Final Supplemental Environmental Impact Statement

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

September 2026

U.S. Department of Transportation
National Highway Traffic Safety Administration

NHTSA

Final Supplemental Environmental Impact Statement for the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule III for Model Years 2022 to 2031 Passenger Cars and Light Trucks

Lead Agency

National Highway Traffic Safety Administration (NHTSA)

Cooperating Agencies

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

Overview

This Final 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 (EPCA), as amended by the Energy Independence and Security Act of 2007 (EISA). Environmental impacts analyzed in this Final SEIS include those related to fuel and energy use, air quality, and climate. In developing the final 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).

Timing of Agency Action

NHTSA is issuing this Final SEIS concurrently with the final rule (Record of Decision), pursuant to 49 U.S.C. 304a(b) and U.S. Department of Transportation Order 5610.1D Section 14.

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Declaration Related to Page Limits

NHTSA has considered the factors mandated by the National Environmental Policy (NEPA) and the Final Supplemental Environmental Impact Statement (SEIS) represents NHTSA's good-faith effort to prioritize documentation of the most important considerations required by the statute within the congressionally mandated page limits. This prioritization reflects NHTSA's expert judgment, and any considerations addressed briefly or left unaddressed were, in NHTSA's judgment, comparatively not of a substantive nature that meaningfully informed the consideration of environmental effects and the resulting decision on how to proceed.

Declaration Related to Deadline

The Final SEIS represents NHTSA's good-faith effort to fulfill NEPA's requirements within the Congressional timeline and is substantially complete. In NHTSA's expert opinion, NHTSA has thoroughly considered the factors mandated by NEPA. In NHTSA's judgment, the analysis contained herein is adequate to inform and reasonably explain NHTSA's final decision regarding the proposed Federal action.

This Final SEIS becomes a Federal document when evaluated, signed, and dated by the Responsible NHTSA Official.

Responsible NHTSA Official:

Jonathan Morrison, NHTSA Administrator

Date: 8/17/2026

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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 Final 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. Because MY 2026 and earlier passenger car and light truck fleets have been already produced and offered for sale by the time NHTSA is issuing a final rule to amend MY 2022-2031 Corporate Average Fuel Economy (CAFE) standards, this Final SEIS analyzes environmental impacts associated only with the MY 2027-2031 CAFE standards.

This Final SEIS compares the potential environmental impacts of the No-Action Alternative and five action alternatives for setting fuel economy standards for MY 2022-2026 and 2027-2031 passenger cars and light trucks. This Final SEIS analyzes the reasonably foreseeable environmental impacts of each CAFE action alternative relative to the No-Action Alternative. The agency's discussion in this Final SEIS of scientific and technical literature does not necessarily constitute an endorsement by the agency of that literature.

NHTSA prepared this Final 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 Final SEIS certain aspects of the analytical frame of prior CAFE Environmental Impact Statements (EISs). Specifically, this Final 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 required in

[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.").

an EIS.[4] Although 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 for informational purposes only.

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 49 U.S.C. ch. 329 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 Final SEIS to evaluate the potential environmental impacts of a reasonable range of alternatives the agency considered 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 Final 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 Alternative.[9] This Final SEIS analyzes reasonably foreseeable environmental impacts and discusses impacts in proportion to their significance.

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[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] 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 CFR 1.95(a)). Accordingly, the Secretary, DOT, and NHTSA are often used interchangeably in this Final SEIS.

[7] 42 U.S.C. 4321–4347.

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

[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 Final SEIS presents the environmental impacts of the Proposed Action and alternatives in comparative form so that reviewers may evaluate their comparative merits.

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]

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 [49 U.S.C. 32903]."[13] Therefore, in accordance with the recent direction from the President and Secretary of Transportation,[14] and pursuant to NHTSA's authority under 49 U.S.C. ch. 329, 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 issuing a final rule to reset the CAFE program to bring it into compliance with Administration policy and applicable substantive statutory requirements.[15]

NHTSA must establish separate average fuel economy standards for passenger cars and light trucks for each model year.[16] Standards must be "based on [one] or more vehicle attributes related to fuel economy" and "express[ed]…in the form of a mathematical function."[17]

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

[14] 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.

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

[16] 49 U.S.C. 32902(b)(1)-(2).

[17] 49 U.S.C. 32902(b)(3)(A).

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 setting new standards, NHTSA's Proposed Action also includes amending NHTSA's vehicle classification regulations (at 49 CFR part 523) starting in MY 2030, 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 setting 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 Final SEIS analyzes environmental impacts associated only with the final 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[18] 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 3.03 percent annually from the MY 2021 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 2030, NHTSA is reclassifying 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 2029 and MY 2030, the change in stringency reflects a change in the average standard value for each class between the two years. Although 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 MY 2022 compliance share for passenger cars and light trucks, as noted under

[18] 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).

each alternative below. A compliance share percentage is used to estimate what portion of the vehicle fleet would comply with a standard. For example, a 75-percent compliance share 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 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 Final SEIS, potential impacts are shown for the No-Action Alternative and five 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. Some values in Table S-1 will differ slightly from the respective table in the rulemaking documents because the Final SEIS analysis fleet differs from the fleet used in the standard-setting analysis. Although the regulatory alternatives considered in the Final SEIS are identical to those considered in the rulemaking analysis, some of the values in the table are a representation of the standards for which calculation includes vehicle-specific footprint values.

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).[19] As part of this analysis, NHTSA considered relevant safety and environmental factors. The alternatives evaluated in this Final SEIS therefore provide decision-makers with the ability to select from a wide range of alternatives. To establish a consistent baseline, all analyzed alternatives begin with a specific MY 2022 compliance share for passenger cars and light trucks. From the No-Action Alternative, stringencies then increase up to 2.81 percent and 3.03 percent for passenger cars and light trucks, respectively. Within this range, stringencies could remain the same or differ year to year between and among regulatory classes.

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

[19] In this Final 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.

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 share [a] MY 2022 0.44% per year for MYs 2023-2029 -0.56% for MY 2030 [b] 0.25% for MY 2031	80% compliance share [a] MY 2022 0.54% per year for MYs 2023-2029 -14.75% for MY 2030 [b] 0.25% for MY 2031
Alternative 2	75% compliance share [a] MY 2022 0.47% per year for MYs 2023-2029 -0.54% for MY 2030 [b] 0.25% for MY 2031	70% compliance share [a] MY 2022 0.46% per year for MYs 2023-2029 -14.79% for MY 2030 [b] 0.25% for MY 2031
Alternative 3 (Preferred)	70% compliance share [a] MY 2022 0.90% per year for MYs 2023-2029 0.25% for MY 2030 [b] 1.00% for MY 2031	50% compliance share [a] MY 2022 0.46% per year for MYs 2023-2029 -14.43% for MY 2030 [b] 1.00% for MY 2031
Alternative 4	55% compliance share [a] MY 2022 1.32% per year for MYs 2023-2029 -0.45% for MY 2030 [b] 0.50% for MY 2031	40% compliance share [a] MY 2022 1.50% per year for MYs 2023-2029 -14.66% for MY 2030 [b] 0.50% for MY 2031
Alternative 5	55% compliance share [a] MY 2022 2.81% per year for MYs 2023-2029 -0.40% for MY 2030 [b] 0.50% for MY 2031	40% compliance share [a] MY 2022 3.03% per year for MYs 2023-2029 -14.70% for MY 2030 [b] 0.50% for MY 2031

Notes:
[a] Compliance shares were determined based on the production-weighted share of vehicles that met or exceeded their target function value for each regulatory alternative in MY 2022.
[b] Stringency change reflects the growth rate in class average standard value from MYs 2029-2030. However, as explained in FRIA Chapter 3 and final rule preamble Section III.B, the standards differ for each vehicle and are mathematical functions of the vehicle's footprint. The coefficients for these mathematical functions, described here, are the same as those used throughout the rulemaking analysis and can be found in FRIA Chapter 3 and final rule preamble Section III.B. Changes in class average standard values reported in this table were calculated using the vehicles included in the Final SEIS analysis fleet. Because the Final SEIS analysis fleet differs from the fleet used in the standard-setting analysis, the changes in class average standards computed using it also differ from those computed using the standard-setting fleet. As a result, values reported here differ from those shown in other sections of the rulemaking analysis.

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	Alt. 4	Alt. 5
2027	47.1	29.7	30.4	32.6	35.9	38.8
2028	47.2	29.8	30.5	32.7	36.3	39.9
2029	48.1	29.9	30.7	32.9	36.8	41.1
2030	49.1	31.4	32.3	34.8	38.9	43.4
2031	50.1	31.5	32.3	35.2	39.1	43.6

Notes:
mpg = miles per gallon.

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 Final SEIS, respectively. Air quality and NCE impacts are reported for the entire light-duty (LD) vehicle fleet (passenger cars and light trucks combined[20]) for the No-Action Alternative and five 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 environmental implications related to the vehicle life-cycle phase considering the materials and 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 final 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 final 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 NCEs discussed in the main chapters of this Final 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

[20] 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.

ordinary prudence would take them into account in reaching a decision[21] 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 if the current CAFE standards were to continue in perpetuity. 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 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) 2026, developed in 2025, shows that the transportation sector accounted for 71.6 percent of total U.S. petroleum consumption and projects it to decrease to 65.0 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 improvements in vehicle fuel economy and increases in U.S. petroleum production, which together have substantially reduced U.S. oil imports, resulting in declining net petroleum imports.

In the foreseeable future, the transportation sector will 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 2026. AEO 2026 projects that the fuel consumed by LD vehicles will consist predominantly of gasoline derived from petroleum through 2050 due to conventional gasoline cars continuing to make up the majority of LD vehicle stock.[22] Detailed discussion of this information can be found in the relevant sections of Appendix E, *Energy*.

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

[22] Discussions about national energy consumption within this Final SEIS are generally based on data from AEO 2026, while reference to vehicle type-specific energy consumption is generally based on the CAFE Model.

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

- **Electricity.** Electricity currently makes up 0.6 percent of LD vehicle fuel consumption and is projected to increase to 7.6 percent across all LD vehicles by 2050, continuing to represent the largest share of fuel consumption outside of gasoline (EIA 2026a).
- **Diesel.** Diesel currently makes up 0.6 percent of fuel consumption for LD vehicles and is projected to increase to 0.9 percent by 2050 (EIA 2026a).
- **Biofuels.** Biofuels, including ethanol (E85), biodiesel, and renewable diesel, currently make up 6.0 percent of total transportation energy consumption.[23] AEO 2026 projects this share to increase to 6.3 percent in 2050 due to projected growth of renewable diesel and gasoline as a transportation fuel (EIA 2026b).
- **Hydrogen.** LD fuel cell vehicle hydrogen consumption is less than 0.01 percent of total LD fuel consumption as of 2025 and is projected to decrease through 2050 (EIA 2026a).

Reasonably Foreseeable Impacts of 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. Although 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.[24] This table reports total 2025 to 2050 fuel consumption under the No-Action Alternative in gasoline gallon equivalents, including gasoline, electricity, diesel, biofuel, and hydrogen, 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 83.9 percent of energy consumption by passenger cars and light trucks in 2050.

[23] The gasoline, diesel, 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.

[24] 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.

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 2027-2050) [a,b]

No-Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Fuel Consumption	**Change in Fuel Use Compared to the CAFE No-Action Alternative**				
2,388	+210 (+9%) [b]	+210 (+9%) [b]	+204 (+9%)	+186 (+8%)	+114 (+5%)

Notes:
[a] The values presented in this table were calculated based on Final SEIS CAFE Model runs and should not be compared with values presented in NHTSA's visualizer, which presents results from standard-setting CAFE Model runs.
[b] DOE made changes to the calculation of the petroleum equivalency factor (PEF) between the Draft SEIS and Final SEIS due to a recent court ruling. This change removed the fuel content factor from the PEF equation and resulted in a dampened impact of EVs on LD fleet compliance. These lower PEF values reduce the CAFE fuel economy values of EVs, which reduces the manufacturers' ability to lower the average fuel economy of their vehicle fleet with their produced EVs. Due to the change in PEF, fuel economy values will be higher for the Final SEIS than in the Draft SEIS. As a result of these higher fuel economy values, the fuel consumption values will also be significantly different from in the Draft SEIS.
[c] The estimated fuel consumption is the same under Alternative 1 and Alternative 2 because starting with MY 2030 vehicle manufacturers are assumed to offer vehicles using nearly the same discrete fuel economy technologies under either Alternative 1 or Alternative 2 and, therefore, 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 diameter equal to or less than 10 microns (PM_{10}) and 2.5 microns ($PM_{2.5}$, 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 $PM_{2.5}$ 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, *Reported Health Effects of Criteria Pollutants and Mobile Source Air Toxics from Studies*. 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 miles traveled 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 2026, passenger cars and light trucks are projected to contribute 41 percent of total U.S. emissions of CO, 11 percent of NO_X, 7 percent of $PM_{2.5}$, 17 percent of PM_{10}, 0.8 percent of SO_2, and 21 percent of VOCs (EPA 2026a). Almost all the PM in motor vehicle exhaust is $PM_{2.5}$; therefore, this analysis focuses on $PM_{2.5}$ rather than PM_{10}. VOCs and NO_X are chemical precursors of ozone. In addition, NO_X and VOCs can be $PM_{2.5}$ precursors. SO_2 and other oxides of sulfur also contribute to the formation of $PM_{2.5}$ in the atmosphere; however, on-road mobile sources account for 1 percent of U.S. SO_2 emissions.

Key Findings for Air Quality

This Final SEIS provides findings for air quality impacts for 2035 and 2050. In 2035 and 2050, emissions of NO_X, $PM_{2.5}$, and SO_2 decrease, and emissions of CO and VOCs increase under all action alternatives, compared to the No-Action Alternative. The changes in emissions are small in relation to total criteria pollutant emissions levels during this period. 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.[25] Other CAFE Model inputs and assumptions, discussed at length in Section II of the final 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.[26] 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 and 2050 were small relative to the emissions under the No-Action Alternative. Emissions of CO and VOCs increase under all action alternatives compared to the No-Action Alternative, while emissions of NO_X, $PM_{2.5}$, and SO_2 decrease. Relative to the No-Action Alternative, the modeling results suggest CO

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

[26] 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 Final 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.

and VOC emissions increases are smaller under Alternative 5 (the most stringent alternative in terms of estimated required miles per gallon) than under the other action alternatives. The increases in CO and VOC emissions in 2050 are larger than those in 2035. The decreases in NO_X, $PM_{2.5}$, and SO_2 emissions relative to the No-Action Alternative are larger under Alternative 5 than under the other action alternatives. The decreases in SO_2 emissions 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. The decreases in NO_X, $PM_{2.5}$, and SO_2 emissions are larger in 2050 than in 2035.

- 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 11.7 percent under Alternatives 1 and 2 in 2050 compared to the No-Action Alternative. Percentage increases in emissions of CO would be less. The smaller increases in CO are not expected to lead to changes in concentrations of criteria pollutants in the ambient air that are measurable. The larger increases in VOCs could lead to changes in ambient pollutant concentrations. The largest relative decreases in emissions (as a percentage) would occur for SO_2, for which emissions would decrease by as much as 7.5 percent under Alternative 5 in 2050 compared to the No-Action Alternative.

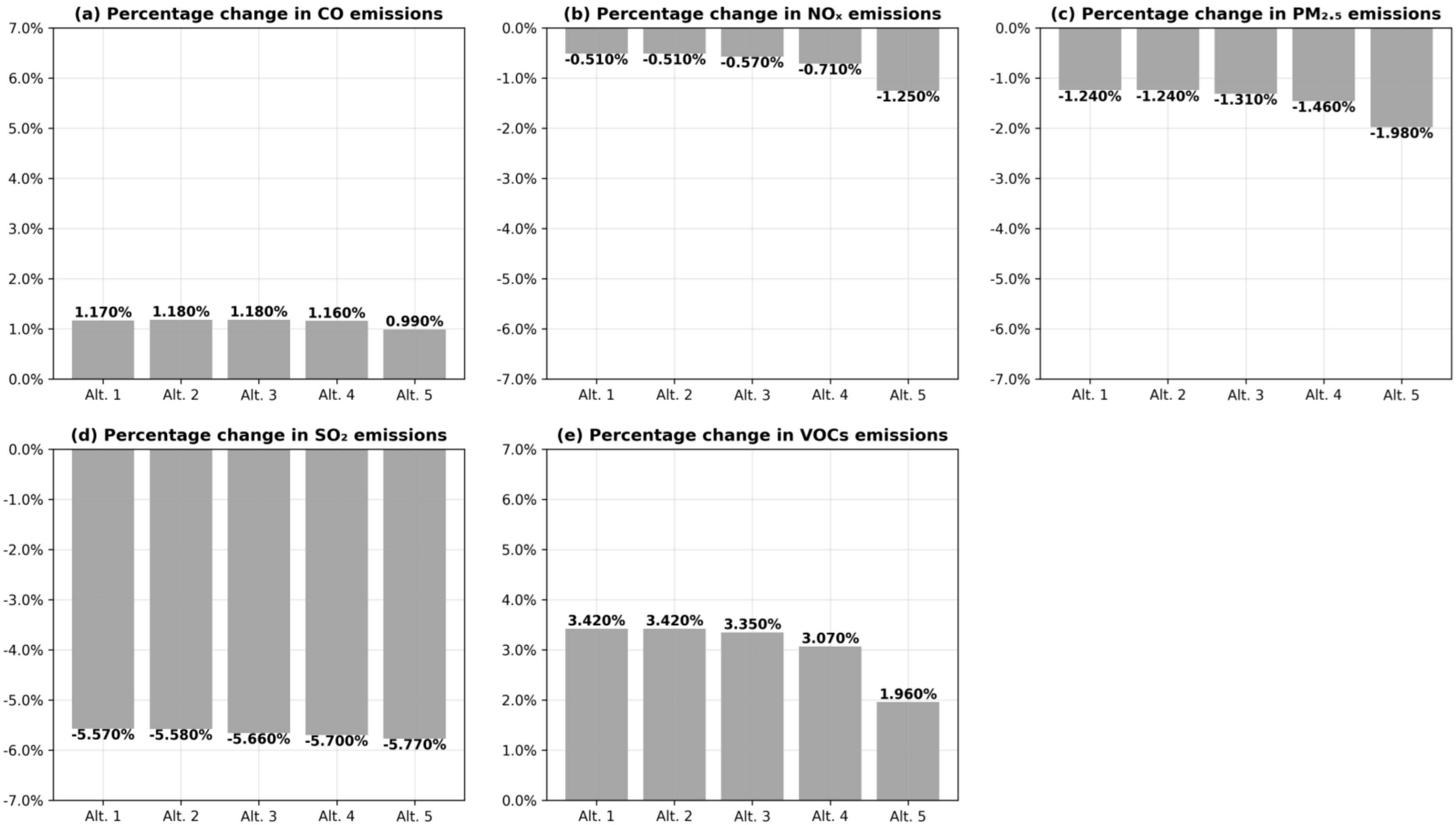
Mobile Source Air Toxics

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 smaller than in 2050). For all MSATs, the values of the increases under Alternatives 1, 2, and 3 (Preferred Alternative) are within 0.3 percent of each other, while the values of the increases under Alternatives 4 and 5 generally are smaller than under Alternatives 1, 2, and 3 (Preferred Alternative).
- The largest relative increases in emissions (as a percentage) generally would occur for formaldehyde for which emissions would increase by as much as 12.6 percent under Alternatives 1 and 2 in 2050 compared to the No-Action Alternative. Percentage increases in emissions of acetaldehyde, acrolein, 1,3-butadiene, benzene, and DPM would be less. The smaller increases are not expected to lead to changes in concentrations of MSATs in the ambient air that are measurable. 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.

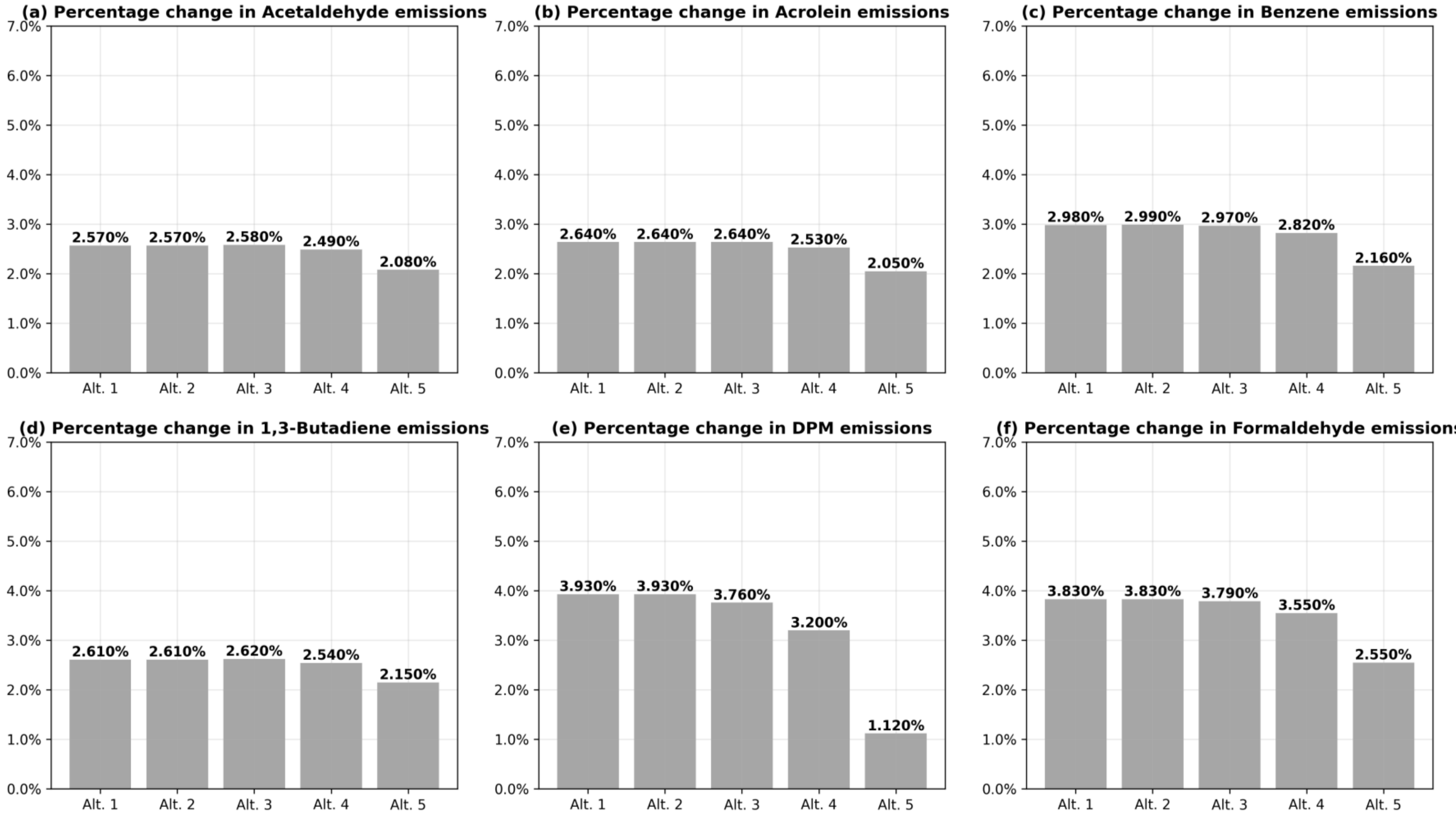
Changes in criteria pollutant emissions in 2035 are shown by action alternative in Figure S-1. Changes in MSAT emissions in 2035 are shown by action alternative in Figure S-2.

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; $PM_{2.5}$ = 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 Final SEIS, Chapter 5, *Non-Criteria Emissions*, includes a discussion of reasonably foreseeable impacts of NCEs, focusing on impacts associated with increases in NCEs from the Proposed Action and alternatives as compared to projected NCEs under the 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 F, Section F.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 No-Action Alternative, resulting in increases compared to the anticipated increases in global CO_2 concentrations, temperature, precipitation, sea level, and ocean acidification that would otherwise occur.[27]

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 F, Section F.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 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 F, Section F.3.4,

[27] 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 Final SEIS uses methods and data to analyze climate impacts that represent the best and most current information available on this topic.

Environmental Consequences: Other Associated Potential Impacts). More information on global emissions scenarios used in this analysis can be found in Appendix F, Section F.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 57,900 million metric tons of carbon dioxide ($MMTCO_2$) from 2027 through 2100 under the No-Action Alternative. Alternative 1 and Alternative 2 would increase these emissions by 13.82 percent by 2100, while Alternative 3 (Preferred Alternative) would increase these emissions by 13.47 percent, Alternative 4 would increase these emissions by 12.44 percent, and Alternative 5 would increase these emissions by 7.94 percent. Emissions would be highest under Alternative 2 and lowest under Alternative 5.[28]

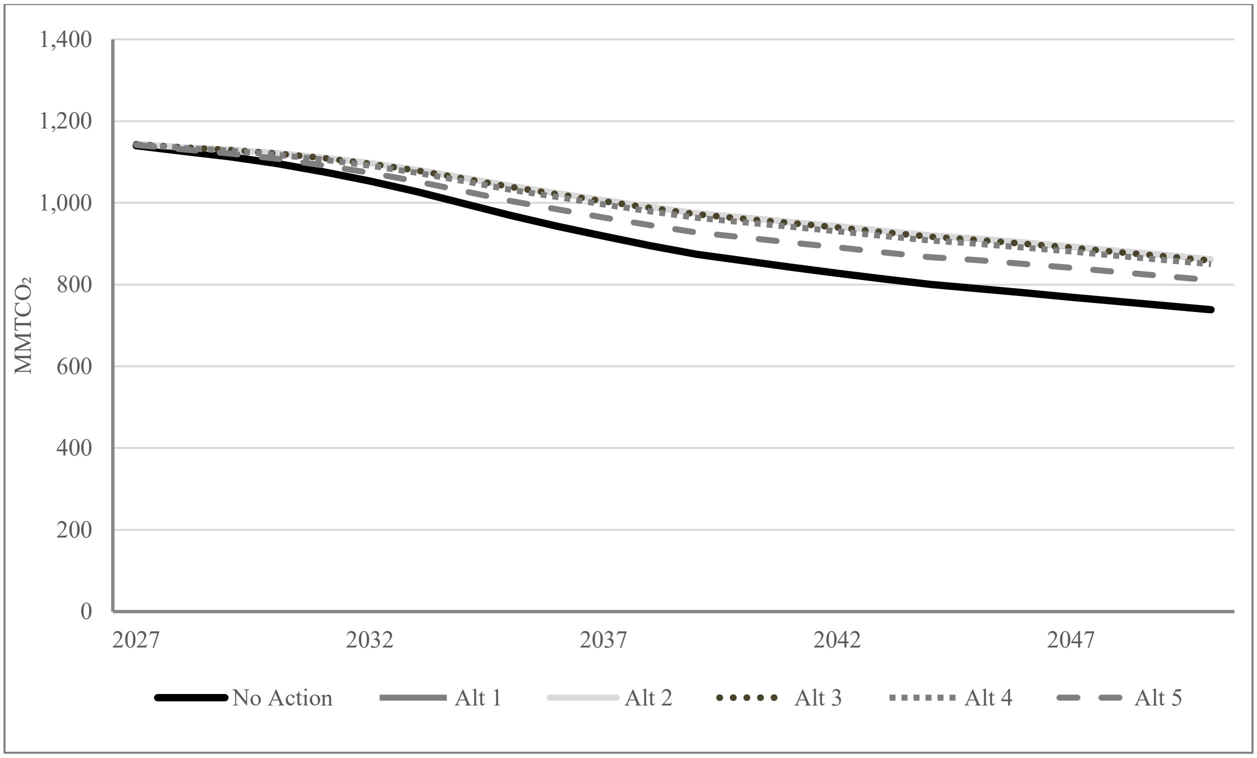
Compared with total projected CO_2 emissions of 679 $MMTCO_2$ from all passenger cars and light trucks under the No-Action Alternative in the year 2100, the action alternatives are expected to increase CO_2 emissions from passenger cars and light trucks in the year 2100 by 16.7 percent under Alternatives 1 and 2, 16.3 percent under Alternative 3 (Preferred Alternative), 15.1 percent under Alternative 4, and 9.8 percent under Alternative 5.

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 global CO_2 by 0.16 percent under Alternatives 1, 2, and 3 (Preferred Alternative), 0.14 percent under Alternative 4, and 0.09 percent under Alternative 5 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 18,332,995 vehicles under Alternative 1, 18,338,398 vehicles under Alternative 2, 17,860,954 vehicles under Alternative 3 (Preferred Alternative), 16,052,155 vehicles under Alternative 4, and 9,134,443 vehicles under Alternative 5. (A total of 246,418,215 passenger cars and light trucks are projected to be on the road in 2035 under the No-Action Alternative.)

[28] All CO_2 emissions estimates associated with the action alternatives include domestic 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. By 2100, each action alternative would increase CO_2 concentrations, global mean surface temperature, sea level, and precipitation, and would decrease ocean pH, compared to the No-Action Alternative.

Comparison of Alternatives

Reasonably Foreseeable Impacts of 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 of the Proposed Action and Alternatives [a]

No-Action [b]	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)	Alt. 4 (Change)	Alt. 5 (Change)
Energy: Combined U.S. Passenger Car and Light Truck Fuel Consumption and Change in Fuel Consumption for 2027-2050 (billion gasoline gallon equivalent)					
2,338	+210 (+9%) [c]	210 (+9%) [c]	+204 (+9%)	+186 (+8%)	+114 (+5%)
Air Quality: Criteria Air Pollutant Emissions in 2035 (tons per year)					
CO: 6,499,337 NO_X: 329,442 $PM_{2.5}$: 20,835 SO_2: 55,157 VOCs: 811,607	Decrease: NO_X (-1,667), $PM_{2.5}$ (-259), and SO_2 (-3,074). Increase: CO (+76,261) and VOCs (+27,743).	Decrease: NO_X (-1,669), $PM_{2.5}$ (-259), and SO_2 (-3,077); emissions are equal to Alt. 1 for $PM_{2.5}$ and lower than Alt. 1 for NO_X and SO_2. Increase: CO (+76,421) and VOCs (+27,762); emissions are higher than Alt. 1.	Decrease: NO_X (-1,867), $PM_{2.5}$ (-272), and SO_2 (-3,120); emissions are lower than Alts. 1 and 2. Increase: CO (+76,795) emissions are higher than Alts. 1 and 2; VOC (+27,205) emissions are lower than Alts. 1 and 2.	Decrease: NO_X (-2,345), $PM_{2.5}$ (-304), and SO_2 (-3,146); emissions are lower than Alts. 1-3. Increase: CO (+75,351) and VOCs (+24,927); emissions are lower than Alts. 1-3.	Decrease: NO_X (-4,124), $PM_{2.5}$ (-412), and SO_2 (-3,183); emissions are lower than Alts. 1-4. Increase: CO (+64,623) and VOCs (+15,919); emissions are lower than Alts. 1-4.
Air Quality: Criteria Air Pollutant Emissions in 2050 (tons per year)					
CO: 3,443,517 NO_X: 241,990 $PM_{2.5}$: 14,181 SO_2: 50,343 VOCs: 516,641	Decrease: NO_X (-3,288), $PM_{2.5}$ (-487), and SO_2 (-3,125). Increase: CO (+271,234) and VOCs (+60,301).	Decrease: NO_X (-3,335), $PM_{2.5}$ (-490), and SO_2 (-3,140); emissions are lower than Alt. 1. Increase: CO (+271,679) and VOCs (+60,357); emissions are higher than Alt. 1.	Decrease: NO_X (-3,836), $PM_{2.5}$ (-519), and SO_2 (-3,246); emissions are lower than Alts. 1 and 2. Increase: CO (+267,792) and VOCs (+59,190); emissions are lower than Alts. 1 and 2.	Decrease: NO_X (-4,796), $PM_{2.5}$ (-578), and SO_2 (-3,431); emissions are lower than Alts. 1-3. Increase: CO (+259,174) and VOCs (+55,887); emissions are lower than Alts. 1-3.	Decrease: NO_X (-7,357), $PM_{2.5}$ (-728), and SO_2 (-3,760); emissions are lower than Alts. 1-4. Increase: CO (+224,481) and VOCs (+41,154); emissions are lower than Alts. 1-4.
Air Quality: Mobile Source Air Toxic Emissions in 2035 (tons per year)					
Acetaldehyde: 2,216 Acrolein: 125 Benzene: 8,108 1,3-butadiene: 822 DPM: 54,286 Formaldehyde: 1,706	Decrease: None. Increase: Acetaldehyde (+57), acrolein (+3), benzene (+242), 1,3-butadiene (+21), DPM (+2,132), and formaldehyde (+65).	Decrease: None. Increase: Acetaldehyde (+57), acrolein (+3), benzene (+242), 1,3-butadiene (+21), DPM (+2,132), and formaldehyde (+65); emissions are equal to Alt. 1.	Decrease: None. Increase: Acetaldehyde (+57), acrolein (+3), benzene (+240), 1,3-butadiene (+22), DPM (+2,042), and formaldehyde (+65); emissions are equal to Alts. 1 and 2 for acetaldehyde, acrolein,	Decrease: None. Increase: Acetaldehyde (+55), acrolein (+3), benzene (+228), 1,3-butadiene (+21), DPM (+1,738), and formaldehyde (+61); emissions are equal to Alts. 1-3 for acrolein and less than Alts. 1-3 for	Decrease: None. Increase: Acetaldehyde (+46), acrolein (+3), benzene (+175), 1,3-butadiene (+18), DPM (+609), and formaldehyde (+44); emissions are equal to Alts. 1-4 for acrolein and less than Alts. 1-4 for

No-Action [b]	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)	Alt. 4 (Change)	Alt. 5 (Change)
			and formaldehyde; greater than Alts. 1 and 2 for 1,3-butadiene; and less than Alts. 1 and 2 for benzene and DPM.	acetaldehyde, benzene, 1,3-butadiene, DPM, and formaldehyde.	acetaldehyde, benzene, 1,3-butadiene, DPM, and formaldehyde.
Air Quality: Mobile Source Air Toxic Emissions in 2050 (tons per year)					
Acetaldehyde: 1,353 Acrolein: 75 Benzene: 4,898 1,3-butadiene: 499 DPM: 46,619 Formaldehyde: 1,033	Decrease: None. Increase: Acetaldehyde (+123), acrolein (+7), benzene (+538), 1,3-butadiene (+48), DPM (+3,545), and formaldehyde (+130).	Decrease: None. Increase: Acetaldehyde (+124), acrolein (+7), benzene (+538), 1,3-butadiene (+48), DPM (+3,543), and formaldehyde (+131); emissions are greater than Alt. 1 for acetaldehyde and formaldehyde, equal to Alt. 1 for acrolein, benzene, and 1,3-butadiene, and less than Alt. 1 for DPM.	Decrease: None. Increase: Acetaldehyde (+122), acrolein (+7), benzene (+530), 1,3-butadiene (+47), DPM (+3,386), and formaldehyde (+128); emissions are equal to Alts. 1 and 2 for acrolein and less than Alts. 1 and 2 for acetaldehyde, benzene, 1,3-butadiene, DPM, and formaldehyde.	Decrease: None. Increase: Acetaldehyde (+118), acrolein (+7), benzene (+509), 1,3-butadiene (+46), DPM (+2,984), and formaldehyde (+122); emissions are equal to Alts. 1-3 for acrolein and less than Alts. 1-3 for acetaldehyde, benzene, 1,3-butadiene, DPM, and formaldehyde.	Decrease: None. Increase: Acetaldehyde (+100), acrolein (+5), benzene (+415), 1,3-butadiene (+39), DPM (+1,381), and formaldehyde (+95); emissions are less than Alts. 1-4.
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 ($MMTCO_2$)					
57,900	+8,000	+8,000	+7,800	+7,200	+4,600
Climate: Changes in Atmospheric Carbon Dioxide Concentrations in 2100 (ppm) [d]					
-0.04	+0.77	+0.77	+0.75	+0.69	+0.45
Climate: Changes in Global Mean Surface Temperature Increase by 2100 in °C (°F) [d]					
-0.000°C (-0.000°F)	+0.003°C (+0.005°F)	+0.003°C (+0.005°F)	+0.003°C (+0.005°F)	+0.003°C (+0.005°F)	+0.002°C (+0.004°F)
Climate: Changes in Global Sea-Level Rise by 2100 in centimeters (inches) [d]					
-0.00 (-0.00)	+0.06 (+0.02)	+0.06 (+0.02)	+0.06 (+0.02)	+0.05 (+0.02)	+0.04 (+0.01)
Climate: Changes in Global Mean Precipitation Increase by 2100 [d,e]					
-0.00%	+0.01%	+0.01%	+0.00%	+0.00%	+0.00%

No-Action [b]	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)	Alt. 4 (Change)	Alt. 5 (Change)
Climate: Changes in Ocean Acidification in 2100 (pH) [d]					
0.0000	-0.0004	-0.0004	-0.0004	-0.0003	-0.0002

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] DOE made changes to the calculation of the PEF between the Draft SEIS and Final SEIS due to a recent court ruling. This change removed the fuel content factor from the PEF equation and resulted in a dampened impact of EVs on LD fleet compliance. These lower PEF values reduce the CAFE fuel economy values of EVs, which reduces the manufacturers' ability to lower the average fuel economy of their vehicle fleet with their produced EVs. Due to the change in PEF, fuel economy values will be higher for the Final SEIS than in the Draft SEIS. As a result of these higher fuel economy values, the emissions and fuel consumption values will also be significantly different from in the Draft SEIS.
[b] Except where otherwise noted, these values represent the totals for the No-Action Alternative.
[c] The estimated fuel consumption is the same under Alternative 1 and Alternative 2 because starting with MY 2030 vehicle manufacturers are assumed to offer vehicles using nearly the same discrete fuel economy technologies under either Alternative 1 or Alternative 2 and, therefore, the resulting fuel consumption would be the same for both alternatives.
[d] 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 changes to its vehicle classification regulations starting in MY 2030, which reconsiders how light trucks are classified; therefore, the two datasets used here will differ in the types of vehicles included. See Section VI of the final rule preamble and Chapter 3 of the Final Regulatory Impact Analysis for additional detail regarding the effect of NHTSA's fleet reclassification.
[e] 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; PEF = petroleum equivalency factor; $PM_{2.5}$ = 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. In June 2024, 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 clearly

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[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).

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] 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 [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

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[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.

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

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 issuing a final rule to reset the CAFE program 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 Final 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 Final SEIS to inform its amendment of MY 2027-2031 CAFE standards.[18] Because MY 2026 and earlier passenger car and light truck fleets have been already produced and offered for sale by the time NHTSA is issuing a final rule to amend MY 2022-2031 CAFE standards, this Final SEIS analyzes environmental impacts associated only with the MY 2027-2031 CAFE standards.

This Final 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 Final 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 Draft SEIS and 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 Final SEIS. The agency's discussion in this Final SEIS of scientific and technical literature does not necessarily constitute an endorsement by the agency of that literature.

NHTSA prepared this Final 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

[15] For further discussion on NHTSA's explanation of this action, see Section V of the final 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 opened a new docket for the Draft SEIS. However, the agency has considered the comments received in the prior docket as part of the preparation of this Final SEIS.

[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).

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 Final SEIS certain aspects of the analytical frame of prior CAFE EISs. Specifically, this Final 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 also 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 described in Section 1.1, *Introduction*, and NHTSA's June 2025 interpretive rule. Accordingly, NHTSA's Proposed Action is a final 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

[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.

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

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's Proposed Action

NHTSA is issuing a final rule to amend CAFE standards for light-duty (LD) vehicles for MYs 2022-2031. This Final SEIS informed NHTSA decision-makers and the public during the development of the standards as part of the rulemaking process.

For this Final SEIS, NHTSA's Proposed Action is 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. The Proposed Action, also known as the Preferred Alternative, and alternatives considered in this Final SEIS are discussed in Chapter 2, *Proposed Action and Alternatives and Analysis Methods*.

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[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* final rule preamble, Section V.A.

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

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

The Proposed Action and alternatives considered by NHTSA would amend CAFE standards for MYs 2022-2031 and would be less stringent than the No-Action Alternative.[31] NHTSA emphasizes that, in developing the CAFE standards that are represented by 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 29.7 to 38.8 miles per gallon (mpg) in MY 2027 and 31.5 to 43.6 mpg in MY 2031. This compares to estimated average required fuel economy levels of 47.1 mpg in MY 2027 and 50.1 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 32.6 mpg in MY 2027 and 35.2 mpg in MY 2031.[32]

However, the actual CAFE standards required to be met for a given manufacturer are dependent on the manufacturer's fleet composition for a given model year. In 2006 (light trucks)[33] and 2011[34] (passenger cars), NHTSA reformed the CAFE program to set standards based on an attribute: vehicle footprint.[35] In this rulemaking for MYs 2022-2031, NHTSA again is issuing attribute-based standards based on vehicle footprint for passenger cars and light trucks.

In Section III of the final rule 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.

1.4 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.[36] 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 Final 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 Final SEIS prior to publication.

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[31] 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.

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

[33] 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.

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

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

[36] 42 U.S.C. 4336a(a); DOT Order 5610.1D, Section 8.

1.5 Public Review and Comment

On December 3, 2025, the DOT announced NHTSA's proposed rule and accompanying Draft SEIS. EPA published a Notice of Availability for NHTSA's Draft SEIS in the *Federal Register* on December 5, 2025; publication of the Notice of Availability in the *Federal Register* triggered the Draft SEIS public comment period.[37] The following week's EPA Notice of Availability clarified that NHTSA was requesting public input on the agency's environmental analysis by January 20, 2026 (Docket No. NHTSA-2025-0490).[38] On December 5, 2025, NHTSA's Notice of Proposed Rulemaking (NPRM) was published in the *Federal Register,* and it invited the public to submit comments on the NPRM on or before January 20, 2026 (Docket No. NHTSA-2025-0491).[39] On January 14, 2026, NHTSA extended the comment period for the Draft SEIS and the NPRM to February 4, 2026.[40]

Consistent with NEPA and DOT Order 5610.1D, NHTSA provided direct notice of the availability of the agency's Draft SEIS to interested individuals and stakeholders. Specifically, NHTSA mailed a notification of the Draft SEIS to governors of every State and U.S. territory and federally recognized Native American tribes and tribal organizations. In addition, NHTSA sent email notification of the availability of the Draft SEIS to other potential stakeholders, including:

- Contacts at Federal agencies with jurisdiction by law or special expertise regarding the environmental impacts involved, or authorized to develop and enforce environmental standards, including other agencies within DOT.
- Organizations representing State and local governments.
- Individuals and contacts at stakeholder organizations that NHTSA reasonably expects to be interested in the NEPA analysis for the amended CAFE standards, including advocacy, industry, and other organizations.

NHTSA also held a virtual public hearing on the Draft SEIS and the proposed rule on January 7, 2026.[41] NHTSA received statements from 78 individuals at the hearing. The agency also received 68,294 comments in the docket for the proposed rule (Docket No. NHTSA-2025-0491) and 2,695 comments in the docket for the Draft SEIS (Docket No. NHTSA-2025-0490). NHTSA reviewed the oral and written submissions in both dockets for comments relevant to the Draft SEIS.

NHTSA addresses all public comments that were relevant to the Draft SEIS in Appendix C, *Responses to Public Comments*, of this Final SEIS. As explained in Appendix C, *Responses to Public Comments*, comments that raised issues central to the rule or the rulemaking process are

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[37] *Environmental Impact Statements; Notice of Availability*, 90 FR 56145 (Dec. 5, 2025).

[38] *Environmental Impact Statements; Notice of Availability*, 90 FR 57758 (Dec. 12, 2025).

[39] *The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rules III for Model Years 2022 to 2031 Passenger Cars and Light Trucks; Notice of Proposed Rulemaking*, 90 FR 56438 (Dec. 5, 2025).

[40] *The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rules III for Model Years 2022 to 2031 Passenger Cars and Light Trucks; Proposed Rule; Extension of Comment Period*, 91 FR 1494 (Jan. 14, 2026).

[41] Public Hearing for Corporate Average Fuel Economy Standards: The Safer Affordable Fuel-Efficient (SAFE) Vehicle Rule III for Model Years 2022 to 2031 Passenger Cars and Light Trucks; Notification of Public Hearing, 90 FR 57726 (Dec. 12, 2025).

addressed in the preamble to the final rule, the Final Regulatory Impact Analysis, or associated documents in the public docket.

1.6 Next Steps in the National Environmental Policy Act and Rulemaking Process

NHTSA is issuing this Final SEIS concurrently with the final rule, which serves as the Record of Decision (ROD). The ROD states and explains NHTSA's decision and describes NHTSA's consideration of applicable environmental laws and policies.[42] NHTSA has determined that concurrent issuance of the Final SEIS and ROD is not precluded by statutory criteria[43] or practicability considerations. NHTSA will publish this Final SEIS on its fuel economy website and file the Final SEIS with EPA's Office of Federal Activities.[44] NHTSA will notify the organizations and individuals that commented substantively on the Draft SEIS of the availability of the Final SEIS, as well as the entities to which the agency distributed the Draft SEIS.[45]

[42] *See* 49 U.S.C. 304a (Pub. L. No. 114-94, 129 Stat. 1312, Section 1311(a)); DOT Order 5610.1D, Sections 13.m and 14; U.S. Department of Transportation, Office of Transportation Policy, *Guidance on the Use of Combined Final Environmental Impact Statements/Records of Decision and Errata Sheets in National Environmental Policy Act Reviews* (Apr. 25, 2019), available at https://www.transportation.gov/sites/dot.gov/files/docs/mission/transportation-policy/permittingcenter/337371/feis-rod-guidance-final-04302019.pdf.

[43] 49 U.S.C. 304a(b)(1)-(2).

[44] DOT Order 5610.1D, Sections 13.n and 13.o.

[45] DOT Order 5610.1D, Section 13.n.

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 Final SEIS, NHTSA prepared this Final 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 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 Final SEIS certain aspects of the analytical frame of prior CAFE EISs. Specifically, this Final 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 Independence and Security Act of

[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.

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

2.2 Proposed Action and Alternatives

In conjunction with issuing a final rule to amend CAFE standards, NHTSA's Proposed Action also includes amending its vehicle classification regulations (at 49 CFR part 523) starting in MY 2030, which reconsiders how light trucks are classified.[5] Though NHTSA is amending MY 2022-2031 CAFE standards, as explained in Chapter 1, *Purpose and Need for the Action*, because no change in manufacturer behavior was possible for MY 2022-2026 passenger car and light truck fleets, this Final SEIS analyzes environmental impacts associated only with the 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 and V of the preamble to the final rule and Section I.c of NHTSA's June 2025 interpretive rule,[8] NHTSA's review of its CAFE standards responds to the conclusion that recently promulgated CAFE standards are inconsistent with the 49 U.S.C. ch. 329 statutory requirements applicable to the CAFE program and contrary to Administration policy.[9]

Consistent with NEPA and DOT Order 5610.1D, this Final SEIS compares a reasonable range of alternatives to the No-Action Alternative (Section 2.2.1, *No-Action Alternative*) and identifies the agency's Preferred Alternative.[10] NHTSA has selected Alternative 3 as the Preferred Alternative. See Section 2.2.2, *Action Alternatives*, for an explanation of all of NHTSA's action alternatives, including Alternative 3 (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

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[5] See Section VI of the final rule preamble, Chapter 3, and Chapter 6 of the Final Regulatory Impact Analysis (FRIA) for additional detail regarding NHTSA's 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.

[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 Final SEIS presents the environmental impacts of the Proposed Action and alternatives in comparative form so that reviewers may evaluate their comparative merits.

trucks. Because NHTSA is setting 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 Final SEIS reflect the combined environmental impacts associated with the 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 Final SEIS. DOT Order 5610.1D advises DOT Operating Administrations 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 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] remain in effect. 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 because the actual standards are coefficients that create a curve based on each manufacturer's fleet average footprint. 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. NHTSA's estimated average required fuel economy standards are based on the 2-cycle tests based on the statutory requirements, where the actual real-world fuel economy differs.[15] See Final Regulatory Impact Analysis (FRIA) 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.

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[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).

[15] 49 U.S.C. 32904 and 49 CFR 531.6 mandate that CAFE compliance calculations rely on the 2-cycle laboratory testing protocol. In contrast, the consumer-facing window sticker fuel economy estimates that drivers are typically accustomed to seeing on new vehicles are determined by the EPA's 5-cycle methodology.

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	47.1	47.2	48.1	49.1	50.1

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 3.03 percent annually from the MY 2021 standards for both passenger cars and light trucks through MY 2031.[16] 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 share for passenger cars and light trucks, as noted under each alternative below. A compliance share 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 share means the standard is calculated assuming 75 percent of vehicles in the MY 2022 fleet will comply with the modeled stringency. See Chapter 1 of the Technical Support Document (TSD) and Section III of the final rule preamble for more information on compliance share.

For purposes of its analysis, NHTSA assumes that the MY 2031 CAFE standards for each alternative would continue indefinitely.[17] 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.[18]

Throughout this Final SEIS, reasonably foreseeable impacts are shown for the No-Action Alternative and five action alternatives that illustrate different ranges of estimated average annual percentage increases in fuel economy[19] for both passenger cars and light trucks, as detailed in Table

[16] An exception to this range of stringency increases is that the stringency changes for MYs 2029-2030 become negative to reflect the growth rate in class average standard value between these two model years due to the fleet reclassification that occurs in MY 2030. Specifically, battery electric vehicles in the passenger car fleet tend to be smaller, and because of the vehicle reclassification adjustment for passenger cars, there is a resulting increase in their estimated required value for MYs 2029-2030.

[17] 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 Final SEIS would also depend on future standards established by NHTSA, but cannot be quantified at this time.

[18] For a full discussion of the agency's balancing of the statutory factors related to maximum feasible standards, consult the final rule. NHTSA balances the statutory factors in Section V.A.2 of the final rule preamble.

[19] 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, one percent more stringent than 30 mpg in one 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).

2.2.2-1. Some values in Table 2.2.2-1 will differ slightly from the respective table in the rulemaking documents, because the Final SEIS analysis fleet differs from the fleet used in the standard-setting analysis. While the regulatory alternatives considered in the Final SEIS are identical to those considered in the rulemaking analysis, some of the values in the table are a representation of the standards for which calculation includes vehicle-specific footprint values.

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	1.50% 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 share [a] MY 2022 0.44% per year for MYs 2023-2029 -0.56% for MY 2030 [b] 0.25% for MY 2031	80% compliance share [a] MY 2022 0.54% per year for MYs 2023-2029 -14.75% for MY 2030 [b] 0.25% for MY 2031
Alternative 2	75% compliance share [a] MY 2022 0.47% per year for MYs 2023-2029 -0.54% for MY 2030 [b] 0.25% for MY 2031	70% compliance share [a] MY 2022 0.46% per year for MYs 2023-2029 -14.79% for MY 2030 [b] 0.25% for MY 2031
Alternative 3 (Preferred)	70% compliance share [a] MY 2022 0.90% per year for MYs 2023-2029 0.25% for MY 2030 [b] 1.00% for MY 2031	50% compliance share [a] MY 2022 0.51% per year for MYs 2023-2029 -14.43% for MY 2030 [b] 1.00% for MY 2031
Alternative 4	55% compliance share [a] MY 2022 1.32% per year for MYs 2023-2029 -0.45% for MY 2030 [b] 0.50% for MY 2031	40% compliance share [a] MY 2022 1.50% per year for MYs 2023-2029 -14.66% for MY 2030 [b] 0.50% for MY 2031
Alternative 5	55% compliance share [a] MY 2022 2.81% per year for MYs 2023-2029 -0.40% for MY 2030 [b] 0.50% for MY 2031	40% compliance share [a] MY 2022 3.03% per year for MYs 2023-2029 -14.70% for MY 2030 [b] 0.50% for MY 2031

Notes:
[a] Compliance shares were determined based on the production-weighted share of vehicles that met or exceeded their target function value for each regulatory alternative in MY 2022.
[b] Stringency change reflects the growth rate in class average standard value from MYs 2029-2030. However, as explained in FRIA Chapter 3 and the final rule preamble Section III.B, the standards differ for each vehicle, and are mathematical functions of the vehicle's footprint. The coefficients for these mathematical functions, described here, are the same as those used throughout the rulemaking analysis and can be found in FRIA Chapter 3 and the final rule preamble Section III.B. Changes in class average standard values reported in this table were calculated using the vehicles included in the Final SEIS analysis fleet. Because the Final SEIS analysis fleet differs from the fleet used in the standard-setting analysis, the changes in class average standards computed using it also differ from those computed using the standard-setting fleet. As a result, values reported here differ from those shown in other sections of the rulemaking analysis.

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 Final 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 specific MY 2022 compliance share for passenger cars and light trucks, and then increase up to 2.81 percent and 3.03 percent for passenger cars and light trucks, respectively. 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 FRIA Chapter 4.3.1, *Compliance and Real-World Fuel Economy "Gap,"* for more discussion about the difference between adjusted and unadjusted fuel economy.

This Final 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 Final SEIS assumes that flexible fuel vehicles operate on gasoline 99 percent of the time and on E85 one percent of the time.

2.2.2.1 Alternative 1

Under Alternative 1, MY 2022 is derived from an 80-percent compliance share for both passenger cars and light trucks. Alternative 1 would require a 0.44-percent annual fleet-wide increase for passenger cars and a 0.54-percent increase for light trucks from MYs 2023-2029. For MY 2030, Alternative 1 would reflect a 0.56-percent annual fleet-wide decrease in required fuel economy standards for passenger cars and a 14.75-percent annual fleet-wide decrease in required fuel economy standards for light trucks from the MY 2029 CAFE standards due to the growth rate in class average standard value from MY 2029 to MY 2030, which reflects the fleet reclassification that occurs in 2030. For MY 2031, Alternative 1 would require a 0.25-percent annual fleet-wide increase in fuel economy for both passenger cars and light trucks from the MY 2030 CAFE standards. 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 Final SEIS.[20]

[20] The analysis performed for this Final 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 Final 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	35.7	35.8	35.6	35.7
Light trucks	27.5	27.7	27.8	23.7	23.7
Combined cars and trucks	29.7	29.8	29.9	31.4	31.5

mpg = miles per gallon.

2.2.2.2 *Alternative 2*

Under Alternative 2, MY 2022 is derived from a 75-percent compliance share for passenger cars and a 70-percent compliance share for light trucks. Alternative 2 would require a 0.47-percent annual fleet-wide increase for passenger cars and a 0.46-percent annual fleet-wide increase for light trucks from MYs 2023-2029. For MY 2030, Alternative 2 would reflect a 0.54-percent annual fleet-wide decrease in required fuel economy standards for passenger cars and a 14.79-percent annual fleet-wide decrease in required fuel economy standards for light trucks from the MY 2029 CAFE standards due to the growth rate in class average standard value from MY 2029 to MY 2030, which reflects the fleet reclassification that occurs in 2030. For MY 2031, Alternative 2 would require a 0.25-percent annual fleet-wide increase in fuel economy for both passenger cars and light trucks. Table 2.2.2-3 lists the estimated average required fleet-wide fuel economy under Alternative 2, as estimated in the analysis performed for this Final 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	36.7	36.9	36.7	36.8
Light trucks	28.2	28.3	28.4	24.2	24.3
Combined cars and trucks	30.4	30.5	30.7	32.3	32.3

mpg = miles per gallon.

2.2.2.3 *Alternative 3 (Preferred Alternative)*

Under Alternative 3 (Preferred Alternative), 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 0.90-percent annual fleet-wide increase for passenger cars and a 0.51-percent annual fleet-wide increase for light trucks from MYs 2023-2029. For MY 2030, Alternative 3 (Preferred Alternative) would reflect a 0.25-percent annual fleet-wide increase in required fuel economy standards for passenger cars and a 14.43-percent annual fleet-wide decrease in required fuel economy standards for light trucks from the MY 2029 CAFE standards due to the growth rate in class average standard value from MY 2029 to MY 2030, which reflects the fleet reclassification that occurs in 2030. For MY 2031, Alternative 3 (Preferred Alternative) would require a 1.00-percent annual fleet-wide increase in fuel economy for both passenger cars and light trucks from the MY 2030 CAFE standards. Table 2.2.2-4 lists the estimated average required fleet-wide fuel economy under Alternative 3 (Preferred Alternative).

Table 2.2.2-4. Alternative 3 (Preferred 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	38.8	39.2	39.5	39.6	40.0
Light trucks	30.2	30.4	30.5	26.1	26.4
Combined cars and trucks	32.6	32.7	32.9	34.8	35.2

mpg = miles per gallon.

2.2.2.4 Alternative 4

Under Alternative 4, MY 2022 is derived from a 55-percent compliance share for passenger cars and a 40-percent compliance share for light trucks. Alternative 4 would require a 1.32-percent annual fleet-wide increase for passenger cars and a 1.5-percent annual fleet-wide increase for light trucks from MYs 2023-2029. For MY 2030, Alternative 4 would reflect a 0.45-percent annual fleet-wide decrease in required fuel economy standards for passenger cars and a 14.66-percent annual fleet-wide decrease in required fuel economy standards for light trucks from the MY 2029 CAFE standards due to the growth rate in class average standard value from MY 2029 to MY 2030, which reflects the fleet reclassification that occurs in 2030. For MY 2031, Alternative 4 would require a 0.5-percent annual fleet-wide increase in fuel economy for both passenger cars and light trucks. Table 2.2.2-5 lists the estimated average required fleet-wide fuel economy under Alternative 4.

Table 2.2.2-5. Alternative 4: 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	43.4	44.0	44.6	44.4	44.6
Light trucks	33.1	33.6	34.1	29.1	29.3
Combined cars and trucks	35.9	36.3	36.8	38.9	39.1

mpg = miles per gallon.

2.2.2.5 Alternative 5

Under Alternative 5, MY 2022 is derived from a 55-percent compliance share for passenger cars and a 40-percent compliance share for light trucks. Alternative 5 would require a 2.81-percent annual fleet-wide increase for passenger cars and a 3.03-percent annual fleet-wide increase for light trucks from MYs 2023-2029. For MY 2030, Alternative 5 would reflect a 0.4-percent annual fleet-wide decrease in required fuel economy standards for passenger cars and a 14.7-percent annual fleet-wide decrease in required fuel economy standards for light trucks from the MY 2029 CAFE standards due to the growth rate in class average standard value from MY 2029 to MY 2030, which reflects the fleet reclassification that occurs in 2030. For MY 2031, Alternative 5 would require a 0.5-percent annual fleet-wide increase in fuel economy for both passenger cars and light trucks. Table 2.2.2-6 lists the estimated average required fleet-wide fuel economy under Alternative 5.

Table 2.2.2-6. Alternative 5: 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	46.8	48.2	49.6	49.4	49.6
Light trucks	35.8	36.9	38.1	32.5	32.6
Combined cars and trucks	38.8	39.9	41.1	43.4	43.6

mpg = miles per gallon.

2.3 Final SEIS Methods and Assumptions

Each of the alternatives considered in this Final 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 Final SEIS, NHTSA used the CAFE Model to estimate annual fuel consumption for each calendar year from 2024, 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 FRIA and in Section IV and V of the final rule preamble differ slightly from those presented in this Final 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.[21] 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."[22] This Final SEIS therefore presents results of an "unconstrained" analysis that considers manufacturers' potential use of banked 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 D, *CAFE Model Analysis Methods*.

[21] 49 U.S.C. 32902(h). See also, Resetting the Corporate Average Fuel Economy Program; Interpretive Rule, 90 FR 24518 (June 11, 2025).

[22] 42 U.S.C. 4332(2)(C)(i); DOT Order 5610.1D, Section 13.f.

2.3.2 Energy Market Forecast Assumptions

In this Final 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.[23]

References to the Annual Energy Outlook (AEO) 2026 (and earlier AEOs) in this Final 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 2026 in this Final SEIS because it is widely used and publicly available.

For more information on NHTSA's energy market forecast assumptions, see Chapter 4.1 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."[24]

In this Final 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 Final 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 Final SEIS, NHTSA reviewed several peer-reviewed studies, rather than undertaking new scientific or technical research, to inform the analysis.[25]

[23] 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.

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

[25] Peer-reviewed studies include the Intergovernmental Panel on Climate Change Sixth Assessment Report (2021a, 2021b) and the U.S. Global Change Research Program (GCRP) Fifth National Climate Assessment (GCRP 2023).

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

In this Final 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,[26] 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 final rule preamble, applies here to the fuel consumption and non-criteria emissions (NCEs)[27] increases anticipated to occur under the Proposed Action and alternatives. The agency's discussion of its responsibilities under the ESA is addressed in the final rule preamble in Section VII.B.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 final 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 final rule preamble and Chapter 7.2.1 of the FRIA.
- **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 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,

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

[27] Throughout this Final 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.

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 FRIA. 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).[28] 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

[28] NHTSA has made analytical updates to how it estimates downstream emissions, as discussed in the final rule preamble.

generation, which can vary regionally. NHTSA estimated domestic upstream emissions of NCEs and criteria air pollutants and global upstream emissions for mobile source air toxics. See TSD Chapter 5.2 for further discussion about NHTSA's upstream emissions methodologies. Upstream emissions considered in this Final SEIS are those associated with changes in fuel consumption between the No-Action Alternative and action alternatives. This includes emissions from recovery, extraction, and transportation of crude petroleum, and refining, storage, and distribution of transportation fuels. Analysis throughout this Final 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. This analysis is presented to ensure a complete disclosure of the fuel cycle. A detailed methodology of how NHTSA models these statistical relationships is provided in TSD Chapter 5. Analysis throughout this Final 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, and hydrogen) 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.

CHAPTER 3 ENERGY

NHTSA's light-duty (LD) vehicle fuel economy standards regulate vehicle fuel economy and fuel efficiency, considering the need of the United States to conserve energy, one of four statutorily required factors.[1] 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 considers the sources of energy for LD vehicles to include petroleum, electricity, diesel, biofuels, and hydrogen. NHTSA also uses the CAFE Model to analyze how the environmental impacts resulting from 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, import, and distribution.[2] NHTSA discusses consumption of all LD energy types and these relevant environmental impacts in this chapter and Appendix E, *Energy*.

3.1 Introduction

To evaluate changes in LD vehicle fuel consumption under the Proposed Action and alternatives and the associated environmental impacts, NHTSA first discusses projected LD vehicle fuel consumption between 2027 and 2050, as estimated by the CAFE Model, and then characterizes the current fuel consumption landscape. All CAFE Model results presented in this chapter are specific to U.S. LD vehicle consumption because other countries have different fuel use patterns. The CAFE Model shows that gasoline (including ethanol used in gasoline blending) is projected to account for 96.7 percent of LD vehicle fuel consumption in 2027, and for 83.9 percent of consumption in 2050.[3] As illustrated in Table 3.1-1, the CAFE Model projects the gasoline share of LD vehicle fuel use to decline mostly as a result of projected growth in electricity, which is projected to increase from 1.8 percent of consumption in 2027 to 13.8 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.

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

[2] 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.

[3] The CAFE Model projections differ from the AEO 2026 projections discussed in this chapter 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 LD CAFE standards.

Table 3.1-1. CAFE Model Estimates of Energy Consumption for LD Vehicles for 2027 and 2050 Under the No-Action Alternative [a]

Fuel	2027 (%)	2050 (%)
Gasoline (including ethanol blending)	96.7	83.9
Electricity	1.8	13.8
Diesel	0.7	1.1
E85	0.8	<0.1
Hydrogen	0.1	1.1

Please consult Chapter 2 in the Technical Support Document for additional information.
[a] The percentages presented in this table were calculated based on Final SEIS CAFE Model runs and should not be compared with values presented in NHTSA's Data Visualization Tool, which presents results from standard-setting CAFE Model runs.

As described in Chapter 2, *Proposed Action and Alternatives and Analysis Methods*, the CAFE Model relies on projections from the 2026 Annual Energy Outlook (AEO) to describe current and future U.S. energy production and consumption. 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 2026 projections presented throughout this chapter reflect the projections from the Alternative Electricity and Transportation Case and represent a hypothetical scenario based on sector-specific policy assumptions and relevant market prices, resource constraints, and available technologies as of December 2025.

In addition, the AEO 2026 projections presented in this chapter are used to characterize baseline energy consumption trends beginning in 2025 and do not incorporate the impacts of the Proposed Action or regulatory alternatives. Accordingly, CAFE Model results are presented starting in MY 2027, the first year in which differences across alternatives emerge. Differences between AEO projections and CAFE Model estimates in overlapping years reflect variations in model structure and underlying assumptions. As such, the two sets of projections are discussed to provide complementary context on U.S. energy market trends but are not directly comparable.

As reported by AEO 2026, transportation sector fuel consumption accounts for 29.9 percent of total U.S. energy consumption (EIA 2026a). Transportation sector fuel consumption is projected to decrease from 28.5 quadrillion British thermal units (quads) in 2025 to 28.1 quads in 2050. In 2025, petroleum (including gasoline and diesel blended with ethanol and biodiesel) supplied 94.0 percent of transportation energy use, biofuel (including blended biofuel totals) 6.0 percent, natural gas 5.0 percent, hydrogen 0.001 percent, liquefied petroleum gas (propane) 0.04 percent, and purchased electricity 0.8 percent (EIA 2026a, 2026b).[4] In 2050, AEO 2026 projects that petroleum would supply 83.4 percent, biofuel 6.3 percent, natural gas 9.6 percent, hydrogen 0.0002 percent, liquefied petroleum gas 0.02 percent, and purchased electricity 7.1 percent of transportation energy use.

In 2025, LD vehicles accounted for 52.1 percent of transportation energy consumption, commercial light trucks for 3.1 percent, buses and freight trucks for 21.1 percent, air travel for

[4] 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.

11.5 percent, and other transportation (*e.g.*, boats, rail, pipeline) for 12.2 percent (EIA 2026c). In 2050, LD vehicles are expected to account for 41.7 percent of transportation energy consumption, with commercial light trucks 3.3 percent, buses and freight trucks 22.2 percent, air travel 14.8 percent, and other transportation 18.0 percent.[5] As further discussed in Appendix E, Section E.3, *Environmental Consequences: Other Associated Potential Impacts*, these projections may overestimate the projected decline in the percentage of transportation energy use attributable to LD vehicles.

In 2025, the transportation sector accounted for 71.6 percent of total U.S. petroleum consumption, and in 2050, it is expected to account for 65.0 percent of U.S. petroleum use (EIA 2026a).[6] Between 2025 and 2050, transportation sector gasoline consumption is projected to decrease by 23.1 percent, despite an 8.0 percent projected increase in vehicle miles traveled by LD vehicles (EIA 2026a, 2026d).

The AEO 2026 Alternative Electricity and Alternative Transportation Case reflects a joint policy scenario in which recent Federal emissions regulations affecting both the electricity and transportation sectors are not in place. For the electricity sector, the case assumes that generators operate under regulatory requirements in place prior to EPA's April 2024 revisions to Clean Air Act section 111, reflecting the assumption that EPA's repeal of those standards is finalized. Therefore, the case assumes the rule regulating carbon dioxide 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 or operating restrictions. Carbon capture technologies may still be deployed if economical, and State or regional programs are modeled consistently with the AEO 2026 Alternative Electricity and Alternative Transportation Case.

For the transportation sector, the AEO 2026 Alternative Electricity and Alternative Transportation Case assumes that the most recent Federal vehicle tailpipe emissions standards are not implemented. Specifically, this case removes EPA tailpipe emissions standards for LD vehicles beginning in MY 2027, as well as EPA Phase 3 emissions and low nitrogen oxide standards for freight trucks and buses beginning in MY 2027. However, standards for MY 2026 and earlier are assumed to remain in effect because while NHTSA is resetting 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 this case in this chapter, Appendix E, *Energy*, and throughout this Final SEIS because these AEO projections are used as inputs in the CAFE Model. However, these projections reflect baseline conditions and do not incorporate the impacts of the Proposed Action or other action alternatives, which are

[5] The projected decline in the percentage of transportation energy used by LD vehicles reflects the fuel economy improvements that would be expected under the No-Action Alternative.

[6] The docket for this Final SEIS (NHTSA-2025-0490) includes an Excel workbook that shows how values reported in this chapter reflect separate AEO 2026 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.

estimated separately using the CAFE Model.[7] Section 3.2, *Affected Environment*, provides additional discussion of transportation energy sources, which are related directly to the current action because any changes in NHTSA's fuel economy standards affect 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.

Broad projections are inherently uncertain and may not incorporate uncertainties and unexpected developments that may affect the central estimate, such as changes in energy markets since the publication of AEO 2026. Uncertainties and unexpected developments that have occurred since the AEO 2026 publication are discussed in Appendix E, Section E.3, *Environmental Consequences: Other Associated Potential Impacts*.[8] 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 E, Section E.3, *Environmental Consequences: Other Associated Potential Impacts*.

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,[9] NHTSA analyzes the changes in quantities of gasoline and diesel fuels consumed as a result of changing CAFE standards. For this Final SEIS analysis, NHTSA also assesses changes in electricity, diesel, biofuels, and hydrogen, 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 E, Section E.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.[10] NHTSA cannot analyze all of the impacts of its action related to LD fuel production and consumption quantitatively, but provides the aforementioned qualitative discussion of environmental impacts to give additional context to its quantitative estimates of changes in LD fuel production, transportation, and consumption. NHTSA does quantitatively analyze the changes in criteria pollutant and non-criteria emissions (NCEs) from LD fuel production in the CAFE Model analysis.

[7] 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 final rule preamble, Final Technical Support Document, and Regulatory Impact Analysis.

[8] Unforeseen shifts and major events, as discussed in Appendix E, Section E.3, include changes in energy markets since the publication of AEO 2026, as well as uncertainties that may not be fully captured in AEO 2026 side cases for the electricity and transportation sectors.

[9] 49 U.S.C. 32902(h).

[10] Appendix E, *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 changes to CAFE standards.

3.3 Environmental Consequences: Reasonably Foreseeable Impacts of the Proposed Action

This section examines the reasonably foreseeable impacts of the Proposed Action and alternatives on energy consumption, production, and transportation. The term *impacts* in this section refers only to impacts of the Proposed Action. Under the No-Action Alternative, the fuel economy, or the distance traveled per unit of energy, of all LD vehicles in use is projected to increase between 2027 and 2050 as older, less efficient vehicles are replaced with newer, more fuel-efficient models. Under all action alternatives, LD vehicle fuel economy is projected to decrease through 2050 relative to the No-Action Alternative.[11]

Consistent with these changes in fleet energy use, total fuel consumption between 2027 and 2050 is projected to increase relative to the No-Action Alternative. Table 3.3-1 shows projected fuel use from 2027 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.

While total fuel consumption varies across alternatives, the composition of fuel use remains broadly similar. For example, gasoline is projected to account for 84 to 89 percent of the total gasoline gallon equivalent[12] use in 2050 under all the alternatives.

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 2027-2050) [a]

No-Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Fuel Consumption	Change in Fuel Use Compared to the No-Action Alternative				
2,338	+210 (+9%) [b]	210 (+9%) [b]	+204 (+9%)	+186 (+8%)	+114 (+5%)

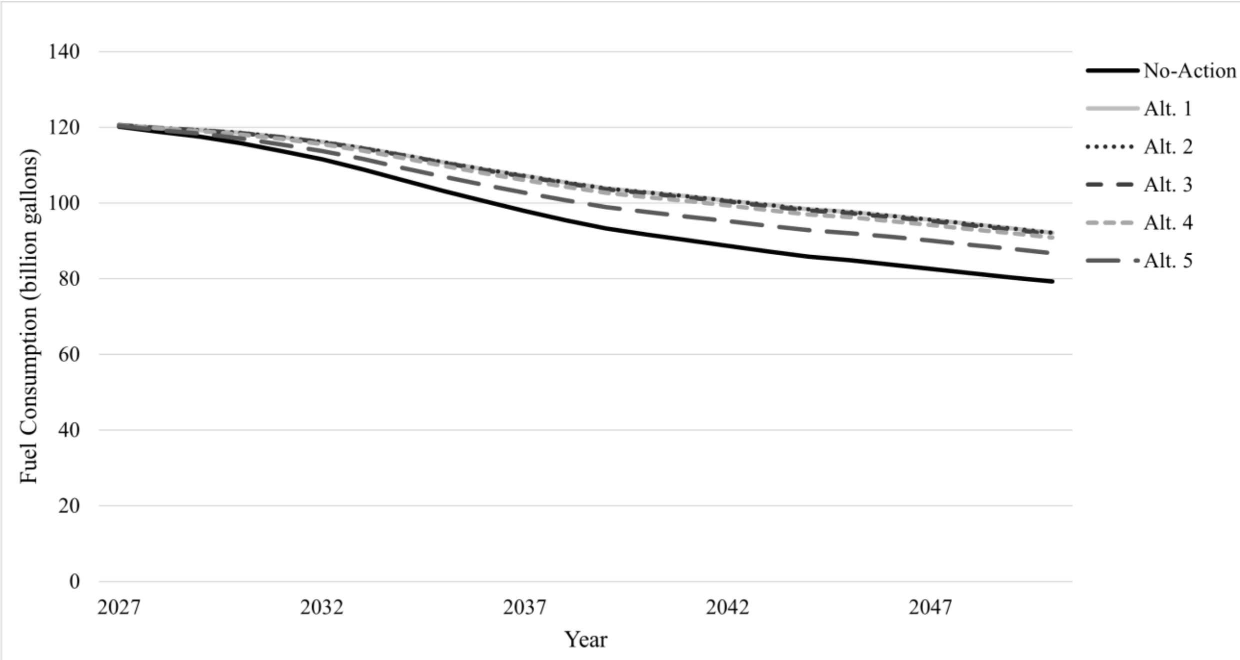
Notes:
[a] The values presented in this table were calculated based on Final SEIS CAFE Model runs and should not be compared with values presented in NHTSA's Data Visualization Tool, which presents results from standard-setting CAFE Model runs.
[b] The estimated fuel consumption is the same under Alternative 1 and Alternative 2 because starting with MY 2030 vehicle manufacturers are assumed to offer vehicles using nearly the same discrete fuel economy technologies under either Alternative 1 or Alternative 2 and, therefore, the resulting fuel consumption would be the same for both alternatives.

Though total LD fuel consumption (2027-2050) is projected to increase relative to the No-Action Alternative, annual LD fuel consumption is projected to decline between 2027 and 2050 for all alternatives, as shown in Figure 3.3-1.

[11] 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.

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

Figure 3.3-1. Total Fuel Consumption by Alternative [a,b]



Notes:
[a] The values presented in this figure were calculated based on Final SEIS CAFE Model runs and should not be compared with values presented in NHTSA's Data Visualization Tool, which presents results from standard-setting CAFE Model runs.
[b] The estimated fuel consumption is the same under Alternative 1 and Alternative 2 because starting with MY 2030 vehicle manufacturers are assumed to offer vehicles using nearly the same discrete fuel economy technologies under either Alternative 1 or Alternative 2 and, therefore, the resulting fuel consumption would be the same for both alternatives. As such, Alternative 1 is not visible in the figure because it underlies Alternative 2.

This decrease in fuel consumption over the analysis period 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 proportionate to the increase in fuel consumption under the Proposed Action and alternatives relative to total U.S. fuel consumption under the No-Action Alternative over the analysis period representing 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 E, Section E.3, *Environmental Consequences: Other Associated Potential Impacts*.

CHAPTER 4 AIR QUALITY

4.1 Affected Environment

4.1.1 Relevant Pollutants and Standards

To power a vehicle, an engine burns a mixture of air and fuel, transferring this mechanical energy through the transmission and driveline to the wheels. This combustion process creates various pollutants as byproducts, which are released into the air through the tailpipe. Because changes in vehicle fuel efficiency directly increase or decrease the total amount of pollutants released into the air, NHTSA closely evaluates these environmental impacts.

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. Under the CAA, as amended, EPA has established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants.[1] The six criteria pollutants are carbon monoxide (CO), nitrogen dioxide (NO_2), ozone, sulfur dioxide (SO_2),[2] particulate matter (PM; less than 10 microns in diameter [PM_{10}] and less than 2.5 microns in diameter [$PM_{2.5}$]),[3] and lead. Vehicles do not directly emit ozone, but this pollutant is evaluated based on emissions of the ozone precursor pollutants, oxides of nitrogen (NO_X) and volatile organic compounds (VOCs). In addition, NO_X and VOCs can be $PM_{2.5}$ precursors.[4] 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.[5] Lead is no longer emitted from motor vehicles in more than negligible quantities. Therefore, this analysis does not address lead. This EIS reports air quality based on CO, NO_X, $PM_{2.5}$, SO_2, and VOCs.

Total emissions from on-road mobile sources (highway vehicles) have declined dramatically since 1970 because of pollution-control technologies 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

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[1] *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.

[2] SO_2 and other oxides of sulfur (SO_X) contribute to the formation of $PM_{2.5}$ in the atmosphere; however, in 2026 on-road mobile sources are projected to account for 1 percent of U.S. SO_2 emissions (EPA 2026a) due to the introduction of fuel sulfur limits for both gasoline and diesel.

[3] Over 90 percent of the PM in motor vehicle exhaust is $PM_{2.5}$ (Cadle *et al*. 1999). The proportion of $PM_{2.5}$ in PM from brake and tire wear is similarly high. The proportion of $PM_{2.5}$ in road dust is much lower and that of PM_{10} is much higher. However, the human respiratory system largely traps PM_{10} in the upper airways (nose, throat, and bronchi), while $PM_{2.5}$ can reach the alveoli and can enter the bloodstream, causing greater health effects than does PM_{10}. Therefore, this analysis focuses on $PM_{2.5}$ rather than PM_{10}.

[4] 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 $PM_{2.5}$. Highway vehicle emissions are large contributors to nitrate formation nationally (EPA 2004).

[5] 40 CFR 51.100(s).

their chemical precursors. In 2026, passenger cars and light trucks are projected to contribute 41 percent of total U.S. emissions of CO, 11 percent of NO_X, 7 percent of $PM_{2.5}$, 17 percent of PM_{10}, 0.8 percent of SO_2, and 21 percent of VOCs (EPA 2026a).

The ambient pollutant concentrations that can result from these emissions vary widely from place to place. Emissions from vehicles can increase pollutant concentrations near roadways. Studies have shown that concentrations of CO, nitric oxide (NO), 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.[6]

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. Exhaust emissions are directed out of the engine and to the vehicle's tailpipe through emissions control systems that capture air pollutants or convert them into less harmful byproducts, such as 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 fuel. Road dust consists of particles present on the road surface, generated by traffic or transported and deposited from near or long-range sources. Particulates released from tire and brake wear are constituents of road dust, where vehicle operations slowly wear down tires and brakes and pieces of their materials are abraded or worn off onto the roadway and near-road environment. Wear of the roadway materials also generates road dust particulates due to the action of tires on the road surface. Vehicle weight affects emissions rates of road dust particles, with heavier vehicles generating greater emissions per VMT than lighter vehicles. Because of these multiple sources, road dust particulates can contain a complex combination of toxic chemicals, microplastics, heavy metals, and soil minerals.

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. NHTSA uses the CAFE Compliance and Effects Modeling System (the CAFE Model)[7] to simulate manufacturers' potential responses to new CAFE standards and to estimate various impacts of those responses.

[6] 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).

[7] For this Final 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 D, *CAFE Model Analysis Methods*, respectively. For additional discussion of how air quality was modeled please see Appendix F, *Air Quality and NCE Methodology and Other Information*.

4.1.1.1 Reported Health Effects of Criteria Pollutants and Mobile Source Air Toxics from Studies

Studies have shown 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.[8] 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 Final SEIS are CO, NO_2, ozone, SO_2, and PM. Health effects of criteria pollutants and mobile source air toxics (MSATs) discussed below occur regardless of the emissions source. The health outcomes with the strongest evidence of linkages to traffic-associated criteria air pollutants are respiratory effects and cardiovascular effects (EPA 2014).[9]

A systematic review and meta-analysis of studies evaluated the risk of childhood leukemia associated with traffic exposure and reported positive associations[10] 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 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).

[8] 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).

[9] 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).

[10] In epidemiology, *association* refers to a statistical relationship between two or more variables that occur together more frequently than would be expected by chance, *e.g*., if a certain dietary pattern is found to occur more often in people with heart disease than in those without, epidemiologists might say there is an association between that diet and heart disease. Association is necessary but not sufficient to establish causation. EPA Integrated Science Assessments for each pollutant cite and explain studies that support causal relationships.

[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).

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 designates all areas of the United States as attainment (measured criteria pollutant concentrations are less than the NAAQS), nonattainment (measured criteria pollutant concentrations have violated the NAAQS), or maintenance (former nonattainment areas in which current concentrations are less than the NAAQS). The conformity requirements apply only in nonattainment and maintenance areas. 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

[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).

can entail air quality modeling studies, consultations with EPA and 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 F, *Air Quality and NCE Methodology and Other Information*, Section F.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 of the Proposed Action

This section examines the reasonably foreseeable impacts of the Proposed Action and alternatives on criteria pollutant and MSAT emissions. To provide a regional perspective, NHTSA projected impacts on nonattainment and maintenance areas because air quality problems have been the greatest in these 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, and are discussed in Section 4.2.1, *Criteria Pollutants*, for criteria pollutants and Section 4.2.2, *Mobile Source Air Toxics*, for MSATs. Estimated health impacts of the action alternatives are discussed in Section 4.2.3, *Health Impacts*. Though 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 F, Section F.2.3, *Environmental Consequences: Other Associated Potential Impacts,* solely for informational purposes.

4.2.1 Criteria Pollutants

4.2.1.1 Emissions Levels

Table 4.2.1-1 summarizes the total upstream[19] and tailpipe 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. Figure 4.2.1-1 shows the trends from 2027 to 2050 in total upstream and tailpipe national emissions under the

[19] *Upstream emissions* are those associated with crude-petroleum (feedstock) recovery and transportation, and with production, refining, transportation, storage, and distribution of transportation fuels.

No-Action Alternative and the action alternatives. Though 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 upstream emissions are not necessary for reasoned decision-making, the agency nonetheless provides such discussions in this chapter solely for informational purposes.

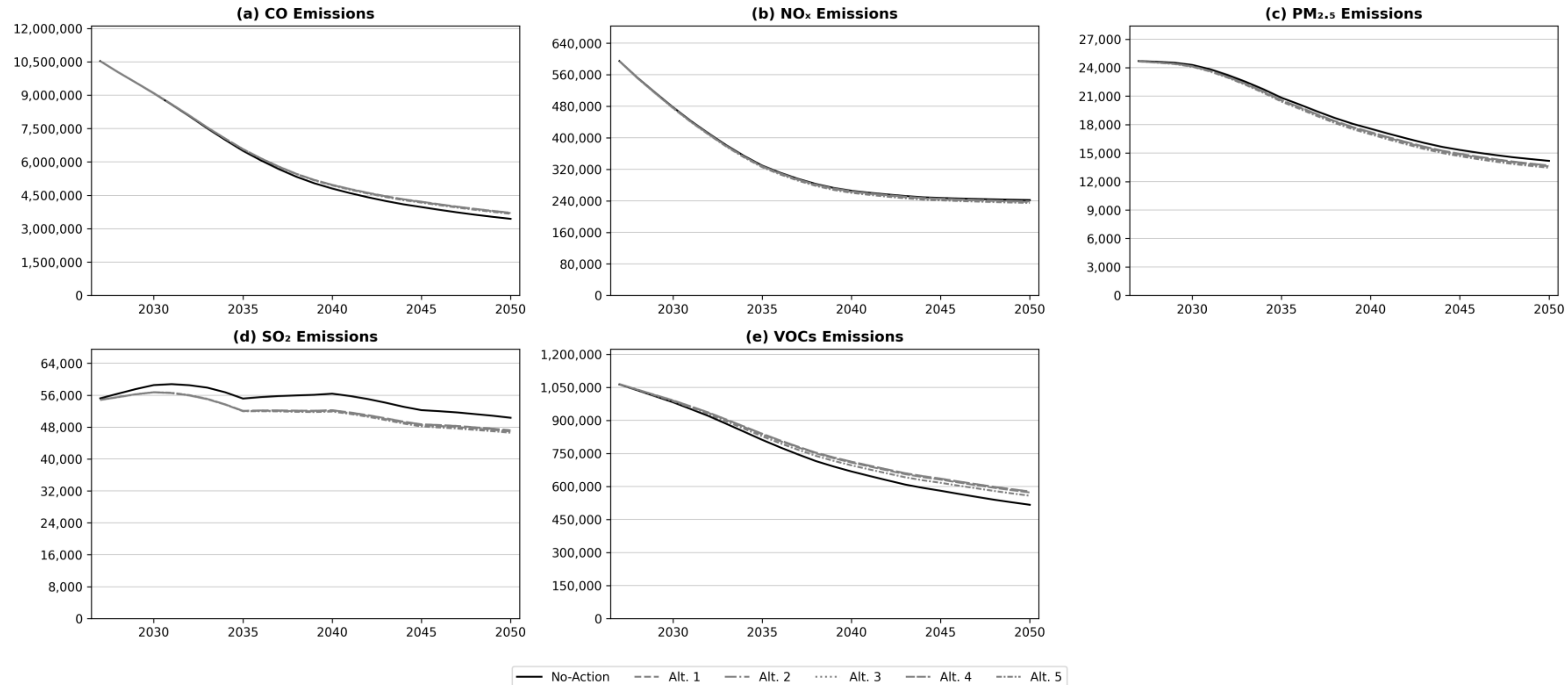
Table 4.2.1-1. Nationwide Criteria Pollutant Emissions (tons[20] per year) from U.S. Passenger Cars and Light Trucks for the No-Action Alternative, and Incremental Change in Emissions by Action Alternative, Proposed Action Impacts [a,b,c]

Year	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)	Alt. 4 (Change)	Alt. 5 (Change)
Carbon monoxide (CO)						
2035	6,499,337	76,261	76,421	76,795	75,351	64,623
2050	3,443,517	271,234	271,679	267,792	259,174	224,481
Nitrogen oxides (NO_X)						
2035	329,442	-1,667	-1,669	-1,867	-2,345	-4,124
2050	241,990	-3,288	-3,335	-3,836	-4,796	-7,357
Particulate matter ($PM_{2.5}$)						
2035	20,835	-259	-259	-272	-304	-412
2050	14,181	-487	-490	-519	-578	-728
Sulfur dioxide (SO_2)						
2035	55,157	-3,074	-3,077	-3,120	-3,146	-3,183
2050	50,343	-3,125	-3,140	-3,246	-3,431	-3,760
Volatile organic compounds (VOCs)						
2035	811,607	27,743	27,762	27,205	24,927	15,919
2050	516,641	60,301	60,357	59,190	55,887	41,154

Notes:
[a] Impacts have been rounded to the nearest whole number.
[b] Negative changes indicate emissions decreases; positive changes indicate emissions increases.
[c] DOE made changes to the calculation of the petroleum equivalency factor (PEF) between the Draft SEIS and Final SEIS due to a recent court ruling. This change removed the fuel content factor from the PEF equation and resulted in a dampened impact of EVs on LD fleet compliance. These lower PEF values reduce the CAFE fuel economy values of EVs, which reduces the manufacturers' ability to lower the average fuel economy of their vehicle fleet with their produced EVs. Due to the change in PEF, fuel economy values will be higher for the Final SEIS than in the Draft SEIS. As a result of these higher fuel economy values, the fuel consumption values will also be significantly different from in the Draft SEIS.

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

Figure 4.2.1-1. Nationwide Trend in Criteria Pollutant Emissions from U.S. Passenger Cars and Light Trucks for 2027-2050 for the Action Alternatives and the No-Action Alternative, Proposed Action Impacts



Notes:
CO = carbon monoxide; NO_X = nitrogen oxides; $PM_{2.5}$ = particulate matter 2.5 microns or less in diameter; SO_2 = sulfur dioxide; VOCs = volatile organic compounds.

Table 4.2.1-1 and Figure 4.2.1-1 show that total emissions of CO, NO_X, $PM_{2.5}$, SO_2, and VOCs are estimated to decrease substantially from 2027 to 2050 under any alternative. These decreases over time occur because of current EPA regulation of emissions from vehicles (Section 4.1.1, *Relevant Pollutants and Standards*) and from EPA regulation of upstream emissions from fuel production, despite nearly no change in total VMT from 2035 to 2050.[21]

For these reasons, all alternatives show trends of decreasing emissions between 2027 and 2050. For CO and VOCs, the decreases over time for the action alternatives are smaller than the decreases over time for the No-Action Alternative. This reflects that in any calendar year the total estimated CO and VOC emissions are greater for the action alternatives than for the No-Action Alternative. For NO_X, $PM_{2.5}$, and SO_2, the decreases over time for the action alternatives are larger than the decreases over time for the No-Action Alternative. This reflects that in any calendar year the total estimated NO_X, $PM_{2.5}$, and SO_2 emissions are less for the action alternatives than for the No-Action Alternative. The incremental differences between the No-Action Alternative and the action alternatives in any year (Table 4.2.1-1) are too small to affect the overall time trend of decreases from 2027 to 2050.

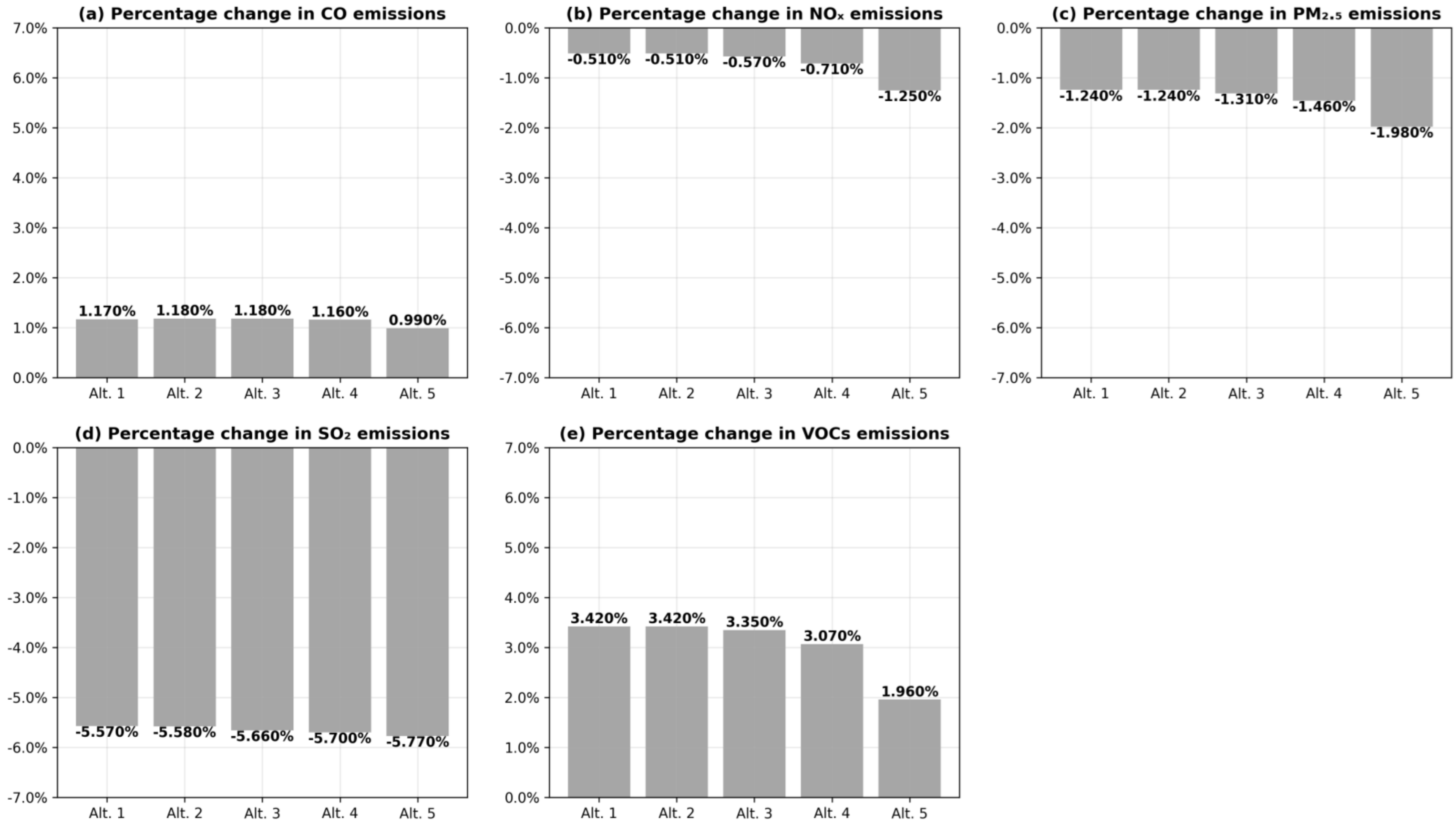
Figure 4.2.1-2 compares the percentage differences in emissions among the alternatives for 2035, a near-term forecast year for passenger cars and light trucks.

Total criteria pollutant emissions consist of four components: two sources of emissions (tailpipe and upstream) for each of the two vehicle classes covered by the standards (passenger cars and light trucks). Appendix F, *Air Quality and NCE Methodology and Other Information*, provides further information on these four components. 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).

It is important to note that the passenger car and light truck vehicle fleet impacts presented in Table 4.2.1-2 are affected significantly by the final rule's reclassification, which shifts less efficient sport utility vehicles (SUVs) and crossover utility vehicles (CUVs) from the light truck fleet to the passenger car fleet starting in MY 2030. Further, the results presented in Table 4.2.1-2 show the changes under each alternative in comparison to the No-Action Alternative, which does not include reclassification. As a result, there are seemingly large increases shown for passenger cars and significant decreases shown for light trucks. Because the fleets being compared are not the same, vehicle-specific data are for informational purposes only and NEPA requires only that the results should be evaluated based on the LD totals.

[21] Continued growth in VMT is projected to occur under all alternatives until 2042; a slight decrease is projected to occur from 2043 to 2044, with a slight increase 2044 to 2045, and slight annual decreases again 2045 to 2050.

Figure 4.2.1-2. 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; $PM_{2.5}$ = particulate matter 2.5 microns or less in diameter; SO_2 = sulfur dioxide; VOCs = volatile organic compounds.

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 Incremental 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)	Alt. 4 (Change)	Alt. 5 (Change)
Carbon monoxide (CO)						
Cars tailpipe	2,345,362	448,671	448,707	449,022	446,500	435,591
Cars upstream	30,880	18,828	18,824	18,743	18,680	18,782
Trucks tailpipe	4,048,125	-368,432	-368,304	-368,142	-366,896	-366,196
Trucks upstream	74,970	-22,806	-22,806	-22,829	-22,932	-23,555
Tailpipe subtotal (cars + trucks)	*6,393,487*	*80,239*	*80,403*	*80,881*	*79,604*	*69,396*
Upstream subtotal (cars + trucks)	*105,850*	*-3,978*	*-3,982*	*-4,086*	*-4,252*	*-4,773*
Total (tailpipe + upstream)	**6,499,337**	**76,261**	**76,421**	**76,795**	**75,351**	**64,623**
Nitrogen oxides (NO_X)						
Cars tailpipe	46,039	8,518	8,519	8,525	8,474	8,264
Cars upstream	52,663	31,809	31,802	31,639	31,385	31,066
Trucks tailpipe	101,781	-7,032	-7,029	-7,025	-6,993	-6,958
Trucks upstream	128,959	-34,962	-34,961	-35,005	-35,212	-36,495
Tailpipe subtotal (cars + trucks)	*147,820*	*1,486*	*1,489*	*1,499*	*1,481*	*1,306*
Upstream subtotal (cars + trucks)	*181,622*	*-3,153*	*-3,159*	*-3,366*	*-3,827*	*-5,429*
Total (tailpipe + upstream)	**329,442**	**-1,667**	**-1,669**	**-1,867**	**-2,345**	**-4,124**
Particulate matter ($PM_{2.5}$)						
Cars tailpipe	2,784	138	138	138	138	138
Cars upstream	3,444	2,291	2,291	2,279	2,260	2,239
Trucks tailpipe	5,658	-105	-105	-104	-103	-102
Trucks upstream	8,950	-2,583	-2,583	-2,586	-2,600	-2,686
Tailpipe subtotal (cars + trucks)	*8,442*	*33*	*33*	*34*	*35*	*36*
Upstream subtotal (cars + trucks)	*12,394*	*-292*	*-292*	*-306*	*-339*	*-447*
Total (tailpipe + upstream)	**20,835**	**-259**	**-259**	**-272**	**-304**	**-412**
Sulfur dioxide (SO_2)						
Cars tailpipe	1,188	780	780	773	745	667
Cars upstream	15,227	8,647	8,645	8,620	8,663	8,945
Trucks tailpipe	3,255	-363	-362	-364	-374	-438
Trucks upstream	35,487	-12,140	-12,140	-12,149	-12,181	-12,358
Tailpipe subtotal (cars + trucks)	*4,443*	*418*	*418*	*409*	*372*	*230*
Upstream subtotal (cars + trucks)	*50,714*	*-3,492*	*-3,495*	*-3,529*	*-3,518*	*-3,413*
Total (tailpipe + upstream)	**55,157**	**-3,074**	**-3,077**	**-3,120**	**-3,146**	**-3,183**

Emissions Component	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)	Alt. 4 (Change)	Alt. 5 (Change)
Volatile organic compounds (VOCs)						
Cars tailpipe	202,393	25,930	25,936	25,960	25,864	25,361
Cars upstream	80,895	52,637	52,633	52,148	50,472	45,819
Trucks tailpipe	311,052	-22,098	-22,088	-22,076	-21,974	-21,857
Trucks upstream	217,268	-28,727	-28,719	-28,827	-29,435	-33,404
Tailpipe subtotal (cars + trucks)	*513,444*	*3,833*	*3,847*	*3,884*	*3,890*	*3,505*
Upstream subtotal (cars + trucks)	*298,163*	*23,910*	*23,915*	*23,321*	*21,037*	*12,414*
Total (tailpipe + upstream)	**811,607**	**27,743**	**27,762**	**27,205**	**24,927**	**15,919**

Notes:
[a] Impacts have been rounded to the nearest whole number.
[b] Negative changes indicate emissions decreases; positive changes 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; changes in the relative proportions of gasoline, diesel, and other fuels in total fuel consumption; and changes in VMT.[22]

In some cases, a more stringent alternative may have greater modeled emissions than a less stringent alternative. For example, in 2035, Alternative 3 (Preferred Alternative) has slightly[23] greater CO emissions than Alternative 2 (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 tailpipe impacts. Though total emissions generally decrease with increasing stringency, upstream and tailpipe 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 2035 (Table 4.2.1-2), while Alternative 3 (Preferred Alternative) increases gasoline consumption less than Alternative 2, the net impact is slightly greater total CO emissions increases under Alternative 3 (Preferred Alternative) than under Alternative 2 (Table 4.2.1-1). That total comprises slightly higher tailpipe emissions but slightly lower upstream emissions in Alternative 3 (Preferred Alternative) relative to Alternative 2, with the increases in tailpipe emissions being larger than the decreases in upstream emissions (Table 4.2.1-2).

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 that 2035 passenger car tailpipe and upstream emissions of the criteria pollutants increase substantially under all action alternatives relative to the No-Action

[22] 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 D, *CAFE Model Analysis Methods*, Chapters 2 through 5 of the TSD, and in the Final Regulatory Impact Analysis issued concurrently with this Final SEIS.

[23] *Slight* as used in Chapter 4 indicates a change on the order of approximately 2 percent or less relative to the comparison point given in the text.

Alternative. Light truck criteria pollutant tailpipe and upstream emissions in 2035 decrease under all action alternatives compared to the No-Action Alternative (with the decreases being slight for $PM_{2.5}$ tailpipe emissions). These changes are primarily due to NHTSA's reclassification of a proportion of light trucks as passenger cars starting in MY 2030, as discussed in Section VI of the final rule preamble and Technical Support Document Chapter 2.7.

Combined LD vehicle tailpipe emissions in 2035 under all action alternatives are projected to increase relative to the No-Action Alternative 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 as a result of the vehicle reclassification. The combined LD vehicle tailpipe emissions increases of individual criteria pollutants are similar[24] under all action alternatives relative to the No-Action Alternative for CO, NO_X, $PM_{2.5}$, and VOCs; for SO_2 the increases are similar under Alternatives 1, 2, and 3 (Preferred Alternative) and are smaller under Alternatives 4 and 5.

Combined LD vehicle upstream emissions in 2035 under all action alternatives increase relative to the No-Action Alternative for VOCs because the decrease for light trucks is smaller than the increase for passenger car upstream emissions. These increases in combined LD vehicle upstream emissions of VOCs are similar for Alternatives 1, 2, and 3 (Preferred Alternative) but are smaller under Alternatives 4 and 5. The combined LD vehicle upstream emissions decrease for the other criteria pollutants because the decrease for light trucks is larger than the increase for passenger car upstream emissions. The upstream emissions decreases are slight for NO_X under Alternatives 1, 2, and 3 (Preferred Alternative). The decreases of combined LD vehicle upstream emissions of CO and SO_2 are similar under Alternatives 1, 2, 3 (Preferred Alternative), and 4 (and larger under Alternative 5); for NO_X and $PM_{2.5.}$ The decreases also are similar under Alternatives 1, 2, and 3 (Preferred Alternative), with larger decreases under Alternatives 4 and 5.

Combined LD vehicle tailpipe emissions in 2050 under all action alternatives are projected to increase relative to the No-Action Alternative for all criteria pollutants (Appendix B, *U.S. Passenger Car and Light Truck Results Reported Separately*, Table B-3). For CO and NO_X, the increases are similar under Alternatives 1, 2, and 3 (Preferred Alternative) and smaller for Alternatives 4 and 5. For $PM_{2.5}$ and VOCs, the increases are similar under Alternatives 1, 2, 3 (Preferred Alternative), and 4 and smaller for Alternative 5. For SO_2, the increases are similar under Alternatives 1 and 2 and smaller for Alternatives 3 (Preferred Alternative), 4, and 5.

Combined LD vehicle upstream emissions in 2050 under all action alternatives are projected to increase for VOCs relative to the No-Action Alternative, with similar increases under Alternatives 1 and 2 and smaller increases under Alternatives 3 (Preferred Alternative), 4, and 5. The combined LD vehicle upstream emissions decrease under all action alternatives relative to the No-Action Alternative for the other criteria pollutants, with similar decreases under Alternatives 1 and 2 and larger decreases under Alternatives 3 (Preferred Alternative), 4, and 5 for CO, $PM_{2.5}$, and SO_2, and similar decreases under Alternatives 1, 2, and 3 (Preferred Alternative) and larger decreases under Alternatives 4 and 5 for NO_X.

The differences in national emissions of criteria air pollutants among the action alternatives compared to the No-Action Alternative would range from slight to 11.7 percent because of the

[24] *Similar* as used in Chapter 4 indicates a change on the order of 0.2 percent or less relative to the comparison point given in the text.

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 would increase slightly under all action alternatives compared to the No-Action Alternative, up to a 1.2 percent increase under Alternatives 1, 2, 3 (Preferred Alternative), and 4. Emissions of VOCs would increase slightly (2 percent) under Alternative 5 and increase under the other alternatives, up to a 3.4 percent increase under Alternatives 1, 2, and 3 (Preferred Alternative). Emissions of NO_X and $PM_{2.5}$ would decrease slightly under all action alternatives, with the largest decrease of 2 percent for $PM_{2.5}$ under Alternative 5. Emissions of SO_2 would decrease under all action alternatives, up to a 5.8 percent decrease under Alternative 5. 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, the emissions increases would be larger and the decreases would be larger relative to the 2035 emissions discussed above. Emissions of CO would increase under all action alternatives compared to the No-Action Alternative, up to a 7.9 percent increase under Alternatives 1 and 2. Emissions of VOCs would increase under all action alternatives, up to an 11.7 percent increase under Alternatives 1 and 2. Emissions of NO_X would decrease (3 percent) under Alternative 5 and decrease slightly under the other alternatives (as much as a 2 percent decrease under Alternative 4). Emissions of $PM_{2.5}$ would decrease under all action alternatives, with the largest decrease of 5.1 percent for Alternative 5. Emissions of SO_2 would decrease under all action alternatives, up to a 7.5 percent decrease under Alternative 5. Decreases in EV use relative to the No-Action Alternative are projected in 2050, and they are larger decreases than in 2035, leading to projections of greater decreases in upstream SO_2 emissions in 2050 relative to 2035.

4.2.1.2 Nonattainment Areas

Table 4.2.1-3 summarizes the criteria air pollutant analysis results by nonattainment area.[25] 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 G, *Air Quality Nonattainment Area Results*, indicates, for 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 the other criteria pollutants, most nonattainment areas would experience increases in emissions across all action alternatives in 2035 and 2050.

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

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 Analysis Years, Proposed Action Impacts [a]

Criteria Pollutant or Precursor	Maximum Increase / Decrease	Emission Change (tons per year)	Year	Alternative	Name of EPA-Designated Area [NAAQS pollutants for which area is nonattainment or maintenance (year of standard and averaging period)]
Carbon monoxide (CO)	Maximum increase	11,672	2050	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); $PM_{2.5}$ (2006 24-hour); $PM_{2.5}$ (2012 Annual)]
	Maximum decrease	-106	2050	Alt. 5	Whatcom County, WA [SO_2 (2010 1-hour)]
Nitrogen oxides (NO_X)	Maximum increase	88	2050	Alt. 1	New York-N. New Jersey-Long Island, NY-NJ-CT [CO (1971 8-hour); Ozone (2008 8-hour); $PM_{2.5}$ (2006 24-hour)]
	Maximum decrease	-1,074	2050	Alt. 5	Houston-Galveston-Brazoria, TX [Ozone (2008 8-hour); Ozone (2015 8-hour)]
Particulate matter ($PM_{2.5}$)	Maximum increase	0.8	2050	Alt. 2	Phoenix-Mesa, AZ [Ozone (2008 8-hour); Ozone (2015 8-hour)]
	Maximum decrease	-58	2050	Alt. 5	Houston-Galveston-Brazoria, TX [Ozone (2008 8-hour); Ozone (2015 8-hour)]
Sulfur dioxide (SO_2)	Maximum increase	24	2050	Alt. 2	New York-N. New Jersey-Long Island, NY-NJ-CT [CO (1971 8-hour); Ozone (2008 8-hour); $PM_{2.5}$ (2006 24-hour)]
	Maximum decrease	-388	2050	Alt. 5	Baton Rouge, LA [Ozone (2008 8-hour)]
Volatile organic compounds (VOCs)	Maximum increase	3,799	2050	Alt. 2	Houston-Galveston-Brazoria, TX [Ozone (2008 8-hour); Ozone (2015 8-hour)]
	Maximum decrease	None	No decreases are predicted for any years or alternatives		None

Notes:
[a] Changes have been rounded to the nearest whole number, except for values below 1, which have been rounded to the first non-zero decimal.
NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide; $PM_{2.5}$ = 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

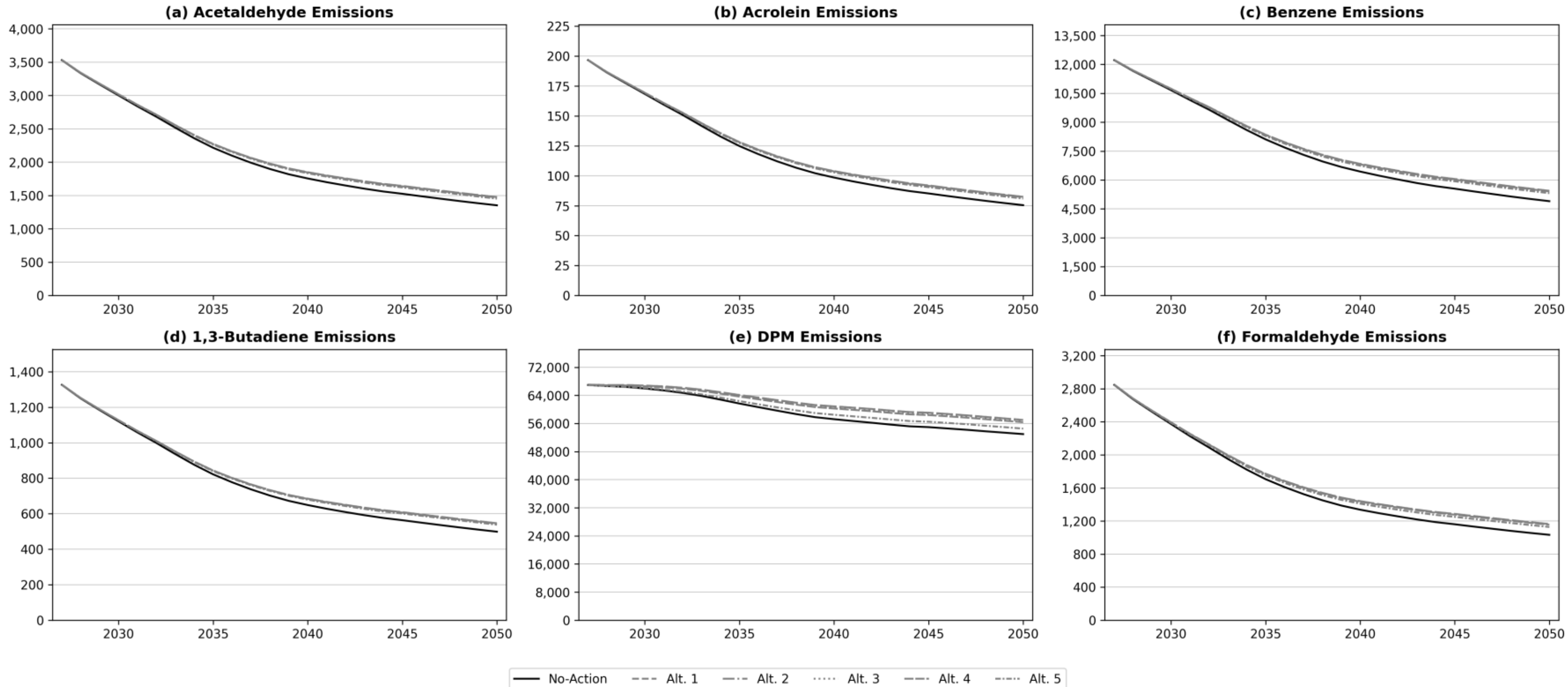
Table 4.2.2-1 summarizes the total upstream and tailpipe national emissions under the No-Action Alternative and the change in emissions by alternative (relative to the No-Action Alternative in the same year) for each of the MSATs and analysis years. Figure 4.2.2-1 shows the trends from 2027 to 2050 in total upstream and tailpipe national emissions under the No-Action Alternative and the action alternatives.

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 Incremental Change in Emissions by Action Alternative, Proposed Action Impacts [a,b]

Year	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)	Alt. 4 (Change)	Alt. 5 (Change)
Acetaldehyde						
2035	2,216	57	57	57	55	46
2050	1,353	123	124	122	118	100
Acrolein						
2035	125	3	3	3	3	3
2050	75	7	7	7	7	5
Benzene						
2035	8,108	242	242	240	228	175
2050	4,898	538	538	530	509	415
1,3-Butadiene						
2035	822	21	21	22	21	18
2050	499	48	48	47	46	39
Diesel particulate matter (DPM)						
2035	54,286	2,132	2,132	2,042	1,738	609
2050	46,619	3,545	3,543	3,386	2,984	1,381
Formaldehyde						
2035	1,706	65	65	65	61	44
2050	1,033	130	131	128	122	95

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

Figure 4.2.2-1. Nationwide Trend in Mobile Source Air Toxic Emissions from U.S. Passenger Cars and Light Trucks for 2027-2050 for the Action Alternatives and the No-Action Alternative, Proposed Action Impacts



Notes:
DPM = diesel particulate matter.

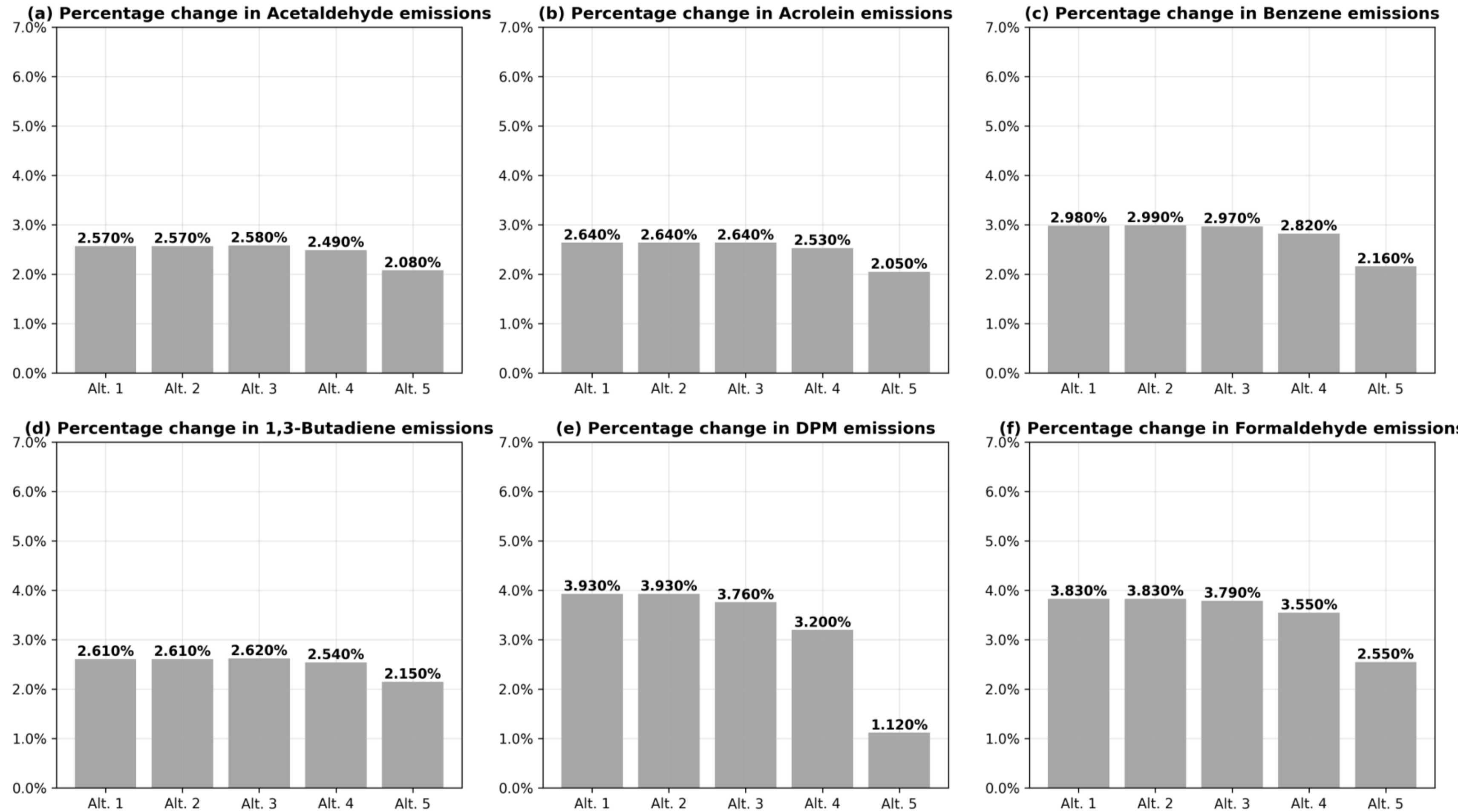
Table 4.2.2-1 and Figure 4.2.2-1 show that total emissions of all MSATs are estimated to decrease substantially from 2027 to 2050 under any alternative. These decreases over time occur because of current EPA regulation of emissions from vehicles (Section 4.1.1, *Relevant Pollutants and Standards*) and from EPA regulation of upstream emissions from fuel production, despite nearly no change in total VMT from 2035 to 2050.[26]

For these reasons, all alternatives show trends of decreasing emissions between 2027 and 2050. The decreases over time for the action alternatives are smaller than the decreases over time for the No-Action Alternative. This reflects that in any calendar year the total estimated MSAT emissions are greater for the action alternatives than for the No-Action Alternative. The incremental differences between the No-Action Alternative and the action alternatives in any year (Table 4.2.2-1) are too small to affect the overall time trend of decreases from 2027 to 2050.

The differences in national emissions of MSATs among the action alternatives compared to the No-Action Alternative would range from 1.1 percent (DPM in Alternative 5 in 2035) to 12.6 percent (formaldehyde in Alternatives 1 and 2 in 2050) 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. Figure 4.2.2-2 compares the percentage differences in MSAT emissions for each alternative in 2035.

[26] Continued growth in VMT is projected to occur under all alternatives until 2042; a slight decrease is projected to occur from 2043 to 2044, with a slight increase 2044 to 2045, and slight decreases again 2045 to 2050.

Figure 4.2.2-2. 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.

As with criteria pollutant emissions, total MSAT emissions consist of four components: two sources of emissions (tailpipe 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).

It is important to note that the passenger car and light truck vehicle fleet impacts presented in Table 4.2.2-2 are affected significantly by the final rule's reclassification, which shifts less efficient SUVs and CUVs from the light truck fleet to the passenger car fleet starting in MY 2030. Further, the results presented in Table 4.2.2-2 show the changes under each alternative in comparison to the No-Action Alternative, which does not include reclassification. As a result, there are seemingly large increases shown for passenger cars and significant decreases shown for light trucks. Because the fleets being compared are not the same, vehicle-specific data are for informational purposes only and NEPA requires only that the results should be evaluated based on the LD totals.

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)	Alt. 4 (Change)	Alt. 5 (Change)
Acetaldehyde						
Cars tailpipe	718	249	249	249	247	240
Cars upstream	15	10	10	10	10	9
Trucks tailpipe	1,441	-197	-197	-197	-197	-197
Trucks upstream	42	-5	-5	-5	-5	-6
Tailpipe subtotal (cars + trucks)	*2,159*	*52*	*52*	*52*	*50*	*43*
Upstream subtotal (cars + trucks)	*57*	*5*	*5*	*5*	*5*	*3*
Total (tailpipe + upstream)	**2,216**	**57**	**57**	**57**	**55**	**46**
Acrolein						
Cars tailpipe	39	13	13	13	13	12
Cars upstream	2	1	1	1	1	1
Trucks tailpipe	78	-10	-10	-10	-10	-10
Trucks upstream	6	-1	-1	-1	-1	-1
Tailpipe subtotal (cars + trucks)	*117*	*3*	*3*	*3*	*3*	*2*
Upstream subtotal (cars + trucks)	*8*	*1*	*1*	*1*	*1*	*0*
Total (tailpipe + upstream)	**125**	**3**	**3**	**3**	**3**	**3**
Benzene						
Cars tailpipe	2,476	705	705	705	701	681
Cars upstream	279	184	184	183	176	158
Trucks tailpipe	4,591	-561	-561	-561	-560	-561
Trucks upstream	761	-86	-86	-86	-89	-103
Tailpipe subtotal (cars + trucks)	*7,067*	*143*	*144*	*144*	*141*	*120*
Upstream subtotal (cars + trucks)	*1,041*	*99*	*99*	*96*	*88*	*54*
Total (tailpipe + upstream)	**8,108**	**242**	**242**	**240**	**228**	**175**

Emissions Component	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)	Alt. 4 (Change)	Alt. 5 (Change)
1,3-Butadiene						
Cars tailpipe	275	100	100	100	99	96
Cars upstream	2	1	1	1	1	1
Trucks tailpipe	541	-79	-79	-79	-78	-79
Trucks upstream	4	0	0	0	0	-1
Tailpipe subtotal (cars + trucks)	*816*	*21*	*21*	*21*	*20*	*17*
Upstream subtotal (cars + trucks)	*6*	*1*	*1*	*1*	*0*	*0*
Total (tailpipe + upstream)	**822**	**21**	**21**	**22**	**21**	**18**
Diesel particulate matter (DPM)						
Cars tailpipe	9	0	0	0	0	0
Cars upstream	14,953	9,668	9,667	9,595	9,381	8,839
Trucks tailpipe	47	0	0	0	0	0
Trucks upstream	39,277	-7,536	-7,535	-7,552	-7,643	-8,230
Tailpipe subtotal (cars + trucks)	*56*	*0*	*0*	*0*	*0*	*0*
Upstream subtotal (cars + trucks)	*54,231*	*2,132*	*2,132*	*2,043*	*1,738*	*609*
Total (tailpipe + upstream)	**54,286**	**2,132**	**2,132**	**2,042**	**1,738**	**609**
Formaldehyde						
Cars tailpipe	430	128	128	128	127	123
Cars upstream	111	73	73	72	70	63
Trucks tailpipe	860	-102	-101	-101	-101	-101
Trucks upstream	305	-34	-34	-34	-35	-41
Tailpipe subtotal (cars + trucks)	*1,290*	*26*	*26*	*26*	*26*	*22*
Upstream subtotal (cars + trucks)	*416*	*39*	*39*	*38*	*35*	*21*
Total (tailpipe + upstream)	**1,706**	**65**	**65**	**65**	**61**	**44**

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

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.[27] In 2035 and 2050, emissions of acetaldehyde, acrolein, benzene, 1,3-butadiene, and formaldehyde would increase under all action alternatives in all nonattainment areas compared to the No-Action Alternative, while for DPM they would increase under all action alternatives in about half of the nonattainment areas compared to the No-Action Alternative (and decrease in the other half). The increases would not be uniformly distributed to individual nonattainment areas (Appendix G, *Air Quality Nonattainment Area Results*).

[27] 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 Analysis Years, Proposed Action Impacts [a]

Mobile Source Air Toxic	Maximum Increase/ Decrease	Emission Change (tons per year)	Year	Alternative	Name of EPA-Designated Area [NAAQS pollutants for which area is nonattainment or maintenance (year of standard and averaging period)]
Acetaldehyde	Maximum increase	5	2050	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); $PM_{2.5}$ (2006 24-hour); $PM_{2.5}$ (2012 Annual)]
	Maximum decrease	None	No decreases are predicted for any years or alternatives		None
Acrolein	Maximum increase	0.3	2050	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); $PM_{2.5}$ (2006 24-hour); $PM_{2.5}$ (2012 Annual)]
	Maximum decrease	None	No decreases are predicted for any years or alternatives		None
Benzene	Maximum increase	18	2050	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); $PM_{2.5}$ (2006 24-hour); $PM_{2.5}$ (2012 Annual)]
	Maximum decrease	None	No decreases are predicted for any years or alternatives		None
1,3-Butadiene	Maximum increase	2	2050	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); $PM_{2.5}$ (2006 24-hour); $PM_{2.5}$ (2012 Annual)]
	Maximum decrease	None	No decreases are predicted for any years or alternatives		None
Diesel particulate matter (DPM)	Maximum increase	272	2050	Alt. 1	Houston-Galveston-Brazoria, TX [Ozone (2008 8-hour); Ozone (2015 8-hour)]
	Maximum decrease	-0.009	2050	Alt. 1	Phoenix-Mesa, AZ [Ozone (2008 8-hour); Ozone (2015 8-hour)]
Formaldehyde	Maximum increase	3	2050	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); $PM_{2.5}$ (2006 24-hour); $PM_{2.5}$ (2012 Annual)]
	Maximum decrease	None	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; $PM_{2.5}$ = particulate matter 2.5 microns or less in diameter.

4.2.3 Health Impacts

This section discusses the estimated health effects specifically of the action alternatives. Predicted air quality and health impacts are subject to many assumptions and uncertainties, as discussed in Appendix F, *Air Quality and NCE Methodology and Other Information*. Though NHTSA is not required to assess impacts that are not a direct result of changes in CAFE standards and has determined that analyses of health impacts that could occur indirectly are not necessary for reasoned decision-making, the agency nonetheless provides such discussions in this section solely for informational purposes.

Adverse nationwide health effects from criteria pollutant emissions are expected to increase in 2035 and 2050 under all action alternatives relative to the No-Action Alternative.[28] The increases in 2035 are slight for all health effects under all action alternatives, and the increases in 2050 are slight under Alternative 5 for premature mortality, respiratory and cardiovascular hospital admissions, and non-fatal heart attacks.

The increases in health effects are predicted despite the predicted decreases in total $PM_{2.5}$ emissions, total NO_X emissions, and total SO_2 emissions discussed in Section 4.2.2, *Mobile Source Air Toxics*. This is because the action alternatives would increase tailpipe emissions but decrease upstream emissions (see Table 4.2.1-2 and Appendix B, *U.S. Passenger Car and Light Truck Results Reported Separately*, Table B-3 for criteria pollutant emission changes stratified by tailpipe and upstream). The incidence of health effects per ton of emissions is greater for tailpipe emissions than for upstream emissions.[29] As a result, for any action alternative the increase in health effects related to tailpipe emissions is greater than the decrease in health effects related to upstream emissions, leading to a net increase in health effects. 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 tailpipe emissions than upstream emissions, and substantially larger for $PM_{2.5}$ emissions than for NO_X and SO_2 (as $PM_{2.5}$ precursors) emissions.

As discussed in Appendix F, Section F.2.1.6, *Health Impacts*, several potential health and environmental effects could not be quantified, and the health effects of pollutants other than $PM_{2.5}$ (with the exception of NO_X and SO_2 as $PM_{2.5}$ precursors) could not be quantified.

In 2035, the increases in individual health effects for respiratory emergency room visits, cardiovascular hospital admissions, and non-fatal heart attacks "all others" would be similar for Alternatives 1, 2, and 3 (Preferred Alternative) and would be smaller for Alternatives 4 and 5; for

[28] The CAFE Model computes select health impacts resulting from population exposure to $PM_{2.5}$ associated with emissions from directly emitted PM and two precursors to $PM_{2.5}$ (NO_X and SO_2). The CAFE Model reports total $PM_{2.5}$-related health impacts by multiplying the estimated tons of each $PM_{2.5}$-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 $PM_{2.5}$ 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 F, Section F.2.1.6, *Health Impacts*.

[29] The health effects per ton of emissions are greater for tailpipe emissions for several reasons. Among the most important are that vehicle emissions occur at ground level and often near people, especially in densely populated urban areas. As a result of the low emissions height and greater population exposure, a larger share of the emissions is inhaled by humans, compared to upstream sources that typically emit from taller stacks and may be located in less-developed areas (Humbert *et al*. 2011; Wolfe *et al*. 2019).

all other health effects, the increases per health effect would be similar for Alternatives 1, 2, 3 (Preferred Alternative), and 4, and smaller for Alternative 5. In 2050, the increases in cardiovascular hospital admissions would be similar for Alternatives 1 and 2 and be smaller for Alternatives 3 (Preferred Alternative), 4, and 5; the same would be true for respiratory hospital admissions and non-fatal heart attacks "all others", while for each other health effect the increases would be similar for Alternatives 1, 2, and 3 (Preferred Alternative) and be smaller for Alternatives 4 and 5. These smaller increases for Alternatives 3 (Preferred Alternative), 4, and 5 reflect the generally greater stringencies of those alternatives. As discussed in Appendix F, Section F.2.1.6, *Health Impacts*, the values in Table 4.2.3-1 are nationwide averages. These values account for impacts of upstream and tailpipe emissions separately but do not reflect localized variations in emissions, meteorology and topography, and population characteristics.[30]

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 action 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 CAFE standards.

Table 4.2.3-1. Nationwide Incremental Changes in Health Effects (cases per year) from $PM_{2.5}$ Emissions from U.S. Passenger Cars and Light Trucks by Action Alternative, Proposed Action Impacts [a,b,c]

Year	No-Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Premature mortality						
2035	0	25	25	24	20	7
2050	0	60	60	58	51	30
Emergency room visits: respiratory						
2035	0	18	18	17	15	7
2050	0	40	40	39	35	22
Acute bronchitis						
2035	0	46	46	44	39	19
2050	0	102	103	99	90	57
Lower respiratory symptoms						
2035	0	578	578	562	497	235
2050	0	1,302	1,302	1,252	1,137	718
Upper respiratory symptoms						
2035	0	830	830	807	714	343
2050	0	1,859	1,860	1,789	1,626	1,031

30 As discussed in Appendix E, Section E.2.1.6, *Health Impacts*, NHTSA's analysis quantifies the health effects of $PM_{2.5}$, 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	Alt. 4	Alt. 5
Minor restricted activity days						
2035	0	27,111	27,124	26,451	23,615	12,289
2050	0	59,210	59,232	57,151	52,309	34,264
Work-loss days						
2035	0	4,570	4,572	4,457	3,975	2,049
2050	0	10,005	10,009	9,653	8,828	5,759
Asthma exacerbation						
2035	0	977	977	951	841	405
2050	0	2,190	2,190	2,107	1,916	1,217
Hospital admissions: cardiovascular						
2035	0	7	7	6	5	2
2050	0	16	16	15	14	8
Hospital admissions: respiratory						
2035	0	6	6	6	5	2
2050	0	15	15	14	13	7
Non-fatal heart attacks (Peters *et al*. 2001)						
2035	0	26	26	25	21	7
2050	0	63	63	60	54	31
Non-fatal heart attacks (all others)						
2035	0	3	3	3	2	1
2050	0	7	7	6	6	3

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 might affect future climate trends, by comparing projected changes in non-criteria emissions (NCEs) from the Proposed Action and alternatives with the No-Action Alternative.[1]

5.1 Introduction

This Final 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[4] 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 F, Section F.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 Final SEIS in line with the Supreme Court's recent decision in *Seven County Infrastructure Coalition v. Eagle County, Colorado* and its progeny.[5] 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 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

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[1] Throughout this Final 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 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. Climate model 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 is directed to make clear in the relevant environmental document that such information is lacking, DOT Order 5610.1D, Section 6.c.4. For a more detailed discussion on this topic see Appendix F, Section F.3.1, *Uncertainty in Climate Modeling.*

[4] 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).

[5] *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).

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 for informational purposes only.

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.[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 of the Proposed Action

This section describes projected impacts of the Proposed Action and alternatives relative to the No-Action Alternative on relevant climate metrics, using the methods described in Appendix F, *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 F, Section F.3.4, *Environmental Consequences: Other Associated Potential Impacts,* solely for informational purposes.

5.3.1 Non-Criteria Emissions

Using the methods described in Appendix F, Section F.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

[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).

[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.

2027, vehicle manufacturers are assumed to offer vehicles using nearly the same fuel economy technologies under either Alternative 1 or Alternative 2; therefore, the results are the same for both alternatives.

Table 5.3.1-1 shows 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. Under Alternatives 1 and 2, LD vehicle emissions increase by up to 8,000 million metric tons of carbon dioxide ($MMTCO_2$) relative to the No-Action Alternative of 57,900 $MMTCO_2$. Compared to the total U.S. emissions projection of 619,064 $MMTCO_2$ over this period in the global emissions reference scenario, increases from the action alternatives would be up to 1.29 percent from projected levels. Compared to the global emissions reference scenario projection of 4,991,547 $MMTCO_2$ over this period, increases from the action alternatives would range from approximately 0.09 to 0.16 percent from projected levels.

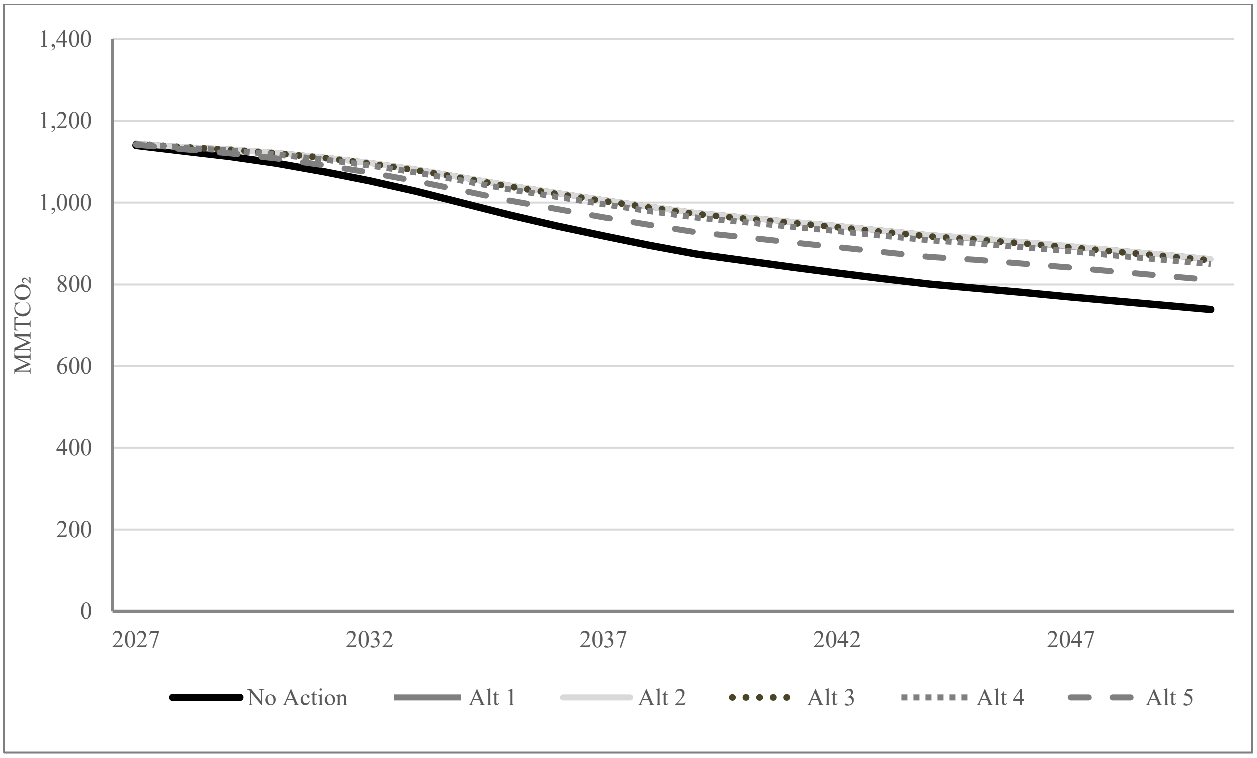
Table 5.3.1-1. Carbon Dioxide Emissions and Emissions Increases ($MMTCO_2$) from All Light-Duty Vehicles, 2027 to 2100, by Alternative [a]

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	57,900	-	-	-	-
Alt. 1		8,000	13.82%	1.29%	0.16%
Alt. 2		8,000	13.82%	1.29%	0.16%
Alt. 3		7,800	13.47%	1.26%	0.16%
Alt. 4		7,200	12.44%	1.16%	0.14%
Alt. 5		4,600	7.94%	0.74%	0.09%

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.

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 7.9 to 13.8 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 increase total U.S. CO_2 emissions in the year 2100 by up to 1.19 percent. Figure 5.3.1-1 shows the projected annual emissions from LD vehicles under the alternatives.

Figure 5.3.1-1. 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 would result in the greatest emissions increases, and Alternative 5 would result in the smallest emissions increases. All alternatives show similar trends of decline between 2027 and 2050, with smaller declines for the regulatory alternatives compared to the No-Action Alternative.

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

NCEs and Year	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)	Alt. 4 (Change)	Alt. 5 (Change)
Carbon dioxide (CO_2)						
2020	1,264	-	-	-	-	-
2040	858	106	106	103	94	57
2060	735	123	123	120	111	72
2080	730	122	122	119	110	71
2100	679	113	113	110	102	66

NCEs and Year	No-Action (Total)	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)	Alt. 4 (Change)	Alt. 5 (Change)
Methane (CH_4)						
2020	7	-	-	-	-	-
2040	9	-1	-1	-1	-1	-1
2060	10	-1	-1	-1	-1	-1
2080	10	-1	-1	-1	-1	-1
2100	10	-1	-1	-1	-1	-1
Nitrous oxide (N_2O)						
2020	16	-	-	-	-	-
2040	10	1	1	1	1	1
2060	9	1	1	1	1	1
2080	9	1	1	1	1	1
2100	8	1	1	1	1	1
Total (all NCEs)						
2020	1,287	-	-	-	-	-
2040	878	106	106	104	94	57
2060	754	123	123	120	111	72
2080	748	122	122	119	110	71
2100	696	113	114	111	103	66

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 small 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 9,134,443 LD vehicles (Alternative 5) to 18,338,398 LD vehicles (Alternative 2) in 2035, compared to the annual emissions under the No-Action Alternative. A total of 246,418,215 LD vehicles are projected to be on the road in 2035 under the No-Action Alternative.[8,9]

5.3.2 Impacts of the Proposed Action on Climate Indicators

This section describes the impacts of the Proposed Action and alternatives on five relevant climate trend indicators, which include atmospheric CO_2 concentration, temperature, sea-level rise, precipitation, and ocean pH. The impacts of the Proposed Action and alternatives on these

[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 domestic upstream emissions from fuel production and distribution. The average LD vehicle is projected to account for 3.93 $MMTCO_2$ emissions in 2035 based on MOVES, the GREET model, and EPA analysis.

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 show close alignment with the results.[10] As discussed further in Appendix F, Section F.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.

As discussed in Appendix F, Section F.3.3.5, *Global Emissions Scenarios*, NHTSA selected SSP3-7.0 as the global emissions reference scenario to represent the No-Action Alternative in the MAGICC modeling runs.[11] The CO_2 concentrations increase by between 0.45 and 0.77 parts per million (ppm) under the action alternatives 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	0.07	0.30	0.77	0.001	0.001	0.003	0.00	0.01	0.06	-0.0001	-0.0002	-0.0004
Alt. 2	0.07	0.30	0.77	0.001	0.001	0.003	0.00	0.01	0.06	-0.0001	-0.0002	-0.0004
Alt. 3	0.07	0.29	0.75	0.000	0.001	0.003	0.00	0.01	0.06	-0.0001	-0.0002	-0.0004
Alt. 4	0.07	0.27	0.69	0.000	0.001	0.003	0.00	0.01	0.05	-0.0000	-0.0002	-0.0003
Alt. 5	0.04	0.17	0.45	0.000	0.001	0.002	0.00	0.01	0.04	-0.0000	-0.0001	-0.0002

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 1986-2005.
[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 datasets used here will differ in the types of vehicles included. See Section VI of the final rule preamble and Chapter 3 of the FRIA for additional detail regarding the effect of NHTSA's fleet reclassification.
°C = degrees Celsius; cm = centimeters; CO_2 = carbon dioxide; ppm = parts per million.

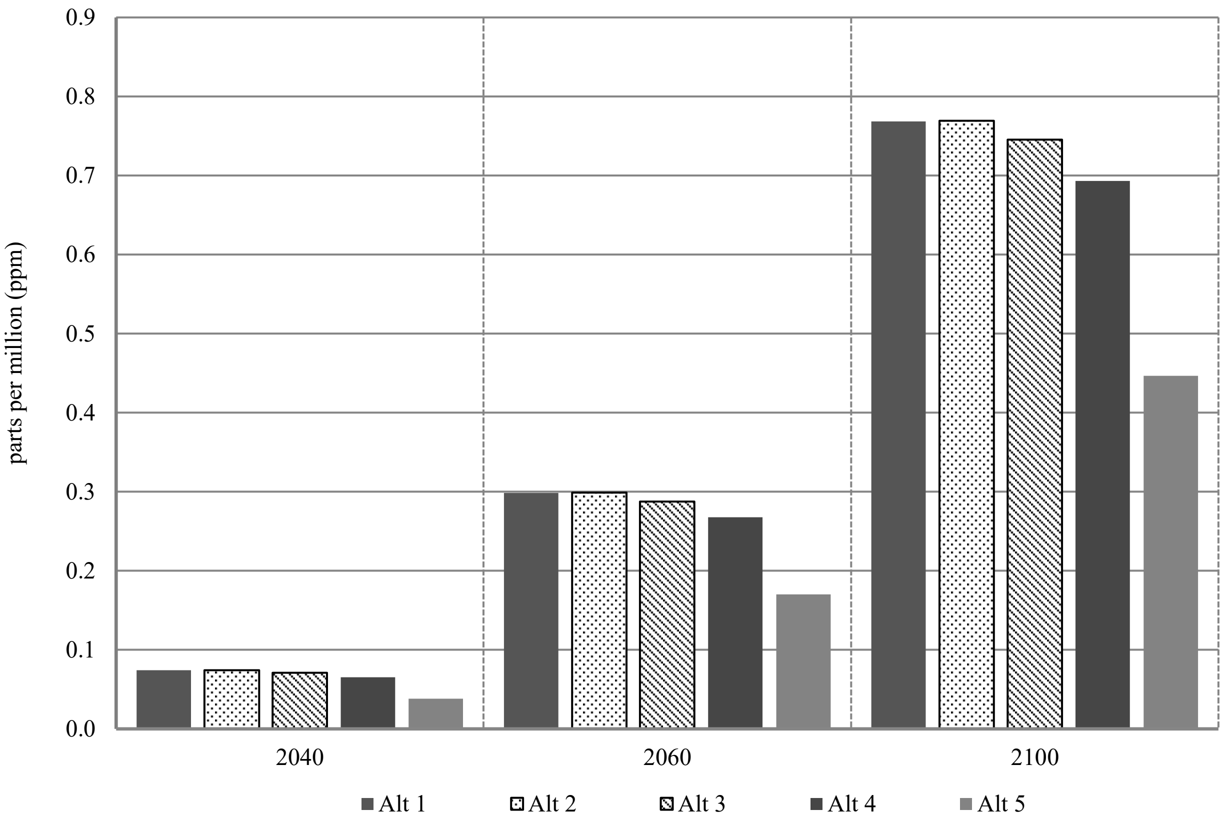
[10] MAGICC7 is the version of MAGICC used in this analysis, which incorporates the latest science and is calibrated to the mean of the multi-model ensemble results for the Shared Socioeconomic Pathway scenarios.

[11] As of 2026, a new scenario framework is being developed under CMIP7 (van Vuuren *et al.* 2026), which will introduce updated emissions pathways to replace the SSP-based forcing pathways used in this analysis. Earth system model simulations under CMIP7 are currently underway, but peer-reviewed output and downscaled data products are not yet available. The scenarios used in this analysis—SSP3-7.0, SSP2-4.5, and SSP1-2.6—remain the most current scenarios with available, peer-reviewed climate model output and continue to represent a robust range of future emissions trajectories.

5.3.2.1 Atmospheric Carbon Dioxide Concentrations

As Figure 5.3.2-1 shows, the 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, Alternatives 1 and 2 result in higher CO_2 concentrations by 2100 than Alternatives 3 (Preferred Alternative), 4, and 5.

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.[12]

[12] 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).

Temperature[13]

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. The temperature increases compared to the No-Action Alternative are between 0.002°C and 0.003°C (0.003 degrees Fahrenheit [°F] and 0.005°F) under each action alternative by 2100 (Table 5.3.2-1).

The Proposed Action and alternatives would also be expected to increase regional impacts slightly 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.[14]

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) (GCRP 2023). Ocean circulation, changes in atmospheric pressure, and geological processes can also influence sea-level rise at a regional scale (GCRP 2023). Mean sea-level rise has been projected for each of the global emissions scenarios (Fifth National Climate Assessment of the GCRP [GCRP 2023]).[15,16]

Some assessments confirm that it is virtually certain that global mean sea level will continue to rise through 2100 (GCRP 2023). 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 49 to 90 centimeters (19.3 to 35.4 inches) for the SSP3-7.0 emissions scenario.[17]

The analysis shows a maximum increase in sea-level rise of between 0.04 and 0.06 centimeter (0.015 and 0.024 inch) by 2100 under the action alternatives compared to the No-Action Alternative (Table 5.3.2-1).

[13] 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 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.

[14] 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.

[15] As noted in Appendix F*, 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 published CMIP6 SSP scenarios to project sea-level rise in this Final SEIS.

[16] Climate model 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.

[17] Climate model 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.

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 (GCRP 2023). 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 (GCRP 2023). Overall, global mean precipitation is generally projected to increase under all climate scenarios (GCRP 2023).[18]

NHTSA expects that the Proposed Action and alternatives would increase 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.[19]

The global mean change in precipitation associated with the SSP emissions scenarios (Riahi *et al*. 2017; IIASA 2018), derived from CMIP6 multi-model output (Eyring *et al*. 2016), 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. Published CMIP6 analyses provide 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).[20]

Table 5.3.2-2. Rates of Global Mean Precipitation Increase over the 21st Century, per Shared Socioeconomic Pathways Emissions Scenario

Scenario	Percent per °C [a,b]
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 (Douville *et al*. 2021). Climate model 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 1995-2014 reference period (Douville *et al*. 2021).
°C = degrees Celsius.

[18] Climate model 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.

[19] 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 Fifth National Climate Assessment (GCRP 2023) summary of precipitation represents a thoroughly reviewed, credible means of producing an assessment of this highly uncertain factor.

[20] Climate model 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 by 0.01 percent or less 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.[21] Regional variations and changes in the intensity of precipitation cannot be further quantified.[22] The Proposed Action and alternatives would still be expected to increase the relative precipitation changes in proportion to the increase in global mean surface temperature rise. However, more specific quantification is not possible because of the limitations of existing models.[23]

Ocean pH

Modeling conducted for this Final SEIS projects a decrease of ocean pH under each action alternative compared to the No-Action Alternative under the global emissions reference scenario for the final standards. Ocean pH under each of the action alternatives shows a maximum decrease in pH of 0.0004 by 2100 compared to the No-Action Alternative.

5.3.2.3 Climate Sensitivity Variations

Using the methods described in Appendix F, Section F.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 of SSP3-7.0.

Table 5.3.2-3 lists the results from the sensitivity analysis under the global emissions reference scenario for the final 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 F, Section F.3.3.7, *Sensitivity Analysis*).

[21] As described in the Fifth National Climate Assessment, heavy precipitation events are projected to become more frequent and more intense across most regions, driven by the strong dependence of the atmosphere's water-holding capacity on temperature (GCRP 2023). Precipitation variability is projected to increase at all timescales and most locations, implying simultaneous increases in both heavy precipitation extremes and drought—a phenomenon GCRP calls *whiplash* (GCRP 2023). Even where average precipitation is expected to decline, increased water vapor from warmer air drives more intense individual precipitation events (GCRP 2023). Soil moisture droughts are projected to increase in frequency and severity in many regions as warming amplifies evapotranspiration and atmospheric "thirst," producing longer-lasting droughts in continental and Mediterranean-climate regions (GCRP 2023). Climate model 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.

[22] 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.

[23] 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 5.3.2-3. 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	0.07	0.29	0.71	0.000	0.001	0.002	0.04	-0.0004
	Medium	0.07	0.30	0.77	0.001	0.001	0.003	0.06	-0.0004
	High	0.08	0.31	0.82	0.001	0.002	0.003	0.08	-0.0004
Changes Under Alternative 2 Compared to the No-Action Alternative									
Alt. 2	Low	0.07	0.29	0.71	0.000	0.001	0.002	0.04	-0.0004
	Medium	0.07	0.30	0.77	0.001	0.001	0.003	0.06	-0.0004
	High	0.08	0.31	0.83	0.001	0.002	0.003	0.08	-0.0004
Changes Under Alternative 3 Compared to the No-Action Alternative									
Alt. 3	Low	0.07	0.28	0.69	0.000	0.001	0.002	0.04	-0.0003
	Medium	0.07	0.29	0.75	0.000	0.001	0.003	0.06	-0.0004
	High	0.07	0.29	0.80	0.000	0.001	0.003	0.07	-0.0004
Changes Under Alternative 4 Compared to the No-Action Alternative									
Alt. 4	Low	0.06	0.26	0.64	0.000	0.001	0.002	0.04	-0.0003
	Medium	0.07	0.27	0.69	0.000	0.001	0.003	0.05	-0.0003
	High	0.07	0.28	0.74	0.001	0.001	0.003	0.07	-0.0003
Changes Under Alternative 5 Compared to the No-Action Alternative									
Alt. 5	Low	0.04	0.17	0.41	0.000	0.001	0.001	0.03	-0.0002
	Medium	0.04	0.17	0.45	0.000	0.001	0.002	0.04	-0.0002
	High	0.04	0.18	0.47	0.001	0.001	0.002	0.05	-0.0002

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 MAGICC7 probabilistic distribution of equilibrium climate sensitivity, which is calibrated to be consistent with the peer-reviewed climate-sensitivity assessment in NCA5 (GCRP 2023). Climate model 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 1986-2005.
[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 datasets used here will differ in the types of vehicles included. See Section VI of the final rule preamble and Chapter 3 of the FRIA for additional detail regarding the effect of NHTSA's 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: warmer air and sea surface temperatures lead to less CO_2 being dissolved in the ocean and 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 increase in 2100 global mean surface temperature from the No-Action Alternative to Alternative 3 (Preferred Alternative) ranges from 0.002°C (0.004°F) to 0.003°C (0.005°F) from the low to high climate sensitivity.

CHAPTER 6 LIFE-CYCLE ASSESSMENT IMPLICATIONS OF VEHICLE MATERIALS

6.1 Introduction

This chapter is informed by a literature review and discusses the life-cycle implications of vehicle materials. This chapter is intended to give decision-makers and the public a clearer understanding of the broader impacts of the final rule.[1] A life-cycle approach is appropriate because 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 life 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. Each phase of a vehicle's life cycle contributes to non-criteria emissions (NCEs), energy use, and other environmental impacts.[2] This chapter largely focuses on NCEs and energy use in the upstream and downstream vehicle life-cycle phases.

A quantitative analysis is not included with this Final SEIS, but a qualitative discussion is included to inform decision-makers and the public about the vehicle life-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 vehicle life-cycle environmental impacts of vehicle materials, including raw material extraction, processing, component manufacture, and vehicle assembly. The agency's discussion in this Final SEIS of scientific and technical literature does not necessarily constitute an endorsement by the agency of that literature.

NHTSA prepared this Final SEIS in line with the Supreme Court's recent decision in *Seven County Infrastructure Coalition v. Eagle County, Colorado* and its progeny.[3] Agencies are granted substantial deference to determine the scope of the environmental impacts that they

[1] A quantitative life-cycle assessment (LCA) of regulatory alternatives is not included in this Final 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 final 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] Throughout this Final 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.

[3] *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).

address and may decide to evaluate environmental impacts from separate projects upstream or downstream from this action.[4] 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 Final SEIS certain aspects of the analytical frame of prior CAFE EISs. Specifically, this Final 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.[5] 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 EISA 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 mass reduction (including via material substitution) as described in Section II of the final rule preamble, this section discusses the vehicle life-cycle impacts of various components. This information is provided to give the decision-makers and the public a better understanding of the upstream and downstream environmental impacts associated with different vehicle material and technology options.

6.2.1 Non-Battery Components

This section discusses the life cycle of vehicle components that include NCEs, energy, and other environmental impacts for non-battery vehicle components. This section focuses on materials that account for the largest shares of vehicle weight and materials with production activities with more notable adverse impacts on the environment. In this section, the environmental impacts of 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). Though the average

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[4] See *Seven Cnty.* 145 S. Ct. at 1504 ("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.").

[5] 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.

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

LD vehicle weight has gradually increased over time with the increasing sales of larger automobiles (*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 production processes.

6.2.1.1 Steel

Steel comprises the greatest share of a vehicle's weight. Excluding batteries, steel 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, global 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-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 2022; Rehman *et al.* 2018).

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[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] Refers to composition of midsize sedans. 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).

[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).

6.2.1.2 Plastics/Polymer Composites

Plastics comprise the second largest share of a vehicle's weight, representing 15 percent of the material composition of both ICE vehicles and BEVs, excluding batteries, across different technologies in the U.S. market (Kelly *et al.* 2023).[13] 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).[14]

6.2.1.3 Aluminum

After steel and plastics, cast aluminum makes up the third largest share of a vehicle's weight and represents about eight percent of the material composition of both ICE vehicles and BEVs, excluding batteries (Kelly *et al.* 2023).[15] 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, NCE, and criteria pollutant emissions intensive than recycled aluminum production and contributes to higher levels of other environmental impacts, such as acidification, eutrophication, and smog (Wang 2022).[16] In addition, 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

[13] Refers to composition of midsize sedans.

[14] 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.

[15] Refers to composition of midsize sedans.

[16] 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).

vehicle components, end-of-life recycling rate, and lifetime of vehicles in use[17] (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).[18]

6.2.1.4 Fluids and Lubricants

Fluids and lubricants accounted for approximately 5 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).[19] 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 EVs use less coolant and do not require engine fluid (ANL 2023).

6.2.1.5 Iron Castings

Excluding batteries, iron castings accounted for about two percent of ICE vehicle weight and zero percent of BEV 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).[20] Iron casting is a highly energy and NCE-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 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).

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[17] 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 eight-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.

[18] 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, though 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).

[19] 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.

[20] Refers to composition of midsize sedans.

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. Excluding batteries, 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[21] and ecological impacts (Sullivan *et al.* 2018; Organisation for Economic Co-operation and Development [OECD] 2020).

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 2020).

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). As of 2020, NMC-based batteries dominate the 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.[22] 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). 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,

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[21] 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).

[22] 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.

increasing the importance placed on recycling (Pathak *et al.* 2022). Research into alternatives to lithium has been conducted to assess the viability of potential substitutes.[23]

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,[24] heating and cooling, materials handling, welding, and supplying compressed air (Kelly *et al.* 2023). The most energy-intensive aspects of the vehicle assembly process are: painting (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 vehicles and other products allows manufacturers to increase their use of recycled material inputs.[25]

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

[23] A consortium of scientists led by Berkeley Lab researched alternatives to nickel and cobalt in batteries. Alternatives include sodium-ion batteries, which are more suitable to stationary energy storage or smaller vehicles because they are less energy dense than lithium-ion batteries (BNEF 2023); ANL invented and patented a new cathode material that enables a higher energy density than earlier sodium-ion batteries, which could potentially power lower-range EVs (Harmon 2024).

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

[25] 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).

resources, and reduce emissions by displacing the extraction 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).[26] 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 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).[27]

6.3.1.2 Plastics/Polymer Composites

Studies vary on whether plastics and polymer composites are viable material substitutes for metals 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). Although composites are less recyclable than metals, incineration offers lower impacts than landfilling (Witik *et al.* 2011). The automotive plastic reuse and recycling rate was 2.6 percent in 2022 and estimated to have the potential to reach 50.4 percent (Cardamone *et al.* 2022).

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. For 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

[26] In 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).

[27] 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.

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).[28]

The automotive industry is the largest market for aluminum casting and cast products and makes 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).[29]

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.[30] 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. In addition, when scrap is separated and disassembled, a significant amount of copper is lost and ends up in other metal recycling loops, in the form of slags or impurities in the recycled metal.[31]

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 2020). 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.

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[28] 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 one percent can lower the overall carbon footprint by 80 kg CO_2e per 1,000 kg of aluminum products (Wang 2022).

[29] 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.

[30] 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).

[31] 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).

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.[32] Production with recycled nickel uses about five percent as much energy as nickel from virgin inputs (ANL 2023).

6.3.1.6 Tires

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 can reduce vehicle life-cycle NCEs.

The disposal and recycling of tires is another important end-of-life consideration for vehicles. Productive end-of-life options for tires include civil engineering applications,[33] energy recovery,[34] retreading,[35] 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 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,[36] 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 one million metric tons in 2024, accounting for an amount equivalent to 70 percent of domestic consumption (USGS

[32] 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).

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

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

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

[36] Pub. Law No. 104-142 of the 104th Congress, May 1996.

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 have a high recycling rate, with 2025 estimates at roughly five percent for end-of-life lithium-ion batteries (Srinivasan *et al.* 2025). Scrap generated during the production of lithium-ion batteries serves as recycling feedstock for secondary materials with fairly high recycling rates ranging from five 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 five 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.

LCAs of lithium-ion battery recycling have focused on three recycling technologies: pyrometallurgy,[37] hydrometallurgy,[38] and direct recycling[39] 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 cell chemistry, recycling can significantly reduce the potential environmental impacts of battery production. 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).

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[37] 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 five 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).

[38] 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).

[39] 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).

6.4 Conclusions

The information in this chapter seeks to help decision-makers and the public 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 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 Alternatives 1-4, while the technology with the highest mass reduction for passenger cars and light trucks—Level 4 with a 15 percent reduction in glider weight—has the highest technology penetration under Alternative 5 in MY 2031.

The unconstrained CAFE Model analysis for this Final SEIS shows that the penetration of strong hybrid electric vehicles (HEVs), PHEVs, and BEVs is higher in the No-Action Alternative relative to the action alternatives (Table 6.4-1). Across the five action alternatives in MY 2031, the model projects that the penetration of HEVs, PHEVs, and BEVs would be approximately 14-19, 1, and 19-21 percent, respectively. The EV technologies and scenarios 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.[40]

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	Alt. 4	Alt. 5
TURBO0: Turbocharging and Downsizing, Baseline Level	5%	15%	15%	15%	14%	7%
HCR: High Compression Ratio Engine	7%	13%	13%	13%	13%	11%
AT8: 8-Speed Automatic Transmission	1%	11%	11%	10%	6%	1%
AT10L3: 10-Speed Automatic Transmission, Level 3	5%	12%	12%	11%	11%	7%

[40] 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.

Technology Type	No-Action	Action Alternative				
		Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Continuously Variable Transmission, Level 2	8%	12%	12%	12%	12%	10%
Conventional Powertrain (Non-Electric)	7%	12%	12%	12%	11%	9%
P2TRB0 – P2 Strong Hybrid/Electric Vehicle with TURBO0 Engine	6%	7%	7%	8%	9%	11%
12-Volt Micro-Hybrid (Stop-Start)	10%	35%	35%	34%	31%	16%
Mass Reduction Technologies						
Mass Reduction: 5% Reduction in Glider Weight	2%	8%	8%	8%	9%	4%
Mass Reduction: 10% Reduction in Glider Weight	10%	38%	38%	39%	37%	24%
Mass Reduction: 15% Reduction in Glider Weight	76%	33%	33%	34%	35%	56%
Low-Rolling-Resistance Tires						
Low-Rolling-Resistance Tires: 30% Reduction in Rolling Resistance	97%	97%	97%	97%	97%	97%
Aero Drag Reduction						
Aero Drag Reduction: 15% Reduction in Aerodynamic Drag	33%	49%	49%	47%	45%	40%
Aero Drag Reduction: 20% Reduction in Aerodynamic Drag	60%	30%	30%	31%	35%	50%
Vehicles Using Batteries						
Strong HEVs	19%	14%	14%	14%	15%	19%
PHEVs	7%	1%	1%	1%	1%	1%
BEVs	22%	19%	19%	19%	19%	21%

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 eight to 17 percent of energy use and three to seven 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, the 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, thereby reducing 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 mineral reuse and recycling are 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]

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[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 Final 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 J, *Distribution List*.

The analysis in this Final 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, compared to the No-Action Alternative, the Proposed Action would decrease emissions of nitrogen oxides (NO_X), particulate matter 2.5 microns in diameter and smaller ($PM_{2.5}$), and sulfur dioxide (SO_2) and would increase criteria pollutant emissions of carbon monoxide (CO) and volatile organic compounds (VOCs) as well as non-criteria emissions.[12] Some criteria pollutant emissions would continue to increase under the Proposed Action and alternatives in later years (*i.e.*, not during the time period of the standards). 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, *Criteria Pollutants*, relative to the No-Action Alternative, emissions of CO and VOCs would increase under all action alternatives in projections for 2035 and 2050. Under all action alternatives, emissions of NO_X, $PM_{2.5}$, and SO_2 are projected to decrease in 2035 and 2050 compared to the No-Action Alternative.[14] Generally, a decrease in the emissions of criteria pollutants could result in a corresponding decrease in damage to historic properties and sacred sites or objects caused by acid deposition.[15] In general, acid deposition impacts under the Proposed Action and alternatives are not quantifiable, because

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[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 Final 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 Final 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. In addition, 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.

[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).

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.

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 Final 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 Final SEIS for the CAFE standards, fuel economy is expected to decrease 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 the No-Action Alternative. Because carbon dioxide (CO_2) emissions from passenger cars and light trucks are a direct consequence of total fuel consumption, these emissions are projected to increase under all action alternatives compared to the No-Action Alternative. NHTSA emphasizes that, in developing the CAFE standards that are represented by the No-Action Alternative, NHTSA impermissibly considered electric vehicles and credit trading in establishing standards (see NHTSA's June 2025 interpretive rule). For other air pollutants, NHTSA estimates that each of the action alternatives would increase emissions of carbon monoxide (CO) and volatile organic compounds (VOCs), and decrease emissions of nitrogen oxides, particulate matter 2.5 microns or less in diameter, and sulfur dioxide compared to the No-Action Alternative. NHTSA estimates that each of the action alternatives would increase emissions of the mobile source air toxics (MSATs) analyzed compared to the No-Action Alternative.

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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).

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]

[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, *Final SEIS Methods and Assumptions*; Chapter 3, Section 3.3, *Environmental Consequences: Reasonably Foreseeable Impacts from the Proposed Action* (energy); Chapter 4, Section 4.2, *Environmental Consequences: Reasonably Foreseeable Impacts of the Proposed Action* (air quality); and Chapter 5, Section 5.3, *Environmental Consequences: Reasonably Foreseeable Impacts from the Proposed Action* (non-criteria emissions).

Table 8.1-1. Proposed Action Impacts of CAFE Standard Alternatives

No-Action [a]	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)	Alt. 4 (Change)	Alt. 5 (Change)
Energy: Combined U.S. Passenger Car and Light Truck Fuel Consumption and Change in Fuel Consumption for 2027-2050 (billion gasoline gallon equivalent)					
2,338	+210 (+9%) [b]	210 (+9%) [b]	+204 (+9%)	+186 (+8%)	+114 (+5%)
Air Quality: Criteria Air Pollutant Emissions in 2035 (tons per year)					
CO: 6,499,337 NO_X: 329,442 $PM_{2.5}$: 20,835 SO_2: 55,157 VOCs: 811,607	Decrease: NO_X (-1,667), $PM_{2.5}$ (-259), and SO_2 (-3,074). Increase: CO (+76,261) and VOCs (+27,743).	Decrease: NO_X (-1,669), $PM_{2.5}$ (-259), and SO_2 (-3,077); emissions are equal to Alt. 1 for $PM_{2.5}$ and lower than Alt. 1 for NO_X and SO_2. Increase: CO (+76,421) and VOCs (+27,762); emissions are higher than Alt. 1.	Decrease: NO_X (-1,867), $PM_{2.5}$ (-272), and SO_2 (-3,120); emissions are lower than Alts. 1 and 2. Increase: CO (+76,795) emissions are higher than Alts. 1 and 2; VOC (+27,205) emissions are lower than Alts. 1 and 2.	Decrease: NO_X (-2,345), $PM_{2.5}$ (-304), and SO_2 (-3,146); emissions are lower than Alts. 1–3. Increase: CO (+75,351) and VOCs (+24,927); emissions are lower than Alts. 1-3.	Decrease: NO_X (-4,124), $PM_{2.5}$ (-412), and SO_2 (-3,183); emissions are lower than Alts. 1-4. Increase: CO (+64,623) and VOCs (+15,919); emissions are lower than Alts. 1-4.
Air Quality: Criteria Air Pollutant Emissions in 2050 (tons per year)					
CO: 3,443,517 NO_X: 241,990 $PM_{2.5}$: 14,181 SO_2: 50,343 VOCs: 516,641	Decrease: NO_X (-3,288), $PM_{2.5}$ (-487), and SO_2 (-3,125). Increase: CO (+271,234) and VOCs (+60,301).	Decrease: NO_X (-3,335), $PM_{2.5}$ (-490), and SO_2 (-3,140); emissions are lower than Alt. 1. Increase: CO (+271,679) and VOCs (+60,357); emissions are higher than Alt. 1.	Decrease: NO_X (-3,836), $PM_{2.5}$ (-519), and SO_2 (-3,246); emissions are lower than Alts. 1 and 2. Increase: CO (+267,792) and VOCs (+59,190); emissions are lower than Alts. 1 and 2.	Decrease: NO_X (-4,796), $PM_{2.5}$ (-578), and SO_2 (-3,431); emissions are lower than Alts. 1–3. Increase: CO (+259,174) and VOCs (+55,887); emissions are lower than Alts. 1-3.	Decrease: NO_X (-7,357), $PM_{2.5}$ (-728), and SO_2 (-3,760); emissions are lower than Alts. 1-4. Increase: CO (+224,481) and VOCs (+41,154); emissions are lower than Alts. 1-4.

No-Action [a]	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)	Alt. 4 (Change)	Alt. 5 (Change)
Air Quality: Mobile Source Air Toxic Emissions in 2035 (tons per year)					
Acetaldehyde: 2,216 Acrolein: 125 Benzene: 8,108 1,3-butadiene: 822 DPM: 54,286 Formaldehyde: 1,706	Decrease: None. Increase: Acetaldehyde (+57), acrolein (+3), benzene (+242), 1,3-butadiene (+21), DPM (+2,132), and formaldehyde (+65).	Decrease: None. Increase: Acetaldehyde (+57), acrolein (+3), benzene (+242), 1,3-butadiene (+21), DPM (+2,132), and formaldehyde (+65); emissions are equal to Alt. 1.	Decrease: None. Increase: Acetaldehyde (+57), acrolein (+3), benzene (+240), 1,3-butadiene (+22), DPM (+2,042), and formaldehyde (+65); emissions are equal to Alts. 1 and 2 for acetaldehyde, acrolein, and formaldehyde; greater than Alts. 1 and 2 for 1,3-butadiene; and less than Alts. 1 and 2 for benzene and DPM.	Decrease: None. Increase: Acetaldehyde (+55), acrolein (+3), benzene (+228), 1,3-butadiene (+21), DPM (+1,738), and formaldehyde (+61); emissions are equal to Alts. 1-3 for acrolein and less than Alt s. 1-3 for acetaldehyde, benzene, 1,3-butadiene, DPM, and formaldehyde.	Decrease: None. Increase: Acetaldehyde (+46), acrolein (+3), benzene (+175), 1,3-butadiene (+18), DPM (+609), and formaldehyde (+44); emissions are equal to Alts. 1-4 for acrolein and less than Alts. 1-4 for acetaldehyde, benzene, 1,3-butadiene, DPM, and formaldehyde.
Air Quality: Mobile Source Air Toxic Emissions in 2050 (tons per year)					
Acetaldehyde: 1,353 Acrolein: 75 Benzene: 4,898 1,3-butadiene: 499 DPM: 46,619 Formaldehyde: 1,033	Decrease: None. Increase: Acetaldehyde (+123), acrolein (+7), benzene (+538), 1,3-butadiene (+48), DPM (+3,545), and formaldehyde (+130).	Decrease: None. Increase: Acetaldehyde (+124), acrolein (+7), benzene (+538), 1,3-butadiene (+48), DPM (+3,543), and formaldehyde (+131); emissions are greater than Alt. 1 for acetaldehyde and formaldehyde, equal to Alt. 1 for acrolein, benzene, and 1,3-butadiene, and less than Alt. 1 for DPM.	Decrease: None. Increase: Acetaldehyde (+122), acrolein (+7), benzene (+530), 1,3-butadiene (+47), DPM (+3,386), and formaldehyde (+128); emissions are equal to Alts. 1 and 2 for acrolein and less than Alts. 1 and 2 for acetaldehyde, benzene, 1,3-butadiene, DPM, and formaldehyde.	Decrease: None. Increase: Acetaldehyde (+118), acrolein (+7), benzene (+509), 1,3-butadiene (+46), DPM (+2,984), and formaldehyde (+122); emissions are equal to Alts. 1-3 for acrolein and less than Alts. 1-3 for acetaldehyde, benzene, 1,3-butadiene, DPM, and formaldehyde.	Decrease: None. Increase: Acetaldehyde (+100), acrolein (+5), benzene (+415), 1,3-butadiene (+39), DPM (+1,381), and formaldehyde (+95); emissions are less than Alts. 1-4.
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 ($MMTCO_2$)					
57,900	+8,000	+8,000	+7,800	+7,200	+4,600
Climate: Changes in Atmospheric Carbon Dioxide Concentrations in 2100 (ppm) [c]					
-0.04	+0.77	+0.77	+0.75	+0.69	+0.45

No-Action [a]	Alt. 1 (Change)	Alt. 2 (Change)	Alt. 3 (Change)	Alt. 4 (Change)	Alt. 5 (Change)
Climate: Changes in Global Mean Surface Temperature Increase by 2100 in °C (°F) [c]					
-0.000°C (-0.000°F)	+0.003°C (+0.005°F)	+0.003°C (+0.005°F)	+0.003°C (+0.005°F)	+0.003°C (+0.005°F)	+0.002°C (+0.004°F)
Climate: Changes in Global Sea-Level Rise by 2100 in centimeters (inches) [c]					
-0.00 (-0.00)	+0.06 (+0.02)	+0.06 (+0.02)	+0.06 (+0.02)	+0.05 (+0.02)	+0.04 (+0.01)
Climate: Changes in Global Mean Precipitation Increase by 2100 [c,d]					
-0.00%	+0.01%	+0.01%	+0.00%	+0.00%	+0.00%
Climate: Changes in Ocean Acidification in 2100 (pH) [c]					
0.0000	-0.0004	-0.0004	-0.0004	-0.0003	-0.0002

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] The estimated fuel consumption is the same under Alternative 1 and Alternative 2 because starting with MY 2030 vehicle manufacturers are assumed to offer vehicles using nearly the same discrete fuel economy technologies under either Alternative 1 or Alternative 2 and, therefore, the resulting fuel consumption would be the same for both alternatives.
[c] 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 changes to its vehicle classification regulations starting in MY 2030, which reconsiders how light trucks are classified; therefore, the two datasets used here will differ in the types of vehicles included. See Section VI of the final rule preamble and Chapter 3 of the FRIA for additional detail regarding the effect of NHTSA's fleet reclassification.
[d] 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; $PM_{2.5}$ = 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 diminish potential adverse impacts.[5] NHTSA's analysis shows that some nonattainment areas could experience localized increases in some air pollutant emissions under the Proposed Action and alternatives compared to the No-Action Alternative, which could lead to changes in exposure to these pollutants for people living in these areas. However, NHTSA does not have the jurisdiction to regulate the specific 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, reducing exposure to associated emissions, controlling other sources of emissions, or a combination. 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 4.2.3-1.

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

The Proposed Action and alternatives would increase U.S. passenger car and light truck fuel consumption and emissions of CO, VOCs, MSATs, and CO_2 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 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]

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[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."

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