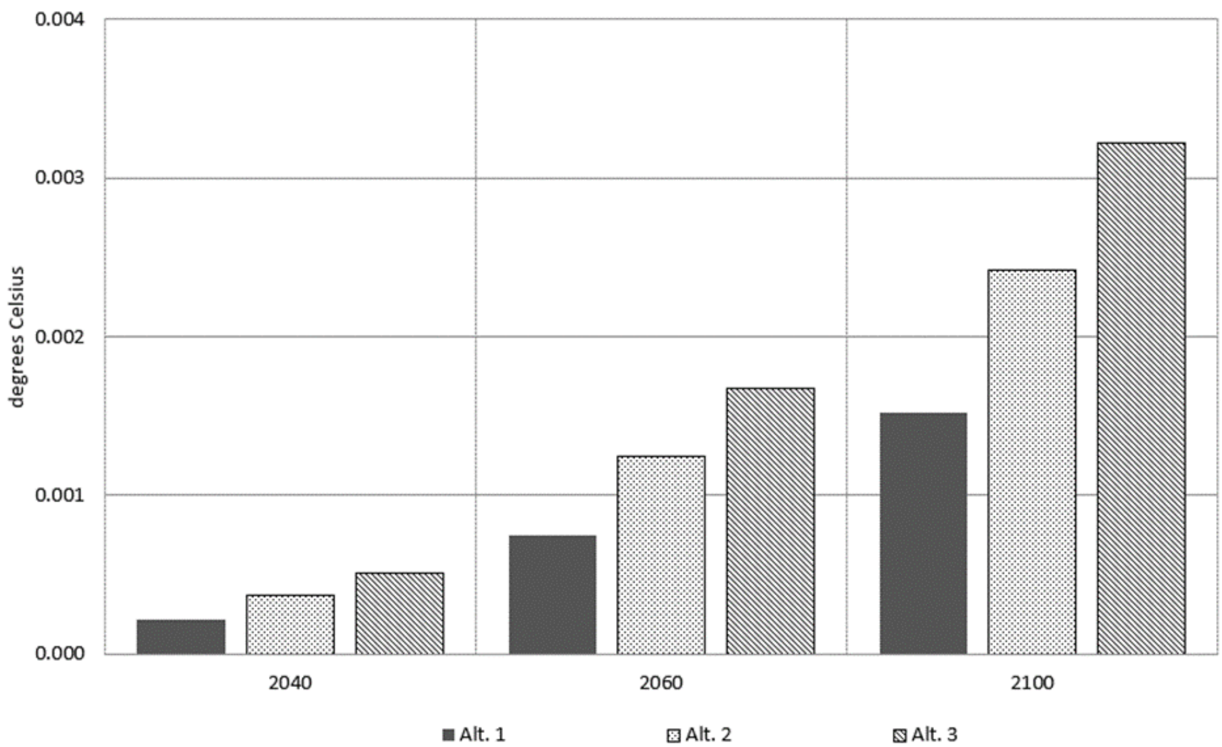
- Projected sea-level rise in 2100 ranges from a high of 76.28 centimeters (30.03 inches) under the No Action Alternative to a low of 76.22 centimeters (30.01 inches) under Alternative 3. Alternative 3 would result in a decrease in sea-level rise equal to 0.06 centimeter (0.03 inch) by 2100 compared with the level projected under the No Action Alternative. Alternative 1 would result in a decrease of 0.03 centimeter (0.01 inch) compared with the No Action Alternative.
- Global mean precipitation is anticipated to increase by 5.85 percent by 2100 under the No Action Alternative. Under the action alternatives, this increase in precipitation would be reduced by 0.00 to 0.01 percent.
- Ocean pH in 2100 is anticipated to be 8.2180 under Alternative 3, about 0.0004 more than the No Action Alternative. Under Alternative 1, ocean pH in 2100 would be 8.2178, or 0.0002 more than the No Action Alternative.

Figure S-5. Reductions in Global Mean Surface Temperature Compared with the No Action Alternative



Cumulative Impacts

The cumulative impact analysis evaluates the impact of the Proposed Action and alternatives in combination with other past, present, and reasonably foreseeable future actions that affect the same resource. The other actions that contribute to cumulative impacts can vary by resource and are defined independently for each resource. However, the underlying inputs, models, and assumptions of the CAFE Model already take into account many past, present, and reasonably foreseeable future actions that affect U.S. transportation sector fuel use and U.S. mobile source air pollutant emissions. Therefore, the analysis of direct and indirect impacts of the Proposed Action and alternatives inherently incorporates projections about the impacts of past, present, and reasonably foreseeable future actions in order to develop a realistic baseline.

For energy and air quality, the focus of the cumulative impacts analysis is on trends in electric vehicle sales and use. For climate, the analysis reflects actions in global climate change policy to reduce GHG emissions. The cumulative impacts analysis for climate also includes qualitative discussions of the cumulative impacts of climate change on key natural and human resources and the nonclimate effects of CO_2.

Energy

Changes in passenger travel, oil and gas exploration, and the electric grid mix may affect U.S. energy use over the long term. In addition to U.S. energy policy, manufacturer investments in PEV technologies and manufacturing in response to government mandates (including foreign PEV quotas) may affect market trends and energy use.

Air Quality

Market-driven changes in the energy sector are expected to affect U.S. emissions and could result in future increases or decreases in emissions. Trends in the prices of fossil fuels and the costs of renewable energy sources will affect the electricity generation mix and, consequently, the upstream emissions from energy production and distribution as well as electric vehicle use. Temporal patterns in charging of electric vehicles by vehicle owners would affect any increase in power plant emissions. Potential changes in federal regulation of emissions from power plants also could result in future increases or decreases in aggregate emissions from these sources.

The forecasts of upstream and downstream emissions that underlie the air quality impact analysis assume the continuation of existing emissions standards for vehicles, oil and gas development operations, and industrial processes such as fuel refining. These standards have become tighter over time as state and federal agencies have sought to reduce emissions to help bring nonattainment areas into attainment. To the extent that the trend toward tighter emissions standards could change in the future, total nationwide emissions from vehicles and industrial processes could change accordingly.

Cumulative changes in health impacts due to air pollution are expected to be consistent with trends in emissions. Higher emissions would be expected to lead to an overall increase in adverse health impacts while lower emissions would be expected to lead to a decrease in adverse health impacts, compared to conditions in the absence of cumulative impacts.

Greenhouse Gas Emissions and Climate Change

The global emissions scenario used in the cumulative impacts analysis differs from the global emissions scenario used for climate change modeling of direct and indirect impacts. In the cumulative impacts analysis, the Reference Case global emissions scenario used in the climate modeling analysis reflects reasonably foreseeable actions in global climate change policy, yielding a moderate level of global GHG reductions from the baseline global emissions scenario used in the direct and indirect analysis. The analysis of cumulative impacts also extends to include not only the immediate effects of GHG emissions on the climate system (atmospheric CO_2 concentrations, temperature, sea level, precipitation, and ocean pH) but also the impacts of past, present, and reasonably foreseeable future human activities that are changing the climate system on key resources (e.g., freshwater resources, terrestrial ecosystems, coastal ecosystems).

Greenhouse Gas Emissions

The following cumulative impacts related to GHG emissions are anticipated.

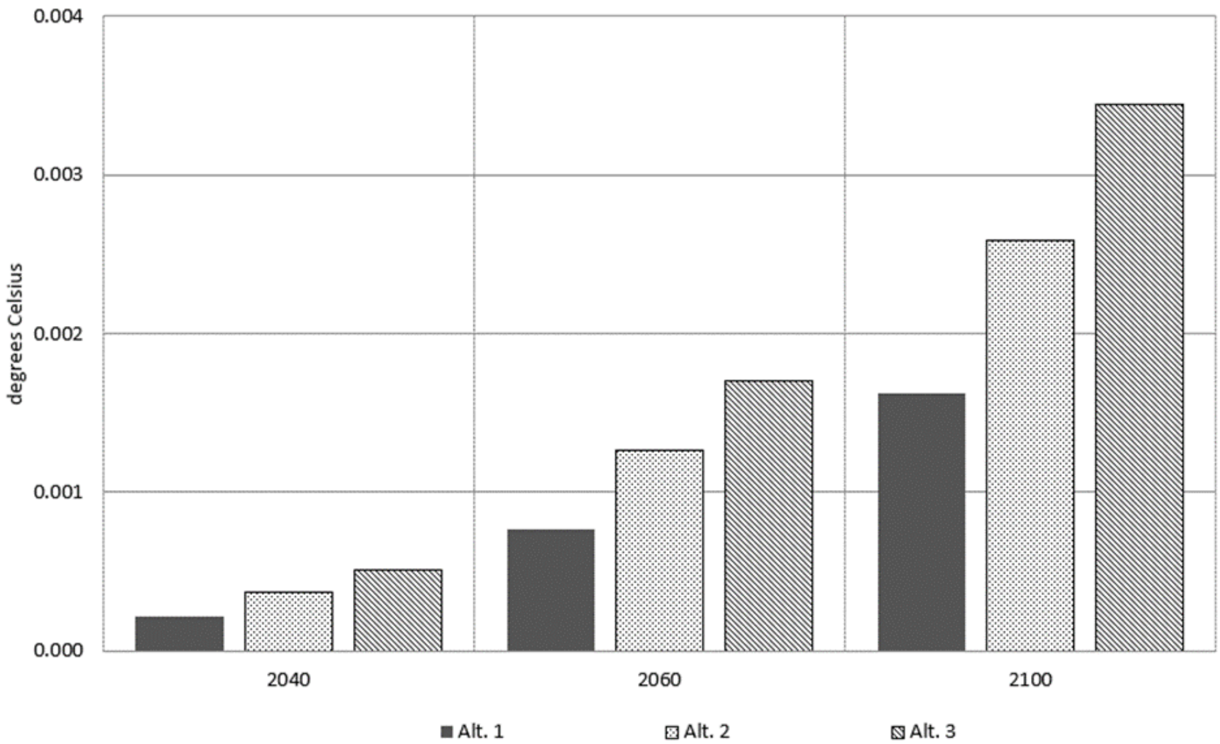
- Projections of total emissions reductions from 2021 to 2100 under the Proposed Action and alternatives and other reasonably foreseeable future actions compared with the No Action Alternative range from 4,100 $MMTCO_2$ (under Alternative 1) to 8,600 $MMTCO_2$ (under Alternative 3). The Proposed Action and alternatives would decrease total vehicle emissions by between 5 percent (under Alternative 1) and 10 percent (under Alternative 3) by 2100.
- Compared with projected total global CO_2 emissions of 4,044,005 $MMTCO_2$ from all sources from 2021 to 2100, the incremental impact of this rulemaking is expected to decrease global CO_2 emissions between 0.10 (Alternative 1) and 0.21 (Alternative 3) percent by 2100.

Climate Change Indicators

The following cumulative impacts related to the climate change indicators of atmospheric CO_2 concentration, global mean surface temperature, precipitation, sea level, and ocean pH are anticipated.

- Estimated atmospheric CO_2 concentrations in 2100 range from a high of 687.29 ppm under the No Action Alternative to a low of 686.55 ppm under Alternative 3, the lowest CO_2 emissions alternative. This is a decrease of 0.74 ppm compared with the No Action Alternative.
- Global mean surface temperature increases for the Proposed Action and alternatives compared with the No Action Alternative in 2100 range from a low of 0.002°C (0.003°F) under Alternative 1 to a high of 0.003°C (0.006°F) under Alternative 3. Figure S-6 illustrates the increases in global mean temperature under each action alternative compared with the No Action Alternative.
- Global mean precipitation is anticipated to increase by 4.77 percent by 2100 under the No Action Alternative. Under the action alternatives, this increase in precipitation would be reduced by 0.00 to 0.01 percent.
- Projected sea-level rise in 2100 ranges from a high of 70.22 centimeters (27.65 inches) under the No Action Alternative to a low of 70.15 centimeters (27.68 inches) under Alternative 3, indicating a maximum increase of sea-level rise of 0.07 centimeter (0.03 inch) by 2100. Sea-level rise under Alternative 1 would be 70.19 centimeters (27.66 inches), a 0.03-centimeter (0.01-inch) increase compared to the No Action Alternative.
- Ocean pH in 2100 is anticipated to be 8.2727 under Alternative 3, about 0.004 more than the No Action Alternative. Under Alternative 1, ocean pH in 2100 would be 8.2725, or 0.0002 more than the No Action Alternative.

Figure S-6. Reductions in Global Mean Surface Temperature Compared with the No Action Alternative, Cumulative Impacts



Health, Societal, and Environmental Impacts of Climate Change

The Proposed Action and 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 (Alternative 3) by the year 2100 is roughly a 0.7 ppm lower concentration of CO_2, three thousandths of a degree increase in temperature rise, a small percentage change in the rate of precipitation increase, a 0.07 centimeter (0.03 inches) decrease in sea-level rise, and an increase of 0.0004 in ocean pH. Although the projected reductions in CO_2 and climate effects are small compared with total projected future climate change, they are quantifiable, directionally consistent, and would represent an important contribution to reducing the risks associated with climate change.

Although NHTSA does quantify the increases in monetized damages that can be attributable to each action alternative (see CO_2 Damage Reduction Benefit metric in the PRIA benefits and net impacts tables), many specific impacts of climate change on health, society, and the environment cannot be estimated quantitatively. Therefore, NHTSA provides a qualitative discussion of these impacts by presenting the findings of peer-reviewed panel reports including those from IPCC, GCRP, CCSP, the National Research Council, and the Arctic Council, among others. While the action alternatives would decrease growth in GHG emissions and reduce the impact of climate change across resources relative to the No Action Alternative, they would not prevent climate change and associated impacts. Long-term climate change impacts identified in the scientific literature are briefly summarized below, and vary regionally, including in scope, intensity, and directionality (particularly for precipitation). While it is difficult to attribute any particular impact to emissions resulting from this ruling, impacts are likely to be beneficially affected to some degree by reduced emissions from the action alternatives.

- Impacts on freshwater resources could include changes in rainfall and streamflow patterns, warming temperatures and reduced snowpack, changes in water availability paired with increasing water demand for irrigation and other needs, and decreased water quality from increased algal blooms. Inland flood risk could increase in response to increasing intensity of precipitation events, drought, changes in sediment transport, and changes in snowpack and the timing of snowmelt.
- Impacts on terrestrial and freshwater ecosystems could include shifts in the range and seasonal migration patterns of species, relative timing of species' life-cycle events, potential extinction of sensitive species that are 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 ocean systems, coastal regions, and low-lying areas could include the loss of coastal areas due to inundation, submersion or erosion from sea-level rise and storm surge, with increased vulnerability of the built environment and associated economies. Changes in key habitats (e.g., increased temperatures, decreased oxygen, decreased ocean pH, increased salinization) and reductions in key habitats (e.g., coral reefs) may affect the distribution, abundance, and productivity of many marine species.
- Impacts on food, fiber, and forestry could include increasing tree mortality, forest ecosystem vulnerability, productivity losses in crops and livestock, and changes in the nutritional quality of pastures and grazing lands in response to fire, insect infestations, increases in weeds, drought, disease outbreaks, or extreme weather events. 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, but the impact varies by species and location. Many marine fish species could migrate to deeper or colder water in response to rising ocean temperatures, and global potential fish catches could decrease. Impacts on food and agriculture, including yields, food processing, storage, and transportation, could affect food prices, socioeconomic conditions, and food security globally.
- Impacts on rural and urban areas could affect water and energy supplies, wastewater and stormwater systems, transportation, telecommunications, provision of social services, incomes (especially agricultural), air quality, and safety. The impacts could be greater for vulnerable populations such as lower-income populations, historically underserved populations, some communities of color and tribal and Indigenous communities, the elderly, those with existing health conditions, and young children.
- Impacts on human health could include increases in mortality and morbidity due to excessive heat and other extreme weather events, increases in respiratory conditions due to poor air quality and aeroallergens, increases in water and food-borne diseases, increases in mental health issues, and changes in the seasonal patterns and range of vector-borne diseases. The most disadvantaged groups such as children, the elderly, the sick, those experiencing discrimination, historically underserved populations, some communities of color and tribal and Indigenous communities, and low-income populations are especially vulnerable and may experience disproportionate health impacts.
- Impacts on human security could include increased threats in response to adversely affected livelihoods, compromised cultures, increased or restricted migration, increased risk of armed conflicts, reduction in adequate essential services such as water and energy, and increased geopolitical rivalry.

In addition to the individual impacts of climate change on various sectors, compound events may occur more frequently. Compound events consist of two or more extreme weather events occurring simultaneously or in sequence when underlying conditions associated with an initial event amplify subsequent events and, in turn, lead to more extreme impacts. To the extent the action alternatives would result in reductions in projected increases in global CO_2 concentrations, this rulemaking would contribute to reducing the risk of compound events.