United States General Accounting Office

GAO

Report to Congressional Requesters

March 2004

AIR POLLUTION

EPA Could Take Additional Steps to Help Maximize the Benefits from the 2007 Diesel Emissions Standards

GAO-04-313

March 2004

AIR POLLUTION

EPA Could Take Additional Steps to Help Maximize the Benefits from the 2007 Diesel Emissions Standards

GAO Accountability • Integrity • Reliability

Highlights

Highlights of GAO-04-313, a report to congressional requesters

Why GAO Did This Study

Diesel engine emissions pose health risks, but one major source—heavy-duty diesel vehicles—is critical for our economy. To reduce risks, the Environmental Protection Agency (EPA) has set stringent emissions standards for diesel engines. In 1998, EPA found that some engine makers were violating standards, so they agreed to build engines that meet 2004 standards early, by October 2002. EPA has set even more stringent standards for 2007. GAO was asked to (1) assess the October 2002 deadline's effects on industry and emissions, and (2) obtain stakeholders' views on the readiness of technology for the 2007 standards and EPA's efforts to ensure this. GAO analyzed information from EPA, 10 large trucking companies, the engine makers subject to the early deadline, and other stakeholders.

What GAO Recommends

GAO recommends that EPA consider ways to address concerns about technology costs, reliability, and availability to meet the 2007 standards—such as better communicating with all stakeholders and using an independent panel to assess progress and consider industry incentives. EPA is concerned about some of GAO's findings and fears a panel could delay progress. GAO maintains its findings are well supported and that a panel could ultimately help improve communications, avoid delays, and ensure the benefits are achieved.

www.gao.gov/cgi-bin/getrpt?GAO-04-313.

To view the full product, including the scope and methodology, click on the link above. For more information, contact John B. Stephenson at (202) 512-6225 or stephensonj@gao.gov.

What GAO Found

Implementing the 2004 diesel emissions standards 15 months early disrupted some industries' operations but also helped reduce pollution earlier. More specifically, because some manufacturers had to build new engines sooner than planned, most could not provide trucking companies with prototype engines early enough to test. Concerned that the new engines would be costly and unreliable, some of the companies said they bought more trucks with old engines than planned before October 2002. Our analysis of truck production and financial data also shows this surge. This adversely affected some companies' operations and profits. To meet the increased demand for trucks with old engines, some manufacturers reported that they ramped up production of such engines before October. But when demand subsequently dropped, they had to decrease production and release workers, reducing profits and disrupting operations, at least until demand increased later in 2003. Manufacturers of the new engines also continued to lose market share to manufacturers that either did not have to meet the early date, or that did but chose not to, paying penalties instead. While accelerating the schedule for new engines affected some industries, it accelerated emissions benefits, although not to the extent or in the time frames anticipated. For example, EPA roughly estimated that its agreements with engine manufacturers that violated standards would reduce nitrogen oxide emissions by about 4 million tons over the life of the engines. But because companies initially bought more trucks with old engines and owners are now operating trucks longer, some of the expected emissions reductions will be delayed.

As for the 2007 standards, EPA has taken a number of steps to aid the transition to the new diesel engines and fuel, but some stakeholders would like more help. Most engine, emissions control, and fuel industry representatives said the needed technologies will be ready on time; but other engine, trucking, and fuel representatives have concerns and would like more help to ensure that the technology will be available. For example, manufacturers plan to have limited numbers of prototype engines ready for a few fleets to test by mid- to late-2005—trucking companies say they need new engines 18 to 24 months before the 2007 deadline to test the engines in all weather conditions and to develop their long-term purchasing plans. Some companies, however, are concerned that providing test engines to only a few fleets may not provide the industry as a whole with sufficient information to judge the engines' performance. In addition, they are still concerned that the new engines may be too costly and much less fuel-efficient. As a result, they expect companies will again buy more trucks with old engines before the deadline, disrupting industry operations and emissions benefits. The fuel industry representatives said they can produce the low-sulfur fuel the new engines require on time and see no reason to delay the standards. Nevertheless, they worry the fuel initially may not be available nationwide and it may be difficult not to contaminate it with other fuels in the distribution system. Environmental and health groups do not want to delay the standards or the expected emissions benefits. Some stakeholders would like more information on technological progress. In addition, they would like more reassurance—such as from an independent review panel—that the technology will be ready on time and additional assistance—such as economic incentives—to encourage timely purchases of trucks with the new technologies.

Contents

Figures

Abbreviations

ACERT	advanced combustion emissions reduction technology
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
BEA	Bureau of Economic Analysis
BLS	Bureau of Labor Statistics
EPA	U. S. Environmental Protection Agency
FHA	Federal Highway Administration
GAO	U. S. General Accounting Office
GDP	Gross Domestic Product
PPI	Producer Price Index

GAO
Accountability * Integrity * Reliability

United States General Accounting Office
Washington, D.C. 20548

March 11, 2004

Congressional Requesters:

Exhaust from diesel engines is among the most pervasive and harmful sources of air pollution. Diesel exhaust contains nitrogen oxides and several other toxic components and chemicals that, combined, pose a cancer risk greater than that of any other air pollutant, according to the American Lung Association.[1] Heavy-duty diesel vehicles—including, among others, those used to haul freight over long distances—are major contributors to nationwide diesel exhaust emissions, generating about 2.5 million tons of nitrogen oxide emissions annually.[2] However, large diesel-powered trucks are also critical to the nation's economy.

To combat diesel-related health risks, EPA, under the Clean Air Act, sets standards for emissions from diesel engines. EPA may take enforcement action against any manufacturers selling engines that fail to comply with the standards. Since 1984, EPA has implemented standards that have progressively lowered the amount of key pollutants from diesel engines by more than 75 percent. In 1998, EPA found that a number of engine manufacturers, accounting for about 90 percent of the U.S. heavy-duty diesel engine market, had sold 1.3 million engines—almost all of the largest engines they had produced since 1987—that under certain circumstances were emitting nitrogen oxides at levels up to three times higher than allowed by the standards in place at that time. To achieve compliance, EPA, the U.S. Department of Justice, and these manufacturers agreed to be bound by consent decrees, legally binding dispute settlements. In what is commonly referred to as the pull-ahead provision of the decrees, the manufacturers found to have violated emissions standards agreed to accelerate by 15 months the schedule for meeting new, more stringent engine standards to October 2002 instead of the original mandatory date of 2004.

[1]While diesel exhaust includes numerous toxic components, this report focuses primarily on nitrogen oxides, commonly referred to as NOx.

[2]This report focuses only on heavy-duty highway diesel engines, defined by EPA as engines used in heavy-duty vehicles with a gross vehicle weight of 8,500 pounds or more. EPA certifies heavy-duty diesel engines in three categories: light heavy-duty (typically used in Class 2b through Class 5 vehicles weighing 8,500 to 19,500 pounds); medium heavy-duty (in Class 6 and 7 vehicles weighing 19,501 to 33,000 pounds); and heavy heavy-duty (in Class 8 vehicles weighing more than 33,000 pounds).

In 2007, all diesel engine manufacturers will be required to meet still more stringent standards and the technology needed to meet them will require significant advancements over current engine and emissions control equipment. In addition, the engines will need a new grade of diesel fuel, with significantly lower sulfur content than current diesel supplies, to prevent degradation of the enhanced emissions control devices. To meet the 2007 requirement that at least 80 percent of all diesel fuel be the low-sulfur grade, refiners must begin producing this cleaner fuel by mid-2006. Distributors may also need to modify the nationwide distribution system to initially accommodate both the current and new fuel grades. Still more stringent emissions requirements are scheduled to go into effect in 2010.

Ultimately, the extent to which the trucking industry purchases trucks with the new engines—either the engines produced for the October 2002 deadline or the 2007 standards—helps to determine whether the expected air quality benefits will be achieved in the time frames anticipated. Uncertainties about the availability, costs, reliability, and fuel-efficiency of these engines could negatively affect truck sales. This, in turn, could affect both the engine manufacturing and trucking industries. In this context, you asked us to (1) assess what impact, if any, the consent decrees' provisions had on trucking companies, engine manufacturers, and expected nitrogen oxide emissions reductions; (2) obtain stakeholders' views on whether new engine technologies and low-sulfur fuel will be available for industries to comply with the 2007 standards; and (3) obtain stakeholders' views on EPA's actions to ensure that the technologies and fuel will be ready in time.

To respond to the first objective, we performed econometric modeling using production data for Class 8 diesel trucks—the largest class of trucks, generally powered by heavy-heavy-duty diesel engines—and other economic data from January 1992 through June 2003 to determine how, if at all, the accelerated implementation of the standards affected purchases of these trucks.[3] We also contacted, among others, officials of 10 of the nation's largest trucking companies. We selected these companies because, on the basis of their truck fleet size, they seemed more likely than smaller companies to have purchased new trucks in the months before and immediately after October 2002. Therefore, they could recount their experience with the new engines and the impacts of the accelerated schedule. Because these companies were not selected randomly, we cannot project our findings to the entire trucking industry. We also contacted officials of the five existing engine manufacturers that were subject to the consent decrees.[4] Three of these manufacturers are also diesel truck manufacturers, and as such are responsible for redesigning truck chassis to incorporate the new engines and emissions control devices. We asked representatives of all five manufacturers a uniform set of questions about their companies' strategies in reacting to the decrees, the resulting effects on their operations, and the manufacturers' experiences with the new engines designed to comply with the decrees. In addition, we reviewed financial statements that some of these trucking and engine manufacturing companies submitted to the Securities and Exchange Commission to identify effects that the companies publicly disclosed. While we asked the engine manufacturers for data to substantiate their views, they generally preferred not to release information about their confidential engine designs. We were unable to identify any other independent analyses of the impacts of the consent decrees.

[3]Our analysis of the consent decrees' effects focuses on class 8 trucks because (1) these trucks comprise the largest class of trucks in service in the United States and, according to EPA data, account for about 90 percent of the emissions reductions expected from the pull-ahead provisions of the decrees, and (2) the manufacturers subject to the decrees account for about 95 percent of the U.S. market for these trucks. For our analysis, we used data starting in January 1992 because this was the earliest date for which detailed monthly truck production data were available, and ending in June 2003 because this was the latest date for which such data were available when we completed this segment of our analysis.

[4]Seven manufacturers were originally subject to the consent decrees. Three of the manufacturers merged into one company, leaving five manufacturers subject to the decrees at the time of our review.

To determine the air quality effects of the decrees, we reviewed EPA's estimates of the expected emissions reductions from accelerating the schedule for the new, cleaner engines. EPA made its estimate by using 1998 truck production data to project the number of trucks with new engines it expected to be on the roads after the October 2002 deadline. We compared EPA's projections of the number of trucks that would have new engines to the actual number of trucks produced with the new engines and assessed the likelihood that EPA would achieve the expected emissions reductions. We also discussed with EPA officials and staff the basis for their estimates of the expected emissions reductions from a second provision of the consent decrees, whereby truck owners would have emission computer controls on their older engines adjusted during engine overhauls.

To identify stakeholders' views on industries' ability to comply with the 2007 standards and EPA's activities to ensure the technologies are ready on time, we contacted officials representing 16 organizations and companies that offered the largest number of comments on EPA's 2007 emissions standards when proposed in 2000. These organizations represent the following industries: fuel, engine, and emissions control equipment manufacturing; trucking; and automobile manufacturers. They also represent environmental and health interests, as well as state and local governments. Finally, we discussed EPA's actions to ensure the new engine technologies and low-sulfur fuel will be ready in time, as well as the agency's plans if the standards cannot be implemented on schedule, with the Director of EPA's Office of Transportation and Air Quality, as well as program managers from the agency's Office of Air and Radiation (in Washington, D.C., and Ann Arbor, Michigan). (App. I includes a more detailed description of our methodology for conducting our work and selecting the stakeholders we interviewed.)

Results in Brief

The consent decrees' accelerated schedule for producing cleaner diesel engines helped reduce emission levels earlier than originally planned but also had a disruptive effect on most of the trucking companies and engine manufacturers we contacted. Most manufacturers were able to produce the cleaner engines by the accelerated deadline. However, they were not able to deliver prototype engines to trucking companies early enough for them to test the engines' reliability, according to representatives of all 10 companies we contacted. As a result, by October 2002, only 2 of the 10 companies had bought a significant number of trucks equipped with the new, cleaner engines—which, according to company representatives, have operated well but have also increased fuel costs and may increase

maintenance costs. The other eight companies initially postponed buying large numbers of trucks with the cleaner engines. For the most part, these companies instead bought more used trucks or new trucks with older technology than planned before October 2002. Truck production data suggest that other companies did this as well. Representatives of some of the eight companies said that their purchasing decisions, which allowed them to avoid the more expensive and potentially unreliable new engines, resulted in excess capacity and idle vehicles. This affected some of the larger companies' operations and profits, according to the representatives, at least in the short term, and some of the small- to mid-sized companies may have also experienced some difficulties.

These truck-purchasing decisions in response to the consent decrees had a ripple effect on engine manufacturers, according to representatives of the five engine manufacturers subject to the consent decrees that we contacted. These representatives told us that, to meet the increased demand for old technology trucks before October 2002, their companies hired new workers and increased operations, concurrently increasing sales. But, after the deadline, engine orders dropped—at least until leveling off again by the end of fiscal year 2003—and the manufacturers let go many new hires and suspended operations at some plants. Such instability resulted in increased costs and a net loss of revenue for some manufacturers, according to their representatives. In addition, four of the five engine manufacturers that had to build the cleaner engines earlier than planned lost a total of 23 percent of the market to other manufacturers between 1998—before the consent decrees went into effect—and September 2003. These four manufacturers lost market shares to one that did not have to make cleaner engines before 2004, and to two that did but chose instead to postpone making the cleaner engines and either pay penalties or compensate for excess emissions through other actions. While other factors also contributed to these changing market trends, representatives of the engine manufacturers and trucking companies we contacted said that the new engines had inherent drawbacks that placed them at a competitive disadvantage with the older diesel engines.

The consent decrees did reduce emissions but not to the extent or in the time frames EPA anticipated. While EPA realized that accelerating the schedule for putting cleaner diesel engines on the roads by 15 months would have some economic impact, it estimated that this action would accelerate emissions reductions, thereby better protecting public health. EPA estimated that two provisions of the consent decrees would achieve a reduction of roughly 4 million tons of nitrogen oxide. For example, EPA

estimated that one provision—accelerating the schedule—would avert about 1 million tons of nitrogen oxides that would have been emitted if trucks with the older engine technology had been operating instead during this time. EPA estimated that a second provision of the consent decrees—requiring that computers on older engines be adjusted to better control emissions when the engines were being overhauled—would avoid about 3 million more tons of nitrogen oxide emissions over the remaining life of these engines. However, at the time EPA made its estimates, it used 1998 truck production data, the most recent available, to predict future production. But overall production from October 2002 to December 2003—the time period of the accelerated schedule—was actually relatively lower. In addition, as discussed, trucking companies bought more trucks with the older-engine technology before October 2002 than expected. Furthermore, truck owners are now operating their trucks longer before overhauling the engines and adjusting the emissions computer controls. As a result, not all of the 4 million in reductions is likely to be achieved in the time frames anticipated.

While EPA and the stakeholders designing new emissions control, engine, and fuel technologies say they will be ready to meet the more stringent standards for 2007, the trucking industry has concerns. Representatives of the association of emissions control technology manufacturers and the five engine manufacturers we contacted said that the technologies to control diesel emissions have advanced. While they acknowledged that several technical problems remain, all of the engine manufacturers reported that they expect to have engines ready by 2007 and plan to have prototype engines ready for trucking companies to test by mid- to late-2005. Trucking companies maintain they need 18 to 24 months to road test an engine's reliability in all weather and operating conditions and to develop their future purchasing plans. Representatives of the fuel industry recognize that further work is needed to resolve such issues as whether (1) low-sulfur fuel will be available on time in sufficient volumes and in enough locations; and (2) fuel distributors will be able to avoid contaminating it with higher sulfur fuel that uses the same distribution systems but damages the emissions control equipment. Nevertheless, fuel industry representatives believe there is sufficient time to resolve these issues and that they are not a reason for delaying the 2007 standards, especially since the industry has made such a considerable investment to date. The environmental and health groups we contacted generally agree it is important not to delay the expected emissions reductions.

Representatives of the trucking companies we contacted, however, are not convinced that the new standards can be implemented smoothly and on time. They cite as problems the lingering questions about engine and fuel technology, the negative economic impact trucking companies experienced under the consent decrees, and the continuing doubts about whether they will have prototype engines early enough to fully test them before 2007. In addition, because the technologies needed to meet the 2007 standards are much more advanced than those associated with prior upgrades, the trucking companies are concerned that the new engines will cost much more and decrease fuel efficiency much more than EPA predicted in 2000 when it was developing the standards. Consequently, according to representatives of 9 of the 10 trucking companies we contacted, companies most likely will once again decide to buy trucks before the deadline, but in larger numbers than they did in response to the consent decrees. This could again disrupt markets and postpone needed emissions reductions.

EPA has taken a number of steps to help with and monitor the engine and fuel technology development, but some of the engine manufacturers and the trucking companies we contacted would like more help and reassurance that the technology will be ready on time. EPA program staff meet continuously with the companies producing all of the new technologies; issue progress reports; provide workshops; and, in 2002, convened the Clean Diesel Independent Review Panel to assess progress. Representatives of some of the engine manufacturers, the emissions control technology manufacturers association, the fuel industry, and the environmental and health groups we contacted commended EPA for its efforts. But some representatives of engine manufacturers and trucking companies would like EPA to provide them with additional help and reassurance that the technologies will be ready when needed. For example, some engine manufacturers said that economic incentives to manufacturers to produce engines on time and to trucking companies to buy the engines as scheduled would be helpful. In addition, some trucking company representatives believe that EPA has not included them in, or listened to their concerns about, implementation of the standards. EPA program managers disagreed, saying that in formulating the 2007 standards, the agency solicited the trucking industry's perspective and all entities had a chance to provide comments on the proposed rule. The EPA program managers added that the agency has gone out of its way to give industry much more lead-time than required to produce the technology and to provide assistance and monitoring. Consequently, they see no evidence that timely implementation of the standards is not achievable. We acknowledge EPA's actions to date, but given the remaining technological

uncertainties and stakeholder concerns—concerns that could have economic and emissions impacts—we are recommending that EPA consider what additional opportunities it could take to address the uncertainties and concerns. This could include better communicating with all stakeholders on the remaining technological uncertainties. In addition, EPA could convene another independent review panel to assess and communicate the progress of technology development, or consider financial incentives or other options to promote it.

In commenting on the report, EPA's Assistant Administrator for Air and Radiation said EPA believes that, in many respects, our report is consistent with the agency's assessment of the situation leading up to the implementation of the 2007 standards. However, the agency has several concerns about the basis for certain of our findings on those standards. In addition, as to our recommendations, EPA agrees that there might be merit—but not necessarily an agency role—in using financial incentives to achieve the 2007 milestone, but is concerned that convening an independent technology review board could delay the schedule, and is not needed. More specifically, EPA raised concerns that we (1) present selected stakeholders' opinions without validating them and ignore evidence that the agency believes would prove or disprove their validity; (2) overstate the challenges to having fuel and engine technologies ready on time to meet the 2007 standards; and (3) inaccurately portray EPA's efforts to work with stakeholders in developing the standards.

With respect to the first concern, we consistently solicited views from all key stakeholders and carefully and accurately characterized them in the report. We assessed these views by reviewing all available and relevant reports and studies issued on the technologies being addressed and that EPA identified or provided. We could not verify stakeholder opinions with actual data because manufacturers of the new technologies said that it would be detrimental to reveal information on their individual designs because it might harm their competitive positions relative to other companies. We did take great care to include the most current information and views possible in the report by, for example, re-contacting certain stakeholders in February 2004. With respect to EPA's concern about the report's tone, we devote considerable narrative to the views of the agency and all stakeholders who maintain the technology is on track. We do, however, have a professional responsibility to acknowledge that some stakeholders expressed concerns about the remaining technological risks and questions and to fully and accurately describe the basis of these concerns. Finally, with respect to EPA's efforts to work with stakeholders,

we agree that EPA deserves credit for taking a number of voluntary actions to outreach to stakeholders, and we describe these activities in depth. We are also very careful to present a balanced view of stakeholders' opinions about these activities, and as such, were obligated to acknowledge that some stakeholders raised issues about EPA's openness to concerns and willingness to address them.

Finally, as to our recommendations, EPA sees merit in using financial incentives to achieve the 2007 milestone, but does not see an agency role in this regard. Neither does the agency see a need to convene an independent technology review board. In this regard, we want to emphasize that we are recommending that EPA consider additional action to address stakeholders' remaining concerns, and thereby enhance the likelihood of achieving emissions reductions, but we did not intend to limit the agency to the alternatives we suggested, especially if it could design more effective solutions. As to financial incentives, we understand that this would require congressional authorization and funding but believe the agency also has a role to play. For example, the Congress might look to the agency to make an initial proposal for incentives, or help to weigh their costs and benefits. As to using an independent panel to review EPA's data and validate its conclusions on technology readiness, we do not believe that convening a panel would unduly disrupt the implementation schedule for the standards. If EPA has the necessary evidence available to demonstrate that technologies are ready as it contends it does, it should not be difficult or take considerable time for an independent body to review the data and validate this conclusion for all affected stakeholders. Furthermore, by addressing stakeholders' concerns, EPA may help to avoid the negative impacts that were associated with the 2002 consent decrees and would ultimately help to ensure that the critical reductions and health benefits from the 2007 standards are achieved in a more timely manner.

Background

Trucks handled more than two-thirds of all freight commodities shipped in 2002, according to a recent report for the American Trucking Associations (ATA), an organization representing the majority of freight-hauling companies. Trucking companies that shipped freight earned revenues of about $585 billion, or 87 percent, of the total transportation revenues that year. The total volume of goods shipped by trucks is expected to rise to 10 billion tons by 2008, with trucking companies' revenues increasing to about $745 billion, according to the ATA report. The majority of trucks transporting freight are powered by diesel engines, primarily because they are 25 percent to 35 percent more energy efficient and more durable and

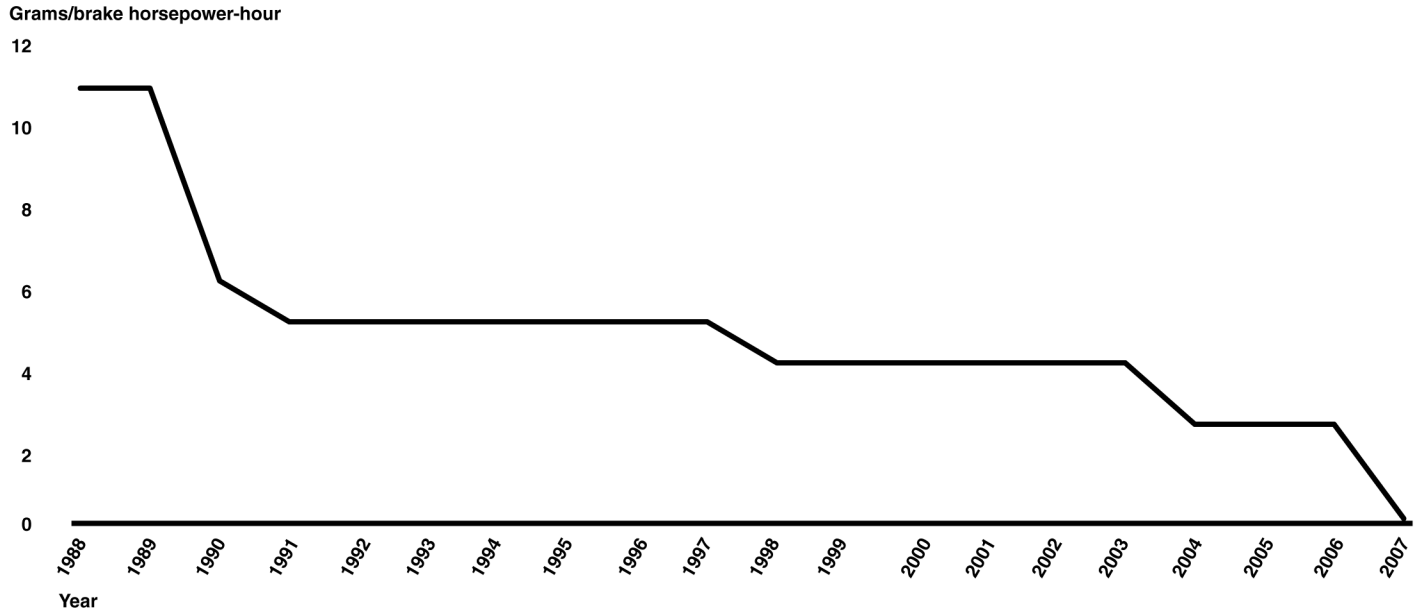
reliable than gasoline-powered engines. Furthermore, diesel fuels generally are less volatile and, therefore, safer to store and handle than gasoline.

On the other hand, diesel engines also have an adverse impact on air quality through their harmful exhaust emissions. Diesel exhaust is composed of several toxic components, including nitrogen oxides, fine particles (particulate matter), and numerous other known harmful chemicals. EPA estimates that exhaust from heavy-duty trucks and buses accounts for about one-third of the nitrogen oxide emissions and one-quarter of the particulate emissions from all mobile sources. EPA's 2002 comprehensive review of the potential health effects from exposure to diesel engine exhaust found that short-term exposure to diesel emissions can cause respiratory irritation and inflammation and exacerbate existing allergies and asthma symptoms. Long-term exposure may cause lung damage and pose a cancer hazard to humans. The harmful components of diesel exhaust can also damage crops, forests, building materials, and statues. The exhaust also impairs visibility in many parts of the country.

Although diesel exhaust is harmful, both EPA and engine manufacturers have successfully reduced the level of emissions from highway diesel engines over the past two decades. Since 1984, EPA has progressively implemented more and more stringent diesel emissions standards, for example, reducing the level of allowable nitrogen oxide emissions from diesel engines from 10.7 grams per unit of work in 1988 to 2.5 grams in 2004 (see fig. 1).[5]

[5]The emission limits are stated in terms of grams of emissions per brake horsepower-hour.

Figure 1: EPA's Nitrogen Oxide Emissions Standards for Heavy-Duty Diesel Truck Engines, 1988 to 2007



Source: EPA.

To meet these standards, engine manufacturers should have made increasingly cleaner engines so that their nitrogen oxide emissions gradually declined to mandated levels. However, EPA determined that, from 1987 to 1998, seven of the nation's largest diesel engine manufacturers sold 1.3 million heavy-duty diesel engines with computer software that altered the engines' pollution control equipment under highway driving conditions.[6] The Clean Air Act prohibits manufacturers from selling or installing motor vehicle engines or components equipped with devices that bypass, defeat, or render inoperative the engine's emission control system. These devices altered the engines' fuel injection timing and, while this improved fuel economy, it also increased nitrogen oxide emissions by two to three times the existing regulatory limits. In response, EPA undertook what it called "the largest Clean Air Act enforcement action in history"

[6]The engine manufacturers involved in this enforcement action were Caterpillar Incorporated, Detroit Diesel Corporation, Cummins Engine Company, Volvo Trucks Corporation, Mack Trucks Incorporated, Renault Vehicules Industriels, s.a., and Navistar International Transportation Company. Volvo subsequently purchased Mack Trucks and Renault in 2001, forming "the Volvo Group."

against the manufacturers. To settle these cases, in 1998, EPA, the U.S. Department of Justice, and the engine manufacturers agreed to be bound by consent decrees. In the decrees, the manufacturers agreed to, among other things, (1) pay civil penalties of about $83 million, the largest civil penalty for an environmental violation as of that date; and (2) collectively invest $109.5 million towards research and development and other projects to lower nitrogen oxide emissions.

Table 1 includes information on

- the number of engines that each manufacturer subject to the decrees produced that violated the emissions standards,
- the amount of nitrogen oxide emissions these engines produced in excess of the amounts allowed by the standards in effect at the time,
- the amount of penalties each company paid, and
- the amount of funds each company committed to invest in environmental projects.

Table 1: Information on the Emission Standards Violations and Conditions of the 1998 Consent Decrees with Diesel Engine Manufacturers

Company	Number of engines with defeat devices	Excess nitrogen oxide emissions (tons)	Civil penalties	Investment in environmental projects
Caterpillar Incorporated	320,000	2,100,000	$25 million	$35 million
Cummins Engine Company	400,000	3,600,000	$25 million	$35 million
Detroit Diesel Corporation	430,000	9,000,000	$12.5 million	$12 million
Mack Trucks, Incorporated/Renault Vehicules Industriels, s.a.	90,000	860,000	$13 million	$18 million
Navistar International Transportation Company	78,000	40,000	$2.9 million	N/A
Volvo Truck Corporation	10,000	148,000	$5 million	$9 million
Total	**1,328,000**	**15,748,000**	**$83.4 million**	**$109 million**

Source: GAO analysis of EPA data.

The manufacturers also agreed to collectively spend $850 million or more to produce significantly cleaner engines by October 1, 2002. The nitrogen oxide emissions from the new engines were not to exceed 2.5 grams.

Without the decrees, the engines would not have been required to meet this standard until January 1, 2004, 15 months later.

The excess emissions caused by the defeat devices were of concern, especially for states and localities with areas that already had air quality problems (meaning that the areas did not meet at least one of the health-based air quality standards). Every state must devise a plan, called a state implementation plan, that indicates what actions they will take to maintain or come into compliance with the standards. In devising these plans, states and localities estimate future emissions and design actions to reduce them as necessary. If the states and localities do not comply, they face certain sanctions, including the loss of access to federal transportation funds. But the use of the pollution control defeat devices that increased engine emissions jeopardized state air quality improvement plans and posed public health risks.

To ease compliance with the accelerated schedule, manufacturers could continue to sell their old engines until October 2002. If manufacturers were not able to, or chose not to, meet the deadline, they could continue to sell engines that did not meet the standards through three actions (1) paying nonconformance penalties, equal to the cost of engines that met the standards, to maintain a "level playing field" between the noncomplying companies and those manufacturers who met the deadline; (2) using a provision that allowed manufacturers to sell noncomplying engines after October 2002 if they sold an equal number of the cleaner engines before that date; and (3) using emissions averaging, banking, and trading to generate emissions credits towards compliance by reducing emissions in other areas.[7]

As the next step in its efforts to address diesel emissions, EPA, in January 2001, finalized a rule—herein referred to as the 2007 rule--establishing new emissions standards that heavy-duty engines and vehicles must generally meet beginning in 2007. These standards, unlike the consent decrees established as the result of an enforcement action, were developed through a public rulemaking process that gave stakeholders from across the industry sectors the opportunity to provide input to EPA for consideration.

[7]Under this approach, manufacturers can certify their engine families at emissions levels above or below the standard, as long as they comply with the standards when averaged across their engine families. Manufacturers generate emissions credits by producing engine families that are certified below the standard, which can then be used to offset production of engine families that are certified to have emissions in excess of the standards.

Also in contrast to the consent decrees, the 2007 standards gave industry 6 to 10 years to develop technologies to meet the rule's requirements. The 2007 rule limits fine particle and nitrogen oxide emissions from heavy-duty diesel engines to 0.01 grams and 0.20 grams, respectively, a significant decrease compared to the consent decrees and 2004 standards. While the fine particle standard is effective in 2007, the nitrogen oxide standard will be phased in based on engine production: 50 percent of the engines sold between 2007 and 2009 and 100 percent of those sold beginning in 2010 must meet the nitrogen oxide emissions standard. EPA estimates that the new standards will reduce emissions of fine particles and nitrogen oxides by 90 percent and 95 percent, respectively, from 2000 levels.

Also in the 2007 rule, EPA regulates both heavy-duty vehicles and their fuel as a single system. To meet the standards, engines must include advanced emission control devices. Because these devices are damaged by sulfur, the rule establishes a mid-2006 deadline for reducing the sulfur allowed in highway diesel fuel. Under the rule, refiners are required to start producing diesel fuel with a sulfur content of no more than 15 parts per million (compared to current diesel fuel, which can contain up to 500 parts per million—a 97 percent reduction) beginning June 1, 2006. All diesel-powered highway vehicles produced in 2007 or later must use the low-sulfur fuel. Under certain conditions, and generally only until 2010, the rule allows refiners to continue producing and selling some diesel fuel with a sulfur content greater than 15 parts per million, but not exceeding 500 parts per million. However, the two fuels must be segregated in the distribution system so that the low-sulfur fuel is not contaminated. The fuel with the higher sulfur content may only be used in heavy-duty vehicles built before 2007 because it will damage emissions control devices on newer engines.

When developing the 2007 rule, EPA had to give appropriate consideration to the rule's costs. The agency projected that the rule's benefits would exceed its costs by a factor of 16 to 1. According to EPA, the new standards will result in significant annual reductions in harmful emissions, with total benefits as of 2030 estimated at about $70 billion. In addition, by 2030, the reduced emissions will prevent 8,300 premature deaths, more than 9,500 hospitalizations, and 1.5 million workdays lost, according to EPA. The agency estimated that these benefits will come at an average cost increase of about $2,000 to $3,200 per new vehicle in the near term and about $1,200 to $1,900 per new vehicle in the long term, depending on the vehicle size. This is relatively small compared to new vehicles whose base cost is about $96,000 for a new heavy heavy-duty truck to $250,000 for a new bus. Furthermore, EPA estimated that, when fully implemented, the sulfur

reduction requirement would increase the cost of producing and distributing diesel fuel by about 4.5 to 5 cents per gallon, an increase of about 3 percent over average U.S. diesel fuel prices as of late November 2003.

The Consent Decrees and Their Accelerated Schedule for Reducing Diesel Emissions Overall Negatively Affected Sales of the Largest Trucks and Engines but Achieved Some Air Quality Benefits

In part because trucking companies did not have what they considered to be sufficient time to adequately road test 2002 prototype engines, they had concerns about the price and reliability of the new engines. Representatives of four of the ten trucking companies we contacted said their companies, among other things, bought more new heavy-duty trucks equipped with older engine technology than planned before October 2002. This adversely affected their operations, at least in the short term, according to company officials. Our analysis of Class 8 truck production data also indicates that trucking companies may have pre-bought these trucks in 2002. To meet the increased demand for trucks with older engines, the major engine manufacturers increased production of new trucks with older engines before October, but had to decrease production when demand subsequently dropped until about early 2003, with detrimental effects, according to representatives of the engine manufacturers we contacted. These manufacturers also said that they lost market share to others that were not subject to the consent decrees or that decided to pay penalties rather than make a new engine on time.

EPA estimated that accelerating the schedule for cleaner engines would accelerate emissions reductions, thereby better protecting public health. EPA roughly estimated that two provisions of the consent decrees would reduce nitrogen oxide emissions by roughly 4 million tons. However, as discussed, trucking companies bought more trucks with the older engine technology than planned, and truck owners are now operating trucks longer than expected, thereby reducing the number of trucks with cleaner engines on the road below anticipated levels. As a result, while emissions levels were reduced, the consent decrees will not achieve the full emissions reductions in the time frames EPA anticipated.

Some Trucking Companies Purchased Large Numbers of Older Trucks Rather Than Trucks with the New, but Unproven Engines, Adversely Affecting Their Short-term Operations

The consent decrees had an adverse effect on some trucking companies even though the trucking industry was not a direct party to the decrees. They affected the industry because trucking companies are the ultimate purchasers of trucks equipped with new diesel engines designed to meet the consent decrees' emissions standards requirements. Manufacturers did not provide trucks with prototype engines to the companies in time to sufficiently road test them, according to many of the trucking company officials we contacted. Several officials noted that their companies did not take delivery of trucks with the new engines for testing until the first half of 2002—too late for their companies to perform what they considered to be adequate road testing. Consequently, many trucking companies decided not to risk the uncertainties associated with the new engines, instead opting for the older, familiar diesel technologies. As table 2 indicates, eight of the ten trucking companies we contacted bought trucks with the older engines prior to October 2002, postponed buying new trucks, or bought only a relatively small number of trucks with new engines, usually for testing purposes.

Table 2: Responses of Ten Large Trucking Companies to the Consent Decrees and Their Basis for These Responses

Number of companies adopting response	Trucking companies' responses to consent decrees	Basis for responses
4	Pre-bought trucks with older engines. Companies reported purchasing an excess capacity of between 840 and 5,000 trucks with older engines prior to October 2002.	• Higher acquisition and operating costs of new engines; • Significant uncertainties about new engines' performance and durability.
1	Purchased new trucks with engines from a manufacturer who did not have to meet the new standards.	• Somewhat concerned about new engines' dependability.
1	Purchased new trucks with engines from a manufacturer who was required to meet the standards but chose not to and instead paid penalties.	• Higher acquisition and operating costs of new engines; • Desire to stay with known, established engine technology; uncertainty about new engines' dependability.
2	Extended their leases on trucks with older engines, but did not lease new trucks.	• Higher acquisition and operating costs of new engines; • Significant uncertainties about new engines' performance and durability.
2	Bought significant numbers of trucks with new engines.	• Desire to maintain consistent relationship with engine suppliers; • Desire to avoid deviating from their established long-term business plan, which would disrupt their operations.

Source: GAO analysis of information from 10 trucking companies.

Werner Enterprises and Swift Transportation publicly reported in their financial statements to shareholders that they pre-bought trucks with older engines and postponed buying new trucks, respectively, because of uncertainties surrounding the new engines. The two trucking companies in table 2 that bought large numbers of trucks with the new engines did so because they wanted to maintain consistent business relationships with their established engine suppliers and follow the fleet acquisition plans that they had developed based on their assessment of long-term business needs, according to company officials.

The four companies that pre-bought large numbers of trucks before the October 2002 deadline did so primarily because they were concerned about the higher price and unproven reliability of the new engines, according to company officials. They said that the new engines would have added from $1,500 to $6,000 to the purchase price of a new heavy-duty truck—whose base cost is about $96,000—and would have reduced fuel economy by 2 to 10 percent. For 2002, these additional costs could have ranged from about $4 million to $27 million per company in purchase price and about $3

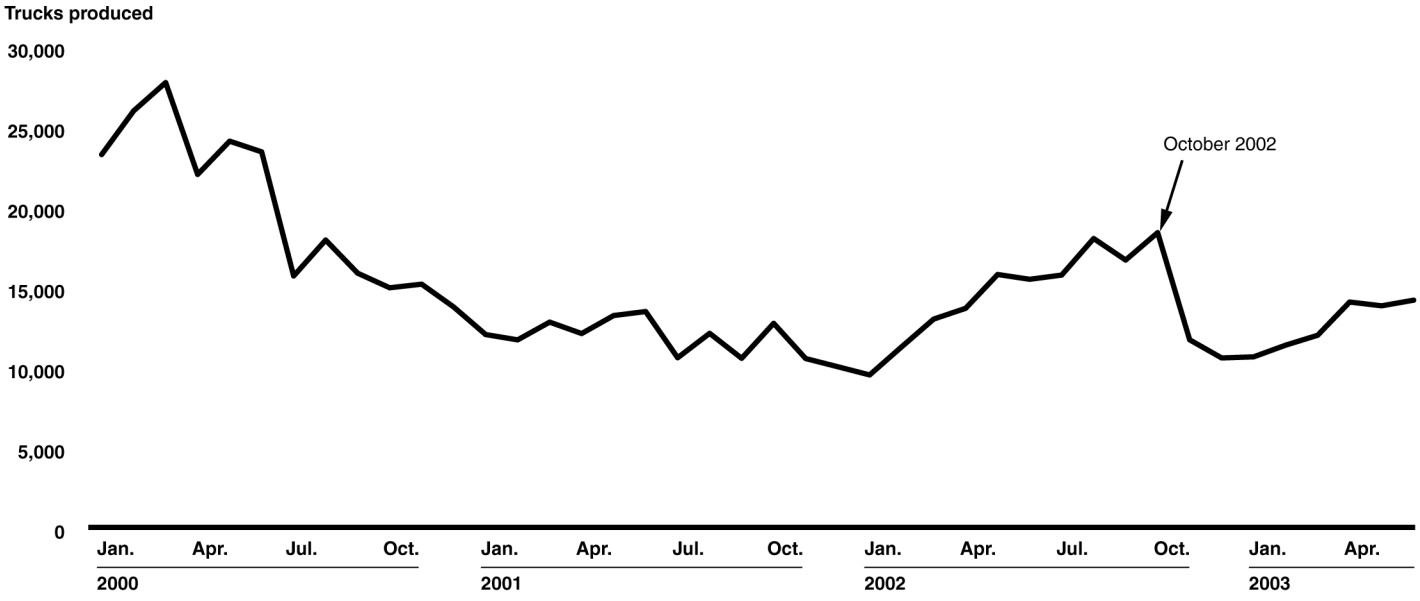
million to $90 million per company in fuel costs. These trucking officials said that these additional costs would have been problematic for some companies because, according to one representative, the industry only returns 3 or 4 cents per dollar invested. Compounding these additional costs, according to trucking officials, is that they come without any clear offsetting economic or business advantages. According to several of the officials, recent engine modifications made to meet increasingly more stringent emissions standards also had positive economic benefits for the trucking companies, such as increased fuel efficiency. EPA officials noted, however, that some of these benefits, including better fuel economy, were achieved as a result of engine manufacturers using the defeat devices to avoid meeting emission standards. The agency acknowledged that trucking companies were not party to the engine manufacturers' tactic but did benefit from it.

Companies that pre-bought trucks found this strategy adversely affected their operations, at least in the short term, according to company officials. Companies had more trucks than they needed and lost money as excess trucks sat idle. For example, one trucking company reported in its financial statement to shareholders that such excess capacity cost the company $16.3 million in revenues—29 percent—in the first quarter of 2003. Despite effects such as these, some trucking officials told us that they would have pre-bought even more trucks with the older engines had they been available. These officials noted that while larger companies may have been able to weather these operational disruptions, smaller companies with narrower profit margins might have found it more difficult.

Our analysis of data on the production of trucks with the new engines suggests that pre-buying in response to the consent decrees was a widely used strategy. As figure 2 shows, truck production began to increase from January through September 2002, despite a generally decreasing trend since April 2000.[8]

[8]As noted, our analysis focuses on class 8 trucks because (1) these trucks comprise the largest class of trucks in service in the United States and, according to EPA data, account for about 90 percent of the emissions reductions expected from the pull-ahead provisions of the decrees, and (2) the manufacturers subject to the decrees account for about 95 percent of the U.S. market for these trucks.

Figure 2: U.S. and Canadian Production of Class 8 Diesel Trucks, January 2000 through June 2003



Source: GAO analysis of data from Ward's Communications.

More specifically, from April through September 2002, manufacturers produced about 93,000 Class 8 trucks. Our analysis shows that this production volume cannot be fully explained by changes in the economy's growth rate or diesel fuel prices, but this increase, and the subsequent decrease, in production may be linked to the consent decrees. We recognize that a number of factors other than the consent decrees are also likely to have contributed to these trends. For example, trucking companies' business decisions are driven by factors that affect their profitability, such as economic growth and activity, their expectations about future profits, their current inventory of trucks, and fuel and operating costs. In addition, other factors such as regulations, taxes, or subsidies affect companies' profitability and truck purchasing decisions. After considering the information trucking companies provided us on their responses to the decrees and controlling for economic growth and fuel costs in our analysis, we estimate that 19,000 to 24,000 (20 percent to 26 percent) of the 93,000 Class 8 trucks produced during this period may have been in response to the consent decrees. Subsequent to this increase, the data also show that production sharply decreased after October 2002 until recovering in 2003.

Those companies that bought trucks with the new engines reported experiencing few serious problems with them, although they generally believe that it is too soon to be certain of the new trucks' maintenance costs. Some stated that preliminary indications may not be encouraging. For example, one company reported that roughly one-half of its 140 new heavy-duty engines experienced an engine valve failure prior to 50,000 miles. In addition, these officials noted that roughly 20 percent of their heavy-duty vehicles with the new engines are out of service at any given time due to maintenance concerns, compared to 5 percent for the remainder of their fleet. Several of these officials expressed a concern that some companies may have difficulty absorbing increased costs from such maintenance problems.

Engine Manufacturers Experienced Temporary Fluctuations in Sales and Shifts in Market Shares as a Result of the Decrees

Initially, trucking companies' increasing demand to pre-buy trucks with older engines in the 6 months before the October 2002 deadline increased the major diesel engine manufacturers' production and sales. In particular, demand was so great, according to some engine manufacturers, they could not keep up with it, despite hiring hundreds of temporary employees and running production lines 24 hours a day, 7 days a week. According to all five of the engine manufacturers we contacted, the pre-buy could have been much larger, but the engine manufacturing industry did not have the capacity to fill the demand. However, once the October 2002 deadline passed, demand for these engines fell dramatically. These dramatic swings in demand had a net adverse impact on engine manufacturers, at least for the short-term, according to those manufacturers we contacted. For example, at least one engine manufacturer laid off all of the temporary employees it had recently hired to meet the rising demand before October, as well as some more established workers. Another manufacturer said that such instability also hindered its ability to make business decisions, acquire capital, and meet customers' demands. However, figure 2 shows that truck sales generally increased again starting in 2003.

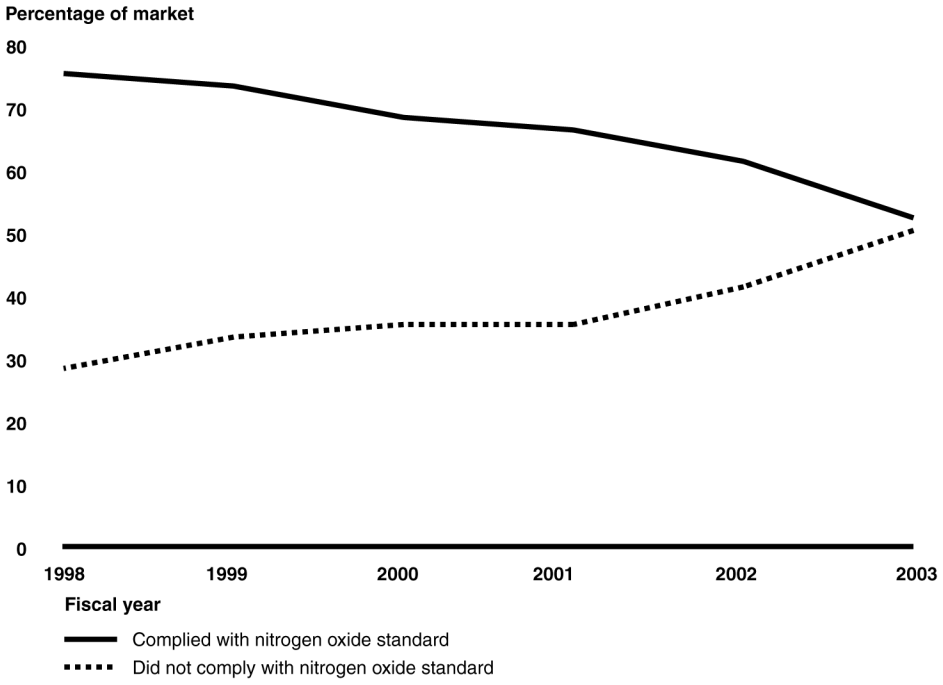
In addition to these general trends, many of the manufacturers of the new, cleaner engines told us that they lost customers to those companies that continued to produce engines that did not meet the new emissions standards. In 1998, the seven manufacturers subject to the consent decrees dominated the U.S. heavy-duty diesel engine market, accounting for about 90 percent of engine sales. In response to the decrees, four of the seven engine manufacturers began to produce cleaner engines. Another of the seven manufacturers, Renault, decided to leave the U.S. heavy-duty diesel truck market in 2002, according to company officials. Furthermore,

according to EPA, Navistar International chose to take other actions to compensate for its excess emissions rather than meet the new emissions standards early, as permitted under its consent decree. Caterpillar, until November 2003, continued to sell heavy-duty engines that did not fully comply with the new nitrogen oxide standards, but paid a nonconformance penalty for each engine sold. Therefore, by mid-2003, the U.S. heavy-duty diesel engine market was dominated by (1) the four manufacturers subject to the decrees that were selling engines that met the new emissions standards—Cummins, Detroit Diesel, Mack Trucks, and Volvo; (2) two manufacturers subject to the decrees that were selling engines that did not meet the standards—Navistar International and Caterpillar; and (3) Mercedes, that entered the U.S. market in 1999 but that did not have to meet the standards until 2004.

In 1998, the year in which EPA and the engine manufacturers entered into the consent decree settlements, the four manufacturers selling engines that met the new standards had a combined share of the U.S. Class 8 truck market of about 73 percent, while the two manufacturers that were not selling such engines had roughly a 27 percent market share.[9] Since then, the market shares of the two groups of engine manufacturers have moved in almost directly opposite directions (see fig. 3).

[9]We adopted 1998 as the base year for this comparison because, shortly after the consent decrees were finalized, the manufacturers began making business decisions regarding how they would respond.

Figure 3: Comparison of Market Shares of Producers of Class 8 Diesel Engines That Complied with the Decrees' Nitrogen Oxide Standard and Those That Did Not Comply with the Decrees' Nitrogen Oxide Standard: 1998 to 2003



Source: GAO analysis of data from Wards Communications.

By September 2003, the market share of the four manufacturers selling cleaner engines had shrunk to 50 percent and the share of the two companies—plus Mercedes—that continued to sell engines that did not meet the new standards increased to 50 percent.

While factors other than the consent decrees contributed to this shift in market shares over the years, according to many engine manufacturer and trucking company officials we contacted, the manufacturers that sold trucks with the cleaner engines also lost business because, as previously noted, these engines had inherent disadvantages relative to the existing engines that made them difficult to sell. Consequently, manufacturers that continued to market trucks with the older engines captured business from those companies selling trucks with the new engines. For example, Caterpillar's share of the Class 8 truck market climbed from 24 percent in 1998 to 35 percent in 2003, while Detroit Diesel's share dropped from 27 percent to 15 percent during the same period. Similarly, Mercedes' market

share rose from zero in 1998 to 10 percent in 2003, while Cummins' share fell from 31 percent to 21 percent.

We were unable to verify all of the claims made by trucking companies and engine manufacturers regarding financial impacts and truck purchase decisions resulting from the consent decrees because much of this information is confidential. To a limited extent, we were able to use financial statements some of these companies submitted to the Securities and Exchange Commission to verify some impacts for some companies. In addition, we conducted econometric analysis to shed light on the possible magnitude of the pre-buy.

The Consent Decrees Accelerated Emissions Reductions but Not to the Full Extent That EPA Had Estimated

Although EPA was not required to conduct a cost-benefit analysis of the provisions of the consent decrees, it did a rough estimate of the potential emissions reductions that could be achieved. At the time it made the estimate, EPA used truck production data from 1998, the most recent available at the time, to estimate that over the 15-month pull-ahead period—from October 2002 to January 2004—some 233,000 more trucks with cleaner engines would be on the road than without the pull-ahead. EPA multiplied this number by the amount of emissions reductions a single cleaner engine could achieve to estimate that the total emissions reductions expected by accelerating the schedule was roughly 1 million tons of nitrogen oxide emissions.

As previously discussed, because trucking companies postponed purchases, bought new trucks with the old engine technology, or bought used trucks rather than the cleaner engines, initially fewer trucks with cleaner engines will be on the road than EPA had estimated. Therefore, the consent decrees are not going to produce the total 1 million reduction, at least not during the time frames EPA predicted. For example, Class 8 truck production data through October 2003, or 13 of the 15 months of the pull ahead, show that about 148,000 fully or partially compliant heavy-heavy-duty diesel engines are on the road, compared to EPA's estimate of 233,000 such compliant engines for the entire 15-month time frame. However, some factors came into play that EPA did not anticipate. For example, EPA did not expect Mercedes to enter the U.S. diesel truck market and claim about a 10 percent share, increasing the number of older-technology engines sold. Furthermore, EPA did not expect Caterpillar, with the largest engine sales when EPA developed its emissions estimates, to produce engines that, although cleaner than previous models, did not fully meet the new standards. Finally, the overall rate of engine production during the 15-

month period covered by EPA's emissions estimates is going to be relatively lower than the rate in 1998, the year on which EPA based its estimates. Therefore, not as many cleaner engines were produced as EPA predicted.

EPA also estimated that a second provision of the consent decrees—a requirement that computers on older engines be adjusted to better control emissions when these engines undergo regularly scheduled rebuilding—would reduce nitrogen oxide emissions by about 3 million tons over the life of the engines. Under these "low-nitrogen oxide rebuild" provisions of the decrees, when operators brought their trucks in to have their engines rebuilt, engine manufacturers were required to supply kits to adjust computer controls to lower excess emissions. This adjustment is called "reflashing." While reflashing can be performed without rebuilding the engine, EPA saw this as a convenient time for performing both operations at once. EPA estimated that this provision of the decrees would eventually apply to roughly 856,000 trucks. In addition, a number of engine manufacturing companies initiated incentive programs to encourage truck companies to voluntarily bring their trucks in to have them reflashed. Under the voluntary program, these trucks would be reflashed earlier than if they waited until the engines needed to be rebuilt under EPA's program, thereby reducing emissions sooner.

As of September 2003, almost 60,000 trucks had been reflashed under the consent decrees' mandatory program and another 43,000 under the voluntary incentive programs, about 12 percent of EPA's projected total. Fewer engines were rebuilt than EPA expected because trucking companies are running their engines longer than in previous years before rebuilding or replacing them. As a result, only a small portion of the emissions reductions predicted by EPA from reflashing may be achieved, depending on how many additional engines are adjusted and the rate at which this occurs. Estimating how many of the remaining 740,000 or more trucks will be reflashed under the consent decree provisions is difficult and must take into account the age and likely future mileage of the trucks. Many of these trucks no longer have enough useful life remaining to make rebuilding their engines cost-effective. Nevertheless, the California Air Resources Board and environmental departments in several other states are considering making reflashing of heavy-duty diesel engines compulsory, to try to reduce diesel emissions as much as possible.

Remaining Technology Challenges Must Be Resolved to Meet the 2007 Standards, and Stakeholders' Opinions Differ as to Whether They Will Be Addressed in Time

A number of engine technology and fuel supply and distribution issues must still be resolved to implement the 2007 standards. Most stakeholders who have made significant investments in developing the engine and fuel technology to meet the standards maintained that the issues can be resolved in time. Engine manufacturers we contacted expect to have new engines ready for 2007 and to be able to meet the trucking companies' time frames for delivering trucks with prototype engines for testing. However, representatives of the fuel industry recognize that there is still work to do to resolve issues about whether (1) low-sulfur fuel will be available in sufficient volumes nationwide and (2) fuel distributors can keep from contaminating it with higher sulfur fuel that damages the emissions control equipment. However, they believe that there is sufficient time to resolve these issues and do not want the 2007 standards delayed. Furthermore, the environmental and health groups we contacted are encouraged by industries' progress in developing the technologies needed to implement the standards. Given these lingering technology questions, the uncertainty about having sufficient time to test new engines, and the negative economic impact they experienced under the consent decrees, representatives of some of the trucking companies we contacted remain concerned that the new standards can be implemented smoothly. Because the technology to meet the 2007 standard is more advanced than prior upgrades, some trucking companies are concerned that the new engines will cost more and decrease fuel efficiency more than EPA has predicted. Consequently, according to representatives of nine of the ten trucking companies we contacted, companies will likely once again pre-buy trucks, potentially disrupting markets and postponing needed emissions reductions.

Engine Manufacturers Believe They Can Resolve Challenges and Produce an Engine in Time for 2007

Representatives of all five engine manufacturers we contacted, as well as the association of emissions control technology manufacturers, noted that control technologies for nitrogen oxide emissions—one of the pollutants addressed by the 2007 standards—have continued to advance. For 2007, manufacturers have evaluated five different engine technology options to control nitrogen oxide emissions—nitrogen oxide adsorbers, selective catalytic reduction, advanced exhaust gas recirculation, a lean nitrogen oxide catalyst, and advanced combustion emissions reduction technology (ACERT—a system developed by Caterpillar for its own engines). Generally, exhaust gas recirculation and ACERT limit the formation of nitrogen oxides, while the catalyst-based approaches promote nitrogen oxides reduction into nitrogen and oxygen. In December 2003, three of the

five engine manufacturers we contacted announced the technologies they plan to use to meet the 2007 emission standards: Caterpillar chose its ACERT technology and Cummins and Volvo selected exhaust gas recirculation. In addition, in January 2004, while not specifically saying that it would use exhaust gas recirculation technology, International announced that it plans to meet the 2007 requirements without using either nitrogen oxide adsorbers or selective catalytic reduction. The company currently uses exhaust gas recycling technology in many of its existing engines. The remaining engine manufacturer is considering selective catalytic reduction.

Caterpillar, Cummins, International, and Volvo chose their respective approaches because each company is already using a basic form of the technology it selected to meet the 2004 standards and believes it can be modified to meet the 2007 standards as well. Several engine manufacturers, however, believe that they may not be able to advance the exhaust gas recirculation technology far enough to comply with the 2010 requirements, so, in planning ahead, they are pursuing this as well as other options. The firm that is considering selective catalytic reduction noted that this technology could meet both the 2007 and 2010 requirements. It has been in use in the United States for several years to control nitrogen oxide emissions from stationary sources, such as power plants or industrial facilities. It has also been used in European demonstration fleets to control pollution in diesel truck emissions. While the engine manufacturer that is considering selective catalytic reduction believes that remaining technological issues are relatively minor and should be resolved by 2007, it is less clear that several implementation issues will be resolved by that time. For example, selective catalytic reduction requires a continuing supply of a chemical compound—such as urea—to function properly. However, some engine manufacturers and other stakeholders, as well as EPA, are concerned because urea is not widely available and the industry would have to build its own distribution infrastructure, such as separate tanks at refueling stations. There are concerns that this may not be possible by 2007, that truck operators will not have sufficient supplies of the chemical when and where they need it, or that the operators will accidentally or intentionally fail to keep the urea tank on their trucks filled, thereby defeating the emissions control equipment. According to EPA officials, the engine manufacturer considering selective catalytic reduction is expected to submit a plan for a urea infrastructure in early 2004. EPA will evaluate the plan at that time.

As for nitrogen oxide adsorbers, EPA has helped to support and develop this technology and believes it remains a viable option for 2007, although

none of the manufacturers has chosen this technology for the earlier deadline. In June 2002, the agency issued a report on, among other things, the progress being made to develop this technology. EPA concluded that, given the rapid progress and the relatively long lead-time before it would be used, adsorbers could be available to meet the 2007 standards. In October 2002, the Clean Diesel Independent Review Panel EPA convened to assess technology development progress reached a similar conclusion, stating that although technological challenges remain, none are insurmountable. The panel further noted that engine, vehicle, and emission control manufacturers were making large investments to ensure the successful development and implementation of the adsorber technology for the 2007 standards. In contrast, the engine manufacturers we contacted generally concurred that adsorbers might be a viable option for meeting the next phase of nitrogen oxide reductions in 2010, but they think the technology faces too many significant technical barriers to be a viable option for 2007.

Engine manufacturers believe they will have nitrogen oxide control technology ready for 2007 model year heavy-duty trucks and that they can make prototype trucks available to trucking companies for testing by mid- to late-2005.[10]

We were unable to independently verify the claims of the engine manufacturers about the progress being made in developing engines and emissions control equipment and when these technologies are likely to be available. This is primarily because companies were concerned about not making information about their unique engine designs and progress readily available so that they can remain competitive.

[10]Seven of the 10 trucking companies we contacted consistently maintained that they need a minimum of 18 months to perform what they consider to be adequate road testing.

Representatives of the Fuel Industry Have Concerns about Adequate Fuel Supplies and Distribution, but Believe They Have Time to Resolve the Concerns and Do Not Want the 2007 Deadline Delayed

The representatives of the diesel fuel industry we contacted—including officials of nine organizations collectively representing refiners, pipeline operators, terminal operators, and retail marketers—still have a number of concerns about implementing the new emissions standards on schedule. But, they believe they can resolve these issues before 2007. Regardless of their concerns, the representatives agreed that EPA should make no changes to the 2007 rule's implementation dates and low-sulfur diesel fuel requirements because changing or delaying the rule would negatively affect the plans and investments already being made. Rather, these representatives believe the certainty the 2007 deadline provides, such as knowing what is required, is key to successfully implementing the standards in a timely and cost-effective manner.

The representatives of the fuel industry organizations we contacted said that most of their members' efforts to meet the low-sulfur diesel fuel requirements are still in the planning phase. While the industry has the technical ability to produce fuel to meet the requirements—low-sulfur fuel is already being produced in limited quantities today—the fuel industry remains concerned about supply and distribution issues that could directly hinder implementing the requirements (see table 3).

Table 3: Fuel Industry Representatives' Primary Concerns

	Contamination	Supply availability	Reliable field testing
Refiners			
American Petroleum Institute	x	x	x
Marathon Ashland Petroleum, LLC[a]	x	x	x
National Petrochemical and Refiners Association	x	x	x
Western Independent Refiners Association	x	x	
Pipeline Operators			
Association of Oil Pipe Lines	x	x	x
Terminal Operators[b]			
Independent Fuel Terminal Operators of America	x	x	x
Independent Liquid Terminals Association	x	x	x
Marketers			
Petroleum Marketers Association of America	x	x	x
Society of Independent Gasoline Marketers of America	x	x	x

Source: GAO.

[a]Marathon Ashland also operates downstream businesses including terminals, retail markets, and a truck fleet.

[b]Terminals exist at fuel source locations, such as refineries, and serve as distribution points near market areas to temporarily store products. Terminals consist of fields of tanks holding different types and grades of petroleum products.

As table 3 shows, the fuel industry's primary concerns include the high probability that low-sulfur fuel supplies will be contaminated before they reach the market or retail level and the potential for shortages of the low-sulfur fuel. The concern over possible contamination of the fuel arises from the limited experience with these products. If such fuel is contaminated, it will damage emissions controls. Although the 2007 rule requires fuel refiners to produce diesel fuel containing no more than 15 parts per million of sulfur, delivering such fuel to the end user may require refiners to produce fuel with an even lower sulfur content. Sulfur from other fuel products may unintentionally be added to low-sulfur supplies through contamination in the distribution system. For example, a pipeline carries many different fuel types, grades, and compositions to accommodate product demands that vary both regionally and seasonally. As a result, there is always a certain amount of intermixing between the first product and the second at the point in the pipeline where the two meet. If these products have different sulfur contents, the mixture where the two fuels meet may contain much more sulfur than the lower graded of the two

products. Furthermore, products containing large amounts of sulfur may leave residual amounts in the system that could become blended into other products, raising their sulfur content. Therefore, according to fuel industry representatives, fuel leaving the refinery must have a much lower sulfur content than 15 parts per million to allow for an increase through contamination.

Because the extent of the contamination cannot be precisely predicted in advance, the exact sulfur level of the fuel that refineries would have to produce is uncertain. Pipeline operators expect that refiners will have to provide diesel fuel with sulfur levels as low as 7 parts per million in order to compensate for possible contamination from higher sulfur products in the system. However, even at these lower levels, the nine fuel industry representatives said that the likelihood of contamination during the delivery of the fuel through the distribution system is extremely high. Even if the low-sulfur fuel that pipeline operators receive meets their specifications, pipeline operators are unsure how they will sequence the new fuel with other products in the pipeline to prevent its contamination.[11] Once contamination occurs, the product could no longer be sold or used as low-sulfur highway fuel, thereby leaving less of the low-sulfur fuel available for sale. Fuel distributors also said that the potential for contamination increases when a fuel additive such as kerosene is blended with diesel fuel. Kerosene is commonly added to highway diesel fuel in the northern United States to prevent fuel from thickening in the cold weather. Although the 2007 rule requires that additives must meet the same low-sulfur standard, refiners are not currently producing low-sulfur kerosene.

Fuel industry representatives also are concerned about the adequacy of testing to detect and avoid widespread contamination of low-sulfur fuel supplies. According to these officials, testing is crucial in determining whether the low-sulfur fuel is meeting the standards at every point in the distribution system. Product testing is performed to control contamination and to define "cut points," locations in a stream of products through a pipeline where one type of product, such as high sulfur diesel, ends and another product, such as low sulfur diesel, begins. Early detection of

[11]Pipeline operators distribute "batches" of different petroleum products or grades of the same product in succession through a pipeline. A batch is a quantity of one product or grade that will be moved before the injection of a second product. Sequencing batches of petroleum products for pipeline transport has become more complex with the proliferation of product types, such as regular grade, mid-grade, and premium grade gasoline and diesel fuel.

contamination gives pipeline and terminal operators flexibility in correcting problems before large portions of a product batch become ruined. However, eight of the fuel industry representatives we contacted expressed concern that a reliable and accurate test or testing device for measuring sulfur content is currently not available.

Because of these contamination issues, nine fuel industry representatives expressed concern about whether there would be an adequate supply of the low-sulfur fuel nationwide during the phase-in period from 2007 to 2010. For example, because adding separate storage tanks for low-sulfur fuel to prevent contamination would be expensive, terminal operators and retail marketers said they may be less likely to make the investment to carry this fuel. Furthermore, according to fuel industry representatives, trucking companies that deliver low-sulfur fuel may need to dedicate trucks exclusively for this purpose to ensure product integrity during delivery. This may lead to fuel shortages, which could be especially severe in the northern United States where fuel distribution is generally limited to delivery by truck.

In contrast to several of the fuel industry's concerns, an EPA report summarizing data on refiners' plans to produce low-sulfur diesel fuel before 2010 stated that (1) the fuel industry is on target for complying with the low-sulfur fuel standard and (2) low-sulfur diesel fuel production will be sufficient to meet demand and the fuel will be available nationwide.[12] Although EPA acknowledges in its report that the information is preliminary, the agency believes that it provided the clearest snapshot of the highway diesel fuel market available at the time. According to EPA, the agency will update this report in 2004 and 2005 based on the most current data from the refiners.

Despite their differing views on the progress towards meeting the 2007 rule's requirements, fuel industry representatives agree there is still sufficient time to resolve their concerns. One of the representatives stated that, even without knowing how much the fuel is likely to be degraded through contamination, refineries are designing their plans and getting their budgets approved to make the needed modifications to their facilities.

[12]*Summary and Analysis of the Highway Diesel Fuel 2003 Pre-compliance Reports*, U.S. Environmental Protection Agency, EPA420-R-03-013, October 2003.

Environmental and Health Groups Have No Major Concerns about Implementing the Standards on Time and Want to Avoid Delays in Achieving Emissions Reductions

The representatives of the five environmental and health groups we contacted are generally encouraged by industries' progress in developing the technologies needed to implement the 2007 rule.[13] While all five groups commented on the 2007 rule when it was proposed in 2000, three of the groups' representatives also were members of EPA's Clean Diesel Independent Review Panel and assessed the industry's progress in developing the needed technologies. In its 2002 report, the panel concluded that significant progress had been made and, although some challenges may remain, none were considered to be insurmountable.[14] The fourth group's representatives have been involved in a number of pilot projects with states, local governments, and the private sector involving the use of innovative emissions control technologies. Those experiences, in conjunction with their involvement in commenting on the proposed 2007 rule, have led the group to believe that the technology is viable. Finally, based on information gathered from emissions control equipment manufacturers, the fifth group's representative believes that the technology is progressing well.

All of the representatives said that they are highly supportive of the 2007 standards. Although two of the five groups initially wanted the standards to be implemented fully in 2007 rather than phasing them in through 2010, none of the groups wanted any changes made to the rule now. In fact, the only concern the representatives we contacted expressed was that there would be a delay in the rule's implementation, resulting in a reduction of the anticipated environmental and health benefits. For example, the representative of the State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials stated that the diesel emissions reductions expected from timely implementation of the 2007 standards are critical to state and local air pollution control agencies' efforts to meet air quality standards. According to this representative, achieving these emissions reductions is especially important for states and localities with areas that already have air quality

[13]These groups include the American Lung Association, Environmental Defense, the Natural Resources Defense Council, Northeast States for Coordinated Air Use Management, and the State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials.

[14]*Meeting Technology Challenges for the 2007 Heavy-Duty Highway Diesel Rule*, Report of the Clean Diesel Independent Review Subcommittee, Clean Air Act Advisory Committee, Oct. 30, 2002.

problems. Many of these areas are relying on the 2007 standards to achieve their expected emissions reductions on time.

Trucking Companies Are Concerned about the New Engines' High Costs and Insufficient Time for Testing and May Pre-Buy Trucks with Old Engines before 2007, Disrupting Markets and Postponing Air Quality Benefits

Trucking officials we contacted expect that the costs of purchasing and operating trucks meeting the 2007 standards will be significantly higher than comparable earlier models, despite EPA's estimates to the contrary. These officials said they do not consider EPA's analysis credible, primarily because they believe the agency previously had seriously underestimated the industry's costs to comply with the consent decrees. For example, EPA's regulatory impact analysis for the 2004 emissions standards concluded that the industrywide cost to reduce nitrogen oxides would be about $224 per ton. Subsequently, in 2000, EPA estimated that to comply with the pull-ahead provisions of the consent decrees, these costs could increase to $272 per ton. However, an industry analysis stated that the actual cost could range between $8,000 and $13,000 per ton. EPA officials, in commenting on the cost variance of its estimates pointed out that the estimates it developed for the 2004 standards and its estimates of engine costs to meet the accelerated deadline for development are not comparable. Accelerating the schedule would generate additional costs that would not have been components of the 2004 estimate. For example, EPA officials noted that when the agency derived its estimates of costs to comply with the 2004 nitrogen oxide standards, it did not know that heavy-duty engine manufacturers had installed defeat devices on existing engines. Thus the actual cost to comply with 2004 standards will include the cost to "catch up" with the previous standard. We did not assess the accuracy of EPA's cost estimates. Nevertheless, the difference in EPA's estimates has raised concerns among trucking company officials about the accuracy of EPA's 2001 estimate of engine costs to comply with the 2007 standards.

One reason many industry officials that we contacted expect the compliance costs of the 2007 standards to be higher than EPA's prediction is because the new trucks will incorporate significant technological advancements over current equipment to control nitrogen oxide emissions. Many of these officials believe this technology will add thousands of dollars to the purchase price of new trucks rather than the long-term $3,200 estimated by EPA. In addition, these officials are concerned that the 2007 trucks will experience another 3 to 5 percent loss in fuel economy—added to the 3 to 5 percent loss resulting from the consent decrees—that could increase their companies' fuel costs by millions of dollars per year. Even minor increases in business costs can have adverse effects in the trucking industry, according to trucking industry officials we contacted, because

these companies' profit margins are very narrow—sometimes only 2 cents per dollar earned. The officials claim that the highly competitive nature of the trucking business precludes companies from passing such significant cost increases to their customers. For example, the two trucking companies we contacted that bought only trucks with the new engines prior to October 2002—and in so doing incurred millions of dollars in additional expenses, according to company representatives—said they had to compete against companies that pre-bought trucks with the older engines and avoided the additional expenses. These two companies felt they could not increase the fees they charged without risking the loss of customers to their competitors. According to officials of these two companies, even large, profitable companies can afford to absorb these losses for only a short time, and small- and mid-sized companies are likely to have also experienced difficulties. None of the engine manufacturers could estimate with precision the amount that acquisition or operating costs are likely to increase. However, all of the engine manufacturers we contacted agreed that the engines and emissions control equipment for 2007 trucks will be more expensive to buy and to operate than comparable previous models.

By February 2004, four of the five engine manufacturers had announced the technologies they planned to pursue for 2007 and all five had stated their plans to have limited numbers of prototype engines available for road testing by mid- to late-2005. However, some trucking companies still had doubts as to whether engine manufacturers would actually deliver prototypes for road testing in the promised timeframes. For example, one trucking company told us that the original timetable, which would allow engine manufacturers to stay on schedule to deliver prototypes no later than mid-2005, was for the manufacturers to select their technologies during the summer of 2003. The 6-month delay added to his concern about the availability of prototypes to enable valid field evaluations by mid-2005. According to 7 of the 10 trucking firms we contacted, they need 18 to 24 months to put a sufficient number of miles on heavy-duty trucks—under a variety of driving conditions through all four seasons of the year—to fully evaluate the vehicles' operating costs, performance, reliability, and durability. Officials at all ten trucking companies said that they were reluctant to take the risks associated with the new technologies unless they have enough time to fully assess the new trucks. For example, officials at one company noted that it has only 12 maintenance facilities nationwide and when a truck breaks down on the highway, it is very expensive to repair. Consequently, these officials are not willing to take a chance on equipment that has not been adequately tested.

Without adequate testing time, the trucking company officials we contacted believe that they and other trucking companies will likely pre-buy trucks with older engines before 2007, with more companies purchasing more trucks than they did before the consent decrees' October 2002 deadline. Even officials from one of the trucking companies that bought only trucks with new engines in 2002 said that they would consider pre-buying if the new equipment is not fully tested. According to most of the trucking industry officials we contacted, the adverse impacts of a pre-buy on trucking companies and engine manufacturers could be worse in 2007 than in 2002. Many of the trucking companies we contacted agreed that the industry needs to have the cost, reliability, and other uncertainties associated with the 2007 trucks resolved in order to achieve greater stability within the industry.

In late February 2004, we again contacted all ten trucking companies to determine the extent to which the engine manufacturers' announcements that test vehicles would likely be available in 2005 may have eased their concerns regarding the introduction of new engine and emissions control technologies in 2007. Of the five companies that responded to our inquiries, one stated unequivocally that the engine manufacturers' announcements had not at all reduced its concerns. Representatives of the remaining four companies stated that their levels of concern had been somewhat reduced by the announcements, but they continue to be concerned about a number of unresolved issues. For example, despite engine manufacturers' assurances, companies continue to be concerned about the durability of the new engines as well as the cost of purchasing and operating them. In addition, representatives of some of these companies questioned whether the availability of a relatively small number of test vehicles in a limited number of fleets could provide sufficient information to allay the concerns of the trucking industry as a whole. Finally, some trucking companies highlighted lingering concerns regarding potential shortages and higher costs of low-sulfur diesel fuel.

Some Stakeholders Commended EPA's Efforts to Ensure Technology Is Ready by 2007, but Others Would Like the Agency to Provide More Certainty

EPA has taken a number of steps to help with and monitor the engine and fuel technology development. For example, EPA staff continue to meet with representatives of the key industries, issue reports on technology progress, and conduct stakeholder workshops. Representatives of some of the engine manufacturers, the emissions control technology manufacturers association, the fuel industry, and the environmental and health groups we contacted commended EPA's efforts for helping to advance the needed technologies. However, some of the engine manufacturers and the trucking companies we contacted would like more help and reassurance that the technology will be ready when needed, including economic incentives to manufacturers to produce engines on time and trucking companies to buy them as scheduled. Furthermore, some trucking representatives believe that EPA has not included them in, or listened to their concerns about, implementation of the standards. EPA program managers maintain that the agency has given the industries more lead-time than required to produce the technology and provided extensive assistance and monitoring. They stated that the agency could take a number of additional actions if the standards cannot be implemented on time, such as granting individual companies temporary relief from the standards or postponing active enforcement. But EPA sees no evidence that timely implementation of the standards is not achievable.

EPA Has Undertaken a Number of Efforts to Monitor and Facilitate the Standards' Timely Implementation

According to EPA, the agency is not required to ensure that the engine and emissions control technologies or low-sulfur fuel supplies will be available on time or that the industries comply in a timely manner. However, the Clean Air Act requires that EPA establish standards taking into consideration the availability and costs of technology, lead-time, and other factors. In responding to the act's requirements, EPA concluded that all of the evidence indicates that industries can and will implement the engine and fuel requirements of the 2007 rule successfully and in a timely manner. According to EPA, the technologies for meeting the standards are well known and some are already in use. For example, refineries are now using technology to reduce sulfur in diesel fuel and engine manufacturers are installing filters that reduce fine particle emissions from engines. In addition, the technologies for meeting the nitrogen oxide standard in the 2007 rule are being developed at a rate faster than anticipated, according to EPA, and the remaining engineering issues are being addressed.

EPA's confidence is based, in part, on provisions that the agency built into the 2007 rule to ease compliance. For example, in developing the rule, EPA

gave the industries 6 to 10 years to plan, develop, and produce fuel and engines that meet the requirements. By comparison, the Clean Air Act only requires EPA to allow no less than 4 years of lead-time for regulated entities to develop any new technologies required to comply with a rule. EPA also included hardship and other provisions to address problems that certain small businesses may have in complying with the rule.

In addition to specific rule provisions, EPA continues to take steps to monitor the development of needed technologies and fuel supplies and to ensure that the standards will be successfully implemented. These efforts include:

- Technology Progress Review Meetings - According to EPA, agency representatives have continuously met with diesel engine manufacturers, emissions control equipment producers, oil refiners, refinery technology companies, and fuel distributors; visited technical research centers; and met with leading engineers and scientists from more than 30 companies for briefings on the progress being made to comply with the 2007 standards.

- Progress Review Reports - In the preamble to the 2007 rule, EPA committed to issuing a progress report every 2 years on the status of nitrogen oxide adsorber technology, the emissions control technology, which the agency believes to be the most promising for meeting the standards. The first report, issued in June 2002, concluded that the engine manufacturers and the emissions control equipment industry's efforts to develop this technology were progressing rapidly and on schedule. The report also included an update on the status of filters to control particulates and the refining industry's progress towards meeting the low sulfur diesel fuel requirements for 2006. The report did not include supporting technical evidence from each company to validate EPA's conclusions. EPA plans to release its second engine progress review report in early 2004.

- Refiners Pre-Compliance Reports - The 2007 rule requires fuel refiners and importers to submit annual reports from 2003 through 2005, which must contain information on, among other things: (1) an estimate of the volumes of low-sulfur and higher-sulfur diesel fuel that each refinery plans to produce or import; and (2) engineering plans, the status of efforts to obtain any necessary permits and financial commitments for making the necessary refinery modifications to produce low-sulfur fuel, and construction progress. EPA summarized these data and issued its

first annual report in October 2003, stating that the industry is on target for complying with the low-sulfur fuel requirements on time, fuel production will be sufficient to meet demand, and low-sulfur fuel will be widely available nationwide. EPA plans to issue additional precompliance reports in 2004 and 2005.

- Implementation Workshops - EPA has held public workshops on the 2007 standards and plans to hold additional ones in the future as appropriate. In November 2002, EPA sponsored a clean diesel fuel implementation workshop, which focused on issues such as record keeping and reporting requirements for the fuel industry and diesel fuel refining, distribution, storage, and marketing challenges. In addition, in August 2003, EPA, the trucking industry, and engine manufacturers co-sponsored another implementation workshop to facilitate the exchange of information among EPA, engine manufacturers, and other parties including truck manufacturers and truck operators, and to give EPA a forum to provide additional guidance on implementation issues.

- Clean Diesel Independent Review Panel - As previously discussed, at EPA's request, the Clean Air Act Advisory Committee's Clean Diesel Independent Review Panel[15]—an expert panel composed of representatives of engine and emissions control equipment manufacturers, trucking companies, fuel refiners and distributors, and environmental and health organizations—independently assessed industries' progress towards complying with the 2007 rule. In its October 2002 final report, the panel found that both the engine and fuel industries were developing the technologies needed to comply with the 2007 standards at an appropriate rate, but that these industries needed to address a number of technical issues for implementation to be successful. The panel agreed that none of these issues was insurmountable and that, for a number of these issues, EPA's planned implementation workshops were an appropriate means to move forward.

[15]The Clean Diesel Independent Review Panel was created by a charter issued under the Clean Air Act Advisory Committee. Generally, the purpose of the Committee is to provide independent advice and counsel to EPA on policy and technical issues associated with implementation of the Clean Air Act Amendments of 1990. The purpose of the panel was to review industries' progress toward developing the technologies necessary to implement the 2007 diesel rules.

- Guidance Documents - In November 2002, EPA issued guidance on engine manufacturers' testing procedures to determine whether their engines comply with the new standards, and the agency also issued a draft document responding to questions raised by the fuel refining and distribution industries during the workshop held earlier that month. EPA plans to issue additional guidance on implementing the 2007 standards, if needed.

- Other Technology-Related Activities - According to EPA, the agency has taken an active role in a number of areas regarding technology development and information-sharing with the diesel engine industry and other stakeholders, including:

  - an on-going testing program at EPA's National Vehicle and Fuel Emissions Laboratory in Ann Arbor, Michigan, in which EPA has evaluated the status of engine and emissions control technology, including particulate filters and nitrogen oxide adsorber catalyst technologies. EPA believes that this program helps to inform the agency of the current state of these technologies and allows EPA to make general information on technology progress publicly available.

  - two government/industry technology demonstration programs sponsored by the Department of Energy: the Diesel Emission Control-Sulfur Effects Project, completed in 2001, which primarily focused on the impacts of diesel fuel sulfur on emission control technologies; and the Advanced Petroleum-Based Fuels-Diesel Emissions Control Project, which focuses on developing and demonstrating engine and emissions control systems that can comply with the 2007 standards.

  - a number of industry-sponsored task groups, including (1) the Diesel Engine Oil Advisory Panel, made up of the American Petroleum Institute, the American Chemistry Council, the American Society for Testing and Materials (ASTM), and a number of individual oil, engine, and additive companies, which is developing voluntary standards for engine oil formulations for the 2007 engines; and (2) the Diesel Fuel Lubricity Task Force, sponsored by ASTM, which is working to develop fuel test methods and specifications. EPA participates in these groups to provide input on technical issues and clarification on the 2007 rule, and to track the industry's progress.

- Other Outreach Activities - EPA has participated in numerous conferences and meetings sponsored by a wide range of stakeholders at which agency officials have made presentations discussing the 2007 rule. EPA believes that these conferences are useful (1) for stakeholders to get the latest information on the status of the 2007 rule implementation and (2) for EPA to answer questions about the rule and hear first-hand input from the regulated industry and other stakeholders.

Based on all of these activities, EPA maintains that industries will successfully implement the requirements of the 2007 rule on time and that, beyond the agency's planned workshops and other monitoring and outreach activities, it needs to take no additional actions to ensure timely compliance.[16]

Some Stakeholders Believe EPA Has Done Enough to Promote the Technology, While Others Would Like More Help and Outreach

In general, a number of stakeholders we contacted—the association of emissions control equipment manufacturers, a number of the fuel industry representatives, the environmental and public health groups, and two of the engine manufacturers—either commended EPA for its efforts to ensure the needed technology is ready on time, or believe the agency is already doing enough to provide such assurances. Two of the remaining engine manufacturers and some fuel industry representatives, as well as all of the trucking companies, would like more help in developing the technology or proof that it is on track.

The association of emissions control equipment manufacturers praised EPA for its efforts to assist in the development of the needed technology. In addition, many of the fuel industry representatives we contacted commended EPA's efforts to reach out to them and actively involve them in preparing for the implementation of the 2007 standards. In particular, the representatives found EPA's implementation workshops and its draft question-and-answer document to be the most helpful.

[16]Engine manufacturers and others challenged the 2007 rule on various grounds, including the feasibility of developing emissions control systems that would satisfy the new nitrogen oxide and particulate matter standards. The court not only found no basis for reversing EPA's prediction of the future development of adequate nitrogen oxide adsorbers, but also denied the other petitions. National Petrochemical and Refiners Association v. EPA, 287 F.3d 1130 (D.C. Cir. 2002).

Representatives of the five environmental and public health groups commended EPA's efforts to implement the 2007 standards and to include them and other stakeholders in the implementation process. Specifically, the groups said that EPA's outreach efforts were comprehensive and inclusive. Not only did EPA solicit comments from as many stakeholders as possible during the rulemaking process, but it also has continued to encourage discussions between the stakeholders at its implementation workshops. Generally, the groups agreed that EPA does not need to go beyond its current and planned activities to ensure timely implementation of the standards.

As for the five engine manufacturers, representatives from one found EPA's efforts to be particularly supportive and representatives from two others said the efforts were "somewhat" effective in easing development of the needed technologies. Officials from one of these manufacturers said that EPA has been responsive to the manufacturers' questions, all of which should help them meet the 2007 standards. Representatives from another manufacturer stated that EPA has been diligent in monitoring the progress of engine development, visiting suppliers as well as the engine makers' facilities, which has helped speed the development of the engines. The agency's work in its Ann Arbor, Michigan, research laboratory has also helped in this regard. In contrast, officials from a fourth company noted that EPA had not been particularly responsive to the industry or its concerns. (The remaining manufacturer's representatives did not express an opinion in this regard.)

On the other hand, two engine manufacturers described workshops sponsored by EPA that focused on complying with the 2007 rule as only marginally effective. For example, one engine manufacturer's officials commented that the workshops appear to be "staged" and convened only to confirm the agency's preconceived ideas, although EPA noted that members of the trucking and engine manufacturing industries co-sponsored these workshops, and that would make it difficult for the agency to preordain their outcomes. These companies' officials further stated that they did not need EPA's help in developing new diesel technologies, but did need the agency's assistance in convincing customers to buy the trucks with the 2007 engines, however. Four of the five manufacturers also asserted that economic incentives for trucking companies could assist them and facilitate the implementation of the 2007 rule. In general, officials from both of these industry groups favored tax breaks or subsidies for trucking companies to purchase the new technologies on time. According to these officials, investing millions of dollars in developing or buying new,

relatively unproven equipment carries an inherent business risk and provides companies with a powerful incentive to stay with older, familiar—and dirtier—equipment. EPA officials told us that the agency would have to request authority from the Congress to provide industries with economic incentives.

As for other stakeholders, representatives of the terminal and marketing segment of the distribution industry, in particular, were disappointed that the Clean Diesel Independent Review Panel addressed only technology issues and not distribution issues, such as contamination. Furthermore, all of the trucking companies we contacted agreed that EPA could do more to address the uncertainties facing their industry, and thereby help minimize any pre-buy that might occur. In particular, while EPA actively involved them in developing the 2007 rule, they believe that the agency has not addressed their concerns in implementing the standards. For example, according to ATA officials, EPA did not initially include representatives of the trucking industry in the agency's Clean Diesel Independent Review Panel, and invited ATA to participate only after the organization complained about being excluded. EPA acknowledged that, in retrospect, they should have included trucking industry representatives on the panel from the outset and responded by adding an ATA representative to the panel. Furthermore, ATA officials told us that the panel's review did not include several important technical issues, such as consideration of alternative emissions control technologies, and that panel members were discouraged from raising such issues. Finally, the ATA officials said that several panel members published reports dissenting with the panel's main conclusion that technology development was on schedule, but that EPA has not made these reports generally available. As a result of these factors, ATA officials said they do not have great confidence in the panel's findings and they remain largely unconvinced that trucking companies' interests have been well represented in EPA's panel process. According to EPA officials, however, panel membership was comprised overwhelmingly of experts on engine and vehicle technology development.

Some trucking companies are also skeptical of the effectiveness of EPA's other efforts to monitor and assist the development of technology for the 2007 rule. For example, several trucking company officials we contacted believe EPA has already made important implementation decisions—largely without input from trucking companies—and the workshops' main function is merely to validate those decisions. Several trucking companies and ATA officials expressed the belief that EPA's overall approach to implementing the 2007 rule is too inflexible. For example, the ATA officials

maintain that EPA's analysis supporting the 2007 rule dramatically understates trucking companies' costs to comply with the rule and ignores the possible severe effects of these costs on the companies. ATA representatives have recommended that EPA update its analysis to take into account better information that is now available. However, EPA officials continue to believe that the regulatory impact analysis it prepared in support of the rule is sufficient, and pointed out that the agency is not required to, and does not routinely, update its analysis supporting such rulemakings. They also maintain that engine manufacturers, not trucking companies, are the entities being regulated under the 2007 rule. As a result, following the rulemaking, most of the EPA's direct dealings were with engine makers, not trucking companies, according to these officials. However, they said that, more recently, EPA has actively consulted trucking companies. The trucking companies would like EPA to work more directly and closely with them, hear and address their concerns, and provide more reassurance that the technologies will be ready by 2007.

EPA Could Take a Number of Actions If the Standards Cannot Be Implemented on Time

According to EPA, the agency is not required to take action in the event that the engine and emissions control technologies and low-sulfur fuel are not available in time to implement the 2007 standards as scheduled. However, according to EPA, if circumstances arise that would require additional action, the agency will address them at that time.

EPA believes that timely implementation of the 2007 standards is achievable and to plan for failure to meet the deadline would undermine the rule. EPA maintains that the collective efforts of the industries to develop plans and technologies needed to meet the standards, combined with the agency's monitoring of their progress, is the proper course of action at this time and is showing significant positive progress towards timely and successful implementation. According to EPA, entities that are being regulated have for decades developed technologies and implemented requirements based on the certainty that the regulations would not be changed in a way that would disrupt their planning and investment. With this in mind, EPA maintains that it would not be prudent or good government to change the regulations or delay their implementation. According to EPA, the agency's efforts to provide the industries significant lead-time for developing the needed technologies, ensure that all stakeholders are actively developing them, and monitor their progress are the most prudent actions the agency can take.

According to EPA, if it appears that industries cannot comply with the 2007 standards on time, the agency would not readily make substantive changes to the rule—such as modifying the implementation dates or changing the allowable emissions levels of the standards—because industries have invested large amounts to comply with the standards in the specified timeframe. Nevertheless, EPA officials point out that, if there was convincing evidence that modifying some aspect of the requirements was justified and necessary, the agency could take a number of actions:

- EPA could revise the rule in response to a specific petition. Under the Clean Air Act,[17] any person can petition the EPA Administrator to change a rule. The petition must demonstrate that it was impracticable to raise the objection during the public comment period when the rule was composed and that the objection is of central relevance to the outcome of the rule. EPA believes that the appropriate mechanism for substantively changing the 2007 requirements would be to undertake a standard rulemaking process in response to a petition, in which the agency would post a notice of rulemaking in the *Federal Register* and request, review, and address public comments on the proposed revisions to the rule.

- EPA could also develop nonconformance penalties in the event that one or more engine manufacturers was unable to produce compliant engines, as it did for the 2004 standards and consent decrees. EPA establishes nonconformance penalties when: (1) the emission standard is more stringent than the previous standard or an existing standard becomes more difficult to achieve because of a new standard, and if EPA finds that it will require substantial work to comply; and (2) it is likely that one or more manufacturers will be a "technological laggard," unable to produce compliant engines by the required date.[18] Typically, EPA decides whether to establish penalties 1 or 2 years before the compliance dates, primarily because information on manufacturers' ability to comply is not available until then. Therefore, EPA believes that it is not appropriate to consider penalties before late 2004.

[17]Clean Air Act, Section 307(d)(7)(B) (codified at 42 U.S.C. 7607(d)(7)(B)).

[18]Previous nonconformance rules have considered a technological laggard to be a manufacturer who cannot meet a particular emission standard due to technological, rather than economic, difficulties and who, in the absence of the penalties, might be forced from the marketplace, including the elimination of one or more engine families or configurations from production.

- In the event that an individual refiner is unable to comply with the 2007 rule, EPA could grant the company relief from meeting its low-sulfur requirement in response to a request under the rule's hardship application process. The refiner would then develop an alternative compliance plan.

- EPA may, in certain circumstances, determine in advance that it will not actively enforce an environmental regulation, including the 2007 rule. However, according to EPA, the agency would take this action only if it is clearly needed to serve the public interest. Typically, EPA grants requests for selective enforcement of a regulation when a weather emergency, fire, explosion, or similar circumstance outside a requester's control makes compliance impracticable, or when compliance with the original rule would cause the regulated entities significant hardship.

Conclusions

The consent decrees and 2007 standards are critical pieces of EPA's strategy to control harmful diesel emissions and protect public health. While the accelerated schedule in the consent decrees had an impact on both the engine and trucking industries, it helped to further the agency's emissions reduction goals by putting cleaner diesel engines on the road earlier than otherwise planned. The agency has also made a significant investment in developing, and ensuring the implementation of, the 2007 standards. Nevertheless, stakeholders from two critical industry groups—engine manufacturers and trucking companies—would like more help. In particular, engine manufacturers would like assurances from EPA that, once the cleaner engines are available, the trucking industry will purchase them. Furthermore, the trucking industry, as a result of its experience with the consent decrees, believes it has not been a key player with EPA in responding to the consent decrees or implementing the 2007 standards. Because the trucking industry is a major source of the emissions EPA is trying to combat, if trucking companies delay purchase of the cleaner engines, the economic effect could be more severe than what occurred as a result of the decrees and could postpone the emissions reductions. The trucking industry is also a key player in the nation's transportation system needed to keep a healthy economy. Therefore, it is important to achieve emissions reductions while minimizing the negative economic effects on trucking and its related industries.

For these reasons, EPA may want to consider what additional efforts it could take to help engine manufacturers produce clean engines in time for road testing, to reassure trucking companies that they will be able to buy

tested engines on time, and to address major concerns of other key stakeholders. Careful consideration should be given to these efforts so that they will not unduly delay progress towards the standards, however. For example, EPA could consider if it has time to establish an independent expert panel, similar to its 2002 panel, to review industry's progress in developing the necessary technologies. The panel should consist of representatives of all of the key stakeholders who would identify and address their major concerns to the extent practicable. The panel could review the data EPA has already collected or new data from the engine and fuel industries to measure the progress of technology development, communicate this to all stakeholders, and determine what, if any, additional actions, such as incentives, are needed to ensure that standards are met. The agency would have to establish the panel as soon as possible in 2004, however, if it is to have enough time to be effective and not unduly delay progress. Making more of an investment in working with all of the stakeholders critical to meeting the 2007 standards would help EPA ensure that it will achieve its goals of reduced emissions and increased public health protection.

Recommendation for Executive Action

To maximize public health and air quality benefits, and minimize adverse impacts on affected industries, we recommend that the Administrator, EPA, consider additional opportunities to allay engine, fuel, and trucking industry concerns about the costs and likelihood of meeting the 2007 standards with reliable engine and fuel technology. Opportunities could include better communicating with all stakeholders on the remaining technological uncertainties. EPA could also convene another independent review panel to (a) address stakeholders' remaining concerns; (b) assess and communicate the progress of technology development; and (c) determine what, if any, additional actions are needed to meet the 2007 standards such as considering the costs and benefits of incentives for developing and purchasing the technology on time, and other alternatives.

Agency Comments and Our Evaluation

We provided EPA with a draft of this report for review. The Assistant Administrator for Air and Radiation said EPA believes that, in many respects, our report is consistent with the agency's assessment of the situation leading up to the implementation of the 2007 standards. However, the agency has concerns about the basis for certain of our findings on the standards. More specifically, EPA asserted that we (1) present selected stakeholders' opinions without validating them and ignore evidence that

the agency believes would prove or disprove their validity, (2) overstate the challenges to having fuel and engine technologies ready on time to meet the 2007 standards, and (3) inaccurately portray EPA's efforts to work with stakeholders in developing the rule. As to our recommendations, EPA sees merit in using financial incentives to achieve the 2007 milestone, but does not see an agency role in this regard. Neither does the agency see a need to convene an independent technology review board.

We disagree with EPA's assertions. In our view, EPA needs to work with stakeholders to better address any remaining concerns they have about the availability of the new engines and fuel required to meet the 2007 standards. We fully appreciate that the anticipated emissions reductions are critical for many states whose air quality is in trouble, that the 2007 standards are vital to protecting public health, and that the agency and the engine, emissions control, and fuel industries have made extensive efforts to successfully implement the 2007 rule. We also recognize that to achieve the rule's objectives, the trucking industry must purchase trucks with the new engines beginning in 2007. Otherwise, we are concerned that the nation may relive the negative effects that resulted from the 2002 consent decrees. In 2002, trucking companies pre-bought older engines before the deadline, delaying emissions and health benefits, because they believed they did not have enough time to test new engines or enough information on costs. To ensure that this does not happen with the 2007 standards, we believe EPA should strengthen its process for working with stakeholders to allay any remaining concerns about whether fuel will be available in sufficient quantities and locations, whether enough new engines will be ready in time to thoroughly test them, and how much the engines will cost to buy and operate.

With respect to EPA's specific assertions, we disagree with EPA's opinion that we present certain stakeholders' views without regard to their validity. We carefully and consistently collected the views of engine and emissions control manufacturers, trucking companies, fuel industry representatives, and environmental and health groups, and were equally careful to accurately present their opinions, consistent with our methodology and quality assurance standards. Furthermore, the report acknowledges that we were unable to verify opinions about the technologies' readiness with hard data on their design and performance because the industries manufacturing the technologies were not comfortable in releasing information about their individual designs. Nevertheless, we did not simply accept stakeholders' views at face value, but where possible, assessed the basis for their opinions, such as reviewing available studies and reports on

the technologies. We also disagree with EPA's assertion that we did not consider additional information and evidence that agency program managers provided to us late in the course of our work after reviewing a draft summary of the facts to be used in the report. At that time, EPA provided extensive written comments on the summary, along with a number of press releases from engine manufacturers and trade press articles. In response, we spent considerable time carefully assessing all of this information and made a number of changes to the report where appropriate. However, the agency did not provide any additional quantitative data or other information that would allow us to better evaluate the stakeholders' positions.

We also disagree with several EPA assertions that the report overstated the technological challenges to successfully delivering the necessary fuel and engines on time. In this regard, we devote considerable narrative to the views of the agency and all the stakeholders who share these views that both technologies are on track. However, we were obligated to acknowledge some stakeholders' concerns over the remaining technological risks and questions. In addition, we include the most current information possible on technological developments in our report. For example, after several manufacturers announced by February 2004 their plans to have a limited number of prototype engines ready for testing in 2005, we re-contacted the trucking company representatives to determine the extent to which these announcements addressed their concerns.

Additionally, we acknowledge that EPA deserves credit for its activities to work with various stakeholders to help ensure that the technologies will be ready in time and we devote considerable narrative to describing these activities in the report. We are also very careful to give a balanced presentation of the stakeholders' opinions about EPA's activities and therefore were obligated to acknowledge that some stakeholders questioned the agency's openness to their concerns and willingness to address them. For example, we note in the report that EPA officials acknowledged the agency initially did not invite anyone from the trucking industry to participate on the 2002 Clean Diesel Independent Review Panel and only did so after the industry lobbied the agency.

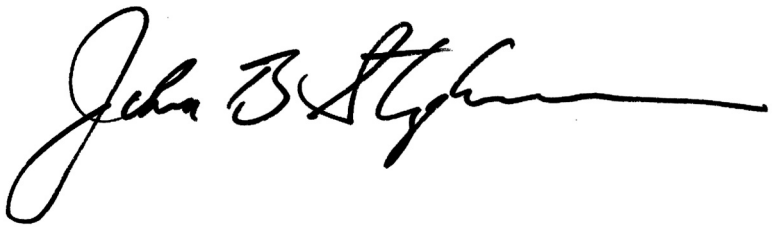
Finally, with regard to EPA's comments on our recommendations, we want to emphasize that we are recommending that the agency consider additional steps to alleviate the remaining concerns raised by stakeholders, avoid a significant pre-buy of older engines, and better guarantee that the emissions and health benefits are achieved. We suggest actions for the

agency to consider, but do not intend to limit the agency to the alternatives we suggested, especially if it could design more effective solutions. In this light, with regard to financial incentives, we recognize that the Congress must provide the agency direction and funding for such an approach, but expect that it would also look to the agency to play a role, such as making the initial proposal for incentives or helping to determine their merits and costs. As to convening an independent review panel, we do not believe that this would unduly delay the schedule for implementing the standards. In addition, we believe a panel could help address stakeholders' remaining concerns, thereby helping to prevent a repeat of the negative impacts from the 2002 consent decrees and instead ultimately ensure that the critical emissions and health benefits anticipated from the 2007 standards are achieved in a timely manner.

Appendix III contains the text of EPA's letter along with our detailed responses to the issues raised. EPA also provided some technical comments, which we have incorporated as appropriate.

We are sending copies of this report to the Chairman and Ranking Minority Member of the Senate Appropriations Committee and its Subcommittee on VA, HUD, and Independent Agencies; the Senate Committee on Environment and Public Works; the Senate Committee on Commerce, Science, and Transportation; the House Appropriations Committee and its Subcommittee on VA, HUD, and Independent Agencies; the House Committee on Energy and Commerce; the House Committee on Transportation and Infrastructure; the House Committee on Government Reform and its Subcommittee on Energy Policy, Natural Resources, and Regulatory Affairs; other interested members of Congress; the Administrator, EPA; the Director of the Office of Management and Budget; and other interested parties. We will also make copies available to others upon request. In addition, the report will be available at no charge on GAO's Web site at http://www.gao.gov. If you have any questions about this report,

please contact me at (202) 512-3841. Key contributors to this report are listed in appendix IV.



John B. Stephenson
Director, Natural Resources and Environment

List of Congressional Requesters

The Honorable Roscoe Bartlett
The Honorable John Boozman
The Honorable Mac Collins
The Honorable Barbara Cubin
The Honorable Sam Graves
The Honorable Mark Green
The Honorable Melissa A. Hart
The Honorable Ernest Istook
The Honorable Walter B. Jones
The Honorable Ray LaHood
The Honorable Jim McCrery
The Honorable C. L. "Butch" Otter
The Honorable Mike Rogers
The Honorable Jim Ryun
The Honorable John Shadegg
The Honorable John Shimkus
The Honorable Bill Shuster
The Honorable Mark Souder
The Honorable Lee Terry
House of Representatives

Scope and Methodology

Our objectives in this review were to determine (1) the effects, if any, of EPA's 1998 consent decrees with diesel engine manufacturers on trucking companies, engine manufacturers, and expected emissions reductions; (2) stakeholders' views on industries' ability to comply with the 2007 standards and EPA's actions to ensure that the new engine technologies and low-sulfur fuel will be ready in time; and (3) if not, EPA's options and plans for mitigating any potential negative effects on key industry sectors.

To address the first objective, we performed econometric modeling using data on new Class 8 diesel truck production, GDP, and diesel fuel prices from January 1992 through June 2003 to determine the extent to which Class 8 truck purchases may have been associated with the consent decrees. We assessed the reliability of these data by reviewing existing information about the data as well as some testing of the truck data for obvious errors. In addition, we had discussions with the vendor concerning the reliability of the truck data. We determined that the data were sufficiently reliable for purposes of this review. Details of our methodology for this specific analysis are included in appendix II.

In addition, we contacted, among others, officials of ten of the nation's largest trucking companies as defined by the number of trucks in their fleets (see table 4).

Table 4: Ten Large Trucking Companies Involved in Freight Transportation in 2002

Truck company	Number of trucks in fleet
Ryder Systems, Incorporated	52,400
US Freightways Corporation	21,200
Penske Truck Leasing Corporation	19,562
Schneider National, Incorporated	14,000
Swift Transportation Company, Incorporated	12,748
Roadway Corporation	12,300
Yellow Corporation	11,657
FedEx Corporation	11,203
J.B. Hunt Transport Services, Incorporated	10,770
United Parcel Service, Incorporated	10,300
Total	**176,140**

Source: American Trucking Associations.

We identified these companies from data provided by the American Trucking Associations (ATA), an organization representing the majority of the trucking companies involved in freight transportation. Because ATA could not identify which of its member companies had purchased engines in the months before and immediately after October 2002, GAO and ATA agreed that the largest trucking companies, as determined by the total number of trucks in their fleets, were more likely than smaller companies to have purchased trucks during that period and, therefore, would be in the best position to recount their experience with both the new engines and the impacts of the accelerated schedule. ATA provided us with a list of 48 of their member companies with truck fleets ranging from a high of over 52,000 trucks to a low of 60 trucks. From this list, we selected those ten companies that each had fleets of over 10,000 trucks in 2002. (This 10,000-truck level provided a natural breaking point in the data, since the next largest company owned about 8,400 trucks.) These 10 companies accounted for a total of 176,000 trucks, 3 percent of the total truck inventory in 2002. Because these companies were not selected randomly, we cannot project our findings to the entire trucking industry. We asked the representatives of these companies a uniform set of questions about the companies' strategies in reacting to the decrees, the effects of the decrees on their operations, and their experiences with the new engines designed to comply with the decrees. We also reviewed financial statements some of these companies submitted to the Securities and Exchange Commission to identify effects that the companies publicly disclosed.

In addition, to determine the effects of accelerating implementation of the 2004 standards on the engine manufacturing industry, we contacted officials of the seven engine manufacturers that were subject to the consent decrees. These companies included Caterpillar Incorporated, Cummins Engine Company, Detroit Diesel Corporation, Mack Trucks Incorporated, Navistar International Transportation Corporation, Renault Vehicules Industriels, s.a., and Volvo Truck Corporation.

As with the trucking companies, we asked the representatives of these engine manufacturers questions about their companies' strategies with regard to the decrees, the decrees' effects on their operations, and the performance of the new engines. We also reviewed some of these manufacturers' Securities and Exchange Commission submissions. While we asked these companies for data to support their statements about the effects of the decrees, generally they said that it would be detrimental to reveal information about their business operations or technology designs because it might harm their competitive positions relative to other

companies. We also did not identify any other independent analyses of the impacts of the consent decrees.

To determine the air quality effects of the decrees, we reviewed EPA's 1998 projections of the emissions reductions expected from accelerating the schedule, based on its estimate of the number of trucks that would have the new engines. We compared this to data on the actual number of trucks with new engines to assess the likelihood that EPA would achieve the expected emissions reductions. We also discussed with EPA officials and staff the basis for their estimates of the expected emissions reductions from a second provision of the consent decrees, whereby truck owners would have emission computer controls on their older engines adjusted during engine overhauls.

To respond to the second objective, we contacted officials representing 16 organizations and companies from among those that offered the largest number of comments on EPA's 2007 emissions standards when proposed in 2000 (see table 5).

Table 5: Stakeholders Providing the Most Comments on EPA's Proposed 2007 Diesel Emissions Rule and the Number of Issues Addressed by Each

Organizations/companies commenting on 2007 rule	Industry/affiliation	Number of issues addressed
Alliance of Automobile Manufacturers	Automobile industry	40
American Lung Association	Environmental/health	103
American Petroleum Institute	Fuel industry	128
American Trucking Associations	Trucking/carrier	24
Cummins Engine Company	Engine manufacturing	78
Detroit Diesel Corporation	Engine manufacturing	39
Engine Manufacturers Association	Engine manufacturing	125
Environmental Defense	Environmental/health	31
Navistar International Transportation Corporation	Engine manufacturing	51
Manufacturers of Emissions Controls Association	Emissions control equipment manufacturing	34
Marathon Ashland Petroleum	Fuel industry	105
National Petrochemical and Refiners Association	Fuel industry	58
Natural Resources Defense Council	Environmental/health	44
Northeast States for Coordinated Air Use Management	State/local government	35
State and Territorial Air Pollution Program Administrators/ Association of Local Air Pollution Control Officials	State/local government	48
Western Independent Refiners Association	Fuel industry	27

Source: GAO analysis of EPA data.

We identified these stakeholders by first reviewing the list of organizations/persons commenting on EPA's proposed 2007 rule during the public comment period in 2000. EPA recorded over 700 separate comments on various issues relating to the rule. We used the number of issues on which individual organizations commented, as determined by EPA, as a proxy for the level of interest or concern by these organizations regarding EPA's 2007 rule. From EPA's response document, we identified over 500 separate commenters, ranging from individual citizens, local interest groups, and companies to national organizations representing major industries and environmental, health, and other interests. Using this information, we placed commenters in general categories reflecting the interests they represented, for example, the fuel industry or environmental and health interests. Within each category, we ranked the commenters based on the total number of issues on which each commented. From each category, we generally selected those commenters who addressed more

than 25. This approach eliminated all but 21 of the more than 500 commenters.

We then made several modifications to this list. First, we made an exception to retain the ATA, which commented on 24 issues, but which represents a large segment of the trucking industry, a key stakeholder affected by the 2007 rule. We also eliminated two commenters who represented agriculture interests, but addressed more than 25 issues because agricultural issues were not relevant to our review. Finally, we eliminated from our list most individual companies whose interests are represented by national organizations that were also on the list of contacts. We made this decision on the assumption that the national organization would reflect the concerns of the individual member companies that also commented. However, we included in our list Marathon Ashland Petroleum because of the large number of issues on which this company commented, although an organization representing its interests was also included. We also included Cummins, Incorporated; Detroit Diesel Corporation; and Navistar International Truck and Engine Corporation, three of the original seven engine manufacturers who were subject to the consent decrees, primarily because we wanted to discuss the effects of the decrees on their industry and took the opportunity to discuss issues relating to the 2007 standards as well.

In addition to the 16 organizations and companies identified through this process, we also contacted representatives of the refining and distribution sectors of the fuel industry to ensure that we had a broad range of views. These sectors did not appear to be represented among the commenting stakeholders, despite their key role in implementing the 2007 rule. These organizations included the Association of Oil Pipe Lines, the Independent Fuel Terminal Operators of America, the Independent Liquid Terminals Association, the Petroleum Marketers Association of America, and the Society of Independent Gasoline Marketers of America.

We asked all of these stakeholders to provide their views on whether the technologies needed to meet the 2007 standards would be available on time. We took a number of steps to try to assess the basis of support for stakeholders' views about the readiness of technology to meet the 2007 standards. First, we asked each engine manufacturer that we contacted if the company could provide us with data to demonstrate the status of technology development. However, the representatives said that it would be detrimental to reveal information about their technology designs or business operations because it might harm their competitive positions

relative to other companies. Alternatively, we evaluated the stakeholders' positions by considering publicly available information, including studies and reports issued on the technologies and on the development of the standards.

Because the representatives of the trucking companies we contacted had views about the availability, readiness, and costs of the engines for 2007 that differed from the other stakeholders, we took some additional steps to assess the basis of their views. For example, we asked the engine manufacturers and EPA officials to respond to the concerns raised by the trucking representatives, and where the manufacturers' and agency's views differed, we reflected them and the basis of their comments in the report for balance. We also considered the information we collected and the analyses we conducted in regard to the impacts of the 2002 consent decrees to determine if they offered any perspectives on the trucking industry's concerns about meeting the 2007 standards. For example, we used the information showing that: (1) the industry pre-bought older engines prior to October 2002 because companies did not have engines in time to test their reliability and possible costs; (2) companies that had bought the new engines determined both the purchase price, and operations and maintenance costs, were higher than estimated and anticipated; and (3) EPA developed its estimate of what it would cost to buy and operate new engines for 2007 in 2000, before technology designs were completed and selected to assess the trucking representatives' concerns about meeting the 2007 standards. We also used the information obtained from the engine manufacturers to assess the trucking industry's concerns about how soon test engines would be available, such as the fact that manufacturers were 6 months behind schedule in selecting the technology they would use to meet the standards.

We also asked all of the stakeholders we contacted to provide their views on EPA's efforts to ensure that the needed engine and fuel technologies will be available by 2007. We obtained information from EPA on their activities in this regard and provided a summary of these activities to the stakeholders we contacted and asked them for their views on the effectiveness of these efforts. We also discussed with the Director of EPA's Office of Transportation and Air Quality as well as program managers from the agency's Office of Air and Radiation (in Washington, D.C., and Ann Arbor, Michigan), their activities to ensure timely compliance with the standards, as well as their plans if the standards cannot be implemented on schedule.

We conducted our work between January 2003 and February 2004 in accordance with generally accepted government auditing standards.

Analysis of Class 8 Truck Production Data: January 1992 through June 2003

This appendix describes the econometric models we used to analyze the relationship between EPA's 1998 consent decrees with diesel engine manufacturers and subsequent demand for Class 8 trucks. We used quarterly data on U.S. and Canadian production of heavy-heavy-duty diesel trucks (classified by the industry as Class 8 trucks) for the years 1992 through 2003.[1] We also accounted for the possible effects of gross domestic product (GDP), diesel fuel prices, and seasonal factors on truck demand in our analysis.

After applying standard econometric techniques to control for possible biases in our analysis, we found that there was a significant increase in Class 8 truck production, ranging from about 19,000 to 24,000 trucks, in the 6 months before October 2002, which may be associated with EPA's consent decrees. These amounts represent 20 percent to 26 percent of the total 93,000 Class 8 diesel trucks produced in U.S. and Canadian plants during that 6-month period.

Theoretical Framework

To describe how EPA's consent decrees may have affected truck demand, we defined a binary variable, *CD*. *CD* takes the value of one for the 6-month period prior to October 2002 and the value of zero otherwise. In addition, since truck demand is likely to be seasonal, related to the strength of the economy, and related to diesel fuel prices, we included these three factors in our basic model.[2]

[1]This information is from Ward's Communications (http://wardsauto.com/reference_sample/index.htm).

[2]We tried to incorporate truck prices in our analysis to account for the price effects on truck demand. Because we did not have data on actual truck prices, we used the class-8 truck Producer Price Index (PPI) from the Bureau of Labor Statistics (BLS). To avoid biases that may arise when estimating truck price and demand simultaneously in one equation, we applied a 2SLS estimation technique. 2SLS is a technique that allows us to first estimate the influence of EPA's consent decrees on truck prices, and then to estimate truck prices' effects on truck demand. However, the consent decrees' effect on the truck production price index is not statistically significant. In addition, the subsequent effects of the truck production price index on truck demand vary widely in different specifications. For this reason, we decided to model EPA's consent decrees' effect on truck demand as in models (1) through (4).

$$Q_t=\beta_0+\gamma_1 T_1+\gamma_2 T_2+\gamma_3 T_3+\beta_1 \Delta GDP_t+\beta_2 DP_t+\beta_3 CD+\varepsilon_t, \quad (1)$$

where β_0, β_1, β_2, β_3, γ_1, γ_2, and γ_3 are coefficients to be estimated. Q_t, ΔGDP_t, and DP_t denote quarterly truck production,[3] annualized growth rate of real GDP, and real diesel fuel prices, respectively. T_1, T_2, *and* T_3 are binary variables, which, like *CD*, take values of one for specified quarters but the value of zero otherwise. The three binary variables, T_1, T_2, *and* T_3, are used to account for likely recurrent quarterly fluctuations in truck production. ε_t is a random error, to which all standard assumptions apply; t is the index for time period.

The GDP is an important indicator of the strength of the economy, which can be used by truck operators to gauge the strength of future demand for their services. We expect truck operators to purchase more trucks in response to a strong economy and vice versa, which implies a positive β_1 in equation (1). On the other hand, we expect truck operators to delay truck purchases if diesel fuel prices are increasing, because of the importance of fuel in operating trucks. As a result, we expect β_2 in equation (1) to be negative. Following the same reasoning, if companies pre-bought so that truck production increased in the 6 months prior to EPA's consent decrees, the coefficient of *CD*, β_3, will be positive in equation (1).

The basic model, as depicted by equation (1), may yield a biased estimate of the coefficient of *CD*, β_3, because it does not account for effects that may arise when the different factors interact with each other over time. To account for these possible effects, we revised the basic model (1) by assuming an autoregressive process of degree one, *AR(1)*,[4] and by including in the basic model (1) several lagged variables as below:

[3]Industry sources indicated that timing of truck production is closely tied to timing of truck purchases. As a result, we will characterize effects on truck production as also affecting truck purchases/demand hereafter.

[4]An autoregressive process (AR) is one of the most commonly used econometric techniques to account for temporal correlation across different time periods. In models (2) through (4), AR(1) assumes that the error term, ε_t, is defined as $\varepsilon_t=\rho\varepsilon_{t-1}+\mu_t$. The numbers for *AR(1)*, as shown in table 7 for the analysis results represent the coefficient ρ_7..

$$Q_t=\beta_0+\gamma_1 T_1+\gamma_2 T_2+\gamma_3 T_3+\beta_1 \Delta GDP_t+\beta_2 DP_t+\beta_3 CD+AR(1)+\mu_t, \quad (2)$$

$$Q_t=\beta_0+\gamma_1 T_1+\gamma_2 T_2+\gamma_3 T_3+\beta_1 \Delta GDP_t+\beta_2 DP_t+\beta_3 CD+\beta_4 Q_{t-1}+AR(1)+\mu_t, \quad (3)$$

$$Q_t=\beta_0+\gamma_1 T_1+\gamma_2 T_2+\gamma_3 T_3+\beta_1 \Delta GDP_t+\beta_2 DP_t+\beta_3 CD+\beta_5 \Delta GDP_{t-1}+\beta_6 DP_{t-1}+AR(1)+\mu_t \quad (4)$$

Including *AR(1)* in models (2) through (4) allows us to account for the possible temporal correlation or autocorrelation of factors that we did not consider—for example, truck insurance premiums and used truck prices, among other factors—with GDP or fuel prices. We included Q_{t-1}, as in model (3), because truck production in the current period is closely associated with production in previous periods. In model (4), we included the lagged GDP growth rate, ΔGDP_{t-1}, and fuel prices, DP_{t-1}, in the previous period because truck operators may purchase more trucks in response to strong growth rates in GDP in previous periods, and they may delay truck purchases when diesel fuel prices have been increasing in previous periods.

Data Used in the Estimation

Data on Class-8 Truck Production in U.S. and Canadian Factories

Although EPA's consent decrees directly affected the cost and engineering of diesel engines, data on diesel engine prices were not available. Therefore, we used data on quarterly Class-8 truck production in the

United States and Canada from 1992 through June 2003.[5] Most of these Class-8 trucks—vehicles weighing more than 33,001 pounds—are powered by diesel engines that are subject to EPA's consent decrees. These data were obtained from a commercial company, Ward's Communications.

GDP and Diesel Fuel Prices

We obtained data on GDP from the Bureau of Economic Analysis (BEA) within the Department of Commerce. We computed retail diesel fuel prices using data on wholesale diesel fuel prices from the U.S. Energy Information Administration within the Department of Energy, and the weighted state tax and federal tax on diesel from the Federal Highway Administration (FHA) within the Department of Transportation. In addition, we adjusted diesel fuel prices to 1996 price levels to account for inflation within the study periods using GDP chain-price levels.[6]

Other Data We Used

According to truck manufacturers we contacted, EPA's consent decrees have resulted in higher prices for new trucks equipped with compliant diesel engines. The higher prices may increase demand for substitutes, such as trucks with noncompliant engines or used trucks. In order to account for pricing effects on truck demand, we used the Class-8 truck PPI from BLS because actual truck prices data were not available.

In addition to using GDP in our analysis, we used the American Trucking Association's (ATA) truck tonnage index and the GDP less expenditures on

[5]Truck production is closely tied to diesel engine production with a slight lag. In addition, for the best measurement, we intended to include only trucks produced, domestically or abroad, for U.S. domestic consumption and exclude those produced for overseas markets. However, this approach would not allow us to include in our analysis data from 1992 through 1997, because Ward's included separate domestic and export data for Class-8 truck production in the United States and Canada only after 1997. Prior to 1998, truck production data were aggregated for both the United States and Canada. The aggregate U.S. and Canadian truck production should reflect closely the number of trucks produced, domestically or abroad, for operation in the United States because the total Canadian truck production was about one-sixth the size of total U.S. and Canada production, about three-quarters of the total Canadian production were exported to the United States, and about 86 percent of the Class-8 trucks produced in the United States are for domestic consumption (calculations based on Ward's data on U.S. and Canadian production from 1998 through the first half of 2003).

[6]We made this adjustment in order to be consistent with BEA's inflation adjustment for GDP at 1996 price levels.

services as alternative measures for GDP. These two indicators are more closely related to truck production than GDP.

Table 6 shows descriptive statistics of the three key variables used in the estimation.

Table 6: Descriptive Statistics of Variables Used in Our Analysis

	Quarterly truck production in the United States and Canada	Annualized GDP growth rate at 1996 price levels	Retail diesel price at 1996 price levels
Mean	51,918	3.13	118.55
Median	51,280	3.09	116.31
Maximum	78,530	6.89	146.67
Minimum	32,154	-1.60	92.99
Standard deviation	13,480	2.06	11.59
Number of observations	45	45	45

Discussion of Results of Analysis

Table 7 presents the results of our analysis using total quarterly class-8 truck production in the United States and Canada as the dependent variable.

Table 7: Results of Selected Specification (t-statistics in parentheses)

Model	(1)	(2)	(3)	(4)
Constant	98201.29*** (4.45)	75056.79*** (4.42)	33086.15*** (2.88)	82488.69*** (3.6)
T_1 *(2nd quarter)*	1563.85 (0.30)	2193.17 (1.62)	2004.48* (1.78)	2314.14 (1.54)
T_2 *(3rd quarter)*	71.51 (0.013)	-832.04 (-0.54)	-3279.56** (-2.44)	-800.93 (-0.48)
T_3 *(4th quarter)*	-1646.69 (-0.30)	-2.56 (-0.0018)	-160.96 (-0.14)	-230.52 (-0.15)
Q_{t-1}	—	—	0.77*** (5.77)	—
ΔGDP_t	1607.96 (1.57)	309.53 (0.99)	455.49* (1.76)	482.32 (1.23)
ΔGDP_{t-1}	—	—	—	231.26 (0.58)
DP_t	-431.08** (-2.47)	-186.19 (--1.63)	-186.67** (-2.37)	-148.48 (-1.19)
DP_{t-1}	—	—	—	-112.06 (-0.92)
CD	-5529.72 (-0.60)	10099.04** (2.7)	12015.87*** (4.02)	9397.99** (2.42)
AR(1)	—	0.92*** (15.46)	0.62*** (2.74)	0.91*** (13.56)
Adj. R^2	0.153	0.871	0.933	0.862
DW statistic	0.352	0.839	1.945	0.945
Number of observations	45	44	44	43

Source: GAO analysis.

Note: *, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent level, respectively.

In addition, we performed various analyses using alternative combinations and definitions of variables to test if our analysis results are sensitive to the choices of variables.[7] The range of estimates produced using model specifications (2) through (4) also do not vary much with respect to what choices of variables we considered in the analysis.

Results of Model (1)

In the basic model (1), only the diesel price in the current period, DP_t, and the constant term, C, are statistically significant. The low value of the adjusted R-squared statistic, (0.153), suggests that much of the variation of Q_t is not explained by the included variables. In addition, the Durbin-Watson (DW) statistic of 0.352, which is less than the critical value of 1.019 for a sample size of 45 with 7 explanatory variables at the 1 percent significance level, suggests a strong positive autocorrelation of residuals between the current and previous periods.

Results of Model (2)

We controlled for the possible autocorrelation, suggested by the low DW statistic in model (1), by modeling the error term as a first-order autoregressive process, AR(1), in model (2). As shown in table 7, the adjusted R^2 statistic improves significantly to 0.87, explaining more of the variation in truck production. The DW statistic also improves significantly to suggest the effectiveness of AR(1) correction for the error terms and indicates a positive autocorrelation of residuals between the current and previous periods.[8] More importantly, only the coefficient of CD and the constant term are statistically significant, suggesting an increase of 20,198 (the coefficient 10,099 multiplied by 2) Class-8 trucks in the 6 months prior to EPA's consent decrees. This increase in truck production may be associated with the decrees.

[7]For example, we substituted GDP with two other measures: GDP less consumption expenditures on services, and ATA's tonnage index. In some analyses, we used annualized percentage change in diesel prices instead of diesel fuel prices at 1996 dollars. In addition, we experimented with different time lags. The results produced using model specifications (2) through (4) with these alternative estimates consistently showed a signifcant increase in truck production associated with EPA's consent decrees. For example, when we re-estimated models (1) through (4) using GDP less expenditures on services, the coefficients of *CD* in models (1) through (4) are –5926.10, 10080.32, 11954.69, and 9381.81, respectively. The above coefficients for models (2) through (4) are statistically significant at the 5 percent level.

[8]The DW statistic of 0.839 is still less than the critical value of 0.974 for a sample size of 45 with 8 explanatory variables at the 1 percent significance level.

Results of Model (3)

For model (3), we added truck production in the previous period, Q_{t-1}, to model (2) to account for the effects of truck inventories. As a result, CD's coefficient increases. The coefficient of ΔGDP_t increased appreciably and becomes statistically significant. The coefficient of DP_t changes little and also becomes statistically significant. The coefficient of Q_{t-1} is positive and statistically significant, suggesting that an increase in truck production in the previous period is likely to be followed by an increase in production in the current period. The high-adjusted R^2 statistic of 0.933 also suggests that much of the variation of Q_t is explained by the included variables. The DW statistic of 1.945 unambiguously suggests that including truck production in the previous period can adequately account for the autocorrelation in the error terms.[9]

Results of Model (4)

In model (4), we added ΔGDP_t, and DP_t of previous periods to model (2) because they also may be good indicators of truck production in the current period. Compared to model (3), including the additional lagged variables to model (2) does not enable us to explain more of the variation in truck production as suggested by a decreasing adjusted R^2 statistic. Like model (2), the DW statistic of model (4) indicates that autocorrelation is still present.

The results of models (2) through (4) suggest that the coefficient of CD is fairly robust to the choice of variables used in the estimation. They also suggest that EPA's consent decrees may be associated with a significant increase in truck production from March through September 2002, the 6 months prior to implementation of the pull-ahead provision of the consent decrees.

Limitation

Our analysis considers only the truck operators' strategy of accelerating their purchases, or pre-buy, in the 6 months leading up to EPA's consent decrees. Truck operators could also comply with EPA's consent decree by buying used trucks, having existing engines remanufactured, or extending the life of the existing fleet. Any of these responses would have resulted in lower truck production. However, in the absence of data on these other

[9]The DW statistic of 1.945 is greater than the critical value of 1.834 for a sample of 45 with 9 explanatory variables (Source: Greene, William H., *Econometric Analysis*, Prentice-Hall, Inc., 1993, pp.738-739).

strategies, our analysis does not assess the full extent of the effects of EPA's consent decrees on truck operators' business operations.

Comments from the Environmental Protection Agency

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

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

February 24, 2004

OFFICE OF
AIR AND RADIATION

Mr. John B. Stephenson
Director, Natural Resources and Environment
United States General Accounting Office
Washington, DC 20548

Dear Mr. Stephenson:

Thank you for your letter of February 3, 2004, to Administrator Leavitt providing a draft copy of the report, "*EPA Could Maximize the Benefits from the 2007 Diesel Emissions Standards By Better Addressing Industry Concerns*." The 2007 Clean Diesel Program for fuel and engines is among the top environmental priorities for this Administration. The health and economic benefits from the program far outweigh the costs. In recent weeks, Administrator Leavitt and I have been working to highlight this program and to reiterate the Administration's commitment to its successful implementation. We appreciate the opportunity to comment on the draft report.

In many key respects, the report is consistent with our assessment of the situation leading up to the implementation of the 2007 standards. For example, the draft report accurately states that *"Stakeholders designing new emissions control, engine, and fuel technologies say they will be ready." "All of the engine manufacturers reported that they expect to have engines ready by 2007." "The [fuel] representatives agreed that EPA should make no changes to the 2007 rules implementation dates and low sulfur diesel fuel requirements."* These statements – which reflect the views of the companies that must comply with the 2007 program – are consistent with our own analysis of the progress that these industries have made in complying with the new standards.

When we heard that GAO was undertaking its own study of the 2007 program, we hoped that GAO would carefully analyze the concerns being expressed by some trucking companies. We have worked with GAO over the last year providing detailed information on the program because we recognized the value that this report could have in providing additional reassurance to the trucking industry.

See comment 1.

I must say, however, that we were disappointed to see that, instead of analyzing the validity of trucking industry concerns, the draft report is much more limited. For the most part, it simply repeats those concerns, and then explains why EPA, engine makers, and the fuel suppliers believe that those concerns are not valid. In many instances, the report goes on at great length about the truckers concerns and then only briefly summarizes all the work that has been done to address those concerns. As a result, the report will leave some readers with the incorrect impression that there is substantial uncertainty about the readiness of engine makers and fuel

Internet Address (URL) • http://www.epa.gov
Recycled/Recyclable • Printed with Vegetable Oil Based Inks on 100% Postconsumer, Process Chlorine Free Recycled Paper

suppliers to meet the 2007 standards. This is not supported by the statements and actions of the regulated industries as they prepare for 2007 implementation.

See comment 2.

Your staff provided an early draft of a statement of facts to the Agency for review in December 2003. In response, we provided extensive comments to GAO including detailed information and evidence regarding a number of the issues raised in the statements of some stakeholders. We hoped that GAO would use this information, and other information it had gathered, to test the validity of claims made by some in the trucking industry. We appreciate the fact that GAO removed the most blatantly erroneous statements, but we are disappointed that the draft report still leaves other statements unquestioned and unverified. This relegates EPA's extensive rulemaking record and subsequent studies and analyses to mere opinions and then juxtaposes them to the opinions of others, well founded or not. A few examples are highlighted in this letter, but we believe that the whole report would be much more useful if it actually evaluated the merits of the various stakeholder opinions, rather than simply restating them.

See comment 3.

GAO's Description of Engine Manufacturer Readiness for 2007

The Agency has invested considerable effort to be fully engaged with the engine industry and to understand well the state of technology progress for 2007. It is clear from our work, and further evidenced by the public statements from the major engine manufacturers, that the heavy-duty trucking industry is well positioned to meet the standards on time in 2007. Given these very clear statements from the industry, the overall negative tone of the report in describing readiness for 2007 is surprising and potentially misleading.

The report makes a number of characterizations regarding engine manufacturer plans for early fleet testing in 2005, but it should also clearly state that all major engine makers have committed to having test engines ready for customers by certain dates. We think it would be better to be clear. Volvo has said it will have early test vehicles in fleets by spring 2005.[1] Mack has said by mid-2005.[2] Cummins has said by mid-2005.[3] Caterpillar has said by mid-2005.[4] Detroit Diesel has said by mid-2005.[5] Within the last few days, we have called each of these manufacturers, and they all assure us that they plan to meet these commitments. We do not see how clear statements regarding readiness from the regulated industry can be construed in any

[1] Press Release: "Volvo Trucks Selects EGR for 2007 Emission Reduction Technology," January 28, 2004.

[2] "Mack Plans to Redesign Vocational Truck Engines," Transport Topics February 9, 2004 page 41.

[3] "Cummins Says '07 Units Will Get Early Testing," Transport Topics, January 12, 2004 pages 3, 28.

[4] Caterpillar, June 10, 2003 ATA/TMC Diesel Engine Emission Summit Presentation, slide 5.

[5] Detroit Diesel Corporation, June 10, 2003 ATA/TMC Diesel Engine Emission Summit Presentation slides 31 and 32.

way other than to conclude the engine manufacturers will be providing the trucking industry with test vehicles well in advance of the 2007 deadline. This is our conclusion based on our understanding of the technical details and the clear statements of the engine manufacturers.

The draft report also accepts without analysis or question the premise that trucking companies must have test vehicles no later than June 30, 2005 for evaluation. The report further creates the impression that failure to deliver against this date is somehow indicative of an engine industry that is behind in its preparations for 2007. We do not understand why GAO believes that June 30 is a critical deadline. In this regard, the report simply appears to accept the views of one set of stakeholders without any analysis or discussion of standard practices within the industry.

We (and more importantly, the engine makers) understand that trucking companies would like to have as much time as possible to evaluate the new engines for reliability and fuel efficiency under all conditions. We are working with all stakeholders (including engine manufacturers, which already have a strong incentive to satisfy their customers) on the introduction of test engines and sufficient amounts of 15 ppm fuel by mid-2005. EPA, engine makers, and fuel suppliers are all highly confident that this goal will be met.

See comment 3.

GAO's Description of Oil Industry Issues

Here, as with engine readiness, the strongly negative tone of the report is surprising given the clear indications from the regulated industry. We agree that there are a number of technical challenges related to the production and distribution of 15 ppm sulfur fuel throughout the country. In fact, we detailed these challenges in the 2007 rulemaking and clearly stated how we believed they would be addressed in the coming years. Further, we have continued to work closely with the industry to address implementation issues (e.g., sulfur measurement methods). Thus, when refining industry representative plainly say that their industry will be ready in 2007 and that they do not desire any changes to the program, they are making these statements based on complete knowledge of the issues they face. They know the challenges and are confident that they will successfully overcome them on time. Yet the report leaves the reader with the incorrect impression that the challenges are overly daunting and that the industry is unable to address them. This impression is simply wrong.

We provided to GAO a copy of our summary pre-compliance report detailing the industry's own refiner by refiner estimates of production volumes for 2007. The report aggregates each refiner's own estimates for 2007 and finds that overall diesel fuel volumes will match the projected demand for 2007 and that more than 95% of diesel fuel volume will be 15 ppm sulfur diesel fuel. These conclusions reflect the industry's own best estimate of what will happen in 2007. As currently drafted, the report implies that EPA's summary pre-compliance report is merely EPA's opinion, rather than the industry's own predictions for 2007. Intentionally or otherwise, the GAO report in repeating the implementation challenges creates the impression that these are predictions by industry of likely outcomes. There is a very important

difference between a concern that industry will work to address and a prediction that these concerns will come to pass. Industry's projection, clearly stated in its own pre-compliance data submissions, are that these challenges will be addressed and the program can and should be implemented on time.

See comment 4.

GAO Draws an Inappropriate Comparison Between the Consent Decrees and 2007

The report suggests that the 2002 heavy-duty engine consent decree experiences are in some way representative of GAO's expectations for 2007. Whether this is GAO's opinion or simply the result of GAO's attempts to characterize the opinions of some in the trucking industry opinions, it is simply wrong. The consent decree process was significantly different from a rulemaking process and was substantially distorted by the long term use of defeat devices that masked the cost of compliance with emission regulations since 1988. These differences are clear and important to understanding what can be learned from the 2002 experience. The 2007 program, as contrasted to the consent decrees, was developed through a public rulemaking process, contains substantial lead-time, and includes a number of flexibilities for the regulated industries designed to facilitate implementation. We believe GAO should not simply accept the opinions of some that the 2002 experience is telling for 2007. Instead, it should critically analyze this proposition in light of the substantial differences between the 2002 consent decrees and the 2007 rulemaking.

See comment 5.

The Draft Report Incorrectly Suggests that the Agency Has Not Engaged Industry

Especially troubling are the suggestions in the report that the Agency failed to engage the trucking industry in the 2007 rulemaking process, and further that the Agency did not appropriately consider the issues raised by the industry in developing the HD 2007 rule. EPA takes particular pride in its outreach efforts to all stakeholders and is diligent in its work to address the concerns of stakeholders in developing regulatory programs. I personally take the Agency's responsibility to engage stakeholders very seriously. To suggest that stakeholders were unrepresented in the 2007 rulemaking process is simply inaccurate.

See comment 6.

GAO's Recommendations for EPA

Based on the stakeholder opinions summarized in the report, GAO suggests that the Agency consider two possible actions: 1) to consider creating another independent panel to address the trucking industries concerns regarding the readiness for 2007; and 2) to consider the cost effectiveness of economic incentives.

As the report acknowledges, the Agency is conducting a comprehensive implementation program designed to ensure that 2007 is implemented as smoothly as possible. We intend to continue this extensive work and will continue to seek input from all stakeholders regarding actions the Agency can take to make sure the 2007 program is a success.

We understand that there is concern in the trucking industry regarding this program. We take those concerns seriously, and we are continuing to work with that community of stakeholders. However, we believe it would be a mistake to create a second independent review panel as a mechanism to reduce uncertainty. Such an independent review panel would be far more likely to create uncertainty where none need exist now. As the report indicates, the regulated industries *"believe the certainty the 2007 deadline provides, such as knowing what is required, is key to successfully implementing the standards in a timely and cost effective manner"*. Even GAO recognizes that an independent review panel could "*unduly delay progress*". In the end this is a result that no one wants. We believe that our ongoing progress reviews, the second of which will be released soon, are a better method for the Agency to monitor industry progress, to report out on industry status and to be prepared to address any implementation issues that could arise in the coming years.

We also note GAO's suggestion that EPA *"consider the cost-effectiveness of economic incentives"*. We do not dispute that there might be merit in introducing additional economic incentives beyond those already incorporated in the rule. As you know, however, the Agency has no authority to set tax policy and will have to look to Congress for direction and funding should such a program be worthwhile.

Finally, I want to reassure you that we take very seriously the input of our stakeholders and the suggestions of GAO. We intend to continue our progress reviews to address the concerns expressed by some in the trucking industry, and we would be happy to work with Congress to consider the advantages that financial incentives could provide.

Sincerely,

Jeffrey R. Holmstead
Assistant Administrator

The following are GAO's comments on the Environmental Protection Agency's letter dated February 24, 2004.

GAO Comments

As a preface to addressing EPA's specific comments on this report below, GAO wants to reiterate that it recognizes how critical the anticipated emissions reductions are for many states whose air quality is in trouble, how critical it is for the 2007 standards to succeed in order to significantly reduce emissions and protect public health, and all of the work and investment the agency and the engine, emissions control, and fuel industries have made. These critically important objectives, however, depend to a large extent on trucking companies' decisions to buy and run the improved engines. In our view, EPA has an important window of opportunity to make some improvements in the process it is using to work with stakeholders to both ensure technology is ready and allay any remaining stakeholder concerns about the new engines and fuel. Addressing concerns about whether fuel will be available in sufficient quantities and locations and the new engines will be ready in time to test should not be overly burdensome and will help to prevent a significant pre-buy of older engines before 2007 that would delay emissions and health benefits as occurred in 2002.

1. EPA agrees that, in many respects, GAO's report is consistent with the agency's assessment of the situation leading up to the implementation of the 2007 standards. However, we do not agree with EPA's assertion that we gave disproportionate weight and consideration to the views of the trucking industry which conflict with the agency's assessment for the following reasons. First, we carefully and consistently collected the views of all stakeholders—engine and emissions control manufacturers, trucking companies, fuel industry representatives, and environmental and health groups—and were equally careful to accurately present and assess their views. Consistent with our methodology and quality assurance standards, we also did not simply accept stakeholders' views at face value, but did where possible assess the basis for their views. For example, we determined that the trucking company representatives' concerns about the reliability and costs of the new engines were based on the technological leap required to meet the 2007 standards; that EPA's estimates of the new engines' costs were developed in 2000 before engine designs were developed; and that some of the engine manufacturers and fuel industry representatives designing the technologies acknowledged that there were remaining technological risks and questions. We also carefully point out that we

were unable to fully confirm some of the views and opinions of stakeholders because the industries designing new engine and fuel technology were not comfortable in releasing information about their individual designs. In addition, we reviewed reports EPA issued on the progress towards the standards, but the reports primarily represented EPA's conclusions and did not present the specific data on which these were based.

2. We also disagree with EPA's assertion that we did not consider additional information and evidence that agency program managers provided to GAO late in the course of our work after reviewing a draft summary of the facts to be used in the report. Throughout our review, we worked closely with the EPA program managers responsible for the 2007 standards to ensure that we clearly understood the issues and EPA's positions, and had the most current information. In addition, to ensure the accuracy of the information in our report, at the conclusion of our work, we provided EPA program managers a summary of the factual information supporting our findings for their review. At that time, EPA provided extensive written comments on the summary, along with a number of press releases from engine manufacturers and trade press articles. However, the agency did not provide any additional quantitative data or other information that would allow us to better assess the stakeholders' positions. We spent considerable time carefully assessing EPA's comments and the additional information and made a number of changes to the report where appropriate. Furthermore, we extended our report time frame by 6 weeks to give EPA extra time to provide its comments and supporting information and for us to carefully assess it and respond accordingly.

3. We also disagree with several EPA assertions that the report has an overall negative tone and overstates the technological challenges to successfully deliver the necessary fuel and engines, does not clearly state engine manufacturers' commitments to have test engines ready in time, and accepts at face value the trucking representatives' position that having test vehicles by mid-2005 is a critical deadline. We devote considerable narrative to the views of the agency and all the stakeholders who share these views that the technologies—for both cleaner engines and low-sulfur fuel—are on track. In addition, though, we have a professional responsibility to acknowledge that some stakeholders—including some engine manufacturers and fuel distribution and trucking industry representatives—expressed concerns over the remaining technological risks and questions. As

such, we accurately describe these challenges and the concerns they create. For example, EPA asserts that the report projects a negative tone with regard to the progress of the oil industry in preparing to supply low-sulfur fuel for 2007. However, we report that the fuel industry stakeholders we contacted identified a number of remaining issues that need to be resolved, none of which they considered to be insurmountable. We reviewed EPA's summary of pre-compliance reports detailing refiners' plans to produce low-sulfur fuel and agree that the refiners' ability to produce the fuel does not appear to be an area of concern. However, these reports do not address the primary concerns that industry representatives raised, which relate to distribution challenges. As we make clear in the report, without trying to further alleviate these and other stakeholder concerns, the agency may not achieve its emissions and public health goals with the 2007 standards.

We also took great care to include the most current information possible in our report. For example, in January 2004, we updated our report to reflect that engine companies had finally publicly announced the technologies they would use to meet the 2007 standards, although 6 months later than planned. In addition, after several of the manufacturers subsequently issued press releases in January and February 2004, stating that they expected to have at least a limited number of prototype engines ready for testing by mid-2005, we re-contacted the trucking company representatives to determine the extent to which these announcements addressed their concerns, and updated the report accordingly.

Additionally, GAO does report the trucking representatives' position that they need to have prototypes by about mid-2005, as well as the basis for their position, which is to (a) determine engine reliability in all seasons and weather conditions and for long enough periods to determine the resulting operating and maintenance impacts, and (b) subsequently develop their acquisition strategies based on this information. These arguments seem plausible. However, more importantly, we report their position because some of the representatives said that without enough testing time, companies were already considering whether to pre-buy older engines before 2007, in larger quantities than they did for 2002, further jeopardizing emissions and health benefits. We believe that this is the important concern EPA needed to be aware of and try to mitigate. We did not attempt to confirm the validity of the 18-24 month testing time frame

representatives said they needed for the 2007 standards with the industry's historical time frames to test upgraded engines. In part, we did not because the engine designs for 2007 are a technological leap over current equipment and may require longer lead times to develop. Similarly, they may need longer lead times for testing.

4. We agree with EPA's concern about clearly distinguishing the 2002 consent decrees and 2007 standards, and made changes to the report as a result. The engine requirements established in the consent decrees were done as part of a legal settlement in response to an enforcement action, not through a public rulemaking process where all stakeholders had input into establishing the requirements. In addition, the engine companies had a relatively small amount of lead time to design the new engines because as part of the settlement, manufacturers agreed to accelerate the schedule for new engines by 15 months. In contrast, the 2007 standards were developed through a more extensive public rulemaking process with wide participation from all stakeholders, and manufacturers and fuel refiners had about 6 years lead time to develop the needed emissions control, engine, and fuel technologies. We disagree with EPA, however, that these two actions are not comparable in any respect. Whether new engines are being designed in response to an enforcement action or rulemaking, the industry's market reaction to the consent decrees may offer some lessons learned that EPA could incorporate into its process for implementing the 2007 standards.

5. We agree that EPA deserves credit for the large number of voluntary activities it has undertaken to work with various stakeholders to help ensure that the technology will be ready in time and devote considerable narrative to describing these activities in the report. We were also very careful to present a balanced view of the stakeholders' opinions about the agency's activities. For this reason, we were obligated to acknowledge that some of the engine manufacturers and trucking representatives raised questions about the agency's openness to their concerns and willingness to address them. EPA maintains that the agency had extensive involvement with stakeholders—including the trucking industry—in developing the 2007 rule. This is true. However, the trucking industry's concerns are not with the 2000 rulemaking process, but with the process EPA has used since then to involve stakeholders in implementing the standards. For example, as we note in the report, EPA officials acknowledged that the agency initially did not invite anyone from the trucking industry to participate

on the 2002 Clean Diesel Independent Review Panel and only did so after the industry lobbied the agency.

6. As to GAO's recommendations, EPA agrees with the merits of providing financial incentives—although the agency does not see a role for itself in this action—and disagrees with the merits of convening an independent panel. We want to clarify that GAO is recommending that the agency consider additional steps to alleviate existing concerns, avoid a significant pre-buy of older engines, and better guarantee that the emissions and health benefits are achieved. We thereby offer several alternative actions for the agency to consider, but do not intend to limit the agency in any way to these alternatives or suggest that they are the only effective means to resolve concerns. That said, with regard to the suggestion of using financial incentives, we recognize that the Congress must provide the agency direction and funding for such an approach, but expect that it would also look to the agency to play a role, such as submitting a proposal for incentives or at least helping to determine their merits and costs. As to convening an independent review panel, we appreciate EPA's concerns that this could unnecessarily delay the schedule for implementing the standards, and the agency is in the best position to determine this. But, if EPA has the necessary evidence available to demonstrate technologies are ready as it contends it does, it should not be difficult or take considerable time for an independent body to review the data and validate this conclusion for all affected stakeholders. Otherwise, if the trucking industry remains concerned and pre-buys older engines prior to 2007, this will in effect delay implementation of the standards and their anticipated benefits.

GAO Contacts and Staff Acknowledgments

GAO Contacts

John B. Stephenson (202) 512-3841
Eileen R. Larence (202) 512-6510
Vincent P. Price (202) 512-6529

Acknowledgments

In addition to the individuals named above, Charles W. Bausell, Jr., Tyra DiPalma-Vigil, Richard Frankel, Terence Lam, and Eugene Wisnoski made key contributions to this report. Important contributions were also made by Nancy Crothers and Amy Webbink.

GAO's Mission

The General Accounting Office, the audit, evaluation and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through the Internet. GAO's Web site (www.gao.gov) contains abstracts and full-text files of current reports and testimony and an expanding archive of older products. The Web site features a search engine to help you locate documents using key words and phrases. You can print these documents in their entirety, including charts and other graphics.

Each day, GAO issues a list of newly released reports, testimony, and correspondence. GAO posts this list, known as "Today's Reports," on its Web site daily. The list contains links to the full-text document files. To have GAO e-mail this list to you every afternoon, go to www.gao.gov and select "Subscribe to e-mail alerts" under the "Order GAO Products" heading.

Order by Mail or Phone

The first copy of each printed report is free. Additional copies are $2 each. A check or money order should be made out to the Superintendent of Documents. GAO also accepts VISA and Mastercard. Orders for 100 or more copies mailed to a single address are discounted 25 percent. Orders should be sent to:

U.S. General Accounting Office
441 G Street NW, Room LM
Washington, D.C. 20548

To order by Phone: Voice: (202) 512-6000
TDD: (202) 512-2537
Fax: (202) 512-6061

To Report Fraud, Waste, and Abuse in Federal Programs

Contact:

Web site: www.gao.gov/fraudnet/fraudnet.htm
E-mail: fraudnet@gao.gov
Automated answering system: (800) 424-5454 or (202) 512-7470

Public Affairs

Jeff Nelligan, Managing Director, NelliganJ@gao.gov (202) 512-4800
U.S. General Accounting Office, 441 G Street NW, Room 7149
Washington, D.C. 20548

United States
General Accounting Office
Washington, D.C. 20548-0001

Official Business
Penalty for Private Use $300

Address Service Requested

Presorted Standard
Postage & Fees Paid
GAO
Permit No. GI00