

GAO

Report to the Chairman, Subcommittee on
Energy and Environment, Committee on
Energy and Commerce, House of
Representatives

February 2010

VEHICLE FUEL ECONOMY

NHTSA and EPA's
Partnership for Setting
Fuel Economy and
Greenhouse Gas
Emissions Standards
Improved Analysis and
Should Be Maintained



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Highlights of [GAO-10-336](#), a report to the Chairman, Subcommittee on Energy and the Environment, Committee on Energy and Commerce, House of Representatives

Why GAO Did This Study

In May 2009, the U.S. administration announced plans to increase the Department of Transportation's (DOT) National Highway Traffic Safety Administration's (NHTSA) corporate average fuel economy (CAFE) standards and establish the Environmental Protection Agency's (EPA) greenhouse gas (GHG) emissions standards for vehicles. NHTSA redesigned CAFE standards for light trucks for model years 2008 through 2011, and some experts raised questions about the rigor of the computer modeling NHTSA used to develop these standards.

GAO was asked to review (1) the design of NHTSA and EPA's proposed standards; (2) how they are collaborating to set these standards; (3) improvements compared to a previous rulemaking, if any, NHTSA made to the modeling; and (4) the extent to which NHTSA analyzed the effects of past light truck standards and the accuracy of data used to set them.

GAO reviewed relevant rulemaking and modeling documents, and interviewed agency officials and other experts.

What GAO Recommends

GAO is recommending NHTSA and EPA document their collaborative process, formalize this relationship for the future, and conduct additional research and analyses of past light truck standards.

EPA agreed and DOT generally agreed with our recommendations.

View [GAO-10-336](#) or [key components](#). For more information, contact Susan Fleming at (202) 512-2834 or flemings@gao.gov.

VEHICLE FUEL ECONOMY

NHTSA and EPA's Partnership for Setting Fuel Economy and Greenhouse Gas Emissions Standards Improved Analysis and Should Be Maintained

What GAO Found

NHTSA and EPA have worked to propose CAFE and GHG standards that are generally aligned so manufacturers can build a single fleet of vehicles to comply with both. The standards are based on vehicle size and will cover model years 2012 to 2016. However, differences between the standards still exist because of variation in the legal authorities of each agency. For example, certain flexibility mechanisms designed to reduce compliance costs for manufacturers apply only to GHG standards, which could make aligning them with CAFE standards more difficult. However, potentially stricter penalties for GHG standard noncompliance could improve compliance with CAFE standards. Also, while NHTSA and EPA expect benefits from adopting a standard based on vehicle size, neither standard has a mechanism to ensure that a specific national target will be met.

NHTSA and EPA are collaborating by sharing resources and expertise to jointly set CAFE and GHG standards. From fiscal years 1996 through 2001, NHTSA was barred from using appropriated funds to raise CAFE standards. In contrast, EPA has continually expanded its automotive engineering expertise, including at its vehicle testing lab. As a result, EPA was able to contribute several original research studies to the proposed joint standards. Because this collaboration is not formally required and the agencies are not documenting the processes used—a recognized best practice—they may not be able to replicate them in the future.

To set the proposed standards, NHTSA improved upon the computer model compared to the version used that had been used to set the CAFE standards for 2008 through 2011 light trucks. One improvement was that NHTSA increased the model's transparency by using publicly available, rather than confidential, data to develop a baseline fleet of vehicles. With EPA's input, NHTSA updated several data inputs such as technology costs and the cost of emissions. While experts GAO interviewed had varying critiques of NHTSA's model, there was no consensus on how NHTSA could further improve it. In particular, experts' opinions differed sharply on two studies, which reported opposing findings concerning the relationship between vehicle weight (a key factor in determining fuel consumption) and safety—suggesting that additional research may be warranted.

In part due to resource and data constraints, NHTSA has not yet evaluated its 2008 through 2011 light truck CAFE standards, which have a similar design to the new standards. Retrospective analyses of efforts and data inputs could inform NHTSA on the extent to which the standards met goals and provide means to improve the process of setting standards. Lacking such analysis, NHTSA does not know whether goals of the standards have been met or if changes are needed to the program. NHTSA officials said that while they would like to conduct such analyses, limited resources and time have prevented them from doing so, and they have no definitive plans to conduct them in the future.

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Abbreviations

CAA	Clean Air Act
CAFE	corporate average fuel economy
CO ₂	carbon dioxide
DOE	Department of Energy
DOT	U.S. Department of Transportation
EIA	Energy Information Administration
EISA	Energy Independence and Security Act of 2007
EPA	Environmental Protection Agency
EPGA	Energy Policy and Conservation Act
GHG	greenhouse gas
g/mi	grams per mile
mpg	miles per gallon
NAS	National Academy of Sciences
OMB	Office of Management and Budget
OMEGA	Optimization Model for Reducing Emissions of Greenhouse Gases from Automobiles

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United States Government Accountability Office
Washington, DC 20548

February 25, 2010

The Honorable Edward J. Markey
Chairman
Subcommittee on Energy and Environment
Committee on Energy and Commerce
House of Representatives

Dear Mr. Chairman:

In May 2009, the U.S. administration announced the National Fuel Efficiency Policy relating to cars and light trucks, which beginning in 2012, would not only increase corporate average fuel economy (CAFE) standards but also establish for the first time greenhouse gas (GHG) emissions standards. According to the administration, this effort will help to accomplish several goals. First, by helping to reduce oil consumption, CAFE standards could decrease the level of oil imports, in turn decreasing both the nation's economic vulnerability to oil price shocks and the trade deficit. Second, the administration intends for CAFE standards and GHG emissions standards to begin addressing global climate change by reducing emissions of GHGs such as carbon dioxide from the sector of the economy that has long been the fastest-growing source of these emissions—mobile sources like cars and trucks. Finally, this program represents a coordinated national approach to reducing GHG emissions and improving fuel economy, allowing auto makers to build a fleet of vehicles to meet one national standard rather than multiple standards set by federal and state governments.

Although the proposed standards offer potential benefits, they also impose costs. Given the nation's current economic challenges, it is imperative that in the course of setting new standards, agencies estimate as accurately as possible the benefits and costs the standards will impose on industry and consumers—as the standards are in part based on estimates of these costs and benefits. For example, if costs to consumers from increased standards are underestimated, then the standards might be too stringent, leading to high costs imposed on consumers without adequate benefits. The stringency of these standards—a key factor in generating costs to the industry and consumers—depends in part on analysis conducted by the National Highway Traffic Safety Administration (NHTSA), the agency responsible for regulating CAFE standards, and the Environmental Protection Agency (EPA), the agency responsible for regulating GHG emissions standards. Experts raised questions in 2006 when NHTSA set

new CAFE standards for model year 2008 through 2011 light trucks. Specifically, experts expressed concerns about some of the data in the model NHTSA used to estimate the potential impact of increasing these standards. In response, NHTSA made changes to the model in preparation for establishing new standards for model years 2012 through 2016.

You asked us to review NHTSA and EPA's joint effort to set CAFE and GHG emissions standards. Specifically, we reviewed (1) the design of the proposed CAFE and GHG emissions standards, including similarities and differences between the two; (2) how NHTSA and EPA are collaborating in setting CAFE and GHG emissions standards and how the resources of both agencies are being used; (3) improvements compared to previous rulemakings, if any, made to NHTSA's process for setting standards—in particular, its regulatory impact analysis (the "Volpe model")—and for obtaining and validating data used in this model; and (4) the extent to which NHTSA analyzed the effects of its light truck standards for model years 2008 through 2011, as well as the accuracy of key data it used to establish these standards. To describe the design of the proposed CAFE and GHG emissions standards, we analyzed (1) rulemaking documents with information on the structure of the standards and how NHTSA and EPA aligned them and (2) legislation governing CAFE and GHG standards, as well as associated penalties for noncompliance. To describe how NHTSA and EPA are collaborating to set CAFE and GHG emissions standards, we reviewed and analyzed relevant rulemaking documents and legislation and interviewed NHTSA and EPA officials on their communication and coordination, analyzing this information against GAO criteria for evaluating communication and coordination among federal agencies. To identify improvements made to the Volpe model, we evaluated (1) documentation about the model against GAO criteria for developing cost estimates and assessing data reliability and (2) federal guidance for conducting regulatory and economic analyses. We interviewed experts and stakeholders with relevant expertise in areas such as economic modeling and automotive technology costs about data inputs and the design of the model. We also interviewed automobile industry stakeholders—including domestic and international automobile manufacturers and an association representing original equipment suppliers. Finally, to determine the steps NHTSA has taken to analyze the effects of the model year 2008 through 2011 light truck standards, we reviewed documentation related to these standards and interviewed NHTSA officials to determine whether NHTSA took steps to assess the outcomes of these standards or the accuracy of data it used to set these standards.

We conducted this performance audit from June 2009 through February 2010, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. (For more information on our scope and methodology, see app. I.)

Background

The Energy Policy and Conservation Act (EPCA)¹, enacted in 1975, established CAFE standards with the goal of reducing oil consumption. EPCA required manufacturers to meet a single fleetwide CAFE standard for all cars and either a single standard or class standards for light trucks. The act provided the U.S. Department of Transportation (DOT) with the authority to administer the CAFE program, and DOT delegated that authority to NHTSA. In addition, other federal agencies have played a role in the CAFE program (see table 1). For example, under EPCA, EPA is responsible for the development of CAFE testing and calculation procedures.² When it was enacted, EPCA specified that the standard for passenger cars would be 18 miles per gallon (mpg) in 1978, rising to 27.5 mpg by 1985, but it permitted NHTSA to determine the standard for light trucks through rulemakings. As required in EPCA, NHTSA began setting CAFE standards for light trucks at the “maximum feasible level” and made incremental increases to these standards from 1979 through 1996. During that time, the light truck CAFE standard increased from 17.9 mpg to 20.7 mpg. However, from fiscal years 1996 through 2001, NHTSA was barred from using appropriated funds made available in DOT’s appropriation to raise CAFE standards.³ The CAFE standard for cars remained at the 1985 setting of 27.5 mpg through model year 2010. The first increase in CAFE standards for cars since 1985 will take place for model year 2011 cars.

¹Pub. L. No. 94-163, 89 Stat. 871 (Dec. 22, 1975).

²EPCA requires EPA to measure fuel economy using procedures prescribed by EPA. Manufacturers are required to provide EPA with all data needed to determine their CAFE level for each model year. For the 2001 model year and later, EPA must generate a summary report of fuel economy values contained in the CAFE calculation. NHTSA uses the end-of-year report from EPA, along with any credits earned in the past or borrowed from the future, to determine if a manufacturer’s fleet is in compliance for that model year, and if not, NHTSA is responsible for notifying the manufacturer of any required fine.

³See e.g. Pub. L. No. 104-50, §330, 109 Stat. 436, 457 (Nov. 15, 1995).

Table 1: Federal Agency Roles in CAFE

Agency	Role
NHTSA	<ul style="list-style-type: none">• Set and enforce CAFE standards
EPA	<ul style="list-style-type: none">• Consultant to NHTSA in setting CAFE standards• Conduct vehicle testing to determine manufacturer fuel-economy levels, which are provided to NHTSA and individual manufacturers• Function as lead in setting GHG emissions standards and joint partner with NHTSA in rulemaking for proposed CAFE and GHG standards
DOE	<ul style="list-style-type: none">• Consultant to NHTSA in setting CAFE standards

Source: GAO analysis.

After years of little CAFE-related activity or movement in the two standards, several changes took place. According to NHTSA officials, DOT requested that the appropriations ban be lifted so that they could raise CAFE standards. The ban was lifted beginning in fiscal year 2002, and in 2003, NHTSA promulgated increased CAFE standards for light trucks for model years 2005 to 2007. In 2006, NHTSA issued another rule to increase and reform the standards for light trucks, which we refer to as the model year 2008 through 2011 light truck standards. In this light truck rulemaking, NHTSA transitioned from a single CAFE standard applicable to each manufacturer’s fleet to a reformed, attribute-based standard based on a vehicle’s “footprint,” or the size of its wheelbase multiplied by its average track width. The move from a single standard for all light trucks to attribute-based standards for each light truck vehicle model based on a vehicle’s footprint was designed to address a number of downsides to “unreformed”⁴ CAFE standards, including potential safety implications and consumer choice limitations. The Energy Independence and Security Act of 2007 (EISA)⁵ amended EPCA to require not only light truck but also passenger car standards to be based on an attribute-based curve and for the fuel economy of the entire industrywide fleet—including cars and light trucks—to reach an average of 35 mpg by model year 2020. Subsequent to the enactment of EISA, in 2008, NHTSA proposed CAFE standards based on vehicle footprints for passenger cars and light trucks for model years 2011 through 2015.⁶ However, a final rule was issued only for model year

⁴Unreformed refers to the single CAFE standard that existed prior to the adoption of attribute-based standards.

⁵Pub. L. No. 110-140, 121 Stat 1492 (Dec. 19, 2007).

⁶DOT, *Average Fuel Economy Standards Passenger Cars Light Trucks Model Years 2011-2015*, 73 Fed. Reg. 24352 (May 2, 2008).

2011 standards in March 2009⁷—a rulemaking effort and CAFE standard that we refer to as the model year 2011 CAFE standard. The goal of this final rule was to reach an estimated fleet average—or target—of 30.2 mpg for cars and 24.1 mpg for light trucks in model year 2011.

In recent years, public concerns have grown about the relationship between the emission of GHGs and global climate change. According to the Intergovernmental Panel on Climate Change—a United Nations organization—global atmospheric concentrations of GHGs have increased as a result of human activities, contributing to a warming of the earth’s climate. If unchecked, this could have serious negative effects, such as rising sea levels and coastal flooding worldwide.

Automobiles represent a significant share of GHG emissions. According to EPA, in 2007, personal vehicle use accounted for 17 percent of total GHG emissions in the U.S. In 2007, the United States Supreme Court ruled that EPA has the statutory authority to regulate GHG emissions from new motor vehicles under the Clean Air Act (CAA) because greenhouse gases meet the CAA’s definition of an air pollutant. Furthermore, the Supreme Court held that EPA must regulate GHGs as such if EPA finds them to be an endangerment to public health or welfare.⁸ Subsequent to this decision, EPA issued a final Endangerment Finding of GHG emissions⁹ in December 2009, laying the foundation for setting GHG emissions standards for vehicles.¹⁰

⁷The previous administration did not publish a final rule for all five model years. For the final rule for model year 2011 see 74 Fed. Reg. 14196 (March 30, 2009).

⁸*Massachusetts v. Environmental Protection Agency*, 549 U.S. 497 (2007).

⁹Section 202 of the CAA requires EPA to regulate the emission of air pollutants from mobile sources which cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. The Endangerment Finding represents the EPA Administrator’s conclusion that four greenhouse gases meet the threshold requirement for regulation under Section 202: carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons. Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66496 (Dec. 15, 2009).

¹⁰A joint resolution of disapproval under the Congressional Review Act has been introduced in the Senate. S.J. Res. 26, 111th Cong. (2010). If enacted, this resolution would void EPA’s finding that GHGs endanger public health and welfare and cause or contribute to air pollution. Similarly, several bills have been introduced which would exclude GHGs from being defined as “air pollutants” subject to regulation under section 202 of the Clean Air Act. See H.R. 4396, 111th Cong. (2010); H.R. 4752, 111th Cong. (2010). In addition, numerous lawsuits have been filed challenging the endangerment finding.

In addition, in 2005, citing compelling and extraordinary impacts of climate change on the state, California filed a request with EPA for a waiver of CAA preemption¹¹ to set GHG emissions standards for new motor vehicles starting in the 2009 model year. The CAA directs EPA to grant a waiver unless EPA finds (1) the state’s protectiveness determination was arbitrary and capricious, (2) the state’s standards are not needed to meet “compelling and extraordinary conditions,” or (3) the state’s standards are inconsistent with section 202(a) of the CAA (provisions related to technical feasibility and lead time to manufacturers). Under certain conditions set forth in the CAA, other states may adopt California’s motor vehicle emissions standards. The automobile industry brought litigation in several states, including California, alleging, among other claims, that the state standards were preempted by EPCA (which preempts state standards relating to fuel economy). Federal district courts in Vermont and California ruled against such claims, in the only two cases to be judged on their merits to date.¹² California’s waiver request was initially denied by the prior administration. EPA determined that California’s standards were not needed to meet compelling and extraordinary conditions, as required by the CAA, because global climate change and local or regional factors represent different causal links affecting air pollution in California—and previous waivers have addressed only the local or regional air pollution problems. In addition, EPA found that the effects of climate change in California are not compelling and extraordinary when compared to the rest of the country.¹³ GAO found in January 2009¹⁴ that the “compelling and extraordinary” test had never

¹¹The CAA generally allows one set of federal standards for new motor vehicle emissions and preempts states from adopting or enforcing their own standards. However, it also requires the EPA Administrator to waive this preemption provision for any state that adopted certain emission standards for new motor vehicles prior to March 1966 if the state makes a finding that its standards are as protective, in the aggregate, as applicable federal standards. California is the only state which has met the requirement for obtaining a waiver.

¹²*Cent. Valley Chrysler-Jeep, Inc. v. Goldstene*, 529 F. Supp. 2d 1151 (E.D. Cal. 2007); *Green Mt. Chrysler Plymouth Dodge Jeep v. Crombie*, 508 F. Supp. 2d 295 (D. Vt. 2007). In both cases, the courts held that that federal preemption did not apply to preclude the state regulations.

¹³California State Motor Vehicle Pollution Control Standards; Notice of Decision Denying a Waiver of Clean Air Act Preemption for California’s 2009 and Subsequent Model Year Greenhouse Gas Emission Standards for New Motor Vehicles, 73 Fed Reg. 12156, 12157 (March 6, 2008).

¹⁴GAO, *Clean Air Act: Historical Information on EPA’s Process for Reviewing California Waiver Requests and Making Waiver Determinations*, [GAO-09-249R](#) (Washington, D.C.: Jan. 16, 2009).

before been used to completely deny a waiver request. The current administration also found that the denial was a historical anomaly, reconsidered the request, and granted the waiver in June 2009 after finding that it should not have been denied under any of the statutory factors.¹⁵ Petition for review of this decision filed by the U.S. Chamber of Commerce and the National Automobile Dealers Association is now pending in front of the U.S. Court of Appeals for the District of Columbia Circuit.¹⁶

In response to the EISA's call for higher CAFE standards and California and other states' desire to establish fuel economy or GHG emissions standards, the current administration announced its National Fuel Efficiency Policy in May 2009. This policy involves setting higher CAFE standards for model years 2012 through 2016 for cars and light trucks, as well as new GHG emissions standards by EPA during this same period. As a result, NHTSA and EPA are conducting a joint rulemaking to increase CAFE standards and set new GHG emissions standards.¹⁷ (See fig. 1 for a timeline of major CAFE and GHG emissions standards milestones.)

¹⁵California State Motor Vehicle Pollution Control Standards; Notice of Decision Granting a Waiver of Clean Air Act Preemption for California's 2009 and Subsequent Model Year Greenhouse Gas Emission Standards for New Motor Vehicles, 74 Fed Reg. 32744, 32767, 32783 (July 8, 2009).

¹⁶Petition for Review, *Chamber of Commerce of the U.S. v. EPA*, No. 09-01237, D.C. Cir. (filed Sept. 8, 2009).

¹⁷For the remainder of this report, we refer to this joint rulemaking and related proposed standards as the proposed model year 2012 to 2016 rule.

Figure 1: Timeline of Major CAFE and GHG Emissions Standards Milestones

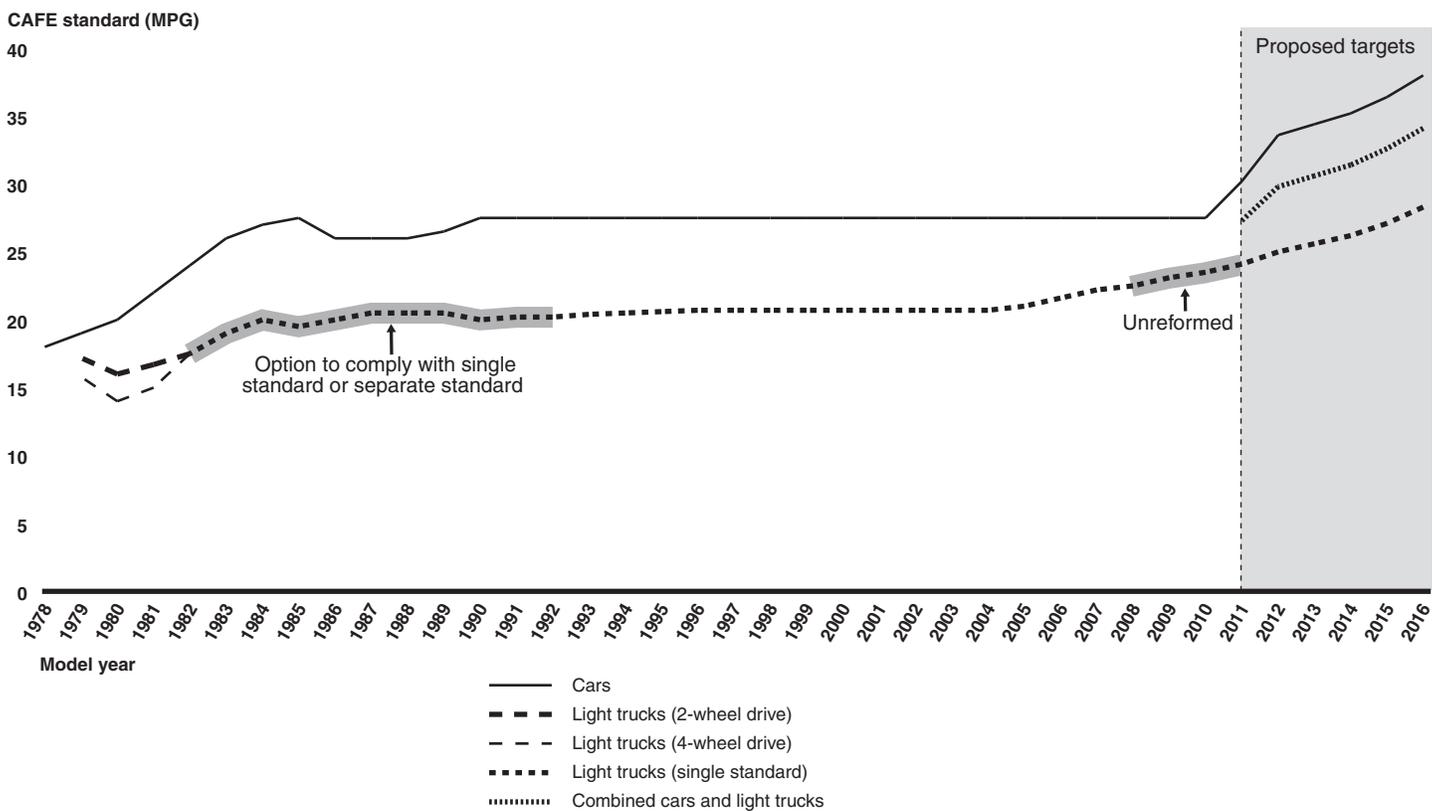
1978	The corporate average fuel economy (CAFE) standards for newly manufactured passenger cars—established in 1975 by the Energy Policy and Conservation Act (EPCA)—take effect. The standards were initially set at 18 mpg.
1979	The first set of light truck CAFE standards, which EPCA directed NHTSA to establish administratively, take effect. The light truck standards vary initially depending on type of vehicle (2-wheel vs. 4-wheel drive) and increase incrementally each year until 1996.
1985	The final incremental increase in car CAFE standards under EPCA takes effect, and newly manufactured cars were required to average 27.5 mpg.
1986	In response to petitions from automakers who noted that consumers were demanding larger cars and engines, largely due to a decline in gasoline prices, NHTSA reduces the CAFE standard for passenger cars to 26.0 mpg.
1990	NHTSA returns CAFE standards for passenger cars to 27.5 mpg.
1992	NHTSA replaces the separate standards for 2-wheel vs. 4-wheel drive light trucks with a single standard of 20.2 mpg.
1996	NHTSA's appropriation prohibits it from conducting any work on CAFE, which freezes the standard for light trucks at 20.7 mpg.
2001	Congress lifts its prohibition on NHTSA conducting work related to CAFE.
2003	NHTSA issues a rule for light truck CAFE standards for model years 2005 to 2007.
2004	The California Air Resources Board (CARB) adopts the nation's first GHG rule, which requires automakers to begin selling vehicles in California with incrementally decreasing GHG emission levels between 2009 and 2016.
2005	CARB submits a request for a waiver of Clean Air Act (CAA) preemption for its GHG emission standards for motor vehicles to take effect in 2009.
2006	NHTSA issued final rule reforming light truck standards for model years 2008 to 2011 and requested Congress to provide authority to reform passenger car standards.
2007 (April)	The U.S. Supreme Court rules that greenhouse gases (GHG) meet the CAA definition of an air pollutant and that EPA has the statutory authority to regulate these emissions from new motor vehicles under the act.
2007 (December)	Congress enacts the Energy Independence and Security Act (EISA), which reforms car standards and calls for CAFE standards to reach an industrywide fleet average (i.e., all manufactured vehicles) of 35 mpg by 2020.
2008	NHTSA's reformed light truck standards, which are designed around the "footprint" (or wheelbase multiplied by track width) of a vehicle rather than as a single standard, take effect.
2009 (March)	NHTSA finalizes CAFE standards for cars and light trucks, to be implemented in 2011, increasing car standards for the first time in about 20 years.
2009 (May)	The current administration announces plans for new CAFE standards, beginning in 2012 and increasing to a fleet average of 35.5 miles per gallon by 2016. The new CAFE standards are to be harmonized with the new vehicle GHG emissions standards to be set by EPA and are based on vehicle footprint for both passenger cars for the first time, as well as light trucks.
2009 (July)	After initially being denied, California is granted a waiver of CAA preemption by EPA, giving the state authority to set GHG emission standards for vehicles in the future. California elects to adopt the national standard being developed by EPA, but also begins looking ahead to standards in 2017.

Source: GAO.

The proposed joint rule would increase CAFE standards to achieve an estimated fleetwide average of 34.1 mpg and implement GHG emissions standards to achieve an estimated fleetwide average of 250 grams per mile (g/mi) of carbon dioxide (CO₂) by model year 2016. The agencies jointly issued a Notice of Upcoming Joint Rulemaking in May 2009, issued a Proposed Rulemaking and held three public hearings across the country in September 2009, held a 60-day public comment period that ended in

November 2009, and plan to issue the final rules by April 1, 2010.¹⁸ (Fig. 2 shows the changes to CAFE standards over time, including the proposed standards).

Figure 2: Historical Changes to CAFE Standards and Proposed Future Targets



Source: NHTSA.

¹⁸As required by EPCA, NHTSA must issue CAFE standards at least 18 months before they are implemented.

In the proposed rule, NHTSA and EPA estimate that the proposed standards will result in both benefits and costs:¹⁹

- *Potential benefits for consumers and society.* The agencies estimate that the new standards will result in approximately 1.8 billion barrels of oil savings and 950 million metric tons of carbon dioxide emissions reductions over the lifetime of vehicles sold in model years 2012 through 2016. In addition, the agencies estimate that new and more fuel-efficient vehicles will save consumers more than \$4,000 in gasoline costs over a model year 2016 vehicle's lifetime.
- *Potential costs for consumers, automobile manufacturers, and others.* The agencies estimate that the proposed standards would require manufacturers to incorporate additional fuel-saving technology into vehicles, which would increase the average cost of a model year 2016 vehicle by around \$1,100. As a result, this will increase the purchase price of vehicles for consumers, or manufacturers will receive lower profits from vehicle sales, or both. However, the agencies estimate that the total benefits of the proposed standards will outweigh the costs, providing net benefits to society of nearly \$200 billion over the lifetimes of the model year 2012 to 2016 vehicles. In addition, the estimated lifetime fuel savings exceeds the \$1,100 increase in vehicle cost for a model year 2016 vehicle, yielding a net savings of about \$3,000 for consumers.

¹⁹The benefits and costs are estimated based on assumptions NHTSA and EPA made in the analyses, and may change if these assumptions (e.g., fuel price) change. See Appendix II for a discussion of NHTSA's analysis.

Although NHTSA and EPA Worked to Propose CAFE and GHG Emissions Standards That Are Aligned, the Programs Have Several Key Differences

Although the Proposed Standards Based on Vehicle Footprint Should Result in Benefits, Actual Vehicle Sales May Affect the Level of Benefits Realized

Although the proposed CAFE and GHG emissions standards are distinct and automobile manufacturers will be subject to both sets, EPA and NHTSA have worked to develop standards that are aligned (what the agencies refer to as “harmonized”) with the intention that manufacturers can build one fleet of vehicles to comply with both sets of standards. This should lower the cost of compliance for manufacturers compared to a case in which the standards were set separately and without regard for the other’s design. This harmonization is possible because fuel economy and GHG emissions have a clear and direct relationship—specifically, vehicle tailpipe carbon dioxide emissions are directly related to the quantity of fuel burned.²⁰ Given the relationship between GHG emissions and fuel economy, actions to increase fuel economy also necessarily reduce GHG emissions; therefore, manufacturers can use the same technologies to help meet both standards.

NHTSA and EPA have proposed standards for both passenger cars and light trucks that are based on vehicle footprint so that each vehicle is subject to a target level based on its footprint, with smaller vehicles having a stricter target (see fig. 3). The footprint-based standard is applied to individual vehicle models based on the size of each vehicle. Because each manufacturer sells a different mix of vehicle sizes, under the proposed standards each manufacturer will have different CAFE and GHG emissions standards.

²⁰Vehicle tailpipe emissions of carbon dioxide account for 90 to 95 percent of all vehicle GHG emissions.

NHTSA first adopted a footprint-based approach—as opposed to a single fleetwide standard—for model year 2008 through 2011 light truck standards.²¹ A number of the experts we interviewed supported the current approach of subjecting both passenger car and light truck fleets to footprint-based standards. In the model year 2008 through 2011 light truck rule, NHTSA cited several potential benefits of a footprint-based approach over a single, fleetwide CAFE standard, including the following:

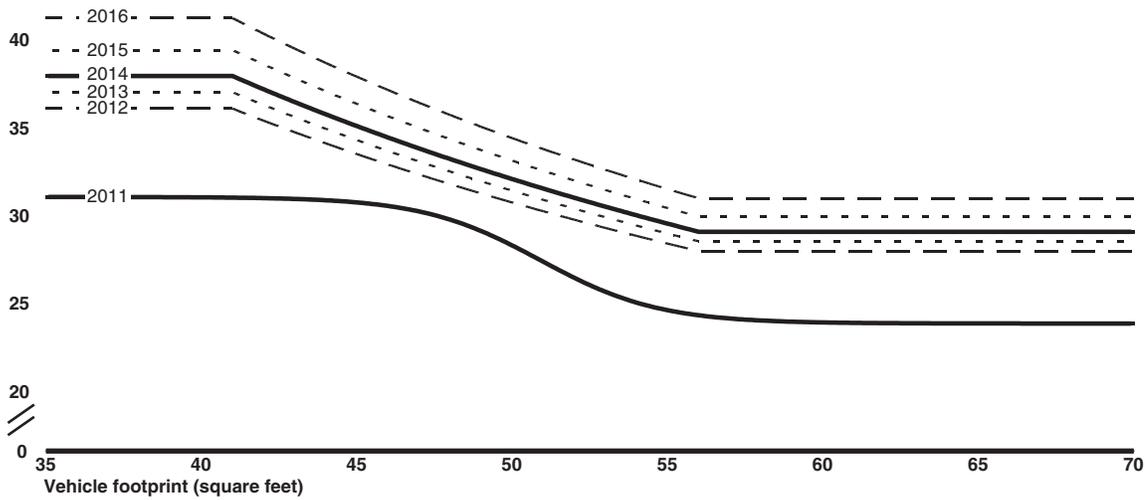
- *Larger reductions in oil consumption.* Oil consumption would be reduced because automakers would be required to improve the fuel economy of vehicles of all sizes rather than only those near the standard.
- *Enhanced safety.* Manufacturers would not have an incentive to comply with CAFE standards by pursuing strategies that compromise safety—such as (1) reducing the size of vehicles (applicable fuel-economy targets now become higher as size decreases) or (2) designing models to be classified as light trucks rather than cars, which can increase a vehicle’s propensity to roll over—in order to comply with CAFE standards. Under a single standard, manufacturers could reduce vehicle size as one approach for CAFE compliance.
- *More even disbursement of the regulatory cost burden.* Fuel-economy improvements would be spread across the industry, instead of concentrating on manufacturers of heavier, lower fuel-economy vehicles.
- *Addressing concerns about consumer choice.* Manufacturers now must improve the fuel economy of all light trucks, regardless of size, which addresses criticisms that single, fleetwide CAFE standards were hindering the efforts of some companies to offer a mix of vehicles matching consumer desires. For instance, under the previous system, instead of installing more fuel-saving technologies across their fleets, manufacturers might have moved toward building fewer large vehicles and more small vehicles to meet new CAFE standards, even though consumers typically have not demanded small vehicles. In a footprint-based standard, manufacturers must improve the fuel economy of all light trucks, no matter their size.

²¹For model year 2008 through 2010 light trucks standards, manufacturers could opt to comply with the reformed footprint-based standards or an equivalent single fleetwide standard. Only General Motors opted to voluntarily comply with the reformed standard in 2008 and 2009. Starting with model year 2011 light trucks, all manufacturers must adhere to the footprint-based standard.

Figure 3: Proposed CAFE Footprint Curves for Passenger Cars and Light Trucks, Model Years 2012 through 2016 and Existing 2011 Curve

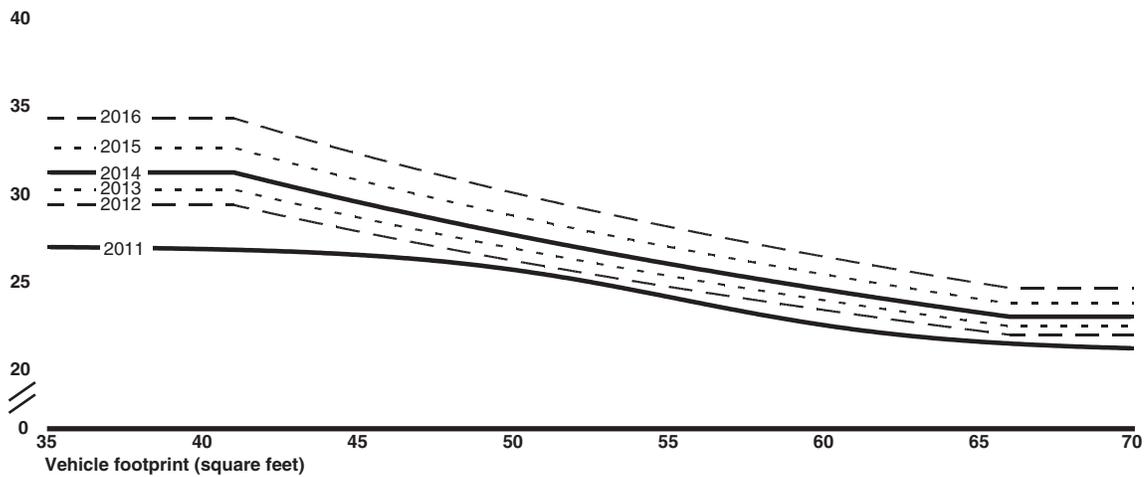
Passenger cars

CAFE target (MPG)
45



Light trucks

CAFE target (MPG)
45



Source: Notice of Proposed Rulemaking for CAFE standards for MY 2012 to 2016.

The CAFE requirement for each manufacturer—which is the basis for determining compliance²²—will be determined at the end of the model year based on actual production. For example, manufacturers selling a greater proportion of large vehicles will have a lower average target to meet than will manufacturers focusing on smaller vehicles. Based on estimated sales projections, the proposed targets are estimated to achieve an average of 34.1 mpg across all model year 2016 vehicles sold.

While NHTSA and EPA expect benefits from adopting a standard based on vehicle footprint and predict that the administration’s goal of a fleetwide average 34.1 mpg and 250 grams per mile carbon dioxide in 2016 will be met, there is no guarantee that a specific national target will be achieved.²³ This is a tradeoff of adopting a footprint standard compared to the single national CAFE standard NHTSA used in the past. Because the actual fleetwide fuel-economy levels will depend on actual vehicle sales—specifically, the size of cars consumers buy—there is the possibility that the actual fleetwide mpg in 2016 will be higher or lower and realized costs and benefits of the standards will be higher or lower than estimated. For example, even though all of the vehicles in each manufacturer’s fleet may be in compliance with its footprint-based requirement, manufacturers may sell a greater number of large-footprint vehicles than predicted, which would lower each manufacturer’s CAFE requirement. If this is the case, the national fleet may not reach the target of 34.1 mpg by 2016, and the estimated benefits of the standards, which assume achieving a national fleetwide average of 34.1 mpg, would not be fully realized.²⁴ The opposite, however, could also be the case. If a greater number of smaller vehicles (generally with higher CAFE levels) are sold than expected, manufacturers will have higher CAFE requirements, the national fleet may exceed the

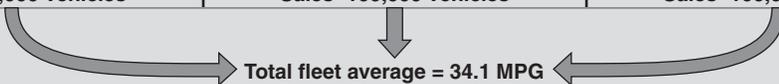
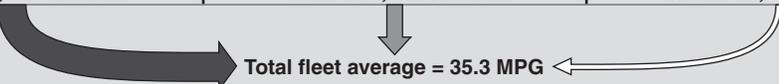
²²Manufacturer compliance will be determined based on the fuel economy levels of actual vehicles produced compared with the CAFE footprint standard for each of those vehicles.

²³The administration’s goal has often been stated as a fleetwide average of 35.5 mpg. This value is equivalent to the 250 grams per mile carbon dioxide value if all of the carbon dioxide reductions come from fuel economy improvements.

²⁴Some public comments on the Notice of Proposed Rulemaking suggested that NHTSA should mitigate against this possibility by imposing a “backstop”—a minimum CAFE standard that all manufacturers would be required to meet regardless of the footprint of their vehicles. EISA requires a backstop standard for domestically-manufactured passenger cars of either 27.5 mpg or 92 percent of the average projected fuel economy level of passenger cars in any given model year, whichever is greater. However, NHTSA did not include a backstop for imported passenger cars or light trucks in the September 2009 proposed rule.

target of 34.1 mpg, and estimated benefits assuming a fleetwide average of 34.1 mpg would be exceeded (see fig. 4). Similar scenarios could occur with respect to EPA’s GHG standards.

Figure 4: Potential Scenarios for Meeting CAFE Targets, Based on Varying Vehicle Sales

	 Vehicle 1 Small vehicle CAFE level: 38.1 MPG	 Vehicle 2 Average size vehicle CAFE level: 34.1 MPG	 Vehicle 3 Large vehicle CAFE level: 30.9 MPG
Scenario #1 (CAFE target met)	Sales=100,000 vehicles	Sales=100,000 vehicles	Sales=100,000 vehicles
	 Total fleet average = 34.1 MPG		
Scenario #2 (CAFE target not met)	Sales=50,000 vehicles	Sales=100,000 vehicles	Sales=150,000 vehicles
	 Total fleet average = 33.0 MPG		
Scenario #3 (CAFE target exceeded)	Sales=150,000 vehicles	Sales=100,000 vehicles	Sales=50,000 vehicles
	 Total fleet average = 35.3 MPG		

Source: GAO analysis of proposed CAFE standards.

Variation in the Standards, Which Result Primarily from Differences in Legal Authorities, May Present Challenges, but GHG Penalties May Increase Compliance

Several key differences between the EPA and NHTSA standards largely arise from the legal authorities under which the standards are set. NHTSA’s authority to administer the CAFE program is derived from EPCA, as amended by EISA, requires that NHTSA, for passenger cars and light trucks in each future model year, establish standards at “the maximum feasible average fuel-economy level that it decides manufacturers can achieve in that model year.” EPCA further directs NHTSA to make this determination based on consideration of four statutory factors: technological feasibility, economic practicability, the effect of other standards of the government on fuel economy, and the need of the nation to conserve energy. However, the law does not direct NHTSA on how to balance these four factors—which can conflict—thereby giving NHTSA discretion to define, give weight to, and balance the four factors based on the circumstances in each CAFE rulemaking. Furthermore, how NHTSA balances these four factors can vary from rulemaking to rulemaking. For example, in the model year 2012 through 2016 rulemaking, NHTSA cited

economic practicability concerns—given the state of the economy and the financial state of automakers—to set standards at a level lower than it otherwise could have in accordance with Office of Management and Budget (OMB) guidelines on federal regulatory impact analysis.²⁵ In addition to the four statutory factors, NHTSA also considers the potential for adverse safety consequences and consumer demand when establishing CAFE standards.

EPA's authority to set GHG standards is derived from the CAA, which authorizes EPA to regulate emissions of air pollutants from all mobile source categories. EPA must prescribe standards for the emission of any air pollutant from motor vehicles which causes or contributes to air pollution that endangers public health or welfare. In prescribing these statutory standards, EPA considers such issues as technology effectiveness, cost of compliance, the lead time necessary to implement the technology, safety, energy impacts associated with the use of the technology, and other impacts on consumers. EPA has the discretion to consider and weigh these various factors, particularly those related to issues of technical feasibility and lead time.

Some differences affect the process each agency must use to set standards, which in turn leads to key differences between the standards. For example, EPCA requires that EPA, in testing fuel economy of passenger vehicles, use 1975 test procedures or procedures that give comparable results under which air conditioning is not turned on. As a result, manufacturers cannot realize the benefits of air conditioning improvements for complying with CAFE standards, and NHTSA has, to date, not taken into account air conditioning improvements when setting CAFE standards.²⁶ Under the CAA, however, EPA is not subject to the same limitations, and its proposed GHG standards account for air conditioner improvements. Specifically, the mpg equivalent of EPA's 2016 target of 250 g/mi of CO₂ emissions corresponds to 35.5 mpg. The CAFE target is 34.1 mpg because it cannot account for air conditioning improvements.

In addition, certain flexibility mechanisms designed to achieve and reduce the cost of compliance are authorized by one program but not the other.

²⁵OMB Circular A-4, September 17, 2003.

²⁶However, in the current proposed rule, NHTSA sought comment on providing manufacturers with CAFE credits for improving air conditioner efficiency for light trucks.

This creates potential challenges to harmonization and for manufacturers attempting to manage the design of a fleet. For example, EPA's proposed GHG standards offer a "temporary lead time" mechanism for manufacturers that sell a limited number of vehicles in the U.S.²⁷ Although this specific flexibility does not exist in the CAFE standards, under EPCA, NHTSA may exempt qualifying small-volume manufacturers (defined as manufacturers that produce under 10,000 vehicles worldwide annually) from the passenger car standard for a model year. As a result, manufacturers that are able to take advantage of EPA's temporary lead time mechanism to comply with GHG standards may face challenges in complying with CAFE standards. Some experts we met with said that these inconsistencies in flexibility mechanisms between the two sets of standards may present challenges to some manufacturers in meeting the harmonized standards.

Mechanisms available for enforcing the standards also differ between the two agencies due to statutory differences. For example, the Clean Air Act prohibits the sale of vehicles without a certificate of conformity from EPA which indicates that the vehicle meets applicable emission standards.²⁸ If EPA determines that a vehicle does not meet the emission standards, it may not issue a certificate, thus preventing the manufacturer from legally selling the vehicle. The Clean Air Act also gives EPA authority to recall noncompliant vehicles. NHTSA can take neither of these actions. Because a CAFE standard applies to a manufacturer's entire fleet for a model year, CAFE fines are assessed for the entire noncomplying fleet. Pursuant to EPCA, fines associated with CAFE noncompliance are currently \$5.50 for every tenth of an mpg a manufacturer's fuel economy is short of the standard multiplied by the number of vehicles in a manufacturer's fleet for a given model year. NHTSA recognizes that some manufacturers regularly pay fines instead of complying with CAFE standards; in particular, many European manufacturers pay fines each year. Fines for CAFE standards have not been increased since 1997, and GAO has reported that, as a result, CAFE penalties may not provide a strong enough incentive for manufacturers to comply with CAFE. NHTSA officials noted that under EPCA, NHTSA has the authority to raise the fines up to \$10 per tenth of an mpg. However, raising fines requires an analysis finding that substantial energy conservation would result and that raising fines would not have

²⁷This allowance is available during model years 2012 through 2015 to manufacturers whose vehicles sales in the U.S. in model year 2009 are below 400,000 vehicles.

²⁸42 USCS § 7522(a)(1).

substantially deleterious impact on the U.S. economy. GAO has recommended that agencies collecting penalties regularly conduct these types of analyses.²⁹

In contrast to CAFE fines, penalties for violation of a motor vehicle emission standard under the CAA, which may be much higher, are determined on a per-vehicle basis. The CAA gives EPA broad authority to levy fines and require manufacturers to remedy vehicles if the agency determines there are a substantial number of noncomplying vehicles.³⁰ EPA must consider an assortment of factors, such as the gravity of the violation, the economic impact of the violation, the violator's history of compliance, and other matters,³¹ in determining the appropriate penalty. The CAA does not authorize manufacturers to intentionally pay fines as an alternative to compliance, and EPA does not include in its standard-setting modeling analysis the option for manufacturers to pay fines instead of compliance. Manufacturers may be subject to fines as high as \$37,500 per vehicle under Section 205 of the CAA. Given that fines for noncompliance with GHG standards may be higher than fines for noncompliance with CAFE, having harmonized standards may provide incentives to manufacturers that have traditionally chosen to pay CAFE penalties instead of complying with standards, to comply with both sets of standards.

²⁹See GAO, *Vehicle Fuel Economy: Reforming Fuel Economy Standards Could Help Reduce Oil Consumption by Cars and Light Trucks, and Other Options Could Complement These Standards*, [GAO-07-921](#) (Washington, D.C.: Aug. 2, 2007) and GAO, *Civil Penalties: Agencies Unable to Fully Adjust Penalties for Inflation under Current Law*, [GAO-03-409](#) (Washington, D.C.: Mar. 14, 2003).

³⁰74 Fed. Reg. 49454, 49477 (Sept. 28, 2009).

³¹42 U.S.C. § 7524(c)(2).

Although the Agencies Closely Collaborated and Capitalized on EPA's Recent Research in Setting Standards, Joint Rulemaking for Future Standards Is Not Guaranteed

EPA and NHTSA Are Collaborating through a Joint Rulemaking Process, Which Represents an Expansion of EPA's Role Compared to Previous CAFE Rulemakings

In conducting the joint rulemaking, the agencies have collaborated on major tasks. For example, the two agencies coordinated time frames so that key milestones of each rulemaking—such as issuance of the Proposed Rulemaking and time frames for public comment—happened at the same time. This enabled manufacturers to learn about both new standards at the same time and plan appropriately. Officials of both agencies told us that staff from both agencies met on a regular basis, often daily, to coordinate their efforts throughout the rulemaking process. In addition, according to agency officials, the two agencies formed a number of joint technical teams to examine data used in modeling efforts—for instance, one team examined data on automotive technology that can improve fuel economy and reduce GHG emissions—to ensure that both agencies were using similar data and making similar assumptions to develop standards. As a result of these efforts, each agency had significant input into the development of both sets of standards.

EISA mandated NHTSA to consult with both EPA and the Department of Energy (DOE) in prescribing CAFE standards beginning with model year 2011.³² NHTSA's use of EPA's expertise in environmental issues and DOE's expertise in energy efficiency in informing CAFE standards is important given CAFE's environmental and energy-security implications. For example, NHTSA has prepared draft and final environmental impact statements, as required by the National Environmental Policy Act, discussing the environmental implications of recent CAFE rulemakings,

³²Pub. L. No. 110-140, § 102(a).

and EPA has reviewed and provided input on that work. However, EPA's role in the joint CAFE and GHG emissions rulemaking goes beyond the EISA requirement for consultation. For example, EISA does not require either EPA or DOE to participate in CAFE rulemaking at as high a level as EPA has in the current joint CAFE and GHG emissions rulemaking.

This level of EPA involvement in the proposed 2012 through 2016 CAFE and GHG rulemaking is greater than EPA's involvement in previous CAFE rulemakings, particularly prior to NHTSA's proposal of CAFE standards for model year 2011. For the model year 2011 proposal, NHTSA and EPA staff jointly assessed which technologies would be available for those model years and their effectiveness and cost. They also jointly assessed key economic and other assumptions affecting the stringency of future standards. Finally, they worked together in updating and further improving the model that had been used to help determine the stringency of the model year 2008 through 2011 light truck standards. However, even in the rulemaking for model year 2011, EPA did not devote as many resources or have as much involvement in setting CAFE standards as it did in the model year 2012 through 2016 proposed CAFE and GHG rulemaking.

The increased involvement by EPA as an equal partner in the proposed model year 2012 through 2016 CAFE and GHG emissions rulemaking came at the direction of the current administration, when it announced plans to increase CAFE standards and introduce GHG emissions standards for vehicles. EPA officials noted that the involvement of the White House and clear directives to both the Secretary of Transportation and Administrator of EPA for a collaborative approach caused both agencies to commit to the joint process, which officials viewed as successful.

Both NHTSA and EPA Used Computer-Based Models to Conduct Analyses That Inform the Level of Standards; Results Were Largely Similar

To determine the appropriate level of CAFE and GHG emissions standards, NHTSA and EPA each conducted its own regulatory impact analysis using computer models. NHTSA used a model developed by the Volpe National Transportation Systems Center (referred to as the Volpe model), earlier versions of which have been used in previous CAFE rulemakings. The model estimates the costs and benefits to manufacturers, consumers, and society of differing levels of CAFE standards. (See app. II for an in-depth description of NHTSA's Volpe model.) EPA developed a similar model called the Optimization Model for Reducing Emissions of Greenhouse Gases from Automobiles (OMEGA) to conduct a similar analysis of and inform its proposed GHG standards.

While the models are distinct from one another, and NHTSA and EPA each conducted its own modeling, the two agencies collaborated on and coordinated this work. In particular, the OMEGA model and Volpe model generally used consistent data inputs and assumptions—for example, the same economic assumptions and, to the extent possible given structural differences between the models, consistent data on vehicle fleets and fuel-saving technologies. According to officials from both agencies, the two agencies worked closely together to develop these data inputs and assumptions. NHTSA’s and EPA’s analyses are also structured similarly and have two components—one that attempts to determine manufacturer response to the standards and another that estimates the effects of the proposed standards on manufacturers, consumers, and society.

In addition, although the two models differ in several ways, analyses conducted with each model produced similar results, helping to validate each modeling effort. Some differences involve the treatment of compliance flexibilities or credits—mechanisms created in a standard to reduce the cost of compliance for manufacturers. Other differences involve how the models account for manufacturers conducting multiyear product planning and how technologies were carried over between model years. Both NHTSA and EPA conducted analyses of the respective effects of the proposed CAFE and GHG standards. However, despite differences between the two models, the aggregate results were largely similar.

Although They Collaborated Closely, the Agencies Provided Differing Levels of Research and Studies to Support Rulemaking

Although NHTSA contributed research to the rulemaking process, it faced challenges in doing so. NHTSA contributed research on fuel efficiency and costs. For example, NHTSA officials said that they conducted new research related to estimating the rebound effect³³ and the costs of oil imports. In 2008, during the development of the model year 2011 rule, NHTSA contracted with an automotive consulting firm to review comments from stakeholders during the public comment period of the rulemaking, which resulted in some technology costs being updated.³⁴ NHTSA officials said that this work helped improve its analysis. NHTSA also contributed safety research. However, NHTSA has not recently

³³Rebound effect is the increase in vehicle miles traveled that result from the decreased costs of driving due to fuel economy increases.

³⁴For example, while a 2002 National Academy of Sciences study estimated the costs of applying reduced rolling-resistance tires at \$14 to \$56, the work with the consulting firm found the cost to be a range of \$6 to \$9.

undertaken new safety research to support the current proposed standards,³⁵ despite significant and ongoing controversy over vehicle safety and CAFE standards, as well as changes in technology available to reduce vehicle weight.³⁶ According to NHTSA officials, NHTSA has made such research a priority for the near-future in order to support future CAFE rulemaking.

In addition, while NHTSA contracted with the National Academy of Sciences (NAS) to provide an updated report on the costs of fuel-saving technologies,³⁷ and NAS held its first public meeting for this work in September 2007, this work was not completed in time to support analysis for the Notice of Proposed Rulemaking. EISA mandated NHTSA to contract with NAS to receive updates to its earlier report of fuel-saving technology cost and effectiveness in 5-year intervals until 2025. We noted in previous work that both experts and NHTSA officials said it would be ideal to complete and update such work before NHTSA issues a new car or light truck fuel-economy standard.³⁸ Also, NAS work on technology costs in 2002 was generally viewed by a wide range of experts as being thorough and unbiased. While NAS indicated in a preliminary report that it would finish its work by spring 2008, according to NAS officials, they required more time to acquire technology cost data than initially anticipated. As a result, the final NAS study has not yet been published and was not available to inform analysis for EPA and NHTSA's September 2009 Notice of Proposed Rulemaking.

³⁵However, the agency indicated in the proposed rule its intentions to refine its analysis for the final rule and sought comments to aid it in doing so.

³⁶As single fleetwide CAFE standards (as opposed to attribute-based standards) can lead to lighter and smaller vehicles being sold due to their generally higher levels of fuel economy, these vehicles are also generally less safe than larger and heavier vehicles. NHTSA's analysis of safety effects of the proposed standards relies on the findings of a 2003 study that has been met with criticism by a number of experts and stakeholders because other studies have produced conflicting results regarding the relationship between vehicle weight, size, and safety. Some experts we met with cited the need for additional research on these issues given the lack of consensus, conflicting research, and the availability of new technology such as lightweight but durable materials for vehicle frames.

³⁷This work is meant as an update to chapter 3 of the NAS study, *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards* (National Academy Press, 2002).

³⁸GAO, *Passenger Vehicle Fuel Economy: Preliminary Observations on Corporate Average Fuel Economy Standards*, [GAO-07-551T](#) (Washington, DC: Mar. 6, 2007).

EPA contributed research in time to provide analysis for the proposed rule. It also contributed funding to a greater degree, especially when compared with past CAFE rulemakings where EPA's role was limited to consulting. For example, EPA conducted or contracted for three peer-reviewed studies to support the rulemaking and the modeling efforts. According to EPA officials, these studies included

- an ongoing \$1.1 million study done in conjunction with a consulting firm to determine the direct manufacturing costs of fuel-saving and GHG emissions-reducing technologies—a key input in both agencies' models;³⁹
- a \$40,000 assessment of indirect costs of manufacturing more fuel-efficient vehicles;⁴⁰ and
- a \$1 million vehicle simulation modeling study done in conjunction with a consulting firm to refine estimates of emissions reduction and fuel-economy improvements stemming from combinations of technology.⁴¹

These studies provided the analysis of both CAFE and GHG standards with updated information and data.

The difference in the extent of new research that NHTSA and EPA conducted for this rulemaking likely results from differences in resources available to the agencies in the recent past. As we mentioned previously, from fiscal years 1996 to 2001—about 6 years—NHTSA was prohibited from using appropriated funds to change CAFE standards. According to NHTSA, the agency lost staff with expertise in this area as a result and did not begin to hire additional automotive engineers until summer 2009. By comparison, EPA has been able to develop and maintain automotive engineering expertise. This expertise has proved helpful in setting GHG emissions standards for automobiles. For example, EPA has been home to the National Vehicle and Fuel Emissions Laboratory since 1971, and in the

³⁹According to EPA staff, this study is still ongoing and the agency has expended \$1.1 million to date. They plan to continue this study to evaluate additional GHG emissions-reducing technologies. EPA, *Light-Duty Technology Cost Analysis Pilot Study*, EPA-420-R-09-020 (December 2009).

⁴⁰EPA, *Automobile Industry Retail Price Equivalent and Indirect Cost Multipliers*, EPA-420-R-09-003 (February 2009).

⁴¹EPA, *A Study of Potential Effectiveness of Carbon Dioxide Reducing Vehicle Technologies—Revised Final Report*, EPA-420-R-08-004a (June 2008).

early 1990s, it expanded its activities to conduct research and development of technologies used to reduce emissions, which are often marketed and licensed to the automobile industry. Although NHTSA brings safety expertise to CAFE standards, which has been a concern with raising CAFE standards in the past, the agency's primary mission and expertise is in vehicle safety, not vehicle power train design and the impact of vehicle emissions on the environment. Thus NHTSA cannot be expected to have the same level of in-house expertise related to vehicle power train design and environmental issues as EPA.

Although the Collaboration between NHTSA and EPA Resulted in Improvements, the Process Is Not Being Formalized or Documented for Future Use

Although the agencies had to work quickly, the joint proposed model year 2012 through 2016 rulemaking has met all of its milestones to date, and the agencies stated that the collaboration has been successful. This is the first time NHTSA and EPA are conducting a joint rulemaking together. The agencies conducted the joint rulemaking under tight time frames and have met all key milestones, such as publishing information about the rule and receiving and responding to public comments. However, the fast pace has left little time or resources to document any effective or efficient processes so they could be used in the future. From the administration's May 2009 release of the Notice of Upcoming Joint Rulemaking to the expected release of the rule, less than 11 months will have transpired. By comparison, according to NHTSA officials, other recent CAFE rulemakings have taken a minimum of 14 months. The accelerated timeline in the current rulemaking stemmed in part from the statutory requirement that NHTSA issue new CAFE standards 18 months prior to the beginning of the model year that will be affected and from the current administration's announcement regarding the development of the new standards in May 2009. In order to issue harmonized standards at the same time, both EPA and NHTSA had to adhere to an accelerated timeline.

Despite the dual challenge of conducting a joint rulemaking for the first time and on a compressed timeline, some experts we spoke with thought that the two agencies worked well with each other and hoped they would continue to do so. In addition, both agencies found the collaborative partnership to be successful. The proposed standards cover model years 2012 through 2016, and while it is not clear how fuel economy and GHG emissions will be regulated after 2016, industry stakeholders and others have said that they would like NHTSA and EPA to begin working on the next set of standards in the near future. Officials with the California Air Resources Board said that the state is already considering state GHG emissions standards that would take effect in 2017, and depending on the stringency of federal standards at that time, California may opt to

implement its own more stringent standards. Many industry stakeholders we interviewed said that they prefer a national program with harmonized standards over different federal and state standards because multiple standards could substantially increase compliance costs. Some expressed interest in EPA and NHTSA considering CAFE and GHG emissions standards for model years beyond 2016 as soon as possible in order to better ensure harmonized national standards and to give manufacturers appropriate lead time to meet standards.⁴²

Although we found interest in NHTSA and EPA developing standards for model years beyond 2016, two issues could prevent the agencies from replicating this effort in the future:

- *The processes for coordinating the rulemaking have not been documented by either agency.* Documented processes that the two agencies would follow—detailing how each communicated, shared resources, and set plans—would help ensure that best practices are followed and that resources are used efficiently. As GAO has reported,⁴³ such guidance can aid regulatory programs by improving efficiency and ensure that benchmarks and time frames are met. In addition, by publishing such documentation, the agencies can increase the transparency of their programs and processes. However, the two agencies have not documented the processes for use during future rulemakings, and officials at both agencies report they currently have no plans to do so. EPA officials, however, told us that documenting the processes would be a worthwhile task.
- *The two agencies are not legally required to continue coordinating in setting CAFE and GHG emissions standards.* As noted, EISA mandated NHTSA to consult with EPA and DOE in setting CAFE standards beginning with model year 2011. However, NHTSA is not required to work with EPA to the extent it has on this joint rule. The collaboration of these two federal agencies came at the direction of the current administration to provide regulatory certainty and ensure that a clear set of rules was established for all automobile manufacturers.

⁴²In addition, legislation may be enacted that would regulate GHG emissions from a wide range of sources on a national level, which could have an impact on CAFE and GHG emissions standards for vehicles. In June 2009, the House of Representatives passed such a bill—H.R. 2454, 111th Cong. (2009). The Senate is currently considering similar legislation in S. 1733, 111th Cong. (2009).

⁴³GAO, *Health and Safety Information: EPA and OSHA Could Improve their Processes for Preparing Communication Products*, [GAO-08-265](#) (Washington, D.C.: Mar. 31, 2008).

NHTSA Improved the Analysis It Uses to Help Set CAFE Standards, and although Experts Still Expressed Some Concerns, They Lacked Consensus on Additional Improvements

NHTSA Evaluates Potential CAFE Standards Using the Volpe Model, Which Attempts to Simulate How Manufacturers Will Meet the Standards and Then Measures the Effects of the Standards

In part because NHTSA has previous experience in setting CAFE standards, we were asked to review any improvements NHTSA made to its process for setting CAFE standards.⁴⁴ We did so by looking in depth at NHTSA's regulatory impact analysis using the Volpe model, which has been used in previous rulemakings as well as the current proposed rule. It has been criticized by some experts in previous rulemakings for, among other things, a lack of transparency that limited public review. Because EPA is setting GHG emissions standards for the first time, we did not conduct a similar review of their modeling efforts using the OMEGA model.

The first key component of the Volpe model is a simulation of how manufacturers might comply with proposed CAFE standards. The "compliance simulation" of the Volpe model attempts to simulate each manufacturer's most cost-effective strategy to make its fleet comply with a more stringent CAFE standard by incorporating technologies until the manufacturer achieves compliance, exhausts all available technologies, or pays fines for noncompliance when it becomes more cost-effective than incorporating additional technologies. It relies on several key sources of data, including

⁴⁴In 2007, GAO reported on concerns with NHTSA's analysis in setting CAFE standards. Specifically, we found that experts were concerned about the values used for certain inputs, such as the estimated social cost of carbon dioxide emissions, that NHTSA officials used in the computer model maintained by DOT's Volpe Center. See [GAO-07-921](#).

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- the “baseline vehicle fleet,” a forecast of the vehicle models manufacturers will produce for sale in the U.S. in future model years;
 - a list of available fuel-saving technologies, categorized into five groups;⁴⁵
 - estimates of the costs, effectiveness in reducing fuel consumption, applicability, and availability of these technologies; and
 - pathways that estimate available fuel-saving technologies and the order in which manufacturers could take advantage of these technologies to most cost-effectively meet new CAFE standards.

This technology simulation is run for each vehicle model in the baseline fleet and produces an estimate of each vehicle’s new fuel economy, weight, and total cost after the manufacturer has modified the vehicle in response to the CAFE standard. The compliance simulation’s output is a forecast of model years 2012 through 2016 vehicles—namely, a re-engineered fleet of vehicles with new prices, fuel types, fuel-economy values, and weights to reflect the changes manufacturers would make to their vehicles to meet the proposed model year 2012 through 2016 CAFE standards. The data for each vehicle in the forecasted model year 2012 through 2016 fleet is then used in the second portion of the analysis.

This “calculation of effects” is the second key component of the Volpe model, which uses the compliance simulation data to estimate the costs and benefits of potential changes to the CAFE standard to manufacturers, consumers, and society as a whole. It uses a variety of data inputs, including fuel prices projected for the lifetimes of the vehicles in the fleet, the economic costs of fuel consumption, and damage costs for criteria pollutants.⁴⁶ This analysis produces information on the estimated benefits and costs of higher CAFE standards, such as the benefit to consumers of fuel savings from driving more fuel-efficient vehicles, increases in new vehicle prices, changes in the number of vehicle miles traveled, and the societal benefits of reductions in carbon dioxide emissions. The estimated

⁴⁵These groups are engine, transmission, electrification/accessory, hybrid, or vehicle.

⁴⁶Ground-level ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur oxides, and lead are called criteria pollutants because EPA regulates them by developing human health-based or environmentally-based criteria (science-based guidelines) for setting permissible levels.

costs and benefits are used by NHTSA to set CAFE standards at a level that appropriately balances their costs and the benefits.

NHTSA Made Several Improvements to Its Analysis That Could Help NHTSA Better Estimate the Costs and Benefits of Increasing CAFE Standards

Transparency

To increase the transparency of inputs to the Volpe model for the 2012 through 2016 rulemaking, NHTSA used publicly available data to develop the model's baseline vehicle fleet. In previous rulemakings, NHTSA developed its baseline fleet by using confidential product plans submitted by manufacturers that described the vehicles manufacturers planned to sell in the U.S. in future years.⁴⁷ However, manufacturers submitted these plans to NHTSA as confidential business information, and NHTSA could not make these plans available to the public.⁴⁸ Comments submitted as part of prior CAFE rulemakings, as well as several experts we spoke to, indicated that the lack of transparency regarding NHTSA's use of product plans was troublesome because researchers could not replicate NHTSA's analysis. In developing their respective models for the joint rulemaking, NHTSA and EPA used a baseline fleet that drew primarily from public and commercially available information to make their analyses more transparent and provide additional validation of the results of their analyses.⁴⁹ Specifically, NHTSA and EPA relied almost entirely on information sources such as model year 2008 vehicle sales data, EPA's emission certification and fuel-economy database, and vehicle sales forecasts from several public sources.

⁴⁷Specifically, NHTSA used product plans to obtain estimates of the volume of each vehicle model a manufacturer expects to produce for sale in future model years, as well as detailed information on the characteristics of individual vehicle models including engines, transmissions, and other technology.

⁴⁸See 49 CFR Part 512.

⁴⁹The same vehicle baseline was used in EPA's OMEGA model.

There are several advantages of using public and commercially available data more extensively than product plans. First, federal regulatory analysis from OMB recommends that analyses be transparent to allow third parties to determine how the model produces its estimates and conclusions. By increasing the transparency of the baseline vehicle fleet, NHTSA allowed outside experts the opportunity to review the model's inputs and outputs and replicate the results of the model to better ensure that its analysis is thorough and sound. Second, because the submission of product plans is strictly voluntary, NHTSA has not consistently received complete information from all manufacturers with U.S. sales, which has inhibited its ability to forecast the future vehicle fleet across manufacturers using that data. Although several companies submit nearly complete product plans, others submit only partial plans, while still others do not submit any information. NHTSA also indicated it could save staff time by not having to correct errors in the manufacturers' submissions that NHTSA does receive.⁵⁰ Third, by using actual fuel-economy test data from model year 2008 vehicles, NHTSA would be able to use this verified fuel-economy information, rather than the estimates of the fuel-economy performance from vehicles' manufacturers.

Despite these advantages, there are some disadvantages to using the publicly available model year 2008 data to establish the baseline vehicle fleet. For example, by forecasting the model year 2012 through 2016 vehicle fleet using model year 2008 vehicle data, NHTSA and EPA's baseline includes vehicles that have been eliminated or for which production has been reduced, such as the Chrysler PT Cruiser and Hummer H2. It also does not include several vehicle models and technologies that manufacturers have recently introduced or plan to introduce, such as Ford's EcoBoost system (a package of engine technologies that in combination significantly improve fuel economy), the Honda Insight (a conventional hybrid), Chevrolet Volt (a plug-in hybrid electric vehicle), or Nissan's all-electric LEAF.⁵¹ In addition to specific vehicles, NHTSA's baseline vehicle fleet forecast does not account for broad-scale changes to vehicle lines that manufacturers have started, such as Chrysler's plans to use Fiat power trains to offer small and medium-

⁵⁰For example, as reported in the proposed rulemaking, one manufacturer's product plans contained important errors in estimates of vehicle footprints.

⁵¹A conventional hybrid uses both gasoline and energy stored in a battery to power the vehicle. A plug-in hybrid can be plugged into an electrical outlet to charge a battery that can power the vehicle.

Technology Data and Economic Inputs

sized cars. Finally, NHTSA has found it difficult to determine, from either public or commercial sources, a number of specific data used in the baseline, such as information on electric power steering and reduced rolling-resistance tires. Consequently, NHTSA has had to use a small amount of data from product plans submitted in spring 2009 to fill these data gaps. NHTSA is also consulting with manufacturers regarding the possible release of model year 2010 or model year 2011 product plans that NHTSA could use in its development and analysis of the final model year 2012 through 2016 standards. Despite these disadvantages, NHTSA, EPA, and several experts we spoke to believe that the new transparency of its analysis outweighs the limitations of using public and commercially available data to establish its baseline.⁵²

In the proposed model year 2012 through 2016 rule, NHTSA updated values for several data inputs in the Volpe model compared to its previous rulemakings, based on its own reviews of published research and several studies EPA conducted:

- *Technology data.* NHTSA reviewed the technology cost information used for model year 2011 CAFE standards, revising the cost estimates for several key fuel-saving technologies and reviewing and incorporating estimates of the effectiveness (i.e., fuel-saving improvements in mpgs) of these technologies (see fig. 5 for an example of technology cost and effectiveness estimates). To determine technology cost estimates for the proposed rule, NHTSA and EPA reviewed the cost information in NHTSA's model year 2011 final rule, EPA's 2008 Staff Technical Report, and other sources.⁵³ The agencies revised component costs for several key

⁵²In addition, NHTSA solicited public comments in the Notice of Proposed Rulemaking on the methodology and data sources used to develop the baseline vehicle fleet and the reasonableness of the results.

⁵³These sources include the 2002 NAS report, the 2004 Northeast States Center for a Clean Air Future study, the 2004 California Air Resources Board Initial Statement of Reasons in support of their carbon rulemaking, a 2006 study by Energy and Environmental Analysis for DOE, a study by the Martec Group for the Alliance of Automobile Manufacturers and the 2008 update to that study, and vehicle fuel economy certification data. Both agencies also reviewed published technical literature that addressed the issue of CO₂ emission control and fuel economy, such as papers published by the Society of Automotive Engineers and the American Society of Mechanical Engineers. In addition, confidential data submitted by vehicle manufacturers in response to NHTSA's request for product plans, and confidential information shared by automotive industry component suppliers in meetings with EPA and NHTSA staff held during the second half of the 2007 calendar year were used as a cross-check of the public data mentioned above but not as a significant basis for the proposed model year 2012 through 2016 rule.

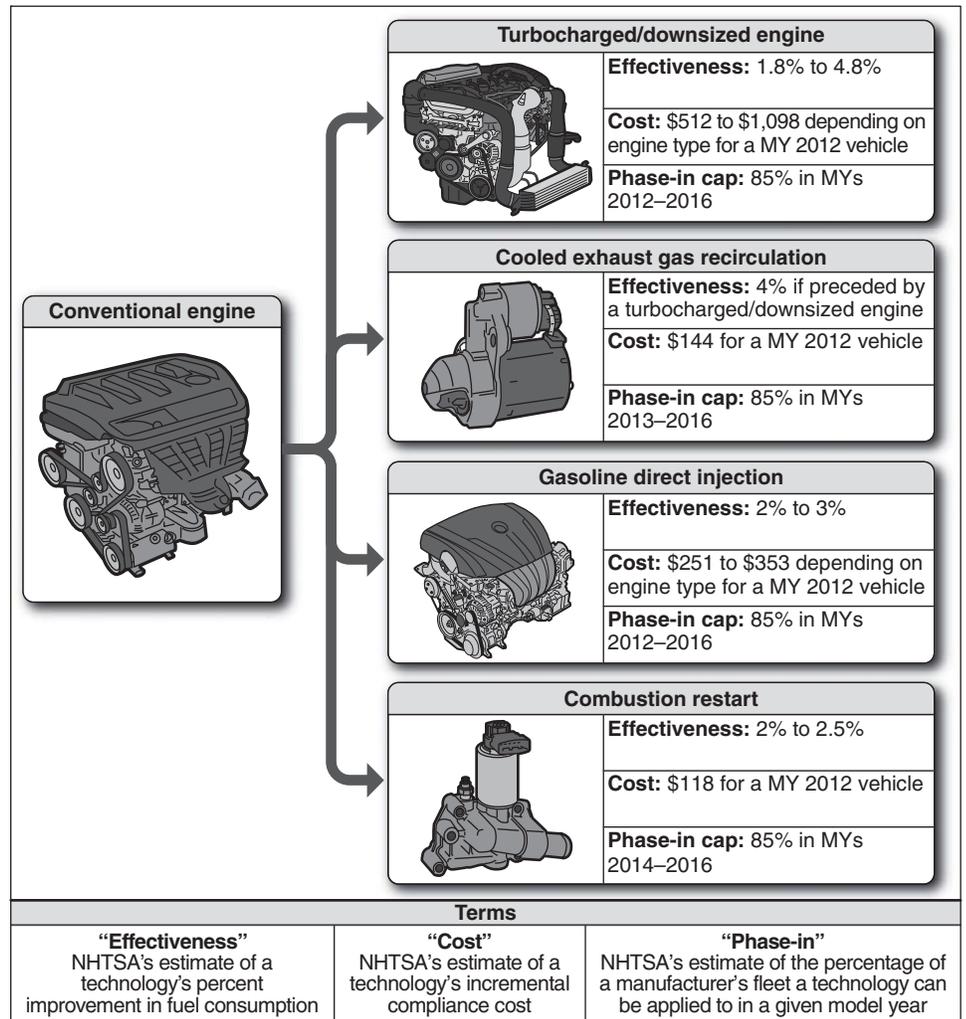
technologies. For example, NHTSA revised the cost of turbocharging and downsizing an engine⁵⁴—a cost range of \$512 to \$1,098, depending on engine type, compared to the range of \$822 to \$1,129 used for the model year 2011 CAFE standards—using data available from EPA’s ongoing teardown study⁵⁵ with FEV, an automotive research, design, and development company. It also revised the costs of several other key technologies such as cylinder deactivation⁵⁶—a cost range of \$28 to \$190, compared to the range of \$306 to \$400 used for the model year 2011 CAFE standards. However, despite this concerted effort, NHTSA and EPA were not able to make further refinements because the anticipated NAS study of vehicle technology was not completed on schedule.

⁵⁴Turbocharging and downsizing reduces an engine’s pumping losses at lighter loads in comparison to a larger engine by increasing the rate at which the engine is able to draw air into the engine’s combustion chambers.

⁵⁵A teardown study is a study in which a vehicle is disassembled in order to determine the specifications of its components, including their costs.

⁵⁶Cylinder deactivation can improve the efficiency of the engine by disabling or deactivating (usually) half of the cylinders when the load is less than half of the engine’s total torque capability. In cylinder deactivation, the valves are kept closed, and no fuel is injected. As a result, the trapped air within the deactivated cylinders is simply compressed and expanded as an air spring, with reduced friction and heat losses. The active cylinders combust at almost double the load required if all of the cylinders were operating. Pumping losses are significantly reduced as long as the engine is operated in this “part-cylinder” mode.

Figure 5: Example of Incremental Cost and Effectiveness Estimates for Technology Applications



Source: GAO.

- Indirect costs to manufacturers.* NHTSA adopted research that EPA had contracted for to refine estimates of the indirect costs to manufacturers of manufacturing more fuel-efficient vehicles. These costs include research and development and marketing costs associated with the introduction of a new technology and give decision makers a more comprehensive view of the total costs a manufacturer would incur for implementing new technology than direct costs alone can provide. EPA supplemented an initial contractor report on this subject with an additional in-house study, which involved significant staff resources.

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- *The social cost of carbon dioxide emissions.* NHTSA adopted an estimate of the damage resulting from carbon dioxide emissions that is more in-line with recent scientific and economic research, leading to a better reflection of the estimated benefits of increased CAFE standards related to reductions in GHG emissions. In the model year 2008 through 2011 light truck rule, NHTSA declined to include an economic value for reducing GHG emissions, citing the wide variation in published estimates of GHG emissions costs. However, a November 2007 federal court decision found that NHTSA's decision to not provide a monetized estimate of the benefit of reducing GHG emissions was arbitrary and capricious.⁵⁷ For the proposed model year 2012 through 2016 standards, NHTSA is using estimates of \$5, \$10, \$20, \$34, and \$56 per metric ton of carbon dioxide—with an emphasis on the \$20 value. These values, also adopted by EPA in its analysis, reflect the current administration's interim set of estimates of the social cost of carbon for agencies to use in regulatory analyses until a federal interagency working group develops a more comprehensive estimate for use in future economic and regulatory analyses.
 - *Projected fuel prices.* NHTSA used the most recent and updated projections of fuel prices provided by the Energy Information Administration (EIA) to place a value on the fuel-saving costs and benefits of different CAFE standards. Among other things, the monetized benefits of the new CAFE standards are more sensitive to changes in fuel prices, meaning that the estimated benefits of more stringent CAFE standards will increase or decrease to a greater extent in response to changes in the price of fuel compared to changes in other variables. For the current proposal, NHTSA is using a range of prices from \$2.50 in 2011 to \$3.82 in 2030, which is consistent with the EIA's 2009 main fuel price projections,⁵⁸ and is focusing on an average retail gas price of \$3.77 per gallon in 2007 dollars. In addition, NHTSA is reviewing the EIA's high and low fuel price projections to determine a range of potential costs and benefits, a best practice recommended by OMB guidance.⁵⁹ In projecting fuel prices, EIA considers recent and likely future developments in the world oil market,

⁵⁷*Center for Biological Diversity v. National Highway Traffic Safety Administration*, 508 F.3d 508 (9th Cir. 2007).

⁵⁸EIA's main price projection is its Reference Case, which represents EIA's current judgment regarding exploration and development costs and accessibility of oil resources in countries that are not members of the Organization of the Petroleum Exporting Countries (OPEC).

⁵⁹In the EIA's 2009 Annual Energy Outlook, the High Oil Price Case uses a range of prices from \$3.36 in 2011 to \$5.47 in 2030, and the Low Oil Price Case uses a range of prices from \$2.19 in 2011 to \$2.04 in 2030.

the effect of the current geopolitical situation on oil supply and prices, and conditions in the domestic fuel supply industry that affect pump prices. However, EIA projections have at times underestimated gas prices, most recently in 2008 during the price spike. Several experts we spoke to noted that gas prices are extremely difficult to predict.⁶⁰ However, most of the experts we spoke to also indicated that despite its limitations, EIA is the most credible source for projected fuel prices. Although EIA officials told us they do not issue guidance to agencies on how to use EIA projections in regulatory impact analyses, they expect agencies to consider that events EIA cannot predict will impact energy demand and fuel prices.

By applying the best research available, NHTSA should obtain better estimates of the benefits and costs of higher CAFE standards and allow standards to be set at a level better reflecting those benefits and costs.

More Thorough Analysis

In line with OMB guidance on federal regulatory analysis, NHTSA conducted more thorough analyses in the proposed model year 2012 through 2016 standards than in previous CAFE rulemakings, including the model year 2008 through 2011 light truck rule. First, NHTSA tested and compared the benefits and costs of a greater number of CAFE levels set at different stringencies (also known as alternative scenarios) than it has in the past. By doing so, NHTSA gives decision makers a better picture of which level of CAFE standards provides the best balance between costs and benefits. NHTSA doubled the number of alternative CAFE scenarios it has tested from four to eight since the model year 2008 through 2011 light truck final rule. Specifically, NHTSA considered scenarios in which fuel-economy levels are increased at an annual average rate ranging from 3 to 7 percent, as well as scenarios in which the benefits are modified—for example, selecting a level at which the total costs of new CAFE standards are equal to their total benefits or a level that maximizes the net benefits of new CAFE standards to society. As a result, NHTSA was able to provide more comprehensive information for decision makers and increase public understanding of NHTSA's process for setting standards.

⁶⁰For example, in its analysis for the model year 2008 through 2011 light truck rule, NHTSA proposed using EIA's reference price case but received comments critical of this decision in light of retail fuel prices that were significantly higher than EIA's reference case. For the final model year 2008 through 2011 light truck rule, NHTSA considered the comments the agency had received and decided to use the EIA's high price case to more accurately estimate the trajectory of gas prices in the future.

However, NHTSA also considered factors external to the model in determining the level of the proposed model year 2012 through 2016 standards. Although OMB guidance on regulatory analysis specifies that agencies should select the scenario that maximizes the net benefits of the regulatory action to society, NHTSA did not propose to select the “maximum net benefits” scenario as its preferred alternative for the standards in the proposed rule. Instead, NHTSA proposed to select a scenario in which CAFE standards increase at an average rate of 4.3 percent per year. According to NHTSA officials, that decision was justified because the four statutory factors that they must weigh when setting CAFE standards outweigh OMB guidance.⁶¹ Several experts we spoke to said that NHTSA’s decision was justified because selecting the “maximum net benefits” scenario would have resulted in CAFE standards that automobile manufacturers could not realistically meet without making significant tradeoffs. For instance, one expert thought manufacturers would have to change their fleet mix to build and sell smaller vehicles and would have to pass on substantial costs to consumers, which could reduce vehicle sales. In addition, another expert thought that if lead time is not sufficient, manufacturers will not be able to hire staff quickly enough to handle the additional work.

Additionally, as provided for in OMB guidance, NHTSA expanded its use of two types of uncertainty analysis, which differs from previous rulemakings. Specifically, relative to previous rulemakings, NHTSA expanded its sensitivity testing and probabilistic uncertainty analyses, both of which assess the uncertainty associated with key assumptions and inputs in its analysis, in comparison to previous rulemakings. NHTSA’s sensitivity analysis and probabilistic uncertainty analysis test whether variability in the values of key model inputs would dramatically affect the costs and benefits of a potential CAFE level. The variability of key inputs may arise from different estimates of credible studies or simply be the result of limited current knowledge. These sensitivity and uncertainty analyses provide decision makers with a sense of which potential CAFE level, despite the variability of key inputs, will best balance benefits and costs. In comparison to the model year 2008 through 2011 light truck rule, NHTSA’s current sensitivity and probabilistic uncertainty analyses considered more case scenarios focusing on a number of critical inputs, including projections of fuel prices, the rebound effect, the value of

⁶¹According to the proposed rule, standards set based on maximizing net benefits would reach an estimated 40.9 mpg fleet average in model year 2016.

reducing carbon dioxide emissions, and the military security benefits of reducing fuel consumption, of which variability in one input or a combination of inputs may affect the results of the overall analysis.

Experts Continue to Have Concerns about the Model, but Do Not Agree on How to Further Improve Inputs to the Model

As part of this work, we spoke with a number of experts familiar with the Volpe model about their assessment of the data used in the model. Although they provided criticism, they did not agree on what needed to be improved (see app. I for information on experts with whom we consulted). In general, nearly all of the experts we spoke to offered some critique of the model and its data. For instance, some, but not all, experts said that NHTSA was too cautious in updating the values for variables such as the social cost of carbon dioxide emissions, given the state of current research. These experts said that NHTSA was underestimating the social cost of carbon dioxide emissions, which would lead to an underestimation of the benefits of CAFE standards and the establishment of standards set at a lower than ideal level. However, we could not find general consensus among experts we spoke to that NHTSA should have modified values for specific variables or made other improvements to the model. For example, NHTSA used a lower value for the rebound effect⁶² (10 percent) to more closely align with values identified in recent research. Several experts thought that NHTSA should have adopted the value (5 percent) identified in the research, which was even lower than what NHTSA used, while others thought that NHTSA's more cautious approach was appropriate until additional studies using different data sets verified the findings.

We did find considerable controversy among experts over the potential safety impact of weight reduction in vehicles—much more so than for other variables assessed in the Volpe model.⁶³ While some experts stated that manufacturers could safely reduce vehicle weight while maintaining the size of the vehicle by substituting lightweight but durable materials for heavier materials (material substitution), other experts maintained that any effort to reduce vehicle weight would adversely affect safety. Two studies, one developed by NHTSA (Kahane study)⁶⁴ and a second

⁶²Rebound effect is the increase in vehicles miles traveled that result from the decreased costs of driving resulting from fuel economy increases.

⁶³While monetized values for safety with respect to loss of life are not included as an input in the Volpe model, safety impacts are considered in determining the appropriate level for CAFE standards.

⁶⁴Charles J. Kahane, *Vehicle Weight, Fatality Risk and Crash Compatibility of Model Year 1991-99 Passenger Cars and Light Trucks*, DOT HS 809 662, October 2003.

conducted by an automotive engineering consulting firm (Dynamic Research, Inc., study),⁶⁵ came to different conclusions on this issue, and to date, no subsequent study has been conducted in a manner designed to resolve the conflict. DOE has sponsored research through the Lawrence Berkeley National Laboratory that examines the relationship between vehicle weight and driver casualty risk using police-reported crash data and CAFE compliance records, but given the high level of ongoing controversy, this approach may not satisfy all the experts invested in this issue. In addition, neither the Kahane study nor the Dynamic Research, Inc., study were able to assess directly how material substitution as a particular approach to weight reduction could affect safety because the vehicles analyzed in the two studies were limited to model years 1985 through 1999. During this period, CAFE standards were not attribute-based, and manufacturers had a greater incentive to improve fuel economy by reducing vehicle size rather than by reducing vehicle weight through material substitution. In addition, several experts noted that by using the Kahane study in its current work, NHTSA may be overestimating the safety implications of higher CAFE standards because the study does not consider technology solutions like material substitution as an option that could improve fuel economy without negatively affecting safety. Because NHTSA accounts for the safety effects of proposed standards by estimating their safety implications, relying on this research in the future could result in standards being set at a lower level. In the past, concerns about safety have prevented non-attribute-based CAFE standards from being increased.

We also learned from experts that vehicle safety is challenging to address because the safety tradeoff between larger, heavier vehicles and smaller, lighter vehicles does not lend itself to a clear policy solution. Generally, larger and heavier vehicles, which enhance the safety of their passengers as a result of their size and weight, pose a greater safety threat to other vehicles on the roadways than smaller, lighter cars do. Conversely, although smaller, lighter cars pose less of a threat to other vehicles on the road, they cannot provide the same degree of safety to their passengers that larger, heavier vehicles do. The degree of difference in the size and weight of vehicles has some bearing on passenger safety: larger, heavier vehicles provide their passengers safety benefits and impose on others

⁶⁵R.M. Van Auken and J.W. Zellner, Dynamic Research, Inc., *Supplemental Results on the Independent Effects of Curb Weight, Wheelbase, and Track on Fatality Risk in 1985-1998 Model Year Passenger Cars and 1985-1997 Model Year LTVS*, DRI-TR-05-01 (Torrance, Calif., May 2005).

safety costs, while smaller, lighter vehicles provide others safety benefits and impose on their passengers safety costs. Several experts with whom we spoke thought that additional research was needed to better understand the relationship between vehicle size, weight, and safety, as well as to identify how best to reduce the weight of vehicles in a manner that creates the least risk. Experts recommended several different methodological approaches to assess this relationship, including future studies that examined material substitution in accident outcomes once vehicles with this technology became more prevalent in the fleet. Others recommended the use of computer crash simulation modeling to identify best practices in the use of material substitution.

Largely Due to Resource Constraints, NHTSA Has Limited Plans to Assess the Model Year 2008 through 2011 Light Truck CAFE Standards or Key Data Used to Develop the Standards

Federal agencies can use retrospective analyses of rulemakings to help determine the extent to which the expected costs, benefits, and goals of a regulation are being realized.⁶⁶ A retrospective analysis of CAFE standards could help NHTSA and Congress determine the extent to which goals of the standards—such as improvements in fuel economy—are being met and provide insight into ways to improve the standards. In addition, a retrospective analysis of key data inputs could help determine if there are systematic issues with the estimation of those data and identify means to improve the data in the future. EPA officials noted that they have used retrospective analyses of other regulatory programs to assess the accuracy of program costs. For example, in 2002, EPA issued a retrospective cost analysis of a large number of light-duty vehicle criteria pollutant standards and mobile source fuel standards implemented between 1992 and 2001.⁶⁷ However, because EPA has not previously issued GHG emissions standards for automobiles, it would not be able to conduct these types of analyses for GHG emissions standards at this time.

⁶⁶GAO, *Reexamining Regulations: Opportunities Exist to Improve Effectiveness and Transparency of Retrospective Reviews*, [GAO-07-791](#) (Washington, D.C.: July 16, 2007).

⁶⁷See for example “Comparison of EPA and Other Estimates of Mobile Source Rule Costs to Actual Price Changes”, J. Anderson and T. Sherwood, US EPA, published in the Society of Automotive Engineers Technical Paper Series, SAE 2002-01-1980, 2002.

With respect to the model year 2008 through 2011 light truck CAFE standards, the following retrospective analyses could be conducted by NHTSA:

- An overall analysis of the standards to determine the extent to which the new, footprint-based standards met intended goals (e.g., increases in fuel economy and reductions in fuel consumption). As the proposed model year 2012 through 2016 CAFE standards are also to be based on vehicle footprint, this analysis could help determine if the move to the footprint based standard provided the intended benefits or imposed unexpected costs.⁶⁸
- An analysis of the accuracy of key data inputs, including the baseline fleet and technology cost estimates. NHTSA has been criticized in the past for not adequately estimating these two sets of data, which provide crucial information for determining the effects of the proposed standards, and thus need to be as accurate as possible.

Although NHTSA officials we spoke with recognize the value of these analyses and hope to conduct them, they report that resource limitations have prevented them from doing so in the past and will prevent them from doing so in the near future. In addition, NHTSA is not required to do any of these analyses. A discussion of NHTSA officials' responses regarding retrospective analyses and the resource limitations that have prevented them from being conducted follows:

- *Model year 2008 through 2011 light truck standards.* NHTSA staff said that such retrospective analysis of the model year 2008 through 2011 light truck standards would be worthwhile and informative. However, according to NHTSA officials, in recent months the agency has devoted all of its dedicated CAFE staff's time to the proposed model year 2012 through 2016 CAFE rule and, as a result, has not been able to devote

⁶⁸As we discussed earlier, there is continuing controversy over the relationship between vehicle size, weight, and safety. Some experts we met with said that some manufacturers, in order to meet increased CAFE standards, may keep vehicle footprint constant while reducing overhang (the area of the car ahead of the wheelbase), which could make passengers more vulnerable in crashes. A retrospective analysis could help determine the extent to which this occurs and the potential safety implications of a footprint-based CAFE standard even assuming that footprints are not reduced.

resources to conducting a retrospective analysis.⁶⁹ In addition, given that NHTSA staff said that the agency is being asked by a majority of commenters addressing the subject to begin working on CAFE standards beyond model year 2016 as soon as possible, they may not be able to work on a retrospective analysis once the model year 2012 through 2016 standards are finalized and released. However, a number of experts we interviewed said that NHTSA should conduct such an analysis in order to provide insight into the standards and their actual effects.

- *Manufacturers' sales data.* While NHTSA told us that it would like to look back at manufacturers' actual sales as a means to assess the accuracy of the product plans that manufacturers submitted and that NHTSA used as the baseline fleet in setting model year 2008 through 2011 light truck standards, it said that it has no definitive plans for conducting this analysis in the near future. NHTSA officials cited a lack of resources in the agency for not conducting such an analysis. In addition, because 2008 sales were an anomaly—they were unusually low given the economic downturn—officials thought a study of the extent to which actual 2008 sales were in-line with the forecasted sales for 2008 that were used to set those standards would be of little value. However, an analysis of actual future years' sales against the estimated sales of the baseline fleet used in the rulemaking would be of value, as it would help validate data and potentially identify means to improve fleet forecasts in future CAFE rulemakings.
- *Cost estimates of technology.* NHTSA officials also told us that an assessment of the cost estimates of technology used in previous analyses would be valuable. However, NHTSA staff also said that such an analysis would be challenging, as it is hard to get accurate data on the actual cost of technology components. This is because these components are either sold directly to, or produced by, automobile manufacturers, meaning that there is no clear, public historical data on their sales price. However, while some experts with whom we spoke recognized the challenges in conducting such an analysis, they thought that such an assessment would provide value and recommended several different approaches for conducting this type of analysis. For example, some experts suggested that costs could be validated through a vehicle teardown program, such as the type of project EPA initiated last year, or through an analysis of sales data

⁶⁹NHTSA does, however, produce an annual Summary of Fuel Economy Performance report that provides information on CAFE standards in the previous year and the actual fuel-economy level of all manufacturers that are subject to the standards. In addition, they publish a summary of CAFE fines assessed on an annual basis.

and technology that manufacturers incorporated into recent models to comply with increased standards. While these studies could potentially impose large resource demands, they would also potentially help improve the cost of technology assumptions in future CAFE rules, helping to create standards that more accurately reflect costs and benefits.

Conclusions

Because CAFE and GHG emissions standards are closely related and automobile manufacturers will be subject to both, close collaboration between NHTSA and EPA can minimize compliance costs to the industry and ensure harmonized standards. Furthermore, regardless of how the government may set any future standards—jointly or independently—a continued partnership between the two agencies can help assure fiscal responsibility by leveraging—rather than duplicating—federal efforts and resources, including expertise and human capital costs. However, the current level of collaboration between NHTSA and EPA, which stems from the joint rulemaking process the agencies undertook at the discretion of the current administration, is not set in law or otherwise required. If NHTSA and EPA do not collaborate closely on future standards, there is a risk that the standards may not be harmonized, which would lead to increased compliance costs for manufacturers; the standards may not reflect the expertise of both agencies, such as the vehicle power train technology and environmental expertise of EPA and vehicle safety expertise of NHTSA; and the goals that the standards are attempting to accomplish may not be met. Also, the standards may not accurately reflect the best estimates of key costs and benefits, thus imposing added costs on the economy or failing to provide as large benefits to society as the standards could.

In addition, this is the first joint rulemaking conducted between these agencies, and NHTSA and EPA are under tight time frames to set the standards. However, the agencies are not documenting the processes being used. If NHTSA and EPA must collaborate on future standards, staff may spend additional time recreating these processes—ones which appear to be working effectively—and relearning how best to interface with one another's leadership structure, management processes, and research activities. As a result, the two agencies may not share their respective expertise and resources as well, potentially leading to inefficiencies, less thorough and rigorous regulatory analyses, and standards that may not be effectively harmonized or developed with similar time frames.

NHTSA has not yet conducted—nor does it have plans to conduct—a full and formal analysis of the effectiveness and outcomes of its adoption of

the footprint-based CAFE standards for light trucks. Also, it has no plans to assess the accuracy of key data inputs used to set these standards, even though it is now proposing a footprint-based approach for passenger vehicles as well. Conducting these types of analyses can help policymakers determine whether anticipated benefits and costs have been realized and identify corrections in or improvements to existing programs. NHTSA is not required to conduct such analyses and has limited staff and resources to devote to this effort. As a result, it is not clear if the new standards have met goals that NHTSA intended—such as fuel savings and improved safety outcomes—and if the move to the footprint-based standards was worthwhile. Furthermore, NHTSA does not know how well it estimated key data inputs that help determine the level at which standards are set, including technology costs; whether manufacturers used the types of technologies NHTSA expected in order to comply with new standards; and whether baseline fleets matched the vehicle mix actually sold. Consequently, agency officials cannot learn from the past and make adjustments to the process, such as seeking different data sources, to ensure that future standards are based on the most accurate data available.

Given the importance of safety in setting CAFE standards, ensuring that decision makers and the public have the most accurate information on the relationship between vehicle size, weight, and safety will be important if the standards are to be changed in the future. In addition, the data inputs that NHTSA and EPA use to help set and analyze the effects of the proposed model year 2012 through 2016 standards should be based upon the best available research and reflect a consensus among experts and stakeholders. Given the controversy among experts and the increasing availability of material substitution—an advancement in technology to reduce weight that could compensate for safety effects—new research could help to answer questions regarding the extent to which weight can be reduced without affecting safety and whether there are best practices for employing material substitution.

Finally, while other sources of technology costs were used in developing CAFE and GHG emissions standards, the 2002 NAS work on technology costs was generally viewed by a wide range of stakeholders and experts as being thorough and unbiased. Congress authorized NHTSA to contract with NAS at 5-year intervals until 2025 so that the agency would have current information available to set future standards. However, if NHTSA cannot ensure that this work is available in time to support analysis in future rulemaking, this study, and the federal money that sponsored it, will be wasted.

Recommendations for Executive Action

Based on our review, we are making five recommendations. We recommend the following to NHTSA and EPA:

- NHTSA and EPA should document the process used in this joint rulemaking to establish a roadmap for any future rulemaking efforts and facilitate future collaboration. In addition, NHTSA and EPA should publish this documentation in order to increase transparency.
- To ensure continued collaboration and an enhanced relationship in any future CAFE and GHG emissions rulemakings, NHTSA and EPA should enter into a Memorandum of Understanding with one another in which the agencies agree to continue their enhanced partnership in any future CAFE and GHG rulemakings.
- NHTSA and EPA, with input from key stakeholders, should conduct or sponsor new research on safety and its relationship to vehicle size and weight, given the controversy and lack of consensus regarding the relationship between vehicle size, weight, and safety and the emergence of new strong-but-lightweight materials among experts and stakeholders.

In addition, we are recommending the following to NHTSA:

- NHTSA should conduct and document a retrospective analysis of the model year 2008 through 2011 light truck standards, given the potential impact of CAFE standards on the automobile industry and consumers. In addition, we recommend that NHTSA identify opportunities to evaluate the accuracy of key estimates, such as technology costs, used to determine the model year 2008 through 2011 light truck standards. As EPA has experience conducting retrospective analyses of regulatory programs, NHTSA should consider involving EPA in this process.
- NHTSA should set delivery time frames for future NAS studies to ensure the availability of these studies in a time frame useful for incorporation in NHTSA's regulatory analyses.

Agency Comments and Our Evaluation

We provided a draft copy of this report to the Department of Transportation and the Environmental Protection Agency for their review. We also provided a relevant section of the report to the Energy Information Administration, and officials confirmed that information characterizing EIA's fuel price projections was accurate.

EPA provided a written response, which is reproduced in appendix III. In its response, EPA agreed with our characterization of NHTSA and EPA's

collaboration on setting CAFE and GHG emissions standards and with our recommendations. In addition, EPA provided technical comments via e-mail which we incorporated as appropriate.

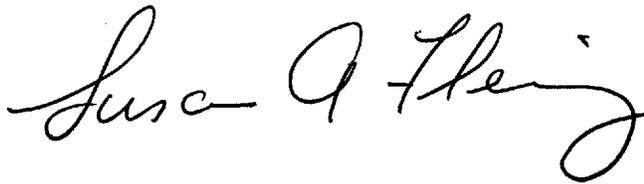
DOT provided its response by e-mail and generally agreed with the report's recommendations. NHTSA also provided technical comments, and while we incorporated a number of these comments, others offer an opportunity for additional discussion. First, NHTSA suggested that our first two recommendations—(1) that NHTSA and EPA document the process used in this joint rulemaking, and (2) that NHTSA and EPA sign a Memorandum of Understanding to continue this enhanced partnership—apply only if future rulemakings are conducted jointly. We did not make this change. Given NHTSA and EPA's successful collaboration on CAFE and GHG emissions standards, we believe continued collaboration will help ensure that federal resources and expertise are leveraged efficiently and effectively—regardless of whether future administrations continue to issue both sets of standards jointly, separately, or pursue only CAFE or GHG emissions standards.

Second, in our discussion of the impact of the appropriations ban from fiscal years 1996 through 2001 that prevented NHTSA from conducting work on CAFE issues, we noted that NHTSA lost staff with relevant expertise and did not begin to hire additional automotive engineers until summer 2009. We looked into this issue because in our 2007 report, NHTSA officials told us they needed additional staff with expertise in automotive engineering and computer modeling to assist in developing technology cost and effectiveness estimates, as well as other tasks, to prepare for future changes in CAFE standards. NHTSA commented in response to this draft that the prohibition did not prevent DOT from sustaining relevant engineering, energy, and environmental expertise, and that after 2001, NHTSA leveraged DOT's expertise. NHTSA also commented that in our current review, we did not examine broader staff capabilities within DOT. We agree that this information is important. However, we were not able to confirm the extent to which NHTSA leveraged DOT's expertise because NHTSA did not provide this information. We continue to believe that NHTSA and EPA have different expertise and resources—ones that likely cannot be replicated efficiently at both agencies but that are crucial for the development of balanced, effective standards for cars and light trucks, and therefore we did not revise the report.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the Secretary of Transportation, the Administrator of the Environmental Protection Agency, the Administrator of the Energy Information Administration, and interested congressional committees. This report will also be available at no charge on the GAO Web site at <http://www.gao.gov>.

If you or your staffs have any questions concerning this report, please contact me at (202) 512-2834 or flemings@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions are listed in appendix IV.

Sincerely yours,

A handwritten signature in black ink that reads "Susan Fleming". The signature is written in a cursive style with a large, looping "S" and "F".

Susan Fleming
Director, Physical Infrastructure Issues

Appendix I: Objectives, Scope, and Methodology

To describe the proposed corporate average fuel economy (CAFE) and greenhouse gas (GHG) emissions standards, we analyzed documentation related to the rulemaking, such as the May 2009 Notice of Upcoming Joint Rulemaking, September 2009 Notice of Proposed Rulemaking, and associated preliminary regulatory impact analyses from both agencies. We analyzed these documents to summarize the structure of each set of standards, describing how the National Highway Traffic Safety Administration (NHTSA) and the Environmental Protection Agency (EPA) harmonized the standards and areas in which there are differences between the standards, such as certain types of flexibilities like temporary lead-time mechanisms. We also summarized related legislation that establishes CAFE fines and summarized EPA's authority under the Clean Air Act to assess fines for noncompliance with GHG standards, to describe the penalties that NHTSA and EPA will apply for noncompliance with the new standards.

To describe NHTSA's and EPA's processes for setting proposed model year 2012 through 2016 CAFE and GHG emissions standards, we reviewed and analyzed relevant rulemaking documents, such as the Notice of Proposed Rulemaking and the legislation establishing CAFE standards and EPA's authority to regulate GHG emissions, noting the types of analyses each agency was allowed to conduct under its individual legal authority. We analyzed documentation related to the analyses the agencies conducted. We also interviewed agency officials and reviewed documentation from NHTSA and EPA related to the work they conducted in setting the standards. To describe how the agencies collaborated with one another to issue the standards, we analyzed these interviews and documentation against GAO criteria for evaluating communication and coordination among federal agencies. Through interviews with officials and by reviewing research each agency developed as part of the rulemaking, we identified the expertise and resources each agency brought to bear in the development of the standards.

To evaluate the improvements made to NHTSA's regulatory impact analyses used in setting CAFE standards, we reviewed relevant documentation, including NHTSA's Preliminary Regulatory Impact Analysis on model year 2011 CAFE standards for passenger cars and light trucks and for the proposed model year 2012 through 2016 standards. We also conducted literature searches for research on fuel economy published since 2007—the year of our last report on CAFE standards. We interviewed NHTSA officials and staff at the Volpe National Transportation Systems Center, as well as automobile industry stakeholders—including domestic and international automobile

manufacturers; an association representing original equipment suppliers; vehicle technology specialists at national laboratories and academic research centers; and independent experts on vehicle technology, transportation, and modeling. We identified these experts through several approaches:

- About half of the experts we contacted had assisted us in our 2007 review of CAFE standards. Several of these experts were members of the current or 2002 National Academy of Sciences (NAS) committee, while others had been recommended by members of the NAS committee or NHTSA.
- We conducted internet searches to identify experts publishing recent research on fuel economy, GHG emissions, economic modeling, and other issues.
- We asked experts participating in our work for recommendations.

We also pursued a more in-depth analysis from stakeholders about safety and vehicle weight by reviewing the methodology of several key studies and interviewing engineers and other organizations with specific expertise in safety and vehicle design, such as the Insurance Institute for Highway Safety and experts from National Laboratories. We also interviewed officials from the Energy Information Administration (EIA) to review gasoline price projections that are used in the Volpe model. To evaluate NHTSA's processes for obtaining and validating data on automobile manufacturer product plans and cost data on fuel-saving technologies, we analyzed NHTSA documentation against GAO criteria for developing, managing, and evaluating cost estimates and for assessing data reliability. To evaluate NHTSA's processes for estimating the costs and benefits of improved vehicle fuel economy in the Volpe model, we analyzed NHTSA documentation against federal guidance for conducting regulatory and economic analyses and GAO guidance for conducting benefit-cost analyses.

To determine the steps NHTSA has taken to analyze the effects of the model year 2008 through 2011 light truck standards, we reviewed and analyzed the Energy Independence and Security Act, NHTSA's final rulemaking on the model year 2008 through 2011 CAFE standards for light trucks, and the data used to set these standards. We interviewed NHTSA officials to determine whether NHTSA has conducted analyses to assess the outcomes of these standards—for example, improvements in vehicle fuel economy and gallons of oil saved—and requested documentation of any analyses. To determine the steps NHTSA has taken to assess the

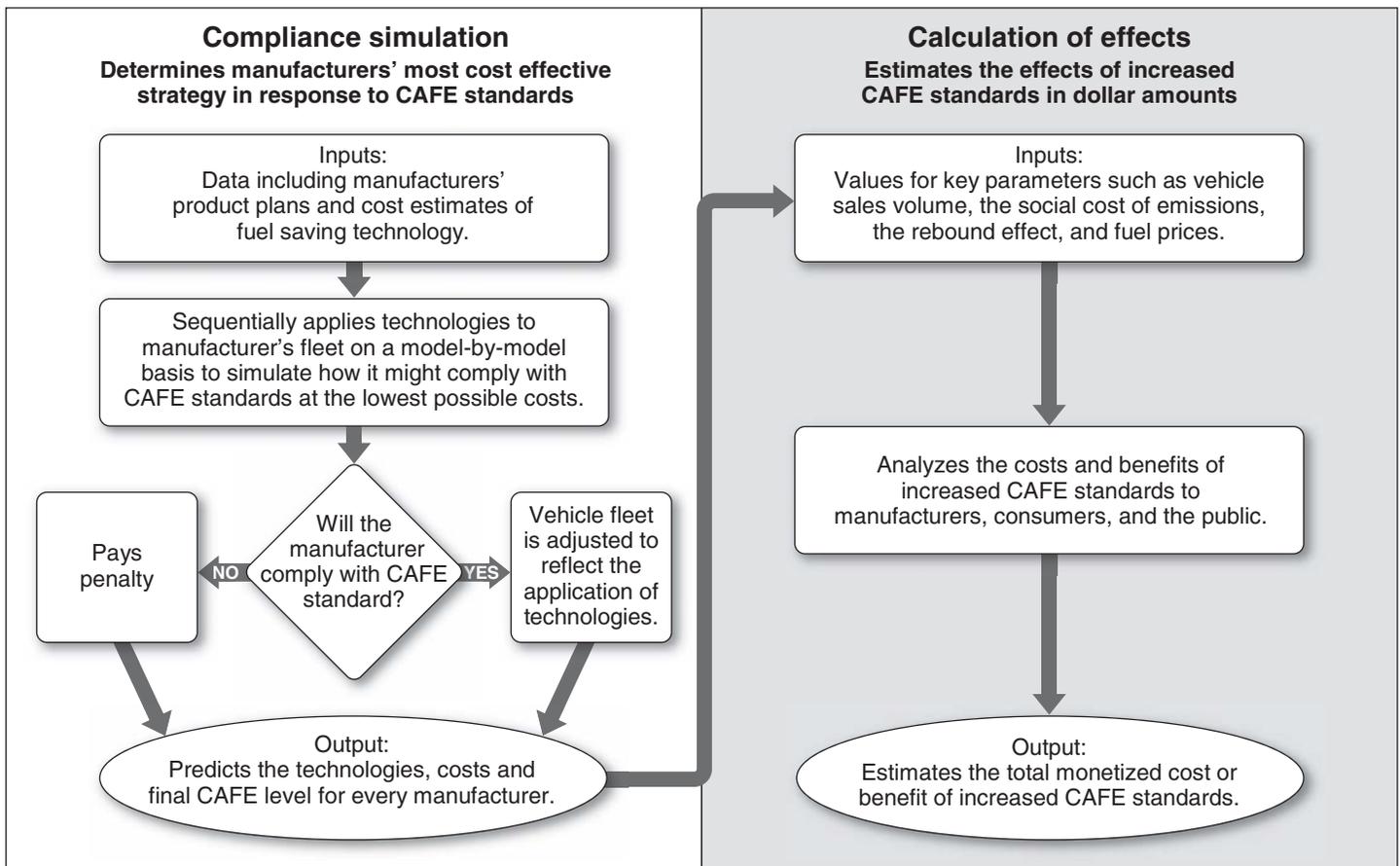
accuracy of input data and assumptions used in developing the model year 2008 through 2011 CAFE standards—particularly assumptions related to cost estimates of technology and manufacturer product plans—we interviewed NHTSA officials and requested documentation of any analyses as appropriate. For example, we assessed whether NHTSA compared data that estimated the costs of fuel-saving technology to actual cost data from 2008. We also interviewed outside experts on options NHTSA could use to conduct such an analysis and the benefits and tradeoffs of doing so. Finally, we reviewed and analyzed these interviews and documentation against GAO guidance for program evaluation.

We conducted this performance audit from June 2009 to February 2010, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: The CAFE Compliance and Effects Modeling System

As part of its regulatory impact analysis of potential CAFE standards, NHTSA uses the CAFE Compliance and Effects Modeling System (commonly known as the Volpe model) developed by the Volpe National Transportation Systems Center to estimate the following: (1) the most cost-effective strategy for automobile manufacturers to respond to proposed CAFE standards and (2) the impacts, such as reduced fuel consumption, increased vehicle prices, and reduced emissions, proposed CAFE standards will have on consumers, manufacturers, and society. For a visual description of the Volpe model's analysis, see figure 6.

Figure 6: The Volpe Model



Source: GAO interpretation based on past use by NHTSA.

Input Files Used in the Volpe
Model

The Volpe model's analysis relies on a number of data inputs, including, among other things, a list of the automobile manufacturers producing vehicles for sale in the U.S. during the period covered by a CAFE rulemaking, a list of fuel-saving technologies¹ and their estimated cost and effectiveness in reducing fuel consumption, simulated alternative CAFE scenarios (i.e., CAFE standards set at range of levels), economic inputs such as the estimated social cost of carbon dioxide emissions and the rebound effect (a phenomenon in which individuals drive more because improving a vehicle's fuel economy effectively lowers the cost per mile of operating that vehicle), and the emissions rates of various pollutants. These data are contained in several input files that are entered into the Volpe model.

The Compliance Simulation

The Volpe model's compliance simulation demonstrates how each automobile manufacturer could attempt to comply with a higher CAFE standard by adding fuel-saving technologies to its vehicle fleet until that level is achieved. Using the information provided in the scenario input file, the Volpe model applies fuel-saving technologies in order of cost-effectiveness and ease of implementation to the vehicle models forecasted in the baseline to simulate how a manufacturer could make progress toward compliance with new CAFE standards.

Definition of the Baseline
Vehicle Fleet

The compliance simulation begins with a forecast of the U.S. vehicle fleet in future model years, which represents the baseline vehicles (including estimates of the volumes and prices of individual vehicle models) manufacturers could modify with fuel-saving technologies to comply with the model year 2012 through 2016 CAFE standards. For the model year 2012 through 2016 rulemaking, the baseline vehicle forecast was developed using public model year 2008 vehicle sales data, vehicle sales forecasts from EIA, forecasts of the relative sales of cars and trucks by manufacturer and market segment from CSM-Worldwide, EPA's emission certification and fuel-economy database, vehicle and technology information from Edmunds.com, Motortrend.com, and Ward's Automotive,

¹In the proposed rule, NHTSA used 39 technology applications, such as engine turbocharging/downsizing, variable valve timing, cylinder deactivation, and engine friction reduction.

Application of Vehicle Technologies

and to a more limited extent than in previous rulemakings, confidential business plans provided by automobile manufacturers upon request.²

Using the baseline vehicle fleet, the Volpe model then simulates how each manufacturer could apply fuel-saving technologies to each vehicle model in its fleet to comply with the model year 2012 through 2016 CAFE standards in the most cost-effective manner. Prior to this simulation, NHTSA estimated the cost, effectiveness in reducing fuel consumption, applicability in terms of vehicle subclass,³ availability by model year, learning rate,⁴ and fleet penetration⁵ of each technology considered in the compliance simulation and included this information in the technology input file. Technologies are categorized within one of five technology groups,⁶ and each technology group has a corresponding “decision tree” which displays the sequence in which NHTSA estimates a manufacturer would apply technologies to the vehicle models in its fleet. For example, a manufacturer could apply electrical power steering, improved electrical accessories, 12-volt micro-hybrid technology, a belt integrated starter generator, and a crank integrated starter generator to a subcompact car using the decision tree for the electrification/accessory technology group. Each technology is positioned along a decision tree according to its estimated incremental cost and fuel-economy improvement, taking into account technologies that have already been applied. Before applying new technologies to a vehicle, the Volpe model first carries over any technologies that were present during the previous model year. Then, proceeding along each technology group’s decision tree, the Volpe model

²In previous rules, NHTSA has relied on confidential product plans provided by manufacturers to create the baseline fleet, but it has shifted away from that approach to make the baseline data more transparent for the proposed rule.

³For the purpose of applying technologies, NHTSA distinguishes vehicles by subclass, including subcompact car, subcompact performance car, compact car, compact performance car, midsize car, midsize performance car, large car, large performance car, minivan, small SUV/pickup/van car, midsize SUV/pickup/van, and large SUV/pickup/van.

⁴Learning is a means of capturing the reduction in cost of the components and manufacturing process involved with a technology. A reduction in cost takes place when the volume of deployment of that technology increases dramatically (volume-based) or when reasons related to other factors, such as negotiated contractual agreements between suppliers and original equipment manufacturers, occur over a period of time (time-based).

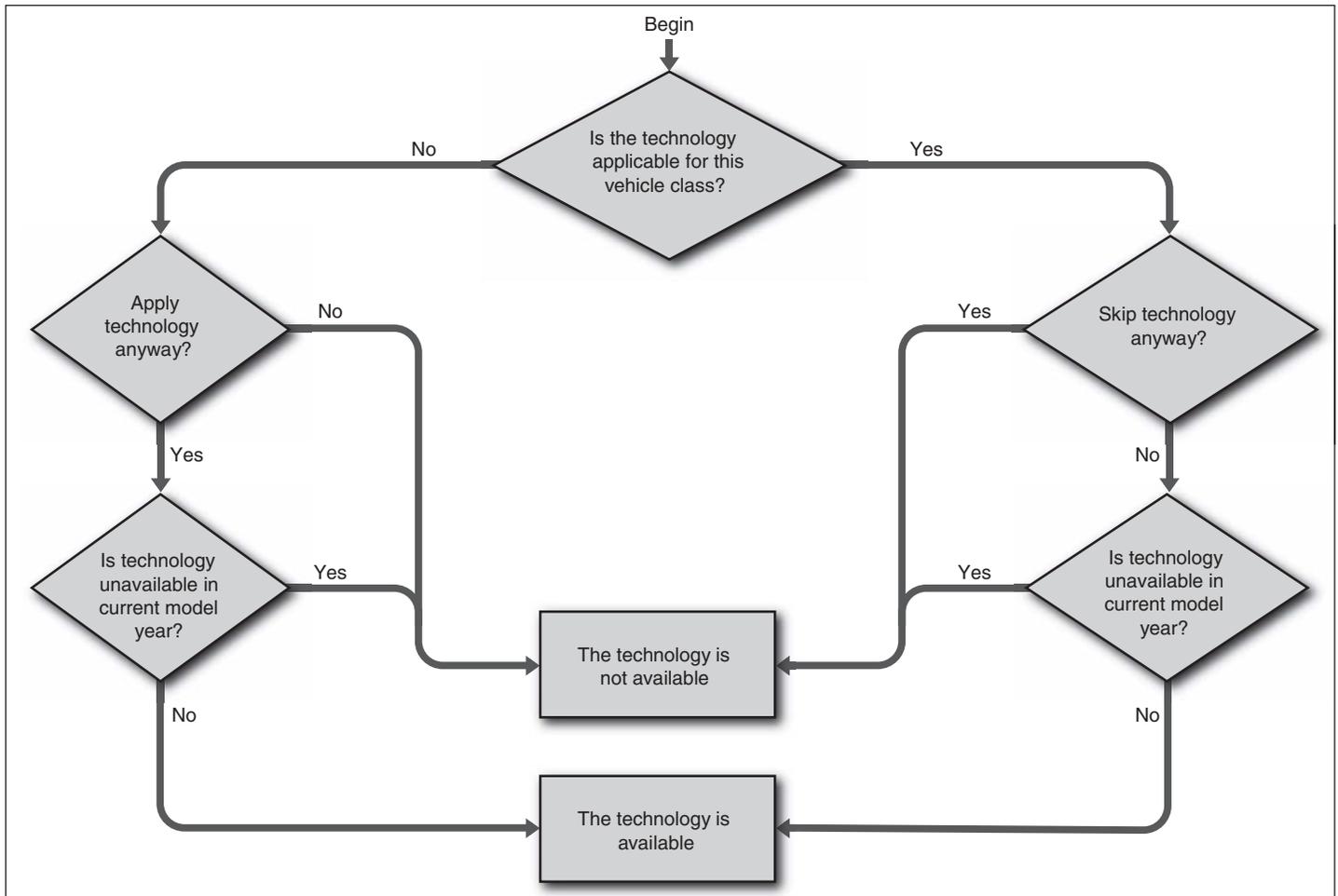
⁵Fleet penetration is the percentage of a fleet that a technology can be applied to in a given model year, which is based on supply constraints and other reasons.

⁶The five technology groups are engine, transmission, electrical accessory, hybrid, or vehicle.

determines the applicability and availability of each technology to every vehicle model. If the phase-in limit for a particular technology has been reached and it is no longer available, the Volpe model proceeds to the estimated next-best technology.⁷ See figure 7 for a visual description of the process by which the Volpe model determines the applicability and availability of a given technology.

⁷The “next-best” methodology operates as follows: the Volpe model considers technologies within one of the five technology groups in sequential order, proceeding to the next technology if the phase-in cap has been reached for a particular technology (i.e., 85 percent penetration for turbocharged/downsized engines). The Volpe model determines whether the technology can be applied to any set of vehicles, evaluates the effective cost of doing so, and identifies the technology from each technology group that would yield the lowest effective cost.

Figure 7: The Volpe Model's Determination of Technology Applicability and Availability



Source: GAO adaptation of the Volpe model's technology applicability determination.

The model repeats this process for each technology group, and then selects the technology with the lowest effective cost—that is, the technology that provides the greatest private benefits with the lowest cost. The compliance simulation continues to apply technologies to each manufacturer's fleet using this approach until (1) the manufacturer's fleet is estimated to be brought into compliance with the CAFE standard for a given model year, (2) the manufacturer has exhausted all the technology options for its fleet, or (3) the Volpe model estimates that it would be more cost-effective for the manufacturer to pay the associated CAFE fines than to apply additional technology to its fleet. The Volpe model accounts for multiyear planning, through which a manufacturer may apply more

technology than necessary in earlier model years in order to carry those technologies forward into future model years and thereby avoid applying other more expensive technologies. When the Volpe model has brought each manufacturer's fleet to one of the three outcomes listed above, the compliance simulation loop ends.

Forecast of the New Vehicle Fleet

The compliance simulation produces an output file that shows, for each vehicle in a manufacturer's fleet, which technologies were included in a vehicle model before the simulation was run, which technologies were skipped in favor of other technologies, and which technologies had been applied to vehicles at the simulation's end. The output file also shows the changes in vehicle weight, improvement in fuel economy, and incurred cost resulting from the technologies applied during the compliance simulation, as well as the total cost of any civil penalties incurred by each manufacturer. At this point, the Volpe model has a new fleet of vehicles with new prices, fuel types (gasoline or diesel), fuel-economy values, and curb weights to reflect how NHTSA estimates manufacturers will apply fuel-saving technologies in response to the CAFE requirements.

The Calculation of Effects

Following the compliance simulation, the Volpe model's calculation of effects component estimates the impact of the fuel-economy improvements made to vehicles to meet new CAFE standards on energy consumption, greenhouse emissions, and other factors. Using the forecasted vehicle fleet (i.e., the output of the compliance simulation), the Volpe model estimates the lifetime travel, fuel consumption, and carbon dioxide and criteria pollutant emissions⁸ resulting from the application of technologies to meet higher CAFE standards for each vehicle in the U.S. fleet over its anticipated life span. After calculating the effects for individual vehicle models, the Volpe model aggregates these effects for all the vehicles in a CAFE class produced during each model year affected by a proposed standard.

Costs, Benefits, and Effects of More Stringent CAFE Standards

The Volpe model measures the effects of increased CAFE standards by calculating the difference in the value of a variable (e.g., gallons of fuel consumed) under the baseline (model year 2011) CAFE standard and its value under a new CAFE standard. These effects include but are not limited to

⁸Ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead are called criteria pollutants because EPA regulates them by developing human health-based or environmentally-based criteria (science-based guidelines) for setting permissible levels.

- reductions in greenhouse gas emissions—increasing CAFE standards will reduce gasoline consumption and the amount of petroleum refined, which will reduce emissions of greenhouse gases;
- higher or lower emissions of air pollutants;
- potential increases in new vehicle prices;
- social value of fuel savings, which is the annual value of fuel savings over the entire expected lifetimes of vehicle models whose fuel economy is improved;
- economic benefits from reduced petroleum imports;
- valuing changes in environmental impacts (i.e., the Volpe model estimates changes in damage costs caused by carbon dioxide emissions); and
- social costs of added driving.

Appendix III: Comments from the Environmental Protection Agency



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

FEB 16 2010

OFFICE OF
AIR AND RADIATION

Ms. Susan Fleming
Director, Physical Infrastructure
Government Accountability Office
441 G. St., N.W.
Washington, D.C. 20548

Dear Ms. Fleming:

Thank you for the opportunity for the Environmental Protection Agency (EPA) to respond to the Government Accountability Office's (GAO) draft report "*NHTSA and EPA's Partnership for Setting Fuel Economy and GHG Emission Standards Improved Analysis and Should be Maintained*," including the recommendations included in the report.

EPA fully understands its responsibilities under the Clean Air Act to protect human health and welfare, including the responsibilities which flow from the April 2007 Supreme Court decision in *Mass. v. EPA* with respect to climate change and greenhouse gases (GHG). As discussed in the GAO report, one of the first formal actions undertaken by EPA in response to the Court's decision was the September 2009 Joint Notice of Proposed Rulemaking (NPRM) for light-duty vehicles from EPA and the National Highway Traffic Safety Administration (NHTSA). In that action, EPA proposed the federal government's first GHG standards for light-duty vehicles, and NHTSA proposed closely coordinated fuel economy standards for the same vehicles covering the same vehicle model years (2012 to 2016). This joint NPRM demonstrates the results of several months of close collaboration between EPA and NHTSA.

GAO's draft report includes a review of the collaboration between EPA and NHTSA over the past year as the two agencies worked together to develop coordinated programs which will reduce GHG emissions, improve vehicle fuel economy, provide the industry with coordinated regulatory programs which can be met by a single national vehicle fleet, result in very large oil savings and GHG reductions, and provide significant positive lifetime fuel savings which far exceed the projected increase in vehicle costs.

GAO presents four recommendations in the draft report which are directed at both EPA and NHTSA. EPA agrees with each of these recommendations, and below we respond to each recommendation.

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GAO recommendation 1: EPA and NHTSA should document their collaborative rule development process.

Comment: EPA agrees with this recommendation. After the completion of our current rulemaking, we will work with our colleagues at NHTSA to document the process by which we worked together for both the NPRM and the final rule in an effort to learn from what we did right and look for opportunities for improvement in future collaborations.

GAO recommendation 2: EPA and NHTSA should formalize their collaborative relationship in order to ensure cooperation on future GHG and CAFE rule development.

Comment: EPA agrees with this recommendation. Given the close relationship between vehicle CO₂ emissions and vehicle fuel economy, it is important that EPA and NHTSA work closely together in the future to ensure that the two agencies' independent regulatory authority is closely coordinated to ensure that each agency's responsibilities are met in a way that ensures a coordinated regulatory regime for the automotive industry. EPA will work with our colleagues at NHTSA to identify ways to strengthen our current collaboration for future regulatory actions, including exploring the possibility of a formal Memorandum of Understanding as suggested by GAO, or some other form of formal agreement.

GAO recommendation 3: NHTSA and EPA, with input from key stakeholders, should conduct or sponsor research on safety and its relationship to vehicle size and weight.

Comment: EPA agrees with this recommendation. EPA has a responsibility under the Clean Air Act to consider the potential impacts of vehicle emission standards, including impacts on vehicle safety. The issue of vehicle size and mass and the potential impact of future GHG standards on vehicle safety is critically important, and EPA intends to work closely with our colleagues at NHTSA to improve the scientific understanding of these issues in the context of future improvements in vehicle GHG performance and fuel economy.

GAO recommendation 4: NHTSA should conduct a retrospective analysis of the 2008-2011 CAFE rule, and NHTSA should consider involving EPA in this analysis.

Comment: EPA has performed retrospective analysis of a number of our past mobile source rulemakings (e.g., fuel standards, light-duty vehicle standards, and heavy-duty engine standards), and we have found such analysis to be instructive. To the extent our colleagues at NHTSA decide to undertake a retrospective analysis of the 2008-2011 CAFE standards, EPA will assist in any way that would be constructive.

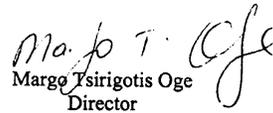
In addition to our comments discussed in this letter, EPA has also provided to GAO a number of suggested editorial changes to the draft report as a mark-up of the draft. Overall, EPA believes the draft report provides an accurate description of the collaboration between EPA and

**Appendix III: Comments from the
Environmental Protection Agency**

NHTSA in the development of the proposed 2012-2016 model year light-duty vehicle GHG and CAFE standards.

Once again, thank you for the opportunity to review this draft report.

Sincerely,



Marge Tsirigotis Oge
Director

Office of Transportation and Air Quality

Appendix IV: GAO Contact and Staff Acknowledgments

GAO Contact

Susan Fleming, (202) 512-2834 or flemings@gao.gov

Staff Acknowledgments

In addition to the contact above, Cathy Colwell (Assistant Director), Timothy Bober, Antoinette Capaccio, Joah Iannotta, Terence Lam, Sara Ann Moessbauer, Josh Ormond, Madhav Panwar, Justin Reed, Matthew Rosenberg, Amy Rosewarne, Frank Rusco, Crystal Wesco, and Chad Williams made key contributions to this report.

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