Institute for Policy Integrity
NEW YORK UNIVERSITY SCHOOL OF LAW

October 26, 2018

VIA ELECTRONIC SUBMISSION

Attn: Christopher Lieske, Office of Transportation and Air Quality, Assessment and Standards Division, Environmental Protection Agency (EPA)

Re: The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks, EPA–HQ–OAR–2018–0283; FRL–9981–74–OAR; RIN 2127–AL76; RIN 2060–AU09

The Institute for Policy Integrity ("Policy Integrity") at New York University School of Law[1] submits the following comments on The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks, 83 Fed. Reg. 42986 (Aug. 24, 2018) ("Proposed Rule").

In the Proposed Rule, the Environmental Protection Agency ("EPA") proposes to reverse course on its final greenhouse gas emissions standards for 2021-2025 ("GHG Standards") and the National Highway Traffic Safety Administration ("NHTSA") proposes to reverse course on the Corporate Average Fuel Economy standards for 2021 as well as the augural standards for 2022-2025 ("CAFE standards") (collectively the "baseline standards").[2]

Policy Integrity is a non-partisan think tank dedicated to improving the quality of government decisionmaking through advocacy and scholarship in the fields of administrative law, economics, and public policy. We write to make the following comments, as more fully described herein:

1. The agencies' approach to weighing their statutory factors is unreasonable.

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[1] This document does not purport to present New York University School of Law's views, if any.

[2] In 2012, EPA set standards for cars and light trucks sold in model years 2017 to 2025. 2017 and Later Model Year Light-Duty vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards 77 Fed. Reg. 62,624 (Oct. 12, 2012) [hereafter "baseline standards"]. NHTSA set final fuel economy standards for model years 2017 to 2021 and non-final "augural" standards for model years 2022 to 2025, meaning that those standards represented the agencies' "best estimate" of the appropriate level of stringency for those model years, based on the information available in 2012. *Id.* at 62,627.

2. The agencies have arbitrarily inflated the costs of the baseline standards through several unreasonable assumptions about compliance costs and the extent to which manufacturers pass those costs through to consumers.
3. The agencies have arbitrarily ignored consumer valuation of fuel savings and the welfare benefits of the baseline standards.
4. The agencies' analysis is riddled with econometric errors.
5. The agencies' assumptions about the impact of the baseline standards on fleet composition, vehicle travel, and safety arbitrarily disregard basic economic theory.
6. The agencies' choice of rebound estimate is arbitrary and capricious.
7. Potential changes in the mass of vehicles caused by the baseline standards do not support the Proposed Rule.
8. The agencies' employment analysis is incomplete.
9. The agencies' emissions analysis is inaccurate and incomplete.
10. The agencies' have arbitrarily failed to provide missing information necessary for meaningful public review of the Proposed Rule.

In addition, Policy Integrity is submitting the following three sets of comments under separate cover, which are incorporated herein:[3]

1. Comments explaining that EPA cannot legally withdraw the Clean Air Act preemption waiver granted to California in 2013 for the greenhouse gas and zero emission vehicle requirements of its Advanced Clean Cars program.
2. Comments, submitted together with several other organizations, explaining how the agencies' analysis of the social cost of carbon in the Proposed Rule is inconsistent with best available science, best practices for economic analysis, and legal standards for rational decisionmaking.
3. Comments, submitted together with several other organizations, explaining how NHTSA's analysis of the social cost of carbon in the Draft Environmental Impact Statement for the Safer Affordable Fuel-Efficient Vehicles Rule for Model Year 2022-2026 Passenger Cars and Light Trucks is inconsistent with best available science, best practices for economic analysis, and legal standards for rational decisionmaking.

The references cited herein are provided in a bibliography at the end of these comments.

[3] All three sets of comments are available here: https://policyintegrity.org/what-we-do/update/3190.

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In their justification for the Proposed Rule,[4] the National Highway Traffic Safety Administration ("NHTSA") and the Environmental Protection Agency ("EPA") (collectively the "agencies") rely heavily on the argument that the baseline standards will substantially increase costs which, in turn, will translate into higher prices faced by new car purchasers. NHTSA estimates that vehicle prices will be approximately $2,700 higher by 2029 under the baseline standards.[5] EPA similarly estimates that vehicle prices will be $2,800 higher in 2030, including maintenance and other costs.[6] Discouraged by the price surge, so the agencies argue, used car scrappage will decrease as consumers increasingly rely on used cars for their transportation needs and retain and drive those cars more. This analysis is the core of the agencies' decision to roll back the baseline standards.

In our comments, we show that the agencies' analysis produced biased and irrational results at each of the steps in that causal chain, leading to a Proposed Rule that vastly overstates the benefits of the rollback and understates the benefits society foregoes with the rollback. The agencies should not finalize the Proposed Rule.

I. THE AGENCIES' APPROACH TO WEIGHING THEIR STATUTORY FACTORS IS UNREASONABLE

In attempting to carry out their statutory mandates to conserve energy[7] and protect public welfare,[8] the agencies have unreasonably interpreted their statutory factors, arbitrarily overlooked important parts of the problem, and fixated on a subset of issues in ways that Congress did not intend. They have misidentified the market failures and problems that their proposed rollback intends to address, and have relied on a biased and manipulated cost-benefit analysis to justify their proposal. A full and balanced analysis of all the costs and benefits that the agencies are charged with considering would reveal—as the midterm review recently confirmed—that the baseline standards will deliver massive net social benefits, and the proposed rollback is unjustified.

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4 The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks, 83 Fed. Reg. 42986 (Aug. 24, 2018) [hereafter "Proposed Rule"].

5 83 Fed. Reg. at 42,994; *see also id.* at 43,263-64, Table VII-4 (see last two rows for MY2025).

6 *Id.* at 43,229 (explaining that these costs "could be passed on to consumers").

7 83 Fed. Reg. at 42,995, 43,015, 43,205 (conceding that EPCA ultimately requires NHTSA to set standards to conserve energy).

8 42 U.S.C. § 7521(a)(1).

A. Standards of rationality for regulatory decisionmaking

Agencies are constrained by the standards of rationality both in interpreting statutory factors[9] and in exercising their regulatory decisionmaking.[10] Agencies may not rely on factors that Congress did not intend for them to consider, fail entirely to consider an important aspect of the problem, or offer an explanation for their decision that runs counter to the evidence before them. Additionally, when agencies propose to reverse course from a prior reasoned decisionmaking—as the agencies propose to do here—they must provide a "reasoned explanation" for dismissing the "facts and circumstances that underlay" the original rule.[11] Finally, agencies' regulatory decisions must stay within the overarching bounds of their statutory mandate.[12]

B. NHTSA's approach to its statutory factors is unreasonable

The Energy Policy and Conservation Act (EPCA) requires NHTSA to set the maximum feasible fuel economy standards after considering technological feasibility, economic practicability, the effect of other motor vehicle standards of the Government on fuel economy, and the need of the United States to conserve energy.[13] NHTSA admits that the overarching mandate under EPCA is to conserve energy.[14]

Need to Conserve Energy: NHTSA has unreasonably defined the "need . . . to conserve energy" factor and has unreasonably ignored aspects of this issue.

To start, the agencies falsely and inconsistently argue that the need to conserve energy has diminished because U.S. reliance on foreign oil has decreased.[15] At the most extreme, the agencies claim that the rollback will result in zero monopsony costs and zero national security costs because the United States is so close to self-sufficiency in its petroleum supply that it is

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9 Chevron U.S.A. Inc. v. NRDC, 467 U.S. 837 (1984).

10 Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Ins. Co., 463 U.S. 29, 43, 48 (1983).

11 *F.C.C. v. Fox Television Stations*, 556 U.S. 502, 515-16 (2009).

12 *See, e.g., Center for Biological Diversity v. NHTSA*, 538 F.3d 1172, 1195 (9th Cir. 2008) (noting that NHTSA's balancing of statutory factors cannot undermine the "fundamental purpose" of the EPCA); *Clean Air Council v. Pruitt*, 862 F.3d 1, 9 (D.C. Cir. 2017) ("It is 'axiomatic' that 'administrative agencies may act only pursuant to authority delegated to them by Congress.'") (quoting *Verizon v. FCC*, 740 F.3d623, 632 (D.C. Cir. 2014)).

13 49 U.S.C. § 32902(f).

14 83 Fed. Reg. at 42,995, 43,015, 43,205 (conceding that EPCA ultimately requires NHTSA to set standards to conserve energy).

15 83 Fed. Reg. at 43,214-15.

"unlikely" that imports would increase as a consequence of the proposed rollback.[16] That assumption is wrong for several reasons, and is inconsistent with other parts of the analysis:

- The latest *Annual Energy Outlook* from the Energy Information Administration projects that the United States will continue to import crude oil through 2050 and "remains a net importer of petroleum and other liquids on an energy basis."[17]
- But even assuming that the United States will soon become a net exporter of petroleum, there are still foreign suppliers in the meantime, and there would continue to be foreign suppliers even after the United States achieves net-export status.[18] Petroleum prices are set in a global market. And because oil is a global market, how much we produce is irrelevant to U.S. exposure to price shocks; the United States will remain vulnerable.[19]
- Moreover, the assumption that the increased petroleum consumption caused by the proposed rollback will be met through 0% imports[20] is also wildly inconsistent with the assumptions made elsewhere in the analysis. For the purposes of calculating the energy price shock effect, the agencies assume that—through the year 2050—75% of the increase in fuel consumption resulting from lower CAFE and CO_2 emissions standards will be reflected in increased U.S. imports."[21] For calculating upstream emissions effects, the agencies assume that—through the year 2050—50% of increased gasoline consumption would be supplied by increased domestic refining and that 90% of this additional refining would use imported crude petroleum."[22] In total, the upstream emission calculations assume that 95%[23] of increased consumption will either be from foreign refining or from foreign crude imports. The agencies inconsistently and opportunistically assume 0% imports when it serves their purposes, but

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16 NHTSA & EPA, Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Year 2021-2026 Passenger Cars and Light Trucks Preliminary Regulatory Impact Analysis 1068, 1077 (Aug. 23, 2018) [hereafter "PRIA"].

17 EIA (2018a), at 24 (showing projections for the reference case); *cf. id.* at 53-54 (showing that the United States is a "modest net export of petroleum *on a volume basis* from 2029 to 20245," as compared to on an energy basis; and showing that under certain oil price scenarios, the United States remains a net importer even on a volume basis; and showing that in the reference case, "the United States returns to being a net petroleum importer in 2045 on a volume basis"). Notably, the AEO2018 assumes that all "current laws and regulations . . . are unchanged throughout the projection period," *id.* at 8, meaning it assumes that the current standards under the 2012 rule will stay in force. Under the proposed rollback, as U.S. demand for petroleum increases, projections for imports could change. *See* EIA (2018b), at 26 ("CAFE standards are increased . . . to meet augural CAFE standards for model year 2022 to 2025," after which "CAFE standards are held constant" at MY2025 levels "through the end of the projection.").

18 EIA (2018a), at 24 (2018) (explaining that even if the United States becomes a net energy exporter, "both imports and exports continue through the projection period").

19 *See* Letter to the Agencies from Jason Bordoff (Oct. 22, 208), https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-3906

20 PRIA at 1068, 1077

21 PRIA at 1073.

22 PRIA at 1291.

23 50% + (50% * 90%) = 95%.

elsewhere in the Proposed Rule, when a different estimate suits them, they instead assume 95% imports. This is patently arbitrary.

- The agencies wrongly conclude that national security costs are zero based on the fact that the "size" of the Strategic Petroleum Reserve (SPR) has not historically varied in response to the level of U.S. petroleum consumption or imports.[24] However, "the budgetary costs for maintaining [the size of] the SPR" is only one possible effect of changes in the level of petroleum consumption or imports. Regardless of whether the United States actually changes the *size* of the SPR in real time to respond to changing levels of U.S. petroleum consumption, the *protective value* that the SPR offers given its size does automatically change as total U.S. petroleum consumption changes.[25] The agencies have failed to assess how much the relative protective value of the SPR will change as total U.S. consumption rises following the proposed rollback, and therefore have failed entirely to consider one important element of the national need to conserve energy.

The agencies also wrongly argue that assessing how environmental considerations create a need to conserve energy is "complicated,"[26] that the 2012 standards may not "sufficiently address climate change to merit their costs,"[27] and that increasing the standards is not "necessary to avoid destructive or wasteful use of energy."[28] The agencies attempt to belittle the standards' effect on climate as "small" by focusing on temperature degree effects rather than on economic impacts.[29] In fact—as detailed in separate comments that Policy Integrity submitted jointly with other organizations—assessing the climate effects of the proposed rollback versus the 2012 standards is not "complicated"; it is quite easily accomplished by monetizing climate damages using the social cost of greenhouse gas metrics. Once climate damages are more fully monetized (as the agencies are required to do[30]), it will become apparent that the proposed rollback will cause billions of dollars in climate damages. Billions of dollars lost to avoidable climate damages is not a small effect, and it very clearly is a "destructive and wasteful" effect. This approach in no way

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24 PRIA at 1077.

25 Dept. of Energy, *Long-Term Strategic Review of the U.S. Strategic Petroleum Reserve: Report to Congress* 64 (2016), https://www.energy.gov/sites/prod/files/2016/09/f33/Long-Term%20Strategic%20Review%20of%20the%20U.%20S.%20Strategic%20Petroleum%20Reserve%20Report%20to%20Congress_0.pdf ("The value of the SPR over the coming decades will be affected by the evolution of future world crude oil markets in terms of future oil price levels and quantities of oil produced and consumed globally.").

26 83 Fed. Reg. at 43,215.

27 *Id.*

28 *Id.*

29 *Id.* at 43,216.

30 See our separate Joint Comments on the Social Cost of Greenhouse Gases, available at https://policyintegrity.org/what-we-do/update/3190 (explaining how the agencies have improperly manipulated and undervalued the climate damage calculations).

places "an outsized emphasis"[31] on this consideration; to the contrary, it simply uses monetization to translate effects into the same metric of dollars that the agencies use to value all other costs and benefits in the proposed rollback. As the agencies explained in the 2012 rule, monetization is an "appropriate[ ]" tool to put climate benefits "in context in the rule."[32] An apples-to-apples comparison of more fully monetized costs and benefits would show—just as the agencies concluded in the 2012 rule—that the climate benefits of the 2012 standards alone offset a significant portion of the technology costs, and together with the other significant private and social benefits, the benefits well justify the costs of the 2012 standards.[33] In addition, if anything, the need to conserve energy to prevent climate and other environmental externalities is only more urgent now than it was during the 2012 rulemaking.[34]

NHTSA's discussion of the "need to conserve" factor also gives short shrift to non-climate environmental externalities, only briefly mentioning the possible effects on other emissions without detailing any of the myriad non-climate public health and welfare consequences from pollution associated with petroleum production and combustion for motor vehicles.[35]

The agencies also wrongly concludes that consumers' need to save money is now "less urgent" and no longer supports a strong overall need to conserve energy.[36] The agencies assert that past

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[31] 83 Fed. Reg. at 43,216.

[32] 77 Fed. Reg. at 62,898. Far from giving monetized climate benefits outsized weight in the 2012 rule, the agencies did not select more stringent standards that would have had even larger net benefit figures. If anything, the agencies gave "outsized" weight in the 2012 rule to economic practicability in selecting a standard that did not maximize net benefits. *Id.* at 63,055 ("We recognize that higher standards would help the need of the nation to conserve more energy . . . [but] [w]e conclude that the correct balancing recognizes economic practicability concerns . . . and sets standards at the [less stringent] levels that the agency is promulgating.").

[33] NHTSA, *Final Regulatory Impact Analysis: Corporate Average Fuel Economy for MY 2017-MY 2025 Passenger Cars and Light Trucks* at 51 (2012) [hereafter "NHTSA 2012 FRIA"] (showing cost and benefit estimates at a 7% discount). Note that even these monetizations of climate damages are almost certainly a severe underestimate. Consideration of unquantified benefits further justifies the 2012 standards. *See* 77 Fed. Reg. at 63,079-80 ("Similarly, the agency's estimate of the value of reduced climate-related economic damages from lower emissions of GHGs excludes many sources of potential benefits from reducing the pace and extent of global climate change. For example, none of the three models used to value climate-related economic damages includes those resulting from ocean acidification or loss of species and wildlife. The models also may not adequately capture certain other impacts, including potentially abrupt changes in climate associated with thresholds that govern climate system responses, interregional interactions such as global security impacts of extreme warming, or limited near-term substitutability between damage to natural systems and increased consumption. Including monetized estimates of benefits from reducing the extent of climate change and these associated impacts would increase the agency's estimates of benefits from adopting higher CAFE standards.").

[34] *See* Intergovernmental Panel on Climate Change, *Global Warming of 1.5ºC: Summary for Policymakers* at SPM-4, SPM-11 (2018), http://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf (reporting with high confidence that warming could likely reach 1.5 degrees by 2030, and detailing the associated risks to health, livelihoods, food security, water supply, human security, and economic growth).

[35] 83 Fed. Reg. at 43,211.

[36] 83 Fed. Reg. at 43,216.

rulemakings were overly and paternalistically focused on "myopia."[37] This statement ignores all the other pathways through which the 2012 standards benefit consumers' need to save money, including by correcting informational asymmetries, attention costs, and other informational failures; positional externalities; and various other supply-side and demand-side explanations for consumers' inability to achieve in an unregulated market the level of fuel economy that they desire. These components of the national need to conserve energy are discussed at length throughout these comments, and were specifically considered by the agencies in the 2012 rule.[38]

Indeed, more broadly, NHTSA has failed to adequately explain its shift since 2012 in its interpretation and application of the need to conserve energy factor. In the 2012 Clean Car Standards, NHTSA noted that the fuel savings of the rule allowed it to comply with the purposes of the statute, estimating that the rule's "fuel economy increases would lead to fuel savings totaling a range from 180 billion to 184 billion gallons."[39] Actual fuel savings, and the associated benefits to consumers, the environment, and society, were at the heart of NHTSA's analysis of the need to conserve energy factor back in 2012.[40] Now the agency ignores those conclusions from 2012 and relies on mistaken and inconsistent interpretations of petroleum import projections and the urgency of climate change to justify ignoring this statutory factor and giving primacy instead to economic practicability and safety effects. The failure to explain this shift in approach is arbitrary.

Economic Practicability: NHTSA discusses consumer valuation, price effects, sales effects, and job impacts in the context of its economic practicability factor. These comments discuss at length how NHTSA has inappropriately analyzed many of these elements of the economic practicability test.

NHTSA additionally claims that economic practicability also encompasses "harm to the nation's economy caused by highway fatalities,"[41] even as the agency also counts safety as its own separate factor.[42] First, NHTSA has miscalculated the safety impacts, as discussed throughout these comments. But second, it is arbitrary to fully include the alleged "harm to the nation's economy caused by highway fatalities" as part of economic practicability even while the agency ignores and undercounts various harms to the nation's economy caused by climate- and pollution-related fatalities, illnesses, and other welfare impacts. Neither under the need to

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37 Id.

38 77 Fed. Reg. at 62,914.

39 77 Fed. Reg. at 63,059.

40 *E.g.*, 77 Fed. Reg. 63,077 (stating that the rule's fuel economy savings offset any rebound-related costs of the rule, producing "significant benefits to society.").

41 83 Fed. Reg. at 43,209.

42 83 Fed. Reg. at 43,226.

conserve energy factor, as noted above, nor under the economic practicability factor does NHTSA fully weigh the monetized damages associated with such climate impacts[43] as:

- property lost or damaged by sea-level rise, coastal storms, flooding, and other extreme weather events, as well as the cost of protecting vulnerable property and the cost of resettlement following property losses;
- changes in energy demand, from temperature-related changes to the demand for cooling and heating;
- lost productivity and other impacts to agriculture, forestry, and fisheries, due to alterations in temperature, precipitation, CO_2 fertilization, and other climate effects;
- human health impacts, including cardiovascular and respiratory mortality from heat-related illnesses, changing disease vectors like malaria and dengue fever, increased diarrhea, and changes in associated pollution;
- changes in fresh water availability;
- ecosystem service impacts;
- impacts to outdoor recreation and other non-market amenities; and
- catastrophic impacts, including potentially rapid sea-level rise, damages at very high temperatures, or unknown events.

It is arbitrary for NHTSA to count alleged safety costs as support for its propose rollback both under the economic practicability factor and as its own separate "bolster[ing]" factor,[44] and yet never fully monetize climate- and pollution-related deaths and other welfare impacts under either the need to conserve energy factor nor under the economic practicability factor.[45]

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[43] These impacts are all included to some degree in the three integrated assessment models (IAMs) used by the IWG (namely, the DICE, FUND, and PAGE models), though some impacts are modeled incompletely, and many other important damage categories are currently omitted from these IAMs. *Compare* Interagency Working Group on the Social Cost of Carbon (2010), at 6-8, 29-33; *with* Howard (2014). For other lists of actual climate effects, including air quality mortality, extreme temperature mortality, lost labor productivity, harmful algal blooms, spread of west nile virus, damage to roads and other infrastructure, effects on urban drainage, damage to coastal property, electricity demand and supply effects, water supply and quality effects, inland flooding, lost winter recreation, effects on agriculture and fish, lost ecosystem services from coral reefs, and wildfires, *see* EPA, *Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment* (2017); U.S. Global Change Research Program, *Climate Science Special Report: Fourth National Climate Assessment* (2017); EPA, *Climate Change in the United States: Benefits of Global Action* (2015); Union of Concerned Scientists, *Underwater: Rising Seas, Chronic Floods, and the Implications for U.S. Coastal Real Estate* (2018).

[44] 83 Fed. Reg. at 43,226.

[45] See our separate comments on NHTSA's failure to fully monetize the social cost of greenhouse gases. https://policyintegrity.org/what-we-do/update/3190.

C. EPA's approach to its statutory factors is unreasonable

EPA acknowledges that it must consider public health and welfare under Section 202 of the Clean Air Act,[46] and yet claims authority to give "particular consideration" to costs and safety.[47] EPA never explains why it may give outsized consideration to costs and safety, even as it devalues important climate and pollution effects. After all, the "primary goal" of the entire Clean Air Act is to advance "pollution prevention."[48] It is therefore arbitrary and inconsistent with the statute for EPA to instead give primacy to cost and safety factors in justifying the proposed rollback, to fixate on alleged traffic deaths avoided without also clearly reporting the climate- and pollution-related deaths, illnesses, and welfare losses that the proposed rollbacks will cause. In its discussion of its statutory factors, EPA specifically highlights the alleged avoided highway fatalities,[49] and yet only reports volume estimates for greenhouse gas changes, without detailing any of the real-world impacts from the increase in greenhouse gas emissions, criteria pollutant emissions, and toxic pollutant emissions, which will include: climate-related deaths and illnesses from excessive heat, excessive cold, extreme weather events, diarrhea, vector-borne diseases, food- and water-borne diseases, cardiovascular and respiratory effects, food scarcity, water scarcity, and conflict;[50] as well as mortalities and morbidities from increases in particulate matter and other pollutants, including premature adult and infant mortality, acute bronchitis, respiratory emergency room visits, non-fatal heart attacks, asthma exacerbations, strokes, reproductive and developmental effects, cancer and genotoxicity effects, and work-loss days.[51] EPA never sufficiently discusses these important aspects of the regulatory problem, and does not explain their connection to its statutory factors. EPA certainly may consider a range of effects, including

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[46] 83 Fed. Reg. at 43,228.

[47] 83 Fed. Reg. at 43,231.

[48] 42 U.S.C. § 7401(c) (defining the goal for "this chapter," which includes § 7521 in subchapter II); *Air Alliance Houston v. EPA*, No. 17-1155 (D.C. Cir., Aug. 17, 2018), 2018 WL 4000490 (citing § 7401(c) as describing congressional intent in enacting the Clean Air Act). "Pollution prevention" is often distinguished from strictly technologically-based end-of-pipe pollution controls, to include process changes that reduce the amount of pollution generated in the first place. S. Rep. No. 101-228, pt. 2, at 168 (1989), 1990 U.S.C.C.A.N. 3385, 3553 ("The technologies, practices or strategies which are to be considered . . . go beyond the traditional end-of-the-stack treatment or abatement system. The Administrator is to give priority to technologies or strategies which reduce the amount of pollution generated through process changes or the substitution of materials less hazardous. Pollution prevention is to be the preferred strategy wherever possible."). Increasing fuel economy of vehicles is precisely the kind of pollution prevention strategy that Congress had in mind.

[49] 83 Fed. Reg. at 43,231.

[50] Carleton et al. (2018); Howard (2014); NHTSA, Draft Environmental Impact Statement at S-21 (2018) [hereafter "SAFE Rule Draft EIS"].

[51] SAFE Rule Draft EIS at S-9, 2-27, 4-24 (listing the human health and welfare impacts from the increased particulate matter emissions under the proposed rollbacks).

safety, energy security, and national security, but there is no statutory basis for giving safety more attention than other important effects such as public "health" and "welfare."[52]

In the 2012 rulemaking, EPA focused on its charge to protect public health and welfare, and spoke at length about the standards' effects on "atmospheric concentrations of CO2, global climate warming, ocean acidification, and sea level rise."[53] The agency also devoted in 2012 a long discussion to the health and air-quality effects of non-GHG pollutants.[54] The Proposed Rule meanwhile, notably lacks any meaningful reference to ocean acidification or sea level rise.[55] EPA now fails to explain its lack of attention to important parts of the problem that the agency previously assessed under its statutory mandate back in 2012.

D. The agencies define the market failure too narrowly

The regulatory impact analysis far too narrowly defines the market failures that fuel economy and greenhouse gas emission standards are intended to address. The regulatory impact analysis claims that, "in the case of the CAFE standards," the market failure is limited to protecting consumers who do not "voluntarily purchase enough fuel economy" to protect themselves "if gasoline prices suddenly rise significantly."[56] With the CO2 standards, the market failure is to protect "the planet from the risks of unchecked climate change."[57]

Under both the statutory mandate from EPCA and best practices for economic analysis,[58] the problems that NHTSA is charged with addressing are not so restricted to only protecting consumers from gas price spikes. As explained above in this section as well as throughout these comments, NHTSA is more broadly charged to address: externalities relating to energy security, national security, positional goods, global climate change, and air and water pollution associated with fuel production and consumption; asymmetric information, attention costs, and other

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52 42 U.S.C.A. § 7521(a)(1) ("The Administrator shall by regulation prescribe . . . standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines, which in his judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare."); *Massachusetts v. E.P.A.*, 549 U.S. 497, 528-29 (2007).

53 77 Fed. Reg. at 62,895.

54 *See* 77 Fed. Reg. at 62,899, 62,910-12.

55 The lone exceptions occur in footnote 477, where the agencies note that the 2012 rule measured sea level rise, but does not mention any sea level effects from this proposed rollback, 83 Fed. Reg. at 43,230; and at page 43,248, discussing California's reasons for a waiver. EPA also mentions that it has estimated sea-level rise under the Executive Order on environmental justice, *id.* at 43,474, but fails to connect such climate impacts to its statutory mandate.

56 PRIA at 110.

57 *Id.*

58 *See* Office of Mgmt. & Budget, *Circular A-4* (2003) [hereafter "OMB Circular A-4"] (defining various market failures, including environmental externalities and informational failures).

information failures; internalities, including myopia; and various supply-side market failures, including first-mover disadvantage.

Similarly, while EPA's primary focus when regulating greenhouse gas emissions should remain the need to protect the planet from unchecked climate change, EPA must not ignore other related market failures that cause harm to public health and welfare, including the issues and market failures listed in the previous paragraph.

In defining the market failures too narrowly, the agencies not only violate the instructions of Executive Order 12,866,[59] but also evince their fundamental misunderstanding of the purposes of the original 2012 standards. The proposed rollback fails to consider important aspects of the problem set before the agencies by Congress, and also fails to consider discussions of these market failures from the 2012 rulemaking, and so the proposed rollback is arbitrary and capricious.

E. The agencies should balance their statutory factors using a full and balanced cost-benefit analysis, not a biased and manipulated cost-benefit analysis

In the past, the agencies have relied on cost-benefit analysis to inform their balancing of their statutory factors. And the agencies should do the same here, after conducting a full, balanced cost-benefit analysis. As we have explained throughout these comments, such as analysis would not support the Proposed Rule.

Past Reliance on Cost-Benefit Analysis: Both agencies have relied on cost-benefit analysis in previous rulemakings to provide an explanation and context for their chosen standards. For example, in the 2012 rule, both NHTSA and EPA cited the costs and benefits in discussing the statutory balancing process. EPA stated that "given the technical feasibility of the standard, the cost per vehicle in light of the savings in fuel costs over the lifetime of the vehicle, the very significant reductions in emissions and in oil usage, and the *significantly greater quantified benefits compared to quantified costs*, EPA is confident that the standards are an appropriate and reasonable balance of the factors to consider under section 202(a)."[60] NHTSA similarly used a marginal cost-benefit analysis to set the 2012 CAFE standards. The agency explained that while the agency is not required to conduct a cost-benefit analysis, "[r]egardless of what type of analysis is or is not used, considerations relating to costs and benefits remain an important part of CAFE standard setting."[61] Similarly, in setting the CAFE standards for MY 2008-2011, NHTSA used a marginal cost-benefit analysis to determine the maximum feasible standards.[62] The U.S.

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[59] Exec. Order 12,866 § 1(b)(1) (1993).

[60] 77 Fed. Reg. at 62,777 (emphasis added).

[61] 77 Fed. Reg. at 62,623, 63,020.

[62] *Center for Biological Diversity*, 538 F.3d at 1186.

Court of Appeals for the Ninth Circuit affirmed the agency's use of cost-benefit analysis to balance the statutory factors of EPCA, explaining that the balancing was appropriate so long as the agency does not balance the factors in such a way that conflicts with the statute's energy conservation mandate, and so long as the agency does not "put a thumb on the scale" by undervaluing or overvaluing particular effects.[63]

In the current rule, the agencies turned their back on these principles and their prior practice without providing a reasoned explanation. Instead, the agencies have balanced the factors in a way that conflicts with their controlling statutes and weighed the statutory factors without regard for the accuracy of the accompanying cost-benefit analysis.

Errors and Oversights in Balancing the Factors: The agencies acknowledges that the proposed rollback will increase fuel usage by about 500,000 barrels per day by the early 2030s.[64] The agencies nonetheless claim that the increased consumption and emissions are justified by the cost savings and safety concerns (in rebound, fleet composition, and mass).[65] But that analysis is severely flawed.[66] First, the increased emissions that will result from the proposed action need to be properly incorporated into the cost-benefit analysis. There are significant health and safety issues associated with the increased greenhouse gas emissions which the agencies are ignoring. See Sections I and IX of these comments, and our separate comments on the social cost of greenhouse gases, for a discussion of the treatment of emissions in the agencies' cost-benefit analysis. Second, the safety considerations have been incorrectly calculated in the cost-benefit analysis. See sections V-VII of these comments for an in-depth discussion of the treatment of scrappage, rebound, and mass effects. The agencies cannot duck their requirements to conserve energy and protect public health and safety by citing automobile safety without an adequate discussion of the health and safety impacts of the Proposed Rule's increased emissions or without an accurate estimate of the actual safety impact of the rollback versus the 2012 standards.

NHTSA claims that it is allowed to use feasibility concerns to deviate from the regulatory standards that would maximize net benefits.[67] Yet if a standard truly were not feasible, then its costs would be prohibitively high, and a full and fair cost-benefit analysis would reflect that. After correcting their currently inaccurate estimations of costs and benefits, in the ways we have laid out in these comments, the agencies should rely on a full and balanced cost-benefit analysis. Such a full and fair analysis will reveal that the proposed rollback is not justified, that the 2012

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[63] *Id.* at 1197.

[64] 83 Fed. Reg. at 42,995, 43,254.

[65] 83 Fed. Reg. 42,995-96, 43,067, 43,230.

[66] *National Ass'n of Home Builders v. EPA*, 682 F.3d 1032, 1040 (D.C. Cir. 2012).

[67] 83 Fed. Reg. at 43,209.

standards remain massively benefit-cost justified, and that, if anything, an increase in stringency is warranted.

Misleading Fatalities Statistics: The agencies' reliance on fatality statistics that include alleged rebound-related traffic fatalities to justify its proposed rollback is arbitrary because the agency's own cost-benefit analysis finds that the rebound effect will have no net welfare impact.[68] The agencies repeatedly cite as justification for the proposed rollback that it will allegedly "reduce highway fatalities by 12,700 lives."[69] Half of this figure comes from fatalities allegedly attributed to the rebound effect.[70] Yet the agencies acknowledge that the increase in driving is "freely chosen" and not "imposed by" the standards,[71] and their analysis reflects this fact by showing that the private welfare gained by consumers from driving more due to the rebound effect will offset any fatalities allegedly caused by the rebound effect. As a result, the agencies are misrepresenting the effects of the proposed rollback by claiming 12,700 lives saved. Compounding this error, the accident related costs associated with the increase in driving that results from the scrappage and dynamic fleet share models—which is also "freely chosen"—are inexplicably and unjustifiably not offset by countervailing mobility benefits in the benefit cost analysis—and the agencies inappropriately claim that these traffic fatalities—which comprise the other half of the 12,700 projection[72]—also justify the roll back. Indeed, the agencies entire "safety" justification for the roll back rests solely on their prediction that by rolling back the standards, people will drive less and this will reduce traffic fatalities. The agencies discussion of the "safety" effects of the standards is thus deeply misleading. Furthermore, the projected traffic fatalities figure is never offset by the significant increase in climate- and pollution-related fatalities from the proposed rollback's increase in greenhouse gas emissions and other pollution. Consequently, the agencies' justification for the proposed rollback runs counter to the evidence before the agencies.

Inconsistent Claims on Net External Costs versus Net External Benefits: In Tables II-25 through II-28, the agencies list positive sums for "net external benefits."[73] Yet, immediately following those tables, the agencies instead report that the proposed rollback will generate net external *costs*: "less stringent . . . standards will produce *net external economic costs*, as the increase in environmental and energy security externalities outweighs external benefits from

[68] 83 Fed. Reg. at 43, 212, 43, 231; *Id.* at 43,105 (discussion of mobility benefits accompanying the rebound effect).

[69] 83 Fed. Reg. at 42,986, 42,995, 43,152; *see also id.* at 43,231-43,232 (where EPA inconsistently refers instead to either 15,680 fatalities or 12,903 fatalities).

[70] *See id.* at 43,153, tbl. II-74.

[71] *Id.* at 43,148.

[72] Leaving aside the small number of mass reduction related fatalities, which the agencies concede are not statistically significant. NPRM at 43,111

[73] *E.g.*, 83 Fed. Reg. at 43,065.

reduced driving and higher fuel tax revenue (line 19)."[74] Adding to the inconsistency, the regulatory impact analysis reports on the exact same figures from line 19 but instead writes "the reduction in external costs imposed by vehicle use combines with higher fuel tax revenue to more than offset the increase in environmental and energy security externalities (line 19)."[75] The summaries from the Proposed Rule and the PRIA are mirror opposites. Given the wording, this discrepancy cannot have resulted from a mere typographical error. Rather, it seems more likely that, at some point in the agencies' analysis of the proposed rollback, the agencies had calculated that the rollback would result in a net external economic cost, but then different numbers were used for the tables. Tellingly, EPA's June 18, 2018 review of the proposed rollback, as shared with OIRA, found that the proposed rollback would cause $83 billion in net social costs.[76] If the agencies do calculate a net external cost for the proposed rollback, then the agencies have not explained why the proposed rollback is justified; if the agencies do not calculate a net external cost despite the statement in the Proposed Rule, the agencies have failed to explain what changed in their analysis to completely switch the sign and magnitude of the calculation of net external effects, from a significant cost to an alleged benefit. Either way, as presented currently, the Proposed Rule and its justification are arbitrary.

II. THE AGENCIES HAVE ARBITRARILY INFLATED THE COSTS OF THE BASELINE STANDARDS

The agencies' estimates of the relative effects on vehicle buyers of the Proposed Rule versus the baseline standards is riddled with errors. First, the agencies have overestimated compliance costs by failing to appropriately model how manufacturers will efficiently deploy flexible compliance options and make fuel economy improvements to reduce their costs. Second, the agencies have overstated the share of vehicle prices that will be passed on to consumers—in particular, to consumers of lower-price vehicles. And third, the agencies have arbitrarily relied on "relatively low" fuel prices to justify the need for the Proposed Rule.

The premise of the Proposed Rule is that, under the baseline standards, vehicle prices will otherwise increase enough to cause a substantial drop in sales, thus allegedly affecting the ability of manufacturers to comply with the standards as well as the relative safety of the cars driven by consumers.[77] That price analysis rests on the assumption that manufactures will pass all of their

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[74] 83 Fed. Reg. at 43,067 (emphasis added).

[75] PRIA at 1085.

[76] EPA, *Further Review of CAFE Model & Inputs* at 2 (June 18, 2018), https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (see Email 5, page 11 of PDF).

[77] 83 Fed. Reg. at 42,993-994

compliance costs on to buyers, a feature known as full "pass-through."[78] Thanks to this pass-through assumption, NHTSA estimates that vehicles will be approximately $2,700 higher by 2029 under the baseline standards.[79] EPA similarly estimates that vehicle prices will be higher by $2,260 in 2030.[80] Additional costs from maintenance, financing, insurance, taxes, and other fees brings the agencies' estimates to a total of $2,810.[81] But those price estimates are inflated, because the agencies incompletely model the use of cost-saving flexibilities, wrongly model the decisions about fuel economy improvements and unreasonably assume a full pass-through of costs to consumers, among other reasons. Additionally, those estimates are offset by the lifetime fuel savings of the baseline standards, which the agencies have underestimated.

Correcting these mistakes, together with other errors in calculating the Proposed Rule's costs and benefits, will show that the baseline standards continue to be benefit-cost justified, and that the Proposed Rule is not justified.

A. The agencies fail to model efficient deployment of all compliance options, including flexibilities, and thus overestimate the baseline standards' costs

The baseline standards incorporate a number of cost-minimizing flexible compliance options. Manufacturers can reduce their costs of compliance by averaging the efficiency levels of vehicles within a fleet, by generating excess compliance credits in one year and banking them for future use, by promising to over-comply in future years and borrowing those credits to make up for an existing deficit, by transferring credits between fleets, by trading credits with other manufacturers, by generating offset credits (or "adjustments" as NHTSA calls them) through off-cycle technologies and other opportunities, and by efficiently relying on penalties as an upper-bound safety valve on compliance costs, among other things.

Studies show that for both fuel economy standards and EPA's history with averaging, banking, and trading (ABT) programs, the expected cost savings from employing these kinds of market-based flexible compliance options relative to uniform standards can be as high as 50%.[82] These compliance flexibilities are especially beneficial given how heterogeneous the car manufacturers

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[78] *Id.* at 43,071; *see also id.* at 43,135 ("CAFE standards force manufacturers to apply fuel saving technologies to offered vehicles and then pass along the cost of those technologies (to the extent possible) to buyers of new vehicles.").

[79] 83 Fed. Reg. at 42,994; *see also id.* at 43,263-64, Table VII-4 (see last two rows for MY2025).

[80] *Id.* at 43,229

[81] *Id.* at 43,229.

[82] *See* Rubin et al. (2009), at 315–328 (2009) (showing the huge potential of cost savings associated with credit trading between firms for the CAFE program); Newell & Stavins (2003), at 56 (estimating the potential cost savings associated with market-based policies); Carlson et al. (2000) (showing gains from trade in transferable sulfur dioxide emission allowances among electric utilities).

are and how diverse individual manufacturers' product lines are.[83] And indeed, with companies as different in their fuel efficiency profiles as Tesla and Porsche, one can expect substantial cost savings from credit trading and other flexible compliance options.[84] The agencies are well aware of the cost-minimizing potentially of these flexibilities.[85] In the proposal, the agencies explain that, "well-functioning banking and trading provisions increase market efficiency and reduce the overall costs of compliance with regulatory objectives."[86] Moreover, as the agencies acknowledge, the introduction of trading has changed the decisions made by manufacturers: "Since NHTSA introduced trading and transferring, manufacturers have largely traded or transferred credits in lieu of paying civil penalties."[87] The agencies also acknowledge "that buying and selling credits is a more cost-effective strategy for manufacturers than paying civil penalties" and quote the decrease in civil penalties paid annually.[88]

By failing to model the most efficient deployment of all these cost-minimizing compliance flexibilities, both NHTSA and EPA have overestimated the costs of complying with the baseline standards.

1. Manufacturers would not automatically apply all technologies defined by the agencies as "cost-effective"

Figure 9 below, copied from NHTSA's Draft CAFE Model Documentation, illustrates how the agencies simulate the manufacturer's compliance decisions in every model year.[89] As shown in Figure 9, the agencies assume that manufacturers apply all technologies considered "cost-effective" in the first step, regardless of how much compliance is needed or how many credits

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83 More formally, the more the marginal costs of compliance differ between the producers, the more costs are saved when trade is introduced. *See* Administrative Conference of the United States, *Recommendations 2017-4 on Marketable Permits* 3 (2017), *available at* 82 Fed. Reg. 61,728, 61,730 (Dec. 29, 2017) (reporting that marketable permit programs are more beneficial when "Regulated parties have sufficiently differing compliance costs, such that the savings from trading are likely to be greater than transaction costs.").

84 *See, e.g.*, Stranlund (2017); 74 Fed. Reg. 14,196, 14206 (Mar. 30, 2009) ("Under Part 536, credit holders . . . will have credit accounts with NHTSA, and will be able to hold credits, apply them to compliance with CAFE standards, transfer them to another 'compliance category' for application to compliance there, or trade them."); *id.* at 14,218 ("In the event that a manufacturer does not comply with a CAFE standard, even after the consideration of credits, EPCA provides for the assessing of civil penalties."); 81 Fed. Reg. at 95,489 ("[S]ince the introduction of credit trading and transfers for MY 2011 and after, many manufacturers have taken advantage of those flexibilities rather than paying civil penalties for non-compliance.").

85 83 Fed. Reg. at 43,231.

86 *Id.* at 42,999.

87 *Id.* at 43,451.

88 *Id.* at 43,451.

89 Draft CAFE Model Documentation, July 2018, Figure 9, at 69, available at ftp://ftp.nhtsa.dot.gov/CAFE/2021-2026_CAFE_NPRM/CAFE_Model/CAFE_Model/CAFE_Model_Documentation_NPRM_2018.pdf (last accessed 10/19/2018) [hereafter "CAFE Model Documentation"]; see also 83 Fed. Reg. at 43,161, 43,174.

they have available. The problem with this assumption lies in the definition of "cost-effective technologies." According to the agencies, cost-effective technologies are the technologies that cost less than the sum of compliance costs that the technology avoids[90] plus the value of 2.5 years of fuel savings achieved by the technology.[91] Given those numbers, some manufacturers could be predicted to over-comply in every year on a technological basis, even as available credits are left to expire.

If consumers are demanding these cost-effective technologies such that manufacturers can earn a profit by including them, that assumption may make some sense. However, the assumption clashes directly with the contradictory assumption that the agencies rely on in the model's sales module, where they implicitly assume that customers entirely disregard fuel efficiency in their purchasing decisions.[92] In that model, the failure to include any estimate for consumer valuation leads the agencies to overestimate how the baseline standard's alleged price increases will depress sales of new vehicles (The problematic assumptions of the sales module, and the inconsistency with the agencies' other assumptions on consumer valuation of fuel economy, are discussed in Section III.)

At the same time, the agencies' schematic of manufacturers' compliance decisions in Figure 9 assumes that manufacturers think that consumers value fuel economy enough that they will demand every technological option with a 2.5-year payback period, even if it causes the manufacturer to over-comply with the standards year after year.

Those positions are inconsistent. The agencies cannot have it both ways. Like under Figure 9's 2.5-year payback assumptions, the agencies' sales module should also assume that consumers do value fuel savings, as explained in Section III, thus changing the estimates of new vehicle sales under the baseline standards.

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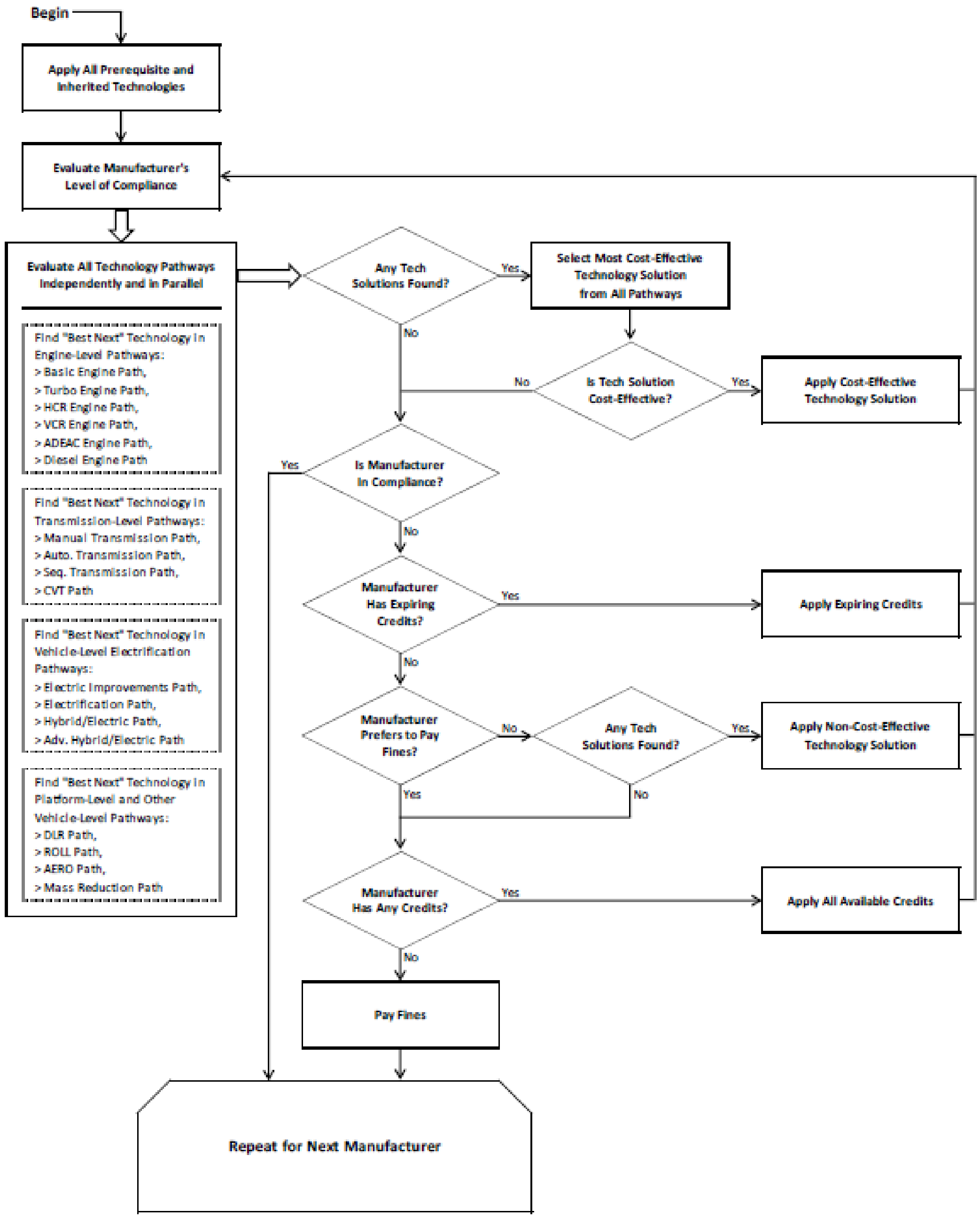
[90] In the case of the CAFE program, this value represents the change in CAFE civil penalties (or fines).

[91] *See* CAFE Model Documentation at 72-75 (explaining cost-effective technologies); 83 Fed. Reg. at 43,179, 43,225.

[92] The assumption that customers do not value fuel efficiency is irrational. *See* Section III.

Figure 9. Compliance Simulation Algorithm



Furthermore, it is unreasonable to assume, that manufacturers will only use their expiring credits or other compliance flexibilities after they have applied all cost-effective technologies, as seen in Figure 9. A manufacturer would not let a credit expire while using costly fuel efficiency technologies. They would be even less likely to do that if customers did not value the technology, as the agencies assume in the sales model. These unreasonable assumptions lead to an overestimation of fuel economy costs and thus bias the findings.

Perhaps a manufacturer would apply cost-effective technologies before using all available credits if the manufacturer is able to transfer or trade any credits about to expire. Yet, as explained more below, the agencies have not fully modeled the trading of excess credits, even when permitted to by statute. This failure further leads to a biased overestimate of total compliance costs for the entire industry.

2. **Many of the agencies' failures to consider efficient deployment of banking, borrowing, trading, and offsets are not mandated by the statute**

The proposed rollback explains that the agencies' model reflects banking as well as transfers between car and truck fleets, but not borrowing or trading.[93] Yet banking and transferring are not accurately modeled. While NHTSA has some limits on what flexibilities it can consider when setting standards, many of the omissions of compliance flexibilities from the model are not dictated by limits in NHTSA's statutory authority; moreover, EPA does not even face such limits.

Banking: The model's default assumption is that manufacturers will hold on to banked credits "for as long as possible," applying credits only after all technological options have been exhausted, and even applying expiring credits only after all "cost-effective" technological options have been exhausted.[94] The model also does not fully capture that manufacturers may strategically over-comply in some years to bank more credits. These assumptions are incorrect and will lead to an overestimation of costs. In reality, manufacturers will take a long-range view to planning their compliance and will identify the most cost-efficient times to generate credits, bank credits, and use credits. Sometimes a manufacturer will be able to save money by over-complying in early years when standards are less stringent, banking those credits, and then applying those credits in later years before installing costlier technologies. The model ignores these potential cost savings.

The model also only incompletely counts credits banked in years before the Proposed Rule would take effect. NHTSA claims that its statutory instructions prohibit it from considering credit availability in setting standards, and so only models credits that are already banked or will be banked and used through "the last year for which new standards are not being considered (MY 2019 in this analysis)."[95] First of all, because the Proposed Rule starts in MY 2021, that means MY 2020—not MY 2019—is the last year for which new standards are not being considered. This difference matters, especially because ignoring a full year of early banked credits will make it seem like manufacturers are further behind in meeting their compliance than they really are, which will affect the agencies' assumptions about the compliance costs

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[93] 83 Fed. Reg. at 43,181.

[94] *Id.* at 43,181.

[95] *Id.* at 43,183.

manufacturers will face from MY 2021 and on. Second, it is not clear that the statutory prohibition on considering credit availability was intended to apply to banked credits. The statutory limit on considering "trading, transferring, or availability of credits," 42 U.S.C. § 32902(h)(3), was added in 2007 as a "conforming amendment" to the Energy Independence and Security Act, which was the statute that gave NHTSA authority to allow credit trading and transferring;[96] meanwhile, banking and borrowing have been part of NHTSA's authority since the original Energy Policy and Conservation Act of 1975.[97] In 1989, for example, NHTSA explicitly relied on the availability of "credit banks" to justify maintaining the MY 1990 standard at 27.5 mpg instead of lowering its stringency.[98] NHTSA has not explained why it now believes it may not more fully consider banking. Third, whatever statutory limit may apply to NHTSA does not apply to EPA under the Clean Air Act. And yet, not only has EPA not separately modeled the cost-saving potential of banking more thoroughly, but the model does not even fully reflect the availability of already-banked CO_2 credits, because the "CAFE model was not modified to allow exceptions to the [assumed five-year] life-span of compliance credits" even though EPA credits for MY 2009-2011 may be used through MY 2021.[99]

All of these errors and unnecessary omissions result in the agencies overestimating total compliance costs, by failing to capture the full cost-saving potentials of banking. The agencies have made similar errors and omissions for all the other flexible compliance options: borrowing, transferring, trading, offsets, and penalties.

Borrowing: The agencies acknowledge that manufacturers have, in the past, sometimes made use of the cost-savings afforded by borrowing, but they chose not to include borrowing in the model because they assume manufacturers would not want to accept the "risk" of this flexible compliance strategy.[100] The agencies do not explain why they believe manufacturers would be particularly risk averse to the use of this compliance flexibility. The fact that manufacturers have, in fact, used borrowing in the past to help save on compliance costs indicates that the agencies should not be so quick to omit borrowing from the model. The result of that omission is likely an overestimation of compliance costs.

Transferring: Just as the model does not fully capture how manufacturers will strategically over-comply in order to bank credits, the model also does not fully capture how manufacturers may

[96] Pub. L. 110-140 § 104, 121 Stat. 1503 (Dec. 19, 2007).

[97] Pub. L. 94-163 § 301 (amending the Motor Vehicle Information and Cost Savings Act §§ 503(a)(1) (on averaging) and § 508 (on banking)).

[98] 54 Fed Reg. 21,985, 21,994 (May 22, 1989) ("given their credit banks, both GM and Ford can easily comply with the MY 1990 standard of 27.5 mpg by use of carryforward credits, i.e., ones that have already been earned").

[99] 83 Fed. Reg. at 43,183.

[100] Id.

save on total costs by over-complying in one fleet to transfer credits to another fleet.[101] Furthermore, "[t]he model prefers to hold on to earned compliance credits within a given fleet," because that is the behavior the agencies have observed from the manufacturers going back to 2009.[102] Yet historical compliance behavior under less stringent standards is not necessarily a useful template for how manufacturers would respond in the future under more stringent standards. As the agencies acknowledge, under the CO_2 standards, given the availability of more early compliance credits, manufacturers have been more strategic about transferring credits between fleets to minimize their costs.[103] The agencies' failure to more realistically model the efficient use of transferring results in an overestimation of total compliance costs.

Trading: The agencies say they have "not attempted" to model trading.[104] Though NHTSA may have some statutory limits on its ability to consider the cost-saving potentials of credit trading, EPA does not face any such statutory limits under the Clean Air Act. The agencies do include a sensitivity analysis that, by pretending all cars and trucks were manufactured by a single company, imperfectly approximates the conditions of trading.[105] Even this imperfect exercise suggests the cost savings afforded by trading could be substantial: by the agencies' own estimates, costs drop by over 12%.[106] Yet in relegating this consideration to a single scenario in the sensitivity analysis, EPA has failed to consider how a model of the cost-savings of trading—combined with other necessary corrections to misestimates of costs and benefits and with other plausible assumptions also buried in sensitivity analysis—could further confirm what the agencies already know from the 2016 midterm evaluation: that compliance with the baseline standards is feasible and affordable, especially compared to the baseline standard's massive benefits. Instead, by relegating any consideration of trading to an imperfect sensitivity analysis, EPA has overestimated compliance costs.

Air-Conditioning and Off-Cycle Credits/Adjustments: The model "does not attempt to project how future off-cycle and A/C efficiency technology use will evolve . . . . Rather, this analysis uses the off-cycle credits submitted by each manufacturer for MY 2017 compliance and carries these forward to future years with a few exceptions."[107] For some manufacturers, that means the agencies assume zero or low[108] use of off-cycle adjustments in perpetuity, just because of their

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[101] *Id.*

[102] *Id.* at 43,185.

[103] *Id.*

[104] *Id.* at 43,181.

[105] *Id.* at 43,367.

[106] Id.

[107] *Id.* at 43,159.

[108] *Id.* at 43,160, tbl. II-79.

compliance choices for MY 2017. That is an illogical and arbitrary assumption. Rather, the agencies should assume that manufacturers will efficiently deploy all cost-saving offset opportunities, especially in the face of increasingly stringent standards.

EPA Is Not Constrained by EPCA: To whatever extent EPCA may limit NHTSA's ability to consider credit trading and transferring, such limits do not extend to EPA. EPA is *not* statutorily prohibited from taking credit trading and transferring into account in setting its standards, and it thus has no excuse not to consider them in analyzing the costs of the standards. To the contrary, EPA is required to "giv[e] appropriate consideration to the cost of compliance,"[109] and by failing to consider the availability of a cost-minimizing compliance strategy, the agency fails to consider an important element of its statutory factors.

If EPA fully models the rational use of credits while NHTSA does not, it is possible that the two agencies would reach somewhat different conclusions about what level of standards are justified. EPA might be tempted to ignore such analytical results and, instead of adopting the standards shown to be cost-benefit justified, just continue to match NHTSA's standards. Yet EPA is not allowed to set lower standards just for the sake of harmonization; to the contrary, full harmonization may be inconsistent with EPA's statutory responsibilities. Harmonization would have very real costs in terms of forgone emissions reductions and consumer savings and would go against EPA's statutory mandate. In addition, EPA would have to assess those costs and explain why the alleged benefits of harmonization would justify those very real costs. The Proposed Rule fails to satisfy this standard.

How the Agencies Considered Compliance Flexibilities in 2012: In prior rules, the agencies discussed and analyzed the impact of various compliance flexibilities when assessing whether new standards were feasible.[110] For example, in 2012, EPA embraced credit trading as a mechanism that allows manufacturers to comply with the standards in the most cost-effective way and took compliance flexibilities such as trading into account.[111] And despite NHTSA's statutory restriction, NHTSA acknowledged in 2012 that credit trading would reduce the cost of complying with the standards to a meaningful extent."[112] In fact, in 2012 NHTSA provided an estimate of the impact that those flexibilities have on the costs and found that compliance flexibilities would reduce the cost of additional technology needed for compliance by $20 billion, or about 15% of the total estimate.[113]

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[109] 42 U.S.C. § 7521(a)(2).

[110] 77 Fed. Reg. at 62,776.

[111] *Id.* at 62,649, 62,776.

[112] *Id.* at 63,082-83.

[113] *Id.* at 63,084.

Importantly, the 2012 analysis found the standards were beneficial even without these savings. Currently, since the agencies now assert that the costs of the original standards exceed their benefits, accounting for credit trading might change the outcome of the analysis and show that the proposed rollback is not justified.

In order to satisfy the requirement to provide a reasoned explanation, this issue must be addressed. When an agency reverses course through a repeal, it must provide a "reasoned explanation" for dismissing the "facts and circumstances that underlay" the original rule.[114] EPA has given no reason for not taking these flexibilities into account now in deciding to roll back its standards. And both NHTSA and EPA have failed to provide a reasoned explanation for ignoring the impact of credits and trading on compliance costs. At minimum, EPA needs to fully incorporate credit trading into its model for the years 2016-2030.

Risk Aversion: As a justification for disregarding credit trading, the agencies claim that "long-term planning is an important consideration for automakers," and that "firms may be reluctant to base their future product strategy on an uncertain future credit availability."[115] But the industry has a well-known track record of using trading and it is unlikely that the market would dry up. The manufacturers face uncertainty that will affect any compliance strategy: uncertainty from steel tariffs and technological innovation and so forth. There is no reason to think that vehicle manufacturers would be particularly risk averse to these particular types of compliance flexibilities. Averaging, banking, and borrowing have been part of the CAFE program since 1975.[116] While trading and transferring were added to the CAFE program later, vehicle manufacturers have been familiar with trading since EPA finalized rules for heavy-duty truck emissions in 1990.[117] Vehicle manufacturers have been comfortable with these compliance flexibilities for decades, and activity in the credit trading markets has increased in recent years.[118] The assumption that industry would be reluctant to use a proven tool that could save it money is arbitrary.

Additionally, there are a variety of ways to structure a credit market, through futures and liability schemes and banking, which can minimize many potential uncertainties.[119] Not only have manufacturers not been calling for such tools, suggesting perhaps a lack of particularized risk here, but also the agencies have failed to explore such tools if they do indeed perceive a risk. In

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[114] *Fox Television Stations*, 556 U.S. at 515-16.

[115] 83 Fed. Reg. at 43,231.

[116] Energy Policy and Conservation Act of 1975, Pub. L. 94-163 § 301 (amending the Motor Vehicle Information and Cost Savings Act §§ 503(a)(1) (on averaging) and 508 (on banking)).

[117] 55 Fed. Reg. 30,584 (July 26, 1990).

[118] Leard & McConnell (2017).

[119] Schwartz (2017).

any event, uncertainty applies to almost all businesses and there is no reason to believe that the vehicle industry is particularly risk averse. For instance, the supply of many "rare earth elements," rare minerals or elements needed to build products in the high tech industry, is legitimately uncertain.[120] But many high tech companies nonetheless operate under on the assumption that those materials will be available in developing their technologies.[121] The availability of trading here is much more certain than the availability of rare earths, and manufacturers are very likely to assume that trading will continue to be available.

3. NHTSA's assumption about which manufacturers are willing to pay penalties leads to an overestimate of compliance costs

The CAFE penalties work like safety valves because they allow car manufacturers to either comply with the standards or pay the penalty if compliance costs are too high.[122] Consequently, when the marginal cost of compliance is lower than the penalty, companies comply with the standards. But when the marginal costs of compliance with the standards exceed the penalty, companies tend to choose to pay penalties.

In assessing the costs of the baseline standards, NHTSA assumes that manufacturers consider paying penalties as a form of compliance only when all cost-effective technologies have already been deployed, and even then assumes that any manufacturer without historic evidence of willingness to pay penalties will instead opt for any non-cost-effective technologies before using any available credits. Ultimately, NHTSA assumes that most manufacturers are not willing to pay penalties beginning in 2020.[123] This effectively inflates the aggregate compliance costs. Combined with NHTSA's disregard for usage of credits after 2020, this assumption implies that each fleet needs to reach at least the fuel efficiency level prescribed by the standards in the given year through technology alone. Such modeling is equivalent to modeling a command-and-control regulation without any flexibilities and, by definition, will result in overstated compliance costs.

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[120] See for instance http://www.airforcemag.com/MagazineArchive/Pages/2018/February%202018/Rare-Earth-Uncertainty.aspx; https://www.wsj.com/articles/SB10001424052748704049904575553792429346772

[121] https://www.osa-opn.org/home/articles/volume_22/issue_7/features/rare_earth_elements_high_demand,_uncertain_supply

[122] NHTSA, CAFE Pub. Info. Ctr., Civil Penalties, https://one.nhtsa.gov/cafe_pic/CAFE_PIC_Fines_LIVE.html ("Manufacturers that do not meet the applicable standards in a given model year can pay a civil penalty."); NHTSA, CAFE Overview, https://one.nhtsa.gov/cafe_pic/CAFE_PIC_home.htm (describing the penalties as one option among several "compliance flexibilities"); *See also* Stranlund (2017), at 238 (describing the economics of compliance); Jacoby & Ellerman (2004) (describing the use of the safety valve principle to limit the cost of emissions restrictions); Roberts & Spence (1976) (describing the benefits of a penalty system enhancing the emission licensing when the abatement costs are unknown; Pizer, (2002) (describing the welfare benefits of enhancing quantity controls by using price controls like penalties when the compliance costs are unknown to the regulator).

[123] The assumptions regarding manufacturer behavior with respect to civil penalties is presented in Table–II–86, 83 Fed. Reg. at 43,180.

The assumptions NHTSA makes about which manufacturers are unwilling to pay penalties are arbitrary. NTHSA claims to base them on the historic data, but that data comes from a time when regulation stringency was much lower as compared to future standards.[124] Under such circumstances, there is no reason to assume—and NHTSA has not explained—that past compliance behavior provides enough relevant information to reliably predict manufacturers' future compliance strategies. With an increased penalty and more stringent fuel economy standard, historic compliance levels are likely to change going forward.[125]

Historical observations cannot explain all of the assumptions made by the agencies. The arbitrariness of NHTSA's penalty assumption is visible in its treatment of FCA (Fiat Chrysler Automobiles), for which NHTSA assumes willingness to pay penalties until year 2025 but never afterwards. NHTSA provides no justification for that arbitrary assumption.[126]

NHTSA assumes that most manufacturers will be unwilling to pay penalties based in part on the fact that most manufacturers have not paid penalties in recent years. The Proposed Rule cites the statutory prohibition on NHTSA considering credit trading as a reason to assume manufacturers without a history of paying penalties will comply through technology alone, whatever the cost.[127] But this is an arbitrary assumption and is in no way dictated by the statute. NHTSA knows as much, since elsewhere in the proposed rollback, the agency explains "EPCA is very clear as to which flexibilities are not to be considered" and NHTSA is allowed to consider off-cycle adjustments because they are not specifically mentioned.[128] But considering penalties are not mentioned as off-limits for NHTSA in setting the standards either. Instead, the prohibition focuses on credit trading and transferring. The penalty safety valve has existed in EPCA for decades, and Congress clearly would have known how to add penalties to the list of trading and transferring. The fact that Congress did not bar NHTSA from considering penalties as a safety valve means that NHTSA must consider manufacturer's efficient use of penalties as a cost-minimizing compliance option. Besides, NHTSA does consider penalties for some of the manufacturers making its statutory justification even less rational.

The agencies also explain that, since the Clean Air Act does not contain a specific civil penalty provision, the model does not assume that manufacturers will choose non-compliance with the CO_2 standards. To the extent it may be true that few manufacturers have a history of failing to comply with EPA's CO_2 standards, it is only because of the existence of useful compliance

[124] *See* Union of Concerned Scientists, Response to Automaker Comments Regarding Raising CAFE Fines at 5 (Dec. 21, 2017), https://www.regulations.gov/document?D=NHTSA-2017-0059-0019.

[125] *See id.*

[126] "The notable exception to this is FCA, who we expect will still satisfy the requirements of the program through a combination of credit application and civil penalties through MY 2025 before eventually complying exclusively through fuel economy improvements in MY 2026." 83 Fed. Reg. at 43,181.

[127] *Id.* at 43,181.

[128] *Id.* at 43,212.

flexibilities like trading and borrowing. And yet the model does not capture trading and borrowing for CO_2 credits, nor does it accurately model other compliance flexibilities. The lack of a civil penalty provision in the Clean Air Act only highlights the need for EPA to fully model all available compliance flexibilities. Otherwise, EPA will overestimate compliance costs, as it has done in the proposed rollback.

4. Credit use does not show that the baseline standards are unaffordable

The agencies' justification for the Proposed Rule also misrepresents how manufacturers make their compliance credit decisions. According to the agencies, further proof that consumers do not sufficiently value fuel efficient vehicles lies in the fact that manufacturers have begun using credits to comply with the baseline standards.[129] This conclusion, however, gets the logic of credit use wrong.

Though automakers have indeed used banked credits to meet some of their compliance obligations under the baseline standards in the last couple of years,[130] there are at least two other reasons to explain that use, which are more likely than the argument that manufactures think they will not be able to comply with the standards in the future.

First, automakers have an incentive to use their banked credits if they are about to expire.[131] Credits earned in a given year can be banked for only a limited number of years,[132] and it would be a waste of money on the part of automakers to fail to use banked credits (or sell for usage) before they expire.

Second, automakers have an incentive to use banked credits when they expect that the future standards will be easier to achieve—not when they expect future standards to be more costly, as EPA asserts. A bank of credits is similar to a "rainy day fund." With a rainy day fund, if a person expects to need the fund in the near future, it would be foolish to use it today. If that person were to use the funds in such a case, the funds would be unavailable when they are really needed in the future. Similarly, if automakers expected compliance to be even more costly in the future, it would not make sense for them to use up their bank of credits right now.

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[129] *Id.* at 43,217; *id.* at 16,079.

[130] EPA, Manufacturer Performance Report for the 2016 Model Year iv (2018) [hereafter "EPA (2018) Manufacturer Performance Report"], available at https://www.epa.gov/regulations-emissions-vehicles-and-engines/greenhouse-gas-ghg-emission-standards-light-duty-vehicles#2016MY; see also 83 Fed. Reg. at 16,079.

[131] Credits can be banked and carried forward for up to five years. NHTSA, CAFE 2017-2015 Fact Sheet at 8, https://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/CAFE_2017-25_Fact_Sheet.pdf.

[132] Credits are usually available for five years, but some credits are available for different periods of time. See 40 CFR § 86.1865-12(k)(6)(ii).

Given this logic, the use of credits over the last couple of years (starting before the election of President Donald Trump, and so starting before promises began to be made about a rollback),[133] indicates that automakers may believe compliance will be less costly in the future than now. Given that the standards are scheduled to go up from 2022 through 2025, why might automakers expect compliance to be easier in the future? Three factors likely explain this belief.

First, rising consumer demand for fuel efficient vehicles caused by increasing fuel prices, as discussed in Section II.C. below, will make compliance easier. Second, increasing availability—and the lower cost—of low-emission vehicle technology will also make compliance less costly. An industry group released a recent analysis of electrified vehicle sales,[134] showing that sales of electrified vehicles have grown for the last two years, both in absolute terms and as a fraction of overall new vehicle sales.[135] This continues a long-running trend of growth in electrified vehicle sales that began when mass-market hybrid vehicles were released in the late 1990s.

Focusing in particular on sales of fully electric cars and trucks, sales growth is even stronger: 2017 was a record year for sales of fully electric vehicles. There were 199,826 fully electric vehicles sold in 2017, an increase of 25% relative to 2016, substantially outpacing growth in sales of vehicles overall.[136] In 2017, fully electric vehicles constituted just over 1% of all new vehicles sold in the United States.[137] In 2016, EPA found that the 2022–2025 standards would be achievable if even 2% of new vehicle sales are electric by 2025.[138] If sales continue to grow at their current rate, then fully electric vehicle sales will be at least double this amount by 2025. Current projections from the EIA show that fully electric vehicles are predicted to be 5.5% of new car sales by 2025.[139]

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[133] *See* EPA (2018) Manufacturer Performance Report at iv (reporting that "[u]nlike the previous four years, in which generating credits was the norm, most large manufacturers (with sales greater than 150,000 vehicles) generated deficits in the 2016 model year" and reported sufficient credits available from prior model years to be able to offset that deficit).

[134] This figure appeared as early as December 2017 in a Center for Automotive Research presentation. Chen (2017), at 18.

[135] Bailo et al. (2018), at 9.

[136] Jonathan M. Gitlin, *2017 was the best year ever for electric vehicle sales in the US*, ARSTECHNICA (Jan. 4, 2018), https://arstechnica.com/cars/2018/01/2017-was-the-best-year-ever-for-electric-vehicle-sales-in-the-us/.

[137] *Id.*

[138] EPA, NHTSA, & California Air Resources Board ("CARB"), Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025 at 12-22 (2016), at https://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/Draft-TAR-Final.pdf [hereafter "Draft TAR"].

[139] EIA, Light-Duty Vehicle Sales by Technology Type (thousands), United States, https://www.eia.gov/opendata/qb.php?category=2642004 (last visited Apr. 26, 2018) (data found at "Light-Duty Vehicle Sales: Alternative-Fuel Cars: 100 Mile Electric Vehicle," "Light-Duty Vehicle Sales: Alternative-Fuel Cars: 200 Mile Electric Vehicle," and "Light-Duty Vehicle Sales: Alternative-Fuel Cars: 300 Mile Electric Vehicle").

Third, the generous electric vehicle credits available under the baseline standards may explain why automakers have expected compliance to be less costly. Since 2017, electric vehicles have allowed automakers to earn credits that can be used to meet compliance shortfalls due to sales of less-efficient vehicles. The credits earned by electric vehicles are especially valuable, because they also earn a "multiplier incentive" from EPA. Any credit earned for sale of an electric vehicle in 2017 through 2019 is doubled. Credits earned in 2020 are worth 1.75 traditional credits, and in 2021, they will be worth 1.5 traditional credits.[140] In addition to using these credits to meet their own compliance obligations, automakers can also sell these credits to other automakers or bank them (for up to five years) for use in the future.[141] The electric-vehicle credits give automakers substantial flexibility when meeting the standards. Given the significant benefits that electric-vehicle sales provide to manufacturers seeking to comply with the standards, the recent high projections of sales of electric vehicles indicate that automakers will have an easier time meeting the standards than EPA could have expected in 2012 or even when analyzing the Final Determination in 2016 and 2017.

B. The agencies' assumption that manufacturers will pass all compliance costs through to consumers is unreasonable

The agencies' full pass-through assumption[142] is unreasonable for two further reasons having to do with the structure of the vehicle markets.

1. Market power

First, the existing level of market power in the vehicle industry means that firms may not pass on all of their costs to consumers. When an industry is perfectly competitive, manufacturers cannot charge consumers more than their marginal cost of production, because competitors are ready and waiting to lure away their customers. Thus, with perfect competition, prices equal the marginal costs of production. In such a case, if production costs increase, the prices rise correspondingly. But the vehicle industry is still characterized by some degree of market power,[143] which means that manufacturers are less constrained in what they chose to pass on to consumers. In other words, firms in a market that is not perfectly competitive likely have a profit margin that is bigger than their marginal cost of production, and they can choose not to pass the

[140] Draft TAR at 11-6. The multiplier for fully electric vehicles ends in 2021, but the credits earned until that point will be available for use for five years after the year in which they were earned.

[141] *Id.* at 11-4.

[142] 83 Fed. Reg. at 43,071.

[143] The market has become increasingly competitive. But strong product differentiation and huge fixed costs of entry have shielded the industry from becoming fully competitive. As a result, only four firms hold 58.1% of the market. Calculations of CR4 based on data from https://www.statista.com/statistics/249375/us-market-share-of-selected-automobile-manufacturers/. Because of this consolidation, the sector has some monopolistic competition, if not an oligopolistic structure.

full cost increases on to consumers through price increases, because they have the ability to absorb costs into their profit margin.[144] The agencies acknowledge that manufacturers have some ability to absorb costs into their profit margin,[145] thus supporting the assumption that manufacturers may choose to do so.

2. Mix shifting

Second, in their pursuit of profits, manufacturers can be expected to use any available means of reducing compliance costs.[146] And as the agencies acknowledge in the proposal, when deciding how to meet the standards, vehicle manufacturers can and do take into account consumers' demand for individual vehicle models and their attributes.[147] Using that information, manufacturers adjust prices across their fleet to optimally attract customers toward more fuel-efficient vehicles—a practice called *mix-shifting*.[148] As the agencies admit, this practice allows manufacturers to cross-subsidize the prices of entry-level vehicles to keep monthly payments low and attract new and young consumers to their brand.[149] It also allows manufacturers to shift the cost of fuel efficiency and emissions control improvements to categories of vehicles where consumers are less price-sensitive, such as luxury vehicles. This approach minimizes the total compliance cost, and in particular minimizes the pass through of costs to consumers of lower-price vehicles. As a result, economic studies tend to point to less than 100% pass though.[150]

While the agencies acknowledge cross-subsidization in the Proposed Rule,[151] in their price analysis, the agencies claim that "it is reasonable to assume that all incremental technology costs

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[144] *See* Hourcade et al. (2007).

[145] 83 Fed. Reg. at 43,085.

[146] *See* Anne C. Mulkern, *Economists see errors in government claims on pricing*, E&E NEWS (August 6, 2018), https://www.eenews.net/climatewire/2018/08/06/stories/1060092785 (quoting economist Mark Jacobsen, associate professor of economics at the University of California, San Diego as saying that "'Automakers don't always raise the price of cars relative to the costs of meeting fuel economy standards" but that instead automakers have "price points they're trying to meet for specific markets.").

[147] 83 Fed. Reg. at 43,186.

[148] *See* Luk et al. (2016), at 154–171; *see also* Goldberg (1998); Austin & Dinan (2005).

[149] 83 Fed. Reg. at 43,224; *see also id.* at 43,083 (acknowledging that technology costs could, among other options, be paid for by manufacturers or dealers rather than be passed onto consumers in their entirety).

[150] Gron & Swenson, (2000), at 316 (rejecting the hypothesis of full cost pass-through and constant markup).

[151] "All of this is paid for through cross subsidization by increasing prices of other vehicles not just in California and other States that have adopted California's ZEV mandate, but throughout the country." 83 Fed. Reg. at 42,999. In addition: "If the body-style level average price change is used, then the assumption is manufacturers do not cross-subsidize across body styles, whereas if the average price change is used then the assumption is they would proportion costs equally for each vehicle. These are implementation questions to be worked out once NHTSA has a historical data source separating price series by body styles, but these do not matter in the current model which only considers the average price of all light-duty vehicles. 83 Fed. Reg. at 43,095.

can be captured by the average price of a new vehicle."[152] This approach completely overlooks vehicle and customer heterogeneity and ignores the profit-maximization idea behind mix-shifting.[153]

In 2012, the agencies acknowledged mix-shifting and pointed to its importance going forward.[154] However, because mix-shifting can only decrease costs compared to baseline standards and the agencies had already found the rule to be beneficial, there was no need for mix-shifting modeling in 2012. But now, the agencies claim that the benefits of the baseline standards no longer outweigh the costs.[155] Yet the agencies cannot possibly reach such a conclusion before they have considered the impact of mix-shifting. Given that the agencies currently find the baseline standards to be detracting from welfare, they should ensure that their results are not driven by biased methodology that inflates the costs of the regulation.

Moreover, evidence of the industry's recent performance, cited in the Proposed Rule, shows that manufacturers have been able to comply with the standards over the past ten years without detriment to their fleets.[156] For example, the agencies explain that manufactures have been able to reduce fleet-wide CO2 emissions while continuing to produce a diverse fleet.[157] This was likely helped in part by the ability to shift any increase in costs due to the standards to models, such as luxury vehicles, where consumers are less likely to react to the price difference and thus continue to keep prices at a competitive level. The agencies now argue that the Proposed Rule is justified on the ground that something different "may" happen with compliance levels than was assumed in the baseline standards.[158] But that conjecture is insufficient to show that "there are good reasons for the new policy."[159]

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[152] 83 Fed. Reg. at 43,186.

[153] *See* Anne C. Mulkern, *Economists see errors in government claims on pricing*, E&E NEWS (August 6, 2018), https://www.eenews.net/climatewire/2018/08/06/stories/1060092785 (quoting economist Christopher R. Knittel, professor of economics at MIT as saying in the context of mix-shifting that "They [the agencies] add up what those technologies would cost, and then that is the change in prices of the vehicles. The EPA and NHTSA analysis, I think, is missing a major part of how the markets operate in the presence of fuel economy standards,").

[154] 77 Fed. Reg. at 63,068 ("We recognize, however, that many manufacturers do in fact cross-subsidize to some extent, and take losses on some vehicles while continuing to make profits from others. NHTSA has no evidence to indicate that manufacturers will inevitably shift production plans in response to these final standards, but nevertheless believes that this issue is worth monitoring in the market going forward.").

[155] As these comments explain, the agencies' analysis is fundamentally flawed.

[156] 83 Fed. Reg. at 43,231.

[157] *Id.* at 43,230.

[158] *Id.* at 43,231.

[159] *Fox Television Stations, Inc.*, 556 U.S. at 515; *see also NetCoalition v. SEC*, 615 F.3d 525, 539 (D.C. Cir. 2013) (holding that the court would not "defer to the agency's conclusory or unsupported suppositions" (internal quotation marks omitted)).

3. The agencies provide no evidence for their claim of past price increases due to the baseline standards

The agencies' suggestions that evidence of full pass-through lies in recent vehicle price increases are also incorrect.

According to the agencies, there have been "tremendous increases" in vehicle prices over the last decade, making vehicles "increasingly unaffordable."[160] But historical prices do not support the agencies' conclusions. As independent surveys show, over the last ten years, the price of lower-cost vehicles has remained constant despite recent increases in the stringency of standards. A study by Synapse Economics shows that the range of prices of new vehicles has increased, but those increases occurred because the price of high-end vehicles has gone up as more features have been added.[161] The price of more affordable vehicles, on the other hand, has not changed in real terms.

Moreover, the agencies' narrative about the average vehicle becoming unaffordable for the median household is ill-conceived and misleading.[162] By definition, the median household does not buy an average vehicle, but rather a median vehicle. To illustrate why that matters, assume that the price of only the most expensive makes (e.g., only Mclaren vehicles) increases. For the median household, this will have no implications: as the median household never buys the most expensive makes, the price of the vehicles it buys has not changed. However, the average price would increase, so using the agencies' logic, we would deduce that the increase of Mclaren car price would make the cars less affordable for the median household. That is obviously unreasonable.

In addition, in its discussion of affordability, the agencies also disregard the fact that the recent changes in average vehicle price can be, and in fact are, demand-driven and thus reflect the shift in consumer preferences, and not a financial burden for customers. For example, the agencies claim that "new vehicles become increasingly unaffordable—with the average new vehicle transaction price recently exceeding $36,000—up by more than $3,000 since 2014 alone."[163]

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[160] 83 Fed. Reg. at 42,993-94 (citing Average New-Car Prices Rise Nearly 4 Percent for January 2018 On Shifting Sales Mix, According To Kelley Blue Book, https://mediaroom.kbb.com/2018-02-01-Average-New-Car-Prices-Rise-Nearly-4-Percent-For-January-2018-On-Shifting-Sales-Mix-According-To-Kelley-Blue-Book (last accessed Jun. 15, 2018).

[161] Tyler Comings & Avi Allison, Synapse Energy Economics, Inc., *More Mileage for Your Money: Fuel Economy Increases While Vehicle Prices Remain Stable* 5 (2017), https://consumersunion.org/wp-content/uploads/2017/03/Synapse-CU-Affordability-Report-3-15-corrected-1.pdf.

[162] ("In fact, a recent independent study indicated that the average new car price is unaffordable to median-income families in every metropolitan region in the United States except one: Washington, DC. Figure I-2 with the average new vehicle transaction price recently exceeding $36,000—up by more than $3,000 since 2014 alone. 83 Fed. Reg. 42,993-42,994.

[163] *Id.* at 42,993.

However, as the quoted article explains: "shifting sales mix to trucks and SUVs has been particularly extreme lately, and as volume shifts away from cars, the average vehicle price ticks up."[164] Clearly, in that context, the agencies' concern about decreasing affordability is misplaced—it is the consumers that have been choosing, on average, the more expensive types of cars.

C. The agencies' reliance on "relatively low" fuel prices is arbitrary and capricious

The agencies' conclusions about the need for the Proposed Repeal also rest on the claim that fuel prices are "relatively low" when compared to fuel prices in 2012.[165] According to the agencies, because of these lower prices, consumers have chosen to buy vehicles that do not improve manufacturers' compliance positions.[166] For example, according to the agencies, because of the new fuel prices, consumers are not interested in hybrids.[167] And according to the agencies, because of these "new facts and circumstances," the agencies are justified in rejecting the 2012 facts and analyses.[168]

But the agencies have arbitrarily ignored EPA's analysis in 2016 and the 2017 Final Determination, which show that the baseline standards were still achievable and justified even though fuel prices had dropped since 2012. For the 2017 Final Determination, EPA's central analysis used the EIA Annual Energy Outlook 2016 ("2016 AEO") forecast of gasoline prices, and analyzed scenarios that included a low estimate of $1.97, up to a high estimate of $4.94. After analyzing those scenarios, EPA found that even with the lowest prices projected in AEO 2016 of close to $2, the "lifetime fuel savings significantly outweigh the increased lifetime costs" of the GHG Standards.[169] In ignoring the 2017 analysis, the Proposed Rule has failed to provide a "reasoned explanation" for dismissing the "facts and circumstances that underlay" the original rule rendering its analysis arbitrary and capricious.[170]

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[164] *Average New-Car Prices Rise Nearly 4 Percent for January 2018 On Shifting Sales Mix, According To Kelley Blue Book*, Kelley Blue Book https://mediaroom.kbb.com/2018-02-01-Average-New-Car-Prices-Rise-Nearly-4-Percent-For-January-2018-On-Shifting-Sales-Mix-According-To-Kelley-Blue-Book.

[165] 83 Fed. Reg. at 42,993; *id.* at 43,069 (explaining that both the high and low fuel prices from 2017 are lower than they were in 2011); *id.* at 42,993 ("Things have changed significantly since 2012, with fuel prices significantly lower than anticipated, and projected to remain low through 2050.").

[166] *Id.* at 43,217.

[167] *Id.* at 43,222.

[168] *Id.* at 43,226.

[169] EPA, Final Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation at 8 (2017, https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100QQ91.pdf [hereafter "Final Determination"].

[170] *Fox Television Stations*, 556 U.S. at 515-16.

Moreover, even if fuel prices are slightly lower than in 2012, for the last several years, fuel prices have been rising again. Fuel prices have been rising steadily since 2016, and as of October 6, 2018, are at $2.866.[171] In the last year, fuel prices have risen by more than 10%.[172] With oil prices reaching currently around $83 per barrel of Brent crude, some analysts and commodity traders predict that 2019 might see prices above $100 per barrel.[173]

If fuel prices rise in line with these forecasts, those rising fuel prices will give consumers an increased incentive to buy fuel-efficient cars, raising demand for fuel efficient vehicles and making it easier for automakers to comply with the standards.[174] Indeed, even if fuel prices do not actually rise, a 2013 study shows that consumers believe future prices will be the same as current prices (stated more formally, average consumer beliefs are typically indistinguishable from a no-change forecast).[175] So the fact that prices are currently rising will motivate consumers to buy more fuel-efficient vehicles. In other words, even if consumers just expect fuel prices to rise (whether or not they actually rise), consumers will have the incentive to buy fuel-efficient cars.

In any event, fuel prices change very quickly and the accuracy of the forecast tends to be very low. As such, the agencies should recognize that the value of fuel efficiency provides an insurance value against future and unpredictable developments in gasoline markets. The agencies should not relegate any consideration of different, realistic gas prices to the sensitivity analysis, but instead should more systematically incorporate various gasoline price scenarios into their main analysis.

III. THE AGENCIES HAVE ARBITRARILY IGNORED CONSUMER VALUATION OF FUEL SAVINGS AND THE WELFARE BENEFITS OF THE BASELINE STANDARDS

The agencies' incomplete and inaccurate estimations of the fuel savings and time savings from increasing vehicle efficiency render its cost-benefit analysis arbitrary. Moreover, much of the proposed rollback's justification undercuts even those partial estimations, alleging that the private benefits of fuel economy standards must be illusory and will be offset by lost welfare from other vehicle attributes. Elsewhere, the agencies' model and the proposed rule's justification depend on inconsistent assumptions that either consumers do not value fuel economy at all, or else that consumers very strongly value fuel economy. The agencies have

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[171] Current gas prices from EIA are available here: https://www.eia.gov/petroleum/gasdiesel/

[172] *Id.*

[173] See https://oilprice.com/Energy/Oil-Prices/100-Oil-Is-A-Distinct-Possibility.html, https://www.aljazeera.com/news/2018/09/oil-prices-hit-year-high-81-looming-iran-sanctions-180925060509728.html and https://www.wsj.com/articles/opecs-wildcards-could-push-oil-to-100-1538737295

[174] EIA (2018A), at 113 (2018) (showing that sales of cars and other high-efficiency automobiles are expected to increase relative to sales of other vehicles starting in 2020 as gas prices motivate consumers to adopt more fuel-efficient vehicles).

[175] Anderson et al. (2013).

failed to consider important economic theories and evidence—both from new literature and from the agencies' own past rulemakings—that explain why fuel economy standards can deliver significant net private welfare gains. One such important concept is that many vehicle attributes, like horsepower and size, are positional goods, and so regulation of fuel economy can help correct the positional externality. The agencies also fail to consider the distributional aspect of consumer valuation of fuel economy and the health effects associated with refueling.

A. The myriad problems with the scrappage, rebound, and sales modules cause the agencies to underestimate the net forgone private savings from fuel economy

In their various tables summarizing the costs and benefits of the proposed rollback, the agencies present the forgone private savings from the proposed rollback as a net calculation. For example, the estimate of "higher fuel costs from lower fuel economy" includes "lost fuel savings from lowered fuel economy of MY's 2017-2029 *and gained fuel savings from more quickly replacing* MY's 1997 to 2029 with newer vehicles."[176] All the myriad problems with the agencies' scrappage, rebound, and sales modules (detailed throughout these comments) have therefore once again infected their calculation of costs and benefits. In this case, by overestimating the effect of the proposed rollback on the replacement of older vehicles with newer vehicles, the agencies have overestimated "gained fuel savings" that will allegedly offset lost fuel savings under the proposed rollback. If the agencies correct the problems with their scrappage, rebound, and sales modules, the estimates of net forgone private savings will increase, showing that the proposed rollback will be more detrimental to the personal welfare of vehicle owners than the agencies currently calculate.

B. The agencies' position on consumer valuation of fuel economy is internally inconsistent and provides false support for the rollback

Much of the Proposed Rule's justification and models depend on the incorrect and unsupported assumption that consumers do not value fuel economy. Nowhere is that wrong assumption more apparent or more problematic than in the agencies' sales module.

When purchasing a vehicle, an individual pays the upfront cost of the vehicle, and the consumer will also need to pay for fuel for the vehicle over time. The degree to which consumers value fuel economy relative to the objective, present discounted value of fuel savings, generally expressed as a ratio or a percentage of full valuation, is a key parameter for assessing how vehicle sales will react to fuel efficiency standards. If consumers have a valuation of less than 100%, that suggests that consumers undervalue fuel efficiency, implying that increases in fuel efficiency will not lead to as large of an increase in automobile demand as a standard economic

[176] *E.g.*, 83 Fed. Reg. at 43,065 (emphasis added).

model would suggest.[177] An undervaluation likely reflects a market failure, such as an informational failure, myopia, supply side failures, positional externalities, or so forth—as discussed below, and as discussed by the agencies at length in the 2012 rulemaking. Fuel economy regulations, therefore, can correct the market failure and so deliver net private welfare gains.[178] If consumers instead have greater than 100% valuation of fuel economy, then emissions standards will increase demand for more fuel-efficient vehicles by *more* than a standard economic model would predict.[179]

Despite the centrality of this parameter to accurate estimation of the demand response to the proposed rollback, the agencies arbitrarily omit the parameter from their sales module, thus implicitly assuming that consumers have a 0% valuation of fuel economy. To derive estimates for how the baseline standards would affect sales (which ultimately leads to the agencies' inflated fatality numbers), the agencies use a model that connects claimed price changes (attributed to the baseline standards) with sales.[180] That sales module ignores consumer valuation of fuel economy and so effectively treats consumers as having zero valuation of fuel economy.[181] Ignoring the amount that consumers value fuel economy in the sales module allows the agency to significantly boost the sales drop that it attributes to the baseline standards.[182] This drop in sales then drives the agencies' inflated estimates about the effect of the baseline standards on fleet size and fatalities.

Similarly, at various points throughout the proposed rule, the agencies assume that consumers' low valuation of fuel economy creates compliance "challenges for achieving increased fuel economy levels and lower CO_2 emission rates" and offer these challenges as a justification for the proposed rollback.[183] Thus, an assumed very low or zero valuation of fuel economy is central to the proposed rollback's justification.

But neither the literature the agencies cite nor any of the literature they ignore supports such an extreme and arbitrary assumption as a very low or zero valuation. The agencies' failure to estimate consumer valuation of fuel economy in their sales module results in their gross

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[177] Steven Berry et al. (1995).

[178] *E.g.*, Alcott & Sunstein (2015) (explaining that CAFE standards can correct internalities).

[179] *See, e.g.* Busse et al. (2013).

[180] *See* 83 Fed. Reg. at 43,074.

[181] *Id.* at 43,075. The agencies claim that their model operates at "too high a level of aggregation to capture" consumer preference for fuel efficiency. *Id.*

[182] The agencies conclude that, because of their assumptions, including their implicit assumption that consumers do not value fuel economy, it is "reasonable to assume" that lowering the standards will "increase total sales of new cars and light trucks during future model years." *Id.*

[183] *E.g.*, *id.* at 42,993; *see also id.* at 43,217 (blaming "consumers not being interested in better fuel economy" for manufacturers' alleged need to "manag[e] their CAFE compliance obligations through use of credits").

overestimation of the alleged safety benefits of this proposed rollback, as explained throughout our comments. In fact, because EPA's 2017 *Final Determination* confirmed that "[e]ven with the lowest fuel prices projected by AEO 2016 . . . the lifetime fuel savings significantly outweigh the increased lifetime costs,"[184] there is good reason to believe that the original standards would raise consumer demand and hasten adoption of new vehicles, while the proposed rollback will have the opposite effect.

Moreover, the 0% valuation conflicts with agencies' own analysis. The agencies conclude—after reviewing only a very narrow set of literature (see next subsection critiquing the agencies' literature review)—that consumers instead value "at least half—and perhaps all—of the savings in future fuel costs."[185] The agencies' rebound module also implicitly assumes that consumers will have an extremely strong reaction to changes in fuel economy, indicating a strong valuation of fuel economy, and the scrappage module incorporates a cost-per-mile factor that assumes consumers value both absolute and relative fuel economy.[186] Elsewhere, the agencies rely on a payback assumption that consumers are willing to pay for fuel economy technology that returns the investment within 30 months.[187]

The agencies' inconsistent positions on consumer valuation of fuel economy are arbitrary and capricious. On the one hand, the agencies argue that consumers value fuel economy so fully that there can be no private welfare benefits to increasing fuel economy by regulation.[188] And on the other hand, the agencies argue the exact opposite, that consumers have so little regard for fuel economy that manufacturers cannot sell efficient vehicles.[189] In fact, neither extreme position is supported either by the literature that the agencies cite nor by the important additional literature that the agencies ignore.

C. The agencies fail to consider important theoretical and empirical literature

The Agencies' Three Preferred Studies: The proposed rollback's discussion of consumer valuation of fuel economy relies almost entirely on three sources: Sallee et al. (2016), Busse et al. (2013), and Allcott & Wozny (2014).[190] Before critiquing the agencies' reason for focusing only on these studies and the agencies' failure to look at other important literature, it is worth

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[184] Final Determination at 7.

[185] 83 Fed. Reg. at 43,073; *see also id.* at 43,075.

[186] See the sections of our comments on new vehicle sales, scrappage, and rebound for more details on all these inconsistent assumptions.

[187] *Id.* at 43,217.

[188] *See, e.g.*, *id.* at 43,072, 43,075.

[189] *Id.* at 42,993.

[190] *Id.* at 43,072-73.

noting that these three sources in no way support either the proposition that consumers do not value fuel economy at all (as the agencies implicitly assume in their sales model), nor the position that consumers already so perfectly value fuel economy that there is no possible benefit to efficiency standards (as the agencies imply in their literature review). The best read of even just these three studies is that consumers do value fuel economy but are not reliably willing to pay exactly $1 today for a net present expected savings in future fuel costs of just over $1, as classic economic theory would predict. Instead, there is a gap, and that gap creates the potential for a well-designed regulation to deliver net private benefits. Allcott & Wozny estimate that consumers are probably incorporating about 55% of future fuel costs into their vehicle purchase decisions;[191] Busse et al. estimate a very wide range (between 54% and 117%);[192] Sallee et al. find that consumers may "incorporate slightly more than 100% of changes in future fuel costs" into their decisions,[193] but also find "modest undervaluation" of "70 to 86%" among large-scale fleet operators.[194] None of these studies estimates a 0% valuation, as the agencies' sales module implicitly does.

The agencies justify their decision to focus almost exclusively on these three studies by highlighting problems with cross-sectional and discrete choice studies, and by citing those problems as a reason to prefer studies based on panel data.[195] While cross-sectional and discrete choice studies may have limitations, the studies the agencies focus on also have limitations. Most notably, as the agencies acknowledge, only one study they rely on, Busse et al., includes any direct examination of new vehicle sales, and even that estimate "is based on more limited information";[196] the other two studies, Sallee et al. and Allcott & Wozny, both focus exclusively on used vehicles.[197] And each of the three studies has various other limitations and idiosyncrasies with its choice of data and methodology. Sallee et al., for example, excludes data on hybrid vehicles.[198] Just as these various limitations would not necessarily be grounds to completely ignore these three studies, neither should all other literature be ignored outright.

Ignoring All Other Empirical Literature: Even as they admit the limitations of the three studies that they rely on, the agencies assume that the limitations of all other studies are fatal flaws and so essentially ignore all other literature, including literature that helps explain the energy

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[191] *Id.* at 43,072. With different model choices, that number either rises to 76%, *id.* (when using oil future market data) or drops to 55%; *id.* at 43,073 (with greater disaggregation of the MPG groups).

[192] *Id.*

[193] *Id.* at 43,072.

[194] *Id.* at 43,703.

[195] *Id.* at 43,071.

[196] *Id.* at 43,073.

[197] *Id.*

[198] PRIA at 936, n. 487.

efficiency paradox. Such an extreme reaction is not warranted. When a study raises useful and relevant points, it should not be ignored simply because the agencies prefer a different methodological structure, or even just because the study has not been published in a peer-reviewed journal. The agencies should assess the study's quality and relevance, and particularly should have a good reason to ignore studies that the agencies previously relied upon.

For example, the agencies identify in footnote 223 that Kilian & Sims (2006) also used a longitudinal approach to examine consumer valuation, similar to the methodology of the agencies' three preferred studies; yet the agencies exclude the results of this study because it is "unpublished" and so its "empirical results are subject to change."[199] It is true that the quality and finality of unpublished studies should be carefully examined before relying on them, and if they are of insufficient quality or relevance, they will not deserve equal consideration with literature published in peer-reviewed journals. Yet neither should unpublished studies, if otherwise relevant and of sufficient quality, be automatically ignored just because they are unpublished.[200] In this case, for example, the Kilian & Sims paper raises a relevant result and theory worthy of further consideration: specifically, that consumers react more strongly to a potential loss of fuel savings than to a potential gain in fuel savings.[201] Given that the agencies have relied on Killian & Sims in the past,[202] and given the relevance of their finding to the proposed decrease in fuel economy standards, the agencies should review the study's quality to determine its relevance, rather than dismiss it out of hand. The agencies should also more thoroughly search the literature for analysis of whether consumers will react differently to a rollback of fuel economy standards than to an increase in standards, and the agencies should generally review the literature that they had previously examined and relied on during the 2012 rulemaking.[203]

[199] 83 Fed. Reg. at 43,072 n.223.

[200] *See, e.g.*, EPA (2010a), at 7-45 ("Because peer-reviewed academic journals may be more likely to publish work using novel approaches compared to established techniques, some studies of interest may be found in government reports, working papers, dissertations, unpublished research, and other 'gray literature.' Including studies from the gray literature may also help mitigate 'publication bias' that results from researchers being more likely to present and/or editors being more likely to publish studies that demonstrate statistically significant results, or results that are of an expected sign or magnitude. . . . [T]he analyst should develop an explicit set of selection criteria to evaluate each of the potentially relevant studies for quality and applicability to the policy case.").

[201] Kilian & Sims (2006), at 3 ("[T]he responses of automobile prices to positive changes in the real price of gasoline are far greater in magnitude than in the baseline case, whereas decreases in the price of gasoline have little or no effect on prices.").

[202] EPA (2010b), at 39 (explaining that Kilian & Sims suggests that consumers may be willing to pay more to avoid a decrease in fuel economy than to gain an increase in fuel economy). This literature review was commissioned in support of NHTSA and EPA's earlier rulemakings.

[203] *Id.*

The agencies should also review the most up-to-date literature. For example, the agencies should consider David Greene et al.'s recently published meta-analysis of marginal willingness-to-pay estimates for fuel economy. These authors find a mean estimate for willingness to pay of $853 for a $0.01/mile reduction in fuel costs.[204] The agencies have failed to do a thorough search of the literature and to base their decision on all of the reliable information available to them.

Ignoring Other Explanations for the Efficiency Paradox: The agencies claim that previous rulemakings relied heavily on the belief that consumers' undervaluation of fuel economy was due to "myopia,"[205] and falsely assert that the prior rules could only be justified by assuming that consumers value less than one-third of fuel savings.[206] In the past, the agencies did raise the idea of consumer myopia and various "internalities" among the many reasons why consumers may fail to achieve their welfare-maximizing level of fuel economy in the marketplace without the assistance of regulation. But, the agencies also previously explored many other reasons for the energy efficiency paradox which supported the decision to adopt the baseline standards—reasons which the agencies now ignore. For example, in the 2012 rule, the agencies explained that what seems like an undervaluation of fuel economy could result from consumers "lack[ing] the information necessary to estimate the value of future fuel savings, or not hav[ing] a full understanding of this information even when it is presented," or that "[i]n the face of such a complicated choice, consumers may use simplified decision rules," and may focus on "visible attributes that convey status."[207] Yet, with no analysis of the relevant literature, the agencies now assume that consumers must be perfectly informed about fuel economy[208] and so conclude that "it is reasonable to believe that U.S. consumers value future fuel savings accurately."[209]

In fact, important literature explains why, even with the assistance of somewhat improved—though surely not yet optimized—labels that provide consumers with information on fuel savings, consumers may still face challenges to fully incorporating that information into their decisionmaking. James Sallee, for example, has explained that:

> [A]ccurate valuation of lifetime present discounted fuel costs is challenging, both because the calculation is cognitively difficult and because the information required is hard to obtain. Government labels aid in this task, but they do not resolve all uncertainty because the labels are incomplete and inaccurate and because

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[204] Greene et al. (2018) at 270-71 (finding a range from a mean estimate of $693 in market sales and revealed preference studies, to $1225 in stated-preference studies; meanwhile, NHTSA data would suggest that a $0.01/mile reduction should deliver about $1150 in lifetime fuel savings).

[205] 83 Fed. Reg. at 43,216.

[206] *Id.* at 43,073.

[207] 77 Fed. Reg. 62,624, 62,914 (Oct. 15, 2012).

[208] 83 Fed. Reg. at 42,993.

[209] *Id.* at 43,216.

heterogeneity in usage patterns implies that labels can resolve only a modest portion of the relevant uncertainty.[210]

Because the variation in fuel costs across automobiles—though "substantial"—is also "dwarfed by variation in prices," and given the costs of obtaining and processing more information about fuel economy, consumers tend to be "inattentive" to fuel economy. The financial loss in future fuel savings to any individual from making a "mistake" in their choice of fuel economy may be less than the costs of the effort to obtain and process more information on fuel economy before the decision—yet, "in the aggregate," the result could be billions of dollars in lost fuel savings across the entire U.S. car market.[211] Because "firms will bring to market only those innovations that garner attention," firms may underprovide important but "shrouded" innovations in fuel economy that may rationally escape consumers' attention.[212] Yet because increased attention "involves real costs" for consumers, policy fixes focused on increasing information and attention may not improve welfare; instead, energy efficiency standards become the optimal policy solution.[213] The agencies have failed to consider the ongoing challenges to information processing that consumers face and so fail to consider how regulation can help consumers overcome these challenges and maximize private welfare.

Similarly, the agencies now ignore explanations of supply-side market failures that helped justify past rulemakings. In the 2012 rule's impact analysis, the agencies explained that imperfect competition in the vehicle market could "reduce[ ] producers' profit incentive to supply the level of fuel economy that buyers are willing to pay for."[214] Asymmetric information between manufacturers and consumers could also cause fuel economy to "remain persistently lower than that demanded by potential buyers."[215] Manufacturers may "deliberately limit the range of fuel economy levels they offer" if manufacturers "mistakenly believe" that consumers are unwilling to pay for improved fuel economy.[216]

Other important literature further explores these supply-side market failures. Manufacturers may face a first-mover disadvantage for developing new fuel-efficiency technologies, and regulation can help overcome that perceived disadvantage as well as bring down costs through economies of scale and learning, and thus may "lead to a more optimal provision of fuel economy in the

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[210] Sallee (2014), at 782. Note also that NHTSA has not fulfilled its statutory obligation to develop a consumer education program on fuel economy and greenhouse gas emissions. 49 U.S.C. § 32908(g).

[211] *Id.* at 783.

[212] *Id.* at 784.

[213] *Id.* at 785. Note that Sallee et al. (2016), which the agencies rely on, cite Sallee (2014) as an important "caveat" to some of the conclusions drawn in Sallee et al. (2016). *See* Sallee et al. (2016), at n. 5.

[214] NHTSA 2012 FRIA at 987-88.

[215] *Id.*

[216] *Id.*

marketplace."[217] As manufacturers offer more fuel-efficiency technology and the technology becomes more widespread in the market, consumer attitudes toward that technology will change.[218] Manufacturers also shape consumer preferences through advertising. Yet now, the agencies assume that it is consumer preferences alone that shape and constrain manufacturers' compliance options,[219] without considering manufacturers' role in shaping the options available in the marketplace and consumers' attitudes toward those options. A review of the broader set of literature, on both supply-side and demand-side obstacles to the efficient provision of fuel economy, demonstrates that the justification for the proposed rollback runs counter to the available evidence.

In Tables II-25 to II-28, the agencies' presentation of costs and benefits seem to count the forgone private savings from the increased fuel economy that the original 2012 standards would provide. Implicit in the calculations in those tables is some theory for why consumers will value fuel savings once a regulatory standard helps deliver increased fuel economy, even though consumers are unable to achieve those fuel savings on their own in an unregulated marketplace. Viable theories supported by the literature include some combination of informational failure, attention costs, myopia, positional externalities, or supply-side failures. Much of the agencies' discussion in the *Federal Register* notice and preliminary regulatory impact analysis either ignores or seems skeptical of these theories, and as already noted, much of their modeling relies on inconsistent assumptions that consumers instead do not value fuel economy. As the agencies redo their analysis in response to these and other public comments, they should preserve the calculation of private savings from fuel economy reported in these tables (corrected so that the mistakes with the scrappage, rebound, and sales modules do not cause an undervaluation of net private savings). By more fully valuing the private fuel savings from the 2012 standards, together with other corrections to the analysis, it will be apparent that the proposed rollback is not justified.

D. Surveys on consumer satisfaction

The proposed rollback insists that consumers value fuel savings accurately,[220] that consumers "generally tend not to be interested in better fuel economy above other attributes,"[221] and that consumers are "unlikely" to "suddenly become more interested in fuel economy over other

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[217] NAS (2015), at 319.

[218] *Id.*

[219] *E.g.*, 83 Fed. Reg. at 43,217 (blaming "consumers not being interested in better fuel economy" for manufacturers' alleged need to "manag[e] their CAFE compliance obligations through use of credits").

[220] *Id.* at 43,216.

[221] *Id.* at 43,217 (citing manufacturer comments and an NAS study; but see *infra* on contradictory evidence from the same NAS study).

attributes" in the "foreseeable future."[222] The agencies rely on these statements to claim there are compliance challenges with the 2012 standards, and so justify the proposed rollback. Yet these conclusions are not supported by extensive data from consumer satisfaction surveys.

National Academy: As reported by a 2015 review of fuel economy standard by the National Academy of Sciences, "the public's perception of the CAFE standards and support for raising the standards has been highly positive for the past 25 years."[223] In one survey, for example, 77% of respondents supported higher fuel economy standards even after being told that it would increase the costs of buying or leasing; in another survey, 82% of respondents supported standards of 56 miles per gallon by 2025.[224] The proposed rollback's various pronouncements on consumer valuation are inconsistent with these findings.

ACSI and J.D. Power Surveys: Two long-running surveys of consumer satisfaction with their motor vehicles provide a good deal of publicly available data: the American Customer Satisfaction Index, and J.D. Power's APEAL survey. The data from these two surveys strongly suggests that consumers at least partly value fuel economy, that they value it even when fuel prices are dropping, that they sometimes value it more than other attributes, that they want more of it and are not satisfied by the levels currently provided, and that fuel economy is among the attributes with the most room for improvement and most potential to contribute to greater customer satisfaction with their vehicles.

This section of our comments will look first at recent evidence from these surveys specifically on fuel economy, before taking a more historical and graphical look at data going back to 1994.

Since 1994, the American Customer Satisfaction Index (ACSI) has conducted annual surveys on consumers' satisfaction with "recent purchases and driving experiences" in both mass-market and luxury cars and trucks.[225] Since 2016, ACSI has included details and scores for individual attributes, including gas mileage. In the 2016, 2017, and 2018 surveys, gas mileage has consistently been the lowest-ranked attribute for consumer satisfaction, in both mass market and luxury vehicles.[226] The results of the 2017 survey confirmed that "[r]egardless of category,

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[222] *Id. see also id.* at 42,993 (assuming that only "a relatively small percentage of buyers" value fuel economy, and citing only a single news report).

[223] NAS (2015), at 317.

[224] *Id.* at 318.

[225] For example, in 2018, they conducted 4,649 interviews about "recent purchases and driving experiences. *See* ACSI, *Automobile Report 2018*, https://www.theacsi.org/news-and-resources/customer-satisfaction-reports/reports-2018/acsi-automobile-report-2018/acsi-automobile-report-2018-download [hereafter "2018 ACSI Report"]. As a result, their data may reflect more than just purchases of new vehicles and may include purchases of used vehicles and driving experiences in vehicles that the interviewee did not directly purchase.

[226] ACSI, *Automobile Report 2016,* https://www.theacsi.org/images/stories/images/reports/16aug_auto-report.pdf [hereafter "2016 ACSI Report"]; ACSI, *Automobile Report 2017*,

everybody wants better gas mileage," and that of all the attributes, gas mileage "shows the most room for improvement."[227] The 2018 report made identical comments, adding that "gas mileage continues to be the low point" among all vehicle attributes.[228]

J.D. Power has conducted the U.S. Automotive Performance, Execution and Layout (APEAL) Study for twenty-three years. Its most recent survey, for example, interviewed nearly 68,000 purchasers and lessees of new Model Year 2018 vehicles within ninety-days of ownership.[229] At various times, the APEAL study has included details and comments on fuel economy specifically, and in more recent years, individual attributes including fuel economy have been scored and ranked separately. In 2007, J.D. Power observed that over half of that year's total drop in overall customer satisfaction with new vehicle performance could be attributed to "a significant decrease in owner delight with fuel economy," noting that "manufacturers that deliver more fuel-efficient vehicles . . . stand a better chance of delighting their customers."[230] In 2008, J.D. Power reported that "fuel economy and practicality are increasingly important in vehicle selection process" and attributed yet another overall dip in consumer satisfaction "primarily due to decline in satisfaction in fuel economy."[231] In 2009, an uptick in overall consumer satisfaction was "driven primarily by increased owner satisfaction with fuel economy," which J.D. Power attributed not just to fuel prices, but also to the fact that more manufacturers were designing--and more consumers were buying--fuel-efficient vehicles.[232] In 2010, the vehicles that scored the best included those with "unexpected fuel economy."[233] In 2011, newly launched vehicle models scored higher than redesigned models, partly due to higher scores for fuel economy.[234] In 2012,

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http://marketing.theacsi.org/acton/attachment/5132/f-0058/1/-/-/-/-/ACSI%20Automobile%20Report%202017.pdf [hereafter "2017 ACSI Report"]; 2018 ACSI Report.

[227] 2017 ACSI Report.

[228] 2018 ACSI Report.

[229] Joseph Dobrian, *2018 New Car Appeal Shows Biggest Improvement in History*, J.D. POWER (July 25, 2018), https://www.jdpower.com/cars/ratings/performance-and-design/2018/2018-us-apeal-study-results.

[230] J.D. Power, *Fuel Price Concerns Lead to Decrease in Vehicle Appeal*, June 26, 2008, https://web.archive.org/web/20090221020855/http://www.jdpower.com/corporate/news/releases/pressrelease.aspx?ID=2008078.

[231] Jeff Youngs, J.D. Power, 2008 APEAL Study Results (Dec. 31, 2007), https://www.jdpower.com/Cars/Ratings/Performance-and-Design/2008/2008-apeal-study-results.

[232] Jeff Youngs, J.D. Power, 2009 APEAL Study Results, Dec. 31, 2008, https://www.jdpower.com/Cars/Ratings/Performance-and-Design/2009/2009-apeal-study-results.

[233] Paul A. Eisenstein, *U.S. Automakers Gain APEAL—and Appeal*, NBC NEWS (July 22, 2010), http://www.nbcnews.com/id/38346050/ns/business-the_driver_seat/t/us-automakers-gain-apeal-appeal/ (reporting on APEAL scores).

[234] J.D. Power, *Automakers Face Up to Tough Market Conditions by Offering the Most Appealing Lineup of New Vehicles in History*, July 27, 2011, https://web.archive.org/web/20120304214343/http://www.jdpower.com:80/content/press-release-auto/7uCb2L3/owner-reported-fuel-economy-from-apeal-study-.htm.

owners shifted toward smaller and more fuel-efficient vehicles, and satisfaction with fuel economy showed the greatest overall increase, helping to drive the total APEAL score up. That year, J.D. power reported that "*47 percent of owners say gas mileage was one of the most important factors in choosing their new vehicle, up from 40 percent in 2011*."[235] In 2014, fuel economy was the only attribute with a year-over-year improvement in owner satisfaction, driven not just by fuel prices but by vehicle efficiency itself. Nevertheless, "fuel economy is still a problem area for automakers . . . [and] *continues to be the lowest-scoring category in the study by a wide margin*."[236] In other words, consumers have not been satisfied with the fuel economy provided by manufacturers, and it drags down their overall satisfaction with their new vehicles. In 2016, an improvement in fuel economy had the largest impact on overall increase in satisfaction; increased satisfaction with the related attribute of driving range was the second-most-important attribute in driving overall gains in consumer happiness.[237] And in 2018, satisfaction with fuel economy rose again slightly (though remained relatively quite low compared to all other attributes), with J.D. Power reporting that "*customers are more satisfied with their fuel economy despite increases in fuel prices*."[238] Driving range rounded out the "top 10 vehicle attributes with the greatest positive effect year over year on overall score."[239] Looking back over J.D. Power's survey results from the last decade, consumers have consistently expressed dissatisfaction with current levels of fuel economy and a desire for greater fuel economy than the market was providing, even during periods when gas prices were falling.

These robust surveys undercut many of the agencies' justifications and conclusions. The upshot from the ACSI and J.D. Power survey is that consumers are not satisfied with the currently available levels of fuel economy, they want greater fuel economy improvements even when gasoline prices fall, and they are unable to obtain in the marketplace the amount of fuel economy they would prefer. Additionally, as the graph in the next subsection suggests, fuel economy could have a relationship to overall customer satisfaction with their vehicles that other attributes, like horsepower and size, in fact might lack.

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[235] J.D. Power, *As Vehicle Appeal Improves, Owners Find that Downsizing Doesn't Necessarily Mean Downgrading*, July 25, 2012, http://www.jdpower.com/press-releases/2012-us-automotive-performance-execution-and-layout-apeal-study.

[236] Jeff Youngs, J.D. Power, 2014 APEAL Study Results (July 23, 2014), https://www.jdpower.com/Cars/Ratings/Performance-and-Design/2014/2014-apeal-study-results.

[237] J.D. Power, Safety Features Score Big, Boosting New-Vehicle Appeal, July 27, 2016, http://www.jdpower.com/press-releases/jd-power-2016-us-automotive-performance-execution-and-layout-apeal-study.

[238] Joseph Dobrian, 2018 New Car Appeal Shows Biggest Improvement in History (July 25, 2018), https://www.jdpower.com/cars/ratings/performance-and-design/2018/2018-us-apeal-study-results.

[239] J.D. Power, Infographic: 2018 Performance and Design Key Stats, July 25, 2018, https://www.jdpower.com/cars/ratings/quality/2018/infographic-2018-us-apeal-study-key-stats.

Graphing Attributes Against Fuel Economy: Data from these long-running, robust consumer satisfaction surveys can be plotted against relative changes in attributes like average horsepower, size, acceleration, and fuel economy. The resulting graph, Figure 1 below, is not a full economic analysis, but even a coarse look at the data is revealing.

These are the data sources for the graph that appears below:

- Horsepower: graphed in red below, data on the percent change in average light-duty vehicle horsepower since a baseline of 1994 is drawn from EPA's 2018 report on *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends*.[240]
- Weight: graphed in yellow below, data on the percent change in average light-duty vehicle weight since a baseline of 1994 is also drawn from that 2018 EPA report.
- Acceleration: graphed in orange below, numerical data on acceleration is not provided directly by the 2018 EPA report; however, numerical estimates of relative changes in average vehicle acceleration since 1994 were backed out from EPA's own chart on acceleration.[241]
- Fuel economy: graphed in green below, data on the percent change in average adjusted fuel economy since 1994 is also drawn from EPA's 2018 report.[242]
- Consumer Satisfaction: graphed in various shades of blue below, there are three sets of data on consumer satisfaction.
    - The American Customer Satisfaction Index (ACSI) has conducted annual surveys since 1994 about consumers' satisfaction with "recent purchases and driving experiences" in both mass-market and luxury cars and trucks.[243] Their survey captures opinions about gas mileage, driving performance, dependability, safety, comfort, and other "critical elements of the automobile experience."[244] Scores out of a possible 100 are given for each manufacturer and as an industry-wide average going back to the baseline year of 1994.[245] The industry-wide average is used here.
    - J.D. Power has conducted the U.S. Automotive Performance, Execution and Layout (APEAL) Study for twenty-three years. Its most recent survey interviewed nearly 68,000 purchasers and lessees of new Model Year 2018 vehicles within ninety-days of ownership.[246] The survey covers 90 attributes in 10 categories: fuel economy, exterior,

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[240] EPA (2018a), at tbl. 2.1.

[241] *Id.* at Figure 3.11.

[242] Adjusted fuel economy values "reflect real world performance and are not comparable to automaker standards compliance levels." EPA, *Trends* at 4.

[243] For example, in 2018, ACSI conducted 4,649 interviews about "recent purchases and driving experiences. *See* 2018 ACSI Report. As a result, their data may reflect more than just purchases of new vehicles, and may include purchases of used vehicles and driving experiences in vehicles that the interviewee did not directly purchase.

[244] ACSI, Automobiles, https://www.theacsi.org/industries/manufacturing/automobile.

[245] ACSI, Benchmarks by Company: Automobiles and Light Vehicles, https://www.theacsi.org/index.php?option=com_content&view=article&id=149&catid=&Itemid=214&i=Automobiles+and+Light+Vehicles.

[246] Joseph Dobrian, J.D. Power, *2018 New Car Appeal Shows Biggest Improvement in History*, July 25, 2018, https://www.jdpower.com/cars/ratings/performance-and-design/2018/2018-us-apeal-study-results.

seats, interior, driving dynamics, storage and space, engine and transmission, visibility and safety, HVAC, and audio/communication/entertainment/navigation.[247] Historical APEAL scores are not compiled in a single database online, but many can be pieced together from press releases and old media coverage. We have compiled industry-wide APEAL scores going back to 2001 (except for the year 2002, which was not available online).[248]

- From personal communications with J.D. Power employees, as well as from observations on how more recent press releases discussed historical scores, we learned that the scale for the scoring was changed between 2005 and 2006.[249] Therefore, there are two separate sets of data from the APEAL survey: 2001 to 2005, with year 2001 results as the baseline; and post 2006, with year 2006 results as the baseline.

There may be some slight time lag between the year when a survey was conducted and the model year of the vehicles covered, though note that, for example, the APEAL survey conducted in the summer of 2018 focused on Model Year 2018 vehicles. The ACSI survey results also cover more than just customer experiences with new vehicles, and also includes all recent vehicle purchases. Yet despite such limitations, the raw data is still revealing.

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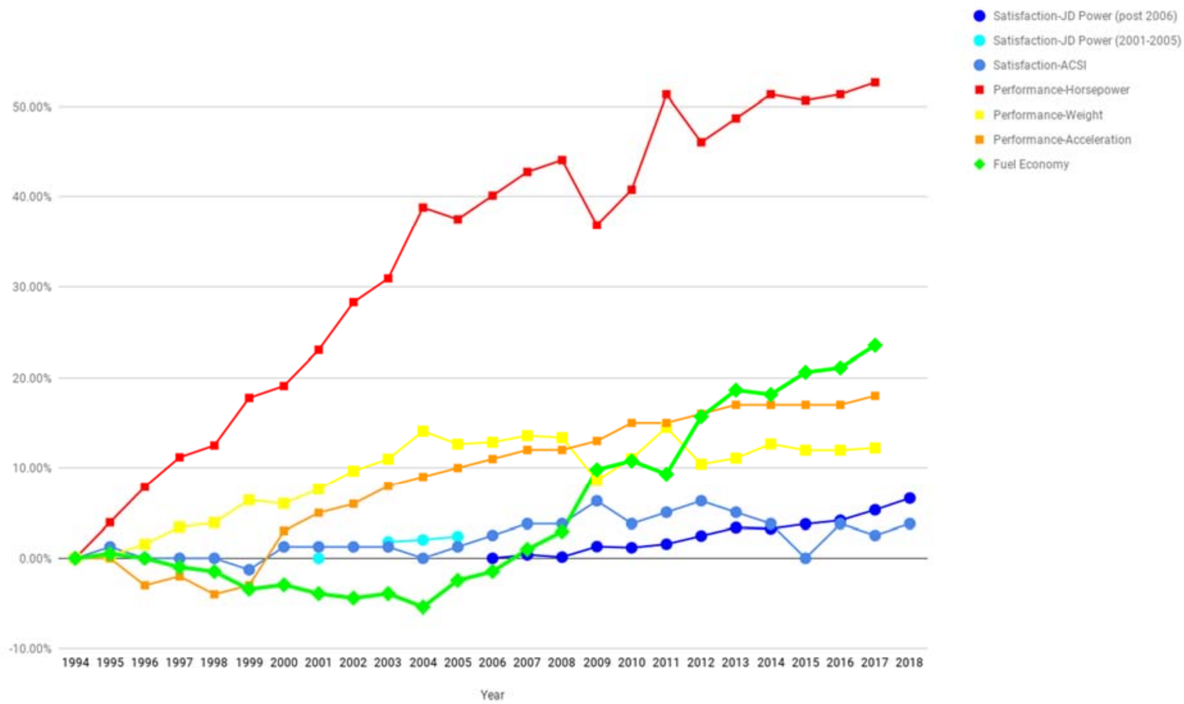
[247] J.D. Power, *U.S. Automotive Performance, Executive and Layout (APEAL) Study*, http://www.jdpower.com/press-releases/jd-power-2017-us-automotive-performance-execution-and-layout-apeal-study.

[248] Data compiled from: 2018 score (https://www.jdpower.com/cars/ratings/performance-and-design/2018/2018-us-apeal-study-results); 2013-2017 scores (http://www.jdpower.com/cars/articles/jd-power-studies/infographic-2017-us-apeal-study-key-stats); 2012 score (http://www.jdpower.com/press-releases/2012-us-automotive-performance-execution-and-layout-apeal-study); 2010-2011 scores (http://www.jdpower.com/cars/articles/jd-power-studies/2011-apeal-study-results); 2009 score (https://www.thetorquereport.com/news/porsche-once-again-leads-in-2009-j-d-power-apeal-study/); 2007-2008 scores (https://web.archive.org/web/20090221020855/http://www.jdpower.com/corporate/news/releases/pressrelease.aspx?ID=2008078); 2006 score (https://acurazine.com/forums/automotive-news-6/j-d-power-apeal-study-news-%2A%2A2014-results-page-1-%2A%2A-394014/; and *American Drivers Rate Midland Motors*, Birmingham Post UK, June 30, 2006, 2006 WLNR 113085817); 2005 score (*Exhaust Notes*, Winnipeg Free Press, Sept. 30, 2005, 2005 WLNR 15414064; and *Lexus Owners Love Their Cars: Power Study*, Globe & Mail, Sept. 29, 2005, 2005 WLNR 15327636); 2004 score (*Nissan Scores Well in Consumer Survey*, Clarion-Ledger (Jackson MS), Oct. 15, 2004., 2004 WLNR 23140691; and *Notebook*, Automotive News (Newsday), Nov. 4, 2004, 2004 WLNR 5166450); 2003 score (http://money.cnn.com/2003/10/07/pf/autos/jdpower_apeal/); 2001 score (*Standard Catalog of Buick 1903-2004* p.329, listing the industry average APEAL score for 2001), *available at* https://books.google.com/books?id=PO65ddhim6kC&pg=PA329&lpg=PA329&dq=%22Automotive+Performance,+Execution,+and+Layout%22+2001+average&source=bl&ots=rPwLoRViPJ&sig=8o2uv-GkvDjIGBlA41hjvP9C0w0&hl=en&sa=X&ved=0ahUKEwjN3MWXr73bAhVpjFQKHcdsC9wQ6AEIVjAH#v=onepage&q=%22Automotive%20Performance%2C%20Execution%2C%20and%20Layout%22%202001%20average&f=false.

[249] E-mail Correspondence between Jason A. Schwartz and J.D. Power staff (June 12, 2018).

Figure 1. Changes in Vehicle Attributes versus Changes in Consumer Satisfaction with Vehicles



Overall, consumer satisfaction with their recent vehicle purchases has been mostly flat since 1994, with some possible slight upticks in recent years. The huge increase in vehicle horsepower from 1994 through 2011—a relative increase of over 50%—does not appear to have had any obvious effect on consumer satisfaction. Vehicle weight and acceleration also rose from the late 1990s through about 2011, but have remained relatively flat since, and there again is no obvious relationship between their early rise and consumer satisfaction.

Meanwhile, horsepower has continued to grow, and to a lesser extent acceleration has continued to increase, even as fuel economy has shot up significantly over the last decade. This period of both significant growth in fuel economy and moderate increases in horsepower and acceleration, does appear to correlate with a slight uptick in consumer satisfaction in recent years.

Though further study would be required, from this graphical presentation of the data there appears no obvious reason to believe that a rise in fuel economy will cause a decrease in vehicle performance or consumer satisfaction—to the contrary, a rise in fuel economy at least appears correlated with similar upticks in horsepower and consumer satisfaction. Furthermore, this graphical presentation of the data shows large increases in vehicle performance attributes in the late 1990s and early 2000s that do not appear to be obviously correlated with any contemporaneous increases in consumer satisfaction. One reason why horsepower could increase by 50% without consumers becoming much happier about their vehicle purchases is because motor vehicles in general, and especially their performance attributes like horsepower, acceleration, and size, are positional goods. The theory and evidence of vehicles as positional goods is explored further in the next section.

E. Vehicles' positional attributes create externalities and impede consumers from achieving efficient levels of fuel economy absent a cooperative regulatory solution

In the regulatory impact analysis, the agencies assert that because requiring manufacturers to focus on fuel economy will necessarily entail lost consumer welfare as the manufacturers sacrifice other improvements to horsepower, weight, and volume, consumers will be "substantially better off under the agencies' proposed action than if the baseline standards remained in force."[250] In fact, the exact opposite may be true: because horsepower, weight, and volume are all positional attributes, the consumption of increasing levels of those attributes may deliver little if any increased consumer welfare.

The value of a "positional good" depends on how it compares with similar goods possessed by others.[251] The owner of a positional good derives more welfare from that good than expected when considering only its functional qualities. The prominent explanation for this phenomenon is that highly visible consumption becomes a signal for status,[252] and people value status because they anticipate it will translate into more favorable treatment in economic and social interactions.[253] For example, jewelry, silk ties, and expensive champagne all have very little functional value, but their consumption is conspicuous and conveys status to others.

Other goods, like cars, have both functional and positional value. Consumers may partially value vehicle size and horsepower for their functional utility like hauling capacity and speed, but a growing body of research indicates that many consumers do not necessarily want the biggest and fastest vehicle, so long as their vehicle is bigger and faster than their friends' and neighbors' vehicles. According to a recent U.S. survey on the visibility of 31 expenditure categories (from food to mobile phones), new or used motor vehicle purchases were the second most visible

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[250] PRIA at 934, 943, 1097; *see also* 83 Fed. Reg. at 43,255 (predicting welfare losses relating to the performance of more efficient vehicles).

[251] Frank (1985), at 101.

[252] *Id.* at 107 ("When an individual's ability level cannot be observed directly, such observable components of his consumption bundle constitute a signal to others about his total income level, and on average, therefore, about his level of ability. . . . [I]mperfect information about ability might create incentives for people to rearrange consumption patterns to favor observable goods."). Consumption patterns might vary depending on the relevant population in the status competition. People might compete among friends, neighbors, and coworkers; within their socio-economic class; with higher classes; or on a society-wide basis. *See* Carlsson et al. (2007), at 590. If a particular population has more reliable, independent information on abilities or income, consumption patterns for observable goods might shift. Frank (1985), at 108.

[253] Weiss & Fershtman (1998), at 802. Status can be instrumental, in that higher status can carry better consumption opportunities, access to better employment, and even better marriage prospects. Hopkins & Kornienko (2004), 1087. Factors like psychology, biological hardwiring, and envy also should not be ignored.

expenditure; related expenditures on gasoline/diesel, vehicle maintenance, and insurance were all substantially less visible.[254] Surveys also consistently confirm that cars are highly positional goods, that people prefer a relative increase in a car's value to an absolute increase,[255] and that the more visible features of cars are more positional.[256] Financial savings, in contrast, are typically considered non-positional.[257]

The more observable prestige features of vehicles include newness, brand, size, design, and power. While many of these traits have functional value (such as capacity, safety, and performance),[258] they also all have relative value: consumers value power not just for speed but for the status signal and for the ability to out-accelerate others at a traffic light; consumers do not necessarily want a *big* car, but they do want a *bigger* car.[259] As Bob Lutz, the former Vice Chairman of General Motors, has stated, "aspirational aspects overwhelm the functional differences" when customers choose cars.[260] Similarly, as J.D. Power has reported, "[w]e strive to own vehicles of which our neighbors will approve."[261] Meanwhile, given the low visibility of

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[254] Heffetz (2011), at 1106 (vehicle purchase had a visibility index of 0.73, second only to tobacco products (0.76); gasoline/diesel had a visibility index of 0.39, car repairs were at 0.42, and car insurance fell near the bottom at 0.23).

[255] Specifically, a majority of people surveyed would trade a decrease in their car's absolute value for an increase in its relative value compared to other people's cars: in other words, they are happy to have their car lose value so long as everyone else loses more value on average. *See, e.g.,* Carlsson et al. (2007), at 588, 593 (reporting results of a Swedish survey); Alpizar et al. (2005), at 412 (reporting results of Costa Rican survey). Though some such surveys were conducted in other countries, if anything positionality for cars could be stronger in the United States, given the American affinity for cars and the income distribution. *See* Heffner et al. (2005), at 2 ("In the words of automobile psychologist G. Clotaire Rapaille, Americans are in 'a permanent search of an identity' and 'cars are very key . . . [they are] maybe the best way for Americans to express themselves.'"); Hopkins & Kornienko (2004) (noting that positional effects increase as society's income increases, because the portion of income spent on conspicuous consumption increases). On the other hand, cars may be more a necessity and less a luxury for some U.S. consumers compared to some consumers in other countries. *See* Grinblatt et al. (2004).

[256] Carlsson et al. (2007), at 588, 593 (finding support for hypothesis that "visible goods and their characteristics, such as the value of cars, are more positional than less visible goods and their characteristics, such as car safety.").

[257] *See, e.g.*, Moav & Neeman (2009).

[258] Carlsson et al. (2007), at 595, could not provide a clear answer to the question of whether cars are completely positional. On average cars are highly positional, but that reflects a good deal of heterogeneity: cars may be completely positional for some people, but are possibly completely non-positional for others. *Id.* at 596.

[259] Verhoef & van Wee (2000), at 4 ("However, most cars in most Western countries have engines with much more power than needed, given the characteristics of infrastructure, speed limits, and travel distances."). *See also* Hoen & Geurs (2011).

[260] George Will, *Americans and Their Cars*, TOWNHALL DAILY, Apr. 18, 2002, *available at* http://townhall.com/columnists/GeorgeWill/2002/04/18/americans_and_their_cars.

[261] Jeff Youngs, J.D. Power, *2007 APEAL Study Results*, Dec. 32, 2006, https://web.archive.org/web/20160514230140/http://www.jdpower.com/cars/articles/jd-power-studies/2007-apeal-study-results

gasoline expenditures and of financial savings, fuel efficiency itself is currently a relatively non-positional good.[262]

A vehicle's size and weight are also positional for safety reasons, in addition to status motivations. To the extent smaller cars may at times fare worse in crashes with bigger cars, consumers may value bigger cars not because of any intrinsic safety value, but because of the average fleet size.

The trouble with positional goods is they impose externalities. This is obvious in the safety context: if Joan upgrades from her compact car to a large pick-up truck, she may feel somewhat safer, but her purchase marginally increases the perceived risk to all other drivers. It also applies in the status context. Again, if Joan buys a big, fast, flashy vehicle to move up the status hierarchy, John's big, fast, flashy car is no longer as rare. John feels relatively worse off and so will have to invest in an even bigger, faster, flashier car just to restore his previous status position. Joan's purchase made John feel worse off (a positional externality), and then John's subsequent purchase made Joan feel worse off (another positional externality), and at the end they wind up with the same relative status that they started with. As a result, both consumers spend resources without actually improving their relative status.

Because vehicle purchase decisions are made non-cooperatively but in fact alter the spending behavior and perceived safety of others, consumers get stuck on a "positional treadmill" that does not increase welfare.[263] Yet if any individual unilaterally tries to opt out of this "expenditure arms race," it would only move that consumer backwards on the status or safety hierarchy, which for most consumers is unacceptable.[264] And given limited resources and limited market options, the over-consumption of positional goods results in under-consumption of non-positional goods (such as fuel efficiency). If consumers could maintain their relative economic position, they might be more willing to pay for non-positional goods.[265]

Fuel economy regulation, therefore, is a cooperative solution that allows consumers to achieve what they could not in the non-cooperative open market: namely, an increase in fuel economy

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[262] *See* Hoen & Geurs (2011).

[263] Frank (2005), at 137.

[264] Frank (2005), at 105-06.

[265] Frank & Sunstein (2001), at 326 ("If people could maintain their relative economic position, they would be willing to pay more, and possibly a great deal more, to purchase many of the goods that regulation attempts to deliver. . . .[W]hen an individual buys additional safety in isolation, he experiences not only an absolute decline in the amounts of other goods and services he can buy, but also a decline in his relative living standards. In contrast, when a regulation requires all workers to purchase additional safety, each worker gives up the same amount of other goods, so no worker experiences a decline in relative living standards. If relative living standards matter, then an individual will value an across-the-board increase in safety more highly than an increase in safety that he alone purchases.").

without losing position in the status hierarchy.[266] Regulations similarly help consumers select fuel economy without falling behind in the safety/size perceived rankings, since with time the average size of vehicles in the fleet will shift. Regulations will also help correct a supply-side problem, since theory predicts that manufacturers will devote their research and development budget to status goods,[267] thus causing an oversupply of positional attributes at the expense of fuel economy.

Positional goods theory explains that: the agencies are incorrect that if manufacturers could redirect their research and development budgets from fuel economy to performance attributes that consumers would inherently become "substantially better off under"; the agencies are incorrect that consumers are able to demand in the market their desired levels of fuel economy; and the agencies are overlooking an important benefit of the regulation, which is correcting the market failures caused by positional externalities.

The Agencies' Proposed Alternative Approaches to Consumer Valuation Ignore Positionality and Other Explanations for the Energy Efficiency Paradox: The agencies suggest two alternative approaches to consumer valuation for the future. They propose either that in the future the agencies should assume that consumers fully (or near fully) value fuel savings in both the baseline scenario and under efficiency standards, or else assume that consumers partly value fuel savings to the same degree in both the baseline scenario and under efficiency standards.[268] The upshot of both alternatives would be similar: the private fuel saving benefits generated by increased efficiency standards would be devalued, and the assumed valuations under the baseline would partly or fully cancel out the private fuel saving benefits under the standards. Either approach would likely send agencies in search of alleged welfare losses attributed to increased fuel efficiency to explain why, if consumers fully value fuel savings, they do not already demand them in the marketplace.

Both of these proposed alternative approaches would be a mistake. There is no evidence that there are substantial private welfare losses associated with increasing fuel economy.[269] To the contrary, the graph presented above depicts neither a loss of consumer satisfaction associated

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[266] Correcting for negative externalities and collective action problems is a classic case for regulation. "Analytically, positional externalities are no different from ordinary environmental pollutants." *Id.* at 364. Such regulation is not about taking public action just because one consumer's increased consumption makes another consumer unhappy or envious; rather, regulation is justified to address a market failure. *Id.* at 365. Even if not everyone wants to solve this particular collective action problem, "we do not require unanimity as a precondition for unquestionably legitimate collective action in other spheres." *Id.* at 366. *See also* Verhoef & van Wee (2000), at 13-14. ("On the free market, consumers would inefficiently strongly stimulate each other to purchase more luxurious variants. Corrective taxes [or a CAFE standard with tradable permits] may protect consumers against such treadmills.").

[267] Cooper et al. (2001).

[268] 83 Fed. Reg. at 43,074.

[269] *See, e.g.*, Huang et al. (2018), at 194 (finding that "automakers have typically been able to implement fuel-saving technologies without harm to vehicle operational characteristics" like "acceleration, handling, ride comfort, noise, braking feel, and vibration").

with increasing fuel economy, nor a gain in consumer satisfaction associated with increasing performance attributes. Moreover, there are several other explanations supported by theory and literature that explain why consumers would fully value private fuel savings achieved under an efficiency standard and yet are unable to demand that the market increase fuel economy under the baseline in the absence of regulatory interventions. Positional goods theory is one important explanation that the agencies have failed to consider, together with explanations about information processing, myopia and internalities, supply-side market failures, and other evidence considered by the agencies in past rulemakings that the agencies now inexplicably ignore. The agencies should continue to value forgone private savings from fuel economy as they have in Tables II-25 to II-28 (once those calculations are corrected for mistakes from the scrappage, rebound, and sales modules).

F. Problems with the agencies' valuation of the refueling surplus

Multiple problems with the agencies' calculation of refueling surplus (the time savings and other benefits from having to refuel less) result in a significant underestimation of the proposed rollback's forgone benefits and show that the agencies have arbitrarily failed to consider important aspects of the issue and have ignored important evidence.

Rebound: First, because the agencies have miscalculated the rebound effect (as described in Section VI), they are overestimating the number of refueling trips that the purchasers of new, more-efficient vehicles would make, and so are underestimating the forgone benefits from the lost refueling surplus.

Outdated Data: Second, the valuation of lost refueling surplus is based on outdated data. Though the agencies' link to the *Value of Travel Time Savings Memo* appearing in footnote 258 of the proposed rollback is a broken link,[270] it seems very likely that the agencies are using an outdated version of NHTSA's own *Value of Travel Time Savings Memo*. The current version was updated last in 2016.[271] The version of the memorandum included in the regulatory docket is the 2011 version.[272] Meanwhile, the values that the proposed rollback uses for the percentages of personal and business travel in urban areas (94.4% versus 5.6%) and in intercity travel (87% versus 13%) match neither the 2016 nor the 2011 versions (both of which list instead, for example, 78.6%

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[270] 83 Fed. Reg. at 43,085 n.258.

[271] Dept. of Transp., *The Value of Travel Time Savings: Departmental Guidance for Conducting Economic Evaluations* (2016), https://www.transportation.gov/sites/dot.gov/files/docs/2016%20Revised%20Value%20of%20Travel%20Time%20Guidance.pdf.

[272] https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0679.

personal travel in intercity); instead, these numbers seem to come from the 2003 version of the memorandum.[273]

Not only are the percentages of personal versus business travel outdated in a way that leads to underestimating the total hourly valuation for intercity travel, but the base wage rate is outdated as well. The agencies inexplicably start with Bureau of Labor Statistics data for "total hourly employer compensation costs *for 2010*," and present the data in uninflated 2010$.[274] Using the same data source and same methodology but updating to current, year 2017 wages would increase the base wage in the agencies' calculations from $29.68 to $35.52.[275] The urban versus rural percentages of the total miles driven figures should also be updated from the 2011 data used in the proposed rollback,[276] to the current FHWA data available for year 2017.[277]

Using these data updates but otherwise keeping the rest of the methodology the same,[278] the total weighted value of travel time per hour used in this regulatory analysis should be at least $21.41, not $17.73. The agencies may have underestimated the value of travel time by 20% just through use of old data.[279]

Excluding Children: The next step in the methodology is to multiply that per individual per hour value of travel time by the average vehicle occupancy during refueling trips. Here, the proposed rollback uses figures of 1.21 people per trip in passenger cars, and 1.23 people per trip in light trucks.[280] The proposed rule cites to the 2011 Tire Pressure Monitoring System study as the

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[273] *See* NHTSA 2012 FRIA at 874 (table viii-6, showing identical numbers as the current proposed rollback's table ii-39); *id.* at 873 n.448 (citing the 1997 and 2003 guidelines).

[274] 83 Fed. Reg. at 43.085 & n.259. At 83 Fed. Reg. 43,088, the proposed rollback does discuss "updating time values to current dollars," but that line follows a reference to having "updated the final rule to reflect peer reviewer suggestions," and includes a citation to a 2012 regulatory docket. It seems likely that this text was cut and pasted from a previous rulemaking (as was much of the analysis and discussions in this section), making it impossible for the reader to tell from the *Federal Register* notice or from the regulatory impact analysis whether the 2010$ figures that appear so prominently in the tables in this section were in fact inflated to current dollars for purposes of tallying forgone benefits.

[275] *See* BLS, *Employer Costs for Employee Compensation Historical Listing*, tbl 1. (data for 2017), https://www.bls.gov/web/ecec/ececqrtn.pdf.

[276] 83 Fed. Reg. at 43,087 n.261.

[277] *Available at* https://www.fhwa.dot.gov/policyinformation/travel_monitoring/17dectvt/17dectvt.pdf. This update would slightly change the weights to about 70% urban, 30% rural, which would slightly decrease the value of time calculation compared to the weights used in the proposed rollback (67.1% urban and 32.9% rural), but would be more up-to-date.

[278] These comments do not necessarily endorse the rest of the methodology. For example, there are questions about discounting personal travel time saved versus business travel time saved.

[279] If the agencies did inflate from 2010$ to more current dollars, the underestimation would still likely exist, though it may not be quite as large.

[280] 83 Fed. Reg. at 43,087.

source of these figures, but the source is unclear because the only document on the Tire Pressure Monitoring System provided in the regulatory docket is the

User's Coding Manual.[281] The agencies' failure to make available the full data and methodology used to calculate these average occupancy figures frustrates any meaningful public review. Nevertheless, the agencies do disclose that their estimated occupancy figures specifically exclude children under 16 years of age,[282] because "it is assumed that the opportunity cost of children's time is zero."[283]

This is the third major problem with the refueling valuation: the exclusion of children's value of time. The choice not to count children violates both NHTSA's own guidelines and best practices for cost-benefit analysis. In the 2016 *Value of Travel Time Savings* memorandum, NHTSA considers whether the value of travel time is different for parents versus children, but ultimately concludes that "it must be assumed that all travelers' VTTS are independent and additive," and later expands that "Although riders may be a family with a joint VTTS or passengers in a car pool or transit vehicle with independent values, these circumstances can seldom be distinguished. Therefore, all individuals are assumed to have independent values. Except for specific distinctions [such as personal versus business travel], we consider it inappropriate to use different income levels or sources for different categories of traveler."[284]

Turning to other cost-benefit guidelines, OMB's *Circular A-4* instructs agencies to estimate "gains or losses of time in work, leisure and/or commuting/travel settings," but nowhere distinguishes between children's and adult's valuations, except to note that, for health effects, "the monetary values for children should be at least as large as the values for adults . . . unless there is specific and compelling evidence to suggest otherwise."[285] Writing on the concept of "standing in cost-benefit analysis," Dale Whittington and Duncan MacRae conclude that "there is a clear consensus that children should be counted" in cost-benefit analysis.[286] The agencies fail to provide any compelling argument why they should break from this clear consensus and treat all children's time as worthless.

In 1965, when Congress first directed the control of motor vehicle air pollution to protect "the health or welfare of *any person*" after taking into "appropriate consideration . . . economic

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[281] https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0681.

[282] 83 Fed. Reg. at 43,087 n.262.

[283] *Id.* at 43,086.

[284] 2016 VTTS Memo, at 5, 12.

[285] OMB Circular A-4 at 31, 37.

[286] Whittington & MacRae. (1986), at 666.

costs,"[287] Congress clearly had in mind not just the welfare and costs of adults, but of "any person." And when Congress mandated the "maximum feasible average fuel economy" after considering "economic practicability . . . and the need of the United States to conserve energy,"[288] it spoke not just of the needs of adults, but of the entire U.S. population. By excluding all children under the age of sixteen, the agencies arbitrarily undercount the proposed rollback's forgone refueling benefits.

Erasing 40%: A fourth major problem with the agencies' refueling valuation is the decision to erase 40% of the total value due to the assumption (drawn from the Tire Pressure Monitoring System study) that "40% of refueling trips are for reasons other than a low reading on the gas gauge" and that "owners who refuel on a fixed schedule will continue to do so."[289] But if vehicles become more efficient such that the gasoline tank is less empty after driving a given number of miles, either drivers will make fewer refueling trips or, minimally, those who continue to refuel on a fixed schedule will spend less time at the pump on each refueling trip, because their gasoline tanks will not have been as depleted over a given period of time. The agencies' own calculations indicate that time spent filling and paying at the pump makes up nearly two-thirds of the total time spent on average refueling trips for both cars and trucks.[290] Even for drivers who continue to refuel on a fixed schedule, they will save time at the pump, because their tanks will be less empty at the start of refueling. The agencies cannot completely discount those time savings.

Additionally, not every refueling trip that is "for reasons other than a low reading on the gas gauge" is automatically an example of someone who "refuel[s] on a fixed schedule." The *User's Coding Manual* for the Tire Pressure Monitoring System study included multiple possible responses for the primary reason for the stop besides either low gas tank or a routine schedule, including refueling trips motivated because it was "convenient at this time," "to get/do something else (e.g., food, rest stop)," to take advantage of "price," to "top off for specific reason (e.g., before long trip)," or for some "other" reason.[291] The refueling portions of stops based on all these reasons may become shorter or may not occur at all if vehicles become more efficient and need less frequent refueling. The agencies cannot throw out the refueling time savings associated with all these other reasons for typical refueling stops.

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[287] Pub. L. 89-272, 79 Stat. 992 (Oct. 20, 1965) (emphasis added); *compare* 42 U.S.C. § 7521(a) (controlling pollution that "endanger[s] public health or welfare," after giving "appropriate consideration to the cost of compliance").

[288] 49 U.S.C. § 32902(f).

[289] 83 Fed. Reg. at 43,088.

[290] *Id.* at 43,087, tbl. II-41.

[291] NHTSA (2017) at 236.

Moreover, the relevance of the agencies' data is questionable. The *User's Coding Manual* for the Tire Pressure Monitoring System study on which the agencies so heavily rely suggest that data was collecting on "vehicles entering the gas station to refuel during five 15-minute data collection time periods (08:00 – 08:15 a.m., 1000 – 10:15 a.m., 12:00 – 12:15 p.m., 2:00 – 2:15 p.m., and 4:00 – 4:15 p.m.). These time periods were to last the full 15 minutes, unless a weather-related reason or cooperation issues resulted in the need to prematurely suspend data collection at that site."[292] The study seems not to have captured those who refuel outside the hours of 8am-4pm, nor to have captured refueling behavior during inclement weather. There is no reason to believe based on the study that drivers who refuel outside of those specific conditions would continue to operate on a rigidly fixed refueling schedule regardless of how full the tank of their more fuel-efficient vehicles may be.

Altogether, the agencies have thrown out 40% of the refueling time savings benefits without a reasonable justification for ignoring those potential benefits—on top of the underestimations of time savings due to the rebound miscalculation, the use of outdated data, and the complete exclusion of all children under the age of 16.

Fuel Cost and Emission Savings*:* Finally, the agencies also may be excluding the cost savings and emissions savings from not having to combust fuel to drive to refueling stations as often. The agencies acknowledge that while these savings "may seem like a small amount" per individual and per year, they are "much more significant at the macro level."[293] Yet even though the agencies explained how "direct estimation . . . of this benefit" would be possible, instead the agencies insisted that "this benefit is implicitly captured in the separate measure of overall valuation of fuel savings."[294] The agencies do not clearly explain how these additional cost savings and emissions reductions are actually accounted for in their methodology, and given all the myriad problems with the agencies' calculations of vehicle miles travel (as detailed throughout these comments), it is quite possible that these additional refueling benefits are, in fact, not "implicitly accounted for elsewhere" in either the fuel savings or emissions reductions calculations. If not, then that is an additional undercounting of the forgone refueling benefits of the proposed rollback.

The agencies also ignore the health and welfare consequences of the emissions associated with refueling and refueling stations.[295] Residential proximity to gasoline stations, for example, may have "a significant association" with childhood leukemia, due to benzene emissions from

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[292] NHTSA (2017) at 31. *See also id.* at 210 (suggesting that no interviews with refueling drivers were conducted after 6pm).

[293] 83 Fed. Reg. at 43,088.

[294] *Id.* at 43,088 (also insisting that emissions benefits are also "implicitly accounted for elsewhere").

[295] *Compare* 83 Fed. Reg. at 43,344 (where the agencies consider the "exposure and health effects associated with traffic," but not those associated with refueling).

gasoline.[296] Regular exposure to refueling stations, from employment or otherwise, may also have genotoxic and other serious health effects.[297] It is not clear that the agencies' consideration of upstream emissions from the fuel distribution system fully capture the health effects from exposure during refueling and from proximity to or working at refueling stations. If not, then the agencies have ignored yet another important aspect of the regulatory issue before them.

G. Distributional impacts

The agencies assert that the alleged reduction in vehicle purchase price will particularly "make the difference" for "some low-income purchasers."[298] First, the agencies' assumptions about the likely change in purchase price are problematic. Not only have the agencies overestimated the average change in purchase price because of multiple mistakes in their analysis—for example, as discussed in these comments, the agencies' failure to accurately model how manufacturers will efficiently use all available compliance flexibilities, including penalties—but the agencies ignore evidence specifically on the price of lower-cost vehicles.[299] For example, a study by Synapse Energy Economics shows that over the last ten years, the price of lower-cost vehicles has remained constant even as fuel economy has risen with the standards.[300] The study shows that while the range of prices of new vehicles has increased, those increases occurred because the price of high-end vehicles went up as more features were added; the price of more affordable vehicles, on the other hand, has not changed.[301] Similar findings were also reported in EPA's own analysis leading up to the 2017 Final Determination. In that analysis, EPA found that car sales recovered to pre-recession sales levels by 2015 under increasing fuel-efficiency standards and have continued to rise since then.[302] Ultimately, EPA found in the 2017 Final Determination that "prices in recent years, adjusted for quality and inflation, have been flat, not increasing."[303]

Second, the agencies have failed to consider the other side of the coin for impacts to low-income consumers: the loss of fuel savings. Low-income consumers spend a relatively larger fraction of

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[296] Infante (2017); Steinmaus & Smith (2017).

[297] *E.g.*, Rekhadevi (2010).

[298] 83 Fed. Reg. at 43,223.

[299] *See* Section II.

[300] Tyler Comings & Avi Allison, Synapse Energy Economics Inc., *More Mileage for Your Money: Fuel Economy Increases While Vehicle Prices Remain Stable* 5 (2017), https://consumersunion.org/wp-content/uploads/2017/03/Synapse-CU-Affordability-Report-3-15-corrected-1.pdf.

[301] *Id.*

[302] Draft TAR at 6-2 (2016).

[303] EPA, Final Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation—Response to Comments 136 (2017) [hereafter "Final Determination RTC"].

their income on fuel than on the up-front price of their vehicles compared to high-income households. As a result, fuel-efficiency increases are more beneficial to low-income consumers than they are to high-income consumers.[304] In other words, the proposed rollback will not *help* low-income consumers as the agencies claim. Instead, reducing the standards will likely harm these consumers the most. As Greene & Welch note, "[The 2022-2025] fuel economy improvements will benefit all income groups and . . . the impacts will be progressive. The highest income quintile is projected to average a savings of 0.5% of their income annually, increasing uniformly to 2.2% of income saved annually for the lowest income quintile."[305] The evidence on the impact of the existing standards on low-income consumers does not support the proposed rollback.

IV. GENERAL PROBLEMS WITH THE AGENCIES' DATA ANALYSIS

The agencies' proposed conclusions regarding sales, fleet size, and VMT are fatally flawed because the agencies made grave mistakes in their econometric analysis, leading to results that should not be used to inform policymaking. These mistakes include:

- **Failing to account for endogeneity** – endogeneity occurs when findings about an explanatory variable—for example, about the impact of new vehicle price on sales—cannot be given a causal interpretation for one of the following reasons:[306]
    - **Omitted variable bias** – omitted variable bias occurs when the agencies fail to control for important variables that have an influence on a feature (like scrappage) but are correlated with one of the variables used to calculate that feature (like new vehicle prices); when this error is present a regression can show incorrect predictions about the relationship between the variables;[307]
    - **Simultaneity** – simultaneity arises when one or more of the explanatory variables is jointly determined with the dependent variable;[308] of particular concern is reverse causation where the variable of interest (like car sales) affects the explanatory variable (like new car price);
- **Unreliable data** – unreliable data limit the extent to which the agencies can learn about the historical relationships and thus predict future circumstances;
- **Overfitting** – overfitting occurs when an analyst includes individual variables and interactions of variables merely to improve the extent to which the model predicts past behavior, instead of basing the specific formulation of the model on a strong theoretical foundation.

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[304] Draft TAR at 6-2.

[305] Greene & Welch (2017), at 13.

[306] Cameron (2005), at 92.

[307] Wooldridge (2009), at 89-90 (for background on the bias introduced by omitted variables).

[308] *Id.* at 546.

All of these problems permeate the agencies' analysis. To evaluate the effects of a policy change, the agencies must understand the true relationships underlying the various elements they investigate. Once those relationships are uncovered and quantified, inferences can be drawn to inform new policies. Those inferences need to be based on causal relationships and not just correlations. Correlations can only show that two elements tend to move together, but when two elements move together that does not necessarily mean that the change in one variable is the cause of the change in the values of the other variable.

For instance, a researcher could look at income data and asthma data and conclude that there is a relationship between low income and high asthma incidence. However, this is not a causal relationship but rather a correlation. It is not the low income in itself that causes asthma but rather environmental factors that tend to be associated with income. For instance, lower income households tend to live closer to highways and freeways as the car noise and pollution make the housing there more affordable. At the same time, major road proximity has been found to elevate risk of asthma.[309] Consider a policy that subsidizes sports facilities in wooded areas for people with low income. Based on historical data, a researcher could infer that there is a relatively low value in building such facilities, given that the low-income population tends to suffer heavily from asthma and thus will spend little time using the facility. But such a conclusion would overlook the fact that with the low-income population spending considerably more time in areas with clean air, the prevalence of asthma in that group could drop. A new sports facility could break the correlational link between the income and asthma, thus demonstrating that any conclusions that had been based on the historical correlations were wrong.

The need to uncover the causal, structural relationships between elements of interest for policymaking was pointed out for the first time by Robert E. Lucas in his seminal article, describing what has been knowns as the "Lucas critique."[310] In the article, Lucas argued that it is a mistaken approach to try to predict the effects of a change in economic policy solely on the basis of relationships observed in historical data, especially highly aggregated historical data. Lucas argued that "[g]iven that the structure of an econometric model consists of optimal decision rules of economic agents, and that optimal decision rules vary systematically with changes in the structure of series relevant to the decision maker, it follows that any change in policy will systematically alter the structure of econometric models." In other words, a policy change might affect or even completely break the correlated relationships. Lucas also adds that reliance on correlations for setting policy is invalid because any attempt to compare different alternatives would be meaningless without any knowledge of the actual causal relationships.[311]

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[309] For discussions about road proximity and asthma incidence, *see* Li, et al. (2011), at 34.

[310] Lucas (1976), at 19–46. The article has been quoted in over 1,000 economic papers (according to the scientific database scienwebofknowledge.com) and multiple textbooks. It has also spurred the shift macroeconomics towards using micro-foundations. *See* Sargent (1987), at 397–98.

[311] Lucas (1976), at 41.

Given that the agencies have set out to predict how the baseline standards and alternatives affect elements such as new car sales, scrappage rates, miles driven, and fatalities in the Proposed Rule, the agencies should examine and uncover the causal relationships between those elements based on good data and economic modeling. But rather than follow the economic literature and principles of good econometric analysis, the agencies have focused only on a series of correlations not causal relationships. Endogeneity problems that manifested themselves as omitted variable bias and simultaneity bias are rampant in the agencies' analysis.

Throughout the agencies' analysis, they ignore signs of these problems. For example, the agencies exclude several critical variables from the scrappage analysis based on incorrect coefficient signs and/or statistical significance, despite the importance of those variables to theory and past analyses[312]; the value of a vehicle as scrap metal or as parts due to statistical insignificance; and the interest rate due to unexpected sign and worsening overall fit of the regressions.[313] Other times, the agencies merely try to explain away the problem without addressing the counterintuitive results, like in the case of the incorrect sign on fuel efficiency for new SUVs and vans in the scrappage model.[314] Instead of ignoring these problems, the agencies should consider the inconsistent results as evidence of serious econometric problems and attempt to address the underlying issues.

V. THE AGENCIES' ANALYSIS OF HOW FUEL ECONOMY AND EMISSION STANDARDS CHANGE FLEET COMPOSITION, VEHICLE TRAVEL, AND SAFETY IS FUNDAMENTALLY FLAWED

The agencies assert that higher new vehicle prices[315] under the baseline standards will cause consumers to reduce their purchases of new vehicles, and retain or buy used vehicles.[316] The agencies analyze these changes using newly developed models of the new vehicle and used vehicle fleets and find huge increases in the total fleet size and vehicle miles traveled (VMT). The agencies then find that the baseline standards will cause a number of negative effects including, most importantly, increased fatalities.[317] Specifically, the agencies claim that the change in composition of the vehicle fleet will result in 6,180 to 7,880 additional fatalities for

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[312] PRIA at 1012, 1030, 1032.

[313] *Id.* at 1030.

[314] *Id.* at 1024.

[315] Whenever we refer to an "increase in new vehicle price" or "higher new vehicle price," this refers to a shift from the Proposed Rule to the baseline standards.

[316] The agencies refer to this effect as slower "turnover." 83 Fed. Reg. at 42,993. The two models, when combined, can be used to analyze the change in the distribution of vehicles by model year caused by a change in fuel economy and emission standards. However, because the models are disconnected, it is impossible to determine which new vehicles replace which used vehicles. It is therefore impossible to estimate the actual change in turnover of vehicles due to the baseline standards using the models the agencies have developed.

[317] 83 Fed. Reg. at 42,993.

model years 1977 to 2029, "as operated throughout those vehicles useful lives," or approximately 50 percent of the total fatalities attributed to the baseline standards.[318]

The agencies' assertion that the baseline standards will cause vehicle prices to go up in such a way that consumers alter their purchasing decisions is flawed. We address that issue in Section II. But even if the agencies are correct that the baseline standards will cause new vehicle prices to increase, their analysis of the implications of those price increases—and, in particular, their estimates of additional fatalities associated with those increases—is fundamentally flawed for two critical reasons.

First, the agencies' estimates and modeling of the impact of price increases on total fleet size and vehicle miles traveled (VMT) violate economic theory. Correcting the agencies' errors in this area will significantly reduce (or even reverse) the purported effect of the baseline standards on safety.

Second, even if the agencies are right that increased new vehicle prices lead to an increase in the number and proportion of older vehicles in the market, the safety impact of those vehicles is overstated. The data supporting the agencies' conclusions are improperly inflated in ways that contradict the agencies' prior analyses and the available evidence.

A. The agencies' assumption that fleet size and VMT will increase under the baseline standards is arbitrary and capricious

The result of the agencies' analysis of the baseline greenhouse gas standards and fuel economy standards—and the effect of rolling back those standards—is strongly dependent on new modeling that attempts to estimate how changes in new vehicle prices and fuel economy affect the number of vehicles by model year and body style (car, SUV, pickup) (the "composition" of the fleet). The agencies use separate models to estimate the composition of the vehicle fleet: (1) a "dynamic sales model," which estimates the change in new vehicle sales for different levels of fuel efficiency and greenhouse gas emission standards;[319] and (2) a "dynamic scrappage model," which estimates the change in the composition of the used vehicle fleet for different levels of fuel efficiency and greenhouse gas emission standards.

The dynamic *sales* model is based on the theory that increasing fuel efficiency will increase new vehicle prices and reduce consumer demand for new vehicles.[320] The dynamic *scrappage* model

[318] *Id.* at 43,152-53 (estimating total fatalities attributed to the baseline CAFE standards, which includes a combination of the effects from the sales model, scrappage model, and dynamic fleet share model); *id.* at 43,157 (estimating the same for a rollback of the GHG emission standards); id. at 43,254 (explaining that the fatality impacts are calculated for "model years through 2029 as operated throughout those vehicles' useful lives").

[319] This is supplemented by a "dynamic fleet share model," which estimates the change in the distribution of new vehicle sales between cars, SUVs, and trucks.

[320] *Id.* at 43,075.

is based on a theory that increases in the cost of buying new vehicles will reduce demand for new vehicles and increase demand for relatively new used vehicles. The increase in demand for used vehicles causes an increase in the price of relatively new used vehicles and, therefore, longer retention of older used vehicles.[321] This effect cascades throughout the used vehicle fleet, eventually resulting in an increase in the price of very old vehicles that might otherwise have been sold for parts and raw materials ("scrapped").[322] The increase in the value of these cars can reduce the rate at which they are scrapped rather than held or resold.[323]

But while those theories may be relatively uncontroversial, the agencies then make a totally unsupported leap to assert that "[b]ecause higher used vehicle prices will lower the number of vehicles whose cost of maintenance is higher than their value, *it is expected that* . . . some vehicles that would have been scrapped without replacement under lower new vehicle prices will now remain on the road because their value will have increased," referred to as "non-replacement scrappage" by the agencies.[324] According to the agencies, that non-replacement scrappage leads to a significant increase in the number of total vehicles on the road, which is attributable to the baseline standards.[325]

The agencies' analysis then assumes that vehicles at each age, including those that, but-for the baseline standards would have been scrapped, are driven the number of miles established in a set of VMT schedules. That is, the agencies assume that existing VMT schedules should be applied to those additional vehicles and thus uses those schedules to calculate the number of fatalities that are attributable to scrappage.[326] Because those schedules assume each vehicle of a certain age and type in the fleet drives a set amount of miles without any adjustment for the increase in total fleet size or vehicle quality (i.e., wear and tear and durability), the finding that the standards cause the fleet size to increase results in a significant increase in total VMT. This increase in VMT in turn drives fatalities.[327]

There are two severe flaws in this analysis, which render the rule arbitrary and capricious and which we discuss in turn below:

- First, the agencies have provided no explanation to support the assumption that higher prices (even if they were real), would lead to non-replacement scrappage and an increase

[321] The agencies' analysis uses a combination of the increased price of new vehicles and the decrease in cost per mile (CPM) of operating new vehicles as proxies for how the standards will increase the prices of used vehicles. PRIA at 1004.

[322] 83 Fed. Reg. at 43,092.

[323] *See* PRIA at 998.

[324] *Id.* at 1004; 83 Fed. Reg. at 43,095.

[325] PRIA at 1004, 1058.

[326] 83 Fed. Reg. at 43,099.

[327] *Id.* at 43,188; PRIA at 998.

in the total fleet size. Indeed, the academic literature and standard economic theory demonstrate that the assumption is unreasonable.
- Second, even if there were additional vehicles on the road, the agencies have not provided a reasonable explanation to support the assumption that total vehicle miles traveled should increase. Again, the academic literature and standard economic theory demonstrate that the assumption is unreasonable.

Any sales and scrappage modeling should take this established economic research into account. In addition, as we also explain in detail below, the agencies' analysis is riddled with serious econometric errors. Should the agencies still seek to estimate scrappage effects, we summarize our advice on a "path forward" below. Ignoring the fundamental principles that we outline here would be arbitrary and capricious.

1. **The agencies' assumption that an increase in vehicle price will substantially increase the size of the used vehicle fleet is fundamentally flawed**

The agencies use a reduced form scrappage model to estimate scrappage rates.

The model ignores the simultaneous interactions and the impact that the variables in the model have on each other and fails to take basic economic theory into account.

The model produces a substantial increase in the size of the used vehicle fleet. The increase is so large that it substantially exceeds the decrease in aggregate new vehicle sales that is predicted by the dynamic sales model. The results of these two models lead to a large increase in total aggregate fleet size attributable to the baseline standards. These conclusions are flawed for a number of reasons discussed at length below:

- They are inconsistent with basic economic theory;
- They are inconsistent with the academic literature, including the work of Howard Gruenspecht, the economist whom the agencies rely on for their theory; and,
- They produce results that are inconsistent with even the agencies' explanation of the relationship between fuel economy and scrappage.

a.) *Standard economic theory supports an assumption that fleet size will either stay the same or decrease with an increase in vehicle prices*

i.) Fleet size will either stay the same or decrease with an increase in vehicle prices

Economic theory supports the possibility that new vehicle price increases may change the distribution of new and used vehicles and, ultimately, could slow scrappage of used vehicles that would have been replaced by other vehicles. If the price of new vehicles increases with more stringent standards, some portion of households that would have purchased a new vehicle may instead keep their current vehicle or purchase a used vehicle. This shift out of the aggregate demand curve for used vehicles may ultimately increase the number of *used* vehicles on the road.

But economic theory provides no support for the idea that a shift to used vehicles will cause an increase in the total number of vehicles on the road.[328]

First, price changes cause only relatively modest changes in scrappage rates in the first place because prices are not the most important factor in scrappage decisions. Most scrappage is due to age-related factors that are unrelated to increases in price.[329] As a result, the elasticity of scrappage with respect to used vehicle price is low (between -0.4 to -0.7),[330] meaning that the shift to used vehicles for a given price increase is low.[331] As such, even if there is a shift to used vehicles, the effect of price on scrappage should be small, and certainly not so large that it overwhelms the reduction in new vehicle sales.

Second, when price increases on both used and new vehicles, the value of the services provided by those vehicles does not change. As a result, in equilibrium, when price increases and the value of the services is unchanged, the amount of the good purchased decreases. In other words, a potentially scrapped vehicle is diverted from the scrap heap only if there is used vehicle demand that the owner can meet by choosing to sell rather than scrap. But the additional used vehicle demand is directly related to a reduction in new vehicle demand. There is no reason to believe that it will increase the number of *total* vehicles on the road. Any shift towards used vehicles is connected to the decrease in new vehicles. New and used cars are substitutes,[332] and as such we should expect that the quantity and prices in the new vehicles sales market will affect quantity and prices in the used vehicles sales market and vice versa.[333]

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[328] As explained further below, just as new vehicle *price* affects scrappage rates only by changing used vehicle demand (and therefore price), changes in new vehicle fuel efficiency (holding price constant) also only affect scrappage rates by changing used vehicle demand (and therefore price). Therefore, fuel efficiency increases should affect only fleet composition and not fleet size. New vehicle fuel efficiency (holding price constant) would have the opposite effect on fleet composition that increased new vehicle price has. As a positive attribute, higher new vehicle fuel efficiency will increase demand for new vehicles, thereby reducing demand for (and price of) used vehicles.

[329] Bento et al. (2018), at 178 (stating that "the inelasticity of this parameter suggests that accurately modeling vehicle lifetime is of first order importance, as most scrappage will occur due to age-related, exogenous scrappage rather than policy induced, endogenous scrappage").

[330] Bento et al. (2018), at 159; Jacobsen & van Benthem (2015), at 1325.

[331] Jacobsen & van Benthem (2015), at 1333 (Table 6).

[332] PRIA at 930, 1053.

[333] For example, in his dissertation, Howard Gruenspecht, includes the scrappage rate, new car price, and new car sales in his regression for used car price. Gruenspecht (1982a), at 81, 99-101. In his structural scrappage regression, Gruenspecht includes new cars sales. *Id.* at 106-107. In his corresponding reduced form regression, he includes vehicle miles traveled per capita to address overall demand for driving, in addition to the vehicle stock in the previous period. *Id.* at 86, 109-113. Finally, Gruenspecht demonstrates that the quantity of new vehicle demand is a function of vehicle miles traveled per capita and vehicle stock in the previous period, in addition to new vehicle price. Gruenspecht (1982a), at 87; *see also* Goulder et al. (2012), at 192 (using a model that solves for supply-demand equilibrium in the new and used car markets").

Ignoring these facts, the agencies assert that higher new vehicle prices will reduce scrappage rates more than they reduce new vehicle purchase rates, so that over time, more used vehicles are retained than needed to replace forgone new vehicle purchases.[334] The enormous discrepancy between the change in new vehicle purchases and the increased fleet size is due in part to the agencies' irrational decision not to connect the results of the new vehicle sales model and the scrappage model so that they influence each other.[335] Moreover, many of the variables—including used car prices, used car scrapping rates, and new car sales—are functions of each other and therefore using one to predict the other can be circular (that is, they suffer from the simultaneity bias). For example, changes in the price of new vehicles changes the scrappage rate of used vehicles. But changing the supply of used vehicles (via scrappage) also affects the price of new vehicles.[336] Lowering the number of used vehicles on the market may increase used vehicle prices, which may reduce the price disparity between relatively new used vehicles and brand new vehicles, thereby increasing demand for new vehicles and, therefore, the price of new vehicles.

The agencies argue that it is not necessary to connect the new vehicle purchase decision and used vehicle scrappage because different households are making the decision to buy a new car and scrapping a used car.[337] But while different households might be making those decisions, the decisions are connected through the market, as new vehicle sales, new vehicle price, used vehicle price, and scrappage rates are jointly determined in the marketplace. The agencies should connect the results from the new sales model and the scrappage model.

Third, instead of an increase, it is actually more likely that price increases would cause a small decrease in the total fleet size. Most households that would have purchased a new vehicle but that instead purchase a used vehicle will likely purchase a close substitute (i.e., a low age/mileage used vehicle). This effect moves down through the fleet before it affects scrappage. As explained above, as the new vehicle price increase raises the prices for used vehicles, a portion of buyers that would have bought young used vehicles will buy vehicles that are slightly older; and vehicles owners who would have bought the older used vehicles will buy even older vehicles; and so on down the chain. Some of the last buyers at the bottom of that chain will be supplied by vehicles that, without the standards, would have been scrapped. But a portion of used vehicle purchasers that would have purchased a used vehicle before used vehicle prices went up

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[334] 83 Fed. Reg. at 43,099 ("Our models indicate that the ratio of the magnitude of the scrappage effect to the sales effect is greater than one so that the fleet grows under more stringent scenarios").

[335] *Id.* (explaining that "while both models are informed by new vehicle prices, the model of vehicle sales does not respond to the size and age profile of the on-road fleet, and the model of vehicle scrappage rates does not respond to the quantity of new vehicles sold").

[336] *See* Gruenspecht (1982a), at 82.

[337] 83 Fed. Reg. at 43,099.

will instead choose to forgo a vehicle purchase. This happens as some who may have been planning to replace their old used car may now decide that, facing higher prices, they are better off opting out of the market into alternative forms of transportation. These consumers may instead make the same number of car trips using fewer vehicles. For example, some families may be unable to afford a used car for their teen, or will sell their sedan to buy a used minivan instead of being able to keep both. Others may reduce their need for a vehicle (or second vehicle) and travel by alternative means such as walking, biking, ride sharing service, or public transit.[338] The magnitude of this decline in fleet size is dependent on the price elasticity of used vehicle supply and the elasticity of substitution between used vehicles and alternative forms of transportation. If demand is very elastic, for example because teenage drivers can get rides with friends or mass transportation is readily available in that location, there will be more of a shift than if demand is inelastic. Either way, this force will likely *reduce* the total number of used vehicles on the road.

ii.) The agencies' explanations for their fleet size results are unavailing

The agencies offer a few explanations to address the fact that their description and results are inconsistent with basic economic theory, but those arguments are unavailing.

First, the agencies assert that the number of vehicles not scrapped will be higher than the decrease in new vehicles sales[339] because the used vehicle fleet is so much larger than the new vehicle fleet.[340] But the total number of vehicles (new and used) and total VMT is determined in general equilibrium where supply meets demand. These market clearing conditions are influenced by underlying supply and demand curves, which are related to the elasticity of demand and the elasticity of scrapping, not magnitudes of the relative markets.

Second, the agencies argue that households require more than one used vehicle to replace the full lifetime of a new vehicle and that this increases the fleet size.[341] But as fleet size is measured on a per annual basis, more cars with a shorter-life span does not lead to a larger annual fleet size. Moreover, this reasoning is predicated on VMT schedules remaining constant (which they should not, as discussed below). In addition, households purchase "close substitute[s] for new models"[342] and those substitutes are unlikely to be multiple used vehicles. Instead, previous purchasers of new

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[338] *See, e.g.*, Gruenspecht (1982a), at 120; Letter from Dr. Mark Jacobsen and Dr. Arthur van Benthem at 2, Docket No. EPA-HQ-OAR-2018-0283 and Docket No. NHTSA-2018-0067 (Oct. 8, 2018), https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-2650 [hereafter "Jacobsen & van Benthem Docket Letter"].

[339] PRIA at 1057.

[340] *Id.* at 1057.

[341] Responses to Interagency Comments on NPRM Round 8 Received 7-11-2018, at 2-3, https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (12th Attachment, pdf page 3).

[342] PRIA at 930.

vehicles will purchase a relatively new used vehicle, an effect that moves down the chain, as explained above.

Third, the agencies concede that their results may not be "intuitive for reviewers" because normally increased prices would not lead to a bigger fleet, rather "reduced prices of new vehicles and increased sales," as promised under the Proposed Rule, "should lead to a larger on-road fleet."[343] The agencies nonetheless argue that "the increased sales" that one might expect from reducing prices under the Proposed Rule are "more than offset" by the accelerated scrappage shown in the agencies' modeling. But this reasoning does not help the agencies because it is the *results of the model* that violate economic theory. The agencies cannot support the theoretical validity of their model by pointing to the results of their model. The fact that a model shows a counterintuitive result is a reason to fix the model, not a reason to dismiss intuition and theory.

For all these reasons, EPA was correct to note in comments on the Proposed Rule prior to its publication that "[t]he total number of registered vehicles would not change significantly as a result of consumer decisions to retain used vehicles longer instead of purchasing new vehicles."[344] As EPA recognized, it is inconsistent with basic economic principles to expect that fleet size would decrease with the Proposed Rule, relative to the baseline.[345]

b.) *The agencies' scrappage assumptions are inconsistent with the academic literature*

In an effort to support the assumption that increased prices lead to a larger fleet, the agencies cite heavily to several academic papers. But those papers do not support the conclusions the agencies reach. Namely, while the academic literature supports a connection between new vehicle prices and slower replacement scrappage, the literature does not support the assumption that fleet size would increase due to non-replacement scrappage. Instead, they show that vehicle price increases and fuel efficiency increases are likely to, if anything, decrease fleet size as explained above.

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[343] 83 Fed. Reg. at 43,098 ("While it might be natural to assume that reduced prices of new vehicles and increased sales should lead to a larger on-road fleet, in our modelling, the increased sales are more than offset by the somewhat accelerated scrappage that accompanies the estimated decrease in new vehicle prices.").

[344] EPA review of CAFE model with "GHG" settings, Slide 8 (08-Mar ver.), attached to Email from William Charmley to Chandana Achanta regarding Material for today's Light-duty GHG NPRM discussion, June 18, 2018, https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (5th attachment).

[345] *See id.*; Responses to Interagency Comments on NPRM Round 8 Received 7-11-2018, at 2-3, https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (12th Attachment, pdf page 3).

i.) The cited literature does not support the assumption that price increases will lead to a slower non-replacement rate of scrapped vehicles and fleet size increases

The agencies' scrappage assumptions are based primarily on a paper and dissertation by Howard Gruenspecht, which studied the impact of fuel efficiency regulations on pollution reductions.[346] In those papers, Gruenspecht found that pollution reductions may be partially offset if a policy-induced fuel efficiency increase causes some potential new-vehicle purchasers to switch from lower-emitting new vehicles to higher-emitting used vehicles, and from lower-emitting used vehicles to higher-emitting older used vehicles.[347] Under Gruenspecht's theory, this effect culminates in a slower rate of vehicle scrappage.

The agencies repeatedly cite to Gruenspecht to support the assumption that higher vehicle prices will lead to both replacement and non-replacement scrappage, which the agencies largely do not distinguish and call collectively the "Gruenspecht effect."[348] But the agencies misunderstand the papers. Gruenspecht's research was concerned with the effect of increases in new vehicle price on the scrappage of used vehicles *that would have been replaced by new vehicles or newer used vehicles*—what the agencies refer to as slower "replacement scrappage," not with non-replacement scrappage.[349] In fact, as Gruenspecht explained in his dissertation, which formed the basis for the 1982 paper, "*the desired number of vehicles in the stock is insensitive to variation in the price of new cars*" and "the primary effect of a change in new car prices is to alter the composition of the vehicle stock via its effect on scrapping decisions" not to change fleet size.[350] Indeed, because of this, Gruenspecht held the "aggregate vehicles miles travelled (VMT) and the total number of vehicles" constant in his analysis, a fact that the agencies ignore in the Proposed Rule.[351]

The other cited authors that have actually studied the phenomenon addressed in the Gruenspecht paper also all address only replacement scrappage, and do not address at all the idea of non-replacement scrappage. For example, the agencies point to an analysis conducted by the California Air Resources Board as support for "including some estimate of the Gruenspecht effect," but the agencies themselves acknowledge that CARB did not analyze non-replacement

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[346] 83 Fed. Reg. at 43,093.

[347] Gruenspecht (1982a), at 129-135; Gruenspecht (1982b), at 330.

[348] 83 Fed. Reg. at 43,093, 43,094, 43,095, 43,096; PRIA at 932, 999, 1002, 1013, 1014.

[349] 83 Fed. Reg. at 43,095 ("Aggregate measure of the Gruenspecht effect will include changes to scrappage rates both from slower replacement rates, and slower non-replacement scrappage rate"); PRIA at 1004. Other academic papers refer to this effect as "used car leakage." *See* Jacobsen & van Benthem (2015), at 1331.

[350] Gruenspecht (1982a), at 120 (emphasis added).

[351] Gruenspecht (1982b), at 328-29.

scrappage.[352] As such the CARB analysis has no bearing at all on the question of whether the agencies should assume that slower non-replacement scrappage is "expected."[353]

Another paper that the agencies cite in support of their scrappage model is an empirical analysis of the relationship between fuel price increases and scrappage rates among used vehicles conducted by Mark Jacobson and Arthur van Benthem.[354] Unlike the Gruenspecht and CARB analyses, Jacobsen & van Benthem did not hold fleet size constant.[355] But after finding that an increase in the price of used vehicles gives owners an incentive to postpone the decision to scrap,[356] Jacobson & van Benthem found a decline in the fleet size when estimating the Gruenspecht effect, not an increase, as the agencies find.[357] The paper did not set out to estimate the *magnitude* of any effect on the total fleet size and cannot be read as support for any magnitude estimate. But because the paper shows a decline in fleet size, it cannot be used to support any conclusion that fleet size should go up with reduced scrappage. As the authors have explained in a letter to the agencies regarding the Proposed Rule, under standard economic theory, if the baseline standards increase vehicle prices, the total fleet size would likely decrease over time.[358] Similarly, an earlier paper by Goulder, Jacobson & van Benthem suggested that tighter emission standards would lead to an overall decrease in fleet size, even after accounting for an increase in used car sales.[359]

In addition to these papers, the agencies assert that Greenspan & Cohen's paper offered "additional foundations from which to think about vehicle stock and scrappage."[360] But that paper does not address non-replacement scrappage. And by the agencies' own admission, Greenspan & Cohen hypothesized a pathway through which "engineering scrappage seems to *increase,*" rather than decrease, with increasing emissions standards because emissions controls

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[352] 83 Fed. Reg. at 43,094.

[353] PRIA at 1004 ("Because higher used vehicle prices will lower the number of vehicles whose cost of maintenance is higher than their value, it is *expected* that not only will replacements of used vehicles slow, but also, that some vehicles that would have been scrapped without replacement under lower new vehicle prices will now remain on the road because their value will have increased. Aggregate measures of the Gruenspecht effect in this analysis will include changes to scrappage rates both from slower replacement rates, and slower nonreplacement scrappage rates") (emphasis added).

[354] 83 Fed. Reg. at 43, 093, 43,094, 43,097 (citing Jacobsen & van Benthem (2015)).

[355] Jacobsen & van Benthem (2015), at 1329-1330.

[356] *Id.*, at 1313.

[357] Jacobsen & van Benthem (2015) found a decline in the fleet size when estimating the Gruenspecht Effect. If NHTSA has not already done so, NHTSA will see this result after running the Jacobsen & van Benthem (2015) code. *See* Jacobsen and Benthem Data, https://www.aeaweb.org/aer/data/10503/20130935_data.zip.

[358] Jacobsen & van Benthem Docket Letter at 1.

[359] Goulder et al. (2012), at 200 (Table 6.3).

[360] PRIA at 1000-1001.

may make vehicles more complicated to maintain.[361] As such, that paper does not support the agencies' argument in the Proposed Rule that higher emissions standards cause reduced scrappage.

The agencies cite to a number of other academic papers as support for their scrappage model.[362] But the cited literature does not support the agencies' analysis.

For example, the papers by Walker, Parks, & Bento et al. estimated the effect of the elasticity of scrappage with respect to new or used vehicle price.[363] The agencies do not use these elasticity estimates in their modeling and do not analyze whether the implied elasticities of scrappage derived from their scrappage model are consistent with this literature. Were the agencies to use those estimates, it is likely that the scrappage effect would decrease substantially because, as Bento et al. found, these elasticities show that most scrappage is due to age-related factors that are unrelated to increases in price.[364]

Greene & Chen (1981) and Feeney & Cardebring (1988) analyzed the life expectancy of different types of vehicles and did not look at the impact of a fuel efficiency program or vehicle price changes on those rates.

Hamilton & Macauley (1999) also looked at vehicle longevity and found that it was likely related to factors such as the driving environment. The paper did not address the impact of vehicle price or fuel efficiency on scrappage.

Busse et al. (2013), Sallee et al. (2016), and Alcott & Wonzy (2014) all focused on whether and how much consumers value fuel efficiency, using data on used vehicles. The former two papers did not calculate a scrappage rate as a function of vehicle price of fuel efficiency. Of these papers, only Alcott & Wonzy (2014, p. 784) estimated a simple scrappage model (i.e., vehicle survival probability as a function of vehicle age, model year, and fuel economy), though this estimate did not analyze the price effect on scrappage.

Li et al. (2009) focused on the effect of gasoline price on fleet fuel economy, not the effect of vehicle prices on scrappage. While Li et al. (2009) controlled for the effect of fuel efficiency on used vehicle scrappage, the paper did not address the key issue underlying the agencies' theory that an increase in existing vehicle prices will reduce the scrappage rate of those vehicles.

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[361] See 83 Fed. Reg. at 43,093; PRIA at 1000. Greenspan and Cohen's results show that any impact on the durability of vehicles doesn't meet the standard 95% significance level with a t-statistic of -1.3. Greenspan & Cohen (1999), at 374-375.

[362] *See* 83 Fed. Reg. at 43,094 (citing to Walker (1968), Parks (1977), Greene and Chen (1981), Feeney and Cardebring (1988); Greenspan and Cohen (1999); Hamilton and Macauley (1999); and Bento et al. (2018)).

[363] Walker (1968); Parks (1977); Greenspan and Cohen (1999); and Bento et al. (2018).

[364] Bento, et al. (2018), at 178 (stating that "the inelasticity of this parameter suggests that accurately modeling vehicle lifetime is of first order importance, as most scrappage will occur due to age-related, exogenous scrappage rather than policy induced, endogenous scrappage"); Goldberg (1998), at 31 (explaining that "the substitution effects towards used cars were estimated to be small" and that "policies oriented towards shifting the composition of the new car fleet towards more fuel efficient vehicles seem promising").

Thus, none of these papers is relevant to the Gruenspecht effect. In sum, contrary to the agencies' assertions, the economic literature provides no support for the agencies' underlying assumption that higher vehicle prices lead to slower non-replacement scrappage.

ii.) The empirical findings of the rebound literature show that increased fuel efficiency should not increase fleet size either directly or through higher new vehicle prices

The empirical literature on the rebound effect also supports the assumption that an increase in new vehicle price or fuel efficiency will not change the overall fleet size and that, if anything, it should *reduce* total vehicles on the road:

- In a study of the relationship between gasoline prices and travel demand, Paul Schimek hypothesized that an increase in vehicle price decreases vehicle stock.[365] Using U.S. time series data primarily from the Federal Highway Administration, Schimek separately estimated the effect of gas prices on vehicle stock, vehicle fuel efficiency, and vehicle miles traveled.[366] His results confirm the hypothesis that real vehicle price has a *negative*, statistically significant impact on vehicle stock.[367]
- In their 2007 study estimating the rebound effect caused by changes in fuel efficiency, Kenneth Small and Kurt Van Dender derived estimates of the relationship between vehicle price and fleet size. By simultaneously estimating a system of equations for VMT per capita, fleet size, and fuel efficiency for the United States from 1966 to 2001, Small and Van Dender also found that an increase in new vehicle price has a *negative*, statistically significant effect on total vehicle stock.[368] They also found that changes in fuel cost per mile had a statistically insignificant effect on fleet size, with the sign of the effect varying by the method of regression.[369]
- Phillippe Barla and coauthors applied the methodology developed by Small and Van Dender to panel data at the provincial level in Canada from 1990 to 2004.[370] They found that new vehicle price, vehicle km traveled per adult, and fuel cost per km all have a negative but statistically insignificant effect on the per-adult stock of vehicles.[371]
- In a 2010 paper, Kent Hymel, Kenneth Small, and Kurt Van Dender extended the methodology developed by Small and van Dender (2007) by including an additional

[365] Schimek (1996), at 84.

[366] Schimek (1996), at 85 (applying OLS after rejecting simultaneity).

[367] *Id.*, at 86 (Table 2).

[368] Small and Van Dender (2007), at 39 (Table 3).

[369] *Id.* (showing coefficient of vehicle price, pv, with a negative statistically significant value).

[370] Barla et al. (2009), at 390.

[371] *Id.* at 398.

simultaneous equation for congestion.[372] They found that the price of new vehicles has a statistically insignificant effect on vehicle stock.[373] A 2015 paper by Hymel and Small also found a statistically insignificant impact.[374]

Overall, these results are consistent with the assumptions utilized by Gruenspecht and the findings of Jacobsen and van Benthem: if an increase in vehicle price has any effect on vehicle stock, it is likely negative. The agencies' contrary analysis is fatally flawed.

c.) *Charts showing simplified impact of a change in new vehicle price*

Figure 2 below demonstrates in simplified form, the changes in supply and demand that might lead from a change in the price of new vehicles. For purposes of simplicity, in these charts we abstract from simultaneity in the vehicle market. For example, we do not show the demand and supply for vehicle miles traveled and safety, which are simultaneously determined with the number of new and used vehicles. For comparability, we also assume that consumer valuation of the fuel efficiency increase is less than ΔK, as the agencies assume in the sales module, though the opposite could be true shifting households from used to new vehicles.

<u>In the first chart</u>, when prices go up, sales decrease from N_1 to N_2 and prices of new vehicles increase from P_1 to P_2. In other words, new vehicle demand shifts out and new vehicle supply shifts in.

<u>The second chart</u> shows changes in the used vehicle market. As increases in new vehicle price shift out used vehicle demand, demand for used vehicles (on net) shifts out and causes increasing sales from U_1 to U_2 and price from C_1 to C_2. The change in prices on the used car market feeds back into the demand curve for new cars. The total effect of the interactions between the two markets is the increased share of used vehicles. The change in vehicle stock is $\Delta U - \Delta N$. This would does not lead to an overall increase in fleet size (i.e., $\Delta U - \Delta N \leq 0$).

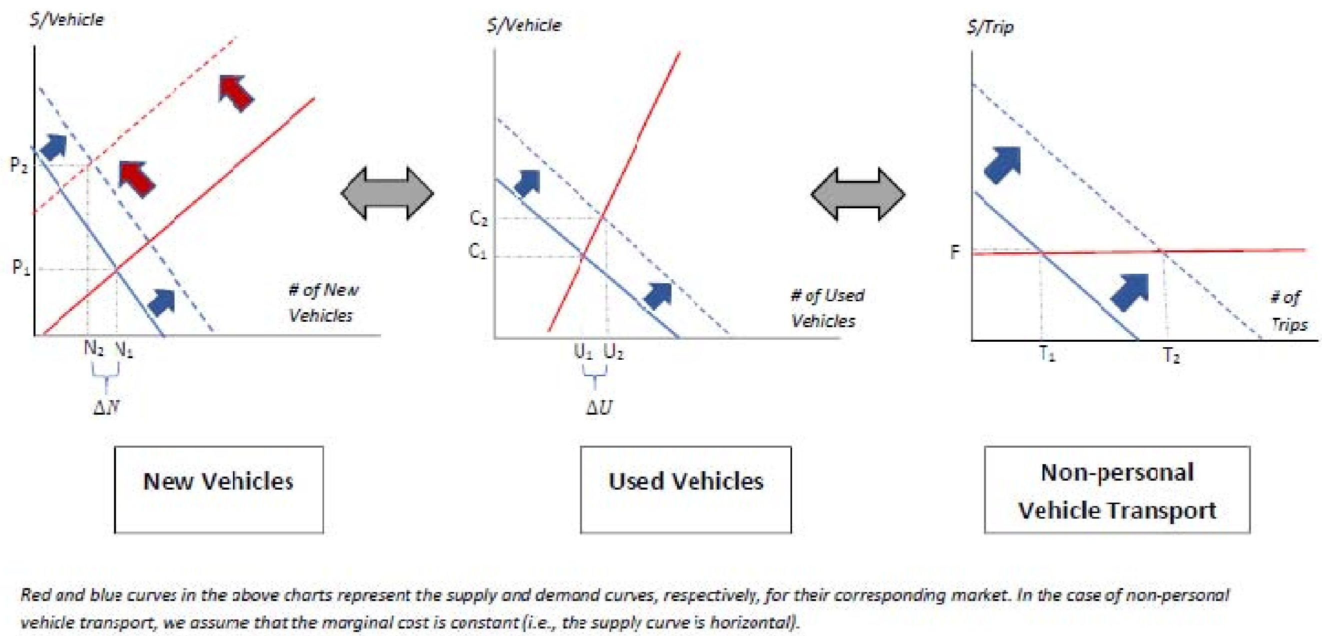
<u>In the third chart</u>, as the price of used vehicles increases, because of the shift in demand for public transportation, the number of mass transit trips increase from T_1 to T_2. Similarly, some households who forgo buying a new vehicle will instead carpool or find other sharing vehicle sharing arrangements within and between households; this will increase the number of passengers per vehicle.

[372] Hymel (2010), at 1221.

[373] *Id.* at 1231 (Table 3 showing a lack of significant of coefficient corresponding to *pv*).

[374] Hymel and Small (2015), at Table B2.

Figure 2. Theory Underlying Gruenspecht Effect (from Proposed Rule to Baseline Standards)



d.) ***Further econometric and analytical errors***

i.) Omitted variables

In the scrappage model, the agencies have, without explanation, omitted a number of other variables that are critical to understanding the scrappage effect including:[375]

- Turnover rate and/or other connections between new and used vehicle markets and VMT (e.g., new vehicle sales, VMT per capita, and vehicle stock);[376]
- The price of scrapped metal and other variables critical to the scrappage theory laid out in the literature by Walk, Parks, Gruenspecht, and Bento[377]

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[375] PRIA at 1012

[376] In his structural scrappage regression, Gruenspecht (1982a) at 106-107, includes new cars sales. In his corresponding reduced form regression, Gruenspecht, 1982a), at 86, 109-113, includes vehicle miles traveled per capita to address overall demand for driving, in addition to the vehicle stock in the previous period. Bento et al. (2018), at page 171, (Table 3)include turnover rate in their structural scrappage regression.

[377] As noted by Gruenspecht (1982b) at 328, a vehicle is scrapped when the price of a vehicle less its scrappage cost is less than its scrappage value. According to the literature cited by NHTSA, maintenance and repair costs (Walker (1968); Parks (1977) at 1104; Gruenspecht (1982a), at 105-114; Greenspan and Cohen (1999); Bento et al., (2018)) and scrappage value (Parks (1977) at 1104; Gruenspecht (2011), at 105-114; Bento et al., (2018)), are almost always included in scrappage regressions. In the exception to the rule, Jacobsen & van Benthem (2015) include various

- Environmental causes of scrappage, including improvements in crash avoidance technology and national migration to fair weather areas; and[378]
- Percent of imported vehicles.[379]

In addition, using new vehicle price to determine scrappage rates fails to control for several variables that affect used vehicles and are independent of new vehicles. For example, odometer readings affect used vehicle price because more driving implies more wear and tear, and lower remaining vehicle value, holding age constant.[380] Vehicle brand can affect used vehicle price because it is a proxy for vehicle durability, which is correlated with used vehicle price and scrappage.[381] Some vehicle brands are associated with durability and a robust used vehicle price. Brand (along with model year) can control for the "repair incidence distribution."[382]

For the sales model, in addition to fuel efficiency, the agencies fail to control for several other important confounding variables.[383] Some key variables that the agencies should control for are: vehicle attributes; vehicle quality or durability; vehicle search costs; socio-economic and demographic variables; and geographic variables.[384] Vehicle miles traveled per capita, vehicle stock and other connections to the used vehicle market, and aggregate VMT are also omitted.[385]

Failure to address the omission of variables critical to the theory underlying the agencies' modeling conclusions raises serious questions about the agencies' ability to appropriately estimate the effect of new vehicle prices on fleet turnover. Indeed, if variables used in the academic literature unexpectedly have an incorrect sign or are insignificant, the agencies should consider the possibility that the model is missspecified or that factors in the model are endogenous.[386]

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fixed effects to address potential omitted variable bias. Consistent with the theory, new vehicle price and all other variables that affect scrappage via used vehicle price should be divided (i.e., indexed) by the maintenance and repair costs. Gruenspecht (1982b), at 328; Parks (1977), at 1105; Greenspan and Cohen (1999), at 375. This is also true for scrappage value or scrappage price (i.e., the value of scrap metal). Gruenspecht (1982b); Parks (1977) at 1104.

[378] Hamilton and Macauley, (1999).

[379] Bento et al., (2018), at 174.

[380] Greenspan and Cohen, (1999) at 375 to 376.

[381] Chen and Lin (2006) at 749 (Table 2); Parks (1977); Jacobsen and Benthem (2015); Li et al. (2009).

[382] Gruenspecht (1982a), at 97, 109-113.

[383] PRIA at 949

[384] Li et al. (2009); McCarthy (1996) at 454.

[385] Gruenspecht (1982a), at 87 (explaining that the quantity of new vehicle demand is a function of vehicle miles traveled per capita and vehicle stock in the previous period, in additional to new vehicle price).

[386] For example, fleet turnover and its common proxy variable – new vehicle sales - are potentially endogenous. Bento et al. (2018) at 163. Due to the aggregate nature of the data (Li et al., (2009) at 125), many other variables

ii.) The impact of fuel efficiency on scrappage in the agencies' results is evidence of a grave error

According to standard economic theory, when price is held constant, fuel efficiency should increase the value of a vehicle and cause demand for the vehicle to go up, leading to higher scrappage rates. In other words, when fuel efficiency improves, that increases demand for new vehicles, which reduces demand for used vehicles, reduces the price of used vehicles, and ultimately, increases (replacement) scrappage.[387] Fuel efficiency would not cause the fleet size to increase. Like new vehicle price, changes in fuel efficiency should not lead to a change in total fleet size, but only a relative change in the proportion of new and used vehicles, as explained above.

The agencies agree that increasing fuel efficiency without changing vehicle prices should increase scrappage.[388] But when the agencies control for price in the scrappage model, the model provides the opposite result: an increase in fuel efficiency leads to both decreased scrappage and an increased fleet size. This is evidence of a grave error.

The error is evident in a sensitivity that the agencies provide. The agencies include cost per mile (CPM) of new vehicles in the scrappage model in order to take into account the effect that fuel efficiency will have on used vehicle demand and scrappage.[389] In the PRIA, the agencies then present results of a sensitivity analysis where they disable the new vehicle sales model and dynamic fleet share model, and rebound,[390] and assume that the baseline standards will cause a $0 price increase in new vehicles.[391] Notably, this sensitivity case does not disable the entire

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may suffer from endogeneity problems; the most critical of which is maintenance and repair costs. PRIA, 1011-1012.[386] Indeed, NHTSA recognizes the potential endogeneity of maintenance and repair costs. PRIA, 1011-1012.

[387] *See* Jacobsen & van Benthem, (2015), at 1318; Gruenspecht (1982a); Gruenspecht (1982b).

[388] 83 Fed. Reg. at 43,093 ("Where [consumers'] additional value of fuel savings associated with a technology is greater than any loss of value from trade-offs with other attributes, the demand for new vehicles will also shift *upwards*."); PRIA at 1027 ("As expected, the cost of travel for new vehicles is inversely related to the scrappage of cars and pickups—as new vehicles are more efficient there is an increase in the demand for new vehicles, and a decrease in the demand for used vehicles, holding new vehicle price constant").

[389] PRIA at 1027. Note, however, that this is only relevant if consumers value fuel efficiency. If consumers do not value fuel efficiency, the CPM on new vehicles would not affect vehicle purchasing decisions and so would not need to be included in the scrappage model. Put another way, only non-quality improvements are arbitraged into used vehicle price. Hamilton and Macauley (1999), at 257 (another way to address this problem would be to subtract the portion of fuel efficiency increases that consumers value from the new vehicle price increase to create a quality adjusted price variable).

[390] This is because the only elements of the agencies' analysis that change VMT are the number of vehicles by Model Year (as determined by the sales and scrappage models) and the rebound analysis, and the only elements of the agencies' analysis that change fatalities are the VMT by model year.

[391] PRIA at 1531 (describing the "Scrappage and Fleet Share Disabled" as an analysis of the baseline and proposed standards when the new vehicle sales remain at levels specified for MY 2016 and new vehicle prices are kept at MY 2016 levels for the purpose of estimating scrappage).

scrappage module. Rather under this case, the fuel efficiency improvements of the baseline standards (expressed as changes in CPM) continue to affect scrappage decisions, and therefore the distribution of vehicle model years within the used vehicle fleet and the total vehicle fleet size.[392]

As such, any difference in fleet size between the baseline standards and the Proposed Rule in this sensitivity case is fully attributable to the fuel efficiency effect on scrappage.[393] In addition, because the agencies present each sensitivity case with the rebound effect disabled, any change in VMT or fatalities between the baseline standards and the Proposed Rule in this sensitivity case is fully attributable to the fuel efficiency effect.

But while holding new vehicle price constant should mean that scrappage goes up, the agencies' sensitivity analysis shows the opposite. As shown in Table 1, the agencies' analysis shows that holding new vehicle price and rebound constant leads to a theoretically nonsensical decrease in scrappage and, as a result, an *increase* in fleet size (by 59 million vehicles), VMT (by 280 billion miles), and fatalities (by 2640 deaths). In fact, these nonsensical results are the cause of 40% of the fleet size increase and fatalities—as well as the related portion of the CO_2 increases, congestion, and fuel consumption—that the agencies attribute to the baseline standards. This points to deep flaws in the agencies' scrappage model.

Table 1. Cumulative Changes in Fleet Size, Travel (VMT) and Fatalities Through MY 2029 Under Baseline CAFE and CO_2 Standards (Without Rebound)

(adapted from Tables 13-5 and 13-6 of the PRIA[394])

Sensitivity Case	**Fleet Size (millions)**	**VMT (billion miles)**	**Fatalities**
Reference Case	190	690	6340
Scrappage and Fleet Share Disabled	59	280	2640

The error appears to be driven by the fuel efficiency estimates for new SUVs and vans. The agencies' scrappage model is separated into different regressions for three styles of vehicle: cars, Vans/SUVs, and Pickups.[395] In the regression for each style, the agencies include variables for new vehicle price and new vehicle CPM as the explanatory variables for determining scrappage

[392] *Id.* at 1050-1051 (describing the scrappage model as using the same variables but with new vehicle price effectively set to its MY 2016 value, and showing that variables related to CPM have not been set to zero).

[393] This is because the only elements of the agencies' analysis that change fleet size are the new vehicle sales, scrappage, and dynamic fleet share model.

[394] PRIA at 1540, 1542.

[395] *Id.*at 1006.

rates. In addition, the agencies include a number of control variables related to vehicle age, model year, used vehicle CPM, and GDP.[396]

The coefficients of the new vehicle CPM variables for each body style represent the extent to which the model expects new vehicle fuel efficiency (represented as new vehicle CPM) to change scrappage rates for that body style. Negative values for the new vehicle CPM variables represent a prediction that as new vehicle fuel efficiency increases (i.e., the costs of driving a new car decrease), scrappage rates will increase. Positive values for new vehicle CPM represent the prediction that as new vehicle fuel efficiency increases (i.e., the costs of driving a new car decrease), scrappage rates will decrease. Economic theory would, therefore, predict only negative values for the new vehicle CPM variable: to the extent new vehicles of different body styles cause different changes to used vehicle demand for a given fuel efficiency change, the only difference in the model should be the magnitude of the change.

But in running the model, the results show that the relationship between scrappage rates and the fuel efficiency of one of those categories of vehicles (SUVs and vans) is positive and of such a high magnitude that it is throwing off the rest of the agencies' results, as shown in Table 2. Specifically, the magnitude of new SUVs and vans is 6.6 times larger than the magnitude of the new car CPM value, and over 13.9 times larger than the new pickups CPM value. The high relative magnitude of the value for SUVs is causing the scrappage model to generate lower scrappage, a larger fleet, additional VMT, and more fatalities due to improvements in fuel efficiency, holding new vehicle price constant.[397] And this effect increases over time because the agencies' dynamic fleet share model increases the proportion of new vehicles that are SUVs (and pickup trucks) as compared to cars.[398]

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[396] *See Id.* at 1044. The agency also includes lagged versions of these variables (e.g., the new vehicle price in the prior year), interactions between the variable and itself (e.g. age^2 and age^3), and interactions between variables (e.g., the interaction between age and model year). The inclusion of interaction variables make it very difficult to evaluate the results of the regression for an individual variable of interest. However, because new and used vehicle CPM are included without any interactions, the results for these variables can be interpreted as the effect of CPM changes on scrappage rates. This is done simply by adding up (new or used) CPM with the lagged variable for (new or used) CPM. *Id.* at 1027 ("By summing the current and lagged period new vehicle cost per mile coefficients, the overall level effect of the cost of travel can be computed by body style").

[397] Because the agencies do not present the effect of changes in CPM on scrappage for the three body styles combined, it is not possible to determine the exact combined effect.

[398] *Id.* at 953, 1046 ("Rather than apply the shares based on the regulatory class distinction [taken from the EIA's NEMS model], the CAFE model applies the shares to body-style. This is done to account for the large-scale shift in recent years to crossover utility vehicles that have model variants in both the passenger car and light truck regulatory fleets.").

Table 2. Aggregated New Vehicle CPM Coefficient Values[399] from Scrappage Model

(adapted from Tables 8-20 and 8-21 of the PRIA[400])

Sensitivity Case	Cars	Vans/SUVs	Pickups
Reference	-0.02087	0.137725	-0.00994
Scrappage Price Disabled	-0.02087	0.137725	-0.00994

There is no possible reason for CPM to have an impact on Vans/SUVs that is up to 14 times larger than for new cars and trucks. Despite the importance of the issue, the agencies try to explain away the inconsistency in one short sentence in the PRIA: "It may be either that cost per mile is negatively correlated with van/SUV attributes consumers value more than fuel economy and/or that increases in the cost of travel result in a shift away from pickups and towards vans/SUVs which may be slightly more fuel efficient."[401]

But that explanation is insufficient. The agencies provide no specific support for the idea that consumers would value other attributes over fuel efficiency so much more than for new pickups. And if consumers are shifting "from pickups and towards vans/SUVs which may be slightly more fuel efficient," that should have the opposite effect because it would show higher valuation of fuel efficiency.[402] Moreover, the agencies do not explain why this effect would be so much more significant for SUVs than for cars or pickups. If the agencies' theory was true, then the CPM coefficients would have opposite *and offsetting* effects between Vans/SUVs and pickups. Yet the SUV coefficients are *substantially* larger than those for pickups.

The sheer magnitude of interrelated econometric errors in the scrappage model (as explained throughout these comments) makes it difficult to pinpoint the specific problem that led to results such as a CPM variable for Vans/SUVs that is the wrong sign and of such high a magnitude that it overpowers the results of other variables, but it is possible that econometric errors led to this problem.

New vehicle CPM is endogenous with many other variables. Scrappage, new vehicle sales, and fuel efficiency are all determined simultaneously and the agencies' did not take this into account.[403] In addition, the agencies have explicitly excluded several theoretically important

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399 Aggregated CPM is the sum of New CPM and Lag New CPM, as described by the agency. *Id.* at 1027.

400 *Id.* at 1044, 1051

401 *Id.* at 1027.

402 *Id.*

403 Small and Van Dender (2007), at 31 (explaining the potential endogeneity of the fuel cost per mile); Li et al. (2009), at 125 (explaining that due to the aggregate nature of the data many other variables may suffer from

explanatory variables (e.g., the cost of maintenance and repair), which are potentially correlated with fuel efficiency.[404]

Notably, the agencies' methodology is inconsistent with almost all of the scrappage studies that the agencies cite as support for their approach.[405] A paper by Shanjun Li et al., provides a useful example of how the agencies could include fuel efficiency in their regression without raising the econometric concerns that may be leading to their nonsensical results. Li et al. include fuel price and vehicle fuel efficiency (gallons per mile) of used vehicles as well as a variable that captures the interaction of fuel efficiency of used vehicles and fuel price in their regression as explanatory variables.[406] Unlike the agencies' model, the regression analysis used in the Li et al. paper found results that are consistent with economic theory: a decrease in overall demand for vehicles and an increase in demand for more fuel-efficient cars.[407]

Another possible error is that the agencies' scrappage regression is overfit. For example, the agencies' regression for Vans/SUVs is different than the regression for cars and trucks. For Vans/SUVs, the agencies include age and age squared, whereas for cars they also included age cubed.[408] The agencies are overfitting their model to predict past behavior by including variables that have no clear relationship with scrappage rates or new car price (such as age cubed), rather than taking the more economically appropriate process of theorizing a model and the variables that should be included in it. Out-of-sample testing would help NHTSA highlight this potential overfit problem. If the agencies cannot address this error, they have two options. They can select an atomistic dataset that has sufficient detail to capture the key features of the scrappage market. Alternatively, they can choose to zero out the incorrect coefficient. As the model currently stands, this incorrect sign leads to fundamentally flawed results.

Moreover, the CPM results in the scrappage model are inconsistent with the agencies' sale model. In the sales module, the agencies have chosen to ignore consumer demand for fuel

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endogeneity problems, such as maintenance and repair costs); *See also* Gruenspecht (1982a), at 82; PRIA at 1015-1016.

[404] *Id.*at 1000 (indirectly making this point with respect to fuel efficiency and maintenance and repair costs when emphasizing that "Greenspan & Cohen also note that engineering scrappage seems to increase where EPA emission standards also increase; as more costs goes towards compliance technologies, it becomes more expensive to maintain and repair more complicated parts, and scrappage increases"). In other words, maintenance and repair costs are correlated with respect to fuel efficiency and scrappage rates.

[405] Walker (1968); Parks (1977); Gruenspecht (1982a); Greenspan and Cohen (1999); Bento et al. (2018). Note that Jacobsen & van Benthem (2015) include a variable related to *used* vehicle fuel efficiency for the same reason the agencies include used vehicle CPM. Jacobson and van Betham (2015), at 1318. However this is different than the inclusion of new vehicle CPM at issue here.

[406] Li et al. (2009), at 127.

[407] Gruenspecht (1982a), at 81.

[408] PRIA at 1025.

economy and significantly boosted the price impact of the baseline standards as a result.[409] But in the scrappage model, the agencies have incongruously allowed consumer valuation of fuel economy to drive a significant portion of the estimated fatalities. This inconsistency is arbitrary and capricious.

2. The agencies' assumption that VMT will go up is flawed

Even if the agencies are correct that the total fleet size would go up with an increase in prices (and they are not), the agencies' conclusion that the increase in the total fleet size would automatically lead to an increase in total VMT is illogical.

The agencies' analysis shows an overall increase of over 2 trillion additional vehicle miles traveled attributable to the baseline standards through 2050.[410] This increase comes from two sources: (1) the rebound effect and (2) an increase in fleet size due to non-replacement scrappage combined with an assumption that each vehicle of the same age and body type drives a fixed average number of miles per year. We address the first effect, rebound, in Section VI. The second effect is the result of a critical error.

Specifically, because the agencies assume that each additional car is driven a number of miles equivalent to the average VMT rate of a car of its age without adjusting per-vehicle VMT based on fleet size increases, the total VMT predicted by the model becomes inflated. And because the agencies' estimates of fatalities attributable to the baseline standards are primarily a function of fleet VMT, the inflated VMT results in substantially inflated fatality estimates and quantified economic costs.[411]

The agencies provide no theoretical explanation for the increase beyond conclusory claims that "if more used vehicles are supplied, there likely is some small resulting increase in VMT" and a "small increase in VMT is consistent with a larger fleet size."[412] But in fact, economic theory, the academic literature, and the agencies prior analyses[413] all show that an increase in the price of new vehicles would not lead to an increase in overall VMT. Instead, aggregate VMT, like vehicle stock, would remain constant or decline. The fact that changes in VMT go in the *opposite direction* (positive rather than negative) from what theory and the literature would support demonstrates that the agencies' modeling approach is critically flawed.

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[409] *See* III.

[410] PRIA at 1412.

[411] *Id.* at 1412.

[412] 83 Fed. Reg. at 43,099; *see also id.* at 43,098 ("The overall size of the on-road fleet determines the total amount of VMT."); PRIA at 1055, 1058 ("[I]t is reasonable to assume that changing the distribution of vehicle age and the fleet size across regulatory alternatives will result in non-constant VMT across those alternatives.").

[413] 77 Fed. Reg. at 62,716 (explaining the agencies' prior approach, which uses static vehicle turnover model and non-rebound VMT schedules that do not vary based on the stringency of the standards); *see also* Draft TAR at 10-6.

a.) ***The increase in VMT that the scrappage model produces is inconsistent with economic theory and the academic literature***

Economic theory does not support the agencies' conclusion that an increase in new vehicle price would lead to an increase in aggregate VMT. Vehicles are durable goods that are purchased not for immediate consumption, but for the consumption of a stream of services over time (in this case VMT). Economic theory makes clear that households select their vehicle and VMT to maximize utility subject to their budget constraints.[414] The number of miles a consumer decides to drive is determined by the relative cost of driving (i.e., its price), subject to a budget constraint.[415] For example, because a consumer's budget constraint is affected by the fixed cost of the vehicle, a policy that increases the price of used vehicles reduces the amount consumers choose to use their vehicle.

In other words, vehicle ownership decisions are influenced by the relationship between fixed costs of owning a vehicle and the value (consumer surplus) that consumers derive from that vehicle ownership.[416] In sum, VMT is influenced by vehicle choice and vehicle choice is influenced by VMT.[417] And a "unified model of vehicle choice and usage" is necessary.[418] In a paper on the distributional effects of fuel efficiency standards, Sarah West summarizes this point:

> The joint nature of the demand for vehicles and miles complicates estimation of these demands. The choice of vehicle and VMT are related because characteristics that influence a household to purchase a certain vehicle may also influence that household's choice of miles . . . . Since the demand for VMT depends on the price per mile, and thus fuel efficiency, the household's choice of vehicle affects their demand for miles, and vice versa. To reliability estimate the demand for miles, one must construct a model of the joint choice of vehicles and miles.[419]

The papers that have analyzed the impact of price changes on VMT in this way have found that increased price decreases total VMT, rather than increases VMT as the agencies found. For example, a 2008 paper by Lucas Davis used household (i.e., microeconomic) data to show that demand for durable goods (such as vehicles) is a function of the marginal cost of using the good

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[414] Gillingham (2011), at 3; Davis (2008), at 531-32; Durbin and McFadden (1984) (discussing simultaneous decisionmaking of purchase and usage for durable goods); West (2004), at 737; Goldberg (1998), at 4-5; Small and Van Dender (2007), at 26.

[415] West (2004), at 739-740; Davis (2008), at 532-33.

[416] Gruenspecht (1982a), at 120.

[417] Goldberg (1998), at 4-5, 8; West (2004), at 737; Davis (2008), at 532-33.

[418] Goldberg (1998), at 4-5.

[419] West (2004), at 737.

and of net income (conditional on household characteristics).[420] Davis' results are consistent with a reduction in VMT as new vehicle price increases. The marginal cost of driving component that determines VMT is not a function of purchase price, but is instead a function of the price of driving and the opportunity cost of driving (i.e., the value of time spent driving as measured by wages) (conditional on the good's characteristics). However, the net income component that determines VMT is a function of the good's price. Because an increase in prices reduces relative income, it would also reduce VMT. [421]

Small and van Dander also estimated rebound using a methodology that relies on macroeconomic data. Their analyses also showed that VMT goes *down* when new vehicle price goes up.[422]

Thus, even if, as the agencies hypothesize, some households end up purchasing multiple used vehicles (or retaining a used vehicle and purchasing an additional used vehicle) to achieve the same level of transportation services as they would have had with a new vehicle,[423] there is no reason to think that they will end up consuming substantially more transportation services (through additional VMT).[424]

To be sure, changes in new and used vehicle prices could have some effect on VMT. Households that were planning to purchase a vehicle without the standards will face one of three choices if standards increase the price of new and used vehicles:

- For consumers that purchase older vehicles, they may choose to drive fewer miles per year than they would have without the standards for reasons beyond effects on the direct cost-per-mile of driving (which should be captured in estimates of rebound). Older vehicles may be less enjoyable to drive than newer vehicles and older vehicles may be less reliable, leading consumers to forgo some trips that they would have taken with a newer vehicle.[425]
- For those households that choose to spend more money on a vehicle when vehicle prices rise, remaining household income will decline and so consumption of other goods (including driving) may decline.

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[420] David (2008), at 533.

[421] *See also* West (2004), at 737; Goldberg (1998), at 4-5. To the extent that any shift to used cars increases any consumer's income, that effect would be small because the shift is not big, as explained above.

[422] Small and Van Dender (2007), at 38-39.

[423] PRIA at 1058 ("used vehicles only have a portion of their original life left, so that it will take more than one used vehicle to replace the full lifetime of a new vehicle, at least in the long-run").

[424] Fleet size increases could have some small increase in VMT because vehicles that are more available will be driven more.

[425] 83 Fed. Reg. at 43,104 (discussing the findings of West et al. (2015), who found that "[b]ecause these replacements offered lower-quality transportation service, their buyers did not drive them more than the vehicles they replaced").

- As discussed above, some households may choose to forgo purchasing a vehicle at all, which could lead the overall fleet size to decrease. These households would obtain transportation services through alternative means (public transportation, bicycle, ride sharing). This would cause an overall, though likely small, decrease in fleet VMT.

Because of these possibilities, to the extent the standards cause a shift from new vehicles to used vehicles, and towards older rather than newer used vehicles, the amount of total driving done by used vehicles, and in particular older used vehicles, relative to new vehicles, may increase. But without significant changes to the demand for VMT, any non-rebound related increases will be a transfer of VMT from new vehicles (that are not sold) to newer used vehicles. None of the scenarios described suggest that economic theory would expect an increase in aggregate VMT.

Gruenspecht recognized the theory behind this principle in his 1982 dissertation[426] and acknowledged that total VMT should not change as a result of the shift from new cars to used cars.[427] As a result, when running the EPA Mobile Source Emissions Model to assess the impact of fuel efficiency regulations on pollution reduction, he imposed an equality constraint on total U.S. VMT. In explaining his decision to control against a decrease he explained:

> "If the relationship between annual per vehicle VMT and vehicle age is held constant despite the shift in the composition of the vehicle stock, aggregate VMT would decrease due to the greater use of low annual VMT (i.e., older) vehicles when standards applied to new cars are made more efficient. To offset this effect, which would be unlikely to accompany real world shifts in composition, annual per VMT is adjusted upwards proportionately by an amount sufficient to restore the baseline level of aggregate VMT."[428]

Gruenspecht's underlying theoretical insight that VMT should not change demonstrates that the agencies' approach is incorrect.

In comments to NHTSA prior to the publication of the Proposed Rule, EPA also took the position that economic theory provides no support for the agencies' conclusion that increases in fuel efficiency and greenhouse-gas emission standards will result in an increase in aggregate VMT, other than through the rebound effect. EPA staff highlighted for NHTSA that with or without the standards, demand for VMT is unchanged, other than through potential changes in the marginal cost of driving, which should already be addressed by the rebound effect.[429] EPA

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[426] The dissertation is dated 1982. The agencies mistakenly cite it as his 1981 dissertation.

[427] Gruenspecht (1982a), at 126.

[428] *Id*.

[429] EPA Further Review of CAFE Model & Inputs, June 18, 2018 at 5, attached to Email from William Charmley (June 18, 2018) ("A change in the overall fleet size due to the Augural standards might not in and of itself be problematic, as long as the VMT schedules are adjusted to account for overall travel activity that is distributed over

staff correctly explained: "With no rebound, we would not expect to see any change in total VMT, since by definition rebound is measured as the change in VMT for a given change in fuel cost per mile."[430] NHTSA never provided an adequate explanation for dismissing EPA's comments and publishing the Proposed Rule.

In sum, the agencies' decision to employ a methodological approach that results in a significant increase in VMT, even though such an increase is inconsistent with economic theory, the academic literature, and agency staff analysis, is arbitrary and capricious. The agencies' reliance on the fatalities and costs that arise from the increase in VMT to justify the rollback is also arbitrary and capricious.

b.) *Any VMT changes caused by the baseline standards should already be captured by the rebound estimates*

Moreover, to the extent that VMT changes at all when price or fuel efficiency changes, that VMT change should already be accounted for in the agencies' rebound estimates. (We separately critique the agencies' rebound estimates in Section IV.)

As we explained above, VMT does not go up with changes in scrappage. But VMT can go up with rebound. As explained more at length in Section IV, rebound is comprised of three separate effects. Two of those effects cause increased driving because of consumers' increased income: (1) a reduction in the relative cost of driving compared to other forms of transportation—the "substitution effect;" (2) an increase in consumers' overall income (since they have to spend less on gasoline) that results in consuming more of many things (including driving)—the "income effect." The third effect depresses driving: (3) a reduction in consumers overall income (since consumers have to spend more for a more expensive but fuel efficient car) that results in consuming less of many things (including driving)— "the capital cost income effect."

Several of the rebound papers that the agencies assess in their rebound estimate calculate the rebound effect of increased fuel efficiency by looking both at the effect that fuel efficiency has on lowering the cost of driving, as well as on total driving and fleet size (partially through changes in vehicle prices).[431] For example, Small and van Dender (2007) define the rebound effect as $\frac{\varepsilon_{M,PM}+\varepsilon_{M,V}\varepsilon_{V,PM}}{1-\varepsilon_{M,V}\varepsilon_{V,M}}$ where $\varepsilon_{M,PM}$ is the elasticity of VMT to the fuel cost per mile, $\varepsilon_{M,V}$ is the elasticity of VMT to fleet size, $\varepsilon_{V,PM}$ is the elasticity of fleet size to the fuel cost per mile, and $\varepsilon_{V,M}$ is the elasticity of fleet size to VMT. In this way, these papers effectively already

a larger number of vehicles."), https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (5th attachment).

430 *Id.* at 9.

431 Scimek (1996), at 84; Small and Van Dender (2007), at 31; Barla et al. (2009), at 389-391; Hymel et al. (2010), at 1223-1224; Hymel and Small (2015), at 31.

account for any possible fleet size changes.[432] These papers demonstrate that, to the extent fleet size is changing at all, that change is best captured through the rebound effect, and not through the scrappage estimates in the Proposed Rule.

c.) *Vehicles scrapped under the proposed policy and not the baseline policy are marginal by definition, and the average VMT does not apply*

Even if the agencies are correct about the impact of non-replacement scrappage (and they are not, as discussed above), the agencies' use of average VMT schedules in the calculations also led to a significant inflation in the agencies' estimates of aggregate VMT increases. Some of the most critical variables for analyzing VMT schedules are: fleet size and composition, accident and repair rates of vehicles of a particular age and class (i.e., controls for quality), vehicle brand (i.e., a control for durability), number of households owning vehicles, and average number of vehicles per household. In the VMT calculations, the agencies applied VMT schedules that were calculated using the number of miles traveled by the average vehicle for a given age and style (car, SUV, pickup truck, van, medium-duty pickup/van) to vehicles that would have been scrapped if not for the baseline standards.[433]

But the agencies ignored confounding variables that could make those vehicles only "marginal" vehicles, with characteristics that would have made them candidates for earlier scrappage relative to the average vehicles of that particular body style and vintage without the baseline standards. These characteristics might include more wear and tear (i.e., higher odometer readings and more accidents) and lower durability (i.e., of a brand with higher scrappage rates). Conditional on age, vehicles with higher odometer readings are both more likely to be scrapped and more likely to be driven fewer miles annually.[434] There is reason to believe that these marginal vehicles are also driven less than average vehicles of the same style and vintage. Data from Sweden indicate that some portion of scrapped vehicles are not driven prior to scrappage even though they are registered and could be driven.[435] As such, it is inappropriate to assume that the vehicles that would be scrapped under the Proposed Rule but would not have been scrapped

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[432] *See also* Joshua Linn, Resources for the Future, *Missing Fuel Cost Savings: Some Clues Emerge* (Oct. 9, 2018), http://www.rff.org/blog/2018/missing-fuel-cost-savings-some-clues-emerge (analyzing the agencies' VMT conclusions with respect to both scrappage and rebound and concluding that they are double counted).

[433] 83 Fed. Reg. at 43,090 ("the CAFE model tabulates 'mileage accumulation' schedules, which relate average annual miles driven to vehicle age, based on vehicles' body style").

[434] The current VMT schedules indicate that households drive vehicles less as the vehicles depreciate. While the agencies' VMT schedules vary VMT by vehicle age, odometer readings are a better indicator of depreciation than age. Busse, et al. (2013), at 233; Salee, et al. (2016), at 63-65. Because "conditional on age, vehicles with higher odometer readings have less remaining life," and have lower economic value (higher depreciation). Salle et al. (2016), at 66 (Figure 1); *see also* Jacobsen & van Benthem (2015), at 1330. At the same time, high mileage vehicles are likely driven less because less reliable vehicles (i.e., vehicles that are more likely to break down) impose a higher marginal costs of driving.

[435] Feeney and Cardebring (1988), at 455.

under the baseline standards would be driven the same as an average vehicle of their age and style.

Given the divergent characteristics of the non-scrapped vehicles and average vehicles, it is also likely that buyers of these almost scrapped vehicles are different than the vehicle owner of the average vehicle of that particular age and style. For example, the drivers may be younger, have lower incomes, live in places where driving every day is not necessary, etc. The owners of marginal vehicles likely make different driving decisions than would the average owners of the average vehicles of the corresponding age and style. Those owners may drive their vehicles less for any number of reasons.

By assuming all vehicles in the fleet are driven the amount that an average vehicle of that age and style are driven even after a vast increase in the fleet size, the agencies have failed to control for omitted variables and inflated the estimates of aggregate VMT increases.

An additional concern with the aggregate VMT analysis is the datasets the agencies use to construct the VMT schedules. For vehicles older than fifteen years, that dataset includes data from the 2008 recession.[436] But as the agencies themselves acknowledge, that year is unrepresentative and so should not be used. Given that a significant number of affected vehicles in the model are fifteen years or older,[437] a significant portion of VMT may come from vehicles whose schedules were calculated using this skewed data. This likely has serious consequences for the aggregate VMT estimates.

d.) *The agencies' analysis is inconsistent with their rebound welfare analysis*

The agencies' VMT analysis is also inconsistent with the agencies' rebound analysis, which finds that all fatalities stemming from those additional vehicle miles are offset by the private welfare benefits of increased driving.[438] It is arbitrary and capricious to include these offsetting benefits for rebound but ignore them for scrappage. Specifically, according to the agencies, drivers would gain expected utility from driving that must exceed their private cost from increased fatality risk (i.e., in this case from having a vehicle in the baseline policy that they do not have under the preferred policy). If an owner does not want to drive his or her used car more (i.e., does not want to take the relative risk to enjoy driving a used car more), that owner can sell the used car to someone else who would want to drive it (otherwise, it would be scrapped). In that case, the *marginal private benefits of driving* are equal to *the marginal costs of driving*. Therefore, the *private benefit of driving* must be greater than the *private fatality cost*, since we know that the private costs of driving include more than just fatality risk (i.e., time and gas

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[436] PRIA at 973.

[437] 83 Fed. Reg. at 43,097.

[438] *Id.* at 43,105 (showing that the costs of rebound are offset by the welfare benefits).

prices). Given that the agencies have included this welfare benefit in the rebound analysis, they should include it in the scrappage context.

3. Path forward

a.) *The agencies must conduct more study and have their models peer reviewed*

As explained above, the agencies' brand new scrappage model goes against basic economic theory.[439] In light of this, as well as the model's novel application, the agencies must have the model peer-reviewed.[440] The agencies should also conduct more inter-model comparisons. As discussed earlier, Bento et al. (2018) estimated that scrappage elasticity is -0.4 and Jacobsen and van Benthem (2015) estimated that it is -0.7.[441] The agencies' results are not consistent with these elasticity estimates. The agencies must provide an explanation for the divergence.

Out-of-sample testing is also necessary for the agencies' scrappage and sales models—as is true of any model. The nonsense results found by NHTSA indicate that NHTSA's scrappage model performs poorly out-of-sample.[442] The need for these kinds of checks is also consistent with the agencies' past consideration of the challenges of modeling scrappage. In its 2016 Proposed Determination, EPA rejected the use of a scrappage model based on the fact that the analysis requires additional scrutiny.[443] Specifically, EPA called for out-of-sample testing and inter-model comparison.[444] Such analyses would be consistent with similar out-of-sample analyses conducted in the scrappage literature.[445] The agencies have not identified anything in the literature or their approach that explains the change in EPA's conclusion on this point now.

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[439] PRIA at 1049 ("In summary, this analysis includes the effect of differentiated fuel economy regulations that only affect new and not used vehicles—and to our knowledge is the first dynamic vehicle scrappage model implemented in a larger framework.").

[440] See 77 Fed. Reg. 62,624 (summarizing the many studies that supported the Clean Car Standards and describing the peer-review that the agencies used to analyze that information).

[441] Jacobsen & van Benthem (2015), at 1333 (Table 6); *see also* Walker (1968), at 505; Gruenspecht (1982b), at 330; Bento et al. (2018), at 159. Though less relevant due to age, older papers estimate that the elasticity of scrappage with respect to new vehicle price is between -0.7 to -1.0. Walker (1968), at 505; Gruenspecht (1982b), at 330.

[442] Jacobsen & van Benthem Docket Letter. Their concern is unsurprising, as the agencies likely overfitted the data as the agencies selected models to maximize their explanation of in sample variation; this is true even as the agencies apply Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) in addition to root mean squared error (RMSE). See PRIA at 1015.

[443] EPA, Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation at A-43 (2016), https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100Q3DO.pdf [hereinafter "Proposed Determination].

[444] *Id*.

[445] Parks (1977), at 1111-1114; Greenstone and Cohen (1999), at 367-380.

b.) *In order to study the impact of new vehicle sales on scrappage and VMT, the agencies should link new vehicle sales and changes in used vehicle retention*

A fundamental flaw of the agencies' analysis is that the agencies have developed separate and unconnected models to estimate the size and composition of the fleet, and the number of miles traveled by various vehicles within that fleet. Consumer decisions regarding when to buy or not buy a new vehicle; decisions about buying, holding, selling, or scrapping a used vehicle; and decisions about how many miles to drive each vehicle that is owned; are all related to each other. The agencies' failure to connect these models is a large part of what is leading to unjustified results. The agencies should abandon their clearly incorrect approach and retain the approach the agencies have used for past fuel efficiency and GHG emission standards.

However, if the agencies insist on evaluating the dynamic changes in fleet composition that would be caused by the baseline standards, they must modify their approach in order to take into account these interconnections. There are a number of options for doing this, including:

- Developing an interconnected vehicle choice model;
- Using more sophisticated econometric techniques to connect the existing separate models;
- Controlling for all omitted variables;
- Applying fleet size and VMT constraints on the existing scrappage model while correcting for some of the econometric errors in the agencies' current approach.

In any of these cases, the agencies should control for omitted variables[446] and abide by the fundamental principles that we have laid out in these comments.

i.) Retaining the peer-reviewed approach from the Clean Car Standards

Without a robust methodology to account for the interconnections between the different fleet composition models, the only economically valid path forward would be to adopt the approach that the agencies used in their regulation promulgating the Clean Car Standards: assume a

[446] If it is not possible to control for the omitted variables, the agencies should consider included fixed effects for the following variables: brand fixed effects, vehicle type (segment or class) fixed effects; time scale fixed effects; geographic fixed effects; age and model year fixed effects, including dummies for the interactions between them. *See* Li et al. (2009) (dummies can control for omitted vehicle attributes and explaining that geographic fixed effects can capture unobserved demographics and other unobserved geographic variables that affect vehicle demand); Hamilton and Macauley, (1999), at 254; Li et al., (2009); PRIA, 948, 1012 (finding strong evidence of time trend in their new vehicles sales analysis and noting that scrap metal quantity decreases over time indicating the potential need for time-period fixed effect); Parks (1977), at 1104, at 1110; Gruenspecht, (1982a), at 97; Hamilton and Macauley, (1999); Jacobsen and Benthem (2015), at 1321. The agencies currently use polynomial variables for age and model year, however fixed effects are flexible and commonly applied in the literature. To "avoid imposing restrictions on the pattern of scrapping responses to new car price development across age groups," Gruenspecht (1982a) at 115) interacts new vehicle price with age dummies. Given the high statistical significance of these parameters, the agencies should consider this alternative instead of time trends.

constant, not dynamic, fleet.[447] Use of the new scrappage model in its current form without fleet size constraints is not a valid option.

In order to address any effects caused by the aging of the vehicle fleet,[448] the agencies could develop a simpler logistic scrappage model like those that solely capture the effect of vehicle age on scrappage, but those would not generally show an increase in overall VMT or fleet size.[449]

ii.) Vehicle choice model

An approach that models consumer decisionmaking using a vehicle choice model could, in theory, be a coherent and integrated approach to estimating the effect of the baseline standards on fleet composition. This is the approach taken by Jacobsen and van Benthem in a paper that the agencies repeatedly cite.[450] However, before making this change, the agencies would have to address the significant shortcomings of vehicle choice models that they identify in the Proposed Rule and ensure that those problems are addressed.[451]

iii.) Simultaneous equations

The agencies could investigate the use of simultaneous equations to estimate new vehicle sales, scrappage, and vehicle-miles traveled simultaneously.

Specifying structural models of the various components, rather than the reduced form, disconnected models, used in the Proposed Rule would aid in both ensuring consistency with the literature, as well as in identifying sources of endogeneity and candidate instrumental variables.

The agencies could build on the estimation strategies begun in Small and Van Dender (2007).[452] However, the agencies would need to separate total fleet size into new and used components.[453]

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[447] 77 Fed. Reg. at 62,716 (explaining the agencies' prior approach, which uses static vehicle turnover model and non-rebound VMT schedules that do not vary based on the stringency of the standards); *see also* Draft TAR at 10-6.

[448] Bento et al. (2018), at 178.

[449] Walker (1968), at 503; Green and Chen (1981), at 383; Feeney and Cardebring (1988), at 460; Hamilton and Macauley (1999), at 253; Bento et al. (2018), at 161.

[450] Jacobson and van Benthem (2015), at 1328-1329 (the authors refer to their model as a simulation model that captures leakage from scrappage and vehicle choice); Proposed Determination at A-43 ("We note that it relies on an estimated model of consumer vehicle choices that, as with most other models, has not been tested for out-of-sample validity or comparability with other models.").

[451] 83 Fed. Reg. at 43,076-43,078. EPA has previously argued that vehicle choice models are insufficient for policy making. Proposed Determination at A-44, A-47, A-48. EPA concluded that vehicle choice models are poor predictors of future shares, *id.* at A-45, often are out-performed by constant share models and have not been tested for their forecast ability. *Id.* at A-44).

[452] *See generally* Small and Van Dender (2007), at 30-33 (discussing methods).

[453] Id.

In addition, in order to properly control for variables at the vehicle and household level, the agencies should estimate VMT schedules of marginally scrapped vehicles.

iv.) Fleetsize and VMT constraints

If the agency does not adopt one of the above approaches, the only economically valid approach would be to apply "constraints" on aggregate fleet size and VMT in the VOLPE simulation so that aggregate fleet size and VMT does not change across the proposed and baseline rules. This approach would not be a panacea and would not address all of the flaws outlined above. But it would at least constrain the errors driving the increases in fleet size and VMT.

In interagency comments to NHTSA, EPA staff proposed a similar solution. EPA recommended that the agencies impose constraints on fleet size and VMT so that the agencies can isolate the Gruenspecht effect (or shift to used vehicles).[454] The methodology proposed by EPA staff would also allow fleet size to grow over time (in line with historical observation) and to just capture the scrappage factor: the aging of the fleet.[455]

In response to EPA's suggestions, NHTSA asserted that it could not use the adjustment factors proposed by EPA because they would be internally inconsistent.[456] But the agencies' scrappage results are inconsistent with basic economic logic and the academic literature and that is why these constraints are necessary. In fact, Gruenspecht himself recognized the need to impose fleet size and VMT constraints after modeling the connections between new car market, the used car market, and households' VMT decisions (as acknowledged by the agencies).[457] Gruenspecht explained that the disadvantage of the reduced form model he used (i.e., where scrappage is modeled as a function of new vehicle price and not the theoretically correct used vehicle price) is

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[454] Summary points from EPA review of CAFE model (NPRM version)–Effect of EPA code revisions. Meeting with Office of Management and Budget/OIRA 6/18/2018, slides 2-3, https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (5th Attachment, pdf pages 4-5); EPA Further Review of CAFE Model & Inputs at 6-7 (June 18, 2018), https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (5th Attachment, pdf pages 15-16).

[455] *See* Bento et al., (2018) at 178. Specifically, EPA found that the scrappage rate curves so that overall fleet size is unaffected by the policy (though it grows over time) and that VMT increases only with the rebound effect (and not scrappage). Summary points from EPA review of CAFE model (NPRM version)–Effect of EPA code revisions, Meeting with Office of Management and Budget/OIRA 6/18/2018, slides 2-3, https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (5th Attachment, pdf pages 4-5); EPA Further Review of CAFE Model & Inputs at 6-7 (June 18, 2018), https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (5th Attachment, pdf pages 15-16).

[456] NHTSA, Responses to Interagency Comments on NPRM Round 8 Received 7-11-2018, https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (12th Attachment, pdf page 4).

[457] Gruenspecht (1982a), at 120, 126; Gruenspecht (1982b), at 329.

that it may produce inaccurate results and that constraints were thus necessary.[458] Specifically, he states:

> The primary argument in favor of the structural approach is based on the observation that new car markets are cleared primarily through quantity variation, while used car markets are cleared mostly though price adjustments. Therefore, used car prices and new car prices need not move in tandem. According to the framework developed in Section 4 and 5, there is no direct link between rational scrapping decisions and new car prices. Therefore a direct regression of scrapping rates on new car prices may fail to yield coefficients that approximate those obtained by solving a structural scrapping model that explicitly models the link between new car prices and used car prices.[459]

In other words, there is no direct link between new vehicle prices and used car scrappage. Instead, any link between scrapping decisions and new car prices is only indirect through the price of used cars. Because of this indirect connection, it is possible that a model will produce strange and theoretically inconsistent results without constraints, as the agencies' model indeed produced in the Proposed Rule.

An additional argument that NHTSA cited is that fleet size and VMT constraints may reverse the aging trend of the fleet observed over the last few decades.[460] But as the methodology could allow average historical fleet size growth as a modeling input, this concern is invalid. In fact, EPA provided an alternative approach to NHSTA during the period before the agencies published the Proposed Rule and modified the code to allow "the user to select a fleet growth rate."[461] The agencies provide no evidence that the problem could not be overcome in that way now.

Even if fleet size and VMT constraints are imposed on the model, other changes are still necessary to ensure that the agencies' approach will yield valid results. In particular, the agencies will need to carefully consider the connections between the simultaneously determined variables among the various disparate new vehicle sales, scrappage, and VMT models. In doing so, the agencies should carefully consider how the variables are connected based on theory. For

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458 Gruenspecht (1982a), at 93.

459 Gruenspecht (1982a), at 93.

460 NHTSA, Response to Interagency Comments on NPRM Round 8 Received 7-11-2018, at 3-4, https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (12th Attachment, pdf pages 3-4).

461 Summary points from EPA review of CAFE model (NPRM version)–Effect of EPA code revisions, Meeting with Office of Management and Budget/OIRA 6/18/2018, slides 2-3, https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (5th Attachment, pdf pages 4-5); EPA Further Review of CAFE Model & Inputs at 6-7 (June 18, 2018), https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (5th Attachment, pdf pages 15-16).

example, Gruenspecht (1981): included the scrappage rate, new vehicle price, and new vehicle sales in his regression for used vehicle price;[462] in his structural scrappage regression, Gruenspecht (1982) included new vehicle sales;[463] in his corresponding reduced form regression, Gruenspecht (1982) included vehicle miles traveled per capita in order to address overall demand for driving, in addition to the vehicle stock in the previous period.[464] Gruenspecht (1982) also demonstrated that the quantity of new vehicle demand is a function of vehicle miles traveled per capita and vehicle stock in the previous period, in addition to new vehicle price.[465] The agencies should include the variables that Gruenspecht and others have traditionally included in their scrappage analysis, including price of vehicles indexed by maintenance and repair costs, the price of scrap metal, and interest rates.[466]

One shortcoming of this methodology is that it cannot capture the possibility of fleet size and VMT declining as new and used vehicle prices increase. Specifically, holding VMT and fleet size constant ignores the possibility that people will switch from used vehicles to shared forms of transit (e.g., mass transportation, existing household vehicles) as these prices increase. These features could cause a decline in fleet size and VMT should the new vehicle price change be large and should be assessed.[467] The agencies should model that as well

B. Safety consequences of changes in fleet composition

Even if the agencies are right that higher new vehicle prices will lead to an increase in the fleet size and total VMT (and they are not), their safety estimates are inflated.

1. Demand for vehicle safety should lower the impact of scrappage estimates

To make their fleet composition calculations, the agencies calculated the change in "distribution of both ages and model years present in the on-road fleet."[468] Then the agencies combined that information with data showing the fatality rates of vehicles by model year.[469]

But in calculating the impact that the price increases have on fatalities through slower turnover, the agencies have failed to consider the impact that a consumer preference for safety would have

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[462] Gruenspecht (1982a), at 81, 99-101.

[463] *Id.* at 106-107.

[464] *Id.* at 86, 109-113.

[465] *Id.* at 87.

[466] *Id. at 70.* Gruenspecht (1982a), at 103, 109-113, 117 (including interest rates).

[467] Jacobsen & van Benthem Docket Letter at 2. (referring to a switch from the baseline policy to the Proposed Rule and stating that the extent to which the fleet will decrease "depends on the magnitude of the price changes and the aggregate elasticity to the outside good").

[468] 83 Fed. Reg. at 43,135.

[469] *Id.* at 43,135-37.

on that slower turnover.[470] For some time, the literature has demonstrated that consumers prefer safer vehicles. Since the 1980s, a top vehicle safety rating for a particular vehicle model has significantly increased demand for that vehicle model.[471] The agencies themselves acknowledge that safety is a vehicle attribute that consumers value.[472] Given this preference, consumers may continue to choose relatively safer new and used cars and manufacturers may continue to supply relatively safer vehicles, and so the impact that any decreased turnover would have on safety would be muted.

It would be unreasonable for the agencies to ignore the fact that safety affects consumer decisionmaking. Academic economists have developed tools that can facilitate analysis of these types of interconnected relationships. For example, fuel efficiency programs may lead to more congestion through rebound, but the additional congestion itself deters travel and depresses the impact of the additional congestion. For that reason, Hymel et al. used simultaneous equations that capture the inter-connected relationship between fuel efficiency and congestion to estimate the impact of fuel-efficiency programs on congestion.[473] Likewise, Small and Van Dender recognized the endogenous characteristic of fuel efficiency: fuel efficiency causes more driving and more driving causes a demand for fuel efficiency to increase. Because of this interaction, Small and Van Dender calculated the impact of fuel efficiency programs on VMT through simultaneous equations.[474] As these papers show, all the vehicle aspects (VMT, fuel efficiency, vehicle age) are interrelated and ignoring the feedback effects (those interconnectedness), as the agencies are currently doing, produces flawed or even meaningless results. The agencies should estimate the simultaneous interaction between fuel-efficiency standards and safety. Without fixing these flaws, the agencies' results are arbitrary and capricious.

2. The failure to control for confounding factors has led to inflated estimates

The agencies also fail to control for confounding factors. There are three major causes of crashes: "the <u>driver</u>, the <u>vehicle</u>, and the <u>environment</u> in which crashes occur."[475] Within these categories, many different features besides design can lead to changes in the real-world

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[470] *See* PRIA at 952-953 (listing the inputs in the sales model, which does not include any variable or proxy variable for vehicle safety).

[471] McCarthy (1990), at 534-41 (explaining that studies in the 1980s showed that vehicle safety was one of the most important attributes for consumers); *see also* Kaul et al. (2010) (describing US consumer preferences for safety features).

[472] PRIA at 933 ("this analysis recognizes that manufacturers' changes in the fuel economy and emissions levels of new vehicles in response to raising or lowering federal standards may also entail changes in other attributes that . . . potential buyers also value . . . include[ing] . . . occupant safety").

[473] Hymel et al. (2010), at 1220-21.

[474] Small & Van Dender (2007), at 30-31; *see also* Hymel & Small (2015), at 95 (using simultaneous equations to calculate impact of fuel efficiency on VMT).

[475] Farmer and Lund (2006), at 342.

performance of the on-road vehicle fleet. For example, improved safety laws and programs (including speed limits and licensing laws), urbanization (i.e., congestion), driver behavior like seat belt use, improved road design, improved traffic law enforcement, less alcohol-impaired driving, economic downturns, and improvements in ambulance response times can all lead to fewer fatalities.[476]

As such, these factors are typically studied in the literature through the age of the vehicle (as a proxy for driver), the model year (to account for vehicle design), and the calendar year (to account for environmental factors).[477]

In the Proposed Rule, the agencies attempt to quantify the influence of vehicle age and vintage (i.e., model year) on fatalities by analyzing aggregate fatality data from years 1996 to 2015.[478] Specifically, the agencies look at "real world performance in the on-road vehicle fleet."[479] The agencies explain that they used age as a proxy variable for driver behavior[480] and vehicle model year as a proxy for safety technology trends. The agencies use the results of those quantifications to predict how changes in turnover will affect road fatalities.

But those quantifications are inflated for two reasons.

First, the agencies fail to control for the third factor that is relevant to crashes: environmental changes.[481] Specifically, as the driving environment has generally improved over time,[482] the coefficients corresponding to model year overestimate improvements in the safety features between the model years. Not controlling for all the non-vehicle variables that increase safety

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[476] See Famer & Lund (2006), at 339-341; Farmer & Lund (2015), at 685-686 (citing the 2008 recession, improvements in road design, and improved driver behavior as potential factors that improved on-road performance); *see also* Anderson & Searson (2015) at 202 (explaining that a vehicle's age and crash risk are likely correlated with the characteristics of the average driver associated with vehicles of a particular age as well as with the distance and type of driving associated with vehicle age and explaining that "[r]isks created by conditions separate from the vehicle (road-safety related changes to infrastructure, speed limits, other legislation, enforcement and behavior)" likely also have an impact on the crash statistics).

[477] Farmer and Lund (2006), at 341-342; Anderson and Searson (2015), at 202.

[478] 83 Fed. Reg. at 43,136. Specifically, the agency regresses U.S. fatalities per billion miles on a polynomial of vehicle age (a proxy for driver behavior) and model year fixed effects: $F_{it} = \beta_0 + \sum_{j=1}^{4} B_j * {Age_{it}}^{j} + \sum_{i=1976}^{2014} \gamma_i * MY_i + \varepsilon_{it}$ where F_{ijt} are fatalities of model year *i* in calendar year *t*, Age_{it} is vehicle age of model year *i* in calendar year *t*, MY_i is model year *i*, and ε_{it} is the error term. In this regression, γ_i are the values of interest (i.e., improvements in safety).

[479] 83 Fed. Reg. at 43,140.

[480] Farmer and Lund (2006), at 341-342; PRIA at 1406-1407.

[481] *See Id.* at 1382; 83 Fed. Reg. at 43,136 (explaining that the model lacked the "internal structure" to account for vehicle speed, seat belt use, drug use, or age of drivers); PRIA at 1392 (stating that "fatality rates associated with different model year vehicles are influenced by the vehicle itself and by driver behavior" ignoring environmental factors altogether).

[482] Farmer and Lund, (2015) at 686 (Figure 2).

over time is unacceptable and biases the results towards very high fatalities under baseline standards.

Second, the vehicle age variables are only a rough proxy for driver behavior because they can only capture driver behavior that does not change over time. For example, if the social acceptance of drunk driving decreases and consequently drunk driving decreases, the age variable would not capture that change. As such, the agencies could not adequately control for driver behavior trends. And a decrease in fatalities could look like it was caused by vehicle improvements over time rather than societal changes.

In statistical terms, because of these problems, the safety estimates suffer from omitted variable bias. The agencies recognize the issues with respect to seat belt use trends but ignore (or fail to recognize) the overall extent of this problem in their analysis.[483]

Omitted variable bias is a serious statistical problem in the vehicle safety context. Omitted variable bias occurs when an omitted variable (e.g., environmental and behavior trends) is correlated with the included regressor (e.g., the age of the vehicle and model year), and when these omitted variables are determinants of the dependent variables (e.g., fatalities).[484] Environmental and behavioral trends clearly affect fatalities and are correlated perfectly with age and model year. Since the bias gets worse as the regressors become more correlated (e.g., age of the vehicle and model year) with the omitted variables (e.g., environmental and behavior trends),[485] the perfect correlation of the calendar year variable with model year plus age creates a severe bias.

As a result of the omission of these variables in the safety analysis, the agencies do not capture causal relationships between vehicle vintage (i.e., model year) and vehicle age and fatalities, but only correlations, leading to misleading and sometimes even meaningless estimates.

Figure 3 shows that results of the agencies' age estimates contradict the literature and intuition. That Figure confirms that the agencies' analysis captures meaningless correlations and not causation. Figure 3 plots the agencies' estimate of the relationship between car age and fatalities and shows a huge drop in fatalities as vehicles age.[486] But as the literature demonstrates, fatalities clearly increase with vehicle age.[487] Indeed, NHTSA recognized this in 2013, in a report cited

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483 PRIA at 1395-1399.

484 Stock and Watson (2007), at 187.

485 *Id.* at 190.

486 The estimated relationship is given by polynomial: $28.59 - 3.63\mathrm{x} + 0.76x^2 - .04x^3 + 0.0005x^4$. *See* 83 Fed. Reg. at 43,138.

487 Farmer and Lund (2006), at 339 (Figure 3); Farmer and Lund (2015), at 686 (Figure 1).

and described in the Proposed Rule.[488] And the agencies also recognized this in the Proposed Rule.[489]

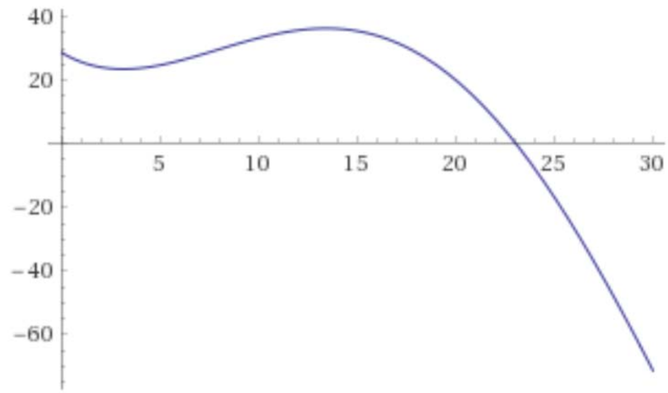

Figure 3. Agencies estimate of relationship between car age (x-axis) and fatalities per billion miles (y-axis)

As Figure 3 helps show, estimating correlations instead of causal relationships poses huge problems for the type of predictive analysis that the agencies have set out to do. As economic textbooks have long acknowledged: "Knowing that two factors are correlated provides no predictive power; prediction requires understanding the causal links between the factors."[490]

The agencies do not adequately address these biases, despite several strategies that are available in the literature. For example, analyses, including by NHTSA itself, have been able to calculate the impact of vehicle design changes on safety, while controlling for many of the related and confounding behavioral or environmental factors.[491] In its prior rules, NHTSA itself has controlled for vehicle age, body type, air bag deployment, roadway function class, day/night, occupant age, gender, number of vehicles in crash, restraint use, principal impact point, speeding involved, speed limit, ejection status, rollover, interstate road, occurring at an intersection, motorcycle involved in the crash, roadway departure, number of occupants; even more

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[488] 83 Fed. Reg. at 43,135 (describing National Center for Statistics and Analysis, *How Vehicle Age and Model Year Relate to Driver Injury Severity in Fatal Crashes* 6 (Aug. 2013), https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/811825).

[489] *Id*.

[490] Grueber (2010), at 66.

[491] *See* Farmer & Lund (2015), at 685-686 (describing studies); Blows et al. (2003), at 354 (controlling for driver demographics (e.g., age, sex, race, education level), behavioral characteristics (e.g., alcohol and marijuana consumption, driving speed, seatbelt usage), and vehicle characteristics (engine size, inspection certificate); Ryb et al. (2013), at 257 (controlling for driver age, sex, weight, seatbelt use); Farmer and Lund (2006), at 339-341.

behavioral variables are controlled for in the literature.[492] Indeed, in the PRIA, the agencies showed how fatalities by vehicle age are correlated with seat belt usage, alcohol consumption, and speeding.[493] The agencies concluded: "[t]herefore, it is important to control for behavioral aspects associated with vehicle age so only vehicle design differences are reflected in the estimate of safety impacts."[494] Inexplicably, the agencies then claimed to have addressed this issue by controlling solely for vehicle age.[495] However, given the omission of important confounding factors in the analysis, controlling solely for age is insufficient.

Rather than control for these factors when analyzing the actual safety impact of changes in fleet turnover, the agencies argue that they are unable to include additional control variables because "[v]ehicle interactions are simply not modeled at this level."[496] But NHTSA has managed to control for these factors before.[497] And as the model's results are counterintuitive and in conflict with economic research, the agencies should fix the model rather than ignoring the problem. The agencies further argue that they cannot control for these variables, because they cannot project (i.e., forecast) the variables into the future.[498] But as long as the agency controls for the confounding variables, it does not matter how those variables change in the future.

Given the flaws of the current methodology and the importance of the safety findings to the agencies' ultimate results, the agencies should control for all of the variables that they have controlled for in the past and which are controlled for in the literature. This should also include all relevant variables from the mass-footprint regressions discussed below to avoid double counting the impacts of vehicle mass on fatalities.

Additionally, as the usage of aggregated data does not allow for full identification of the effects,[499] the agencies should disaggregate their data (i.e., use more atomistic or regional data) allowing them to break the strict equality between calendar year, model year, and age of vehicle (discussed above); this would allow the agencies to control more generally for trends in environment and behavioral safety over time.[500] For example, the agencies can create model year

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492 Glassbrenner (2012), at 26-39, 4349; NHTSA (2013b), at 2-3; NHTSA (2018), at 528.

493 PRIA at 1393-94.

494 *Id.* at 1394.

495 *Id.* at 1394-95.

496 *Id.* at 1381.

497 NHTSA (2013b), at 2-3.

498 PRIA at 1381-82.

499 *See* NHTSA (2013b), at 6

500 Ideally, we would like to control for other safety trends over time independent of vehicle design. Ideally, the agency could instead estimate $F_{it} = \beta_0 + \sum_{j=1}^{4} B_j * {Age_{it}}^j + \sum_{i=1976}^{2014} MY_i + \sum_{k=1}^{K} \mu_k * {Time_t}^k + \alpha X_{it} + \varepsilon_{it}$ where X_{it} would control for more detailed behavioral and environmental variables (discussed in the previous suggestion)

groups for which safety features do *not* change (i.e., between model redesigns) to break the link between calendar year, model year, and vehicle age[501]; this requires data at the vehicle model and body style level in addition to calendar year and model year.[502] The agencies should also consider running an age-period-cohort (APC) model as a sensitivity analysis, where model year is the cohort.[503] The agencies should also conduct a sensitivity analysis that replaces the age variable with a calendar year variable and use that specification if it improves model fit.

The agencies performed some plausibility checks on their results, but they are unconvincing. For example, the agencies compared their results with those of Glassbrenner, one of the authors who has conducted studies on the impact of vehicle design improvements and who has controlled for some of the confounding factors discussed above.[504] The agencies also compared their results with data from Kahane, who controlled for seatbelt usage.[505] The agencies claimed that it is "encouraging" that their approach and the Kahane and Glassbrenner approaches showed a "similar directional trend" in their results.[506] But the fact that the directional trend is similar does not address whether or not the agencies' approach ignores too many confounding variables to be at all reliable. Indeed, the agencies could be *vastly* inflating the change in fatalities and the directional trends could still go in the same direction. In fact, the agencies acknowledge that their analysis shows some significant divergence with the data provided by Kahane and attribute this difference to the fact that Kahane directly controls for seatbelt usage whereas their analysis does not.[507] Comparing the results with the Kahane and Glassbrenner results is thus not sufficient. The agencies should control for the confounding variables themselves, as described here, and provide the estimates to the public for comment. Any other strategy would lead to unreliable and inflated results.

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and the polynomial of time (i.e., calendar year or the year that the accident occurred in) would control for more generally for trends in environment and behavioral trends. However, panel data only allows an analyst to control for two of these three variables, as the calendar year equals vehicle age plus model year. Anderson and Searson (2015), at 203. A consequence of this technical problem in safety regressions is that analysts can only control for two out of the three variables using a standard regression analysis, such that the coefficients of the remaining variables (i.e., the age variable and the model year fixed effects) suffer from omitted variable bias. This situation is known as the classical age-period-cohort (APC) problem that arises in human health studies. *Id.*

[501] Farmer and Lund (2006), at 336.

[502] *Id.* at 335.

[503] *See* Anderson & Searson (2015), at 203-205 (discussing age-cohort models).

[504] PRIA at 1395-1396.

[505] *Id*. at 1396-1397.

[506] *Id*.

[507] PRIA at 1397.

Given the counterintuitive results shown above for vehicle age, the agencies should also expand the set of model fit tests. Specifically, they should compare the model results to Farmer and Lund (2015) and NHTSA (2013); the latter of which is an update of Glassbrenner by NHTSA.

3. **The agencies have not provided an adequate explanation for why past safety trends are likely to continue until the mid-2020s**

The agencies' estimates of safety trends lacks an adequate explanation. To evaluate the impact of turnover on safety, it is critical to understand the improvements in safety that would be obtained through more turnover as distinct from those that would be obtained regardless of fleet turnover. Specifically, the agencies must come up with an estimate or prediction about the safety improvements that would be missed with lower turnover. In the Proposed Rule, the agencies analyze the past safety trends and assume that the past trend in safety improvements will continue until the mid-2020s.[508]

But data on existing and past safety trends reflects improvements that are different in kind from the safety improvements that are expected between now and the mid-2020s, and so data on past trends is not a good basis for concluding that safety will continue to increase along the same trajectory through the mid-2020s.

The safety trend data reflects a number of improvements that were made to vehicles, which generally improve passenger safety if and when there is a crash. For example, the improvements that have been adopted over the past decade or so include, electronic stability controls,[509] side airbags,[510] and bumper alignment.[511] But to improve safety in the future, manufacturers will have to adopt more engineering changes that help vehicles *avoid* crashes, rather than focusing on mitigating them. Some potential technologies include forward collision warning; crash imminent braking; dynamic brake support; pedestrian automatic emergency breaking (PAEB); rear automatic breaking; semi-automatic headlamp beam switching; rear turn signal lamp color; lane departure warning; and blind spot detection.[512] Crash avoidance technology may not be adopted as easily or readily as crash mitigation technologies have been. In fact, the agencies acknowledge that the effectiveness of crash avoidance technologies and the pace of their adoption "are highly uncertain."[513] These future safety technologies differ from past safety technologies in a fundamental way. Should those new safety technologies be adopted, the predicted fatalities for

[508] 83 Fed. Reg. at 43,139.

[509] Wenzel (2013), at 71-81.

[510] *Id.* at Figure 3.

[511] *Id.* at Figure 4.

[512] *See* 83 Fed. Reg. at 43,139-40.

[513] *Id.* at 43,139.

all the older vehicle vintages will have to be lowered as well because effective crash avoidance technologies will lower all vehicles' fatality costs.

NHTSA should explain how its assumption that the trends will continue through the mid-2020s is valid.

VI. THE AGENCIES' CHOICE OF REBOUND EFFECT IS ARBITRARY AND CAPRICIOUS

Improved vehicle efficiency makes driving cheaper, and so encourages more driving. This is termed the "rebound effect."[514] Rebound is expressed in terms of the percentage of any fuel economy savings that will be lost once consumers act on those preferences for increased driving. That additional driving results in a number of costs (increased air pollution, fuel consumption, traffic congestion, and vehicle crashes), and benefits (additional consumer utility of driving, reduced time to refuel vehicles) and the agencies have previously considered these costs and benefits when setting their standards.[515] The agencies relied on a 10% rebound estimate in the Clean Car Standards. But now the agencies have arbitrarily doubled that estimate.[516]

To arrive that the new estimate, the agencies make significant changes to their assumptions about the magnitude of the rebound effect. These changes result in a significant increase in the costs and fatalities that the agencies attribute to the baseline standards.[517] These fatalities and costs serve as a justification for rolling back those standards.[518] These methodological changes account for 3,170, or 25 percent of the additional fatalities that the agencies ascribe to the baseline standards,[519] and 6.5-6.8 percent of the quantified net benefits that the agencies claim would be gained from rolling back the baseline standards.[520] But the agencies' methodological changes are inconsistent with the best available evidence regarding rebound. And the agencies have failed to provide a reasoned basis for their new rebound conclusions.

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[514] 77 Fed. Reg. at 62,924. More specifically, this is considered the "direct" rebound effect. While the academic literature also discusses an indirect rebound effect, *see* Gillingham et al. (2016), at 72, that effect has not been incorporated into the agencies' analysis and is not the subject of our comments on rebound.

[515] Draft TAR at 10-9 to 10-10-21; 77 Fed. Reg. at 62,716.

[516] *Compare* 77 Fed. Reg. at 62,716, 62,924 (10%) *with* 83 Fed. Reg. at 43,104 (20%).

[517] PRIA at 1546, 1548 (showing higher net benefits of roll back under agencies new rebound assumptions than under previous rebound assumptions).

[518] 83 Fed. Reg. at 43,211 (explaining that NHTSA considers increased emissions that result from additional driving due to the rebound effect); *id.* at 43,212 (explaining that NHTSA considers increased fatalities that result from additional driving due to the rebound effect); *id.* at 43,230 (explaining that EPA considers the level of GHG emission reductions, which is determined, in part, by increased driving due to rebound); *id.* at 43,231 (explaining that EPA considers additional fatalities that result from increased driving due to rebound).

[519] *Id*. at 43,153; see also PRIA at 1540.

[520] *Id*. at 1546, 1548.

A. Defining rebound

There are three different components of rebound with fuel efficiency regulations. First, fuel efficiency lowers the per mile cost of driving. As the activity costs less, consumers will do more of it compared to other things. This is called the "substitution effect." Second, as driving costs less, consumers can afford more of everything, including driving. This is called the "income effect." Third, the decrease in the cost of driving is enabled by fuel efficiency technology that could increase the cost of the vehicle.[521] So consumers who spend more money upfront on a fuel efficient vehicle will have less income to spend on other products, including driving. This "capital cost income effect" has a negative rebound effect by offsetting the income effect from fuel savings. These components of rebound should be analyzed using the following formula:

ΔVMT equals $\frac{\partial q^H}{\partial p}\Delta p + \frac{\partial q}{\partial I}(q\Delta p - C)$

Where:

- $\frac{\partial q^H}{\partial p}$ is the change in (Hicksian) demand for VMT from a price change,
- $\frac{\partial q_0}{\partial I}$ is the change in (Marshallian) demand for VMT from an income change,
- q is the demand for VMT,
- p is the cost per mile of driving, and
- C is the additional cost associated with acquiring the improved energy efficient vehicle.[522]

This definition includes the three independent effects on VMT from the purchasing of a vehicle:

- $\frac{\partial q^H}{\partial p}\Delta p$ measures the substitution (effect) towards more driving with a decrease in the cost of driving (from a more efficient vehicle);
- $\frac{\partial q}{\partial I}q\Delta p$ measures the increased demand for driving due to more money being in a household's pocket from a lower cost of driving;
- and $\frac{\partial q}{\partial I}C$ measures the decreased demand for driving due to less money being in a household's pocket from the capital cost of acquiring the vehicle.

B. The agencies arbitrarily changed their rebound estimates to 20% from the previous estimates of 10%

The agencies have proposed to use a rebound estimate of 20% after previously setting it at 10%.[523] But the agencies have failed to show that there are good reasons for their decision to

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[521] For more detail on this aspect of the formula, see Section II.

[522] Gillingham (2014b), at 11375-11378.

[523] 83 Fed. Reg. at 43,104.

reverse course in this way.[524] The agencies cite NHTSA's 2005-2011 CAFE standards to assert that they are merely returning to past practice in using a 20% rebound estimate.[525] But in doing so, they ignore 10 years of their own analyses, the advances in the academic literature, and expert conclusions regarding the appropriate rebound estimate. Since that 2005 rulemaking, the agencies have updated their analysis and they have not relied on that 20% rate. In 2010, the agencies used a 10% rebound estimate as part of the agencies' joint CAFE and GHG emission standards for MY2012-2016.[526] In 2012, in adopting the Clean Car Standards, the agencies again arrived at the conclusion that an estimate of 10% would best reflect the rebound expected for the baseline standards.[527] In 2016, in the Draft TAR, the agencies collectively updated their evaluation of the literature and proposed to reaffirm their conclusion that 10% was the appropriate rebound estimate.[528] In 2017, EPA finalized its portion of that proposal and found that the 10% rebound estimate was appropriate.[529] In fact, as far back as 2009, NHTSA determined that the literature did not support a 20% rebound estimate.[530]

All of the arguments that the agencies provide for reserving course on these prior analyses are unavailing. As such, the agencies have failed to satisfy their duty to provide a "reasoned explanation . . . for disregarding facts and circumstances that underlay or were engendered by the prior policy."[531]

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[524] Fox Television Stations, 556 U.S. at 515.

[525] 83 Fed. Reg. at 43,104 (explaining that the use of 20% "represents a return to the value employed in the analyses for MYs 2005-2011 CAFE standards").

[526] Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule, 75 Fed. Reg. 25,324, 25,516-516 (May 7, 2010) (explaining use of 10% estimate).

[527] 77 Fed. Reg. at 62,924.

[528] Draft TAR at 10-9 to 10-21.

[529] *See* Final Determination (concluding that the baseline standards were appropriate in light of the Draft TAR, Proposed Determination, Proposed Determination TSD, and public comments); EPA, Proposed Determination on the Appropriateness of the Model year 2025-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards under the Midterm Evaluation: Technical Support Document at 3-8 to 3-21 (2016), https://nepis.epa.gov/Exe/ZyPDF.cgi/P100Q3L4.PDF?Dockey=P100Q3L4.PDF [hereafter "Proposed Determination TSD"] (reconsidering rebound literature on rebound considered as part of Draft TAR and literature since Draft TAR to conclude 10% rebound estimate is appropriate).

[530] At that time, NHTSA used a 15% rebound rate when establishing the MY 2011-2015 CAFE standards, without EPA's involvement. NHTSA, Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks: Final Regulatory Impact Analysis at VIII-5 to VIII-8 (2009), https://www.nhtsa.gov/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/CAFE_Final_Rule_MY2011_FRIA.pdf (explaining why NHTSA selected a 15% rebound estimate); *id.* at I-47 to I-49 (explaining why the agency rejected a 20% rebound estimate advocated by some commenters).

[531] *Fox Television Stations*, 556 U.S. at 516.

1. The agencies point to no new evidence supporting a 20% rebound and, in fact, ignore new evidence on rebound that does not support the new 20% assumption

In order to support a 20% rebound estimate, the agencies primarily point to an average that they calculate from various rebound estimates in the academic literature and criticize their prior conclusions as inconsistent with those averages.[532]

As a preliminary matter, the data that the agencies discuss in the proposed rule has generally already been discussed and considered by the agencies in previous rulemakings in which they arrived at the 10% rebound estimate. And the agencies have not identified a meaningful change in the facts, which would justify the new estimate. Specifically, the table on pre-2008 studies that the agencies cite contains the same data that the agencies used to arrive at a different conclusion in 2012.[533] As is made clear in Table 3 below, derived from the various cited rules, virtually all of the post-2008 studies that the agencies now list and discuss were already considered when the agencies promulgated the Clean Car Standards and when they reaffirmed those standards as part of the Draft TAR and EPA's Final Determination. The agencies have not explained how they arrived at different factual conclusions using the same evidence.

[532] 83 Fed. Reg. at 43,100-101, 43,104, 43,105.

[533] NHTSA 2012 FRIA at 849 (TABLE VIII–1, presenting summary statistics on rebound estimates for pre-2008 studies).

Table 3. Post-2008 Rebound Studies Discussed or Considered as Part of Rulemaking and Analyses

	SAFE Proposed Rule[534]	Clean Car Standards[535]	TAR[536]	EPA Final Determination[537]
Small and Van Dender (2007)	X	X	X	X
Barla et al. (2009)	X		*	*
Bento (2009)	X		X	X
Waddud (2009)	X		X	X
Hymel et al. (2010)	X[538]	X	X	X
Gillingham (2011)		X	X	
West and Pickrell (2011)	X		X	
Anjovic and Haas	X			
Green (2012)	X (not discussed)	X	X	X
Su (2012)	X		X	X
Linn (2013)	X		X	X
Frondel and Vance (2013)	X		X	X
Liu (2014)	X		X	X
Gillingham (2014)	X		X	X
Wang and Chen (2014)				X
Weber and Farsi (2014)	X			
Hymel & Small (2015)	X		X	X
West et al. (2015)	X		X	X
DeBorger (2016)	X		X	X
Gillingham et al. (2016)			X	X
Stapleton et al. (2016, 2017)	X (only in PRIA[539])			
Italicized studies are studies that have been considered in previous agency analyses but that are not discussed in the Proposed Rule. **Bold** studies are studies considered in the Proposed Rule that have not been considered previously. * included in discussion of Gillingham (2016)				

[534] PRIA at 983-992.

[535] EPA & NHTSA, Joint Technical Support Document: Final Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards at 4-23 to 4-24 (2012) [hereafter "Clean Car Standards TSD"].

[536] Draft TAR at 10-9 to 10-19

[537] Proposed Determination TSD at 3-8 to 3-21.

[538] The agencies discuss Hymel et al. (2010) but do not include it in the list of studies they considered. *See* 83 Fed. Reg. at 43,103; PRIA at 983.

[539] *Id.* at 992.

As Table 3 shows, the Proposed Rule identifies three studies that the agencies did not previously consider: Anjovic and Haas (2012), Weber and Farsi (2014); and Stapleton et al. (2016; 2017).[540] But the agencies do not even purport to rely on these new studies as particularly relevant when selecting their rebound estimate.[541] And in any event, the new studies do not provide strong new support for the agencies' 20% rebound estimate. All three of the papers studied rebound outside the United States, which, as we explain in detail below, should receive relatively less weight. Moreover, Weber and Farsi (2014) used cross-sectional data (an analysis of rebound in only one year), which, as we also explain below, should also receive relatively less weight. Therefore, the only new evidence that the agencies considered does not support the change in position.

While the studies the agencies discuss in the proposed rule have previously been considered, the Proposed Rule inexplicably fails to discuss a number of studies that were previously considered. As demonstrated by the bolded studies in Table 3, the agencies fail to discuss, mention, or even list a number of studies that they previously considering in arriving at their 10% rebound estimate, including Gillingham (2011), Wang and Chen (2014), and Gillingham (2016). These latter two studies provided substantial support for the agencies' 2012 and 2016 decisions to use a 10% rebound estimate.[542] The agencies also fail to analyze Greene (2012), even though it is listed in a table in the PRIA.[543] That paper also provided strong support for the agencies' previous 10% rebound findings.[544] Ignoring these studies now is arbitrary and capricious.

As Table 3 helps illustrate, contrary to the agencies' claim,[545] they have not conducted a complete survey of the economic literature on the rebound effect with respect to vehicles. Many of the missing studies are high-quality studies that should inform the agencies' decisionmaking. Besides the studies that the agencies previously considered, the agencies also omit many of the recent papers on this topic, including a 2015 study by Ken Gillingham, A Jenn, and I.M

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[540] *See* 83 Fed. Reg. at 43,101.

[541] *See* PRIA at 992-994 (discussing the key studies the agencies use to select a rebound estimate without discussing any of these studies).

[542] Draft TAR at 10-19 to 10-20 (listing Gillingham (2016) in the "Basis for Rebound Effect Used in the Draft TAR" section); Proposed Determination TSD at 3-16, 3-19 (discussing Wang and Chen (2014) as the only new study since the Draft TAR, and relying on the fact that the study found *no* rebound effect for households other than low-income households as part of the "Basis for Rebound Effect Used in this Proposed Determination" discussion).

[543] PRIA at 983 (listing Green (2012) in Table 8-8 without any further discussion).

[544] Proposed Determination TSD at 3-12 to 3-13, 3-20 (stating that Greene (2012) "appears to support the theory that the magnitude of the rebound effect "is by now on the order of 10 percent" and discussing the study in the "Basis for Rebound Effect Used in this Proposed Determination" section); Draft TAR at 10-14, 10-20 (same).

[545] PRIA at 982 ("Table 8-8 summarizes estimates of the rebound effect reported in research that has become available since the agencies' original survey, which extended through 2008").

Azevedo,[546] and a 2018 paper by T.P. Wenzel and K.S. Fujita.[547] These estimates generally contain rebound estimates that are lower than 20% and the agencies should not ignore them.

In addition, a large number—32—of the studies identified in a recent meta-analysis of the rebound literature are missing from the agencies' analysis, including 14 US-based estimates.[548] Of these omitted estimates, Wang and Chen (2014) and Dillon et al. (2015) are particularly useful rebound studies because they provided estimates of U.S. rebound, estimated fuel efficiency rebound (which, as is described below is distinct from other less useful estimates of rebound that appear in the literature), and used methods that account for endogeneity.[549] These additional studies do not support the agencies' decision to reject the 10% estimate and adopt the 20% instead and the agencies should not ignore them either.

2. The Proposed Rule's criticisms of the 10% rebound estimate are not compelling

In defending their reinterpretation of the evidence, the agencies primarily argue that the basis for the 10% rebound estimate was limited to a 2007 study by Small and Van Dender, whose assumptions have not borne out.[550] Specifically, the agencies argue that the 10% estimate was justified only if income increases are as assumed in that paper, and according to the agencies, follow-up analyses by Hymel et al. (2010) and Hymel and Small (2015), found a weaker relationship between rebound and income and produced higher rebound estimates as a result.[551] But this argument is wrong for several reasons.

First, the agencies are incorrect that the single Small and Van Dender (2007) study formed the only basis for their prior conclusion that rebound falls as incomes rise and that a 10% estimate was appropriate. In their 2012 Clean Car Standards, the agencies also cited to a wider range of academic literature, including Greene (2007), and Hymel et al. (2010), to support the specific claim that rebound will decline over time due to increases in income.[552] The agencies reaffirmed this claim in 2016 and cited several high quality and more recent academic studies, including Wadud et al. (2009), Green (2012), Gillingham (2014), and Hymel and Small (2015).[553] In the

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[546] Gillingham et al. (2015).

[547] Wenzel & Fujita (2018).

[548] *Compare* Dimitropoulos et al. (2018), at 173 (identifying 45 studies, including 21 studies of the U.S.) *with* PRIA at 983 (identifying 16 studies, including 10 studies of the U.S. included in Dimitropoulos et al. (2018) and 3 studies of the U.S. that are not included in Dimitropoulos et al. (2018)).

[549] Dillon et al. (2015); Wang & Chen (2014). Note, however, that both studies omit capital costs and are cross-sectional estimates; the latter study provides only short-run estimates. *See* Dimitropoulos et al. (2018), Appendix D.

[550] 83 Fed. Reg. at 43,104-105; PRIA at 989.

[551] 77 Fed. Reg. at 62,924 (discussing academic literature supporting a rebound rate that declines over time)

[552] 77 Fed. Reg. at 62,924 (citing Greene (2007), and Hymel et al. (2010)).

[553] Proposed Determination TSD at 3-20 ("Wadud et al. (2009) and Gillingham (2014) find that household and individual-vehicle rebound increases, respectively, with increases in household income"); Draft TAR at 10-20

2016 analyses, the agencies also cited a 2016 peer-reviewed assessment of the rebound literature by Ken Gillingham and coauthors.[554] The Gillingham paper developed selection criteria for identifying the most reliable studies, and selected only two studies of US rebound effect as meeting the criteria.[555] Both of these studies arrived at rebound estimates below 10%.[556] All of these papers supported the previous conclusion that rebound falls with income. Ignoring all of this support for the 2012 and 2016 determinations is arbitrary and capricious.

Second, the agencies now point to a handful of studies that they had already considered, including Hymel et al. (2010), Hymel and Small (2015), and claim those studies undermine the agencies' previous conclusions about the relationship between income and rebound and the 10% estimate.[557] The agencies fail to acknowledge that they previously used these very studies to *support* the income effect, as described above. Moreover, while some of the rebound estimates presented in those studies are higher than those found in Small and Van Dender (2007), those higher estimates do not undermine the 10% estimate for several reasons.[558] For example, the 18% estimate in Hymel and Small (2015) that the agencies now rely on was produced using a deliberately simplified model, which the agencies previously concluded is more relevant for estimating rebound from changes in fuel prices than rebound from changes in fuel efficiency.[559] In any event, using more sophisticated modeling, the Hymel and Small (2015) paper found a 4.0%-4.2% rebound estimate, which the authors found to be more representative than the 18% rebound estimate cited by the agencies.[560] As such, that paper recognizes that the 18% estimate may not be accurate. In addition, Hymel and Small (2015) studied a time period that included the

("Greene [2012] reports evidence that the magnitude of the rebound effect is likely to be declining over time as household incomes rise which would be consistent with Gillingham's (2014) results showing that individual-vehicle rebound increases with household income").

[554] Draft TAR at 10-20; Proposed Determination TSD at 3-20.

[555] Gillingham (2016), at 75 (Table 1). Of the 8 studies cited, the only two estimates for the U.S. are below 10% (focusing on the data for the more recent time period from Hughes et al. (2008). The four state estimates average to 13%. *Id.*

[556] Gillingham (2016) at 75. Gillingham also lists estimates from U.S. states, which average to 13%. *Id.*

[557] *See* 83 Fed. Reg. at 43,105.

[558] Draft TAR at 10-17 ("these influences are small enough in magnitude that they do not fully offset the downward trend in VMT response elasticities due to higher incomes and other factors. Hence, even assuming that the variables retain their 2003–2009 values into the indefinite future, they would not prevent a further diminishing of the magnitude of the rebound effect if incomes continue to grow at anything like historic rates").

[559] Draft TAR at 10-17 (explaining that the Hymel and Small conclusions are "important to understand the rebound effect based upon fuel prices, they may not be as relevant to the rebound effect due to fuel efficiency").

[560] Hymel and Small (2015), at 98 ("The results for our preferred specification, labeled Model 3, are summarized in Table 3"); *id.* at 103 (Table 8, presenting US 2000-2009 average fuel efficiency elasticity under more sophisticated Models 3 and 5 of -0.042 and -0.040). The confusion over their preferred estimate likely arises because they refer to model 1 as their "base specification" and "base model" as it similar to the model estimated in Small and Van Dender (2007).

2008 recession, which the authors characterizes as a period of "turmoil in energy markets;" the authors noted that the financial crisis biased their estimates upwards.[561] The agencies have elsewhere criticized data based on this time period as non-representative.[562] And the papers still found a significant income effect and found that the rebound effect declines with income increases, which confirms rather than undermines the findings of Small and Van Dender (2007).[563] As Professor Kenneth Small, one of the authors of Small and Van Dender (2007), Hymel et al. (2010), and Hymel and Small (2015), has explained in a letter to the agencies,[564] the agencies mischaracterize the conclusions of these papers; due to expected future changes in income and other factors, Small states that the best estimate of the type of rebound at issue in the Proposed Rule is *substantially* lower than even the agencies' previous 10% estimate: 0.2% in 2025.[565]

The agencies also point to the recent study from DeBorger et al. (2016), as evidence that the income effect in Small and Van Dender was overstated.[566] But that study, according to its authors, lacked sufficient data to robustly test for the existence of the income effect, and called for additional testing of their results with respect to the income effect.[567] Even then, like Small and Van Dender (2007), the study found a negative income effect (though it is statistically insignificant). [568] Moreover, the study was based in Holland which differs considerably from the

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561 PRIA at 993-994 (citing Hymel and Small (2015), at 94 (discussing weakness of studies of driving during the "most significant recession since the 1930s, accompanied by turmoil in housing markets including foreclosures requiring many people to move"); Hymel and Small (2015), at 93 ("We also estimated Model 2 omitting years 2008 and 2009, in order to evaluate the effect of the financial crisis on the rebound effect. This change decreases the rebound effect through changes in pm, pm2, and pm ∗ inc. The short run rebound effect falls by about 1 percentage point and the long run rebound effect falls by about 8 percentage points, relative to the version of Model 2 that includes years 2008 and 2009. One would expect that drivers would be more sensitive to driving costs following the financial crisis, and our estimation bears that out… The estimates from a version of Model 1 without years 2008 and 2009 also yielded smaller rebound effect estimates compared to the 1966–2009 version.").

562 83 Fed. Reg. at 43,089; PRIA at 966.

563 Hymel and Small (2015), at 102-103 ("Furthermore, we confirm earlier findings that the rebound effect became substantially smaller in magnitude over the course of that time period, probably due to a combination of higher real incomes, lower real fuel costs, and higher urbanization").

564 Letter from Dr. Kenneth Small, Docket No. EPA-HQ-OAR-2018-0283 and Docket No. NHTSA-2018-0067 (Sept. 14, 2018), https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-2698; *see also* Hymel et al. (2010) (estimating rebound of 13% in 2004); Hymel and Small (2015) (estimating rebound of 18% during 200-2009 period).

565 Letter from Dr. Kenneth Small at 2, Docket No. EPA-HQ-OAR-2018-0283 and Docket No. NHTSA-2018-0067 (Sept. 14, 2018), https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-2698.

566 PRIA at 983.

567 DeBorger et al. (2016), at 13 (emphasizing that their result "has to be corroborated by other studies").

568 The study found a statistically insignificant relationship between income and rebound, the direction of that impact was still negative. *Id* ("Although we use panel data, the number of MOT-tests observed in a 10-year period is too small to carry out a panel data analysis of the impact of changes in income on the coefficients for fuel price and

U.S., and should be given considerably less weight on this issue than Small and Van Dender (2007), Hymel et al. (2010), and Hymel and Small (2015). As such, that study does not support the agencies' proposed conclusions.[569]

Third, the agencies' argument that the slowdown in income from the levels expected in 2012 undermines the prior 10% estimate is incorrect. The relevant time-period for estimating income growth and rebound is the period during which consumers will be using vehicles subject to the baseline standards: 2020 to 2050, not the earlier time periods discussed in Small and Van Dender (2007) and Hymel and Small (2015). At this time, the agencies expect GPD per capita to be substantially higher during the 2020 to 2050 period than the 2000s.[570] Pointing to the fact that income grew at a slower rate than expected in the 2007 paper does not undermine the agencies' conclusions in issuing the Clean Car Standards that over the 2020-2050 period, income will be sufficiently high to support a 10% rebound estimate.[571]

Fourth, the agencies provide an unsupported assertion that rebound may *increase* as income increases because increases in income will allow consumers to own multiple cars, which will then be driven more. The agencies argue that higher income families have multiple vehicles and cite to "some studies," which they do not identify, that find that households with multiple vehicles have higher rebound.[572] In fact, a systematic analysis of studies suggests that the rebound effect is *smaller* for households with multiple vehicles.[573] The Proposed Rule's analysis on this point conveniently ignores the Wang and Chen (2014) study, which found that the rebound effect is only significant for households making $25,000 or less—an important insight that should be taken into account in rebound assessments.[574]

As these papers all show, the relationship between rising incomes and lower rebound is strongly supported. The literature indicates that the rebound effect should decline with rising income for

fuel efficiency in our demand equation. However, what we can do is carry out a cross-sectional analysis and analyze whether the sensitivity of kilometre demand for changes in the fuel price and in fuel efficiency depend on a household's place in the income distribution…The point estimates also seem to suggest that the sensitivity of demand to changes in fuel efficiency declines with income. However, the interaction term of the fuel efficiency variable with income is not significant at the usual significance levels, and we are unable to reject the hypothesis that the size of the rebound effect is independent of a household's position in the income distribution").

569 PRIA at 989 n. 528.

570 *Id.* at 993.

571 *Id.* at 982 ("income growth that had been anticipated to erode the value of the rebound effect had not materialized").

572 *Id.* at 989.

573 Dimitropoulos (2018), at 170-171.

574 Proposed Determination TSD at 3-16 (Wang and Chen (2014) "find that the rebound effect is only significant for the lowest income households (up to $25,000)").

two reasons.[575] First, as incomes rise, the rebound income effect diminishes because household demand for vehicle travel is closer to saturation levels. In particular, high-income families will feel less of a budget constraint (i.e., they are consuming all goods, including driving, nearer to or at their optimal level).[576] Second, as incomes rise, the opportunity cost of spending time in a vehicle increases. As time costs increase relative to energy costs, the relative importance of energy costs should decline, and drivers should limit the extent to which fuel efficiency will increase driving.[577] This effect is magnified by the fact that as income and driving increase over time, congestion will also increase. This will require drivers to spend more time in their vehicles and limit the extent to which drivers respond to lower prices with more driving.[578]

A few additional details support a lower rebound estimate as income increases. For example, there is evidence in the literature regarding rebound and energy efficiency outside of the passenger vehicle sector, which shows that rebound declines with income.[579] This includes studies of rebound related to residential energy use from greater adoption of efficient appliances such as refrigerators, air conditioners, and solar lanterns. Studies that compare rebound across countries also provide empirical support for the agencies' prior conclusions that the rebound effect declines as income rises.[580] In addition, because congestion can have a moderating effect on rebound, the agencies should model the impact that expected increases in congestion will have on rebound during 2020-2050.[581] Finally, high-quality academic literature that the agencies have failed to consider provides independent support for the prior 10% rebound estimate. In particular, in a 2009 literature review of the direct rebound effect in multiple sectors, Steve Sorrell and coauthors conclude that long-run rebound is between 10% to 30%, with the best estimate closer to 10%.[582]

For all of these reasons, EPA was correct to note during the interagency review process that NHTSA's own analysis and the literature indicate that the rebound effect is expected to decline

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[575] Sorrell et al. (2009), at 1357, 1360 n. 8; Dimitropoulos et al. (2018), at 171.

[576] *Id.* at 1357.

[577] *Id.* at 1366 n. 8.

[578] *See* Hymel et al. (2010) at 1221.

[579] Azevedo (2014), at 411-12 (identifying studies that show that the rebound effect of home energy use varies by income).

[580] *See* Dimitropoulos et al. (2018), at 172.

[581] The agencies should also take into account the relationship between income, congestion, and VMT when developing VMT schedules. *See* Section V.A.2.

[582] Sorrell et al. (2009) at 1360; *id.* at 1361 ("Moreover, most studies assume that the response to a change in fuel prices is equal in size to the response to a change in fuel efficiency, but opposite in sign . . . Few studies test this assumption explicitly and those that do are either unable to reject the hypothesis that the two elasticities are equal in magnitude, or find that the fuel-efficiency is less than the fuel cost per kilometer elasticity . . . The implication is that the direct rebound effect may lie towards the lower end of the above range (i.e., around 10%).")

over time as income rises.[583] As this section demonstrates, the literature does not support the agencies' proposal to abandon the 10% rebound estimate that they previously adopted.

C. The agencies' approach led them to estimate an inflated rebound effect

The agencies have adopted a methodology that uses the average of the estimates of rebound that they have collected.[584] However, using averages is a disfavored approach for a number of reasons. The averaging approach does not address the disparity in precision and quality of the estimates that are part of the average. It does not account for the pertinence of specific estimates to the particular policy context. And it does not address the fact that multiple studies have overlapping samples, overlapping authors, or overlapping methods. Using an averaging method here was inappropriate because the estimates of rebound presented in the academic literature are not equally valid estimates of rebound and are not equally relevant to the question the agencies investigate here. As such, as described further below, a simple average does not lead to a reliable estimate.

The agencies should more proactively evaluate rebound estimates based on selection criteria. In the alternative, the agencies should conduct a sophisticated meta-analysis of the existing rebound literature to arrive at the best estimate, consistent with EPA's guidelines for reaching conclusions using multiple studies. In either case, a rebound estimate of 20% would not be supported.

1. The simple average that the agencies use to calculate the rebound effect in the Proposed Rule is unreliable and produces improperly inflated estimates

Instead of considering all available studies equally, the agencies should consider only those estimates of rebound that are predictive of the kind of rebound at issue here or should give non-preferred studies only partial weight. Many of the studies that the agencies include in their average do not meet the below requirements for full weight or inclusion. That error renders the agencies' conclusions arbitrary and capricious.

In summary, the best estimates include:

- Measures of the driving changes due to changes in fuel efficiency, rather than measures of how driving changes as fuel price changes or that measure how fuel consumption changes as fuel price changes.
- U.S.-based national studies rather than studies of rebound in other countries or within single U.S. states.
- Measures that best reflect the time period of the analysis (i.e., 2020-2050), including studies that use more recent data (i.e., measures conducted after the 2008 recession).

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[583] EPA, *Comments on NPRM and Preliminary RIA sent to OMB,* at 1659 (July 26, 2018) (explaining that literature and NHTSA's previous findings reported "persuasive evidence that the magnitude of the rebound effect is likely to be declining over time").

[584] 83 Fed. Reg. at 43,100 (finding that the average values of pre-2008 studies to be 22-23%); *id.* at 43,105 (discussing 10%-40% average rebound of post-2008 studies); PRIA at 993.

- Studies with high quality identification strategies, including those that account for the endogeneity of fuel efficiency.
- Measures that include data from multiple years (i.e., panel methods) or that apply an experimental/quasi-experimental approach and that are internally valid.
- Short-run and medium run estimates of rebound because long-run estimates suffer from identification problems.[585]

The most important categories of rebound estimates are discussed in turn. The agencies should follow these guidelines.

a.) *The agencies should consider estimates of fuel efficiency rebound rather than other proxy estimates of rebound*

There are four types of econometric estimates of the rebound effect in the academic literature, some of which are better than others for estimating the rebound rate of fuel efficiency or emissions standards.[586]

The agencies should give the most weight to estimates of the elasticity of distance traveled with respect to fuel efficiency, as this is the directly relevant estimate. For this reason, in a recent meta-analysis of rebound estimates in the literature, Dimitropoulos and coauthors explained that "the elasticity of travel demand with respect to fuel efficiency should be preferred to other measures whenever this is possible."[587]

- **Fuel efficiency rebound**. The most relevant rebound estimate for the purposes of the Proposed Rule is the extent to which driving changes due to changes in fuel efficiency—called the "elasticity of distance travelled with respect to fuel efficiency" or "fuel efficiency rebound." The agencies have previously acknowledged that estimates of fuel efficiency rebound are the most directly relevant measures for the purpose of estimating the effect of the baseline standards.[588]
- **CPM rebound**. When fuel efficiency rebound cannot be measured, the next closest proxy estimate would be to measure the extent to which driving changes as the cost per mile (CPM) of driving decreases—called the "elasticity of distance traveled with respect to the cost of driving" or "CPM rebound." The cost of driving includes fuel costs per mile (fuel price divided by fuel efficiency), but could also include other costs such as depreciation. However, its estimation raises several concerns, in particular because measures of CPM rebound diverge from measures of fuel efficiency rebound for a number of behavioral economic

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[585] Gillingham et al. (2016), at 74-75.

[586] Sorrel et al., (2009), at 1358-1360; Dimitropoulos et al., (2018) at 164.

[587] Dimitropoulos et al. (2018), at 196.

[588] NHTSA 2012 FRIA at 847 ("ideally, the rebound effects measured directly by estimating the change in vehicle use, during some time period that results from a change in vehicle fuel efficient").

reasons. Changes in CPM, and particularly changes in gasoline prices, are highly salient and so have more influence on consumer behavior than fuel efficiency changes.[589] In addition, many of the recent studies that measure the change in cost of driving have been measures of consumer response to fuel price *increases*, but consumers tend to be more responsive to price increases than decreases[590] and because fuel efficiency acts like a price *decrease*, studies that measure rebound based on price increases may overestimate fuel efficiency rebound. The Dimitropoulos meta-analysis found that the elasticity of driving with respect to fuel efficiency is significantly lower than the elasticity of driving with respect to fuel costs and fuel price.[591] In addition, changes in fuel price can change the cost of driving for both new and used vehicles. Studies of CPM rebound often use data on the change in driving behavior of both new and used vehicles. Yet, the change in driving by newer vehicles is less responsive than the change in driving by older vehicles for a given fuel efficiency increase.[592] Therefore, by including used vehicles, studies of CPM rebound will be an overestimate of fuel efficiency rebound. Finally, in a large portion of the studies of CPM rebound, the methods used to measure rebound have been flawed and have biased estimates upward.[593] When costs of driving increase (such as due to a gasoline price hike), consumers are more likely to buy a more fuel efficient vehicle. However, the type of consumer that is likely to buy a fuel efficient vehicle when prices increase is also likely to be the type to benefit most from a fuel efficient vehicle (i.e., they have a long commute).[594] A large portion of studies of CPM rebound do not account for this relationship (such as by controlling for the endogeneity of fuel-efficiency), and so effectively assume that these interactions do not occur. This causes an overestimate of CPM rebound and therefore, when used as a proxy for fuel efficiency rebound, causes the rebound rate to be inflated.

- **Fuel price rebound.** A subset of the cost of driving, fuel price, introduces a third estimate of rebound: the extent to which driving changes due to changes in fuel price— the "elasticity of distance travelled with respect to fuel price" or "fuel price rebound."[595] Fuel price is a component of the cost of driving and so fuel price rebound is a poor proxy for fuel efficiency rebound for the same reasons that CPM rebound is a poor proxy. But fuel price rebound is

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[589] Gillingham et al. (2016), at 74; Azevedo (2014), at 409. Some economists argue that the elasticity of distance traveled with respect to fuel efficiency should be higher than elasticity of distance traveled with respect to cost of driving due to its permanence relative to the fleeting nature of price changes. Tierney & Hibbard (2018), at 14. However, empirical evidence does not support this finding, as discussed later.

[590] Tierney & Hibbard (2018), at 15.

[591] Dimitropoulos et al. (2018), at 169-170.

[592] Gillingham et al. (2015), at S49.

[593] Small and Van Dender (2007), at 27.

[594] *Id.*

[595] Dimitropoulos et al. (2018), at 164.

also an overestimate for an additional reason: fuel price rebound considers only reductions in the fuel-related costs of driving, whereas fuel efficiency involves reduction in the cost of driving but also includes the increased cost of purchasing a more fuel efficient vehicle.[596] Studies of fuel price rebound do not take into account the capital cost income effect, which has a moderating effect on rebound. So, when used as a proxy for fuel efficiency rebound, fuel price driving will cause estimates to be inflated.[597]

- **Fuel consumption rebound.** The least useful measure of the rebound effect caused by fuel efficiency changes comes from estimates of the extent to which fuel *consumption* changes as fuel price changes—the "elasticity of fuel consumption with respect to fuel price" or "fuel consumption rebound." This type of estimate does not directly measure changes in driving. And academic studies have shown that changes in fuel consumption will always produce higher rebound estimates than changes in fuel efficiency will in a real world setting (i.e., when fuel efficiency is endogenous), and so this rebound estimate serves as an upper bound when used as a proxy for the rebound effect.[598] This has led some academics to ignore this latter group of estimates when trying to estimate the relationship between fuel efficiency and driving.[599]

Given that fuel efficiency rebound is the effect that the agencies are trying to measure, and given the lack of evidence that the other measures are equivalent, the agencies should focus primarily, if not exclusively, on studies that measure fuel efficiency rebound.

b.) *The agencies should take care in selecting studies to avoid features that would improperly inflate the estimates*

In addition, there are several features that could make fuel-efficiency rebound studies unreliable. The agencies need to consider these issues as well in selecting which studies to include:

Estimates of rebound that incorporate capital costs. The agencies should prefer elasticity estimates that account for the capital cost of the new vehicles. Because high capital costs reduce rebound by reducing consumers' income available to purchase other goods, such as driving (the "capital cost income effect"), analyses that omit capital costs will yield inflated estimates of

596 Gillingham et al. (2016), at 69. Cost of driving rebound may also suffer from this problem to the extent that the cost of driving parameter fails to include an estimate of vehicle capital costs.

597 Dimitropoulos et al. (2018), Appendix D; Gillingham et al. (2016), at 68-69. Note however that a handful of studies of the elasticity of driving with respect to fuel price control for the capital cost and so would not suffer from this error. However, this still constitutes a minority of studies. Of the 1,142 rebound estimates in the Dimitropoulos et al. (2018) dataset, 236 estimates account for capital costs.

598 Sorrel et al., (2009), at 1359 n. 6; Sorrel and Dimitropoulos (2008), at 16-18.

599 Dimitropoulos et al. (2018), at 165.

rebound.[600] Only 14% of the studies on which the agencies relied account for capital costs,[601] we should expect this to bias a simple average upwards.

Estimates of rebound in the United States. U.S.-based estimates are far more relevant than foreign estimates for measuring the effects of a policy that would change the cost of driving for U.S. drivers. It is not merely that U.S. drivers and foreign drivers are culturally different. Rather, the U.S. differs substantially from other regions in terms of the price of gasoline, the density of the population, and income levels; each of which has been shown in various studies to affect the rebound effect.[602] The U.S. has characteristics that are generally associated with lower rebound in the academic literature: higher incomes, lower population densities, and lower fuel prices.[603] Many countries that are the subject of rebound studies—generally European countries—have higher income, population density, and fuel prices. Therefore, taking an average of both U.S. and foreign estimates will inflate the estimate of rebound that will occur in the U.S. In addition, studies at the national-scale are more relevant than studies of various states and subregions, as the latter only capture subsets of the relevant population. Because state studies are more likely to use reliable data sources such as odometer readings, state level studies should not be ignored. However, in developing a methodology to weight studies, the agencies should take into account the divergent characteristics of the state studied. Only 56% of estimates in the agencies' analysis are for the United States,[604] so we should expect the use of these estimates to bias a simple average upwards.

Estimates of rebound that will occur in 2020-2050. As discussed above, rebound is relevant in the context of the Proposed Rule only to the extent that improved fuel efficiency increases driving during the 2020-2050 period. The agencies should therefore use studies that can project the rebound effect of the 2020-2050 timeframe rather than assume that estimates of historic rebound can be directly applied to the baseline standards. More recent studies that look at more recent data will be more applicable than older studies. In other words, more recent studies are better predictors of future rebound because "behavioral responses are contingent upon technical, institutional, policy and demographic factors that vary widely between groups and over time."[605]

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[600] Dimitropoulos et al. (2018) at 171.

[601] *See id.*, Appendix D (listing studies). Dimitropoulos excluded three estimates that contain this feature: Waddud (2009), West and Pickrell (2011), and West et al. (2015).

[602] Dimitropoulos et al. (2018) at 172; EPA (2018), at 31; Gillingham et al. (2016), at 75.

[603] Dimitropoulos et al. (2018), at 171.

[604] *See id.*, Appendix D (listing studies). Specifically, the following recent studies use data from outside of the United States: De Borger (2016) (Denmark); Barla (2009) (Canada); Frondel and Vance (2012); Anajovic and Haas (2012); Weber and Farsi (2014); and Stapleton (2016, 2017). This other estimates using date from outside of the United States were not included in Dimitropoulos et al. (2018): Waddud (2009), West and Pickrell (2011), and West et al. (2015).

[605] Sorrel et al. (2009), at 1359.

In the Clean Car Standards, the agencies noted that "[w]hile some older studies provide valuable information on the potential magnitude of the rebound effect, those that include more recent information may provide more reliable estimates of how this rule will affect future driving behavior."[606] Now the agencies rely on many older studies, including a number of studies prior to 2008 when income was depressed, in calculating average rebound effects.[607] This reliance on older studies using data on older vehicles biases the estimate upwards.[608]

Studies using strong statistical methods and data. The agencies should only rely on, or should more heavily weight, studies with a strong statistical and methodological basis and reliable data.[609] Most importantly, reliable studies account for the fact that fuel efficiency is correlated with other attributes (that is, fuel efficiency is endogenous).[610] There is evidence that more fuel-efficient vehicles have a lower rebound effect.[611] Energy efficiency may be correlated with other vehicle attributes,[612] household attributes, and time; some of which are unobservable.[613] As such, the agencies should place greater weight on studies that address this endogeneity, usually using instrumental variables or simultaneous equations.[614] Failure to account for endogeneity means that the study is unable to disentangle to what extent VMT is rising because of fuel efficiency and to what extent it has risen due to changes in other factors (including reverse causality). In other words, studies that do not address issues with endogeneity may overstate the extent to

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606 NHTSA 2012 RIA at 848.

607 PRIA at 981 (Table 8-7).

608 Dimitropoulos et al. (2018), at 171.

609 Gillingham et al. (2016), at 74.

610 *Id.*; Small and Van Dender (2007), at 30; Sorrell et al. (2009), at 1363.

611 Gillingham et al. (2015), at 549.

612 Sorrell et al. (2009), at 1357; Gillingham et al. (2016), at 69.

613 Sorrell et al. (2009), at 1358.

614 The net effect of these trends is unclear. Dimitropoulos et al., (2018), at 171. GDP increases over time and will decrease the rebound effect. Congestion and density tend to increase over time and increasing congestion will decrease rebound, Hymel et al. (2010), while increased density has been shown to increase the rebound effect. As such, the agencies should also include a density adjustment to their VMT schedules to control for density. Similarly, the future direction of gasoline prices is relatively uncertain. The U.S. Energy Information Agency generally assumes a long-run upward trend in gasoline prices, which implies a higher rebound effect. But as with density, this suggests a need to adjust VMT schedules.

which fuel efficiency is the cause of extra VMT.[615] Only 28% of estimates in the agencies' analysis account for endogeneity,[616] and we should expect this to bias a simple average upwards.

Additionally, some estimation strategies are preferred to others. For example, cross-sectional studies should be given less weight (or dropped altogether) as they: disagree over appropriate specification;[617] suffer from omitted variable bias making them unreliable;[618] and are only as representative as the year the data was taken.[619] Time-series data may not be as reliable due to the fact that a limited number of data points are available.[620] Academic economists also disagree about how to properly construct models using this data.[621] These econometric issues led one careful survey of the literature to conclude that "estimates from many econometric studies appear vulnerable to bias, likely leading to an inflated estimate. The most likely effect of the latter is to lead the direct rebound effect to be overestimated."[622] Panel methods and experimental designs should be treated as preferred methodologies.[623]

Studies that use odometer data at the vehicle or household level are the most reliable. This is particularly the case because some micro-economic data are known to be problematic. For example, many cross-sectional microeconomic studies use data from the 2009 NHTSA household survey. Those estimates "should be interpreted with caution" since they present rebound estimates that range from 0% to 87% using identical datasets.[624] The 2009 NHTSA dataset is also problematic because it includes data from 2009, a highly non-representative year,

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615 Small and Van Dender (2007), at 40; Dimitropoulos et al. (2018), at 172 & n. 23. Note that there is some evidence pointing to downward bias as well. *See* Small and Van Dender (2007), at 30. A meta-analysis by Dimitropoulos finds some downward bias. Dimitropoulos et al., (2018), at 172 & n. 23. However multi-collinearity raises questions about how to accurately interpret this result. The direction of the bias is not completely unclear.

616 *See* Dimitropoulos et al. (2018), Appendix D (listing studies with this feature). Specifically, the following studies have this feature: West and Pickrell (2011), Su (2012), Linn (2013), Liu et. al (2014), Gillingham (2014), and West et. al. (2015). Dimitroupoulos excluded three estimates with this feature: Waddud (2009), West and Pickrell (2011), and West et al. (2015).

617 Sorrell et al. (2009), at 1360.

618 Gillingham et al. (2016), at 73-74.

619 83 Fed. Reg. at 43,089; PRIA at 966.

620 Sorrel et al. (2009), at 1360.

621 *Id.* (identifying disagreement regarding appropriate specification with respect serial correlation and lagged dependent variables).

622 *Id.* at 1364. *But see* Dimitropoulos et al. (2018), at 169 (finding some evidence of negative bias).

623 Gillingham et al., (2016), at 74 (recommending quasi-experimental approaches); *but see* Sorrel et al. (2009), at 1364 ("The methodological quality of many quasi-experimental studies is poor, while the estimates from many econometric studies appear vulnerable to bias. The most likely effect of the latter is to lead the direct rebound effect to be overestimated"). Advances in experimental design may explain some of the difference between Gillingham et al.'s 2016 conclusions and Sorrel et al.'s earlier conclusions.

624 Sorrel et al. (2009), at 1360.

relies on self-reported odometer readings and has a poor sample size.[625] Alternatively, studies that rely on more aggregated data on travel demand can have significant measurement errors.[626] As shown in Table 4, 44% of the studies in the agencies' analysis are cross-sectional, of which 86% are based on the problematic NHTSA household surveys.

Medium-run elasticity estimates are more reliable. Academic studies of rebound often include different estimates for different timeframes, including rebound over the short-run, over the medium-run, and over the long-run. Generally, these estimates find that the rebound effect increases over time (i.e., driving is less elastic in the short-run than in the long-run) because households have more opportunities to take action that results in more driving over time (e.g., taking a new job further from home).[627] Currently, NHTSA relies exclusively on long-run estimates.

The agencies need to take a dynamic approach to rebound instead of disregarding short and medium-run estimates as in the current approach. Not only is the current approach incorrect but it is also inconsistent with the agencies' approach elsewhere. For instance, the agencies' scrappage model employs lagged variables that capture the shifts in behavior from short- to long-run.[628] At the very least, the agencies should incorporate the movement from short-run rebound effects to long-run rebound effects on VMT rather than apply a single rebound estimate to all vehicles in all years.

In addition, long-run rebound estimates do not have a strong statistical and methodological basis.[629] In an analysis of the rebound effect and related academic literature, which the agencies have inexplicably failed to consider, Ken Gillingham and coauthors note that

> Long-run elasticities are harder to estimate credibly and thus harder to come by. All [reliable studies also] provide either short-run or medium-run estimates. . . . . [W]e believe that short-run and medium-run estimates are more reliable.[630]

The agencies should consider reducing their reliance on long-run estimates by substituting them with the medium-run estimates available in the literature, by including both long-run and medium-run estimates, or by carefully selecting only those long-run estimates that were developed using methodologies that address the concerns identified above.

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625 83 Fed. Reg. at 43,089; PRIA at 966.

626 Dimitropoulos et al. (2018), at 165 & n. 6.

627 Gillingham et al. (2016), at 74.

628 PRIA at 1044 (showing lagged variables in the scrappage model).

629 Gillingham et al. (2016), at 74.

630 Gillingham et al. (2016), at 74.

The agencies have ignored many relevant and recent studies of rebound in the academic literature and relied on several studies that contain problematic and non-representative data and findings, as summarized in Table 4. And the studies that they include in their calculations of average rebound estimates largely fail to meet the criteria of reliable and predictive estimates for the type of rebound at issue in the Proposed Rule. Moreover, these lower quality estimates tend to be biased in one direction: upwards.[631] As a result, the agencies' conclusions regarding the appropriate rebound estimate of 20% are, inappropriately biased upwards.

[631] Upward biases result from including studies that: estimate elasticities of VMT demand and fuel consumption with respect to driving cost and fuel price, forget capital costs, use data from non-US countries, and estimate the long-run effect. Other quality issues have an unclear effect. No approach that the agencies use clearly biases estimates downwards.

Table 4. Disfavored Features in the Post-2008 Rebound Studies Considered by Agencies[632]

Authors (Date)	Non-preferred rebound estimate [a]	Omitted Capital Costs[b]	Non-US Data	Non-representative period[c]	Ignores endogeneity[d]	Not panel data	2009 NHTSA Survey
Barla et al. (2009)	✓		✓		*		
Bento (2009)	✓				✓	✓	
Wadud (2009)	✓	✓		✓	✓	✓	
West and Pickrell (2011)	*	✓			✓	✓	✓
Anjovic and Haas (2012)	✓	✓	✓	✓	✓	✓	
Su (2012)	✓	✓			✓	✓	✓
Greene (2012)	*	✓		✓	✓	✓	
Linn (2013)	*	✓			*	✓	✓
Frondel and Vance (2013)	*	✓	✓		*		
Liu (2014)	*	✓				✓	✓
Gillingham (2014)	X	✓	State-level		*		
Weber and Farsi (2014)		✓	✓		*	✓	
Hymel & Small (2015)	✓						
West et al. (2015)		✓				✓	✓
DeBorger (2016)	*	✓	✓		*		
Stapleton et al. (2016, 2017)	*	✓	✓	✓	✓	✓	

* *At least one estimate in the study avoids the problem. If a range is presented, some estimates that make up the range may suffer from the problem.*

[a] *Wadud (2009) is the sole fuel consumption rebound estimate.* *(cont. on next page)*

[b] *West et al. (2015) accounts for the price of the vehicle. But the authors also look at groups that do and do not receive a vehicle subsidy. This is problematic because the subsidy group buys a cheaper vehicle and receives a subsidy. Therefore, the results of this study should be interpreted as supporting a negative rebound effect if capital costs are accounted for.*

[c] *We define a study as using data from a non-representative time period if it includes data from before the 1990s. Note that even if studies use data from a non-representative period, this issue can be explicitly addressed through updating explanatory variables (e.g., GDP per capita) ex-post in some cases.*

[d] *While West and Pickrell (2011) attempt to address simultaneity, the study did so inadequately according to the authors*

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[632] The information in this table is derived from Dimitropoulos et al. (2018), Appendix D, with the exception of Wadud (2009), West and Pickrell (2011), and West, et al (2015).

2. The Agencies should follow EPA guidelines regarding how to draw valid conclusions from an academic literature that involves multiple estimates

EPA has developed guidelines on meta-analysis that provide best practices for how the agency should rigorously evaluate circumstances such as this where the academic literature is varied and contains a number of potentially relevant estimates.[633] EPA's guidelines are consistent with the best practices established in the academic literature.[634] By using a simple average of many studies of varying quality, the agencies have failed to follow EPA's own guidelines and so their conclusions regarding the appropriate rebound rate are not reliable.

In its guidelines, EPA identifies a number of types of meta-analysis methods.[635] EPA explicitly describes four types of meta-analysis in a 2016 update on its guidelines:

(1) **Closely Matched Studies:** "Develop independent estimates for relevant cases, using only studies that are closely matched on . . . individual characteristics."[636]
(2) **Weighted Average:** "Develop a baseline distribution of estimates . . . and a set of adjustment factors for . . . individual characteristics as warranted."[637]
(3) **Meta-regression:** "Develop a meta-regression model to estimate [rebound] as a function of . . . individual characteristics."[638]
(4) **Structural Model:** "Develop and estimate a structural preference function."[639]

By generally averaging studies without any specific weighting, the agencies have adopted none of these meta-analysis techniques.

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633 EPA, *Report of the EPA Working Group on VSL Meta-Analyses*, Report EE-0494. (2006), http://yosemite.epa.gov/ee/epa/eerm.nsf/vwAN/EE-0494-01.pdf/$file/EE-0494-01.pdf [hereafter "EPA Meta-Analysis Guidelines"]; *see also* EPA, *Valuing Mortality Risk Reductions for Environmental Policy: A White Paper* at 46-53 (2010), https://www.epa.gov/sites/production/files/2017-08/documents/ee-0563-1.pdf [hereafter "Meta-Analysis Guidelines 2010 Update"]; EPA, Valuing Mortality Risk Reductions for Policy: a Meta-Analytic Approach (2016), https://yosemite.epa.gov/sab/sabproduct.nsf/36a1ca3f683ae57a85256ce9006a32d0/0CA9E925C9A702F285257F380050C842/$File/VSL+white+paper_final_020516.pdf. [hereafter "Meta-Analysis Guidelines 2016 Update"].

634 Several guidelines are available for meta-regression in the academic literature: Nelson, & Kennedy (2009); Rhodes (2012).

635 EPA Meta-Analysis Guidelines at 19-24.

636 *Id.* at 8.

637 *Id.*

638 *Id.*

639 *Id.*

EPA's initial guidelines and subsequent application of those guidelines include direction for how the agencies should consider multiple studies to arrive at an individual value for use in a regulatory setting.[640] The agencies have failed to meet a number of these directives including:

- The need to establish *a priori* decision rules for which studies and individual values will be included or excluded or more heavily weighted;[641]
- The need to use a valid method for synthesizing the results of multiple studies in order to address econometric complications, including duplicate estimates, dependent errors (overlapping data and study authors), and heteroskedasticity (variance in precision of study);[642]
- The need to identify the population to be studied up-front (e.g., rebound *caused by fuel efficiency* among *U.S. households*);[643]
- The need to characterize and measure the uncertainty of combined estimates, such as through standard errors or confidence intervals;[644]
- The preference for analyses that incorporate several study characteristics together (e.g., meta-regression) over separate analyses of individual predictors of outcomes for different subsets of studies.[645]

The agencies' approach in the Proposed Rule—averaging estimates from a seemingly arbitrary subset of estimates in the literature—does not meet these criteria. The agencies have not identified any particular criteria for including or rejecting studies. Nor have they identified how exactly they synthesized the results from multiple studies. They have used studies that cover a wide range of populations (e.g., U.S. based studies and non-U.S. based studies, studies that measure elasticity of driving with respect to cost of driving and studies that measure elasticity of driving with respect to fuel efficiency, etc). Beyond reporting incredibly large ranges within the literature, the agencies do not discuss uncertainty in their preferred 20% rebound estimate. And by averaging all studies, the agencies incorporate different study characteristics but do so in a way that treats all characteristics equally.

The agencies should move away from the proposed approach and use one of the meta-analysis methodologies discussed in EPA's meta-analysis guidelines instead. Each option is discussed in turn.

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[640] The purpose of the meta-analysis guidance was for the construction of the Value of a Statistical Life (VSL). *Id.* However, the procedures and principles are broadly applicable.

[641] *Id.* at 9.

[642] *Id.* at 10.

[643] *Id.* at 19-20.

[644] *Id.* at 20.

[645] *Id.* at 22.

Meta-Regression. Meta-regression is a particularly valuable form of meta-analysis,[646] which uses econometric techniques to combine different studies and arrive at joint conclusions. Meta-regression allows analysts to adjust for factual and methodological causes of variation between different studies.[647] Specifically, it can control for many of the features of rebound studies that make them less relevant to the particular policy context of the Proposed Rule. Done correctly, meta-regression can address a variety of confounding issues including duplicate estimates, omitted variables, measurement error, dependent errors, and heteroskedasticity. EPA's guidelines provide detailed recommendations for the construction of a proper meta-regression.[648]

Only one academic study, by Alexandros Dimitropoulos and coauthors, has conducted a meta-regression of the rebound effect.[649] The study produces a variety of rebound estimates, including two estimates using two different preferred regression methods—fixed-effects regression and weighted-least squares regression.[650] While approximately one third of the data is not from the U.S., the study's meta-regression methodology at least partially addresses the issue of divergent geographic studies. This allows the authors to derive a long-run rebound effect of approximately 15% for a country approximately like the U.S.[651]

The study's methodology is sound. But the agencies should not rely on the study's rebound estimates for three reasons. First, the standard errors of the top-line regressions are so large that they limit the ability to make statistically significant claims about the magnitude of rebound for the purpose of setting policy.[652] Second, the two different preferred regression methods in the paper produce substantially different results about the overall magnitude of the rebound effect. Third, the results of the weighted-least squares regression demonstrate that very imprecise studies (i.e., studies with a very wide range of estimates) are driving up the rebound effect in the fixed effects regression.[653] These features of the study suggest that the specific estimates of the study are not reliable indicators of rebound.

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[646] Howard and Sterner (2017), at 205.

[647] *Id.* at 205-06.

[648] EPA Meta-Analysis Guidelines at 10-25 with specific focus on meta-regression at 23-25; Meta-Analysis Guidelines 2010 Update at 46-53; Meta-Analysis Guidelines 2016 Update at 20-25.

[649] Dimitropoulos et al. (2018), at 163, 166; *id.* at 170 (Table IV).

[650] The paper also reports results in its abstract. Dimitropoulos et al. (2018), at 163. However, these estimates are not the results of their sophisticated meta-regression.

[651] *Id.* at 172 (Table V).

[652] *Id.*

[653] Dimitropoulos et al. (2018) makes their data and code available in Appendix D. Applying the average sample size as weights within groups in the fixed effects regression also produces a negative estimate of -0.55 instead of -0.4 or 0.15. Additionally, variables for sample size and standard errors are statistically significant if included individually or jointly in the fixed effects regression, which indicates an upward bias. Furthermore, the increased capital cost of new vehicles is not accounted for and should further push down these rebound effect estimates.

While the study is not useful for making specific claims about rebound, it is nonetheless useful as evidence of the directional impact of particular estimate attributes. This meta-regression finds that rebound is lower for elasticities of fuel-efficiency than elasticities of fuel price and CPM; rebound is lower as income increases, rebound is lower over time and is generally lower in the U.S., and rebound is higher for single vehicle owners than multi-vehicle families.[654] These directional estimates can be taken into account through other meta-analysis methodologies, discussed above.

Closely Matched Studies. An alternative methodology to meta-regression would be for the agencies to use only studies that most closely match the context of the policy.[655] This can be accomplished by applying selection criteria to the available studies. In addition, because studies often contain multiple estimates or ranges of estimates based on different factors, the agencies should select the estimate within each study that most accurately reflects the rebound at issue in this Proposed Rule. For example, if a study provides rebound estimates for different countries, the estimate for U.S. households should be used rather than a range of estimates based on estimates from different geographies. Similarly, estimates with greater statistical precision (e.g., estimates with a larger number of observations) should be selected. And as the agencies explained when selecting the 10% rebound estimate for the Clean Car Standards, a rebound of 10% is better justified than 20% when the agencies clearly define selection criteria for the best estimates of the rebound effect.[656]

An approach that considers only rebound estimates that are highly relevant to the agencies' proposal would also be consistent with the recommendations that EPA provided to NHTSA as part of the interagency review of the Proposed Rule. As part of that interagency process, EPA recommended that NHTSA not use an average, but instead critically examine which studies are most likely to reflect rebound from fuel economy standards.[657] And EPA explained that of the 18 studies (12 U.S. and 6 international) in the last decade, EPA identified two that most clearly meet its criteria: Hymel and Small (2015), which estimates a rebound effect of 4% to 18%, and Greene (2012), which estimates a rebound effect of 10%. As EPA explained, "recent U.S. aggregate, time series studies find a rebound effect lower than 20%."[658] The agencies should follow this more careful and accurate approach in analyzing the rebound effect in this Proposed Rule. In

[654] *Id.* at 170 (Table IV).

[655] Meta-Analysis Guidelines 2016 Update at 8.

[656] 77 Fed. Reg. at 62,924 (identifying criteria that led the agencies to put less emphasis on certain studies including those that measure the elasticity of demand for gasoline and studies of rebound outside the US).

[657] EPA, Review of CAFE model with "GHG" settings (08-Mar ver.), at 31-33, attached to Email from William Charmley to Chandana Achanta regarding Material for today's Light-duty GHG NPRM discussion, June 18, 2018, https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0453 (5th attachment, pdf pages 120-122).

[658] *Id.*

addition, many of the peer reviewed papers that are discussed above but that are largely ignored by the agencies attempt to do just this.[659] Using criteria to select for only high quality and relevant studies, these literature syntheses arrive at a common value of 10% for the long-run rebound effect. These consensus values are far below the 20% selected by the agencies in the Proposed Rule.

Two other approaches to meta-analysis discussed in EPA's guidelines would not be optimal to estimate rebound:

Weighted Average. While not preferred, the agencies could develop an approach that weights studies by their quality and relevance to the policy context of the Proposed Rule (rebound caused by fuel efficiency increases in the U.S. during the 2020-2050 period). Lower-quality and less precise studies would be given less weight in line with our recommendations in these comments and so would have less influence over the weighted-average rebound value. However, it is not clear what weights would be appropriate for studies of different populations or of different types of effects. For this reason, using closely matched studies or a more sophisticated meta-regression would likely be preferable approaches to this type of meta-analysis.

Structural Model. Instead of relying on existing estimates of rebound in the academic literature, the agencies could build a structural model to estimate rebound, similar to how the agencies constructed models to estimate new vehicle sales and scrappage. For this approach to be valid, the agencies would have to be careful to avoid the structural and econometric criticisms raised throughout these comments. For example, the agencies would have to appropriately address the fact that VMT, including due to rebound, is simultaneously determined with fleet size. This type of approach would be a significant undertaking and should be subject to peer review and other validation.

[659] Sorrell et al. (2009), at 1360-1361; Gillingham et al (2016), at 73-78.

D. The agencies' rebound analysis is inconsistent with other parts of the Proposed Rule

In addition to the discussion above, the agencies' use of a 20% rebound effect is arbitrary and capricious because the assumptions underlying that value are inconsistent with the agencies' analysis regarding other issues in the Proposed Rule.

The Proposed Rule assumes both higher new vehicle costs associated with compliance with baseline standards and a higher rebound effect than were previously used when promulgating and evaluating the Clean Car Standards. However, higher new vehicle purchase prices for the same level of fuel efficiency should result in a reduction in the rebound effect. Specifically, higher vehicle purchase prices will increase the "capital cost income effect," (the C in the third component of the rebound effect defined in the introduction of this section (i.e., $\frac{\partial q}{\partial I}C$)).This will reduce (or even reverse) the level of rebound caused by the baseline standards attributable to the income and substitution effects. The agencies have wholly failed to acknowledge any relationship between increasing their assumptions about new vehicle prices under the baseline standards and, simultaneously, increasing estimates of rebound from the same level of fuel efficiency.

In addition, the agencies fail to acknowledge the inconsistency between their assumptions about rebound and their assumptions about, and costs attributable to, congestion. The agencies' analysis concludes that the baseline standards will result in higher levels of congestion than would occur under the Proposed Rule.[660] However, rising congestion over time should decrease the rebound effect.[661] The agencies have ignored the relationship between congestion and rebound. The agencies' assumptions that congestion (and its underlying costs) will increase under the baseline standards compared to the Propose Rule, without also changing the magnitude of the rebound effect under the baseline standards relative to the Proposed Rule is internally inconsistent.

Finally, the Proposed Rule is inconsistent in its modeling of short-run and long-run effects. Specifically, ignoring short and medium-run estimates of rebound is inconsistent with the agencies' approach to other dynamic effects that change over time. For example, the agencies' new vehicle sales model and scrappage model employ lagged variables in order to capture the shifts in behavior from short- to long-run.[662]

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[660] PRIA at 977-978

[661] Hymel et al. (2010), at 1235.

[662] PRIA at 949 (showing lagged variables in the sales model); *id.* at 1044 (showing lagged variables in the scrappage model).

VII. THE AGENCIES SHOULD NOT RELY ON THE SAFETY CONSEQUENCES OF MASS

The agencies claim that the impact of the baseline standards on vehicle mass justifies the Proposed Rule. According to the agencies, the baseline standards will cause manufacturers to reduce the weight of new cars and light trucks.[663] In the agencies' analysis, that weight reduction has the potential to increase the risk of injury for the occupants of those lighter vehicles.[664] According to the agencies, under the baseline standards, the mass issue will lead to approximately 160-468[665]of additional fatalities when compared to the Proposed Rule.[666] And the agencies assert that the emissions reductions and lost fuel-savings that the Proposed Rule will cause are justified because of the safety concerns associated with this mass issue, along with the rebound and fleet composition concerns (addressed in Sections V and VI).[667]

The agencies' reliance on the mass-related fatalities is flawed because as the agencies' own analysis shows, there is no relationship between vehicle mass and safety. As the agencies explain, the effect of mass reductions in light duty vehicles is not statistically significant at the 95th percent confidence level.[668] In other words, the effect of mass reduction on safety cannot be reliably distinguished from zero. Only once the agency calculates the impact at the 85th percent confidence level do the results for two out of the five categories of vehicles show any statistical significance.[669] But anything lower than the 90th percent confidence interval is likely not reliable.[670]

Notably, the impact of mass is even less significant now than it was when the Clean Car Standards were issued. In 2012 and 2016, the agencies found minimal evidence of any relationship between mass and safety, and that evidence was statistically significant only at the

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[663] 83 Fed. Reg. at 42,991.

[664] *Id.* at 43,067 (line 6).

[665] *Id.* at 43,149-158; PRIA at 1411-1418. The agencies do not provide any information about the timeframe for this loss.

[666] 83 Fed. Reg. at 43,152 (estimating total fatalities attributed to mass from a rollback of the fuel efficiency standards); *id.* at 43,157 (estimating total fatalities attributed to mass from a rollback of the GHG emission standards).

[667] *Id.* at 42,995.

[668] *Id.* at 43,111.

[669] *Id.* at 43,111.

[670] *See* Wooldridge (2009), at 137 (explaining that reliance on variables that are statistically significant below 90% requires further study). Ninety-five percent is the default confidence interval in commonly used statistical programs like STATA, SAS, and MATLAB. *See* https://www.stata.com/manuals13/rregress.pdf; http://support.sas.com/documentation/cdl/en/procstat/67528/HTML/default/viewer.htm#procstat_univariate_examples09.htm; https://www.mathworks.com/help/stats/prob.normaldistribution.paramci.html; http://repec.org/bocode/o/outreg2.html.

90th confidence interval, which is weak evidence.[671] Now the agencies are not even able to say that much. The fact that the mass effects are not statistically significant even at the 90th confidence interval now is consistent with the most recent literature on this topic. In a recent paper, Wenzel reviewed NHTSA's data and concluded that the "effect of mass reduction while maintaining footprint on societal U.S. fatality risk is small, and not statistically significant at the 95% or 90% confidence level for all vehicle types."[672] According to the study, "[r]educing vehicle mass does not consistently increase risk across all footprint deciles for any combination of vehicle type and crash type."[673] In fact, after running a decline analysis, Wenzel finds that reducing mass increases safety more than decreases safety for the vast majority of crash and vehicle combinations:

> Reducing vehicle mass does not consistently increase risk across all footprint deciles for any combination of vehicle type and crash type. Risk increases with decreasing mass in a majority of footprint deciles for only 6 of the 27 crash and vehicle combinations, but few of these increases are statistically significant. On the other hand, risk decreases with decreasing mass in a majority of footprint deciles for 16 of the 27 crash and vehicle combinations; in some cases these risk reductions are large and statistically significant. If reducing vehicle mass while maintaining footprint inherently leads to an increase in risk, the coefficients on mass reduction should be more consistently positive, and with a larger R2, across the 27 vehicle/crash combinations, than shown in the analysis.[674]

Wenzel found that the impact of mass was insignificant even as the weight of trucks has trended upwards over time.[675]

Indeed, the research and analysis actually supports a conclusion that reducing mass improves safety if anything.[676] For example, Bento et al. looked at impacts of CAFE standards on weight distribution and mean weight and found that pre-footprint standards actually decreased fatalities on net by reducing weight of vehicles (even as it spread out the distribution). Specifically, he found that pre-footprint regulations saved 393 lives nationally.[677] Given that the agencies' results showing fatalities associated with changes in vehicle mass due to the baseline standards are not statistically significant, Bento's results are not outside the range of possibility even under NHTSA's own analysis.

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[671] Draft TAR at 8-21, 8-22, 8-27 and 8-31; 77 Fed. Reg. at 62,747-48.

[672] Wenzel (2018), at x.

[673] *Id.* at v.

[674] Id.

[675] *See* 83 Fed. Reg. at 43,111-12 (describing trend upward trend in vehicle mass).

[676] See, e.g., Wenzel (2018), at 110.

[677] Bento et al, (2017), at 24-25.

Moreover, footprint-based standards were introduced in 2012 to mitigate the potential negative effects of decreasing the mass of vehicles (i.e., by creating crumple space). And when footprint is held fixed, "no judicious combination of mass reductions in the various classes of vehicles results in a statistically significant fatality increase and many potential combinations are safety-neutral as point estimates."[678] Similarly, a 2015 study by the National Academy of Sciences found that "a reduction in the weight of vehicles is not generally associated with greater societal safety risks" as long as the size mix of vehicles remains roughly the same.[679] Similarly, in a 2013 study, Jacobsen found no evidence that footprint standards affect fatalities.[680]

There may be several reasons other than the fact that standards are footprint-based, to explain the evidence showing that mass reductions do not affect safety.

First, other independent factors likely reduce the impact of mass on safety. For example, as the agencies concede, the "designs and materials of more recent model year vehicles may have weakened the historical statistical relationships between mass, size, and safety."[681] Additionally, fuel efficiency and safety ratings may be positively related via production decisions.[682]

Second, recent work by Tolouei also supports the findings that narrowing the weight distribution of vehicles will save lives.[683]

Third, as the National Academy of Sciences has explained, manufacturers will reduce mass "across all vehicle sizes, with proportionately more mass removed from heavier vehicles."[684] This decreases any negative effect that mass reductions would have on safety.[685]

Due to this factor, in the 2016 Draft TAR, EPA analyzed the impact of mass by adding weight reduction constraints.[686] Ignoring all of this research, the agencies' current analysis applies mass

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678 Wenzel (2018), at x.

679 NAS (2015), at 363-364 (finding 10.2); *see also* Anderson, et al. (2011), at 6-7 (concluding that "the impact of fuel economy standards on road safety is less clear. . . based on the available literature, it is difficult to draw definitive conclusions about the direction, let alone the magnitude, of the link between external accident costs and fuel economy regulations").

680 Jacobsen (2013), at 2.

681 PRIA at 1333.

682 Chen & Run (2010), at 114.

683 Tolouei (2015), at 267.

684 NAS (2015), at 240.

685 *Id.*; Wenzel (2018), at 110.

686 Draft TAR at 8-58, 8-59.

reductions without regard to the size of the vehicle.[687] If nothing else, the agencies should use the same constraints that EPA used in the Draft TAR when analyzing the Proposed Rule.

As a last point, NHTSA had LBNL analyze its mass results and LBNL found that mass reductions may increase the number of accidents but that each crash results in fewer fatalities.[688] That unexpected result demonstrates that the agencies' conclusions are incorrect.

As the evidence shows, there is no negative safety impact due to mass changes. EPA is on record reaching a similar conclusion. In 2017, EPA explained in the Final Determination that the fleet can absorb modest levels of mass reduction without any net increase in fatalities.[689] The agencies have failed to explain their changed conclusion now and have presented no new evidence that would justify the change. The agencies' reliance on those fatalities despite their statistical insignificance is arbitrary and capricious.

VIII. THE AGENCIES' EMPLOYMENT ANALYSIS IS INCOMPLETE

The agencies' employment analysis does not provide any justification for the Proposed Rule either. The agencies introduce the Proposed Rule by explaining that the proposal follows the President's promise to change the standards if they threaten automotive sector jobs.[690] But the actual analysis conducted by the agencies shows that this concern does not support the Proposed Repeal at all. To the contrary, according to the agencies' own numbers, the Proposed Repeal would *reduce* auto-sector jobs due to the decision to eliminate the mandate to use fuel-efficient technologies, with 50 to 60 thousand jobs lost between 2020 and 2030.[691]

The agencies' jobs analysis is incomplete. In particular, the agencies' analysis focuses on the automotive sector only and does not investigate the job losses in the long-term or with reference to other job sectors.[692] As even the agencies acknowledge, total economy-wide employment effects might be very different from those found within the regulated sector.[693] A proper methodology should thus look at the economy-wide effects, including all relevant general equilibrium channels.[694]

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[687] *See* 83 Fed. Reg. at 43,113 (explaining how the agencies calculated fatalities as a function of mass without any discussion of footprint); *id.* at 43,110 (discussing correlation between mass and footprint but then arguing that correlation has decreased over time).

[688] PRIA at 1336-1337.

[689] Final Determination at 26-27.

[690] 83 Fed. Reg. at 42,987.

[691] *Id.* at 43,436-37 (Table VIII-39).

[692] *Id.* at 43,078-79, 43,436.

[693] *Id.* at 43,078-79.

[694] In their annual reports on the costs and benefits of federal regulations, OMB has repeatedly advised agencies not to fall into the "pitfall" of ignoring long-run and economy-wide effects. *See*

Additionally, employment effects should be part of traditional cost-benefit analysis and should be conducted in a way that makes it easy for both decisionmakers and the public to assess how the employment effects compare to other effects of the proposed regulatory change. Therefore, instead of simply reporting the number of jobs affected, the agencies should focus on the associated welfare effects and use a recognized cost-benefit methodology to quantify the respective employment welfare impacts.[695]

IX. THE AGENCIES' EMISSIONS' ANALYSIS IS INACCURATE AND INCOMPLETE

The agencies have inaccurately and incompletely quantified the increases in both greenhouse gas emissions and emissions of criteria and toxic pollutants that will result from the Proposed Rule. As detailed more thoroughly in our separate comments that were submitted jointly with other organizations on the social cost of greenhouse gases,[696] at least the following serious problems cause significant underestimates of the Proposed Rule's health and welfare effects:

- The myriad modeling problems, especially with the rebound, scrappage, and sales modules, cause the agencies to underestimate the increase in fuel consumption—and so underestimate the increase in upstream and downstream emissions associated with fuel consumption—that will result from the proposed rollback.
- The agencies have assumed that 50% of the increase in fuel consumption from the Proposed Rule will be met by increased imports of refined gasoline, and that 45% will be met by increased domestic refining of imported crude oil. Yet the agencies arbitrarily ignore all upstream emissions associated with fuel production that occur abroad, even though all foreign emissions of greenhouse gases, and some foreign emissions of other pollutants, will have direct effects on the United States. Additionally, those assumptions on imports are completely inconsistent with other parts of the agencies' model.
- The agencies overestimate upstream emissions from electric vehicles by arbitrarily applying a national average to upstream electricity emissions, instead of accounting for cleaner regional mixes.
- The agencies' treatment of emissions associated with refueling trips is unclear, and so those emissions may be undercounted.
- The inconsistency between the total emissions tallies in the preliminary regulatory impact analysis and the draft environmental impact statement is unexplained.

Additionally, the agencies fixate on alleged on-road fatality effects while arbitrarily ignoring the mortalities, morbidities, and other welfare effects associated with emissions. The agencies

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https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/2015_cb/2015-cost- benefit-report.pdf at 42. *See also* SAB Advice on the Use of Economy-Wide Models in Evaluating the Social Costs, Benefits, and Economic Impacts of Air Regulations, Environmental Protection Agency Science Advisory Board Economy-Wide Modeling Panel, EPA-SAP-17-012 (2017).

[695] *See* Bartik (2012); Bartik (2015).

[696] *See* https://policyintegrity.org/what-we-do/update/3190.

misleadingly tout figures on how many lives the Proposed Rule will allegededly save from traffic accidents, without assessing any of the real-world impacts from the increase in greenhouse gas emissions, criteria pollutant emissions, and toxic pollutant emissions, which will include: climate-related deaths and illnesses from excessive heat, excessive cold, extreme weather events, diarrhea, vector-borne diseases, food- and water-borne diseases, cardiovascular and respiratory effects, food scarcity, water scarcity, and conflict;[697] as well as mortalities and morbidities from increases in particulate matter and other pollutants, including premature adult and infant mortality, acute bronchitis, respiratory emergency room visits, non-fatal heart attacks, asthma exacerbations, strokes, reproductive and developmental effects, cancer and genotoxicity effects, and work-loss days.[698] In the entire Proposed Rule, ocean acidification—a major environmental impact from increased carbon dioxide emissions—is never mentioned, and a host of other climate- and pollution-related effects are arbitrarily omitted or given short shrift.

As our separate comments on the social cost of greenhouse gases explain, the agencies must more accurately and fully monetize climate damages by applying the Interagency Working Group's estimates of the social cost of greenhouse gases. The agencies' so-called "interim" estimates have manipulated and decimated the valuation of the full costs of climate damages in ways at odds with the best available science, the best practices for economic analysis, and the legal standards for rational decisionmaking. The "interim" values ignore the real costs of climate change by arbitrarily attempting to limit the valuation to purportedly domestic-only effects; by arbitrarily discounting future climate effects at a 7% discount rate that is inappropriate for long-term climate effects; and by arbitrarily failing to address uncertainty over catastrophic damages, tipping points, option value, and risk aversion.

X. MISSING DOCKET INFORMATION

Finally, we submitted comments flagging important information that was missing from the docket and so impeding public review.[699] That information has still not been provided. The missing information frustrates the opportunity for meaningful public comment.

Respectfully,

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Bethany Davis Noll
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Richard Revesz
Jason Schwartz
Avi Zevin

[697] Carleton et al. (2018); Howard (2014); SAFE Rule Draft EIS at S-21.

[698] SAFE Rule Draft EIS at S-9, 2-27, 4-24 (listing the human health and welfare impacts from the increased particulate matter emissions under the proposed rollbacks).

[699] https://www.regulations.gov/document?D=EPA-HQ-OAR-2018-0283-0899.

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