Draft Supplemental Environmental Impact Statement

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

December 2025

U.S. Department of Transportation

National Highway Traffic Safety Administration

NHTSA

Draft Supplemental Environmental Impact Statement

for

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Lead Agency:

National Highway Traffic Safety Administration

Cooperating Agencies:

U.S. Environmental Protection Agency
U.S. Department of Energy

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U.S. Environmental Protection Agency (EPA), U.S. Department of Energy (DOE)

Overview

This Draft Supplemental Environmental Impact Statement (SEIS) analyzes the environmental impacts of fuel economy standards and reasonable alternative standards for model year (MY) 2022–2031 passenger cars and light trucks. NHTSA has proposed these new Safer Affordable Fuel-Efficient (SAFE) standards under the Energy Policy and Conservation Act of 1975, as amended by the Energy Independence and Security Act of 2007. Environmental impacts analyzed in this Draft SEIS include those related to fuel and energy use, air quality, and climate. In developing the SAFE standards, NHTSA considered "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," as required by 49 United States Code (U.S.C.) 32902(f).

Public Comment Period

EPA will publish a Notice of Availability of this Draft SEIS in the *Federal Register*, including the date by which comments must be received. Additionally, NHTSA will publish the public comment period end date on its website at https://www.nhtsa.gov/laws-regulations/corporate-average-fuel-economy. To submit comments electronically, go to http://www.regulations.gov and follow the online instructions for submitting comments. File comments in Docket No. NHTSA-2025-0490. If sending by mail, send an original and two copies of comments to Docket Management Facility, M-30, U.S. Department of Transportation, West Building, Ground Floor, Room W12-140, 1200 New Jersey Avenue, SE, Washington, DC 20590. You must reference Docket No. NHTSA-2025-0490. Comments may also be submitted by fax to (202) 493-2251. Any announcements about public hearings will be made on the NHTSA website and in a *Federal Register* notice.

NHTSA will simultaneously issue the Final SEIS and Record of Decision, pursuant to 49 U.S.C. 304a(b) and U.S. Department of Transportation *Final Guidance on the Use of Combined Final Environmental Impact Statements/Records of Decision and Errata Sheets in National Environmental Policy Act Reviews* (https://www.transportation.gov/transportation-policy/permittingcenter/guidance-use-combined-feisrod-and-errata-sheets-nepa-reviews) unless it is determined that statutory criteria or practicability considerations preclude simultaneous issuance.

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SUMMARY

Foreword

Pursuant to the National Environmental Policy Act (NEPA) and U.S. Department of Transportation (DOT) Order 5610.1D,[1] the National Highway Traffic Safety Administration (NHTSA) has prepared this Draft Supplemental Environmental Impact Statement (SEIS) to analyze and disclose certain potential environmental impacts of the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule III standards for passenger cars and light trucks for model years (MYs) 2022–2026 and 2027–2031.

This Draft SEIS compares the potential environmental impacts of the No-Action Alternative and three action alternatives for setting fuel economy standards for MY 2022–2026 and 2027–2031 passenger cars and light trucks. This Draft SEIS analyzes the reasonably foreseeable environmental impacts of each Corporate Average Fuel Economy (CAFE) action alternative relative to the No-Action Alternative. The agency's discussion in this Draft SEIS of scientific and technical literature does not necessarily constitute an endorsement by the agency of that literature. The agency welcomes comment on any literature or analysis in this Draft SEIS or submission of any additional relevant information.

NHTSA prepared this Draft SEIS in line with the Supreme Court's recent decision in *Seven County Infrastructure Coalition v. Eagle County, Colorado* and its progeny.[2] Agencies are granted substantial deference to determine the scope of the environmental impacts that they address and may decide to evaluate environmental impacts from separate projects upstream or downstream from this action.[3] This Proposed Action amends standards for model years for which CAFE standards have previously been established. Accordingly, the agency has decided to retain in this Draft SEIS certain aspects of the analytical frame of prior CAFE Environmental Impact Statements (EISs). Specifically, this Draft SEIS includes a discussion of potential environmental impacts of sectors other than those the agency regulates, where changes in those impacts are linked to the action and alternatives under consideration here. *In Seven County*, the Court clarified that NEPA analysis beyond the direct regulatory effect at issue is not

[1] The NEPA statute is codified at 42 U.S.C. 4321 et seq.; DOT Order 5610.1D, 90 FR 29621 (Jul. 3, 2025), is available at https://www.transportation.gov/mission/dots-procedures-considering-environmental-impacts; and NHTSA-specific NEPA implementing procedures are contained in Subpart D of DOT Order 5610.1D.

[2] *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).

[3] 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.").

required in an EIS.[4] While NHTSA is not required to assess impacts that are not a direct result of changes in CAFE standards and has determined that analyses of such impacts are not necessary for NHTSA to undertake reasoned decision-making pursuant to its authority under the Energy Policy and Conservation Act of 1975 (EPCA), as amended by the Energy Independence and Security Act of 2007 (EISA),[5] the agency nonetheless provides discussion of those impacts solely for informational purposes.

NHTSA solicits comment on the required scope of NEPA analysis in connection with a CAFE standards rulemaking, including whether NHTSA has any statutory authority to take environmental consequences of such a rulemaking into account when exercising its statutory authority, and, to the extent that it lacks such authority, whether NHTSA is required to undertake any NEPA analysis in connection with a CAFE standards rulemaking.

Background

EPCA mandates that NHTSA establish and implement a regulatory program for motor vehicle fuel economy, known as the CAFE program, to reduce national energy consumption. As codified in Chapter 329 of Title 49 of the U.S. Code (U.S.C.) and as amended by EISA, EPCA sets forth specific requirements concerning the establishment of average fuel economy standards for passenger cars and light trucks, which are motor vehicles with a gross vehicle weight rating less than 8,500 pounds and medium-duty passenger vehicles with a gross vehicle weight rating less than 10,000 pounds. The Secretary of Transportation has delegated responsibility for implementing the CAFE program to NHTSA.[6]

To inform its development of the new CAFE standards and pursuant to NEPA,[7] NHTSA prepared this Draft SEIS to evaluate the potential environmental impacts of a reasonable range of alternatives the agency is considering for MY 2022–2026 and 2027–2031 CAFE standards. NEPA directs that Federal agencies proposing “major federal actions significantly affecting the quality of the human environment” must prepare a detailed statement on the environmental impacts of the proposed action (including alternatives to the proposed action).[8] In this Draft SEIS, NHTSA analyzes, discloses, and compares the potential environmental impacts of a reasonable range of alternatives for CAFE standards, including a No-Action Alternative and a Preferred

[4] At issue in *Seven County* was the scope of analysis required under NEPA when an agency issues a permit authorizing construction of a segment of linear infrastructure; our discussion here applies that case’s holding to the current context, where NHTSA is undertaking NEPA analysis in connection with a regulatory standards rulemaking.

[5] Public Law (Pub. L.) No. 110-140, 121 Stat. 1499 (2007).

[6] The Secretary of Transportation has delegated the responsibility for implementing the CAFE program to NHTSA (49 Code of Federal Regulations [CFR] 1.95(a)). Accordingly, the Secretary, DOT, and NHTSA are often used interchangeably in this Draft SEIS.

[7] 42 U.S.C. 4321–4347.

[8] 42 U.S.C. 4332.

Alternative.[9] This Draft SEIS analyzes reasonably foreseeable environmental impacts and discusses impacts in proportion to their significance.

Purpose and Need for the Action

In accordance with EPCA, as amended by EISA, as well as NHTSA's June 2025 interpretive rule,[10] the purpose of NHTSA's rulemaking is to set CAFE standards for MY 2022–2026 and 2027–2031 passenger cars and light trucks to reflect "the maximum feasible average fuel economy level that the Secretary [of Transportation] decides the manufacturers can achieve in that model year."[11] When determining the maximum feasible levels manufacturers can achieve in each model year, EPCA requires that NHTSA consider the four statutory factors of 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. In addition, when determining the maximum feasible levels, the agency considers relevant safety and environmental factors. NHTSA is prohibited from considering the availability of alternative fuel technologies (e.g., electric vehicles [EVs] or plug-in hybrid EV electric operation) or compliance credits when setting standards.[12]

NHTSA must establish separate average fuel economy standards for passenger cars and light trucks for each model year.[13] Standards must be "based on [one] or more vehicle attributes related to fuel economy" and "express[ed]…in the form of a mathematical function."[14]

Proposed Action and Alternatives

NHTSA's action is a rulemaking to set fuel economy standards for passenger cars and light trucks. NHTSA has selected a reasonable range of alternatives to evaluate the potential environmental impacts of the CAFE standards and alternatives under NEPA. In addition to proposing new standards, NHTSA's Proposed Action also includes a proposed change to NHTSA's vehicle classification regulations (at 49 Code of Federal Regulations part 523) starting in MY 2028, which would result in vehicles currently classified as light trucks being reclassified as passenger cars, to align better with the original intent expressed in the statute. NHTSA is proposing MY 2022–2026 and 2027–2031 CAFE standards but, because no change in manufacturer behavior is possible for MY 2022–2026 passenger car and light truck fleets, this

[9] NHTSA's identification of a Preferred Alternative is consistent with DOT Order 5610.1D, Section 13.e. The Preferred Alternative is the alternative identified as the favored course of action by the lead agency during the NEPA process. For a given set of standards (CAFE), the "Proposed Action and alternatives" constitute the entire range of alternatives evaluated by NHTSA and include the agency's Preferred Alternative. Consistent with DOT Order 5610.1D, Section 13.e., this Draft SEIS presents the environmental impacts of the Proposed Action and alternatives in comparative form so that reviewers may evaluate their comparative merits.

[10] Resetting the Corporate Average Fuel Economy Program; Interpretive Rule, 90 FR 24518, 24519 (June 11, 2025).

[11] 49 U.S.C. 32902(a).

[12] 49 U.S.C. 32902(h).

[13] 49 U.S.C. 32902(b)(1)-(2).

[14] 49 U.S.C. 32902(b)(3)(A).

Draft SEIS analyzes environmental impacts associated only with the proposed MY 2027–2031 CAFE standards.

No-Action and Action Alternatives

The No-Action Alternative for MYs 2027–2031 assumes that the MY 2027–2031 CAFE standards finalized in 2024[15] remain in effect. The No-Action Alternative also assumes that manufacturers would make production decisions in response to estimated market demand for fuel economy, considering estimated fuel prices, estimated product development cadence, and estimated availability, applicability, cost, and effectiveness of fuel-saving technologies.

The No-Action Alternative provides an analytical baseline against which to compare the environmental impacts of the action alternatives. It is important to note for this analysis that NHTSA promulgated the 2022 and 2024 final standards, which represent the baseline, based on consideration of EVs and credit trading, but such consideration is impermissible pursuant to EPCA. In addition, NHTSA has concluded that manufacturers are not, as discussed in the preamble, able to achieve those standards with the gasoline- and diesel-powered vehicles in their fleet. Therefore, the effects relative to the baseline may be less than presented in this document.

NHTSA has analyzed a range of CAFE action alternatives with fuel economy stringencies that increase, depending on the model year and alternative, between 0.25 percent and 1.5 percent annually from the MY 2022 standards for both passenger cars and light trucks. In most cases stringencies represent a multiplicative shift in the target function used to compute standards. However, in MY 2028, NHTSA is proposing a reclassification of some models from the light truck fleet to the passenger car fleet. As part of this reclassification, NHTSA is using updated function parameters (slope, intercept, minimum, and maximum) based on estimates conducted using the updated fleets. As a result, between MY 2027 and MY 2028, the change in stringency reflects a change in the average standard value for each class between the two years. Though NHTSA's action alternatives are described in terms of increasing stringency from the previous year, all of NHTSA's action alternatives would require standards in a given year to be lower than the standards under the No-Action Alternative that, as noted above, represents standards set impermissibly based on consideration of EVs and credit trading. Each of the action alternatives is derived from a different MY 2022 compliance fit for passenger cars and light trucks, as noted under each alternative below. A compliance fit percentage is used to estimate what portion of the vehicle fleet would comply with a standard. For example, a 75 percent compliance fit means the standard is calibrated such that 75 percent of vehicles in a regulatory class would meet or exceed their fuel economy target, accounting for technological feasibility, cost, and market behavior. This range of the No-Action Alternative and action alternatives encompasses

[15] 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; Final Rule, 89 FR 52540 (June 24, 2024). Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles; Final Rule, 89 FR 27842 (Apr. 18, 2024).

a spectrum of possible standards NHTSA could determine is the maximum feasible based on the different ways the agency could weigh EPCA's four statutory factors.

Throughout this Draft SEIS, potential impacts are shown for the No-Action Alternative and three action alternatives that illustrate different ranges of estimated average annual percentage increases in fuel economy for both passenger cars and light trucks, as detailed in Table S-1.

Table S-1. Regulatory Alternatives Under Consideration for MY 2022–2031 Passenger Car and Light Truck Standards

Name of Alternative	Passenger Car Stringency Changes	Light Truck Stringency Changes
No-Action Alternative	1.50% for MY 2023 8.00% per year for MYs 2024–2025 10.00% for MY 2026 2.00% per year for MYs 2027–2031	1.50% for MY 2023 8.00% per year for MYs 2024–2025 10.00% for MY 2026 0% per year for MYs 2027–2028 2.00% per year for MYs 2029–2031
Alternative 1	80% compliance fit [a] MY 2022 0.50% per year for MYs 2023–2026 0.10% for MY 2027 0.30% for MY 2028 [b] 0.25% per year for MYs 2029–2031	80% compliance fit [a] MY 2022 0.50% per year for MYs 2023–2026 0.80% for MY 2027 0.60% for MY 2028 [b] 0.25% per year for MYs 2029–2031
Alternative 2 (Preferred)	75% compliance fit [a] MY 2022 0.50% per year for MYs 2023–2026 0.35% for MY 2027 0.25% for MY 2028 [b] 0.25% per year for MYs 2029–2031	70% compliance fit [a] MY 2022 0.50% per year for MYs 2023–2026 0.70% for MY 2027 0.25% for MY 2028 [b] 0.25% per year for MYs 2029–2031
Alternative 3	70% compliance fit [a] MY 2022 0.50% per year for MYs 2023–2026 1.40% for MY 2027 1.50% for MY 2028 [b] 1.00% per year for MYs 2029–2031	50% compliance fit [a] MY 2022 0.50% per year for MYs 2023–2026 0.40% for MY 2027 0.20% for MY 2028 [b] 1.00% per year for MYs 2029–2031

Notes:
[a] Compliance fits 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.
[b] Stringency change reflects the growth rate in class average standard value from MYs 2027–2028.

Table S-2 shows the estimated average required fleet-wide fuel economy forecasts by model year for each alternative.

Table S-2. Projected Average Required Fleet-Wide Fuel Economy (mpg) for Combined U.S. Passenger Cars and Light Trucks by Model Year and Alternative

Model Year	No-Action	Alt. 1	Alt. 2	Alt. 3
2027	47.5	29.9	30.7	32.6
2028	47.7	33.4	34.3	36.5
2029	48.7	33.5	34.4	36.9
2030	49.8	33.6	34.5	37.3
2031	50.9	33.7	34.6	37.7

Notes:
mpg = miles per gallon.

These alternatives reflect, among other things, differences in the degree of technology adoption across the fleet, costs to manufacturers and consumers, and conservation of oil and related reductions in non-criteria emissions (NCEs).[16] As part of this analysis, NHTSA considered relevant safety and environmental factors. The alternatives evaluated in this Draft SEIS therefore provide decision-makers the ability to select among and between a wide range of alternatives analyzed in this Draft SEIS, which begin with the No-Action Alternative, are adjusted to account for a specific MY 2022 compliance fit for passenger cars and light trucks, and then increase up to 1.5 percent. Within this range, stringencies could remain the same or differ year to year between and among regulatory classes.

Environmental Consequences

This section describes how the reasonably foreseeable impacts from the Proposed Action could affect energy use, air quality, and climate, as reported in Chapter 3, *Energy*; Chapter 4, *Air Quality*; and Chapter 5, *Non-Criteria Emissions*, of this Draft SEIS, respectively. Air quality and NCE impacts are reported for the entire light-duty (LD) vehicle fleet (passenger cars and light trucks combined[17]) for the No-Action Alternative and three action alternatives; results are reported separately for passenger cars and light trucks in Appendix B, *U.S. Passenger Car and Light Truck Results Reported Separately*. No quantifiable, alternative-specific impacts were identified for the other resource areas discussed in Chapter 6, *Life-Cycle Assessment Implications of Vehicle Materials*, and Chapter 7, *Historic and Cultural Resources;* as a result, these resource areas are summarized at a high level here and not included in the discussion of impacts below.

Chapter 6, *Life-Cycle Assessment Implications of Vehicle Materials,* describes the life-cycle environmental implications related to the vehicle cycle phase considering the materials and

[16] In this Draft SEIS, the term *non-criteria emissions* (NCEs) refers specifically to carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride, which are not classified as criteria pollutants under the Clean Air Act.

[17] Passenger cars and light trucks also are referred to as LD vehicles. The terms *passenger automobile*, *light truck*, and *medium-duty passenger vehicle* are defined in 49 CFR part 523.

technologies that vehicle manufacturers might use to comply with the CAFE standards. The chapter discusses the impacts related to raw material extraction for materials used for vehicle manufacture, material processing for materials used for vehicle manufacture, component manufacture and vehicle assembly, and vehicle end of life (i.e., disposal and recycling) that might be applied by manufacturers to improve fuel economy to comply with the rulemaking. Manufacturers can choose how to respond to the proposed standards and, depending on vehicle manufacturers' responses in using the various materials or technologies, impacts would vary substantially. As discussed in Chapter 6, Section 6.1, *Introduction,* manufacturers may rely on the different materials or technologies assessed in Chapter 6 and fuel sources assessed in Chapter 3, *Energy*, and as a result, NHTSA cannot quantitatively distinguish between action alternatives in terms of life-cycle implications of vehicle materials. Chapter 6, *Life-Cycle Assessment Implications of Vehicle Materials*, further notes that the magnitude of life-cycle NCE impacts associated with materials and technologies is smaller in comparison with the emissions reductions from avoided fuel consumption during vehicle use.

Chapter 7, *Historic and Cultural Resources*, qualitatively describes potential impacts on historic and cultural resources, such as deterioration due to acid deposition. The Proposed Action and alternatives would not result in significant impacts on historic and cultural resources. In general, impacts under the Proposed Action and alternatives are not quantifiable because it is not possible to distinguish between acid deposition deterioration impacts that would result from the proposed rule and acid deposition deterioration impacts resulting from other activities, as well as deterioration impacts from natural weathering (rain, wind, temperature, and humidity) on historic buildings and structures and the varying impact of a specific geographic location on any particular historic property or sacred site or object.

The potential impacts on energy use, air quality, and climate discussed in the main chapters of this Draft SEIS include reasonably foreseeable environmental impacts from the Proposed Action. Reasonably foreseeable environmental impacts mean changes to the human environment from the Proposed Action or alternatives that are sufficiently likely to occur such that a person of ordinary prudence would take them into account in reaching a decision[18] and have a reasonably close causal relationship to the Proposed Action or alternatives.

To derive the reasonably foreseeable environmental impacts of the action alternatives, NHTSA compares each CAFE alternative to the No-Action Alternative, which reflects trends that would be expected in the absence of any regulatory action by NHTSA. Because NHTSA is required to set CAFE standards for each model year, environmental impacts would also depend on future standards established by NHTSA that cannot be quantified at this time.

Energy

NHTSA's CAFE standards regulate fuel economy and, therefore, affect U.S. transportation fuel consumption. Transportation fuel accounts for a large portion of total U.S. energy consumption and energy imports and has a significant impact on the functioning of the energy sector as a

[18] DOT Order 5610.1D, Section 26.t.

whole. Though U.S. energy efficiency increased and the U.S. share of worldwide energy consumption declined over previous decades, total U.S. energy consumption increased over that same period. Until a decade ago, most of this increase was driven by rising energy imports, largely for use in the transportation sector. However, in recent years, higher domestic oil and gas production, additional electricity generation, and improved energy efficiency have made the United States a net energy exporter, resulting in declining transportation fuel consumption and imports.

Petroleum is the largest source of energy used in the transportation sector, and transportation accounts for the largest share of total U.S. petroleum consumption. The Energy Information Administration's Annual Energy Outlook (AEO) 2025, developed in 2024, shows that the transportation sector accounted for 74.0 percent of total U.S. petroleum consumption and projects it to decrease to 67.6 percent of total U.S. petroleum consumption by 2050.

Given that the transportation sector is projected to account for the majority of U.S. petroleum consumption, U.S. net petroleum imports in 2050 are expected primarily to be attributed to fuel consumption by LD and heavy-duty (HD) vehicles. The United States is expected to continue to be a net energy exporter through 2050, due to a combination of improvements in vehicle fuel economy, combined with increases in U.S. petroleum production, which have substantially reduced U.S. oil imports, resulting in declining net petroleum imports.

In the foreseeable future, the transportation sector would continue to be the largest consumer of U.S. petroleum and the second-largest consumer of total U.S. energy, after the industrial sector, according to AEO 2025. AEO projects that the fuel consumed by LD vehicles would consist predominantly of gasoline derived from petroleum for the foreseeable future due to conventional gasoline cars continuing to make up the majority of LD vehicle stock through 2050.[19] Detailed discussion of this information can be found in the relevant sections of Appendix D, *Energy*.

Other sources of energy used in the U.S. transportation sector include electricity, diesel and biofuels, natural gas, and hydrogen.

- **Electricity.** Electricity currently makes up 0.8 percent of LD vehicle fuel consumption, but the CAFE Model projects this proportion to increase to 11.2 percent across all LD vehicles by 2050, representing the largest share of fuel consumption outside of gasoline.
- **Diesel.** Diesel currently makes up 0.6 percent of fuel consumption for LD vehicles and the CAFE Model projects this proportion to decrease to 0.3 percent by 2050.
- **Biofuels.** Biofuels, including ethanol (E85), biodiesel, and renewable diesel, currently make up 1.9 percent of transportation energy consumption. AEO 2025 projects this share to increase through 2050 due to projected growth of renewable diesel and gasoline as a transportation fuel.
- **Natural gas.** Natural gas currently makes up less than 0.01 percent of fuel consumption for LD vehicles. AEO 2025 projects LD natural gas consumption to decrease through 2050.

[19] Discussions about national energy consumption within this Draft SEIS are generally based on data from AEO 2025, while reference to vehicle type-specific energy consumption is generally based on the CAFE Model.

- **Hydrogen.** LD fuel cell vehicle hydrogen consumption is less than 0.01 percent of total LD fuel consumption. The CAFE Model projects hydrogen to increase to 0.08 percent of LD fuel consumption by 2050.

Reasonably Foreseeable Impacts from the Proposed Action

To calculate the impacts on fuel consumption for each action alternative, NHTSA subtracted projected fuel consumption under the relevant No-Action Alternative from the level under each action alternative. While total fuel consumption decreases as the action alternatives become more stringent, all action alternatives result in higher total fuel consumption compared to the No-Action Alternative. Table S-3 displays these relationships, showing that the increase in fuel consumption relative to the No-Action Alternative is smallest under the most stringent alternative.[20] This table reports total 2024 to 2050 fuel consumption under the No-Action Alternative in gasoline gallon equivalents, including diesel, gasoline, electricity, hydrogen, and biofuel, for passenger cars and light trucks and the incremental fuel use changes for the action alternatives relative to the No-Action Alternative. Gasoline is expected to account for 88.4 percent of energy consumption by passenger cars and light trucks in 2050.

Table S-3. Fuel Consumption (for the No-Action Alternative) and Change in Fuel Consumption by Alternative for all Light-Duty Vehicles (Passenger Cars and Light Trucks) (billion gasoline gallon equivalent total for calendar years 2024–2050)

No-Action	Alt. 1	Alt. 2	Alt. 3
Fuel Consumption	Change in Fuel Use Compared to the CAFE No-Action Alternative		
2,867	+77 (+3%) [a]	+77 (+3%) [a]	+71 (+2%)

Notes:
[a] The estimated fuel consumption is the same under Alternative 1 and Alternative 2 (Preferred Alternative) because starting with MY 2027, vehicle manufacturers are assumed to offer vehicles using the same fuel economy technologies under either Alternative 1 or Alternative 2 (Preferred Alternative), and the resulting fuel consumption would be the same for both alternatives.

Air Quality

The Proposed Action and alternatives would affect air pollutant emissions and air quality, which, in turn, would affect public health and welfare and the natural environment. The air quality analysis in Chapter 4, *Air Quality*, assesses the Proposed Action impacts on emissions of pollutants of concern from mobile sources, and the resulting impacts on human health. The changes in emissions would vary by pollutant, calendar year, and action alternative.

Under the authority of the Clean Air Act and its amendments, the U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards for six relatively common air pollutants known as *criteria pollutants*: carbon monoxide (CO), nitrogen dioxide, ozone, sulfur dioxide (SO_2), lead, and particulate matter (PM) with an aerodynamic

[20] NHTSA used 2050 as the end year for its analysis because it is the year by which nearly the entire U.S. vehicle fleet will be composed of MY 2027–2031 or later LD vehicles.

diameter equal to or less than 10 microns (PM10) and 2.5 microns (PM2.5, or fine particles). Ozone is not emitted directly from vehicles but is formed in the atmosphere from emissions of ozone precursor pollutants such as nitrogen oxides (NO_X) and volatile organic compounds (VOCs).

Toxic air pollutants from vehicles are known as mobile source air toxics (MSATs). The MSATs included in this analysis are acetaldehyde, acrolein, benzene, 1,3-butadiene, diesel particulate matter (DPM), and formaldehyde. DPM is a component of exhaust from diesel-fueled vehicles and falls almost entirely within the PM2.5 particle-size class.

Criteria pollutants and MSATs have been shown to have health effects on individuals at various concentrations and exposures; for more information see Chapter 4, Section 4.1.1.1, *Health Effects of Criteria Pollutants and Mobile Source Air Toxics.* In addition to criteria pollutants, motor vehicles emit some substances defined by the 1990 Clean Air Act amendments as toxic air pollutants.

Contribution of U.S. Transportation Sector to Air Pollutant Emissions

The U.S. transportation sector is a major source of emissions of certain criteria pollutants or their chemical precursors. Emissions of these pollutants from on-road mobile sources have declined since 1970 because of pollution controls on vehicles and regulation of the chemical content of fuels, despite continuing increases in vehicle travel and fuel consumption. Nevertheless, the U.S. transportation sector remains a major source of emissions of certain criteria pollutants or their chemical precursors. As noted in Chapter 4, *Air Quality*, in 2024, on-road mobile sources were responsible for emitting 12.322 million tons[21] per year of CO (27 percent of total U.S. emissions), 66,972 tons per year (1 percent) of PM2.5, and 188,636 tons per year (1 percent) of PM10. In 2026, passenger cars and light trucks will contribute 84 percent of U.S. highway emissions of CO, 49 percent of highway emissions of PM2.5, and 64 percent of highway emissions of PM10. Almost all the PM in motor vehicle exhaust is PM2.5; therefore, this analysis focuses on PM2.5 rather than PM10. In 2024, on-road mobile sources also emitted 895,989 tons per year (7 percent of total U.S. emissions) of VOCs and 1.745 million tons per year (25 percent) of NO_X, both of which are chemical precursors of ozone. In 2026, passenger cars and light trucks will emit 78 percent of U.S. highway emissions of VOCs and 31 percent of U.S. highway emissions of NO_X. NO_X is a PM2.5 precursor, and VOCs can be PM2.5 precursors. SO_2 and other oxides of sulfur are important because they contribute to the formation of PM2.5 in the atmosphere; however, on-road mobile sources account for less than 1 percent of U.S. SO_2 emissions.

Key Findings for Air Quality

This Draft SEIS provides findings for air quality impacts for 2035 and 2050. In 2035, emissions of SO_2 decrease, and emissions of CO, NO_X, PM2.5, and VOCs increase under all action alternatives, compared to the No-Action Alternative. In 2050, emissions of CO, NO_X, PM2.5, SO_2, and VOCs increase under all action alternatives, compared to the No-Action Alternative. The estimated

[21] The term *ton(s)* as used in this chapter refers to U.S. tons (2,000 pounds).

emissions are the same under Alternative 1 and Alternative 2 (Preferred Alternative) because starting with MY 2027, vehicle manufacturers are assumed to offer vehicles using the same fuel economy technologies under either Alternative 1 or Alternative 2 (Preferred Alternative), and the resulting emissions would be the same for both alternatives.

The changes in emissions are small in relation to total criteria pollutant emissions levels during this period and, overall, the health effects due to changes in criteria pollutant emissions through 2050 are projected to increase. The directions and magnitudes of the changes in total emissions are not consistent across all pollutants. This reflects the complex interactions between tailpipe emissions rates of the various vehicle types; the technologies assumed to be incorporated by manufacturers in response to the standards; upstream emissions rates; the relative proportions of gasoline, diesel, and other fuels in total fuel consumption changes; and changes in vehicle miles traveled (VMT) from the rebound effect.[22] Other CAFE Model inputs and assumptions, discussed at length in Section II of the proposed rule preamble and Chapters 2 through 5 of the Technical Support Document, including the rate at which new vehicles are sold, will also affect these air quality impact estimates.[23] It is important to stress that changes in these assumptions would alter the air pollution estimates.

Criteria Pollutants

The air quality analysis identified the following impacts on criteria air pollutants.

- Modeled increases under the action alternatives in 2035 were small relative to the emissions under the No-Action Alternative. Emissions of CO, NO_X, PM2.5, and VOC increase slightly under all action alternatives compared to the No-Action Alternative, while emissions of SO_2 decrease slightly. Relative to the No-Action Alternative, the modeling results suggest CO, NO_X, and VOC emissions increases are smaller under Alternative 3 (the most stringent alternative in terms of estimated required miles per gallon) than under Alternatives 1 and 2 (Preferred Alternative), whereas the emissions increases of PM2.5 are unchanged across the action alternatives relative to the No-Action Alternative. The decreases in SO_2 emissions relative to the No-Action Alternative reflect the projected decrease in EV use across all action alternatives, which would result in reduced emissions from fossil-fueled power plants to generate the electricity for charging the EVs. Upstream sources constitute over 90 percent of SO_2 emissions but less than 90 percent of emissions of other criteria pollutants.
- Modeled increases under the action alternatives in 2050 were small relative to the emissions under the No-Action Alternative. Emissions of CO, NO_X, PM2.5, SO_2, and VOC increase under all action alternatives compared to the No-Action Alternative. Relative to the

[22] The rebound effect refers to the increase in vehicle use resulting from improved fuel economy.

[23] 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 Draft SEIS. Any analysis of regulatory actions that will be implemented several years in the future, the benefits and costs of which 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.

No-Action Alternative, the modeling results suggest NO_X, PM2.5, SO_2, and VOC emissions increases are smaller under Alternative 3 than under Alternatives 1 and 2 (Preferred Alternative), while CO emissions increases are larger under Alternative 3 than under Alternatives 1 and 2 (Preferred Alternative), due to increased tailpipe emissions of CO. Decreases in EV use relative to the No-Action Alternative are projected in 2050, but they are smaller decreases than in 2035, such that the projected increases in vehicle gasoline consumption lead to projected slight increases in overall SO_2 emissions (through increases in tailpipe emissions of SO_2 and increases in upstream SO_2 emissions from increased fuel refining).

- Under each action alternative compared to the No-Action Alternative, the largest relative increases in emissions (as a percentage) among the criteria pollutants would occur for VOCs, for which emissions would increase by as much as 3.9 percent under Alternatives 1 and 2 (Preferred Alternative) in 2050 compared to the No-Action Alternative. Percentage increases in emissions of CO, NO_X, and PM2.5 would be less. The smaller increases in CO, NO_X, and PM2.5 are not expected to lead to measurable changes in concentrations of criteria pollutants in the ambient air. The larger increases in VOCs could lead to changes in ambient pollutant concentrations.

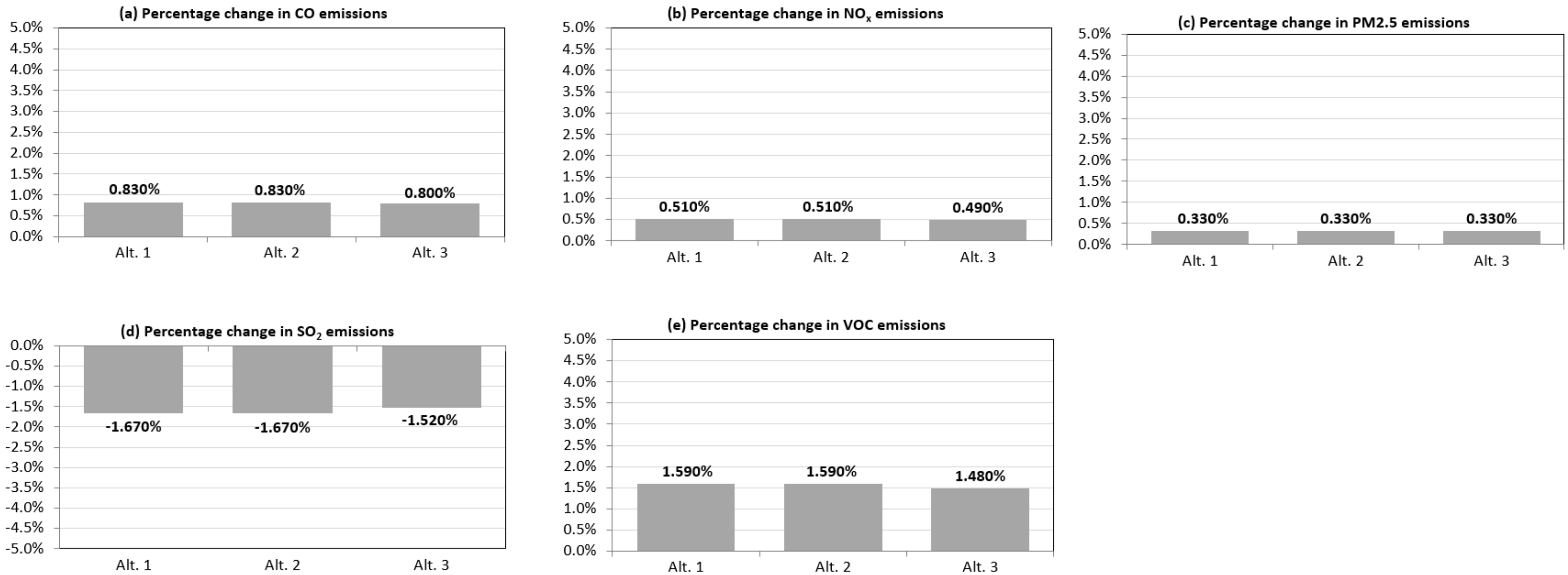
Mobile Source Air Toxics

The air quality analysis identified the following impacts on MSATs.

- MSAT emissions across the action alternatives increase in 2035 and 2050 relative to the No-Action Alternative (increases in 2035 are slight). The increases stay the same or get larger from Alternatives 1 and 2 (Preferred Alternative) to Alternative 3 for acetaldehyde (in 2050), acrolein (in 2035 and 2050), and 1,3-butadiene (in 2035 and 2050), but get smaller for acetaldehyde (in 2035), benzene (in 2035 and 2050), DPM (in 2035 and 2050), and formaldehyde (in 2035 and 2050).
- The largest relative increases in emissions (as a percentage) generally would occur for formaldehyde for which emissions would increase by as much as 3.8 percent under Alternatives 1 and 2 (Preferred Alternative) 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 MSATs 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.

Changes in criteria pollutant emissions in 2035 are shown by action alternative in Figure S-1. Changes in MSAT emissions in 2035 are shown by action alternative in Figure S-2.

Figure S-1. Nationwide Percentage Changes in Criteria Pollutant Emissions from U.S. Passenger Cars and Light Trucks for 2035 by Action Alternative Compared to the No-Action Alternative, Proposed Action Impacts



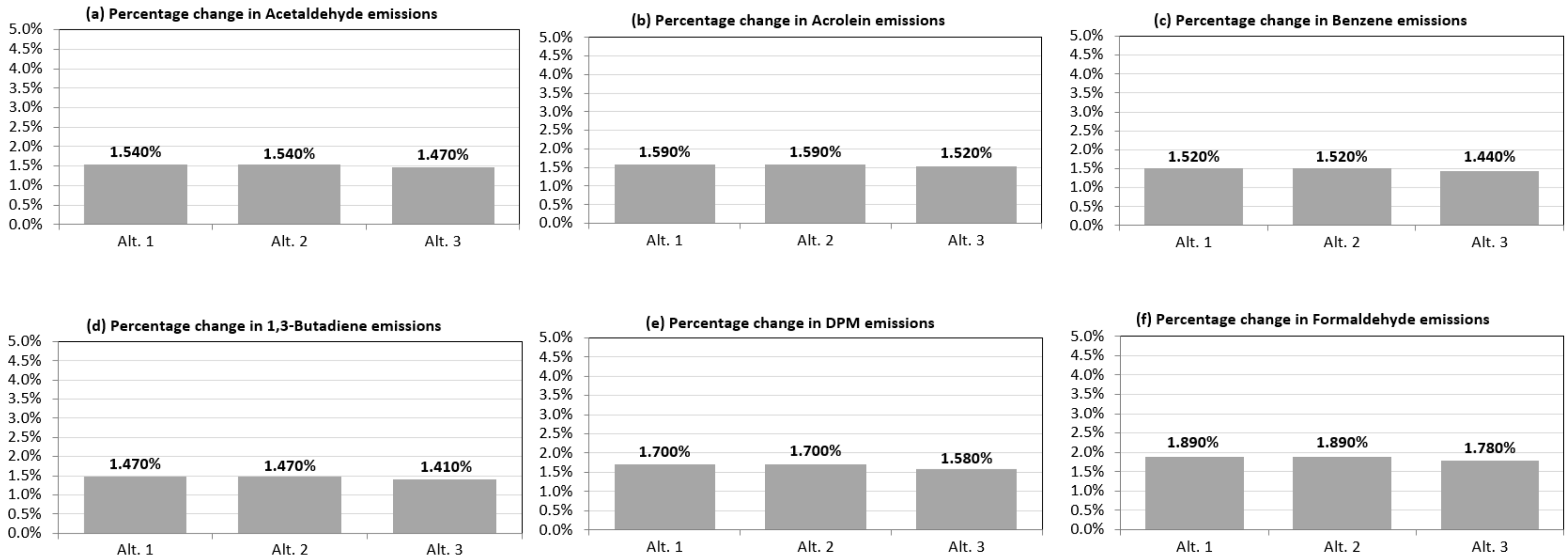
Notes:

The vertical (percentage) scale differs by pollutant.

Negative values indicate emissions decreases; positive values are emissions increases.

CO = carbon monoxide; NO_X = nitrogen oxides; PM2.5 = particulate matter 2.5 microns or less in diameter; SO_2 = sulfur dioxide; VOCs = volatile organic compounds.

Figure S-2. Nationwide Percentage Changes in Mobile Source Air Toxic Emissions from U.S. Passenger Cars and Light Trucks for 2035 by Action Alternative Compared to the No-Action Alternative, Proposed Action Impacts



Notes:
Positive values indicate emissions increases.
DPM = diesel particulate matter.

Non-Criteria Emissions

This section describes how the Proposed Action and alternatives could affect NCEs. In this Draft SEIS, the discussion of reasonably foreseeable impacts of NCEs focuses on impacts associated with increases in NCEs from the Proposed Action and alternatives as compared to projected NCEs under the relevant No-Action Alternative.

Contribution of the U.S. Transportation Sector to Carbon Dioxide Emissions

Human activities that emit NCEs into the atmosphere include fossil fuel production and combustion. Isotopic- and inventory-based studies have indicated that the rise in the global CO_2 concentration is largely a result of the release of carbon that has been stored underground through the combustion of fossil fuels (coal, petroleum, and natural gas) used to power motor vehicles, among other uses (as discussed in Appendix E, Section E.3.3.5, *Global Emissions Scenarios*).

In 2022, the U.S. transportation sector was the single leading source of CO_2 emissions from fossil fuels, contributing over one-third of total U.S. CO_2 emissions from fossil fuels, with passenger cars and light trucks accounting for 57 percent of total U.S. CO_2 emissions from transportation (EPA 2024a). From 1990 to 2022, CO_2 emissions from passenger cars and light trucks increased by 10 percent, which is attributed to a 47 percent increase in VMT by LD motor vehicles (passenger cars and light trucks) driven by population growth, economic growth, and low fuel prices (EPA 2024a).

Key Findings for Emissions

The Proposed Action and alternatives would increase both U.S. passenger car and light truck fuel consumption and CO_2 emissions compared with the relevant No-Action Alternative, resulting in minor increases to the anticipated increases in global CO_2 concentrations, temperature, precipitation, sea level, and ocean acidification that would otherwise occur.[24]

Estimates of NCEs and increases are presented for each of the action alternatives for CAFE standards. The impacts of the Proposed Action and alternatives on global mean surface temperature, precipitation, sea level, and ocean pH would be small in relation to global emissions trajectories because of the global and multi-sectoral nature of climate trends.

As discussed further in Appendix E, Section E.3.1, *Uncertainty in Climate Modeling*, the potential climate impacts of the Proposed Action and alternatives involve uncertainty inherent in all projections of future climate conditions and cannot reliably be determined with complete accuracy.

[24] Uncertainty exists regarding the magnitude of impact. The methods used to characterize NCEs and climate impacts consider multiple sources of uncertainty. Scientific understanding of the climate system is incomplete; like any analysis of complex, long-term changes to support decision-making, evaluating reasonably foreseeable impacts on the human environment involves many assumptions and uncertainties. This Draft SEIS uses methods and data to analyze climate impacts that represent the best and most current information available on this topic.

For the analysis of reasonably foreseeable impacts from the Proposed Action, NHTSA selected a global emissions reference scenario to represent the No-Action Alternative in the modeling runs. NHTSA also modeled other global emissions scenarios (see Appendix E, *Air Quality and NCE Methodology and Other Information,* Section E.3.4, *Environmental Consequences: Other Associated Potential Impacts*). More information on global emissions scenarios used in this analysis can be found in Appendix E, *Air Quality and NCE Methodology and Other Information,* Section E.3.3.5, *Global Emissions Scenarios.*

Non-Criteria Emissions

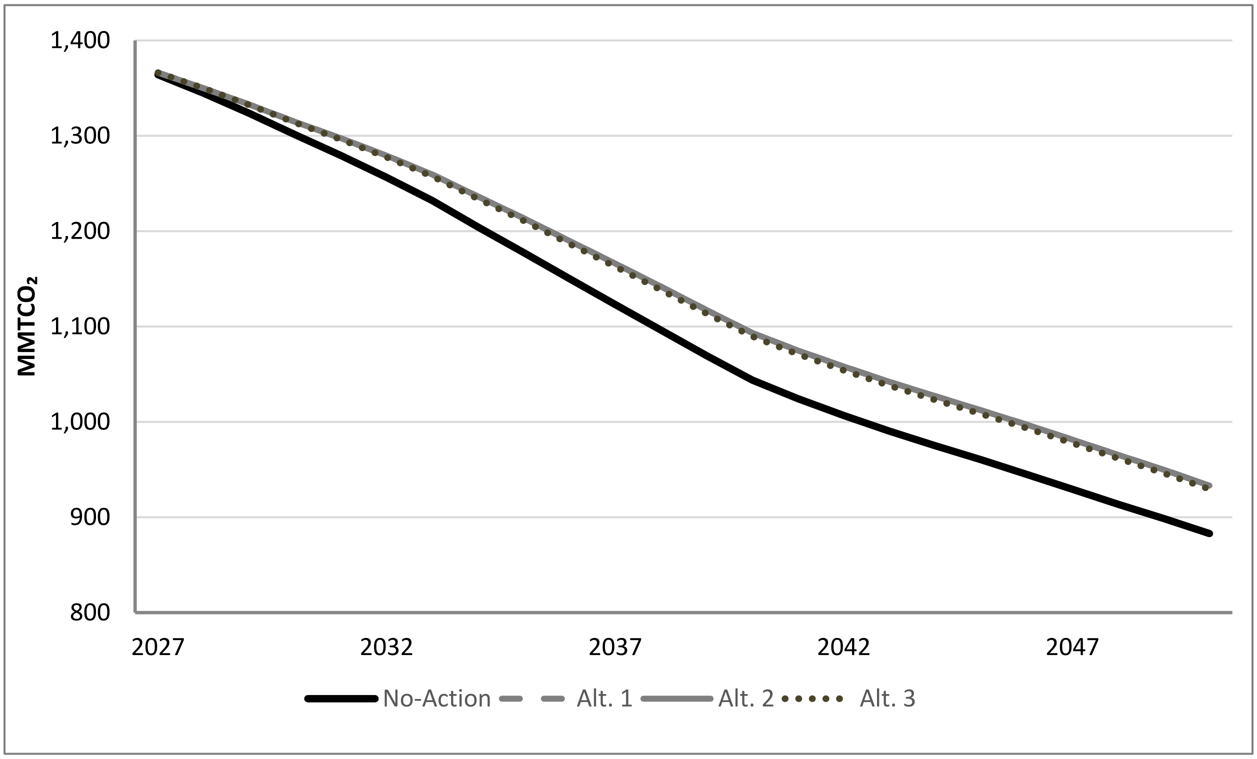
The alternatives would have the following impacts related to NCEs.

Figure S-3 shows projected annual CO_2 emissions from passenger cars and light trucks under all alternatives. Passenger cars and light trucks are projected to emit 69,400 million metric tons of carbon dioxide ($MMTCO_2$) from 2027 through 2100 under the No-Action Alternative. Alternative 1 and Alternative 2 (Preferred Alternative) would increase these emissions by 4.90 percent by 2100, while Alternative 3 would increase these emissions by 4.47 percent. Emissions would be highest under Alternatives 1 and 2 (Preferred Alternative). The estimated emissions are the same under Alternative 1 and Alternative 2 (Preferred Alternative) because starting with MY 2027, vehicle manufacturers are assumed to offer vehicles using nearly the same fuel economy technologies under either Alternative 1 or Alternative 2 (Preferred Alternative), and the resulting emissions would be the same for both alternatives.[25]

- Compared with total projected CO_2 emissions of 811 $MMTCO_2$ from all passenger cars and light trucks under the No-Action Alternative in the year 2100, the action alternatives are expected to increase CO_2 emissions from passenger cars and light trucks in the year 2100 by 5.7 percent under Alternatives 1 and 2 (Preferred Alternative), and 5.3 percent under Alternative 3.
- Compared to the total global reference scenario CO_2 emissions projection of 4,991,547 $MMTCO_2$ under the No-Action Alternative from 2027 through 2100, the action alternatives are expected to increase slightly global CO_2 by 0.07 percent under Alternatives 1 and 2 (Preferred Alternative), and 0.06 percent under Alternative 3 by 2100.
- The emissions increases 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 (Preferred Alternative), and 7,143,671 vehicles under Alternative 3. (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.)

[25] All CO_2 emissions estimates associated with the action alternatives include upstream emissions.

Figure S-3. Projected Annual Carbon Dioxide Emissions ($MMTCO_2$) from All U.S. Passenger Cars and Light Trucks by Alternative



$MMTCO_2$ = million metric tons of carbon dioxide.

Climate Indicators

CO_2 emissions affect the concentration of CO_2 in the atmosphere, which in turn affects global temperature, sea level, precipitation, and ocean pH. However, by 2100, each action alternative would only slightly increase CO_2 concentrations, global mean surface temperature, sea level, and precipitation, and would only slightly decrease ocean pH, compared to the No-Action Alternative.

Comparison of Alternatives

Reasonably Foreseeable Impacts from the Proposed Action

Table S-4 summarizes the reasonably foreseeable impacts of the action alternatives on each resource. The results are based on a climate analysis using the SSP3-7.0 global emissions reference scenario where noted.

Table S-4. Reasonably Foreseeable Impacts from the Proposed Action and Alternatives

No-Action [a]	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)
Energy: Combined U.S. Passenger Car and Light Truck Fuel Consumption and Change in Fuel Consumption for 2024–2050 (billion gasoline gallon equivalent)			
2,867	+77 (+3%)	+77 (+3%)	+71 (+2%)
Air Quality: Criteria Air Pollutant Emissions in 2035 (tons per year)			
CO: 6,522,972 NO_X: 305,340 PM2.5: 20,274 SO_2: 62,128 VOCs: 823,686	Decrease: SO_2 (-1,036). Increase: CO (54,129), NO_X (1,556), PM2.5 (66), and VOCs (13,100).	Decrease: SO_2 (-1,036); emissions equal to Alt. 1. Increase: CO (54,129), NO_X (1,556), PM2.5 (66), and VOCs (13,100); emissions equal to Alt. 1.	Decrease: SO_2 (-941); emissions larger than Alts. 1 and 2. Increase: CO (51,915), NO_X (1,500), PM2.5 (66), and VOCs (12,202); emissions equal to Alts. 1 and 2 (for PM2.5) or less than Alts. 1 and 2 (for CO, NO_X, and VOCs).
Air Quality: Criteria Air Pollutant Emissions in 2050 (tons per year)			
CO: 3,602,777 NO_X: 174,815 PM2.5: 10,608 SO_2: 45,426 VOCs: 549,795	Decrease: None. Increase: CO (95,198), NO_X (4,567), PM2.5 (242), SO_2 (293), and VOCs (21,296).	Decrease: None; emissions equal to Alt. 1. Increase: CO (95,198), NO_X (4,567), PM2.5 (242), SO_2 (293), and VOCs (21,296); emissions equal to Alt. 1.	Decrease: None. Increase: CO (95,678), NO_X (4,287), PM2.5 (221), SO_2 (227), and VOCs (20,184); emissions greater than Alts. 1 and 2 (for CO) or less than Alts. 1 and 2 (for NO_X, PM2.5, SO_2, and VOCs).
Air Quality: Mobile Source Air Toxic Emissions in 2035 (tons per year)			
Acetaldehyde: 2,273 Acrolein: 128 Benzene: 8,335 1,3-butadiene: 846 DPM: 55,690 Formaldehyde: 1,763	Decrease: None. Increase: Acetaldehyde (35), acrolein (2), benzene (127), 1,3-butadiene (12), DPM (949), and formaldehyde (33).	Decrease: None. Increase: Acetaldehyde (35), acrolein (2), benzene (127), 1,3-butadiene (12), DPM (949), and formaldehyde (33); emissions equal to Alt. 1.	Decrease: None. Increase: Acetaldehyde (33), acrolein (2), benzene (120), 1,3-butadiene (12), DPM (882), and formaldehyde (31); emissions equal to Alts. 1 and 2 (for acrolein and 1,3-butadiene, when rounded to the nearest ton) or less than Alts. 1 and 2 (for acetaldehyde, benzene, DPM, and formaldehyde).

No-Action [a]	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)
Air Quality: Mobile Source Air Toxic Emissions in 2050 (tons per year)			
Acetaldehyde: 1,420 Acrolein: 78 Benzene: 5,309 1,3-butadiene: 534 DPM: 48,030 Formaldehyde: 1,108	Decrease: None. Increase: Acetaldehyde (41), acrolein (2), benzene (175), 1,3-butadiene (15), DPM (1,380), and formaldehyde (42).	Decrease: None. Increase: Acetaldehyde (41), acrolein (2), benzene (175), 1,3-butadiene (15), DPM (1,380), and formaldehyde (42); emissions equal to Alt. 1.	Decrease: None. Increase: Acetaldehyde (42), acrolein (2), benzene (173), 1,3-butadiene (16), DPM (1,251), and formaldehyde (41); emissions greater than Alts. 1 and 2 (for acetaldehyde and 1,3-butadiene), equal to Alts. 1 and 2 (for acrolein, when rounded to the nearest ton), or less than Alts. 1 and 2 (for benzene, DPM, and formaldehyde).
Climate: Combined U.S. Passenger Car and Light Truck Carbon Dioxide Emissions and Carbon Dioxide Emissions Changes for U.S. Passenger Cars and Light Trucks for 2027–2100 ($MMTCO_2$)			
69,400	+3,400	+3,400	+3,100
Climate: Changes in Atmospheric Carbon Dioxide Concentrations in 2100 (ppm) [b]			
-0.04	+0.32	+0.32	+0.30
Climate: Changes in Global Mean Surface Temperature Increase by 2100 in °C (°F) [b]			
-0.000°C (-0.000°F)	+0.001°C (+0.002°F)	+0.001°C (+0.002°F)	+0.001°C (+0.002°F)
Climate: Changes in Global Sea-Level Rise by 2100 in centimeters (inches) [b]			
-0.00 (-0.00)	+0.03 (+0.01)	+0.03 (+0.01)	+0.02 (+0.01)
Climate: Changes in Global Mean Precipitation Increase by 2100 [b,c]			
-0.00%	0.00%	0.00%	0.00%
Climate: Changes in Ocean Acidification in 2100 (pH) [b]			
0.0000	-0.0002	-0.0002	-0.0001

Notes:

The numbers in this table have been rounded for presentation purposes. Therefore, the increases might not reflect the exact difference of the values in all cases.

[a] Except where otherwise noted, these values represent the totals for the No-Action Alternative.

[b] Results based on a climate analysis utilizing the global emissions reference scenario. Values for the No-Action Alternative represent the difference between the Preferred Alternative (PC2LT002) and the No-Action Alternative in the Final Environmental Impact Statement for Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks, Model Years 2027 and Beyond, and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans, Model Years 2030 and Beyond (NHTSA 2024). Values reported as 0.00, 0.000, or 0.0000 are greater than zero. Values reported as -0.00, -0.000, or -0.0000 are less than zero. NHTSA's Proposed Action also includes proposed changes to its vehicle classification regulations starting in MY 2028, which reconsiders how light trucks are classified; therefore, the two data sets used here will differ in the types of vehicles

included. See Section VI of the proposed rule preamble and Chapter 3 of the Preliminary Regulatory Impact Analysis for additional detail regarding the effect of NHTSA's proposed fleet reclassification.
[c] The Proposed Action and alternatives are projected to increase precipitation by less than 0.01 percent for all alternatives based on the scaling factor from the global emissions reference scenario.
°C = degrees Celsius; °F = degrees Fahrenheit; CAFE = Corporate Average Fuel Economy; CO = carbon monoxide; DPM = diesel particulate matter; $MMTCO_2$ = million metric tons of carbon dioxide; NO_X = nitrogen oxides; PM2.5 = particulate matter 2.5 microns or less in diameter; ppm = parts per million; SO_2 = sulfur dioxide; VOCs = volatile organic compounds.

CHAPTER 1 PURPOSE AND NEED FOR THE ACTION

1.1 Introduction

The Energy Policy and Conservation Act of 1975 (EPCA)[1] established the Corporate Average Fuel Economy (CAFE) program as part of a comprehensive approach to Federal energy policy. To reduce national energy consumption, EPCA directs the National Highway Traffic Safety Administration (NHTSA) within the U.S. Department of Transportation (DOT) to prescribe and enforce average fuel economy standards for passenger cars and light trucks sold in the United States.[2] As codified in chapter 329 of title 49 of the U.S. Code (U.S.C.), and as amended by the Energy Independence and Security Act of 2007 (EISA),[3] EPCA sets forth specific requirements for establishing average fuel economy standards for passenger cars and light trucks. These are motor vehicles with a gross vehicle weight rating (GVWR) of less than 8,500 pounds, and medium-duty passenger vehicles with a GVWR of less than 10,000 pounds.[4]

NHTSA has set fuel economy standards since the 1970s. Most recently, NHTSA issued final CAFE standards for model year (MY) 2027–2031 passenger cars and light trucks.[5] On January 20, 2025, the President issued Executive Order (E.O.) 14148, *Initial Rescissions of Harmful Executive Orders and Actions*, which revoked various E.O.s issued by the previous administration, including several that directed NHTSA to reconsider the fuel economy standards finalized in 2020.[6] The President also issued E.O. 14154, *Unleashing American Energy*, which laid out 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

[1] Public Law (Pub. L.) No. 94-163, 89 Stat. 871 (Dec. 22, 1975). EPCA was enacted for purposes that include conserving energy supplies through energy conservation programs and improving the energy efficiency of motor vehicles.

[2] The Secretary of Transportation has delegated the responsibility for implementing the CAFE program to NHTSA (49 Code of Federal Regulations [CFR] 1.95(a)). Accordingly, the Secretary, DOT, and NHTSA are used interchangeably in this Draft Supplemental Environmental Impact Statement (SEIS).

[3] Pub. L. No. 110–140, 121 Stat. 1492 (Dec. 19, 2007). EISA amends and builds on EPCA by setting out a comprehensive energy strategy for the 21st century, including the reduction of fuel consumption from all motor vehicle sectors.

[4] Passenger cars and light trucks that meet these criteria are also referred to as light-duty (LD) vehicles. The terms *passenger automobile, light truck,* and *medium-duty passenger vehicle* are defined in 49 CFR part 523.

[5] 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; Final Rule, 89 FR 52540 (June 24, 2024).

[6] E.O. 14148, Initial Rescissions of Harmful Executive Orders, 90 FR 8237 (Jan. 28, 2025). Among others, E.O. 14148 rescinded E.O. 14008 of January 27, 2021, Tackling the Climate Crisis at Home and Abroad (instituting a whole-of-government effort to reduce carbon dioxide emissions); E.O. 14037 of August 5, 2021, Strengthening American Leadership in Clean Cars and Trucks ("setting a goal that 50 percent of all new passenger cars and light trucks sold in 2030 be zero-emission vehicles" and directing the Secretary of Transportation to set fuel economy standards accordingly); E.O. 14057 of December 8, 2021, Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability (promoting government procurement of electric vehicles [EVs]); E.O. 14082 of September 12, 2022, Implementation of the Energy and Infrastructure Provisions of the Inflation Reduction Act of 2022 (applying incentives for production and sale of EVs); and E.O. 14094 of April 6, 2023, Modernizing Regulatory Review (directing use of modified cost-benefit analysis that inflates the estimated long-term benefits of carbon-reduction regulations, such as higher CAFE standards).

clearly applicable law;" and "to eliminate the 'electric vehicle (EV) mandate' and promote true consumer choice."[7] The E.O. directed that the United States do this 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."[8]

On January 28, 2025, the Secretary of Transportation issued a memorandum, *Fixing the CAFE Program*, which stated that there is "strong reason to conclude that the [2022 and 2024 final rule] CAFE standards promulgated by NHTSA are contrary to Administration policy as reflected in [the President's] Executive Orders and are inconsistent with [statutory requirements]."[9] The memorandum directed NHTSA to "commence an immediate review and reconsideration of all existing fuel economy standards applicable to all models of motor vehicles produced from [MY] 2022 forward," including in particular the agency's 2022 final rule (setting MY 2024–2026 CAFE standards) and 2024 final rule (setting MY 2027–2031 CAFE standards and MY 2030–2035 fuel efficiency [FE] standards for heavy-duty pickup trucks and vans [HDPUVs]).[10] Further, the Secretary directed NHTSA, at the earliest opportunity, to "propose the rescission or replacement of any fuel economy standards as determined necessary to bring the CAFE program into compliance with Administration policy and the requirements of the law."[11]

After the President's and Secretary's initial direction on reconsidering the CAFE program, the President issued E.O. 14219, *Ensuring Lawful Governance and Implementing the President's "Department of Government Efficiency" Deregulatory Initiative*.[12] This E.O. directed agencies, among other things, to identify regulations "based on anything other than the best reading of the underlying statutory authority or prohibition" and to work with White House offices and personnel to rescind or modify those regulations, as appropriate.[13]

As explained in NHTSA's June 2025 interpretive rule, EPCA specifically provides that 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

[7] E.O. 14154, Section 2, Unleashing American Energy, 90 FR 8353 (Jan. 29, 2025).

[8] E.O. 14154, Section 2(e).

[9] Memorandum from the Secretary of Transportation to Office of the Administrator of the National Highway Traffic Safety Administration (NHTSA), Office of the Assistant Secretary for Policy (OST-P) and Office of General Counsel (OGC), *Fixing the CAFE Program* (Jan. 28, 2025), https://www.transportation.gov/briefing-room/memorandum-fixing-cafe-program.

[10] Id.

[11] Id.

[12] E.O. 14219, Ensuring Lawful Governance and Implementing the President's "Department of Government Efficiency" Deregulatory Initiative, 90 FR 10583 (Feb. 25, 2025).

[13] E.O. 14219, Section 2.

[49 U.S.C. 32903]."[14] Therefore, in accordance with the recent direction from the President and Secretary of Transportation, and pursuant to NHTSA's authority under chapter 329 of title 49 of the U.S.C., NHTSA has identified CAFE program regulations not explicitly required by EPCA and EISA that run counter to the purpose and intent of both statutes. NHTSA is engaging in rulemaking to reset the CAFE program, as necessary, to bring it into compliance with Administration policy and applicable substantive statutory requirements.[15]

To inform its development of the CAFE standards for MYs 2022–2031, and pursuant to the National Environmental Policy Act (NEPA),[16] NHTSA prepared this Draft Supplemental Environmental Impact Statement (SEIS) to evaluate the potential environmental impacts of the proposed action and a reasonable range of alternatives.[17] 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 MY 2027–2031 CAFE standards.[18] 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 MY 2022–2031 CAFE standards, this Draft SEIS analyzes environmental impacts associated only with the proposed MY 2027–2031 CAFE standards.

This Draft SEIS analyzes, discloses, and compares the potential environmental impacts of a reasonable range of alternatives, including a No-Action Alternative and a Preferred Alternative, pursuant to NEPA and DOT Order 5610.1D.[19] This Draft SEIS analyzes reasonably foreseeable impacts, which are discussed in proportion to their significance. NHTSA is also informed by the public comments it received on the prior Draft EIS and Final EIS, which are available to review in the docket,[20] in addition to approximately 15 years of recent CAFE and fuel efficiency NEPA documents, to determine the appropriate fact-dependent, contextual scope for this Draft SEIS. The agency's discussion in this Draft SEIS of scientific and technical literature does not necessarily constitute an endorsement by the agency of that literature. The agency welcomes comment on any literature or analysis in this Draft SEIS or submission of any additional relevant information.

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[14] Resetting the Corporate Average Fuel Economy Program; Interpretive Rule, 90 FR 24518, 24519 (June 11, 2025).

[15] For further discussion on NHTSA's explanation of this action, see Section V of the proposed rule preamble.

[16] 42 U.S.C. 4321–4347.

[17] NEPA directs that Federal agencies proposing "major federal actions significantly affecting the quality of the human environment" must, "to the fullest extent possible," prepare "a detailed statement" on the environmental impacts of the proposed action (including alternatives to the proposed action). 42 U.S.C. 4332.

[18] DOT Order 5610.1D, Section 18.c, 90 FR 29621 (July 3, 2025). Available at: https://www.transportation.gov/mission/dots-procedures-considering-environmental-impacts. (Accessed: July 15, 2025).

[19] 42 U.S.C. 4332(2)(C)(iii); DOT Order 5610.1D, Section 13.e.

[20] Comments on the agency's Notice of Intent to Prepare an EIS, Draft EIS, and Final EIS are available in Docket Number NHTSA-2022-0075, which can be accessed at https://www.regulations.gov/. To reduce confusion, NHTSA is opening a new docket for this Draft SEIS. However, the agency has considered the comments received in the prior docket as part of the preparation of this Draft SEIS.

NHTSA prepared this Draft SEIS in line with the Supreme Court's recent decision in *Seven County Infrastructure Coalition v. Eagle County, Colorado* and its progeny.[21] Agencies are granted substantial deference to determine the scope of the environmental impacts that they address and may decide to evaluate environmental impacts from separate projects upstream or downstream from this action.[22] This Proposed Action amends standards for model years for which CAFE standards have previously been established. Accordingly, the agency has decided to retain in this Draft SEIS certain aspects of the analytical frame of prior CAFE EISs. Specifically, this Draft SEIS includes a discussion of potential environmental impacts of sectors other than those the agency regulates, where changes in those impacts are linked to the action and alternatives under consideration here. *In Seven County*, the Court clarified that NEPA analysis beyond the direct regulatory impact at issue is not required in an EIS.[23] While NHTSA is not required to assess impacts that are not a direct result of changes in CAFE standards and has determined that analyses of such impacts are not necessary for NHTSA to undertake reasoned decision-making pursuant to its authority under EPCA, as amended by EISA, the agency nonetheless provides discussion of those impacts solely for informational purposes.

It is important to note in reviewing this analysis that NHTSA promulgated the 2022 and 2024 final standards, which represent the baseline, based on consideration of EVs and credit trading, but such consideration is impermissible pursuant to EPCA. In addition, NHTSA has concluded that manufacturers are not, as discussed in the preamble, able to achieve those standards with the gasoline- and diesel-powered vehicles in their fleet. Therefore, the impacts relative to the baseline may be less than presented in this document to the extent that manufacturers are unable to comply with standards using a full suite of available compliance options.

1.2 Purpose and Need

NEPA requires that agencies develop alternatives to a proposed action based on the action's purpose and need. The purpose and need statement explains why the action is needed, describes the action's intended purpose, and serves as the basis for developing the range of alternatives to be considered in the NEPA analysis.[24] NHTSA's purpose and need for the rulemaking are the statutory authority and directives in EPCA, as amended by EISA, for the agency to set CAFE standards, as well as the recent Presidential and Secretarial directions

[21] *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).

[22] 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.").

[23] At issue in *Seven County* was the scope of analysis required under NEPA when an agency issues a permit authorizing construction of a segment of linear infrastructure; our discussion here applies that case's holding to the current context, where NHTSA is undertaking NEPA analysis in connection with a regulatory standards rulemaking.

[24] *See* 42 U.S.C. 4332(2)(C)(iii), 4336a(d); DOT Order 5610.1D, Sections 13.d and 13.e.

described in Section 1.1, *Introduction*, and NHTSA's June 2025 interpretive rule. Accordingly, NHTSA's Proposed Action is a proposed rule to amend CAFE standards for MY 2022–2031 passenger cars and light trucks to reflect "the maximum feasible average fuel economy level that the Secretary [of Transportation] decides the manufacturers can achieve in that model year."[25] When determining the maximum feasible levels that manufacturers can achieve in each model year, EPCA requires that NHTSA consider the four statutory factors of "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."[26] NHTSA construes these statutory factors as including safety and environmental considerations.[27] NHTSA has interpreted the four EPCA statutory factors as follows:[28]

- *Technological feasibility* refers to whether a particular method of improving fuel economy can be available for commercial application in the model year for which a standard is being established.
- *Economic practicability* refers to 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 significant job losses or the unreasonable elimination of consumer choice.
- *The effect of other motor vehicle standards of the Government on fuel economy* involves analysis of the effects of compliance with emissions, safety, noise, or damageability standards on fuel economy capability and thus on average fuel economy.
- *The need of the United States to conserve energy* means the consumer cost, national balance of payments, environmental, and foreign policy implications of the nation's need for petroleum, especially imported petroleum.

NHTSA must establish separate average fuel economy standards for passenger cars and light trucks for each model year.[29] Standards must be "based on [one] or more vehicle attributes related to fuel economy" and "express[ed]…in the form of a mathematical function."[30]

1.3 CAFE Rulemaking Process

NHTSA is proposing a rule to amend CAFE standards for light-duty (LD) vehicles for MYs 2022–2031. This Draft SEIS informs NHTSA and the public during the development of the standards as

[25] 49 U.S.C. 32902(a).

[26] 49 U.S.C. 32902(a), 32902(f).

[27] For safety considerations, *see, e.g., Competitive Enter. Inst.* v. *NHTSA,* 956 F.2d 321, 322 (D.C. Cir. 1992) (*citing Competitive Enter. Inst.* v. *NHTSA,* 901 F.2d 107, 120 n.11 (D.C. Cir. 1990)). For environmental considerations, *see Center for Auto Safety* v. *NHTSA,* 793 F.2d 1322, 1325 n. 12 (D.C. Cir. 1986); *Public Citizen* v. *NHTSA,* 848 F.2d 256, 262-3 n. 27 (D.C. Cir. 1988) (noting that "NHTSA has itself interpreted the factors it must consider in setting CAFE standards as including environmental effects"); *Center for Biological Diversity* v. *NHTSA,* 538 F.3d 1172, 1196 (9th Cir. 2008).

[28] *See* proposed rule preamble, Section V.A.

[29] 49 U.S.C. 32902(b)(1)-(2).

[30] 49 U.S.C. 32902(b)(3)(A).

part of the rulemaking process. Section 1.3.1, *Proposed Action*, details the components of NHTSA's Proposed Action.

1.3.1 Proposed Action

For this Draft SEIS, NHTSA's Proposed Action is proposing to amend the MY 2022–2031 CAFE standards for passenger cars and light trucks, in accordance with EPCA, as amended by EISA, and in accordance with recent E.O. and DOT directives. In NHTSA's 2020 SAFE Vehicles Final Rule, NHTSA set CAFE standards for MY 2021–2026 passenger cars and light trucks.[31] In the agency's 2022 CAFE final rule, NHTSA amended the MY 2024–2026 CAFE standards.[32] In NHTSA's 2024 final rule, NHTSA set CAFE standards for MY 2027–2031 passenger cars and light trucks and FE standards for MY 2030–2035 HDPUVs.[33] As part of the current rulemaking, NHTSA is considering a range of alternatives for amending CAFE standards for MY 2022–2031 passenger cars and light trucks. The Proposed Action, also known as the Preferred Alternative, and alternatives considered in this Draft SEIS are discussed in Chapter 2, *Proposed Action and Alternatives and Analysis Methods*.

1.3.2 Level of the Standards

NHTSA is proposing to promulgate CAFE standards for passenger cars and light trucks under the agency's statutory authority. The alternatives under consideration by NHTSA would amend CAFE standards for MYs 2022–2031 and would be less stringent than the No-Action Alternative[34] from MY 2027 through MY 2031. NHTSA emphasizes that, in developing the No-Action Alternative, NHTSA impermissibly considered EVs and credit trading in establishing standards (see NHTSA's June 2025 interpretive rule). Under NHTSA's action alternatives, the agency currently estimates that the combined average of manufacturers' required fuel economy levels would range from 29.9 to 32.6 miles per gallon (mpg) in MY 2027 and 33.7 to 37.7 mpg in MY 2031. This compares to estimated average required fuel economy levels of 47.5 mpg in MY 2027 and 50.9 mpg in MY 2031 under the No-Action Alternative. Under NHTSA's Preferred Alternative, the agency currently estimates that the combined average of manufacturers' required fuel economy levels would be 30.7 mpg in MY 2027 and 34.6 mpg in MY 2031.[35]

[31] SAFE Vehicles Final Rule, 85 FR 24174 (Apr. 30, 2020).

[32] Corporate Average Fuel Economy Standards for Model Years 2024–2026 Passenger Cars and Light Trucks; Final Rule, 87 FR 25710 (May 2, 2022).

[33] 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; Final Rule, 89 FR 52540 (June 24, 2024).

[34] As explained in Chapter 2, Section 2.2.1, *No-Action Alternative*, the No-Action Alternative assumes that NHTSA's MY 2027–2031 CAFE standards finalized in 2024 remain in effect and that the MY 2031 CAFE standards continue in perpetuity.

[35] The CAFE standards are attribute-based and apply separately to each manufacturer and separately to passenger cars and light trucks. While NHTSA estimates the future composition of the fleet based on current market forecasts of future sales to compute the estimated average required fuel economy levels under each regulatory alternative, any estimates of future sales

1.3.3 Form of the Standards

In 2006, NHTSA released the Light Truck Average Fuel Economy Standards, Model Years 2008–2011,[36] which reformed the CAFE program to set standards based on an attribute: vehicle footprint. NHTSA extended this approach to passenger cars in the CAFE rule for MY 2011, as required by EISA.[37] Since then, NHTSA has used an attribute standard when setting CAFE standards for LD vehicles.[38] In this rulemaking for MYs 2022–2031, NHTSA again proposes attribute-based standards based on vehicle footprint for passenger cars and light trucks.

In Section III of the Notice of Proposed Rulemaking (NPRM) preamble and Chapter 1 of the Technical Support Document, NHTSA includes a full discussion of the equations and coefficients that define the passenger car and light truck curves established for each model year.

1.3.4 Compliance

Flexibility provisions are discussed in Section VI of the NPRM preamble.

In NHTSA's June 2025 interpretive rule, the agency stated that, pending the completion of the rulemaking process to replace MY 2022–2031 CAFE standards, NHTSA will exercise its enforcement authority with regard to all existing CAFE standards in accordance with the interpretations set forth in the interpretive rule.[39] NHTSA also recognizes that civil penalties for violations of the CAFE standards were set at $0 in the One Big Beautiful Bill Act, Pub. L. No. 119-21 (enacted on July 4, 2025).

1.4 Cooperating Agencies

NEPA emphasizes agency cooperation early in the NEPA process and authorizes a lead agency (in this case, NHTSA) to request the assistance of other agencies that have either jurisdiction by law or special expertise regarding issues considered in an EIS.[40] NHTSA invited the U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE) to become cooperating agencies with NHTSA in the development of this Draft SEIS. EPA and DOE accepted NHTSA's invitation and agreed to become cooperating agencies. EPA and DOE personnel were asked to review and comment on this Draft SEIS prior to publication.

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are subject to considerable uncertainty. Therefore, the average future required fuel economy under each regulatory alternative is also subject to considerable uncertainty.

[36] Average Fuel Economy Standards for Light Trucks Model Years 2008–2011; Final Rule, 71 FR 17566 (Apr. 6, 2006). Prior to this rulemaking, NHTSA set flat CAFE standards: one value that all manufacturers had to meet on average for each model year. The 2006 Light Truck Average Fuel Economy Standards rule established standards that used an equation based on footprint and production volume to determine the standard for a fleet.

[37] Average Fuel Economy Standards Passenger Cars and Light Trucks Model Year 2011; Final Rule; Record of Decision, 74 FR 14196 (Mar. 30, 2009).

[38] *See* Chapter 2 of previous CAFE EISs (NHTSA 2010, 2012, 2020, 2022, 2024).

[39] Resetting the Corporate Average Fuel Economy Program; Interpretive Rule, 90 FR 24518, 24526 (June 11, 2025).

[40] 42 U.S.C. 4336a(a); DOT Order 5610.1D, Section 8.

1.5 Next Steps in the National Environmental Policy Act and Joint Rulemaking Process

This Draft SEIS is being issued for public review and comment concurrently with the NPRM to amend MY 2022–2026 and MY 2027–2031 passenger car and light truck CAFE standards. NHTSA invites comments on this Draft SEIS, including the alternatives evaluated and methodologies used for analysis. Specifically, NHTSA solicits comments on the range of alternatives considered for CAFE standards, including intended model years and stringencies. Individuals may submit their written comments on the Draft SEIS, identified by docket number NHTSA-2025-0490, by any of the following methods:

- **Federal eRulemaking Portal***:* Go to http://www.regulations.gov. Follow the online instructions for submitting comments.
- **Mail:** Docket Management Facility: U.S. Department of Transportation, 1200 New Jersey Avenue S.E., West Building Ground Floor, Room W12-140, Washington, D.C. 20590-0001.
- **Hand Delivery or Courier:** West Building Ground Floor, Room W12-140, 1200 New Jersey Avenue S.E., Washington, D.C. 20590-0001 between 9 a.m. and 5 p.m. ET, Monday through Friday, except Federal holidays. To be sure someone is there to help you, please call (202) 366-9826 before coming.

Regardless of how you submit your comments, you must include Docket No. NHTSA-2025-0490 on your comments. All comments received, including any personal information provided, will be posted without change to http://www.regulations.gov, as described in the system of records notice (DOT/ALL-14 FDMS), which can be reviewed at https://www.transportation.gov/privacy. Anyone is able to search the electronic form of all comments received into any of our dockets by the name of the individual submitting the comment (or signing the comments, if submitted on behalf of an association, business, labor union, etc.). You may call the Docket Management Facility at (202) 366-9826.

EPA will publish a Notice of Availability of this Draft SEIS in the *Federal Register*. That notice will include a deadline by which comments on this Draft SEIS must be received. The deadline for receiving comments will also be posted on NHTSA's website. A public hearing will be held during the public comment period; details regarding and a date for the public hearing will be released on NHTSA's website.

At the final rule stage, NHTSA will simultaneously issue the Final SEIS and Record of Decision (i.e., the final rule), pursuant to 49 U.S.C. 304a(b), 23 U.S.C. 139(n), and DOT Order 5610.1D, Section 13.m, unless it is determined that statutory criteria or practicability considerations preclude simultaneous issuance.

CHAPTER 2 PROPOSED ACTION AND ALTERNATIVES AND ANALYSIS METHODS

2.1 Introduction

NEPA requires that, when an agency prepares an EIS, it must evaluate the environmental impacts of its proposed action and a reasonable range of alternatives that meet the purpose and need for the proposed action.[1]

This chapter describes the Proposed Action and alternatives, explains the methods and assumptions applied in the analysis of environmental impacts, describes the resource areas dismissed from further consideration, and describes the resource areas affected. As stated elsewhere in this Draft SEIS, NHTSA prepared this Draft SEIS in line with the Supreme Court's recent decision in *Seven County Infrastructure Coalition v. Eagle County, Colorado* and its progeny.[2] Agencies are granted substantial deference to determine the scope of the environmental impacts that they address and may decide to evaluate environmental impacts from separate projects upstream or downstream from this action.[3] This Proposed Action amends standards for model years for which CAFE standards have previously been established. Accordingly, the agency has decided to retain in this Draft SEIS certain aspects of the analytical frame of prior CAFE EISs. Specifically, this Draft SEIS includes a discussion of potential environmental impacts of sectors other than those the agency regulates, where changes in those impacts are linked to the action and alternatives under consideration here. *In Seven County*, the Court clarified that NEPA analysis beyond the direct regulatory impact at issue is not required in an EIS.[4] While NHTSA is not required to assess impacts that are not a direct result of changes in CAFE standards and has determined that analyses of such impacts are not necessary for NHTSA to undertake reasoned decision-making pursuant to its authority under the Energy Policy and Conservation Act of 1975 (EPCA), as amended by the Energy

[1] 42 U.S.C. 4332(2)(C)(iii) and 42 U.S.C. 4332(2)(H). An agency must explore and evaluate all reasonable alternatives, including the alternative of taking no action. For alternatives eliminated from detailed analysis, an EIS must briefly discuss the reasons for their exclusion. DOT Order 5610.1D, Section 13.e, Procedures for Considering Environmental Impacts, 90 FR 29621 (July 1, 2025), available at https://www.transportation.gov/mission/dots-procedures-considering-environmental-impacts.

[2] *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).

[3] 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.").

[4] At issue in *Seven County* was the scope of analysis required under NEPA when an agency issues a permit authorizing construction of a segment of linear infrastructure; our discussion here applies that case's holding to the current context, where NHTSA is undertaking NEPA analysis in connection with a regulatory standards rulemaking.

Independence and Security Act of 2007 (EISA), the agency nonetheless provides discussion of those impacts solely for informational purposes.

NHTSA solicits comment on the required scope of NEPA analysis in connection with a CAFE standards rulemaking, including whether NHTSA has any statutory authority to take environmental consequences of such a rulemaking into account when exercising its statutory authority, and, to the extent that it lacks such authority, whether NTHSA is required to undertake any NEPA analysis in connection with a CAFE standards rulemaking.

2.2 Proposed Action and Alternatives

In conjunction with proposing new CAFE standards, NHTSA's Proposed Action also includes proposed changes to its vehicle classification regulations (at 49 CFR part 523) starting in MY 2028, which reconsiders how light trucks are classified.[5] Though NHTSA is proposing MY 2022–2031 CAFE standards, as explained in Chapter 1, *Purpose and Need for the Action*, because no change in manufacturer behavior is possible for MY 2022–2026 passenger car and light truck fleets, this Draft SEIS analyzes environmental impacts associated only with the proposed MY 2027–2031 CAFE standards.

In developing the Proposed Action and alternatives, NHTSA considered the four EPCA statutory factors that guide the agency's determination of maximum feasible standards: 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.[6] As part of that analysis, NHTSA considered relevant safety and environmental factors.[7] As discussed further in Section III of the preamble to the proposed rule and Section I.c of NHTSA's 2025 interpretive rule,[8] NHTSA's review of its CAFE standards responds to the conclusion that recently promulgated CAFE standards are contrary to Administration policy and inconsistent with the 49 U.S.C. chapter 329 statutory requirements applicable to the CAFE program.[9]

Consistent with NEPA and DOT Order 5610.1D, this Draft SEIS compares a reasonable range of alternatives to the No-Action Alternative (Section 2.2.1, *No-Action Alternative*) and identifies

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[5] See Section VI of the proposed rule preamble and Chapter 3 of the Preliminary Regulatory Impact Analysis (PRIA) for additional detail regarding the effect of NHTSA's proposed fleet reclassification.

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

[7] As noted in Chapter 1, *Purpose and Need for the Action*, NHTSA interprets the statutory factors as including environmental issues and permitting the consideration of other relevant societal issues, such as safety. *See*, e.g., *Competitive Enter. Inst. v. NHTSA*, 956 F.2d 321, 322 (D.C. Cir. 1992) (citing *Competitive Enter. Inst. v. NHTSA*, 901 F.2d 107, 120 n.11 (D.C. Cir. 1990)); and Average Fuel Economy Standards, Passenger Cars and Light Trucks; Model Years 2011–2015; Proposed Rule, 73 FR 24352 (May 2, 2008).

[8] Resetting the Corporate Average Fuel Economy Program; Interpretive Rule, 90 FR 24518 (June 11, 2025).

[9] *See also* Memorandum from the Secretary of Transportation to Office of the Administrator of the National Highway Traffic Safety Administration (NHTSA), Office of the Assistant Secretary for Policy (OST-P) and Office of the General Counsel (OGC) (Jan. 28, 2025), https://www.transportation.gov/briefing-room/memorandum-fixing-cafe-program.

the agency's Preferred Alternative.[10] NHTSA has recommended Alternative 2 as the Preferred Alternative. See Section 2.2.2, *Action Alternatives*, for a detailed explanation of all of NHTSA's action alternatives, including Alternative 2 (Preferred Alternative).

Under EPCA, as amended by EISA, NHTSA is required to set the fuel economy standards for passenger cars in each model year at the maximum feasible level and to do so separately for light trucks. Because NHTSA intends to set separate standards for passenger cars and light trucks, and because evaluating the environmental impacts of this rule requires consideration of the impacts of the standards for both vehicle classes, the main analyses of impacts of the Proposed Action and alternatives presented in this Draft SEIS reflect the combined environmental impacts associated with the proposed MY 2027–2031 CAFE standards for passenger cars and light trucks.[11]

2.2.1 No-Action Alternative

The No-Action Alternative provides an analytical baseline against which to compare the environmental impacts of the action alternatives presented in the Draft SEIS. DOT Order 5610.1D advises DOT OAs to consider a "no action" alternative in their NEPA analyses and to compare the impacts of taking no action with the impacts of action alternatives to demonstrate the environmental impacts of the action alternatives.[12] The environmental impacts of the action alternatives are evaluated in relation to the baseline of the No-Action Alternative.

The No-Action Alternative assumes that the NHTSA's MY 2027–2031 CAFE standards finalized in 2024 remain in effect. The analysis of the No-Action Alternative assumes the existing CAFE standards remain in place. These standards include the CAFE standards for MYs 2024–2026 finalized in the 2022 final rule,[13] and the CAFE standards for MYs 2027–2031 finalized in the 2024 final rule.[14]

Table 2.2.1-1 shows the estimated average required fleet-wide fuel economy NHTSA forecasts under the No-Action Alternative for the existing MY 2027–2031 passenger car and light truck fleets. The values reported in that table do not strictly apply to manufacturers in those model years. The values in Table 2.2.1-1 reflect NHTSA's estimate based on application of the mathematical function defining the alternative (i.e., the curves that define the MY 2027–2031 CAFE standards) to the market forecast defining the estimated future fleets of new passenger cars and light trucks across all manufacturers. The fuel economy numbers presented here do

[10] The Preferred Alternative is the alternative identified as the favored course of action by the lead agency during the NEPA process. For a given set of CAFE standards, the "Proposed Action and alternatives" constitute the entire range of alternatives evaluated by NHTSA and include the agency's Preferred Alternative. Consistent with DOT Order 5610.1D, Section 13.e, this Draft SEIS presents the environmental impacts of the Proposed Action and alternatives in comparative form so that reviewers may evaluate their comparative merits.

[11] Appendix B, *U.S. Passenger Cars and Light Truck Results Reported Separately*, shows separate results for passenger cars and light trucks under each action alternative.

[12] DOT Order 5610.1D, Section 13.e.

[13] 87 FR 25710 (May 2, 2022).

[14] 89 FR 52540 (June 24, 2024).

not include a fuel economy adjustment factor to account for real-world driving conditions. See Preliminary Regulatory Impact Analysis (PRIA) Chapter 4.3.1, *Compliance and Real-World Fuel Economy "Gap,"* for more discussion about the difference between CAFE and real-world miles per gallon (mpg) values.

Table 2.2.1-1. No-Action Alternative: Estimated Average Required U.S. Passenger Car and Light Truck Fleet-Wide Fuel Economy (mpg) by Model Year

	MY 2027	MY 2028	MY 2029	MY 2030	MY 2031
Passenger cars	59.9	61.1	62.3	63.6	64.9
Light trucks	42.6	42.6	43.5	44.4	45.3
Combined cars and trucks	47.5	47.7	48.7	49.8	50.9

mpg = miles per gallon.

2.2.2 Action Alternatives

NHTSA analyzed a range of alternatives with fuel economy stringencies that increase, on average, between 0.25 percent and 1.5 percent annually from the MY 2021 standards for both passenger cars and light trucks. Though NHTSA's action alternatives are described in terms of increasing stringency from the previous year, all of NHTSA's action alternatives would require standards in a given year lower than the standards under the No-Action Alternative. This is a direct result of NHTSA's impermissible consideration of electric vehicles (EVs) and manufacturer credits in establishing the 2022 and 2024 final rules. Each of the action alternatives is derived from a different MY 2022 real compliance data fit for passenger cars and light trucks, as noted under each alternative below. A compliance fit percentage is used to estimate how stringently standards should be set, based on assumptions about how manufacturers will achieve CAFE standards. For example, a 75 percent compliance fit means the standard is calibrated assuming manufacturers will comply with 75 percent of the modeled stringency. See Chapter 1 of the Technical Support Document (TSD) and Section III of the proposed rule preamble for more information on compliance fit.

For purposes of its analysis, NHTSA assumes that the MY 2031 CAFE standards for each alternative would continue indefinitely.[15] The agency believes that, based on the different ways the agency could weigh EPCA's four statutory factors, the maximum feasible level of CAFE stringency falls within the range of the action alternatives under consideration.[16]

Throughout this Draft SEIS, reasonably foreseeable impacts are shown for the No-Action Alternative and three action alternatives that illustrate different ranges of estimated average

[15] All alternatives assume the MY 2031 standards would continue indefinitely. Because EPCA, as amended by EISA, requires NHTSA to set CAFE standards for each model year, environmental impacts reported in this Draft SEIS would also depend on future standards established by NHTSA, but cannot be quantified at this time.

[16] For a full discussion of the agency's balancing of the statutory factors related to maximum feasible standards, consult the proposed rule. NHTSA balances the statutory factors in Section VI.A of the proposed rule preamble.

annual percentage increases in fuel economy[17] for both passenger cars and light trucks, as detailed in Table 2.2.2-1.

Table 2.2.2-1. Regulatory Alternatives Under Consideration for MY 2022–2031 Passenger Car and Light Truck Standards

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 fit [a] MY 2022 0.50% per year for MYs 2023–2026 0.1% for MY 2027 0.3% for MY 2028 [b] 0.25% per year for MYs 2029–2031	80% compliance fit [a] MY 2022 0.50% per year for MYs 2023–2026 0.8% for MY 2027 0.6% for MY 2028[b] 0.25% per year for MYs 2029–2031
Alternative 2 (Preferred)	75% compliance fit [a] MY 2022 0.50% per year for MYs 2023–2026 0.35% for MY 2027 0.25% for MY 2028 [b] 0.25% per year for MYs 2029–2031	70% compliance fit [a] MY 2022 0.50% per year for MYs 2023–2026 0.7% for MY 2027 0.25% for MY 2028 [b] 0.25% per year for MYs 2029–2031
Alternative 3	70% compliance fit [a] MY 2022 0.50% per year for MYs 2023–2026 1.4% for MY 2027 1.5% for MY 2028 [b] 1% per year for MYs 2029–2031	50% compliance fit [a] MY 2022 0.50% per year for MYs 2023–2026 0.4% for MY 2027 0.2% for MY 2028 [b] 1% per year for MYs 2029–2031

Notes:
[a] Compliance fits 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.
[b] Stringency change reflects the growth rate in class average standard value from MYs 2027–2028.

The alternatives under consideration encompass a range of possible standards that NHTSA could select based on how it weighs EPCA's four statutory factors. These alternatives reflect differences in the degree of technology adoption across the fleet, costs to manufacturers and consumers, and conservation of oil. By providing environmental analyses at discrete representative points, the decision-makers and the public can determine the projected environmental impacts of points that fall between the individual alternatives. The alternatives evaluated in this Draft SEIS therefore provide decision-makers the ability to select from a wide range of alternatives that begin with the No-Action Alternative, are adjusted to account for a

[17] The different action alternatives are defined in terms of percent increases in stringency from year to year, but readers should recognize that those year-over-year changes in stringency are not measured in terms of mpg differences (as in, 1 percent more stringent than 30 mpg in 1 year equals 30.3 mpg in the following year), but rather in terms of shifts in the footprint functions that form the basis of the actual CAFE standards (as in, on a gallon-per-mile basis, the CAFE standards change by a given percentage from one model year to the next).

specific MY 2022 compliance fit for passenger cars and light trucks, and then increase up to 1.5 percent for passenger cars and light trucks. Within this range, stringencies could remain the same or differ year to year between and among regulatory classes.

Tables for each of the action alternatives in the sections below show estimated average required fuel economy levels reflecting application of the mathematical functions defining the alternatives to the market forecast defining the estimated future fleets of new passenger cars and light trucks across all manufacturers. The actual standards under the alternatives are footprint-based and each manufacturer would have a CAFE standard that is unique to each of its fleets, depending on the footprints and production volumes of the vehicle models produced by that manufacturer. The required fuel economy values projected for each action alternative do not include a fuel economy adjustment factor to account for real-world driving conditions. See PRIA Chapter 4.3.1, *Compliance and Real-World Fuel Economy "Gap,"* for more discussion about the difference between adjusted and unadjusted fuel economy.

This Draft SEIS assumes a weighted average of flexible fuel vehicles' fuel economy levels when operating on gasoline and on flex fuel (E85; an ethanol-gasoline fuel blend containing 51 to 83 percent ethanol fuel). In particular, this Draft SEIS assumes that flexible fuel vehicles operate on gasoline 99 percent of the time and on E85 1 percent of the time.

2.2.2.1 Alternative 1

Under Alternative 1, MY 2022 is derived from an 80 percent compliance fit for both passenger cars and light trucks. Alternative 1 would require a 0.5 percent annual fleet-wide increase for both passenger cars and light trucks from MYs 2022–2026. For MY 2027, Alternative 1 would require a 0.1 percent annual fleet-wide increase in fuel economy for passenger cars and a 0.8 percent annual fleet-wide increase in fuel economy for light trucks from the MY 2026 CAFE standards. For MY 2028, Alternative 1 would require a 0.3 percent annual fleet-wide increase in fuel economy for passenger cars and a 0.6 percent annual fleet-wide increase in fuel economy for light trucks from the MY 2027 CAFE standards. For MYs 2029–2031, Alternative 1 would require a 0.25 percent annual fleet-wide increase in fuel economy for both passenger cars and light trucks. Table 2.2.2-2 lists the estimated average required fleet-wide fuel economy under Alternative 1 for MYs 2027–2031, as estimated in the analysis performed for this Draft SEIS.[18]

[18] The analysis performed for this Draft SEIS does not impose constraints (i.e., regarding the treatment of CAFE compliance credits and alternative fuel vehicles) required per EPCA for the analysis informing NHTSA's decisions regarding the maximum feasible levels of CAFE standards. As a result, the size and composition of the estimated future new vehicle fleet differs between the Draft SEIS and standard-setting analyses. Because CAFE requirements depend on the composition of the fleet (i.e., the distribution among different footprints), the projected average fuel economy requirements also differ between the two analyses.

Table 2.2.2-2. Alternative 1: Estimated Average Required U.S. Passenger Car and Light Truck Fleet-Wide Fuel Economy (mpg) by Model Year

	MY 2027	MY 2028	MY 2029	MY 2030	MY 2031
Passenger cars	35.5	35.8	35.9	36.0	36.1
Light trucks	27.6	27.8	27.8	27.9	28.0
Combined cars and trucks	29.9	33.4	33.5	33.6	33.7

mpg = miles per gallon.

2.2.2.2 Alternative 2 (Preferred Alternative)

Under Alternative 2 (Preferred Alternative), MY 2022 is derived from a 75 percent compliance fit for passenger cars and a 70 percent compliance fit for light trucks. Alternative 2 (Preferred Alternative) would require a 0.5 percent annual fleet-wide increase for both passenger cars and light trucks from MYs 2022–2026. For MY 2027, Alternative 2 (Preferred Alternative) would require a 0.35 percent annual fleet-wide increase in fuel economy for passenger cars and a 0.7 percent annual fleet-wide increase in fuel economy for light trucks from the MY 2026 CAFE standards. For MYs 2028–2031, Alternative 2 (Preferred Alternative) would require a 0.25 percent annual fleet-wide increase in fuel economy for passenger cars and light trucks. Table 2.2.2-3 lists the estimated average required fleet-wide fuel economy under Alternative 2 (Preferred Alternative), as estimated in the analysis performed for this Draft SEIS.

Table 2.2.2-3. Alternative 2: Estimated Average Required U.S. Passenger Car and Light Truck Fleet-Wide Fuel Economy (mpg) by Model Year

	MY 2027	MY 2028	MY 2029	MY 2030	MY 2031
Passenger cars	36.6	36.9	37.0	37.1	37.2
Light trucks	28.3	28.4	28.5	28.5	28.6
Combined cars and trucks	30.7	34.3	34.4	34.5	34.6

mpg = miles per gallon.

2.2.2.3 Alternative 3

Under Alternative 3, MY 2022 is derived from a 70 percent compliance fit for passenger cars and a 50 percent compliance fit for light trucks. Alternative 3 would require a 0.5 percent annual fleet-wide increase for both passenger cars and light trucks from MYs 2022–2026. For MY 2027, Alternative 3 would require a 1.4 percent annual fleet-wide increase in fuel economy for passenger cars and a 0.4 percent annual fleet-wide increase in fuel economy for light trucks from the MY 2026 CAFE standards. For MY 2028, Alternative 3 would require a 1.5 percent annual fleet-wide increase in fuel economy for passenger cars and a 1.5 percent annual fleet-wide increase in fuel economy for light trucks from the MY 2027 CAFE standards. For MYs 2029–2031, Alternative 3 would require a 1.0 percent annual fleet-wide increase in fuel economy for passenger cars and light trucks. Table 2.2.2-4 lists the estimated average required fleet-wide fuel economy under Alternative 3.

Table 2.2.2-4. Alternative 3: Estimated Average Required U.S. Passenger Car and Light Truck Fleet-Wide Fuel Economy (mpg) by Model Year

	MY 2027	MY 2028	MY 2029	MY 2030	MY 2031
Passenger cars	38.4	39.1	39.5	40.0	40.4
Light trucks	30.2	30.3	30.6	30.9	31.2
Combined cars and trucks	32.6	36.5	36.9	37.3	37.7

mpg = miles per gallon.

2.3 Draft SEIS Methods and Assumptions

Each of the alternatives considered in this Draft SEIS represents a different manner in which NHTSA could balance its statutory factors and considerations in setting the CAFE standards.

NHTSA has assessed the effectiveness and costs of technologies as well as market forecasts and economic assumptions for fuel economy standards, as described in the TSD. NHTSA uses the CAFE Model to assess the technologies that manufacturers could apply to their fleet to comply with each alternative and to evaluate many regulatory options efficiently, systematically, and reproducibly. TSD Chapters 2 through 5 describe this model and its inputs and provide an overview of the analytical pieces and tools used in the analysis of alternatives.

For this Draft SEIS, NHTSA used the CAFE Model to estimate annual fuel consumption for each calendar year from 2022, the most recent year for which the new vehicle market was observed, through 2050, when almost all passenger cars and light trucks in use would have been manufactured and sold during or after NHTSA's standard-setting model years in this action.

2.3.1 Constrained versus Unconstrained CAFE Model Analysis

NHTSA's CAFE Model results for the CAFE program presented in Chapter 8 of the PRIA and in Section V of the proposed rule preamble differ slightly from those presented in this Draft SEIS. EPCA and EISA require that the Secretary of Transportation determine the maximum feasible levels of CAFE standards in a manner that sets aside the potential use of CAFE credits or application of alternative fuel technologies toward compliance when setting new standards.[19] NEPA, however, does not impose such constraints on analysis; instead, NEPA requires that Federal agencies develop a detailed statement on "reasonably foreseeable environmental [impacts] of the proposed agency action."[20] This Draft SEIS therefore presents results of an "unconstrained" analysis that considers manufacturers' potential use of CAFE credits and application of alternative fuel technologies (including plug-in hybrid EVs, battery EVs, and fuel cell EVs) to disclose and allow consideration of the real-world environmental consequences of the Proposed Action and alternatives. NHTSA discusses the full range of modeled electrified technologies in Appendix C, *CAFE Model Analysis Methods*.

[19] 49 U.S.C. 32902(h). See also Resetting the Corporate Average Fuel Economy Program; Interpretive Rule, 90 FR 24518 (June 11, 2025).

[20] 42 U.S.C. 4332(2)(C)(i); DOT Order 5610.1D, Section 13.f.

2.3.2 Energy Market Forecast Assumptions

In this Draft SEIS, NHTSA uses projections of energy prices, global petroleum demand, and supply derived from the U.S. Department of Energy, Energy Information Administration, which collects and provides official energy statistics for the United States.[21]

References to the Annual Energy Outlook (AEO) 2025 (and earlier AEOs) in this Draft SEIS refer to the published annual AEO, and the agency is citing directly to the AEO Alternative Electricity case for electric grid forecasts and the Alternative Transportation case for all other forecasts. NHTSA relies on the AEO 2025 in this Draft SEIS because it is widely used and publicly available.

For more information on NHTSA's energy market forecast assumptions, see Chapter 2 in the TSD.

2.3.3 Approach to Scientific Uncertainty and Incomplete Information

DOT Order 5610.1D recognizes that limited information and substantial uncertainties may need to be considered when analyzing the potential environmental impacts of proposed actions. Accordingly, the order provides agencies with a means of formally acknowledging incomplete or unavailable information in NEPA documents. Where "there is incomplete or unavailable information that cannot be obtained at a reasonable cost or the means to obtain it are unknown," the order requires the drafting office to "make clear in the relevant environmental document that such information is lacking."[22]

In this Draft SEIS, NHTSA acknowledges incomplete or unavailable information where relevant to the agency's analysis of the potential environmental impacts of the Proposed Action and alternatives. With respect to the CAFE Model, NHTSA has continued its ongoing effort to refine and expand the capabilities of the Model for use in analyzing regulatory alternatives as considered in this Draft SEIS. 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. In addition, for this Draft SEIS, NHTSA reviewed several peer-reviewed studies, rather than undertaking new scientific or technical research, to inform the analysis.[23]

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[21] The Energy Information Administration (EIA) is the primary source of data that government agencies and private firms use to analyze and model energy systems. Every year, EIA issues projections of energy consumption and supply for the U.S. Annual Energy Outlook (AEO) and the world in the International Energy Outlook. EIA reports energy forecasts through 2050 for a range of fuels, sectors, and geographic regions.

[22] DOT Order 5610.1D, Section 6.c.(4).

[23] Peer-reviewed studies include the Intergovernmental Panel on Climate Change Sixth Assessment Report (2021a, 2021b), the U.S. Global Change Research Program (GCRP) Fifth National Climate Assessment (GCRP 2023), and the U.S. Department of Energy *A Critical Review of Impacts of Greenhouse Gas Emissions on U.S. Climate* (DOE 2025a).

2.4 Resource Areas Dismissed from Further Consideration in this Draft SEIS and Draft SEIS Organization

In this Draft SEIS, NHTSA has not analyzed certain resource areas because the Proposed Action and alternatives would not have a substantive impact on these resource areas that would meaningfully inform the consideration of environmental impacts,[24] or because they are discussed in other documents available for public review (e.g., safety impacts on human health). These resource areas are as follows:

- **Endangered Species Act (ESA).** NHTSA has concluded that consultation pursuant to Section 7(a)(2) of the ESA is not required for this rulemaking action to set CAFE standards. Any potential for a specific impact on particular listed species and their habitats associated with emissions changes achieved by this rulemaking is too uncertain and remote to trigger the threshold for a Section 7(a)(2) consultation. That conclusion, based on the discussion and analysis included in NHTSA's proposed rule preamble, applies here to the fuel consumption and non-criteria emissions (NCEs)[25] increases anticipated to occur under the Proposed Action and alternatives. The agency's discussion of its responsibilities under the ESA is addressed in the proposed rule preamble in Section VIII.3.
- **Section 4(f) Resources.** Section 4(f) (49 U.S.C. 303/23 U.S.C. 138) limits the ability of DOT agencies to approve the use of land from publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historic sites unless certain conditions apply. Because the Proposed Action and alternatives are not a transportation program or project requiring the use of Section 4(f) resources, a Section 4(f) evaluation has not been prepared.
- **Safety Impacts on Human Health.** In developing the proposed standards, NHTSA analyzed how future changes in fuel economy in the light-duty sector might affect human health and welfare through vehicle safety performance and the rate of traffic fatalities. To estimate the possible safety impacts of the standards, NHTSA analyzed impacts from mass reduction, fleet turnover, and the rebound effect. NHTSA used statistical analyses of historical crash data to create estimates of how mass reduction would influence safety outcomes in a crash based on body style and size. NHTSA also examined the safety impacts that would result from delayed purchases of safer, newer model year vehicles due to higher vehicle prices resulting from CAFE standards. Finally, NHTSA examined the impact on vehicle miles traveled (VMT) due to changes in the cost of driving, also known as the rebound effect. These impacts are discussed in Section II.H.3 of the proposed rule preamble and Chapter 7.2.1 of the PRIA.
- **Noise.** NHTSA has analyzed noise impacts as part of this rulemaking and determined that there would be no significant impact. NHTSA has completed EISs since 2010 for setting CAFE standards, and all prior EISs have concluded that the rulemakings would not result in

[24] DOT Order 5610.1D, Section 13.g.(2).

[25] Throughout this Draft SEIS, the term *non-criteria emissions* refers specifically to carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride, which are not classified as criteria pollutants under the Clean Air Act.

noise impacts. In general, noise levels from vehicles are location-specific, meaning that factors such as the time of day when increases in traffic occur, existing ambient noise levels, the presence or absence of noise abatement structures, and the location of schools, residences, and other sensitive noise receptors all influence whether there would be noise impacts. While a truly local analysis (i.e., at the individual roadway level) is impractical for a nationwide EIS, NHTSA believes the potential noise impacts would apply to roadways and sensitive locations in general. NHTSA does estimate the impacts of one component of noise resulting from the Proposed Action and alternatives in its modeling, which is the social cost of decreased noise due to additional VMT from the rebound effect. Regardless of the action or no action from any CAFE rulemaking, the rebound effect exists and these VMT effects are more dramatic with increasing CAFE standards. The discussion of values employed in the model are discussed in Chapter 6.2.3 of the TSD and the results of the analysis are presented in Chapter 8.4.2 of the PRIA. However, both the underlying research and results of this study show that the resulting impacts are extremely small. Considered together, NHTSA concludes that the Proposed Action and alternatives would have no significant impact on noise compared to the No-Action Alternative.

The affected environment and environmental consequences of the Proposed Action and alternatives on resources other than those listed above are described in Chapter 3, *Energy*, Chapter 4, *Air Quality*, Chapter 5, *Non-Criteria Emissions*, Chapter 6, *Life-Cycle Assessment Implications of Vehicle Materials*, and Chapter 7, *Historic and Cultural Resources.*

2.5 Resource Areas Affected and Types of Emissions

The major resource areas affected by the Proposed Action and alternatives are energy, air quality, and climate, discussed in Chapter 3, *Energy*, Chapter 4, *Air Quality*, and Chapter 5, *Non-Criteria Emissions*. Chapter 6, *Life-Cycle Assessment Implications of Vehicle Materials,* describes the vehicle life-cycle impacts implications of differing assumptions relating to vehicle materials and technology. The Proposed Action and alternatives also would affect (though to a lesser degree than energy, air quality, and climate) historic and cultural resources, discussed in Chapter 7, *Historic and Cultural Resources*.

Emissions, including NCEs, criteria pollutants, and mobile source air toxics, are categorized for purposes of this analysis as either *downstream* or *upstream*. Downstream emissions are released from a vehicle while it is in operation, parked, or being refueled, and consist of tailpipe exhaust, evaporative emissions of volatile organic compounds from the vehicle's fuel storage and delivery system, and particulates generated by brake and tire wear. All downstream emissions estimates in the CAFE Model use emissions factors from EPA's Motor Vehicle Emission Simulator (MOVES5) model (EPA 2024b). Upstream emissions related to the Proposed Action and alternatives are those associated with crude-petroleum extraction, transportation, and refining and with transportation, storage, and distribution of gasoline, diesel, and other finished transportation fuels. Emissions from each of these phases of fuel supply are estimated using factors obtained from Argonne National Laboratory's (ANL) Greenhouse Gas, Regulated

Emissions, and Energy Use in Transportation (GREET) model (ANL 2023).[26] Upstream emissions from EVs also include emissions associated with using primary feedstocks (e.g., coal, natural gas, nuclear) to generate the electricity needed to run these vehicles. The amounts of emissions created when generating electricity depends on the composition of fuels used for generation, which can vary regionally. NHTSA estimated global upstream emissions of NCEs and domestic upstream emissions of criteria air pollutants and mobile source air toxics. Upstream emissions considered in this Draft SEIS are those that are estimated to occur directly as a result of changes in fuel economy standards (specifically between the No-Action Alternative and action alternatives) and include those that occur during the recovery, extraction, and transportation of crude petroleum, as well as during the refining, storage, and distribution of transportation fuels.[27] Analysis throughout this Draft SEIS is provided through either 2060 or 2100, depending on the resource area being analyzed, and is noted in the corresponding text, figures, and tables.

The CAFE Model considers how changes in fuel economy standards—for example, between the No-Action Alternative and action alternatives—will change the balance of crude petroleum sourced domestically and internationally. Specifically, the CAFE Model analyzes (for gasoline, E85, diesel, electricity, hydrogen, and compressed natural gas) the extent to which changes in fuel consumption lead to changes in net imports of finished fuel, changes in fuel consumption lead to changes in domestic refining output, changes in domestic refining output lead to changes in domestic crude oil production, and changes in domestic refining output lead to changes in net imports of crude oil. To assess the environmental impacts related to changes in fuel economy standards related to these factors that change directly as a result of changing standards, NHTSA assumes that a portion of finished motor fuels is refined within the United States using imported crude petroleum as a feedstock, and GREET's emissions factors are used to estimate emissions associated with transporting imported petroleum from coastal port facilities to U.S. refineries, refining it to produce transportation fuels, and storing and distributing those fuels. In addition, GREET's emissions factors are used to estimate the NCEs produced in foreign countries during the extraction, refining, transportation, storage, and distribution of refined fuels imported to the United States from abroad.

[26] NHTSA is proposing analytical updates to how it estimates downstream emissions, as discussed in the preamble.

[27] Additional discussion, including detailed modeling methodology, of how NHTSA relates changes in fuel consumed by the vehicle fleet as a result of changes in CAFE standards to these specific fuel activities is discussed in Draft TSD Chapter 5.

CHAPTER 3 ENERGY

NHTSA's light-duty (LD) vehicle fuel economy standards regulate vehicle fuel economy and fuel efficiency, considering, as one of four statutorily required factors, the need of the United States to conserve energy.[1] The sources of energy for LD vehicles include petroleum and other fuels (e.g., electricity, natural gas, biofuels). Changes in vehicle fuel economy standards directly affect the amount of energy used by the U.S. LD vehicle fleet because, all else being equal, a vehicle with a higher fuel economy value can use less fuel to drive the same number of miles than a vehicle with a lower fuel economy value.

NHTSA uses the CAFE Model to analyze the direct impacts of this change in energy use by the U.S. LD vehicle fleet by calculating the difference between the amount of fuel consumed by the vehicle fleet under the No-Action Alternative and the amount of fuel consumed by the vehicle fleet under the various action alternatives. NHTSA also uses the CAFE Model to analyze how the environmental impacts of changes in fuel consumption differ between the No-Action Alternative and various action alternatives. These analyzed environmental impacts include impacts that occur from petroleum extraction, transportation, and refining, as well as fuel transportation, storage, and distribution. Though the United States is currently a net energy exporter, petroleum is still being imported into the United States. As a result, the CAFE Model incorporates assumptions about changes in petroleum imports resulting from changes in CAFE standards. Therefore, NHTSA discusses those relevant environmental impacts in this chapter and Appendix D, *Energy*.

3.1 Introduction

The Annual Energy Outlook (AEO) is an annual projection of U.S. domestic energy markets to 2050 produced by the Energy Information Administration (EIA) within the U.S. Department of Energy (DOE) and includes projections under several alternative cases based on possible policy and economic scenarios. The AEO 2025 projections presented throughout this chapter, referred to as the Alternative Transportation and Alternative Electricity case projections, represent hypothetical scenarios based on sector-specific policy assumptions and relevant market prices, resource constraints, and available technologies as of December 2024.

In particular, the Alternative Electricity case assumes that generators operate under pre-April 2024 regulations, meaning the EPA's April 2024 Clean Air Act section 111 rule regulating carbon emissions from new gas turbines and existing fossil fuel-fired steam units are not in effect. As a result, existing coal-fired power plants are allowed to continue operations without emissions-reducing upgrades and new natural gas plants may be built without complying with carbon capture technology requirements.

The Alternative Transportation case assumes key Federal and California vehicle fuel economy and emissions standards are not in place, including the EPA and NHTSA standards for MYs 2027–2032 as well as California's recent zero-emission truck mandates. However, standards for

[1] 49 U.S.C. 32902(f). NHTSA's interpretation of this statutory factor is discussed more in preamble Section V.

MY 2026 and earlier are assumed to remain in effect because while NHTSA is proposing to reset MY 2022–2026 standards to bring the CAFE program into compliance with law, vehicles for these model years have already been produced, or production is already underway. NHTSA discusses these cases in this chapter and throughout this Draft SEIS because these projections are used as inputs in the CAFE Model to analyze the impacts of different levels of CAFE standards.[2]

Broad projections are inherently uncertain and may fail to incorporate major events that generate sudden, unforeseen shifts (DOE 2025a). Unforeseen shifts and major events that have occurred since the AEO 2025 publication are discussed in Appendix D, Section D.3, *Environmental Consequences: Other Associated Potential Impacts*. In addition, energy market projections are highly uncertain because it is difficult to predict changes in forces that shape these markets, such as changes in technology, demographics, resources, and policy. To address uncertainties in future energy prices, economic conditions, technology costs, and oil and gas supply, EIA develops additional side cases with low and high assumptions for each uncertainty category. The AEO side cases relevant to the Proposed Action are discussed briefly in Appendix D, Section D.3, *Environmental Consequences: Other Associated Potential Impacts*.

Transportation sector fuel consumption accounts for 31.0 percent of total U.S. energy consumption (EIA 2025a). AEO 2025 projects transportation sector fuel consumption to decrease from 29.1 quadrillion British thermal units (quads) in 2024 to 27.8 quads in 2050. In 2024, petroleum (including gasoline and diesel blended with ethanol and biodiesel) supplied 94.5 percent, biofuel (including blended biofuel totals) 6.1 percent, natural gas 4.7 percent, liquefied petroleum gas (propane) 0.04 percent, and electricity 0.3 percent of transportation energy use (EIA 2025a, 2025b).[3] In 2050, AEO 2025 projects that petroleum would supply 86.2 percent, biofuel 6.4 percent, natural gas 7.0 percent, hydrogen 0.0005 percent, liquefied petroleum gas 0.03 percent, and electricity 4.2 percent of transportation energy use.

Section 3.2, *Affected Environment*, provides additional discussion of these energy sources, which are directly related to the current action because any changes in NHTSA's fuel economy standards affects either the amount of energy used by a vehicle to operate (i.e., its fuel economy) or the energy intensity of the fuels used to power those vehicles.

In 2024, LD vehicles accounted for 52.6 percent of transportation energy consumption, commercial light trucks for 3.0 percent, buses and freight trucks for 21.4 percent, air travel for 11.3 percent, and other transportation (e.g., boats, rail, pipeline) for 11.7 percent (EIA 2025c). In 2050, LD vehicles are expected to account for 45.3 percent of transportation energy consumption, with commercial light trucks 2.2 percent, buses and freight trucks 22.4 percent, air travel 15.3 percent, and other transportation 14.9 percent. The projected decline in the percentage of transportation energy used by LD vehicles reflects the fuel economy

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[2] Additional discussion of how NHTSA incorporates these projections in the CAFE Model analysis of the reasonably foreseeable impacts of different levels of CAFE standards is located in the preamble, Draft Technical Support Document, and Preliminary Regulatory Impact Analysis.

[3] The petroleum and biofuels categories are not mutually exclusive. Ethanol and biodiesel, which are biofuels blended into gasoline and diesel, are counted in both categories, reflecting the integrated nature of fuel blending practices. This overlap causes the percentage totals to exceed 100 percent but does not indicate a calculation error.

improvements that would be expected under the No-Action Alternative. As further discussed in Appendix D, Section D.3, *Environmental Consequences: Other Associated Potential Impacts*, the accuracy of these projections is uncertain due to the assumptions made by NHTSA's 2022 and 2024 fuel economy standards that are assumed to remain in effect by AEO's Alternative Transportation case.

In 2024, the transportation sector accounted for 74.0 percent of total U.S. petroleum consumption, and transportation is expected to account for 67.6 percent of U.S. petroleum use in 2050 (EIA 2025a).[4] Between 2024 and 2050, transportation sector gasoline consumption is projected to decrease by 21.4 percent, despite an 11.2 percent projected increase in vehicle miles traveled by LD vehicles (EIA 2025a, 2025d).

The CAFE Model projects LD vehicle fuel consumption through 2050. All CAFE Model results presented in this chapter are specific to U.S. LD vehicle consumption because other countries may have different fuel use patterns. The CAFE Model shows that gasoline (including ethanol used in gasoline blending) accounted for 97.4 percent of LD vehicle fuel consumption in 2024, and it is projected to account for 88.4 percent of consumption in 2050.[5] As illustrated in Table 3.1-1, the CAFE Model projects the gasoline share of LD vehicle fuel use to decline as a result of projected growth in electricity, which is projected to increase from 0.8 percent of consumption in 2024 to 11.2 percent in 2050. Though the energy share is projected to shift across fuel types, total energy consumption is projected to decrease over this period. A net decrease in energy and fuel consumption may result in reduced emissions from the transportation sector.

Table 3.1-1. CAFE Model Estimates of Energy Consumption for LD Vehicles for 2024 and 2050

Fuel	2024 (%)	2050 (%)
Gasoline (including ethanol blending)	97.4	88.4
Electricity	0.8	11.2
Diesel	0.6	0.3
E85	1.0	<0.1
Other fuels	0.2	<0.1

Please consult Chapter 2 in the Technical Support Document for additional information.

[4] The docket for this Draft SEIS (NHTSA-2025-0490) includes an Excel workbook that shows how values reported in this chapter reflect separate AEO 2025 tables for energy supply and disposition, energy consumption by sector and source, renewable consumption by sector and source, and domestic electricity generation and capacity (file name "DSEIS Chapter 3 Data and Figures"). The data presented in this chapter include electricity losses to provide supply and demand values that are comparable. The British thermal unit (Btu) amounts used in electricity generation include electricity losses because those losses are part of the supply Btus (e.g., coal, natural gas) used to deliver electricity for consumption.

[5] The CAFE Model projections differ from the AEO 2025 projections discussed above because the CAFE Model projections include different technology detail and level of aggregation of the transportation sector and reductions in energy consumption from NHTSA's latest proposed LD CAFE standards.

3.2 Affected Environment

The impact of CAFE standards on energy consumption for any given CAFE rulemaking involves assessing changes in the quantities of different types of fuels used to power LD vehicles. For the agency's standard-setting analysis, consistent with statute,[6] NHTSA analyzes the changes in quantities of gasoline and diesel fuels consumed as a result of changing CAFE standards; for this Draft SEIS analysis, NHTSA also assesses changes in electricity, biofuels, natural gas, and hydrogen, which are all fuels that can be used to power LD vehicles.

The environmental impacts of the production and consumption of LD vehicle fuels are described in Appendix D, Section D.2, *Affected Environment*, to provide context for the CAFE Model's analytical results of changes in quantities of these fuels consumed as a result of changes in CAFE standards.[7] NHTSA cannot analyze all of the impacts of its action related to petroleum transportation quantitatively, but provides the aforementioned discussion to give additional context to its quantitative estimates of changes in environmental impacts due to petroleum transportation. NHTSA does quantitatively analyze the changes in criteria pollutant and non-criteria emissions (NCEs) from petroleum transportation in the CAFE Model analysis.

3.3 Environmental Consequences: Reasonably Foreseeable Impacts from the Proposed Action

The term *impacts* in this section refers only to impacts of the Proposed Action. All the action alternatives are projected to increase U.S. energy intensity, or the amount of energy required per unit of distance, through 2050 relative to the No-Action Alternative.[8] Under the No-Action Alternative, the average fuel economy of all LD vehicles in use is projected to increase by an average of 2.0 percent each year from 2024 through 2050. Under Alternative 2 (the Preferred Alternative for CAFE standards), Alternative 1, and Alternative 3, the average fuel economy of all LD vehicles in use is projected to increase by 1.8 percent each year across all alternatives, between 2024 and 2050, as older, less-efficient vehicles are replaced with newer, more fuel-efficient models. In general, improvements in fuel economy could contribute to reduced net petroleum imports.

Gasoline is projected to account for 88 to 90 percent of the total gasoline gallon equivalent[9] use in 2050 under all the alternatives. Table 3.3-1 shows projected fuel use from 2024 to 2050 under the Proposed Action and each alternative, compared to the No-Action Alternative, including the percentage change in fuel use relative to the No-Action scenario.

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[6] 49 U.S.C. 32902(h).

[7] Appendix D, *Energy*, provides further environmental context on energy production and consumption associated with LD vehicle fuels by examining how their production, distribution, and use would change as a result of proposed changes to CAFE standards.

[8] For a discussion of the factors in the No-Action Alternative, see Chapter 2, Section 2.2.1, *No-Action Alternative*. For additional information, see Technical Support Document, Chapter 1.

[9] *Gasoline gallon equivalent* is the amount of an alternative fuel required to equal the energy content of 1 liquid gallon of gasoline.

Table 3.3-1. Fuel Consumption Under the No-Action Alternative and Incremental Changes in Fuel Consumption by Action Alternative for all Light-Duty Vehicles (Passenger Cars and Light Trucks) (billion gasoline gallon equivalent total for calendar years 2024–2050)

No-Action	Alt. 1	Alt. 2	Alt. 3
Fuel Consumption	Change in Fuel Use Compared to the No-Action Alternative		
2,867	+77 (+3%) [a]	+77 (+3%) [a]	+71 (+2%)

Notes:
[a] The estimated fuel consumption is the same under Alternative 1 and Alternative 2 (Preferred Alternative) because starting with MY 2027 vehicle manufacturers are assumed to offer vehicles using nearly the same fuel economy technologies under either Alternative 1 or Alternative 2 (Preferred Alternative) and, therefore, the resulting fuel consumption would be the same for both alternatives.

Though total LD fuel consumption (2024–2050) is projected to increase relative to the No-Action Alternative, annual LD fuel consumption is projected to decline between 2024 and 2050 for all alternatives. This decrease in fuel consumption may lead to reduced oil extraction and refining activity (EIA 2025e). The Proposed Action impacts on resource areas, such as air quality, NCEs, surface water, groundwater, land, wildlife, and human health are likely to be minimal because the decreased fuel consumption under the Proposed Action and alternatives represents a small percentage of total fuel consumption over a long period.

Additional impacts may result from the combination of the CAFE standards and other actions, and are discussed in Appendix D, Section D.3, *Environmental Consequences: Other Associated Potential Impacts*.

CHAPTER 4 AIR QUALITY

4.1 Affected Environment

4.1.1 Relevant Pollutants and Standards

Many human activities cause gases and particles to be emitted into the atmosphere, including driving cars and trucks. When fuel is injected into a vehicle and combined with air in the vehicle's engine, it provides motive power for the vehicle through combustion. Various pollutants are produced as byproducts of combustion. These pollutants are emitted out of a vehicle through its tailpipe and released into the air. In addition, when petroleum is extracted, refined, stored, and transported to gas stations to be used as fuel for vehicles, all aspects of those processes also result in air pollutants. NHTSA considers the environmental impacts related to these air pollutants because when a vehicle fleet uses more or less fuel to perform the same amount of work, more or less pollutants are released into the air as a result.

Total emissions from on-road mobile sources (highway vehicles) have declined dramatically since 1970 because of pollution controls on vehicles and regulation of the chemical content of fuels, despite continuing increases in vehicle miles traveled (VMT). Nevertheless, the U.S. transportation sector remains a major source of emissions of certain criteria pollutants or their chemical precursors. In 2024, on-road mobile sources were responsible for emitting 12.322 million tons[1] per year (27 percent of total U.S. emissions) of carbon monoxide (CO), 1.745 million tons per year (25 percent) of nitrogen oxides (NO_X), 66,972 tons per year (1 percent) of particulate matter (PM) with a diameter equal to or less than 2.5 microns (PM2.5), 188,636 tons per year (1 percent) of particulate matter with a diameter equal to or less than 10 microns (PM10), 10,189 tons per year (0.6 percent) of sulfur dioxide (SO_2), and 895,989 tons per year (7 percent) of volatile organic compounds (VOCs) (EPA 2025a). In 2026, passenger cars and light trucks are projected to contribute 84 percent of U.S. highway emissions of CO, 49 percent of U.S. highway emissions of PM2.5, 64 percent of U.S. highway emissions of PM10, 78 percent of U.S. highway emissions of VOCs, and 31 percent of U.S. highway emissions of NO_X (EPA 2025b). Studies have stated that concentrations of CO, nitric oxide (NO), nitrogen dioxide (NO_2, one of several oxides of nitrogen), benzene, aldehydes, PM, black carbon, and many other compounds are elevated in ambient air within 300 to 600 meters (about 1,000 to 2,000 feet) of major roadways.[2]

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[1] The term *ton(s)* as used in this chapter refers to U.S. tons (2,000 pounds).

[2] Studies that focused on measurements during meteorological conditions that tend to inhibit the dispersion of emissions have found that concentrations of traffic-generated air pollutants can be elevated for as much as 2,600 meters (about 8,500 feet) downwind of roads under such meteorological conditions (Hu et al. 2009, 2012). The highest concentrations of most pollutants emitted directly by motor vehicles are found at locations within 50 meters (about 165 feet) of the edge of a roadway's traffic lanes. More recent studies continue to show significant concentration gradients of traffic-related air pollution around major roads (Apte et al. 2017; Dabek-Zlotorzynska et al. 2019; Moutinho et al. 2020; Rattigan et al. 2020; Chambliss et al. 2021). Furthermore, two studies using TROPospheric Ozone Monitoring Instrument (TROPOMI) satellite sensors have provided evidence that NO_2 concentrations are high in areas with a high density of highways (Demetillo et al. 2021; Kerr et al. 2021).

To reduce air pollution levels, the Federal Government and state agencies have passed legislation and established regulatory programs to control sources of emissions. The Clean Air Act (CAA) is the primary Federal legislation that addresses air quality (DOE 2025a). Under the CAA, as amended, EPA has established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants.[3] The six criteria pollutants are CO, NO_2, ozone, SO_2,[4] PM10, PM2.5,[5] and lead. Vehicles do not directly emit ozone, but this pollutant is evaluated based on emissions of the ozone precursor pollutants NO_X and VOCs. In addition, NO_X is a PM2.5 precursor and VOCs can be PM2.5 precursors.[6] VOCs include non-methane organic gases (hydrocarbon emissions plus oxygenated hydrocarbons such as alcohols and aldehydes, minus methane) but exclude ethane and acetone, which contribute little to ozone formation.[7] Lead is no longer emitted from motor vehicles in more than negligible quantities. Therefore, this analysis does not address lead.

Vehicle-related sources of air pollutants include exhaust emissions, evaporative emissions, resuspension of road dust, and tire and brake wear. Exhaust emissions refer to emissions of pollutants resulting from combustion used to power a vehicle that are directed out of the engine and to the vehicle's tailpipe through a system that makes those emissions less harmful when released into the air, such as through a catalytic converter. Evaporative emissions refer to emissions that are released into the air through the vehicle's fuel system when the vehicle is refueling, parked, or driving. Evaporative emissions differ from exhaust emissions because they do not directly involve the combustion of gasoline in an engine to power the vehicle, as with exhaust emissions. Road dust consists of particles present on the road surface, generated by traffic or transported and deposited from near or long-range sources.

Assessing how concentrations of air pollutants emitted directly from motor vehicles change as a result of changing CAFE standards is relevant to this action because a vehicle that uses less fuel to do the same amount of work is responsible for less air pollution than one that uses more fuel to do that work. Because air pollutant emissions change in response to changes in CAFE standards, NHTSA analyzes them as reasonably foreseeable environmental impacts of potential changes in CAFE standards, even as total emissions of criteria pollutants continue to decline.

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[3] *Criteria pollutants* is a term used to describe the six common air pollutants for which the CAA requires EPA to set NAAQS. EPA calls these pollutants criteria air pollutants because it regulates them by developing human health-based or environmentally based criteria (i.e., science-based guidelines) for setting permissible levels. See: https://www.epa.gov/criteria-air-pollutants/naaqs-table.

[4] SO_2 and other oxides of sulfur (SO_X) contribute to the formation of PM2.5 in the atmosphere; however, on-road mobile sources account for less than 1 percent of U.S. SO_2 emissions (EPA 2025a) due to the introduction of fuel sulfur limits for both gasoline and diesel.

[5] Over 90 percent of the PM in motor vehicle exhaust is PM2.5 (Cadle et al. 1999); therefore, this analysis focuses on PM2.5 rather than PM10.

[6] NO_X can undergo chemical transformations in the atmosphere to form nitrates. VOCs can undergo chemical transformations in the atmosphere to form other various carbon compounds. Nitrates and carbon compounds can be major constituents of PM2.5. Highway vehicle emissions are large contributors to nitrate formation nationally (EPA 2004).

[7] 40 CFR 51.100(s).

NHTSA uses the CAFE Compliance and Effects Modeling System (the CAFE Model)[8] to simulate manufacturers' potential responses to new CAFE standards and to estimate various impacts of those responses.

4.1.1.1 Health Effects of Criteria Pollutants and Mobile Source Air Toxics

Studies have stated that air pollution near major roads can increase the risk of adverse health effects in populations that live, work, or attend school near major roads.[9] Any changes in vehicle fuel economy as a result of CAFE standards will change the amount of criteria pollutants emitted from both the fuel production and fuel combustion processes, which may cause health effects. The five criteria pollutants discussed in this Draft SEIS are CO, NO_2, ozone, SO_2, and PM. The health outcomes with the strongest evidence of linkages to traffic-associated criteria air pollutants are respiratory effects and cardiovascular effects (EPA 2014).[10]

A systematic review and meta-analysis of studies evaluated the risk of childhood leukemia associated with traffic exposure and reported positive associations between postnatal proximity to traffic and leukemia risks but no such association for prenatal exposures (Boothe et al. 2014). Other studies have found an association between exposure to ambient air pollution during pregnancy and childhood cancer risks and an association between postnatal exposure and childhood cancer risks (e.g., Lavigne et al. 2017; Tamayo-Uria et al. 2018), as well as associations between prenatal exposure to ultrafine particles and childhood asthma (Wright et al. 2021). Other possible adverse health effects resulting from high traffic exposure are less studied and lack sufficient evidence to draw definitive conclusions.[11] In addition to reporting health outcomes, particularly cardiopulmonary effects, numerous studies suggest mechanisms by which traffic-related air pollution affects health and leads to those reported outcomes, indicating that near-roadway exposures may increase systemic inflammation, affecting organ

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[8] For this Draft SEIS an unconstrained version of the CAFE Model is used. For a discussion of the constrained and unconstrained CAFE Model please see the Technical Support Document (TSD) Chapter 1 and Appendix C, *CAFE Model Analysis Methods*, respectively. For additional discussion of how air quality was modeled please see Appendix E, *Air Quality and NCE Methodology and Other Information*.

[9] Most of the information in the remainder of this section appeared originally in the EPA 2014 Final Rule establishing Tier 3 motor vehicle emissions and fuel standards (Control of Air Pollution from Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards; Final Rule, 79 FR 23414 [Apr. 28, 2014]); in the EPA 2024 Final Rule establishing Tier 4 motor vehicle emissions standards (Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles; Final Rule, 89 FR 27842 [Apr. 18, 2024]); and in the EPA 2024 Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles—Phase 3 Final Rule, 89 FR 29440 (Apr. 22, 2024).

[10] For further information on the health effects of criteria pollutants, see the Final Environmental Impact Statement for Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks, Model Years 2027 and Beyond, and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans, Model Years 2030 and Beyond, Appendix C, *Air Quality* (NHTSA 2024). The qualitative discussion includes scientific studies and assessments representing a summary of the state of the science at the time of Final EIS drafting, which NHTSA considered and is providing as contextual background for the analysis presented in this document. For additional information see the EPA Integrated Science Assessment for each criteria pollutant (EPA 2010a, 2016, 2017a, 2020a, 2020b).

[11] Among these less-studied potential outcomes are neurological effects (e.g., autism and reduced cognitive function) and reproductive outcomes (e.g., preterm birth and low birth weight) (e.g., Volk et al. 2011; Franco-Suglia et al. 2007; Power et al. 2011; Wu et al. 2011; Xu et al. 2016; Salvi and Salim 2019; Stenson et al. 2021; Gartland et al. 2022).

systems, including blood vessels and lungs (e.g., Riediker 2007; Alexeef et al. 2011; Eckel et al. 2011; Zhang et al. 2009; Puett et al. 2019).

Hazardous air pollutants emitted from vehicles that are known or suspected to cause cancer or other serious health and environmental impacts are referred to as MSATs.[12] The MSATs included in this analysis are acetaldehyde, acrolein,[13] benzene, 1,3-butadiene, diesel particulate matter (DPM), and formaldehyde. Any changes in vehicle fuel economy as a result of CAFE standards will change the amount of MSATs emitted from both the fuel production and fuel combustion processes.[14]

4.1.1.2 Conformity Regulations

The CAA prohibits a Federal agency from engaging in, supporting, licensing, or approving any activity that does not conform to a State Implementation Plan (SIP) or Federal Implementation Plan after EPA has approved or promulgated it, or that would affect a state's compliance with NAAQS.[15] The purpose of the conformity requirement is to ensure that federally sponsored or conducted activities do not interfere with meeting emissions targets in SIPs, cause or contribute to new violations of NAAQS, or impede the ability of a state to attain or maintain NAAQS or delay interim milestones. EPA has issued two sets of regulations to implement the conformity requirements: the Transportation Conformity Rule and the General Conformity Rule.

The Transportation Conformity Rule[16] 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). The General Conformity Rule[17] applies to all other Federal actions not covered under the Transportation Conformity Rule. The General Conformity Rule establishes emissions thresholds for use in evaluating the conformity of an action that results in emissions increases.[18] If the net increases of direct and indirect emissions are lower than these thresholds, then the action is presumed to conform and no further conformity evaluation is required. 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, consultations with EPA and

[12] A list of all MSATs identified by EPA to date can be found in the *Regulatory Impact Analysis for Final Rule: Control of Hazardous Air Pollutants from Mobile Sources* (signed Feb. 9, 2007), EPA420-R-07-002, Tables 1.1-1 and 1.1-2 (EPA 2007).

[13] EPA no longer considers acrolein to be a key driver of health risk from mobile sources (EPA 2018a). However, this analysis retains acrolein for consistency with the Federal Highway Administration's MSAT guidance (Federal Highway Administration 2023).

[14] For further information on the health effects of MSATs, see the Final Environmental Impact Statement for Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks, Model Years 2027 and Beyond, and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans, Model Years 2030 and Beyond, Appendix C, *Air Quality* (NHTSA 2024). The qualitative discussion includes scientific studies and assessments representing a summary of the state of the science at the time of Final EIS drafting, which NHTSA considered and is providing as contextual background for the analysis presented in this document.

[15] 42 U.S.C. 7506(c)(1)-(2).

[16] 40 CFR part 51, subpart T, and part 93, subpart A.

[17] 40 CFR part 51, subpart W, and part 93, subpart B.

[18] 40 CFR 93.153(b).

state air quality agencies, and commitments to revise the SIPs or to implement measures to mitigate air quality impacts.

The CAFE standards and associated program activities are not developed, funded, or approved under 23 U.S.C. or 49 U.S.C. chapter 53. Further, the standards are not a highway or transit project funded, approved, or implemented by the Federal Highway Administration or Federal Transit Administration. Accordingly, this action and associated program activities are not subject to the Transportation Conformity Rule. 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 originating in nonattainment or maintenance areas equaling or exceeding the rates specified in 40 CFR 93.153(b)(1) and (2). As explained in Appendix E, *Air Quality and NCE Methodology and Other Information*, Section E.2.2, *Conformity Regulations*, NHTSA's Proposed Action and alternatives would result in neither direct nor indirect emissions as defined in 40 CFR 93.152, and the General Conformity Rule does not apply.

4.2 Environmental Consequences: Reasonably Foreseeable Impacts from the Proposed Action

This section examines the reasonably foreseeable impacts of the Proposed Action and alternatives on criteria pollutant and MSAT emissions and projected impacts on nonattainment areas. The term *impacts* in this section refers only to impacts of the Proposed Action. The analysis shows that the action alternatives would result in different levels of emissions from vehicles when measured against projected trends under the No-Action Alternative. These changes in emissions would vary by pollutant, calendar year, and action alternative. Additional impacts may result from the combination of the CAFE standards and other actions, and are discussed in Appendix E, Section E.2.3, *Environmental Consequences: Other Associated Potential Impacts*.

The estimated emissions of criteria pollutants and MSATs, as well as health impacts, are the same under Alternative 1 and Alternative 2 (Preferred Alternative) because, starting with MY 2027, vehicle manufacturers are assumed to offer vehicles using nearly the same fuel economy technologies under either Alternative 1 or Alternative 2 (Preferred Alternative), and the resulting emissions would be the same for both alternatives.

4.2.1 Criteria Pollutants

4.2.1.1 Emissions Levels

Table 4.2.1-1 summarizes the total upstream and downstream[19] national emissions under the No-Action Alternative and the change in emissions by alternative (relative to the No-Action Alternative in the same year) for each of the criteria pollutants and analysis years.

[19] Due to modeling limitations, downstream emissions do not include evaporative emissions from vehicle fuel systems.

Table 4.2.1-1. Nationwide Criteria Pollutant Emissions (tons per year) from U.S. Passenger Cars and Light Trucks for the No-Action Alternative, and Change in Emissions by Action Alternative, Proposed Action Impacts [a,b]

Year	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)
Carbon monoxide (CO)				
2035	6,522,972	54,129	54,129	51,915
2050	3,602,777	95,198	95,198	95,678
Nitrogen oxides (NO_X)				
2035	305,340	1,556	1,556	1,500
2050	174,815	4,567	4,567	4,287
Particulate matter (PM2.5)				
2035	20,274	66	66	66
2050	10,608	242	242	221
Sulfur oxides (SO_2)				
2035	62,128	-1,036	-1,036	-941
2050	45,426	293	293	227
Volatile organic compounds (VOCs)				
2035	823,686	13,100	13,100	12,202
2050	549,795	21,296	21,296	20,184

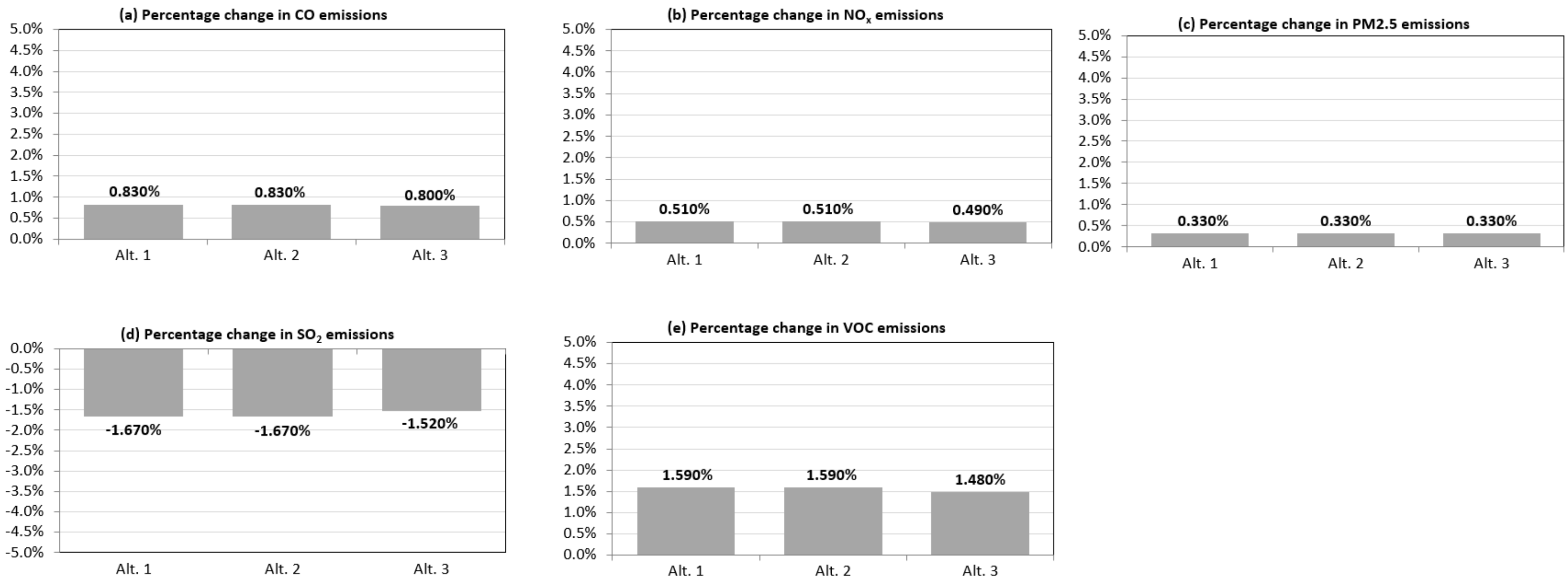
Notes:
[a] Impacts have been rounded to the nearest whole number.
[b] Negative values indicate emissions decreases; positive values indicate emissions increases.

Table 4.2.1-1 shows a consistent time trend among the criteria pollutants. Emissions of CO, NO_X, PM2.5, SO_2, and VOCs are estimated to decrease substantially from 2035 to 2050 because of current EPA regulation of emissions from vehicles (Section 4.1.1, *Relevant Pollutants and Standards*) and from reductions in upstream emissions from fuel production, despite nearly no change in total VMT from 2035 to 2050.[20]

Figure 4.2.1-1 compares the percentage differences in emissions among the alternatives for 2035, a near-term forecast year for passenger cars and light trucks.

[20] Continued growth in VMT is projected to occur under all alternatives until 2040; a slight decrease is projected to occur from 2042 to 2050.

Figure 4.2.1-1. Nationwide Percentage Changes in Criteria Pollutant Emissions from U.S. Passenger Cars and Light Trucks for 2035 by Action Alternative Compared to the No-Action Alternative, Proposed Action Impacts



Notes:

The vertical (percentage) scale differs by pollutant.

Negative values indicate emissions decreases; positive values are emissions increases.

CO = carbon monoxide; NO_X = nitrogen oxides; PM2.5 = particulate matter 2.5 microns or less in diameter; SO_2 = sulfur dioxide; VOCs = volatile organic compounds.

Total criteria pollutant emissions consist of four components: two sources of emissions (downstream [i.e., tailpipe emissions] and upstream) for each of the two vehicle classes covered by the standards (passenger cars and light trucks). Table 4.2.1-2 shows the total emissions of criteria pollutants under the No-Action Alternative and the change in emissions by alternative (relative to the No-Action Alternative in the same year) broken out by these four components for calendar year 2035 (i.e., cars tailpipe, cars upstream, trucks tailpipe, and trucks upstream).

Table 4.2.1-2. Nationwide Criteria Pollutant Emissions (tons per year) in 2035 from U.S. Passenger Cars and Light Trucks by Emissions Component for the No-Action Alternative, and Change in Emissions by Action Alternative, Proposed Action Impacts [a,b,c]

Emissions Component	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)
Carbon monoxide (CO)				
Cars tailpipe	2,383,338	614,572	614,572	615,320
Cars upstream	26,539	16,396	16,396	16,397
Trucks tailpipe	4,057,717	-560,204	-560,204	-563,203
Trucks upstream	55,378	-16,635	-16,635	-16,599
Tailpipe subtotal (cars + trucks)	*6,441,055*	*54,368*	*54,368*	*52,117*
Upstream subtotal (cars + trucks)	*81,917*	*-239*	*-239*	*-202*
Total (tailpipe + upstream)	**6,522,972**	**54,129**	**54,129**	**51,915**
Nitrogen oxides (NO_X)				
Cars tailpipe	46,842	11,968	11,968	11,983
Cars upstream	49,585	31,080	31,080	31,082
Trucks tailpipe	101,586	-10,941	-10,941	-10,996
Trucks upstream	107,327	-30,552	-30,552	-30,568
Tailpipe subtotal (cars + trucks)	*148,428*	*1,027*	*1,027*	*987*
Upstream subtotal (cars + trucks)	*156,912*	*528*	*528*	*514*
Total (tailpipe + upstream)	**305,340**	**1,556**	**1,556**	**1,500**
Particulate matter (PM2.5)				
Cars tailpipe	2,834	504	504	504
Cars upstream	3,741	2,310	2,310	2,311
Trucks tailpipe	5,746	-461	-461	-463
Trucks upstream	7,953	-2,286	-2,286	-2,286
Tailpipe subtotal (cars + trucks)	*8,580*	*43*	*43*	*41*
Upstream subtotal (cars + trucks)	*11,694*	*24*	*24*	*25*
Total (tailpipe + upstream)	**20,274**	**66**	**66**	**66**
Sulfur oxides (SO_2)				
Cars tailpipe	1,321	935	935	935
Cars upstream	19,749	11,303	11,303	11,297
Trucks tailpipe	3,448	-766	-766	-780
Trucks upstream	37,610	-12,508	-12,508	-12,394
Tailpipe subtotal (cars + trucks)	*4,769*	*169*	*169*	*155*
Upstream subtotal (cars + trucks)	*57,359*	*-1,205*	*-1,205*	*-1,097*
Total (tailpipe + upstream)	**62,128**	**-1,036**	**-1,036**	**-941**

Emissions Component	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)
Volatile organic compounds (VOCs)				
Cars tailpipe	201,953	36,879	36,879	36,932
Cars upstream	87,873	61,453	61,453	61,486
Trucks tailpipe	309,684	-33,892	-33,892	-34,066
Trucks upstream	224,177	-51,341	-51,341	-52,151
Tailpipe subtotal (cars + trucks)	*511,637*	*2,987*	*2,987*	*2,866*
Upstream subtotal (cars + trucks)	*312,050*	*10,112*	*10,112*	*9,335*
Total (tailpipe + upstream)	**823,686**	**13,100**	**13,100**	**12,202**

Notes:
[a] Impacts have been rounded to the nearest whole number.
[b] Negative values indicate emissions decreases; positive values indicate emissions increases.
[c] Totals may not sum due to rounding.

The directions and magnitudes of the changes in total emissions are not consistent across all pollutants, which reflects the complex interactions between tailpipe emissions rates of the various vehicle types; the technologies assumed to be incorporated by manufacturers in response to the standards; upstream emissions rates; the relative proportions of gasoline, diesel, and other fuels in total fuel consumption changes; and changes in VMT.[21]

In some cases, a more stringent alternative may have greater modeled emissions than a less stringent alternative. For example, in 2050, Alternative 3 has slightly greater CO emissions than Alternative 2 (Preferred Alternative) (Table 4.2.1-1). This can occur because the technology choices manufacturers make between one alternative and another, as predicted by the CAFE Model, can have both upstream and downstream (tailpipe) impacts. Though total emissions generally decrease with increasing stringency, upstream and downstream impacts can affect emissions in the same or opposite directions depending on the model-predicted technology choices. For example, in the case of CO emissions in 2050 (Appendix B, *U.S. Passenger Car and Light Truck Results Reported Separately*, Table B-3), while Alternative 2 (Preferred Alternative) increases gasoline consumption more than Alternative 3, the net impact is slightly greater total CO emissions increases under Alternative 3 than under Alternative 2 (Preferred Alternative) (Table 4.2.1-1). That total comprises slightly higher tailpipe emissions but slightly lower upstream emissions in Alternative 3 relative to Alternative 2 (Preferred Alternative), with the increases in tailpipe emissions being larger than the decreases in upstream emissions (Appendix B, *U.S. Passenger Car and Light Truck Results Reported Separately*, Table B-3).

Table 4.2.1-1 and Table 4.2.1-2 show small changes in emissions relative to total emissions of each pollutant. This result also has insignificant upstream and tailpipe impacts due to the small incremental changes in emissions which are within the error of the CAFE Model.

Table 4.2.1-2 shows, relative to the No-Action Alternative, that 2035 passenger car tailpipe and upstream emissions of the criteria pollutants increase substantially under all action

[21] Other CAFE Model inputs and assumptions, including the rate at which new vehicles are sold, also will affect these air quality impact estimates. These inputs and assumptions are discussed in Appendix C, *CAFE Model Analysis Methods*, Chapters 2 through 5 of the TSD, and in the Preliminary Regulatory Impact Analysis (PRIA) issued concurrently with this Draft SEIS.

alternatives. Light truck criteria pollutant tailpipe and upstream emissions in 2035 decrease substantially under all action alternatives compared to the No-Action Alternative. These changes are primarily due to NHTSA's proposed reclassification of a proportion of light trucks as passenger cars starting in MY 2028, as discussed in Section VI of the proposed rule preamble and Technical Support Document Chapter 2.7.

Combined LD vehicle tailpipe emissions in 2035 are projected to increase for SO_2 and increase slightly for the other criteria pollutants because the increase for passenger cars is larger than the decrease for light truck tailpipe emissions. The combined LD vehicle tailpipe emissions increases are the same under Alternatives 1 and 2 (Preferred Alternative) but slightly less under Alternative 3. Combined LD vehicle upstream emissions in 2035 decrease for SO_2 and decrease slightly for CO compared to the No-Action Alternative because the decrease for light trucks is larger than the increase for passenger car upstream emissions; the combined decrease under Alternatives 1 and 2 (Preferred Alternative) is slightly larger than under Alternative 3. Combined LD vehicle upstream emissions in 2035 increase for VOC and increase slightly for NO_X compared to the No-Action Alternative because the increase for passenger cars is larger than the decrease for light truck upstream emissions; the combined increase under Alternatives 1 and 2 (Preferred Alternative) is slightly larger than under Alternative 3. Combined LD vehicle upstream emissions of PM2.5 increase slightly compared to the No-Action Alternative because the increase for passenger cars is larger than the decrease for light truck upstream emissions; the combined increase under Alternatives 1 and 2 (Preferred Alternative) is slightly smaller than under Alternative 3.

In 2050, the combined LD vehicle tailpipe emissions increases of CO and NO_X are the same under Alternatives 1 and 2 (Preferred Alternative) and slightly greater under Alternative 3 (Appendix B, *U.S. Passenger Car and Light Truck Results Reported Separately*, Table B-3). The combined LD vehicle tailpipe emissions increases of PM2.5 are the same under all three alternatives. The combined LD vehicle tailpipe emissions increases of SO_2 and VOC are the same under Alternatives 1 and 2 (Preferred Alternative) but slightly less under Alternative 3. The combined LD vehicle upstream emissions increase for NO_X, PM2.5, and VOCs, and increase slightly for CO and SO_2, compared to the No-Action Alternative; the increase under Alternatives 1 and 2 (Preferred Alternative) is slightly larger than under Alternative 3.

The differences in national emissions of criteria air pollutants among the action alternatives compared to the No-Action Alternative would range from slight (2 percent or less) to about 4 percent because of the interactions of the multiple factors described previously. The smaller differences are not expected to lead to measurable changes in concentrations of criteria pollutants in the ambient air. The larger differences in emissions could lead to changes in ambient pollutant concentrations.

In 2035, emissions of CO, NO_X, PM2.5, and VOC increase slightly under all action alternatives compared to the No-Action Alternative, while emissions of SO_2 decrease slightly. The largest relative increases in emissions (as a percentage) among the criteria pollutants would occur for VOCs, for which emissions would increase by as much as 1.59 percent under Alternatives 1 and 2 (Preferred Alternative) compared to the No-Action Alternative. The decreases in SO_2 emissions relative to the No-Action Alternative reflect the projected decrease in electric vehicle

(EV) use across all action alternatives, which would result in reduced emissions from fossil-fueled power plants to generate the electricity for charging the EVs. Upstream sources constitute over 90 percent of SO_2 emissions but less than 90 percent of emissions of other criteria pollutants.

In 2050, emissions increase for CO, NO_X, PM2.5, and VOC, and increase slightly for SO_2, under all action alternatives compared to the No-Action Alternative. The largest relative increases in emissions (as a percentage) among the criteria pollutants would occur for VOCs, for which emissions would increase by as much as 3.9 percent under Alternatives 1 and 2 (Preferred Alternative) compared to the No-Action Alternative. Decreases in EV use relative to the No-Action Alternative are projected in 2050, but they are smaller decreases than in 2035, such that the projected increases in vehicle gasoline consumption lead to projected slight increases in overall SO_2 emissions (through increases in tailpipe emissions of SO_2 and slight increases in upstream SO_2 emissions from increased fuel refining).

4.2.1.2 Nonattainment Areas

Table 4.2.1-3 summarizes the criteria air pollutant analysis results by nonattainment area.[22] For each pollutant, Table 4.2.1-3 lists the nonattainment areas in which the maximum increases and decreases in emissions would occur. The increases and decreases would not be uniformly distributed to individual nonattainment areas. Appendix F, *Air Quality Nonattainment Area Results*, indicates, for NO_X, PM2.5, and VOCs, that all nonattainment areas would experience increases in emissions across all action alternatives in 2035 and 2050 compared to the No-Action Alternative. For CO and SO_2, most nonattainment areas would experience increases in emissions across all action alternatives in 2035, while all nonattainment areas would experience emissions increases across all action alternatives in 2050 compared to the No-Action Alternative.

Table 4.2.1-3. Maximum Changes in Criteria Pollutant Emissions (tons per year) from U.S. Passenger Cars and Light Trucks, Across All Nonattainment or Maintenance Areas, Alternatives, and Years, Proposed Action Impacts [a]

Criteria Pollutant or Precursor	Maximum Increase/ Decrease	Emissions Change (tons per year)	Year	Alternative	Nonattainment or Maintenance Area (NAAQS Standard[s])
Carbon monoxide (CO)	Maximum increase	4,184	2050	Alt. 3	Los Angeles-South Coast Air Basin, CA [CO (1971 8-hour); NO_2 (1971 Annual); Ozone (2008 8-hour); Ozone (2015 8-hour); PM2.5 (2006 24-hour); PM2.5 (2012 Annual)]
	Maximum decrease	-2	2035	Alt. 1, Alt. 2	Whatcom County, WA [SO_2 (2010 1-hour)]

[22] In this section, the term *nonattainment* refers to both nonattainment areas and maintenance areas.

Criteria Pollutant or Precursor	Maximum Increase/ Decrease	Emissions Change (tons per year)	Year	Alternative	Nonattainment or Maintenance Area (NAAQS Standard[s])
Nitrogen oxides (NO_X)	Maximum increase	361	2050	Alt. 1, Alt. 2	Los Angeles-South Coast Air Basin, CA [CO (1971 8-hour); NO_2 (1971 Annual); Ozone (2008 8-hour); Ozone (2015 8-hour); PM2.5 (2006 24-hour); PM2.5 (2012 Annual)]
	Maximum decrease	0	No decreases are predicted for any years or alternatives		None
Particulate matter (PM2.5)	Maximum increase	17	2050	Alt. 1, Alt. 2	Houston-Galveston-Brazoria, TX [Ozone (2008 8-hour); Ozone (2015 8-hour)]
	Maximum decrease	0	No decreases are predicted for any years or alternatives		None
Sulfur oxides (SO_2)	Maximum increase	12	2050	Alt. 1, Alt. 2	Los Angeles-South Coast Air Basin, CA [CO (1971 8-hour); NO_2 (1971 Annual); Ozone (2008 8-hour); Ozone (2015 8-hour); PM2.5 (2006 24-hour); PM2.5 (2012 Annual)]
	Maximum decrease	-111	2035	Alt. 1, Alt. 2	Baton Rouge, LA [Ozone (2008 8-hour)]
Volatile organic compounds (VOCs)	Maximum increase	1,315	2050	Alt. 1, Alt. 2	Houston-Galveston-Brazoria, TX [Ozone (2008 8-hour); Ozone (2015 8-hour)]
	Maximum decrease	0	No decreases are predicted for any years or alternatives		None

Notes:
[a] Changes have been rounded to the nearest whole number.
NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide; PM2.5 = particulate matter 2.5 microns or less in diameter.

Each nonattainment area implements emissions controls and other requirements, in accordance with its SIP, that aim to reduce emissions so the area will reach attainment levels under the schedule specified in the CAA. In a nonattainment area where emissions of a nonattainment pollutant or its precursors would increase under an action alternative, the increase would represent a slight decrease in the rate of emission reduction projected in the SIP. In response, the nonattainment area could revise its SIP to require greater emissions reductions.

4.2.2 Mobile Source Air Toxics

4.2.2.1 Emissions Levels

Table 4.2.2-1 summarizes the total upstream and downstream[23] emissions of MSATs under the No-Action Alternative and the change in emissions by alternative (relative to the No-Action Alternative in the same year) for each of the MSATs and analysis years. Table 4.2.2-1 shows a consistent time trend among the MSATs, where emissions decrease substantially from 2035 to 2050 because of increasingly stringent EPA regulation of emissions from vehicles (Section 4.1.1, *Relevant Pollutants and Standards*) and from reductions in upstream emissions from fuel production despite nearly no change in total VMT.

Table 4.2.2-1. Nationwide Mobile Source Air Toxic Emissions (tons per year) from U.S. Passenger Cars and Light Trucks for the No-Action Alternative, and Change in Emissions by Action Alternative, Proposed Action Impacts [a,b]

Year	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)
Acetaldehyde				
2035	2,273	35	35	33
2050	1,420	41	41	42
Acrolein				
2035	128	2	2	2
2050	78	2	2	2
Benzene				
2035	8,335	127	127	120
2050	5,309	175	175	173
1,3-Butadiene				
2035	846	12	12	12
2050	534	15	15	16
Diesel particulate matter (DPM)				
2035	55,690	949	949	882
2050	48,030	1,380	1,380	1,251
Formaldehyde				
2035	1,763	33	33	31
2050	1,108	42	42	41

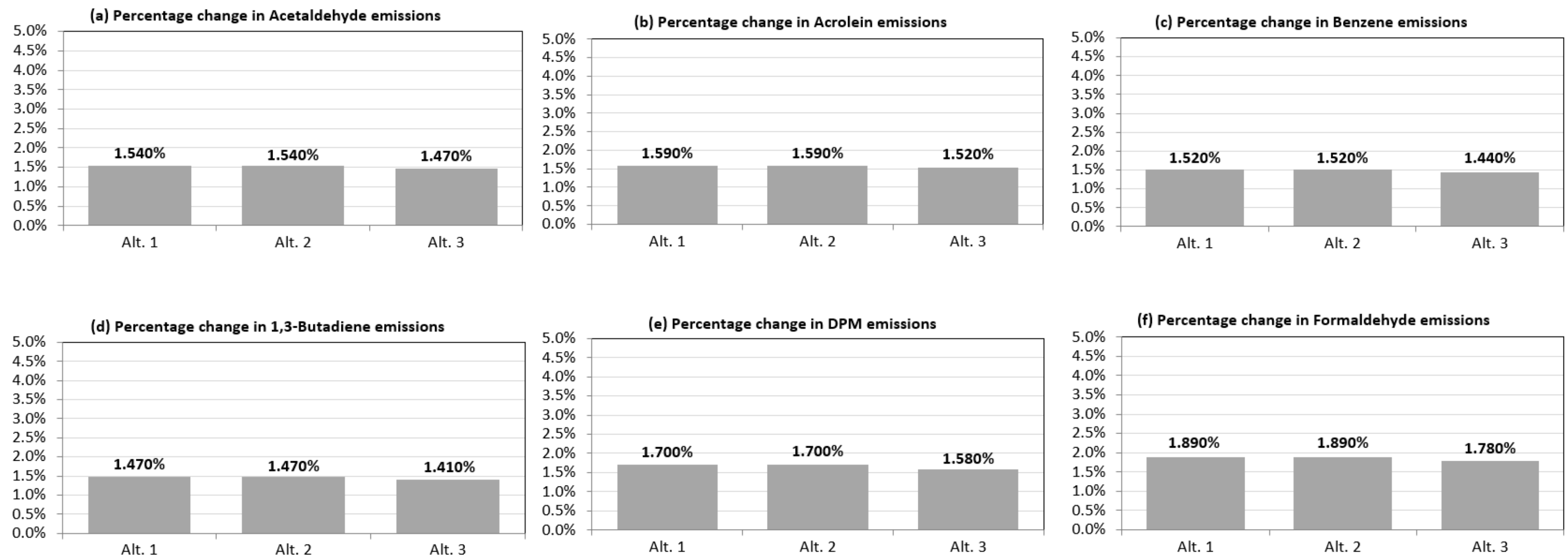
Notes:
[a] Impacts have been rounded to the nearest whole number.
[b] Negative values indicate emissions decreases; positive values indicate emissions increases.

The largest relative increases in emissions (as a percentage) occur for formaldehyde for which emissions would increase by as much as 3.8 percent under Alternatives 1 and 2 (Preferred Alternative) in 2050 compared to the No-Action Alternative (Table 4.2.2-1). Percentage

[23] Downstream emissions do not include evaporative emissions from vehicle fuel systems due to modeling limitations.

increases in emissions of acetaldehyde, acrolein, 1,3-butadiene, benzene, and DPM would be less. These trends are accounted for by the extent of technologies assumed to be deployed under the different action alternatives to meet the different levels of fuel-economy requirements. Figure 4.2.2-1 compares the percentage differences in MSAT emissions for each alternative in 2035.

Figure 4.2.2-1. Nationwide Percentage Changes in Mobile Source Air Toxic Emissions from U.S. Passenger Cars and Light Trucks for 2035 by Action Alternative Compared to the No-Action Alternative, Proposed Action Impacts



Notes:
The vertical (percentage) scale differs by pollutant.
Negative values indicate emissions decreases; positive values indicate emissions increases.
DPM = diesel particulate matter.

As with criteria pollutant emissions, total MSAT emissions consist of four components: two sources of emissions (downstream [i.e., tailpipe emissions] and upstream) for each of the two vehicle classes covered by the standards (passenger cars and light trucks). Table 4.2.2-2 shows the total emissions of MSATs under the No-Action Alternative and the change in emissions by alternative (relative to the No-Action Alternative in the same year) broken out by these four components for calendar year 2035 (i.e., cars tailpipe, cars upstream, trucks tailpipe, and trucks upstream).

Table 4.2.2-2. Nationwide Mobile Source Air Toxic Emissions (tons per year) in 2035 from U.S. Passenger Cars and Light Trucks, by Emissions Component for the No-Action Alternative, and Change in Emissions by Action Alternative, Proposed Action Impacts [a,b,c]

Emissions Component	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)
Acetaldehyde				
Cars tailpipe	755	332	332	332
Cars upstream	17	12	12	12
Trucks tailpipe	1,457	-299	-299	-301
Trucks upstream	44	-9	-9	-10
Tailpipe subtotal (cars + trucks)	*2,212*	*33*	*33*	*31*
Upstream subtotal (cars + trucks)	*61*	*3*	*3*	*2*
Total (tailpipe + upstream)	**2,273**	**35**	**35**	**33**
Acrolein				
Cars tailpipe	41	17	17	17
Cars upstream	2	2	2	2
Trucks tailpipe	79	-15	-15	-15
Trucks upstream	6	-1	-1	-1
Tailpipe subtotal (cars + trucks)	*120*	*2*	*2*	*2*
Upstream subtotal (cars + trucks)	*8*	*1*	*1*	*1*
Total (tailpipe + upstream)	**128**	**2**	**2**	**2**
Benzene				
Cars tailpipe	2,570	956	956	957
Cars upstream	311	221	221	221
Trucks tailpipe	4,646	-869	-869	-873
Trucks upstream	808	-181	-181	-184
Tailpipe subtotal (cars + trucks)	*7,216*	*87*	*87*	*84*
Upstream subtotal (cars + trucks)	*1,119*	*40*	*40*	*37*
Total (tailpipe + upstream)	**8,335**	**127**	**127**	**120**
1,3-Butadiene				
Cars tailpipe	290	132	132	132
Cars upstream	2	1	1	1
Trucks tailpipe	550	-120	-120	-120
Trucks upstream	4	-1	-1	-1
Tailpipe subtotal (cars + trucks)	*840*	*12*	*12*	*12*
Upstream subtotal (cars + trucks)	*6*	*0*	*0*	*0*
Total (tailpipe + upstream)	**846**	**12**	**12**	**12**

Emissions Component	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)
Diesel particulate matter (DPM)				
Cars tailpipe	9	0	0	0
Cars upstream	16,677	11,030	11,030	11,034
Trucks tailpipe	45	1	1	1
Trucks upstream	38,960	-10,082	-10,082	-10,153
Tailpipe subtotal (cars + trucks)	*54*	*1*	*1*	*1*
Upstream subtotal (cars + trucks)	*55,637*	*948*	*948*	*881*
Total (tailpipe + upstream)	**55,690**	**949**	**949**	**882**
Formaldehyde				
Cars tailpipe	449	176	176	176
Cars upstream	123	88	88	88
Trucks tailpipe	868	-159	-159	-160
Trucks upstream	323	-72	-72	-73
Tailpipe subtotal (cars + trucks)	*1,317*	*17*	*17*	*16*
Upstream subtotal (cars + trucks)	*446*	*16*	*16*	*15*
Total (tailpipe + upstream)	**1,763**	**33**	**33**	**31**

Notes:
[a] Impacts have been rounded to the nearest whole number.
[b] Negative values indicate emissions decreases; positive values indicate emissions increases.
[c] Totals may not sum due to rounding.

The differences in national emissions of MSATs among the action alternatives compared to the No-Action Alternative would range from slight (2 percent or less) to almost 4 percent due to the similar interactions of the multiple factors described for criteria pollutants. These differences are not expected to lead to measurable changes in concentrations of MSATs in the ambient air. For such small changes, the impacts of those action alternatives would be essentially equivalent.

4.2.2.2 Nonattainment Areas

EPA has not designated nonattainment areas for MSATs. To provide a regional perspective, changes in MSAT emissions were evaluated for areas that are in nonattainment for criteria pollutants. For each pollutant, Table 4.2.2-3 lists the nonattainment areas in which the maximum increases in emissions would occur.[24] In 2035 and 2050, emissions of acetaldehyde, acrolein, benzene, 1,3-butadiene, DPM, and formaldehyde would increase under all action alternatives in all nonattainment areas compared to the No-Action Alternative. The increases would not be uniformly distributed to individual nonattainment areas.

[24] EPA has not established NAAQS for airborne toxics. Therefore, none of these areas is classified as a nonattainment area because of airborne toxics emissions. MSAT emissions data for nonattainment areas are provided for information only.

Table 4.2.2-3. Maximum Changes in Mobile Source Air Toxic Emissions (tons per year) from U.S. Passenger Cars and Light Trucks across All Nonattainment or Maintenance Areas, Alternatives, and Years, Proposed Action Impacts [a]

Air Toxic	Maximum Increase/ Decrease	Emissions Change (tons per year)	Year	Alternative	Nonattainment or Maintenance Area (NAAQS Standard[s])
Acetaldehyde	Maximum increase	2	2050	Alt. 3	Los Angeles-South Coast Air Basin, CA [CO (1971 8-hour); NO_2 (1971 Annual); Ozone (2008 8-hour); Ozone (2015 8-hour); PM2.5 (2006 24-hour); PM2.5 (2012 Annual)]
	Maximum decrease	0	No decreases are predicted for any years or alternatives		None
Acrolein	Maximum increase	0.09	2050	Alt. 3	Los Angeles-South Coast Air Basin, CA [CO (1971 8-hour); NO_2 (1971 Annual); Ozone (2008 8-hour); Ozone (2015 8-hour); PM2.5 (2006 24-hour); PM2.5 (2012 Annual)]
	Maximum decrease	0	No decreases are predicted for any years or alternatives		None
Benzene	Maximum increase	6	2050	Alt. 3	Los Angeles-South Coast Air Basin, CA [CO (1971 8-hour); NO_2 (1971 Annual); Ozone (2008 8-hour); Ozone (2015 8-hour); PM2.5 (2006 24-hour); PM2.5 (2012 Annual)]
	Maximum decrease	0	No decreases are predicted for any years or alternatives		None
1,3-Butadiene	Maximum increase	0.7	2050	Alt. 3	Los Angeles-South Coast Air Basin, CA [CO (1971 8-hour); NO_2 (1971 Annual); Ozone (2008 8-hour); Ozone (2015 8-hour); PM2.5 (2006 24-hour); PM2.5 (2012 Annual)]
	Maximum decrease	0	No decreases are predicted for any years or alternatives		None
Diesel particulate matter (DPM)	Maximum increase	106	2050	Alt. 1, Alt. 2	Houston-Galveston-Brazoria, TX [Ozone (2008 8-hour); Ozone (2015 8-hour)]
	Maximum decrease	0	No decreases are predicted for any years or alternatives		None
Formaldehyde	Maximum increase	1	2050	Alt. 3	Los Angeles-South Coast Air Basin, CA [CO (1971 8-hour); NO_2 (1971 Annual); Ozone (2008 8-hour); Ozone (2015 8-hour); PM2.5 (2006 24-hour); PM2.5 (2012 Annual)]
	Maximum decrease	0	No decreases are predicted for any years or alternatives		None

Notes:
[a] Changes have been rounded to the nearest whole number.
NAAQS = National Ambient Air Quality Standards; CO = carbon monoxide; NO_2 = nitrogen dioxide; PM2.5 = particulate matter 2.5 microns or less in diameter.

4.2.3 Health Effects

Adverse nationwide health effects from criteria pollutant emissions are expected to increase slightly in 2035 and increase in 2050 under all action alternatives relative to the No-Action Alternative.[25] This is due primarily to increases in the downstream emissions of NO_X, SO_2, and particularly PM2.5 in these years under each action alternative relative to the No-Action Alternative. Information on the PM-related health effects per ton of emissions is available in the Emission Health Impacts worksheet in the CAFE Model parameters Excel file, which can be found in the NHTSA EIS docket (Docket No. NHTSA-2025-0490) by filtering for Supporting & Related Material. As shown by these incidence-per-short-ton estimates, the health effects per ton of emissions are substantially larger for downstream emissions than upstream emissions, and substantially larger for PM2.5 emissions than NO_X and SO_2 emissions.

The increases in health effects would stay the same or get slightly smaller from Alternatives 1 and 2 (Preferred Alternative) to Alternative 3 in 2035 and 2050, reflecting the generally greater stringency of Alternative 3. As discussed in Appendix E, Section E.2.1.6, *Health Impacts*, the values in Table 4.2.3-1 are nationwide averages. These values account for impacts of upstream and downstream emissions separately but do not reflect localized variations in emissions, meteorology and topography, and population characteristics.[26]

Under any alternative, total criteria pollutant emissions from passenger cars and light trucks are expected to decrease substantially by 2050 compared to the near-term forecast year (2035) conditions (Table 4.2.1-1). As a result, under any alternative, the total health effects of emissions from passenger cars and light trucks are expected to decrease over time compared to existing conditions. However, under any alternative, the total health effects of emissions from passenger cars and light trucks are expected to increase compared to the No-Action Alternative in the same year (Table 4.2.3-1). The increases are slight in 2035 but get larger in 2050, reflecting the increasing proportion of VMT accounted for by vehicles subject to proposed CAFE standards.

Table 4.2.3-1. Nationwide Changes in Health Effects (cases per year) from Criteria Pollutant Emissions from U.S. Passenger Cars and Light Trucks by Alternative, Proposed Action Impacts [a,b,c]

Year	No-Action	Alt. 1	Alt. 2	Alt. 3
Premature mortality (Krewski et al. 2009)				
2035	0	23	23	22
2050	0	38	38	37

[25] The CAFE Model computes select health impacts resulting from population exposure to PM2.5 associated with emissions from directly emitted PM and two precursors to PM2.5 (NO_X and SO_2). The CAFE Model reports total PM2.5-related health impacts by multiplying the estimated tons of each PM2.5-related pollutant (in tons) by the corresponding health incidence per ton value. The CAFE Model health impacts inputs are based partially on the structure of EPA's 2018 TSD, *Estimating the Benefit per Ton of Reducing PM2.5 Precursors from 17 Sectors* (referred to here as the 2018 EPA source apportionment TSD). NHTSA includes additional discussion of uncertainties in the Benefit Per Ton approach in Appendix E, Section E.2.1.6, *Health Impacts*.

[26] As discussed in Appendix E, Section E.2.1.6, *Health Impacts*, NHTSA's analysis quantifies the health effects of PM2.5, DPM, and precursor emissions (NO_X and SO_2). However, sufficient data are not available for NHTSA to quantify the health effects of exposure to other pollutants (EPA 2024c).

Year	No-Action	Alt. 1	Alt. 2	Alt. 3
Emergency room visits: respiratory				
2035	0	14	14	14
2050	0	23	23	22
Acute bronchitis				
2035	0	37	37	35
2050	0	58	58	56
Lower respiratory symptoms				
2035	0	466	466	446
2050	0	735	735	711
Upper respiratory symptoms				
2035	0	665	665	636
2050	0	1,044	1,044	1,010
Minor restricted activity days				
2035	0	20,530	20,530	19,605
2050	0	31,400	31,400	30,391
Work-loss days				
2035	0	3,485	3,485	3,328
2050	0	5,345	5,345	5,173
Asthma exacerbation				
2035	0	781	781	747
2050	0	1,226	1,226	1,187
Hospital admissions: cardiovascular				
2035	0	6	6	6
2050	0	10	10	10
Hospital admissions: respiratory				
2035	0	6	6	5
2050	0	10	10	9
Non-fatal heart attacks (Peters et al. 2001)				
2035	0	24	24	23
2050	0	40	40	39
Non-fatal heart attacks (All others)				
2035	0	3	3	2
2050	0	4	4	4

Notes:

[a] Negative changes indicate fewer health effects; positive changes indicate additional health effects.

[b] Changes for the No-Action Alternative are shown as zero because the No-Action Alternative is the reference baseline to which the action alternatives are compared.

[c] Effects have been rounded to the nearest whole number.

CHAPTER 5 NON-CRITERIA EMISSIONS

This chapter describes how the Proposed Action and alternatives potentially would affect future climate trends, comparing projected increases in non-criteria emissions (NCEs) from the Proposed Action and alternatives with NCEs from the No-Action Alternative.[1]

5.1 Introduction

This Draft SEIS draws primarily on panel-reviewed synthesis and assessment reports to describe the affected environment and contextualize environmental consequences because these reports assess numerous individual studies to draw general conclusions about the state of climate science and potential impacts of climate trends.[2] Even where assessment reports include consensus conclusions of expert authors, uncertainty still exists,[3] as with all assessments of environmental impacts. For this reason, NHTSA relies on methods and data to analyze climate trends that represent the most relevant current information available on this topic and that have been subjected to extensive peer review and scrutiny, including by supplementing discussions from synthesis reports with more recent standalone peer-reviewed literature. As discussed further in Appendix E, Section E.3.1, *Uncertainty in Climate Modeling*, the potential climate impacts of the Proposed Action and alternatives involve uncertainty inherent in all projections of future climate conditions and cannot reliably be determined with complete accuracy.

NHTSA prepared this Draft SEIS in line with the Supreme Court's recent decision in *Seven County Infrastructure Coalition v. Eagle County, Colorado* and its progeny.[4] Agencies are granted substantial deference to determine the scope of the environmental impacts that they address and may decide to evaluate environmental impacts from separate projects upstream or downstream from this action. Any analysis of the environmental impacts of a regulatory action

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[1] Throughout this Draft SEIS, the term *non-criteria emissions* (NCEs) refers specifically to carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride, which are not classified as criteria pollutants under the Clean Air Act.

[2] Panel-reviewed synthesis and assessment reports include those from the Intergovernmental Panel on Climate Change (IPCC) and the U.S. Global Change Research Program (GCRP), supplemented with past reports from the U.S. Climate Change Science Program (CCSP), the National Research Council (NRC), and the Arctic Council. IPCC data and projections inevitably carry substantial uncertainties due to the complexities of climate modeling and limitations in observational records. All climate models inherently make numerous assumptions, all of which introduce additional uncertainty and variability in projected outcomes.

[3] When an agency is evaluating an action's reasonably foreseeable impacts on the human environment and there is incomplete or unavailable information that cannot be obtained at a reasonable cost or the means to obtain it are unknown, the agency will make clear in the relevant environmental document that such information is lacking. Assessing climate trend impacts involves uncertainty, including with regard to discrete and localized impacts. Given the nature of climate trends and the need to communicate uncertainty to a variety of decision-makers, NHTSA uses a system included in various assessment reports to describe uncertainty associated with climate trend impacts. For a more detailed discussion on this topic see the Final Environmental Impact Statement for Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks, Model Years 2027 and Beyond, and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans, Model Years 2030 and Beyond, Appendix F, Section F.1.1, *Uncertainty in the IPCC Framework* (NHTSA 2024).

[4] *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).

that will be implemented several years in the future, the benefits and costs of which would evolve over decades, requires many assumptions. Further, given the nature of the state of climate science and literature, any forecasts of climate trends are subject to uncertainty. Accordingly, the discussion in this chapter involves many assumptions and uncertainties. While NHTSA is not required to assess impacts that are not a direct result of changes in CAFE standards and has determined that analyses of such impacts are not necessary or too uncertain for reasoned decision-making, the agency nonetheless provides discussions solely for informational purposes.

5.2 Affected Environment

NCEs are generated as a direct byproduct of fuel combustion in a vehicle's engine and those NCEs are emitted from vehicle tailpipes into the environment. This section describes the environmental resources that NHTSA has determined would be affected by the CAFE rulemaking in consideration of the current and anticipated trends in NCEs and climate.[5,6] NCEs refer to emissions of gaseous constituents, both natural and anthropogenic, that absorb and re-emit terrestrial infrared radiation. Examples of such gaseous constituents include water vapor, carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and ozone. NCEs trap heat in the lower atmosphere (the atmosphere extending from Earth's surface to approximately 4 to 12 miles above the surface), absorb heat energy emitted by Earth's surface and lower atmosphere, and reradiate much of it back to Earth's surface rather than allowing it to return to space as terrestrial infrared radiation.

5.3 Environmental Consequences: Reasonably Foreseeable Impacts from the Proposed Action

This section describes projected impacts from the Proposed Action and alternatives relative to the No-Action Alternative on relevant climate metrics, using the methods described in Appendix E, *Air Quality and NCE Methodology and Other Information*. While NHTSA is not required to assess impacts that are not a direct result of changes in CAFE standards and has determined that analyses of environmental impacts that could occur from other actions in combination with the Proposed Action and alternatives are not necessary for reasoned decision-making, the agency nonetheless provides such discussions in Appendix E, Section E.3.4, *Environmental Consequences: Other Associated Potential Impacts,* solely for informational purposes.

[5] Climate trends include long-term (i.e., multi-decadal) trends in global average surface temperature, precipitation, ice cover, sea level, cloud cover, sea surface temperatures and currents, and other climate conditions, driven by factors including NCEs, aerosols, clouds, ozone, solar radiation, and surface changes (e.g., changes in vegetation, snow or ice cover, ocean color).

[6] For more discussion of data and trends in key climate attributes, see the Final Environmental Impact Statement for Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks, Model Years 2027 and Beyond, and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans, Model Years 2030 and Beyond, Appendix F (NHTSA 2024).

5.3.1 Non-Criteria Emissions

Using the methods described in Appendix E, Section E.3.2, *Methods for Modeling Emissions,* NHTSA estimated projected emissions increases of U.S. light-duty (LD) vehicles in use under the No-Action Alternative and each action alternative for 2027 through 2100. The projected change in fuel production and use under each alternative determines the resulting impacts on total energy use and petroleum consumption, which, in turn, determines the increase in CO_2 emissions under each alternative.[7] For all results presented in this chapter, starting with MY 2027, vehicle manufacturers are assumed to offer vehicles using nearly the same fuel economy technologies under either Alternative 1 or Alternative 2 (Preferred Alternative); therefore, the results are the same for both alternatives.

Table 5.3.1-1 and Figure 5.3.1-1 show total U.S. LD vehicle CO_2 emissions under the No-Action Alternative and emissions increases that would result from the Proposed Action and alternatives from 2027 to 2100. All action alternatives would result in higher CO_2 emissions than the No-Action Alternative because all action alternatives involve less stringent standards than the No-Action Alternative. LD vehicle emissions increase by up to 3,400 million metric tons of carbon dioxide ($MMTCO_2$) under Alternatives 1 and 2 (Preferred Alternative) compared to 69,400 $MMTCO_2$ under the No-Action Alternative. Compared to the total U.S. emissions projection of 619,064 $MMTCO_2$ over this period in the global emissions reference scenario, increases would be approximately 0.5 percent from projected levels. Compared to the global emissions reference scenario projection of 4,991,547 $MMTCO_2$ over this period, slight increases from the action alternatives would range from approximately 0.06 to 0.07 percent from projected levels.

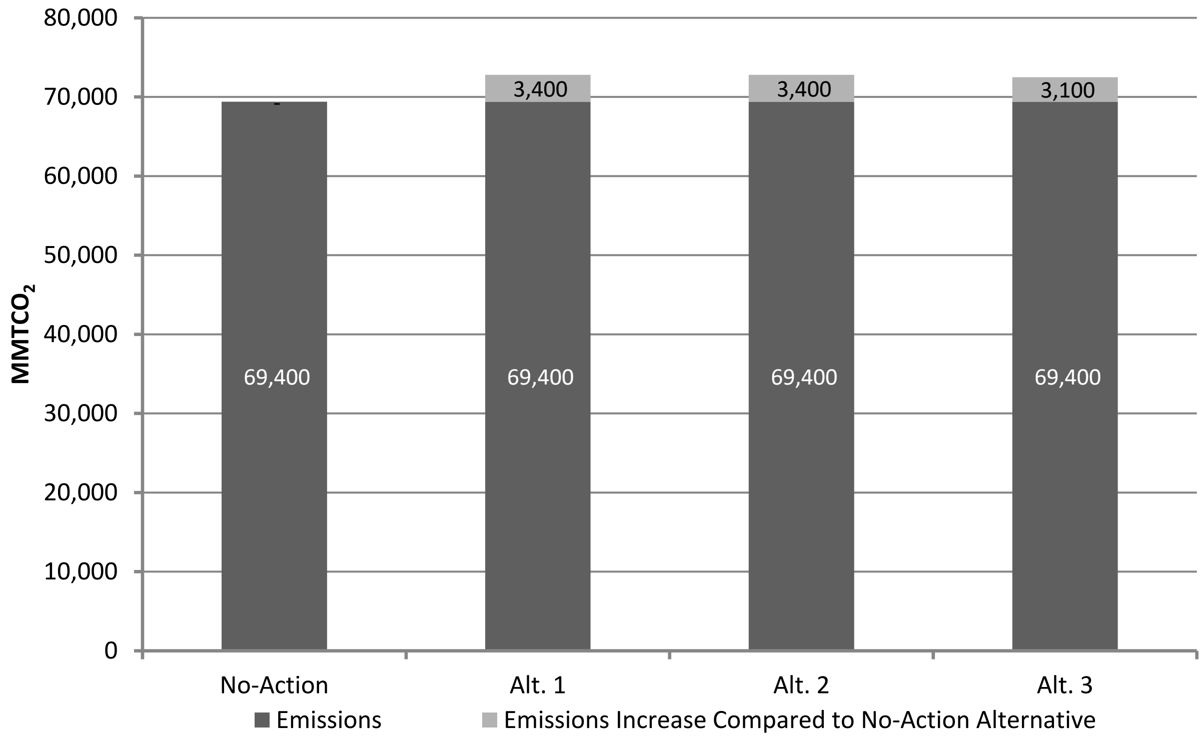
Table 5.3.1-1. Carbon Dioxide Emissions and Emissions Increases ($MMTCO_2$) from All Light-Duty Vehicles, 2027 to 2100, by Alternative [a]

Alternative	Total Emissions	Emissions Increases Compared to No-Action Alternative	Percent Emissions Increases Compared to No-Action Alternative Emissions	Percent Emissions Increases Compared to Cumulative U.S. Emissions	Percent Emissions Increases Compared to Cumulative Global Emissions
No-Action	69,400	-	-	-	-
Alt. 1	-	3,400	4.90%	0.55%	0.07%
Alt. 2	-	3,400	4.90%	0.55%	0.07%
Alt. 3	-	3,100	4.47%	0.50%	0.06%

Notes:
[a] The numbers in this table have been rounded for presentation purposes. As a result, the values do not reflect the exact differences between the values.
$MMTCO_2$ = million metric tons of carbon dioxide.

[7] Because CO_2 accounts for such a large fraction of total NCEs emitted during fuel production and use—more than 95 percent, even after accounting for the higher global warming potentials of other NCEs—NHTSA's consideration of NCE impacts focuses on increases in CO_2 emissions expected under the Proposed Action and alternatives. However, in assessing the Proposed Action impacts and other action impacts on climate indicators, NHTSA incorporates increases of all NCEs by the nature of the models used to project changes in the relevant climate indicators.

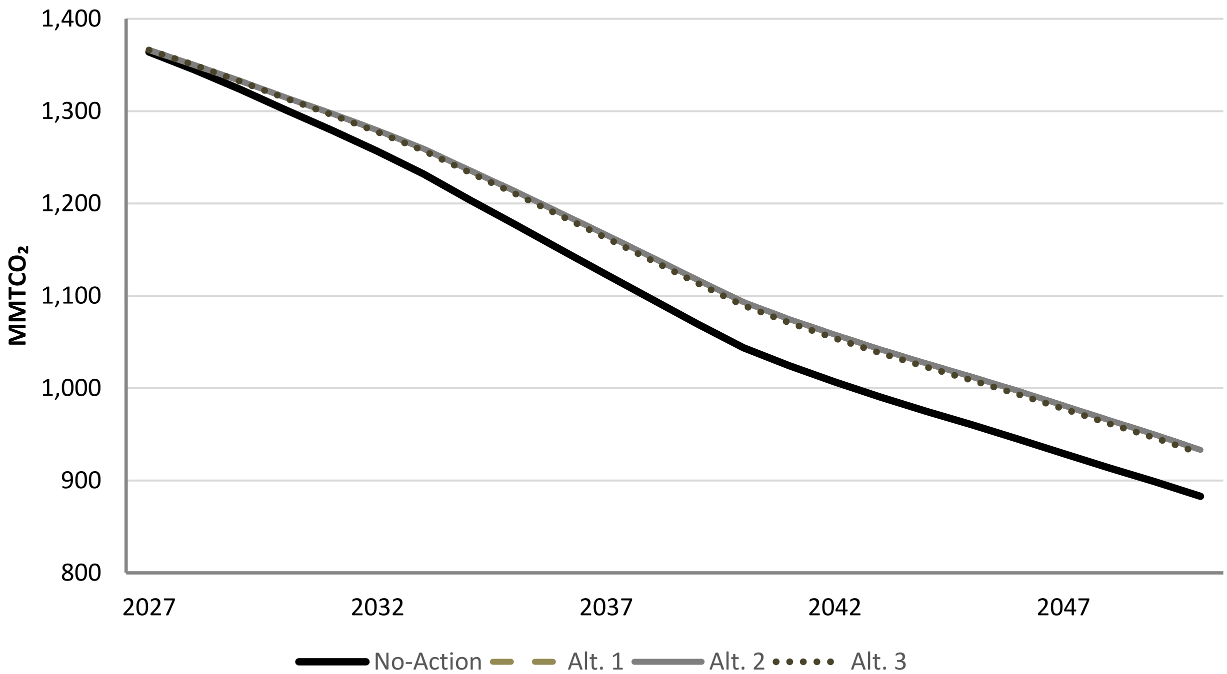
Figure 5.3.1-1. Carbon Dioxide Emissions and Emissions Increases ($MMTCO_2$) from All Light-Duty Vehicles, 2027 to 2100, by Alternative



$MMTCO_2$ = million metric tons of carbon dioxide.

LD vehicles currently account for 20.0 percent of CO_2 emissions in the United States. The action alternatives would increase total CO_2 emissions from U.S. LD vehicles by a range of 4.5 to 4.9 percent from 2027 to 2100 compared to the No-Action Alternative. Compared to annual U.S. CO_2 emissions of 9,478 $MMTCO_2$ from all sources at the end of the century projected by the global emissions reference scenario, the action alternatives would slightly increase total U.S. CO_2 emissions in the year 2100 by roughly 0.5 percent. Figure 5.3.1-2 shows the projected annual emissions from LD vehicles under the alternatives.

Figure 5.3.1-2. Projected Annual Carbon Dioxide Emissions ($MMTCO_2$) from All Passenger Cars and Light Trucks by Alternative



$MMTCO_2$ = million metric tons of carbon dioxide.

Table 5.3.1-2 shows that the Proposed Action and alternatives would increase LD vehicle emissions of CO_2, CH_4, and N_2O from their projected levels under the No-Action Alternative. Of the action alternatives, Alternatives 1 and 2 (Preferred Alternative) would result in the greatest emissions increases.

Table 5.3.1-2. Emissions of Non-Criteria Emissions ($MMTCO_2e$ per year) from All Passenger Cars and Light Trucks for the No-Action Alternative, and Change in Emissions by Alternative [a,b]

NCEs and Year	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)
Carbon dioxide (CO_2)				
2020	1,488	-	-	-
2040	1,044	49	49	46
2060	878	50	50	46
2080	872	50	50	46
2100	811	46	46	43
Methane (CH_4)				
2020	55	-	-	-
2040	39	2	2	2
2060	33	2	2	2
2080	32	2	2	2
2100	30	2	2	1

NCEs and Year	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)
Nitrous oxide (N_2O)				
2020	17	-	-	-
2040	11	0	0	0
2060	10	0	0	0
2080	9	0	0	0
2100	9	0	0	0
Total (all NCEs)				
2020	1,560	-	-	-
2040	1,094	52	52	48
2060	921	52	52	48
2080	914	52	52	48
2100	850	48	48	45

Notes:
[a] Emissions from 2051 to 2100 were scaled using the rate of change for the U.S. transportation fuel consumption from the global emissions reference scenario. These assumptions project a slight decline over this period. Totals may not sum due to independent rounding.
[b] Values reported as '–' indicate zero. Values reported as 0 represent amounts greater than 0 but less than 0.5. The numbers in this table have been rounded for presentation purposes. As a result, the values do not reflect the exact differences between the values.
$MMTCO_2e$ = million metric tons of carbon dioxide equivalent; NCEs = non-criteria emissions.

5.3.1.1 Comparison to Annual Emissions from Light-Duty Vehicles

The emissions increases under the action alternatives would be equivalent to the annual emissions from 7,143,671 LD vehicles (Alternative 3) to 7,727,819 LD vehicles (Alternatives 1 and 2 [Preferred Alternative]) in 2035, compared to the annual emissions under the No-Action Alternative. A total of 252,733,312 LD vehicles are projected to be on the road in 2035 under the No-Action Alternative.[8,9]

5.3.2 Impacts from the Proposed Action on Climate Indicators

This section describes the impacts of the Proposed Action and alternatives on five relevant climate trend indicators. The impacts of the Proposed Action and alternatives on these indicators would be small compared to the expected changes associated with the emissions trajectories in the global emissions reference scenario. The Model for the Assessment of Greenhouse Gas-Induced Climate Change (MAGICC) is a reduced-complexity climate model to which the modeling results from the analysis have been compared. The results from MAGICC7

[8] Values for vehicle totals have been rounded.

[9] The LD 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 LD vehicle is projected to account for 4.66 $MMTCO_2$ emissions in 2035 based on MOVES, the GREET model, and EPA analysis.

show close alignment with the results.[10] As discussed further in Appendix E, Section E.3.1, *Uncertainty in Climate Modeling*, the potential climate impacts of the Proposed Action and alternatives involve uncertainty inherent in all projections of future climate conditions and cannot reliably be determined with complete accuracy. For more information, see Appendix E, *Air Quality and NCE Methodology and Other Information*.

As discussed in Appendix E, Section E.3.3.5, *Global Emissions Scenarios*, NHTSA selected a global emissions reference scenario to represent the No-Action Alternative in the MAGICC modeling runs. The CO_2 concentrations increase by 0.30 parts per million (ppm) under Alternative 3 and by 0.32 ppm under Alternatives 1 and 2 (Preferred Alternative) compared to the No-Action Alternative in 2100 (Table 5.3.2-1). For 2040 and 2060, the corresponding range of ppm differences across alternatives is even smaller. Because CO_2 concentrations are the key determinant of other climate impacts, this leads to very small differences in these impacts.

Table 5.3.2-1. Changes in Carbon Dioxide Concentrations, Global Mean Surface Temperature, Sea-Level Rise, and Ocean pH by Alternative [a]

	CO_2 Concentration (ppm)			Global Mean Surface Temperature (°C) [b,c]			Sea-Level Rise (cm) [b,c]			Ocean pH [c]		
	2040	2060	2100	2040	2060	2100	2040	2060	2100	2040	2060	2100
No-Action [d]	-0.01	-0.02	-0.04	-0.000	-0.000	-0.000	-0.00	-0.00	-0.00	0.0000	0.0000	0.0000
Alt. 1	0.04	0.13	0.32	0.000	0.001	0.001	0.00	0.01	0.03	-0.0000	-0.0001	-0.0002
Alt. 2	0.04	0.13	0.32	0.000	0.001	0.001	0.00	0.01	0.03	-0.0000	-0.0001	-0.0002
Alt. 3	0.03	0.12	0.30	0.000	0.001	0.001	0.00	0.00	0.02	-0.0000	-0.0001	-0.0001

Notes:
[a] The numbers in this table have been rounded for presentation purposes. As a result, the values might not reflect the exact difference of the values in all cases.
[b] The values for global mean surface temperature and sea-level rise are relative to the average of the years 1986 to 2005.
[c] Values reported as 0.00, 0.000, or 0.0000 are greater than zero. Values reported as -0.00, -0.000, or -0.0000 are less than zero.
[d] Values for the No-Action Alternative represent the difference between the Preferred Alternative (PC2LT002) and the No-Action Alternative in the Final Environmental Impact Statement for Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks, Model Years 2027 and Beyond, and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans, Model Years 2030 and Beyond (NHTSA 2024). NHTSA's Proposed Action also includes proposed changes to its vehicle classification regulations starting in MY 2028, which reconsiders how light trucks are classified; therefore, the two data sets used here will differ in the types of vehicles included. See Section VI of the proposed rule preamble and Chapter 3 of the PRIA for additional detail regarding the effect of NHTSA's proposed fleet reclassification.
°C = degrees Celsius; cm = centimeters; CO_2 = carbon dioxide; ppm = parts per million.

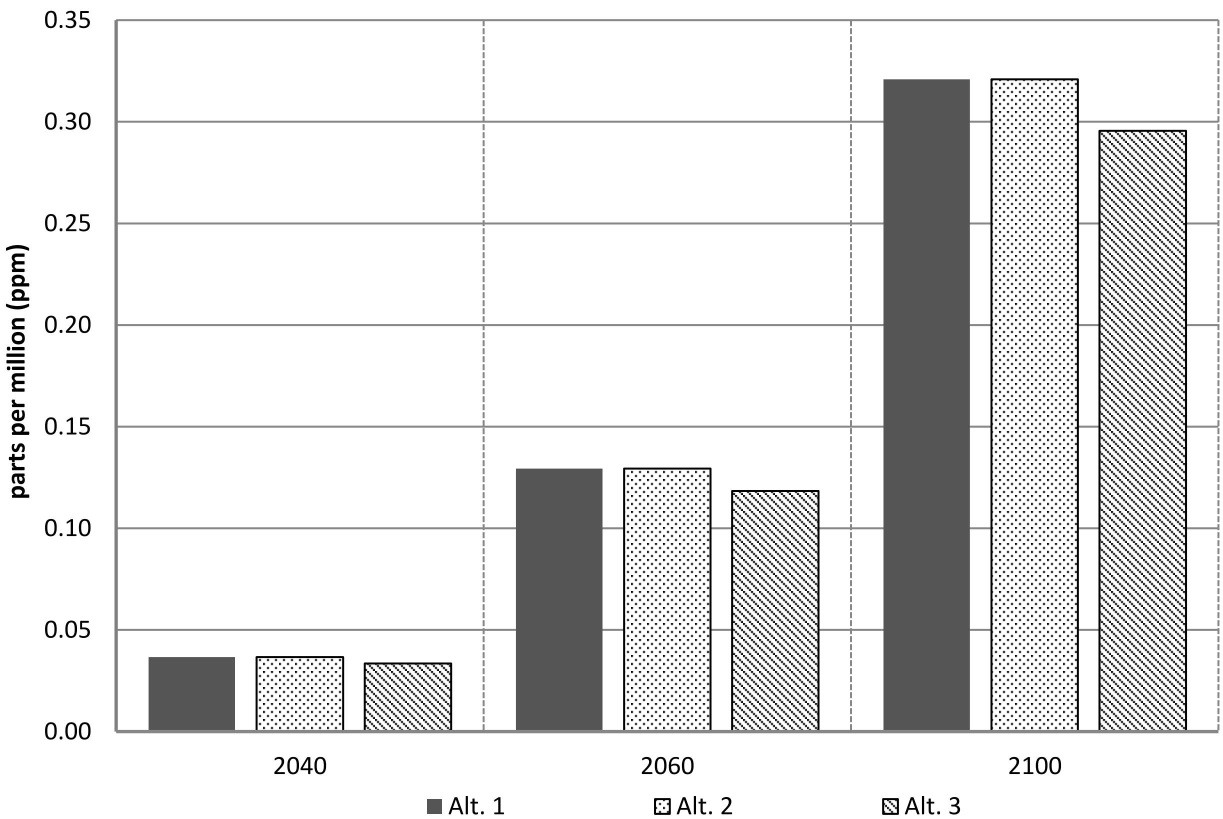
5.3.2.1 Atmospheric Carbon Dioxide Concentrations

As Figure 5.3.2-1 shows, the slight increase in projected CO_2 concentrations under the Proposed Action and alternatives compared to the No-Action Alternative amounts to a very small fraction of the projected total increases in CO_2 concentrations. As shown in Figure 5.3.2-1, the slight

[10] MAGICC7 is the version of MAGICC used in this analysis, which incorporates the latest science and is calibrated to the mean of the multi-model ensemble results for the Shared Socioeconomic Pathway scenarios.

increase in CO_2 concentrations by 2100 under Alternatives 1 and 2 (Preferred Alternative) compared to the No-Action Alternative is slightly larger than that of Alternative 3.

Figure 5.3.2-1. Increases in Atmospheric Carbon Dioxide Concentrations (ppm) Compared to the No-Action Alternative



5.3.2.2 Changes in Climate Attributes

This section presents an overview of the impacts on climate attributes of temperature, sea-level rise, precipitation, and ocean pH.[11]

Temperature[12]

The differences among the increases in global surface air temperature projected to result from the various action alternatives are small compared to total projected temperature increases.

[11] For informational purposes, see also the Final Environmental Impact Statement for Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks, Model Years 2027 and Beyond, and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans, Model Years 2030 and Beyond, Appendix F, Section F.3, *Climate Change Trends* (NHTSA 2024).

[12] Because the actual increase in global mean surface temperature lags behind the *commitment to warming* (i.e., the extra warming already locked in by past emissions, which will show up gradually because the climate system reacts slowly), the impact on global mean surface temperature increase is less than the impact on the long-term commitment to warming. The

The slight temperature increases compared to the No-Action Alternative are all approximately 0.001°C (0.002°F) under each action alternative by 2100 (Table 5.3.2-1).

The Proposed Action and alternatives would also be expected to increase slightly regional impacts in proportion to increases in global mean surface temperature increases. However, more specific quantification is not possible because of the limitations of existing climate models.[13]

Sea-Level Rise

Global sea-level rise is the result of changes in both thermal expansion due to warming and ice loss on land from changes in the cryosphere (e.g., melting of glaciers and the Antarctic and Greenland ice sheets) and land-water storage (e.g., surface water, soil moisture and groundwater storage) (IPCC 2021a; DOE 2025a). Ocean circulation, changes in atmospheric pressure, and geological processes can also influence sea-level rise at a regional scale (IPCC 2021b). Mean sea-level rise has been projected for each of the global emissions scenarios (Sixth Assessment Report of the United Nations Intergovernmental Panel on Climate Change [IPCC AR6]).[14,15]

Some assessments confirm that it is virtually certain that global mean sea level will continue to rise through 2100 (IPCC 2021a). By the year 2100, sea level is likely to rise 28 to 55 centimeters (11 to 21.7 inches) under the Shared Socioeconomic Pathway (SSP)1-1.9 emissions scenario and 63 to 102 centimeters (24.8 to 40.2 inches) for the SSP5-8.5 emissions scenario.[16]

The analysis shows a maximum increase in sea-level rise of slightly less than 0.03 centimeter (0.012 inch) by 2100 under the action alternatives compared to the No-Action Alternative (Table 5.3.2-1).

Precipitation

In some areas, the increase in energy available to the hydrologic cycle is expected to increase precipitation. Increases in precipitation result from higher temperatures causing more water evaporation, which causes more water vapor to be available for precipitation (IPCC 2021b).

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actual increase in surface temperature lags behind the commitment primarily due to the time required to heat the ocean to the level committed by the concentrations of the NCEs.

[13] For a qualitative review of how the CAFE standards would affect temperature in different regions, readers may consult Section 5.4.1.2 of Final Environmental Impact Statement for Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks, Model Years 2027 and Beyond, and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans, Model Years 2030 and Beyond (NHTSA 2024), as there have been minimal changes in the time since publishing.

[14] As noted in Appendix E*, Air Quality and NCE Methodology and Other Information,* NHTSA has used the relationship between the sea-level rise and temperature increases for each of the scenarios from IPCC AR6 to project sea-level rise in this Draft SEIS.

[15] IPCC data and projections inevitably carry substantial uncertainties due to the complexities of climate modeling and limitations in observational records. All climate models inherently make numerous assumptions, all of which introduce additional uncertainty and variability in projected outcomes.

[16] IPCC data and projections inevitably carry substantial uncertainties due to the complexities of climate modeling and limitations in observational records. All climate models inherently make numerous assumptions, all of which introduce additional uncertainty and variability in projected outcomes.

Increased evaporation leads to increased precipitation in areas where surface water is sufficient, such as over oceans and lakes. In drier areas, increased evaporation can accelerate surface drying (IPCC 2021b). Overall, global mean precipitation is expected to increase under all climate scenarios (IPCC 2021a).[17]

NHTSA expects that the Proposed Action and alternatives would increase slightly anticipated changes in precipitation (i.e., in a Reference case with no NCE reduction policies) in proportion to the impacts of the alternatives on temperature.[18]

The global mean change in precipitation provided by IPCC for the SSP emissions scenarios (IPCC 2021b) is given as the scaled change in precipitation (expressed as a percentage change from 1995 to 2014 averages for SSP emissions scenarios) divided by the increase in global mean surface warming for the same period (per °C), as shown in Table 5.3.2-2. IPCC provides average scaling factors in the year range of 2006 to 2100. In the analysis of SSP emissions scenarios, NHTSA used the scaling factor for the global emissions reference scenario because it also yields an effective radiative forcing of approximately 7.0 watts per square meter (W/m^2) in the year 2100. Table 5.3.2-2 describes the mean change in precipitation for each SSP emissions scenario, ranging from an increase of 1.71 percent per °C (SSP3-7.0) to 3.05 percent per °C (SSP1-2.6).[19]

Table 5.3.2-3. Rates of Global Mean Precipitation Increase over the 21st Century, per Shared Socioeconomic Pathways Emissions Scenario

Scenario	Percent per °C [a,b]
SSP5-8.5	1.83
SSP3-7.0 (global emissions reference scenario)	1.71
SSP2-4.5	2.16
SSP1-2.6	3.05

Notes:
[a] Global percent precipitation anomalies are calculated relative to model averages over 1995–2014 for 2081–2100 from Table 4.3 in IPCC 2021a. IPCC data and projections inevitably carry substantial uncertainties due to the complexities of climate modeling and limitations in observational records. All climate models inherently make numerous assumptions, all of which introduce additional uncertainty and variability in projected outcomes.
[b] Percent per °C is calculated by evaluating the global mean precipitation change (%) relative to the global mean surface temperature change (°C) for the same scenario and period, scaled to the new reference period of 1995–2014 (IPCC 2021a).
°C = degrees Celsius.

[17] IPCC data and projections inevitably carry substantial uncertainties due to the complexities of climate modeling and limitations in observational records. All climate models inherently make numerous assumptions, all of which introduce additional uncertainty and variability in projected outcomes.

[18] MAGICC does not directly simulate changes in precipitation, and NHTSA has not undertaken precipitation modeling with a full atmospheric-ocean general circulation model (AOGCM). However, the IPCC (2021a) summary of precipitation represents the most thoroughly reviewed, credible means of producing an assessment of this highly uncertain factor.

[19] IPCC data and projections inevitably carry substantial uncertainties due to the complexities of climate modeling and limitations in observational records. All climate models inherently make numerous assumptions, all of which introduce additional uncertainty and variability in projected outcomes.

Applying these scaling factors to the increases in global mean surface warming presented in Table 5.3.2-1 provides estimates of changes in global mean precipitation. The Proposed Action and alternatives are projected to increase precipitation slightly (by less than 0.01 percent) for all alternatives based on the scaling factor from the global emissions reference scenario.

In addition to changes in mean annual precipitation, climate trends are anticipated to affect the intensity of precipitation.[20] Regional variations and changes in the intensity of precipitation cannot be further quantified.[21] The Proposed Action and alternatives would still be expected to increase the relative precipitation changes in proportion to the slight increase in global mean surface temperature rise. However, more specific quantification is not possible because of the limitations of existing models.[22]

Ocean pH

Modeling conducted for this Draft SEIS projects a slight decrease of ocean pH under each action alternative compared to the No-Action Alternative under the global emissions reference scenario for the proposed standards. Ocean pH under each of the action alternatives shows a maximum decrease in pH of 0.0002 by 2100 compared to the No-Action Alternative.

5.3.2.3 Climate Sensitivity Variations

Using the methods described in Appendix E, Section E.3.3.7, *Sensitivity Analysis*, NHTSA examined the sensitivity of projected climate impacts on key technical or scientific assumptions used in the analysis. This examination included modeling the impact of various climate sensitivities on the climate trends under the No-Action Alternative using the global emissions reference scenario.

Table 5.3.2-3 lists the results from the sensitivity analysis under the global emissions reference scenario for the proposed standards, which includes climate sensitivities of 2.4°C, 3.0°C, and 3.9°C (4.3°F, 5.4°F, and 7.0°F) for a doubling of CO_2 compared to preindustrial atmospheric concentrations (278 ppm CO_2) (Appendix E, Section E.3.3.7, *Sensitivity Analysis*).

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[20] As described in the IPCC AR6, "heavy precipitation events are projected to increase in both frequency and intensity across most regions, including tropical, mid-latitude, and high-latitude zones. Even in areas where average precipitation is expected to decline, such as subtropical regions, the intensity of individual precipitation events is still projected to rise, accompanied by longer dry intervals between them. Additionally, mid-continental regions are expected to experience heightened drought risk, particularly during summer months, due to increased evaporation and reduced soil moisture." (IPCC 2021b). IPCC data and projections inevitably carry substantial uncertainties due to the complexities of climate modeling and limitations in observational records. All climate models inherently make numerous assumptions, all of which introduce additional uncertainty and variability in projected outcomes.

[21] These models typically are used to provide results among scenarios with very large changes in emissions, such as the selection of the SSP scenarios; very small changes in emissions profiles (such as those resulting from the Proposed Action and alternatives) would produce results that would be difficult to resolve among scenarios.

[22] For a qualitative review of how the CAFE standards would affect precipitation in different regions, readers may consult Section 5.4.1.2, *Direct and Indirect Impacts on Climate Change Indicators*, of Final Environmental Impact Statement for Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks, Model Years 2027 and Beyond, and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans, Model Years 2030 and Beyond (NHTSA 2024), as there have been minimal changes in the time since publishing.

Table 5.3.2-4. Changes in Carbon Dioxide Concentrations, Global Mean Surface Temperature, Sea-Level Rise, and Ocean pH for Varying Climate Sensitivities by Alternative [a]

Alternative	Climate Sensitivity	CO_2 Concentration (ppm)			Global Mean Surface Temperature (°C) [b,c]			Sea Level Rise (cm) [c]	Ocean pH [c]
		2040	2060	2100	2040	2060	2100	2100	2100
Changes Under the No-Action Alternative [d]									
No-Action	Low	-0.01	-0.02	-0.02	-0.000	-0.000	-0.000	-0.00	0.0000
	Medium	-0.01	-0.02	-0.03	-0.000	-0.000	-0.000	-0.00	0.0000
	High	-0.01	-0.02	-0.03	-0.000	-0.000	-0.000	-0.01	0.0000
Changes Under Alternative 1 Compared to the No-Action Alternative									
Alt. 1	Low	0.03	0.13	0.30	0.000	0.001	0.001	0.02	-0.0001
	Medium	0.04	0.13	0.32	0.000	0.001	0.001	0.02	-0.0002
	High	0.04	0.13	0.35	0.000	0.001	0.001	0.03	-0.0002
Changes Under Alternative 2 Compared to the No-Action Alternative									
Alt. 2	Low	0.03	0.13	0.30	0.000	0.001	0.001	0.02	-0.0001
	Medium	0.04	0.13	0.32	0.000	0.001	0.001	0.03	-0.0002
	High	0.04	0.13	0.35	0.000	0.001	0.001	0.03	-0.0002
Changes Under Alternative 3 Compared to the No-Action Alternative									
Alt. 3	Low	0.03	0.11	0.27	0.000	0.000	0.001	0.02	-0.0001
	Medium	0.03	0.12	0.30	0.000	0.001	0.001	0.02	-0.0001
	High	0.03	0.12	0.31	0.000	0.001	0.001	0.03	-0.0001

Notes:
[a] The numbers in this table have been rounded for presentation purposes. As a result, the values do not reflect the exact difference of the values. Low (2.4 °C), medium (3.0 °C), and high (3.9 °C) climate sensitivities were assessed, corresponding to the 5th, 50th, and 95th percentiles of the probability distribution of climate sensitivity values from IPCC AR6. IPCC data and projections inevitably carry substantial uncertainties due to the complexities of climate modeling and limitations in observational records. All climate models inherently make numerous assumptions, all of which introduce additional uncertainty and variability in projected outcomes.
[b] The values for global mean surface temperature and sea-level rise are relative to the average of the years 1986 through 2005.
[c] Values reported as 0.00, 0.000, or 0.0000 are greater than zero. Values reported as -0.00, -0.000, or -0.0000 are less than zero.
[d] Values for the No-Action Alternative represent the difference between the Preferred Alternative (PC2LT002) and the No-Action Alternative in the Final Environmental Impact Statement for Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks, Model Years 2027 and Beyond, and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans, Model Years 2030 and Beyond (NHTSA 2024). NHTSA's Proposed Action also includes proposed changes to its vehicle classification regulations starting in MY 2028, which reconsiders how light trucks are classified; therefore, the two data sets used here will differ in the types of vehicles included. See Section VI of the proposed rule preamble and Chapter 3 of the PRIA for additional detail regarding the effect of NHTSA's proposed fleet reclassification.
°C = degrees Celsius; cm = centimeters; CO_2 = carbon dioxide; ppm = parts per million.

As Table 5.3.2-3 shows, varying climate sensitivities can affect not only estimated warming, but also estimated sea-level rise, ocean pH, and atmospheric CO_2 concentration. This complex set of interactions occurs because both atmospheric CO_2 and temperature affect ocean absorption of atmospheric CO_2, which reduces ocean pH. Specifically, higher temperatures result in lower aqueous solubility of CO_2, while higher concentrations of atmospheric CO_2 lead to more ocean absorption of CO_2. Atmospheric CO_2 concentrations are affected by the amount of ocean carbon storage. Therefore, as Table 5.3.2-3 shows, projected future atmospheric CO_2

concentrations differ with varying climate sensitivities even under the same alternatives despite the fact that CO_2 emissions are fixed under each alternative.

Simulated atmospheric CO_2 concentrations in 2040, 2060, and 2100 are a function of changes in climate sensitivity. The small changes in concentration are due primarily to small changes in the aqueous solubility of CO_2 in ocean water: slightly warmer air and sea surface temperatures lead to less CO_2 being dissolved in the ocean and slightly higher atmospheric concentrations. The response of simulated global mean surface temperatures under the global emissions reference scenario to variation in the climate sensitivity parameter similarly varies among the years 2040, 2060, and 2100, as shown in Table 5.3.2-3. The slight increase in 2100 global mean surface temperature from the No-Action Alternative to Alternative 3 is 0.001°C (0.002°F) for each climate sensitivity.

CHAPTER 6 LIFE-CYCLE ASSESSMENT IMPLICATIONS OF VEHICLE MATERIALS

6.1 Introduction

This chapter of the Draft SEIS fills in gaps not covered in the prior chapters by discussing the life-cycle implications of vehicle materials to give the public a clearer understanding of the broader impacts.[1] This chapter synthesizes literature related to the vehicle cycle to provide an understanding of the life-cycle implications of the vehicle cycle for light-duty (LD) vehicles. This is relevant to the outcomes of this rulemaking as the CAFE Model predicts changes in the types and levels of vehicle technologies that manufacturers could employ to meet a set of CAFE standards, which will in turn lead to changes in impacts across the life cycle of those vehicles. The vehicle cycle includes three main phases: (1) the vehicle production phase including raw material extraction and production of vehicle inputs, production of fuel or electricity required for vehicle production, and the vehicle manufacture itself; (2) the use/operation phase of vehicles, including fuel combustion, electricity use, or both, and vehicle maintenance; and (3) the vehicle end-of-life phase of recycling or disposal of the vehicle and vehicle parts. In addition, transportation of fuel and materials occurs between each of these phases.

A quantitative analysis is not included with this Draft SEIS, but a qualitative discussion is included to inform the decision-maker about the vehicle cycle phases and impacts of commonly used vehicle materials that could be used as manufacturers respond to the standards. In accordance with DOT Order 5610.1D(16)(b), *DOT's Procedures for Considering Environmental Impacts*, NHTSA qualitatively summarizes the life-cycle environmental impacts of vehicle materials, including raw material extraction, processing, component manufacture, and vehicle assembly. The agency's discussion in this Draft SEIS of scientific and technical literature does not necessarily constitute an endorsement by the agency of that literature. The agency welcomes comment on any literature or analysis in the Draft SEIS or submission of any additional relevant information.

NHTSA prepared this Draft SEIS in line with the Supreme Court's recent decision in *Seven County Infrastructure Coalition v. Eagle County, Colorado* and its progeny.[2] Agencies are granted substantial deference to determine the scope of the environmental impacts that they address and may decide to evaluate environmental impacts from separate projects upstream or

[1] A quantitative life-cycle assessment (LCA) of regulatory alternatives is not included in this Draft SEIS due to the extensive and uncertain data requirements associated with predicting future vehicle designs, technology adoption, manufacturing processes, material choices, and regional energy mixes. As manufacturers are not mandated to adopt specific technologies under the proposed standards, the variability in potential compliance pathways makes a robust quantitative comparison infeasible. Instead, NHTSA provides a qualitative discussion informed by existing LCA studies to help decision-makers and the public understand the life-cycle implications of energy production, material substitution, and fuel economy technologies. For additional information, see the qualitative LCA discussions presented in prior CAFE EISs.

[2] *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).

downstream from this action.[3] This Proposed Action amends standards for model years for which CAFE standards have previously been established. Accordingly, the agency has decided to retain in this Draft SEIS certain aspects of the analytical frame of prior CAFE EISs. Specifically, this Draft SEIS includes a discussion of potential environmental impacts of sectors other than those the agency regulates, where changes in those impacts are linked to the action and alternatives under consideration here. *In Seven County*, the Court clarified that NEPA analysis beyond the direct regulatory impact at issue is not required in an EIS.[4] While NHTSA is not required to assess impacts that are not a direct result of changes in CAFE standards and has determined that analyses of such impacts are not necessary for NHTSA to undertake reasoned decision-making pursuant to its authority under the Energy Policy and Conservation Act of 1975, as amended by the Energy Independence and Security Act of 2007, the agency nonetheless provides discussion of those impacts solely for informational purposes.

6.2 Raw Material Extraction through Vehicle Assembly

This section discusses environmental impacts occurring during raw material extraction, material processing, and manufacture of vehicle material components and batteries, as well as vehicle assembly. Because manufacturers may comply with CAFE standards in several ways, including through vehicle light-weighting and material substitution, this section discusses the life-cycle impacts of various components. This information is provided to give the public a better understanding of different compliance options and the associated environmental impacts.

6.2.1 Non-Battery Components

This section discusses the life-cycle non-criteria emissions (NCEs), energy, and other environmental impacts for non-battery vehicle components focusing on materials that account for the largest shares of vehicle weight, materials with production activities with more notable adverse impacts on the environment, or both.[5] In this section, the environmental impacts of

[3] 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.").

[4] At issue in *Seven County* was the scope of analysis required under NEPA when an agency issues a permit authorizing construction of a segment of linear infrastructure; our discussion here applies that case's holding to the current context, where NHTSA is undertaking NEPA analysis in connection with a regulatory standards rulemaking.

[5] Throughout this Draft SEIS, the term *non-criteria emissions* (NCEs) refers specifically to carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride, which are not classified as criteria pollutants under the Clean Air Act.

different materials are assessed through the extraction, processing, and manufacturing phases, with some discussion on the vehicle use phase with these materials.[6]

Steel comprises the vast majority of U.S. vehicle components, followed by plastics and aluminum (Kelly et al. 2023; American Chemistry Council [ACC] 2024). Although LD vehicle weight has been gradually increasing over time with the popularity of larger passenger vehicles (i.e., crossovers, sport utility vehicles, and light trucks), that growth has been tempered by the replacement of heavier materials used in those vehicles (particularly steel) with lighter-weight materials (including aluminum, carbon fiber, and plastic). The Greenhouse Gas, Regulated Emissions, and Energy Use in Transportation (GREET) model analysis shows that plastics comprise a larger share of material composition than aluminum (Kelly et al. 2023). Steel use dominates vehicle content regardless of vehicle powertrain type (Kelly et al. 2023).[7] The Kelly et al. (2023)[8] report and the 2023 R&D GREET2 Vehicle-Cycle Model[9] provide information on energy use, water use, and emissions for vehicle components and processes.

6.2.1.1 Steel

Currently, steel comprises the greatest share of a vehicle's weight. Excluding batteries, steel currently accounts for about 60 percent of the material composition of gasoline internal combustion engine (ICE) vehicles and around 63 percent of battery electric vehicles (BEVs) in the United States (Kelly et al. 2023).[10] Steel manufacturing is an energy- and NCE-intensive process. In 2024, steel production had a carbon dioxide (CO_2) intensity of 1.92 tons CO_2 per ton steel, resulting in roughly 3.6 billion metric tons of direct CO_2 emissions (World Steel Association 2024).[11]

Increasing secondary steel production with electricity-based processes can help lower emissions but also requires improvements in the steel recycling processes and continued expansion of less NCE-intensive energy grids. Substitution of conventional steel with high-

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[6] The environmental impacts of vehicle materials during the end-of-life phase are detailed in Section 6.3, *Vehicle Disposal and Recycling*.

[7] The powertrain, defined by NHTSA, includes the engine, transmission, exhaust system, fuel systems, and cooling systems.

[8] *Cradle-to-Grave Lifecycle Analysis of U.S. Light-Duty Vehicle-Fuel Pathways: A Greenhouse Gas Emissions and Economic Assessment of Current (2020) and Future (2030–2035) Technologies.*

[9] https://greet.es.anl.gov.

[10] Conventional or mild steel is the most common form of steel. While it is weaker than other steel alternatives, it can be less expensive to produce, though cost savings may be seen in the welding process of high-strength steel (Zhang et al. 2018). High-strength steel materials are stronger alternatives and, as a result, less material is needed to fulfill the same function as conventional steel (Zhang et al. 2018).

[11] Virgin steel manufacture involves iron ore extraction and processing, coke production, sintering, and production using a blast furnace and basic oxygen furnace, among other steps. Recycled steel production involves use of an electric arc furnace (EAF), which relies on electricity to melt steel scrap. Production with EAFs is less energy intensive and results in lower NCEs than production using blast furnaces and blast oxygen furnaces (World Steel Association 2024); however, the extent to which they lower emissions is dependent on the grid mix powering the EAFs (Benavides et al. 2024).

strength steel offers net energy and NCE reduction benefits.[12] The reduced energy use and NCEs during the vehicle use phase outweighs the increased energy use (and associated NCEs) during the vehicle production phase (Modaresi et al. 2014; Sebastian and Thimons 2017). Other environmental impacts from raw material extraction for steel production include degradation of land, contamination of nearby soil, emission of criteria air pollutants, and pollution of water (Jhariya et al. 2016; Ilutiu-Varvara and Aciu 2022; Liu et al. 2014; Strezov and Chaudhary 2017; EPA 2022a; Rehman et al. 2018).

6.2.1.2 Plastics/Polymer Composites

Plastics comprise the second largest share of a vehicle's weight, representing about 13 to 16 percent of the material composition of vehicles across different technologies in the U.S. market (Kelly et al. 2023). Plastics are typically used for interior or exterior parts that do not have structural strength requirements, such as front and rear fascia, lighting, trim, or instrument panels (Park et al. 2012; Modi and Vadhavkar 2019). However, polymer composites such as nanocomposites can offer strength that is comparable to conventional steel and are more commonly being used in structural and load-bearing automotive components (ACC 2020). They offer light-weighting benefits in various vehicle applications compared to steel and aluminum (Singh et al. 2018; Bailo et al. 2020).

Approximately 65 percent of the plastics used in a vehicle in North America comes from four polymers: polypropylene, polyurethane, polyamide, and polyvinyl chloride (Nexant 2019; ACC 2024). The raw material extraction, including oil extraction and refining, and manufacturing phases for polymer composites are more energy and NCE intensive than those for conventional steel, but typically less than those for aluminum (Cheah 2010; Tempelman 2011; Khanna and Bakshi 2009; Raugei et al. 2015; Koffler and Provo 2012). However, over the life cycle, these impacts are lower for these lighter-weight composites due to the fuel use reductions during the vehicle use phase (Delogu et al. 2016).[13]

6.2.1.3 Aluminum

After steel and plastics, aluminum makes up the third largest share of a vehicle's weight and represents about 6 to 16 percent of the material composition of vehicles (Kelly et al. 2023). Similar to high-strength steel, aluminum can reduce vehicle weight while still providing strength and rigidity similar to and sometimes greater than conventional steel. Automotive-grade aluminum, which is used extensively in the transportation sector, has a high strength-to-weight ratio, corrosion resistance, and processability (Wang 2022; Yu and Jiang 2024).

Virgin production of both cast and wrought aluminum begins with mining of bauxite ore followed by a series of processing steps. Virgin aluminum production is far more energy and

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[12] Several studies have examined the life-cycle impacts of substituting conventional steel components in vehicles with lighter-weight materials like high-strength steel, aluminum, and plastics (e.g., Mayyas et al. 2012; Shinde et al. 2016; Kelly et al. 2015; Modaresi et al. 2014; Hardwick and Outteridge 2015; Sebastian and Thimons 2017; Milovanoff et al. 2019).

[13] The environmental impacts across a range of impact categories—including energy use, NCEs, acidification potential, and more—are lower for polymer composites than those for steel and aluminum across the vehicle life cycle.

NCE intensive than recycled aluminum production and contributes to higher levels of other environmental impacts, such as acidification, eutrophication, and smog (Wang 2022).[14] Additionally, substituting lighter-weight aluminum for conventional steel results in lower energy use and NCEs over the vehicle life cycle due to the fuel use reductions during the vehicle use phase. The magnitude of life-cycle NCE reductions and energy-use savings are influenced by the location of aluminum production, the amount of recycled material used in vehicle components, end-of-life recycling rate, and lifetime of vehicles in use[15] (Mayyas et al. 2012; Liu and Müller 2012; Shinde et al. 2016; Kelly et al. 2015; Das 2014; Modaresi et al. 2014; Raugei et al. 2015; Sebastian and Thimons 2017; Milovanoff et al. 2019; Palazzo and Geyer 2019).[16]

6.2.1.4 Fluids and Lubricants

Fluids and lubricants accounted for 4.7 percent of vehicle weight in 2023 (ACC 2024). Vehicle fluids and lubricants include adhesives, transmission fluid, powertrain coolant (50 percent ethylene glycol and 50 percent water), engine oil, windshield fluid (50 percent methanol and 50 percent water), and brake fluid (Argonne National Laboratory [ANL] 2023).[17] In addition to the energy use and NCEs from vehicle fluids and lubricants, these substances can have additional adverse impacts on the environment (Madanhire and Mbohwa 2016). The same quantities of adhesives, windshield fluid, and brake fluid are used across the vehicle types, but plug-in hybrid electric vehicles (PHEVs) and electric vehicles (EVs) use less transmission fluid and coolant, and do not require engine fluid (ANL 2023).

6.2.1.5 Iron Castings

Iron castings accounted for about 2 percent of vehicle weight in the U.S. market according to the ANL analysis (Kelly et al. 2023). Cast-iron parts are made using scrap iron and steel and are used to make vehicle parts like engine blocks (Kelly et al. 2023). Iron casting is a highly energy- and emissions-intensive process, particularly during the melting step in the production process (Abdelshafy et al. 2022). Increasing the share of steel scrap in cast iron is one method of

[14] The production of 1 metric ton of primary aluminum ingot in North America emits approximately 37 kilograms (kg) of sulfur dioxide equivalent (SO_2e), 0.82 kg of nitrogen equivalent (eutrophication potential), and 274 kg ozone equivalent (O_3e, smog formation potential), while recycled aluminum emits 0.87 kg SO_2e, 0.04 kg nitrogen equivalent, and 15.64 kg O_3e (Wang 2022).

[15] LCA studies often use different assumptions for vehicle lifetime that can influence final results. For example, a study that expresses results per vehicle as a functional unit (e.g., kg carbon dioxide equivalent [CO_2e]/vehicle) would have greater life-cycle emissions with a 10-year lifetime assumption than an 8-year assumption. Vehicle miles traveled assumptions over a vehicle's lifetime can also significantly affect results, which is why many vehicle LCAs express results per kilometer or mile as a functional unit.

[16] The following studies in this literature review indicated that they relied at least partially on industry funding or industry-funded data to evaluate the life-cycle impacts of aluminum and high-strength steel material substitution: Kim et al. (2010), Geyer (2007, 2008), Dubreuil et al. (2010), Das (2014), Sebastian and Thimons (2017), and Milovanoff et al. (2019). Most of the studies reviewed have undergone peer review for publication in academic journals, although Sebastian and Thimons (2017) was not published in an academic journal. Certain studies noted where critical reviews were conducted in accordance with ISO 14044 standards on either the method (Geyer 2008), life-cycle inventory inputs (Dubreuil et al. 2010), or both (Sebastian and Thimons 2017), or where critical review was not performed (Bertram et al. 2009).

[17] The R&D GREET2 Vehicle-Cycle Model provides a breakdown of the weight of various vehicle fluids, as well as the per-vehicle lifetime energy consumption and NCEs associated with all fluids for all vehicle types.

reducing carbon intensity because steel scrap is less energy intensive. However, recycled steel scrap requires additives to maintain the same alloy composition, which can increase the carbon footprint of the cast iron when the steel scrap content of the alloy exceeds 25 percent (Abdelshafy et al. 2022). Cast-iron production can also result in negative impacts on the environment (Mitterpach et al. 2017).

6.2.1.6 Other Powertrain Metals (Copper, Cobalt, Nickel)

Powertrain components such as copper and ferromagnetic materials like cobalt and nickel play a vital role in vehicle function, but their extraction and production can have significant environmental impacts. Powertrain components such as the gearbox and heat exchanger use copper, the braking system uses copper-nickel brake lines, and magnets used in motors and drivers are often composed of ferromagnetic materials such as cobalt and nickel. Copper can account for over 1 percent of the overall vehicle weight (International Energy Agency [IEA] 2022; Aniziol 2020). The quantities of ferromagnetic metals such as cobalt and nickel used in vehicles are relatively low; however, their mining, production, and recycling activities can result in high NCEs[18] and ecological impacts (Sullivan et al. 2018; Organisation for Economic Co-operation and Development [OECD] 2019).

Cobalt, nickel, and copper mining can have a range of impacts on the environment. The use of chemicals and explosives, while essential to certain mining operations, also requires careful oversight to minimize potential impacts on water resources and local wildlife (Slack et al. 2017; Nickel Institute 2023a; Mudd 2010; Savinova et al. 2023; OECD 2019).

6.2.2 Battery Components

The lithium-ion battery is today's preferred battery technology for EVs and PHEVs because of its electrochemical potential, lightweight properties, high-temperature performance, comparatively low maintenance requirements, and minimal self-discharge characteristics, the latter of which enables lithium-ion batteries to stay charged longer compared to other battery chemistries (DOE 2023a). Life-cycle assessment (LCA) literature has focused on three cathode types: lithium manganese oxide, lithium iron phosphate, and lithium nickel manganese cobalt oxide (NMC) (Nealer and Hendrickson 2015). NMC-based batteries dominate the current market and are anticipated to continue to hold a large share in the foreseeable future (Kelly et al. 2020). Manufacturing lithium-ion batteries is an energy-intensive process, particularly the coating and drying phases.[19] Estimates for the relative contribution of lithium-ion batteries on the vehicle life-cycle NCEs can vary significantly both between and within LCAs (Congressional Research Service 2020; Kawamoto et al. 2019; Dunn et al. 2015). Ranges in results are large;

[18] NCEs from copper production are, at an average 2.6 kg CO_2e/1 kg copper (International Copper Association Australia 2020); NCEs for refined cobalt metal are 28.6 kg CO_2e/1 kg cobalt metal (Cobalt Institute 2019); NCEs from Class I nickel production are 7.64 kg CO_2e/1 kg Class I nickel (Mistry et al. 2016).

[19] The drying phase involves application of heat to remove the flammable solvent in the cathode after the coating process. Drying is an important step in the manufacture of lithium-ion batteries as it helps ensure the stability of the lithium salts used as electrolytes under least humidity conditions. High humidity causes the lithium salts to react with water and produce hydrogen fluoride, compromising the battery life.

studies have shown batteries can contribute 10 to 30 percent of total life-cycle vehicle NCEs (Llamas-Orozco et al. 2023; IEA 2020).

Beyond NCEs and energy consumption, the mining and processing stages of lithium-ion batteries from virgin materials can have local adverse environmental impacts (Dunn et al. 2015; Congressional Research Service 2020). The reliance of lithium-ion batteries on critical mineral supplies requires consideration of other environmental concerns and resource availability, increasing the importance placed on recycling (Pathak et al. 2022). Research into alternatives to lithium has been conducted to verify the viability of potential substitutes (Bloomberg New Energy Finance 2023; Harmon 2024).

6.2.3 Vehicle Assembly

The vehicle assembly process generally consists of two assembly lines: one for the body and one for the chassis. The main processes involved in vehicle assembly include painting,[20] heating and cooling, handling materials, welding, and compressed air supplying (Kelly et al. 2023). The most energy-intensive aspects of the vehicle assembly process are: paint booths (27–50 percent), heating, ventilation, and air conditioning (HVAC) (11–20 percent), lighting (15 percent), compressed air (9–14 percent), welding (9–10 percent), material handling/tools (7–8 percent), and metal forming (2–9 percent) (Energy Star 2015). Fuel consumption tends to range from 60 to 69 percent of total energy use with electricity consumption making up the rest (Energy Star 2015). Beyond energy use, water use, and NCEs, the vehicle manufacturing process also results in other air emissions and soil contamination (Rivera and Reyes-Carillo 2014). Compared to other industrial manufacturing processes in the United States, the energy intensity of automobile manufacturing is relatively low when measured as total energy expenditures (e.g., fuel and electricity costs) divided by total operating expenditures (e.g., material costs, labor, capital expenses). Energy expenditures make up 0.4 percent of total operating expenditure for automobile manufacturing compared to 37.2 percent for lime manufacturing and 34.6 percent for industrial gas manufacturing (Oh and Hildreth 2014). Furthermore, automobile manufacturing plants have options to improve efficiency to further reduce the energy and emissions intensity of the automobile manufacturing process (Giampieri et al. 2020).

6.3 Vehicle Disposal and Recycling

End-of-life practices are critical considerations when assessing vehicles and any technology life-cycle impact. The ability to reuse, recycle, or re-integrate in the supply chain parts or materials of a vehicle at its end of life can lessen its environmental impact. Recovery of scrap from

[20] Painting activities are responsible for most of the environmental impacts during vehicle assembly (Rivera and Reyes-Carillo 2014).

vehicles and other products allows manufacturers to increase their use of recycled material inputs.[21]

6.3.1 Non-Battery Powertrain Vehicle Disposal and Recycling

Proper end-of-life treatment of non-battery powertrain vehicle components through disposal and recycling processes can help reduce total life-cycle NCEs. While recycling processes require energy and produce emissions, recycling vehicle components can save energy, conserve resources, and reduce emissions by displacing the production of virgin materials, reducing the total life-cycle NCEs for a vehicle.

The overall process for dismantling a vehicle for disposal and recycling requires an estimated energy expenditure of 1.5 million British thermal units per vehicle (Kelly et al. 2023).[22] The following subsections discuss the NCEs, energy, and other environmental impacts and considerations for non-battery vehicle component materials at vehicle end of life.

6.3.1.1 Steel

Scrap steel can be recycled by melting scrap steel using electricity-based processes. Limestone is often used in the process as a means of removing impurities from the scrap steel. Alloy materials are sometimes added depending on the planned end use of the recycled steel. The steel is then poured into ingot molds to prepare for shipping to be recast for specific vehicle components (Burnham et al. 2006). High-strength steel consistently showed lower life-cycle NCEs compared to conventional steel with the use of recycled material inputs (Sebastian and Thimons 2017).[23]

6.3.1.2 Plastics/Polymer Composites

Studies vary on whether plastics and polymer composites are viable material substitutes from a life-cycle NCE perspective, with outcomes heavily influenced by end-of-life treatment, recyclability, and whether virgin or recycled materials are used (Rikhter et al. 2022; Overly et al. 2002; Khanna and Bakshi 2009; Lloyd and Lave 2003; Weiss et al. 2000; Meng et al. 2017; Tempelman 2011; Koffler and Provo 2012). While composites are less recyclable than metals, incineration offers lower impacts than landfilling (Witik et al. 2011). Automotive plastic reuse and recycling rate is currently 2.6 percent but has the potential to reach 50.4 percent (Cardamone et al. 2022).

[21] ANL's R&D GREET2 Vehicle-Cycle Model includes estimates of the average virgin, recycled, and scrap content by material type in a MY 2022 vehicle and shows that lead and cast aluminum contain the highest recycled content in the vehicle with 100 and 80 percent, respectively (ANL 2023).

[22] In current technology for sedans and small sport utility vehicles, the powertrain makes up approximately 20 percent of the total weight of gasoline ICE vehicles (Kelly et al. 2023).

[23] They reached this conclusion in scenarios accounting for a credit from metals recycling (e.g., assuming that using scrap inputs offsets the use of virgin material inputs) and scenarios that did not include a credit for avoided use of virgin materials. Life-cycle NCEs from aluminum components exceeded those of both conventional and high-strength steel vehicles when not including a credit for avoided use of virgin materials.

6.3.1.3 Aluminum

Recycled aluminum is produced through scrap preparation, melting, ingot casting, and then parts casting. Separation of cast and wrought aluminum is important for preserving the quality of the recycling materials (Burnham et al. 2006).

Life-cycle NCE reductions and energy-use savings are influenced by the amount of recycled material used in vehicle components, end-of-life recycling rate, lifetime of vehicles in use, and location of aluminum production. Every additional percent of end-of-life recycling of aluminum, energy demand could be reduced by 1,266 megajoules and emissions reduced by 80 kilograms (kg) carbon dioxide equivalent (CO_2e) based off 1 metric ton of aluminum (Wang 2022). Recycling aluminum saves 93 percent of the energy required to produce aluminum from bauxite ore and reduces the carbon footprint by 94 percent (Wang 2022).[24]

The automotive industry is the largest market for aluminum casting and cast products make up more than half of the aluminum used in cars today (Aluminum Association 2021). There is a growing need to consolidate the increasing demand for aluminum (including aluminum casting and extrusion products) with the expansion of recycled aluminum production (Smirnov et al. 2018).[25]

6.3.1.4 Fluids and Lubricants

Vehicle fluids and lubricants contain toxic chemicals that, if not properly managed at end of life, can have adverse impacts on the environment and human health.[26] Many of these fluids such as engine oil, transmission fluid, and power steering fluid can be recycled. Other fluids that cannot be recycled must be disposed of properly to minimize additional impacts. Certain automotive fluids and lubricants may be hazardous and generally need to be disposed of in accordance with applicable laws and regulations.

6.3.1.5 Other Powertrain Metals

Other metals, such as copper, nickel, and cobalt, found in non-battery powertrain components have good recycling potential and are increasingly recovered for recycling.

During the lifetime of products, small amounts of copper are lost due to factors such as corrosion and abrasion. Additionally, when scrap is separated and disassembled, a significant

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[24] This is based on aluminum produced for the North American market and recycled in North America. This study found that increasing the aluminum recycling rate by just 1 percent can lower the overall carbon footprint by 80 kg CO_2e per 1,000 kg of aluminum products (Wang 2022).

[25] The *North American Light Vehicle Aluminum Content and Outlook* study found that that the average North American passenger car contained approximately 58 pounds of aluminum extrusion in 2022, which is projected to grow to 92 pounds per vehicle by 2030 (Ducker 2023). This projection emphasizes the opportunity presented by integrating recycled aluminum as a part of the supply chain for aluminum casting and extrusion products used in vehicle manufacturing. Doing this would decrease the environmental impact of the two technologies by reducing the operations (and emissions) related to sourcing new aluminum and by producing products that can themselves be recycled at the end of life of the vehicle.

[26] For example, ethylene glycol, a common substance in antifreeze, coolants, brake fluid, and other fluids, can cause respiratory issues and other negative health effects (National Center for Biotechnology Information 2023).

amount of copper is lost and ends up in other metal recycling loops, in the form of slags or impurities in the recycled metal.[27]

Recycled cobalt represented about 25 percent of U.S. cobalt consumption in 2024 (U.S. Geological Survey [USGS] 2025a). Cobalt can be recovered from secondary sources by incorporating the recycled material into a primary refining or transformation process, resulting in final products such as cathodes, powders, oxides, salts, or solutions, depending on market demand (OECD 2019). Cobalt recycling requires 46 percent less energy and 40 percent less water than primary production. It also results in a 59 percent reduction in NCEs and a 98 percent reduction in sulfur oxide emissions.

Nickel is a fully recyclable natural resource that can be recycled again and again without any loss of quality (Nickel Institute 2023b). Nickel and nickel-containing alloys can be recycled and transformed into their original state or another valuable form.[28] Production with recycled nickel uses about 5 percent as much energy as nickel from virgin inputs (ANL 2023).

6.3.1.6 Tires

The disposal and recycling of tires is another important end-of-life consideration for vehicles. Tires are an energy-intensive vehicle component to manufacture, and their chemical composition slows or prevents degradation in the environment (Valentini and Pegoretti 2022). It takes approximately 90 gigajoules/ton to prepare the rubber compound used in tires and an additional 115 gigajoules/ton to manufacture the tires (Valentini and Pegoretti 2022). As a result, reusing or recycling tires will reduce vehicle life-cycle NCEs.

Productive end-of-life options for tires include civil engineering applications,[29] energy recovery,[30] retreading,[31] or recycling (Valentini and Pegoretti 2022). In the energy recovery process, only about 15 percent of the energy required to make a tire can be recovered. In 2019, approximately 30.9 million tons of tires were at the end of their life globally. However, only 59 percent of these tires were disposed of properly. The other 41 percent were either disposed of in landfills, stockpiled, or lost.

6.3.2 Battery Disposal and Recycling

6.3.2.1 Lead-Acid Batteries

Lead-acid batteries (LABs) on their own in ICE vehicles have negligible NCEs relative to the rest of the vehicle's life cycle (Hawkins et al. 2012). However, mishandling these batteries in

[27] In addition, some copper is not collected after the end of its useful lifetime and remains in place, known as *abandoned in place* (Glöser et al. 2013).

[28] In 2010, about 68 percent of all available nickel from consumer products was recycled, 15 percent entered the carbon steel loop, and around 17 percent still ended up in landfills, mostly in metal goods and waste electrical and electronic equipment (Nickel Institute 2023b).

[29] Using tires in retaining walls, drainage basins, or other civil projects.

[30] Shredding and burning tires as fuel for cement kilns to recover some of the energy used to produce them.

[31] Extending the useful life of the tire by adding a new tread.

disposal and end of life can lead to exposure to toxic and hazardous materials, specifically lead and sulfuric acid (Los Angeles County 2015; Kentucky Division of Waste Management 2017). Because of these risks, more than 40 states have some form of purchase fee, disposal requirement, or recycling requirement designed to address the end-of-life handling of LABs (Battery Council International 2020).

In North America, the recycling rate for LABs is almost 100 percent due in large part to the Mercury-Containing and Rechargeable Battery Management Act, which requires all sellers of LABs to accept these products at their end of life for recycling (Bird et al. 2022). It is estimated that recycled lead from LABs contributes 62 percent of the total amount of lead needed for a new LAB in the United States (International Lead Association 2022). U.S. secondary lead, including lead from LABs, is recycled through a smelting process and totaled about 1 million metric tons in 2024, accounting for an amount equivalent to 70 percent of domestic consumption (USGS 2025b). Secondary lead recycling through smelting can generate toxic lead emissions, which are regulated by ambient air standards domestically.

6.3.2.2 Lithium-Ion Batteries

Lithium-ion batteries do not yet have a high recycling rate, with current estimates at less than 5 percent for end-of-life lithium-ion batteries (DOE 2019).[32] Scrap generated during the production of lithium-ion batteries serves as important recycling feedstock for secondary materials with fairly high recycling rates ranging from 5 to 30 percent (Gaines et al. 2021). Some states have laws banning the disposal of lithium-ion batteries in landfills (Winslow et al. 2017), but there are no specific Federal, state, or local laws addressing lithium-ion battery recycling (Bird et al. 2022). Lithium-ion batteries differ in size, shape, and components, so increased forethought toward uniformity, labeling, and design would be crucial in increasing the success of lithium-ion battery recycling in the future (Bird et al. 2022).

Because EV batteries have a long lifespan (12 to 15 years) (DOE 2023b), battery waste stream will lag EV deployments, allowing time for recycling infrastructure and supporting activities to be developed.

Recycling lithium-ion batteries can reduce the life cycle of NCEs by anywhere from 5 to 29 kg (11–63.9 pounds) CO_2e per kilowatt-hour with a median of 20 kg (44.1 pounds) CO_2e per kilowatt-hour (Aichberger and Jungmeier 2020). At the end of the useful life of an EV or PHEV, the battery is most likely not fully exhausted and could be used for other purposes to mitigate environmental impacts.

[32] Includes batteries from various applications in addition to automotive. The recycling rate for lithium-ion batteries is likely higher, though difficult to estimate (Gaines et al. 2021).

LCAs of lithium-ion battery recycling have focused on three recycling technologies: pyrometallurgy,[33] hydrometallurgy,[34] and direct recycling[35] using physical processes, all of which result in different energy usage (Dunn et al. 2012; EPA 2013a; Hendrickson et al. 2015; Zwolinski and Tichkiewitch 2019; Xu et al. 2020; ANL 2019, 2023; Sambamurthy et al. 2021).

Depending on the cell chemistry, recycling can significantly reduce the potential environmental impacts of battery production. There are other life-cycle benefits of using recycled materials from spent batteries. One study found that using materials from recycled batteries can potentially decrease costs by 40 percent and reduce energy use by 82 percent, water use by 77 percent, and oxides of sulfur emissions by 91 percent (Federal Consortium for Advanced Batteries 2021).

6.4 Conclusions

The information in this chapter seeks to help decision-makers understand the environmental impacts, with a focus on NCEs and energy use, that arise during vehicle material and battery production, vehicle assembly, and end-of-life phases. The degree of these environmental impacts is dependent on vehicle manufacturers' decisions in response to the action alternatives under consideration, which may affect the materials used and overall numbers of vehicle types assembled, as well as the vehicle materials and batteries entering the waste stream. NHTSA does not know how manufacturers will rely on the different materials or technologies assessed in this chapter and fuel sources assessed in Chapter 3, *Energy*, and as a result cannot quantitatively distinguish between action alternatives.

The non-battery powertrain-specific technologies that are projected by the CAFE Model to have the highest technology penetration in the LD vehicle fleet along with the hybrid and EV-based vehicle technologies are shown in Table 6.4-1 for MY 2031. The higher penetration of mass reduction technologies, such as those discussed in this chapter, will in most cases contribute to lowering vehicle life-cycle NCEs, with the largest reductions in the use phase. The use of high-strength steel, plastics and polymer composites, and aluminum, and in particular recycled versions of these materials in place of conventional steel, offer mass reduction and net life-cycle NCE benefits; however, extraction of virgin inputs can lead to additional environmental

[33] Pyrometallurgy uses a combination of smelting followed by leaching to recover slag and valuable metals. Yu et al. (2020) found that remanufacturing an NMC battery using the pyrometallurgical method could result in a nearly 5 percent reduction in NCEs compared with production from new materials alone. This process has been largely commercialized across the United States and Europe (Yu et al. 2022).

[34] Hydrometallurgy uses chemical leaching, capable of recovering valuable metals and lithium. Most studies comparing the two processes find that hydrometallurgy produces fewer emissions and produces higher-quality products than pyrometallurgy (Bruckner et al. 2020; Sambamurthy et al. 2021). Closed-loop recycling, the process by which a product can be continually used and recycled without losing its properties, can be set up with initial pyrometallurgical followed by hydrometallurgical processing to convert the alloy into metal salts (Xu et al. 2020). Depending on the recycling technology used, closed-loop recycling could meet 20 to 70 percent of battery demand with secondary materials between 2040 and 2050 (Xu et al. 2020).

[35] Direct recycling aims at maintaining chemical structures in the process of recovering the cathode materials. It involves the recovery of useful components through physical processes like disassembly, crushing, and sorting without using any chemical processes (Dunn et al. 2012). Direct recycling results in lower energy use and higher recovery rates than hydrometallurgy and pyrometallurgy; however, it is still in the early stages of development (Harper et al. 2019).

impacts. As shown in Table 6.4-1, the technology with the second highest mass reduction for passenger cars and light trucks—Level 3 with a 10 percent reduction in glider weight—has the highest technology penetration in the alternatives in MY 2031.

The unconstrained CAFE Model analysis for this Draft SEIS shows that the penetration of strong hybrid electric vehicles (HEVs), PHEVs, and BEVs is slightly higher in the No-Action Alternative relative to the action alternatives (Table 6.4-1). Across the three action alternatives in MY 2031, the model projects that the penetration of HEVs, PHEVs, and BEVs would be approximately 14, 3, and 18 percent, respectively. The vehicle technologies and scenarios with greater shares of lithium-ion batteries projected would result in overall reduced life-cycle NCEs; for PHEVs and dedicated EVs, the level of impact would vary depending on the electric grid mix.[36]

Table 6.4-1. Summary of CAFE Model's Highest Technology Penetration Rates for Passenger Car and Light Trucks in MY 2031

Technology Type	No-Action	Action Alternative		
		Alt. 1	Alt. 2	Alt. 3
TURBO0: Turbocharging and Downsizing, Baseline Level	11%	14%	14%	13%
HCR: High Compression Ratio Engine	16%	19%	19%	19%
AT8: 8-Speed Automatic Transmission	1%	10%	10%	9%
AT10L3: 10-Speed Automatic Transmission, Level 3	11%	9%	9%	9%
Continuously Variable Transmission, Level 2	13%	9%	9%	10%
Conventional Powertrain (Non-Electric)	11%	13%	13%	13%
P2TRB0 – P2 Strong Hybrid/Electric Vehicle with TURBO0 Engine	16%	13%	13%	14%
12-Volt Micro-Hybrid (Stop-Start)	23%	31%	31%	31%
Mass Reduction Technologies				
Mass Reduction, Level 1 (5% Reduction in Glider Weight)	8%	14%	14%	14%
Mass Reduction, Level 3 (10% Reduction in Glider Weight)	38%	49%	49%	49%
Mass Reduction, Level 4 (15% Reduction in Glider Weight)	48%	28%	28%	28%
Low-Rolling-Resistance Tires				
Low-Rolling-Resistance Tires, Level 3 (30% Reduction)	97%	97%	97%	97%
Aero Drag Reduction				
Aero Drag Reduction, Level 1 (10% Reduction)	51%	57%	57%	56%
Aero Drag Reduction, Level 2 (20% Reduction)	44%	30%	30%	30%
Vehicles Using Batteries				
Strong HEVs	16%	14%	14%	14%
PHEVs	4%	3%	3%	3%
BEVs	21%	18%	18%	18%

[36] As discussed in Chapter 3, *Energy*, the grid mix would not affect the use phase for strong HEVs because those vehicles are not plugged in and do not depend on electricity and charging stations for power.

Shifts toward more efficient, lighter vehicles could result in changes in mining land use patterns. Because lightweight materials are typically scarcer (Lewis et al. 2019), mining for the minerals needed to construct lighter vehicles could shift some metal extraction activities to areas where these resources are more abundant. The CAFE Model projects a substantial penetration of mass reduction technologies in the LD vehicle fleet under the No-Action Alternative and the action alternatives, implying that a shift toward lighter-weight materials is likely, potentially leading to new mining sites.

The magnitude of life-cycle NCEs associated with materials and technologies is small in comparison with the emissions changes attributable to fuel consumption during vehicle use. To summarize some of the key findings in this chapter related to the life-cycle impacts of vehicle materials:

- **Raw material extraction.** The extraction and manufacture of vehicle materials is generally energy and NCE intensive. This is the case for the materials that account for the greatest share of vehicle weight—including steel, plastics, aluminum, fluids and lubricants, iron castings, and other metals used in the vehicle powertrain. The extraction and production processes also result in other adverse environmental impacts, such as land degradation, soil contamination, and air and water pollution.
- **Vehicle assembly.** The processes involved in vehicle assembly—painting, HVAC, lighting, heating, compressed air, welding, and material handling—account for about 8 to 17 percent of energy use and 3 to 7 percent of water use over the vehicle material life cycle (excluding vehicle operation), depending on the vehicle type. The painting process is the most energy- and emissions-intensive part of the assembly process.
- **Net environmental benefits of materials.** Lightweight vehicle materials manufactured using aluminum, high-strength steel, and plastics and composites require more energy to produce than similar conventional steel components but often offer overall life-cycle energy and emissions benefits through fuel efficiency improvements. The operating efficiencies gained can be significant, often leading to a net decrease in environmental impacts and NCEs. However, mining of lightweight materials results in other environmental consequences, including adverse land, air, and water use impacts.
- **End-of-life practices.** Vehicle disposal processes require about 27 percent as much energy and emit about 27 percent of the NCEs associated with vehicle assembly. The end-of-life pathway for vehicles and component materials has important environmental implications. Recovery of scrap from vehicles and other products allows manufacturers to increase their use of recycled material inputs in place of virgin inputs, and thereby reduces upstream impacts on the environment. The amount of recycled material used in vehicle components, end-of-life recycling rate, lifetime of vehicles in use, and location of production all influence the magnitudes of life-cycle NCE reductions and energy-use savings for vehicles.
- **Lithium-ion batteries.** Lithium-ion batteries with graphite anodes are the standard in EV designs, but active-material chemistries continue to evolve. Battery manufacture is an energy-intensive process; however, because BEVs have significantly lower vehicle-use-phase emissions, they have lower life-cycle emissions than ICE vehicles. However, mining for critical minerals used in batteries and processing causes local adverse environmental

impacts including air, soil, and water pollution, as well as high levels of water consumption. Recent research has focused on battery reuse and recycling technologies including recovery of secondary lithium from batteries. While current mineral reuse and recycling is low, in the future these practices could reduce reliance on critical mineral supplies and lessen environmental impacts caused by mining. In parallel, efforts are underway to develop and scale up domestic lithium mining operations, to reduce reliance on foreign supply chains and meet the need for critical minerals.

CHAPTER 7 HISTORIC AND CULTURAL RESOURCES

7.1 Affected Environment

NEPA states that Federal agencies shall take into consideration impacts on the human environment and consider alternatives. According to DOT Order 5610.1D, "human environment" comprehensively means the natural and physical environment and the relationship of Americans with that environment, and the impacts include ecological, historic, and cultural impacts, among others.[1] As such, NHTSA considers historical properties[2] and cultural resources in assessing the reasonably foreseeable impacts of its Proposed Action and alternatives on the natural and physical environment.

Section 106 of the National Historic Preservation Act of 1966[3] and its implementing regulations[4] require Federal agencies to consider the impacts of federally funded or approved undertakings that have the potential to affect historic properties listed in or eligible for listing in the National Register of Historic Places.

Other relevant Federal historic preservation laws include, but are not limited to:

- American Indian Religious Freedom Act of 1978[5]
- Antiquities Act of 1906 and recodified in 2014[6]
- Archaeological Resources Protection Act of 1979[7]
- Executive Order (E.O.) 13007, *Indian Sacred Sites*[8]
- E.O. 13175, Consultation and Coordination with Indian Tribal Governments[9]

[1] DOT Order 5610.1D, Sections 26(h) and 26(i).

[2] The Advisory Council on Historic Preservation (ACHP) defines historic properties as any "prehistoric or historic district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places (NRHP). This term includes artifacts, records, and remains…related to and located within these National Register properties. The term also includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization, so long as that property also meets the criteria for listing in the National Register (ACHP 2021)." For purposes of this Draft SEIS, NHTSA considers cultural resources to include historic properties as well as additional resources, such as sacred sites and archaeological sites not eligible for the NRHP.

[3] 54 U.S.C. 100101 et seq. (codified in 2014).

[4] 36 CFR part 800.

[5] 42 U.S.C. 1996. The American Indian Religious Freedom Act and Executive Order (E.O.) 13007 require agencies to evaluate their policies to protect the religious freedom of Native Americans, including access to sacred sites, use and possession of sacred objects, and freedom to worship through traditional ceremonies.

[6] 16 U.S.C. 431–433 recodified pursuant to Pub. L. No. 113-287 at 54 U.S.C. 320301–320303.

[7] 16 U.S.C. 470aa–mm.

[8] 61 FR 26771–26772.

[9] 65 FR 67249–67252. E.O. 13175 affirms the Federal Government's commitment to a government-to-government relationship with Native American tribes and directs agencies to ensure that Federal undertakings and actions do not conflict with tribal rights and resources protected by the treaties.

- National Trails System Act of 1968[10]
- Native American Graves Protection and Repatriation Act of 1990[11]

NHTSA mailed a notification of the scoping notice to the Native American tribes and tribal organizations listed in Appendix H, *Distribution List*.

The analysis in this Draft SEIS chapter provides additional information to disclose reasonably foreseeable impacts from the Proposed Action and alternatives under NEPA.

7.2 Environmental Consequences: Reasonably Foreseeable Impacts from the Proposed Action

In general, the Proposed Action slightly would increase criteria pollutant emissions and non-criteria emissions.[12] Some criteria pollutant emissions would continue to increase slightly under the Proposed Action and alternatives in later years (i.e., not during the time period of the standards), as the CAFE Model projects potential slight increases in power plant emissions. Potential environmental consequences to historic and cultural resources related to these criteria pollutant emissions are discussed in this section.[13]

As discussed in Chapter 4, Section 4.2.1.1, *Criteria Pollutants*, relative to the No-Action Alternative, emissions of the criteria pollutants, with the exception of sulfur dioxide (SO_2) emissions, increase slightly under all action alternatives in projections for 2035 and 2050. Total SO_2 emissions are anticipated to decrease under all action alternatives in 2035 and increase slightly under all action alternatives in 2050. Under the action alternatives, downstream (tailpipe) and upstream (refinery and power plant) emissions of nitrogen oxides and SO_2 are projected to decrease in 2035 and 2050 for light trucks, and increase slightly for passenger cars, compared to the No-Action Alternative.[14] Generally, a slight increase in the emissions of criteria pollutants could result in a corresponding slight increase in damage to historic properties and

[10] Pub. L. No. 90-543 as amended through Pub. L. No. 111-11, March 30, 2009.

[11] Pub. L. No. 101-601, 25 U.S.C. 3001 et seq., 104 Stat. 3048. The Native American Graves Protection and Repatriation Act also protects Native American burial sites and associated objects and access to them.

[12] Throughout this Draft SEIS, the term *non-criteria emissions* refers specifically to carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride, which are not classified as criteria pollutants under the Clean Air Act.

[13] However, specific impacts cannot be quantified as criteria pollutant emissions that cause environmental consequences travel long distances in the atmosphere, and thus, the changes in emissions and impacts would vary by location across the country. Further, the potential environmental consequences would differ based on how manufacturers respond to the new fuel economy standards, such as where manufacturers build a fleet that differs in technology use from the fleet projected under the assumptions of the Draft SEIS analysis.

[14] Because these changes in emissions and impacts would vary by location across the country, the reasonably foreseeable impacts of the Proposed Action and alternatives would vary by location. Additionally, because oxides of nitrogen and SO_2 emissions that lead to acid deposition can travel long distances in the atmosphere, the specific location of impacts is difficult to predict.

sacred sites or objects caused by acid deposition.[15] In general, acid deposition impacts under the Proposed Action and alternatives are not quantifiable, because it is not possible to distinguish between acid deposition deterioration impacts and natural weathering (rain, wind, temperature, and humidity) impacts on historic buildings and structures, varying by geographic location, on any particular historic property (Striegel et al. 2003) or sacred site or object.

[15] The corrosion of metals and the deterioration of paint and stone, as well as other historic materials, can be caused by both acid rain and the dry deposition of pollution (EPA 2017b). This damage can reduce the integrity of character-defining features that convey the significance of NRHP-listed or -eligible historic properties, such as buildings, statues, and cars, among others. This could also cause damage to sacred sites or objects that are of importance to Native American tribes. Deposition of dry acidic compounds found in acid rain can also dirty historic buildings and structures, causing visual impacts and increased maintenance costs (EPA 2017b).

CHAPTER 8 COMPARISON OF ALTERNATIVES AND MITIGATION

DOT Order 5610.1D requires that an EIS discuss "any means identified to mitigate adverse environmental impacts" caused by a proposed action or alternatives.[1]

Under NEPA, an agency does not have to formulate and adopt a complete mitigation plan,[2] but should analyze and consider all reasonable measures that could be adopted.

8.1 Comparison of Alternatives

DOT Order 5610.1D requires an EIS to "present the environmental impacts of the proposal and alternatives in comparative form," thus sharply defining the issues and providing a clear basis for choice among options by the decision-maker and the public.[3] NHTSA has presented the environmental impacts of the Proposed Action and alternatives in comparative form through each of the substantive chapters in this Draft SEIS. To supplement that information, this section summarizes and compares the reasonably foreseeable impacts from the Proposed Action and alternatives on energy, air quality, and climate. No quantifiable, alternative-specific impacts were identified for the other resource areas, so they are not summarized here.

Under the alternatives analyzed in this Draft SEIS for the CAFE standards, fuel economy is expected to decrease slightly compared to current levels under the No-Action Alternative. This would result in a projected increase in total fuel consumption by passenger cars and light trucks compared to current conditions. Because carbon dioxide (CO_2) and upstream emissions are a direct consequence of total fuel consumption, the same result is projected for total CO_2 and upstream emissions from passenger cars and light trucks. NHTSA estimates that each of the action alternatives would increase fuel consumption and CO_2 emissions from the future levels that would otherwise occur under the relevant No-Action Alternative.

This section compares the impacts of the No-Action Alternative and the action alternatives on energy, air quality, and climate (Table 8.1-1). The potential impacts on energy use, air quality, and climate include reasonably foreseeable environmental impacts from the Proposed Action.[4]

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[1] DOT Order 5610.1D, Section 13(f)(1)(e); *see also* DOT Order 5610.1D, Section 26(l).

[2] *Northern Alaska Environmental Center v. Kempthorne*, 457 F.3d 969, 979 (9th Cir. 2006) (citing *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 352 (1989) [noting that NEPA does not contain a substantive requirement that a complete mitigation plan be actually formulated and adopted]). See also *Valley Community Preservation Comm'n v. Mineta*, 231 F. Supp. 2d 23, 41 (D.D.C. 2002) (noting that NEPA does not require that a complete mitigation plan be formulated and incorporated into an EIS).

[3] DOT Order 5610.1D, Section 13(e).

[4] DOT Order 5610.1D, Section 13(g)(3). For detailed discussions of the assumptions and methods used to estimate the Proposed Action impacts, see Chapter 2, Section 2.3, *Draft SEIS Methods and Assumptions*; Chapter 3, Section 3.3, *Environmental Consequences* (energy); Chapter 4, Section 4.2, *Environmental Consequences* (air quality); and Chapter 5, Section 5.3, *Environmental Consequences* (non-criteria emissions).

Table 8.1-1. Proposed Action Impacts of CAFE Standards and Alternatives

No-Action [a]	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)
Energy: Combined U.S. Passenger Car and Light Truck Fuel Consumption and Change in Fuel Consumption for 2024–2050 (billion gasoline gallon equivalent)			
2,867	+77 (+3%)	+77 (+3%)	+71 (+2%)
Air Quality: Criteria Air Pollutant Emissions in 2035 (tons per year)			
CO: 6,522,972 NO_X: 305,340 PM2.5: 20,274 SO_2: 62,128 VOCs: 823,686	Decrease: SO_2 (-1,036). Increase: CO (54,129), NO_X (1,556), PM2.5 (66), and VOCs (13,100).	Decrease: SO_2 (-1,036); emissions equal to Alt. 1. Increase: CO (54,129), NO_X (1,556), PM2.5 (66), and VOCs (13,100); emissions equal to Alt. 1.	Decrease: SO_2 (-941); emissions larger than Alts. 1 and 2. Increase: CO (51,915), NO_X (1,500), PM2.5 (66), and VOCs (12,202); emissions equal to Alts. 1 and 2 (for PM2.5) or less than Alts. 1 and 2 (for CO, NO_X, and VOCs).
Air Quality: Criteria Air Pollutant Emissions in 2050 (tons per year)			
CO: 3,602,777 NO_X: 174,815 PM2.5: 10,608 SO_2: 45,426 VOCs: 549,795	Decrease: None. Increase: CO (95,198), NO_X (4,567), PM2.5 (242), SO_2 (293), and VOCs (21,296).	Decrease: None; emissions equal to Alt. 1. Increase: CO (95,198), NO_X (4,567), PM2.5 (242), SO_2 (293), and VOCs (21,296); emissions equal to Alt. 1.	Decrease: None. Increase: CO (95,678), NO_X (4,287), PM2.5 (221), SO_2 (227), and VOCs (20,184); emissions greater than Alts. 1 and 2 (for CO) or less than Alts. 1 and 2 (for NO_X, PM2.5, SO_2, and VOCs).
Air Quality: Mobile Source Air Toxic Emissions in 2035 (tons per year)			
Acetaldehyde: 2,273 Acrolein: 128 Benzene: 8,335 1,3-butadiene: 846 DPM: 55,690 Formaldehyde: 1,763	Decrease: None. Increase: Acetaldehyde (35), acrolein (2), benzene (127), 1,3-butadiene (12), DPM (949), and formaldehyde (33).	Decrease: None. Increase: Acetaldehyde (35), acrolein (2), benzene (127), 1,3-butadiene (12), DPM (949), and formaldehyde (33); emissions equal to Alt. 1.	Decrease: None. Increase: Acetaldehyde (33), acrolein (2), benzene (120), 1,3-butadiene (12), DPM (882), and formaldehyde (31); emissions equal to Alts. 1 and 2 (for acrolein and 1,3-butadiene, when rounded to the nearest ton) or less than Alts. 1 and 2 (for acetaldehyde, benzene, DPM, and formaldehyde).

No-Action [a]	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)
Air Quality: Mobile Source Air Toxic Emissions in 2050 (tons per year)			
Acetaldehyde: 1,420 Acrolein: 78 Benzene: 5,309 1,3-butadiene: 534 DPM: 48,030 Formaldehyde: 1,108	Decrease: None. Increase: Acetaldehyde (41), acrolein (2), benzene (175), 1,3-butadiene (15), DPM (1,380), and formaldehyde (42).	Decrease: None. Increase: Acetaldehyde (41), acrolein (2), benzene (175), 1,3-butadiene (15), DPM (1,380), and formaldehyde (42); emissions equal to Alt. 1.	Decrease: None. Increase: Acetaldehyde (42), acrolein (2), benzene (173), 1,3-butadiene (16), DPM (1,251), and formaldehyde (41); emissions greater than Alts. 1 and 2 (for acetaldehyde and 1,3-butadiene), equal to Alts. 1 and 2 (for acrolein, when rounded to the nearest ton), or less than Alts. 1 and 2 (for benzene, DPM, and formaldehyde).
Climate: Combined U.S. Passenger Car and Light Truck Carbon Dioxide Emissions and Carbon Dioxide Emissions Changes for U.S. Passenger Cars and Light Trucks for 2027–2100 ($MMTCO_2$)			
69,400	+3,400	+3,400	+3,100
Climate: Changes in Atmospheric Carbon Dioxide Concentrations in 2100 (ppm) [b]			
-0.04	+0.32	+0.32	+0.30
Climate: Changes in Global Mean Surface Temperature Increase by 2100 in °C (°F) [b]			
-0.000°C (-0.000°F)	+0.001°C (+0.002°F)	+0.001°C (+0.002°F)	+0.001°C (+0.002°F)
Climate: Changes in Global Sea-Level Rise by 2100 in centimeters (inches) [b]			
-0.00 (-0.00)	+0.03 (+0.01)	+0.03 (+0.01)	+0.02 (+0.01)
Climate: Changes in Global Mean Precipitation Increase by 2100 [b,c]			
-0.00%	0.00%	0.00%	0.00%
Climate: Changes in Ocean Acidification in 2100 (pH) [b]			
0.0000	-0.0002	-0.0002	-0.0001

Notes:

The numbers in this table have been rounded for presentation purposes. Therefore, the increases might not reflect the exact difference of the values in all cases.

[a] Except where otherwise noted, these values represent the totals for the No-Action Alternative.

[b] Results based on a climate analysis utilizing the global emissions reference scenario. Values for the No-Action Alternative represent the difference between the Preferred Alternative (PC2LT002) and the No-Action Alternative in the Final Environmental Impact Statement for Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks, Model Years 2027 and Beyond, and Fuel Efficiency Standards for Heavy-Duty Pickup Trucks and Vans, Model Years 2030 and Beyond (NHTSA 2024). Values reported as 0.00, 0.000, or 0.0000 are greater than zero. Values reported as -0.00, -0.000, or -0.0000 are less than zero. NHTSA's Proposed Action also includes proposed changes to its

vehicle classification regulations starting in MY 2028, which reconsiders how light trucks are classified; therefore, the two data sets used here will differ in the types of vehicles included. See Section VI of the proposed rule preamble and Chapter 3 of the PRIA for additional detail regarding the effect of NHTSA's proposed fleet reclassification.
[c] The Proposed Action and alternatives are projected to increase precipitation by less than 0.01 percent for all alternatives based on the scaling factor from the global emissions reference scenario.
°C = degrees Celsius; °F = degrees Fahrenheit; CAFE = Corporate Average Fuel Economy; CO = carbon monoxide; DPM = diesel particulate matter; $MMTCO_2$ = million metric tons of carbon dioxide; NO_X = nitrogen oxides; PM2.5 = particulate matter 2.5 microns or less in diameter; ppm = parts per million; SO_2 = sulfur dioxide; VOCs = volatile organic compounds.

8.2 Mitigation Measures

DOT practices and procedures concerning mitigation refer to mitigation measures that the agency can include to lessen potential adverse impacts.[5] NHTSA's analysis shows that some nonattainment areas could experience localized increases in some air pollutant emissions as a result of the Proposed Action and alternatives, which could lead to changes in exposure to these pollutants for people living in these areas. However, even if emissions in some nonattainment areas increase, the associated harm might not increase simultaneously. Regarding the air pollutants that NHTSA projects would increase slightly under the Proposed Action and alternatives in certain analysis years, NHTSA does not have the jurisdiction to regulate the specified pollutants projected to increase as a result of the Proposed Action and alternatives. In addition, any potential negative impacts of the Proposed Action and alternatives could be mitigated through other means by other Federal, state, or local agencies. Such actions would mitigate environmental and health impacts by reducing fuel use, exposure to associated emissions, or both. NHTSA, however, is unable to implement any of these potential mitigation strategies as they are not within the agency's statutory jurisdiction.

8.3 Potential Impacts

As discussed in Chapter 3, *Energy*, the Proposed Action and alternatives are projected to increase gasoline and diesel fuel consumption in the transportation sector relative to the No-Action Alternative even though total gasoline and fuel consumption by the transportation sector is projected to decline across all alternatives. The Proposed Action and alternatives are expected to have no discernable impact on energy consumption by other sectors of the U.S. economy. Chapter 4, *Air Quality*, discusses that the Proposed Action and alternatives are projected to increase emissions of most criteria air pollutants relative to the No-Action Alternative. Emissions of mobile source air toxics are projected to remain the same or increase relative to the No-Action Alternative. Higher emissions could lead to an overall increase in adverse health effects compared to conditions under the No-Action Alternative. As shown in Chapter 4, Table 4.2.1-9, the predicted increases in health effects are relatively small across all action alternatives.

8.4 Short-Term Uses, Long-Term Productivity, and Irreversible and Irretrievable Commitments of Resources

The Proposed Action and alternatives would increase both U.S. passenger car and light truck fuel consumption and CO_2 emissions relative to the No-Action Alternative. To meet CAFE standards, manufacturers may apply various fuel-saving technologies during the production of passenger cars and light trucks. Some vehicle manufacturers may commit additional resources to existing, redeveloped, or new production facilities to meet the fuel economy standards. NHTSA cannot predict with certainty what actions manufacturers may take, such as the specific

[5] Per DOT Order 5610.1D, Section 26(l), "[w]hile NEPA requires consideration of mitigation, it does not mandate the form or adoption of any mitigation."

technologies and materials manufacturers would apply and in what order. The specific amounts and types of resources (e.g., electricity, other forms of energy) that manufacturers would expend in meeting the CAFE standards would depend on the technologies and materials manufacturers select.[6]

[6] For further discussion of the costs and benefits of the proposed rule, consult Chapter 4.4 of NHTSA's Preliminary Regulatory Impact Analysis.