RESOURCES *for the* FUTURE

Comments to EPA on the Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light- and Medium-Duty Vehicles

Joshua Linn

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Environmental Protection Agency
EPA Docket Center, OAR
Docket EPA-HQ-OAR-2022-0829
Mail Code 28221T
1200 Pennsylvania Avenue NW
Washington, DC 20460

Dear Administrator Regan:

I am pleased to share the accompanying comments to the Environmental Protection Agency (EPA) on the Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles. I am a senior fellow at Resources for the Future (RFF) and a professor at the University of Maryland. Opinions expressed in these comments are my own and statements made do not reflect the views or values of the university.

RFF is an independent, nonprofit research institution in Washington, DC. Its mission is to improve environmental, energy, and natural resource decisions through impartial economic research and policy engagement. RFF is committed to being the most widely trusted source of research insights and policy solutions leading to a healthy environment and a thriving economy.

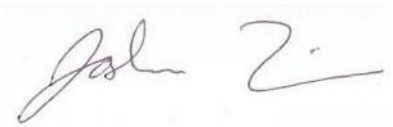
While RFF researchers are encouraged to offer their expertise to inform policy decisions, the views expressed here are those of the individual authors and may differ from those of other RFF experts, its officers, or its directors. RFF does not take positions on specific policy proposals.

I enclose comments on two issues. First, EPA "solicits comments on the proposed changes to the shape of the footprint curves, including the flattening of the car curve and our approach for deriving the truck curve from the car curve." Using estimated compliance costs estimated from a **recent working paper**, I quantify how much the existing footprint curves incentivize vehicle manufacturers to reclassify cars as light trucks and to increase vehicle footprint. The implication is that flattening the curves would reduce these incentives. This comment is based on a **blog post** I published on RFF *Common Resources*.

Second, EPA seeks comment on the proposed standards and on three alternatives to its proposed standards. Using the RFF light-duty vehicle model, I estimate benefits and costs of the proposed standards and two alternatives. For vehicles sold in 2030, tighter standards improve social welfare by $128 billion (2022$) over the lifetimes of those vehicles. Lower-income households enjoy larger fuel cost reductions than other households, which causes them to enjoy a disproportionately large share of the overall benefits. This comment is based on a **new report** that evaluates the overall benefits and costs of the proposed GHG emissions standards and the distribution of benefits across new vehicle consumers.

If you have any questions or would like additional information, please contact me at **linn@umd.edu**.

Sincerely,



Joshua Linn

Senior Fellow, RFF

1. How Much Do Regulations for Fuel Economy and Emissions Incentivize the Production of Larger Vehicles?

In Section III.B.2.ii of the proposed standards, EPA "solicits comments on the proposed changes to the shape of the footprint curves, including the flattening of the car curve and our approach for deriving the truck curve from the car curve." Using estimated compliance costs estimated from a recent working paper, I quantify how much the existing footprint curves incentivize vehicle manufacturers to reclassify cars as light trucks and to increase vehicle footprint. The implication is that flattening the curves would reduce these incentives.

Since 2012, vehicle manufacturers have faced greenhouse gas (GHG) emissions requirements that depend on the mix of vehicles sold; a manufacturer that sells larger vehicles and light trucks rather than cars faces less stringent requirements for GHG emissions. This regulatory structure **incentivizes** manufacturers to shift their product offerings to avoid strict GHG requirements, which potentially increases emissions. Just how strong are those incentives?

1.1. Regulatory Background and Recent Vehicle Size and Class Trends

Safety and technology rationales have driven GHG emissions standards to depend on vehicle size and class (e.g., car or light truck). Prior to 2012, a single fuel economy standard of 27 miles per gallon applied to all cars, and about 20–25 miles per gallon applied to all trucks. Reducing a car's weight and size can *both* increase its fuel economy and reduce its GHG emissions—making a vehicle smaller and lighter could help a manufacturer meet both standards.

However, the US Department of Transportation's (DOT) concerns about the safety of smaller vehicles have led it to discourage manufacturers from reducing vehicle size by setting higher Corporate Average Fuel Economy (CAFE) requirements for smaller vehicles relative to larger ones. In turn, EPA harmonized its GHG standards with CAFE standards by setting weaker GHG emissions standards for larger vehicles like trucks, given that GHG emissions are inversely related to fuel economy. DOT and EPA have made the car/truck distinction for statutory and technological reasons, since vehicle attributes that are common to light trucks, such as all-wheel drive, increase a vehicle's emissions rate and reduce its fuel economy.

Since the adoption of size-based standards in 2012, new vehicles have been getting larger, and sales have shifted from cars to light trucks. Between 2011 and 2022, the average vehicle footprint (roughly, the area defined by the four wheels) increased by about 4 percent, and the share of cars in total passenger vehicle sales dropped from about 65 percent to 40 percent. In the GHG standards that EPA proposed in April this year, the agency notes that the increasing size and shift from cars to trucks has **increased average emissions rates by about 10 percent**.

1.2. Incentives to Increase Vehicle Size or Convert Cars to Light Trucks

What could have caused the size increase of vehicles and the shift to light trucks? The GHG regulations themselves could be a factor, since increasing a vehicle's size or converting a car to a light truck hypothetically would yield extra compliance credits, all else equal (a car can be reclassified as a light truck if it has all-wheel drive and satisfies a few other conditions). Consumer demand also could play a role, if consumers want big cars and light trucks and manufacturers respond to consumer preferences. Production costs also may affect vehicle size. For instance, lower production costs for larger vehicles may motivate manufacturers to make more large vehicles.

Disentangling these explanations is not easy since we'd have to predict what sizes and car/truck mix manufacturers would have offered if consumer demand were different or if emissions and fuel economy standards did not depend on vehicle footprint. But we can get a sense of the relative incentive of the existing standards by comparing them with incentives that instead are created by consumer demand.

From a regulatory standpoint, the value of making a vehicle larger or converting a car to a light truck depends on how many compliance credits are generated and the value of those credits. In **recent research**, I estimated those credit values (**other research** has used the few publicly observed trades to estimate those credit values). Table 1 shows how much a manufacturer would have profited by increasing a vehicle's size or converting a car to a light truck, based on the credit values and crediting rules from 2022. Note that these calculations hold all else equal, so the numbers don't account for the decrease in fuel economy that typically results from making a vehicle larger (and heavier) or converting a car to a light truck.

Table 1. Incentives to Increase Vehicle Size or Convert Cars to Light Trucks

	Increase vehicle size	Reclassify car as a light truck
Value of additional greenhouse gas credits	$2,679	$3,124
How much consumers would pay	$12,264	$8,942

Note: Figures are presented as 2022 dollars.

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Table 1 shows that increasing a vehicle's footprint from 45 to 55 square feet generates about $2,700 in additional credits per vehicle. For reference in terms of smaller vehicles, a Toyota Prius v has a footprint of 45 square feet, and the Mercedes S-Class (a large luxury car) has a footprint of 55 square feet. For light trucks, the Honda CRV (a small crossover) has a footprint of 45 square feet, and the Range Rover has a footprint of roughly 55 square feet. These examples are meant to contextualize the footprint numbers—remember that the $2,700 refers to hypothetically taking the Prius v or CRV and increasing its footprint from 45 to 55 square feet without changing the vehicle's fuel economy or performance. The table also shows that converting a car to a light truck, again without changing fuel economy or performance, yields about $3,100 per vehicle.

Consumers also incentivize manufacturers to offer larger vehicles and convert cars to light trucks. Consumers tend to prefer larger vehicles because of the additional cabin and cargo space. They also may prefer light trucks to cars (all else equal) because of some of the attributes that trucks tend to offer, such as all-wheel drive or extra towing capacity, or because of differences in style or perception. I've **estimated** consumer preferences for vehicle size and all-wheel drive, which can provide a sense of how much consumers have incentivized manufacturers to offer larger vehicles or convert cars to light trucks. Table 1 shows that consumers value a car or light truck that has 55 rather than 45 square feet to the tune of about $12,000, which is more than four times the value of the additional credits derived from selling a larger vehicle. Likewise, consumers are willing to pay about $8,900 extra for all-wheel drive, which captures some of the value of a light truck over a car, which is about three times larger than the value of the additional credits for reclassifying the vehicle.

Do these numbers represent a big or small incentive for a manufacturer to increase a vehicle's footprint or convert a car to a light truck? The calculations in Table 1 show that the standards for GHG emissions and fuel economy have provided a substantial incentive to increase vehicle size or convert cars to light trucks. The incentives from the regulations are smaller than the incentives of consumer demand, but several thousand dollars per vehicle could be sufficient to change how manufacturers approach vehicle size or classification.

1.3. Conclusions

When EPA finalizes the post-2026 standards, the agency could reduce the importance of vehicle footprint or the difference in credit value between cars and light trucks. Such changes would make it less likely that reclassifying cars or increasing vehicle size would undermine expected emissions gains of the post-2026 standards. The changes would reduce the incentives for increasing vehicle size or reclassifying vehicles, not just for gasoline-powered vehicles but also for plug-in electric models. Any changes in the final standards also could affect the demand for batteries and critical minerals indirectly, given that larger plug-in vehicles require larger batteries, which in turn increases vehicle weight and the need for critical minerals.

2. How Would the Proposed Emissions Standards Affect New Vehicle Consumers?

In Section I.D of the proposed standards, "EPA is seeking comment on three alternatives to its proposed standards." As described in more detail in a **new RFF report**, I use the RFF light-duty vehicle model to estimate the benefits and costs of the proposed standards and two alternatives. I quantify how the benefits to new vehicle consumers vary across income groups.

Despite the Biden administration's **interest** in environmental justice and equity, the EPA analysis of the proposed standards does not quantify how effects may vary across consumers. The standards will increase sales of plug-in vehicles while simultaneously making gasoline vehicles more fuel efficient. Both changes reduce fuel costs for drivers, which disproportionately benefits low-income households because they spend a much larger share of their income on gasoline than do high-income households. However, low-income households typically have lower demand for plug-in vehicles than high-income households (even putting aside the high up-front purchase price), and by shifting the market from gasoline to plug-in vehicles, the standards may reduce purchasing options for low-income households.

The model monetizes benefits and costs to new-vehicle buyers by income group, costs to manufacturers, and the GHG benefits of the standards. Table 1 summarizes the main results for two scenarios: a baseline that assumes the standards for year 2026 do not change in subsequent years (this is the same baseline that EPA assumes); and tightening standards by about 40 percent between 2026 and 2030.

Table 2. Aggregate Effects in 2030 of Proposed Greenhouse Gas Emissions Standards

		Baseline (2026 stringency)	Proposed
A. Plug-in sales share and tax expenditure	Share of plug-in sales in total sales	0.56	0.62
	Federal purchase subsidy expenditure (2022$ billions)	45	50
B. Consumer benefits and manufacturer profits	Consumer benefits (2022$ billions)	264	374
	Manufacturer profits (2022$ billions)	156	151
C. Greenhouse gas emissions	Emissions (million metric tons)	488	379
	Damages (2022$ billions)	72	49
D. Total social benefits	Change in benefits relative to baseline (2022$ billions)		128

The baseline market share of plug-in vehicles is about 56 percent in 2030, which is slightly higher than the Biden administration's target. This market share lies in the middle of the **wide range** of recent forecasts. The proposed standards would increase plug-in vehicles' market share to 62 percent, which is comparable to (though slightly lower than) EPA's analysis.

Expenditure on plug-in vehicle subsidies under the Inflation Reduction Act is about $45 billion in the baseline and $50 billion in the proposed standards. The baseline number is about 20 times greater than the estimate by the Joint Committee on Taxation, reflecting different assumptions about policies (such as the ZEV standards) and consumer preferences. However, the estimate is **similar to recent estimates** that have used different computer models.

Panel B shows the consumer benefits of purchasing vehicles in 2030. The consumer welfare number measures the benefits of the vehicles compared with hypothetical purchases of used vehicles instead. The proposed standards would increase consumer welfare by $110 billion.

The tighter GHG standards benefit consumers because people **undervalue** fuel cost savings when they purchase vehicles. Consider a consumer who wants a particular vehicle and is offered the opportunity to purchase an otherwise identical vehicle that has lower fuel costs. Based on purchase choices that consumers make, **on average** a consumer is willing to pay about $35 for a hypothetical $100 reduction in fuel costs—in other words, people don't pay as much as they should for the lower fuel costs. Consequently, they buy vehicles with higher fuel costs than is privately optimal for them. By addressing these mistakes, the standards can increase consumer welfare.

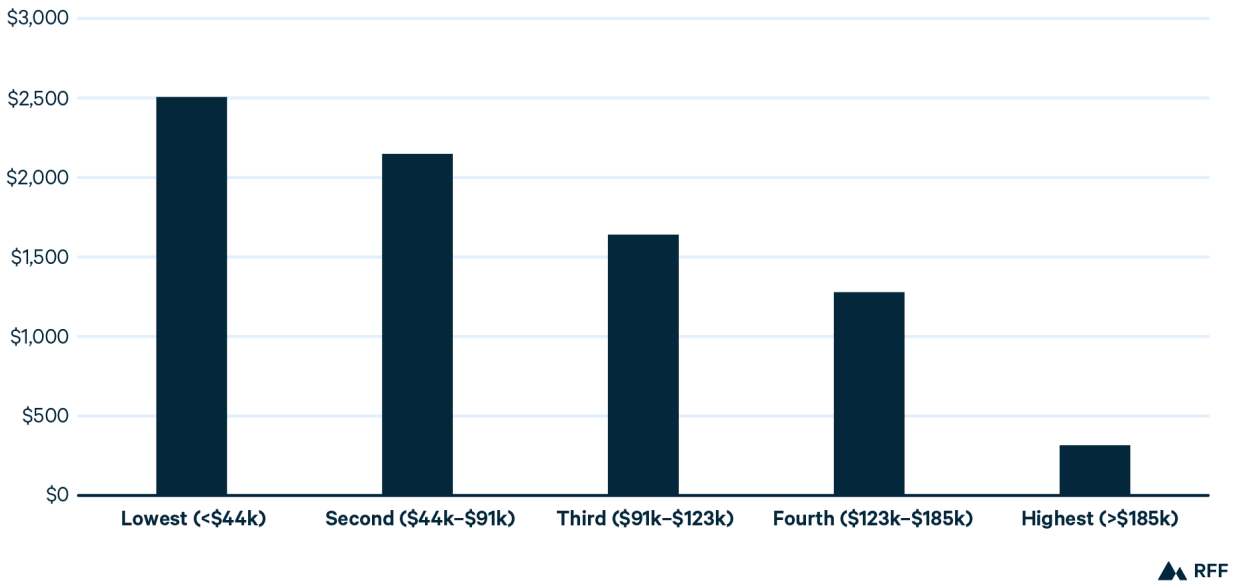
Manufacturer profits are the difference between revenue and costs. The tighter standards reduce manufacturer profits by about $5 billion. This result differs from EPA's since the agency assumes that manufacturers raise prices sufficiently to cover their costs. In contrast, my modeling indicates that competition constrains the extent to which manufacturers can increase their prices. That is, if an individual manufacturer tries to increase its prices enough to offset its higher costs, it will lose customers to other manufacturers. Because vehicle manufacturers cannot coordinate with one another on price changes, this competitive pressure prevents manufacturers from fully passing costs on to consumers.

Panel C shows the GHG emissions (CO_2 and methane) from producing and consuming gasoline and electricity to power the vehicles. The emissions numbers represent the emissions from the vehicles sold in 2030 over their lifetimes. The proposed standards reduce climate damages from $72 billion to $49 billion over the lifetimes of vehicles sold in 2030, yielding climate benefits of about $23 billion.

Panel D shows that the proposed standards would increase welfare by about $128 billion, where welfare includes new-vehicle consumer welfare, manufacturer profits, and GHG emissions. The agency's numbers are computed differently from the numbers reported in Table 2, so the two should not be compared explicitly. Rather, the results in Table 2, as well as EPA's analysis, reveal that the proposed standards are likely to yield large welfare gains.

Figure 1 shows how the benefits vary across new vehicle consumers, again comparing the proposed standards with the baseline. The figure plots the average welfare change per household; for example, the blue bar indicates that the proposed standards would benefit the average household in the lowest income group (below $44,000) by about $2,500. These benefits, which include fuel cost savings net of any welfare cost of the policy (such as paying higher vehicle prices) and do not include climate or local air quality benefits, could be substantial.

Figure 1. Change in Consumer Welfare per Household for Proposed Relative to Baseline



That the bars diminish in height from left to right in the diagram means that the proposed standards benefit low-income households more than high-income households. This pattern holds for other levels of stringency and assumptions described in the report. Benefits concentrate among lower-income households because they substantially **undervalue** fuel cost savings, whereas high-income consumers undervalue by a moderate amount. If there were no GHG or fuel economy standards, low-income consumers would buy vehicles that have higher fuel costs than would be optimal for them; the GHG standards benefit these consumers by reducing their fuel costs. In contrast, without standards, high-income consumers would buy vehicles that have only slightly higher fuel costs than would be optimal, and thus the standards give them smaller benefits.

An important factor underlying these results is that the modeling indicates that vehicle manufacturers will introduce many low-price electric vehicle options. If it proves challenging for vehicle manufacturers to produce and market low-price electric vehicles, low-income consumers will likely benefit less from the proposed GHG standards than these results indicate. More generally, whether benefits of plug-in vehicles are widespread across consumer income groups will depend on how consumer interest in those vehicles evolves and whether manufacturers can successfully introduce low-price plug-in options.

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