Corporate Average Fuel Economy Standards

Passenger Cars and Light Trucks

Model Years 2017-2025

Draft 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 model year (MY) 2017–2025 Corporate Average Fuel Economy (CAFE) Standards for passenger cars and light trucks (the Proposed Action). This document was prepared 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 (i.e., the proposed standards) 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 standards 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. NHTSA is delegated responsibility for implementing EPCA fuel economy requirements assigned to the Secretary. 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, as well as 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 rules 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 joint 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 was developed by NHTSA, EPA, and the California Air Resources Board (CARB), 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 auto manufacturers, automotive suppliers, states, environmental groups, consumer groups, and the United Auto Workers, who all expressed support for a 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 like compliance flexibilities and the mid-term evaluation. That NPRM is being issued simultaneously with this Draft EIS.

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 proposed CAFE standards, NHTSA prepared this EIS, which analyzes, discloses, and compares the potential environmental impacts of a reasonable range of action alternatives, including a proposed 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 the range of alternatives to be considered in the NEPA analysis. In accordance with EPCA, as amended by EISA, one purpose of the Joint Rulemaking is to establish MY 2017–2025 CAFE standards 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, EPCA requires that the agency 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 the Department 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. The NEPA analysis in this EIS informs the agency's action in setting CAFE standards for MY 2017–2025 passenger cars and light trucks.

PROPOSED ACTION AND ALTERNATIVES

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 MY 2017–2025 passenger cars and light trucks in accordance with EPCA, as amended by EISA. In developing the proposed standards 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.

Because in any single rulemaking under EPCA, standards may be established for not more than 5 model years, NHTSA intends to issue conditional standards for MYs 2022–2025. The CAFE standards for MYs 2022–2025 will be determined with finality in a subsequent, de novo notice and comment rulemaking conducted in full compliance with Section 32902 of Title 49 of the United States Code and other applicable law. Because these two NHTSA actions are being proposed together to increase the efficiency of the light-duty vehicle fleet, and because they are part of a joint NHTSA/EPA rulemaking for a coordinated National Program covering MYs 2017–2025, this EIS addresses the potential environmental impacts of the proposed alternatives for the full MY 2017–2025 period together, notwithstanding the provision for a mid-term evaluation.

NHTSA has selected a reasonable range of alternatives to evaluate the potential environmental impacts of the proposed CAFE standards and alternatives under NEPA. The specific alternatives NHTSA selected, described below and listed in Table S-1 and Sections 2.2.1 and 2.2.2 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 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 action alternatives.

In recognition of the uncertainty inherent in forecasting the fuel economy of the future light-duty vehicle fleet in the absence of the agencies' action, this EIS provides two analyses regarding the No Action Alternative and the corresponding impacts of action alternatives. "Analysis A" reflects a No Action Alternative that assumes that, in the absence of the Proposed Action, the baseline light-duty vehicle fleet in MYs 2017–2025 and beyond would attain an average fleetwide fuel economy no higher than that required under the agencies' MY 2016 standards established by final rule in April 2010. In addition, Analysis A assumes that fleetwide fuel economy after MY 2025 under the action alternatives will never exceed the level of the MY 2025 standards. Tables and figures in this summary that depict results for Analysis A include an "A" after the table or figure number.

"Analysis B" reflects a No Action Alternative that assumes that, in the absence of the agencies' 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. NHTSA forecasted this fleet 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 of the same inputs as for Analysis A, but applied a payback period of 1 year for purposes of calculating the value of future fuel savings when simulating whether a manufacturer would apply additional technology to an already CAFE-compliant fleet. For technologies applied to a manufacturer's fleet that has not yet achieved compliance with CAFE standards, the agency continued to apply a 5-year payback period. Further discussion of this methodology is available in Section IV.G of the NPRM. For the action alternatives, the agency has assumed that fleetwide fuel economy will continue to increase after MY 2025 beyond the levels necessary to meet the MY 2025 standards. Specifically, the agency assumes that the fuel economy achieved by new passenger cars and light trucks will increase at rates of 0.2 percent and 0.4 percent annually after MY 2025. These rates of increase were developed by examining 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 Analysis B include a "B" after the table or figure number.

Table S-1. Estimated Average Required and Achieved Fleetwide Fuel Economy (mpg) for Combined U.S. Passenger Cars and Light Trucks by Model Year and Alternative

Alternative	MY 2017	MY 2018	MY 2019	MY 2020	MY 2021	MY 2022	MY 2023	MY 2024	MY 2025
Required									
2 - 2%/Year Cars and Trucks	35.4	36.2	37.1	37.9	38.7	39.6	40.4	41.4	42.3
3 - Preferred	35.3	36.4	37.5	38.8	40.9	42.9	45.0	47.3	49.6
4 - 7%/Year Cars and Trucks	37.2	40.3	43.5	46.9	50.6	54.6	59.0	63.8	69.0
Achieved									
1 - No Action, Analysis A	33.4	33.8	34.1	34.4	34.5	34.6	34.7	34.8	34.9
1 - No Action, Analysis B	33.3	33.9	34.2	34.5	34.6	34.7	34.9	35.1	35.3
2 - 2%/Year Cars and Trucks	34.1	35.3	36.7	37.7	38.6	39.2	39.7	40.4	40.9
3 - Preferred	34.3	35.8	37.8	39.4	41.0	42.0	43.3	44.9	46.7
4 - 7%/Year Cars and Trucks	36.6	39.0	41.7	44.3	45.8	47.5	49.9	53.3	55.6

Table S-1 shows the estimated average required and achieved fleetwide fuel economy that NHTSA forecasts under the No Action Alternative and the action alternatives for both Analysis A and Analysis B by model year during the regulatory period. Because Analysis A and Analysis B differ only in relation to fuel economy gains under the No Action Alternative and after 2025, the estimated achieved fuel economy levels under the action alternatives for the regulatory period (MYs 2017–2025) are essentially the same for both analyses.

NHTSA has analyzed a 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 NHTSA stated in the Notice of Intent to issue an EIS, the agency 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. Table S-1 shows the estimated average required and achieved fleetwide fuel economy NHTSA forecasts by model year under the three action alternatives. These action alternatives are as follows:

- Alternative 2 – Alternative 2 would require a 2 percent average annual fleetwide increase in mpg 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 40.9 mpg in MY 2021 and 49.6 mpg in MY 2025. For passenger cars, the annual increase in the stringency between model years 2017 and 2021 averages 4.1 percent. In recognition of manufacturers' unique challenges in improving the fuel economy and GHG emissions of full-size pickup trucks while preserving the utility (e.g., towing and payload capabilities) of those vehicles, NHTSA is proposing a slower annual rate of improvement for light trucks in the first phase of the program. For light trucks, the proposed annual increase in stringency in MYs 2017 through 2021 averages 2.9 percent per year. In the second phase of the program (MYs 2022–2025), the annual increase in stringency for passenger cars is expected to average 4.3 percent, and for light trucks, 4.7 percent.
- Alternative 4 – Alternative 4 would require a 7 percent average annual fleetwide increase in mpg 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.

The range under consideration in the 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.

The agency's Preferred Alternative 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 explanation of the alternatives, *see* Section 2.2 of this EIS.

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 alternative NHTSA is evaluating. As a result, the most stringent alternative would impose greater costs and achieve greater energy conservation and related reductions in GHGs than other action alternatives, compared to the No Action Alternative.

POTENTIAL ENVIRONMENTAL CONSEQUENCES

This section describes how the Proposed Action and alternatives could affect energy use, air quality, and climate. The EIS also qualitatively describes potential additional impacts on water resources, biological resources, safety, hazardous materials and regulated wastes, noise, and environmental justice. Appendix A to the EIS provides the impacts of the proposed standards for passenger cars and light trucks separately.

The impacts on energy use, air quality, and climate described in this Summary include *direct*, *indirect*, and *cumulative impacts*. Direct impacts occur at the same time and place as the action. Indirect impacts occur later in time or are farther removed in distance. Cumulative impacts are the incremental 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 of the proposed standards compares the action alternatives of a particular analysis (A or B) with the No Action Alternative for that analysis, applying their respective assumptions as described above. The cumulative impacts analysis accounts for 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 proposed rule 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.

Energy

NHTSA's proposed standards would regulate fuel economy and therefore impact U.S. transportation sector fuel consumption. 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, 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.

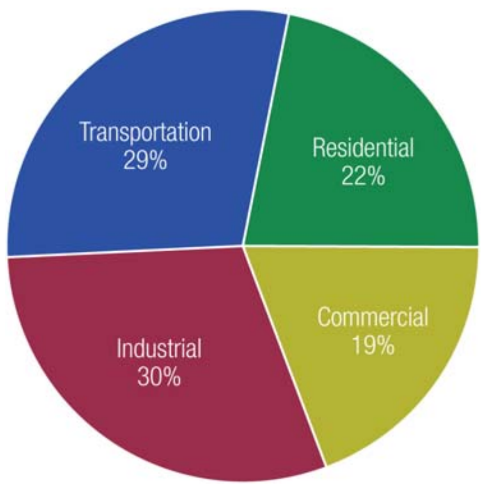
DOE has stated that vehicle efficiency has the greatest short- to mid-term impact on oil consumption.

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 was reduced by 54 percent over 4 decades (from 15,890 British thermal units [Btu] per real dollar of GDP in 1970 to 7,330 Btu per real dollar of GDP in 2009), 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.

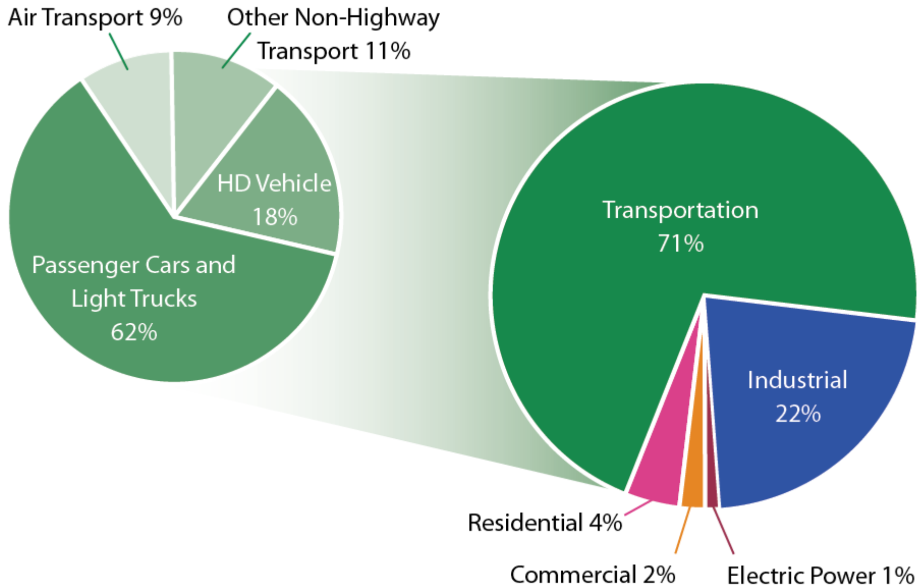
The transportation sector is the second-largest consumer of energy in the United States (after the industrial sector), representing 29 percent of total U.S. energy use, as shown in Figure S-1. Petroleum is by far the largest source of energy used in the transportation sector, accounting for almost 95 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, 71 percent of the petroleum used in the United States is consumed by the transportation sector.

Figure S-1. U.S. Energy Consumption by Sector, 2009



Source: EIA (Energy Information Administration). 2011. Annual Energy Review 2010. Table 2.1a—Energy Consumption by Sector, Selected Years, 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: November 2, 2011).

Figure S-2. U.S. Petroleum Consumption by Sector, 2009



HD = heavy-duty

Left Pie Chart Data Source: EIA. 2011. Annual Energy Outlook 2011. Table 7—Transportation Sector key Indicators and delivered energy Consumption, reference Case, 2008-2035. DOE/EIA-0383 (2011), April. U.S. Department of Energy: Washington, D.C. Available at: <http://www.eia.gov/oiaf/aeo/tablebrowser/>. (Accessed: October 18, 2011).

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: October 27, 2011).

More than half of transportation sector energy use can be attributed to petroleum (gasoline and diesel fuel) consumption from 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 proposed 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 through 2060 (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 under both Analysis A and Analysis B. Total combined gas and diesel fuel consumption by all U.S. passenger cars and light trucks during the period 2017–2060 would decrease from approximately 7,000 billion gallons under the No Action Alternative (7,092 in Analysis A; 6,421 in Analysis B) to approximately 5,000 billion gallons under Alternative 4 (5,216 in Analysis A; 4,964 in Analysis B). Total fuel consumption under the Preferred Alternative falls between these two levels, amounting to 5,860 billion gallons in Analysis A and 5,583 billion gallons in Analysis B during the period 2017–2060.

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-A and S-3-B demonstrate fuel savings for Analysis A and Analysis B, respectively, from 2017–2060 under each alternative compared to the No Action Alternative. Total fuel savings from 2017–2060 compared to the No Action Alternative ranges from a low of approximately 731 billion gallons in Analysis A (446 billion gallons in Analysis B) under Alternative 2 to a high of approximately 1,877 billion gallons in Analysis A (1,457 billion gallons in Analysis B) under Alternative 4. Total fuel savings under the Preferred Alternative falls between these two levels, amounting to 1,232 billion gallons in Analysis A and 838 billion gallons in Analysis B during the period 2017–2060.

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

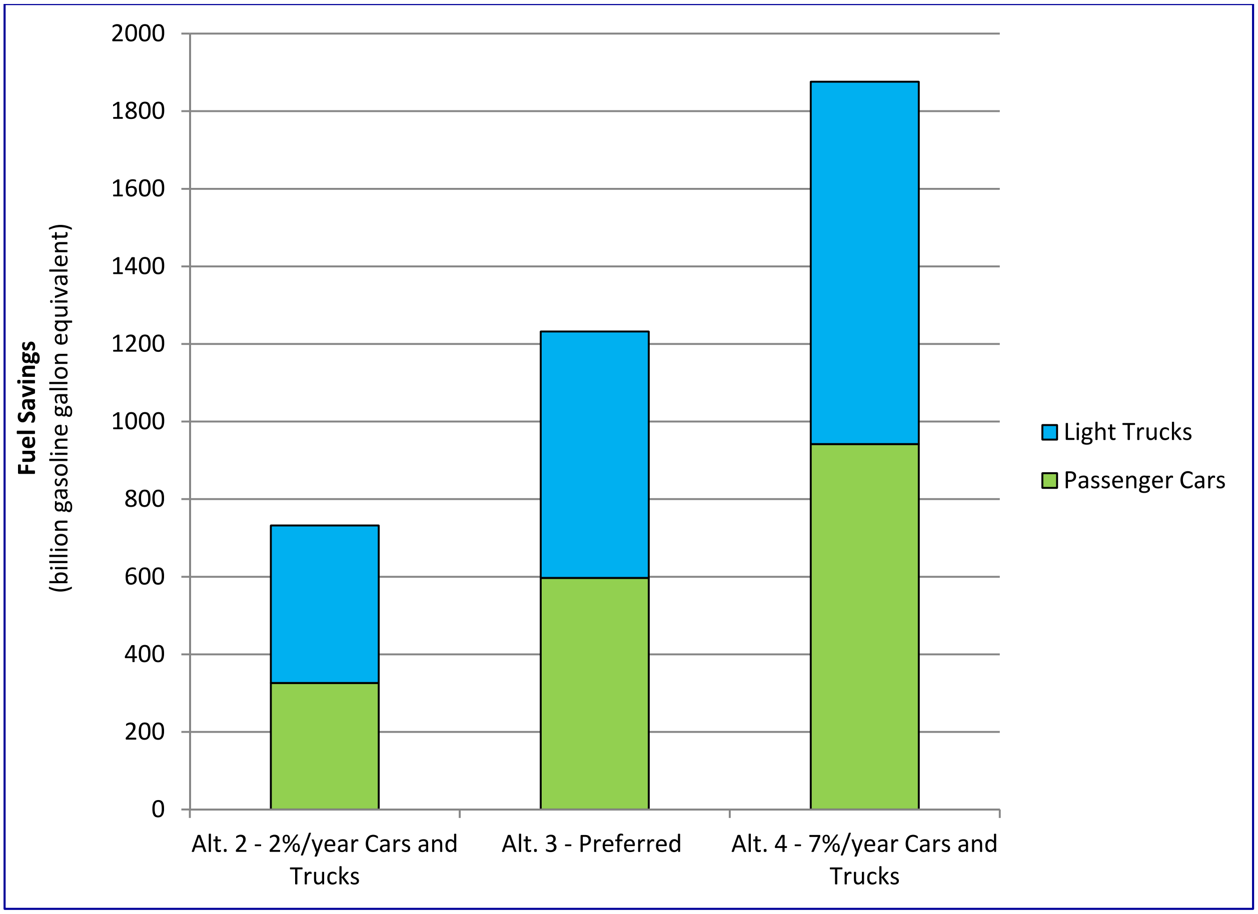
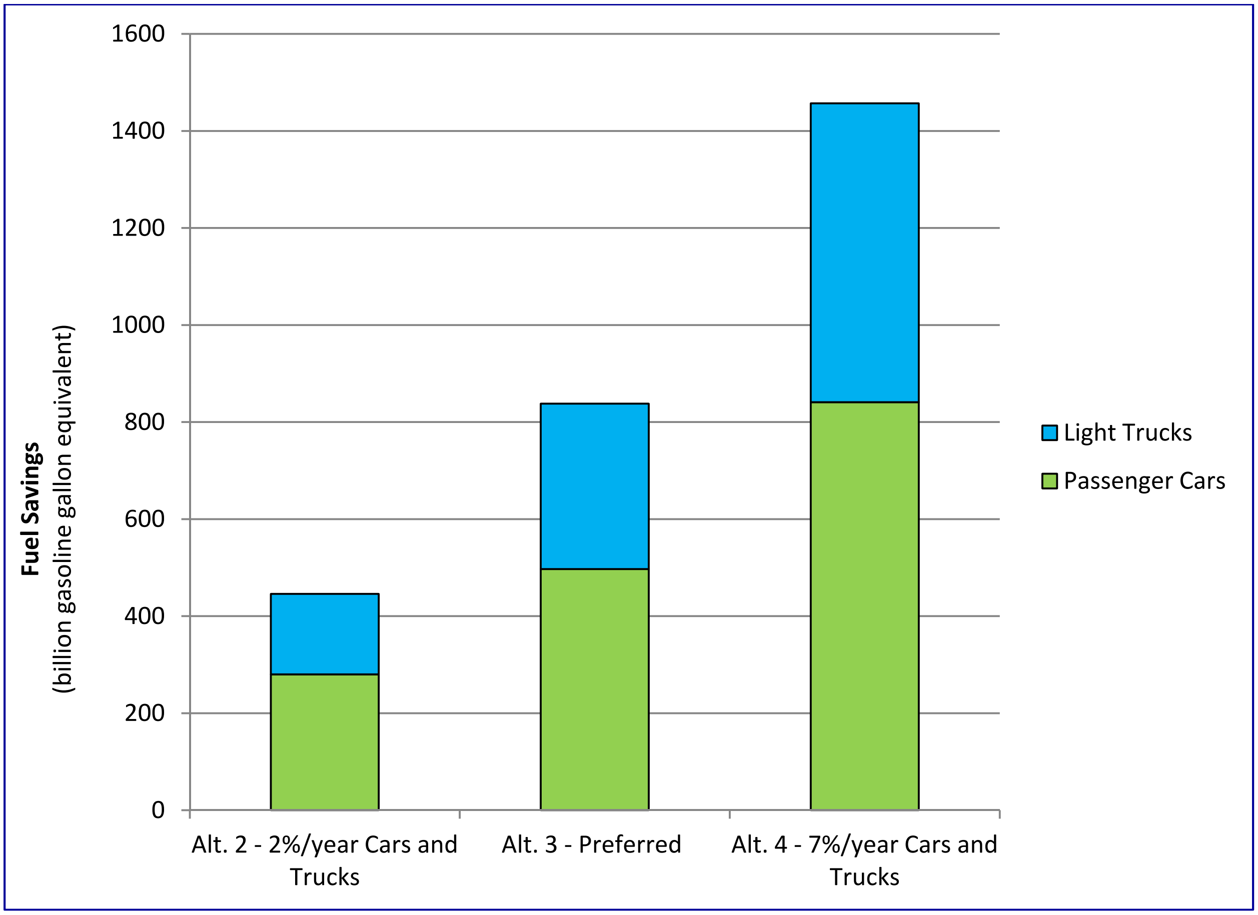


Figure S-3-B. U.S. Passenger Car and Light Truck Fuel Savings by Alternative (billion gasoline gallon equivalent total for calendar years 2017–2060), Direct and Indirect Impacts (Analysis B)

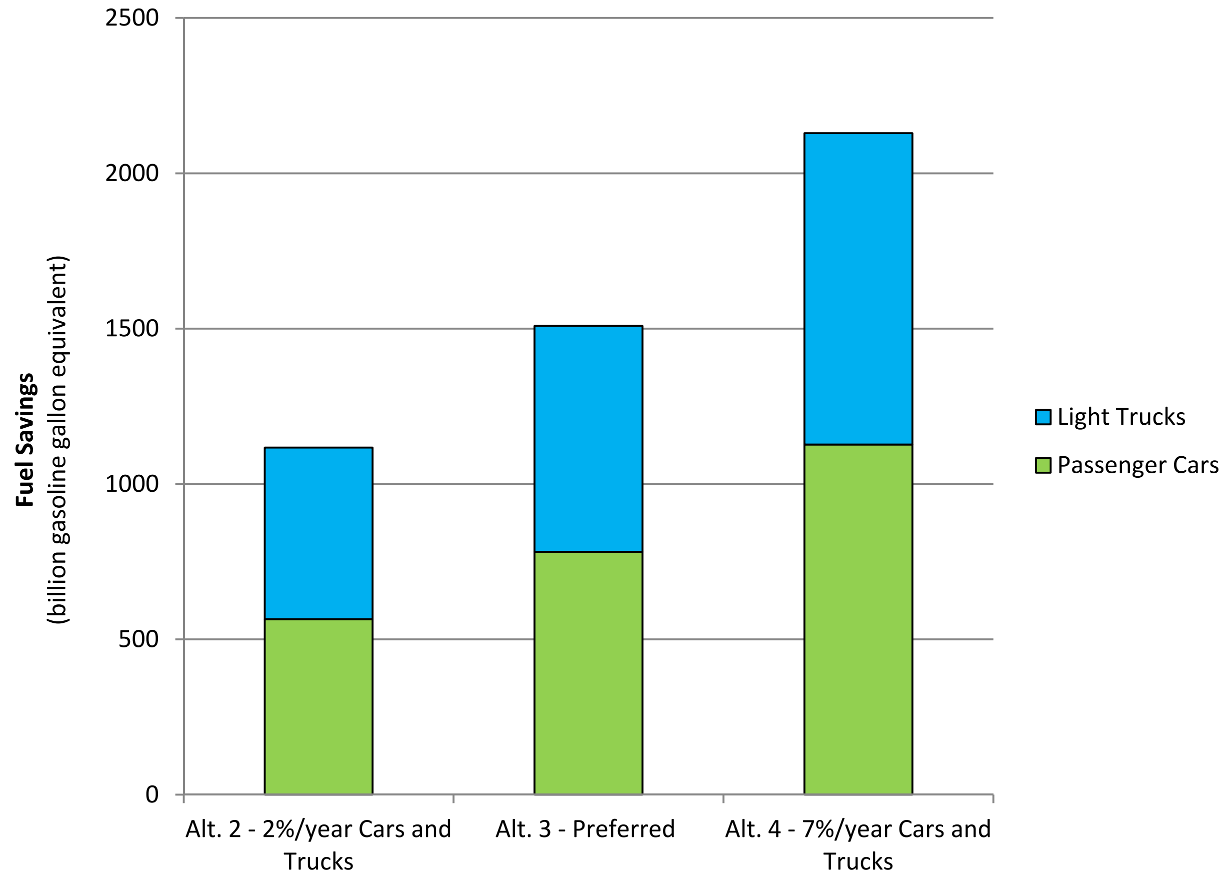


Cumulative Impacts

As with direct and indirect impacts, fuel consumption under each alternative will decrease with increasing stringency under the cumulative impacts analysis, which incorporates other past, present, and reasonably foreseeable future actions. Under the No Action Alternative, total combined gas and diesel fuel consumption during the period 2017–2060 would be 7,092 billion gallons. Total fuel consumption under the action alternatives ranges from a low of 4,964 billion gallons under Alternative 4 to a high of 5,975 billion gallons under Alternative 2. Total fuel consumption under the Preferred Alternative falls between these levels, amounting to 5,583 billion gallons.

Similarly, under the cumulative impacts analysis, fuel savings from passenger cars and light trucks increase with increased fuel economy stringency. Figure S-4 demonstrates fuel savings for the period 2017–2060 under each alternative compared to the No Action Alternative. Fuel savings during this period range from a low of 1,117 billion gallons under Alternative 2 to a high of 2,128 billion gallons under Alternative 4. Under the cumulative impacts analysis, fuel savings under the Preferred Alternative falls between these levels, amounting to 1,509 billion gallons.

Figure S-4. U.S. Passenger Car and Light Truck Fuel Savings by Alternative (billion gasoline gallon equivalent total for calendar years 2017–2060), Cumulative Impacts



Air Quality

Air pollution and air quality can affect public health, public welfare, and the environment. The alternative MY 2017–2025 CAFE standards 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 assumed to be incorporated by manufacturers 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 the ozone precursor pollutants 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.

Key Findings for Air Quality

The findings for air quality effects are shown for 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 MY 2017–2025 standards. The results reported in this section apply to both Analysis A and Analysis B for 2040, unless otherwise noted. The EIS provides findings for air quality effects for 2021, 2025, 2040, and 2060.

In general, emissions of criteria and toxic air pollutants decrease with increased stringency across alternatives. This trend is true for all criteria pollutants except CO and SO_2, which would have higher emissions under some of the action alternatives than under the No Action Alternative. Under the Preferred Alternative, emissions of all criteria air pollutants would be lower than under the No Action Alternative, except for CO and NO_x which in some years would be slightly higher.

Toxic air pollutants are more variable in their response to increasing fuel economy. Compared to the No Action Alternative, the action alternatives result in reduced emissions of benzene and DPM, but slightly higher emissions of formaldehyde and acrolein. Acetaldehyde and 1,3-butadiene emissions would be higher or lower than the No Action Alternative depending on the action alternative. Emissions of all toxic air pollutants would be higher under the Preferred Alternative than under the No Action Alternative for acetaldehyde, formaldehyde, and acrolein; lower for benzene and DPM; and higher or lower for 1,3-butadiene, depending on the year.

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, the proportion of electric vehicles in the passenger car and light truck population, and increases in VMT.

Monetized $PM_{2.5}$-related health benefits and the associated reduced incidence of adverse health effects from the emission reductions were estimated by multiplying direct $PM_{2.5}$ and $PM_{2.5}$ precursor emission reductions (NO_x, SO_2, and VOCs) by pollutant-specific benefit-per-ton estimates provided by EPA. 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-5-A and S-5-B. CO and SO_2 are exceptions to this general trend, with CO emissions increasing under Alternative 2, decreasing under the Preferred Alternative and then decreasing further under Alternative 4, and SO_2 emissions decreasing under Alternative 2 and the Preferred Alternative and then increasing under Alternative 4.

- Emissions of CO, NO_x, $PM_{2.5}$, and VOCs generally are lowest under Alternative 4, while emissions of SO_2 are lowest under the Preferred Alternative.
- Under the Preferred Alternative, emissions of all criteria pollutants would be reduced compared to the No Action Alternative, except CO emissions, which would increase slightly from the No Action Alternative. Excluding CO, emissions under the Preferred Alternative generally would be lower than emissions under Alternative 2, but higher than emissions under Alternative 4. Emissions of CO and SO_2 vary inconsistently by alternative and year.

Figure S-5-A. Nationwide Criteria Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Direct and Indirect Impacts (Analysis A)

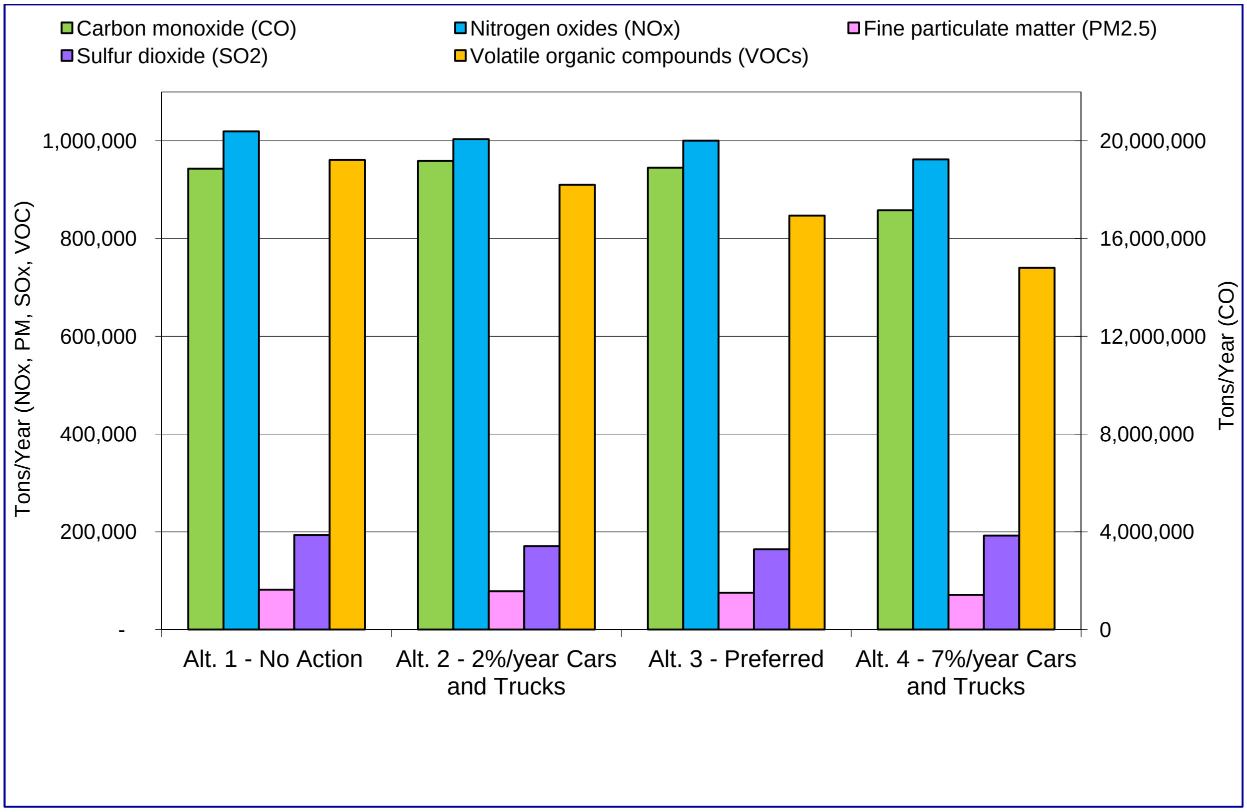
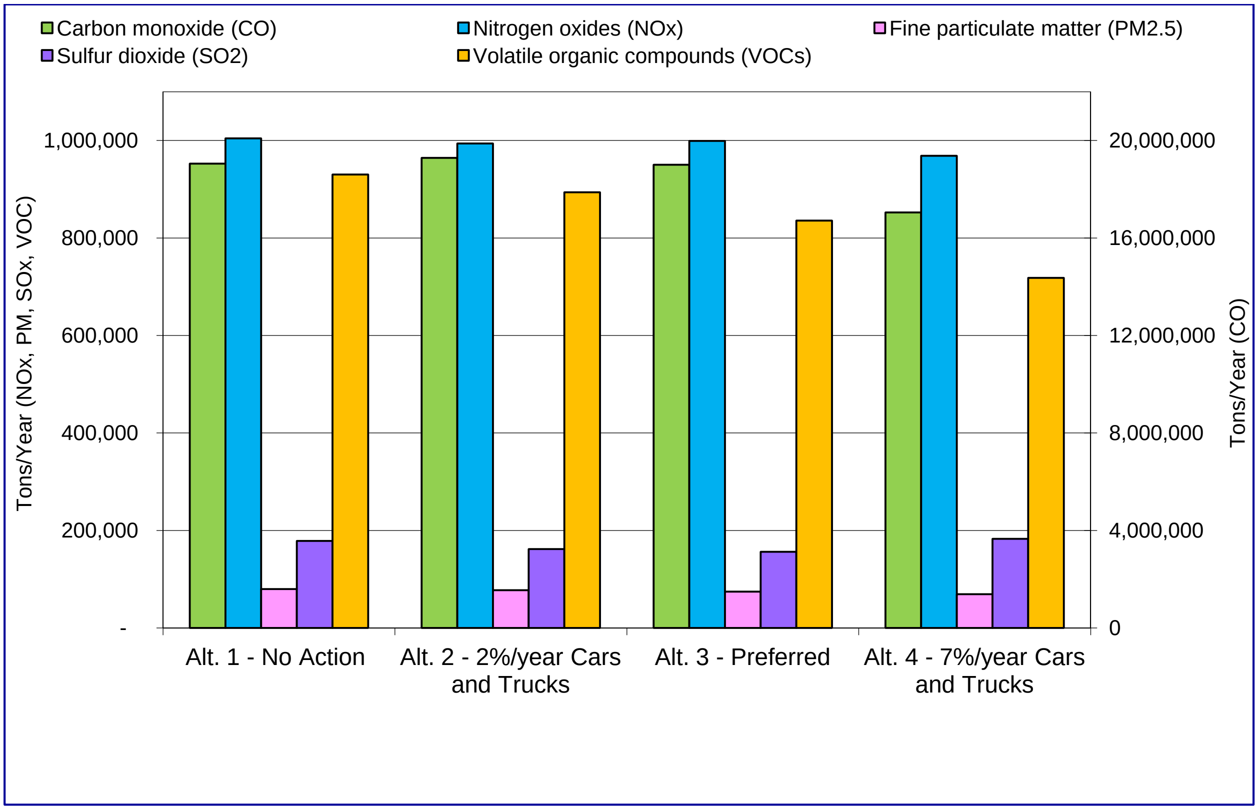


Figure S-5-B. Nationwide Criteria Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Direct and Indirect Impacts (Analysis B)



Hazardous Air Pollutants

- Emissions of benzene are highest under the No Action Alternative and decline as fuel consumption decreases across the alternatives, as shown in Figures S-6-A and S-6-B. Emissions of acetaldehyde and 1,3-butadiene generally increase under Alternative 2 and the Preferred Alternative and decrease under Alternative 4. Emissions of DPM generally decrease under Alternatives 2 and 3, but increase under Alternative 4. Emissions of acrolein and formaldehyde increase for all action alternatives compared to the No Action Alternative.
- Emissions of acetaldehyde, benzene, and 1,3-butadiene are lowest under Alternative 4 in most years, while emissions of acrolein and formaldehyde are lowest under the No Action Alternative. Emissions of DPM are lowest under Alternative 2, the Preferred Alternative, or Alternative 4, depending on the year.
- Under the Preferred Alternative, emissions of benzene, 1,3-butadiene (in some years), and DPM (in some years) would be reduced compared to the No Action Alternative. In contrast, emissions of acetaldehyde, acrolein, and formaldehyde would increase under the Preferred Alternative compared to the No Action Alternative. Emissions of benzene, 1,3-butadiene, and DPM under the Preferred Alternative would be lower than under Alternative 2 in most years, and either higher or lower than under Alternative 4, depending on the pollutant, year, and analysis. Emissions of acetaldehyde, acrolein, and formaldehyde under the Preferred Alternative would be higher than under Alternative 2 and either higher or lower than under Alternative 4, depending on the pollutant, year, and analysis.

Figure S-6-A. Nationwide Toxic Air Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Direct and Indirect Impacts (Analysis A)

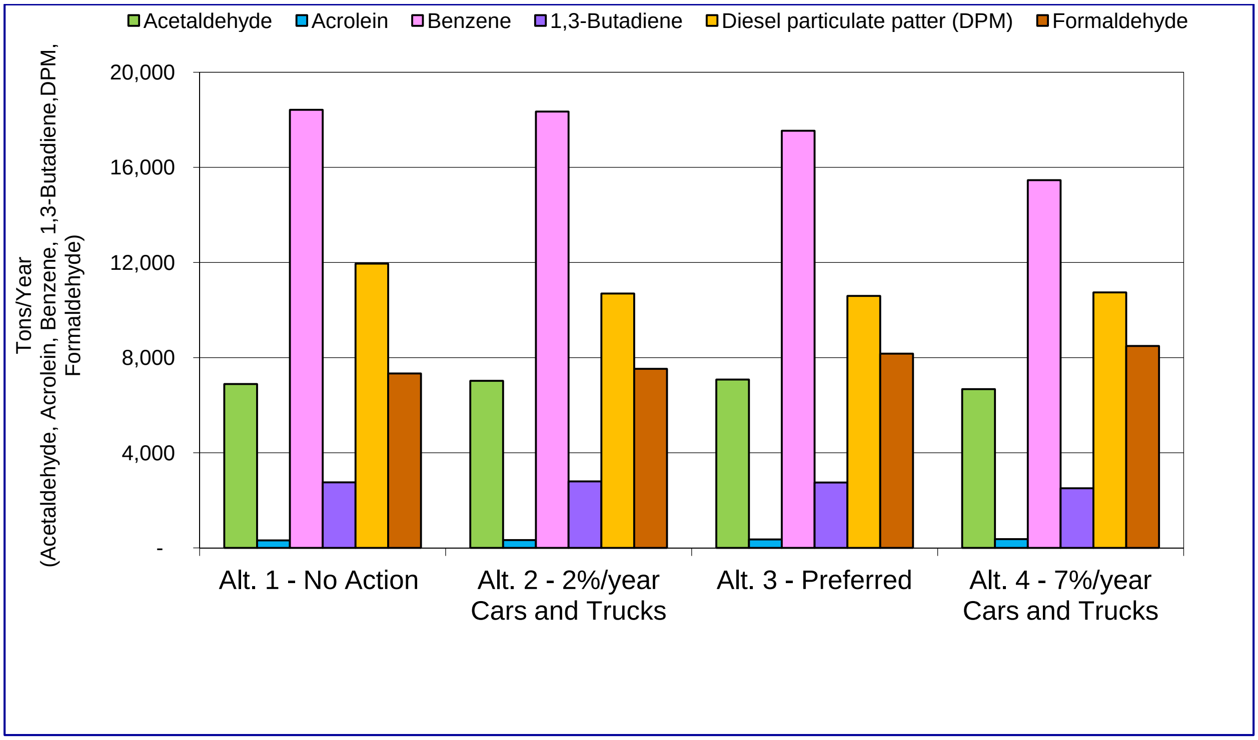
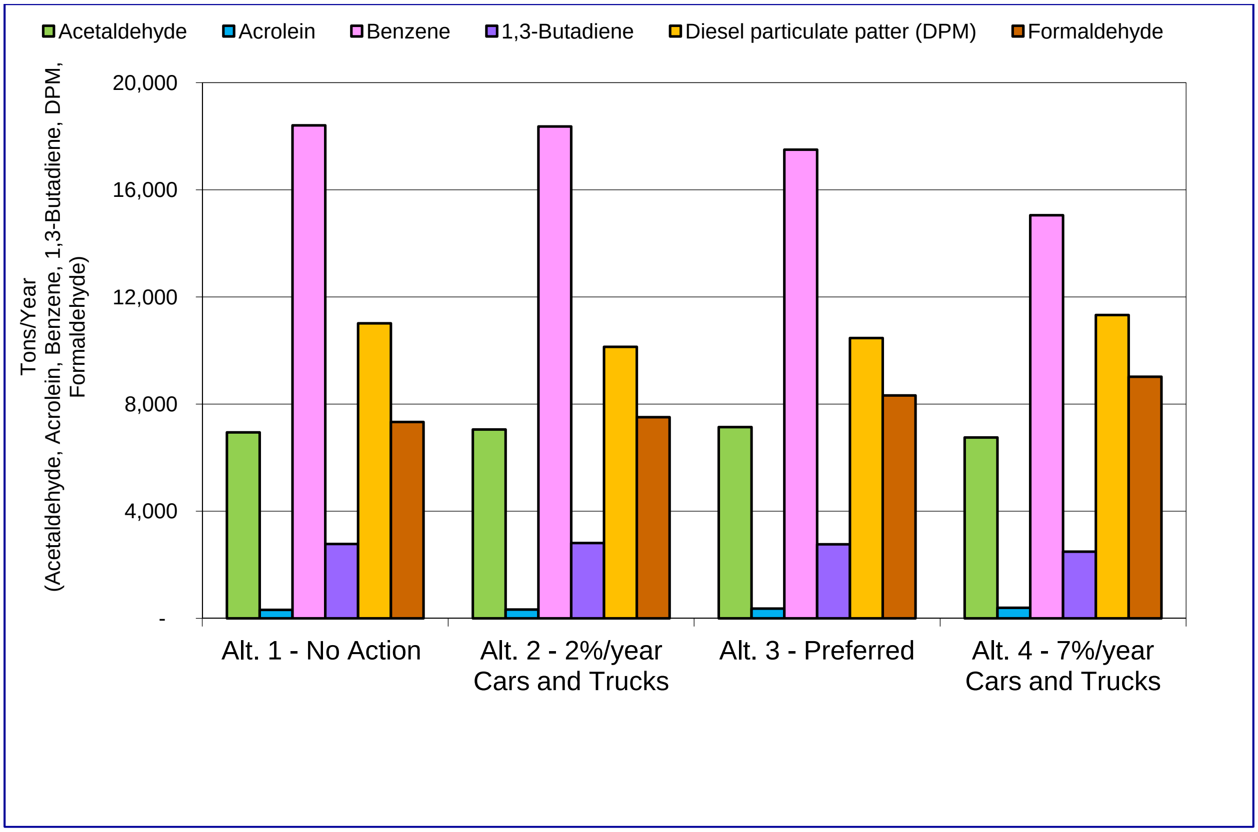


Figure S-6-B. Nationwide Toxic Air Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Direct and Indirect Impacts (Analysis B)



Health and Monetized Health Benefits

- All action alternatives would 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. Reductions increase as fuel consumption decreases across alternatives.
- Because monetized health benefits increase with reductions in adverse health effects, monetized benefits would 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 both 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. Estimated monetized health benefits in 2040 range from a low of $1.6 billion in Analysis A ($1.1 billion in Analysis B) for Alternative 2 (using the lowest of the four calculations) to a high of $9.6 billion in Analysis A ($8.8 billion in Analysis B) for Alternative 4 (using the highest of the four calculations).
- Under the Preferred Alternative, adverse health outcomes would be fewer and monetized health benefits would be greater than under the No Action Alternative and Alternative 2; however, adverse health outcomes would be greater and monetized health benefits would be less than under Alternative 4.

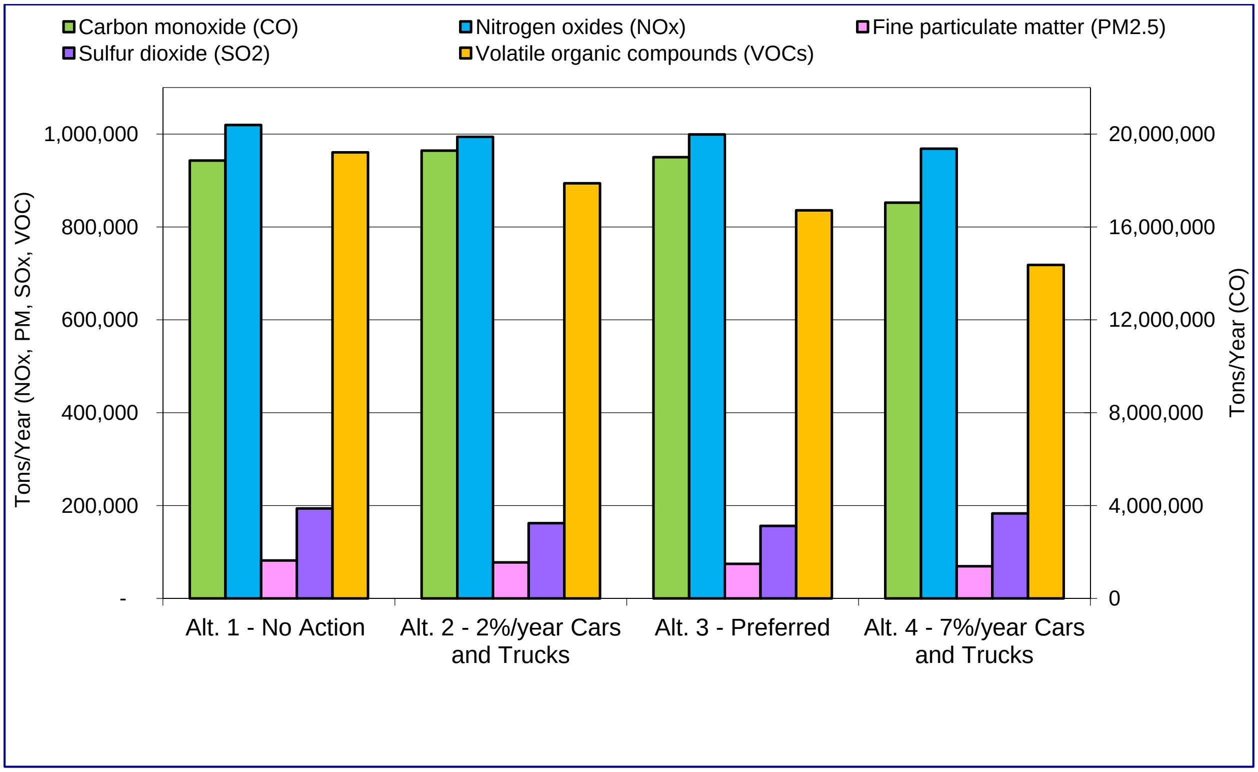
See Section 4.2 of this EIS for data on the direct effects of criteria and hazardous air pollutant emissions, as well as monetized health benefits for the alternatives.

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 Figure S-7. CO and SO_2 are exceptions to this general trend, with CO emissions increasing under Alternative 2, decreasing under the Preferred Alternative and then decreasing further under Alternative 4, and SO_2 emissions decreasing through the Preferred Alternative and then increasing under Alternative 4 but remaining less than emissions under the No Action Alternative.
- 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 or Alternative 4, depending on the year.
- Under the Preferred Alternative, emissions of all criteria pollutants would be reduced compared to the No Action Alternative, except for CO emissions, which would be slightly higher under the Preferred Alternative than under the No Action Alternative. Emissions of all criteria pollutants under the Preferred Alternative would be lower than emissions under Alternative 2, but higher than emissions under Alternative 4, with the exception of NO_x and SO_2 emissions, which are higher under the Preferred Alternative or Alternative 4 depending on the year.

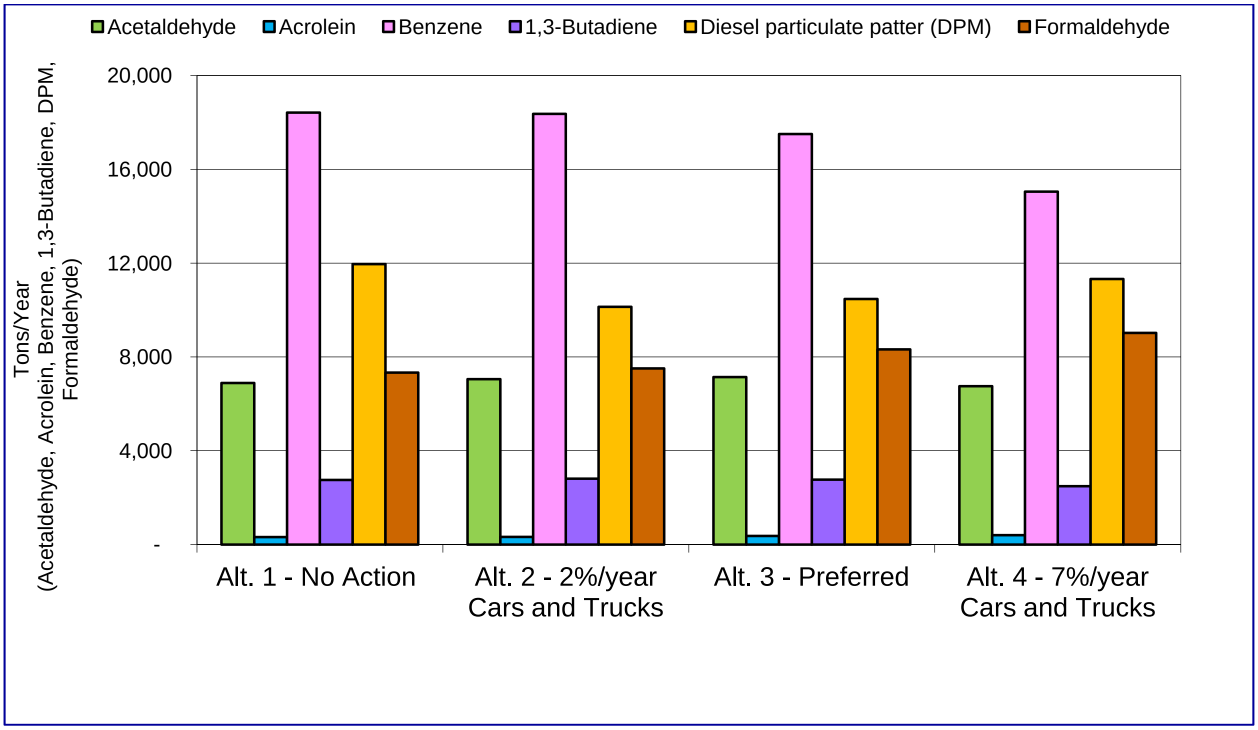
Figure S-7. Nationwide Criteria Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Cumulative Impacts



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 Figure S-8. Emissions of acetaldehyde increase under Alternative 2 and the Preferred Alternative and generally decrease under Alternative 4, and emissions of 1,3-butadiene increase under Alternative 2 and generally decrease under the Preferred Alternative and Alternative 4. Emissions of DPM are highest under the No Action Alternative and decrease, although not consistently, across the action alternatives. Emissions of acrolein and formaldehyde increase with decreasing fuel consumption across all the action alternatives.
- Emissions of acetaldehyde, benzene, and 1,3-butadiene generally are lowest under Alternative 4, while emissions of acrolein and formaldehyde are lowest under the No Action Alternative. Emissions of DPM are the lowest under Alternative 2, the Preferred Alternative, or Alternative 4, depending on the year.
- Under the Preferred Alternative, emissions of benzene, 1,3-butadiene (in some years), and DPM (in some years) would be reduced compared to the No Action Alternative. In contrast, emissions of acetaldehyde (in some years), acrolein, and formaldehyde would increase under the Preferred Alternative compared to the No Action Alternative. Emissions of benzene and 1,3-butadiene under the Preferred Alternative generally would be lower than under Alternative 2 and higher than under Alternative 4. Emissions of acetaldehyde, acrolein, 1,3-butadiene (in some years), DPM (in some years), and formaldehyde under the Preferred Alternative would be higher than under Alternative 2. Emissions of acetaldehyde under the Preferred Alternative would be higher (in some years) than under Alternative 4, while emissions of acrolein, DPM, and formaldehyde under the Preferred Alternative generally would be lower than under Alternative 4.

Figure S-8. Nationwide Toxic Air Pollutant Emissions (tons/year) from U.S. Passenger Cars and Light Trucks for 2040 by Alternative, Cumulative Impacts



Health and Monetized Health Benefits

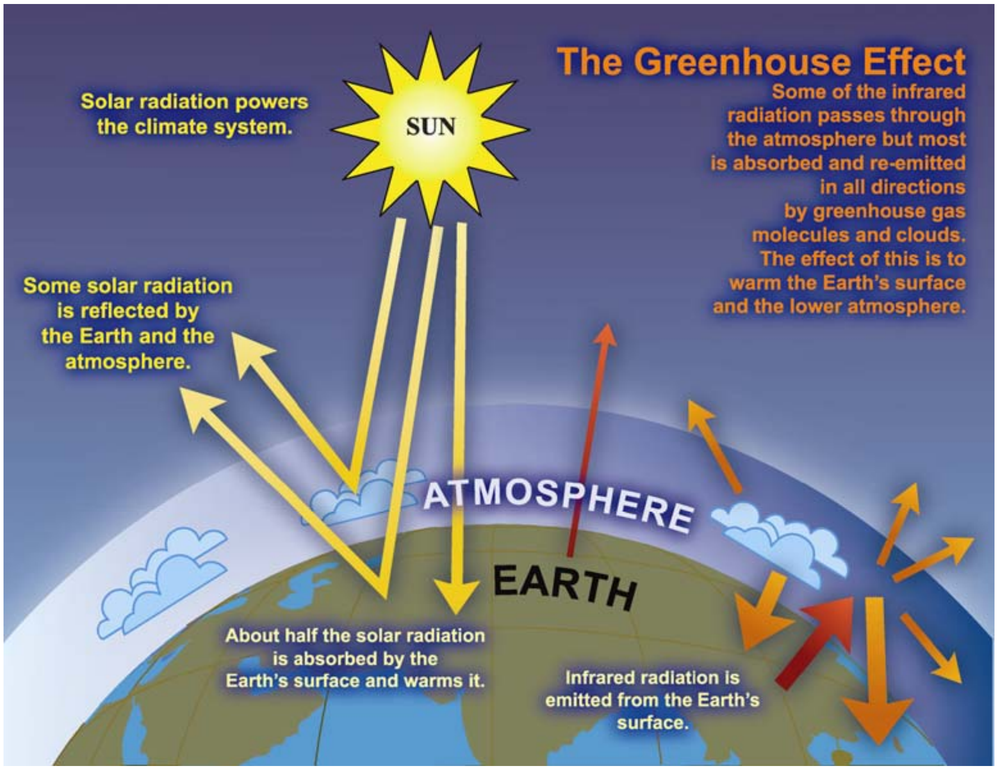
- Alternatives 2 through 4 would result in reduced adverse health effects nationwide compared to the No Action Alternative. Reductions generally increase as fuel consumption decreases across alternatives.
- The monetized health benefits follow the same patterns as the reductions in adverse health effects. Estimated annual monetized health benefits in 2040 range from a low of $2.2 billion under Alternative 2 (lowest of the four calculations) to a high of $11.7 billion under Alternative 4 (highest of the four calculations).
- Under the Preferred Alternative, cumulative adverse health outcomes would be fewer and monetized health benefits would be greater than under the No Action Alternative and Alternative 2. Cumulative adverse health outcomes would be greater and monetized health benefits would be less under the Preferred Alternative than under Alternative 4.

See Section 4.2 of this EIS for cumulative effects data on criteria and hazardous air pollutant emissions, as well as 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-9). 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-9. 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 degrees 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. Our 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.

- 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 infestation, 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.

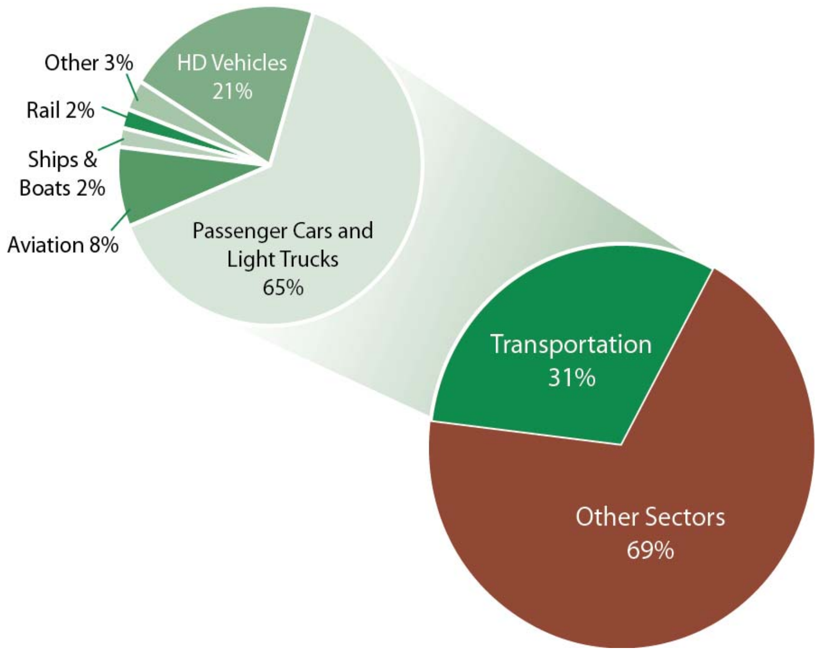
In addition to its role as a GHG in the atmosphere, CO_2 is transferred from the atmosphere to water, plants, and soil. In water, CO_2 combines with water molecules to form carbonic acid. When CO_2 dissolves in seawater, a series of well-known chemical reactions begins that increases the concentration of hydrogen ions and makes seawater more acidic, which has adverse effects on 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. As shown in Figure S-10, the U.S. transportation sector contributed 31 percent of total U.S. CO_2 emissions in 2009, with passenger cars and light trucks accounting for 65 percent of total U.S. CO_2 emissions from transportation. Therefore, 20 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 4 percent of total global CO_2 emissions.

Figure S-10. Contribution of Transportation to U.S. CO_2 Emissions and Proportion Attributable by Mode, 2009



HD = heavy-duty

Source: EPA (U.S. Environmental Protection Agency). 2011. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2009. Tables 2-14 and 2-15. Washington, D.C. EPA 430-R-11-005. 441 pgs. Available at: <http://www.epa.gov/climatechange/emissions/usinventoryreport.html> (Accessed: October 18, 2011).

Key Findings for Climate

The Proposed Action and alternatives would decrease the growth in global GHG emissions, 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 all alternatives analyzed in this EIS, growth in the number of passenger cars and light trucks in use throughout the United States, combined with assumed increases in their average use (annual VMT per vehicle), is projected to result in growth in total vehicle travel. This growth in travel outpaces improvements in fuel economy under Alternative 2 and the Preferred Alternative, resulting in projected increases in total fuel consumption by passenger cars and light trucks in the United States over the long term. Because CO_2 emissions are a direct consequence of fuel consumption, the same result is projected for total CO_2 emissions from passenger cars and light trucks. Under Alternative 4, increases in fuel economy result in projected fuel consumption and CO_2 emission levels through and beyond 2060 that are lower than present annual CO_2 emission levels.

NHTSA estimates that the proposed MY 2017–2025 CAFE standards 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-11-A and S-11-B).

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 the climate change modeling for 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 this EIS for additional explanation of the cumulative effects methodology.

Estimates of GHG emissions and reductions (both direct and indirect effects and cumulative impacts) are presented below for each of the four alternatives. Climate effects such as mean global increase in surface temperature and sea-level rise 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 the increased radiative forcing.

The impacts of the Proposed Action and 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-lived; therefore, in aggregate they can have large consequences for health and welfare.

Direct and Indirect Impacts

Greenhouse Gas Emissions

- Compared to the sum of projected U.S. passenger car and light truck CO_2 emissions of 166,500 million metric tons of carbon dioxide ($MMTCO_2$) under the No Action Alternative from 2017 through 2100 in Analysis A (139,500 $MMTCO_2$ in Analysis B), the action alternatives would reduce these emissions by 11 to 29 percent in Analysis A (6 to 22 percent in Analysis B) by 2100. Figures S-11-A and S-11-B show projected annual CO_2 emissions from passenger cars and light trucks under each alternative. As shown in the figure, 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 total CO_2 emissions by between 3.7 and 9.2 percent in Analysis A (1.2 and 5.3 percent in Analysis B) in 2100.
- 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 total global CO_2 emissions by between 0.4 and 0.9 percent in Analysis A (0.2 and 0.6 percent in Analysis B) by 2100.

- The emission reductions under the alternatives are equivalent to the annual emissions from between 13.2 and 32.9 million passenger cars and light trucks in 2025 in Analysis A (12.7 and 32.7 in Analysis B), compared to the annual emissions that would occur under the No Action Alternative. Emission reductions in 2025 under the Preferred Alternative fall within this range, equating to annual emissions from 20.2 million passenger cars and light trucks in Analysis A (19.6 in Analysis B).

Figure S-11-A. Projected Annual CO_2 Emissions ($MMTCO_2$) from U.S. Passenger Cars and Light Trucks by Alternative, Direct and Indirect Impacts (Analysis A)

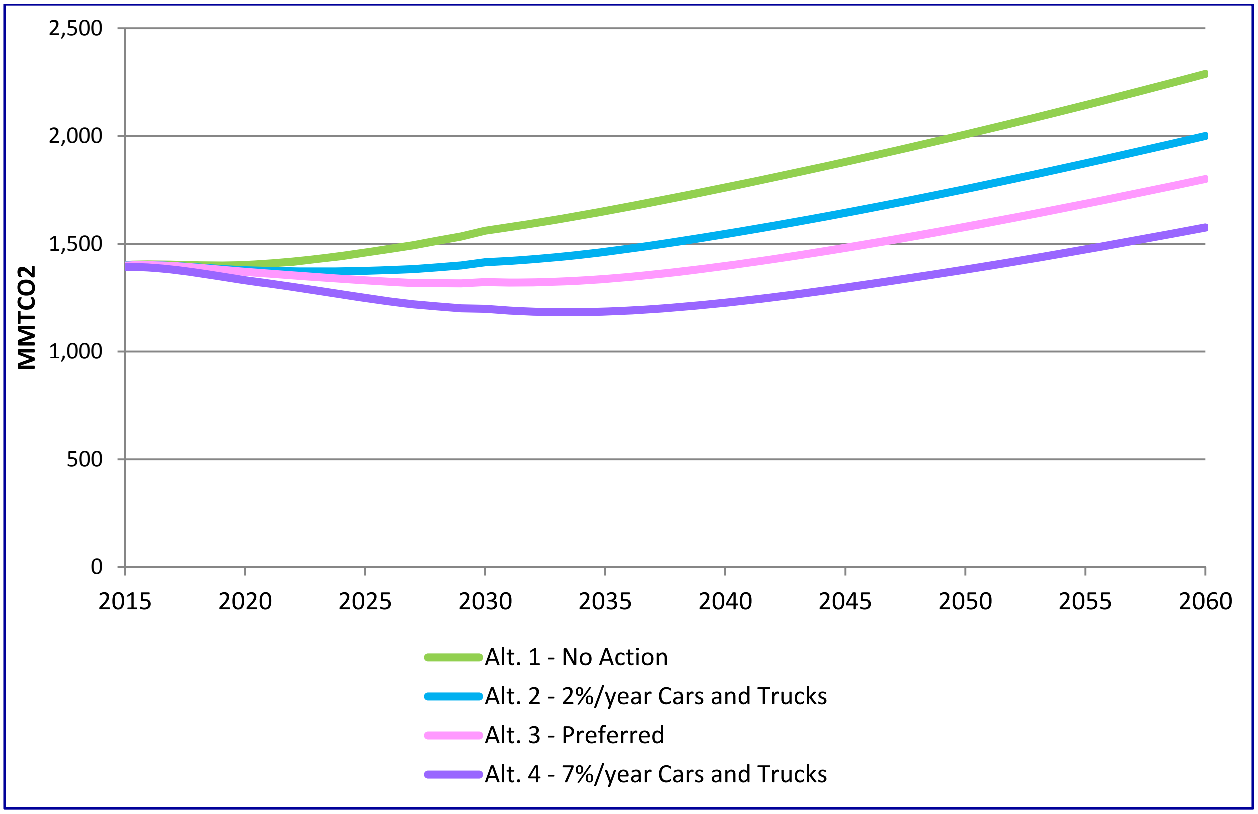
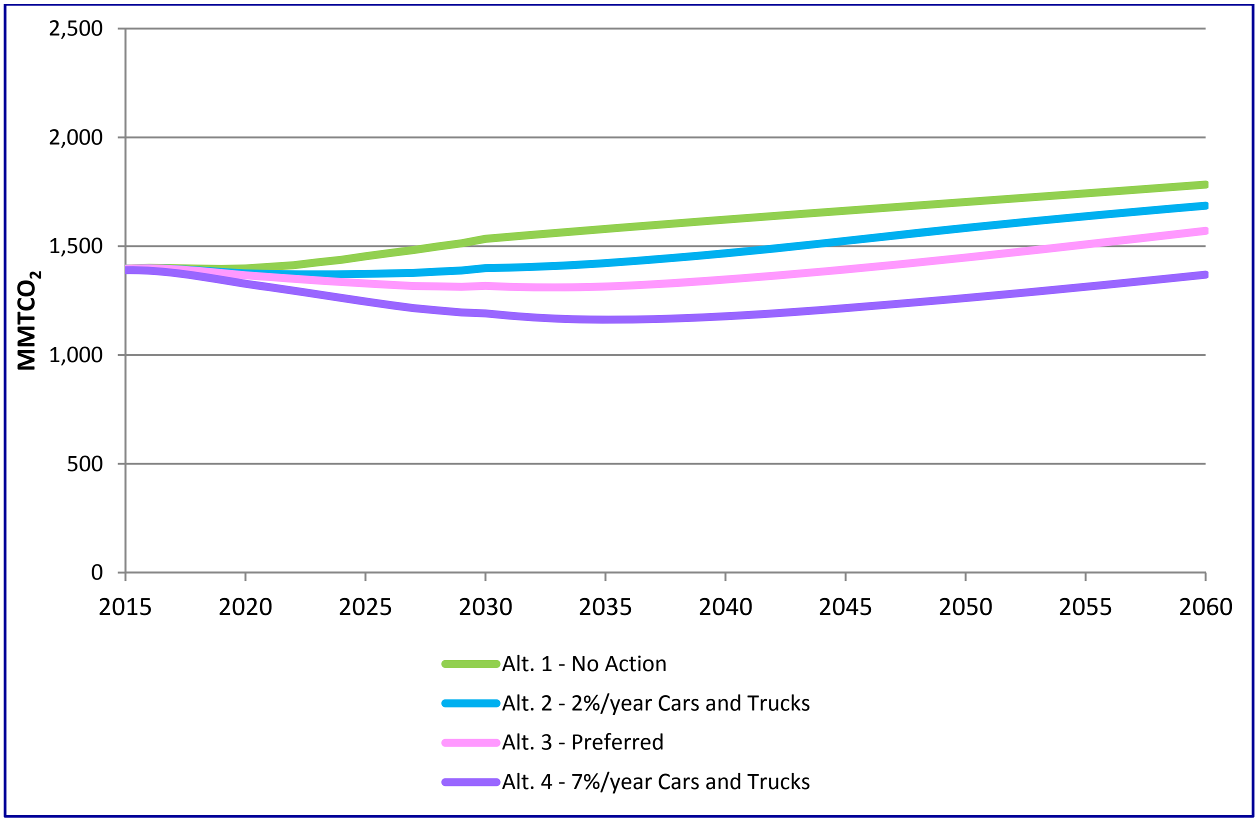


Figure S-11-B. Projected Annual CO_2 Emissions ($MMTCO_2$) from U.S. Passenger Cars and Light Trucks by Alternative, Direct and Indirect Impacts (Analysis B)



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 GCAM Reference 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-lived.

- Estimated CO_2 concentrations in the atmosphere for 2100 would range from approximately 780 parts per million (ppm) in Analysis A (782 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 5 ppm from the No Action Alternative in Analysis A (3 ppm in Analysis B). The Preferred Alternative would reduce global CO_2 concentrations by approximately 3.1 ppm in Analysis A (1.6 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 0.016 °C (0.029 °F) in

Analysis A (0.011 °C [0.020 °F] in Analysis B), while implementing Alternative 2 would reduce projected temperature increase by 0.006 °C (0.011 °F) in Analysis A (0.003 °C [0.005 °F] in Analysis B). Falling between these two levels, the Preferred Alternative would decrease projected temperature increase under the No Action Alternative by 0.011 °C (0.020 °F) in Analysis A (0.006 °C [0.011 °F] in Analysis B). Figures S-12-A and S-12-B demonstrate reductions in the growth of projected global mean temperature from 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 37.25 centimeters (14.66 inches) in Analysis A (37.29 centimeters [14.68 inches] in Analysis B) under Alternative 4. Therefore, the action alternatives would result in a maximum reduction of sea-level rise equal to 0.15 centimeter (0.06 inch) in Analysis A (0.11 centimeter [0.04 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 0.10 centimeter (0.039 inch) in Analysis A (0.06 centimeter [0.024 inch] in Analysis B) from the No Action Alternative.

Figure S-12-A. Reduction in Global Mean Surface Temperature Compared to the No Action Alternative (Analysis A)

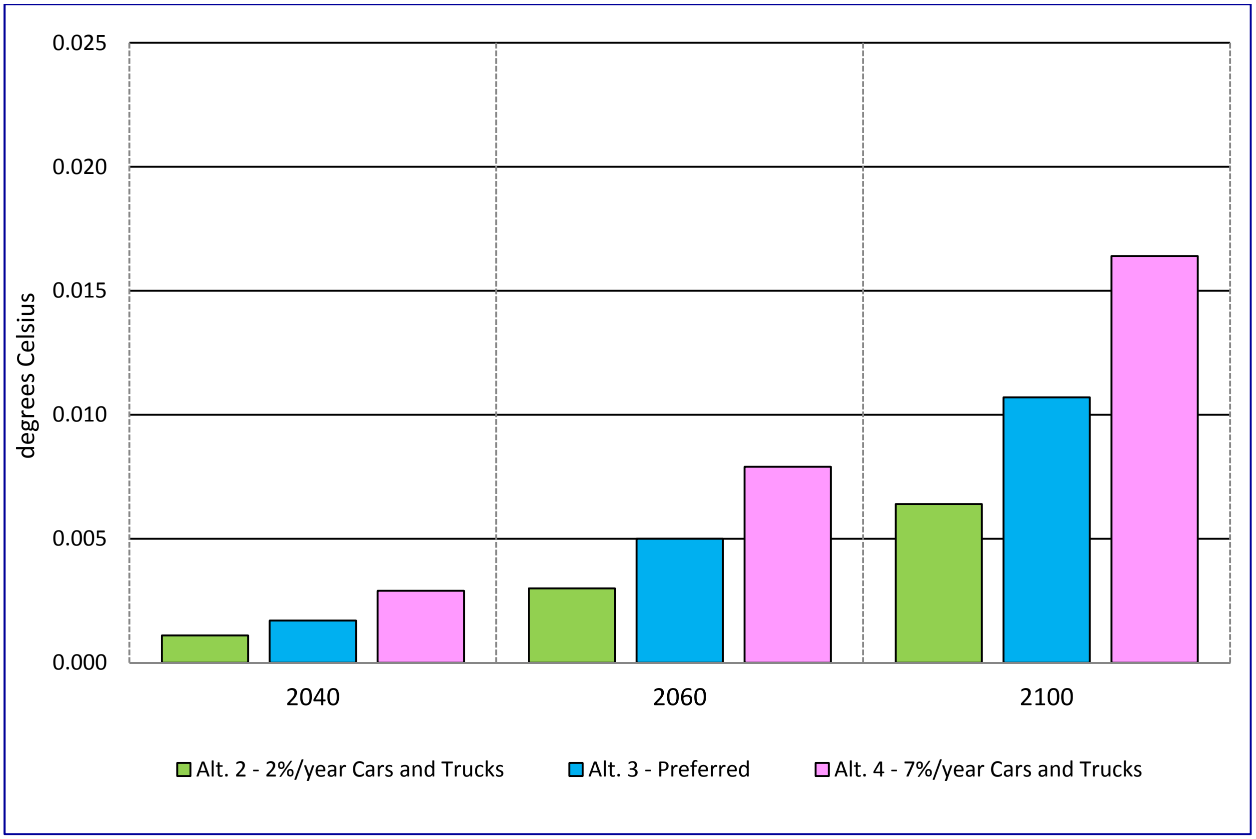
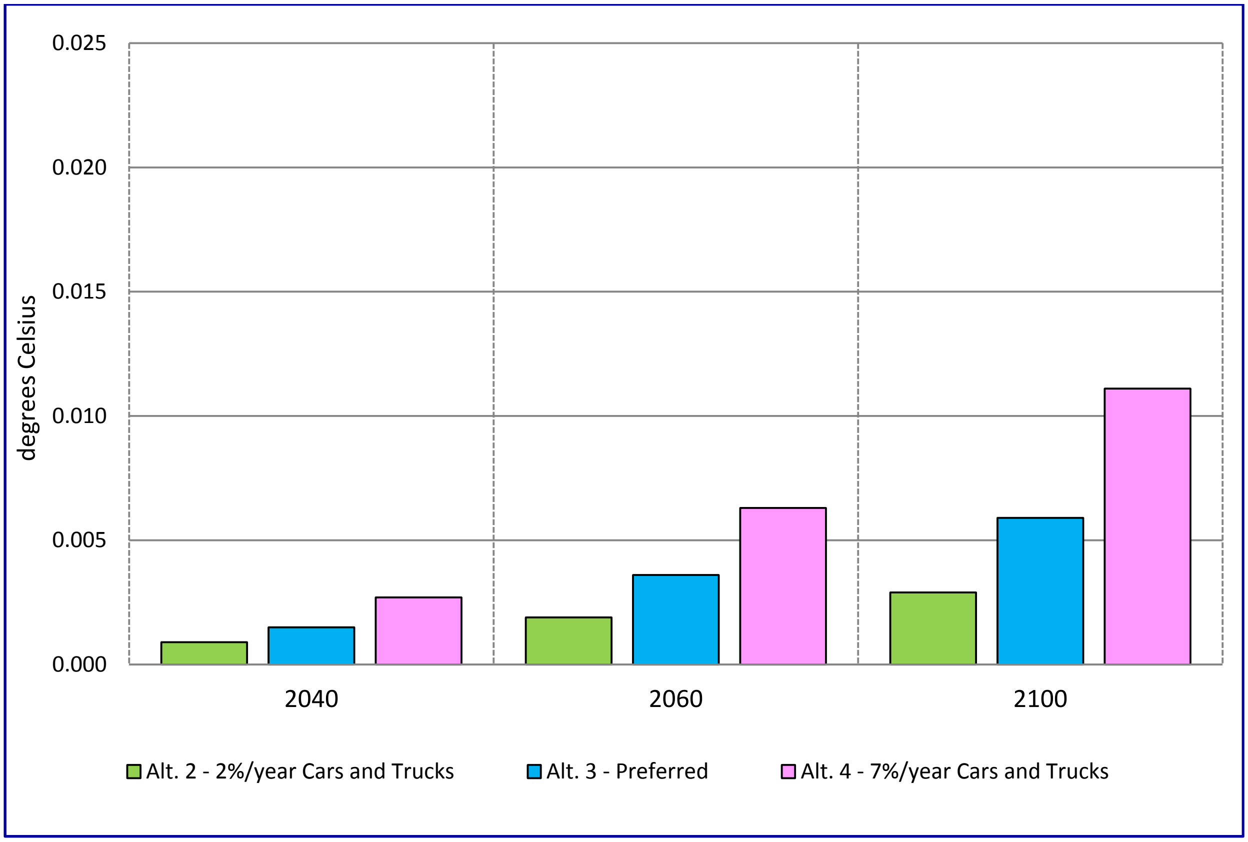


Figure S-12-B. Reduction in Global Mean Surface Temperature Compared to the No Action Alternative (Analysis B)



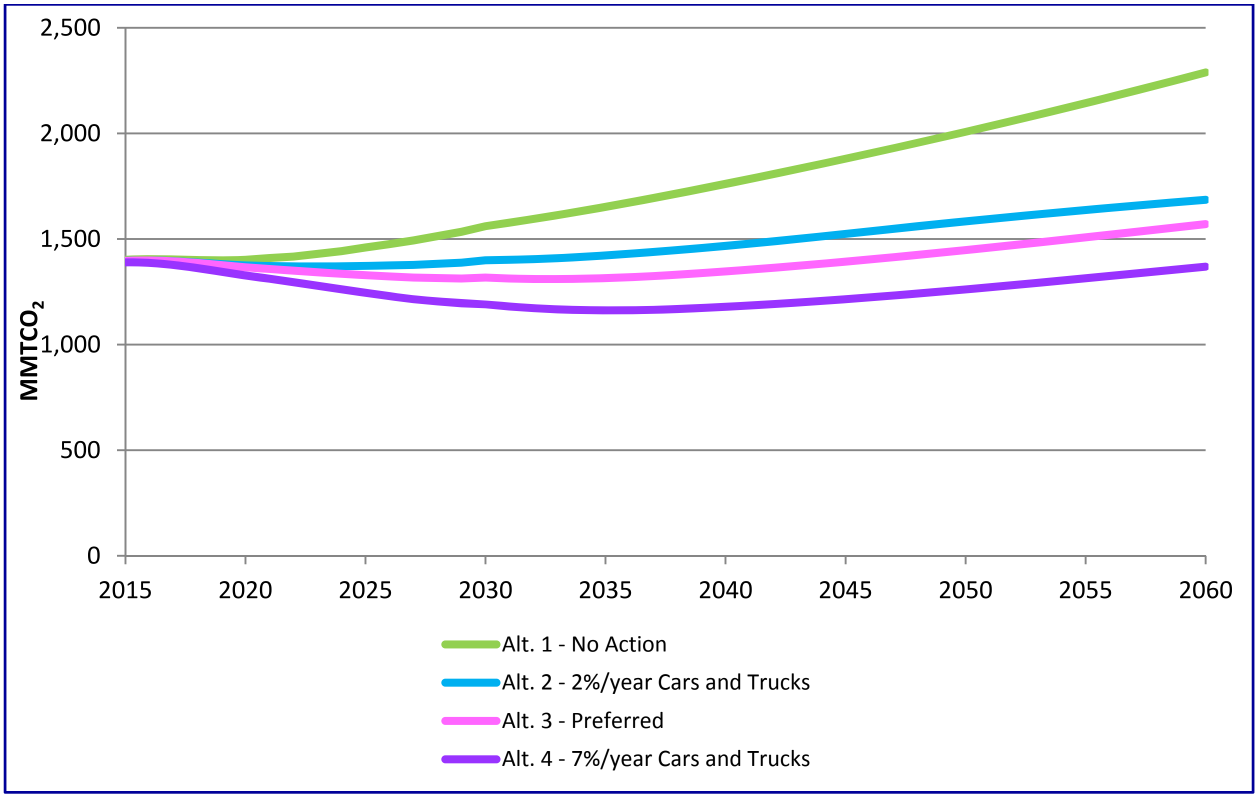
- Global mean precipitation is anticipated to increase by 4.50 percent by 2090 under the No Action Alternative. Under the action alternatives, this increase would be reduced by approximately 0.02 percent under Alternative 4 to 0.01 percent (0.00 percent in Analysis B) under Alternative 2. The Preferred Alternative would result in a 0.02 percent in Analysis A (0.01 percent in Analysis B) reduction in global mean precipitation increase, indicating a total increase of 4.48 percent in Analysis A (4.49 percent in Analysis B), instead of the 4.50 percent projected under the No Action Alternative.

Cumulative Impacts

Greenhouse Gas Emissions

- Projections of total emission reductions over the 2017 through 2100 period due to the proposed MY 2017–2025 CAFE standards and other reasonably foreseeable future actions (i.e., forecasted fuel efficiency increases resulting from market-driven demand) range from 35,600 to 58,300 $MMTCO_2$ as compared to the No Action Alternative. The action alternatives would reduce total passenger car and light truck emissions by between 21 and 35 percent by 2100. Figure S-13 shows 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 0.8 to 1.4 percent from their projected levels under the No Action Alternative.

Figure S-13. Projected Annual CO_2 Emissions ($MMTCO_2$) from U.S. Passenger Cars and Light Trucks by Alternative, Cumulative Impacts

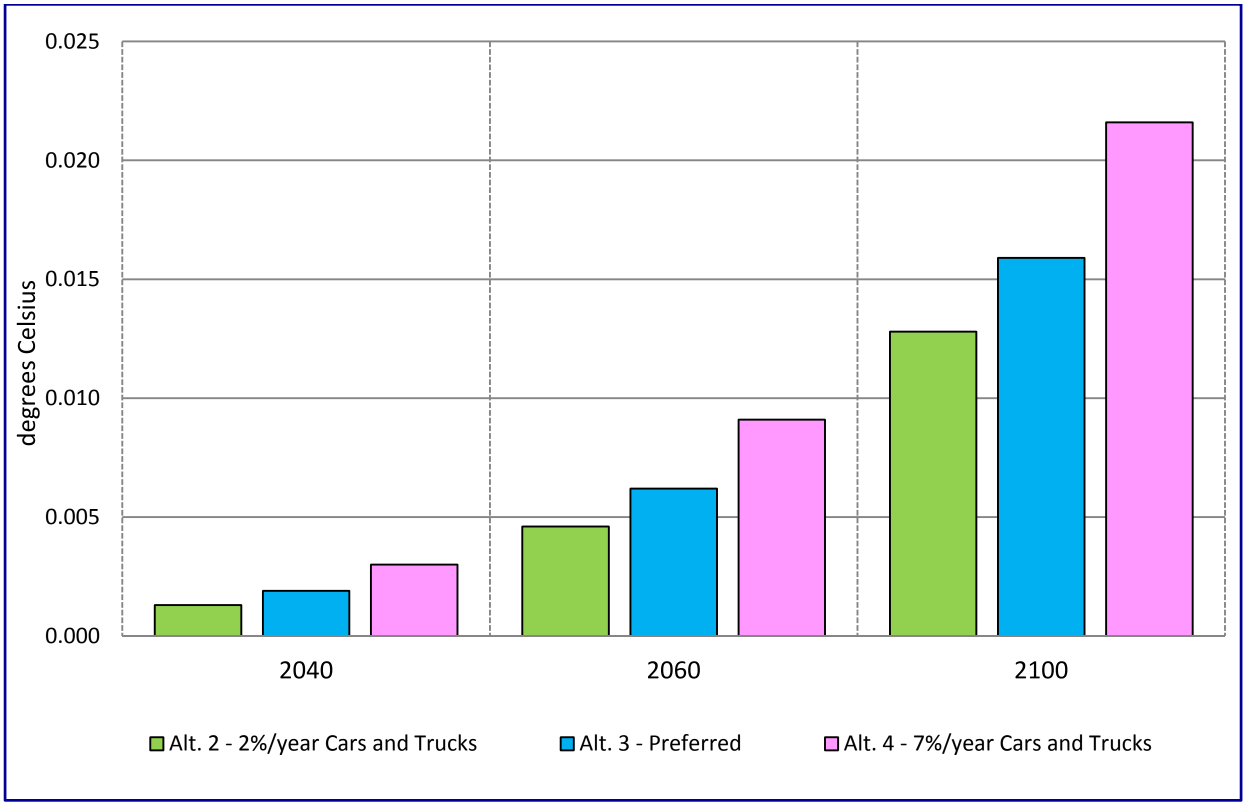


CO_2 Concentration, Global Mean Surface Temperature, Sea-Level Rise, and Precipitation

- Estimated atmospheric CO_2 concentrations for 2100 range from a low of 672.4 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 673.7 ppm, a reduction of 4.1 ppm from the No Action Alternative level.
- 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 0.013 °C (0.023 °F) to a high of 0.022 °C (0.040 °F). The Preferred Alternative would result in a reduction of 0.016 °C (0.029 °F) from the projected temperature increase of 2.564 °C (4.615 °F) under the No Action Alternative. Figure S-14 illustrates 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 (13.15 inches) under the No Action Alternative to a low of 33.24 centimeters (13.08 inches) under Alternative 4, indicating a maximum reduction of sea-level rise equal to 0.18 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 33.29 centimeters (13.11 inches), a 0.13 centimeter (0.05 inch) reduction from the No Action Alternative level.

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

Figure S-14. Reduction in Global Mean Surface Temperature Compared to the No Action Alternative, Cumulative Impacts



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 alternative is roughly 3 to 5 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 (0.040 to 0.080 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 will contribute 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 this EIS. The changes in non-climate impacts (such as ocean acidification by CO_2) associated with the alternatives are discussed in this EIS in Section 5.6.