U.S. Department
of Transportation

Final Environmental Assessment

National Highway Traffic Safety Administration Corporate Average Fuel Economy (CAFE) Standards

March 29, 2006

Prepared by:

Office of International Vehicle, Fuel Economy, and Consumer Standards
National Highway Traffic Safety Administration

John A. Volpe National Transportation Systems Center
Research and Innovative Technology Administration

TABLE OF CONTENTS

LIST OF TABLES

EXECUTIVE SUMMARY

This Final Environmental Assessment (EA) evaluates the projected environmental impacts associated with the National Highway Traffic Safety Administration's ("NHTSA" or "the agency") action to set Corporate Average Fuel Economy Standards for Model Year (MY) 2008 – 2011 light trucks. The agency previously published a Draft EA to facilitate public participation and comment on its proposed action. Comments on the Draft EA have been taken into account in preparing the Final EA, and the agency's responses to specific comments are detailed further in the preamble of the final rule.

The Final EA was prepared in accordance with the requirements of the National Environmental Policy Act (NEPA), the regulations of the Council on Environmental Quality (40 CFR Part 1500), and NHTSA regulations (49 CFR Part 520). These regulations collectively establish policies and procedures to ensure that information on potential environmental impacts of Federal regulatory actions is available to decision makers, regulatory agencies, and the public. Under NHTSA regulations, the Final EA and associated documents will constitute an "Environmental Review Report."

This document describes the environment and resources that might be affected by alternative light truck CAFE standards for MY 2008-2011. The estimated impacts of each alternative action are assessed by comparing them to the impacts that would result from maintaining the light truck CAFE standard of 22.2 miles per gallon previously established for MY 2007. The range of alternatives considered and evaluated was guided by the limitations imposed by statutory obligations set out in the Energy Policy and Conservation Act (EPCA).[1]

The analysis employs the following two definitions of "light truck." The first includes vehicles such as pickup trucks, vans (cargo and passenger), minivans, and sport-utility vehicles that have a gross vehicle weight rating of up to 8,500 pounds. The second definition expands the first by including vehicles up to 10,000 pounds gross vehicle weight rating that are manufactured primarily for the transportation of passengers.

ACTIONS ANALYZED BY THE AGENCY

This Final EA evaluates a number of alternative forms and stringency levels for the CAFE standard that would apply to light-duty trucks manufactured during MY 2008-11. Potential environmental impacts for each alternative are estimated. Evaluating these alternatives assisted the agency in reforming the structure of the CAFE program.

The agency evaluates standards established under the traditional light truck CAFE structure (Unreformed CAFE) and a reformed CAFE structure (Reformed CAFE).

[1] 49 U.S.C. § 32901, et seq.

Under the Reformed CAFE program, fuel economy standards are restructured so that they are based on a measure of vehicle size called "footprint,"[2] defined as the product of a vehicle's wheelbase multiplied by its track width. The Reformed CAFE standard sets higher fuel economy targets for light trucks with smaller footprints, while larger light trucks are compared to lower targets.

The Reformed CAFE structure has two basic elements:

(1) a function that sets fuel economy targets for different values of vehicle footprint; and

(2) a Reformed CAFE standard for each manufacturer, which is equal to the production-weighted harmonic average of the fuel economy targets corresponding to the footprint values of each light truck models it produces.

The Reformed CAFE alternatives included in this analysis are differentiated by whether they employ a step or continuous function. A step function sets different fuel economy targets for specific ranges of vehicle footprint (for example, from 40 to 50 square feet), establishing a system of footprint categories with different fuel economy targets for each category. In contrast, a continuous function varies fuel economy targets gradually as vehicle footprint changes, avoiding the sudden changes in fuel economy targets that occur at the boundaries between footprint categories associated with a step function.

By varying a vehicle's fuel economy in a gradual but continuous manner as its footprint changes, a continuous function reduces the incentive to increase the size of a vehicle whose footprint is near a category boundary and thus relax its fuel economy target significantly. At the same time, a continuous function also reduces any incentive to reduce the size of a vehicle, since reducing a vehicle's size under a continuous function increases the stringency of its fuel economy target.

The Reformed CAFE alternatives also differ by whether they include or exclude medium duty passenger vehicles (MDPV). An MDPV is defined by the U.S. Environmental Protection Agency (EPA) as a "heavy duty vehicle"[3] with a gross vehicle weight rating (GVWR) of less than 10,000 pounds. MDPVs are designed primarily for the transportation of persons. The MDPV definition does not include any vehicle that:

(1) Is an "incomplete truck" as defined in 40 CFR §86.1803-01; or

(2) Has a seating capacity of more than 12 persons; or

---

[2] Footprint is thus measured in units of area, such as square inches or square feet.

[3] The EPA defines "heavy duty vehicle" as a motor vehicle that is rated at more than 8,500 lbs GVWR; or that has a vehicle curb weight of more than 6,000 lbs; or that has a basic vehicle frontal area in excess of 45 square feet.

(3) Is designed for more than 9 persons in seating rearward of the driver's seat; or

(4) Is equipped with an open cargo area (for example, a pick-up truck box or bed) of 72.0 inches or more in interior length. (A covered box not readily accessible from the passenger compartment is considered an open cargo area for purposes of this definition.) [4]

The Reformed CAFE structure provides for a transition period during MY 2008-10. During that period, manufacturers have the option of complying with the fleet-wide light truck standard established under the Unreformed CAFE standard, or with the Reformed CAFE standard. The Unreformed CAFE standards are 22.5 miles per gallon (mpg) for MY 2008, 23.1 mpg for MY 2009, and 23.5 mpg for MY 2010. Beginning with MY 2011, all manufacturers would be required to comply with the Reformed CAFE standard.

Compliance with the Reformed CAFE standard is assessed by calculating each manufacturer's required level of CAFE for a given model year using its actual total production of light trucks, the footprint value of each model it produces during that model year, and the fuel economy target for that footprint value.[5] Specifically, a manufacturer's required CAFE level for a model year is calculated by:

(1) determining the fuel economy target for each model by inserting its footprint value into the function used to set targets;
(2) dividing each model's production by its fuel economy target;
(3) summing the results of step (2) for all models produced by a manufacturer; and
(4) dividing the manufacturer's total production for the model year by this sum.

Each manufacturer's required CAFE level for a model year is compared to its actual CAFE level for that year to determine whether it has complied with the Reformed CAFE standard. Its actual CAFE level is determined by repeating steps (1) through (4), with each light truck model's actual fuel economy rating replacing its fuel economy target.

ALTERNATIVES

As indicated previously, the agency considered a number of different alternatives for setting MY 2008-11 light truck CAFE standards. We examined various alternatives in light of EPCA's statutory mandate to establish fuel economy standards at the "maximum feasible level," while considering the statutory criteria provided by Congress. After carefully considering these factors, the agency selected a Baseline alternative, an Unreformed CAFE alternative that sets a single fleet-wide CAFE standard for all light

[4] 40 CFR § 86.1803-01.

[5] Since the calculation of a manufacturer's required level of average fuel economy for a particular model year would require knowing the final production figures for that model year, the final formal calculation of that level would not occur until after those figures are submitted by the manufacturer to EPA. That submission would not, of course, be made until after the end of that model year.

truck manufacturers, and three alternative versions of a Reformed CAFE system. These alternatives are discussed briefly below, and are described in greater detail in Section 2.

The alternatives are as follows:

A. The Baseline, which would extend the MY 2007 standard of 22.2 mpg to apply to model years 2008 through 2011.

B. The Unreformed CAFE standards for MY 2008-10, combined with the Reformed CAFE standard for MY 2011 with fuel economy targets set using a continuous function. MDPVs are included in 2011 only.

C. The Reformed CAFE standard for MY 2008-11 with fuel economy targets established by a continuous function. Impacts for this alternative are shown both excluding MDPVs during all model years and including MDPVS in MY 2011 only.

D. The Reformed CAFE system described in the NPRM, which used a system of six footprint categories with separate fuel economy targets for each category. This alternative excludes MDPVs during all model years.

E. The Reformed CAFE system described in the NPRM, with revised fuel economy targets for each of its six footprint categories. Impacts for this alternative are shown both excluding MDPVs during all model years and including MDPVs in MY 2011 only.

Thus, Alternatives D and E employ step functions to set fuel economy targets for vehicles with different footprints. A step function sets constant fuel economy targets within separate ranges of vehicle footprint (or categories), so that all vehicles whose footprints fall within a category have the same fuel economy target. Because fuel economy targets do not change within a footprint category, a graph of the fuel economy targets established by this function resembles a series of staircase steps.

In contrast, Alternative C uses a continuous function to set fuel economy targets. A continuous function differs from a step function in that a continuous function sets a different fuel economy target for each value of vehicle footprint, rather than setting the same target over some range of footprint values. Therefore, a graph of the fuel economy targets set by a continuous function resembles a smooth curve without the sharp breaks present in a step function.

Unlike Alternative D, Alternatives B, C and E examine the effects of requiring MDPVs to meet the light truck fuel economy standards. Under Alternative B, MDPVs would be subject to the light truck CAFE standard for MY 2011 only. Impacts for Alternatives C and E are presented both excluding MDPVs during all model years and including MDPVs during MY 2011 only.

Alternative A (the baseline alternative) represents the lower boundary for the range of potential energy and environmental effects of the alternatives considered. It also serves as the baseline against which the increased energy and environmental impacts projected to result from Alternatives B, C, D, and E are measured. Alternatives C and E are projected to result in the largest reductions in fuel consumption, energy use, and environmental effects among these alternatives. The agency projects that the energy and environmental impacts of Alternatives C and E will be closely comparable, and that the impacts of each of the other alternatives it considered will fall within the range bounded by Alternatives A and Alternatives C and E. The agency projects that the range of impacts spanned by these alternatives would be relatively narrow.

The agency established a methodology to analyze the energy use and environmental effects of the various alternatives. This methodology is described in detail in Section 1.

OTHER POSSIBLE ALTERNATIVES

The agency considered but did not evaluate alternatives that would result in more stringent fuel economy requirements. As explained in the preamble to the final rule and in the Final Regulatory Impact Analysis, the agency determined that standards more stringent than those represented by the alternatives would not satisfy the statutory requirement to establish standards at the maximum feasible level using the criteria set by Congress. Specifically, more stringent standards would be inconsistent with the agency's statutory mandate to establish standards that are both technologically feasible and economically practicable. The NEPA's requirements do not take priority over an agency's statutes. Here, the NEPA's requirements must be applied in light of the constraints placed on the agency by EPCA.

The agency also considered but did not evaluate alternatives that incorporate a backstop or "minimum fuel saving" mechanism, as suggested by several commenters on the NPRM. We determined that such regulatory mechanisms were contrary to EPCA, and could result in fuel economy standards that were more stringent than those permitted under our statutory mandate.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Increasing the fuel economy of MY 2008-11 light trucks would reduce their lifetime fuel consumption, energy use, and greenhouse gas emissions (which result from the combustion of carbon-based fuels) compared to their levels that would result from extending the MY 2007 standard to apply to these model years. Reducing fuel consumption would also lower emissions of greenhouse gases and criteria air pollutants that occur during fuel production and distribution (often referred to as "upstream" or "well to tank" emissions).

However, improving fuel economy also reduces the fuel cost of driving and thus leads to additional use of light trucks, a response referred to as the fuel economy "rebound effect."[6] The added driving caused by the rebound effect in turn results in increased emissions of criteria pollutants by light trucks. Net changes in emissions of criteria pollutants were determined by combining the reductions in emissions estimated to result from reduced fuel refining and distribution with the increases in emissions caused by added light truck use resulting from the rebound effect. Thus, the net effect of an increase in fuel economy on emissions of each criteria pollutant depends on the relative magnitudes of emissions that occur during vehicle use, and during fuel production and distribution.

Alternatives B – E are projected to result in net reductions in lifetime emissions of most criteria pollutants by MY 2008-11 light trucks, including volatile organic compounds (VOC), nitrogen oxides (NOx), sulfur dioxide (SO_2), and particulate matter (PM). This result occurs because the reduction in emissions of each of these pollutants that results from reduced fuel refining and distribution outweighs the increase in emissions that results from additional driving. In contrast, carbon monoxide (CO) emissions are expected to rise slightly under each of these alternatives, since the projected increase in CO emissions from added light truck use exceeds the projected reduction in CO emissions during fuel production and distribution.

The changes in lifetime fuel consumption and emissions by MY 2008-11 light trucks projected to result from each alternative are distributed over the entire period these vehicles are expected to remain part of the U.S. vehicle fleet, which extends from 2008 (the year when MY 2008 light trucks are produced and sold) through 2046, when virtually all MY 2008-11 light trucks will have been retired from service.[7] During any year of this period, however, MY 2008-2011 light duty trucks will account for only a limited fraction of total light truck use, fuel consumption, and emissions, since vehicles produced before MY2008 and after MY2011 will account for a large share of total fuel consumption and emissions by the nation's light truck fleet.

Table ES-1 compares the projected energy and environmental impacts for the Baseline (Alternative A) and the alternatives that would impose more stringent CAFE standards, measured over the expected lifetimes of MY 2008-2011 light trucks. The projected impacts reported in the table were estimated using the NHTSA/Volpe CAFE compliance and impact estimation model described in Section 2 below.[8]

---

[6] For a complete discussion of the rebound effect and the derivation of the estimate employed in this analysis, see NHTSA, *Final Regulatory Impact Analysis: Corporate Average Fuel Economy Standards for MY 2008-11 Light Trucks*, Chapter VIII.

[7] The year in which the fuel use and emissions impacts of these vehicles is largest depends on the fraction that remain in service during each year of their expected lifetimes, the decline in their average usage as they age, and the increase in their per-mile emissions that occurs as they age. The exact year at which this occurs varies depending on the particular impact in question.

[8] For complete documentation of the model, see NHTSA, *CAFE Compliance and Effects Modeling System Documentation*, Docket NHTSA-2005-22223-3 and NHTSA-2005-22223-4.

Table ES-1. Summary of Energy and Environmental Impacts of Alternative Model Year 2008-2011 Light Truck CAFE Standards

Impact	A. Baseline	Change from Baseline Under Different Alternatives:					
		B. Unreformed CAFE	C. Reformed CAFE with Continuous Targets		D. NPRM Reformed CAFE	E. Revised NPRM Reformed CAFE	
			No MDPVs	MDPVs in 2011		No MDPVs	MDPVs in 2011
Fuel Consumption (billion gallons)	295.9	-6.3	-7.5	-7.8	-5.4	-7.6	-7.8
Energy consumption (quadrillion BTU)	33.90	-0.72	-0.86	-0.89	-0.62	-0.87	-0.89
CO emissions (million tons)	103.8	0.3	0.2	0.3	0.3	0.4	0.4
VOC emissions (million tons)	3.234	-0.002	-0.006	-0.005	-0.001	-0.002	-0.002
NO_x emissions (million tons)	3.521	-0.006	-0.010	-0.009	-0.004	-0.006	-0.006
$PM_{2.5}$ emissions (million tons)	0.129	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
SO_2 emissions (million tons)	0.457	-0.008	-0.010	-0.010	-0.007	-0.010	-0.010
CO_2 emissions (million metric tons)	2,840	-59	-70	-73	-52	-71	-73

Source: Estimated using NHTSA/Volpe CAFE Compliance and Effects Estimation Model; see text for description.

As Table ES-1 shows, the four alternatives that would increase light truck CAFE standards – Alternatives B, C, D, and E – are projected to reduce lifetime fuel consumption by MY 2008-11 light trucks by 5.4 to 7.8 billion gallons, and to reduce their lifetime energy use by 0.62 to 0.89 quadrillion Btu. As a consequence of lower fuel and energy use, these alternatives are projected to reduce emissions of carbon dioxide (CO_2), the main greenhouse gas produced by motor vehicle operation, by 52 to 73 million metric tons over the lifetimes of MY 2008-11 light trucks.[9] These projected reductions in energy use and greenhouse gas emissions result from both lower fuel consumption by light trucks, and lower energy use and emissions in fuel production and distribution. The table also shows that the reductions in fuel use, energy consumption, and CO_2 emissions under Alternatives C and E would be slightly larger if MDPVs were subjected to the Reformed CAFE standard in MY 2011.

Each alternative is also projected to result in net reductions in emissions of most criteria pollutants. Alternatives B, C, D, and E are each projected to reduce lifetime emissions of VOC (volatile organic compounds), NOx, SO_2, and PM by MY 2008-11 light trucks from

[9] For consistency with the emissions estimates reported by EPA in its annual Inventory of Greenhouse Gas Emissions and Sinks (http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissions.html), reductions in greenhouse gas emissions resulting from lower fuel consumption by light trucks are reported in million metric tons of carbon dioxide (CO_2). Carbon dioxide emissions account for more than 95% of total greenhouse gas emissions resulting from fuel consumption by motor vehicles; see EPA, Draft Inventory of U.S. Greenhouse Gas Emissions And Sinks: 1990-2004 (http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2006.html), Table 2-16, pp. 45-46.

the levels that would occur under the Baseline alternative. These reductions are again expected to be slightly larger if MDPVs are included in MY 2011 under Alternatives C and E. These reductions in emissions would be in addition to those expected to result from stricter federal regulations on light-duty vehicle emissions and fuel composition.

In contrast, CO emissions under each alternative are expected to rise, since the projected increase in tailpipe emissions of CO from added light truck use exceeds the expected reduction in emissions during fuel production and distribution. However, the increases in CO emissions projected to result from each alternative are small by comparison to lifetime emissions by MY 2008-11 light trucks under the Baseline alternative. As Table ES-1 shows, the increases in lifetime emissions for Alternatives B, C, D, and E range from 0.2 to 0.4 million tons, or 0.2 to 0.4 percent of lifetime CO emissions of 103.8 million tons under the Baseline alternative.

Because these projected increases in lifetime CO emissions of MY 2008-11 light trucks are distributed over the 40-year period (from 2008 through 2047) when these vehicles are expected to be in service, the increase in CO emissions during any single year of this period is expected to be extremely small. The largest increases in annual CO emissions projected to occur under the different alternatives would amount to 0.01 to 0.02 percent of current nationwide CO emissions from all sources.[10] Analysis of EPA air quality monitoring data indicates that if typical CO concentrations across the U.S. had been higher by this same proportion during recent years, no additional exceedances of the National Ambient Air Quality Standards (NAAQS) for CO would have occurred.[11]

The changes in energy use and environmental impacts projected to result from Alternative B through E are small when compared to their levels under the Baseline (Alternative A). Alternative B (Unreformed CAFE) is projected to result in the smallest impacts among the alternatives that would raise light truck CAFE standards from their level under the Baseline alternative, while Alternatives C (the Continuous Reformed CAFE standard) and E (the NPRM Reformed CAFE standards with adjusted fuel economy targets) result in the largest changes in energy and emissions from the Baseline. The reductions in these impacts expected under Alternatives C and E are projected to be slightly larger when MDPVs are included under the CAFE standards for MY 2011.

[10] Increases in annual CO emissions resulting from the alternative light truck CAFE standards considered in this analysis are projected to reach their maximum level in the year 2017 or 2018, depending on the specific alternative, and these increases are projected to range from 14 to 24 thousand tons. Total CO emissions by all sources in the U.S. were estimated to be 109,343 thousand tons during 2000; see U.S. EPA, National Air Quality and Emissions Trend Report, 2003, Table A-2, http://www.epa.gov/air/airtrends/aqtrnd03/pdfs/a2.pdf Thus the projected increases would amount to 0.01% to 0.02% of U.S. CO emissions from all sources during the year 2000.

[11] During the period from 2003 through 2005, there were a total of 5 exceedances of the NAAQS for CO, but no other CO concentrations recorded at U.S. monitoring sites were within 2% of the level specified by the NAAQS for CO. These figures were calculated from U.S. EPA, Air Quality Monitoring Data, http://www.epa.gov/air/data/monvals.html?us~USA~United%20States

To evaluate the cumulative energy use and environmental impacts resulting from the agency's current and previous actions to set light truck CAFE standards, we have focused on those impacts estimated to result from actions taken by the agency since Congressional funding restrictions that held the light truck CAFE standard at a constant level (20.7 mpg) were lifted in 2001. These actions include the 2003 Rule setting CAFE standards for MY 2005-07 light trucks at 21.2, 21.7, and 22.2 mpg, together with the different alternatives that were considered for the agency's current action. The estimated cumulative energy and environmental impacts from the agency's actions setting CAFE standards for MY 2005-11 light trucks under each alternative for the current action are consistent with the impacts reported previously in the EA accompanying the 2003 Rule setting MY 2005-2007 light truck CAFE standards.[12]

Table ES-2 shows the projected cumulative impacts from the agency's previous action setting MY 2005-2007 light truck CAFE standards and its current action setting MY 2008-2011 standards. In the column labeled "Without Previous Action," the table reports the estimated lifetime energy and environmental impacts of MY 2005-2011 light trucks that would have resulted if the MY 2004 CAFE standard of 20.7 mpg had been extended to apply to all light trucks produced from MY 2005-2011. These projections represent the estimated lifetime impacts of MY 2005-2011 light trucks that would have occurred if the agency had taken *neither* the previous action to increase light truck CAFE standards for MY 2005-07 from the MY 2004 level of 20.7 mpg, nor the current action to increase light truck CAFE standards for MY 2008-11 from the MY 2007 level of 22.2 mpg adopted by the previous action.

Next, Table ES-2 shows how the estimated lifetime impacts of MY 2005-2011 light trucks would be affected by each of the alternatives considered for the current action. The column labeled "A. Baseline" reports the changes in energy use and emissions that are projected to result from the Baseline alternative for the current action, which would extend the 22.2 mpg CAFE standard adopted previously for MY 2007 light trucks to apply to MY 2008-2011. The remaining columns in the table show the changes in lifetime energy and environmental impacts of MY 2005-11 light trucks estimated to result from Alternatives B, C, D, and E for current action, each of which would increase MY 2008-11 light truck standards from the level previously established for MY 2007.

[12] NHTSA, *Final Environmental Assessment for the Corporate Average Fuel Economy Standards for Light Trucks, Model Years 2005-07*. Docket NHTSA-2002-11419-18360.

Table ES-2. Estimated Cumulative Environmental Impacts of MY 2005-2011 Light Truck CAFE Standards

Impact	Without Previous Action	Cumulative Change in Impact with Alternative Actions for MY2008-11						
		A. Baseline	B. Unreformed CAFE	C. Reformed CAFE with Continuous Targets		D. NPRM Reformed CAFE	E. Revised NPRM Reformed CAFE	
				No MDPVs	MDPVs in 2011		No MDPVs	MDPVs in 2011
Fuel Consumption (billion gallons)	537.8	-12.8	-19.0	-20.3	-20.5	-18.2	-20.3	-20.5
Energy consumption (quadrillion BTU)	61.45	-1.46	-2.18	-2.32	-2.34	-2.08	-2.32	-2.35
CO emissions (million tons)	109.2	0.6	0.9	0.9	0.9	0.9	1.0	1.0
VOC emissions (million tons)	7.523	0.012	0.010	0.007	0.007	0.011	0.010	0.010
NO_x emissions (million tons)	7.480	-0.001	-0.007	-0.011	-0.010	-0.005	-0.007	-0.007
$PM_{2.5}$ emissions (million tons)	0.182	-0.001	-0.002	-0.002	-0.002	-0.002	-0.003	-0.003
SO_2 emissions (million tons)	1.135	-0.016	-0.025	-0.026	-0.026	-0.023	-0.026	-0.026
CO_2 emissions (million metric tons)	5,163	-122	-182	-193	-195	-174	-194	-196

Source: Estimated using NHTSA/Volpe CAFE Compliance and Effects Estimation Model; see text for description.

As the table indicates, the cumulative effect of the agency's previous action and each alternative considered for the current action will be to reduce projected lifetime fuel and energy use, emissions of most criteria pollutants, and emissions of carbon dioxide (CO_2, the primary greenhouse gas produced by transportation vehicles) by MY 2005-11 light trucks from the levels that would have resulted if the agency had taken neither action. Modest reductions would result from the Baseline alternative (Alternative A) for the current action, while larger reductions in these impacts would result from each alternative for the current action that would further increase light truck CAFE standards (Alternatives B through E).

Table ES-2 also shows that under any of the alternatives for the current action, lifetime emissions by MY 2005-11 light trucks of carbon monoxide (CO) and of volatile organic compounds (VOC) would increase slightly compared to their levels if neither action had been taken. Because the agency's previous action increased CO emissions by MY 2005-07 light trucks, and each alternative for the current action would increase CO emissions by MY 2008-11 light trucks (see Table ES-1), the current action will *increase* the cumulative effect of the two actions on lifetime CO emissions by MY 2005-11 light trucks.

In contrast, while the previous action also increased VOC emissions for MY 2005-07 light trucks, each alternative for the current action (except Alternative A, the Baseline) would result in lower VOC emissions by MY 2008-11 vehicles (see Table ES-1). Thus each alternative for the current action that would further increase light truck CAFE standards (Alternatives B through E) would *reduce* the cumulative effect of the agency's two actions on lifetime VOC emissions by MY 2005-11 light trucks.[13]

The cumulative increases in lifetime CO and VOC emissions projected to result from the past and current actions are small when compared to the emissions levels that would have resulted if the agency had taken neither action, as the table also shows. Depending on the alternative chosen for the current action, the cumulative increases in lifetime CO emissions by MY 2005-11 light trucks shown in Table ES-2 represent increases of 0.6 to 0.9 percent from their levels if the agency had taken neither action.[14] Similarly, the cumulative increases in lifetime VOC emissions by MY 2005-11 light trucks resulting from the two actions are projected to range from 0.1 to 0.2 percent of their levels if the agency had not acted to increase light truck CAFE standards in 2003 or at present.[15]

These cumulative increases in lifetime CO and VOC emissions resulting from the agency's two actions establishing light truck CAFE standards for MY 2005-07 and for MY 2008-11 would be distributed over the period when the vehicles they affect are in service, which extends from 2005 through 2046. During the calendar year when the increase in emissions by MY 2005-11 light trucks is expected to be largest, it would add about 0.03 to 0.05 percent to current annual nationwide CO emissions from all sources, and about 0.003 percent to total annual VOC emissions from all sources, depending on the specific alternative chosen for the current action.[16]

---

[13] Alternative A under the current action would leave the cumulative effect of the two actions on lifetime VOC emissions by MY 2005-11 light trucks unchanged from the level resulting from the agency's previous action setting standards for MY 2005-07 light trucks.

[14] The increases in CO emissions of 0.6 million to 1.0 million tons shown in Table ES-2 represent 0.6 to 0.9 percent of lifetime CO emissions of 109.2 million tons (also shown in Table ES-2) that would have occurred if neither the previous action to increase light truck standards for MY 2005-07 nor the current action to further increase standards for MY 2008-11 had been taken.

[15] The increases in VOC emissions of 0.007 million to 0.012 million tons shown in Table ES-2 represent 0.1 to 0.2 percent of estimated lifetime VOC emissions of 7.523 million tons (also shown in Table ES-2) that would have occurred if neither action had been taken.

[16] Depending on the specific alternative for the current action, the cumulative increase in CO emissions is projected to range from 36 to 59 thousand tons during the year when the two actions have their maximum cumulative impact on CO emissions. Total CO emissions by all sources in the U.S. were estimated to be 109,343 thousand tons during 2000; see U.S. EPA, National Air Quality and Emissions Trend Report, 2003, Table A-2, http://www.epa.gov/air/airtrends/aqtrnd03/pdfs/a2.pdf Thus the cumulative increases projected to result from the agency's two actions would amount to 0.03% to 0.05% of U.S. CO emissions from all sources during the year 2000. Cumulative increases in annual VOC emissions resulting from the agency's previous and current actions are projected to range from 530 to 690 tons in the year when they are largest, depending on the specific alternative for the current action. Total VOC emissions from all sources in the U.S. were estimated to be 20,384 thousand tons during 2000; see U.S. EPA, National Air Quality and Emissions Trend Report, 2003, Table A-5, http://www.epa.gov/air/airtrends/aqtrnd03/pdfs/a5.pdf Thus the cumulative increase projected to result from the agency's actions would amount to 0.003% of U.S. VOC emissions from all sources during the year 2000.

These projected increases are unlikely to result in more frequent exceedances of federal air quality standards for CO.[17] With respect to VOC emissions, the effect of the projected increases on the frequency of exceedances of the ozone NAAQS is extremely difficult to anticipate, because the contribution of VOC to ozone formation varies depending on their exact chemical composition, weather, other atmospheric conditions, and the presence of other chemical precursors of ozone.[18] While the cumulative effect of the agency's previous and current actions on ozone levels at specific geographic locations is extremely difficult to anticipate precisely, it is important to note that each of the alternatives considered for the current action would lower VOC emissions by MY 2008-11 light trucks, thus *reducing* this cumulative impact.

---

[17] During the period from 2003 through 2005, there were a total of 5 exceedances of the NAAQS for CO, but no other CO concentrations recorded at U.S. monitoring sites were within 2% of the level specified by the NAAQS for CO. These figures were calculated from U.S. EPA, Air Quality Monitoring Data, http://www.epa.gov/air/data/monvals.html?us~USA~United%20States

[18] VOC includes a large number of individual chemical compounds, which have different reactivities in forming ozone

1. PURPOSE AND NEED

The National Environmental Policy Act (NEPA),[19] the regulations of the Council on Environmental Quality (40 CFR part 1500), NHTSA regulations (49 CFR part 520), DOT Order 5610.1C, and NHTSA Order 560-1 collectively establish policies and procedures to ensure that information regarding the environmental impacts of Federal actions considered by NHTSA is available to decision makers and to the public.

This Final Environmental Assessment (EA) evaluates the projected environmental impacts associated with the National Highway Traffic Safety Administration's ("NHTSA" or "the agency") action to set Corporate Average Fuel Economy (CAFE) Standards for MY 2008-2011 light trucks. The alternatives considered in this document reflect the limitations imposed by EPCA on the agency's discretion to set light truck CAFE standards. The alternatives use two definitions of "light truck." One definition includes vehicles such as pickup trucks, vans (cargo and passenger), minivans, and sport-utility vehicles that have a gross vehicle weight rating of up to 8,500 pounds. The second definition includes all the vehicles in the first definition, plus vehicles manufactured primarily for the transportation of passengers and that have a gross vehicle weight rating of up to 10,000 pounds.

This document describes how revised CAFE standards for light trucks might affect the use of energy resources, evaluates the environmental impacts, and assesses the potential impacts of alternative light truck standards for MY 2008-11. Section 2, entitled "Baseline and Alternatives," provides a detailed description of the baseline and alternatives utilized in the analysis. The baseline (labeled Alternative A) assumes that the fuel economy standard of 22.2 mpg for MY 2007 light trucks would be extended to apply to MY 2008 – 2011 light trucks. Four alternatives to this baseline would increase CAFE standards to various levels above the baseline. Alternative B, the Unreformed CAFE standard, sets increasing fleet-wide standards for MY 2008-10, and would require all manufacturers to comply with the continuous Reformed CAFE standard beginning in MY 2011. Alternative C, the continuous Reformed CAFE standard, sets gradually varying fuel economy targets for light trucks with different footprints and uses these targets to determine a separate required CAFE level for each manufacturer.

Alternative D represents the Reformed CAFE system described in the NPRM, which sets different fuel economy targets for six different categories, with each category representing a range of footprint values, and uses these targets to determine a separate required CAFE level for each manufacturer. Finally, Alternative E uses the same six footprint categories as Alternative D, but sets slightly higher fuel economy targets for each category based on new product plan data that were submitted to the agency by some manufacturers after the NPRM was issued. Alternative B is assumed to include MDPVs during MY 2011 only, while Alternatives C and E include two variations: one that

[19] 42 U.S.C. § 4321 et seq.

excludes MDPVs during all model years, and another that includes MDPVs during MY 2011 only.

Section 3, "Affected Resources," describes the environmental resources that may be impacted by the agency's action, and provides a context in which to consider the environmental impacts associated with each alternative. Section 4, "Environmental Consequences," focuses on assessing the primary energy use and air quality effects of each alternative. In Section 4, the agency assumes that the analysis of secondary effects conducted in the Final EA for the MY2005-2007 light truck rulemaking continues to apply to this action, since a relatively short time has elapsed between the time that analysis was completed in 2003 and the publication of this document. These secondary effects, which are effects that result indirectly from the primary effects of improved fuel economy on energy and air quality, include impacts on water and biological resources, land use and development, and the use of hazardous materials. Therefore, the discussions in Section 4 pertaining to secondary effects will integrate much of the text from the previous EA.

BACKGROUND

In December 1975, in the aftermath of the energy crisis created by the oil embargo of 1973-1974, Congress enacted the Energy Policy and Conservation Act (EPCA). The EPCA established an automotive fuel economy regulatory program by adding Title V, "Improving Automotive Fuel Efficiency," to the Motor Vehicle Information and Cost Savings Act. Title V has been codified as Chapter 329 of Title 49 of the United States Code. Section 32902(a) of Chapter 329 requires the Secretary of Transportation to prescribe by regulation CAFE standards for light trucks for each model year, based on the maximum feasible average fuel economy level that the manufacturers can achieve. In determining the maximum feasible average fuel economy level, the Secretary must balance four criteria: technological feasibility, economic practicability, the effect of other Government motor vehicle standards on fuel economy, and the need for the United States to conserve energy. EPCA does not require that the agency act affirmatively to reduce particular types of emissions. The Secretary has delegated the authority to administer the CAFE program to the NHTSA Administrator.

A manufacturer whose light truck fleet does not meet the CAFE standard prescribed for a specific model year is assessed a civil penalty. The penalty is $5.50 multiplied by each tenth of a mile per gallon that the manufacturer's light truck fleet fuel economy level falls short of the standard for the given year, multiplied by the number of automobiles produced by the manufacturer to which the standard applied during the model year. The CAFE structure also embodies an incentive system whereby credits are allocated to manufacturers whose vehicle fleets exceed the CAFE standard in a given year. Manufacturers may carry forward previously earned credits and may carry back future credits for up to three years to account for any fuel economy deficit.

The first fuel economy standards for light trucks – for MY 1979 – were established on March 14, 1977 (42 FR 13807). The standards covered light duty vehicles with a GVWR of 6,000 pounds or less. For subsequent model years, NHTSA established the standards for vehicles with a GVWR of up to 8,500 pounds. By law, NHTSA must issue fuel economy standards 18 months prior to the beginning of the affected model year.

In accordance with NEPA, we have considered the cumulative impacts of the light truck CAFE program. We note that restrictions in the DOT and Related Agencies Appropriations Acts for FY 1996-2001 precluded the agency from setting CAFE standards differing from those in existence prior to the imposition of the restrictions.[20] The agency's last action prior to these Congressional restrictions was to set light truck standards for MY 1996 and MY 1997 in 1994. The agency's first effort to set CAFE standards since the lifting of the restrictions (other than the ministerial setting of standards at already prescribed levels during the intervening years subject to Congressional restrictions) was establishing the MY 2005-2007 standards in April 2003 (68 FR 16868). Based on the EA for that action, the agency concluded no significant environmental impact would result.[21]

On December 29, 2003, the Agency published an Advance Notice of Proposed Rulemaking (ANPRM), 68 FR 74908, seeking comment on various issues related to the CAFE program. The ANPRM requested comments concerning possible enhancements to the CAFE program that would assist in furthering fuel conservation while protecting motor vehicle safety and the economic vitality of the auto industry. The Agency was particularly interested in suggestions for improvements to the structure of the CAFE program under current statutory authority, as distinguished from comments concerning the specific level for a future CAFE standard. The comment period closed on April 27, 2004. The ANPRM and responses can be found on the Department of Transportation Docket Management System (DMS) website at http://dms.dot.gov (Docket No. 16128).

The Agency simultaneously published a Request for Comments (RFC) that sought future product plan information. 68 FR 74931 (Dec. 29, 2003). This information was used to help the agency analyze possible reforms to the CAFE program and assess the effect of CAFE reforms on fuel economy, manufacturers, consumers, the economy, and motor vehicle safety. The comment period closed on April 27, 2004. The RFC and its responses can be found on the Department of Transportation's Docket Management System (DMS) website at http://dms.dot.gov (Docket No. 16709).

Following analysis of the comments received under the RFC, the Agency analyzed the fuel economy improvement capabilities of light truck manufacturers for MY 2008-2011. As a result, the agency published in the Federal Register a notice of proposed rulemaking

---

[20] *See* Pub. L. No. 104-50 (Nov. 15, 1995), 109 Stat. 436, 457 (FY 1996); Pub. L. No. 104-205 (Sept. 30, 1996), 110 Stat. 2951, 2972 (FY 1997); Pub. L. No. 105-66 (Oct. 27, 1997), 111 Stat. 1425, 1445 (FY 1998); Pub. L. No. 105-277, Div. A, § 101(g) (Oct. 21, 1998), 112 Stat. 2681-439, 2681-469 (FY 1999); Pub. L. No. 106-69 (Oct. 9, 1999), 113 Stat. 986, 1019 (FY 2000); *and* Pub. L. No. 106-346, § 101(a)(1) (Oct. 23, 2000), 114 Stat. 1356A-1, 1356A-28 (FY 2001).

[21] *See* Docket NHTSA-2002-11419-18360 (Final Environmental Assessment for MY 2005-2007 Light Truck CAFE Standards).

(NPRM) (70 FR 51414; Aug. 30, 2005), to propose new CAFE standards, accompanied by a draft EA. Although not required under NEPA, the agency published the draft EA to solicit public comment on the potential environmental impacts of the proposed rule and facilitate public participation.

The agency received in excess of 45,000 comments concerning the NPRM. Among the comments received, two raised issues regarding the sufficiency of the Draft EA that NHTSA prepared. Specific issues that were raised by those commenters and the agency's responses to their comments are addressed in the preamble to the final rule.

NEED FOR ACTION

In accordance with Chapter 329 of Title 49 of the United States Code, and the delegation of authority from the Secretary of Transportation to the NHTSA Administrator NHTSA is required to set CAFE standards for light trucks for each model year at least 18 months in advance of the model year. The MY 2007 standard (22.2 mpg) was set in FY 2003. NHTSA must now take affirmative action to set the light truck standard for subsequent years at the maximum feasible average fuel economy level considering, in part, the four statutory criteria identified above.

SCOPE OF ANALYSIS

This document analyzes the environmental impacts associated with various alternatives to the existing CAFE program. Specifically, it assesses the impacts of these alternatives against a Baseline of 22.2 mpg (the light truck CAFE standard in place for MY 2007). The analysis concludes with an examination of the estimated cumulative impacts of the agency's MY 2005-2007 and MY 2008-2011 light truck fuel economy rulemakings.

METHODOLOGY

Environmental impacts from adopting higher CAFE standards for light trucks were estimated separately for each model year over its expected life span in the U.S. vehicle fleet (approximately 36 years). The underlying source of all environmental impacts considered in this analysis is the reduction in gasoline use resulting from the improvement in fuel economy of new light-duty trucks produced during the model years affected by the rule. Fuel savings are measured by the *difference* between total gallons of fuel consumed by light trucks produced during a single model year over their entire life span in the fleet if the MY 2007 standard of 22.2 mpg had been extended to apply to MY 2008-11, and total gallons of fuel consumed with each analyzed alternative.

Fuel economy levels for each future model year's light trucks were estimated using the model of fuel economy technology application developed for NHTSA by the U.S.

Department of Transportation's Volpe Center.[22] The NHTSA/Volpe fuel economy model simulates the improvements in the fuel economy of each light truck model planned for production during model years 2008-11 in response to higher light truck CAFE standards. Although current CAFE levels and product plans vary among manufacturers, we tentatively determined that the proposed changes to light truck standards would not require manufacturers to change light trucks in ways that would have important environmental effects unrelated to vehicle use such as material substitution. Rather, all manufacturers would be able to meet the proposed standards through changes in vehicle design (*e.g.*, aerodynamics) and components (*e.g.*, transmissions), neither of which is expected to alter appreciably the quantity or mix of materials used for vehicle production.

The number of light trucks manufactured during each model year that remains in service during each subsequent calendar year is estimated by applying estimates of the proportion of vehicles surviving each year up to 36 years.[23] The total number of miles driven by light trucks of a particular model year during each year of their life span in the fleet with the baseline standard (22.2 mpg) in effect is estimated by multiplying age-specific estimates of annual miles driven per vehicle by the number of vehicle expected to remain in service at each age.[24]

By reducing the cost of gasoline per mile driven, tighter CAFE standards are expected to result in a slight increase in annual miles driven per vehicle from the levels of annual vehicle use if the baseline standard remained in effect. This increase in the annual number of miles each vehicle is driven, usually referred to as the "rebound effect," also results in a corresponding increase in the *total* number of miles driven by light trucks of each model year during each calendar year that they remain in the fleet. In the NHTSA/Volpe model, the increase in light truck use due to the rebound effect is estimated by applying an elasticity of average annual vehicle use with respect to fuel cost per mile driven of –0.20 (corresponding to a 20% rebound effect) to the reduction in that cost that would result from requiring light trucks to achieve higher fuel economy.[25]

---

[22] For complete documentation of the model, see "CAFE Compliance and Effects Modeling System Documentation," Docket NHTSA-2005-22223-3 and NHTSA-2005-22223-4.

[23] These "survival rates" are estimated from the experience with recent model-year light trucks, adjusted to reflect expected continued improvements in the durability and economic lifetimes of future model year light-duty vehicles. See NHTSA, "Vehicle Survivability and Travel Mileage Schedules," Office of Regulatory Analysis and Evaluation, January 2005, Docket NHTSA-2005-22223-23, pp. 15-17.

[24] The measures of annual miles driven per vehicle again reflect experience with actual utilization of the current light truck fleet, adjusted to reflect expected slight reductions in the use in response to recent increases in fuel prices. See NHTSA, "Vehicle Survivability and Travel Mileage Schedules," Office of Regulatory Analysis and Evaluation, January 2005, Docket NHTSA-2005-22223-23, Appendix.

[25] For a complete discussion of the rebound effect and the references used to derive the estimate employed in this analysis, see NHTSA, *Final Regulatory Impact Analysis: Corporate Average Fuel Economy Standards for MY 2008-11 Light Trucks*, Chapter VIII.

Total fuel consumption by light trucks from a single model year during each calendar year they remain in service is calculated by dividing the total number of miles the surviving population of vehicles of that model year are estimated to be driven by the average on-road fuel economy level associated with the baseline standard. When those same light trucks are assumed to meet a higher CAFE standard, their total fuel consumption during each calendar year is calculated by dividing the increased number of miles they are driven as a result of the rebound effect by the higher on-road fuel economy level necessary to comply with that stricter standard. Actual fuel economy levels achieved by light trucks in on-road driving fall significantly short of those measured under test conditions, and the estimates of fuel consumption by light trucks produced by the NHTSA/Volpe model are adjusted to reflect this fuel economy "gap."[26]

The difference between estimated total fuel use by light trucks of a given model year during each calendar year with the base CAFE standard in effect and estimated fuel use under a stricter standard represents the fuel savings attributable to tightening the standard. The sum of these annual fuel savings over each calendar year vehicles from that model year remain in service represents the cumulative fuel savings due to requiring them to meet a stricter standard.

Reducing light truck fuel use results in lower emissions of carbon dioxide, the main greenhouse gas emitted as a result of refining, distribution, and consumption of transportation fuels.[27] Lower fuel use reduces carbon dioxide emissions directly, by reducing the amount of carbon available to be converted to carbon dioxide during the fuel combustion process. The NHTSA/Volpe model calculates the reduction in carbon dioxide emissions from lower fuel use by assuming that the entire carbon content of the fuel saved would have been converted to carbon dioxide in the combustion process.[28]

Lower fuel consumption also reduces carbon dioxide emissions that result from fuel refining and distribution, and these reductions in "upstream" emissions add to those CO_2 reductions resulting from lower fuel use. The NHTSA/Volpe CAFE model calculates reductions in these emissions using carbon dioxide emission rates for upstream activities

---

[26] EPA currently estimates that actual average on-road fuel economy of light-duty vehicles is approximately 15% lower than that measured under test conditions.

[27] Carbon dioxide emissions account for more than 95% of total greenhouse gas emissions resulting from the operation of motor vehicles; see EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2004, [EPA-430-R-05-003], Draft, February 23, 2006, http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBSC3/$File/06_Complete_Report.pdf , Table 2-16, pp. 45-46. Carbon dioxide also accounts for nearly 90% of greenhouse gas emissions emitted during the production and distribution of transportation fuels; see and Argonne National Laboratories, *The Greenhouse Gas and Regulated Emissions from Transportation (GREET) Model*, Version 1.6, February 2002, http://www.transportation.anl.gov/ttrdc/greet/index.html

[28] This assumption results in a slight overestimate of reductions in carbon dioxide emissions, since a small fraction of the carbon content of gasoline is emitted in the form of carbon monoxide and unburned hydrocarbons. However, the magnitude of this overestimate is likely to be extremely small.

obtained from Argonne National Laboratories' Greenhouse Gases and Regulated Emissions in Transportation (GREET) model.[29] Based on a review of historical changes in U.S. fuel consumption and sources of petroleum supply and on modeling conducted with the U.S. Energy Information Administration's National Energy Modeling System (NEMS), the NHTSA/Volpe model assumes that 50% of any reduction in light truck fuel use will be reflected in lower imports of refined gasoline, while the remaining 50% will result in reduced domestic fuel refining. The resulting reduction is assumed not to change the fractions of imported and domestically produced crude petroleum that is currently refined within the U.S.

Finally, stricter CAFE standards can result in higher or lower emissions of "criteria" pollutants, by-products of fuel combustion that are emitted in extremely small amounts by the internal combustion engines used to power light trucks, as well as during gasoline refining and distribution. Criteria pollutants emitted by light-duty motor vehicles include carbon monoxide (CO), various hydrocarbon compounds (volatile organic compounds, or VOC), nitrogen oxides (NOx), sulfur dioxide (SO_2), and fine particulate matter (PM).

On one hand, the increased use of light trucks that occurs through the effect of higher fuel economy on the fuel cost per mile driven (the "rebound effect") causes increased emissions of criteria pollutants, since federal standards limit permissible emissions of these pollutants on a per-mile basis. The NHTSA/Volpe model estimates additional emissions of these pollutants due to added driving by multiplying the increase in total miles driven by light trucks during a calendar year by per-mile emission rates estimated using the U.S. Environmental Protection Agency's MOBILE6.2 motor vehicle emissions factor model.[30]

At the same time, however, reductions in gasoline consumption and refining from stricter light truck CAFE standards lower emissions of criteria pollutants that occur during refining, distribution, and retailing of gasoline. Reductions in criteria pollutant emissions from gasoline refining and distribution are calculated using emission rates obtained from Argonne National Laboratories' GREET model. On balance, emissions of criteria pollutants can either increase or decrease as a result of stricter CAFE standards, depending on whether the increased emissions resulting from added vehicle use due to the rebound effect outweigh the reduction in emissions from gasoline refining and distribution.

[29] Argonne National Laboratories, *The Greenhouse Gas and Regulated Emissions from Transportation (GREET) Model*, Version 1.6, February 2002, http://www.transportation.anl.gov/ttrdc/greet/index.html .

[30] U.S. Environmental Protection Agency, MOBILE6 Vehicle Emission Modeling Software, http://www.epa.gov/otaq/m6.htm#m60

2. BASELINE AND ALTERNATIVES

BASELINE

NEPA requires an agency to compare the impacts of alternatives it is considering with those that would result from taking no action at all (the "no action" alternative). In this instance, however, taking no action is unavailable as an option because 49 U.S.C. § 32902(a) affirmatively requires the Secretary of Transportation to prescribe average fuel economy standards for light trucks. Thus the legal effect of complete inaction would be to contravene this statutory requirement. The closest alternative to taking no action that is available to the agency would be to maintain the CAFE standard for MY 2008-11 light trucks at the level of 22.2 mpg it previously established for MY 2007, in which case the agency's current action would result in no *new or additional* impacts compared to those resulting from the previous rulemaking.[31]

The agency estimated the energy and environmental impacts that would occur if the MY 2007 standard of 22.2 mpg were adopted for MY 2008-11, and used these estimates as a baseline against which to measure and evaluate the impacts of alternative options that would increase light truck CAFE standards. These baseline levels of fuel consumption and emissions reflect the average fuel economy that manufacturers would achieve if the 22.2 mpg standard were extended to apply to MY 2008-2011. Under this baseline alternative, referred to as Alternative A, all manufacturers are assumed to achieve at least the 22.2 mpg standard. However, the product plan data submitted to the agency by some manufacturers indicate that they plan to exceed this standard slightly during certain model years. In such instances, the agency relied on the manufacturer's projected fuel economy. Thus the industry average level of fuel economy under Alternative A slightly exceeds the 22.2 mpg standard. Updates to the baseline used in the NPRM analysis were made based on more current product information and comments submitted by manufacturers in response to the NPRM.

ALTERNATIVES

The agency considered a number of different alternatives with respect to its CAFE proposal. It narrowed the alternatives it would examine in detail based on the goal of achieving the maximum feasible fuel economy level while recognizing the limitations presented by EPCA. After careful consideration of all of these factors, the agency decided on five alternatives (including the baseline) to examine for possible use as the basis for a reformed CAFE system.

[31] As explained in the final EA for the MY 2005-2007 rulemaking, the No Action alternative would not satisfy the statutory requirement to set the standard at the maximum feasible average fuel economy level. However, we include this level for purposes of comparison.

All alternatives examined are projected to increase the light truck CAFE standards to levels above the 22.2 mpg light truck standard for MY 2007.

Alternative A is the baseline, representing those energy and environmental effects that would occur if the 22.2 standard were extended to MY 2008 – 2011 light trucks.

Alternative B represents the Unreformed CAFE standards for MY 2008-2010, which is the agency's traditional method for establishing the light truck CAFE standards. The Unreformed standards are set using the same procedure that NHTSA has employed to set previous light truck standards, which uses NHTSA's "Stage Analysis" projections of technologies available to individual manufacturers to improve the fuel economy of the light truck models they plan to produce in future model years. The Stage Analysis relies on the agency's engineering judgment and a manufacturer's confidential product plans to apply technologies to improve the fuel economy of that manufacturer's light truck fleet. The Stage Analysis produces estimates of each manufacturer's costs for achieving progressively higher fuel economy levels during each model year.[32]

The Stage Analysis is used to set the level of the Unreformed standards with particular regard to the availability of technologies to improve fuel economy and their financial impacts on the "least capable" full line manufacturer of light trucks (one that produces a wide variety of types and sizes of vehicles) with a significant share of the market. The least capable manufacturer is generally defined as the manufacturer that would bear the largest cost burden for improving the fuel economy of its light truck models to comply with the standard. This process sets CAFE standards at a level that the Stage Analysis indicates can be achieved by the least capable manufacturer without causing it to suffer unacceptable financial harm.

The Unreformed standard sets a single CAFE level for each model year, and requires all manufacturers to achieve that level of fuel economy. The agency previously proposed Unreformed light truck CAFE standards for MY 2008-10 in the NPRM, and these standards, which are included as part of Alternative B, are shown in Table 2-1.[33] As proposed in the NPRM, Alternative B also includes a Reformed CAFE standard for MY 2011. Specifically, Alternative B incorporates the Reformed CAFE standard for MY 2011 described in Alternative C below, which uses a continuous function of vehicle footprint to set fuel economy targets for light trucks of different sizes.

[32] Chapters V and VI of the Final Regulatory Impact Analysis provide a detailed description of the Stage Analysis methodology, the costs and effectiveness of the fuel economy technologies each manufacturer employs, and the results of its application to the light truck models each manufacturer plans to produce for MY 2008-11.

[33] The Unreformed CAFE standards analyzed in this document are identical to the previously proposed Unreformed standards; for a detailed discussion of the proposed and final Unreformed CAFE standards, see NHTSA, *Final Regulatory Impact Analysis: Corporate Average Fuel Economy Standards for MY 2008-11 Light Trucks*, Chapter III.

Table 2-1. Unreformed CAFE Standards for MY 2008-10 (Alternative B)

Model Year	CAFE Standard (miles per gallon)
2008	22.5
2009	23.1
2010	23.5

Source: Derived using NHTSA Stage Analysis; see text for discussion.

Alternatives C – E
Alternatives C through E each incorporate a footprint-based target system. As explained in the preamble, use of this structure furthers the goals of reforming CAFE. The agency proposed to reform CAFE in order to address several of the deficiencies present in the Unreformed CAFE system. While a detailed discussion of the goals of Reformed CAFE are provided in the preamble to the final rule, there are four basic advantages to a system that relies on footprint-based targets to calculate a manufacturer's required fuel economy level:

> (1) Such a system accounts for size differences in manufacturers' product mixes. As a result virtually all light-truck manufacturers will be required to improve the fuel economy of their vehicles, thereby increasing the potential for fuel savings;
>
> (2) A footprint-based target CAFE system reduces any incentive for manufacturers to pursue unsafe compliance strategies. Such a system reduces the incentive for manufacturers to downsize vehicles, design vehicles to permit classification as "light-trucks" for CAFE purposes, and offer smaller and lighter vehicles to offset sales of larger heavier vehicles. The adverse safety effects of downsizing and downweighting have previously been documented for passenger cars in the CAFE program. When a manufacturer designs a vehicle to permit its classification as a light truck, it may increase the vehicle's propensity to roll over;
>
> (3) A footprint-based target CAFE system provides a more equitable regulatory framework for different vehicle manufacturers. A manufacturer's required fuel economy level is reflective of the manufacturer's actual fleet. By requiring manufacturers to comply with fuel economy levels reflective of the potential fuel economy of their actual fleets, such a system spreads the regulatory cost burden for fuel economy more broadly across the industry; and
>
> (4) Such a system is more market-oriented because it more fully respects economic conditions and consumer choice and does not force manufacturers to manufacture vehicles not demanded by the public solely for the purpose of CAFE compliance.

Moreover, footprint-based target CAFE system incorporates several important elements of reform suggested by the National Academy of Sciences in its 2002 report, Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards.[34] As explained in the preamble to the final rule and the NPRM, the agency considers a variety of other CAFE structures, but determined that reliance on footprint-based fuel economy targets to calculate a manufacturer's required fuel economy level best furthered the goals of reform.

Alternative C is a continuous function Reformed CAFE standard for MY 2008-11. Like the Reformed CAFE standard described in the NPRM, the continuous function Reformed CAFE standard sets fuel economy targets for light trucks with different footprint, and uses these targets in conjunction with each manufacturer's planned production of light trucks of different sizes to determine its required CAFE level for each future model year. Each manufacturer's required CAFE level is its production-weighted harmonic average of the fuel economy targets for the footprint values of all light truck models it produces.

The continuous function Reformed CAFE standard uses a mathematical relationship between vehicle footprint and fuel economy to set different fuel economy targets for light trucks of each footprint value. This relationship is established by fitting a specific mathematical function to data on footprint and fuel economy levels for all manufacturers' light truck models for each future model year, after each model's fuel economy has been improved to the point where the cost of increasing it further would outweigh the value of fuel savings and other benefits from doing so.

In the NPRM, the agency discussed reliance on a continuous function in a reform system. The agency provided an example of a continuous function and requested comment on such a system. While manufacturers were generally opposed to a continuous-function standard, the Insurance Institute for Highway Safety (IIHS) stated that a CAFE standard based on a continuous function provided several advantages over a step function, including reducing the incentive for manufacturers to respond to the standard in a manner that might have negative safety implications.[35]

For MY 2008-10, the fuel economy targets specified by this function are then adjusted upward or downward until the total costs for all manufacturers to achieve their required CAFE levels (which are partly determined by these targets) are equal to those under the Unreformed CAFE standard. (Total compliance costs under the Unreformed CAFE standard are determined from the Stage Analysis.) For MY 2011, the fuel economy targets specified by the fitted function are adjusted until the change in industry-wide costs for achieving the CAFE levels they require each manufacturer to achieve offsets the resulting change in the total value of fuel savings and other benefits.[36]

[34] National Research Council, *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards*, Washington, D.C., National Academy Press, 2002.

[35] A detailed summary of IIHS' comments is provided in the preamble to the final rule.

[36] The process for establishing and adjusting this function is described in detail in the Preamble.

The mathematical function used to set fuel economy targets for each different value of light truck footprint is:

$$mpg = \frac{1}{\frac{1}{a} + \left(\frac{1}{b} - \frac{1}{a}\right)\frac{e^{(x-c)/d}}{1+e^{(x-c)/d}}}$$

where

mpg = the fuel economy target (in mpg) for a vehicle model with footprint *x*
x = footprint (in square feet, rounded to the nearest tenth) of that vehicle model
a = the maximum fuel economy target (in mpg)
b = the minimum fuel economy target (in mpg)
c = the footprint value (in square feet) at which the fuel economy target is midway between *a* and *b*
d = the parameter (in square feet) defining the rate at which the value of targets decline from the largest to smallest footprint values
e = 2.718; and

Table 2-2 gives the values of the parameters a, b, c, and d for model years 2008 through 2011, which were established using the procedure described above.

Table 2-2. Parameter Values for Function Used to Set Reformed CAFE Fuel Economy Targets

Parameter	Parameter Value During Model Year:			
	2008	**2009**	**2010**	**2011**
a	28.56	30.07	29.96	30.42
b	19.99	20.87	21.20	21.79
c	49.30	48.00	48.49	47.74
d	5.58	5.81	5.50	4.65

Source: Derived using NHTSA/Volpe CAFE Compliance and Effects Estimation Model.

Table 2-3 shows sample fuel economy targets for various value of vehicle footprint for MY 2011 that result from applying this function with the appropriate parameter values for that model year. These are the fuel economy targets included in Alternative C.

Table 2-3. Sample Fuel Economy Targets by Vehicle Footprint for MY 2011 (Alternative C)

Sample Vehicles	Footprint (square feet)	Fuel Economy Target (MPG)
Ford F-150	75.9	21.80
GM Silverado	67.4	21.88
Lincoln Navigator	55.3	22.85
Honda Odyssey	54.9	22.96
Hummer H3	50.7	24.17
GM Equinox	48.2	25.18
Saturn Vue	45.7	26.34
Ford Escape	43.5	27.32

Source: Calculated from equation for fuel economy targets and parameter values reported in Table 2-2.

Under the Reformed CAFE standard that uses a continuous function to set fuel economy targets, each manufacturer's required CAFE level is its production-weighted harmonic average of the fuel economy targets for the footprint values of all light truck models it produces. A manufacturer's production volume at each footprint value is the sum of its production volumes for all of its light truck models with that footprint value. Each manufacturer's required CAFE level is compared to the production-weighted harmonic average of the actual fuel economy of each of its light truck models to assess whether it has achieved compliance. Two variations of Alternative C were included, one in which MDPVs were excluded during all model years and another in which MDPVs were included only in MY 2011.

As explained in the preamble, a continuous function addresses three major concerns raised by commenters with regard to the proposed Reformed CAFE structure. Reliance on continuous function (1) eliminates potential problems associated with the need to redefine category boundaries in future rulemakings; (2) substantially reduces the incentive for manufacturers to "upsize" vehicles; and (3) substantially reduces the incentive for manufacturers to respond to the CAFE requirements through downsizing, a compliance option that can reduce a vehicle's safety.

Alternative D is the Reformed CAFE standard described in the NPRM. The NPRM Reformed CAFE standard established a system of six footprint categories and set separate fuel economy targets for each category. All light truck models within each footprint category are subject to the fuel economy standard set for that category. A manufacturer's required CAFE level under the NPRM Reformed CAFE standard is its production-weighted harmonic average of the fuel economy targets for the footprint values of all light truck models it produces.

For MY 2008-10, the fuel economy targets for the NPRM Reformed CAFE standard were set to result in total industry-wide compliance costs equal to those under the Unreformed CAFE standard presented in the NPRM, which were determined by applying the Stage Analysis to the manufacturers' product plan data that were available to the agency at the time the NPRM was prepared. For MY 2011, the fuel economy targets for each of the six footprint categories were adjusted in equal increments until the change in industry-wide compliance costs is exactly offset by the change in the value of fuel savings and other benefits.

In the NPRM, the agency described the process for determining the category boundaries and fuel economy targets. This process considered the manufacturers' projected product plans. The agency received updated product plans from manufacturers after the NPRM was issued, which would have resulted in category boundaries and targets different than those proposed. However, several commenters suggested that if the agency adopted the proposed Reformed CAFE system (i.e., the bin system), it should maintain the categories and targets described in the NPRM. Alternative D evaluates the impacts of such a system.

Table 2-4 shows the six footprint categories employed among the Reformed CAFE standard described in the NPRM, and reports the fuel economy targets proposed for each footprint category. Alternative D does not include MDPVs in the vehicles subject to the standard for any model year.

Table 2-4. Footprint Categories and Fuel Economy Targets

Proposed in NPRM (Alternative D)

Footprint Category (square feet)	Fuel Economy Target for Model Year (miles per gallon):			
	2008	2009	2010	2011
< 43	28.56	29.72	29.87	30.37
43-47	25.94	26.66	26.96	27.17
47-52	22.74	23.28	23.82	24.19
52-57	22.45	23.04	23.32	23.51
57-65	20.96	21.73	22.09	22.48
> 65	19.99	20.70	21.16	21.98

Source: NPRM

Alternative E uses the same footprint categories established by the Reformed CAFE standard proposed in the NPRM, but sets slightly higher fuel economy targets for each category in MY 2008-10. The targets for Alternative E were set at levels that resulted in industry-wide compliance costs equal to those under the Unreformed CAFE standard, rather than (as in Alternative D) under the NPRM Unreformed CAFE standard. Because the Stage Analysis conducted to establish the Unreformed CAFE standard resulted in higher industry compliance costs than the Stage Analysis for the Unreformed standard presented in the NPRM, the fuel economy targets under Alternative E are slightly higher than those under Alternative D.

The agency did not consider changing the footprint values that represent the boundaries between categories established by the Reformed CAFE standard proposed in the NPRM.

As discussed in the preamble of the final rule, the agency's process for establishing category boundaries described in the NPRM did not provide an objective basis for adjusting those boundaries in response to manufacturers' provision of updated product plan data. Thus the agency maintained the category boundaries originally proposed in the Reformed CAFE system described in the NPRM for this alternative. The fuel economy targets for MY 2011 under Alternative E were established in exactly the same way as those under Alternative D.

Table 2-5 shows the revised fuel economy targets for the NPRM footprint categories, which correspond to Alternative E. Two variations of Alternative E were analyzed, one in which MDPVs were excluded during all model years, and another in which MDPVs were included for MY 2011 only.

Table 2-5. Footprint Categories Proposed in NPRM

and Revised Fuel Economy Targets (Alternative E)

Footprint Category (square feet)	Fuel Economy Target for Model Year (miles per gallon):				
	2008	2009	2010	2011 (excluding MDPVs)	2011 (including MDPVs)
< 43	28.39	29.81	29.87	30.55	30.79
43-46	26.57	27.15	27.48	27.83	28.10
46-50	23.38	24.20	24.53	25.04	25.26
50-54	22.59	23.20	23.63	23.99	24.23
54-59	21.68	22.52	22.79	23.09	23.19
> 59	19.96	20.79	21.12	21.95	21.75

Source: Derived using NHTSA/Volpe CAFE Compliance and Effects Estimation Model.

OTHER POSSIBLE ALTERNATIVES

In the NPRM, the agency proposed a transition period for MY 2008-2010. During the transition, manufacturers may either comply with the Unreformed CAFE standard or attain the fuel economy levels that the reformed CAFE system requires them to achieve. However, because the agency was unable to anticipate how individual light truck manufacturers would respond to the choice of complying with the Unreformed or Reformed standards during MY 2008-11, it did not attempt to develop alternatives that predicted individual manufacturers' choices during the transition period. The agency cannot predict how individual manufacturers will choose to comply with CAFE during the transition period, since their decisions depend not only on the costs they face for complying with each standard, but on a variety of other factors as well. For example, a manufacturer may choose to comply under the Reformed CAFE system prior to being required to do so in order to gain experience with such a system.

However, if the agency had been able to develop alternatives that predicted manufacturers' compliance choices, the energy and environmental impacts would fall within the range established by the Unreformed and Reformed CAFE standard. This is illustrated by the comments of the Union of Concerned Scientists (UCS) on the NPRM, in which UCS attempted to estimate the lowest industry-wide average CAFE levels that could result from manufacturers' choices of compliance options during each model year of the transition period. UCS concluded that under what it termed the "worst of both worlds" scenario, industry-wide fuel economy levels would average 22.4, 23.0, and 23.2 mpg during model years 2008, 2009, and 2010.[37]

These fuel economy levels are within the range of CAFE levels that would result from the alternatives considered in this analysis. This range extends from 22.2 to 22.7 mpg for MY 2008, 22.2 to 23.3 mpg for MY 2009, and 22.2 to 23.6 mpg for MY 2010. Because the energy and environmental impacts resulting from each alternative depend primarily on the fuel economy levels it requires and the resulting fuel savings, the impacts of the scenario identified by UCS would still fall within the range of impacts established by the alternatives included in this analysis. Thus including alternatives that assumed some manufacturers would comply with the Unreformed CAFE standard while others would elect to comply with the Reformed standard would have been unlikely to alter our conclusions about the likely energy and environmental impacts of this rule.

Several commenters suggested that the agency incorporate a backstop or "ratcheting mechanism" in the final rule. "Backstop" refers to a required fuel economy level that would be applicable to an individual manufacturer (or to the industry) if the required fuel economy level calculated under the Reformed CAFE system for a manufacturer (or for the industry) were below a predetermined minimum. The concept of a backstop is to prevent or minimize the loss of fuel savings from one model year to the next. Such a requirement would essentially be the same as an Unreformed CAFE standard. A "ratcheting mechanism" is a regulatory mechanism that would automatically increase the stringency of the required fuel economy level for a manufacturer or the industry if fuel savings dropped below a predetermined level.

Although the agency considered such mechanisms, we did not evaluate a CAFE system with either a backstop or a "ratcheting mechanism." As explained in the preamble, such systems are contrary to the intent of EPCA because they would limit a manufacturer's ability to respond to shifts in the market.[38] Such systems may also require manufacturers

[37] Union of Concerned Scientists, *Comments Concerning NHTSA's Notice of Proposed Rulemaking Regarding Average Fuel Economy Standards for Light Trucks – Model Years 2008-11*, Docket NHTSA-2005-22223-1978, p. 9.

[38] Congress directed that:

> [A]ny regulatory program must be carefully drafted so as to require of the industry what is attainable without either imposing impossible burdens on it or unduly limiting consumer choice as to the capacity and performance of motor vehicles.

H. Rep. 94-340 (p. 87)

to achieve fuel economy levels beyond those that are technologically feasible or economically practicable. Furthermore, the agency believes that replacing the step function proposed in the NPRM with the continuous function employed in the final rule, addresses the concern voiced by several commenters that manufacturers might upsize individual models or their entire fleets in order to reduce the stringency of their required light truck CAFE levels.

The agency also considered alternatives that would have resulted in more stringent standards. However, the agency did not evaluate such standards as we determined that they would beyond the "maximum feasible" level. Standards more stringent than those considered in this document would require applying technologies under lead times more aggressive than those relied upon by the agency, and which were based on the 2002 National Academy of Science Report, "Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards." The more aggressive application of technologies would be contrary to the balance of the statutory criteria for determining the "maximum feasible" level.

RANGE OF IMPACTS

The impacts on energy use and the environment impacts projected to result from the alternatives described above and fall within a narrow range. Alternative A (the No-Action alternative) represents the lower boundary for potential impacts and serves as the baseline value for all comparisons. Alternatives C and E are projected to produce the largest reductions in fuel consumption and resulting environmental impacts among the alternatives that would raise CAFE standards for MY 2008-11 light trucks (Alternatives B. C, D, and E), and their impacts are projected to be slightly larger if MDPVs are included under light truck CAFE standards in MY 2011. The impacts from the remaining alternatives that were examined would fall within this range. Section 4 examines these impacts in more detail, and presents quantitative estimates of their magnitude.

3. AFFECTED ENVIRONMENT

This section describes the resources that would be affected by the alternative CAFE standards considered in this analysis. The primary effects of setting fuel economy standards are expected to include changes in energy use, emissions of criteria pollutants and their chemical precursors, and emissions of greenhouse gases. This section also discusses the potential secondary CAFE effects, to the extent that they augment and clarify the discussion of the potentially affected environment. Following this discussion, Section 4 presents a comprehensive quantitative assessment of the potential impacts of alternative CAFE standards considered for MY 2008-11 light trucks, focusing principally on the primary impacts of these alternatives on energy use, criteria pollutant emissions, and greenhouse gas emissions.

ENERGY

U.S. demand for oil is expected to increase from 21 million barrels per day in 2004 to 28 million barrels per day in 2030. In the AEO2006 reference case, world oil consumption increases through 2030 at a rate of 1.4 percent annually, from 82 million barrels per day in 2004 to 118 million barrels per day in 2030 (AEO2006). Approximately 67 percent of the increase in world consumption is projected to occur in North America and emerging Asia. Energy use in the transportation sector is projected to increase at an annual rate of 1.8 percent through 2025 (AEO2006).

To meet this projected increase in consumption, worldwide production capacity would have to increase by more than 36 million barrels per day over current levels. OPEC producers are expected to supply 40 percent of the increased production. In contrast, U.S. crude oil production is projected to increase from 8.4 million barrels per day in 2004 to 9.6 million in 2015, and then begin declining, falling to 8.9 million barrels per day in 2025. By 2025, 60 percent of the petroleum products consumed in the U.S. are expected to be imported directly or refined from imported oil.[39]

Energy is an essential input to the U.S. economy, and having a strong economy is essential to maintaining and strengthening our national security. Secure, reliable, and affordable energy sources are fundamental to economic stability and development. Rising energy consumption poses a challenge to energy security, given increased reliance on global energy markets. As noted above, U.S. energy consumption has increasingly been outstripping U.S. energy production.

---

[39] Energy Information Administration, *Annual Energy Outlook 2006*, Table 11, http://www.eia.doe.gov/oiaf/aeo/pdf/aeotab_11.pdf

AIR QUALITY

Air pollution is a significant cause for concern because of its potential effects on public health and welfare. In response to these concerns, Federal regulations have been developed for six "criteria" pollutants, relatively commonplace pollutants that can accumulate in the atmosphere as a result of normal levels of human activity. The U.S. Environmental Protection Agency has established National Ambient Air Quality Standards (NAAQS) that reflect levels of each of these pollutants considered potentially harmful to public health. The six criteria pollutants are carbon monoxide (CO), airborne lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and fine particulate matter (PM).

Table 3-1 shows the primary and secondary air quality standards established by the NAAQS for each criteria pollutant. Primary standards are set at levels that are intended to protect against adverse effects on human health, while secondary standards are intended to protect against adverse effects on public welfare, such as damage to agricultural crops or vegetation, and damage to buildings or other property. Because each criteria pollutant has different potential effects on human health and public welfare, the NAAQS specify different permissible levels for each pollutant.

Table 3-1. National Ambient Air Quality Standards (NAAQS)

Pollutant	Standard Value		Standard Type
Carbon Monoxide			
8-Hour Average	9 ppm*	(10 mg/m^3)	Primary
1-Hour Average	35 ppm	(40 mg/m^3)	Primary
Nitrogen Dioxide (NO_2)			
Annual Arithmetic Mean	0.053 ppm	(100 µg/m^3)	Primary & Secondary
Ozone (O_3)			
1-Hour Average	0.12 ppm	(235 µg/m^3)	Primary & Secondary
Lead (Pb)			
Quarterly Average	1.5 µg/m^3		Primary & Secondary
Particulate Matter (PM 10) ***Particles with diameters of 10 micrometers or less***			
Annual Arithmetic Mean	50 µg/m^3		Primary & Secondary
24-Hour Average	150 µg/m^3		Primary & Secondary
Particulate Matter (PM 2.5) ***Particles with diameters of 2.5 micrometers or less***			
Annual Arithmetic Mean	15 µg/m^3		Primary & Secondary
24-Hour Average	65 µg/m^3		Primary & Secondary
Sulfur Dioxide (SO_2)			
Annual Arithmetic Mean	0.03 ppm	(80 µg/m^3)	Primary
24-Hour Average	0.14 ppm	(365 µg/m^3)	Primary
3-Hour Average	0.50 ppm	(1300 µg/m^3)	Secondary

* Parts per million. Parenthetical value is approximately equivalent concentration in micrograms per cubic meter.

Source: http://epa.gov/air/criteria.html

In addition, the NAAQS for some pollutants include standards for both short-term and long-term average levels. Short-term standards, which typically specify higher levels of a pollutant, are intended to protect against acute health effects from short-term exposure to high levels, while long-term standards are established to protect against chronic health effects resulting from long-term exposure to lower levels of a pollutant. Table 3-2 describes each criteria pollutant and its potential health effect.

Table 3-2. Criteria Air Pollutants and Potential Health Effects

Pollutant	Description	Potential Health Effects
CO	Colorless, odorless gas that is produced by incomplete carbon combustion	CO acts as an asphyxiant by interfering with the blood's ability to carry oxygen from the lungs to the rest of the body. It can impair the brain's ability to function properly and is a threat especially to individuals with cardiovascular disease.
Pb	Solid emitted usually as an inorganic particle from any processors that use lead such as smelters, battery manufactures, etc.	Inhalation and/or congestion can result in behavioral changes, learning disabilities, seizures, severe and permanent brain damage, and death.
NO_2	Reddish-brown, highly reactive gas formed from high temperature combustion through reactions involving nitrogen and oxygen.	NO_2 can irritate lungs, cause bronchitis and pneumonia, and impair an individual's resistance to infections.
O_3	Gas that is formed by VOC and NOX in the presence of heat and sunlight.	Exposure to O_3 can cause chest constrictions and irritations of the mucous membranes.
PM	Particulate matter either solid or liquid usually in the range of 0.005 to 100 micrometers in aerodynamic diameter. Other related terms include aerosols, dust, fumes, soot, etc.	In general, the smaller the PM, the deeper it can penetrate into the respiratory system, and the more damage it can cause. Depending on the size and composition, PM can damage lung tissue, aggravate existing respiratory and cardiovascular diseases, and cause cancer.
SO_2	Gas formed from combustion of fuels containing sulfur	As a gas, it is highly soluble in water and will likely be trapped in the upper respiratory tract causing irritations but less long-term damage. When entrained in an aerosol, SO_2 can reach far deeper into the respiratory system causing severe respiratory distress.
CO_2	Gas released to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), and wood and wood products are burned.	Increase in greenhouse gases can lead to climate change. Hot temperatures can lead to cardiovascular problems, heat exhaustion, and some respiratory problems. There may be an increased risk of infectious diseases due to increased temperatures. Heat can also increase the concentration of ground-level ozone.

Source: http://epa.gov/air/urbanair/6poll.html

The air quality of a geographic region is usually assessed by comparing the levels of criteria air pollutants found in the atmosphere to the levels established by the NAAQS. Concentrations of criteria pollutants within the air mass of a region are measured in parts of a pollutant per million parts of air (ppm) or in micrograms of a pollutant per cubic meter ($\mu g/m^3$) of air present in repeated air samples taken at designated monitoring locations. These ambient concentrations of each criteria pollutant are compared to the permissible levels specified by the NAAQS in order to assess whether the region's air quality is potentially unhealthful.

When the measured concentrations of a criteria pollutant within a geographic region are below those permitted by the NAAQS, the region is designated as an attainment area for that pollutant, while regions where concentrations of criteria pollutants exceed federal standards are called nonattainment areas. Nonattainment areas are required to develop and implement plans to comply with the NAAQS within specified time periods.

Our assessment of the energy and environmental impacts pertaining to criteria pollutants takes into account the anticipated effects of the Clean Air Act Tier 2 requirements. Under the Tier 2 requirements, passenger cars, SUVs, pickups, vans, and multi-duty passenger vehicles (MDPVs)[40] are subject to the same emission standards, regardless of whether they run on gasoline or diesel fuel. The Tier 2 regulations took effect beginning with MY 2004, and will be fully phased in over subsequent model years. The phase-in schedule for MDPVs under the Tier 2 program requires that 50% of the fleet must comply by MY 2008, and 100% by MY 2009.

EPA also regulates MDPVs under "Interim Non-Tier 2" standards, which apply to MDPVs on a phase-in schedule beginning with MY 2004. This phase-in schedule requires compliance at the following levels: 25% in 2004, 50% in 2005, 75% in 2006 and 100% in 2007. Beginning in 2008, half of MDPVs are expected to comply with Tier 2 standards while the remaining half continue compliance with the "Interim Non-Tier 2 Standards." The fraction of MDPVs complying with the Tier 2 Standards is expected to increase in succeeding years.

The U.S. transportation sector is a major source of emissions of certain criteria pollutants or their chemical precursors. Transportation-related sources are responsible for most emissions of carbon monoxide (CO), a criteria pollutant, and oxides of nitrogen (NO_X, a family of compounds that includes chemical precursors to ozone, NO_2, and PM). Transportation sources also contribute nearly half of total nationwide emissions of volatile organic compounds (VOC, which include other chemical precursors to ozone), as well as nearly a quarter of total PM emissions.

Contributions to airborne lead (Pb) and SO_X emissions (which include SO_2 and some precursors to PM) by transportation vehicles are extremely small, because federal regulations have eliminated lead and significantly reduced the presence of sulfur in transportation fuels. However, SO_X is also formed when gasoline is extracted from crude oil in petroleum refineries, while energy use in petroleum extraction and fuel refining also generates emissions of CO, VOC, NOx, SOx, and PM. The analysis of criteria pollutant emissions presented in Section 4 will focus on the potential effects from setting light truck CAFE standards on emissions of CO, NO_X, VOC, PM, and SO_X. As that analysis shows, each of the alternatives considered is expected to result in extremely small changes in emissions of criteria pollutants from the baseline scenario.

GREENHOUSE GASES

The global carbon cycle is made up of large carbon flows and reservoirs. Hundreds of billions of tons of carbon in the form of CO_2 are absorbed by oceans and living biomass (sinks) and are emitted to the atmosphere annually through natural processes (sources). When in equilibrium, carbon fluxes among these various reservoirs are roughly balanced. However, since the Industrial Revolution, changes in this equilibrium of atmospheric carbon have been observed. Atmospheric concentrations of CO_2 have risen principally because of fossil fuel combustion, which accounted for almost 98 percent of total U.S.

[40] MDPVs are light trucks with a GVWR between 8,500 lb. and 10,000 lb. designed primarily to transport passengers. *See* 40 CFR § 86.1803.01.

CO_2 emissions in 1998. Changes in land use and forestry practices can also result in the emission of CO_2 (e.g., through conversion of forest land to agricultural or urban use) or can act as a sink for CO_2 (e.g., through net additions to forest biomass).

Increasing concentrations of greenhouse gases are likely to accelerate the rate of climate change. Some scientific projections estimate that the average global surface temperature could rise 1-4.5°F (0.6-2.5°C) in the next fifty years, and 2.2-10°F (1.4-5.8°C) in the next century, with significant regional variation. Evaporation will increase as the climate warms, which will increase average global precipitation. Soil moisture is likely to decline in many regions, and intense rainstorms are likely to become more frequent. Sea levels could rise as much as two feet along most of the U.S. coastline.[41]

The transportation sector is a significant source of greenhouse gas (GHG) emissions, accounting for approximately 28 percent of all greenhouse gas emissions in the United States.[42] Although this figure includes emissions by other sources such as aircraft, ships, and locomotives, motor vehicles – including light trucks – account for the majority of transportation sector emissions. By themselves, light trucks account for 28 percent of U.S. transportation sector GHG emissions, although they represent a much smaller share – about 8 percent – of overall U.S.GHG emissions, since transportation is only one of several activities that generate emissions of greenhouse gases.[43]

As discussed in greater detail in Section 4, each of the alternatives examined in this analysis is projected to reduce light truck and total U.S. GHG emissions. Coupled with the effects resulting from the 2003 light truck rule, the effects resulting from the agency's current action are expected to lessen the GHG impacts discussed above.

WATER RESOURCES

Water resources include surface water and groundwater. Surface waters are sources open to the atmosphere, such as rivers, lakes, reservoirs, and wetlands. Groundwater is found in natural reservoirs or aquifers below the earth's surface. Sources of groundwater include rainfall and surface water, which penetrate and move through the soil to the water table.

---

[41] For information on emissions of greenhouse gases caused by human activity, their contribution to climate change, and its potential effects, see http://yosemite.epa.gov/oar/globalwarming.nsf/content/climate.html

[42] EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2004, [EPA-430-R-05-003], Draft, February 23, 2006, http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBSC3/$File/06_Complete_Report.pdf Table 2-16, pp. 45-46. This figure includes greenhouse gas emissions from sources other than road vehicles, including aircraft, ships and boats, locomotives, pipelines, and portable construction and industrial equipment.

[43] EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2004, [EPA-430-R-05-003], Draft, February 23, 2006, http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBSC3/$File/06_Complete_Report.pdf Table 2-16, pp. 45-46, and Table 2-17, pp. 47-48.

Water quality may be affected by changes in fuel consumption, as fuel consumption determines the level of oil drilling and oil transport activities, which in turn determine the risk of oil spills and leaks, pipeline blowouts, and water contamination during the drilling process. Additionally, fuel consumption determines the need for oil refining and associated oil refinery liquid waste and thermal pollution of waters near refineries (Epstein and Selber 2002). Water quality may also be affected by the frequency, intensity, and distribution of precipitation events, which could be influenced by climate change variability.

In addition, because of wet deposition of air pollutants, changes in air emissions of criteria pollutants could be a source of concern for their potential effects on water quality. The generation of air pollution decreases air quality and adversely impacts water resources through the creation of acid rain. NO_X and SO_X emissions are contributors to the formation of acid rain and acidification of freshwater bodies. The ecological effects of acid rain are most clearly seen in aquatic environments. Acid rain flows to streams, lakes, and marshes after falling on forests, fields, buildings, and roads. Acid rain also falls directly on aquatic habitats.[44]

As discussed in Section 4, each alternative examined in the agency's current action is expected to decrease NO_X and SO_X levels. These pollutants are also reduced when considering the cumulative effects of the 2003 light truck rule in combination with the effects of the current action. Thus, the agency's actions are expected to decrease acid rain generation, and to have beneficial impacts on water resources.

BIOLOGICAL RESOURCES

Biological resources consist of all terrestrial and aquatic flora and fauna and the habitats in which they occur. The U.S. Fish and Wildlife Service has jurisdiction over terrestrial and freshwater ecosystems and the National Marine Fisheries Service has jurisdiction over marine ecosystems. Protected biological resources include sensitive habitats and species under consideration for listing (candidate species) or listed as threatened or endangered by the U.S. Fish and Wildlife Service or by individual States. Sensitive habitats include areas protected by legislation or habitats of concern to regulating agencies.

Petroleum drilling, refining, and transport activities, as well as emissions from fuel consumption, have the potential to impact biological resources through habitat destruction and encroachment, and air and water pollution, raising concern about their effects on the preservation of animal and plant populations and their habitats. Oil exploration and extraction result in intrusions into onshore and offshore natural habitats, and may involve construction within natural habitats. Oil drilling and transportation can also result in oil spills and pipeline breaks; oil contamination of aquatic and coastal habitats can smother small species and is dangerous to animals and fish through oil ingestion and oil coatings on fur and skin. Similarly, oil refining and related activities

---

[44] See http://www.epa.gov/acidrain/index.html#what

result in water and thermal pollution, both of which can be harmful to animal and plant populations (Epstein and Selber 2002). Finally, offshore drilling and oil transport from other countries can lead to vessel grounding, vessel collision, and other accidents that could affect plant and animal communities and their environments.

Oil drilling, refining, and transport activities, as well as the burning of fuel during the operation of light trucks, result in air emissions that have an effect on air quality and that could have secondary effects on animal and plant populations and their supporting ecosystems. Potential effects on biological resources could be derived from particulate deposition and acid rain effects on water bodies, soils, and vegetation. Because of the interdependence of organisms in an aquatic ecosystem, acid rain and the changes it causes to pH or mineral and metal levels could affect biodiversity as well.

In addition, acid rain enhances eutrophication of lakes, estuaries, and coastal environments. Eutrophication, defined as enrichment of a water body with plant nutrients, usually results in communities dominated by phytoplankton, and could result in the contamination of aquatic environments and harmful algal blooms, among other undesirable effects. Acid rain also causes slower growth, injury, or death of forests, and has been linked to forest and soil degradation in many areas of the eastern United States. The acidification of soils can also produce depletion of soil minerals that result in harmful mineral deficiencies for plants and wildlife. As discussed further in Section 4, the estimated reduction in fuel production and consumption is projected to lead to minor reductions in impacts to biological resources.

LAND USE AND DEVELOPMENT

Land use and development refers to human activities that alter land (e.g., industrial and residential construction in urban and rural settings, clearing of forests for agricultural or industrial use) and may affect the amount of carbon or biomass in existing forest or soil stocks in the affected areas. For the purposes of this analysis, potential manufacturing plant changes that manufacturers may institute in response to the final rule are the principal issue. However, as discussed in Section 4, the agency expects that the manufacturers will comply with the CAFE standards by technology additions to existing and planned vehicle models, which will not require the construction of new facilities in addition to those already planned.

HAZARDOUS MATERIALS

Hazardous materials are solid, liquid, or gaseous materials that because of their quantity, concentration, or physical, chemical, or infectious characteristics may cause or contribute to an increase in mortality or an increase in irreversible illness or pose a substantial hazard to human health or the environment when improperly treated, stored, transported, or disposed of. Hazardous materials are designated by the Secretary of Transportation as posing an unreasonable risk to health, safety, property, and environment. Hazardous materials include hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, and materials identified by the DOT in the Code of Federal Regulations. Hazardous wastes are generated during the oil refining process. These wastes include oily sludges, spent caustics, spent catalysts, wastewater, maintenance and materials handling wastes, and other process wastes (Freeman 1995). Because the agency's action is expected to decrease crude petroleum extraction as well as fuel refining, storage, and distribution, it is expected to reduce hazardous waste generation.

4. ENVIRONMENTAL CONSEQUENCES

This section addresses the range of estimated environmental effects associated with the alternatives for MY 2008-11 light truck CAFE standards that were examined. This range is represented by Alternatives A through E, which were described previously in Section 2. Alternative A, which would extend the previously adopted MY 2007 light truck CAFE standard of 22.2 mpg to apply to MY 2008-11, serves as the baseline against which the alternatives that would increase light truck CAFE standards are compared. Alternative A also provides a lower boundary for the range of estimated environmental effects.

This section considers all impacts associated with the agency's action, but focuses on assessing the primary effects of that action, which are its impacts on energy use and criteria and greenhouse gas emissions. These impacts include the changes in energy use and emissions resulting from fuel consumption by the affected motor vehicles, as well as from energy use in the oil extraction, transportation, and refining processes.

The changes in lifetime fuel consumption, GHG emissions, and emissions of criteria air pollutants by MY 2008-11 light trucks that are projected to result from each alternative would be distributed over the entire period these vehicles are expected to remain part of the U.S. vehicle fleet. This period extends from 2008, when MY 2008 light trucks are produced and sold, through 2046, when virtually all MY 2008-11 light trucks will have been retired from service.[45] During any year of this period, however, MY 2008-2011 light duty trucks will account for only a limited fraction of total light truck fuel consumption and emissions, since vehicles produced before MY2008 and after MY2011 will account for most fuel use and emissions by the nation's light truck fleet.

ENERGY

Table 4-1 summarizes the projected impacts of the various alternatives on light truck fuel use and energy consumption for selected calendar years, and places these projected impacts in the larger context of the Energy Information Administration forecast of total fuel and energy use by the U.S. light truck fleet. As the table indicates, the estimated fuel and energy savings resulting from each alternative are projected to be largest in absolute terms during 2015, when most of the light trucks manufactured under the proposed stricter CAFE standard remain in the fleet, and to decline in succeeding years. The largest reductions in fuel consumption and energy use are projected to result from the Revised NPRM Reformed CAFE standard and the continuous function Reformed CAFE standard, and these reductions are slightly larger for the variation of those alternatives that includes MDPVs under the light truck CAFE standard in MY 2011.

[45] The year in which the fuel use and emissions impacts of these vehicles is largest depends on the fraction that remain in service during each year of their expected lifetimes, the decline in their average usage as they age, and the increase in their per-mile emissions that occurs as they age. The exact year at which this occurs varies depending on the particular impact in question.

Table 4-1. Estimated Changes in Light Truck Fuel Use and Energy Consumption Compared to Energy Information Administration (EIA) Forecast

Measure	Calendar Year	A. Baseline*	B. Unreformed CAFE	C. Reformed CAFE with Continuous Targets		D. NPRM Reformed CAFE	E. Revised NPRM Reformed CAFE	
				No MDPVs	MDPVs in 2011		No MDPVs	MDPVs in 2011
Fuel Consumption by MY 2008-11 Light Trucks (billion gallons)	2010	18.55	18.18	18.14	18.14	18.26	18.13	18.13
	2015	19.23	18.81	18.73	18.71	18.86	18.72	18.71
	2020	12.09	11.82	11.77	11.76	11.86	11.77	11.76
	2025	6.10	5.97	5.94	5.93	5.98	5.94	5.93
Percent Change in Fuel Consumption from Baseline	2010	--	-2.0%	-2.2%	-2.2%	-1.6%	-2.3%	-2.3%
	2015	--	-2.2%	-2.6%	-2.7%	-1.9%	-2.6%	-2.7%
	2020	--	-2.2%	-2.6%	-2.7%	-1.9%	-2.7%	-2.7%
	2025	--	-2.2%	-2.7%	-2.8%	-2.0%	-2.7%	-2.8%
Energy Consumption by MY 2008-11 Light Trucks (quadrillion BTU)	2010	2.125	2.082	2.077	2.077	2.092	2.077	2.077
	2015	2.202	2.155	2.145	2.143	2.160	2.145	2.143
	2020	1.385	1.354	1.348	1.347	1.358	1.348	1.347
	2025	0.699	0.683	0.680	0.679	0.685	0.680	0.679
Change in Energy Consumption by MY 2008-11 Light Trucks (quadrillion Btu)	2010	--	-0.04	-0.05	-0.05	-0.03	-0.05	-0.05
	2015	--	-0.05	-0.06	-0.06	-0.04	-0.06	-0.06
	2020	--	-0.03	-0.04	-0.04	-0.03	-0.04	-0.04
	2025	--	-0.02	-0.02	-0.02	-0.01	-0.02	-0.02
Total Energy Consumption by All U.S. Light Trucks** (quadrillion Btu)	2010	8.6	--	--	--	--	--	--
	2015	9.9	--	--	--	--	--	--
	2020	11.1	--	--	--	--	--	--
	2025	12.1	--	--	--	--	--	--
Percent Change in Total Energy Consumption by All U.S. Light Trucks	2010	--	-0.50%	-0.55%	-0.55%	-0.38%	-0.56%	-0.56%
	2015	--	-0.48%	-0.58%	-0.60%	-0.42%	-0.58%	-0.60%
	2020	--	-0.27%	-0.33%	-0.34%	-0.24%	-0.33%	-0.34%
	2025	--	-0.13%	-0.15%	-0.16%	-0.11%	-0.15%	-0.16%

*Value with MY 2007 light truck CAFE standard of 22.2 mpg remaining in effect for MYs 2008-11.
**Forecast of total energy use by U.S. light trucks with MY2007 light truck CAFE standard remaining in effect for MYs 2008-2025; source: Energy Information Administration, Annual Energy Outlook 2006 (http://www.eia.doe.gov/oiaf/aeo/index.html), Table 33.

Source: Estimated using NHTSA/Volpe CAFE Compliance and Effects Estimation Model; see text for description.

Table 4-2 shows the estimated effects of the alternatives on lifetime fuel consumption and energy use by MY 2008-2011 light trucks. As it indicates, the various alternatives that were considered would result in projected lifetime fuel savings for MY 2008-2011 light trucks ranging from 1.8 to 2.6 percent of their fuel use under the Baseline alternative, corresponding to 5.4-7.8 billion gallons.

These reductions in fuel and energy use would occur over the period from 2008, when the first light trucks produced under any of these alternative standards would be produced and sold, through the year 2047 when virtually all light trucks subject to the MY 2008-11 standards will have been retired from service. The estimated reductions in fuel production and use would also be expected to result in corresponding energy savings from reductions in crude oil extraction, storage, and transportation, as well as from reductions in gasoline refining or importation, storage, and distribution.

Table 4-2. Estimated Lifetime Fuel and Energy Use by MY 2008-2011 Light Trucks

Model Year(s)	A. Baseline*	B. Unreformed CAFE	C. Reformed CAFE with Continuous Targets		D. NPRM Reformed CAFE	E. Revised NPRM Reformed CAFE	
			No MDPVs	MDPVs in 2011		No MDPVs	MDPVs in 2011
	Lifetime Fuel Consumption (billion gallons)						
2008	72.4	71.8	71.6	71.6	72.0	71.5	71.5
2009	74.3	72.5	72.4	72.4	72.8	72.4	72.4
2010	74.9	72.9	72.7	72.7	73.4	72.7	72.7
2011	74.3	72.4	71.7	71.5	72.3	71.8	71.5
2008-11	295.9	289.7	288.4	288.2	290.5	288.4	288.2
	Change from Baseline (billion gallons)						
2008	--	-0.6	-0.7	-0.7	-0.4	-0.8	-0.8
2009	--	-1.8	-1.9	-1.9	-1.5	-1.9	-1.9
2010	--	-2.0	-2.2	-2.2	-1.5	-2.2	-2.2
2011	--	-1.9	-2.6	-2.8	-2.0	-2.6	-2.8
2008-11	--	-6.3	-7.5	-7.8	-5.4	-7.6	-7.8
	Percent Change from Baseline						
2008	--	-0.8%	-1.0%	-1.0%	-0.5%	-1.2%	-1.2%
2009	--	-2.4%	-2.6%	-2.6%	-2.0%	-2.6%	-2.6%
2010	--	-2.7%	-3.0%	-3.0%	-2.0%	-2.9%	-2.9%
2011	--	-2.5%	-3.5%	-3.8%	-2.7%	-3.5%	-3.7%
2008-11	--	-2.1%	-2.5%	-2.6%	-1.8%	-2.6%	-2.6%
	Lifetime Energy Consumption (quadrillion Btu)						
2008	8.3	8.2	8.2	8.2	8.2	8.2	8.2
2009	8.5	8.3	8.3	8.3	8.3	8.3	8.3
2010	8.6	8.4	8.3	8.3	8.4	8.3	8.3
2011	8.5	8.3	8.2	8.2	8.3	8.2	8.2
2008-11	33.9	33.2	33.0	33.0	33.3	33.0	33.0
	Change from Baseline (quadrillion Btu)						
2008	--	-0.06	-0.09	-0.09	-0.04	-0.10	-0.10
2009	--	-0.21	-0.22	-0.22	-0.17	-0.22	-0.22
2010	--	-0.23	-0.26	-0.26	-0.17	-0.25	-0.25
2011	--	-0.22	-0.30	-0.32	-0.23	-0.29	-0.32
2008-11	--	-0.72	-0.86	-0.89	-0.62	-0.87	-0.89
	Percent Change from Baseline						
2008	--	-0.8%	-1.0%	-1.0%	-0.5%	-1.2%	-1.2%
2009	--	-2.4%	-2.6%	-2.6%	-2.0%	-2.6%	-2.6%
2010	--	-2.7%	-3.0%	-3.0%	-2.0%	-2.9%	-2.9%
2011	--	-2.5%	-3.5%	-3.8%	-2.7%	-3.5%	-3.7%
2008-11	--	-2.1%	-2.5%	-2.6%	-1.8%	-2.6%	-2.6%

***Value with MY 2007 light truck CAFE standard of 22.2 mpg remaining in effect for MYs 2008-11.**

Source: Estimated using NHTSA/Volpe CAFE Compliance and Effects Estimation Model; see text for description.

AIR QUALITY

Each of the alternatives considered in this analysis is projected to result in extremely modest changes in total nationwide emissions of criteria pollutants and their chemical precursors. Table 4-3 reports estimated lifetime emissions of CO, VOC, NO_X, PM, and

SO_2 by MY 2008-2011 light trucks under each alternative, while Table 4-4 shows the changes in these lifetime emissions that would result under each alternative to the No Action baseline. As these tables show, emissions of VOC, NO_X, PM, and SO_2 are expected to decline from their Baseline levels under each of the other alternatives considered. In contrast, slight increases from Baseline levels in lifetime emissions of CO are projected to occur under each of the alternatives, because the decreases in upstream CO emissions do not completely offset the increases in tailpipe CO emissions resulting from the "rebound effect."[46]

Table 4-3. Estimated Lifetime Emissions of Criteria Pollutants and Greenhouse Gases by MY 2008-11 Light Trucks

Lifetime Emissions (million tons)	Model Year	A. Baseline*	B. Unreformed CAFE	C. Reformed CAFE with Continuous Targets		D. NPRM Reformed CAFE	E. Revised NPRM Reformed CAFE	
				No MDPVs	MDPVs in 2011		No MDPVs	MDPVs in 2011
Carbon Monoxide (CO)	2008	25.8	25.9	25.9	25.9	25.9	25.9	25.9
	2009	26.1	26.3	26.3	26.3	26.3	26.3	26.3
	2010	26.2	26.3	26.2	26.2	26.3	26.3	26.3
	2011	25.6	25.7	25.6	25.7	25.7	25.7	25.7
	2008-11	103.8	104.1	104.0	104.1	104.1	104.2	104.2
Volatile Organic Compounds (VOC)	2008	0.841	0.841	0.841	0.841	0.841	0.841	0.841
	2009	0.815	0.816	0.816	0.816	0.815	0.816	0.816
	2010	0.804	0.802	0.801	0.801	0.803	0.802	0.802
	2011	0.775	0.773	0.771	0.772	0.774	0.773	0.773
	2008-11	3.234	3.232	3.229	3.229	3.233	3.232	3.232
Nitrogen Oxides (NO_x)	2008	0.886	0.886	0.885	0.885	0.885	0.885	0.885
	2009	0.888	0.888	0.888	0.888	0.888	0.888	0.888
	2010	0.886	0.883	0.881	0.881	0.884	0.883	0.883
	2011	0.862	0.859	0.856	0.857	0.859	0.859	0.858
	2008-11	3.521	3.515	3.511	3.512	3.517	3.515	3.515
Fine Particulate Matter ($PM_{2.5}$)	2008	0.031	0.031	0.031	0.031	0.031	0.031	0.031
	2009	0.032	0.032	0.032	0.032	0.032	0.032	0.032
	2010	0.033	0.033	0.033	0.033	0.033	0.032	0.032
	2011	0.033	0.033	0.032	0.032	0.032	0.032	0.032
	2008-11	0.129	0.128	0.128	0.128	0.128	0.128	0.128
Sulfur Dioxide (SO_2)	2008	0.111	0.111	0.111	0.111	0.111	0.110	0.110
	2009	0.115	0.112	0.112	0.112	0.113	0.112	0.112
	2010	0.116	0.113	0.113	0.113	0.114	0.113	0.113
	2011	0.115	0.112	0.111	0.111	0.112	0.112	0.111
	2008-11	0.457	0.449	0.447	0.447	0.450	0.447	0.447
Carbon Dioxide (CO_2)**	2008	694	689	687	687	690	686	686
	2009	713	695	694	694	698	694	694
	2010	719	700	699	699	705	699	699
	2011	714	697	690	688	695	690	688
	2008-11	2,840	2,781	2,770	2,768	2,788	2,769	2,767

***Value with MY 2007 light truck CAFE standard of 22.2 mpg remaining in effect for MYs 2008-11.**

****Carbon dioxide (CO_2) emissions in million metric tons.**

Source: Estimated using NHTSA/Volpe CAFE Compliance and Effects Estimation Model; see text for description.

[46] For a complete discussion of the rebound effect and the specific estimate employed in this analysis, see NHTSA, *Final Regulatory Impact Analysis: Corporate Average Fuel Economy Standards for MY 2008-11 Light Trucks*, Chapter VIII.

Table 4-4. Estimated Changes in Lifetime Emissions of Criteria Pollutants and Greenhouse Gases by Model Year 2008-2011 Light Trucks

Lifetime Emissions (million tons)	Model Year	B. Unreformed CAFE	C. Reformed CAFE with Continuous Targets		D. NPRM Reformed CAFE	E. Revised NPRM Reformed CAFE	
			No MDPVs	MDPVs in 2011		No MDPVs	MDPVs in 2011
Carbon Monoxide (CO)	2008	0.0	0.1	0.1	0.0	0.1	0.1
	2009	0.2	0.2	0.2	0.1	0.2	0.2
	2010	0.1	0.0	0.0	0.1	0.1	0.1
	2011	0.0	0.0	0.0	0.1	0.1	0.1
	2008-11	0.3	0.2	0.3	0.3	0.4	0.4
Volatile Organic Compounds (VOC)	2008	0.000	0.000	0.000	0.000	0.001	0.001
	2009	0.001	0.001	0.001	0.001	0.001	0.001
	2010	-0.002	-0.003	-0.003	-0.001	-0.002	-0.002
	2011	-0.002	-0.004	-0.004	-0.002	-0.002	-0.002
	2008-11	-0.002	-0.006	-0.005	-0.001	-0.002	-0.002
Nitrogen Oxides (NO_x)	2008	0.000	0.000	0.000	0.000	0.000	0.000
	2009	0.000	0.000	0.000	0.000	0.000	0.000
	2010	-0.003	-0.004	-0.004	-0.001	-0.003	-0.003
	2011	-0.003	-0.005	-0.005	-0.003	-0.003	-0.003
	2008-11	-0.006	-0.010	-0.009	-0.004	-0.006	-0.006
Fine Particulate Matter ($PM_{2.5}$)	2008	0.000	0.000	0.000	0.000	0.000	0.000
	2009	0.000	0.000	0.000	0.000	0.000	0.000
	2010	0.000	0.000	0.000	0.000	0.000	0.000
	2011	0.000	0.000	0.000	0.000	0.000	0.000
	2008-11	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
Sulfur Dioxide (SO_2)	2008	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	2009	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
	2010	-0.003	-0.003	-0.003	-0.002	-0.003	-0.003
	2011	-0.002	-0.003	-0.004	-0.003	-0.003	-0.004
	2008-11	-0.008	-0.010	-0.010	-0.007	-0.010	-0.010
Carbon Dioxide (CO_2)*	2008	-5	-7	-7	-4	-8	-8
	2009	-17	-19	-19	-14	-19	-19
	2010	-19	-21	-21	-14	-21	-21
	2011	-18	-24	-26	-19	-24	-26
	2008-11	-59	-70	-73	-52	-71	-73

* Carbon dioxide (CO_2) emissions in million metric tons.

Source: Estimated using NHTSA/Volpe CAFE Compliance and Effects Estimation Model; see text for description.

During the year when the increases in light truck CO emissions resulting from the alternative CAFE standards considered in this analysis are expected to be largest, they would increase annual nationwide CO emissions from *all* sources by only about 0.01 to 0.02 percent.[47] Although the effect of increases in estimated CO emissions on measured

[47] The increases in lifetime CO emissions by MY 2008-11 light trucks projected to result from alternative CAFE standards are distributed over the entire period these vehicles are expected to remain part of the U.S. vehicle fleet, which extends from 2008 (the year when MY 2008 light trucks are produced and sold) through 2046 (the year when virtually all MY 2008-11 light trucks will have been retired from service). The exact year in which the increase in annual CO emissions from these vehicles is largest depends on the fraction that remain in service during each year of their expected lifetimes, the decline in their average usage as they age, and the increase in their per-mile emissions of CO that occurs as they age and accumulate mileage. Increases in annual CO emissions resulting from the alternative light truck CAFE standards considered in this analysis are projected to reach their maximum level in the year 2017 or 2018, depending on the specific alternative, and these increases are projected to range from 14 to 24 thousand

CO concentrations is somewhat uncertain (i.e., the relationship between CO emissions and CO ambient levels is not linear), these estimated increases in nationwide emissions would be expected to raise ambient CO levels throughout the U.S. by approximately this same percentage.

Analysis of EPA air quality monitoring data for the period from 2003 through 2005 indicates that increases in CO concentrations of the projected magnitude would not have resulted in additional exceedances of the Primary National Ambient Air Quality Standard (NAAQS) for CO during that period. Further, because the NAAQS are set at levels to protect human health, the projected CO levels are unlikely to result in adverse health impacts. [48]

GREENHOUSE GASES

Changes in carbon dioxide (CO_2) emissions were determined by combining the estimated reductions in CO_2 emissions resulting from lower fuel consumption with the projected reductions in upstream emissions resulting from lower fuel production and distribution. The reduction in carbon dioxide emissions resulting from lower fuel consumption by light trucks was estimated by assuming that the entire carbon content of the fuel that is saved would have been converted to carbon dioxide in the combustion process. The estimate of net fuel savings used to develop in this estimate reflects both the reduction in fuel consumption from improved light truck fuel economy, and the increase in driving and fuel use resulting from the rebound effect. Reductions in upstream CO_2 emissions were calculated using disaggregated emissions rates for fuel production and distribution obtained from Argonne National Laboratories' Greenhouse Gases and Regulated Emissions in Transportation (GREET) model.[49]

The reductions in lifetime carbon dioxide (CO_2) emissions by MY 2008-11 light trucks shown in Table 4-4 range from 52 to 73 million metric tons, corresponding to 1.8 to 2.6 percent of their expected level of 2,840 million metric tons under the Baseline alternative (shown previously in Table 4-3). The U.S. transportation sector accounted for 31 percent of total U.S. CO_2 emissions in 2004, and the nation's light truck fleet in turn accounted

tons. Total U.S. CO emissions were estimated to amount to 109,343 thousand tons during 2000, the most recent year for which these data are available; see U.S. EPA, National Air Quality and Emissions Trend Report, 2003, Table A-2, http://www.epa.gov/air/airtrends/aqtrnd03/pdfs/a2.pdf Thus the projected increases would amount to 0.01% to 0.02% of U.S. CO emissions from all sources during the year 2000.

[48] During the period from 2003 through 2005, there were a total of 5 exceedances of the 8-hour NAAQS for CO (there were no exceedances of the 1-hour NAAQS during this period). However, only 4 other 8-hour CO concentrations recorded at U.S. monitoring sites were within 5% of the 8-hour NAAQS for CO, and none of these was within 2% of the 8-hour NAAQS for CO. These figures were calculated from U.S. EPA, Air Quality Monitoring Data, http://www.epa.gov/air/data/monvals.html?us~USA~United%20States

[49] Argonne National Laboratories, *The Greenhouse Gas and Regulated Emissions from Transportation (GREET) Model*, Version 1.6, February 2002, http://www.transportation.anl.gov/ttrdc/greet/index.html .

for 28 percent of transportation sector CO_2 emissions.[50] The various alternatives for MY 2008-11 light truck CAFE standards would thus reduce U.S. greenhouse gas emissions by about 0.2 percent from the levels that would have been expected under the baseline alternative.[51]

WATER RESOURCES

The estimated reduction in fuel production and consumption is projected to lead to reductions in contamination of water resources. These include oil spills and leaks, pipeline blowouts, oil refinery liquid waste. The various alternatives are projected to result in overall reductions in NO_X and SO_2 emissions, resulting in benefits to water resources from reduced acid rain generation.

BIOLOGICAL RESOURCES

A decrease in fuel consumption can lead to environmental benefits by reducing oil exploration, drilling and extraction, transportation, and refining. Oil exploration and drilling often require deep intrusion into natural habitats. Oil drilling and extraction require heavy equipment, pipelines, and drilling structures that can disrupt wildlife and human communities, and may also lead to deforestation. Thus a decrease in oil drilling and extraction will have minor benefits for topographic and geological structures, which may be affected during onshore and offshore oil drilling. Offshore drilling can also contaminate sediments and lead to oil leakage into ocean water. Noise pollution from drilling can disrupt animals and humans. Oil drilling can also lead to oil spills and leakage, fires, and explosions, which can be harmful to wildlife and human health.

A decrease in fuel consumption can also lead to a decrease in oil transport. Accidental oil leaks and spills and pipeline bursts can occur between the point of extraction and the point of consumption. Oil leaks and spills and pipeline bursts can harm habitats, wildlife, coastal and inland waters, and human communities.

A decrease in fuel consumption will lead to reductions in the volume of fuel refined and related activities at petroleum refineries. Chemicals used in the refinery process and byproducts produced in the refining process can be toxic to wildlife and humans. The physical presence of refineries can harm natural habitats, wildlife, and human communities through thermal pollution, water contamination, noise pollution, and air pollution. Workers are also exposed to these hazards on a daily basis (Epstein and Selber 2002).

---

[50] U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2004* [EPA-430-R-05-003], Draft, February 23, 2006, http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBSC3/$File/06_Complete_Report.pdf ,Table 2-3, p. 24, and Table 2-17, pp. 47-48. However, the EPA definition of "light trucks" used for greenhouse gas accounting purposes is somewhat more expansive than the regulatory definition used by the Agency for this rulemaking.

[51] Calculated as (0.018 to 0.026) x 0.28 x 0.31x 100 = 0.16 percent to 0.23 percent.

The estimated reduction in fuel production and consumption is projected to lead to minor reductions in impacts to biological resources. These include habitat encroachment and destruction, air and water pollution, greenhouse gases, and oil contamination from petroleum refining and distribution.

LAND USE AND DEVELOPMENT

Major changes to manufacturing facilities might have implications for environmental issues associated with land use and development. However, analysis of available technologies and manufacturer capabilities indicates that manufacturers can comply with the levels in the considered alternatives by applying technologies rather than, for example, changing product mix in ways that would lead to manufacturing plant changes. Therefore, the various alternatives are not projected to have an impact on land use or development.

HAZARDOUS MATERIALS

The various alternatives are not projected to alter the existing regulatory framework governing the transportation or storage of hazardous materials. However, the projected reduction in fuel production and consumption may lead to a reduction in the amount of hazardous wastes created by the oil refining process.

CUMULATIVE IMPACTS

Under previous actions, the agency issued EAs to evaluate environmental impacts of CAFE standards, including the cumulative impacts of these past actions, and concluded that these actions would not result in a significant impact on the quality of the human environment. As noted previously, restrictions in the DOT and Related Agencies Appropriations Acts for FY 1996-2001 precluded the agency from setting CAFE standards differing from those in existence prior to the imposition of the restrictions. As a consequence, the agency's last CAFE action unaffected by the Congressional restrictions was taken almost 10 years ago, in 1994 (setting light truck standards for MY 1996 and MY 1997).

The first action taken by NHTSA to set CAFE standards since the lifting of the restrictions (other than the ministerial setting of standards at prescribed levels during the intervening years subject to Congressional restrictions) was the 2003 rule establishing light truck CAFE standards for MY 2005-07. Because of the substantial period of time that elapsed between the agency's last CAFE action that was unaffected by Congressional restrictions and the 2003 light truck rulemaking, and the significant changes in vehicle fleet composition and other parameters affecting the CAFE program that occurred during that period , we believe that the most practicable approach to evaluating cumulative impacts is to focus on impacts of activities that have occurred since the lifting of the Congressional restrictions.

To assess the cumulative impacts of the agency's actions since Congressional restrictions were lifted, we have estimated the impacts on lifetime fuel use and emissions by MY 2005-11 light trucks under each alternative considered for the current action. The impact of each alternative is measured by the difference between lifetime fuel use and emissions levels with that alternative in effect and the levels that would have occurred if the light truck CAFE standard of 20.7 mpg that existed prior to MY 2005 had remained in effect for MY 2005 through 2011.

The agency's 2003 Rule increased light truck CAFE standards from the previous standard of 20.7 mpg, to 21.2 mpg for MY 2005, 21.7 mpg for MY 2006, and 22.2 mpg for MY 2007. Thus, even the baseline alternative under the current action, which would extend the MY 2007 light truck CAFE standard established by the previous action, would result in CAFE standards for each MY from 2005 through 2011 above the 20.7 mpg standard that prevailed before the agency's previous action. As a consequence, each of the alternatives considered for the current action, including the baseline alternative, would affect lifetime fuel use and emissions of MY 2005-11 light trucks.

Our assessment of the cumulative energy and environmental impacts of each alternative for the current action also takes account of the anticipated effects of the Clean Air Act Tier 2 requirements. EPA projects that with the Tier 2/Gasoline Sulfur standards in effect, NOx and VOC emissions by light-duty vehicles will continue their current downward trend past the year 2020, despite continuing increases in VMT. When compared to the significant reductions in motor vehicle emissions that are expected to result from the Tier 2 standards, the cumulative increases in emissions of some criteria pollutants that are projected to result from increasing light truck CAFE standards under the previous and current actions are extremely small.

Table 4-5 shows the estimated cumulative effects of the agency's actions establishing light truck CAFE standards for MY 2005-07 and MY 2008-2011 on lifetime fuel consumption, energy use, emissions of criteria pollutants and greenhouse gases by MY 2005-2011 light trucks, under each alternative considered for the current action. These projected effects are measured by adding the effects of the agency's previous action to the effects projected to result from each alternative considered for the current action.[52]

Table 4-5 also reports lifetime fuel use and emissions by MY 2005-11 light trucks if the agency had taken neither the previous action to increase light truck CAFE standards for MY 2005-07 nor the current action to set standards for MY 2008-11. The lifetime energy use and emissions for MY 2005-11 light trucks shown for the Baseline alternative under the current action reflect those that would have occurred if the agency had taken its previous action to increase light truck CAFE standards to 22.2 mpg for MY 2007, but

[52] The estimated effects of the agency's previous action are reported in reported in *Final Environmental Assessment: National Highway Traffic Safety Administration Corporate Average Fuel Economy (CAFE) Standards, March 31, 2003, DOT-VNTSC-NHTSA-01-01*

took no further action and thus allowed light truck standards to remain at this level for MY 2008-11.

Table 4-5. Cumulative Effect of MY 2005-07 and MY 2008-11 Light Truck CAFE Standards on Lifetime Environmental Impacts of MY 2005-2011 Light Trucks

Impact	Without Previous Action*	With Alternative Actions for MY 2008-11:						
		A. Baseline**	B. Unreformed CAFE	C. Reformed CAFE with Continuous Targets		D. NPRM Reformed CAFE	E. Revised NPRM Reformed CAFE	
				No MDPVs	MDPVs in 2011		No MDPVs	MDPVs in 2011
Fuel Consumption (billion gallons)	537.8	525.0	518.7	517.5	517.3	519.6	517.5	517.2
Energy consumption (quadrillion BTU)	61.45	59.99	59.27	59.13	59.10	59.37	59.13	59.10
CO emissions (million tons)	109.2	109.8	110.1	110.1	110.1	110.1	110.2	110.2
VOC emissions (million tons)	7.523	7.536	7.533	7.530	7.530	7.534	7.534	7.533
NO_x emissions (million tons)	7.480	7.479	7.474	7.470	7.470	7.475	7.473	7.473
$PM_{2.5}$ emissions (million tons)	0.182	0.181	0.180	0.180	0.180	0.180	0.180	0.180
SO_2 emissions (million tons)	1.135	1.119	1.111	1.109	1.109	1.112	1.109	1.109
CO_2 emissions (million metric tons)	5,161	5,039	4,979	4,968	4,966	4,987	4,967	4,965

*Lifetime environmental impacts of MY2005-11 light trucks if MY2004 standard of 20.7 mpg had remained in effect for MY2005-11.

**Lifetime environmental impacts of MY2005-11 light trucks if MY2007 standard of 22.2 mpg remains in effect for MY2008-11.

Sources: Estimated using NHTSA/Volpe CAFE Compliance and Effects Estimation Model (see text for description) and impacts previously reported in *Final Environmental Assessment: National Highway Traffic Safety Administration Corporate Average Fuel Economy (CAFE) Standards, March 31, 2003, DOT-VNTSC-NHTSA-01-01.*

Table 4-6 expresses the information contained in Table 4-5 as the cumulative *changes* in lifetime fuel use, energy consumption, and emissions by MY 2005-2011 light trucks that would result from the agency's previous action to establish CAFE standards for MY 2005-7 and its current action setting standards for MY 2008-11. Table 4-6 shows how the cumulative effect of these two actions on the lifetime environmental impacts of MY 2005-11 light trucks would differ among the alternatives considered for the current action. The impacts reported in Table 4-6 represent changes in fuel consumption, energy use, and emissions over the lifetimes of MY 2005-2011 light trucks from those that would have resulted if the MY 2004 light truck CAFE standard of 20.7 mpg had been extended from MY 2005 through MY 2011, under each alternative for the current action.

As the first column of Table 4-6 shows, the lifetime environmental impacts of MY 2005-2011 light trucks under the Baseline alternative for MY 2008-2011 are projected to differ from the levels estimated to occur if the MY 2004 standard had been extended through MY 2011. This is because the Baseline alternative for the current action would extend the MY 2007 standard of 22.2 mpg adopted as part of the agency's previous action to apply to MY 2008-2011. As the entries in this column indicate, *additional* fuel savings and other impacts would result even under the Baseline alternative for the agency's current action, which would simply extended the MY 2007 standard of 22.2 mpg to MY 2008-11.

Table 4-6. Estimated Cumulative Changes in Lifetime Impacts of MY 2005-11 Light Trucks Under Alternative CAFE Standards for MY 2008-11

Impact	Cumulative Change in Impact with Alternative Actions for MY2008-11						
	A. Baseline*	B. Unreformed CAFE	C. Reformed CAFE with Continuous Targets		D. NPRM Reformed CAFE	E. Revised NPRM Reformed CAFE	
			No MDPVs	MDPVs in 2011		No MDPVs	MDPVs in 2011
Fuel Consumption (billion gallons)	-12.8	-19.0	-20.3	-20.5	-18.2	-20.3	-20.5
Energy consumption (quadrillion BTU)	-1.46	-2.18	-2.32	-2.34	-2.08	-2.32	-2.35
CO emissions (million tons)	0.6	0.9	0.9	0.9	0.9	1.0	1.0
VOC emissions (million tons)	0.012	0.010	0.007	0.007	0.011	0.010	0.010
NO_x emissions (million tons)	-0.001	-0.007	-0.011	-0.010	-0.005	-0.007	-0.007
$PM_{2.5}$ emissions (million tons)	-0.001	-0.002	-0.002	-0.002	-0.002	-0.003	-0.003
SO_2 emissions (million tons)	-0.016	-0.025	-0.026	-0.026	-0.023	-0.026	-0.026
CO_2 emissions (million metric tons)	-122	-182	-193	-195	-174	-194	-196

*** Change in lifetime environmental impacts of MY2005-11 light trucks if MY2007 standard of 22.2 mpg remained in effect for MY2008-11.**

Source: Estimated using NHTSA/Volpe CAFE Compliance and Effects Estimation Model (see text for description) and impacts previously reported in *Final Environmental Assessment: National Highway Traffic Safety Administration Corporate Average Fuel Economy (CAFE) Standards, March 31, 2003, DOT-VNTSC-NHTSA-01-01.*

As Table 4-6 indicates, in conjunction with the agency's previous action to increase light truck CAFE standards for MY 2005-07, each of the alternatives for the current action is projected to reduce lifetime fuel use, energy consumption, and greenhouse gas emissions by MY 2005-11 light trucks.

The agency estimates that together with the previous action raising MY 2005-07 light truck CAFE standards, the various alternatives for the current action will reduce lifetime carbon dioxide (CO_2) emissions from MY 2005-11 light trucks by 122 to 196 million metric tons, or by 2.4 percent to 3.8 percent from their level if neither action had been taken (5,161 million metric tons, reported previously in Table 4-5).[53] In 2004, the transportation sector accounted for 31 percent of U.S. carbon dioxide emissions, and the nation's light truck fleet in turn accounted for about 28 percent of U.S. transportation

[53] As Table 4-6 reports, the cumulative reductions in carbon dioxide emissions resulting from the agency's previous and current actions are projected to range from 122 to 196 million metric tons depending on the alternative for the current action. As Table 4-5 reported previously, lifetime carbon dioxide emissions by MY 2005-11 light trucks were projected to total 5,161million metric tons if the agency had taken neither the previous nor the current action to increase light truck CAFE standards, and had instead allowed the standard to remain at its level for MY 2004. Thus the reductions reported in Table 4-6 range from 2.4 to 3.8 percent of lifetime emissions for MY 2005-11 light trucks that would have occurred if the agency had taken neither action.

sector CO_2 emissions.[54] The various alternatives for MY 2008-11 light truck CAFE standards are projected to result in cumulative reductions from the previous and current actions ranging from 0.2 to 0.3 percent of U.S. greenhouse gas emissions over the lifetimes of MY 2005-11 light trucks.[55]

As Table 4-6 also reports, cumulative lifetime emissions of most criteria pollutants by MY 2005-11 light trucks would also decline slightly under each alternative for the current action. The exceptions to this pattern are CO and VOC emissions, which Table 4-6 shows would increase slightly under each alternative.

Each alternative under the current action would add slightly to the increases in CO emissions already expected to result from the previous action, thus adding to the cumulative impact of the agency's previous and current actions on lifetime CO emissions by MY 2005-11 light trucks. However, these cumulative increases would represent extremely small increases in total CO emissions from all sources under any of the alternatives for the current action. Depending on the alternative chosen, the cumulative lifetime CO emissions by MY 2005-11 light trucks are projected to increase by 0.6 to 0.9 percent from their levels if the agency had taken neither action.[56]

During the year when the cumulative increase in emissions by MY 2005-11 light trucks is expected to be largest, it would add about 0.03 to 0.05 percent to current annual nationwide CO emissions from all sources.[57] Because ownership and use of light trucks are distributed broadly over the nation, these estimated increases in nationwide emissions would be expected to raise total CO emissions and ambient CO levels in most areas of the

---

[54] U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2004* [EPA-430-R-05-003], Draft, February 23, 2006, http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBSC3/$File/06_Complete_Report.pdf Table 2-3, p. 24, and Table 2-17, pp. 47-48. However, that EPA definition of "light trucks" used for greenhouse gas accounting purposes is somewhat more expansive than the regulatory definition used by the Agency for this rulemaking.

[55] Calculated as (0.024 to 0.038) x 0.28 x 0.31x 100 = 0.21 percent to 0.33 percent.

[56] As Table 4-6 reports, the cumulative reductions in carbon monoxide (CO) emissions resulting from the agency's previous and current actions are projected to range from 0.6 to 1.0 million tons, depending on the alternative for the current action. As Table 4-5 reported previously, lifetime CO emissions by MY 2005-11 light trucks were projected to total 109.2 million tons if the agency had taken neither the previous nor the current action to increase light truck CAFE standards, and had instead allowed the standard to remain at its level for MY 2004. Thus the reductions reported in Table 4-6 range from 0.6 to 0.9 percent of lifetime emissions for MY 2005-11 light trucks that would have occurred if the agency had taken neither action.

[57] The cumulative increases in lifetime CO emissions resulting from the agency's previous action to establish light truck CAFE standards from MY 2005-07, together with the alternative light truck CAFE standards for MY 2008-11 considered in this analysis, are distributed as annual increases over the period from 2005 through 2046. These increases are projected to range from 36 to 59 thousand tons during the year when the two actions have their maximum cumulative impact on CO emissions. Total CO emissions by all sources in the U.S. were estimated to be 109,343 thousand tons during 2000; see U.S. EPA, National Air Quality and Emissions Trend Report, 2003, Table A-2, http://www.epa.gov/air/airtrends/aqtrnd03/pdfs/a2.pdf

U.S. by approximately this same percentage. Analysis of EPA air quality monitoring data for 2003 through 2005 indicates that increases in CO concentrations of this magnitude would have resulted in no additional exceedances of the National Ambient Air Quality Standards for CO during that period.[58]

The cumulative effect of the previous and current actions will also be to increase VOC emissions slightly under each alternative for the present action, because the largest reduction in VOC emissions for MY 2008-11 light trucks expected to result from any alternative under the current action is insufficient to offset the increase in VOC emissions for MY 2005-07 resulting from the previous CAFE rule. However, the maximum cumulative increase in VOC emissions by MY 2005-11 light trucks under any alternative for the current action would amount to less than 0.2% of their expected level if the agency had taken neither the previous nor this current action to increase light truck CAFE standards.

The cumulative increase in light truck VOC emissions resulting from these two actions would correspond to an increase of less than 0.003 percent of current annual VOC emissions from all sources during the year when it was largest.[59] Again, because light truck use is now distributed broadly over the nation, these estimated increases in nationwide VOC emissions would be expected to raise total VOC emissions and ambient levels in most areas of the U.S. by approximately this same percentage. The effect of increases in VOC emissions of this magnitude on the frequency of exceedances of the ozone NAAQS is extremely difficult to anticipate, because the contribution of VOC to ozone formation varies depending on their exact chemical composition, weather, other atmospheric conditions, and the presence of other chemical precursors of ozone.[60]

---

[58] *Exceedances* of the NAAQS occur whenever measured atmospheric concentrations of criteria pollutants recorded at an individual monitoring site exceed specified thresholds. Violations (or *nonattainment*) of the NAAQS occur when the frequency or severity of exceedances recorded at all monitoring sites within a prescribed geographic area exceed permitted levels. During the period from 2003 through 2005, there were a total of 5 exceedances of the 8-hour NAAQS for CO (there were no exceedances of the 1-hour NAAQS during this period). However, only 4 other 8-hour CO concentrations recorded at U.S. monitoring sites were within 5% of the 8-hour NAAQS for CO, and none of these was within 2% of the 8-hour NAAQS for CO. These figures were calculated from U.S. EPA, Air Quality Monitoring Data, http://www.epa.gov/air/data/monvals.html?us~USA~United%20States

[59] As with CO emissions, the cumulative increases in lifetime VOC emissions by MY 2005-11 light trucks projected to result from the agency's previous and current actions are distributed over the entire period these vehicles are expected to remain part of the U.S. vehicle fleet. Cumulative increases in annual VOC emissions resulting from the agency's previous action to set light truck CAFE standards for MY 2005-07, together with the alternative light truck CAFE standards for MY 2008-11 considered in this analysis, are projected to range from 530 to 690 tons in the year when they are largest. Total VOC emissions from all sources in the U.S. were estimated to be 20,384 thousand tons during 2000; see U.S. EPA, National Air Quality and Emissions Trend Report, 2003, Table A-5, http://www.epa.gov/air/airtrends/aqtrnd03/pdfs/a5.pdf

[60] VOC includes a large number of individual chemical compounds, which have different reactivities in forming ozone.

While the cumulative effect of the agency's previous and current actions on ozone levels at specific geographic locations is extremely difficult to anticipate precisely, it is important to note that each of the alternatives considered for the current action would *reduce* this cumulative impact. This is because as Table 4-6 shows, each alternative that would increase CAFE standards for MY 2008-11 light trucks is projected to offset partly the increase in VOC emissions projected to result from the agency's previous action setting CAFE standards for MY 2005-07 light trucks, which represents the Baseline alternative for the current action.

As Table 4-6 also shows, none of the alternatives for the current action would completely offset the effect of the previous action, since the cumulative effect of the two actions under each alternative would still be to increase lifetime VOC emissions by MY 2005-11 light trucks slightly. Nevertheless, each alternative that would increase CAFE standards for MY 2008-11 would reduce the cumulative impact of the agency's previous and current actions on VOC emissions.

SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS

Table 4-7 provides a qualitative summary of all projected environmental impacts for the baseline standard (22.2 mpg) and the alternative CAFE standards for MY 2008-11 light trucks that were analyzed. Each potential environmental impact from the agency's action is discussed briefly following Table 4-7. Table 4-8 summarizes the previous numerical estimates of the changes in fuel consumption, energy use, emissions of criteria pollutants, and greenhouse gas emissions projected to result under the Baseline alternative and each of the alternatives that would increase CAFE standards.

Table 4-7. Summary of Potential Environmental Impacts

Resource	Baseline Standard (22.2 mpg)	Analyzed Actions
Energy	Continuation of current energy trends characterized by an increase in fuel consumption for light trucks.	Slower rate of growth in fuel consumption for light trucks. Slower rate of growth in oil exploration and extraction, oil refining, and oil transport.
Criteria Pollutant Emissions	Continuation of air quality trends characterized by an increase in criteria pollutant emissions from oil refining and distribution and the operation of light trucks.	Minor overall increase in CO. Minor overall reductions in NO_X, PM 2.5, VOC, and SO_X. Overall minor changes in Air Quality based on extremely small changes in criteria pollutant emissions.
Greenhouse Gases	Increase in GHG emissions from oil refining and distribution and the operation of light trucks.	Reduction of GHG emissions.
Water Resources	Continuation of energy and air quality trends.	Minor benefit from reductions in energy consumption GHG emissions and extremely small changes in criteria pollutant emissions.
Biological Resources	Continuation of energy and air quality trends.	Minor benefit from reductions in energy consumption GHG emissions and extremely small changes to criteria pollutant emissions.
Land Use and Development	No new construction of light truck manufacturing plants.	No new construction of light truck manufacturing plants.
Hazardous Materials	Continuation of hazardous materials use and generation trends from the manufacturing of light trucks.	Minor reduction in the rate of growth of the generation of hazardous wastes (oily sludges, spent caustics, spent catalysts, wastewater, maintenance and materials handling wastes, and other process wastes) from the oil refining process. Continuation of hazardous materials use and generation from manufacturing of light trucks.

Energy. The alternatives analyzed for this action would result in lifetime fuel savings for MY 2008-2001 light trucks ranging from 5.4 to 7.8 billion gallons, corresponding to energy savings of 624-890 trillion BTU. They would also result in reductions in energy use during crude petroleum exploration and extraction, crude oil transportation, fuel refining, and storage and distribution of both domestically-refined and imported fuel.

Criteria Pollutant Emissions. Implementation of the analyzed actions would result in extremely small changes in emissions of criteria pollutants. In particular, there would be an overall increase in emissions of CO, but overall reductions in emissions of PM, VOC, and NO_X, and SO_X. On an annual basis, there would be small increases in emissions of CO during all years that MY 2008-11 light trucks remain in the fleet, in VOC emissions beginning in 2020-24 (depending on the alternative adopted), and under certain alternatives, in NO_X emissions beginning in 2021-23.

Modest reductions in emissions of VOC would occur through 2019 under each alternative, in NO_X emissions through at least 2021 (and through the analysis period under certain alternatives), and in PM 2.5 and SO_X throughout the study period under all alternatives. However, all of the projected changes in criteria pollutants are extremely small when compared to both total motor vehicle and transportation sector emissions.[61] They are also small when compared to the continued reductions in criteria pollutant emissions by motor vehicles that are expected over this period as a result of continued turnover of the light-duty vehicle fleet, stricter emissions standards for new light-duty vehicles, and federal motor fuel standards.

Greenhouse Gases. Each of the alternatives analyzed would reduce emissions of CO_2, the primary greenhouse gas generated by motor vehicle use, both on an annual basis and in total over the entire study period. While the projected reductions in CO_2 emissions would represent sizeable fractions of lifetime CO_2 emissions by MY 2008-11 light trucks, they would be much smaller when expressed as a percent of total CO_2 emissions by motor vehicles, transportation sector emissions, or total U.S. CO_2 emissions from all sources.

Water Resources. The projected reduction in fuel production and consumption should lead to reductions in contamination of water resources. These include oil spills and leaks, pipeline blowouts, oil refinery liquid waste. The analyzed actions could also result in overall reductions in NO_X and SO_X emissions, resulting in benefits to water resources from reduced acid rain generation.

Biological Resources. The projected reduction in fuel production and consumption should lead to minor reductions in impacts to biological resources. These include habitat encroachment and destruction, air and water pollution, and oil contamination from petroleum refining and distribution.

---

[61] See EPA, *Air Emissions Trends – Continued Progress Through 2003*, Complete Tables of National Emissions Totals, http://www.epa.gov/air/airtrends/aqtrnd04/pdfs/detailedtable.xls

Land Use and Development. Major changes to manufacturing facilities could have implications for environmental issues associated with land use and development. However, analysis of available technologies and manufacturer capabilities indicates that manufacturers would be able to meet the proposed standards by applying technologies rather than, for example, changing product mix in ways that would lead to manufacturing plant changes. Therefore, the analyzed actions are not expected to have impacts on land use or development.

Hazardous Materials. The analyzed actions would not alter the existing regulatory framework governing the transportation or storage of hazardous materials. However, the projected reduction in fuel production and consumption may lead to a reduction in the amount of hazardous wastes created by the oil refining process.

Table 4-8. Summary of Estimated Lifetime Environmental Impacts of MY 2008-2011 Light Trucks

Impact	Baseline Alternative*	Change from Baseline Impact:					
		Unreformed CAFE	Reformed CAFE with Continuous Targets		NPRM Reformed CAFE	Revised NPRM Reformed CAFE	
			No MDPVs	MDPVs in 2011		No MDPVs	MDPVs in 2011
Fuel Consumption (billion gallons)	295.9	-6.3	-7.5	-7.8	-5.4	-7.6	-7.8
Energy consumption (quadrillion BTU)	33.90	-0.719	-0.859	-0.888	-0.624	-0.865	-0.890
CO emissions (million tons)	103.8	0.3	0.2	0.3	0.3	0.4	0.4
VOC emissions (million tons)	3.234	-0.002	-0.006	-0.005	-0.001	-0.002	-0.002
NO_x emissions (million tons)	3.521	-0.006	-0.010	-0.009	-0.004	-0.006	-0.006
$PM_{2.5}$ emissions (million tons)	0.129	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
SO_2 emissions (million tons)	0.457	-0.008	-0.010	-0.010	-0.007	-0.010	-0.010
CO_2 emissions (million metric tons)	2,840	-59	-70	-73	-52	-71	-73

* Value with MY 2007 light truck CAFE standard of 22.2 mpg remaining in effect for MYs 2008-11.

Source: Tables 4-2 and 4-4.

As Tables 4-7 and 4-8 indicate, raising CAFE standards for light trucks leads manufacturers to increase the fuel economy of new light trucks, which reduces total fuel consumption over their lifetimes compared to its level if standards had been maintained at current levels. Reducing fuel use by light trucks in turn lowers energy consumption and, because all motor fuels are currently carbon-based, also reduces emissions of carbon dioxide (CO_2, a greenhouse gas) that occur during light truck use. Because extracting and transporting crude petroleum, refining it into fuel, and storing and distributing fuel also consume energy and generate emissions of criteria pollutants, reducing fuel consumption also lowers emissions of greenhouse gases and criteria air pollutants throughout the fuel production process.

Thus, increasing the fuel economy of light trucks unambiguously reduces energy use and greenhouse gas emissions. However, improving fuel economy also reduces the fuel cost of driving and thus leading to some additional use of light trucks, which increases their emissions of criteria pollutants. The net effect of higher light truck fuel economy on emissions of criteria pollutants thus depends on the relative rates at which they are emitted during vehicle use and fuel production, and because these relative rates differ among individual pollutants, the net effect of improving fuel economy on light truck emissions of each pollutant can also differ.

The alternatives examined for the MY 2008-11 light truck CAFE standard are each projected to reduce lifetime fuel consumption, energy use, and greenhouse gas emissions by these vehicles compared to the levels that would have resulted if the previous (MY 2007) standard were simply extended to apply to these model years (the Baseline alternative in this analysis). These reductions are projected to be modest (2 to 3 percent) when expressed in relation to their expected levels under the Baseline alternative, and much smaller in proportion to total energy use and greenhouse gas emissions throughout the transportation sector or the entire U.S. economy.

The alternative increases in the light truck CAFE standard examined in this analysis are also projected to result in net reductions in emissions of most criteria pollutants (or their chemical precursors) emitted by motor vehicles, including VOC, NOx, SO_2, and PM. These net reductions result from the fact that the reductions in emissions of these pollutants that result from lower fuel production and distribution are projected to more than offset the increases that result from increased light truck use. Thus, each alternative examined in this analysis would add to the continued reductions in emissions of criteria pollutants that are expected to result from stricter federal regulations on light-duty vehicle emissions and fuel composition over the next two decades.

The sole exception to this pattern is emissions of CO, where the increase in tailpipe emissions from added light truck use exceeds the reduction in emissions during fuel production and distribution, resulting in a net increase in CO emissions under each alternative that would increase light truck standards. However, the increases in CO emissions projected to result from each alternative are small by comparison to lifetime emissions by MY 2008-11 light trucks under the baseline alternative (0.2 to 0.4 percent). These increases in CO emissions are also extremely small when viewed in the context of the continued reductions in light-duty vehicle CO emissions that are projected to occur over their lifetimes as a result of stricter federal emissions regulations and fuel standards.

Further, the largest increase in annual CO emissions projected to occur over the lifetimes of light trucks affected by the rule is *extremely* small (0.01 to 0.02 percent) when expressed as a fraction of current nationwide CO emissions from all sources. Analysis of EPA air quality monitoring data indicates that if typical CO concentrations measured across the U.S. had been higher by this same proportion during recent years, no additional exceedances of the National Ambient Air Quality Standards (NAAQS) for CO would have occurred. Because the NAAQS are established at levels intended to avoid adverse effects on human health, this suggests that the resulting increases in ambient CO levels would have had no adverse effect on public health.

5. LIST OF AGENCIES CONSULTED

US Department of Energy

US Environmental Protection Agency

6. REFERENCES

Argonne 2002. *The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model, Version 1.6*. Argonne National Laboratory Transportation Technology. February 2002. http://www.transportation.anl.gov/ttrdc/greet/index.html.

EIA 2003. *International Energy Annual 2003,* Energy Information Administration. July 2005. http://www.eia.doe.gov/pub/international/iealf/tableh1co2.xls

EIA 2006. *Annual Energy Outlook 2006.* U.S. Department of Energy, Energy Information Administration. http://www.eia.doe.gov/oiaf/aeo/supplement/index.html.

EPA 2002a. *MOBILE Model (on-road vehicles)*. Office of Transportation and Air Quality, U.S. Environmental Protection Agency. http://www.epa.gov/otaq/mobile.htm.

EPA 2002b. *EPA Global Warming Site*. U.S. Environmental Protection Agency. http://www.epa.gov/globalwarming/index.html.

EPA 2002c. *EPA National Ambient Air Quality Standards (NAAQS)*. U.S. Environmental Protection Agency. http://www/epa.gov/airs/criteria.html.

EPA 2003. *National Air Quality and Emissions Trends Report, 2003*. http://www.epa.gov/air/airtrends/aqtrnd03

EPA 2005. MOBILE6 Vehicle Emission Modeling Software. http://www.epa.gov/otaq/m6.htm#m60

EPA 2006. Air Quality Monitoring Data. http://www.epa.gov/air/data/monvals.html?us~USA~United%20States

EPA 2006. *Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2004* [EPA-430-R-05-003]. February 23, 2006. http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2006.html.

Epstein, Paul R. and Selber, Jesse, ed. 2002. *Oil: A Life Cycle Analysis of its Health and Environmental Impacts*. Boston: The Center for Health and the Global Environment.

Freeman, Harry M. 1995. *Industrial Pollution Prevention Handbook*. United States: McGraw-Hill, Inc. pp.740.

NRC 2002. *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards*. Washington D.C.: National Academy Press.

NHTSA 1977. *Final Environmental Impact Statement, Proposed Rulemaking concerning Passenger Automotive Average Fuel Economy*. June 24, 1977

NHTSA 1978. *Final Impact Assessment of the Light Truck and Fuel Economy Standards for MY 1980 and 1981*. March 15, 1978.

NHTSA 1987. *Final Environmental Impact Statement for the Corporate Average Fuel Economy Standards for Light Trucks, Model Years 1985-1987*.

NHTSA 2003. *Final Environmental Assessment for MY 2005-2007 Light Truck CAFE Standards*, Docket NHTSA-2002-11419-18360. March 31, 2003.

NHTSA 2005. *CAFE Compliance and Effects Modeling System Documentation*, Docket NHTSA-2005-22223-3 and NHTSA-2005-22223-4.

NHTSA 2006. "Vehicle Survivability and Travel Mileage Schedules," Office of Regulatory Analysis and Evaluation, January 2006, Docket NHTSA-2005-22223-23.

NHTSA 2006. *Final Regulatory Impact Analysis: Corporate Average Fuel Economy Standards for MY 2008-11 Light Trucks*. March 2006.

Union of Concerned Scientists 2005. *Comments Concerning NHTSA's Notice of Proposed Rulemaking Regarding Average Fuel Economy Standards for Light Trucks – Model Years 2008-11*, Docket NHTSA-2005-22223-1978.