight ratio in the compliance scenario increased relative to the reference case by 4.1% for cars, 7.9% for light trucks, and 5.5% overall. Using the Real World settings, the power-to-weight ratio in 2028 instead increases by 4.0% for cars, 7.4% for light trucks, and 5.5% overall. Hence our conclusion remains unchanged. We reference MY2028 due to NHTSA's identification of MY2028 as the year in which the new vehicle fleet reaches the MY2025 standard through tested fuel economy alone.

**Net Benefits**

Table 13.25 in the draft TAR provides the estimated present value of costs, benefits, and net benefits, over the lifetimes of MY 2016-2028 vehicles, of the MY 2022-2025 standards relative to continuation of the MY 2021 standard. NHTSA finds an $85 billion net benefit from the augural standards. However, using the Volpe model to run other stringencies, we found even greater net benefits from more stringent alternative scenarios.

In our TAR comments, we stated (p.12) that the 6% per year improvement provided the largest net benefits, based on Standard Setting runs. Here we discuss the results using the Real World settings instead, in order to provide the proper comparison with the analysis in the draft TAR. The Real World runs show maximum benefits at even higher rates of improvement, based on benefit and cost outputs from the Volpe model. We used discounted technology costs and maintenance costs from the Volpe "compliance report" and crashes, fatalities, congestion, noise, fuel savings, refueling time, energy security, increased mobility, and pollutant aspects from the "societal costs report". As shown in the table below, maximum net benefits of MY 2022-2025 standards for MY 2016-2028 vehicles occur at 9% per year improvement in fuel economy. The net benefit at 9% per year is $145 billion, compared with $85 billion for the augural standards.

**Net Benefits of MY 2022-2025 Standards over Lifetime of MY 2016-2028 Vehicles**

| Scenario | Net Benefit ($b) |
|---|---|
| %/year improvement | |
| Augural | $ 85 |
| 6% | $ 116 |
| 7% | $ 124 |
| 8% | $ 136 |
| 9% | $ 145 |
| 10% | $ 142 |
| 11% | $ 133 |
| 12% | $ 92 |

Source: ACEEE Volpe model runs

We computed these benefits over the lifetime of MY 2016-2028 vehicles in order to provide a basis for comparison across scenarios. However, standards set at higher rates of increase "stabilize" later, in the sense used by NHTSA in the draft TAR (i.e., the fleet meets the standard based on achieved average miles per gallon alone. While the 9% per year scenario does not stabilize within the time horizon of the Volpe model runs (MY 2032), scenarios of 6% and 7% per year improvement do so, and 8% per year very nearly does so, falling 0.029% short, as shown in the table below.

**Percent Shortfall/Overcompliance with Standards by Model Year, Volpe Model Runs with Real World Settings**

| Achieved vs. Standard MPG | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| MY | Augural | 6% | 7% | 8% | 9% | 10% | 11% | 12% |
| 2015 | -0.31% | -0.31% | -0.31% | -0.31% | -0.31% | -0.31% | -0.31% | -0.31% |
| 2016 | -1.78% | -1.78% | -1.78% | -1.74% | -1.65% | -1.64% | -1.63% | -1.62% |
| 2017 | -0.61% | -0.59% | -0.59% | -0.49% | -0.38% | -0.37% | -0.13% | -0.10% |
| 2018 | 1.94% | 2.45% | 2.82% | 3.31% | 3.62% | 3.90% | 4.28% | 4.68% |
| 2019 | 3.18% | 4.23% | 5.07% | 5.90% | 6.44% | 6.82% | 7.26% | 7.98% |
| 2020 | 4.02% | 5.52% | 6.59% | 7.86% | 8.95% | 9.82% | 10.65% | 11.67% |
| 2021 | 4.94% | 7.43% | 8.91% | 10.78% | 12.68% | 14.57% | 15.89% | 17.43% |
| 2022 | 3.63% | 5.46% | 6.35% | 7.70% | 9.13% | 10.70% | 11.73% | 12.61% |
| 2023 | 1.61% | 2.48% | 2.85% | 3.63% | 4.34% | 5.13% | 5.30% | 5.84% |
| 2024 | -1.01% | -0.85% | -1.18% | -1.03% | -1.21% | -1.38% | -2.16% | -2.08% |
| 2025 | -3.04% | -3.88% | -5.03% | -6.23% | -7.05% | -7.70% | -9.44% | -8.78% |
| 2026 | -1.30% | -1.84% | -2.83% | -4.08% | -4.85% | -5.53% | -7.16% | -6.74% |
| 2027 | 0.42% | -0.26% | -1.16% | -2.26% | -2.71% | -3.12% | -4.51% | -4.54% |
| 2028 | **1.14%** | 0.37% | -0.32% | -1.23% | -1.72% | -2.06% | -2.49% | -2.85% |
| 2029 | 1.45% | **0.85%** | 0.27% | -0.44% | -0.91% | -1.50% | -1.85% | -2.08% |
| 2030 | 1.67% | 1.06% | **0.45%** | -0.26% | -0.67% | -1.29% | -1.51% | -1.67% |
| 2031 | 1.90% | 1.26% | 0.67% | -0.029% | -0.41% | -1.04% | -1.27% | -1.37% |
| 2032 | 1.90% | 1.26% | 0.67% | **-0.029%** | -0.41% | -1.05% | -1.27% | -1.38% |

Source: ACEEE Volpe model runs

Over the lifetime of MY 2016-2032 vehicles, the 8% per year improvement scenario provides maximum net benefits among scenarios that stabilize by that year. The table below compares maximum net benefits under various percent per year improvement scenarios, across three groups of model years: MY 2016-2028 (used in the draft TAR), MY 2022-2025 (the model years nominally covered by the augural standards), and MY 2016-2032 (by which time several scenarios will have stabilized).

**Net Benefits of MY 2022-2025 Standards over Lifetime of Three Vehicle Groups**

| | Net Benefit ($b) | | |
|---|---|---|---|
| **Scenario** | **MY 2016-2028** | **MY 2022-2025** | **MY 2016-2032** |
| %/yr. improvement | | | |
| Augural | $ 85 | $ 36 | $ 134 |
| 6% | $ 116 | $ 48 | $ 177 |
| 7% | $ 124 | $ 50 | $ 182 |
| 8% | $ 136 | $ 58 | **$ 198** |
| 9% | **$ 145** | $ 63 | * |
| 10% | $ 142 | **$ 64** | * |
| 11% | $ 133 | $ 60 | * |
| 12% | $ 92 | $ 45 | * |

Source: ACEEE Volpe model runs

* No value provided for these scenarios because this column is meant to compare only those scenarios that have stabilized by 2032.

For all vehicle groups considered, maximum net benefits occur for a scenario in which the rate of fuel economy increase greatly exceeds the rate in the augural standards. Hence we reaffirm this statement in ACEEE's original comments: "While not dispositive, these results corroborate that the agencies need to investigate the possibility that standards for MY 2022–2025 should be more stringent than the augural standards."

Attachment 4

ACEEE comments on proposed glider repeal

# ACEEE Comments on EPA's Proposed Repeal of Emissions Requirements for Glider Vehicles, Glider Engines, and Glider Kits

**Docket ID No. EPA-HQ-OAR-2014-0827**

**Siddiq Khan, Ph.D.**
**January 5, 2018**

## Introduction

The adoption of the Phase 2 heavy-duty greenhouse gas (GHG) emissions and fuel efficiency standards for heavy-duty vehicles and engines in 2016 (called 'Phase 2' hereafter) would provide substantial gains in fuel efficiency for heavy-duty vehicles by 2027. It would also provide continuity and certainty to vehicle manufacturers, deliver savings at the pump to truck owners and operators, and reduce freight costs to consumers. The Phase 2 program would strengthen the leadership of U.S. manufacturers and suppliers in certain advanced truck technologies in a global market. The Phase 2 program also offers the potential of new jobs in the design and production of new vehicle technologies.

While Phase 2 was a great step forward, the proposed glider repeal that removes gliders from Phase 2 regulation is a big step backward. Exempting gliders would increase fuel consumption and greatly increase emissions from tractor trucks, significantly increasing health risks for all. The proposed glider rule is detrimental in several fundamental ways, as discussed below.

## Removing glider trucks from Phase 2 will increase fuel consumption

EPA proposed to repeal the glider provisions of Phase 2 following a July 10, 2017 petition for reconsideration of the application of the Phase 2 rule to gliders. The petition was submitted by Fitzgerald Glider Kits LLC, Harrison Truck Centers, Inc., and Indiana Phoenix, Inc., collectively "the petitioners".[1] EPA in its proposed repeal cites various claims of the petitioners, including, ''Glider vehicle GHG emissions are less than those of OEM vehicles…due to gliders' greater fuel efficiency,'' (p. 53444). EPA seeks information and analysis addressing the question of whether glider vehicles produce significantly fewer emissions overall compared to the older trucks they would replace.

*Response.* The assertion that glider vehicles have lower emissions and higher fuel efficiency than all-new vehicles is incorrect for multiple reasons. To begin, most glider engines will have higher emissions and lower efficiency than new engines. Most gliders use pre-2002 model year engines, in some cases remanufactured, which were built before the commercialization of exhaust gas recirculation (EGR).[2] A remanufactured engine is spec'd to the original blueprints and exact specifications, and is therefore unlikely to differ in efficiency from the original engine.[3] While EGR helped control engine-out oxides of nitrogen (NOx) emissions, it typically resulted in a loss in efficiency. However, subsequent regulations from EPA and innovation from engine manufacturers helped eliminate that efficiency penalty in 2007 and 2010.[4, 5] By 2010, engine brake thermal efficiency (BTE) exceeded pre-2002 efficiency due to engine improvements and the use of selective catalytic reduction (SCR). SCR alone provided up to 5% fuel savings.[6] As we see in figure 1, pre-2000 heavy-duty engines had 38% BTE while post-2010 engines

[1] https://www.epa.gov/sites/production/files/2017-07/documents/hd-ghg-fr-fitzgerald-recons-petition-2017-07-10.pdf
[2] Phase 2 rule (FR Vol. 81, No. 206, October 25, 2016), p. 73943
[3] https://www.jasperengines.com/remanufactured-diesel-faq
[4] https://energy.gov/sites/prod/files/2014/03/f8/deer11_greszler.pdf
[5] https://www.theicct.org/sites/default/files/publications/HDV_engine-efficiency-eval_WVU-rpt_oct2014.pdf
[6] https://www.dieselforum.org/about-clean-diesel/what-is-scr

had 39-40% BTE.[7] Figure 1, copied from a 2014 West Virginia University Report, shows engine BTE over the Federal Test Procedure (FTP) cycle, calculated from WVU's large database of engine and chassis dynamometer test data. The figure also displays historical values of peak BTE calculated from brake-specific fuel consumption presented by Volvo at DOE's 2011 Directions in Engine-Efficiency and Emissions Research (DEER) Conference.

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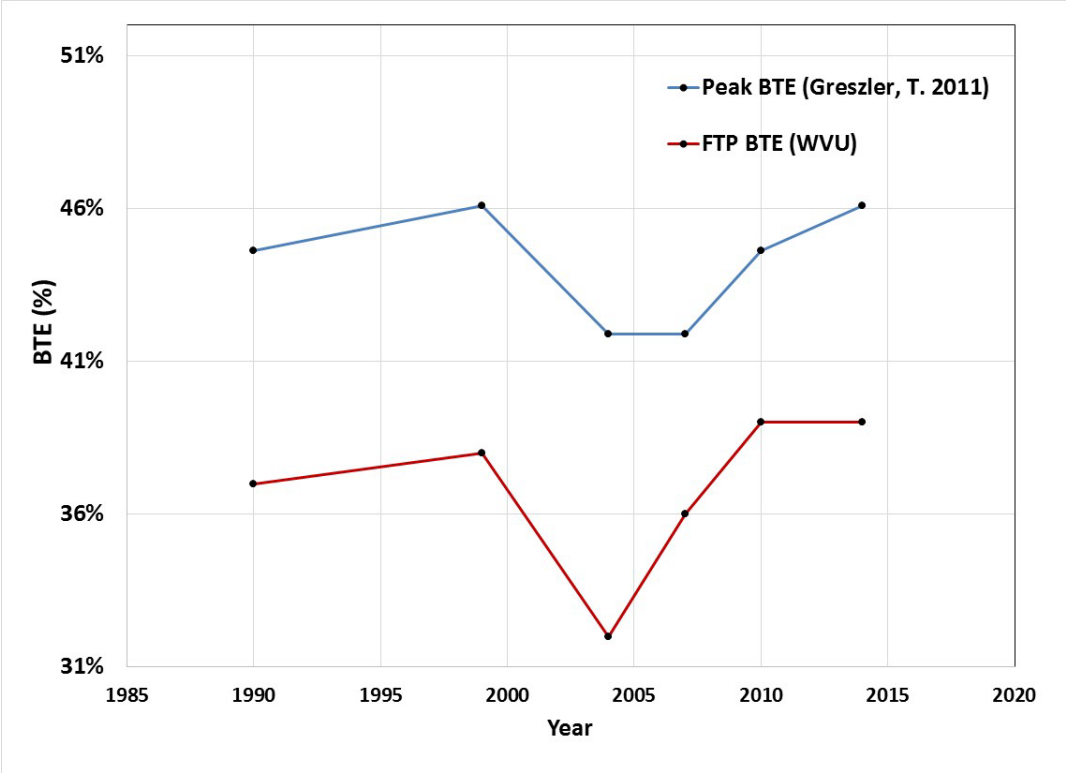


Figure 1 Historical changes in heavy-duty engine efficiency from WVU FTP and Volvo peak BTE, Source: WVU

The Phases 1 and 2 heavy-duty GHG emissions and fuel efficiency program will make engines even more efficient. The Phase 1 program improved fuel efficiency of 2010 model year heavy-duty diesel engines by about 6% while Phase 2 would further improve their efficiency by 5% from the 2017 level. As result, Phase 2-compliant engines would have 45% or higher BTE. Therefore, pre-2002 engines used in glider vehicles would be more than 10% less efficient than Phase 2 compliant engines.

The inefficiencies of unregulated gliders would go well beyond the engine. The Phase 2 rule will improve the efficiency of the whole truck: engine, transmission, body, and trailer. Manufacturers have to improve truck aerodynamics, tires, and other areas. Although glider bodies are new, they will not need to adopt efficiency technologies if glider trucks are not subject to the standard. Hence, it should be assumed there would be no improvement in the fuel efficiency of these vehicles over time. Given sales of 10,000 gliders per year, or about 5% of tractor sales, no improvement in glider fuel efficiency would mean a loss of 5% in the fuel savings of the tractor truck standards, which, in ACEEE estimate,

[7] Brake thermal efficiency, BTE is a measure of engine efficiency, that is, how an engine converts its heat input into mechanical energy.

would be about 21,000 barrels of oil per day in 2035.[8] Furthermore, the glider repeal could produce further losses by driving additional glider sales in the future.

Finally, we note that, if gliders did in fact have better fuel efficiency than the all-new trucks subject to standards, then they would have no difficulty complying with the standards and there would be no need to exempt them.

## Glider engines will greatly increase NOx and PM emissions

EPA in its proposal cited the petitioners' reference to a Tennessee Technological University Study that ''analyz[ed] the NOX, PM, and carbon monoxide . . . emissions from both remanufactured and OEM engines,'' and ''reached a contrary conclusion," meaning emissions of these pollutants from glider vehicles were found to be lower than those from OEM engines (p. 53443). EPA seeks comment on the relative expected emissions impacts if the regulatory requirements at issue here were to be repealed or were to be left in place (p. 53447).

*Response.* The assertion that emissions from glider vehicles are lower than those from new vehicles is not credible, and the evidence in the record in support of this claim is flawed.

In reversing its own earlier conclusions regarding the need to regulate gliders, EPA has cited only the claims of the petitioners, who used data from a flawed Tennessee Technological University (TTU) study, and failed to counter those claims with their own data in the proposal. TTU used a test facility that was owned by one of the petitioners.[9] TTU did not do repeat emissions testing. They did not collect any PM samples but instead made a visual assessment of PM, which is a primitive method relative to today's PM measurement protocols and is completely unacceptable in view of the current understanding of the disproportionate impact of ultrafine diesel particles on human health. The TTU study used a different test cycle than the standards require and did not follow standard test protocols. The TTU study reported a range of 0.44 to 6.45 grams per horsepower-hour for NOx emissions from eight gliders and five OEM trucks they tested, stating that the lowest emissions came from a glider truck; but did not present the individual NOx levels from other glider trucks. Yet, based on these shoddy claims from the petitioners, EPA highlighted their claim of about equal or lower NOx emissions from glider trucks in the proposal. We also note that the reported NOx levels are between 2 times and 32 times the NOx limit for post-2010 engines.[10] EPA also cited without examination the petitioners' claims of equal or lower PM emissions and higher fuel efficiency of glider vehicles.[9]

EPA has made remarkable progress in reducing engine out emissions from on-road diesel vehicles. Thanks to EPA regulations in the last decade, oxides of nitrogen (NOx) and particulate matter (PM) emissions from new diesel engines are more than 90% below what they were 15 years ago.[10] The proposed repeal of glider provisions in the Phase 2 heavy-duty rule would keep older engines on the road and greatly increase harmful emissions. Glider engines emit high levels of NOx, PM, CO, and HC, since most gliders use pre-2002 model year engines, which were not equipped with EGR and SCR, two important technologies that were commercialized in 2002 and 2010, respectively, to reduce NOx and

[8] EPA-420-F-15-904, July 2015

[9] EPA memorandum from George Mitchell to docket EPA-HQ-OAR-2014-0827, dated November 13, 2017

[10] https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100O9ZZ.pdf

other emissions. Pre-2002 engines did not have diesel particulate filters (DPFs), which were commercialized in 2007 and helped reduce diesel PM by more than 90%.[11] EGR and SCR could reduce NOx emissions by up to 90 percent and particulate matter (PM) emissions by 30-50 percent while simultaneously reducing hydrocarbons (HC) and carbon monoxide (CO) emissions by 50-90 percent.[12] EGR helped manufacturers achieve the 2 grams per brake horsepower-hour NOx standards in 2002.[13] Therefore, glider engines could be expected to produce significantly higher NOx and PM emissions than post-2010 engines.

Recent EPA data validates that claim. Two 2016 and 2017 model year glider trucks in recent EPA chassis testing were found to emit up to 43 and 450 times as much NOx and PM emissions, respectively, as 2014 and 2015 model year tractor trucks.[14] In fact, while testing for particulates, EPA had to adjust the flow of exhaust through their system because the levels were so high that the sensor could not effectively measure them. In the Phase 2 rule, EPA noted in support of regulating glider engines that if "engines lack both EGR and exhaust aftertreatment, they would have NOx and PM emissions 20–40 times higher than current engines. If miscalibrated, emissions could be even higher."[15]

Such levels of emissions would significantly increase total truck emissions. EPA's analysis showed that if gliders were not regulated, glider vehicles on the road in 2025 would emit nearly 300,000 tons of NOx and nearly 8,000 tons of PM annually, about one third of projected NOx and PM emissions from heavy-duty tractor trucks in 2025.[15] Such high levels of NOx and PM emissions would have a substantial impact on human health. Exposure to particulates can affect human lungs and hearts, while NOx exposure can lead to asthma and respiratory infections. EPA estimated that the removal of all unregulated glider vehicle emissions from the atmosphere would yield between $6 to $14 billion in benefits annually (2013$).[15]

## Documentation of claims in the EPA proposal is woefully inadequate

As shown in the previous section, the quality of the technical case for the proposed repeal is very poor. This stands in sharp contrast to the careful work EPA did to develop appropriate assumptions and analyses for the truck standards adopted last fall. For example, EPA in the Phase 2 final rule cited glider sales data from both parties who opposed and parties who supported regulation of gliders. Furthermore, EPA's past proposed rules were accompanied by a comprehensive regulatory impact assessment (RIA), which was notably absent in this proposed repeal. In the proposal, EPA failed even to mention its own earlier conclusions, presented in the Phase 2 rule, that glider trucks would have NOx and PM emissions 20–40 times higher than current engines.[15]

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[11] https://www.arb.ca.gov/msprog/onrdiesel/documents/DPFEval.pdf

[12] https://www.dieselforum.org/about-clean-diesel/what-is-scr

[13] https://www.dieselnet.com/tech/engine_egr.php

[14] EPA. Chassis Dynamometer Testing of Two Recent Model Year Heavy-Duty On-Highway Diesel Glider Vehicles. Ann Arbor. November 20, 2017

[15] Phase 2 rule (FR Vol. 81, No. 206, October 25, 2016), p. 73943

## Glider trucks are not a suitable option for small business and independent operators

EPA states in the proposal its belief "that a glider vehicle is often a suitable option for those small businesses and independent operators who cannot afford to purchase a new vehicle, but who wish to replace an older vehicle with a vehicle that is equipped with up-to-date safety features" (pp. 53446-53447). EPA "solicits comment and information on whether limiting the availability of glider vehicles could result in older, less safe, more-polluting trucks remaining on the road that much longer" (p. 53447).

*Response.* The assumption that small business and independent operators must choose between buying a gilder vehicle and keeping an older vehicle on the road is unsubstantiated. Glider trucks are about 10% to 25% cheaper than similarly spec'd OEM trucks, which translates to about $15,000 to $35,000 less in upfront costs.[16] However, current model OEM trucks are over 20% more fuel-efficient than 2010 model year trucks and therefore will save more than $15,000 in fuel costs per year at today's diesel fuel price. Hence, owners would typically recover the additional upfront costs of the newer trucks that comply with the standards in less than two years. Therefore, buying a glider truck instead of an all-new tractor is not a beneficial option for any purchaser.

Historically, glider sales have been very small compared to overall tractor truck sales. Until recently, annual glider production was less than 1,000, or less than 1% of the tractor truck market. Sales have increased sharply in the last few years, jumping to almost 10,000 in 2015, which is 5% of the tractor truck market.[17] According to EPA, the surge in glider sales is attributable to fleets' avoiding use of 2010 emissions-compliant engines.[18] This is not a trend that EPA should enable and promote by repealing emissions requirements for glider vehicles.

## Conclusion

ACEEE strongly opposes EPA's proposal to repeal emissions requirements for glider vehicles, glider engines, and glider kits from the Phase 2 standards. Repealing the glider provisions is unjustified and unnecessary, and would be a big step backwards. The proposal lacks technical merit and the documentation was woefully inadequate. This repeal promotes the use of old technology over innovation, encourages inefficiency, and protects the interests of the few at the expense of the general public.

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[16] https://www.overdriveonline.com/gliders-101-five-common-questions-about-glider-kits-answered/

[17] EPA-HQ-OAR-2014-0827-2379

[18] EPA-420-F-15-904, July 2015