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U.S. Department of Transportation

National Highway Traffic Safety Administration

Memorandum

NHTSA-02-11419-18360

Subject: Final Environmental Assessment for MY 2005-2007 Light Truck CAFE Standards

Date: APR 1 2003

From: Noble N. Bowie, Director
Office of Planning and Consumer Standards

Reply to Attn. of:

To: Docket

Thru: Jacqueline Glassman
Chief Counsel

Please submit the attached Final Environmental Assessment and Finding of No Significant Impact to Docket 2002-11419; Notice 3.

Attachments (2)

DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

FINDING OF NO SIGNIFICANT ENVIRONMENTAL IMPACT

FOR

MODEL YEAR 2005-2007

LIGHT TRUCK FUEL ECONOMY STANDARDS

The National Highway Traffic Safety Administration (NHTSA) hereby determines that the model year 2005-2007 light truck fuel economy standards, described in the attached Environmental Assessment, will not have a significant effect on the human environment.

This finding of no significant impact is based on the attached Final Environmental Assessment (EA), which was prepared by the John A. Volpe National Transportation Systems Center and this agency. This EA, which is incorporated by reference, is a final version of the Draft Environmental Assessment prepared in support of the proposed rule. NHTSA has reviewed the EA and determined that it adequately and accurately discusses the environmental issues and impacts of the proposed action, and provides sufficient evidence and analysis for determining that an Environmental Impact Statement is not required.

March 31, 2003
Date

Jeffrey W. Runge, M.D.
Administrator

U.S. Department
of Transportation

**Research and Special
Programs Administration**

Final Environmental Assessment

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

March 31, 2003

Prepared by:

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13. ABSTRACT (Maximum 200 words) The National Highway Traffic Safety Administration (NHTSA) must set Corporate Average Fuel Economy (CAFE) standards for light trucks. This was authorized by the Energy Policy and Conservation Act, which added Title V: Improving Automotive Fuel Efficiency to the Motor Vehicle Information and Cost Saving Act (now codified at 49 U.S.C. Chapter 329). NHTSA is statutorily required to set CAFE standards at the "maximum feasible level" based on four criteria: technological feasibility, economic practicability, the effect of government motor vehicle standards on fuel economy and the need of the U.S. to conserve energy. With the lifting of the Congressional freeze on CAFE standards in December 2001, NHTSA is proposing new CAFE standards for MY 2005-2007 light trucks. To satisfy the requirements of the National Environmental Policy Act (NEPA), NHTSA, with the assistance of the John A Volpe National Transportation Systems Center (Volpe), prepared a Draft Environmental Assessment, assessing the potential environmental impacts associated with the proposed action. This Final Environmental Assessment provides responses to comments received on the Draft and includes refinements to the analytical methodology and assumptions.			
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LIST OF ACRONYMS

AFV	alternative fuel vehicle
CAFE	Corporate Average Fuel Economy
CARB	California Air Resources Board
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CNG	compressed natural gas
CO	carbon monoxide
CO_2	carbon dioxide
DMS	Docket Management System
DOE	Department of Energy
DOT	Department of Transportation
EA	Environmental Assessment
EPA	Environmental Protection Agency
EPCA	Energy Policy and Conservation Act
ESA	Endangered Species Act of 1973
GHG	greenhouse gases
g/mi	grams per mile
GREET	Greenhouse Gases and Regulated Emissions in Transportation Model
GVWR	gross vehicle weight rating
GWP	Global Warming Potential
HCHO	formaldehyde
HFCs	hydrofluorocarbons
HOV	high occupancy vehicle
LDGT	light-duty gasoline-fueled trucks
LEV	low emission vehicle
LTV	light truck
MMTCe	million metric tons of carbon equivalent
MOBILE	EPA Mobile Source Emission Factor Model
mpg	miles per gallon

MY	model year
N_2O	nitrous oxide
NAS	National Academy of Sciences
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NEPD	National Energy Policy Development (Group)
NHPA	National Historic Preservation Act of 1966
NHTSA	National Highway Traffic Safety Administration
NMHC	non-methane hydrocarbon
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
O_3	ozone
OEM	original equipment manufacturer
OPEC	Oil Producing and Exporting Countries
OTAQ	Office of Transportation and Air Quality
PATP	pay at the pump
PAYD	pay as you drive
Pb	lead
PC	passenger car
PFCs	perflourocarbons
PM	particulate matter
ppm	parts per million
SF_6	sulfur hexafluoride
SO_2	sulfur dioxide
SULEV	super ultra low emission vehicle
SUV	sport utility vehicle
ULEV	ultra low emission vehicle
VOC	volatile organic compounds

EXECUTIVE SUMMARY

This Final Environmental Assessment (EA) addresses comments received on a previously issued Draft EA and evaluates the potential environmental impacts associated with the National Highway Traffic Safety Administration's (NHTSA) action to set Corporate Average Fuel Economy (CAFE) Standards for Model Year (MY) 2005-2007 light trucks. The Draft and Final EAs were 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). Under NHTSA regulations these documents constitute an "Environmental Review Report." Light trucks are defined as vehicles of 8,500 lbs. gross vehicle weight rating (GVWR) or less, and include pickup trucks, vans (cargo and passenger), minivans, and sport-utility vehicles (NHTSA 1998). This Final EA describes the environmental resources that might be affected by the setting of CAFE standards, and assesses the impacts of the Proposed Action (21.0 mpg for MY 2005, 21.6 mpg for MY 2006, and 22.2 for MY 2007) against a baseline of 20.7 mpg (the most recent light truck CAFE standard, through MY 2004).

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Table ES-1 summarizes and compares the potential impacts for the baseline (20.7 mpg) standard and the Proposed Action. Discussion of specific resources follows the table.

Energy. Implementation of the Proposed Action would result in lifetime fuel savings for MY 2005-2007 light trucks of approximately 3.6 billion gallons (411 trillion BTU), and therefore a reduction in oil exploration and extraction, transport, refining, and importation.

Criteria Pollutant Emissions. Implementation of the Proposed Action would result in extremely small changes in emissions of criteria pollutants. In particular, there would be overall increases in emissions of CO, VOC, and NO_X, and overall reductions in emissions of PM, and SO_X. On an annual basis, there would be small increases in emissions of CO, VOC (after 2012), and NO_X (after 2013), and small reductions in emissions of VOC (up to 2011), NO_X (up to 2012), and PM 2.5 and SO_X throughout the study period. All changes in criteria pollutants are extremely small when compared to total vehicle and transportation emissions, respectively.

Greenhouse Gas Emissions. Implementation of the Proposed Action would result in extremely small changes in emissions of CO_2 (a greenhouse gas). In particular, there would be overall decreases in emissions of CO_2. On an annual basis, there would be small decreases in emissions of CO_2 throughout the study period. All changes in CO_2 are extremely small when compared to total vehicle and transportation emissions, respectively.

Table ES-1. Summary of Potential Impacts

Resource	Baseline Standard (20.7 mpg)	Proposed Action
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 increases in CO, VOC, and NO_X emissions and minor overall reductions in PM 2.5, and SO_X. Overall minor changes in Air Quality based on extremely small changes in criteria pollutant emissions.
Greenhouse Gas Emissions	Increase in GHG emissions from oil refining and distribution and the operation of light trucks.	Minor reduction of GHG emissions.
Water Resources	Continuation of energy and air quality trends.	Minor benefit from reductions in energy consumption, GHG emissions, and minor positive and negative effects based on 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 minor positive and negative effects based on 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 trends from the manufacturing of light trucks.

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 Proposed Action could also result in overall reductions in 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.

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 Proposed Action would have no impacts on land use or development.

Hazardous Materials. The Proposed Action 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.

1.0 PURPOSE AND NEED

1.1. INTRODUCTION

This document accompanies the rulemaking to set light truck fuel economy standards for Model Years (MY) 2005-2007. The term "light truck" includes pickup trucks, vans (cargo and passenger), minivans, and sport-utility vehicles that have a gross vehicle weight rating (GVWR) up to and including 8,500 pounds.

The National Environmental Policy Act of 1969 (NEPA)[1] and the implementing regulations of the Council on Environmental Quality (CEQ)[2] establish policies and procedures to ensure that information on environmental impacts is available to decision makers, regulatory agencies, and the public before Federal actions are implemented. The John A. Volpe National Transportation Systems Center prepared this Final Environmental Assessment (EA) to assist NHTSA in evaluating the potential environmental impacts associated with setting light truck fuel economy standards at the levels identified above. This EA satisfies the requirements of the CEQ regulations and NHTSA's Procedures for Considering Environmental Impacts (49 CFR Part 520) implementing the provisions of NEPA. Under NHTSA regulations this document constitutes an "Environmental Review Report."

The National Highway Traffic Safety Administration (NHTSA or "the Agency") analyzed the fuel economy improvement capabilities of light truck manufacturers for MY 2005-2007, with emphasis on the six light truck manufacturers with the largest market share (General Motors, Ford, DaimlerChrysler, Toyota, Honda, and Nissan). As a result of that analysis, the agency published in the **Federal Register** (67 FR 77015) a notice of proposed rulemaking (NPRM) to set the corporate average fuel economy (CAFE) standards at the levels shown in Table 1-1 (NHTSA 2002).

Table 1-1. Proposed Fuel Economy Standards for MY 2005-2007 Light Trucks

Model Year (MY)	CAFE Standard (mpg)
2005	21.0
2006	21.6
2007	22.2

[1] 42 U.S.C. § 4321 et seq.

[2] 40 CFR § 1500 et seq.

A Draft EA was placed in the docket in conjunction with the NPRM. NHTSA requested comments on the Draft EA in the NPRM. Throughout both the Draft EA and this Final EA, the proposed standards set forth in Table 1-1 are referred to as the "Proposed Action."

As part of this Final EA, a new appendix (Appendix D) has been added, with an analysis of non-attainment areas. Also, another appendix (Appendix E) has been added which provides a discussion and analysis of the comments received in response to the Draft EA, including comments on significant assumptions used in the Draft EA that were also used in other agency documents. Other changes of note between the Draft EA and this Final EA are:

- Update of values, tables, and figures in Chapter 4 as a result of the changes to assumptions and analytical methodology based on the comments received.
- Revisions to language in Chapter 2, concerning alternatives, and in the introduction, air quality and summary sections in Chapter 4 to address issues presented in the comments received.
- Nonattainment area analysis to study the potential effects of the increases in some criteria pollutants in selected nonattainment areas (Chapter 4 and Appendix D).

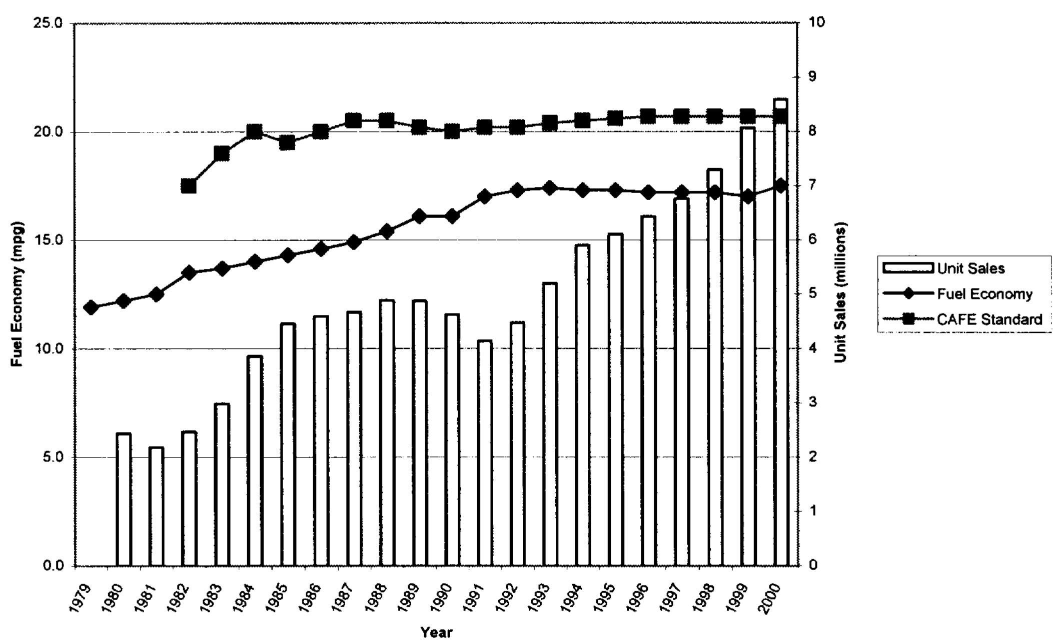
1.2. BACKGROUND

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 Act established an automotive fuel economy regulatory program by adding Title V, "Improving Automotive Fuel Efficiency," to the Motor Vehicle Information and Cost Saving 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. That section states that the standard is to be the maximum feasible average fuel economy level that the Secretary decides the manufacturers can achieve in that model year, taking into account 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. (For a detailed description of these criteria refer to the NPRM.) The Secretary has delegated the authority to administer the CAFE program to the NHTSA Administrator.

There is a penalty structure in place that dictates that a manufacturer whose light truck fleet does not meet the CAFE standard prescribed for a specific model year is liable to the United States Government for 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 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 a system whereby credits are allocated to manufacturers that 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. Figure 1-1 shows light truck fuel economy standards, actual fuel economy achieved, and light truck sales volumes for MY 1979-2000.

The DOT and Related Agencies Appropriations Acts for FY 1996-2001 each contained a provision that precluded the setting of CAFE standards differing from those promulgated prior to the enactment of FY 1996 appropriations and from spending any funds to collect and analyze data relating to CAFE levels. Hence, for the period covering MY 1998 through MY 2003, light truck CAFE standards remained at 20.7 mpg. The Congressional freeze was lifted in FY 2002. The MY 2004 light truck CAFE standard also remains at 20.7 mpg. By law, NHTSA must issue fuel economy standards 18 months prior to the beginning of the affected model year. Therefore, a final rule setting the MY 2004 light truck standard had to be issued by April 1, 2002. Due to this severe time constraint, NHTSA did not have sufficient time to lay the factual or analytical foundation necessary to establish the MY 2004 standard at a level other than 20.7 mpg.



Source: Fuel economy data from EIA 2002a.
Sales Volume: 1987-2000 data from Ward's Automotive Yearbook. 1980-1986 data from American Automobile Manufacturer's Association. The fuel economy numbers represented in this column reflect real world fuel economy estimates, which are arrived at by adjusting the EPA laboratory fuel economy numbers downward by 15 percent.

Figure 1-1. CAFE Standards, Actual CAFE Achieved, and Sales Volumes, 1973-2001

On February 7, 2002, after the lifting of the Congressional freeze, NHTSA published a Request for Comments (RFC) in the Federal Register (67 FR 5767), seeking information to assist NHTSA in setting CAFE standards for MY 2005-2010 light trucks. The RFC also requested comments on possible modifications or reforms to the CAFE program. The RFC discussed general issues that NHTSA considered in evaluating fuel economy, and directed specific questions to light truck manufacturers. The comment period closed on May 8, 2002. The RFC and responses from commenters can be found on the Department of Transportation Docket Management System (DMS) website at http://dms.dot.gov, searching under Docket No. 11419.

Manufacturers responded to the RFC in varying levels of detail. In particular, product plan information concerning model years beyond MY 2007 was much less detailed than the same information for MY 2005-2007. On the basis of the level of detail of information received in response to the February 7, 2002 notice, and the statutory requirement to issue at least the MY 2005 standards no later than April 1, 2003, the agency decided to limit the proposed action to MY 2005-2007 light trucks, rather than extending it to MY 2010. Additional agency actions and appropriate environmental analyses will address future model years.

1.3. 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 current standard (20.7 mpg), set in FY 1994 for MY 1996 and MY 1997, is in place through MY 2004, due to the restrictions in the FY 1996 – 2001 appropriations acts. With the lifting of the restrictions in December 2001, NHTSA must now take affirmative action to set the light truck standard at the maximum feasible average fuel economy level, based on the four statutory criteria identified above. Accordingly, NHTSA published an NPRM, proposing CAFE standards for light trucks for MYs 2005–2007 (See Table 1-1). The Agency action is consistent with the recommendations presented in the Administration's National Energy Policy.

1.4. SCOPE OF ANALYSIS

This Final EA analyzes the potential environmental impacts associated with the CAFE standards proposed in the NPRM and responds to comments submitted in response to the Draft EA. Responses to comments are set forth in Appendix E. Where we have changed analytical methodology, approach, or assumptions in response to comments, the changes are reflected in the analysis presented in Chapter 4 and Appendices B, C, and D of this Final EA.

The Final EA describes the environment and resources that might be affected by the setting of CAFE standards, and the types of impacts that are possible. The Final EA then assesses the impacts of the Proposed Action against a baseline of 20.7 mpg (the light truck CAFE standard in place through MY 2004). Finally, the analysis concludes with a section on cumulative impacts.

2.0 ALTERNATIVES

Outlined below are the action proposed in the NPRM, the No Action Alternative to the Proposed Action, and Other Alternatives, discussed within the unique context of the CAFE program and its statutory requirements.

2.1. PROPOSED ACTION

Under the action proposed by NHTSA in the NPRM, NHTSA would set CAFE standards for light trucks at 21.0 mpg for MY 2005, 21.6 mpg for MY 2006, and 22.2 mpg for MY 2007. These levels have been tentatively determined by NHTSA in the NPRM to be the maximum feasible average fuel economy levels, based on the four statutory criteria (NHTSA 2002). Throughout this Final EA, when addressing these proposed standards, we will refer to them as the *"Proposed Action."*

2.2. NO ACTION ALTERNATIVE

The alternative of taking no action is unavailable because 49 U.S.C. 32902(a) requires the Secretary of Transportation to prescribe, by rule, average fuel economy standards for light trucks. We have determined that the legal effect of inaction would be that no fuel economy standard would be in place for the years at issue, with the result that the fuel economy achieved by light trucks would be unconstrained. Therefore, pursuing the No Action Alternative would not effectuate the Congressional purpose underlying the enactment of the Energy Policy and Conservation Act—to conserve energy—and would contravene the statutory requirement that the agency take action.

The closest to a No Action Alternative available to the agency is to maintain the standard at the MY 2004 level of 20.7 mpg, in which case there would be no new impacts associated with the Agency's action relative to the standard set for MY 2004 in previous rulemaking. However, in accordance with statute, NHTSA must set CAFE standards for light trucks at the maximum feasible level, a level that is identified in the final rule as above 20.7 mpg for each of the model years under consideration. The No Action Alternative does not satisfy the statutory requirement to set the standard at the maximum feasible average fuel economy level, would not result in increased energy conservation, and is not considered a practicable alternative. However, the 20.7-mpg level will be used as a baseline against which to compare the Proposed Action and to evaluate potential environmental impacts. Throughout this EA, when addressing the 20.7-mpg level, we will refer to it as the "*Baseline.*"

2.3. OTHER ALTERNATIVES

Various commenters to the NPRM suggested that other alternatives to the setting of CAFE standards (such as tax policy) should be explored. We do not consider such alternatives here, as they are precluded by the limitations of our statute and could only be implemented after significant changes in government policy or legislation. An important purpose of alternatives analysis under NEPA is to lay out other options reasonably available to the decision-maker prior to the rendering of a final decision. However, as discussed in Section 2.2, above, the agency is statutorily required to set CAFE standards for light trucks, and the election of an alternative to that course of action is not a viable option, because it would violate the statute and leave the agency without a standard in place during the years at issue.

The agency is mindful, however, that the CAFE program has inherent deficiencies, and its operation over the last several decades may have produced unintended results. Consequently, we recognize the value of considering alternative approaches under the program, and have begun that process now that the Congressional freeze has been lifted. As noted in Section 1.2, in February 2002, NHTSA published a request for comments (RFC) in the Federal Register, seeking (among other things) comments on possible modifications or reforms to the CAFE program. The RFC seeks comment on such concepts as fuel economy credits, changes in vehicle weight classifications subject to CAFE, and the like. The agency is committed to continuing the exploration of alternatives it began with the publication of the RFC, and expects to publish a notice on this matter in the near future. In this way, NHTSA will ensure that agency decisions under the CAFE program are informed by a comprehensive understanding of the surrounding issues, and of alternatives that might be pursued in the longer term.

3.0 AFFECTED ENVIRONMENT

This Chapter briefly describes the range of resources that might be affected by the setting of CAFE standards and the types of impacts to health and the environment that might occur. Consult Chapter 4 for an evaluation of actual environmental impacts associated with the Proposed Action.

3.1. ENERGY

U.S. petroleum consumption has been steadily increasing recently, while U.S. petroleum production has been decreasing, as demonstrated in Figure 3-1. Consequently, U.S. net petroleum imports (defined as imports minus exports) have been increasing. The United States is increasingly dependent on imported oil, increasing its import oil share from 39.6 percent in 1991 to 55.5 percent in 2001. Domestic oil production has declined steadily since it peaked in 1985 and is expected to continue to decline by 0.2 percent per year from 2000 to 2020, with year 2020 production estimated at 5.6 million barrels per day. Although the U.S. holds only about three percent of the world's known oil reserves, it is the second largest oil producer (EIA 2002a).

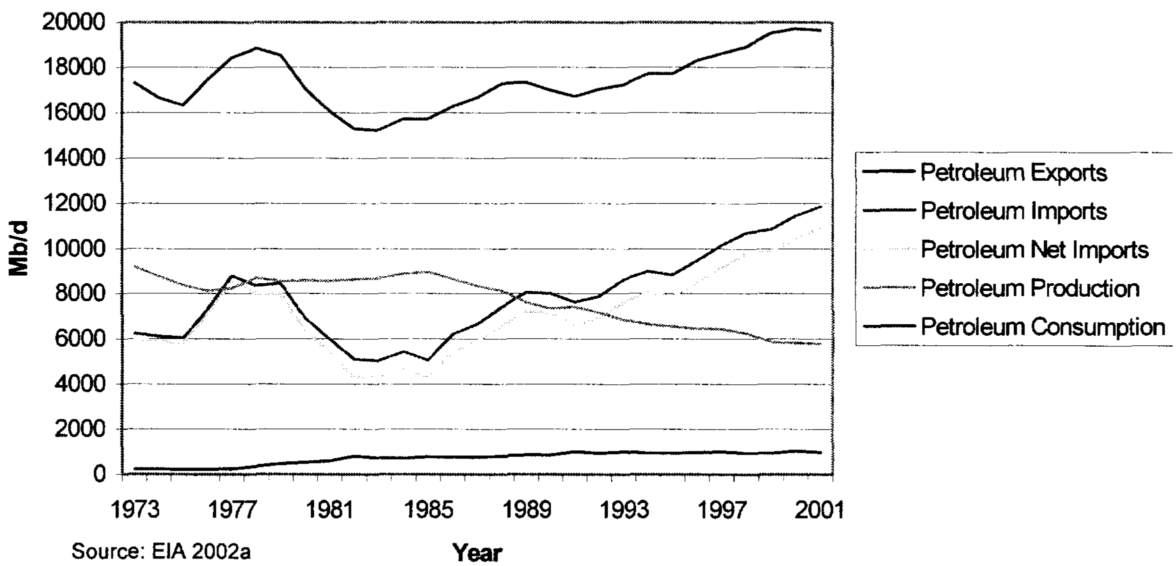
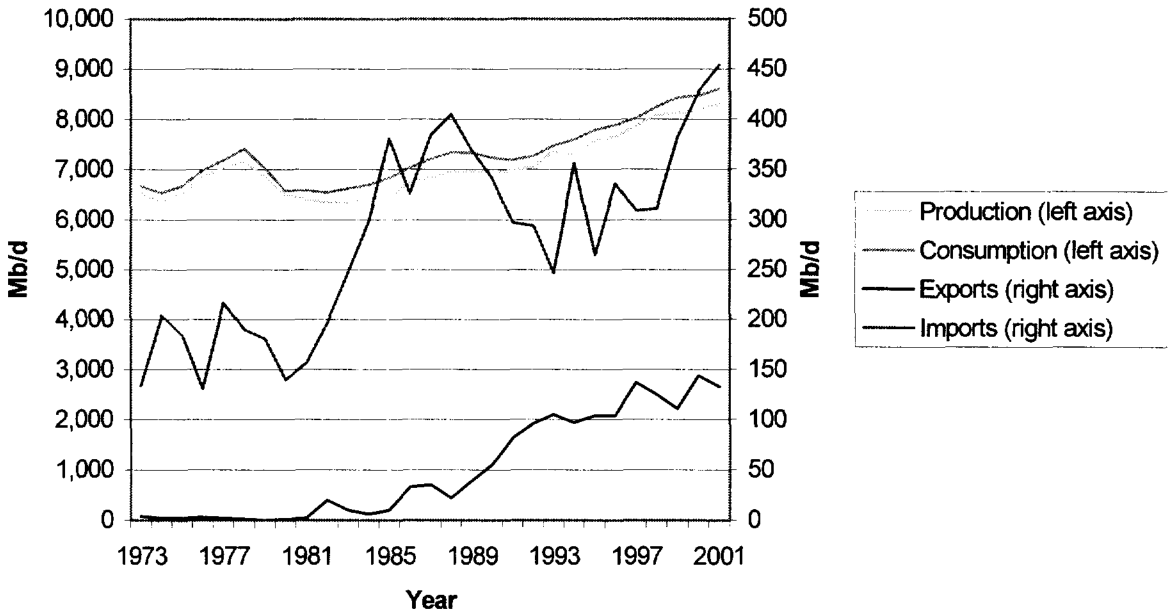


Figure 3-1. U.S. Petroleum Imports, Exports, Production, and Consumption 1972-2001

Energy demand growth in the transportation sector averaged 2.0 percent per year during the 1970s but was slowed in the 1980s by rising fuel prices and new Federal efficiency standards. Currently, oil accounts for 95 percent of all energy consumed in the transportation sector. Within the transportation sector, gasoline consumption and imports have been increasing over time, as shown in Figure 3-2.



Source: EIA 2002a

Figure 3-2. U.S. Transportation Gasoline Import and Export, 1973-2001

From 1991 to 2000, fuel consumption for light trucks has varied between 668 and 721 gallons per vehicle per year, following no specific trend. During this same time period light truck adjusted on-road fuel economy (which is calculated by adjusting the EPA laboratory fuel economy numbers downward by 15 percent) has varied between 17.0 and 17.5 miles per gallon, with average annual mileage for these vehicles ranging from 11,684 to 12,430 miles. Table 3-1 details annual light truck fuel consumption, fuel economy, and annual mileage for 1973 through 2000.

Table 3-1. Light truck fuel consumption, fuel rate, and mileage, 1973-2000

Date	Vans, Pickup Trucks and Sport Utility Vehicles, Fuel Consumption (gallons/vehicle)	Vans, Pickup Trucks and Sport Utility Vehicles, Fuel Economy (mpg)[1]	Vans, Pickup Trucks and Sport Utility Vehicles, Mileage (miles)
1973	931	10.5	9,779
1974	862	11	9,452
1975	934	10.5	9,829
1976	934	10.8	10,127
1977	947	11.2	10,607
1978	948	11.6	10,968
1979	905	11.9	10,802
1980	854	12.2	10,437
1981	819	12.5	10,244
1982	762	13.5	10,276
1983	767	13.7	10,497
1984	797	14	11,151
1985	735	14.3	10,506
1986	738	14.6	10,764
1987	744	14.9	11,114
1988	745	15.4	11,465
1989	724	16.1	11,676
1990	738	16.1	11,902
1991	721	17	12,245
1992	717	17.3	12,381
1993	714	17.4	12,430
1994	701	17.3	12,156
1995	694	17.3	12,018
1996	685	17.2	11,811
1997	703	17.2	12,115
1998	707	17.2	12,173
1999	701	17	11,957
2000	668	17.5	11,684

Source: EIA 2002a
[1]The fuel economy numbers represented in this column reflect real world fuel economy estimates, which are arrived at by adjusting the EPA laboratory fuel economy numbers downward by 15 percent.

In recent years, most auto manufacturers were able to meet the corporate average fuel economy standards for light trucks of 20.7 mpg, as shown in Table 3-2 (Ward's 2001).

Table 3-2. New Light Truck U.S. CAFE, MY 1993-2000

	1993	1995	1997	1998	1999	2000	2001	2002
CAFE Standard	20.4	20.6	20.7	20.7	20.7	20.7	20.7	20.7
Manufacturer	**Combined**	**Combined**	**Combined**	**Combined**	**Combined**	**Combined**	**Combined**	**Combined**
BMW	—	—	—	—	—	17.5	19.2	19.5
Chrysler	21.2	20.1	20.2	20.7	—	—	—	—
DaimlerChrysler	—	—	—	—	20.8	21.4	20.7	20.9
Ford	20.9	20.8	20.3	20.4	20.8	21.0	20.5	20.5
General Motors*	20.2	20.1	20.5	21.2	20.3	21.0	20.5	21.2
Honda	—	—	26.9	26.9	26.1	25.4	24.9	25.2
Isuzu	21.8	20.3	19.6	21.4	21.1	20.9	21.1	21.0
Kia		24.4	23.7	24.4	24.4	23.5	22.9	21.4
Land Rover	15.5	16.3	17.2	17.2	16.9	16.8	—	—
Mazda	23.6	20.9	—	—	—	—	—	—
Mercedes	—	—	—	21.3	—	—	—	—
Mitsubishi	21.3	20.2	21.9	22.9	22.4	21.5	—	—
Nissan	23.7	22.4	22.3	22.3	21.2	20.8	20.7	20.9
Subaru	29.1	—	—	—	—	—	—	—
Suzuki	28.9	28.1	27.4	27.4	23.8	23.0	22.0	21.8
Toyota	22.3	21.2	22.6	23.5	22.9	21.8	22.1	22.2
Volkswagen	21.0	19.6	18.5	—	19.1	18.9	20.5	20.4
Total Fleet	21.0	20.5	20.6	21.1	20.9	21.3	20.9	21.2

Note: Data is miles per gallon for trucks 8,500 lbs. Gross vehicle weight or less.
DaimlerChrysler includes Chrysler and Mercedes after MY 1998
Ford includes Mazda after MY 1995, Land Rover after MY 2000, and Volvo from inception.
CAFE Values include alternative fuel credits where applicable.

3.2. AIR QUALITY

3.2.1. Criteria Pollutant Emissions

Air quality is measured by determining the concentration of air pollutants present within the air mass of a region, in parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). Air pollutants are a significant cause of concern for both public health and welfare. In response to both of these concerns, Federal regulations have been developed for six criteria pollutants, under the National Ambient Air Quality Standards (NAAQS), that are considered harmful to public health and the environment. The six criteria pollutants are carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter (PM). Nitrogen dioxide reacts in the atmosphere over the course of several hours and is often referred to simply as nitrogen oxides (NO_X).

The ambient concentration of pollutants is compared with the EPA's NAAQS in order to measure air quality. There are two types of standards – primary and secondary. Table C-1 in Appendix C shows these standards. Primary standards protect against adverse health effects; secondary standards protect against adverse welfare effects, such as damage to farm crops and vegetation and damage to buildings. Because different pollutants have different effects, the NAAQS for each pollutant is different. Some pollutants have standards for both long-term and short-term averaging times. The short-term standards were designed to protect against acute, or short-term, health effects, while the long-term standards were established to protect against chronic health effects.

When a geographic area falls within the NAAQS established by the Clean Air Act, it is called an attainment area; when concentrations of criteria pollutants in the region exceed the standards, it is called a non-attainment area. The EPA continuously monitors ambient air quality within counties and air basins in the U.S. A detailed description of the criteria pollutants and their sources, current status, and potential health effects is presented in Appendix C.

As shown in Table C-3 of Appendix C, transportation sources in the United States account for the highest or second highest levels of emissions for several pollutants. The transportation sector continues to be a substantial source of air pollutants at the national level, and is responsible for most of the total CO and NO_X emissions, close to half of the total VOCs (volatile organic compounds), and a quarter of total PM emissions. The contributions to Pb and SO_X emissions from vehicles are relatively less, partly due to their reduced presence in transportation fuels (Pb has essentially been eliminated from gasoline). However, SO_X is formed when fuel that contains sulfur, such as coal and oil, is burned, and when gasoline is extracted from oil in petroleum refineries. Thus, the analysis of criteria pollutant emissions presented in Chapter 4 will focus on the effects of the Proposed Action on CO, NO_X, VOC, PM, and SO_X emissions.

3.2.2. Greenhouse Gas Emissions

The transportation sector – specifically, motor-vehicle operation – is also a substantial contributor to greenhouse gas emissions, accounting for approximately one third of all greenhouse gas emissions in the United States. The operation of motor vehicles, including light trucks, accounts for the majority of these emissions. Thus, this Final EA examines the effects of the proposed light truck CAFE standards on the greenhouse gases. Greenhouse gases occur naturally, but also result from human activities, such as fossil fuel combustion, industrial processes, agricultural activities, deforestation, and waste treatment activities.

CO_2 is one of the main products of motor vehicle exhaust and, although it does not directly impair human health and is not regulated, in recent years it has started to be viewed as an issue of concern for its global climate change potential. The analysis includes calculations of changes of CO_2 as representative of emissions of greenhouse gases.

3.3. 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.

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).

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 are contributors to the formation of acid rain and acidification of freshwater bodies (EPA 2001). 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.

3.4. 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. Also, oil drilling and transport 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 activities 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 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. Finally, emissions of criteria pollutants and greenhouse gases could result in ozone layer depletion and promote climate change that could affect species and ecosystems.

3.5. 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 Final EA, the main concern over land use and development issues is potential manufacturing plant changes that manufacturers may institute to respond to the Proposed Action.

3.6. 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 significantly 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).

4.0 ENVIRONMENTAL CONSEQUENCES

This Chapter addresses the potential environmental impacts associated with the Proposed Action, as compared to the Baseline (20.7 mpg). It begins with a discussion of assumptions, methodologies, and limitations, and how these might affect the reliability of the impact assessment. Next, it considers energy use, from the standpoint of both the refined fuel consumed by the affected motor vehicles and the energy used in the oil extraction, transportation, and refining process. Finally, it considers the impacts on environmental resources.

4.1. ASSUMPTIONS, METHODOLOGIES, AND LIMITATIONS

4.1.1. Assumptions and Methodologies

The following assumptions and methodologies were used to assess and quantify the environmental effects of the Proposed Action. It is important to note that these assumptions are inherently uncertain. However, the quantitative information presented in this chapter provides reasonable estimates of the approximate impacts of the Proposed Action. These estimates can also be used for comparison with national level projections.

Key analytical and modeling assumptions are described below. For further detail, refer to Appendix A.

Baseline. For purposes of this Final EA, it is assumed that under the Baseline, the light truck CAFE standards for each of MY 2005-2007 would remain at the 20.7-mpg level. The Baseline is used to measure the potential effects of the Proposed Action. Some manufacturers already exceed this level, or have indicated plans to do so during one or more of MYs 2005-2007. Other manufacturers have indicated plans to achieve a level below 20.7 mpg, reflecting unadjusted CAFE levels (*i.e.*, CAFE levels that do not account for credit use or adjustments to fuel economy levels for alternative- and flexible-fuel vehicles).

Technology Use. The analysis assumes that the fleet mix will remain the same, and that fuel economy increases will result from technological changes. Two major elements of the model methodology include: (1) projections of the technical characteristics and sales volumes of future product offerings, and (2) estimates of the applicability and incremental cost and fuel savings associated with different technologies that might be utilized. This information was used, along with assumptions about the value of anticipated fuel savings to vehicle purchasers, to estimate the level of technology utilization each manufacturer might undertake in response to the Proposed Action. Standard stock accounting and valuation techniques were then used to estimate corresponding future fuel consumption – and associated criteria pollutant and carbon emissions changes. Undiscounted environmental impacts were estimated separately for each model year over its lifetime in the U.S. vehicle fleet.

MY Lifetime and Survival Rate. Environmental impacts resulting from the Proposed Action were estimated separately for each model year over its lifespan in the U.S. vehicle fleet, extending from the initial year when the model year is offered for sale through the year when nearly all vehicles from the model year have been retired or scrapped (approximately 25 years). A "survival rate" is assumed by applying estimates of the proportion of vehicles surviving at each age interval up to 25 years. Undiscounted environmental impacts resulting from a tighter CAFE standard were estimated separately for each model year over its lifetime. (For more details see Appendix E, Section 3).

Lifetime and Annual Data. Fuel consumption and emissions information is presented in lifetime and annual data formats. Lifetime data present a summary of aggregate changes over 25 years. Annual information is also important because energy and emissions budgets are developed on an annual basis. The three calendar years corresponding to the model year light trucks affected by the Proposed Action (2005, 2006, and 2007) were considered, as well as years 2010, 2015, and 2020. The year 2020 was selected as the end-point for annual data since it corresponds with the year used in energy and environmental forecasts and projections (EIA 2002). The five-year intervals were chosen to capture additional information. See Appendices B and C for detailed annual data.

Rebound Effect. Tightening CAFE standards reduces the fuel component of the cost of operating light-duty vehicles, leading to an increase in vehicle use. The resulting increase, termed the "rebound effect," offsets part of the reduction in gasoline consumption and petroleum use that results from improved fuel efficiency.

The most recent estimates of the magnitude of the rebound effect for light-duty vehicles fall in the relatively narrow range of 10% to 20%, which implies that increasing vehicle use will offset 10–20% of the fuel savings resulting from an improvement in fuel economy. A rebound effect of 20% was employed after reviewing the literature; this value was selected as reasonable by according greater emphasis to studies that analyze more recent data on light duty vehicle use. The rebound effect produces a corresponding increase in the total number of miles driven for each subsequent calendar year the subject vehicles remain in the fleet. (For more details see Appendix E, Section 1).

Vehicle-Miles-Traveled (VMT). The analysis assumes a baseline average annual VMT growth rate of 1.8 %[3] over the entire study period. The growth rate was used to project future travel trends and to calculate the resulting emissions from all vehicles in the fleet. Estimates of future emissions from all vehicles were used as a baseline, and compared with the contribution of emissions from the light trucks affected by the Proposed Action.

Fuel Production. The demand for fuel for MY 2005-2007 light trucks was assumed to be supplied by a combination of imported refined gasoline and domestic refining of crude

[3] Based on EIA (2002b).

oil. Based on a review of historical data and on modeling using the National Energy Modeling System (NEMS), we assigned a 50% share to imports of refined gasoline and a 50% share to domestically refined crude oil for the marginal changes in fuel consumption. (For more details see Appendix E, Section 2.)

Industry-wide Estimates of Environmental Effects. The analysis developed for the Final EA relies on industry-wide estimates of effects, such as changes in fuel consumption and emissions. This level of aggregation is consistent with the estimation of national-scale environmental effects. However, in some cases, the Final EA reports effects on an average per-vehicle basis. Such reporting provides an alternative sense of scale that may make the information more easily accessible to the reader.

Manufacturing Plans. Although current CAFE levels and product plans vary among manufacturers, the proposed changes to light truck CAFE standards would not likely require any manufacturers to change light trucks in ways that would have important environmental effects unrelated to vehicle use. Rather, all manufacturers would likely 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 significantly alter the quantity or mix of materials used for vehicle production.

Criteria Pollutant Emissions Deterioration. The MOBILE6.2 model projects significant emissions deterioration over a vehicle's useful life. In particular, the model projects that CO, VOC, and NO_X emission rates would each increase over the useful life of trucks affected by the Proposed Action. This increase plays an important role in the evolution of total annual emissions from trucks sold as they age. Emissions associated with the rebound effect and marginal changes in petroleum supply are also influenced.

Greenhouse Gas Emissions. The analysis includes calculations of changes of CO_2 emissions from light trucks due to the Proposed Action, but not calculations of changes in emissions of other greenhouse gases. When different species are weighted by their respective global warming potentials, carbon dioxide accounts for more than 95% of the total greenhouse gas emissions from the transportation sector (EPA 1999a). Additionally, CO_2 emissions result directly from and are directly proportional to the combustion of fuels. Because of the importance of CO_2, and because the other greenhouse gases make only a minor contribution, the analysis focuses on assessing CO_2 as representative of all greenhouse gases. The Intergovernmental Panel on Climate Change (IPCC) guidelines also employ CO_2 as representative of greenhouse gas emissions (EPA 2002b).

4.1.2 Limitations

The emissions estimates presented in this section are dependent on both the rebound effect and the marginal dynamics of petroleum supply, both of which are highly uncertain. If the actual additional vehicle miles driven are smaller or larger than the range assumed for the rebound effect, for example, the model could be over or under-estimating the resulting impacts. Thus, the calculations of net emissions changes are also uncertain. However, the analysis yields estimates of net emissions changes that are, without exception, extremely small relative to aggregate national emissions. In addition, under any set of reasonable assumptions regarding the marginal petroleum supply, the magnitude of these calculated net changes in criteria pollutants is extremely small.

The results of the analysis are also highly dependent on projections of future vehicle survival rates and annual use (*i.e.*, VMT). If actual values diverge from these projections, the proposal's actual effects will differ from the estimates presented in this Final EA.

Actual CAFE levels achieved may differ from the assumptions in the calculations. However, the manufacturer response is estimated for both the Proposed Action and the Baseline and the analysis takes into account the possibility of over and under compliance.

With respect to the impacts on reduced refinery emissions due to decreases in consumption, a recent EIA report states that increases in fuel economy standards, depending on the magnitude and timing of such increases, will yield a similar share of gasoline consumption savings, reflected in reduced imports of gasoline (EIA 2002c). However, estimates of market responses relating to gasoline imports and domestic refining are variable and highly uncertain, such that other refining/import scenarios are plausible.

4.2. ENERGY

A change in CAFE standards changes fuel consumption. Air quality and other resources are impacted by changes in fuel consumption. For example, a decrease in fuel consumption due to higher CAFE standards may cause a decrease in oil refining and distribution emissions, but an increase in tailpipe emissions attributable to the assumed rebound effect.

In order to estimate the impacts of the Proposed Action, the total energy consumption of the affected trucks in the fleet for a 25-year lifetime will be calculated, as well as a yearly analysis of gasoline consumed. These data will then be compared to the fuel used under the Baseline.

4.2.1. Baseline

Lifetime Fuel Consumption

The methodology described in Appendix A was used to estimate the total fuel consumption for MY 2005-2007 light trucks throughout their lifetime in the fleet under the Baseline. The total would be approximately 218.7 billion gallons (25,050 trillion BTU).

Annual Fuel Consumption

A yearly analysis of gasoline consumption was developed to illustrate the effects of light truck fuel consumption over time in "Annual Snapshots." Fuel consumption data for the same calendar years as the proposed action (2005, 2006, and 2007), and for 2010, 2015, and 2020 are presented. Figure 4-1 shows the total gallons of fuel consumed on an annual basis for those calendar years. These numbers are aggregated across MY 2005-2007. Thus, the calendar year 2005 consumption value includes MY 2005 and MY 2006 light trucks that are sold and operated in calendar year 2005, the calendar year 2006 consumption value includes MY 2005 light trucks operating in calendar year 2006 plus MY 2006 and MY 2007 light trucks sold and operated in calendar year 2006, and the calendar year 2007 consumption value includes MY 2005, MY 2006, and MY 2007 light trucks operating in calendar year 2007. The calendar year 2010, 2015, and 2020 values include the MY 2005-2007 light trucks still operating in each respective calendar year.

Figure 4-1 shows a projected increase in gallons of gasoline consumed during calendar years 2005 through 2007 by MY 2005-2007 light trucks as the number of vehicle introductions of those model years increase. The amount of gasoline consumed during calendar years 2010-2020 by MY 2005-2007 light trucks is projected to decrease because vehicle miles traveled decrease over time as vehicles are scrapped. Refer to Table B-1 in Appendix B for an estimate of total energy consumption calculations per year for calendar years 2004-2031.

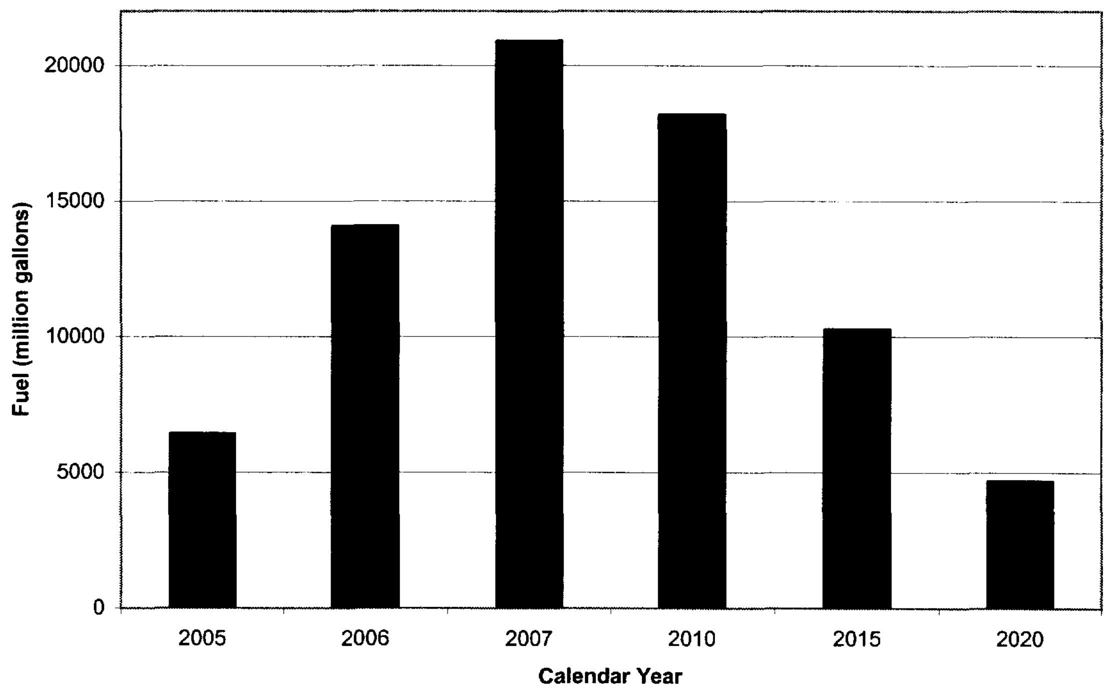


Figure 4-1. Baseline – Annual Fuel Consumption, 2005-2020

4.2.2. Proposed Action

Lifetime Fuel Consumption

The methodology described in Appendix A was used to estimate fuel consumption for MYs 2005-2007 light trucks throughout their lifetime in the fleet, under the Proposed Action. The total gasoline consumption for these trucks is estimated at approximately 215.1 billion gallons (24,638 trillion BTU). When compared to the Baseline, the Proposed Action results in an estimated reduction in gasoline consumption of approximately 3.6 billion gallons (412 trillion BTU) over the lifetime in the fleet of MY 2005-2007 light trucks.

Annual Fuel Consumption

A yearly analysis of gasoline consumption was developed to estimate future energy consumption under the Proposed Action. Figure 4-2 shows the projected total fuel consumed by MY 2005 – 2007 light trucks on an annual basis during 2005, 2006, 2007, 2010, 2015, and 2020. These numbers are aggregated across MY 2005-2007. Thus, the calendar year 2005 consumption value includes MY 2005 and MY 2006 light trucks that are sold and operated in calendar year 2005, the calendar year 2006 consumption value includes MY 2005 light trucks operating in calendar year 2006 plus MY 2006 and MY 2007 light trucks sold and operated in calendar year 2006, and the calendar year 2007 consumption value includes MY 2005, MY 2006, and MY 2007 light trucks operating in calendar year 2007. Similarly the calendar year 2010, 2015, and 2020 values include the MY 2005-2007 light trucks still operating at each respective calendar year. Figure 4-2 shows an upward trend in fuel consumed over calendar years 2005-2007 as more vehicles are introduced, and a downward trend over calendar years 2010 – 2020 as the trucks age or are retired. Refer to Table B-2 in Appendix B for total fuel consumption projections per year for calendar years 2004-2031.

The aggregated numbers under the Proposed Action were compared to those under the Baseline in order to show the amount of fuel saved. This change in fuel consumption was then compared with the Energy Information Administration (EIA) projected overall fuel consumption by all light trucks on an annual basis. The EIA forecasts total energy consumption in BTUs on a yearly basis, so fuel consumption figures were converted to BTUs for comparison purposes.

Table 4-1 shows the projected amount of fuel and energy saved on an annual basis when the Proposed Action is compared to the Baseline and annual savings as a percentage of the EIA 2002 energy consumption forecast. The amount and percent of fuel saved increases over calendar years 2005-2007 as the number of MY 2005-2007 light trucks on the road increases. The amount and percent of fuel saved from calendar years 2010-2020 by MY 2005-2007 light trucks decreases because vehicle miles traveled decrease over time, although savings remain positive. Overall, the total estimated amount of fuel saved (under the Proposed Action, as compared to the Baseline) continues to increase through calendar year 2020. Refer to Table B-3 in Appendix B for total change in fuel consumption calculations per year for the years 2004-2031.

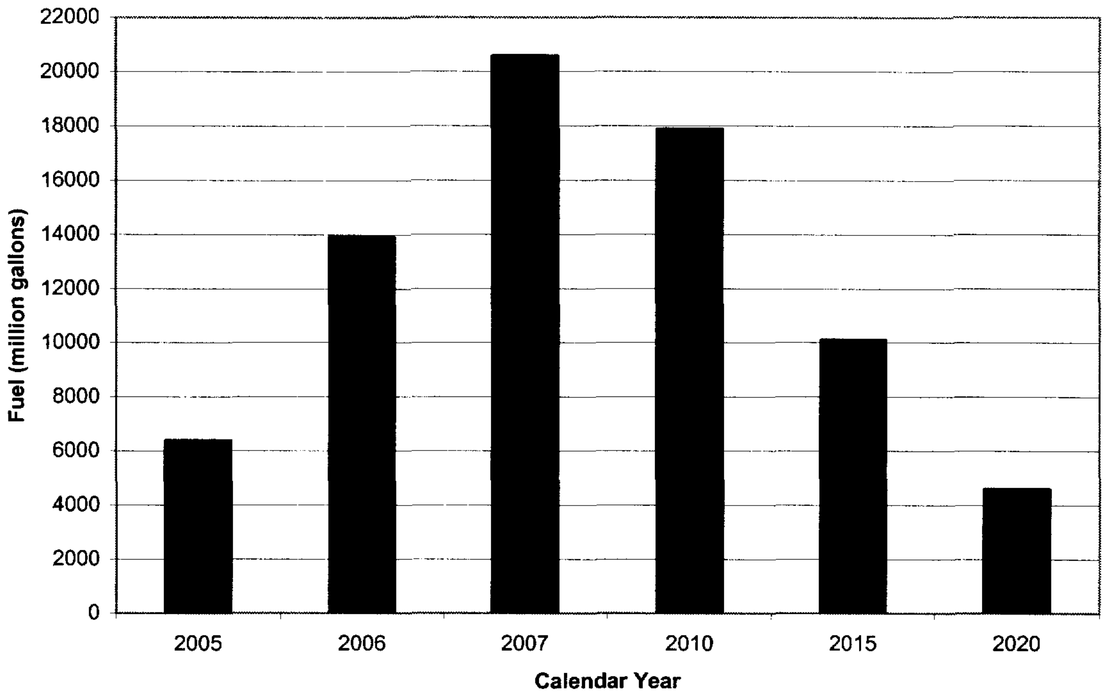


Figure 4-2. Proposed Action – Annual Fuel Consumption, 2005-2020

Table 4-1. Proposed Action – Change in Fuel and Energy Consumption and Baseline EIA Energy Consumption Projections, 2005- 2020

	2005	2006	2007	2010	2015	2020
Reduction in Fuel Consumption (million gallon)	42.5	161.2	334.0	310.2	177.8	82.6
Reduction in Energy Consumption (trillion BTU)	4.9	18.5	38.3	35.5	20.4	9.5
Baseline Energy Forecast (trillion BTU)*	8764.4	9103.1	9442	10469	11829.4	12866.6
Projected Reduction %	0.06%	0.20%	0.41%	0.34%	0.17%	0.07%

*EIA estimate of total BTUs consumed by light trucks (EIA 2002b)
Note: Gallons of gasoline converted to BTU's using a conversion factor of 114,540 BTU/gallon as defined in the benefits model (Appendix A).
Source: EIA 2002b

Figure 4-3 illustrates the projected amount of energy – in BTUs – saved on an annual basis under the Proposed Action. The amount of energy saved increases over calendar years 2005-2007 as the number of MY 2005-2007 light trucks on the road increases. The amount of energy saved from calendar years 2010-2020 by MY 2005-2007 light trucks decreases (although it still remains positive) because vehicle miles traveled decrease over time.

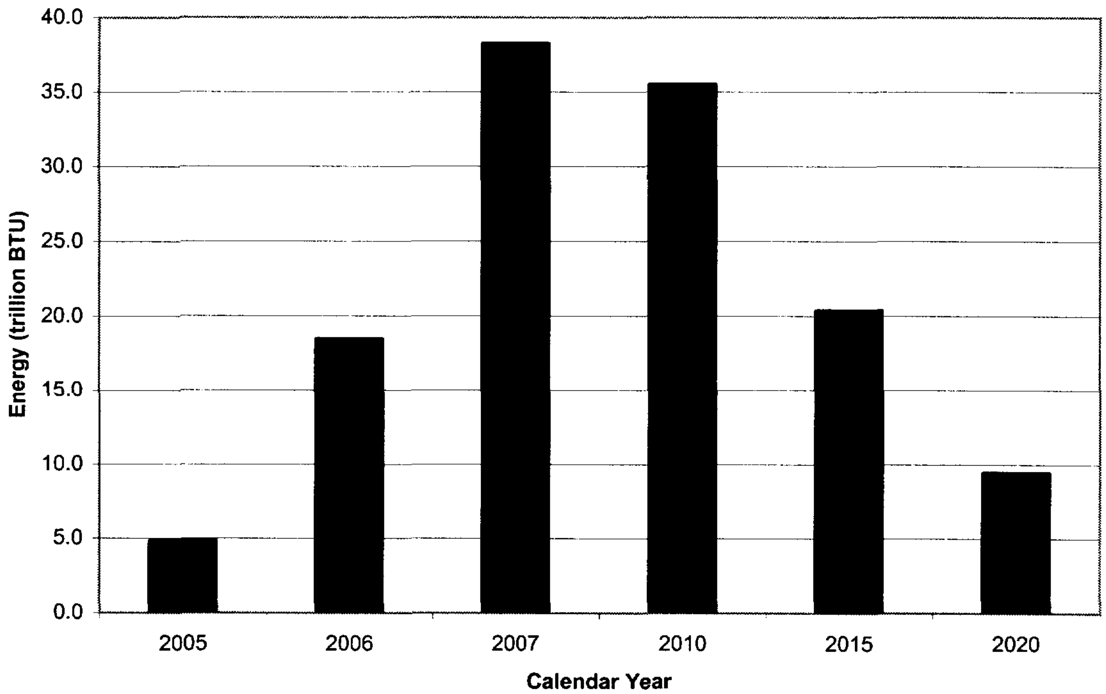


Figure 4-3. Proposed Action – Reduction in Energy Consumption, 2005-2020

Figure 4-4 shows the projected amount of energy saved on an annual basis as a percentage of the EIA 2002 energy consumption forecast for the respective calendar years of interest. The percent of energy saved increases over calendar years 2005-2007 as the number of MY 2005-2007 light trucks on the road increases. The percent of energy saved from calendar years 2010-2020 by MY 2005-2007 light trucks decreases (although still positive) because vehicle miles traveled decrease over time.

As illustrated by the table and figures, the fuel consumption under the Proposed Action is projected to decrease on an annual basis and on an aggregate basis throughout the lifetime of the affected fleet.

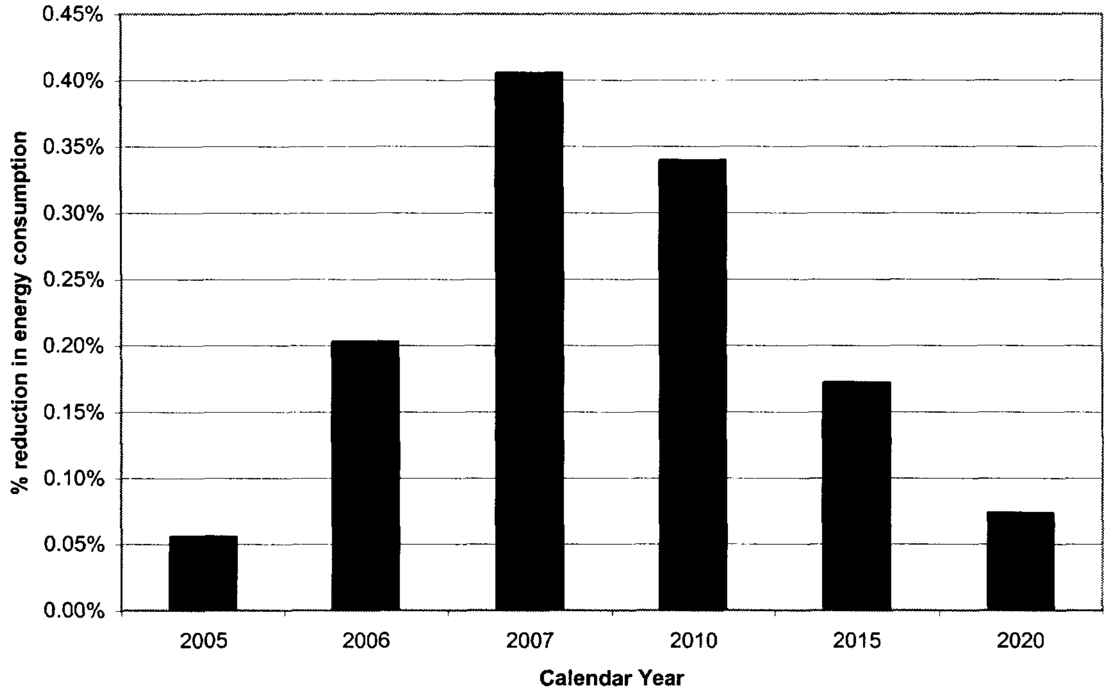


Figure 4-4. Proposed Action – Annual Reduction in Energy Consumption as a Percentage of EIA Annual Energy Consumption Forecast

4.3. AIR QUALITY

4.3.1. Criteria Pollutant Emissions

The EPA emissions model, MOBILE6.2, was used to estimate changes in criteria pollutant emissions. MOBILE6.2 is an emissions factor model used for predicting grams-per-mile emissions of VOC, CO, NO_X, PM, SO_X, and toxics from cars, trucks, and motorcycles under various conditions. It accounts for several new national emission control measures for both light-duty vehicles under 8,500 pounds gross vehicle weight rating (GVWR) and heavy-duty diesel engines. It also includes the benefits of low sulfur fuel for both light and heavy-duty vehicles. The MOBILE6.2 model was used to compare projected emissions of criteria pollutants from MY 2005-2007 light trucks to the overall contribution of emissions from all vehicles in the U.S. fleet. Using expected VMT, the projected baseline emissions for all vehicles (including passenger cars and trucks) was used to develop an emissions inventory.

Because it is difficult to estimate a given action's effect on the atmospheric concentration of some pollutants, emission inventories are also used to gauge the effects of such actions. An emission inventory is a summation of the total mass of a pollutant that is released to the atmosphere within a given geographic area and during a specified period. A national input file was obtained from the EPA Office of Transportation and Air Quality (OTAQ) and used to estimate the emissions of CO, VOC, NO_X, PM 2.5, and SO_X. The model was executed for calendar years 2005, 2006, 2007, 2010, 2015, and 2020.

Changes in criteria pollutants were estimated by combining estimates of reductions in "upstream" emissions (crude oil extraction, crude oil transportation and storage, crude oil refining into gasoline, and gasoline transportation, storage, and distribution) with estimates of emissions increases from increased VMT as a result of the rebound effect (see Appendix A). Reductions in upstream criteria pollutant emissions were estimated using disaggregated emissions rates obtained from Argonne National Laboratories' Greenhouse Gases and Regulated Emissions in Transportation model (GREET) (Argonne 2002).

The contribution of emissions from the Proposed Action was estimated by comparing the estimated emissions for the Proposed Action with those for the Baseline. Under the Baseline, upstream emissions are assessed to estimate CO, VOC, NO_X, PM 2.5, and SO_X levels. The Proposed Action assesses upstream emissions, and also CO, VOC, NO_X, PM 2.5, and SO_X emissions associated with the 20% rebound effect.

Emissions estimates for MY 2005-2007 light trucks were developed on a yearly basis for all light trucks for each of those model years. In order to determine the overall implications of the Proposed Action over the 25-year lifetime, as compared to the Baseline, the yearly emissions calculations were summarized to estimate aggregated lifetime emissions for MY 2005-2007 light trucks under the Baseline and Proposed Action. In addition, emission inventories for individual calendar years of interest – through 2020 were calculated to provide estimates of annual changes in emissions under the Proposed Action as compared to the Baseline. The annual emissions inventories were calculated by adding the emissions from all MY 2005, 2006, and 2007 light trucks in operation for the particular calendar year. For example, total emissions for calendar year 2010 were calculated by adding the total emissions from MY 2005-2007 light trucks still in operation that year.

Baseline

Lifetime Projected Emissions

The methodology described in Appendix A was used to project the total CO, VOC, NO_X, PM 2.5, and SO_X emissions for MY 2005-2007 light trucks throughout their lifetime in the fleet, assumed to be 25 years. As presented in Figure 4-5, under the Baseline, it is estimated that CO upstream emissions would be approximately 42,400.4 thousand tons, VOC emissions would be approximately 2,757.9 thousand tons, NO_X emissions would be approximately 3,124.3 thousand tons, PM2.5 emissions would be approximately 74.4 thousand tons, and SO_X emissions would be approximately 464.0 thousand tons for the 25-year lifetime of MY 2005-2007 light trucks.

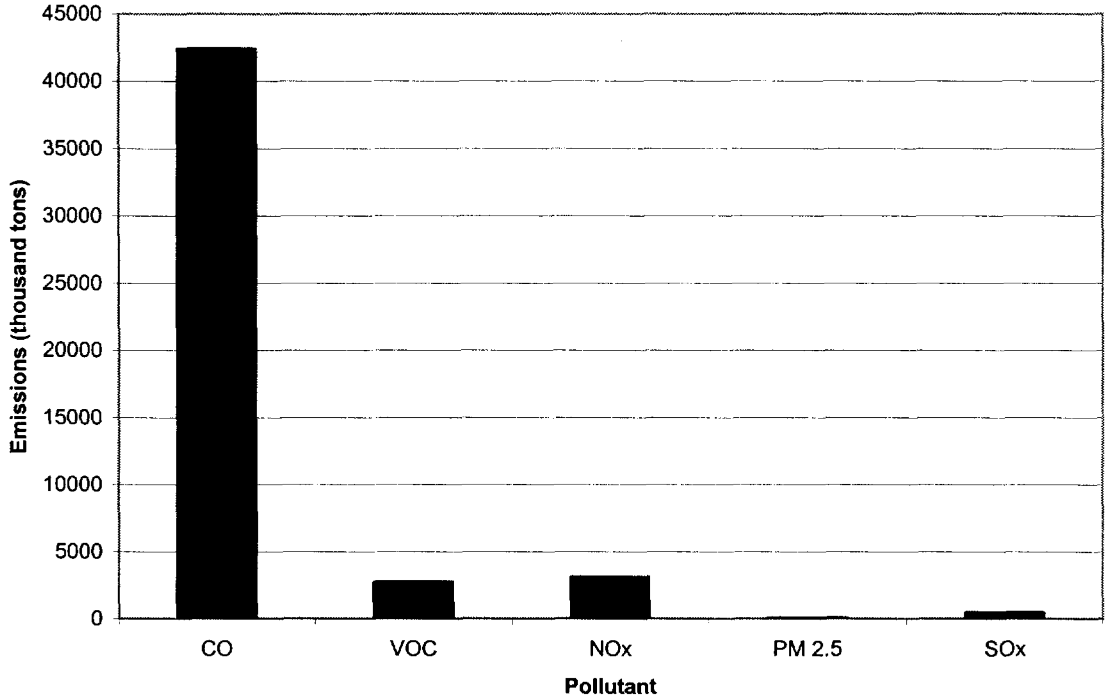


Figure 4-5. Baseline – Lifetime Upstream Emissions for Criteria Pollutants

Annual Projected Emissions

A yearly breakdown of projected upstream emissions for criteria pollutants generated under the Baseline can be found in Tables C-7 through C-11 in Appendix C. Criteria pollutant upstream emissions for calendar years 2005, 2006, 2007, 2010, 2015, and 2020 were closely examined in order to compare them to baseline emissions projected using the MOBILE6.2 model. Figure 4-6 projects criteria pollutant emissions from MY 2005-2007 light trucks for calendar years 2005, 2006, 2007, 2010, 2015, and 2020 under the Baseline.

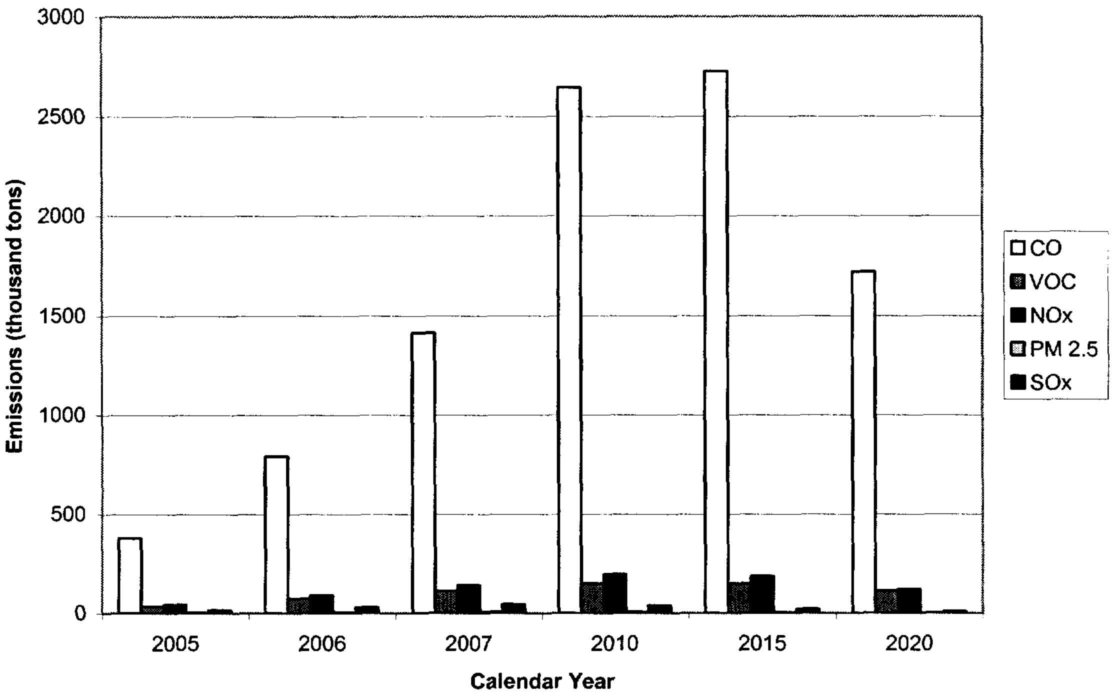


Figure 4-6. Baseline – Annual Upstream Emissions for Criteria Pollutants, 2005-2020

Proposed Action

Lifetime Projected Emissions

Under the Proposed Action, it is estimated that criteria pollutant emissions would be approximately 42,566.2 thousand tons for CO, 2,761.1 thousand tons for VOC, 3,124.5 thousand tons for NO_X, 74 thousand tons for PM 2.5, and 459.4 thousand tons for SO_X, respectively, for the 25-year lifetime of MY 2005-2007 light trucks. Figure 4-7 presents a graphical representation of these values. As noted in the introduction, total lifetime emissions reported in this figure reflect the sum of upstream (refinery and distribution) and rebound-effect related emissions.

When compared to the Baseline, the Proposed Action is projected to result in an increase in CO, VOC and NO_X emissions of 165.8 thousand tons, 3.2 thousand tons, and 0.2 thousand tons, respectively, and a decrease of PM 2.5 and SO_X emissions of 0.4 thousand tons, and 4.6 thousand tons, respectively, over the 25-year lifetime of the MY 2005-2007 light trucks. This is shown in Figure 4-8. Thus, implementation of the Proposed Action is projected to result in increases in lifetime emissions of CO, VOC, and NO_X, and reductions in lifetime emissions of PM 2.5 and SO_X.

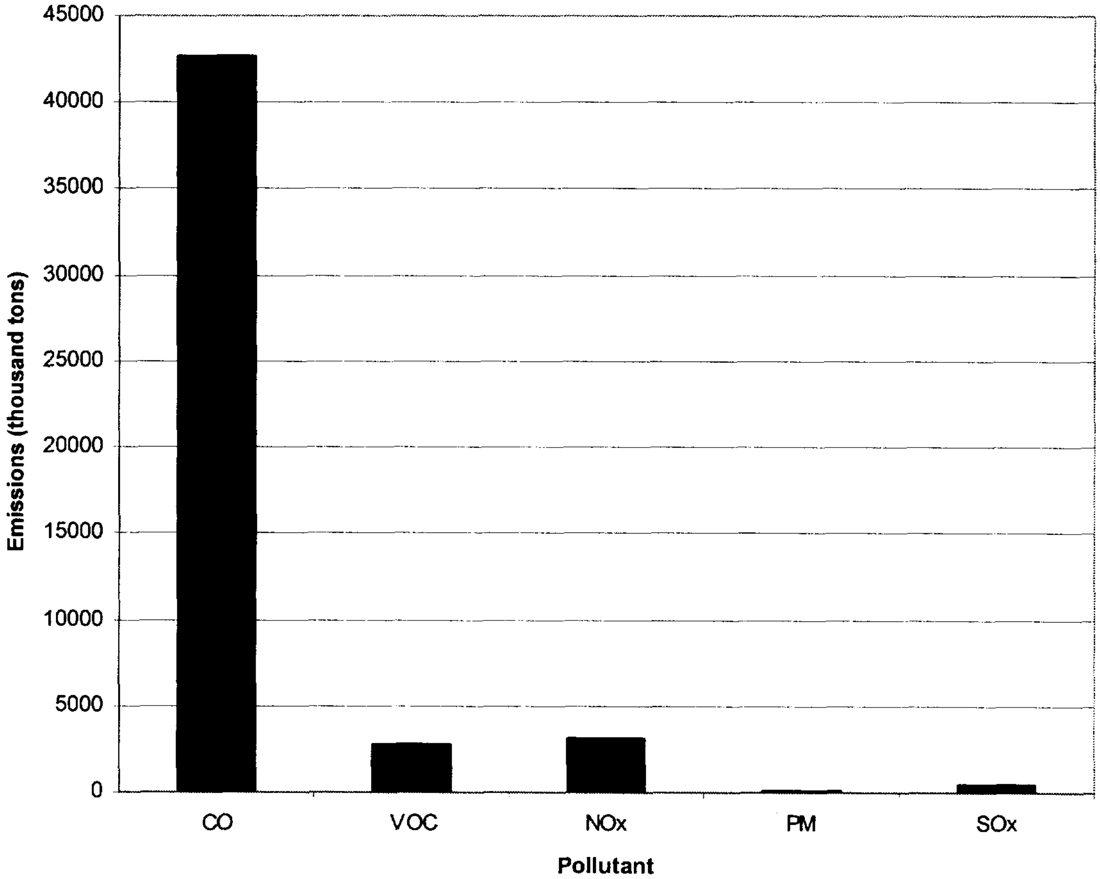


Figure 4-7. Proposed Action – Lifetime Emissions for Criteria Pollutants

Annual Projected Emissions

In order to compare Proposed Action emissions to the overall contribution of emissions from vehicles, yearly upstream and rebound emissions for criteria pollutants were projected. A yearly breakdown of the upstream and rebound emissions generated under the Proposed Action can be found in Tables C-13 through C-17 in Appendix C. Figure 4-9 shows Proposed Action upstream and rebound emissions from MY 2005-2007 light trucks for calendar years 2005, 2006, 2007, 2010, 2015, and 2020.

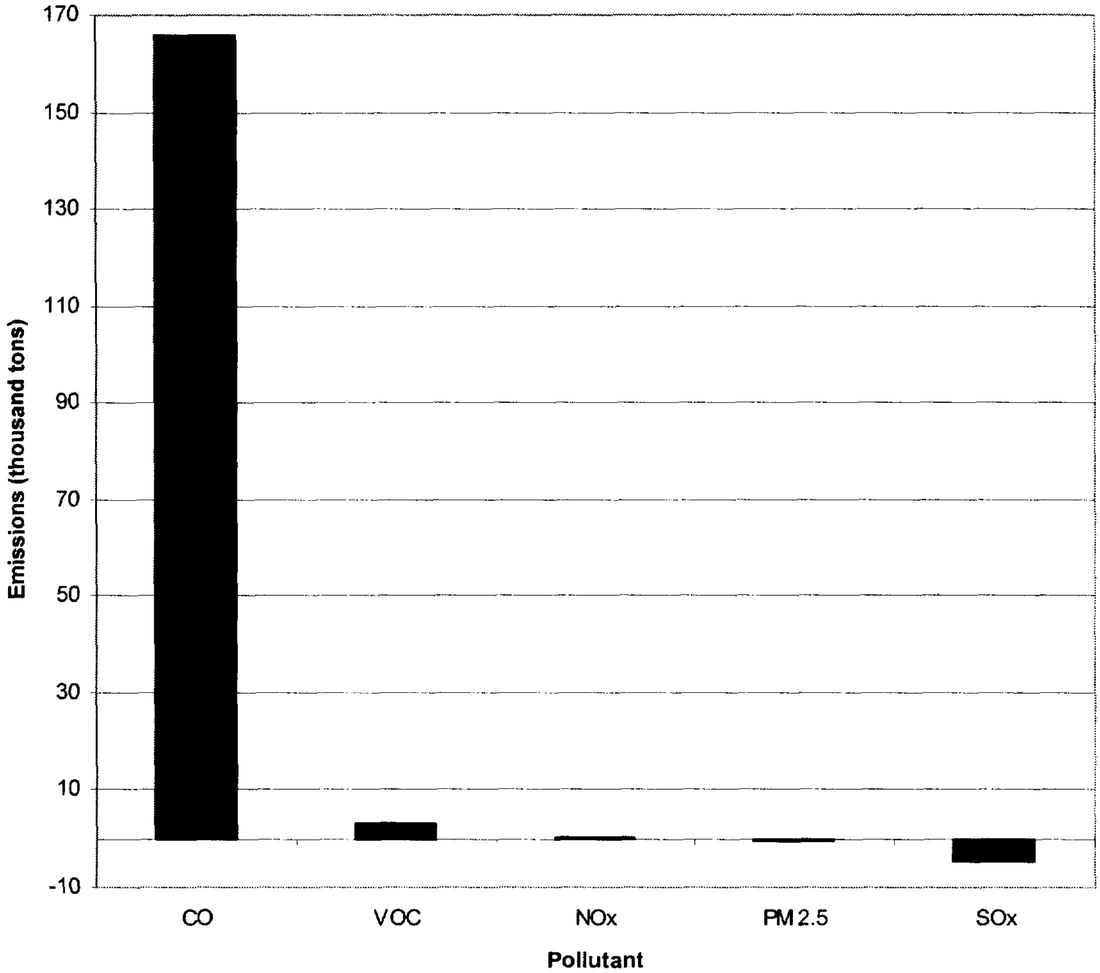


Figure 4-8. Proposed Action – Change in Lifetime Emissions for Criteria Pollutants

When Proposed Action upstream and rebound emissions from calendar years 2005, 2006, 2007, 2010, 2015, and 2020 are compared to Baseline upstream emissions, projected CO emissions increase each calendar year. CO emissions increase because, while the savings in gasoline use and the resulting reduction in CO upstream emissions grow over time, increase in vehicle CO emissions resulting from the rebound effect more than offsets this reduction. When compared to the Baseline, the Proposed Action results in a projected initial decrease in VOC emissions through calendar year 2011, but a projected increase in emissions for calendar years 2012 through 2020.

The Proposed Action also results in a projected initial decrease in NO_X emissions through calendar year 2012, but a projected increase in emissions for calendar years 2013 through 2020. Compared to the Baseline, the Proposed Action would result in a projected decrease in PM 2.5 and SO_X emissions from the beginning of the study period through calendar year 2020.

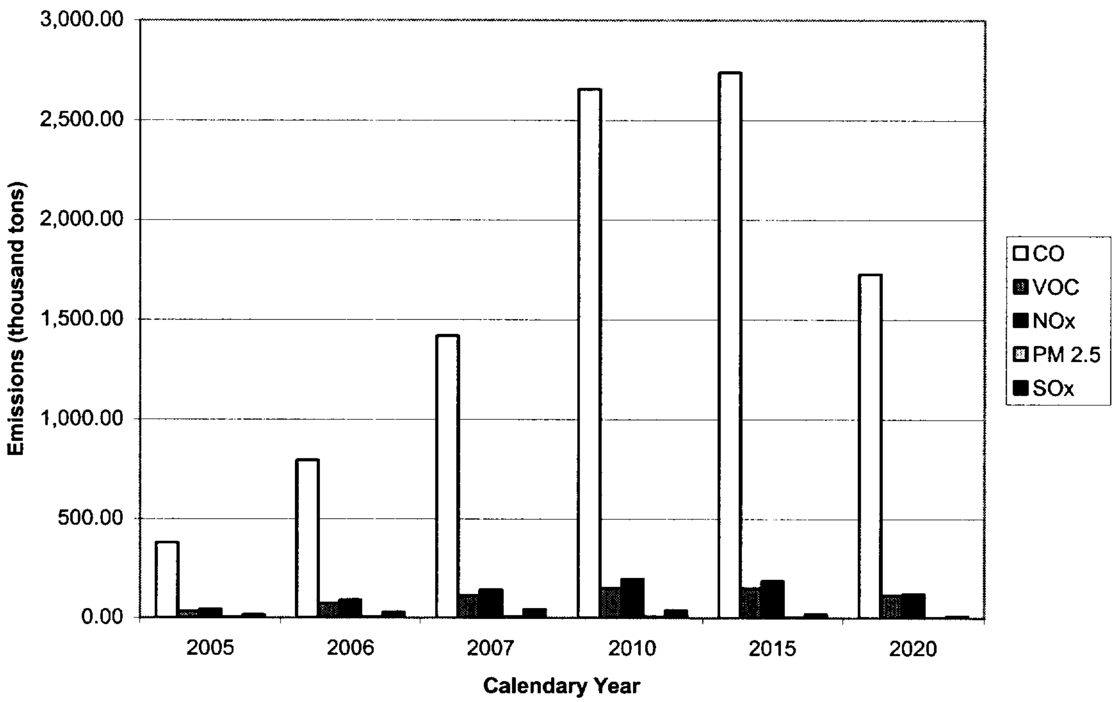


Figure 4-9. Proposed Action – Annual Upstream and Rebound Emissions for Criteria Pollutants 2005-2020

When considering these results, it is important to recall that changes in criteria pollutant emissions were estimated assuming that reductions in imports of refined gasoline would account for 50% of the reductions in domestic gasoline consumption attributed to the Proposed Action. Under this analysis, some of the emission benefits from reduced refining and distribution would not occur in the U.S., and are thus not accounted for in this analysis.

In order to compare emissions of criteria pollutants from MY 2005-2007 light trucks to the overall contribution of vehicle emissions, estimates of VMT projections were developed and the MOBILE6.2 model was run to project baseline emissions for all vehicles. Table 4-2 shows projected changes in criteria pollutant emissions for light trucks, as well as baseline emissions projections for all vehicles and light truck emissions changes as compared to emissions from all vehicles for calendar years 2005, 2006, 2007, 2010, 2015, and 2020.

Table 4-2. Proposed Action – Percent Change in Criteria Pollutant Emissions under the Proposed Action when compared to Baseline Emissions Projections for all Vehicles[4] (Calendar Years 2005-2020)

CO	Change in Emissions - Light Trucks (000 tons)			Baseline Estimate - All Vehicles (000 short tons)	Projected Change %
	Rebound Operations	Upstream	Total		
2005	0.599	-0.030	0.569	40200.160	0.001%
2006	1.994	-0.114	1.881	35724.215	0.005%
2007	4.607	-0.236	4.371	34889.831	0.013%
2010	10.091	-0.220	9.871	31337.755	0.031%
2015	11.140	-0.125	11.015	28382.508	0.039%
2020	7.226	-0.059	7.168	27723.646	0.026%

VOC	Change in Emissions - Light Trucks (000 tons)			Baseline Estimate - All Vehicles (000 short tons)	Projected Change %
	Rebound Operations	Petroleum Refining	Total		
2005	0.036	-0.072	-0.037	4131.599	-0.001%
2006	0.122	-0.277	-0.155	3820.816	-0.004%
2007	0.254	-0.575	-0.321	3613.996	-0.009%
2010	0.444	-0.540	-0.096	2928.454	-0.003%
2015	0.527	-0.304	0.223	2234.946	0.010%
2020	0.431	-0.145	0.286	1898.880	0.015%

NO_x	Change in Emissions - Light Trucks (000 tons)			Baseline Estimate - All Vehicles (000 short tons)	Projected Change %
	Rebound Operations	Petroleum Refining	Total		
2005	0.035	-0.103	-0.068	5743.663	-0.001%
2006	0.105	-0.393	-0.289	5280.486	-0.005%
2007	0.216	-0.815	-0.600	4963.562	-0.012%
2010	0.475	-0.760	-0.285	3938.576	-0.007%
2015	0.583	-0.433	0.150	2510.218	0.006%
2020	0.424	-0.203	0.221	1837.972	0.012%

PM	Change in Emissions - Light Trucks (000 tons)			Baseline Estimate - All Vehicles (000 short tons)	Projected Change %
	Rebound Operations	Petroleum Refining	Total		
2005	0.002	-0.006	-0.004	309.801	-0.001%
2006	0.005	-0.023	-0.017	312.587	-0.006%
2007	0.011	-0.047	-0.036	318.213	-0.011%
2010	0.010	-0.044	-0.033	335.708	-0.010%
2015	0.006	-0.025	-0.019	367.029	-0.005%
2020	0.003	-0.012	-0.009	401.273	-0.002%

SOx	Change in Emissions - Light Trucks (000 tons)			Baseline Estimate - All Vehicles (000 short tons)	Projected Change %
	Rebound Operations	Petroleum Refining	Total		
2005	0.006	-0.056	-0.051	134.613	-0.038%
2006	0.008	-0.214	-0.205	95.730	-0.214%
2007	0.017	-0.442	-0.425	40.345	-1.054%
2010	0.015	-0.411	-0.396	25.478	-1.555%
2015	0.009	-0.235	-0.227	28.183	-0.805%
2020	0.004	-0.110	-0.106	30.812	-0.343%

Figure 4-10 shows projected changes in emissions for criteria pollutants for calendar years 2005, 2006, 2007, 2010, 2015, and 2020. For a yearly breakdown of changes in emissions, see Tables C-19 through C-23 in Appendix C.

[4] All Vehicles includes all passengers cars and trucks

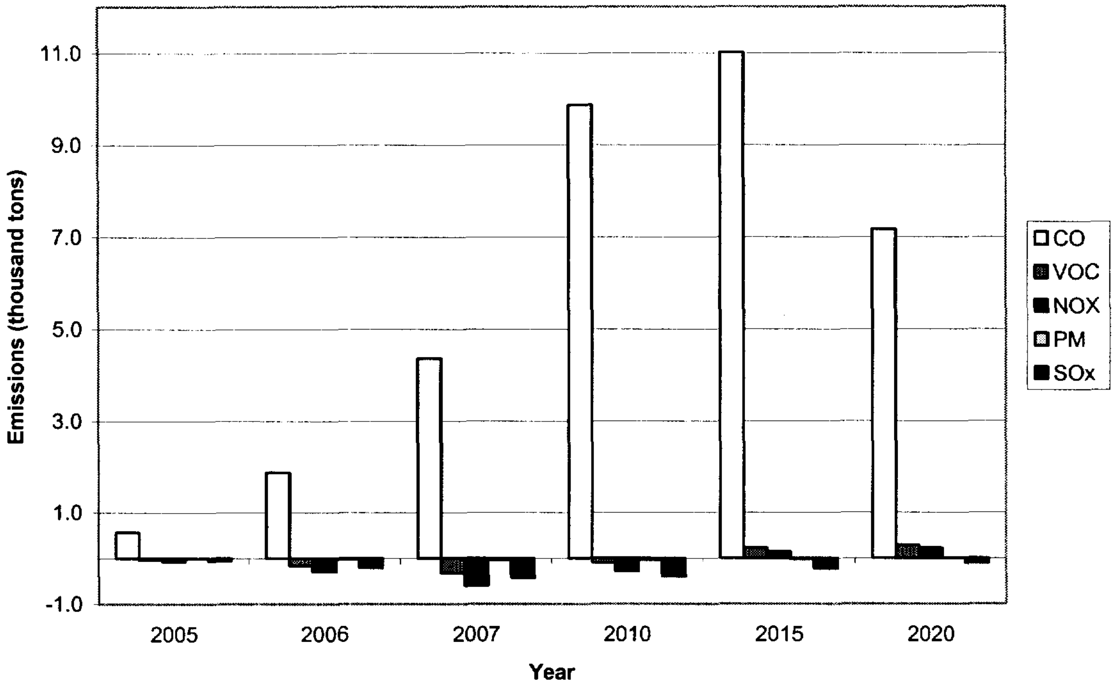


Figure 4-10. Proposed Action – Annual Change in Emissions for Criteria Pollutants, Calendar Years, 2005-2020

Figure 4-11 shows projected changes in emissions from MY 2005-2007 light trucks – at different calendar years during their lifetime in the fleet – as a percentage of projected aggregate national criteria pollutant emissions for all vehicles. The increase of CO emissions from light trucks comprises at most an estimated 0.039 percent – in calendar year 2015 – of the baseline emissions projections for all vehicles during the years covered by the study period (2005-2020). The initial decrease in VOC emissions comprises at most 0.009 percent – in calendar year 2007 – of the baseline emissions projections for all vehicles during the study period. Subsequent increases in VOC emissions, associated with the rebound effect, offset upstream emissions decreases. This comprises an increase of at most 0.015 percent – in calendar year 2020 – of the baseline emissions projections for all vehicles during the study period. The initial decrease in NO_X emissions comprises at most 0.012 percent (calendar year 2007) of the baseline emissions projections for all vehicles during the study period. Subsequent increases in NO_X emissions comprise at most 0.012 percent (in calendar year 2020) of the baseline emissions projections for all vehicles during the study period. For the analyzed study period, the decreases in PM 2.5 emissions from MY 2005-2007 light trucks ranged between 0.001 percent and 0.011 percent of total PM 2.5 emissions from all vehicles. The decreases in SO_X emissions from MY 2005-2007 light trucks ranged between 0.038 percent and 1.555 percent of total SO_X emissions from all vehicles. As the figure illustrates, SO_X emission changes reflect the significant reduction in gasoline sulfur content resulting from the EPA Tier 2 Emission Standards.

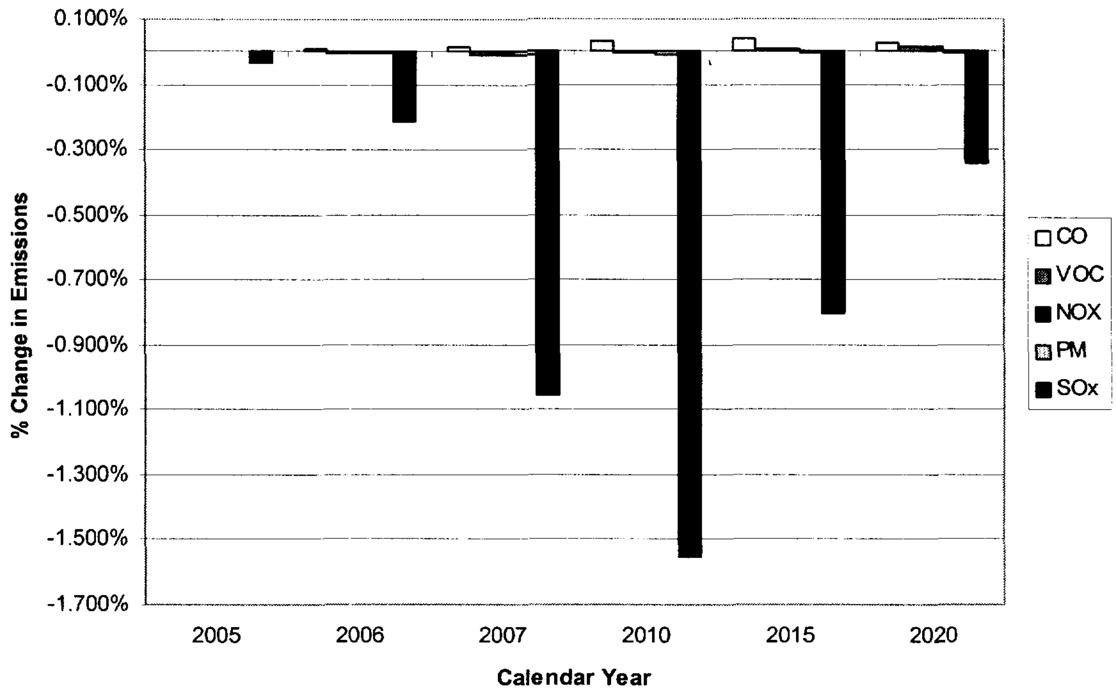


Figure 4-11. Proposed Action – Change in Criteria Pollutant Emissions as a Percent of all Vehicle Emissions, Calendar Years 2005-2020

Although there are projected small increases in CO, VOC and NO_X emissions at different times during the study period, these values are very small percentages in relation to projections of aggregate national emissions for all vehicles. Yearly decreases in VOC and NO_X at different times during the study period, along with decreases in PM 2.5 and SO_X through calendar year 2020 would provide benefits. In addition, the net changes in emissions are extremely small in relation to national levels of criteria pollutant emissions for all vehicles.

4.3.2. Greenhouse Gas Emissions

Changes in CO_2 were projected by combining estimates of upstream emissions reductions with estimates of emissions increases from increased VMT as a result of the rebound effect (see Appendix A). Reductions in CO_2 upstream emissions were projected using disaggregated emissions rates obtained from Argonne National Laboratories' Greenhouse Gases and Regulated Emissions in Transportation model (GREET) (Argonne 2002). The reduction of CO_2 emissions from the Proposed Action was projected using the same methodology as for criteria pollutants, by comparing the estimated emissions for the Proposed Action with those for the Baseline. Under the Baseline, greenhouse gas upstream emissions are assessed. The Proposed Action also assesses CO_2 emissions associated with the 20% rebound effect, as well as those from upstream sources.

CO_2 emissions estimates for MY 2005-2007 light trucks were also developed on a yearly basis for all light trucks for each of those model years. In order to determine the overall implications of the Proposed Action over the 25-year lifetime, as compared to the Baseline, the yearly emissions calculations were summarized to estimate aggregated lifetime emissions for MY 2005-2007 light trucks under the Baseline and Proposed Action. In addition, emission inventories for individual calendar years of interest – through 2020 were calculated to provide estimates of annual changes in CO_2 emissions under the Proposed Action as compared to the Baseline. The annual emissions inventories were calculated in the same way as those for criteria pollutant emissions.

Baseline

Estimates of greenhouse gas upstream emissions are presented in millions of metric tons of carbon equivalents (MMTCe).

Lifetime Projected Emissions
Under the Baseline, 340.5 MMTCe of CO_2 are estimated to be emitted during the 25-year lifetime of MY 2005-2007 light trucks. These emissions will be used as a basis to determine potential impacts from the Proposed Action.

Annual Projected Emissions
A yearly breakdown of upstream emissions for greenhouse gases projected to be generated under the Baseline can be found in Table C-12 in Appendix C. Greenhouse gas upstream emissions for calendar years 2005, 2006, 2007, 2010, 2015, and 2020 were closely examined. Figure 4-12 shows projected greenhouse gas emissions for calendar years 2005, 2006, 2007, 2010, 2015, and 2020 under the Baseline. As expected, greenhouse gas upstream emissions are highest in calendar year 2007 (compared to calendar years 2005, 2006, 2010, 2015, and 2020), since the vast majority of MY 2005-2007 light trucks are in use and vehicle miles traveled are at their highest level.

Proposed Action

Estimates of greenhouse gas upstream emissions are presented in millions of metric tons of carbon equivalents (MMTCe).

Lifetime Projected Emissions
Under the Proposed Action, 331.1 MMTCe of carbon emissions (from CO_2 only) are estimated to result from the 25-year lifetime of MY 2005-2007 light trucks. Compared to the Baseline, the Proposed Action is projected to reduce carbon emissions by an estimated 9.4 MMTCe for the 25-year lifetime of MY 2005-2007 light trucks. Additionally, a reduction in carbon emissions is estimated for each calendar year of the 2005-2020-study period. Thus, the Proposed Action should provide a benefit as a result of the reduction of GHG emissions from transportation in the U.S.

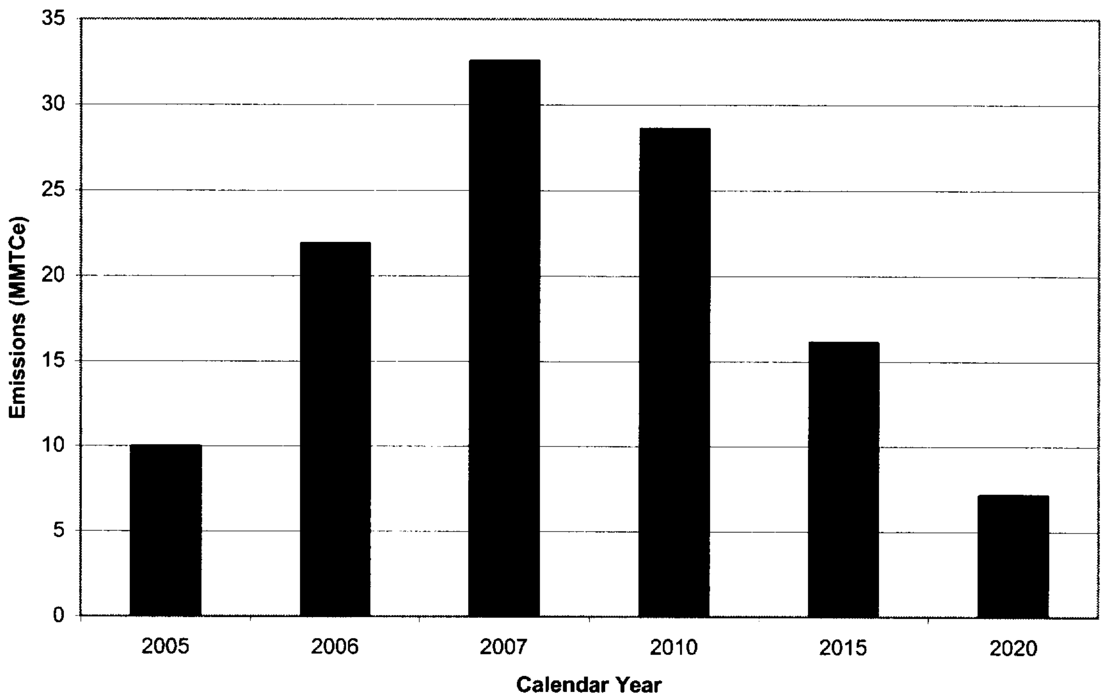


Figure 4-12. Baseline – Annual Upstream Emissions for Greenhouse Gases, 2005-2020

Annual Projected Emissions

The projected changes in CO_2 emissions – when comparing Baseline and Proposed Action emissions – for light trucks for calendar years 2005, 2010, 2015, and 2020 were compared to the EIA annual energy projections of total CO_2 emissions for the transportation sector for those calendar years. The EIA did not estimate emissions for calendar years 2006 and 2007 in its 2002 forecast (EIA 2002b). For calendar years 2005, 2010, 2015, and 2020, estimated decreases in CO_2 emissions from light trucks ranged between 0.019 percent and 0.127 percent of total emissions from all transportation CO_2 emissions. The benefits peak in 2010 and then decrease over time. Therefore, there is a projected benefit in CO_2 emissions when compared to total transportation CO_2 emissions on an annual basis. Table 4-3 shows projected changes in CO_2 emissions for MY 2005-2007 light trucks, baseline CO_2 emissions projections for the transportation sector, and estimated light truck CO_2 emissions change as compared to the total transportation sector for calendar years 2005, 2010, 2015, and 2020.

Figure 4-13 shows projected changes in emissions as a percent composition of total transportation emissions for CO_2 (the negative sign of the changes is representative of emissions reductions).

Table 4-3. Proposed Action – Estimated Reduction in CO_2 Emissions and Baseline CO_2 Emissions Projections, 2005-2020

CO2	Reduction in Emissions - Light Trucks (MMTCe)			Baseline Estimate - All Transportation (MMTCe)*	Projected Change %
	Rebound Operations	Upstream	Total		
2005	-0.100	-0.011	-0.111	576.1	-0.019%
2006	-0.380	-0.040	-0.421	NA	NA
2007	-0.788	-0.083	-0.872	NA	NA
2010	-0.732	-0.077	-0.809	639.4	-0.127%
2015	-0.420	-0.044	-0.464	700.2	-0.066%
2020	-0.195	-0.021	-0.215	752.7	-0.029%

* Source: EIA 2002b

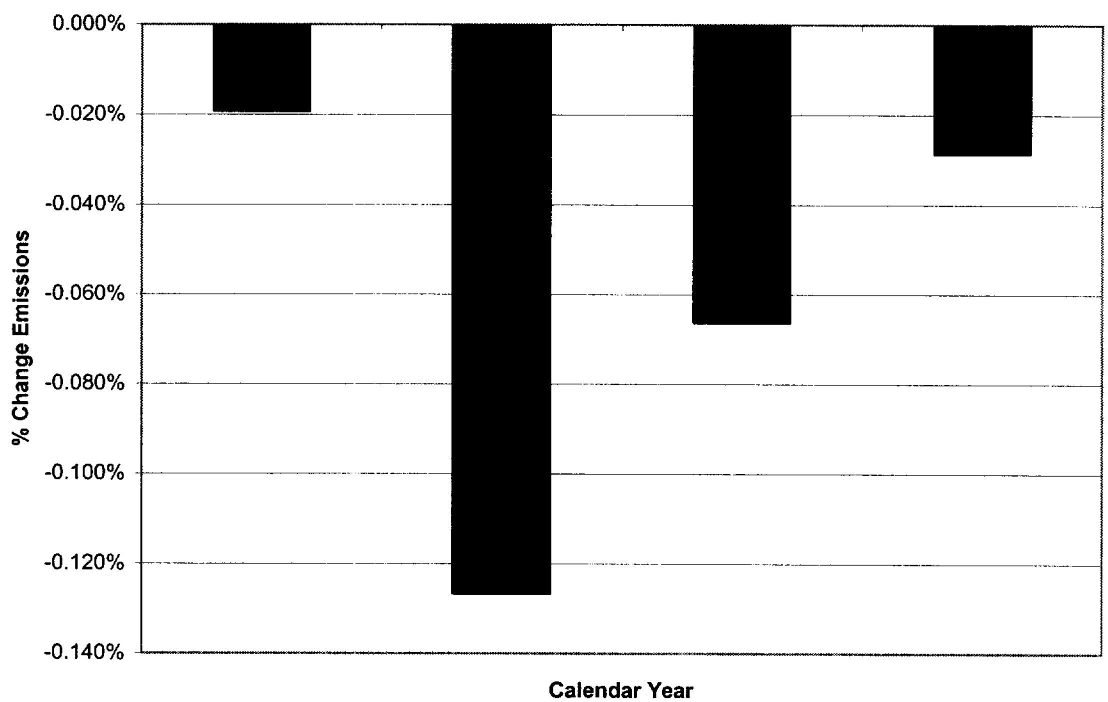


Figure 4-13. Proposed Action Changes in Emissions as a Percent of Total Transportation Emissions for CO_2, 2005-2020

4.4. WATER RESOURCES

Water quality may be affected by changes in energy consumption. The decrease in fuel consumption could result in reductions in oil spills and leaks, pipeline blowouts, and water contamination during the drilling process. Additionally, there could be reductions in oil refining and associated oil refinery liquid waste and thermal pollution of waters near refineries. The analysis projects decreases in NO_X through 2012, and a lifetime increase over the 25- year study period. The analysis also projects decreases in SO_X emissions on an annual basis throughout the study period, and also a lifetime reduction over the 25- year study period. Some benefits to water resources from reduced acid rain generation could be realized.

Therefore, the Proposed Action could result in benefits to water resources from reduced energy consumption. However, since the energy consumption changes are small when compared to fuel consumption from other transportation activities, these water resource benefits would be small.

4.5. BIOLOGICAL RESOURCES

Biological resources may be affected by changes in energy consumption. A decrease in fuel consumption could result in reductions in petroleum drilling, refining, and transport activities, potentially reducing impacts to biological resources resulting from habitat destruction and encroachment, and air and water pollution. In addition, there could be reductions in oil exploration and extraction, potentially resulting in decreased intrusions into onshore and offshore natural habitats, and construction within natural habitats. Also, reductions in oil drilling and transport could result in decreases in oil spills and pipeline breaks, reducing potential impacts from oil contamination of aquatic and coastal habitats. Additionally, there could be reductions in oil refining and associated oil refinery liquid waste and thermal pollution of waters near refineries. Finally, decreases in oil drilling and refining activities can also result in reduced noise pollution, with a positive benefit to animal populations. The Proposed Action is projected to result in decreases in greenhouse gas emissions that could result in benefits to ecosystems.

Therefore, the Proposed Action could result in benefits to biological resources from reduced energy consumption. However, since the changes are small when compared to fuel consumption and emissions from other transportation activities, these benefits would be small.

4.6. LAND USE AND DEVELOPMENT

For the purposes of this Final EA, land use and development issues relate to potential manufacturing plant changes that manufacturers may embark on to respond to a change in light-truck fuel economy standards. As indicated in the manufacturers' comments, product changes would be likely in order for manufacturers to comply with increased fuel economy. Additionally, changes in the light-truck economic market independent of the Proposed Action (e.g., a change in the number of light trucks purchased by consumers or a consumer switch to different brands or types of vehicles) may cause plants to be built or shut down.

Major changes to manufacturing facilities could have implications for environmental issues associated with land use and development. However, as discussed above in Section 4.1.1, NHTSA's analysis of available technologies and manufacturer capabilities indicates that manufacturers would likely be able to meet the proposed standards by applying technologies rather than, for example, changing product mix in ways that would that lead to manufacturing plant changes. Therefore, the Proposed Action would not likely impact land use or development.

4.7. HAZARDOUS MATERIALS

The projected reduction in fuel consumption under the Proposed Action may lead to a reduction in the amount of hazardous wastes created by the oil refining process. These wastes may include oily sludges, spent caustics, spent catalysts, wastewater, maintenance and materials handling wastes, and other process wastes (Freeman 1995). As a result, there could be small benefits with regard to hazardous materials from the implementation of the Proposed Action.

4.8. SUMMARY OF POTENTIAL ENVIRONMENTAL EFFECTS

Table 4-4 summarizes the potential impacts under the Baseline and the Proposed Action.

Table 4-4. Summary of Potential Impacts

Resource	Baseline – Current Standard	Proposed Action
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 increases in CO, VOC, and NO_X emissions and minor overall reductions in PM 2.5, and SO_X. Overall minor changes in Air Quality based on extremely small changes in criteria pollutant emissions.
Greenhouse Gas Emissions	Increase in GHG emissions from oil refining and distribution and the operation of light trucks.	Minor reduction in GHG emissions.
Water Resources	Continuation of energy and air quality trends.	Minor benefit from reductions in energy consumption, GHG emissions, and minor positive and negative effects based on 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 minor positive and negative effects based on 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 trends from the manufacturing of light trucks.

4.8.1. Summary of Energy Effects

Table 4-5 summarizes projected fuel consumption under the Baseline and Proposed Action Alternatives. Comparison of the Proposed Action with the Baseline shows that the Proposed Action results in a projected decrease in fuel consumption over the lifetime of the MY 2005 – 2007 fleet. The total amount of fuel saved under the Proposed Action over the useful lifetime of the affected light truck fleet (MY 2005-2007) is projected to be approximately 3.6 billion gallons (412 trillion BTU). Therefore, the Proposed Action should also result in a reduction in oil exploration and extraction, oil transport, and oil refining.

Table 4-5. Fuel Consumption under the Baseline and the Proposed Action

	No Action Alternative	Proposed Action	Change (PA-NA)
	Fuel Consumption (million gallons)	Total Fuel Consumption (million gallons)	Total Fuel Consumption (million gallons)
2005	6432.4	6389.9	-42.5
2006	14077.5	13916.2	-161.2
2007	20904.7	20570.6	-334.0
2010	18192.8	17882.6	-310.2
2015	10275.3	10097.4	-177.8
2020	4690.4	4607.9	-82.6
Lifetime*	218702.3	215106.9	-3595.4

* Lifetime emissions equal the amount of emissions for MY 2005-2007 light trucks over their 25-year lifetime

4.8.2. Summary of Air Quality Effects

Table 4-6 summarizes the projected effects of the Baseline and the Proposed Action on CO, VOC, NO_X, PM 2.5, SO_X, and CO_2 emissions. Emission totals include upstream (refinery and distribution) and rebound-related emissions. While there is a projected decrease in upstream emissions for all criteria pollutants and greenhouse gases under the Proposed Action, this decrease is partially or completely offset by emissions attributed to the rebound effect. In particular, a net increase in lifetime emissions of CO, VOC, and NO_X is projected to result.

Criteria Pollutant Emissions

As the analysis results show, the savings in gasoline use and the resulting reduction in CO upstream emissions are projected to grow over time. However, the projected increase in CO emissions from vehicle exhaust from added light truck use – resulting from the rebound effect – more than offsets this reduction. While CO emissions increase slightly under the Proposed Action, national CO concentrations have decreased and there are few non-attainment areas in the U.S. In addition, a recent report from the National Research Council (NRC) shows that most of the remaining Nonattainment areas in the country are primarily related to weather influences and not necessarily to traffic conditions (NRC 2002). Therefore, the small projected increase in CO emissions – relative to national CO emissions from all vehicles (at most 0.031 percent in 2015) – will be unlikely to result in new or more frequent yearly violations of the CO standard.

VOC emissions are projected to decline until calendar year 2011 as the increase in emissions from more intensive use of light trucks manufactured under the Proposed Action is offset by the reduction in emissions from lower gasoline refining and distribution. Starting in calendar year 2012 the situation is reversed and total VOC emissions are projected to increase slightly as a result of the rebound effect and the effect of degraded emissions performance from aging vehicles. This projected increase in VOC emissions is a small percentage of projected aggregate national VOC emissions for all vehicles. As presented above, the projected annual VOC emissions increases comprise at most 0.015 percent – in calendar year 2020 – of the VOC emissions projections for all vehicles during the study period.

Table 4-6. Summary of Baseline and Proposed Action Emissions

CO (000 tons)	No Action Alternative			Proposed Action			Change (PA-NA)		
	Upstream	Rebound	Total**	Upstream	Rebound	Total**	Upstream	Rebound	Total**
2005	378.49	0.00	378.49	378.47	0.60	379.06	-0.03	0.60	0.57
2006	792.49	0.00	792.49	792.38	1.99	794.37	-0.11	1.99	1.88
2007	1414.63	0.00	1414.63	1414.40	4.61	1419.00	-0.24	4.61	4.37
2010	2644.66	0.00	2644.66	2644.44	10.09	2654.53	-0.22	10.09	9.87
2015	2727.04	0.00	2727.04	2726.92	11.14	2738.06	-0.13	11.14	11.01
2020	1720.71	0.00	1720.71	1720.65	7.23	1727.87	-0.06	7.23	7.17
Lifetime*	42400.41	0.00	42400.41	42397.87	168.34	42566.21	-2.54	168.34	165.80

VOC (000 tons)	No Action Alternative			Proposed Action			Change (PA-NA)		
	Upstream	Rebound	Total**	Upstream	Rebound	Total**	Upstream	Rebound	Total**
2005	33.99	0.00	33.99	33.91	0.04	33.95	-0.07	0.04	-0.04
2006	73.13	0.00	73.13	72.85	0.12	72.97	-0.28	0.12	-0.16
2007	112.09	0.00	112.09	111.52	0.25	111.77	-0.57	0.25	-0.32
2010	150.07	0.00	150.07	149.53	0.44	149.97	-0.54	0.44	-0.10
2015	149.50	0.00	149.50	149.20	0.53	149.72	-0.30	0.53	0.22
2020	112.90	0.00	112.90	112.76	0.43	113.19	-0.14	0.43	0.29
Lifetime*	2757.95	0.00	2757.95	2751.72	9.39	2761.11	-6.23	9.39	3.17

NOx (000 tons)	No Action Alternative			Proposed Action			Change (PA-NA)		
	Upstream	Rebound	Total**	Upstream	Rebound	Total**	Upstream	Rebound	Total**
2005	43.35	0.00	43.35	43.25	0.04	43.28	-0.10	0.04	-0.07
2006	89.43	0.00	89.43	89.03	0.10	89.14	-0.39	0.10	-0.29
2007	141.74	0.00	141.74	140.93	0.22	141.14	-0.82	0.22	-0.60
2010	195.69	0.00	195.69	194.93	0.48	195.41	-0.76	0.48	-0.28
2015	186.03	0.00	186.03	185.60	0.58	186.18	-0.43	0.58	0.15
2020	121.04	0.00	121.04	120.83	0.42	121.26	-0.20	0.42	0.22
Lifetime*	3124.30	0.00	3124.30	3115.50	9.04	3124.54	-8.80	9.04	0.24

PM 2.5 (000 tons)	No Action Alternative			Proposed Action			Change (PA-NA)		
	Upstream	Rebound	Total**	Upstream	Rebound	Total**	Upstream	Rebound	Total**
2005	2.80	0.00	2.80	2.80	0.00	2.80	-0.01	0.00	0.00
2006	4.73	0.00	4.73	4.71	0.01	4.71	-0.02	0.01	-0.02
2007	7.04	0.00	7.04	6.99	0.01	7.00	-0.05	0.01	-0.04
2010	6.12	0.00	6.12	6.08	0.01	6.09	-0.04	0.01	-0.03
2015	3.46	0.00	3.46	3.43	0.01	3.44	-0.02	0.01	-0.02
2020	1.58	0.00	1.58	1.57	0.00	1.57	-0.01	0.00	-0.01
Lifetime*	74.38	0.00	74.38	73.88	0.12	74.00	-0.51	0.12	-0.38

SOx (000 tons)	No Action Alternative			Proposed Action			Change (PA-NA)		
	Upstream	Rebound	Total**	Upstream	Rebound	Total**	Upstream	Rebound	Total**
2005	15.91	0.00	15.91	15.85	0.01	15.86	-0.06	0.01	-0.05
2006	29.77	0.00	29.77	29.56	0.01	29.57	-0.21	0.01	-0.21
2007	44.23	0.00	44.23	43.79	0.02	43.80	-0.44	0.02	-0.43
2010	38.29	0.00	38.29	37.88	0.01	37.89	-0.41	0.01	-0.40
2015	21.63	0.00	21.63	21.39	0.01	21.40	-0.24	0.01	-0.23
2020	9.88	0.00	9.88	9.77	0.00	9.77	-0.11	0.00	-0.11
Lifetime*	464.02	0.00	464.02	459.25	0.18	459.43	-4.77	0.18	-4.59

CO2 (MMTCe)	No Action Alternative			Proposed Action			Change (PA-NA)		
	Upstream	Rebound	Total**	Upstream	Rebound	Total**	Upstream	Rebound	Total**
2005	9.97	0.00	9.97	9.96	-0.10	9.86	-0.01	-0.10	-0.11
2006	21.88	0.00	21.88	21.84	-0.38	21.46	-0.04	-0.38	-0.42
2007	32.57	0.00	32.57	32.49	-0.79	31.70	-0.08	-0.79	-0.87
2010	28.60	0.00	28.60	28.52	-0.73	27.79	-0.08	-0.73	-0.81
2015	16.12	0.00	16.12	16.08	-0.42	15.66	-0.04	-0.42	-0.46
2020	7.14	0.00	7.14	7.12	-0.19	6.93	-0.02	-0.19	-0.22
Lifetime*	340.51	0.00	340.51	339.61	-8.49	331.12	-0.90	-8.49	-9.39

* Lifetime emissions equal the amount of emissions for MY 2005-2007 light trucks over their 25-year lifetime
** Total emissions include upstream and rebound emissions only

NO_X emissions are projected to increase over the lifetime of MY 2005-2007 light trucks, and on an annual basis until calendar year 2012 as the increase in emissions from more intensive use of light trucks manufactured under the Proposed Action is offset by the reduction in emissions from lower gasoline refining and distribution. Starting in calendar year 2013 the situation is reversed and total NO_X emissions are projected to increase slightly as a result of the rebound effect and the effect of degraded emissions performance from aging vehicles. This post-2013 projected increase in NO_X emissions is an extremely small percentage of projected aggregate national NO_X emissions for all vehicles. As presented above, the projected annual NO_X emissions increases comprise at most 0.012 percent – in calendar year 2020 – of the NO_X emissions projections for all vehicles during the study period.

Under the Proposed Action, PM emissions are projected to decrease over the lifetime of MY 2005-2007 light trucks, as well as on an annual basis during the study period. The changes (decreases) are extremely small (at most 0.011 percent in 2007) when compared to the projected aggregate national PM emissions.

Under the Proposed Action, SO_X emissions are projected to decrease over the lifetime of MY 2005-2007 light trucks, as well as on an annual basis during the study period. The changes (decreases) are extremely small (at most 1.555 percent in 2010) when compared to the projected aggregate national SO_X emissions.

Non-Attainment Area Analysis for Criteria Pollutants

As established under the provisions of the Clean Air Act, areas are classified in non-attainment when concentrations of one or more criteria pollutants exceed the NAAQS. As summarized above, implementation of the Proposed Action would result in projected increases of several criteria pollutants, both on an annual basis – in different years during the study period – and over the lifetime of MY 2005-2007 light trucks. Thus, in order to evaluate the cumulative effects associated with those increases in non-attainment areas, in light of all the actions that occur in those areas, a non-attainment area analysis is presented in Appendix D. This analysis focused on a small sample of large non-attainment areas geographically distributed across the country. Specific areas were selected for each criteria pollutant for which the analysis results in projected emission increases, with special attention to those areas where motor vehicle use is an important factor. Historical emissions trends data were used to determine the effect of the projected Proposed Action increases on the attainment status goals for those areas. The analysis indicates that the projected increases in emissions of criteria pollutants in most or all Nonattainment Areas are likely to be negligible by comparison to current and projected future emissions levels in these areas.

Table 4-7 presents a summary of the estimated increases in relevant criteria pollutant emissions for selected Nonattainment areas. These results are expected to be applicable on a national scale for other potential areas of concern. (See Appendix D for complete discussion).

Table 4-7. Criteria Pollutant Emissions for Selected Nonattainment Areas

Nonatainment Area	Pollutants of Concern	Maximum Increase in Emissions (tons/year)			Annual Emissions Inventory (tons/year)			% Increase in Emissions		
		CO	VOC	NOx	CO	VOC	NOx	CO	VOC	NOx
Atlanta	Ozone	575.28	15.62	17.66	--	191,988	216,262	--	0.008%	0.008%
Chicago-NW Indiana	Ozone	927.25	25.17	28.46	--	395,854	447,097	--	0.006%	0.006%
Houston-Galveston	Ozone	635.85	17.26	19.52	--	269,850	563,503	--	0.006%	0.003%
California South Coast	Ozone, CO	1843.80	50.05	56.59	2,984,940	390,910	610,372	0.062%	0.013%	0.009%
New York-NNJ	Ozone	1684.93	45.74	51.72	--	368,195	392,927	--	0.012%	0.013%
Phoenix	Ozone, CO	346.17	9.40	10.62	717,958	130,314	159,740	0.048%	0.007%	0.007%
Washington, D.C.	Ozone	484.99	13.17	14.89	--	17,790	17,718	--	0.074%	0.084%

Greenhouse Gas Emissions

Under the Proposed Action, GHG emissions are projected to decrease over the lifetime of MY 2005-2007 light trucks, as well as on an annual basis during the study period (Table 4-6). The projected reduction in GHG emissions constitutes a benefit.

4.8.3. Fuel Consumption, Refinery Emissions, and Impacts on Water and Biological Systems

A decrease in fuel consumption can lead to environmental benefits through the reduction of oil exploration, drilling and extraction, transport, 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 lead to deforestation. Thus, a decrease in oil drilling and extraction is expected to result in minor benefits to topographic and geological structures. Offshore drilling can also contaminate sediments and lead to oil leakage into the 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 extraction would lead to a reduction in the amount of fuel refined. 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).

4.8.4. Cumulative Effects

Under previous actions, the agency issued EAs to evaluate environmental impacts, evaluated the cumulative effects 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 in the Background section to this document, 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. 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 Proposed Action this EA addresses constitutes the first effort 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).

Given this substantial gap in time, and the resulting changes in vehicle fleet composition and other relevant parameters impacting the CAFE program, we believe that the most practicable approach to evaluating cumulative impacts is to direct our focus on impacts of activities that have occurred since the lifting of the Congressional restrictions. In order to survey such cumulative impacts in a useful manner, we have assessed the impacts of the Proposed Action on Clean Air Act non-attainment areas, which are subject to emissions from numerous sources, and from a variety of actions unrelated to the CAFE program. We have sampled seven geographically diverse Nonattainment areas across the United States, and assessed the potential changes in relevant criteria pollutants within their boundaries. The results of our Nonattainment area analysis and related discussion are included in Appendix D.

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LIST OF APPENDICES

APPENDIX A – ANALYTICAL METHODOLOGY

This section outlines the methodology used to estimate the environmental impacts associated with the Proposed Action, compared to the baseline (20.7 mpg). Most environmental impacts considered in this analysis are projected from reductions in gasoline use due to the higher fuel economy of new light trucks produced during the model years in question. Environmental impacts from increased CAFE standards include reductions in emissions of carbon dioxide and other "greenhouse" gases attributable to reduced upstream emission sources and gasoline use. Additionally, net changes in emissions of regulated or "criteria" air pollutants are projected from increased light truck use ("rebound effect") and reduced upstream emissions sources.

Potential environmental impacts were estimated separately for each model year light truck over its life span in the U.S. vehicle fleet. The life span of a light truck extends from the initial year when it is offered for sale, typically late in the preceding calendar year, until the time when nearly all vehicles from that model year have been scrapped or retired from service, assumed to be 25 years after the vehicle is first sold. Each environmental impact is measured by determining the *difference* in a variable – such as total gallons of fuel consumed by light trucks of a single model year during a future calendar year –when comparing the fuel economy under the Proposed Action with the baseline standard of 20.7 mpg. These estimated impacts are calculated and reported separately both for light trucks manufactured during each model year from 2005 through 2007, and for each future calendar year during which those vehicles remain in the U.S. vehicle fleet. Environmental impacts from tighter CAFE standards aggregated for each model year over its expected life span are reported in both undiscounted terms and as their present value discounted to the year when each model year is first offered for sale.

Table A-1 summarizes the main assumptions and parameters used in the analysis.

Table A-1. Summary of Main Assumptions and Parameters

Variable	Value	Source
Light Truck Sales (millions):		Energy Information Administration, *Annual Energy Outlook 2002*, Table 45.
Model Year 2005	7.65	
Model Year 2006	7.80	
Model Year 2006	7.92	
Light Truck Sales Shares (all model years)		Light truck manufacturers' submissions to NHTSA.
Under 6,000 lbs. Gross Vehicle Weight	59%	
6,000-8,500 lbs. Gross Vehicle Weight	41%	
"Gap" between test and on-road MPG	15%	U.S. EPA
"Rebound" effect	20%(1)	Greene *et al.*, "Fuel Economy Rebound Effect for U.S. Household Vehicles," *The Energy Journal,* Volume 20 (1999), pp. 1-31, and others
Discount rate applied to future benefits	7.0%	Office of Management and Budget
Share of reduction in fuel use attributed to reduced imports of gasoline	50%	Derived from historical data on U.S. gasoline consumption and imports, and forecasts of gasoline use and imports reported in the Energy Information Administration, *Annual Energy Outlook 2003*.
Share of reduction in fuel use attributed to reduced domestic gasoline refining	50%	
Light truck emission rates for criteria pollutants (grams/vehicle-mile)	Vary by model year	Estimated by Volpe Center using U.S. EPA, MOBILE6.2 Motor Vehicle Emission Factor Model.
Light truck emission rates for greenhouse gases (carbon equivalent in grams per gallon of gasoline consumed)	2,366	Derived from gasoline specifications reported in Argonne National Laboratory, *Greenhouse Gas and Regulated Emissions in Transportation (GREET)* Model, Technical Documentation, February 2002, Table 3.3.
Criteria pollutant and greenhouse emission rates for gasoline refining and distribution (grams/gallon)	Vary by pollutant	Estimated by Volpe Center using Argonne National Laboratory, *Greenhouse Gas and Regulated Emissions in Transportation (GREET)* Model, version 6.2.
Light truck usage	Varies by vehicle age	EPA, Update of Fleet Characterization Data for Use in Mobile6 – Final Report, EPA420-P-98-016, June 1998, Table 4-5, p. 4-35.
Light truck survival rates	Vary by vehicle age	Oak Ridge National Laboratory, *Transportation Energy Data Book,* Volume 22, Table 6.10.

(1) Elasticity of annual miles driven per vehicle with respect to fuel cost per mile driven equals minus 0.2.

VARIABLES

Sales and Populations. Forecasts of light truck sales for future calendar years were obtained from the Energy Information Administration's (EIA) *Annual Energy Outlook 2002* (AEO 2002), a standard government reference for forecasts of energy production and consumption in different sectors of the U.S. economy (DOE 2002a). Forecasted light truck sales during each calendar year were allocated between the model years expected to be offered for sale during each calendar year, on the basis of dates when new model years are typically introduced, and recent monthly sales patterns for light trucks. For example, both *model year* 2006 and 2007 light trucks will be sold at different times during *calendar* year 2006, although sales of the two model years may overlap for some time after the new model year is introduced. The number of light trucks manufactured during each model year that remain in service during each subsequent calendar year is estimated by applying estimates of the proportion of vehicles initially produced and sold during a model year that remain in service at each age up to 25 years, by which time only a small fraction of vehicles initially sold during an earlier model year typically remain in service. These "survival rates" are based on experience with recent model-year light trucks (CTA 2002). Separate survival rates for each vehicle age are employed for two weight classes of light trucks, those under 6,000 pounds gross vehicle weight (GVW), and those from 6,001-8,500 pounds GVW, the upper weight limit for vehicles currently classified as light trucks for fuel economy standards (DOE 2002b).

Light Truck Fuel Economy. Projected actual fuel economy levels for each future model year's light trucks under the Proposed Action and the Baseline were estimated. Under the Baseline and under the Proposed Action, average projected actual fuel economy for all new light trucks manufactured during each model year slightly exceeds the applicable standard, as measured using the U.S. government fuel economy testing procedures. However, actual fuel economy levels achieved by light trucks in on-road driving falls significantly short of the level measured under these test conditions, and the actual fuel economy performance of each model year's light trucks is adjusted to reflect the expected size of this fuel economy "gap" in future calendar years (DOE 2002c).

Light Truck Usage and Total Miles Driven. The total number of miles driven by light trucks of each model year during each year of their life span in the fleet with the baseline standard of 20.7 mpg in effect is estimated by multiplying age-specific estimates of annual miles driven per vehicle by the number of vehicles of that model year remaining in service at each age. The age of a given model year vehicle during any future calendar year is equal to the difference between that calendar year and the model year, plus one. For example, a model year 2005 vehicle is defined to be 10 years old during calendar year 2014. The measures of annual miles driven per vehicle for light trucks of various ages used in this analysis reflect experience with actual use of recent model year light trucks; separate estimates of annual use at different ages for light trucks under 6,000 pounds GVW and those of 6,001-8,500 pounds GVW are again employed (EPA 1998a).

By reducing the cost of gasoline per mile driven, tighter CAFE standards result in a slight increase in annual miles driven per vehicle. This increase in the annual number of miles each vehicle is driven, often referred to as the "rebound effect," also produces a corresponding increase in the *total* number of miles driven by light trucks of each model year during each subsequent calendar year they remain in the fleet. The magnitude of the rebound effect is calculated by applying a representative estimate of the elasticity of vehicle use with respect to fuel cost per mile driven to the percentage reduction in that cost that would result from requiring light trucks to achieve higher fuel economy than the 20.7 mpg Baseline standard. Recent estimates of the rebound effect resulting from higher fuel economy standards for light-duty vehicles indicate that a 10% reduction in fuel costs per mile results in a 1-2% increase in the number of miles driven.[5] The average fuel cost per mile for operating light trucks of any model year during a subsequent calendar year is calculated from the forecasted retail price of gasoline during that future year, divided by the average actual on-road fuel economy level achieved by light trucks of that model year at either the Baseline or with a stricter CAFE standard in effect during the year that vehicle was produced (DOE 2002d).

Fuel Savings. At the Baseline standard, 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 driven by the surviving population of vehicles of that model year by the average on-road fuel economy expected to be achieved if the vehicles are manufactured to comply with the Baseline 20.7 mpg standard. If that same model year's light trucks are required to meet a higher CAFE standard, their total fuel consumption during each subsequent 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 they achieve during each year of their life span in the fleet as a result of being initially required to comply with that stricter CAFE standard.

The difference between estimated total fuel use by light trucks of a given model year during each calendar year with the Baseline standard in effect and under a stricter standard represents the fuel savings attributable to tightening the standard to that higher level. The sum of these annual fuel savings over each calendar year represents the total fuel savings projected from applying a stricter CAFE standard to light trucks produced during that model year. Similarly, total fuel savings projected from an increased CAFE standard during any future calendar year are equal to the sum of fuel savings produced by light trucks of each model year remaining in the fleet that was initially required to comply with the higher standard.

[5] These values are derived from statistical estimates of the elasticity of miles driven per vehicle with respect to fuel cost per mile that range from approximately –0.10 to –0.20; see for example Greene, David L., "Vehicle Use and Fuel Economy: How Big is the Rebound Effect?" *The Energy Journal*, 13:1 (1992), 117-143; Greene, David L., James R. Kahn, and Robert C. Gibson, "Fuel Economy Rebound Effect for Household Vehicles," *The Energy Journal*, 20:3 (1999), 1-31; Jones, Clifton T., "Another Look at U.S. Passenger Vehicle Use and the 'Rebound' Effect from Improved Fuel Efficiency, *The Energy Journal*, 14:4 (1993), 99-110; and Goldberg, Pinelopi Koujianou Goldberg, "The Effects of the Corporate Average Fuel Efficiency Standards in the U.S.," *The Journal of Industrial Economics*, 46:1 (1998), 1-33.

ENVIRONMENTAL IMPACTS OF REDUCED GASOLINE USE

Environmental impacts from petroleum use occur primarily as a result of petroleum refining and the distribution and combustion of petroleum products such as gasoline. These impacts include emissions of greenhouse gases, which are widely believed to increase the potential for global climate change, and emissions of regulated or "criteria" air pollutants, which can adversely affect human health and damage property in sufficient concentrations. Emissions of greenhouse gases and criteria pollutants occur during crude oil extraction, transportation and storage, petroleum refining, as well as during the subsequent distribution and consumption of petroleum products such as gasoline. Tighter CAFE standards for light-duty trucks will reduce gasoline consumption and the amount of petroleum refined, and both of these effects will in turn reduce emissions of greenhouse gases. While reduced gasoline consumption will also lower emissions of criteria pollutants, the increased use of light trucks that results from improving their fuel economy (the rebound effect) will raise emission of these pollutants. Therefore, tighter CAFE standards can reduce or increase emissions of criteria pollutants.

As explained in Appendix E, Section 5, upstream emissions factors were estimated using the GREET model to account for emissions from different stages in the petroleum cycle. Upstream emissions factors were disaggregated into four main components: (a) crude oil extraction; (b) crude oil transportation and storage; (c) crude oil refining into gasoline; and (d) gasoline transportation, storage, and distribution (emissions during gasoline retailing are correlated with driving behavior and are thus included in our "tailpipe" emission factors and reflected under the "rebound" emissions presented in the analysis). The following assumptions were used: (1) reductions in imports of gasoline reduce only gasoline transportation, storage, and distribution; (2) reductions in domestic refining of gasoline using imported crude oil as a feedstock reduce crude oil transportation and storage, crude oil refining into gasoline, and gasoline transportation, storage, and distribution; and (3) reductions in domestic refining of gasoline using domestically-produced crude oil as a feedstock reduce crude oil extraction, crude oil transportation and storage, crude oil refining into gasoline, and gasoline transportation, storage, and distribution. Since a significant proportion of upstream emissions are due to fuel use in transporting crude oil and gasoline, we in effect assume that the distances that crude oil travels to refineries are about the same regardless of whether it is coming from domestic oilfields or import terminals, and that the distances that gasoline travels from refineries to retail stations are about the same as it travels from import terminals to gasoline stations.

Reductions in Greenhouse Gas Emissions. Fuel savings from stricter light truck CAFE standards will result in lower emissions of carbon dioxide, the main greenhouse gas emitted as a result of refining, distribution, and use of transportation fuels (EPA 1999a). Lower fuel consumption reduces carbon dioxide emissions directly because the primary source of these emissions is fuel use in internal combustion engines, which convert stored fuel energy into vehicle propulsion energy. This analysis projects reductions in carbon dioxide emissions from vehicle operation by assuming that the entire carbon content of gasoline is converted to carbon dioxide in the combustion process. This assumption results in an overestimate of 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 extremely small. At the same time, lower fuel consumption also reduces carbon dioxide emissions resulting from fuel combustion and other energy use that occurs during crude oil extraction, crude oil transportation and storage, crude oil refining into gasoline, and gasoline transportation, storage, and distribution. Reductions in emissions from these activities are projected using estimates of carbon dioxide emission rates per unit of fuel energy refined and distributed for retail sale (Argonne 2002).

Changes in Criteria Pollutant Emissions. Stricter CAFE standards can result in higher or lower emissions of "criteria" pollutants, by-products of fuel combustion that are emitted by internal combustion engines and by crude oil extraction, crude oil transportation and storage, crude oil refining into gasoline, and gasoline transportation, storage, and distribution activities. Criteria pollutants emitted by light-duty motor vehicles include carbon monoxide, various hydrocarbon compounds, nitrogen oxides, and fine particulate matter. A higher fuel economy standard may increase the use of light trucks (the "rebound effect"). This in turn would cause increased emissions of criteria pollutants, since federal standards regulate permissible emissions of these pollutants on a per-mile basis. Conversely, reductions in gasoline consumption and refining from stricter light truck CAFE standards will lower emissions of criteria pollutants that occur during crude oil extraction, transportation and storage, crude oil refining, and gasoline distribution, and retailing (Argonne 2002).

Additional emissions of these pollutants from vehicle operation are estimated by multiplying the increase in total miles driven by light trucks of each model year and age during a calendar year by per-mile emission rates for each of these four pollutants (EPA 2002a). Future changes in air pollutant emission standards for light trucks, notably the "Tier 2" emission standards for light-duty vehicles that are scheduled to take effect beginning in model year 2004, will cause emissions of criteria pollutants to vary among light trucks manufactured during the specific model years included in this analysis. Because each future year's light truck fleet will include a different mix of vehicles produced during these model years, the increase in emissions of criteria pollutants caused by "rebound effect" driving will vary over future years.

The reduction in emissions is estimated by applying emission factors for each criteria pollutant per unit of fuel energy refined to the reduction in gasoline use (expressed in terms of its total energy content) resulting from an increase in light truck CAFE standards. Each future year's estimate of reductions in criteria pollutant emissions from reduced upstream sources is combined with the annual change in emissions from increased light truck use to determine the annual net change in emissions of each pollutant. On balance, emissions of some criteria pollutants are likely to increase as a result of stricter CAFE standards, as increased emissions during vehicle operation outweigh the reduction in upstream emissions, while the opposite situation occurs for other criteria pollutants, thus lowering their total emissions. However, the pattern of these net changes in criteria emissions varies, both over future years and among individual pollutants during any year.

APPENDIX B – ENERGY

This Appendix presents detailed information on changes in energy consumption projected from the Proposed Action. This section serves as a complement to the general energy information provided in the Energy Section in Chapter 3 (Section 3.1) and the Energy Section in Chapter 4 (Section 4.1), as revised in response to comments to the Draft EA (see Appendix E).

BACKGROUND

Based on the methodology described in Appendix A, a yearly analysis of fuel consumption was developed for calendar years 2004-2031 under the Baseline and Proposed Action.

The numbers in these yearly calculations are aggregated across MY 2005-2007. Thus, the calendar year 2005 fuel consumption value includes MY 2005 and MY 2006 light trucks sold and operated in calendar year 2005, the calendar year 2006 consumption value includes MY 2005 light trucks operating in calendar year 2006 plus MY 2006 and 2007 light trucks sold and operating in calendar year 2006, and the calendar year 2007 consumption value includes MY 2005, MY 2006, and MY 2007 light trucks operating in calendar year 2007. Similarly, the calendar years 2008 through 2031 values include the MY 2005-2007 light trucks still operating in each respective year.

Table B-1 shows the projected total amount of fuel consumed by MY 2005-2007 light trucks on an annual basis under the Baseline for the calendar years 2004-2031.

Table B-2 shows the projected total amount of fuel consumed by MY 2005-2007 light trucks on an annual basis under the Proposed Action for the calendar years 2004-2031.

Table B-3 shows the projected total reduction in fuel consumed by MY 2005-2007 light trucks on an annual basis under the Proposed Action for the calendar years 2004-2031.

Table B-1. Annual Fuel Use – Baseline (million gallons)

Model Year	Calendar Year:																												Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
2005	359.5	6,069.3	7,583.3	7,099.3	6,592.9	6,010.2	5,446.1	4,892.2	4,362.7	3,859.1	3,387.0	2,946.3	2,540.6	2,172.1	1,835.6	1,538.6	1,277.6	1,049.4	853.3	685.7	545.3	428.8	334.4	257.6	197.0	148.8	0.0	0.0	72,113.4
2006	0.0	363.1	6,130.1	7,659.2	7,170.4	6,658.9	6,070.4	5,500.7	4,941.2	4,406.4	3,897.8	3,420.9	2,975.8	2,566.1	2,193.9	1,854.0	1,554.0	1,290.4	1,059.9	861.8	692.5	550.8	433.1	337.8	260.2	199.0	150.3	0.0	73,198.9
2007	0.0	0.0	364.1	6,146.1	7,679.2	7,189.1	6,676.3	6,086.2	5,515.1	4,954.1	4,417.9	3,908.0	3,429.9	2,983.6	2,572.8	2,199.6	1,858.8	1,558.1	1,293.8	1,062.7	864.1	694.3	552.2	434.2	338.7	260.9	199.5	150.7	73,390.1
Total	359.5	6,432.4	14,077.5	20,904.7	21,442.5	19,858.2	18,192.8	16,479.2	14,819.0	13,219.7	11,702.8	10,275.3	8,946.3	7,721.8	6,602.2	5,592.2	4,690.4	3,897.9	3,207.0	2,610.2	2,101.9	1,673.9	1,319.7	1,029.6	795.9	608.7	349.8	150.7	218,702.3

Table B-2. Annual Fuel Use – Proposed Action (million gallons)

Model Year	Calendar Year:																												Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
2005	357.4	6,033.2	7,538.1	7,057.0	6,553.6	5,974.4	5,413.7	4,863.1	4,336.7	3,836.1	3,366.8	2,928.8	2,525.5	2,159.2	1,824.7	1,529.4	1,270.0	1,043.2	848.2	681.6	542.1	426.2	332.5	256.1	195.8	148.0	0.0	0.0	71,683.5
2006	0.0	356.8	6,023.5	7,526.0	7,045.7	6,543.1	5,964.8	5,405.0	4,855.3	4,329.8	3,830.0	3,361.4	2,924.1	2,521.4	2,155.7	1,821.7	1,527.0	1,268.0	1,041.5	846.8	680.5	541.2	425.5	331.9	255.7	195.5	147.7	0.0	71,925.8
2007	0.0	0.0	354.7	5,987.7	7,481.2	7,003.7	6,504.2	5,929.3	5,372.8	4,826.4	4,304.0	3,807.2	3,341.4	2,906.7	2,506.4	2,142.9	1,810.9	1,517.9	1,260.4	1,035.3	841.8	676.4	538.0	423.0	329.9	254.1	194.4	146.8	71,497.6
Total	357.4	6,389.9	13,916.2	20,570.6	21,080.5	19,521.2	17,882.6	16,197.4	14,564.9	12,992.3	11,500.9	10,097.4	8,791.0	7,587.3	6,486.8	5,494.0	4,607.9	3,829.0	3,150.1	2,563.7	2,064.3	1,643.9	1,296.0	1,011.0	781.5	597.6	342.1	146.8	215,106.9

Table B-3. Reduction in Fuel Use under Proposed Action (million gallons)

Model Year	Calendar Year:																												Undiscounted Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
2005	2.1	36.2	45.2	42.3	39.3	35.8	32.5	29.2	26.0	23.0	20.2	17.6	15.1	12.9	10.9	9.2	7.6	6.3	5.1	4.1	3.3	2.6	2.0	1.5	1.2	0.9	0.0	0.0	429.9
2006	0.0	6.3	106.6	133.2	124.7	115.8	105.6	95.7	85.9	76.6	67.8	59.5	51.8	44.6	38.2	32.2	27.0	22.4	18.4	15.0	12.0	9.6	7.5	5.9	4.5	3.5	2.6	0.0	1,273.1
2007	0.0	0.0	9.4	158.5	198.0	185.4	172.2	156.9	142.2	127.7	113.9	100.8	88.4	76.9	66.3	56.7	47.9	40.2	33.4	27.4	22.3	17.9	14.2	11.2	8.7	6.7	5.1	3.9	1,892.5
Total	2.1	42.5	161.2	334.0	362.0	337.0	310.2	281.8	254.2	227.4	201.9	177.8	155.3	134.5	115.4	98.1	82.6	68.9	56.9	46.5	37.6	30.0	23.8	18.6	14.4	11.1	7.8	3.9	3,595.4

APPENDIX C – AIR QUALITY

This section presents detailed information on criteria pollutants, air quality health effects, current state of the environment, source characteristics, and changes in emissions under the Proposed Action. This section serves as a complement to the general air quality information provided in the Air Quality Section in Chapter 3 (Section 3.2) and the Air Quality Section in Chapter 4 (Section 4.2), as revised in response to comments to the Draft EA (see Appendix E).

BACKGROUND

Table C-1 shows the primary and secondary standards used to regulate air pollution in the U.S. The standards for short term averages (i.e., less than 24 hours) are devised to protect the public from short term exposures resulting in adverse health effects, and the standards for long term averages (i.e., annual) are devised to protect the public from both short term and prolonged exposures (EPA 2001).

Table C-1. National Ambient Air Quality Standards

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

Parenthetical value is an approximately equivalent concentration.
Source: EPA 2002c

Criteria Pollutants

Carbon Monoxide (CO)

Carbon monoxide is a colorless, odorless, poisonous gas formed when carbon in fuels is not burned completely. It is a byproduct of highway vehicle exhaust, which contributes about 60 percent of all CO emissions nationwide. In cities, automobile exhaust can cause as much as 95 percent of all CO emissions. Other sources of CO emissions include industrial processes and fuel combustion in sources such as boilers and incinerators.

Carbon monoxide enters the bloodstream and reduces oxygen delivery to the body's organs and tissues. The health threat from exposure to CO is most serious for those who suffer from cardiovascular disease. Healthy individuals are also affected, but only at higher levels of exposure. Exposure to elevated CO levels is associated with visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability, and difficulty in performing complex tasks. EPA's health-based national air quality standard for CO is 9 ppm measured as an annual second-maximum 8-hour average concentration.

Nationally, the 2000 ambient average CO concentration is 61 percent lower than it was in 1981 and is the lowest level recorded during the past 20 years. CO emissions levels decreased 18 percent over the same period. Between 1991 and 2000, ambient CO concentrations decreased 41 percent, and the estimated number of violations of the national standard decreased 95 percent while CO emissions fell 5 percent. This improvement occurred despite a 24 percent increase in vehicle miles traveled in the United States during this 10-year period (EPA 2001).

Lead (Pb)

Prior to the enactment of EPA regulations that reduced the content of lead in gasoline during the late 1970s and early 1980s, the primary source of lead emissions in the U.S. was the automobile. Now smelters and battery plants are the major sources of lead in the air. The highest concentrations of lead are found in the vicinity of nonferrous smelters and other stationary sources of lead emissions.

Exposure to lead mainly occurs through inhalation of air and ingestion of lead in food, paint, water, soil, or dust. Lead accumulates in the body in blood, bone, and soft tissue. Because it is not readily excreted, lead can also affect the kidneys, liver, nervous system, and other organs. Excessive exposure to lead may cause anemia, kidney disease, reproductive disorders, and neurological impairments such as seizures, mental retardation, and/or behavioral disorders. Even at low doses, lead exposure is associated with changes in fundamental enzymatic, energy transfer, and other processes in the body. Fetuses and children are especially susceptible to low doses of lead, often suffering central nervous system damage or slowed growth. Recent studies show that lead may be a factor in high blood pressure and subsequent heart disease in middle-aged white males. Lead may also contribute to osteoporosis in post-menopausal women. EPA's health-based national air quality standard for lead is 1.5 $\mu g/m^3$ measured as an annual maximum quarterly average concentration.

Because of the phase-out of leaded gasoline, lead emissions and concentrations decreased sharply during the 1980s and early 1990s. The 2000 average air quality concentration for lead is 93 percent lower than in 1981. Emissions of lead decreased 94 percent over that same 20-year period. Today, the only violations of the national air quality standard for lead occur near large industrial sources such as lead smelters (EPA 2001).

Nitrogen Dioxide (NO_2)
Nitrogen dioxide belongs to a family of highly reactive gases called nitrogen oxides (NO_X). These gases form when fuel is burned at high temperatures, and come principally from motor vehicle exhaust and stationary sources such as electric utilities and industrial boilers. A suffocating, brownish gas, nitrogen dioxide is a strong oxidizing agent that reacts in the air to form corrosive nitric acid, as well as toxic organic nitrates. It also plays a major role in the atmospheric reactions that produce ground-level ozone (or smog).

Nitrogen dioxide can irritate the lungs and lower resistance to respiratory infections such as influenza. The effects of short-term exposure are still unclear, but continued or frequent exposure to concentrations that are typically much higher than those normally found in the ambient air may cause increased incidence of acute respiratory illness in children. EPA's health-based national air quality standard for NO_2 is 0.053 ppm (measured as an annual arithmetic mean concentration). Nitrogen oxides contribute to ozone formation and can have adverse effects on both terrestrial and aquatic ecosystems. Nitrogen oxides in the air can significantly contribute to a number of environmental effects such as acid rain and eutrophication in coastal waters like the Chesapeake Bay. Eutrophication occurs when a body of water suffers an increase in nutrients that leads to a reduction in the amount of oxygen in the water, producing an environment that is destructive to fish and other animal life.

Over the past 20 years, monitored levels of NO_2 have decreased 14 percent. All areas of the country that once violated the national air quality standard for NO_2 now meet that standard. While levels around urban monitors have fallen, national emissions of nitrogen oxides have actually increased over the past 20 years by 4 percent. This increase is the result of a number of factors, the largest being an increase in nitrogen oxides emissions from diesel vehicles. This increase is of concern because NO_X emissions contribute to the formation of ground-level ozone (smog) and other environmental problems, like acid rain and nitrogen loadings to water bodies (EPA 2001).

Ozone (O_3)
Ground-level ozone (the primary constituent of smog) is the most complex, difficult to control, and pervasive of the six principal air pollutants. Unlike other pollutants, ozone is not emitted directly into the air by specific sources. Sunlight acting on NO_X and VOC in the air creates ozone. There are many sources of these gases. Some of the common sources include gasoline vapors, chemical solvents, combustion products of fuels, and consumer products. Emissions of NO_X and VOC from motor vehicles and stationary sources can be carried hundreds of miles from their origin, and result in high ozone concentrations over very large regions.

Scientific evidence indicates that ground-level ozone not only affects people with impaired respiratory systems (such as asthmatics), but healthy adults and children as well. Exposure to ozone for 6 to 7 hours, even at relatively low concentrations, significantly reduces lung function and induces respiratory inflammation in normal, healthy people during periods of moderate exercise. It can be accompanied by symptoms such as chest pain, coughing, nausea, and pulmonary congestion. Recent studies provide evidence of an association between elevated ozone levels and increases in hospital admissions for respiratory problems in several U.S. cities. Results from animal studies indicate that repeated exposure to high levels of ozone for several months or more can produce permanent structural damage in the lungs. EPA's health-based national air quality standard for ozone is currently set at 0.12 ppm (measured as the second daily 1-hour maximum concentration). Ozone is responsible for approximately 1 to 2 billion dollars of agricultural crop yield loss (by a disrupting process that suppresses photosynthesis) in the U.S. each year. Ozone also damages forest ecosystems in California and the eastern U.S.

Over the past 20 years, national ambient ozone levels decreased 21 percent based on 1-hour data, and 10 percent based on 8-hour data. Between 1981 and 2000, emissions of VOCs have decreased 32 percent. During that same time period, emissions of NO_X increased 4 percent. Because sunlight and heat play a major role in ozone formation, changing weather patterns contribute to yearly differences in ozone concentrations. EPA makes analytical adjustments to account for this annual variability in meteorology. For 52 metropolitan areas, the adjusted trend for 1-hour ozone levels shows improvement over the 20-year period from 1981–2000. However, beginning in 1994, the rate of improvement appears to level off and the trend in the last 10 years is relatively flat (EPA 2001).

Particulate Matter (PM)

Particulate matter is the term for solid or liquid particles found in the air. Some particles are large or dark enough to be seen as soot or smoke. Others are so small they can be detected only with an electron microscope. Because particles originate from a variety of mobile and stationary sources (diesel trucks, woodstoves, power plants, etc.), their chemical and physical compositions vary widely. Particulate matter can be directly emitted or can be formed in the atmosphere when gaseous pollutants such as SO_2 and NO_X react to form fine particles.

PM 2.5 describes the "fine" particles that are less than or equal to 2.5 micrometers in diameter. PM 10 describes "coarse" particles that are greater than 2.5, but less than or equal to 10 micrometers in diameter. EPA's health-based national air quality standards for PM 2.5 are set at 15 $\mu g/m^3$ (measured as an annual mean) and 65 $\mu g/m^3$ (measured as a daily concentration). EPA's health-based national air quality standards for PM 10 are 50 $\mu g/m^3$ (measured as an annual mean) and 150 $\mu g/m^3$ (measured as a daily concentration). Major concerns for human health from exposure to PM include effects on breathing and respiratory systems, damage to lung tissue, cancer, and premature death. The elderly, children, and people with chronic lung disease, influenza, or asthma, are especially sensitive to the effects of particulate matter. Acidic PM can also damage human-made materials and is a major cause of reduced visibility in many parts of the U.S.

Because the national monitoring network started in 1999, there is not enough data to show a national long-term trend in urban PM2.5 air quality concentrations. However, 36 sites in the network (10 in the East, and 26 in the West) have enough data to assess trends in average rural PM2.5 concentrations from 1992–1999. In the East, where sulfates contribute most to PM2.5, the annual average across the 10 sites decreased 5 percent from 1992–1999. The peak in 1998 is associated with increases in sulfates and organic carbon. Average PM2.5 concentrations across the 26 sites in the West from 1992–1999 were about one-half of the levels measured at Eastern sites.

Sites in the East typically have higher annual average PM2.5 concentrations. Most of the regional difference is attributable to higher sulfate concentrations in the eastern United States. Sulfate concentrations in the eastern sites are 4 to 5 times greater than those in the western sites. Sulfate concentrations in the East largely result from sulfur dioxide emissions from coal-fired power plants. In the West, rural PM2.5 levels are generally less than one-half of Eastern levels (EPA 2001).

Sulfur Dioxide (SO_2)

Sulfur dioxide belongs to the family of gases called sulfur oxides (SO_X). These gases are formed when fuel containing sulfur (mainly coal and oil) is burned, and during metal smelting and other industrial processes.

The major health concerns associated with exposure to high concentrations of SO_2 include effects on breathing, respiratory illness, alterations in pulmonary defenses, and aggravation of existing cardiovascular disease. Children, the elderly, and people with asthma, cardiovascular disease or chronic lung disease (such as bronchitis or emphysema), are most susceptible to adverse health effects associated with exposure to SO_2. EPA's health-based national air quality standard for SO_2 is 0.03 ppm (measured on an annual arithmetic mean concentration) and 0.14 ppm (measured over 24 hours). SO_2 is a precursor to sulfates, which are associated with acidification of lakes and streams, accelerated corrosion of buildings and monuments, reduced visibility, and adverse health effects.

Nationally, average SO_2 ambient concentrations have decreased 50 percent from 1981–2000 and 37 percent over the more recent 10-year period 1991–2000. SO_2 emissions decreased 31 percent from 1981 to 2000 and 24 percent from 1991– 2000. Reductions in SO_2 concentrations and emissions since 1994 are due, in large part, to controls implemented under EPA's Acid Rain Program beginning in 1995 (EPA 2001).

Greenhouse Gases

Carbon Dioxide (CO_2)

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, this equilibrium of atmospheric carbon has been altered. Atmospheric concentrations of CO_2 have risen principally because of fossil fuel combustion, which accounted for almost 98 percent of total U.S. 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. Scientists expect 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 level is likely to rise two feet along most of the U.S. coast.

Transportation activities – excluding international bunker fuels – accounted for 31 percent of CO_2 emissions from fossil fuel combustion in 1999 in the United States. Virtually all of the energy consumed in this end-use sector came from petroleum products. Just under two thirds of the emissions resulted from gasoline consumption in motor vehicles. The remaining emissions came from other transportation activities, including the combustion of diesel fuel in heavy-duty vehicles and jet fuel in aircraft (EPA 2002b).

Summary Tables for Criteria Pollutants and CO_2

The formation of criteria pollutants and carbon dioxide are presented in Table C-2. The health effects can be categorized into two general categories, acute and chronic. Acute or short-term effects usually include irritation, headaches, and nausea. Chronic or long-term effects may include decreased lung capacity and cancer (EPA 2001, 2002b).

Table C-2. Criteria Pollutant Descriptions and Potential Health Effects

Pollutant	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 VOCs 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.

Table C-3 presents the contribution of different sectors of the U.S. economy to total emissions of criteria pollutants and carbon dioxide. Transportation emissions include all ground, air, and water transportation systems.

Table C-3. Source Contribution to Emissions for the United States

Pollutant	Percent Source Contribution			
	Transportation	Industrial Processes	Fuel Combustion	Miscellaneous
CO	**77.1**	**7.8**	**5.5**	**9.6**
Pb	12.8	75.3	11.9	0.0
NO_2	55.5	3.7	39.5	1.3
VOC	47.0	44.1	5.0	3.9
PM 10	24.7	41.5	33.8	0.0
SO_2	6.9	7.8	85.3	0.1
	Transportation	**Industrial**	**Residential**	**Commercial**
CO_2*	31	33	19	16

Source: EPA 1999b
* Source: EPA 2002b

Table C-4 shows the changes in emissions and concentrations of pollutants in the U.S. for the last 20 years.

Table C-4. Percent Changes in Emissions and Concentration of Pollutants

Pollutant	Percent Change in Emissions	Percent Change in Atmospheric Concentrations
CO	-21	-57
Pb	-94	-94
NO_2	+4	-25
VOC/O_3	-31a	-12b
PM 10	-15c	-18c
SO_2	-27	-50

a Emissions of VOCs
b Concentration of O_3 for 8-hr
c For 1990-1999

Source: EPA 2001

Table C-5 presents a summary of the contribution of the different types of on-road vehicles to total vehicle emissions in the United States. Vehicles are classified according to size and fuel type.

Table C-5. Total Emissions from On-Road Mobile Sources in 1999

POLLUTANT	Total Emissions by Vehicle Category (thousand short tons)					Total from all Sources(f)
	LDGV(a)	LDGT(b)	HDGV(c)	Diesels(d)	Total On-Road Vehicles(e)	
CO	27,382	16,115	4,262	2,230	49,989	88,063
Pb	14	7	1	0	22	4,199
NO_2	2,859	1,638	459	3,635	8,590	25,393
VOC	2,911	1,722	375	289	5,297	18,145
PM 10	59	36	12	189	295	23,679
SO_2	137	91	17	118	363	18,867
	Total Emissions by Vehicle Category (Tg CO2 Eq.)					
	Passenger Cars		Light Trucks		Other Trucks	Total from all Sources(f)
CO_2*	687.2		366.5		282.4	5558.1

(a)LDGV = Light Duty Gas Vehicle (Includes motorcycles)
(b)LDGT = Light Duty Gas Truck
(c)HDGV = Heavy Duty Gas Vehicle
(d)Diesels = Encompasses all diesel vehicles
(e)Values may not equal total due to rounding
(f)Includes all sources (i.e., transportation, industrial processes, fuel combustion, and miscellaneous)

Source: EPA 1999b
* Source: EPA 2002b

Table C-6 presents the estimated total pollutant emissions by light trucks due to combustion of gasoline.

AIR QUALITY ANALYSIS OF REVISED CAFE STANDARDS

The remaining tables refer to the air quality impact analysis completed for Chapter 4 of this Final EA. Except where noted, all values and tables in this section were taken or derived from the analysis developed.

Tables C-7 to C-12 present a yearly breakdown of estimated emissions – for criteria pollutants and carbon dioxide – generated at the Baseline 20.7 mpg level for MY 2005-2007.

Tables C-13 to C-18 present a yearly breakdown of estimated emissions – for criteria pollutants and carbon dioxide – generated under the Proposed Action.

Tables C-19 to C-24 present a yearly breakdown of estimated changes in criteria pollutant and carbon dioxide emissions, when comparing the Baseline and the Proposed Action.

Table C-6. Emissions for Light Trucks from Combustion of Gasoline

POLLUTANT (Thousand short tons)	1970	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO	16,570	15,767	16,137	18,960	17,274	17,133	15,940	13,816	15,014	14,567	15,196	17,350	14,829	19,271	18,943	18,726	NA	NA
NO_X	1,278	1,461	1,408	1,530	NA	1,419	1,386	1,256	1,339	1,356	1,420	1,657	1,520	1,950	1,955	1,917	NA	NA
VOC	2,770	2,289	2,059	2,425	NA	2,129	1,867	1,622	1,688	1,588	1,647	1,909	1,629	2,060	2,017	2,015	NA	NA
SO_2	40	48	50	55	NA	58	58	57	59	59	60	70	71	95	97	99	NA	NA
PM10	70	72	55	43	NA	37	34	30	32	31	31	35	32	41	41	40	NA	NA
Pb (short tons)	22,683	19,440	11,671	4,061	NA	605	232	100	4	4	5	5	5	7	7	7	NA	NA
CO_2* (Tg CO_2 eq.)	NA	NA	NA	NA	NA	NA	NA	283.1	282.2	282.1	294.2	318.4	325.3	333.5	337.3	356.4	366.5	369.4

Source: EPA 1998b
* Source: EPA 2002d

Table C-7. Baseline CO Emissions (thousand tons)

Model Year	2004	Analysis Year 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2005	21.459	362.240	502.507	695.673	848.180	943.465	1003.125	1027.131	1022.965	995.146	950.224	891.527	823.596	750.769
2006	0.000	16.255	274.414	456.071	634.185	787.576	880.750	940.446	966.223	965.037	941.101	908.644	846.597	783.487
2007	0.000	0.000	15.572	262.887	432.634	611.163	760.786	851.852	910.422	936.024	935.398	926.872	873.686	821.645
Total	21.459	378.495	792.492	1414.631	1914.999	2342.204	2644.660	2819.429	2899.611	2896.206	2826.723	2727.044	2543.880	2355.901

Model Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Undiscounted Total
2005	673.696	598.037	524.663	454.540	389.381	329.368	275.789	228.357	187.664	152.402	122.995	98.138	0.000	0.000	14873.037
2006	715.356	642.875	571.466	502.004	435.444	373.459	316.256	265.095	219.731	180.759	146.941	118.705	91.542	0.000	13980.419
2007	760.674	694.768	624.578	555.391	488.046	423.473	363.305	307.744	258.036	213.941	176.046	143.150	113.313	85.550	13546.957
Total	2149.726	1935.680	1720.707	1511.935	1312.871	1126.301	955.351	801.196	665.431	547.102	445.982	359.993	204.855	85.550	42400.413

Table C-8. Baseline VOC Emissions (thousand tons)

Model Year	2004	Analysis Year 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2005	1.918	32.340	43.762	47.294	51.089	53.547	55.205	55.542	55.191	54.029	52.154	49.889	47.349	44.633
2006	0.000	1.646	27.776	37.978	42.770	46.885	49.767	51.534	52.333	52.316	51.454	49.869	47.881	45.740
2007	0.000	0.000	1.589	26.819	36.408	41.046	45.097	47.745	49.599	50.441	50.507	49.743	48.272	46.603
Total	1.918	33.986	73.128	112.091	130.267	141.478	150.069	154.821	157.123	156.786	154.115	149.501	143.501	136.977

Model Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Undiscounted Total
2005	41.691	38.744	35.800	32.836	29.941	27.095	24.366	21.750	19.328	17.013	14.906	12.809	0.000	0.000	960.223
2006	43.145	40.557	37.707	35.051	33.116	29.403	26.683	24.062	21.533	19.182	16.923	14.858	12.757	0.000	912.923
2007	44.280	42.123	39.394	36.942	35.177	31.493	28.858	26.241	23.711	21.262	18.976	16.772	14.652	11.050	884.802
Total	129.117	121.424	112.900	104.829	98.234	87.991	79.907	72.053	64.572	57.457	50.805	44.439	27.409	11.050	2757.947

Table C-9. Baseline NO_X Emissions (thousand tons)

Model		Analysis Year																											Undiscoun
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	ted Total
2005	2.452	41.376	54.346	65.445	72.424	76.730	79.587	79.721	78.620	76.116	72.571	68.145	63.099	57.691	51.928	46.262	40.742	35.434	30.466	25.848	21.705	17.761	14.423	11.574	9.230	7.257	0.000	0.000	1200.953
2006	0.000	1.977	33.354	47.149	54.866	60.725	64.304	66.503	67.067	66.337	64.442	61.674	58.137	54.051	49.619	44.844	40.113	35.468	30.968	26.727	22.759	19.180	15.708	12.764	10.248	8.176	6.428	0.000	1023.588
2007	0.000	0.000	1.728	29.151	40.237	46.795	51.800	55.002	57.130	57.902	57.567	56.211	54.085	51.264	47.921	44.229	40.180	36.127	32.102	28.164	24.419	20.885	17.674	14.493	11.789	9.475	7.647	5.779	899.756
Total	2.452	43.353	89.428	141.745	167.527	184.251	195.691	201.226	202.817	200.354	194.580	186.030	175.321	163.006	149.468	135.335	121.035	107.028	93.536	80.739	68.884	57.826	47.805	38.831	31.268	24.908	14.075	5.779	3124.297

Table C-10. Baseline PM 2.5 Emissions (thousand tons)

Model		Analysis Year																											Undiscoun
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	ted Total
2005	0.159	2.681	2.544	2.382	2.209	2.013	1.824	1.639	1.461	1.293	1.135	0.987	0.851	0.728	0.615	0.515	0.428	0.351	0.286	0.230	0.183	0.144	0.112	0.086	0.066	0.050	0.000	0.000	24.970
2006	0.000	0.122	2.063	2.578	2.410	2.238	2.040	1.849	1.661	1.481	1.310	1.150	1.000	0.862	0.737	0.623	0.522	0.434	0.356	0.290	0.233	0.185	0.146	0.114	0.087	0.067	0.051	0.000	24.609
2007	0.000	0.000	0.123	2.080	2.595	2.429	2.256	2.057	1.864	1.674	1.493	1.321	1.159	1.008	0.869	0.743	0.628	0.526	0.437	0.359	0.292	0.235	0.187	0.147	0.114	0.088	0.067	0.051	24.803
Total	0.159	2.803	4.731	7.040	7.213	6.681	6.121	5.544	4.986	4.448	3.938	3.457	3.010	2.598	2.222	1.882	1.578	1.311	1.079	0.878	0.707	0.563	0.444	0.346	0.268	0.205	0.118	0.051	74.381

Table C-11. Baseline SO_X Emissions (thousand tons)

Model		Analysis Year																											Undiscoun
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	ted Total
2005	0.897	15.139	16.030	15.006	13.863	12.637	11.451	10.286	9.173	8.114	7.122	6.196	5.343	4.568	3.861	3.237	2.688	2.209	1.796	1.444	1.148	0.903	0.705	0.543	0.415	0.314	0.000	0.000	155.087
2006	0.000	0.768	12.969	16.203	15.089	14.012	12.773	11.574	10.397	9.272	8.202	7.199	6.262	5.400	4.618	3.903	3.272	2.717	2.232	1.815	1.459	1.161	0.913	0.712	0.549	0.420	0.317	0.000	154.211
2007	0.000	0.000	0.771	13.020	16.181	15.148	14.066	12.823	11.619	10.437	9.308	8.233	7.226	6.287	5.421	4.635	3.918	3.284	2.728	2.241	1.822	1.465	1.165	0.917	0.715	0.551	0.422	0.319	154.722
Total	0.897	15.908	29.771	44.229	45.133	41.797	38.290	34.683	31.189	27.823	24.631	21.628	18.632	16.255	13.900	11.775	9.878	8.210	6.756	5.500	4.430	3.529	2.783	2.172	1.679	1.285	0.739	0.319	464.020

Table C-12. Baseline GHG Emissions (MMTCe)

Model Year	2004	Calendar Year: 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Undiscounted Total
2005	0.555	9.413	11.816	11.105	10.345	9.452	8.577	7.709	6.872	6.070	5.315	4.607	3.954	3.360	2.818	2.341	1.924	1.561	1.252	0.990	0.774	0.597	0.456	0.343	0.256	0.189	0.000	0.000	112.653
2006	0.000	0.560	9.507	11.934	11.216	10.449	9.547	8.663	7.787	6.941	6.131	5.368	4.653	3.993	3.393	2.847	2.365	1.943	1.577	1.265	1.000	0.782	0.603	0.460	0.347	0.259	0.191	0.000	113.781
2007	0.000	0.000	0.562	9.532	11.965	11.246	10.476	9.572	8.686	7.807	6.959	6.147	5.382	4.665	4.004	3.402	2.854	2.371	1.948	1.581	1.268	1.003	0.784	0.604	0.462	0.347	0.259	0.191	114.078
Total	0.555	9.973	21.885	32.571	33.527	31.146	28.600	25.945	23.345	20.818	18.405	16.122	13.988	12.018	10.215	8.590	7.143	5.876	4.777	3.836	3.042	2.382	1.842	1.408	1.064	0.795	0.450	0.191	340.512

Table C-13. Proposed Action CO Emissions (thousand tons)

Model Year	2004	Analysis Year 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Undiscounted Total
2005	21.488	362.745	503.211	696.668	849.405	944.834	1004.586	1028.631	1024.462	996.604	951.618	892.836	824.806	751.873	674.688	598.918	525.436	455.210	389.955	329.854	276.196	228.694	187.941	152.627	123.176	98.283	0.000	0.000	14894.748
2006	0.000	16.319	275.499	457.917	636.809	790.872	884.458	944.422	970.320	969.137	945.106	912.518	850.210	786.833	718.414	645.625	573.912	504.154	437.310	375.060	317.612	266.232	220.674	181.535	147.573	119.216	91.935	0.000	14039.669
2007	0.000	0.000	15.663	264.418	435.213	614.895	765.487	857.151	916.110	941.889	941.272	932.704	879.190	826.827	765.476	699.157	628.527	558.905	491.135	426.156	365.607	309.695	259.672	215.299	177.164	144.059	114.033	86.093	13631.796
Total	21.488	379.064	794.373	1419.002	1921.426	2350.601	2654.531	2830.204	2910.892	2907.631	2837.997	2738.058	2554.206	2365.533	2158.577	1943.699	1727.874	1518.268	1318.400	1131.070	959.416	804.621	668.287	549.461	447.913	361.558	205.968	86.093	42566.212

Table C-14. Proposed Action VOC Emissions (thousand tons)

Model Year	2004	Analysis Year 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Undiscounted Total
2005	1.916	32.310	43.729	47.272	51.079	53.548	55.216	55.561	55.216	54.059	52.188	49.926	47.387	44.671	41.729	38.781	35.836	32.871	29.974	27.127	24.395	21.777	19.353	17.035	14.925	12.827	0.000	0.000	960.707
2006	0.000	1.640	27.665	37.852	42.683	46.833	49.750	51.548	52.372	52.376	51.529	49.956	47.975	45.840	43.248	40.661	37.810	35.153	33.219	29.496	26.771	24.144	21.609	19.252	16.986	14.914	12.806	0.000	914.086
2007	0.000	0.000	1.579	26.645	36.210	40.902	45.007	47.708	49.608	50.488	50.583	49.843	48.389	46.732	44.417	42.267	39.540	37.090	35.328	31.633	28.993	26.368	23.830	21.372	19.078	16.864	14.734	11.112	886.319
Total	1.916	33.949	72.973	111.770	129.972	141.283	149.973	154.818	157.196	156.923	154.300	149.724	143.750	137.243	129.394	121.710	113.186	105.114	98.521	88.256	80.159	72.288	64.791	57.659	50.989	44.605	27.540	11.112	2761.112

Table C-15. Proposed Action NO_X Emissions (thousand tons)

Model Year	2004	Analysis Year 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Undiscounted Total
2005	2.449	41.320	54.280	65.405	72.404	76.727	79.600	79.745	78.652	76.154	72.613	68.190	63.143	57.734	51.970	46.301	40.778	35.467	30.494	25.873	21.726	17.779	14.438	11.586	9.240	7.265	0.000	0.000	1201.331
2006	0.000	1.965	33.151	46.919	54.698	60.610	64.237	66.479	67.077	66.375	64.500	61.747	58.220	54.139	49.708	44.932	40.198	35.548	31.041	26.793	22.818	19.231	15.751	12.800	10.278	8.200	6.447	0.000	1023.864
2007	0.000	0.000	1.708	28.821	39.850	46.490	51.569	54.843	57.033	57.857	57.565	56.243	54.143	51.341	48.011	44.327	40.281	36.226	32.198	28.255	24.502	20.959	17.740	14.549	11.836	9.513	7.679	5.803	899.342
Total	2.449	43.285	89.139	141.145	166.951	183.828	195.406	201.067	202.762	200.386	194.678	186.179	175.507	163.214	149.689	135.560	121.256	107.240	93.734	80.921	69.047	57.970	47.929	38.935	31.354	24.978	14.126	5.803	3124.536

Table C-16. Proposed Action PM 2.5 Emissions (thousand tons)

Model Year		Analysis Year																											Undiscounted Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
2005	0.159	2.678	2.539	2.377	2.204	2.009	1.821	1.636	1.459	1.290	1.132	0.985	0.849	0.726	0.614	0.514	0.427	0.351	0.285	0.229	0.182	0.143	0.112	0.086	0.066	0.050	0.000	0.000	24.925
2006	0.000	0.122	2.052	2.564	2.397	2.226	2.029	1.839	1.652	1.473	1.303	1.143	0.995	0.858	0.733	0.620	0.519	0.431	0.354	0.288	0.231	0.184	0.145	0.113	0.087	0.066	0.050	0.000	24.472
2007	0.000	0.000	0.122	2.063	2.574	2.410	2.238	2.040	1.848	1.661	1.481	1.310	1.150	1.000	0.862	0.737	0.623	0.522	0.434	0.356	0.290	0.233	0.185	0.145	0.113	0.087	0.067	0.051	24.601
Total	0.159	2.799	4.714	7.004	7.175	6.645	6.088	5.514	4.959	4.424	3.916	3.438	2.994	2.584	2.209	1.871	1.570	1.304	1.073	0.873	0.703	0.560	0.442	0.344	0.266	0.204	0.117	0.051	73.998

Table C-17. Proposed Action SO_X Emissions (thousand tons)

Model Year		Analysis Year																											Undiscounted Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
2005	0.894	15.097	15.972	14.952	13.813	12.591	11.409	10.249	9.140	8.085	7.096	6.173	5.324	4.552	3.847	3.225	2.678	2.201	1.790	1.438	1.144	0.900	0.702	0.541	0.414	0.313	0.000	0.000	154.540
2006	0.000	0.760	12.834	16.034	14.930	13.864	12.638	11.452	10.287	9.174	8.115	7.123	6.196	5.343	4.569	3.862	3.237	2.689	2.209	1.796	1.444	1.149	0.903	0.705	0.543	0.415	0.314	0.000	152.586
2007	0.000	0.000	0.759	12.819	15.929	14.911	13.846	12.622	11.437	10.274	9.162	8.105	7.114	6.188	5.337	4.563	3.857	3.233	2.685	2.206	1.794	1.442	1.147	0.902	0.704	0.542	0.415	0.314	152.307
Total	0.894	15.857	29.565	43.804	44.671	41.366	37.894	34.323	30.864	27.533	24.374	21.401	18.633	16.084	13.752	11.650	9.772	8.122	6.683	5.441	4.382	3.490	2.753	2.148	1.661	1.271	0.729	0.314	459.432

Table C-18. Proposed Action GHG Emissions (MMTCe)

Model Year		Calendar Year:																											Undiscounted Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
2005	0.549	9.319	11.698	10.995	10.242	9.359	8.493	7.633	6.804	6.010	5.262	4.561	3.914	3.326	2.790	2.317	1.904	1.545	1.239	0.980	0.766	0.590	0.451	0.339	0.253	0.187	0.000	0.000	111.525
2006	0.000	0.544	9.229	11.587	10.891	10.146	9.271	8.414	7.562	6.741	5.954	5.213	4.518	3.877	3.294	2.762	2.294	1.885	1.529	1.225	0.969	0.757	0.583	0.445	0.335	0.250	0.184	0.000	110.459
2007	0.000	0.000	0.537	9.119	11.449	10.762	10.027	9.162	8.315	7.474	6.662	5.884	5.151	4.464	3.830	3.254	2.729	2.266	1.861	1.510	1.210	0.956	0.747	0.575	0.439	0.330	0.246	0.181	109.140
Total	0.549	9.862	21.464	31.700	32.582	30.267	27.791	25.209	22.682	20.225	17.878	15.658	13.583	11.667	9.914	8.334	6.927	5.696	4.629	3.715	2.944	2.303	1.780	1.359	1.027	0.766	0.430	0.181	331.125

Table C-19. Proposed Action Net Change in CO Emissions (thousand tons)

Model Year	Analysis Year																												Undiscounted Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
2005	0.030	0.504	0.704	0.994	1.224	1.369	1.461	1.500	1.497	1.458	1.394	1.309	1.211	1.104	0.992	0.881	0.773	0.670	0.574	0.486	0.407	0.337	0.277	0.225	0.182	0.145	0.000	0.000	21.711
2006	0.000	0.064	1.085	1.846	2.624	3.296	3.708	3.976	4.097	4.101	4.006	3.873	3.612	3.346	3.057	2.749	2.446	2.150	1.868	1.601	1.356	1.137	0.943	0.776	0.631	0.510	0.393	0.000	59.249
2007	0.000	0.000	0.091	1.531	2.579	3.732	4.702	5.299	5.687	5.865	5.874	5.832	5.504	5.182	4.802	4.389	3.949	3.514	3.089	2.682	2.302	1.951	1.637	1.358	1.118	0.909	0.720	0.543	84.838
Total	0.030	0.569	1.881	4.371	6.427	8.397	9.871	10.775	11.281	11.424	11.274	11.015	10.326	9.632	8.851	8.020	7.168	6.333	5.529	4.769	4.065	3.425	2.857	2.359	1.930	1.564	1.113	0.543	165.799

Table C-20. Proposed Action Net Change in VOC Emissions (thousand tons)

Model Year	Analysis Year																												Undiscounted Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
2005	-0.002	-0.030	-0.033	-0.022	-0.010	0.001	0.011	0.019	0.025	0.031	0.034	0.036	0.038	0.038	0.038	0.037	0.036	0.035	0.033	0.031	0.029	0.026	0.024	0.022	0.019	0.017	0.000	0.000	0.484
2006	0.000	-0.007	-0.112	-0.126	-0.087	-0.051	-0.017	0.014	0.039	0.060	0.076	0.087	0.095	0.100	0.102	0.104	0.103	0.102	0.102	0.094	0.088	0.082	0.076	0.069	0.063	0.056	0.049	0.000	1.164
2007	0.000	0.000	-0.010	-0.173	-0.199	-0.144	-0.090	-0.036	0.008	0.046	0.076	0.100	0.117	0.129	0.137	0.144	0.146	0.148	0.151	0.140	0.134	0.127	0.119	0.110	0.101	0.092	0.082	0.062	1.517
Total	-0.002	-0.037	-0.155	-0.321	-0.295	-0.194	-0.096	-0.003	0.073	0.137	0.186	0.223	0.249	0.266	0.277	0.286	0.286	0.285	0.287	0.265	0.252	0.235	0.219	0.202	0.184	0.165	0.131	0.062	3.165

Table C-21. Proposed Action Net Change in NO_X Emissions (thousand tons)

Model Year	Analysis Year																												Undiscounted Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
2005	-0.003	-0.056	-0.066	-0.041	-0.020	-0.003	0.012	0.024	0.032	0.038	0.042	0.044	0.045	0.043	0.041	0.039	0.036	0.032	0.029	0.025	0.022	0.018	0.015	0.012	0.010	0.008	0.000	0.000	0.377
2006	0.000	-0.012	-0.203	-0.230	-0.169	-0.115	-0.067	-0.024	0.010	0.038	0.058	0.073	0.083	0.088	0.090	0.088	0.085	0.080	0.074	0.066	0.059	0.051	0.043	0.036	0.029	0.024	0.019	0.000	0.276
2007	0.000	0.000	-0.019	-0.329	-0.387	-0.305	-0.231	-0.159	-0.097	-0.045	-0.002	0.032	0.058	0.077	0.090	0.097	0.100	0.100	0.096	0.090	0.083	0.074	0.066	0.056	0.047	0.038	0.032	0.024	-0.414
Total	-0.003	-0.068	-0.289	-0.600	-0.576	-0.424	-0.285	-0.159	-0.055	0.032	0.099	0.150	0.186	0.208	0.221	0.225	0.221	0.212	0.198	0.182	0.163	0.144	0.124	0.104	0.086	0.070	0.051	0.024	0.240

Table C-22. Proposed Action Net Change in PM 2.5 Emissions (thousand tons)

Model Year	Analysis Year																												Undiscounted Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
2005	0.000	-0.003	-0.005	-0.005	-0.004	-0.004	-0.003	-0.003	-0.003	-0.002	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.045
2006	0.000	-0.001	-0.011	-0.014	-0.013	-0.012	-0.011	-0.010	-0.009	-0.008	-0.007	-0.006	-0.006	-0.005	-0.004	-0.003	-0.003	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001	-0.001	0.000	0.000	0.000	0.000	-0.136
2007	0.000	0.000	-0.001	-0.017	-0.021	-0.020	-0.018	-0.017	-0.015	-0.014	-0.012	-0.011	-0.009	-0.008	-0.007	-0.006	-0.005	-0.004	-0.004	-0.003	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001	-0.001	0.000	-0.202
Total	0.000	-0.004	-0.017	-0.036	-0.039	-0.036	-0.033	-0.030	-0.027	-0.024	-0.022	-0.019	-0.017	-0.014	-0.012	-0.010	-0.009	-0.007	-0.006	-0.005	-0.004	-0.003	-0.003	-0.002	-0.002	-0.001	-0.001	0.000	-0.383

Table C-23. Proposed Action Net Change in SO_X Emissions (thousand tons)

Model Year	Analysis Year 2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2005	-0.003	-0.043	-0.058	-0.054	-0.050	-0.046	-0.041	-0.037	-0.033	-0.029	-0.026	-0.022	-0.019
2006	0.000	-0.008	-0.136	-0.170	-0.159	-0.148	-0.135	-0.122	-0.110	-0.098	-0.087	-0.076	-0.066
2007	0.000	0.000	-0.012	-0.202	-0.253	-0.237	-0.220	-0.200	-0.181	-0.163	-0.145	-0.129	-0.113
Total	-0.003	-0.051	-0.205	-0.425	-0.462	-0.430	-0.396	-0.360	-0.324	-0.290	-0.258	-0.227	-0.198

Model Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Undiscounted Total
2005	-0.017	-0.014	-0.012	-0.010	-0.008	-0.007	-0.005	-0.004	-0.003	-0.003	-0.002	-0.002	-0.001	0.000	0.000	-0.548
2006	-0.057	-0.049	-0.041	-0.035	-0.029	-0.024	-0.019	-0.015	-0.012	-0.010	-0.008	-0.006	-0.004	-0.003	0.000	-1.625
2007	-0.098	-0.085	-0.072	-0.061	-0.051	-0.043	-0.035	-0.029	-0.023	-0.018	-0.014	-0.011	-0.009	-0.007	-0.005	-2.416
Total	-0.172	-0.148	-0.125	-0.106	-0.088	-0.073	-0.059	-0.048	-0.039	-0.030	-0.024	-0.018	-0.014	-0.010	-0.005	-4.589

Table C-24. Proposed Action Net Change in GHG Emissions (MMTCe)

Model Year	Analysis Year 2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2005	-0.006	-0.094	-0.118	-0.110	-0.103	-0.093	-0.085	-0.076	-0.068	-0.060	-0.053	-0.046	-0.040
2006	0.000	-0.016	-0.278	-0.348	-0.325	-0.302	-0.275	-0.250	-0.224	-0.200	-0.177	-0.155	-0.135
2007	0.000	0.000	-0.024	-0.414	-0.517	-0.484	-0.449	-0.409	-0.371	-0.333	-0.297	-0.263	-0.231
Total	-0.006	-0.111	-0.421	-0.872	-0.945	-0.879	-0.809	-0.735	-0.663	-0.593	-0.527	-0.464	-0.405

Model Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Undiscounted Total
2005	-0.034	-0.029	-0.024	-0.020	-0.016	-0.013	-0.011	-0.008	-0.007	-0.005	-0.004	-0.003	-0.002	0.000	0.000	-1.127
2006	-0.116	-0.100	-0.084	-0.071	-0.059	-0.048	-0.039	-0.031	-0.025	-0.020	-0.015	-0.012	-0.009	-0.007	0.000	-3.322
2007	-0.201	-0.173	-0.148	-0.125	-0.105	-0.087	-0.072	-0.058	-0.047	-0.037	-0.029	-0.023	-0.018	-0.013	-0.010	-4.938
Total	-0.351	-0.301	-0.256	-0.215	-0.180	-0.148	-0.121	-0.098	-0.078	-0.062	-0.049	-0.038	-0.029	-0.020	-0.010	-9.387

APPENDIX D – NONATTAINMENT AREA ANALYSIS

Criteria pollutants can accumulate to unhealthful levels primarily in urban areas, where the industrial, commercial, and transportation activities that produce emissions of these pollutants (or their chemical precursors) are most concentrated. Locations where atmospheric levels of these criteria pollutants exceed thresholds specified by the National Ambient Air Quality Standards (NAAQS) are designated as Nonattainment Areas, and States containing these areas are required to prepare detailed plans for reducing emissions to levels that will enable them to comply with the NAAQS. One concern raised by the potential increase in nationwide emissions of criteria pollutants caused by additional use of light trucks as a result of the incremental driving derived from the rebound effect is whether emissions of criteria pollutants in Nonattainment Areas might increase sufficiently to hamper the respective States' efforts to comply with the NAAQS.

The impact of criteria pollutant emissions increases was analyzed by estimating the corresponding increase in emissions in a selected sample of Nonattainment Areas, and then comparing this increase to total emissions in the respective areas. Gasoline-powered motor vehicles – including light trucks – contribute primarily to emissions of carbon monoxide (CO), particulate matter (PM), sulfur dioxide (SO_2), volatile organic compounds (VOCs), and nitrogen oxides (NO_X), the latter two of which contribute to the formation of ground-level ozone. However, the implementation of the proposed CAFE standards results in projected decreases – both on a lifetime and annual basis – of emissions of PM2.5 and SO_2. Thus, this Nonattainment area analysis focused only on the potential increases in emissions of CO, VOC, and NO_X in CO and ozone Nonattainment Areas.

The nationwide increases in CO, VOC, and NO_X emissions estimated to result from additional light truck use were allocated to individual Nonattainment Areas using the shares of nationwide motor vehicle travel accounted for by each sample area, which were estimated using travel data for urban areas reported by the Federal highway Administration (FHWA 2001).

The savings in gasoline use estimated to result from the proposed CAFE standard for light trucks would also reduce emissions of these same pollutants that occur during crude oil extraction and transportation, gasoline refining, and gasoline distribution. To estimate the reduction in these "upstream" emissions in each sample Nonattainment Area, this analysis first used the fraction of criteria pollutant emissions during each phase of gasoline production and distribution that occurs in urban areas to estimate the nationwide reduction in urban emissions of CO, VOC, and NO_X. As with the nationwide increases in tailpipe emissions from the rebound effect, these reductions in upstream emissions within urban areas were then allocated to the sample Nonattainment Areas using the same fraction of nationwide urban motor vehicle use estimated to occur within each area.

The estimated change in emissions of these pollutants in each sample Nonattainment Area is the net result of combining its share of the nationwide *increase* in emissions from additional light truck use with its share of the nationwide *reduction* in upstream emissions. These net changes in emissions of criteria pollutants within each Nonattainment Area were then compared to the estimates of total emissions of each pollutant from all sources during 1999. The estimates of total emissions for sample Nonattainment Areas were constructed by summing estimated total emissions from all sources for the individual counties comprising each Nonattainment Area. County-level emissions estimates for the year 1999 were obtained from the U.S. EPA National Emission Trends (NET) database.[6]

Table D-1 shows the estimated results for the sample of Nonattainment areas examined in this analysis. For those areas designated in Nonattainment of the NAAQS for carbon monoxide, the table shows the maximum annual increase in CO emissions over the lifetime of the light trucks (MY 2005-2007) affected by the Proposed Action; for ozone Nonattainment Areas, the table reports the maximum yearly increases in emissions of VOC and NO_X, the two major chemical precursors of urban ozone.[7] It should be noted that the ratio of VOC and NO_X is the important parameter in ozone formation. Increases of these pollutants change this ratio but do not always result in increases of ozone depending on the local area concentrations. This comparison shows that the increases in emissions of these pollutants estimated to result from the Proposed Action would be *extremely* small in relation to total current emissions in every Nonattainment Area examined.[8]

Table D-1. Increases in Criteria Pollutant Emissions for Selected Nonattainment Areas

Nonatainment Area	Pollutants of Concern	Maximum Increase in Emissions (tons/year)			Annual Emissions Inventory (tons/year)			% Increase in Emissions		
		CO	VOC	NOx	CO	VOC	NOx	CO	VOC	NOx
Atlanta	Ozone	575.28	15.62	17.66	--	191,988	216,262	--	0.008%	0.008%
Chicago-NW Indiana	Ozone	927.25	25.17	28.46	--	395,854	447,097	--	0.006%	0.006%
Houston-Galveston	Ozone	635.85	17.26	19.52	--	269,850	563,503	--	0.006%	0.003%
California South Coast	Ozone, CO	1843.80	50.05	56.59	2,984,940	390,910	610,372	0.062%	0.013%	0.009%
New York-NNJ	Ozone	1684.93	45.74	51.72	--	368,195	392,927	--	0.012%	0.013%
Phoenix	Ozone, CO	346.17	9.40	10.62	717,958	130,314	159,740	0.048%	0.007%	0.007%
Washington, D.C.	Ozone	484.99	13.17	14.89	--	17,790	17,718	--	0.074%	0.084%

[6] The counties included within each designated Nonattainment Area (and boundaries of the portions of counties only partially included) are listed in http://www.epa.gov/oar/oaqps/greenbk/index.html. The National Emission Trends database is available at http://www.epa.gov/air/data/netdb.html.

[7] The maximum yearly increase in emissions typically occurs during the 2010-2015 period, somewhat later than the year when light trucks produced during the three model years affected by the proposed standard reach their peak representation in the vehicle fleet (this occurs in 2008). This occurs because emissions per vehicle-mile increase slightly as vehicles age and accumulate mileage, and for some period this increase in per-mile emissions offsets the gradual decline in the total number of miles these vehicles are driven. (The total number of miles that vehicles produced in a model year are driven during each subsequent calendar year is the product of the number remaining in service and their average annual use, both of which decline gradually as they age.) After that time, however, their total emissions begin to decline gradually.

[8] The baseline emissions inventories calculated using the NET database could slightly overstate actual emissions for the areas selected since they assume that the whole area is in nonattainment while in some instances only sectors of the areas selected are in nonattainment. Thus, the calculated percentage increases in emissions could be understating the actual percentage increases. However, the difference should be very minor and the contributions to emissions in the respective areas will still be extremely small.

As Table D-1 reports, the peak annual net increases in CO emissions estimated to result from the Proposed Action range from 0.05% to about 0.06% percent of total CO emissions in the Phoenix and Los Angeles Nonattainment Areas during 1999. The estimated increases of VOC and NO_X emissions in the six ozone Nonattainment Areas sampled for this analysis are even smaller, ranging from 0.003% to a maximum of 0.084% of 1999 emissions of ozone precursors in these areas. These estimated increases are extremely small by comparison to current emissions levels, and are likely to be well within the range of uncertainty surrounding estimates of total annual emissions in any Nonattainment Area. While emissions of CO and ozone precursors are expected to decline in each of these areas over the future, the increases estimated to result from the Proposed Action would continue to represent extremely minor additions to total emissions over the foreseeable future.

There is likely to be significant uncertainty in estimating emission inventories, in part because of the inherent variability in the activities that generate emissions, but also because of imprecision in measuring the level of these activities and the rates at which they generate emissions of various pollutants (EPA 1996). The increases in emissions of criteria pollutants projected for the selected Nonattainment areas are likely to fall well within the range of uncertainty surrounding the estimates of their current totals, and perhaps even within the range of uncertainty for some large individual sources (such as electric utilities or refineries) within these Nonattainment areas.

On the basis of this analysis, which considers cumulative impacts on Nonattainment Areas, we believe that any emissions increases associated with the Proposed Action are unlikely to require Nonattainment Areas to adopt additional emissions control measures to offset them, or to complicate in any other way the areas' efforts to comply with the NAAQS.

APPENDIX E – DISCUSSION AND ANALYSIS OF COMMENTS

A. Introduction

In this Appendix, we address comments on the Draft EA, including comments on assumptions used in the Draft EA that were also used in other NHTSA documents (e.g., NHTSA's Preliminary Economic Assessment).

We received comments on a number of the assumptions used in the Draft EA. Many of the comments concerned assumptions related to the expected usage of MY 2005-2007 light trucks. Commenters addressed the Draft EA's estimates of baseline vehicle miles traveled (VMT) and VMT rate of growth. Commenters also addressed the extent to which vehicle usage will increase as a result of the rebound effect, i.e., increased vehicle usage that will occur as a result of the lower cost of driving associated with more fuel-efficient vehicles. They also addressed the Draft EA's assumptions concerning the expected life of a vehicle.

We also received comments concerning the Draft EA's assumptions about the amount of reduced fuel expected to be attributable to domestic vs. foreign refining, and on the analysis and calculation of reduced emissions from refineries. Two commenters questioned the existence of environmental benefits.

We received a very large number of comments addressing the levels of the MY 2005-2007 light truck CAFE standards. The levels of the standards are based on NHTSA's consideration of specified statutory criteria, and reflect NHTSA's analysis of manufacturer capabilities. The comments on the levels of the standards are not addressed in this document but will be addressed in NHTSA's Final Economic Assessment and in the preamble of NHTSA's final rule.

Responses to the comments below were prepared by NHTSA, with the assistance of the Volpe Center. Where we have changed methodologies, calculations, or approaches in response to a comment, the new approaches and results are reflected in Chapter 4 of the Final EA.

B. Specific Issues

1) The Fuel Economy "Rebound" Effect

In the Draft EA, we stated that tightening CAFE standards reduces the fuel component of the cost of operating light-duty vehicles, leading to an increase in vehicle use. The resulting increase, termed the "rebound effect," offsets part of the reduction in gasoline consumption and petroleum use that results from improved fuel efficiency. We stated that the most recent estimates of the magnitude of the rebound effect for light-duty vehicles fall in the relatively narrow range of 10% to 20%, which implies that increasing vehicle use will offset 10 to 20% of the fuel savings resulting from an improvement in fuel economy. After reviewing these recent estimates, we elected to use an estimate of

15% in the NPRM and the Draft EA for the future fuel economy rebound effect in light truck use under the Proposed Action.

The Alliance, GM, and Ford urged the agency to use a value of 35% rather than 15%, with a sensitivity analysis of 20% to 50%. These commenters each based this recommendation on a recent survey article, Greening, Greene, and Difiglio (Energy Policy 28 (2000) 389-401) and on the agreement of participants in "Car Talk," a Clinton Administration dialogue on fuel economy among the auto industry, environmental organizations, think tanks, and government organizations. DaimlerChrysler seemed also to recommend a value of about 35%, stating that "the commonly accepted price elasticity of VMT is a negative 3.5 percent, which means that a 10 percent reduction in per mile vehicle fuel consumption actually only reduces fuel consumption by 7 percent."

GM stated that the agency's 15% figure is not supported by most literature. It urged the agency to consider the comments it submitted in May 2002 and the research it cited. In its May 2002 comments, GM stated that the Greening, Greene, and Difiglio article estimated the rebound effect at between 20 and 50%. In its new comment, GM stated that this article reviewed 75 articles on the rebound effect, including 22 on automotive transport. The company stated that very few of the reviewed articles showed a rebound effect of less than 20%, except for the short term, and several of the reviewed articles showed a rebound effect of up to 50%. GM stated that a more thorough review of the literature would have led NHTSA to use a rebound estimate of more than 20%.

GM included as an attachment to its comment a study of costs and benefits prepared by Dr. Andrew N. Kleit. Dr. Kleit stated that a recent study (Greene et al, 1999) found a rebound effect of 20%, and he employed that result in his study. Dr. Kleit also cited the Greening, Greene, and Difiglio survey article, and stated that a 20% rebound effect is a conservative estimate. Dr. Kleit stated that the Congressional Budget Office, in a recent report on CAFE standards, also assumed a rebound effect of 20%.

ACEEE noted that, with regard to the rebound effect, NHTSA stated in the NPRM that increasing fuel economy by 10% would produce an estimated 8-9% reduction in fuel economy. According to ACEEE, this implies that the rebound effect is between 1% and 12%, in contrast to the rebound effect of 15% used to calculate benefits reported in the agency's Preliminary Economic Analysis. ACEEE stated that clarification was necessary, and offered that a 15% rebound might be too high.

After careful review of the studies in light of the comments, the agency has determined that a rebound effect of 20% is appropriate for this action. The agency disagrees with the comments of the Alliance, GM, Ford and DaimlerChrysler that a number higher than 20% should be used. The recent comprehensive analysis of the effectiveness of CAFE standards conducted by the National Research Council concluded that the best estimate of the current rebound effect was 10-20%,[9] and the agency's analysis of NRC's fuel saving estimates indicates that the 20% figure was used in deriving them. The NRC's estimate

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[9] Committee on the Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards, National Research Council, Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards, Washington, D.C., National Academy Press, 2002, pp. 19-20.

was based on a review of recent studies that focused specifically on the fuel economy rebound effect for light duty vehicles, rather than on more general consumer purchases of durable goods and other energy-saving devices, which formed the basis of some of the studies emphasized in the Greening, Greene, and Difiglio survey.

The agency also believes that a careful analysis of the Greening, Greene and Difiglio survey on the rebound effect, which is a compendium of results of other studies surveying a wide range of rebound effects (including those associated with durable goods and energy-saving devices), shows that use of 20 percent for the rebound effect is reasonable when limiting the review to the studies analyzing vehicle use.

In response to ACEEE's comments, the agency notes that an 8-9% reduction in fuel use in response to a 10% improvement in fuel economy means that 1-2 percentage points of the fuel savings that would otherwise result from the 10% increase in fuel economy is offset by additional driving. This response implies a rebound effect ranging from 10% (calculated as 1% divided by 10%) to 20% (2% divided by 10%), the range specified in the Preliminary Economic Analysis and also used in the Draft Environmental Assessment.

After further reviewing the studies, in light of the comments, we have revised the estimate of the fuel economy rebound effect for light trucks used in this analysis from 15% to 20%. Since we continue to believe that the appropriate range for the fuel economy rebound effect at current fuel prices and fuel economy levels is 10% to 20%, the revised value is a conservative one, and represents what we believe to be the highest plausible value for that parameter over the period spanned by this analysis.

2) Effects of CAFE Fuel Savings on Imports of Refined Gasoline

In the NPRM, we assumed that 45% of the reduction in fuel use would be reflected in reduced domestic gasoline refining, and that the remaining 55% would be met by reduced imports of refined gasoline. We stated, "Part of the fuel savings resulting from the Proposed Action leads to lower U.S. imports of refined gasoline, and thus does not affect refinery emission levels in the U.S. However, the remaining fuel savings are assumed to reduce the volume of gasoline refined within the U.S. (from either imported or domestically-produced crude petroleum), which produces a corresponding reduction in criteria pollutant refinery emissions. This analysis assumes 55% of refined gasoline is imported and 45% is refined domestically." This estimate was based on a detailed analysis of differences in gasoline consumption, imports, and domestic refining between the "Low Economic Case" and the "Reference Case" forecasts presented in the Energy Information Administration's (EIA) *Annual Energy Outlook 2002*. (This analysis was conducted by EIA at the request of the agency.) .

GM questioned this assumption, noting that there is little evidence that this same proportion would apply to reductions in fuel use under the Proposed Action. GM cited new low sulfur fuel requirements and suggested that this might constrain the ability of foreign suppliers to meet U.S. refined fuel needs, with the result that a reduction in fuel consumption could lead to lower imports of refined gasoline rather than less refining in the U.S. GM also questioned the existence of emission reductions from domestic oil refineries based on the idea that they might fall under a cap and trade system, which would allow them to trade any potential reduction in emissions or adjust production to remain at the cap. Finally, GM commented that the domestic-import split in refined gasoline should be examined in terms of its marginal effects on refinery and other sources of emissions during the gasoline supply process.

In response to GM's comment about emissions caps, the agency contacted EPA, which stated that refineries are not regulated under any national cap and trade system. While refineries in States with Clean Air Act State Implementation Plans may be under some regulatory framework at the local or regional level, we found no regulatory programs that lead us to question the existence of real reductions in refinery emissions from baseline levels. GM's comment that the domestic-import split be examined in terms of its marginal effects on emissions is addressed in section 5.

Based on the remainder of GM comments, we have reexamined this issue and have determined that additional data are available to support a revised assumption about the distribution of CAFE fuel savings between savings in gasoline imports and reduced domestic refining. More detailed data obtained from EIA provide a direct measure of historical and current variations in imported and domestic sources of gasoline in response to variations in U.S. gasoline consumption. Although these data capture the integrated effect o all factors—not just fuel economy—that influence the market for gasoline, we believe that as observations rather than forecasts, they provide one reliable source of information related to this issue. According to the EIA, "In 2001, United States refineries produced over 90 percent of the gasoline used in the United States." Current EIA data[10] for the four-week period ending February 14 corroborate this figure by stating that 91.5% (7.939 MBPD) of the gasoline used by the U.S. during that period was refined domestically, and 8.5% (0.736 MBPD) was imported. These data (although not on an on-the-margin basis) produce an estimate that approximately 90% of the reduction in fuel use from the proposed CAFE standard would be met by lower domestic refining, while the remaining 10% would be reflected in reduced imports of refined gasoline.

Analysis of historical data concerning variations in gasoline consumption and imports reported by EIA supports a similar estimate of the likely response to gasoline savings. This analysis compares annual changes in domestic gasoline refining and gasoline imports to annual changes in U.S. gasoline consumption. From the period 1992 to 2002, growth in foreign refining accounted for 10% of the total growth in gasoline consumption.[11] The U.S. Environmental Protection Agency has also assumed a similar distribution of reductions in domestic and foreign refining in some analyses of potential reductions in refinery emissions in response to gasoline savings.

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[10] www.eia.gov, "This Week in Gasoline," four-week period ending February 14, 2003.
[11] Calculated from data reported in Energy Information Administration, Monthly Energy Review Database, "Petroleum," Table 3.4 (http://www.eia.doe.gov/emeu/mer/mets/table3_4.xls).

GM's criticism of the agency's analysis of refining emissions based on the theory that the pending low sulfur fuel regulations (part of the "Tier 2" regulations) [12] might inhibit foreign refiners from being able to meet increased U.S. gasoline demand appears to misinterpret the analysis presented in the Draft EA. The Tier 2 regulations are not a part of the agency's CAFE action, but they do provide part of the backdrop against which we must evaluate our action. If the low sulfur requirements do result in an increased fraction of U.S. gasoline consumption being supplied by domestic refiners, as GM suggests, it follows that a similarly increased fraction of fuel *savings* resulting from the agency's CAFE action would be reflected in reduced domestic refining, with the result that the associated domestic emissions from gasoline refining would be reduced by more than would otherwise be the case. Thus GM's comment *supports* rather than undermines the agency's treatment of potential emissions reductions from reduced domestic refining.

We acknowledge, however, that the distribution of fuel savings between reductions in domestic refining (90%) and reductions in gasoline imports (the remaining 10%) discussed above differs from the distribution forecast by EIA's National Energy Modeling System (NEMS). Following the DOE's release of the version of NEMS used to develop Annual Energy Outlook 2003 (AEO 2003), we used this modeling system to more closely explore this issue. To develop a baseline, we ran the model with all inputs at values provided by DOE for the AEO 2003 reference case. To test the effects of the Proposed Action, we then ran the model after changing only those inputs corresponding to light truck CAFE standards. For each calendar year during 2006-2020, we calculated the extent to which these cases differed in terms of petroleum product consumption and imports. We then calculated the ratio between changes in imports and changes in consumption. Unexpectedly, total petroleum product imports were calculated to be 0.039 quads higher in 2006 with the proposed standards than in the reference case, although this was more than offset by a calculated 0.073 quad decline in crude oil imports. Thus, the above-mentioned ratio was -1.05 in 2006. However, during the rest of the period, petroleum product imports were calculated to always be lower with the proposed light truck standards than in the reference case, and the ratio of changes in petroleum product imports to changes in petroleum product consumption ranged from 0.62 to 1.14. Considering cumulative changes, the ratio was 0.97 during 2006-2020 and 0.99 during 2007-2020. In other words, for every CAFE-induced 100-gallon reduction in petroleum product consumption, NEMS predicted that petroleum product imports would fall by 97-99 gallons.

We have discussed the disparity between these forecast trends and the implications of current and historic gasoline supply data with representatives of the Department of Energy (DOE) and EIA. They acknowledge that predicting the specific gasoline supply sources likely to be affected by the reductions in U.S. gasoline use associated with the Proposed Action is extremely difficult and its results uncertain. DOE also indicated that the sources of changes in refined gasoline supply vary greatly by region of the U.S., with nearly all variation in gasoline demand on the East Coast met by changes in supply from foreign refiners, while changes in demand in other regions of the U.S. are met almost

[12] The Tier 2 limits on gasoline sulfur content are schedule to take effect beginning in 2006; for details, see EPA, Tier 2/Gasoline Sulfur Final Rulemaking (http://www.epa.gov/otaq/tr2home.htm).

entirely by changes in domestic refining activity. As a consequence, the specific geographic pattern of fuel savings resulting from the agency's action – which depends in turn on the distribution of light truck purchases and use – is likely to influence the mix of reduced gasoline imports and domestic refining that occurs in response to these fuel savings.

The agency believes that the consistent association between changes in gasoline demand and domestic refining activity revealed in current and historical data is notable, and that the effect of the pending Tier 2 fuel standards will reinforce this association. However, we also realize that the effects of *future* variation in gasoline demand on foreign and domestic sources of supply may differ from these historical patterns. Since the proposed action will take place in the future, the agency believes it is prudent also to consider these forecast changes in foreign and domestic gasoline supply in its analysis.

In an effort to do so, as well as to recognize the uncertainty inherent in forecasting the future effects of lower gasoline demand on specific supply pathways, the agency has elected to assume that 50% of the reduction in future light truck gasoline use resulting from its action will be reflected in reduced imports of refined gasoline, while the remaining 50% will be translated into reductions in domestic gasoline refining. The agency recognizes that neither historical data nor forecast trends indicate that changes in gasoline use are likely to have equal effects on gasoline imports and domestic refining. However, this assumed distribution represents a probability-weighted "expected" impact of reduced gasoline consumption, which incorporates both the extreme range of possible outcomes suggested by historical and forecast data, as well as the approximately equal likelihood that either outcome will occur.

The agency further assumes that the resulting decline in U.S. gasoline production will reduce domestic refiners' use of imported and domestic crude petroleum feedstocks in direct proportion to their current fractions of total U.S. refinery feedstock use. The implications of these assumptions for the resulting changes in emissions occurring during various phases of the gasoline supply chain are discussed in detail in Section 5, below, addressing GM's concern that the agency examine the domestic-import split in terms of its marginal effects on refining and other sources of emissions.

3) Baseline Usage Estimates and Survival Rates

In both the NPRM and the Draft Environmental Assessment, we stated that we had performed an analysis of the environmental impacts of the proposed CAFE standards by estimating fuel savings over the expected lifetimes of light trucks produced during the model years affected by the Proposed Action. The lifetime of a model-year cohort is assumed to extend for 25 years from the time that model year is manufactured and sold. "Survival rates" represent estimates of the fraction of all vehicles originally produced during a model year that are expected to remain in service at each age interval during that model year's assumed 25-year lifetime in the fleet. As these survival rates show, a gradually declining fraction of a model year's original production remains in service as its age increases, so that only a few percent of its original production remain in service by age 25. It is important to note that the expected lifetime of an *individual* new vehicle – as contrasted with an entire model-year cohort -- is considerably shorter than 25 years; as an illustration, the survival rates used in the agency's analysis imply that half of the light trucks produced during the model years affected by the proposed action will be retired from service by age 15 years.

The analysis accompanying the NPRM also incorporated an estimate that new light trucks are driven approximately 12,000 miles per year, and that the average usage of light trucks from a given model year declines gradually from this initial level as the vehicles age. This figure was based on an earlier NHTSA analysis of vehicle survival and usage data from the Department of Energy's Residential Transportation Energy Consumption Survey (RTECS).[13] We also indicated in our analysis that we were examining more recent information on vehicle usage, and that we expected to update these estimates for the final rule. Our analysis used these survival rates and annual usage levels to estimate the total number of miles driven by light trucks during each year of their life span in the fleet, by multiplying the age-specific estimates of annual miles driven per vehicle by the number of vehicles from a model year remaining in service at each age. In turn, we employed these estimates of total annual miles driven by vehicles of each model year to calculate the increased mileage driven, the total fuel use, and the savings in fuel use from the proposed action during each year of the affected model years' lifetimes.

UCS criticized the agency's estimates of annual light truck use, stating that these estimates were too low, beginning with a 12,800 mileage estimate used for the first year with subsequent years' mileage declining thereafter. UCS argued that NHTSA should instead use figures based on the National Personal Transportation Survey provided in the Transportation Databook of Oak Ridge National Laboratories, which indicate that the average new vehicle is driven about 15,000 miles during its first year, and the mileage does not drop to 12,000 for several years. Alternatively, UCS suggested that the agency's analysis should employ the estimates of annual vehicle use reported in the NRC analysis (15,600 miles for new vehicles, declining 4.5% annually). UCS supported employing a sensitivity analysis for higher and lower mileage estimates. UCS contended that because the agency's estimates of light truck use were too low, its analysis underestimated the gasoline savings associated with fuel economy improvements.

Ford and the Alliance stated that the agency should recalculate costs using a model year lifetime that was limited to 25-years, citing estimates of vehicle survival rates reported in the most recent edition of the Transportation Energy Data Book.[14] (The agency notes that it did, in fact, apply a 25-year lifetime in the analyses of the Proposed Action. Data reflecting a previous assumption of a 30-year lifetime inadvertently included in a spreadsheet placed in the docket, but these data were not used in the agency's calculations.)

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[13] National Highway Traffic Safety Administration, "Updated Vehicle Survivability and Travel Mileage Schedules," November 1995, Table 13.
[14] U.S. Department of Energy, Oak Ridge National Laboratory, *Transportation Energy Data Book Number 22*, http://wwwta.ornl.gov/data/tedb22.

GM argued that our figures for the number of light trucks of each model year assumed to be in service during the years they are offered for sale should be adjusted slightly downward, apparently to reflect the fact that most new vehicles are not in service for the entire calendar year in which they are sold.

In response to these comments, we have made certain changes to our estimates of light truck populations, survival rates, and annual usage. First, we replaced the estimates of average annual light truck use at each age with more recent estimates developed by EPA in its update of the MOBILE vehicle emission factor model. These estimates, which apply specifically to light trucks, were derived from detailed analysis of vehicle use data from the 1995 Nationwide Personal Transportation Study (NPTS) and the 1992 Truck Inventory and Use Survey (TIUS).[15] These data suggest that light truck use is significantly higher at each age than the estimates used in our previous analysis. Second, we replaced our previous estimates of light truck survival rates with updated estimates calculated from the most recent edition of the Transportation Energy Data Book, as suggested in the comments provided by the Alliance and by Ford.[16]

Finally, we note that our previous analysis did adjust for the fact that new vehicles are typically in service for less than twelve months during the year in which they are sold, although it did so using a slightly different procedure than that suggested in GM's comments. Instead of adjusting the estimated *sales* of vehicles of each model year downward during the calendar years when they are available for sale, as GM seems to recommend, we adjusted our estimates of light truck *usage* (average annual miles driven per vehicle) downward for those ages corresponding to the years when each model year is on sale.[17] We believe that this procedure is consistent with that recommended by GM in its comments, and we have also applied it to the revised estimates of annual light truck use incorporated in our revised analysis.

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[15] Update of Fleet Characterization Data for Use in MOBILE6 – Final Report EPA420-P-98-016, (http://www.epa.gov/otaq/models/mobile6/m6flt002.pdf), June 1998 Tables 4-4 and 4-5.

[16] These updated survival rates were calculated from U.S. Department of Energy, Oak Ridge National Laboratory, *Transportation Energy Data Book Number 22*, Table 6.10, http://wwwta.ornl.gov/data/tedb22/Spreadsheets/Table6.xls

[17] Specifically, our analysis adjusted the estimated usage figure for "age zero" light trucks (those sold during the calendar year preceding their model year) to assume that they are in service for an average of two months of the calendar year in which each model year is introduced. This assumption is intended to reflect the typical dates on which model years are introduced and monthly sales patterns for recent model years. Similarly, we adjusted the usage figure for "age 1" light trucks (those sold during the same calendar year as their model year) using the assumptions that one-quarter of those vehicles had been purchased during the previous calendar year and were thus in service for the entire calendar year, and that the remaining three-quarters were purchased throughout the first eight months of the following year (and were thus in service for, on average, two-thirds of that year). These assumptions are consistent with monthly sales patterns for recent model-year light trucks.

4) Growth in Vehicle-Miles Traveled (VMT)

The rate of growth in vehicle-miles traveled (VMT) is a key parameter used to account for the effect of future travel trends on the resulting levels of vehicle emissions. The analysis accompanying the Proposed Action assumed that the number of miles traveled by all motor vehicles (combined) in the U.S. would continue to grow at 1.8% annually. We used estimates of future-year VMT together with average per-mile emissions for the mix of vehicles projected to be in service to estimate total annual emissions of various pollutants during selected future years.

Historical data indicate that total annual VMT by all types of vehicles has increased steadily, and this trend is expected to continue. The forecast of 1.8% annual growth was derived from forecasts of motor vehicle use over the 2000-2020 period reported in EIA's *Annual Energy Outlook 2002* (AEO2002). The time span covered by the Agency's action falls largely within this period, and thus the rate of growth in vehicle use forecast by EIA was used for the agency's analysis.

Ford was the principal commenter on the VMT growth rate, claiming that annual VMT has remained relatively stable over the last ten years. Therefore, Ford argued that the Agency should revise downward the VMT growth rate assumed in its analysis. The agency notes, however, that the data provided by Ford in support of its comment measure average annual VMT *per vehicle* per year, rather than total annual VMT accounted for by all vehicles. In contrast, the 1.8% annual growth rate assumed in the Draft Environmental Assessment applies to *total* annual VMT by all motor vehicles. In light of this distinction, the agency disagrees with Ford's comment, and has elected to retain the assumption that total VMT by all U.S. motor vehicles will increase by 1.8% annually in the Final EA.

5) Changes in Emissions from Gasoline Supply and Distribution

The agency's Draft EA estimated the reduction in emissions from decreased gasoline refining and distribution associated with the Proposed Action. In doing so, we adopted the simplified assumption that reductions in domestic refining of gasoline (see the discussion of reductions in domestic refining and gasoline imports in Section 2, above) would reduce emissions in all activities related to domestic gasoline production and distribution, while reductions in gasoline imports would have no effect on these emissions. We estimated the reduction in emissions of various pollutants during domestic gasoline production and distribution using emission factors per gallon of gasoline that were derived from Argonne National laboratory's Greenhouse Gases and Regulated Emissions in Transportation (GREET) model.[18] These emission factors incorporate emissions that occur during all phases of gasoline production and

[18] Argonne National Laboratories, *The Greenhouse Gas and Regulated Emissions from Transportation (GREET) Model*, Version 1.6, February 2000, http://www.transportation.anl.gov/ttrdc/greet/index.html.

distribution, including crude oil extraction and transportation, gasoline refining, and gasoline storage and distribution to retail outlets.

GM commented that the agency's environmental analysis did not apply the emission factors we derived from GREET appropriately. According to GM, NHTSA incorrectly included reductions in emissions during domestic crude oil extraction in its estimates of emissions reductions from lower domestic gasoline production, thereby overestimating those reductions. GM maintained that if emissions from crude petroleum extraction were excluded from the agency's estimates of emissions reductions, the assumed savings in emissions per gallon of domestic gasoline refining eliminated would be reduced for CO, VOC, NO_X, and PM by 24%, 55%, 25%, and 16%, respectively.

Upon reviewing this issue, the agency agrees with GM's comment that we did not appropriately account for the emissions reductions likely to result from gasoline savings due to the agency's CAFE action. However, the agency disagrees with GM's contention that emissions attributable to petroleum extraction would be unaffected by the action and should thus be excluded from its analysis of the action's potential environmental impacts.

In response to GM's comments, we have used information derived from Argonne's GREET model to disaggregate total emissions throughout the gasoline supply process into those occurring during each different stages in that process, and we have employed these disaggregated emission factors to develop more reliable estimates of the reduction in emissions associated with lower gasoline consumption by light trucks. Specifically, we have used information extracted from the GREET model to develop separate estimates of emissions that occur during each of four phases of the gasoline production and distribution process: Crude oil extraction; crude oil storage and transportation to refineries; gasoline refining; and transportation, storage, and distribution of refined gasoline. (Emissions that occur during vehicle refueling at gasoline stations included in our estimates of increased emissions from additional light truck use due to the rebound effect, and are presented separately in the analysis.)

Our revised analysis incorporates the following assumptions in estimating the reductions in these emissions from lower gasoline use by light trucks: (1) reductions in imports of gasoline reduce emissions associated with gasoline transportation, storage, and distribution; (2) reductions in domestic refining of gasoline from imported crude oil reduce emissions associated with crude oil transportation and storage, crude oil refining into gasoline, and gasoline transportation, storage, and distribution; and (3) reductions in domestic refining of gasoline from domestically-produced crude oil reduce emissions associated with crude oil extraction, crude oil transportation and storage, gasoline refining, and gasoline transportation, storage, and distribution.[19]

[19] In effect, these assumptions imply that the distance that crude oil typically travels to reach refineries is approximately the same regardless of whether it is transported from domestic oilfields or import terminals, and that the distance that domestically-refined gasoline travels from refineries to retail gasoline stations is approximately the same as foreign-refined gasoline must be transported from import terminals to these same gasoline stations.

We use these assumptions in conjunction with the disaggregated emission factors for each phase of the gasoline supply process and the previously-discussed assumptions regarding the reductions in imports and domestic refining of gasoline (see Section 2, above) attributable to fuel savings from the Proposed Action. The resulting estimates of emissions reductions associated with gasoline supply and distribution are reflected in the calculations of the Final EA. We believe these estimates to be more accurate than those reported in the Draft EA, and to respond to GM's concerns.