Docket ID No. NHTSA-2025-0491

The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule III for Model Years 2022 to 2031 Passenger Cars and Light Trucks

Appendix to Comments of Zero Emission Transportation Association (ZETA)

REPORT ON THE PROPOSED FUEL ECONOMY STANDARDS FOR LIGHT-DUTY VEHICLES 2022–2031

A report to the

Zero Emission Transportation Association

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I. INTRODUCTION

This report identifies and analyzes several important deficiencies in the proposed rule, entitled "Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule III for Model Years 2022 to 2031 Passenger Cars and Light Trucks (NHTSA, 2025)." It focuses on economic and engineering assumptions and methods. Although it is necessarily premised on an interpretation of the requirements and purposes of the Corporate Average Fuel Economy (CAFE) law and of cost-benefit analysis of regulations, it is not an assessment of legal positions taken by NHTSA in the proposed rule.

The report has eight sections.

Section II addresses the fact that **the proposed standards are not maximum feasible**. NHTSA's cost-benefit analysis shows that much higher standards satisfy all the statutory requirements. The CAFE law requires the Secretary of Transportation to set fuel economy standards at the maximum feasible level taking into consideration technological feasibility, economic practicability, the need of the nation to conserve energy and other government regulations. The proposed standards do not do that. Instead, NHTSA has proposed standards at levels far below their own estimates of what manufacturers will achieve.

Section III explains that **the baseline is not a best assessment of the state of the world in the absence of the proposed standards because it excludes alternative fuel vehicles**. The proposed standards pretend that electric vehicles (EVs), now 10% of new U.S. vehicle sales and more than 20% worldwide, do not and did not exist. NHTSA deleted EVs from its baseline database, past, present and future. Assuming an unrealistic world in which EVs do not exist prevents setting maximum feasible standards for petroleum fueled vehicles. EVs are inherently far more energy efficient than petroleum-fueled, internal combustion engine vehicles and must be included when determining manufacturers' compliance with CAFE standards.

Section IV explains why the proposed **elimination of inter-manufacturer credit trading will increase costs and reduce consumer choice.** NHTSA proposes to eliminate credit trading among manufacturers. But credit trading increases the economic efficiency of the standards, saves consumers money, and preserves consumers' ability to choose the kinds of vehicles they prefer.

Section V addresses how the proposed **retroactive standards harm manufacturers by disrupting their product plans**. Congress required NHTSA to give manufacturers advanced notice of regulations to avoid disrupting product plans and stranding investment. NHTSA proposes to retroactively alter past standards back to 2022 thereby making past and current product plans obsolete.

Section VI demonstrates that **NHTSA's treatment of implicit opportunity costs (IOCs) is inconsistent with economic theory and lacks empirical evidence**. In the agency's cost-benefit analysis, IOCs play an outsized role but are an ad hoc, unsupported assumption by the agency that was considered unreliable by the agency in previous rules.

Section VII shows that the agency is **using outdated estimates of hybrid electric vehicle (HEV) costs and market acceptance**. Strong hybridization can improve fuel economy by 30% to 50%. Strong hybrids make up 50% of the light-duty market in 2031 in the agency's preferred alternative. Inflated hybrid costs bias the cost-benefit analysis against improved fuel economy.

Section VIII discusses several additional issues that diminish the validity of NHTSA's cost-benefit analysis.

NHTSA's choices have interdependent impacts. Creating a baseline fleet that excludes historical and expected future sales of dedicated alternative fuel vehicles (AFV) like electric vehicles prevents NHTSA from setting maximum feasible standards for non-AFVs. Overestimating the cost of strong hybrid vehicles, a critically important and increasingly popular fuel economy technology, distorts the assessment of proposed standards' economic practicability. Eliminating credit trading increases the costs of the standards in general and limits the combined fleet fuel economy that can be achieved cost-effectively. Although these issues are discussed separately in this report, because they are interdependent their combined effect is to more severely undermine the purpose of the CAFE law.

The six main sections of this report deal with errors that squarely impact the validity of NHTSA's rulemaking analysis, either because they are not consistent with the requirements of the CAFE law and regulatory assessment or because the mistakes have a profound impact on the cost-benefit analysis of the proposal. The failure to set maximum feasible standards, the adoption of a fictitious baseline, and setting retroactive standards for four previous years all contradict the intentions of the law. The introduction of conjectural implicit opportunity costs of standards and the inflation of the costs of full hybrid vehicles that make up 50% of the new car fleet by 2031 have major impacts on the costs and benefits of maximum feasible standards. The agency justifies its proposed elimination of credit trading as a way of undermining manufacturers who produce and sell dedicated alternative fuel vehicles even though the law intended to encourage development of such vehicles. Moreover, eliminating credit trading is economically inefficient and will restrict consumers' vehicle choices.

References

1. National Highway Traffic Safety Administration (NHTSA), 2025. "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule III for Model Years 2022 to 2031 Passenger Cars and Light Trucks". Available at https://www.federalregister.gov/documents/2025/12/05/2025-22014/the-safer-affordable-fuel-efficient-safe-vehicles-rule-iii-for-model-years-2022-to-2031-passenger. Note that page numbers referring to the NPRM in this report are based on the Notice of Proposed

Rulemaking accessed at https://www.govinfo.gov/content/pkg/FR-2025-12-05/pdf/2025-22014.pdf.

II. THE PROPOSED ALTERNATIVES ARE NOT MAXIMUM FEASIBLE

The Notice of Proposed Rulemaking falls short of meeting the statutory requirement to set standards at the "maximum feasible" level. The agency's analysis of alternatives proves that it failed to do so.

> "This proposal fulfills NHTSA's statutory obligation to set CAFE standards at the maximum feasible level that the agency determines vehicle manufacturers can achieve in each model year, balancing four key factors: technological feasibility, economic practicability, the need of the nation to conserve energy, and the effect of other federal regulations on fuel economy." (NPRM, p. 56444)

The retroactive standards of NHTSA's proposed rule would set standards at levels well below what nearly all manufacturers and the market as a whole have already achieved. For passenger cars, calculated required levels for 2022 to 2024 range from 3.2 to 6.7 mpg below achieved levels, and for light trucks, the corresponding gaps are 2.1 to 4.8 mpg (NPRM, Table I-2, p. 56448). For the total light-duty fleet, the achieved standards exceed the required standards by 1.5 mpg in 2022, 2.3 mpg in 2023 and 5.3 mpg in 2024. NHTSA's future preferred standards are set well below what NHTSA's analysis expects the market to achieve, as discussed below.

a. Technological Feasibility

The statute requires maximum feasible standards determined by weighing four criteria. The first is technological feasibility. The CAFE Model and its inputs are designed to ensure technological feasibility by including only technologies that are known to be manufacturable at commercial scale, estimating their effects on vehicle operation using full vehicle simulation modeling, ensuring engineering compatibility among adopted technologies, and respecting the industry's pacing of refresh and redesign schedules when adopting technologies.

The CAFE Model's analyses of the alternative standards demonstrate that a substantially higher standard than any of the alternatives considered would be technologically feasible. The analyses estimate that if the "Preferred Alternative 2" is adopted, the combined passenger car and light truck fuel economy levels for model years (MY) 2027 through 2031 will exceed the required levels by more than 6 miles per gallon (mpg). This analysis excludes dedicated alternative fuel vehicles from the baseline in addition to prohibiting adding new dedicated AFVs or converting existing vehicles to AFV as options to meet the standards (NPRM, p. 56528). Compare the "Preferred Achieved" levels of fuel economy with the "Preferred Required" levels in Figure 1 and Table 1. That manufacturers would choose to exceed the standards by a wide margin although they are not required to do so establishes the technological feasibility of higher standards. NHTSA's analysis finds that only two low-volume specialty manufacturers, Ferrari and Ineos, would not exceed the Preferred Alternative standards. Moreover, NHTSA's analysis estimates that manufacturers would continue to exceed the 2031 requirement through 2050.

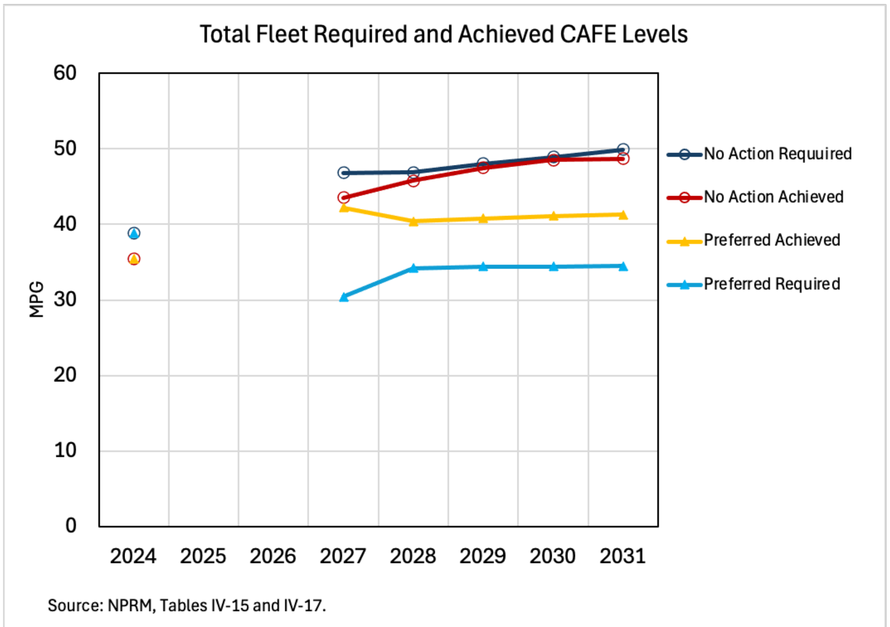

Figure 1. Estimated production-weighted light-duty vehicle mpg in the No-Action and Preferred Alternative for 2024 to 2031 (NPRM, Tables IV-15 and IV-17. pp. 56559–56560).

Table 1. Estimated Required and Achieved Total Fleet Fuel Economy in No-Action and Preferred Alternative

Year	No Action Required	No Action Achieved	Preferred Required	Preferred Achieved
2024	38.8	35.4	38.8	35.4
2025				
2026				
2027	46.8	43.5	30.4	42.2
2028	46.9	45.8	34.2	40.4
2029	48.0	47.5	34.4	40.8
2030	48.9	48.5	34.4	41.1
2031	49.9	48.7	34.5	41.3

Source: NPRM Table IV-17. The years 2025 and 2026 are not shown in Table IV-17, p. 56560.

NHTSA's analysis (PRIA Figure 8-4, p. 8–22) shows that almost all manufacturers in the great majority of years exceed the proposed standards by 20% or more (Figure 2). Only two low-volume manufacturers fail to exceed the standards: Ferrari and Ineos. Note that the calculations in Figure 2 below do not include sales of BEVs or PHEVs when operating on grid electricity.

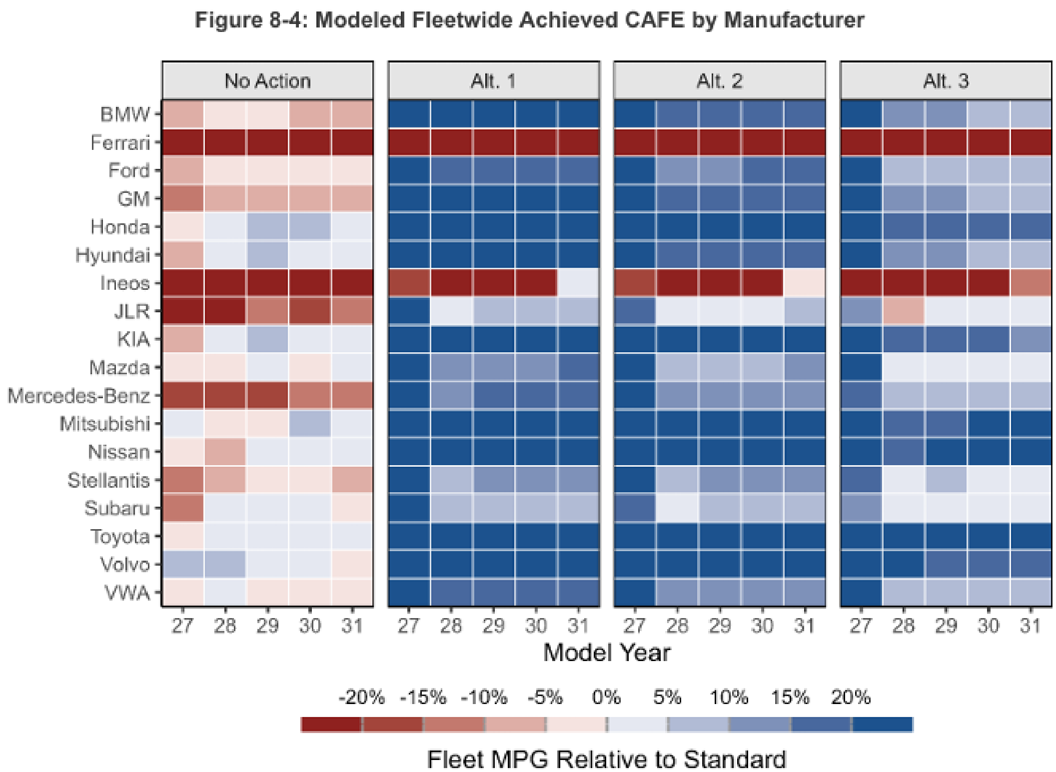

Figure 2. CAFE Model Estimates of Manufacturers' Achieved Fuel Economies Relative to the Preferred Alternative 2 Standard (PRIA p. 8–22).

The estimated achieved fuel economy levels under Alternative 2 are roughly midway between the estimated achieved levels under the existing fuel economy standards (No-Action) and the Preferred Required standards. As a result, the agency estimates that the No-Action and Preferred Alternative will produce very similar outcomes in areas such as pollutant emissions from the stock of vehicles in use in the future. This is surprising because NHTSA has traditionally set maximum feasible standards close to the levels its analysis estimated that manufacturers would achieve.

Figure 1 shows estimates for combined cars and light trucks because the agency also proposes a large-scale reclassification of vehicles now considered light trucks starting with MY 2028. Reclassifying a large fraction of light trucks as passenger cars will have pronounced effects on the fuel economies of the two fleets but no effect on the combined fleet fuel economy. As the NPRM states:

> "This reclassification will have the effect of significantly lowering the average fuel economy of both fleets, leaving all else equal, but maintaining the overall combined fuel economy standards at the same level as MY 2027." (NPRM, p. 56599)

In the analysis, passenger cars before MY 2028 and after MY 2027 are very different sets of vehicles, as are light trucks before MY 2028 and after MY 2027.

b. Economic Practicability

The second balancing factor is economic practicability.

Although the required fuel economy levels of Preferred Alternative 2 do not require manufacturers to do so, NHTSA's NPRM estimates that under the Preferred Alternative 2 light-duty vehicles would exceed required fuel economy levels by an average of 6 to 7 MPG from 2027 to 2031. The only manufacturer that fails to achieve compliance with the Preferred Alternative standards for MYs 2027–2031 is Ferrari (NPRM, Table V-5, p. 56600). All manufacturers over-comply by at least 4 mpg except Ferrari, Ineos, Mazda, Mercedes Benz, and Subaru. Several major OEMs over-comply by wide margins including GM (+9), Honda (+9 to+10), Kia (+9), Mitsubishi (+1 to +13), Nissan (+13 to +15), Toyota (+17 to +18), and Volvo (+10 to +9) (NPRM, Table V-5, p. 56600). NHTSA asserts that this is because the No-Action standards require manufacturers to adopt technologies that consumers did not want. The cost-benefit analysis, however, undermines this conclusion about economic practicability.

NHTSA estimates that the increase in vehicle costs necessary to attain the achieved Preferred Alternative 2 levels of fuel economy would be less than the present value of the fuel they would save. This is not immediately obvious, because the rulemaking documents do not provide technology costs and fuel savings for comparing the required level of fuel economy under Alternative 2 to the fuel economy achieved under Alternative 2. Instead, one can compare the technology costs and fuel savings achieved under the substantially higher No-Action Alternative with those achieved under Preferred Alternative 2. Because the CAFE Model generally adopts technologies in order of decreasing cost-effectiveness, the incremental technology cost per dollar of fuel saved by increasing from the Preferred Alternative 2 achieved levels to the higher No-Action alternative achieved levels will be greater than the technology cost per dollar of fuel savings for increasing from the required level of fuel economy under Alternative 2 to the achieved level (see Figure 1). That is, assuming three fuel economy levels where A<B<C, if it is cost-effective to increase fuel economy from B to C, it is at least as cost-effective to increase from A to B. Even though the NPRM does not provide the data necessary to calculate the vehicle cost per dollar of fuel saved for increasing fuel economy from the Required Preferred Alternative 2 levels (A) to the Achieved Preferred Alternative 2 levels (B), the principle of increasing marginal costs implies that they must be less than or equal to the vehicle cost per dollar of fuel saved for increasing from the achieved Preferred Alternative 2 (B) levels to the higher achieved No-Action levels (C).

The fact that the higher Achieved level of fuel economy under the Preferred Alternative is cost-effective for consumers indicates that the Required level is not maximum feasible. Cost-effectiveness can be measured by the dollars spent to make vehicles more fuel efficient per dollar of fuel saved. The changes in present-value dollar vehicle costs to consumers per present value dollars of fuel saved are shown in Table 2. Compared to the No-Action Alternative, Preferred Alternative 2 reduces both the costs per vehicle and the value of fuel saved, and so both quantities are negative and the ratio of vehicle costs per dollar saved is positive. Regardless of whether future costs are discounted to present value at the 3% or 7% rate and whether costs and benefits apply only to MYs through 2031 or to all vehicles on the road from 2024 to 2050, the cost/benefit ratios are less than 1.0, indicating that consumers would save money if fuel economy were increased from the levels achieved under the Preferred Alternative to the levels achieved under the No-Action Alternative. Given that the CAFE Model generally applies technologies in order of increasing cost per gallon of fuel saved, the fact that the estimated dollar of vehicle cost per dollar of fuel saved is less than 1.0 for increasing fuel economy from the level achieved under Preferred Alternative 2 up to the level achieved under the No-Action Alternative implies that fuel economy improvement from the required level of Alternative 2 to the achieved level of Alternative 2 would be at least that cost effective and almost certainly more cost effective than increasing fuel economy from the achieved level of Alternative 2 to the higher No-Action level.

Table 2. Incremental Costs and Benefits of the Preferred Alternative 2 versus the No-Action Alternative (Billions 2024 $)

Over Lifetime of Light-duty Vehicles Through MY 2031		
Discount Rate =	3%	7%
Technology Cost	-37.1	-30.2
Fuel Savings	-53.9	-34.2
$Cost/$Saved	0.69	0.89
On-Road Light-duty Vehicle Fleet from 2024 to 2050		
Technology Cost	-150.0	-94.0
Fuel Savings	-185.4	-100.6
$Cost/$Saved	0.81	0.93

Sources: NPRM Tables IV-26 and IV-27, pp. 56567–56568.

Consumers' surplus is an economic measure of the difference between consumers' willingness to pay for a good and its cost. NHTSA's estimates of benefits and costs indicate that the loss of consumers' surplus for the Preferred Alternative 2 versus the No-Action Alternative in billion 2024 dollars is -0.0 (a small gain for the Preferred Alternative). Despite the fact that NHTSA includes erroneous Implicit Opportunity Costs in calculating consumers' surplus, the estimated loss is very small, certainly less than $0.051 billion, which is less than 0.0067% of the approximately $764 billion in revenue from light-duty vehicle sales in 2024 (Sales: FRED, 2025; Price: Cox Automotive, 2025). Thus, according to NHTSA's calculations, even if the standards were set at the levels of the No-Action Alternative, the loss of consumer satisfaction with the higher mpg vehicles would be very small and pose no threat to the economic viability of the industry.

Other impacts on the automobile industry of the higher mpg levels under the No-Action Alternative are favorable to the industry. Although total sales in MY 2031 are 0.4% lower under the No-Action Alternative than under the Preferred Alternative 2 (PRIA, Table 469), vehicle sales prices are an estimated $925 or 1.9% higher. The result is that total industry revenues would increase by approximately 1.5%. Employment impacts of the No-Action Alternative are also favorable. The number of jobs in the automobile industry is estimated to be 0.9% higher under the No-Action Alternative compared with Preferred Alternative 2 (Figure IV-2, p. 56565).

c. The Need of the Nation to Conserve Energy

The third balancing factor is the need of the Nation to conserve energy.

NHTSA's analysis fails to mention the beneficial impact of reduced U.S. oil consumption due to improved fuel economy, a key reason for the Energy Policy and Conservation Act of 1975. A peer reviewed analysis of the effect of increased fuel economy since 1975 on petroleum use by U.S. light-duty vehicles estimated that U.S. gasoline use would be approximately 5 million barrels per day (mmbd) higher today had car and light truck fuel economy remained at the 1975 level (USDOT/BTS, 2025). Although petroleum consumption has not decreased below the 1975 level, it would have been approximately 5 mmbd higher had improved fuel economy not restrained the growth of gasoline demand, which would make the U.S. a net importer of petroleum.

In addition, notably absent from NHTSA's consideration is the well documented harm to the environment and public health caused by emission of greenhouse gases (e.g., NASEM, 2025). Appropriately accounting for the benefits of reducing greenhouse gas emissions would support setting higher fuel economy standards.

d. Other Government Regulations

The final balancing factor is the effect of other government regulations on fuel economy. NHTSA has taken such regulatory requirements and their possible effects on fuel economy into account in its Draft Regulatory Impact Analysis and Draft Environmental Impact Statement and generally concludes that other regulations will not interfere with CAFE standards over the period in question.

However, the NPRM does not consider the effects of EPA's existing emissions and greenhouse gas regulations covering the period of the proposed rule because EPA has proposed to rescind them. Including EPA's existing GHG regulations would significantly change the baseline case.

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7. U.S. Department of Transportation, National Highway Traffic Safety Administration, “Draft Technical Support Document (TSD) The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule III for Model Years 2022 to 2031 Passenger Cars and Light Trucks”, December 2025. Accessed at https://www.nhtsa.gov/sites/nhtsa.gov/files/2025-12/CAFE-SAFE-MY-2022-2031-NPRM-TSD-tag-v2.pdf.

III. NHTSA ADOPTS THE WRONG BASELINE

OMB Circular A-4 requires agencies to analyze the costs and benefits of their proposed rules in comparison to a baseline representing their best assessment of state of the world without their proposal. Because electric vehicles have already reached 10% of new U.S. light-duty vehicle sales and have a substantial public charging infrastructure in place, they are part of the state of the world against which NHTSA is proposing fuel economy standards.

The proposed rule asserts that the law requires setting standards assuming EVs do not exist. A choice that is more representative of the real world, for example, would be to exclude converting existing non-AFVs to AFVs or introducing new AFV models as a strategy for meeting new fuel economy standards but to include EV sales in computing the baseline. As is demonstrated below, genuinely maximum feasible fuel economy standards cannot be set without using a baseline that includes a best assessment of EV sales in the baseline.

a. What is a Baseline?

In CAFE rulemaking the term "baseline" is used in two important but related ways. There is the "baseline fleet" of vehicles, which is a database of all new vehicles sold in the U.S. in the most recent year available, including sales, prices, technological status relevant to fuel economy and other vehicle attributes. The baseline fleet is critical technical information for beginning the estimation of maximum feasible fuel economy levels for rulemaking model years.

The second important use of "baseline" is to describe the state of the world without the new standards for the purpose of estimating its impacts, costs, and benefits. With respect to the cost-benefit baseline, OMB Circular A4 requires that agencies:

> "Identify a baseline. Benefits and costs are defined in comparison with a clearly stated alternative. This normally will be a no action baseline: what the world will be like if the proposed rule is not adopted." (OMB, 2003)

Elaborating on the nature of the baseline, the OMB's primer on regulatory impact analysis states:

> "The baseline represents the agency's best assessment of what the world would be like absent the action. To specify the baseline, the agency may need to consider a wide range of factors and should incorporate the agency's best forecast of how the world will change in the future, with particular attention to factors that affect the expected benefits and costs of the rule. For example, population growth, economic growth, and the evolution of the relevant markets should all be taken into account." (OIRA, 2026, p. 4).

When historical years are included in the rulemaking, the baseline for regulatory analysis must represent the best information available to the agency on the actual state of the world as it was without the proposed rule. Because large numbers of battery-only electric and plug-in hybrid electric vehicles were sold from 2022 to 2025, electric vehicles must be included in the baseline for any regulatory analysis for those years. EVs are now mass-market vehicles in the U.S. and the world. More than 1.5 million EVs (BEVs and PHEVs) were sold in the U.S. in 2024, approximately 10% of the U.S. light-duty vehicle market (AAI, 2026). The market shares of BEVs and PHEVs from January through September 2025 were 8.85% and 2.06% for a combined EV share of 10.92% and total sales of 1,127,717 vehicles (AAI, 2026). Through the third quarter of 2025, 24.5% of light-duty vehicle sales in California were EVs (CEC, 2026). Globally, the EV market is large and growing. Eleven million EVs were sold in China in 2024 and constituted nearly half of total car sales in China (IEA, 2025). In the EU, sales of EVs surpassed those of internal combustion engine vehicles for the first time in the month of December 2025 (Parodi, 2026).

Unlike liquid and gaseous alternative fuels, the infrastructure for delivering the energy required by EVs is ubiquitous, in the form of the U.S. electricity grid. EVs can be conveniently charged overnight at low power levels, which means they require fewer public refueling sites than conventional gasoline vehicles. However, a 14,261-station public intercity fast charging network is already in place, with 67,729 charging ports (AFDC, 2026).

b. A Credible "Best Assessment" Baseline Would Include EVs

The U.S. Energy Information Administration produced an EV sales projection as an alternative transportation case to its Annual Energy Outlook 2025. The alternative case differed from AEO's Reference Case by omitting the existing CAFE and GHG standards (Figure 1). Even though it excludes the existing GHG standards and some other incentives for EVs, nonetheless, EIA's projection indicates that EV sales are expected to persist and increase over time.

The EIA projection was used by NHTSA in its rule making analysis to project the number of gasoline- and diesel-powered vehicles.

> "NHTSA uses the AEO 2025 Alternative Transportation Case projection for the growth rate of market shares of limited electric and fuel cell electric vehicles (FCEV) in future years. NHTSA applies these market shares to total LD sales projections in order to isolate the number of gas-powered LD sales expected in future years." (TSD, p. 4-12)

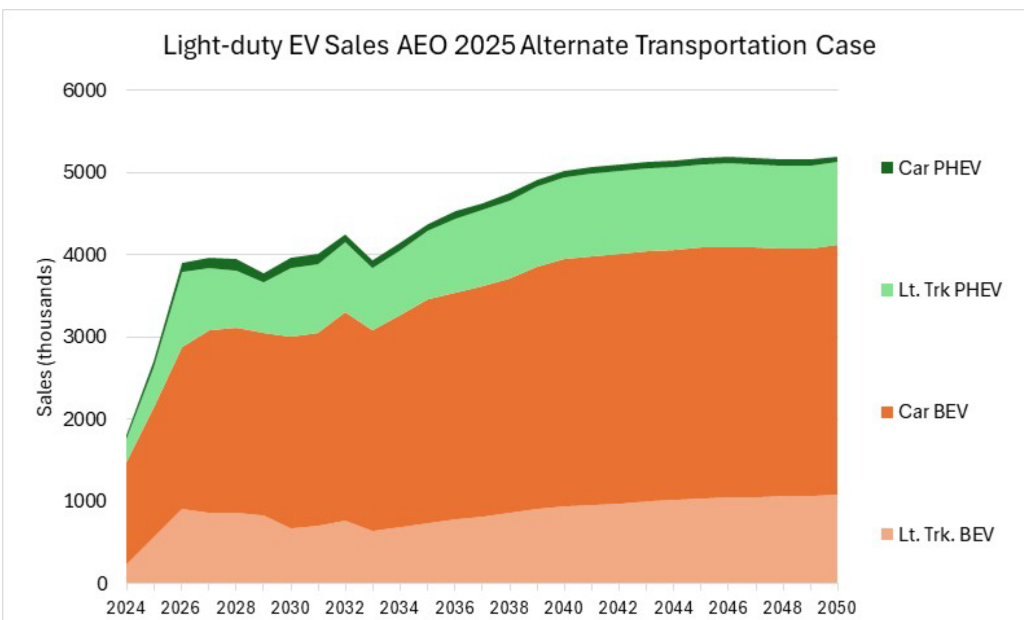

Figure 1. Light-duty EV Sales in the Annual Energy Outlook 2025 Alternative Transportation Case that Eliminates EV and Charging Infrastructure Subsidies (EIA, 2025).

c. Assuming EVs Do Not Exist Is Misguided

NHTSA deleted dedicated vehicles from the baseline fleet, which is contained in its Market Data Input File.

> "The agency then identified and removed all the model types of dedicated AFVs from the Market Data Input File, consistent with the section 32902(b) prohibition on considering the fuel economy of dedicated and dual-fueled vehicles when setting maximum feasible standards." (NPRM, p. 56524–56525, see also p. 56528)

This deletion was not necessary to eliminate the fuel economy of dedicated AFVs from consideration when setting maximum feasible standards because NHTSA's CAFE model settings can be chosen to prevent manufacturers from adding new EV models or converting existing gasoline- and diesel-powered internal combustion engine (ICE) vehicles to dedicated alternative fuel vehicles. Thus, the CAFE model can be constrained to never allow manufacturers to add EVs or any other dedicated AFV technology to the baseline in order to meet any proposed new standard.

d. A Best Assessment of Future EVs is Necessary to Calculate Maximum Feasible MPG

The effect of deleting EVs from the historical baseline is to create a fictitious, unrepresentative history of U.S. vehicle sales. Forecasting future sales of EVs is difficult and uncertain but must be done to construct a realistic baseline for cost-benefit analysis. Even a forecast of zero sales is a forecast and would have to be justified as the agency's best assessment. OMB guidance notes:

> "The choice of an appropriate baseline may require consideration of a wide range of potential factors, including:
>
> - evolution of the market,
> - changes in external factors affecting benefits and costs,
> - changes in regulations promulgated by the agency or other government entities, and
> - the degree of compliance by regulated entities with other regulations."

To estimate the numbers of future gasoline- and diesel-powered vehicle sales, NHTSA chose the Energy Information Administration's Annual Energy Outlook 2025 Alternative Transportation case AFV sales projections, thereby acknowledging that EVs are and will continue to be an important part of the light-duty vehicle market. From this case it calculated market shares for EVs and other AFVs that it applied to its own forecast of total light duty vehicle sales.

NHTSA says:

> "The enormous fuel economy values assigned to EVs have, heretofore, been included in the baseline fleet fuel economy for subsequent CAFE rulemakings upon which stringency increases are applied -- thereby significantly increasing the fuel economy requirements for traditional gasoline- or diesel-fueled fleets." (NPRM, p. 56443)

This is not correct. In fact, including a realistic estimate of future EV sales is necessary to set maximum feasible standards for internal combustion engine vehicles (ICEs). Unless the presence of EVs in future sales is included, proposed standards will be less than maximum feasible. This can be illustrated by an example calculation. First, consider setting a new standard for the historical year of 2024, as the proposed rule does. The market share of EVs was approximately 10% in 2024. For purposes of illustration assume a regulatory average fuel economy of 301.71 mpg for the EVs, the number used in DOE's 2026 rule's sample calculation (DOE, 2026, p. 555). Assume that a CAFE model analysis determined that non-AFVs could achieve a maximum feasible fuel economy of 40 mpg with available, gasoline- and diesel-only fuel economy technologies. Including EVs, the achieved compliance fleet average fuel economy would be $1/(0.1/301.71 + 0.9/40) = 43.8$ mpg. But, if the fleet average standard had been set at 40 mpg assuming EVs did not exist, manufacturers would not have to achieve 40 mpg with their gasoline- and diesel-powered fleets. The manufacturers could achieve the 40-mpg target with a gasoline- and diesel-powered fleet average of 36.484 mpg: $1/(0.1/301.71 + 0.9/36.484) = 40.0$. Including only gasoline- and diesel-powered vehicles in the baseline, it is not possible to set a true maximum feasible standard for the gasoline- and diesel-powered fleet. To set a maximum feasible standard for the gasoline- and diesel-powered fleet, an accurate estimate of the number of EVs must be included in the baseline. Without including the historical sales of EVs, the retrospective standard of 40 mpg is not maximum feasible for the gasoline- and diesel-powered fleet because it requires only 36.484 mpg.

The retroactive standard could not force manufacturers to sell more EVs because the sales are historical fact.

Similar reasoning can be applied going forward. Without a best assessment of the sales of AFVs, it is not possible to set maximum feasible standards for non-AFVs because that standard will not in fact require the expected fuel economy improvement for non-AFVs. To set maximum feasible fuel economy standards for gasoline- and diesel-powered vehicles, the agency must forecast the future sales of AFVs and include them in the baseline.

In short, the better approach is for NHTSA to prohibit the CAFE model from converting existing non-AFVs to EVs or introducing new EV models as a strategy for meeting new fuel economy standards. However, EVs would be included in calculating the baseline.

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IV. ENDING CREDIT TRADING IS INEFFICIENT AND LIMITS CONSUMER CHOICE

The CAFE standards are technical performance standards. They require vehicle manufacturers to meet a measurable fuel economy requirement for the vehicles they produce while allowing manufacturers to choose the technologies and methods necessary to meet the standard (Yeh et al., 2021). The 2007 Energy Independence and Security Act enabled NHTSA to establish a system of credit trading among manufacturers for model year 2011. Credit trading allows manufacturers who exceed standards to earn credits they can sell to manufacturers who fail to meet standards.

a. Credit Trading Is an Environmental Success Story

A well-designed competitive credit trading system improves the economic efficiency of standards by equalizing the (marginal) cost of compliance across manufacturers and thereby achieving industry-wide compliance at the lowest cost (Baumol and Oates, 1971). According to economic theory, the efficiency of tradable permit systems does not depend on how permits are initially allocated (Montgomery, 1972).

Tradable technical performance standards in the U.S. date back to Congress' 1990 amendments to the Clean Air Act. Credit trading systems have established a record of successfully accomplishing environmental goals at lower cost. Allowing inter-firm credit trading combined with emissions standards reduced both the costs and time required to comply with sulfur dioxide emissions regulations to control acid rain in the U.S. (Siikamäki, et al., 2012; Carlson et al., 2000). A 1998 review published by the American Economics Association concluded:

> "An efficient market for emissions permits developed in a few years, and this program more than achieved its early goals on time, and it cost less than had been projected." (Schmalensee et al., 1998)

Also known as cap-and-trade systems, tradable performance standards have been successfully applied to solve numerous other environmental problems, including phasing lead out of gasoline, the Regional Clean Air Incentives Market in California, trading nitrogen oxide credits in the Eastern U.S., northeastern states' Regional Greenhouse Gas Initiative, California's GHG cap and trade system under AB-32, and the European Union's Emissions Trading System (Schmalensee and Stavins, 2017). The leaded gasoline phasedown trading program accomplished its goal faster than expected, reduced costs by an estimated 20% (Hahn and Hester, 1989; U.S. EPA, 1985) and induced adoption of cost-effective technology (Kerr and Newell, 2003). The California Regional Clean Air Incentives Market saved and estimated $1 billion per year, and the NOx credit trading program was estimated to have achieved cost savings of 40% to 47% (Schmalensee and Stavins, 2017, Appendix Table 1).

b. *Experience with Tradable CAFE Credits*

Firms will not trade credits if there is no advantage to doing so. An initial analysis of the economic benefits of CAFE credit trading estimated that interfirm credit trading would reduce the industry-wide cost of compliance with CAFE standards by 10% (Rubin et al., 2009). After the establishment of the CAFE credit trading system in 2011, credit trading increased rapidly as the standards were raised, and manufacturers took advantage of the opportunity to reduce costs (Figure 1). An early evaluation of the combined EPA GHG and NHTSA CAFE standards called for close coordination of the two systems to maximize their benefit and noted the importance of credit trading to lowering compliance costs as standards became more stringent (Leard and McConnell, 2017). Leard and McConnell (2019) urged NHTSA to account for credit trading in the agency's cost benefit analysis of future standards because of its potential to lower costs of compliance.

> "Credit trading lowers compliance costs by equating marginal costs of increasing fuel economy across manufacturers. Previous economic research has shown that marginal costs across manufacturers are quite heterogeneous, suggesting that the compliance cost savings from credit trading could be substantial. Prior literature using simulation-based methods estimates cost savings from credit trading to be between 15-20 percent." (Leard and McConnell, 2019).

Leard and McConnell (2021) analyzed the early years of CAFE credit trading and concluded that the trading appeared to be producing economically efficient credit prices, as expected.

Credit trading not only reduces the costs of compliance with CAFE standards but can also expand the range of vehicle choices for consumers. Manufacturers whose customers prefer high performance cars or highly powered trucks can fall short of fuel economy standards yet still offer their customers the products they prefer (Davis, 2026). Additional benefits due to associated criteria pollutant and GHG emissions reductions are likewise achieved at a lower cost.

Use of earned and traded credits has become manufacturers' preferred option for resolving shortfalls from fuel economy standards. Data reported by NHTSA (2019) indicate that from 2011–2017 manufacturers took advantage of credits of all types, both earned and traded, to resolve the great majority of instances in which they failed to meet CAFE standards. In 2011, the first year in which trading was allowed, 63% of shortfalls were resolved by credits. The percentage resolved by credits increased to 93% in 2012, 90% in 2013, 99% in 2014, 100% in 2015, 92% in 2016 and 92% in 2017. These percentages include both earned and traded credits. The importance of traded credits has increased over time. In 2023 (the most recent year for which data is available from NHTSA's Public Information Center website) trades among firms (shown in orange in Figure 1) accounted for the majority of manufacturers' options for resolving shortfalls (NHTSA, 2026).

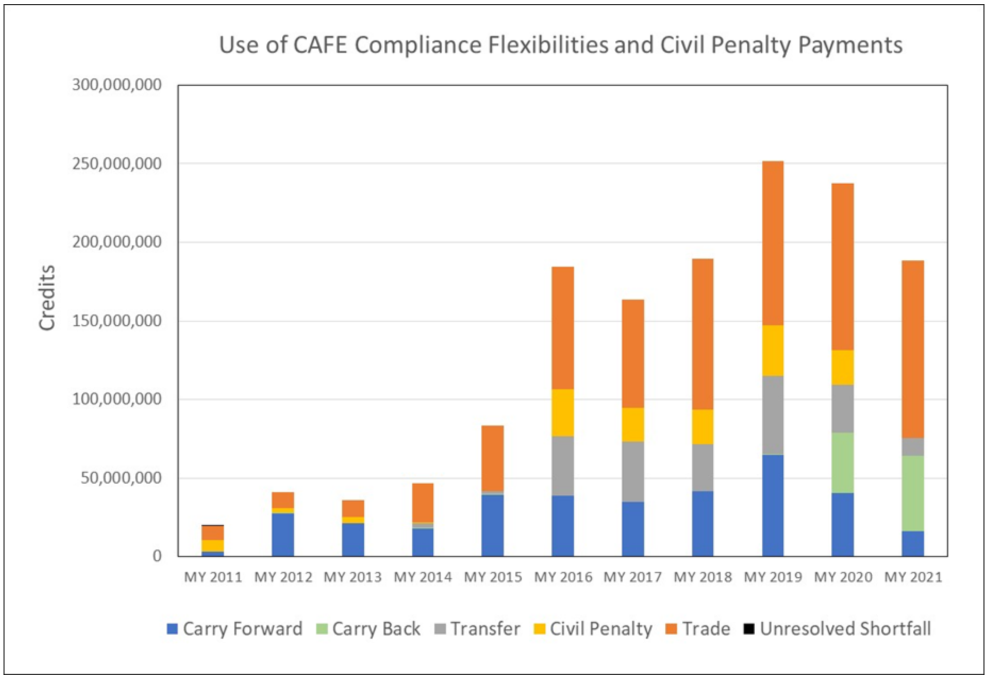

Figure 1. Use of Credit Trading and Other Compliance Options: 2011–2021 (NHTSA, 2026).

c. *Eliminating Credit Trading Undermines the CAFE Program's Purposes*

NHTSA's stated rationale for eliminating credit trading among manufacturers is to discourage using credits earned by manufacturers for selling dedicated alternative fuel vehicles, particularly electric vehicles. However, the CAFE law intended to encourage progress toward AFVs that could succeed in the marketplace.

> "While NHTSA does not consider the availability of credits or credit trading in establishing standards, the agency believes that eliminating inter manufacturer credit trading will encourage manufacturers to provide for steady improvement in fuel economy across their fleets over time, as opposed to relying upon credits acquired from third-party EV manufacturers." (NPRM, pp. 56445).

This goal is contrary to the intent of the CAFE laws with respect to dedicated alternative fuel vehicles. The intent of the law is not to discourage dedicated alternative fuel vehicles (AFV) from succeeding in the marketplace. In fact, it is the opposite. The intent is to prevent regulators from *requiring* manufacturers to sell AFVs, while at the same time stimulating technological progress and promoting consumer acceptance of AFVs.

Today, EVs are in the process of accomplishing the ambitions of the CAFE law. More than 1.5 million EVs (BEVs and PHEVs) were sold in the U.S. in 2024, approximately 10% of the U.S. light-duty vehicle market (AAI, 2025). Through the third quarter of 2025, 24.5% of light-duty vehicle sales in California were EVs (CEC, 2026). Eleven million EVs were sold in China in

2024, nearly half of total car sales in China (IEA, 2025). In the EU, sales of EVs surpassed those of internal combustion engine vehicles for the first time in December 2025 (Parodi, 2026).

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V. RETROACTIVE STANDARDS DISRUPT MANUFACTURERS’ BUSINESS PLANS

Vehicle manufacturers must plan their products years in advance and make investments to make those plans happen. NHTSA’s CAFE Model introduces fuel economy technologies according to manufacturers’ vehicle-specific schedules for refresh (for minor changes) and redesign cycles (for major changes). Redesign schedules vary across manufacturers and for product lines within a manufacturer, but the average length of time between full redesigns in the CAFE Model is 6.7 years (NHTSA, TSD, p. 2–23).

> “Redesigns are major investments, and require coordination of product development, manufacturing, and marketing and sales.” (TSD, p. 2–23)

Manufacturers’ plans to comply with CAFE standards include billions of dollars of investments in engineering design, capital, tooling, parts, and labor, as well as earning, selling, and purchasing CAFE credits. For example, NHTSA estimated the cost to manufacturers of meeting the 2024–2026 CAFE standards at $76.4 billion 2018 dollars (NHTSA, 2022, Table III-37). Retroactively changing standards, including lowering them, changes the conditions on which manufacturers’ business plans were based, denying firms the opportunity to adapt decisions made years ago to the changed standards.

The banking and borrowing provisions of the CAFE law link past, present and future; firms may carry credits and deficits forward five years and back three years. Some firms will have invested in technologies to earn fuel economy credits by exceeding required mpg levels, expecting to sell the credits earned to other firms. Lowering the historical standards can create credit surpluses for firms that would otherwise have credit deficits, reducing their future demand for credits and devaluing the credits held by firms that exceeded the standards. Other firms will have planned to exceed standards in the future and carry back credits to offset past shortfalls and made investments to enable future exceedances. Changing historical standards can make those investments unnecessary, thereby stranding capital. Other firms will have purchased credits and banked them in anticipation of using them in the future.

Retroactively lowered standards can have negative effects on manufacturers’ marketing strategies. For example, a firm that believes its customers prefer highly powered vehicles with less fuel economy technology may plan to use purchased credits to allow it to continue producing the types of vehicles it believes its customers prefer, while other manufacturers make vehicles with more advanced technology to meet or exceed standards. Lowering historical standards not only devalues the credits purchased by the firm but makes it easier for other manufacturers to also produce highly powered, lower-technology vehicles to more effectively compete in the firm's preferred market niche.

NHTSA's publicly available credit data show that by 2021 manufacturers had banked hundreds of millions of credits for future use (NHTSA, 2026). Because NHTSA does not report data on trades between firms or credit prices, it is not possible to directly observe trades and quantify the potential market-wide damage due to retroactively lowering historical CAFE standards. Also, because NHTSA's published credit data is not up to date, manufacturers' credit balances through only 2021 are publicly available. These balances, however, indicate that manufacturers on average were banking credits to be used in the future. Adjusting credit balances to passenger car equivalents using the formula for transferring credits between passenger cars and light trucks (CFR 49 B V § 536), the "Grand Total" of credit balances including years from 2016 to 2021 was +886 million in exceedances, -190 million in deficits for a net excess of 696 million. Valuing those credits at between $5.50 and $15.00 each (historical CAFE fine values) produces ranges of estimated value of +$4.9 to +$13.3 billion for the positive credits held and -$1.0 to -$2.9 billion for the deficits. For year 2021 credits, the market balances were +374 million, -94 million for a net of 279 million (rounded to nearest million), with estimated ranges of value of +$2.1 to +$5.6 billion for the exceedances and -0.5 to -$1.4 billion for the deficits. The proposed elimination of interfirm credit trading will seriously erode the value of the credits manufacturers have banked.

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VI. CONJECTURAL IMPLICIT OPPORTUNITY COSTS ARE UNSUPPORTED BY ECONOMIC THEORY OR EMPIRICAL EVIDENCE

NHTSA's proposed rule asserts that the existing CAFE standards will cause large, unobserved "Implicit Opportunity Costs" (IOC). Opportunity costs are defined as the benefits foregone when one option is chosen over another. To evaluate opportunity costs, the costs and benefits of all relevant options must be calculated and compared. The agency provides no empirical evidence for its assumed costs and uses a method to estimate them which is not consistent with economic theory. In previous rules, the agency has declined to try to quantify such costs, noting that it lacks the data and modeling capability. Whether or not opportunity costs exist depends on the unresolved questions of whether consumers undervalue future fuel savings and, if so, by how much (see, e.g., NASEM, 2021, Ch.11.3 and NASEM, 2015, pp. 311–318 for confirmation), and how advanced fuel economy technologies may change engineering tradeoffs. Correctly estimating the opportunity costs of vehicle attributes that might be foregone as a result of fuel economy regulations requires analyzing and quantifying two factors: 1) the engineering tradeoff between fuel economy and the other attribute and 2) consumers' willingness to pay (also known as demand) for the attribute. NHTSA makes no attempt to analyze the first and presents an inadequate and misleading analysis of the second.

The decision to include IOCs in the proposed rule has a very large impact on the agency's cost-benefit analysis, as shown below. Reversing NHTSA's historical position on such an important topic requires a thorough assessment of the evidence for and against the decision. Instead, the proposal presents a superficial review of the literature on consumer valuation of fuel economy, a misinterpretation of the few sources they do present, no assessment of engineering tradeoffs, and a methodology that is inconsistent with established economic theory.

a. The Conjectural IOCs Have a Large Impact on the Agency's Cost-Benefit Analysis

When NHTSA's CAFE Model estimates the effects of technologies on a particular vehicle's fuel economy, it assumes that other attributes consumers value must not be increased or diminished but held constant. The model then applies the technology to increase fuel economy, taking into consideration other technologies already applied to the vehicle, and adds the fully marked up cost of the technology to the vehicle's price. In an unregulated, competitive market, a technology like turbocharging, for example, could be used to increase horsepower instead of or in addition to increasing fuel economy. However, the CAFE Model has not been designed to estimate what attributes in addition to fuel economy might be produced, or how much of each, or how the cost should be apportioned between fuel economy and other attributes. The Technical Support Document notes this fact, referring to the value of alternative attributes not produced as an "opportunity cost."

> "These simplifying assumptions combine to make the Model unsuitable for some purposes, including directly measuring the opportunity cost of meeting fuel economy standards." (TSD, p. 6–8)

Having acknowledged this feature of the CAFE Model, NHTSA proposes an alternative, *ad hoc* method of estimating the IOC of attributes foregone by applying technologies solely to improve fuel economy while preserving other attributes. The method proposed and used in the cost-benefit analysis is inconsistent with established economic theory as well as the key tenets of behavioral economics. This is important because the estimated IOCs are large relative to fuel savings and other private costs and are also large relative to the estimated net benefits of the proposed standards.

Selected, relevant categories of costs and benefits for the Preferred Alternative taken from the NPRM are shown in Table 1 in billions of 2024 dollars. The first two columns show costs and benefits for the lifetimes of light-duty vehicles produced through 2031, while the rightmost two columns show larger benefits for all light-duty vehicles on the road through calendar year 2050. The present value of future costs and benefits discounted at 3% per year are larger than those discounted at 7%, as expected. In all cases, IOCs are relatively large: 27.5% to 36.5% of total private costs, 49.2% to 64.3% of total fuel savings, and 76.1% to 116.0% of net benefits. Thus, the IOCs by themselves can make the cost-benefit analysis look favorable or unfavorable. Because the full prices of fuel economy technologies are included in the cost-benefit analysis, and because the IOCs may be positive, negative, or zero as explained below, valid estimates of IOCs are critical to the validity of the overall cost-benefit analysis.

Table 1. Importance of IOCs Relative to Other Key Cost-Benefit Estimates (Billion 2024$)

Billion 2024$	Table IV-26 Light-Duty Fleet Through Model Year 2031		Table IV-27 On-Road Fleet Calendar Years to 2050	
Cost-Benefit Category	Discount Rates			
	3%	7%	3%	7%
Implicit Opportunity Costs	-26.5	-16.9	-119.2	-57.4
Total Private Costs	-86.4	-61.5	-326.4	-182.6
Fuel Savings	-53.9	-34.2	-185.4	-100.6
Net Benefits	+24.0	+22.2	+102.8	+62.1

b. NHTSA's Method Is Not How the Value of Foregone Attributes Should be Measured

A theoretically correct method of estimating consumers' loss of utility due to restricting the use of technologies to produce only increased fuel economy would begin by identifying attributes of vehicles valued by consumers for which a trade-off with fuel economy exists and rigorously describing the engineering trade-off. Instead, in the TSD NHTSA casually suggests a highly questionable list of attributes that might be traded off for fuel economy because of CAFE standards but makes no effort to rigorously define or explain the engineering tradeoffs.

> "These attributes include occupant protection and other safety features, vehicle size and carrying capacity (for both passengers and luggage or cargo), ride comfort, and

> performance attributes, such as acceleration, power braking, and maneuverability. Many of the technology investments that manufacturers make to improve vehicles' efficiency in converting stored fuel energy to mechanical propulsion could instead be directed toward improving some or all these other attributes." (TSD, p. 6-4, 6-5).

The final sentence of the above quote seems to imply that the opportunity cost arises at least in part from the diversion of limited capacity to invest in improvements. That is, NHTSA suggests that requiring investments in fuel economy technology would make manufacturers unable to invest in other improvements for which consumers are willing to pay. This implies that automobile manufacturers lack access to capital to produce attributes for which consumers are willing to pay. NHTSA provides no supporting evidence for this and perhaps did not mean to imply it. If consumers are willing to pay for improvements, it would be a market failure if capital were not available to manufacturers to make such improvements. If capital investments are required to improve occupant protection and other safety features, ride comfort, power braking, handling, advance collision warning, leather seats, enhanced stereo systems, or any other attribute for which consumers are willing to pay, manufacturers should be able to access the necessary capital.

It is stranger still that NHTSA would list vehicle size as a trade-off with fuel economy because the standards are functions of vehicle size (footprint) that NHTSA has intentionally designed to remove incentives to upsize or downsize vehicles as a means of complying with standards. The footprint functions enable manufacturers to increase or decrease vehicle size without penalty, thereby removing the incentive to trade off fuel economy for vehicle size.

NHTSA's safety analysis of the standards indicates that the footprint functions are also likely to nullify any effects of the standards on safety through changes in vehicle mass. NHTSA estimates that its proposed lowering of the existing standards will cause an increase of 27 fatalities attributable to changes in vehicle mass (NPRM, Table IV-30, p. 56576). The estimate of +27 fatalities is 0.069% of the 39,345 traffic fatalities in 2024 and is a highly uncertain estimate well within the margin of error of estimation. In addition, safety features required by regulation are included in NHTSA's analysis:

> "There are no safety standards with compliance dates within the timeframe of this proposal expected to impose further effects on light-duty vehicle mass." (NPRM, p. 56586)

There is no explanation of how safety features such as forward collision avoidance, blind spot monitoring or lane-keeping might affect fuel economy, nor is there any explanation of how power-braking or maneuverability might be materially affected by vehicle fuel economy. If NHTSA expects other attributes to affect vehicle mass, or rolling resistance or aerodynamic drag, it must specify the changes in vehicle design and calculate the fuel economy trade-offs.

c. NHTSA's Method Is an Ad Hoc Conjecture

Instead of conducting a thorough and rigorous analysis, NHTSA used an *ad hoc* method that makes IOCs large by assumption:

> "NHTSA approximates that cost by assuming it must be large enough to account for buyers' apparent unwillingness to purchase models offering higher fuel economy even when the resulting savings in their future costs would repay their higher purchase price." (TSD, p. 6-9)

NHTSA assumes without evidence that the apparent undervaluing of fuel economy must be due to implicit opportunity costs. In previous rules, NHTSA assumed that car buyers were willing to pay for only 30 months of undiscounted fuel savings, rather than their full discounted present value over the lifetime of a vehicle (e.g., NHTSA, TSD, p. 4-6). They cited manufacturers' statements to them as a primary justification:

> "This assumption was based on what manufacturers communicated to the agency in the past about how they believed buyers value future fuel savings." (TSD, p. 4-6)

Similarly, NASEM (2015) stated:

> "During its information gathering process, the committee found that auto manufacturers perceive that typical consumers would pay upfront for only one to four years of fuel savings, a fraction of the lifetime discounted present value." (NASEM, 2015, p. 315)

In the proposed rule, NHTSA changes the payback period from 30 months to 36 months and additionally assumes that consumers actually valued 75% of lifetime present value fuel savings, but that IOCs made it appear that they valued only 36 months. This assessment is based on a selective misinterpretation of the empirical, peer-reviewed literature. The TSD (p. 4-7) presents the table below as evidence. The table contains only a small fraction of the available peer reviewed studies of consumers' willingness to pay for fuel economy. Helfand and Wolverton (2011) reviewed 25 studies of consumers' willingness to pay for fuel economy and classified 12 as showing undervaluing, 8 as about right and 5 as overvaluing relative to the lifetime present value. In a meta-analysis of willingness to pay for vehicle attributes, Greene et al. (2018) analyzed 52 studies (including many of those reviewed by Helfand and Wolverton) that presented 117 estimates of consumers' willingness to pay for reducing vehicle's fuel costs. The meta-analysis documents an implausibly wide range of marginal willingness to pay (MWTP) estimates, with approximately 98% of the variance due to differences in the studies' assumptions, data sources, and methods of inference.

The seven studies shown in the TSD table below also omit a recent peer-reviewed study that found that consumers value between 16% and 39% of lifetime present value fuel savings (Gillingham et al., 2021). Worse still, for studies in the table that reported the number of months of undiscounted savings for which consumers were willing to pay but not a percent of lifetime fuel cost savings, NHTSA ignored the studies' findings. There is obviously a strong correlation between the two metrics; the shorter the "Payback Period" the smaller the "Percent of Lifetime Fuel Cost Savings" included. Using the four studies with both measures to infer the relationship between payback period and percent of fuel savings[2], and adding Gillingham et al.'s estimate as 28%, produces a mean of 52% and median of 45% for the nine estimates, not 75%. Even omitting Gillingham et al. (2021), which there is no reason to do, gives a mean and median of 55% and 51%. Although NHTSA offers no precise estimation method, statements in the TSD (p.4-6) imply that the number 75% was derived by assuming that the percentages in table 4-2 range from 50% to 100% and taking the midpoint of that range, a misrepresentation of what the seven studies in the table indicate, in part because the payback months are ignored. Had NHTSA assessed all available peer-reviewed studies, included Gillingham et al.'s (2021) estimates, or even reasonably considered just the seven studies listed in their table, they could not justify their estimate of 75%.

Table 2. Literature Cited by NHTSA to Support its Estimate of 75% Valuation of Fuel Savings

Table 4-2: Payback Periods Implied by Recent Research on Car Buyers' Behavior[522]

Author(s) (Publication Date)	Scope	Approximate Equivalent Payback Period (months)	Percent of Lifetime Fuel Cost Savings
Greene, Evans, and Hiestand (2013)[523]	Interviews of new car shoppers and buyers	24-36 months*	
Allcott and Wozny (2014)[524]	Used cars	60 months#	45% (at 3% DR)
Busse, Knittel, and Zettelmayer (2013)[525]	New cars	120 months to > full-vehicle lifetime#	54%-87% (at 3% DR)
	Used cars	72 months#	
Sallee, West, and Fan (2016)[526]	New and used vehicles	> Full-vehicle lifetime*	101% (at 5% DR)
Leard (2018)[527]	New vehicles	48 months#	
Leard, Linn, and Zhou (2023)[528]	New vehicles	72 months#	69% (at 5% DR)
Leard, Linn, and Springel (2023)[529]	New vehicles	36 months*	

*Reported by author(s).

Estimated by NHTSA staff using current CAFE Model data on mileage accumulation and survival probability by vehicle age; assumes buyers do not discount future fuel savings. When ranges of estimates are reported in a study, NHTSA staff included the midpoint of the range in the table above.

Furthermore, NHTSA's CAFE model contradicts their 75% estimate and more closely approximates manufacturers' opinions. The TSD states that the change from using a 30-month payback period to 36-month period in the CAFE model is based on comparing the model's predictions with actual technology adoption rates.

[2] A quadratic function was estimated using the four points without % estimates: $0.020245+0.008985x-0.000021x^2$. $R^2=0.95$. The paired (months,%) predictions were: (30,27%) (72,56%) (48,40%) (36,32%).

> "In addition to reconsidering the academic literature on the topic, NHTSA examined the agency's historical 30 month assumption by comparing past predictions of technology adoption by the CAFE Model with observed penetration rates. NHTSA compared its analysis under several competing payback period assumptions and found that a 36-month assumption performed well relative to significantly longer or shorter payback periods." (TSD, p. 4-7)

Thus, NHTSA's CAFE Model is most consistent with manufacturers acting as if consumers were willing to pay for 36 months (about one third) of the lifetime present value of fuel savings.

Regardless of NHTSA's incomplete and flawed interpretation of the available evidence on consumers' willingness to pay for improved fuel economy, NHTSA's method of estimating IOCs is inconsistent with economic theory because it assumes that the potential for fuel economy technology to produce other attributes reduces consumers' willingness to pay for fuel economy. Consumers' willingness to pay for fuel economy is by definition their demand function for fuel economy. It is a consequence of consumers' preferences, the income they have available to allocate among goods and services, and the prices of goods and services. NHTSA's method confuses consumers' willingness to pay (demand) for fuel economy with the result of the interaction of supply (production of vehicle attributes) and demand (willingness to pay for those attributes) in the market for vehicles. NHTSA assumes that the potential to produce another attribute, such as acceleration, reduces consumers' willingness to pay for fuel economy. But that is not consistent with the definition of opportunity cost. The opportunity cost, if there is any, of applying technology to produce only fuel economy is the difference between the consumers' satisfaction with the amount of fuel savings minus its cost, and the consumers' satisfaction with applying the technology to provide some amount of fuel economy and some amount of another attribute, say acceleration, minus the cost of doing that. NHTSA's formula is a willingness to pay estimate minus another willingness to pay estimate and bears no logical relationship to the economic concept of opportunity cost.

Furthermore, careful consideration of the factors influencing consumers demand for fuel economy indicates that adopting fuel economy technologies to improve fuel economy while holding other attributes constant may have positive or negative opportunity costs. According to NHTSA's estimates, technology adoption in the No-Action case produces fuel savings that exceed their costs, relative to the Preferred Alternative 2 (see Table 1). This means that consumers' real incomes would increase in the No-Action case because they could spend the excess of savings minus costs on other goods and services. NHTSA provides no evidence that there are alternative uses of the same technology that would give consumers greater satisfaction by producing fuel economy plus other attributes. Below this report presents evidence that adopting advanced fuel economy improving technologies could decrease the cost of increasing a vehicle's rate of acceleration by changing the shape of the tradeoff function between fuel economy and acceleration. Thus, it is possible that applying fuel economy technologies solely to improve fuel economy while holding other attributes constant could both increase consumers' incomes and decrease the cost of improving vehicle performance.

NHTSA presents a graphical analysis of the market determination of trade-offs between competing attributes. The text and graphics demonstrate that the agency understands the importance of technical substitution, and the distinction between supply-side technological trade-offs and willingness to pay. However, when it comes to proposing a theoretically sound method, the agency confounds the two, and it does not recognize that the trade-off function could change with changes in powertrain technology.

> "NHTSA recognizes that a complete analysis would incorporate both consumers' valuation of fuel savings and any loss in WTP attributable to sacrifices in other features made by manufacturers to comply with higher standards." (TSD, p. 4-7)

A theoretically sound method would explicitly consider the rates at which technology allows fuel economy to be traded off for specific other attributes based on engineering analysis, as well as consumers' willingness to pay for fuel economy and the attributes in question. The method NHTSA used does not do this. The effect of NHTSA's method is to artificially inflate the cost of fuel economy technology in the agency's cost-benefit analysis.

d. NHTSA Has Rejected the Conjectural Approach in Previous Rules

NHTSA has evaluated the question of opportunity costs of adopting fuel economy technologies since at least the 2008–2011 car and light truck rule. In 2009 the agency maintained that holding other attributes constant is sufficient to ensure that opportunity costs will be negligible:

> "First, the agency believes that manufacturers could meet the standards adopted in this final rule at the estimated compliance costs without noticeably affecting vehicle performance or utility." (NHTSA, 2009, p.355)

In subsequent rules NHTSA considered the possibility that there might be additional costs of requiring manufacturers to increase fuel economy but either declined to estimate them or relegated its admittedly speculative estimates to sensitivity cases. In two rules NHTSA and the EPA state that they are conducting research to develop more rigorous methods, but in later rules NHTSA acknowledges that the methods did not prove to be sufficiently reliable to be used in the agency's primary analysis. The agencies' inability to develop credible methods for estimating IOCs has apparently been hindered by two unresolved issues. The first is consumers' apparent undervaluing of future fuel economy benefits. NHTSA and EPA have long held that consumers appear to value only a minor share of the expected, discounted present value of fuel economy improvements over a vehicle's lifetime. Why this is the case and what it means for consumers' satisfaction with vehicles required by regulation to have increased fuel economy is an unresolved issue (see, e.g., NASEM, 2021, Ch. 11.3; Allcott and Sunstein, 2015; Greene, 2019). The second issue is that it has proven extremely difficult to quantitatively infer car buyers' willingness to pay for increases in vehicle attributes, in general. The existing peer-reviewed literature provides such a wide range of estimates, plausible and implausible, that the agencies have not been able to come up with defensible estimates (e.g., Greene et al., 2018).

In the Final Rule establishing CAFE standards for 2012–2016 MY cars and light trucks, NHTSA included sensitivity cases that assumed 25% and 50% of the lifetime fuel savings benefits to vehicle buyers would be offset by the opportunity costs of foregone other attributes. This method is very similar to what the agency adopted in the current proposed rule and likewise has no rigorous basis either empirically or theoretically. NHTSA decided against including such estimates in its primary analysis.

In the joint GHG and CAFE rule for MY 2017 and later vehicles, NHTSA and the EPA reasserted that their fuel economy technology cost estimates included maintaining other vehicle attributes constant and that that was sufficient. However, the agencies noted that they were in the process of developing an empirical model of car buyers' vehicle choices that would enable estimation of the net change in consumers' welfare from changes in vehicle prices, fuel economies, and other attributes. The agencies stated that the project had not been completed in time for use in the 2017 and later rule making (NHTSA, 2012, p. 62988). The agencies again included a sensitivity analysis based on the 25% and 50% assumptions.

In the combined CAFE and GHG rule for 2021–2026, the two agencies once again did not include an "implicit opportunity cost" for foregone other attributes in their primary analysis (NHTSA/EPA, 2020, p. 24701–24702). However, the agencies did estimate a sensitivity case including such costs. The method used was again similar to that of the current proposed rule. The agencies assumed that consumers would value 30 months of undiscounted fuel savings. They further assumed that:

> "…the value of other vehicle attributes must be greater than the fuel savings for the remaining term of the useful life of the vehicle—as these are fuel economy savings that consumers are clearly willing to forego."

No empirical evidence of this assertion was provided. In fact, the agencies obtained their estimate of the IOC as the undiscounted value of the first 72 months of fuel savings minus that of the first 30 months.

In the Final Rule for 2024–26, NHTSA (2022, p. 25857) decided not to include estimates of IOCs, stating:

> "NHTSA acknowledges that the opportunity cost of regulations on other vehicle attributes is an under-researched topic and relies heavily on economic theory, and for this reason, we are excluding estimates of this particular theoretical opportunity cost in its (sic) primary analysis."

Again, the agency included a sensitivity analysis of opportunity costs in its FRIA but stated,

"…NHTSA is not confident that the assumptions used to generate this estimate are sound." (NHTSA, 2022, p. 25857)

"The sensitivity estimate should be considered as an overestimate of the potential effects, and is not sufficiently robust to include in the main analysis. Opportunity cost from other vehicle attributes, to the extent it exists, may be small."

In the Final Rule for 2027 and beyond, NHTSA pointed out that when fuel economy standards were constant from 2000 to 2010 real world fuel economy increased at 1.2% per year, weight increased at 0.4%/yr., and 0–60 mph acceleration time decreased at -0.8%/yr. The agency compared this with the period from 2010 to 2023 when standards were increased substantially and fuel economy increased at a higher rate of 2.4% per year, yet weight increased at an almost identical but slightly higher rate of 0.5%/yr. and 0–60 mph acceleration time decreased even more rapidly at an average rate of -1.4%/yr. The agency noted that these "headline" numbers do not suggest that other attributes valued by consumers were foregone. The agency concludes that the original assumption of holding other attributes constant remains the best approach.

"Since NHTSA believes that its assumption of performance neutrality is a reasonable approach to modeling compliance, and since alternative approaches would introduce highly uncertain effects (with unknown directionality) and are currently infeasible, NHTSA has chosen to maintain its assumption of performance neutrality." (NHTSA, 2024, p. 52691)

e. Reducing Acceleration Requires Little Sacrifice of Fuel Economy

In general, fuel economy can be traded off for acceleration. Newton's second law of motion describes how acceleration (a) can be increased either by increasing the force applied (F) or decreasing the mass (m) of the object being accelerated.

$$F = ma \Rightarrow a = \frac{F}{m}$$

However, engine and transmission technologies that improve fuel economy can change the relationship between fuel consumption and acceleration. Full vehicle simulation modeling has shown that advanced powertrain technologies can further reduce the tradeoff between fuel economy and acceleration. When the application of fuel economy technology changes the tradeoff rate, especially if it reduces it, the result could be positive, negative, or no opportunity costs.

The automotive engineering literature provides useful evidence on the tradeoff between 0–60 miles per hour (mph) acceleration times and fuel consumption (gallons per mile, gpm, the inverse of fuel economy). Using a full vehicle simulation model, Moskalik and Newman (2020) derived trade-off rates for various engine technologies and compared their estimates to estimates derived by others via simulation or statistical analysis. They concluded that: 1) the rate at which acceleration can be traded off for fuel economy has been declining over time and, 2) an appropriate rate of technical substitution for 2013 model year gasoline direct-injection engine vehicles with a 6-speed transmission is approximately a 3% increase in fuel consumption (gpm) on the combined federal test cycle for a 10% reduction in 0–60 mph time. Using the US06 test cycle which has more realistic driving behavior, they estimate a 1.5% increase in fuel consumption for a 10% reduction in seconds from 0–60 mph. Nevertheless, both estimates indicate that manufacturers can provide a relatively large reduction in acceleration time for a relatively small loss of fuel economy, the loss being smaller in actual driving than on the combined city and highway test cycles used for compliance with CAFE standards and in compliance estimation in NHTSA's CAFE Model. The SAE analysis also found that future (relative to 2013), more energy efficient engine technologies could further reduce the tradeoff between acceleration and fuel consumption to -0.14 on the combined cycle and -0.017 on the US06. In that case, as NHTSA asserted in its 2024 Final Rule, adding cost-effective technologies that substantially increase fuel economy could lower the cost of providing additional acceleration performance. (NHTSA, 2024, p. 52691). When fuel efficient drive train technologies change the tradeoff between fuel economy and acceleration, it is not clear whether there would or would not be any opportunity costs to increasing fuel economy.

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VII. THE COSTS OF FULL HYBRIDS ARE OVERESTIMATED

According to NHTSA’s estimates, strong hybrid electric vehicle technology (SHEV, also known as HEVs or full hybrids) can reduce fuel consumption by 30–50% (TSD, Figure 3-12, p. 3-65). This makes gasoline-only hybrid electric vehicles the single most impactful petroleum-fueled fuel economy technology in NHTSA’s database. NHTSA’s estimates of hybrid technologies’ impacts on fuel consumption are accurate and consistent with other sources (e.g., NASEM, 2021, Table 4.5; Isenstadt and Slowik, 2025, Fig. 4). However, except for battery costs NHTSA’s estimates of hybrid component costs are out of date and therefore overestimated. The TSD cites two sources from 2011 (FEV, 2011) and 2017 (DOE, 2017) as the sources of their estimates. The cost estimates are excessively high and contradicted by current and recent historical market price comparisons. NHTSA’s incremental price estimates for medium-car and small SUV power split hybrids in 2024$ are about $5,000, while price increments for P2 hybrids are lower, about $3,000. Recent evidence indicates that NHTSA's power split price premiums are approximately three times current market prices, while the P2 markups are inflated by about $1,000. The overestimated hybrid prices have an important effect on the benefit-cost analysis of the proposed rule because HEV market shares increase to over 50% by 2031 even in the Preferred Alternative 2.

NHTSA's hybrid cost estimates have been strongly criticized in past rulemakings (e.g., NHTSA, 2020, pp. 24521–24523). NHTSA may attempt to defend its cost estimates by: 1) citing the outdated studies on which they are based as the best available, 2) asserting that studies like NASEM (2021) omit certain components, 3) arguing that manufacturers' suggested retail price (MSRP) comparisons are not valid estimates of fully marked up manufacturing costs or 4) by arguing that manufacturers are subsidizing hybrids to meet fuel economy and GHG standards. Costs based on 15-year-old tear-down studies miss three generations of hybrid technology improvements. NASEM's (2021) cost estimates may categorize components differently but include all important components and enjoy the support of the most experienced hybrid vehicle manufacturer. While MSRPs are not transaction prices, vehicles and options like hybrid drivetrains sell both above and below MSRP. In general, if MSRPs deviate from transaction prices it is typically but not always as an overestimate, by 5% to 10%. When fuel economy standards induce significant credit prices, manufacturers may subsidize high fuel economy vehicles. However, hybrid costs have been consistently declining over time even when standards are raised.

An analysis of NHTSA's cost estimates for P2 and power split hybrids below identifies excess electrical component costs as the key factor inflating the cost of power split hybrids in NHTSA's analysis. With respect to the validity of MSRP comparisons, the volume of historical data showing falling HEV MSRPs and much lower incremental HEV costs (over 20 years and nearly 200 HEV non-HEV matched pairs) is now so substantial and consistent that it can no longer be ignored. Hybrid vehicle sales are now so substantial, especially for Toyota, the leading manufacturer of power split hybrids, that large cross subsidies are highly unlikely. With total U.S. sales of 2.45 million over the twelve months from 10/24 to 9/25, a subsidy of only $1,000 per vehicle would cost manufacturers $2.45 billion per year. None of these factors can explain NHTSA's greatly inflated hybrid prices.

a. Strong Hybrids' Market Share Is Large and Growing

NHTSA's perception of consumers' acceptance of strong hybrids is likewise out of date and inconsistent with recent sales trends and evaluations in the trade press. Strong hybrid vehicles play a major role in NHTSA's proposed rule, accounting for more than half of total LDV sales by 2031. The proposed rule estimates that under the preferred alternative the market share of strong hybrid technology will increase from 10.4% in 2024 to 24.5% in 2025, 40.6% in 2026 and reach 46.2% in 2027, then gradually increase to 52.4% in 2031 (NPRM, Table V-4, p. 56598). The latest sales data shows that HEVs claimed 17.5% of the U.S. LDV market during the 12 months from 10/24 through 9/2025. The 17.5% share is up 30% (4 points) from the same period the previous year (AAI, 2026). Although final HEV sales for model year 2025 will not reach the 24.5% HEV market share estimated by NHTSA for 2025, combined electrified vehicle sales, including HEVs, PHEVs and BEVs will. Together they claimed 28% of the U.S. LDV market over the 12 months from 10/24 to 9/25 (AAI, 2026).

b. MSRP Comparisons Consistently Indicate Much Lower HEV Prices

For years, the DOE/EPA (2019-2026) website fueleconomy.gov has identified 40+ comparable hybrid and non-hybrid models' MSRPs. Vehicles that did not have a clearly comparable non-hybrid model, such as the Toyota Prius, or that could not be closely matched at the trim level to an ICE model were not included. The data includes power split hybrids like the Toyota Corolla Hybrid SE and P2 hybrids like the Kia Sportage Hybrid EX AWD. Combining the two types of HEVs is consistent with the findings of NASEM (2021, Table 4.7) and Isenstadt and Slowik (2025, Table 5) that the costs of the two systems should be within a few hundred dollars of each other for the same vehicle.

Manufacturers' pricing strategies introduce variability into even head-to-head comparisons of paired trim levels. And when CAFE standards are increasing, it is reasonable to hypothesize that manufacturers may subsidize HEVs to help achieve the standards. However, CAFE standards were constant from 2020 to 2023 yet incremental HEV MSRPs were slightly lower in 2022 and 2023 than in prior years. In the model year 2025 data, the smallest incremental MSRP for a HEV is $600 and the largest is $3,250. Estimates of mean and median price differences for full hybrids are shown for model years 2019, 2021-2023 and 2025 in Table 1. Manufacturers' suggested retail price (MSRP) differences are in 2024 dollars. The average and median 2025 hybrid price markups are consistent with media reporting: $1,617 and $1,600, respectively. Cars.com reported that the 2024 Toyota Corolla (a power split SHEV) cost $1,450 more than the equivalent non-hybrid version and that a hybrid Ford Maverick cost $1,550 more than the non-hybrid version. Other sources report ranges of incremental prices for hybrids of $1,400 to $3,000 (e.g., Brown, 2025; Atiyeh, 2025). Consumer Reports observed: "Today's average hybrid costs about $1,700 more, but the Ford Maverick pickup and Lexus NX SUV hybrids actually have lower sticker prices than gas-only versions." (Barry, 2025)

The DOE/EPA data shows mean and median on-road mpg benefits for hybrids of 49% and 48% respectively, which is consistent with NHTSA's effectiveness estimates. At today's gas prices ($3.37/gal.) and annual mileage of 13,000 the mean and median payback periods were 3.2 and 2.8 years, respectively.

Table 1. Additional MSRP, MPG Benefit and Payback Period for Full Hybrids: 2019-2025

	MSRP Difference (2024 $)	Fuel Economy Benefit (%)	Payback (yrs.)	Vehicle Pairs

Model Year	Mean	Median	Mean	Median	Mean/Median	Count
2019	$1,877	$1,657	+46%	+44%	3.8/3.8	37
2021	$1,899	$1,621	+49%	+49%	3.3/2.8	38
2022	$1,641	$1,394	+49%	+48%	3.1/2.7	37
2023	$1,361	$1,441	+46%	+44%	2.9/2.6	41
2025	$1,575	$1,607	+49%	+48%	3.2/2.8	42

Source: U.S. DOE/EPA, www.fueleconomy.gov, "Can a hybrid save me money".

Historical price trends show HEV prices falling over time. Isenstadt and Slowik (2025) tracked the MSRPs of succeeding generations of 12 popular strong hybrid vehicles on the market between 2001 and 2025. They found consistent and large cost reductions from one generation to the next for all models and years except the second generation of the Toyota Highlander in 2011 (Figure 1). The introduction of a new generation allows manufacturers to incorporate new technology, improved designs, and scale economies. The data show that generational changes are accompanied by price reductions of thousands of dollars. Isenstadt and Slowik (2025) also compared MSRPs of eighteen 2024 models with equivalent hybrid and non-hybrid models: the range of price differences was $500 to $3,720, with a mean of $2079 and a median of $1,800.

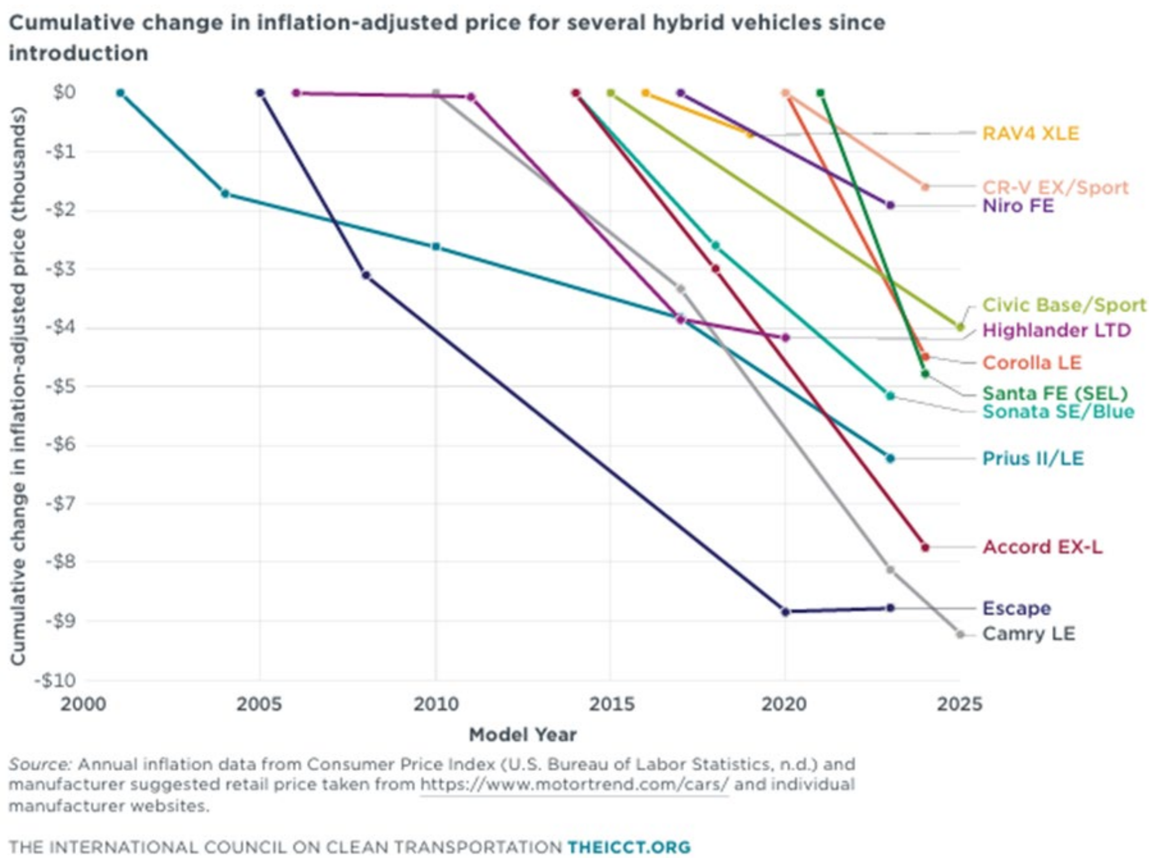

Figure 1. Cumulative change in inflation-adjusted price for several hybrid vehicles since introduction (Isenstadt and Slowik, 2025).

c. NHTSA's HEV Cost and Price Estimates Are Overestimated

In NHTSA's CAFE model, the incremental cost of converting a non-hybrid ICE to a strong hybrid varies with the non-hybrid's current engine and transmission. This is a sound methodology but makes generalizing about the incremental cost of hybrids more complicated. Since NHTSA's TSD (2025) presents detailed cost estimates for two vehicle types, medium-sized passenger car and small SUV (as does NASEM, 2021), the same vehicle types are considered here. The car and small SUV are assumed to have the same engine transmission configuration, a 4-cylinder turbocharged engine (TURBO1 in NHTSA terminology) and an 8-speed advanced automatic transmission (AT8L2). NHTSA provides cost estimates for the engines and transmissions for model years 2022 and 2026 in 2024$, which is converted here to 2024 by simple averaging. For example, the TURBO1 I4 engine full cost (including retail price equivalent, RPE, markup) is $7,808 in 2022 and $7,774 in 2026 (TSD Table 3-26), and the average is $7,791 for 2024. Similarly, the AT8L2 transmission RPE is $2,947.50 for 2024, giving a total powertrain price for both vehicles of $10,738.50.

The proposed rule's Technical Support Document, Table 3-68 summarizes NHTSA's strong hybrid cost estimates for a "Medium Car" and a "Small SUV". Cost estimates are shown for a parallel HEV with a turbocharged engine (P2TRB0) and a power split HEV (SHEVPS). Costs are shown as direct manufacturing costs (DMC), which must be multiplied by NHTSA's RPE markup of 1.5 to obtain an estimate of the retail price equivalent (RPE). The table includes only the costs of hybridization (including batteries and transmission) and does not include the cost of internal combustion engines. Battery costs are not itemized separately but are included as the difference between "Electrical Component Total Costs" and "Electrical Component DMC" (both are DMC). Contrary to other estimates that show approximately equal costs for the two systems (e.g., NASEM, 2021; Isenstadt and Slowik, 2025), Table 3-68 estimates that power split hybrids cost $1,700 (Medium Car) to $2,000 (Small SUV) more than parallel P2 hybrids (about $2,500 to $3,000 RPE). The two strong hybrid systems should have similar costs because they fulfill the same role, providing similar electrical power at similar voltages and require similar amounts of battery storage. In 2021, Toyota, the world's leading manufacturer of strong hybrid vehicles, advised NHTSA that its estimates of hybrid costs were too high and that the costs of P2 and power split systems should be similar.

> "NHTSA's estimated costs are significantly higher than Toyota's understanding based on our current products and experience developing and marketing hybrid systems over the last two decades."
>
> "Toyota's experience is that the relative cost of the power split and P2 systems depends on vehicle class and operational requirements, and that for many applications power split and P2 system costs are much more similar than NHTSA's estimates suggest." (Toyota, 2021, Attachment pp. 7–8)

The difference is essentially due to the estimated “Motor and Inverter” costs, which are $2,918 for the power split but only $637 for the P2. There is no reason why the cost difference should be anywhere close to that larger. The power split does have two electric motors instead of one, but the P2’s motor is more powerful, larger, and therefore more expensive than either power split motor. Over time, power split hybrids like those manufactured by Toyota have reduced the sizes of both motors and increased their speed (rpm) to maintain or increase torque, thereby reducing their cost (see Figure 1). NHTSA’s large cost difference stands in stark contrast to the National Academies’ cost estimates for P2 and power split motors. For a “Medium Car” in 2025, NASEM (2021, Tables 4.6 and 4.7) estimated $320 for the power split traction motor, $140 for the motor generator and $490 for power electronics and inverter (2018$). Converting the sum to 2024$ the cost of the two motors, inverter and power electronics is estimated to be $1,187, $1,700 less than NHTSA’s estimate. The NASEM report estimated the cost of the P2 motor at $240 and inverter and power electronics at $315, for a total of $555, $693 in 2024$, $494 less than the power split. NHTSA overestimated the power split’s motor and inverter costs by approximately $2,300.

The power split hybrid system pairs a high-compression ratio (Atkinson cycle) 4-cylinder engine (I4 HCR) with an eCVT transmission, while the parallel P2 hybrid combines a turbocharged I4 with the AT8L2 transmission. The hybrid system costs are from Table 3-68 of the TSD and are direct manufacturing costs (DMC) that have been multiplied by 1.5 to obtain the estimated RPEs in Table 2.

Table 2. Estimated Retail Prices of Strong Hybrids and Increment Versus Non-Hybrids (2024$ in 2024 Model Year).

Vehicle	Powertrain	Hybridization DMC Cost	Engine RPE	SHEV RPE	RPE Difference	Source TSD Tables
Medium Car I4	SHEVPS	$5,918	$6,724.50	$15,601.50	$4,861.00	3-29, 3-68
	P2TRB0	$4,211	$7,419.00	$13,735.50	$2,997.00	3-26, 3-68
Small SUV I4	SHEVPS	$6,210	$6,724.50	$16,039.50	$5,301.00	3-20, 3-68
	P2TRB0	$4,214	$7,419.00	$13,740.00	$3,001.50	3-26, 3-68

Source: Calculations by author using the TSD tables cited in the right-hand column.

NHTSA’s power split hybrid prices are approximately $5,000 more than a comparable non-hybrid gasoline vehicle, while the parallel P2 hybrid powertrain prices are about $3,000 more. Compared with the MSRP differences from fueleconomy.gov, NHTSA’s power split retail prices are about three times the observed MSRP differences and NHTSA’s P2 prices are almost double the MSRP difference. Compared with ICCT’s comparative prices, NHTSA’s power split price estimates are $2,900 to $3,200 higher and its P2 price estimates are $900 to $1,200 higher. In short, NHTSA considerably overestimates the costs of both powertrains.

NHTSA recognizes that from an engineering perspective, any light-duty vehicle can be fully hybridized if not with power split technology, then with parallel P2 technology. However, NHTSA's analysis makes SHEVs seem less economical than they are because P2 prices are almost twice the observed MSRP differences and power split prices are three times higher than market prices. With approximately one quarter of LDVs estimated to be hybrids in 2025 and 50% hybrid in 2031 in the Preferred Alternative 2, cost differences of $1,000 to $3,000 per car have an enormous impact on the cost-benefit analysis. Very roughly, NHTSA's baseline projects gasoline-only vehicle sales of about 12,000,000 vehicles in 2030. An error in the RPEs of hybrids of only $1,000 would add $500 to average per vehicle technology costs and create excess costs on the order of $6 billion in 2030 and approximately $20 billion over the five years from 2027 to 2031. For comparison, NHTSA estimated the industry average per vehicle technology costs at $2,104 for model year 2031 in the No-Action Alternative, and $1,179 in the Preferred Alternative. Overestimating hybrid costs directly inflates the technology costs of all the Alternatives. These excess costs have an important direct effect on new vehicle sales and indirect effects on stock turnover, fuel consumption, emissions, safety, manufacturer revenues, and employment. More realistic hybrid costs would have a major impact on the cost-effectiveness of all the Alternatives and favor substantially higher fuel economy improvements.

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VIII. OTHER ISSUES

a. Summary of Systematic Changes from Previous Rules

Section II on maximum feasible standards documents that NHTSA's analysis shows manufacturers exceeding its Preferred Alternative 2 standards by a wide margin. The changes NHTSA has assumed to justify such below maximum feasible standards are summarized below. Following that, the fact that the Proposed Alternatives reduce employment in the automotive industry, increase GHG and other pollutant emissions, and reduce energy security relative to the No-Action (existing standards) is reviewed.

1. **Removing AFVs, especially EVs from the baseline fleet**. NHTSA did this for the retroactive standards, the future standard setting period, and beyond. Including actual historical EV sales in the CAFE Model would make it easier for the manufacturers to

meet the existing standards and harder for NHTSA to show that the existing standards are not feasible.

2. **NHTSA set the social cost of carbon (SCC) at zero**. There is no scientific or economic basis for this decision. It biases the cost-benefit analysis against more stringent standards.

3. **NHTSA introduced Implicit opportunity costs** (IOC) into the primary cost-benefit analysis. These are a large factor working against the cost-effectiveness of more stringent standards. NHTSA repeatedly relegated IOCs to sensitivity cases in previous rules due to the lack of sound theoretical or empirical support.

4. **For strong hybrid (SHEV)** technologies, NHTSA continues to use **out-of-date high costs**, assume consumer resistance to gasoline-only SHEVs and impose outdated limits on the adoption of SHEV technology for highly powered vehicles. Strong hybrids using power split (e.g., Toyota, Ford) or P2 (e.g., Hyundai, Kia) hybrid technology increase fuel economy by about 50%; no other gasoline-only technology can do this. Hybrid costs have been coming down rapidly, by thousands of dollars MSRP, as new generations of technology replace older ones (Isenstadt and Slowik, 2025). For years, the DOE/EPA website fueleconomy.gov has paired 40+ comparable hybrid/non-hybrid models' trim level MSRPs. The average and median price differences in 2025 were $1,617 and $1,600, respectively. The mean and median on-road mpg benefits are 49% and 48% respectively. At today's gas prices, mean and median payback periods were 3.2 and 2.8 years respectively. The trade press backs up these numbers and NHTSA's own mpg effect estimates back up the mpg benefits. HEVs claimed 17.5% of the LDV market from 10/24 through 9/2025, up 30% from the same period the previous year (AAI, 2026). Still, hybrids reach about 40% market share in NHTSA's preferred alternative. From an engineering perspective, any light-duty vehicle can be hybridized. There should be more, less expensive hybrids in the proposed rule.

5. **NHTSA increased the rebound effect** by changing the elasticity from -0.1 to -0.15. The main effect of this is to reduce vehicle travel when mpg decreases in the Preferred Alternative 2. In the CAFE Model cost-benefit analysis more LDV travel is a net bad as externalities outweigh the private value of more VMT, so there are net benefits to reducing it. This makes the lower standards look better.

b. Employment and Other Economic Issues

The economic impacts NHTSA estimates for its Preferred Alternative can be surprising because nearly all manufacturers exceed the Preferred Alternative by a wide margin, as shown in the figure below from the PRIA. As a result, many of the impacts are those of a much higher fuel economy standard. This is discussed in section II above, on why the standards were not maximum feasible.

NHTSA's analysis predicts a small increase in sales in all the Alternatives to the No-Action case (Figure 1). The increase in sales is due to consumers undervaluing lost fuel economy benefits, combined with vehicle price reductions that are somewhat greater than the value of the undervalued fuel savings. While NHTSA assumes that consumers undervalue fuel savings at the time of new vehicle purchase, they recognize that all fuel savings are real by including them in social benefits in their cost-benefit analysis. If consumers were assumed to fully value the fuel savings at the time of purchase, sales would increase rather than decrease. This is important because there is not a consensus in the economics literature about whether and by how much consumers undervalue fuel economy, and whether CAFE standards might change the context of consumers' fuel economy valuation and thus increase consumers' perception of the value of higher fuel economy vehicles (see, e.g., NASEM 2021, Ch. 11.3; 2015 pp. 311–318).

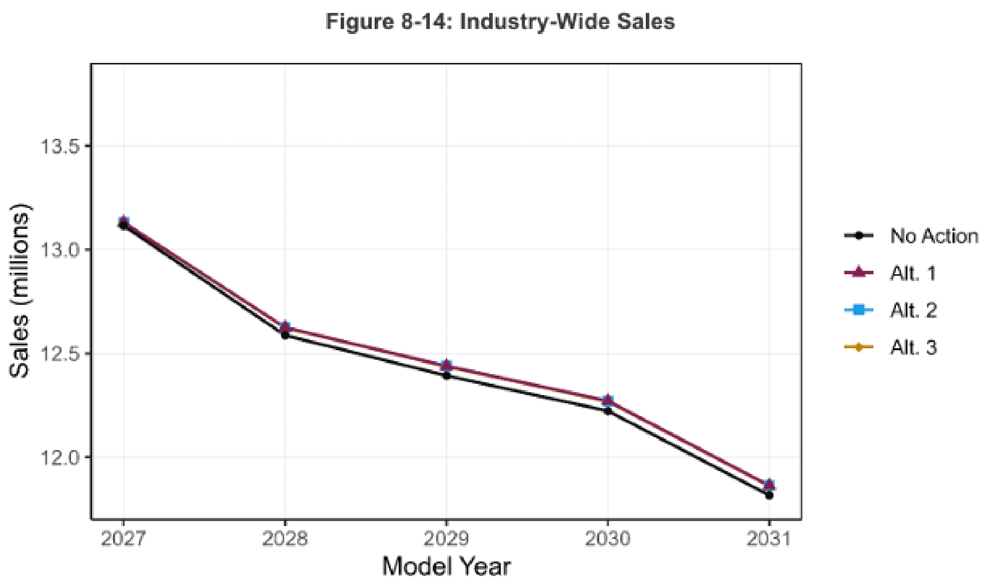

Figure 1. Industry-Wide Sales in the Alternatives and No-Action Case.

NHSTA also predicts fewer jobs in the automotive industry in the Alternatives than in the No-Action case because the removal of advanced technologies decreases employment more than higher sales increase it (Table 1). Although manufacturers' revenues are not reported in the rulemaking documents, the evidence shows they are lower in the Alternatives than in the No-Action case. Here's why. NHTSA assumes that all technology costs required by the standards are fully passed through to consumers as a price increase. The price increase reduces sales but with an elasticity of only -0.4 (a 10% increase in price causes a 4% reduction in demand). The inelasticity of new vehicle demand is a result of the interaction of used and new vehicle markets. When new car prices go up, that induces an increase in demand for used vehicles and an increase in used vehicle prices because new and used vehicles are substitutes and the supply of used vehicles is very inelastic. The increased price of used vehicles then increases demand for new vehicles somewhat, and that process continues until a market equilibrium is reached. The equilibrium effect of an increase in new car prices on new car demand is less than it would have been without the mediating effect of the used vehicle market. This was introduced in the previous rule due to a study by Prof. Mark Jacobsen of the University of California at San Diego that quantified the effect (Jacobsen, et al., 2021). Revenue equals price times quantity, so prices going up 10% and sales going down 4% gives (approximately) 1.1(100-4) = 105.6 or 5.6% more revenue. The additional revenue is spent on vehicles that have more content, in the form of added fuel economy technologies. The additional content requires more labor, capital, and material throughout the supply chain. NHTSA's analysis shows an increase in employment due to the increased expenditures in vehicle manufacturing.

Table 8-2: Industry-Wide Labor Utilization Effects (in Full-Time Equivalent Jobs)

Model Year	No-Action Alternative	Difference From No-Action		
		Alt. 1	Alt. 2	Alt. 3
2024	887,000	0	0	0
2025	865,000	0	0	0
2026	873,000	0	0	0
2027	874,000	-1,680	-1,690	-1,300
2028	846,000	-4,240	-4,250	-3,750
2029	834,000	-6,350	-6,350	-5,540
2030	824,000	-6,970	-6,970	-6,130
2031	797,000	-7,190	-7,190	-6,400
2032	774,000	-7,120	-7,120	-6,340
2033	793,000	-7,650	-7,650	-6,840
2034	781,000	-7,530	-7,530	-6,740
2035	770,000	-7,390	-7,400	-6,620
2036	765,000	-7,370	-7,370	-6,590
2037	759,000	-7,230	-7,230	-6,490
2038	755,000	-7,110	-7,110	-6,430
2039	750,000	-6,780	-6,780	-6,120
2040	746,000	-6,620	-6,620	-6,010
2041	740,000	-6,530	-6,530	-5,920
2042	735,000	-6,430	-6,430	-5,830
2043	727,000	-6,320	-6,320	-5,740
2044	723,000	-6,260	-6,260	-5,690
2045	718,000	-6,200	-6,200	-5,630
2046	713,000	-6,100	-6,100	-5,540
2047	708,000	-6,010	-6,010	-5,400
2048	700,000	-5,820	-5,820	-5,230
2049	693,000	-5,740	-5,740	-5,150
2050	684,000	-5,670	-5,670	-5,090

Table 1. Industry-Wide Employment Effects of the Alternative vs. No-Action Case

c. Environmental Effects

NHTSA's analysis also fails to include any costs from increasing GHG emissions or even to report changes in GHG emissions. Reducing GHG emissions reduces the impacts of climate change on the U.S. and other nations. Adding these benefits to the NHTSA's analysis would improve the cost-benefit analyses of all Alternatives and especially the No-Action case and make increased fuel economy more cost-effective. NHTSA also expects the Alternatives to have lower health benefits than the No-Action case (health costs increase) for all the alternatives (Figure 2).

The PRIA does not discuss emissions reduction in the context of the need of the nation to conserve energy. Apparently, NHTSA does not consider improving environmental quality a motivation to conserve energy. This is a clear break with past rulemakings that have valued all environmental benefits of CAFE standards, including GHG reductions.

The Alternatives also have smaller energy security benefits than the No-Action baseline due to the economy's increased exposure to oil price shocks as a result of increased petroleum consumption. The smaller energy security benefits are shown in NHTSA's Figure 8-23 (PRIA, p. 8-25). In the proposed rule, NHTSA considers only the potential effects of oil price shocks in calculating the energy security benefits of the standards (TSD, p. 6-34).

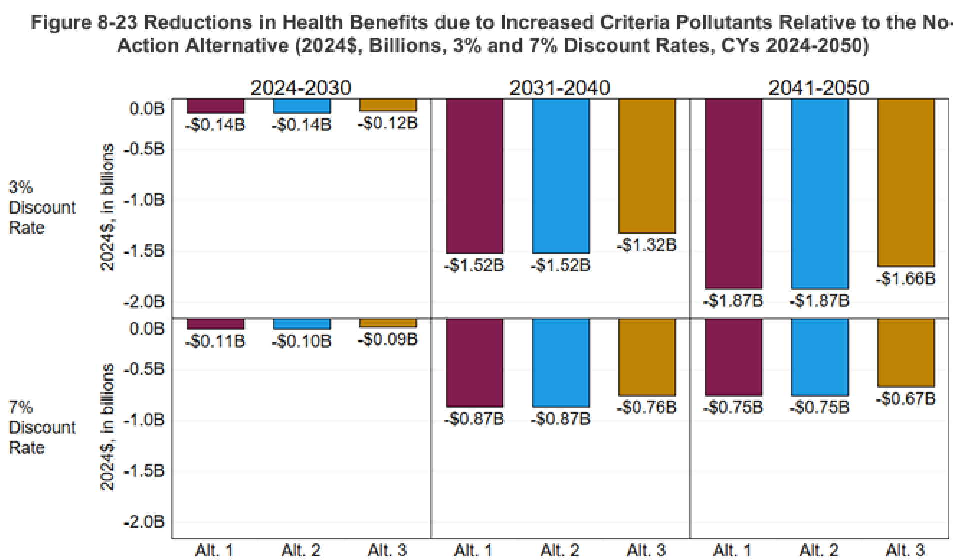

Figure 2. Reductions in Health Benefits due to Increased Criteria Pollutants vs. the No-Action Case.

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