Corporate Average Fuel Economy Standards

Passenger Cars and Light Trucks

Model Years 2017-2025

Final Environmental Impact Statement

Summary

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SUMMARY

FOREWORD

The National Highway Traffic Safety Administration (NHTSA) prepared this Environmental Impact Statement (EIS) to analyze and disclose the potential environmental impacts of the proposed Corporate Average Fuel Economy (CAFE) standards for passenger cars and light trucks for model years (MYs) 2017 and beyond (the Proposed Action). NHTSA prepared this document pursuant to Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) implementing regulations, U.S. Department of Transportation (DOT) Order 5610.1C, and NHTSA regulations.

This EIS compares the potential environmental impacts of four alternative approaches to regulating light-duty vehicle fuel economy for MYs 2017–2025, including a Preferred Alternative and a No Action Alternative. This EIS analyzes direct, indirect, and cumulative impacts in proportion to their potential significance. The alternatives NHTSA selected for evaluation encompass a reasonable range of alternatives to evaluate the potential environmental impacts of the Proposed Action and alternatives under NEPA. EIS chapters and appendices provide or reference all relevant supporting information.

BACKGROUND

The Energy Policy and Conservation Act of 1975 (EPCA) established the CAFE program to reduce national energy consumption by increasing the fuel economy of passenger cars and light trucks. EPCA directs the Secretary of Transportation to set and implement fuel economy standards for passenger cars and light trucks sold in the United States. The Secretary has delegated responsibility for implementing the CAFE program to NHTSA.

In December 2007, Congress enacted the Energy Independence and Security Act of 2007 (EISA), amending the EPCA CAFE program requirements by providing DOT additional rulemaking authority and responsibilities. Pursuant to EISA, NHTSA has issued final CAFE standards for MY 2011 passenger cars and light trucks, and standards for MY 2012–2016 passenger cars and light trucks and MY 2014–2018 medium- and heavy-duty vehicles in joint rulemakings with the Environmental Protection Agency (EPA).

On May 21, 2010, President Obama issued a Presidential Memorandum entitled “Improving Energy Security, American Competitiveness and Job Creation, and Environmental Protection through a Transformation of our Nation’s Fleet of Cars and Trucks.” This memorandum builds on the President’s previous memorandum from January 26, 2009, which established a Joint National Program and led to the NHTSA and EPA joint final rulemaking establishing fuel economy and greenhouse gas (GHG) standards for MY 2012–2016 passenger cars and light trucks. The President’s 2010 memorandum requested that NHTSA and EPA continue the joint National Program by developing federal standards to improve fuel efficiency and reduce the GHG emissions of U.S. passenger cars and light trucks manufactured in MYs 2017–2025. The President requested that the agencies develop a Notice of Intent announcing plans for setting those standards by September 30, 2010, which would include “potential standards that could be practicably implemented nationally for the 2017–2025 model years and a schedule for setting those standards as expeditiously as possible, consistent with providing sufficient lead time to vehicle manufacturers.”

On September 30, 2010, NHTSA and EPA issued a Notice of Intent that announced plans to develop a rulemaking setting stringent fuel economy and GHG emissions standards for U.S. passenger cars and light trucks for MY 2017 and beyond. The notice was accompanied by an Interim Joint Technical Assessment Report, intended to inform the rulemaking process, which NHTSA, EPA, and the California Air Resources Board (CARB) developed in coordination with the U.S. Department of Energy (DOE). On December 8, 2010, the agencies published a Supplemental Notice of Intent highlighting many of the key comments received in response to the September Notice of Intent and the Interim Joint Technical Assessment Report. Over the next several months, the agencies, working with California, engaged in discussions with individual automobile manufacturers, automotive suppliers, states, environmental groups, consumer groups, and the United Auto Workers, who all expressed support for continuation of the National Program. These discussions and efforts focused on developing information that supported the underlying technical assessments that informed the proposed standards. On May 10, 2011, NHTSA published a Notice of Intent to prepare an EIS for new CAFE standards. On July 29, 2011, NHTSA and EPA issued a final Supplemental Notice of Intent generally describing the agencies' expectations for the Notice of Proposed Rulemaking (NPRM), including the intended levels of standards to be proposed and key program elements, such as compliance flexibilities and the mid-term evaluation. The NPRM was issued together with the Draft EIS on November 16, 2011.

NHTSA developed this EIS pursuant to NEPA, which 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). To inform its development of the final CAFE standards, NHTSA prepared this EIS, which analyzes, discloses, and compares the potential environmental impacts of a reasonable range of alternatives, including a Preferred Alternative, and discusses impacts in proportion to their significance.

PURPOSE AND NEED FOR THE PROPOSED ACTION

NEPA requires that proposed alternatives be developed 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 a reasonable range of alternatives to be considered in the NEPA analysis. In accordance with EPCA/EISA, one purpose of the Joint Rulemaking is to establish CAFE standards for MYs 2017 and beyond at "the maximum feasible average fuel economy level that the Secretary of Transportation decides the manufacturers can achieve in that model year." When determining the maximum feasible levels that manufacturers can achieve in each model year, EPCA requires that the Secretary of Transportation 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, the agency has the authority to – and traditionally does – consider other relevant factors, such as the effect of the CAFE standards on motor vehicle safety.

Under EISA, NHTSA must establish separate standards for passenger cars and light trucks for each model year, subject to two principal requirements. First, in certain years, the standards are subject to a minimum requirement regarding stringency – they must be set at levels high enough to ensure that the combined U.S. passenger car and light-truck fleet achieves an average fuel economy level of not less than 35 miles per gallon (mpg) not later than MY 2020. Second, the agency must establish separate average fuel economy standards for all new passenger cars and light trucks at the maximum feasible average fuel economy level that the Secretary of Transportation decides the manufacturers can achieve in that model year.

Finally, NHTSA also is acting pursuant to President Obama's memorandum to DOT on May 21, 2010, as described in Section 1.1 of this EIS. This memorandum further outlines the purpose of and need for the Proposed Action.

PROPOSED ACTION AND ALTERNATIVES AND ANALYSIS METHODOLOGIES

NEPA requires an agency to compare the potential environmental impacts of its proposed action and a reasonable range of alternatives. NHTSA's Proposed Action is to set fuel economy standards for passenger cars and light trucks in accordance with EPCA/EISA. In developing the Proposed Action and alternatives, NHTSA considered the four EPCA factors that guide the agency's determination of "maximum feasible" standards. NHTSA's decisionmaking process balances the four statutory EPCA factors, along with considerations such as environmental impacts and safety.

In any single rulemaking under EPCA, fuel economy standards may be established for not more than 5 model years. For this reason, NHTSA's proposal is limited to setting standards for MYs 2017–2021. In the NPRM, NHTSA also set forth values for MYs 2022–2025 that reflected the agency's estimate of the standards we would have proposed and adopted had we the authority to do so. The CAFE standards for MYs 2022–2025 will be determined in a subsequent, de novo notice and comment rulemaking. However, because NHTSA's effort is part of a joint NHTSA/EPA rulemaking for a coordinated and harmonized National Program covering MYs 2017–2025, this EIS addresses the potential impacts of the proposed standards for MY 2017–2021 and the values set forth for MYs 2022–2025 for each of the alternatives, thus covering the full MY 2017–2025 period. When NHTSA refers to the standards in this EIS as "required," it recognizes that fuel economy standards for MY 2022–2025 will not, in fact, be required in this rulemaking. Rather, it is assumed for purposes of the analysis in this EIS that the values set forth for MYs 2022–2025 will be made required in the future. Similarly, when NHTSA refers to the "Proposed Action" or to the "proposed standards," these terms are intended to identify the full time period covered by the coordinated National Program (MYs 2017–2025) for purposes of analysis, but subject to the specific caveats noted above.

NHTSA has selected a reasonable range of alternatives to evaluate the potential environmental impacts of the Proposed Action under NEPA. The specific alternatives NHTSA selected, described below and listed in Table S-1 and Sections 2.2.4 and 2.2.5 of this EIS, encompass a reasonable range within which to set CAFE standards and to evaluate the potential environmental impacts under NEPA, in view of EPCA requirements. Pursuant to CEQ regulations, the agency has included a No Action Alternative (Alternative 1), which assumes no action would occur under the National Program. The No Action Alternative assumes that NHTSA would not issue a rule regarding CAFE standards for MY 2017–2025 2025 passenger cars and light trucks; rather, consistent with previous EISs, the agency assumes that NHTSA's MY 2016 fuel economy standards and EPA's MY 2016 GHG standards would continue indefinitely. This alternative provides an analytical baseline against which to compare the environmental impacts of the three action alternatives.

Uncertainty over Market-Driven Improvements in Fuel Economy

In recognition of the uncertainty inherent in forecasting the fuel economy of the future light-duty vehicle fleet in the absence of agency action, this EIS provides two sets of analyses regarding the No Action Alternative against which the corresponding impacts of the action alternatives were measured. Analyses A1 and A2 reflect a No Action Alternative that assumes that, in the absence of the Proposed Action, the baseline light-duty vehicle fleet in MY 2017 and beyond would attain an average fleetwide fuel economy no higher than the minimum levels necessary to comply with NHTSA and EPA's MY 2016 standards established by final rule in April 2010. Analyses A1 and A2 also assume that the average annual fleetwide fuel economy under the action alternatives would be no higher than the minimum necessary to comply with the level of the agency's CAFE standard for a particular year during the rulemaking period. Finally, after MY 2025, NHTSA assumes that average fleetwide fuel economy under the action alternatives will never exceed the level set forth for the MY 2025 standards. Tables and figures in this summary that depict results for Analysis A have "A1" or "A2" after the table or figure number.

Analyses B1 and B2 reflect a No Action Alternative that assumes that, in the absence of the Proposed Action, the average fleetwide fuel economy level of passenger cars and light trucks would continue to increase beyond the level necessary to meet the MY 2016 standards. These analyses also reflect action alternatives that assume that once manufacturers comply with the CAFE standard for a particular year during the MY 2017–2025 period, they would consider making further improvements in fuel economy if it is cost-effective to do so. NHTSA forecast the fleets assumed in Analyses B1 and B2 using the "voluntary over-compliance" simulation capability of the Volpe model, described in Section 2.2.1 of this EIS and in Section IV.C.4.c of the NPRM. For this simulation, the agency used all the same inputs as for Analysis A, but applied a payback period of 1 year for purposes of simulating whether a manufacturer would apply additional technology to an already CAFE-compliant fleet through MY 2025. In other words, NHTSA assumed manufacturers would continue to add fuel economy technologies that pay for themselves through fuel savings within 1 year. More discussion of this methodology is available in Section IV.G of the NPRM. In Analyses B1 and B2, the agency has also assumed that average fleetwide fuel economy will continue to increase after MY 2025 at rates consistent with historical changes in the fuel economy of new passenger cars and light trucks during periods when CAFE standards remained fixed and did not require manufacturers to offer vehicles with higher fuel economy than in the immediately preceding model years. Tables and figures in this summary that depict results for Analyses B1 and B2 have "B1" or "B2" after the table or figure number.

Uncertainty in New Vehicle Fleet Forecast

To evaluate the environmental impacts of the proposed alternatives, NHTSA must project what vehicles and technologies will exist in future model years and then evaluate what technologies can feasibly be applied to those vehicles to raise their fuel economy. To project the future fleet, NHTSA must develop a baseline vehicle fleet. For this Final EIS, NHTSA has analyzed the potential environmental impacts of the Proposed Action and alternatives using two different forecasts of the light-duty vehicle fleet through MY 2025.

In the NPRM, NHTSA and EPA used 2008 MY CAFE certification data to establish the "2008-based fleet projection." In addition to the MY 2008 CAFE certification data, NHTSA based the forecast of the light-duty vehicle fleet through 2025 on the Annual Energy Outlook (AEO) 2011 interim projection of future fleet sales volumes and on the CSM Worldwide future new vehicle fleet forecast from 2009. In this Final EIS, one new vehicle fleet forecast (referred to as the MY 2008 baseline and assumed in Analyses A1 and B1) is similar to the one used in the NPRM. In response to comments, this Final EIS also includes another new vehicle fleet forecast (generally referred to as the MY 2010 baseline and assumed in Analyses A2 and B2) using a baseline fleet constructed from MY 2010 CAFE certification data, AEO 2012 Early Release fleet sales projections to MY 2025 published in 2012, and a purchased LMC Automotive-based new vehicle fleet projection (by vehicle type and manufacturer) out to MY 2025. The significant uncertainty associated with forecasting sales volumes, vehicle technologies, fuel prices, consumer demand, and other variables out to MY 2025 makes it reasonable and appropriate to evaluate the impacts of the Proposed Action and alternatives using two baselines.

The two new vehicle fleet forecasts have certain differences. For example, the MY 2008 vehicle data (reflected in Analyses A1 and B1) represent the most recent model year for which the industry had sales data that were not affected by the subsequent economic recession. However, the CSM forecast used for the MY 2008 baseline, appears to have been particularly influenced by the recession, showing major declines in market share for some manufacturers (e.g., Chrysler), which NHTSA does not believe is reasonably reflective of future trends. On the other hand, the MY 2010 baseline (reflected in Analyses A2 and B2) employs a future new vehicle fleet that is more current.

In addition, although MY 2010 CAFE certification data have become available since the publication of the NPRM, it continues to show the effects of the recession. For example, industry-wide sales were skewed down 20 percent compared to pre-recession MY 2008 levels. Using the MY 2008 vehicle data avoids using these sudden and perhaps temporary baseline market shifts when projecting the future new vehicle fleet. On the other hand, the MY 2010 CAFE certification data accounts for the phase-out of some brands and the introduction of some technologies, which might be more reflective of the future new vehicle fleet.

Designation of Analyses in this EIS Based on Uncertainties

In light of the uncertainties discussed above, this Final EIS presents the potential environmental impacts for each of the alternatives using two different assumptions regarding market-driven fuel economy improvements and two different sets of fleet characteristic assumptions. By retaining the assumptions used in Analysis A and Analysis B from the Draft EIS, this approach produces four sets of results for direct and indirect impacts – Analyses A1 and A2 and Analyses B1 and B2 – for each alternative as described below. The two sets of fleet-characteristic assumptions also produce two sets of results for cumulative impacts – Analyses C1 and C2 – for each of the alternatives as described below.

- In Analyses A1 and A2, the agency assumes that the average fleetwide fuel economy for light-duty vehicles would not exceed the minimum level necessary to comply with CAFE standards. Therefore, Analyses A1 and A2 measure the impacts of the action alternatives under which average fleetwide fuel economy in each model year does not exceed the level of the CAFE standards for that model year, compared to a No Action Alternative under which average fleetwide fuel economy after MY 2016 will never exceed the level of the agencies' MY 2016 standards established by final rule in April 2010. Tables and figures in this Final EIS that depict results for Analysis A1 (these have "A1" after the table or figure number) show estimated impacts derived from a MY 2008 baseline fleet, fleet sales projections to MY 2025 from AEO 2011, and a CSM-based fleet projection. Tables and figures that depict results for Analysis A2 (these have "A2" after the table or figure number) show estimated impacts derived from a MY 2010 baseline fleet, fleet sales projections to MY 2025 from the AEO 2012 Early Release, and an LMC-based fleet projection.
- In Analyses B1 and B2, the agency assumes continued improvements in average fleetwide fuel economy for light-duty vehicles due to higher market demand for fuel-efficient vehicles. Therefore, Analyses B1 and B2 measure the impacts of the action alternatives assuming overcompliance by certain manufacturers through MY 2025 and ongoing improvements in new vehicle fuel economy after MY 2025, compared to a No Action Alternative that assumes the average fleetwide fuel economy level of light-duty vehicles would continue to increase beyond the level necessary to meet the MY 2016 standards, even in the absence of agency action. Tables and figures in this Final EIS

that depict results for Analysis B1 (these have "B1" after the table or figure number) show estimated impacts derived from a MY 2008 baseline fleet, fleet sales projections to MY 2025 from AEO 2011, and a CSM-based fleet projection. Tables and figures that depict results for Analysis B2 (these have "B2" after the table or figure number) show estimated impacts derived from a MY 2010 baseline fleet, fleet sales projections to MY 2025 from the AEO 2012 Early Release, and an LMC-based fleet projection.

- CEQ NEPA implementing regulations require agencies to consider the cumulative impacts of major federal actions. NHTSA refers to the cumulative impacts analysis as Analysis C throughout this EIS. In Analyses C1 and C2, the agency compares action alternatives assuming overcompliance by certain manufacturers through MY 2025 and ongoing fuel economy improvements after MY 2025 with a No Action Alternative under which there are no continued improvements in fuel economy after MY 2016 (i.e., the average fleetwide fuel economy for light-duty vehicles would not exceed the latest existing standard). In this way, the cumulative impacts analysis combines the No Action Alternative from Analyses A1 and A2 with the action alternatives from Analyses B1 and B2. Tables and figures in this Final EIS that depict results for Analysis C1 (these have "C1" after the table or figure number) show estimated impacts derived from a MY 2008 baseline fleet, fleet sales projections to MY 2025 from AEO 2011, and a CSM-based fleet projection. Tables and figures that depict results for Analysis C2 (these have "C2" after the table or figure number) show estimated impacts derived from a MY 2010 baseline fleet, fleet sales projections to MY 2025 from the AEO 2012 Early Release, and an LMC-based fleet projection. For more explanation of NHTSA's methodology regarding the cumulative impacts analysis, *see* Section 2.5.

Analysis A1 is generally comparable to Analysis A in the Draft EIS, and Analysis B1 is generally comparable to Analysis B in the Draft EIS. Analysis A2 and Analysis B2 make the same assumptions about growth during and after the years of the Proposed Action as Analysis A1 and Analysis B1, respectively, except these analyses reflect a MY 2010 baseline fleet (as described above).

NHTSA has provided separate tables illustrating the environmental impacts projected in each analysis. In discussing these impacts, NHTSA often presents the results of Analyses A1 and A2 together and Analyses B1 and B2 together in what appears to be a range (e.g., "light-duty vehicle 2017–2060 fuel consumption is projected to range from 4,987 to 5,372 billion gallons under the Preferred Alternative in Analyses A1 and A2"). This form of presenting the results is not intended to bound all the possible, or even likely, potential impacts that may occur under a given alternative in a given year. In other words, the values should not be interpreted as a true minimum or maximum potential impact. Rather, this format presents results using the same methodology but under different assumptions, as described above.

Alternatives

NHTSA has analyzed a reasonable range of action alternatives with stringencies that increase annually, on average, 2 percent to 7 percent from the MY 2016 standards for passenger cars and for light trucks. As the agency stated in the Notice of Intent to issue an EIS and in the Draft EIS, NHTSA believes that, based on the different ways it could weigh EPCA's four statutory factors, the maximum feasible level of CAFE stringency falls within this range. Throughout this EIS, estimated impacts are shown for three action alternatives that illustrate this range of average annual percentage increases in fleetwide fuel economy. The regulatory alternatives analyzed here are the same as those presented in the Draft EIS and the NPRM. Table S-1 shows the estimated average required and achieved fleetwide fuel economy forecasts by model year under the alternatives. The action alternatives are as follows:

- Alternative 2 – Alternative 2 would require a 2 percent average annual fleetwide increase in fuel economy for both passenger cars and light trucks for MYs 2017–2025. Alternative 2 represents the lower bound of the range of annual stringency increases NHTSA believes includes the maximum feasible stringency.
- Alternative 3 (Preferred) – Under the Preferred Alternative, manufacturers would be required to meet an estimated average fleetwide fuel economy level of 40.3 to 41.0 mpg in MY 2021 and 48.7 to 49.7 mpg in MY 2025. These averages are uncertain, because, as discussed in Section 1.3.2.1 of this EIS, the actual average required fuel economy levels in the future will depend upon the actual composition of the future fleet, which can only be estimated – with considerable uncertainty – at this time. The proposed stringency increases to the attribute-based standards (i.e. the target functions as expressed on a gallons per mile [gpm] basis) for MYs 2017–2021 average 3.6 percent for passenger cars. In recognition of manufacturers' unique challenges in improving the fuel economy and GHG emissions of full-size pickup trucks (a subset of light trucks) as we transition from the MY 2016 standards to MY 2017 and later, while preserving the utility (e.g., towing and payload capabilities) of those vehicles, NHTSA's proposal includes a slower annual rate of improvement for light trucks in the first phase of the program. The proposed stringency increases to the attribute-based standards for MYs 2017–2025 average 2.3 percent (on a gpm basis) for light trucks. For MYs 2022–2025, the annual stringency increases set forth average 4.4 percent (also on a gpm basis) for both passenger cars and light trucks. The target curves identified as the Preferred Alternative and analyzed in this Final EIS are the same as those that defined the Preferred Alternative in the Draft EIS and outlined as the proposal in the NPRM. In other words, the rate of increase in stringency of the Preferred Alternative analyzed in the Final EIS has not changed.
- Alternative 4 – Alternative 4 would require a 7 percent average annual fleetwide increase in fuel economy for both passenger cars and light trucks for MYs 2017–2025. Alternative 4 represents the upper bound of the range of annual stringency increases NHTSA believes includes the maximum feasible stringency.

Table S-1. Estimated Average Required[a] and Achieved[b] Fleetwide Fuel Economy (mpg) for Combined U.S. Passenger Cars and Light Trucks by Model Year and Alternative under each Analysis

Alternative	Analysis	MY 2017	MY 2018	MY 2019	MY 2020	MY 2021	MY 2022	MY 2023	MY 2024	MY 2025
Estimated Average Required										
1 – No Action	A1 & B1	34.6	34.7	34.8	34.8	34.8	34.9	34.9	35.0	35.1
	A2 & B2	34.3	34.3	34.3	34.3	34.3	34.4	34.4	34.5	34.5
2 – 2%/Year Cars and Trucks	A1 & B1	35.5	36.3	37.2	37.9	38.8	39.6	40.5	41.5	42.5
	A2 & B2	35.1	35.8	36.6	37.4	38.2	39.0	39.8	40.8	41.6
3 – Preferred	A1 & B1	35.4	36.5	37.7	38.9	41.0	43.0	45.1	47.4	49.7
	A2 & B2	35.1	36.1	37.1	38.3	40.3	42.3	44.3	46.5	48.7
4 – 7%/Year Cars and Trucks	A1 & B1	37.3	40.3	43.6	47.0	50.8	54.8	59.2	64.0	69.2
	A2 & B2	36.9	39.8	42.9	46.3	49.9	53.9	58.2	62.8	67.8

Table S-1. Estimated Average Required[a] and Achieved[b] Fleetwide Fuel Economy (mpg) for Combined U.S. Passenger Cars and Light Trucks by Model Year and Alternative under each Analysis (continued)

Alternative	Analysis	MY 2017	MY 2018	MY 2019	MY 2020	MY 2021	MY 2022	MY 2023	MY 2024	MY 2025
Estimated Average Achieved										
1 – No Action	A1	33.7	34.1	34.4	34.6	34.9	34.9	35.0	35.1	35.2
	A2	33.3	33.7	33.9	34.3	34.4	34.5	34.5	34.6	34.6
	B1	34.5	35.3	36.1	36.4	36.7	37.0	37.2	37.3	37.5
	B2	34.1	34.5	35.2	35.7	36.2	36.4	36.6	36.8	36.9
2 – 2%/Year Cars and Trucks	A1	35.0	36.1	37.5	38.6	39.6	40.2	40.8	41.6	41.9
	A2	34.7	35.6	36.7	37.9	38.8	39.2	39.9	40.7	40.9
	B1	35.2	36.4	37.7	38.8	39.4	40.2	40.7	41.5	42.2
	B2	34.8	35.6	36.8	38.0	38.9	39.4	40.1	40.9	41.5
3 – Preferred	A1	35.0	36.6	38.7	40.8	42.6	43.8	44.6	46.0	47.4
	A2	34.8	36.0	38.2	39.9	42.0	42.9	44.2	45.6	46.2
	B1	35.6	37.1	39.1	40.8	42.3	43.6	44.6	46.1	48.1
	B2	34.9	36.1	38.4	40.3	42.1	43.2	44.5	45.7	47.1
4 – 7%/Year Cars and Trucks	A1	37.8	40.3	43.4	46.7	49.7	52.3	53.8	56.4	58.4
	A2	37.2	39.0	42.1	45.1	47.7	49.7	51.9	54.5	57.1
	B1	37.9	40.5	43.9	46.7	49.6	51.6	53.8	56.1	58.3
	B2	37.0	38.8	42.2	45.5	48.3	50.2	52.0	54.8	56.9

a. Estimated average *required* fuel economy levels are based on application of the mathematical function defining the alternative to the market forecast defining the estimated future fleets of new passenger cars and light trucks.

b. For the No Action Alternative, estimated average *achieved* fuel economy levels reflect the agency's estimates of manufacturers' potential responses to these requirements, taking into account available technology, available adjustments to fuel economy levels based on reduction of air conditioner energy consumption, fuel economy calculations specific to electric vehicles, and EISA/EPCA provisions allowing manufacturers to earn CAFE credits by producing flexible-fuel vehicles, to pay civil penalties in lieu of achieving compliance with CAFE standards, to carry CAFE credits forward between model years (up to 5 years), and to transfer CAFE credits between the passenger car and light-truck fleets. In addition, for the action alternatives, estimated achieved levels take into account available adjustments to fuel economy levels based on application of technologies (other than those that improve air conditioner efficiency) that reduce off-cycle energy consumption.

The range being considered under the action alternatives encompasses a spectrum of possible standards the agency could select, based on the different ways NHTSA could weigh EPCA's four statutory factors. By providing environmental analyses of these points and the Preferred Alternative, the decisionmaker and the public can determine the environmental effects of points that fall between Alternatives 2 and 4. The action alternatives evaluated in this EIS therefore provide decisionmakers with the ability to select from a wide variety of other potential alternatives with stringencies that increase annually at average percentage rates between 2 and 7 percent. This includes, for example, alternatives with stringencies that increase at different rates for passenger cars and for light trucks, and stringencies that increase by different rates in different years.

These alternatives reflect differences in the degree of technology adoption across the fleet, in costs to manufacturers and consumers, and in conservation of oil and related reductions in GHGs. For example, the most stringent alternative NHTSA is evaluating (Alternative 4) would require greater adoption of technology across the fleet, including more advanced technology, than the least stringent action alternative (Alternative 2) NHTSA is evaluating. As a result, Alternative 4 would impose greater costs and achieve greater energy conservation and related reductions in GHGs than other action alternatives, compared to the No Action Alternative. The agency's Preferred Alternative (Alternative 3) represents the required fuel economy level NHTSA has tentatively determined to be the maximum feasible level under EPCA, based on balancing the four statutory factors and other relevant considerations. For a detailed description of the alternatives, *see* Section 2.2 of this Final EIS.

POTENTIAL ENVIRONMENTAL CONSEQUENCES

This section describes how the Proposed Action and alternatives could affect energy use, air quality, and climate, as reported in Chapters 3, 4, and 5 of the EIS, respectively. Air quality and climate impacts are reported for the entire light-duty vehicle fleet (passenger cars and light trucks combined), while Appendix A to the EIS provides the air quality and climate impacts of the Proposed Action and alternatives for passenger cars and light trucks separately. The EIS also qualitatively describes potential additional impacts on water resources, biological resources, hazardous materials and regulated wastes, noise, and environmental justice.

The impacts on energy use, air quality, and climate described in the EIS include *direct*, *indirect*, and *cumulative impacts*. Direct impacts occur at the same time and place as the action. Indirect impacts occur later in time and/or are farther removed in distance. Cumulative impacts are the incremental direct and indirect impacts resulting from the action added to those of other past, present, and reasonably foreseeable future actions.

The analysis of the direct and indirect impacts compares the action alternatives in a particular analysis (A1, A2, B1, or B2) with the No Action Alternative in that analysis, applying their respective assumptions as described above. The cumulative impacts analysis accounts for other past, present, and reasonably foreseeable future actions, consistent with NEPA requirements. The cumulative impacts analysis presents the environmental impacts (including impacts to energy, air quality, and climate) due to the fuel economy improvements that result directly or indirectly from the action alternatives in addition to reasonably foreseeable improvements in fuel economy caused by other actions – that is, fuel economy improvements that would result from actions taken by manufacturers without the agency's action and in response to market demands. The cumulative impacts analysis also compares the action alternatives in a particular analysis (C1 or C2) with the No Action Alternative in that analysis, applying their respective assumptions as described above.

Energy

NHTSA's Proposed Action would regulate fuel economy and therefore impact fuel consumption in the U.S. transportation sector. Transportation fuel comprises 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. Because automotive fuel consumption is expected to account for most U.S. net energy imports through 2035, the United States has the potential to achieve large reductions in imported oil use and, consequently, reductions in the country's net energy imports during this time by increasing the fuel economy of its fleet of passenger cars and light trucks.

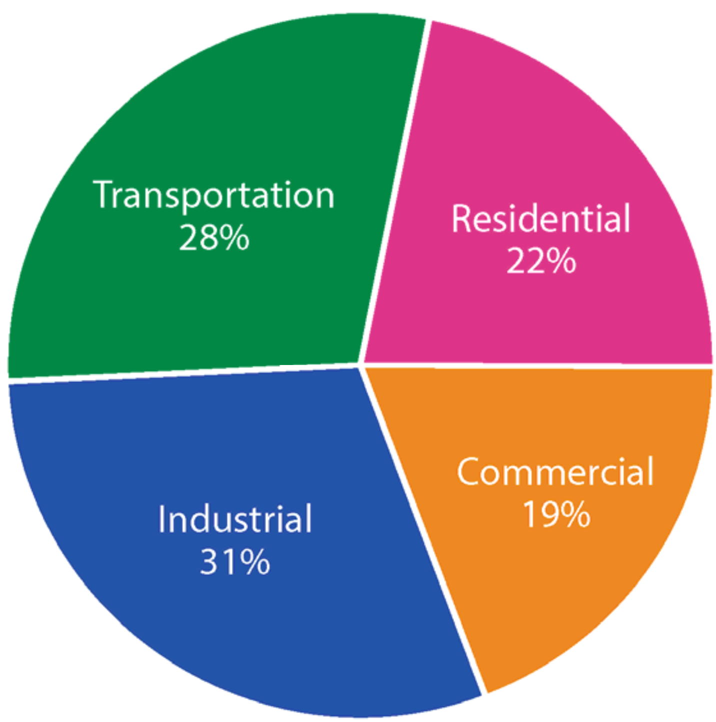
Increasing the fuel economy of the light-duty vehicle fleet is likely to have far-reaching impacts related to reducing U.S. dependence on foreign oil. Reducing dependence on energy imports is a key component of the President's March 30, 2011, *Blueprint for a Secure Energy Future*, which indicates that increasing transportation efficiency is an essential step toward that goal. The 1-year progress report to the President's *Blueprint* reaffirms the major role increased fuel efficiency in transportation has already played in reducing U.S. dependence on foreign oil. Similarly, DOE has stated that vehicle efficiency has the greatest short- to mid-term impact on oil consumption.

Energy intensity measures the efficiency at which energy is converted to Gross Domestic Product (GDP), with a high value indicating an inefficient conversion of energy to GDP and a lower value indicating a more efficient conversion. The energy intensity of the U.S. economy has decreased by 54 percent over 4 decades (from 15,890 British thermal units [Btu] per real dollar of GDP in 1970 to 7,400 Btu per real dollar of GDP in 2010), indicating an overall increase in the efficiency with which the U.S. uses energy. Although U.S. energy efficiency has been increasing and the U.S. share of global energy consumption has been declining in recent decades, total U.S. energy consumption has been increasing over that same period.

Most of the increase in U.S. energy consumption over the past decades has not come from increased domestic energy production, but instead from the increase in imports largely for use in the transportation sector. Transportation fuel consumption has grown steadily on an annual basis. Transportation is now the largest consumer of petroleum in the U.S. economy and a major contributor to U.S. net imports. The United States is poised to reverse the trend of the last 4 decades and achieve large reductions in net energy imports through 2035 due to continuing increases in U.S. energy efficiency and recent developments in U.S. energy production. Stronger fuel economy standards for light-duty vehicles have the potential to further increase U.S. energy efficiency in the transportation sector and reduce U.S. dependence on petroleum.

The transportation sector is the second-largest consumer of energy in the United States (after the industrial sector), representing 28 percent of total U.S. energy use, as shown in Figure S-1.

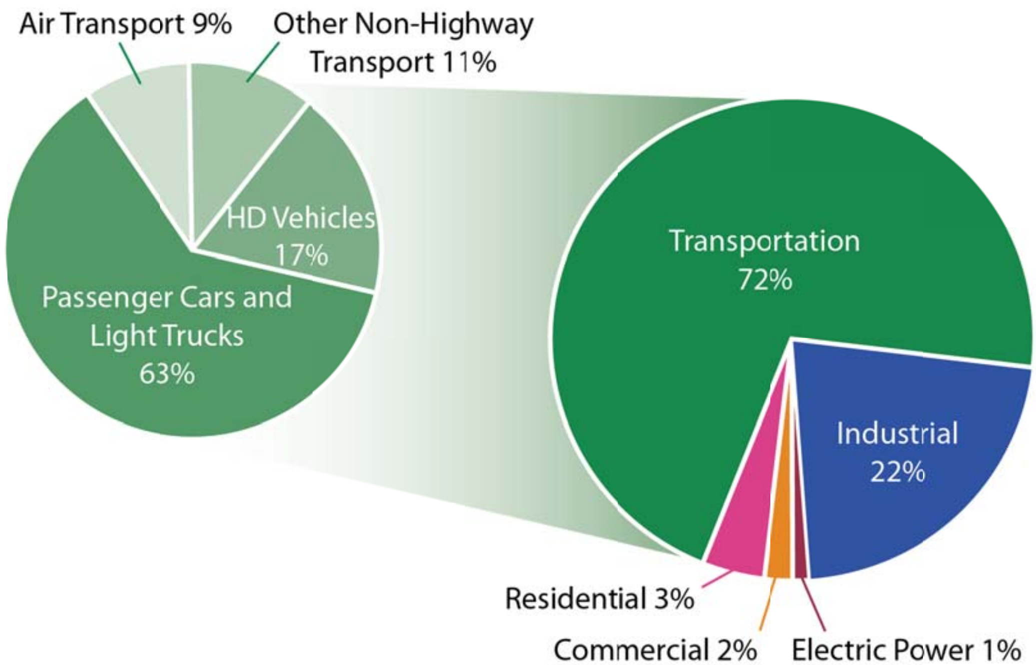
Figure S-1. U.S. Energy Consumption by Sector, 2010



Source: EIA (Energy Information Administration). Annual Energy Outlook 2012. Early Release Overview. DOE/EIA-0383ER. U.S. Department of Energy: Washington, DC. *Available at*: <http://www.eia.gov/forecasts/aeo/er/>. (Accessed: May 31, 2012).

Petroleum is by far the largest source of energy used in the transportation sector, accounting for almost 95 percent of this sector's energy consumption. Consequently, transportation accounts for the largest share of total U.S. petroleum consumption. As shown in Figure S-2, the transportation sector consumes 72 percent of the petroleum used in the United States.

Figure S-2. U.S. Petroleum Consumption by Sector, 2010



HD = heavy-duty

Left Pie Chart Data Source: EIA. 2012. Annual Energy Outlook 2012. Early Release Overview. Table 7—Transportation Sector key Indicators and Delivered Energy Consumption. DOE/EIA-0383ER. U.S. Department of Energy: Washington, D.C. Available at: <http://www.eia.gov/oiaf/aeo/tablebrowser/>. (Accessed: May 31, 2012).

Right Pie Chart Data Source: EIA. 2011. Annual Energy Review 2010. Table 5.13a-d—Petroleum Consumption Estimates, 1949–2010. DOE/EIA-0384 (2010). U.S. Department of Energy: Washington, D.C. Available at: <http://www.eia.gov/totalenergy/data/annual/pdf/aer.pdf>. (Accessed: April 20, 2012).

More than half of transportation-sector energy use can be attributed to petroleum (gasoline and diesel fuel) consumption by passenger cars and light trucks. In the future, the transportation sector will continue to be the largest petroleum consumer and the second largest component of total U.S. energy consumption after the industrial sector. NHTSA's analysis of fuel consumption in this EIS assumes that fuel consumed by passenger cars and light trucks will consist predominantly of gasoline and diesel fuel derived from petroleum for the foreseeable future.

Key Findings for Energy Use

To calculate fuel savings for each action alternative, NHTSA subtracted projected fuel consumption under each action alternative from the level under the No Action Alternative. The fuel consumption and savings figures presented below are for 2017–2060 (2060 being the year by which nearly the entire U.S. light-duty vehicle fleet will likely be composed of MY 2017–2025 and later vehicles).

Direct and Indirect Impacts

As the alternatives increase in stringency, total fuel consumption decreases in all of the analyses. In Analyses A1 and A2, light-duty vehicle fuel consumption from 2017–2060 under the No Action Alternative is projected to range from 6,052 to 6,562 billion gallons. Light-duty vehicle fuel consumption from 2017–2060 is projected to range from 5,400 to 5,812 billion gallons under Alternative 2, 4,987 to 5,372 billion gallons under the Preferred Alternative, and 4,456 to 4,795 billion gallons under Alternative 4. In Analyses B1 and B2, light-duty vehicle fuel consumption from 2017–2060 under the No Action Alternative is projected to range from 5,280 to 5,694 billion gallons. Light-duty vehicle fuel consumption from 2017–2060 is projected to range from 5,080 to 5,476 billion gallons under Alternative 2, 4,694 to 5,054 under the Preferred Alternative, and 4,261 to 4,559 billion gallons under Alternative 4.

Fuel savings is the reduction in fuel consumption over a specific period. In contrast to fuel consumption, fuel savings under each action alternative compared to the No Action Alternative increases with stringency. Figures S-3-A1, A2, B1, and B2 demonstrate fuel savings for Analyses A1, A2, B1 and B2, respectively, from 2017–2060 under each action alternative compared to the No Action Alternative. In Analyses A1 and A2, light-duty vehicle 2017–2060 fuel savings would range from 652 to 751 billion gallons under Alternative 2, 1,066 to 1,190 billion gallons under the Preferred Alternative, and 1,597 to 1,767 billion gallons under Alternative 4. In Analyses B1 and B2, light-duty vehicle 2017–2060 fuel savings would range from 200 to 219 billion gallons under Alternative 2, 585 to 640 billion gallons under the Preferred Alternative, and 1,019 to 1,135 billion gallons under Alternative 4.

Figure S-3-A1. U.S. Passenger Car and Light Truck Fuel Savings by Alternative (billion gasoline gallon equivalent total for calendar years 2017–2060), Analysis A1

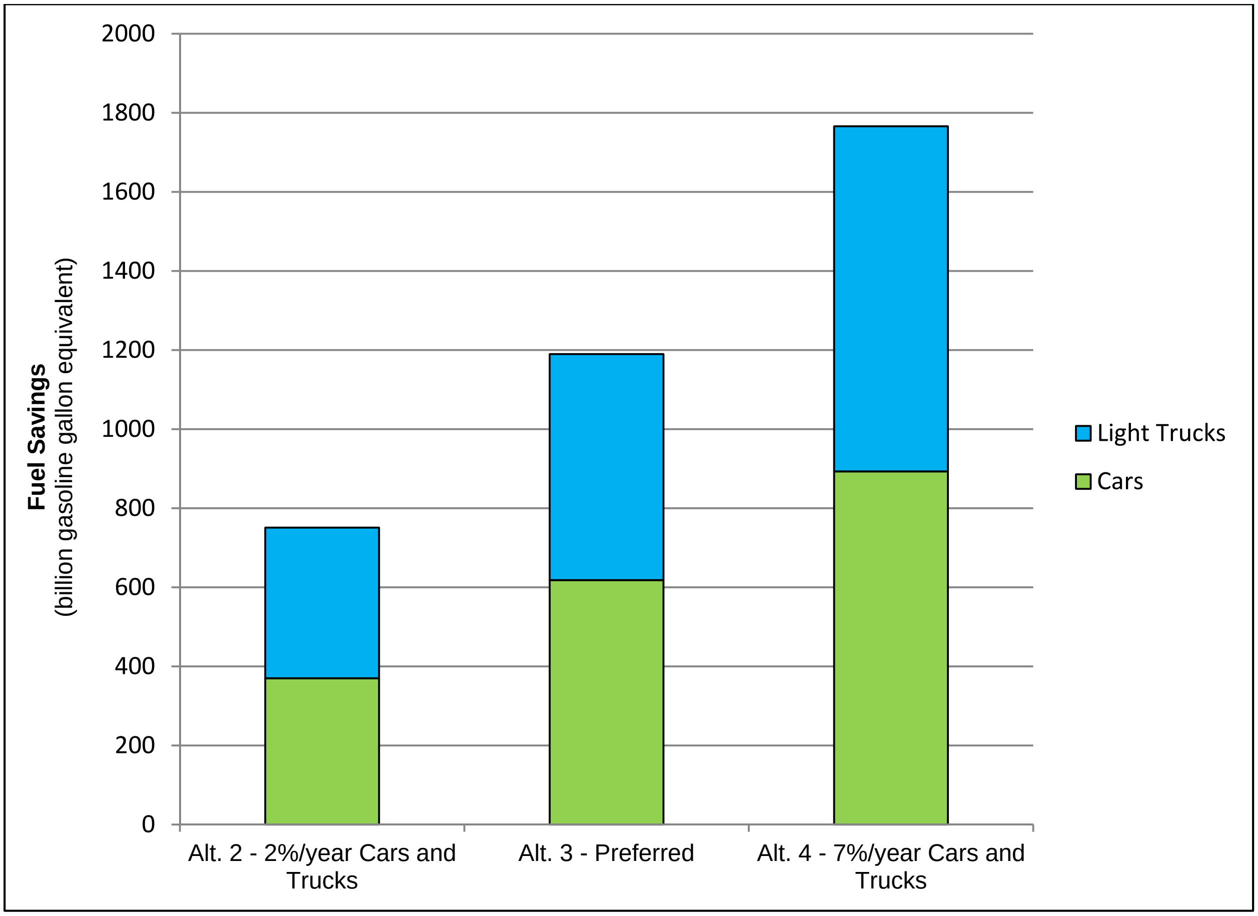


Figure S-3-A2. U.S. Passenger Car and Light Truck Fuel Savings by Alternative (billion gasoline gallon equivalent total for calendar years 2017–2060), Analysis A2

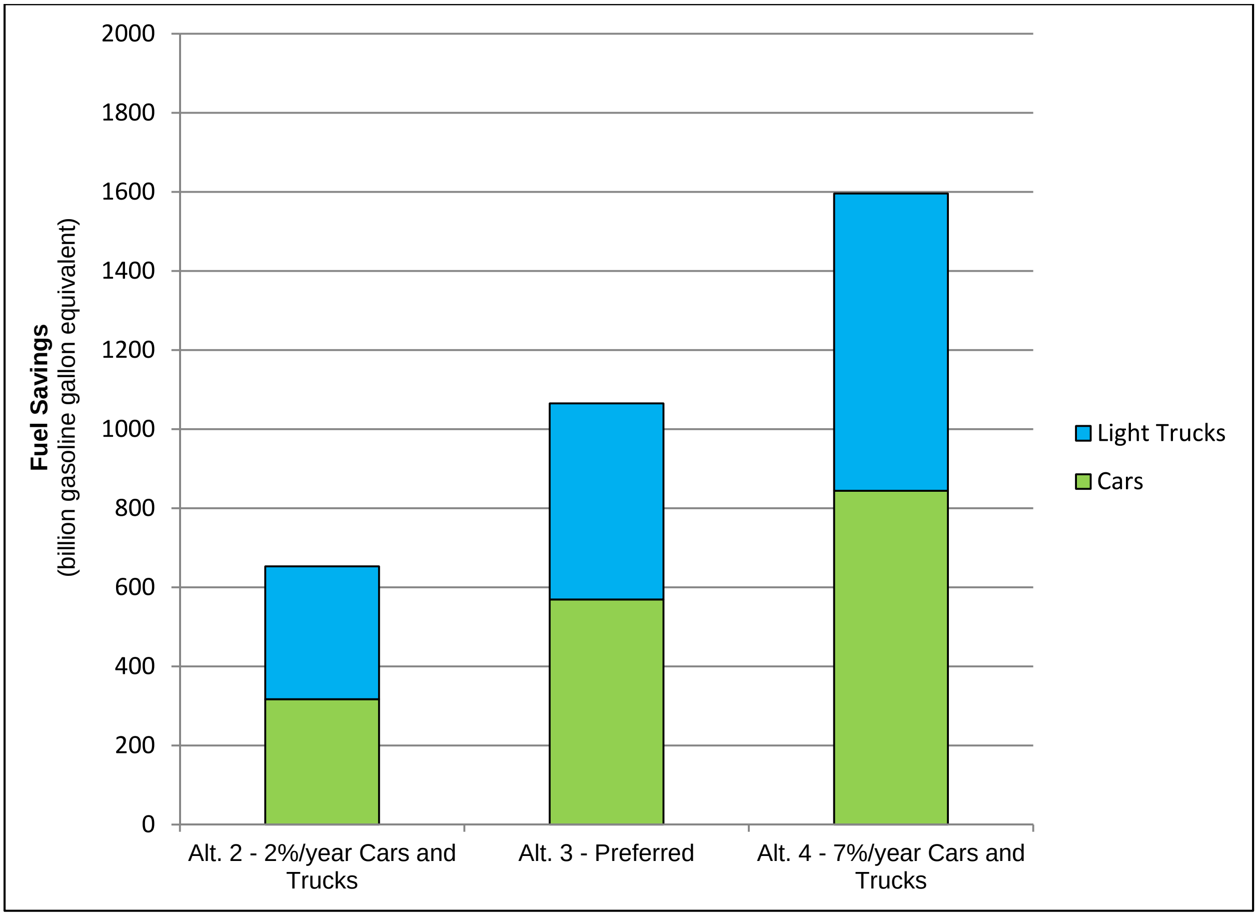


Figure S-3-B1. U.S. Passenger Car and Light Truck Fuel Savings by Alternative (billion gasoline gallon equivalent total for calendar years 2017–2060), Analysis B1

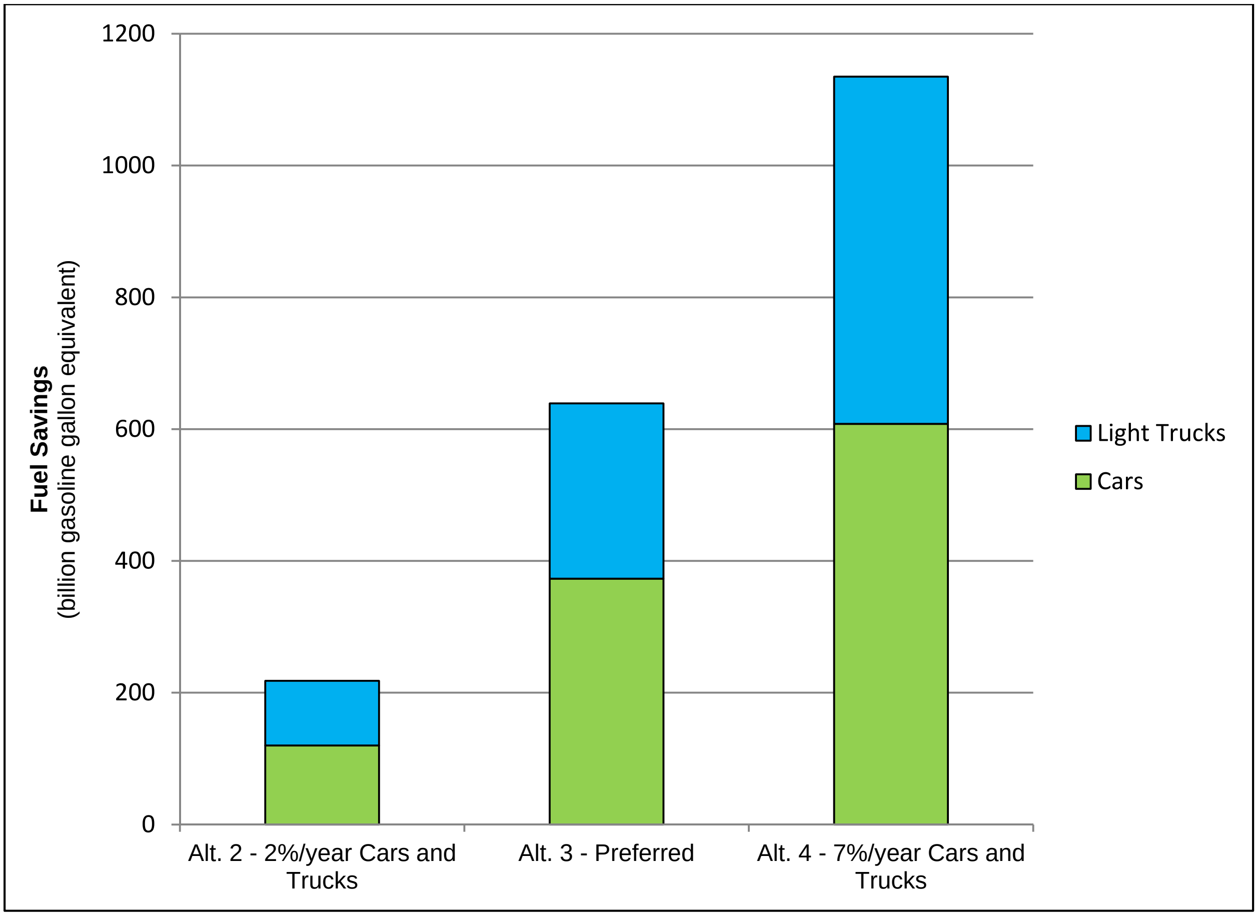
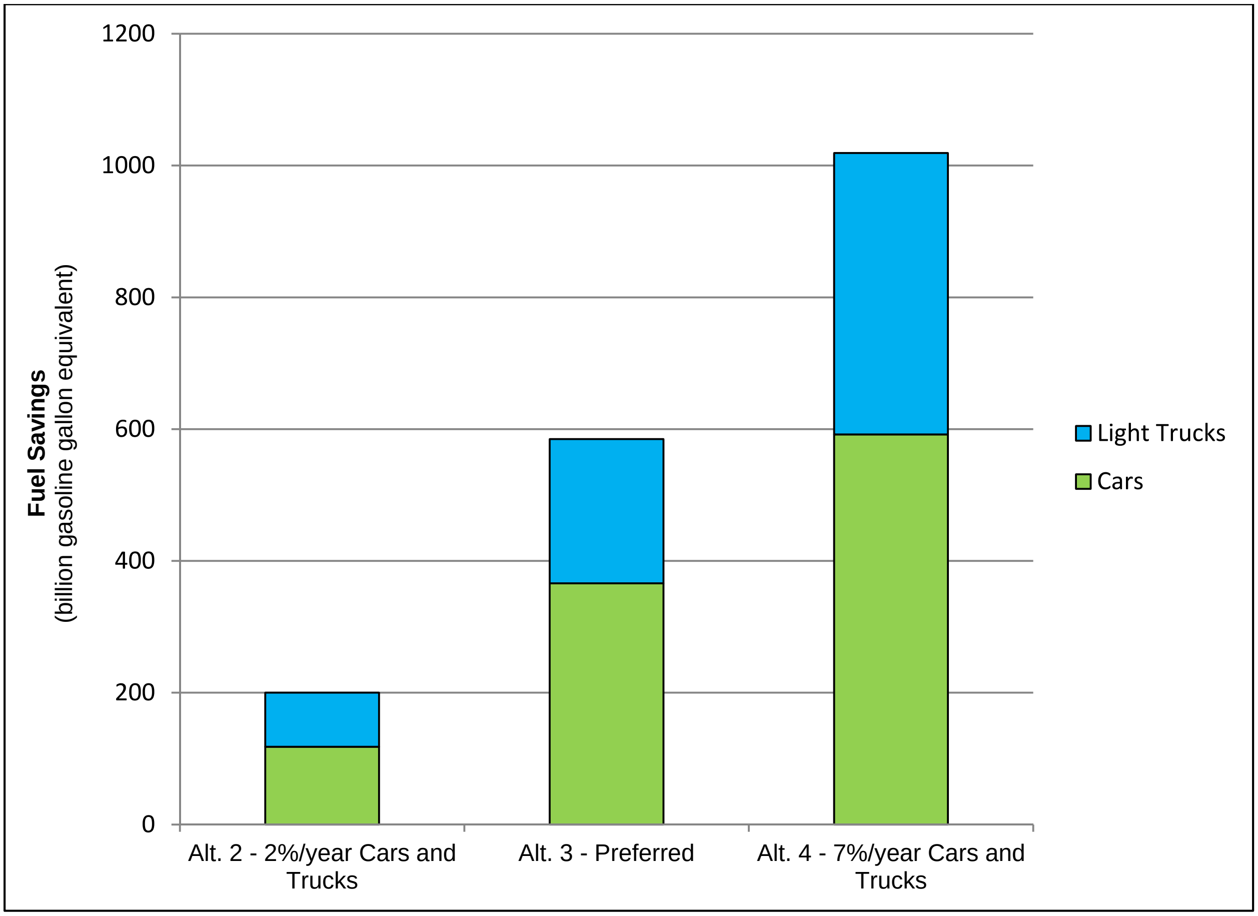


Figure S-3-B2. U.S. Passenger Car and Light Truck Fuel Savings by Alternative (billion gasoline gallon equivalent total for calendar years 2017–2060), Analysis B2



Cumulative Impacts

As with direct and indirect impacts, fuel consumption under each action alternative will decrease with increasing stringency under the cumulative impacts analysis, which incorporates other past, present, and reasonably foreseeable future actions that would lead to improvements in fuel economy. Under the No Action Alternative, total combined gas and diesel fuel consumption during the period 2017–2060 is projected to be 6,562 billion gallons in Analysis C1 and 6,052 billion gallons in Analysis C2. In Analysis C1, total fuel consumption for the same period under the action alternatives ranges from a low of 4,559 billion gallons under Alternative 4 to a high of 5,476 billion gallons under Alternative 2. Total fuel consumption under the Preferred Alternative falls between these levels, amounting to 5,054 billion gallons. In Analysis C2, total fuel consumption under the action alternatives ranges from a low of 4,261 billion gallons under Alternative 4 to a high of 5,080 billion gallons under Alternative 2. Total fuel consumption under the Preferred Alternative falls between these levels, amounting to 4,694 billion gallons.

Similarly, under the cumulative impacts analysis, fuel savings from passenger cars and light trucks increase with increased fuel economy stringency. Figures S-3-C1 and C2 show fuel savings for the period 2017–2060 under each alternative compared to the No Action Alternative. In Analysis C1, fuel savings during this period range from a low of 1,087 billion gallons under Alternative 2 to a high of 2,003 billion gallons under Alternative 4. Fuel savings under the Preferred Alternative in Analysis C1 falls between these levels, amounting to 1,508 billion gallons. In Analysis C2, fuel savings range from a low of 973 billion gallons under Alternative 2 to a high of 1,792 billion gallons under Alternative 4. Fuel savings under the Preferred Alternative in Analysis C2 falls between these levels, amounting to 1,358 billion gallons.

Figure S-3-C1. U.S. Passenger Car and Light Truck Fuel Savings by Alternative (billion gasoline gallon equivalent total for calendar years 2017–2060), Analysis C1

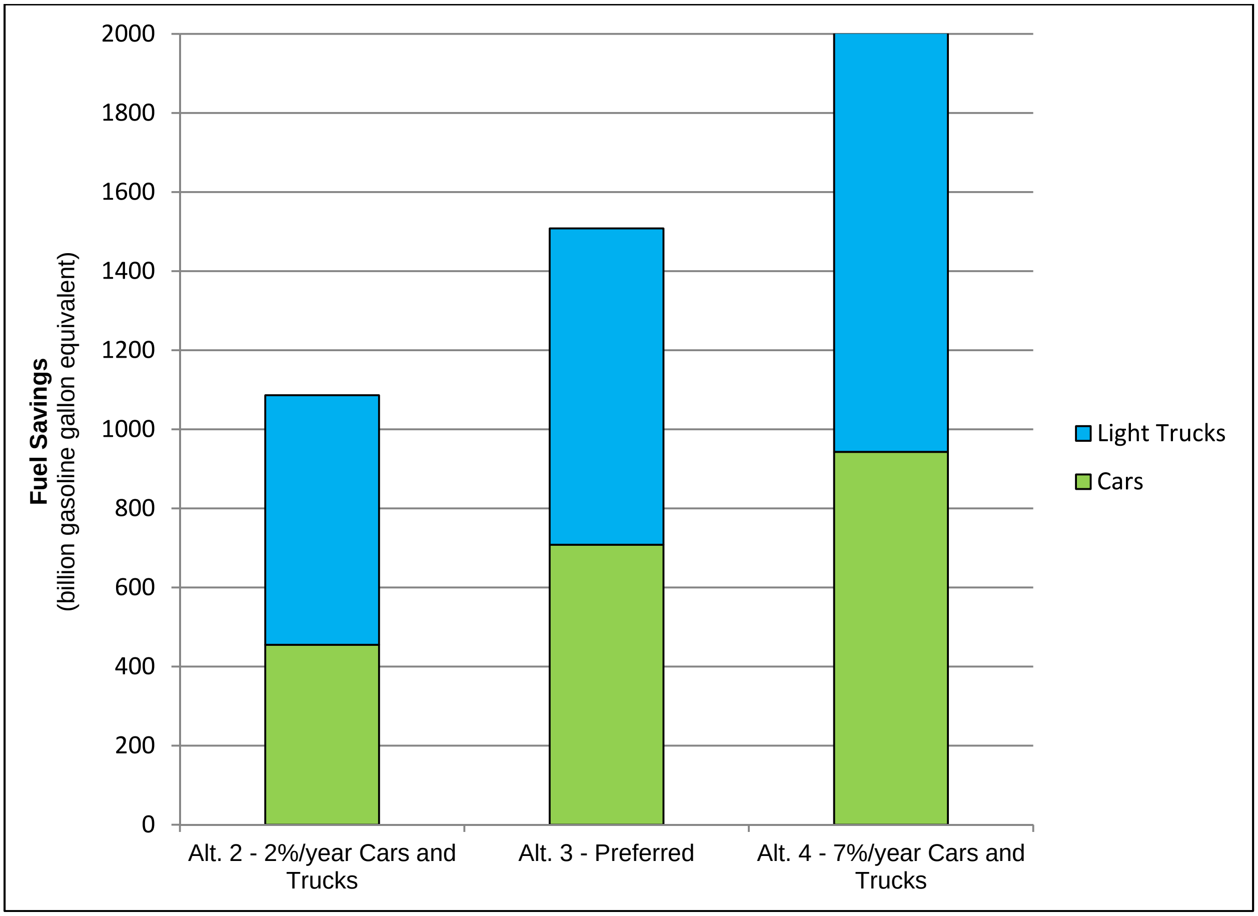
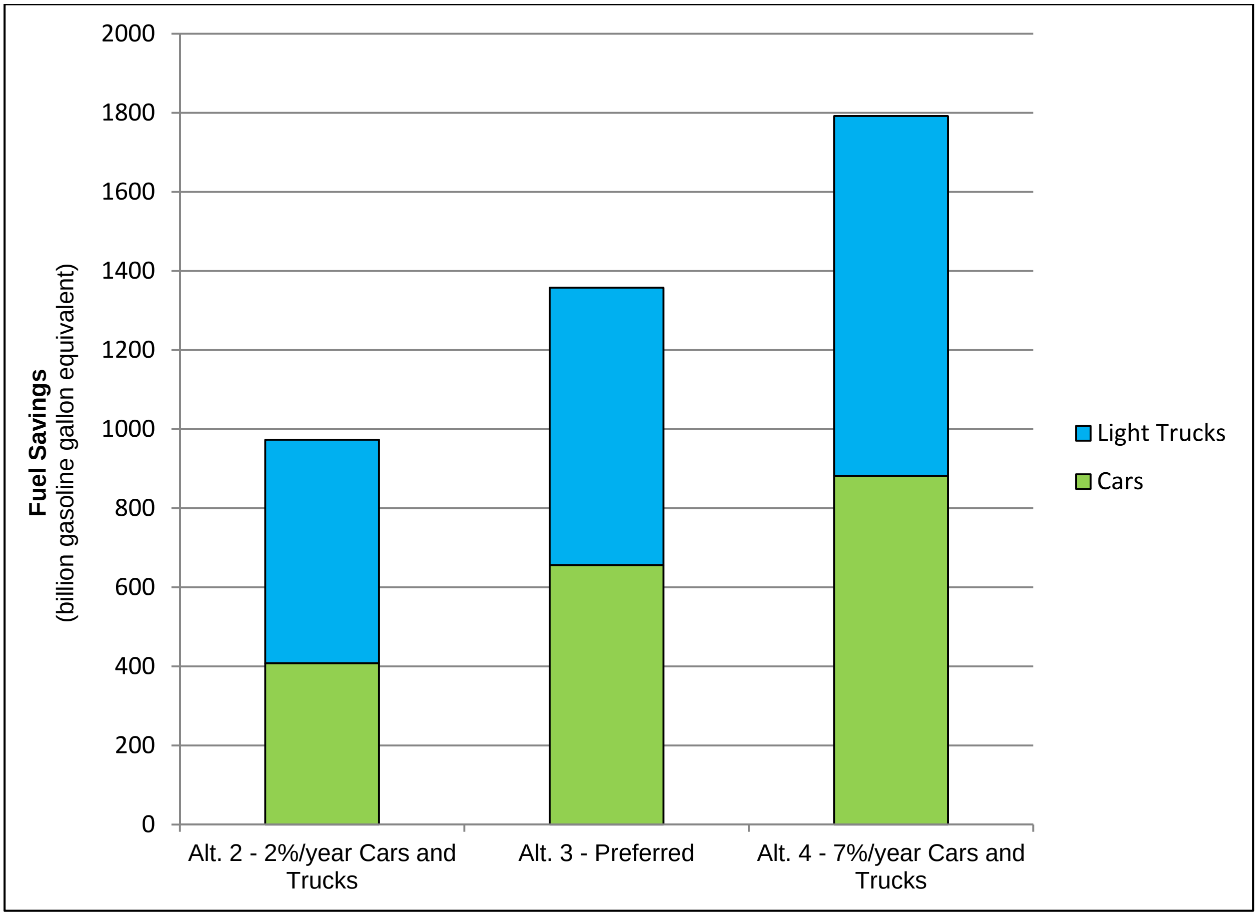


Figure S-3-C2. U.S. Passenger Car and Light Truck Fuel Savings by Alternative (billion gasoline gallon equivalent total for calendar years 2017–2060), Analysis C2



Air Quality

Air pollution and air quality can affect public health, public welfare, and the environment. The Proposed Action and alternatives under consideration would affect air pollutant emissions and air quality. The EIS air quality analysis assesses the impacts of the alternatives in relation to emissions of pollutants of concern from mobile sources, the resulting impacts to human health, and the monetized health benefits of emissions reductions. Although air pollutant emissions generally decline under the action alternatives compared to the No Action Alternative, the magnitudes of the declines are not consistent across all pollutants (and some air pollutant emissions might increase), reflecting the complex interactions between tailpipe emission rates of the various vehicle types, the technologies NHTSA assumes manufacturers will incorporate to comply with the standards, upstream emission rates, the relative proportions of gasoline and diesel in total fuel consumption reductions, and increases in vehicle miles traveled (VMT).

Under the authority of the Clean Air Act (CAA) and its amendments, EPA has established National Ambient Air Quality Standards (NAAQS) for six relatively common air pollutants – known as “criteria” pollutants because EPA regulates them by developing human health-based or environmentally based criteria for setting permissible levels. The criteria pollutants are carbon monoxide (CO), nitrogen dioxide

(NO_2), 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 from emissions of ozone precursor pollutants such as nitrogen oxides (NO_x) and volatile organic compounds (VOCs).

In addition to criteria pollutants, motor vehicles emit some substances defined by the 1990 CAA Amendments as hazardous air pollutants. Hazardous air pollutants include certain VOCs, compounds in PM, pesticides, herbicides, and radionuclides that present tangible hazards based on scientific studies of human (and other mammal) exposure. Hazardous 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. EPA and the Federal Highway Administration have identified these air toxics as the MSATs that typically are of greatest concern when analyzing impacts of highway vehicles. DPM is a component of exhaust from diesel-fueled vehicles and falls almost entirely within the $PM_{2.5}$ particle-size class.

Health Effects of the Pollutants

The criteria pollutants assessed in the EIS have been shown to cause a range of adverse health effects at various concentrations and exposures, including:

- Damage to lung tissue
- Reduced lung function
- Exacerbation of existing respiratory and cardiovascular diseases
- Difficulty breathing
- Irritation of the upper respiratory tract
- Bronchitis and pneumonia
- Reduced resistance to respiratory infections
- Alterations to the body's defense systems against foreign materials
- Reduced delivery of oxygen to the body's organs and tissues
- Impairment of the brain's ability to function properly
- Cancer and premature death

MSATs are also associated with adverse health effects. For example, EPA classifies acetaldehyde, benzene, 1,3-butadiene, formaldehyde, and certain components of DPM as either known or probable human carcinogens. Many MSATs are also associated with non-cancer health effects, such as respiratory irritation.

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 dramatically since 1970 as a result of pollution controls on vehicles and regulation of the chemical content of fuels.

Highway vehicles (including vehicles covered by the proposed rule) are responsible for approximately 53 percent of total U.S. emissions of CO, 1.7 percent of $PM_{2.5}$ emissions, and 1.2 percent of PM_{10} emissions. Highway vehicles also contribute approximately 24 percent of total nationwide emissions of VOCs and 31 percent of NO_x, both of which are chemical precursors of ozone. In addition, NO_x is a $PM_{2.5}$ precursor and VOCs can be $PM_{2.5}$ precursors. Highway vehicles contribute less than 0.4 percent of SO_2, but SO_2

and other oxides of sulfur (SO_x) are important because they contribute to the formation of $PM_{2.5}$ in the atmosphere. With the elimination of lead in automotive gasoline, it is no longer emitted from motor vehicles in more than negligible quantities and therefore is not assessed in this analysis.

Methodology

The air quality results presented in this EIS, including impacts to human health, are based on a number of assumptions about the types and rates of emissions from the combustion of fossil fuels. In addition to tailpipe emissions, the analysis accounts for upstream emissions from the production and distribution of fuels, including contributions from the power plants that generate the electricity used to recharge electric vehicles (EVs) and from the production of the fuel burned in those power plants. Emissions and other environmental impacts from electricity production depend on the efficiency of the power plant and the mix of fuel sources used, sometimes referred to as the "grid mix." To estimate upstream emissions, the analysis uses the GREET model (1 2011 version developed by DOE Argonne National Laboratory), which contains data on emissions intensities (amount of pollutant emitted per unit of electrical energy generated) that extend to 2020. To project the U.S. average electricity generating fuel mix for the reference year 2020, the analysis uses the National Energy Modeling System (NEMS) AEO 2012 Early Release version, an energy-economy modeling system from DOE.

Assumptions in the modeling tools result in a temporally static and geographically homogeneous grid that overstates air quality impacts under alternatives that predict a high level of EV deployment. Therefore, NHTSA has added an alternate analysis to illustrate the effects of a cleaner future grid on air quality. This analysis is based on an assumption of steady improvements to the grid during the course of the next several decades — the period during which any EV deployment associated with increases in the CAFE standards would occur — and, if the current early trends continue, a higher concentration of EVs in areas served by cleaner electrical grids. This alternate analysis was performed using the same methodology used throughout the document, and it generated the inputs necessary to allow modeling of air quality impacts and their resulting health outcomes and monetized health effects. The results of the health outcomes and monetized health effects of these two cases are reported alongside each other for comparison in Chapter 4 of the EIS, and summarized below. In the discussion below, the "Base Grid Mix" is the analysis presented throughout this document and is based on NEMS AEO 2012 Early Release version fuel mix and emissions projections for the year 2020. The "Alternate Grid Mix" is based on the fuel mix and emissions projections of the cleaner "GHG Price Economy-Wide" emissions side case in the final AEO 2011 for the year 2035. Supporting calculations for the Alternate Grid Mix appear in the charts in Appendix H.

Key Findings for Air Quality

The findings for air quality effects are shown for the year 2040 in this Summary, a mid-term forecast year by which time a large proportion of passenger car and light-truck VMT would be accounted for by vehicles that meet the proposed standards. The results reported in this section apply to Analyses A1, A2, B1, B2, C1, and C2 for 2040, unless otherwise noted. The EIS provides findings for air quality effects for 2021, 2025, 2040, and 2060. In general, emissions of criteria air pollutants decrease with increased stringency across alternatives, with several exceptions. The increases and decreases in emissions reflect the complex interactions among tailpipe emission rates of the various vehicle types, the technologies assumed to be incorporated by manufacturers in response to the proposed standards, upstream emission rates, the relative proportions of gasoline and diesel in total fuel consumption reductions, and increases in VMT.

To estimate reduced incidence of $PM_{2.5}$-related adverse health effects and the associated monetized health benefits from the emission reductions, NHTSA multiplied direct $PM_{2.5}$ and $PM_{2.5}$ precursor (NO_x, SO_2, and VOCs) emission reductions by EPA-provided pollutant-specific benefit-per-ton estimates. Reductions in adverse health outcomes include reduced incidences of premature mortality, chronic bronchitis, respiratory emergency room visits, and work-loss days.

Direct and Indirect Impacts

Criteria Pollutants

- Emissions of criteria pollutants are highest under the No Action Alternative and generally decline as fuel consumption decreases from the least stringent alternative (No Action) to the most stringent (Alternative 4), as shown in Figures S-4-A1, A2, B1, and B2. CO is a partial exception to this general trend, with CO emissions increasing under Alternatives 2 and 3, and decreasing under Alternative 4. These increases under Alternatives 2 and 3 occur because the increases in vehicle emissions due to the rebound effect more than offset reductions in upstream emissions due to improved fuel economy and the resulting decline in the volume of fuel refined and distributed. Under Alternative 4, the reverse is true. NO_x and SO_2 are also partial exceptions, with emissions generally decreasing under Alternatives 2 and 3, and increasing under Alternative 4. Many of the emissions changes are relatively small, especially under Alternatives 2 and 3 in the years before 2060.
- Emissions of CO, $PM_{2.5}$, and VOCs generally are lowest under Alternative 4, while emissions of SO_2 and NO_x are highest under Alternative 4.
- Under the Preferred Alternative, emissions of all criteria pollutants are reduced compared to the No Action Alternative for most analyses, except CO emissions, which increase slightly from the No Action Alternative in all analyses. Excluding CO, emissions under the Preferred Alternative generally are lower than emissions under Alternative 2 for all pollutants. Emissions of $PM_{2.5}$ and VOCs under the Preferred Alternative are generally higher than emissions under Alternative 4, while emissions of NO_x and SO_2 under the Preferred Alternative are generally lower than emissions under Alternative 4.
- As discussed above, these results depend upon assumptions regarding the future electrical grid mix. NHTSA has also conducted an alternate analysis which examines the impacts of the action alternatives assuming a cleaner grid mix.

Figure S-4-A1. Nationwide Criteria Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Analysis A1

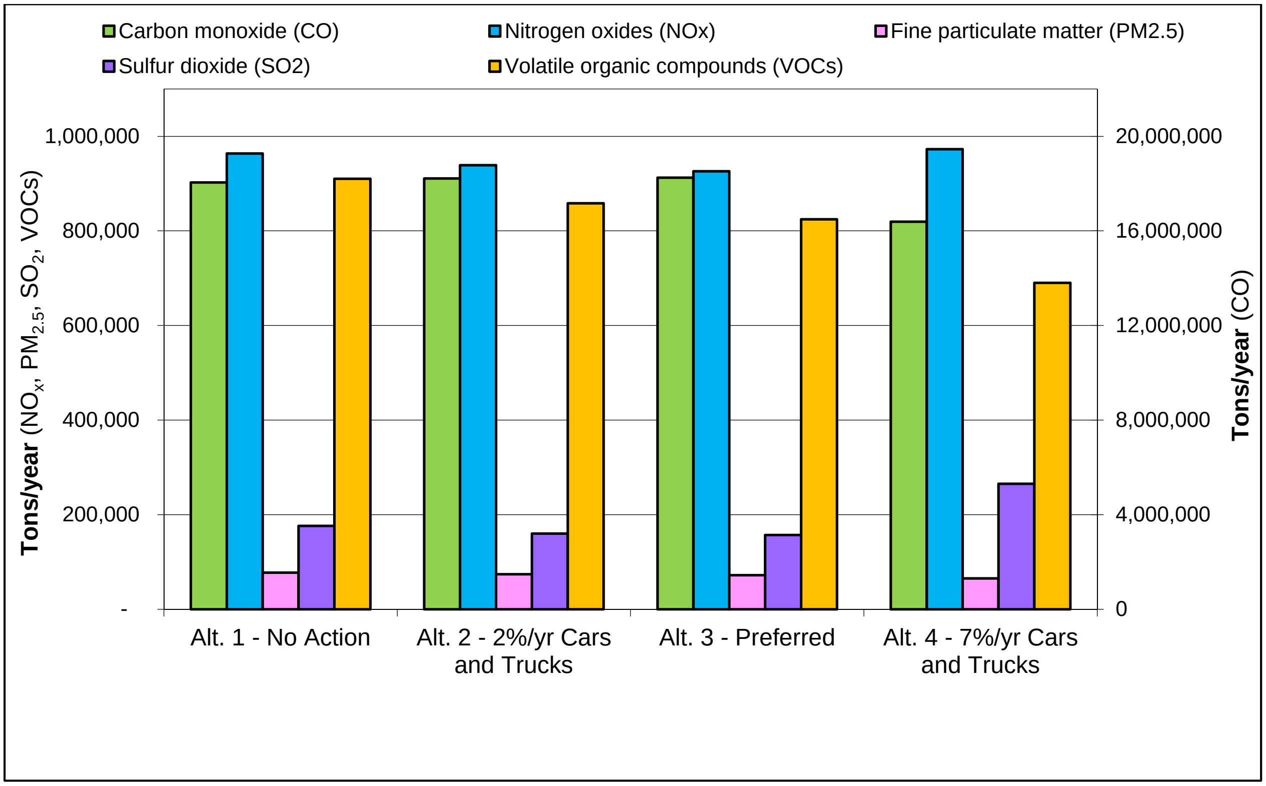


Figure S-4-A2. Nationwide Criteria Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Analysis A2

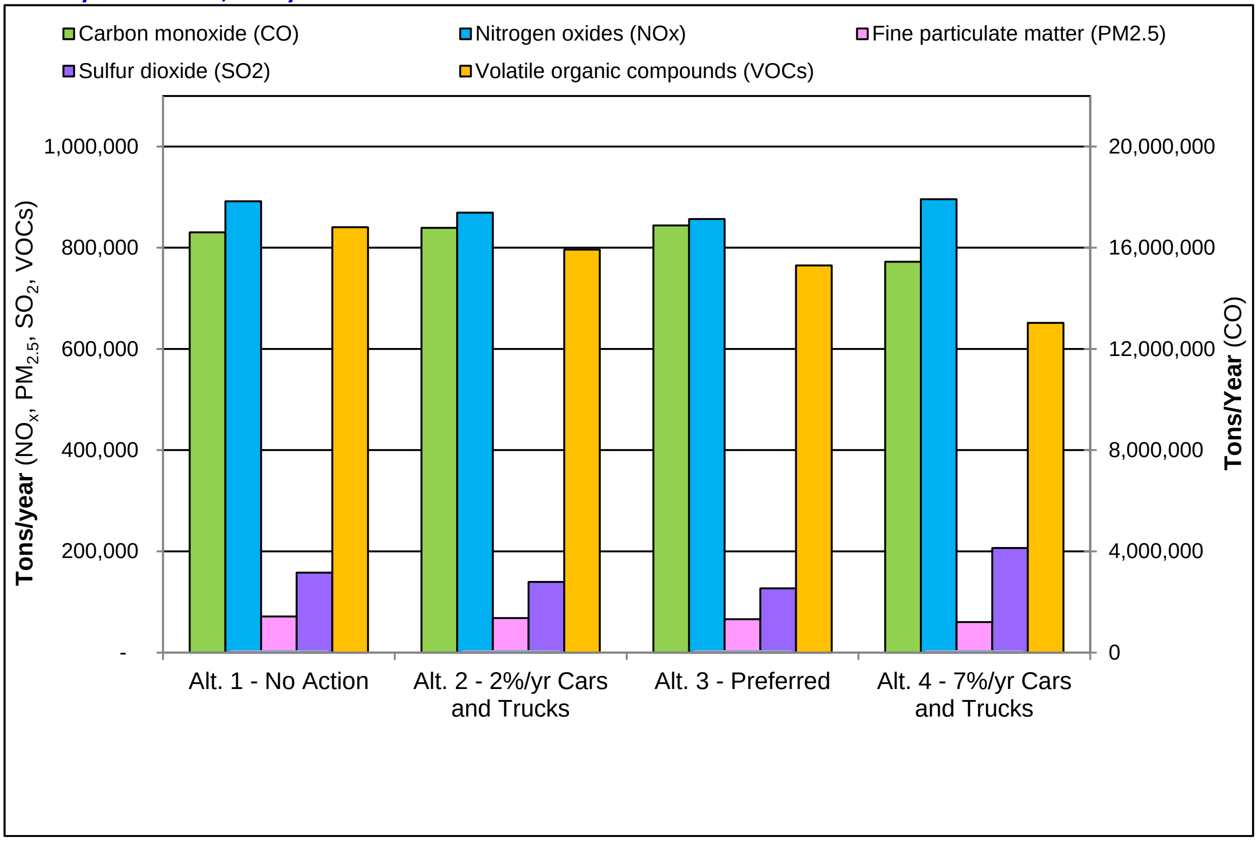


Figure S-4-B1. Nationwide Criteria Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Analysis B1

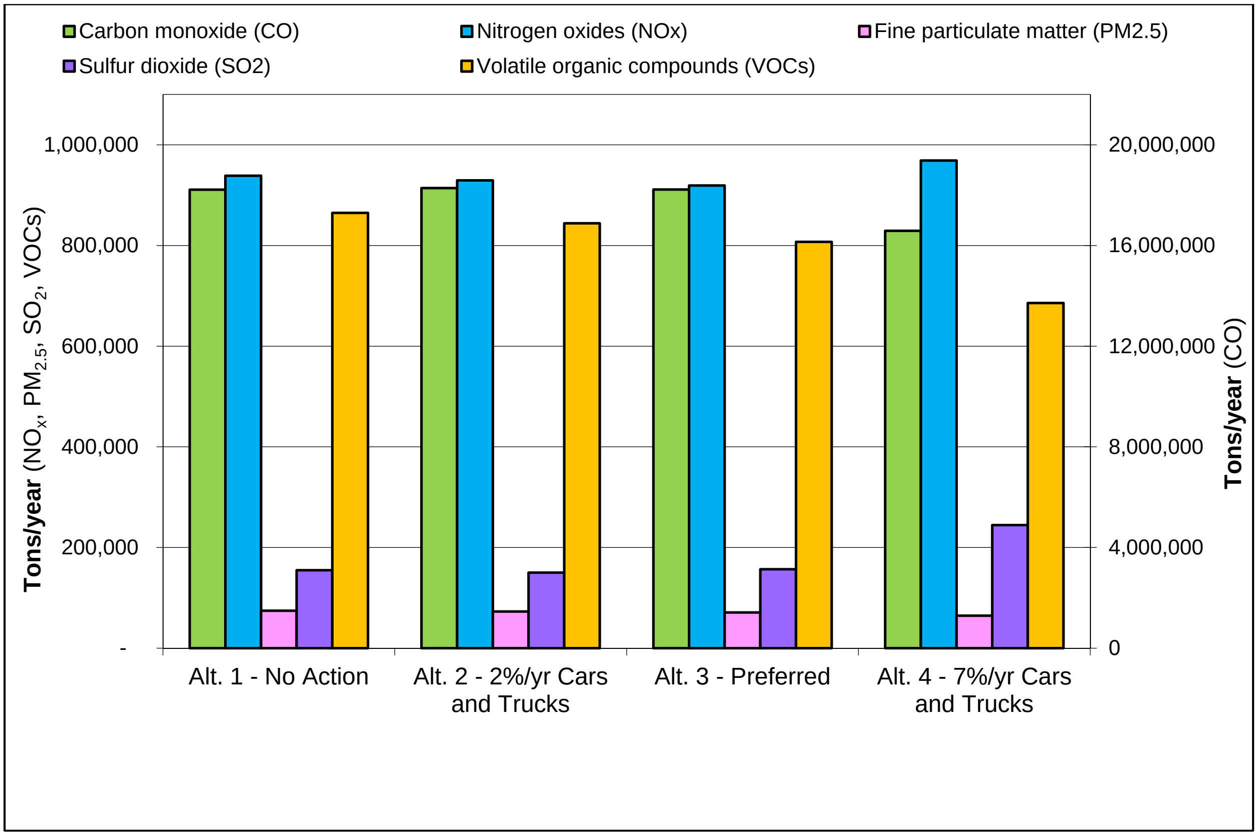
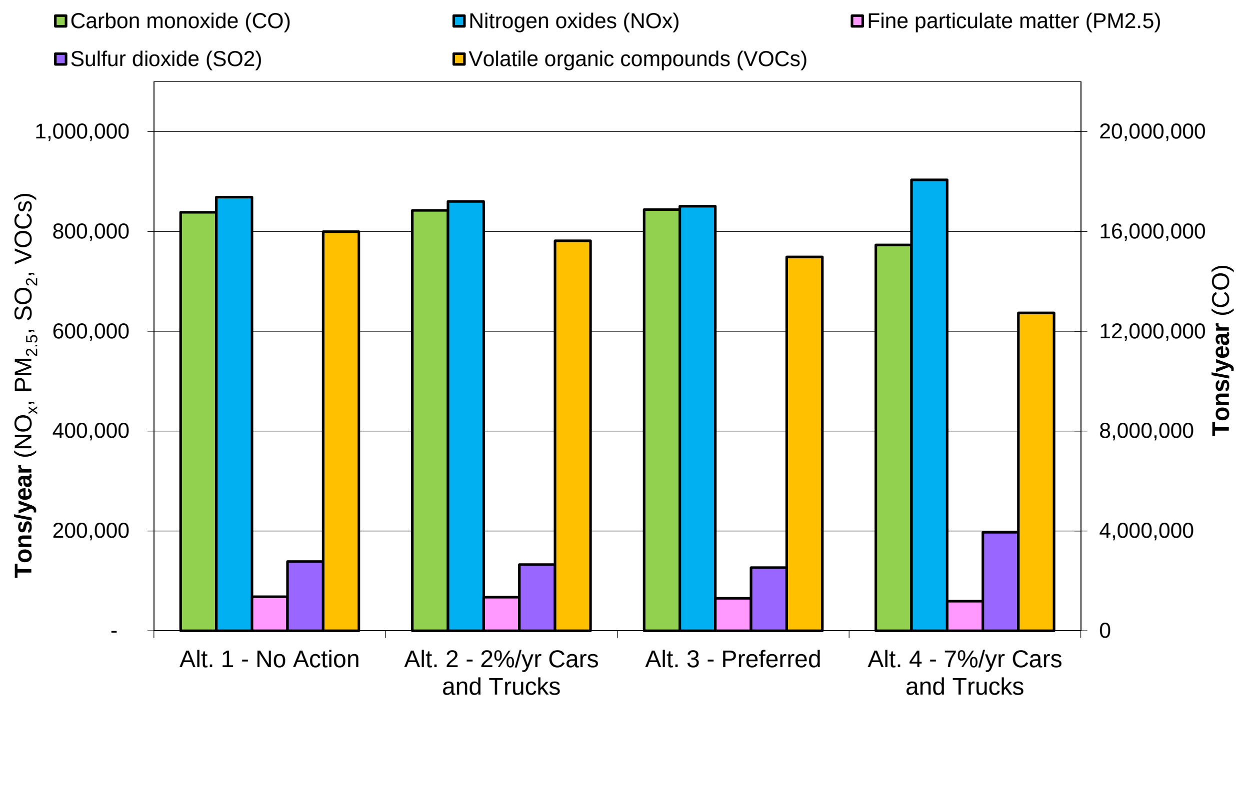


Figure S-4-B2. Nationwide Criteria Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Analysis B2



Hazardous Air Pollutants

- Emissions of acetaldehyde, acrolein, and formaldehyde generally increase from Alternative 1 to Alternative 4, as shown in Figures S-5-A1, A2, B1, and B2. These increases occur because the increases in vehicle emissions due to the rebound effect more than offset reductions in upstream emissions due to improved fuel economy and the resulting decline in the volume of fuel refined and distributed. This trend is least pronounced for formaldehyde, for which emissions decrease under Alternatives 2 and 3 for several combinations of analyses and years. Acetaldehyde emissions also decrease under Alternative 4 for certain analyses and years. Many of the emissions changes are relatively small, especially under Alternatives 2 and 3 in the years before 2060.
- Emissions of 1,3-butadiene are approximately equivalent for each alternative and year (except for decreases under Alternative 4 in 2040 and 2060). Benzene emissions generally decrease from Alternative 1 to Alternative 4. DPM emissions generally decrease from Alternative 1 to Alternative 3 for all analysis years. Under Alternative 4, DPM emissions decrease until 2025 by an amount that is smaller than under the other action alternatives, and increase to just below or above the No Action Alternative levels (except in Analysis A1). These trends are accounted for by the extent of technologies assumed to be deployed under the different alternatives to meet the different levels of fuel economy requirements.
- Under the Preferred Alternative, emissions of benzene and DPM are generally reduced compared to the No Action Alternative. In contrast, emissions of acetaldehyde, acrolein, and 1,3-butadiene generally increase under the Preferred Alternative compared to the No Action Alternative.

Emissions of formaldehyde under the Preferred Alternative either increase or decrease compared to the No Action Alternative, depending on the analysis. Emissions of benzene and DPM under the Preferred Alternative are lower than under Alternative 2, and higher than under Alternative 4 (except for DPM in Analyses A1 and A2). Emissions of acetaldehyde, acrolein and 1,3-butadiene under the Preferred Alternative are generally higher than under Alternative 2 and either higher or lower than under Alternative 4, depending on the year and analysis. Emissions of formaldehyde under the Preferred Alternative are either lower or higher than under Alternative 2 depending on the analysis, but lower than under Alternative 4 across all analyses.

Figure S-5-A1. Nationwide Toxic Air Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Analysis A1

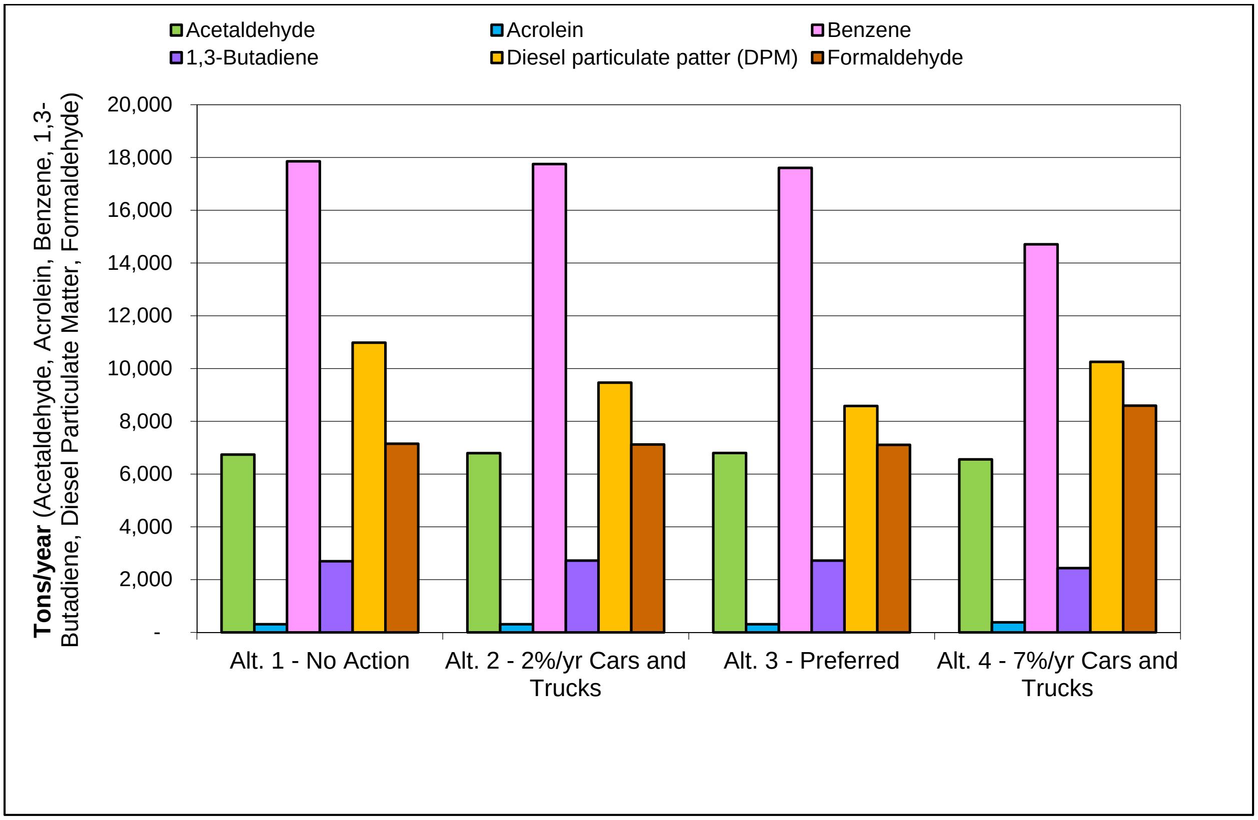


Figure S-5-A2. Nationwide Toxic Air Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Analysis A2

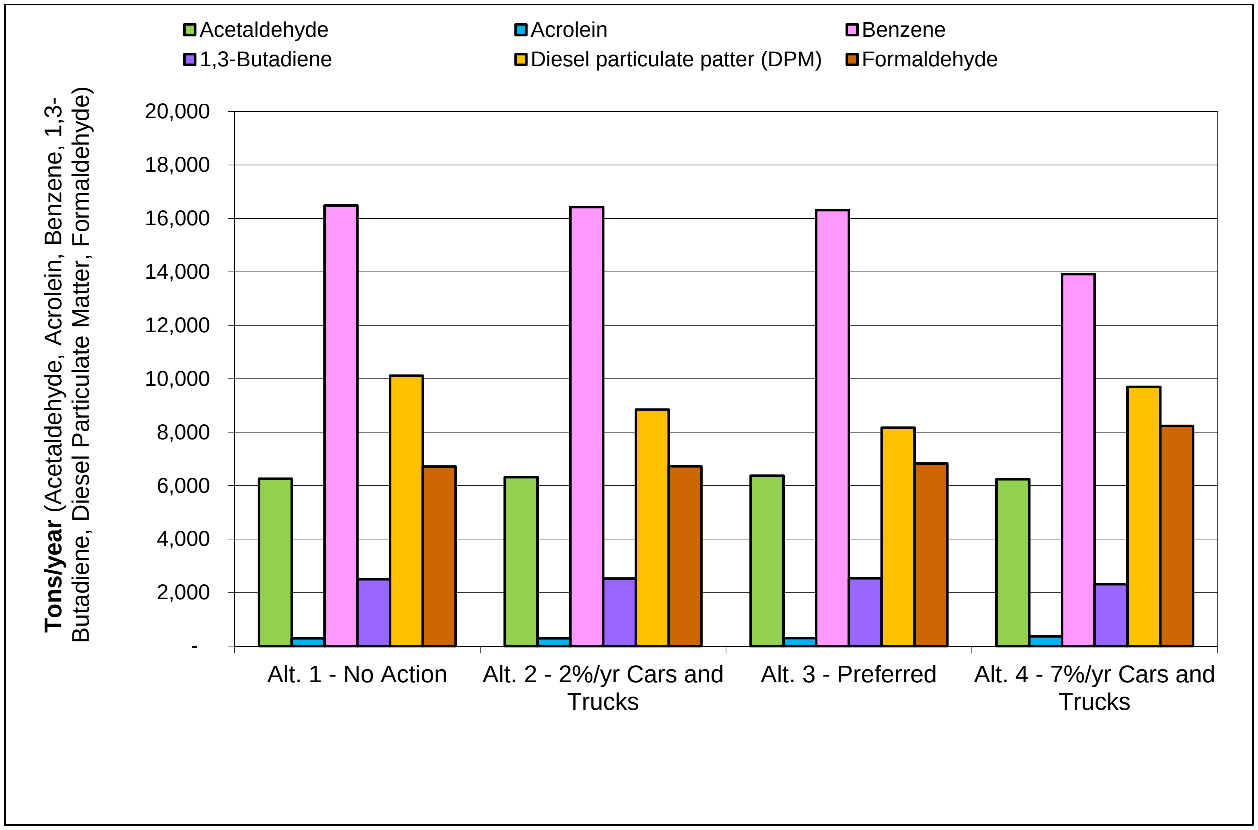


Figure S-5-B1. Nationwide Toxic Air Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Analysis B1

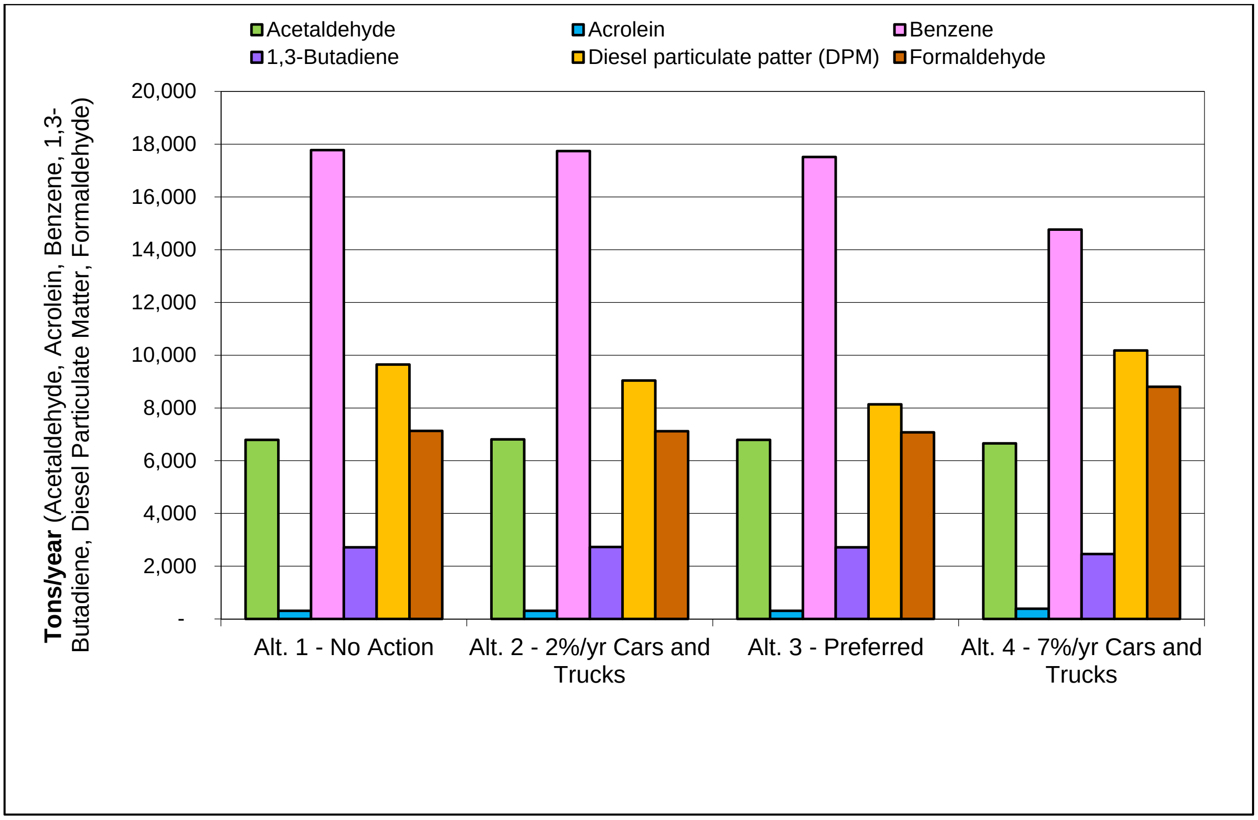
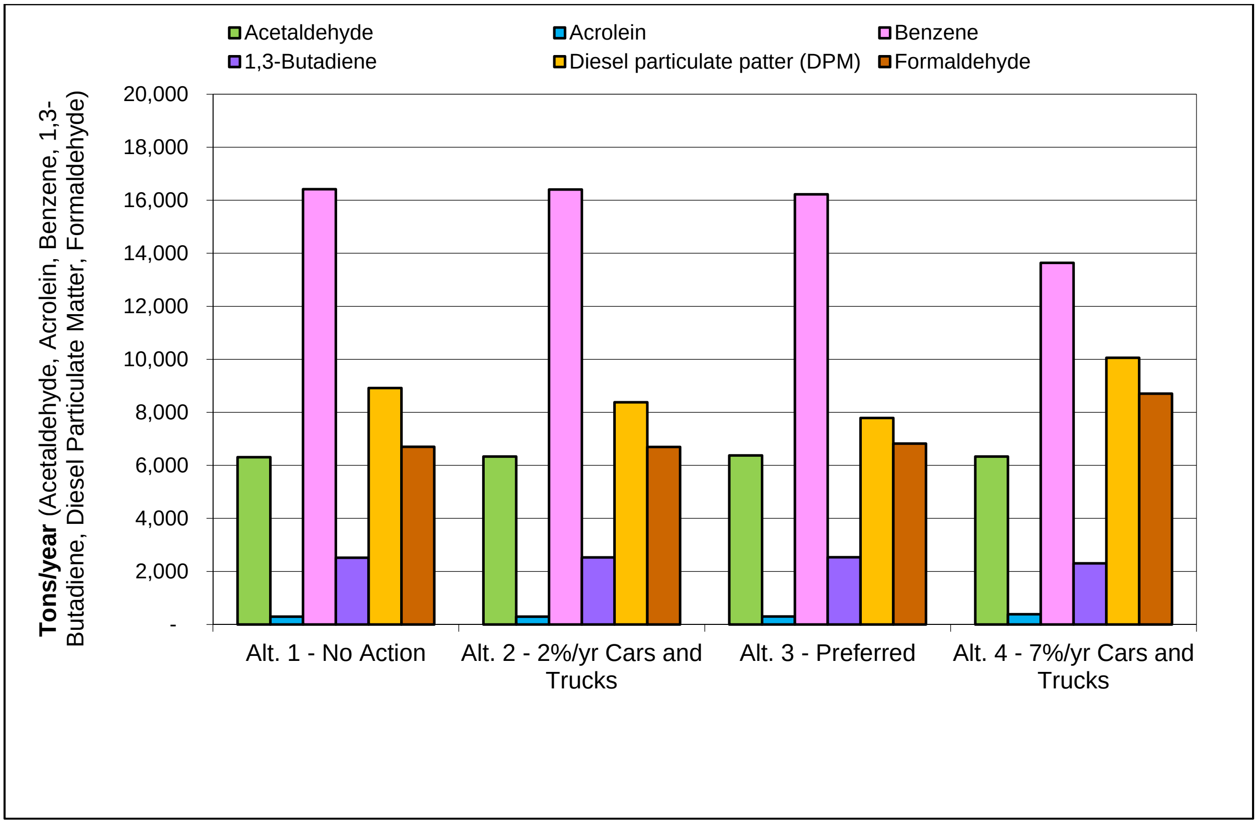


Figure S-5-B2. Nationwide Toxic Air Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Analysis B2



Health and Monetized Health Benefits

- All action alternatives would generally result in reduced adverse health effects (mortality, chronic bronchitis, emergency room visits for asthma, and work-loss days) nationwide compared to the No Action Alternative. Exceptions to this trend in the Base Grid Mix case are Alternative 2 in 2060 and Alternative 4 in 2040 and 2060, under which adverse health outcomes increase in Analyses B1 and B2 compared to the No Action Alternative. Assuming the Alternate Grid Mix, all action alternatives would generally result in reduced adverse health effects nationwide compared to the No Action Alternative.
- Because monetized health benefits increase with reductions in adverse health effects, monetized benefits would generally increase across alternatives along with increasing fuel economy standards. When estimating quantified and monetized health impacts, EPA relies on results from two $PM_{2.5}$-related premature mortality studies it considers equivalent: Pope et al. (2002) and Laden et al. (2006). EPA recommends that monetized benefits be shown using incidence estimates derived from each of these studies and valued using a 3 percent and a 7 percent discount rate to account for an assumed lag in the occurrence of mortality after exposure, for a total of four separate calculations of monetized health benefits in each grid mix. Assuming the Base Grid Mix, estimated monetized health benefits in 2040 range from $750 million to $6.7 billion ($2.3 billion to $6.7 billion under the Preferred Alternative) in Analyses A1 and A2. In Analyses B1 and B2, monetized health impacts in 2040 range from a negative impact of $48 million to a benefit of $3.7 billion ($1.0 billion to $3.7 billion under the Preferred Alternative). With the Alternate Grid Mix, estimated monetized health

benefits in 2040 range from $1.5 billion to $9.1 billion in Analyses A1 and A2. In Analyses B1 and B2, monetized health benefits in 2040 range from $590 million to $6.3 billion.

- Under the Preferred Alternative in the Base Grid Mix case, reductions in adverse health outcomes are greater and monetized health benefits are higher than under the No Action Alternative, Alternative 2, and Alternative 4 (except in 2021). Under the Preferred Alternative in the Alternate Grid Mix case, reductions in adverse health outcomes are greater and monetized health benefits are higher than under the No Action Alternative and Alternative 2, but lower than under Alternative 4 in all years.

See Section 4.2.1 of this EIS for data on the direct effects of criteria and hazardous air pollutant emissions, and monetized health benefits for the alternatives.

Cumulative Impacts

Criteria Pollutants

- Cumulative emissions of criteria pollutants are highest under the No Action Alternative and generally decline as fuel consumption decreases across the action alternatives, as shown in Figures S-4-C1 and C2. CO is a partial exception to this general trend, with CO emissions increasing under Alternative 2, increasing or decreasing under the Preferred Alternative (depending on analysis), and decreasing further under Alternative 4 to below the level of the No Action Alternative. Increases that are projected to occur under Alternatives 2 and 3 do so because the increases in vehicle emissions due to the rebound effect more than offset reductions in upstream emissions due to improved fuel economy and the resulting decline in the volume of fuel refined and distributed. NO_x and SO_2 are also partial exceptions, with emissions decreasing under Alternative 2 and the Preferred Alternative but increasing under Alternative 4.
- Emissions of CO, $PM_{2.5}$, and VOCs are lowest under Alternative 4, while emissions of NO_x and SO_2 are lowest under the Preferred Alternative (except in 2021) or Alternative 4 (in 2021).
- Under the Preferred Alternative, emissions of all criteria pollutants are reduced compared to the No Action Alternative, except for CO emissions, which are slightly higher under the Preferred Alternative than under the No Action Alternative. Emissions of all criteria pollutants under the Preferred Alternative are lower than emissions under Alternative 2 (except CO emissions for some years). Emissions of $PM_{2.5}$ and VOCs under the Preferred Alternative are higher than emissions under Alternative 4, while emissions of NO_x and SO_2 under the Preferred Alternative are generally lower than emissions under Alternative 4.
- As discussed above, these results depend upon assumptions regarding the future electrical grid mix. NHTSA has also conducted an alternate analysis which examines the impacts of the action alternatives assuming a cleaner grid mix.

Figure S-4-C1. Nationwide Criteria Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Analysis C1

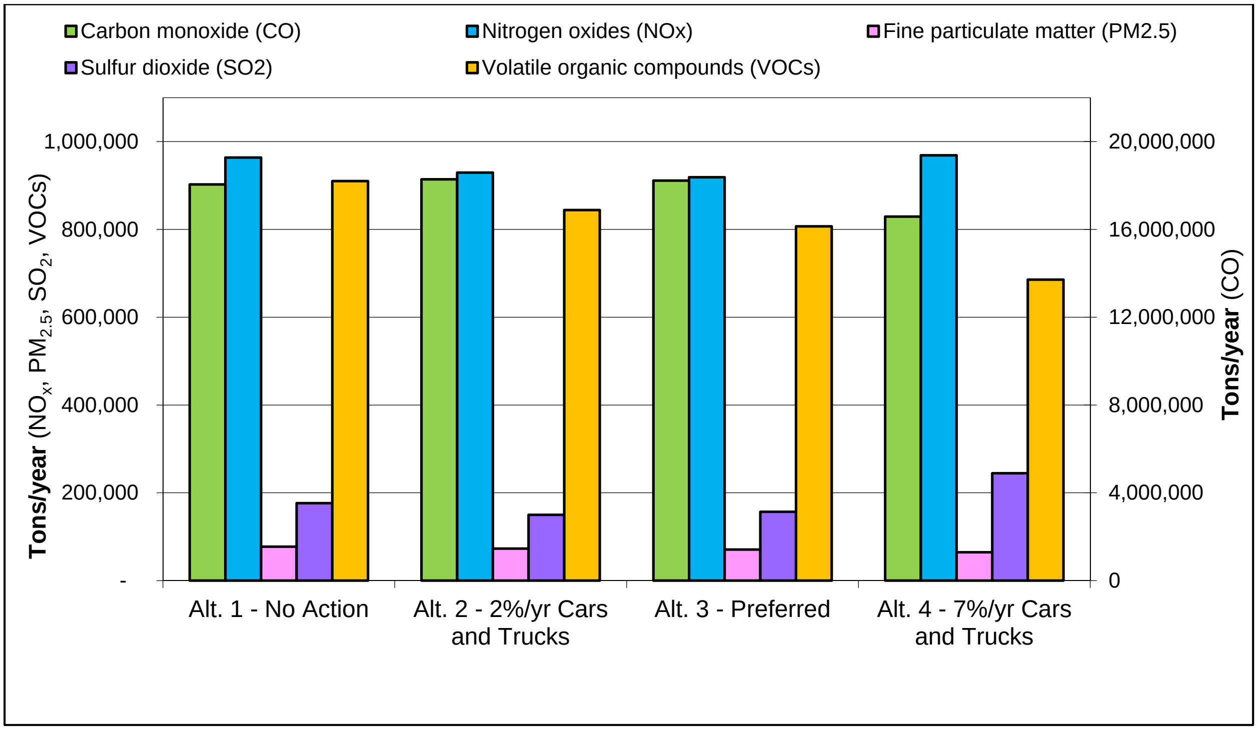
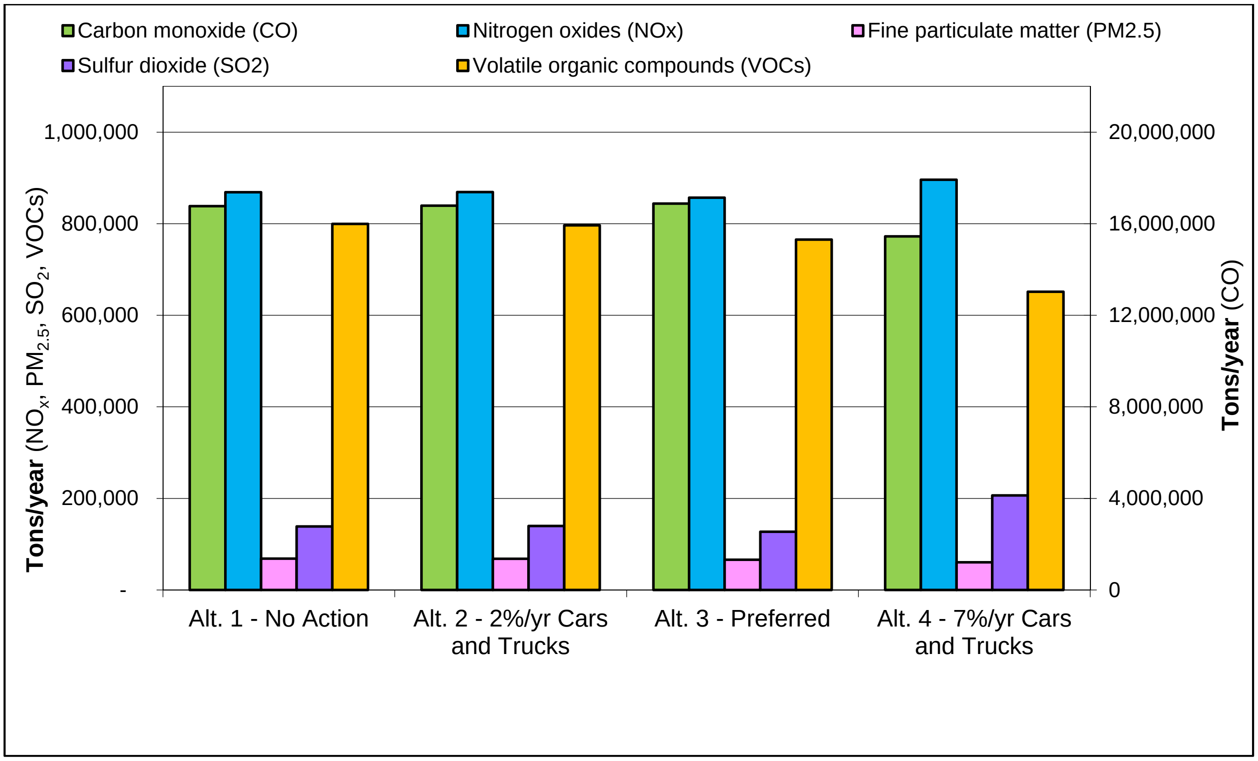


Figure S-4-C2. Nationwide Criteria Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Analysis C2



Hazardous Air Pollutants

- Emissions of benzene generally are highest under the No Action Alternative and decline as fuel consumption decreases across the action alternatives, as shown in Figures S-5-C1 and C2. Emissions of acetaldehyde and 1,3-butadiene increase under Alternative 2 and the Preferred Alternative and generally decrease under Alternative 4. Emissions of DPM are highest under the No Action Alternative, decrease under Alternative 2 and the Preferred Alternative, and decrease by a lesser amount under Alternative 4. Emissions of acrolein and formaldehyde generally increase with decreasing fuel consumption across all the action alternatives because of increased driving due to the rebound effect.
- Emissions of benzene and 1,3-butadiene generally are lowest under Alternative 4, while emissions of acrolein, are lowest under the No Action Alternative. Emissions of DPM are lowest under the Preferred Alternative or Alternative 4, depending on the analysis. Emissions of acetaldehyde are the lowest under the No Action Alternative or Alternative 4, depending on the analysis, and emissions of formaldehyde are lowest under the Alternative 2 or the Preferred Alternative, depending on the analysis.
- Under the Preferred Alternative, emissions of acetaldehyde and acrolein generally increase compared to the No Action Alternative. Emissions of benzene under the Preferred Alternative generally are lower than under Alternative 2 and higher than under Alternative 4. Emissions of 1,3-butadiene under the Preferred Alternative are slightly higher than under Alternative 2 and generally higher than under Alternative 4. Under the Preferred Alternative, emissions of DPM are reduced compared to the No Action Alternative, but are higher or lower than under Alternative 4, depending on the analysis. Formaldehyde emissions under the Preferred Alternative are either higher or lower compared to the No Action Alternative, depending on the analysis, but lower than under Alternative 4.

Figure S-5-C1. Nationwide Toxic Air Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Analysis C1

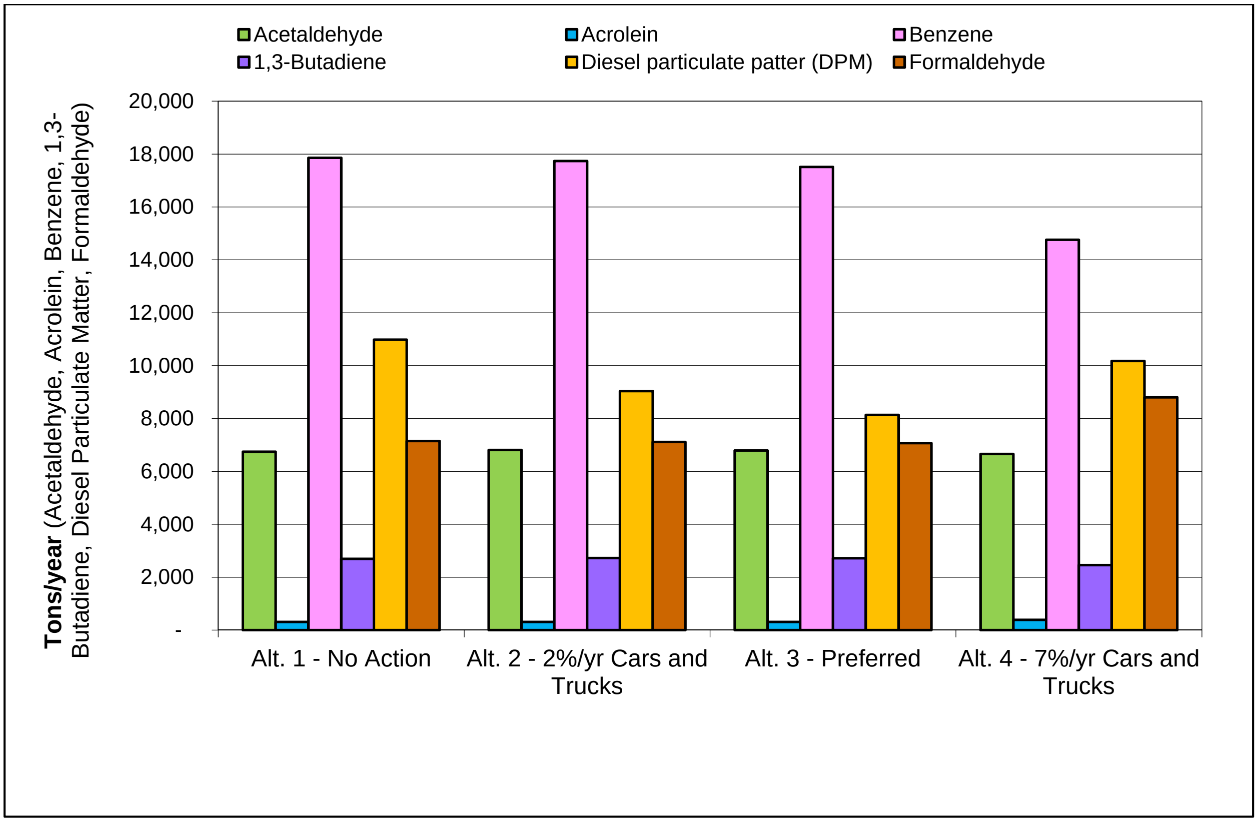
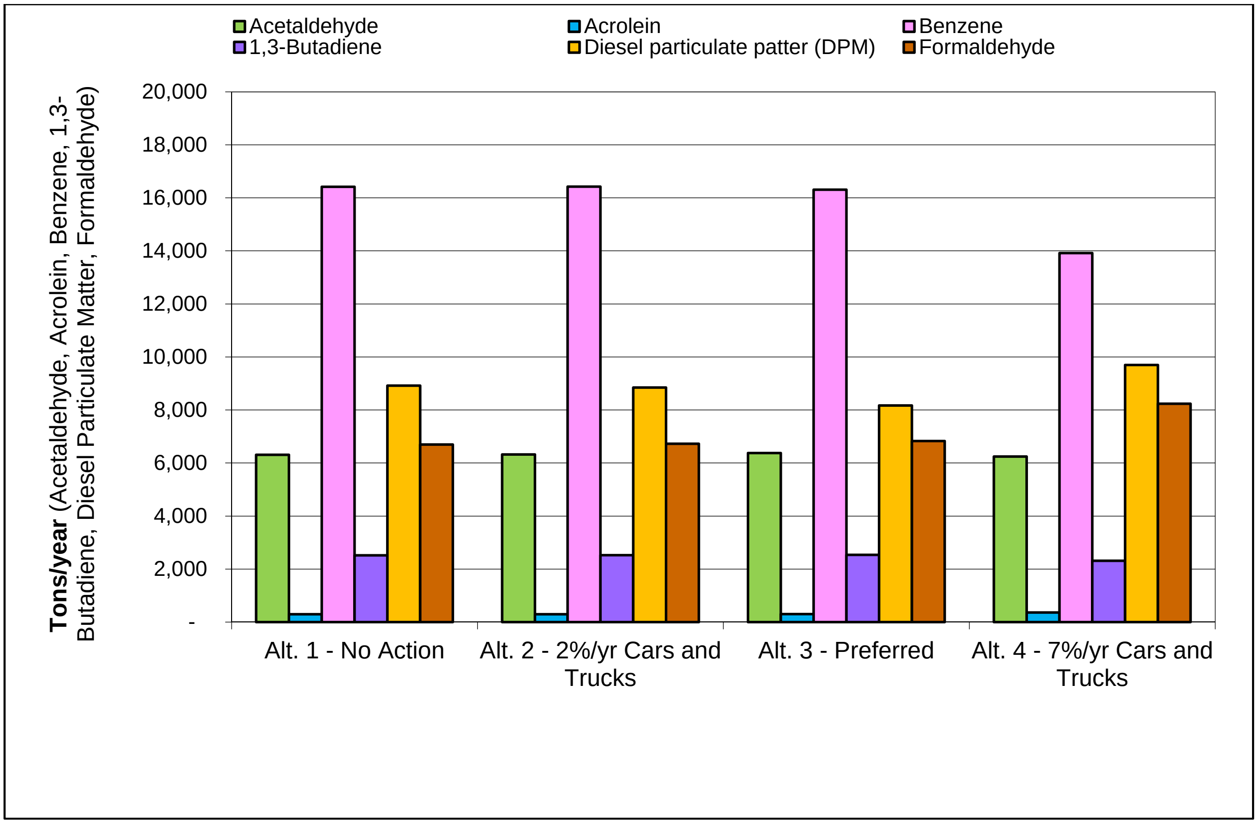


Figure S-5-C2. Nationwide Toxic Air Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Analysis C2



Health and Monetized Health Benefits

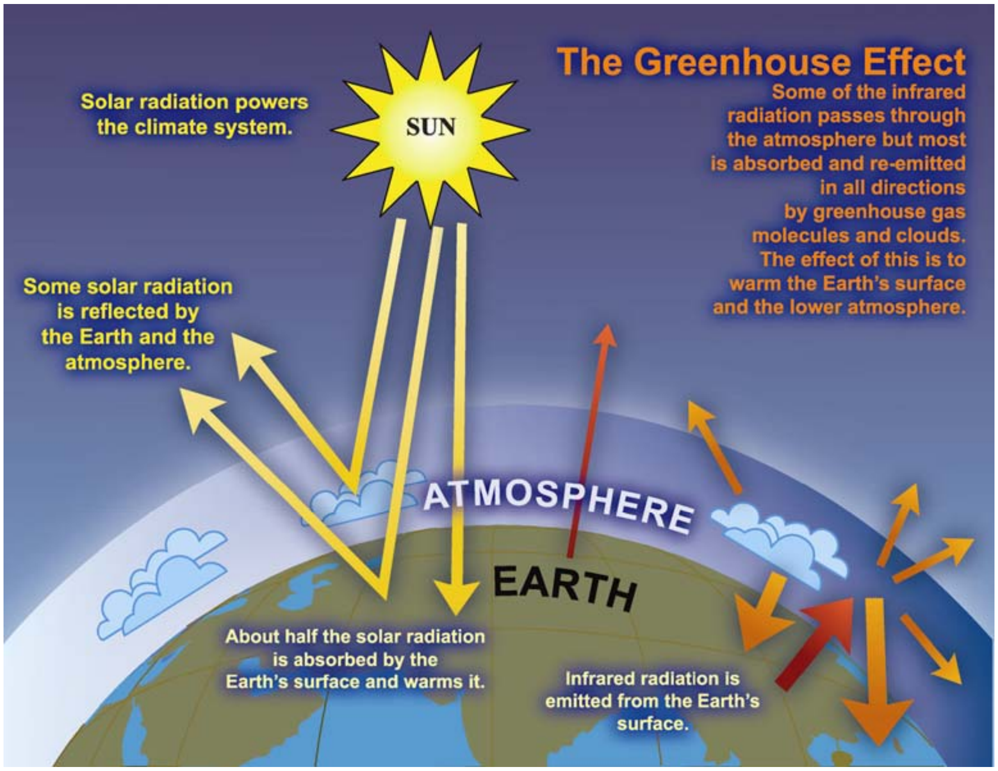
- Alternatives 2 through 4 would result in reduced adverse health effects nationwide compared to the No Action Alternative. Reductions generally increase as fuel consumption decreases across alternatives.
- The monetized health benefits follow the same patterns as the reductions in adverse health effects. In the Base Grid Mix case, estimated annual monetized health benefits in 2040 range from a low of $1.6 billion to a high of $7.6 billion ($2.6 billion to $7.6 billion under the Preferred Alternative). In the Alternate Grid Mix case, estimated monetized health benefits in 2040 range from $2.0 billion to $10.0 billion ($2.2 billion to $6.7 billion under the Preferred Alternative).
- Under the Preferred Alternative with the Base Grid Mix, cumulative reductions in adverse health outcomes are greater and monetized health benefits are higher than under the No Action Alternative, Alternative 2, and Alternative 4. Under the Preferred Alternative with the Alternate Grid Mix, reductions in adverse health outcomes are greater and monetized health benefits are higher than under the No Action Alternative and Alternative 2, but lower than under Alternative 4.

See Section 4.2.2 of this EIS for cumulative effects data on criteria and hazardous air pollutant emissions*,* monetized health benefits for the alternatives.

Climate

Earth's natural greenhouse effect is responsible for maintaining surface temperatures warm enough to sustain life (*see* Figure S-6). Human activities emit greenhouse gases (GHGs) to the atmosphere through the combustion of fossil fuels, industrial processes, solvent use, land-use change, forest management, agricultural production, and waste management. Carbon Dioxide (CO_2) and other GHGs trap heat in the troposphere (the layer of the atmosphere that extends from Earth's surface up to approximately 8 miles), absorb heat energy emitted by Earth's surface and its lower atmosphere, and radiate much of it back to the surface. Without GHGs in the atmosphere, most of this heat energy would escape back to space.

Figure S-6. The Greenhouse Effect



Source: IPCC (Intergovernmental Panel on Climate Change). 2007. Climate Change 2007: The Physical Science Basis. Contribution of working group I to the Fourth Assessment report of the Intergovernmental Panel on Climate Change. [Solomon, S., d. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.l. Miller (eds.)] Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 996 pgs.

The amount of CO_2 and other natural GHGs in the atmosphere – such as methane (CH_4), nitrous oxide (N_2O), water vapor, and ozone – has fluctuated over time, but natural emissions of GHGs are largely balanced by natural sinks, such as vegetation (which, when buried and compressed over long periods, becomes fossil fuel) and the oceans, which remove the gases from the atmosphere.

Since the industrial revolution, when fossil fuels began to be burned in increasing quantities, concentrations of GHGs in the atmosphere have increased. CO_2 has increased by more than 38 percent since pre-industrial times, while the concentration of CH_4 is now 149 percent above pre-industrial levels.

This buildup of GHGs in the atmosphere is upsetting Earth's energy balance and causing the planet to warm, which in turn affects sea levels, precipitation patterns, cloud cover, ocean temperatures and currents, and other climatic conditions. Scientists refer to this phenomenon as "global climate change."

During the past century, Earth's surface temperature has risen by an average of approximately 0.74 degree Celsius (°C) (1.3 degrees Fahrenheit [°F]) and sea levels have risen 0.17 meter (6.7 inches), with a maximum rate of about 2 millimeters (0.08 inch) per year over the past 50 years on the northeastern coast of the United States.

A recent National Research Council (NRC) report stated that there is a strong, credible body of evidence, based on multiple lines of research, documenting that climate is changing and that the changes are largely caused by human activities. These activities – such as the combustion of fossil fuel, the production of agricultural commodities, and the harvesting of trees – contribute to increased concentrations of GHGs in the atmosphere, which in turn trap increasing amounts of heat, altering Earth's energy balance.

Throughout this EIS, NHTSA has relied extensively on findings of the United Nations Intergovernmental Panel on Climate Change (IPCC), the U.S. Climate Change Science Program (CCSP), the NRC, the Arctic Council, the U.S. Global Change Research Program (GCRP), and EPA. This discussion focuses heavily on the most recent, thoroughly peer-reviewed, and credible assessments of global and U.S. climate change. *See* Section 5.1 of this EIS for more detail.

Impacts of Climate Change

Climate change is expected to have a wide range of effects on temperature, sea level, precipitation patterns, severe weather events, and water resources, which in turn could affect human health and safety, infrastructure, food and water supplies, and natural ecosystems. For example:

- Impacts on freshwater resources could include changes in precipitation patterns; decreasing aquifer recharge in some locations; changes in snowpack and timing of snowmelt; saltwater intrusion from sea-level changes; changes in weather patterns resulting in flooding or drought in certain regions; increased water temperature; and numerous other changes to freshwater systems that disrupt human use and natural aquatic habitats.
- Impacts on terrestrial ecosystems could include shifts in species range and migration patterns, potential extinctions of sensitive species unable to adapt to changing conditions, increases in the occurrence of forest fires and pest infestations, and changes in habitat productivity due to increased atmospheric concentrations of CO_2.
- Impacts on coastal ecosystems could include the loss of coastal areas due to submersion and erosion, additional impacts from severe weather and storm surges, and increased salinization of estuaries and freshwater aquifers.
- Impacts on land use could include flooding and severe-weather impacts on coastal, floodplain and island settlements; extreme heat and cold waves; increases in drought in some locations; and weather- or sea level-related disruptions of the service, agricultural, and transportation sectors.
- Impacts on human health could include increased mortality and morbidity due to excessive heat, increases in respiratory conditions due to poor air quality, increases in water and food-borne diseases, changes in the seasonal patterns of vector-borne diseases, and increases in malnutrition.

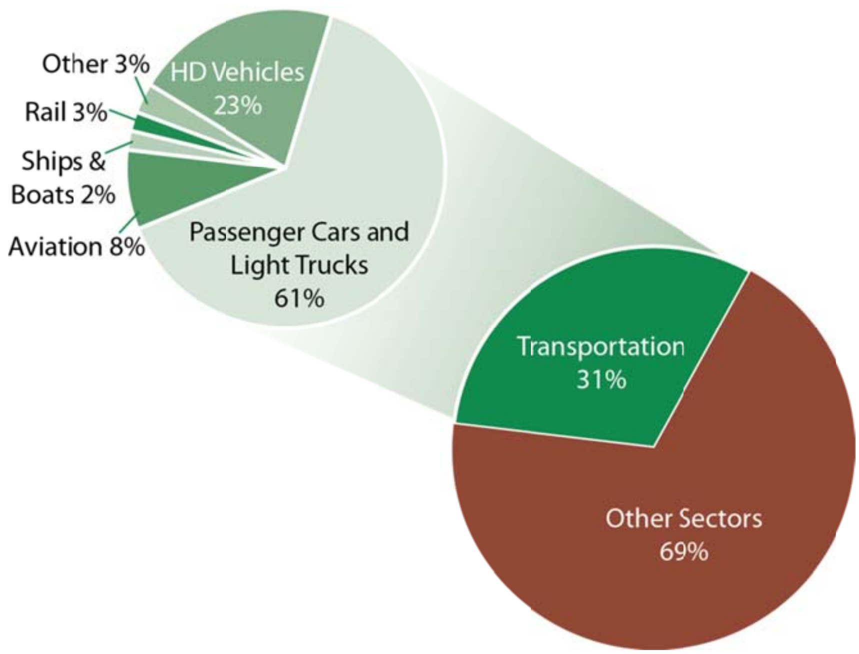
In addition to its role as a GHG in the atmosphere, CO_2 is transferred from the atmosphere to water, plants, and soil. In water, CO_2 combines with water molecules to form carbonic acid. When CO_2 dissolves in seawater, a series of well-known chemical reactions begins that increases the concentration of hydrogen ions and makes seawater more acidic, which adversely affects corals and other marine life.

Increased concentrations of CO_2 in the atmosphere can also stimulate plant growth to some degree, a phenomenon known as the CO_2 fertilization effect. The available evidence indicates that different plants respond in different ways to enhanced CO_2 concentrations.

Contribution of the U.S. Transportation Sector to Climate Change

Contributions to the buildup of GHGs in the atmosphere vary greatly from country to country and depend heavily on the level of industrial and economic activity. Emissions from the United States account for approximately 17.4 percent of total global CO_2 emissions (based on comprehensive global CO_2 emissions data available for 2005). As shown in Figure S-7, the U.S. transportation sector contributed 31 percent of total U.S. CO_2 emissions in 2010, with passenger cars and light trucks accounting for 61 percent of total U.S. CO_2 emissions from transportation. Therefore, 18.8 percent of total U.S. CO_2 emissions come from passenger cars and light trucks. From a global perspective, U.S. passenger cars and light trucks account for roughly 3.3 percent of total global CO_2 emissions.

Figure S-7. Contribution of Transportation to U.S. CO2 Emissions and Proportion Attributable by Mode, 2010



HD = heavy-duty

Source: EPA (U.S. Environmental Protection Agency). 2012. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2010. Tables 2-14 and 2-15. Washington, D.C. EPA 430-R-12-001. Available at: <http://www.epa.gov/climatechange/emissions/usinventoryreport.html>. (Accessed: April 20, 2012).

Key Findings for Climate

The action alternatives would decrease the growth in global GHG emissions when compared to the No Action Alternative, resulting in reductions in the anticipated increases that are otherwise projected to occur in CO_2 concentrations, temperature, precipitation, and sea level. They would also, to a small degree, reduce the impacts and risks of climate change.

Note that under the No Action Alternative, total CO_2, CH_4, and N_2O emissions from passenger cars and light trucks in the United States are projected to substantially increase between 2017 and 2100 in Analyses A1 and A2, while undergoing little to moderate growth in Analyses B1 and B2. Growth in the number of passenger cars and light trucks in use throughout the United States, combined with assumed increases in their average use, is projected to result in a growth in VMT. Because CO_2 emissions are a direct consequence of total fuel consumption, the same result is projected for total CO_2 emissions from passenger cars and light trucks.

NHTSA estimates that the action alternatives would reduce fuel consumption and CO_2 emissions from what they would be in the absence of the standards (i.e., fuel consumption and CO_2 emissions under the No Action Alternative) (*see* Figures S-8-A1, A2, B1, and B2).

The global emissions scenario used in the cumulative effects analysis (and described in Chapter 5 of this EIS) differs from the global emissions scenario used for climate change modeling of direct and indirect effects. In the cumulative effects analysis, the Reference Case global emissions scenario used in the climate modeling analysis reflects reasonably foreseeable actions in global climate change policy; in contrast, the global emissions scenario used for the analysis of direct and indirect effects assumes that no significant global controls on GHG emissions are adopted. *See* Section 5.3.3.2.2 of the EIS for more explanation of the cumulative effects methodology.

Estimates of GHG emissions and reductions (direct and indirect impacts and cumulative impacts) are presented below for each of the four alternatives. Key climate effects, such as mean global increase in surface temperature and sea-level rise, which result from changes in GHG emissions, are also presented for each of the four alternatives. These effects are typically modeled to 2100 or longer due to the amount of time required for the climate system to show the effects of the GHG (or in this case, emission) reductions. This inertia primarily reflects the amount of time required for the ocean to warm in response to increased radiative forcing.

The impacts of the action alternatives on global mean surface temperature, precipitation, or sea-level rise are small in relation to the expected changes associated with the emissions trajectories that assume that no significant global controls on GHG emissions are adopted. This is due primarily to the global and multi-sectoral nature of the climate problem. Although these effects are small, they occur on a global scale and are long-lasting; therefore, in aggregate they can have large consequences for health and welfare and would be an important contribution to reducing the risks associated with climate change.

Direct and Indirect Impacts

Greenhouse Gas Emissions

- In Analyses A1 and A2, U.S. passenger cars and light trucks are projected to emit between 138,800 and 155,400 million metric tons of carbon dioxide ($MMTCO_2$) in the period 2017–2100. In Analyses B1 and B2, these vehicles are projected to emit between 111,400 and 124,100 $MMTCO_2$. The action alternatives would reduce these emissions by 12 to 28 percent in Analyses A1 and A2 and by 2 to 18 percent in Analyses B1 and B2 by 2100. Figures S-8-A1, A2, B1, and B2 show projected annual CO_2 emissions from passenger cars and light trucks under each alternative. As shown in the figures, emissions are highest under the No Action Alternative, while Alternatives 2 through 4 show increasing reductions in emissions compared to the No Action Alternative.

- Compared to total projected U.S. emissions of 7,193 $MMTCO_2$ under the No Action Alternative in 2100, the action alternatives are expected to reduce U.S. CO_2 emissions in 2100 by between 3.2 and 8.3 percent in Analysis A and between 0.1 and 3.6 percent in Analysis B.
- Compared to total global CO_2 emissions from all sources of 5,099,256 $MMTCO_2$ under the No Action Alternative from 2017 through 2100, the action alternatives are expected to reduce global CO_2 emissions by between 0.33 and 0.84 percent in Analysis A and between 0.05 and 0.43 percent in Analysis B by 2100.
- The emission reductions under the alternatives are equivalent to the annual emissions from between 14.8 and 36.9 million passenger cars and light trucks in 2025 in Analysis A and between 9.2 and 30.6 million passenger cars and light trucks in Analysis B, compared to the No Action Alternative. Emission reductions in 2025 under the Preferred Alternative fall within this range, and are projected to be equivalent to a reduction of between 22.9 to 23.3 million passenger cars and light trucks in Analysis A and 17.5 million passenger cars and light trucks in Analysis B.

Figure S-8-A1. Projected Annual CO_2 Emissions ($MMTCO_2$) from U.S. Passenger Cars and Light Trucks by Alternative, Analysis A1

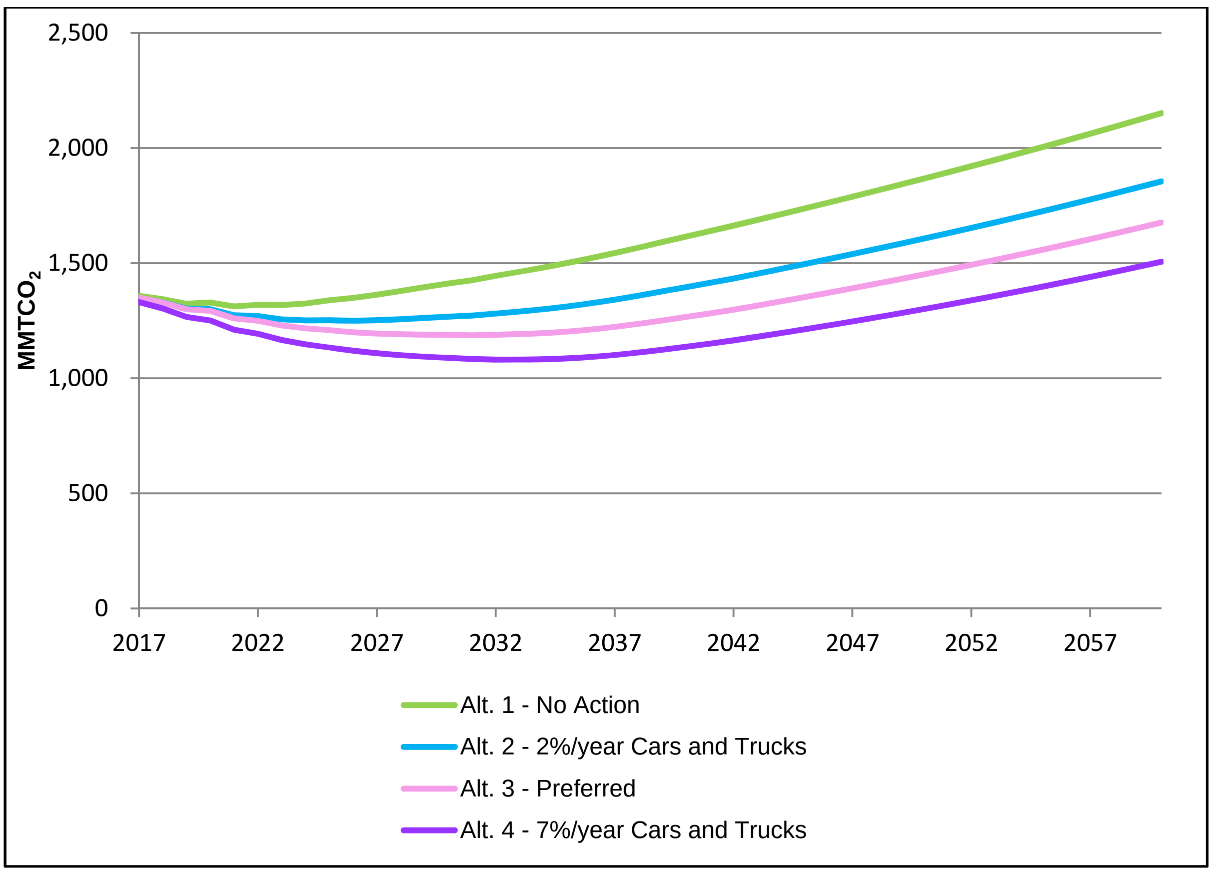


Figure S-8-A2. Projected Annual CO_2 Emissions ($MMTCO_2$) from U.S. Passenger Cars and Light Trucks by Alternative, Analysis A2

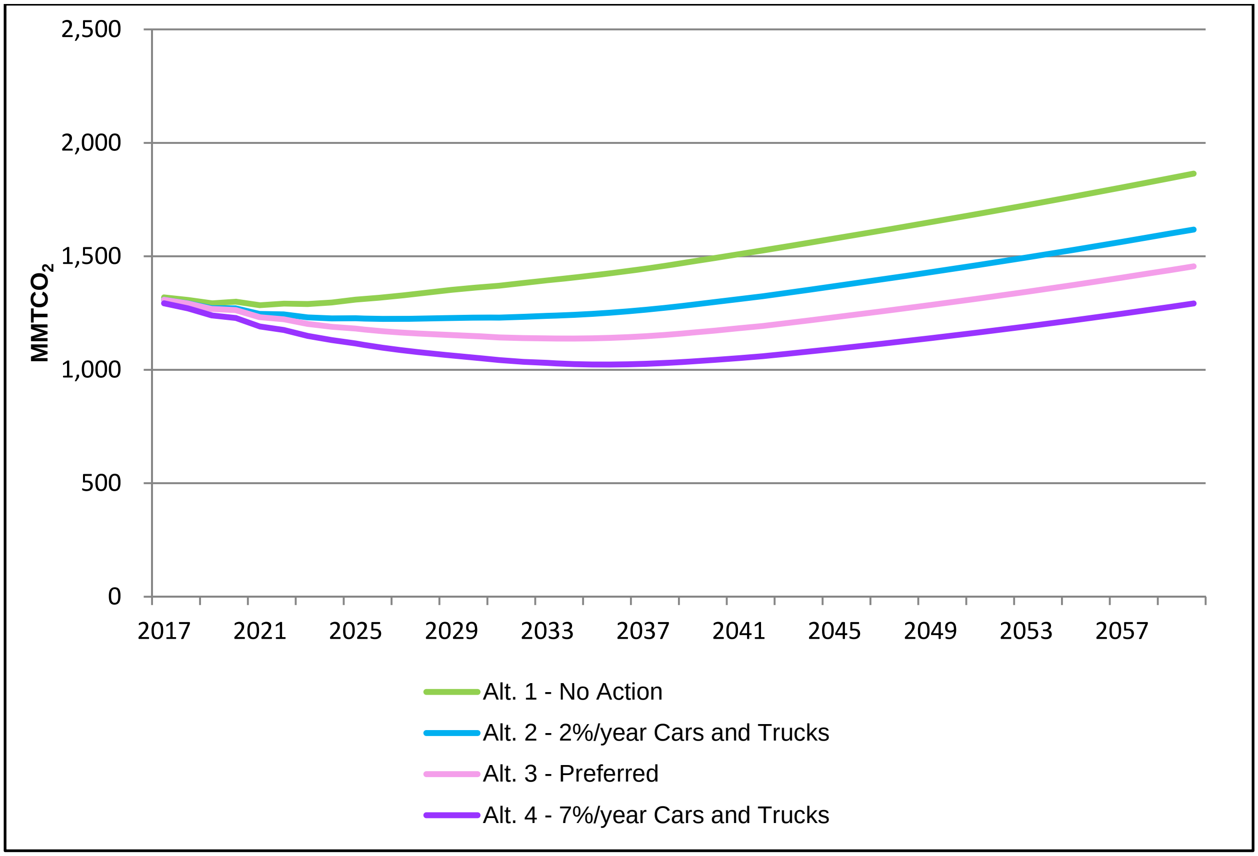


Figure S-8-B1. Projected Annual CO_2 Emissions ($MMTCO_2$) from U.S. Passenger Cars and Light Trucks by Alternative, Analysis B1

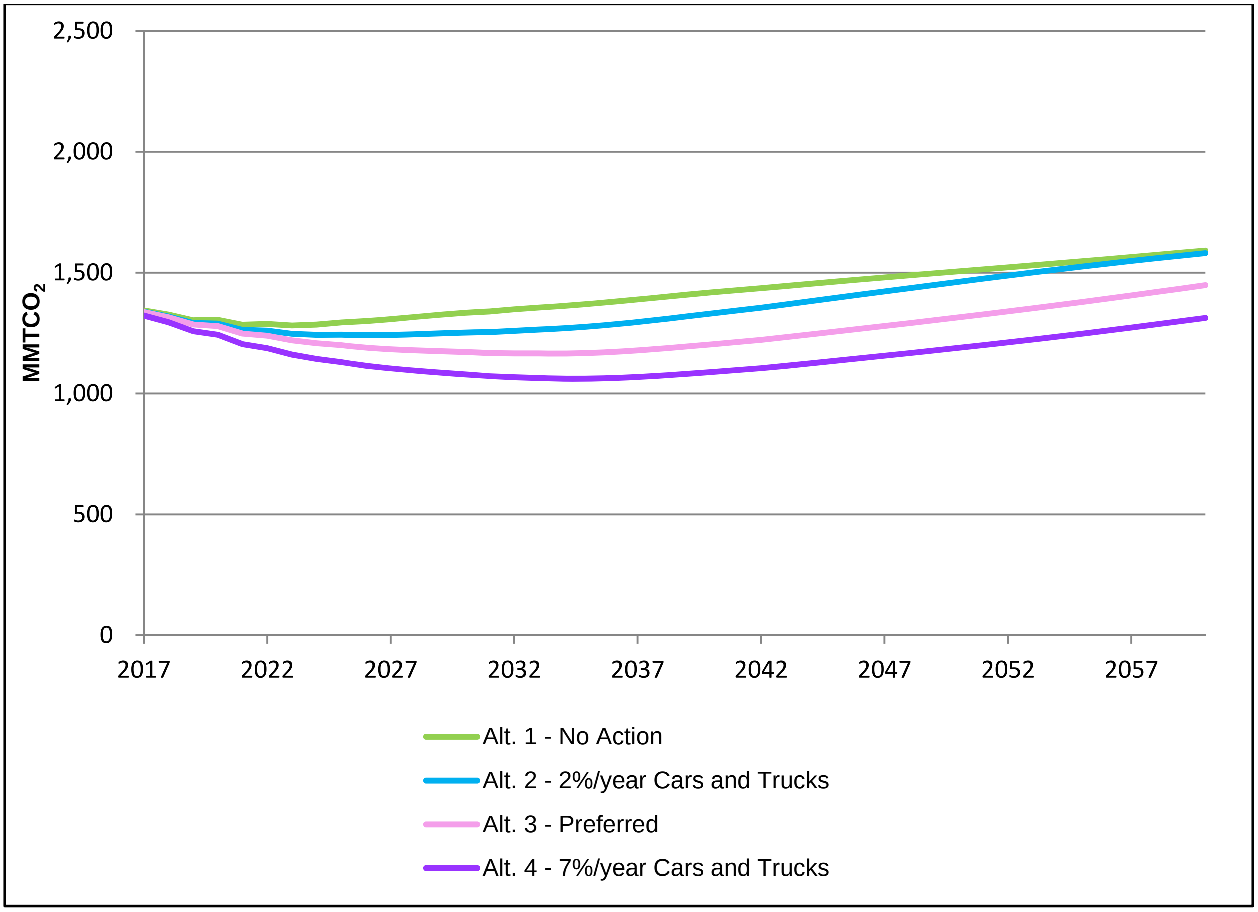
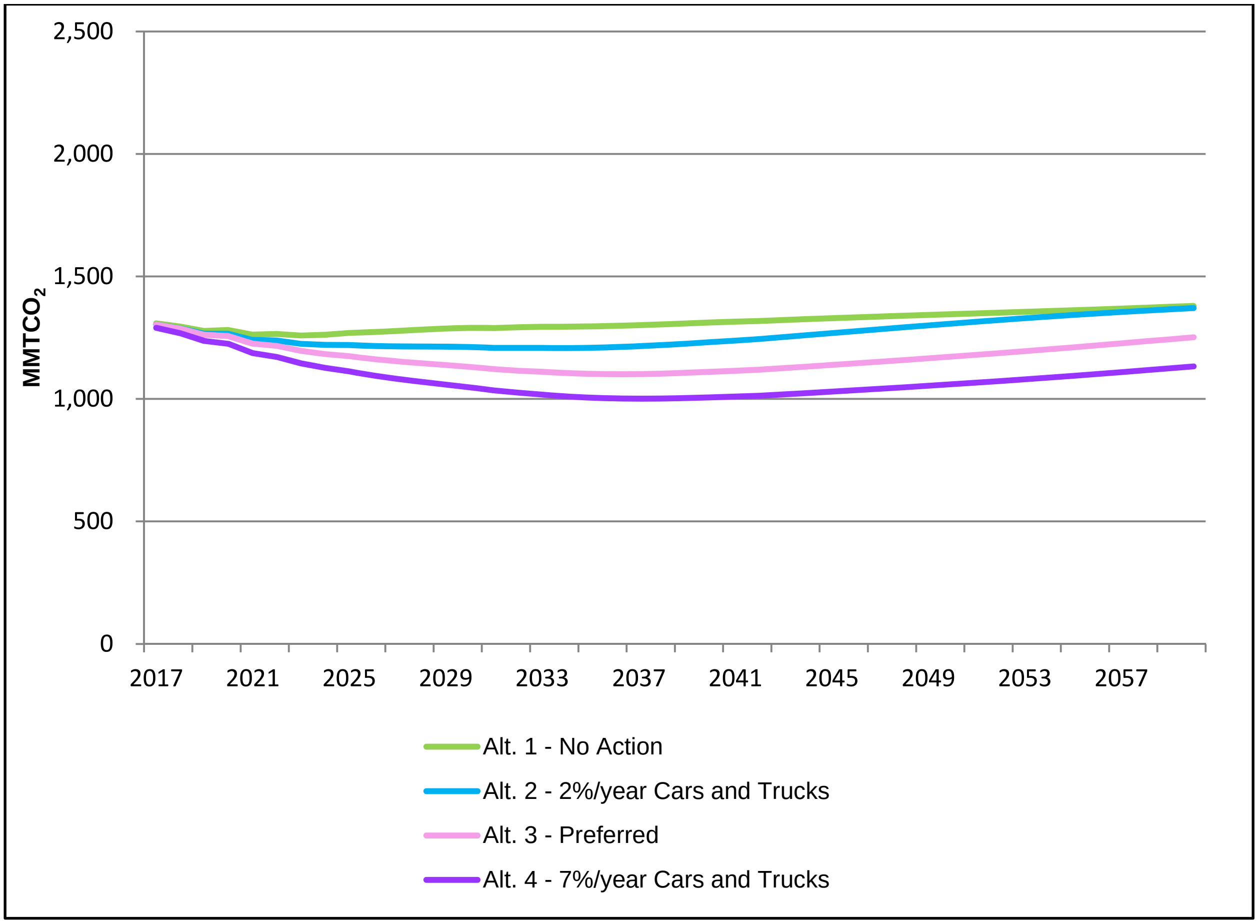


Figure S-8-B2. Projected Annual CO_2 Emissions ($MMTCO_2$) from U.S. Passenger Cars and Light Trucks by Alternative, Analysis B2



CO_2 Concentration, Global Mean Surface Temperature, Sea-level Rise, and Precipitation

CO_2 emissions affect the concentration of CO_2 in the atmosphere, which in turn affects global temperature, sea level, and precipitation patterns. For the analysis of direct and indirect effects, NHTSA used the GCAMReference scenario to represent the Reference Case emissions scenario; that is, future global emissions assuming no additional climate policy. The impacts of the Proposed Action and alternatives on temperature, precipitation, or sea-level rise are small in absolute terms because the action alternatives result in a small proportional change to the emissions trajectories in the Reference Case scenario to which the alternatives were compared. Although these effects are small, they occur on a global scale and are long-lasting, and would be an important contribution to reducing the risks associated with climate change.

- Estimated CO_2 concentrations in the atmosphere for 2100 would range from approximately 781 parts per million (ppm) in Analysis A and 783 ppm in Analysis B under Alternative 4 to approximately 785 ppm under the No Action Alternative, indicating a maximum atmospheric CO_2 reduction of approximately 4 ppm from the No Action Alternative in Analysis A and 2 ppm in Analysis B. The Preferred Alternative would reduce global CO_2 concentrations by approximately 3.0 ppm in Analysis A and 1.1 ppm in Analysis B from CO_2 concentrations under the No Action Alternative.

- Global mean surface temperature is anticipated to increase by approximately 3.06 °C (5.51 °F) under the No Action Alternative by 2100. Implementing the most stringent alternative (Alternative 4) would reduce this projected temperature increase by between 0.014 and 0.015 °C (0.025 and 0.027 °F) in Analysis A and between 0.007 and 0.008 °C (0.013 and 0.014 °F) in Analysis B, while implementing Alternative 2 would reduce projected temperature increase by up to 0.006 °C (0.011 °F) in Analysis A and 0.001 °C (0.002 °F) in Analysis B. Falling between these two levels, the Preferred Alternative would decrease projected temperature increase under the No Action Alternative by between 0.009 and 0.010 °C (0.016 and 0.018 °F) in Analysis A and 0.004 °C (0.007 °F) in Analysis B. Figures S-9-A1, A2, B1, and B2 demonstrate show in the growth of projected global mean temperature under each action alternative compared to the No Action Alternative.
- Projected sea-level rise in 2100 ranges from a high of 37.40 centimeters (14.72 inches) under the No Action Alternative to a low of 37.26 centimeters (14.67 inches) in Analysis A and 37.32 centimeters (14.69 inches) in Analysis B under Alternative 4. Therefore, the action alternatives would result in a maximum reduction of sea-level rise equal to 0.14 centimeter (0.06 inch) in Analysis A and 0.08 centimeter (0.03 inch) in Analysis B by 2100 from the level projected under the No Action Alternative. Sea-level rise under the Preferred Alternative would be reduced by between 0.09 centimeter and 0.10 centimeter (0.035 and 0.039 inch) in Analysis A to between 0.04 centimeter and 0.05 centimeter (0.016 and 0.020 inch) in Analysis B from the No Action Alternative.
- Global mean precipitation is anticipated to increase by 4.50 percent by 2090 under the No Action Alternative. Under the action alternatives, this increase would be reduced by approximately 0.02 percent under Alternative 4 to between 0.00 percent and 0.01 percent under Alternative 2. The Preferred Alternative would result in a reduction of between 0.01 percent and 0.02 percent in Analysis A (0.01 percent in Analysis B) in global mean precipitation increase, indicating a total increase of 4.49 percent in Analysis A (4.50 percent in Analysis B).

Figure S-9-A1. Reduction in Global Mean Surface Temperature Compared to the No Action Alternative, Analysis A1

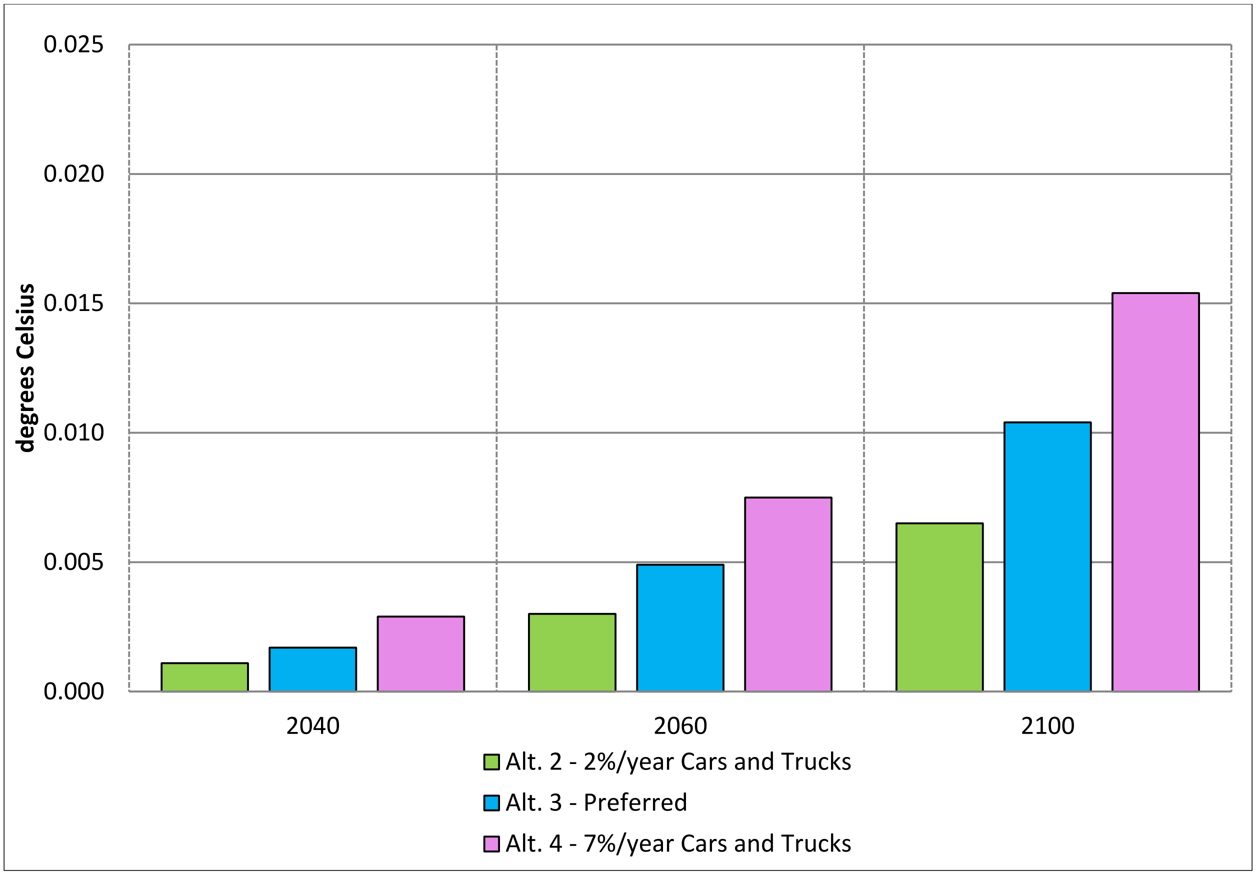


Figure S-9-A2. Reduction in Global Mean Surface Temperature Compared to the No Action Alternative, Analysis A2

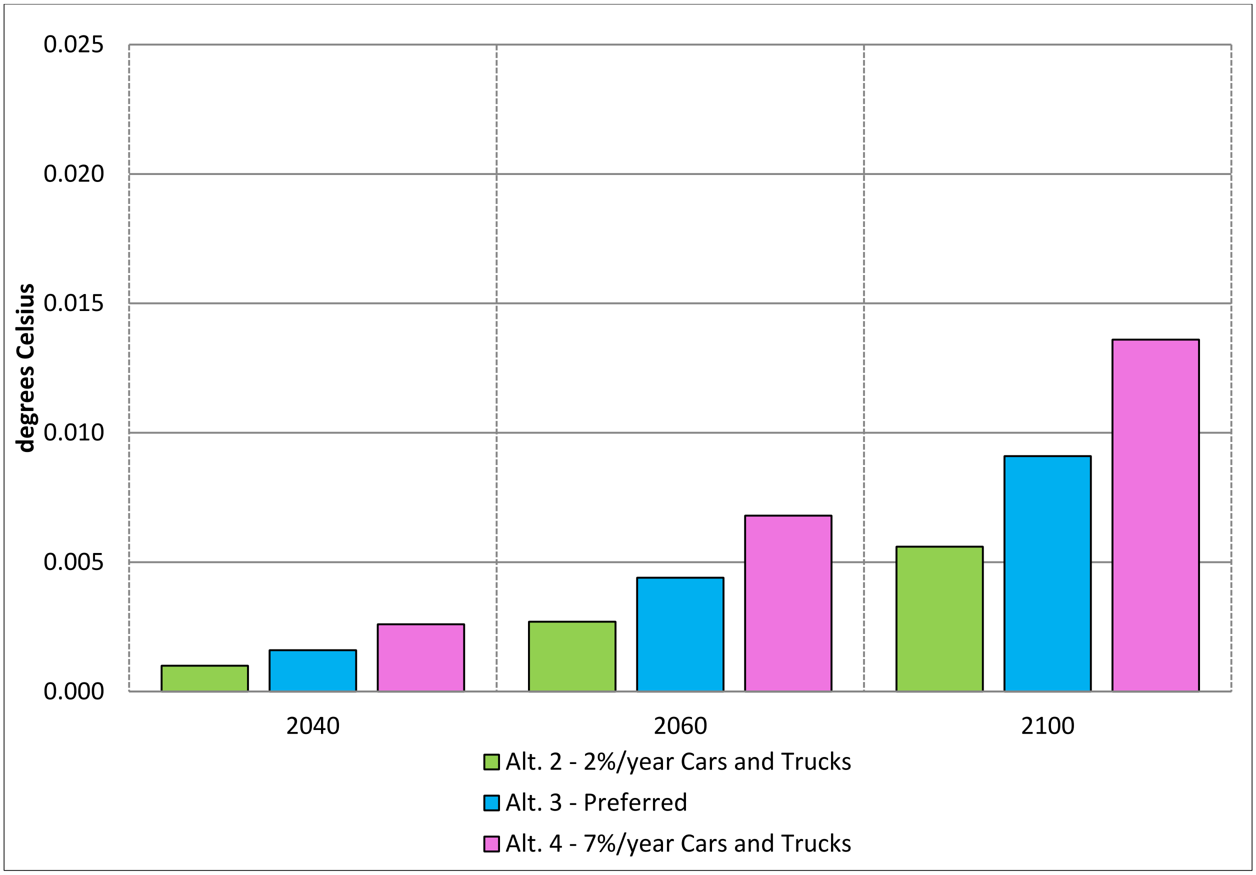


Figure S-9-B1. Reduction in Global Mean Surface Temperature Compared to the No Action Alternative, Analysis B1

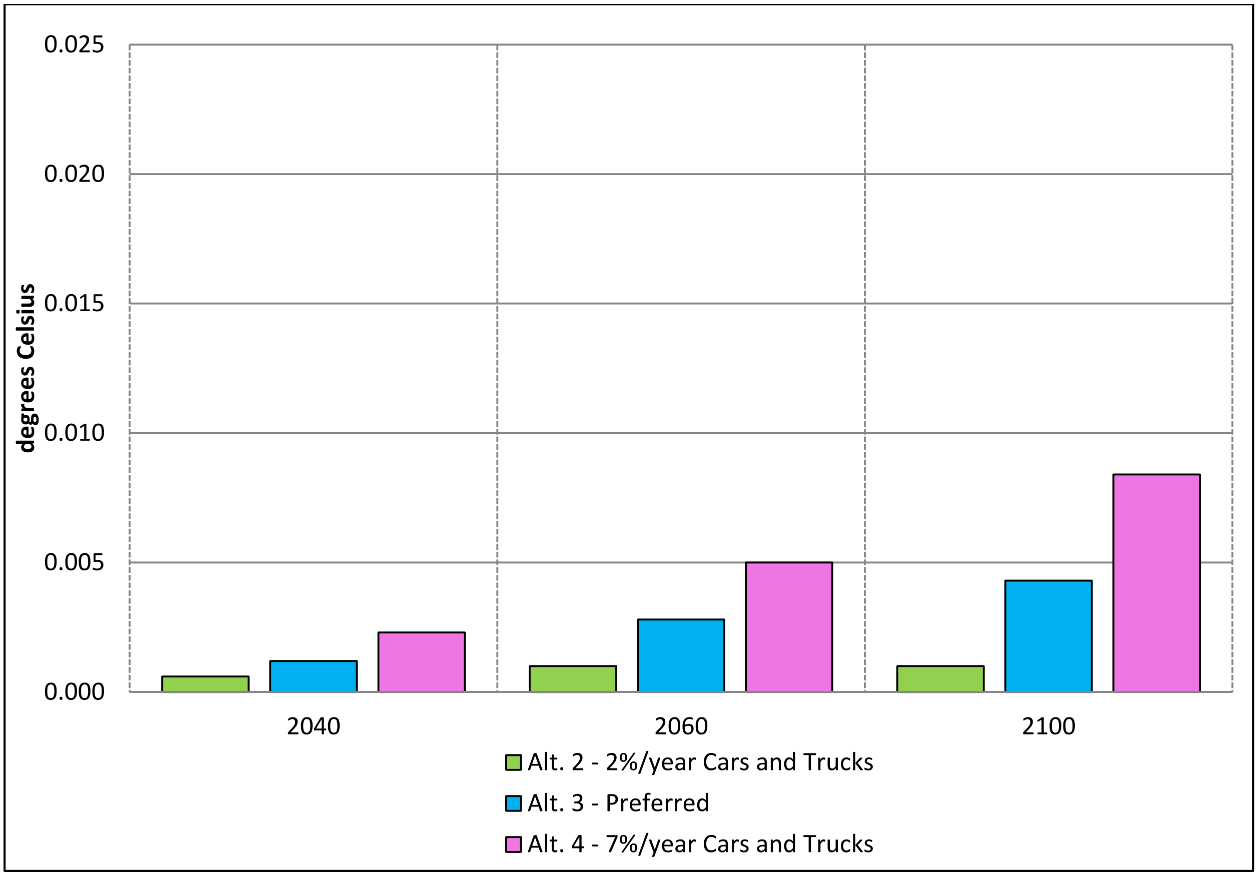
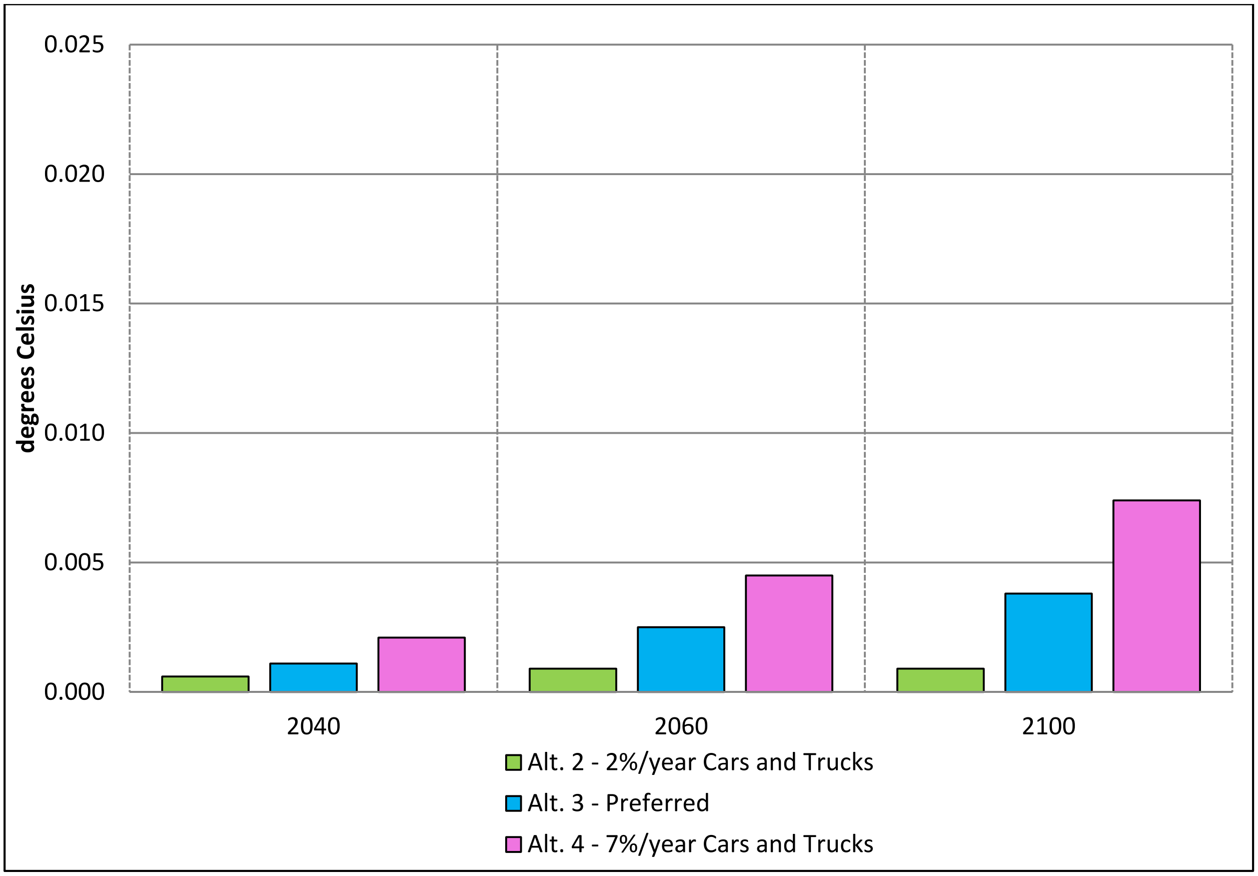


Figure S-9-B2. Reduction in Global Mean Surface Temperature Compared to the No Action Alternative, Analysis B2



Cumulative Impacts

Greenhouse Gas Emissions

- Projections of total emission reductions over the 2017–2100 period under the action alternatives and other reasonably foreseeable future actions (i.e., forecasted fuel-efficiency increases resulting from market-driven demand) range from 29,800 to 53,300 $MMTCO_2$ compared to the No Action Alternative. The action alternatives would reduce total U.S. passenger car and light-truck emissions by between 22 and 34 percent by 2100. Figures S-8-C1 and C2 show projected annual CO_2 emissions from U.S. passenger cars and light trucks by alternative compared to the No Action Alternative.
- Compared to projected total global CO_2 emissions from all sources of 4,190,614 $MMTCO_2$ from 2017 through 2100, the incremental impact of this rulemaking is expected to reduce global CO_2 emissions by about 0.7 to 1.3 percent across all action alternatives from their projected levels under the No Action Alternative.

Figure S-8-C1. Projected Annual CO_2 Emissions ($MMTCO_2$) from U.S. Passenger Cars and Light Trucks by Alternative, Analysis C1

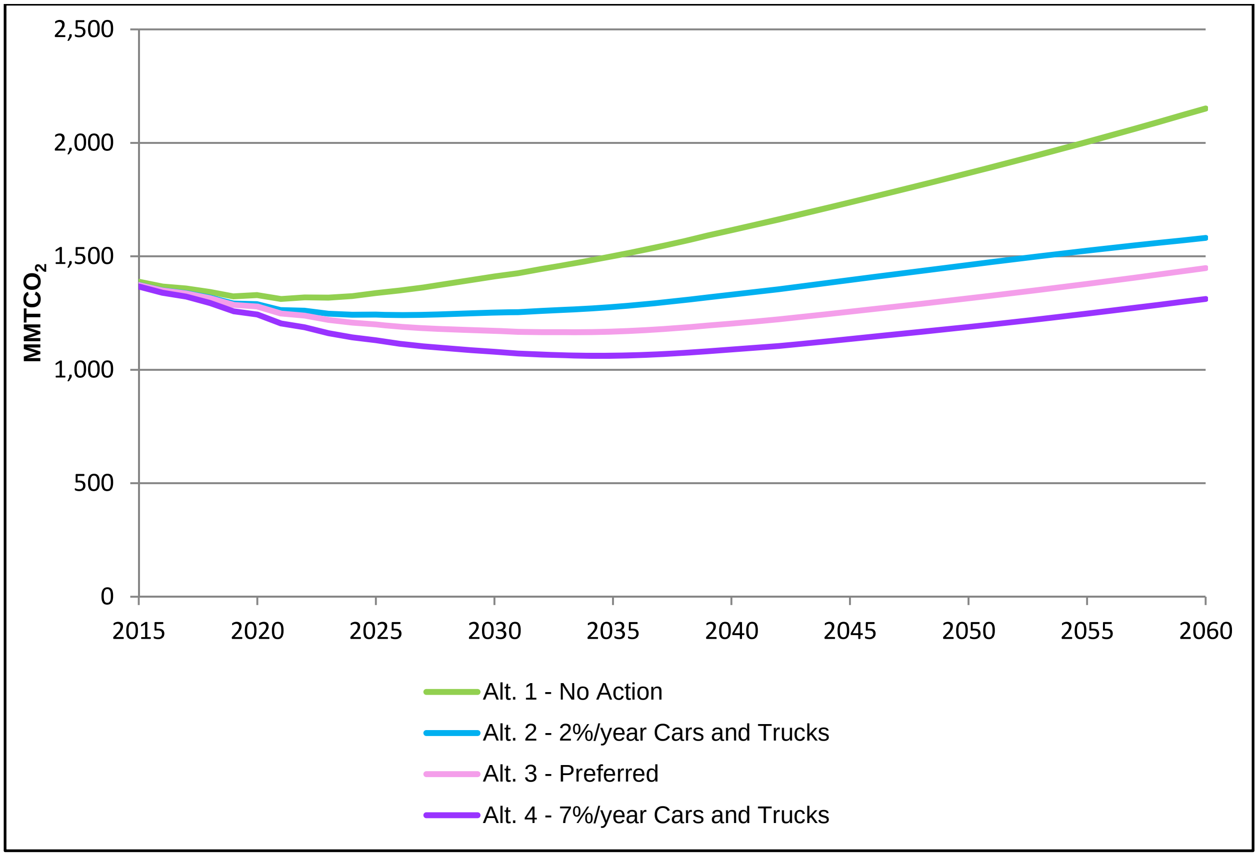
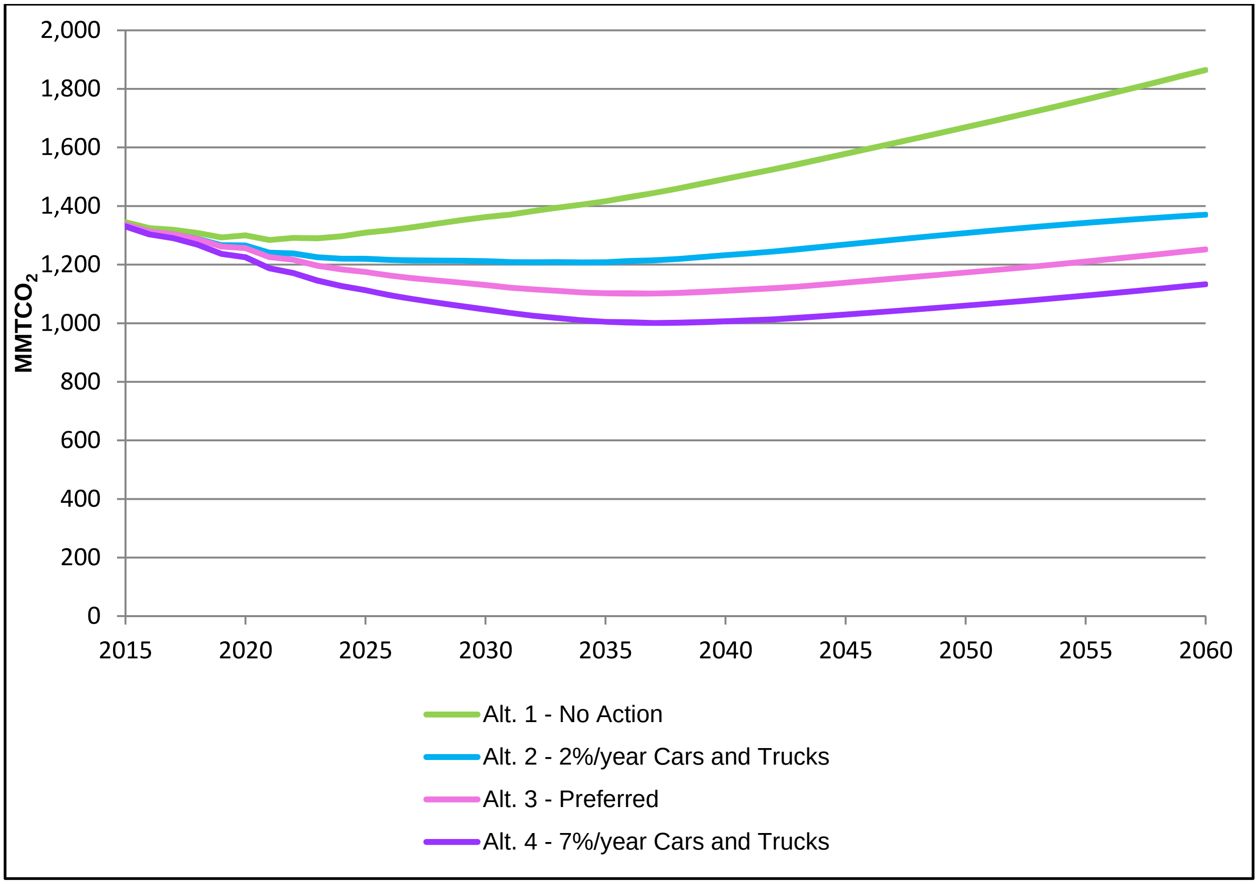


Figure S-8-C2. Projected Annual CO_2 Emissions ($MMTCO_2$) from U.S. Passenger Cars and Light Trucks by Alternative, Analysis C2



CO_2 Concentration, Global Mean Surface Temperature, Sea-level Rise, and Precipitation

- Estimated atmospheric CO_2 concentrations for 2100 range from a low of 672.9 ppm under Alternative 4 to a high of 677.8 ppm under the No Action Alternative. The Preferred Alternative would result in CO_2 concentrations of between 673.8 ppm and 674.3 ppm, a reduction of between 3.5 and 4.0 ppm from the No Action Alternative.
- The reduction in global mean temperature increase for the action alternatives in relation to the No Action Alternative in 2100 ranges from a low of 0.011 °C (0.020 °F) to a high of 0.020 °C (0.036 °F). The Preferred Alternative would result in a reduction of between 0.014 and 0.016 °C (0.25 and 0.029 °F) from the projected temperature increase of 2.564 °C (4.615 °F) under the No Action Alternative. Figures S-9-C1 and C2 illustrate reductions in the increase of global mean temperature under each action alternative compared to the No Action Alternative.
- Projected sea-level rise in 2100 ranges from a high of 33.42 centimeters (13.16 inches) under the No Action Alternative to a low of 33.25 centimeters (13.09 inches) under Alternative 4, indicating a maximum reduction of sea-level rise equal to 0.17 centimeter (0.07 inch) by 2100 from the level that could occur under the No Action Alternative. Sea-level rise under the Preferred Alternative would be between 33.29 and 33.30 centimeters (13.106 to 13.110 inches), a 0.13- to 0.12-centimeter (0.051- to 0.047-inch) reduction from the No Action Alternative.

See Section 5.4 of this EIS for more details about the direct, indirect, and cumulative impacts on climate.

Figure S-9-C1. Reduction in Global Mean Surface Temperature Compared to the No Action Alternative, Analysis C1

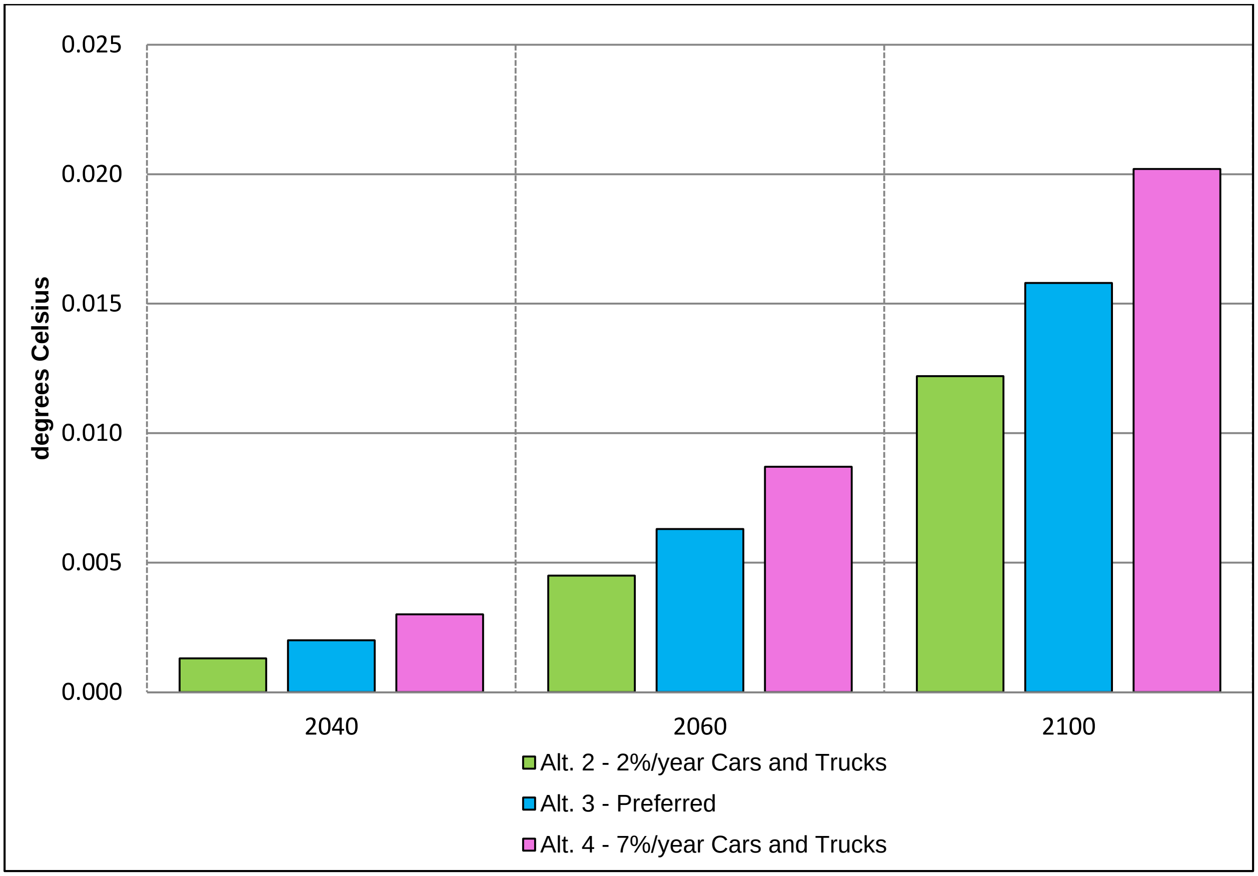
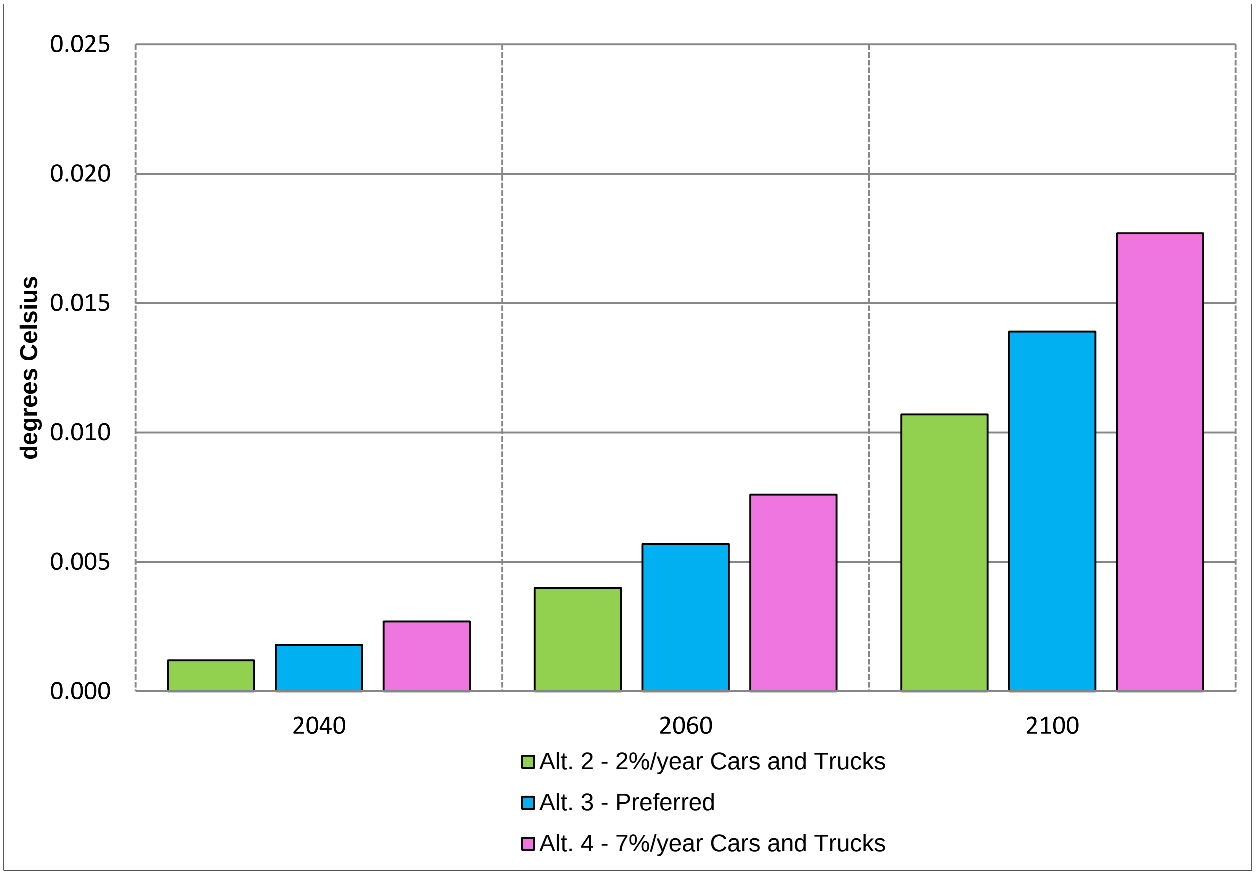


Figure S-9-C2. Reduction in Global Mean Surface Temperature Compared to the No Action Alternative, Analysis C2



Health, Societal, and Environmental Impacts of Climate Change

The action alternatives would reduce the impacts of climate change that would otherwise occur under the No Action Alternative. The magnitude of the changes in climate effects that would be produced by the most stringent action alternative is roughly 2 to 4 ppm less of CO_2, a few hundredths of a degree difference in temperature increase, a small percentage change in the rate of precipitation increase, and 1 to 2 millimeters (0.04 to 0.08 inch) of sea-level rise. Although the projected reductions in CO_2 and climate effects are small compared to total projected future climate change, they are quantifiable, directionally consistent, and would be an important contribution to reducing the risks associated with climate change. While NHTSA does quantify the reductions in monetized damages attributable to each action alternative (in the social cost of carbon analysis), many specific impacts on health, society, and the environment cannot be estimated quantitatively. Therefore, NHTSA provides a detailed discussion of the impacts of climate change on various resource sectors in Section 5.5 of the EIS. Section 5.6 discusses the changes in non-climate impacts (such as ocean acidification by CO_2) associated with the alternatives.