DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Parts 523, 531, 533, 536, and 537

[NHTSA–2025–0491]

RIN 2127–AM76

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

AGENCY: National Highway Traffic Safety Administration (NHTSA).

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: NHTSA, on behalf of the Department of Transportation (DOT), proposes to substantially recalibrate the Corporate Average Fuel Economy (CAFE) program to realign this program with Congressional intent. That recalibration includes proposing to amend DOT's fuel economy standards for light-duty vehicles for model years (MYs) 2022–2026 and MYs 2027–2031. Consistent with statutory requirements, the fuel economy standards proposed in this rule are founded on light-duty vehicles powered by gasoline and diesel fuels, a category that includes non-plug-in hybrid vehicles. In formulating the proposed standards, NHTSA has not considered, consistent with law, the imputed fuel-economy performance of battery-powered electric vehicles (EVs) or the electric operation of vehicles that use plug-in hybrid electric powertrains, nor compliance credits or adjustments to the two-cycle fuel economy test procedures to account for air conditioning and off-cycle technologies. NHTSA also is proposing to eliminate the inter-manufacturer credit trading system and to amend the light-duty vehicle fleet classification system to allocate vehicles into passenger and non-passenger automobile fleets appropriately, based on their attributes and capabilities, starting in MY 2028. Elimination of unlawful considerations, combined with several of the proposed changes, would significantly improve the capabilities of manufacturers to meet fuel economy standards, better align the program with Congressional intent, and reduce manufacturer incentives to design vehicles and add features that are not desired by American consumers and that have questionable real-world fuel economy benefits. NHTSA is therefore proposing to set fuel economy standards that increase from newly proposed MY 2022 standards at a rate of 0.5 percent per year through MY 2026, followed by 0.25 percent per year through MY 2031, with MY 2027 stringency established as a bridge between the two sets of standards. The reduced stringency increases in later years, coupled with a reevaluation of the coefficients that define the functions governing fuel economy standards, are intended to establish maximum feasible standards in a manner that gains real-world fuel-economy-benefits, while enabling the industry to adapt to the proposed substantial recalibration of the CAFE program. NHTSA projects that the amended standards would correspond to the industry fleetwide average for all light-duty vehicles of roughly 34.5 miles per gallon (mpg) in MY 2031.

DATES:

Comments: Comments are requested on or before January 20, 2026. See the **SUPPLEMENTARY INFORMATION** section on ''Public Participation,'' below, for more information about written comments. In compliance with the Paperwork Reduction Act, NHTSA is also seeking comments on a modification of an existing information collection. For additional information, see the Paperwork Reduction Act section under Section VIII below. All comments relating to the information collection requirements should be submitted to NHTSA and to the Office of Management and Budget (OMB) at the address listed in the **ADDRESSES** section on or before 45 days from date of publication.

Public Hearings: NHTSA will hold one virtual public hearing during the public comment period. The agency will announce the specific date and web address for the hearing in a supplemental **Federal Register** notice. The agency will accept oral and written comments on the rulemaking documents and will also accept comments on the Draft Supplemental Environmental Impact Statement (Draft SEIS) at this hearing. The hearing will start at 9 a.m. Eastern time and continue until everyone has had a chance to speak. See the **SUPPLEMENTARY INFORMATION** section on ''Public Participation,'' below, for more information about the public hearing.

ADDRESSES: For access to the dockets or to read background documents or comments received, please visit *https://www.regulations.gov,* or Docket Management Facility, M–30, U.S. Department of Transportation, West Building, Ground Floor, Rm. W12–140, 1200 New Jersey Avenue SE, Washington, DC 20590. The Docket Management Facility is open between 9 a.m. and 4 p.m. Eastern time, Monday through Friday, except Federal holidays.

Comments on the proposed information collection requirements should be submitted to: Office of Management and Budget at *www.reginfo.gov/public/do/PRAMain.* To find this information collection, select ''Currently under Review—Open for Public Comment'' or use the search function. It is requested that comments sent to the OMB also be sent to the NHTSA rulemaking docket identified in the heading of this document.

FOR FURTHER INFORMATION CONTACT: For technical and policy issues, Joseph Bayer, CAFE Program Division Chief, Office of Rulemaking, National Highway Traffic Safety Administration, 1200 New Jersey Avenue SE, Washington, DC 20590; email: *CAFE_Mbox@dot.gov.* For legal issues, Hannah Fish, NHTSA Office of Chief Counsel, National Highway Traffic Safety Administration, 1200 New Jersey Avenue SE, Washington, DC 20590; email: *CAFE_Mbox@dot.gov.*

SUPPLEMENTARY INFORMATION:

TABLE OF ACRONYMS AND ABBREVIATIONS

Abbreviation	Term
4WD	Four Wheel Drive.
AC	Air conditioning.
ACME	Adaptive Cylinder Management Engine.
ADEAC	Advanced Cylinder Deactivation.
ADEACD	Advanced cylinder deactivation on a dual-overhead camshaft engine.
ADEACS	Advanced cylinder deactivation on a single overhead camshaft engine.
ADSL	Advanced Diesel Engine.
AEB	Automatic Emergency Braking.
AEO	Annual Energy Outlook.

TABLE OF ACRONYMS AND ABBREVIATIONS—Continued

Abbreviation	Term
AER	All-Electric Range.
AERO	Aerodynamic Drag Technology.
AERO0	Base Level Aerodynamic Drag Technology.
AERO5	Aerodynamic Drag, 5% Drag Coefficient Reduction.
AERO10	Aerodynamic Drag, 10% Drag Coefficient Reduction.
AERO15	Aerodynamic Drag, 15% Drag Coefficient Reduction.
AERO20	Aerodynamic Drag, 20% Drag Coefficient Reduction.
AFV	Alternative Fuel Vehicle.
AHSS	Advanced High Strength Steel.
AIS	Abbreviated Injury Scale.
AMFA	Alternative Motor Fuels Act of 1988.
AMPC	Advanced Manufacturing Production Tax Credit.
AMTL	Advanced Mobility Technology Laboratory.
Argonne	Argonne National Laboratory.
ANSI	American National Standards Institute.
APA	Administrative Procedure Act.
AT	Automatic Transmission.
AWD	All-Wheel Drive.
BEV	Battery Electric Vehicle.
BGEPA	Bald and Golden Eagle Protection Act.
BISG	Belt Integrated Starter Generator.
BLS	Bureau of Labor Statistics.
BMEP	Brake Mean Effective Pressure.
BSD	Blind Spot Detection.
BSFC	Brake-Specific Fuel Consumption.
BTW	Brake and Tire Wear.
CAA	Clean Air Act.
CAFE	Corporate Average Fuel Economy.
CARB	California Air Resources Board.
CBI	Confidential Business Information.
CEGR	Cooled Exhaust Gas Recirculation.
CFR	Code of Federal Regulations.
CH_4	Methane.
CNG	Compressed Natural Gas.
CO_2	Carbon Dioxide.
COVID–19	Coronavirus disease of 2019.
CPM	Cost Per Mile.
CR	Compression Ratio.
CVC	Clean Vehicle Credits.
CVT	Continuously Variable Transmission.
CW	Curb Weight.
CY	Calendar Year.
CZMA	Coastal Zone Management Act.
DCT	Dual-Clutch Transmission.
DEAC	Dynamic Cylinder Deactivation.
DMC	Direct Manufacturing Costs.
DOE	U.S. Department of Energy.
DOI	U.S. Department of the Interior.
DOHC	Dual-Overhead Camshaft.
DOT	U.S. Department of Transportation.
DSLI	Advanced Diesel Engine With Improvements.
eCVT	Electronic Continuously Variable Transmissions.
EGR	Exhaust Gas Recirculation.
EIA	U.S. Energy Information Administration.
EISA	Energy Independence and Security Act of 2007
E.O.	Executive Order.
EPA	U.S. Environmental Protection Agency.
EPCA	Energy Policy and Conservation Act of 1975.
ESA	Endangered Species Act.
ETDS	Electric Traction Drive System.
EV	Electric Vehicle.
FCEV	Fuel Cell Electric Vehicle.
FCIV	Fuel Consumption Improvement Value.
FCW	Forward Collision Warning.
FEOC	Foreign entity of concern.
FHWA	Federal Highway Administration.
FIP	Federal Implementation Plan.
FRIA	Final Regulatory Impact Analysis.
FTP	Federal Test Procedure.
FWD	Front-wheel Drive.
FWS	U.S. Fish and Wildlife Service.
GCWR	Gross Combined Weight Rating.

TABLE OF ACRONYMS AND ABBREVIATIONS—Continued

Abbreviation	Term
GDP	Gross Domestic Product.
GES	General Estimates System.
GM	General Motors.
GREET	Greenhouse gases, Regulated Emissions, and Energy use in Transportation.
GVWR	Gross Vehicle Weight Rating.
HCR	High Compression Ratio.
HCRD	High Compression Ratio Engine with Cylinder Deactivation.
HCRE	High Compression Ratio Engine with Cooled Exhaust Gas Recirculation.
HEG	High Efficiency Gearbox.
HEV	Hybrid Electric Vehicle.
HFET	Highway Fuel Economy Test.
HP	Horsepower.
HVAC	Heating, Ventilation, and Air Conditioning.
IAV	Ingenieurgesellschaft Auto und Verkehr.
ICCT	International Council on Clean Transportation.
ICE	Internal Combustion Engine.
ICR	Information Collection Request.
IIHS	Insurance Institute for Highway Safety.
IRA	Inflation Reduction Act.
LCA	Lane Change Assist.
LD	Light-Duty.
LDW	Lane Departure Warning.
LDWF	Light-Duty Work Factor.
LFP	Lithium Iron Phosphate.
LIVC	Late Intake Valve Closing.
LKA	Lane Keep Assist.
MAD	Minimum Absolute Deviation.
MAGICC	Model for the Assessment of Greenhouse Gas Induced Climate Change.
MBTA	Migratory Bird Treaty Act.
MDPCS	Minimum Domestic Passenger Car Standard.
MDPV	Medium-Duty Passenger Vehicle.
MOVES	Motor Vehicle Emission Simulator.
mpg	Miles Per Gallon.
mph	Miles Per Hour.
MR	Mass Reduction.
MR0	Base Level Mass Reduction Technology.
MSRP	Manufacturer Suggested Retail Price.
MY	Model Year.
NAAQS	National Ambient Air Quality Standards.
NADA	National Automotive Dealers Association.
NAICS	North American Industry Classification System.
NAS	National Academy of Sciences.
NCE	Non-Criteria Emission.
NEMS	National Energy Modeling System.
NEPA	National Environmental Policy Act.
NHPA	National Historic Preservation Act.
NHTSA	National Highway Traffic Safety Administration.
NMC	Nickel Manganese Cobalt.
NO_X	Nitrogen Oxide.
NPRM	Notice of Proposed Rulemaking.
NRC	National Research Council.
NTTAA	National Technology Transfer and Advancement Act.
NVO	Negative Valve Overlaps.
gpm	gallons per mile.
OC	Off-Cycle.
OCR	Optical Character Recognition.
OEM	Original Equipment Manufacturer.
OHV	Overhead Valve.
OLS	Ordinary Least Square.
OMB	Office of Management and Budget.
OPEC	Organization of the Petroleum Exporting Countries.
ORNL	Oak Ridge National Laboratory.
PAEB	Pedestrian Automatic Emergency Braking.
PC	Passenger Car.
PEF	Petroleum Equivalency Factor.
PHEV	Plug-in Hybrid Electric Vehicle.
$PM_{2.5}$	Particulate matter 2.5 microns or less in diameter.
PPC	Passive Prechamber Combustion.
ppm	parts per million.
PRA	Paperwork Reduction Act of 1995.
PRIA	Preliminary Regulatory Impact Analysis.
ROLL	Tire Rolling Resistance.

TABLE OF ACRONYMS AND ABBREVIATIONS—Continued

Abbreviation	Term
ROLL0	Base Level Tire Rolling Resistance.
ROLL10	Tire Rolling Resistance, 10% Improvement.
ROLL20	Tire Rolling Resistance, 20% Improvement.
ROLL30	Tire Rolling Resistance, 30% Improvement.
RPE	Retail Price Equivalent.
RPM	Revolutions Per Minute.
RRC	Rolling Resistance Coefficient.
RWD	Rear-Wheel Drive.
SAE	Society of Automotive Engineers.
SEC	Securities and Exchange Commission.
SEIS	Supplemental Environmental Impact Statement.
SGDI	Stoichiometric Gasoline Direct Injection.
SHEV	Strong Hybrid Electric Vehicle.
SHEVPS	Power-Split Strong Hybrid Electric Vehicle.
SI	Spark Ignition.
SIP	State Implementation Plan.
SKIP	Refers to skip input in Market Data Input File.
SOC	State of Charge.
SOHC	Single Overhead Camshaft.
SO_X	Sulfur Oxide.
SS12V	12V Micro Hybrid Start-Stop System.
SUV	Sport Utility Vehicle.
SwRI	Southwest Research Institute.
TAR	Technical Assessment Report.
TS&D	Fuel Transportation, Storage, and Distribution.
TSD	Technical Support Document.
TURBO0	Reference baseline turbocharged downsized technology.
TURBO1	Turbocharged downsized technology.
TURBO2	Advanced turbocharged downsized technology.
TURBOAD	Turbocharged engine with advanced cylinder deactivation.
TURBOD	Turbocharged engine with cylinder deactivation.
TURBOE	Turbocharged engine with cooled exhausted recirculation.
UMRA	Unfunded Mandates Reform Act.
U.S.	United States.
U.S.C	Unites States Code.
VCR	Variable Compression Ratio.
Volpe or Volpe Center	Volpe National Transportation Systems Center.
VMT	Vehicle Miles Traveled.
VSL	Value of a Statistical Life.
VTG	Variable Turbo Geometry.
VTGE	Variable Turbo Geometry (Electric).
VVL	Variable Valve Lift.
VVT	Variable Valve Timing.
VWA	Volkswagen Group of America.
ZEV	Zero Emission Vehicle.

Does this action apply to me?

This proposal affects companies that manufacture or sell new passenger automobiles (passenger cars) and non-passenger automobiles (light trucks), as defined under NHTSA's CAFE regulations.[1] Regulated categories and entities include:

[1] *See* 49 CFR part 523.

Category	NAICS Codes[A]	Examples of Potentially Regulated Entities
Industry	336110 336310 336350	Motor Vehicle & Parts Manufacturers.
Industry	811111 811112 811198 423110	Commercial Importers of Vehicles and Vehicle Components.
Industry	335312 336312 336399 811198	Alternative Fuel Vehicle (AFV) Converters.

[A] **North American Industry Classification System (NAICS).**

This list is not intended to be exhaustive but rather provides a guide regarding entities likely to be regulated by this action. To determine whether particular activities may be regulated by this action, you should carefully examine the regulations. You may direct questions regarding the applicability of this action to the persons listed in **FOR FURTHER INFORMATION CONTACT**.

Table of Contents

I. Executive Summary

The relationship between the light-duty vehicle market and the CAFE program has gone through several cycles over its almost 50-year history. First created to require conservation of petroleum in response to price shocks caused by the Arab oil embargoes of the 1970s, the CAFE program has led not only to the desired improvements in fuel economy but also created unintended responses from vehicle manufacturers—often to the detriment of consumers.

Over the CAFE program's history, separate standards for the passenger car and light truck fleets (referred to by law as passenger automobiles and non-passenger automobiles) have led manufacturers to reshape the market in unanticipated ways—such as by almost eliminating the production of station wagons (passenger cars that generally have more robust cargo capacity, adding mass and reducing fuel economy) in favor of vehicles like minivans and crossover utility vehicles (considered light trucks, and subject to less stringent standards).

Strict mile-per-gallon-based standards in the program's early years also led manufacturers to seek significant reductions in vehicle size and mass, leading to increased injury or fatality risk for occupants of smaller vehicles involved in a crash.[2] NHTSA sought to mitigate these responses by creating attribute-based standards that relate the ''footprint'' size of vehicles to fuel economy, to some positive effect.

Meanwhile, the U.S. Environmental Protection Agency (EPA) started providing special fuel economy adjustments for technologies that had potential for fuel economy improvements but were not measurable using the laboratory test procedures (*i.e.,* the ''two-cycle'' tests) for vehicle fuel economy. This included accommodating adjustments to efficiency values if manufacturers implemented preferred air conditioning (AC) technologies, and if manufacturers installed special technologies with purported fuel-saving benefits that could not be captured on the aforementioned two-cycle tests, accordingly known as ''off-cycle'' (OC) technologies (*e.g.,* vehicle stop/start functions that shut off the engine when the vehicle has stopped). These regulatory adjustments have led to widespread adoption of technologies with uncertain real-world benefits, added costs, and, in many cases, consumer backlash.

The creation of a system for inter-manufacturer credit trading—intended to improve the cost-effectiveness of the CAFE program by allowing manufacturers that could improve the fuel economy of their fleets more cost-effectively to earn credits for exceeding fuel economy standards and sell those credits to manufacturers that would need to incur higher costs to meet fuel economy standards—has also resulted in a windfall for EV-exclusive manufacturers that sell credits to other non-EV manufacturers, which in turn pay for those credits with capital that could be invested toward improving the fuel economy performance or other desirable attributes of their traditional fleets. 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.[3]

At the same time, the classification system that has long divided the fleet between passenger cars (intended to

[2] Transportation Research Board and National Research Council, Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards, National Academies Press: Washington, DC (2002), available at: *https://nap.nationalacademies.org/catalog/10172/effectiveness-and-impact-of-corporate-average-fuel-economy-cafe-standards* (accessed: Feb. 7, 2024). This report describes at length and quantifies the potential safety problem with average fuel economy standards that specify a single numerical requirement for the entire industry, noting that smaller and lighter vehicles incentivized by those standards could be less safe for their occupants.

[3] In a hypothetical and simplified example, if the baseline passenger car fleet of vehicles with an identical footprint consisted of nine gasoline-powered vehicles achieving 30 mpg and one EV achieving 150 mpg, the baseline fleet to which stringency increases would apply would be measured at 42 mpg. When CAFE standards are set unlawfully considering EV fuel economy, manufacturers of gasoline-powered vehicles would face a challenge in catching up to the overall fleet fuel economy, requiring disproportionate investment in fuel-saving technologies, and incentivizing the purchase of regulatory credits from the EV manufacturer.

move passengers) and light trucks (intended to move cargo or operate off road) no longer lives up to its anticipated use. Indeed, while 68 percent of the light-duty fleet meets the current light truck regulatory definition, the majority of these vehicles (*e.g.,* all-wheel drive (AWD) crossover utility vehicles, vehicles with three or more rows of seating, and vehicles that do not have an approach angle high enough to handle an off-highway obstacle) cannot realistically operate off road and have little value moving cargo. Instead, most of these vehicles are designed and intended primarily to move passengers but have additional features solely to meet regulatory definitions [4]—resulting in little added functionality, reduced fuel economy performance, added cost, and a fairly homogenous design language lacking in creativity.

While the CAFE program was intended to push manufacturers to improve fuel economy while preserving their ability to design and produce vehicles that meet market demands, the system has spun off its axis and requires recalibration. Instead of allowing manufacturers to design and produce vehicles they believe their customers will want and need, while spreading real-world fuel economy improvements across their fleets, the system has increasingly led manufacturers to try to fit square vehicle pegs in round classification holes to force the adoption of technologies that do not meet the demands of American families simply to obtain on-paper fuel economy improvements that may have little basis in reality. All of this adds inefficiency and cost—pushing even more consumers out of an already unaffordable new car market.

By delegation of authority from the Secretary of Transportation (the Secretary), NHTSA is proposing to amend the previously promulgated CAFE standards applicable to passenger and non-passenger automobiles (colloquially referred to as passenger cars and light trucks, and together known as light-duty vehicles) produced for MYs 2022–2026 and MYs 2027–2031. Proposing amended standards beginning with MY 2022 is consistent with the Secretary's direction in the January 28, 2025, memorandum titled ''Fixing the CAFE Program'' and is also the earliest model year for which NHTSA has not concluded CAFE compliance proceedings; additional discussion regarding NHTSA's proposal to amend standards beginning in MY 2022 can be found in Section V.

Consistent with the terms of the CAFE program mandated in the Energy Policy and Conservation Act (EPCA), as amended by the Energy Independence and Security Act (EISA) and other laws (codified in chapter 329 of title 49, United States Code), the fuel economy standards proposed herein are founded on light-duty vehicles powered by gasoline and diesel fuels, a category that includes non-plug-in hybrid vehicles.[5] In formulating the proposed standards, NHTSA has not considered the imputed fuel-economy performance of EVs or the electric operation of plug-in hybrid electric vehicles (PHEVs). This approach marks a change from previous rulemakings, as described above, but brings the CAFE program into compliance with statutory restrictions.

This proposed rule 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.[6] This balancing must take into account current and projected circumstances and cannot consider the availability of alternative fuel technologies (*e.g.,* EVs or PHEV electric operation), or compliance credits.[7] This action is also consistent with Executive Order (E.O.) 14148, ''Initial Rescissions of Harmful Executive Orders and Actions,'' [8] and E.O. 14154, ''Unleashing American Energy,'' [9] as well as the Secretarial memorandum titled ''Fixing the CAFE Program.'' [10]

The standards presented in this proposal significantly differ from those finalized in the 2020, 2022, and 2024 rules because, in formulating those prior standards, NHTSA considered both the fuel economy of EVs and PHEVs and compliance credits that could be earned when a manufacturer over-complied with an applicable fuel economy standard impermissibly. As a result, the fuel economy standards previously established by NHTSA for passenger cars and light trucks for MYs 2022–2031 failed to satisfy substantive statutory requirements. NHTSA is proposing in this NPRM the ''maximum feasible'' amended fuel economy requirements for the model years in question that best reflect and balance the various practical considerations and limitations mandated for the CAFE program.

This rulemaking is intended to establish maximum feasible fuel economy standards while restoring the functionality intended by Congress. It marks a significant reset. As an initial matter, NHTSA proposes to remove consideration of prohibited technologies and credits from every aspect of the standards development process to bring the program back within its statutory constraints. NHTSA discussed extensively its prior unlawful consideration of prohibited technologies and credits in the standards development process in the final rule, *Resetting the Corporate Average Fuel Economy Program,*[11] and includes a more detailed discussion in Section V, below.

NHTSA is proposing to remove consideration of AC efficiency and OC fuel consumption improvement values (FCIVs) from its standard-setting analysis starting with MY 2028, which is the first year in which a removal of FCIVs could go into effect.[12] This change will ensure that NHTSA's CAFE standards are achievable without the implementation of technologies not demanded by consumers and with questionable fuel economy benefits.

The agency also proposes to eliminate the inter-manufacturer credit trading program (which is authorized, but not required, by 49 U.S.C. 32903(f)) beginning with MY 2028. This change in the program is long overdue. While NHTSA does not consider the availability of credits or credit trading in

[4] Section VI discusses NHTSA's proposal to amend regulatory definitions for passenger and non-passenger automobiles in detail and includes examples of manufacturers excluding or including specific features solely to meet regulatory definitions. Two examples discussed in more detail in Section VI include manufacturers discontinuing FWD versions of vehicles after NHTSA properly reclassified over 1 million FWD automobiles as passenger automobiles in line with EPCA and opting to instead manufacture only AWD or 4WD versions to keep more of their products in the non-passenger automobile fleets (74 FR 14196, Mar. 30, 2009), and manufacturers including aerodynamic technologies to increase on-highway functionality instead of opting to meet approach angle requirements, which would make the vehicle more capable of approaching off-highway obstacles and, thus, more off-highway capable.

[5] Non-plug-in hybrid vehicles are not dual-fueled vehicles under Chapter 329 because any electricity generated by the electric motors or other electric components are generated solely by the petroleum-fueled engine and the batteries are incapable of charging from an external source: ''a vehicle which is entirely dependent on a petroleum fuel for its motive power, regardless of whether electricity is used in the powertrain, is powered by petroleum.'' 63 FR 66066 (Dec. 1, 1998).

[6] 49 U.S.C. 32902(a) and (f).

[7] 49 U.S.C. 32902(h).

[8] 90 FR 8237 (Jan. 28, 2025).

[9] 90 FR 8353 (Jan. 29, 2025).

[10] See DOT, Memorandum: Fixing the CAFE Program (2025), available at: *https://www.transportation.gov/briefing-room/memorandum-fixing-cafe-program* (accessed: Sept. 10, 2025).

[11] 90 FR 24518 (June 11, 2025).

[12] 49 U.S.C. 32904(d).

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. NHTSA recognizes that manufacturers have made investments in particular compliance pathways—pathways that may include purchasing credits from other manufacturers even though the availability of those credits is uncertain—and is proposing this change beginning with MY 2028 to provide manufacturers with adequate transition time, in recognition of any particular reliance interests in the trading program to achieve compliance, before the program ends. However, NHTSA is proposing standards in this notice at levels that do not consider the use of compliance credits, thus minimizing any impacts that this change may have on manufacturers' decisions about compliance pathways. Moreover, this change will not impact automakers' ability to *transfer* earned credits between different categories of vehicles in their own fleets or carry their own credits forwards and backwards across model years, as prescribed by statute.

The agency also proposes a substantial reclassification of the light-duty fleet in a manner intended by Congress in creating the CAFE program—with the passenger car fleet consisting of vehicles primarily designed to move people, and the light truck fleet consisting of vehicles primarily designed to operate off road or move cargo. NHTSA believes these proposed changes are necessary to restore the CAFE program to its intended orbit but recognizes the changes will introduce significant design consideration for manufacturers. Moving a large fraction of vehicles previously classified as light trucks into a manufacturer's passenger vehicle fleet will have a significant effect on the overall fuel economy performance of the manufacturer's passenger fleet—after all, even if based upon the same platform as a passenger car, the additional vehicle height adds significant mass and decreases fuel economy. Meanwhile, removal of vehicles from a manufacturer's light truck fleet will leave that fleet consisting of even heavier and less aerodynamic vehicles, such as large sports utility vehicles and pickup trucks, thereby decreasing the overall average fuel economy of the light truck fleet. Accordingly, while a manufacturer's combined overall fleet fuel economy may remain the same, both its passenger car and light truck fleets will necessarily achieve lower measured fuel economy. NHTSA is also proposing to update the classification criteria from technology-based to performance-based standards where applicable, consistent with best practices for regulation. This proposal intends to take these changes into account through amendments to both the footprint curves and standards applicable to various points within the curves. NHTSA intends that, as a result of this proposed update, automobiles classified as non-passenger will exhibit true non-passenger capabilities that display relevant off-highway vehicle attributes such as approach angle and running clearance or include design features that provide higher payload and towing abilities for transporting property.

By surveying the measured fuel economy performance of gasoline- and diesel-powered passenger cars and light trucks produced for the U.S. market in MY 2022, NHTSA has created a maximum feasible foundation from which to establish standards for subsequent model years. NHTSA is proposing to set fuel economy standards that increase from the newly proposed MY 2022 standards at a rate of 0.5 percent per year through MY 2026 followed by 0.25 percent per year through MY 2031, with MY 2027 stringency as a bridge between the two sets of standards.

In addition to the proposed standards (also referred to as the ''Preferred Alternative'') NHTSA considers a range of regulatory alternatives for each fleet, consistent with the agency's obligations under the Administrative Procedure Act (APA), National Environmental Policy Act (NEPA), and E.O. 12866. The regulatory alternatives are as follows:

Table I-1: Regulatory Alternatives Under Consideration for MYs 2022-2031 Passenger Car and Light Truck CAFE Standards[13]

Name of Alternative	Passenger Car Stringency Changes	Light Truck Stringency Changes
No-Action Alternative	1.5% for MY 2023 8% per year for MYs 2024-2025 10% for MY 2026 2% per year for MYs 2027-2031	1.5% for MY 2023 8% per year for MYs 2024-2025 10% for MY 2026 0% per year for MYs 2027-2028 2% per year for MYs 2029-2031
Alternative 1	80% compliance share* MY 2022 0.50% per year for MYs 2023-2026 0.1% for MY 2027 0.3% for MY 2028** 0.25% per year for MYs 2029-2031	80% compliance share* MY 2022 0.50% per year for MYs 2023-2026 0.8% for MY 2027 0.6% for MY 2028** 0.25% per year for MYs 2029-2031
Alternative 2 (Preferred)	75% compliance share* MY 2022 0.50% per year for MYs 2023-2026 0.35% for MY 2027 0.25% for MY 2028** 0.25% per year for MYs 2029-2031	70% compliance share* MY 2022 0.50% per year for MYs 2023-2026 0.7% for MY 2027 0.25% for MY 2028** 0.25% per year for MYs 2029-2031
Alternative 3	70% compliance share* MY 2022 0.50% per year for MYs 2023-2026 1.4% for MY 2027 1.5% for MY 2028** 1% per year for MYs 2029-2031	50% compliance share* MY 2022 0.50% per year for MYs 2023-2026 0.4% for MY 2027 0.2% for MY 2028** 1% per year for MYs 2029-2031

* Compliance shares were determined based on the production-weighted share of vehicles that met or exceeded their target function value for each regulatory alternative in MY 2022.
** Stringency change reflects the growth rate in class average standard value from MYs 2027-2028.

NHTSA[13] has concluded tentatively that the levels of standards represented by Alternative 2 are the maximum feasible level for these model years, as discussed in more detail in Section V of this preamble. NHTSA has determined that the proposed standards satisfy the statutory requirements of maximum feasibility across the full range of gasoline- and diesel-powered vehicles currently on the market. These standards will be appropriately stringent in promoting fuel efficiency in the Nation's light-duty vehicle fleet while remaining technologically feasible and economically practicable to achieve without regard to EV dedicated fuel economy or PHEV electric operation. The proposed standards also consider the effect of other Federal regulatory mandates on the fuel economy performance of new motor vehicles, as well as the need of the Nation to conserve energy. NHTSA has tentatively determined that it is both reasonable and congruent with EPCA's energy conservation goals to weigh the need of the United States to conserve energy such that vehicle fuel economy standards require continuous improvements over time, but at sustainable levels for manufacturers, consumers, and society at large. In particular, the diminishing effects attributable to fuel economy improvements from higher standards moderates against weighing the need of the United States to conserve energy too heavily compared to the other statutory factors.[14] Manufacturers have limited supplies of capital for technological advancement and are constrained in recovering those investments by what consumers can afford to pay for technological innovations in new vehicles. Maximum feasible fuel economy standards, when set appropriately weighing economic practicability, should never incentivize manufacturers to add technology that consumers reject at the cost of investments in, or application of, for instance, vehicle safety technologies. Instead, when truly maximum feasible standards apply, manufacturers should be able continually to develop, and apply, both proven fuel-saving and safety-enhancing technologies in such a manner that allows consumers both to desire and to afford the new vehicle.

NHTSA's preliminary conclusion is that this decision best comports with statutory requirements and is justified to reset standards set in final rules issued in 2020, 2022, and 2024, respectively, which were established improperly above the maximum feasible level because NHTSA considered statutorily prohibited factors in establishing those

13 Percentages in the table represent the year over year reduction in gal/mile applied to the mpg values on the target curves. The reduction in gal/mile results in an increased mpg.

14 As an example, a vehicle owner who drives a light vehicle 15,000 miles per year and trades in a vehicle with fuel economy of 15 mpg for one with fuel economy of 20 mpg, will reduce their annual fuel consumption from 1,000 gallons to 750 gallons—saving 250 gallons annually. If, however, that owner trades in a vehicle with fuel economy of 30 mpg for one with fuel economy of 40 mpg, then the owner's annual gasoline consumption would drop from 500 gallons/year to 375 gallons/year—a fuel savings of only 125 gallons even though the mpg improvement is twice as large. Going from 40 to 50 mpg would save only 75 gallons/year. Yet each additional fuel economy improvement becomes much more expensive as the easiest to achieve low-cost technological improvement options are exhausted.

standards.[15] Those rules resulted in distortions in the marketplace, which this proposed rule would minimize. These distortions include major non-market-based changes in automobile designs and the introduction of fundamental alterations in their production processes not primarily driven by market demand.

Increasing the stringency of standards at modest annual rates, following a reset to eliminate the consideration of impermissible factors that were applied in setting the current standards, and coupled with a re-examination of the shape of the fuel economy target functions and the vehicle classification definitions, best comports with statutory requirements. Moreover, the level, shape, and applicability of the standards to the proposed passenger and non-passenger automobile fleets are justified by the inappropriate distortions the existing regulations have caused in the marketplace. Those regulations resulted in unnecessary regulatory burdens that did not further statutory purposes because the standards were not attainable for the gasoline- and diesel-powered vehicle fleet.

The proposed CAFE standards remain vehicle-footprint-based, like the current CAFE standards in effect since MY 2011. The footprint of a vehicle is the area calculated by multiplying the wheelbase times the track width, essentially the rectangular area of a vehicle measured from tire to tire where the tires hit the ground. This means that the standards are defined by mathematical equations that represent constrained linear functions relating vehicle footprint to fuel economy targets for passenger cars and light trucks.[16] For this proposal, NHTSA has updated the mathematical functions (*i.e.,* the target curves relating footprint to fuel economy) for passenger cars and light trucks based on the latest available data. NHTSA has concluded preliminarily, based on this data, that the relationship between footprint and fuel economy has shifted from MY 2008 (the model year on which the current curves are based) and it is thus appropriate to modify the mathematical functions accordingly. NHTSA has also updated the functions that would be applied beginning in MY 2028 to reflect changes based on the proposed reclassified fleet.

NHTSA estimates that the proposed standards would correspond to a combined industry fleetwide average of roughly 34.5 mpg in MY 2031 for passenger cars and light trucks.[17] NHTSA notes that this is a projection, since the actual CAFE standards are the footprint target curves for passenger cars and light trucks. This is important because it means that the ultimate fleetwide levels will vary depending on the mix of vehicles that manufacturers produce for sale in those model years. NHTSA also calculates and presents ''estimated achieved'' fuel economy levels, which differ somewhat from the estimated required levels for each fleet, for each year.[18] Note that the industry-average required and achieved values presented below reflect the end of manufacturers' ability to claim AC and FCIV adjustments, beginning in MY 2028, and updated vehicle classification regulatory definitions, which are also applicable beginning in MY 2028.

For simplification, NHTSA provides industry-wide mpg estimates corresponding to the proposed standards in the table below but reiterates that the coefficients that define the mathematical functions comprise the actual standards.

[15] 85 FR 24174 (Apr. 30, 2020); 87 FR 25710 (May 2, 2022); 89 FR 52540 (June 24, 2024).

[16] Generally, passenger cars have more stringent targets than light trucks regardless of footprint, and smaller vehicles will have more stringent targets than larger vehicles because smaller vehicles are generally more fuel efficient. No individual vehicle or vehicle model need meet its target exactly, but a manufacturer's compliance is determined by how its average fleet fuel economy compares to the average fuel economy of the targets of the vehicles it manufactures.

[17] NHTSA notes both that real-world fuel economy is generally 20–30 percent lower than the estimated required CAFE level stated above, since CAFE compliance is evaluated per 49 U.S.C. 32904(c) Testing and Calculation Procedures, which states that the EPA Administrator (responsible under EPCA/EISA for measuring vehicle fuel economy) must use the same procedures used for MY 1975 (weighted 55 percent urban cycle and 45 percent highway cycle) or comparable procedures. Colloquially, this is known as the 2-cycle test. The ''real-world'' or 5-cycle evaluation includes the 2-cycle tests and three additional tests that are used to adjust the city, and highway estimates to account for higher speeds, AC use, and colder temperatures. In addition to calculating vehicle fuel economy, EPA is responsible for providing the fuel economy data that is used on the fuel economy label on all new cars and light trucks, which uses the ''real-world'' values. In 2006, EPA revised the test methods used to determine fuel economy estimates (city and highway) appearing on the fuel economy label of all new cars and light trucks sold in the United States, effective with MY 2008 vehicles.

[18] NHTSA's analysis reflects that almost all manufacturers make the technological improvements prompted by CAFE standards at times that coincide with existing product ''refresh'' and ''redesign'' cycles, rather than unrealistically applying new technology every year regardless of those cycles. It is significantly more cost effective to make fuel economy-improving technology updates when a vehicle is being updated. See the Draft TSD and preamble Section II for additional discussion about manufacturer refresh and redesign cycles.

Table I-2: Estimated Required Average and Estimated Achieved Average of CAFE Levels (mpg) for Passenger Cars and Light Trucks, Preferred Alternative[19]

Model Year	2022[a]	2023[a]	2024	2025[b]	2026[b]	2027	2028[c]	2029	2030	2031
Passenger Car										
Required[d]	36.0	36.0	36.5	36.6	36.8	36.9	37.1	37.2	37.3	37.4
Achieved	39.5	39.2	43.2	-	-	54.3	45.5	45.9	46.1	46.3
Light Truck										
Required[d]	27.7	27.7	27.9	28.0	28.1	28.3	28.4	28.5	28.5	28.6
Achieved	29.8	29.7	32.7	-	-	38.6	31.1	31.5	31.8	32.1
Total LD Fleet										
Required[d]	31.2	29.8	30.1	30.4	30.4	30.4	34.2	34.4	34.4	34.5
Achieved	32.7	32.1	35.4	-	-	42.2	40.4	40.8	41.1	41.3

a: Achieved values do not include the effects of AC and FCIV adjustments.
b: Production for model years not complete. Achieved values neither included nor estimated.
c: Achieved values decline due to removal of AC and FCIV adjustments. Regulatory class achieved values decline due to effects of reclassification.
d: Based on compliance data for MYs 2022-2024. Projected forward for later years using the CAFE Model. MYs 2025-2026 determined using the baseline projection of the fleet in these years and the proposed standards. MYs 2027-2031 determined using the Preferred Alternative's fleet projection and the proposed standards.

To the extent that manufacturers appear to be over-complying with required fuel economy levels in MY 2027, NHTSA notes that this is due to factors including previous application of fuel economy technologies required by standards set improperly for prior model years that unlawfully considered prohibited alternative fuel (*e.g.,* EV) technology applications. Once the program is restored to its intended strictures and standards are established that consider all statutory factors and limitations appropriately, manufacturers that previously applied technologies to meet exaggerated requirements will have relief, while manufacturers that faced certain penalties can continue to improve efficiency to meet maximum feasible standards. NHTSA's review of achieved compliance at the manufacturer level also shows that, while some manufacturers manage to achieve greater over-compliance, other manufacturers are expected to achieve compliance values that will track the levels of the new standards more closely. In addition, NHTSA believes that the proposed standards established for model years prior to the significant MY 2028 fleet reclassification will allow manufacturers to plan strategically with sufficient lead time to manage that transition within their projected model year sales cycles. For all fleets, average requirements and average achieved CAFE levels will depend ultimately on manufacturer and consumer response to standards, technology developments, economic conditions, fuel prices, and other factors.

NHTSA is also proposing new minimum domestic passenger car CAFE standards (MDPCS) for MYs 2022–2026 and MYs 2027–2031 as required by EISA, which are applied to passenger cars that are deemed to be manufactured in the United States. Section 32902(b)(4) of 49 U.S.C. requires NHTSA to project the minimum domestic standard when it promulgates passenger car standards for a model year; these standards are shown in Table I–3 below. NHTSA continues to apply an offset (albeit a far smaller one than was first used in the 2020 final rule and applied to the 2022 and 2024 final rules) when calculating the MDPCSs for MYs 2027–2031, reflecting prior differences between passenger car footprints forecast originally by the agency and passenger car footprints as they occurred in the real world. The proposed minimum domestic passenger car standards (MDPCS) for each model year are as shown in the table below.

Table I-3: Minimum Domestic Passenger Car Standard (mpg)

2022	2023	2024	2025	2026	2027*	2028*	2029*	2030*	2031*
33.1	33.1	33.5	33.7	33.9	33.8	33.9	34.0	34.0	34.1

*Includes 0.7 percent offset

[19] There is no legal requirement for combined passenger car and light truck fleets, but NHTSA presents information this way in recognition of the fact that many readers will be accustomed to seeing such a value.

NHTSA uses the CAFE Compliance and Effects Modeling System (the CAFE Model) developed and maintained by the Volpe National Transportation Systems Center (Volpe Center or Volpe) as a tool for assessing the likely regulatory effects of the proposal and various regulatory alternatives. The Model does not determine which standards satisfy the requirements of EPCA, and no model can predict precisely the engineering configurations automakers are likely to introduce in response to evolving trends in market demand. However, the analysis developed using the CAFE Model provides further support for NHTSA's preliminary judgment that the standards proposed in this rule are the maximum standards that are technologically feasible and economically practicable for the gasoline- and diesel-powered vehicles covered by the proposed rule, considering the effect of other motor vehicle standards of the Government on fuel economy, and the need of the United States to conserve energy.

One significant modification from previous standard-setting proceedings and previous applications of the CAFE Model is that NHTSA did not include EVs in the base fleet for analysis purposes and did not consider or model the potential production of EVs as a CAFE compliance strategy for automakers. Section 32902 of chapter 49 directs NHTSA to establish fuel economy standards that are feasible and practicable for gasoline- and diesel-powered vehicles without regard to any reliance on non-gasoline- or diesel-powered alternatives. Automakers, of course, are free to produce EVs in response to market demand, and their production and sale of EVs will earn credit toward compliance with the CAFE standards in accordance with the ''petroleum equivalency factor,'' or ''PEF,'' prescribed by the Department of Energy (DOE).[20]

Additional updates to the CAFE Model and its inputs since the 2024 final rule include updating the Market Data Input File to reflect the change in analysis fleet from MYs 2022–2024, updating the modeling capability to allow for vehicle reclassification, updating the Scenarios Input File to set the value of civil penalties at zero,[21] updating the Parameters Input File to set the monetary value of changes in non-criteria emissions at zero, updating other economic values, such as rebound elasticity and the payback periods, and updating fuel price projections using the 2025 Annual Energy Outlook's (AEO) Alternative Transportation Case. These and other updates are described in more detail in Section II and the Draft TSD.

NHTSA estimates that this proposed rule would reduce the average up-front vehicle costs due to CAFE standards by approximately $900, cutting in half what consumers might expect to pay as a result of increased requirements under the No-Action Alternative. NHTSA also estimates that this rule will be net beneficial economically for society. The tables below summarize estimates of selected impacts viewed from both the MY and calendar year (CY) perspectives,[22] for each of the regulatory alternatives, relative to the No-Action Alternative.

Table I-4: Estimated Monetized Costs and Benefits – Passenger Cars and Light Trucks – MY and CY Perspectives by Alternative and Discount Rate[23]

	Alt. 1		Alt. 2 (Preferred Alternative)		Alt. 3	
Monetized Benefits ($billion)						
	3% DR	7% DR	3% DR	7% DR	3% DR	7% DR
MYs 1985-2031	-85.2	-53.9	-85.1	-53.8	-73.5	-46.5
CYs 2024-2050	-291.2	-157.4	-291.1	-157.4	-256.5	-138.4
Monetized Costs ($billion)						
	3% DR	7% DR	3% DR	7% DR	3% DR	7% DR
MYs 1985-2031	-109.2	-76.1	-109.1	-76.0	-97.1	-67.7
CYs 2024-2050	-393.9	-219.6	-393.8	-219.5	-353.8	-197.2
Monetized Net-Benefits ($billion)						
	3% DR	7% DR	3% DR	7% DR	3% DR	7% DR
MYs 1985-2031	24.0	22.2	24.0	22.2	23.7	21.2
CYs 2024-2050	102.8	62.1	102.8	62.1	97.3	58.8

[20] 49 U.S.C. 32904(a)(2)(B); Public Law 96–185, 93 Stat. 1324 (1980). *https://www.congress.gov/96/statute/STATUTE-93/STATUTE-93-Pg1324.pdf*; 10 CFR part 474.

[21] *See* Public Law 119–21, 139 Stat. 72 (July 4, 2025). *https://www.congress.gov/119/plaws/publ21/PLAW-119publ21.pdf.*

[22] The bulk of the analysis for passenger cars and light trucks presents a ''model year'' perspective rather than a ''calendar year'' perspective. The model year perspective considers the lifetime impacts attributable to all passenger cars and light trucks produced through MY 2031, accounting for the operation of these vehicles over their entire lives (with some MY 2031 vehicles estimated to be in service as late as 2050). This approach emphasizes the role of the model years for which new standards are being proposed. The calendar year perspective, on the other hand, includes the annual impacts attributable to all vehicles estimated to be in service in each calendar year for which the analysis includes a representation of the entire registered light-duty fleet. For this proposed rule, this calendar year perspective covers each of CYs 2024–2050. Compared to the model year perspective, the calendar year perspective includes model years of vehicles produced in the longer term, beyond those model years for which standards are being proposed.

[23] For this and similar tables in this section, net benefits may differ from benefits minus costs due to rounding.

The current estimates of costs and benefits are important considerations, performed as directed by E.O. 12866, and also serve as an informative data point in NHTSA's consideration of the factors that NHTSA is required to balance by statute when determining maximum feasible standards. NHTSA concludes, for the purposes of this proposal, that Alternative 2 is maximum feasible on the basis of these respective factors. NHTSA also considered several sensitivity cases by varying different inputs and concluded that, even when varying inputs resulted in changes to net benefits, those changes were not significant enough to alter the tentative conclusion that Alternative 2 is maximum feasible.

Finally, NHTSA has computed ''annualized'' benefits and costs relative to the No-Action Alternative, as follows:

Table I-5: Estimated Annualized Monetized Costs and Benefits – Passenger Cars and Light Trucks – MY and CY Perspectives by Alternative and Discount Rate[24]

	Alt. 1		Alt. 2 (Preferred Alternative)		Alt. 3	
Monetized Benefits ($billion)						
	3% DR	7% DR	3% DR	7% DR	3% DR	7% DR
MYs 1985-2031	-3.4	-3.9	-3.4	-3.9	-2.9	-3.4
CYs 2024-2050	-15.9	-13.1	-15.9	-13.1	-14.0	-11.5
Monetized Costs ($billion)						
	3% DR	7% DR	3% DR	7% DR	3% DR	7% DR
MYs 1985-2031	-4.4	-5.6	-4.4	-5.6	-3.9	-4.9
CYs 2024-2050	-21.5	-18.3	-21.5	-18.3	-19.3	-16.4
Monetized Net Benefits ($billion)						
	3% DR	7% DR	3% DR	7% DR	3% DR	7% DR
MYs 1985-2031	1.0	1.6	1.0	1.6	0.9	1.6
CYs 2024-2050	5.6	5.2	5.6	5.2	5.3	4.9

Though NHTSA is prohibited from considering the availability of certain flexibilities in making its determination about the levels of CAFE standards that would be maximum feasible, manufacturers have a variety of flexibilities available to aid their compliance. NHTSA is proposing certain changes to these flexibilities and other features of the CAFE program as shown in Table I–6, and as described further in Section VI of this preamble.

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[24] For this and similar tables in this section, net benefits may differ from benefits minus costs due to rounding.

Table I-6: Overview of Changes to CAFE Program

Fleet Performance Requirements			
Component	**Applicable Regulation (Statutory Authority)**	**General Description**	**Proposed Changes in NPRM**
Fuel Economy Standards	49 CFR 531.5 and 49 CFR 533.5 (49 U.S.C. 32902)	Fuel economy standards are footprint-based fleet average standards for each of a manufacturer's compliance category (i.e., domestic passenger automobile, import passenger automobile, and non-passenger automobile), which are expressed in miles per gallon (mpg). NHTSA sets average fuel economy standards that are the maximum feasible for each compliance category and model year (i.e., passenger automobiles and non-passenger automobiles). In setting these standards, NHTSA considers technological feasibility, economic practicability, the effect of other motor vehicle standards of the Government on fuel economy, and the need of the U.S. to conserve energy. NHTSA is precluded from considering the fuel economy of vehicles that operate only on alternative fuels, the portion of operation of a dual-fueled vehicle powered by alternative fuel, and the trading, transferring, or availability of credits.	Amendments to 49 CFR 531.5(a) and 49 CFR 533.5(a) to set standards for MYs 2022-2026 and MYs 2027-2031.
Vehicle Classification	49 CFR part 523	Standards are set for two regulatory categories (i.e., passenger automobiles and non-passenger automobiles). Vehicles are assigned to either the passenger automobile or non-passenger automobile categories based on definitions in EPCA, as implemented through definitions and specific criteria in NHTSA's regulations.	Amendments to 49 CFR part 523 to amend the criteria for non-passenger automobiles.
Minimum Domestic Passenger Car Standards	49 CFR 531.5 (49 U.S.C. 32902(b)(4))	Domestic passenger automobile fleets are required to meet a MDPCS. This standard applies in addition to the footprint-based standard.	Amendments to 49 CFR 531.5(b) to set MDPCS for MYs 2022-2026 and MYs 2027-2031.
Determining Average Fleet Performance			
Component	**Applicable Regulation (Statutory Authority)**	**General Description**	**Proposed Changes in NPRM**
2-Cycle Testing	49 CFR 531.6(a) citing 40 CFR part 600 and 49 CFR 533.6 citing 40 CFR part 600	Vehicle testing is conducted by EPA using the Federal Test Procedure (light-duty FTP or "city" test) and Highway Fuel Economy Test (HFET or "highway" test).	None

	(49 U.S.C. 32904)		
AC Efficiency FCIVs	49 CFR 531.6(b)(1) citing 40 CFR 86.1868-12 and 49 CFR 533.6(c)(1) citing 40 CFR 86.1868-12 (49 U.S.C. 32904)	This adjustment to the results of the 2-cycle testing for fuel consumption improvement from technologies that improve AC efficiency that are not accounted for in the 2-cycle testing. The AC efficiency FCIV program began in MY 2017 for NHTSA. Starting in MY 2027, AC efficiency FCIVs may only be generated by internal combustion engine (ICE) vehicles.	NHTSA is removing consideration of FCIVs from its standard-setting analysis beginning in MY 2028. NHTSA is also proposing technical amendments to 49 CFR 531.6 and 533.6 to remove references to EPA's regulations for AC efficiency FCIVs.
OC FCIVs	49 CFR 531.6(b)(2) and (3) citing 40 CFR 86.1869-12 and 49 CFR 533.6(c)(3) and (4) citing 40 CFR 86.1869-12 (49 U.S.C. 32904)	This adjustment to the results of the 2-cycle testing for fuel consumption improvement from technologies that are not accounted for or not fully accounted for in the 2-cycle testing. The OC FCIV program began in MY 2017 for NHTSA. Starting in MY 2027, OC FCIVs may only be generated by ICE vehicles, with the program phasing out and in ending with MY 2032 under EPA's current regulations.	NHTSA is removing consideration of FCIVs from its standard-setting analysis beginning in MY 2028. NHTSA is also proposing technical amendments to 49 CFR 531.6 and 533.6 to remove references to EPA's regulations for OC FCIVs.
Advanced Full-Size Pickup Truck FCIVs	49 CFR 533.6(c)(2) citing 40 CFR 86.1870-12 (49 U.S.C. 32904)	This adjustment increases a manufacturer's average fuel economy for full-size pickup trucks equipped with hybridized or other performance-based technologies. Manufacturers were eligible to earn these adjustments in MYs 2017-2021 and MYs 2023-2024.	None
Dedicated Alternative-Fueled Vehicles	49 CFR 536.10 citing 40 CFR 600.510-12(c) (49 U.S.C. 32905(a) and (c))	EPA calculates the fuel economy of dedicated alternative fueled vehicles assuming that a gallon of liquid/gaseous alternative fuel is equivalent to 0.15 gallons of gasoline per 49 U.S.C. 32905(a). For BEVs, EPA uses the petroleum equivalency factor as defined by the DOE (*see* 10 CFR 474.3) (per 49 U.S.C. 32904(a)(2)).	None
Dual-Fueled Vehicles	49 CFR 536.10 citing 40 CFR 600.510-12(c) (49 U.S.C. 32905(b), (d), and (e)) and (49 U.S.C. 32906(a))	EPA calculates the fuel economy of dual-fueled vehicles using a utility factor to account for the portion of power energy consumption from the different energy sources. For EVs, EPA uses DOE's petroleum equivalency factor for the electric portion of the vehicle's expected energy use (per 49 U.S.C. 32904(a)(2). Starting in MY 2020 and subject to statutory limit, the average fuel economy of certain dual-fueled vehicles cannot increase a manufacturer's average fuel economy.	None
Earning and Using Credits for Over-compliance and Addressing Shortfalls			
Earning Credits	49 CFR 536.4 (49 U.S.C. 32903(a))	Manufacturers earn credits for each one tenth of mile by which the average fuel economy vehicles in a particular compliance category in a model year	None

		exceeds the applicable fuel economy standard, multiplied by the number of vehicles sold in that compliance category (i.e., fleet).	
Carry-Forward Credits	49 CFR part 536 (49 U.S.C. 32903(a)(2))	Manufacturers may carry forward credits up to five model years into the future.	None
Carry-Back Credits	49 CFR Part 536 (49 U.S.C. 32903(a)(1))	Manufacturers may carry back credits up to three model years into the past.	None
Credit Transfers	49 CFR Part 536 (49 U.S.C. 32903(g))	Manufacturers may transfer credits between their fleets to increase a fleet's average fuel economy by up to 2 mpg. Manufacturers may not use transferred credits to meet the MDPCS (*see* 49 U.S.C. 32903(g)(4) and 49 CFR 536.9).	None
Credit Trading	49 CFR 536.8 (49 U.S.C. 32903(f))	Manufacturers may trade over-compliance credits into fleets of the same compliance category. A manufacturer may then transfer those credits to a different compliance category, but only up to the 2-mpg limit for transfers. Manufacturers may not use traded credits to meet the MDPCS (*see* 49 U.S.C. 32903(f)(2) and 49 CFR 536.9).	Amendments to 49 CFR 536.6 and 536.8 to reflect that beginning in MY 2028 credit trading will no longer be allowed.
Civil Penalties	49 CFR 578.6(h) (49 U.S.C. 32912)	Civil penalties may be assessed for CAFE credit shortfalls that are not resolved through credit flexibilities. Pub. L. 119-21 set civil penalties for the CAFE program to $0 starting in MY 2022.	None[25]

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The following sections of this preamble discuss the technical foundation for NHTSA's analysis, the regulatory alternatives considered in this proposed rule, the estimated effects of the regulatory alternatives, the basis for NHTSA's tentative conclusion that the proposed standards are maximum feasible, and NHTSA's approach to compliance and enforcement. The extensive record for this action consists of this proposed rule, a Draft Technical Support Document (Draft TSD), a Preliminary Regulatory Impact Analysis (PRIA), and a Draft SEIS, along with extensive analytical documentation, supporting references, and many other resources. Most of these resources are available on NHTSA's website,[26] and other references not available on NHTSA's website can be found in the rulemaking docket, the docket number of which is listed at the beginning of this preamble. NHTSA seeks comment on all aspects of this proposal and seeks comment on particular topics where indicated in each Section.

II. Technical Foundation for the NPRM Analysis

A. Why is NHTSA conducting this analysis?

When NHTSA promulgates new regulations or amends its existing regulations, it generally presents an analysis that estimates the impacts of those regulations, including the impacts of other regulatory alternatives it considered during the rulemaking. These analyses derive from statutes such as the APA[27] and the National Environmental Policy Act (NEPA),[28] from Executive orders (such as E.O. 12866),[29] and from other administrative guidance (*e.g.,* Office of Management and Budget (OMB) Circular A–4).[30] For this analysis in particular, EPCA contains several requirements governing the scope and nature of fuel economy standard setting.[31] Among these, some have been in place since EPCA was first signed into law in 1975, some were added in the Alternative Motor Fuels Act of 1988 (AMFA)[32] and in the Energy Policy Act of 1992,[33] and others were added in 2007 when Congress

[25] DOT will update the CAFE civil penalties regulations in 49 CFR 578.6(h) to reflect the statutory amendment in section 40006 of Public Law 119–21 in the next DOT-wide annual civil penalties update rulemaking.

[26] See NHTSA, Corporate Average Fuel Economy, Last revised: 2023, *https://www.nhtsa.gov/laws-regulations/corporate-average-fuel-economy* (accessed: Sept. 10, 2025).

[27] Codified in 5 U.S.C. 551–559.

[28] Codified in 42 U.S.C. 4321–4347.

[29] Regulatory Planning and Review, 58 FR 51735 (Oct. 4, 1993).

[30] Office of Management and Budget, Circular A–4 (Sept. 17, 2003), available at: *https://www.whitehouse.gov/wp-content/uploads/2025/08/CircularA-4.pdf* (accessed Sept. 10, 2025).

[31] Public Law 94–163, 89 Stat. 871 (Dec. 22, 1975). *https://www.govinfo.gov/content/pkg/STATUTE-89/pdf/STATUTE-89-Pg871.pdf.*

[32] Public Law 100–494, 102 Stat. 2441 (Oct. 14, 1988). *https://www.govinfo.gov/content/pkg/STATUTE-102/pdf/STATUTE-102-Pg2441.pdf.*

[33] Public Law 102–486, 106 Stat. 2776 (Oct. 24, 1992). *https://www.govinfo.gov/content/pkg/STATUTE-106/pdf/STATUTE-106-Pg2776.pdf.*

passed the EISA.[34] Most recently, One Big Beautiful Bill Act (OB3) amended EPCA's civil penalty provisions.[35]

These statutes contain a variety of requirements for which NHTSA seeks to account in its analysis. NHTSA captures all of these requirements by presenting an analysis that spans a meaningful range of regulatory alternatives; that quantifies a range of technological, economic, and environmental impacts; and that does so in a manner that accounts for various express statutory requirements for the CAFE program (*e.g.,* passenger cars and light trucks must be regulated separately; and the standard for each fleet must be set at the maximum feasible level in each model year). NHTSA's standards are thus supported by, though not dictated by, extensive analysis of potential impacts of the regulatory alternatives under consideration. Together with this preamble, a Draft TSD, a PRIA, and a Draft SEIS provide a detailed enumeration of related analysis methods, estimates, assumptions, and results. These additional analyses can be found in the rulemaking docket for this proposed rule and on NHTSA's website.[36] [37]

This section provides further detail on the key features and components of NHTSA's standard-setting (also known as ''constrained'') analysis. NHTSA's standard-setting analysis reflects statutory limitations on what NHTSA can consider when determining maximum feasible CAFE standards. In determining maximum feasible fuel economy levels, ''the Secretary of Transportation—(1) may not consider the fuel economy of dedicated automobiles; (2) shall consider dual fueled automobiles to be operated only on gasoline or diesel fuel; and (3) may not consider, when prescribing a fuel economy standard, the trading, transferring, or availability of credits.'' [38] NHTSA also conducts an ''unconstrained'' CAFE Model analysis to evaluate, as required by NEPA, the reasonably foreseeable environmental effects of its proposed action and a reasonable range of alternatives that meet the purpose and need for the proposed action.[39] The technical assumptions for EIS simulations are discussed in the Draft EIS Appendix C.

This section also describes how NHTSA's analysis has been constructed specifically to reflect other governing law applicable to CAFE standards, reviews how NHTSA's analysis has been updated to represent relevant statutory provisions more closely, and describes additional technical work recently conducted by the agency. The analysis for this proposed rule aids NHTSA in implementing its statutory obligations, including the weighing of various considerations, by informing decision-makers about the estimated effects of different regulatory alternatives.

1. What are the key components of NHTSA's analysis?

NHTSA's analysis makes use of a range of data (*i.e.,* observations of things that have occurred), estimates (*i.e.,* things that are unknown or may occur in the future), and models (*i.e.,* methods for making estimates). Two examples of *data* include (1) records of actual odometer readings used to estimate annual mileage accumulation at different vehicle ages and (2) CAFE compliance data used as the foundation for the ''reference fleet'' containing, among other things, production volumes and fuel economy levels of specific configurations of specific vehicle models produced for sale in the United States. Two examples of *estimates* include (1) forecasts of future gross domestic product (GDP) growth used, with other estimates, to forecast future vehicle sales volumes and (2) technology cost estimates, which include estimates of the technologies' ''direct cost,'' marked up by a ''retail price equivalent'' factor, to estimate the ultimate cost to consumers of a given fuel-saving technology, and an estimate of ''cost learning effects'' (*i.e.,* the tendency that it will cost a manufacturer less to apply a technology as the manufacturer gains more experience doing so).

In coordination with the DOT Volpe National Transportation Systems Center (Volpe or the Volpe Center), NHTSA uses the CAFE Compliance and Effects Modeling System (CAFE Model or the Model) to simulate and analyze manufacturers' potential responses to new CAFE standards and to estimate various impacts of those responses. NHTSA has used the CAFE Model to perform analyses supporting every CAFE rulemaking since 2001. Working together, NHTSA and Volpe ensure that the CAFE Model's operation reflects the statutory directives discussed in more detail in Section II below.

The CAFE Model first estimates how vehicle manufacturers might respond to a given regulatory scenario; from that potential compliance solution, the system estimates what impact that response will have on fuel consumption, emissions, safety impacts, and economic externalities. The following section summarizes information necessary to understand the analysis, while Draft TSD Chapter 2 and the CAFE Model Documentation present additional details on the Model's operation.

The CAFE Model may be characterized as an integrated system of models that estimate the impact of various policy options. For example, one model estimates manufacturers' responses, another estimates resultant changes in total vehicle sales, and still another estimates resultant changes in fleet turnover (*i.e.,* scrappage). Importantly, the modeling system does not determine the form or stringency of the standards, which must be developed in consideration of statutory factors that must be balanced by policy-makers. Instead, the CAFE Model applies inputs specifying the form and stringency of standards to be analyzed and produces outputs showing the impacts of manufacturers working to meet those standards, which become part of the basis for comparing different potential stringencies. A regulatory scenario, meanwhile, involves specification of the form, or shape, of the standards (*e.g.,* flat standards, or linear or logistic attribute-based standards), scope of passenger car and light truck regulatory classes, and stringency of the standards for each model year to be analyzed. For example, a regulatory scenario may define standards for a particular class of vehicles that increase in stringency by a given percent per year for a given number of consecutive years.

Manufacturer compliance simulation and the ensuing effects estimation, collectively referred to as compliance modeling, encompass numerous subsidiary elements. Compliance simulation begins with a detailed user-provided initial forecast of the vehicle models offered for sale during the simulation period.[40] The compliance simulation then attempts to bring each

[34] Public Law 110–140, 121 Stat. 1492 (Dec. 19, 2007). *https://www.govinfo.gov/content/pkg/STATUTE-121/pdf/STATUTE-121-Pg1492.pdf.*

[35] Public Law 119–21, 139 Stat. 72 (July 4, 2025). *https://www.congress.gov/119/plaws/publ21/PLAW-119publ21.pdf.*

[36] Docket Nos. NHTSA–2025–0491; NHTSA–2025–0490.

[37] See NHTSA, Corporate Average Fuel Economy, Last revised: 2023, available at: *https://www.nhtsa.gov/laws-regulations/corporate-average-fuel-economy* (accessed: Sept. 10, 2025).

[38] 49 U.S.C. 32902(h).

[39] 42 U.S.C. 4332.

[40] Because the CAFE Model is publicly available, anyone can develop their own initial forecast (or other inputs) for the Model to use. The DOT-developed Market Data Input File that contains the forecast for this proposed rule is available on NHTSA's website at *https://www.nhtsa.gov/corporate-average-fuel-economy/cafe-compliance-and-effects-modeling-system.*

manufacturer into compliance with the standards defined by the regulatory scenario contained within an input file developed by the user.

Estimating impacts involves calculating resulting changes in new vehicle costs, estimating a variety of costs (*e.g.,* for fuel expenditures or reduced or increased technology costs) and effects (*e.g.,* gallons of fuel used by the fleet) occurring as vehicles are driven over their lifetimes before eventually being scrapped, and estimating the monetary value of these effects. Estimating impacts also involves consideration of consumer responses (*e.g.,* the impact of vehicle fuel economy, operating costs, and vehicle price on consumer demand for light-duty vehicles). Both basic analytical elements involve the application of many inputs. Many of these inputs are developed outside of the Model and not by the Model. For example, the Model applies fuel price projections from DOE; it does not estimate fuel prices.

NHTSA also uses EPA's Motor Vehicle Emission Simulator (MOVES) model to estimate ''vehicle'' or ''downstream'' emission factors for criteria pollutants [41] and uses four DOE and DOE-sponsored models to develop inputs to the CAFE Model, including three developed and maintained by DOE's Argonne National Laboratory (Argonne). The agency uses the National Energy Modeling System (NEMS) of DOE's Energy Information Administration (EIA) to estimate fuel prices [42] and uses Argonne's Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) Model to estimate emissions rates from fuel production and distribution processes.[43] DOT also sponsors Argonne to run its Autonomie full-vehicle modeling and simulation system to estimate the fuel economy impacts for over a million combinations of technologies and vehicle types.[44] The Draft TSD and PRIA describe details of the agency's use of these models. In addition, as discussed in the Draft SEIS accompanying this proposed rule, NHTSA relied on a range of models to estimate various environmental impacts.

To prepare for the analysis that supports this proposed rule, DOT has continued to refine and expand the capabilities of the CAFE Model. As examples, and as discussed in more detail below, the reference fleet uses mid-MY 2024 compliance data (the most recent available data at the time of the analysis) and includes the capability (in addition to capabilities integrated into the modeling system) to account for proposed changes to the regulatory vehicle classification definitions. The analysis also employs separate input files for the modeling runs that NHTSA uses for its standard-setting analysis, which excludes the 49 U.S.C. 32902(h) factors that NHTSA cannot consider (constrained analysis), and the modeling runs that NHTSA uses for its analysis of impacts under the National Environmental Policy Act, which does not exclude the 49 U.S.C. 32902(h) factors (unconstrained analysis), and those input files have been updated accordingly. Common to both analyses are routine updates to dollar year values (*e.g.,* 2021$ to 2024$) or routine updates to gas price projections. Some other updates, like updates to manufacturer credit banks, are confined to the unconstrained analysis only and are discussed further in the Draft SEIS Appendix C. The values of many inputs remain uncertain, and NHTSA has conducted sensitivity analyses around selected inputs to attempt to capture some of that uncertainty. These changes reflect DOT's long-standing commitment to ongoing refinement of its approach to estimating the potential impacts of new CAFE standards. These and other updated analytical inputs are outlined in Section II below and discussed in detail in the Draft TSD and PRIA.

2. How do statutory requirements shape NHTSA's analysis?

Multiple requirements govern the scope and nature of CAFE standard setting; the specific requirements regarding the technical characteristics of CAFE standards and the analysis thereof include, but are not limited to, the following:

Corporate Average Standards: 49 U.S.C. 32902 requires that standards apply to the average fuel economy levels achieved by each manufacturer's fleet of vehicles produced for sale in the United States. The CAFE Model calculates the average fuel economy of each manufacturer's fleet based on estimated production volumes and characteristics, including fuel economy levels of distinct vehicle models that could be produced for sale in the United States.

Separate Standards for Passenger and Non-Passenger Automobiles: 49 U.S.C. 32902 requires DOT to set CAFE standards separately for passenger and non-passenger automobiles. The CAFE Model accounts separately for passenger and non-passenger automobiles, including differentiated standards and compliance.

Attribute-Based Standards: 49 U.S.C. 32902 requires DOT to define CAFE standards for passenger and non-passenger automobiles as mathematical functions expressed in terms of one or more attributes related to fuel economy. This means that, for a given manufacturer's fleet of vehicles produced for sale in the United States in a given regulatory class and model year, the applicable minimum CAFE requirement (*i.e.,* the numerical value of the requirement) is computed based on the applicable mathematical function as well as the mix and attributes of vehicles in the manufacturer's fleet. The CAFE Model accounts for such functions and vehicle attributes explicitly.

Separately Defined Standards for Each Model Year: 49 U.S.C. 32902 requires DOT to set CAFE standards (separately for passenger and non-passenger automobiles) at the maximum feasible levels in each model year. The CAFE Model represents each model year explicitly and accounts for the production relationships between model years. For example, a new engine first applied to a given vehicle model/configuration in MY 2030 most likely will be retained in MY 2031 for that same vehicle model to reflect the fact that manufacturers do not apply brand-new engines to a given vehicle model every single year. The CAFE Model is designed to account for this reality, while still respecting applicable statutory constraints.

Separate Compliance for Domestic and Imported Passenger Car Fleets: 49 U.S.C. 32904 requires EPA to determine average fuel economy separately for each manufacturer's fleet of domestic passenger cars and imported passenger

[41] See *https://www.epa.gov/moves.* This proposed rule uses version MOVES5 (the latest version at the time of analysis), available at *https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves.*

[42] See *https://www.eia.gov/outlooks/aeo/.* This proposed rule uses fuel prices estimated using the Annual Energy Outlook (AEO) 2025 version of NEMS. See *https://www.eia.gov/outlooks/aeo/tables_ref.php.*

[43] Information regarding GREET is available at *https://greet.anl.gov/.* This proposed rule uses the R&D GREET 2023 version.

[44] As part of the Argonne simulation effort, individual technology combinations simulated in Autonomie were paired with Argonne's BatPaC model to estimate the battery cost associated with each technology combination based on characteristics of the simulated vehicle and its level of electrification. Information regarding Argonne's BatPaC model is available at *https://www.anl.gov/cse/electrochemical-chemical-TEA.* In addition, the impact of engine technologies on fuel consumption, torque, and other metrics was characterized using GT–POWER simulation modeling in combination with other engine modeling that was conducted by IAV Automotive Engineering, Inc. (IAV). The engine characterization ''maps'' resulting from this analysis were used as inputs for the Autonomie full-vehicle simulation modeling. Information regarding GT–POWER is available at *https://www.gtisoft.com/gt-power/.*

cars. A passenger car is considered to be domestic or imported based on the definitions provided in 49 U.S.C. 32904. The CAFE Model accounts explicitly for this requirement when simulating manufacturers' potential responses to CAFE standards.

Minimum CAFE Standards for Domestic Passenger Car Fleets: 49 U.S.C. 32902 requires that domestic passenger car fleets also meet a minimum CAFE standard, which is calculated as 92 percent of the average fuel economy projected by the Secretary for the combined passenger car fleet manufactured for sale in the United States by all manufacturers in the model year. This projection is published at the time the standard is promulgated. The CAFE Model accounts explicitly for this requirement.

Statutory Basis for Stringency: 49 U.S.C. 32902 requires DOT to set CAFE standards for passenger and non-passenger automobiles at the maximum feasible levels, considering technological feasibility, economic practicability, the need of the U.S. to conserve energy, and the impact of other motor vehicle standards of the Government on fuel economy. The analysis and balancing of these factors necessarily changes in light of current and projected economic and market conditions. Accordingly, NHTSA has continued to expand and refine its qualitative and quantitative analysis to account for these statutory factors in light of such conditions. For example, the simulations of technology effectiveness reflect the agency's judgment that it would not be economically practicable, appropriate, or cost effective for a manufacturer to ''split'' an engine shared among many vehicle models/configurations into myriad versions each optimized to a single vehicle model/configuration.

Civil Penalties for Noncompliance: 49 U.S.C. 32912 (and implementing regulations) prescribe a rate (in dollars per tenth of a mile per gallon (mpg)) at which the Secretary is to levy civil penalties if a manufacturer fails to comply with a CAFE standard for a given fleet in a given model year. When civil penalties are applicable (*i.e.,* when they are not set by statute to a value of $0, as they have been at the time of this analysis of the proposed rule), the CAFE Model will calculate civil penalties for CAFE shortfalls (if directed to do so by the user). However, as stated, civil penalty values are currently set by statute to a value of $0; therefore, the CAFE Model's calculations will always result in zero civil penalties.

Dual-Fueled and Dedicated Alternative Fuel Vehicles: For purposes of calculating CAFE standards used to determine passenger and non-passenger automobile fleet compliance, 49 U.S.C. 32905 and 32906 specify methods for calculating the fuel economy levels of vehicles operating on alternatives to gasoline or diesel fuels. The CAFE Model can account for these requirements explicitly for each relevant vehicle model. However, 49 U.S.C. 32902 also prohibits consideration of the fuel economy of dedicated alternative fuel vehicle (AFV) models (or the non-gasoline or non-diesel calculated fuel economy of dual-fueled AFVs) when NHTSA determines what levels of passenger and non-passenger automobile CAFE standards are maximum feasible. Therefore, the CAFE Model is run in a manner that excludes dedicated AFV technologies and limits the consideration of a dual-fueled AFV's fuel economy to only its gasoline or diesel operation. NHTSA operates the Model with this limitation when performing the analysis that is used to inform the setting of standards. The CAFE Model can also be run without this analytical constraint, and the agency does so in the NEPA analysis described below.

Creation and Use of Compliance Credits: 49 U.S.C. 32903 provides that manufacturers may earn CAFE ''credits'' by achieving an average fuel economy level beyond that required of a given fleet in a given model year and specifies how these credits may be used to offset the amount by which a different fleet falls short of its corresponding requirement. These provisions allow credits to be ''carried forward'' a maximum of five model years, ''carried back'' a minimum of three model years, transferred between regulated classes, and traded between manufacturers. However, credit use is also subject to specific limits: the statute caps the amount of credit that can be transferred between a manufacturer's fleets and prohibits manufacturers from applying traded or transferred credits to offset a failure to achieve the minimum standard for domestic passenger automobiles. The CAFE Model has the capability to simulate manufacturers' potential use of credits carried forward from prior model years or transferred from other fleets;[45] however, this capability is not used in the standard-setting analysis because 49 U.S.C. 32902 prohibits consideration of manufacturers' potential application of CAFE compliance credits when setting maximum feasible CAFE standards for passenger and non-passenger automobiles.

National Environmental Policy Act (NEPA): The Draft SEIS accompanying this proposed rule documents changes in fuel use and emissions as estimated using the CAFE Model and also documents corresponding estimates—based on the application of other models documented in the Draft SEIS—of environmental impacts of the regulatory alternatives under consideration.

3. What updated capabilities and assumptions does the current Model reflect as compared to the version used in the analysis of the 2024 final rule?

DOT has continued its ongoing effort to refine and expand the capabilities of the CAFE Model for use in analyzing regulatory alternatives as considered in this proposal. Any analysis of regulatory actions that will be implemented several years in the future, and whose benefits and costs accrue over decades, requires many assumptions. Over such time horizons, many, perhaps even most, of the relevant assumptions in such an analysis are inevitably uncertain. To help address this, NHTSA updates the assumptions used in each successive CAFE analysis to reflect the current state of the world more accurately and to apply the best current estimates of future conditions. Accordingly, since the 2024 final rule, DOT has made the following changes to the CAFE Model and its inputs:

- Updating the Market Data Input File to reflect the change in analysis fleet from MYs 2022–2024;
- Updating algorithms and settings to remove statutorily prohibited inputs from the standard-setting analysis and to select between different types of analyses (*i.e.,* constrained and unconstrained);
- Updating the base dollar year from 2021$ to 2024$;
- Updating the capability to exclude plug-in hybrid electric vehicle (PHEV) electricity usage when PHEV fuel economy operation is in gasoline-only mode for standard setting;

[45] Note that the CAFE Model does not simulate the potential for manufacturers to carry CAFE credits back (*i.e.,* borrow) from future model years or acquire and use CAFE compliance credits from other manufacturers. NHTSA believes that there is significant uncertainty in how manufacturers may choose to use these particular flexibilities in the future: for example, while it is reasonably foreseeable that a manufacturer who over-complies in 1 year may ''coast'' through several subsequent years relying on that prior improvement rather than continuing to make technology improvements year after year, it is harder to assume with confidence that manufacturers will rely on future technology investments to offset prior-year shortfalls, or whether and how manufacturers will trade credits with market competitors rather than make their own technology investments.

• Updating the modeling capability to allow for vehicle reclassification;
• Updating the Market Data Input File to include vehicle reclassification;
• Updating the Model to use a bracketed costing approach to determine prices for the five levels of mass reduction (MR);
• Updating the Scenarios Input File to remove AC and OC FCIVs;
• Updating the Market Data Input File to include advanced truck credits for MY 2024 vehicles, noting that those credits sunset after MY 2024 and are therefore only applicable to that one year;
• Updating the Parameters Input File to set the social cost of carbon at zero;
• Updating the Parameters Input File for changes in other economic variables;
• Updating the Scenarios Input File with an adjusted tax credit phase-out timeframe;
• Updating the Scenarios Input File to set civil penalties to zero;
• Updating selected economic assumptions:
  ○ Rebound elasticity;
  ○ Payback period;
  ○ Value of travel time per vehicle; and
  ○ Numerous other updates based on the 2025 AEO; and
• Updating emission rates based on EPA's ''MOVES5'' model.

These and other updated analytical inputs are discussed in the remainder of this section and in detail in the Draft TSD.

B. What is NHTSA analyzing?

NHTSA is analyzing the effects of different potential CAFE standards on industry, consumers, and society at large. These different potential standards are described as ''regulatory alternatives,'' and, amongst the regulatory alternatives, NHTSA identifies which ones the agency is proposing to select. EPCA, as amended by EISA, expressly requires that CAFE standards for passenger cars and light trucks be based on one or more vehicle attributes related to fuel economy and be expressed in the form of a mathematical function.[46] Thus, the standards (and the regulatory alternatives) for passenger cars and light trucks take the form of fuel economy targets expressed as functions of vehicle footprint (the product of vehicle wheelbase and average track width) that are separate for passenger cars and light trucks.

Under the footprint-based standards, the function defines a fuel economy performance target for each unique footprint combination within a car or truck model type. Using the functions, each manufacturer thus will have an average fuel economy standard for each year that is unique to each of its regulatory fleets (*i.e.,* passenger automobiles and non-passenger automobiles, consistent with 49 U.S.C. 32902(b)), based on the footprint and production volumes of the vehicle models produced by that manufacturer. The functions are negatively sloped, so that larger vehicles (*i.e.,* vehicles with larger footprints) will generally be subject to lower mpg targets than smaller vehicles. This is because smaller vehicles are typically more capable of achieving higher levels of fuel economy, because they tend not to require as much energy to propel the mass necessary to perform their driving task. Although a manufacturer's fleet average standard could be estimated throughout the model year based on the projected production volume of its vehicle fleet (and is estimated as part of EPA's certification process), the standards with which the manufacturer must comply are determined by its final model year production figures. A manufacturer's calculation of its fleet average standards, as well as its fleets' average performance at the end of the model year, will thus be based on the production-weighted average target and performance of each model in its fleet.[47]

For passenger cars, consistent with prior rulemakings, NHTSA is defining fuel economy targets as shown in Equation II–1.

Equation II–1: Passenger Car Fuel Economy Footprint Target Curve

$$\boldsymbol{TARGET_{FE} = \frac{1}{MIN\left[MAX\left(c \times FOOTPRINT + d, \frac{1}{a}\right), \frac{1}{b}\right]}}$$

Where:

$TARGET_{FE}$ is the fuel economy target (in mpg) applicable to a specific vehicle model type with a unique footprint combination,
a is a minimum fuel economy target (in mpg),
b is a maximum fuel economy target (in mpg),
c is the slope (in gallons per mile (or gpm) per square foot) of a line relating fuel consumption (the inverse of fuel economy) to footprint, and
d is an intercept (in gpm) of the same line.

Here, *MIN* and *MAX* are functions that take the minimum and maximum values, respectively, of the set of included values. For example, *MIN*[40, 35] = 35 and *MAX*(40, 25) = 40, such that *MIN*[*MAX*(40, 25), 35] = 35.

For light trucks, also consistent with prior rulemakings, NHTSA is defining fuel economy targets as shown in Equation II–2.

Equation II–2: Light Truck Fuel Economy Footprint Target Curve

$$TARGET_{FE} = \frac{1}{MIN\left[MAX\left(c \times FOOTPRINT + d, \frac{1}{a}\right), \frac{1}{b}\right]}$$

Where:

$TARGET_{FE}$ is the fuel economy target (in mpg) applicable to a specific vehicle model type with a unique footprint combination, and
a, b, c, and *d* are as for passenger cars, but take values specific to light trucks.

Though the general model of the target function equation is the same for passenger cars and light trucks, and the

[46] 49 U.S.C. 32902(a)(3)(A).

[47] As discussed in prior rulemakings, a manufacturer may have some vehicle models that exceed their target and some that are below their target. Compliance with a fleet average standard is determined by comparing the fleet average standard (based on the production-weighted average of the target levels for each model) with fleet average performance (based on the production-weighted average of the performance of each model). This is inherent in the statutory structure of CAFE, which requires NHTSA to set *corporate average* standards.

same for each model year, the parameters of the function equation differ for cars and trucks.

The parameters defining the general curve shapes have remained the same since the 2012 final rule. NHTSA periodically reconsiders whether to update the mathematical functions but in each prior instance concluded that the existing curves continued to represent the relationship between footprint and fuel economy reasonably. Consistent with the agency's past practice of reviewing the mathematical functions prior to each rulemaking, NHTSA re-examined the curve shapes for this proposal.

More specifically, NHTSA performed descriptive statistical analyses using manufacturer-reported data for the MY 2022 and MY 2024 fleets. NHTSA used the MY 2022 fleet for analysis of curve shapes relevant to the MYs 2022–2027 standards and used the MY 2024 ''reclassified'' fleet for analysis of curve shapes relevant to the MYs 2028–2031 standards. As discussed in more detail in Draft TSD Chapter 1, the proposed updates to NHTSA's vehicle classification regulations beginning in MY 2028 have material impacts on the relationship between fuel economy and footprint for each regulatory class, as expressed by the standards-defining functions.

To estimate the relationship between fuel economy and footprint and to maintain general consistency with analyses of past rules (and the conformance to statutory prohibitions), the agency excluded all diesel engine vehicles and all plug-in electric vehicles, which include plug-in hybrid electric vehicles, battery electric vehicles (BEV), and fuel cell electric vehicles (FCEV), and applied weighting and other adjustments to the fuel consumption and footprint data. Table II–1 summarizes the methodological approaches that NHTSA considered for reassessing the footprint curves.

Table II-1: Summary of Methodological Approaches Considered for Assessing Footprint Curves

Category	Type	Description	Key Considerations
Regression types	Ordinary Least-Squares (OLS)	Regression solution that minimizes squared errors	Describes the average relationship between footprint and fuel economy; outliers receive additional weight.
	Minimum Absolute Deviation (MAD)	Regression solution that minimizes absolute errors	Describes the median relationship between footprint and fuel economy; does not give outliers as much weight as OLS.
Datapoint weighting	Production weights	Data weighted by production volumes of each vehicle model	High production, mass-market vehicles have a greater influence on the footprint curve form than vehicles with lower production levels.
	Model weights	Each vehicle model receives equal weighting	Estimates treat all vehicle model lines equally and therefore measures footprint curves based on vehicle model offerings (i.e., ignores the effect of sales volume).
Vehicle technology levels	Existing technology	Analysis dataset contains information on current observed technology in the baseline fleet	Represents the existing market, including demand factors; retains existing heterogeneity in technology application across the fleet.
	Simulated maximum technology[48]	Analysis dataset derived from simulation modeling that assumes maximum allowable technology, with multiple candidates for technology limits.	Represents the "engineering" relationship between fuel consumption and footprint by limiting heterogeneity in current technology application across the fleet (i.e., this represents the technology frontier for the current fleet).
Controls	Curb weight (CW) to footprint	Removes variation in fuel consumption caused by above/below average CW-to-footprint.	Limits noise in the observed relationship between fuel consumption and footprint that is introduced by manufacturers optimizing other attributes (e.g., increased acceleration); accounts for some of the variation by body style.
	Horsepower (HP) to CW	Removes variation in fuel consumption caused by above/below average HP-to-CW.	
	Both	Removes variation in fuel consumption caused by above/below average CW-to-footprint and HP-to-CW.	

[48] The maximum technology fleet was simulated with the CAFE Model, assuming a MY 2024 fleet and maximum allowable technology application.

NHTSA believes that the ordinary least-squares (OLS) regression framework continues to be an appropriate method for estimating the relationship of footprint to fuel economy. While the agency relied on the minimum absolute deviation (MAD) regression framework in the 2010 final rule to address the effects of ''outlier'' vehicles in the fleet, the agency addresses outlier vehicles in this reconsideration through technology-based exclusions (*i.e.,* by excluding diesels, PHEVs, BEVs, and FCEVs, as mentioned above) and data normalization through the application of controls, including curb weight (CW) to footprint, horsepower (HP) to CW, and both together, depending on the regulatory fleet under consideration, as it has in each of its CAFE rulemaking actions since 2012. The curves also reflect updated fleet data to reset the ''cutpoints,'' or the places at the lowermost and uppermost bounds of vehicle footprint distributions where the standards remain flat (*i.e.,* the mpg target does not continue to increase as footprint decreases, and vice versa). The resulting footprint curves are shown in Section III's discussion of the regulatory alternatives.

As discussed in Draft TSD Chapter 1, NHTSA considers a variety of technical and policy issues when determining the footprint curve shape in any CAFE rulemaking action. For example, standards that decrease sharply with increasing footprint could create incentives for manufacturers to upsize vehicles, since small changes in vehicle footprint would result in a significant change in the vehicle's fuel economy target; conversely, flatter standards could create a significant amount of additional technology burden for larger vehicles to meet fuel economy targets like those of smaller vehicles. That said, NHTSA performed an analysis for the 2024 final rule showing that vehicle footprints, within vehicle types, have been stable on a sales-weighted basis since MY 2012.[49] The biggest increase to within-type footprints was for the sedan/wagon category, which increased by 3.4 percent (or about 2 square feet) from 2012 (for reference, a 1.5-square foot increase would equate to about a 2-inch increase in the track width of a MY 2022 Toyota Corolla). NHTSA concluded that the disconnect between vehicle class-level characteristics and what was being perceived at the fleet level (*i.e.,* vehicles seemingly getting larger) was traceable to the increase in the share of fleet vehicles classified as light trucks relative to the share of passenger cars. Available data indicate that the use of footprint as an attribute did not appear to lead to manufacturers significantly altering the size of their vehicles within vehicle classes and that the major shift in fleet share was not a result of the shape of the footprint curves.

The footprint curve updates for this proposal are intended to ensure that the agency appropriately captures the footprint-to-fuel economy relationship using the most current data. As discussed in Draft TSD Chapter 1, the observed relationship between footprint and fuel economy for both the passenger car and light truck fleets is on average ''flatter'' (*i.e.,* on average, the fuel economy did not vary as much across footprint levels) than the MY 2008 fleet used to create the footprint curves for the past several rules. While the technical concerns and policy trade-offs associated with the curve shapes still hold to some extent, NHTSA believes it is more likely, as shown from the agency's 2024 analysis and the updated analysis presented in Section VI, that any shift in vehicle attributes present in the market over time has not been due to the shapes of curves or the use of footprint as the relevant attribute. NHTSA seeks comments on this belief, as well as the updated footprint curve shape analysis, discussed in more detail in Draft TSD Chapter 1.

Finally, the required CAFE level applicable to a passenger car (either domestic or import) or light truck fleet in a given model year is determined by calculating the production-weighted harmonic average of fuel economy targets applicable to specific vehicle model configurations in the fleet, as shown in Equation II–3.

Equation II–3: Calculation for Required CAFE Level

$$CAFE_{required} = \frac{\sum_i PRODUCTION_i}{\sum_i \frac{PRODUCTION_i}{TARGET_{FE,i}}}$$

Where:

$CAFE_{required}$ is the CAFE level the fleet is required to achieve,

i refers to specific vehicle model configurations in the fleet,

$PRODUCTION_i$ is the number of model configuration i produced for sale in the United States, and

$TARGET_{FE,\ i}$ is the fuel economy target (as defined above) for model configuration i.

Additional details about the specific values defining the mathematical functions and visual representations of the fuel economy target curves are presented in Section III, below.

C. What inputs does the compliance analysis require?

The first step in the agency's analysis of the effects of different levels of fuel economy standards is the compliance simulation. As used throughout this rulemaking, ''compliance simulation'' means the simulation of how manufacturers could comply with different levels of CAFE standards by adding fuel economy-improving technology to an existing fleet of vehicles, using the CAFE Model. The CAFE Model uses a variety of data, including data provided by manufacturers, to simulate final fleet sales and performance.[50]

At the most basic level, a model is a set of equations, algorithms,[51] or other calculations used to make predictions about a complex system. A model may consider various inputs, such as technology costs or other relevant factors, and use those inputs to generate output predictions. NHTSA used two separate approaches for which it is proposing to amend the existing CAFE standards, one for MYs 2022–2026 and one for MYs 2027–2031. The sections

[49] NHTSA, Technical Support Document: Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks for Model Years 2027 and Beyond and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans for Model Years 2030 and Beyond, NHTSA: Washington, DC, pp. 1–20 (2024).

[50] When NHTSA uses the phase ''the Model'' throughout this section, NHTSA is referring to the CAFE Model. Any other model is specifically named.

[51] See Merriam-Webster ''algorithm.'' Broadly, an algorithm is a step-by-step procedure for solving a problem or accomplishing some end. More specifically, an algorithm is a procedure for solving a mathematical problem (as of finding the greatest common divisor) in a finite number of steps that frequently involves repetition of an operation.

below discuss the inputs each of those analyses used.

1. What inputs does the analysis require for 2022–2026?

For the MYs 2022–2026 analysis, NHTSA has performed two exercises: first, it has re-evaluated the statistical model used to determine the shape (*i.e.,* slope, intercept, and cutpoints) of the target functions for passenger cars and light trucks. Based on its preferred choice of shape, NHTSA has evaluated the compliance position of manufacturers in MYs 2022–2024 under alternative stringencies and compared results to the manufacturers' achieved average fuel economy in these years. For both exercises, NHTSA relies on compliance data from manufacturer mid-year compliance reports. For its curve fitting analysis, NHTSA uses vehicle model level data on vehicle attributes, including footprint, HP, CW, and 2-cycle fuel economy. NHTSA also uses mid-year estimates of model sales from manufacturer compliance data for this exercise. NHTSA's curve fitting analysis is described in greater detail in Draft TSD Chapter 1. For NHTSA's comparison of achieved fuel economy and proposed standards levels, the agency uses compliance data at the model level for vehicle footprint, 2-cycle fuel economy, and mid-year estimates of vehicle sales.

For MYs 2022–2024, NHTSA uses each proposed standard to calculate vehicle model target function values for each vehicle model in the standard-setting fleet.[52] Consistent with past rulemakings, the agency uses piecewise linear functions of vehicle footprint, which map to a target value of fuel consumption rate in gallons-per-mile.[53] NHTSA determines a vehicle's target fuel economy level in miles per gallon for a given set of standards, and then takes the reciprocal of this value. NHTSA determines the CAFE standards for each manufacturer at the regulatory class level under each alternative by taking the sales-weighted harmonic mean of the relevant models produced by the manufacturer in each regulatory class in each model year. The agency repeats these calculations for each model year under consideration to determine a single value for each regulatory class in which the manufacturer produced vehicles.

NHTSA also computes the MDPCS for each model year by taking the sales-weighted harmonic mean of the model-level target function values for all vehicles in the passenger car fleet in that model year and multiplying the value by 92 percent.[54]

NHTSA determines each manufacturer's achieved fuel economy in miles per gallon separately for each regulatory class using the sales-weighted average of the 2-cycle fuel economy values of all models produced by the manufacturer in the relevant regulatory class. NHTSA then compares this achieved value to the corresponding manufacturer regulatory class standard in each model year to determine whether the fleet of vehicles to which it corresponds would comply with each proposed standard in that model year. To determine the total number of vehicles out of compliance, NHTSA determines compliance for each manufacturer's regulatory fleet in each model year under each proposed alternative, and if a fleet is determined to be out of compliance, the agency sums the total number of vehicles sold in the non-compliant fleet.

As discussed in more detail in Section IV, NHTSA analyzes the difference between each manufacturer's fleet CAFE compliance value and the proposed standard. NHTSA has considered using the CAFE Model to simulate behavior for the MYs 2022–2026 compliance period to estimate how manufacturers and consumers could have responded to different CAFE standards. However, for MYs 2022–2025, production is already closed or is in process, and MY 2026 production plans likely are solidified and underway by the time of this NPRM's publishing. This type of analysis overestimates the ability of manufacturers to optimize in response to the proposed standards for these years and likely leads to different results from the actual outcomes. Thus, simulating a response and any monetized costs or benefits deriving from that do not represent real economic effects from the proposed change in policy.

2. What inputs does the compliance analysis require for 2027–2031?

For the MYs 2027–2031 amendment analysis, NHTSA used the CAFE Model to simulate manufacturers' potential responses to new CAFE standards and to estimate the various impacts of those responses on manufacturers and society. The Model considers various inputs, such as technology effectiveness data, technology costs, and other relevant factors, and uses those inputs to generate output predictions.

NHTSA attempts to ensure that the technology inputs and assumptions that go into the CAFE Model are based on sound science and reliable data and that NHTSA's reasons for using those inputs and assumptions are transparent and understandable to stakeholders. This section and the following section discuss at a high level how the agency generates the technology inputs and assumptions that the CAFE Model uses for the compliance simulation.[55] The Draft TSD, CAFE Model Documentation, CAFE Analysis Autonomie Documentation,[56] and other technical reports supporting this proposed rule discuss the agency's technology inputs and assumptions in more detail.

NHTSA incorporates technology inputs and assumptions either directly in the CAFE Model or in the CAFE Model's various input files. The compliance simulation algorithm is at the heart of the CAFE Model's decisions about how to apply technologies to a manufacturer's vehicles to project how the manufacturer could meet CAFE standards. The compliance simulation algorithm consists of several equations that direct the Model to apply fuel economy-improving technologies to vehicles in a way that simulates how manufacturers might apply those technologies to their vehicles in the real world. The compliance simulation algorithm projects a cost-effective pathway for manufacturers to comply with different levels of CAFE standards, considering the technology present on manufacturers' vehicles now and what technology could be applied to their vehicles in the future. Embedded in the CAFE Model is the universe of technology options that the Model can consider and rules about the order in which it can consider those options, as well as estimates of how effective fuel economy-improving technology is on different types of vehicles (*e.g.,* sedan or pickup truck).

[52] Per 49 U.S.C. 32902(h), dedicated alternative fueled vehicles, such as EVs, are excluded from this analysis. For duel-fueled vehicles, the analysis uses a fuel economy value for the vehicles operating only on gasoline or diesel fuel. *Id.*

[53] See Chapter 1.2 of the Draft TSD discussing footprint functions.

[54] 49 U.S.C. 32902(b)(4).

[55] As explained throughout this section, a NHTSA input is a specific number or datapoint used by the Model, and NHTSA's assumptions are based on judgment after careful consideration of available evidence. An assumption can be an underlying reason for the *use* of a specific datapoint, function, or modeling process. For example, an input might be the fuel economy value of the Ford Mustang, whereas the assumption is that the Ford Mustang's fuel economy value reported in Ford's CAFE compliance data should be used in NHTSA's modeling.

[56] The Argonne report is titled ''Vehicle Simulation Process to Support the Analysis for MY 2027 and Beyond CAFE and MY 2030 and Beyond HDPUV FE Standards.'' However, for ease of use and consistency with the Draft TSD it is referred to as ''CAFE Analysis Autonomie Documentation.''

Technology inputs and assumptions are also located in all four of the CAFE Model Input Files. The Market Data Input File is a spreadsheet file that characterizes the fleet of vehicles used as the starting point for the CAFE Model. There is one row describing each vehicle model and model configuration manufactured for the United States market in a model year (or years) and input and assumption data that links those vehicles to technology and economic, environmental, and safety inputs and assumptions. The Technologies Input File identifies 71 technologies the agency uses in the analysis, along with information used to inform the compliance simulation and effects estimates, including phase-in caps to identify when and how widely each technology can be applied to specific types of vehicles, most of the technology costs (hybrid vehicle battery costs are provided in a separate file), and the fuel share percentage for PHEV to capture the charge sustaining operation. The Scenarios Input File provides the coefficient values defining the standards for each regulatory alternative [57] and other relevant information applicable to modeling each regulatory scenario.[58] Finally, the Parameters Input File contains mainly economic and environmental data.[59]

NHTSA generates these technology inputs and assumptions in several ways, including using data submitted by vehicle manufacturers pursuant to their CAFE reporting obligations; public data on vehicle models from manufacturer websites, press materials, marketing brochures, and other publicly available information; collaborative research, testing, and modeling with other Federal agencies, like Argonne; and research, testing, and modeling with independent organizations, like IAV GmbH Ingenieurgesellschaft Auto und Verkehr (IAV), Southwest Research Institute (SwRI), National Academy of Sciences (NAS), and FEV North America. NHTSA also considers the work done to develop inputs and assumptions for prior rules to the extent it is still relevant and applicable; feedback from stakeholders on prior rules and from meetings conducted before the commencement of this proposed rule; and NHTSA's own engineering judgment. NHTSA uses the term ''engineering judgment'' throughout this rulemaking to refer to decisions made by a team of NHTSA engineers and analysts. This judgment is based on their experience working in the automotive industry and other relevant fields and assessment of all the data sources described above. Most importantly, the agency uses engineering judgment to assess how best to represent vehicle manufacturers' potential responses to different levels of CAFE standards within the boundaries of the agency's modeling tools, as ''a model is meant to simplify reality in order to make it tractable.'' [60] In other words, NHTSA uses engineering judgment to concentrate potential technology inputs and assumptions from millions of discrete data points from hundreds of sources into four external input files and three datasets integrated into the CAFE Model. How the CAFE Model decides to apply technology (*i.e.,* the compliance simulation algorithm), has been developed using engineering judgment, considering factors that manufacturers consider when they add technology to vehicles in the real world. The specific technology inputs and assumptions are discussed in more detail in the following sections and in the associated technical documentation.

a. Technology Options and Pathways

NHTSA begins the compliance analysis by defining the range of fuel economy-improving technologies that the CAFE Model could add to a manufacturer's vehicles in the U.S. market.[61] These are technologies that the agency believes are representative of what vehicle manufacturers currently use on their vehicles, and that vehicle manufacturers could use on their vehicles in the timeframe for the proposed standards (MYs 2027–2031). The technology options include engines, transmissions, hybridization, and road load technologies, which include MR, aerodynamic improvement (aerodynamic drag technology (AERO)), and tire rolling resistance (ROLL) reduction technologies.[62]

Adding a technology to the range of options that the CAFE Model can consider requires several data elements, including a broadly applicable technology definition, estimates of how effective that technology is at improving fuel economy on different vehicle types (*e.g.,* sedan or pickup truck), and the cost to apply that technology to each. Each technology the agency selects is designed to be representative of a wide range of specific technology applications used in the automotive industry. Some manufacturers' systems may perform better or worse than NHTSA's modeled systems, and some may cost more or less than NHTSA's modeled systems. However, selecting representative technology definitions for the agency's analysis ensures the agency captures a reasonable level of costs and benefits that would result from any manufacturer applying the technology.

NHTSA has been refining the technology options it considers since first developing the CAFE Model in 2002. In this context, ''refining'' means both adding and removing technology options depending on current technology availability and projected future availability in the U.S. market, while balancing a reasonable amount of modeling and analytical complexity. In recent years, the agency has refined the internal combustion engine (ICE) technology options, particularly the TURBO and HCR pathways, to reflect better the diversity of engines in the current fleet. Consistent with NHTSA's interpretation of EPCA/EISA, discussed further in Section II.0 and V, the agency includes several hybrid technologies to represent appropriately the diversity of current and anticipated future technology options while ensuring NHTSA's analysis remains consistent with statutory limitations prohibiting the consideration of EVs in establishing standards and considering only the gas or diesel operation of dual fueled automobiles.

The technology options do not include technologies NHTSA has determined will not be available in the rulemaking timeframe. As with past analyses, the agency does not include technologies unlikely to be feasible in the rulemaking timeframe, engine technologies designed for markets other than the United States market required to use unique gasoline,[63] or technologies

[57] The coefficient values are defined in PRIA Chapter 3 for the CAFE standard.

[58] This file also includes information about the amount of fuel consumption improvement values a manufacturer may generate for compliance purposes for model years in which a manufacturer may generate them.

[59] See CAFE Model Documentation for a detailed discussion of what inputs are held in each of the input data files.

[60] Chem. Mfrs. Ass'n v. EPA, 28 F.3d 1259, 1264–65 (D.C. Cir. 1994) (citing Milton Friedman, in Friedman, M., The Methodology of Positive Economics, in Essays in Positive Economics 3, University of Chicago Press: Chicago, IL, pp. 14–15 (1953), available at: *https://www.wiwiss.fu-berlin.de/fachbereich/bwl/pruefungs-steuerlehre/loeffler/Lehre/bachelor/investition/Friedman_the_methology_of_positive_economics.pdf* (accessed: Sept. 10, 2025)).

[61] 40 CFR 86.1806–17, Onboard diagnostics; 40 CFR 86.1818–12, Greenhouse gas emission standards for light-duty vehicles, light-duty trucks, and medium-duty passenger vehicles; Commission Directive 2001/116/EC—European Union emission regulations for new LDVs—including passenger cars and light commercial vehicles (LCV).

[62] Draft TSD Chapter 3 contains discussion on the technology tree and technologies available.

[63] In general, most vehicles produced for sale in the United States have been designed to use ''regular'' gasoline, or 87 octane. See EIA, Gasoline

for which appropriate data are not available for the range of vehicles that the agency models in the analysis (*i.e.,* technologies that are still in the research and development phase and not ready for mass-market production). Each technology section below and Chapter 3 of the Draft TSD discuss these modeling decisions in detail.

In this analysis, the CAFE Model does not dictate or predict the technologies manufacturers must use to comply; rather, the CAFE Model outlines a technology pathway that manufacturers could use to meet the standards cost effectively. While NHTSA estimates the costs and benefits for different levels of CAFE standards based on a simulation of the technology manufacturers could apply in the rulemaking timeframe, it is entirely possible and reasonable that manufacturers may use different technology options to meet the agency's standards in the real world and may even use technologies that NHTSA does not include in the analysis. This is because NHTSA's standards do not mandate the application of any particular technology. Rather, NHTSA's standards are performance-based: manufacturers in the real world can and do use a range of compliance solutions that include technology application and encouraging sales shifts from one vehicle model or trim level to another.[64] The agency has determined that the 71 technology options included in the analysis strike a reasonable balance between representing the diversity of technology used by the entire industry and simplifying reality to make modeling workable.[65]

Chapter 3 of the Draft TSD and Section II.0 below describe the technologies that NHTSA uses for the analysis. Each technology has a name that loosely corresponds to its real-world technology equivalent. NHTSA abbreviates the name to a short signifier for the CAFE Model to read. The agency organizes those technologies into groups based on technology type: basic and advanced engines, transmissions, hybridization, and road load technologies, which include MR, aerodynamic improvement, and low rolling resistance tire technologies.

NHTSA then organizes the groups into pathways. The pathways instruct the CAFE Model how and in what order to apply technology. In other words, the pathways define mutually exclusive technologies (*i.e.,* those that cannot be applied at the same time) and define the direction in which vehicles can advance as the Model evaluates which technologies to apply. The respective technology chapters in the Draft TSD and Section 4 of the CAFE Model Documentation include a visual of each technology pathway. In general, the paths are tied to ease of implementation of additional technology and how closely related the technologies are.

As an example, NHTSA's ''Turbo Engine Path'' consists of five different engine technologies that employ different levels of turbocharging technology. A turbocharger is essentially a small turbine driven by exhaust gases produced by the engine. As these gases flow through the turbocharger, they spin the turbine, which in turn spins a compressor that pushes more air into an engine's cylinders. Having more air in the engine's cylinders allows the engine to burn more fuel, which then creates more power, without needing a physically larger engine. In the agency's analysis, an engine that is turbocharged ''downsizes,'' or becomes smaller. Choosing to turbocharge an engine allows a manufacturer to maintain similar levels of performance to a larger, non-turbocharged engine with a smaller engine that uses less fuel to do the same amount of work. Allowing basic engines to be downsized and turbocharged instead of just turbocharged keeps the vehicle's utility and performance constant so that NHTSA can measure the costs and benefits of different levels of fuel economy improvements, rather than the change in different vehicle attributes. This concept of performance neutrality is discussed further, below.

The Model only allows forward movement along the technology pathways, adding more advanced technology as the Model moves through the technology tree. This ensures that a vehicle that uses a more advanced technology cannot downgrade to a less advanced version of the technology or ensures that a vehicle does not switch to technology that is significantly technically different. This progressive order also realistically represents how manufacturers often start with the lowest and most cost-effective technologies and generally advance along particular technology pathways. As an example, if a vehicle in the compliance simulation begins with a TURBOD engine—a turbocharged engine with cylinder deactivation—it cannot adopt a TURBO0 engine.[66] Similarly, this vehicle with a TURBOD engine cannot adopt an advanced cylinder deactivation on a dual-overhead camshaft engine (ADEACD) engine.[67] As an example of NHTSA's rationale for ordering technologies on the technology tree, an engine could potentially be changed from TURBO0 to TURBO2 without redesigning the engine block or requiring significantly different expertise to design and implement. A change to ADEACD likely would require a different engine block that might not fit in the engine bay of the vehicle without a complete redesign and different technical expertise requiring years of research and development. This change, which would strand capital and impact parts sharing, is why the advanced engine paths restrict most movement between them. The concept of stranded capital is discussed further in Section II.C.2.f.

NHTSA also considers two categories of technology, for model years in which the technology categories are applicable, that the agency could not simulate as part of the CAFE Model's technology pathways. ''Off-cycle'' and AC efficiency are two types of technologies that improve vehicle fuel economy but are not accounted for using 2-cycle testing. To account for the benefits of these technologies, EPA has allowed manufacturers to generate FCIVs when they add these technologies, which are used to improve a manufacturers' certified fuel economy. As an example, manufacturers can generate FCIVs for technology like active seat ventilation and solar reflective surface coatings that make the cabin of a vehicle more comfortable for the occupants without using less efficient accessories like heat or AC. Instead of including OC and AC efficiency technologies in the technology pathways, NHTSA includes the improvement as a defined benefit that gets applied to a manufacturer's entire fleet in applicable model years instead of to individual vehicles. The defined benefit that each manufacturer receives in the analysis for using OC and AC efficiency technology on their vehicles is located in the Market Data

Explained: What is octane?, Last revised: Nov. 17, 2022, available at: *https://www.eia.gov/energy explained/gasoline/octane-in-depth.php* (accessed: Sept. 10, 2025).

[64] Manufacturers could increase their production of one type of vehicle with higher fuel economy, like the hybrid version of a conventional vehicle model, to meet the standards. For example, Ford has conventional and hybrid versions of its F–150 pickup truck, and Toyota has conventional, hybrid, and plug-in hybrid versions of its RAV4 sport utility vehicle.

[65] For each technology option, the analysis includes distinct technology cost and effectiveness values for 10 different types of vehicles, resulting in nearly half a million different technology effectiveness and cost data points.

[66] TURBO0 is the baseline turbocharged engine and TURBOD is TURBO0 with the addition of cylinder deactivation (DEAC). Chapter 3 of the Draft TSD provides more discussion on engine technologies.

[67] ADEACD is a dual-overhead camshaft engine with advanced cylinder deactivation. Chapter 3 of the Draft TSD provides more discussion on engine technologies.

Input File. Chapter 3.7 of the Draft TSD provides more discussion on how OC and AC efficiency technologies are developed and modeled. Preamble Section VI contains discussion of this program's updates in this rule.

To illustrate how NHTSA simulates technology application, throughout this section NHTSA follows the hypothetical vehicle mentioned above that begins the compliance simulation with a TURBOD engine. The agency's hypothetical vehicle, Generic Motors' Ravine Runner F Series, is a roomy, top-of-the-line sport utility vehicle (SUV). The Ravine Runner F Series starts the compliance simulation with technologies from most technology pathways; specifically, after looking at Generic Motors' website and marketing materials, the agency determines that it has technology that loosely fits within the following technologies that the agency considers in the CAFE Model: it has a turbocharged engine with cylinder deactivation, a fairly advanced 10-speed automatic transmission, a 12V start-stop system, the least advanced tire technology, a fairly aerodynamic vehicle body, and it employs a fairly advanced level of MR. NHTSA tracks the technologies on each vehicle using a ''technology key,'' which is the string of technology abbreviations for each vehicle. The vehicle technologies and their abbreviations that the agency considers in this analysis are shown in Draft TSD Chapter 2. The technology key for the Ravine Runner F Series is ''TURBOD; AT10L2; SS12V; ROLL0; AERO5; MR3.''

b. Defining Manufacturers' Current Technology Positions in the Analysis Fleet

The Market Data Input File is one of four Excel input files that the CAFE Model uses for compliance and effects simulation. The Market Data Input File's ''Vehicles'' tab (or worksheet) houses one of the most significant compilations of technology inputs and assumptions in the analysis, which is a characterization of the fleet of vehicle models each manufacturer produced for sale in the United States for MY 2024. This provides the starting point from which the CAFE Model adds fuel economy-improving technology. NHTSA calls this fleet the ''analysis fleet.'' The analysis fleet includes a number of inputs necessary for the Model to add fuel economy-improving technology to each vehicle for the compliance analysis and to calculate the resulting impacts for the effects analysis.

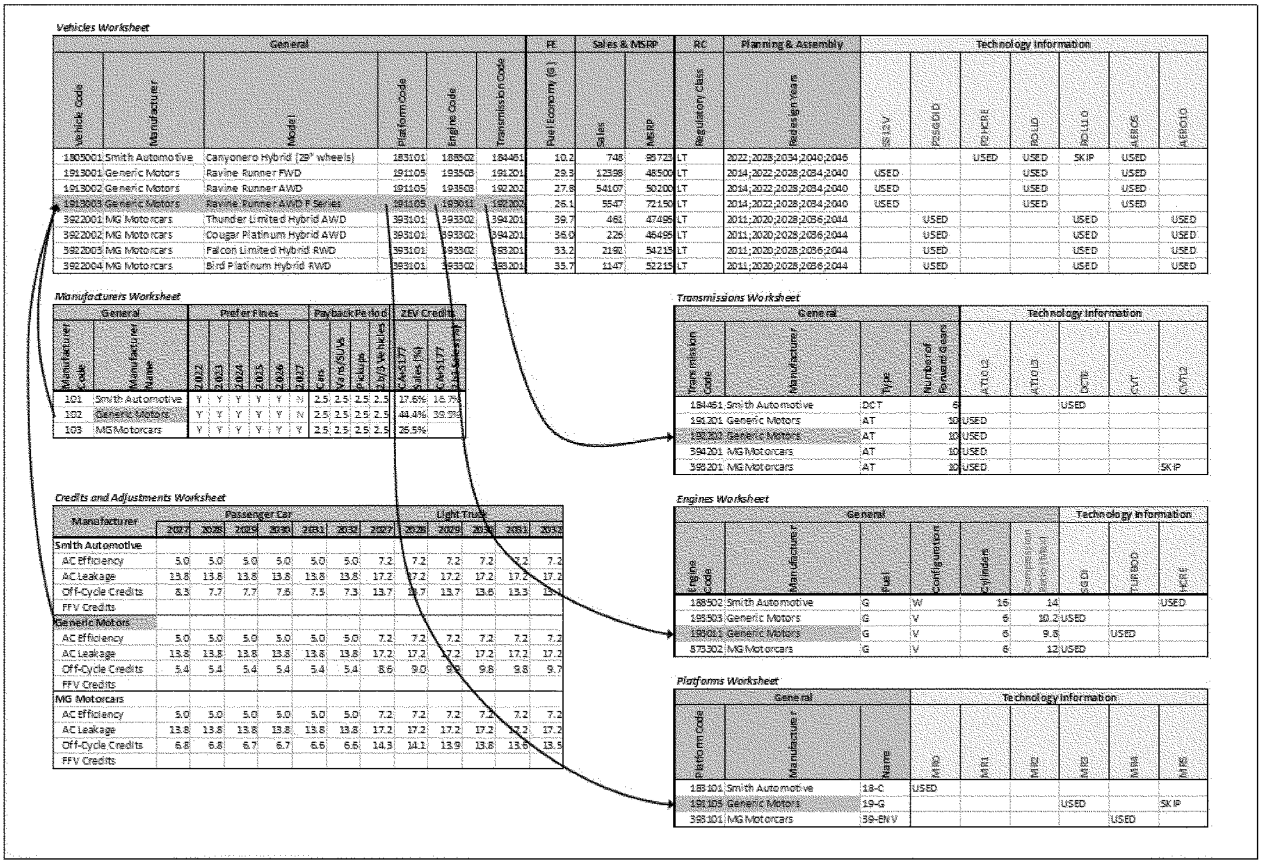
The ''Vehicles'' tab contains a separate row for each vehicle model. Vehicle models are vehicles that share the same fuel economy value and vehicle footprint. This means that vehicle models with different configurations that affect the vehicle's certification fuel economy value are distinguished in separate rows in the Vehicles tab. For example, the agency's Ravine Runner example vehicle comes in three different configurations—the Ravine Runner FWD, Ravine Runner AWD, and Ravine Runner F Series—which would result in three separate rows.

In each row, NHTSA also designates a vehicle's engine, transmission, and platform codes.[68] Vehicles that have the same engine, transmission, or platform code are deemed to ''share'' that component in the CAFE Model. Parts sharing helps manufacturers achieve economies of scale, deploy capital efficiently, and make the most of shared research and development expenses, while still presenting a wide array of consumer choices to the market. The CAFE Model has been developed to treat vehicles, platforms, engines, and transmissions as separate entities, which allows the modeling system to evaluate technology improvements on multiple vehicles that may share a common component concurrently. Sharing also enables realistic propagation, or ''inheriting,'' of previously applied technologies from an upgraded component down to the vehicle ''users'' of that component that have not yet realized the benefits of the upgrade. Section 2.1 and Section 4.4 of the CAFE Model Documentation contain additional information about the initial state of the fleet, as well as technology evaluation and inheriting within the CAFE Model.

Figure II–1 below shows how NHTSA separates the different configurations of the hypothetical Ravine Runner. NHTSA sees by the Platform Codes that these Ravine Runners all share the same platform, but only the Ravine Runner FWD and Ravine Runner AWD share an engine. Even so, all three certification fuel economy values are different, which is common for vehicles that differ in drive type (drive type meaning whether the vehicle has AWD, 4-wheel drive (4WD), front-wheel drive (FWD), or rear-wheel drive (RWD). While it is simpler to aggregate vehicles by model, ensuring that NHTSA captures model variants with different fuel economy values improves the accuracy of the analysis and the potential that estimated costs and benefits from different levels of standards are appropriate. NHTSA includes information about other vehicle technologies at the farthest right side of the Vehicles tab, and in the ''Engines,'' ''Transmissions,'' and ''Platforms'' worksheets, as discussed further below.

[68] Each numeric engine, transmission, or platform code designates important information about that vehicle's technology; for example, a vehicle's 6-digit transmission code includes information about the manufacturer, the vehicle's drive configuration (*e.g.,* front-wheel drive, all-wheel drive, 4WD, or rear-wheel drive), transmission type, number of gears (*i.e.,* a 6-speed transmission has 6 gears), and the transmission variant.

Figure II-1: Generic Motors' Ravine Runner F Series in the Market Data Input File[69]



Moving from left to right on the Vehicles tab, after including general information about vehicles and their compliance fuel economy value, NHTSA includes sales and manufacturer's suggested retail price (MSRP) data, regulatory class information (*e.g.,* domestic passenger automobile, import passenger automobile, or non-passenger automobile), and information about how NHTSA classifies vehicles for the effectiveness and safety analyses. Each of these data points is important to different parts of the compliance and effects analysis, so that the CAFE Model can accurately average the technologies required across a manufacturer's regulatory fleet to meet its CAFE standard or estimate the impacts of higher fuel economy standards on vehicle sales.

Next, NHTSA includes vehicle information necessary for applying different types of technology; for example, designating a vehicle's body style allows NHTSA to apply aerodynamic technology appropriately, and designating starting CW values allows the agency to apply MR technology more accurately. Importantly, this section also includes vehicle footprint data, which is needed because NHTSA sets footprint-based standards.

NHTSA also sets product design cycles, which are the years in which the CAFE Model can apply technologies to vehicles. Manufacturers often introduce fuel-saving technologies at a ''redesign'' of their product or adopt technologies at ''refreshes'' in between product redesigns. As an example, the redesigned third generation Chevrolet Silverado was released for MY 2019 and featured a new platform, updated drivetrain, increased towing capacity, reduced weight, improved safety, and expanded trim levels, to name a few improvements. For MY 2022, the Chevrolet Silverado received a refresh (or facelift as it is commonly called), with an updated interior, infotainment, and front-end appearance.[70] Setting these product design cycles provides realistic durations of product stability and ensures that the CAFE Model simulates the opportunities manufacturers have to apply technologies in line with refresh and redesign cycles.

During modeling, all improvements from technology application are initially realized on a component and then propagated (or inherited) down to the vehicles that share that component. As such, new component-level technologies are initially evaluated and applied to a platform, engine, or transmission during their respective redesign or refresh years. Any vehicles that share the same redesign or refresh schedule as the component apply these technology improvements during the same model year. The rest of the vehicles inherit technologies from the component during their refresh or redesign year (for engine- and transmission-level technologies) or during a redesign year only (for platform-level technologies). Section 4.4 of the CAFE Model Documentation contains additional information about technology evaluation and inheriting within the CAFE Model.

The CAFE Model also considers the potential safety effect of MR technologies and crash compatibility of

[69] Note that not all data columns are shown in this example for brevity.

[70] GM Authority, 2022 Chevy Silverado, Last revised: 2022, available at: *https://gmauthority.com/blog/gm/chevrolet/silverado/2022-chevrolet-silverado/* (accessed: Sept. 10, 2025).

different vehicle types. MR technologies lower the vehicle's CW, which may change crash compatibility and safety, depending on the type of vehicle. NHTSA assigns each vehicle in the Market Data Input File a ''safety class'' that best aligns with the CAFE Model's analysis of vehicle mass, size, and safety, and include the vehicle's starting CW.[71] [72]

The CAFE Model includes procedures to consider the direct labor impacts of manufacturers' responses to CAFE regulations, considering the assembly location of vehicles, engines, and transmissions; the percent U.S. content (based on the percent U.S. and Canadian content, as reported by manufacturers to NHTSA); and the dealership employment associated with new vehicle sales. Estimated labor information, by vehicle, is included in the Market Data Input File. Sales volumes included in and adapted from the market data also influence total estimated direct labor projected in the analysis. Chapter 6.2.5 of the Draft TSD contains additional discussion of the labor utilization analysis.

NHTSA then assigns the technologies to individual vehicles. This initial linkage of vehicle technologies is how the CAFE Model knows how to advance a vehicle down each technology pathway. Assigning CAFE Model technologies to individual vehicles is dependent on the mix of information the agency has about any particular vehicle and trends about how a manufacturer has added technology to that vehicle in the past, equations and models that translate real-world technologies to their counterparts in NHTSA's analysis (*e.g.,* drag coefficients and body styles can be used to determine a vehicle's AERO level), and the agency's engineering judgment.

As discussed further below, the agency uses information directly from manufacturers to populate some fields in the Market Data Input File, like vehicle HP ratings and vehicle weight. NHTSA also uses manufacturer data as an input to various other models that calculate how a manufacturer's real-world technology equates to a technology level in the agency's model. For example, the agency calculates initial MR, aerodynamic drag reduction, and ROLL levels by looking at industry-wide trends and calculating—through models or equations—levels of improvement for each technology. The models and algorithms that the agency uses are described further below and in detail in Chapter 3 of the Draft TSD. Other fields, like vehicle refresh and redesign years, are projected forward based on historic trends.

Recall the Ravine Runner F Series example with the technology key ''TURBOD; AT10L2, SS12V; ROLL0; AERO5; MR3.'' For this example, Generic Motor's publicly available spec sheet for the Ravine Runner F Series says that it uses Generic Motor's Turbo V6 engine with proprietary Adaptive Cylinder Management Engine (ACME) technology. Generic Motor's ACME improves fuel economy and lowers emissions by operating the engine using only three of the engine's cylinders in most conditions and using all six engine cylinders when more power is required. Based on this information, NHTSA would conclude that this engine is turbocharged and uses a form of cylinder deactivation, meaning it would be appropriately classified as TURBOD. Generic Motors uses this engine in several of their vehicles, and the specifications of the engine can be found in the Engines Tab of the Market Data Input File, under a six-digit engine code.[73]

This is a relatively easy engine to assign based on publicly available specification sheets, but some technologies are more difficult to assign. Manufacturers use different trade names or terms for different technology, and the way that the agency assigns the technology in the agency's analysis may not necessarily line up with how a manufacturer describes the technology. NHTSA must use some engineering judgment to determine how discrete technologies in the market best fit the technology options that the agency considers in the agency's analysis. The agency discusses factors used to assign each vehicle technology in the individual technology subsections below.

In addition to the Vehicles Tab that houses the analysis fleet, the Market Data Input File includes information that affects how the CAFE Model might apply technology to vehicles in the compliance simulation. Specifically, the Market Data Input File's ''Manufacturers'' tab includes a list of vehicle manufacturers considered in the analysis and several pieces of information about their economic and compliance behaviors. For this analysis, the compliance simulation assumes that manufacturers continue to apply technology to the extent practicable to reach compliance. This modeling change is made by indicating in the ''Manufacturers'' tab that all manufacturers will comply with NHTSA's standards and is consistent with the recent amendment to EPCA that set civil penalties (*i.e.,* fines) to $0 effective for MY 2022 vehicles and beyond.[74] The CAFE Model's compliance simulation algorithm is discussed in Section II.C.2.f.

Finally, NHTSA designates a ''payback period'' for each manufacturer. The payback period represents an assumption that consumers are willing to buy vehicles with more fuel economy technology because the fuel economy technology saves them money on gas in the long run. For the past several rulemaking analyses using the CAFE Model the agency has assumed that in the absence of CAFE or other regulatory standards, manufacturers apply technology that ''pays for itself''—by saving the consumer money on fuel—in 30-months, or 2.5 years. NHTSA has updated the agency's payback period for this proposed rule to assume a full 3-year payback period based on an examination of empirical economics literature. This is discussed in detail in Section II.E.1.a below, and in the Draft TSD and PRIA.

Before the agency begins building the Market Data Input File for any analysis, NHTSA must consider what model year vehicles comprise the analysis fleet. There is an inherent time delay in the data the agency can use for any particular analysis because NHTSA receives compliance data after a model year has been completed.

Using recent data for the analysis fleet is more likely to reflect the current vehicle fleet than older data. Recent data reflects (1) manufacturers' realized decisions on what fuel economy-improving technology to apply; (2) mix shifts in response to consumer preferences; (*e.g.,* more recent data reflects manufacturer and consumer preference towards larger vehicles),[75] and (3) industry sales volumes that incorporate substantive macroeconomic events. Using an analysis fleet year that

[71] Vehicle curb weight is the weight of the vehicle with all fluids and components but without the drivers, passengers, or cargo.

[72] NPRM preamble Section II.H.1 and Draft TSD Chapter 7.3 provides more in depth discussion on the impacts of mass reduction on safety.

[73] Like the transmission codes discussed above, the engine codes include information identifying the manufacturer, engine displacement (how many liters the engine is), whether the engine is naturally aspirated or force-inducted (turbocharged), and other unique engine attributes.

[74] *See* Public Law 119–21, 139 Stat. 72, sec. 40006 (July 4, 2025), *https://www.congress.gov/119/plaws/publ21/PLAW-119publ21.pdf.*

[75] See EPA, The 2024 EPA Automotive Trends Report, Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975, EPA–420–R–24–022, pp. 17—21 (2024), available at: *https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P101CUU6.TXT* (accessed: Sept. 10, 2025) (hereinafter, ''2024 EPA Automotive Trends Report'').

has been impacted by these transitory shocks may not represent trends in future years; however, on balance, updating to using the most complete set of available fleet data provides the most accurate analysis fleet for the CAFE Model to calculate compliance and effects of different levels of future fuel economy standards. Also, using recent data decreases the likelihood that the CAFE Model selects compliance pathways for future standards that affect vehicles already built in previous model years.[76]

At the time NHTSA starts building the analysis fleet, data received from vehicle manufacturers [77] offers the best snapshot of vehicles for sale in the United States in a model year. The mid-model year reports include information about individual vehicles at the vehicle configuration level. NHTSA uses the vehicle configuration, certification fuel economy, sales, regulatory class, and additional technology data from these reports as the starting point to build a ''row'' (*i.e.,* a vehicle configuration, with all necessary information about the vehicle) in the Market Data Input File's Vehicles Tab. Additional technology data comes from publicly available information, including vehicle specification sheets, manufacturer press releases, owner's manuals, and websites. NHTSA also generates some assumptions in the Market Data Input File for data fields where there is limited data, like refresh and redesign cycles for future model years, and technology levels for certain road load reduction technologies like MR and aerodynamic drag reduction.

For this analysis, the light-duty analysis fleet consists of every vehicle model in MY 2024 in nearly every configuration that has a different compliance fuel economy value. This results in nearly 4,000 individual rows in the Vehicles Tab of the Market Data Input File.

The next section discusses how the agency's analysis evaluates how effectively adding technology to a vehicle in the analysis fleet improves that vehicle's fuel economy value.

c. Technology Effectiveness Values

The CAFE Model uses technology effectiveness values to allow it to know which technologies to apply. Without these values, it does not know how effective any particular technology is at improving a vehicle's fuel economy value. Accurate technology effectiveness estimates require information about (1) the vehicle type and size; (2) other technologies on the vehicle or being added to the vehicle at the same time; and (3) and how the vehicle is driven. Any oversimplification of these complex factors could make the effectiveness estimates less accurate.

To build a database of technology effectiveness estimates that includes these factors, NHTSA partners with Argonne. Argonne has developed and maintains a modeling and simulation tool called Autonomie that generates technology effectiveness estimates for the CAFE Model. The Autonomie Model is a mathematical representation of an entire vehicle, including its individual technologies (such as the engine and transmission), overall vehicle characteristics (such as mass and aerodynamic drag), and environmental conditions (such as ambient temperature and barometric pressure). The Autonomie Model simulates vehicle behavior over time.

NHTSA simulates a vehicle model's behavior over the two-cycle tests used to measure vehicle fuel economy.[78] The two-cycle test is carried out by operating a vehicle on a dynamometer. Using a dynamometer is like running a car on a treadmill following a program—or more specifically, two programs. The programs are the Federal Test Procedure (FTP) and the Highway Fuel Economy Test (HFET). The FTP and HFET are also commonly referred to as the urban cycle and highway cycle, respectively. For the FTP drive cycle, the vehicle meets certain speeds at certain times during the test, or in technical terms, the vehicle must follow a designated speed trace.[79] The FTP is meant to simulate stop-and-go city driving, and the HFET is meant to simulate steady flowing highway driving at about 50 miles per hour (mph). The agency also uses Society of Automotive Engineers (SAE) recommended practices to simulate hybridized drive cycles,[80] which involves the test cycles mentioned above as well as additional test cycles to measure battery energy consumption and range. For PHEVs, this analysis utilizes only the gasoline (charge-sustaining) mode for the drive cycles.

Measuring every vehicle's fuel economy value by using the same test cycles ensures that the fuel economy certification results are repeatable for each vehicle model and comparable across all of the different vehicle models. When performing physical vehicle cycle testing, sophisticated test and measurement equipment is calibrated according to strict industry standards, which ensures repeatability and comparability of the results. Testing variables can include dynamometers, environmental conditions, types and locations of measurement equipment, and precise testing procedures. These physical tests provide the benchmarking empirical data used to develop and verify Autonomie's vehicle control algorithms and simulation results. Autonomie's inputs are discussed in more detail later in this section.

Full-vehicle modeling and simulation are also essential to measuring how all technologies on a vehicle interact. For example, if technology A improves a particular vehicle's fuel economy by 5 percent and technology B improves a particular vehicle's fuel economy by 10 percent, an analysis using single or limited point estimates may erroneously assume that applying both of these technologies together would achieve a simple additive fuel economy improvement of 15 percent. Single point estimates generally do not provide accurate effectiveness values because they do not capture complex relationships among technologies. Technology effectiveness often differs significantly depending on the vehicle type (*e.g.,* sedan or pickup truck) and the way in which the technology interacts with other technologies on the vehicle, as different technologies may provide different incremental levels of fuel economy improvement if implemented alone or in combination with other technologies. Any oversimplification of these complex factors could lead to less accurate technology effectiveness estimates.

[76] For example, in this analysis, the CAFE Model must apply technology to the MY 2024 fleet from MYs 2025–2026 for the compliance simulation that begins in MY 2027. While manufacturers have already built MY 2024 and beyond vehicles, the most current, complete dataset with regulatory fuel economy test results to build the analysis fleet at the time of writing remains MY 2024 data for the light-duty fleet.

[77] 49 U.S.C. 32907(a)(2) and 49 CFR part 537.

[78] NHTSA is statutorily required to use the two-cycle tests to measure vehicle fuel economy in the CAFE program. *See* 49 U.S.C. 32904(c) (''Testing and calculation procedures. . . . [T]he Administrator shall use the same procedures for passenger automobiles the Administrator used for model year 1975 (weighted 55 percent urban cycle and 45 percent highway cycle), or procedures that give comparable results.'').

[79] EPA, Emissions Standards Reference Guide: EPA Federal Test Procedure (FTP), Last revised: Mar. 13, 2025, available at: *https://www.epa.gov/emission-standards-reference-guide/epa-federal-test-procedure-ftp* (accessed: Sept. 10, 2025).

[80] SAE, Recommended Practice for Measuring the Exhaust Emissions and Fuel Economy of Hybrid-Electric Vehicles, Including Plug-in Hybrid Vehicles, SAE Standard J1711_202302 (2023), SAE International: Warrendale, PA, available at: *https://www.sae.org/standards/content/j1711_202302/* (accessed: Sept. 10, 2025); SAE, Battery Electric Vehicle Energy Consumption and Range Test Procedure, SAE Standard J1634_202104 (2021), SAE International: Warrendale, PA, available at: *https://www.sae.org/standards/content/j1634_202104/* (accessed: Sept. 10, 2025).

In addition, because manufacturers often add several fuel-saving technologies simultaneously when redesigning a vehicle, it is difficult to isolate the effect of adding any one individual technology to the full-vehicle system. Modeling and simulation offer the opportunity to isolate the effects of individual technologies by using a single or small number of initial vehicle configurations and incrementally adding technologies to those configurations. This provides a consistent reference point for the incremental effectiveness estimates for each technology and for combinations of technologies for each vehicle type. Vehicle modeling also reduces the potential for overcounting or undercounting technology effectiveness.

Argonne does not build an individual vehicle model for every single-vehicle configuration in NHTSA's light-duty Market Data Input File. This would be nearly impossible, because Autonomie requires very detailed data on hundreds of different vehicle attributes (*e.g.,* the weight of the vehicle's fuel tank, the weight of the vehicle's transmission housing, the weight of the engine, or the vehicle's 0–60 mph time) to build a vehicle model. For practical reasons, NHTSA cannot acquire 4,000 vehicles and obtain these measurements every time the agency promulgates a new rule, and the agency cannot acquire vehicles that have not yet been built. Rather, Argonne builds a discrete number of vehicle models representative of the most popular vehicles on sale today. The agency refers to the vehicle model's type and performance level as the vehicle's "technology class." By assigning each vehicle in the Market Data Input File a "technology class," NHTSA can connect it to the Autonomie effectiveness estimate that best represents how effective the technology would be on the vehicle, accounting for vehicle characteristics like body style (*e.g.,* sedan or pickup truck) and performance metrics. Because each vehicle technology class has unique characteristics, the effectiveness of technologies and combinations of technologies is different for each technology class.

There are 10 technology classes for this analysis: small car (SmallCar), small performance car (SmallCarPerf), medium car (MedCar), medium performance car (MedCarPerf), small SUV (SmallSUV), small performance SUV (SmallSUVPerf), medium SUV (MedSUV), medium performance SUV (MedSUVPerf), pickup truck (Pickup), and high towing pickup truck (PickupHT).

NHTSA uses a two-step process that involves two algorithms to give vehicles a "fit score" that determines which vehicles best fit into each technology class. At the first step, the agency determines the vehicle's size. At the second step, NHTSA determines the vehicle's performance level. Both algorithms consider several metrics about the individual vehicle and compare that vehicle to other vehicles in the analysis fleet. This process is discussed in detail in Draft TSD Chapter 2.2.

Consider NHTSA's example Ravine Runner F Series, which is a medium-sized performance SUV. The exact same combination of technologies on the Ravine Runner F Series operate differently in a compact car or pickup truck because they are different vehicle sizes. The example Ravine Runner F Series also achieves slightly better performance metrics than other medium-sized SUVs in the analysis fleet. By "performance metrics," the agency means power, acceleration, handling, braking, and so on. For the performance versus standard technology classification, the agency considers the vehicle's estimated 0–60 mph time compared to an average 0–60 mph time for the vehicle's technology class. Accordingly, the "technology class" for the Ravine Runner F Series in the agency's analysis is "MedSUVPerf," because it meets the criteria of a "performance" 0–60 mph acceleration time.

Table II–2 shows how vehicles in different technology classes that use the exact same fuel economy technology have very different absolute fuel economy values. Note that the Autonomie absolute fuel economy values are not used directly in the CAFE Model; NTHSA calculates the ratio between two Autonomie absolute fuel economy values (one for each technology key for a specific technology class) and applies that ratio to an analysis fleet vehicle's starting fuel economy value.

Table II-2: Examples of Technology Class Differences

Technology Class and Technology Key	Autonomie Absolute Fuel Economy Value (mpg)
MedSUVPerf TURBOD; AT10L2; SS12V; ROLL0; AERO5; MR3	30.8
MedSUV TURBOD; AT10L2; SS12V; ROLL0; AERO5; MR3	34.9
CompactPerf TURBOD; AT10L2; SS12V; ROLL0; AERO5; MR3	42.2
Pickup TURBOD; AT10L2; SS12V; ROLL0; AERO5; MR3	29.7

Depending on the technology, when two technologies are added to the vehicle together, they may not result in an additive fuel economy improvement. This is an important concept to understand because in Section II.D, NHTSA presents technology effectiveness estimates for every single combination of technology that could be applied to a vehicle. In some cases, technology effectiveness estimates show that a combined technology has a different effectiveness estimate than if the individual technologies were added together individually. However, this is expected and not an error. Continuing NHTSA's example from above, turbocharging technology and dynamic cylinder deactivation (DEAC) technology both improve fuel economy by reducing the engine displacement and accordingly burning less fuel. Turbocharging allows a manufacturer to use a smaller engine that can offer performance equivalent to a larger naturally aspirated engine, and its fuel efficiency improvements are, in part, due to the reduced displacement. DEAC effectively makes an engine with a particular displacement intermittently offer some of the fuel economy benefits of a smaller displacement engine by deactivating cylinders when the work demand does not require the full engine displacement and reactivating them as-needed to meet higher work demands;

the greater the displacement of the deactivated cylinders, the greater the fuel economy benefit. Therefore, a manufacturer upgrading to an engine that uses both a turbocharger and DEAC technology, like the TURBOD engine in the example above, would not see the full combined fuel economy improvement from that specific combination of technologies. Table II–3 shows a vehicle's fuel economy value when using the first-level DEAC technology and when using the first-level turbocharging technology, compared to the agency's example vehicle that uses both of those technologies combined with a TURBOD engine.

Table II-3: Example of Technology Synergies

MedSUVPerf Technology Key	Autonomie Absolute Fuel Economy Value (mpg)
DOHC; SGDI; AT10L2; SS12V; ROLL0; AERO5; MR3	28.6
DOHC; SGDI; DEAC; AT10L2; SS12V; ROLL0; AERO5; MR3	29.1
TURBO0; AT10L2; SS12V; ROLL0; AERO5; MR3	30.7
TURBOD; AT10L2; SS12V; ROLL0; AERO5; MR3	30.8

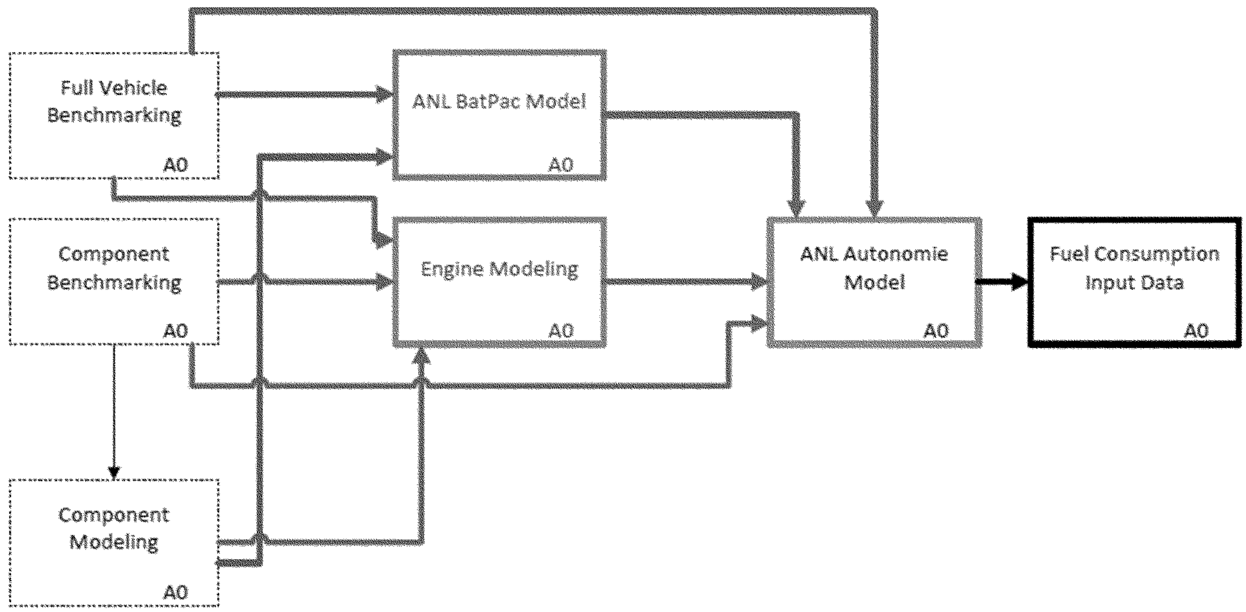
As expected, the percent improvement in Table II–3 between the first and second rows is 1.7 percent and between the third and fourth rows is 0.3 percent, even though the only difference within the two sets of technology keys is the DEAC technology (note that the agency only compares technology keys within the same technology class). This is because there are complex interactions between all fuel economy-improving technologies. The agency models these individual technologies and groups of technologies to reduce the uncertainty and improve the accuracy of the CAFE Model outputs.

Some technology synergies that NHTSA discusses in Section II.D include advanced engine and hybrid powertrain technology synergies. As an example, NHTSA does not see a particularly high effectiveness improvement from applying advanced engines to existing parallel strong hybrid (*e.g.,* P2) architectures.[81] In this instance, the P2 powertrain improves fuel economy, in part, by allowing the engine to spend more time operating at efficient engine speed and load conditions. This reduces the advantage of adding advanced engine technologies, which also improve fuel economy, by broadening the range of speed and load conditions for the engine to operate at high efficiency. This redundancy in fuel-saving mechanisms results in a lower effectiveness when the technologies are added to each other. Again, NHTSA expects that different combinations of technologies will provide different effectiveness improvements on different vehicle types. These examples all illustrate relationships observed using only full-vehicle modeling and simulation.

Just as NHTSA's CAFE Model analysis requires a large set of technology inputs and assumptions, the Autonomie modeling uses a large set of technology inputs and assumptions. Figure II–2 below shows the suite of fuel consumption input data used in the Autonomie modeling to generate the fuel consumption input data NHTSA uses in the CAFE Model.

[81] A parallel strong hybrid powertrain is fundamentally similar to a conventional powertrain but adds one electric motor to improve efficiency. Draft TSD Chapter 3 shows all of the parallel strong hybrid powertrain options that NHTSA has modeled in this analysis.

Figure II-2: Fuel Consumption Input Data Used in the Autonomie Modeling



As shown in Figure II–2 above, full-vehicle benchmarking is a major source of data for the Autonomie model. For full-vehicle benchmarking, vehicles are instrumented with sensors and tested on both the road and chassis dynamometers (*i.e.,* the full-vehicle treadmills used to exercise the vehicle to provide means to calculate vehicle's fuel economy values) under different conditions and duty-cycles. Vehicles are selected for benchmarking with the goal of selecting a mix of vehicles most representative of vehicle fleet and available technologies, taking into account sales volume, cost, and availability. Some examples of full-vehicle benchmark testing performed in conjunction with the agency's partners at Argonne include a 2019 Chevrolet Silverado, a 2021 Toyota Rav4 Prime, and a 2022 Hyundai Sonata Hybrid.[82] NHTSA has produced a report for each vehicle benchmarked, which can be found in the docket. As discussed further below, full-vehicle benchmarking data are used as inputs to the engine modeling and Autonomie full-vehicle simulation modeling. Component benchmarking is like full-vehicle benchmarking, but instead of testing a full vehicle, the agency instruments a single production component or prototype component with sensors and tests it on a similar duty-cycle as a full vehicle. Examples of components NHTSA benchmarks include engines, transmissions, axles, electric motors, and batteries. Component benchmarking data are used as an input to component modeling, where a production or prototype component is changed in fit, form, or function and modeled in the same scenario. As an example, NHTSA might model a decrease in the size of holes in fuel injectors to see the fuel atomization impact or see how it affects the fuel spray angle.

NHTSA uses a range of models to do the component modeling. As shown in Figure II–2, battery pack modeling using Argonne's BatPaC Model and engine modeling are two of the most significant component models used to generate data for the Autonomie modeling. NHTSA discusses BatPaC in detail in Section II.D, but briefly, BatPaC is the battery pack modeling tool used to estimate the cost of vehicle battery packs for all hybridized vehicles, which is based on the materials chemistry, battery design, and manufacturing design of the plants manufacturing the battery packs.

Engine modeling is used to generate engine fuel map models that define the fuel consumption rate for an engine equipped with specific technologies when operating over a variety of engine load and engine speed conditions. Some performance metrics captured in engine modeling include power, torque, airflow, volumetric efficiency, fuel consumption, turbocharger performance and matching, pumping losses, and more. Each engine map model has been developed ensuring the engine will still operate under real-world constraints using a suite of other models. Some examples of these models that ensure the engine map models capture real-world operating constraints include simulating heat release through a predictive combustion model, simulating knock characteristics through a kinetic fit knock model,[83] and using physics-based heat flow and friction models, among others. NHTSA simulates these constraints using data gathered from component benchmarking as well as engineering and physics calculations.

IAV develops the engine map models, using their GT–POWER modeling tool, by creating a base, or root, engine map and then modifying that root map, incrementally, to isolate the effects of the added technologies. The engine maps are based on real-world engine

[82] For all Argonne full-vehicle benchmarking reports, see Docket No. NHTSA–2023–0022–0010.

[83] Engine knock occurs when combustion of some of the air/fuel mixture in the cylinder does not result from propagation of the flame front ignited by the spark plug; rather one or more pockets of air/fuel mixture explode outside of the envelope of the normal combustion front. Engine knock can result in unsteady operation and damage to the engine.

designs. An important feature of the engine maps is that they use a knock model. As noted above, a knock model ensures that any engine size or specification that the agency models in the analysis does not result in engine knock, which could damage engine components in a real-world vehicle. Though the same engine map models are used for all vehicle technology classes, the effectiveness varies based on the characteristics of each class. For example, as discussed above, a compact car with a turbocharged engine has a different effectiveness value than a pickup truck with the same engine technology type. The engine map model development and specifications are discussed further in Chapter 3 of the Draft TSD.

Argonne also compiles a database of vehicle attributes and characteristics reasonably representative of the vehicles in that technology class used to build the vehicle models. Relevant vehicle attributes may include a vehicle's fuel efficiency, HP, 0–60 mph acceleration time, and stopping distance, among others, while vehicle characteristics may include whether the vehicle has all-wheel-drive, 18-inch wheels, summer tires, and so on. Argonne has identified representative vehicle attributes and characteristics for the light-duty fleet from publicly available information and automotive benchmarking databases, such as A2Mac1,[84] Argonne's Downloadable Dynamometer Database (D^3),[85] EPA compliance and fuel economy data,[86] EPA guidance on 2-cycle tests,[87] and industry partnerships.[88] The resulting vehicle technology class baseline assumptions and characteristics database consists of over 100 different attributes like vehicle height and width and weights for individual vehicle parts.

Argonne then assigns ''reference'' technologies to each vehicle model. The reference technologies are the technologies on the first step of each CAFE Model technology pathway, and they closely (but not exactly) correlate to the technology abbreviations that NHTSA uses in the CAFE Model. As an example, the first Autonomie vehicle model in the MedSUVPerf technology class starts out with the least advanced engine, which is DOHC (a dual-overhead cam engine) in the CAFE Model, or eng01 in the Autonomie modeling. The vehicle has the least advanced transmission (AT5), the least advanced MR level (MR0), the least advanced aerodynamic body style (AERO0), and the least advanced ROLL level (ROLL0). The first vehicle model is also defined by initial vehicle attributes and characteristics that consist of data from the suite of sources mentioned above. Again, these attributes are meant to represent the average of vehicle attributes found on vehicles in a certain technology class.

Then, just as a vehicle manufacturer tests its vehicles to ensure they meet specific performance metrics, Autonomie ensures that the built vehicle model meets its performance metrics. NHTSA includes quantitative performance metrics in the agency's Autonomie modeling to ensure that the vehicle models can meet real-world performance metrics that consumers observe and that are important for vehicle utility and customer satisfaction. The four performance metrics that NHTSA uses in the Autonomie modeling for light-duty vehicles are low-speed acceleration (the time required to accelerate from 0 to 60 mph), high-speed passing acceleration (the time required to accelerate from 50 to 80 mph), gradeability (the ability of the vehicle to maintain constant 65 mph speed on a 6-percent upgrade), and towing capacity for light-duty pickup trucks. The agency has been using these performance metrics for the last several CAFE Model analyses, and vehicle manufacturers have agreed that these performance metrics are representative of the metrics considered in the automotive industry.[89] Argonne simulates the vehicle model driving the two-cycle tests (*i.e.,* running its treadmill ''programs'') to ensure that it meets its applicable performance metrics (*i.e.,* NHTSA's MedSUVPerf does not have to meet the towing capacity performance metric because it is not a pickup truck). These metrics are based on commonly used metrics in the automotive industry, including SAE J2807 tow requirements.[90] Additional details about how NHTSA sizes light-duty powertrains in Autonomie to meet defined performance metrics can be found in the CAFE Analysis Autonomie Documentation.

If the vehicle model does not initially meet one of the performance metrics, then Autonomie's powertrain sizing algorithm increases the vehicle's engine power. The increase in power is achieved by increasing engine displacement (which is the measure of the volume of all cylinders in an engine), which might involve an increase in the number of engine cylinders, which may lead to an increase in the engine weight. This iterative process then determines if the baseline vehicle with increased engine power and corresponding updated engine weight meets the required performance metrics. The powertrain sizing algorithm stops once all the baseline vehicle's performance requirements are met.

Some technologies require extra steps for performance optimization before the vehicle models are ready for simulation. Specifically, the sizing and optimization process is more complex for hybridized vehicles, which include hybrid electric vehicle (HEVs) and PHEVs, compared to vehicles with only ICE engines, as discussed further in the Draft TSD Chapter 3.3.4. As an example, a PHEV powertrain that can travel a certain number of miles on its battery energy alone (referred to as all-electric range (AER)), or as performing in electric-only mode) is also sized to ensure that it can

[84] A2Mac1: Automotive Benchmarking (proprietary data), available at: *https://www.a2mac1.com* (accessed: Sept. 10, 2025). A2Mac1 is subscription-based benchmarking service that conducts vehicle and component teardown analyses. Annually, A2Mac1 removes individual components from production vehicles, such as oil pans, electric machines, engines, and transmissions, among many other components. These components are weighed and documented for key specifications, which are then available to subscribers.

[85] Argonne National Laboratory, Downloadable Dynamometer Database, Last revised: 2025, available at: *https://www.anl.gov/taps/downloadable-dynamometer-database* (accessed: Sept. 10, 2025).

[86] EPA, Compliance and Fuel Economy Data: Data on Cars Used for Testing Fuel Economy, Last revised: May 19, 2025, available at: *https://www.epa.gov/compliance-and-fuel-economy-data/data-cars-used-testing-fuel-economy* (accessed: Sept. 10, 2025).

[87] EPA PD TSD, at pp. 2–265—2–266.

[88] North American Council for Freight Efficiency, Research & Analysis Are Fundamental (2025), available at: *https://www.nacfe.org/research/overview* (accessed: Sept. 10, 2025).

[89] See NHTSA–2021–0053–1492, at 134 (''Vehicle design parameters are never static. With each new generation of a vehicle, manufacturers seek to improve vehicle utility, performance, and other characteristics based on research of customer expectations and desires, and to add innovative features that improve the customer experience. [NHTSA and EPA] have historically sought to maintain the performance characteristics of vehicles modeled with fuel economy-improving technologies. Auto Innovators encourages the Agencies to maintain a performance-neutral approach to the analysis, to the extent possible. Auto Innovators appreciates that the Agencies continue to consider high-speed acceleration, gradeability, towing, range, traction, and interior room (including headroom) in the analysis when sizing powertrains and evaluating pathways for road-load reductions. All of these parameters should be considered separately, not just in combination. (For example, we do not support an approach where various acceleration times are added together to create a single 'performance' statistic. Manufacturers must provide all types of performance, not just one or two to the detriment of others.)'').

[90] SAE, Performance Requirements for Determining Tow-Vehicle Gross Combination Weight Rating and Trailer Weight Rating, SAE Standard J2807_202411, SAE International: Warrendale, PA, available at: *https://doi.org/10.4271/J2807_202411* (accessed: Sept. 10, 2025).

meet the performance requirements of the SAE standardized drive cycles mentioned above in electric-only mode. Autonomie follows EPA's regulatory guidance and uses the SAE J1711 test procedure to model the incremental effectiveness of adding PHEV technology to a vehicle. The procedure from this guidance is divided into several phases that model ''charge sustaining,'' ''charge depleting,'' and ''cold operation'' [91] calculations for different test cycles. This is described in detail in the CAFE Analysis Autonomie Documentation.[92] Draft TSD Chapter 3.3.4 and the CAFE Analysis Autonomie Documentation contain more information on PHEV effectiveness.

Every time a vehicle model in Autonomie adopts a new technology, the vehicle weight is updated to reflect the weight of the new technology. For some technologies, the direct weight change is easy to assess. For example, when a vehicle is updated to a higher geared transmission, the weight of the original transmission is replaced with the corresponding transmission weight (*e.g.,* the weight of a vehicle moving from a 6-speed automatic (AT6) to an 8-speed automatic (AT8) transmission is updated based on the 8-speed transmission weight). For other technologies, like engine technologies, calculating the updated vehicle weight is more complex. As discussed earlier, modeling a change in engine technology involves both the new technology adoption and a change in power (because the reduction in vehicle weight leads to lower engine loads and a resized engine). When a vehicle adopts new engine technology, the associated weight change to the vehicle is accounted for based on a regression analysis of engine weight versus power.[93]

In addition to using performance metrics commonly used by automotive manufacturers, NHTSA instructs Autonomie to mimic real-world manufacturer decisions by resizing engines only at specific intervals in the analysis and in specific ways. When a vehicle manufacturer is making decisions about how to change a vehicle model to add fuel economy-improving technology, the manufacturer could entirely *redesign* the vehicle, or the manufacturer could *refresh* the vehicle with relatively more minor technology changes. NHTSA discusses how the agency's modeling captures vehicle refreshes and redesigns in more detail below, but the details are easier to understand if the agency starts by discussing some straightforward yet important concepts. First, most changes to a vehicle's engine happen when the vehicle is redesigned and not refreshed, as incorporating a new engine in a vehicle is a 10- to 15-year endeavor at a cost of $750 million to $1 billion.[94] However, manufacturers will use that same basic engine, with only minor changes, across multiple vehicle models. NHTSA models engine ''inheriting'' from one vehicle to another in both the Autonomie modeling and the CAFE Model. During a vehicle refresh, one vehicle may inherit an already redesigned engine from another vehicle that shares the same platform. In the Autonomie modeling, when a new vehicle adopts fuel-saving technologies that are inherited, the engine is not resized (*i.e.,* the properties from the reference vehicle are used directly). While this may result in a small change in vehicle performance, manufacturers have consistently told NHTSA that the high costs for redesign and the increased manufacturing complexity that would result from resizing engines for small technology changes preclude them from doing so. In addition, when a manufacturer applies MR technology (*i.e.,* makes the vehicle lighter), the vehicle can use a less powerful engine because there is less weight to move. However, Autonomie will use a resized engine only at certain MR application levels, as a representation of how manufacturers update their engine technologies. Again, this is intended to reflect manufacturers' comments that it would be unreasonable and unaffordable to resize powertrains for every unique combination of technologies. NHTSA has determined that the agency's rules about performance neutrality and technology inheritance result in a fleet that is essentially performance neutral.

NHTSA's analysis ensures that vehicle models maintain consistent performance levels to allow NHTSA to estimate the costs and benefits of different levels of fuel economy standards more accurately. For its analysis, NHTSA wants to capture only the costs and benefits that result from NHTSA changing its CAFE standards. For example, a manufacturer may add a turbocharger to its engine without downsizing the engine and then direct all the additional engine work to additional vehicle HP instead of vehicle fuel economy improvements. If NHTSA modeled increases or decreases in performance because of fuel economy-improving technology, then that increase in performance has a monetized benefit attached to it that is not specifically due to the agency's fuel economy standards. By ensuring that the agency's vehicle modeling remains performance neutral, NHTSA can better ensure that the agency is reasonably capturing the costs and benefits due only to potential changes in the fuel economy standards.

Autonomie then adopts one single fuel-saving technology to the initial vehicle model, keeping everything else the same except for that one technology and the attributes associated with it. Once one technology is assigned to the vehicle model and the new vehicle model meets its performance metrics, the vehicle model is used as an input to the full-vehicle simulation. This means that Autonomie simulates driving the optimized vehicle models for each technology class on the test cycles NHTSA described above. As an example, the Autonomie modeling could start with 10 initial vehicle models (one for each technology class in the analysis). Those 10 initial vehicle models use a 5-speed automatic transmission (AT5). Argonne then builds 10 new vehicle models; the only difference between the 10 new vehicle models and the first set of vehicle models is that the new vehicle models have a 6-speed automatic transmission (AT6). Replacing the AT5 with an AT6 would lead either to an increase or decrease in the total weight of the vehicle because each technology class includes different assumptions about transmission weight. Argonne then ensures that the new vehicle models with the 6-speed automatic transmission meet their performance metrics. Argonne has 20 different vehicle models that can be simulated on the two-cycle tests. This process is repeated for each technology option and for each technology class. This results in 10 separate datasets, each with over

[91] SAE J1711 cold test operation occurs in both Charge Sustaining and Charge Depleting modes.

[92] Chapter ''Vehicle Sizing Process'' of the CAFE Analysis Autonomie Documentation.

[93] Merriam-Webster, Definition: Regression analysis, available at: *https://www.merriam-webster.com/dictionary/regression%20analysis* (accessed: Sept. 10, 2025) (''the use of mathematical and statistical techniques to estimate one variable from another especially by the application of regression coefficients, regression curves, regression equations, or regression lines to empirical data''). In this case, NHTSA is estimating engine weight by looking at the relationship between engine weight and engine power.

[94] 2015 NAS Report, at p. 256. It is likely that manufacturers have made improvements in the product lifetime and development cycles for engines since this NAS report and the report that NAS relied on, but NHTSA does not have data on how much. NHTSA believes that it is still reasonable to conclude that generating an all-new engine or transmission design with little to no carryover from the previous generation would be a notable investment.

100,000 results, which include information about a vehicle model made of specific fuel economy-improving technology and the fuel economy value that the vehicle model achieved by driving its simulated test cycles.

NHTSA condenses the million-or-so datapoints from Autonomie into three datasets used in the CAFE Model. These three datasets include (1) the fuel economy value that each modeled vehicle achieved while driving the test cycles, for every technology combination in every technology class (converted into ''fuel consumption,'' which is the inverse of fuel economy; fuel economy is mpg and fuel consumption is gallons per mile); (2) the fuel economy value for PHEVs driving those test cycles, when those vehicles drive on gasoline only; and (3) optimized battery costs for each vehicle that adopts some sort of hybridized powertrain (discussed in more detail below). NHTSA then uses these datapoints to produce the technology effectiveness values in the CAFE Model.

Technology effectiveness values allow the CAFE Model to simulate how manufacturers can improve fuel economy relative to a consistent reference point by adding technology and combinations of technologies. The effectiveness values represent the simulated relative improvement of fuel economy that can be applied to a vehicle when new technology is added. These values are calculated based on comparing the achieved fuel economies simulated using the Autonomie full-vehicle models.

NHTSA adds the technology effectiveness values to the CAFE Model as inputs. When the CAFE Model runs a simulation, the effectiveness values for that vehicle's class determine how much the vehicle's fuel economy improves with the application of each technology. The CAFE Model's compliance simulation begins with actual fuel economy values derived from compliance data. As the CAFE Model adds technology, the technology effectiveness values are applied to estimate the new fuel economy value for the vehicle, and the CAFE Model runs millions of combinations of technologies on different vehicles to find the most cost-effective means of compliance for each manufacturer and fleet.

Return to the Ravine Runner F Series example, which has a starting fuel economy value of just over 26 mpg and a starting technology key ''TURBOD; AT10L2; SS12V; ROLL0; AERO5; MR3.'' The equivalent Autonomie vehicle model has a starting fuel economy value of just over 30.8 mpg and is represented by the technology descriptors Midsize SUV, Perfo, Micro Hybrid, eng38, AUp 10, MR3, AERO1, or ROLL0. In MY 2028, the CAFE Model determines that Generic Motors needs to redesign the Ravine Runner F Series to reach Generic Motors' new CAFE standard. The Ravine Runner F Series now has new fuel economy-improving technology, a parallel strong HEV with a TURBOE engine, an integrated 8-speed automatic transmission, 30-percent improvement in ROLL, 20-percent aerodynamic drag reduction, and 10-percent lighter glider (*i.e.,* MR). Its new technology key is now P2TRBE, ROLL30, AERO20, MR3. Table II–4 shows how the incremental fuel economy improvement from the Autonomie simulations is applied to the Ravine Runner F Series' starting fuel economy value.

Table II-4: Example Translation from the Autonomie Effectiveness Database to the CAFE Model

Model	Starting Technology Key/Technology Descriptors	MPG	Ending Technology Key/Technology Descriptors	MPG
CAFE Model	TURBOD; AT10L2; SS12V; ROLL0; AERO5; MR3	26.1	P2TRBE, ROLL30, AERO20, MR3	36.3
Autonomie	Midsize_SUV, Perfo, Micro Hybrid, eng38, AUp, 10, MR3, AERO1, ROLL0	30.8	Midsize_SUV, Perfo, Par HEV, eng37, AUp 8, MR3, AERO4, ROLL3	42.9

Note that the fuel economy values NHTSA obtains from the Autonomie modeling are based on the city and highway test cycles (*i.e.,* the two-cycle test) described above. This is because NHTSA's analysis is based on the EPA procedures used for calculating fuel economy for CAFE compliance, which uses two-cycle testing.[95] In 2008, EPA introduced three additional test cycles to bring fuel economy ''label'' values from two-cycle testing in line with the efficiency values consumers were experiencing in the real world, particularly for hybrids. This is known as 5-cycle testing. Generally, the revised 5-cycle testing values have proven to be a good approximation of what consumers will experience while driving and are significantly more representative than the previous two-cycle test values at representing real-world fuel economy. Though the compliance modeling uses two-cycle fuel economy values, the agency uses the ''on-road'' fuel economy values, which are the ratio of 5-cycle to 2-cycle testing values (*i.e.,* the CAFE compliance values to the ''label'' values)[96] to calculate the value of fuel savings to the consumer in the effects analysis. This is because the 5-cycle test fuel economy values better represent

[95] 49 U.S.C. 32904(c) (EPA ''shall measure fuel economy for each model and calculate average fuel economy for a manufacturer under testing and calculation procedures prescribed by the Administrator. However, except under section 32908 of this title, the Administrator shall use the same procedures for passenger automobiles the Administrator used for model year 1975 (weighted 55 percent urban cycle and 45 percent highway cycle), or procedures that give comparable results.'').

[96] NHTSA applied a certain percentage difference between the 2-cycle test value and 5-cycle test value to represent the gap in compliance fuel economy and real-world fuel economy.

fuel savings that consumers will experience from real-world driving. PRIA Chapter 4.3.1 and Section 5.3.2 of the CAFE Model Documentation contain more information about these calculations. NHTSA's discussion of the effects analysis is presented later in this section.

In sum, NHTSA uses Autonomie to generate modeling and simulation technology effectiveness estimates. These estimates ensure that the modeling captures differences in technology effectiveness due to (1) vehicle size and performance relative to other vehicles in the analysis fleet; (2) other technologies on the vehicle or being added to the vehicle at the same time; and (3) how the vehicle is driven. The modeling approach allows the isolation of technology effects in the analysis supporting an accurate assessment and comports with the NAS 2015 recommendation to use full-vehicle modeling supported by the application of lumped improvements at the sub-model level.[97]

In NHTSA's analysis, ''technology effectiveness values'' are the relative difference between the fuel economy value for one Autonomie vehicle model driving the two-cycle tests and a second Autonomie vehicle model that uses new technology driving the two-cycle tests. NHTSA adds the difference between two Autonomie-generated fuel economy values to a vehicle in the Market Data Input File's CAFE compliance fuel economy value. NHTSA then calculates the costs and benefits of different levels of fuel economy standards using the incremental improvement required to bring an analysis fleet vehicle model's fuel economy value to a level that contributes to a manufacturer's fleet meeting its CAFE standard.

In the next section, Technology Costs, NHTSA describes the process of generating costs for the Technologies Input File.

d. Technology Costs

NHTSA estimates present and future costs for fuel-saving technologies by taking into consideration the type of vehicle or type of engine when technology costs vary by application. These cost estimates are based on three main inputs. First, direct manufacturing costs (DMCs), or the component and labor costs of producing and assembling the physical parts and systems, are estimated assuming high-volume production. Second, NHTSA estimates indirect costs. DMCs generally do not include the indirect costs of tools, capital equipment, financing, engineering, sales, administrative support, or return on investment. NHTSA accounts for these indirect costs via a scalar markup of DMCs, which is termed the retail price equivalent (RPE). Finally, the costs for technologies may change over time as industry streamlines design and manufacturing processes. To model this, the agency estimates potential cost improvements with cost learning. The retail cost of equipment in any future year is estimated to be equal to the product of the DMC, RPE, and cost learning. Considering the retail cost of equipment, instead of merely DMCs, allows NHTSA to account for the real-world price effects of a technology as well as market realities. Each of these technology cost components is described briefly below and in the following individual technology sections as well as in detail in Chapters 2 and 3 of the Draft TSD.

DMCs are the component and assembly costs of the physical parts and systems that make up a complete vehicle. NHTSA uses agency-sponsored tear-down studies of vehicles and parts to estimate the DMCs of individual technologies, in addition to independent tear-down studies, other publications, and confidential business information (CBI). In the simplest cases, NHTSA sponsors studies to produce results that confirm or refute third-party industry estimates and determine alignment with confidential information provided by manufacturers and suppliers. In cases where the tear-down study results differ significantly from credible independent sources, the agency scrutinizes the study assumptions and sometimes revises or updates the analysis accordingly.

Due to the variety of technologies and their applications and the cost and time required to conduct detailed tear-down analyses, NHTSA did not sponsor teardown studies for every technology. In addition, the analysis includes some fuel-saving technologies that are pre-production or sold in very small pilot volumes, but for whom appropriate data are available for the range of vehicles the agency models. For those technologies, NHTSA could not conduct a tear-down study to assess costs because the product is not yet in the marketplace for evaluation. In these cases, the agency relies upon third-party estimates and confidential information from suppliers and manufacturers; however, there are some concerns with relying on CBI to estimate costs. The agency and the source may have had incongruent or incompatible definitions of the reference point from which to measure costs. The source may have provided DMCs at a date many years in the future and assumed very high production volumes, important caveats to consider for agency analysis. In addition, a source may provide incomplete information. In other cases, intellectual property considerations and strategic business partnerships may have contributed to a manufacturer's cost information and could be difficult to account for in the CAFE Model, as not all manufacturers may have access to proprietary technologies at stated costs. In light of these concerns, NHTSA carefully evaluates new information, especially regarding emerging technologies.

While costs for fuel-saving technologies reflect the best estimates available today, technology cost estimates likely will change in the future as technologies are deployed, production is expanded, and nascent technologies mature. For emerging technologies, NHTSA uses the best information available at the time of the analysis and continues to update cost assumptions for any future analysis. Chapter 3 of the Draft TSD discusses each category of technologies (*e.g.,* engines, transmissions, or hybridization) and the cost estimates the agency uses for this analysis.

As discussed above, direct costs represent the cost associated with acquiring raw materials, fabricating parts, and assembling vehicles with the various technologies that manufacturers are expected to use to improve the fuel economy of their fleets. They include materials, labor, and variable energy costs required to produce and assemble the vehicle. However, they do not include overhead costs required to develop and produce the vehicle, costs incurred by manufacturers or dealers to sell vehicles, or the profit manufacturers and dealers make from their investments. These items together contribute to the price consumers ultimately pay for the vehicle. Table II–5 illustrates how these components can affect retail prices.

[97] 2015 NAS Report, at p. 292.

Table II-5: Retail Price Components

Direct Costs	
Manufacturing Cost	Cost of materials, labor, and variable energy needed for production
Indirect Costs	
Production Overhead	
Warranty	Cost of providing product warranty
Research and Development	Cost of developing and engineering the product
Depreciation and amortization	Depreciation and amortization of manufacturing facilities and equipment
Maintenance, repair, and operations	Cost of maintaining and operating manufacturing facilities and equipment
Corporate Overhead	
General and Administrative	Salaries of nonmanufacturing labor, operations of corporate offices, and others
Retirement	Cost of pensions for nonmanufacturing labor
Health Care	Cost of health care for nonmanufacturing labor
Selling Costs	
Transportation	Cost of transporting manufactured goods
Marketing	Manufacturer costs of advertising manufactured goods
Dealer Costs	
Dealer selling expense	Dealer selling and advertising expense
Dealer profit	Net Income to dealers from sales of new vehicles
Net income	Net income to manufacturers from production and sales of new vehicles

To estimate total consumer costs (*i.e.,* both direct and indirect costs), NHTSA multiplies a technology's DMCs by an indirect cost factor (the RPE) to represent the average price for fuel-saving technologies at retail. The RPE markup factor is based on an examination of historical financial data contained in 10–K reports filed by manufacturers with the Securities and Exchange Commission (SEC). It represents the ratio between the retail price of motor vehicles and the direct costs of all activities in which manufacturers engage.

For more than three decades, the retail price of motor vehicles has been, on average, roughly 50 percent above the direct cost expenditures of manufacturers. That is, the retail price is approximately 1.5 times the direct cost expenditures.[98] This ratio has been consistent, averaging roughly 1.5 with minor variations from year to year over this period. At no point has the RPE markup based on 10–K reports exceeded 1.6 or fallen below 1.4, based on data from 1972–1997 and 2007.[99] During this timeframe, the average annual increase in real direct costs was 2.5 percent, and the average annual increase in real indirect costs was also 2.5 percent. The RPE averages 1.5 across the lifetime of technologies of all ages, with a lower average in earlier years of a technology's life, and, because of learning effects on direct costs, a higher average in later years. Many automotive industry stakeholders have either endorsed the 1.5 markup or have estimated alternative RPE values. As seen in Table II–6, all estimates range between 1.4 and 2.0, and most are in the 1.4 to 1.7 range.[100]

[98] Rogozhin, A. et al., Automobile Industry Retail Price Equivalent and Indirect Cost Multipliers, Finale, EPA–420–R–09–003, EPA: Ann Arbor, MI (2009), available at: *https://nepis.epa.gov/Exe/ZyPDF.cgi/P100AGJ1.PDF?Dockey=P100AGJ1.PDF* (accessed: Sept. 10, 2025); Spinney, B.C. et al., Advanced Air Bag Systems Cost, Weight, and Lead Time Analysis Summary Report, National Highway Traffic Safety Administration: Washington, DC (1999).

[99] Data is not available for intervening years, but results for 2007 seem to indicate no significant change in the historical trend.

[100] See Comment of the Alliance of Automobile Manufacturers, Docket No. EPA–HQ–OAR–2018–0283–6186 at 143 (Oct. 26, 2018), available at: *https://www.regulations.gov/comment/EPA-HQ-OAR-2018-0283-6186* (accessed: Sept. 10, 2025) ("The Alliance supports the use of retail price equivalents in the compliance cost modeling . . . .").

Table II-6: Alternate Estimates of the RPE[101]

Author and Year	Value, Comments
Jack Faucett Associates for EPA, 1985	1.26 initial value, later corrected to 1.7+ by Sierra research
Vyas et al., 2000	1.5 for outsourced, 2.0 for OEM, and hybrid vehicles
NRC, 2002	1.4 (corrected to > by Duleep)
McKinsey and Company, 2003	1.7 based on European study
CARB, 2004	1.4 (derived using the JFA initial 1.26 value, not the corrected 1.7+ value)
Sierra Research for American Automobile Association, 2007	2.0 or >, based on Chrysler data
Duleep, 2008	1.4, 1.56, 1.7 based on integration complexity
NRC, 2011	1.5 for Tier 1 supplier, 2.0 for OEM
NRC, 2015	1.5 for OEM

An RPE of 1.5 does not mean that manufacturers automatically mark up each vehicle by exactly 50 percent. Rather, it means that, over time, the competitive marketplace has resulted in pricing structures that average out to this relationship across the entire industry. Prices for any individual model may be marked up at a higher or lower rate depending on market demand. On average, over time and across the vehicle fleet, consumers spend about $1.50 for each dollar of direct costs incurred by manufacturers. Based on NHTSA's own evaluation and the widespread use and acceptance of the RPE by automotive industry stakeholders, the agency has determined that the RPE provides a reasonable indirect cost markup for use in the analysis. A detailed discussion of indirect cost methods and the basis for the agency's use of the RPE to reflect these costs, rather than other indirect cost markup methods, is available in the Final Regulatory Impact Analysis (FRIA) for the 2020 final rule.[102]

Finally, manufacturers make improvements to production processes over time, which often result in lower costs. ''Cost learning'' reflects the effect of experience and volume on the cost of production, which generally results in better utilization of resources, leading to higher and more efficient production. As manufacturers gain experience through production, they refine production techniques, raw material and component sources, and assembly methods to maximize efficiency and reduce production costs.

NHTSA estimates cost learning by considering methods established by T.P. Wright and later expanded upon by J.R. Crawford. Wright, examining aircraft production, found that every doubling of cumulative production of airplanes resulted in decreasing labor hours at a fixed percentage. This fixed percentage is commonly referred to as the progress rate or progress ratio, where a lower rate implies faster learning as cumulative production increases. J.R. Crawford expanded upon Wright's learning curve theory to develop a single unit cost model, which estimates the cost of the nth unit produced where the following information is known: (1) cost to produce the first unit; (2) cumulative production of n units; and (3) the progress ratio.

Consistent with Wright's learning curve, most technologies in the CAFE Model use the basic approach by Wright, where NHTSA estimates technology cost reductions by applying a fixed percentage to the projected cumulative production of a given fuel economy technology in a given model year.[103] The agency estimates the cost to produce the first unit of any given technology by identifying the DMC for a technology in a specific model year. As discussed in detail below, and in Chapter 3 of the Draft TSD, NHTSA's technology DMCs come from studies, teardown reports, other publicly available data, and feedback from manufacturers and suppliers. Because different studies or cost estimates are based on costs in specific model years, the agency identifies the ''base'' model years for each technology where the learning factor is equal to 1.00. Then, the agency applies a progress ratio to back-calculate the cost of the first unit produced. The majority of technologies in the CAFE Model use a progress ratio (*i.e.,* the slope of the learning curve, or the rate at which cost reductions occur with respect to cumulative production) of approximately 0.89, which is derived from average progress ratios researched in studies funded or identified by NHTSA.[104] Many fuel economy

[101] Duleep, K.G., Analysis of Technology Cost and Retail Price, Presentation to Committee on Assessment of Technologies for Improving LDV Fuel Economy, Detroit, MI (2008); Jack Faucett Associates, Update of EPA's Motor Vehicle Emission Control Equipment Retail Price Equivalent (RPE) Calculation Formula, Report, No. 68–03–3244, EPA: Ann Arbor, MI (1985), available at: *https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=940047LI.txt* (accessed: Sept. 10, 2025); McKinsey & Company, Preface to the Auto Sector Cases, New Horizons Multinational Company Investment in Developing Economies (2023); Transportation Research Board and National Research Council, Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards, National Academies Press: Washington, DC, pp. 5, 12 (2002), available at: *https://nap.nationalacademies.org/catalog/10172/effectiveness-and-impact-of-corporate-average-fuel-economy-cafe-standards;* National Research Council, Assessment of Fuel Economy Technologies for Light-Duty Vehicles, National Academies Press: Washington, DC (2011), available at: *https://nap.nationalacademies.org/catalog/12924/assessment-of-fuel-economy-technologies-for-light-duty-vehicles* (accessed: Sept 10, 2025); NRC, Cost, Effectiveness, and Deployment of Fuel Economy Technologies in LDVs, National Academies Press (2015); Sierra Research, Inc, Study of Industry-Average Mark-Up Factors Used to Estimate Changes in Retail Price Equivalent (RPE) for Automotive Fuel Economy and Emissions Control Systems, Sierra Research, Inc.: Sacramento, CA (2007); Vyas, A. et al., Comparison of Indirect Cost Multipliers for Vehicle Manufacturing, Center for Transportation Research: Argonne, IL (2000), available at: *https://publications.anl.gov/anlpubs/2000/05/36074.pdf* (accessed: Sept. 10, 2025).

[102] NHTSA and EPA, FRIA: The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Year 2021–2026 Passenger Cars and Light Trucks (2020), available at: *https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/final_safe_fria_web_version_200701.pdf* (accessed: Sept. 10, 2025).

[103] NHTSA uses statically projected cumulative volume production estimates because the CAFE Model does not support dynamic projections of cumulative volume at this time.

[104] Simons, J.F., Cost and Weight Added by the Federal Motor Vehicle Safety Standards for MY 1968–2012 Passenger Cars and LTVs, Report No. DOT HS 812 354, NHTSA: Washington DC, pp. 30–33 (2017), available at: *https://downloads.regulations.gov/NHTSA-2021-0053-1643/attachment_44.pdf* (accessed: Oct. 2, 2025); Argote, L. et al., The Acquisition and Depreciation of Knowledge in a Manufacturing Organization—Turnover and Plant Productivity, Working Paper, Graduate School of Industrial Administration, Carnegie Mellon University (1997); Benkard, C.L., Learning and Forgetting: The Dynamics of Aircraft Production, *The American Economic Review.* Vol.

technologies that have existed in vehicles for some time will have a gradual sloping learning curve implying that cost reductions from learning is moderate and eventually becomes less steep toward MY 2050. Conversely, newer technologies have an initial steep learning curve where cost reduction occurs at a high rate. Mature technologies generally have a flatter curve and may not incur much cost reduction, if at all, from learning. Draft TSD Chapter 2.4.4 provides an illustration showing various slopes of learning curves.

The agency assigns groups of similar technologies or technologies of similar complexity to each learning curve. While the grouped technologies differ in operating characteristics and design, NHTSA chooses to group them based on market availability, complexity of technology integration, and production volume of the technologies that can be implemented by manufacturers and suppliers. In general, the agency considers most basic engine and transmission technologies to be mature technologies that do not experience any additional improvements in design or manufacturing. Other basic engine technologies, like VVL, SGDI, and DEAC, decrease in costs through around MY 2036, because those were introduced into the market more recently. All advanced engine technologies follow the same general pattern of a gradual reduction in costs until MY 2036, when they plateau and remain flat. NHTSA expects the cost to decrease as production volumes increase, manufacturing processes are improved, and economies of scale are achieved. The agency has assigned advanced engine technologies based on a singular preceding technology to the same learning curve as that preceding technology. Similarly, the more advanced transmission technologies experience a gradual reduction in costs through MY 2031, when they plateau and remain flat. Lastly, the agency estimates that the learning curves for road load technologies, with the exception of the most advanced MR level (which decreases at a fairly steep rate through MY 2040, as discussed further below and in Chapter 3.4 of the Draft TSD), will decrease through MY 2036 and then remain flat.

For technologies that have been in production for many years, like some engine and transmission technologies, this approach produces reasonable estimates that NHTSA can compare against other studies and publicly available data. Generating the learning curve for battery packs for hybrid vehicles in future model years is significantly more complicated, and NHTSA discusses how the agency generated those learning curves in detail in Chapter 3.3 of the Draft TSD. NHTSA's battery pack learning curves recognize that there are many factors that could potentially lower battery pack costs over time outside of cost reductions from improvements in manufacturing processes due to knowledge gained through experience in production.

Table II–7 shows how some of the technologies on the MY 2024 Ravine Runner F Series decrease in cost over several years. Note that these costs are specifically applicable to the MedSUVPerf class, and other technology classes may have different costs for the same technologies. These costs are pulled directly from the Technology Costs Input File, meaning that they include the DMC, RPE, and learning.

Table II-7: Absolute Costs for Example Ravine Runner F Series Technologies in 2024$

Technology (MedSUVPerf)	2024	2027	2031
TURBOD (8C2B)	$10,118.42	$10,090.64	$10,061.14
AT10L2	$3,213.19	$3,190.24	$3,172.38
SS12V	$309.44	$289.97	$273.68
AERO5	$60.52	$57.87	$55.36

e. Simulating Tax Credits

The Inflation Reduction Act (IRA) included several tax credits intended to encourage the adoption of clean vehicles.[105] OB3 amended these credits and removed many of the clean vehicle credits.[106] Consistent with prior rulemakings, NHTSA also assumes that hybrids do not qualify for the IRA tax credits because their battery size is below the minimum thresholds set within the IRA. As noted throughout this preamble, NHTSA is statutorily prohibited from considering the fuel economy of dedicated automobiles and therefore has excluded dedicated vehicles from the analysis. The agency considers the fuel-based efficiency of dual-fueled vehicles, such as PHEVs, which are the only vehicles the agency models that are eligible for tax credits.

NHTSA models three provisions of the IRA only through MY 2025 and does not model any of these provisions from MY 2026 forward. The first is the advanced manufacturing production tax credit (AMPC), which provides a $35 per kWh tax credit for manufacturers of battery cells and an additional $10 per kWh for manufacturers of battery modules (all applicable to manufacture in the United States).[107]

90(4): pp. 1034–54 (2000), available at: *https://www.aeaweb.org/articles?id=10.1257/aer.90.4.1034* (accessed: Oct. 2, 2025); Epple, D. et al., Organizational Learning Curves: A Method for Investigating Intra-Plant Transfer of Knowledge Acquired through Learning by Doing, *Organization Science.* Vol. 2(1): pp. 58–70 (1991), available at: *https://www.jstor.org/stable/2634939* (accessed: Oct. 2, 2025); Epple, D. et al., An Empirical Investigation of the Microstructure of Knowledge Acquisition and Transfer Through Learning by Doing, *Operations Research,* Vol. 44(1): pp. 77–86 (1996), available at: *https://ideas.repec.org/a/inm/oropre/v44y1996i1p77-86.html* (accessed: Oct. 2, 2025); Levitt, S.D. et al., Toward an Understanding of Learning by Doing: Evidence From an Automobile Assembly Plant, Journal of Political Economy, Vol. 121(4): pp. 643–81 (2013), available at: *https://www.nber.org/papers/w18017* (accessed: Sept. 10, 2025).

[105] Public Law 117–169, 136 Stat. 1818 (Aug. 16, 2025). *https://www.congress.gov/117/plaws/publ169/PLAW-117publ169.pdf.*

[106] Enacted as Public Law 119–21, 139 Stat. 72 (July 4, 2025) *https://www.congress.gov/119/plaws/publ21/PLAW-119publ21.pdf.*

[107] 26 U.S.C. 45X. If a manufacturer produces a battery module without battery cells, it is eligible to claim up to $45 per kWh for the battery module. Two other provisions of the AMPC are not modeled at this time; (1) a credit equal to 10 percent of the manufacturing cost of electrode active materials and (2) a credit equal to 10 percent of the manufacturing cost of critical minerals for battery production. NHTSA is not modeling these credits directly because of how battery costs are estimated, and to avoid the potential to double-count the tax credits if they are included into other analyses that feed into NHTSA's inputs. For a full account of the credit and any limitations, please refer to the statutory text.

NHTSA also models two credits available to new vehicle buyers, the clean vehicle credit (30D) [108] and the credit for qualified commercial clean vehicles (45W) [109] (collectively, the Clean Vehicle Credits or ''CVCs''). The30D credit provides up to $7,500 toward the purchase of clean vehicles with critical minerals either extracted or processed in the United States or a country with which the United States has a free trade agreement or recycled in North America and battery components manufactured or assembled in North America.[110] In contrast to 30D, the 45W credit does not have the same critical minerals and production restraints, but instead the credit value is the lesser of the incremental cost to purchase a comparable ICE vehicle or 15 percent of the cost basis for PHEVs up to $7,500 for vehicles with GVWR less than 14,000. To date, the Department of the Treasury has allowed all eligible vehicles to qualify for the maximum value provided by statute based on DOE's Incremental Purchase Cost Methodology and Results for Clean Vehicles report.[111] The 45W credit is also available only to commercial purchasers; however, the Department of the Treasury determined that leased vehicles qualify given that the ''purchaser'' is the financing company.

NHTSA assumes, based on the updated constraints in OB3 that the impact of the credits would be *de minimis,* particularly for the vehicles and model years considered in this analysis. Thus, the agency removes the availability of CVCs consistent with the AMPC tax credit discussed below. NHTSA includes a sensitivity case related to the AMPC, which is discussed in detail in PRIA Chapter 9, and monitors this area to develop assumptions related to the updated AMPC provisions to include for the final rule. NHTSA also does not model individual state tax credits or rebate programs. State clean vehicle tax credits and rebates vary from jurisdiction to jurisdiction and are subject to more uncertainty than their Federal counterparts.[112] Tracking sales by jurisdiction and modeling each program's individual compliance program would require significant revisions to the CAFE Model and likely provide minimal changes in the net outputs of the analysis.

NHTSA jointly models the CVCs. Both credits are available at the time of sale and provide up to $7,500 towards the purchase of light-duty vehicles placed in service before the end of 2025. Since only one of the CVCs may be claimed for purchasing a given vehicle, NHTSA models them jointly.

As mentioned above, NHTSA is including the tax credits in its analysis through MY 2025. This was a natural terminal point for the CVCs, which are set to expire this year. The agency elected not to model the AMPC in future model years because of the more stringent foreign entity of concern (FEOC) constraints (*i.e.,* constrained eligibility for the tax credit based on materials sources) and American component threshold percentages. NHTSA conducts a sensitivity analysis in which the tax credits are included in the analysis for taking effect through the standard-setting years.

The agency assumes that manufacturers and consumers will each capture half of the dollar value of the AMPC and CVCs. The agency assumes that manufacturers' shares of both credits will offset part of the cost to supply models eligible for the credits—PHEVs, specifically. The subsidies reduce the costs of eligible vehicles and increase their attractiveness to buyers. Because the AMPC credit scales with battery capacity, NHTSA determines average battery energy capacity for passenger cars, and light trucks based on Argonne simulation outputs. Draft TSD Chapter 2.3.2 contains a detailed discussion of these assumptions. NHTSA accounts for all the eligibility requirements of 30D, and the AMPC, such as the location of final assembly and battery production, the origin of critical minerals, and the income restrictions of 30D through the credit schedules constructed in part based off of these factors and allows all PHEVs produced and sold during the timeframe that tax credits are offered to be eligible for those credits subject to the MSRP restrictions discussed above.[113]

To account for the agency's inability dynamically to model sourcing requirements and income limits for 30D, NHTSA uses projected values of the average value of 30D and the AMPC for the proposal. The projections increase throughout the analysis due to the expectation that gradual improvements in supply chains over time would allow more vehicles to qualify for the credits.

NHTSA uses a DOE report that provides combined values of the CVCs.[114] These values consider the latest information of PHEV penetration rates, PHEV retail prices, the share of United States PHEV sales that meet the critical minerals and battery component requirements, the share of vehicles that exclude suppliers that are ''Foreign Entities of Concern,'' and lease rates for vehicles that qualify for the 45W CVC. The DOE projections are the most detailed and rigorous projections of credit availability that NHTSA is aware of at this time. If DOE releases projections that reflect the passing of OB3 into law, NHTSA will consider using those projections for the final rule. According to DOE's analysis, the average credit value for the CVCs across all PHEV sales in a given year never reaches its full $7,500 value for all vehicles. DOE, therefore, projects a maximum average credit value of $6,000. Draft TSD Chapter 2.5.3 includes more information on the average AMPC credit per kWh that NHTSA uses in this proposal.

The CAFE Model accounts for the statutory MSRP restrictions of 30D by assuming that the CVCs cannot be applied to cars with an MSRP above $55,000 or other vehicles with an MSRP above $80,000, which are ineligible for 30D. 45W does not have the same MSRP restrictions; however, because NHTSA is unable to model the CVCs separately at this time, the agency has to choose whether to model the restriction for both CVCs or not to model the restriction at all. NHTSA chooses to include the restriction for both CVCs to be conservative.[115] Chapter 2.5.2 of the Draft TSD contains additional details on

[108] 26 U.S.C. 30D. For a full account of the credit and any limitations, please refer to the statutory text.

[109] 26 U.S.C. 45W. For a full account of the credit and any limitations, please refer to the statutory text.

[110] Vehicle price and consumer income limitations apply to § 30D credits, as well. See Congressional Research Service, Tax Provisions in the Inflation Reduction Act of 2022 (H.R. 5376) (2022), available at: *https://www.congress.gov/crs-product/R47202* (accessed: Sept. 10, 2025).

[111] See Internal Revenue Service, Frequently Asked Questions Related to New, Previously-Owned and Qualified Commercial Clean Vehicle Credits, Q4 and Q8 (2022), available at: *https://www.irs.gov/pub/taxpros/fs-2022-42.pdf* (accessed: Sept. 10, 2025).

[112] States have additional mechanisms to amend or remove tax incentives or rebates. Sometimes, even after these programs are enacted, uncertainty persists. See Farah, N., The Untimely Death of America's ''Most Equitable'' EV Rebate, Last revised: Jan. 30, 2023, available at: *https://www.eenews.net/articles/the-untimely-death-of-americas-most-equitable-ev-rebate/* (accessed: Sept. 10, 2025).

[113] *See* 88 FR 56179 (Aug. 17, 2023) for a more detailed explanation of the process used for the previous proposal.

[114] U.S. Department of Energy, Estimating Federal Tax Incentives for Heavy Duty Electric Vehicle Infrastructure and for Acquiring Electric Vehicles Weighing Less Than 14,000 Pounds, Memorandum (Mar. 11, 2024).

[115] Bureau of Transportation Statistics, New and Used Passenger Car and Light Truck Sales and Leases, available at: *https://www.bts.gov/content/new-and-used-passenger-car-sales-and-leases-thousands-vehicles* (accessed: Sept. 10, 2025).

how NHTSA implements the IRA and OB3 tax credits.

NHTSA uses real dollars for future costs and benefits, such as technology costs in future model years. Including the tax credits as nominal dollars instead of real dollars artificially raises the value of the credits in respect to other costs, so NHTSA converts the DOE projections to real dollars.

The CAFE Model projects vehicles in model year cohorts rather than on a calendar year basis. Given that model years and calendar years can be misaligned (*e.g.,* a MY 2024 vehicle could be sold in CYs 2023, 2024, or even 2025), choosing which calendar year a model year falls into is important for assigning tax credits that are phased out during the analytical period. NHTSA analyzes the timing of new vehicle sales and new vehicle registrations and determines that, for this proposed rule, it is appropriate to assume that credits available in a given calendar year are available to all vehicles sold in the following model year. By contract, NHTSA models vehicles in a given model year as eligible for credits available in the same calendar year. As a result, NHTSA applies the credits to MYs 2024–2025 in this analysis.

f. Technology Applicability Equations and Rules

As NHTSA describes above, the CAFE Model simulates cost-effective ways that vehicle manufacturers could comply with CAFE standards, subject to limits that ensure that the Model reasonably replicates manufacturers' decisions in the real world. This section describes the equations the CAFE Model uses to determine how to apply technology to vehicles, including whether technologies are cost effective, and why the agency believes the CAFE Model's calculation of potential compliance pathways reasonably represents manufacturers' decision-making. This section also gives a high-level overview of real-world limitations that vehicle manufacturers face when designing and manufacturing vehicles and how the agency includes those in the technology inputs and assumptions in the analysis.

For each manufacturer's fleet, the CAFE Model first determines whether any technology should be ''inherited'' from an engine, transmission, or platform that currently uses the technology and should be applied to a vehicle that is due for a refresh or redesign. NHTSA describes above how vehicle manufacturers use the same or similar engines, transmissions, and platforms across multiple vehicle models, and the agency tracks vehicle models that share technology by assigning Engine, Transmission, and Platform Codes to vehicles in the analysis fleet. As an example, variants of the Ford 10R80 10-speed transmission are currently used in the following Ford Motor Company vehicles: 2017-present Ford F–150, 2018-present Ford Mustang, 2018-present Ford Expedition/Lincoln Navigator, 2019-present Ford Ranger, and the 2020-present Ford Explorer/Lincoln Aviator. The 2WD variant of the 10R80, as applied to the CAFE Model, is shared by the 2WD Expedition models, 2WD F–150 models, and the Mustang, thus linking these models by the same Transmission Code. If one of these three vehicle model types receives a transmission upgrade, the other two would automatically receive the same upgrade at their next redesign or refresh.

After applying inherited technologies, the Model begins the process of evaluating what technologies could be applied to the manufacturer's vehicles. The CAFE Model applies the most cost-effective technology out of the universe of technology options that the Model could potentially apply. To determine whether a particular technology is cost effective, the Model calculates the ''effective cost'' of multiple technology options and chooses the option that results in the lowest ''effective cost.'' A technology that has an effective cost less than zero (Equation II–4 results in a negative number) is considered cost effective, as a negative effective cost implies that the technology ''pays for itself.'' The ''effective cost'' calculation is actually multiple calculations, but this section describes only the highest levels of that logic; interested readers can consult the CAFE Model Documentation for additional information on the calculation of effective cost. Equation II–4 shows the CAFE Model's effective cost calculation for this analysis.

Equation II-4: CAFE Model Effective Cost Calculation

$$EffCost = \frac{TechCost_{Total} - TaxCredits_{Total} - FuelSavings_{Total} - \Delta Fines}{\Delta ComplianceCredits}$$

Where:

$TechCost_{Total}$:
the total cost of a candidate technology evaluated on a group of selected vehicles;

$TaxCredits_{Total}$:
the cumulative value, if any, of additional vehicle and battery tax credits (or Federal incentives) resulting from application of a candidate technology evaluated on a group of selected vehicles;

$FuelSavings_{Total}$:
the value of the reduction in fuel consumption (or fuel savings) resulting from application of a candidate technology evaluated on a group of selected vehicles;

ΔFines:
the change in manufacturer's fines in the analysis year, if applicable;

ΔComplianceCredits:
the change in manufacturer's CAFE compliance credits in the analysis year (denominated in thousands of gallons);

EffCost:
the calculated effective cost attributed to application of a candidate technology evaluated on a group of selected vehicles.

The components of this ''cost per credit'' effective cost calculation are described further here. The CAFE Model considers the total cost of a technology (TechCost) that could be applied to a group of connected vehicles, just as a vehicle manufacturer might consider what new technologies it has ready for the market and which vehicles should and could receive the upgrade. Next, like the technology costs, the CAFE Model calculates the total value of Federal incentives (TaxCredits) available for a technology that could be applied to a group of vehicles and subtracts that total incentive from the total technology costs. The total fuel cost savings (FuelSavings) are the savings in fuel expense resulting from switching from one technology to another. For this, the CAFE Model must calculate the total fuel cost for the vehicle before application of a technology and subtract the total fuel cost for the vehicle after calculation of that technology. The total fuel cost for a given vehicle depends on both the price of gas (or gasoline equivalent fuel) and the number of miles that a vehicle is driven, among other factors.[116] As

[116] This fuel cost savings is calculated using the miles driven over 3 years, based on the assumption that consumers are likely to buy vehicles with fuel

Continued

technology is applied to vehicles in groups, the total fuel cost for the vehicle is then multiplied by the sales volume of a vehicle in a model year to equal total fuel cost savings, which is then subtracted in the numerator of the effective cost equation. Finally, in the numerator, the agency subtracts the change in a manufacturer's expected fines (ΔFines), which are set at $0 for this analysis as a result of Public Law 119–21, before and after application of a specific technology, if any.[117] This approach can be thought of as subtraction of the fines *avoided* by upgrading to a certain technology. Then, the result from the sequence above is divided by the change in compliance credits (Δ*ComplianceCredits*), which means a manufacturer's credits earned in a compliance category before and after the application of a technology to a group of vehicles. This approach can be thought of as dividing the result by the *gain* in credits resulting from upgrading to a certain technology.

After inherited technologies and cost-effective technologies are applied, the CAFE Model determines whether the manufacturer's fleet meets its CAFE standard. If the manufacturer is still not in compliance, the Model applies non-cost-effective technologies (which have an effective cost greater than zero) until it runs out of technology options.

The Model runs the compliance simulation successively and accounts for technology added during each previous model year by carrying forward technologies between model years once they are applied. The CAFE Model does this by mirroring real-world decisions of manufacturers to carry forward most technologies between model years, concentrating the application of new technology to vehicle redesigns or mid-cycle ''freshenings,'' and design cycles vary widely among manufacturers and specific products. Comments from manufacturers and Model peer reviewers for past CAFE rules have strongly supported explicit year-by-year simulation. The multi-year planning capability increases the Model's ability to simulate manufacturers' real-world behavior, accounting for the fact that manufacturers will seek out compliance paths for several model years at a time, while accommodating the year-by-year requirement.

In addition to the Model's technology application decisions pursuant to the compliance simulation algorithm, several technology inputs and assumptions work together to determine which technologies the CAFE Model can apply. The technology pathways, discussed in detail above, are one significant way that the agency instructs the CAFE Model to apply technology. Again, the pathways define mutually exclusive technologies (*i.e.,* those that cannot be applied at the same time) and define the direction in which vehicles can advance as the modeling system evaluates specific technologies for application. Then, the arrows between technologies instruct the Model on the order in which to evaluate technologies on a pathway, to ensure that a vehicle that uses a more fuel-efficient technology cannot downgrade to a less efficient option.

In addition to technology pathway logic, NHTSA uses several technology applicability rules to replicate better manufacturers' decision-making. The ''skip'' input—represented in the Market Data Input File as ''SKIP'' in the appropriate technology column corresponding to a specific vehicle model—is particularly important for accurately representing how a manufacturer applies technologies to their vehicles in the real world. This tells the Model not to apply a specific technology to a specific vehicle model. SKIP inputs are used to simulate manufacturer decisions, including: (1) parts and process sharing; (2) stranded capital; and (3) performance neutrality.

First, parts sharing includes the concepts of platform, engine, and transmission sharing, which are discussed in detail in Section II.C.2 and Section II.C.3, above. A ''platform'' refers to engineered underpinnings shared on several differentiated vehicle models and configurations. Manufacturers share and standardize components, systems, tooling, and assembly processes within their products (and occasionally with the products of another manufacturer) to manage complexity and costs for development, manufacturing, and assembly. Detailed discussion for this type of SKIP is provided in the ''adoption features'' section for different technologies, if applicable, in Chapter 3 of the Draft TSD.

Similar to vehicle platforms, manufacturers create engines that share parts. For instance, manufacturers may use different piston strokes on a common engine block or bore out common engine block castings with different diameters to create engines with an array of displacements. Head assemblies for different displacement engines may share many components and manufacturing processes across the engine family. Manufacturers may finish crankshafts with the same tools to similar tolerances. Engines on the same architecture may share pistons and connecting rods, and the same engine architecture may include both 6- and 8-cylinder engines. One engine family may appear on many vehicles on a platform, and changes to that engine may or may not carry through to all the vehicles. Some engines are shared across a range of different vehicle platforms. Vehicle model/configurations in the analysis fleet that share engines belonging to the same platform are identified as such, and the agency also may apply a SKIP to a particular engine technology where it is known that a manufacturer shares an engine throughout several of their vehicle models and the engine technology is not appropriate for any of the platforms that share the same engine.

It is important to note that manufacturers can define a ''common'' engine platform in different ways. Some manufacturers consider engines as ''common'' if the engines share an architecture, components, or manufacturing processes. Other manufacturers take a narrower approach and consider engines ''common'' only if the parts in the engine assembly are the same. In some cases, manufacturers designate each engine in each application as a unique powertrain. For example, a manufacturer may have listed two engines separately for a pair that share designs for the engine block, the crankshaft, and the head because the accessory drive components, oil pans, and engine calibrations differ between the two. In practice, many engines share parts, tooling, and assembly resources, and manufacturers often coordinate design updates between two similar engines. NHTSA considers engines to be on a common platform (for purposes of coding, discussed in Section II.C.2 above, and for SKIP application) if the engines share a common cylinder count and configuration, displacement, valvetrain, and fuel type, or if the engines only differ slightly in compression ratio (CR), HP, and displacement.

Parts sharing also includes the concept of sharing manufacturing lines (the systems, tooling, and assembly processes discussed above), because manufacturers are unlikely to build a new manufacturing line to build a completely new engine. A new engine designed to be mass manufactured on an existing production line has limits in number of parts used, type of parts used, weight, and packaging size due to the weight limits of the pallets, material handling interaction points, and

economy-improving technology that pays for itself within 3 years.

[117] See Section VI noting the value of civil penalties are set to $0 in this analysis.

conveyance line design to produce one unit of a product. The restrictions are reflected in the usage of a SKIP of engine technology that the manufacturing line would not accommodate.

SKIPs also relate to instances of stranded capital when manufacturers amortize research, development, and tooling expenses over many years, especially for engines and transmissions. The traditional production life cycles for transmissions and engines have been a decade or longer. If a manufacturer launches or updates a product with fuel-saving technology, and then later replaces that technology with an unrelated or different fuel-saving technology before the equipment and research and development investments have been fully paid off, there will be unrecouped, or stranded, capital costs. Quantifying stranded capital costs accounts for such lost investments. One design where manufacturers take an iterative redesign approach, as described in a recent SAE paper,[118] is the MacPherson strut suspension. It is a popular low-cost suspension design, and manufacturers use it across their fleets. As the agency observed previously, manufacturers may be shifting their investment strategies in ways that may alter how stranded capital could be considered. For example, some suppliers sell similar transmissions to multiple manufacturers. Such arrangements allow manufacturers to share in capital expenditures or amortize expenses more quickly. Manufacturers share parts on vehicles around the globe, achieving greater scale and greatly affecting tooling strategies and costs.

As a proxy for stranded capital, the CAFE Model accounts for platform and engine sharing and includes redesign and refresh cycles for significant and less significant vehicle updates. This analysis continues to rely on the CAFE Model's explicit year-by-year accounting for estimated refresh and redesign cycles, and shared vehicle platforms and engines, to moderate the cadence of technology adoption and thereby limit the implied occurrence of stranded capital and the need to account for it explicitly. In addition, confining some manufacturers to specific advanced technology pathways through technology adoption features acts as a proxy to account for stranded capital indirectly. Adoption features specific to each technology, if applied on a manufacturer-by-manufacturer basis, are discussed in each technology section.

D. Technology Pathways, Effectiveness, and Cost

The previous section has discussed, at a high level, how NHTSA generates the technology inputs and assumptions used in the CAFE Model. The process for generating these inputs and assumptions involves NHTSA using engineering judgment to evaluate and synthesize data from a variety of sources, including data submitted by vehicle manufacturers; consolidated publicly available data, such as press materials, marketing brochures, and other information; data from collaborative research, testing, and modeling with other Federal agencies and laboratories; data from research, testing, and modeling with independent organizations; data and assumptions from work done for prior rules; and feedback from stakeholders on prior rules and meetings conducted prior to the commencement of this rulemaking, to the extent it is still relevant and applicable.

This section discusses the specific technology pathways, effectiveness, and cost inputs and assumptions used in the compliance analysis. As an example, NHTSA has explained in the previous section that the starting point for estimating technology costs is an estimate of the DMC—the component and assembly costs of the physical parts and systems that make up a complete vehicle—for any particular technology. This section then explains how NHTSA bases the transmission technology DMCs on estimates from NAS.

After spending over a decade refining the technology pathways, effectiveness, and cost inputs and assumptions used in successive CAFE Model analyses, NHTSA has developed guiding principles to ensure that the CAFE Model's compliance analysis reflects impacts reasonably expected in the real world. These guiding principles are as follows:

Technologies have complementary or non-complementary interactions with the full-vehicle technology system. The fuel economy improvement from any individual technology must be considered in conjunction with the other fuel economy-improving technologies applied to the vehicle, because technologies added to a vehicle do not result in a simple additive fuel economy improvement from each individual technology. In particular, NHTSA expects this result from engine and other powertrain technologies that improve fuel economy by allowing the ICE to spend more time operating at efficient engine speed and load conditions or from combinations of engine technologies that work to reduce the effective displacement of the engine.

The effectiveness of a technology depends on the type of vehicle to which the technology is being applied. When discussing ''vehicle type'' in the analysis, NHTSA is referring to the vehicle technology classes (*e.g.,* a small car, a medium performance SUV, or a pickup truck), among other classes. A small car and a medium performance SUV that use the exact same technology start with very different fuel economy values; so, when the exact same technology is added to both of those vehicles, the technology provides a different effectiveness improvement for each of those vehicles.

The cost and effectiveness values for each technology are reasonably representative of what can be achieved across the entire industry. Each technology model employed in the analysis is designed to be representative of a wide range of specific technology applications used in industry. Some manufacturers' systems may perform better or worse than the modeled systems and some may cost more or less than the modeled systems; however, employing this approach ensures that, on balance, the analysis captures a reasonable level of costs and benefits that would result from any manufacturer applying the technology.

A consistent reference point for cost and effectiveness values must be identified before assuming that a cost or effectiveness value could be employed for any individual technology. For example, this analysis uses a set of engine map models developed by starting with a small number of engine configurations, and then, in a systematic and controlled process, adding specific well-defined technologies to create a new map for each unique technology combination. Again, providing a consistent reference point to measure incremental technology effectiveness values ensures that NHTSA is capturing accurate effectiveness values for each technology combination.

The following sections discuss the engine, transmission, hybridization, MR, aerodynamic, tire rolling resistance, and other vehicle technologies considered in this analysis. The following sections discuss:

• How NHTSA defines technology in the CAFE Model;[119]

[118] Pilla, S. et al., Parametric Design Study of McPherson Strut to Stabilizer Bar Link Bracket Weld Fatigue Using Design for Six Sigma and Taguchi Approach, SAE Technical Paper 2021–01–0235, SAE International: (2021), available at: *https://doi.org/10.4271/2021-01-0235* (accessed: Sept. 10, 2025).

[119] Note: Due to the diversity of definitions industry employs for technology terms, or in

Continued

• How NHTSA assigns technology to vehicles in the analysis fleet used as a starting point for this analysis;

• Any adoption features applied to the technology, so the analysis better represents manufacturers' real-world decisions;

• Technology effectiveness values; and

• Technology cost.

Note that the following technology effectiveness sections provide *examples* of the *range* of effectiveness values that a technology could achieve when applied to the entire vehicle system, in conjunction with the other fuel economy-improving technologies already in use on the vehicle. To see the incremental effectiveness values for any particular vehicle moving from one technology key to a more advanced technology key, see the CAFE Model Fuel Economy Adjustment Files that are installed as part of the CAFE Model Executable File, and *not* in the input/output folders. Similarly, the technology costs provided in each section are *examples* of absolute costs seen in specific model years, for specific vehicle classes. The Technologies Input File contains all absolute technology costs used in the analysis across all model years.

1. Engine Paths

ICE vehicles convert chemical energy in fuel to useful mechanical power. The chemical energy in the fuel is released and converted to mechanical power by being oxidized, or burned, inside the engine. The air/fuel mixture entering the engine and the burned fuel/exhaust by-products leaving the engine are the working fluids in the engine. The engine power output is a direct result of the work interaction between these fluids and the mechanical components of the engine.[120] The generated mechanical power is used to perform useful work, such as vehicle propulsion.[121]

NHTSA classifies the extensive variety of light-duty vehicle ICE technologies into discrete Engine Paths. These paths are used to model the most representative characteristics, costs, and performance of the fuel economy-improving engine technologies most likely available during the rulemaking timeframe. The paths are intended to be representative of the range of potential performance levels for each engine technology. In general, the paths are tied to ease of implementation of additional technology and how closely related the technologies are. The technology paths are presented in Chapter 3.1.1 of the Draft TSD.

The Engine Paths have been selected and refined over a period of more than 10 years, based on engines in the market, stakeholder comments, and engineering judgment, subject to the following factors: the included technologies are those most likely available during the rulemaking timeframe and within the range of potential performance levels for each technology, and excluded technologies are those unlikely to be feasible in the rulemaking timeframe, unlikely to be compatible with U.S. fuels, or for which there was not appropriate data available to allow the simulation of effectiveness across all vehicle technology classes in this analysis.

The Engine Paths begin with one of the three base engine configurations: dual-overhead camshaft (DOHC) engines have two camshafts per cylinder head (one operating the intake valves and one operating the exhaust valves), single overhead camshaft (SOHC) engines have a single camshaft, and overhead valve (OHV) engines also have a single camshaft located inside of the engine block (beneath the valves rather than overhead) connected to a rocker arm through a pushrod that actuates the valves. DOHC and SOHC engine configurations are common in the light-duty fleet.

The next step along an Engine Path is the Basic Engine Path technologies. These include variable valve lift (VVL), stoichiometric gasoline direct injection (SGDI), and a basic level of cylinder deactivation (DEAC). VVL dynamically adjusts how far the valve opens and reduces fuel consumption by reducing pumping losses and optimizing airflow over a broader range of engine operating conditions. Instead of injecting fuel at lower pressures and before the intake valve, SGDI injects fuel directly into the cylinder at high pressures allowing for more precise fuel delivery while providing a cooling effect and allowing for an increase in the CR, more optimal spark timing for improved efficiency, or both. DEAC disables the intake and exhaust valves and turns off fuel injection and spark ignition on select cylinders, which effectively allows the engine to operate temporarily as if it were smaller while also reducing pumping losses to improve efficiency. For this proposal, NHTSA has integrated variable valve timing (VVT) technology in all non-diesel engines, so there is not a separate box for it on the Basic Engine Path. VVL, SGDI, and DEAC can be applied to an engine individually or in combination with each other.

Moving beyond the Basic Engine Path technologies are the ''advanced'' engine technologies, which means that applying the technology—both in NHTSA's analysis and in the real world—requires significant changes to the structure of the engine or an entirely new engine architecture. The advanced engine technologies represent the application of alternate combustion cycles, various applications of forced induction technologies, or advances in cylinder deactivation.

Advanced cylinder deactivation (ADEAC) systems, also known as rolling or dynamic cylinder deactivation systems, allow the engine to vary the percentage of cylinders deactivated and the sequence in which cylinders are deactivated. Depending on the engine's speed and associated torque requirements, an engine might have most cylinders deactivated (*e.g.,* low torque conditions, as with slower speed driving) or it might have all cylinders activated (*e.g.,* high torque conditions, as with merging onto a highway).[122] An engine operating at low-speed/low-torque conditions can save fuel by operating at a fraction of its total displacement. NHTSA models two ADEAC technologies, advanced cylinder deactivation on a single overhead camshaft engine (ADEACS), and ADEACD.

Forced induction gasoline engines include both supercharged and turbocharged downsized engines, which can pressurize or force more air into an engine's intake manifold when higher power output is needed. The raised pressure results in an increased amount of airflow into the cylinder to support combustion, increasing the specific power of the engine. The first-level turbocharged downsized technology (TURBO0) engine represents a basic level of forced air induction technology being applied to a DOHC engine. A cooled exhaust gas recirculation (CEGR) system takes engine exhaust gases, passes them through a heat exchanger to reduce their temperature, then mixes them with incoming air in the intake

describing the specific application of technology, the terms defined here may differ from how the technology is defined in some parts of the industry.

[120] Heywood, J. B., Internal Combustion Engine Fundamentals, McGraw-Hill Education (2018), Chapter 1 (hereinafter, Heywood (2018)).

[121] *Ibid,* containing a complete discussion on fundamentals of engine characteristics, such as torque, torque maps, engine load, power density, brake mean effective pressure (BMEP), combustion cycles, and components.

[122] See Tula Technology, Inc. Dynamic Skip Fire, available at: *https://www.tulatech.com/combustion-engine/* (accessed: Sept. 10, 2025), discussing how the company's proprietary cylinder deactivation technology operates in real-world situations. NHTSA's modeled ADEAC system is not based on this specific system, and therefore the effectiveness improvement is different in NHTSA's analysis than with this system; however, the theory still applies.

manifold to reduce peak combustion temperature, thereby improving fuel efficiency and emissions. NHTSA models the base TURBO0 turbocharged engine with the addition of cooled exhausted recirculation (TURBOE), basic cylinder deactivation (TURBOD), variable valve lift (TURBO1), and advanced cylinder deactivation (TURBOAD). Advancing further into the Turbo Engine Path leads to an engine with a higher BMEP, which is a function of displacement and power. In other words, the higher the BMEP, the higher the power density of the engine. NHTSA models an advanced turbocharging technology (TURBO2) that runs increasingly higher turbocharger boost levels, burning more fuel and making more power for a given displacement. This analysis pairs turbocharging with engine downsizing, meaning that the turbocharged downsized engines improve vehicle fuel economy by using less fuel to power the smaller engine while maintaining vehicle performance.

The technology pathways represent an increase in the level or combinations of technologies being applied, with lower levels at the top and higher levels at the bottom of the path. Chapter 3.1.1 of the Draft TSD shows the technology pathways for visualization purposes; however, the CAFE Model could apply any cost-effective combinations of technologies from those given pathways. Levels of improvement are dependent upon the vehicle class and the technology combinations. Again, in general, the paths are tied to ease of implementation of additional technology and how closely related the technologies are. An example of how this applies to the TURBO family of technologies is described below. The pathways are not aligned from ''least effective'' to ''most effective'' because assuming so would ignore several important considerations, including how technologies interact on a vehicle, how technologies interact on vehicles of different sizes that have different power requirements, and how hardware changes may be required for a particular technology For example, the scenario below describes how, once a manufacturer downsizes an engine accompanying the application of a turbocharger, it would most likely not re-upsize the engine to add a less advanced turbocharger. The interaction of these technology combinations is discussed in more detail in Draft TSD Chapter 2.

While TURBO0 is modeled with cooled EGR (TURBOE) and with DEAC (TURBOD), these technologies do not apply to TURBO1 or TURBO2; this decision is intentional. NHTSA defines TURBO1 in the analysis by adding VVL to the TURBO0 engine, and TURBO2 is the highest turbo downsized engine with a high BMEP. The benefits of cooled EGR and DEAC on TURBO1 and TURBO2 technologies would occur at high engine speeds and loads, which do not occur on the two-cycle tests. Because NHTSA measured technology effectiveness in this analysis based on the delta in improvements in vehicles' two-cycle test fuel consumption values, adding cooled EGR and DEAC to TURBO1 and TURBO2 would provide little effectiveness improvement for the corresponding increase in cost, a technology decision that the agency does not believe manufacturers would adopt in the real world. NHTSA's modeling effectively captured these complex interactions among technologies—an example of why effectiveness values from different technologies cannot simply be added together.[123] This potential for added costs with limited efficiency benefit is also an example of why the CAFE Model technology tree is not ordered from least to most effective technology and why particular technologies are included on the technology tree while others are not. Draft TSD Chapter 2 provides more discussion on interactions among individual technologies in the full-vehicle simulations.

Consistent with the approach of preventing moving backward in the technology tree, the Model does not allow a vehicle assigned a TURBO2 technology to adopt a TURBOE technology. A vehicle in the analysis fleet that is assigned the TURBO2 technology indicates a manufacturer made the decision to either skip over or move on from lower levels of force induction technology. Moving backwards in the technology tree from TURBO2 to any of the lower turbo technologies would require the engine to be upsized to meet the same performance metrics as the analysis fleet vehicle. As discussed further in Section II.C.2.c, NHTSA ensures the vehicles in this analysis meet similar performance levels after the application of fuel economy-improving technology, because the agency's objective is to measure the costs and benefits of manufacturers responding to CAFE standards in this analysis, and not the costs or benefits related to changing performance metrics in the fleet. Moving from a higher to a lower turbo technology works counter to saving fuel as the engine would grow in displacement, requiring more fuel, adding frictional losses, and increasing weight and cost. Accordingly, the agency believes that the Turbo engine pathway appropriately captures the ways manufacturers might apply increasing levels of turbocharging technology to their vehicles.

In this analysis, high compression ratio (HCR) engines represent a class of engines that achieve a higher level of fuel efficiency by implementing a high geometric CR with varying degrees of late intake valve closing (LIVC) (*i.e.,* closing the intake valve later than usual) using VVT, and without the use of an electric drive motor.[124] These engines operate on a modified Atkinson cycle, allowing for improved fuel efficiency under certain engine load conditions while still offering enough power not to require an electric motor; however, there are limitations on how HCR engines can apply LIVC and the types of vehicles that can use this technology. The way that each individual manufacturer implements a modified Atkinson cycle is unique, as each manufacturer must balance not only fuel efficiency considerations, but also emissions, on-board diagnostics, and safety considerations, which include the vehicle being able to operate responsively to the driver's demand.

NHTSA defines HCR engines as being naturally aspirated, gasoline, spark ignition (SI), using a geometric CR of 12.5:1 or greater,[125] and able dynamically to apply various levels of LIVC based on load demand. An HCR engine uses less fuel for each engine cycle, which increases fuel economy but decreases power density (or torque). Generally, during high loads—when more power is needed—the engine will use variable valve actuation to reduce the level of LIVC by closing the intake valve earlier in the compression stroke (leaving more air/fuel mixture in the combustion chamber), increasing the effective CR, reducing over-expansion, and sacrificing efficiency for increased power density.[126] However, there is a

[123] NHTSA–2021–0053–0007–A3 at 15; NHTSA–2021–0053–0002–A9, at pp. 21–23.

[124] LIVC is a method manufacturers use to reduce the effective compression ratio and allow the expansion ratio to be greater than the compression ratio resulting in improved fuel economy but reduced power density. Further technical discussion on HCR and Atkinson engines are discussed in Draft TSD Chapter 3.1.1.2.3. The 2015 NAS Report, Appendix D, includes a short discussion on thermodynamic engine cycles.

[125] Note that even if an engine has a compression ratio of 12.5:1 or greater, it does not necessarily mean it is an HCR engine in NHTSA's analysis, as discussed below. NHTSA looks at a number of factors to perform baseline engine assignments.

[126] Variable valve actuation is a general term used to describe any single or combination of VVT, VVL,

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limit to how much the air-fuel mixture can be compressed before ignition in the HCR engine due to the potential for engine knock.[127] Engine knock can be mitigated in HCR engines with higher octane fuel; however, the fuel specified for use in most vehicles is not higher octane fuel. Conversely, at low loads, the engine will typically increase the level of LIVC by closing the intake valve later in the compression stroke, reducing the effective CR, increasing the over-expansion, and sacrificing power density for improved efficiency. By closing the intake valve later in the compression stroke (*i.e.,* applying more LIVC), the engine's displacement is effectively reduced, which results in less air and fuel for combustion and a lower power output.[128] Varying LIVC can be used to mitigate, but not eliminate, the low power density issues that can constrain the application of an Atkinson-only engine.

The phrase ''low power density issues'' translates to a low torque density,[129] meaning that the engine cannot create the torque required at necessary engine speeds to meet load demands. To the extent that a vehicle requires more power in a given condition than an engine with low power density can provide, that engine would experience issues like engine knock for the reasons discussed above; more importantly, an engine designer would not allow a particular engine design to be used in conditions where the engine has the potential to operate in unsafe conditions in the first place. Instead, a manufacturer could significantly increase an engine's displacement (*i.e.,* size) to overcome those low power density issues,[130] or could add an electric motor and battery pack to provide the engine with more power; however, a far more effective pathway would be to apply a different type of engine technology, like a downsized, turbocharged engine.[131] Because of these limitations with HCR engines, NHTSA restricts the Model from applying this technology to vehicles that would be negatively impacted by the technology, like pickup trucks.[132]

Vehicle manufacturers' intended performance attributes for a vehicle—like payload and towing capability, features for off-road use, and other attributes that affect aerodynamic drag and rolling resistance—dictate whether an HCR engine can be a suitable technology choice for that vehicle.[133] As vehicles require higher payloads and towing capacities,[134] experience road load increases from larger all-terrain tires or less aerodynamic designs, or experience driveline losses for AWD and 4WD configurations, more engine torque is required at all engine speeds. When more engine torque is required, the application of HCR technology becomes less effective and more limited.[135] For these reasons, and to maintain a performance-neutral analysis, NHTSA limits non-hybrid and non-plug-in-hybrid HCR engine application to certain categories of vehicles.[136]

NHTSA includes three HCR Engine Path technology options in this analysis: (1) a first-level Atkinson-enabled engine (HCR) with VVT and SGDI; (2) an Atkinson-enabled engine with cooled exhaust gas recirculation (HCRE); and, (3) an Atkinson-enabled engine with DEAC (HCRD). This updated family of HCR engine map models also reflects the statement in NHTSA's May 2, 2022, final rule that a single engine that employs an HCR, CEGR, *and* DEAC ''is unlikely to be utilized in the rulemaking timeframe based on comments received from the industry leaders in HCR technology application.'' [137]

These three HCR Engine Path technology options (HCR, HCRE, HCRD) should not be confused with the hybrid and plug-in hybrid electric pathway options that also utilize HCR engines in combination with a P2 hybrid powertrain (*e.g.,* P2HCR, P2HCRE, PHEV20H, and PHEV50H); those hybridization path options are discussed in Section II.D.3 below. In contrast, Atkinson engines in NHTSA's power-split hybrid powertrains (SHEVPS, PHEV20PS, and PHEV50PS) run the Atkinson Cycle full time but are connected to an electric motor. The full-time Atkinson engines are also discussed in Section II.D.3.

The Miller cycle is another alternative combustion cycle that effectively uses an extended expansion stroke, similar to the Atkinson cycle but with the application of forced induction to improve fuel efficiency. Miller cycle-enabled engines have a similar trade-off in power density as Atkinson engines; the lower power density requires a larger volume engine in comparison to an Otto cycle-based turbocharged system for similar applications.[138] To address the impacts of the extended expansion stroke on power density during high load operating conditions, the Miller cycle operates in combination

and variable valve duration used to dynamically alter an engine's valvetrain during operation.

[127] Engine knock in spark ignition engines occurs when combustion of some of the air/fuel mixture in the cylinder does not result from propagation of the flame front ignited by the spark plug rather, one or more pockets of air/fuel mixture explode outside of the envelope of the normal combustion front.

[128] Power = (force × displacement)/time.

[129] Torque = radius × force.

[130] 2024 EPA Trends Report at 54 (''As vehicles have moved towards engines with a lower number of cylinders, the total engine size, or displacement, is also at an all-time low.''). The discussion below describes why NHTSA does not believe manufacturers will increase the displacement of HCR engines to make the necessary power because of the negative impacts it has on fuel efficiency.

[131] See Toyota, 2024 Toyota Tacoma Makes Debut on the Big Island, Hawaii (2023), available at: *https://pressroom.toyota.com/2024-toyota-tacoma-makes-debut-on-the-big-island-hawaii/* (accessed: Sept. 10, 2025). The 2024 Toyota Tacoma comes in eight ''grades,'' all of which use a turbocharged engine.

[132] Draft TSD Chapter 3.1.1.2.3 includes more discussion on HCR and HCR restrictions.

[133] Supplemental Comments of Toyota Motor North America, Inc., Notice of Proposed Rulemaking: Safer Affordable Fuel-Efficient Vehicles Rule, Docket ID Numbers: NHTSA–2018–0067 and EPA–HQ–OAR–2018–0283, at 6; Feng, R. et al. Investigations of Atkinson Cycle Converted from Conventional Otto Cycle Gasoline Engine, SAE Technical Paper 2016–01–0680, (2016), available at: *https://www.sae.org/publications/technical-papers/content/2016-01-0680/* (accessed: Sept. 10, 2025).

[134] See Tucker, S., What Is Payload: A Complete Guide. Kelly Blue Book, (last revised: Feb. 2, 2023), available at: *https://www.kbb.com/car-advice/payload-guide/#link3* (accessed: Sept. 10, 2025). (''Roughly speaking, payload capacity is the amount of weight a vehicle can carry, and towing capacity is the amount of weight it can pull. Automakers often refer to carrying weight in the bed of a truck as hauling to distinguish it from carrying weight in a trailer or towing.'').

[135] See Supplemental Comments of Toyota Motor North America, Inc., Docket Nos: NHTSA–2018–0067 and EPA–HQ–OAR–2018–0283 at 6, 8 (March 25, 2019), available at: *https://www.regulations.gov/comment/NHTSA-2018-0067-12376* (accessed: Sept. 10, 2025) (Supplemental Toyota Comments) (''Tacoma has a greater coefficient of drag from a larger frontal area, greater tire rolling resistance from larger tires with a more aggressive tread, and higher driveline losses from 4WD. Similarly, the towing, payload, and off-road capability of pick-up trucks necessitate greater emphasis on engine torque and horsepower over fuel economy. This translates into engine specifications such as a larger displacement and a higher stroke-to-bore ratio. . . . Tacoma's higher road load and more severe utility requirements push engine operation more frequently to the less efficient regions of the engine map and limit the level of Atkinson operation. . . . This endeavor is not a simple substitution where the performance of a shared technology is universal. Consideration of specific vehicle requirements during the vehicle design and engineering process determine the best applicable powertrain.'').

[136] To maintain performance neutrality when sizing powertrains and selecting technologies, NHTSA performs a series of simulations in Autonomie, which are further discussed in the Draft TSD Chapter 2.3.4 and in the CAFE Analysis Autonomie Documentation. The concept of performance neutrality is discussed in detail above in Section II.C.2.c, Technology Effectiveness Values, and additional reasons why NHTSA maintains a performance neutral analysis are discussed in Section II.C.2.f, Technology Applicability Equations and Rules.

[137] 87 FR 25796 (May 2, 2022).

[138] National Research Council, Assessment of Technologies for Improving Fuel Economy of Light-Duty Vehicles—2025–2035, National Academies Press: Washington, DC (2021), available at: *https://doi.org/10.17226/26092* (accessed: Sept. 10, 2025) (hereinafter, ''2021 NAS report'').

with a forced induction system. In NHTSA's analysis, the first-level Miller cycle-enabled engine includes the application of variable turbo geometry technology (VTG), or what is also known as a variable-geometry turbocharger. VTG technology allows for the adjustment of key geometric characteristics of the turbocharging system, thus allowing adjustment of boost profiles and response based on the engine's operating needs. The adjustment of boost profile during operation increases the engine's power density over a broader range of operating conditions and increases the functionality of a Miller cycle-based engine. The use of a variable geometry turbocharger also supports the use of CEGR. NHTSA's second level of VTG engine technology (VTGE) is an advanced Miller cycle-enabled system that includes the application of at least a 40V-based electronic boost system. An electronic boost system has an electric motor added to assist the turbocharger; the motor assist mitigates turbocharger lag and low boost pressure by providing the extra boost needed to overcome the torque deficit at low engine speeds.

Variable compression ratio (VCR) engines work by changing the length of the piston stroke of the engine to optimize the CR and improve thermal efficiency over the full range of engine operating conditions. Engines that use VCR technology are currently in production as small-displacement, turbocharged, in-line four-cylinder, high BMEP applications.

Diesel engines have several characteristics that result in better fuel efficiency over traditional gasoline engines, including reduced pumping losses due to lack of (or greatly reduced) throttling, high-pressure direct injection of fuel, a combustion cycle that operates at a higher CR, and a very lean air/fuel mixture relative to an equivalent-performance gasoline engine. However, diesel technologies require additional systems to control NO_X emissions, such as a NO_X adsorption catalyst system or a urea/ammonia selective catalytic reduction system. NHTSA included two levels of diesel engine technology in the analysis: the first-level diesel engine technology (Advanced Diesel Engine (ADSL)) is a turbocharged diesel engine, and the more advanced diesel engine (DSLI) adds DEAC to the ADSL engine technology. The diesel engine maps are new for this analysis. The light-duty diesel engine maps are based on a modern 3.0L turbo-diesel engine.

Finally, compressed natural gas (CNG) systems are ICE vehicles that run on natural gas as a fuel source. The fuel storage and supply systems for these engines differ tremendously from gasoline, diesel, and flexible-fuel vehicles.[139] The CNG engine option has been included in past analyses; however, the light-duty analysis fleet does not include any dedicated CNG vehicles. As with the last analyses, CNG engines are included as an analysis fleet-only technology and are not applied to any vehicle that did not already include a CNG engine.

There are other vehicle technologies that work in various ways to improve fuel efficiency, such as turbo compounding, negative valve overlaps in-cylinder fuel reforming (NVO), passive prechamber combustion (PPC), and high energy ignition; however, NHTSA's analysis did not include these technologies. While suitable explanations for their exclusion could be that these technologies are in various stages of development and some, like PPC, are in very limited production, the primary reason NHTSA opted not to include them in the analysis is that the agency believes these technologies will not gain enough adoption during the rulemaking timeframe. This topic was discussed in detail in the 2022 final rule,[140] and the agency has not found evidence of significant development since then that would indicate manufacturers are now pursuing these costly technologies within the same standard-setting years.

The first step in assigning engine technologies to vehicles in the analysis fleet is to use data for each manufacturer to determine which vehicle platforms share engines. Within each manufacturer's fleet, NHTSA develops and assigns unique engine codes based on configuration, technologies applied, displacement, CR, and power output. NHTSA also assigns engine technology classes, which are codes that identify engine architecture (*i.e.,* how many cylinders the engine has, whether it is a DOHC or SOHC, and so on) to account accurately for engine costs in the analysis.

When assigning engine technologies to vehicles in the analysis fleets, it is important to consider the actual technologies on a manufacturer's engine and compare them to the engine technologies in the analysis. NHTSA has over 250 unique engine codes in the light-duty analysis fleet, meaning that the technologies present on those engines in the real world must be identified and matched to the 29 engine map models (and therefore engine technology on the technology tree)[141] that best represents those real-world engines. When considering how best to fit each of those 250 engines to the 29 engine technologies and engine map models, NHTSA uses specific technical elements contained in manufacturer publications, press releases, vehicle benchmarking studies, technical publications, manufacturer's specification sheets, occasionally CBI (for specific technologies, displacement, CR, and power mentioned above), and engineering judgment. For example, an engine having a 13.0:1 CR is a good indication that the engine would be considered an HCR engine. Some engines that achieve a slightly lower CR (*e.g.,* 12.5), may also be considered an HCR engine depending on other technology on the engine, such as the inclusion of SGDI, increased engine displacement compared to other competitors, reduction of engine parasitic losses through variable or electric oil and water pumps, or the combination of these technologies. Importantly, engine technologies are never assigned based on one factor alone but rather using data and engineering judgment to assign complex real-world engines to their corresponding engine technologies in the analysis. NHTSA believes that the initial characterization of the fleet's engine technologies reasonably captures the current state of the market while maintaining a reasonable amount of analytical complexity. Also, in addition to the 29 engine map models used in the Engine Paths Collection, there are 16 additional potential powertrain technology assignments available in the Hybridization Paths Collection.

Engine technology adoption in the Model is defined through a combination of technology path logic, refresh and redesign cycles, phase-in capacity limits,[142] and SKIP logic. Path logic defines technology adoption by preventing an engine design from moving from one advanced engine tree to another. Once in an advanced engine tree, it must stay there. For example, any light-duty basic engine can adopt one of the TURBO engine technologies, but vehicles that have turbocharged engines in the analysis fleet stay on the

[139] Flexible-fuel vehicles (FLEX) are designed to run on gasoline or gasoline-ethanol blends of up to 85 percent ethanol.

[140] 87 FR 25784 (May 2, 2022).

[141] NHTSA assigns each engine code technology that most closely corresponds to an engine map; for most technologies, one box on the technology tree corresponds to one engine map that corresponds to one engine code.

[142] Though NHTSA applies phase-in caps for this analysis, as discussed in Chapter 3.1.1 of the Draft TSD, those phase-in caps are not binding because the Model has several other less advanced technologies available to apply first at a lower cost, as well as the redesign schedules. The Draft TSD contains more information on engine phase-in caps.

Turbo Engine Path to prevent unrealistic engine technology change in the short timeframe considered in the rulemaking analysis. This represents the concept of stranded capital, which is when manufacturers amortize research, development, and tooling expenses over many years. Besides technology path logic, which applies to all manufacturers and technologies, NHTSA places additional constraints on the adoption of VCR and HCR technologies.

VCR technology requires a complete redesign of the engine and, in the analysis fleet, Nissan is the only manufacturer (including the Infiniti brand) to incorporate this technology. VCR engines are complex, costly by design, and address many of the same efficiency losses as mainstream technologies like turbocharged downsized engines. This makes it unlikely that a manufacturer that has already started down an incongruent technology path would adopt VCR technology. Because of these issues, VCR engine technology adoption is limited to original equipment manufacturers (OEMs) that have already employed the technology and their partners. NHTSA does not believe any other manufacturers will invest in developing and market this technology in their fleet in the rulemaking timeframe.

As recognized in past analyses,[143] HCR engines excel in lower power applications for lower load conditions, such as driving around a city or steady state highway driving without large payloads. Thus, their adoption is more limited than some other technologies. Accordingly, HCR engines are subject to three limitations.

First, vehicles with 405 or more HP, and (to simulate parts sharing) vehicles that share engines with vehicles with 405 or more HP, are not allowed to adopt HCR engines due to their prescribed power needs being more demanding and likely not supported by the lower power density found in HCR-based engines.[144] Because LIVC essentially reduces the engine's displacement, to make more power and keep the same levels of LIVC, manufacturers would need to increase the displacement of the engine to make the necessary power. NHTSA does not believe manufacturers will increase the displacement of their engines to accommodate HCR technology adoption, because as displacement increases, so do friction, pumping losses, and fuel consumption. This bears out in industry trends: total engine size (or displacement) is at an all-time low, and trends show that industry focus on turbocharged downsized engine packages are leading to their much higher market penetration.[145] Separately, as seen in the analysis fleet, manufacturers generally use HCR engines in applications where the vehicle's power requirements fall significantly below the agency's HCR HP threshold. In fact, the average HP for the sales-weighted average of vehicles in the analysis fleet that use HCR Engine Path technologies is 194 hp, demonstrating that HCR engine use has indeed been limited to lower hp applications, and well below the 405 hp threshold. In fringe cases where a vehicle classified as having higher load requirements does have an HCR engine, it is coupled to a hybrid system.[146]

Second, to maintain a performance-neutral analysis,[147] pickup trucks and (to simulate parts sharing) [148] vehicles that share engines with pickup trucks are excluded from receiving HCR engines that are not accompanied by a hybrid powertrain. In other words, pickup trucks and vehicles that share engines with pickup trucks can receive HCR-based engine technologies only in the Hybridization Paths Collection of technologies. Pickup trucks and vehicles that share engines with pickup trucks are excluded from receiving HCR engines not accompanied by a hybrid powertrain because these often-heavier vehicles have higher low-speed torque needs, higher base road loads, increased payload and towing requirements,[149] and have powertrains sized and tuned to perform this additional work beyond what passenger cars are required to conduct. Again, vehicle manufacturers' intended performance attributes for a vehicle—like payload and towing capability, intention for off-road use, and other attributes that affect aerodynamic drag and rolling resistance—dictate whether an HCR engine can provide a reasonable fuel economy improvement for that vehicle.[150] For example, road loads are composed of aerodynamic loads, which include vehicle frontal area and its drag coefficient, along with tire rolling resistance, all of which contribute to higher engine loads as vehicle speed increases.[151] NHTSA assumes that a manufacturer intending to apply HCR technology to their pickup truck or vehicle that shares an engine with a pickup truck would do so in combination with an electric system to assist with the vehicle's load needs.

Finally, HCR engine application is restricted for some heavily performance-focused manufacturers that have demonstrated a significant commitment to power-dense technologies such as

[143] The discussions at 83 FR 43038 (Aug. 24, 2018), 85 FR 24383 (Apr. 30, 2020), 86 FR 49658 and 49661 (Sept. 3, 2021), and 87 FR 25786 and 25790 (May 2, 2022) are incorporated here by reference.

[144] Heywood (2018) at Chapter 5.

[145] See 2024 EPA Trends Report at 54, 85.

[146] See the Market Data Input File. As an example, the reported total system horsepower for the Ford Maverick HEV is also 191 hp, well below the 405 hp threshold. See also the Lexus LC/LS 500h: the Lexus LC/LS 500h also uses premium fuel to reach this performance level.

[147] As discussed in detail in Section II.C.2.c and II.C.2.f above, NHTSA maintains a performance-neutral analysis to capture only the costs and benefits of manufacturers adding fuel economy-improving technology to their vehicles in response to CAFE standards.

[148] See Section II.C.2.f.

[149] See SAE, Performance Requirements for Determining Tow-Vehicle Gross Combination Weight Rating and Trailer Weight Rating, SAE Standard J2807_202411, SAE International: Warrendale, PA, available at: *https://doi.org/10.4271/J2807_202411* (accessed: Sept. 10, 2025).; Reed, T, SAE J207 Tow Tests—The Standard, Motortrend (2015), available at: *https://www.motortrend.com/how-to/1502-sae-j2807-tow-tests-the-standard/* (accessed: Sept. 10, 2025). When stating ''increased payload and towing requirements,'' NHTSA is referring to a literal defined set of requirements that manufacturers follow to ensure the manufacturer's vehicle can meet a set of performance measurements when building a tow vehicle to give consumers the ability to ''cross-shop'' between different manufacturers' vehicles. As discussed in detail above in Section II.C.2.c and II.C.2.f, NHTSA maintains a performance-neutral analysis to ensure that the analysis is only accounting for the costs and benefits of manufacturers adding technology in response to CAFE standards. This means that adoption features, like the HCR application restriction, are applied to a vehicle that begins the analysis with specific performance measurements, like a pickup truck, where application of the specific technology would likely not allow the vehicle to meet the manufacturer's baseline performance measurements.

[150] ICCT asked NHTSA to stop quoting a 2019 Toyota comment explaining why NHTSA does not allow HCR engines in pickup trucks, stating that Toyota's purpose in explaining that the Tacoma and Camry achieve different effectiveness improvements using their HCR engines is being misinterpreted. See NHTSA–2018–0067–12387 NHTSA disagrees. Toyota's comment is still relevant for this proposed rule as the limitations of the technology have not changed, which Toyota describes in the context of comparing why the technology provides a benefit in the Camry that one should not expect to see in the Tacoma. See Supplemental Toyota Comments at 6, 8. Note that Toyota also submitted a second set of supplemental comments (NHTSA–2018–0067–12431) that confirms NHTSA's understanding of the most important concept to support NHTSA's decision to limit HCR adoption on pickup trucks, which is that Atkinson operation is limited on pickup trucks. See Supplemental Comments of Toyota Motor North America, Inc., in the NHTSA Docket No. NHTSA–2018–0067–12376–A1 at 8–9 in *Regulations.gov*. See Supplemental Comments of Toyota Motor North America, Inc., Docket Nos. NHTSA–2018–0067 and EPA–HQ–OAR–2018–0283 at 2–3 (July 15, 2019), available at: *https://www.regulations.gov/comment/NHTSA-2018-0067-12431* (accessed: Sept. 10, 2025).

[151] 2015 NAS Report, at pp. 207–242.

turbocharged downsizing,[152] such that their fleets use nearly 100 percent turbocharged downsized engines. This means that no vehicle manufactured by these manufacturers can receive an HCR engine. Again, this adoption feature is implemented to avoid an unquantified amount of stranded capital that would be realized if these manufacturers switched from one technology to another.

Note that these adoption features apply only to vehicles that receive HCR engines that are not accompanied by a hybrid powertrain. A P2 hybrid system that uses an HCR engine overcomes the low-speed torque needs using the electric motor and thus has no restrictions or SKIPs applied.

NHTSA realizes that engine technology, vehicle type, and their applications are always evolving. The Hyundai Santa Cruz, a unibody pickup truck with a 4-cylinder HCR engine, is one example of a pickup truck with a non-hybrid HCR engine. However, the Santa Cruz is not comparable in capability to other pickup models like the Tacoma, Colorado, and Canyon, and it therefore cannot be assumed that those pickup models should be able to adopt non-hybrid HCR technology as well. Small unibody pickup trucks like the Santa Cruz and the Ford Maverick do not have the same capabilities and functionality as a mid-size body-on-frame pickup like the Toyota Tacoma.[153] NHTSA believes that its current restrictions for HCR are reasonable and appropriate, and the agency has not been presented with any new information that would suggest otherwise. NHTSA's stance on this issue has also borne out in real-world trends. Manufacturers who currently offer HCR engines in their fleets and therefore had the potential to introduce HCR technologies on recently redesigned vehicles that previously used high-displacement NA engines (such as Toyota Tacoma or Chevrolet Colorado) or TURBO technologies (such as the Mazda CX–90 replacing CX–9) have instead opted to introduce or continue to pursue turbocharged or hybrid engines. NHTSA does not believe HCR in its current state can provide enough fuel efficiency benefit for us to remove the current HCR restrictions; however, this by no means precludes manufacturers from developing and deploying HCR technology for future iterations of their pickup trucks.

NHTSA also emphasizes that, in the real world, manufacturers are not required to follow the technology pathways to compliance that the agency models in the standard-setting analysis but can instead take their own pathway based on their respective business models, technology availability, market share, and others. The CAFE Model simulates an example of a low-cost compliance pathway, and no manufacturer has to comply with the pathway as it has been modeled. Instead, manufacturers are free to choose their own path to compliance. NHTSA has added features and restrictions into the CAFE Model to make the compliance simulation more representative of how manufacturers make decisions about technology adoption in the real world. This is to ensure that the CAFE Model does not simulate unrealistic compliance pathways. For example, if the CAFE Model simulated manufacturers abandoning one technology in favor for another, particularly with respect to HCR technology for pickup trucks and high HP vehicles, the results and corresponding costs and benefits would be unrealistic and could lead to NHTSA setting standards that are more stringent than maximum feasible. For this and other reasons, the agency endeavors to model the most realistic and low-cost pathway to compliance. NHTSA's standard-setting analysis is also restricted in ways that manufacturers are not, increasing the likelihood that manufacturers will not follow the technology pathways projected in the standard-setting analysis.[154]

How effective an engine technology is at improving a vehicle's fuel economy depends on several factors, such as the vehicle's technology class and any additional technology added or removed from the vehicle in conjunction with the new engine technology, as discussed in Section II.C above. The Autonomie model's full-vehicle simulation results provide most of the effectiveness values that are used as inputs to the CAFE Model. Chapter 2.4 of the Draft TSD and the CAFE Analysis Autonomie Documentation provide a full discussion of the Autonomie modeling. The Autonomie modeling uses engine map models as the primary inputs for simulating the effects of different engine technologies.

Engine maps provide a three-dimensional representation of engine performance characteristics at each engine speed and load point across the operating range of the engine. Engine maps have the appearance of topographical maps, typically with engine speed on the horizontal axis and engine torque, power, or BMEP on the vertical axis. A third engine characteristic, such as brake-specific fuel consumption (BSFC), is displayed using contours overlaid across the speed and load map. The contours provide the values for the third characteristic in the regions of operation covered on the map. Other characteristics typically overlaid on an engine map include engine emissions, engine efficiency, and engine power. The engine maps developed to model the behavior of the engines in this analysis are referred to as engine map models.

The engine map models used in this analysis are representative of technologies currently in production or expected to be available in the rulemaking timeframe. The engine map models are developed to be representative of the performance achievable across the industry for a given technology, and they are not intended to represent the performance of a single manufacturer's specific engine. NHTSA targets a broadly representative performance level because the same combination of technologies produced by different manufacturers will differ in performance, due to manufacturer-specific designs for engine hardware, control software, and emissions calibration. Accordingly, the agency expects that the engine maps developed for this analysis will differ from engine maps for manufacturers' specific engines. However, it is intended and expected that the incremental changes in performance modeled for this analysis, due to changes in technologies or technology combinations, will be similar to the incremental changes in performance observed in manufacturers' engines for the same changes in technologies or technology combinations.

IAV developed most of the engine map models used in this analysis. IAV is one of the world's leading automotive industry engineering service partners with an over 35-year history of performing research and development for powertrain components, electronics, and vehicle design.[155] SwRI developed the light-duty diesel engine maps for this analysis. SwRI has been providing automotive science, technology, and engineering services for over 70

[152] Three manufacturers that meet the criteria (near 100 percent turbo downsized fleet, and future hybrid systems are based on turbo downsized engines) described and are excluded: BMW, Mercedes-Benz, and Jaguar Land Rover.

[153] The specification of 2024 Ford Maverick, Toyota Tacoma, and Hyundai Santa Cruz are in the docket accompanying this proposed rule.

[154] 49 U.S.C. 32902(h).

[155] IAV Automotive Engineering, available at: *https://www.iav.com/* (accessed: Sept. 10, 2025).

years.[156] Both IAV and SwRI developed these engine maps using the GT–POWER© Modeling tool (GT–POWER). GT–POWER is a commercially available industry-standard engine performance simulation tool. GT–POWER can be used to predict detailed engine performance characteristics, such as power, torque, airflow, volumetric efficiency, fuel consumption, turbocharger performance and matching, and pumping losses.[157]

Just like Argonne optimizes a single vehicle model in Autonomie following the addition of a singular technology to the vehicle model, these engine map models were built in GT–POWER by incrementally adding engine technology to an initial engine—built using engine test data, component test data, and manufacturers' and suppliers' technical publications—and then optimizing the engine to consider real-world constraints like heat, friction, and knock. One of the basic assumptions the agency makes when developing these engine maps is using 87 octane Tier 3 gasoline because it is the most common octane rating on which engines are designed to operate, and it is the test fuel manufacturers will have to use for EPA fuel economy testing.[158] [159] [160] A small number of initial engine configurations with well-defined BSFC maps are used, and then, in a systematic and controlled process, specific well-defined technologies are added to optimize a BSFC map for each unique technology combination. This could theoretically be done through engine or vehicle testing, but such an approach would require conducting tests on a single engine, and each configuration would require physical parts and associated engine calibrations to assess the impact of each technology configuration. This is impractical for the rulemaking analysis because of the extensive design, prototype part fabrication, development, and laboratory resources that are required to evaluate each unique configuration. Both NHTSA and the automotive industry use modeling as an approach to assess an array of technologies with more limited physical testing. Modeling offers the opportunity to isolate the effects of individual technologies by using a single or small number of initial engine configurations and incrementally adding technologies to those initial configurations. This provides a consistent reference point for the BSFC maps for each technology and for combinations of technologies that enable us to identify and quantify carefully the differences in effectiveness among technologies.

Before its use in the Autonomie analysis, both IAV and SwRI validated the generated engine maps against a global database of benchmarked data, engine test data, single-cylinder test data, prior modeling studies, technical studies, and information presented at conferences.[161] IAV and SwRI also validated the effectiveness values from the simulation results against detailed engine maps produced from the Argonne engine benchmarking programs, as well as published information from industry and academia.[162] This ensures reasonable representation of simulated engine technologies. Additional details and assumptions that are used in the engine map modeling are described in detail in Chapter 3.1 of the Draft TSD and the CAFE Analysis Autonomie Model Documentation chapter titled ''Autonomie—Engine Model.''

Note that absolute BSFC levels are never applied from the engine maps to any vehicle model or configuration for the rulemaking analysis; only the absolute fuel economy values from the full-vehicle Autonomie simulations are used to determine incremental effectiveness for switching from one technology to another technology. The incremental effectiveness is then applied to the absolute fuel economy or fuel consumption value of vehicles in the analysis fleet, which are based on CAFE or FE compliance data. For subsequent technology changes, NHTSA applies incremental effectiveness changes to the absolute fuel economy level of the previous technology configuration. Therefore, for a technically sound analysis, it is most important that the differences in BSFC among the engine maps be accurate and not the absolute values of the individual engine maps.

While the fuel economy improvements for most engine technologies in the analysis are derived from the database of Autonomie full-vehicle simulation results, the analysis incorporates a handful of what the agency refers to as ''analogous effectiveness values.'' These are used when an engine map model is not available for a particular technology combination. To generate an analogous effectiveness value, data from analogous technology combinations for available engine map models are used by conducting a pairwise comparison to generate a data set of emulated performance values for adding technology to an initial application. Analogous effectiveness values are used only for four SOHC technologies. NHTSA has determined that the effectiveness results using these analogous effectiveness values provided reasonable results. This process is discussed further in Chapter 3.1.4.2 of the Draft TSD.

The engine technology effectiveness values for all vehicle technology classes can be found in Chapter 3.1.4 of the Draft TSD. These values show the calculated improvement for upgrading the listed engine technology for a given combination of other technologies. The range of effectiveness values listed for each specific technology (*e.g.,* TURBO1) represents the addition of the TURBO1 technology to every technology combination that could select the addition of TURBO1. These values are derived from the Argonne Autonomie simulation dataset and the righthand side Y-axis shows the number of Autonomie simulations that achieve each percentage effectiveness improvement point. The dashed line and gray shading indicate the median and 1.5X interquartile range (IQR), which is a helpful metric to identify outliers. After comparing these histograms to the box and whisker plots

[156] Southwest Research Institute, available at: *https://www.swri.org* (accessed: Sept. 10, 2025).

[157] This weblink has additional information on the GT–POWER tool: *https://www.gtisoft.com/gt-power/.*

[158] 79 FR 23414 (Apr. 28, 2014).

[159] DOE, Selecting the Right Octane Fuel, available at: *https://www.fueleconomy.gov/feg/octane.shtml#:~:text=You%20should%20use%20the%20octane%20rating%20required%20for,others%20are%20designed%20to%20use%20higher%20octane%20fuel* (accessed: Sept. 10, 2025).

[160] It is also important to note that regulation of fuels used for determining CAFE compliance is outside the scope of NHTSA's authority. 49 U.S.C. 32904(c).

[161] Friedrich, I. et al., Automatic Model Calibration for Engine-Process Simulation with Heat-Release Prediction, SAE Technical Paper 2006–01–0655, Warrendale, VA: SAE International (2006), available at: *https://doi.org/10.4271/2006-01-0655* (accessed: Sept. 10, 2025); Rezaei, R. et al., Zero-Dimensional Modeling of Combustion and Heat Release Rate in DI Diesel Engines, *SAE International Journal Of Engines.* Vol. 5(3) at 874–85 (2012), available at: *https://doi.org/10.4271/2012-01-1065* (accessed: Sept. 10, 2025); Berndt, R. et al., Multistage Supercharging for Downsizing with Reduced Compression Ratio, *MTZ Worldwide.* Vol. 76 at 10–11 (2015), available at: *https://doi.org/10.1007/s38313-015-0036-4* (accessed: Sept. 10, 2025); Neukirchner, H. et al., Symbiosis of Energy Recovery and Downsizing, *MTZ Worldwide,* Vol. 75 at 4–9 (2014), available at: *https://doi.org/10.1007/s38313-014-0219-4* (accessed: Sept. 10, 2025).

[162] Bottcher, L., Grigoriadis, P., ANL—BSFC map prediction Engines 22–26, Washington, DC: National Highway Traffic Safety Association (2019), available at: *https://lindseyresearch.com/wp-content/uploads/2021/09/NHTSA-2021-0053-0002-20190430_ANL_Eng-22-26-Updated_Docket.pdf* (accessed: Sept. 10, 2025); Reinhart, T., Engine Efficiency Technology Study, Final Report, SwRI Project No. 03.26457, San Antonio, TX: Southwest Research Institute (2022), available at: *https://downloads.regulations.gov/EPA-HQ-OAR-2022-0829-0230/attachment_17.pdf* (accessed: Aug. 18, 2025).

presented in prior CAFE program rule documents, the number of effectiveness outliers is extremely small.

The engine costs in NHTSA's analysis are the product of engine DMCs, RPE, and the LE, updated to a consistent dollar year. Engine DMCs are obtained from multiple sources but primarily from the 2015 NAS report.[163] For VTG and VTGE technologies (*e.g.,* Miller Cycle), NHTSA uses cost data from a FEV technology cost assessment performed for International Council on Clean Transportation (ICCT),[164] which is aggregated using individual component and system costs from the 2015 NAS report. Costs from the 2015 NAS report that have referenced a Northeast States Center for a Clean Air Future (NESCCAF) 2004 report [165] are considered, but NHTSA believes the reference material from the FEV report provides more updated cost estimates for the VTG technology.

All engine technology costs start with a base engine cost, and then additional technology costs are based on cylinder and bank count and configuration; the DMC for each engine technology is a function of unit cost times either the number of cylinders or number of banks, based on how the technology is applied to the system. The total costs for all engine technologies in all model years across all vehicle classes can be found in the Technologies Input File.

2. Transmission Paths

Transmissions transmit torque generated by the engine from the engine to the wheels. Transmissions primarily use two mechanisms to improve fuel efficiency: (1) a wider gear range, which allows the engine to operate longer at higher efficiency speed-load points and (2) improvements in friction or shifting efficiency (*e.g.,* improved gears, bearings, seals, pumps, and other components), which reduce parasitic losses.

NHTSA models only automatic transmissions in the light-duty analysis. The three subcategories of automatic transmissions that are modeled in this analysis include traditional automatic transmissions (AT), dual-clutch transmissions (DCT), and continuously variable transmissions (CVT and eCVT).[166] The agency also includes high efficiency gearbox (HEG) technology improvements as options to the transmission technologies (designated as L2 or L3 in the analysis to indicate level of technology improvement).[167] There has been a significant reduction in manual transmissions over the years, and they make up less than 1 percent of the vehicles produced in MY 2024.[168] Due to the declining trend of manual transmissions and their current low production volumes, NHTSA has removed manual transmissions from this analysis and assigned vehicles using manual transmissions as DCTs in the analysis fleet.

To assign transmission technologies to vehicles in the analysis fleets, NHTSA identifies which Autonomie transmission model is most like a vehicle's real-world transmission, considering the transmission's configuration, costs, and effectiveness. As with engines, data from manufacturers' CAFE reports and publicly available information are used to assign transmissions to vehicles and determine which platforms share transmissions. Transmission codes that include information about the manufacturer, drive configuration, transmission type, and number of gears are used to link shared transmissions in a manufacturer's fleet. Just as manufacturers share transmissions in multiple vehicles, the CAFE Model treats transmissions as ''shared'' if they share a transmission code and transmission technologies will be adopted together.

While identifying an AT's gear count is fairly easy, identifying HEG levels for ATs and CVTs is more difficult. NHTSA reviews the age of the transmission design, relative performance versus previous designs, and technologies incorporated to assign an HEG level. There are no HEG Level 3 automatic transmissions in the analysis fleet. NHTSA finds all 7-speed, all 9-speed, all 10-speed, and some 8-speed automatic transmissions to be advanced transmissions operating at HEG Level 2 equivalence. The agency assigns eight-speed automatic transmissions and CVTs newly introduced for the light-duty market in MY 2016 and later as HEG Level 2. All other automatic transmissions are assigned to their respective transmission's initial technology level (*e.g.,* AT6, AT8, and CVT). For DCTs, the number of gears in the assignments usually match the number of gears listed by the data sources, with some exceptions (dual-clutch transmissions with seven and nine gears are assigned to DCT6 and DCT8, respectively). NHTSA assigns any vehicle in the light-duty analysis fleet with a power-split hybrid (SHEVPS) powertrain an electronic continuously variable transmission (eCVT). Finally, the limited number of manual transmissions in the light-duty fleet are assigned as DCTs, as manual transmissions are not modeled in Autonomie for this analysis.

Most transmission adoption features are instituted through technology path logic (*i.e.,* decisions about how less advanced transmissions of the same type can advance to more advanced transmissions of the same type). Technology pathways are designed to prevent ''branch hopping''—changes in transmission type that would correspond to significant changes in transmission architecture—for vehicles that are relatively advanced on a given pathway. For example, any automatic transmission with more than five gears cannot move to a DCT. NHTSA also prevents ''branch hopping'' as a proxy for stranded capital, which is discussed in more detail in Section II.C and Chapter 2.6 of the Draft TSD.

The automatic transmission path precludes adoption of other transmission types once a platform progresses past an AT8. This restriction is used to avoid the significant level of stranded capital loss that could result from adopting a completely different transmission type shortly after adopting an advanced transmission, which would occur if a different transmission type has been adopted after AT8 in the rulemaking timeframe. Vehicles that did not start out with AT7L2 transmissions cannot adopt that technology in the Model. It is likely that other vehicles will not adopt the AT7L2 technology, as vehicles that have moved to more advanced automatic transmissions have

[163] Table S.2, at pp. 7–8 of National Research Council, Cost, Effectiveness, and Deployment of Fuel Economy Technologies for Light-Duty Vehicles, National Academies Press: Washington, DC (2015), available at: *https://doi.org/10.17226/21744* (accessed: Sept. 10, 2025) (hereinafter, ''2015 NAS report'').

[164] Isenstadt A. et al., Downsized, Boosted Gasoline Engines, Draft, International Council on Clean Transportation (2016), available at: *https://theicct.org/publication/downsized-boosted-gasoline-engines-2/* (accessed: Sept. 10, 2025).

[165] NESCCAF, Reducing Greenhouse Gas Emissions from Light-Duty Motor Vehicles, Final Report (2004), available at: *https://www.nesccaf.org/documents/rpt040923ghglightduty.pdf* (accessed: Sept. 10, 2025).

[166] Note that eCVT transmissions are only coupled with hybrid electric drivetrains and are therefore not included as a standalone transmission option on the CAFE Model's technology pathways.

[167] See 2015 NAS Report at 191. HEG improvements for transmissions represent incremental advancements in technology that improve efficiency, such as reduced friction seals, bearings and clutches, super finishing of gearbox parts, and improved lubrication. These advancements are all aimed at reducing frictional and other parasitic loads in transmissions to improve efficiency. NHTSA considers three levels of HEG improvements in this analysis based on the NAS 2015 recommendations and CBI data.

[168] 2024 EPA Automotive Trends Report.

overwhelmingly moved to 8-speed and 10-speed transmissions.[169]

Vehicles that do not originate with a CVT or vehicles with multispeed transmissions beyond AT8 in the analysis fleet cannot adopt CVTs. Vehicles with multispeed transmissions greater than AT8 demonstrate increased ability to operate the engine at a highly efficient speed and load. Once on the CVT path, the platform is allowed to apply only improved CVT technologies. Due to the limitations of current CVTs, discussed in Draft TSD Chapter 3.2, this analysis restricts the application of CVT technology on light-duty vehicles with greater than 300 lb.-ft of engine torque. This is because of the higher torque (load) demands of those vehicles and CVT torque limitations based on durability constraints. NHTSA believes the 300 lb.-ft restriction represents an increase over current levels of torque capacity that is likely to be achieved during the rulemaking timeframe. This restriction aligns with CVT application in the analysis fleet, in that CVTs are seen only on vehicles with under 280 lb.-ft of torque.[170] In addition, this restriction is used to avoid stranded capital. Finally, the analysis allows vehicles in the analysis fleet that have DCTs to apply an improved DCT and allows vehicles with an AT5 to consider DCTs. Drivability and durability issues with some DCTs have resulted in a low relative adoption rate over the last decade. This is also broadly consistent with manufacturers' technology choices.[171]

Autonomie models transmissions as a sequence of mechanical torque gains. The torque and speed are multiplied and divided, respectively, by the current ratio for the selected operating condition. Furthermore, torque losses corresponding to the torque/speed operating point are subtracted from the torque input. Torque losses are defined based on a three-dimensional efficiency lookup table that has the following inputs: input shaft rotational speed, input shaft torque, and operating condition. NHTSA populates transmission template models in Autonomie with characteristics data to model specific transmissions.[172] Characteristics data are typically tabulated data for transmission gear ratios, maps for transmission efficiency, and maps for torque converter performance, as applicable. Different transmission types require different quantities of data. The characteristics data for these models come from peer-reviewed sources, transmission and vehicle testing programs, results from simulating current and future transmission configurations, and confidential data obtained from OEMs and suppliers.[173] HEG improvements are modeled via improvements to the efficiency map of the transmission. As an example, the AT8 model data comes from a transmission characterization study.[174] The AT8L2 has the same gear ratios as the AT8; however, gear efficiency map values are increased to represent application of the HEG level 2 technologies. The AT8L3 models the application of HEG level 3 technologies using the same principle, further improving the gear efficiency map over the AT8L2 improvements. There are 15 transmissions in the light-duty analysis, and each transmission is modeled in Autonomie with defined gear ratios, gear efficiencies, gear spans, and unique shift logic for the technology configuration to which the transmission is applied. These transmission maps are developed to represent the gear counts and span, shift and torque converter lockup logic, and efficiencies that can be seen in the fleet, along with upcoming technology improvements, all while balancing key attributes, such as drivability, fuel economy, and performance neutrality. This modeling is discussed in detail in Chapter 3.2 of the Draft TSD and the CAFE Analysis Autonomie Documentation chapter titled ''Autonomie—Transmission Model.''

The effectiveness values for the transmission technologies, for all light-duty technology classes, are shown in Chapter 3.2.4 of the Draft TSD. Note that the effectiveness for the AT5 and eCVT technologies is not shown. The eCVT transmissions do not have standalone effectiveness values because those technologies are implemented only as part of hybrid-electric powertrains. The AT5 has no effectiveness values because it is a reference-point technology against which all other transmission technologies are compared.

NHTSA's transmission DMCs come from the 2015 NAS report and studies cited therein. The costs are taken almost directly from the 2015 NAS report adjusted to the current dollar year or for the appropriate number of gears. Chapter 3.2 of the Draft TSD discusses the specific 2015 NAS report costs used to generate these transmission cost estimates, and all transmission costs across all model years can be found in the CAFE Model's Technologies Input File. NHTSA has used the 2015 NAS report transmission costs for the last several light-duty CAFE Model analyses (since re-evaluating all transmission costs for the 2020 final rule) and has not received comments or feedback on these costs.

3. Hybridization Paths

The hybridization paths each include a set of technologies that share common hybrid powertrain components, like batteries and electric motors, for certain vehicle functions that were powered solely by ICEs traditionally. While all vehicles (including conventional ICE vehicles) use batteries and electric motors in some form, some component designs and powertrain architectures contribute to greater levels of hybridization than others, allowing the vehicle to use less gasoline or other fuel.

As explained elsewhere, NHTSA endeavors to model how manufacturers could apply technology to respond to CAFE standards. Hybrid technologies can improve fuel economy, and NHTSA believes that the inputs and assumptions selected to represent hybrid technologies are reasonable to use in NHTSA's CAFE Model. NHTSA provides details of the inputs and assumptions in the Draft TSD accompanying this proposed rule and provides more information regarding the agency's rationale and approach throughout Section II and III of this preamble.

Unlike with other technologies in the analysis, Congress placed specific limitations on how NHTSA considers the fuel economy of alternative fueled vehicles, which includes not only BEVs and FCEVs but also PHEVs.[175] For PHEVs, which are discussed in this section in addition to other hybrid technologies, NHTSA restricts its analysis by using fuel economy values that assume ''charge sustaining''

[169] 2024 EPA Automotive Trends Report, at p. 79, Figure 4.24.

[170] Market Data Input File.

[171] 2024 EPA Automotive Trends Report, at p. 79, Figure 4.24.

[172] Autonomie Input and Assumptions Description Files.

[173] Argonne National Laboratory, Downloadable Dynamometer Database, Last revised: 2025, available at: *https://www.anl.gov/taps/downloadable-dynamometer-database;* Kim, N. et al., Advanced Automatic Transmission Model Validation Using Dynamometer Test Data, SAE 2014–01–1778, presented at the SAE World Congress: Detroit, MI (2014); Kim, N. et al., Development of a Model of the Dual Clutch Transmission in Autonomie and Validation With Dynamometer Test Data, *International Journal of Automotive Technologies,* Vol. 15(2): pp. 263–71 (2014), available at: *https://www.sae.org/publications/technical-papers/content/2014-01-1778/* (accessed: Sept. 10, 2025).

[174] CAFE Analysis Autonomie Documentation chapter titled ''Autonomie—Transmission Model.''

[175] 49 U.S.C. 32902(h)(1) and (2). In determining maximum feasible fuel economy levels, ''the Secretary of Transportation—(1) may not consider the fuel economy of dedicated automobiles; [and] (2) shall consider dual fueled automobiles to be operated only on gasoline or diesel fuel.''

(gasoline-only) operation only.[176] The fuel economies of BEVs and FCEV technologies are excluded entirely from NHTSA's standard-setting analysis.[177] Draft TSD Chapter 2.2 contains discussion of NHTSA's consideration of PHEVs, BEVs, and FCEVs in the EIS analysis.

Among the simpler configurations with the fewest hybrid components is micro HEV technology (SS12V), which uses a 12-volt system that simply restarts the engine from a stop. Mild HEVs use a 48-volt belt integrated starter generator (BISG) system that restarts the engine from a stop and provides some regenerative braking functionality.[178] Mild HEVs are often also capable of minimal electric assist to the engine on take-off.

Strong hybrid-electric vehicles (SHEVs) have higher system voltages compared to mild hybrids with BISG systems and are capable of engine stop/start, regenerative braking, electric motor assist of the engine at higher speeds and power demands with the ability to provide limited all-electric propulsion. Common SHEV powertrain architectures, classified by the interconnectivity of common hybrid vehicle components, include both a series-parallel architecture by power-split device (SHEVPS) as well as a parallel architecture (SHEVP2). SHEVP2s—though enhanced by the electric components, including just one electric motor—remains fundamentally similar to a conventional powertrain.[179] In contrast, SHEVPS powertrains are considerably different than a conventional powertrain, as they use two electric motor/generators, which allows the use of a lower power-density engine. This results in a higher potential for fuel economy improvement compared to a SHEVP2, though the SHEVPS engine power density is lower.[180] Put another way, ''[a] disadvantage of the power split architecture is that when towing or driving under other real-world conditions, performance is not optimum.'' [181] In contrast, ''[o]ne of the main reasons for using parallel hybrid architecture is to enable towing and meet maximum vehicle speed targets.'' [182] This is an important distinction to understand why NHTSA allows certain types of vehicles to adopt SHEVP2 powertrains and not SHEVPS powertrains.

PHEVs utilize a combination gasoline-electric powertrain, like that of a SHEV, but have the ability to plug into the electric grid to recharge the battery, like that of a BEV; this contributes to all-electric mode capability in both blended and non-blended PHEVs.[183] The analysis includes PHEVs with an AER of 20 and 50 miles to encompass the range of PHEV AER in the market today. Draft TSD Chapter 3.3 contains more information on every hybrid technology considered in the analysis, including common acronyms and a brief description of each hybrid technology. For brevity, NHTSA refers to technologies by their acronyms in this section.

As with previous CAFE analyses, there are a number of engine options available for SHEVs and PHEVs. These engines better represent the variety of different hybrid architectures and engine options available in the real world for SHEVs and PHEVs while still maintaining a reasonable level of analytical complexity.

NHTSA did not include additional mild hybrid technology such as more capable, higher output 48-volt mild hybrid systems beyond P0 mild hybrids, such as ''P2, P3, or P4 configurations'' [184] which offer additional benefits of ''electric power take-offs'' [185] (*i.e.,* launch assist) or ''slow-speed electric driving'' [186] on the vehicle's drive axle(s). NHTSA will consider mild hybrid advancements in future analysis if they become more prevalent in the U.S. market.

As described in Draft TSD Chapter 3.3, NHTSA assigns hybrid technologies to vehicles in the analysis fleet [187] using manufacturer-submitted CAFE compliance information, publicly available technical specifications, marketing brochures, articles from reputable media outlets, and data subscriptions.[188] Draft TSD Chapter 3.3.2 shows the penetration rates of hybrid technologies in the standard-setting analysis fleets. Over half the analysis fleet has some level of hybridization, with the vast majority—over 50 percent of the fleet—being micro hybrids. Like the other technology pathways, as the CAFE Model adopts hybrid technologies for vehicles, more advanced levels of hybrid technologies will supersede all prior levels, while certain technologies within each level are mutually exclusive. The only adoption feature applicable to micro (SS12V) and mild (BISG) hybrid technology is path logic; vehicles may adopt micro and mild hybrid technology only if the vehicle did not already have a more advanced level of hybridization.

The adoption features that NHTSA applies to strong hybrid technologies include path logic, powertrain substitution, and vehicle class restrictions. Per the technology pathways, SHEVPS, P2x, P2TRBx, and the P2HCRx technologies are considered mutually exclusive. When the Model applies one of these technologies, the others are immediately disabled from future application. However, all vehicles on the strong hybrid pathways can still advance to one or more of the plug-in technologies, when applicable in the modeling scenario (*i.e.,* allowed in the Model).

When the Model applies any strong hybrid technology to a vehicle, the transmission technology on the vehicle is superseded; regardless of the transmission originally present, P2 hybrids adopt an advanced 8-speed automatic transmission (AT8L2), and PS hybrids adopt a continuously variable transmission via power-split device (eCVT). When the Model applies the P2

[176] NHTSA has estimated two sets of technology effectiveness values using the Argonne full-vehicle simulations: one set does not include the electrification portion of PHEVs, and one set includes the combined fuel economy for both ICE operation and electric operation. Draft TSD Chapter 3.3 has more information.

[177] CAFE Model Documentation at S4.6 Technology Fuel Economy Improvements.

[178] See 2015 NAS Report, at p. 130 (''During braking, the kinetic energy of a conventional vehicle is converted into heat in the brakes and is thus lost. An electric motor/generator connected to the drivetrain can act as a generator and return a portion of the braking energy to the battery for reuse. This is called regenerative braking. Regenerative braking is most effective in urban driving and in the urban dynamometer driving schedule (UDDS) cycle, in which about 50 percent of the propulsion energy ends up in the brakes (NRC 2011, 18).'').

[179] Kapadia, J. et al., Powersplit or Parallel—Selecting the Right Hybrid Architecture, *SAE International Journal of Alternative Power,* Vol. 6(1): pp. 68—76 (2017), available at: *https://doi.org/10.4271/2017-01-1154* (accessed: Sept. 10, 2025) (hereinafter, ''Kapadia et al. (2017)''). Parallel hybrids architecture typically adds the electrical system components to an existing conventional powertrain.

[180] *Id.*

[181] 2015 NAS Report, at p. 134.

[182] Kapadia et al. (2017).

[183] Some PHEVs operate in charge-depleting mode (*i.e.,* ''electric-only'' operation—depleting the high-voltage battery's charge) before operating in charge-sustaining mode (similar to strong hybrid operation, the gasoline and electric powertrains work together), while other (blended) PHEVs switch between charge-depleting mode and charge-sustaining mode during operation.

[184] John German, Docket No. NHTSA–2023–0022–53274–A1 at 6–7.

[185] MECA, Docket No. NHTSA–2023–0022–63053–A1 at 13.

[186] ICCT, Docket No. NHTSA–2023–0022–54064–A1 at 20.

[187] The standard-setting analysis fleet does NOT contain BEVs or FCEVs; the EIS fleet considers all technologies, including BEVs and FCEVs.

[188] Wards Intelligence, U.S. Car and Light Truck Specifications and Prices, 22 Model Year (2022), available at: *https://omdia.tech.informa.com/welcome* (accessed: Sept. 10, 2025).

technology, the Model can consider various engine options to pair with the P2 architecture according to existing engine path constraints—taking into account relative cost effectiveness. For SHEVPS technology, the existing engine is replaced with a full-time Atkinson cycle engine.[189] For P2s, NHTSA picks the 8-speed automatic transmission to supersede the vehicle's incoming transmission technology. This is because most P2s in the market use an 8-speed automatic transmission,[190] therefore it is representative of the fleet now. NHTSA also thinks that 8-speed transmissions are representative of the transmissions that will continue to be used in these hybrid vehicles, as NHTSA anticipates manufacturers will continue to use these ''off-the-shelf'' transmissions based on availability and ease of incorporation in the powertrain. The eCVT (power-split device) *is* the transmission for SHEVPSs and is therefore the technology NHTSA has picked to supersede the vehicle's prior transmission when adopting the SHEVPS powertrain.

SKIP logic is also used to constrain adoption of SHEVPS and PHEVx0PS technologies. These technologies are ''skipped'' for vehicles with engines[191] that meet one of the following conditions: the engine belongs to an excluded manufacturer;[192] the engine belongs to a pickup truck (*i.e.,* the engine is on a vehicle assigned the ''pickup'' body style); the engine's peak HP is more than 405 hp; or the engine is on a non-pickup vehicle but is shared with a pickup. The reasons for these conditions are similar to those for the SKIP logic that NHTSA applies to HCR engine technologies, discussed in more detail in Section II.D.1. In the real world, performance vehicles with certain powertrain configurations cannot adopt the technologies listed above and maintain vehicle performance without redesigning the entire powertrain.

It may be helpful to understand why NHTSA does not apply SKIP logic to P2s but does apply SKIP logic to SHEVPSs. Note the difference between SHEVP2 and SHEVPS architectures: P2 architectures are better for ''larger vehicle applications because they can be integrated with existing conventional powertrain systems that already meet the additional attribute requirements'' of large-vehicle segments.[193] No SKIP logic applies to P2s because NHTSA believes that this type of hybridized powertrain is sufficient to meet all the performance requirements for all types of vehicles. Manufacturers have proven this with vehicles like the Ford F–150 Hybrid and Toyota Tundra Hybrid.[194] If NHTSA were to size (in the Autonomie simulations) the SHEVPS motors and engines to achieve ''not optimum'' performance, the electric motors would be unrealistically large (on both a size and cost basis), and the accompanying engine also would have to be a very large displacement engine, which is not characteristic of how vehicle manufacturers apply SHEVPS to ICE vehicles in the real world. Instead, for vehicle applications that have particular performance requirements—which the analysis defines as vehicles with engines that belong to an excluded manufacturer, engines belonging to a pickup truck or shared with a pickup truck, or the engine's peak HP is more than 405 hp—those vehicles can adopt P2 architectures that should be able to handle the vehicle's performance requirements.

While strong hybridization is allowed on all vehicle types, NHTSA allows different types of strong hybrid powertrains to be applied to different types of vehicles for the reasons discussed above. NHTSA believes that allowing SHEVPS and P2 powertrains to be applied subject to the base vehicle's performance requirements is a reasonable approach to maintaining a performance-neutral analysis.

The engine and transmission technologies on a vehicle are superseded when PHEV technologies are applied. For example, the Model applies an AT8L2 transmission with all PHEV20T/50T plug-in technologies, and the Model applies an eCVT transmission for all PHEV20PS/50PS and PHEV20H/50H plug-in technologies in the fleet; Draft TSD Chapter 3.3 provides more details on different system combinations of hybridization. A vehicle adopting PHEV20PS/50PS receives a hybrid full-time Atkinson cycle engine, and a vehicle adopting PHEV20H/PHEV50H receives an HCR engine. For PHEV20T/50T, the vehicle receives a TURBO1 engine.

Autonomie determines the effectiveness of each hybridized powertrain type by modeling the basic components, or building blocks, for each powertrain and then combining the components modularly to determine the overall efficiency of the entire powertrain. The components, or building blocks, which contribute to the effectiveness of a hybridized powertrain in the analysis include the vehicle's battery, electric motors, power electronics, and accessory loads. Autonomie identifies components for each hybridized powertrain type and then interlinks those components to create a powertrain architecture. Autonomie then models each hybridized powertrain architecture and provides an effectiveness value for each architecture. For example, Autonomie determines a PHEV's efficiency in part by considering the efficiencies of the battery (including charging efficiency), the electric traction drive system (ETDS) (the electric machine and power electronics), and mechanical power transmission devices.[195] Autonomie further combines the modeled hybrid components of the hybrid powertrain to include the ICE and related power for transmission components.[196] Argonne uses data from their Advanced Mobility Technology Laboratory (AMTL) to develop Autonomie's hybrid powertrain models. The modeled powertrains are not intended to represent any specific manufacturer's architecture but act as surrogates predicting representative levels of effectiveness for each hybrid technology. NHTSA discusses the procedures for modeling each of these subsystems in detail in the Draft TSD and in the CAFE Analysis Autonomie Documentation and provides a summary below.

The fundamental components of a hybrid powertrain's propulsion system—the electric motor and inverter—ultimately determine the vehicle's performance and efficiency. For this analysis, Autonomie employs a set of electric motor efficiency maps created by Oak Ridge National Laboratory (ORNL), one for a traction

[189] This engine type is designated as Eng26 in the list of engine map models used in the analysis. Draft TSD Chapter 3.1.1.2.3 provides more information.

[190] NHTSA is aware that some Hyundai vehicles use six-speed transmissions, and some Ford vehicles use 10-speed transmissions, but NHTSA has observed that the majority of P2s use eight-speed transmissions.

[191] This refers to the engine assigned to the vehicle in the 2022 analysis fleet.

[192] Excluded manufacturers include BMW, Daimler, and Jaguar Land Rover.

[193] Kapadia et al. (2017).

[194] Buchholz, K., 2022 Toyota Tundra: V8 Out, Twin-Turbo Hybrid Takes Over, Warrendale, VA: SAE International, Last revised: Aug. 22, 2021, available at: *https://www.sae.org/news/2021/09/2022-toyota-tundra-gains-twin-turbo-hybrid-power* (accessed: Sept. 10, 2025); Visnic, B., Hybridization the Highlight of Ford's All-New 2021 F–150, Last revised: June 30, 2020, available at: *https://www.sae.org/articles/hybridization-highlight-fords-new-2021-f-150-sae-ma-03885* (accessed: Sept. 10, 2025).

[195] Iliev, S. et al., Vehicle Technology Assessment, Model Development, and Validation of a 2021 Toyota RAV4 Prime, DOT HS 813 356, NHTSA: Washington, DC (2023), available at: *https://downloads.regulations.gov/NHTSA-2023-0022-0010/attachment_6.pdf* (accessed: Sept. 10, 2025).

[196] See the CAFE Analysis Autonomie Documentation.

motor and an inverter, the other for a motor/generator and inverter.[197] The electric motor efficiency maps, created from production vehicles like the 2007 Toyota Camry hybrid and the 2011 Hyundai Sonata hybrid, represent electric motor efficiency as a function of torque and motor rotations per minute (RPM). These efficiency maps provide nominal and maximum speeds, as well as a maximum torque curve. Argonne uses the maps to determine the efficiency characteristics of the motors, which include some of the losses due to power transfer through the electric machine.[198] Specifically, Argonne scales the efficiency maps, specific to powertrain type, to have total system peak efficiencies ranging from 96 to 98 percent [199]—such that their peak efficiency value corresponds to the latest state-of-the-art technologies, as opposed to retaining dated system efficiencies (90 to 93 percent).[200]

Beyond the powertrain components, Autonomie also considers electric accessory devices that consume energy and affect overall vehicle effectiveness, such as headlights, radiator fans, wiper motors, engine control units, transmission control units, cooling systems, and safety systems. In real-world driving and operation, the electrical accessory load on the powertrain varies depending on how the driver uses certain features and the condition in which the vehicle is operating, such as night driving or hot weather driving. However, for regulatory test cycles related to fuel economy, the electrical load is repeatable because the fuel economy regulations control these factors. Accessory loads during test cycles vary by powertrain type and vehicle technology class, since distinctly different powertrain components and vehicle masses consume different amounts of energy.

The analysis fleets consist of different vehicle types with varying accessory electrical power demand. For instance, vehicles with different motor and battery sizes require different sizes of electric cooling pumps and fans to manage component temperatures optimally. Autonomie has built-in models that can simulate these varying subsystem electrical loads. However, for this analysis, NHTSA uses a fixed (by vehicle technology class and powertrain type), constant power draw to represent the effect of these accessory loads on the powertrain on the 2-cycle test. NHTSA intends and expects that fixed accessory load values will, on average, have similar impacts on effectiveness as found on actual manufacturers' systems. This process is in line with the past analyses.[201] [202] NHTSA aggregates electrical accessory load modeling assumptions for the different powertrain types (hybridized and conventional) and technology classes from data from the Draft TAR, EPA Proposed Determination,[203] data from manufacturers,[204] research and development data from DOE's Vehicle Technologies Office,[205] [206] [207] and DOT-sponsored vehicle benchmarking studies completed by Argonne's AMTL.

Certain technologies' effectiveness for reducing fuel consumption requires optimization through the appropriate sizing of the powertrain. Autonomie uses sizing control algorithms based on data collected from vehicle benchmarking,[208] and the modeled hybrid components are sized based on performance neutrality considerations. This analysis iteratively minimizes the size of the powertrain components to maximize efficiency while enabling the vehicle to meet multiple performance criteria. The Autonomie simulations use a series of resizing algorithms that contain ''loops,'' such as the acceleration performance loop (0–60 mph), which automatically adjusts the size of certain powertrain components until a criterion, like the 0–60 mph acceleration time, is met. As the algorithms examine different performance or operational criteria that must be met, no single criterion can degrade; once a resizing algorithm completes, all criteria will be met, and some may be exceeded as a necessary consequence of meeting others.

Autonomie applies different powertrain sizing algorithms depending on the type of vehicle considered because different types of vehicles not only contain specific, optimized components, but they must also operate in varying driving modes. While the conventional powertrain sizing algorithm must consider only the power of the engine, the more complex algorithm for hybridized powertrains must simultaneously consider multiple factors, which could include the engine power, electric machine power, battery power, and battery capacity. Also, while the resizing algorithm for all vehicles must satisfy the same performance criteria, the algorithm for some electric powertrains must also allow those hybridized vehicles to operate in certain driving cycles, like the US06 cycle, without assistance of the combustion engine and ensure the electric motor/generator and battery can handle the vehicle's regenerative braking power, all-electric mode operation, and intended range of travel.

To establish the effectiveness of the technology packages, Autonomie simulates the vehicles' performance on compliance test cycles.[209] For vehicles with conventional powertrains and micro hybrid powertrains, Autonomie simulates the vehicles using the 2-cycle test procedures and guidelines.[210] For mild HEVs and strong HEVs, Autonomie simulates the same 2-cycle test, with the addition of repeating the drive cycles until the final state-of-charge (SOC) is approximately the same as the initial SOC, a process described in SAE J1711; SAE J1711 also provides test cycle guidance for testing specific to plug-in

[197] Burress, T. et al., Evaluation of the 2007 Toyota Camry Hybrid Synergy Drive System, ORNL: Washington, DC (2008), available at: *https://doi.org/10.2172/928684* (accessed: Sept. 10, 2025) (hereinafter, ''Burress et al. (2008)''); Olszewski, M., Annual Progress Report for the Power Electronics and Electric Machinery Program, ORNL/TM–2011/263, ORNL: Washington, DC (2011), available at: *https://info.ornl.gov/sites/publications/files/Pub31483.pdf* (accessed: Sept. 10, 2025) (hereinafter, ''Olszewski (2011)'').

[198] CAFE Analysis Autonomie Documentation chapter titled ''Vehicle and Component Assumptions—Electric Machines—Electric Machine Efficiency Maps.''

[199] CAFE Analysis Autonomie Documentation chapter titled ''Vehicle and Component Assumptions—Electric Machines—Electric Machine Peak Efficiency Scaling.''

[200] Burress et al. (2008); Olszewski (2011).

[201] Technical Assessment Report at Chapter 5 (2016).

[202] EPA Proposed Determination TSD at pp. 2–270 (2016).

[203] *Id.*

[204] Alliance of Automobile Manufacturers (now Auto Innovators) Comments on Draft TAR, at p. 30.

[205] DOE, Electric Drive Systems Research and Development, Office of Energy Efficiency & Renewable Energy (EERE) (2025), available at: *https://www.energy.gov/eere/vehicles/electric-drive-systems-research-and-development* (accessed: Sept. 10, 2025).

[206] Argonne National Laboratory, Advanced Mobility Technology Laboratory (AMTL) (2025), available at: *https://www.anl.gov/taps/advanced-mobility-technology-laboratory* (accessed: Sept. 10, 2025).

[207] DOE's lab years are 10 years ahead of manufacturers' potential production intent (*e.g.,* 2020 lab year is MY 2030).

[208] CAFE Analysis Autonomie Documentation chapter titled ''Vehicle Sizing Process—Vehicle Powertrain Sizing Algorithms—Light-Duty Vehicles—Conventional Vehicle Sizings Algorithm.''

[209] EPA, How Vehicles are Tested (2025), available at: *https://www.fueleconomy.gov/feg/how_tested.shtml* (accessed: Sept. 10, 2025); Good, D., EPA Test Procedures for Electric Vehicles and Plug-in Hybrids, Draft Summary, EPA: Washington, DC (2017), available at: *https://www.fueleconomy.gov/feg/pdfs/EPA%20test%20procedure%20for%20EVs-PHEVs-11-14-2017.pdf* (accessed: Sept. 10, 2025); CAFE Analysis Autonomie Documentation, chapter titled ''Test Procedure and Energy Consumption Calculations.''

[210] 40 CFR part 600.

HEVs.[211] PHEVs have a different range of modeled effectiveness during ''standard-setting'' CAFE Model runs, in which the PHEV operates under a ''charge sustaining'' (gasoline-only) mode—similar to how SHEVs function.

Chapters 2.4 and 3.3 of the Draft TSD and the CAFE Analysis Autonomie Documentation chapter titled ''Test Procedure and Energy Consumption Calculations'' discuss the components and test cycles used to model each hybrid powertrain type; please refer to those chapters for more technical details on each of the modeled technologies discussed in this section.

The range of effectiveness for the hybrid technologies used in this analysis is a result of the interactions between the components listed above and how the modeled vehicle operates on its respective test cycle. This range of values results in some modeled effectiveness values being close to real-world measured values and some modeled values departing from measured values, depending on the level of similarity between the modeled hardware configuration and the real-world hardware and software configurations. The range of effectiveness values for the hybrid technologies applied in the fleet is shown in Draft TSD Figure 3–23 and Figure 3–24.

Some advanced engine technologies indicate low effectiveness values when paired with hybrid architectures. The low effectiveness results from the application of advanced engines to existing P2 architectures. This effect is expected and illustrates the importance of using the full-vehicle modeling to capture interactions between technologies and to capture instances of both complementary technologies and non-complementary technologies. In developing its hybrid engine maps, NHTSA considers the engine, engine technologies, electric motor power, and battery pack size. The hybrid engine maps are calibrated to operate in their respective hybrid architecture most effectively and to allow the electric machine to provide propulsion or assistance in regions of the engine map that are less efficient. As the Model sizes the powertrain for any given application, it considers all these parameters as well as performance neutrality metrics to provide the most efficient solution. In this instance, the P2 powertrain improves fuel economy, in part, by allowing the engine to spend more time operating at efficient engine speed and load conditions. This reduces the advantage of adding advanced engine technologies, which also improve fuel economy, by broadening the range of speed and load conditions for the engine to operate at high efficiency. This redundancy in fuel-saving mechanisms results in a lower effectiveness when the technologies are added to each other.

The technology effectiveness values are developed specifically to support analyses for a rulemaking timeframe. For example, the hybrid Atkinson engine peak thermal efficiency was updated based on 2017 Toyota Prius engine data.[212] As mentioned above, Argonne scales the efficiency maps, specific to powertrain type, to have total system peak efficiencies ranging from 96 to 98 percent [213]—such that their peak efficiency value corresponds to the latest state-of-the-art technologies, as opposed to retaining dated system efficiencies (90 to 93 percent).[214] The 2016 maps scaled to peak efficiency are equivalent to (if not exceed) efficiencies seen in vehicles today and in the future. Though the base references for these technologies are from a few years ago, NHTSA has worked with Argonne to update individual inputs to reflect the latest improvements. Accordingly, NHTSA has made no changes to the electric machine efficiency maps for this proposed rule analysis.

When the CAFE Model turns a vehicle powered by an ICE into a hybridized vehicle, it must remove the parts and costs associated with the ICE (and, potentially, the transmission—depending on the hybridization level and powertrain type) and add the costs of a battery pack and other non-battery hybridization components, such as the electric motor and power inverter. To estimate battery pack costs for this analysis, NHTSA needs an estimate of how much battery packs cost now (*i.e.,* a ''base year'' cost) and estimates of how that cost could reduce over time (*i.e.,* the ''learning effect''). The general concept of learning effects is discussed in detail in Section II.C and in Chapter 2 of the Draft TSD, while the specific learning effect NHTSA applied to battery pack costs in this analysis is discussed below. NHTSA estimates base year battery pack costs for most hybrid technologies using BatPaC, which is an Argonne model designed to calculate the cost of hybrid battery packs.

Traditionally, a user would use BatPaC to cost a battery pack for a single vehicle, and the user would vary factors such as battery cell chemistry, battery power and energy, battery pack interconnectivity configurations, battery pack production volumes, charging constraints, or combinations of these factors, to name a few, to see how those factors would increase or decrease the cost of the battery pack. However, several hundreds of thousands of simulated vehicles in the analysis have hybridized powertrains, meaning that NHTSA would have to run individual BatPaC simulations for each full-vehicle simulation that requires a battery pack. This would have been computationally intensive and impractical. Instead, Argonne staff builds ''lookup tables'' with BatPaC that provide battery pack manufacturing costs, battery pack weights, and battery pack cell capacities for vehicles with varying power requirements modeled in these large-scale simulation runs.

Just like with other vehicle technologies, the specifications of different vehicle manufacturers' battery packs are extremely diverse. NHTSA, therefore, endeavored to develop battery pack costs that reasonably encompass the cost of battery packs for vehicles in each technology class.

In conjunction with the agency's partners at Argonne working on the CAFE analysis Autonomie modeling, NHTSA references assessment and outlook reports,[215] vehicle teardown reports,[216] and stakeholder

[211] PHEV testing is broken into several phases based on SAE J1711: charge-sustaining on the city and HWFET cycle, and charge-depleting on the city and HWFET cycles.

[212] Atkinson Engine Peak Efficiency is based on 2017 Prius peak efficiency scaled up to 41 percent. Autonomie Model Documentation at 138. See ANL—All Assumptions_Summary_NPRM_022021.xlsx, ANL—Summary of Main Component Performance Assumptions_NPRM_022021.xlsx, Argonne Autonomie Model Documentation_NPRM.pdf and ANL—Data Dictionary_NPRM_022021.XLSX, which can be found in the rulemaking docket (NHTSA–2023–0022) by filtering for Supporting & Related Material.

[213] See CAFE Analysis Autonomie Documentation, chapter titled ''Electric Machine Peak Efficiency Scaling.''

[214] Burress et al. (2008); Olszewski (2011).

[215] Rho Motion, EV Battery subscriptions, available at: *https://rhomotion.com/* (accessed: Sept. 10, 2025); BNEF, Electric Vehicle Outlook 4Q 2023: Growth Ahead, Last revised: Jan. 4, 2024, available at: *https://about.bnef.com/insights/clean-transport/electrified-transport-market-outlook-4q-2023-growth-ahead/* (accessed: Sept. 10, 2025); Benchmark Mineral Intelligence, Cathode, Anode, and Gigafactories subscriptions, available at: *https://benchmarkminerals.com/* (accessed: Sept. 10, 2025); International Energy Agency, Global EV Outlook 2022: Securing Supplies For an Electric Future, International Energy Agency (2022) available at: *https://iea.blob.core.windows.net/assets/ad8fb04c-4f75-42fc-973a-6e54c8a4449a/GlobalElectricVehicleOutlook2022.pdf* (accessed: Sept. 10, 2025).

[216] Hummel, P. et al., UBS Evidence Lab Electric Car Teardown—Disruption Ahead? UBS: Zurich, Switzerland (2017), available at: *https://neo.ubs.com/shared/d1ZTxnvF2k* (accessed: Sept. 10, 2025); A2Mac1: Automotive Benchmarking, (proprietary data), available at: *https://portal.a2mac1.com/* (accessed: Sept. 10, 2025).

discussions[217] to determine common battery pack chemistries for each modeled hybrid technology. The CAFE Analysis Autonomie Documentation chapter titled ''Battery Performance and Cost Model—BatPaC Examples From Existing Vehicles in the Market'' includes more detail about the reports referenced for this analysis.[218] For mild hybrids, NHTSA uses the lithium iron phosphate (LFP)–G[219] chemistry because power and energy requirements for mild hybrids are very low, the charge and discharge cycles (or need for increased battery cycle life) are high, and the battery raw materials are much less expensive than a nickel manganese cobalt (NMC)-based cell chemistry. NHTSA uses NMC622–G[220] for all other hybrid vehicle technology base (MY 2022) battery pack cost calculations. NHTSA believes that, based on available data,[221] NMC622 is more representative for the MY 2022 base year battery costs than LFP, and any additional cost reductions from manufacturers switching to LFP chemistry-based battery packs in years beyond 2022 are accounted for in the battery cost learning effects. The learning effects estimate potential cost savings for *future* battery advancements (a learning rate applied to the battery pack DMC); this proposed rule includes a dynamic NMC/LFP cathode mix over each future model year (for PHEVs). The battery chemistry that NHTSA uses is intended to represent reasonably what is used in the MY 2022 U.S. fleet, which is the DMC base year for the BatPaC calculations.[222]

NHTSA also looks at vehicle sales volumes for MY 2022 to determine a reasonable base production volume assumption.[223] In practice, a single battery plant can produce packs using different cell chemistries with different power and energy specifications, as well as battery pack constructions with varying battery pack designs—different cell interconnectivities (to alter overall pack power end energy) and thermal management strategies—for the same base chemistry. However, in BatPaC, a battery plant is assumed to manufacture and assemble a specific battery pack design, and all cost estimates are based on one single battery plant manufacturing only that specific battery pack. For example, if a manufacturer has more than one PHEV in its vehicle lineup and each uses a specific battery pack design, a BatPaC user would include manufacturing volume assumptions for each design separately to represent each plant producing each specific battery pack. NHTSA has examined battery pack designs for vehicles sold in MY 2022 to determine a reasonable manufacturing plant production volume assumption. NHTSA considers each assembly line designed for a specific battery pack and for a specific PHEV as an individual battery plant. Since battery technologies and production are still evolving, it is likely to be some time before battery cells can be treated as commodities where the specific numbers of cells are used for varying battery pack applications and all other metrics remain the same.

Similar to previous rulemakings, NHTSA uses sales as a starting point to analyze potential base modeled battery manufacturing plant production volume assumptions. Since actual production data for specific battery manufacturing plants are extremely hard to obtain and the battery cell manufacturer is not always the battery pack manufacturer,[224] NHTSA calculates an average production volume per manufacturer metric to approximate hybrid vehicle production volumes for this analysis. This metric is calculated by taking an average of all of one hybrid vehicle type (for example, all PHEVs) battery energies reported in a vehicle manufacturer's pre-MY 2022 reports[225] and dividing by the averaged sales-weighted energy per-vehicle; the resulting volume is then rounded to the nearest 5,000. Manufacturers are not required to report gross battery pack sizes for the pre-model year or mid-model year compliance reports, so NHTSA estimates pack size for each vehicle based on proprietary data and publicly available data, like a manufacturer's published or announced specifications. This process is repeated for all hybrid vehicle technologies. NHTSA believes this provided a reasonable base year plant production volume—especially in the absence of actual production data—since the compliance report data from manufacturers already includes accurate related data, such as vehicle model and estimated sales information metrics.[226] The final battery manufacturing plant production volume assumptions for different hybrid technologies are as follows: mild hybrid and strong hybrids are manufactured assuming 200,000 packs and PHEVs are manufactured assuming 20,000 packs.

As mentioned above, the BatPaC Lookup Tables provide $/kWh battery pack costs based on vehicle power and energy requirements. As the total cost of a battery pack increases the higher the power/energy requirements, the cost per kWh decreases. This represents the cost of hardware that is needed in all battery packs but is deferred across more kW/kWh in larger packs, which reduces the per kW/kWh cost. Table 3–78 in Draft TSD Chapter 3.3.5 shows an example of the BatPaC-based lookup tables for SHEVPS technology classes.

Note that the values in the table discussed above should *not* be considered the total battery $/kWh costs that are used for vehicles in the analysis in future model years. As detailed below, battery costs are also projected to decrease over time as manufacturers improve production processes, shift battery chemistries, and make other technological advancements. In addition, select modeled tax credits further reduce the estimated costs; additional discussion of those tax credits is located throughout this preamble, Draft TSD Chapter 2.3, and PRIA Chapters 8 and 9.

The CAFE Analysis Autonomie Documentation details other specific assumptions that Argonne used to simulate battery packs and their associated base year costs for the full-vehicle simulation modeling, including updates to the battery management unit

[217] See Docket Submission of Ex Parte Meetings Prior to Publication of the Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks for Model Years 2027–2032 and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans for Model Years 2030–2035 Notice of Proposed Rulemaking memorandum, which can be found in the rulemaking docket (NHTSA–2023–0022) by filtering for Supporting & Related Material.

[218] CAFE Analysis Autonomie Documentation chapter titled ''Battery Performance and Cost Model—BatPac Examples From Existing Vehicles in the Market.''

[219] Lithium iron phosphate ($LiFePO_4$) cathode and graphite anode.

[220] Lithium nickel manganese cobalt oxide ($LiNiMnCoO_2$) cathode and graphite anode.

[221] Rho Motion, EV Battery subscriptions, available at: *https://rhomotion.com/* (accessed: Sept. 10, 2025); International Energy Agency, Global EV Outlook 2023, International Energy Agency (2023), available at *https://www.iea.org/reports/global-ev-outlook-2023* (accessed: Sept. 10, 2025).

[222] For this analysis, 2021$ costs have been updated to 2024$; this is not reflected directly in the base Battery Cost csv file, however, as this conversion was performed external to the file itself.

[223] See Chapter 2.2.1.1 of the Draft TSD for more information on data NHTSA uses for sales volumes.

[224] Zhou, Y. et al., Lithium-Ion Battery Supply Chain for E-Drive Vehicles in the United States: 2010–2020, ANL/ESD–21/3, Argonne, IL: Argonne National Laboratory (2021), available at: *https://publications.anl.gov/anlpubs/2021/04/167369.pdf* (accessed: Sept. 10, 2025); Gohlke, D. et al., Quantification of Commercially Planned Battery Component Supply in North America Through 2035, Final Report, ANL–24/14, ANL: Alexandria, VA (2024), available at: *https://publications.anl.gov/anlpubs/2024/03/187735.pdf* (accessed: Sept. 10, 2025).

[225] 49 CFR 537.7.

[226] NHTSA uses publicly available range and pack size information and linked the information to vehicle models.

costs and the range of power and energy requirements used to bound the lookup tables.[227] CAFE Analysis Autonomie Documentation and Chapter 3.3 of the Draft TSD provide further information about how NHTSA used BatPaC to estimate base year battery costs. The full range of BatPaC-generated battery DMCs is in the file ANL—Summary of Main Component Performance Assumptions_ NPRM_2206.[228] Note again that these charts represent the DMC using a dollar per kW/kWh metric; battery absolute costs used in the analysis by technology key can be found in the CAFE Model Battery Costs File.

The DOE and Argonne have developed battery cost correlation equations from BatPaC for use in the 2024 CAFE final rule analysis—cost equations that continue to be used in this analysis.[229] These cost equations—developed for use through MY 2035—are tailored for different vehicle segments,[230] different levels of hybridization,[231] and anticipated plant production volumes.[232] These equations represent cost improvements achieved from advanced manufacturing, pack design, and cell design with current and anticipated future battery chemistries,[233] design parameters, forecasted market prices, and vehicle technology penetration. Argonne's Cost Analysis and Projections for U.S.-Manufactured Automotive Lithium-ion Batteries report contains a detailed discussion of the inputs and assumptions used to generate these cost equations.[234]

While batteries and relative battery components are the biggest cost drivers of hybridization, non-battery hybridization components, such as electric motors, power electronics, and wiring harnesses, also add to the total cost required to electrify a vehicle. Different levels of hybrid vehicles have variants of non-battery hybridization components and configurations to accommodate different vehicle classes and applications with respective designs. For instance, some SHEVs may be engineered with only one electric motor, while other SHEVs may be engineered with two or even three electric motors within their powertrains to provide AWD functionality. In addition, some hybrid vehicle types still include conventional powertrain components, like an ICE and transmission.

For all hybrid vehicle powertrain types, NHTSA groups non-battery hybridization components into four major categories: electric motors, power electronics (generally including the DC–DC converter, inverter, and power distribution module), charging components (charger, charging cable, and high-voltage cables), and thermal management systems. NHTSA further groups the components into those composing the electric traction drive system, and all other components. Though each manufacturer's ETDS and power electronics vary between the same hybrid vehicle types and between different hybrid vehicle types, NHTSA considers the ETDS for this analysis to be composed of the electric motor and inverter, power electronics, and thermal system.

When researching costs for different non-battery hybridization components, NHTSA finds that different reports vary in components considered and cost breakdown. This is not surprising, as vehicle manufacturers use different non-battery hybridization components in different vehicle systems, or even in the same vehicle type, depending on the application. In order of the component categories discussed above, NHTSA examines cost teardown studies discussed in Draft TSD Chapter 3.3.5 on Table 3–82. Using the best available estimate for each component from the different reports captures components in most manufacturers' systems but not all; NHTSA believes, however, that this is a reasonable metric and approach for this analysis, given the non-standardization of hybrid powertrain designs and subsequent component specifications. Other sources NHTSA uses for non-battery hybridization component costs include an EPA-sponsored FEV teardown of a 2013 Chevrolet Malibu ECO with eAssist for some BISG component costs,[235] which were validated against a 2019 Dodge Ram eTorque system's publicly available retail price,[236] and the 2015 NAS report.[237] Broadly, the total BISG system cost, including the battery, fairly matches these other cost estimates. NHTSA is not making any changes to hybrid vehicle costs for this proposed rule, outside of transitioning to 2024$.

For the non-battery electrification component learning curves, NHTSA uses cost information from Argonne's 2016 Assessment of Vehicle Sizing, Energy Consumption, and Cost Through Large-Scale Simulation of Advanced Vehicle Technologies report.[238] The report provides estimated cost projections from the 2010 lab year to the 2045 lab year for individual vehicle components.[239] NHTSA considers the component costs used in EVs and determines the learning curve by evaluating the year over year cost change for those components. Argonne published a 2020 and a 2022 version of the same report; however, those versions did not include a discussion of the high- and low-cost estimates for the same components.[240] The learning estimates generated using the 2016 report align in the middle of the high and low cost estimates from the Argonne reports, and therefore NHTSA continues to apply the learning curve estimates based on the 2016 report. There are many sources that NHTSA could have picked to develop learning

[227] CAFE Analysis Autonomie Documentation chapter titled ''Battery Performance and Cost Model—Use of BatPac in Autonomie for FRM runs.''

[228] The DMCs in the Argonne file are in 2021$ (from the 2024 final rule).

[229] Argonne National Laboratory, Cost Analysis and Projections for U.S.-Manufactured Automotive Lithium-Ion Batteries. ANL/CSE–24/1, (2024), available at: *https://publications.anl.gov/anlpubs/2024/01/187177.pdf* (accessed: Sept. 10, 2025) (hereinafter, ''ANL/CSE–24/1'').

[230] The vehicle classes considered in this project include compact cars, midsize cars, midsize SUVs, and pickup trucks.

[231] The levels of hybridization considered in this project include light-duty micro HEVs, mild HEVs, strong HEVs, and PHEVs.

[232] Production volumes were determined for each vehicle class and type for each model year. See ANL/CSE–24/1 at Equation 1 and Table 13.

[233] Battery cathode chemistries considered in this project include nickel-based materials (NMC622, NMC811, NMC95, and LMNO) as well as lower cost LFP cathodes; varying percentages of silicon content (5%, 15%, and 35%) within a graphite anode were considered, as well.

[234] ANL/CSE–24/1.

[235] FEV, Inc., Light Duty Vehicle Technology Cost Analysis: 2013 Chevrolet Malibu ECO With eAssist BAS Technology Study, FEV P311264, Contract No. EP–C–12–014, WA 1–9 (2014); EPA: Washington, DC (2014), available at: *https://www.regulations.gov/document/EPA-HQ-OAR-2015-0827-0342* (accessed: Sept. 10, 2025).

[236] Colwell, K.C., The 2019 Ram 1500 eTorque Brings Some Hybrid Tech, if Little Performance Gain, to Pickups, Car and Driver, Last revised: Mar. 14, 2019, available at: *https://www.caranddriver.com/reviews/a22815325/2019-ram-1500-etorque-hybrid-pickup-drive* (accessed: Sept. 10, 2025).

[237] 2015 NAS Report, at p. 305.

[238] Moawad, A. et al., Assessment of Vehicle Sizing, Energy Consumption and Cost Through Large Scale Simulation of Advanced Vehicle Technologies, ANL/ESD–15/28 (2016), available at: *https://doi.org/10.2172/1245199* (accessed: Sept. 10, 2025).

[239] DOE's lab year equates to 5 years after a model year (*e.g.,* DOE's 2010 lab year equates to MY 2015). ANL/ESD–15/28 at 116.

[240] Islam, E. et al., Energy Consumption and Cost Reduction of Future Light-Duty Vehicles Through Advanced Vehicle Technologies: A Modeling Simulation Study Through 2050, ANL/ESD–19/10, ANL (2020), available at: *https://publications.anl.gov/anlpubs/2020/08/161542.pdf* (accessed: Sept. 10, 2025); Islam, E. et al., A Comprehensive Simulation Study to Evaluate Future Vehicle Energy and Cost Reduction Potential, ANL/ESD–22/6, Alexandria: VA (2022), available at: *https://publications.anl.gov/anlpubs/2023/11/179337.pdf* (accessed: Sept. 10, 2025).

curves for non-battery electrification component costs; however, given the uncertainty surrounding extrapolating costs out to MY 2050, NHTSA believes these learning curves provide a reasonable estimate.

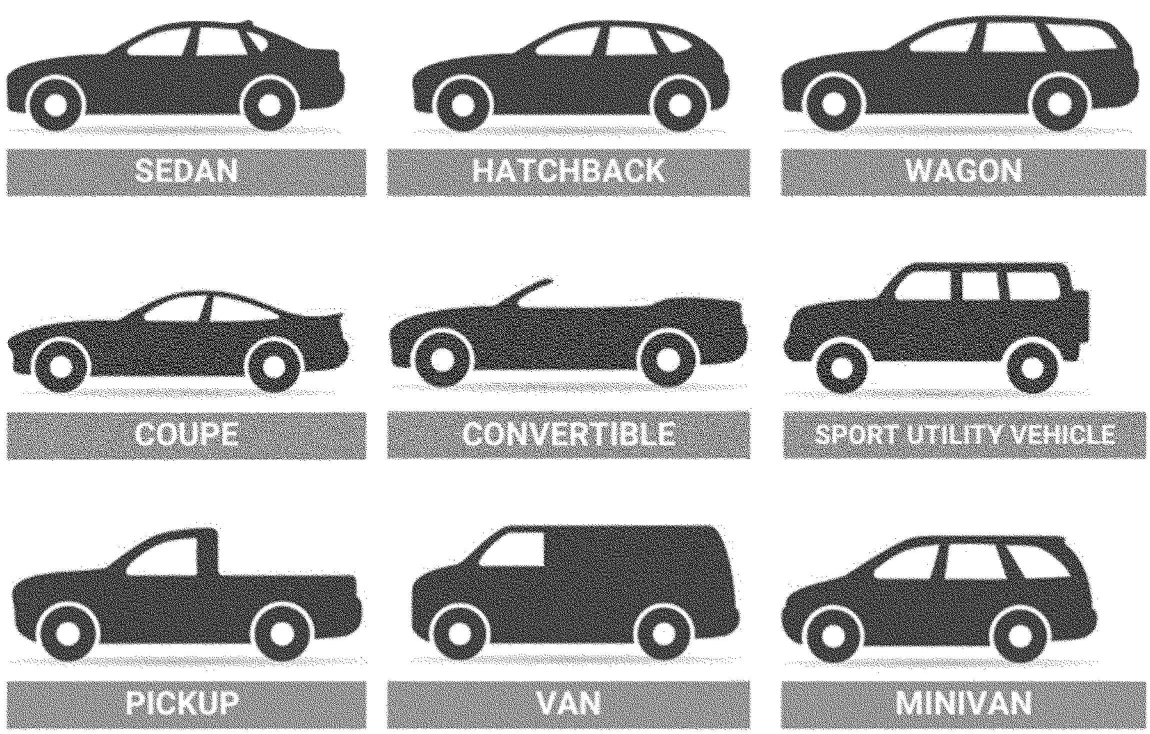
In summary, NHTSA calculates the total hybrid powertrain costs by summing individual component costs, which ensures that all technologies in a hybrid powertrain appropriately contribute to the total system cost. NHTSA combines the costs associated with the ICE (if applicable) and transmission, non-battery hybridization components like the electric machine, and battery pack to create a full-system cost. Chapter 3.3.5.4 of the Draft TSD presents the total costs for each hybrid powertrain option, broken out by the components NHTSA discussed throughout this section. In addition, the section discusses where to find each of the component costs in the CAFE Model's various input files.

4. Road Load Reduction Paths

No car or truck uses energy (whether gas or otherwise) 100 percent efficiently when it is driven down the road. If the energy in a gallon of gas is thought of as a pie, the amount of energy ultimately available from that gallon to propel a car or truck down the road would only be a small slice. Instead, most of the energy is lost due to thermal and frictional losses in the engine and drivetrain and drag from ancillary systems (*e.g.,* the air conditioner, alternator generator, or various pumps). The rest is lost to what engineers call road loads. For the most part, road loads include wind resistance (or aerodynamics), drag in the braking system, and rolling resistance from the tires. At low speeds, aerodynamic losses are very small, but as speeds increase these losses rapidly become dramatically higher than any other road load. Drag from the brakes in most cars is practically negligible. Tire rolling resistance losses can be significant: at low speeds rolling resistance losses can be more than aerodynamic losses. Whatever energy is left after these road loads is spent on accelerating the vehicle anytime its speed increases. This is where reducing the mass of a vehicle is important to efficiency because the amount of energy to accelerate the vehicle is always directly proportional to a vehicle's mass. All else being equal, reduce a car's mass and better fuel economy is guaranteed. However, at freeway speeds, aerodynamics plays a more dominant role in determining fuel economy than any other road load or vehicle mass.

NHTSA includes three road load reducing technology paths in this analysis: the Mass Reduction Path, Aerodynamic Improvements (AERO) Path, and Low Rolling Resistance Tires (ROLL) Path. For all three paths, NHTSA assigns analysis fleet technologies and identifies adoption features based on the vehicle's body style. The light-duty fleet body styles NHTSA includes in the analysis are convertible, coupe, sedan, hatchback, wagon, SUV, pickup, minivan, and van. Figure II–3 shows the light-duty fleet body styles used in the analysis.

Figure II-3: Light-Duty Fleet Body Styles



As expected, the road load forces described above operate differently based on a vehicle's body style, and the technology adoption features and effectiveness values reflect this. The following sections discuss the three Road Load Reduction Paths.

5. Mass Reduction

MR is a relatively cost-effective means of improving fuel economy, and vehicle manufacturers are expected to apply various MR technologies to meet fuel economy standards. Vehicle manufacturers can reduce vehicle mass through several different techniques, such as modifying and optimizing vehicle component and system designs, part consolidation, and adopting materials that are conducive to MR (*e.g.,* advanced high strength steel (AHSS), aluminum, magnesium, and plastics, including carbon fiber reinforced plastics).

For this analysis, NHTSA considers five levels of MR technology (MR1–MR5) that include increasing amounts of advanced materials and MR techniques applied to the vehicle's glider.[241] The subsystems that may make up a vehicle glider include the vehicle body, chassis, interior, steering, electrical accessory, brake, and wheels systems. NHTSA accounts for mass changes associated with powertrain changes separately.[242] The agency's estimates of how manufacturers could reach each level of MR technology, and a discussion of advanced materials and MR techniques can be found in Chapter 3.4 of the Draft TSD.

The MR5 technology represents a high level of MR and requires a blend of aluminum and carbon fiber components. Achieving MR5 with aluminum exclusively is unlikely to be achievable by manufacturers during the rulemaking timeframe. While aluminum technology can be a potent MR pathway, it has its limitations. First, aluminum does not have a fatigue endurance limit. That is, with aluminum components there is always some combination of stress and cycles when failure occurs. Automotive design engineering teams will dimension highly stressed cross sections to provide an acceptable number of cycles to failure. But this often comes at mass savings levels that fall short of what would be expected purely based on density specific strength and stiffness properties for aluminum.

Looking at real data, the mostly aluminum (cab and bed are made from aluminum) 2021 Ford F150 achieves less than a 14-percent MR compared to its 2014 all-steel predecessor.[243] This is an especially pertinent comparison because both vehicles have the same footprint within a 2-percent margin and presumably were engineered to similar duty cycles given that they both came from the same manufacturer. Per the agency's regression analysis, the Ford F–150 achieves MR3. As mentioned in the Draft TSD Chapter 3.4, a body in white structure made almost entirely from aluminum is roughly required to get to MR4. It may be possible to achieve MR5 without the use of carbon fiber, but the resultant vehicle would not achieve performance parity with customer expectations in terms of crash safety, noise and vibration levels, and interior content. The discontinued Lotus Elise is an example of an aluminum and fiberglass car that achieved MR5 but represents an extremely niche vehicle application that is unlikely to translate to mainstream, high-volume models. Therefore, it is entirely reasonable to assume that carbon fiber ''hang on'' panels and closures would be necessary to achieve MR5 at performance parity.

In past rules, commenters have noted that the NAS study relies on very little application of carbon fiber technology to achieve their highest level of MR technology. NHTSA notes that the NAS study espouses a maximum level of MR of approximately 14.5 percent using composites (*e.g.,* fiberglass) and carbon fiber technology only in closures structures (*e.g.,* doors, hoods, and decklids) and hang-on panels (*e.g.,* fenders). This is the ''alternative scenario 2'' in the NAS study and is a similar light-weighting technology application strategy to what the analysis roughly associates with MR5, but MR5 requires a 20-percent MR. In this scenario, NHTSA is allotting more MR potential for the same carbon fiber technology application than the NAS study does.

NHTSA assigns MR levels to vehicles in the analysis fleet by using regression analyses that consider a vehicle's body design[244] and body style, in addition to several vehicle design parameters, like footprint, power, bed length (for pickup trucks), and battery pack size (if applicable), among other factors. NHTSA has been improving on the light-duty regression analysis since the 2016 Draft Technical Assessment Report (TAR) and continues to find that it reasonably estimates MR technology levels of vehicles in the analysis fleet. Chapter 3.4 of the Draft TSD contains a full description of the regression analyses used for the analysis fleet and examples of results of the regression analysis for select vehicles.

There are several ways NHTSA ensures that the CAFE Model considers MR technologies in the way that manufacturers might apply them in the real world. Given the degree of commonality among the vehicle models built on a single platform, manufacturers do not have complete freedom to apply unique technologies to each vehicle that shares the same platform. While some technologies (*e.g.,* low rolling resistance tires) are very nearly ''bolt-on'' technologies, others involve substantial changes to the structure and design of the vehicle and therefore often necessarily affect all vehicle models that share that platform. In most cases, MR technologies are applied to platform level components and therefore the same design and components are used on all vehicle models that share the platform. Each vehicle in the analysis fleet is associated with a specific platform family. A platform ''leader'' in the analysis fleet is a vehicle variant of a given platform that has the highest level of MR technology in the analysis fleet. As the Model applies technologies, it ''levels up'' all variants on a platform to the highest level of MR technology on the platform. For example, if a platform leader is already at MR3 in MY 2024, and a ''follower'' starts at MR0 in MY 2024, the follower will get MR3 at its next redesign (unless the leader is redesigned again before that time, and further increases the MR level associated with that platform, then the follower would receive the new MR level).

In addition to leader-follower logic for vehicles that share the same platform, NHTSA also restricts MR5 technology to platforms that represent 80,000 vehicles or fewer. The CAFE Model does not apply MR5 technology to platforms representing high-volume sales, like a Chevrolet Traverse, for example, where hundreds of thousands of units are sold

[241] Note that in the previous analysis associated with the MYs 2024–2026 final rule, there was a sixth level of mass reduction available as a pathway to compliance. For this analysis, this pathway was removed because it relied on extensive use of carbon fiber composite technology to an extent that is only found in purpose-built racing cars and a few hundred road legal sports cars costing hundreds of thousands of dollars. Draft TSD Chapter 3.4 provides additional discussion on the decision to include five mass reduction levels in this analysis.

[242] Glider mass reduction can sometimes enable a smaller engine while maintaining performance neutrality. Smaller engines typically weigh less than bigger ones. NHTSA captures any changes in the resultant fuel savings associated with powertrain mass reduction and downsizing via the Autonomie simulation. Autonomie calculates a hypothetical vehicle's theoretical fuel mileage using a mass reduction to the vehicle curb weight equal to the sum of mass savings to the glider plus the mass savings associated with the downsized powertrain.

[243] Ford, 2021 F–150 Technical Specifications, available at: *https://www.fromtheroad.ford.com/content/dam/fordmediasite/us/en/library/2021/specs/2021-F-150-Technical-Specs.pdf* (accessed: Sept. 10, 2025); Ford, 2014 F–150 Technical Specifications, available at: *https://www.edmunds.com/ford/f-150/2014/features-specs/* (accessed: Sept. 10, 2025).

[244] The body design categories NHTSA uses are 3-box and 2-box pickup trucks. A 3-box has a box in the middle for the passenger compartment, a box in the front for the engine and a box in the rear for the luggage compartment. A 2-box has a box in front for the engine and then the passenger and luggage box are combined into a single box.

per year. NHTSA uses the combination of the leader-follower logic and 80,000-unit threshold to make the simulation of MR technologies more realistic. This is because NHTSA assumes that MR5 would require carbon fiber technology.[245] There is high global demand from a variety of industries for a limited supply of carbon fibers; specifically, aerospace, military/defense, and industrial applications demand most of the carbon fiber currently produced. Today, only about 10 percent of the global dry carbon fiber supply is allocated to the automotive industry, limiting the global supply base to supporting approximately 70,000 vehicles.[246] In addition, the production process for carbon fiber components is significantly different than for traditional vehicle materials. NHTSA uses this adoption feature as a proxy for stranded capital (*i.e.,* when manufacturers amortize research, development, and tooling expenses over many years) from leaving the traditional processes and to represent the significant paradigm change to tooling and equipment that would be required to support molding carbon fiber panels. There are no other adoption features for MR in the analysis.

In the Autonomie simulations, MR technology is simulated as a percentage of mass removed from the specific subsystems that make up the glider. The mass of subsystems that make up the vehicle's glider is different for every technology class, based on glider weight data from the A2Mac1 database [247] and two NHTSA-sponsored studies that examined light-weighting a passenger car and light truck. NHTSA accounts for MR from powertrain improvements separately from glider MR. Autonomie considers several components for powertrain MR, including engine downsizing and fuel tank, exhaust systems, and cooling system light-weighting.[248] With regard to the light-duty vehicle fleet, the 2015 NAS report suggested an engine downsizing opportunity exists when the glider mass is light-weighted by at least 10 percent. The 2015 NAS report also suggested that 10-percent light-weighting of the glider mass alone would boost fuel economy by 3 percent and any engine downsizing following the 10-percent glider MR would provide an additional 3-percent increase in fuel economy.[249] The NHTSA light-weighting studies applied engine downsizing (for some vehicle types but not all) when the glider weight was reduced by 10 percent. Accordingly, the analysis limits engine resizing to several specific incremental technology steps; important for this discussion, engines in the analysis are resized only when MR of 10 percent or greater is applied to the glider mass or when one powertrain architecture replaces another architecture. A summary of how the different MR technology levels improve fuel consumption is shown in Draft TSD Chapter 3.4.4.

NHTSA's MR costs are based on two NHTSA light-weighting studies—the teardown of a MY 2011 Honda Accord and a MY 2014 Chevrolet Silverado pickup truck [250]—and the 2021 NAS report.[251] The costs for MR1–MR4 rely on the light-weighting studies, while the cost of MR5 references the carbon fiber costs provided in the 2021 NAS report. Unlike the other technologies in this analysis that have a fixed technology cost (for example, it costs about $3,000 to add an AT10L3 transmission to a light-duty SUV or pickup truck in MY 2027), the cost of MR is calculated on a dollar per pound saved basis based on a vehicle's starting weight. Put another way, for a given vehicle platform, an initial mass is assigned using the aforementioned regression model. The amount of mass to reach each of the five levels of MR is calculated by the CAFE Model based on this number and then multiplied by the dollar per pound saved figure for each of the five MR levels. The dollar per pound saved figure increases at a nearly linear rate going from MR0 to MR4. However, this figure increases steeply going from MR4 to MR5 because the technology cost to realize the associated mass savings level is an order of magnitude larger. This dramatic increase is reflected by all three studies NHTSA relied on for MR costing, and NHTSA believes that it reasonably represents what manufacturers would expect to pay for using increasing amounts of carbon fiber on their vehicles.

Like past analyses, NHTSA considers several options for MR technology costs. The agency has determined that the NHTSA-sponsored studies accounted for significant factors the agency believes are important to include in this analysis, including materials considerations (material type and gauge, while considering real-world constraints such as manufacturing and assembly methods and complexity), safety (including the Insurance Institute for Highway Safety's (IIHS) small overlap tests), and functional performance (including towing and payload capacity and noise, vibration, and harshness (NVH)), and gradeability in the pickup truck study.[252]

First, NHTSA limits application of MR5 in the analysis to represent the limited volume of available dry carbon fiber and the resultant high costs of the raw materials. This constraint is described above and in more detail in Draft TSD Chapter 3. The CAFE Model assumes that there is not enough carbon fiber readily available to support vehicle platforms with more than 80,000 vehicles sold per year. NHTSA believes this volume constraint does more to limit the application of MR5 technology in the analysis than does its high price. Even if a lower price is used, the dominant constraint would still be volume. Second, NHTSA does not believe that a lower price would prove to be a competitive pathway to compliance with exotic materials technology compared to other less expensive technologies with higher effectiveness. The MR5 effectiveness as applied to vehicles in this analysis considers the total effect of reducing that level of mass from the vehicle, from the vehicle's starting MR level. As an example, while the cost of going from MR0 or MR1 to MR5 may be slightly overstated (but still limited in total application by the volume cap), the cost of going from MR4 to MR5 is not. NHTSA continues to consider the balance of carbon fiber and other

[245] See the Final TSD for CAFE standards for MYs 2024–2026 and Chapter 3.4 of the Draft TSD accompanying this rulemaking for more information about carbon fiber.

[246] Sloan, J., Carbon Fiber Suppliers Gear Up for Next Generation Growth, Last revised: Feb. 11, 2020, available at: *https://www.compositesworld.com/articles/carbon-fiber-suppliers-gear-up-for-next-gen-growth* (accessed: Sept. 10, 2025).

[247] A2Mac1: Automotive Benchmarking, available at: *https://portal.a2mac1.com/* (accessed: Sept. 10, 2025). The A2Mac1 database tool is widely used by industry and academia to determine the bill of materials (a list of the raw materials, sub-assemblies, parts, and quantities needed to manufacture an end-product) and mass of each component in the vehicle system.

[248] Though NHTSA does not account for mass reduction in transmissions, NHTSA does reflect design improvements as part of mass reduction when going from, for example, an older AT6 to a newer AT8 that has similar if not lower mass.

[249] 2015 NAS Report

[250] Singh, H., Mass Reduction for Light-Duty Vehicles for Model Years 2017–2025, Final Report, DOT HS 811 666 (2012), available at: *https://static.nhtsa.gov/nhtsa/downloads/CAFE/2017-25_Final/811666.pdf* (accessed: Sept. 10, 2025); Singh, H. et al., Mass Reduction for Light-Duty Vehicles for Model Years 2017–2025, Report No. DOT HS 812 487, NHTSA: Washington, DC (2018), available at: *https://downloads.regulations.gov/NHTSA-2021-0053-0011/attachment_5.pdf* (accessed: Sept. 10, 2025).

[251] This analysis applied the cost estimates per pound derived from passenger cars to all passenger car segments, and the cost estimates per pound derived from full-size pickup trucks to all light-duty truck and SUV segments. The cost estimates per pound for carbon fiber (MR5) were the same for all segments.

[252] Draft TSD Chapter 7.3 has additional detail on this analysis.

advanced materials for MR to meet MR5 levels and may update that value in future rules.

6. Aerodynamic Improvements

The energy required for a vehicle to overcome wind resistance, or more formally what is known as aerodynamic drag, ranges from minimal drag at low speeds to extremely significant drag at highway speeds.[253] Reducing a vehicle's aerodynamic drag is, therefore, an effective way to reduce the vehicle's fuel consumption. Aerodynamic drag is characterized as proportional to the frontal area (A) of the vehicle and a factor called the coefficient of drag (C_d). The coefficient of drag (C_d) is a dimensionless value that represents a moving object's resistance against air, which depends on the shape of the object and flow conditions. The frontal area (A) is the cross-sectional area of the vehicle as viewed from the front. Aerodynamic drag of a vehicle is often expressed as the product of the two values, C_dA, which is also known as the drag area of a vehicle. The force imposed by aerodynamic drag increases with the square of vehicle velocity, accounting for the largest contribution to road loads at higher speeds.[254]

Manufacturers can reduce aerodynamic drag either by reducing the drag coefficient or reducing vehicle frontal area, which can be achieved by passive or active aerodynamic technologies. Passive aerodynamics refers to aerodynamic attributes that are inherent to the shape and size of the vehicle. Passive attributes can include the shape of the hood, the angle of the windscreen, or even overall vehicle ride height. Active aerodynamics refers to technologies that variably deploy in response to driving conditions. Examples of active aerodynamic technologies are grille shutters, active air dams, and active ride height adjustment. Manufacturers may employ both passive and active aerodynamic technologies to improve aerodynamic drag values.

There are four levels of aerodynamic improvement (over AERO0, the first level) available in the analysis (AERO5, AERO10, AERO15, AERO20). Refer to Figure II–3 for a visual of each body style considered in the analysis. Each AERO level is associated with 5-, 10-, 15-, or 20-percent aerodynamic drag improvement values over a reference value computed for each vehicle body style. These levels, or bins, respectively correspond to the level of aerodynamic drag reduction over the reference value (*e.g.,* ''AERO5'' corresponds to the 5-percent aerodynamic drag improvement value over the reference value). While each level of aerodynamic drag improvement is technology agnostic—that is, manufacturers can ultimately choose how to reach each level by using whatever technologies work for the vehicle—NHTSA estimates a pathway to each technology level based on data from a National Research Council of Canada-sponsored wind tunnel testing program. The program included an extensive review of production vehicles utilizing aerodynamic drag improvement technologies and of industry comments.[255] NHTSA's example pathways for achieving each level of aerodynamic drag improvement are discussed in Chapter 3.5 of the Draft TSD.

NHTSA assigns aerodynamic drag reduction technology levels in the analysis fleets based on vehicle body styles.[256] NHTSA computes an average coefficient of drag based on vehicle body styles, using coefficient of drag data from the MY 2015 analysis fleet. Different body styles offer different utility and have varying levels of form drag. This analysis considers both frontal area and body style as unchangeable utility factors affecting aerodynamic forces; therefore, the analysis assumes all reductions in aerodynamic drag forces come from improvements in the drag coefficient. Then NHTSA uses drag coefficients for each vehicle in the analysis fleet to establish an initial aerodynamic technology level for each vehicle. NHTSA compares the vehicle's drag coefficient to the calculated drag coefficient by body style mentioned above to assign initial levels of aerodynamic drag reduction technology to vehicles in the analysis fleets. NHTSA can find most vehicles' drag coefficients in manufacturers' publicly available specification sheets; however, in cases where this information cannot be found, NHTSA uses engineering judgment to assign the initial technology level.

NHTSA looks at vehicle body style and vehicle HP to determine which types of vehicles can adopt different aerodynamic technology levels. For this analysis, AERO15 and AERO20 cannot be applied to minivans, and AERO20 cannot be applied to convertibles, pickup trucks, and wagons. NHTSA does not allow application of AERO15 and AERO20 technology to vehicles with more than 780 HP. This threshold is informed by information about performance of ICE vehicles. NHTSA recognizes that manufacturers tune aerodynamic features on these vehicles to provide desirable downforce at high speeds and to provide sufficient cooling for the powertrain, rather than reducing drag, resulting in middling drag coefficients despite advanced aerodynamic features. Therefore, manufacturers may have limited ability to improve aerodynamic drag coefficients for high performance ICE vehicles without reducing HP. This threshold for performance vehicles only limits the application of aerodynamic technologies on 2,518 units of sales volume in the analysis fleet.[257]

The aerodynamic technology effectiveness values that show the potential fuel consumption improvement from AERO0 technology are found and discussed in Chapter 3.5.4 of the Draft TSD. For example, the AERO20 values represent the range of potential FCIVs that could be achieved through the replacement of AERO0 technology with AERO20 technology for every technology key that is not restricted from using AERO20. NHTSA uses the change in fuel consumption values between entire technology keys and not the individual technology effectiveness values. Using the change between whole technology keys captures the complementary or non-complementary interactions among technologies.

NHTSA has carried forward the established AERO technology costs previously used in the 2020 final rule, the MYs 2024–2026 standards analysis,[258] and the 2024 rulemaking and has updated those costs to the dollar-year used in this analysis. For light-duty AERO improvements, the cost to achieve AERO5 is relatively low, as manufacturers can make most of the improvements through body styling changes. The cost to achieve AERO10 is higher than AERO5, due to the addition

[253] 2015 NAS Report, at p. 207.

[254] See, *e.g.,* Pannone, G., Technical Analysis of Vehicle Load Reduction Potential for Advanced Clean Cars, Final Report (2015), available at: *https://ww2.arb.ca.gov/sites/default/files/2020-04/13_313_ac.pdf* (accessed: Sept. 10, 2025). The graph on p. 20 shows how the aerodynamic force becomes the dominant load force at higher speeds.

[255] Larose, G. et al., Evaluation of the Aerodynamics of Drag Reduction Technologies for Light-Duty Vehicles: A Comprehensive Wind Tunnel Study, *SAE International Journal of Passenger Cars—Mechanical Systems,* Vol. 9(2): pp. 772–84 (2016), available at: *https://doi.org/10.4271/2016-01-1613* (accessed: Sept. 10, 2025).

[256] These assignments do not necessarily match the body styles that manufacturers use for marketing purposes. Instead, NHTSA makes these assignments based on engineering judgment and the categories used in the modeling, considering how this affects a vehicle's AERO and vehicle technology class assignments.

[257] See the Market Data Input File.

[258] Note the FRIA accompanying the 2020 final rule, Chapter VI.C.5.e.

of several passive aerodynamic technologies, and consecutively the cost to achieve AERO15 and AERO20 is much higher than AERO10 due to use of both passive and active aerodynamic technologies. The cost estimates are based on CBI submitted by the automotive industry in advance of the 2018 CAFE NPRM and on the agency's assessment of manufacturing costs for specific aerodynamic technologies. The 2018 FRIA contains discussion of the cost estimates.[259] NHTSA has not received additional comments in previous rulemakings from stakeholders regarding the AERO costs since they were established in the 2018 FRIA during the MYs 2024–2026 standards analysis and has continued to use the established costs for this analysis. Draft TSD Chapter 3.5 contains additional discussion of aerodynamic improvement technology costs, and costs for all technology classes across all model years are in the CAFE Model's Technologies Input File.

7. Low Rolling Resistance Tires

Tire rolling resistance burns additional fuel when driving. As a car or truck tire rolls, at the point the tread touches the pavement, the tire flattens out to create what tire engineers call the contact patch. The rubber in the contact patch deforms to mold to the tiny peaks and valleys of the pavement. The interlock between the rubber and these tiny peaks and valleys creates grip. Every time the contact patch leaves the road surface as the tire rotates, it must recover to its original shape, and then as the tire goes all the way around, it must create a new contact patch that molds to a new piece of road surface. However, this molding and repeated re-molding action takes energy. Just like stretching a rubber band requires work, so does deforming the rubber and the tire to form the contact patch. When thinking about the efficiency of driving a car down the road, this means that not all the energy produced by a vehicle's engine can go into propelling the vehicle forward. Instead, some small, but appreciable, amount goes into deforming the tire and creating the contact patch repeatedly. This also explains why tires with low pressure have higher rolling resistance than properly inflated tires. When the tire pressure is low, the tire deforms more to create the contact patch, which is the same as stretching the rubber farther in the analogy above. Larger deformations consume even more energy, which results in worse fuel economy. Low rolling resistance tires have characteristics that reduce frictional losses associated with the energy dissipated mainly in the deformation of the tires under load, thereby improving fuel economy.

NHTSA uses three levels of low rolling resistance tire technology for the light-duty analysis. Each level of low rolling resistance tire technology reduces rolling resistance by 10 percent from an industry-average rolling resistance coefficient (RRC) value of 0.009.[260] RRC data from a NHTSA-sponsored study shows that similar vehicles across the light-duty vehicle categories have been able to achieve similar RRC improvements. Chapter 3.6 of the Draft TSD presents more information on this comparison. Draft TSD Chapter 3.6.1 shows the light-duty low rolling resistance technology options and their associated RRC.

NHTSA has been using ROLL10 and ROLL20 in the last several CAFE Model analyses. NHTSA has only recently included ROLL30 due to lack of widespread commercial adoption of ROLL30 tires in the fleet within the rulemaking timeframe, despite commenters' argument on availability of the technology on current vehicle models and the possibility that there would be additional tire improvements over the next decade.[261] NHTSA has received comments in previous CAFE rules that also reflect the application of ROLL30 by OEMs, though they discourage considering the technology due to high cost and possible wet traction reduction. With increasing use of ROLL30 application by OEMs,[262] and material selection making it possible to design low rolling resistance independent of tire wet grip (discussed in detail in Chapter 3.6 of the Draft TSD), NHTSA considers ROLL30 as a viable future technology during this rulemaking period. NHTSA believes that the tire industry is in the process of moving automotive manufacturers towards higher levels of low rolling resistance technology in the vehicle fleet. NHTSA believes that, at this time, the emerging tire technologies that would achieve 30-percent improvement in rolling resistance, like changing tire profile, stiffening tire walls, employing novel synthetic rubber compounds, or adopting improved tires along with active chassis control, among other technologies, may be available for commercial adoption in the fleet during this rulemaking timeframe.

Assigning low rolling resistance tire technology to the analysis fleet is difficult because RRC data are not part of tire manufacturers' publicly released specifications, and because vehicle manufacturers often offer multiple wheel and tire packages for the same nameplate. Consistent with previous rules, NHTSA uses a combination of CBI, data from a NHTSA-sponsored ROLL study, and assumptions about parts-sharing to assign tire technology in the analysis fleet. A slight majority of vehicles (54.9 percent) in the analysis fleet do not use any ROLL improvement technology, while 13.0 percent of vehicles use ROLL10, and 28.4 percent of vehicles use ROLL20. Only 3.7 percent of vehicles in the analysis fleet use ROLL30.

The CAFE Model can apply ROLL technology at either a vehicle refresh or redesign. NHTSA recognizes that some vehicle manufacturers prefer to use higher RRC tires on some performance cars and SUVs. Since many performance cars have higher torque, to avoid tire slip, OEMs prefer to use higher RRC tires for these vehicles. Like the aerodynamic technology improvements discussed above, NHTSA applies ROLL technology adoption features based on vehicle HP and body style. All vehicles in the light-duty fleet that have below 350 hp can adopt all levels of ROLL technology. Draft TSD Chapter 3.6.3 shows that all light-duty vehicles under 350 hp can adopt ROLL technology, and as vehicle HP increases, fewer vehicles can adopt the highest levels of ROLL

[259] Note the PRIA accompanying the 2018 NPRM, Chapter 6.3.10.1.2.1.2 for a discussion of these cost estimates.

[260] See Technical Analysis of Vehicle Load Reduction by CONTROLTEC for California Air Resources Board (Apr. 29, 2015). NHTSA determined the industry-average baseline RRC using a CONTROLTEC study prepared for the CARB, in addition to considering CBI submitted by vehicle manufacturers prior to the 2018 light-duty NPRM analysis. The RRC values used in this study were a combination of manufacturer information, estimates from coast-down tests for some vehicles, and application of tire RRC values across other vehicles on the same platform. The average RRC from surveying 1,358 vehicle models by the CONTROLTEC study is 0.009. The CONTROLTEC study compared the findings of their survey with values provided by the U.S. Tire Manufacturers Association for original equipment tires. The average RRC from the data provided by the U.S. Tire Manufacturers Association is 0.0092, compared to the average of 0.009 from CONTROLTEC.

[261] See The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks, Docket No. NHTSA–2018–0067–11985.

[262] See Evaluation of Rolling Resistance and Wet Grip Performance of OEM Stock Tires Obtained From NCAP Crash Tested Vehicles Phase One and Two, Memo to Docket—Rolling Resistance Phase One and Two; Technical Analysis of Vehicle Load Reduction by CONTROLTEC for California Air Resources Board, Docket No. NHTSA–2021–0053–0010 (Apr. 29, 2015); Evans, L. R. et al., NHTSA Tire Fuel Efficiency Consumer Information Program Development: Phase 2—Effects of Tire Rolling Resistance Levels on Traction, Treadwear, and Vehicle Fuel Economy, Report No. DOT HS 811 154, Docket No NHTSA–2008–0121–0035 (2009).

technology. Draft TSD Chapter 3.6 shows how effective the different levels of ROLL technology are at improving vehicle fuel consumption.

DMCs and learning rates for ROLL10 and ROLL20 are the same as prior analyses [263] but are updated to the dollar-year used in this analysis. In the absence of ROLL30 DMCs from tire manufacturers, vehicle manufacturers, or studies, NHTSA extrapolated the DMCs from ROLL10 and ROLL20 to develop the DMC for ROLL30. NHTSA believes that the added cost of each tire technology accurately represents the price difference that would be experienced by the different fleets. ROLL technology costs are discussed in detail in Chapter 3.6 of the Draft TSD, and ROLL technology costs for all vehicle technology classes can be found in the CAFE Model's Technologies Input File.

8. Simulating Air-Conditioning Efficiency and Off-Cycle Technologies

For this proposal, NHTSA's analysis of the regulatory alternatives removes FCIVs) for AC efficiency and OC technologies starting in MY 2028. NHTSA is making this change to align with its conclusion that technology specific incentives should not be considered when running the compliance simulation that informs its consideration of maximum feasible standards. Instead, NHTSA's analysis for MY 2028 and beyond is based on simulating compliance based on 2-cycle testing. To simulate compliance pathways using the CAFE Model without AC efficiency and OC technologies, NHTSA sets the maximum allowable FCIV to 0g carbon dioxide (CO_2)/mi in the Scenarios Input File. Section VI contains a more detailed discussion of how AC efficiency and OC benefits affect compliance with NHTSA's fuel economy standards.[264]

Under EPA's current procedures for determining fleet average fuel economy for CAFE compliance, manufacturers may generate FCIVs, which improve their fuel economy values. Manufacturers may generate FCIVs for the addition of OC and AC efficiency technologies, which can provide fuel economy benefits in real-world vehicle operation that are not fully captured using the 2-cycle test procedures (*e.g.,* FTP and HFET) used to measure fuel economy.[265] Starting in MY 2027, only automobiles powered by ICEs are eligible to generate FCIVs, and the OC FCIV program is currently being phased out between MYs 2031–2033, with manufacturers no longer being able to generate OC FCIVs for MY 2033 and beyond. OC technologies can include, but are not limited to, thermal control technologies, high-efficiency alternators, and high-efficiency exterior lighting. As an example, manufacturers can generate FCIVs for the addition of thermal control technologies like active seat ventilation and solar reflective surface coating, which help to regulate the temperature within the vehicle's cabin—making it more comfortable for the occupants and reducing the use of low-efficiency heating, ventilation, and air-conditioning (HVAC) systems. AC efficiency technologies are technologies that reduce the operation of or the loads on the compressor, which pressurizes AC refrigerant. The less the compressor operates or the more efficiently it operates, the less load the compressor places on the engine or battery storage system, resulting in better fuel efficiency. AC efficiency technologies can include, but are not limited to, blower motor controls, internal heat exchangers, and improved condensers/evaporators.

Since EPA first proposed allowing manufacturers to earn FCIVs for AC efficiency and OC technologies, NHTSA has not modeled AC efficiency and OC technologies in the CAFE Model like other vehicle technologies, for several reasons. Each time NHTSA adds a technology option to the CAFE Model's technology pathways, the agency increases the number of Autonomie simulations by approximately a hundred thousand. This means that adding just five AC efficiency and five OC technology options would double the agency's Autonomie simulations to around 2 million total simulations. Instead, for applicable model years, the CAFE Model applies predetermined AC efficiency and OC benefits to each manufacturer's fleet after the CAFE Model applies traditional technology pathway options. The CAFE Model attempts to apply pathway technologies and AC efficiency and OC technologies in a way that both minimizes cost and allows the manufacturer to meet a given CAFE standard without over-or under-complying. The predetermined benefits that the CAFE Model applies for AC efficiency and OC technologies are based on manufacturers' MY 2024 mid-model year CBI compliance reports.

NHTSA uses manufacturers' MY 2024 AC efficiency and OC FCIVs they achieved via the ''menu'' as a starting point for each regulatory class, then holds those values constant from MYs 2024–2031 for the No-Action Alternative and through MY 2027 for action alternatives. Unlike previous versions of this analysis, NHTSA does not extrapolate the MY 2024 values to future model years. Instead, the CAFE Model assumes that FCIVs for MY 2027 will be the same as they were for MY 2024. Manufacturers have been able to settle in on a level of AC efficiency and OC technologies that maximize their return on investment (ROI); therefore, NHTSA does not anticipate a significant increase in manufacturers' AC efficiency and OC FCIVs between MYs 2024–2027 for any regulatory category. Additional details about how NHTSA determines AC efficiency and OC technology application rates are discussed Chapter 3.7 of the Draft TSD.

Because the CAFE Model applies AC efficiency and OC technology benefits independent of the technology pathways, NHTSA must account for the costs of those technologies independently, as well. NHTSA generates costs for these technologies on a dollars per gram of CO_2 per mile ($ per g/mi) basis, as AC efficiency and OC technology benefits are applied in the

[263] See Transportation Research Board, Tires and Passenger Vehicle Fuel Economy: Informing Consumers, Improving Performance, Special Report 286 (2006), available at: *https://nap.nationalacademies.org/catalog/11620/tires-and-passenger-vehicle-fuel-economy-informing-consumers-improving-performance* (accessed: Sept. 10, 2025); NHTSA, Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks, Final Regulatory Impact Analysis (2009), available at: *https://www.nhtsa.gov/sites/nhtsa.gov/files/cafe_final_rule_my2011_fria.pdf* (accessed: Sept. 10, 2025); EPA and NHTSA, Joint Technical Support Document: Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards 3–77 (2010), available at: *https://www.federalregister.gov/documents/2010/05/07/2010-8159/light-duty-vehicle-greenhouse-gas-emission-standards-and-corporate-average-fuel-economy-standards* (accessed: Sept. 10, 2025); EPA and NHTSA, Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022–2025 at 5–153 and 154, 5–419, EPA–420–D–16–900 (July 2016), available at: *https://www.nhtsa.gov/sites/nhtsa.gov/files/draft-tar-final.pdf* (accessed: Sept. 10, 2025). In brief, the estimates for ROLL10 are based on the incremental $5 value for four tires and a spare tire in the NAS/NRC Special Report and confidential manufacturer comments that provided a wide range of cost estimates. The estimates for ROLL20 are based on incremental interpolated ROLL10 costs for four tires (as NHTSA and EPA believed that ROLL20 technology would not be used for the spare tire) and are seen to be fairly consistent with CBI suggestions by tire suppliers.

[264] Compliance with NHTSA's fuel economy standards is determined in accordance with EPA's calculation procedures at 40 CFR 600.512.

[265] *See* 49 U.S.C 32904(c) (''The Administrator shall measure fuel economy for each model and calculate average fuel economy for a manufacturer under testing and calculation procedures prescribed by the Administrator. . . . [T]he Administrator shall use the same procedures for passenger automobiles the Administrator used for model year 1975 (weighted 55 percent urban cycle and 45 percent highway cycle), or procedures that give comparable results.'').

CAFE Model on a gram per mile basis (as in the regulations). NHTSA updates the AC efficiency and OC technology costs by implementing an updated calculation methodology and converting the DMCs to 2024 dollars. The AC efficiency costs are based on data from EPA's 2010 FRIA and the 2010 and 2012 Joint NHTSA/EPA TSDs.[266] [267] [268] NHTSA has used data from EPA's 2016 Proposed Determination TSD [269] to develop the updated OC costs that were used for the 2022 final rule and now this proposed rule.

For this rulemaking, NHTSA is removing FCIVs from its standard-setting analysis starting with MY 2028, which is the first year in which a removal of FCIVs could go into effect.[270] NHTSA believes that the FCIVs generated under the OC and AC efficiency programs are no longer representative of real-world fuel savings. The values for adding such technologies were estimated from emission-reduction assessments performed on MY 2008 automobiles. As fuel economy has improved in the model years since these assessments were performed, the FCIVs for adding OC technologies have increasingly represented a larger percentage improvement in putative fuel economy values. As a result, the values for FCIVs have become less representative of real-world fuel savings and have created market distortions that undermine EPCA's purposes by incentivizing the addition of technology that does not provide commensurate fuel savings in the real world. NHTSA seeks comment on this determination. Additional details and assumptions used for AC efficiency and OC costs are discussed in Chapter 3.7.2 of the Draft TSD.

E. Consumer Responses to Manufacturer Compliance Strategies

The prior subsections of Section II have discussed how manufacturers might respond to the proposed standards. While the technology analysis outlined different compliance strategies available to manufacturers, the costs and benefits that would accrue because of the proposed standards are dependent on how consumers respond to manufacturers' compliance decisions. The next few subsections describe how the agency models how consumers may respond to changes in vehicle prices and attributes caused by manufacturers' compliance decisions, as simulated by the CAFE Model.

1. Consumer Responses to Manufacturer Compliance Strategies for 2027–2031

a. Macroeconomic and Consumer Behavior Assumptions

Most of the economic effects simulated within the analysis are influenced by macroeconomic conditions that are outside the agency's influence. For example, fuel prices are determined mainly by global petroleum supply and demand, yet they affect how much fuel efficiency-improving technology U.S. manufacturers would apply to their vehicles, how much more consumers would be willing to pay to purchase models offering higher fuel economy, how much buyers would drive those vehicles, and the value of each gallon of fuel saved from improved fuel efficiency. Constructing these forecasts of the consequences of CAFE standards requires robust projections of demographic and macroeconomic variables that span the full timeframe of the analysis, including real GDP, consumer confidence, U.S. population, and real disposable personal income.

The analysis presented with the proposal employs fuel price projections developed by EIA, an agency within DOE, which collects, analyzes, and disseminates independent and impartial energy information to promote sound policy-making and public understanding of energy. EIA uses its National Energy Modeling System (NEMS) to produce its AEO, which presents projections of future fuel prices (among many other economic and energy-related variables), and these are the source of some inputs to the agency's analysis. The agency's analysis for the proposal uses AEO's 2025 Alternative Transportation Case projections of U.S. population, GDP, disposable personal income, GDP deflator, and fuel prices. NHTSA uses AEO's 2025 Alternative Transportation Case because this case is intended to reflect recent policy directives and therefore provides a more informed analysis of conditions that will affect fuel prices than the reference case (which is tied, in part, to Federal energy policies that are no longer in place), especially in the near-term. The analysis also relies on S&P Global's forecasts of the total number of U.S. households [271] and the University of Michigan's Consumer Sentiment Index from its fall 2024 U.S. Economic Forecast, which EIA also uses to develop the projections it reports in its AEO.

These macroeconomic assumptions are important inputs to the analysis, but they are also uncertain, particularly over the long lifetimes of the vehicles affected by this proposed rule. To reflect the effects of this uncertainty, the agency also uses AEO's Low Oil Price and High Oil Price side cases to analyze the sensitivity of its analysis to alternative fuel price projections. The purpose of the sensitivity analysis, which is discussed in greater detail in Chapter 9 of the PRIA, is to measure the degree to which different assumptions about fuel prices can change simulated outcomes. NHTSA similarly uses low and high economic growth cases from S&P Global's March 2025 forecast as bounding cases for the macroeconomic variables in its analysis.

The agency will consider updating these inputs if newer versions of the data are available prior to conducting the analysis for the final rule. NHTSA seeks comments on these data sources. If commenters feel that there are better alternative sources of the same or similar data, the agency requests commenters to identify their preferred data source and explain why they believe it is more appropriate within the context of this CAFE rulemaking.

The analysis presented for this proposed rulemaking uses a 2024 base year, consistent with the use of vehicle data for MY 2024, and data for that year represents actual observations rather than estimates to the extent possible. Chapter 4.1 of the Draft TSD discusses macroeconomic forecasts and assumptions NHTSA uses in this analysis.

Another key assumption that permeates the agency's analysis is how much consumers are willing to pay for improved fuel economy. The payback period assumption also has important implications for other regulatory analysis results, including the effect of standards on sales and the use of new vehicles, as well as the number and use

[266] EPA, Final Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards Regulatory Impact Analysis for MYs 2012–2016, Last revised: May 14, 2025, available at: *https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-model-year-2012-2016-light-duty-vehicle* (accessed: Sept. 10, 2025) (hereinafter, ''Final Rulemaking MYs 2012–2016'').

[267] Final Rulemaking MYs 2012–2016.

[268] EPA, Joint Technical Support Document: Final Rulemaking for 2017–2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, EPA–420–R–12–901, EPA: Washington, DC (2012) available at: *https://www.nhtsa.gov/sites/nhtsa.gov/files/joint_final_tsd.pdf* (accessed: Sept. 10, 2025).

[269] EPA, Proposed Determination on the Appropriateness of the Model Year 2022–2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation: Technical Support Document, EPA–420–R–16–020 (2016).

[270] 49 U.S.C. 32904(d).

[271] NHTSA sourced the data from IHS-Polk. S&P Global purchased IHS Markit and rights to this data in 2022.

of older, used vehicles. The agency has updated its review of the academic literature on willingness to pay as part of its analysis of this proposal, which is discussed in Draft TSD Chapter 4.21 and PRIA Chapter 2.1.2. As noted in previous rulemakings, the range of estimates presented in the literature is wide. Some of the studies conclude that consumers value much of the potential savings in fuel costs from driving higher mpg vehicles, while others conclude that consumers significantly undervalue expected fuel savings. The more recent studies suggest that consumers value somewhere between 24 and the full lifetime value of undiscounted fuel savings, which is also supported by several of the older studies.

Manufacturers have repeatedly informed the agency that they believe that consumers only value between 2 to 3 years of fuel savings when choosing among competing models to purchase,[272] and the plurality of consumers when surveyed about their payback preferences have stated they are willing to pay for technology that repays the upfront cost within 24 months.[273] The agency also performed a retrospective analysis using the CAFE Model with reference fleets created to support prior rules. The agency modeled how the 2020 reference fleet (used for the 2022 final rule), similarly projected forward, compared with the 2022 reference fleet (used in the 2024 final rule), and how the 2022 reference fleet (used for the 2024 final rule) projected forward with different payback assumptions compared with the 2024 reference fleet used in this NPRM. These simulations provided model predictions about the technology penetration rates under different assumptions about the length of the payback period and under different projections of future fuel prices and technology costs. By comparing these to actual penetration rates NHTSA could judge the Model's ability to predict technology adoption under each payback assumption. The payback assumption that most accurately predicted technology adoption is 36 months, followed by 30 months. Both longer and shorter payback periods create a larger divergence.

After weighing the results from the academic literature, previous statements from manufacturers, and the agency's retrospective analysis, NHTSA is using a 36-month payback assumption for the analysis of this proposal. While this estimate represents a longer payback period assumption than was applied in the analysis of the previous three CAFE rules, the agency tentatively believes that the preponderance of the evidence suggests that 36 months is appropriate. NHSTA seeks comments on whether this represents an appropriate representation of consumer willingness to pay higher upfront prices for future fuel savings. Recognizing the consequences of the payback assumption in the agency's regulatory analysis, NHTSA also includes sensitivity cases to examine the impacts of longer and shorter payback periods in Chapter 9 of the PRIA. These concepts are explored more thoroughly in Chapter 4.2.1.1 of the Draft TSD and Chapter 2.1 of the PRIA.

b. Fleet Composition

The composition of the on-road fleet—and how it changes in response to standards—determines many of the costs and benefits of the proposed rule. For example, how much fuel is consumed depends on the number and efficiency of new vehicles sold and how rapidly older, less efficient, less safe vehicles are retired. Reducing the stringency of the CAFE standards would lower the price of new vehicles compared to the No-Action Alternative and would lead to a relative increase in sales of newer, safer vehicles, which in turn would decrease the price of used vehicles leading to the quicker retirement of the oldest, least safe, and less fuel-efficient vehicles on the road.

The analysis accompanying the proposal dynamically simulates changes in the vehicle fleet's size, composition, and usage as manufacturers and consumers respond to regulatory alternatives, fuel prices, and macroeconomic conditions. The analysis of fleet composition is composed of two forces: how sales of new vehicles and their integration into the existing fleet change in response to each regulatory alternative, and how economic and regulatory factors influence the retirement of used vehicles from the fleet (scrappage). NHTSA models sales and scrappage independently.

CAFE standards have been rising every year for nearly two decades. This constant increase in standards has been accompanied by a rise in both the costs of new vehicles and the age of the on-road fleet. The average selling price for new cars and light trucks rose nearly 50 percent between 2012 and 2024 and now approaches $50,000, while U.S. households' average income increased only about half as much over that same period. As the financial burden on households to purchase a new vehicle has increased substantially, recent annual sales of new cars and light trucks have been slightly lower than they were immediately before and after the 2008 recession. Meanwhile, the total number of cars and light trucks in use rose by about 30 million, with the entire increase representing used vehicles, while their average age rose from 10.6 to 12.6 years.[274]

Below are brief descriptions of how the agency models sales and scrappage; for full explanations, readers should refer to Chapter 4.2.1 of the Draft TSD.

(1) Sales

By reducing the regulatory costs of complying with fuel economy standards, the proposal would lead to an increase in new vehicle sales relative to the No-Action Alternative. For the purposes of regulatory evaluation, the relevant metric is the *difference* in the number of new vehicles sold between the baseline and each alternative rather than the absolute number of sales under any alternative. The agency's analysis of the response of new vehicle sales to different stringencies of fuel economy standards includes three components: a forecast of sales based exclusively on macroeconomic factors, which is used to determine the sales quantity for the No-Action Alternative; the assumed price elasticity of new vehicle demand, which interacts with estimated price increases under each alternative to create differences in sales relative to the No-Action Alternative; and a fleet share model that projects differences in the passenger and non-passenger automobile fleet shares under each alternative.

The first component of the sales response model is the nominal total new vehicle sales forecast, which is based on a small set of macroeconomic inputs that together determine the size of the new vehicle market in each future year under the baseline alternative. This statistical model is intended to provide only an initial forecast of light-duty vehicle sales; it does not incorporate the effect of prices on sales and is not intended to be used for analysis of the response to price changes in the new vehicle market. NHTSA's projection oscillates in the early model years

[272] *See, e.g.,* 87 FR 25710, 25856 (May 2, 2022).

[273] Some survey data such as Consumer Reports shows consumers with lower payback periods (around 24 months). However, the methodology employed by surveys like Consumer Reports are less rigorous than the revealed preferences data from the other sources, which is why Circular A–4 directs the agencies to attempt to use studies that rely on revealed preferences when feasible.

[274] Parekh, N., & Campau T., Average Age of Vehicles Hits New Record in 2024, Last revised: May 22, 2024, available at: *https://www.spglobal.com/mobility/en/research-analysis/average-age-vehicles-united-states-2024.html* (accessed: Sept. 10, 2025).

before settling to follow a constant trend in the 2030s. This result is generally consistent with the continued response to sales volatility in the years following the coronavirus disease of 2019 (COVID–19) pandemic and the supply chain challenges immediately thereafter. NHTSA acknowledges that excluding the regulatory costs to comply with the baseline standards has the potential to underestimate the effect of prevailing conditions on vehicle sales; however, given that the macroeconomic assumptions used in this analysis take into account the effects of various regulatory policies and the fact that the relevant metric is the differences created by alternative CAFE stringencies, the agency feels that this approach provides a reasonable starting point. NHTSA will continue to monitor changes in macroeconomic conditions and their effects on new vehicle sales and will update its baseline forecast for use in the final rule analysis as appropriate.

The agency's baseline sales forecast assumes that total new vehicle sales are driven primarily by conditions in the U.S. economy that are outside the influence of the automobile industry. Over time, new vehicle sales have been cyclical—rising when prevailing economic conditions are positive (periods of growth) and falling during periods of economic contraction. While changes to vehicles' designs and prices that occur as consequences of manufacturers' compliance with earlier standards (and with regulations on vehicles' features other than fuel economy) exert some influence on the volume of new vehicle sales, they are far less influential than macroeconomic conditions. The effects of compliance are not large enough to reverse broader cyclical trends in sales; instead, they produce the marginal differences in sales among regulatory alternatives that the agency's sales module is designed to simulate. Increases in new models' prices caused by higher regulatory costs reduce sales below the cyclical trend, and slow fleet turnover, while decreases in prices have the opposite effect.

NHTSA is statutorily barred from considering the fuel economy of dedicated automobiles (*e.g.,* battery electric or hydrogen vehicles) and therefore has removed dedicated automobiles from the sales forecast it uses to analyze the proposed rule. NHTSA uses market penetration rates from the AEO 2025 Alternative Transportation Case to estimate the market share of the gasoline-powered fleet. The agency then applies this market share to the total light-duty forecast produced by the nominal forecast.[275] An independent projection like the AEO 2025 Alternative Transportation Case is a reliable estimate of the future market share for gasoline-powered vehicles.

The second component of the sales response model captures how price changes affect the number of vehicles sold. NHTSA estimates the change in sales from its initial forecast during future years under each regulatory alternative by applying an assumed price elasticity of new vehicle demand to the percent difference in average price between the regulatory alternatives and the No-Action Alternative. This price change does not represent an increase or decrease from the previous model year, but rather the percent difference in the average price of new vehicles between the baseline and each regulatory alternative for that particular model year. The average new vehicle price in the baseline is defined as the observed price in 2024 (the last historical data year before the simulation is run) plus the average regulatory cost associated with the No-Action Alternative for each future model year.[276] The agency also subtracts any tax credits for which a PHEV may qualify from those regulatory costs to simulate sales.[277]

Within the CAFE Model's logic, there is an implicit assumption that new vehicle models within the same regulatory class (*e.g.,* passenger automobiles) are close substitutes for one another, including vehicles with differing powertrains.[278] NHTSA recognizes that different vehicle attributes may alter the perceived value of vehicles. NHTSA implements several guardrails to prevent the CAFE Model from adopting technologies for fuel economy that could adversely affect the utility of vehicles, such as maintaining performance neutrality, including phase-in caps, and defining technology pathways by using engineering judgement. The agency acknowledges that, even with these constraints, it is possible that CAFE standards may influence attributes other than price or fuel economy that are unaccounted for in the agency's sales analysis.

NHTSA has previously invested considerable resources in developing a discrete choice model of the new automobile market that would (1) enable the agency to incorporate the effect of additional vehicle attributes on buyers' choices among competing models; (2) reflect consumers' differing preferences for specific vehicle attributes; and (3) provide the capability to simulate responses, such as strategic pricing strategies by manufacturers intended to alter the mix of models they sell and enable them to comply with new CAFE standards. However, those efforts have not yet produced a satisfactory and operational model.[279] Instead, NHTSA accounts for the possibility of decreased utility of vehicles because of CAFE standards outside of the sales module.

Because the price elasticity that is applied in the Model assumes no perceived change in the quality of the product, and the vehicles produced under different regulatory scenarios have inherently different operating costs, the price metric must account for this difference. The price change to which the elasticity is applied in this analysis represents the residual price difference *between the baseline and each regulatory alternative* after deducting the value of fuel savings over the first 3 years of each model year's lifetime.

The price elasticity is also specified as an input, and for the proposal, the agency assumed a value of –0.4, meaning that a 5-percent increase in the average price of a new vehicle produces a 2-percent decrease in total sales.

[275] NHTSA also considers other approaches, such as assuming the full fleet in future model years would be composed of gasoline-powered vehicles or holding the current market penetration rate for dedicate automobiles constant. Draft TSD Chapter 4.2.1.2 provides more discussion of the selected approach and alternatives considered.

[276] The CAFE Model currently operates as if all costs incurred by the manufacturer as a consequence of meeting regulatory requirements, whether those costs are the cost of additional technology applied to vehicles in order to improve fleetwide fuel economy or civil penalties paid when fleets fail to achieve their standard, are ''passed through'' to buyers of new vehicles in the form of price increases.

[277] For additional details about how NHTSA models tax credits, see Section II.C.5b above.

[278] The CAFE Model does not assign different preferences between technologies, and outside the standard-setting restrictions, the Model will apply technology on a cost-effectiveness basis. Similarly, outside of the sales response to changes in regulatory costs, consumers are assumed to be indifferent to specific technology pathways and will demand the same vehicles despite any changes in technological composition.

[279] NHTSA's experience partly reflects the fact that these models are highly sensitive to their data inputs and estimation procedures, and even versions that fit well when calibrated to data from a single period—usually a cross section of vehicles and shoppers or actual buyers—often produce unreliable forecasts for future periods, which NHTSA's regulatory analyses invariably require. This occurs because they are often unresponsive to relevant shifts in economic conditions or consumer preferences, and also because it is difficult to incorporate factors such as the introduction of new model offerings—particularly those utilizing advances in technology or vehicle design—or shifts in manufacturers' pricing strategies into their representations of choices and forecasts of future sales or market shares. For these reasons, most vehicle choice models have been better suited for analysis of the determinants of historical variation in sales patterns than for forecasting future sales, volumes and market shares of particular categories.

NHTSA has used this same elasticity in prior rulemakings. Estimates of this parameter reported in published literature vary widely,[280] and NHTSA believes that its choice is a reasonable one within this range, but NHTSA also presents sensitivity cases that explore higher and lower elasticities in PRIA Chapter 9. Chapter 4.2.1.2 of the Draft TSD further presents the evidence that NHTSA believes supports its decision. The agency seeks comment on this sales elasticity assumption—including whether NHTSA should consider applying separate short-run and long-run elasticity assumptions in the analysis. If commenters believe that an alternative assumption would be appropriate, NHTSA requests that they provide specific references to estimates in the econometric literature that would support such alternatives.

The third and final component of the sales model is the dynamic fleet share module (DFS). This analysis uses the DFS developed during the previous rulemaking. The baseline fleet share projection is derived from the agency's own compliance data for the 2024 fleet and from the 2025 AEO projections for subsequent model years. These shares are applied to the total industry sales derived in the first stage of the total sales model to estimate sales volumes of car and light truck body styles. NHTSA determines individual model sales using the following sequence: (1) individual manufacturer shares of each regulatory class (either passenger cars or light trucks) are multiplied by total industry sales of vehicles in that regulatory class and then (2) each vehicle within a manufacturer's volume of that regulatory class is assigned the same percentage share of that manufacturer's sales as in MY 2024. This assumes that consumer preferences for particular styles of vehicles are determined in the aggregate (*i.e.,* at the industry level), but that manufacturers' sales shares of those body styles are consistent with their MY 2024 sales. Within a given regulatory class, NHTSA assumes a manufacturer's sales shares of individual models are also constant over time.

This approach also implicitly assumes that manufacturers are currently pricing individual vehicle models within market segments in a way that maximizes their profit. Without more information about each manufacturer's true cost of production, including its fixed and variable components and its target profit margins for its individual vehicle models, there is no basis to assume that strategic shifts within a manufacturer's portfolio will occur in response to standards.

Similar to the second component of the sales module, the DFS applies an elasticity to the change in price between each regulatory alternative and the No-Action Alternative to determine the change in fleet share from its baseline value. NHTSA uses the net regulatory cost differential (costs minus fuel savings) in a logistic model to capture the changes in fleet share between passenger cars and light trucks, with a relative price coefficient of −0.000042. NHTSA selects this methodology and price coefficient based on a review of academic literature.[281] When the total regulatory costs for passenger automobiles of meeting standards minus the value of the resulting fuel savings exceed that of non-passenger automobiles, the market share of non-passenger automobiles will rise relative to passenger automobiles. For example, a $100 net regulatory cost increase in passenger automobiles relative to light trucks would produce around a 0.1-percent shift in market share towards light trucks, assuming the latter initially represent 60 percent of the fleet.

As discussed in preamble Section VI, the agency proposes to modify its regulatory definitions for vehicle classification starting with MY 2028. The agency takes account of this reclassification after it simulates the aggregate sales and dynamic fleet share responses to changes in vehicle prices. NHTSA assigns vehicles both an ''initial'' classification based on how they are classified under the current regulations and a ''revised'' classification for how they would be classified under the proposed regulations. The aggregate sales response is calculated at the fleetwide level, so regulatory classification only affects changes in sales insofar as a reclassified vehicle model incurs a different regulatory cost to comply with the requirements of its new regulatory class. For the dynamic fleet share model, the regulatory costs are borne by a vehicle's ''initial'' classification, so an SUV that is reclassified from the light truck fleet to the passenger car fleet has its regulatory costs for the dynamic fleet share analysis attributed to the light truck fleet throughout the analysis. This method assumes that each individual model's sales shares within the ''initial'' regulatory class remain constant. This may cause the counterintuitive effect of an increase in a vehicle's price, leading to an increase in that vehicle's sales. NHTSA considered applying its existing model to sales shares determined by the ''revised'' classification but decided against this due to the cross-elasticities used in this analysis being estimated based on the current classification system. NHTSA includes several sensitivity cases to explore different approaches, as presented in PRIA Chapter 9. NHTSA seeks comment on this approach and whether it is appropriate to apply the dynamic fleet share's price coefficient to the ''revised'' regulatory classes, and if not, if there is an alternative elasticity or methodology the agency could employ in its analysis.

(2) Scrappage

New and used vehicles can substitute for each other within broad limits. When the price of a good increases, so does the demand for its substitutes, causing the equilibrium price and quantity of substitutes supplied to rise. Because the proposal would lower the price of new vehicles, demand for used vehicles would decrease, causing the equilibrium market price for used vehicles to decrease and simultaneously increasing the rate at which used vehicles are retired. Because used vehicles are not manufactured, their supply only can be increased by keeping more of those that would otherwise be retired in use longer, which corresponds to a reduction in their scrappage or retirement rates. As older vehicles are used longer, the average age of the fleet rises and the safety risk to all road users likewise increases, because older vehicles are less safe than newer ones.

When new vehicles become more expensive, demand for used vehicles increases. Because used vehicles are more valuable in such circumstances, they are scrapped at a lower rate, and just as rising new vehicle prices push some prospective buyers into the used vehicle market, rising prices for used vehicles force some prospective buyers to acquire even older vehicles or models with fewer desired attributes. The effect of fuel economy standards on scrappage is partially dependent on how consumers value future fuel savings; NHTSA assumes consumers values only the first 36 months of fuel savings when making a purchasing decision.

Many competing factors influence the decision to scrap a vehicle, including the cost to maintain and operate it, the

[280] See Jacobsen, M. et al., The Effects of New-Vehicle Price Changes on New- and Used-Vehicle Markets and Scrappage, EPA–420–R–21–019 (2021), available at: *https://cfpub.epa.gov/si/si_public_record_Report.cfm?Lab=OTAQ&dirEntryId=352754* (accessed: Sept. 10, 2025) (reporting a range of estimates, with a value of approximately –0.4 representing an upper bound of this range). NHTSA selects this point estimate for the central case and explores alternative values in the sensitivity analysis.

[281] NHTSA describes this literature review and the calibrated logit model in more detail in the accompanying docket memo ''Calibrated Estimates for Projecting Light-Duty Fleet Share in the CAFE Model.''

household's demand for vehicle miles traveled (VMT), the cost of alternative means of transportation, and the value that can be attained through reselling or scrapping the vehicle for parts. In theory, a car owner will decide to scrap a vehicle when the value of the vehicle minus the cost to insure, register, maintain, and repair the vehicle is less than its value as scrap material; in other words, when the owner realizes more value from scrapping the vehicle than from continuing to drive it or from selling it. Typically, the owner that scraps the vehicle is not the original owner.

While scrappage decisions are made at the household level, NHTSA is unaware of sufficiently detailed household data to capture scrappage at that level. Instead, NHTSA uses aggregate data measures that capture broader market trends. In addition, the aggregate results are consistent with the rest of the CAFE Model, as the Model does not attempt to project manufacturers' pricing strategies; the Model assumes instead that all regulatory costs to make a particular vehicle compliant are passed on to the purchaser who buys the vehicle.

The dominant source of scrappage is ''engineering scrappage,'' which is largely determined by the age of a vehicle and the durability of the specific model year or vintage it represents. NHTSA uses proprietary vehicle registration data from S&P Global to estimate vehicle age and durability. Other factors affecting owners' decisions to retire used vehicles or retain them in service include fuel economy and new vehicle prices; for historical data on new vehicle transaction prices, NHTSA uses National Automobile Dealers Association (NADA) data.[282] The data consists of the average transaction price of all light-duty vehicles; because the transaction prices are not broken down by body style, the scrappage module may miss unique trends within a particular vehicle body style. The transaction prices reflect the amount consumers paid for new vehicles and exclude any trade-in value credited towards the purchase. This may be relevant particularly for pickup trucks, which have experienced considerable changes in average price as luxury and high-end options entered the market over the past decade. Future versions of the agency's scrappage module may consider incorporating price series that consider the price trends for cars, SUVs and vans, and pickups separately, and NHTSA asks commenters to identify any data or resources that could assist the agency in this pursuit.

Vehicle survival rates, which are determined over time by scrappage, follow a roughly logistic function with age—that is, when a vintage is young, few vehicles in the cohort are scrapped; as they age, more and more of the cohort are retired each year, and the annual rate at which vehicles are scrapped reaches a peak. Scrappage then declines as vehicles enter their later years, as fewer and fewer vehicles in the cohort remain on the road. The analysis uses a logistic function to capture this trend of vehicle scrappage with age. The data shows that the durability of successive model years generally increases over time; put another way, historically, newer vehicles last longer than older vintages. However, this trend is not constant across all vehicle ages—the instantaneous scrappage rate of vehicles is lower generally for more recent vintages up to a certain age, but must increase thereafter so that the final share of vehicles remaining converges to a similar share remaining for historically observed vintages.[283] NHTSA's scrappage model uses fixed effects to capture potential changes in durability across model years and ensures that vehicles approaching the ends of their lives are scrapped in the analysis.

The final source of vehicle scrappage is from cyclical effects, which the Model captures using forecasts of GDP and fuel prices. The macroeconomic conditions variables discussed above are included in the logistic model to capture cyclical effects. Finally, the change in new vehicle prices projected in the Model (technology costs minus 36 months of fuel savings and any tax credits passed through to the consumer) is included, and changes in this variable are the source of differing scrappage rates among regulatory alternatives. NHTSA seeks comment on its scrappage module and asks that commenters with any suggested revisions provide resources with sufficient detail to analyze alternative methodologies.

In addition to the variables included in the scrappage module, NHTSA considers several other potential variables that likely either directly or indirectly influence scrappage in the real world, including maintenance and repair costs, the value of scrapped metal, vehicle characteristics, the quantity of new vehicles purchased, higher interest rates, and unemployment. These variables are excluded from the scrappage module either because of difficulties in obtaining data to measure them accurately or other modeling constraints. Their exclusion from the module is not intended to diminish their importance but rather highlights the practical constraints of modeling intricate decisions like scrappage. NHTSA seeks comments on whether it should include any of these variables and, if so, requests that commenters suggest specific methodologies that would produce robust and unbiased estimates that could be used in a regulatory analysis setting.

NHTSA expects that the proposed reset would accelerate the retirement of older vehicles compared to the No-Action Alternative. Because the proposed standard would reduce the regulatory burden on manufacturers and by extension the price of new vehicles, the demand and price for used vehicles would decrease, which would incentivize households to replace the older vehicles that are costly to maintain with newer, cheaper options—including newer used vehicles.

c. Changes in Vehicle-Miles Traveled

As described in the fleet turnover section, fuel economy standards influence the quantity of new vehicles sold and how quickly older vehicles are retired. Model years of different vintages possess distinguishable characteristics, with newer vehicles typically being more fuel efficient and safer than their older contingents. While the decision itself to buy a new vehicle or retire an older vehicle may confer certain costs and benefits to their owners, most of the effects are realized only through the use of those vehicles. The agency's proposal to lower standards would accelerate fleet turnover compared to the baseline, which would result in more miles being driven in newer, safer vehicles compared to older, less safe vehicles. As a result, fewer miles would be driven in the oldest, least safe vehicles on the road, and the number of fatal accidents would be expected to decrease as well.

Deciphering which vehicles are being driven is just as important as how many miles are being driven. Any shift in miles driven by older vehicles to newer vehicles creates a corresponding shift in societal benefits, which include both safety and environmental benefits. To capture how CAFE standards influence the distribution of miles across the fleet, NHTSA estimates VMT based on the average use of vehicles at different ages, the total number of vehicles in use, and the composition of the fleet by ages.

[282] The data can be obtained from NADA. For reference, the data for MY 2024 may be found at *https://www.nada.org/nada/research-data/nada-data.*

[283] Some possible reasons for why durability may have changed are new automakers entering the market or general changes to manufacturing practices like switching some models from a car chassis to a truck chassis.

These three components—average vehicle usage, new vehicle sales, and older vehicle scrappage—jointly determine total VMT projections for each alternative.

VMT is determined by how much households want to drive and how much they can afford to do so. NHTSA believes that a significant portion of light-duty VMT is unaffected by fuel economy standards. Households have some basic level of travel demand that needs to be met such as driving to work or school, and those households will drive those miles regardless of the imposition that fuel economy standards may impose. NHTSA's perspective is that the total demand for VMT should not vary excessively across alternatives. To prevent large differences from arising among the regulatory alternatives, the agency constrains the aggregate amount of VMT—besides VMT attributable to the ''rebound effect''—across alternatives to be equal with the No-Action Alternative.

In prior rules, the agency used the Federal Highway Administration (FHWA) VMT Forecasting Model to project total VMT in future calendar years and then adjusted alternatives based on fleet composition. NHTSA employed this methodology because it used a reliable, external projection of annual VMT as a starting point. However, since the FHWA model includes miles that will be driven in dedicated automobiles, NHTSA reconsidered for this analysis how to calculate VMT.

The No-Action Alternative's projection of VMT for this proposal uses the simulated projections of the gas-powered fleet produced by the sales and scrappage models and applies it to estimates of VMT per vehicle. Vehicles of different ages and body styles have different costs to own and operate, and usage changes across vehicle ages independent of CAFE standards. To account properly for the average value of consumer and societal costs and benefits associated with vehicle usage under various alternatives, it is necessary to partition miles by age and body type. Using S&P Global odometer data, NHTSA creates ''mileage accumulation schedules'' as an initial estimate of how much a vehicle is expected to drive at each age throughout its life. The mileage accumulation schedules also account for differences in driving habits based on body style. Multiplying the numbers of each vehicle projected to be in the fleet by the per-vehicle VMT estimates from the mileage accumulation schedules creates a forecast of VMT in each calendar year.

The methodology to allocate miles within the regulatory alternatives is similar. NHTSA uses the forecasts of the fleet produced by the sales and scrappage models and multiplies those by mileage accumulation schedules to create a total estimate of VMT. NHTSA then scales the alternative's VMT to match the No-Action Alternative's aggregate VMT, preserving the percentage of VMT driven by each model.

NHTSA seeks comments on whether it should remove the VMT constraint and allow alternatives to have differing levels of VMT. While much of household VMT is likely inelastic, it may be reasonable to assume that fleets with differing sizes, age distributions, and inherent cost of operation may have marginally different annual VMT (even without considering VMT associated with rebound miles). In previous rules, NHTSA elected to continue to constrain VMT across alternatives in part because of the difficulty of determining whether VMT would shift to other modes of transportation and, if so, how to account for the impacts of any such mode shift. NHTSA seeks comments on whether it is appropriate to consider mode shifts if the agency removes the VMT constraints and asks commenters to provide either any data or suggested modeling approaches that could assist the agency.

An example of a portion of household travel that *is* elastic is known as ''rebound'' mileage. The fuel economy rebound effect—a specific example of the well-documented energy efficiency rebound effect for energy-consuming capital goods—refers to motorists who choose to increase vehicle use (as measured by VMT) when fuel economy is improved and, as a result, the cost per mile (CPM) of driving declines. If fuel economy increases, the cost to drive additional miles decreases, resulting in vehicles with better fuel efficiency being driven more. For the proposed rule, reducing the level of fuel economy required by government regulation would reduce the number of miles driven.

NHTSA has employed several different rebound effect estimates through the years. Until recently, the agency had historically used an estimate between 15 and 20 percent. The agency lowered its estimate in the 2022 final rule to 10 percent, a value that was also carried forward in the 2024 final rule. To support this proposal, NHTSA re-reviewed the literature related to the fuel economy rebound effect, which is extensive and covers multiple decades and geographic regions.[284] The totality of evidence, without artificially excluding certain studies based on arbitrary selection criteria, suggests that a plausible range for the rebound effect is 10–50 percent. This range implies that, for example, a 10-percent reduction in vehicles' fuel CPM would lead to an increase of between 1 to 5 percent in the number of miles they are driven annually. The central tendency of this range appears to be at or slightly above its midpoint, which is 30 percent. Considering only those studies that NHTSA believes utilize robust and reliable data, employ identification strategies that are likely to prove effective at isolating the rebound effect, and apply rigorous estimation methods, suggests a range of approximately 10–45 percent, with most of the estimates falling in the 15–30 percent range.

When NHTSA reviewed the literature for both the 2022 and 2024 rules, the agency arrived at a similar result. However, NHTSA chose to use an estimate at the lowest end supportable by the academic literature. NHTSA argued that both economic theory and empirical evidence suggested that the rebound effect was declining over time due to factors such as increasing income (which increases the value of travelers' time), progressively smaller reductions in fuel costs in response to continuing increases in fuel economy, and slower growth in car ownership and the number of license holders. The agency also noted that certain studies with lower estimates of the rebound effect were associated with recently published studies that rely on U.S. data, measure vehicle use using actual odometer readings, control for the potential endogeneity of fuel economy, and—critically—estimate the response of vehicle use to variation in fuel economy itself rather than to fuel cost per distance driven or fuel prices. The agency gave greater weight to these studies, which suggested a rebound effect in the 5–15 percent range.

Consistent with NHTSA's surveys of the latest available data for each successive CAFE analysis, as discussed above, the agency reconsidered for this analysis its prior assumptions about rebound effect trends discussed in the 2022 and 2024 final rules—in particular assumptions about the rebound effect declining over time—and concluded that a rebound estimate of 15 percent is appropriate. In particular, a meta-analysis of 74 recently published studies of the rebound effect noted that ''the magnitude of the rebound effect in

[284] Draft TSD Chapter 4.3.4 provides more information.

road transport can be considered to be, on average, in the area of 20 [percent],'' and that the most likely long-run estimate was about 32 percent[285]—both significantly higher than the agency's prior 10 percent-value and higher than the 15 percent-value employed in this analysis. The agency believes that selecting a rebound estimate that is well-supported by the scientific consensus is more appropriate than speculating about trends that have yet to manifest. NHTSA examines the sensitivity of estimated impacts to values of the rebound effect ranging from 10 to 20 percent to account for the uncertainty surrounding its exact value. NHTSA seeks comments on its approach to accounting for the rebound effect. For a more complete discussion of the rebound literature, refer to Draft TSD Chapter 4.3.4.

In order to calculate total VMT after allowing for the rebound effect, the CAFE Model applies the price elasticity of VMT (taken from the FHWA forecasting model) to the change in fuel cost per mile resulting from higher fuel economy and uses the result to adjust the initial estimate of each model's annual use accordingly. The CAFE Model applies this adjustment after the reallocation step described previously, because that adjustment is intended to ensure that total VMT is identical among alternatives *before* considering the contribution of increased driving due to the rebound effect. Its contribution differs among regulatory alternatives because alternatives requiring higher fuel economy lead to larger reductions in the per-mile fuel cost of driving and thus to larger increases in vehicle use.

To summarize, because the proposed standards would lower the cost of newer vehicles, more of the base household travel demand will be satisfied by safer, newer vehicles, and simultaneously, newer vehicles will have lower fuel economy, leading to fewer miles being driven and resulting in a further reduction in fatalities and fuel expenditures.

Chapter 4.3 of the Draft TSD provides more information on how NHTSA accounts for and models VMT.

[285] Dimitropoulos, A. et al., The Rebound Effect in Road Transport: A Meta-analysis of Empirical Studies, OECD Environment Working Papers, No. 113, OECD Publishing: Paris, France (2016), available at: *https://dx.doi.org/10.1787/8516ab3a-en* (accessed: Sept. 10, 2025).

d. Changes to Fuel Consumption

NHTSA uses the fuel economy, age, and VMT estimates to determine changes in fuel consumption. NHTSA divides the expected vehicle use by the anticipated mpg to calculate the gallons consumed by each simulated vehicle, and when aggregated, the total fuel consumed in each alternative.

F. Simulating Emissions Impacts of Regulatory Alternatives

Changes in fuel consumption because of changes in CAFE standards (and resulting technology application) will result in changes in emissions of various pollutants.[286] Vehicle-related emissions are computed by multiplying vehicle activity (*e.g.,* miles traveled, hours operated, or gallons of fuel burned), population (or number of vehicles), and emission factors. An emission factor is a representative rate that attempts to relate the quantity of a pollutant released to the atmosphere per unit of activity. As in past rules, the CAFE Model generates vehicle activity levels (both miles traveled and fuel consumption), while emission factors have been adapted from models developed and maintained by other Federal agencies.

This section provides a brief overview of how the agency estimates the resulting changes in emissions and associated effects from emissions of those pollutants.[287] In this section, emissions that are generated between the initial point of oil extraction and delivering fuel to vehicles' fuel tanks or energy storage systems are referred to as ''upstream'' emissions, while ''downstream'' emissions refer to those emitted by vehicles' exhaust systems, and also include other emissions generated during vehicle refueling, use, and inactivity (called ''soaking''), including hydrofluorocarbons leaked from vehicles' AC systems.[288] Emissions also include particulate matter released into the atmosphere by brake and tire wear (BTW), as well as evaporation of volatile organic compounds from fuel pumps and vehicles' fuel storage systems during refueling and when parked.

For the proposed rule, the agency updated upstream petroleum emission factors using R&D GREET 2024, a lifecycle emissions model developed by Argonne.[289] As in past analyses, the agency derived emission factors for the following four upstream emission processes for gasoline and diesel: (1) petroleum extraction; (2) petroleum transportation and storage; (3) petroleum refining; and (4) fuel transportation, storage, and distribution (TS&D). A detailed description of how the agency used R&D GREET 2024 to generate upstream emission factors appears in Chapter 5 of the Draft TSD. In this proposal, NHTSA uses a simplified parameterized economic model for estimating the response of domestic fuel production to changes in U.S. fuel consumption, as such responses also affect upstream emissions estimates related to the rule. Using this model, NHTSA estimates that 20 percent of the reduction in fuel consumption will be translated into reductions in domestic fuel production.

The agency estimated downstream emission factors for gasoline and diesel fuels for the majority of pollutants using EPA's MOVES5 model, a regulatory highway emissions inventory model developed by that agency's National Vehicle and Fuel Emissions Laboratory.[290] [291]

[286] The various pollutants include carbon monoxide (CO), volatile organic compounds (VOCs), nitrogen oxides (NO_X), sulfur oxides (SO_X), particulate matter with a diameter of 2.5-micron (µm) or less ($PM_{2.5}$), carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

[287] While NHTSA considers the impacts of this rulemaking on the levels of various pollutant emissions, the main analysis does not include a monetization of any changes in levels of carbon dioxide, methane, and nitrous oxide emissions. (An analysis using the domestic-only valuation of those emissions is included in a sensitivity case). Monetized changes in criteria pollutant emissions are discussed in the preamble Section II.G and Chapter 6.2.2 of the Draft TSD.

[288] Emissions from HFC leakage from air conditioner systems are not captured in the CAFE Model analysis due to limitations in the pollutants modelled by MOVES5.

[289] Argonne National Laboratory, The Research and Development Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (R&D GREET) Model 2024, Last revised: Jan. 2025, available at: *https://greet.anl.gov/* (accessed: Sept. 10, 2025).

[290] EPA, Motor Vehicle Emission Simulator: MOVES5, Office of Transportation and Air Quality, Last revised: Aug. 26, 2025, available at: *https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves* (accessed: Sept. 10, 2025).

[291] The one exception is that downstream CO_2 emission factors were generated based on the carbon content and mass density per unit of each specific type of fuel assuming each fuel's entire carbon content is converted to CO_2 emissions during combustion.

Currently, the MOVES5 methodology for projecting future emission inventories includes estimated effects from Federal emissions standards for light-duty vehicles, including EPA's CO_2 standards for MYs 2024–2026 and MYs 2027–2031. NHTSA conducted this analysis prior to EPA publishing its proposal to rescind its action titled ''Endangerment and Cause or Contribute Finding for Greenhouse Gases Under Section 202(a) of the Clean Air Act'' (Endangerment Finding) and all resulting greenhouse gas emissions standards for light-, medium-, and heavy-duty vehicles and engines [292] and is exploring options to update the relevant emission factors consistent with EPA's latest methodology for the final rule. For purposes of this proposal, NHTSA believes the existing model provides a reasonable basis for estimating emission inventories in response to the policy options analyzed but requests comments on this assumption.

Another update to the analysis that NHTSA is exploring is the methodology for applying downstream emission factors to vehicle classes within the CAFE Model. MOVES regulatory classes no longer directly map to the CAFE Model vehicle classes beginning in MY 2028, at which time NHTSA is proposing to subject vehicles to the amended vehicle classification definitions. Adjusting the downstream emission factors requires an understanding of the implications of reclassification on mapping regulatory and vehicles classes between MOVES and the CAFE Model. It is NHTSA's expectation that any modification of downstream emission factors will result in only minor changes in the magnitude of the relative differences among alternatives. Draft TSD Chapter 5.3 contains additional detail about how the agency generated the downstream emission factors used in this analysis, and Section VI presents additional information about NHTSA's proposals for vehicle reclassification beginning in MY 2028.

As with downstream emission factors, the agency generated BTW emission factors using the latest version of EPA's MOVES5 model.[293] NHTSA believes that compared to previous versions of MOVES, MOVES5's updated assumptions about brake pad composition and vehicle weights to estimate brake wear emissions that vary by model year, regulatory class, and fuel type present reasonable estimates for use in the agency's regulatory analysis. For further reading on BTW assumptions and how the agency employed those assumptions in the CAFE Model, please refer to Draft TSD Chapter 5.3.3.4. NHTSA seeks comments on this methodology.

The CAFE Model computes select health impacts resulting from localized population exposure to $PM_{2.5}$ and its precursor pollutants that are measured by the number of instances predicted to result from exposure to each ton of relevant pollutant.[294] As in past CAFE analyses, NHTSA relied on publicly available scientific literature to estimate $PM_{2.5}$-related effects for each upstream and downstream emissions source [295] and employed certain assumptions to determine the most reasonable approach to incorporate estimates from literature into the Model.[296] NHTSA includes additional discussion of the agency's approach to estimating these effects in Chapter 5.4 of the Draft TSD.

G. Simulating Economic Impacts of Regulatory Alternatives

The following sections describe NHTSA's approach for measuring the economic costs and benefits that would result from amending previously established CAFE standards. OMB Circular A–4 states that benefits and costs reported in regulatory analyses must be defined and measured consistently with economic theory and also should reflect how alternative regulations are anticipated to change the behavior of producers and consumers from a baseline scenario without the regulation.[297] Fuel economy standards affect vehicle manufacturers, buyers of new vehicles, owners of used vehicles, and suppliers of fuel, all of whom respond in complex ways to the standards that DOT establishes for future model years. NHTSA's accounting framework for the economic costs and benefits of CAFE standards was developed for a scenario in which standards are being set for cars and light trucks produced during future model years, for which no standards currently exist. Under this framework, NHTSA assumes hypothetical baseline standards for those future years to be identical to those in the last model year for which the agency previously established standards. Costs of alternative standards considered for future model years are measured relative to those for meeting the baseline standards, while benefits for each alternative are savings or other gains to buyers and users of new cars and light trucks or the general public, again measured in reference to the baseline alternative.

Most of the agency's rulemakings have established standards for future model years that are above their hypothetical baseline level, so the costs of meeting them have consisted primarily of manufacturers' outlays to increase the fuel economy of their car and light truck models to meet those higher standards, while benefits have consisted primarily of fuel savings for buyers and subsequent owners of models offering higher fuel economy. In rulemakings, such as this one, where the agency is proposing to *reduce* previously established standards for future model years due to updated economic, market, and technological realities, manufacturers' costs will be reduced compared to those for meeting the previous standards, while new cars and light trucks will consume more fuel

[292] Reconsideration of 2009 Endangerment Finding and Greenhouse Gas Vehicle Standards; Proposed Rule, 90 FR 36288 (2025), available at: *https://www.federalregister.gov/documents/2025/08/01/2025-14572/reconsideration-of-2009-endangerment-finding-and-greenhouse-gas-vehicle-standards* (accessed: Sept. 10, 2025).

[293] EPA, Brake and Tire Wear Emissions from Onroad Vehicles in MOVES5, EPA: Washington, DC, pp. 1–69 (2024), available at: *https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P101CTUW.pdf* (accessed: Sept. 10, 2025).

[294] As the health incidences for the different source sectors are all based on the emission of 1 ton of the same pollutants, NO_X, SO_X, and directly emitted $PM_{2.5}$, differences in the incidence per ton values arise from differences in the geographic distribution of each pollutant's emissions, which in turn affects the number of people exposed to the estimated concentrations of each pollutant.

[295] EPA, Estimating the Benefit per Ton of Reducing $PM_{2.5}$ Precursors from 17 Sectors, EPA: Washington, DC, pp. 1–108 (2018), available at: *https://19january2017snapshot.epa.gov/benmap/estimating-benefit-ton-reducing-pm25-precursors-17-sectors_.html* (accessed: Sept. 10, 2025); Fann, N. et al., Assessing Human Health $PM_{2.5}$ and Ozone Impacts from U.S. Oil and Natural Gas Sector Emissions in 2025, *Environmental Science & Technology,* Vol. 52(15): pp. 8095–103 (2018), available at: *https://doi.org/10.1021/acs.est.8b02050* (accessed: Sept. 10, 2025) (hereinafter, ''Fann et al.''); Wolfe, P. et al., Monetized Health Benefits Attributable to Mobile Source Emission Reductions Across the United States in 2025, *The Science of the Total Environment,* Vol. 650(Pt 2): pp. 2490–98 (2019), available at: *https://doi.org/10.1016/j.scitotenv.2018.09.273* (accessed: Sept. 10, 2025) (hereinafter, ''Wolfe et al.''). Health incidence per ton values corresponding to this paper were sent by EPA staff.

[296] Some CAFE Model upstream emissions components do not correspond to any single EPA source sector identified in available literature, so NHTSA determined the most reasonable approach was to use a weighted average of different source sectors to generate those values. NHTSA is also aware that EPA in 2023 updated its estimated benefits for reducing $PM_{2.5}$ from several sources, but those do not include mobile sources (which include the vehicles subject to CAFE standards). NHTSA has thus retained the $PM_{2.5}$ incidence per ton values from the previous CAFE analysis for consistency with the current mobile source emissions estimates.

[297] Office of Management and Budget, Circular A–4 (Sept. 17, 2003), available at: *https://www.whitehouse.gov/wp-content/uploads/2025/08/CircularA-4.pdf* (accessed Sept. 10, 2025).

than if those previous standards remained in place.

Thus, the estimated costs of meeting the revised standards are reported as negative values—representing regulatory cost savings—while vehicle buyers' increased costs for fuel are similarly reported as negative benefits. When the agency has historically raised CAFE standards, it has assumed that manufacturers' costs to increase fuel economy would be passed on to buyers as increased purchase prices for new models, and the analysis supporting this proposed rule assumes that reduced costs to manufacturers for meeting less demanding CAFE standards will be reflected in lower prices for new cars and light trucks.

NHTSA's approach to estimating the economic impacts of regulatory alternatives it considers in this rulemaking, including the assumptions it relies upon and the methodologies it employs, is discussed in detail in Chapter 6 of the Draft TSD and throughout the PRIA (particularly Chapter 5). The safety implications of the proposed rule, including monetary measures of those impacts, are covered in Section II.H below.

Regulatory analysis needs to express costs and benefits that occur at different future times in comparable terms, which is done by discounting each future year's impacts to their present values. Following guidance presented in OMB Circular A–4 (2003), NHTSA presents the current values of all economic impacts quantified in its regulatory analysis discounting using the recommended rates of 3 and 7 percent.

The categories of economic costs and benefits resulting from NHTSA's proposed amendment to its previously established CAFE standards are described in Chapter 5 of the PRIA (see in particular Table 5–1). Monetary values of those estimates are presented in Chapter 8 (for the central analysis) and Chapter 9 (showing the results of various sensitivity analyses around key parameters and assumptions) of the accompanying PRIA.

Table II–8 below lists the economic benefits and costs analyzed in conjunction with this proposal and identifies where to find explanations of how they were estimated. The organization of the table shows how individual elements of the analysis are grouped together to produce NHTSA's estimates of each alternative's private and external costs and benefits.[298] Private benefits and costs are those borne by vehicle manufacturers and by users of new cars and light trucks, including their initial purchasers and subsequent owners. External costs and benefits result indirectly from producing and consuming fuel and are borne by the public rather than just those who purchase and use vehicles. Social costs and benefits are the sum of their private and external components.

[298] Changes in tax revenues are a transfer and not an economic externality as traditionally defined, but NHTSA groups tax revenue changes together with other external costs because fuel taxes fund government activities affecting society as a whole rather than only consumers or manufacturers.

Table II-8: Benefits and Costs Resulting from NHTSA's Regulatory Action[299]

Entry	Section of Preamble Discussion	Chapter of Draft TSD Modeling Explanation	Chapter of PRIA Discussion
Private Costs			
Technology Costs	II.G.1.a(1)	Chapter 6.1	Chapter 7.1.1
Consumer Surplus Loss	II.G.1.a(2)	Chapter 6.1.2	Chapter 7.1.4
Maintenance and Repair Costs	II.G.3	-	Chapter 7.1.1
Sacrifice in Other Vehicle Attributes	II.G.1	Chapter 6.1.3	Chapters 7.1.1
Safety Costs Internalized by Drivers	II.H.3	Chapter 7.5	Chapters 7.1.5, 8.5.5
Subtotal—Internal Costs or Cost Savings			
External Costs			
Congestion and Noise Costs From Rebound-Effect Driving	II.G.2.a(1)	Chapter 6.2.3	Chapter 7.2.2, 8.4.2
Loss in Fuel Tax Revenue	II.G.2.a(2)	Chapters 6.1.4, 6.2	Chapter 7.3.1
Safety Costs Not Internalized by Drivers	II.H.1 and II.H.2	Chapter 7	Chapters 7.1.5, 8.5.5
Subtotal—External Costs or Cost Savings			
Total Costs or Cost Savings			
Private Benefits			
Fuel Cost Savings[300]	II.G.1.b(1)	Chapter 6.1.4	Chapter 7.3.1
Refueling Frequency	II.G.1.b(2)	Chapter 6.1.5	Chapter 8.4.2
Benefits From Additional Driving	II.G.1.b(3)	Chapter 6.1.6	Chapter 7.2.1
Subtotal—Private Benefits			
External Benefits			
CO_2, methane (CH_4), and N_20 Emissions	II.G.2.b(1)	Chapter 6.2.1	Chapter 8.5.1
Health Outcomes	II.G.2.b(2)	Chapter 6.2.2	Chapter 8.4.1
Petroleum Market Security	II.G.2.b(3)	Chapter 6.2.4	Chapter 7.3.2

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Subtotal—External Benefits			Sum of above entries
Social Benefits			Sum of private and external benefits
Net Private Benefits		Private Benefits – Private Costs	
Net External Benefits		External Costs – External Benefits	
Net Social Benefits		Social Benefits – Social Costs	

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The remainder of this section briefly describes the key economic impacts of the proposed amendment and explains how they are categorized within the PRIA (with the exception of safety costs, which as noted earlier are covered in Section II.H).

1. Private Costs and Benefits

Manufacturers' efforts to meet CAFE standards consist primarily of adding new technology to their car and light truck models, and together with any necessary design or engineering modifications, this increases their production costs. NHTSA assumes manufacturers pass these costs on to buyers of models that offer higher fuel economy by raising their selling prices.[301] While the agency incorporates the effects of available tax credits in its analysis, these credits simply transfer revenue from taxpayers to vehicle buyers and have no net effect on the benefits or costs of the proposed rule. Estimates of technology costs reported throughout this proposed rule should be interpreted as excluding the value of tax credits unless otherwise noted.

Resetting prevailing CAFE standards would reduce the cost of technology that manufacturers would need to add to their car and light truck models in order to comply with CAFE standards, and NHTSA assumes that this reduction in regulatory costs would be passed through to vehicle buyers in the form of lower prices. Relaxing standards would reduce the regulatory burden on manufacturers and enable them to produce models that offer combinations of fuel economy, other features, and prices that align more closely with consumer demand, resulting in higher vehicle sales compared to the No-Action Alternative. The CAFE reset would improve consumer welfare for consumers who are able to purchase vehicles at lower prices, and their collective welfare gain is measured by the increase in consumer surplus from higher sales of new cars and light trucks. Consumer surplus represents the value a good or service provides to consumers (the maximum they would have been willing to pay for it) over and above its market price, and OMB guidance states that it should be accounted for in regulatory analysis.[302] Resetting previous standards will keep would-be purchasers from being priced out of the new vehicle market as manufacturers raise prices to recover their costs for applying more technology to meet higher standards, so buyers' consumer surplus will increase as sales rise rather than decline as it would have with the higher fuel economy standards in the No-Action Alternative. Section II.C.2.f of this preamble and Chapter 2.4 of the Draft TSD provide more details.

Generally, NHTSA's CAFE rulemaking analyses include estimates of benefits to consumers from improving fuel economy, measured by the resulting reduction in vehicles' fuel costs. However, while improved fuel economy reduces vehicles' fuel cost throughout their lifetimes, new car buyers and subsequent owners do not appear to value those savings fully. If they did, manufacturers would presumably offer the levels of fuel economy that buyers demand, and market-determined fuel economy levels would balance the costs of improving it against the private benefits from saving fuel. To the extent regulating fuel economy does not improve the welfare of vehicle owners, regulation can only be justified if it produces additional benefits that are not experienced by buyers themselves. As discussed in II.E, NHTSA assumes that consumers are only willing to pay for fuel economy improvements that repay the higher prices of models offering those improvements within 36 months.

In past rulemakings, the agency has described its assumption that buyers will forgo purchasing vehicles with higher fuel economy, even when they appear to offer future savings exceeding their price premiums, as an example of what is often termed an ''energy paradox'' or ''energy-efficiency gap.'' Although there has been extensive debate about whether and why such a gap might arise, NHTSA has recently justified stricter standards partly by assuming that potential car and light truck buyers act shortsightedly when they refuse to purchase models whose lower fuel costs would more than repay their higher purchase prices. This rationale is fundamentally different from the agency's traditional justification that fuel economy standards are necessary to remedy some ''externality''—whereby buyers' choices cause economic harm to others—that arises from producing and consuming fuel.

Without clear evidence of such ''myopia,'' continuing to raise CAFE standards distorts the market by constraining manufacturers to provide levels of fuel economy above those consumers demand, causing manufacturers to raise prices to recover their higher costs for producing those vehicles or to sacrifice improvements in their models' other features. Instead, the agency increasingly believes a more likely explanation for buyers' reluctance to purchase higher mpg models is that their unsatisfactory combinations of price and other features offset the attraction of lower fuel costs, and recent

[299] This table presents the societal costs and benefits. Costs and benefits that affect only the consumer analysis, such as sales taxes, insurance costs, and reallocated VMT, are intentionally omitted from this table. Chapters 8.2.3 and 8.3.3 of the PRIA describe consumer-specific costs and benefits.

[300] Since taxes are transfers from consumers to governments, a portion of the Savings in Retail Fuel Costs includes taxes avoided. The Loss in Fuel Tax Revenue is completely offset within the Savings in Retail Fuel Costs.

[301] While NHTSA recognizes that some manufacturers may defray their regulatory costs for meeting increased fuel economy standards through more complex pricing strategies, the agency lacks sufficient insight into manufacturers' pricing strategies to analyze such alternative approaches.

[302] OMB's Circular A–4 explains that the ''net reduction in the total surplus (consumer plus producer) is a real cost to society,'' and recommends that changes in consumer or producer surplus should be monetized ''when they are significant.''

research supports this interpretation.[303] Chapter 6.1.3 of the Draft TSD provides further detailed review of this research. NHTSA has acknowledged this potential ''opportunity cost'' of raising fuel economy standards in its recent rules but has attempted to estimate its magnitude only as one of a large number of sensitivity analyses. The agency has justified this decision by claiming there is uncertainty in the literature over the degree to which requiring higher fuel economy will lead manufacturers to delay or forgo improvements to their models' features and how consumers would react. NHTSA has also cited data from EPA's Fuel Economy Trends Report showing that HP and acceleration have not decreased even when fuel economy standards were rising. However, these arguments did not consider the possibility that manufacturers could have offered *further improvements* in their models' other features or lower prices without continuing pressure to increase fuel economy.

NHTSA includes an estimate of the extent to which relaxing standards will reduce the opportunity cost of meeting previously established standards in its primary analysis of this proposed rule. The agency assumes that this cost must be sufficient to account for buyers' apparent unwillingness to purchase models whose higher fuel economy would repay their higher purchase prices. NHTSA estimates the opportunity cost as the value of fuel savings consumers are unwilling to pay for voluntarily that accrues between years 4 and 10 of a vehicle's life.[304] In practice, manufacturers will respond to lower standards by adjusting the technologies they add to vehicles as well as by altering the tuning of these technologies and mix of vehicles in their production fleets, with the goal of increasing profits. For individual vehicle models this could result in a pure cost reduction, an improvement in other vehicle features, or a combination of the two.[305] At the vehicle level, NHTSA's estimates of changes in costs and other vehicle attributes could be over- or under-estimates. However, at the aggregate level it is reasonable to assume, as NHTSA does, that there is likely to be a combination of lower technology costs and a reduction in the implicit opportunity cost relative to the No-Action Alternative. Chapter 6.1.3 of the Draft TSD includes a detailed description of the agency's method for developing this measure, including its assumptions about manufacturers' anticipated response; the agency seeks comments on its approach as well as suggestions for improving it.

Resetting previously established CAFE standards will permit lower fuel economy for some new cars and light trucks, thus increasing their fuel consumption and raising their owners' fuel costs accordingly. The difference between fuel consumption in the No-Action Alternative and in each regulatory alternative represents that alternative's effect on total fuel use, and the cost of this additional consumption is estimated using forecasts of retail fuel prices. The agency's assumptions about future fuel prices are discussed in detail in Chapter 4.1.2 of the Draft TSD.

Lowering existing standards will lead to relatively shorter driving ranges of models that achieve lower fuel economy in the action alternatives, requiring their users to refuel more frequently than under the No-Action Alternative. Drivers (and passengers) of future new cars and light trucks will economize on refueling stops as fuel economy increases over time under each regulatory alternative. However, their savings will be more modest than under the No-Action Alternative, so it appears as an incremental increase in the frequency of refueling stops in the analysis. NHTSA estimates the cost of more frequent fill-ups by calculating the amount of time it takes to locate a retail outlet, refuel one's vehicle, and pay, accounting for the typical number of passengers traveling with the driver, and multiplying by DOT's recommended value of travel time. For a full description of the agency's methodology, refer to Chapter 6.1.5 of the Draft TSD. The agency seeks comment on whether, and the extent to which, a reasonable manufacturer may simply install a larger fuel tank—potentially eliminating any refueling time savings.

Under the regulatory alternatives, new car and light truck models that achieve lower fuel economy would be driven slightly less than in the No-Action Alternative, as their higher fuel cost reduces the fuel economy rebound effect described in preamble Section II.E.1.c. Again, the proposed rule would continue to raise fuel economy standards but at a slower rate than under the No-Action Alternative. For example, while vehicle use would continue to increase under each regulatory alternative, it would increase more slowly than under the No-Action Alternative. Additional driving enables buyers of new cars and light trucks to travel more frequently or reach more desirable destinations, but because vehicle use would grow more slowly, these benefits would be more modest when CAFE standards are reset.[306]

In addition to the private costs and benefits described above, Table II–8 includes maintenance and repair cost savings as a line item without an associated dollar value; the agency expects the proposed reset of CAFE standards to reduce technology requirements for meeting the new standards and thus to lower buyers' costs to repair and maintain new vehicles. However, the agency does not currently possess robust data to quantify maintenance and repair costs in the analysis. NHTSA requests comments on whether the agency should include estimates of repair and maintenance costs—and that interested commenters provide sufficiently robust data to support an informed analysis.

NHTSA also is aware that alternative approaches based on revealed preference have been used to estimate the implicit compliance cost of similar vehicle regulations.[307] Observed

[303] For example, Leard et al. (2023) finds that consumers value performance improvements at three times the rate at which they value improvements in fuel economy and that forgone improvements in performance from recent changes in CAFE standards have essentially offset consumer welfare improvements from the fully valued savings in fuel costs. Klier and Linn (2016) find that if performance trade-offs resulted from a hypothetical 10-percent increase in regulatory stringency, U.S. consumers would value the resulting fuel economy gains at levels approximately 65–85-percent greater than their willingness to pay for any associated forgone horsepower. Reynaert (2020) finds that the European Union's emission standards caused manufacturers to choose between fuel economy and performance, and that the standards were ultimately not welfare improving. In addition to forgoing technological improvements that would improve performance, economists have also modeled manufacturers trading off performance for fuel economy at a fixed level of technology in order to reduce compliance costs (Whitefoot et al. 2017).

[304] As explained in Chapter 6.1.3 of the Draft TSD, consumers value the first 10 years of discounted fuel savings but are unwilling to pay for more than 3 years, because the value of fuel savings during years 4 through 10 is offset by the cost of sacrifices in improvements to vehicles' other attributes.

[305] As explained in Draft TSD Chapter 2.3.5, NHTSA attempts to maintain performance neutrality when a technology is applied to a vehicle so that the change is only applied to improving fuel economy.

[306] NHTSA does not estimate benefits associated with reallocating travel among vehicles of different ages, because there is no associated change in total VMT until the rebound effect is introduced. Chapter 6.1.5 of the Draft TSD explains NHTSA's methodology for reallocating travel and discusses whether any benefits would result as well as how they would be measured. NHTSA seeks comment on its methodology for calculating the benefits from reallocated mileage, as well as on whether it is reasonable to assume that reduced sales of new vehicles leads to a transfer of some travel to older models and any welfare implications of such a transfer.

[307] EPA, Reconsideration of 2009 Endangerment Finding and Greenhouse Gas Vehicle Standards, Draft Regulatory Impact Analysis, Appendix B

behavior also shows that consumers prefer vehicles with fuel economy technologies added only if fuel savings exceed the technology costs within a fairly short period, despite the fact that estimated lifetime fuel costs are conspicuously printed on the Monroney window sticker. Analyses that rely on revealed preferences may better capture consumer preferences and the potential costs imposed by regulations than an engineering-based approach. NHTSA has included an alternative analysis of the benefits and costs of the proposed rule in Appendix II applying a revealed preference approach and seeks comment on the assumptions, methodology and data sources used in this analysis.

2. External Costs and Benefits

In general, NHTSA's CAFE rulemakings set standards for which there are no existing standards and require manufacturers to improve fuel economy. Higher fuel economy standards increase vehicle use via the rebound effect and contribute to increased traffic congestion and highway noise. These impacts are largely felt by other road users (and nearby residents) rather than the drivers generating additional mileage. Conversely, resetting previous CAFE standards will reduce fuel economy levels compared to the No-Action Alternative, and the resulting reduction in travel will lower the external costs that congestion and noise impose on others. NHTSA estimates these impacts by updating per-mile congestion and noise costs from increased automobile and light truck use originally reported in FHWA's 1997 Highway Cost Allocation Study to account for changes in congestion levels, travelers' value of time, and inflation, an approach it also used for the 2020, 2022, and 2024 final rules.

Part of the change in new car and light truck buyers' costs for fuel represents changes in tax revenue received by Federal, state, and some local government agencies. Any variation in the fuel tax burden on drivers is exactly offset by changes in tax revenues, so this transfer does not affect net benefits from changing CAFE standards. However, NHTSA estimates those offsetting changes in drivers' fuel tax payments and tax revenue received by government agencies to highlight this transfer and show its potential impact on government finances.

Fuel production, distribution, and use generate emissions of certain ''criteria'' or regulated pollutants, and the population's exposure to these pollutants causes adverse effects on public health. Raising or lowering CAFE standards affects these emissions by changing the volume of fuel produced and consumed, and NHTSA estimates these changes in emissions and their economic consequences for public health. The CAFE Model estimates monetized health effects associated with population exposure to fine particulate matter, which is emitted directly by refineries and vehicles and also formed in the atmosphere via physical and chemical reactions involving other regulated pollutants emitted by refining and using fuel.[308] Chapter 5 of the Draft TSD accompanying this proposed rule includes a detailed description of the Model's procedures for calculating emissions of these pollutants and assessing their consequences for public health.

NHTSA does not include monetized estimates of changes in so-called greenhouse gas (GHG) emissions in the central analysis.[309] There are significant uncertainties related to the monetization of GHGs that include, but are not limited to: the magnitude of the change in climate due to a change in GHG emissions; the relationship between changes in the climate and the economy and, therefore, the resulting economic impacts; future economic and population growth, which are important for estimating vulnerability, willingness to pay to avoid impacts, and the ability to adapt to future changes; future technological advancements that would reduce vulnerability and impacts; the share of impacts from GHG emissions that affect citizens and residents of the United States; and the appropriate discount rates to use when discounting in an intergenerational context.

Due to the many uncertainties related to monetizing impacts of changes in GHG emissions, NHTSA does not monetize these impacts in the central analysis. Monetizing these impacts could potentially result in flawed decision-making due to overreliance on highly uncertain values. To confirm that NHTSA's exclusion of this value does not bias the cost-benefit analysis that informs NHTSA's determination of maximum feasible standards, and in accord with the decision in *Center for Biological Diversity* v. *NHTSA,*[310] NHTSA has included a sensitivity case in PRIA Chapter 9 using the domestic-only monetization of the GHG estimate that was previously used in the 2020 final rule.

Resetting CAFE standards would increase domestic consumption of gasoline compared to the regulatory baseline, producing a corresponding increase in the Nation's demand for crude petroleum. The U.S. accounts for a significant share of global oil consumption, so the resulting increase in global petroleum demand will exert some upward pressure on worldwide prices, but the financial consequences of higher prices are transfers that do not affect economic welfare. Unlike in decades past, when the U.S. was heavily dependent upon foreign petroleum and therefore broadly exposed to price shocks attributable to supply disruption, the U.S. is now an established net exporter of petroleum. Accordingly, while domestic petroleum production does not completely insulate the U.S. from international disruptions in petroleum generation, any transfer from global consumers to petroleum producers becomes a financial benefit to the U.S. economy.

Higher U.S. petroleum consumption increases all domestic consumers' exposure to the risks of potential rapid increases in oil prices and interruptions in petroleum imports, although rising domestic production cushions the latter's effect. Individual petroleum users are unlikely to consider the effect of their own consumption on such economy-wide risks, so they may unwittingly impose costs on others that increase with domestic petroleum use. NHTSA includes this effect as a cost of the proposed standards, and Chapter 6.2.4.4 of the Draft TSD explains how the agency estimates its magnitude.

Some analysts assert that raising or lowering petroleum imports may also influence U.S. military spending, but most careful studies conclude that

(2025), available at: *https://www.epa.gov/system/files/documents/2025-07/420d25003.pdf* (accessed: Sept. 10, 2025).

[308] As discussed in Section II.F above, although other criteria pollutants are currently regulated, only impacts from these three pollutants are calculated since they are emitted regularly by refineries and motor vehicles, cause the most severe effects on human health, and have been the subject of extensive research to quantify and monetize their health impacts. NHTSA's regulatory analysis does not attempt to quantify the adverse health effects of air toxics, which are emitted during fuel production and use, or ozone, which is formed in the atmosphere by emissions of regulated pollutants.

[309] E.O. 14154, Unleashing American Energy (Jan. 20, 2025), available at: *https://www.govinfo.gov/content/pkg/DCPD-202500121/pdf/DCPD-202500121.pdf* (accessed: Sept. 10, 2025); Office of Information and Regulatory Affairs, Guidance Implementing Section 6 of Executive Order 14154, ''Unleashing American Energy,'' M–25–27 (May 5, 2025), available at: *https://www.whitehouse.gov/wp-content/uploads/2025/02/M-25-27-Guidance-Implementing-Section-6-of-Executive-Order-14154-Entitled-Unleashing-American-Energy.pdf* (accessed: Sept. 10, 2025).

[310] *Ctr. for Biological Diversity* v. *Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1198 (9th Cir. 2008).

changes in petroleum use on the scale likely to result from changing CAFE standards are unlikely to affect military activity. Thus, as Chapter 6.2.4.5 of the Draft TSD explains in detail, NHTSA does not consider the potential impact of changing CAFE standards on military spending.

NHTSA is also monitoring the availability of critical minerals used in electrified powertrains and whether any shortage of such materials could emerge as an additional energy security concern. While nearly all electricity in the United States is generated through the conversion of domestic energy sources and thus its supply does not raise security concerns, EVs (as well as hybrids and plug-in hybrids) also require batteries to store and deliver that electricity. Currently, the most common EV battery chemistries include relatively scarce materials (compared to other automotive parts) which are sourced, in large part, from foreign adversaries or potentially insecure or unstable overseas sites. While all mined materials (including those in vehicles powered by ICEs) can pose environmental challenges during extraction and conversion to usable material, this is particularly true with minerals used in battery production. Known supplies of some of these critical minerals are also highly concentrated in a few countries and therefore face similar market power concerns to petroleum products.

NHTSA is restricted from considering the fuel economy of alternative fuel sources in determining CAFE standards, so the agency only considers the gasoline powered fleet in simulating compliance with fuel economy regulatory alternatives and determining their effects. While the cost of critical minerals may affect the cost to supply both plug-in and non-plug-in hybrids that require larger batteries, this would apply primarily to manufacturers whose voluntary compliance strategy emphasizes hybridization. NHTSA does not include costs or benefits related to these emerging energy security considerations in its analysis for its proposal because, as noted above, pursuant to its statutory authority to set CAFE standards, NHTSA cannot consider alternative fueled vehicles when setting standards.

The analysis considers the direct labor effects that the proposed standards would have across the automotive sector. The effects include: (1) dealership labor related to new light-duty sales; (2) assembly labor for new vehicles, engines, and transmissions; and (3) labor for developing and producing technologies that improve fuel economy but exclude any broader implications of fuel economy standards for economy-wide employment. NHTSA has used this approach in several recent rulemakings but has not highlighted its results because of its limited scope and the uncertainty introduced by rapidly changing labor inputs for vehicle assembly and technology development. NHTSA seeks comment on alternative approaches to the labor analysis that the agency could consider, including approaches that could supplement the agency's current approach or succeed it in future rulemakings. Chapter 6.2.5 of the Draft TSD describes the current process NHTSA uses to estimate labor impacts in additional detail.

H. Simulating Safety Effects of Regulatory Alternatives

Fuel economy standards have the potential to lead manufacturers to alter the vehicles they produce in ways that may have unintended consequences for motor vehicle safety. The analysis accompanying the proposal includes a comprehensive measure of safety impacts from three sources:

• Changes in Vehicle Mass

NHTSA calculates the safety impact of changes in vehicle mass made to reduce fuel consumption to comply with the standards. Statistical analysis of historical crash data indicates reducing mass in heavier vehicles generally improves safety for occupants in lighter vehicles and other road users such as pedestrians and cyclists, while reducing mass in lighter vehicles generally reduces safety.

• Impacts of Vehicle Prices on Fleet Turnover

Vehicles have become safer over time through a combination of new safety regulations and voluntary safety improvements. NHTSA expects this trend to continue as emerging technologies, such as advanced driver assistance systems, are incorporated into new vehicles. Safety improvements will continue regardless of changes in the standards. Vehicle technologies added to comply with increased fuel economy standards increase vehicle prices, slowing the acquisition of newer vehicles and retirement of older ones.

The standards also influence the composition of the new light-duty sales mix. As the safety of light trucks, SUVs, and passenger cars is affected by technologies that manufacturers employ to meet the standards differently—particularly MR—fleets with different compositions of body styles have varying safety risks. Therefore, changing the share of each type of light-duty vehicle in the projected future fleet impacts safety outcomes.

• Changes in Safety Associated With ''Rebound Effect'' Driving

The ''rebound effect'' predicts consumers will drive more when the cost of driving declines. More stringent standards reduce vehicle operating costs, and in response, some consumers may choose to drive more. Additional driving increases exposure to risks associated with motor vehicle travel, and this added exposure translates into higher fatalities and injuries. Slowing vehicle turnover results in an older fleet on average. As a result, this slowing turnover exacerbates the safety costs of additional driving resulting from the ''rebound effect.''

Resetting the CAFE standards as proposed would improve safety overall. Setting less stringent standards would accelerate fleet turnover, limit the amount of rebound driving, and reduce the need to apply MR across the fleet.

The contributions of the three factors described above generate the differences in safety outcomes among regulatory alternatives. NHTSA's analysis makes extensive efforts to allocate the differences in safety outcomes between the three factors. Fatalities expected during future years under each alternative are projected by deriving a fleetwide fatality rate (fatalities per VMT) that incorporates the effects of differences in each of the three factors from the reference baseline and then multiplying it by that alternative's expected VMT. Fatalities are converted into a societal cost by multiplying estimated fatalities by the DOT-recommended value of a statistical life (VSL), supplemented by additional economic costs not considered in VSL measurements. Traffic injuries and property damage are also modeled directly using the same process and valued using costs specific to each injury severity level.

All three factors influence predicted fatalities, but only two of them—changes in vehicle mass and in the composition of the light-duty fleet in response to changes in vehicle prices—impose increased risks on drivers and passengers not compensated for by accompanying benefits. In contrast, increased driving associated with the rebound effect is a consumer choice that reveals the benefits of additional travel. Consumers who choose to drive more have decided that the utility of additional driving exceeds the additional costs for doing so, including the crash risk that they perceive additional driving involves. As discussed in Chapter 7 of the Draft TSD, the benefits of rebound driving are accounted for by offsetting a portion of the added safety costs.

NHTSA's analysis considers the safety impact to both vehicle occupants and non-occupants, such as pedestrians and cyclists. The agency categorizes safety outcomes through three measures of light-duty vehicle safety: fatalities occurring in crashes, serious injuries, and the amount of property damage incurred in crashes with no injuries. Counts of fatalities among occupants of automobiles and non-occupants are obtained from NHTSA's Fatal Accident Reporting System for 1975–2022. Estimates of the number of serious injuries to drivers and passengers of light-duty vehicles are tabulated from NHTSA's General Estimates System (GES) for 1990–2015, and from its Crash Report Sampling System (CRSS) for 2016–2021. Both GES and CRSS include annual samples of motor vehicle crashes occurring throughout the United States. Weights for different types of crashes were used to expand the samples of each type to estimates of the total number of crashes occurring during each year. Finally, estimates of the number of automobiles involved in property damage-only crashes each year were also developed using CRSS.

NHTSA does not anticipate, and does not model, any changes in safety from the proposed changes in vehicle classification. A vehicle's safety performance is unrelated to its CAFE vehicle classification; instead, the safety risk is dependent on its physical attributes, the safety technologies incorporated, and how the vehicle is used.

1. Mass Reduction Impacts

Vehicle MR can be one of the more cost-effective means of improving efficiency, particularly for makes and models built with less high-strength steel or aluminum closures or low-mass components. Manufacturers have stated that they would continue to reduce mass of some of their models to meet more stringent standards (such as those currently in place), and therefore, this expectation is incorporated into the modeling analysis supporting the proposal. Safety trade-offs associated with MR have occurred in the past, particularly before standards were attribute-based, because manufacturers chose, in response to standards, to build smaller and lighter vehicles; these smaller, lighter vehicles did not fare as well in crashes as larger, heavier vehicles, on average. Although NHTSA now uses attribute-based standards, in part to reduce or eliminate the incentive to downsize vehicles to comply with the standards, NHTSA is mindful of the possibility of related safety trade-offs. For this reason, NHTSA accounts for how the application of MR to meet standards affects the safety of a specific vehicle given changes in GVWR.

For this proposed rule, the agency employed the modeling technique, developed in the 2016 Puckett and Kindelberger report, to analyze the updated crash and exposure data by examining the cross sections of the societal fatality rate per billion VMT by mass and footprint, while controlling for driver age, gender, and other factors, in separate logistic regressions for five vehicle groups and nine crash types. NHTSA utilized the relationships between weight and safety from this analysis, expressed as percentage increases in fatalities per 100-pound weight reduction (which is how MR is applied in the technology analysis; see Section II.D.2.e), to examine the weight impacts applied in this analysis. The effects of MR on safety were estimated relative to (incremental to) the regulatory baseline in the analysis, across all vehicles for MY 2024 and beyond. The analysis of MR includes two opposing impacts.

Research has consistently shown that MR affects "lighter" and "heavier" vehicles differently across crash types. The 2016 Puckett and Kindelberger report found MR concentrated among the heaviest vehicles is likely to have a beneficial effect on overall societal fatalities, while MR concentrated among the lightest vehicles is likely to have a detrimental effect on occupant fatalities but a slight benefit to pedestrians and cyclists. This represents a relationship between the dispersion of mass across vehicles in the fleet and societal fatalities: decreasing dispersion is associated with a decrease in fatalities. For collisions with large mass disparities, MR in heavier vehicles would be more beneficial to the occupants of lighter vehicles than it would be harmful to the occupants of the heavier vehicles. MR in lighter vehicles is more harmful to the occupants of lighter vehicles than it is beneficial to the occupants of the heavier vehicles.

To capture the differing effect on lighter and heavier vehicles accurately, NHTSA splits vehicles into lighter and heavier vehicle classifications in the analysis. However, this poses a challenge to creating statistically meaningful results. There is limited relevant crash data to use for the analysis. Each partition of the data reduces the number of observations per-vehicle classification and crash type and thus reduces the statistical robustness of the results. The methodology employed by NHTSA was designed to balance these competing forces as a trade-off to capture the impact of mass-reduction across vehicle CWs and crash types while preserving the potential to identify robust estimates.

While the mass-size-safety coefficients employed in the analysis are not statistically significant at the 95th-percent confidence level, multiple coefficients are significant at the 85th-percent confidence level, and, to NHTSA's best knowledge, represent the most robust and accurate representation of the safety impact of MR. It is essential for NHTSA, as a safety agency, to consider potential safety impacts of its regulations using the best available estimates. As the agency believes that the point estimates still represent the best available data, NHTSA continues to include a measurement of mass-safety impacts in its analysis.

While the agency does not attempt to model safety impacts on a vehicle model-level basis, resetting the standards as proposed would lessen the need to apply MR broadly across the fleet and would allow manufacturers to incorporate MR more tactfully within its fleet. In addition, the agency's proposed vehicle reclassification could incentivize manufacturers to apply MR to larger vehicles, which would provide other road users tangible safety benefits.

A more detailed description of the mass-safety analysis can be found in Chapter 7.3 of the Draft TSD.

2. Sales/Scrappage Impacts

As described in Section II.E.1.b, resetting CAFE standards would have important safety consequences because of the resulting acceleration in fleet turnover. Less stringent standards would allow manufacturers to sell more vehicles demanded by consumers at cheaper prices, which would increase the rate at which newer vehicles, and their associated safety improvements, enter the on-road population. The sales response also influences the mix of vehicles on the road based on the relative net price increases caused by CAFE standards. Setting less stringent standards also removes distortionary effects, pushing consumers into less preferred body styles, which may have different intrinsic safety risks. Similarly, as the price of new vehicles decreases, the fleet turnover compared to the baseline increases, meaning more newer, safer vehicles would replace older, less safe vehicles on the road. These effects would reduce the safety risk not only for both the occupants of newer vehicles but also for other road users who benefit from newer vehicles equipped with advanced driving assistance systems.

Any effect of sales and scrappage on fleet composition will affect the distribution of both ages and model years present in the on-road light-duty fleet. Because each of these vintages carries with it inherent rates of fatal crashes, and newer vintages are generally safer than older ones, changing that distribution will change the safety performance of the fleet, affecting the total number of on-road fatalities under each regulatory alternative. Similarly, the dynamic fleet share model captures the changes in the light-duty fleet's composition of cars and light trucks. As cars and trucks have different fatality rates, differences in fleet composition across the alternatives will affect fatalities.

At the highest level, NHTSA calculates the impact of the sales and scrappage effects by multiplying the VMT of a vehicle by the fatality risk of that vehicle. For this analysis, NHTSA uses the distribution of miles calculated in Chapter 4.3 of the Draft TSD. The fatality risk measures the likelihood that a vehicle will be involved in a fatal accident per mile driven. NHTSA calculates the fatality risk of a vehicle based on the vehicle's model year, age, and style, while controlling factors that are independent of the intrinsic nature of the vehicle, such as behavioral characteristics. Using this same approach, NHTSA designed separate models for fatalities, non-fatal injuries, and property damaged vehicles.

The vehicle fatality risk described above captures the historical evolution of automotive safety. Given that modern technologies are proliferating faster than ever and offer greater safety benefits than traditional safety improvements through crash avoidance, NHTSA augmented the fatality risk projections with knowledge about forthcoming safety improvements. NHTSA applied estimates of the market uptake and improving effectiveness of crash avoidance technologies to estimate their effect on the fleetwide fatality rate, including incorporating both the direct effect of those technologies on the crash involvement rates of new vehicles equipped with them, as well as the ''spillover'' effect of those technologies on improving the safety of occupants of vehicles that are not equipped with these technologies.

NHTSA's approach to measuring these impacts first derives effectiveness rates for these advanced crash avoidance technologies from safety technology literature. NHTSA then applies these effectiveness rates to specific crash target populations for which the crash avoidance technology is designed to mitigate, which are then adjusted to reflect the current pace of adoption of the technology, including any public commitment by manufacturers to install these technologies or recent regulatory actions. These technologies include Forward Collision Warning (FCW), Automatic Emergency Braking (AEB), Lane Departure Warning (LDW), Lane Keep Assist (LKA), Blind Spot Detection (BSD), Lane Change Assist (LCA), and Pedestrian Automatic Emergency Braking (PAEB). The products of these factors produce a fatality rate reduction percentage that is applied to the fatality rate trend model discussed above, which projects both vehicle and non-vehicle safety trends. The combined model produces a projection of impacts of changes in vehicle safety technology as well as behavioral and infrastructural trends. A much more detailed discussion of the methods and inputs used to make these projections of safety impacts from advanced technologies is provided in Chapter 7 of the Draft TSD.

3. Rebound Effect Impacts

The additional VMT demanded due to the rebound effect is accompanied by more exposure to risk. However, rebound miles are not imposed on consumers by regulation, but rather are a freely chosen activity resulting from reduced vehicle operational costs. As such, NHTSA has long believed that a large portion of the safety risks associated with additional driving are offset by the benefits drivers gain from added driving. The level of risk internalized by drivers is uncertain. This analysis assumes that drivers internalize 90 percent of this risk, which mostly offsets the societal impact of added fatalities from this voluntary consumer choice. However, by resetting the standards, NHTSA would expect fewer rebound miles and therefore fewer crashes, injuries, and fatalities. Additional discussion of internalized risk is contained in Chapter 7.5 of the Draft TSD. NHTSA seeks comment on this assumption. In particular, the agency asks commenters for any evidence that could be used to bolster a higher or lower estimate of how much consumers internalize the risk of driving an additional mile.

4. Value of Safety Impacts

Fatalities, nonfatal injuries, and property damage crashes are valued as a societal cost within the CAFE Model's cost and benefit accounting. Their value is based on the comprehensive value of a fatality, which includes lost quality of life and is quantified in the VSL, as well as economic costs related to medical and emergency care, insurance administrative costs, legal costs, and other economic impacts not captured in the VSL. These values were first derived from data in Blincoe et al. (2015), updated in Blincoe et al. (2023), adjusted to 2024 dollars, and updated to reflect DOT guidance on the VSL.[311]

Nonfatal injury costs, which differ by severity, were weighted according to the relative incidence of injuries across the Abbreviated Injury Scale (AIS). To determine this incidence, NHTSA applied a KABCO/MAIS translator to CRSS KABCO based injury counts from 2017–2019. This produced the MAIS-based injury profile. This profile was used to weight nonfatal injury unit costs derived from Blincoe et al. (2023), adjusted to 2024 price and income levels and updated consistently with DOT guidance on the VSL. Property-damaged vehicle costs were also taken from Blincoe et al. (2023) and adjusted to 2024 economics.

For the analysis, NHTSA assigns a societal value of $14.1 million for each fatality, $338,000 for each nonfatal injury, and $9,700 for each property damaged vehicle. As discussed in the previous section, NHTSA discounts 90 percent of the safety costs associated with the rebound effect. The remaining 10 percent of those safety costs are not considered to be internalized by drivers and appear as a cost of the standards that influence net benefits. Similarly, the effects on safety attributable to changes in mass and fleet turnover are not offset by additional benefits since manufacturers are responsible for deciding how to design and price vehicles. However, 90 percent of these costs are also treated as private costs since they are borne by owners of vehicles rather than society more broadly. The safety costs not internalized by drivers are equal to 10 percent of the sum of the mass-safety effects, fleet turnover effects, and rebound-related fatality and non-fatal injuries, plus the cost of any property damage.

III. Regulatory Alternatives Considered in This NPRM

A. General Basis for Alternatives Considered

NHTSA considers regulatory alternatives in rulemaking analyses as a way of evaluating the comparative

[311] DOT, Departmental Guidance on Valuation of a Statistical Life in Economic Analysis, Last revised: Apr. 28, 2025, available at: *https://www.transportation.gov/office-policy/transportation-policy/revised-departmental-guidance-on-valuation-of-a-statistical-life-in-economic-analysis* (accessed: Sept. 10, 2025).

effects of different potential ways of accomplishing its desired goal, which in this case is to fulfill the statutory mandate to set maximum feasible standards. E.O. 12866 and E.O. 13563, as well as OMB Circular A–4, encourage agencies to evaluate regulatory alternatives in their rulemaking analyses.

For this proposal, NHTSA developed separate alternatives for two distinct periods of time (MYs 2022–2026 and MYs 2027–2031) and two distinct fleets (passenger cars (PC) and light trucks (LT)). Alternatives analysis begins with a ''No-Action'' Alternative, typically described as what would occur in the absence of any regulatory action by the agency—in other words, the baseline.[312] Accordingly, NHTSA developed 16 total alternatives: a No-Action and three action alternatives for passenger cars for MYs 2022–2026; a No-Action and three action alternatives for light trucks for MYs 2022–2026; a No-Action and three action alternatives for passenger cars for MYs 2027–2031; and a No-Action and three action alternatives for light trucks for MYs 2027–2031. The proposed standards may, in places, be referred to as the ''Preferred Alternative(s),'' but NHTSA intends ''proposed standards'' and ''Preferred Alternative(s)'' to be used interchangeably for purposes of this document. While the agency tentatively believes the Preferred Alternative(s) represent the maximum feasible fuel economy standards for each model year under consideration when viewed in context of the proposed structural changes (*i.e.,* reclassification, elimination of FCIVs, and elimination of credit trading) and in light of statutory constraints (*i.e.,* not considering dedicated vehicles, non-petroleum performance of dual fueled vehicles, or the availability of regulatory credits), NHTSA requests comment on each alternative analyzed.

Each action alternative sets fuel economy stringency levels for each model year that can be defined in terms of percentage changes in stringency from one model year to the next, which may be different for passenger cars and light trucks.[313] Although the stringency levels can be defined in terms of percentage changes in stringency from one model year to the next for ease of understanding, pursuant to the statute they are actually defined as coefficients that define the following mathematical functions that relate fuel economy to footprint levels.

For passenger cars, NHTSA is defining final fuel economy targets as shown in Equation III–1.

Equation III–1: Passenger Car Fuel Economy Footprint Target Curve

$$TARGET_{FE} = \frac{1}{MIN\ [MAX\left(c \times FOOTPRINT + d,\ \frac{1}{a}\right), \frac{1}{b}]}$$

Where:

$TARGET_{FE}$ is the fuel economy target (in mpg) applicable to a specific vehicle model type with a unique footprint combination, and
a is a maximum fuel economy target (in mpg),
b is a minimum fuel economy target (in mpg),
c is the slope (in gallons per mile per square foot, or gpm per square foot), of a line relating fuel consumption (the inverse of fuel economy) to footprint, and
d is an intercept (in gpm) of the same line.

Here, MIN and MAX are functions that take the minimum and maximum values, respectively, of the set of included values. For example, MIN[40, 35] = 35 and MAX(40, 25) = 40, such that MIN[MAX(40, 25), 35] = 35.

The resulting functional form is depicted in graphs displaying the passenger car target function in each model year for each regulatory alternative in Sections III.B.1 and III.B.3 below.

For light trucks, NHTSA is defining fuel economy targets as shown in Equation III–2.

Equation III–2: Light Truck Fuel Economy Footprint Target Curve

$$TARGET_{FE} = \frac{1}{MIN\ [MAX\left(c \times FOOTPRINT + d,\ \frac{1}{a}\right), \frac{1}{b}]}$$

[312] Office of Management and Budget, Circular A–4 (Sept. 17, 2003), available at: *https://www.whitehouse.gov/wp-content/uploads/2025/08/CircularA-4.pdf* (accessed Sept. 10, 2025), General Issues, 2. Developing a Baseline.

[313] Note that the percentage changes from 1 year to the next are applied to the footprint functions that define the standards, rather than to an average or summary mpg value corresponding to a given footprint function. The PC and LT target curve function coefficients are defined in Equation III–1 and Equation III–2, respectively. See Draft TSD Chapter 1.2.1 for a complete discussion of the footprint curve functions and how they are calculated.

Where:

$TARGET_{FE}$ is the fuel economy target (in mpg) applicable to a specific vehicle model type with a unique footprint combination, and

a, b, c, and d are as for passenger cars, but taking values specific to light trucks.

The exception to defining action alternatives in terms of yearly stringency changes occurs in the transition from MYs 2027–2028, where NHTSA is proposing to change the regulatory classifications for non-passenger automobiles. Because NHTSA is using a different set of initial footprint curve parameters (*i.e.,* slope, intercept, and cutpoints) for each fleet starting in MY 2028, the change in stringency from MYs 2027–2028 cannot be defined using multiplication by a common factor. Instead, NHTSA first applied a year-over-year stringency adjustment to each proposed alternative for each regulatory class ''m'' in MY 2027 to generate initial target function parameters for MY 2028 shown in Equation III–3.

Equation III–3: Scaling Equations for Initial MY 2028 Target Function Parameters

$$a_{2028,0}^{m} = \frac{1}{k_1} \times a_{2027}^{m}$$
$$b_{2028,0}^{m} = \frac{1}{k_1} \times b_{2027}^{m}$$
$$c_{2028,0}^{m} = k_1 \times c_{2027}^{m}$$
$$d_{2028,0}^{m} = k_1 \times d_{2027}^{m}$$
$$k_1 = 1 - \Delta_{2028}$$

Here ''Δ_{2028}'' equals the percentage year-to-year change in stringency from MYs 2027–2028 in a given alternative. The agency then uses Equation III–4 to determine the MY 2028 predicted average standard for each regulatory class without reclassification. To calculate the average standard, the agency uses the total number of automobiles in each class in the MY 2024 fleet data.

Equation III–4: Determination of MY 2028 Class Average Standards Under No Reclassification

$$\text{STANDARD}_{2028}^{m,0} = \frac{\boldsymbol{n_{m,0}}}{\sum_{j=1}^{n_{m,0}} \frac{1}{TARGET_j^{2028,0}}}$$

$$TARGET_j^{2028,0} \; \frac{1}{\text{MIN}\left[\text{MAX}\left(c_{2028,0} \times \text{FOOTPRINT}_j + d_{2028,0}, \frac{1}{a_{2028,0}}\right), \frac{1}{b_{2028,0}}\right]}$$

Here ''$\eta_{m,0}$'' equals the total number of automobiles produced in class ''m'' according to the classifications based on existing regulations.

NHTSA then performed an analogous calculation using Equation III–5 to determine the predicted average standard for each regulatory class under the proposed reclassification condition. The alternative classification and the initial parameter estimates are described in Chapter 1 of the Draft TSD. To calculate the average standard, the agency uses the MY 2024 fleet data with the new reclassification criteria applied in each class.

Equation III–5: Determination of MY 2028 Class Average Stringencies Under Alternative Classification using Alternative Parameter Estimates

$$\textbf{STANDARD}_{\boldsymbol{2028}}^{\boldsymbol{m,A}} = \frac{\boldsymbol{n_{m,A}}}{\sum_{j=1}^{n_{C,A}} \frac{1}{TARGET_j^{2028,A}}}$$

$$TARGET_j^{2028,A} \; \frac{1}{\text{MIN}\left[\text{MAX}\left(c_{2028,A} \times \text{FOOTPRINT}_j + d_{2028,A}, \frac{1}{a_{2028,A}}\right), \frac{1}{b_{2028,A}}\right]}$$

Here "$\eta_{m,A}$" equals the total number of automobiles produced in class "m" according to the proposed reclassification.

The class averages are used to generate a ratio, which is used as a scaling factor to generate the final target function coefficients in each alternative as shown in Equation III–6:

Equation III–6: Scaling Equations for Final MY 2028 Target Function Parameters

$$a_{2028}^{m}=\frac{1}{k_2}\times a_{2028,A}^{m}$$
$$b_{2028}^{m}=\frac{1}{k_2}\times b_{2028,A}^{m}$$
$$c_{2028}^{m}=k_2\times c_{2028,A}^{m}$$
$$d_{2028}^{m}=k_2\times d_{2028,A}^{m}$$
$$k_2=\frac{\mathrm{STANDARD}_{2028}^{m,A}}{\mathrm{STANDARD}_{2028}^{m,0}}$$

This process ensures that a change in target function shape preserves the year-to-year change in stringency "Δ_{2028}" for the class.

For this proposal, NHTSA applies individual rates of change to the passenger car and the light truck fleet standards in different model years in some of the action alternatives. In the Preferred Alternative, the respective standards for both fleets change at the same rate starting in MY 2028. However, the two remaining action alternatives evaluated for this proposal have passenger car fleet rates-of-change in fuel economy that differ from the rates-of-change in fuel economy for the light truck fleet in MY 2028. NHTSA has discretion to set CAFE standards that increase at different rates for passenger cars and light trucks, because NHTSA, by law, must set maximum feasible CAFE standards separately for passenger cars and light trucks.

1. MYs 2022–2026

NHTSA's analysis resets the passenger and non-passenger automobile fuel economy target functions in 2022 and increases them through 2026 at levels consistent with the available data for that timeframe and the context for those years, as discussed in more detail in Section V. Unlike past rules that set CAFE standards, in which the last model year for which standards are currently set serves as the base year for describing the regulatory alternatives considered in terms of annual percentage increases in standards, NHTSA analyzed reset standards for this proposed rule using MY 2022 as the base year, consistent with the Secretary's memorandum titled "Fixing the CAFE Program" (Jan. 28, 2025).[314] NHTSA considered several potential approaches for analyzing regulatory alternatives for that model year within a reasonable range of feasible average fuel economy standards.

The agency relied in large part on the observed capabilities of the gasoline- and diesel-powered vehicle fleets over the model years covered by the standards. While NHTSA always examines manufacturer capabilities (also referred to as "achieved" fuel economy values for each manufacturer's fleet in each model year) relative to the proposed standards as part of its evaluation of maximum feasible standards, this analysis is unique in that the data-based projections that NHTSA would generally rely on to estimate manufacturer behavior are not necessary because, by definition, there cannot be projections for MYs 2022–2025 (and likely for MY 2026, by which time a final rule will be issued), but only observed data. That said, as discussed in Section V, NHTSA believes the appropriate qualitative context exists for giving meaning to the section 32902(f) factors related to manufacturer compliance for model years that have already passed or are currently underway.

NHTSA defined a potential standards range using the mean fit curve and the mean fit curve minus one standard deviation,[315] and then selected three levels of standards that the agency believed represented reasonable low-, medium-, and high-level resetting functions for the MY 2022 passenger car and light truck fleets, respectively. These three functions represent different ways that NHTSA could consider the available data for MY 2022, accounting for the removal of section 32902(h) technologies and compliance credits, and consistent with the agency's balancing of the four factors as described in more detail in Section V. The lowest level function for MY 2022 that NHTSA considered for this proposal represents standards that weigh economic practicability most heavily by recognizing that the prior standards for that model year were not only infeasible for the gasoline- and diesel-powered vehicle fleets (from the perspective of manufacturers reasonably being able to apply technology during the rulemaking timeframe), but also that the fleet-average performance has been below the fleet-average standards for several years and that a low-level standard represents an opportunity for vehicle manufacturers to comply with a standard that influences their obligations to improve fleet fuel economy without distorting typical design cycles or technology application in a manner inconsistent with NHTSA's statutory authority.[316] Under these standards, about 80 percent of passenger cars and light trucks would have met or exceeded their target function values for MY 2022.

On the opposite end, the high-level function considered for MY 2022 represents a balancing that still weighs economic practicability, but recognizes that some manufacturers have been able to apply technology that improves the fuel economy levels of their gasoline- and diesel-powered fleets at a cadence that, if applicable to the rest of the fleet had the model year not already passed, would have pushed the fleet to higher average fuel economy levels, thereby saving more fuel and placing more weight on energy conservation. That said, the fact that a large number of manufacturers' gasoline- and diesel-based fleets cannot comply with that standard—some by a significant amount—is evidence that such a standard is beyond maximum feasible for the gasoline- and diesel-powered passenger and non-passenger automobile fleets for MY 2022. Under these standards, about 30 percent of passenger cars and 50 percent of light trucks, by sales volume, failed to meet their target function values for MY 2022.

The MY 2022 mid-level functions that NHTSA is proposing as the Preferred Alternative for passenger and non-passenger automobiles reflect a standard that the agency tentatively concludes is maximum feasible, based on the exclusion of factors prohibited from consideration by section 32902(h) and a subsequent balancing of the section 32902(f) factors considering the real-world context for this action. The mid-level functions represent NHTSA's consideration of the actual, measured gasoline- and diesel-based fleet average

[314] See DOT, Memorandum: Fixing the CAFE Program (2025), available at: *https://www.transportation.gov/briefing-room/memorandum-fixing-cafe-program* (accessed: Sept. 10, 2025).

[315] Mean fit level here refers to standards developed based on the relationship between fuel consumption and footprint using ordinary least-squares without any further adjustment. NHTSA examined fleetwide compliance and found that around half of the vehicles produced in the MY 2022 fleet complied with these standards. For the mean fit minus standard deviation, NHTSA reasoned that focusing on the central mass of the distribution of vehicles' fuel economy values would seem to be a good indicator that the proposed level was technologically feasible and economically practicable.

[316] See "Resetting the Corporate Average Fuel Economy Program," 90 FR 24518 (June 11, 2025).

fuel economy performance and represents standards at a level that the agency believes is technologically feasible and economically practicable for the entire MY 2022 fleet. NHTSA believes the mid-level function represents a balancing pursuant to section 32902(f) that recognizes the prior standards were set at levels aimed to induce changes in technology application and automobile designs beyond what the market could bear, and in doing so, considered vehicle technologies and manufacturers' use of compliance credits in a manner prohibited by section 32902(h). The failure by a significant number of manufacturers' fleets to meet these standards is evidence that they exceeded the maximum feasible standards for the model year. At the same time, the mid-level standard recognizes that compliance actions by several manufacturers may be evidence that additional fleet fuel economy improvements could have been feasible, subject to the concept expressed at the time of EPCA's passage, that NHTSA's standards should not impose impossible burdens on the automotive industry or unduly limit consumer choice as to capacity and performance of motor vehicles.

Some manufacturers have chosen to respond to prior standards—which NHTSA has determined were set in contravention of EPCA's prohibition against consideration of EVs or plug-in hybrids using the battery to facilitate propulsion—by producing electric and plug-in hybrid vehicles and applying or acquiring credits generated by such vehicles to achieve compliance. That said, the mid-level functions for MY 2022 represent NHTSA's best judgment in establishing maximum feasible standards, recognizing that inclusion of section 32902(h) factors in prior rulemakings has pushed standards beyond maximum feasible levels. The agency has tentatively concluded that the proposed standard for MY 2022 provides the most reasonable weighting of the section 32902(f) factors as an appropriate reformed starting point upon which to base increases in the stringency of standards for subsequent model years. Under these proposed standards, about 75 percent of passenger cars and 70 percent of light trucks, by sales volume, would have met or exceeded their target function values for MY 2022—but 25 percent of passenger cars and 30 percent of light trucks would have failed to do so.

For MYs 2023–2026, NHTSA considered a range of standards based on the low-, mid-, and high-range functions all increasing at the same rate—a relatively modest rate of 0.5 percent per year—from each alternative's MY 2022 starting point. This is a different approach than NHTSA has taken in previous standard-setting actions, but it is an approach that better effectuates NHTSA's reset of the CAFE standards to maximum feasible levels beginning in MY 2022. In reaching this tentative conclusion, NHTSA examined both real-world data and input on the capabilities of manufacturers' gasoline- and diesel-powered fleets to improve consistently over time. Critically, this was done while excluding consideration of prohibited technology and policy factors for the first time since alternative fueled vehicles have worked their way into the light-duty fleet in appreciable numbers.

Using data from EPA's 2024 Automotive Trends Report, the latest report available at the time this NPRM was drafted, NHTSA analyzed recent yearly improvements in ICE efficiency using data categorized by engine package.[317] That data shows that since MY 2010, gasoline- and diesel-powered vehicle fuel consumption has improved on average by 1 percent per year. In some years, fuel consumption improved by as much as 5.7 percent from the prior year; however, in some years prior to 2020, fuel consumption increased over the prior year by only 1.2 percent. From MYs 2020–2023, fuel consumption only improved by an average of 0.7 percent per year. Correspondingly, Auto Innovators (formerly known as the Alliance of Automobile Manufacturers, or the Alliance, for short) commented on NHTSA's 2023 NPRM that ''[b]etween 2012 and 2022, the average 2-cycle fuel consumption (gal/mile) of non-EVs improved at an average annual rate of 1.3 [percent] (passenger cars) and 2.0 [percent] (light trucks).'' [318] In addition, based on the data used for this analysis,[319] the change in fuel economy for gasoline- and diesel-powered vehicles from MYs 2022–2024 was a total of 2 percent, or an average of 1 percent per year.

NHTSA is proposing the 0.5 percent rate of increase for MYs 2023–2026 in part because the agency believes that higher rates of increase were driven by standards set by NHTSA or other agencies that either unlawfully considered prohibited statutory factors or exceeded statutory authority. In addition, to the extent that prior unrealistically high standards induced technology application that was either not ready or not attractive to the market, the proposed stringency rates afford automakers the opportunity to determine the most economically practicable and technologically feasible paths forward for their individual product mixes, while still ensuring that the gasoline- and diesel-fueled vehicle fleet sees real-world improvements in fuel economy.

While fuel-economy-improving technologies applicable to the gasoline- and diesel-powered vehicle fleet certainly exist, much of that technology has been applied to vehicles over the past 15 years—a period of rapidly increasing fuel economy standards. With a baseline fleet inclusive of EVs and plug-in hybrids using battery propulsion, manufacturers seeking to comply with standards solely using gasoline- and diesel-based powertrain efficiency improvements, cannot continually add additional technology to gasoline- and diesel-fueled vehicles at a reasonable cost. Table III–1 shows that as basic naturally aspirated engine technology penetration rates decreased sharply, there was a concurrent increase in rates of advanced powertrain technology, including the addition of mild and strong hybrid technology. As discussed in Section II above, it is unreasonable to assume that all technologies can be applied to all vehicle types, depending on vehicle functionality and capability, and technology that increases fuel economy at more than incremental levels on vehicles where it could feasibly be applied is available only at significant cost. NHTSA anticipates that the proposed rates of annual increase would allow technology penetration rates to propagate across the fleet in a cost-effective manner.

[317] EPA, Explore the Automotive Trends Data (2025), available at: *https://www.epa.gov/automotive-trends/explore-automotive-trends-data* (accessed: Sept. 10, 2025).

[318] See Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks for Model Years 2027–2032 and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans for Model Years 2030–2035, Docket No. NHTSA–2023–0022–60652, at p. 7. The Alliance cited S&P Global Mobility research that was subsequently provided to NHTSA for review.

[319] Comparison of the MY 2022 mid-model year data set and the MY 2024 mid-model year data set, as discussed in Section II.

Table III-1: Technology Penetration Differences in MY 2022 and MY 2024[320]

Powertrain Technology	MY 2022	MY 2024
Basic Naturally Aspirated	37.9%	22.0%
Turbo Engines	36.0%	46.3%
Advanced Cylinder Deactivation	3.5%	4.3%
High Compression Ratio	18.1%	23.4%
Other Advanced Engines	4.5%	4.0%
Mild Hybrids	59.8%	67.2%
Strong Hybrids	7.3%	10.4%
Plug-in Hybrids	1.8%	2.9%

While the rate of increase for all MYs 2023–2026 alternatives is the same, the actual level of standards required by each regulatory alternative is different based on the differing MY 2022 reset points. Accordingly, NHTSA has presented a range of stringency options to allow the agency to analyze or select an alternative in its final rule from any stringency level within that range. The range of alternatives represents different ways that the agency could balance the section 32902(f) factors for MYs 2022–2026. Specifically, NHTSA considers both the unique contextual situation applicable to those model years [321] and technologically feasible and economically practicable rates of per-year increases for the gasoline- and diesel-powered fleets. NHTSA seeks comment on these alternatives for MYs 2022–2026, in addition to any other regulatory alternatives that the agency should consider for these model years.

2. MYs 2027–2031

Consistent with NHTSA's approach for MYs 2022–2026, the agency endeavored to reset future model years' standards at levels that reflect the technological and economic capabilities of the gasoline- and diesel-powered vehicle fleets, but also in a manner that reflects how proposed compliance provisions (discussed in more detail in Section VI) would impact manufacturers' ability to comply. NHTSA performed an analysis, similar to its analysis of feasible per-year rates of stringency increase for gasoline- or diesel-powered vehicle improvements for MYs 2022–2026 discussed above, to establish a range of regulatory alternatives that encompassed the ways the agency believes manufacturers could improve their fleet fuel economies year-over-year.

The agency began by using MY 2024 market data as a starting point for characterizing the technology and compliance levels of the vehicle fleet, and then relied on the CAFE Model to simulate the fleet's expected evolution under the current regulatory fleet classifications in future years in the No-Action Alternative and using the proposed alternative classification regulations starting in MY 2028 in the action alternatives. NHTSA's proposed action alternatives are consistent with footprint curves estimated using the current classification for MY 2027, and consistent with footprint curves estimated using the alternative classification for MY 2028 onward.

NHTSA developed alternatives to produce class average target function values that reflected different rates of growth from MYs 2022–2028, with MY 2027 acting as a ''bridge'' year between MYs 2026–2028, when NHTSA proposes to use updated regulatory classification definitions. Class average target functions were computed by taking the production-weighted harmonic mean of the target function values for vehicles in each class as shown in Equation III–4. To produce estimates of the class average target function values in MY 2022 and MY 2026, NHTSA used the MY 2022 fleet under current classification regulations and the proposed standards in each year. This produced a value for each fleet in MY 2022 and MY 2026. For MY 2027, NHTSA used the MY 2024 fleet under the pre-existing classification regulations and using the relevant proposed standards for each alternative. This produced a value for each class in each alternative. For MY 2028, NHTSA used the MY 2024 fleet under the proposed reclassification regulations and using the relevant proposed standards for each alternative. This once again produced a value for each class in each alternative. NHTSA followed this approach to determine class averages using standard coefficients, classifications, and fleets consistent with how the underlying footprint curves were estimated for each model year.

For Alternative 1, NHTSA set the 2028 standards such that the class average target function values were equal to those computed for 2022 using this approach. For MY 2027, standards for Alternative 1 were set such that the class average equaled the midpoint between class averages calculated for MY 2026 and those proposed for MY 2028. In this way MY 2027 acts as a link between the 2026 standards, which were developed using the MY 2022 fleet and initial classification, and the proposed MY 2028 standards, which were developed using the MY 2024 fleet and the proposed reclassification.

NHTSA used a similar approach to develop Alternative 3. For Alternative 3, NHTSA set standards in MY 2028 such that the class average target function values were equal to those obtained by applying a 1.5-percent annual increase to the MY 2022 standards. NHTSA then used the same approach as in Alternative 1 to determine the midpoint of the average target function values in MY 2026 and MY 2028 and set standards that would achieve that level of stringency based on the MY 2024 fleet and the initial classification. NHTSA estimated the 1.5-percent annual increases as an upper bound for Alternative 3 stringency based on the agency's assessment, using the EPA Automotive Trends report of gasoline- and diesel-powered vehicle fuel

[320] Some vehicles will have multiple powertrain technologies, such as pairing a turbo engine with a mild hybrid stop/start technology. This will result in the technology penetration rates adding up to more than 100 percent.

[321] NHTSA is proposing to reset standards for these model years, which have passed or for which manufacturers have already determined their fleets, or such determination is well underway, because NHTSA determined that in establishing the prior standards, the agency impermissibly considered electric vehicles in its analysis.

economy values and additional stakeholder feedback.

For Alternative 2, NHTSA proposed MY 2027 standards such that the class average target function values were equal to those obtained by applying a 0.5-percent annual growth rate to the MY 2022 standards. For MY 2028, NHTSA determined the class average target function values by applying a 0.25-percent adjustment to the class averages for 2027. While both years' standards were determined using these growth rates, the rate of change year to year between the coefficients does not exactly equal these factors due to the change in fleet and classification used to compute these averages. NHTSA estimated that these were appropriate mid-range annual increases based on the agency's assessment of feasible annual increases for gasoline- and diesel-powered vehicle fleet and because manufacturers would likely require time in MY 2028 and beyond to recalibrate production decisions based on the combination of reset stringency levels and vehicle classification updates.

For MYs 2029–2031, NHTSA applied simple year over year percentage increases to its proposed 2028 standards. For Alternative 1 and Alternative 2, NHTSA used a rate of 0.25 percent per year, while for Alternative 3, NHTSA used a rate of 1 percent per year. Alternative 3's higher rate of increase supposes that manufacturers could respond to standards that increase more rapidly in the later years, while for the other alternatives 0.25 percent was chosen to illustrate how manufacturers would be able to adjust compliance to a more moderate rate of increase following the adjustment to reclassification mentioned above and described in more detail in Section VI.

The projected levels of fuel economy under each of the three regulatory alternatives for MYs 2027–2031 continually push manufacturers to improve real-world fuel economy, and even the least stringent option would exceed fuel efficiency merely driven by market demand.[322] NHTSA treated market demand for fuel-economy improvements as a floor for determining action alternatives in MY 2027 and MY 2028 by rescaling its estimated coefficients using the approach outlined in Equation III–3 through Equation III–6 such that they produced standards achievable for manufacturers when only market demanded technology was applied. Any standard less stringent than this floor would not be projected to change manufacturers' technology adoption decisions from those they would make in the absence of standards. In accordance with the purpose of the statutory scheme to increase fleet fuel economy of gasoline- and diesel-powered vehicles, NHTSA chose alternatives lying above this floor.

NHTSA recognizes that the process for creating regulatory alternatives for this proposal is different in some ways from how the agency has created regulatory alternatives in past rules; however, the process used was necessary to effectuate a reset to bring the CAFE program into compliance with the law and require a significant reclassification of the passenger car and light truck fleets to reflect better the intent of the CAFE program established by Congress. Previously, NHTSA evaluated regulatory alternatives based on varying levels of stringency increases from the last year of the previously established standards. Since NHTSA considered the fuel efficiency of EVs in establishing those previous standards, in contravention of the law, a stringency increase from the last year of those standards is on its face higher than the maximum feasible standards NHTSA could establish if only considering gasoline- and diesel-fueled vehicles. In fact, as discussed in more detail in Section V, NHTSA is proposing to set standards that are, on their face, lower in MY 2022 than MY 2021 in part because actual compliance data clearly demonstrated that manufacturers were unable to achieve the MY 2022 standards with their gasoline- and diesel-powered vehicle fleets. Additional information on how NHTSA's development of these regulatory alternatives comports with the agency's requirements to set maximum feasible standards is discussed in Section V. Like for MYs 2022–2026, the alternatives considered for MYs 2027–2031 include a range of stringency options to allow the agency to analyze or select an alternative in its final rule from any stringency level within that range. NHTSA seeks comment on the range of alternatives presented, in addition to any other alternatives that the agency should consider.

3. Minimum Domestic Passenger Car Standard Analysis Update

EPCA, as amended by EISA, requires that any manufacturer's domestically manufactured passenger car fleet must meet the greater of either 27.5 mpg on average or 92 percent of the average fuel economy projected by the Secretary for the combined domestic and non-domestic passenger automobile fleets manufactured for sale in the United States by all manufacturers in the model year. Along with calculating each regulatory alternative, NHTSA must calculate a minimum standard for domestically manufactured passenger automobiles in accordance with 49 U.S.C. 32902(b)(4)(B). Since the 2020 final rule, NHTSA has calculated the ''minimum domestic passenger car standard'' (MDPCS) using an offset to account for the fact that the agency's model cannot predict any shift in vehicle designs (as opposed to technology application) that manufacturers might make in response to CAFE standards. Additional information about the origin of the MDPCS and the related offset calculation can be found in Section V.

NHTSA reviewed the analysis it uses to calculate the MDPCS offset, which accounts for differences between the passenger car standards the agency forecasts in its rulemaking analyses and the actual passenger car standards EPA calculates for CAFE final compliance in accordance with 49 U.S.C. 32904(a). In support of its 2020 final rule, NHTSA used forecasted data from its 2009, 2010, and 2012 final rule analyses and actual CAFE final compliance data for MYs 2011–2018 to develop the initial MDPCS offset of 1.9 percent. NHTSA developed the original offset value for use in its 2020 final rule; however, the agency continued to use that same offset value in its 2022 and 2024 final rules without updating the underlying analysis. In addition to promulgating two final rules since it developed the initial MDPCS offset, NHTSA has also collected five additional model years of final compliance data—with two of those model years having been verified by EPA in accordance with 49 U.S.C. 32904(a). For this rulemaking, NHTSA updated the analysis to add new data sources and refine the methodology used to calculate the value of the offset.

NHTSA supplemented the original analysis with additional data, such as estimated passenger car standards from subsequent rulemaking analyses and calculated passenger car standards from newer CAFE final compliance data. NHTSA began with the Market Data Input File containing the MY 2017

[322] As discussed in more detail in Section II, NHTSA's assumptions about market-driven fuel economy improvements in the absence of regulatory requirements involve manufacturer application of technology that pays for itself within 36 months. NHTSA makes this assumption based on manufacturer statements over successive CAFE rulemakings and also believes that this assumption is supported by the relevant literature. NHTSA has not attempted to quantify manufacturer behavior in the absence of standards other than this payback assumption but is interested in comments on any other assumptions of manufacturer behavior in the absence of standards that the agency should consider.

baseline fleet, which the agency used in the 2020 final rule analysis, covering MYs 2021–2026. The agency then identified and removed all the model types of dedicated AFVs from the Market Data Input File, consistent with the section 32902(h) prohibition on considering the fuel economy of dedicated and dual-fueled vehicles when setting maximum feasible standards. Next, NHTSA ran the 2020 final rule version of the CAFE Model with the modified Market Data Input File to produce an analysis devoid of dedicated AFVs. The agency then extracted the passenger car standard from the resulting Compliance Output Report for MYs 2017–2050.

Next, NHTSA added the following CAFE final compliance data for additional model years to the analysis: MYs 2012–2021, which have been verified by EPA in accordance with 49 U.S.C. 32904(a), and MYs 2022–2023, which have yet to be verified. As a proxy for individual model types of dedicated AFVs, NHTSA identified and removed the manufacturers that produce only dedicated AFVs from the compliance data and calculated the passenger car standard for MYs 2012–2023.[323]

Next, NHTSA modified the methodology it uses to calculate the offset. In the original offset analysis, NHTSA included comparisons between actual passenger car standards calculated from final model year compliance data to passenger car standards projected in proposed rules, in addition to those projected in final rules. For CAFE compliance, manufacturers are required to meet only those standards estimated and published in final rules, not those estimated and published in proposed rules. Consequently, including comparisons to proposed rules may skew the results from the offset analysis. NHTSA included comparisons to passenger car standards forecasted only in final rules in the updated analysis.

NHTSA compared the MDPCSs estimated from CAFE Model outputs from MYs 2017–2050 to the MDPCSs calculated from actual compliance data from MYs 2012–2023 and calculated the relative change (in percent) between them for each model year. NHTSA then calculated the offset by taking the average of the relative changes in MDPCS for MYs 2017–2023, which are those model years where the CAFE Model outputs (excluding all individual model types of dedicated AFVs) overlapped with CAFE compliance data that excluded manufacturers that produced only dedicated AFVs. The updated MDPCS offset analysis shows that the passenger car standards projected with the MY 2017 baseline fleet and the 2020 final rule version of the CAFE Model were more stringent than the actual passenger car standards calculated for CAFE final compliance by an average of 0.7 percent, less than half of the offset calculated previously.

The MYs 2027–2031 proposed MDPCSs presented in this Table III–2 include the 0.7-percent offset. NHTSA believes that the basis for the offset, which is based on the agency's inability to project the precise mix of vehicles sold in the future, is inapplicable to the proposed MYs 2022–2026 standards because those standards incorporate the most up-to-date data available to the agency for vehicle sales volume and footprint sizes in MY 2022. The agency's proposed MDPCSs for MYs 2027–2031 include this offset to ensure that the standard is sufficiently reflective of industry capabilities while still considering the original intent behind the MDPCS.

The proposed MDPCS for each model year is as follows:

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Table III-2: Minimum Domestic Passenger Car Standard (mpg)

2022	2023	2024	2025	2026	2027*	2028*	2029*	2030*	2031*
33.1	33.1	33.5	33.7	33.9	33.8	33.9	34.0	34.0	34.1

*Includes 0.7-percent offset

B. Regulatory Alternatives Considered

The regulatory alternatives considered by the agency in this proposed rule are presented in Table III–3 as percentage changes in stringency over the preceding model year. In the sections that follow, NHTSA presents the literal coefficients that define the standards curves in each model year for each alternative that corresponds to these percentage rates.

[323] Because NHTSA does not receive final model year data in the same format from EPA as manufacturers submit their pre-model year data and final model year data to the agency, NHTSA cannot simply remove Excel rows with dedicated vehicles as the agency did to create its MY 2022 and MY 2024 Market Data Input Files. For purposes of this analysis, NHTSA believes that final model year data are the appropriate source to use.

Table III-3: Regulatory Alternatives Under Consideration for MYs 2022-2031 Passenger Cars and Light Trucks

Name of Alternative	Passenger Car Stringency Changes	Light Truck Stringency Changes
No-Action Alternative	1.5% for MY 2023 8% per year for MYs 2024-2025 10% for MY 2026 2% per year for MYs 2027-2031	1.5% for MY 2023 8% per year for MYs 2024-2025 10% for MY 2026 0% per year for MYs 2027-2028 2% per year for MYs 2029-2031
Alternative 1	80% compliance share* MY 2022 0.50% per year for MYs 2023-2026 0.1% for MY 2027 0.3% for MY 2028** 0.25% per year for MYs 2029-2031	80% compliance share* MY 2022 0.50% per year for MYs 2023-2026 0.8% for MY 2027 0.6% for MY 2028** 0.25% per year for MYs 2029-2031
Alternative 2 (Preferred)	75% compliance share* MY 2022 0.50% per year for MYs 2023-2026 0.35% for MY 2027 0.25% for MY 2028** 0.25% per year for MYs 2029-2031	70% compliance share* MY 2022 0.50% per year for MYs 2023-2026 0.7% for MY 2027 0.25% for MY 2028** 0.25% per year for MYs 2029-2031
Alternative 3	70% compliance share* MY 2022 0.50% per year for MYs 2023-2026 1.4% for MY 2027 1.5% for MY 2028** 1% per year for MYs 2029-2031	50% compliance share* MY 2022 0.50% per year for MYs 2023-2026 0.4% for MY 2027 0.2% for MY 2028** 1% per year for MYs 2029-2031

* Compliance shares were determined based on the production-weighted share of vehicles that met or exceeded their target function value for each regulatory alternative in MY 2022.
** Stringency change reflects the growth rate in class average standard value from MYs 2027-2028.

The following subchapters define the regulatory alternatives (including the No-Action Alternative) by time period and provide details on how NHTSA developed them.

1. No-Action Alternatives for Passenger Cars and Light Trucks

a. No-Action Alternative for MYs 2022–2026 Amendment

The analysis of the No-Action Alternative assumes that the following CAFE standards remain in place: the CAFE standards for MYs 2022–2023 that were finalized in the 2020 final rule,[324] and the CAFE standards for MYs 2024–2026 that were finalized in the 2022 final rule.[325] The analysis also applies the statutory limitations in 49 U.S.C. 32902(h) in all model years in the analysis; specifically, the fuel economy of dedicated automobiles is not considered, dual-fueled automobiles are considered only when operated on gasoline or diesel fuel, and the trading, transferring, or availability of credits is not considered.

The No-Action Alternative standards for the existing MYs 2022–2026 passenger car and light truck fleets are defined by the following coefficients:

Table III-4: Passenger Car CAFE Target Function Coefficients for the No-Action Alternative for the MYs 2022-2026 Amendment

	2022	2023	2024	2025	2026
a (mpg)	50.24	51.00	55.44	60.26	66.95
b (mpg)	37.59	38.16	41.48	45.08	50.09
c (gpm per s.f)	0.00044662	0.00043992	0.00040473	0.00037235	0.00033512
d (gpm)	0.00159413	0.00157022	0.00144460	0.00132903	0.00119613

[324] 85 FR 24174 (Apr. 30, 2020).

[325] 87 FR 25710 (May 2, 2022).

Table III-5: Light Truck CAFE Target Function Coefficients for the No-Action Alternative for the MYs 2022-2026 Amendment

	2022	2023	2024	2025	2026
a (mpg)	40.31	40.93	44.48	48.35	53.73
b (mpg)	26.02	26.42	26.74	29.07	32.3
c (gpm per s.f)	0.00049869	0.00049121	0.00045191	0.00041576	0.00037418
d (gpm)	0.00436016	0.00429476	0.00395118	0.00363509	0.00327158

These equations are represented graphically below, where the x-axis represents vehicle footprint and the y-axis represents fuel economy.

Figure III-1: No-Action Alternative, Passenger Car Fuel Economy, Target Curves for the MYs 2022-2026 Amendment

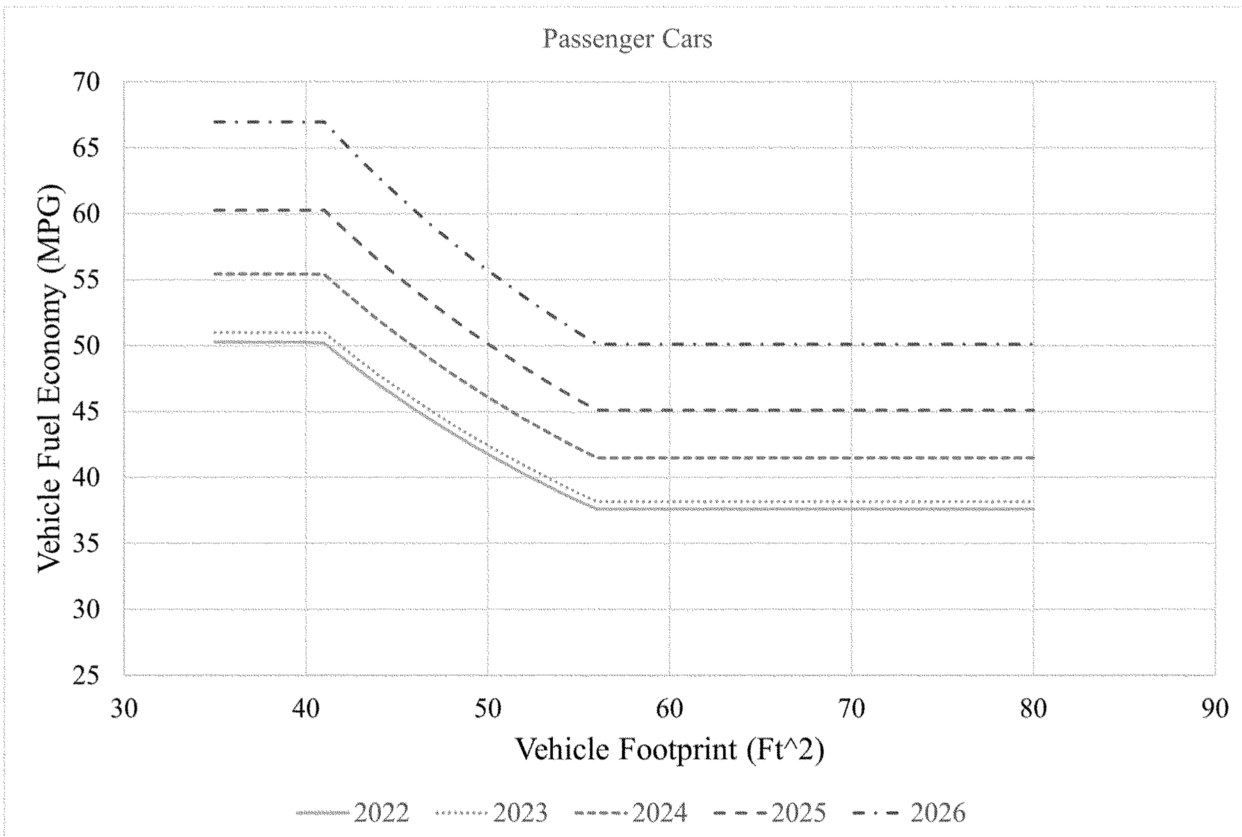
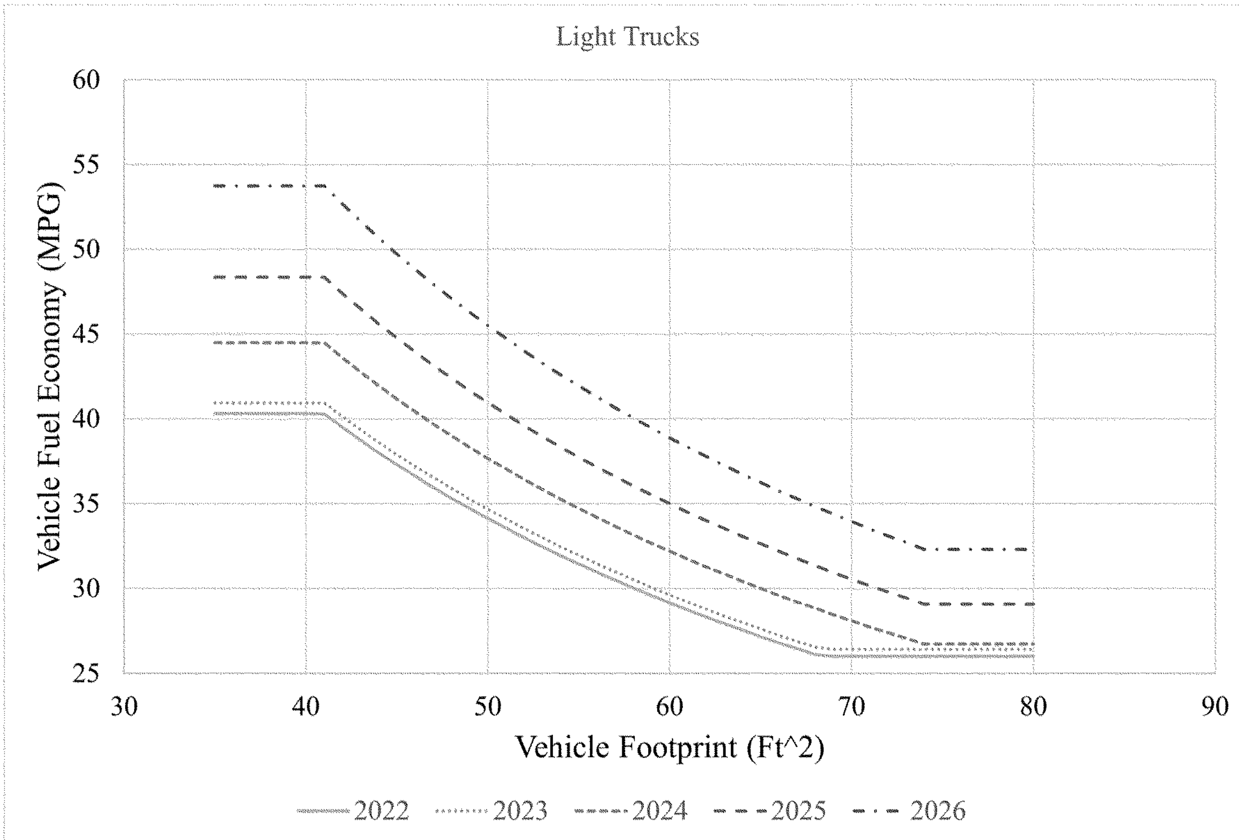


Figure III-2: No-Action Alternative, Light Truck Fuel Economy, Target Curves for the MYs 2022-2026 Amendment



For the No-Action Alternative for MYs 2022–2026, the MDPCS is applied as it was established in the 2020 and 2022 final rules, including the offset originally calculated in those rules to account for recent projection errors as part of estimating the total passenger car fleet fuel economy standard.

Table III-6: No-Action Alternative – MDPCS (MPG) for the MYs 2022-2026 Amendment

2022	2023	2024	2025	2026
40.6	41.1	44.3	48.1	53.5

b. No-Action Alternative for MYs 2027–2031 Amendment

The analysis of the No-Action Alternative assumes the following CAFE standards remain in place: the CAFE standards for MYs 2024–2026 that were finalized in the 2022 final rule [326] and the CAFE standards for MYs 2027–2031 that were finalized in the 2024 final rule.[327] The analysis also applies the statutory limitations in 49 U.S.C. 32902(h) in all model years in the analysis; specifically, the fuel economy of dedicated automobiles is not considered, dual-fueled automobiles are considered only as operated on gasoline or diesel fuel, and the trading, transferring, or availability of credits is not considered.

The No-Action Alternative standards for the existing MYs 2027–2031 passenger car and light truck fleets are defined by the following coefficients, which (for the purposes of this analysis) are assumed to persist without change in subsequent model years:

[326] 87 FR 25710 (May 2, 2022).

[327] 89 FR 52540 (June 24, 2024).

Table III-7: Passenger Car CAFE Target Function Coefficients for the No-Action Alternative for the MYs 2027-2031 Amendment

	2027	2028	2029	2030	2031
a (mpg)	68.32	69.71	71.14	72.59	74.07
b (mpg)	51.12	52.16	53.22	54.31	55.42
c (gpm per s.f)	0.00032841	0.00032184	0.00031541	0.00030910	0.00030292
d (gpm)	0.00117220	0.00114876	0.00112579	0.00110327	0.00108120

Table III-8: Light Truck CAFE Target Function Coefficients for the No-Action Alternative for the MYs 2027-2031 Amendment

	2027	2028	2029	2030	2031
a (mpg)	53.73	53.73	54.82	55.94	57.08
b (mpg)	32.30	32.30	32.96	33.63	34.32
c (gpm per s.f)	0.00037418	0.00037418	0.00036670	0.00035936	0.00035218
d (gpm)	0.00327158	0.00327158	0.00320615	0.00314202	0.00307918

These equations are represented graphically below:

These equations are represented graphically below:

Figure III-3: No-Action Alternative, Passenger Car Fuel Economy, Target Curves for the MYs 2027-2031 Amendment

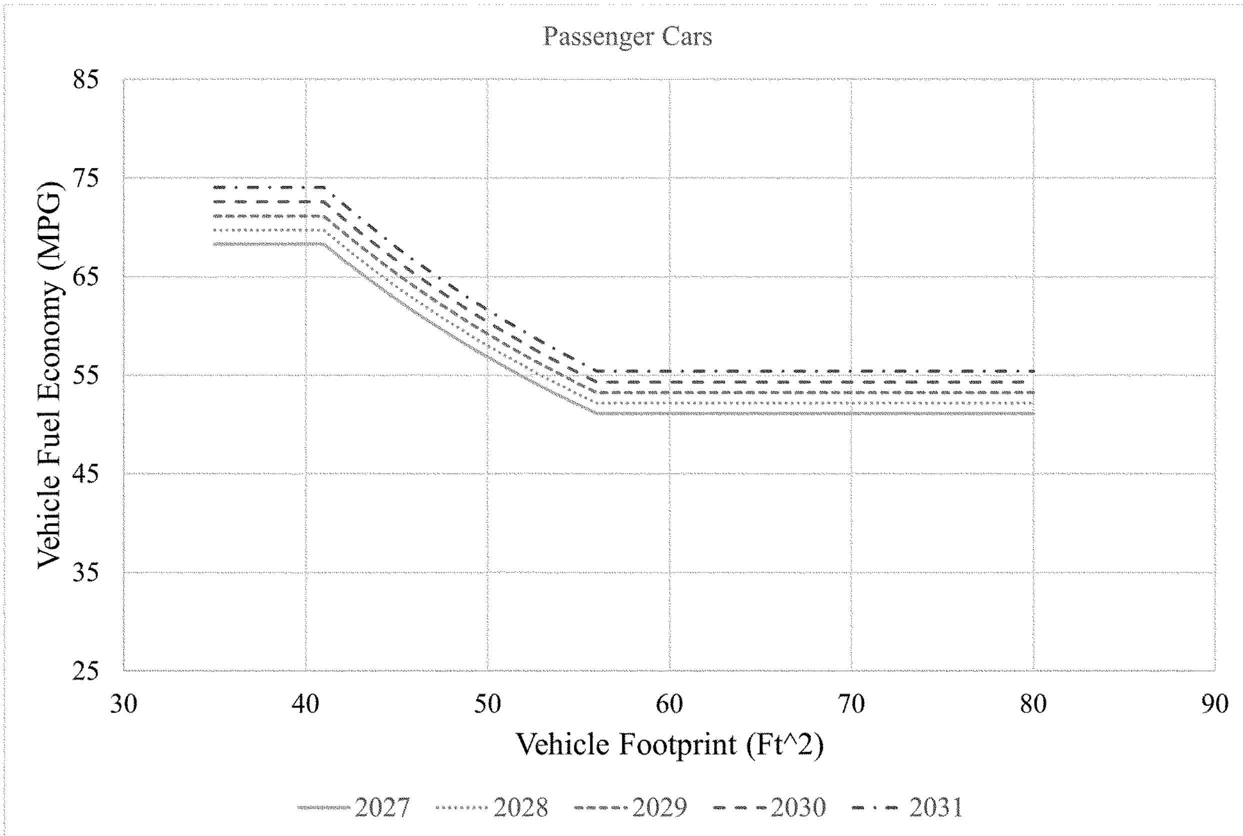
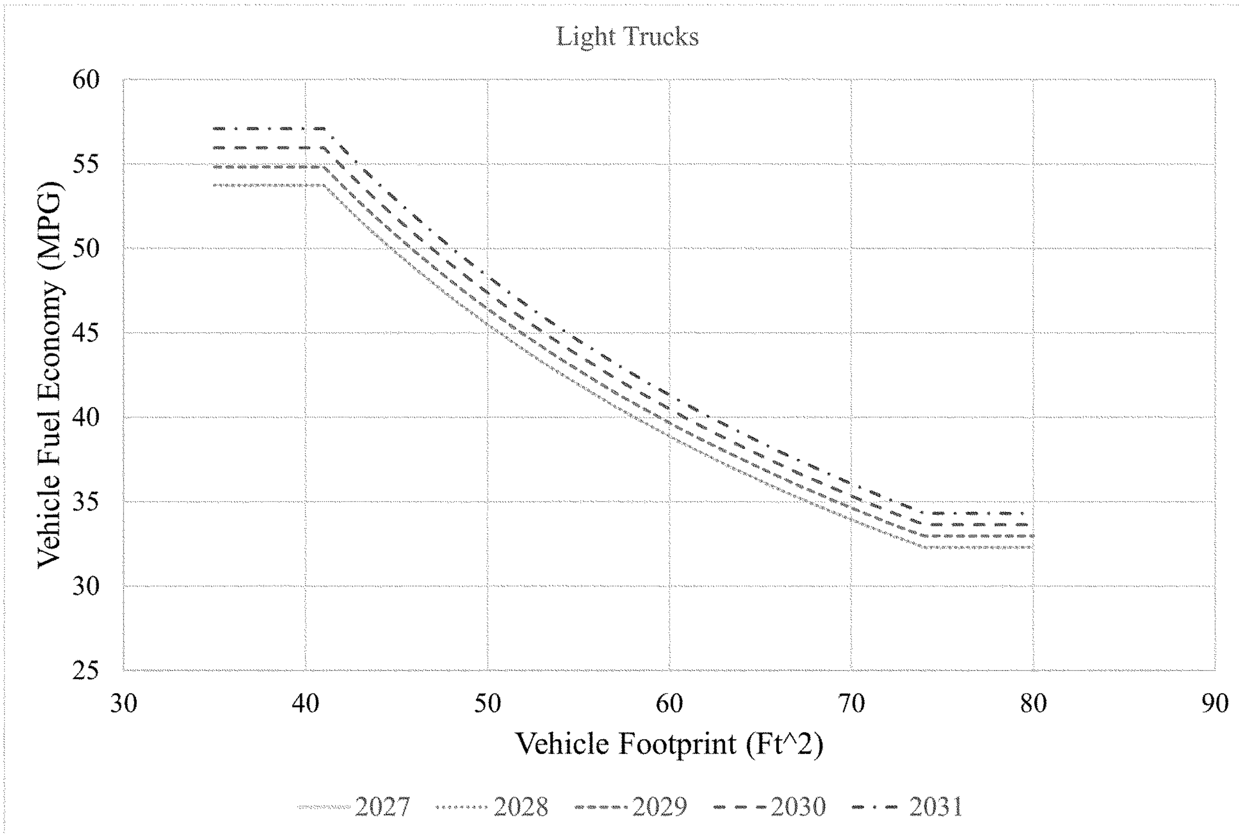


Figure III-4: No-Action Alternative, Light Truck Fuel Economy, Target Curves for the MYs 2027-2031 Amendment[328]



For the No-Action Alternative for MYs 2027–2031, the MDPCS is applied as it was established in the 2024 final rule.

Table III-9: No-Action Alternative – Minimum Domestic Passenger Car Standard (MDPCS) (MPG) for the MYs 2027-2031 Amendment

2027	2028	2029	2030	2031
54.2	55.5	56.4	57.5	58.7

2. Action Alternatives for Passenger Cars and Light Trucks

In addition to the No-Action Alternative, NHTSA has considered three action alternatives for passenger cars and light trucks. These action alternatives are specified below and demonstrate different possible approaches to balancing the statutory factors applicable for setting fuel economy standards for passenger cars and light trucks, as discussed in more detail in Section V.

a. Action Alternatives for MYs 2022–2026 Amendment

(1) Alternative 1

Alternative 1 begins with a MY 2022 set of target function parameters with which 80 percent of the passenger car fleet complied in MY 2022, and with which 80 percent of light trucks complied in MY 2022. From there, Alternative 1 would increase CAFE stringency by 0.5 percent per year for MYs 2022–2026 for passenger cars and light trucks.

[328] The light truck CAFE target function coefficients established in the 2024 final rule are identical for MY 2027 and MY 2028. As a result, the MY 2027 and MY 2028 lines overlap with each other.

Table III-10: Passenger Car CAFE Target Function Coefficients for Alternative 1 for the MYs 2022-2026 Amendment

	2022	2023	2024	2025	2026
a (mpg)	37.10	37.28	37.47	37.66	37.85
b (mpg)	31.62	31.78	31.94	32.10	32.26
c (gpm per s.f)	0.00042463	0.00042251	0.00042041	0.00041832	0.00041624
d (gpm)	0.00869688	0.00865362	0.00861056	0.00856772	0.00852510

Table III-11: Light Truck CAFE Target Function Coefficients for Alternative 1 for the MYs 2022-2026

	2022	2023	2024	2025	2026
a (mpg)	33.96	34.12	34.30	34.47	34.64
b (mpg)	19.78	19.88	19.98	20.08	20.18
c (gpm per s.f)	0.00065929	0.00065601	0.00065275	0.00064950	0.00064627
d (gpm)	0.00176047	0.00175171	0.00174300	0.00173432	0.00172570

These equations are represented graphically below:

Figure III-5: Alternative 1, Passenger Car Fuel Economy, Target Curves for the MYs 2022-2026 Amendment

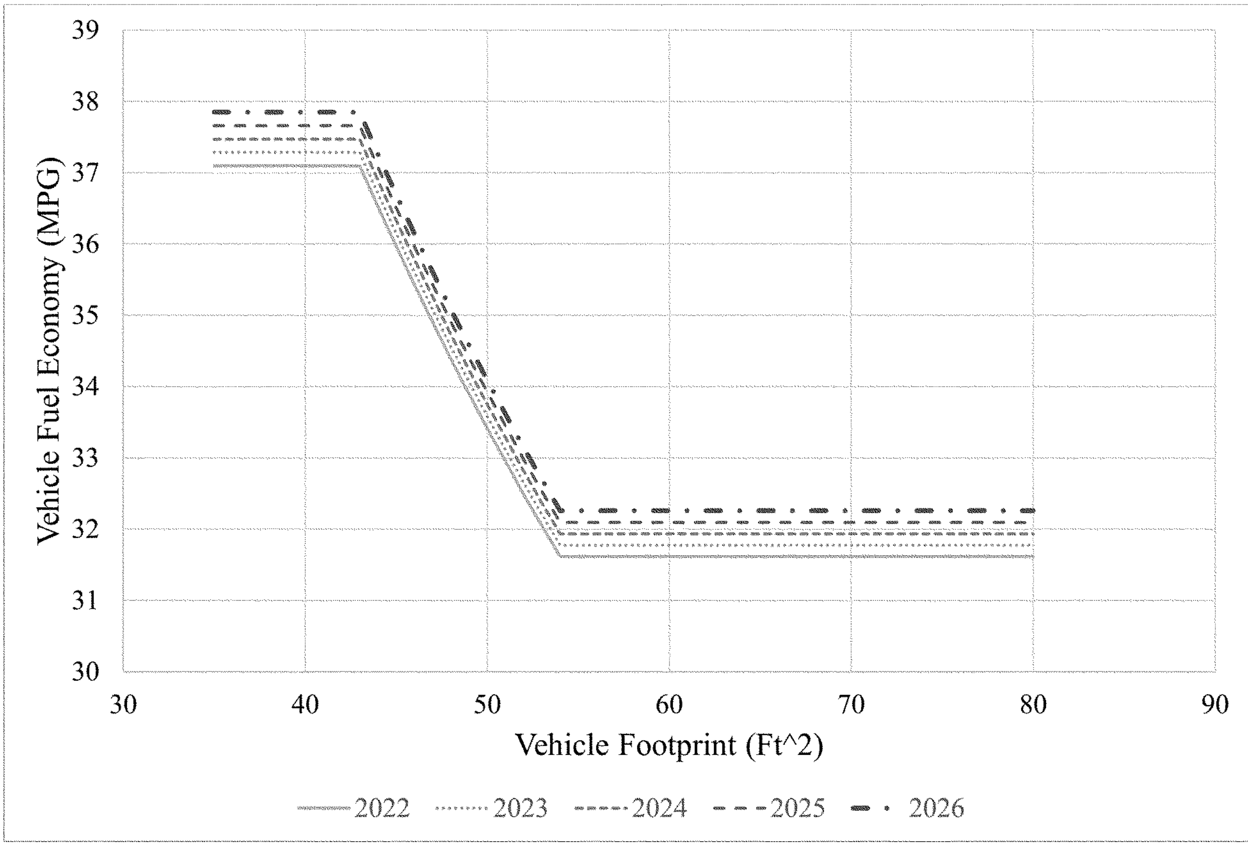
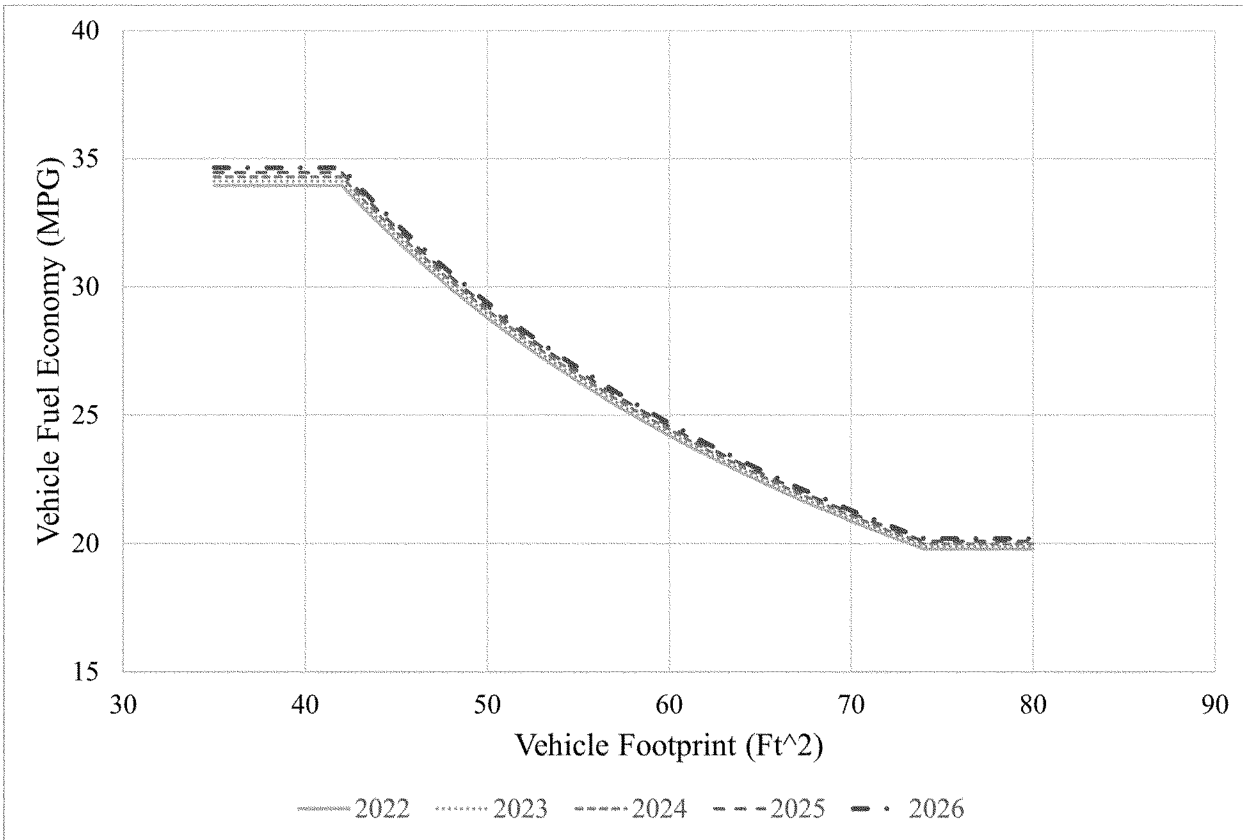


Figure III-6: Alternative 1, Light Truck Fuel Economy, Target Curves for the MYs 2022-2026 Amendment



Under this alternative, the MDPCS is as follows:

Table III-12: Alternative 1 – Minimum Domestic Passenger Car Standard (MDPCS) (MPG) for the MYs 2022-2026 Amendment

2022	2023	2024	2025	2026
32.2	32.2	32.6	32.8	33.0

(2) Alternative 2—Preferred Alternative

The Preferred Alternative begins with a MY 2022 set of target function parameters with which 75 percent of the passenger car fleet complied in MY 2022, and with which 70 percent of light trucks complied in MY 2022. From there, the Preferred Alternative would increase CAFE stringency by 0.5 percent per year for MYs 2022–2026 for passenger cars and light trucks.

Table III-13: Passenger Car CAFE Target Function Coefficients for Alternative 2 for the MYs 2022-2026 Amendment

	2022	2023	2024	2025	2026
a (mpg)	38.14	38.33	38.52	38.71	38.91
b (mpg)	32.51	32.67	32.83	33.00	33.16
c (gpm per s.f)	0.00041302	0.00041097	0.00040892	0.00040689	0.00040487
d (gpm)	0.00845926	0.00841718	0.00837530	0.00833363	0.00829217

Table III-14: Light Truck CAFE Target Function Coefficients for Alternative 2 for the MYs 2022-2026 Amendment

	2022	2023	2024	2025	2026
a (mpg)	34.89	35.06	35.24	35.41	35.59
b (mpg)	20.33	20.43	20.53	20.63	20.74
c (gpm per s.f)	0.00064166	0.00063847	0.00063529	0.00063213	0.00062899
d (gpm)	0.00171340	0.00170487	0.00169639	0.00168795	0.00167955

These equations are represented graphically below:

Figure III-7: Alternative 2, Passenger Car Fuel Economy, Target Curves for the MYs 2022-2026 Amendment

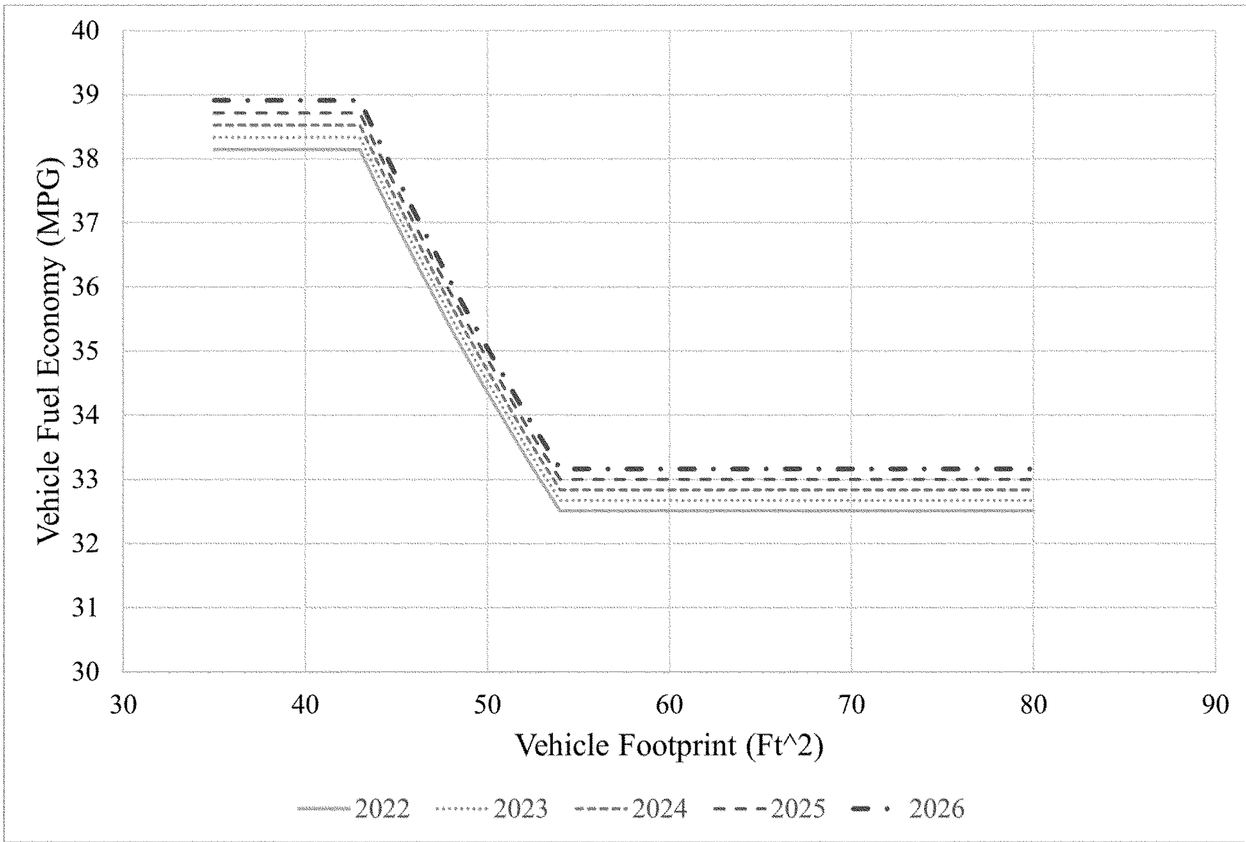
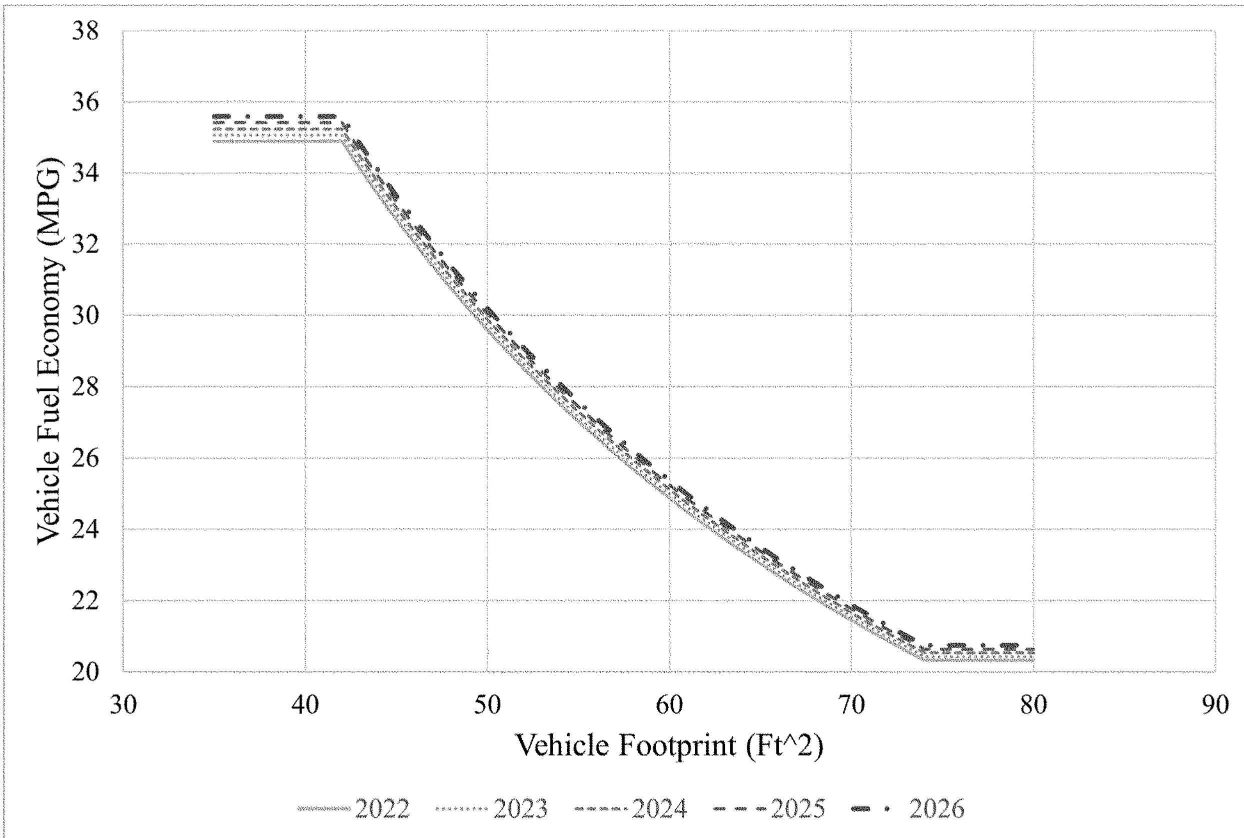


Figure III-8: Alternative 2, Light Truck Fuel Economy, Target Curves for the MYs 2022-2026 Amendment



Under this alternative, the MDPCS is as follows:

Table III-15: Alternative 2 – Minimum Domestic Passenger Car Standard (MDPCS) (MPG) for the MYs 2022-2026 Amendment

2022	2023	2024	2025	2026
33.1	33.1	33.5	33.7	33.9

(3) Alternative 3

Alternative 3 begins with a MY 2022 set of target function parameters with which 70 percent of the passenger car fleet complied in MY 2022, and with which 50 percent of light trucks complied in MY 2022. From there, Alternative 3 would increase CAFE stringency by 0.5 percent per year for MYs 2022–2026 for passenger cars and light trucks.

Table III-16: Passenger Car CAFE Target Function Coefficients for Alternative 3 for the MYs 2022-2026 Amendment

	2022	2023	2024	2025	2026
a (mpg)	39.60	39.80	40.00	40.20	40.40
b (mpg)	33.75	33.92	34.09	34.26	34.43
c (gpm per s.f)	0.00039781	0.00039583	0.00039386	0.00039190	0.00038995
d (gpm)	0.00814761	0.00810707	0.00806674	0.00802660	0.00798667

Table III-17: Light Truck CAFE Target Function Coefficients for Alternative 3 for the MYs 2022-2026 Amendment

	2022	2023	2024	2025	2026
a (mpg)	37.31	37.50	37.69	37.88	38.07
b (mpg)	21.74	21.85	21.96	22.07	22.18
c (gpm per s.f)	0.00059995	0.00059697	0.00059400	0.00059104	0.00058810
d (gpm)	0.00160203	0.00159406	0.00158613	0.00157824	0.00157038

Table III-18: Alternative 3 – Minimum Domestic Passenger Car Standard (MDPCS) (MPG) for the MYs 2022-2026 Amendment

2022	2023	2024	2025	2026
34.4	34.4	34.8	35.0	35.2

These equations are represented graphically below:

Figure III-9: Alternative 3, Passenger Car Fuel Economy, Target Curves for the MYs 2022-2026 Amendment

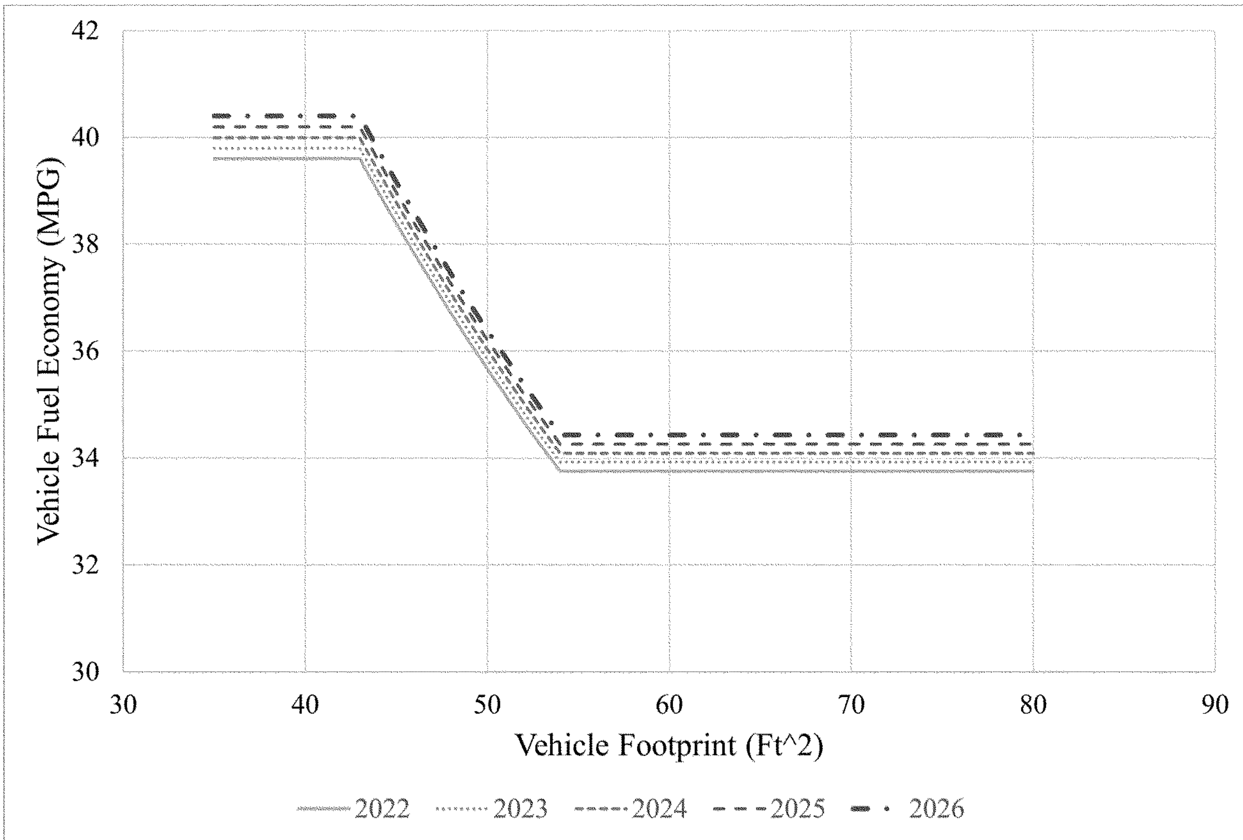
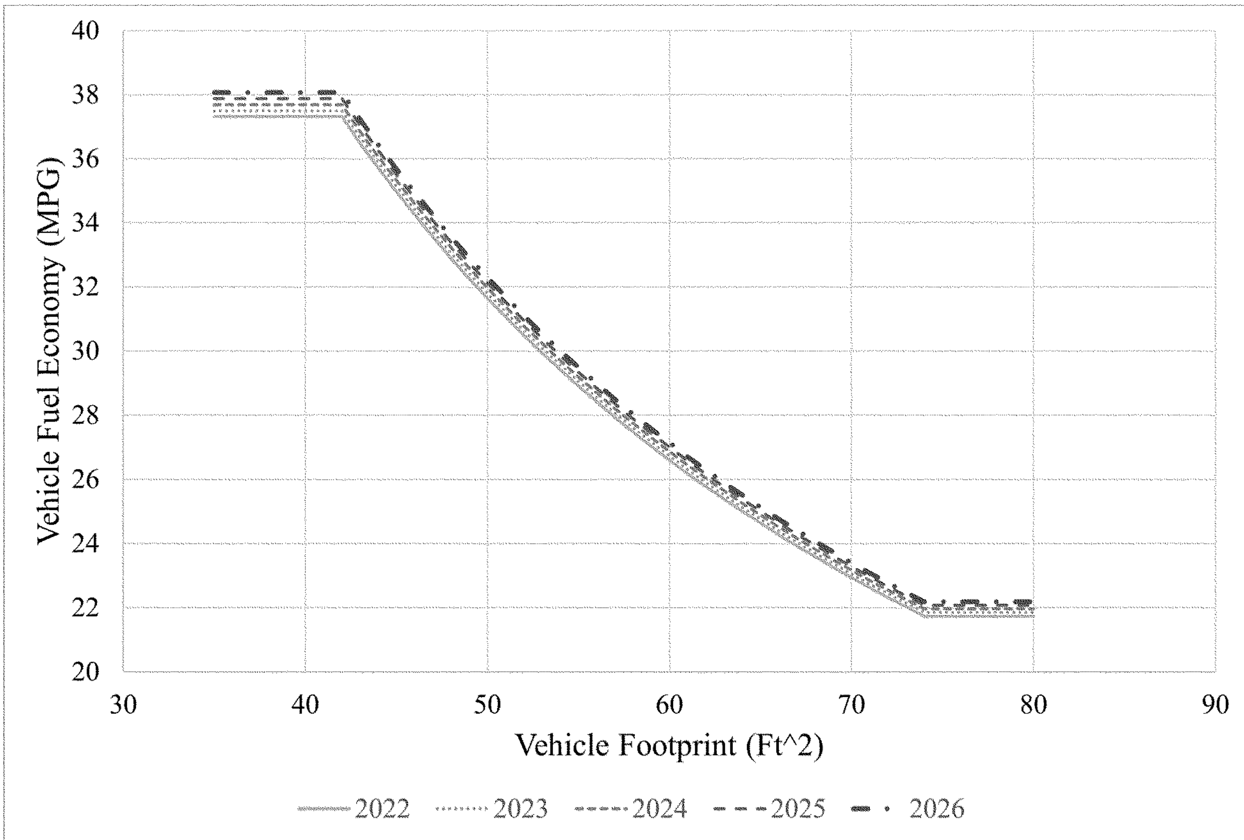


Figure III-10: Alternative 3, Light Truck Fuel Economy, Target Curves for the MYs 2022-2026 Amendment



b. Action Alternatives for MYs 2027–2031 Amendment

(1) Alternative 1

Alternative 1 would increase CAFE stringency for passenger cars by 0.1 percent from MYs 2026–2027, by 0.3 percent from MYs 2027–2028, and 0.25 percent per year for MYs 2029–2031. Alternative 1 would increase CAFE stringency for light trucks by 0.8 percent from MYs 2026–2027, by 0.6 percent from MYs 2027–2028, and by 0.25 percent year over year for MYs 2029–2031.

Table III-19: Passenger Car CAFE Target Function Coefficients for Alternative 1 for the MYs 2027-2031 Amendment

	2027	2028	2029	2030	2031
a (mpg)	37.89	39.37	39.47	39.57	39.67
b (mpg)	32.29	29.48	29.56	29.63	29.71
c (gpm per s.f)	0.00041574	0.00070967	0.00070790	0.00070613	0.00070436
d (gpm)	0.00851494	-0.00653427	-0.00651793	-0.00650164	-0.00648539

Table III-20: Light Truck CAFE Target Function Coefficients for the Alternative 1 for the MYs 2027-2031

	2027	2028	2029	2030	2031
a (mpg)	34.91	30.75	30.83	30.91	30.98
b (mpg)	20.34	25.34	25.41	25.47	25.53
c (gpm per s.f)	0.00064119	0.00038562	0.00038465	0.00038369	0.00038273
d (gpm)	0.00171212	0.01246562	0.01243445	0.01240337	0.01237236

These equations are represented graphically below. Note that the shapes of the curves for MY 2027 are also different from the shapes of the curves for MYs 2028–2031 due to the proposed reclassification in MY 2028.

Figure III-11: Alternative 1, Passenger Car Fuel Economy, Target Curves for the MYs 2027-2031 Amendment

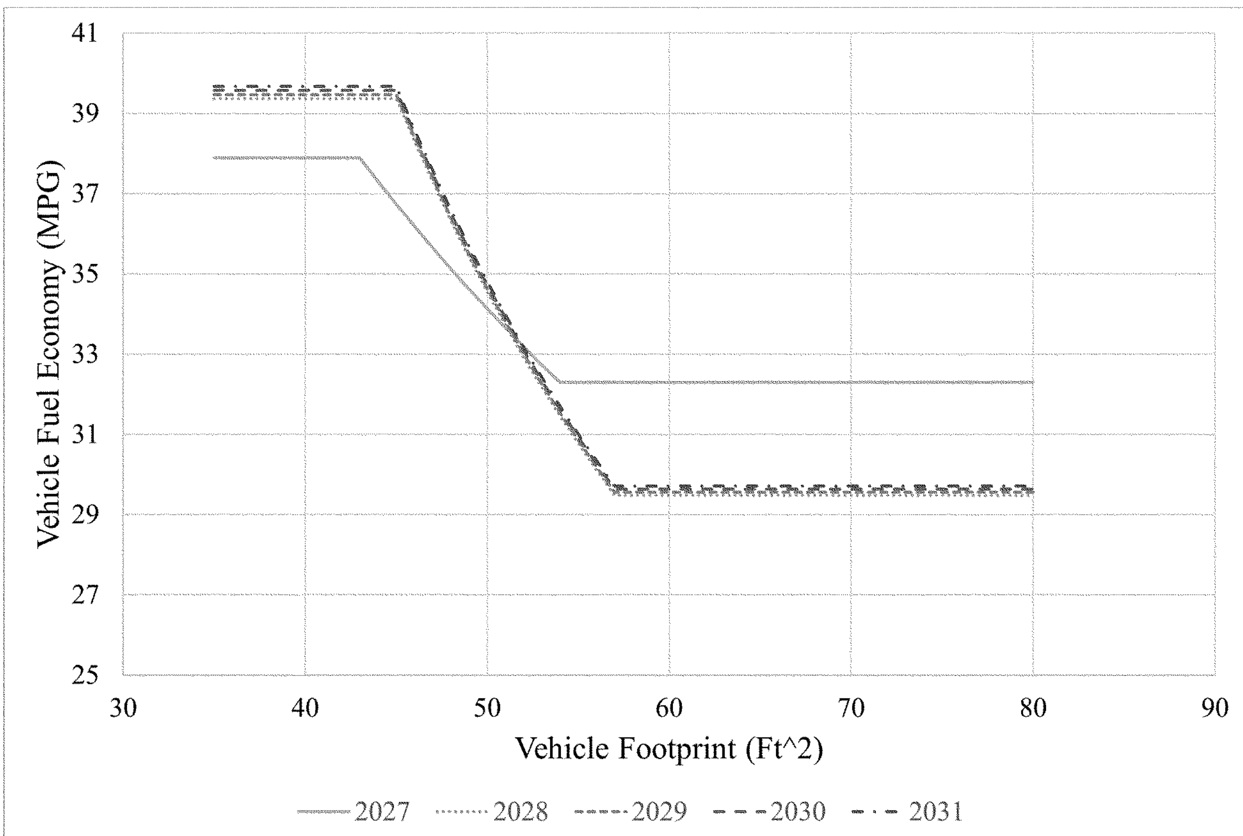
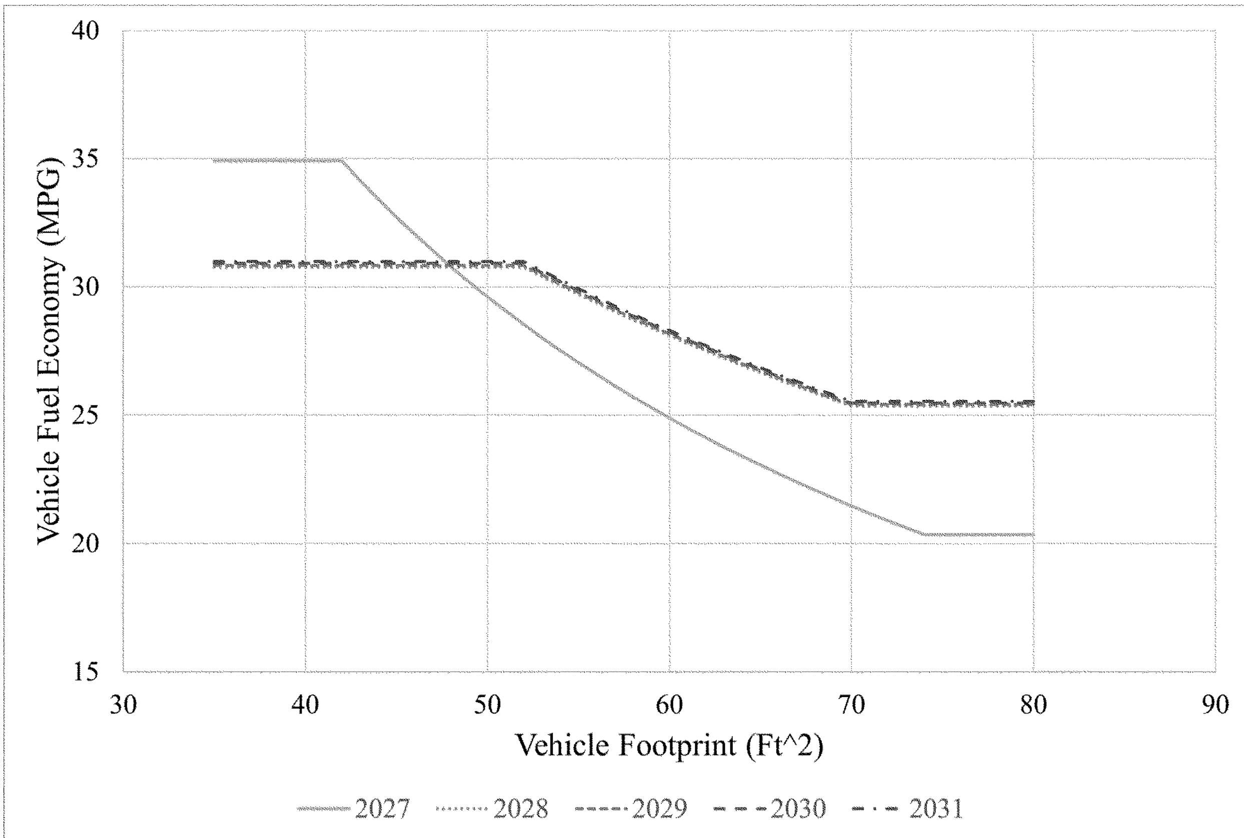


Figure III-12: Alternative 1, Light Truck Fuel Economy, Target Curves for the MYs 2027-2031 Amendment



For this rulemaking, NHTSA has updated the analysis it uses to estimate the offset and calculated an offset of 0.7 percent, which will be applicable to the MDPCS for each action alternative in MYs 2027–2031. Under this alternative, the MDPCS is as follows:

Table III-21: Alternative 1 – Minimum Domestic Passenger Car Standard (MDPCS) (MPG) for the MYs 2027-2031 Amendment

2027	2028	2029	2030	2031
33.0	33.1	33.2	33.2	33.3

(2) Alternative 2—Preferred Alternative

The Preferred Alternative would increase CAFE stringency for passenger cars by 0.35 percent from MYs 2026–2027, by 0.25 percent from MYs 2027–2028, and 0.25 percent per year for MYs 2029–2031. The Preferred Alternative would increase CAFE stringency for LTs by 0.7 percent from MYs 2026–2027, by 0.25 percent from MYs 2027–2028, and by 0.25 percent per year for MYs 2029–2031.

Table III-22: Passenger Car CAFE Target Function Coefficients for Alternative 2 for the MYs 2027-2031 Amendment

	2027	2028	2029	2030	2031
a (mpg)	39.04	40.57	40.67	40.78	40.88
b (mpg)	33.28	30.38	30.46	30.54	30.61
c (gpm per s.f)	0.00040346	0.00068863	0.00068691	0.00068519	0.00068348
d (gpm)	0.00826345	-0.00634053	-0.00632468	-0.00630887	-0.00629310

Table III-23: Light Truck CAFE Target Function Coefficients for Alternative 2 for the MYs 2027-2031

	2027	2028	2029	2030	2031
a (mpg)	35.84	31.45	31.53	31.61	31.69
b (mpg)	20.88	25.92	25.99	26.05	26.12
c (gpm per s.f)	0.00062460	0.00037701	0.00037607	0.00037513	0.00037419
d (gpm)	0.00166784	0.01218745	0.01215698	0.01212659	0.01209627

These equations are represented graphically below. Note that the shapes of the curves for MY 2027 are also different from the shapes of the curves for MYs 2028–2031 due to the proposed reclassification in MY 2028.

Figure III-13: Alternative 2, Passenger Car Fuel Economy, Target Curves for the MYs 2027-2031 Amendment

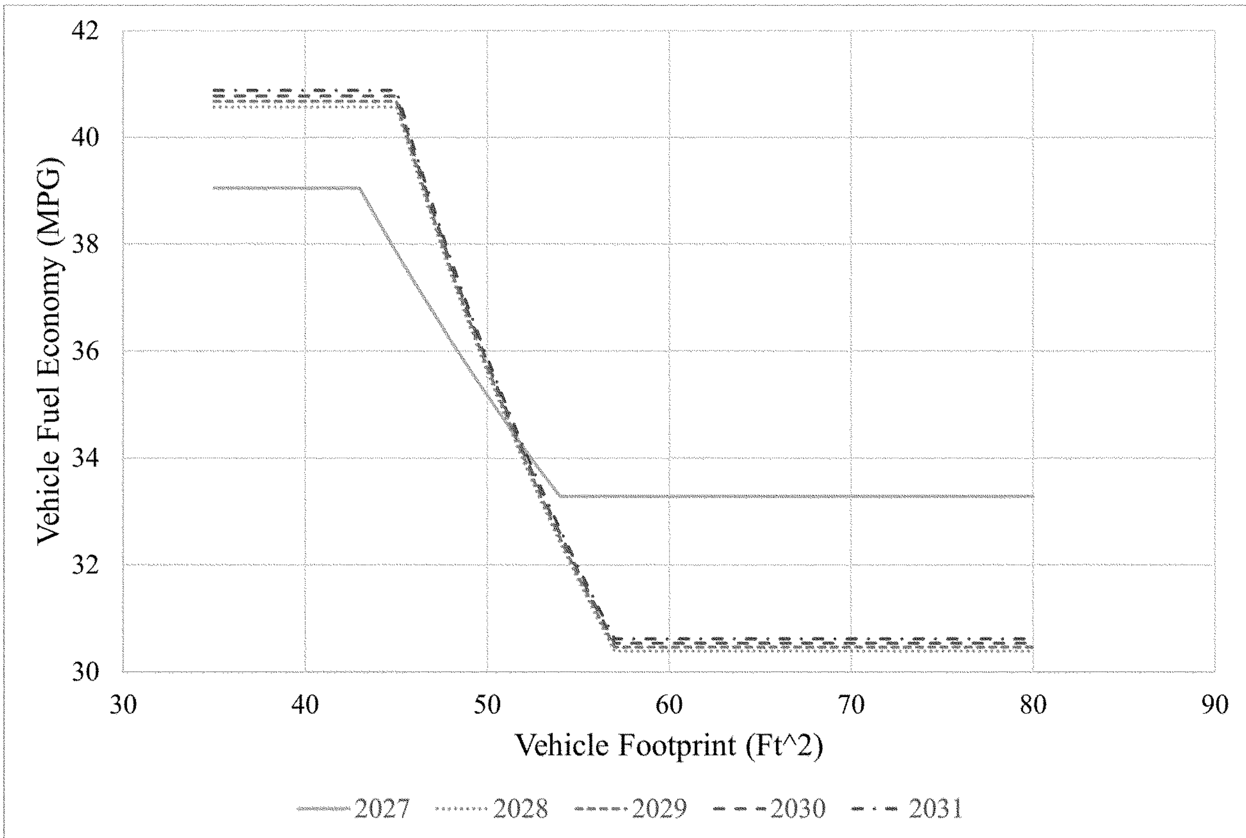
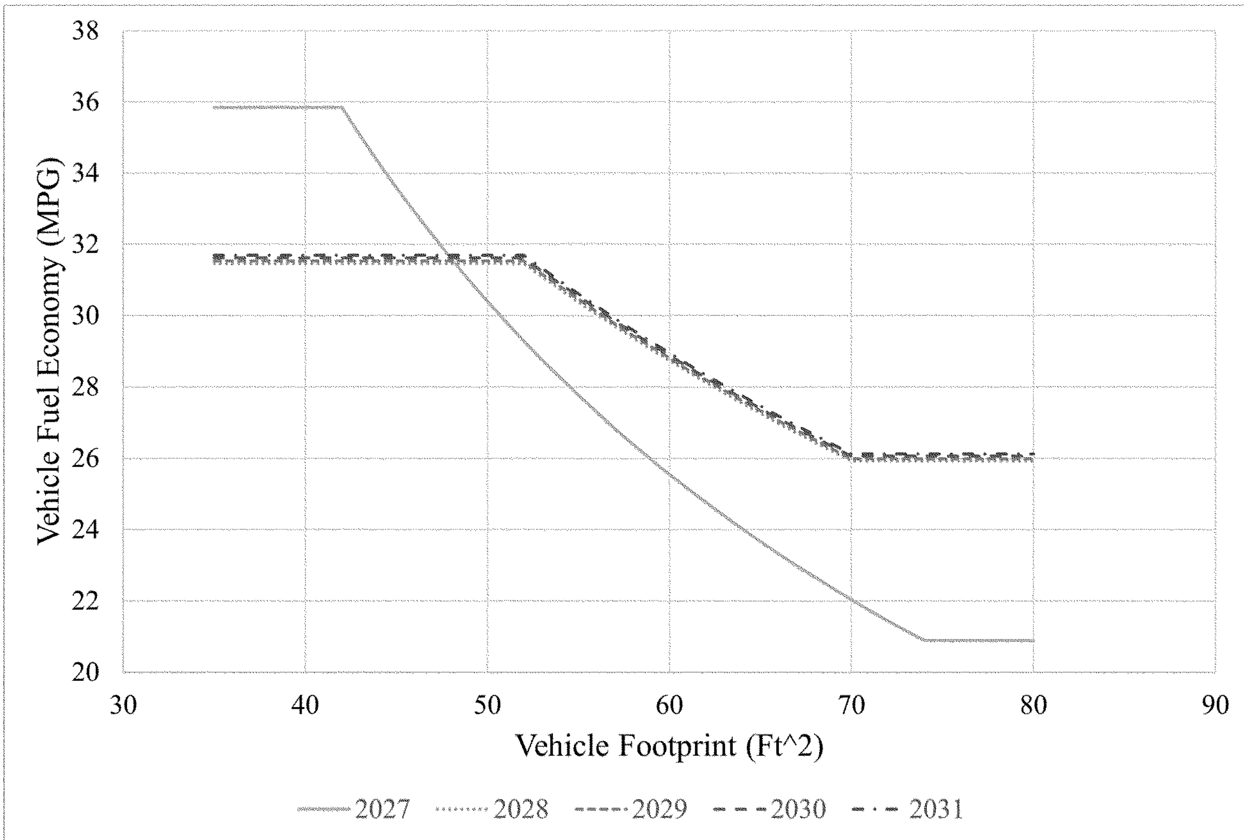


Figure III-14: Alternative 2, Light Truck Fuel Economy, Target Curves for the MYs 2027-2031 Amendment



For this rulemaking, NHTSA has updated the analysis it uses to estimate the offset applied to the MDPCS, which is now calculated at 0.7 percent and is applied to each action alternative in MYs 2027–2031. Under this alternative, the MDPCS is as follows:

Table III-24: Alternative 2 – Minimum Domestic Passenger Car Standard (MDPCS) (MPG) for the MYs 2027-2031 Amendment

2027	2028	2029	2030	2031
34.0	34.1	34.2	34.2	34.3

(3) Alternative 3

Alternative 3 would increase CAFE stringency for passenger cars by 1.4 percent from MYs 2026–2027, by 1.5 percent from MYs 2027–2028, and 1.0 percent year over year for MYs 2029–2031. Alternative 3 would increase CAFE stringency for LTs by 0.4 percent from MYs 2026–2027, by 0.2 percent from MYs 2027–2028, and by 1.0 percent year over year for MYs 2029–2031.

Table III-25: Passenger Car CAFE Target Function Coefficients for Alternative 3 for the MYs 2027-2031 Amendment

	2027	2028	2029	2030	2031
a (mpg)	40.96	43.09	43.52	43.96	44.41
b (mpg)	34.91	32.27	32.59	32.92	33.26
c (gpm per s.f)	0.00038460	0.00064843	0.00064195	0.00063553	0.00062917
d (gpm)	0.00787715	-0.00597040	-0.00591070	-0.00585159	-0.00579307

Table III-26: Light Truck CAFE Target Function Coefficients for Alternative 3 for the MYs 2027-2031 Amendment

	2027	2028	2029	2030	2031
a (mpg)	38.21	33.52	33.86	34.20	34.54
b (mpg)	22.26	27.62	27.90	28.18	28.47
c (gpm per s.f)	0.00058580	0.00035380	0.00035026	0.00034676	0.00034329
d (gpm)	0.00156423	0.01143710	0.01132273	0.01120950	0.01109741

These equations are represented graphically below. Note that the shapes of the curves for MY 2027 are also different from the shapes of the curves for MYs 2028–2031 due to the proposed reclassification in MY 2028.

Figure III-15: Alternative 3, Passenger Car Fuel Economy, Target Curves for the MYs 2027-2031 Amendment

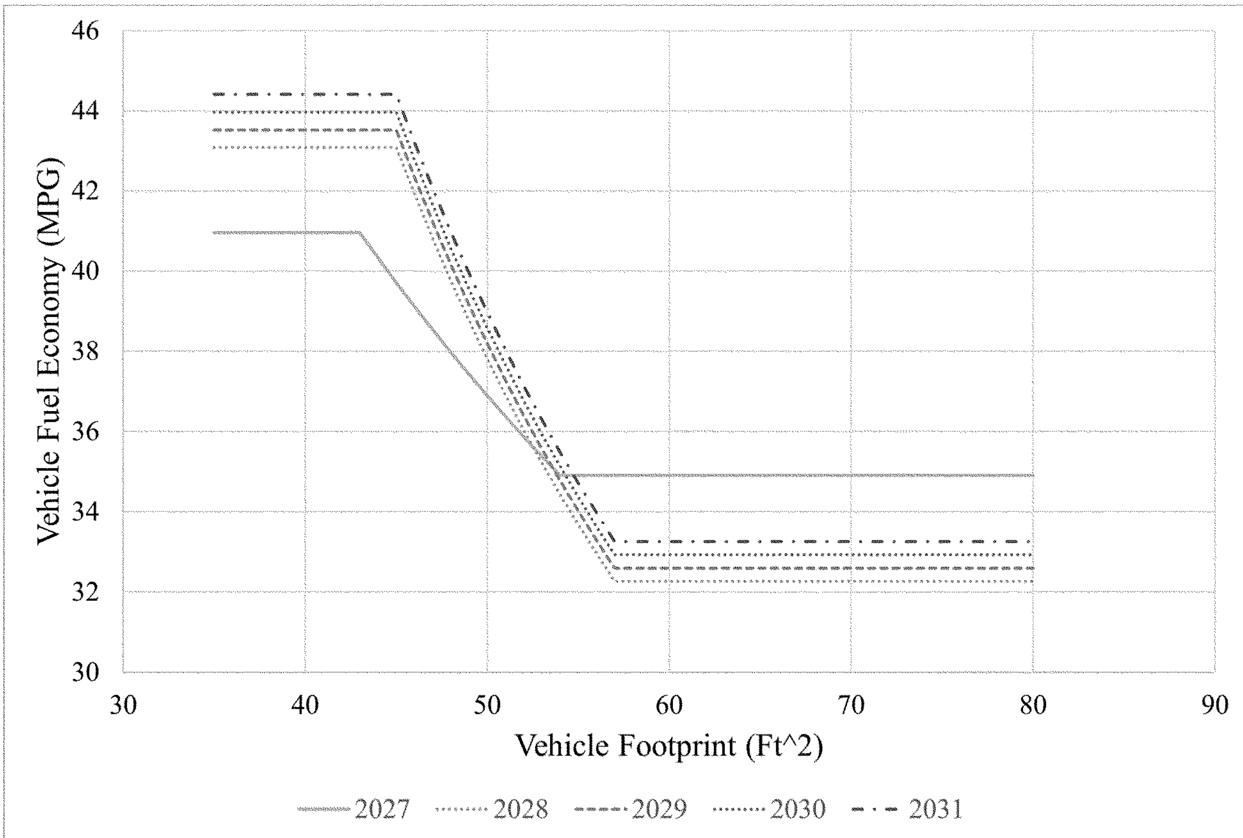
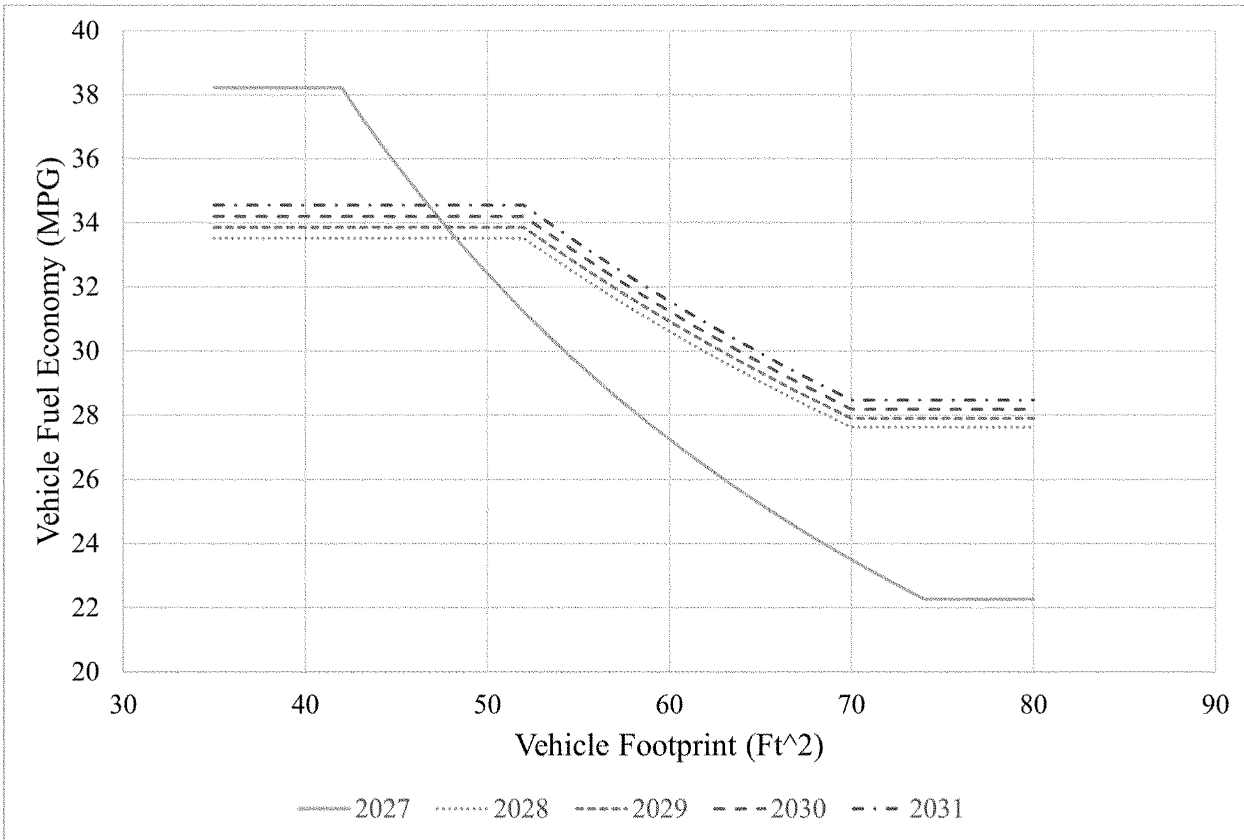


Figure III-16: Alternative 3, Light Truck Fuel Economy, Target Curves for the MYs 2027-2031 Amendment



Under this alternative, the MDPCS is as follows:

Table III-27: Alternative 3 – Minimum Domestic Passenger Car Standard (MDPCS) (MPG) for the MYs 2027-2031 Amendment

2027	2028	2029	2030	2031
35.7	36.2	36.6	36.9	37.3

IV. Effects of the Regulatory Alternatives

A. Effects of the Regulatory Alternatives for MYs 2022–2026

NHTSA does not estimate any impacts from changes to the MY 2022–2026 standards other than the difference between the estimated achieved compliance value and the proposed standard for each manufacturer's fleet. At the time of the proposal, manufacturers have already produced fleets for MYs 2022–2025, either partially or completely. Furthermore, manufacturers have already made vehicle design decisions related to their MY 2026 fleets, leaving them limited options to adjust their production for that year in response to the proposed standards. As a result, NHTSA's proposed standards are expected to have no impact on manufacturers' production decisions. Similarly, new vehicles produced for MYs 2022–2024 have already been purchased, as have, at the time of this proposal, most new vehicles produced in MY 2025. While manufacturers may adjust prices for vehicles produced in MYs 2025–2026 in response to the proposed standards, modeling such price changes would require significant speculation about how manufacturers will make decisions regarding their pricing strategies.

Table IV–1 through Table IV–9 present compliance gaps for domestic passenger cars, imported passenger cars, and non-passenger automobile fleets for MYs 2022–2024, comparing the fuel economy levels that have been achieved to those that would have been achieved under the standards contemplated by NHTSA.

Table IV-1: Manufacturer Compliance Positions, Domestic Passenger Car, MY 2022[329]

Manufacturer	Achieved Fuel Economy (mpg)[330]	Standard (mpg)			
		No-Action Alternative	Alternative 1	Alternative 2	Alternative 3
Ford	34.6	44.1	34.8	35.8	37.2
GM	35.7	44.0	34.7	35.7	37.1
Honda	43.4	44.7	35.2	36.2	37.5
Hyundai	50.7	48.7	37.1	38.1	39.6
Karma	32.8	40.9	32.2	33.1	34.4
KIA	45.0	45.8	35.8	36.8	38.2
Nissan	41.7	44.5	35.0	36.0	37.4
Stellantis	27.8	41.3	33.2	34.1	35.4
Toyota	41.0	43.0	34.2	35.1	36.5
Volvo	39.3	42.2	33.7	34.7	36.0
VWA	32.8	41.4	33.3	34.3	35.6
Industry	39.1	44.1	34.8	35.8	37.1

[329] Domestic passenger car standard equals the larger of two values: the value computed based on the manufacturer's domestic passenger car fleet, and the minimum domestic passenger car standard for the model year. The minimum domestic passenger car standard is set equal to 92 percent of the average fuel economy for the entire passenger car fleet in the model year as projected by NHTSA when the standards are promulgated.

[330] Calculated achieved fuel economy does not include the effects of AC/OC adjustments.

Table IV-2: Manufacturer Compliance Positions, Imported Passenger Car, MY 2022

Manufacturer	Achieved Fuel Economy (mpg)[331]	Standard (mpg)			
		No-Action Alternative	Alternative 1	Alternative 2	Alternative 3
BMW	33.9	43.2	34.3	35.2	36.6
GM	41.1	47.1	36.4	37.4	38.9
Honda	29.4	44.9	35.3	36.3	37.6
Hyundai	40.8	44.2	34.9	35.8	37.2
JLR	29.4	43.1	34.2	35.2	36.5
KIA	40.5	44.5	35.0	36.0	37.4
Mazda	39.5	46.1	35.7	36.7	38.1
Mercedes-Benz	32.7	41.9	33.6	34.5	35.8
Mitsubishi	41.0	47.0	36.1	37.1	38.5
Nissan	41.9	45.1	35.4	36.4	37.8
Stellantis	32.2	44.8	35.3	36.2	37.6
Subaru	37.0	45.9	35.9	36.9	38.3
Toyota	44.8	45.3	35.5	36.5	37.9
Volvo	34.5	41.5	33.2	34.2	35.5
VWA	35.9	45.7	35.7	36.7	38.1
Industry	40.0	44.8	35.2	36.2	37.6

Table IV-3: Manufacturer Compliance Positions, Non-Passenger Automobile, MY 2022

Manufacturer	Achieved Fuel Economy (mpg)[332]	Standard (mpg)			
		No-Action Alternative	Alternative 1	Alternative 2	Alternative 3
BMW	28.8	32.5	27.3	28.1	30.0
Ford	28.1	30.9	25.6	26.3	28.2
GM	26.5	30.0	24.7	25.4	27.2
Honda	32.8	34.0	28.7	29.5	31.5
Hyundai	33.9	34.0	28.6	29.4	31.5
JLR	27.2	32.6	27.4	28.2	30.1
KIA	32.3	34.0	28.7	29.5	31.5
Mazda	34.3	36.0	30.6	31.4	33.6
Mercedes-Benz	29.4	32.9	27.7	28.4	30.4
Mitsubishi	35.6	37.0	31.5	32.4	34.6
Nissan	30.9	32.9	27.7	28.4	30.4
Stellantis	26.7	30.8	25.7	26.4	28.2
Subaru	36.6	36.5	31.0	31.9	34.1
Toyota	32.5	32.9	27.6	28.4	30.3
Volvo	32.1	33.4	28.1	28.9	30.9
VWA	29.7	33.9	28.6	29.4	31.5
Industry	29.8	32.3	27.0	27.7	29.6

Table IV-4: Manufacturer Compliance Positions, Domestic Passenger Car, MY 2023[333]

Manufacturer	Achieved Fuel Economy (mpg)[334]	Standard (mpg)			
		No-Action Alternative	Alternative 1	Alternative 2	Alternative 3
Ford	33.8	44.7	34.9	35.9	37.3
GM	33.5	44.3	34.7	35.7	37.0
Honda	44.5	45.0	35.1	36.1	37.5
Hyundai	40.5	44.8	35.0	36.0	37.3
Kia	41.9	45.6	35.4	36.4	37.8
Mazda	41.6	45.7	35.5	36.5	37.9
Nissan	41.5	45.2	35.2	36.2	37.6
Stellantis	26.0	41.2	32.3	33.2	34.4
Subaru	41.9	43.9	34.4	35.4	36.8
Toyota	45.1	45.6	35.5	36.5	37.9
Volvo	38.3	42.9	33.9	34.8	36.2
VWA	28.3	41.2	32.2	33.1	34.4
Industry	37.9	44.3	34.6	35.6	37.0

Table IV-5: Manufacturer Compliance Positions, Imported Passenger Car, MY 2023

Manufacturer	Achieved Fuel Economy (mpg)[335]	Standard (mpg)			
		No-Action Alternative	Alternative 1	Alternative 2	Alternative 3
BMW	33.4	44.0	34.5	35.4	36.8
Ferrari	20.4	44.0	34.6	35.5	36.9
GM	40.3	47.0	36.3	37.3	38.7
Hyundai	40.5	44.8	35.0	36.0	37.3
JLR	26.0	45.4	35.3	36.3	37.7
Kia	41.9	45.6	35.4	36.4	37.8
Mazda	39.5	47.8	36.2	37.2	38.7
Mercedes-Benz	32.8	42.7	33.9	34.8	36.2
Mitsubishi	53.0	50.9	37.3	38.3	39.8
Nissan	45.2	45.6	35.5	36.5	37.9
Stellantis	29.8	42.8	33.8	34.8	36.1
Subaru	36.7	46.5	36.0	37.0	38.4
Toyota	45.1	45.6	35.5	36.5	37.9
Volvo	34.9	42.1	33.4	34.3	35.6
VWA	35.7	46.1	35.7	36.7	38.1
Industry	40.2	45.4	35.3	36.3	37.7

Table IV-6: Manufacturer Compliance Positions, Non-Passenger Automobile, MY 2023

Manufacturer	Achieved Fuel Economy (mpg)[336]	Standard (mpg)			
		No-Action Alternative	Alternative 1	Alternative 2	Alternative 3
BMW	30.0	33.6	28.0	28.7	30.7
Ford	27.7	30.4	24.8	25.5	27.2
GM	26.0	30.4	24.8	25.5	27.3
Honda	31.9	33.6	27.9	28.7	30.7
Hyundai	31.8	34.4	28.7	29.5	31.5
INEOS	19.6	34.6	28.8	29.6	31.7
JLR	26.2	32.7	27.1	27.9	29.8
Kia	33.2	34.6	28.9	29.7	31.7
Mazda	35.0	36.4	30.6	31.4	33.6
Mercedes-Benz	27.5	33.3	27.6	28.4	30.4
Mitsubishi	35.6	37.5	31.6	32.5	34.7
Nissan	33.1	34.3	28.6	29.4	31.4
Stellantis	27.6	31.6	26.1	26.8	28.7
Subaru	35.9	37.0	31.1	32.0	34.2
Toyota	31.7	33.4	27.7	28.5	30.5
Volvo	32.1	34.1	28.5	29.2	31.3
VWA	29.7	34.4	28.7	29.5	31.5
Industry	29.7	32.7	27.0	27.7	29.6

Table IV-7: Manufacturer Compliance Positions, Domestic Passenger Car, MY 2024[337]

Manufacturer	Achieved Fuel Economy (mpg)[338]	Standard (mpg)			
		No-Action Alternative	Alternative 1	Alternative 2	Alternative 3
Ford	32.8	48.8	35.2	36.2	37.6
GM	35.3	48.4	35.0	36.0	37.4
Honda	45.2	49.1	35.4	36.4	37.8
KIA	44.3	50.6	36.2	37.2	38.6
Nissan	44.6	49.5	35.6	36.6	38.0
Toyota	42.3	47.7	34.6	35.6	36.9
Volvo	39.5	46.6	34.0	35.0	36.3
VWA	29.7	45.3	32.6	33.5	34.8
Industry	41.3	48.9	35.3	36.3	37.7

Table IV-8: Manufacturer Compliance Positions, Imported Passenger Car, MY 2024

Manufacturer	Achieved Fuel Economy (mpg)[339]	Standard (mpg)			
		No-Action Alternative	Alternative 1	Alternative 2	Alternative 3
BMW	34.2	47.5	34.5	35.5	36.8
Ferrari	21.2	47.5	34.7	35.7	37.0
GM	42.0	50.6	36.2	37.2	38.6
Hyundai	41.1	48.6	35.1	36.1	37.4
JLR	28.4	47.4	34.4	35.4	36.8
KIA	41.8	49.1	35.4	36.4	37.8
Mazda	39.9	50.6	36.0	37.0	38.4
Mercedes-Benz	34.0	46.1	33.9	34.8	36.1
Mitsubishi	53.9	55.4	37.5	38.5	40.0
Nissan	41.9	49.6	35.7	36.7	38.1
Stellantis	38.7	50.5	36.1	37.2	38.6
Subaru	36.3	50.5	36.1	37.1	38.5
Toyota	46.5	49.7	35.7	36.7	38.1
Volvo	30.5	47.7	34.6	35.6	37.0
VWA	36.7	50.7	36.1	37.2	38.6
Industry	41.2	49.5	35.6	36.6	38.0

Table IV-9: Manufacturer Compliance Positions, Non-Passenger Automobile, MY 2024

Manufacturer	Achieved Fuel Economy (mpg)[340]	Standard (mpg)			
		No-Action Alternative	Alternative 1	Alternative 2	Alternative 3
BMW	31.0	36.4	28.0	28.8	30.8
Ford	28.9	33.4	25.5	26.2	28.0
GM	26.2	32.4	24.6	25.3	27.0
Honda	34.7	37.4	28.9	29.7	31.7
Hyundai	33.1	37.4	28.9	29.7	31.8
INEOS	19.9	36.5	28.1	28.9	30.9
JLR	26.9	35.3	27.1	27.8	29.8
KIA	31.4	37.0	28.6	29.3	31.4
Mazda	34.7	38.5	29.8	30.6	32.7
Mercedes-Benz	27.4	35.8	27.5	28.2	30.2
Mitsubishi	35.9	40.8	31.8	32.6	34.9
Nissan	30.7	36.2	27.8	28.6	30.6
Stellantis	27.3	34.5	26.4	27.1	29.0
Subaru	36.1	40.3	31.4	32.3	34.5
Toyota	34.4	35.7	27.4	28.2	30.1
Volvo	33.6	37.0	28.5	29.3	31.3
VWA	30.7	37.8	29.2	30.0	32.1
Industry	30.5	35.5	27.2	27.9	29.9

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Unlike MYs 2022–2024, NHTSA is not yet in possession of pre- or mid-model year manufacturer data for MYs 2025–2026 from which to generate estimates of fuel economy standards and values. As a reminder, a manufacturer's fleet fuel economy standard is generated based on a calculation of sales-weighted volumes of vehicles by footprint and fuel economy in a particular regulatory fleet. MPG values are not the standards; instead, the coefficients that go into the mathematical functions that create the footprint-to-fuel economy relationship curves define the standards. Accordingly, without data for MYs 2025–2026 in hand, NHTSA performed sensitivity cases using the CAFE Model to generate estimated fleet average CAFE standards for MYs 2025–2026.

Table IV–10 through Table IV–13 show the estimated required CAFE level for MYs 2025–2026. Table IV–10 shows these values for passenger cars, light trucks, and the fleet as a whole for the Preferred Alternative. Tables Table IV–11through Table IV–13 show these values by regulatory class (domestic passenger cars, imported passenger cars, and light trucks) for each manufacturer in each alternative. It is important to note that these values are projections of the average mpg that the fleets will need to achieve. The actual level of performance that each manufacturer would need to meet varies and is calculated for each manufacturer's compliance fleet based on the footprint of each vehicle in the fleet and the corresponding footprint curve.

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[331] Calculated achieved fuel economy does not include the effects of AC/OC adjustments.

[332] Calculated achieved fuel economy does not include the effects of AC/OC adjustments.

[333] Domestic passenger car standard equals the larger of two values: the value computed based on the manufacturer's domestic passenger car fleet, and the minimum domestic passenger car standard for the model year. The minimum domestic passenger car standard is set equal to 92 percent of the average fuel economy for the entire passenger car fleet in the model year as projected by NHTSA when the standards are promulgated.

[334] Calculated achieved fuel economy does not include the effects of AC/OC adjustments.

[335] Calculated achieved fuel economy does not include the effects of AC/OC adjustments.

[336] Calculated achieved fuel economy does not include the effects of AC/OC adjustments.

[337] Domestic passenger car standard equals the larger of two values: the value computed based on the manufacturer's domestic passenger car fleet, and the minimum domestic passenger car standard for the model year. The minimum domestic passenger car standard is set equal to 92 percent of the average fuel economy for the entire passenger car fleet in the model year as projected by NHTSA when the standards are promulgated.

[338] Calculated achieved fuel economy does not include the effects of AC/OC adjustments.

[339] Calculated achieved fuel economy does not include the effects of AC/OC adjustments.

[340] Calculated achieved fuel economy does not include the effects of AC/OC adjustments.

[341] Values derived from CAFE Model analysis using proposed MYs 2022–2026 footprint curves. See RIA Chapter 9, sensitivity case ''Proposed standards (2022–2026)'' for additional details.

Table IV-10: Estimated Required Average CAFE Levels (mpg), Alternative 2, MYs 2025-2026[341]

	2025	2026
Passenger Car	36.6	36.8
Light Truck	28.0	28.1
Total LD Fleet	30.4	30.4

Table IV-11: Estimated Required Average CAFE Levels (mpg), Domestic Passenger Car, MYs 2025-2026

Manufacturer	2025				2026			
	No Action	Alt. 1	Alt. 2	Alt. 3	No Action	Alt. 1	Alt. 2	Alt. 3
Ford	53.0	35.4	36.4	37.8	58.9	35.6	36.6	38.0
GM	52.6	35.2	36.2	37.6	58.5	35.4	36.4	37.7
Honda	53.4	35.6	36.5	37.9	59.3	35.7	36.7	38.1
KIA	55.0	36.4	37.4	38.8	61.1	36.5	37.6	39.0
Nissan	53.9	35.8	36.8	38.2	59.9	36.0	37.0	38.4
Toyota	51.8	34.8	35.8	37.1	57.6	35.0	35.9	37.3
Volvo	50.7	34.2	35.2	36.5	56.3	34.4	35.3	36.7
VWA	48.1	32.8	33.7	35.0	53.5	32.9	33.9	35.2
Industry	53.2	35.5	36.5	37.8	59.1	35.7	36.6	38.0

Table IV-12: Estimated Required Average CAFE Levels (mpg), Imported Passenger Car, MYs 2025-2026

Manufacturer	2025				2026			
	No Action	Alt. 1	Alt. 2	Alt. 3	No Action	Alt. 1	Alt. 2	Alt. 3
BMW	51.7	34.7	35.7	37.0	57.4	34.9	35.8	37.2
Ferrari	51.7	34.9	35.8	37.2	57.5	35.0	36.0	37.4
GM	55.0	36.4	37.4	38.8	61.2	36.6	37.6	39.0
Hyundai	52.9	35.3	36.2	37.6	58.7	35.4	36.4	37.8
JLR	51.5	34.6	35.6	37.0	57.2	34.8	35.8	37.1
KIA	53.4	35.6	36.6	38.0	59.4	35.8	36.8	38.2
Mazda	55.1	36.2	37.2	38.6	61.2	36.4	37.4	38.8
Mercedes-Benz	50.1	34.0	35.0	36.3	55.7	34.2	35.1	36.5
Mitsubishi	60.2	37.7	38.7	40.2	66.9	37.8	38.9	40.4
Nissan	54.0	35.8	36.9	38.3	60.0	36.0	37.0	38.5
Stellantis	54.9	36.3	37.4	38.8	61.0	36.5	37.5	39.0
Subaru	54.9	36.3	37.3	38.7	61.0	36.5	37.5	38.9
Toyota	54.0	35.9	36.9	38.3	60.0	36.1	37.1	38.5
Volvo	51.9	34.8	35.8	37.2	57.7	35.0	36.0	37.3
VWA	55.1	36.3	37.3	38.8	61.2	36.5	37.5	39.0
Industry	53.9	35.8	36.8	38.2	59.8	36.0	37.0	38.4

Table IV-13: Estimated Required Average CAFE Levels (mpg), Non-Passenger Automobile, MYs 2025-2026

Manufacturer	2025				2026			
	No Action	Alt. 1	Alt. 2	Alt. 3	No Action	Alt. 1	Alt. 2	Alt. 3
BMW	39.6	28.1	28.9	30.9	43.9	28.3	29.0	31.1
Ford	36.3	25.6	26.3	28.1	40.4	25.7	26.4	28.3
GM	34.9	24.5	25.2	26.9	38.8	24.6	25.3	27.0
Honda	40.7	29.0	29.8	31.9	45.2	29.2	30.0	32.1
Hyundai	40.7	29.0	29.8	31.9	45.2	29.2	30.0	32.1
INEOS	39.7	28.3	29.0	31.1	44.1	28.4	29.2	31.2
JLR	38.4	27.2	28.0	29.9	42.7	27.3	28.1	30.1
KIA	40.3	28.7	29.5	31.5	44.7	28.8	29.6	31.7
Mazda	41.8	29.9	30.7	32.9	46.5	30.1	30.9	33.0
Mercedes-Benz	38.9	27.6	28.4	30.3	43.2	27.7	28.5	30.5
Mitsubishi	44.3	31.9	32.8	35.1	49.2	32.1	33.0	35.3
Nissan	39.4	28.0	28.7	30.7	43.7	28.1	28.9	30.9
Stellantis	37.5	26.5	27.3	29.1	41.7	26.7	27.4	29.3
Subaru	43.9	31.6	32.4	34.7	48.7	31.7	32.6	34.9
Toyota	38.8	27.5	28.3	30.3	43.1	27.7	28.4	30.4
Volvo	40.2	28.6	29.4	31.5	44.7	28.8	29.6	31.6
VWA	41.1	29.4	30.2	32.3	45.7	29.5	30.3	32.5
Industry	38.4	27.2	28.0	29.9	42.7	27.4	28.1	30.1

B. Effects of the Regulatory Alternatives for 2027–2031

1. Effects on Vehicle Manufacturers

Each regulatory alternative considered in this proposed rule, aside from the No-Action Alternative, would change the stringency of both passenger car and light truck CAFE standards during MYs 2027–2031. To estimate the potential effects of each of these alternatives, including effects beyond these years, NHTSA has, as it has done with all recent CAFE rulemakings, assumed that standards would continue unchanged after the last model year to be covered by CAFE targets (in this case, after MY 2031).

The estimated required average fuel economy values for the passenger car, light truck, and total fleets for each action alternative that NHTSA considered alongside values for the No-Action Alternative are presented in Table IV–14 below. NHTSA recognizes that the size and composition of the fleet (*i.e.,* in terms of distribution across the range of vehicle footprints) can change over time, affecting the average fuel economy requirements under both the passenger car and light truck standards, and for the overall fleet. To the extent the fleet differs from NHTSA's projections, average requirements also would differ from NHTSA's projections.

Table IV-14: Estimated Required Average Fuel Economy (MPG), by Regulatory Fleet

Model Year	2024	2027	2028	2029	2030	2031
Passenger Car						
No-Action	49.3	60.7	62.0	63.2	64.5	65.8
Alternative 1	49.3	35.9	36.0	36.1	36.2	36.2
Alternative 2	49.3	36.9	37.1	37.2	37.3	37.4
Alternative 3	49.3	38.8	39.4	39.8	40.2	40.6
Light Truck						
No-Action	35.4	42.7	42.7	43.6	44.5	45.4
Alternative 1	35.4	27.6	27.8	27.9	27.9	28.0
Alternative 2	35.4	28.3	28.4	28.5	28.5	28.6
Alternative 3	35.4	30.2	30.3	30.6	30.9	31.2

Table IV-15: Estimated Required Average Fuel Economy (MPG), Total Light-Duty Fleet

Model Year	2024	2027	2028	2029	2030	2031
No-Action	38.8	46.8	46.9	48.0	48.9	49.9
Alternative 1	38.8	29.6	33.3	33.4	33.5	33.6
Alternative 2	38.8	30.4	34.2	34.4	34.4	34.5
Alternative 3	38.8	32.3	36.4	36.8	37.2	37.5

Manufacturers' achieved average fuel economy does not always exactly match each CAFE standard in each model year, and some manufacturers have tended to exceed at least one requirement.[342] NHTSA uses the CAFE Model to approximate compliance solutions of manufacturers, while observing statutory constraints on the factors NHTSA may consider in setting standards (and thus its analysis of alternative standards).[343] As discussed in the accompanying PRIA and Draft TSD, NHTSA simulates manufacturers' responses to each alternative given a wide range of input estimates (*e.g.,* technology cost and efficacy and fuel prices), each of which is subject to uncertainty. NHTSA's analysis simply illustrates one potential way manufacturers could respond to each regulatory alternative; manufacturers' actual responses may differ from NHTSA's simulations, and therefore the achieved compliance levels will likely differ from the estimated achieved fuel economy for each regulatory alternative shown in these tables.

[342] Over-compliance can be the result of multiple factors including projected ''inheritance'' of technologies (*e.g.,* changes to engines shared across multiple vehicle model/configurations) applied in earlier model years, future technology cost reductions (*e.g.,* decreased technology costs due to learning), and changes in fuel prices that affect technology cost effectiveness. As in all past rulemakings over the last decade, NHTSA assumes that beyond fuel economy changes in response to CAFE standards, manufacturers may also improve fuel economy via technologies that would pay for themselves within the first 36 months of vehicle operation.

[343] NHTSA's standard-setting analysis does not consider factors prohibited under 49 U.S.C. 32902(h), including the application of compliance credits and consideration of fuel economy attributable to alternative fuel sources. For plug-in hybrid vehicles, this means only the gasoline-powered operation (*i.e.,* non-electric fuel economy, or charge sustaining mode operation only) is considered when selecting technology to meet the standards.

Table IV-16: Estimated Achieved Average Fuel Economy (MPG), by Regulatory Fleet

Model Year	2024	2027	2028	2029	2030	2031
Passenger Car						
No-Action	43.2	56.1	58.5	61.9	62.2	62.8
Alternative 1	43.2	54.3	45.5	45.9	46.1	46.3
Alternative 2	43.2	54.3	45.5	45.9	46.1	46.3
Alternative 3	43.2	54.4	45.8	46.2	46.5	46.7
Light Truck						
No-Action	32.7	39.8	42.1	43.3	44.5	44.7
Alternative 1	32.7	38.6	31.0	31.5	31.8	32.1
Alternative 2	32.7	38.6	31.1	31.5	31.8	32.1
Alternative 3	32.7	38.8	31.3	32.0	32.4	32.6

Table IV-17: Estimated Achieved Average Fuel Economy (MPG), Total Light-Duty Fleet

Model Year	2024	2027	2028	2029	2030	2031
No-Action	35.4	43.5	45.8	47.5	48.5	48.8
Alternative 1	35.4	42.2	40.3	40.8	41.1	41.3
Alternative 2	35.4	42.2	40.4	40.8	41.1	41.3
Alternative 3	35.4	42.4	40.6	41.3	41.6	41.8

The SHEV share of the fleet initially (*i.e.,* in MY 2024) is around 10 percent, and the Model shows this share increasing to 41 percent for all alternatives by MY 2026. By the end of the regulatory period (MYs 2027–2031), SHEV penetration rates reach 52–55 percent for the action alternatives and 80 percent for the No-Action Alternative (including both the passenger car and light truck fleets). SHEVs are estimated to make up a similar portion of the light truck fleet and the passenger car fleet across MYs 2027–2031 in each of the regulatory alternatives.

The PHEV share of the fleet in MY 2024 is around 3.4 percent for light trucks and 1.7 percent for passenger cars. While their market shares do not increase to the levels seen for SHEVs, PHEVs are estimated to make up around 13 percent of the light truck fleet for all the regulatory alternatives by MY 2031, and around 10 percent for the No-Action Alternative. In the passenger car fleet, PHEV penetration stays under 3 percent for all regulatory alternatives across MYs 2027–2031.[344]

Variation in penetration rates across regulatory alternatives generally results from differences in the number of vehicles or models a manufacturer would need to add technology to comply with each alternative. For example, a certain technology pathway could be the most cost-effective pathway if a manufacturer is just shy of its fuel economy target, but the pathway likely becomes ineffective if there's a larger gap, which may necessitate pursuing broader changes in powertrain technology across the manufacturer's fleet. For more detail on the technology application by regulatory fleet, see PRIA Chapter 8.2.2.1.

[344] Due to the statutory constraints imposed on the analysis by EPCA that exclude consideration of AFVs, BEVs are not a compliance option in any model year. Similarly, PHEVs can be introduced by the CAFE Model, but only their charge-sustaining fuel economy value (as opposed to their charge-depleting fuel economy value) is considered in this analysis.

Table IV-18: Estimated Strong Hybrid Electric Vehicle (SHEV) Penetration Rate, by Regulatory Fleet

Model Year	2024	2027	2028	2029	2030	2031
Passenger Car						
No-Action	8.7	57.5	68.0	82.0	83.4	86.2
Alternative 1	8.7	52.7	51.0	51.4	51.5	52.4
Alternative 2	8.7	52.7	51.0	51.4	51.5	52.4
Alternative 3	8.7	52.9	53.1	53.5	53.7	54.6
Light Truck						
No-Action	11.2	51.5	60.2	67.3	74.0	77.8
Alternative 1	11.2	43.3	42.0	47.6	50.5	52.4
Alternative 2	11.2	43.3	42.0	47.6	50.5	52.4
Alternative 3	11.2	45.8	42.8	52.2	55.1	57.2

Table IV-19: Estimated Strong Hybrid Electric Vehicle (SHEV) Penetration Rate, Total Light-Duty Fleet

Model Year	2024	2027	2028	2029	2030	2031
No-Action	10.4	53.3	62.4	71.7	76.7	80.2
Alternative 1	10.4	46.1	48.5	50.4	51.3	52.4
Alternative 2	10.4	46.1	48.5	50.4	51.3	52.4
Alternative 3	10.4	47.9	50.3	53.2	54.1	55.3

Table IV-20: Estimated Plug-in Hybrid-Electric Vehicle (PHEV) Penetration Rate, by Regulatory Fleet

Model Year	2024	2027	2028	2029	2030	2031
Passenger Car						
No-Action	1.7	1.7	1.7	1.7	1.7	1.7
Alternative 1	1.7	1.7	2.6	2.6	2.6	2.6
Alternative 2	1.7	1.7	2.6	2.6	2.6	2.6
Alternative 3	1.7	1.7	2.6	2.6	2.6	2.6
Light Truck						
No-Action	3.4	7.1	9.6	9.6	9.6	9.6
Alternative 1	3.4	7.1	13.3	13.3	13.3	13.3
Alternative 2	3.4	7.1	13.3	13.3	13.3	13.3
Alternative 3	3.4	7.1	13.3	13.3	13.3	13.3

Table IV-21: Estimated Plug-in Hybrid-Electric Vehicle (PHEV) Penetration Rate, Total Light-Duty Fleet

Model Year	2024	2027	2028	2029	2030	2031
No-Action	2.9	5.5	7.3	7.3	7.3	7.3
Alternative 1	2.9	5.5	5.5	5.5	5.5	5.5
Alternative 2	2.9	5.5	5.5	5.5	5.5	5.5
Alternative 3	2.9	5.5	5.5	5.5	5.5	5.5

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The PRIA also presents NHTSA's estimates of manufacturers' potential application of fuel-saving technologies, including advanced transmissions, aerodynamic improvements, and reduced vehicle mass, in response to each regulatory alternative. The accompanying PRIA Appendix provides more detailed and comprehensive results, and the underlying CAFE Model Output File provide all the information used to construct these estimates, including the specific combination of technologies estimated to be applied to every vehicle model/configuration in each of MYs 2024–2050.

NHTSA's analysis estimates manufacturers' regulatory costs for compliance with the CAFE standards. As summarized in Table IV–22, NHTSA estimates manufacturers' *cumulative* regulatory costs across MYs 2027–2031 would total $117 billion under the No-Action Alternative and $73.9 billion, $73.9 billion, and $77.8 billion under regulatory alternatives 1, 2, and 3, respectively, considered in this proposal. These regulatory costs account for fuel-saving technologies added in the simulation (and AC improvements and other OC technologies through MY 2027). Table IV–22 below shows estimated costs by manufacturer. The variation in aggregate costs among manufacturers is a function of both differences in the quantities of vehicles produced for sale in the United States and differences in technology application and compliance pathways. Technology costs for each model year are defined on an incremental basis, with costs equal to the relevant technology applied minus the costs of the initial technology state in a reference fleet (*i.e.,* MY 2024).[345] The accompanying PRIA Appendix presents results separately for each manufacturer's compliance fleets (*i.e.,* domestic passenger car, imported passenger car, and light truck) under each regulatory alternative and model year, and the underlying CAFE Model Output File also show results for each manufacturer's combined passenger car fleet (*i.e.,* domestic and imported cars).

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[345] As discussed in the Draft TSD, the technology costs considered in the CAFE Model reflect a markup factor to account for manufacturer profits and other retail costs. For more detail regarding the calculation of technology costs, see the CAFE Model Documentation.

Table IV-22: Estimated Cumulative Technology Costs ($b) During MYs 2027-2031

Model Year	No-Action	Alternative 1	Alternative 2	Alternative 3
BMW	2.8	2.0	2.0	2.0
Ferrari	0.0	0.0	0.0	0.0
Ford	12.1	6.6	6.6	7.7
GM	32.8	24.2	24.2	24.2
Honda	6.9	3.9	3.9	3.9
Hyundai	8.2	3.6	3.6	3.6
INEOS	0.1	0.1	0.1	0.1
JLR	0.6	0.4	0.4	0.5
KIA	7.8	5.4	5.4	5.4
Mazda	3.4	0.9	0.9	0.9
Mercedes-Benz	1.3	0.9	0.9	1.0
Mitsubishi	1.0	0.9	0.9	0.9
Nissan	5.0	3.4	3.4	3.5
Stellantis	10.4	5.2	5.2	5.9
Subaru	4.0	0.2	0.2	0.5
Toyota	13.0	10.7	10.7	11.9
Volvo	0.8	0.7	0.7	0.7
VWA	7.1	4.8	4.8	5.1
Industry Total	117.4	73.9	73.9	77.8

NHTSA assumes that technology costs are reflected in vehicle prices. NHTSA's estimates of the average costs to new vehicle purchasers from MYs 2027–2031 are summarized in Table IV–23 and Table IV–24.

Table IV-23: Estimated Average Per-Vehicle Regulatory Cost ($), by Regulatory Fleet

Model Year	2024	2027	2028	2029	2030	2031
Passenger Car						
No-Action	0	1,476	1,705	2,000	1,997	2,019
Alternative 1	0	1,237	1,108	1,100	1,092	1,090
Alternative 2	0	1,237	1,108	1,100	1,092	1,090
Alternative 3	0	1,248	1,150	1,142	1,138	1,136
Light Truck						
No-Action	0	1,469	1,874	2,008	2,111	2,139
Alternative 1	0	1,165	1,423	1,419	1,423	1,414
Alternative 2	0	1,166	1,427	1,419	1,423	1,414
Alternative 3	0	1,210	1,502	1,584	1,586	1,581

Table IV-24: Estimated Average Per-Vehicle Regulatory Cost ($), Total Light-Duty Fleet

Model Year	2024	2027	2028	2029	2030	2031
No-Action	0	1,471	1,825	2,006	2,078	2,104
Alternative 1	0	1,186	1,194	1,186	1,182	1,179
Alternative 2	0	1,187	1,195	1,186	1,182	1,179
Alternative 3	0	1,221	1,246	1,262	1,260	1,257

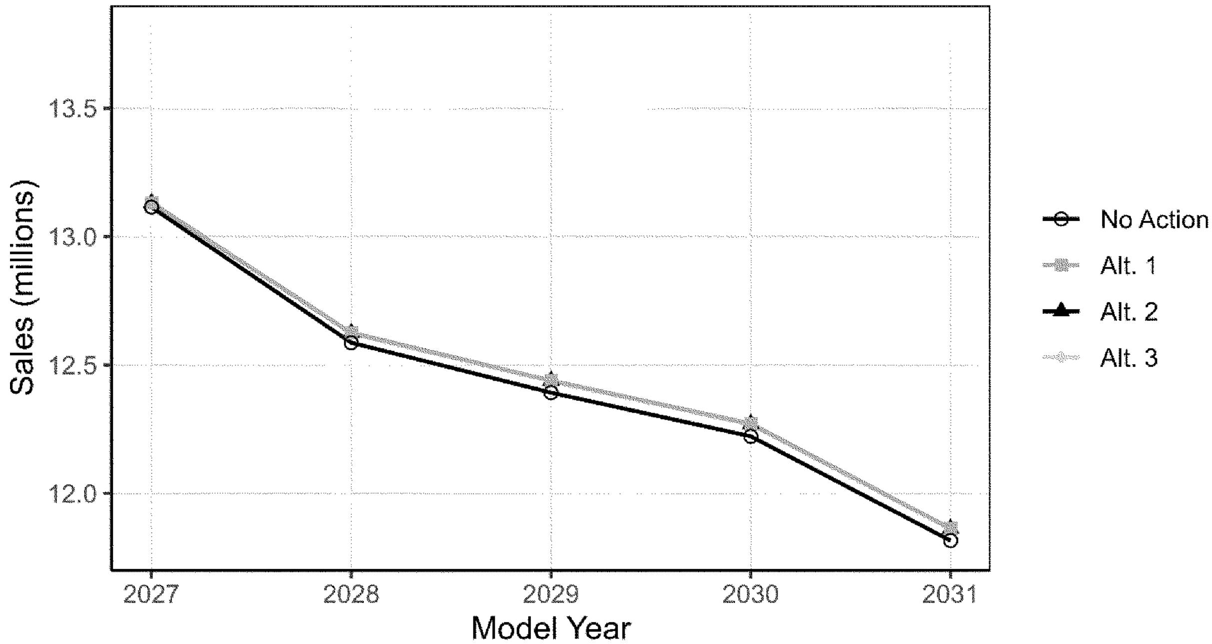
Table IV–25 shows how these costs could vary among manufacturers. See Chapter 8.2.2 of the PRIA for more details of the effects on vehicle manufacturers, including compliance and regulatory costs.

Table IV-25: Average Manufacturer Per-Vehicle Costs by Alternative, Total Light-Duty Fleet, MY 2031 ($)

Model Year	No-Action	Alternative 1	Alternative 2	Alternative 3
BMW	1,844	1,208	1,208	1,208
Ferrari	2,968	2,970	2,970	2,969
Ford	1,874	932	932	1,075
GM	3,596	2,356	2,356	2,356
Honda	1,420	649	649	648
Hyundai	2,585	991	991	991
INEOS	2,735	2,735	2,735	2,735
JLR	1,284	274	274	735
KIA	2,715	1,665	1,665	1,665
Mazda	2,078	593	593	594
Mercedes-Benz	1,442	709	709	848
Mitsubishi	1,380	1,235	1,235	1,235
Nissan	1,513	885	885	902
Stellantis	2,447	1,161	1,161	1,306
Subaru	1,285	44	44	182
Toyota	1,392	994	994	1,166
Volvo	1,396	1,136	1,136	1,136
VWA	2,188	1,413	1,413	1,537
Industry Average	2,104	1,179	1,179	1,257

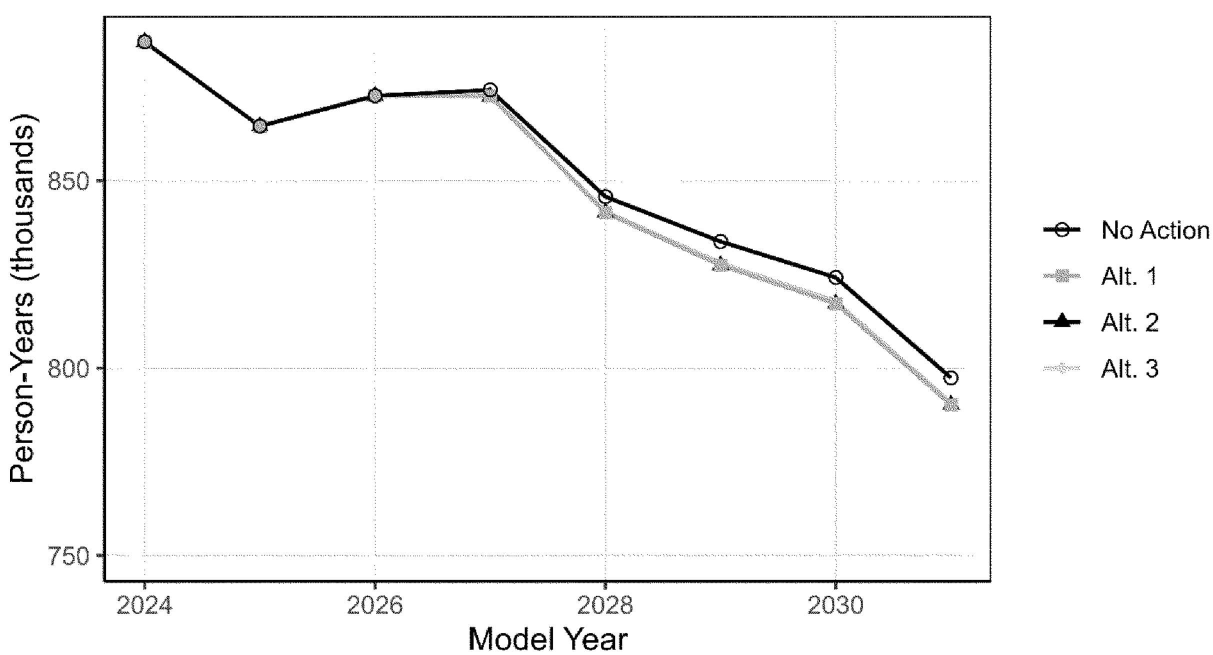
Fuel savings and regulatory costs act as countervailing forces on new vehicle sales. All else being equal, as fuel savings increase, the CAFE Model projects higher new vehicle sales, but as regulatory costs increase, the CAFE Model projects lower new vehicle sales. Both fuel savings and regulatory costs increase with stringency. The magnitude of these fuel savings and vehicle price increases depend on manufacturer compliance decisions, especially technology application. Draft TSD Chapter 4.2.1.2 discusses NHTSA's approach to estimating new vehicle sales. For all scenarios modeled in this analysis, vehicle sales stay constant relative to the No-Action Alternative through MY 2026, after which the CAFE Model begins applying technology differently in response to the standards that would be set under the various regulatory alternatives. The three regulatory alternatives result in essentially the same vehicle sales for all model years. The No-Action Alternative, which has higher projected regulatory costs starting in MY 2027, results in approximately 0.1 to 0.4 percent lower vehicle sales in each model year for MY 2027 and beyond, compared to the regulatory alternatives. Figure IV–1 shows the estimated annual light-duty industry sales by regulatory alternative.

Figure IV-1: Estimated Annual Light-Duty Vehicle Sales (Millions)



Differences in sales and the cost of technology applied to vehicles in turn tend to affect projected automobile industry labor utilizations. Because the action alternatives produce similar levels of technology costs and sales volumes, the related changes in labor predicted by the CAFE Model across these alternatives are also negligible. For the No-Action Alternative, since the CAFE Model directly translates costs into labor hours, the additional technology costs convert to a higher labor impact than decreased sales volumes, resulting in a level of automotive employment, measured in person years, that is about 1 percent higher than the regulatory alternatives by MY 2031. Figure IV–2 shows the estimated number of person years under each alternative.

Figure IV-2: Estimated Light-Duty Automobile Industry Labor as Thousands of Person Years



The accompanying Draft TSD Chapter 6.2.5 discusses NHTSA's approach to estimating automobile industry employment, and the accompanying PRIA Chapter 8 (and its Appendix I) and CAFE Model Output File provide more detailed results of NHTSA's light-duty analysis.

2. Effects on Society

NHTSA accounts for the effects of the standards on society using a benefit-cost framework. The categories considered include private costs borne by manufacturers and passed on to consumers; external costs, which include government costs and costs pertaining to emissions, congestion, noise, and energy security; and costs associated with safety impacts. In this accounting framework, the CAFE Model records costs and benefits related to vehicles in the fleet throughout the lifetime of a particular model year and also allows for the accounting of costs and benefits by calendar years. Examining program effects through this lens illustrates the temporal differences in major cost and benefit components and allows NHTSA to examine costs and benefits tied only to those vehicles that are directly impacted by this proposal.

NHTSA splits effects on society into private costs, external costs, private benefits, and external benefits. Table IV–26 and Table IV–27 present NHTSA's estimates of the costs and benefits of changing CAFE standards in each alternative considered in this proposal, as well as the party (private interests or society as a whole) to which they accrue. Manufacturers are directly regulated under the program and incur additional production costs when they apply technology to their vehicle offerings to improve fuel economy. NHTSA assumes that those costs are fully passed through to new car and truck buyers in the form of higher prices (and conversely, that decreases in technology costs pass through as lower prices for consumers).

While incremental maintenance and repair costs and benefits would change for buyers of new cars and trucks affected by modified CAFE standards, NHTSA does not include these impacts in the analysis because they are difficult to estimate, and NHTSA does not currently have sufficient data to estimate them accurately. NHTSA may include estimates of the impact that CAFE standards have on lifetime maintenance and repair costs in future analyses if sufficient data become available.

The analysis's estimates also take into account the rebound effect, in which vehicles are driven more as increased fuel economy reduces the cost of driving. NHTSA also assumes that drivers of new vehicles internalize 90 percent of the risk associated with increased exposure to crashes when they engage in additional travel.

The value of fuel savings,[346] which accrue to new car and truck buyers, is the largest component of the estimated private benefits associated with each of the regulatory alternatives. For this proposal, the estimates reflect forgone fuel savings for consumers, as fuel efficiency is lower than it would be under the No-Action Alternative. NHTSA is exploring options for the final rule to present the value of fuel savings as those savings accrue to multiple buyers over the vehicle's life; currently, the value of fuel savings is presented as one value attached to the entire vehicle's life. In contrast, in the real world, a vehicle may have multiple owners that experience different benefits between the up-front savings from reduced technology application under lower fuel economy standards and the forgone fuel savings for the vehicle's first owner for the time that they own the vehicle. NHTSA seeks comment on such alternative presentations of fuel savings that the agency could include for informational purposes in the final rule, in addition to its traditional presentation of fuel savings as shown below.

Benefits to new vehicle buyers are also expected to be reduced as the regulatory alternatives increase the cost of driving relative to the No-Action Alternative (*i.e.,* lower fuel economy increases the per-mile cost of travel) and results in more frequent refueling and a rebound-related reduction in the mobility benefits of travel. While fuel savings diminish under the proposed standards, by reducing standards NHTSA enables manufacturers to provide a mix of vehicles with attributes that consumers desire. NHTSA accounts for forgone improvements in attributes other than fuel economy due to CAFE standards through the implicit opportunity cost in its analysis; however, the agency does not account for changes in the fleet mix offered by manufacturers in an effort to comply with standards, including eliminating some models entirely. Because the proposed standards would prevent these distortionary effects, it would increase the range of choices available to Americans and would, thus, provide additional benefits to new car and truck buyers.

In addition to private benefits and costs—those borne by manufacturers, buyers, and owners of cars and light trucks—there are other benefits and costs from resetting CAFE standards that are borne more broadly throughout the economy or society, which NHTSA refers to as external benefits and costs.[347] In the case of the proposed standards, the increase in per-mile fuel costs would lead to a reduction in congestion and road noise costs, due to reduced rebound travel.[348] The external benefits of health outcomes related to exposure of criteria pollutants and of improved energy security also would decrease slightly relative to the No-Action Alternative under each of the regulatory alternatives considered in this proposal.

Table IV–26 and Table IV–27 below present NHTSA's estimates of the benefits and costs of each regulatory alternative at different discount rates and from both model year and calendar year perspectives. Estimated net benefits are positive for all regulatory alternatives at both the 3- and 7-percent discount rates and for each perspective, with higher costs and benefits estimated in the calendar year analysis.

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[346] Fuel savings are valued in NHTSA's analysis at retail fuel prices (inclusive of Federal and state taxes).

[347] Some of these external benefits and costs result from changes in economic and environmental externalities from supplying or consuming fuel, while others do not involve changes in such externalities but are similar in that they are borne by parties other than those whose actions impose them.

[348] NHTSA also accounts for changes in fuel tax revenue that occurs as a result of changes in fuel consumption. Changes in tax revenues are considered a transfer and not an economic externality as defined traditionally, but NHTSA groups these with social costs instead of private costs because that loss in revenue affects society as a whole as opposed to impacting only consumers or manufacturers. The offsetting changes in costs to consumers are accounted for in the estimates of fuel cost savings, which are valued at retail prices inclusive of taxes.

Table IV-26: Incremental Benefits and Costs Over the Lifetimes of Total Light-Duty Fleet Produced Through MY 2031 (2024$ Billions), by Alternative[349]

	3% Discount Rate			7% Discount Rate		
	Alt 1	Alt 2	Alt 3	Alt 1	Alt 2	Alt 3
Private Costs						
Technology Costs	-37.1	-37.1	-33.7	-30.3	-30.3	-27.5
Maintenance and Repair Costs*	-	-	-	-	-	-
Sacrifice in Other Vehicle Attributes	-26.6	-26.5	-23.0	-16.9	-16.9	-14.6
Consumer Surplus Loss	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
Safety Costs Internalized by Drivers	-22.9	-22.9	-20.5	-14.4	-14.4	-12.9
Subtotal - Private Costs	-86.5	-86.4	-77.2	-61.6	-61.5	-55.0
External Costs						
Congestion and Noise Costs from Rebound-Effect Driving	-9.6	-9.6	-8.5	-6.1	-6.1	-5.4
Safety Costs Not Internalized by Drivers	-4.1	-4.1	-3.7	-2.6	-2.6	-2.3
Loss in Fuel Tax Revenue	-9.0	-9.0	-7.8	-5.8	-5.8	-5.0
Subtotal - External Costs	-22.7	-22.7	-20.0	-14.5	-14.5	-12.7
Total Costs (incl. private)	-109.2	-109.1	-97.1	-76.1	-76.0	-67.7
Private Benefits						
Fuel Cost Savings	-53.9	-53.9	-46.5	-34.2	-34.2	-29.5
Benefits from Additional Driving	-25.1	-25.1	-21.7	-15.8	-15.8	-13.7
Refueling Frequency	-3.0	-3.0	-2.7	-1.9	-1.9	-1.7
Subtotal - Private Benefits	-82.1	-82.0	-70.8	-52.0	-51.9	-44.9
External Benefits						
Petroleum Market Security	-2.2	-2.2	-1.9	-1.4	-1.4	-1.2
Health Outcomes	-0.8	-0.8	-0.7	-0.5	-0.5	-0.4
Total Benefits (incl. private)	-85.2	-85.1	-73.5	-53.9	-53.8	-46.5
Net Total Benefits	24.0	24.0	23.7	22.2	22.2	21.2
*Maintenance and repair costs are not quantified in the analysis.						

Table IV-27 Incremental Benefits and Costs for the On-Road Light-Duty Fleet CYs 2024-2050 (2024$ Billions), by Alternative[350]

	3% Discount Rate			7% Discount Rate		
	Alt 1	**Alt 2**	**Alt 3**	**Alt 1**	**Alt 2**	**Alt 3**
Private Costs						
Technology Costs	-150.1	-150.0	-138.0	-94.0	-94.0	-86.3
Maintenance and Repair Costs*	-	-	-	-	-	-
Sacrifice in Other Vehicle Attributes*	-119.2	-119.2	-105.2	-57.4	-57.4	-50.5
Consumer Surplus Loss	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Safety Costs Internalized by Drivers	-57.3	-57.3	-51.1	-31.3	-31.3	-27.9
Subtotal - Private Costs	-326.5	-326.4	-294.1	-182.6	-182.6	-164.6
External Costs						
Congestion and Noise Costs from Rebound-Effect Driving	-26.6	-26.6	-23.6	-14.6	-14.6	-12.9
Safety Costs Not Internalized by Drivers	-11.0	-11.0	-9.8	-6.0	-6.0	-5.4
Loss in Fuel Tax Revenue	-29.8	-29.8	-26.2	-16.3	-16.3	-14.3
Subtotal - External Costs	-67.4	-67.4	-59.7	-37.0	-36.9	-32.6
Total Costs (incl. private)	-393.9	-393.8	-353.8	-219.6	-219.5	-197.2
Private Benefits						
Fuel Cost Savings	-185.4	-185.4	-163.3	-100.6	-100.6	-88.4
Benefits from Additional Driving	-84.3	-84.3	-74.1	-45.4	-45.4	-39.8
Refueling Frequency	-10.1	-10.1	-9.0	-5.5	-5.5	-4.9
Subtotal - Private Benefits	-279.8	-279.7	-246.5	-151.5	-151.4	-133.2
External Benefits						
Petroleum Market Security	-7.8	-7.8	-6.9	-4.2	-4.2	-3.7
Health Outcomes	-3.5	-3.5	-3.1	-1.7	-1.7	-1.5
Total Benefits (incl. private)	-291.2	-291.1	-256.5	-157.4	-157.4	-138.4
Net Total Benefits	102.8	102.8	97.3	62.1	62.1	58.8
*Maintenance and repair costs are not quantified in the analysis.						

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3. Physical and Environmental Effects

NHTSA estimates various physical and environmental effects associated with the standards. These include quantities of fuel consumed, non-criteria and criteria pollutant emissions, and health and safety impacts. Table IV–28 shows the average annual impacts, including the on-road fleet sizes, vehicle-miles traveled (VMT), fuel consumption, and CO_2 emissions, across alternatives and grouped by decade. The overall size of the on-road ICE fleet decreases in later decades regardless of alternative due to declining ICE sales, with the lowest on-road fleet size projected under the No-Action Alternative.[351] All three regulatory alternatives result in marginally larger fleets by 2050 compared to the No-Action Alternative. Increased sales over time increases the existing vehicle stock, thereby expanding the size of the overall fleet.

In the No-Action Alternative, the decreasing size of the overall ICE fleet results in ICE VMT decreases in the later decades, with the lowest average VMT per year occurring between 2041 and 2050. Similarly, on an annual basis fuel consumption (measured in gallons of gasoline gallon equivalents) and non-criteria emissions decline in the later decades due to reduced VMT and new, more efficient vehicles replacing older, less efficient vehicles in the fleet. Relative to the No-Action Alternative, all regulatory alternatives considered

349 Totals in the following table may not sum perfectly due to rounding.

350 Totals in the following table may not sum perfectly due to rounding.

351 NHTSA's projection of total sales excludes BEVs and FCEVs.

result in slightly lower VMT but increase fuel consumption and non-criteria emissions due to a larger ICE fleet, with the largest increases observed in Alternative 1.

Table IV-28: Average Annual Effects for All Alternatives by Calendar Year Cohort

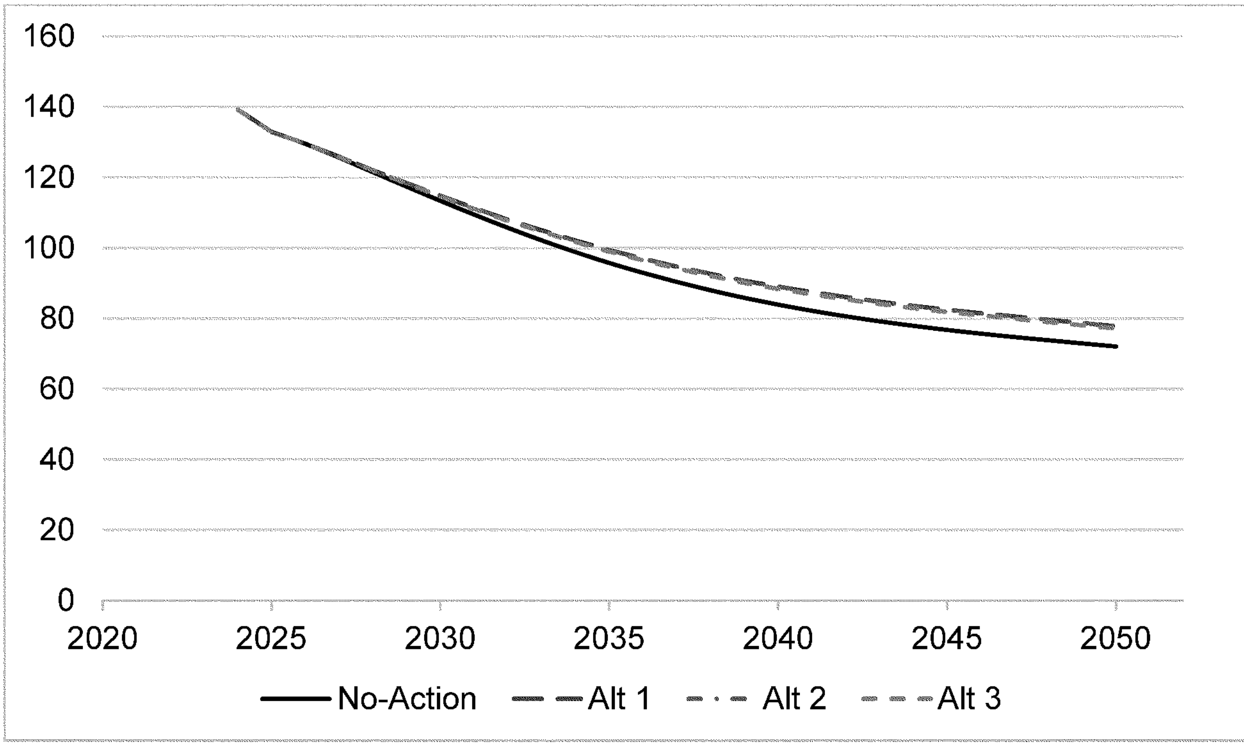
	No-Action	Alt 1	Alt 2	Alt 3
On-Road ICE Fleet (Million Units)[352]				
2024 - 2030	251	251	251	251
2031 - 2040	222	222	222	222
2041 - 2050	198	199	199	199
ICE Vehicle-Miles Traveled (Billion Miles)[353]				
2024 - 2030	3,082	3,081	3,081	3,081
2031 - 2040	2,776	2,762	2,762	2,764
2041 - 2050	2,527	2,506	2,506	2,508
ICE Fuel Consumption (Billion Gallons/GGE)				
2024 - 2030	126	126	126	126
2031 - 2040	95	99	99	99
2041 - 2050	77	82	82	82

NHTSA's analysis estimates total annual consumption of fuel by the ICE on-road fleet on a calendar basis for 2024 through 2050, as shown in Figure IV–3 for the No-Action Alternative, Alternative 1, Alternative 2, and Alternative 3. Gasoline consumption decreases over time, with smaller decreases seen under the regulatory alternatives compared to the No-Action Alternative. Note that in many of the figures presented, the lines representing different regulatory alternatives lay nearly on top of each other, indicating that estimated impacts are very similar.

[352] These rows report total vehicle units observed during the period. For example, 1,760 million units are modeled in the on-road fleet for CYs 2024–2030. On average, this represents approximately 251 million vehicles in the on-road fleet for each calendar year in this calendar year cohort; this is the highest average across all cohorts.

[353] These rows report total miles traveled during the period. For example, 21,577 billion miles traveled in CYs 2024–2030. On average, this represents approximately 3.08 trillion annual miles traveled in this calendar year cohort.

Figure IV-3: Gasoline Consumption by Calendar Year and Alternative (Billions of Gallons)



NHTSA estimates the non-criteria emissions attributable to the light-duty on-road fleet, from both vehicles and upstream energy sector processes (*e.g.,* petroleum refining, or fuel transportation and distribution) as shown in Figure IV–4, Figure IV–5, and Figure IV–6.[354] All three non-criteria emissions follow similar trends of decline in the years between 2024–2050, with smaller declines for the regulatory alternatives compared to the No-Action Alternative.[355]

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[354] While NHTSA considers the impacts of this rulemaking on the levels of CO_2, CH_4, and N_2O emissions, the analysis does not include a monetization of any changes. An analysis using the domestic-only value of these emissions is included in a sensitivity case.

[355] Note that CO_2 emissions are expressed in units of million metric tons (mmt) while emissions from other pollutants are expressed in metric tons.

Figure IV-4: Total CO_2 Emissions by Calendar Year and Alternative (Million Metric Tons)

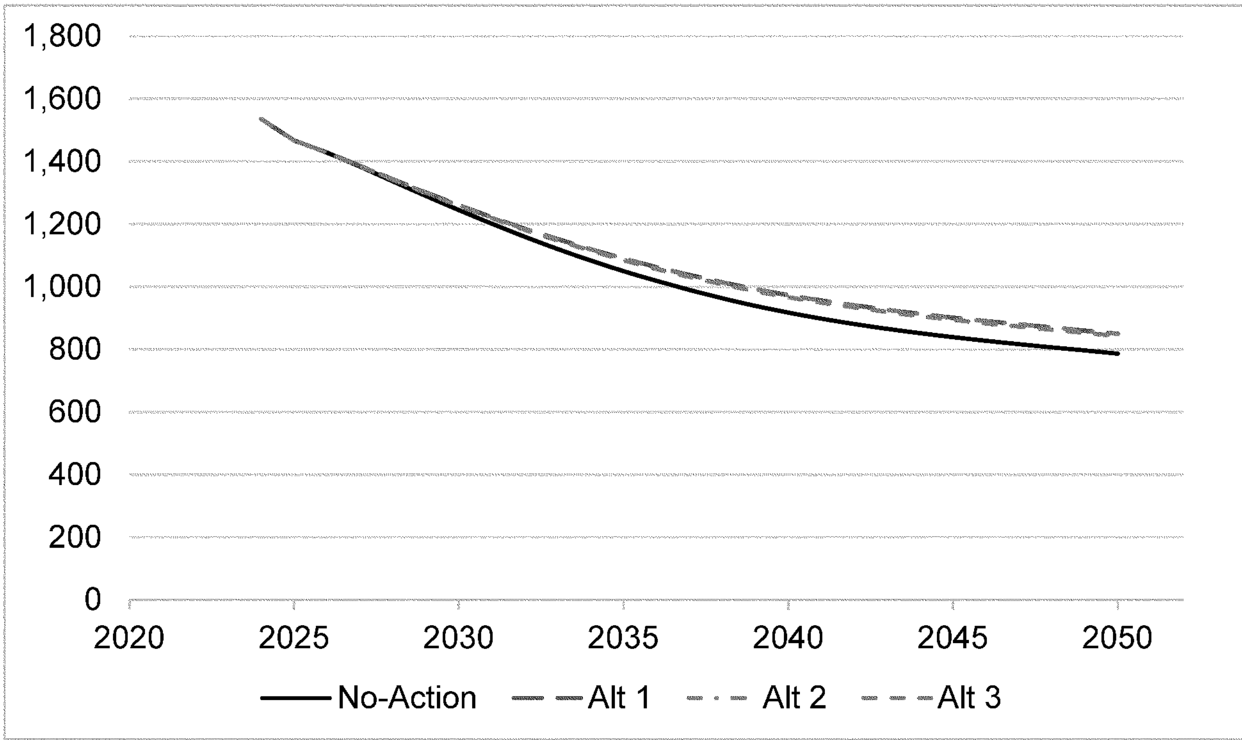


Figure IV-5: Total CH_4 Emissions by Calendar Year and Alternative (Tons)

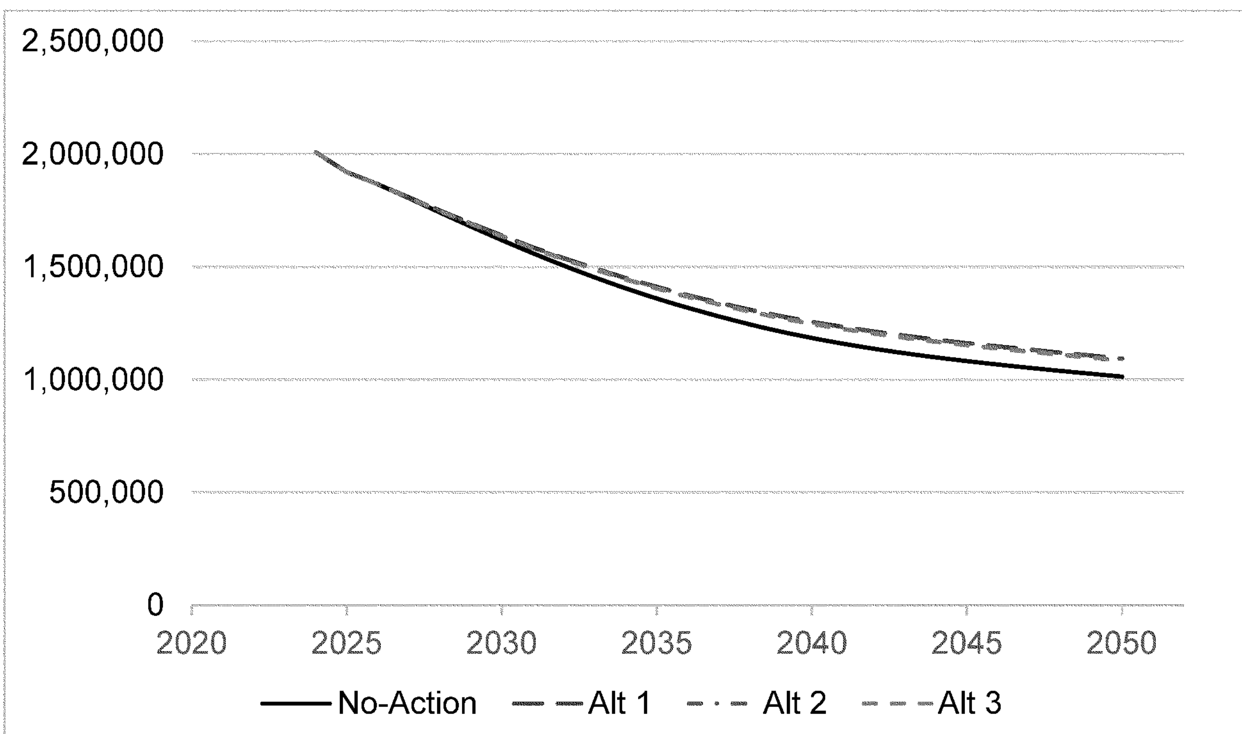
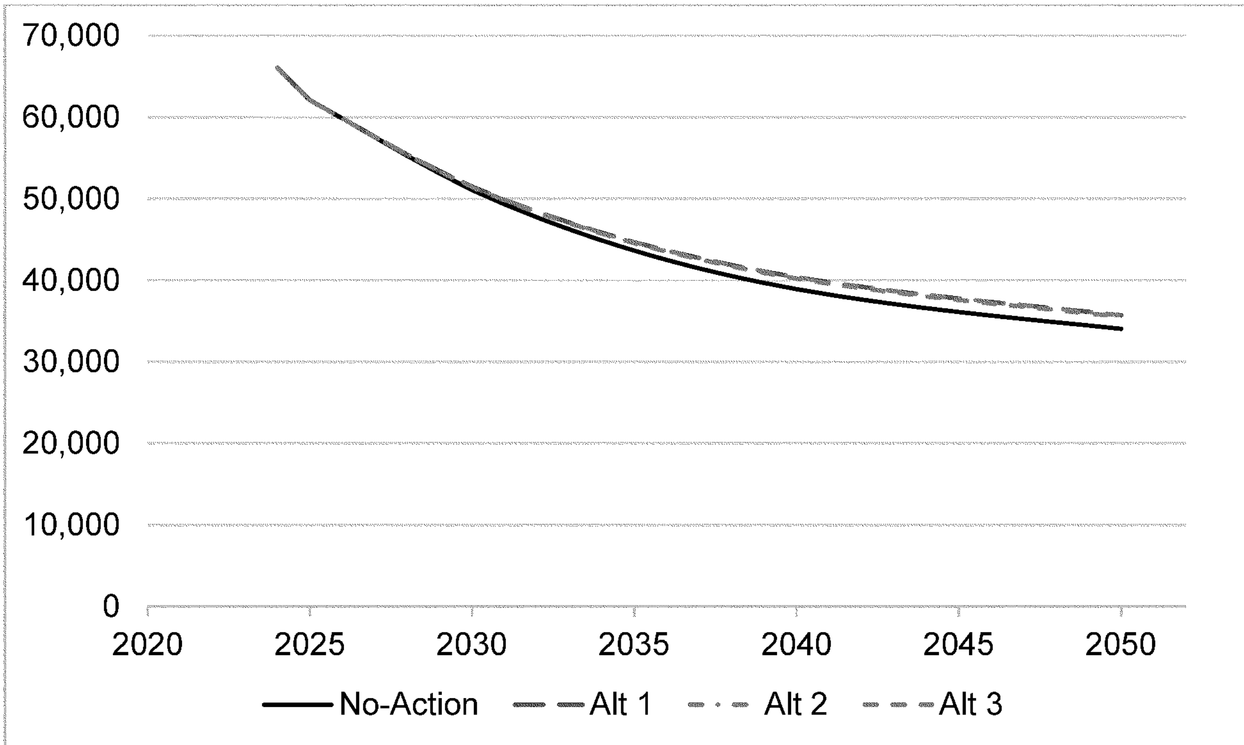


Figure IV-6: Total N_2O Emissions by Calendar Year and Alternative (Tons)



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NHTSA estimates criteria pollutant emissions attributable to the light-duty on-road fleet from both vehicles and upstream energy sector processes (*e.g.,* petroleum refining, or fuel transportation and distribution) as shown in Figure IV–8, Figure IV–9, and Figure IV–10. Changes in criteria pollutant emissions in turn lead to changes in adverse health outcomes described in later sections. Under the No-Action Alternative and each regulatory alternative, NHTSA projects a decrease in emissions of all criteria pollutants attributable to the light-duty on-road ICE fleet between 2024 and 2050 due to the analogous decrease in VMT and retirement of older less efficient vehicles. These criteria for pollutant emissions increase relative to the baseline as the stringencies of proposed alternatives decrease.

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Figure IV-7: Total NO_X Emissions by Calendar Year and Alternative (Tons)

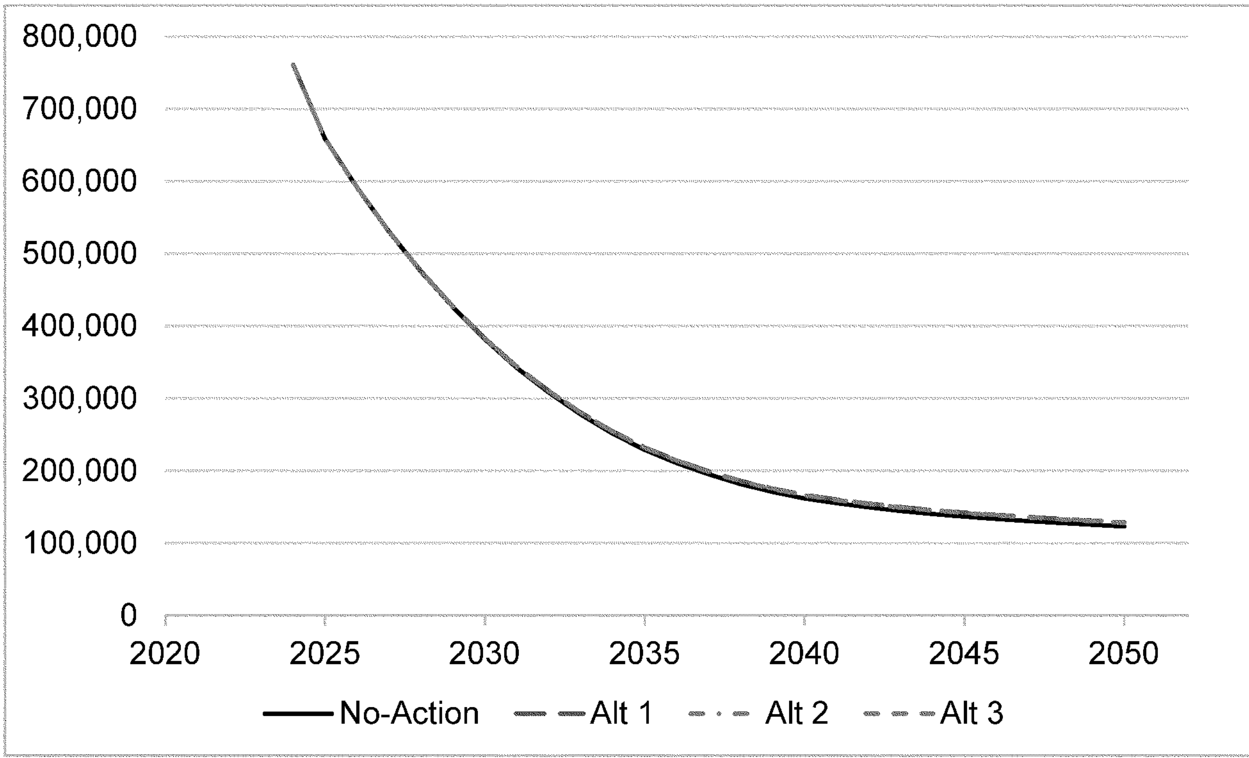


Figure IV-8: Total SO_2 Emissions by Calendar Year and Alternative (Tons)

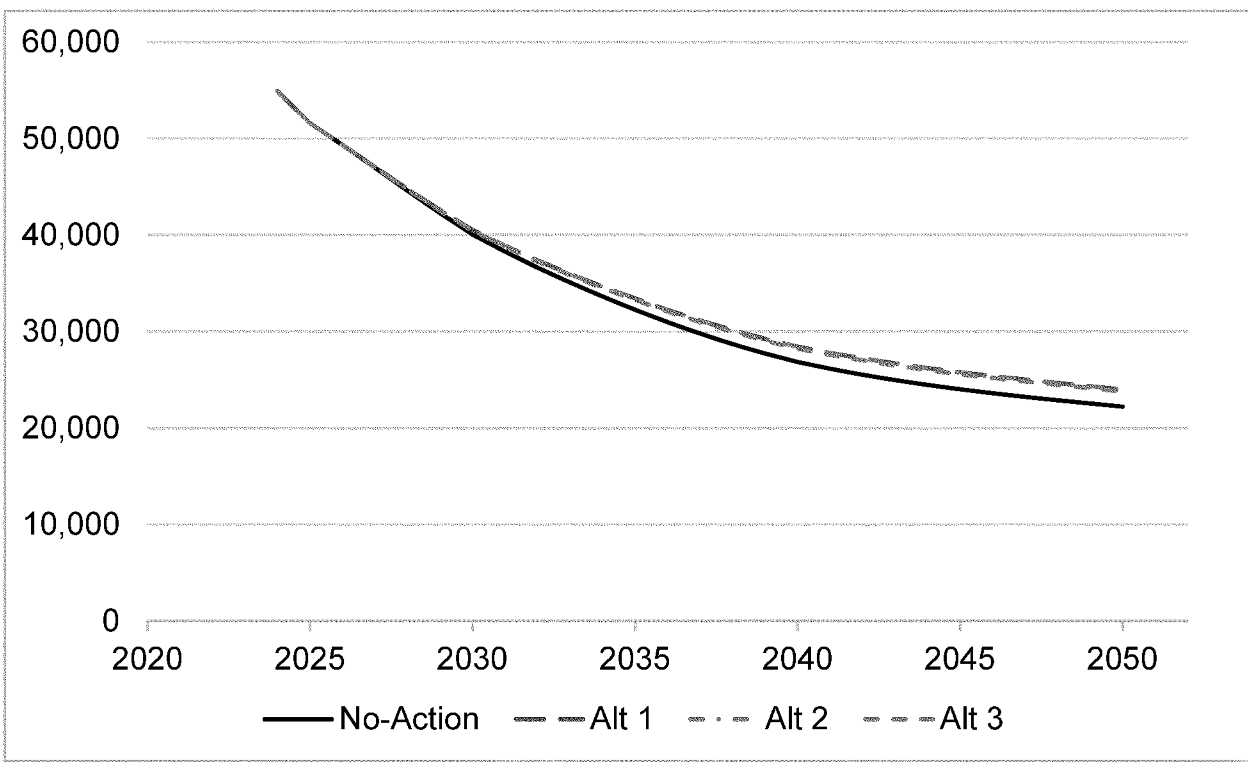
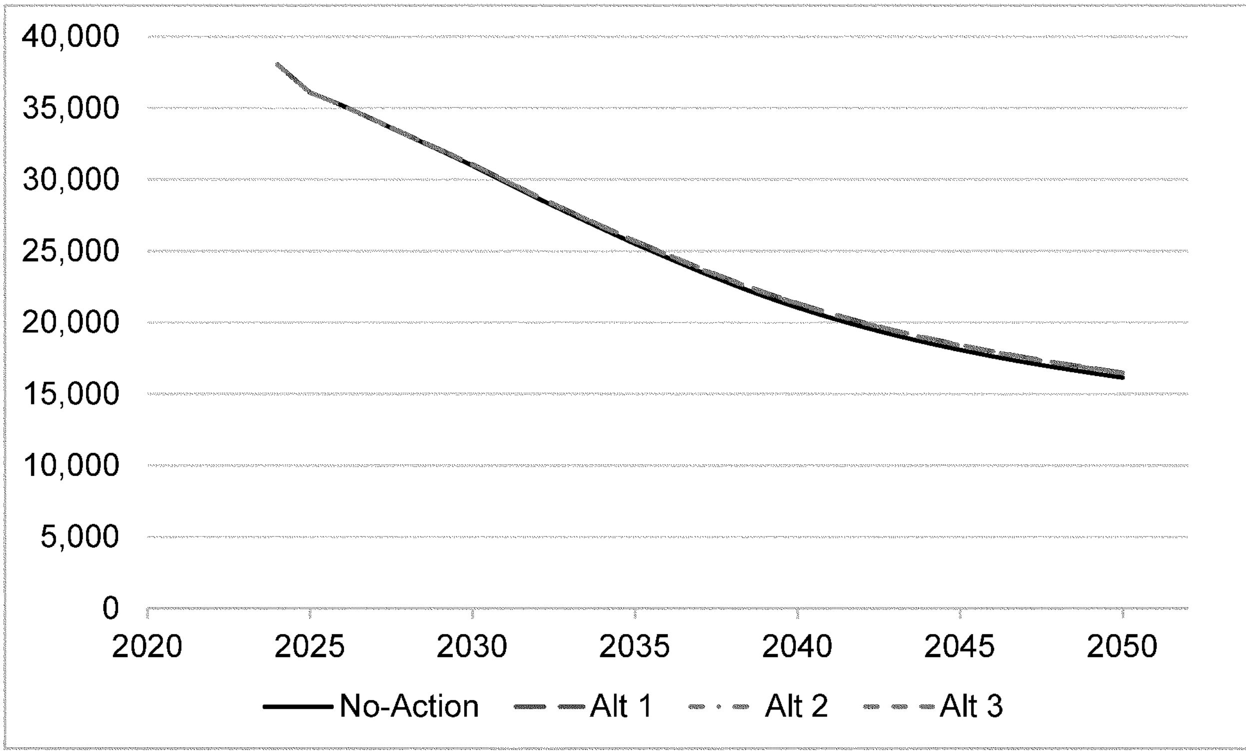


Figure IV-9: Total $PM_{2.5}$ Emissions by Calendar Year and Alternative (Tons)



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Health impacts quantified by the CAFE Model include various instances of hospital visits due to respiratory problems, minor restricted activity days, non-fatal heart attacks, acute bronchitis, premature mortality,[356] and other effects of criteria pollutant emissions on health. Table IV–29 shows changes in select health outcomes relative to the No-Action Alternative, across all action alternatives. The magnitude of the differences relates directly to the changes in the volumes of criteria pollutants emitted. See Chapter 5.4 of the Draft TSD for information regarding how the CAFE Model calculates these health impacts.

[356] Premature mortality includes deaths that are estimated to occur before the normally expected life span of persons within a group defined by specific demographic characteristics.

Table IV-29: Emission Health Outcomes Across Alternatives Relative to the No-Action Alternative (CYs 2024-2050)

Measures (Incidents)	Alternative 1	Alternative 2	Alternative 3
Premature Mortality	473	473	416
Respiratory Emergency Room Visits	267	267	234
Acute Bronchitis	661	661	581
Lower Respiratory Symptoms	8,435	8,434	7,412
Upper Respiratory Symptoms	11,896	11,893	10,452
Minor Restricted Activity Days	349,387	349,316	306,969
Work Loss Days	59,714	59,702	52,465
Asthma Exacerbation	13,946	13,943	12,253
Cardiovascular Hospital Admissions	126	126	111
Respiratory Hospital Admissions	121	121	106
Non-Fatal Heart Attacks (Peters)	491	491	432
Non-Fatal Heart Attacks (All Others)	53	53	47

NHTSA also quantifies safety impacts in its analysis. These include the estimated numbers of fatalities, non-fatal injuries, and property damage crashes occurring over the lifetimes of the light-duty vehicles considered in the analysis. The following table shows the changes in these projected outcomes under the action alternatives relative to the reference baseline.

Table IV-30: Change in Safety Outcomes Across Alternatives Relative to the No-Action Alternative (CYs 2024-2050)

Alternative	Alt 1	Alt 2	Alt 3
Fatalities			
Fatalities from Mass Changes	27	27	20
Fatalities from Rebound Effect	-1,528	-1,528	-1,354
Fatalities from Sales/Scrappage	-66	-66	-64
Total - Fatalities	-1,568	-1,567	-1,398
Non-Fatal Injuries			
Non-Fatal Injuries from Mass Changes	4,264	4,264	3,221
Non-Fatal Injuries from Rebound Effect	-245,022	-244,963	-217,158
Non-Fatal Injuries from Sales/Scrappage	-5,709	-5,709	-5,564
Total - Non-Fatal Injuries	-246,467	-246,408	-219,501
Property Damage Crashes			
Property Damage Crashes from Mass Changes	13,629	13,629	10,379
Property Damage Crashes from Rebound Effect	-835,103	-834,915	-740,855
Property Damage Crashes from Sales/Scrappage	26,991	26,989	25,437
Total - Property Damage Crashes	-794,482	-794,297	-705,039

Decreasing fuel economy stringency leads to a reduction in adverse safety outcomes from rebound-related reductions in VMT (motorists choosing to drive less as driving becomes more expensive), and the increase in scrappage causing newer vehicles with more safety features to enter the fleet sooner. The impacts of mass changes are nonlinear and depend on the specific fleet receiving those changes, with mass increases in passenger cars causing a reduction in adverse safety outcomes and mass increases for light trucks causing an increase in adverse safety outcomes. Though the point estimates applied suggest a marginal increase under the regulatory alternatives, NHTSA notes that none of these safety outcomes due to mass changes can be distinguished statistically from zero. Chapter 7.1.5 of the PRIA accompanying this document contains an in-depth discussion of the effects of the various alternatives on these safety measures, and Chapter 7 of the Draft TSD contains information regarding the construction of the safety estimates.

4. Sensitivity Analysis

The regulatory impact analysis conducted to support this rulemaking relies on many different inputs, parameters, and other analytical assumptions that reflect the agency's best judgments regarding a variety of factors relevant to the anticipated outcomes of the proposed CAFE standards reset, which are all applied within an analytical framework using the CAFE Model. NHTSA recognizes that the values of many analytical inputs are uncertain, and some to a significant degree, which in turn results in uncertainty for some estimates of the benefits, costs, and other outcomes. Some of the uncertain input parameters have a considerable influence on specific types of estimated impacts, and some are likely to do so for the bulk, while others may affect the results of the analysis more broadly. To understand the effect that particular assumptions have on the estimated outcomes, NHTSA conducted a sensitivity analysis by running the CAFE Model using alternative assumptions (referred to as "sensitivity cases"). The results allow NHTSA to explore a range of potential analytical inputs and to understand the sensitivity of estimated impacts to changes in these specified model inputs. The sensitivity cases developed for this analysis span assumptions related to technology applicability and cost, economic conditions, consumer response, externality values, and safety assumptions, among others.[357]

A sensitivity analysis can identify two critical pieces of information: *how big an influence* does each parameter exert on the analysis, and *how sensitive the model results are* to that assumption. NHTSA acknowledges, however, that influence is different from likelihood. NHTSA does not mean to suggest that any one of the sensitivity cases presented here is inherently more likely than the collection of assumptions that represent the analysis NHTSA conducted to support the proposals advanced in this rulemaking (referred to as the "central analysis"). The sensitivity analysis simply provides an indication of which assumptions have the greatest impact and the extent to which future deviations from the central analysis assumptions could affect the actual future costs and future benefits of the rule.

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[357] In contrast to an uncertainty analysis, where many assumptions are varied simultaneously, the sensitivity analyses included here vary a single assumption and provide information about the influence of each individual factor, rather than suggesting that an alternative assumption would have justified a different Preferred Alternative.

Table IV-31: Cases and Baselines Included in the Sensitivity Analysis

Case Name	Description
Central analysis	The analysis that NHTSA uses to estimate the impacts of this proposed rulemaking. This is the analysis to which each sensitivity case is compared.
Annual vehicle redesigns	Vehicles redesigned every model year
No advanced engines	Skips advanced engine technologies including start/stop 12V and 48V systems
Oil price (high)	Fuel prices from AEO 2025 High Oil Price Case
Oil price (low)	Fuel prices from AEO 2025 Low Oil Price Case
GDP (high)	GDP and sales based on spring Global Insights optimistic economic growth case
GDP (low)	GDP and sales based on spring Global Insights pessimistic economic growth case
Oil market externalities (low)	Price shock component set to 10th percentile of estimates.
Oil market externalities (high)	Price shock component set to 90th percentile of estimates.
Fuel reduction import share (50%)	Assume 50 percent share of fuel consumption reduction supplied by imports
Fuel reduction import share (100%)	Assume 100 percent share of fuel consumption reduction supplied by imports
No payback period	Payback period set to 0 months
24-month payback period	Payback period set to 24 months
30-month payback period	Payback period set to 30 months
60-month payback period	Payback period set to 60 months
Rebound (10%)	Rebound effect set at 10 percent
Rebound (20%)	Rebound effect set at 20 percent
Sales-scrappage response (-0.1)	Sales-scrappage model with price elasticity multiplier of -0.1
Sales-scrappage response (-1)	Sales-scrappage model with price elasticity multiplier of -1
Light-duty vehicle sales (AEO Ref. 2025 growth)	Light-duty vehicles sales rate of change and gas-powered share in 2025-50 consistent with AEO 2025 Reference Case
No fleet share price response	Fleet share elasticity estimate set to 0 (i.e., no fleet share response across alternatives)
Fixed fleet share	Fleet share level fixed at 2024 value
Fixed fleet share, no price response	Fixed fleet share at 2024 level, fleet share elasticity set to zero
Mass-size-safety (low)	The lower bound of the 95 percent confidence interval for all mass-size-safety model coefficients.
Mass-size-safety (high)	The upper bound of the 95 percent confidence interval for all mass-size-safety model coefficients.
Crash avoidance (low)	Lower bound estimate of effectiveness of six current crash avoidance technologies at avoiding fatalities, injuries, and property damage
Crash avoidance (high)	Upper bound estimate of effectiveness of six current crash avoidance technologies at avoiding fatalities, injuries, and property damage

Apply CO_2 value[358]	2019 EPA domestic only CO_2 monetization value
Apply CO_2, CH_4, N_2O values	2019 EPA domestic only CO_2, CH_4, and N_2O monetization values
AMPC 26-31	Advanced Manufacturing Production Credit included in MYs 2026-2031
No vehicle reclassification	Remove reclassification in the action alternatives
Reclassified vehicles in the No-Action Alternative	Include reclassification in the No-Action Alternative
AC/OC phase-out in 2032	Maintain central analysis AC/OC levels through action alternatives
No AC/OC in No-Action Alternative	AC/OC phased out in MY 2028 in all alternatives including No-Action Alternative
Proposed standards (2022-2026)	Replace existing MYs 2022-2026 standards with Alternative 2's (Preferred Alternative) standards

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Chapter 9 of the accompanying PRIA summarizes results for each of the sensitivity cases, and detailed model inputs and outputs are available on NHTSA's website.[359] The figures in Section IV.B.1 illustrate the relative changes produced by the sensitivity effects of selected inputs on the costs and benefits estimated for this proposal. Each collection of figures groups sensitivity cases by the category of input assumption (*e.g.,* macroeconomic assumptions, technology, and safety assumptions). The figures provide a sense of which inputs are ones for which a different assumption would have a much different effect on analytical findings, and which ones would not have been much affected. For example, assuming a different oil price trajectory would have a relatively large effect, as would changing the assumptions about the effects of changes in vehicle mass on safety outcomes. Chapter 9 of the PRIA provides an extended discussion of these findings and presents net benefits estimated under each of the cases included in the sensitivity analysis. The results presented in the earlier subsections of Section IV and discussed in Section V are drawn from the central analysis and reflect NHTSA's best judgments regarding many different factors; the sensitivity analysis discussed here is simply to illustrate how differences in assumptions can lead to differences in analytical outcomes, some of which can be large and some of which may be smaller.

Overall, NHTSA finds that, for light-duty vehicles, the Preferred Alternative in this proposal, Alternative 2, produces positive estimated net benefits under all sensitivity cases, at both 3- and 7-percent discount rates. Societal net benefits are highest in the ''Mass-size-safety (high)'' case ($46.7 billion) and lowest in the ''Mass-size-safety (low)'' case ($1.3 billion), when applying a 3-percent social discount rate.

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[358] NHTSA's sensitivity cases applying a monetized value to changes in NCEs use NCE values derived from the 2019 EPA Regulatory Impact Analysis for the Repeal of the Clean Power Plan. EPA, Regulatory Impact Analysis for the Repeal of the Clean Power Plan, and the Emission Guidelines for Greenhouse Gas Emissions From Existing Electric Utility Generating Units, EPA–452/R–19–003 EPA: Washington, DC (2019), available at: *https://www.epa.gov/sites/default/files/2019-06/documents/utilities_ria_final_cpp_repeal_and_ace_2019-06.pdf* (accessed: Sept. 10, 2025). These values (per metric ton) range from $8.98 (2024) to $13.98 (2050) for CO2, $268.58 to $474.37 for CH4, and $3144.65 to $5033.59 for N20 (3% discount rate, 2024 dollars). The specific values used for this sensitivity at both 3-percent and 7-percent discount rates can be found in the Parameters Input file associated with these sensitivity cases.

[359] NHTSA, Corporate Average Fuel Economy, (2025), available at: *https://www.nhtsa.gov/laws-regulations/corporate-average-fuel-economy* (accessed: Sept. 10, 2025).

Figure IV-10: Net Social Benefits for Lifetime of Vehicles through MY 2031 (MYs 1985-2031), Alternative 2 Relative to the Central Analysis, Technology and Safety Assumptions Sensitivity Cases (2024$, 3% Discount Rate)

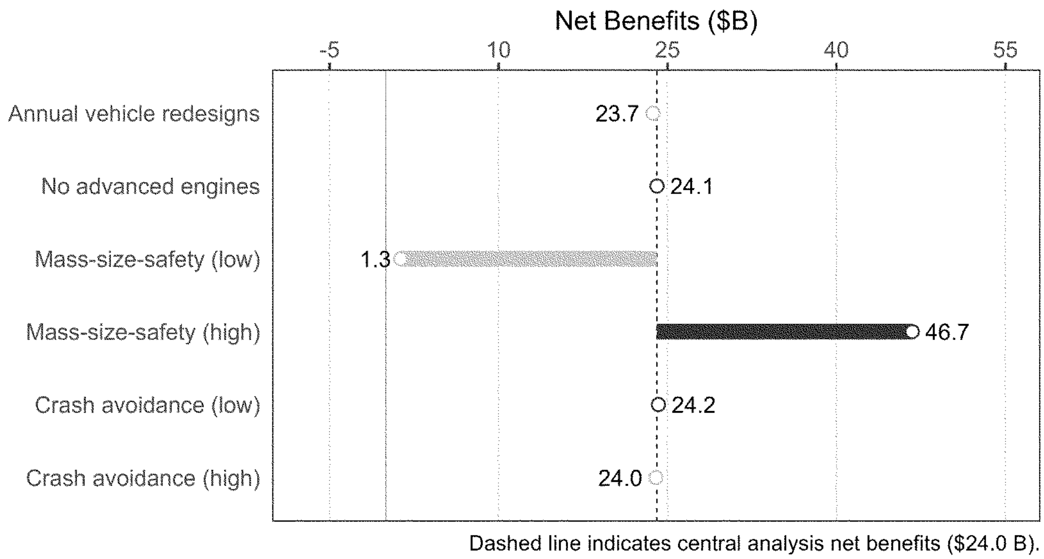


Figure IV-11: Net Social Benefits for Lifetime of Vehicles through MY 2031 (MYs 1985-2031), Alternative 2 Relative to the Central Analysis, Macroeconomic Assumptions Sensitivity Cases (2024$, 3% Discount Rate)

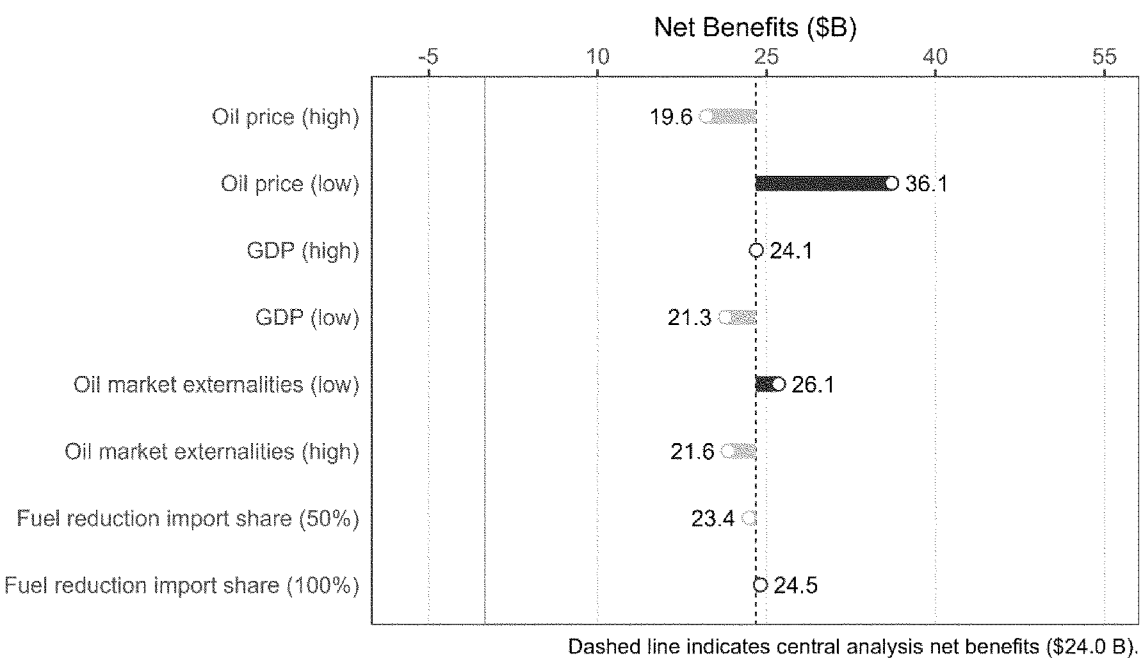


Figure IV-12: Net Social Benefits for Lifetime of Vehicles through MY 2031 (MYs 1985-2031), Alternative 2 Relative to the Central Analysis, Payback, VMT, and Fleet Turnover Assumptions Sensitivity Cases (2024$, 3% Discount Rate)

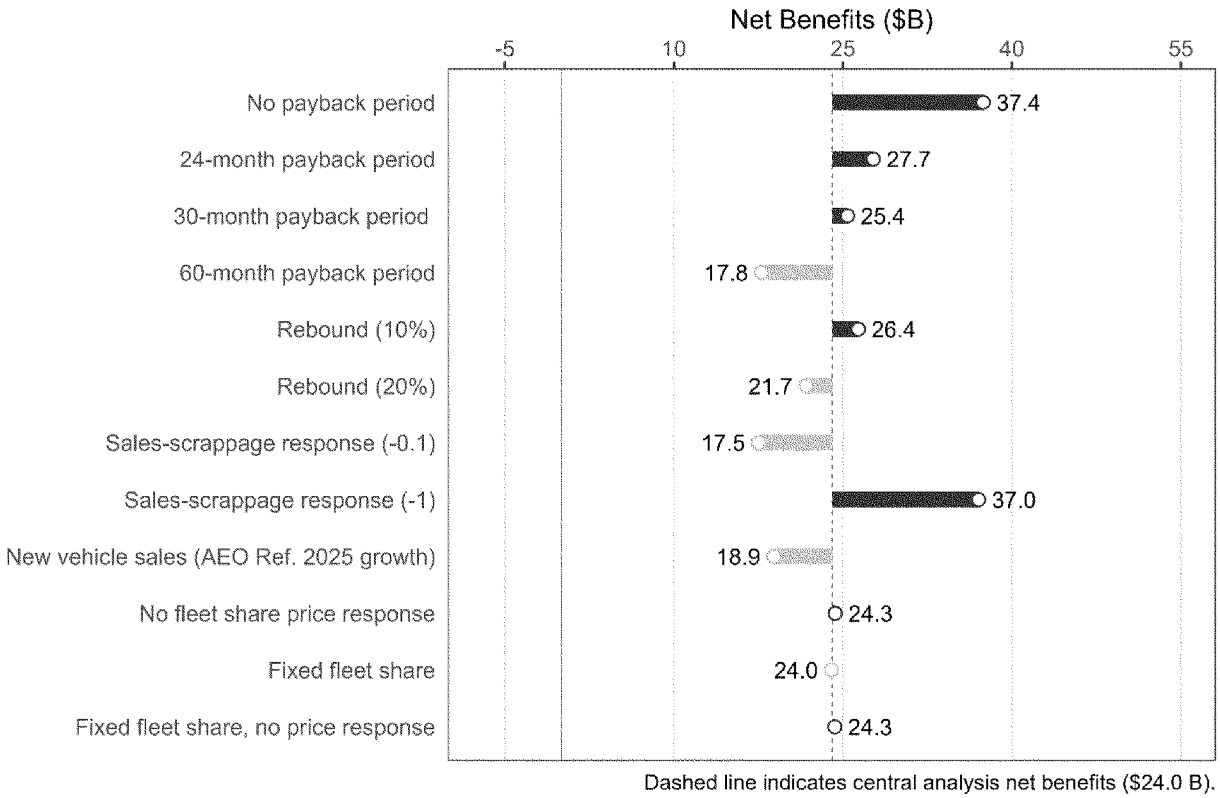
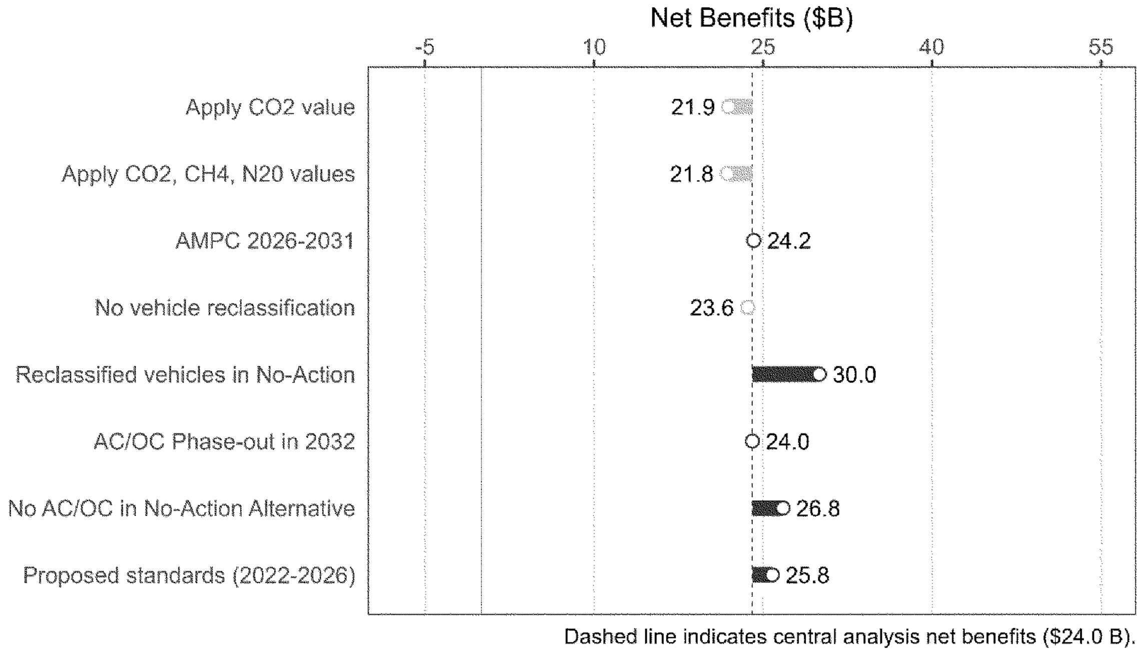


Figure IV-13: Net Social Benefits for Lifetime of Vehicles through MY 2031 (MYs 1985-2031), Alternative 2 Relative to the Central Analysis, Policy and Other Assumptions Sensitivity Cases (2024$, 3% Discount Rate)



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V. Basis for NHTSA's Tentative Conclusion That the Proposed Standards Are Maximum Feasible

In this section, NHTSA discusses the statutory and other factors, data, and analysis that the agency has considered in the selection of the proposed CAFE standards for MYs 2022–2026 and MYs 2027–2031.

A. EPCA, as Amended by EISA

Under EPCA, NHTSA is required to set separate average fuel economy standards for new passenger cars and light trucks produced or imported for sale in the United States at the ''maximum feasible'' levels NHTSA determines manufacturers can achieve in each model year to which the standards apply.[360] That mandate is subject to important limiting considerations, which center on the statutory concept of ''maximum feasibility.'' In determining maximum feasibility, NHTSA must consider the factors set forth in section 32902(f). Specifically, the fuel economy standards established by NHTSA must be based on consideration of technological feasibility, economic practicability, the effects of other Government standards applicable to motor vehicles, and the need of the Nation to conserve energy.[361]

Consistent with the terms of the CAFE program, fuel economy standards are designed based on light-duty vehicles powered by ''fuel,'' which is defined in EPCA to include gasoline, diesel fuel, or other liquid or gaseous fuels with similar combustion properties as identified by NHTSA.[362] While EPCA includes specific provisions designed to incentivize automakers to invest in the development of new technologies, including battery-electric and other alternative-fuel powertrains, BEVs are fueled by electricity, which is an ''alternative fuel'' as defined by EPCA.[363] EPCA prohibits NHTSA from considering the fuel economy of alternative-fueled vehicles in setting or amending its standards.[364] As for dual-fueled vehicles, such as plug-in hybrid electric vehicles (but not non-plug-in hybrid vehicles),[365] the statute requires NHTSA to consider their fuel economy only while operated exclusively on gasoline or diesel fuel.[366] EPCA also prohibits NHTSA from considering the availability of compliance credits in setting or amending its standards.[367]

In addition to these considerations, section 32902 includes several provisions specifying how NHTSA must prescribe CAFE standards, including the form that the CAFE standards must take and the manner and timing of setting such standards and any subsequent amendments. The following subsections discuss in greater detail these requirements, including the requirement to set maximum feasible fuel economy standards.

[360] 49 U.S.C. 32902(a) and (b)(2)(B).

[361] 49 U.S.C. 32902(f).

[362] 49 U.S.C. 32901(a)(10).

[363] 49 U.S.C. 32901(a)(1)(J).

[364] 49 U.S.C. 32902(h).

[365] *See* 63 FR 66066 (Dec. 1, 1998). Non-plug-in hybrid vehicles are not dual-fueled vehicles under Chapter 329 because any electricity generated by the electric motors or other electric components are generated solely by the petroleum-fueled engine and the batteries are incapable of charging from an external source: ''a vehicle which is entirely dependent on a petroleum fuel for its motive power, regardless of whether electricity is used in the powertrain, is powered by petroleum.''

[366] 49 U.S.C. 32901(a)(1), (8), (9), and (10); 49 U.S.C. 32902(h).

[367] *Id.* at 32902(h)(3).

1. Administrative Provisions Governing CAFE Standard Setting

a. Lead Time, Amendatory Authority, and Number of Model Years for Which Standards May Be Set at a Time

EPCA requires that NHTSA prescribe new CAFE standards at least 18 months before the beginning of each model year.[368] In addition, EPCA authorizes NHTSA to prescribe regulations amending the standard established previously for a model year to a level that the Secretary decides is the maximum feasible average fuel economy level for that model year.[369] NHTSA had interpreted EPCA previously to allow amendments reducing the stringency of an industry-wide fuel economy standard for a particular model year up until the beginning of the model year in question.[370] The beginning of the model year is considered generally to be October 1st of the calendar year preceding the named model year (*e.g.,* a MY 2027 vehicle might be offered for sale on or after October 1st, 2026).[371] However, the statute does not contain any language suggesting that reading or any limitation on the model years for which standards may be amended. The only statutory provision addressing a time limitation of an amendment to an existing standard states that NHTSA must provide at least 18 months of lead time if the standards are amended to become more stringent.[372] EPCA contains no lead time requirement if the amendment makes an average fuel economy standard less stringent. As such, NHTSA interprets EPCA as authorizing amendment of standards after a model year has concluded, so long as the amendment makes the standard less stringent. NHTSA proposes to amend standards beginning in MY 2022 as set forth in this NPRM. Proposing amended standards beginning with MY 2022 is consistent with the Secretary's direction in the January 28, 2025, memorandum titled ''Fixing the CAFE Program'' and is also the earliest model year for which NHTSA has not concluded compliance proceedings.

NHTSA is aware that this is a change in its previous interpretation of the statute, with respect to generally applicable standards.[373] NHTSA's prior interpretation was made in response to a manufacturer request for broad downward adjustment to standards in response to manufacturer non-compliance. In this case, NHTSA proposes to amend existing standards because they were promulgated in violation of specific statutory provisions and do not advance the purposes of the CAFE program in the manner most faithful to Congress's design. NHTSA does not believe that Congress intended for NHTSA to leave in place codified standards promulgated in violation of such statutory provisions, and moreover, did not intend for NHTSA to place several vehicle manufacturers in the position of committing violations because they could not meet a standard that is beyond maximum feasible.[374] This conclusion is consistent with NHTSA's rationale for amending standards for low-volume manufacturers in some cases well after the conclusion of a model year, to avoid penalizing manufacturers for NHTSA's own conduct (there, a delay in addressing the manufacturers' petitions).[375] NHTSA's interpretation here is further supported by recent legislative action amending the CAFE civil penalty provision, which applies to years for which the Secretary of Transportation (NHTSA, by delegation) has not notified a manufacturer of the penalty due for an average fuel economy less than the applicable standard.[376] That statutory change likewise applies to MY 2022 and later.[377]

EISA also requires NHTSA to ''issue regulations . . . prescribing average fuel economy standards for at least 1, but not more than 5, model years.'' [378] In the 2020 final rule, NHTSA explained that it interpreted EISA's legislative history to suggest that Congress included the 5-year maximum limitation so NHTSA would issue standards for a period of time where it would have reasonably realistic estimates of market conditions, technologies, and economic practicability (*i.e.,* not setting standards too far into the future because of potential feasibility challenges or the uncertainty surrounding future market conditions).[379] NHTSA explained, however, that the concerns Congress sought to address by imposing those limitations are not present for nearer model years where NHTSA already has existing standards and noted that revisiting existing standards is contemplated by both 49 U.S.C. 32902(c) and 32902(g). NHTSA stated that the agency therefore believed that it is reasonable to interpret section 32902(b)(3)(B) as applying only to the establishment of new standards rather than to the combined action of establishing new standards and amending existing standards.

In addition, NHTSA stated that the statute allows NHTSA to revisit existing standards and separately the statute allows NHTSA to prescribe new standards ''for at least 1, but not more than 5, model years'' when it ''issue[s] regulations.'' NHTSA also explained that it was not clear whether the statute precluded multiple concurrent or quickly sequential rulemakings ''issuing regulations'' for different periods of time. NHTSA provided as an example that it could issue two separate rulemakings, one amending a single model year's standard and one setting new standards for the five immediately ensuing model years, but this would be an unnecessary waste of resources that could be saved by consolidating agency (and commenter) work into a single rulemaking. For these reasons, NHTSA concluded that its interpretation was reasonable and appropriate.

Consistent with the 2020 interpretation, NHTSA continues to believe that the 5-year maximum applies only to rulemakings establishing new standards, and not to—as in this case—the amendment of existing standards. Unlike a situation when NHTSA must be cautious about setting new standards for distant future years, the agency is proposing amended standards to rectify placing

[368] 49 U.S.C. 32902(a).

[369] 49 U.S.C. 32902(c).

[370] 49 FR 41250, 41255 (Oct. 22, 1984); 53 FR 14241, 14241–14302 (Apr. 28, 1988).

[371] *See In re Ctr. for Auto Safety,* 793 F.2d 1346 (D.C. Cir. 1986).

[372] 49 U.S.C. 32902(c).

[373] 49 FR 41250, 41255 (Oct. 22, 1984) (referencing the EPCA Conference Report's statement that ''[a]n amendment which has the effect of making an average fuel economy standard less stringent can be promulgated at any time prior to the beginning of the model year in question,'' the Administrative Procedure Act's definition of a ''rule,'' and the agency's belief that Congress intended to provide certainty and finality for manufacturers' planning purposes and that Congress intended standards to ''encourage the achievement of particular fuel economy levels rather than simply ratifying past conduct.''); 53 FR 14241–14302 (Apr. 28, 1988) (explaining that retroactive downward adjustments were inconsistent with the statutory scheme as inferred by congressionally imposed credit and civil penalty provisions, equity considerations, the APA, and General Motors' perceived theories of Congressional intent). *See also* Gen. Motors Corp. v. Nat'l Highway Traffic Safety Admin., 898 F.2d 165 (D.C. Cir. 1990).

[374] 49 U.S.C. 32911(b) (''A manufacturer of automobiles commits a violation if the manufacturer fails to comply with an applicable average fuel economy standard under section 32902 of this title.'').

[375] *See* 87 FR 39439, 39441 (July 1, 2022).

[376] Section 40006 of Public Law 119–21, 139 Stat. 72 (July 4, 2025). *https://www.congress.gov/119/plaws/publ21/PLAW-119publ21.pdf.*

[377] NHTSA's prior justification that amending standards after the end of a model year ''would undermine the limits Congress placed on NHTSA's authority to mitigate penalties'' no longer applies now that Congress has removed the civil penalty for all model years for which NHTSA is proposing to amend standards. *See Gen. Motors Corp.,* 898 F.2d at 173.

[378] 49 U.S.C. 32902(b)(3)(B).

[379] 85 FR 24174, 25129 (Apr. 30, 2020).

manufacturers in a situation where they violate unlawful standards set at beyond maximum feasible levels due to the consideration of factors prohibited explicitly from consideration in 49 U.S.C. 32902(h). Moreover, as in the example NHTSA provided in the 2020 final rule, the agency believes the public interest in efficiency is best served by presenting proposed amendments for all model years covered by this proposed rule in one notice. NHTSA emphasizes that two separate analyses were conducted for the 2022–2026 and 2027–2031 standards, as described elsewhere in the preamble. It made sense, however, to seek public input on the standards in a single proceeding. In addition, this is the first time that NHTSA's consideration of maximum feasible standards for all model years has appropriately excluded the 32902(h) factors, meaning this is the first time the public will be able to provide comments on a fuel economy standards trajectory for the automotive fleet that appropriately only includes gasoline- and diesel-powered vehicles. Accordingly, NHTSA has concluded that it is appropriate to present all years covered by this amendment in one action.

b. Separate Standards for Passenger Automobiles and Non-Passenger Automobiles

EPCA requires NHTSA to set separate standards for passenger automobiles and non-passenger automobiles for each model year.[380] Based on the plain language of the statute, NHTSA has long interpreted this requirement as preventing NHTSA from setting a single combined CAFE standard for passenger and non-passenger automobiles. EPCA requires separate CAFE standards for passenger and non-passenger automobiles to reflect the different fuel economy capabilities of those different types of vehicles; over the history of the CAFE program, this requirement has remained unchanged.

Since 2012, NHTSA has at times proposed or finalized standards for passenger and non-passenger automobiles that increase at different numerical rates year over year.[381] Even if NHTSA set passenger and non-passenger automobile standards previously with the same numerical rates of increase (*i.e.,* percentage increase from the prior years' standard, which could, for example, increase at a rate of 2 percent for both passenger and non-passenger automobiles), the standards themselves were different because of the starting point for each fleet. This underscores that NHTSA's obligation is to set maximum feasible standards separately for each fleet, based on an assessment of each fleet's circumstances and considering the four statutory factors: technological feasibility, economic practicability, the effect of other motor vehicle standards of the Government on fuel economy, and the need of the United States to conserve energy.

c. Minimum Standards for Domestic Passenger Automobiles

The 2007 EISA CAFE amendments also required NHTSA to begin setting a separate standard for domestically manufactured passenger automobiles.[382] Unlike the generally applicable standards for passenger and non-passenger automobiles described above, the compliance obligation of the MDPCS is identical for all manufacturers. The statute states that any manufacturer's domestically manufactured passenger car fleet must meet the greater of either 27.5 mpg on average or ''92 percent of the average fuel economy projected by the Secretary for the combined domestic and non-domestic passenger automobile fleets manufactured for sale in the United States by all manufacturers in the model year, which projection shall be published in the **Federal Register** when the standard for that model year is promulgated in accordance with [49 U.S.C. 32902(b)].''[383] Consistent with the statutory language stating that the 92-percent standards must be determined at the time an overall passenger car standard is promulgated and published in the **Federal Register**, NHTSA has also determined that it must recalculate the MDPCS when amending a passenger car standard.[384]

Since the first post-EISA CAFE rules establishing the MDPCS (the 2008 proposal for MYs 2011–2015 standards and the subsequent 2009 final rule for MY 2011 standards), NHTSA has interpreted ''92 percent of the average fuel economy projected by the Secretary'' to mean 92 percent of the average fuel economy standard projected by the Secretary.[385] Consistent with NHTSA's longstanding interpretation, the proposed MDPCS presented in this NPRM for each model year is based on the projected passenger automobile standards. NHTSA has also limited the proposed MDPCS to the gasoline- and diesel-powered vehicles assessed in this analysis. NHTSA believes doing so is required by EPCA for the reasons discussed throughout this proposal and in the interpretive rule ''Resetting the Corporate Average Fuel Economy Program,'' issued in May 2025,[386] which is discussed in more detail below. In short, EPCA itself is premised on gasoline- and diesel-powered vehicles and it presumes that U.S. fleets will be composed of those vehicles. It is inconsistent with the statute's text and structure to peg the domestic standard to vehicles—specifically EVs, which are powered by an ''alternative fuel'' within the statutory definition—that are different in kind from the gasoline- and diesel-powered vehicles presupposed by EPCA.

As in the 2020, 2022, and 2024 final rules, NHTSA continues to recognize industry concerns that actual total passenger car fleet standards have differed significantly from past projections, perhaps more so when NHTSA projects into the future. In the 2020 final rule, the compliance data showed that the standards projected in the 2012 final rule were consistently more stringent than the actual standards as calculated at the end of the model year, by an average of 1.9 percent. NHTSA stated that this difference indicated that in rulemakings conducted in 2009 through 2012, NHTSA's and

[380] 49 U.S.C. 32902(b)(1).

[381] *See* 85 FR 24174, 25186 (Apr. 30, 2020) (while the agency finalized a different set of standards, it considered and explained that net benefits appear to be maximized under the 2 percent/3 percent alternative, which proposed to raise PC standards at 2 percent per year and LT standards at 3 percent per year); 89 FR 52540, 52547 (June 24, 2024) (explaining that after consideration of relevant data and comments, an alternative that raised PC stringency at 2 percent per year and held LT stringency at 0 percent per year for 2 years, followed by 2 percent increases, was maximum feasible).

[382] 49 U.S.C. 32902(b)(4). In the CAFE program, ''domestically manufactured'' is defined by Congress in 49 U.S.C. 32904(b). The definition roughly provides that a passenger car is ''domestically manufactured'' as long as at least 75 percent of the cost to the manufacturer is attributable to value added in the United States, Canada, or Mexico, unless the assembly of the vehicle is completed in Canada or Mexico and the vehicle is imported into the United States more than 30 days after the end of the model year.

[383] 49 U.S.C. 32902(b)(4). Since the statutory requirement was established, the ''92 percent'' has always been greater than 27.5 mpg and foreseeably will continue to be so in the future.

[384] 77 FR 62624, 63028 (Oct. 15, 2012) (explaining that the agency does not read EISA as precluding ''any change, ever, in the minimum standard after it is first promulgated for a model year'' and that ''the language of the statute suggests that the 92 percent should be determined anew any time the passenger car standards are revised''); 85 FR 24174, 25124 (Apr. 30, 2020); 87 FR 25710, 25962 (May 2, 2022).

[385] 74 FR 14196, 14410 (May 29, 2009) (''NHTSA calculated 92 percent of the final projected passenger car standards as the minimum standard, which for MY 2011 is 27.8.''); 75 FR 25324, 25614 (May 7, 2010); 89 FR 52540, 52792 (June 24, 2024).

[386] 90 FR 24518 (June 11, 2025).

EPA's projections of passenger car vehicle footprints and production volumes underestimated the production of larger passenger cars over the MYs 2011–2018 period.[387] Unlike the passenger car standards and light truck standards, which are vehicle-attribute-based and automatically adjust with changes in consumer demand, the MDPCS is not attribute-based, and therefore it does not adjust with changes in consumer demand and production. Instead, it is a fixed standard established at the time of the rulemaking. As a result, by assuming a smaller footprint fleet, on average, than what was actually produced, the MYs 2011–2018 MDPCS ended up being more stringent and placed a greater burden on manufacturers of domestic passenger cars than was projected and expected at the time of the rulemakings that established those standards.

In the 2020 final rule, NHTSA concurred with industry concerns over the impact of changes in consumer demand (especially when contrasted against what was assumed in the 2012 rulemaking about future consumer demand for greater fuel economy) on manufacturers' ability to comply with the MDPCS, particularly for those manufacturers that produce larger passenger cars domestically. Some of the largest civil penalties for noncompliance in the history of the CAFE program have been paid based on noncompliance with the MDPCS.[388] NHTSA also expressed concern at that time that consumer demand may shift even more in the direction of larger passenger cars if fuel prices continue to remain low. NHTSA explained that sustained low oil prices can be expected to have real effects on consumer demand for additional fuel economy, and if that occurs, it is foreseeable that consumers may be even more interested in 2WD crossovers and passenger-car-fleet SUVs (and less interested in smaller passenger cars) than they were at the time. Therefore, to help avoid outcomes from application of the MDPCS in the MYs 2021–2026 timeframe similar to those observed over the preceding model years, NHTSA determined that it was reasonable and appropriate to consider the recent projection errors as part of estimating the total passenger car fleet fuel economy for MYs 2021–2026. Thus, in the 2020 final rule, NHTSA projected the passenger car fleet fuel economy standard for each model year and applied an offset based on the historical 1.9-percent difference identified for MYs 2011–2018.

NHTSA continued to apply the 1.9-percent offsets in calculating the MDPCS for the 2022 and 2024 final rules after additional quantitative and qualitative analysis showing the offset, and specifically the 1.9 percent-value, was still appropriate and reasonable. NHTSA noted in the 2022 final rule its concern with the stringency in overall standards for MYs 2024–2026 and the increase in the civil penalty rate as reasons why the agency should continue to employ the 1.9-percent offset, specifically if automakers struggling to meet the MDPCS would choose to import their passenger cars rather than produce them domestically.[389] In the 2024 final rule, NHTSA retained the offset, stating all of the reasons presented previously for the offset continued to apply.

For this rulemaking, NHTSA reviewed the analysis it used to calculate the MDPCS offset and updated the analysis to add new data sources and refine the methodology used to calculate the offset value. NHTSA describes the updated analysis in more detail in Section III. The MYs 2027–2031 proposed MDPCS presented in this NPRM accordingly includes a recalculated 0.7 percent-offset. NHTSA believes that the basis for the offset, the inability to project precisely the mix of vehicles sold in the future, is inapplicable to the proposed MYs 2022–2026 standards because those standards incorporate the most up-to-date data available to the agency for vehicle sales volume and footprint sizes in MY 2022. NHTSA's proposed MDPCS for MYs 2027–2031 include this offset to ensure that the standard sufficiently reflects industry capabilities while still considering the original intent behind the MDPCS.

The proposed MDPCS for each model year is as follows:

Table V-1: Minimum Domestic Passenger Car Standard (mpg)

2022	2023	2024	2025	2026	2027*	2028*	2029*	2030*	2031*
33.1	33.1	33.5	33.7	33.9	33.8	33.9	34.0	34.0	34.1

*Includes 0.7-percent offset

d. Attribute-Based Standards Defined by a Mathematical Function

EISA requires NHTSA to set CAFE standards "based on 1 or more vehicle attributes related to fuel economy and express[ed] . . . in the form of a mathematical function." [390] Under attribute-based standards, every vehicle model has a fuel economy target, the levels of which depend on the level of that vehicle's determining attribute. The manufacturer's fleet average CAFE performance is calculated by the harmonic production-weighted average of those targets. This means that no vehicle is required to meet its target; instead, manufacturers are free to balance improvements however they deem best within their fleets.

While CAFE standards for passenger cars and light trucks must be specified as a mathematical function dependent on one or more attributes related to fuel economy, NHTSA has the authority to select *which* attributes and mathematical functions. Prior to the requirement that CAFE standards be attribute-based and defined by a mathematical function, CAFE standards were instead specified as single mpg values (*e.g.,* 27.5 mpg for passenger cars and 20.7 mpg for light trucks). Because these single-mpg standards were wholly independent of fleet composition, these requirements posed a significantly greater technical challenge for manufacturers producing more larger vehicles for the U.S. market than for manufacturers focused more on smaller

[387] 85 FR 24174, 25127 (Apr. 30, 2020).

[388] See the Civil Penalties Report visualization tool at *https://www.nhtsa.gov/corporate-average-fuel-economy/cafe-public-information-center* for more specific information about civil penalties previously paid.

[389] 87 FR 25710, 25965–25966 (May 2, 2022).

[390] 49 U.S.C. 32902(b)(3)(A).

vehicles, because smaller vehicles achieve greater fuel economy levels generally. Therefore, because the standards are fleet-average standards, these single-mpg standards presented an inherent incentive to shift production toward smaller vehicles rather than increasing the application of fuel-saving technologies across entire fleets, meaning that fuel economy benefits would be available primarily to purchasers of smaller vehicles, rather than available broadly to consumers with a more diverse range of vehicle preferences.

In setting attribute-based standards, NHTSA has sought to reflect the trade-off (*i.e.,* the relationship) between the attribute and fuel economy, consistent with the overarching purpose of the program to conserve energy. If the shape of the standards captures these trade-offs, every manufacturer is more likely to continue adding fuel-efficient technology across the distribution of the attribute within their fleet, instead of changing the attribute—and other correlated attributes, including fuel economy—as part of their compliance strategy. The shape of the standards is discussed in more detail in Draft TSD Chapter 1.

Historically, NHTSA has based standards on vehicle footprint, and the agency is proposing to continue to do so in this rulemaking. As in previous rulemakings, NHTSA is proposing to define the standards in the form of a constrained linear function that sets higher (more stringent) targets for smaller footprint vehicles and lower (less stringent) targets for larger footprint vehicles. These footprint curves are discussed in more detail in Section II and Draft TSD Chapter 1.

2. Maximum Feasible Standards

As discussed above, EPCA requires NHTSA to consider four factors in determining what levels of CAFE standards would be maximum feasible. In the sections below, NHTSA presents its understanding of the meanings of those four factors, in addition to other statutory requirements the agency must consider.

a. Technological Feasibility

Under EPCA, ''[t]echnological feasibility'' refers to whether a particular method of improving fuel economy is available for deployment in commercial application in the model year for which a standard is being established. Though NHTSA is not limited in determining the level of new standards to technology already being commercially applied at the time of the rulemaking, NHTSA is not required to attempt to account for every technology that might conceivably be applied to improve fuel economy and has considered it unnecessary to do so given that many technologies address fuel economy in similar ways. It is also important to note that technological feasibility and economic practicability are often conflated. The question of whether a fuel-economy-improving technology does or will exist (technological feasibility) is a different question from what economic consequences could ensue if NHTSA effectively requires that technology to become widespread in the fleet in the absence of sufficient consumer demand for such technologies (economic practicability). Accordingly, it is possible for standards to be technologically feasible but still beyond the level that NHTSA determines to be maximum feasible due to consideration of the other relevant factors.

NHTSA has long rejected interpretations of the technological feasibility factor that would require NHTSA to set ''technology-forcing'' standards. NHTSA has recognized that ''[i]t is important to remember that technological feasibility must also be balanced with the other of the four statutory factors. Thus, while 'technological feasibility' can drive standards higher by assuming the use of technologies that are not yet commercial, 'maximum feasible' is still also defined in terms of economic practicability, for example, which might caution the agency against basing standards (even fairly distant future standards) *entirely* on such technologies'' (emphasis original).[391] NHTSA has also concluded that ''as the 'maximum feasible' balancing may vary depending on the circumstances at hand for the model years in which the standards are set, the extent to which technological feasibility is simply met or plays a more dynamic role may also shift.'' [392]

NHTSA continues to believe that the crucial question on the technological feasibility factor is not whether technologies exist to meet the standards. Rather, the question is how much existing technology should be required to be added to new cars and trucks to conserve fuel, and how appropriately to balance any additional fuel conserved against the additional cost the mileage requirements will impose on new vehicles. Regardless of whether technological feasibility allows the agency to set technology-forcing standards, technological feasibility does not require, by itself, NHTSA to set technology-forcing standards if other statutory factors would point the agency in a different direction. NHTSA has applied this moderating interpretation of technological feasibility over the course of multiple rulemakings.[393]

b. Economic Practicability

NHTSA has long interpreted ''[e]conomic practicability'' to focus on whether a standard is one ''within the financial capability of the industry, but not so stringent as to'' lead to ''adverse economic consequences, such as a significant loss of jobs or the unreasonable elimination of consumer choice.'' [394] In evaluating economic practicability, the agency considers the uncertainty surrounding future market conditions and consumer demand for fuel economy alongside consumer demand for other vehicle attributes. NHTSA has explained in the past that this factor can be especially important during rulemakings in which the auto industry is facing significantly adverse economic conditions (with a corresponding risk of significant job losses). Consumer acceptability is also a major component of economic practicability,[395] which can involve consideration of anticipated consumer responses not just to increased vehicle cost, but also to the way manufacturers may change vehicle models and vehicle sales mix in response to CAFE standards. In attempting to determine the economic practicability of attribute-based standards, NHTSA considers a wide variety of elements, including the annual rate at which manufacturers can increase the percentage of their fleet that employs a particular type of fuel-saving technology, as well as manufacturer fleet mixes. NHTSA also considers the effects on consumer affordability resulting from costs to comply with the standards, and consumers' valuation of fuel economy, among other things.

NHTSA's consideration of economic practicability depends on a number of elements. These include expected availability of capital to make investments in new technologies and production facilities; manufacturers' expected ability to sell vehicles with certain technologies; likely consumer choices; and other elements. NHTSA's

[391] 77 FR 62624, 63015 (Oct. 15, 2012).

[392] *Id.*

[393] *Id.; see also* 75 FR 25324, 25605 (May 7, 2010).

[394] 67 FR 77015, 77021 (Dec. 16, 2002).

[395] *See Ctr. for Auto Safety* v. *NHTSA*, 793 F.2d 1322 (D.C. Cir. 1986) (Administrator's consideration of market demand as component of economic practicability found to be reasonable); *see also Public Citizen* v. *NHTSA*, 848 F.2d 256 (D.C. Cir. 1988) (Congress established broad guidelines in the fuel economy statute; agency's decision to set lower standards was a reasonable accommodation of conflicting policies).

analysis also incorporates assumptions to capture aspects of consumer preferences, vehicle attributes, safety, and other elements relevant to an impacts estimate. Although the agency accounts for safety independently under its longstanding practice, it also considers safety as closely related to, and in some circumstances, a subcomponent of economic practicability. Because manufacturers have finite resources to invest in research and development, investment into the development and implementation of fuel-saving technology necessarily comes at the expense of investing in other areas, such as safety technology. Moreover, when making decisions on how to equip vehicles, manufacturers must balance cost considerations to avoid pricing more consumers out of the market. As manufacturers add technology to increase fuel efficiency, they may decide against installing additional safety equipment to reduce cost increases. And as the prices of new vehicles increase beyond the reach of more consumers, such consumers continue to drive or purchase older, less safely used vehicles. In assessing economic practicability, NHTSA thus also considers the harm to the U.S. economy caused by highway fatalities and injuries.

c. The Effect of Other Motor Vehicle Standards of the Government on Fuel Economy

The effect of other motor vehicle standards of the Government on fuel economy involves analysis of the effects of compliance with emission, safety, noise, or damageability standards on fuel economy capability and thus on average fuel economy. From the CAFE program's earliest years until recently,[396] the effects of compliance with such standards on fuel economy capability over the history of the CAFE program have been negative ones. For example, safety standards that have the effect of increasing vehicle weight thereby lower fuel economy capability, thus decreasing the level of average fuel economy that NHTSA can determine to be feasible. For recent proposals, including this proposal, NHTSA has captured the added weight due to safety standards in baseline vehicle mass estimates. There are no safety standards with compliance dates within the timeframe of this proposal expected to impose further effects on light-duty vehicle mass. NHTSA had also previously considered EPA's motor vehicle emissions standards set pursuant to the CAA when both agencies had set standards in joint rules and also set separate yet coordinated standards. However, this proposal does not incorporate EPA's non-criteria emissions standards as a result of the proposed rescission of its Endangerment Finding and all resulting greenhouse gas emissions standards for light-, medium-, and heavy-duty vehicles and engines.[397] NHTSA will continue to monitor actions in this area for the final rule.

In addition, as discussed further below in the section titled ''Factors That NHTSA Is Prohibited from Considering'' and at length in the final rule titled ''Resetting the Corporate Average Fuel Economy Program,''[398] NHTSA acknowledges that in the previous rulemakings, the agency considered standards set by the California Air Resources Board (CARB). Regardless of whether NHTSA previously explicitly considered those standards as ''other motor vehicle standards of the Government'' or otherwise, NHTSA now explicitly rejects such consideration. For the reasons explained in this section, CARB's standards are not ''other motor vehicle standards of the Government on fuel economy.''

Under EPCA's blanket preemption provision, states may not adopt or enforce regulatory requirements related to fuel economy standards.[399] This preemption mandate holds true regardless of whether EPA has granted waivers for emissions requirements under the CAA. In any event, the President has signed into law three resolutions adopted by Congress under the Congressional Review Act (CRA) to disapprove waivers EPA granted under CAA section 209,[400] including for, as is relevant to the model years and vehicle classes under consideration in this proposal, the Advanced Clean Cars II action. Given the above, CARB standards cannot be justified as policies properly incorporated in the analytical baseline for EPCA purposes.

In addition, regardless of the status of the CARB standards given EPA's proposed repeal, NHTSA believes that the best interpretation of the text of EPCA rebuts the conclusion that CARB's standards are appropriately considered under this section 32902(f) factor. The statute uses the singular ''the Government,'' which refers to the Federal Government, consistent with the 1994 recodification discussed below. This reference likely reflects that only the Federal Government has authority to set standards ''on fuel economy,'' as EPCA itself provides. Under this reading, even if California were held to have authority to set vehicle emission standards pursuant to a waiver under the CAA, for purposes of the maximum feasibility determination, such standards could not be considered because they are not standards of ''the Government,'' as that term is used in EPCA. Again, the use of the definite article ''the'' in reference to the relevant Government suggests that Congress limited consideration to standards set by the Federal Government. Congress easily could have referred to standards set by ''a government'' if it sought to authorize NHTSA to consider state standards in the maximum feasible determination. Congress did not do so.

EPCA's history buttresses the plain meaning of the text. As initially passed in 1975, EPCA mandated average fuel economy standards for passenger cars beginning with MY 1978. The law required the Secretary of Transportation to establish, through regulation, maximum feasible fuel economy standards for MYs 1981–1984 with the intent to provide steady increases to achieve the standard established for 1985 and thereafter authorized the Secretary to adjust that standard. For the statutorily established standards for MYs 1978–1980, EPCA provided each manufacturer with the right to petition for changes in the fuel economy standards applicable to that manufacturer, based on the application of other Federal standards.[401] A petitioning manufacturer had the burden of demonstrating that a ''Federal fuel economy standards reduction'' was likely to exist for that manufacturer in one or more of those model years and that it had made reasonable technology choices. ''Federal standards,'' for that limited purpose, included not only safety standards, noise emission standards, property loss reduction standards, and emission standards issued under various Federal statutes, but also ''emissions standards applicable by reason of section 209(b) of [the CAA].'' Critically, all definitions, processes, and required findings regarding a Federal fuel economy

[396] 42 FR 63184, 63188 (Dec. 15, 1977); *see* 42 FR 33534, 33537 (June 30, 1977).

[397] 90 FR 36288 (Aug. 1, 2025).

[398] 90 FR 24518 (June 11, 2025).

[399] *See* 49 U.S.C. 32919.

[400] H.J. Res. 87 (Pub. L. 119–15); H.J. Res. 88 (Pub. L. 119–16); H.J. Res. 89 (Pub. L. 119–17); *see also* The White House, Statement by the President, Last revised: June 12, 2025, available at: *https://www.whitehouse.gov/briefings-statements/2025/06/statement-by-the-president/* (accessed: Sept. 10, 2025).

[401] Public Law 94–163, 89 Stat. 871 (Dec. 22, 1975). *https://www.govinfo.gov/content/pkg/STATUTE-89/pdf/STATUTE-89-Pg871.pdf.*

standards reduction were located within a single self-contained subsection of 15 U.S.C. 2002, which applied only to MYs 1978–1980.[402]

In 1994, Congress recodified several laws related to transportation. As part of this recodification, the CAFE provisions were moved to title 49 of the United States Code. In doing so, unnecessary provisions were deleted. Specifically, the recodification eliminated subsection (d). The House report describing the recodification declared that the subdivision was already ''executed,'' and described its purpose as ''[p]rovid[ing] for modification of average fuel economy standards for model years 1978, 1979, and 1980.'' [403] It is generally presumed, when Congress includes text in one section and not in another, that Congress knew what it was doing and made the decision deliberately. As part of the same recodification, the relevant language now found at 49 U.S.C. 32902(f) changed from ''effect of other *Federal* motor vehicle standards on fuel economy'' to ''effect of other motor vehicle standards of *the Government* on fuel economy'' (emphasis added).[404] The Senate report accompanying the legislation clarified that ''United States Government'' is substituted for ''United States'' (when used in referring to the Government), ''Federal Government'' and other terms identifying the Government the first time the reference appears in a section. Thereafter, in the same section, ''Government'' is used unless the context requires the complete term to be used to avoid confusion with other governments.[405]

Accordingly, consistent with the statutory intent and text, NHTSA has limited its consideration to the effect of other Federal motor vehicle standards on fuel economy.

d. The Need of the United States To Conserve Energy

NHTSA has historically interpreted ''the need of the United States to conserve energy'' to mean ''the consumer cost, national balance of payments, environmental, and foreign policy implications of our need for large quantities of petroleum, especially imported petroleum.'' [406]

(1) Consumer Costs and Fuel Prices

With regard to NHTSA's consideration of the need for energy conservation, fuel purchases for vehicles are costly to vehicle owners and operators. Projections of future fuel prices help NHTSA to determine the value of fuel savings both to new vehicle buyers and to society and the amount of fuel economy that the new vehicle market is likely to demand in the absence of new standards. Future fuel prices also inform NHTSA about ''the consumer cost9 . . . of our need for large quantities of petroleum.'' [407] In this proposal, NHTSA's analysis relies on fuel price projections from EIA's AEO for 2025, Alternative Transportation Case.[408] Federal Government agencies generally use EIA's price projections in their assessment of future energy-related policies.

(2) National Balance of Payments

The need of the United States to conserve energy has historically included consideration of the ''national balance of payments'' because of concerns that importing large amounts of oil created a significant wealth transfer to oil-exporting countries and left the U.S. economically vulnerable.[409] In the 20th and early 21st centuries, the U.S. trade deficit was mainly driven by petroleum.[410] As recently as 2009, almost half of the deficit was composed of petroleum imports.[411] However, this concern has largely abated in more recent CAFE actions, in part because other factors besides petroleum consumption have since played a bigger role in the U.S. trade deficit, and because of the substantial rebalancing of international petroleum markets largely driven by shale oil productivity in the United States. In light of significant increases in U.S. oil production and corresponding decreases in oil imports, this concern is likely to remain far less pronounced for the foreseeable future.[412] Increasingly, changes in the price of fuel have come to represent transfers between domestic consumers of fuel and domestic producers of petroleum rather than gains or losses to foreign entities.

Although total energy independence is not possible for any country that participates in the global energy market, the fact that the U.S. is now a net oil exporter necessarily reduces risks from global price fluctuation. Even if the U.S. consumed only domestically produced petroleum and continued to export, the U.S. economy would still be subject to oil price fluctuations due to external events and situations. But changes in the oil market mean that the risk of damage to the U.S. economy and of additional pain for U.S. drivers is lower than it was in previous decades. To be sure, risk still exists, and both production and consumption of oil are relevant to how big that risk might be. But the risk is much lower than it would have been in the absence of the rapid growth in U.S. oil production, and this diminished risk means that the need of the U.S. to conserve energy is significantly less than it was at earlier points in the history of the program.

(3) Environmental Effects

Beginning with the outset of the CAFE program, NHTSA has consistently considered environmental issues, mindful of the need to conserve energy under EPCA, of its statutory authority to set CAFE standards, and of the National

[402] As originally enacted as part of Public Law 94–163, that subsection was designated as sec. 502(d) of the Motor Vehicle Information and Cost Savings Act.

[403] H.R. Rep. No. 103–180, at 583–584, tab. 2A.

[404] *See* Public Law 103–272, 108 Stat. 745 (July 5, 1994), *https://www.congress.gov/103/statute/STATUTE-108/STATUTE-108-Pg745.pdf* (to revise, codify, and enact without substantive changes certain laws related to transportation).

[405] S. Rep. 103–265.

[406] 42 FR 63184, 63188 (Dec. 15, 1977).

[407] *Id.*

[408] EIA, Annual Energy Outlook 2025: Case Descriptions, EIA: Washington, DC (2025), available at *https://www.eia.gov/outlooks/aeo/assumptions/pdf/case_descriptions.pdf* (accessed: Sept. 10, 2025). The Alternative Transportation case removes the following policies from the modeling: NHTSA CAFE and EPA tailpipe greenhouse gas standards for light-duty vehicles in MY 2027 and beyond, EPA Phase 3 tailpipe greenhouse gas standards for freight trucks and buses in MY 2027 and beyond, EPA low nitrogen oxide requirements for freight trucks in MY 2027 and beyond, and California Air Resources Board's Advanced Clean Truck (ACT) rule (for both California and CAA sec. 177 states). That case also modifies the following behavioral assumptions: Passenger vehicle manufacturers introduce new electric vehicle nameplates endogenously based on growth in EV sales, rather than based on plans announced in 2024; charging infrastructure buildout is coupled with growth in EV registrations, rather than being exogenously determined based on private- and public-sector announcements; and projected increase in eligibility for IRA sec. 30D credits—in other words, manufacturer reshoring of EV and battery supply chains—is significantly slowed.

[409] 42 FR 63184, 63192 (Dec. 15, 1977) (''A major reason for this need [to reduce petroleum consumption] is that the importation of large quantities of petroleum creates serious balance of payments and foreign policy problems. The United States currently spends approximately $45 billion annually for imported petroleum. But for this large expenditure, the current large U.S. trade deficit would be a surplus.'').

[410] EIA, Today in Energy: Recent improvements in petroleum trade balance mitigate U.S. trade deficit, U.S. Energy Information Administration, Last revised: July 21, 2014, available at: *https://www.eia.gov/todayinenergy/detail.php?id=17191* (accessed: Sept. 10, 2025).

[411] *Id.*

[412] Although future changes in trade policy and its potential macroeconomic impacts remain a source of uncertainty in EIA's outlooks, the most recent Short Term Energy Outlook projections U.S. crude oil production to remain around 13.3 million barrels per day in 2026 compared with 13.4 million barrels per day in 2025, and U.S. crude oil inventories are expected to increase by almost 12 percent from 2025 to 2026. See EIA, Short-Term Energy Outlook, Last revised: Sept. 9, 2025, available at: *https://www.eia.gov/outlooks/steo/*.

Environmental Policy Act (NEPA).[413] In addition to discussing how these effects are weighted in NHTSA's balancing of maximum feasible standards for this action, discussed below, NHTSA also summarizes information related to the environmental effects of this action in Chapter 8.2.5 of the PRIA, and in the section below titled ''National Environmental Policy Act.'' For more detail on the NEPA analysis conducted in conjunction with this proposal, please refer to the accompanying Draft Supplemental Environmental Impact Statement (Draft SEIS).

NHTSA seeks comment on whether Congress has given it authority under EPCA to consider environmental effects when setting fuel economy standards. EPCA's charge is for the agency to set maximum feasible fuel economy standards to reduce national vulnerability to supply shocks while balancing statutory factors—none of which includes environmental effects. Among those statutory considerations is the effect of other Federal government standards on fuel economy. NHTSA has traditionally considered the fact that the vehicles NHTSA regulates are also subject to compliance obligations under the Environmental Protection Agency's criteria emission standards (*e.g.,* mass attributable to adding a catalytic converter) in setting fuel-economy standards. This is appropriate, since EPA is the Federal environmental regulator. NHTSA is not an environmental regulator, and rather than turn NHTSA into one, Congress instead directed the agency to consider the impact of regulations established by environmental regulators on fuel economy when establishing standards. This question of the appropriateness of NHTSA's historic consideration of environmental effects when setting fuel economy standards has become more relevant in light of the United States recent emergence as a net petroleum exporter. NHTSA solicits comment on whether consideration of potential effects of upstream activity such as domestic extraction and refining of petroleum conflicts with or is otherwise not contemplated by Congress' delegation of fuel-economy regulatory authority to NHTSA, including because those upstream activities are subject to regulation by the EPA under the Clean Air Act. In light of EPCA's initial passage as an energy conservation statute and the United States being a net energy exporter, the agency seeks comment on whether environmental effects should remain relevant under ''the need of the United States to conserve energy,'' or any other factor.

(4) Foreign Policy Implications

U.S. consumption and imports of petroleum products can impose costs on the domestic economy that are not reflected in the market price for crude petroleum or in the prices paid by consumers for petroleum products such as gasoline. These costs include the risk of disruptions to the U.S. economy caused by sudden increases in the global price of oil and its resulting impact on fuel prices faced by U.S. consumers.[414] Higher U.S. consumption of crude oil or refined petroleum products could increase the magnitude of external economic costs, thus increasing the true economic cost of supplying transportation fuels above the resource costs of producing them. Conversely, reducing U.S. consumption of crude oil or refined petroleum products (by reducing motor fuel use) can reduce these external costs.

While these costs are considerations, the United States has significantly increased oil production capabilities in recent years and has become a net energy exporter.[415] The U.S. today produces enough oil to satisfy nearly all its energy needs and is projected to continue to do so. In 1977, the U.S. consumed 18.43 million barrels of oil per day, producing 10.39 million, and importing 8.81 million. By 2007, when EISA was adopted, U.S. consumption had risen to 20.68 million barrels of oil per day, with production dropping to 7.85 million, and imports increasing significantly to 13.47 million. By 2022, the landscape had dramatically shifted toward stability, with U.S. consumption dropping slightly to 20.01 million barrels of oil per day, production skyrocketing to 20.08 million, and imports plummeting to 8.32 million.[416] Further, as petroleum imports have declined substantially, even the source of such imports has shifted away from more volatile sources in the Middle East and toward North America. And the source of these imports shifted dramatically as well. In 1977, 8.64 million barrels of oil per day were imported from OPEC and Persian Gulf countries, while only 540 thousand barrels were imported from Canada. In 2007, 8.14 million barrels per day were imported from OPEC and Persian Gulf countries, but Canadian imports increased to 2.23 million. By 2022, OPEC and Persian Gulf imports dropped to only 2.23 million barrels per day, while Canadian imports jumped to 4.37 million. This significant change in circumstances has added new stable supply to the global oil market since the adoption of EPCA and EISA, even as U.S. imports shifted away from volatile and adversarial sources and toward North American sources. NHTSA's assessment of the weight of this factor in balancing the ''need of the Nation to conserve energy'' has shifted accordingly, as discussed in more detail below.

e. Factors That NHTSA Is Prohibited From Considering

EPCA also provides that in determining the level at which NHTSA should set CAFE standards for a particular model year, the agency may not consider the fuel economy of dedicated automobiles; must consider dual-fueled automobiles to be operated only on gasoline or diesel fuel; and may not consider, when prescribing a fuel economy standard, the trading, transferring, or availability of credits under section 32903.[417] Because of the location of these restrictions in the United States Code, at 49 U.S.C. 32902(h), these are also referred to as the ''section 32902(h)'' factors for brevity.

On June 11, 2025, NHTSA published in the **Federal Register** an interpretive rule titled ''Resetting the Corporate Average Fuel Economy Program,'' which set forth NHTSA's interpretation of how it could consider the section 32902(h) limitations when setting maximum feasible CAFE standards.[418] That rule described the history surrounding EPCA's passage in 1975: EPCA was passed in the context of the Arab oil embargoes of the 1970s when American consumers and the U.S. economy were threatened by gasoline shortages and high fuel prices. The House report accompanying EPCA noted that, as a result, the legislation sought to address the national security

[413] 53 FR 33080, 33096 (Aug. 29, 1988); 53 FR 39275, 39302 (Oct. 6, 1988).

[414] While the U.S. maintains a military presence in certain parts of the world to help secure global access to petroleum supplies, that is neither the primary nor the sole mission of U.S. forces overseas. In addition, the scale of oil consumption reductions associated with CAFE standards would be insufficient to alter any existing military missions focused on ensuring the safe and expedient production and transportation of oil around the globe. See Chapter 7 of the PRIA for more information on this topic.

[415] EIA, U.S. Energy Facts Explained: The United States has been an annual net total energy exporter since 2019, Last revised: July 15, 2025, available at: *https://www.eia.gov/energyexplained/us-energy-facts/imports-and-exports.php* (accessed: Sept. 10, 2025).

[416] EIA, Oil and Petroleum Products Explained, Last revised: Jan. 19, 2024, available at: *https://www.eia.gov/energyexplained/oil-and-petroleum-products/imports-and-exports.php* (accessed: Sept. 10, 2025).

[417] 49 U.S.C. 32902(h).

[418] 90 FR 24518 (June 11, 2025).

dangers of America's dependence on foreign oil.[419] Consistent with that context, the House report stated that the purpose of the CAFE program was to induce automakers into offering America's consumers more fuel-efficient vehicle options to advance the national goal of conserving energy while simultaneously ''recogniz[ing] that the automobile industry has a central role in our national economy and that any regulatory program must be carefully drafted so as to require of the industry what is attainable without either imposing impossible burdens on it or unduly limiting consumer choice as to capacity and performance of motor vehicles.'' [420]

As originally enacted, EPCA did not limit the Secretary's consideration of factors when setting maximum feasible standards. Limitations in section 32902(h) first appeared in the AMFA.[421] AMFA aimed to displace energy derived from imported oil to help achieve energy security and improve air quality by encouraging the development of widespread use of methanol, ethanol, and natural gas as transportation fuels by consumers and the production of methanol, ethanol, and natural gas-powered motor vehicles. The statute specified that, in carrying out responsibilities to set maximum feasible fuel economy standards, ''the Secretary shall not consider the fuel economy of alcohol powered automobiles or natural gas powered automobiles, and the Secretary shall consider dual energy automobiles and natural gas dual energy automobiles to be operated exclusively on gasoline or diesel fuel.'' [422] One member of Congress described AMFA's approach as ''evenhanded'' in that the bill did not favor one alternative fuel over another; rather, ''[i]t allow[ed] the market to pick the non-petroleum alternative fuel of the future.'' [423]

The conferees specifically noted their intent to ensure that the Secretary of Transportation did not erase the AMFA incentives by setting the CAFE standards for passenger or non-passenger automobiles ''at a level that assumes a certain penetration of alternative fueled vehicles.'' [424] Specifically, ''[i]t is intended that [NHTSA's maximum feasibility] examination will be conducted without regard to the penetration of alternative fuel vehicles in any manufacturer's fleet, in order to ensure that manufacturers taking advantage of the incentives offered by this bill do not then find DOT including those incentive increases in the manufacturer's 'maximum fuel economy capability.' '' [425]

The Energy Policy Act of 1992 expanded the section 32902(h) limitations to include all dedicated alternative-fueled vehicles.[426] The Energy Policy Act's accompanying House report acknowledged that the widespread use of alternative fuels faced several problems, but expanded the AMFA requirements to keep the program ''fuel neutral.'' [427] This statutory expansion was because ''all the data, experience, and knowledge gathered concerning alternative fuels over the past two decades points to the fact that no one fuel is 'the winner.' '' [428]

There have been no subsequent substantive changes to the language in 49 U.S.C. 32902(h),[429] including with the enactment of EISA in 2007. The statutory prohibition was clear at the time of enactment and has remained clear: it is impermissible for NHTSA to consider the fuel economy of dedicated automobiles in setting maximum feasible fuel economy standards. NHTSA affirms that it did not consider any of these statutorily prohibited factors in determining the maximum feasible standards proposed in the present rulemaking.

f. Additional Considerations Relevant to NHTSA's Statutory Determination of Maximum Feasibility

There are additional considerations relevant to NHTSA's determination of maximum feasible standards that the agency evaluates in conjunction with its analysis of the four enumerated section 32902(f) factors mentioned above.

NHTSA has historically considered the potential for adverse safety consequences in setting CAFE standards, both independently and in the context of the section 32902(f) factors.[430] NHTSA assesses the potential safety impacts of alternative standards and considers them in balancing the statutory considerations and determining the maximum feasible level of the standards. Courts have upheld NHTSA's implementation of EPCA in this manner.[431]

NHTSA also considers consumer demand, which is ''not specifically designated as a factor, but neither is it excluded from consideration; the factors of 'technological feasibility' and 'economic practicability' are each broad enough to encompass the concept.'' [432] As the D.C. Circuit has recognized, NHTSA ''is directed to weigh the 'difficulties of individual automobile manufacturers;' there is no reason to conclude that difficulties due to consumer demand for a certain mix of vehicles should be excluded.'' [433]

In concert with E.O. 12866, NHTSA considers net benefits as relevant to determining maximum feasible CAFE standards. EPCA does not mandate that NHTSA set standards at the point at which net benefits are maximized, and NHTSA does not believe it is compelled to do so.[434] That said, this proposed rule

[419] *See* H.R. Rep. No. 94–340, at 6–10, 87–88 (1975) (available in the docket for this action) (''In 1973 the embargo affected 14 percent of U.S. petroleum consumption and precipitated a $10- to $20-billion drop in GNP. . . . In June of 1973 the average selling price for regular gasoline was reported to be approximately 38.8 cents per gallon, including tax. By June of 1974 that price had increased to 55.1 cents per gallon, an addition in excess of 42 percent. Yet in the same period, gasoline demand went from 6.8 million barrels per day to 7.0 million barrels per day. In other words, gasoline demand actually increased by 2.9 percent even though prices had jumped by over 42 percent. . . . Part B of title V of the bill establishes a long range program for improving automobile fuel economy by requiring manufacturers and importers to meet increasingly stringent average fuel economy standards, and to disclose the fuel economy of each new automobile sold in the United States.'').

[420] *Id.* at p. 87.

[421] Alternative Motor Fuels Act of 1988, Public Law 100–494, 102 Stat. 2441 (Oct. 14, 1988). *https://www.govinfo.gov/content/pkg/STATUTE-102/pdf/STATUTE-102-Pg2441.pdf.*

[422] *Id.* at 102 Stat. 2450.

[423] 134 Cong. Rec. H25122 (Sept. 23, 1988) (statement of Rep. Sharp).

[424] *Id.* at 25124 (statement of Rep. Dingell).

[425] *Id.*

[426] Energy Policy Act of 1992, Public Law 102–486 (1992) (''Title V of the Motor Vehicle Information and Cost Savings Act (15 U.S.C. 2001 *et seq.*) is amended . . . in section 502(e)—(A) by striking 'alcohol powered automobiles or natural gas powered' and inserting in lieu thereof 'dedicated' '').

[427] H.R. Rep. No. 102–474, at 35 (1992).

[428] *Id.*

[429] In 1994, Congress restated the laws related to transportation in one comprehensive title in the recodification of title 49 of the United States Code, *see* S. Rep. No. 103–265 (1994); H.R. Rep. No. 103–180 (1993). The recodification, which was enacted to restate without substantive change all transportation laws in one title, substituted simple language for ''awkward and obsolete terms,'' and eliminated superseded, executed, and obsolete laws. The standard changes made uniformly throughout the revised section are explained in a report preceding the law. Important for this interpretation, ''[t]he words 'may not' are used in a prohibitory sense, as 'is not authorized to' and 'is not permitted to.' ''

[430] *See* 42 FR 33534, 33551 (June 30, 1977).

[431] *See Center for Biological Diversity* v. *NHTSA,* 538 F.3d 1172, 1203–04 (9th Cir. 2008) (upholding NHTSA's analysis of vehicle safety issues associated with weight in connection with the MYs 2008–2011 light truck CAFE rulemaking).

[432] *Ctr. for Auto Safety* v. *Nat'l Highway Traffic Safety Admin.,* 793 F.2d 1322, 1338 (D.C. Cir. 1986).

[433] *Id.* at 1339.

[434] See the 2010 final rule, which considered among the regulatory alternatives one that maximized net benefits, but explained that nothing in EPCA or EISA mandated that NHTSA choose CAFE standards that maximize net benefits (75 FR 25324, 25606 (May 7, 2010)); the 2012 final rule, which also considered among the regulatory alternatives one that maximized net benefits, and

Continued

is net beneficial as required by DOT Order 2100.7, *Ensuring Reliance Upon Sound Economic Analysis in Department of Transportation Policies, Programs, and Activities.*[435] While E.O. 12866 states that agencies should ''in choosing among alternative regulatory approaches, . . . select those approaches that maximize net benefits,'' [436] even if NHTSA believed it could quantify enough relevant factors to determine the CAFE levels at which net benefits were maximized with reasonable accuracy, there may be other considerations that would lead the agency to conclude that maximum feasible CAFE standards are not the ones that maximize net benefits—especially if weighing statutory factors would lead to a different conclusion. For example, in 2012, NHTSA rejected the regulatory alternative that appeared to maximize net benefits (and all alternatives more stringent than that one) based on the conclusion that even though estimated net benefits were maximized, the ''resultant technology application and cost'' were simply too high, and thus made those standards economically impracticable, and thus beyond maximum feasible.[437]

In addition, NHTSA has historically considered that some manufacturers may choose to pay a civil penalty rather than meet their applicable CAFE standard if the cost of paying the civil penalty is less than the cost of adding fuel economy technology. NHTSA did so through an option in the CAFE Model's Market Data Input file that provided that, if ''Y'' for ''yes'' was selected for a specific manufacturer's fine payment preferences, then the algorithm would stop applying additional technology to this manufacturer's product line when cost-effective technology solutions were exhausted.[438] NHTSA had historically justified programming the CAFE Model's technology selection algorithm accordingly because some manufacturers did choose to pay a civil penalty when applicable (*i.e.,* when the civil penalty rate was higher than $0) rather than apply technology, and NHTSA believed that its modeling was intended to reflect manufacturer decision-making in response to standards, even if that decision was to pay penalties.

In July 2025, Congress eliminated CAFE civil penalties, resetting the penalty rate to $0. In this rulemaking, and notwithstanding the change in the CAFE penalty rate, NHTSA has assumed, based upon its review and analysis of the relevant statutory provisions, that manufacturers will make the maximum practicable effort to comply with the proposed standards. ''Practicable'' in this context means subject to real-world constraints on technology application such as refresh and redesign cycles and technology applicability, concepts discussed in detail in Section II. This reading of all of EPCA's provisions best effectuates the statute's command that NHTSA establish maximum feasible standards that achieve industry-wide fuel economy improvements.[439] NHTSA remains charged with setting maximum feasible standards and the July 2025 amendment only altered the civil penalty rate. If NHTSA considered a manufacturer's ability to elect a $0 penalty as a factor in setting standards, it could significantly distort the consideration of maximum feasible standards by making virtually any standards look feasible. Making the assumption that manufacturers will make maximum practicable efforts to comply means that the 49 U.S.C. 32902(f) factors that NHTSA must consider in setting maximum feasible standards—in particular, economic practicability—are given meaning. To be clear, this does not mean NHTSA assumes all manufacturers will comply with standards for all fleets. For example, if a manufacturer could not redesign a portion of their fleet within the standard-setting years or if their baseline compliance position was simply lower than that of the rest of the industry, the CAFE Model is not assuming the manufacturer will nevertheless comply at any cost. This approach appropriately places the focus in standard setting on the feasibility of manufacturers to meet the standards through their vehicle production, consistent with the statutory direction to set maximum feasible standards without regard to the availability of compliance pathways that NHTSA cannot statutorily consider.[440]

NHTSA's modeling assumption that manufacturers will make maximum practicable efforts to comply with CAFE standards despite the $0 penalty rate is supported by longstanding real-world experience. For example, the 1979 ''Automotive Fuel Economy Program Third Annual Report to the Congress'' issued by DOT stated in its recommendation that the statutory scheme be amended to allow a longer period for credit carry forward and carry back that ''[a] number of manufacturers have raised the point that failure to meet the fuel economy standards involves a violation of the law, regardless of whether the short fall involves a penalty or involves the use of credits being carried forward or backward. The manufacturers have expressed strong reluctance to engage in any corporate planning that would involve violations.'' [441]

Today and more recently, many manufacturers have formal corporate policies committing themselves to complying with applicable legal standards. For example, Jaguar Land Rover states in its Code of Conduct that the products and services that they offer ''shall comply with applicable laws, including emissions and safety standards.'' [442] In the proposal preceding the 2024 final rule, NHTSA sought comment on its manufacturer fine payment preference assumptions—which are differentiated by specific manufacturer and model year—and Jaguar Land Rover commented that they do ''not view fine payment as an appropriate compliance route or as a

also explained that nothing in EPCA or EISA mandated that NHTSA choose CAFE standards that maximize net benefits, in fact, directly rejecting the regulatory alternative that maximized net benefits as beyond maximum feasible for the MYs 2017–2025 timeframe (77 FR 62624 (Oct. 15, 2012)); and the 2020 final rule, which stated that if the difference in net benefits between regulatory alternatives was within $20 billion that was relatively small in the total context of the program and therefore the agency did not believe that the point at which net benefits were maximized was meaningful for determining maximum feasible CAFE standards in that final rule.

[435] See DOT, Ensuring Reliance Upon Sound Economic Analysis in Department of Transportation Policies, Programs, and Activities, Last revised: Jan. 29, 2025, available at: *https://www.transportation.gov/mission/ensuring-reliance-upon-sound-economic-analysis-department-transportation-policies-programs* (accessed: Sept. 10, 2025), which requires DOT rulemaking activities to be based on sound economic principles and analysis supported by rigorous cost-benefit requirements and data-driven decisions regardless of whether the rulemaking falls below the economic threshold required for review by the Office of Information and Regulatory Affairs.

[436] 58 FR 51735 (Oct. 4, 1993).

[437] 77 FR 63050 (Oct. 15, 2012).

[438] See CAFE Model Documentation for 2024 FRM, at 82.

[439] NHTSA notes that in all modern CAFE analyses NHTSA employed a threshold at which regulatory costs (technology costs plus civil penalty payments) would be indicative that a standard exceeded maximum feasibility. NHTSA's longstanding position that a standard that would require significant civil penalty payment would exceed maximum feasibility remains unchanged.

[440] 49 U.S.C. 32902(h). It could be considered evading the statutory prohibition to instead consider an alternative means of addressing a shortfall, such as through the use of credit application.

[441] 44 FR 5742 (Jan. 29, 1979).

[442] Jaguar Land Rover Code of Conduct, p. 16, available at: *https://www.jlr.com/download-centre?_gl=1*1nnalls*_ga*MTkyNDk3NDUzNy4xNzUyNTk3MDE4*_ga_G78VTFVFM0*czE3NTI1OTcwMTckbzEkZzEkdDE3NTI1OTcwNTYkajIxJGwwJGgw* (accessed: Sept. 10, 2025).

flexibility in the regulation.'' [443] NHTSA changed this assumption for Jaguar Land Rover for the 2024 final rule. Similarly, the General Motors (GM) global environmental policy states that the company is ''committed to complying with all applicable laws and regulations,'' [444] and Toyota's Code of Conduct states that Toyota will comply with ''applicable laws and regulations'' and ''international environmental standards.'' [445] Honda's corporate responsibility statement likewise states that Honda shall comply with all applicable environmental laws and regulations in all jurisdictions in which they operate,[446] and Stellantis' code of conduct and most recent Climate Policy Report state that the company is both committed to complying with applicable laws and to CAFE compliance specifically.[447] NHTSA does not assume that all companies listed have formerly treated civil penalty payment as a violation of CAFE standards, but rather that when an applicable standard is in effect, manufacturers have reasons to give that standard due consideration even given a $0 penalty rate. NHTSA thus believes that it is reasonable to assume in its analysis of maximum feasibility that manufacturers will make the maximum practicable effort to comply with the applicable standards. NHTSA seeks comment on this assumption.

B. Other Statutory Requirements

1. Administrative Procedure Act

The APA governs agency rulemaking generally and provides the standard of judicial review for agency actions. To be upheld under the ''arbitrary and capricious'' standard of judicial review under the APA, an agency rule must be rational, based on consideration of the relevant factors, and within the scope of authority delegated to the agency by statute. The agency must examine the relevant data and articulate a satisfactory explanation for its action, including a ''rational connection between the facts found and the choice made.'' [448] The APA also requires that agencies provide notice and comment to the public when proposing regulations,[449] as NHTSA is doing with this NPRM and its accompanying materials.

2. National Environmental Policy Act

The National Environmental Policy Act of 1969, 42 U.S.C. 4321 *et seq.,* as amended (NEPA) directs that environmental considerations be integrated into the Federal decision-making process, considering the purpose and need for agencies' actions. To explore the potential environmental consequences of this rulemaking action, NHTSA prepared a Draft Supplemental Environmental Impact Statement (Draft SEIS) for the proposed rule. Although NHTSA is proposing MYs 2022–2031 CAFE standards, because no change in manufacturer behavior is possible for MYs 2022–2026 passenger car and light truck fleets, the main analyses of reasonably foreseeable impacts of the Proposed Action and alternatives presented in the Draft SEIS cover expected environmental impacts associated only with the proposed MYs 2027–2031 standards.

EPCA and EISA require that the Secretary of Transportation determine the maximum feasible levels of CAFE standards in a manner that disregards the potential use of CAFE credits or application of alternative fuel technologies toward compliance in model years for which NHTSA is issuing new standards.[450] NEPA, however, does not impose such constraints on analysis; instead, NEPA requires Federal agencies to consider reasonably foreseeable environmental impacts of their proposed actions.[451] NHTSA's Draft SEIS therefore presents results of an ''unconstrained'' analysis that considers manufacturers' potential use of CAFE credits and application of alternative fuel technologies (including PHEVs using their charge depleting fuel economy values, BEVs and FCEVs) to allow consideration of real-world environmental consequences of the proposed action and alternatives.[452] The rest of this preamble, and importantly NHTSA's balancing of relevant EPCA/EISA factors explained in Section V.C.1 and 2, employs the ''standard setting'' modeling to avoid consideration of the prohibited items in 49 U.S.C. 32902(h) in determining maximum feasible standards. As a result, the impacts reported in this section may differ from those reported elsewhere in the preamble. NHTSA conducts modeling both ways (''standard setting'' and ''unconstrained'') to reflect the various statutory requirements of EPCA/EISA and NEPA, respectively.

NHTSA's Draft SEIS describes the reasonably foreseeable impacts across a variety of environmental resources, including energy, air quality, emissions effects, and historic and cultural resources. The impacts of the Proposed Action and alternatives are discussed in proportion to their significance, qualitatively and quantitatively, as applicable.[453] The findings of the analysis are summarized in Section V.C.3, and more detailed discussion—in particular for any qualitative resource assessment—can be found in the Draft SEIS.

The Draft SEIS is one input among many to NHTSA's decision-making process to set CAFE standards. In preparing the Draft SEIS, NHTSA has considered and taken into account the Supreme Court's recent opinion in *Seven County Infrastructure Coalition* v. *Eagle County, Colorado* and its progeny.[454] Agencies are granted substantial deference to determine the scope of the environmental effects that they address and may decide whether to evaluate environmental effects from separate projects upstream or downstream from this action.[455]

[443] Jaguar, Docket No. NHTSA–2023–0022–57296, at p. 5.

[444] GM, General Motors Global Environmental Policy (2023), available at: *https://investor.gm.com/static-files/f5f872bd-9612-47f9-a5e1-d6c0ce1e6772* (accessed: Sept. 10, 2025).

[445] Toyota Code of Conduct, pp. 14 and 17 (2023), available at: *https://www.toyota.com/content/dam/tusa/usa/our-story/code-of-conduct-en.pdf* (accessed: Sept. 10, 2025).

[446] Honda, Honda Corporate Responsibility Statement, available at *https://csr.honda.com/longform-content/honda-corporate-responsibility-statement/* (accessed: Oct. 20, 2025).

[447] Stellantis, Code of Conduct, available at *https://www.stellantis.com/content/dam/stellantis-corporate/group/governance/code-of-conduct/Stellantis_CoC_EN.pdf* (accessed: Oct. 21, 2025); Stellantis, 2024/2025 Climate Policy Report, *https://www.stellantis.com/content/dam/stellantis-corporate/sustainability/csr-disclosure/stellantis/2024/Stellantis-2024-Climate-Policy-Report.pdf* (accessed: Oct. 21, 2025).

[448] *Burlington Truck Lines, Inc.* v. *U.S.,* 371 U.S. 156, 168 (1962).

[449] 5 U.S.C. 553.

[450] 49 U.S.C. 32902(h). See Resetting the Corporate Average Fuel Economy Program; Interpretive Rule, 90 FR 24518 (June 11, 2025).

[451] 42 U.S.C. 4332(2); DOT Order 5610.1D, sec. 13.f.

[452] See Appendix C of the Draft SEIS for a discussion of the full range of modeled electrified technologies.

[453] Section 13.g(2) of DOT Order 5610.1D.

[454] *Seven Cnty. Infrastructure Coal.* v. *Eagle Cnty., Colorado,* 145 S. Ct. 1497 (2025); see also *Sierra Club* v. *FERC,* 145 F.4th 74, 88–9 (D.C. Cir. 2025).

[455] See *Seven Cnty. Infrastructure Coal.* v. *Eagle Cnty., Colorado,* 145 S. Ct. 1497, 1504 (2025) (''Courts should defer to agencies' discretionary decisions about where to draw the line when considering indirect environmental effects and whether to analyze effects from other projects separate in time or place. See *Department of Transportation* v. *Public Citizen,* 541 U.S. 752, 767, 124 S. Ct. 2204, 159 L.Ed.2d 60. In sum, when assessing significant environmental effects and feasible alternatives for purposes of NEPA, an agency will invariably make a series of fact-dependent, context-specific, and policy-laden choices about the depth and breadth of its inquiry—and also about the length, content, and level of detail of the resulting EIS. Courts should afford substantial deference and should not micromanage those agency choices so long as they fall within a broad zone of reasonableness.'').

Because the Proposed Action amends standards for vehicle model years for which CAFE standards have previously been established, the Draft SEIS discusses certain potential environmental effects from sectors that EPCA does not delegate authority to NHTSA to regulate. NHTSA's prior CAFE EISs contained analysis of the potential environmental impacts from these sectors. *Seven County* made clear, however, that NEPA does not require NHTSA to analyze potential environmental effects from these sectors.

NHTSA has determined that analyses of such effects are not necessary for reasoned decision-making with respect to setting CAFE standards, because Congress has not given NHTSA authority under EPCA to take those effects into account when setting CAFE standards. NHTSA includes a discussion of these effects in the Draft SEIS solely for informational purposes.

Additionally, in light of the *Seven County* opinion, together with the 2023 legislative amendments to the NEPA statute and the 2025 rescission of CEQ NEPA regulations, NHTSA seeks comment on whether NHTSA is required to prepare an EIS for any similar CAFE standard-setting action—that is to say, whether Congress has given NHTSA discretion, when setting CAFE standards, to take into account the potential environmental effects of its CAFE standards in terms of the environmental effects from the sector that those standards directly regulate (*i.e.,* the regulated vehicles themselves).

C. Evaluating the Statutory Factors and Other Considerations To Arrive at the Proposed Standards

The following discussion contains NHTSA's explanation of how the agency has considered the analysis in this preamble and the accompanying Draft TSD and PRIA and other relevant information in tentatively determining that the proposed standards are maximum feasible for MYs 2022–2031 passenger cars and light trucks. As discussed in detail throughout the section below, NHTSA believes the proposed small, steady, incremental increases in fuel economy standards over time, which preserve the ability for manufacturers to focus on safety, affordability, and consumer choice, are reasonable and appropriate, and appropriately balance the four EPCA factors.

1. Why is NHTSA's tentative conclusion different from the 2020, 2022, and 2024 final rules?

The fuel economy standards NHTSA has promulgated in recent years have failed to satisfy faithfully EPCA's requirements in 49 U.S.C. 32902(h) because the prior standards considered the fuel economy of dedicated vehicles and dual-fueled vehicles in charge-depleting mode. Consequently, they do not advance and, indeed, have come to undermine the goals established in EPCA for the CAFE program. In accordance with its authority to reconsider and modify past policy decisions,[456] and in exercise of the Secretary's express authority to ''prescribe regulations amending'' CAFE standards,[457] NHTSA now proposes to reset the CAFE program and sets out the following reasons for the proposed changes in this NPRM.

As summarized in NHTSA's final rule published on June 11, 2025,[458] and relevant to the model years under consideration in this action, NHTSA in its 2020, 2022, and 2024 final rules took the position that the agency could account for the factors prohibited from consideration in section 32902(h) by using a narrow construction of that provision. This narrow interpretation permitted dedicated alternative and dual-fueled vehicles to be added to the fleet of vehicles in response to reasons other than NHTSA's CAFE standards,[459] and outside of the years for which NHTSA was setting standards. Specifically, in the 2022 and 2024 final rule baselines, NHTSA accounted for Zero Emission Vehicle (ZEV) mandates applicable in California and the other states that have adopted them,[460] and some vehicle manufacturers' voluntary commitments to the state of California to continued annual nationwide reductions of vehicle greenhouse gas emissions through MY 2026, with greater rates of electrification than would have been expected under NHTSA's 2020 final rule; and in all three final rules' baselines, NHTSA accounted for manufacturers' joint responses to previously promulgated fuel economy and greenhouse gas emissions standards, which included dedicated EVs. NHTSA prohibited the consideration of dedicated or dual-fueled vehicles only as a compliance option in response to the agency's fuel economy standards during ''standard setting'' years (*i.e.,* the model years being evaluated as the subject of the active rulemaking), and similarly prohibited consideration of manufacturers' use of compliance credits only during the standard setting years. In other words, the model did not apply dedicated or dual-fueled technology to a manufacturer's fleet of vehicles when simulating a cost-effective pathway for the manufacturer to comply with a given level of CAFE standards in standard setting years only, but application of the technology was otherwise permitted.

As NHTSA concluded in the June 2025 final rule and reaffirms here, its prior consideration of the factors prohibited in section 32902(h)—even if in response to reasons other than NHTSA's standards and even if in non-standard setting years—is inconsistent with a plain reading of section 32902(h) and with the most faithful approach to standard setting in furtherance of the design and purposes of EPCA.

As discussed below, the large increases in the stringency of standards applicable to the succeeding model years through MY 2026 were not feasible or practicable, within the meaning of EPCA, for new gas-powered cars and trucks likely to be produced in those years. The inclusion of EVs inherently impacted the agency's determination of maximum feasible standards because EVs are generally imputed to have significantly higher fuel economy than ICE vehicles.[461] NHTSA would not have proposed or adopted standards as stringent as the previous standards if NHTSA had not considered the fuel economy of EVs in its modeling analysis. NHTSA reasoned that this was appropriate because ''accounting for technology improvements that manufacturers would make even in the absence of CAFE standards allows NHTSA to gain

[456] *See, e.g., Phoenix Hydro Corp.* v. *FERC,* 775 F.2d 1187, 1191 (D.C. Cir. 1985); *Alabama Educ. Ass'n* v. *Chao,* 455 F.3d 386, 392 (D.C. Cir. 2006) (quoting *Motor Vehicle Mfrs. Ass'n of U.S., Inc.* v. *State Farm Mut. Auto. Ins. Co.,* 463 U.S. 29, 57 (1983)); *Encino Motorcars, LLC* v. *Navarro,* 136 S. Ct. 2117, 2125 (2016); *FCC* v. *Fox Television Stations, Inc.,* 556 U.S. 502 (2009).

[457] 49 U.S.C. 32902(c).

[458] 90 FR 24518 (June 11, 2025).

[459] In accordance with E.O. 12866 of Sept. 30, 1993 (58 FR 51735, Oct. 4, 1993) and OMB Circular A–4 (Sept. 17, 2003), to evaluate properly the benefits and costs of regulations and their alternatives, agencies must identify a ''no action'' baseline: what the world will be like if the proposed rule is not adopted.

[460] 42 U.S.C. 7507. Other states have adopted California's ZEV program requirements under sec. 177 of the Clean Air Act (so-called ''Section 177 states'').

[461] Fuel economy for EVs is determined using the PEF set by the Department of Energy. For example, one EV manufacturer had a fuel economy performance of 739.9 and 751.9 miles per gallon for its MY 2020 domestic passenger and light truck fleets as compared to the 43.4 and 30.2 miles per gallon overall performance of the same fleets for all manufacturers.

a more accurate understanding of the effects of the final rule.'' [462] However, the inclusion of dedicated vehicles in NHTSA's previous analysis impacted materially the standards that ultimately were promulgated.

The following chart shows the stringency of the existing CAFE standards for MYs 2022–2026 passenger cars and light trucks as estimated in the 2020 and 2022 final rules and compares those standards to the provisional (*i.e.,* not based on EPA final compliance data) fuel economy performance levels of gas-powered vehicles manufactured for sale in MYs 2022–2024.[463]

Table V-2: CAFE Standards Estimated in the 2020 and 2022 Rules and Provisional Gasoline- and Diesel-Powered Vehicle Fuel Economy Performance, MYs 2022-2026

	2022	2023	2024	2025	2026
Passenger Cars					
2020 Estimated Stds.	44.9	45.6	46.3	47.0	47.7
2022 Estimated Stds.	44.6	45.2	49.2	53.4	59.4
Provisional Performance	39.5	39.2	41.2	-	-
Light Trucks					
2020 Estimated Stds.	32.1	32.6	33.1	33.6	34.1
2022 Estimated Stds.	31.9	32.4	35.1	38.2	42.4
Provisional Performance	29.8	29.7	30.5	-	-

The gasoline- and diesel-powered vehicle fleet—the only fleet that NHTSA is allowed to consider in setting standards—is unable to comply with the previously estimated standards in all model years and all regulatory classes for which the agency has provisional gasoline- and diesel-powered vehicle fuel economy performance data; the noncompliance increases in each successive model year because the baseline fleet upon which the current standards continuously apply stringency increases is inclusive of EVs that inflate overall fleet fuel economy performance. Indeed, compared to the provisional performance data for the 2022, 2023, and 2024 passenger car fleets, the 2022 standards are 12.9 percent, 15.3 percent, and 19.4 percent higher, respectively. Compared to the provisional performance data for the 2022, 2023, and 2024 light truck fleet, the 2022 standards are 7.0 percent, 9.1 percent, and 15.1 percent higher, respectively. While some may argue that such an analysis is not relevant when conducted across the entire U.S. fleet, because fuel economy standards apply to individual manufacturer fleets, the conclusion that the 2022 standards exceeded maximum feasibility is confirmed on a manufacturer-by-manufacturer fleet level analysis as well. On an individual manufacturer basis, only a single manufacturer's passenger car fleet can meet the MY 2022 standard with gasoline- or diesel-fueled vehicles (Hyundai's domestic passenger car fleet), and only a single manufacturer's gasoline- or diesel-fueled light truck fleet meets their standard (Subaru). This information confirms that the existing standards were set in a way that considered factors beyond the capability of gasoline- and diesel-powered vehicle fleets at the time the standards were promulgated.

NHTSA also recognizes that its tentative conclusion that MYs 2022–2023 standards are legally impermissible differs from NHTSA's and EPA's joint 2020 final rule.[464] However, that final rule also suffered from some of the same deficiencies as the 2022 and 2024 final rules by including consideration of the section 32902(h) factors, though to a lesser extent than the 2022 and 2024 final rules because of the inclusion of CARB's ZEV standards in the baseline used for those later rules. Furthermore, the annual 1.5-percent rate of increase applied in the 2020 final rule, which reflected consideration of input provided by several major automakers and other interested parties, has not proven to reflect the real-world year-over-year fuel economy improvements feasible for gasoline- and diesel-powered vehicles. Indeed, compared to the provisional performance data for the 2022, 2023, and 2024 passenger car fleets, the 2020 standards are 13.7 percent, 16.3 percent, and 12.4 percent higher, respectively. Compared to the provisional performance data for the 2022, 2023, and 2024 light truck fleet, the 2020 standards are 7.7 percent, 9.8 percent, and 8.5 percent higher, respectively.

The same faults apply to the existing standards for MY 2027 and beyond. For passenger cars, based on NHTSA's updated estimates of manufacturer compliance with the No-Action Alternative, approximately 77 percent of the MY 2027 fleet will not be able to comply with the standard and only three individual manufacturers' fleets will comply.[465] This is likely based on the significant (8 percent, 8 percent, and 10 percent) stringency increases in MYs 2024–2026, which, as discussed in Section III, greatly outweigh manufacturers' ability to improve the fuel economy of their ICE fleets.[466] In fact, NHTSA estimates that the gasoline- and diesel-fueled passenger car fleet will not be able to comply with the standard in any year from MYs 2027–2031, with anywhere from 47 to 77

[462] 89 FR 52540, 52611 (June 24, 2024).

[463] Provisional performance values are based on non-final fuel economy performance (*i.e.,* submitted to NHTSA as part of manufacturers' pre- and mid-model year reports, but not EPA final compliance data) and are subject to change based on final verified fuel economy values and sales volumes.

[464] 85 FR 24174 (Apr. 30, 2020).

[465] Manufacturers that are projected to comply are Mazda, Mitsubishi, and Toyota.

[466] The stringency of the MYs 2024–2026 standards were one reason why NHTSA held non-passenger automobile standards flat in MYs 2027–2028 in the 2024 final rule. *See* 89 FR 52540, 52848 (June 24, 2024) (''Further stringency increases at a comparable rate, immediately on the heels of the increases for model years 2024–2026, may therefore be beyond maximum feasible for model years 2027–2032.'').

percent of the fleet out of compliance during those years. Similarly, NHTSA estimates that 91 percent of the gasoline- and diesel-fueled light truck fleet will not be able to comply with the MY 2027 standards, again most likely because of the overly stringent standards in MYs 2024–2026. By MY 2031, the projected disparity between the standards and compliance decreases, more so for non-passenger automobiles, likely again because of the 2 years of flat standards. However, the gasoline- and diesel-fueled passenger car fleet is projected to miss the No-Action Alternative standards by more than 3 miles per gallon in MY 2031.

It is apparent that the existing standards depended upon the imputed fuel economy performance of EVs and PHEVs that NHTSA assumed would be manufactured in the relevant model years in contravention of both section 32902(h) and of the design and purposes of the CAFE program to avoid setting standards that cannot be met feasibly with gasoline- and diesel-fueled vehicles as part of a push toward alternative powertrains. The above results confirm that automakers are unable to meet the current standards without shifting significant capacity to EVs or purchasing credits from EV manufacturers, and without producing at volume the full range of ICE-driven passenger cars and light trucks that American consumers continue to want and need. Many of the gasoline- and diesel-powered vehicle models most popular with American families would be unsustainable for manufacturers to produce under the existing standards, and it is unlikely that an EV alternative could provide the same performance, utility, or recreational value at a comparable price (or at all). Thus, the existing CAFE standards do not preserve market demand, consumer choice, and the economic realities of the auto industry. Of course, automakers are free to invest in the production of EVs in response to market demand, but they should not be compelled to do so by NHTSA's fuel economy standards; such industry-transforming regulatory compulsion is inconsistent with EPCA.

In the analyses supporting the existing standards, NHTSA also failed to consider countervailing costs to manufacturers, consumers, and society that may have led the agency to conclude that such stringent standards were in fact not feasible. NHTSA substantially underestimated the technological costs the standards are expected to impose on manufacturers, including the direct expenditures made to redesign and reconfigure gasoline- and diesel-powered vehicles attributable to the acceleration in EV production caused by the regulatory forcing of the CAFE standards.[467] Nor did the agency's economic analysis adequately consider the dramatically different supply chain and manufacturing implications of such an acceleration.[468] NHTSA also underestimated the costs that the typical American would incur in owning and operating an EV (including, among others, charging costs, repair costs, battery-replacement costs, and insurance costs) as compared to the costs of owning and operating a gasoline- or diesel-powered vehicle. And NHTSA failed to quantify in its main analysis of maximum feasible standards costs to consumers from forgone features, including vehicle performance.

Additional costs to society more generally (not borne just by EV purchasers) include the costs associated with the massive and rapid national buildout of charging infrastructure and electricity generation and transmission capacity necessary to accommodate the anticipated ramp up in EV sales,[469] and the safety concerns accompanying lithium battery fires,[470] specifically including costs incurred by state and local governments and first responders to prepare for and respond to the predicted spike in battery-related fires and emergency situations that will follow from more EVs on the road.[471] Most importantly, using the CAFE program to push automakers into producing EVs more rapidly than market demand would otherwise support undermines the national security goal behind EPCA because it moves the United States into a position of greater strategic dependence on foreign suppliers of critical automotive inputs, including the processed minerals needed for the manufacture of EV batteries. Such additional societal costs are avoided in the present proposed rulemaking, which is based on a faithful implementation of EPCA's text and design without improperly considering the factors prohibited by section 32902(h).

For the reasons laid out above, the existing fuel economy standards promulgated by NHTSA for each of the model years covered by these proposed rules do not comply with the requirements of EPCA and the goals in EPCA for the CAFE program. Indeed, the existing standards have undermined those goals, harming the freedom and economic interests of America's

[467] See, *e.g.,* Chris Isidore, Ford just reported a massive loss on every electric vehicle it sold, CNN (Apr. 25, 2024), available at *https://www.cnn.com/2024/04/24/business/ford-earnings-ev-losses;* Caleb Miller, GM's Electric Vehicles Finally Earned More Than They Cost to Make, Car and Driver (Jan. 29, 2025), available at *https://www.caranddriver.com/news/a63608612/gm-stops-losing-money-on-evs/* (noting that GM's ''variable profit positive'' metric does not include ''fixed costs such as creating new assembly lines, so GM's massive investments in its EV factories and the engineering of the new models are taken out of the equation.''). The production costs of EVs greatly exceed the manufacturers' current EV sales revenues and are cross-subsidized by the sale of gasoline- and diesel-powered vehicles. If the production of EVs actually did increase at the rate previously projected by NHTSA and EPA, which would require an unrealistic jump in consumer demand for EVs, automakers would no longer be able to subsidize the full extent of their losses on EVs through price increases on gasoline- and diesel-powered vehicles.

[468] Manufacturers cannot easily add a new production line to an existing assembly facility to produce an EV, given differences in manufacturing processes and facility needs. Instead, manufacturers generally either convert an existing facility away from internal combustion vehicle assembly or build a new facility—adding to overall costs and reducing production capacity for internal combustion vehicles. Similarly, suppliers cannot simply add a propulsion battery production line to an existing facility, and much of the expertise and intellectual property for such technologies exists overseas—especially in China. These all add substantial expense for manufacturers, which is passed along to consumers in the form of higher prices.

[469] 87 FR 25888 (May 2, 2022). As the agency conceded in the previous rulemaking, there are massive costs involved with not only converting the fleets, but also the ''ancillary costs of electric vehicles, such as building additional charging stations [and] improving the grid.'' This includes costs borne by utility companies, and passed on to rate payers, to expand infrastructure to support an increased number of households charging vehicles at home or charging locations at private businesses or public locations—including high-powered DC fast charge equipment.

[470] While internal combustion vehicles are also susceptible to fire risks (generally after a very severe high-speed crash), the risks presented by electric vehicle battery fires is on a significantly higher scale and can be presented in surprising situations. See, *e.g.,* IER, Hurricane Ian Is not a Friend of Electric Vehicles, Institute for Energy Research: Washington, DC, Last revised: Oct. 20, 2022, available at: *https://www.instituteforenergyresearch.org/renewable/hurricane-ian-is-not-a-friend-of-electric-vehicles/* (accessed: Sept. 10, 2025). As happened in Hurricane Ian, during emergencies, these battery fires can force ''local fire departments to divert resources away from hurricane recovery to control and contain the fires.'' And these ''fires can become life-threatening if water-damaged electric cars are parked near houses or in garages. Some Florida homes were lost to fires caused by flooded electric vehicles.''

[471] See Larsson, F. et al., Toxic Fluoride Gas Emissions from Lithium-Ion Battery Fires, *Scientific Reports,* Vol. 7: 10018 (2017), available at: *https://doi.org/10.1038/s41598-017-09784-z* (accessed: Sept. 10, 2025). Lithium-ion battery fires are a common occurrence with EVs, and these fires generate intense heat and toxic fluoride gas emissions, making them more difficult to extinguish than conventional vehicle fires and increasing the costs and management challenges of maintaining effective first responder capabilities. See also IAFC, IAFC's Fire Department Response to Electric Vehicle Fire's Bulletin, available at: *https://www.iafc.org/topics-and-tools/resources/resource/iafc-s-fire-department-response-to-electric-vehicle-fires-bulletin* (accessed: Sept. 10, 2025). The dangers from these batteries are forcing fire departments around the country to expend significant resources to purchase equipment that can deal with unstoppable battery fires.

families, significantly degrading highway safety in all regions of the country, weakening the vitality of the U.S. auto industry, lessening the Nation's security by increasing America's strategic dependence on other countries for EV battery materials, and exacerbating the vulnerabilities of America's electricity grid. NHTSA preliminarily determines that each of the factors discussed above in isolation would warrant the amendment of the prior standards. Accordingly, NHTSA proposes to set aside the previous light-duty fuel economy standards established for MY 2022 and following. NHTSA proposes to consider anew the ''maximum feasible'' replacement standards for the model years in question.

2. Considerations Justifying the Proposed Standards

EPCA conferred on the Secretary of Transportation (and NHTSA by delegation) the authority to prescribe maximum feasible fuel economy standards for the light-duty vehicle fleet, and to exercise discretion in weighing the factors of technological feasibility, economic practicability, the need of the Nation to conserve energy, and the effect of other motor vehicle standards of the Government on fuel economy. In exercising its authority, NHTSA has examined three regulatory alternatives that represent different ways the agency could balance the four section 32902(f) factors, consistent with the section 32902(h) prohibition on considering certain factors when setting maximum feasible standards.

NHTSA has also considered other contextual aspects of the statutory scheme in formulating the three regulatory alternatives the agency examined for this proposal. One original aspect of the CAFE program that was abandoned thematically in the development of existing standards is the concept of ''steady progress.'' EPCA's original provision for the MYs 1981–1984 standards included a requirement that the agency's standards ''will result in steady progress toward meeting'' the statutorily established ''standard . . . for model year 1985.'' [472] EISA included a similar provision for MYs 2011–2020 standards to ''increase ratably'' to the statutorily prescribed 2020 level.[473] While EPCA does not include the same requirement for standards applicable to MYs 2021–2030, EPCA does not prohibit NHTSA from providing for the same steady progress in its development of the maximum feasible standards considering the four factors in 32902(f). Given this context, and particularly in light of prior standards that failed to track gasoline- and diesel-fueled vehicle capabilities, NHTSA believes that small, steady, incremental increases in fuel economy standards over time, while preserving the ability for manufacturers to focus on safety, affordability, and consumer choice, are reasonable and balance EPCA's priorities appropriately. Further, while NHTSA is not considering the availability of credits or credit trading in establishing standards, the agency believes that eliminating the credit trading system beginning with MY 2028 will encourage manufacturers to provide for steady improvement in fuel economy across their fleets over time, as opposed to relying upon credits acquired by third-party EV manufacturers. The following discussion presents NHTSA's tentative conclusion about why the proposed standards are maximum feasible.

a. Technological Feasibility and the Effect of Other Motor Vehicle Standards of the Government on Fuel Economy

As in all recent fuel economy rules, technological feasibility and the effect of other motor vehicle standards of the Government on fuel economy are considered in NHTSA's balancing of the relevant factors, but they continue to play a less significant role.

Regarding technological feasibility, that factor continues to be less constraining than in the past: manufacturers can comply with standards under each regulatory alternative by applying existing technology to their vehicles. Whether that technology can be applied to vehicles in the rulemaking timeframe and at what cost is a question of economic practicability; as NHTSA stated in 2020, all alternatives could be considered technologically feasible, but that does not mean that any of them could be maximum feasible.[474] Put another way, ''[a]ny of the alternatives could thus be achieved on a technical basis alone if the level of resources that might be required to implement the technologies is not considered.'' [475] However, the level of resources needed to apply those technologies and whether consumers will purchase vehicles equipped with those technologies are still prescient factors to consider and are discussed below in more detail with regard to the economic practicability of the standards.

Regarding the effect of other motor vehicle standards of the Government on fuel economy, NHTSA has considered both the agency's own safety standards and EPA's criteria pollutant emissions standards in various aspects of the technical modeling. Neither presents a barrier nor a reason why the agency would select a different regulatory alternative than the proposed alternative. In addition, as discussed above, to the extent that non-Federal vehicle standards played a role in the agency's prior consideration of the effect of other motor vehicle standards of the Government on fuel economy, NHTSA now proposes to reject such consideration. NHTSA also recognizes that EPA has recently proposed to rescind all greenhouse gas emission standards for all categories of new motor vehicles and engines, including light-duty vehicles, to effectuate its reading of CAA section 202(a).[476] NHTSA will continue to monitor EPA's actions in this area as this CAFE rulemaking progresses.

b. Economic Practicability and Safety (Both Independently and as a Subset of Economic Practicability)

Economic practicability remains a complex yet critical factor to consider and balance. As discussed above, NHTSA's consideration of economic practicability encompasses several elements, including the available technology and cadence for each manufacturer to apply that technology in the rulemaking timeframe, manufacturers' compliance shortfalls due to constraints that limit their ability to apply the required technology, increases in vehicle costs attributable to technology application that consumers may see, and the resulting consumer demand for those technologies. As such, NHTSA considered how manufacturers might weigh offering and improving vehicle attributes that consumers want against how manufacturers may change different attributes in response to fuel economy standards. In accordance with EPCA's purpose and design, and with case law affirming NHTSA's consideration of consumer demand as an element of economic practicability,[477] that consideration is appropriately included in NHTSA's analysis. The economic practicability factor also encompasses estimated sales and employment impacts; consumer cost impacts, which include changes in

[472] Public Law 94–163, sec. 502(a)(3)(B), 89 Stat. 871 (Dec. 22, 1975). *https://www.govinfo.gov/content/pkg/STATUTE-89/pdf/STATUTE-89-Pg871.pdf.*

[473] 49 U.S.C. 32902(b)(2).

[474] 85 FR 24174, 25174 (Apr. 30, 2020).

[475] 77 FR 62624, 63037 (Oct. 15, 2012).

[476] 90 FR 36288 (Aug. 1, 2025).

[477] *Ctr. for Auto Safety* v. *Nat'l Highway Traffic Safety Admin.*, 793 F.2d 1322 (D.C. Cir. 1986).

fuel expenditures and other vehicle-related costs like registration and insurance; and safety impacts. Each of these is evaluated in turn.

NHTSA discussed above that technological feasibility is not a limiting factor for this proposal, as manufacturers can comply with standards under each regulatory alternative by applying to their vehicles technology that currently exists. However, ''whether a fuel-economy-improving technology does or will exist (technological feasibility) is a different question from what economic consequences could ensue if NHTSA effectively requires that technology to become widespread in the fleet and the economic consequences of the absence of consumer demand for technology that are projected to be required (economic practicability).'' [478]

In the face of increasing fuel economy standards under the existing rules, vehicle manufacturers have taken different approaches to adding fuel-economy-improving technology to their vehicles. Some manufacturers that invested heavily in early deployment of EVs to meet the technology forcing (rather than performance-based) standards set in 2024 likely conserved scarce resources by not investing in improvements to their ICE fleets and will find themselves with gasoline- and diesel-fueled fleets with lower fleet fuel economy values. Manufacturers that invested heavily in bridge technologies like non-plug-in hybrid powertrains and complied only marginally with 2024's technology-forcing standards presumably have ICE fleets with higher fleet fuel economy values. EPCA's command—to set maximum feasible fleet average fuel economy values for vehicles that run on ''fuel'' as defined in the statute—becomes somewhat more difficult as the fleet bifurcates and manufacturers find themselves in very different competitive postures. Analyzing whether technology can feasibly be applied to vehicles during the rulemaking timeframe, and at what cost, requires careful consideration of each individual manufacturer's technology levels and the potential economic consequences resulting from manufacturers efforts to comply with different levels of standards.

Although, as discussed above, manufacturers have used a range of technologies to improve the fuel economy of their gasoline and diesel vehicles, only one manufacturer's gasoline- and diesel-based passenger automobile fleet met the existing MY 2022 standard (Hyundai's domestic passenger automobile fleet), and only one manufacturer's gasoline- and diesel-based non-passenger automobile fleet met that standard (Subaru). While manufacturers are free to use any available compliance solutions to meet CAFE standards, NHTSA is subject to statutory constraints when setting standards, which, therefore, should not drive the use of particular compliance solutions. Because the prior rules violated EPCA's prohibition on considering these factors, NHTSA is resetting standards based only on consideration of what is achievable with gasoline- and diesel-powered vehicles; necessarily, the starting point for setting these new standards is the most recently produced fleet of gasoline- and diesel-powered vehicles for which the agency has data.

The amount of under-compliance in the gasoline- and diesel-based fleet relative to the standards shown above indicates that the prior standards exceeded maximum feasibility. While NHTSA is not considering the availability of dedicated vehicles, dual-fuel vehicles operating with electric propulsion, or credit transfers or trading, one would reasonably expect the real-world gasoline- and diesel-powered fleet to under-comply relative to the standards, to the extent that manufacturers apply compliance flexibilities the agency cannot consider when setting standards (*e.g.,* producing alternative fueled vehicles or using credits earned in other years or fleets). That said, any fuel economy improvements required by NHTSA's standards must be feasible to achieve by vehicles powered by ''fuel'' as defined in 49 U.S.C. 32901. That is what EPCA requires, and the agency is accordingly limiting its role to ensuring that, whatever technological pathway manufacturers choose to increase the fuel economy of the vehicle fleet, fleet fuel economy does in fact increase over time in accordance with EPCA's design and purpose (including the constraints it imposes on factors that may be considered in setting standards).

NHTSA does not intend for its proposed reset standards to penalize manufacturers that increased their fleet fuel economy values using EV technology. Rather, NHTSA recognizes that resetting standards at a level where all manufacturers can respond to market demand, consider affordability, and consider safety, would effectuate EPCA's structure and purpose by letting technology equalize as a baseline for further increases that better reflect consumer needs and preferences.

Besides the obvious effects of considering the section 32902(h) technologies in the prior standards, the stringency and pace of prior standards may have driven technology application in other ways that the agency's analysis could not capture. To the extent that NHTSA previously overestimated manufacturers' abilities to apply technologies based on incongruent product design cycles and manufacturing capabilities, or underestimated manufacturers' needs to deploy capital for necessary reasons unrelated to fuel economy (like safety technology) the agency believes it is reasonable to reset standards at levels that do not artificially inflate vehicles' fuel economy capabilities.

Consistent with the above discussion, NHTSA recognizes that vehicle manufacturers have had to incur significant costs from adding technology to vehicles subject to prior standards for MYs 2022–2026; however, it is impossible for the agency to quantify those costs. What the agency *can* quantify is the technology levels present in the fleet in MY 2022, the first year for which NHTSA is proposing to reset standards, and MY 2024, the model year for which NHTSA had relatively complete fuel economy data from which to build the Market Data Input File used as a starting point for the CAFE Model analysis. The agency cannot conclude, however, that those levels were economically practicable such that the no-action standards could be sustained. Table V–3 shows powertrain technology penetration rates in the MY 2022 and MY 2024 fleet.[479] The table shows that as basic naturally aspirated engine technology penetration rates have decreased, there has been a concurrent increase in rates of advanced powertrain technology, in addition to increases in the rates of mild and strong hybrid technology.

[478] 85 FR 24174, 25130 (Apr. 30, 2020).

[479] Manufacturers might pair multiple powertrain technologies in a vehicle, such as a turbo engine with a mild hybrid stop/start technology. This will result in the technology penetration rates adding up to more than 100 percent.

Table V-3: Technology Penetration Differences in MY 2022 and MY 2024

Powertrain Technology	MY 2022	MY 2024
Basic Naturally Aspirated	37.9%	22.0%
Turbo Engines	36.0%	46.3%
Advanced Cylinder Deactivation	3.5%	4.3%
High Compression Ratio	18.1%	23.4%
Other Advanced Engines	4.5%	4.0%
Mild Hybrids	59.8%	67.2%
Strong Hybrids	7.3%	10.4%
Plug-in Hybrids	1.8%	2.9%

The relevant questions for the agency then become whether these increases in technology penetration rates would have occurred absent unlawfully stringent vehicle fuel economy standards and what sacrifices manufacturers and consumers had to make in response. While NHTSA cannot know whether manufacturers would have, for example, created such things as 4-cylinder turbocharged pickup trucks absent regulatory obligations, NHTSA does know that for some vehicle technologies ostensibly applied solely in response to increasing regulatory requirements, like stop-start technology (referred to in the agency's analysis as SS12V technology), consumers frequently opt to deactivate the technology when able to do so,[480] negating any potential fuel economy benefit. Similarly, manufacturers must make trade-offs regarding how to shift capital investments between safety and fuel economy. Manufacturers have limited supplies of capital for technological advancement and are constrained in recovering those investments by what consumers can afford to pay for technological innovations in new vehicles. Maximum feasible fuel economy standards, when appropriately weighing economic practicability, should never incentivize manufacturers to add technology that consumers reject at the cost of investments in, or application of, vehicle safety technologies. Instead, when truly maximum feasible standards apply, manufacturers should be able continually to develop, and apply, both proven fuel-saving and safety-enhancing technologies in such a manner that allows consumers both to desire and to afford the new vehicle.

For MYs 2027–2031, the CAFE Model estimates a significant amount of technology application in the vehicle fleet in all simulated scenarios by assuming the prior MYs 2024–2026 standards exist in the regulatory baseline. The CAFE Model does not remove technology from vehicles in the face of less stringent standards, meaning that any technology applied by the model to reach the existing stringent MYs 2024–2026 standards modeled as such in accordance with Circular A–4's definition of a ''no-action baseline'' will continue to exist in the fleet in the model for MYs 2027–2031. While manufacturers invest significant capital in developing new vehicle technologies and may try to recoup their investments, it is entirely possible that manufacturers may choose to discontinue employing particular technologies earlier than anticipated or may price their vehicles in a way that would shift sales from a vehicle model using one technology to a vehicle model using another when faced with the proposed standards. NHTSA presents technology penetration rates for MYs 2027–2031 below but recognizes that manufacturers' responses to standards will be different in ways that the simulated analysis likely cannot capture.

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[480] See Ford, How does Auto Start-Stop Technology Work in My Ford?, available at: *https://www.ford.com/support/how-tos/more-vehicle-topics/engine-and-transmission/how-does-auto-start-stop-technology-work-in-my-ford/* (accessed: Sept. 10, 2025); Autostop Eliminator, Don't Let the Auto Start-Stop Embarrass You, available at: *https://www.autostopeliminator.com/?srsltid=AfmBOoqNh1ZBMJe-3ZN-DMV9LHsarkgT_Vb4lT4r0l042uq6DdWml59i* (accessed: Sept. 10, 2025).

Table V-4: Fleetwide Penetration Levels for Selected Technologies, MYs 2024-2031

	2024	2025	2026	2027	2028	2029	2030	2031
Advanced gasoline engines								
No Action	37.0	28.4	22.9	17.7	12.9	6.7	2.7	1.9
Alt. 1	-	-	-	+2.0	+5.1	+8.9	+11.5	+12.4
Alt. 2	-	-	-	+2.0	+5.1	+8.9	+11.5	+12.4
Alt. 3	-	-	-	+1.9	+5.0	+7.9	+10.4	+11.1
12V Micro Hybrid (SS12V)								
No Action	63.0	52.6	38.7	27.8	17.9	12.8	8.4	6.2
Alt. 1	-	-	-	+5.9	+13.9	+18.9	+22.6	+24.5
Alt. 2	-	-	-	+5.9	+13.9	+18.9	+22.6	+24.5
Alt. 3	-	-	-	+4.2	+12.2	+16.3	+20.0	+21.8
SHEV								
No Action	10.4	24.5	40.6	53.3	62.4	71.7	76.7	80.2
Alt. 1	-	-	-	-7.1	-13.9	-21.3	-25.4	-27.8
Alt. 2	-	-	-	-7.1	-13.9	-21.3	-25.4	-27.8
Alt. 3	-	-	-	-5.4	-12.1	-18.5	-22.6	-24.9
PHEV								
No Action	2.9	2.8	5.4	5.5	7.3	7.3	7.3	7.3
Alt. 1	-	-	-	0.0	-1.8	-1.8	-1.8	-1.8
Alt. 2	-	-	-	0.0	-1.8	-1.8	-1.8	-1.8
Alt. 3	-	-	-	0.0	-1.8	-1.8	-1.8	-1.8

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As the table shows, the analysis projects that manufacturers attempting to meet the No-Action Alternative standards without the use of EVs or PHEVs in charge-depleting mode results in a significant penetration of strong hybrid vehicles. Even then, the CAFE Model shows that manufacturers will fail to comply with the No-Action Alternative standards at the fleet level by more than 1 mile per gallon. Under all three alternatives, manufacturers can continue using gasoline engines throughout the years covered by the standards compared to the baseline, and the strong hybrid vehicle penetration rate drops by almost 28 percent by 2031 compared to the baseline. There is still some PHEV penetration by 2031, as those vehicles' gas-only (charge-sustaining) fuel economy values essentially amount to a strong hybrid vehicles' fuel economy value, but the penetration rate decreases marginally in each regulatory alternative compared to the baseline. NHTSA expects that the penetration of SS12V technology will drop from its high in MY 2024 as more effective hybridization technology can be applied in response to the standards and as manufacturers respond to revised standards set without considering OC technologies.

Given that NHTSA's analysis shows significant penetration rates for strong hybrid vehicles by MY 2031, the agency also believes it is appropriate to consider not just potential consumer acceptance issues associated with that technology, but also the technologies that may be set aside by manufacturers to pursue additional technology that consumers would prefer. NHTSA has performed this same analysis in prior rules. Because NHTSA has again determined that no consumer choice model satisfactorily predicts future behavior for the agency's purposes (see the detailed discussion of this in Section II.E), the following analysis remains a qualitative one.

It is important to note that NHTSA's consideration of consumer demand as relevant to economic practicability has been upheld by the D.C. Circuit in *Center for Auto Safety* v. *NHTSA*,[481] in which the court highlighted the broad discretion that Congress granted the agency in setting fuel economy standards. In the court's assessment, ''Congress clearly contemplated that consumers would benefit from the flexibility accorded to the manufacturer by a system of fuel economy standards, which [Senate Report 94–179] predicted 'should result in a more diverse product mix and wide consumer choice.' '' [482] The court also identified what might be deemed guardrails to NHTSA's consideration of consumer demand: ''it would clearly be impermissible for NHTSA to rely on consumer demand to such an extent that it ignored the overarching goal of fuel conservation. At the other extreme, a standard with harsh economic consequences for the auto industry also would represent an unreasonable balancing of EPCA's policies.'' [483]

NHTSA's last assessment of consumer demand for strong hybrid vehicles occurred in the 2020 final rule, when the agency determined that demand for

[481] *Ctr. for Auto Safety* v. *Nat'l Highway Traffic Safety Admin.*, 793 F.2d 1322 (D.C. Cir. 1986).

[482] *Ctr. for Auto Safety* v. *Nat'l Highway Traffic Safety Admin.*, 793 F.2d 1322, 1338 (D.C. Cir. 1986).

[483] *Ctr. for Auto Safety* v. *Nat'l Highway Traffic Safety Admin.*, 793 F.2d 1322, 1340 (D.C. Cir. 1986).

strong hybrid vehicles was closely linked to fuel prices.[484] In 2020, the agency observed that strong hybrids were able to capture additional market share when fuel prices were at or above $3.50 per gallon, but the agency did not expect fuel prices to return to that level for quite some time pursuant to then-current projections. At that point, the agency determined that the significant levels of strong hybrid penetration rates were dependent on consumer acceptance, and for manufacturers to achieve similar fuel economy levels with non-hybrid technologies would increase compliance costs. NHTSA concluded that those higher costs could have implications for the vehicle sales response, vehicle retirement rates in the existing vehicle population, and the penetration rates of emerging safety features.

Since 2020, the production share of strong hybrid vehicles has more than doubled,[485] while gasoline prices have also increased. In April 2020, when NHTSA published the 2020 final rule retail gasoline prices averaged $1.94 a gallon; prices peaked in summer 2022 at $5.03 a gallon and have stabilized around $3.00 to $3.20 per gallon since October 2024.[486] NHTSA's fuel price projection assumes that prices will generally remain around that level through 2050, briefly dipping below $3.00 per gallon in 2028 but rising again by 2033. Whether those prices remain correlated with strong hybrid market share in the real world remains to be seen. NHTSA's central analysis shows strong hybrid penetration rates more than doubling from MY 2024 to MY 2025 and then increasing by another 16 percentage points from MY 2025 to MY 2026. As discussed above, this modeling result is driven by the extremely aggressive MYs 2024–2026 standards in the baseline that occur prior to the proposed reset standards beginning in MY 2027. From MYs 2027–2031, strong hybrid penetration rates increase slightly and essentially plateau by MY 2031. That said, NHTSA's analysis describes just one potential pathway that manufacturers could use to comply with the proposed standards, and the agency expects actual compliance pathways will likely be different. Data shows that strong hybrid penetration rates have yet to increase at greater than approximately 5 percentage points year over year.[487] Accordingly, NHTSA intends that strong hybrid vehicles remain an option but not a mandate; while the agency expects that manufacturers will continue providing strong hybrids to gasoline-price-conscious consumers, manufacturers should ultimately comply with standards in the way that they see fit, consistent with responding to the needs and preferences of consumers.

While the differences in technology penetration rates between the alternatives are small compared to changes between the baseline and alternatives, examining the effect of the technology required by different regulatory alternatives on manufacturers' compliance positions is more instructive. In terms of how this technology application in response to standards influences manufacturer compliance positions, this action is unique in that the 2022 and 2024 standards incorporated into the baseline result in excessive fuel economy technology application in years prior to the standard setting years, and that technology carries through to MY 2031. This results in over-compliance for some manufacturers' fleets; however, over-compliance for some manufacturers' fleets is not indicative that the proposed standard is not maximum feasible. NHTSA must set industry-wide standards, considering the capabilities of all manufacturers. All manufacturers struggle to comply with the baseline MYs 2024–2026 standards that increase at rates of 8 percent and 10 percent per year with their gasoline- and diesel-powered vehicle fleets. That is because those rates of increase are significantly higher than historic rates of gasoline- and diesel-powered technology improvement and is significantly higher than the gasoline- and diesel-based fleet can manage based on the most up-to-date data available for those years. On an industry-wide basis, NHTSA's MY 2024 analysis fleet used as an input to the CAFE Model show the MY 2024 gasoline- and diesel-powered passenger car fleet under-complying by over 6 miles per gallon with the baseline standard, and the gasoline- and diesel-powered light truck fleet under-complying by 2.7 miles per gallon with the baseline standard. NHTSA proposes to reset the CAFE program consistent with EPCA to address this significant, industry-wide compliance concern. Leaving in place standards for which compliance is not possible does nothing to improve the fuel economy of gasoline- and diesel-powered vehicles.

This action is also unique in that, in MY 2028, NHTSA is proposing to update the regulatory definitions for passenger cars and light trucks (referred to as passenger automobiles and non-passenger automobiles in EPCA), which would result in moving many models of what are currently considered lower fuel economy light trucks into the passenger car fleet, leaving the light truck fleet to consist of vehicles with attributes originally contemplated by the statute to be put towards non-passenger capabilities, thereby reducing the overall average fuel economy levels of the non-passenger fleet accordingly. This reclassification will have the effect of significantly lowering the average fuel economy values of both fleets, leaving all else equal, but maintaining the overall combined fleet fuel economy standards at the same level as MY 2027. This will have a dramatic effect on all manufacturers with both passenger cars and light truck fleets. To anticipate the reclassification change, NHTSA proposed to set MY 2027 standards in such a way as to bridge the gap between the amended MY 2026 standards (reflecting technology decisions that have been locked in at the time of publication), and the MY 2028 reclassification.[488] This transition adjustment is estimated to result in over-compliance in MY 2027. Manufacturers' estimated compliance positions relative to the standards are displayed in Table V–5 and Table V–6, which report over-compliance or shortfall in mpg (cell shading indicates shortfalls):

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[484] 85 FR 24174, 25181 (Apr. 30, 2020).

[485] 2024 EPA Automotive Trends Report, Figure 4.14. Gasoline Hybrid Engine Production Share Hybrid Type.

[486] EIA, U.S. All Grades All Formulations Retail Gasoline Prices (Dollars per Gallon), Last revised: Sept. 16, 2025, available at: *https://www.eia.gov/dnav/pet/hist/leafhandler.ashx?f=m&n=pet&s=emm_epm0_pte_nus_dpg* (accessed: Sept. 10, 2025).

[487] EIA, Hybrid vehicle sales continue to rise as electric and plug-in vehicle shares remain flat, Last revised: May 30, 2025, available at: *https://www.eia.gov/todayinenergy/detail.php?id=65384#:~:text=About%2022%25%20of%20light%2Dduty,the%20first%20quarter%20of%202024* (accessed: Sept. 10, 2025).

[488] For additional discussion of how NHTSA developed the regulatory alternatives for this proposal see preamble Section III.

Table V-5: Achieved Fuel Economy in MPG Relative to Required Levels Under Regulatory Alternatives, Passenger Cars

	No Action								Alt. 1							
Model Year	24	25	26	27	28	29	30	31	24	25	26	27	28	29	30	31
BMW	-12	-12	-13	-13	-10	-11	-12	-11	-12	-12	-13	10	7	7	7	8
Ferrari	-26	-30	-36	-37	-38	-39	-39	-39	-26	-30	-36	-14	-14	-14	-13	-12
Ford	-14	-19	-22	-20	-21	23	-24	-25	-14	-19	-22	3	5	5	5	5
GM	-9	-10	-8	-6	-7	-3	-4	-5	-9	-10	-8	17	10	10	10	10
Honda	-1	-5	-4	-4	0	7	6	5	-1	-5	-4	20	10	11	12	11
Hyundai	-6	-9	-11	-4	1	4	2	1	-6	-9	-11	13	8	8	8	8
Ineos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JLR	-18	-22	-12	-14	-15	-16	-17	-18	-18	-22	-12	10	6	6	6	6
KIA	-5	-4	-6	-6	-4	6	4	3	-5	-4	-6	19	10	10	10	10
Mazda	-9	-10	3	2	1	0	-2	-3	-9	-10	3	28	4	4	4	6
Mercedes-Benz	-11	-14	-18	-17	-17	-14	-13	-13	-11	-14	-18	5	2	3	4	5
Mitsubishi	0	-5	13	12	10	9	8	6	0	-5	13	42	12	12	15	14
Nissan	-4	0	-3	2	1	0	-1	-2	-4	0	-3	26	14	16	16	16
Stellantis	-10	-14	-20	-15	-16	-18	-18	-20	-10	-14	-20	10	5	5	5	5
Subaru	-13	-14	-20	-10	0	-1	-2	-4	-13	-14	-20	7	3	4	3	3
Toyota	-2	-2	4	4	3	2	2	2	-2	-2	4	28	18	18	19	19
Volvo	-8	-12	-7	-8	-6	-7	-8	-9	-8	-12	-7	16	11	11	10	10
VWA	-13	-13	-12	-12	-8	-10	-11	-11	-13	-13	-12	13	6	6	6	6
Industry Avg.	-6	-7	-7	-5	-4	-1	-2	-3	-6	-7	-7	18	10	10	10	10

	Alt. 2								Alt. 3							
Model Year	24	25	26	27	28	29	30	31	24	25	26	27	28	29	30	31
BMW	-12	-12	-13	9	6	6	6	7	-12	-12	-13	7	4	4	3	4
Ferrari	-26	-30	-36	-15	-15	-15	-14	-13	-26	-30	-36	-16	-17	-18	-17	-16
Ford	-14	-19	-22	2	4	4	4	4	-14	-19	-22	1	3	3	3	2
GM	-9	-10	-8	16	9	9	9	9	-9	-10	-8	14	7	6	6	6
Honda	-1	-5	-4	19	9	10	10	10	-1	-5	-4	17	7	7	7	7
Hyundai	-6	-9	-11	12	7	7	7	7	-6	-9	-11	10	4	4	4	3
Ineos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JLR	-18	-22	-12	9	5	5	5	5	-18	-22	-12	7	3	2	2	2
KIA	-5	-4	-6	18	9	9	9	9	-5	-4	-6	16	7	7	6	6
Mazda	-9	-10	3	27	3	3	3	5	-9	-10	3	25	1	1	0	2
Mercedes-Benz	-11	-14	-18	4	1	2	3	4	-11	-14	-18	3	0	1	2	2
Mitsubishi	0	-5	13	41	11	11	13	13	0	-5	13	39	8	8	10	10
Nissan	-4	0	-3	24	13	15	15	15	-4	0	-3	23	10	12	12	12
Stellantis	-10	-14	-20	8	4	4	4	4	-10	-14	-20	8	2	2	2	1
Subaru	-13	-14	-20	6	2	2	2	2	-13	-14	-20	4	0	1	0	0
Toyota	-2	-2	4	27	17	17	18	18	-2	-2	4	26	14	14	14	14
Volvo	-8	-12	-7	15	10	10	10	9	-8	-12	-7	13	8	7	7	6
VWA	-13	-13	-12	12	5	5	5	5	-13	-13	-12	10	4	3	3	3
Industry Avg.	-6	-7	-7	17	8	9	9	9	-6	-7	-7	16	6	6	6	6

Table V-6: Achieved Fuel Economy in MPG Relative to Required Levels Under Regulatory Alternatives, Light Trucks

	No Action								Alt. 1							
Model Year	24	25	26	27	28	29	30	31	24	25	26	27	28	29	30	31
BMW	-3	-2	-4	2	2	2	2	0	-3	-2	-4	13	8	8	8	8
Ferrari	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ford	-1	-3	-6	-1	0	-1	1	0	-1	-3	-6	12	5	5	6	6
GM	-4	-5	-4	-4	-2	-2	-2	-2	-4	-5	-4	10	4	4	4	5
Honda	0	2	-1	-1	1	0	2	0	0	2	-1	15	8	8	8	8
Hyundai	-2	-4	-4	-3	1	3	2	1	-2	-4	-4	13	4	4	4	4
Ineos	-16	-19	-23	-20	-20	-21	-22	-14	-16	-19	-23	-5	-8	-8	-8	0
JLR	-7	-8	-10	-9	-9	-6	-7	-5	-7	-8	-10	6	0	1	1	2
KIA	-4	-2	-2	-2	3	2	1	0	-4	-2	-2	14	0	0	0	0
Mazda	-2	-5	-9	-2	-2	0	0	2	-2	-5	-9	11	0	0	0	0
Mercedes-Benz	-7	-10	-5	-5	-5	-6	-3	-4	-7	-10	-5	10	7	7	7	7
Mitsubishi	-4	-4	-2	-2	-2	-3	2	1	-4	-4	-2	15	0	0	0	0
Nissan	-4	-5	-8	-5	-5	0	3	2	-4	-5	-8	9	0	1	4	4
Stellantis	-6	-7	-10	-6	-3	0	-1	-2	-6	-7	-10	7	2	4	4	4
Subaru	-2	-6	-11	-6	1	2	1	0	-2	-6	-11	7	0	0	0	0
Toyota	1	-1	-3	-2	0	0	1	0	1	-1	-3	13	1	1	1	1
Volvo	-1	0	-1	4	4	4	3	1	-1	0	-1	19	0	0	0	0
VWA	-5	-2	-4	2	4	3	2	0	-5	-2	-4	14	3	3	3	3
Industry Avg.	-3	-4	-6	-3	-1	0	0	-1	-3	-4	-6	11	3	4	4	4

	Alt. 2								Alt. 3							
Model Year	24	25	26	27	28	29	30	31	24	25	26	27	28	29	30	31
BMW	-3	-2	-4	12	7	7	7	7	-3	-2	-4	10	5	5	5	4
Ferrari	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ford	-1	-3	-6	11	4	4	5	5	-1	-3	-6	10	2	2	3	3
GM	-4	-5	-4	9	4	4	4	4	-4	-5	-4	7	2	2	1	2
Honda	0	2	-1	14	8	8	8	7	0	2	-1	12	6	5	5	5
Hyundai	-2	-4	-4	12	4	3	3	3	-2	-4	-4	10	2	1	1	0
Ineos	-16	-19	-23	-6	-9	-9	-9	-1	-16	-19	-23	-8	-11	-11	-12	-4
JLR	-7	-8	-10	5	-1	0	0	2	-7	-8	-10	3	-3	0	0	1
KIA	-4	-2	-2	13	0	0	0	0	-4	-2	-2	11	0	0	0	0
Mazda	-2	-5	-9	10	0	0	0	0	-2	-5	-9	8	0	0	0	0
Mercedes-Benz	-7	-10	-5	9	7	6	6	6	-7	-10	-5	8	5	4	4	4
Mitsubishi	-4	-4	-2	14	0	0	0	0	-4	-4	-2	12	0	0	0	0
Nissan	-4	-5	-8	9	0	0	4	4	-4	-5	-8	7	-2	-1	2	1
Stellantis	-6	-7	-10	7	1	3	3	3	-6	-7	-10	6	0	2	2	1
Subaru	-2	-6	-11	6	0	0	0	0	-2	-6	-11	4	0	0	0	0
Toyota	1	-1	-3	12	0	0	0	0	1	-1	-3	10	-1	0	-1	-1
Volvo	-1	0	-1	18	0	0	0	0	-1	0	-1	16	0	0	0	0
VWA	-5	-2	-4	13	2	2	2	2	-5	-2	-4	12	1	0	0	0
Industry Avg.	-3	-4	-6	10	3	3	3	4	-3	-4	-6	9	1	1	2	1

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Consistent with the above discussion, the tables show most manufacturers under-complying significantly in each fleet under the baseline standards. And manufacturers that seemingly comply with baseline standards do so at an extreme cost, as discussed in more detail below. Under the regulatory alternatives, different manufacturers would have difficulties complying depending upon fleet. While NHTSA proposes to amend the baseline standards to a lower level, several manufacturers fail to meet the standards in particular model years with their gasoline- and diesel-powered fleets. In somewhat of a reversal of historical trends, when the proposed fleet reclassification occurs in MY 2028, the manufacturers' fleets with projected achieved fuel economy values closest to the standards include Toyota's light truck fleet, which just complies with the proposed standards in Alternative 2 yet under-complies in Alternative 3. On the other hand, the GM, Ford, and Stellantis light truck fleets range from higher over-compliance to slight over-compliance between the three regulatory alternatives considered in this proposal.

NHTSA also considered with the MY 2028 reclassification proposal that manufacturers may comply with the new standards by changing product offerings or vehicle attributes, which NHTSA's analysis cannot capture. Manufacturers may choose to optimize their compliance pathway by making changes to the mix of vehicles they produce in several ways: instead of adding fuel economy-improving technology, a manufacturer could instead choose to change their product offerings to sell more vehicles that meet or exceed the new fuel economy targets while discontinuing other, less efficient vehicles. Alternatively, they may change a vehicle's attributes (*e.g.,* to meet off-road vehicle requirements) such that the vehicle would have a lower fuel economy target.

The CAFE Model does not simulate changes in product offerings or changes in particular vehicle attributes in response to CAFE standards because NHTSA does not intend for manufacturers to need to change those offerings or attributes to comply with standards. However, to the extent that NHTSA's standards may disincentivize the production of particular types of vehicles, NHTSA believes it is appropriate to consider this factor when considering economic practicability. Specifically, NHTSA believes that past CAFE standards may have disincentivized the production of passenger automobiles in favor of non-passenger automobiles.

EPCA's CAFE framework recognizes that certain automobiles inherently have features that make them less fuel efficient, such as high ground clearances for off-highway operation, 4WD, reinforced frames, suspensions, and axles for transporting heavy loads, or certain cargo-transporting body styles and configurations, as in cargo vans or pickup trucks. By separating the automobiles into two categories, CAFE standards aim to avoid penalizing automobiles with these non-passenger features, thus preserving consumer choice. However, because non-passenger automobiles and passenger automobiles are subject to different fuel economy standards, it is possible that NHTSA's standards could implicitly favor either the production of non-passenger automobiles or passenger automobiles, creating an incentive for manufacturers to change their vehicles' characteristics to reclassify them.[489] The incentive to reclassify a vehicle would exist if there were a mismatch between the amount a standard is lower for a non-passenger automobile, compared to a passenger automobile of the same footprint, and the additional fuel usage and costs associated with adding a particular qualifying non-passenger characteristic or feature to the automobile.

Available information indicates that past CAFE standards have caused a market distortion by disincentivizing the production of passenger automobiles relative to non-passenger automobiles.[490] As explained in more detail in Section VI, there has been a significant shift in the proportions of passenger and non-passenger automobiles in the light-duty fleet.

[489] In NHTSA's 2012 final rule setting standards for 2017–2025, NHTSA recognized that ''manufacturers may have an incentive to classify vehicles as light trucks if the fuel economy target for light trucks with a given footprint is less stringent than the target for passenger cars with the same footprint.'' (77 FR 62624, Oct. 15, 2012).

[490] As an example, when NHTSA properly reclassified over 1 million FWD automobiles as passenger automobiles in line with EPCA, manufacturers opted to discontinue the FWD variant of vehicle lines to keep more of their products in the non-passenger automobile fleets (74 FR 14196, Mar. 30, 2009).

Under NHTSA's proposed changes to vehicle classification, a significant portion of non-passenger automobiles would be reclassified as passenger automobiles. These proposed changes, if finalized, would realign the CAFE program with EPCA and ensure that vehicles are properly classified based upon their intended real-world usage. NHTSA believes that these changes, coupled with the proposed standards, also would remove much of the incentive for manufacturers to change vehicle attributes to allow a vehicle that primarily functions as a passenger automobile to be classified as a non-passenger automobile. Specifically, NHTSA believes the proposed CAFE standards reset, including a new curve fitting analysis to reshape the coefficient curves and the small, incremental increases proposed in this NPRM that increase the passenger automobile and non-passenger automobile standards at rates sustainable for each respective regulatory fleet, would further reduce any incentive to change vehicle attributes or offerings in response to CAFE standards. Such assessment also reflects the agency's longstanding position that revisiting the vehicle classification regulations likely would need to be accompanied by changes to the shapes of the footprint curves or the stringency of the standards to ensure the standards still reflect maximum feasibility for the adjusted fleets.[491]

[491] 90 FR 24518, 24524 (June 11, 2025) (citing 77 FR 62624, 63123).

While consumer preferences change over time, the CAFE program should not set standards that drive changes in market offerings, particularly if it drives changes that decrease market offerings that are more affordable to consumers. NHTSA tentatively concludes that the proposed standards would neither limit manufacturers' product offerings inconsistent with market demand, nor provide a reduction in attributes that consumers value.

Returning to the results of the analysis, at the individual manufacturer level, the No-Action Alternative imposes large annual technology cost increases on manufacturers but still leads to significant under-compliance with their gasoline- and diesel fueled fleets. Under each of the action alternatives, all manufacturers see a significant reduction in vehicle technology costs. Given fierce price competition in the automotive industry, NHTSA expects these cost reductions will be passed on to consumers. With a few outliers (*e.g.,* Ferrari and INEOS), Figure V–1 shows significant technology cost decreases for all manufacturers relative to the No-Action Alternative. These technology cost decreases would have significant ripple effects in the new vehicle market, including increasing sales and fleet turnover, as discussed in more detail below.

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Figure V-1: Per-Vehicle Technology Costs Relative to No-Action Alternative (2024$)

	No Action					Alt. 2 (relative to No Action)				
Model Year	27	28	29	30	31	27	28	29	30	31
BMW	1,573	1,718	1,801	1,800	1,844	-399	-475	-568	-583	-636
Ferrari	2,228	2,252	2,184	2,906	2,968	0	-1	-1	1	2
Ford	1,432	1,697	1,676	1,896	1,874	-491	-752	-741	-952	-942
GM	2,437	3,236	3,458	3,515	3,596	-76	-825	-1,083	-1,157	-1,240
Honda	858	1,175	1,422	1,433	1,420	-59	-423	-729	-777	-771
Hyundai	1,455	2,257	2,652	2,617	2,585	-465	-1,233	-1,642	-1,616	-1,594
Ineos	814	810	802	795	2,735	0	0	0	0	0
JLR	1,480	1,453	1,536	1,517	1,284	-150	-149	-625	-618	-1,010
KIA	1,787	2,374	2,770	2,733	2,715	-40	-644	-1,066	-1,048	-1,050
Mazda	1,374	1,354	1,882	1,861	2,078	-946	-938	-1,437	-1,424	-1,484
Mercedes-Benz	908	928	992	1,451	1,442	-137	-145	-273	-711	-734
Mitsubishi	1,410	1,391	1,372	1,399	1,380	0	0	0	-146	-144
Nissan	1,205	1,186	1,356	1,492	1,513	-236	-238	-484	-592	-628
Stellantis	1,636	2,161	2,502	2,477	2,447	-632	-1,097	-1,316	-1,305	-1,286
Subaru	887	1,254	1,327	1,305	1,285	-806	-1,218	-1,274	-1,256	-1,241
Toyota	972	1,030	1,164	1,327	1,392	-40	-95	-208	-343	-397
Volvo	1,332	1,446	1,434	1,419	1,396	-165	-276	-272	-267	-260
VWA	1,909	2,207	2,180	2,155	2,188	-460	-753	-741	-732	-774
Industry Avg.	1,471	1,825	2,006	2,078	2,104	-284	-630	-820	-896	-925

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One of the most important aspects of resetting CAFE standards is to reduce the up-front costs that consumers must pay for new vehicles due to CAFE standards. NHTSA assumes that technology costs due to increased or decreased CAFE standards are passed on to the consumer in the form of higher or lower new vehicle prices. For this proposed reset, all regulatory alternatives considered reduce the technology costs attributable to CAFE standards by half compared to the baseline. These technology cost reductions result in reducing the average price of a vehicle by more than $900 by MY 2031, which represents a significant up-front cost savings for consumers and results in significant cascading cost savings for insurance, registration, taxes, and finance charges. NHTSA believes that vehicle affordability is an important aspect to consider when setting CAFE standards under the economic practicability factor; while the agency attempts to quantify multiple aspects related to vehicle affordability in its analysis both quantitatively and qualitatively, NHTSA seeks comment on additional ways that affordability could be included in the agency's assessment of maximum feasible standards. Aside from the cascading benefits mentioned above, consumers also would receive a benefit from reset standards in the form of manufacturers' ability to improve vehicle attributes that they were not able to improve given the former overly aggressive imperative to improve vehicle fuel economy. That value is a tangible monetized benefit for each regulatory alternative compared to the baseline and is quantified as an opportunity cost in this analysis.

Consumers would see marginally higher fuel costs in all alternatives relative to the baseline, with a difference of approximately $200 between the lowest and highest stringency alternatives, spread out over the life of the vehicle. However, large up-front vehicle cost savings can make the purchase of a new vehicle affordable for more consumers in the nearer term, while higher fuel costs likely are realized over the decades-long life of the vehicle and depend on future fuel prices, which are uncertain. Manufacturers are also free to produce more fuel-efficient vehicles for those consumers who wish to purchase them. Accordingly, NHTSA seeks comment—as discussed in more detail in Section IV—on alternative presentations of the fuel savings that accrue to the different owners over a vehicle's life.

Another intended benefit of the proposed reset standards is that vehicle sales will increase as a result of lower vehicle prices, getting Americans into newer, safer, and less polluting vehicles more quickly. While the regulatory alternatives do not differ meaningfully in projected sales effects, they all increase vehicle sales relative to the baseline standards. NHTSA recognizes that there are several macroeconomic factors that influence vehicle purchasing decisions and that changes in vehicle prices are based on significantly more factors than the lowering or increasing of CAFE standards and a subsequent addition or re-evaluation of technology applications. Regardless, any standards set by the agency should not impede the ability of manufacturers and dealers to sell vehicles.

Table V-7: Industry-Wide Sales Effects (in thousands of vehicles)

Model Year	No-Action Alternative	Difference from No-Action		
		Alt. 1	Alt. 2	Alt. 3
2024	13,706	0	0	0
2025	13,360	0	0	0
2026	13,241	0	0	0
2027	13,115	16	16	15
2028	12,588	38	38	36
2029	12,393	47	47	44
2030	12,222	49	49	46
2031	11,816	47	47	45

NHTSA also estimates employment effects as a result of the different regulatory alternatives. The agency's model for estimating labor impacts in the parts supply space is fairly simplistic: any reduction in costs translates directly to an assumption of reduced labor hours into a metric called "person years." The agency's methodology does not account for a diversion of such labor into development or production of different technologies. Based on the agency's method for calculating labor effects, NHTSA's analysis shows a decrease in cumulative person years from less stringent standards relative to the baseline, in part because of the decreased need for development and application of additional fuel-economy-improving technology. However, as Table V–8 shows, the relative changes between the No-Action and Action Alternatives are less than 1 percent.

Table V-8: Industry-Wide Labor Utilization Effects (Percent Change in Person Years From No-Action)

Model Year	Alt. 1	Alt. 2	Alt. 3
2024	0.0	0.0	0.0
2025	0.0	0.0	0.0
2026	0.0	0.0	0.0
2027	-0.2	-0.2	-0.1
2028	-0.5	-0.5	-0.4
2029	-0.8	-0.8	-0.7
2030	-0.8	-0.8	-0.7
2031	-0.9	-0.9	-0.8

While NHTSA's quantitative estimates of changes in employment effects capture some factors related to how the automotive industry may respond to lower fuel economy standards, there are a number of potential employment impacts from lower fuel economy standards that have not been captured in the analysis. As an example, the analysis does not capture the effects of manufacturers' shifting vehicle and powertrain production to the United States in response to factors other than the agency's CAFE standards.[492] Given a range of potential industry responses, not only to new fuel economy standards, but also to the larger macroeconomic context, NHTSA cannot conclude that its estimates of changes in employment effects would lead it to changing its proposed determination on maximum feasible standards.

NHTSA also considers safety effects in determining maximum feasible CAFE standards, both because of its expertise as a safety agency and also as an element of economic practicability.[493]

[492] See The White House, TRUMP EFFECT: Mercedes to Shift More Vehicle Production to U.S., Last revised: May 1, 2025, available at: *https://www.whitehouse.gov/articles/2025/05/trump-effect-mercedes-to-shift-more-vehicle-production-to-u-s/* (accessed: Sept. 10, 2025); The White House, Fact Sheet: President Donald J. Trump Incentivizes Domestic Automobile Production, Last revised: Apr. 29, 2025, available at: *https://www.whitehouse.gov/fact-sheets/2025/04/fact-sheet-president-donald-j-trump-incentivizes-domestic-automobile-production/* (accessed: Sept. 10, 2025).

[493] *See* 88 FR 56256 (Aug. 17, 2023) ("As a safety agency, NHTSA has long considered the potential for adverse or positive safety consequences when establishing CAFE and fuel efficiency standards."). *See also Competitive Enterprise Institute* v. *NHTSA*, 901 F.2d 107, 120 n.11 (D.C. Cir. 1990) ("Petitioners

As the Nation's primary vehicle safety regulator, NHTSA, acting in accordance with EPCA, endeavors to avoid the adoption of fuel economy standards that are likely to result in a significant increase in roadway deaths and serious injuries. As new vehicle models become unaffordable or unappealing, many American families will be left driving older and older used cars, and the age of the Nation's auto fleet will persistently rise. Already, the average age of a car on the road in the United States is approaching 13 years, and many cars are on their fifth or sixth owners.[494] The aging of the American fleet has negative safety consequences, as NHTSA's studies show that older vehicles are much less safe than newer models in an accident.[495] In addition to examining the effects of its proposed standards on fleet turnover, NHTSA also examines the effects of the proposed standards on safety due to changes in vehicle-miles traveled (VMT) caused by the rebound effect and changes in mass disparities in the vehicle fleet, as discussed in more detail below.

Safety issues related to vehicle size and mass existed prior to the introduction of attribute-based CAFE standards. Manufacturers' responses to the early one-dimensional mpg-based standards included dramatic reductions in vehicle size and mass in a way that resulted in lighter vehicles that failed to protect occupants in crashes as effectively as larger, heavier vehicles. Under attribute-based standards, NHTSA's modern CAFE safety assessment has since evolved to include three elements: changes in vehicle mass, the impacts of vehicle prices on fleet turnover, and changes in exposure to risks associated with motor vehicle travel due to changes in VMT because of the standards, which are associated in this case primarily with changes due to the rebound effect. NHTSA examines how the proposed standards could impact fatalities, non-fatal injuries, and property damage from crashes for both vehicle occupants and non-occupants (*e.g.,* pedestrians and cyclists) for each of those elements.

Table V–9 and Table V–10 show the following trends relevant to inform NHTSA's standard-setting decision. First, effects from mass changes are expected to increase incrementally compared to the No-Action Alternative, as less MR is expected to be applied in the heaviest vehicles in response to lower standards, negating some of what would otherwise result in a lessening of mass disparity between the smallest and largest vehicles in the fleet. Appropriate caveats about the safety module's confidence with regards to projecting results are discussed in Draft TSD Chapter 7 and PRIA Chapter 8 and warrant discussion here as well. While the mass-safety parameters estimated from the statistical models used in the CAFE analysis are statistically indistinguishable from zero, the point estimates are in expected directions based on the agency's own safety studies and other outside studies, which helps support the agency's conclusions about the general levels of effects between the No-Action Alternative standards and the alternatives. In addition, to the extent vehicle manufacturers can adopt updated approaches to their product offerings better in line with market demand, once the proposed reclassification diminishes manufacturers' incentives to add features to place passenger-oriented vehicles in the light truck regulatory class (with its lower fuel economy standards), there may be additional lessening of the mass disparity between vehicles, and consequently the associated effects, in the light-duty fleet.

Next, NHTSA acknowledges that, as has been the case for the past several rulemakings, the magnitude of the rebound effect on vehicle safety dominates the overall safety picture across the three alternatives. For this rulemaking, the projected decrease in VMT under the reset standards leads to a significant projected decrease in fatalities, injuries, and property damage only (PDO) crashes.

Finally, regarding safety, NHTSA estimates an increase in safety effects in the action alternatives compared to the No-Action Alternative as newer, safer vehicles enter the fleet more quickly than they would have in the No-Action Alternative because of reduced vehicle prices. As vehicles become safer, many crashes that would otherwise result in death or injury do not result in such harms, leading to an increase in PDO crashes and the related sales/scrappage cost estimates but a decrease in the more severe types of crashes and an overall safety benefit for the proposal in terms of lives saved and injuries avoided.

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have never clearly identified the precise statutory basis on which safety concerns should be factored into the CAFE scheme, although they alluded to occupant safety as part of the 'economic practicability' criterion in their MY 1989 petition to NHTSA and at oral argument. We do not find this failure fatal, however, because NHTSA has always examined the safety consequences of the CAFE standards in its overall consideration of relevant factors since its earliest rulemaking under the CAFE program (citations omitted). Moreover, NHTSA itself believes that Congress was cognizant of safety issues when it enacted the CAFE program. As evidence, NHTSA discusses a congressional report that dealt with the safety consequences of a downsized fleet of cars which had been considered by Congress during its enactment of the CAFE program.'').

[494] S&P Global Mobility., Average Age of Light Vehicles in the U.S. Hits Record High 12.5 years, according to S&P Global Mobility, (2023), available at: *https://press.spglobal.com/2023-05-15-Average-Age-of-Light-Vehicles-in-the-US-Hits-Record-High-12-5-years,-according-to-S-P-Global-Mobility* (accessed: Sept. 10, 2025).

[495] See NHTSA, Learn the Facts about New Cars: Why newer cars are safer than ever before, available at: *https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/newer-cars-safer-cars_fact-sheet_010320-tag.pdf* (accessed: Sept. 10, 2025).

Table V-9: Change in Safety Costs from the No-Action Alternative, CYs 2024-2050, 3% Discount Rate

	Alt 1	Alt 2	Alt 3
Fatality Costs ($b)			
Fatality Costs From Mass Changes	0.2	0.2	0.2
Fatality Costs From Rebound Effect Driving	-12.8	-12.8	-11.4
Fatality Costs From Sales/Scrappage	-0.7	-0.7	-0.7
Total - Fatality Costs	-13.4	-13.4	-11.9
Non-Fatal Crash Costs ($b)			
Non-Fatal Crash Costs From Mass Changes	0.8	0.8	0.6
Non-Fatal Crash Costs From Rebound Effect Driving	-49.5	-49.5	-43.8
Non-Fatal Crash Costs From Sales/Scrappage	-1.6	-1.6	-1.6
Total - Non-Fatal Crash Costs	-50.3	-50.3	-44.8
Property Damage Costs ($b)			
Property Damage Costs From Mass Changes	0.1	0.1	0.1
Property Damage Costs From Rebound Effect Driving	-4.9	-4.9	-4.3
Property Damage Costs From Sales/Scrappage	0.2	0.4	0.4
Total - Property Damage Costs	-4.7	-4.7	-4.7
Societal Crash Costs ($b)			
Crash Costs From Mass Changes	1.1	1.1	0.8
Crash Costs From Rebound Effect Driving	-67.2	-67.2	-59.5
Crash Costs From Sales/Scrappage	-2.2	-2.0	-1.9
Total - Societal Crash Costs	-68.4	-68.4	-61.4

Table V-10: Change in Safety Effects from the No-Action Alternative for CYs 2024-2050

	Alt 1	Alt 2	Alt 3
Fatalities			
Fatalities From Mass Changes	27	27	20
Fatalities From Rebound Effect Driving	-1,528	-1,528	-1,354
Fatalities From Sales/Scrappage	-66	-66	-64
Total - Fatalities	-1,568	-1,567	-1,398
Non-Fatal Injuries			
Non-Fatal Injuries From Mass Changes	4,264	4,264	3,221
Non-Fatal Injuries From Rebound Effect Driving	-245,022	-244,963	-217,158
Non-Fatal Injuries From Sales/Scrappage	-5,709	-5,709	-5,564
Total - Non-Fatal Injuries	-246,467	-246,408	-219,501
Property Damage Crashes			
Property Damage Crashes From Mass Changes	13,629	13,629	10,379
Property Damage Crashes From Rebound Effect Driving	-835,103	-834,915	-740,855
Property Damage Crashes From Sales/Scrappage	26,991	26,989	25,437
Total - Property Damage Crashes	-794,482	-794,297	-705,039

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To conclude, NHTSA's safety analysis reinforces that the reset standards (and all regulatory alternatives considered) would improve safety outcomes relative to the No-Action Alternative. While the magnitude of positive benefits may be small in terms of measurability with NHTSA's current modeling capabilities, the directionality is consistent with what NHTSA's research shows: getting Americans into newer, safer vehicles is beneficial for safety.[496]

c. The Need of the United States To Conserve Energy

In the past decade, the consumer costs (via fuel prices), national balance of payments, and foreign policy implications of the need for large quantities of petroleum in the United States, especially imported petroleum, have shaped the consideration of this factor in ways that Congress could not have foreseen in the 1970s when EPCA was originally passed. As NHTSA acknowledged in the 2020 final rule, there are two approaches to increasing petroleum independence: the first is simply to use less petroleum, and the second is for the United States to produce more of its own petroleum and to use less petroleum purchased from abroad. The United States has recently excelled at the second approach; our Nation became a net exporter of petroleum on an annual basis in 2020 (and on a monthly basis for the first time in September 2019) for the first time since at least 1949 and continued to export more petroleum than it imported in 2021, 2022, and 2023.[497] In fact, the United States currently produces the most oil (particularly shale oil) of any country.[498] The sources of imports to the U.S. have also changed significantly since EPCA's passage; whereas OPEC nations were the source of 70 percent of U.S. total petroleum imports in 1977, Canada now represents the largest source at 52 percent of gross total petroleum imports, and imports from OPEC nations represent only 16 percent.[499] This shift helps insulate the U.S. from supply shocks attributable to imports from the most volatile regions. A concurrent change in global oil market dynamics has helped steady the fuel prices that consumers experience in the wake of potential impacts to supply from foreign oil-producing countries: the oil market is simply less reactive to global events.[500] Isolated subnational events, like the 2021 Colonial Pipeline ransomware attack, still have the potential to cause short-term price spikes in specific areas of the country,[501] but that national-level gasoline prices have held steady and have even modestly decreased through

[496] NHTSA, How Vehicle Safety Has Improved Over the Decades, available at: *https://www.nhtsa.gov/how-vehicle-safety-has-improved-over-decades* (accessed: Sept. 10, 2025); NHTSA, Learn the Facts About New Cars: Why newer cars are safer than ever before, available at: *https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/newer-cars-safer-cars_fact-sheet_010320-tag.pdf* (accessed: Sept. 10, 2025); NHTSA, Learn the Facts About New Cars: Why newer cars are safer than ever before, Version 2, available at: *https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/newer-cars-safer-cars_infographic_010320_2-tag.pdf* (accessed: Sept. 10, 2025).

[497] EIA, Oil and Petroleum Products Explained, Last revised: Jan. 19, 2024, available at: *https://www.eia.gov/energyexplained/oil-and-petroleum-products/imports-and-exports.php* (accessed: Sept. 10, 2025); EIA, Frequently Asked Questions (FAQs): How Much Petroleum Does the United States Import and Export?, Last revised: Mar. 29, 2024, available at *https://www.eia.gov/tools/faqs/faq.php?id=727&t=6* (accessed: Sept. 10, 2025).

[498] EIA, Today in Energy: United States Produces More Crude Oil Than Any Country, Ever, Last revised: Mar. 11, 2024, available at: *https://www.eia.gov/todayinenergy/detail.php?id=61545#* (accessed: Sept. 10, 2025).

[499] *Id.*

[500] See, *e.g.,* Domonoske, C., Why a War in the Middle East Hasn't Sparked an Oil Crisis, Last revised: June 25, 2025, available at: *https://www.npr.org/2025/06/25/nx-s1-5444030/oil-prices-iran-israel* (accessed: Sept. 10, 2025).

[501] Thorbecke, C., Gas Hits Highest Price in 6 years, Fuel Outages Persist Despite Colonial Pipeline Restart, Last revised: May 17, 2021, available at: *https://abcnews.go.com/US/gas-hits-highest-price-years-fuel-outages-persist/story?id=77735010* (accessed: Sept. 10, 2025) (gas prices in Southern states jumped 18–21 cents, while the national average rose eight cents).

major global events evidences at least some decoupling of fuel prices and the concerns that led to EPCA's passage in 1975.

NHTSA's quantitative analysis of energy security benefits estimates that the level of standards the agency is proposing as maximum feasible to change the costs of petroleum market externalities only modestly relative to the No-Action Alternative. Specifically, the largest incremental change in energy security externalities is approximately 1.3 percent of the total petroleum market externality costs in the No-Action Alternative.

At the same time, even though fuel economy standards have increased dramatically over the past 15 years, fuel use has not decreased appreciably. Since the agency began setting fuel economy standards in the early 2010s that increased at significant rates, motor gasoline consumption in the United States has hovered in the realm of the upper 8 million to low 9 million barrels per day (with a brief decrease in 2020 to just 8 million barrels per day).[502] There are a number of reasons why fuel consumption may hold steady as vehicle fuel economy increases (*e.g.,* vehicle-miles traveled have increased substantially in response to the economy or the rebound effect), but the fact that even significantly increased vehicle fuel economy standards have not decreased fuel consumption at measurable levels in the real world should be considered by NHTSA in how heavily it weighs the need of the United States to conserve energy relative to other factors. This is particularly true given the diminishing effects attributable to fuel economy improvements: as fuel economy standards increase in stringency, the benefit of continuing to increase stringency decreases. In mpg terms, a vehicle owner who drives a light vehicle 15,000 miles per year (a typical assumption for analytical purposes) and trades in a vehicle with fuel economy of 15 mpg for one with fuel economy of 20 mpg, will reduce their annual fuel consumption from 1,000 gallons to 750 gallons—saving 250 gallons annually. If, however, that owner trades in a vehicle with fuel economy of 30 mpg for one with fuel economy of 40 mpg, then the owner's annual gasoline consumption would drop from 500 gallons/year to 375 gallons/year—a fuel savings of only 125 gallons even though the mpg improvement is twice as large. Going from 40 to 50 mpg would save only 75 gallons/year. Yet each additional fuel economy improvement becomes much more expensive as the easiest to achieve low-cost technological improvement options are exhausted. While fuel economy standards may support energy conservation, the agency must moderate its consideration of those impacts in setting maximum feasible standards, based on real-world effects, with the other three statutory factors.

Whether CAFE standards remain the most effective way to accomplish the goal of using less gasoline in the light-duty motor vehicle fleet to increase energy security is a decision for Congress, but for now, EPCA's directive to NHTSA is to set CAFE standards in each model year, and that is what the agency will continue to do. Within this framework, however, accounting for particular realities—specifically that oil consumption in the United States has remained steady or increased even in the face of significantly increased fuel economy standards while the country has simultaneously become a net petroleum exporter and the world's largest oil producer—leads the agency to conclude tentatively that the weight of these three facets of the need of the United States to conserve energy do not lead the agency to consider higher CAFE standards as maximum feasible.

Regarding environmental concerns, another factor historically considered as part of the need of the United States to conserve energy, the proposed reset standards decrease vehicle costs compared to the baseline, which results in incrementally more vehicle sales, particularly of vehicles that are modestly less fuel efficient compared to vehicles under the baseline standards. This would result in a modest increase in fuel consumption but also results in less driving demand than the baseline because the total cost-per-mile of driving is higher. The net result of these countervailing factors—increased vehicle sales of less fuel-efficient vehicles but subsequently fewer miles driven in those vehicles due to decreased rebound driving—is more fuel consumed from vehicles regulated under the proposed reset standards compared to the baseline standards. Emissions of various pollutants would increase relative to the No-Action Alternative as a result of both increased upstream emissions from the various fuel production processes and increased downstream emissions from fuel combustion as vehicles are driven commensurate with the fuel consumption increases. However, in the context of total emissions compared to the baseline, the incremental increases would be marginal. In addition, non-criteria emissions (NCEs) in all three action alternatives decrease over time, as newer vehicles enter the fleet. Criteria pollutant emissions similarly increase relative to the No-Action Alternative, but all three action alternatives result in decreased criteria pollutant emissions over time. PRIA Chapter 8 provides additional detail on the changes in emissions and, for criteria emissions specifically, associated calculated health outcomes. NHTSA's NEPA analysis similarly shows only marginal differences between the baseline and alternatives considered in this proposal. The results of that analysis are summarized below and in the Draft SEIS.

NHTSA does not believe that the magnitude of fuel consumption and emission increases over the baseline would lead the agency to conclude that standards set at higher levels than the agency analyzed are maximum feasible. The fact that the agency's proposed reset standards are so significantly different than the baseline standards and yet result in only marginal increases in fuel consumption as shown in Table V–11 (and associated emissions metrics, as shown in PRIA Chapter 8 and the Draft SEIS) confirms NHTSA's tentative conclusion that the environmental elements of the need of the Nation to conserve energy do not weigh heavily enough against the countervailing factors of technological feasibility and economic practicability to merit the adoption of more stringent standards. The following table shows the difference between the baseline and alternatives for changes in fuel consumption for the gasoline- and diesel-powered vehicle fleet; emissions outcomes are generally commensurate with these levels and are discussed further in PRIA Chapter 8 and the Draft SEIS.

[502] EIA, Petroleum & Other Liquids: U.S. Product Supplied of Finished Motor Gasoline, Last revised: Aug. 29, 2025, available at: *https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MGFUPUS2&f=A* (accessed: Sept. 10, 2025).

Table V-11: Fuel Consumption Levels and Changes From Baseline for Selected Calendar Years

	2027	2028	2029	2030	2031	2040	2050
Total Consumption (b. gal)							
No Action	125.7	121.5	117.4	113.4	109.4	83.9	72.1
Alt. 1	125.8	122.0	118.4	114.8	111.3	89.0	77.8
Alt. 2	125.8	122.0	118.4	114.8	111.3	89.0	77.8
Alt. 3	125.8	121.9	118.2	114.6	111.0	88.4	77.2
Change from No Action (b. gal)							
Alt. 1	0.2	0.5	0.9	1.4	1.9	5.1	5.7
Alt. 2	0.2	0.5	0.9	1.4	1.9	5.1	5.7
Alt. 3	0.2	0.4	0.8	1.2	1.6	4.5	5.1
Change from No Action (%)							
Alt. 1	0%	0%	1%	1%	2%	6%	8%
Alt. 2	0%	0%	1%	1%	2%	6%	8%
Alt. 3	0%	0%	1%	1%	1%	5%	7%

Regardless of the level of standards that NHTSA tentatively concludes is maximum feasible in this proposal, light-duty vehicle fuel consumption is still forecast to decline substantially in the long run as shown above in Table V–11, both as a result of NHTSA's standards and fleet turnover. The environmental effects related to fuel consumption, both because of NHTSA's standards and other light-duty transportation trends, will decrease proportionally based on effect or pollutant. NHTSA has accordingly determined that, at the time of this proposed rule, the need of the United States to conserve energy weighs in favor of fuel economy standards' acting as an insurance policy against risk, with standards that increase at steady, incremental, manageable rates for the light-duty gasoline- and diesel-powered fleets following their reset to align more closely with EPCA.

In sum, NHTSA has tentatively determined that a proper consideration of ''the need of the United States to conserve energy'' should result in fuel economy standards that become *less stringent* as America continues to tap into its proven oil reserves because the Nation's exposure to oil shocks is inherently diminished. This is especially true as the remaining petroleum imported into the U.S. has shifted dramatically away from volatile OPEC nations and toward Mexico and Canada since the passage of EPCA, and even EISA. The U.S. currently possesses a superabundance of domestic energy resources, especially petroleum and natural gas. Following the shale-oil boom, America has attained energy independence and does not have the same need to conserve liquid-fuel energy resources that it had in the wake of the Arab oil embargoes of the 1970s. United States energy independence was unthinkable when EPCA was enacted. Accordingly, NHTSA believes that it is both reasonable and congruent with EPCA's energy conservation goals to weigh the need of the United States to conserve energy such that vehicle fuel economy standards require continuous improvements over time, but at sustainable levels for manufacturers, consumers, and society at large.

Finally, as discussed above, NHTSA considers estimated net benefits as relevant to determining maximum feasible CAFE standards. The agency's analysis shows that all three regulatory alternatives would result in positive net benefits at both 3 percent and 7 percent discount rates, with the Preferred Alternative, Alternative 2, resulting in $24.0 billion in estimated net benefits using a 3-percent discount rate and $22.2 billion in net benefits using a 7-percent discount rate.[503] While the difference in net benefits between regulatory alternatives is small, NHTSA believes that the yearly stringency increases represented by the Alternative 2 standards best comport with the technological and economic capabilities of the gasoline- and diesel-powered vehicle fleets while still resulting in small, steady incremental increases in fleet fuel economy and positive benefits for society.

Balancing all factors and issues identified above, NHTSA is proposing to increase fuel economy standards from the newly proposed MY 2022 standards at a rate of 0.5 percent per year through MY 2026 followed by 0.25 percent per year through the remainder of the 10 model years covered by this proposal. NHTSA's preliminary conclusion is that this decision to increase the stringency of the standards at annual rates achievable by gasoline- and diesel-powered vehicles, coupled with a re-examination of the shape of the fuel economy target functions and the vehicle classification definitions, best comports with the substantive textual requirements of EPCA. Moreover, the level, shape, and applicability of the standards to the passenger and non-passenger automobile fleets, as reclassified under this proposal, is justified by the extraordinary distortions the existing regulations have caused in the marketplace. Imposing such market distortions is inconsistent with a proper application of EPCA and results only in unnecessary regulatory burden without insulating the United States from major disruptions in the global oil market. Consistent with the discussion above, NHTSA believes that small, steady, incremental increases in fuel economy standards over time, while preserving the ability of manufacturers to focus on

[503] As is discussed in Chapter 8 of the PRIA, NHTSA estimates the benefits and costs of the regulatory alternatives under consideration from both model year and calendar year perspectives. The estimates shown here are for the model year approach.

safety, affordability, and consumer choice, are reasonable and appropriate, and appropriately balance EPCA's priorities, including energy conservation goals.

3. Draft Supplemental Environmental Impact Statement Analysis Results

NHTSA described above that the agency's NEPA-related obligation is to ''take a 'hard look' at the environmental consequences'' of an action, as appropriate.[504] Significantly, ''[i]f the adverse environmental [impacts] of the proposed action are adequately identified and evaluated, the agency is not constrained by NEPA from deciding that other values outweigh the environmental costs.'' [505] NHTSA considers the impacts reported in the Draft SEIS, in addition to the other information presented in this preamble, the Draft TSD, and the PRIA, as part of its decision-making process.

Per DOT Order 5610.1D, NHTSA considers a ''no action'' alternative in its NEPA analyses and presents the environmental impacts of the proposal and alternatives, including the No-Action Alternative, in comparative form.[506] The range of CAFE standard action alternatives, including the No-Action Alternative, encompasses a spectrum of possible fuel economy standards that NHTSA could determine is the maximum feasible based on the different ways NHTSA could weigh the applicable statutory factors. The agency's Draft SEIS describes the reasonably foreseeable impacts for all alternatives across a variety of environmental resources, including energy, air quality, emissions effects, and historic and cultural resources. The impacts of the Proposed Action are discussed in proportion to their significance, qualitatively and quantitatively, as applicable.[507] The findings of the analysis are summarized here, and more detailed discussion—in particular for any qualitative resource assessment—can be found in the Draft SEIS.

Reasonably foreseeable energy impacts from the Proposed Action include changes in vehicle fuel consumption. All three action alternatives would increase fuel consumption compared to the No-Action Alternative,[508] with fuel consumption increases that range from 71 billion gasoline gallon equivalents (GGE) under Alternative 3 to 77 billion GGE under Alternative 1 and Alternative 2 (the Preferred Alternative).

The relationship between CAFE standards and criteria pollutant and air toxics emissions is less straightforward than the relationship between CAFE standards and energy use, because the criteria pollutant and air toxics relationship reflects the complex interactions among many factors. In general, emissions of criteria air pollutants decrease with increasing stringency. However, the analysis shows that the action alternatives would result in different levels of emissions when measured against projected trends under the No-Action Alternative. These reductions and increases in emissions would vary by pollutant, calendar year, and action alternative. The differences in national emissions of criteria air pollutants among the action alternatives compared to the No-Action Alternative would range from less than 1 percent to about 4 percent. Adverse health outcomes from criteria pollutant emissions are expected to increase nationwide in 2035 and 2050 under all action alternatives relative to the No-Action Alternative. This is due primarily to increases in downstream emissions, particularly of $PM_{2.5}$. The increases in health effects would stay the same or get smaller from Alternatives 1 and 2 to Alternative 3 in 2035 and 2050, reflecting the generally greater stringency of Alternative 3. However, emissions still decrease over time with each action alternative.

Toxic air pollutant emissions would remain the same or increase in 2035 and 2050 for all action alternatives relative to the No-Action Alternative. The increases stay the same or get larger from Alternatives 1 and 2 to Alternative 3 for acetaldehyde (in 2050), acrolein (in 2035 and 2050), 1,3-butadiene (in 2035 and 2050), and formaldehyde (in 2050), but get smaller for acetaldehyde (in 2035), benzene (in 2035 and 2050), DPM (in 2035 and 2050), and formaldehyde (in 2035). The largest relative increases in emissions generally would occur for formaldehyde for which emissions would increase by as much as 3.8 percent under Alternatives 1 and 2 in 2050 compared to the No-Action Alternative. Percentage increases in emissions of acetaldehyde, acrolein, 1,3-butadiene, benzene, and DPM would be less. The smaller increases are not expected to lead to measurable changes in concentrations of toxic air pollutants in the ambient air. For such small changes, the impacts of those action alternatives would be essentially equivalent. The larger increases in emissions could lead to changes in ambient pollutant concentrations.

Overall changes in health effects due to air pollution are expected to be consistent with any resulting emissions trends. Higher emissions would be expected to lead to an overall increase in adverse health effects while lower emissions would be expected to lead to a decrease in adverse health effects. The changes in health effects due to changes in emissions also are dependent on geographic population distribution, meteorological and topographical conditions, and people's proximity to roadways and upstream facilities.

The Proposed Action and alternatives would result in slight increases in CO_2 concentrations, surface temperature, sea level, and precipitation, and a slight decrease in ocean pH compared to the No-Action Alternative, based on projections using a reduced-complexity climate model. They also could, to a small degree, increase the impacts and risks of climate trends. Uncertainty exists regarding the magnitude of impact on these climate variables, as well as to the impacts and risks of climate trends. The impacts of the Proposed Action and alternatives on global mean surface temperature, precipitation, sea level, and ocean acidification would be small in relation to global emissions trajectories. This is because of the global and multi-sectoral nature of climate trends. These impacts also would occur on a global scale and would not affect the United States disproportionately. To put these emissions changes in perspective, the emissions increase from all passenger cars and light trucks in 2035 compared with emissions under the No-Action Alternative are approximately equivalent to the annual emissions from 7,727,819 vehicles under Alternatives 1 and 2, and 7,143,671 vehicles under Alternative 3. For reference, a total of 252,733,312 passenger cars and light trucks are projected to be on the road in 2035 under the No-Action Alternative.[509]

In cases where quantitative impacts assessment was not possible, NHTSA presented the findings of a literature review of scientific studies for

[504] *Baltimore Gas & Elec. Co.* v. *Natural Resources Defense Council, Inc.,* 462 U.S. 87, 97 (1983).

[505] *Robertson* v. *Methow Valley Citizens Council,* 490 U.S. 332, 350 (1989).

[506] DOT Order 5610.1D, sec. 13.e.

[507] Section 13.g(2) of DOT Order 5610.1D.

[508] Total light-duty vehicle fuel consumption from 2024 to 2050 under the No-Action Alternative is projected to be 2,867 billion gasoline gallon equivalents (GGE).

[509] The light-duty vehicle equivalency is based on an average per-vehicle emissions estimate, which includes both tailpipe CO_2 emissions and associated upstream emissions from fuel production and distribution. The average light-duty vehicle is projected to account for 4.66 metric tons of CO_2 emissions in 2035 based on MOVES, the GREET model, and EPA analysis.

informational purposes in the Draft SEIS.

The SEIS is one factor in NHTSA's decision-making process to set CAFE standards. NHTSA evaluated the range of reasonable alternatives in the Draft SEIS, along with other factors during the rulemaking process and tentatively determined that Alternative 2 is the Preferred Alternative because it is maximum feasible. NHTSA is informed by the Draft SEIS in arriving at its conclusion that Alternative 2 is maximum feasible.

D. Severability

For the reasons discussed above, NHTSA believes that its authority to propose and implement CAFE standards for the MYs 2022–2026 and 2027–2031 is well-supported in law and practice and should be upheld in any legal challenge. NHTSA also believes that its exercise of authority reflects sound policy.

However, in the event that any portion of the proposed rule is declared invalid, NHTSA intends that the various aspects of the proposal be severable and, specifically, that each set of proposed standards, for MYs 2022–2026 and MYs 2027–2031, is severable, as well as the various compliance proposals discussed in the following section of this preamble. The proposed standards for MYs 2027–2031 could be implemented independently if any of the other proposed standards were struck down, and NHTSA firmly believes that it would be in the best interests of the Nation for the standards to be applicable to support EPCA's overarching purpose of energy conservation. Each proposed standard is justified independently on both legal and policy grounds and could be implemented effectively by NHTSA.

VI. Compliance and Enforcement

NHTSA is proposing changes to its CAFE enforcement program for light-duty automobiles. These changes include: (1) modifying the criteria for classification as a non-passenger automobile; (2) removing credit trading from the CAFE program beginning with MY 2028; (3) removing references to EPA's regulations regarding manufacturers' ability to generate AC efficiency and OC FCIVs; (4) modifying manufacturer reporting requirements; and (5) making other technical amendments. To provide context for these changes, Section VI.A first provides an overview of NHTSA's CAFE enforcement program. Section VI.B then discusses and explains the proposed changes to the CAFE program.

A. Background and Overview of Compliance and Enforcement

NHTSA's CAFE enforcement program is largely established by EPCA, as amended by EISA, and is prescriptive regarding enforcement. EPCA and EISA also establish a number of flexibilities and incentives that are available to manufacturers to help them comply with the CAFE standards. The statute also authorizes NHTSA to establish, at its discretion, additional flexibilities by regulation. The light-duty CAFE program includes all vehicles with a gross vehicle weight rating (GVWR) of 8,500 pounds or less as well as vehicles between 8,501 and 10,000 pounds that are classified as medium-duty passenger vehicles (MDPVs).[510] [511] Table VI–1 provides an overview of the CAFE program, including statutory and regulatory citations, and an overview of the changes proposed in this NPRM.

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[510] As prescribed in 49 U.S.C. 32901(a)(19)(B), an MDPV is ''defined in section 86.1803–01 of title 40, Code of Federal Regulations, as in effect on the date of the enactment of the Ten-in-Ten Fuel Economy Act.'' In accordance with the statutory definition, NHTSA defines MDPV at 49 CFR 523.2 as any complete or incomplete motor vehicle rated at more than 8,500 pounds GVWR and less than GVWR that is designed primarily to transport passengers, but does not include a vehicle that: (1) Is an ''incomplete truck'' meaning any truck that does not have the primary load carrying device or container attached; or (2) Has a seating capacity of more than 12 persons; or (3) Is designed for more than 9 persons in seating rearward of the driver's seat; or (4) Is equipped with an open cargo area (for example, a pickup truck box or bed) of 72.0 inches in interior length or more. A covered box not readily accessible from the passenger compartment will be considered an open cargo area for purposes of this definition.

[511] See ''heavy-duty vehicle'' definition in 40 CFR 86.1803–01. MDPVs are classified as either passenger automobiles or light trucks depending on whether they meet the criteria to be a non-passenger automobile under 49 CFR 523.5. If the MDPV is classified as a non-passenger automobile by meeting the requirements in 49 CFR 523.5, it is subject to the requirements in 49 CFR 533. If the MDPV does not meet the criteria in 49 CFR 523.5 to be a non-passenger automobile, then it is classified as a passenger automobile and subject to the requirements in 49 CFR 531.

Table VI-1: Overview of Compliance for the CAFE Program

Fleet Performance Requirements			
Component	**Applicable Regulation (Statutory Authority)**	**General Description**	**Proposed Changes in NPRM**
Fuel Economy Standards	49 CFR 531.5 and 49 CFR 533.5 (49 U.S.C. 32902)	Fuel economy standards are footprint-based fleet average standards for each of a manufacturer's compliance category (i.e., domestic passenger automobile, import passenger automobile, and non-passenger automobile), which are expressed in miles per gallon (mpg). NHTSA sets average fuel economy standards that are the maximum feasible for each compliance category and model year (i.e., passenger automobiles and non-passenger automobiles). In setting these standards, NHTSA considers technological feasibility, economic practicability, the effect of other motor vehicle standards of the Government on fuel economy, and the need of the U.S. to conserve energy. NHTSA is precluded from considering the fuel economy of vehicles that operate only on alternative fuels, the portion of operation of a dual-fueled vehicle powered by alternative fuel, and the trading, transferring, or availability of credits.	Amendments to 49 CFR 531.5(a) and 49 CFR 533.5(a) to set standards for MYs 2022-2026 and MYs 2027-2031.
Vehicle Classification	49 CFR part 523	Standards are set for two regulatory categories (i.e., passenger automobiles and non-passenger automobiles). Vehicles are assigned to either the passenger automobile or non-passenger automobile categories based on definitions in EPCA, as implemented through definitions and specific criteria in NHTSA's regulations.	Amendments to 49 CFR part 523 to amend the criteria for non-passenger automobiles.
Minimum Domestic Passenger Car Standards	49 CFR 531.5 (49 U.S.C. 32902(b)(4))	Domestic passenger automobile fleets are required to meet the MDPCS. This standard applies in addition to the footprint-based standard.	Amendments to 49 CFR 531.5(b) to set MDPCS for MYs 2022-2026 and MYs 2027-2031.
Determining Average Fleet Performance			
Component	**Applicable Regulation (Statutory Authority)**	**General Description**	**Proposed Changes in NPRM**
2-Cycle Testing	49 CFR 531.6(a) citing 40 CFR part 600 and 49 CFR 533.6 citing 40 CFR part 600	Vehicle testing is conducted by EPA using the Federal Test Procedure (light-duty FTP or "city" test) and Highway Fuel Economy Test (HFET or "highway" test).	None

	(49 U.S.C. 32904)		
AC Efficiency FCIVs	49 CFR 531.6(b)(1) citing 40 CFR 86.1868-12 and 49 CFR 533.6(c)(1) citing 40 CFR 86.1868-12 (49 U.S.C. 32904)	This adjustment to the results of the 2-cycle testing for fuel consumption improvement from technologies that improve AC efficiency that are not accounted for in the 2-cycle testing. The AC efficiency FCIV program began in MY 2017 for NHTSA. Starting in MY 2027, AC efficiency FCIVs may only be generated by ICE vehicles.	Amendments to 49 CFR 531.6 and 533.6 to remove references to EPA's regulations for AC efficiency FCIVs.
OC FCIVs	49 CFR 531.6(b)(2) and (3) citing 40 CFR 86.1869-12 and 49 CFR 533.6(c)(3) and (4) citing 40 CFR 86.1869-12 (49 U.S.C. 32904)	This adjustment to the results of the 2-cycle testing for fuel consumption improvement from technologies that are not accounted for or not fully accounted for in the 2-cycle testing. The OC FCIV program began in MY 2017 for NHTSA. Starting in MY 2027, OC FCIVs may only be generated by ICE vehicles, with the program phasing out and ending with MY 2032 under EPA's current regulations.	Amendments to 49 CFR 531.6 and 533.6 to remove references to EPA's regulations for OC FCIVs.
Advanced Full-Size Pickup Truck FCIVs	49 CFR 533.6(c)(2) citing 40 CFR 86.1870-12 (49 U.S.C. 32904)	This adjustment increases a manufacturer's average fuel economy for full-size pickup trucks equipped with hybridized or other performance-based technologies. Manufacturers were eligible to earn these adjustments in MYs 2017-2021 and MYs 2023-2024.	None
Dedicated Alternative-Fueled Vehicles	49 CFR 536.10 citing 40 CFR 600.510-12(c) (49 U.S.C. 32905(a) and (c))	EPA calculates the fuel economy of dedicated alternative fueled vehicles assuming that a gallon of liquid/gaseous alternative fuel is equivalent to 0.15 gallons of gasoline per 49 U.S.C. 32905(a). For BEVs, EPA uses the petroleum equivalency factor as defined by the DOE (*see* 10 CFR 474.3) (per 49 U.S.C. 32904(a)(2)).	None
Dual-Fueled Vehicles	49 CFR 536.10 citing 40 CFR 600.510-12(c) (49 U.S.C. 32905(b), (d), and (c)) and (49 U.S.C. 32906(a))	EPA calculates the fuel economy of dual-fueled vehicles using a utility factor to account for the portion of power energy consumption from the different energy sources. For EVs, EPA uses DOE's petroleum equivalency factor for the electric portion of the vehicle's expected energy use (per 49 U.S.C. 32904(a)(2)). Starting in MY 2020 and subject to statutory limit, the average fuel economy of certain dual-fueled vehicles cannot increase a manufacturer's average fuel economy.	None
Earning and Using Credits for Over-compliance and Addressing Shortfalls			
Earning Credits	49 CFR 536.4 (49 U.S.C. 32903(a))	Manufacturers earn credits for each one tenth of mile by which the average fuel economy vehicles in a particular compliance category in a model year exceed the applicable fuel economy standard, multiplied by the number of vehicles sold in that compliance category (i.e., fleet).	None
Carry-Forward Credits	49 CFR part 536 (49 U.S.C. 32903(a)(2))	Manufacturers may carry forward credits up to five model years into the future.	None

Carry-Back Credits	49 CFR part 536 (49 U.S.C. 32903(a)(1))	Manufacturers may carry back credits up to three model years into the past.	None
Credit Transfers	49 CFR part 536 (49 U.S.C. 32903(g))	Manufacturers may transfer credits between their fleets to increase a fleet's average fuel economy by up to 2 mpg. Manufacturers may not use transferred credits to meet the MDPCS (*see* 49 U.S.C. 32903(g)(4) and 49 CFR 536.9).	None
Credit Trading	49 CFR 536.8 (49 U.S.C. 32903(f))	Manufacturers may trade over-compliance credits into fleets of the same compliance category. A manufacturer may then transfer those credits to a different compliance category, but only up to the 2-mpg limit for transfers. Manufacturers may not use traded credits to meet the (*see* 49 U.S.C. 32903(f)(2) and 49 CFR 536.9).	Amendments to 49 CFR 536.6 and 536.8 to reflect that beginning in MY 2028 credit trading will no longer be allowed.
Civil Penalties	49 CFR 578.6(h) (49 U.S.C. 32912)	Civil penalties may be assessed for CAFE credit shortfalls that are not resolved through credit flexibilities. Pub. L. 119-21 set civil penalties for the CAFE program to $0. This new value applies starting in MY 2022.	None[512]

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In general, as prescribed by Congress, NHTSA sets fleet average fuel economy standards for light-duty vehicles on an mpg basis. As specified in statute, light-duty vehicles are separated into three separate compliance categories: passenger automobiles manufactured domestically (referred to as domestic passenger cars), passenger automobiles not manufactured domestically (referred to as imported passenger cars), and non-passenger automobiles (which are also referred to as light trucks).[513] Each standard applies to a manufacturer's compliance category as a whole and not to individual vehicles, and a manufacturer can balance the performance of their vehicles (via the application of fuel-saving technology) in complying with standards. NHTSA sets standards based on vehicle footprint (*i.e.,* the area calculated by multiplying the wheelbase times the track width), and each manufacturer must comply with the fleet average standard derived from their vehicles' target standards. These target standards are taken from a set of mathematical functions for each fleet. While NHTSA sets the standards for light-duty vehicles, EPA, as authorized and directed by EPCA, establishes procedures for calculating a manufacturer's average fuel economy for CAFE compliance. Average fuel economy values are based on vehicle testing conducted using the FTP (or ''city'' test) and HFET (or ''highway'' test).[514]

At the end of each model year, EPA determines the fleet average fuel economy performance for the individual fleets as determined by procedures set forth in 40 CFR part 600. NHTSA then confirms whether a manufacturer's fleet average fuel economy performance for each of its compliance categories of light-duty vehicles meets the applicable target-based fleet standard. NHTSA makes its final determination of whether a manufacturer has met its CAFE compliance obligation based on official reported and verified CAFE data received from EPA. Pursuant to 49 U.S.C. 32904(e), EPA is responsible for calculating manufacturers' CAFE values so that NHTSA can determine compliance with its CAFE standards. A manufacturer's final model year report must be submitted to EPA no later than May 1st following the end of the model year.[515] EPA verifies the data submitted by manufacturers and issues final CAFE reports that are sent to manufacturers and to NHTSA electronically between April and October of the calendar year following the end of model year. NHTSA then assesses each manufacturer's compliance for each of their fleets and calculates each manufacturer's credit amounts (credits for vehicles exceeding the applicable CAFE standard) and shortfalls (amount by which a fleet fails to meet the applicable CAFE standards). A manufacturer meets NHTSA's fuel economy standard if its fleet average performance is greater than or equal to its required standard.

If one of a manufacturer's compliance categories fails to meet its fuel economy standard, NHTSA will provide written notification to the manufacturer that it has not met the standard. The written notification will also include the shortfall amount for each compliance category, which is calculated using the following equation: (Fuel Economy Achieved − Fuel Economy Standard) × 10 × Production Volume. To determine the civil penalty amount, NHTSA multiplies the total shortfall (in credits) by the applicable civil penalty rate.[516] When the manufacturer receives the written notification, it will be required to confirm the shortfall amount and submit a plan indicating how it will allocate existing credits or earn, transfer, and/or acquire credits to apply toward the shortfall, or inform NHTSA of its intention to pay a civil penalty to resolve the shortfall.[517] [518] The manufacturer must submit a plan or applicable civil penalty payment within

[512] Updating the CAFE civil penalties regulations in 49 CFR 578.6(h) to reflect the statutory amendment in Public Law 119–21 (OB3) will occur in the next DOT-wide annual civil penalties update rulemaking.

[513] 49 U.S.C. 32903(g)(6)(B).

[514] 40 CFR part 600.

[515] 40 CFR 600.512–12(b).

[516] For MY 2022 and beyond the applicable civil penalty rate is $0. Public Law 119–21 (OB3), 139 Stat. 72 (July 4, 2025). *https://www.congress.gov/119/plaws/publ21/PLAW-119publ21.pdf.*

[517] In accordance with 49 U.S.C. 32903(g)(3)(C), the maximum increase in any compliance category attributable to transferred credits is 2.0 mpg.

[518] In accordance with 49 U.S.C. 32903(f)(2) and (g)(4), manufacturers are restricted from using traded and transferred credits to resolve MDPCS shortfalls.

60 days of receiving the written notification from NHTSA. Credit allocation plans and carryback plans (*i.e.,* plans to use future earned or acquired credits to apply toward the shortfall) received from the manufacturer will be reviewed by NHTSA, and NHTSA will approve a credit allocation plan unless it finds the proposed credits are unavailable or that it is unlikely that the plan will result in the manufacturer earning sufficient credits to offset the shortfall. If a plan is rejected, NHTSA will notify the manufacturer and request a revised plan.

B. Proposed Changes to the CAFE Program

Consistent with the overall reset of the CAFE program discussed earlier in Section V, NHTSA is proposing two changes intended to align NHTSA's regulations with EPCA in a manner that will better effectuate the statutory purpose of the CAFE program. First, NHTSA is proposing to amend the criteria for classification as a non-passenger automobile to align NHTSA's regulations with the best reading of the statue.[519] Second, NHTSA is proposing to end credit trading between manufacturers in MY 2028 (*i.e.,* MY 2027 will be the last year in which manufacturers may use traded credits to satisfy shortfalls). NHTSA is also proposing technical amendments to its regulations to remove references to EPA's regulations for OC FCIVs, and proposing to make modifications to reporting requirements, and to make a few technical amendments. The proposed changes are discussed in detail in the following sections.

1. Modification of Vehicle Classification in the CAFE Program

NHTSA is proposing to amend the criteria for non-passenger automobiles. This proposal is informed by an examination of how NHTSA's vehicle classification criteria in 49 CFR part 523, *Vehicle Classification,* align with and implement the vehicle definitions in 49 U.S.C. 32901.

This is not the first time NHTSA has examined this issue. In its 2010 and 2012 final rules, NHTSA considered amending its vehicle classification regulations but ultimately decided to monitor and revisit them in future rulemakings.[520] [521] Notably, NHTSA stated that "no one can predict with certainty how the market will change between now and 2025" specifically regarding how vehicle manufacturers may "make more deliberate redesign efforts to move vehicles out of the car fleet and into the truck fleet in order to obtain the lower target." [522] It is now 2025, and NHTSA has completed an updated analysis using current data.

The starting point of NHTSA's analysis was a recognition of the market shift from passenger automobiles to non-passenger automobiles (as currently classified) in the light-duty vehicle market. In 1975, non-passenger automobiles represented 19.3 percent of the light-duty automobile market,[523] and today they make up 64.7 percent.[524] Figure VI–1 below illustrates the year-over-year light-duty fleet shares of passenger automobiles and non-passenger automobiles over the last 50 model years (*i.e.,* from 1975 to 2024).

[519] 90 FR 24524 (June 11, 2025).

[520] 75 FR 25661 (May 7, 2010).

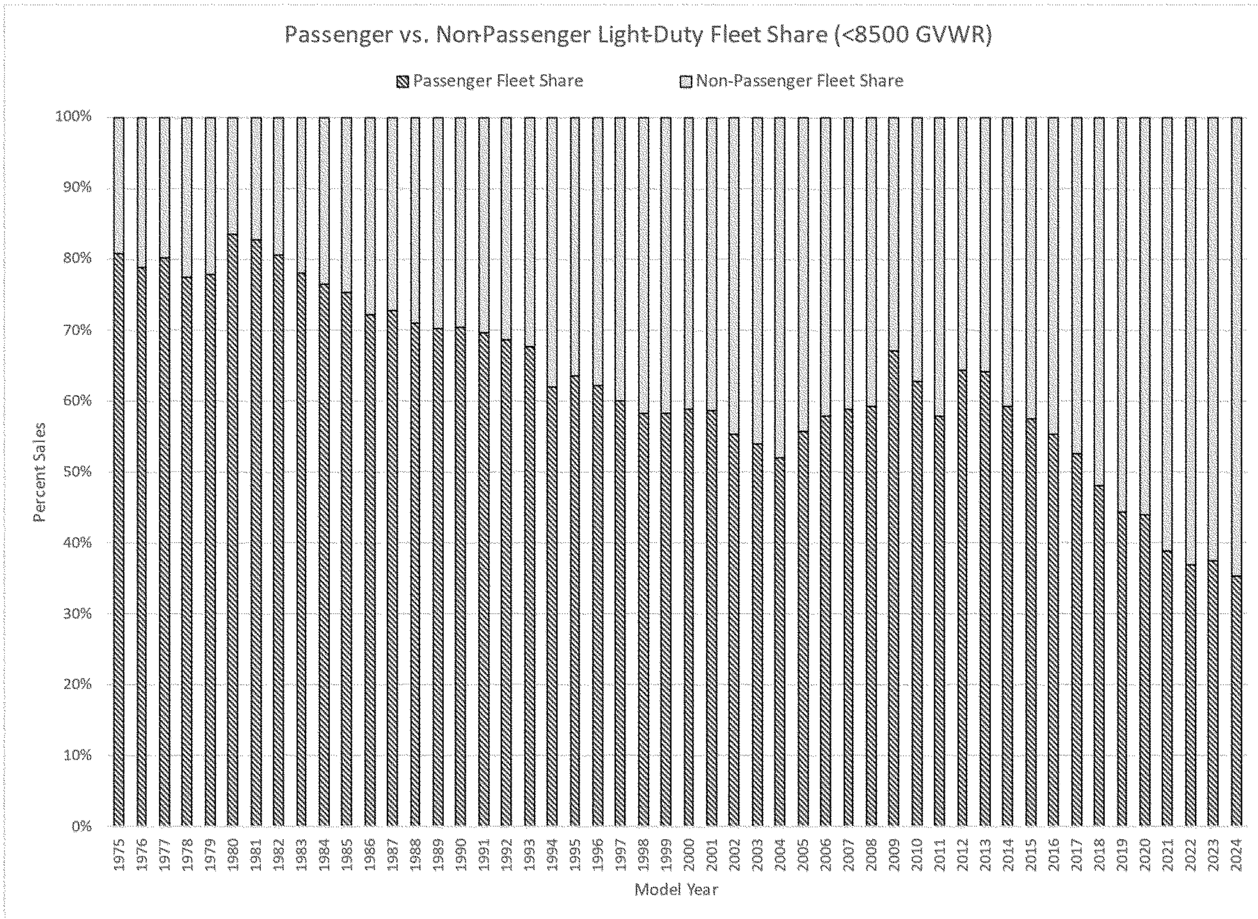
[521] 77 FR 63124 (Oct. 15, 2012).

[522] 77 FR 63122 (Oct. 15, 2012).

[523] DOE, Composition of New U.S. Light-Duty Vehicles by Vehicle Type, Last revised: Jan. 2024, available at: *https://afdc.energy.gov/data/10306* (accessed: Sept. 10, 2025).

[524] This is based on MY 2024 mid-model year reporting and includes dedicated alternative fuel automobiles. Considering only vehicles that are powered by internal combustion engines, the share of automobiles classified as non-passenger automobiles is 67.9 percent.

Figure VI-1: Passenger Versus Non-Passenger Automobile YoY Fleet Share



Leading up to the 2010 and 2012 final rules there was no clear year-over-year trend in the share of each fleet, but the fleet composition has since steadily and sharply continued the long-term trend towards non-passenger automobiles. As discussed in Draft TSD Chapter 1, multiple factors likely have contributed to this trend, including, of particular relevance, NHTSA's vehicle classification criteria. Based on its new analysis, NHTSA believes that the criteria it uses to delineate between the fleets need to be changed to ensure that the classification of the fleets meets the intent by Congress when it enacted EPCA. These changes and the processes by which they were evaluated are described in detail in the subsequent paragraphs and sections.

To assess how the current criteria in section 523.5 of NHTSA's regulations align with the statutory definitions and intent, NHTSA conducted an analysis beginning with the compiled classification data from manufacturers' MY 2024 mid-model year fuel economy compliance reports.[525] To supplement this information, NHTSA conducted extensive research using publicly available manufacturer publications, such as owner's manuals, marketing brochures, and specification sheets,[526] to develop a comprehensive dataset of vehicle models and any non-passenger automobile criteria that each vehicle model meets. This additional research was necessary, as manufacturers' mid-model year reports generally only provide the minimum data needed to demonstrate qualification as a non-passenger automobile. For example, for a three-row SUV that qualifies as a non-passenger automobile via 49 CFR 523.5(a)(5), the manufacturer may not provide data on off-highway angles and clearances specified in 49 CFR 523.5(b)(2). Incorporating this data made it possible for NHTSA to check all possible regulatory pathways that could qualify a vehicle as a non-passenger automobile. A detailed discussion of how the MY 2024 analysis fleet dataset was developed and used can be found in Draft TSD Chapter 2.7.[527] The agency seeks comment and supporting material from manufacturers and stakeholders for any vehicle in the dataset found to contain erroneous or missing data that would impact the outcome of this analysis.

Based on this analysis, NHTSA is proposing to amend the criteria for non-passenger automobiles to align with the best reading of the statute. These changes are discussed in detail in the following sections.

a. Non-Passenger Automobile Definition

EPCA requires NHTSA to set separate maximum feasible standards for ''passenger automobiles'' and ''non-

[525] As required in 49 CFR 537.7(c)(5).

[526] The catalog of reference specification sheets (broken down by manufacturer, by nameplate) used to populate and confirm missing information for vehicle reclassification is available on NHTSA's website. BMW Data, Ferrari Data, FCA Data, Ford Data, Hyundai Data, Ineos Data, Kia Data, Mazda Data, Mercedes Data, Mullen Data, Nissan Data, Subaru Data, Toyota Data, Volvo Data, GM Data, Honda Data, Mitsubishi Data, VW Data, Jaguar Land Rover (JLR) Data, and Vinfast Data.

[527] See Non-Passenger_Analysis.xlsx, Docket No. NHTSA–2025–0491 for the complete dataset used in the analysis.

passenger automobiles.'' All vehicles in the light-duty fleet are classified into one of these two categories based on the presence or lack of certain vehicle characteristics and features. EPCA defines, at 49 U.S.C. 32901(a)(17), a non-passenger automobile to mean ''an automobile that is not a passenger automobile or a work truck.'' By statute, the definition of non-passenger automobile is linked to the definition of passenger automobile found at 49 U.S.C. 32901(a)(18). A passenger automobile is a vehicle that NHTSA ''decides by regulation is manufactured primarily for transporting not more than 10 individuals, but does not include an automobile capable of off-highway operation'' that NHTSA decides by regulation ''has a significant feature (except 4-wheel drive) designed for off-highway operation'' and ''is a 4-wheel drive automobile or is rated at more than 6,000 pounds gross vehicle weight.'' In accordance with the statute, NHTSA has issued regulations at 49 CFR part 523 to establish criteria for determining whether a vehicle is a passenger automobile or non-passenger automobile. Under EPCA and NHTSA's regulations, there are three primary pathways for an automobile (*i.e.,* a vehicle under 10,000 pounds GVWR that is not a work truck) to be classified as a non-passenger automobile: (1) the automobile is designed to carry more than ten individuals; (2) the automobile is not manufactured primarily for transporting individuals; or (3) the automobile is capable of off-highway operation. NHTSA is proposing changes to the criteria used to classify non-passenger automobiles via the second and third pathways.[528] These proposed changes are discussed in detail in the following sections.

b. Proposed Changes to Criteria for Off-Highway Capability

The third pathway for classification as a non-passenger automobile includes automobiles ''capable of off-highway operation'' that NHTSA decides by regulation: (1) ''has a significant feature (except 4-wheel drive) designed for off-highway operation'' and (2) ''is a 4-wheel drive automobile or is rated at more than 6,000 pounds gross vehicle weight.'' [529] Through rulemaking, NHTSA determined that ''high ground clearance'' would constitute a feature designed for off-highway operation and derived a specific list of dimensions that comprise high ground clearance.[530] Specifically, the regulation requires automobiles to meet minimum prescribed values for four out of the following five dimensions: running clearance, axle clearance, approach angle, breakover angle, and departure angle. When issuing these criteria, NHTSA explained that the agency arrived at these values ''[a]fter comparing the ground clearance of automobiles used on highways only with automobiles used off as well as on the highway.'' [531] In the final rule, NHTSA noted that Ford and International Harvester commented that the five ground clearance measurements proposed in the NPRM would adequately serve to distinguish automobiles capable of off-highway operation from other automobiles. The agency also stated that ''[i]f a need arises in the future to establish additional criteria, the NHTSA will initiate rulemaking.'' [532] After almost 50 years, NHTSA is now re-evaluating whether the criteria appropriately differentiate between vehicles that are and are not capable of off-highway operation. After conducting a new analysis using the MY 2024 fleet, NHTSA is proposing two changes to the existing standard for determining high ground clearance, which are discussed in detail below. To provide adequate lead time, NHTSA is proposing that these changes take effect in MY 2028.

First, beginning in MY 2028, NHTSA proposes to eliminate axle clearance as a characteristic used to define a vehicle with high ground clearance, which is currently set 2 centimeters below the running clearance threshold. The objective of high ground clearance as an off-highway feature is to describe automobiles capable of off-highway operation. The axle configuration most impacted by the axle clearance characteristic is the solid axle, where the differential must be housed and vertically centered along a linear path between the center of the wheels on either side of the axle. In contrast, independent axles can vertically center the differential gears above the same linear path, effectively making running clearance the only constraining vertical measurement. Solid axles excel in off-highway operation at the expense of on-highway ride quality. NHTSA finds that creating an additional clearance characteristic that typically applies only to this axle type does not align with the statutory intent that the significant feature would indicate off-highway capability, and the agency therefore proposes to remove it.

Second, also beginning with MY 2028, NHTSA proposes that vehicles classified as non-passenger automobiles under the off-highway criteria meet the given thresholds for all four of the remaining characteristics that comprise the high ground clearance feature. NHTSA is not proposing to change the thresholds themselves, and they would thus remain the same. Using the MY 2024 fleet classification data, NHTSA determined the manufacturing volumes of vehicles that qualified as non-passenger automobiles based on the vehicle's having a high ground clearance, as determined by meeting at least four of the five factors, as well as the angle and clearance values of each of those vehicles. Of particular importance was determining the subset of vehicles that met both the GVWR or 4WD off-highway criteria described in 49 CFR 523.5(b)(1) and exactly four of the five existing off-highway criteria described in 49 CFR 523.5(b)(2). NHTSA found that within this subset of current off-highway classified automobiles: [533]

- 98.9 percent do not meet the approach angle minimum threshold of 28 degrees.
- The remaining 1.1 percent of vehicles are from a single nameplate.[534]
- 66.2 percent have an approach angle of less than the required departure angle of 20 degrees.[535]

After reviewing this data, NHTSA took a closer look at why so few vehicles in this category meet the approach angle requirement and whether this vehicle feature is necessary for off-highway operation. The vehicle attributes outlined in 49 CFR 523.5(b)(2) include approach angle, breakover angle, departure angle, and running clearance, which work together to define what NHTSA believes represents a vehicle designed with an off-highway capability intent, without having to define the off-highway environment explicitly. The approach angle attribute is of particular importance because it is the first feature of a vehicle to engage

[528] The first criterion is set in statute and NHTSA thus does not have authority to change it by regulation. While the third criterion is also set in statute, EPCA (as amended by EISA) provides the Secretary of Transportation with the flexibility to decide by regulation a significant feature (except 4-wheel drive) indicating that the automobile was designed for off-highway operation.

[529] 49 U.S.C. 32901(a)(18).

[530] 41 FR 55371 (Dec. 20, 1976).

[531] 41 FR 55371 (Dec. 20, 1976).

[532] 42 FR 38367 (July 28, 1977).

[533] All percentages described were evaluated using ''Non-Passenger_Analysis.xlsx'' in Docket No. NHTSA–2025–0491, tab ''Existing Reg Classification.''

[534] The Kia Seltos has a running clearance of 7.3 inches (~18.5 cm), below the 20 cm threshold. It has an approach angle of 28.0 degrees, meeting the minimum threshold.

[535] An approach angle less than the minimum required departure angle for off-highway capability would mean that the automobiles represented in this bullet are geometrically more capable off-highway when driven in reverse.

with an off-highway obstacle or grade and will determine whether the vehicle can navigate the obstacle. If the vehicle does not have the ability to approach the obstacle, then the other off-highway attributes become irrelevant. Because of the varying nature of off-highway environments and the equally varying ways to navigate them, the approach angle is set higher to maximize the capability of the other vehicle attributes. This higher approach angle feature can also be seen on vehicles in the 2024 fleet that are specifically designed with high levels of off-highway capability such as the Jeep Wrangler, Ford Bronco, and Land Rover Defender.[536] NHTSA determined in its analysis that manufacturers are significantly reducing the approach angle to as low as 14 degrees in pursuit of on-road aerodynamic improvements, ultimately degrading off-highway capability. NHTSA sees the approach angle as an important off-highway vehicle attribute, which is why it was originally and continues to be set at 28 degrees. The agency finds this approach angle observation as a clear indication that regulatory definitions have caused shifts in vehicle design characteristics, where manufacturers apply the remaining high ground clearance characteristics (breakover angle, departure angle, and running clearance) to vehicles otherwise not intended for off-highway operation. The passenger automobile fleet's fuel economy stringencies originated and evolved at a time when high-frontal area automobiles that consumers have shown a preference for were not present in the light-duty fleet. The gradual introduction of and accompanying consumer preference for high frontal area passenger-carrying automobiles made it difficult for manufacturers to meet the passenger automobile CAFE standards, which had originated and evolved prior to the widespread proliferation of this type of light-duty vehicle. Manufacturers, therefore, applied 4 out of the 5 high ground clearance characteristics, retaining aerodynamic (*i.e.,* low) approach angles that severely limit off-highway capability for the sole purpose of placing these vehicles in the non-passenger automobile fleet. NHTSA is proposing to correct this divergence between fleet composition and off-highway statutory intent by re-establishing the standard curves using a fleet allocation that better aligns with the statute. This proposed reclassification would eliminate the need for manufacturers to decide between unnecessary high ground clearance characteristics and achieving passenger automobile fuel economy standards.

As part of its evaluation of the criteria for off-highway capability, NHTSA also investigated the statute's ''4-wheel drive'' off-highway feature, specifically with regard to the differences between 4WD (4x4) and AWD drivetrains. Currently, 4WD and AWD technologies are both considered to meet the 4WD statutory directive in regulation.[537] The agency found that there is significant overlap in present-day 4WD and AWD peripheral technologies, such as axle differential locks, interaxle locks, low-range gearing and torque availability, and intelligent traction control systems that make it difficult, if not impossible, to assess off-highway ability based on the exclusively differentiating features of 4WD and AWD systems. NHTSA seeks comment on this assessment but is not currently proposing to change its position that any drivetrain capable of sending power to all four wheels, including both 4WD and AWD systems, meets the statute's intent.

c. Proposed Changes to Criteria for Functional Performance

A passenger automobile is defined, in part, as an automobile that is ''manufactured primarily for transporting not more than 10 individuals.'' [538] When the agency first issued vehicle classification regulations for the CAFE program in 1977, the agency grappled with the meaning of the lone word ''primarily'' in addition to the meaning of the phrase ''manufactured primarily for transporting not more than 10 individuals'' in the context of vehicle classification.[539] Ultimately, NHTSA determined that the phrase consisted of two criteria for passenger automobiles: (1) that passenger automobiles must be designed to carry 10 or fewer persons and (2) that passenger automobiles are ''chiefly'' for carrying persons. In the 1977 final rule, NHTSA noted that if ''primarily'' were interpreted to mean ''substantially,'' then almost every automobile would be a passenger automobile, because a substantial function of almost every automobile is to transport passengers. Because this was clearly not the intent of Congress, NHTSA instead interpreted the word ''primarily'' to mean ''chiefly'' or ''predominantly'' [540] and established criteria for the classification of an automobile as a non-passenger automobile based on the presence of certain chief characteristics. In the 1977 final rule, NHTSA stated its belief that Congress clearly intended that ''passenger automobile'' include only those vehicles traditionally regarded as passenger cars (*i.e.,* vehicles whose major design features, including body style, reflect the purpose of carrying persons). NHTSA also provided examples of design features that, singly or in combination, would indicate that an automobile is not a passenger automobile: an open bed for carrying cargo; heavy-duty suspension; and greater cargo-carrying than passenger-carrying volume.[541]

Under this interpretation, NHTSA created five different criteria of functional performance, any one of which would qualify the vehicle as a non-passenger automobile. The first, and most obvious type, is an automobile designed for transporting more than 10 individuals.[542] The four other criteria were used to identify automobiles designed primarily or chiefly for carrying property or a derivative of an automobile designed primarily for the transportation of property and included automobiles that: (1) provide temporary living quarters; (2) transport property on an open bed; (3) provide greater cargo-carrying than passenger-carrying volume; or (4) permit expanded use of the automobile for cargo-carrying purposes through the removal of seats by means installed for that purpose by the manufacturer or with simple tools, so as to create a flat, floor level surface extending from the forwardmost point of installation of those seats to the rear of the automobile's interior.[543] The first three of these criteria have remained static over time and are codified at 49 CFR 523.5(a)(2)–(4). The fourth criteria, for automobiles derived from an automobile designed primarily for the transportation of property, has expanded over time. Currently, section 523.5(a)(5) classifies as non-passenger any automobile with at least three rows of designated seating positions as standard equipment and has foldable or pivoting seats that can be removed, stowed, or folded to create a flat, leveled surface extending from the forward most point of installation (of the third-row seat) to the rear of the automobile's interior.

After conducting an analysis of the fleet and vehicle characteristics, NHTSA no longer believes that the criteria in

[536] See Non-Passenger_Analysis.xlsx, Docket No. NHTSA–2025–0491, tab ''Existing Reg Classification.''

[537] 75 FR 25659 (May 7, 2010), Footnote 750.

[538] 49 U.S.C. 32901(a)(18).

[539] 42 FR 38365 (July 28, 1977).

[540] *Id.*

[541] 42 FR 38362, 38365 (July 28, 1977).

[542] 49 CFR 523.5(a)(1).

[543] 42 FR 38367 (July 28, 1977).

section 523.5(a)(5) is in accordance with the best reading of the statute. NHTSA's analysis has indicated that many vehicles that qualify as non-passenger automobiles solely on this criterion (*i.e.,* the automobile does not meet any of the other criteria to be a non-passenger automobile) would be classified more appropriately as passenger automobiles: the presence of a foldable, stowable, or removable third row seat is not a significant design characteristic indicating that a chief purpose for the vehicle is to transport property. However, NHTSA's analysis also indicates that there is a subset of vehicles that are currently classified as non-passenger automobiles based on this criterion for vehicles with three or more rows of seating that NHTSA believes should remain in the non-passenger automobile category, as they have some chief design characteristics for transporting property that are not currently captured by section 523.5(a). To ensure that NHTSA's criteria for automobiles that are chiefly or significantly for transporting property effectuate the best reading of the statutory definitions, NHTSA is proposing two changes to the criteria in section 523.5(a). First, NHTSA is proposing to remove the current criteria in section 523.5(a)(5) for vehicles with three or more rows. Second, the agency is proposing to add a new criterion premised on a performance-based light-duty work factor (LDWF) utility metric. These proposed changes are discussed in more detail below.

(1) Automobiles With Three or More Rows of Seating

As referenced above, automobiles with at least three rows of designated seating positions as standard equipment qualify as non-passenger automobiles under section 523.5(a)(5) if the removal or stowing of foldable seats creates a flat, leveled cargo surface extending from the forwardmost point of installation of those seats to the rear of the automobile's interior. The original version of this provision in the 1977 final rule was for automobiles that had removable seats, such that the automobile permits expanded use of the automobile for cargo-carrying purposes. In explaining the rationale for creating the criteria, the 1977 preamble stated:

> [I]t is not the convertibility factor alone which results in passenger vans being classified as non-passenger automobiles. It is that factor together with the derivative nature of those vans . . . . [S]ince a passenger van is designed with the same chassis, springs, and suspension system as a cargo van, it is treated in the same way as a cargo van.[544]

When 49 CFR 523.5(a)(5) was applied to the original CAFE reference fleet, it achieved its intended objective of identifying those derivative vehicles, where purchasers could have instead opted for a ''cargo'' version of that vehicle. However, unlike the other regulations in section 523.5(a), the regulation at 523.5(a)(5) does not directly describe a chief non-passenger characteristic, but rather a passenger-based design feature that does not reveal, describe, or quantify a chief non-passenger characteristic when applied to the current automobile fleet. The automobile fleet of the late 1970s was fundamentally different from the automobile fleet being manufactured and sold today as there are no ''cargo van'' derivatives ''designed with the same chassis, springs, and suspension system'' in the present-day light-duty fleet. The regulatory text at 523.5(a)(5) applied to the late-1970s fleets accommodated the derivative vehicles as they existed at the time, but that same regulatory text applied to today's fleet misaligns with the statutory intent and text. Meeting the criterion in section 523.5(a)(5) is simply not enough to indicate that the automobile is not ''manufactured primarily'' for carrying passengers. In fact, the presence of at least three rows of designated seating positions indicates the opposite, as having three rows of designated seating positions is a significant feature indicating that a primary purpose of that automobile is for carrying numerous passengers. Accordingly, NHTSA is proposing to remove 49 CFR 523.5(a)(5) as a non-passenger classification criterion beginning with MY 2028.

(2) Light-Duty Work Factor

With the proposal to remove the expanded use criterion for vehicles with three or more rows of seating, NHTSA recognizes that some automobiles that have significant functional characteristics for the transportation of property would be classified as passenger automobiles unless NHTSA were to make further amendments to the criteria in section 523.5. To address this, NHTSA is proposing a new criterion for classification as a non-passenger automobile, beginning in MY 2028. While the criterion NHTSA is proposing to remove for vehicles with three or more rows of seating is based primarily on a passenger-carrying design element (three rows of seats), NHTSA is proposing a new non-passenger automobile pathway that can be described independent of vehicle construction, platform, equipment, materials, or passenger-based metrics (such as rated cargo load[545] or seating arrangements). This new performance-based utility attribute, which NHTSA is referring to as the light-duty work factor (LDWF), would be determined based on a light-duty vehicle's ability to transport property via its payload and towing capacities. Performance-based standards preclude design or technology obsolescence by only prescribing a target without guidance or restriction on how it should be achieved. A complete discussion of NHTSA's analysis and the process by which the LDWF formula and threshold were derived can be found in Draft TSD Chapter 2.7.

NHTSA developed an analysis fleet specifically for the LDWF analysis, referred to as the LDWF analysis fleet. Beginning with the full MY 2024 non-passenger fleet, NHTSA created the LDWF analysis fleet by removing vehicles that qualified as non-passenger automobiles via any of the following pathways:

- Transport more than 10 persons.
- Provide temporary living quarters.
- Transport property on an open bed.
- Provide, as sold to the first retail purchaser, greater cargo-carrying than passenger-carrying volume.
- Has either 4WD or a GVWR of more than 6000 lbs., and meets all four of the following criteria:[546]
  - Approach angle of not less than 28 degrees
  - Breakover angle of not less than 14 degrees
  - Departure angle of not less than 20 degrees
  - Running clearance of not less than 20 centimeters

The agency opted to omit vehicles that qualified via these alternative non-passenger pathways due to their designs' containing other non-passenger characteristics or off-highway features that could skew the results of an analysis intended to evaluate whether a vehicle was designed chiefly for enhanced property-transporting utility. The remaining vehicles were subject to the LDWF analysis to evaluate an appropriate formula and threshold for the work factor.

In performing the fleet analysis to determine at what threshold of LDWF a vehicle would qualify as a non-

[544] 42 FR 38367 (July 28, 1977).

[545] Per 49 CFR 571.110 S.3, rated cargo load can be calculated as the vehicle capacity weight (payload capacity) minus 68 kg (150 lbs.) times the vehicle's designated seating capacity.

[546] These sub-bullets reflect the proposed changes to criteria for off-highway capability, which are discussed in detail in NPRM preamble Section VI.B.1.b and Draft TSD Chapter 2.7.

passenger vehicle, NHTSA recognized that many vehicles could be specified with or without a trailering package (also commonly referred to as a ''tow package'' or ''towing package''). These packages can range from minor changes, such as the inclusion of trailer wiring and a tow hitch, to more significant changes, such as higher capacity cooling packages, enhanced suspensions, or reinforced driveline components. These changes do not significantly impact the powertrain or fuel economy of the base vehicle. In other words, trailering packages unlock utility that the powertrain and vehicle platform are already designed to provide. Therefore, in establishing the LDWF analysis fleet, NHTSA assumes that for a vehicle that would qualify as a non-passenger automobile via the LDWF criterion when specified with its trailering equipment, manufacturers will in the future not remove trailering capability as standard equipment on a vehicle that is otherwise designed to include it. These maximum available towing capacities for each vehicle in the LDWF analysis fleet were applied to the dataset used in the analysis.[547]

NHTSA is proposing to calculate LDWF as the weighted sum of a vehicle's payload and towing capacities and is proposing a minimum threshold for this non-passenger criterion based on extensive analysis. In determining appropriate weighting for payload and towing capacity in the LDWF calculation, NHTSA is considering the vehicle design considerations and property-transporting capabilities of payload capacity versus towing capacity. Designing for a higher payload capacity includes considerations for axle, frame, suspension, wheel, and tire capacities. These higher capacity components add weight to the vehicle and, when combined with the additional payload capacity, may require only modest enhancements to the powertrain and driveline to maintain performance and utility characteristics. In contrast, designing for a higher towing capacity includes considerations for pulling, including frame reinforcements to resist trailer forces acting opposite the direction of motion, increases to powertrain torque and power, and reinforcing driveline components to handle the additional torque. There is also a modest consideration for payload increases when considering increases to towing capacity due to a trailer's tongue weight.[548] In addition to the more expansive design considerations, towing capacity is a more effective means of providing cargo-transporting utility. For example, the highest payload capacity in the LDWF analysis fleet is nearly 2,100 pounds, compared to the highest towing capacity of 10,000 pounds; the range of payload capacity across the entire LDWF analysis fleet spans approximately 1,500 pounds compared to a 10,000-pound spread in towing capacity. Accordingly, NHTSA is proposing a higher weighting for towing capacity when determining the LDWF.[549] Draft TSD Chapter 2.7 provides the complete analysis and also describes the differences between the LDWF and the HDPUV work-factor attribute. Both the Draft TSD Chapter 2.7 and NPRM preamble Section IX Regulatory Text provide the LDWF formula and threshold.

In connection with the proposed addition of the LDWF, NHTSA is proposing to update its definition of curb weight and add two additional definitions for ''nominal tank capacity'' and ''optional equipment'' which would be used in determining curb weight. NHTSA is changing the definition of curb weight and defining the additional terms to provide clarity regarding how NHTSA would test a vehicle to determine whether it meets the LDWF or off-road criteria for non-passenger automobiles. The update to the curb weight definition is intended to ensure that every vehicle a manufacturer reports as a non-passenger automobile meets the criteria as configured at the time of first retail purchase (*i.e.,* it must meet the criteria in any configuration offered by the manufacturer).

2. Removal of Credit Trading in the CAFE Program

Under EPCA, as amended by EISA, manufacturers are afforded several compliance flexibilities that can be used to achieve compliance with CAFE standards. While some of these flexibilities are provided to manufacturers by statute, such as the ability to carry forward and backward credits earned from over-complying with a CAFE standard in a given model year, others are provided by regulations issued at NHTSA's discretion. Credit trading among manufacturers is one flexibility that the statute authorizes but does not mandate. Credit trading refers to the ability of manufacturers or persons to sell credits to, or purchase credits from, another manufacturer. EISA gave NHTSA discretion to establish by regulation a CAFE credit trading program to allow credits to be traded between vehicle manufacturers.[550] While establishing the credit trading program is discretionary, it is also limited by statute. Total oil savings must be preserved when credits are traded, and traded credits are not permitted to be used to meet the MDPCS.[551] Under this discretionary authority, NHTSA established a credit trading program in its 2009 final rule, permitting manufacturers to trade credits earned in MY 2011 and later.[552] Under NHTSA's regulations, traded credits are subject to an ''adjustment factor'' to ensure total oil savings.[553]

NHTSA has observed, in recent years, that credit trading increasingly has been used by manufacturers of ICE vehicles to purchase credits from manufacturers of alternative fueled vehicles. As fuel economy standards increase, manufacturers generally look for the most cost-effective means of compliance. As standards increased to levels unattainable for ICE vehicles, credit trading has become an increasingly more attractive means of satisfying CAFE requirements. This situation is due, in part, to EV manufacturers' earning credits that are not representative of real-world fuel savings. The fuel economy values for EVs have been artificially high, resulting from the multiplier in the PEF[554] and EV manufacturers' generating FCIVs for AC efficiency and OC technologies that are not representative of real-world fuel savings.[555] As a result, EV manufacturers have been earning an abundance of credits. Under NHTSA's credit trading program, EV manufacturers can sell their credits to

[547] See Non-Passenger_Analysis.xlsx, Docket No. NHTSA–2025–0491, tab ''Existing Reg Classification,'' column ''Max Spec Tow Capacity (lb.).''

[548] SAE, Performance Requirements for Determining Tow-Vehicle Gross Combination Weight Rating and Trailer Weight Rating, SAE Standard J2807_202411, SAE International: Warrendale, PA, available at: *https://doi.org/10.4271/J2807_202411* (accessed: Sept. 10, 2025).

[549] The proposed weighting is ⅔ of towing capacity and ⅓ of payload capacity, with a threshold of greater than or equal to 5,500, calculated in pounds. See Draft TSD Chapter 2.7.

[550] 49 U.S.C. 32903(f).

[551] 49 U.S.C. 32903(f)(1) and (2).

[552] 74 FR 14206 (Mar. 30, 2009).

[553] 49 CFR 536.4(c).

[554] In DOE's final rule (89 FR 22041, Mar. 29, 2024), DOE explained that ''by significantly overvaluing the fuel savings effects of EVs in a mature EV market with CAFE standards in place, the fuel content factor [in the PEF] will disincentivize both increased production of EVs and increased deployment of more efficient ICE vehicles,'' which DOE concludes ''results in higher petroleum use than would otherwise occur.''

[555] In EPA's Apr. 18, 2024, final rule (89 FR 27842), EPA noted that EVs are ''receiving a windfall of credits [for AC efficiency technologies] that fails to correspond to any real-world reduction in vehicle emissions'' and that there is ''no technical basis for providing BEVs with off-cycle credits.''

ICE vehicle manufacturers, effectively subsidizing the production of EVs. This was never NHTSA's intention in establishing a credit trading program nor Congress's intention in authorizing such a program, as it creates market distortion that undermines EPCA's overarching purposes.

NHTSA is proposing to end credit trading by MY 2028, with MY 2027 being the last year in which manufacturers can use traded credits for CAFE compliance. Because NHTSA, as required by statute, is proposing standards in this rulemaking without considering alternative fueled vehicles or the use of compliance credits, NHTSA believes that manufacturers of ICE vehicles will be able to meet CAFE standards without credit trading, thus minimizing any impacts that this would have on manufacturers' decisions about what vehicles and technologies to offer in the marketplace. As shown in Section IV.B.1 Effects on Vehicle Manufacturers, NHTSA's standard-setting analysis indicates that manufacturers at both the individual fleet level and total fleet level exceed the standards year over year from MY 2028 to MY 2031. This demonstrates that NHTSA's proposed CAFE standards are achievable with ICE technologies without consideration of the factors NHTSA is prohibited from considering pursuant to 49 U.S.C. 32902(h), namely, alternative fueled vehicles and the availability of credits. The inputs for the compliance simulations that inform NHTSA's standard-setting analysis are discussed further in Section II.C.2. In addition, while NHTSA's analysis indicates that manufacturers will be able to meet the proposed standards by applying a diverse set of technologies available in the market now, manufacturers will continue to be able to transfer credits between their own fleets, subject to the 2-mpg statutory limit on how much a manufacturer can improve a fleet's average fuel economy using transferred credits.[556] NHTSA is not proposing changes to how manufacturers may transfer earned credits between different compliance fleets, such as between their domestic passenger car and non-passenger car fleets, as this form of credit transfer is permitted explicitly by statute.

The agency recognizes that manufacturers have made investments in fuel-saving technologies, which they have factored into their future design and compliance plans. Or, instead of investing in potential technology application, NHTSA recognizes that manufacturers may have reliance interests in the credit trading program to fulfill their current CAFE compliance obligations. However, NHTSA believes that its proposal to end credit trading within the CAFE program by MY 2028 provides manufacturers adequate transition time before trading ends. NHTSA has also proposed standards in this notice that explicitly do not account for manufacturers' use of credits to comply with standards. These adjustments to the fuel economy standards also should limit any potential impacts manufacturers will experience because of NHTSA's proposed programmatic changes. NHTSA seeks comment on this proposal, including on its assumptions about manufacturers' compliance pathways exclusive of credit trading as an compliance option. NHTSA also seeks comment on the extent to which the presence of credits changed manufacturer compliance behavior, and on the value of credits now that the civil penalty rate has been updated by law.

3. Technical Amendments To Remove References to EPA's Regulations for AC Efficiency and Off-Cycle Fuel Consumption Improvement Values

In its 2012 final rule, NHTSA issued regulations to align with EPA's provisions that allowed manufacturers to generate FCIVs for the adoption of AC efficiency and OC technologies beginning in MY 2017. EPA established the AC efficiency and OC programs to account for technologies that are not fully captured in the 2-cycle test procedures (FTP and HFET) that EPA uses to measure fuel economy for the CAFE program. Under EPA's provisions, FCIVs generated by manufacturers are factored into each manufacturer's calculation of its average fuel economy for purposes of CAFE compliance. As explained in Section II, NHTSA is now proposing to remove FCIVs from its standard-setting analysis starting in MY 2028. NHTSA is making this change to ensure that it sets maximum feasible standards that are achievable without consideration of technology-specific standards. Upon examination of NHTSA's existing regulations, NHTSA has identified technical changes to remove references to EPA regulations pertaining to AC efficiency and OC FCIVs.

AC efficiency technologies are technologies that reduce the operation of or the loads on the vehicle engine by reducing AC usage. For example, the less frequently the AC compressor operates or the more efficiently it operates, the less load the AC compressor places on the engine, resulting in better fuel efficiency. AC efficiency technologies can include, but are not limited to, blower motor controls, internal heat exchangers, and improved condensers/evaporators. OC technologies are technologies that also reduce the operation of ICE engines, but they cover other areas of vehicle operation. Examples of OC technologies include thermal control technologies, high-efficiency alternators, and high-efficiency exterior lighting.[557]

Under EPA's current regulations, manufacturers are eligible to earn AC efficiency and OC FCIVs for all types of automobiles equipped with those technologies in their fleet through MY 2026. Starting in MY 2027, only automobiles powered by ICEs are eligible to generate FCIVs, and the OC FCIV program is currently being phased out between MYs 2031–2033, with manufacturers no longer being able to generate OC FCIVs for MY 2033 and beyond.

NHTSA is proposing to remove the references to EPA's regulations regarding FCIVs from 49 CFR 531.6 and 49 CFR 533.6 because such references are unnecessary and create a potential for confusion. As noted above, fuel economy is calculated pursuant to testing and calculation procedures prescribed by EPA. Accordingly, NHTSA is proposing to remove the references to EPA regulations.

4. Modification of Manufacturer Reporting Requirements

In support of the proposed modifications to vehicle classification, including the new light-duty work factor (LDWF), NHTSA is proposing to make gross combined weight rating (GCWR) a required reporting element for all non-passenger automobiles in the pre-model year and mid-model year reports beginning in MY 2028. GCWR is the value specified by the manufacturer as the loaded weight of a combination vehicle. Currently, GCWR is one option that manufacturers may use to support a vehicle's classification as a full-sized pickup. NHTSA is proposing to require GCWR due in part to the proposed introduction of the LDWF, as GCWR information would be needed to determine whether an automobile qualifies as a non-passenger automobile under the LDWF criteria. NHTSA is also proposing to require GCWR for all non-passenger automobiles because it will allow NHTSA to understand fleet characteristics better, as non-passenger automobiles may qualify under multiple criteria. NHTSA is proposing that this

[556] 49 U.S.C. 32903(g)(3)(c).

[557] 40 CFR 86.1869–12(b), Credit available for certain off-cycle technologies.

change would first apply for MY 2028 reporting.

NHTSA is also proposing to remove 49 CFR 523.5(a)(5) and 49 CFR 523.5(b)(2)(v) beginning with MY 2028. Additional details regarding their removal can be found in Section VI.B.1.b and in Draft TSD Chapter 2.7. Due to these changes, starting in MY 2028 manufacturers will no longer be required to provide information related to these two regulations, which are described in 49 CFR 537.7(c)(5), paragraphs (c)(5)(i)(E) and (c)(5)(ii)(D), respectively.

C. Technical Amendments

NHTSA is proposing to make certain technical amendments through this rulemaking, which include amendments removing residual mentions of fuel efficiency standards for trailers; technical amendments removing reference to civil penalties for non-compliance with fuel economy standards; removing provisions applicable only to model years before MY 2022; and technical amendments correcting regulatory citations and incorporating minor spelling, grammatical, and formatting edits to 49 CFR parts 523, 531, 533, 536, and 537. NHTSA has included in the docket redline text highlighting all of the proposed changes to the regulations. Instructions for accessing the docket can be found in Section VII Public Participation.

1. Technical Amendments To Remove Residual Mention of Fuel Efficiency Standards for Trailers in NHTSA's Vehicle Classification Regulations

In November 2021, the United States Court of Appeals for the District of Columbia ''vacate[d] all portions of the [2016 joint NHTSA and EPA] rule that apply to trailers.'' [558] The underlying statute authorizes NHTSA to examine the fuel efficiency of and prescribe fuel economy standards for ''work trucks and commercial medium-duty or heavy-duty on-highway vehicles.'' 49 U.S.C. 32902(b)(1)(C); 49 U.S.C. 32902(k)(2). The court reasoned that trailers do not qualify as ''vehicles'' when that term is used in the fuel economy context because trailers are motorless and use no fuel. *Truck Trailer Mfrs. Ass'n, Inc.,* 17 F.4th at 1200, 1204–08. Accordingly, the court held that NHTSA does not have the authority to regulate the fuel economy of trailers. *Id.* at 1208.[559]

On March 15, 2024, NHTSA published the final rule titled ''Improvements for Heavy-Duty Engine and Vehicle Fuel Efficiency Test Procedures, and Other Technical Amendments.'' (89 FR 18808). In that final rule, NHTSA removed portions of its regulations that were vacated by that decision. While that final rule removed all the fuel efficiency standards for trailers and most of the mentions of those standards from its regulations, a residual mention of those standards remains in NHTSA's vehicle classification regulations at 49 CFR 523.10(a)(3). NHTSA is proposing to amend 49 CFR 523.10(a)(3) by deleting the sentence that mentions fuel efficiency standards for trailers.

2. Technical Amendment To Remove Heavy-Duty Trailers From the List of Heavy-Duty Vehicle Regulatory Categories

On June 24, 2024, NHTSA published the final rule titled ''Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks for Model Years 2027 and Beyond and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans for Model Years 2030 and Beyond.'' (89 FR 52540, June 24, 2024). In Section VII.C.8.e of that final rule,[560] NHTSA finalized the removal of ''Heavy-duty trailers'' from the list of four heavy-duty vehicle regulatory categories in 49 CFR 523.6(a). However, NHTSA inadvertently excluded the necessary changes from the final rule's amendatory text. To align with its original intent as expressed in its 2024 final rule, NHTSA is proposing to amend 49 CFR 523.6(a) introductory text by stipulating that heavy-duty vehicles are divided into three regulatory categories and removing paragraph (a)(4)—which lists heavy-duty trailers as a heavy-duty vehicle regulatory category—from 49 CFR 523.6(a).

3. Technical Amendments To Remove Civil Penalties for Non-Compliance With Fuel Economy Standards From the CAFE Program

NHTSA is proposing to remove the mention of civil penalty payments for manufacturers that do not meet their fuel economy standards in the CAFE program from 49 CFR part 536. These amendments are to remove the mention of civil penalties from 49 CFR 536.5(d)(2) and (6), § 536.9(e), § 536.10(b); and to remove § 536.7(b) through (d).

4. Additional Technical Amendments

NHTSA is proposing to incorporate minor technical amendments to 49 CFR parts 523, 531, 533, 536, and 537. These amendments are to correct regulatory citations and incorporate minor spelling, grammatical, and formatting edits. Specifically, NHTSA is proposing to incorporate the following technical amendments.

a. Technical Amendments to Part 523

NHTSA is proposing to add and remove text, correct spelling errors, and incorporate other grammatical edits to clarify several definitions, including *Cargo-carrying volume, Electric vehicle, Transmission configuration,* and *Vocational vehicle (or heavy-duty vocational vehicle)* in § 523.2 and § 523.3 and to correct a regulatory citation in § 523.4.

b. Technical Amendments to Part 531

NHTSA is proposing to correct regulatory citations in § 531.5(b), (c), and (e) and Table 14 to § 531.5(e)(10); to correct capitalization errors in § 531.5(a) through (c) and Table 16 to § 531.5(e)(12); to correct spelling errors in Table 8 to § 531.5(e)(4), Table 11 to § 531.5(e)(7), Table 12 to § 531.5(e)(8), Table 13 to § 531.5(e)(9), Table 14 to § 531.5(e)(10), Table 15 to § 531.5(e)(11), Table 16 to § 531.5(e)(12), Table 21 to § 531.5(e)(17), Table 22 to § 531.5(e)(18), Table 23 to § 531.5(e)(19), and Table 24 to § 531.5(e)(20); to add clarifying text to § 531.5(c); to incorporate other grammatical edits in Table 8 to § 531.5(e)(4), Table 16 to § 531.5(e)(12), Table 19 to § 531.5(e)(15), Table 20 to § 531.5(e)(16), Table 21 to § 531.5(e)(17), Table 22 to § 531.5(e)(18), Table 23 to § 531.5(e)(19), and Table 24 to § 531.5(e)(20); and to incorporate grammatical edits in § 531.6(b)(4)(ii)(C).

c. Technical Amendments to Part 533

NHTSA is proposing to correct formatting errors in the text supporting Figure 1 to § 533.5; to correct capitalization errors in § 533.5(j); and to incorporate a grammatical edit in § 533.6(c)(5)(ii)(C).

d. Technical Amendments to Part 536

NHTSA is proposing to change the title of a section in Part 536 Introductory Text; to remove text and to correct terminology to clarify a provision in § 536.1; to remove text to clarify a provision in § 536.2; to add text to

[558] *Truck Trailer Mfrs. Ass'n, Inc.* v. *EPA*, 17 F.4th 1198, 1200 (D.C. Cir. 2021).

[559] For similar reasons, the court also held that the statute authorizing EPA to regulate the emissions of ''motor vehicles'' does not encompass trailers. *Id.* at 1200–03. The court affirmed, however, that both agencies still ''can regulate *tractors* based on the trailers they pull.'' *Id.* at 1208 (emphasis original). Moreover, NHTSA is still authorized to regulate trailers in other contexts, such as under 49 U.S.C. chapter 301. *See* 49 U.S.C. 30102(a)(7) (defining ''motor vehicle'' to include ''a vehicle . . . drawn by mechanical power''); *Truck Trailer Mfrs. Ass'n, Inc.,* 17 F.4th at 1207 (''A trailer is 'drawn by mechanical power.' '').

[560] 89 FR 52540, 52933 (June 24, 2024).

clarify the definition of *Credit holder (or holder)* in § 536.3(b)(6); to remove text to clarify the definition of *Light truck* in § 536.3(b)(10); to add and remove text to clarify the definition of *Trade* in § 536.3(b)(11); add and remove text to clarify the definition of *Transfer* in § 536.3(b)(12); to correct a capitalization error in § 536.4(c); to add and remove text to clarify provisions in § 536.4(a) through (c) and Figure 1 to § 536.4(c); to correct a table heading in Table 1 to § 536.4(c); to rename the title of § 536.6; to add a new paragraph (a) to § 536.6; to change the existing paragraph (a) to paragraph (a)(1) in § 536.6; to change the existing paragraph (b) to paragraph (a)(2) in § 536.6; to add a new paragraph (b) to § 536.6; to change the existing paragraph (c) to paragraph (b)(1); to add a new paragraph (2) to § 536.6(b); to add a new paragraph (3) to § 536.6(b); and to add text to the title of § 536.8; correct a spelling error in § 536.8(a) and (f).

e. Technical Amendments to Part 537

NHTSA is proposing to correct a spelling error in § 537.4(b)(3) and a regulatory citation in § 537.7(c)(7)(i).

VII. Public Participation

NHTSA requests comments on all aspects of this NPRM. This section describes how you can participate in this process.

How do I prepare and submit comments?

Your comments must be written and in English.[561] To ensure that your comments are correctly filed in the docket, please include the docket number NHTSA–2025–0491 at the top of your comments. Your comments must not be more than 15 pages long.[562] NHTSA established this limit to encourage you to write your primary comments in a concise fashion. However, you may attach necessary additional documents to your comments, and there is no limit on the length of the attachments. If you are submitting comments electronically as a PDF (Adobe) file, NHTSA asks that the documents be scanned using the Optical Character Recognition (OCR) process, thus allowing NHTSA to search and copy certain portions of your submissions.[563] Please note that pursuant to the Data Quality Act, for substantive data to be relied upon and used by NHTSA, it must meet the information quality standards set forth in the OMB and DOT Data Quality Act guidelines. Accordingly, NHTSA encourages you to consult the guidelines in preparing your comments. OMB's guidelines may be accessed at *https://www.gpo.gov/fdsys/pkg/FR-2002-02-22/pdf/R2-59.pdf.* DOT's guidelines may be accessed at *https://www.transportation.gov/dot-information-dissemination-quality-guidelines.*

[561] 49 CFR 553.21.

[562] *Id.*

[563] OCR is the process of converting an image of text, such as a scanned paper document or electronic fax file, into computer-editable text.

Tips for Preparing Your Comments

When submitting comments, please remember to:

• Identify the rulemaking by docket number and other identifying information (subject heading, Regulation Identifier Number (RIN), **Federal Register** date, and page number).

• Explain why you agree or disagree, suggest alternatives, and substitute language for your requested changes.

• Describe any assumptions and provide any technical information either or data that you used.

• If you estimate potential costs or burdens, explain how you arrived at your estimate in sufficient detail to allow for it to be reproduced.

• Provide specific examples to illustrate your concerns and suggest alternatives.

• Explain your views as clearly as possible, avoiding the use of profanity or personal threats.

• Make sure to submit your comments by the comment period deadline identified in the DATES section above.

How can I be sure that my comments were received?

If you submit your comments to NHTSA's docket by mail and wish DOT Docket Management to notify you upon receipt of your comments, please enclose a self-addressed, stamped postcard in the envelope containing your comments. Upon receiving your comments, Docket Management will return the postcard by mail.

How do I submit Confidential Business Information (CBI)?

If you wish to submit any information under a claim of confidentiality, you should submit your complete submission, including the information you claim to be CBI, to NHTSA's Office of the Chief Counsel. When you send a comment containing CBI, you should include a cover letter setting forth the information specified in our CBI regulation.[564] In addition, you should submit a copy from which you have deleted the claimed CBI to the docket by one of the methods set forth above.

[564] *See* 49 CFR part 512.

NHTSA is currently treating electronic submission as an acceptable method for submitting CBI to NHTSA under 49 CFR part 512. Any CBI submissions sent via email should be sent to an attorney in the Office of the Chief Counsel at the address given above under FOR FURTHER INFORMATION CONTACT. Likewise, for CBI submissions via a secure file transfer application, an attorney in the Office of the Chief Counsel must be set to receive a notification when files are submitted and have access to retrieve the submitted files. At this time, regulated entities should not send a duplicate hardcopy of their electronic CBI submissions to DOT headquarters. If you have any questions about CBI or the procedures for claiming CBI, please consult the person identified in the FOR FURTHER INFORMATION CONTACT section.

Will NHTSA consider late comments?

NHTSA will consider all comments received before the close of business on the comment closing date indicated above under DATES. To the extent practicable, NHTSA will also consider comments received after that date. If interested persons believe that any information that NHTSA places in the docket after the issuance of the NPRM affects their comments, they may submit comments after the closing date concerning how NHTSA should consider that information for the proposed rule. However, NHTSA's ability to consider any such late comments in this rulemaking will be limited.

If a comment is received too late for NHTSA to practicably consider in developing a proposed rule, NHTSA will consider that comment as an informal suggestion for future rulemaking action.

How can I read the comments submitted by other people?

You may read the materials placed in the dockets for this document (*e.g.,* the comments submitted in response to this document by other interested persons) at any time by going to *https://www.regulations.gov.* Follow the online instructions for accessing the dockets. You may also read the materials at the DOT Docket Management Facility by going to the street address given above under ADDRESSES.

How do I participate in the public hearings?

NHTSA will hold one virtual public hearing during the public comment period. NHTSA will announce the specific date and web address for the hearing in a supplemental **Federal Register** notification. NHTSA will accept oral and written comments to the rulemaking documents and will also accept comments to the Draft EIS at this hearing. The hearing will start at 9 a.m. Eastern time and will continue until everyone has had a chance to speak.

NHTSA will conduct the hearing informally, and technical rules of evidence will not apply. NHTSA will arrange for a written transcript of the hearing to be posted in the dockets as soon as it is available and keep the official record of the hearing open for 30 days following the hearing to allow you to submit supplementary information.

How do I comment on the Draft Environmental Impact Statement?

The Draft EIS associated with this proposal has a unique public docket number and is available at Docket No. NHTSA–2025–0491. Comments on the Draft EIS can be submitted electronically at *https://www.regulations.gov,* at this docket number. You may also mail or hand-deliver comments to Docket Management, U.S. Department of Transportation, 1200 New Jersey Avenue SE, Room W12–140, Washington, DC 20590 (referencing Docket No. NHTSA–2025–0491), between 9 a.m. and 5 p.m., Monday through Friday, except on Federal holidays. To be sure that someone is there to help you, please call (202) 366–9322 before coming. All comments and materials received, including the names and addresses of the commenters who submit them, will become part of the administrative record and will be posted on the internet without change at *https://www.regulations.gov.*

VIII. Regulatory Notices and Analyses

A. Executive Order 12866, ''Regulatory Planning and Review''; Executive Order 13563, ''Improving Regulation and Regulatory Review''; Executive Order 14192, ''Unleashing Prosperity Through Deregulation''; and Executive Order 14219, ''Ensuring Lawful Governance and Implementing the President's 'Department of Government Efficiency' Deregulatory Initiative''

E.O. 12866, ''Regulatory Planning and Review'' (58 FR 51735, Oct. 4, 1993), reaffirmed by E.O. 13563, ''Improving Regulation and Regulatory Review'' (76 FR 3821, Jan. 21, 2011), provides for determining whether a regulatory action is ''significant'' and therefore subject to the Office of Management and Budget (OMB) review process and to the requirements of the Executive order. This action is a ''significant regulatory action'' under Section 3(f)(1) of E.O. 12866 because it is likely to have an annual effect on the economy of $100 million or more. Accordingly, NHTSA submitted this action to OMB for review and any changes made in response to interagency feedback submitted via the OMB review process have been documented in the docket for this action. The estimated benefits and costs of this proposed rule are described above and in the PRIA, located in the docket and on NHTSA's website.

E.O. 14192, ''Unleashing Prosperity Through Deregulation'' (90 FR 9065, Feb. 6, 2025) requires an agency, unless prohibited by law, to identify at least ten existing regulatory requirements to be repealed when the agency publicly proposes for notice and comment or otherwise promulgates a new significant regulatory rule. Section 3(c) of E.O. 14192 also requires that the total incremental costs associated with an agency's proposed new regulations must, to the extent permitted by law, be offset by the elimination of costs associated with other previous regulations of the agency. This proposed rule, if finalized as proposed, is expected to be an E.O. 14192 deregulatory action and thus is not expected to generate net new incremental costs. The estimated cost savings of this proposal are detailed in the PRIA.

E.O. 14219, ''Ensuring Lawful Governance and Implementing the President's 'Department of Government Efficiency' Deregulatory Initiative'' (90 FR 10583, Feb. 19, 2025) requires agency heads to review their regulations and identify regulations that, among other things, are based on anything other than the best reading of the underlying statutory authority or prohibition or that implicate matters of social, political, or economic significance that are not authorized by clear statutory authority. NHTSA has identified its CAFE standards issued in 2022 and 2024 as falling within an enumerated category of E.O. 14219. Specifically, as described in an interpretive rule published on June 11, 2025, NHTSA determined that the CAFE standards issued in 2022 and 2024 are not authorized by clear statutory authority. NHTSA is issuing this proposed rule to reset the CAFE standards and bring the CAFE program into compliance with relevant statutory requirements. NHTSA discusses compliance with relevant statutory requirements in Section V above.

B. Environmental Considerations

1. National Environmental Policy Act

To inform its development of the CAFE standards for MYs 2022–2031, and pursuant to the National Environmental Policy Act (NEPA), 42 U.S.C. 4321 *et seq.,* and DOT Order 5610.1D, 90 FR 29621 (July 3, 2025), NHTSA prepared a Draft SEIS to evaluate the potential environmental impacts of the proposed action and a reasonable range of alternatives. In revising the CAFE standards established in NHTSA's June 2024 final rule, NHTSA is making substantial changes to the proposed action examined in the 2024 Final EIS and, as such, prepared this Draft SEIS to inform its amendment of MYs 2027–2031 CAFE standards. Because the MY 2026 passenger car and light truck fleets will already be produced and for sale by the time NHTSA issues a final rule to amend MYs 2022–2031 CAFE standards, this Draft SEIS analyzes environmental impacts associated only with the proposed MYs 2027–2031 CAFE standards. The Draft SEIS analyzes reasonably foreseeable impacts of the proposed rule on the potentially affected environment, which are discussed in proportion to their significance. It also discusses NHTSA's reasonable range of alternatives, including a No-Action Alternative and a Preferred Alternative, and other factors used in developing this proposed rule. The Draft SEIS addresses mitigation measures considered as part of the environmental analysis.[565]

NHTSA has considered the information contained in the Draft SEIS as part of developing this proposed rule. As explained in NHTSA's June 2025 interpretive rule, NHTSA ''must not consider the fuel economy of dedicated automobiles; must consider dual-fueled automobiles to be operated only on gasoline or diesel fuel; and must not consider, when prescribing a fuel economy standard, the trading, transferring, or availability of credits under [49 U.S.C. 32903]'';[566] NEPA, however, does not impose such constraints on analysis; instead, NEPA requires that Federal agencies consider reasonably foreseeable environmental impacts of their proposed actions.[567]

[565] DOT Order 5610.1D, sec. 26.l (''Mitigation means measures that avoid, minimize, or compensate for environmental impacts caused by a proposed action or alternatives. . . . While NEPA requires consideration of mitigation, it does not mandate the form or adoption of any mitigation.'').

[566] Resetting the Corporate Average Fuel Economy Program; Interpretive Rule, 90 FR 24518, 24519 (June 11, 2025).

[567] 42 U.S.C. 4332(2); DOT Order 5610.1D, sec. 13.f.

NHTSA's Draft SEIS therefore presents results of an ''unconstrained'' analysis that considers manufacturers' potential use of CAFE credits and application of alternative fuel technologies (including PHEVs using their charge depleting fuel economy values, BEVs, and FCEVs) in order to disclose and allow consideration of real-world environmental consequences of the Proposed Action and alternatives.[568]

The Draft SEIS is available for public comment; instructions for the submission of comments are included within the document. Afterward, NHTSA will simultaneously issue the Final SEIS and Record of Decision (ROD), pursuant to Section 14 of DOT Order 5610.D, unless NHTSA determines the statutory criteria or practicability considerations preclude simultaneous issuance. For additional information on NHTSA's NEPA analysis, please see the Draft SEIS.

2. Clean Air Act as Applied to NHTSA's Proposed Rule

CAA (42 U.S.C. 7401 *et seq.*) is the primary Federal legislation that addresses air quality. Under the authority of the CAA and subsequent amendments, EPA has established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants, which are reviewed every 5 years.

The air quality of a geographic region is usually assessed by comparing the levels of criteria air pollutants found in the ambient air to the levels established by the NAAQS (also considering the other elements of a NAAQS: averaging time, form, and indicator). Concentrations of criteria pollutants within the air mass of a region are measured in parts of a pollutant per million parts (ppm) of air or in micrograms of a pollutant per cubic meter ($\mu g/m^3$) of air present in repeated air samples taken at designated monitoring locations using specified types of monitors. These ambient concentrations of each criteria pollutant are compared to the levels, averaging time, and form specified by the NAAQS to assess whether the region's air quality is in attainment with the NAAQS.

When the measured concentrations of a criteria pollutant within a geographic region are below those permitted by the NAAQS, EPA designates the region as an attainment area for that pollutant, while regions where concentrations of criteria pollutants exceed Federal standards are called nonattainment areas. Former nonattainment areas that are now in compliance with the NAAQS are designated as maintenance areas. Each state with a nonattainment area is required to develop and implement a State Implementation Plan (SIP) documenting how the region will reach attainment levels within the time periods specified in the CAA. For maintenance areas, the SIP must document how the state intends to maintain compliance with the NAAQS. EPA develops a Federal Implementation Plan (FIP) if a state fails to submit an approvable plan for attaining and maintaining the NAAQS. When EPA revises a NAAQS, each state must revise its SIP to address how it plans to attain the new standard.

No Federal agency may ''engage in, support in any way or provide financial assistance for, license or permit, or approve'' any activity that does not ''conform'' to a SIP or FIP after EPA has approved or promulgated it.[569] Further, no Federal agency may ''approve, accept or fund'' any transportation plan, program, or project developed pursuant to title 23 or chapter 53 of title 49, U.S.C., unless the plan, program, or project has been found to ''conform'' to any applicable implementation plan in effect.[570] The purpose of these conformity requirements is to ensure that federally sponsored or conducted activities do not interfere with meeting the emissions targets in SIPs or FIPs, do not cause or contribute to new violations of the NAAQS, and do not impede the ability of a state to attain or maintain the NAAQS or delay any interim milestones. EPA has issued two sets of regulations to implement the conformity requirements:

(1) The Transportation Conformity Rule[571] applies to transportation plans, programs, and projects that are developed, funded, or approved under 23 U.S.C. (Highways) or 49 U.S.C. chapter 53 (Public Transportation).

(2) The General Conformity Rule[572] applies to all other Federal actions not covered under the Transportation Conformity Rule. The General Conformity Rule establishes emissions thresholds, or de minimis levels, for use in evaluating the conformity of an action that results in emissions increases.[573] If the net increases of direct and indirect emissions exceed any of these thresholds, and the action is not otherwise exempt, then a conformity determination is required. The conformity determination can entail air quality modeling studies, consultation with EPA and state air quality agencies, and commitments to revise the SIP or to implement measures to mitigate air quality impacts.

The proposed CAFE standards and associated program activities are not developed, funded, or approved under 23 U.S.C. or 49 U.S.C. chapter 53. Accordingly, this proposed action and associated program activities would not be subject to transportation conformity. Under the General Conformity Rule, a conformity determination is required where a Federal action would result in total direct and indirect emissions of a criteria pollutant or precursor in a nonattainment or maintenance areas equaling or exceeding the rates specified in 40 CFR 93.153(b)(1) and (2). As explained below, NHTSA's proposed action would not result in direct or indirect emissions as defined in 40 CFR 93.152.

The General Conformity Rule defines direct emissions as ''those emissions of a criteria pollutant or its precursors that are caused or initiated by the Federal action and originate in a nonattainment or maintenance area and occur at the same time and place as the action and are reasonably foreseeable.''[574] NHTSA's proposed action would set fuel economy standards for passenger cars and light trucks. It therefore would not cause or initiate direct emissions consistent with the meaning of the General Conformity Rule.[575]

Indirect emissions under the General Conformity Rule are ''those emissions of a criteria pollutant or its precursors: (1) [t]hat are caused or initiated by the Federal action and originate in the same nonattainment or maintenance area but occur at a different time or place as the action; (2) [t]hat are reasonably foreseeable; (3) [t]hat the agency can practically control; and (4) [f]or which the agency has continuing program responsibility.''[576] Each element of the definition must be met to qualify as indirect emissions. NHTSA has determined, for purposes of general conformity, that emissions (if any) that may result from its fuel economy standards would not be caused by the agency's action, but rather would occur

[568] See Appendix C of the Draft SEIS for a discussion of the full range of modeled electrified technologies.

[569] 42 U.S.C. 7506(c)(1).

[570] 42 U.S.C. 7506(c)(2).

[571] 40 CFR part 51, subpart T, and part 93, subpart A.

[572] 40 CFR part 51, subpart W, and part 93, subpart B.

[573] 40 CFR 93.153(b).

[574] 40 CFR 93.152.

[575] *Dep't of Transp.* v. *Pub. Citizen,* 541 U.S. 752, 772 (2004) (''[T]he emissions from the Mexican trucks are not 'direct' because they will not occur at the same time or at the same place as the promulgation of the regulations.''). NHTSA's proposed action would establish fuel economy standards for MYs 2022–2031 passenger cars and light trucks; any emissions increases would occur in a different place and well after promulgation of the proposed rule.

[576] 40 CFR 93.152.

because of subsequent activities the agency cannot practically control. ''[E]ven if a Federal licensing, rulemaking or other approving action is a required initial step for a subsequent activity that causes emissions, such initial steps do not mean that a Federal agency can practically control any resulting emissions.'' [577]

EPCA requires NHTSA to set fleetwide average fuel economy standards for the CAFE program using performance-based standards. NHTSA is not authorized to dictate how manufacturers are to comply with the standards, nor may NHTSA require manufacturers to use specific technologies to achieve improved fuel economy in their fleets. Furthermore, NHTSA cannot control consumer purchasing or driving behavior, both of which can have a considerable effect on vehicle emissions of criteria pollutants. It is the combination of factors outside NHTSA's control, such as manufacturers' decisions to apply fuel economy technologies and consumers' purchasing and driving behaviors, which determine the aggregate levels of criteria pollutant and precursor emissions. For purposes of analyzing the environmental impacts of the alternatives considered under NEPA, NHTSA has necessarily made assumptions regarding all of these factors.

In addition, NHTSA does not have the statutory authority or practical ability to control the actual vehicle miles traveled (VMT) by drivers. As the extent of emissions is directly dependent on the operation of motor vehicles, changes in any emissions that would result from NHTSA's proposed CAFE standards are not changes NHTSA can practically control or for which NHTSA has continuing program responsibility. Therefore, the proposed CAFE standards and alternative standards considered by NHTSA would not cause indirect emissions under the General Conformity Rule, and a general conformity determination is not required.

3. Endangered Species Act (ESA)

Under Section 7(a)(2) of the ESA, Federal agencies must ensure that actions they authorize, fund, or carry out are ''not likely to jeopardize the continued existence'' of any federally listed threatened or endangered species (collectively, ''listed species'') or result in the destruction or adverse modification of the designated critical habitat of these species.[578] If a Federal agency determines that an agency action may affect a listed species or designated critical habitat, it must initiate consultation with the appropriate service—the U.S. Fish and Wildlife Service (FWS) of the Department of the Interior (DOI) or the National Oceanic and Atmospheric Administration's National Marine Fisheries Service of the Department of Commerce (together, ''the Services''), or both, depending on the species involved—in order to ensure that the action is not likely to jeopardize the species or destroy or adversely modify designated critical habitat.[579] Under this standard, the Federal agency taking action evaluates the possible effects of its action and determines whether to initiate consultation.[580]

The Services have previously provided legal and technical guidance about whether CO_2 emissions associated with a specific proposed Federal action trigger ESA Section 7(a)(2) consultation. NHTSA analyzed the Services' history of actions, analysis, and guidance in Appendix G of the MYs 2012–2016 CAFE standards EIS and now incorporates by reference that appendix here.[581] In that appendix, NHTSA looked at the history of the Polar Bear Special Rule and several guidance memoranda provided by FWS and the U.S. Geological Survey. Ultimately, DOI concluded that a causal link could not be made between CO_2 emissions associated with a proposed Federal action and specific effects on listed species; therefore, no Section 7(a)(2) consultation would be required.

Subsequent to the publication of that appendix, a court vacated the Polar Bear Special Rule on NEPA grounds, though it upheld the ESA analysis as having a rational basis.[582] FWS then issued a revised Final Special Rule for the Polar Bear.[583] In that final rule, FWS provided for ESA Section 7, that the determination of whether consultation is triggered is narrow and focused on the discrete effect of the proposed agency action. FWS wrote, ''[T]he consultation requirement is triggered only if there is a causal connection between the proposed action and a discernible effect to the species or critical habitat that is reasonably certain to occur. One must be able to 'connect the dots' between an effect of proposed action and an impact to the species and there must be a reasonable certainty that the effect will occur.'' [584] The statement in the revised Final Special Rule is consistent with the prior guidance published by FWS and remains valid today.[585] If the consequence is not reasonably certain to occur, it is not an ''effect of a proposed action'' and does not trigger the consultation requirement.

Pursuant to Section 7(a)(2) of the ESA, NHTSA considered the effects of the proposed CAFE standards and reviewed applicable ESA regulations, case law, and guidance to determine what, if any, impact there might be to listed species or designated critical habitat. Based on this assessment, the agency has determined that the action of setting CAFE standards does not require consultation under Section 7(a)(2) of the ESA and has concluded the agency's review of this action under Section 7 of the ESA.

4. Other Regulatory Analyses Discussed in the Draft SEIS

NHTSA conducted brief qualitative reviews of the impacts of action alternatives on potentially affected resources, including those related to the statutory requirements and orders listed below, in the Draft SEIS, and determined that setting CAFE standards for passenger cars and light trucks is not the type of activity to have impacts on such resource categories:

- National Historic Preservation Act (NHPA);
- Fish and Wildlife Conservation Act (FWCA);
- Coastal Zone Management Act (CZMA);
- Floodplain Management (E.O. 11988 and DOT Order 5650.2);
- Preservation of the Nation's Wetlands (E.O. 11990 and DOT Order 5660.1a);
- Migratory Bird Treaty Act (MBTA), Bald and Golden Eagle Protection Act (BGEPA), E.O. 13186; and
- Department of Transportation Act (Section 4(f)).

[577] 40 CFR 93.152.

[578] 16 U.S.C. 1536(a)(2).

[579] *See* 50 CFR 402.14.

[580] *See* 50 CFR 402.14(a) (''Each Federal agency shall review its actions at the earliest possible time to determine whether any action may affect listed species or critical habitat.'').

[581] Available on NHTSA's Corporate Average Fuel Economy website at: NHTSA, Appendix G: Endangered Species Act Consideration, available at: *https://static.nhtsa.gov/nhtsa/downloads/CAFE/2012-2016%20Docs-PCLT/2012-2016%20Final%20Environmental%20Impact%20Statement/Appendix_G_Endangered_Species_Act_Consideration.pdf* (accessed: Sept. 10, 2025).

[582] In re: Polar Bear Endangered Species Act Listing and § 4(D) Rule Litigation, 818 F.Supp.2d 214 (D.D.C. Oct. 17, 2011).

[583] 78 FR 11766 (Feb. 20, 2013).

[584] 78 FR 11784–11785 (Feb. 20, 2013).

[585] See DOI, Guidance on the Applicability of the Endangered Species Act Consultation Requirements to Proposed Actions Involving the Emissions of Greenhouse Gases, Solicitor's Opinion No. M–37017, DOI: Washington, DC (2008), available at: *https://www.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/M-37017.pdf* (accessed: Sept. 10, 2025).

5. Executive Order 13045: ''Protection of Children From Environmental Health Risks and Safety Risks''

This action is subject to E.O. 13045 (62 FR 19885, Apr. 23, 1997). Pursuant to E.O. 13045, NHTSA must prepare an evaluation of the environmental health or safety effects of the planned action on children and an explanation of why the planned action is preferable to other potentially effective and reasonably feasible alternatives considered by NHTSA. Further, this analysis may be included as part of any other required analysis.

While environmental and health effects associated with criteria pollutant and toxic air pollutant emissions vary over time and across alternatives, negative effects, when estimated, are extremely small. This preamble and the Draft SEIS discuss air quality, climate, and their related environmental and health effects. In addition, Section V of this preamble explains why NHTSA believes the proposed CAFE standards are preferable to other alternatives considered. Together, this preamble and Draft SEIS satisfy NHTSA's responsibilities under E.O. 13045.

6. Executive Order 14154: ''Unleashing American Energy''

E.O. 14154, ''Unleashing American Energy'' (90 FR 8353, Jan. 29, 2025), announced the administration's policy regarding energy resources, specifically to promote the production, distribution, and use of reliable domestic energy supplies, including oil, natural gas, and biofuels; to ensure that all regulatory requirements related to energy are ''grounded in clearly applicable law''; and ''to eliminate the 'electric vehicle (EV) mandate' and promote true consumer choice'' [586] by ''removing regulatory barriers to motor vehicle access; by ensuring a level regulatory playing field for consumer choice in vehicles; by terminating, where appropriate, state emissions waivers that function to limit sales of gasoline-powered automobiles; and by considering the elimination of unfair subsidies and other ill-conceived government-imposed market distortions that favor EVs over other technologies and effectively mandate their purchase by individuals, private businesses, and government entities alike by rendering other types of vehicles unaffordable.'' [587] E.O. 14154 also directs agencies to adhere only to relevant legislated requirements for environmental considerations and to eliminate any considerations beyond these requirements. Further, the Executive order specifically directed the Council on Environmental Quality to propose rescinding its NEPA regulations found at 40 CFR 1500. CEQ rescinded its NEPA regulations in an interim final rule published on February 25, 2025. That rule went into effect on April 11, 2025.[588]

This proposed rule follows the direction of E.O. 14154 to ensure that all analysis related to energy is grounded in clearly applicable law and that only the relevant legislated requirements for environmental considerations and any considerations beyond these requirements are eliminated from the assessment of maximum feasible standards and the Draft SEIS.

7. Executive Order 14173: ''Ending Illegal Discrimination and Restoring Merit-Based Opportunity''

E.O. 14173, ''Ending Illegal Discrimination and Restoring Merit-Based Opportunity'' (90 FR 8633, Jan. 31, 2025), removed ''diversity, equity, and inclusion'' (DEI) and ''diversity, equity, inclusion, and accessibility'' (DEIA) principles from mandates, policies, programs, activities, guidance, regulations, and requirements. This Executive order revoked E.O. 12898, ''Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations'' (59 FR 7629, Feb. 11, 1994), which directed Federal agencies to identify and address, as appropriate, ''disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.'' [589] The proposed rule is in compliance with E.O. 14173, and the Draft SEIS analyzes the impacts on the quality of life of all Americans potentially affected by the proposed action.

C. Regulatory Flexibility Act

Pursuant to the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.,* as amended), whenever an agency is required to publish an NPRM, it must prepare and make available for public comment a regulatory flexibility analysis that describes the effect of the rule on small entities (*e.g.,* small businesses, small organizations, and small governmental jurisdictions). No regulatory flexibility analysis is required if the head of an agency certifies the rule will not have a significant economic impact on a substantial number of small entities and publishes with the proposed rule a statement of the factual basis for certifying that a rule will not have a significant economic impact on a substantial number of small entities.

NHTSA has considered the impacts of this proposed rule under the Regulatory Flexibility Act, and the NHTSA Administrator certifies this proposed rule will not have a significant economic impact on a substantial number of small entities. NHTSA's statement providing the factual basis for this certification pursuant to 5 U.S.C. 605(b) follows.

Small businesses are defined based on the North American Industry Classification System (NAICS) code.[590] One of the criteria for determining size is the number of employees in the firm. For establishments primarily engaged in manufacturing or assembling automobiles, the firm must have less than 1,500 employees to be classified as a small business. This rulemaking would affect motor vehicle manufacturers. As shown in Table VIII–1, NHTSA has identified twelve small manufacturers that produce passenger cars, light trucks, and SUVs. NHTSA acknowledges that some very new manufacturers may potentially not be listed. However, those new manufacturers tend to have transportation products that are not part of the light-duty vehicle fleet and have yet to start production of relevant vehicles.[591]

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[586] E.O. 14154, sec. 2, Unleashing American Energy, 90 FR 8353 (Jan. 29, 2025).

[587] E.O. 14154, sec. 2(e).

[588] See Removal of National Environmental Policy Act Implementing Regulations, Docket No. CEQ–2025–0002.

[589] E.O. 12898, sec. 1–101.

[590] Classified in NAICS under Subsector 336—Transportation Equipment Manufacturing for Automobile and Light Duty Motor Vehicle Manufacturing (336110), available at: *https://www.sba.gov/document/support-table-size-standards* (accessed: Sept. 10, 2025).

[591] 5 U.S.C. 605(b).

Table VIII-1: Small Domestic Manufacturers

Manufacturers	Founded	Employees[592]	Estimated Annual Production[593]
BXR Motors	2007	< 25	< 100
Equus Automotive	2008	< 25	< 100
Falcon Motorsports	2009	< 25	< 100
Faraday Future	2014	249	<100
Lucra Cars	2005	< 25	< 100
Lyons Motor Car	2012	< 25	< 100
Panoz	1988	< 50	< 100
RAESR	2013	< 25	< 100
Rezvani Motors	2014	< 25	< 100
Rossion Automotive	2007	< 50	< 100
Saleen Automotive, Inc.	1984	113	< 100
SSC Automotive	1999	< 25	< 100

NHTSA believes that the proposed rule would not have a significant economic impact on small vehicle manufacturers. The proposal is intended to reset the CAFE standards consistent with NHTSA's statutory authority. In addition, under 49 CFR part 525, passenger car manufacturers building less than 10,000 vehicles per year can petition NHTSA to have alternative standards apply to them. The listed manufacturers producing gasoline- and diesel-powered vehicles do not currently meet the standard and must already petition NHTSA for relief. This proposal to amend standards is not expected to have a meaningful impact on these manufacturers—they are still expected to be required to go through the same process and petition for relief, as the amended standards are expected to exceed the maximum feasibility of these small manufacturers. Accordingly, a regulatory flexibility analysis was not prepared.

D. Executive Order 13132 (''Federalism'')

E.O. 13132, ''Federalism'' (64 FR 43255, Aug. 10, 1999), requires Federal agencies to develop an accountable process to ensure ''meaningful and timely input by state and local officials in the development of regulatory policies that have federalism implications.'' The Executive order defines the term ''[p]olicies that have federalism implications'' to include regulations that have ''substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government.'' Under the Executive order, agencies may not issue a regulation that has federalism implications, which imposes substantial direct compliance costs, unless the Federal Government provides the funds necessary to pay the direct compliance costs incurred by the state and local governments, or the agencies consult with state and local officials early in the process of developing the proposed rule.

NHTSA has determined that this proposed rule does not implicate E.O. 13132, because it neither imposes substantial direct compliance costs on state, local, or tribal governments, nor does it preempt state law. Thus, this proposed rule does not implicate the consultation procedures that E.O. 13132 imposes on agency regulations that would either preempt state law or impose substantial direct compliance costs on state, local, or tribal governments, because the only entities subject to this proposed rule are vehicle manufacturers.

NHTSA is not taking any action regarding preemption in this proposed rule, as this rule's purpose is to propose amended CAFE standards. Nothing in EPCA or EISA provides that NHTSA must make a determination or pronouncement on preemption.

E. Executive Order 12988 (''Civil Justice Reform'')

With respect to the review of the promulgation of a new regulation, Section 3(b) of E.O. 12988, ''Civil Justice Reform'' (61 FR 4729, Feb. 7, 1996), requires that executive agencies make every reasonable effort to ensure that the regulation: (1) clearly specifies the preemptive effect; (2) clearly specifies the effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct, while promoting simplification and burden reduction; (4) clearly specifies the retroactive effect, if any; (5) specifies whether administrative proceedings are to be required before parties file suit in court; (6) adequately defines key terms; and (7) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. This document is consistent with these requirements.

NHTSA has examined this proposed rule to reset the CAFE standards applicable to MYs 2022–2026 and MYs 2027–2031 and determined that it meets the requirements of the Executive order. In particular, the issue of preemption is discussed above and the agency's assessment of the rule's effect on prior model years is discussed in Section V. NHTSA notes further that there is no requirement that individuals submit a petition for reconsideration or pursue

592 Estimated number of employees as of Jan. 2025, source: *linkedin.com, zoominfo.com, rocketreach.co,* and *datanyze.com.*

593 Rough estimate of LDV production for MY 2024.

other administrative proceedings before they file suit in court. In addition, the rule provides a clear legal standard for compliance, establishing CAFE standards for passenger cars and light trucks for MYs 2022–2026 and MYs 2027–2031.

F. Executive Order 13175 (''Consultation and Coordination With Indian Tribal Governments'')

This proposed rule does not have tribal implications, as specified in E.O. 13175, ''Consultation and Coordination with Indian Tribal Governments'' (65 FR 67249, Nov. 9, 2000). This proposed rule would be implemented at the Federal level and would directly impact only vehicle manufacturers. Thus, E.O. 13175, which requires consultation with tribal officials when agencies are developing policies that have ''substantial direct effects'' on tribes and tribal interests, does not apply to this proposed rule.

G. Unfunded Mandates Reform Act

Section 202 of the Unfunded Mandates Reform Act of 1995 (UMRA) requires Federal agencies to prepare a written assessment of the costs, benefits, and other effects of a proposed or final rule that includes a Federal mandate likely to result in the expenditure by state, local, or tribal governments, in the aggregate, or by the private sector, of more than $100 million in any 1 year (adjusted for inflation with base year of 1995). Adjusting this amount by the implicit GDP price deflator for 2024 results with $187 million (125.23/ 66.939 = 1.87).[594] Before promulgating a rule for which a written statement is needed, Section 205 of UMRA generally requires NHTSA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost effective, or least burdensome alternative that achieves the objective of the rule. The provisions of Section 205 do not apply when they are inconsistent with applicable law. Moreover, Section 205 allows NHTSA to adopt an alternative other than the least costly, most cost effective, or least burdensome alternative if NHTSA publishes with the rule an explanation of why that alternative was not adopted.

This proposed rule will not result in the expenditure by state, local, or tribal governments, in the aggregate, of more than $187 million annually, but it will result in cost savings exceeding that amount for vehicle manufacturers and their suppliers. In developing this proposed rule, NHTSA considered a range of alternative fuel economy standards. As explained in detail in Section V of the preamble above, NHTSA concludes its selected alternatives are the maximum feasible alternatives that achieve the objectives of this proposed rule, as required by EPCA/EISA.

H. Regulation Identifier Number

DOT assigns a regulation identifier number (RIN) to each regulatory action listed in the Unified Agenda of Federal Regulations. The Regulatory Information Service Center publishes the Unified Agenda in the spring and fall of each year. The RIN contained in the heading at the beginning of this document may be used to find this action in the Unified Agenda.

I. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act (NTTAA) requires NHTSA to evaluate and use existing voluntary consensus standards in its regulatory activities unless doing so would be inconsistent with applicable law (*i.e.,* the statutory provisions regarding NHTSA's vehicle safety authority) or otherwise impractical.[595]

Voluntary consensus standards are technical standards developed or adopted by voluntary consensus standards bodies. Technical standards are defined by the NTTAA as ''performance-based or design-specific technical specification and related management systems practices.'' They pertain to ''products and processes, such as the size, strength, or technical performance of a product, process, or material.'' [596]

Examples of organizations generally regarded as voluntary consensus standards bodies include the American Society for Testing and Materials, International, the SAE, and the American National Standards Institute (ANSI). If NHTSA does not use available and potentially applicable voluntary consensus standards, it is required by the act to provide Congress, through OMB, an explanation of reasons for not using such standards. There are currently no consensus standards that NHTSA administers relevant to these proposed CAFE standards.

J. Department of Energy Review

In accordance with 49 U.S.C. 32902(j)(2), NHTSA submitted this proposed rule to DOE for review. That agency did not make any comments that NHTSA did not address.[597]

K. Paperwork Reduction Act

Under the procedures established by the Paperwork Reduction Act of 1995 (PRA) (44 U.S.C. 3501 *et seq.*), Federal agencies must obtain approval from the OMB for each collection of information they conduct, sponsor, or require through regulations. A person is not required to respond to a collection of information by a Federal agency unless the collection displays a valid OMB control number. The Information Collection Request (ICR) for a modification to NHTSA's existing information collection for CAFE Reporting described below is being forwarded to OMB for review and comment. In compliance with these requirements, NHTSA asks for public comments on the following proposed collection of information for which the agency is seeking approval from OMB.

Title: Corporate Average Fuel Economy Reporting.

OMB Control Number: 2127–0019.

Form Number: NHTSA Form 1474 (CAFE Projections Reporting Template).

Type of Request: Modification of a currently approved collection.

Type of Review Requested: Regular.

Requested Expiration Date of Approval: Three years from date of approval.

Summary of the Collection of Information: NHTSA is submitting to OMB, in connection with this NPRM, an information collection request (ICR) for NHTSA's information collections for the CAFE program. The ICR covers 11 information collections: two required projection reports (pre-model year and mid-model year reports), eight additional compliance submissions that are required to be submitted under certain circumstances, and one information collection for a petition process that is required to receive a benefit. NHTSA is requesting approval for the modification of the ICR to cover proposed changes in this NPRM, including both additions and removals to required reporting. Specifically, the modifications include: (1) amending reporting elements related to vehicle classification on the pre-model year and mid-model year reports; (2) removing data elements related to AC and OC fuel consumption incentive values (FCIVs), in line with the AC and OC FCIV

[594] Bureau of Economic Analysis (BEA), National Income and Product Accounts, NIPA Table 1.1.9: Implicit Price Deflators for Gross Domestic Product (2025), available at: *https://apps.bea.gov/iTable/?reqid=19&step=2&isuri=1&categories=survey* (accessed: Sept. 10, 2025).

[595] 15 U.S.C. 272.

[596] 142 Cong. Rec. S1081 (Feb. 7, 1996) (statement of Sen. Rockefeller).

[597] DOE's letter of review for the notice of the proposed rule.

program ending in MY 2027; (3) removing reporting requirements for credit trading in line with NHTSA's proposal to end credit trading in MY 2027, which includes credit trade contracts, credit allocation plans, credit transaction requests, and credit value reports; and (4) updating the pre-model year and mid-model year reporting templates to align with revised requirements. In addition, NHTSA is removing information collection requirements that were already ending in the regulation for reporting requirements related to AC and OC FCIV petitions, which are set to end in MY 2026 and reporting requirements related to hybrid/electric full-size pickup truck FCIVs, which end in MY 2024.

The following table provides a summary of each of the information collections in the ICR.

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Table VIII-2: CAFE Information Collections

Report or Submission Title	Regulatory Requirement	Description of Reported Information
Pre-model Year Reports	§ 537.5, § 537.7(b), § 537.7(c)(1) and (2), § 537.7(c)(3) and (4), § 537.7(c)(5), § 537.7(c)(7)	1. General reporting information for identifying the manufacturer.
		2. Projected required fuel economy.
		3. Combined fuel economy and projected sales information.
		4. Vehicle configuration design and attribute data (e.g., transmission and engine information).
		5. Non-passenger automobile (light truck) attribute data (e.g., 4WD and ground clearance measurements).
		6. Any improved AC, OC and full-size pickup truck technologies used each model year to calculate the average fuel economy specified in 40 CFR 600.510-12(c).
		7. Additional reporting fields for AC/OC and other clarifying data fields have been added to the template since last review.
Mid-model Year Reports	§ 537.5, § 537.7(b), § 537.7(c)(1) and (2)	1. General reporting information for identifying the manufacturer.
		2. Projected required fuel economy.
		3. Combined fuel economy and projected sales information.
		4. Vehicle configuration design and attribute data (e.g., transmission and engine information).
		5. Non-passenger automobile (light truck) attribute data (e.g., 4WD and ground clearance measurements).
		6. Any improved AC, OC and full-size pickup truck technologies used each model year to calculate the average fuel economy specified in 40 CFR 600.510-12(c).
		7. Additional reporting fields for AC/OC and other clarifying data fields have been added to the template since last review.
Supplementary Reports	§ 537.5, § 537.8	1. General reporting information for identifying the manufacturer.
		2. Projected required fuel economy.
		3. Combined fuel economy and projected sales information.
		4. Vehicle configuration design and attribute data (e.g., transmission and engine information).
		5. Non-passenger automobile (light truck) attribute data (e.g., 4WD and ground clearance measurements).
		6. Any improved AC, OC and full-size pickup truck technologies used each model year to calculate the average fuel economy specified in 40 CFR 600.510-12(c).
		7. Additional reporting fields for AC/OC and other clarifying data fields have been added to the template since last review.
Information for setting future CAFE standards	49 U.S.C. 32902	Information on platform series fuel economy for CAFE Modeling.
Petitions for alternative CAFE standards	§ 525.6 and § 525.7	Petitions for small volume manufacturers seeking relief to allow them to comply with less stringent alternative CAFE standards. Manufacturers submit information on production and fuel efficiency of the vehicles they plan to produce.

Reports on corporate relationship transactions	§ 534.5(e) and § 534.6 and § 536.8(c)	Manufacturers file certified reports when one manufacturer has assumed a controlling stock ownership or control over the design, production or sale of vehicles of another manufacturer, affecting the allocation of credits or liabilities.
Credit Trade Contract	§ 536.5(c) and § 536.8	Manufacturers submit instructions to NHTSA to execute credit transactions using earned, transferred, traded, carry-forward, and carryback credit transactions/allocations using the Credit Transaction Template.
Credit Allocation Plan	§ 536.5(d)	If a manufacturer's vehicles in a particular compliance category have below standard fuel economy, upon notification from NHTSA, the manufacturer will be required to submit a plan indicating how it will allocate existing credits, earn, transfer and/or acquire credits, or pay the appropriate civil penalty.
Credit transaction requests	§ 536.5(e)	Manufacturers submit instructions to NHTSA to execute credit transactions using earned, transferred, traded, carry-forward, and carryback credit transactions/allocations.
Credit Carry-back Plan	§ 536.7	Manufacturers submit plans to carryback credits earned in a compliance category in any model year, pursuant to 49 U.S.C. 32903(b), for up to three model years prior to the year in which the credit was earned.
Credit Value Reporting	§ 536.5(c)	NHTSA will collect credit cost information in accordance with 49 CFR 536.5(c)(5).

Description of the Need for the Information and Proposed Use of the Information: The following table provides a brief description of the need and use of each information collection.

Table VIII-3: Description of Data Collection Uses

Report or Submission Title	Description of how, by whom and what purpose the information is used
Pre-model Year Reports	NHTSA uses these reports for reference to help the agency anticipate potential compliance issues as early as possible and help manufacturers plan compliance strategies. NHTSA also uses the reports for auditing and testing purposes, which helps manufacturers correct errors prior to the end of the model year and facilitates acceptance of their final CAFE report by EPA.
Mid-model Year Reports	NHTSA uses these reports for reference to help the agency anticipate potential compliance issues as early as possible and help manufacturers plan compliance strategies. NHTSA also uses the reports for auditing and testing purposes, which helps manufacturers correct errors prior to the end of the model year and facilitates acceptance of their final CAFE report by EPA.
Supplementary Reports	NHTSA uses these reports to help the agency understand any changes to the production predicted in the pre-model year or mid-model year reports as soon as possible in the reporting cycle. NHTSA also uses the reports for auditing and testing purposes, which helps manufacturers correct errors prior to the end of the model year and facilitates acceptance of their final CAFE report by EPA.
Information for setting future CAFE standards	NHTSA uses certain data from projection reports to prepare a market data file, which supports the development of the CAFE Model.
Petitions for alternative CAFE standards	NHTSA uses these petitions to determine if a manufacturer is eligible for small volume exemptions. If it is determined that they qualify, NHTSA publishes a *Federal Register* Notice.
Reports on corporate relationship transactions	NHTSA uses these reports to determine corporate relationships between manufacturers, and subsequent handling of combined or separated credit banks.
Credit Trade Contract	NHTSA uses these to evaluate if a credit trade can be executed, for example, if there are enough credits available to complete the trade. Once NHTSA has determined the requested trade can be executed, NHTSA uses these reports as instructions to execute the trade.
Credit Allocation Plan	NHTSA uses the credit allocation plans to determine how manufacturers will solve their credit shortfalls each year.
Credit Transaction Requests	NHTSA uses these to evaluate if a credit transaction can be executed, for example, if there are enough credits available to complete the transaction. Once NHTSA has determined the requested transaction can be executed, NHTSA uses these reports as instructions to execute the transaction.
Credit Carry-back Plan	NHTSA uses these to evaluate if a credit transaction can be executed, for example, if there are enough credits available to complete the transaction. Once NHTSA has determined the requested transaction can be executed, NHTSA uses these reports as instructions to execute the transaction.
Credit Value Reporting	NHTSA uses the credit value reporting to determine the value of a credit in the market. This will help NHTSA when setting standards and fines in the future.

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Affected Public: Respondents are manufacturers of engines and vehicles within the North American Industry Classification System (NAICS) and use the coding structure as defined by NAICS, including codes 33611, 336111, 336112, 33631, 33632, 336320, 33635, and 336350 for motor vehicle and parts manufacturing.

Estimated Number of Respondents: 28.

The two largest information collections for the pre-model year and mid-model year reports each have an estimated 25 respondents per year. These respondents are the vehicle manufacturers that manufacture automobiles subject to the CAFE standards in 49 CFR parts 531 and 533 and they must report pursuant to 49 CFR part 537. For the remaining collections, the number of respondents varies each year, as the information is collected on an as-needed basis from the 25 respondents each year, except for the small volume petitions. NHTSA estimates that, on average, three small volume manufacturers will petition NHTSA for alternative standards in each year, and these three respondents will be unique from those 25 respondents who must submit pre-model year and mid-model year reports annually. Accordingly, NHTSA estimates there will be 28 unique respondents to the CAFE reporting requirements annually.

Frequency: Varies by collection.

The pre-model year and mid-model year reports are both annual reports. However, the other collections are submitted when needed and are generally based on compliance obligations arising in particular circumstances.

Number of Responses: Varies.

NHTSA estimates that there will be an average of 25 responses for the pre-model year and mid-model year reporting requirements. For the other collections, the number of responses varies and NHTSA has provided annualized averages for each collection in Table VIII–4 below.

Estimated Total Annual Burden Hours: 4,576 hours.

The total number of burden hours associated with this collection is estimated to be 4,576 hours. The average number of respondents and responses estimated for each submission type is based on a 3-year average from MY 2026 through MY 2028. Certain reporting elements will be discontinued starting in MY 2028, which is reflected in the 3-year average.

An average of 25 automobile manufacturers submitted CAFE pre-model year and mid-model year reports over MYs 2017–2025 under 49 CFR part 537. Manufacturers use engineers, managers, legal, and clerical staff to prepare and submit CAFE reports to NHTSA. All manufacturers use electronic database systems to produce CAFE reports, and manufacturers can use those databases to export the compliance data required by Part 537. The template has been updated since the last rulemaking based on feedback from manufacturers on functionality. The burden hours associated with producing CAFE reports primarily involve engineers and managers reviewing the output of these database systems. NHTSA estimates that each pre-model year and mid-model year report takes each manufacturer approximately 51 hours. Therefore, NHTSA estimates that manufacturers spend a total of 1,275 hours (25 respondents × 51 hours) each year producing pre-model year reports and 1,275 hours (25 respondents × 51 hours) each year producing the required mid-model year CAFE reports.

Manufacturers may also be required to submit supplementary reports if the information in their mid-model year report needs to be corrected. NHTSA receives on average three supplementary reports from manufacturers each year requesting to make corrections to previously submitted reports. These revisions account for 93 (3 respondents × 31 hours) additional burden hours.

Starting with the 2017 compliance model year, manufacturers began incurring additional burden hours for incorporating information regarding AC technologies, OC technologies, and advanced technology that is applied to full-sized pickup trucks into pre-model year and mid-model year reports. However, this reporting burden will cease when these incentives are no longer applicable, which end in MY 2024 for advanced technology that is applied to full-sized pickup trucks and in MY 2026 for AC and OC technologies. This results in a reduction in burden for submitting pre-model year and mid-model year reports.

Manufacturers may also be required occasionally to submit existing production information (*e.g.,* what engines are shared across vehicle models) to NHTSA for its analysis in modeling potential future economy improvements and standards. The production information is similar to the information submitted as part of EPA's final model year report (*e.g.,* final model year vehicle volumes). NHTSA anticipates that each manufacturer may periodically spend 13 hours for each submission of information for NHTSA's analysis, which will result in a total burden of 325 hours annually (25 respondents × 13 hours) for the automotive industry.

On average, three small volume manufacturers submit petitions for alternative standards to NHTSA each year. These petitions are seeking relief from complying with conventional CAFE standards. These small volume manufacturers primarily include exotic sports car manufacturers (*e.g.,* Aston Martin and McLaren). The associated burden hours involve attorneys, engineers, and managers collecting fuel economy performance and production information on their production vehicles and preparing petitions for submission to NHTSA. These professionals will spend approximately 89 hours to prepare each petition. As a result, the estimated total industry burden will be 267 annual hours (3 respondents × 89 hours) for preparing and submitting CAFE petitions for alternative standards to NHTSA.

Very few manufacturers incur burden each year in submitting documents to NHTSA for corporate relationship changes. On average, only one manufacturer each model year submits documents to NHTSA for corporate relationship changes. The burden hours associated with this activity primarily involve attorneys preparing documents. Minimal amounts of burden hours are necessary for engineers and managers to review documents and for clerical staff to submit them to NHTSA. The estimated total industry burden will be 19 annual hours (1 respondent × 19 hours) for preparing and submitting information on corporate relationship changes to NHTSA.

Nearly all vehicle manufacturers will incur burden hours in managing their CAFE credit accounts each year. Credit management is a significant activity for vehicle manufacturers that are addressing a current credit shortfall or are preparing to avoid one in the future. Manufacturers manage their credit accounts using engineers, managers, and attorneys to prepare documents and then clerical staff to submit credit allocation plans, credit transaction instructions and trade documents to NHTSA. Manufacturers submit credit transaction instructions to NHTSA at various times throughout the model year when transferring credit trades from one manufacturer to another or when submitting a credit allocation plan to NHTSA because of a credit shortfall. On average, based upon compliance data for MYs 2017–2025, NHTSA receives 25 credit transaction instructions from vehicle manufacturers each model year. There are an additional 11 credit shortfalls/credit allocation plans submitted each year. There are an additional 17 credit trades with accompanying credit trades documents, which have been reduced due to credit trades no longer being applicable starting in MY 2028. Both credit allocation plans and credit transaction requests have their labor hour burdens slightly reduced due to credit trades no longer being applicable starting in MY 2028. Therefore, NHTSA estimates that manufacturers will spend a total of approximately 374 hours for credit trade documents each year (17 respondents × 22 hours), 297 hours for credit allocation plans (11 respondents × 27 hours), and 250 hours for credit transaction requests (25 respondents × 10 hours).

NHTSA rarely receives carryback plans. A temporary increase in respondents for carryback plans occurred only for MYs 2019–2021, maintaining the average at approximately one respondent per year. NHTSA estimates that on average 27 hours (1 respondent × 27 hours) will be incurred by any manufacturer preparing a credit carryback plans each year.

NHTSA requires all manufacturers engaging in trades to report credit cost information, so that NHTSA can determine the monetary and non-monetary values of credit trades. Manufacturers are required to submit this information every time they fill out a credit trade contract per 49 CFR 536.5(c)(5). In the 2021 NPRM, NHTSA had proposed a Credit Value Reporting Template to ease the process of reporting credit cost information. In response to comments, NHTSA decided to hold off on requiring the Credit Value Reporting Template. Credit cost information is still required in the format that manufacturers choose to submit to meet the requirements of this section, and the hourly burden remains the same even without a Credit Value Reporting Template. NHTSA currently receives an average of 25 credit trade contracts annually, but the average will drop off due to the removal of credit trading starting in MY 2028, resulting in an estimated average of 17 respondents. Therefore, the total burden hours for submitting credit value information in conjunction with credit trade contracts is estimated to be 374 hours (17 reports × 22 hours). The total combined hours for the industry to manage their credit accounts is estimated to be 1,322 hours annually (374 hours + 297 hours + 250 hours + 27 hours + 374 hours).

Table VIII–4 provides a summary of the annual burden hours for each of the 11 information collections.

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Table VIII-4: Annual Burden Hours

Report or Submission Title	Total Annual Reponses	Manufacturer Labor Hours					Total Fleet Hours
		Engineer	Manager	Legal	Clerical	Burden Per Respondent	
Pre-model Year Reports	25	41	7	1	2	51	1275
Mid-model Year Reports	25	41	7	1	2	51	1275
Supplementary Reports	3	22	6	1	2	31	93
Information for setting future CAFE standards	25	8	4	0	1	13	325
Petitions for alternative CAFE standards	3	40	8	40	1	89	267
Reports on corporate relationship transactions	1	1	1	16	1	19	19
Credit Trade Contract	17	2	2	16	2	22	374
Credit Allocation Plan	11	14	4	8	1	27	297
Credit Transaction Requests	25	7	1	1	1	10	250
Credit Carry-back Plan	1	16	2	8	1	27	27
Credit Value Reporting	17	2	2	16	2	22	374
Totals	153	194	44	108	16	362	4,576

The estimated total annual labor hour cost associated with 4,576 burden hours for CAFE reporting is $437,468.62. The cost is based upon the estimated burden hours and current average labor rates for engineers, managers, attorneys, and clerical staff to prepare and send CAFE information to NHTSA. Table VIII–4 provides the breakdown of the associated costs based upon individual hourly mean wage estimates from the Bureau of Labor Statistics (BLS) for 2024 National Industry-Specific Occupational Employment and Wage Statistics,[598] which are adjusted for employee compensation costs.

BLS estimates that the hourly mean wage for Engineers (Engineer) (BLS Occupation code 17–2199) in the Motor Vehicle Manufacturing Industry is $54.54. BLS estimates that the hourly mean wage for Administrative Services Managers (Manager) (BLS Occupation code 11–3012) in the Motor Vehicle Manufacturing Industry is $69.75. BLS estimates that the hourly mean wage for Lawyers (Legal) (BLS Occupation code 23–1011) in the Motor Vehicle Manufacturing Industry is $117.96. BLS estimates that the hourly mean wage for Other Office and Administrative Support Workers (Clerical) (BLS Occupation code 43–9000) in the Motor Vehicle Manufacturing Industry is $30.34.

In addition to base hourly wages, respondents also incur costs associated with employee compensation. The Bureau of Labor Statistics estimates that private industry workers' wages represent 70.3 percent of total labor compensation costs.[599] Therefore, NHTSA estimates the modified hourly wages used in Table VIII–5 as follows:

- Engineer (17–2199): $77.58
- Manager (11–3012): $99.22
- Legal (23–1011): $167.80
- Clerical (43–9000): $43.16

Table VIII-5: Annual Labor Costs*,**

Report or Submission Title	Hourly Labor Costs				Total Costs per Activity*					Annual Costs (All MFRs)**
	Engineer	Manager	Legal	Clerical	Engineer	Manager	Legal	Clerical	Total Cost	Total Annual Cost
Pre-model Year Reports	$77.58	$99.22	$167.80	$43.16	$3,180.85	$694.52	$167.80	$86.32	$4,129.49	$103,237.20
Mid-model Year Reports	$77.58	$99.22	$167.80	$43.16	$3,180.85	$694.52	$167.80	$86.32	$4,129.49	$103,237.20
Supplementary Reports	$77.58	$99.22	$167.80	$43.16	$1,706.80	$595.31	$167.80	$86.32	$2,556.22	$7,668.65
Information for setting future CAFE standards	$77.58	$99.22	$167.80	$43.16	$620.65	$396.87	$0.00	$43.16	$1,060.68	$26,517.07
Petitions for alternative CAFE standards	$77.58	$99.22	$167.80	$43.16	$3,103.27	$793.74	$6,711.81	$43.16	$10,651.98	$31,955.93
Reports on corporate relationship transactions	$77.58	$99.22	$167.80	$43.16	$77.58	$99.22	$2,684.72	$43.16	$2,904.68	$2,904.68
Credit Trade Contract	$77.58	$99.22	$167.80	$43.16	$155.16	$198.44	$2,684.72	$86.32	$3,124.64	$53,118.83
Credit Allocation Plan	$77.58	$99.22	$167.80	$43.16	$1,086.15	$396.87	$1,342.36	$43.16	$2,868.53	$31,553.88
Credit Transaction Requests	$77.58	$99.22	$167.80	$43.16	$543.07	$99.22	$167.80	$43.16	$853.24	$21,331.08
Credit Carry-back Plan	$77.58	$99.22	$167.80	$43.16	$1,241.31	$198.44	$1,342.36	$43.16	$2,825.26	$2,825.26
Credit Value Reporting	$77.58	$99.22	$167.80	$43.16	$155.16	$198.44	$2,684.72	$86.32	$3,124.64	$53,118.83
Totals					$15,050.87	$4,365.58	$18,121.88	$690.53	$38,228.85	**$437,468.62**

* Based upon the labor hours in Table VIII-3

** Based upon the number of manufacturers involved in each activity as described in Table VIII-3

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Estimated Total Annual Burden Cost: $0.

NHTSA estimates there are no costs to respondents or record keepers other

[598] Bureau of Labor Statistics, 2024 National Industry-Specific Occupational Employment and Wage Statistics NAICS 336100—Motor Vehicle Manufacturing, (2025), available at: *https://data.bls.gov/oes/#/industry/336100* (accessed: Sept. 10, 2025).

[599] Bureau of Labor Statistics, Employer Costs for Employee Compensation by ownership—March 2025, Last revised: Mar. 2025, available at: *https://www.bls.gov/news.release/archives/ecec_06132025.pdf* (accessed: Sept. 10, 2025).

than the labor costs associated with the burden hours.

Public Comments Invited: You are asked to comment on any aspects of this information collection, including (a) whether the proposed collection of information is necessary for the proper performance of the functions of the Department, including whether the information will have practical utility; (b) the accuracy of the Department's estimate of the burden of the proposed information collection; (c) ways to enhance the quality, utility, and clarity of the information to be collected; and (d) ways to minimize the burden of the collection of information on respondents, including the use of automated collection techniques or other forms of information technology.

Please submit any comments, identified by the docket number in the heading of this document, by the methods described in the **ADDRESSES** section of this document to NHTSA and OMB. Although comments may be submitted during the entire comment period, comments received within 30 days of publication are most useful.

L. Rulemaking Summary, 5 U.S.C. 553(b)(4)

As required by 5 U.S.C. 553(b)(4), a summary of this rule can be found in the Abstract section of the Department's Unified Agenda entry for this rulemaking at *www.reginfo.gov.*

IX. Regulatory Text

List of Subjects

49 CFR Part 523

Fuel economy.

49 CFR Part 531

Energy conservation, Fuel economy, Gasoline, Imports, Motor vehicles, Reporting and recordkeeping requirements.

49 CFR Parts 533, 536, and 537

Fuel economy, Reporting and recordkeeping requirements.

For the reasons discussed in the preamble, NHTSA proposes to amend 49 CFR parts 523, 531, 533, 536, and 537 as follows:

■ 1. Revise part 523 to read as follows:

PART 523—VEHICLE CLASSIFICATION

Authority: 49 U.S.C. 32901; delegation of authority at 49 CFR 1.95.

§ 523.1 Scope.

This part establishes categories of vehicles subject to title V of the Motor Vehicle Information and Cost Savings Act, 15 U.S.C. 2001 *et seq.*

§ 523.2 Definitions.

As used in this part:

Ambulance has the meaning given in 40 CFR 86.1803.

Approach angle means the smallest angle, in a plane side view of an automobile, formed by the level surface on which the automobile is standing and a line tangent to the front tire static loaded radius arc and touching the underside of the automobile forward of the front tire.

Axle clearance means the vertical distance from the level surface on which an automobile is standing to the lowest point on the axle differential of the automobile.

Base tire (for passenger automobiles, non-passenger automobiles, and medium-duty passenger vehicles) means the tire size specified as standard equipment by the manufacturer on each unique combination of a vehicle's footprint and model type. Standard equipment is defined in 40 CFR 86.1803.

Basic vehicle frontal area is used as defined in 40 CFR 86.1803–01 for passenger automobiles, non-passenger automobiles, medium-duty passenger vehicles and Class 2b through 3 pickup trucks and vans. For heavy-duty tracts and vocational vehicles, it has the meaning given in 40 CFR 1037.801.

Breakover angle means the supplement of the largest angle, in the plane side view of an automobile that can be formed by two lines tangent to the front and rear static loaded radii arcs and intersecting at a point on the underside of the automobile.

Bus has the meaning given in 49 CFR 571.3.

Cab-complete vehicle means a vehicle that is first sold as an incomplete vehicle that substantially includes the vehicle cab section as defined in 40 CFR 1037.801. For example, vehicles known commercially as chassis-cabs, cab-chassis, box-deletes, bed-deletes, and cut-away vans are considered cab-complete vehicles. A cab includes a steering column and a passenger compartment. Note that a vehicle lacking some components of the cab is a cab-complete vehicle if it substantially includes the cab.

Cargo-carrying volume means the luggage capacity or cargo volume index, as appropriate, and as those terms are defined in 40 CFR 600.315–08, in the case of automobiles to which either of these terms apply. With respect to automobiles to which neither of these terms apply, ''cargo-carrying volume'' means the total volume in cubic feet, rounded to the nearest 0.1 cubic feet, of either an automobile's enclosed non-seating space that is intended primarily for carrying cargo and is not accessible from the passenger compartment, or the space intended primarily for carrying cargo bounded in the front by a vertical plane that is perpendicular to the longitudinal centerline of the automobile and passes through the rearmost point on the rearmost seat and elsewhere by the automobile's interior surfaces.

Class 2b vehicles are vehicles with a gross vehicle weight rating (GVWR) ranging from 8,501 to 10,000 pounds.

Class 3 through Class 8 vehicles are vehicles with a gross vehicle weight rating (GVWR) of 10,001 pounds or more as defined in 49 CFR 565.15.

Coach bus has the meaning given in 40 CFR 1037.801.

Commercial medium- and heavy-duty on-highway vehicle means an on-highway vehicle with a gross vehicle weight rating of 10,000 pounds or more as defined in 49 U.S.C. 32901(a)(7).

Complete vehicle has the meaning given to *completed vehicle* as defined in 49 CFR 567.3.

Concrete mixer has the meaning given in 40 CFR 1037.801.

Curb weight means the actual weight of the vehicle in operational status, including the weight of all standard and all optional equipment installed on the vehicle as sold to the first retail purchaser, and the weight of fuel at nominal tank capacity.

Dedicated vehicle has the same meaning as dedicated automobile as defined in 49 U.S.C. 32901(a)(8).

Departure angle means the smallest angle, in a plane side view of an automobile, formed by the level surface on which the automobile is standing and a line tangent to the rear tire static loaded radius arc and touching the underside of the automobile rearward of the rear tire.

Dual-fueled vehicle (multi-fuel, or flexible-fuel vehicle) has the same meaning as dual fueled automobile as defined in 49 U.S.C. 32901(a)(9).

Electric vehicle means a vehicle that does not include a combustion engine and is powered solely by an external source of electricity and/or solar power. Note that this does not include hybrid-electric or hydrogen combustion vehicles that use a chemical fuel such as gasoline, diesel fuel, or hydrogen.

Electric vehicles may also be referred to as BEVs and fuel cell electric vehicles to distinguish them from hybrid-electric vehicles.

Emergency vehicle means one of the following:

(1) For passenger automobiles, non-passenger automobiles, and medium-duty passenger vehicles, emergency vehicle has the meaning given in 49 U.S.C. 32902(e).

(2) For heavy-duty vehicles, emergency vehicle has the meaning given in 40 CFR 1037.801.

Engine code has the meaning given in 40 CFR 86.1803.

Final-stage manufacturer has the meaning given in 49 CFR 567.3.

Fire truck has the meaning given in 40 CFR 86.1803.

Footprint is defined as the product of track width (measured in inches, calculated as the average of front and rear track widths, and rounded to the nearest tenth of an inch) times wheelbase (measured in inches and rounded to the nearest tenth of an inch), divided by 144 and then rounded to the nearest tenth of a square foot. For purposes of this definition, track width is the lateral distance between the centerlines of the base tires at ground, including the camber angle. For purposes of this definition, wheelbase is the longitudinal distance between front and rear wheel centerlines.

Full-size pickup truck means a non-passenger automobile, including a medium-duty passenger vehicle, that meets the specifications in 40 CFR 86.1803–01 for a full-size pickup truck.

Gross axle weight rating (GAWR) has the meaning given in 49 CFR 571.3.

Gross combination weight rating (GCWR) has the meaning given in 49 CFR 571.3.

Gross vehicle weight rating (GVWR) has the meaning given in 49 CFR 571.3.

Heavy-duty engine means any engine used for (or for which the engine manufacturer could reasonably expect to be used for) motive power in a heavy-duty vehicle. For purposes of this definition in this part, the term ''engine'' includes internal combustion engines and other devices that convert chemical fuel into motive power. For example, a fuel cell and motor used in a heavy-duty vehicle is a heavy-duty engine. Heavy duty-engines include those engines subject to the standards in 49 CFR part 535.

Heavy-duty vehicle means a vehicle as defined in § 523.6.

Hitch means a device attached to the chassis of a vehicle for towing.

Incomplete vehicle has the meaning given in 49 CFR 567.3.

Manufacturer has the meaning given in 49 U.S.C. 32901(a)(14).

Medium-duty passenger vehicle means any complete or incomplete motor vehicle rated at more than 8,500 pounds GVWR and less than 10,000 pounds GVWR that is designed primarily to transport passengers, but does not include a vehicle that—

(1) Is an ''incomplete truck,'' meaning any truck that does not have the primary load carrying device or container attached; or

(2) Has a seating capacity of more than 12 persons; or

(3) Is designed for more than 9 persons in seating rearward of the driver's seat; or

(4) Is equipped with an open cargo area (for example, a pick-up truck box or bed) of 72.0 inches in interior length or more. A covered box not readily accessible from the passenger compartment will be considered an open cargo area for purposes of this definition. (See paragraph (1) of the definition of *medium-duty passenger vehicle* at 40 CFR 86.1803–01.)

Mild hybrid gasoline-electric vehicle means a vehicle as defined by EPA in 40 CFR 86.1866–12(e).

Motor home has the meaning given in 49 CFR 571.3.

Motor vehicle has the meaning given in 49 U.S.C. 30102.

Nominal tank capacity means a fuel tank's volume as specified by the manufacturer.

Optional equipment means any equipment or feature not standard on a vehicle model that is installed by the manufacturer or provided by the manufacturer for installation prior to a vehicle's first retail purchase.

Passenger-carrying volume means the sum of the front seat volume and, if any, rear seat volume, as defined in 40 CFR 600.315–08, in the case of automobiles to which that term applies. With respect to automobiles to which that term does not apply, ''passenger-carrying volume'' means the sum in cubic feet, rounded to the nearest 0.1 cubic feet, of the volume of a vehicle's front seat and seats to the rear of the front seat, as applicable, calculated as follows with the head room, shoulder room, and leg room dimensions determined in accordance with the procedures outlined in Society of Automotive Engineers Recommended Practice J1100, Motor Vehicle Dimensions (Report of Human Factors Engineering Committee, Society of Automotive Engineers, approved November 2009).

(1) For front seat volume, divide 1,728 into the product of the following SAE dimensions, measured in inches to the nearest 0.1 inches, and round the quotient to the nearest 0.001 cubic feet.

(i) H61-Effective head room—front.

(ii) W3-Shoulder room—front.

(iii) L34-Maximum effective leg room-accelerator.

(2) For the volume of seats to the rear of the front seat, divide 1,728 into the product of the following SAE dimensions, measured in inches to the nearest 0.1 inches, and rounded the quotient to the nearest 0.001 cubic feet.

(i) H63-Effective head room—second.

(ii) W4-Shoulder room—second.

(iii) L51-Minimum effective leg room—second.

Pickup truck means a non-passenger automobile that has a passenger compartment and an open cargo area (bed).

Pintle hooks means a type of towing hitch that uses a tow ring configuration to secure to a hook or a ball combination for the purpose of towing.

Recreational vehicle or RV means a motor vehicle equipped with living space and amenities found in a motor home.

Refuse hauler has the meaning given in 40 CFR 1037.801.

Running clearance means the distance from the surface on which an automobile is standing to the lowest point on the automobile, excluding unsprung weight.

School bus has the meaning given in 49 CFR 571.3.

Static loaded radius arc means a portion of a circle whose center is the center of a standard tire-rim combination of an automobile and whose radius is the distance from that center to the level surface on which the automobile is standing, measured with the automobile at curb weight, the wheel parallel to the vehicle's longitudinal centerline, and the tire inflated to the manufacturer's recommended pressure.

Strong hybrid gasoline-electric vehicle means a vehicle as defined by EPA in 40 CFR 86.1866–12(e).

Temporary living quarters means a space in the interior of an automobile in which people may temporarily live that includes sleeping surfaces, such as beds, and household conveniences, such as a sink, stove, refrigerator, or toilet.

Transmission class has the meaning given in 40 CFR 600.002.

Transmission configuration has the meaning given in 40 CFR 600.002.

Transmission type has the meaning given in 40 CFR 86.1803.

Truck tractor has the meaning given in 49 CFR 571.3 and 49 CFR 535.5(c). This includes most heavy-duty vehicles specifically designed for the primary purpose of pulling trailers, but does not include vehicles designed to carry other loads. For purposes of this definition ''other loads'' would not include loads carried in the cab, sleeper compartment, or toolboxes. Examples of vehicles similar to tractors but not tractors under this part include dromedary tractors, automobile haulers, straight trucks with trailers hitches, and tow trucks.

Van means a vehicle with a body that fully encloses the driver and a cargo carrying or work performing compartment. The distance from the leading edge of the windshield to the foremost body section of vans is typically shorter than that of pickup trucks and sport utility vehicles.

Vocational tractor means a tractor that is classified as a vocational vehicle according to 40 CFR 1037.630

Vocational vehicle (or heavy-duty vocational vehicle) has the meaning given in § 523.8 and 49 CFR 535.5(b). This includes any vehicle that is equipped for a particular industry, trade, or occupation such as construction, heavy hauling, mining, logging, oil fields, or refuse and includes vehicles such as school buses, motorcoaches, and RVs.

Work truck means a vehicle that is rated at more than 8,500 pounds and less than or equal to 10,000 pounds gross vehicle weight, and is not a medium-duty passenger vehicle as defined in 49 U.S.C. 32901(a)(19).

§ 523.3 Automobile.

An automobile is any 4-wheeled vehicle propelled by fuel, or by alternative fuel, manufactured primarily for use on public streets, roads, and highways and rated at less than 10,000 pounds gross vehicle weight, except:

(a) A vehicle operated only on a rail line;

(b) A vehicle manufactured in different stages by 2 or more manufacturers, if no intermediate or final-stage manufacturer of that vehicle manufactures more than 10,000 multi-stage vehicles per year; or

(c) A work truck.

§ 523.4 Passenger automobile.

A passenger automobile is any automobile (other than an automobile capable of off-highway operation) manufactured primarily for use in the transportation of not more than 10 individuals. A medium-duty passenger vehicle that does not meet the criteria for non-passenger motor vehicles in § 523.5 is a passenger automobile.

§ 523.5 Non-passenger automobile.

A non-passenger automobile means an automobile that is not a work truck and possesses one or more of the characteristics described in paragraph (a) of this section or meets the off-highway features described in paragraph (b) of this section. A medium-duty passenger vehicle that meets the criteria in either paragraph (a) or (b) of this section is a non-passenger automobile.

(a) An automobile not manufactured primarily for transporting 10 or fewer individuals, determined by the presence of at least one of the following chief characteristics:

(1) Transports more than 10 individuals;

(2) Provides temporary living quarters, as defined in § 523.2 of this chapter;

(3) Transports property on an open bed;

(4) Provides, as sold to the first retail purchaser, greater cargo-carrying than passenger-carrying volume, such as in a cargo van; if a vehicle is sold with two or more rows of seating, its cargo-carrying volume is determined with those seats installed, regardless of whether the manufacturer has described that seat as optional; or

(5) Permits expanded use of the automobile for cargo-carrying purposes or other non-passenger-carrying purposes through:

(i) For automobiles manufactured in model year 2022 through model year 2027, for vehicles equipped with at least 3 rows of designated seating positions as standard equipment, permit expanded use of the automobile for cargo-carrying purposes or other non-passenger-carrying purposes through the removal or stowing of foldable or pivoting seats so as to create a flat, leveled cargo surface extending from the forwardmost point of installation of those seats to the rear of the automobile's interior.

(ii) [Reserved]

(6) For automobiles manufactured in model year 2028 and beyond, as sold to the first retail purchaser, has a light-duty work factor (LDWF) value greater than or equal to 5500, calculated according to Figure 1 to this paragraph (a).

Figure 1 to § 523.5(a)

$$LDWF = \frac{1}{3} * [GVWR - C_w] + \frac{2}{3} * [GCWR - GVWR]$$

Where:

GVWR is the gross vehicle weight rating;
C_w is the curb weight;
GCWR is the gross combined weight rating;
GVWR minus C_w is the payload capacity;
GCWR minus GVWR is the towing capacity.

(b) An automobile capable of off-highway operation, as indicated by the presence of the significant features contained in this paragraph (b):

(1) (i) Has 4-wheel drive; or

(ii) Is rated at more than 6,000 pounds gross vehicle weight; and

(2) For automobiles manufactured through model year 2027, has at least four of the following high ground clearance feature characteristics measured when the automobile is at curb weight, on a level surface, with the front wheels parallel to the automobile's longitudinal centerline, and the tires inflated to the manufacturer's recommended pressure—

(i) Approach angle of not less than 28 degrees.

(ii) Breakover angle of not less than 14 degrees.

(iii) Departure angle of not less than 20 degrees.

(iv) Running clearance of not less than 20 centimeters.

(v) Front and rear axle clearances of not less than 18 centimeters each.

(3) For automobiles manufactured in model year 2028 and beyond, has all four of the following high ground clearance feature characteristics measured when the automobile is at curb weight, on a level surface, with the front wheels parallel to the automobile's longitudinal centerline, and the tires inflated to the manufacturer's recommended pressure—

(i) Approach angle of not less than 28 degrees.

(ii) Breakover angle of not less than 14 degrees.

(iii) Departure angle of not less than 20 degrees.

(iv) Running clearance of not less than 20 centimeters.

§ 523.6 Heavy-duty vehicle.

(a) A heavy-duty vehicle is any commercial medium- or heavy-duty on-highway vehicle or a work truck, as defined in 49 U.S.C. 32901(a)(7) and (19). For the purpose of this section, heavy-duty vehicles are divided into three regulatory categories as follows:

(1) Heavy-duty pickup trucks and vans;

(2) Heavy-duty vocational vehicles; and

(3) Truck tractors with a GVWR above 26,000 pounds.

(b) The heavy-duty vehicle classification does not include vehicles excluded as specified in 49 CFR 535.3.

§ 523.7 Heavy-duty pickup trucks and vans.

(a) Heavy-duty pickup trucks and vans are pickup trucks and vans with a gross vehicle weight rating between 8,501 pounds and 14,000 pounds (Class 2b through 3 vehicles) manufactured as complete vehicles by a single or final-stage manufacturer or manufactured as incomplete vehicles as designated by a manufacturer. See references in 40 CFR 86.1801–12, 40 CFR 86.1819–17, 40 CFR 1037.150, and 49 CFR 535.5(a).

(b) Heavy duty vehicles above 14,000 pounds GVWR may be optionally certified as heavy-duty pickup trucks and vans and comply with fuel consumption standards in 49 CFR 535.5(a), if properly included in a test group with similar vehicles at or below 14,000 pounds GVWR. Fuel consumption standards apply to these vehicles as if they were Class 3 heavy-duty vehicles. The work factor for these vehicles may not be greater than the largest work factor that applies for vehicles in the test group that are at or below 14,000 pounds GVWR (see 40 CFR 86.1819–14).

(c) Incomplete heavy-duty vehicles at or below 14,000 pounds GVWR may be optionally certified as heavy-duty pickup trucks and vans and comply with the fuel consumption standards in 49 CFR 535.5(a).

§ 523.8 Heavy-duty vocational vehicle.

Heavy-duty vocational vehicles are vehicles with a gross vehicle weight rating (GVWR) above 8,500 pounds excluding:

(a) Heavy-duty pickup trucks and vans defined in § 523.7;

(b) Medium-duty passenger vehicles; and

(c) Truck tractors, except vocational tractors, with a GVWR above 26,000 pounds.

§ 523.9 Truck tractors.

Truck tractors for the purpose of this part are considered as any truck tractor as defined in 49 CFR part 571 having a GVWR above 26,000 pounds.

§ 523.10 Heavy-duty trailers.

(a) A trailer means a motor vehicle with or without motive power, designed for carrying cargo and for being drawn by another motor vehicle as defined in 49 CFR 571.3. For the purpose of this part, heavy-duty trailers include only those trailers designed to be drawn by a truck tractor excluding non-box trailers other than flatbed trailers, tanker trailers, and container chassis, and those that are coupled to vehicles exclusively by pintle hooks or hitches instead of a fifth wheel. Heavy-duty trailers may be divided into different types and categories as follows:

(1) Box vans are trailers with enclosed cargo space that is permanently attached to the chassis, with fixed sides, nose, and roof. Tank trailers are not box vans.

(2) Box vans with front-mounted HVAC systems are refrigerated vans. Note that this includes systems that provide cooling, heating, or both. All other box vans are dry vans.

(3) Trailers that are not box vans are non-box trailers.

(4) Box vans with a length greater than 50 feet are long box vans. Other box vans are short box vans.

(5) The following types of equipment are not trailers:

(i) Containers that are not permanently mounted on chassis.

(ii) Dollies used to connect tandem trailers.

(iii) Equipment that serves similar purposes but are not intended to be pulled by a tractor.

(b) Heavy-duty trailers do not include trailers excluded in 49 CFR 535.3.

■ 2. Revise part 531 to read as follows:

PART 531—PASSENGER AUTOMOBILE AVERAGE FUEL ECONOMY STANDARDS

Sec.

Authority: 49 U.S.C. 32902, delegation of authority at 49 CFR 1.95.

§ 531.1 Scope.

This part establishes average fuel economy standards pursuant to 49 U.S.C. 32902 for passenger automobiles.

§ 531.2 Purpose.

The purpose of this part is to increase the fuel economy of passenger automobiles by establishing minimum levels of average fuel economy for those vehicles.

§ 531.3 Applicability.

This part applies to manufacturers of passenger automobiles.

§ 531.4 Definitions.

(a) *Statutory terms.* (1) The terms *average fuel economy, manufacture, manufacturer,* and *model year* are used as defined in 49 U.S.C. 32901.

(2) The terms *automobile* and *passenger automobile* are used as defined in 49 U.S.C. 32901 and in accordance with the determination in part 523 of this chapter.

(b) *Other terms.* As used in this part, unless otherwise required by the context—

(1) The term *domestically manufactured passenger automobile* means the vehicle is deemed to be manufactured domestically under 49 U.S.C. 32904(b)(3) and 40 CFR 600.511–08.

(2) [Reserved]

§ 531.5 Fuel economy standards.

(a) Except as provided in paragraph (c) of this section, for model years 2022 through 2031, a manufacturer's passenger automobile fleet shall comply with the fleet average fuel economy level calculated for that model year according to Figure 1 to this paragraph (a) and the appropriate values in Table 1 to this paragraph (a).

Figure 1 to Paragraph (a)

$$CAFE_{required} = \frac{\sum_i PRODUCTION_i}{\sum_i \frac{PRODUCTION_i}{TARGET_i}}$$

Where:

$CAFE_{required}$ is the fleet average fuel economy standard for a given fleet (domestic passenger automobiles or imported passenger automobiles);

Subscript *i* is a designation of multiple groups of automobiles, where each group's designation, *i.e., i* = 1, 2, 3, etc., represents automobiles that share a unique model type and footprint within the applicable fleet, either domestic passenger automobiles or imported passenger automobiles;

$Production_i$ is the number of passenger automobiles produced for sale in the United States within each *ith* designation, *i.e.,* which share the same model type and footprint; and

$TARGET_i$ is the fuel economy target in miles per gallon (mpg) applicable to the footprint of passenger automobiles within each *ith* designation, *i.e.,* which share the same model type and footprint, calculated according to Figure 2 to this paragraph (a) and rounded to the nearest hundredth of a mpg, *i.e.,* 35.455 = 35.46 mpg, and the summations in the numerator and denominator are both performed over all models in the fleet in question.

Figure 2 to Paragraph (a)

$$TARGET = \frac{1}{MIN\left[MAX\left(c \times FOOTPRINT + d, \frac{1}{a}\right), \frac{1}{b}\right]}$$

Where:

TARGET is the fuel economy target (in mpg) applicable to vehicles of a given footprint (*FOOTPRINT,* in square feet);

Parameters *a, b, c,* and *d* are defined in Table 1 to this paragraph (a); and

The *MIN* and *MAX* functions take the minimum and maximum, respectively, of the included values.

Table 1 to Paragraph (a)—Parameters for the Passenger Automobile Fuel Economy Targets, MYs 2022-2031

Model year	Parameters			
	a (mpg)	b (mpg)	c (gal/mi/ft^2)	d (gal/mi)
2022	38.14	32.51	0.00041302	0.00845926
2023	38.33	32.67	0.00041097	0.00841718
2024	38.52	32.83	0.00040892	0.00837530
2025	38.71	33.00	0.00040689	0.00833363
2026	38.91	33.16	0.00040487	0.00829217
2027	39.04	33.28	0.00040346	0.00826345
2028	40.57	30.38	0.00068863	-0.00634053
2029	40.67	30.46	0.00068691	-0.00632468
2030	40.78	30.54	0.00068519	-0.00630887
2031	40.88	30.61	0.00068348	-0.00629310

(b) In addition to the requirements of paragraph (a) of this section, each manufacturer, other than manufacturers subject to standards in paragraph (c) of this section, shall also meet the minimum fleet standard for domestically manufactured passenger automobiles expressed in Table 2 to this paragraph (b):

Table 2 to Paragraph (b)—Minimum Fuel Economy Standards for Domestically Manufactured Passenger Automobiles, MYs 2022-2031

Model year	Minimum standard
2022	33.1
2023	33.1
2024	33.5
2025	33.7
2026	33.9
2027	33.8
2028	33.9
2029	34.0
2030	34.0
2031	34.1

(c) The following manufacturers shall comply with the standards indicated in paragraphs (c)(1) through (4) of this section for the specified model years:

(1) *Aston Martin Lagonda Limited.*

Table 3 to § 531.5(c)(1)—Average Fuel Economy Standards

Model year	Miles per gallon
2022	24.9
2023	24.9

(2) *Koenigsegg.*

Table 4 to § 531.5(c)(2)—Average Fuel Economy Standards

Model year	Miles per gallon
2022	16.9
2023	16.9

(3) *McLaren.*

Table 5 to § 531.5(c)(3)—Average Fuel Economy Standards

Model year	Miles per gallon
2022	24.6
2023	25.7

(4) *Pagani.*

Table 6 to § 531.5(c)(4)—Average Fuel Economy Standards

Model year	Miles per gallon
2022	15.5
2023	15.5

§ 531.6 Measurement and calculation procedures.

The fleet average fuel economy performance of all passenger automobiles manufactured for sale in the United States for a model year shall be determined in accordance with procedures established by the Administrator of the Environmental Protection Agency (EPA) under 49 U.S.C. 32904 and set forth in 40 CFR part 600.

Appendix A to Part 531—Example of Calculating a Fleet Average Fuel Economy Standard for a Passenger Automobile Fleet Under § 531.5(a)

Assume a hypothetical manufacturer (Manufacturer X) produces a fleet of passenger automobiles as follows:

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Appendix A—Table I

Model type				Description	Base tire size	Wheelbase (inches)	Track width F&R average (inches)	Footprint (ft²)	Volume	Fuel economy target standard (mpg)
Group	Carline name	Basic engine (L)	Transmission class							
1	PC A FWD	1.8	A5	2-door sedan	205/75R14	99.8	61.2	42.4	1,500	35.01
2	PC A FWD	1.8	M6	2-door sedan	215/70R15	99.8	60.9	42.2	2,000	35.14
3	PC A FWD	2.5	A6	4-door wagon	215/70R15	100.0	60.9	42.3	2,000	35.08
4	PC A AWD	1.8	A6	4-door wagon	235/60R15	100.0	61.2	42.5	1,000	35.95
5	PC A AWD	2.5	M6	2-door hatchback	225/65R16	99.6	59.5	41.2	3,000	35.81
6	PC B RWD	2.5	A6	4-door wagon	265/55R18	109.2	66.8	50.7	8,000	30.33
7	PC B RWD	2.5	A7	4-door sedan	235/65R17	109.2	67.8	51.4	2,000	29.99
8	PC C AWD	3.2	A7	4-door sedan	265/55R18	111.3	67.8	52.4	5,000	29.52
9	PC C FWD	3.2	M6	2-door coupe	225/65R16	111.3	67.2	51.9	3,000	29.76
	TOTAL								27,500	

Note to Table I to this Appendix: With the appropriate fuel economy targets determined for each unique model type and footprint combination, Manufacturer X's required fleet average fuel economy standard would be calculated as illustrated in Figure 1 to this appendix.

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Appendix A Figure 1—Calculation of Manufacturer X's Fleet Average Fuel Economy Standard Using Table I

$$FE_{Standard} = \frac{(Manufacturer's\ Passenger\ Automobile\ Production\ for\ Applicable\ Model\ Year)}{\sum_i \left(\frac{Group_1\ Production}{Group_1\ Target\ Standard} + \frac{Group_2\ Production}{Group_2\ Target\ Standard} + \cdots + \frac{Group_9\ Production}{Group_9\ Target\ Standard} \right)}$$

$$FE_{Standard} = \frac{27{,}500}{\left(\frac{1{,}500}{35.01} + \frac{2{,}000}{35.14} + \frac{2{,}000}{35.08} + \frac{1{,}000}{35.95} + \frac{3{,}000}{35.81} + \frac{8{,}000}{30.33} + \frac{2{,}000}{29.99} + \frac{5{,}000}{29.52} + \frac{3{,}000}{29.79} \right)}$$

$$FE_{Standard} = 31.6\ mpg$$

■ 3. Revise part 533 to read as follows:

PART 533—NON–PASSENGER AUTOMOBILE FUEL ECONOMY STANDARDS

Authority: 49 U.S.C. 32902; delegation of authority at 49 CFR 1.95.

§ 533.1 Scope.

This part establishes average fuel economy standards pursuant to 49 U.S.C. 32902 for non-passenger automobiles.

§ 533.2 Purpose.

The purpose of this part is to increase the fuel economy of non-passenger automobiles by establishing minimum levels of average fuel economy for those vehicles.

§ 533.3 Applicability.

This part applies to manufacturers of non-passenger automobiles.

§ 533.4 Definitions.

(a) *Statutory terms.* (1) The terms *average fuel economy, average fuel economy standard, fuel economy, import, manufacture, manufacturer,* and *model year* are used as defined in 49 U.S.C. 32901.

(2) The term *automobile* is used as defined in 49 U.S.C. 32901 and in accordance with the determinations in part 523 of this chapter.

(b) *Other terms.* As used in this part, unless otherwise required by the context—

(1) *Non-passenger automobile* is used in accordance with the determinations in part 523 of this chapter.

(2) *Captive import* means, with respect to a non-passenger automobile, one that is not domestically manufactured, as defined in section 502(b)(2)(E) of the Motor Vehicle Information and Cost Savings Act, but that is imported in the 1980 model year or thereafter by a manufacturer whose principal place of business is in the United States.

(3) *4-wheel drive, general utility vehicle* means a 4-wheel drive, general purpose automobile capable of off-highway operation that has a wheelbase of not more than 280 centimeters, and that has a body shape similar to 1977 Jeep CJ–5 or CJ–7, or the 1977 Toyota Land Cruiser.

(4) *Basic engine* means a unique combination of manufacturer, engine displacement, number of cylinders, fuel system (as distinguished by number of carburetor barrels or use of fuel injection), and catalyst usage.

(5) *Limited product line non-passenger automobile* means a non-passenger automobile manufactured by a manufacturer whose light truck fleet is powered exclusively by basic engines that are not also used in passenger automobiles.

§ 533.5 Requirements.

(a) Each manufacturer of non-passenger automobiles shall comply with the following fleet average fuel economy standards, expressed in miles per gallon, in the model year (MY) specified as applicable:

(1) For model years 2022–2031, a manufacturer's non-passenger automobile fleet shall comply with the fleet average fuel economy standard calculated for that model year according to Figures 1 and 2 to this paragraph (a) and the appropriate values in Table 1 to this paragraph (a).

Figure 1 to § 533.5(a)

$$CAFE_{required} = \frac{\sum_i PRODUCTION_i}{\sum_i \frac{PRODUCTION_i}{TARGET_i}}$$

Where:

$CAFE_{required}$ is the fleet average fuel economy standard for a given non-passenger automobile fleet;

Subscript i is a designation of multiple groups of non-passenger automobiles, where each group's designation, *i.e.,* i = 1, 2, 3, etc., represents non-passenger automobiles that share a unique model type and footprint within the applicable fleet;

$Production_i$ is the number of non-passenger automobiles produced for sale in the United States within each *ith* designation, *i.e.,* which share the same model type and footprint; and

$TARGET_i$ is the fuel economy target in miles per gallon (mpg) applicable to the footprint of non-passenger automobiles within each *ith* designation, *i.e.,* which share the same model type and footprint, calculated according to Figure 2 to this paragraph (a) and rounded to the nearest hundredth of a mpg, *i.e.,* 35.455 = 35.46 mpg, and the summations in the numerator and denominator are both performed over all models in the fleet in question.

Figure 2 to § 533.5(a)

$$TARGET = \frac{1}{MIN\left[MAX\left(c \times FOOTPRINT + d, \frac{1}{a}\right), \frac{1}{b}\right]}$$

Where:

TARGET is the fuel economy target (in mpg) applicable to vehicles of a given footprint (*FOOTPRINT,* in square feet);

Parameters *a, b, c,* and d are defined in Table 1 to this paragraph (a); and

The *MIN* and *MAX* functions take the minimum and maximum, respectively, of the included values.

Table 1 to § 533.5(a)—Parameters for the Non-Passenger Automobile Fuel Economy Targets for MYs 2022-2031

Model year	Parameters			
	a (mpg)	b (mpg)	c (gal/mi/ft^2)	d (gal/mi)
2022	34.89	20.33	0.00064166	0.00171340
2023	35.06	20.43	0.00063847	0.00170487
2024	35.24	20.53	0.00063529	0.00169639
2025	35.41	20.63	0.00063213	0.00168795
2026	35.59	20.74	0.00062899	0.00167955
2027	35.84	20.88	0.00062460	0.00166784
2028	31.45	25.92	0.00037701	0.01218745
2029	31.53	25.99	0.00037607	0.01215698
2030	31.61	26.05	0.00037513	0.01212659
2031	31.69	26.12	0.00037419	0.01209627

(2) [Reserved]

(b) [Reserved]

§ 533.6 Measurement and calculation procedures.

(a) Any reference to a class of non-passenger automobiles manufactured for sale in the United States in a model year shall be deemed—

(1) To include all non-passenger automobiles in that class manufactured by persons who control, are controlled by, or are under common control with, such manufacturer;

(2) To include only automobiles that qualify as non-passenger vehicles in accordance with § 523.5 of this chapter; and

(3) To exclude all non-passenger automobiles in that class manufactured (within the meaning of paragraph (a)(1) of this section) during a model year by such manufacturer that are exported prior to the expiration of 30 days following the end of such model year.

(b) The fleet average fuel economy performance of all non-passenger automobiles manufactured for sale in the United States in a model year shall be determined in accordance with procedures established by the Administrator of the Environmental Protection Agency (EPA) under 49 U.S.C. 32904 and set forth in 40 CFR part 600.

Appendix A to Part 533—Example of Calculating a Fleet Average Fuel Economy Standard for a Non-Passenger Automobile Fleet Under § 533.5(a)

Assume a hypothetical manufacturer (Manufacturer X) produces a fleet of non-passenger automobiles as follows:

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Appendix A—Table I

Model type				Description	Base tire size	Wheelbase (inch)	Track width F&R avg (inch)	Footprint (ft^2)	Volume	Fuel economy target standard (mpg)
Group	Carline name	Basic engine (L)	Transmission class							
1	Pickup A 2WD	4	A5	Reg cab, MB	235/75R15	100.0	68.8	47.8	800	27.30
2	Pickup B 2WD	4	M5	Reg cab, MB	235/75R15	100.0	68.2	47.4	200	27.44
3	Pickup C 2WD	4.5	A5	Reg cab, LB	255/70R17	125.0	68.8	59.7	300	23.79
4	Pickup C 2WD	4	M5	Ext cab, MB	255/70R17	125.0	68.8	59.7	400	23.79
5	Pickup C 4WD	4.5	A5	Crew cab, SB	275/70R17	150.0	69.0	71.9	400	22.27
6	Pickup D 2WD	4.5	A6	Crew cab, SB	255/70R17	125.0	68.8	59.7	400	23.79
7	Pickup E 2WD	5	A6	Ext cab, LB	255/70R17	125.0	68.8	59.7	500	23.79
8	Pickup E 2WD	5	A6	Crew cab, MB	285/70R17	125.0	69.2	60.1	500	23.68
9	Pickup F 2WD	4.5	A5	Reg cab, LB	255/70R17	125.0	68.9	59.8	1,600	23.76
10	Pickup F 4WD	4.5	A5	Ext cab, MB	275/70R17	150.0	69.0	71.9	800	22.27
11	Pickup F 4WD	4.5	A5	Crew cab, SB	285/70R17	150.0	69.2	72.1	800	22.27
Total									6,700	

NOTE TO TABLE I TO THIS APPENDIX: With the appropriate fuel economy targets determined for each unique model type and footprint combination, Manufacturer X's required fleet average fuel economy standard would be calculated as illustrated in Figure 1 to this appendix:

Appendix A Figure 1—Calculation of Manufacturer X's Fleet Average Fuel Economy Standard Using Table I

$$FE_{Standard} = \frac{(Manufacturer's\ Light\ Truck\ Production\ for\ Applicable\ Model\ Year)}{\sum_i \left(\frac{Group_1\ Production}{Group_1\ Target\ Standard} + \frac{Group_2\ Production}{Group_2\ Target\ Standard} + \cdots + \frac{Group_{11}\ Production}{Group_{11}\ Target\ Standard}\right)}$$

$$FE_{Standard} = \frac{6{,}700}{\left(\frac{800}{27.30} + \frac{200}{27.44} + \frac{300}{23.79} + \frac{400}{23.79} + \frac{400}{22.27} + \frac{400}{23.79} + \frac{500}{23.79} + \frac{500}{23.68} + \frac{1{,}600}{23.76} + \frac{800}{22.27} + \frac{800}{22.27}\right)}$$

$$FE_{Standard} = 23.7\ mpg$$

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■ 4. Revise part 536 to read as follows:

PART 536—TRANSFER AND TRADING OF FUEL ECONOMY CREDITS

Authority: 49 U.S.C. 32903; delegation of authority at 49 CFR 1.95.

§ 536.1 Scope.

This part establishes regulations governing the use and application of corporate average fuel economy (CAFE) credits up to three model years before and five model years after the model year in which the credit was earned. It also specifies requirements for manufacturers wishing to transfer fuel economy credits between their compliance categories. It also establishes regulations that allow manufacturers and other persons to trade fuel economy credits through model year 2027.

§ 536.2 Application.

This part applies to all credits earned for exceeding applicable average fuel economy standards in a given model year for domestically manufactured passenger automobiles, imported passenger automobiles, and non-passenger automobiles.

§ 536.3 Definitions.

(a) *Statutory terms.* All terms defined in 49 U.S.C. 32901(a) are used pursuant to their statutory meaning.

(b) *Other terms.* (1) *Above standard fuel economy* means, with respect to a compliance category, that the automobiles manufactured by a manufacturer in that compliance category in a particular model year have greater average fuel economy (calculated in a manner that reflects the incentives for alternative fuel automobiles per 49 U.S.C. 32905) than that manufacturer's fuel economy standard for that compliance category and model year.

(2) *Adjustment factor* means a factor used to adjust the value of a traded or transferred credit for compliance purposes to ensure that the compliance value of the credit when used reflects the total volume of oil saved when the credit was earned.

(3) *Below standard fuel economy* means, with respect to a compliance category, that the automobiles manufactured by a manufacturer in that compliance category in a particular model year have lower average fuel economy (calculated in a manner that reflects the incentives for alternative fuel automobiles per 49 U.S.C. 32905) than that manufacturer's fuel economy standard for that compliance category and model year.

(4) *Compliance* means a manufacturer achieves compliance in a particular compliance category when:

(i) The average fuel economy of the vehicles in that category exceed or meet the fuel economy standard for that category; or

(ii) The average fuel economy of the vehicles in that category do not meet the fuel economy standard for that category, but the manufacturer proffers a sufficient number of valid credits, adjusted for total oil savings, to cover the gap between the average fuel economy of the vehicles in that category and the required average fuel economy. A manufacturer achieves compliance for its fleet if the conditions in paragraph (b)(4)(i) of this section or this paragraph (b)(4)(ii) are simultaneously met for all compliance categories.

(5) *Compliance category* means any of three categories of automobiles subject to Federal fuel economy regulations in this chapter. The three compliance categories recognized by 49 U.S.C. 32903(g)(6) are domestically manufactured passenger automobiles, imported passenger automobiles, and non-passenger automobiles.

(6) *Credit holder (or holder)* means a legal person or entity that has valid possession of credits, either because they are a manufacturer who has earned credits by exceeding an applicable fuel economy standard in this chapter, or because they are a designated recipient who has received credits from another holder. Credit holders need not be manufacturers, although all manufacturers may be credit holders.

(7) *Credits (or fuel economy credits)* means an earned or purchased allowance recognizing that the average fuel economy of a particular manufacturer's vehicles within a particular compliance category and model year exceeds that manufacturer's fuel economy standard for that compliance category and model year. One credit is equal to 1⁄10 of a mile per gallon above the fuel economy standard per one vehicle within a compliance category. Credits are denominated according to model year in which they are earned (vintage), originating manufacturer, and compliance category.

(8) *Expiry date* means the model year after which fuel economy credits may no longer be used to achieve compliance with fuel economy regulations in this chapter. Expiry dates are calculated in terms of model years: For example, if a manufacturer earns credits for model year 2011, these credits may be used for compliance in model years 2008–2016.

(9) *Fleet* means all automobiles manufactured by a manufacturer in a particular model year and are subject to fuel economy standards under parts 531 and 533 of this chapter. For the purposes of this part, a manufacturer's fleet means all domestically

manufactured and imported passenger automobiles and non-passenger automobiles. ''Work trucks'' and medium and heavy trucks are not included in this definition for purposes of this part.

(10) *Originating manufacturer* means the manufacturer that originally earned a particular credit. Each credit earned will be identified with the name of the originating manufacturer.

(11) *Trade* means the movement of credits from the account of a credit holder to the account of another credit holder within the same compliance category in which the credits were originally earned, in accordance with all applicable provisions under this part.

(12) *Transfer* means the movement of credits from one compliance category to another in accordance with all applicable provisions under this part. Subject to the credit transfer limitations of 49 U.S.C. 32903(g)(3), credits can also be transferred across compliance categories and banked or saved in that category to be carried forward or backwards later to address a credit shortfall.

(13) *Vintage* means, with respect to a credit, the model year in which the credit was earned.

§ 536.4 Credits.

(a) *Type and vintage.* In each credit account, credits are identified and distinguished by the manufacturer that earned the credits, the compliance category in which they were earned, and the model year in which they were earned (vintage).

(b) *Application of credits.* All credits earned and applied (*i.e.,* used to resolve an existing credit shortfall) are calculated, per 49 U.S.C. 32903(c), in tenths of a mile per gallon by which the average fuel economy of vehicles in a particular compliance category manufactured by a manufacturer in the model year in which the credits are earned exceeds the applicable average fuel economy standard, multiplied by the number of vehicles sold in that compliance category. However, credits that have been traded between credit holders or transferred between compliance categories are valued for compliance purposes using the adjustment factor specified in paragraph (c) of this section, pursuant to the ''total oil savings'' requirement of 49 U.S.C. 32903(f)(1).

(c) *Adjustment factor.* When traded or transferred fuel economy credits are applied, they are adjusted to ensure fuel oil savings is preserved. For traded credits, the user (or buyer) must multiply the calculated adjustment factor by the number of shortfall credits it plans to offset in order to determine the number of equivalent credits to acquire from the earner (or seller). For transferred credits, the user of credits must multiply the calculated adjustment factor by the number of shortfall credits it plans to offset to determine the number of equivalent credits to transfer from the compliance category holding the available credits. The adjustment factor is calculated according to the following equation in Figure 1 to this paragraph (c):

Figure 1 to § 536.4(c)—Equation for Calculating Adjustment Factor

$$A = \frac{VMT_u \times MPG_{ae} \times MPG_{se}}{VMT_e \times MPG_{au} \times MPG_{su}}$$

Where:

A = Adjustment factor applied to traded and transferred credits. The quotient shall be rounded to 4 decimal places;

VMTe = Lifetime vehicle miles traveled as provided in the following Table 1 to this paragraph (c) for the model year and compliance category in which the credit was earned;

VMTu = Lifetime vehicle miles traveled as provided in the following Table 1 to this paragraph (c) for the model year and compliance category in which the credit is used for compliance;

MPGse = Required fuel economy standard for the originating (earning) manufacturer, compliance category, and model year in which the credit was earned;

MPGae = Actual fuel economy for the originating manufacturer, compliance category, and model year in which the credit was earned;

MPGsu = Required fuel economy standard for the user (buying) manufacturer, compliance category, and model year in which the credit is used for compliance; and

MPGau = Actual fuel economy for the user manufacturer, compliance category, and model year in which the credit is used for compliance.

Table 1 to § 536.4(c)—Lifetime Vehicle Miles Traveled

Category (model years 2017-2031)	Lifetime vehicle miles traveled (VMT)
Passenger Automobiles	195,264
Non-passenger Automobiles	225,865

§ 536.5 Trading infrastructure.

(a) *Accounts.* NHTSA maintains ''accounts'' for each credit holder. The account consists of a balance of credits in each compliance category and vintage held by the holder.

(b) *Who may hold credits.* Every manufacturer subject to fuel economy standards under part 531 or 533 of this chapter is automatically an account holder. If the manufacturer earns credits pursuant to this part, or receives credits from another party, so that the manufacturer's account has a non-zero balance, then the manufacturer is also a credit holder. Any party designated as a recipient of credits by a current credit holder will receive an account from NHTSA and become a credit holder, subject to the following conditions:

(1) A designated recipient must provide name, address, contact information, and a valid taxpayer identification number or Social Security number;

(2) NHTSA does not grant a request to open a new account by any party other than a party designated as a recipient of credits by a credit holder; and

(3) NHTSA maintains accounts with zero balances for a period of time, but reserves the right to close accounts that have had zero balances for more than 1 year.

(c) *Automatic debits and credits of accounts.* (1) To carry credits forward, backward, transfer credits, or trade credits into other credit accounts, a manufacturer or credit holder must submit a credit instruction to NHTSA. A credit instruction must detail and include:

(i) The credit holder(s) involved in the transaction.

(ii) The originating credits described by the amount of the credits, compliance category, and the vintage of the credits.

(iii) The recipient credit account(s) for banking or applying the originating credits described by the compliance category(ies), model year(s), and if applicable the adjusted credit amount(s) and adjustment factor(s).

(iv) For trades, a contract authorizing the trade signed by the manufacturers or credit holders or by managers legally authorized to obligate the sale and purchase of the traded credits.

(2) Upon receipt of a credit instruction from an existing credit holder, NHTSA verifies the presence of sufficient credits in the account(s) of the credit holder(s) involved as applicable and notifies the credit holder(s) that the credits will be debited from and/or credited to the accounts involved, as specified in the credit instruction. NHTSA determines if the credits can be debited or credited based upon the amount of available credits, accurate application of any adjustment factors and the credit requirements prescribed by this part that are applicable at the time the transaction is requested.

(3) After notifying the credit holder(s), all accounts involved are either credited or debited, as appropriate, in line with the credit instruction. Traded credits identified by a specific compliance category are deposited into the recipient's account in that same compliance category and model year. If a recipient of credits as identified in a credit instruction is not a current account holder, NHTSA establishes the credit recipient's account, subject to the conditions described in paragraph (b) of this section, and adds the credits to the newly opened account.

(4) NHTSA will automatically delete unused credits from holders' accounts when those credits reach their expiry date.

(5) Starting January 1, 2022, all parties trading credits must also provide NHTSA the price paid for the credits including a description of any other monetary or non-monetary terms affecting the price of the traded credits, such as any technology exchanged or shared in exchange for the credits, any other non-monetary payment for the credits, or any other agreements related to the trade.

(6) Starting September 1, 2022, manufacturers or credit holders issuing credit instructions or providing credit allocation plans as specified in paragraph (d) of this section, must use and submit the NHTSA Credit Template fillable form (Office of Management and Budget (OMB) Control No. 2127–0019, NHTSA Form 1475). In the case of a trade, manufacturers or credit holders buying traded credits must use the credit transactions template to submit trade instructions to NHTSA. Manufacturers or credit holders selling credits are not required to submit trade instructions. The NHTSA Credit Template must be signed by managers legally authorized to obligate the sale and/or purchase of the traded credits from both parties to the trade. The NHTSA Credit Template signed by both parties to the trade serves as an acknowledgement that the parties have agreed to trade a certain amount of credits, and does not dictate terms, conditions, or other business obligations of the parties.

(7) NHTSA will consider claims that information submitted to the agency under this section is entitled to confidential treatment under 5 U.S.C. 552(b) and under the provisions of part 512 of this chapter if the information is submitted in accordance with the procedures of part 512. The NHTSA Credit Template is available for download on the CAFE Public Information Center website. Manufacturers must submit the cost information to NHTSA in a PDF document along with the Credit Template through the CAFE email, *cafe@dot.gov.* NHTSA reserves the right to request additional information from the parties regarding the terms of the trade.

(d) *Compliance.* (1) NHTSA assesses compliance with fuel economy standards each year, utilizing the certified and reported CAFE data provided by the Environmental Protection Agency (EPA) for enforcement of the CAFE program pursuant to 49 U.S.C. 32904(e). Credit values are calculated based on the CAFE data from EPA. If a particular compliance category within a manufacturer's fleet has above standard fuel economy, NHTSA adds credits to the manufacturer's account for that compliance category and vintage in the appropriate amount by which the manufacturer has exceeded the applicable standard.

(2) If a manufacturer's vehicles in a particular compliance category have below standard fuel economy, NHTSA will provide written notification to the manufacturer that it has failed to meet a particular fleet target standard. The manufacturer will be required to confirm the shortfall and may also submit a plan indicating how it will allocate existing credits or earn, transfer and/or acquire credits to achieve compliance. If the manufacturer submits a plan, the plan must be submitted within 60 days of receiving agency notification.

(3) Credits used to offset shortfalls are subject to the three- and five-year limitations as described in § 536.6.

(4) Transferred credits are subject to the limitations specified by 49 U.S.C. 32903(g)(3) and this part.

(5) The value, when used for compliance, of any credits received via trade or transfer is adjusted, using the adjustment factor described in § 536.4(c), pursuant to 49 U.S.C. 32903(f)(1).

(6) Credit allocation plans received from a manufacturer will be reviewed and approved by NHTSA. Starting in model year 2022, credit holders must use the NHTSA Credit Template (OMB Control No. 2127–0019, NHTSA Forms 1475) to record the credit transactions. The template is a fillable form that has an option for recording and calculating credit transactions for credit allocation plans. The template calculates the required adjustments to the credits. The credit allocation plan and the completed transaction templates must be submitted to NHTSA. NHTSA will approve the credit allocation plan unless it finds that the proposed credits are unavailable or that it is unlikely that the plan will result in the manufacturer earning sufficient credits to offset the subject credit shortfall. If the plan is approved, NHTSA will revise the respective manufacturer's credit account accordingly. If the plan is rejected, NHTSA will notify the respective manufacturer and may request a revised plan.

(e) *Reporting.* (1) NHTSA periodically publishes the names and credit holdings of all credit holders. NHTSA does not publish individual transactions, nor respond to individual requests for updated balances from any party other than the account holder.

(2) NHTSA issues an annual credit status letter to each party that is a credit holder at that time. The letter to a credit holder includes a credit accounting record that identifies the credit status of the credit holder including any activity

(earned, expired, transferred, traded, carry-forward and carry-back credit transactions/allocations) that took place during the identified activity period.

§ 536.6 Credit flexibilities in the CAFE program.

(a) *Carrying back and carrying forward of credits.*

(1) Credits earned in a compliance category may be applied by the manufacturer that earned them to carryback plans for that compliance category approved up to three years prior to the year in which the credits were earned, or may be held or applied for up to five model years after the year in which the credits were earned.

(2) [Reserved]

(b) *Transferring and trading of credits.*

(1) Credits earned in a compliance category in model years 2022 through 2027 may be transferred or traded in accordance with all applicable provisions under this part.

(2) Credits earned in a compliance category in model year 2028 and beyond may be transferred in accordance with all applicable provisions under this part. Credits earned in a compliance category in model year 2028 and beyond may not be traded.

§ 536.7 Treatment of carryback credits.

(a) Carryback credits earned in a compliance category in any model year may be used in carryback plans approved by NHTSA, pursuant to 49 U.S.C. 32903(b), for up to three model years prior to the year in which the credit was earned.

(b) No credits from any source (earned, transferred, and/or traded) will be accepted in lieu of compliance if those credits are not identified as originating within one of the three model years after the model year of the confirmed shortfall.

§ 536.8 Conditions for the trading of credits.

(a) *Trading of credits.* If a credit holder wishes to trade credits to another party, the current credit holder and the receiving party must jointly issue an instruction to NHTSA, identifying the quantity, vintage, compliance category, and originator of the credits to be traded. If the recipient is not a current account holder, the recipient must provide sufficient information for NHTSA to establish an account for the recipient. Once an account has been established or identified for the recipient, NHTSA completes the trade by debiting the transferor's account and crediting the recipient's account. NHTSA will track the quantity, vintage, compliance category, and originator of all credits held or traded by all account holders.

(b) *Using traded credits to comply with fuel economy standards.* For credits earned in model years 2022 through 2027, and used to satisfy compliance obligations for model years 2019 through 2027 in accordance with all applicable provisions under this part:

(1) Manufacturers may use credits originally earned by another manufacturer in a particular compliance category to satisfy compliance obligations within the same compliance category.

(2) Once a manufacturer acquires by trade credits originally earned by another manufacturer in a particular compliance category, the manufacturer may transfer the credits to satisfy its compliance obligations in a different compliance category, but only to the extent that the CAFE increase attributable to the transferred credits does not exceed the limits in 49 U.S.C. 32903(g)(3). For any compliance category, the sum of a manufacturer's transferred credits earned by that manufacturer and transferred credits obtained by that manufacturer through trade must not exceed that limit.

(c) *Changes in corporate ownership and control.* Manufacturers must inform NHTSA of corporate relationship changes to ensure that credit accounts are identified correctly and credits are assigned and allocated properly.

(1) In general, if two manufacturers merge in any way, they must inform NHTSA how they plan to merge their credit accounts. NHTSA will subsequently assess corporate fuel economy and compliance status of the merged fleet instead of the original separate fleets.

(2) If a manufacturer divides or divests itself of a portion of its automobile manufacturing business, it must inform NHTSA how it plans to divide the manufacturer's credit holdings into two or more accounts. NHTSA will subsequently distribute holdings as directed by the manufacturer, subject to provision for reasonably anticipated compliance obligations.

(3) If a manufacturer is a successor to another manufacturer's business, it must inform NHTSA how it plans to allocate credits and resolve liabilities per part 534 of this chapter.

(d) *No short or forward sales.* NHTSA will not honor any instructions to trade or transfer more credits than are currently held in any account. NHTSA will not honor instructions to trade or transfer credits from any future vintage (*i.e.,* credits not yet earned). NHTSA will not participate in or facilitate contingent trades.

(e) *Cancellation of credits.* A credit holder may instruct NHTSA to cancel its currently held credits, specifying the originating manufacturer, vintage, and compliance category of the credits to be cancelled. These credits will be permanently null and void; NHTSA will remove the specific credits from the credit holder's account and will not reissue them to any other party.

(f) *Error or fraud in earning credits.* If NHTSA determines that a manufacturer has been credited, through error or fraud, with earning credits, NHTSA will cancel those credits if possible. If the manufacturer credited with having earned those credits has already traded them when the error or fraud is discovered, NHTSA will hold the receiving manufacturer responsible for returning the same or equivalent credits to NHTSA for cancellation.

(g) *Error or fraud in trading.* In general, all trades are final and irrevocable once executed, and may only be reversed by a new, mutually agreed transaction. If NHTSA executes an erroneous instruction to trade credits from one holder to another through error or fraud, NHTSA will reverse the transaction if possible. If those credits have been traded away, the recipient holder is responsible for obtaining the same or equivalent credits for return to the previous holder.

§ 536.9 Use of credits with regard to the domestically manufactured passenger automobile minimum standard.

(a) Each manufacturer is responsible for compliance with both the minimum standard and the attribute-based standard set out in the chapter.

(b) In any particular model year, the domestically manufactured passenger automobile compliance category credit excess or shortfall is determined by comparing the actual CAFE value against either the required standard value or the minimum standard value, whichever is larger.

(c) Transferred or traded credits may not be used, pursuant to 49 U.S.C. 32903(g)(4) and (f)(2), to meet the domestically manufactured passenger automobile minimum standard specified in 49 U.S.C. 32902(b)(4) and in 49 CFR 531.5(b).

(d) If a manufacturer's average fuel economy level for domestically manufactured passenger automobiles is lower than the attribute-based standard, but higher than the minimum standard, then the manufacturer may achieve compliance with the attribute-based standard by applying credits.

(e) If a manufacturer's average fuel economy level for domestically manufactured passenger automobiles is lower than the minimum standard, then the difference between the minimum standard and the manufacturer's actual fuel economy level may only be relieved by the use of credits earned by that manufacturer within the domestic passenger automobile compliance category that have not been transferred or traded. If the manufacturer does not have available earned credits to offset a credit shortage below the minimum standard, then the manufacturer can submit a carry-back plan that indicates sufficient future credits will be earned in its domestic passenger automobile compliance category.

§ 536.10 Treatment of dual-fuel and alternative fuel vehicles—consistency with 49 CFR part 538.

(a) The fuel economy of alternative fueled and dual fueled automobiles is calculated pursuant to EPA's regulations at 40 CFR 600.510–12 and included as part of EPA's calculation of a manufacturer's fleet average fuel economy for the model year and compliance category to which the alternative fueled or dual fueled automobile belongs, in accordance with 49 U.S.C. 32905 and limited by 49 U.S.C. 32906.

(b) If a manufacturer's calculated fuel economy for a particular compliance category, including any alternative fueled and dual fueled automobiles, is higher or lower than the applicable fuel economy standard, manufacturers will earn credits or must apply credits equal to the difference between the calculated fuel economy level in that compliance category and the applicable standard. Credits earned are the same as any other credits, and may be held, transferred, or traded by the manufacturer subject to the limitations of the statute and this part.

■ 5. Revise part 537 to read as follows:

PART 537—AUTOMOTIVE FUEL ECONOMY REPORTS

Sec.

Authority: 49 U.S.C. 32907; delegation of authority at 49 CFR 1.95.

§ 537.1 Scope.

This part establishes requirements for automobile manufacturers to submit reports to the National Highway Traffic Safety Administration regarding their efforts to improve automotive fuel economy.

§ 537.2 Purpose.

The purpose of this part is to obtain information to aid the National Highway Traffic Safety Administration in evaluating automobile manufacturers' plans for complying with average fuel economy standards and in preparing an annual review of the average fuel economy standards.

§ 537.3 Applicability.

This part applies to automobile manufacturers, except for manufacturers subject to an alternate fuel economy standard under 49 U.S.C. 32902(d).

§ 537.4 Definitions.

(a) *Statutory terms.* (1) The terms *average fuel economy standard, fuel, manufacture,* and *model year* are used as defined in 49 U.S.C. 32901.

(2) The term *manufacturer* is used as defined in 49 U.S.C. 32901 and in accordance with part 529 of this chapter.

(3) The terms *average fuel economy, fuel economy,* and *model type* are used as defined in subpart A of 40 CFR part 600.

(4) The terms *automobile, automobile capable of off-highway operation,* and *passenger automobile* are used as defined in 49 U.S.C. 32901 and in accordance with the determinations in part 523 of this chapter.

(b) *Other terms.* (1) The term *loaded vehicle weight* is used as defined in subpart A of 40 CFR part 86.

(2) The terms *axle ratio, base level, body style, car line, combined fuel economy, engine code, equivalent test weight, gross vehicle weight, inertia weight, transmission class,* and *vehicle configuration* are used as defined in subpart A of 40 CFR part 600.

(3) The terms *approach angle, axle clearance, breakover angle, cargo carrying volume, departure angle, passenger carrying volume, running clearance,* and *temporary living quarters* are used as defined in part 523 of this chapter.

(4) The term *incomplete automobile manufacturer* is used as defined in part 529 of this chapter.

(5) As used in this part, unless otherwise required by the context:

(i) *Administrator* means the Administrator of the National Highway Traffic Safety Administration or the Administrator's delegate.

(ii) *Current model year* means:

(A) In the case of a pre-model year report, the full model year immediately following the period during which that report is required by § 537.5(b) to be submitted.

(B) In the case of a mid-model year report, the model year during which that report is required by § 537.5(b) to be submitted.

(iii) *Average* means a production-weighted harmonic average.

(iv) *Total drive ratio* means the ratio of an automobile's engine rotational speed (in revolutions per minute) to the automobile's forward speed (in miles per hour).

§ 537.5 General requirements for reports.

(a) For each current model year, each manufacturer shall submit a pre-model year report, a mid-model year report, and, as required by § 537.8, supplementary reports.

(b)(1) The pre-model year report required by this part for each current model year must be submitted during the month of December (*e.g.,* the pre-model year report for the 1983 model year must be submitted during December 1982).

(2) The mid-model year report required by this part for each current model year must be submitted during the month of July (*e.g.,* the mid-model year report for the 1983 model year must be submitted during July 1983).

(3) Each supplementary report must be submitted in accordance with § 537.8(c).

(c) Each report required by this part must:

(1) Identify the report as a pre-model year report, mid-model year report, or supplementary report as appropriate;

(2) Identify the manufacturer submitting the report;

(3) State the full name, title, and address of the official responsible for preparing the report;

(4) Be submitted electronically to *cafe@dot.gov*. For each report, manufacturers should submit a confidential version and a non-confidential (*i.e.,* redacted) version. The confidential report should be accompanied by a request letter that contains supporting information, pursuant to § 512.8 of this chapter. Your request must also include a certificate, pursuant to § 512.4(b) of this chapter and part 512, appendix A, of this chapter. The word ''CONFIDENTIAL'' must appear on the top of each page containing information claimed to be confidential. If an entire page is claimed to be confidential, the submitter must

indicate clearly that the entire page is claimed to be confidential. If the information for which confidentiality is being requested is contained within a page, the submitter shall enclose each item of information that is claimed to be confidential within brackets: ''[ ].'' Confidential portions of electronic files submitted in other than their original format must be marked ''Confidential Business Information'' or ''Entire Page Confidential Business Information'' at the top of each page. If only a portion of a page is claimed to be confidential, that portion shall be designated by brackets. Files submitted in their original format that cannot be marked as described above must, to the extent practicable, identify confidential information by alternative markings using existing attributes within the file or means that are accessible through use of the file's associated program. A representative from NHTSA's Office of Chief Counsel, as designated by NHTSA, should be copied on any submissions with confidential business information;

(5) Identify the current model year;

(6) Be written in the English language; and

(7) (i) Specify any part of the information or data in the report that the manufacturer believes should be withheld from public disclosure as trade secret or other confidential business information.

(ii) With respect to each item of information or data requested by the manufacturer to be withheld under 5 U.S.C. 552(b)(4) and 15 U.S.C. 2005(d)(1), the manufacturer shall:

(A) Show that the item is within the scope of sections 552(b)(4) and 2005(d)(1);

(B) Show that disclosure of the item would result in significant competitive damage;

(C) Specify the period during which the item must be withheld to avoid that damage; and

(D) Show that earlier disclosure would result in that damage.

(d) Beginning with model year 2023, each manufacturer shall generate reports required by this part using the NHTSA CAFE Projections Reporting Template (Office of Management and Budget (OMB) Control No. 2127–0019, NHTSA Form 1474). The template is a fillable form.

(1) Manufacturers must select the option to identify the report as a pre-model year report, mid-model year report, or supplementary report as appropriate.

(2) Manufacturers must complete all required information for the manufacturer and for all vehicles produced for the current model year required to comply with corporate average fuel economy (CAFE) standards. The manufacturer must identify the manufacturer submitting the report, including the full name, title, and address of the official responsible for preparing the report and a point of contact to answer questions concerning the report.

(3) Manufacturers must use the template to generate confidential and non-confidential reports for each of the compliance fleets (*i.e.,* domestic passenger automobile, imported passenger automobile, non-passenger automobile) produced by the manufacturer for the current model year. Manufacturers must submit a request for confidentiality in accordance with part 512 of this chapter to withhold projected production sales volume estimates from public disclosure. If the request is granted, NHTSA will withhold the projected production sales volume estimates from public disclosure until all the vehicles produced by the manufacturer have been made available for sale (usually 1 year after the current model year).

(4) Manufacturers must submit confidential reports and requests for confidentiality to NHTSA on CD–ROM in accordance with § 537.12. Email copies of non-confidential (*i.e.,* redacted) reports to NHTSA's secure email address: *cafe@dot.gov.* Requests for confidentiality must be submitted in a PDF or MS Word format. Submit 2 copies of the CD–ROM to: Administrator, National Highway Traffic Administration, 1200 New Jersey Avenue SE, Washington, DC 20590, and submit emailed reports electronically to the following secure email address: *cafe@dot.gov.*

(5) Manufacturers can withhold information on projected production sales volumes under 5 U.S.C. 552(b)(4) and 15 U.S.C. 2005(d)(1). In accordance, the manufacturer must:

(i) Show that the item is within the scope of sections 552(b)(4) and 2005(d)(1);

(ii) Show that disclosure of the item would result in significant competitive damage;

(iii) Specify the period during which the item must be withheld to avoid that damage; and

(iv) Show that earlier disclosure would result in that damage.

(e) Each report required by this part must be based upon all information and data available to the manufacturer 30 days before the report is submitted to the Administrator.

§ 537.6 General content of reports.

(a) *Pre-model year and mid-model year reports.* Except as provided in paragraph (c) of this section, each pre-model year report and the mid-model year report for each model year must contain the information required by § 537.7(a).

(b) *Supplementary report.* Except as provided in paragraph (c) of this section, each supplementary report for each model year must contain the information required by § 537.7(a)(1) and (2), as appropriate for the vehicle fleets produced by the manufacturer, in accordance with § 537.8(b)(1) through (4) as appropriate.

(c) *Exceptions.* The pre-model year report, mid-model year report, and supplementary report(s) submitted by an incomplete automobile manufacturer for any model year are not required to contain the information specified in § 537.7(c)(4)(xv) through (xviii) and (c)(5). The information provided by the incomplete automobile manufacturer under § 537.7(c) shall be according to base level instead of model type or carline.

§ 537.7 Pre-model year and mid-model year reports.

(a) *Report submission requirements.* (1) Manufacturers must provide a report with the information required by paragraphs (b) and (c) of this section for each domestic and imported passenger automobile fleet, as specified in part 531 of this chapter, for the current model year.

(2) Manufacturers must provide a report with the information required by paragraphs (b) and (c) of this section for each non-passenger automobile fleet, as specified in part 533 of this chapter, for the current model year.

(3) For model year 2023 and later, for passenger automobiles specified in part 531 and non-passenger automobiles specified in part 533 of this chapter, manufacturers must provide the information for pre-model and mid-model year reports in accordance with the NHTSA CAFE Projections Reporting Template (OMB Control No. 2127–0019, NHTSA Form 1474). The required reporting template can be downloaded from NHTSA's website.

(i) Manufacturers are only required to provide the actual information on vehicles and technologies in production at the time the pre- and mid-model year reports are required. Otherwise, manufacturers must provide reasonable estimates or updated estimates where possible for pre-and mid-model year reports.

(ii) Manufacturers should attempt not to omit data, which should only be the done for products pending production and with unknown information at the time CAFE reports are prepared.

(b) *Projected average and required fuel economy.*

(1) Manufacturers must state the projected average fuel economy for the manufacturer's automobiles determined in accordance with § 537.9 and based upon the fuel economy values and projected sales figures provided under paragraph (c)(2) of this section.

(2) Manufacturers must state the projected final average fuel economy that the manufacturer anticipates having if changes implemented during the model year will cause that average to be different from the average fuel economy projected under paragraph (b)(1) of this section.

(3) Manufacturers must state the projected required fuel economy for the manufacturer's passenger automobiles and non-passenger automobiles determined in accordance with §§ 531.5(a) and 533.5 of this chapter and based upon the projected sales figures provided under paragraph (c)(2) of this section. For each unique model type and footprint combination of the manufacturer's automobiles, the manufacturer must provide the information specified in paragraphs (b)(3)(i) and (ii) of this section in tabular form. The manufacturer must list the model types in order of increasing average inertia weight from top to bottom down the left side of the table and list the information categories in the order specified in paragraphs (b)(3)(i) and (ii) of this section from left to right across the top of the table. Other formats, such as those accepted by the Environmental Protection Agency (EPA), which contain all the information in a readily identifiable format, are also acceptable. For model year 2023 and later, for each unique model type and footprint combination of the manufacturer's automobiles, the manufacturer must provide the information specified in paragraphs (b)(3)(i) and (ii) of this section in accordance with the CAFE Projections Reporting Template (OMB Control No. 2127–0019, NHTSA Form 1474).

(i) In the case of passenger automobiles, manufacturers must report the following:

(A) Beginning model year 2013, base tire as defined in § 523.2 of this chapter;

(B) Beginning model year 2013, front axle, rear axle, and average track width as defined in § 523.2 of this chapter;

(C) Beginning model year 2013, wheelbase as defined in § 523.2 of this chapter;

(D) Beginning model year 2013, footprint as defined in § 523.2 of this chapter; and

(E) The fuel economy target value for each unique model type and footprint entry listed in accordance with the equation provided in part 531 of this chapter.

(ii) In the case of non-passenger automobiles, manufacturers must report the following:

(A) Beginning model year 2013, base tire as defined in § 523.2 of this chapter;

(B) Beginning model year 2013, front axle, rear axle, and average track width as defined in § 523.2 of this chapter;

(C) Beginning model year 2013, wheelbase as defined in § 523.2 of this chapter;

(D) Beginning model year 2013, footprint as defined in § 523.2 of this chapter; and

(E) The fuel economy target value for each unique model type and footprint entry listed in accordance with the equation provided in part 533 of this chapter.

(4) Manufacturers must state the projected final required fuel economy that the manufacturer anticipates having if changes implemented during the model year will cause the targets to be different from the target fuel economy projected under paragraph (b)(3) of this section.

(5) Manufacturers must state whether the manufacturer believes that the projections it provides under paragraphs (b)(2) and (4) of this section, or if it does not provide an average or target under paragraphs (b)(2) and (4), the projections it provides under paragraphs (b)(1) and (3) of this section, sufficiently represent the manufacturer's average and target fuel economy for the current model year for purposes of the Act. In the case of a manufacturer that believes that the projections are not sufficiently representative for the purpose of determining the projected average fuel economy for the manufacturer's automobiles, the manufacturers must state the specific nature of any reason for the insufficiency and the specific additional testing or derivation of fuel economy values by analytical methods believed by the manufacturer necessary to eliminate the insufficiency and any plans of the manufacturer to undertake that testing or derivation voluntarily and submit the resulting data to EPA under 40 CFR 600.509–12.

(c) *Model type and configuration fuel economy and technical information.*

(1) For each model type of the manufacturer's automobiles, the manufacturers must provide the information specified in paragraph (c)(2) of this section in tabular form. List the model types in order of increasing average inertia weight from top to bottom down the left side of the table and list the information categories in the order specified in paragraph (c)(2) of this section from left to right across the top of the table. For model year 2023 and later, CAFE reports required by this part shall for each model type of the manufacturer's automobiles provide the information specified in paragraphs (c)(2) and (4) of this section using the NHTSA CAFE Projections Reporting Template (OMB Control No. 2127–0019, NHTSA Form 1474) and list the model types in order of increasing average inertia weight from top to bottom.

(2) (i) Combined fuel economy; and

(ii) Projected sales for the current model year and total sales of all model types.

(3) For pre-model year reports not subject to § 537.5(d) of this chapter, for each vehicle configuration whose fuel economy was used to calculate the fuel economy values for a model type under paragraph (c)(2) of this section, manufacturers must provide the information specified in paragraph (c)(4) of this section.

(4) (i) Loaded vehicle weight;

(ii) Equivalent test weight;

(iii) Engine displacement, liters;

(iv) Society of Automotive Engineers (SAE) net rated power, kilowatts;

(v) SAE net horsepower;

(vi) Engine code;

(vii) Fuel system (number of carburetor barrels or, if fuel injection is used, so indicate);

(viii) Emission control system;

(ix) Transmission class;

(x) Number of forward speeds;

(xi) Existence of overdrive (indicate yes or no);

(xii) Total drive ratio (N/V);

(xiii) Axle ratio;

(xiv) Combined fuel economy;

(xv) Projected sales for the current model year;

(xvi) (A) In the case of passenger automobiles:

(*1*) Interior volume index, determined in accordance with subpart D of 40 CFR part 600; and

(*2*) Body style;

(B) In the case of non-passenger automobiles:

(*1*) All functional ability characteristic metrics described in (c)(5)(i) of this subpart; and

(*2*) All off-highway characteristic metrics described in (c)(5)(ii) of this subpart;

(xvii) Frontal area;

(xviii) Road load power at 50 miles per hour, if determined by the manufacturer for purposes other than compliance with this part to differ from the road load setting prescribed in 40 CFR 86.177–11(d); and

(xix) Optional equipment that the manufacturer is required under 40 CFR parts 86 and 600 to have actually installed on the vehicle configuration, or the weight of which must be included in the curb weight computation for the vehicle configuration, for fuel economy testing purposes.

(5) For each model type of automobile classified as a non-passenger automobile under part 523 of this chapter, manufacturers must provide the following for each unique trim or configuration of the model type that alters any characteristic or feature described in the sections contained in paragraphs (c)(5)(i) and (ii) of this section:

(i) For an automobile not manufactured primarily for transporting 10 or fewer passengers, determined by the presence of at least one chief non-passenger characteristic in accordance with § 523.5(a) of this chapter, provide:

(A) A yes or no confirmation for whether the number of designated seating positions is greater than ten. If yes, provide the number of designated seating positions;

(B) A yes or no confirmation for the presence of temporary living accommodations, such as a bed, sink, stove, refrigerator, or toilet. If yes, list the provided accommodations;

(C) A yes or no confirmation for the ability to transport property on an open bed. If yes, provide bed width and length in inches, measured to the nearest tenth of inch;

(D) Maximum passenger carrying volume and minimum cargo carrying volume, as defined in § 523.2 of this chapter, with all seats, as sold to the first retail purchaser, installed and in their passenger-carrying position; and

(E) For automobiles manufactured in model year 2022 through model year 2027:

(*1*) A yes or no confirmation for the presence of three or more rows of designated seating positions;

(*2*) A yes or no confirmation that the 2nd and 3rd row seating can be removed, stowed, or folded as described in § 523.5(a)(5) of this chapter;

(3) A yes or no confirmation that the 2nd and 3rd rows create a flat, level surface when in their cargo-carrying configuration as described in § 523.5(a)(5) of this chapter.

(F) For automobiles manufactured in 2028 and beyond, curb weight, gross vehicle weight rating (GVWR), and gross combined weight rating (GCWR) for the calculation of the light duty work factor (LDWF).

(ii) For an automobile capable of off-highway operation, provide the features in paragraphs (c)(5)(ii)(A) through (D) of this section in accordance with § 523.5(b) of this chapter:

(A) A yes or no confirmation for the presence of 4-wheel drive;

(B) The gross vehicle weight rating (GVWR) in pounds;

(C) Measured in accordance with § 523.5(b)(2), provide the value of:

(*1*) Approach angle rounded to the nearest 0.1 degrees;

(*2*) Breakover angle rounded to the nearest 0.1 degrees;

(*3*) Departure angle rounded to the nearest 0.1 degrees; and

(*4*) Running clearance rounded to the nearest 0.1 centimeters.

(D) For automobiles manufactured through model year 2027, measured in accordance with § 523.5(b)(2), provide the value of:

(*1*) Front axle clearance rounded to the nearest 0.1 centimeters; and

(*2*) Rear axle clearance rounded to the nearest 0.1 centimeters.

(6) Manufacturers must determine the fuel economy values provided under paragraphs (c)(2) and (4) of this section in accordance with § 537.9.

(7) For the model years specified in paragraphs (c)(7)(i) through (iii) of this section, manufacturers must identify any air-conditioning (AC), off-cycle and full-size pick-up truck technologies used each model year to calculate the average fuel economy specified in 40 CFR 600.510–12.

(i) For automobiles manufactured in years in which a manufacturer may generate fuel consumption improvement values pursuant to 40 CFR part 600, each manufacturer must provide a list of each air conditioning (AC) efficiency improvement technology utilized in its fleet(s) of vehicles for each model year for which the manufacturer qualifies for fuel consumption improvement values . For each technology identify vehicles by make and model types that have the technology, which compliance category those vehicles belong to, and the number of vehicles for each model equipped with the technology. For each compliance category (domestic passenger automobile, imported passenger automobile, and non-passenger automobile), report the AC fuel consumption improvement value in gallons/mile in accordance with the applicable equation specified in 40 CFR part 600.

(ii) For automobiles manufactured in model years in which a manufacturer may generate fuel consumption improvement values pursuant to 40 CFR part 600, each manufacturer must provide a list of off-cycle efficiency improvement technologies utilized in its fleet(s) of vehicles for each model year that is pending or approved by EPA for which the manufacturer qualifies for fuel consumption improvement values. For each technology, manufacturers must identify vehicles by make and model types that have the technology, which compliance category those vehicles belong to, the number of vehicles for each model equipped with the technology, and the associated off-cycle credits (grams/mile) available for each technology. For each compliance category (domestic passenger automobile, imported passenger automobile, and non-passenger automobile), manufacturers must calculate the fleet off-cycle fuel consumption improvement value in gallons/mile in accordance with the applicable equation specified in 40 CFR part 600.

(iii) For model years up to 2024, each manufacturer must provide a list of full-size pickup trucks in its fleet that meet the mild and strong hybrid vehicle definitions. For each mild and strong hybrid type, manufacturers must identify vehicles by make and model types that have the technology, the number of vehicles produced for each model equipped with the technology, the total number of full-size pickup trucks produced with and without the technology, the calculated percentage of hybrid vehicles relative to the total number of vehicles produced, and the associated full-size pickup truck credits (grams/mile) available for each technology. For the non-passenger automobile compliance category, manufacturers must calculate the fleet pickup truck fuel consumption improvement value in gallons/mile in accordance with the applicable equation specified in 40 CFR part 600.

§ 537.8 Supplementary reports.

(a)(1) Except as provided in paragraph (d) of this section, each manufacturer whose most recently submitted mid-model year report contained an average fuel economy projection under § 537.7(b)(2) or, if no average fuel economy was projected under that section, under § 537.7(b)(1) that was not less than the applicable average fuel economy standard in this chapter and who now projects an average fuel economy that is less than the applicable standard in this chapter shall file a supplementary report containing the information specified in paragraph (b)(1) of this section.

(2) Except as provided in paragraph (d) of this section, each manufacturer that determines that its average fuel economy for the current model year as

projected under § 537.7(b)(2) or, if no average fuel economy was projected under § 537.7(b)(2), as projected under § 537.7(b)(1), is less representative than the manufacturer previously reported it to be under § 537.7(b)(3), this section, or both, shall file a supplementary report containing the information specified in paragraph (b)(2) of this section.

(3) For model years through 2022, each manufacturer whose mid-model year report omits any of the information specified in § 537.7(b) or (c) shall file a supplementary report containing the information specified in paragraph (b)(3) of this section.

(4) Starting model year 2023, each manufacturer whose mid-model year report omits any of the information shall resubmit the information with other information required in accordance with the NHTSA CAFE Projections Reporting Template (OMB Control No. 2127–0019, NHTSA Form 1474).

(b) (1) The supplementary report required by paragraph (a)(1) of this section must contain:

(i) Such revisions of and additions to the information previously submitted by the manufacturer under this part regarding the automobiles whose projected average fuel economy has decreased as specified in paragraph (a)(1) of this section as are necessary—

(A) To reflect the change and its cause; and

(B) To indicate a new projected average fuel economy based upon these additional measures.

(ii) An explanation of the cause of the decrease in average fuel economy that led to the manufacturer's having to submit the supplementary report required by paragraph (a)(1) of this section.

(2) The supplementary report required by paragraph (a)(2) of this section must contain:

(i) A statement of the specific nature of and reason for the insufficiency in the representativeness of the projected average fuel economy;

(ii) A statement of specific additional testing or derivation of fuel economy values by analytical methods believed by the manufacturer necessary to eliminate the insufficiency; and

(iii) A description of any plans of the manufacturer to undertake that testing or derivation voluntarily and submit the resulting data to the Environmental Protection Agency under 40 CFR 600.509–12.

(3) The supplementary report required by paragraph (a)(3) of this section must contain:

(i) All of the information omitted from the mid-model year report under § 537.6(c); and

(ii) Such revisions of and additions to the information submitted by the manufacturer in its mid-model year report regarding the automobiles produced during the current model year as are necessary to reflect the information provided under paragraph (b)(3)(i) of this section.

(4) The supplementary report required by paragraph (a)(4) of this section must contain:

(i) All information omitted from the mid-model year reports under § 537.6(c); and

(ii) Such revisions of and additions to the information submitted by the manufacturer in its pre-model or mid-model year reports regarding the automobiles produced during the current model year as are necessary to reflect the information provided under paragraph (b)(4)(i) of this section.

(c) (1) Each report required by paragraph (a)(1), (2), (3), or (4) of this section must be submitted in accordance with § 537.5(c) not more than 45 days after the date on which the manufacturer determined, or could have determined with reasonable diligence, that the report was required.

(2) [Reserved]

(d) A supplementary report is not required to be submitted by the manufacturer under paragraph (a)(1) or (2) of this section:

(1) With respect to information submitted under this part before the most recent mid-model year report submitted by the manufacturer under this part; or

(2) When the date specified in paragraph (c) of this section occurs after the day by which the pre-model year report for the model year immediately following the current model year must be submitted by the manufacturer under this part.

(e) For model years 2008, 2009, and 2010, each manufacturer of non-passenger automobiles, as that term is defined in § 523.5 of this chapter, shall submit a report, not later than 45 days following the end of the model year, indicating whether the manufacturer is opting to comply with § 533.5(f) or (g) of this chapter.

§ 537.9 Determination of fuel economy values and average fuel economy.

(a) *Vehicle subconfiguration fuel economy values.* (1) For each vehicle subconfiguration for which a fuel economy value is required under paragraph (c) of this section and has been determined and approved under 40 CFR part 600, the manufacturer shall submit that fuel economy value.

(2) For each vehicle subconfiguration specified in paragraph (a)(1) of this section for which a fuel economy value approved under 40 CFR part 600, does not exist, but for which a fuel economy value determined under 40 CFR part 600 exists, the manufacturer shall submit that fuel economy value.

(3) For each vehicle subconfiguration specified in paragraph (a)(1) of this section for which a fuel economy value has been neither determined nor approved under 40 CFR part 600, the manufacturer shall submit a fuel economy value based on tests or analyses comparable to those prescribed or permitted under 40 CFR part 600 and a description of the test procedures or analytical methods used.

(4) For each vehicle configuration for which a fuel economy value is required under paragraph (c) of this section and has been determined and approved under 40 CFR part 600, the manufacturer shall submit that fuel economy value.

(b) *Base level and model type fuel economy values.* For each base level and model type, the manufacturer shall submit a fuel economy value based on the values submitted under paragraph (a) of this section and calculated in the same manner as base level and model type fuel economy values are calculated for use under subpart F of 40 CFR part 600.

(c) *Average fuel economy.* Average fuel economy must be based upon fuel economy values calculated under paragraph (b) of this section for each model type and must be calculated in accordance with subpart F of 40 CFR part 600, except that fuel economy values for running changes and for new base levels are required only for those changes made or base levels added before the average fuel economy is required to be submitted under this part.

§ 537.10 Incorporation by reference by manufacturers.

(a) A manufacturer may incorporate by reference in a report required by this part any document other than a report, petition, or application, or portion thereof submitted to any Federal department or agency more than two model years before the current model year.

(b) A manufacturer that incorporates by reference a document not previously submitted to the National Highway Traffic Safety Administration shall append that document to the report.

(c) A manufacturer that incorporates by reference a document shall clearly identify the document and, in the case of a document previously submitted to the National Highway Traffic Safety Administration, indicate the date on which and the person by whom the document was submitted to this agency.

§ 537.11 Public inspection of information.

Except as provided in § 537.12, any person may inspect the information and data submitted by a manufacturer under this part in the docket section of the National Highway Traffic Safety Administration. Any person may obtain copies of the information available for inspection under this section in accordance with the regulations of the Secretary of Transportation in part 7 of this title.

§ 537.12 Confidential information.

(a) *Treatment of confidential information.* Information made available under § 537.11 for public inspection does not include information for which confidentiality is requested under § 537.5(c)(7), is granted in accordance with section 505 of the Act and 5 U.S.C. 552(b) and is not subsequently released under paragraph (c) of this section in accordance with section 505 of the Act.

(b) *Denial of confidential treatment.* When the Administrator denies a manufacturer's request under § 537.5(c)(7) for confidential treatment of information, the Administrator gives the manufacturer written notice of the denial and reasons for it. Public disclosure of the information is not made until after the 10-day period immediately following the giving of the notice.

(c) *Release of confidential information.* After giving written notice to a manufacturer and allowing 10 days, when feasible, for the manufacturer to respond, the Administrator may make available for public inspection any information submitted under this part that is relevant to a proceeding under the Act, including information that was granted confidential treatment by the Administrator pursuant to a request by the manufacturer under § 537.5(c)(7).

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Jonathan Morrison,

Administrator.

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