Federal Register

Thursday,
February 10, 2000

Part II

Environmental Protection Agency

40 CFR Parts 80, 85, and 86

Control of Air Pollution From New Motor Vehicles: Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements; Final Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 80, 85, and 86

[AMS–FRL–6516–2]

RIN 2060–AI23

Control of Air Pollution From New Motor Vehicles: Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: Today's action finalizes a major program designed to significantly reduce the emissions from new passenger cars and light trucks, including pickup trucks, vans, minivans, and sport-utility vehicles. These reductions will provide for cleaner air and greater public health protection, primarily by reducing ozone and PM pollution. The program is a comprehensive regulatory initiative that treats vehicles and fuels as a system, combining requirements for much cleaner vehicles with requirements for much lower levels of sulfur in gasoline. A list of major highlights of the program appears at the beginning of the **SUPPLEMENTARY INFORMATION** section of this **Federal Register**.

The program we are finalizing today will phase in a single set of tailpipe emission standards that will, for the first time, apply to all passenger cars, light trucks, and larger passenger vehicles operated on any fuel. This set of ''Tier 2 standards'' is feasible and the use of a single set of standards is appropriate because of the increased use of light trucks for personal transportation. The miles traveled in light trucks is increasing and the emissions from these vehicles are thus an increasing problem. This approach builds on the recent technology improvements resulting from the successful National Low-Emission Vehicles (NLEV) program.

To enable the very clean Tier 2 vehicle emission control technology to be introduced and to maintain its effectiveness, we are also requiring reduced gasoline sulfur levels nationwide. The reduction in sulfur levels will also contribute directly to cleaner air in addition to its beneficial effects on vehicle emission control systems. Refiners will generally install additional refining equipment to remove sulfur in their refining processes. Importers of gasoline will be required to import and market only gasoline meeting the sulfur standards. Today's action also introduces an averaging, banking, and trading program to provide flexibility for refiners and ease implementation of the gasoline sulfur control program.

The overall program focuses on reducing the passenger car and light truck emissions most responsible for causing ozone and particulate matter problems. Without today's action, we project that emissions of nitrogen oxides from these vehicles will represent as much as 40 percent of this ozone-forming pollutant in some cities, and almost 20 percent nationwide, by the year 2030.

Today's program will bring about major reductions in annual emissions of these pollutants and also reduce the emissions of sulfur compounds resulting from the sulfur in gasoline. For example, we project a reduction in oxides of nitrogen emissions of at least 856,000 tons per year by 2007 and 1,236,000 by 2010, the time frame when many states will have to demonstrate compliance with air quality standards. Emission reductions will continue increasing for many years, reaching at least 2,220,000 tons per year in 2020 and continuing to rise further in future years. In addition, the program will reduce the contribution of vehicles to other serious public health and environmental problems, including VOC, PM, and regional visibility problems, toxic air pollutants, acid rain, and nitrogen loading of estuaries.

Furthermore, we project that these reductions, and their resulting environmental benefits, will come at an average cost increase of less than $100 per passenger car, an average cost increase of less than $200 for light trucks, and an average cost increase of about $350 for medium-duty passenger vehicles, and an average increase of less than 2 cents per gallon of gasoline (or about $120 over the life of an average vehicle).

DATES: This rule is effective April 10, 2000.

The incorporation by reference of certain publications contained in this rule are approved by the Director of the Federal Register as of April 10, 2000.

ADDRESSES: *Comments:* All comments and materials relevant to today's action have been placed in Public Docket No. A–97–10 at the following address: U.S. Environmental Protection Agency (EPA), Air Docket (6102), Room M–1500, 401 M Street, S.W., Washington, D.C. 20460. EPA's Air Docket makes materials related to this rulemaking available for review at the above address (on the ground floor in Waterside Mall) from 8:00 a.m. to 5:30 p.m., Monday through Friday, except on government holidays. You can reach the Air Docket by telephone at (202) 260–7548 and by facsimile at (202) 260–4400. We may charge a reasonable fee for copying docket materials, as provided in 40 CFR Part 2.

FOR FURTHER INFORMATION CONTACT: Carol Connell, U.S. EPA, National Vehicle and Fuels Emission Laboratory, 2000 Traverwood, Ann Arbor MI 48105; Telephone (734) 214–4349, FAX (734) 214–4816, E-mail connell.carol@epa.gov.

SUPPLEMENTARY INFORMATION:

Highlights of the Tier2/Gasoline Sulfur Program

For cars, and light trucks, and larger passenger vehicles, the program will—

- Starting in 2004, through a phase-in, apply for the first time the same set of emission standards covering passenger cars, light trucks, and large SUVs and passenger vehicles. These emission levels (''Tier 2 standards'') are feasible for these vehicles. The Tier 2 standards are also appropriate because of the increased use of light trucks for personal transportation—the miles traveled in light trucks is increasing and the emissions from these vehicles are thus an increasing problem.
- Introduce a new category of vehicles, ''medium-duty passenger vehicles,'' thus bringing larger passenger vans and SUVs into the Tier 2 program.
- During the phase-in, apply interim fleet emission average standards that match or are more stringent than current federal and California ''LEV I'' (Low-Emission Vehicle, Phase I) standards.
- Apply the same standards to vehicles operated on any fuel.
- Allow auto manufacturers to comply with the very stringent new standards in a flexible way while ensuring that the needed environmental benefits occur.
- Build on the recent technology improvements resulting from the successful National Low-Emission Vehicles (NLEV) program and improve the performance of these vehicles through lower sulfur gasoline.
- Set more stringent particulate matter standards.
- Set more stringent evaporative emission standards.

For commercial gasoline, the program will—

- Significantly reduce average gasoline sulfur levels nationwide as early as 2000, fully phased in in 2006. Refiners will generally add refining equipment to remove sulfur in their refining processes. Importers of gasoline will be required to import and market only gasoline meeting the sulfur limits.

• Provide for flexible implementation by refiners through an averaging, banking, and trading program.

• Encourage early introduction of cleaner fuel into the marketplace through an early sulfur credit and allotment program.

• Apply temporary gasoline sulfur standards to certain small refiners and gasoline marketed in a limited geographic area in the western U.S.

• Enable the new Tier 2 vehicles to meet the emission standards by greatly reducing the degradation of vehicle emission control performance from sulfur in gasoline. Lower sulfur gasoline also appears to be necessary for the introduction of advanced technologies that promise higher fuel economy but are very susceptible to sulfur poisoning (for example, gasoline direct injection engines).

• Reduce emissions from NLEV vehicles and other vehicles already on the road.

Regulated Entities

This action will affect you if you produce new motor vehicles, alter individual imported motor vehicles to address U.S. regulation, or convert motor vehicles to use alternative fuels. It will also affect you if you produce, distribute, or sell gasoline motor fuel.

The table below gives some examples of entities that may have to comply with the regulations. But because these are only examples, you should carefully examine these and existing regulations in 40 CFR parts 80 and 86. If you have questions, call the person listed in the **FOR FURTHER INFORMATION CONTACT** section above.

Category	NAICS codes [a]	SIC Codes [b]	Examples of potentially regulated entities
Industry	336111	3711	Motor Vehicle Manufacturers.
	336112		
	336120		
Industry	336311	3592	Alternative fuel vehicle converters.
	336312	3714	
	422720	5172	
	454312	5984	
	811198	7549	
	541514	8742	
	541690	8931	
Industry	811112	7533	Commercial Importers of Vehicles and Vehicle Components.
	811198	7549	
	541514	8742	
Industry	324110	2911	Petroleum Refiners.
Industry	422710	5171	Gasoline Marketers and Distributors.
	422720	5172	
Industry	484220	4212	Gasoline Carriers.
	484230	4213	

[a] North American Industry Classification System (NAICS).
[b] Standard Industrial Classification (SIC) system code.

Access to Rulemaking Documents Through the Internet

Today's action is available electronically on the day of publication from the Office of the Federal Register Internet Web site listed below. Electronic copies of this preamble and regulatory language as well as the Response to Comments document, the Regulatory Impact Analysis and other documents associated with today's final rule are available from the EPA Office of Mobile Sources Web site listed below shortly after the rule is signed by the Administrator. This service is free of charge, except any cost that you already incur for connecting to the Internet.

Federal Register Web Site: http://www.epa.gov/docs/fedrgstr/epa-air/ (Either select a desired date or use the Search feature.)

Office of Mobile Sources (OMS) Web Site: http://www.epa.gov/oms/ (Look in ''What's New'' or under the ''Automobiles'' topic.)

Please note that due to differences between the software used to develop the document and the software into which the document may be downloaded, changes in format, page length, etc., may occur.

Outline of This Preamble

I. Introduction

Since the passage of the 1990 Clean Air Act Amendments, the U.S. has made significant progress in reducing emissions from passenger cars and light trucks. The National Low-Emission Vehicle (NLEV) and Reformulated Gasoline (RFG) programs are important examples of control programs that are in place and will continue to help reduce car and light-duty truck emissions into the near future.

Nonetheless, due to increasing vehicle population and vehicle miles traveled, passenger cars and light trucks will continue to be significant contributors to air pollution inventories well into the future. In fact, the emission contribution of light trucks and sport utility vehicles now matches that of passenger cars. (This is occurring because of the combination of growth in miles traveled by light trucks and the fact that their emission standards are currently less stringent than those of passenger cars). The program we describe below builds on the NLEV and RFG Phase II programs to develop a strong new national program to protect public health and the environment well into the next century. The program, while reducing VOC and other emissions, focuses especially on NO_X, because that is where the largest air quality gains can be achieved.

We have followed several overarching principles in developing this final rule:

• Design a strong national program that will assist states in every region of the country to meet their air quality objectives and that will ensure that cars and trucks continue to contribute a fair share to our nation's overall air quality solutions;

• View vehicles and fuels as an integrated system, recognizing that only by addressing both can the best overall emission performance be achieved;

• Establish a single set of emission standards that apply regardless of the fuel used and whether the vehicle is a car, a light truck, or a larger passenger vehicle;

• Provide compliance flexibilities that allow vehicle manufacturers and oil refiners to adjust to future market trends and honor consumer preferences;

• Not preclude the development of advanced low emission or fuel efficient technologies such as lean-burn engines; and

• Ensure sufficient leadtime for phase-in of the Tier 2 and gasoline sulfur program.

With these principles as background, we turn now to an overview of the vehicle and fuel aspects of the program. Sections I and II of this preamble will give you a brief overview of our program and our rationale for implementing it. Subsequent sections will expand on the air quality need, technological feasibility, economic impacts, and provide a detailed description of the specifics of the program. A public participation section reviews the process we followed in soliciting and responding to public comment. The final sections deal with several administrative requirements. You may also want to review our Final Regulatory Impact Analysis (RIA) and our Response to Comments document, both of which are found in the docket and on the Internet. They provide additional analyses and discussions of many topics raised in this preamble.

A. What Are the Basic Components of the Program?

The nation's air quality, while certainly better than in the past, will nevertheless continue to expose tens of millions of Americans to unhealthy levels of air pollution well into the future in the absence of significant new controls on emissions from motor vehicles. EPA is therefore finalizing a major, comprehensive program designed to reduce emission standards for passenger cars, light trucks, and large passenger vehicles (including sport-utility vehicles, minivans, vans, and pickup trucks) and to reduce the sulfur content of gasoline. Under the program, automakers will produce vehicles designed to have very low emissions when operated on low-sulfur gasoline, and oil refiners will provide that much cleaner gasoline nationwide. In this preamble, we refer to the comprehensive program as the ''Tier 2/ Gasoline Sulfur program.''

1. Vehicle Emission Standards

Today's action sets new federal emission standards (''Tier 2 standards'') for passenger cars, light trucks, and larger passenger vehicles. The program is designed to focus on reducing the emissions most responsible for the ozone and particulate matter (PM) impact from these vehicles—nitrogen oxides (NO_X) and non-methane organic gases (NMOG), consisting primarily of hydrocarbons (HC) and contributing to ambient volatile organic compounds (VOC). The program will also, for the first time, apply the same set of federal standards to all passenger cars, light trucks, and medium-duty passenger vehicles. Light trucks include ''light light-duty trucks'' (or LLDTs), rated at less than 6000 pounds gross vehicle weight and ''heavy light-duty trucks'' (or HLDTs), rated at more than 6000 pounds gross vehicle weight).[1] ''Medium-duty passenger vehicles'' (or MDPVs) form a new class of vehicles introduced by this rule that includes SUVs and passenger vans rated at between 8,500 and 10,000 GVWR. The program thus ensures that essentially all vehicles designed for passenger use in the future will be very clean vehicles.

The Tier 2 standards finalized today will reduce new vehicle NO_X levels to an average of 0.07 grams per mile (g/mi). For new passenger cars and light LDTs, these standards will phase in beginning in 2004, with the standards to be fully phased in by 2007.[2] For heavy LDTs and MDPVs, the Tier 2 standards will be phased in beginning in 2008, with full compliance in 2009.

During the phase-in period from 2004–2007, all passenger cars and light LDTs not certified to the primary Tier 2 standards will have to meet an interim average standard of 0.30 g/mi NO_X, equivalent to the current NLEV standards for LDVs and more stringent than NLEV for LDT2s (e.g., minivans).[3] During the period 2004–2008, heavy LDTs and MDPVs not certified to the final Tier 2 standards will phase in to an interim program with an average standard of 0.20 g/mi NO_X, with those not covered by the phase-in meeting a per-vehicle standard (i.e., an emissions ''cap'') of 0.6 g/mi NO_X (for HLDTs) and 0.9 g/mi NO_X (for MDPVs). The average standards for NO_X will allow manufacturers to comply with the very stringent new standards in a flexible way, assuring that the average emissions of a company's production meet the target emission levels while allowing the manufacturer to choose from several more- and less-stringent emission categories for certification.

We are also setting stringent particulate matter standards that will be especially important if there is substantial future growth in the sales of diesel vehicles. Before 2004, we are establishing more stringent interim PM standards for most light trucks than exist now under NLEV. With higher sales of diesel cars and light trucks, they could easily contribute between one-half and two percent of the PM10 concentration allowed by the NAAQS, with some possibility that the contribution could be as high as 5 to 40 percent in some roadside situations with heavy traffic. These increases would make attainment even more difficult for 8 counties which we already predict to need further emission reductions even without an increase in diesel sales, and would put at risk another 18 counties which are now within 10 percent of a NAAQS violation. Thus, by including a more stringent PM standard in the program finalized today, we help address environmental concerns about the potential growth in the numbers of light-duty diesels on the road—even if that growth is substantial. The new requirements also include more stringent hydrocarbon controls (exhaust NMOG and evaporative emissions standards). We will also monitor the progress of the development of advanced technologies and the role of fuels.

2. Gasoline Sulfur Standards

The other major part of today's action will significantly reduce average gasoline sulfur levels nationwide. We expect these reductions could begin to phase in as early as 2000, with full compliance for most refiners occurring by 2006. Refiners will generally install advanced refining equipment to remove sulfur during the production of gasoline. Importers of gasoline will be required to import and market only gasoline meeting the sulfur limits. Temporary, less stringent standards will apply to a few small refiners through 2007. In addition, temporary, less stringent standards will apply to a limited geographic area in the western U.S. for the 2004–2006 period.

This significant new control of gasoline sulfur content will have two important effects. The lower sulfur levels will enable the much-improved emission control technology necessary to meet the stringent vehicle standards of today's rule to operate effectively over the useful life of the new vehicles. In addition, as soon as the lower sulfur gasoline is available, all gasoline vehicles already on the road will have reduced emissions—from less degradation of their catalytic converters and from fewer sulfur compounds in the exhaust.

Today's action will encourage refiners to reduce sulfur in gasoline as early as 2000. The program requires that most refiners and importers meet a corporate average gasoline sulfur standard of 120 ppm and a cap of 300 ppm beginning in 2004. By 2006, the cap will be reduced to 80 ppm and most refineries must produce gasoline averaging no more than 30 ppm sulfur. The program builds upon the existing regulations covering gasoline composition as it relates to emissions performance. It includes provisions for trading of sulfur credits, increasing the flexibility available to refiners for complying with the new requirements. We intend for the credit program to ease compliance uncertainties by providing refiners the flexibility to phase in early controls in 2000–2003 and use credits gained in these years to delay some control until as late as 2006. As finalized today, the program will achieve the needed environmental benefits while providing substantial flexibility to refiners.

B. What Is Our Statutory Authority for Today's Action?

1. Light-Duty Vehicles and Trucks

We are setting motor vehicle emission standards under the authority of section 202 of the Clean Air Act. Sections 202(a) and (b) of the Act provide EPA with general authority to prescribe vehicle standards, subject to any specific limitations otherwise included in the Act. Sections 202(g) and (h) specify the current standards for LDVs and LDTs, which became effective beginning in model year 1994 (''Tier 1 standards'').

Section 202(i) of the Act provides specific procedures that EPA must follow to determine whether standards more stringent than Tier 1 standards for LDVs and certain LDTs[4] are appropriate beginning between the 2004 and 2006 model years.[5] Specifically, we are required to first issue a study regarding ''whether or not further reductions in emissions from light-duty vehicles and light-duty trucks should be required * * *'' (the ''Tier 2 Study''). This study ''shall examine the need for further reductions in emissions in order to attain or maintain the national ambient air quality standards.'' It is also to consider: (1) The availability of technology to meet more stringent standards, taking cost, lead time, safety, and energy impacts into consideration; and (2) the need for, and cost effectiveness of, such standards, including consideration of alternative methods of attaining or maintaining the national ambient air quality standards. A certain set of ''default'' emission

[1] A vehicle's ''Gross Vehicle Weight Rating,'' or GVWR, is the curb weight of the vehicle plus its maximum recommended load of passengers and cargo.

[2] By comparison, the NO_X standards for the National Low Emission Vehicle (NLEV) program, which will be in place nationally in 2001, range from 0.30 g/mi for passenger cars to 0.50 g/mi for medium-sized light trucks (larger light trucks are not covered). For further comparison, the standards met by today's Tier 1 vehicles range from 0.60 g/mi to 1.53 g/mi.

[3] There are also NMOG standards associated with both the interim and Tier 2 standards. The NMOG standards vary depending on which of various individual sets of emission standards manufacturers choose to use in complying with the average NO_X standard. This ''bin'' approach is described more fully in section IV.B. of this preamble.

[4] LDTs with a loaded vehicle weight less than or equal to 3750 pounds, called LDT1s and LDT2s.

[5] Section 202(b)(1)(C) forbids EPA from promulgating mandatory standards more stringent than Tier 1 standards until the 2004 model year.

standards for these vehicle classes is among those options for new standards that EPA is to consider.

After the study is completed and the results are reported to Congress, EPA is required to determine by rulemaking whether: (1) There is a need for further emission reductions; (2) the technology for more stringent emission standards from the affected classes is available; and (3) such standards are needed and cost-effective, taking into account alternatives. If EPA answers "yes" to these questions, then the Agency is to promulgate new, more stringent motor vehicle standards ("Tier 2 standards").

EPA submitted its report to Congress on July 31, 1998. Today's final rule makes affirmative responses to the three questions above (see Section II below) and sets new standards that are more stringent than the default standards in the Act.

EPA is also setting standards for larger light-duty trucks and MDPVs under the general authority of Section 202(a)(1) and 202(b) and under Section 202(a)(3) of the Act, which requires that standards applicable to emissions of hydrocarbons, NO_X, CO and PM from heavy-duty vehicles[6] reflect the greatest degree of emission reduction available for the model year to which such standards apply, giving appropriate consideration to cost, energy, and safety. We are also setting standards for formaldehyde under our authority in sections 202(a) and (l).

2. Gasoline Sulfur Controls

We are adopting gasoline sulfur controls pursuant to our authority under Section 211(c)(1) of the Clean Air Act.[7] Under Section 211(c)(1), EPA may adopt a fuel control if at least one of the following two criteria is met: (1) The emission products of the fuel cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare; or (2) the emission products of the fuel will significantly impair emissions control systems in general use or which will be in general use were the fuel control to be adopted.

We are adopting gasoline sulfur controls based on both of these criteria. Under the first criterion, we believe that sulfur in gasoline used in Tier 1 and LEV technology vehicles contributes to ozone pollution, air toxics, and PM. Under the second criterion, we believe that gasoline sulfur in fuel will significantly impair the emissions control systems expected to be used in Tier 2 technology vehicles, as well as emissions control systems currently used in LEVs. Please refer to Section IV.C. below and to the Final Regulatory Impact Analysis (RIA) for more details of our analysis and findings. The RIA includes a more detailed discussion of EPA's authority to set gasoline sulfur standards, including a discussion of our conclusions relating to the factors required to be considered under Section 211(c).

C. The Tier 2 Study and the Sulfur Staff Paper

On July 31, 1998, EPA submitted its report to Congress containing the results of the Tier 2 study.[8] The study indicated that in the 2004 and later time frame, there will be a need for emission reductions to aid in meeting and maintaining the National Ambient Air Quality Standards (NAAQS) for both ozone and PM. Air quality modeling showed that in the 2007–2010 time frame, when Tier 2 standards will become fully effective, a number of areas will still be in nonattainment for ozone and PM even after the implementation of existing emission controls. The study also noted the continued existence of carbon monoxide (CO) nonattainment areas. It also found ample evidence that technologies will be available to meet more stringent Tier 2 standards. In addition, the study provided evidence that such standards could be implemented at a similar cost per ton of reduced pollutants as other programs aimed at similar air quality problems. Finally, the study identified several additional issues in need of further examination, including the relative stringency of car and light truck emission standards, the appropriateness of identical versus separate standards for gasoline and diesel vehicles, and the effects of sulfur in gasoline on catalyst efficiency. Section IV of this preamble describes the steps we have taken to follow up on the Tier 2 Study.

In addition, on May 1, 1998, EPA released a staff paper presenting EPA's understanding of the impact of gasoline sulfur on emissions from motor vehicles and exploring what gasoline producers and automobile manufacturers could do to reduce sulfur's impact on emissions. The staff paper noted that gasoline sulfur degrades the effectiveness of catalytic converters and that high sulfur levels in commercial gasoline could affect the ability of future automobiles—especially those designed for very low emissions—to meet more stringent standards in use. It also pointed out that sulfur control will provide additional benefits by lowering emissions from the current fleet of vehicles.

D. Relationship of Diesel Fuel Sulfur Control to the Tier 2/Gasoline Sulfur Program

In the NPRM, we raised the question of what if any changes to diesel fuel may be needed to enable diesel vehicles to meet the Tier 2 standards or any future heavy-duty diesel engine standards. Specifically, we raised the question of whether diesel sulfur levels need to be controlled. Since diesel fuel controls of any kind would have an impact on the refinery as a whole, and since in some cases (including potential diesel sulfur limits) could have implications for gasoline sulfur control, we requested comment on this issue in our proposal. We also indicated that we planned to release an Advance Notice of Proposed Rulemaking to solicit more information on this subject.

We published the ANPRM on May 13, 1999 (64 FR 26142). We are in the process of considering all of the comments received in response to the ANPRM and plan to issue a Notice of Proposed Rulemaking (NPRM) in early spring of 2000. We received many comments on the subject of diesel fuel control along with the comments submitted on the proposed Tier 2/Gasoline Sulfur regulations. We have prepared brief responses to some of these comments in the Response to Comments document, and will deal fully with these comments as part of the forthcoming NPRM on diesel fuel. We are taking no action on diesel fuel as part of today's action.

II. Tier 2 Determination

Based on the statutory requirements described above and the evidence provided in the Tier 2 Study and since its release, as described elsewhere in this preamble, EPA has determined that new, more stringent emission standards are indeed needed, technologically feasible, and cost effective.

[6] LDTs that have gross vehicle weight ratings above 6000 pounds are considered "heavy-duty vehicles" under the Act. See section 202(b)(3). For regulatory purposes, we refer to these LDTs as "heavy light-duty trucks" made up of LDT3s and LDT4s.

[7] We currently have regulatory requirements for conventional and reformulated gasoline adopted under Sections 211(c) and 211(k) of the Act, in addition to the "substantially similar" requirements for fuel additives of Section 211(f). These requirements have the effect of limiting sulfur levels in gasoline to some extent. See the Final RIA for more details.

[8] On April 28, 1998, EPA published a notice of availability announcing the release of a draft of the Tier 2 study and requesting comments on the draft. The final report to Congress included a summary and analysis of the comments EPA received.

A. There Is a Substantial Need for Further Emission Reductions in Order to Attain and Maintain National Ambient Air Quality Standards

EPA finds that there is a clear air quality need for new emission standards, based on the continuing air quality problems predicted to exist in future years. As the discussion in Section III.B. illustrates, 26 metropolitan areas are each certain or highly likely to need additional reductions. These areas are distributed across most regions of the U.S., and have a combined population of over 86 million. Section III.B. also shows that an additional 12 areas each has a moderate to significant probability of needing additional reductions, representing another 25 million people. This provides ample evidence that further emission reductions are needed to meet the 1-hour ozone NAAQS.

In addition to these ozone concerns, our analysis of PM_{10} monitoring data and PM_{10} projections indicates that 15 PM_{10} nonattainment counties violated the PM_{10} NAAQS in recent years, and that 8 of them with a 1996 population of almost 8 million have a high risk of failing to attain and maintain without more emission reductions. Eighteen other counties, with a population of 23 million have a significant risk of failing or are within 10 percent of violating the PM_{10} NAAQS. It is also important to recognize that nonattainment areas remain for other criteria pollutants (*e.g.,* CO) and that non-criteria pollution (*e.g.,* air toxics and regional haze) also contributes to environmental and health concerns.

B. More Stringent Standards for Light-Duty Vehicles and Trucks Are Technologically Feasible

We find that emission standards significantly more stringent than current Tier 1 and National Low Emission Vehicle (NLEV) levels are technologically feasible. This is true both for the LDVs and LDTs specifically covered in section 202(i) and for the medium-duty passenger vehicles also included in today's final rule. Manufacturers are currently producing NLEV vehicles that meet more stringent standards than similar Tier 1 models. Our analysis shows that mainly through improvements in engine control software and catalytic converter technology, manufacturers can build and are building durable vehicles and trucks, including heavy light-duty trucks, which have very low emission levels.[9] Section IV.A. below discusses our feasibility conclusions in more detail.

Many current production vehicles are already certified at or near the Tier 2 standards. For year 2000 certification (although not yet complete), over 50 vehicle models have emissions at or below Tier 2 levels. In addition, we performed a demonstration program at our EPA laboratory that showed that even large vehicles, which would be expected to face the toughest challenges reaching Tier 2 emission levels, can do so with conventional technology. Others, including the Manufacturers of Emission Controls Association (MECA) and the State of California, have also performed demonstration programs, with similar results. Manufacturers have also certified LDVs and LDTs to NMOG and CO levels as much as 80 percent below Tier 1 standards. Furthermore, for passenger vehicles greater than 8500 lbs GVWR, we believe that by using technologies and control strategies similar to what will be used on lighter vehicles, manufacturers will be able to meet the Tier 2 emission standards.

Thus, we believe that, by the 2004–2009 time frame, manufacturers will be fully able to comply with the new Tier 2 emission standard levels. In addition, to facilitate manufacturers' efforts to meet these new standards, the Tier 2 regulations include a phase-in over several years and a corporate fleet average NO_X standard, which will allow manufacturers to optimize the deployment of technology across their product lines with no loss of environmental benefit. Our analysis of the available technology improvements and the very low emission levels already being realized on these vehicles leads us to find that the standards adopted today are fully feasible for LDVs and LDTs.

C. More Stringent Standards for Light-Duty Vehicles and Trucks Are Needed and Cost Effective Compared to Available Alternatives

In this action, we also find that more stringent motor vehicle standards are both necessary and cost effective. As discussed above, substantial further reductions in emissions are needed to help reduce the levels of unhealthy air pollution to which millions of people are being exposed; in particular, we expect that a number of areas will not attain or maintain compliance with the National Ambient Air Quality Standards for ozone and PM_{10} without such reductions. (We describe this further in Section III below and in the RIA.)

Furthermore, mobile sources are important contributors to the air quality problem. As we will explain more fully later in this preamble, in the year 2030, the cars and light trucks that are the subject of today's final rule are projected to contribute as much as 40 percent of the total NO_X inventory in some cities, and almost 20 percent of nationwide NO_X emissions. This situation would have been considerably worse without the NLEV program created by vehicle manufacturers, EPA, the Northeastern states, and others.

These emission reductions are clearly necessary to meet and maintain the 1-hour ozone NAAQS. We project that while the emission reductions of this program will lead to substantial progress in meeting and maintaining the NAAQS, many areas will still not come into attainment even with this magnitude of reductions.

We find that the Tier 2/Gasoline Sulfur program is a reasonable, cost-effective method of providing substantial progress towards attainment and maintenance of the NAAQS, costing about $2000 per ton of NO_X plus hydrocarbon emissions reduced. This program will reduce annual NO_X emissions by about 2.2 million tons per year in 2020 and 2.8 million tons per year in 2030 after the program is fully implemented. By way of comparison, when EPA established its 8-hour NAAQS for ozone, we identified several types of emission control programs that were reasonably cost effective. If all of the controls identified in that analysis costing less than $10,000/ton were implemented nationwide, they would produce NO_X emission reductions of about 2.9 million tons per year. (That is, to achieve about the same emission reductions as the Tier 2/Gasoline Sulfur program, other alternative measures would have a significantly higher cost per ton). These emission reductions are clearly necessary to meet and maintain the one-hour ozone NAAQS. We project that while the emission reductions of this program will lead to substantial progress in meeting and maintaining the NAAQS, many areas will still not come into attainment even with this magnitude of reductions.

In addition, the magnitude of emission reductions that can be achieved by a comprehensive national Tier 2/Gasoline Sulfur program will be difficult to achieve from any other source category. Given the large contribution that light-duty mobile source emissions make to the national emissions inventory and the range of control programs ozone-affected areas

[9] The Final RIA contains a more detailed analysis, and Section IV.A. below has further discussion of the technological feasibility of our standards including detailed discussions of the various technology options that we believe manufacturers may use to meet these standards.

already have in place or would be expected to implement, we believe it will be very difficult, if not impossible, to meet (and maintain) the ozone NAAQS in a cost-effective manner without large emission reductions from LDVs and LDTs. We expect emissions from MDPVs to also play an increasing role.

Furthermore, we project that the Tier 2/Gasoline Sulfur program will significantly reduce direct and secondary particulate matter coming from LDVs, LDTs, and MDPVs—by about 36,000 tons per year of direct PM alone by 2030; large secondary PM reductions from significantly lower NO_X and SO_X emissions will add to the overall positive impact on airborne particles. These reductions will be very cost-effective compared to other measures to reduce PM pollution. Because direct PM emissions from gasoline vehicles are related the presence of sulfur in gasoline, no new emission control devices, beyond what manufacturers are expected to install to meet the NO_X and NMOG standards, will be necessary to provide the reductions expected for these pollutants under the program. The standards will provide valuable insurance against increases in PM emissions from LDVs, LDTs, and MDPVs.

Finally, the Tier 2/Gasoline Sulfur program will significantly reduce CO emissions from LDVs, LDTs, and MDPVs. (See Chapter III of the RIA for an analysis of these reductions.) The technical changes needed to meet the NMOG standards will also result in CO reductions sufficient to meet the CO standards. Thus, these CO reductions will be very cost-effective since they will not require any new emission control devices beyond what manufacturers are expected to install to meet the NO_X and NMOG standards.

We conclude, then, that today's final rule is a major source of ozone precursor, PM, and CO emission reductions when compared to other available options. The discussions of cost and cost effectiveness later in this preamble and in the RIA explain the derivation of cost effectiveness estimates and compares them to the cost effectiveness of other alternatives. That discussion indicates that this program will have a cost effectiveness comparable to both the Tier 1 and NLEV standards and will also be cost effective when compared to non-mobile source programs.

III. Air Quality Need For and Impact Of Today's Action

In the absence of significant new controls on emission, tens of millions of Americans would continue to be exposed to unhealthy levels of air pollution. Emissions from passenger cars and light trucks are a significant contributor to a number of air pollution problems. Today's action will significantly reduce emissions from cars and light trucks and hence will significantly reduce the health risks posed by air pollution. This section summarizes the results of the analyses we performed to arrive at our determination that continuing air quality problems are likely to exist, that these air quality problems would be in part due to emissions from cars and light trucks, and that the new standards promulgated by today's final rule will improve air quality and mitigate other environmental problems.

A. Americans Face Serious Air Quality Problems That Require Further Emission Reductions

Air quality in the United States continues to improve. Nationally, the 1997 air quality levels were the best on record for all six criteria pollutants. [10] In fact, the 1990s have shown a steady trend of improvement, due to reductions in emissions from most sources of air pollution, from factories to motor vehicles. Despite great progress in air quality improvement, in 1997 there were still approximately 107 million people nationwide who lived in counties with monitored air quality levels above the primary national air quality standards. [11] There are also people living in counties outside of the air monitoring network where violations of the NAAQS could have also occurred during the year. Moreover, unless there are reductions in overall emissions beyond those that are scheduled to be achieved by already committed controls, many of these Americans will continue to be exposed to unhealthy air.

Ambient ozone is formed in the lower atmosphere through a complex interaction of VOC and NO_X emissions. Cars and light trucks emit a substantial fraction of these emissions. Ambient PM is emitted directly from cars and light trucks; it also forms in the atmosphere from NO_X, sulfur oxides (SO_X), and VOC, all of which are emitted by motor vehicles. When ozone exceeds the air quality standards, otherwise healthy people often have reduced lung function and chest pain, and hospital admissions for people with respiratory ailments like asthma increase; for longer exposures, permanent lung damage can occur. Similarly, fine particles can penetrate deep into the lungs. Results of studies suggest a likely causal role of ambient PM in contributing to reported effects, such as: premature mortality, increased hospital admissions, increased respiratory symptoms, and changes in lung tissue. When either ozone or PM air quality problems are present, those hardest hit tend to be children, the elderly, and people who already have health problems.

The health effects of high ozone and PM levels are not the only reason for concern about continuing air pollution. Ozone and PM also harm plants and damage materials. PM reduces visibility and contributes to significant visibility impairment in our national parks and monuments and in many urban areas. In addition, air pollution from motor vehicles contributes to cancer and other health risks, acidification of lakes and streams, eutrophication of coastal and inland waters, and elevated drinking water nitrate levels. These problems impose a substantial burden on public health, our economy, and our ecosystems.

In recognition of this burden, Congress has passed and subsequently amended the Clean Air Act. The Clean Air Act requires each state to have an approved State Implementation Plan (SIP) that shows how an area plans to meet its air quality obligations, including achieving and then maintaining attainment of all of the National Ambient Air Quality Standards (NAAQS), such as those for ozone and PM. The Clean Air Act also requires EPA to periodically re-evaluate the NAAQS in light of new scientific information. Our most recent re-evaluation of the ozone and PM NAAQS led us to revise both standards (62 FR 38856, July 18, 1997 and 62 FR 38652, July 18, 1997). These revised standards reflected additional information that had become available since the previous revision of the ozone and PM standards, respectively.

On May 14, 1999, a panel of the United States Court of Appeals for the District of Columbia Circuit reviewed EPA's revisions to the ozone and PM NAAQS and found, by a 2–1 vote, that sections 108 and 109 of the Clean Air Act, as interpreted by EPA, represent unconstitutional delegations of Congressional power. *American Trucking Ass'n., Inc. et al.,* v. *Environmental Protection Agency*, 175 F.3d 1027 (D.C. Cir. 1999). Among other things the Court remanded the record

[10] National Air Quality and Emissions Trend Report, 1997, Air Quality Trends Analysis Group, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, N.C., December 1998 (available on the World Wide Web at http://www/epa.gov/oar/aqtrnd97/).

[11] U.S. Environmental Protection Agency, *Latest Findings on National Air Quality: 1997 Status and Trends.* December 1998.

for the 8-hour ozone NAAQS and the $PM_{2.5}$ NAAQS to EPA. On October 29, 1999, EPA's petition for rehearing by the three judge panel was denied, with the exception that the panel modified its prior ruling regarding EPA's authority to implement a revised ozone NAAQS under Part D subpart 2 of Title I. EPA's petition for rehearing en banc by the full Circuit was also denied, although five of the nine judges considering the petition agreed to rehear the case.

As a result of the Court's decision, requirements on the States to implement the new 8-hour ozone standard have been suspended although the standard itself is still in force and the science behind it has generally not been contradicted. The court also did not question EPA's findings regarding the health effects of PM_{10} and $PM_{2.5}$. However, due to the uncertainty regarding the status of the new NAAQS, we will rely on the preexisting NAAQS in determining air quality need under section 202(i) of the Act.

Carbon monoxide (CO) can cause serious health effects for those who suffer from cardiovascular disease, such as angina pectoris. There has been considerable progress in attaining the longstanding NAAQS for carbon monoxide, largely through more stringent standards for CO from motor vehicles. This progress has been made despite large increases in travel by vehicle. In 1997, there were about 9 million people living in three counties with CO concentrations above the level of the CO NAAQS. In the recent past, this figure has fluctuated up and down. At the present time there are 15 counties classified as serious CO nonattainment areas, all with a recent history of NAAQS violations. At this time, prospects for these areas attaining by the serious CO area attainment deadline of December 31, 2000 are uncertain. While violations of the NAAQS have not occurred recently in most of the other 33 counties still classified as nonattainment, even these must demonstrate that they will remain safely below the NAAQS for ten years despite expected growth in vehicle travel and other sources of CO emissions before they can be reclassified to attainment. Because of the large role of motor vehicles in causing high ambient CO concentrations, where there is reason to be concerned about CO attainment and maintenance, local areas look to national emission standards for most of the solution.

As discussed below, EPA has also finalized regulations that regions and states implement plans for protecting and improving visibility in the 156 mandatory Federal Class I areas as defined in Section 162(a) of the Clean Air Act. These areas are primarily national parks and wilderness areas.

To accomplish the goal of full attainment in all areas according to the schedules for the various NAAQS, and to achieve the goals of the visibility program, the federal government must assist the states by reducing emissions from sources that are not as practical to control at the state level as at the federal level. Vehicles and fuels move freely among the states, and they are produced by national or global scale industries. Most individual states are not in a position to regulate these industries effectively and efficiently. The Clean Air Act therefore gives EPA primary authority to regulate emissions from the various types of highway vehicles and their fuels. Our actions to reduce emissions from these and other national sources are a crucial and essential complement to actions by states to reduce emissions from more localized sources.

If we were not to adopt new standards to reduce emissions from cars and light trucks, emissions from these vehicles would remain a large portion of the emissions burden that causes elevated ozone and continued nonattainment with the ozone NAAQS, which in turn would affect tens of millions of Americans. Because the contribution of cars and light trucks to both local emissions and transported pollution would be so great, and the expected emission reduction shortfall in many areas is so large, further reductions from cars and light trucks will be an important element of many attainment strategies, especially for ozone in the 2007 to 2010 time frame. The contribution of these vehicles to PM exposure and PM nonattainment would also remain significant, and would increase considerably if diesel engines are used in more cars or light trucks. Furthermore, without new standards, steady annual increases in fleet size and miles of travel would outstrip the benefits of current emission controls, and would cause ozone-forming emissions from cars and trucks to grow each year starting about 2013.

The standards being promulgated by today's actions will reduce emissions of ozone precursors and PM precursors from cars and light trucks greatly. However, even with this decrease, many areas will likely still find it necessary to obtain additional reductions from other sources in order to fully attain the ozone and PM NAAQS. Their task will be easier and the economic impact on their industries and citizens will be lighter as a result of the standards promulgated by today's actions. Following implementation of the Regional Ozone Transport Rule, states will have already adopted emission reduction requirements for nearly all large sources of VOC and NO_X for which cost-effective control technologies are known. Those that remain in nonattainment therefore will have to consider their remaining alternatives. Many of the state and local programs states may consider as alternatives are very costly, and the emissions impact from each additional emissions source subjected to new emissions controls would be considerably smaller than the emissions impact of the standards being promulgated today. Therefore, the emission reductions from these standards for gasoline, cars, and light trucks will ease the need for states to find first-time reductions from the mostly smaller sources that have not yet been controlled, including area sources that are closely connected with individual and small business activities. The emission reductions from the standards being promulgated today will also reduce the need for states to seek even deeper reductions from large and small sources already subject to emission controls.

We project that today's actions will also have important benefits for carbon monoxide, regional visibility, acid rain, and coastal water quality.

For these and other reasons discussed in this document, we have determined that significant emission reductions will still be needed by the middle of the next decade and beyond to achieve and maintain further improvements in air quality in many, geographically dispersed areas. We also believe that a significant portion of these emission reductions will be obtained by reducing emissions from cars and light trucks as a result of today's actions. We believe that such reductions are necessary (since cars and light trucks are such large contributors to current and projected ozone problems) and reasonable (since these reductions can be achieved at a reasonable cost compared to other alternative reductions).

The remainder of this section describes the health and environmental problems that today's actions will help mitigate and the expected health and environmental benefits of these actions. Ozone is discussed first, followed by PM, other criteria pollutants, visibility, air toxics, and other environmental impacts. The emission inventories and air quality analyses are explained more fully in the Regulatory Impact Analysis for today's actions.

B. Ozone

1. Background on Ozone Air Quality

Ground-level ozone is the main harmful ingredient in smog.[12] Ozone is produced by complex chemical reactions when its precursors, VOC and NO_X, react in the presence of sunlight.

Short-term (1–3 hours) and prolonged (6–8 hours) exposures to ambient ozone at levels common in many cities have been linked to a number of health effects of concerns. For example, increased hospital admissions and emergency room visits for respiratory causes have been associated with ambient ozone exposures at such levels. Repeated exposures to ozone can make people more susceptible to respiratory infection, result in lung inflammation, and aggravate pre-existing respiratory diseases such as asthma. Other health effects attributed to ozone exposures include significant decreases in lung function and increased respiratory symptoms such as chest pain and cough. These effects generally occur while individuals are engaged in moderate or heavy exertion.

Children active outdoors during the summer when ozone levels are at their highest are most at risk of experiencing such effects. Other at-risk groups include adults who are active outdoors (*e.g.,* outdoor workers), and individuals with pre-existing respiratory disease such as asthma and chronic obstructive lung disease. In addition, longer-term exposures to moderate levels of ozone present the possibility of irreversible changes in the lungs which could lead to premature aging of the lungs and/or chronic respiratory illnesses.

Ozone also affects vegetation and ecosystems, leading to reductions in agricultural and commercial forest yields, reduced growth and survivability of tree seedlings, and increased plant susceptibility to disease, pests, and other environmental stresses (*e.g.,* harsh weather). In long-lived species, these effects may become evident only after several years or even decades, thus having the potential for long-term effects on forest ecosystems. Ground-level ozone damage to the foliage of trees and other plants also can decrease the aesthetic value of ornamental species as well as the natural beauty of our national parks and recreation areas.

Many areas which were classified as nonattainment when classifications were made under the 1990 Clean Air Act Amendments have not experienced violations more recently. However, 50 metropolitan areas had ozone design values above the NAAQS in either or both of the 1995–1997 and the 1996–1998 monitoring periods. In many urban areas, the downward trend in ozone that prevailed earlier has become less strong or stopped in the last few years, even when adjustments are made for meteorological conditions. We believe that one factor that has worked against ozone improvement in the last few years has been the growing use of light trucks with higher emissions than the cars used formerly. The predictions of future ozone concentrations used in developing today's action take account of this growing use of light trucks.

2. Additional Emission Reductions Are Needed To Attain and Maintain the Ozone NAAQS

a. Summary

We have determined that additional emission reductions are needed to attain and maintain the 1-hour ozone NAAQS. This overall conclusion is based on our prediction that 26 metropolitan areas are each certain or highly likely to need additional reductions, and that an additional 12 areas each have a moderate to significant probability of needing them.

To determine whether additional reductions are needed in order to attain and maintain the ozone NAAQS, we used ozone modeling to predict what areas would not attain the NAAQS in the future. We accounted for the emission reductions that have already been achieved, those that will be achieved in the future by actions already underway, and increases in emissions expected from increased use of sources of pollution.

In our May 13, 1999 proposal, we presented information from photochemical modeling we performed to predict what areas would meet the ozone NAAQS in 2007. The year 2007 falls after the expected date of most emission reductions which states are required to achieve or have otherwise committed to achieve, and near the attainment deadline for many ozone nonattainment areas. We presented additional information from the same photochemical modeling work in two supplemental notices, on June 30, 1999 (to better explain the basis for our proposal in light of the Court's ruling on the 8-hour ozone NAAQS), and October 25, 1999 (to explain the implications for our Tier 2/Gasoline Sulfur proposal from our more recent proposal, which we expect to make final shortly, to re-instate the 1-hour ozone NAAQS in many areas). In Response to Comments on these Federal Register notices, we made revisions to our own ozone modeling. We also obtained ozone modeling results from a number of state air planning agencies and from members of the automobile manufacturing industry. We have considered all of this information as part of our determination that the regulations promulgated in this rule are needed and appropriate.

Based on the available ozone modeling and other information, we project that there are 26 metropolitan areas which will be unable to attain and maintain the NAAQS, in the absence of additional reductions. These areas had a combined population of over 86 million in 1996, and are distributed across most regions of the U.S. We have concluded that each is certain or very likely to require additional reductions to attain the NAAQS. Taken together and considering their number, size, and geographic distribution, these areas establish the case that additional reductions are needed in order to attain and maintain the 1-hour standard.

In addition, our analysis suggests there will be other areas that will have problems attaining and maintaining compliance with the one-hour ozone standard in the future. There are 12 additional metropolitan areas with a total 1996 population of over 25 million people in this category. EPA's ozone modeling for 2007 predicts exceedances for each of these areas. However, for six of them local recent monitoring information is not indicating nonattainment. Given how close to nonattainment these areas are, EPA believes it is likely that at least a significant subset of this group of areas will face compliance problems by 2007 or beyond if additional actions to lower air emissions are not taken. This belief is based on historical experience with areas that will undergo economic and population growth over time and that are in larger regions that are also experiencing growth. The other six areas in this group are nonattainment now, and local modeling shows them reaching attainment by 2005 or 2007. Modeling uncertainties and growth beyond the attainment date make it likely that at least some of these areas will also face compliance problems if additional actions to lower air emissions are not taken. This situation further supports our determination that additional reductions in mobile source emissions are needed for attainment and maintenance.

We would like to emphasize that the advantages of the Tier 2/Gasoline Sulfur program will be enjoyed by the whole country. There are important advantages for approximately 30 more metropolitan

[12] Total column ozone, a large percentage of which occurs in the stratosphere and a smaller percentage of which occurs in the troposphere, helps to provide a protective layer against ultraviolet radiation.

areas, with close to 30 million people residing in them, whose ozone levels are now within 10 percent of violating the 1-hour NAAQS.[13] Most of these areas have been in nonattainment in the past. We believe the emission reductions from the Tier 2/Gasoline Sulfur program are an important component of an overall EPA-state approach to enable these areas to continue to maintain clean air given expected growth. EPA believes that the long term ability of the states to continue to meet the NAAQS is extremely important. In the future, EPA will be considering additional approaches for assisting in maintenance of the NAAQS. Also, we believe that the Tier 2/Gasoline Sulfur program has important benefits for other nonattainment areas which our modeling and local modeling show to be on a path to come into attainment in the next eight years. For these areas, the extra emission reductions from the program will take some of the uncertainty out of their plan to attain the standard and give them a head start on developing their plan to stay in attainment.

In every area of the country, the new standards will give transportation planning bodies and industrial development leaders more options within the area's overall emissions constraints. This will allow local and state officials to better accommodate local needs and growth opportunities. With these new standards for vehicles and gasoline, unusually adverse weather or strong local economic growth will be less likely to cause ozone levels high enough to trigger the planning requirements of the Clean Air Act. In addition, by reducing emissions and ozone levels across the nation as a whole, there will be less transport of ozone between areas, reducing the amount of ozone entering downwind areas. This will give the downwind areas a better opportunity to maintain and attain the NAAQS through local efforts.

All of our determinations presented here about the need for the Tier 2/ Gasoline Sulfur program take into account the prior NO_X reductions we expect from the Regional Ozone Transport Rule. This rule is now in litigation. If the outcome of that litigation reduces the NO_X reductions that will be achieved, the need for the Tier 2/Gasoline Sulfur program will be even greater.

[13] As measured by ozone design value.

b. Ozone Modeling Presented in Our Proposal and Supplemental Notices

The ozone modeling we presented in our proposal and the two supplemental notices was originally conducted as part of our development of the Regional Ozone Transport Rule. The ''revised budget'' emission control scenario we modeled for the Regional Ozone Transport Rule contained the right set of existing and committed emission controls for it to serve as the starting point for making our determination on the need for additional emission reductions. We added a new ''control case'' to represent the effects of our proposed vehicle and gasoline standards.

This ozone modeling provided predictions of ozone concentrations in 2007 across the eastern U.S., under certain meteorological conditions. Predictions of attainment or nonattainment are based on these predicted ozone concentrations. Two approaches to making attainment predictions have been used or advocated in the past: a rollback approach and an exceedance approach. In the NPRM of May 13, 1999, we presented predictions of attainment and nonattainment using a rollback approach. For the 1-hour standard, we reported that 8 metropolitan areas and two rural counties were predicted to be in nonattainment in 2007 under the rollback method. In the first supplemental notice of June 30, 1999 we presented a prediction that 17 areas would be nonattainment based on the exceedance method, and invited comment on all aspects of the modeling and its interpretation. Our second and last notice on October 27, 1999, presented predictions of violations using the exceedance method for additional areas which we had previously excluded because the 1-hour standard did not apply to them. This was in anticipation of the reinstatement of the 1-hour standard to these areas, which we proposed on October 25, 1999 and expect to complete very soon. 64 FR 57524. We also announced that we were conducting another round of modeling, described below. See the Response to Comments document for more discussion of the rollback and exceedance approaches.

c. Updated and Additional Ozone Modeling

We have updated and expanded our ozone modeling. We updated the ozone modeling so that it is now based on estimates of vehicle emissions that reflect the most recent data and our best understanding of several aspects of emissions estimation.[14] We also changed most of the episodes for which we modeled ozone concentrations, with all of our final episode days coming from a single calendar year. By selecting days from within a single year, we responded to a comment that the original episode periods might together contain an atypically high number of days favorable to ozone formation for some parts of the country. The new episodes are also better at representing conditions that lead to high ozone in areas along the Gulf Coast, whose ozone-forming conditions were not well represented in the episodes used for the original modeling.

While we considered these improvements necessary and appropriate in light of comments and other information available to us, the actual results of the two rounds of modeling with regard to the need for additional reductions have turned out to be similar. The latest round of modeling provided us ozone predictions for 2007 and 2030 in the eastern U.S., and for 2030 in the western U.S. There are some differences in specific results, where and when the two models can be directly compared. However, the same conclusion would be reached from either, namely that there is a broad set of areas with predicted ozone concentrations in 2007 above 0.124 ppm, in the baseline scenario without additional emission reductions.

We have compared and supplemented our own ozone modeling with other modeling studies, either submitted to us as comments to this rulemaking, as state implementation plan (SIP) revisions, or brought to our attention through our consultations with states on SIP revisions that are in development. The ozone modeling in the SIP revisions has the advantage of using emission inventories that are more specific to the area being modeled, and of using meteorological conditions selected specifically for each area. Also, the SIP revisions included other evidence and analysis, such as analysis of air quality and emissions trends, observation based models that make use of data on concentrations of ozone precursors, alternative rollback analyses, and information on the responsiveness of the air quality model. For some areas, we decided that the predictions of attainment or nonattainment from our

[14] While the use of these emissions estimates was new to our baseline ozone modeling in the latest ozone modeling, they were not new to this rulemaking, having already been used in calculations of cost-effectiveness in the draft RIA. We therefore were able to consider public comments on these estimates prior to using them in the latest ozone modeling

modeling were less reliable than conclusions that could be drawn from this additional evidence and analysis. For example, in some areas our episodes did not capture the meteorological conditions that have caused high ozone, while local modeling did so.

d. Results and Conclusions

As discussed in detail below, it is clear that the NO_X and VOC reductions to be achieved through the Tier 2/ Gasoline Sulfur program are needed to attain and maintain compliance with the 1 hour ozone NAAQS. Although the general pattern observed in our modeling indicates improvements in the near term, growth in overall emissions will lead to worsening of air quality over the long term.

Based on our ozone modeling, we have analyzed ozone predictions for 52 metropolitan areas for 1996, 2007, and 2030. In addition, we reviewed ozone attainment modeling and other evidence covering 15 of these areas, from SIP submittals or from modeling underway to support SIP revisions. This local modeling addressed only the current or requested attainment date in each area. We then made attainment and nonattainment predictions from this information.

The general pattern we observed with the baseline scenario, i.e., without new emission reductions, is a broad reduction between 1996 and 2007 in the geographic extent of ozone concentrations above the NAAQS, and in the frequency and severity of exceedances. This is consistent with the national emissions inventory trend between these two years. At the same time, we also found that peak ozone concentrations and the frequency of exceedances in 2030 were generally somewhat higher than in 2007 for most areas analyzed. This too is consistent with our analysis of emission inventory trends, which shows that the total NO_X inventory from all sources will decline from 2007 to about 2015 and then begin to increase due to growth in the activity of emission sources. In 2030, our analysis predicts that NO_X emissions from all sources will be about one percent higher than in 2007. While we did not model ozone concentrations for years between 2007 and 2030, we expect that they would track the national emissions trend by showing a period of improvement after 2007 and then deterioration, although individual areas will vary due to local source mix and growth rates.[15]

Within this general pattern of ozone attainment changes between 1996 and 2030, we have determined that 26 metropolitan areas are certain or highly likely to need additional reductions to attain and maintain the 1-hour ozone NAAQS. These 26 areas are those that have current violations of the 1-hour ozone NAAQS and are predicted by the best ozone modeling we have available to still be in violation without a new federal vehicle program in 2007.[16] Based on the general trends described above, without further emissions reductions many of these areas may also have violations continuously throughout the period from 2007 to 2030, while others may briefly attain and then return to nonattainment on or before 2030. These 26 metropolitan areas are listed in Table III.B–1, along with their 1996 population which totals over 86 million. The sizes of these areas and their geographical distribution strongly support an overall need for additional reductions in order to attain and maintain under section 202(i). Because ozone concentration patterns causing violations of the 1-hour NAAQS are well established to endanger public health or welfare, this determination also supports our actions today under the general authority of sections 202(a)(1), 202(a)(3), and 202(b).

As indicated above, in reaching this conclusion about these 26 areas, we examined local ozone modeling in SIP submittals. These local analyses are considered to be more extensive than our own modeling for estimating whether there would be NAAQS nonattainment without further emission reductions, when interpreted by a weight of evidence method which meets our guidance for such modeling. One of the areas which submitted a SIP revision was a special case. We have recently proposed to approve the 1-hour ozone attainment demonstration for the nonattainment area of Washington, D.C. (but not Baltimore). We have nevertheless included this area on the list of 26 that are certain or highly likely to require further reductions to attain and maintain, because its SIP attainment demonstration assumed emission reductions from vehicles meeting the National Low Emissions Vehicle (NLEV) standards.

However, by its own terms, the NLEV standards would not extend beyond the 2003 model year if we did not promulgate Tier 2 vehicle standards at least as stringent as the NLEV standards. See 40 CFR 86.1701–99(c). Thus, the emission reductions relied upon from 2004 and later model year NLEV vehicles are themselves ''further reductions'' for the purposes of CAA section 202(i).[17] The local modeling indicating attainment with these reductions is therefore strong evidence that further reductions are needed past 2003, beyond those provided by the Tier 1 program. Based on this, and on the fact that our own ozone modeling showed the Washington, DC area to violate the NAAQS in 2007 even with full NLEV emission reductions, we have concluded that it should be included with areas that do require further reductions to attain and maintain the 1-hour ozone NAAQS.

The 1-hour ozone NAAQS presently does not apply in 12 of the 26 areas listed in Table III.B–1, but we have proposed to re-instate it and expect to complete that action shortly. These areas are indicated in the table. Our decision to include these areas on this list is based on the contingency that we will re-instate the 1-hour standard in these areas. However, even if we considered only the 14 areas where the 1-hour standard applies as of the signature date of this notice, we have concluded that our determination would be the same.

TABLE III.B–1.—TWENTY-SIX METROPOLITAN AREAS WHICH ARE CERTAIN OR HIGHLY LIKELY TO REQUIRE ADDITIONAL EMISSION REDUCTIONS IN ORDER TO ATTAIN AND MAINTAIN THE 1-HOUR OZONE NAAQS

Metropolitan area	1996 Population (millions)
Atlanta, GA MSA	3.5
Barnstable-Yarmouth, MA MSA [a]	0.2
Baton Rouge, LA MSA	0.6
Beaumont-Port Arthur, TX MSA	0.4
Birmingham, AL MSA	0.9
Boston-Worcester-Lawrence, MA–NH–ME–CT CMSA [a]	5.6
Charlotte-Gastonia-Rock Hill, NC–SC MSA [a]	1.3

[15] EPA's modeling presumed that cars and light trucks will continue to meet the emission levels of the National Low Emissions Vehicle (NLEV) program after model year 2003, even though the program will end in model year 2003 or shortly thereafter. Had our modeling not included such levels in its inventory assumptions, trends for ozone concentrations would have shown earlier increases in ozone concentrations.

[16] The date of the predicted violation was 2007 for most areas, 2010 in the case of Los Angeles, CA, and 2030 in the case of Portland-Salem, OR.

[17] With regard to eventual final action on the 1-hour attainment demonstration for Washington, DC, the issue of the continuation of the NLEV standards is mooted by the promulgation of the Tier 2/ Gasoline Sulfur program. A portion of the emission reductions from this program will replace the post-2003 model year NLEV reductions assumed in the SIP.

TABLE III.B–1.—TWENTY-SIX METROPOLITAN AREAS WHICH ARE CERTAIN OR HIGHLY LIKELY TO REQUIRE ADDITIONAL EMISSION REDUCTIONS IN ORDER TO ATTAIN AND MAINTAIN THE 1-HOUR OZONE NAAQS—Continued

Metropolitan area	1996 Population (millions)
Cincinnati-Hamilton, OH–KY–IN CMSA	1.9
Dallas-Fort Worth, TX CMSA	4.6
Houma, LA MSA [a]	0.2
Houston-Galveston-Brazoria, TX CMSA	4.3
Huntington-Ashland, WV–KY–OH MSA [a]	0.3
Indianapolis, IN MSA [a]	1.5
Los Angeles-Riverside-San Bernardino CA CMSA	15.5
Louisville, KY–IN MSA	1.0
Macon, GA MSA [a]	0.3
Memphis, TN–AR–MS MSA [a]	1.1
Nashville, TN MSA [a]	1.1
New York-Northern New Jersey-Long Island, NY–NJ–CT–PA CMSA	19.9
Philadelphia-Wilmington-Atlantic City, PA–NJ–DE–MD CMSA	6.0
Pittsburgh, PA MSA	2.4
Portland-Salem, OR–WA CMSA [a]	2.1
Providence-Fall River-Warwick, RI–MA MSA [a]	1.1
Richmond-Petersburg, VA MSA [a]	0.9
St. Louis, MO–IL MSA	2.5
Washington-Baltimore, DC–MD–VA–WV CMSA	7.2
Total Population	86.3

Notes:
[a] The 1-hour ozone NAAQS does not currently apply, but we have proposed and expect to re-instate it shortly.

There are 12 additional metropolitan areas, with another 25.3 million people in 1996, for which the available ozone modeling suggests significant risk of failing to attain and maintain the 1-hour ozone NAAQS without additional emission reductions. Table III.B–2 lists the areas we put in this second category. Our own ozone modeling predicted these 12 areas to need further reductions to avoid violations in 2007. For six of these areas, recent air quality monitoring data indicate violation, but we have reviewed local ozone modeling and other evidence indicating attainment in 2007.[18] Based on this evidence, we have kept these areas separate from the previous set of 26 areas which we consider certain or highly likely to need additional reductions. However, we still consider there to be a significant risk of failure to attain and maintain in these six areas because this local modeling has inherent uncertainties, as all ozone modeling does. Moreover, the local modeling did not examine the period after initial attainment.

For the other six of the 12 areas, the air quality monitoring data shows current attainment but with less than a 10 percent margin below the NAAQS. This suggests these areas may remain without violations for some time, but we believe there is still a moderate risk of future violation of the NAAQS because meteorological conditions may be more severe in the future.

It is highly likely that at least some of these 12 areas will violate the NAAQS without additional reductions, and it is a distinct possibility that many of them will do so. We consider the situation in these areas to support our determination that, overall, additional reductions are needed for attainment and maintenance. However, we reiterate that our predictions for the 26 areas listed in Table III.B–1, and even our predictions for only the 14 of those 26 for which the 1-hour standard now applies, are a sufficient basis for our determination of an overall need for additional reductions and for our actions today.

TABLE III.B–2.—TWELVE METROPOLITAN AREAS WITH MODERATE TO SIGNIFICANT RISK OF FAILING TO ATTAIN AND MAINTAIN THE 1-HOUR OZONE NAAQS WITHOUT ADDITIONAL EMISSION REDUCTIONS

Metropolitan area	1996 Population (millions)
Benton Harbor, MI MSA [a]	0.2
Biloxi-Gulfport-Pascagoula, MS MSA [a]	0.3
Chicago-Gary-Kenosha, IL–IN–WI CMSA	8.6
Cleveland-Akron, OH CMSA [a]	2.9
Detroit-Ann Arbor-Flint, MI CMSA [a]	5.3
Grand Rapids-Muskegon-Holland, MI MSA [a]	1.0
Hartford, CT MSA	1.1
Milwaukee-Racine, WI CMSA	1.6
New London-Norwich, CT–RI MSA [a]	1.3
New Orleans, LA MSA [a]	0.3
Pensacola, FL MSA [a]	0.4
Tampa, FL MSA [a]	2.2
Total Population	25.3

Notes:
[a] The 1-hour ozone NAAQS does not currently apply, but we have proposed and expect to re-instate it shortly.

e. Issues and Comments Addressed

We received detailed comments from the automobile industry related to ozone modeling and the need for additional emission reductions in order to attain and maintain. These were of three types.

Accuracy of modeling ozone concentrations.—The automobile industry commenters pointed out that in the modeling presented with our proposal, the ozone model and exceedance predicted violations of the NAAQS in 1995 in areas where monitoring data indicated no violations. They cited these cases as examples of model inaccuracy. We have made improvements to our emissions estimates, our episodes, and other aspects of the modeling system. These changes have improved the accuracy of the predicted ozone concentrations. Also, as stated above, our list of 26 areas that support our finding that additional reductions are needed does not include any areas where recent monitoring data shows no violations. The final RIA addresses issues of model accuracy in more depth.

As explained in the final RIA, our very latest estimates of car and light truck emissions without the benefits of our new standards are actually somewhat higher than the estimates used in the final round of ozone modeling, because the most recent data indicate even more serious adverse emissions effects from sulfur in

[18] The SIP revisions for Chicago and Milwaukee demonstrated that these two areas as well as Benton Harbor and Grand Rapids areas in Michigan (which are maintenance areas but have experienced ozone NAAQS violations recently) would not experience NAAQS violations in 2007, with a strategy that relied only on Tier 1 vehicle emission standards. We have also recently proposed to approve the 1-hour attainment demonstration for Greater Connecticut, covering the Hartford and New London areas, which assumed full NLEV emission reductions. However, Connecticut is committed in its SIP to adopt California vehicle standards if NLEV does end with the 2003 model year if a more stringent federal program is not promulgated. The California standards are more stringent than NLEV. The case of one additional area whose attainment demonstration we recently proposed to approve, Western Massachusetts (Springfield), should be explained here to avoid possible confusion. Our own ozone modeling predicted that Springfield would attain the NAAQS in 2007. Massachusetts has adopted the California vehicle emission standards, so there is no issue of the continuation of the NLEV standards.

gasoline. Thus, we think our predictions of ozone nonattainment using emission estimates prepared before this most recent data on sulfur was considered, may be conservative. This topic is discussed in more detail in section III.B.3.

Prediction of attainment/nonattainment.—For most areas, we predicted 2007 or 2030 attainment or nonattainment based on the exceedance method. The exceedance method predicts an area to be in attainment only if there are no predicted exceedances of the NAAQS during any episode day. However, for the areas for which we have received 1-hour attainment demonstrations in SIP revisions, our predictions were based on a larger and more robust set of data. When a state's modeling shows an exceedance that would otherwise indicate nonattainment, we allow the state to submit a variety of other evidence and analysis, such as locality specific meteorological conditions, analysis of air quality and emissions trends, observational based models that make use of data on concentrations of ozone precursors, a rollback analysis, and information on the responsiveness of the air quality model. We then make a weight-of-evidence determination of attainment or nonattainment based on consideration of all this local evidence. We did this in forming the set of 26 areas we consider certain or highly likely to need additional reductions to attain or maintain, in some cases concluding that attainment was demonstrated and in others that it was not.

The auto industry commenters recommended the use of rollback as the single method for making attainment and nonattainment predictions from predicted ozone concentrations. They stated that the rollback method would be more consistent than the exceedance method with the NAAQS's allowance of three exceedances in a three year period. They also believed that the rollback method would compensate for what they considered to be model over predictions of ozone concentrations. We believe that the rollback method is not appropriate for use as the sole, or even a primary, test of 1-hour ozone attainment or nonattainment. A rollback analysis may overlook violations that occur away from ozone monitors, and it may inappropriately project the effect of a recent period of favorable weather into the prediction of future attainment. In determining the attainment and maintenance prospects of numerous areas, as here, it is not possible to assemble and consider the full set of local evidence that should accompany any consideration of a rollback analysis. In such a situation, we believe that the exceedance method is the appropriate choice. A fuller explanation of our reasons for considering the exceedance method more appropriate than rollback is given in our Response to Comments document.

We have not completely excluded the rollback approach from the determinations in this rulemaking. We have considered it for those areas for which we had enough information to allow us to consider it in its proper context, i.e., for those areas covered by recent 1-hour SIP submissions. Of these areas, we concluded that some will not attain without additional reductions and some will.

While we disagree with the use of the rollback method, we have conducted a hypothetical analysis of 2007 attainment in all areas based only on our own ozone modeling, applying the rollback method recommended by the commenters. We calculated in this analysis that 15 metropolitan areas and three other counties with nearly 56 million in population in 1996 would violate the NAAQS in 2007. Moreover, these 15 metro areas are geographically spread out [19]. We believe that this result using the rollback method does not fully capture the likely nonattainment that would exist in 2007 in the absence of additional emission reductions. However, even if we were to consider the use of rollback valid, we consider this set of areas to also be an adequate basis for making the same determinations we have made based on the more appropriate exceedance-based analysis. The details of our hypothetical analysis using the rollback method are given in the final RIA and the technical support document for our ozone modeling analyses.

Ozone modeling and predictions.—Members of the automobile manufacturing industry submitted two modeling studies: (1) a repetition of our first round of modeling of the 37-state eastern U.S. domain but with their recommendations regarding estimates of motor vehicle emissions in 2007 and with the rollback method used to predict 2007 nonattainment, and (2) finer grid modeling for three smaller domains, also with their recommended estimates of emissions and with nonattainment predicted using a rollback method. Both modeling efforts showed less widespread nonattainment than we have determined and described here. Taken together, these studies predicted 2007 violations by the rollback method in or downwind of New York City, Chicago, Milwaukee, western Michigan, Baton-Rouge, and Houston.

The main difference between the automobile industry's ozone modeling and ours is in the emission estimates. We have reviewed the emissions estimates used in the industry studies. We concluded that the industry's emissions estimates employ inappropriate analytical steps in the calculation. Among the problems are that the adjustments for the benefits of inspection and maintenance programs were not consistent with the base estimate of in-use emissions, and the sales trend towards light trucks and SUVs was not properly captured. Also, as stated, we disagree with the use of the rollback approach as the sole test of attainment. As a consequence, we conclude that the industry's ozone modeling is not an appropriate basis for making predictions of future attainment or nonattainment. The final RIA explains in detail how we have addressed these and other emissions modeling issues in a manner which is more technically consistent and correct,[20] and how we have considered the results from rollback analyses but only as part of broad weight-of-evidence determinations for areas for which this was possible at this time. Our point-by-point review is given in our Response to Comments document.

The material on ozone modeling submitted by the commenters, having been prepared by the rollback method, was difficult to re-interpret according to our preferred exceedance method. However, it appears that if this modeling were interpreted by the exceedance method, it would indicate 2007 nonattainment in Baltimore and Washington, D.C. in addition to New York City, Chicago, Milwaukee, western Michigan, Baton-Rouge, and Houston. Overall, we conclude that the material submitted by the automobile industry does not contradict the facts we have used to make our determinations or the actions we are taking today.

f. 8-Hour Ozone

The predictions of ozone concentrations from the ozone modeling

[19] We did not include the Los Angeles-Riverside-San Bernardino area in this analysis, since it was not covered by our 2007 modeling, but we do believe it is rightly part of the basis for a determination on the need for additional reductions.

[20] As explained in the final RIA, our very lastest estimates of car and light truck emissions without the benefits of our new standards are actually somewhat higher than the estimates used in the final round of ozone modeling, because more recent data indicate even more serious adverse emissions effects from sulfur in gasoline. Thus, we think our predictions of ozone nonattainment may be conservative.

can be used to make predictions of attainment or nonattainment with the 8-hour ozone NAAQS. In our draft RIA, we estimated that 28 metropolitan areas and 4 rural counties with a combined population of 80 million people would violate the 8-hour ozone NAAQS in 2007 without additional emission reductions. Commenters noted differences between exact rollback procedure we had used in this projection and the steps specified in recent draft guidance we have issued on 8-hour ozone modeling. We agree with the commenters that the steps specified in our guidance are the correct ones to use. However, since we are not basing our promulgation of the Tier 2/Gasoline Sulfur Program on the 8-hour ozone NAAQS, we have not made any new predictions of 8-hour ozone nonattainment areas in 2007. Based on our findings in previous analyses of this sort, however, we believe that in the absence of the Tier 2/Gasoline Sulfur program there would be 8-hour nonattainment areas that are not also areas which we have concluded are certain or highly likely to violate the 1-hour NAAQS. If we considered it appropriate to proceed with implementation of the 8-hour standard, these areas would support our determination on the need for emission reductions, and the appropriateness and necessity of the vehicle and gasoline standards we are establishing.

3. Cars and Light-duty Trucks Are a Big Part of the NO_X and VOC Emissions, and Today's Action Will Reduce This Contribution Substantially

Emissions of VOCs and NO_X come from a variety of sources, both natural and man-made. Natural sources, including emissions that have been traced to vegetation, account for a substantial portion of total VOC emissions in rural areas. The remainder of this section focuses on the contribution of motor vehicles to emissions from human sources. Man-made VOCs are released as byproducts of incomplete combustion as well as evaporation of solvents and fuels. For gasoline-fueled cars and light trucks, approximately half of the VOC emissions come from the vehicle exhaust and half come from the evaporation of gasoline from the fuel system. NO_X emissions are dominated by man-made sources, most notably high-temperature combustion processes such as those occurring in automobiles and power plants. Emissions from cars and light trucks are currently, and will remain, a major part of nationwide VOC and NO_X emissions. In 1996, cars and light trucks comprised 25 percent of the VOC emissions and 21 percent of the NO_X emissions from human sources in the U.S.[21] The contribution in metropolitan areas was generally larger.

We have made significant improvements in the analysis used to estimate the emission inventory impacts of this action, including improving the emission factor modeling, using more detailed local modeling input, and using a more conservative (lower) estimate of VMT growth. These changes are detailed in the Regulatory Impact Analysis for this rule. The following discussion is based on this improved analysis.

In addition to the improvements which are incorporated in this analysis, we also made further improvements in the emission factor modeling after analyzing comments which we did not have time to incorporate into the detailed inventory analysis described here. The most notable change is related to data which indicates that NO_X and NMOG emissions are even more sensitive to gasoline sulfur than previously thought. This change and others are described in detail in the Response to Comments. Our early analysis of these changes indicates that incorporating them into this analysis would provide further support for this action because these changes result in both increases in the baseline emissions without Tier 2 and in the reductions that would result from Tier 2. For example, in the detailed inventory analysis we report below, we project nationwide Tier 2/Gasoline Sulfur control NO_X reductions from cars and light trucks of 856,471 tons per year in 2007. Using the version of the emission factor model that incorporates these additional changes increases the estimated Tier 2 reductions to approximately 1.0 million tons per year in 2007 (estimated baseline emissions without Tier 2 increase from 3.1 million tons per year in 2007 to approximately 3.7 million tons per year using the version of the emission factor model that incorporates these additional changes). Therefore, the estimates of the inventory reductions given here (and used as the basis for the ozone air quality analysis) are clearly conservative.

Motor vehicle emission controls have led to significant improvements in emissions released to the air (the "emission inventory") and will continue to do so in the near term[22]. In the current analysis, we continue to find that total emissions from the car and light truck fleet would continue to decline for a period, even if we were not establishing the Tier 2/Gasoline Sulfur program. This decline would result from the introduction of cleaner reformulated gasoline in 2000, the introduction of National Low Emission Vehicles (NLEVs) and vehicles complying with the Enhanced Evaporative Test Procedure and Supplemental Federal Test Procedures, and the continuing removal of older, higher-emitting vehicles from the in-use vehicle fleet. On a per mile basis, VOC and NO_X emissions from cars and light trucks combined would have continued to decline well beyond 2015, reflecting the continuing effect of fleet turnover under existing emission control programs. However, projected increases in vehicle miles traveled (VMT) will cause total emissions from these vehicles to increase. With this increase in travel and without additional controls, we project that combined NO_X and VOC emissions for cars and light trucks without the Tier 2/Gasoline Sulfur program would increase starting in 2013 and 2016, respectively, so that by 2030 they would return to levels above or nearly the same as they will be in 2000. In cities experiencing rapid growth, such as Charlotte, North Carolina, the near-term trend towards lower emissions tends to reverse sooner.[23] With additional improvements in the modeling done in Response to Comments, we now estimate that without the Tier 2/Gasoline Sulfur program, there will be a constant increase in these emission over time.

Figure III–1 illustrates this expected trend in car and light truck NO_X emissions in the absence of today's action. The figure also allows the contribution of cars to be distinguished from that of light trucks. The figure clearly shows the impact of steady growth in light truck sales and travel on overall light-duty NO_X emissions; the decrease in overall light-duty emission levels is due solely to reductions in LDV emissions. In 2000, we project that

[21] Emission Trend Report, 1997.

[22] The auto manufacturer and northeastern state commitments to the NLEV program are scheduled to end in 2004 without further EPA action on Tier 2 standards, although continued voluntary compliance by automobile manufacturers and the affected states is a possibility. Our analysis of emission trends and the emission benefits expected from today's action assumes for the base scenario a continuation of the NLEV program past 2004. If the NLEV program does not continue beyond 2004, the reductions resulting from Tier 2 would be larger than what is shown here. It also includes all other control measures assumed to be implemented in local areas, such as reformulated gasoline in all required and opt-in areas and enhanced I/M where required.

[23] Also, if the NLEV program ends in model year 2004 or shortly thereafter, as scheduled, this trend would reverse more quickly in all areas.

trucks will produce about 50 percent of combined car and light truck NO_X emissions. We project that truck emissions would actually increase after 2000, and over the next 30 years, trucks would grow to dominate light-duty NO_X emissions. By 2010, we project trucks would make up two-thirds of light-duty NO_X emissions; by 2020, nearly three-quarters of all light-duty NO_X emissions would be produced by trucks.

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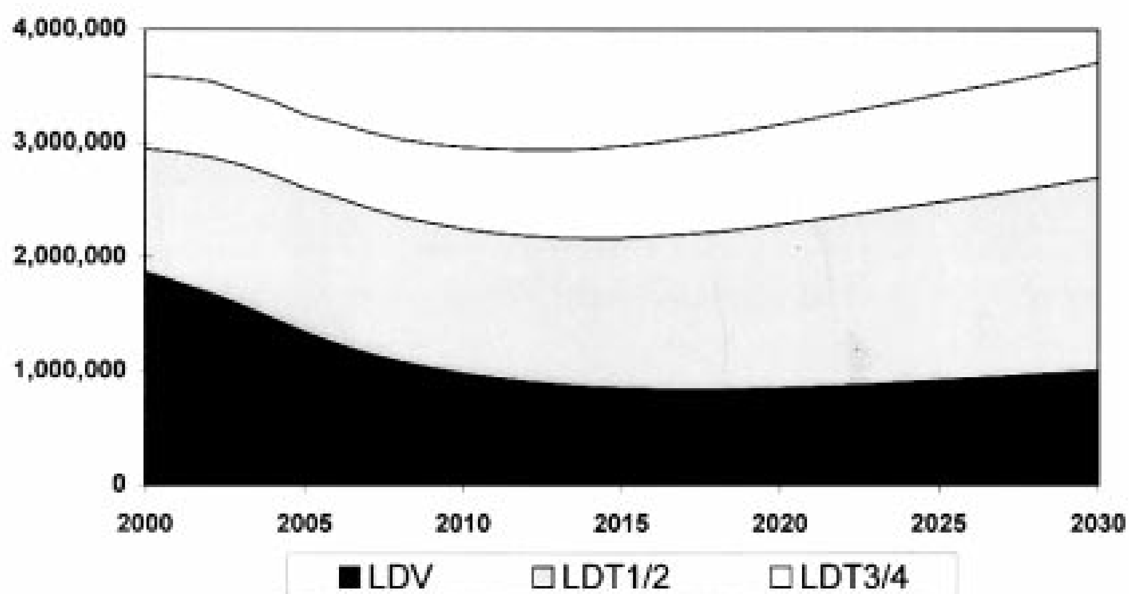
Figure III-1.

Light-Duty NOx Emissions Without Tier 2 (tons per year)

[Estimates exclude California, Alaska, and Hawaii, although reductions will occur in all three states.]



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Today's action will significantly decrease NO_X and VOC emissions from cars and light trucks, and will delay the date by which NO_X and VOC emissions will begin to increase due to continued VMT growth. With Tier 2/Gasoline Sulfur control, light-duty vehicle NO_X and VOC emissions are projected to continue their downward trend past 2020. Table III.B–3 shows the annual tons of NO_X that we project will be reduced by today's action.[24] These projections include the benefits of low sulfur fuel and the introduction of Tier 2 car and light truck standards.

TABLE III.B–3.—NO_X EMISSIONS FROM CARS AND LIGHT TRUCKS AS PERCENT OF TOTAL EMISSIONS, AND REDUCTIONS DUE TO TIER 2/GASOLINE SULFUR CONTROL (TONS PER YEAR) [a]

Year	Light-duty tons— without tier 2	Light-duty percent of total without tier 2	Light-duty tons reduced by tier 2 [c, c]
2007	3,095,698	16	856,471
2010	2,962,093	16	1,235,882
2015	2,968,707	17	1,816,767
2020	3,160,155	17	2,220,210

[24] Today's action for both vehicles and fuels will apply in 49 states and the U.S. territories, excluding only California. There will also be emissions reductions in California from vehicles that relocate or visit from other states. However, much of the emissions inventory analysis for this action was made for a 47-state region which excludes California, Alasks, and Hawaii. The latter two states were not included in the scope of ozone, PM and economic benefits modeling.

TABLE III.B–3.—NO_X EMISSIONS FROM CARS AND LIGHT TRUCKS AS PERCENT OF TOTAL EMISSIONS, AND REDUCTIONS DUE TO TIER 2/GASOLINE SULFUR CONTROL (TONS PER YEAR) [a]—Continued

Year	Light-duty tons— without tier 2	Light-duty percent of total without tier 2	Light-duty tons reduced by tier 2 [b, c]
2030	3,704,747	19	2,795,551

Notes:
[a] Estimates exclude California, Alaska, and Hawaii, although reductions will occur in all three.
[b] Does not include emission reductions from heavy-duty gasoline vehicles.
[c] These numbers represent a conservative estimate of the benefits of the Tier 2/Sulfur program. Based on the updated emission factor model developed in response to comments, the program will result in significantly larger benefits. For example, our new model projects NO_X reductions of 1,100,000 tons in 2007.

The lower sulfur levels in today's action will produce large emission reductions on pre-Tier 2 vehicles as soon as low-sulfur gasoline is introduced, in addition to enabling Tier 2 vehicles to achieve lower emission levels. Among the pre-Tier 2 vehicles, the largest per vehicle emission reductions from lower sulfur in gasoline will be achieved from vehicles which automobile manufacturers will have sold under the voluntary National Low Emission Vehicle program. These vehicles are capable of substantially lower emissions when operated on low sulfur fuel. Older technology vehicles experience a smaller but significant effect.

In 2007, when all gasoline will meet the new sulfur limit and when large numbers of 2004 and newer vehicles meeting these standards will be in use, the combined NO_X emission reduction from vehicles and fuels will be over 850,000 tons per year. After 2007, emissions will be reduced further as the fleet turns over to Tier 2 vehicles operating on low sulfur fuel. By 2020, NO_X emissions will be reduced by 70% from the levels that would occur without today's action. This reduction equals the NO_X emissions from over 164 million pre-Tier 2 cars and light trucks. This reduction represents a 12 percent reduction in NO_X emissions from all manmade sources.

VOC emissions will also be reduced by today's action, with reductions increasing as the fleet turns over. We estimate that the reductions as a percent of emissions from cars and light trucks will be 7 percent in 2007 and grow to 17 percent in 2020.

As discussed earlier, in California, smaller but still substantial reductions in both NO_X and VOC will be achieved because vehicles visiting and relocating to California will be designed to meet these standards. Also, vehicles from California visiting other states will not be exposed to high sulfur fuel. California Air Resources Board staff have estimated that Tier 2/Sulfur will reduce NO_X emissions in the South Coast Air Quality Management District by approximately 4 tons per day in 2007.[25] CARB staff plan to incorporate these reductions in their revised attainment plan for this district, which includes most of the Los Angeles-Long Beach region.

These estimates of emission reductions reflect a mixture of urban, suburban, and rural areas. However, cars and light trucks generally make up a larger fraction of the emission inventory for urban and suburban areas, where human population and personal vehicle travel is more concentrated than emissions from other sources such as heavy-duty highway vehicles, power plants, and industrial boilers. We have estimated emission inventories for three cities using the same methods as were used to project the nationwide inventories, and we present the results for 2007 below in Table III.B–4.

These results confirm that light-duty vehicles make up a greater share of the NO_X emission inventories in urban areas than they do in the nationwide inventory. While these vehicles' share of national NO_X emissions in 2007 is about 16 percent, it is estimated to be about 34 percent in the Atlanta area. There is also a range in VOC contributions, with Atlanta again being the area with the largest car and light truck contribution at 17 percent. In metropolitan areas with high car and light truck contributions, today's action will represent a larger step towards attainment since it will have a larger effect on total emissions.

TABLE III.B–4—Proportion of the Total Urban Area NO_X and VOC Inventory in 2007 Attributable to Light-Duty Vehicles[a]

Region	NO_X (percent)	VOC (percent)
Nationwide	16	13
New York urban area	18	6
Atlanta urban area	34	17
Charlotte urban area	24	15

Notes:
[a] The estimates reflect continuation of NLEV beyond 2004.

Another useful perspective from which to view the magnitude of the emission reductions from today's proposal is in terms of the additional emission reductions from all human sources that areas will need to attain the 1-hour ozone standard. For this analysis, we reviewed our proposals for action on the 1-hour attainment demonstrations submitted by the states. With these proposals, EPA identified estimates of additional emission reductions (measures in addition to those submitted by the state in their plans) necessary for attainment for some

[25] California Air Resources Board, Executive Order G–99–037, May 20, 1999, Attachment A, 6–7, 10. These NO_X reductions represent a small fraction of the emission reductions needed in the South Coast to attain the NAAQS.

of the areas. These estimates of additional emission reductions are documented in the individual **Federal Register** Notices. Using these estimates and the estimates of Tier 2 reductions developed for today's action, we have determined what portion of these additional emission reductions would be accounted for by today's action. These estimates are reported in Table III.B–5, which shows the contribution of Tier 2/Sulfur NO_X reductions to the additional emission reduction necessary for attainment for three metropolitan areas. For example, for the New York nonattainment area, 89% of the additional NO_X emission reductions needed for attainment are provided for with today's action. This leaves 11% of the additional NO_X emission reductions to be addressed by the State through other local sources.

EPA and the States already have significant efforts underway to lower ozone precursor emissions through national regulations and State Implementation Plans. Table III.B–5 shows the contribution of Tier 2 to the substantial State-led efforts to provide attainment with the ozone NAAQS. Since the Tier 2 program has evolved in the past year after much of the States' efforts were completed, many of the States were unable to estimate the benefits of Tier 2 in their areas. EPA's proposal actions on these SIPs for the ozone NAAQS addresses the need for Tier 2 in many areas. More specifically, Tier 2 is being used to help States identify additional measures, in addition to those in their plans, necessary for attainment.

These estimates are subject to change as the states review and comment on our proposed action on the SIPs. These figures show that today's proposal would make a very substantial contribution to these cities' attainment programs, but that there will still be a need for additional reductions from other sources. The emission reductions from today's proposal would clearly not exceed the reductions needed from an air quality perspective for these areas.

TABLE III.B–5.—CONTRIBUTION OF TIER 2/SULFUR NO_X REDUCTIONS TO OZONE ATTAINMENT EFFORTS OF SELECTED NONATTAINMENT AREAS

Nonattainment area (attainment date)	Percent of additional NO_X reductions necessary for attainment	
	From tier 2	Needed after tier 2
Baltimore (2005)	100	0
New York (2007)	89	11
Philadelphia (2005)	87	13

4. Ozone Reductions Expected From This Rule

The large reductions in emissions of ozone precursors from today's standards will be very beneficial to federal and state efforts to lower ozone levels and bring about attainment with the current one-hour ozone standard. The air quality modeling for the final rule shows that improvements in ozone levels are expected to occur throughout the country because of the Tier 2/Gasoline Sulfur program.[26] EPA found that the program significantly lowers model-predicted exceedances of the ozone standard. In 2007 the number of exceedances in CMSA/MSAs is forecasted to decline by nearly one-tenth and in 2030, when full turnover of the vehicle fleet has occurred, the program lowers such exceedances by almost one-third. In these same areas, the total amount of ozone above the NAAQS is forecasted to decline by about 15 percent in 2007 and by more than one-third in 2030. In the vast majority of areas, the air quality modeling predicts that the program will lower peak summer ozone concentrations for both 2007 and 2030. The reduction in daily maximum ozone is nearly 2 ppb on average in 2007 and over 5 ppb on average in 2030. These reductions contribute to EPA's assessment that the program will provide the large set of public health and environmental benefits summarized in Section IV.D of the Preamble. The forecasted impacts of the program on ozone in 2007 and 2030 are further described in the Tier 2 Air Quality Modeling Technical Support Document.

During the public comment period on the proposed rule, EPA received several comments that expressed concern about potential increases in ozone that might occur as a result of this rule. As indicated above, the air quality modeling results indicate an overall reduction in ozone levels in 2007 and 2030 during the various episodes modeled. In addition to ozone reductions, a few areas had predicted ozone increases in portions of the area during parts of the episodes modeled. In most of these cases, we observed a net reduction in ozone levels in these areas due to the program. In the very small number of exceptions to this, the Agency did find benefit from reduction of peak ozone levels. Based upon a careful examination of this issue, including EPA's modeling results as well as consideration of the modeling and analyses submitted by commenters, it is clear that the significant ozone reductions from this rule outweigh the limited ozone increases that may occur. Additional details on this issue are provided in the Response to Comments document and in the Tier 2 Air Quality Modeling Technical Support Document.

Taken together, EPA believes these results indicate that it will be much easier for States to develop State Implementation Plans which will attain and maintain compliance with the one-hour ozone standard. EPA will work with States conducting more detailed local modeling of their specific ozone situation, to ensure that their SIPs will provide attainment. Notably, there are also other upcoming federal measures to lower ozone precursors that will aid these efforts. If the State modeling of local programs shows a need, the Agency will work with states to plan further actions to produce attainment with the NAAQS in order to protect the public's health and the environment. Further details on EPA's modeling results can be found in the Agency's Response to Comments and technical support documents.

C. Particulate Matter

The need to control the contribution of cars and light trucks to ambient concentrations of particulate matter (PM) is the basis for our adoption of the new PM emission standards for vehicles. PM is also a supplemental consideration in our promulgation of

[26] EPA assessment of air quality changes for 2007 and 2030 focused on 37 states in the East because these states cover most of the areas with 1-hour nonattainment problems.

the vehicle emission standards for NO_X and VOC, and for the limits on sulfur in gasoline, because SOx, NO_X, and VOC are PM precursors.

For cars and for light trucks under 3750 pounds loaded vehicle weight, we are establishing new emission standards under the provisions of CAA section 202(i), which ties our action to the need for additional emission reductions in order to attain and maintain the NAAQS. The NAAQS relevant to the PM emission standards is the PM_{10} NAAQS. The PM_{10} NAAQS also provides additional but not essential support to our promulgation of the NO_X and VOC standards, since these standards are fully supportable on the basis of the 1-hour ozone NAAQS.

For the vehicles not subject to CAA 202(i), and for the gasoline sulfur limits, our actions are tied to determinations regarding public health and welfare risks more broadly, under CAA sections 202(a), 202(b), and 211(c). The role of NO_X, VOC, and PM emissions in contributing to atmospheric concentrations of PM_{10} is an important element of the risk that these emissions pose to public health and welfare.

PM also poses risks to public health not fully reflected in the PM_{10} NAAQS. Though EPA has not relied on the adverse health impacts of fine PM to promulgate this rule, it is well established that such impacts exist. A summary of these effects is given in the next section. In addition, based on the available science, EPA's Office of Research and Development has recently submitted to a committee of our Science Advisory Board a draft assessment document which contains a proposed conclusion that diesel exhaust is a likely human cancer hazard and is a potential cause of other nonmalignant respiratory effects. The scientific advisory committee has met to discuss this document, and we are awaiting written review comments from the committee. We expect to submit a further revision of the document to the advisory committee before we make the document final.

1. Background on PM

Particulate matter (PM) represents a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. The NAAQS that regulates PM addresses only PM with a diameter less than or equal to 10 microns, or PM_{10}. The coarse fraction of PM_{10} consists of those particles which have a diameter in the range between 2.5 and 10 microns, and the fine fraction consists of those particles which have a diameter less than or equal to 2.5 microns, or $PM_{2.5}$. These particles and droplets are produced as a direct result of human activity and natural processes, and they are also formed as secondary particles from the atmospheric transformation of emissions of SO_X, NO_X, ammonia, and VOCs.

Natural sources of particles in the coarse fraction of PM_{10} include windblown dust, salt from dried sea spray, fires, biogenic emanation (*e.g.,* pollen from plants, fungal spores), and volcanoes. Fugitive dust and crustal material (geogenic materials) comprise approximately 80% of the coarse fraction of the PM_{10} inventory as estimated by methods in use today.[27] Manmade sources of these coarser particles arise predominantly from combustion of fossil fuel by large and small industrial sources (including power generating plants, manufacturing plants, quarries, and kilns), wind erosion from crop land, roads, and construction, dust from industrial and agricultural grinding and handling operations, metals processing, and burning of firewood and solid waste. Coarse-fraction PM_{10} remains suspended in the atmosphere a relatively short period of time.

Most of the emission sources listed for coarse particles also have a substantial fine particle fraction. Their share of the $PM_{2.5}$ inventory is somewhat smaller, however, because of the role of other sources that give rise primarily to $PM_{2.5}$. The other sources of $PM_{2.5}$ include carbon-based particles emitted directly from gasoline and diesel internal combustion engines, sulfate-based particles formed from SO_X and ammonia, nitrate-based particles formed from NO_X and ammonia, and carbonaceous particles formed through transformation of VOC emissions. $PM_{2.5}$ particles from fugitive dust and crustal sources comprise substantially less than their share of coarse PM emissions, approximately one-half of the directly emitted $PM_{2.5}$ inventory as estimated by methods in use today. The presence and magnitude of crustal $PM_{2.5}$ in the ambient air is much lower even than suggested by this smaller inventory share, due to the additional presence of secondary PM from non-crustal sources and the removal of a large portion of crustal emissions close to their source. This near-source removal results from crustal PM's lack of inherent thermal buoyancy, low release height, and interaction with surrounding vegetation (which acts to filter out some of these particles).

Secondary PM is dominated by sulfate particles in the eastern U.S. and parts of the western U.S., with nitrate particles and carbonaceous particles dominant in some western areas. Mobile sources can reasonably be estimated to contribute to ambient secondary nitrate and sulfate PM in proportion to their contribution to total NO_X and SO_X emissions.

The sources, ambient concentration, and chemical and physical properties of PM_{10} vary greatly with time, region, meteorology, and source category. A first step in developing a plan to attain the PM_{10} NAAQS is to disaggregate ambient PM_{10} into the basic categories of sulfate, nitrate, carbonaceous, and crustal PM, and then determine the major contributors to each category based on knowledge of local and upwind emission sources. Following this approach, SIP strategies to reduce ambient PM concentrations have generally focused on controlling fugitive dust from natural soil and soil disturbed by human activity, paving dirt roads and controlling soil on paved roads, reducing emissions from residential wood combustion, and controlling major stationary sources of PM_{10} where applicable. The control programs to reduce stationary, area, and mobile source emissions of sulfur dioxide, oxides of nitrogen, and volatile organic compounds in order to achieve attainment with the sulfur dioxide and ozone NAAQS also have contributed to reductions in the fine fraction of PM_{10} concentrations. In addition, the EPA standards for PM emissions from highway and nonroad engines are contributing to reducing PM_{10} concentrations. As a result of all these efforts, in the last ten years, there has been a downward trend in PM_{10} concentrations, with a leveling off in the later years.

Particulate matter, like ozone, has been linked to a range of serious respiratory health problems. Scientific studies suggest a likely causal role of ambient particulate matter in contributing to a series of health effects. The key health effects categories associated with particulate matter include premature mortality, aggravation of respiratory and cardiovascular disease (as indicated by increased hospital admissions and emergency room visits, school absences, work loss days, and restricted activity days), changes in lung function and increased respiratory symptoms, changes to lung tissues and structure, and altered respiratory defense

[27] U.S. EPA (1998) National Air Pollutant Emission Trends Update, 1970–1997. EPA–454/E–98–007. There is evidence from ambient studies that emissions of these materials may be overestimated and/or that once emitted they have less of an influence on monitored PM concentrations (of both PM_{10} and $PM_{2.5}$) than this inventory share would suggest.

mechanisms. PM also causes damage to materials and soiling. It is a major cause of substantial visibility impairment in many parts of the U.S.

Motor vehicle particle emissions and the particles formed by the transformation of motor vehicle gaseous emissions tend to be in the fine particle range. Fine particles are a special health concern because they easily reach the deepest recesses of the lungs. Scientific studies have linked fine particles (alone or in combination with other air pollutants), with a series of significant health problems, including premature death; respiratory related hospital admissions and emergency room visits; aggravated asthma; acute respiratory symptoms, including aggravated coughing and difficult or painful breathing; chronic bronchitis; and decreased lung function that can be experienced as shortness of breath.

These effects are discussed further in EPA's "Staff Paper" and "Air Quality Criteria Document" for particulate matter.[28]

EPA first established primary (health-based) and secondary (welfare-based) National Ambient Air Quality Standards for PM_{10} in 1987. The annual and 24-hour primary PM_{10} standards were set at 50 $\mu g/m^{3}$[3], and 150 $\mu g/m^3$, respectively.[29] In July 1997, the primary standards were revised to add two new $PM_{2.5}$ standards. At the same time, we changed the statistical form of the primary PM_{10} standard and set all the secondary standards to be the same as the primary.

On May 14, 1999, a panel of the U.S. Court of Appeals for the District of Columbia Circuit reviewed EPA's revisions to the ozone and PM NAAQS and found, by a 2–1 vote, that sections 108 and 109 of the Clean Air Act, as interpreted by EPA, represent unconstitutional delegations of Congressional power. *American Trucking Ass'ns, Inc., et al.,* v. *Environmental Protection Agency*, 175 F.3d 1027 (D.C. Cir. 1999). Among other things the Court remanded the record for the 8-hour ozone NAAQS and the $PM_{2.5}$ NAAQS to EPA. On October 29, 1999, EPA's petition for rehearing by the three judge panel was denied, with an exception regarding the revised ozone NAAQS. EPA's petition for rehearing en banc by the full Circuit was also denied, although five of the nine judges considering the petition agreed to rehear the case.

The pre-existing PM_{10} NAAQS remains in effect (except for one area—Boise, ID—where prior to the court's decision we had determined it no longer to apply). We believe that given the uncertain status of the new $PM_{2.5}$ NAAQS, it is most appropriate to rely primarily on the pre-existing PM_{10} NAAQS in establishing the Tier 2/Gasoline Sulfur program's vehicle emission standards and limits on sulfur in gasoline. However, because we believe, and the Court did not dispute, that there are very substantial public health risks from $PM_{2.5}$ and substantial health and economic benefits from reducing $PM_{2.5}$ concentrations, we have conducted analyses of the $PM_{2.5}$ changes likely to occur from the Tier 2/Gasoline Sulfur program. These analyses are summarized in the section of this preamble dealing with the economic benefits of the new standards, section IV.D.5, and corresponding sections of the final RIA.

There is additional concern regarding the health effects of PM from diesel vehicles, apart from the health effects which were considered in setting the NAAQS for PM_{10} and $PM_{2.5}$. Diesel PM contains small quantities of chemical species that are known carcinogens, and diesel PM as a whole has been implicated in occupational epidemiology studies. EPA's Office of Research and Development has considered these studies, and has recently submitted to a committee of our Science Advisory Board a draft conclusion that diesel exhaust is a "highly likely" human cancer hazard.[30] Because we are awaiting a formal response from our advisory committee before revising and finalizing our assessment document, we are not relying on the conclusions in this document as formal support for our action today. More information about this aspect of PM air quality is given in section III.F of this preamble.

2. Need for Additional Reductions to Attain and Maintain the PM_{10} NAAQS

The most recent PM_{10} monitoring data indicates that 15 designated PM_{10} nonattainment counties, with a population of almost 9 million in 1996, violated the PM_{10} NAAQS in the period 1996–1998. The areas that are violating do so because of exceedances of the 24-hour PM_{10} NAAQS. No areas had monitored violations of the annual standard in this period. Table III.C–1 lists the 15 counties. The table also indicates the classification for each area and the status of our review of the State Implementation Plan.

TABLE III.C–1.—FIFTEEN PM_{10} NONATTAINMENT AREAS VIOLATING THE PM_{10} NAAQS IN 1996–1998 [a]

Area	Classification	SIP approved?	1996 Population (millions)
Clark Co., NV	Serious	No	0.93
El Paso, TX	Moderate	Yes	0.67
Gila, AZ	Moderate	No	0.05
Imperial Co., CA	Moderate	No	0.14
Inyo Co., CA	Moderate	No	0.02
Kern Co., CA	Serious	No	0.62
Mono Co., CA	Moderate	No	0.01
Kings Co., CA	Serious	No	0.11
Maricopa Co., AZ	Serious	No	2.61
Power Co., ID	Moderate	No	0.01
Riverside Co., CA	Serious	No	1.41
San Bernardino Co., CA	Serious	No	1.59
Santa Cruz Co., AZ	Moderate	No	0.04
Tulare Co., CA	Serious	No	0.35

[28] U.S. EPA, 1996, Air Quality Criteria for Particulate Matter, EPA/600/P–95/001aF. Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper, EPA–452 R–96–013, July 1996.

[29] The annual average PM10 NAAQS is based on a three-year average, and the 24-hour NAAQS is based on expected exceedances over a three-year period.

[30] Health Assessment Document for Diesel Emissions, SAB Review Draft EPA/600/8–90/057D. November 1999. The document is available electronically at http://www.epa.gov/ncea/diesel.htm.

TABLE III.C–1.—FIFTEEN PM_{10} NONATTAINMENT AREAS VIOLATING THE PM_{10} NAAQS IN 1996–1998 [a]—Continued

Area	Classification	SIP approved?	1996 Population (millions)
Walla Walla Co., WA	Moderate	Yes	0.05
Total Population			8.61

[a] Although we do not believe that we are limited to considering only designated nonattainment areas in implementing CAA section 202(i), we have focused on the designated areas in the case of PM_{10}. An official designation of PM_{10} nonattainment indicates the existence of a confirmed PM_{10} problem that is more than a result of a one-time monitoring upset or a results of PM_{10} exceedances attributable to natural events. In addition to these designated nonattainment areas, there are 15 unclassified counties in 12 geographically spread out states, with a 1996 population of over 4 million, for which the state has reported PM_{10} monitoring data for this period indicating a PM_{10} NAAQS violation. We have not yet excluded the possibility that a one-time monitoring upset or a natural event(s) is responsible for the monitored violations in 1996–1998 in the 15 unclassified counties. We adopted a policy in 1996 that allows areas whose PM_{10} exceedances are attributable to natural events to remain unclassified if the state is taking all reasonable measures to safeguard public health regardless of the source of PM_{10} emissions. Areas that remain unclassified areas are not required to submit attainment plans, but we work with each of these areas to understand the nature of the PM_{10} problem and to determine what best can be done to reduce it. The Tier 2/Gasoline Sulfur program will reduce PM_{10} concentrations in these 15 unclassified counties, because all have car and light truck travel that contributes to PM_{10} and precursor emissions loadings. This reduction will assist these areas in reducing their PM_{10} nonattainment problem, if a problem is confirmed upon closer examination of each local situation. Boise, ID, had also been classified as a PM_{10} nonattainment area at one time and was monitored to have a PM_{10} NAAQS violation in 1996–1998. However, the pre-existing PM_{10} NAAQS does not presently apply in Boise, ID, because in the period between our revision of the old PM_{10} NAAQS and the Court's decision to vacate the revised PM_{10} NAAQS, we determined that Boise was in attainment with the old PM_{10} NAAQS and that it therefore no longer applied in that area.

Because the types and sources of PM_{10} are complex and vary from area to area, the best projections of future PM_{10} concentrations are the local emission inventory and air quality modeling analyses that states have developed or are still in the process of developing for their PM_{10} attainment plans. We do employ a modeling approach, known as the source-receptor matrix approach, for relating emission reductions to PM_{10} reductions on a national scale. This approach is one of our established air quality models for purposes of quantifying the health and welfare related economic benefits of PM reductions from major regulatory actions. One application of this modeling approach was for the Regulatory Impact Analysis for the establishment of the new PM NAAQS [31]. This model is also the basis for the estimates of PM_{10} (and $PM_{2.5}$) concentrations reductions we have used to estimate the economic benefits of the Tier 2/Gasoline Sulfur program in 2030. Its use for this purpose is described in the final RIA. In both applications, we modeled an emissions scenario corresponding to controls currently in place or committed to by states. As such, this scenario is an appropriate baseline for determining if further reductions in emissions are needed in order to attain and maintain the PM_{10} NAAQS.

In the RIA for the establishment of the PM NAAQS, we projected that in 2010 there will be 45 counties not in attainment with the original PM^{10} NAAQS . We cited these modeling results in our proposal for the Tier 2/ Gasoline Sulfur program and in our first supplemental notice. After reviewing public comments on our presentation of these modeling results, we have concluded that while the source-receptor matrix approach is a suitable model for estimating PM concentration reductions for economic benefits estimation, it is not a tool we can use with high confidence for predicting that individual areas that are now in attainment will become nonattainment in the future. However, we believe the source-receptor matrix approach is appropriate for, and is a suitable tool for, determining that a current designated nonattainment area has a high risk of remaining in PM_{10} nonattainment at a future date. Therefore, we have cross-matched the results for 2030 from our final RIA for Tier 2 and the list of current PM_{10} nonattainment areas with monitored violations in 1996 to 1998 shown in Table III.C–1.[32] Based on this, we conclude that the 8 areas shown in Table III.C–2 have a high risk of failing to attain and maintain without further emission reductions. These areas have a population of nearly 8 million. Included in the group are the counties that are part of the Los Angeles, Phoenix, and Las Vegas metropolitan areas, where traffic from cars and light trucks is substantial. California areas will benefit from the Tier 2/Gasoline Sulfur program because of travel within California by vehicles originally sold outside the state, and by reduced poisoning of catalysts from fuel purchased outside of California.

TABLE III.C–2.—EIGHT AREAS WITH A HIGH RISK OF FAILING TO ATTAIN AND MAINTAIN THE PM_{10} NAAQS WITHOUT FURTHER REDUCTIONS IN EMISSIONS

Area	1996 population (millions)
Clark Co., NV	0.93
Imperial Co., CA	0.14
Kern Co., CA	0.62
Kings Co., CA	0.11
Maricopa Co., AZ	2.61
Riverside Co., CA	1.41
San Bernardino Co., CA	1.59
Tulare Co., CA	0.35
Total population	7.76

Table III.C–2 is limited to designated PM_{10} nonattainment areas which both had monitored violations of the PM_{10} NAAQs in 1996–1998 and are predicted to be in nonattainment in 2030 in our PM_{10} air quality modeling. This gives us high confidence that these areas require further emission reductions to attain and maintain, but does not fully

[31] Regulatory Impact Analyses for the Particulate Matter and Ozone National Ambient Air Quality Standards and Proposed Regional Haze Rule, Innovative Strategies and Economics Group, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, N.C., July 16, 1997.

[32] We used the more recent modeling for 2030 rather than the earlier modeling for 2010, because the modeling the 2030 incorporates more recent estimates of emissions inventories. Our emission estimates in our final RIA indicate that PM_{10} emissions under the basline scenario increase steadily between 1996 and 2030, for 47 states combined and for four specific cities, suggesting that areas in nonattainment in both 1996–1998 and 2030 will be in nonatainment in the intermediate years as well assuming no further emission reductions. A factor tending to make Table III.C–2 shorter is that we have not relied on the source-receptor matrix model's prediction of 24-hour nonattainment, as those predictions on an individual areas basis are less reliable than the predictions of annual average nonattainment.

consider the possibility that there are other areas which are now meeting the PM_{10} NAAQS which have at least a significant probability of requiring further reductions to continue to maintain it. Our air quality modeling predicted 2030 violations of the annual average PM_{10} NAAQS in five additional counties that in either 1997 or 1998 had single-year annual average monitored PM_{10} levels of at least 90 percent of the NAAQS, but did not exceed the formal definition of the NAAQS over the three-year period ending in 1998 [33]. These areas are shown in Table III.C–3. They have a combined population of almost 17 million, and a broad geographic spread. Unlike the situation for ozone, for which precursor emissions are generally declining over the next 10 years or so before beginning to increase, we estimate that emissions of PM_{10} will rise steadily unless new controls are implemented. The small margin of attainment which these areas currently enjoy will likely erode; the PM air quality modeling suggests that it will be reversed. We therefore consider these areas to each individually have a significant risk of failing to maintain the NAAQS without further emission reductions. There is a substantial risk that at least some of them would fail to maintain without further emission reductions. The emission reductions from the Tier 2/Gasoline Sulfur program will help to keep them in attainment.

TABLE III.C–3.—FIVE AREAS WITH A SIGNIFICANT RISK OF FAILING TO ATTAIN AND MAINTAIN THE PM_{10} NAAQS WITHOUT FURTHER REDUCTIONS IN EMISSIONS

Area	1996 population (millions)
New York Co., NY	1.33
Cuyahoga Co., OH	1.39
Harris, Co., TX	3.10
San Diego Co., CA	2.67
Los Angeles Co., CA	8.11
Total population	16.6

Taken together and considering their number, size, and geographic distribution, these 13 areas are sufficient to establish the case that additional reductions are needed in order to attain and maintain the PM_{10} NAAQS. This determination provides additional support for the NOx and VOC standards and for the limits on gasoline sulfur, which are also fully supported on ozone attainment and health effects considerations. The sulfate particulate, sulfur dioxide, NO_X, and VOC emission reductions from the Tier 2/Gasoline Sulfur program will help the 8 areas in Table III.C–2 and the 5 areas in Table III.C.–3 to attain and maintain the PM_{10} NAAQS. The new PM standards for gasoline and diesel vehicles are also supported by this PM_{10} determination.

We are also establishing the new PM emissions standard today to avoid the possibility that PM_{10} concentrations in these and other areas do get even worse due to an increase in sales of diesel vehicles, which could create a need for further reductions which would be larger and would affect more areas of the country. At the present time, virtually all cars and light trucks being sold are gasoline fueled. The ambient PM_{10} air quality data for 1996 to 1998 reflects that current situation, and this data was an important factor in what areas are listed in Tables III.C–2 and III.C–3. Also, the predictions of future PM_{10} air quality, used to develop the Tables III.C–2 and III.C–3 lists of areas with high or significant risk of being unable to attain and maintain, are based on an assumption that this will continue to be true. However, we are concerned over the possibility that diesels will become more prevalent in the car and light-duty truck fleet, since automotive companies have announced their desire to increase their sales of diesel cars and light trucks. Because current diesel vehicles emit higher levels of PM_{10} than gasoline vehicles, a larger number of diesel vehicles could dramatically increase levels of exhaust PM_{10}, especially if more stringent PM emissions standards are not in place. The new PM emissions standards will ensure that an increase in the sales of diesel cars and light trucks will not increase PM emissions from cars and light trucks so substantially as to endanger PM_{10} attainment and maintenance on a more widespread basis. Given this potential, it is appropriate to establish the new PM emissions standards now on the basis of the increase in sales of diesel vehicles being a reasonable possibility without such standards. Establishing the new PM emissions standards now avoids the public health impact and industry disruption that could result if we waited until an increase in sales of diesels with high PM emissions had already occurred.

In order to assess the potential impact of increased diesel sales penetration on PM emissions, we analyzed the increase in PM_{10} emissions from cars and trucks under a scenario in which the use of diesel engines in cars and light trucks increases. We used projections developed by A.D. Little, Inc. as part of a study conducted for the American Petroleum Institute. The ''Most Likely'' case projected by A.D. Little forecasts that diesel engines'' share of the light truck market will grow to 24 percent by the 2015 model year. Diesel engines' share of the car market would grow somewhat more slowly, reaching 9 percent by 2015. The A.D. Little forecasts did not address the period after 2015; we have assumed that diesel sales stabilize at the level reached in 2015, with the fraction of in-use vehicles with diesel engines continuing to increase through turnover. We believe these projections are more realistic than the scenario of even higher sales of diesels described in the notice for the proposed Tier 2/Gasoline Sulfur program, though the A.D. Little forecasts still show much higher percentages of diesel vehicles in the light-duty fleet than have ever existed historically in the U.S.

The A.D. Little scenario of increased diesels, and even more so the scenario described in our proposal, would result in dramatic increases in direct PM_{10} emissions from cars and light trucks, if there were no change in these vehicles' PM standards. The increase in diesel exhaust PM_{10} emissions would more than overcome the reduction in direct PM_{10} attributable to the sulfur reduction in gasoline. With no change in the existing PM standards for cars and light trucks, our analysis of this scenario shows that direct PM_{10} emissions in 2020 would be approximately 98,000 tons per year, which is nearly two times the 50,000 tons projected if diesel sales do not increase. The portion of ambient PM_{10} concentrations attributable to cars and light trucks would climb steadily. The final RIA presents alternative estimates of the amount by which future PM_{10} concentrations could increase due to such an emissions increase, based on extrapolations from several studies' estimates of the contribution that heavy-duty diesel vehicles have made to recent or PM_{10} concentrations. The increase is estimated to range from 0.6 to 20 μg/m3.

The added PM_{10} emissions from cars and trucks due to an increase in diesel sales without action to reduce PM_{10} from new diesel vehicles would exacerbate the PM_{10} nonattainment problems of the areas listed in Tables

[33] In fact, in two of these areas, New York Co., NY and Harris Co., TX, the average PM_{10} level in 1998 was above the 50 $\mu g/m^3$ value of the NAAQS. These two areas are not included in the Table III.C–2 list of areas with a high risk of failing to attain and maintain because lower PM_{10} levels in 1996 and 1997 caused their three-year average PM_{10} level to be lower than the NAAQS. Official nonattainment determinations for the annual PM_{10} NAAQS are made based on the average of 12 quarterly PM_{10} averages.

III.C–2 and III.C–3, for which our air quality modeling predicted future nonattainment even without an increase in diesel sales. Moreover, it might cause PM_{10} nonattainment in additional areas. In addition to the counties already listed in Tables III.C–2 and III.C–3, there are other areas for which 1997 and 1998 data indicate that maintenance of the PM_{10} NAAQS is at risk if diesel sales of cars and light truck increase. Table III.C–4 lists additional counties for which either 1997 or 1998 monitoring data, or both, indicated a second-high PM_{10} concentration for the single year within 10 percent of the PM_{10} 24-hour NAAQS or an annual average PM_{10} concentration within 10 percent of the annual average PM_{10} NAAQS. Only counties which are part of metropolitan statistical areas are listed in Table III.C–4, in order to focus on those in which traffic densities are high. Considering both the annual and 24-hour NAAQS, there were 13 areas within 10 percent of the standard. Increases in PM_{10} emissions from more diesel vehicles would put these areas in greater risk of violating the PM_{10} NAAQS, especially if growth in other sources is high or meteorological conditions are more adverse than in the 1996 to 1998 period.

TABLE III.C–4.—THIRTEEN METROPOLITAN STATISTICAL AREA COUNTIES WITH 1997 AND/OR 1998 AMBIENT PM_{10} CONCENTRATIONS WITHIN 10 PERCENT OF THE ANNUAL OR 24-HOUR THE PM_{10} NAAQS [a]

	1996 population (millions)
Areas within 10 percent of the annual PM_{10} NAAQS:	
Lexington Co., SC	0.20
Union Co., TN	0.02
Washoe Co., NV	0.30
Madison Co., IL	0.26
Dona Ana Co., NM	0.16
El Paso Co., TX	0.68
Ellis Co., TX	0.97
Fresno Co., CA	0.74
Philadelphia Co., PA	1.47
Areas within 10 percent of the 24-hour PM_{10} NAAQS:	
Lexington Co., SC	0.20
El Paso Co., TX	0.68
Union Co., TN	0.02
Mobile Co., AL	0.40
Dona Ana Co., NM	0.16
Lake Co., IN	0.48
Philadelphia Co., PA	1.47
Pennington Co., SD	0.09
Ventura Co., CA	0.71
Total Population of all 13 areas	6.48

Notes:

[a] These areas are listed based on their second high 24-hour concentration and annual average concentration in 1997, 1998, or both. Official nonattainment determinations are made based on three years of data, and on estimates of expected exceedances of the 24-hour standard.

Fortunately, the standards included in today's actions will result in a steady decrease in total direct PM_{10} from cars and light trucks even if this increase in the use of diesel engines in these vehicles were to occur. If the A.D. Little ''Most Likely'' scenario for increased diesel engines in light trucks were to occur, today's actions would reduce diesel PM_{10} from cars and light trucks by over 75 percent in 2020. Stated differently, by 2030 today's actions would reduce 98,000 tons of the potential increase in PM_{10} emissions from passenger cars and light trucks. The result would be less direct PM_{10} than is emitted today, because the increase in diesel PM_{10} would be more than offset by the reduction in PM_{10} emissions from gasoline vehicles resulting from lower gasoline sulfur levels.

We are establishing tighter PM standards for cars and light trucks to help avoid the adverse impact of greater diesel PM emissions on PM_{10} attainment and public health and welfare if diesel sales increased in the future without the protection of the tighter standards. Because diesel vehicles will essentially be performing the same functions as the gasoline vehicles they will replace, it is appropriate for the new PM standards to also apply equally to gasoline and diesel vehicles. We expect that gasoline vehicles will need little or no redesign to meet the new PM standards when free of defects and properly operating. However, the new vehicle and gasoline sulfur standards may achieve some reduction in real world PM emissions from gasoline vehicles by encouraging more durable designs and by ensuring that these vehicles are operated on lower-sulfur fuel. The new standards for PM will also prevent any changes in gasoline engine design which would increase PM emissions. These changes would otherwise be possible because the current PM standard is so much higher than the current performance on the gasoline vehicles.

3. $PM_{2.5}$ Discussion

We are not basing our promulgation of the Tier 2 vehicle standards on a finding on the need for additional emission reductions in order to attain and maintain the NAAQS for $PM_{2.5}$. We are providing this information to explain that this program will result in substantial benefit in reduction of $PM_{2.5}$ concentrations, to an even broader set of geographic areas than will benefit in terms of PM_{10} attainment.

The annual and 24-hour $PM_{2.5}$ NAAQS set in 1997 are numerically much lower than the corresponding PM_{10} standards: 15 versus 50 $\mu g/m^3$ for the annual average standards and 65 versus 150 $\mu g/m^3$ for the 24-hour average standards. While geographically broad $PM_{2.5}$ monitoring is just now reaching the end of the first of three years of operation needed to determine compliance, our best analysis from the more limited $PM_{2.5}$ conducted in some areas indicates that many areas that are in compliance with the PM_{10} standards will be found to be in violation of the annual average $PM_{2.5}$ standard. Violations of the 24-hour $PM_{2.5}$ standard appear to be infrequent.

Therefore, if we considered it appropriate to proceed with implementing the $PM_{2.5}$ NAAQS, we are confident that there would be a larger set of areas for which we would determine that further reductions in emissions are needed in order to attain and maintain the NAAQS.

Moreover, gasoline and diesel cars and light trucks have a more important contributing role for ambient $PM_{2.5}$ concentrations, and other emission sources that play a major role in ambient PM_{10} concentrations will be relatively less important. Cars and light trucks contribute essentially the same absolute amount to ambient concentrations of PM_{10} and of $PM_{2.5}$. However, most other sources contribute much more to PM_{10} than to $PM_{2.5}$, so the relative contribution from cars and light trucks is larger. In addition, the absolute contribution from cars and light trucks is larger in relationship to the numerically lower $PM_{2.5}$ standard, making them more important to attainment and maintenance. This is also true for the potential contribution that more diesel cars and light trucks would make to ambient $PM_{2.5}$ concentrations.

4. Emission Reductions and Ambient PM Reductions

The NO_X and VOC emission reductions from the Tier 2/Gasoline Sulfur program are presented in the ozone section above. The SO_X and PM reductions are presented in our final RIA, and are essentially unchanged from those presented in our proposal, except for the revision of the diesel sales scenario discussed above.

Because virtually all of the PM reduction from the Tier 2/Gasoline

Sulfur program is in the fine fraction of PM_{10}, our estimates of the $PM_{2.5}$ and PM_{10} reductions are essentially the same. Estimates of the ambient PM reductions in 2030 in different parts of the nation, after full phase in of the vehicle standards, are presented in the final RIA. The reductions in ambient PM are largest in the parts of the country with more vehicle travel, i.e, larger in the east than in the west and larger in urban areas than in rural areas. In the eastern half of the nation, the reductions in annual average PM concentrations range from 0.2 to over 1.2 micrograms per cubic meter.

D. Other Criteria Pollutants: Carbon Monoxide, Nitrogen Dioxide, Sulfur Dioxide

The standards being promulgated today will help reduce levels of three other pollutants for which NAAQSs have been established: carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). As of 1998, every area in the United States has been designated to be in attainment with the NO_2 NAAQS. As of 1997, one area (Buchanan County, Missouri) did not meet the primary SO_2 short-term standard, due to emissions from the local power plant. There are currently 20 designated CO nonattainment areas, with a combined population of 33 million. There are also 24 designated maintenance areas with a combined population of 22 million. However, the broad trends indicate that ambient levels of CO are declining. In 1997, 6 of 537 monitoring sites reported ambient CO levels in excess of the CO NAAQS.

The reductions in SO_2 precursor emissions from today's actions are essentially equal to the SO_X reductions described in Section III.B. and III.C., respectively. The impact of today's actions on NO_2 emissions depends on the specific emission control technologies used to meet the Tier 2 vehicle emission standards. However, essentially all of the NO_X emitted by cars and light trucks converts to NO_2 in the atmosphere; therefore, it is reasonable to assume that today's actions will substantially reduce ambient NO_2 levels by the same proportion. Today's rule also will require light trucks to meet more stringent CO standards. These more stringent standards will help extend the trend towards lower CO emissions from motor vehicles and thereby help the remaining CO nonattainment areas reach attainment while helping other areas remain in attainment with the CO NAAQS. Our analysis of CO reductions from today's program is found in Chapter III of the RIA. The analysis of economic benefits and costs found in Section IV.D.–5. does not account for the economic benefits of the CO reductions expected to result from today's proposal.

E. Visibility

Visibility impairment occurs as a result of the scattering and absorption of light by particles and gases in the atmosphere. It is most simply described as the haze that obscures the clarity, color, texture, and form of what we see. The principal cause of visibility reduction is fine particles between 0.1 and 1 μm in size. Of the pollutant gases, only NO_2 absorbs significant amounts of light; it is partly responsible for the brownish cast of polluted skies. While the contribution of NO_2 to visibility impairment varies from area to area, it is generally responsible for less than ten percent of visibility reduction.

The CAA requires EPA to protect visibility, or visual air quality, through a number of programs. These programs include the national visibility program under Sections 169a and 169b of the Act, the Prevention of Significant Deterioration program for the review of potential impacts from new and modified sources, and the secondary NAAQS for PM_{10} and $PM_{2.5}$. The national visibility program established in 1980 requires the protection of visibility in 156 mandatory federal Class I areas across the country (primarily national parks and wilderness areas). More than 65 million visitors travel each year to these parks and wilderness areas. The CAA established as a national visibility goal, ''the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory federal Class I areas in which impairment results from manmade air pollution.'' The Act also calls for state programs to make ''reasonable progress'' toward the national goal. In addition, a recent national opinion poll on the state of the national parks found that more than 80 percent of Americans believe air pollution affecting these parks should be cleaned up for the benefit of future generations.[34]

There has been improvement in visibility in the western part of the country over the last ten years. However, visibility impairment remains a serious problem in Class I areas. Visibility in the East does not seem to have improved. As one part of addressing this national problem, EPA has required states to adopt and implement effective plans for protecting and improving visibility in Class I federal areas (64 FR 35714, July 1, 1999).

Today's actions will result in visibility improvements due to the reduction in local and upwind PM and PM precursor emissions. Since mobile source emissions contribute to the formation of visibility-reducing PM, control programs that reduce the mobile source emissions of direct and secondary PM would have the effect of improving visibility. The Grand Canyon Visibility Transport Commission's final recommendations report[35] found that reducing total mobile source emissions is an essential part of any program to protect visibility in the Western U.S. The Commission found that motor vehicle exhaust is responsible for about 14 percent of human-caused visibility reduction (excluding road dust). A substantial portion of motor vehicle exhaust comes from cars and light trucks. In light of that impact, the Commission's recommendations in 1996 supported federal Tier 2/Gasoline Sulfur standards, as EPA is proposing today. More recently, a number of Western Governors noted the importance of controlling mobile sources as part of efforts to improve visibility in their comments on the Regional Haze Rule and on the need to protect the 16 Class I areas on the Colorado Plateau. In their joint letter dated June 29, 1998, they stated that, ''* * * the federal government must do its part in regulating emissions from mobile sources that contribute to regional haze in these areas. * * *'' and called on EPA to make a ''binding commitment * * * to fully consider the Commission's recommendations related to the * * * federal national mobile source emission control strategies.'' These recommendations included Tier 2 vehicle standards and reductions in gasoline sulfur levels.

The recent Northern Front Range Air Quality Study provides another indication of how important car and light truck emissions can be to fine PM and visibility. This study reported findings that indicate that cars and light trucks are responsible for 39 percent of fine PM at a site within the metropolitan Denver area, and for 40 percent at a downwind rural site. This contribution includes both direct PM and indirect PM formed from sulfur dioxide and NO_X from these vehicles.

[34] ''National Parks and the American Public: A National Public Opinion Survey on the National Park System,'' Summary Report, National Parks and Conservation Association, June 1998.

[35] ''Recommendations for Improving Western Vistas,'' Report of the Grand Canyon Visibility Transport Commission to the United States Environmental Protection Agency, June 10, 1996.

The analysis of economic benefits and costs found in Section IV.D.5. accounts for the economic benefits of the visibility improvements expected to result from today's actions.

F. Air Toxics

Section 202(a) provides that EPA may promulgate standards regulating any air pollutants that in the Administrator's judgment, cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. Section 202(l) provides specific provisions for regulation of hazardous air pollutants from motor vehicles and fuels, and states that at a minimum such regulations should apply to emissions of benzene and formaldehyde.

Emissions from cars and light trucks include a number of air pollutants that are known or suspected human or animal carcinogens or that are known or suspected to have other, non-cancer health impacts. These pollutants include benzene, formaldehyde, acetaldehyde, 1,3-butadiene, and diesel particulate matter. For several of these pollutants, motor vehicle emissions are believed to account for a significant proportion of total nation-wide emissions. All of these compounds are present in exhaust emissions; benzene is also found in evaporative emissions from gasoline-fueled vehicles.

The health effects of diesel particulate matter are of particular relevance to today's actions, because of the possibility for increased diesel-powered truck sales and the more stringent PM standard that will apply to these trucks as a result of today's actions. While we have not finalized our decision about the carcinogenicity of diesel exhaust, we are in the process of addressing this question. The Agency's recently released draft assessment[36] concludes that diesel exhaust is a highly likely human lung cancer hazard, but that the data are currently unsuitable to make a confident quantitative statement of risk. The draft report concludes, however, that this risk is applicable to ambient exposures and that the risk may be in the range of regulatory interest (greater than one in a million over a lifetime). Several other agencies and governing bodies have designated diesel exhaust or diesel PM as a ''potential'' or ''probable'' human carcinogen.[37] The California Air Resources Board (ARB), for example, found that diesel particulate matter constituted a toxic air contaminant and estimated a potency range of 1.3×10^{-4} to 2.4×10^{-3} per µg/m^3.[38] The ARB's findings suggest that 130 to 2400 persons in one million exposed to 1 µg/m^3 of diesel exhaust particulate continuously for their lifetime (70 years) would develop cancer as a result of their exposure.

Because our assessment for diesel exhaust is not complete, we are not presenting absolute estimates of how potential cancer risks from diesel particulate matter could be affected by today's rule. However, we can offer a qualitative or relative discussion of these risks. Diesel engines used in nonroad equipment and heavy-duty highway vehicles currently constitute a far larger source of diesel PM than cars and light-duty trucks, since diesel engines are used in a very small portion of the cars and light-duty trucks in service today. However, engine and vehicle manufacturers have projected that diesel engines are likely to be used in an increasing share of cars and light trucks, and some manufacturers have announced capital investments to build such engines.

If these projections are valid, then the proportion of cars and light trucks powered by diesel engines, and the associated potential health risks from diesel PM, could increase substantially. We modeled the most likely level of increase in light duty diesel engine sales developed for the American Petroleum Institute.[39] We found that the greater diesel engine usage in cars and light trucks resulted in an 80 percent increase in emissions from all diesel-powered highway vehicles by 2020—emissions that have been implicated in potential cancer risks—assuming no change in the current light-duty diesel PM standards.

Today's rule would limit the increase in the potential cancer risks from cars and light trucks associated with any potential increase in light-duty diesel engines. Using the same sales projections discussed above, we have estimated that today's rule would limit the increase in total highway diesel PM emissions in 2020 due to growth in light duty diesels to under 10 percent, in contrast to the 80 percent increase projected to occur without the Tier 2 PM standards. An analogous analysis that accounted for exposure patterns, but that assumed even more widespread use of diesels in the car and light truck fleet, found that today's rule would limit the increase in total highway diesel PM exposure to about 8 percent. This analysis is discussed more fully in Chapter III.F.2 of the Regulatory Impact Analysis. In addition, the VOC emission reductions resulting from today's rule would reduce the potential cancer risk posed by air pollutants other than diesel PM emitted by cars and light trucks, since many of these pollutants are themselves VOCs. Furthermore, the rule would align the formaldehyde standards for all Tier 2 LDVs and LDTs with the formaldehyde standards for LDVs and LDT1s from the NLEV program, thereby helping to harmonize the Federal and California formaldehyde standards.

The analysis of economic benefits and costs found in Section IV.D.5. does not account for the economic benefits of the reduction in cancer risk from air toxics that could result from today's rule. Although we have completed a peer reviewed assessment of the impact of today's rule on exposure to toxic emissions, we have not engaged in a peer-reviewed assessment of the baseline air toxics risks (including a final quantitative risk assessment of the diesel particulate risks) or of the reductions that would be achieved by today's rule.

We plan to complete our analysis of air toxics risks as part of our responsibilities under section 202(l)(2) of the Clean Air Act, which requires EPA to establish regulations for the control of hazardous air pollutants from motor vehicles. The regulations may address vehicle emissions or fuel properties that influence emissions, or both. We plan to issue a proposal to address this requirement in April 2000, and a final rule in December 2000.

[36] EPA's diesel health assessment (Health Assessment Document for Diesel Emissions, SAB Review Draft, U.S. Environmental Protection Agency, Washington, DC. EPA/600/8–90/057D, November 1999) can be found at the following EPA website: *http://www.epa.gov/ncea/diesel.htm.*

[37] National Institute for Occupational Safety and Health (1988) Carcinogenic effects of exposure to diesel exhaust. NIOSH Current Intelligence Bulletin 50. DHHS (NIOSH) Publication No. 88–116. Centers for Disease Control, Atlanta, GA.

International Agency for Research on Cancer (1989) Diesel and gasoline engine exhausts and some nitroarenes, Vol. 46. Monographs on the evaluation of carcinogenic risks to humans. World Health Organization, International Agency for Research on Cancer, Lyon, France.

World Health Organization (1996) Diesel fuel and exhaust emissions: International program on chemical safety. World Health Organization, Geneva, Switzerland.

California Environmental Protection Agency, Office of Environmental Health Hazard Assessment: Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant, Part B Health Risk Assessment for Diesel Exhaust. April 22, 1998.

[38] California Environmental Protection Agency, Office of Environmental Health Hazard Assessment: Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant, Part B Health Risk Assessment for Diesel Exhaust. April 22, 1998.

[39] ''U.S. Light-Duty Dieselization Scenarios—Preliminary Study'', report to the American Petroleum Institute, July 2, 1999. Prepared by Arthur D. Little, Inc.

G. Acid Deposition [40]

Acid deposition, or acid rain as it is commonly known, occurs when SO_2 and NO_X react in the atmosphere with water, oxygen, and oxidants to form various acidic compounds that later fall to earth in the form of precipitation or dry deposition of acidic particles. It contributes to damage of trees at high elevations and in extreme cases may cause lakes and streams to become so acidic that they cannot support aquatic life. In addition, acid deposition accelerates the decay of building materials and paints, including irreplaceable buildings, statues, and sculptures that are part of our nation's cultural heritage. To reduce damage to automotive paint caused by acid rain and acidic dry deposition, some manufacturers use acid-resistant paints, at an average cost of $5 per vehicle—a total of $61 million per year if applied to all new cars and trucks sold in the U.S. The general economic and environmental effects of acid rain are discussed at length in the RIA.

Acid deposition primarily affects bodies of water that rest atop soil with a limited ability to neutralize acidic compounds. The National Surface Water Survey (NSWS) investigated the effects of acidic deposition in over 1,000 lakes larger than 10 acres and in thousands of miles of streams. It found that acid deposition was the primary cause of acidity in 75 percent of the acidic lakes and about 50 percent of the acidic streams, and that the areas most sensitive to acid rain were the Adirondacks, the mid-Appalachian highlands, the upper Midwest and the high elevation West. The NSWS found that approximately 580 streams in the Mid-Atlantic Coastal Plain are acidic primarily due to acidic deposition. Hundreds of the lakes in the Adirondacks surveyed in the NSWS have acidity levels incompatible with the survival of sensitive fish species. Many of the over 1,350 acidic streams in the Mid-Atlantic Highlands (mid-Appalachia) region have already experienced trout losses due to increased stream acidity. Emissions from U.S. sources contribute to acidic deposition in eastern Canada, where the Canadian government has estimated that 14,000 lakes are acidic. Acid deposition also has been implicated in contributing to degradation of high-elevation spruce forests that populate the ridges of the Appalachian Mountains from Maine to Georgia. This area includes national parks such as the Shenandoah and Great Smoky Mountain National Parks.

The SO_X and NO_X reductions from today's actions will help reduce acid rain and acid deposition, thereby helping to reduce acidity levels in lakes and streams throughout the U.S. These reductions will help accelerate the recovery of acidified lakes and streams and the revival of ecosystems adversely affected by acid deposition. Reduced acid deposition levels will also help reduce stress on forests, thereby accelerating reforestation efforts and improving timber production. Deterioration of our historic buildings and monuments, and of buildings, vehicles, and other structures exposed to acid rain and dry acid deposition, also will be reduced, and the costs borne to prevent acid-related damage may also decline.

While the reduction in sulfur and nitrogen acid deposition will be roughly proportional to the reduction in SO_X and NO_X emissions, respectively, the precise impact of today's vehicle and fuel standards will differ across different areas. Each area is affected by emissions from different source regions, and the mobile source contribution to the total SO_X and NO_X emission inventory will differ across different source regions. Nonetheless, the projected impact of today's actions on SO_X and NO_X emission inventories provides a rough indicator of the likely effect of the Tier 2/Gasoline Sulfur standards on acid deposition. Our analysis indicates that today's actions will reduce SO_X emissions by 1.8 percent and NO_X emissions by 14.5 percent in 2030.

The analysis of economic benefits and costs found in Section IV.D.5. did not account for the economic benefits of the reduction in acid deposition expected to result from today's actions.

H. Eutrophication/Nitrification

Nitrogen deposition into bodies of water can cause problems beyond those associated with acid rain. The Ecological Society of America has included discussion of the contribution of air emissions to increasing nitrogen levels in surface waters in a recent major review of causes and consequences of human alteration of the global nitrogen cycle in its Issues in Ecology series [41]. Long-term monitoring in the United States, Europe, and other developed regions of the world shows a substantial rise of nitrogen levels in surface waters, which are highly correlated with human-generated inputs of nitrogen to their watersheds. These nitrogen inputs are dominated by fertilizers and atmospheric deposition.

Human activity can increase the flow of nutrients into those waters and result in excess algae and plant growth. This increased growth can cause numerous adverse ecological effects and economic impacts, including nuisance algal blooms, dieback of underwater plants due to reduced light penetration, and toxic plankton blooms. Algal and plankton blooms can also reduce the level of dissolved oxygen, which can also adversely affect fish and shellfish populations. This problem is of particular concern in coastal areas with poor or stratified circulation patterns, such as the Chesapeake Bay, Long Island Sound, or the Gulf of Mexico. In such areas, the ''overproduced'' algae tends to sink to the bottom and decay, using all or most of the available oxygen and thereby reducing or eliminating populations of bottom-feeder fish and shellfish, distorting the normal population balance between different aquatic organisms, and in extreme cases causing dramatic fish kills.

Collectively, these effects are referred to as eutrophication, which the National Research Council recently identified as the most serious pollution problem facing the estuarine waters of the United States (NRC, 1993). Nitrogen is the primary cause of eutrophication in most coastal waters and estuaries [42]. On the New England coast, for example, the number of red and brown tides and shellfish problems from nuisance and toxic plankton blooms have increased over the past two decades, a development thought to be linked to increased nitrogen loadings in coastal waters. Airborne NO_X contributes from 12 to 44 percent of the total nitrogen loadings to United States coastal water bodies. For example, approximately one-quarter of the nitrogen in the Chesapeake Bay comes from atmospheric deposition.

Excessive fertilization with nitrogen-containing compounds can also affect terrestrial ecosystems [43]. Research suggests that nitrogen fertilization can alter growth patterns and change the

[40] Much of the information in this section was excerpted from the EPA document, Human Health Benefits from Sulfate Reduction, written under Title IV of the 1990 Clean Air Act. Amendments, U.S. EPA, Office of Air and Radiation, Acid Rain Division, Washington, DC, November 1995.

[41] Vitousek, Peter M., John Aber, Robert W. Howarth, Gene E. Likens, et al. 1997. Human Alteration of the Global Nitrogen Cycle: Causes and Consequences. Issues in Ecology. Published by Ecological Society of America, Number 1, Spring 1997.

[42] Much of this information was taken from the following EPA documenta: Deposition of Air Pollutants to the Great Waters-Second Report to Congress, Office of Air Quality Planning and Standards, June 1997, EPA–453/R–97–011.

[43] Terrestrial nitrogen deposition can act as a fertilizer. In some agricultural areas, this effect can be beneficial.

balance of species in an ecosystem. In extreme cases, this process can result in nitrogen saturation when additions of nitrogen to soil over time exceed the capacity of the plants and microorganisms to utilize and retain the nitrogen. This phenomenon has already occurred in some areas of the U.S.

Deposition of nitrogen from cars and light trucks contributes to these problems. As discussed in Section III.B. above, today's actions will reduce total NO_X emissions by 4.5 percent in 2007 and by 14.5 percent in 2030. The NO_X reductions should reduce the eutrophication problems associated with atmospheric deposition of nitrogen into watersheds and onto bodies of water, particularly in aquatic systems where atmospheric deposition of nitrogen represents a significant portion of total nitrogen loadings. Since air deposition accounts for 12–44 percent of total nitrogen loadings in coastal waters, the reduction in NO_X from today's actions is projected to reduce nitrogen loadings by 0.5–2.0 percent in 2007 and 1.7–6.4 percent in 2030. To put these reductions in perspective, the reductions expected in the Chesapeake Bay area would amount to about 9 percent of the total reduction in nitrogen loading needed to maintain the reduction in nutrient loads agreed to by the signatory states in the Chesapeake Bay Agreement (40 percent of ''controllable nutrient loads'' by the year 2000).

The analysis of economic benefits and costs found in Section IV.D.5. does not account for the economic benefits of reduced eutrophication or reduced terrestrial nitrogen deposition expected to result from today's actions.

I. Cleaner Cars and Light Trucks Are Critically Important to Improving Air Quality

Despite continued progress in reducing ozone and PM levels, tens of millions of Americans are still exposed to levels of these pollutants that exceed the National Ambient Air Quality Standards. Our projections show that without further action to reduce these pollutants, tens of millions of Americans will continue to breathe unhealthy air for decades to come. Our projections also show that emissions from cars and light trucks will continue to contribute a substantial share of the ozone and PM precursors in current and projected nonattainment areas, and in upwind areas whose emissions contribute to downwind nonattainment, unless additional measures are taken to reduce their emissions. Cars and light trucks also contribute substantially to ambient concentrations of CO. These vehicles will also continue to contribute to the ambient PM that affects visibility in Class I federal areas and some urban areas. Emissions from cars and light trucks also play a significant role in a wide range of health and environmental problems, including known and potential cancer risks from inhalation of air pollutants (a problem that could become more significant if sales of diesel-powered cars and light trucks were to increase), health risks from elevated drinking water nitrate levels, acidification of lakes and streams, and eutrophication of inland and coastal waters.

Today's actions will reduce NO_X, VOC, CO, PM, and SO_X emissions from these vehicles substantially. These reductions will help reduce ozone levels nationwide and reduce the extent and severity of violations of the 1-hour ozone standard. These reductions will also help reduce PM levels, both by reducing direct PM emissions and by reducing emissions that give rise to secondary PM. The CO reductions will help extend the downward trend in carbon monoxide levels, thereby helping the remaining CO nonattainment areas attain the CO standard and helping other areas stay in attainment with the CO standard despite continued increases in vehicle miles traveled. The NO_X and SO_X reductions will help reduce acidification problems, and the NO_X reductions will help reduce eutrophication problems and drinking water nitrate levels. The PM standards included in today's actions will help improve visibility and would help mitigate adverse health effects in the event of increases in light-duty diesel engine sales.

IV. What Are the New Requirements for Vehicles and Gasoline?

A. Why Are We Proposing Vehicle and Fuel Standards Together?

1. Feasibility of Stringent Standards for Light-Duty Vehicles and Light-Duty Trucks.

a. Gasoline Fueled Vehicles

We believe that the standards being promulgated today for gasoline-fueled vehicles are well within the reach of existing control technology. Our determination of feasibility is based on the use of catalyst-based strategies that are already in use and are well proven on the existing fleet of vehicles. In fact, as you will see below, many current engine families are already certified to levels at or below the new final Tier 2 requirements. All of the certification and research testing discussed below was performed on low-sulfur test fuel (nominally 30 ppm).

i. LDVs and LDT1s–LDT4s

Certainly, larger vehicles and trucks, which are heavier and have larger frontal areas, will face the biggest challenges in meeting the final Tier 2 standards. However, conventional technology will be sufficient for even these vehicles, especially in light of the extra leadtime we have provided before LDT3s and LDT4s have to meet Tier 2 levels. We are also changing the test conditions for these trucks from ''adjusted loaded vehicle weight'' to ''loaded vehicle weight.'' Adjusted loaded vehicle weight, suitable for commercial truck operation, loads the truck to half of its full payload. Loaded vehicle weight, on the other hand, represents curb weight plus 300 pounds. This change more accurately reflects how these vehicles are used and makes heavy LDT testing consistent with passenger car and light LDT testing. This change is consistent with treating these vehicles as they were designed, *i.e.,* for light-load use.

Emission control technology has evolved rapidly in recent years. Emission standards applicable to 1990 model year vehicles required roughly 90 percent reductions in exhaust HC and CO emissions and a 75 percent reduction in NO_X emissions compared to uncontrolled emissions. Today, some vehicles currently in production are well below these levels, showing even greater overall emissions reductions of all three of these pollutants. These vehicles' emissions are well below those necessary to meet the current federal Tier 1 and even California Low-Emission Vehicle (LEV–I) standards. The reductions have been brought about by ongoing improvements in engine air-fuel management hardware and software plus improvements in catalyst designs, all of which are described fully in the RIA.

The types of changes being seen on current vehicles have not yet reached their technological limits, and continuing improvement will allow both LDVs and LDTs to meet the final standards. The RIA describes a range of specific techniques that we believe could be used. These range from improved computer software and engine air-fuel controls to increases in precious metal loading and other exhaust system/catalyst system improvements. All of these technologies are currently used on one or more production vehicle models. There is no need to invent new approaches or technologies. The focus of the effort is primarily development, application, and optimization of these existing technologies.

We can gain significant insight into the difficulty of meeting the final new standards by looking at current full-life certification data. There are at least 48 engine family-control systems combinations, out of approximately 400, certified in 1999 at levels below the Tier 2 NO_X standard of 0.07 g/mi. Of these, 35 also have hydrocarbon levels of 0.09 g/mi or below. Looking at a somewhat higher threshold to identify vehicles certified near the final standard, there are an additional 113 car and light truck families certified at levels between 0.07 g/mi and 0.10 g/mi NO_X. Although not yet complete at this time, we also examined the 2000 model year certification data and found that there are at least 60 engine family-control systems combinations certified at levels below the Tier 2 NO_X standard of 0.07 g/mi and of those, 52 also have hydrocarbon levels of 0.09 g/mi or below.

All of the above vehicles are already able, or close to being able, to certify to our final standards. The further reductions needed are those to provide a compliance margin, or cushion, between the certified level and the emission standard. The degree of compliance margin required is a function of a variety of factors designed to provide the manufacturer a high confidence that production vehicles will meet the standards in-use over their useful life. Historically, these determinations are manufacturer specific, with cushions generally growing smaller as standards decline (reflecting more precision and repeatability in vehicle performance as more sophisticated controls are developed). The certification data reflects compliance cushions from as little as 20 percent below the standard to as high as 80 percent below the standard.

The manufacturers commented that the most difficult vehicles to bring into compliance with the Tier 2 standards would be the larger light-duty trucks, specifically those trucks currently certified under the LDT3 and LDT4 weight categories. Because of this, we undertook a technology demonstration program aimed at lowering the emissions of several large 1999 light-duty trucks. Two LDT3 Chevrolet Silverado pick-up trucks were tested, one internally and one under contract. Two LDT4 Ford Expedition sport-utility vehicles were also tested, also with one tested internally and one under contract. Both types of vehicles were tested with optional high horsepower engines (270 hp for the Silverado and 230 hp for the Expedition) and were equipped with four-wheel drive. The vehicles had curb weights of 4,500 pounds (GVWR of 6,100 lbs) for the Silverados and 5,800 pounds (GVWR of 7,200 lbs) for the Expeditions.

Figures IV.A.–1 and IV.A.–2 show the results to date of the emissions tests performed during this demonstration program at our National Vehicle and Fuel Emissions Laboratory (NVFEL) and also for emissions tests conducted in parallel by and under contract at Southwest Research Institute (SwRI) using similar Ford Expeditions and GM Chevrolet Silverados. During the evaluation, the trucks were equipped with a variety of catalysts that typically featured higher volume, higher precious metal loading, and higher cell-densities than the original hardware used by the vehicles to meet California LEV–I standards. Details of the catalysts tested are included in the RIA. Different exhaust manifolds featuring an insulating air-gap and low thermal mass were also evaluated. Finally, calibration changes were made to the powertrain control modules [44] to better match engine operating characteristics to the new catalyst systems, and to lower engine-out NOx emissions. The Silverado and Expedition had very similar results. Similar results were also achieved by us and SwRI, but by fairly different methods. The SwRI work on both trucks relied primarily on engine calibration changes and secondary air injection. The advanced catalyst systems used by SwRI contained advanced washcoat formulations with only minor changes to catalyst volume and precious metal content compared to the manufacturer's original configuration. The work we conducted on the Expedition also relied primarily on engine calibration changes with no secondary air injection. The catalyst system also contained advanced washcoat formulations with modest changes to catalyst volume and precious metal content. The work we conducted on the Silverado relied primarily on an advanced catalyst system with volume and precious metal content changes, with only minor changes to engine calibration.

As can be seen in the charts, the emissions of the vehicles tested clearly show the feasibility of the Tier 2 standards on the most difficult to certify vehicle categories. All vehicles reached emission levels well below the Tier 2 full-life NOx and NMOG standards. At the same time, there were no significant impacts on either fuel economy or performance of the vehicles.

Compared to the intermediate (50,000 mile) standards, the Ford Expedition tested at NVFEL consistently emitted NOx at less than one-third of the intermediate useful life standard.[45] NMHC/NMOG emissions were slightly below the intermediate standard level with no use of secondary-air-injection for cold-start hydrocarbon control. The Silverado tested at NVFEL met the intermediate standards with primarily hardware (catalyst) changes and only very minor calibration changes. The trucks tested at SwRI differed from those tested at NVFEL in their combination of emissions control hardware and calibration strategies, but achieved approximately the same emissions levels.

The above results point out that not only are the Tier 2 standards feasible for larger trucks, but there are multiple means that can be taken in order to achieve the necessary emissions levels. All of those paths involve fairly simple enhancements to current technology systems. Furthermore, the testing was conducted with a very limited budget over a limited amount of time. With the interim program for heavy trucks under Tier 2, the manufacturers will have 9 years from the publishing of the Tier 2 rule to bring the largest trucks into compliance with the Tier 2 standards. Manufacturers will also have considerably more resources with respect to calibration changes and hardware design to bring trucks of this type within compliance than were available within this limited, but successful, demonstration.

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[44] Powertrain control modules are computers used to control engine, transmission, and other vehicle functions on newer automobiles and trucks. The changes involved software changes in the case of the EPA-NVFEL work, or the use of alternate means of engine control in the case of the SwRI work.

[45] Although this testing was done on vehicles with catalysts aged to 50,000, we belive the overall experiments also strongly suggest that the Tier 2 full-life standards would be achieved by high-mileage vehicles.

Figure IV.A.-1:

Emissions After an Equivalent of 50,000 Miles for Various Tested Configurations of Ford Expedition LDT4 SUVs with 5.4L V8 Engines

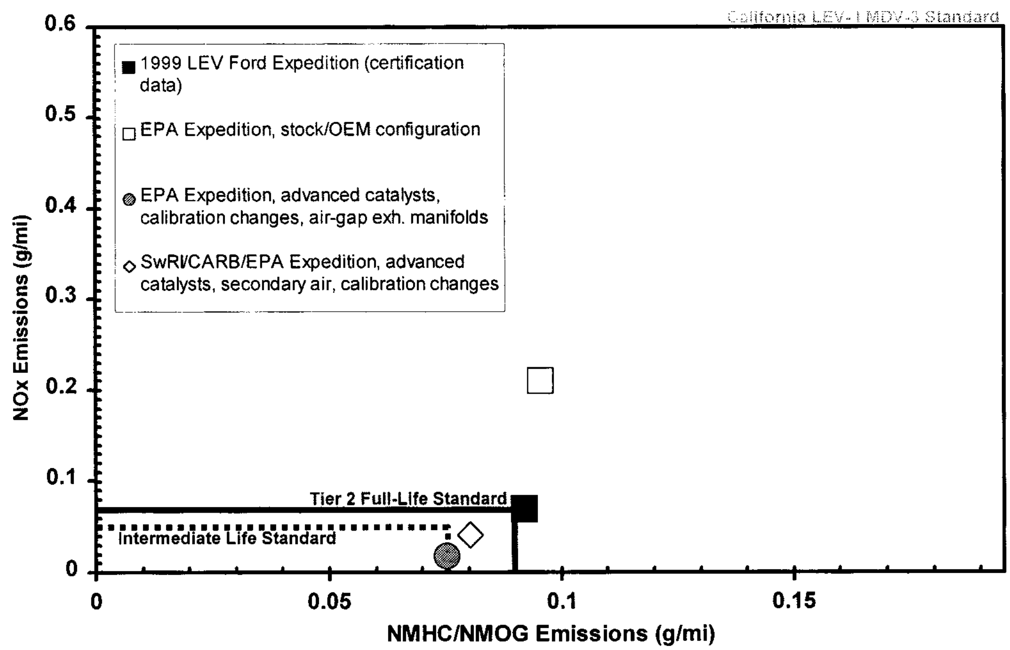
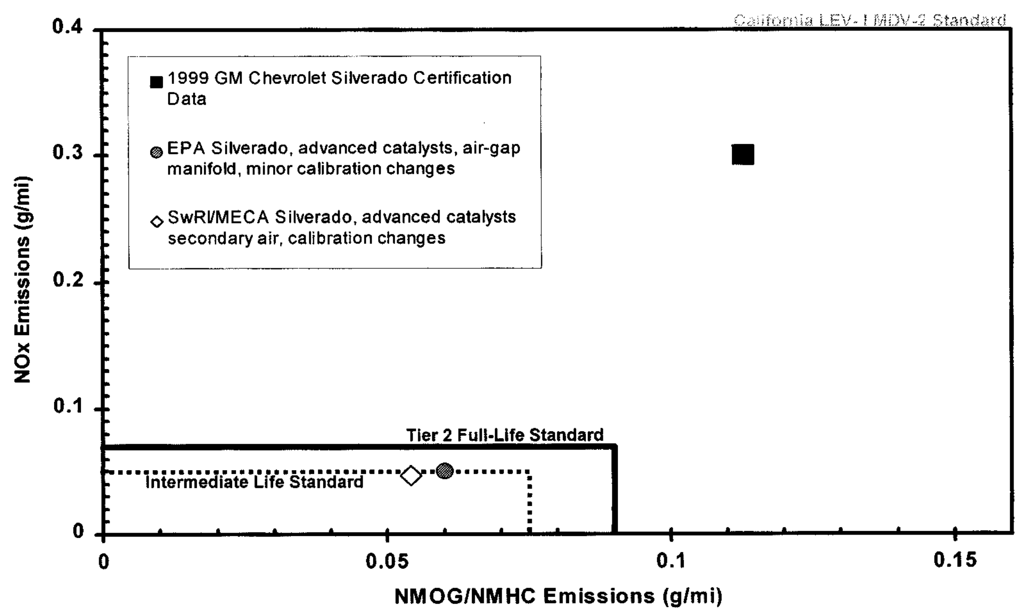


Figure IV.A.-2:

Emissions After an Equivalent of 50,000 Miles for Various Tested Configurations of 1999 GM Chevrolet Silverado LDT3 Pickups with 5.3L V8 Engines.



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The Manufacturers of Emission Controls Association (MECA) sponsored a program that took two LDVs (a Crown Victoria and a Buick LeSabre) and one LDT2 (a Toyota T100) certified to the federal Tier 1 standards and replaced the original catalytic converter systems with more advanced catalytic converters, thermally aged to approximately 50,000 miles. With these systems and some related emission control modifications, the LeSabre and T100 emissions were well below our intermediate (50,000 mile) useful life standards, and the Crown Victoria was well below the NMOG standard and very close to the NO_X standard.

Finally, the California Air Resources Board (ARB) tested five different production LEV light-duty vehicle models. Three of the five models met the Tier 2 standards for NMOG and NO_X prior to any modifications. After installing low mileage advanced catalytic converters and making some minor adjustments to fuel bias, air injection, and spark timing, all of the vehicles had emission levels well below the Tier 2 intermediate useful life NMOG and NO_X standards. ARB also tested several Ford Expeditions (LDT4) equipped with advanced catalytic converters. By adjusting several parameters, they were able to reduce NO_X emissions to 0.06 g/mi and NMOG to 0.07 g/mi with a catalyst aged to 50,000 miles of use.

A more expanded analysis of the feasibility of the Tier 2 standards for gasoline fueled vehicles can be found in the RIA, considering the types of changes that will allow manufacturers to extend effective new controls to the entire fleet of affected vehicles. That analysis includes discussion of gasoline direct-injection engines, as well as the feasibility of the CO, formaldehyde and evaporative emission standards. The conclusion of all of our analyses is that the standards are feasible for gasoline-fueled vehicles. As gasoline-fueled vehicles represent the overwhelming majority of the LDV and LDT population (*i.e.,* over 99%), EPA concludes that the Tier 2 standards are feasible overall for LDVs and LDTs under 8500 lbs GVWR.

ii. Medium-Duty Passenger Vehicles (MDPVs)

The technologies and emission control strategies that will be used for LDT3 and LDT4 vehicles with a GVWR less than 8,500 pounds should apply directly to MDPV vehicles that have a GVWR greater than 8,500 pounds. In our LDT technology demonstration program discussed above, we found that a combination of calibration changes and improvements to the catalyst system resulted in emission levels for NO_X well below and NMHC/NMOG approximately at the Tier 2 intermediate useful life standards. The catalyst improvements consisted of increases in volume and precious metal loading, and higher cell-densities than those found in the original hardware. We are confident that the use of secondary-air-injection will greatly help cold-start hydrocarbon control, making the NMOG standards achievable.

The most significant difference between LDT4s less than 8,500 pounds GVWR and MDPVs greater than 8,500 pounds GVWR is that MDPVs have a vehicle weight up to 800 pounds more than LDT4s. MDPVs will also be typically equipped with larger displacement engines. The potential impact of these differences is higher engine-out emissions than LDT4s due to the larger engine displacement and greater load that the engine will be operated under due to the extra weight. However, neither of these preclude manufacturers from applying the same basic emission control technologies and strategies as used by LDVs and LDTs. The only difference will likely be the need for larger catalysts with higher precious metal loading than found in LDT4s. We are confident that MDPVs will be capable of meeting the final Tier 2 standards.

We are currently testing a Ford Excursion as part of our LDT technology demonstration program. Preliminary baseline results with a 'green'' (*i.e.,* nearly new) catalyst indicate that emission levels are higher than baseline emissions for the Ford Expedition. These results, although with a green catalyst, are well below our interim Tier 2 upper bin standards. In fact, the majority of these vehicles certified on the chassis dynamometer in California have certification levels well below our interim upper bin standards. While this testing is ongoing, we feel that the preliminary results are encouraging since they suggest that the difference in emissions between the Excursion and Expedition suggest that the strategies used on the Expedition can be successful with the Excursion. Therefore, we believe that by using technologies and control strategies similar to what will be used by LDVs and LDTs, combined with larger catalysts, MDPVs will be able to meet our Tier 2 emission standards.

b. Diesel Vehicles

As discussed above, the Tier 2 standards are intended to be ''fuel neutral.'' In today's document, we establish that the Tier 2 standards are technologically feasible and cost-effective for LDVs and LDTs overall, based on the discussion in Section IV.A.1.a. above. Under the principle of fuel neutrality, all cars and light trucks, including those using diesel engines, will be required to meet the Tier 2 standards. Contrary to some of the comments received on our proposal, given that the overwhelming majority of vehicles in these classes are gasoline-fueled, we do not believe it is appropriate to provide less stringent standards for diesel-fueled vehicles. Manufacturers of LDVs and LDTs today provide consumers with a wide choice of vehicles that are overwhelmingly gasoline-fueled. Less stringent standards for diesels would create provisions that could undermine the emission reductions expected from this program, especially given the expectation that some manufacturers may intend to greatly increase their diesel sales.

As with gasoline engines, manufacturers of diesels have made abundant progress over the past 10 years in reducing engine-out emissions from diesel engines. In heavy trucks and buses, PM emission standards, which were projected to require the use of exhaust aftertreatment devices, were actually met with only engine modifications. Indeed, emissions and performance of lighter diesel engine are rapidly approaching the characteristics of gasoline engines, while retaining the durability and fuel economy advantages that diesels enjoy. Against this background of continuing progress, we believe that the technological improvements that would be needed could be made in the time that would be available before diesels would have to meet the new Tier 2 standards.

Manufacturers may take advantage of the flexibilities in today's rulemaking to delay the need for diesel LDVs and LDTs to meet the final Tier 2 levels until late in the phase-in period (as late as 2007 for LDVs/LLDTs and 2009 for HLDTs), giving manufacturers a relatively large amount of leadtime. In a recent public statement, Cummins Engine Company has indicated that the interim Tier 2 standards in effect for vehicles and trucks in the early years of the Tier 2 program are feasible for diesel equipped models through further development of currently available engine and exhaust aftertreatment technology.[46]

While reductions in ''engine-out'' emissions, including incorporation of EGR strategies, may continue to be made, increasing emphasis is being placed on various aftertreatment devices for diesels. We believe that the use of aftertreatment devices will allow diesels to comply with the Tier 2 standards for NO_X and PM.

For NO_X emissions, potential aftertreatment technologies include lean NO_X catalysts, NO_X adsorbers and selective catalytic reduction (SCR). Lean NO_X catalysts are still under development, but generally appear capable of reducing NO_X emissions by about 15–30%. This efficiency is not likely to be sufficient to enable compliance with the final Tier 2 standards, but it could be used to meet the interim standards that would begin in 2004, with current diesel fuel.

NO_X adsorbers appear capable of reaching efficiency levels as high as 90%. Efficiency in this range is likely to be sufficient to enable compliance with the proposed Tier 2 standards. NO_X adsorbers temporarily store the NO_X and thus the engine must be run periodically for a brief time with excess fuel, so that the stored NO_X can be released and converted to nitrogen and oxygen using a conventional three-way catalyst, like that used on current gasoline vehicles.

There is currently a substantial amount of development work being directed at NO_X adsorber technology. While there are technical hurdles to be overcome, progress is continuing and it is our judgement that the technology should be available by the time it would be needed for the final Tier 2 standards.

One serious concern with current NO_X adsorbers is that they are quickly poisoned by sulfur in the fuel. Some manufacturers have strongly emphasized their belief that, in order to meet the final Tier 2 levels, low sulfur diesel fuel would also be required to mitigate or prevent this poisoning problem. In its comments on the NPRM, Navistar indicated that the Tier 2 standards may be achievable given low sulfur fuel and other programmatic changes such as those included in this Final Rule. Navistar has also been quoted publically as describing the Tier 2 standards as ''challenging but achievable'' given appropriate low sulfur fuel.[47] We intend to issue a Notice of Proposed Rulemaking early in the year 2000 intended to reduce sulfur in highway diesel fuel as a step to enable the technology most likely to be used to meet the Tier 2 standards.

SCR has been demonstrated commercially on stationary diesel engines and can reduce NO_X emissions by 80–90%. This efficiency would be sufficient to enable compliance with the proposed Tier 2 standards. However, SCR requires that the chemical urea be injected into the exhaust before the catalyst to assist in the destruction of NO_X. The urea must be injected at very precise rates, which is difficult to achieve with an on-highway engine, because of widely varying engine operating conditions. Otherwise, emissions of ammonia, which have a very objectionable odor, can occur. Substantial amounts of urea are required, meaning that vehicle owners would have to replenish their vehicles' supply of urea frequently, possibly as often as every fill-up of fuel. As the engine and vehicle would operate satisfactorily without the urea (only NO_X emissions would be affected), some mechanism would be needed to ensure that vehicle owners maintained their supply of urea. Otherwise, little NO_X emission reduction would be expected in-use.

[46] ''Cummins Sees Diesel Feasible for Early Years of Tier 2''. Hart Diesel Fuel News, Sept. 20, 1999, p.2.

[47] Harts Diesel Fuel News, August 9, 1999, p4.

Regarding PM, applicable aftertreatment devices tend to fall into two categories: Oxidation catalysts and traps. Diesel oxidation catalysts can reduce total PM emissions by roughly 15–30%. They would need to be used in conjunction with further reductions in PM engine-out emissions in order to meet the proposed Tier 2 standards. Diesel particulate traps, on the other hand, can eliminate up to 90% of diesel PM emissions. However, some of the means of accomplishing the regeneration of particulate traps involve catalytic processes that also convert sulfur dioxide in the exhaust to sulfate. These techniques, if used, would also require a low sulfur fuel.

In summary, we believe that the structure of our final program, including the available bins and phase-in periods, will allow the orderly development of clean diesel engine technologies. We believe that the interim standards are feasible for diesel LDV/LDTs, within the bin structure of this rule and without further reductions in diesel fuel sulfur levels. And, as indicated earlier, at least one major diesel engine manufacturer (Cummins) has publicly agreed with this assessment. We further believe that in the long-term, the final standards will be within reach for diesel-fueled vehicles in combination with appropriate changes to diesel fuel to facilitate aftertreatment technologies. Manufacturers have argued that low sulfur diesel fuel will be required to permit diesels to meet the final Tier 2 standards, and we agree. At least one major manufacturer (Navistar) has indicated its belief that the final Tier 2 standards may be achievable for diesel engines with low sulfur diesel fuel.

2. Gasoline Sulfur Control Is Needed to Support the Proposed Vehicle Standards

As we discussed in the previous section, we believe that the stringent standards in this final rule are needed to meet air quality goals and are feasible for LDVs and LDTs. At the same time, we believe that for these standards to be feasible for gasoline LDVs and LDTs, low sulfur gasoline must be made available. The following paragraphs explain why we think gasoline sulfur control must accompany Tier 2 vehicle standards.

Catalyst manufacturers generally use low sulfur gasoline in the development of their catalyst designs. Vehicle manufacturers then equip their vehicles with these catalysts and EPA certifies them to the exhaust emission standards, usually based on testing the manufacturer does using low sulfur gasoline. However, fundamental chemical and physical characteristics of exhaust catalytic converter technology generally result in a significant degradation of emission performance when these vehicles use gasoline with sulfur levels common in most of the country today. This sensitivity of catalytic converters to gasoline sulfur varies somewhat depending on a number of factors, some better understood than others. Clearly, however, as we discuss in the following paragraphs, gasoline sulfur's impact is large, especially in vehicles designed to meet very low emission standards.

This is the reason EPA has decided to adopt a comprehensive approach to addressing emissions from cars and light trucks, including provisions to get low sulfur gasoline into the field in the same time frame needed for Tier 2 vehicles.

a. How Does Gasoline Sulfur Affect Vehicle Emission Performance?

We know that gasoline sulfur has a negative impact on vehicle emission controls. Vehicles depend on the catalytic converter to reduce emissions of HC, CO, and NO_X. Sulfur and sulfur compounds attach or ''adsorb'' to the precious metal catalysts that are required to convert these emissions. Sulfur also blocks sites on the catalyst designed to store oxygen that are necessary to optimize NO_X emissions conversions. While the amount of sulfur contamination can vary depending on the metals used in the catalyst and other aspects of the design and operation of the vehicle, some level of sulfur contamination will occur in any catalyst.

Sulfur sensitivity is impacted not only by the catalyst formulation (the types and amounts of precious metals used in the catalyst) but also by factors including the following:

- The materials used to provide oxygen storage capacity in the catalyst, as well as the general design of the catalyst,
- The location of the catalyst relative to the engine, which impacts the temperatures inside the catalyst,
- The mix of air and fuel entering the engine over the course of operation, which is varied by the engine's computer in response to the driving situation and affects the mix of gases entering the catalyst from the engine, and
- The speeds the car is driven at and the load the vehicle is carrying, which also impact the temperatures experienced by the catalyst.

Since these factors vary for every vehicle, the sulfur impact varies for every vehicle to some degree. There is no single factor that guarantees that a vehicle will be very sensitive or very insensitive to sulfur. We now believe that there are not (and will not be in the foreseeable future) emission control devices available for gasoline-powered vehicles that can meet the proposed Tier 2 emission standards that would not be significantly impaired by gasoline with sulfur levels common today.

b. How Large Is Gasoline Sulfur's Effect on Emissions?

High sulfur levels have been shown to significantly impair the emission control systems of cleaner, later technology vehicles. The California LEV standards and Federal NLEV standards, as well as California's new LEV–II standards and our Tier 2 standards, require catalysts to be extremely efficient to adequately reduce emissions over the full useful life of the vehicle. In the NPRM we estimated that, based on data from test programs conducted by EPA and the automotive and oil industries, LEV and ULEV vehicles could experience, on average, a 40 percent increase in NMHC and 134 percent increase in NO_X emissions when operated on 330 ppm sulfur fuel (our estimate in the NPRM of the current national average sulfur level) compared to 30 ppm sulfur fuel. New data generated since the NPRM on similar LEVs and ULEVs show that when these vehicles were driven on high sulfur (330 ppm) fuel for a few thousand miles (as opposed to less than 100 miles for the previous data), the NMHC and NO_X emission increase due to high sulfur fuel increased by 149 percent and 47 percent, respectively. In other words, instead of the previous estimated 40 percent and 134 percent increases in NMHC and NO_X emissions, respectively, more realistic estimates would be 100 percent and 197 percent, respectively.[48] Also, new data generated since the NPRM for late model LEV and ULEV vehicles that meet the federal and California supplemental federal test procedure (SFTP) standards and also have very low FTP emission levels, indicate that, on average, a 51 percent increase in NMHC and a 242 percent increase in NO_X emissions when operated for a short period of time on 330 ppm compared to 30 ppm could be realized.

This level of emissions increase is significant enough on its own to cause a vehicle to exceed the full useful life emission standards when operated on sulfur levels that are substantially higher than the levels required by today's rule, even with the margin of

[48] The air quality impacts discussed above under Section III above do not reflect these new estimates.

safety that auto manufacturers generally include. Average sulfur levels in the U.S. are currently high enough to significantly impair the emissions control systems in new technology vehicles, and to potentially cause these vehicles to fail emission standards required for vehicles up through 100,000 miles (or more) of operation.

For older vehicles designed to meet Tier 0 and Tier 1 emission standards, the effect of sulfur contamination is somewhat less. Still, testing shows that gasoline sulfur increases emissions of NMHC and NO_X by almost 17% when one of these vehicles is operated on gasoline for less than 100 miles containing 330 ppm sulfur compared to operation on gasoline with 30 ppm sulfur. Thus, Tier 0 and Tier 1 vehicles can also have higher emissions when they are exposed to sulfur levels substantially higher than the proposed sulfur standard. This increase is generally not enough to cause a vehicle to exceed the full useful life emission standards in practice, but it can result in in-use emissions increases since the vehicle could emit at levels higher than it would if it operated consistently on 30 ppm sulfur gasoline.

As discussed in the RIA, NLEV and Tier 2 vehicles are significantly more sensitive to sulfur poisoning than Tier 1 and Tier 0 vehicles. Because of this, even in the absence of Tier 2 standards, gasoline sulfur control to 30 ppm would achieve about 700,000 tons of NO_X reductions per year from LDVs and LDTs by 2020. This represents about a third of the national NO_X emission reductions otherwise available from these vehicles. Without these potential emission reductions, many states would face the potentially unmeetable challenge of finding enough other cost-effective sources of NO_X emission reductions to address their ozone nonattainment and maintenance problems.

Sulfur reductions will result in reductions of other pollutants as well. For example, the increase in CO emissions at 330 ppm compared to 30 ppm were very similar to the results above for NMHC. Thus, sulfur reductions would greatly reduce CO emissions. Another example is sulfur reductions will help reduce emissions of particulate matter, providing some benefit to PM nonattainment areas (which may or may not coincide with ozone nonattainment areas) as well as with visibility problems. Sulfur reductions will also have benefits for areas across the country with acid deposition problems. Furthermore, sulfur reduction, by enabling tighter Tier 2 standards and by improving emissions performance of the vehicles already on the road, will lead to fewer NMOG emissions, since, as explained in the RIA, NMOG emissions are also impacted by gasoline sulfur (although to a lesser extent than NO_X emissions). Some of the NMOG emissions reduced are air toxics. As described in Section III above, air toxics, also known as hazardous air pollutants, or HAPs, contribute to a variety of human health problems.

c. Sulfur's Negative Impact on Tier 2 Catalysts

As we discussed in the last section, sulfur contaminates the catalyst. In addition, essentially all vehicles that have been tested show that this effect is not reversible for one or more pollutants. The ability to reverse sulfur's negative effect on catalyst performance is dependent on a number of factors. The same factors that impact sulfur sensitivity also impact the irreversibility of the sulfur effect. For example, the location of the catalyst relative to the engine, the materials used to provide oxygen storage capacity in the catalyst, and the general design of the catalyst and the mix of air and fuel (A/F) entering the engine over the course of operation affect irreversibility, to name a few.

Perhaps the most significant factors for reversibility are the mixture of air and fuel entering the engine and catalyst temperature. The results of numerous studies and test programs show that rich exhaust (absence of oxygen) mixtures in addition to high catalyst temperatures (in excess of 700°C) can remove sulfur from the catalyst. Rich exhaust mixtures can occur intentionally and unintentionally, depending on the level of sophistication of the fuel control system. An intentional rich exhaust mixture is known as fuel ''enrichment.'' There are different types of enrichment. For example, there is ''commanded'' enrichment, which is used to provide extra power when the engine is under a load (*e.g.,* accelerations), as well as a means to cool the catalyst. Also, there is enrichment which results from the normal fluctuations in A/F that occur during typical ''closed-loop'' FTP operating conditions. The amount of enrichment necessary for sulfur removal is a function of several factors: the ''magnitude'' of the enrichment event, the duration of the enrichment event, and the frequency of which the enrichment event occurs.

While the amount of fuel enrichment is critical in the removal of sulfur from the catalyst, high catalyst temperature is equally as important. In order to meet strict Tier 2 standards, manufacturers are going to have to balance tight A/F control with improved catalyst performance, with an eye towards better catalyst thermal management. Many manufacturers are going to have to depend more on the precious metal palladium for oxidation of NMOG and CO emissions, as well as the reduction of NO_X, because palladium is more tolerant to high temperatures. Since the vast majority of emissions still occur immediately following a cold start when the catalyst is still cool, further reductions to cold start emissions can be achieved by locating the catalysts very close to the engine. The closer proximity to the engine helps to activate the catalyst sooner by taking advantage of the additional heat supplied to the catalyst by the exhaust manifolds. Palladium is very sensitive to sulfur and, consequentially, catalyst systems that rely heavily on this metal tend to be more sensitive to sulfur and less reversible. The precious metal platinum, although usually a little more effective at oxidizing NMOG and CO and slightly less sensitive to sulfur than palladium, is too sensitive to high temperature to survive the close proximity to the engine and is not anticipated to be used for close-coupled applications.

As discussed above, manufacturers will need to make modifications to their emission system calibrations by optimizing fuel control, spark timing, EGR and other parameters in conjunction with improvements to catalyst systems, in order to meet Tier 2 emission standards. This combination of emission control strategies can result in significant trade-offs between NMOG and NO_X control. There can be considerable uncertainty associated with balancing these trade-offs at very low emissions levels if the vehicle is periodically operated on high sulfur fuels.

Our federal supplemental federal test procedure (SFTP) standards, as well as California's SFTP standards, both of which take effect in the 2001 model year, can further exacerbate this problem. The SFTP standards are intended to better address and control emissions under driving conditions not captured when compliance with our FTP-based exhaust emissions standards is demonstrated, such as operation with the air conditioning turned on or driving at very high rates of acceleration and vehicle speeds (hereafter referred to simply as aggressive driving). This is an important factor in assessing sulfur irreversibility, because Tier 2 vehicles will have to meet more stringent exhaust emission standards and will have to meet these standards over the wider variety of operating conditions included in the SFTP provisions. Hence, they will have to be designed to meet the emission standards under all such operating conditions; these design changes may influence how irreversible the sulfur effect will be, as explained below.

Since wide variations in the A/F ratio help to remove sulfur from the catalytic surface, there is concern that vehicles which meet the SFTP standards, when driven aggressively, will experience insufficient enrichment to purge sulfur from the catalyst. Currently, when driven aggressively, the A/F ratio for most vehicles (those not certified to SFTP standards) is quite variable. Meeting the SFTP standards will ensure that manufacturers carefully control the A/F ratio over essentially all in-use driving conditions. This absence of widely varying A/F could therefore inhibit the removal of sulfur from the catalyst once operation on high sulfur fuel ceased.

In order to quantify how irreversible the sulfur effect would be when catalysts exposed to high sulfur fuel are then exposed to lower sulfur fuel, several test programs were developed by EPA and industry. The vehicles in these test programs consisted of LDVs and LDTs that met either EPA Tier 1 or California LEV and ULEV emission standards. All of the vehicles were first tested at a low sulfur level (*e.g.,* 30 or 40 ppm) to establish a baseline. The vehicles were then re-tested with high sulfur fuel (*e.g.,* 350 to 540 ppm). After emission results had stabilized, the vehicles were again re-tested with low sulfur fuel. Prior to each of the second series of low sulfur tests, the vehicles were operated over a short driving cycle to help purge (*i.e.,* remove) sulfur from the catalyst. Two different cycles were used to purge sulfur, representing different types of driving: moderate urban conditions and aggressive conditions. The FTP cycle, which represents moderate urban driving, and the REP05 [49] cycle, which represents very aggressive driving (*e.g.,* hard accelerations, high speed cruises), were the two cycles used.

The vehicles tested exhibited a wide range of irreversibility, for reasons that are not fully understood. The data published in the NPRM, showed that the effect of operation on high sulfur fuel was irreversible on one or more pollutants after operation on low sulfur fuel. NO_X emissions were 15 percent irreversible. None of the vehicles were designed or modified to meet either the California or federal SFTP emissions standards. The only data used in an attempt to quantify the effect of aggressive operation on sulfur reversibility was from a catalyst manufacturer that performed some vehicle testing with catalysts which were bench aged with low and high sulfur fuel that appeared to closely approximate the impact aggressive operation would have on sulfur irreversibility. It was this data on which we based our projection of sulfur irreversibility for Tier 2 vehicles at 50 percent for NMHC and NO_X emissions. Subsequent comments on the validity of these estimates after the publishing of the NPRM prompted several additional test programs on sulfur irreversibility.

The sulfur irreversibility test programs that followed the NPRM focused on vehicles that had emission levels that met or were close to Tier 2 emission standards and also met the US06 or aggressive driving portion of the SFTP emission standards. Although numerous vehicles were tested, only four met both of the above criteria. (We had tried to supplement the data base, but we were only able to add a limited number of vehicles.) We also decided to quantify irreversibility for NMHC and NO_X emissions together instead of independently, because per our discussion above, sensitivity and irreversibility of either pollutant appears to be very dependent on the particular strategy chosen to reduce these emissions (particularly engine calibration and catalyst loading of precious metals and oxygen storage).

The new data exhibited a range of variability among vehicles and pollutants, similar to the data presented in the NPRM. The most important distinction between the new FRM data and the old NPRM data was that the new data showed that, on average, NMHC+NO_X emissions in three out of four vehicles were not fully reversible after aggressive driving. Based on this data, we project that NMHC+NO_X emissions will be 20 to 65 percent irreversible for Tier 2 vehicles under typical in-use driving, including aggressive driving.

As discussed above, the combination of calibration changes and emission system hardware modifications needed to meet our stringent Tier 2 emissions standards, can result in significant trade-offs between NMHC/NMOG and NO_X control. There can be considerable uncertainty associated with balancing these trade-offs at very low emissions levels if the vehicle is periodically operated on high sulfur fuels, making the ability to remove sulfur from the catalyst highly uncertain. For example, a given catalyst today may be fully reversible for one pollutant and only partially reversible for another. However, because of the trade-off in NMOG and NO_X performance, the modifications necessary to get that vehicle to meet both emission standards may result in the opposite effect for reversibility; *i.e.,* full reversibility for NMOG and partial reversibility for NO_X. There is no technical certainty that both the NMOG and NO_X emission standards can be met without compromising reversibility performance. Therefore, we continue to believe that sulfur's negative impact on Tier 2 catalysts is a substantial concern.

The preceding discussion focused on the irreversibility of the sulfur impact on emissions from current gasoline engine technologies. There are new technologies under development, which could be sold in the U.S. in the middle of the next decade (the same time that Tier 2 vehicles are being introduced), which also appear to be very sensitive to sulfur and largely unable to reverse this sulfur impact. One of these technologies is the direct injection gasoline (GDI) engine. These engines utilize much more air than is needed to burn the fuel, unlike conventional gasoline engines that operate under conditions where only just enough air to completely burn the fuel is introduced into the engine. This GDI technology allows these engines to be up to 25% more fuel efficient than current gasoline engines and to emit up to 20% less carbon dioxide. GDI engines are currently being introduced in both Japan and Europe (which have or will soon require low sulfur gasolines). Because of the significant operating differences with GDI engines, these vehicles will likely require emission control technology substantially different from that used on conventional gasoline engines. For example, a GDI engine may require a NO_X adsorber to meet the proposed Tier 2 NO_X standard. High fuel sulfur levels quickly and permanently degrade the performance of these NO_X adsorbers. Thus, to enable the sale of advanced, high efficiency GDI engines in the U.S. under the Tier 2 standards, it appears that low sulfur gasoline would have to be available nationwide by the time this technology becomes available.

The fuel cell is another promising propulsion system that is being developed for possible introduction to

[49] The FTP (Federal Test Procedure) is the basic driving cycle used for federal emissions testing; the LA4 cycle is a component of the FTP. The REP05 cycle developed by EPA is representative of all driving that occurs outside the LA4 or FTP cycle. All but one of the aggressive accelerations found in the US06 cycle were taken from the REP05. While each segment of the US06 cycle was taken from actual in-use driving, the timing and combination of these segments is not representative of in-use driving in the way REP05 is representative.

consumers early in the next century. Fuel cells are being designed to operate on a variety of fuels, including gasoline and diesel fuel. The basic fuel cell technology is highly sensitive to sulfur. Almost any level of sulfur in the fuel will disable the fuel cell. One possible solution is to install a technology that essentially filters out the sulfur before it enters the fuel cell. However, such sulfur ''guards'' are costly and could not practically be used like a disposable filter (requiring the vehicle owner to change the sulfur guard frequently, much like changing an oil filter) in situations where constant exposure to high sulfur levels occurs. (Even exposure to relatively low sulfur levels will likely require periodic replacement of the sulfur guard to ensure adequate protection for the fuel cell.) Therefore, the amount of sulfur in the fuel must be limited to that which can be removed by one or at most two sulfur guards over the life of the vehicle. Thus, in order for fuel cells operating on gasoline to be feasible in the U.S., low sulfur fuels would have to be available nationwide by the time this technology becomes available.

d. Sulfur Has Negative Impacts on OBD Systems

As discussed in more detail in the RIA, EPA believes that sulfur in gasoline can adversely impact the onboard diagnostic (OBD) systems of current vehicles as well as vehicles meeting the Tier 2 standards. This is an important factor supporting the need for a national sulfur control program. EPA's onboard diagnostics (OBD) regulations require that all vehicles be equipped with a system that monitors, among other things, the performance of the catalyst and warns the owner if the catalyst is not functioning properly. The OBD catalyst monitor is designed to identify those catalysts with pollutant conversion efficiencies that have been reduced to the extent that tailpipe emissions would exceed a specified multiple of the applicable hydrocarbon emissions standard. For California LEV and federal NLEV vehicles, that multiple is 1.75 times the applicable hydrocarbon emissions standard; for federal Tier 1 vehicles, that multiple is 1.5 times the applicable hydrocarbon standard added to the 4,000 mile emission level.

We want to ensure that OBD systems operate correctly, and thus the possibility that gasoline sulfur may interfere with these systems was another consideration when evaluating the need for a national sulfur program. Our evaluation of sulfur's effect on OBD systems was summarized in a staff paper in 1997.[50] We concluded that sulfur can affect the decisions made by the OBD systems. Sulfur appears to affect the oxygen sensor downstream of the catalyst, which is used in the OBD systems, and it is not clear that the conditions that seem to reverse sulfur's effect on the catalyst will also reverse any sulfur impact on the downstream oxygen sensors. Indirectly, sulfur impacts OBD systems because it can impair a catalyst that would otherwise be operating satisfactorily, thereby triggering the OBD warning lights. While this would indicate a properly operating OBD system, auto manufacturers have expressed the concern that consumers using high sulfur fuel may experience OBD warnings much more frequently than they would if operating on low sulfur gasoline, and that this could lead to a loss of consumer confidence in or support for OBD systems. Consumers may then ignore the OBD warning system and drive a potentially high emitting vehicle (which may have nothing to do with exposure to sulfur), contributing even more to air quality problems. Another possible scenario is that the OBD system may be impaired by sulfur in such a way that it does not register an improperly functioning catalyst, even if the catalyst is impaired for reasons unrelated to exposure to sulfur. This would defeat the purpose of OBD systems.

The reduction of sulfur levels for gasoline should resolve any concerns over the ability of the OBD system to make proper decisions. The use of low sulfur fuel should ensure that the OBD warning light goes on when it is supposed to and is not influenced by sulfur contamination of the catalyst and/or OBD system.

B. Our Program for Vehicles

The program we are establishing today for cars, light trucks, and large passenger vehicles will achieve the same large NO_X reductions that we projected for the proposed program. The program is very similar to our proposed program in all major respects. We have been able to retain the general structure, stringency, and emissions benefits of the proposal in this final rule. Where we have made adjustments to the proposed program, we have done so in ways that improve the implementation of the program without changing the overall environmental benefits that the program will achieve. And by creating a new category of vehicles subject to the Tier 2 standards, medium-duty passenger vehicles, the final rule will ensure that all passenger vehicles expected to be on the road in the foreseeable future will be very clean.

We have seriously considered the input of all stakeholders in developing our final rule and believe the program finalized below balances the concerns of all stakeholders while achieving the needed air quality benefits. In general, the adjustments we have made are aimed at improving the implementation efficiency of the program by better aligning the federal Tier 2 program with the NLEV program and with California's program especially during the interim program.[51] Extensive comments from manufacturers led us to conclude that better harmony between the two programs would reduce the engineering, testing and certification workload related to our interim program. Where we could make changes to increase the overlap of the two programs while maintaining the NO_X reductions of the proposal, we have done so. These changes are discussed in detail in this section IV.B. and in sections V.A. and V.B.

Our final rule also includes provisions to regulate complete heavy-duty passenger vehicles (primarily SUVs and passenger vans) of less than 10,000 pounds GVWR within the Tier 2 program. Standards for these vehicles were not included in the Tier 2 NPRM, but were proposed in a subsequent NPRM on October 29, 1999 (64 FR 58472). The final provisions for these vehicles are addressed in section IV.B.4.g. These heavier vehicles have been recategorized as medium duty passenger vehicles (MDPVs). They are included in the Tier 2 program starting with model year 2004 and will be treated similarly to HLDTs, unless otherwise noted.

The next sections of the preamble describe our final program in detail and include changes and adjustments from the NPRM that we believe address many concerns raised by the Alliance and others. While these changes ease the burden on manufacturers, they have little or no impact on the air quality benefits of the Tier 2 program.

[50] U.S. EPA, ''OBD & Sulfur Status Report: Sulfur's Effect on the OBD Catalyst Monitor on Low Emission Vehicles,'' March 1997, updated September 1997.

[51] In this section and also in section V, we make various references to the Tier 2 program, the interim program (or standards) and the final Tier 2 standards. The Tier 2 program includes the interim program (or standards) and the final Tier 2 standards. Some discussion is applicable to the entire Tier 2 program, some to the interim program (or standards) only and some is only applicable to the final Tier 2 standards. As the program is complex, we advise you to read carefully to discern the applicability of the text to the proper model years and categories of vehicles.

In a number of places in the following text, we mention that changes are being made ''in response to comments''. For a full summary of the comments and for our responses to those comments, we refer you to the Response to Comments document contained in the docket for this rulemaking or available from the Office of Mobile Sources web site (see web address at the beginning of this document).

1. Overview of the Vehicle Program

The vehicle-related part of today's final rule covers a wide range of standards, concepts, and provisions that affect how vehicle manufacturers will develop, certify, produce, and market Tier 2 vehicles. This Overview subsection provides readers with a broad summary of the major vehicle-related aspects of the rule. Readers for whom this Overview is sufficient may want to move on to the discussion of the key gasoline sulfur control provisions (Section IV.C.). Readers wishing a more detailed understanding of the vehicle provisions can continue beyond the Overview to deeper discussions of key issues and provisions (Sections IV.B.–2, 3, and 4) as well as discussions of additional provisions (Section V.A.). Readers should refer to the regulatory language found at the end of this preamble for a complete compilation of the requirements.

To understand how the program will work, it is useful to review EPA's classification system for light-duty vehicles and trucks. The light-duty category of motor vehicles includes all vehicles and trucks at or below 8500 pounds gross vehicle weight rating, or GVWR (*i.e.,* vehicle weight plus rated cargo capacity). Table IV.B.–1 shows the various light-duty categories and also shows our new medium-duty passenger vehicle (MDPV) category, discussed in section IV.B.4.g.. In the discussion below, we make frequent reference to two separate groups of light vehicles: (1) LDV/LLDTs, which include all LDVs and all LDT1s and LDT2s; and (2) HLDTs, which include LDT3s and LDT4s. We also make mention of MDPVs although the details of our program for those vehicles are deferred to IV.B.4.g. at the end of section IV.B.

TABLE IV.B.—1 LIGHT-DUTY VEHICLES AND TRUCKS AND MEDIUM-DUTY PASSENGER VEHICLES; CATEGORY CHARACTERISTICS

	Characteristics
LDV	A passenger car or passenger car derivative seating 12 passengers or less.
Light LDT (LLDT)	Any LDT rated at up through 6,000 lbs GVWR. Includes LDT1 and LDT2.
Heavy LDT (HLDT).	Any LDT rated at greater than 6,000 lbs GVWR. Includes LDT3 and LDT4s.
MDPV	A heavy-duty passenger vehicle rated at less than 10,000 lbs GVWR. (The inclusion of MDPVs is discussed primarily in Section IV.B.4.g.)

a. Introduction

Today's final rule incorporates concepts from the federal NLEV program which began phase-in in the 1999 model year for LDV/LLDTs.[52] The program in today's rule takes the corporate averaging concept and other provisions from NLEV but changes the focus from NMOG to NO_X and applies them to all LDVs and LDTs. The final rule is compatible with the California LEV II (CalLEV II) program scheduled to take effect in 2004. The emission standard ''bins'' used for this average calculation are different in several respects from those of the CalLEV II program, yet still allow harmonization of federal and California vehicle technology.

The Tier 2 corporate average NO_X level to be met through these requirements ultimately applies to all of a manufacturer's LDVs and LDTs (subject to two different phase-in schedules) regardless of the fuel used. Meanwhile, until the final Tier 2 standards are completely phased in, separate interim standards apply to LDV/LLDTs and HLDTs.

As proposed in the NPRM and finalized in today's document, the Tier 2 program will take effect in 2004, with full phase in occurring by 2007 for LDV/LLDTs and 2009 for HLDTs. During the phase-in years of 2004–2008, vehicles not certified to Tier 2 requirements will meet interim requirements also using a bins system, but with less stringent corporate average NO_X standards.

[52] The NLEV program is a voluntary program, adopted by all major LDV and LDT manufacturers. It applies only to LDVs, LDT1s and LDT2s. It does not apply to HLDTs.

In the discussions below, we set forth different Tier 2 phase-in schedules for the two different groups of vehicles (LDV/LLDTs and HLDTs) as well as two different interim fleet average NO_X standards for 2004 and later model year vehicles awaiting phase-in to the Tier 2 standards.

In the NPRM, we set forth separate tables of full life standard bins for the interim programs and the final Tier 2 program, but we proposed that manufacturers could use all bins for interim or Tier 2 vehicles during the phase-in years.[53] We also proposed similar sets of tables for intermediate life standards. In this final rule, for simplicity and to accommodate additional bins, including some suggested by the Alliance, we have combined all of the full life bins into one table and all of the intermediate life bins into one table. The bins system and the choice of the individual bins is discussed in detail below.

References to California LEV II Program

Throughout this preamble, we make reference to California's LEV II program and its requirements. The LEV II program was approved by the California ARB at a hearing of November 5, 1998. Numerous draft documents were prepared by ARB staff in advance of that hearing and made available to the public. Those documents were referenced in our NPRM and included in the docket. Some of those documents were modified as a result of changes to the proposed program made at the hearing and due to comments received after the hearing. ARB prepared final documents without significant change. The final program was approved by California's Office of Administrative Law on October 28, 1999 and filed with the Secretary of State to become effective on November 27, 1999.

We have placed copies of the latest available documents, some of which we used in the preparation of this final rule, in the docket. You may also obtain these documents and other information about California's LEV II program from ARB's web site: (www.arb.ca.gov/regact/levii/levii.htm).

In the regulatory text that follows this preamble, we incorporate by reference a number of documents related to LEVII and California test procedures under

[53] Throughout this text, the term ''full life'' is used in reference to vehicle standards to mean ''full useful life'' which is currently 10 years/100,000 miles for LDVs and LLDTs, but 11 years/120,000 miles for HLDTs. Similarly, ''intermediate life'' refers to intermediate useful life standards which apply for the period of 5 years/50,000 miles. In this rulemaking we are retaining the current full useful life period for interim LDVs and LLDTs, but raising it for Tier 2 vehicles to 10 years/120,000 miles.

LEVII. These documents are available in the docket for today's rulemaking.

b. Corporate Average NO_X Standard

The program we are finalizing today will ultimately require each manufacturer's average full life NO_X emissions over all of its Tier 2 vehicles to meet a NO_X standard of 0.07 g/mi each model year. Manufacturers will have the flexibility to certify Tier 2 vehicles to different sets of exhaust standards that we refer to as "bins," but will have to choose the bins so that their corporate sales weighted average full life NO_X level for their Tier 2 vehicles is no more than the 0.07 g/mi. (We discuss the bins in the next subsection.)

A corporate average standard enables the program's air quality goals to be met while allowing manufacturers the flexibility to certify some models above and some models below the standard. Manufacturers can apply technology to different vehicles in a more cost-effective manner than under a single set of standards that all vehicles have to meet.

Each manufacturer will determine its year-end corporate average NO_X level by computing a sales-weighted average of the full life NO_X standards from the various bins to which it certified any Tier 2 vehicles. The manufacturer will be in compliance with the standard if its corporate average NO_X emissions for its Tier 2 vehicles meets or falls below 0.07 g/mi. In years when a manufacturer's corporate average is below 0.07 g/mi, it can generate credits. It can trade (sell) those credits to other manufacturers or use them in years when its average exceeds the standard (i.e. when the manufacturer runs a deficit). The averaging program is described in detail in later text.

c. Tier 2 Exhaust Emission Standard "Bins"

We are finalizing a Tier 2 bin structure having eight emission standards bins (bins 1–8), each one a set of standards to which manufacturers can certify their vehicles. Table IV.B.–2a shows the full useful life standards that will apply for each bin in our final Tier 2 program, i.e. after full phase-in occurs for all LDVs and LDTs. Two additional bins, bins 9 and 10, will be available only during the interim program and will be deleted before final phase-in of the Tier 2 program. Table IV.B.–2b shows all the bins from Table IV.B.–2a and also shows extra bins and higher available standards for certain pollutants that are available prior to full Tier 2 phase-in. An eleventh bin, only for MDPVs is discussed in section IV.B.4.g.

Many bins have the same values as bins in the California LEV II program as a means to increase the economic efficiency of the transition to as well as model availability. Further, we added bins that are not a part of the California program to modestly increase the flexibility of the program for manufacturers without compromising air quality goals. As discussed in Section IV.B.4. below, we believe these extra bins will help provide incentives for manufacturers to produce vehicles with emissions below 0.07 g/mi NO_X. The two highest of the ten bins shown in Table IV.B.2b. are designed to provide flexibility only during the phase-in years and will terminate after the standards are fully phased in, leaving eight bins in place for the duration of the Tier 2 program.

The NPRM full life standards contained seven Tier 2 bins as well as two separate tables of bins for interim vehicles. We proposed that manufacturers would be able to use all the bins during the phase in years regardless of whether they were certifying Tier 2 vehicles or interim vehicles.

The program we are finalizing today:

- Combines the bins from the NPRM;
- Omits two bins that were included in the NPRM for harmony with California but which are unlikely to be used; [54];
- Adds 2 bins to increase compliance flexibility without reducing environmental benefits;
- Adds a temporary bin only for MDPVs that expires after 2008. This bin is in addition to the 10 bins shown in tables of bins in this preamble;
- Establishes a PM value for the highest bin available during the interim program (bin 10) that is more stringent than the corresponding standard in the NLEV program;
- Provides temporary higher NMOG standards that expire after 2006 for certain interim LDT2s and LDT4s produced by qualifying manufacturers.

Tables IV.B.–2a and 2b show the bins for full life standards. Table IV.B.–2b is repeated later in the text where intermediate life standards are also shown. These tables omit the temporary bin for MDPVs. This bin is usable only by MDPVs and is addressed separately in section IV.B.4.g.

TABLE IV.B.–2A.—FINAL TIER 2 LIGHT-DUTY FULL USEFUL LIFE EXHAUST EMISSION STANDARDS

[Grams per mile]

Bin No.	NO_X	NMOG	CO	HCHO	PM
8	0.20	0.125	4.2	0.018	0.02
7	0.15	0.090	4.2	0.018	0.02
6	0.10	0.090	4.2	0.018	0.01
5	0.07	0.090	4.2	0.018	0.01
4	0.04	0.070	2.1	0.011	0.01
3	0.03	0.055	2.1	0.011	0.01
2	0.02	0.010	2.1	0.004	0.01
1	0.00	0.000	0.0	0.000	0.00

[54] These bins are unlikely to be used in the Federal program because they contain the same NO_X standard as the Federal bins, but contain more stringent NMOG standards than the Federal bins. These bins, which provide extra opportunity for a manufacturer to gain NMOG credits in California are not needed or useful in the Federal program where there is no NMOG corporate average standard. The two deleted bins are bin 4 from the proposed Tier 2 bins and bin 3 from the proposed interim bins for LDV/LLDTs. Dropping these bins does not affect harmonization with California standards because the federal program includes bins having the same NO_X standard with higher NMOG standards.

TABLE IV.B.–2B.—TIER 2 LIGHT-DUTY FULL USEFUL LIFE EXHAUST EMISSION STANDARDS—INCLUDING BINS APPLICABLE DURING INTERIM PROGRAM ONLY

[Grams per mile]

Bin No.	NO_X	NMOG	CO	HCHO	PM	Comments
10	0.6	0.156/0.230	4.2/6.4	0.018/0.027	0.08	a b c d
9	0.3	0.090/0.180	4.2	0.018	0.06	a b c
8	0.20	0.125/0.156	4.2	0.018	0.02	b f

Notes:
[a] Bin deleted at end of 2006 model year (2008 for HLDTs).
[b] The higher of the two temporary NMOG, CO and HCHO values apply only to HLDTs.
[c] An additional higher temporary bin restricted to MDPVs is discussed in section IV.B.4.g.
[d] Optional temporary NMOG standard of 0.280 g/mi applies for qualifying LDT4s and MDPVs only, see text.
[e] Optional temporary NMOG standard of 0.130 g/mi applies for qualifying LDT2s only, see text.
[f] Higher temporary NMOG value of 0.156g/mi deleted at end of 2008 model year.

The corporate average concept using bins will provide a program that gets essentially the same emission reductions we would expect from a straight 0.07 g/mi standard for all vehicles because all NO_X emissions from Tier 2 vehicles in bins above 0.07 g/mi will need to be offset by NO_X emissions from Tier 2 vehicles in bins below 0.07 g/mile. This focus on NO_X allows NMOG [55] emissions to ''float'' in that the fleet NMOG emission rate depends on the mix of bins used to meet the NO_X standard. However, as you can see by examining the bins, any combination of vehicles meeting the 0.07 g/mi average NO_X standard will have average NMOG levels below 0.09 g/mi. The actual value will vary by manufacturer depending on the sales mix of the vehicles used to meet the 0.07 g/mi average NO_X standard. In addition, there will be overall improvements in NMOG since Tier 2 incorporates HLDTs, which are not covered by the NLEV program. Tier 2 also imposes tighter standards on LDT2s than the NLEV program by making them average with the LDVs and LDT1s. NLEV has separate, higher standards for LDT2s. We did not adopt any bins for LDVs and LDTs with standards higher than we proposed.

[55] In the NPRM, we proposed that hydrocarbon standards would be measured in terms of ''non-methane organic gases'' (NMOG) regardless of fuel. For reasons explained elsewhere in this preamble we will permit non-methane hydrocarbons (NMHC) as an option in the final rule for all fuels except alcohol fuels and compressed natural gas . NMHC and NMOG are very similar for gasoline and diesel fuel emissions.

d. Schedules for Implementation

We recognize that the Tier 2 standards pose greater technological challenges for larger light duty trucks (HLDTs) than for LDVs and smaller trucks (LDT1s and LDT2s). We believe that additional leadtime is appropriate for HLDTs. HLDTs have historically been subject to less stringent vehicle-based standards than lighter trucks and LDVs. Also, HLDTs were not subject to the voluntary emission reductions implemented for LDVs, LDT1s and LDT2s in the NLEV program. Consequently we are finalizing as proposed, separate phase-in programs for HLDTs and LDV/LLDTs . Our phase-in approach will provide HLDTs with extra time before they need to begin phase-in to the final Tier 2 standards and will also provide two additional years for them to fully comply. Table IV.B–3 provides a graphical representation of how the phase-in of the Tier 2 program will work for all vehicles. This table shows several aspects of the program:

- Phase-in of the Tier 2 standards;
- Phase-in/phase-out requirements of the interim programs;
- Phase-in requirements of new evaporative standards;
- Years that can be included in alternative phase-in schedules;
- Years in which manufacturers can bank NO_X credits through ''early banking'' and
- ''Boundaries'' on averaging sets in the Tier 2 and interim programs.
- Averaging provisions for MDPVs (see section IV.B.4.g. for discussion)

We discuss each of these topics in detail below and make numerous references to Table IV.B–3.

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Table IV.B-3
TIER 2 AND INTERIM NON-TIER 2 PHASE-IN AND EXHAUST AVERAGING SETS
(Bold lines around shaded areas indicate averaging sets)

	2001	2002	2003	2004 %	2005 %	2006 %	2007 %	2008 %	2009+ later %	NOx STD. (g/mi)
LDV/LLDT (INTERIM)	NLEV	NLEV	NLEV	75 max	50 max	25 max				0.30 avg
LDV/LLDT (TIER 2 +evap)	*early banking* b	b	b	25	50	75	100	100	100	0.07 avg
HLDT (TIER 2 +evap)	*early banking* b	b	b	b	b	b	b	50	100	0.07[d] avg
HLDT (INTERIM)	TIER 1 b	TIER 1 b	TIER 1 b	25 c,e	50 e	75 e	100 e	50 max		0.20[a,d] avg
MDPVs (INTERIM)	HDE	HDE	HDE							
MDPVs (TIER 2 + evap)	*early banking* b	b	b	b	b	b	b	50	100	0.07[d] avg

NOTES

a. 0.6 NOx cap applies to balance of LDT3s/LDT4s, respectively, during the 2004-2006 phase-in years

b. Alternative phase-in provisions permit manufacturers to deviate from the 25/50/75% 2004-2006 and 50% 2008 phase-in requirements and provide credit for phasing in some vehicles during one or more of these model years.

c. Required only for manufacturers electing to use optional NMOG values for LDT2s or LDT4s and MDPV flexibilities during the applicable interim program and for vehicles whose model year commences on or after the fourth anniversary date of the signature of this rule. See discussion in preamble text.

d. HLDTs and MDPVs must be averaged together.

e. Diesels may be engine-certified through the 2007 model year. See discussion in preamble text.

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As described in detail in the Response to Comments document, the Alliance proposal would have delayed final implementation of Tier 2 standards until 2011. We are not adopting the Alliance's time schedule, because we believe the shorter schedule we proposed is feasible and that there is no reason to delay the final benefits of the Tier 2 standards. In fact, numerous commenters representing state, environmental and health groups argued that our original proposal gave manufacturers too much time to bring the HLDTs into line with LDVs and LLDTs. We believe the two extra years proposed in the NPRM remain appropriate. HLDTs will face greater challenges than LDVs/LLDTs because their emission control systems will need to be durable under potentially heavier loads and tougher operating conditions than LDV/LLDTs. Their sales are small relative to the rest of the light duty fleet (they will comprise about 14% of the light duty fleet in 2004), and they will benefit from industry experience with the lighter vehicles. In addition, HLDTs will not remain at high Tier 1 levels until they phase-in to Tier 2. Rather, they will have to meet interim standards that impose a NO_X cap of 0.60 g/mi and phase-in a corporate average NO_X standard of 0.20 g/mi. These standards represent a significant reduction from applicable Tier 1 standards.[56] Interim standards are discussed in detail later in this preamble.

i. Implementation Schedule for Tier 2 LDVs and LLDTs

We are finalizing the implementation schedule for the Tier 2 standards as proposed in the NPRM. Thus, the standards will take effect beginning with the 2004 model year for light duty vehicles and trucks at or below 6000 pounds GVWR (LDV/LLDTs). Manufacturers will phase their vehicles into the Tier 2 standards beginning with 25 percent of LDV/LLDT sales that year, 50 percent in 2005, 75 percent in 2006, and 100 percent in 2007. Manufacturers will be free to choose which vehicles are phased-in each year. However, in each year during (and after) the phase-in, the manufacturer's average NO_X for its Tier 2 vehicles must meet the 0.07 g/mi corporate average standard. This phase-in schedule, which is consistent with that of the California LEV II program, provides between four and seven years of leadtime for the manufacturers to bring all of their LDV/LLDT production into compliance. These vehicles constitute about 86 percent of the light duty fleet.

To increase manufacturer flexibility and provide incentives for early introduction of Tier 2 vehicles, we are also finalizing provisions from the NPRM that permit manufacturers to use alternative phase-in schedules that will still require 100 percent phase-in by 2007, but recognize the benefits of early introduction of Tier 2 vehicles, and allow manufacturers to adjust their phase-in to better fit their own production plans. (See section IV.B.4.b.ii. below.)

ii. Implementation Schedule for Tier 2 HLDTs

The Tier 2 phase-in schedule for HLDTs is also being finalized as proposed. The phase-in for final Tier 2 standards for HLDTs will start later and end later than that for LDVs and LLDTs. Fifty percent of each manufacturer's HLDTs must meet Tier 2 standards in 2008, and 100 percent must meet Tier 2 standards in 2009. As with the LDV/LLDTs, the Tier 2 HLDTs must meet a corporate average NO_X standard of 0.07 g/mi. This delayed phase-in schedule:

- Provides significant interim emission reductions starting in 2004 (discussed separately below);
- Recognizes the relatively high emission standards that currently apply to HLDTs;
- Provides manufacturers with adequate lead time before they must bring HLDTs into compliance with final Tier 2 standards;
- Provides manufacturers the opportunity to apply and evaluate Tier 2 technology on LDV/LLDTs before having to apply it to HLDTs; and
- Provides manufacturers the opportunity to apply and evaluate Tier 2 technology on HLDTs on a relatively small scale to meet California LEV II requirements before having to apply it to HLDTs nationwide.

As with the LDV/LLDTs above, to encourage early introduction of Tier 2 HLDTs and to provide manufacturers with greater flexibility, we are finalizing provisions to permit manufacturers to generate early Tier 2 NO_X credits and to use alternative phase-in schedules that still result in 100% phase-in by 2009. (See sections IV.B.4.d.iv. and IV.B.4.b.ii, respectively, below.)

e. Interim Standards

The interim standards discussed below are a major source of emission reductions in the early years of the vehicle control program. The NO_X emission standards for LDT2s and LDT4s, which comprise about 40 percent of the fleet, are more stringent than the corresponding standards in the NLEV and CAL LEV I programs. These standards also are important because they set the stage for a smooth transition to the final Tier 2 standards.

The two groups of vehicles (LDV/LLDTs and HLDTs) will be approaching the Tier 2 standards from quite different emission ''backgrounds''. LDV/LLDTs will be at NLEV levels, which require NO_X emissions of either 0.3 or 0.5g/mi on average,[57] while HLDTs will be at Tier 1 levels facing NO_X standards of either 0.98 or 1.53 g/mi, depending on truck size. These Tier 1 NO_X levels for HLDTs are very high (by a factor of 14–22) relative to our 0.07 g/mi Tier 2 NO_X average. To address the disparity in emission ''backgrounds'', while gaining air quality benefits from vehicles during the phase-in period, we proposed and are finalizing separate interim average NO_X standards for the two vehicle groups during the phase-in period. The provisions described below will apply in 2004 for all LDVs and LDTs not certified to Tier 2 standards. The relationship of the interim programs to the final Tier 2 standards is shown in Table IV.B–3.

Interim vehicles will certify to the same bins as Tier 2 vehicles. As described earlier in this preamble, we have merged the tables of bins from the NPRM for simplicity and added a few bins. Bins 9 and 10 were drawn from the tables of interim bins in the NPRM, and are intended only for use during the phase-in years. Therefore, these two bins will be discontinued after 2006 (2008 for HLDTs).

i. Interim Exhaust Emission Standards for LDV/LLDTs

Beginning with the 2004 model year, all new LDVs, LDT1s and LDT2s not incorporated under the Tier 2 phase-in will be subject to an interim corporate average NO_X standard of 0.30 g/mi. This is effectively the LEV NO_X emission standard for LDVs and LDT1s under the NLEV program.[58] This interim program will hold LDVs and LLDTs to NLEV levels if they are not yet subject to Tier 2 standards during the phase-in. By implementing these interim standards for LDVs and LLDTs we will ensure that the accomplishments of the NLEV program continue. Additionally, this program will bring about substantial and important NO_X emission reductions from LDT2s in the early years of the program. LDT2s will be held to a 0.3 g/mi NO_X average in contrast to a 0.5 g/mi average in the NLEV program.

Because the Tier 2 standards are phased-in beginning in the 2004 model year, the interim standards for LDVs and LLDTs apply to fewer vehicles each year, *i.e.,* they are ''phase-out'' standards. Table IV.B–2 shows the maximum percentage of LDVs and LLDTs subject to the interim standards each year— 75% in 2004, 50% in 2005, 25% in 2006 and 0% in 2007.

As mentioned above, the interim program for LDV/LLDTs is designed to hold these vehicles to the NLEV NO_X level for LDVs and LDT1s, and a few of our bins are derived from the NLEV program. Our proposal to bring LDT2s into line with the LDVs and LDT1s during the interim program by requiring all LDVs, LDT1s and LDT2s to meet the same average NO_X standard (0.30) g/mi was of concern to industry commenters. In the final rule, we are retaining this requirement, but we are providing an optional NMOG standard of 0.130 for LDT2s certified to bin 9 when the manufacturers of those LDT2s elect to bring all of their 2004 model year

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[56] Under Tier 1 standards, LDT3s are subject to a 0.98 g/mi NO_X standard while LDT4s are subject to an even higher NO_X standard of 1.53 g/mi.

[57] The NLEV program imposes NMOG average standards that translate into full useful life NO_X levels of about 0.3 g/mi for LDV/LDT1s and 0.5 g/mi for LDT2s.

[58] The NLEV program does not impose average NO_X standards, but the NMOG average standards that it does impose will lead to full useful life NO_X levels of about 0.3 g/mi for LDV/LDT1s.

HLDTs under our interim program and phase 25% of those HLDTs into the 0.20 g/mi average NO_X standard. (See ii. below). These provisions are discussed in detail below and also in the Response to Comments document.

ii. Interim Exhaust Emission Standards for HLDTs

Our interim standards for HLDTs will begin in the 2004 model year similar to our proposal in the NPRM. The Interim Program for HLDTs will require compliance with a corporate average NO_X standard of 0.20 g/mi that will be phased in between 2004 and 2007. The interim HLDT standards, like those for LDV/LLDTs will make use of the bins in Tables IV.B. –4 and –5. We believe that our interim standards, which start in 2004, will produce significant emission reductions from HLDTs produced during the interim period. For example, HLDTs will have to reduce emissions in the interim program relative to the NLEV program. These standards, by themselves, represent a major reduction in emission standards and we believe it is likely that some manufacturers will apply their Tier 2 technology to HLDTs in order to comply with the interim standards.

As shown in Table IV.B.–3, the phase-in schedule for HLDTs to the 0.20 g/mi corporate average NO_X standard will be 25 percent in the 2004 model year (except as noted below), 50 percent in 2005, 75 percent in 2006, and 100 percent in 2007. As for the Tier 2 standards, alternative phase-in schedules (see Section IV.B.4.b.ii.) will be available. The interim program will remain in effect through 2008 to cover those HLDTs not yet phased into the Tier 2 standards (a maximum of 50%). Interim HLDTs not subject to the interim corporate average NO_X standard during the applicable phase-in years (2004–2006 or 2005–2006) will be subject to the least stringent bins so their NO_X emissions will be effectively capped at 0.60 g/mi. These vehicles will be excluded from the calculation to determine compliance with the interim 0.20 g/mi average NO_X standard.

This approach will allow more time for manufacturers to bring the more difficult HLDTs to Tier 2 levels while achieving real reductions from those HLDTs that may present less of a challenge.

Due to statutory leadtime considerations, we were not able to finalize the HLDT standards to be in effect by the time the 2004 model year begins. For this reason, we are providing incentives for HLDTs to comply with the Tier 2 standards for all 2004 model year HLDTs. This change and the leadtime issue are discussed further under section IV.B.4.e. below and also in the Response to Comments document.

iii. Interim Programs Will Provide Reductions Over Previous Standards

As is the case with the primary Tier 2 standard structure, the interim programs will focus on NO_X but will also provide reductions in NMOG beyond the NLEV program. This is because the interim programs will reduce emissions from LDT2s and HLDTs compared to their previous standards. Without the interim standards, HLDTs could be certified to the Tier 1 NMHC levels (0.46 g/mi or 0.56 g/mi). With the interim standards, however, exhaust NMOG [59] should average approximately 0.09 g/mi for all non-Tier 2 LDV/LLDTs and 0.24 g/mi or less for HLDTs. CO under Tier 1 could be as high as 7.3 g/mi for LDT4s. Under the interim program, CO standards for most bins will be well below 7.3 g/mi.

f. Generating, Banking, and Trading NO_X Credits

As proposed in the NPRM and finalized in this notice, manufacturers will be permitted to average the NO_X emissions of their Tier 2 vehicles and comply with a corporate average NO_X standard. In addition, when a manufacturer's average NO_X emissions fall below the corporate average NO_X standard, it can generate NO_X credits for later use (banking) or to sell to another manufacturer (trading). NO_X credits will be available under the Tier 2 standards, the interim standards for LDVs and LLDTs, and the interim standards for HLDTs. These NO_X credit provisions will facilitate compliance with the fleet average NO_X standards and be very similar to those currently in place for NMOG emissions under California and federal NLEV regulations.

A manufacturer with an average NO_X level for its Tier 2 vehicles in a given model year below the 0.07 gram per mile corporate average standard can generate Tier 2 NO_X credits that it can use in a future model year when its average NO_X might exceed the 0.07 standard. Manufacturers must calculate their corporate average NO_X emissions at year end and then compute credits generated based on how far below 0.07 g/mi the corporate average falls.

Manufacturers will be free to retain any credits they generate for future use or to trade (sell) those credits to other manufacturers. Credits retained or purchased can be used by manufacturers with corporate average Tier 2 NO_X levels above 0.07 g/mi. Under provisions described in Section IV.B.4.d.iv., manufacturers can implement NO_X emission reductions as early as the 2001 model year and earn early Tier 2 NO_X credits to help LDVs and LLDTs meet Tier 2 standards. Similarly, manufacturers can earn early credits for HLDTs as early as the 2001 model year. In model years up through 2005, manufacturers can earn extra credits when they certify vehicles to bins 1 or 2.

Banking and trading of NO_X credits under the interim non-Tier 2 standards will be similar to that under the Tier 2 standards, except that a manufacturer must determine its credits based upon the 0.30 or 0.20 gram per mile corporate average NO_X standard applicable to vehicles in the interim programs. As we proposed in the NPRM, interim credits from LDVs/LLDTs and interim credits from HLDTs will not be permitted to be used interchangeably due to the differences in the interim corporate average NO_X standards. As proposed in the NPRM, there will be no provisions for early banking under the interim standards and manufacturers will not be allowed to use interim credits to address the Tier 2 NO_X average standard. This is because we remain concerned that credits can be generated relatively easily under less stringent standards (the Tier 1 or interim standards) and then used in such a way to delay implementation of the Tier 2 standards.

Banking and trading of NO_X credits and related issues are discussed in greater detail in Section IV.B.4.d. below.

2. Why Are We Finalizing the Same Set of Standards for Tier 2 LDVs and LDTs?

Before we provide a more detailed description of the vehicle program, we want to review two overarching principles of today's rule. The first is our goal to bring all LDVs and LDTs under the same set of emission standards. Historically, LDTs—and especially the heavier trucks in the LDT3 and LDT4 categories—have been subject to less stringent emission standards than LDVs (passenger cars). In recent years the proportion of light truck sales has grown to approximately 50 percent. Many of these LDTs are minivans, passenger vans, sport utility vehicles and pick-up trucks that are used primarily or solely for personal transportation; *i.e.,* they are used like passenger cars.

As vehicle preferences have increasingly shifted from passenger cars to light trucks there has been an

[59] In the Tier 1 program, exhaust hydrocarbon standards are in terms of NMHC, not NMOG. However, as we have explained elsewhere in this preamble, NMHC and NMOG results are very similar for gasoline and diesel-fueled vehicles.

accompanying increase in emissions over what otherwise would have occurred because of the increase in miles traveled by LDTs and the less stringent standards for LDTs as compared to LDVs. As Section III. above makes clear, reductions in these excess emissions (and in other mobile and stationary source emissions) are seriously needed. Since both LDVs and LDTs are within technological reach of the standards in the Tier 2 bin structure, and since none of the comments have been persuasive that manufacturers can not meet the standards, we are finalizing our proposal to equalize the regulatory useful life mileage for LDVs and LDTs and apply the same Tier 2 exhaust emission standard bins to all of them. This program will ensure that substantial reductions occur in all portions of the light-duty fleet and that the movement from LDVs to LDTs will not counteract these reductions.

Once the phase in periods end for all vehicles in 2009, manufacturers will include all LDVs and LDTs together in calculating their corporate average NO_X levels.[60] As mentioned above and described in more detail in Section IV.B.–4. below, manufacturers can choose the emission bin for any test group of vehicles provided that, on a sales weighted average basis, the manufacturer meets the average NO_X standard of 0.07 g/mi for its Tier 2 vehicles that year.

Some manufacturers have suggested that a program with different requirements is needed for heavy LDTs. Recognizing that compliance will be most challenging for HLDTs, the delay in the start of the phase-in and the additional phase-in years for those vehicles will allow manufacturers to delay the initial impact of the Tier 2 standards until the 2008 model year. This represents four additional model years of leadtime beyond the time when passenger cars and LDT1s and LDT2s will achieve Tier 2 standards in substantial numbers. We believe this phase-in and other provisions of this rule respond to these concerns. Note that in the NPRM, we requested comments on the need for different hydrocarbon standards for these vehicles recognizing that a tradeoff often exists between HC and NO_X emissions. We also proposed that several bins have higher hydrocarbon standards for HLDTs during the interim program. We are finalizing these bins as proposed. Also, as an option, we are permitting the use of NMOG values similar to those in the NLEV program for bins 9 and 10 only for certain LDT2s and LDT4s during the interim program (see section IV.B.1.e.ii. above for details).

We are not adopting the Alliance's proposed phase-in schedule which would have provided a phase-in lasting until 2011. At the end of the Alliance's proposed phase-in, all vehicles would comply with an average NO_X standard of 0.07 g/mi. A fixed 0.09 NMHC standard would apply to LDVs and LLDTs while a fixed 0.156 NMHC standard would apply to HLDTs.[61] Our final program provides HLDTs until 2008 before any have to meet 0.07 g/mi on average and permits them to be averaged with LDV/LLDTs beginning in 2009, when all must meet 0.07 g/mi NO_X on average. We believe that eight years is a significant amount of leadtime to apply Tier 2 technology. We heard clearly from the public hearings and written comments that the public sees no justification for and does not want even more time provided for HLDTs. Furthermore, we see no technological need for more time than we proposed. Indeed, many believe that HLDTs should meet the Tier 2 standards in step with the LDV/LLDTs.

We are not promulgating the fixed NMHC standards suggested by the Alliance, but are sticking with the concept of bins containing lower NMOG standards connected to lower NO_X (and other) standards. We believe that providing final exhaust emission standards for HLDTs that deviate from those for LDV/LLDTs would violate one of the overarching principles of the Tier 2 program, i.e. that all LDVs and LDTs should be subject to the same exhaust emission standards. Further, the idea of NMOG values that differ from California's runs counter to other arguments raised by the Alliance that EPA should align bins with California's to promote 50 state certification of test groups.

3. Why Are We Finalizing the Same Standards for Both Gasoline and Diesel Vehicles?

The second overarching principle of our vehicle program is the use of the same Tier 2 standards for all LDVs and LDTs, regardless of the fuel they are designed to use. The same exhaust emission standards and useful life periods we are finalizing today will apply whether the vehicle is built to operate on gasoline or diesel fuel or on an alternative fuel such as methanol or natural gas. Diesel powered LDVs and LDTs tend to be used in the same applications as their gasoline counterparts, and thus we believe they should meet the same standards. Less stringent standards for diesels could create incentives for manufacturers to build more diesel vehicles, thus endangering the emission reductions expected by this program.

Manufacturers have expressed concerns that diesel-fueled vehicles would have difficulty meeting NO_X and particulate matter levels like those contained in today's rule. Clearly, these standards will be challenging. As discussed in Section IV.A.–1. above, we expect that the Tier 2 NO_X and NMOG standards will be challenging for gasoline vehicles, but that major technological innovations will not be required. For diesels, however, the final Tier 2 NO_X and PM standards will likely require applications of aftertreatment, most likely accompanied by changes in diesel fuel as such devices are sensitive to diesel fuel quality, particularly sulfur content. We do not believe such devices will be necessary to meet the top bin for our interim standards.[62] Given the small percentage of diesel vehicles and the phase-in of the standards, that bin should be sufficient for any manufacturer to market diesels and still comply with the interim program. We anticipate that manufacturers that choose to build diesel vehicles for the final Tier 2 standards will adopt aftertreatment technologies such as NO_X adsorber catalysts and continuously regenerating particulate traps to meet Tier 2 requirements. We issued an Advanced Notice of Proposed Rulemaking to seek input on potential diesel fuel quality changes on May 13, 1999 (64 FR 26142). We anticipate issuing a Notice of Proposed Rulemaking to reduce the sulfur limit on diesel fuel in the spring of 2000 followed by a final rule in late 2000. Our goal in that rulemaking is to have low sulfur diesel fuel available which will allow diesel vehicles to meet the Tier 2 standards, within the bin structure, by the time the Tier 2 standards are required for the entire fleet.

[60] Because of the different phase-in percentages and phase-in schedules for the two groups, during the duration of the phase-in (through 2008), manufacturers will average Tier 2 LDV/LLDTs separately from HLDTs.

[61] The Alliance proposed NMHC standards in lieu of the NMOG standards we proposed and are finalizing today. We are including a provision in the final rule to accept NMHC results, subject to an adjustment factor, to demonstrate compliance with NMOG standards, although we are not adopting the fixed standards proposed by the Alliance.

[62] The interim PM standard in this new bin, which represents a reduction from the NLEV PM standards, should be feasible without aftertreatment. The technologies needed to meet the PM standard we proposed for this bin would likely have required low sulfur diesel fuel, which may not be widely available during the interim program. This change is also discussed in section V.A.

Today, diesels comprise less than one-half of one percent of all LDV/LDT sales. While this is a small fraction, the potential exists for diesels to gain a considerable market share in the future. All one need do is review the dramatic increase in recent years of diesel engine use in the lightest category of heavy duty vehicles (8500–10,000 pounds GVWR) to see the potential for significant diesel engine use in LDTs, and perhaps LDVs, in the future. Just ten years ago, diesels made up less than 10 percent of this class of vehicles. In 1998, this fraction approached 50 percent.

The potential impact of large-scale diesel use in the light-duty fleet underscores the need for the same standards to apply to diesels as other vehicles. Given the health concerns associated with diesel PM emissions (see Section III. above), we believe that it is prudent to address PM emissions from diesel LDVs and LDTs while their numbers are relatively small. In this way the program can minimize the PM impact that would accompany significant growth in this market segment while allowing manufacturers to incorporate low-emission technology into new light-duty diesel engine designs.

4. Key Elements of the Vehicle Program

The previous subsections IV.B.–1.2. and 3. provide an overview of the Tier 2 vehicle program and the two key principles it is built on. This subsection elaborates on the major vehicle-related elements of today's rule. Later in this preamble, Section V.A. discusses the rest of the vehicle provisions.

a. Basic Exhaust Emission Standards and ''Bin'' Structure

Our final Tier 2 program contains a basic requirement that each manufacturer meet, on average, a full useful life NO_X standard of 0.07 g/mi for all its Tier 2 LDVs and LDTs. Manufacturers will have the flexibility to choose the set of standards that a particular test group [63] of vehicles must meet. For a given test group of LDVs or LDTs, manufacturers will select a set of full useful life [64] standards from the same row (''emission bin'' or simply ''bin'') in Table IV.B.–4. below. Each bin contains a set of individual NMOG, CO, HCHO, NO_X, and PM standards. For technology harmonization purposes, our proposed emission bins include or otherwise cover all of those adopted in California's LEV II program.[65,66]

In the NPRM, we proposed that interim vehicles and Tier 2 vehicles (except for those Tier 2 vehicles in the lowest bins) would also have to meet intermediate useful life standards, *i.e.,* standards that apply for 5 years or 50,000 miles. We are finalizing these intermediate useful life standards as proposed. Where we have added new full life bins, we have included corresponding intermediate life bins as appropriate. Our intermediate life standards are generally aligned with California's, they only impact the higher bins, and we do not believe they add substantial burden to the program. Further, they provide a check on the allowed emission deterioration during the life of the vehicle. For the final rule, we have made two changes involving intermediate life standards. First, we are providing that diesel vehicles, which will likely certify to bin 10 during the interim program, may opt not to meet the intermediate life standards associated with this bin. Low sulfur diesel fuel may be needed for diesels to meet our interim intermediate life standards and it is not likely to be widely available during the time frame of the interim program. Secondly, for all vehicles, we are finalizing a provision that will make intermediate life standards optional for any test group that is certified to a full useful life of 150,000 miles. This provision is described in more detail with other useful life issues in section V.B.

TABLE IV.B–4.—TIER 2 LIGHT–DUTY FULL USEFUL LIFE EXHAUST EMISSION STANDARDS

[Grams per mile]

Bin No.	NO_X	NMOG	CO	HCHO	PM	Comments
10	0.6	0.156/0.230	4.2/6.4	0.018/0.027	0.08	(a,b,c,d)
9	0.3	0.090/0.180	4.2	0.018	0.06	(a,b,e)
The above temporary bins expire in 2006 (for LDVs and LLDTs) and 2008 (for HLDTs)						
8	0.20	0.125/0.156	4.2	0.018	0.02	(b,f)
7	0.15	0.090	4.2	0.018	0.02	
6	0.10	0.090	4.2	0.018	0.01	
5	0.07	0.090	4.2	0.018	0.01	
4	0.04	0.070	2.1	0.011	0.01	
3	0.03	0.055	2.1	0.011	0.01	
2	0.02	0.010	2.1	0.004	0.01	
1	0.00	0.000	0.0	0.000	0.00	

Notes:
[a] Bin deleted at end of 2006 model year (2008 for HLDTs).
[b] The higher temporary NMOG, CO and HCHO values apply only to HLDTs and expire after 2008.
[c] An additional temporary higher bin restricted to MDPVs is discussed in section IV.B.4.g.
[d] Optional temporary NMOG standard of 0.280 g/mi applies for qualifying LDT4s and MDPVs only.
[e] Optional temporary NMOG standard of 0.130 g/mi applies for qualifying LDT2s only, see text.
[f] Higher temporary NMOG standard is deleted at end of 2008 model year.

[63] A ''test group'' is the basic classification unit for certification of light-duty vehicles and trucks under EPA certification procedures for the CAP2000 program. ''Test group'' is a broader classification unit than ''engine family'' used prior to the implementation of the CAP2000 program. We discuss the CAP2000 program in more detail in section V.A.9. of this preamble.

[64] The regulatory ''useful life'' value for Tier 2 vehicles is specifically addressed in Section V.A.2. of this preamble. Full useful life will be 10 years or 120,000 miles for all vehicles except LDT3s and LDT4s, for which it is 11 years or 120,000 miles. Intermediate useful life, where standards are applicable, is 5 years or 50,000 miles.

[65] EPA's current standards for Clean Fuel Vehicles are less stringent than the Tier 2 standards. *See* 40 CFR 88.104–94. The Tier 2 standards will supercede the current CFV standards, and the Agency intends to undertake a rulemaking to revise the CFV standards accordingly.

[66] In some cases our bins do not match California's exactly, because they have higher NMOG standards. These bins ''cover'' the California bin in that a vehicle certified to the California standards will comply with the standards in these bins.

TABLE IV.B.–5.—LIGHT-DUTY INTERMEDIATE USEFUL LIFE (50,000 MILE) EXHAUST EMISSION STANDARDS

[Grams per mile]

Bin No.	NO_X	NMOG	CO	HCHO	PM	Comments
10	0.4	0.125/0.160	3.4/4.4	0.015/0.018		([a,b,c,d,f,h])
9	0.2	0.075/0.140	3.4	0.015		([a,b,e,h])
The above temporary bins expire in 2006 (for LDVs and LLDTs) and 2008 (for HLDTs)						
8	0.14	0.100/0.125	3.4	0.015		([b,g,h])
7	0.11	0.075	3.4	0.015		([h])
6	0.08	0.075	3.4	0.015		([h])
5	0.05	0.075	3.4	0.015		([h])

Notes:
[a] Bin deleted at end of 2006 model year (2008 for HLDTs).
[b] The higher temporary NMOG, CO and HCHO values apply only to HLDTs and expire in 2008.
[c] An additional higher temporary bin restricted to MDPVs is discussed in section IV.B.4.g.
[d] Optional temporary NMOG standard of 0.195 g/mi applies for qualifying LDT4s and MDPVs only.
[e] Optional temporary NMOG standard of 0.100 g/mi applies for qualifying LDT2s only, see text.
[f] Intermediate life standards are optional for diesels certified to bin 10.
[g] Higher temporary NMOG value deleted at end of 2008 model year.
[h.] Intermediate life standards are optional for any test group certified to a 150,000 mile useful life (if credits are not claimed).

Under a ''bins'' approach, a manufacturer may select a set of emission standards (a bin) to comply with, and a test group must meet all standards within that bin. Ultimately, the manufacturer must also ensure that the emissions of a targeted pollutant—NO_X in this case—from all of its vehicles taken together meet a ''corporate average'' emission standard. This corporate average emission standard ensures that a manufacturer's production yields the required overall emission reductions. (See Section IV.B.–4.c. below for more discussion of the corporate average NO_X standard.)

In addition to the Tier 2 standards described above, we are also finalizing an interim average NO_X standard derived from the LDV/LDT1 NLEV program to cover all non-Tier 2 LDVs and LLDTs during the Tier 2 phase-in. We are finalizing a separate interim average NO_X standard for HLDTs. As in the Tier 2 program, manufacturers will select bins from Table IV.B.–4 to use to comply with the interim standards. Bins with NO_X values at or above 0.07 g/mi also have associated intermediate life standards which are shown in Table IV.B.–5. (We describe the interim standards in detail in Section IV.B.4.e. below.)

i. Why Are We Including Extra Bins?

Compared to the CalLEV II program, our Tier 2 proposal included additional bins. The California program contains no bins that will allow NO_X levels above the 0.07 g/mi level. Therefore, under the California program, no engine family can be certified above 0.07 g/mi, even with the application of offsetting credits. We proposed to add two bins (with NO_X values of 0.15 and 0.20) above the 0.07 bin and another below (with a NO_X value of 0.04) to provide manufacturers with additional flexibility. Based upon comments received from the Alliance and others that additional bins provide important added flexibility, we are finalizing a total of three bins above the LEV level (the additional bin has a NO_X value of 0.10 g/mi) and are adding one more below the LEV level (this additional bin has a NO_X value of 0.03 g/mi). Due to the NO_X averaging requirement of this rule, these bins will not result in any increase in NO_X emissions. Further, these bins will address concerns raised by some that a wider variety of bins, and bins with higher NO_X values, are needed to avoid a situation where the Tier 2 program discourages the development of advanced technology high fuel economy vehicles, which may, at least in their earliest years, have NO_X emissions higher than more conventional vehicles.

In our NPRM we proposed that during the Tier 2 phase-in years (through 2006 for LDV/LLDTs and 2008 for HLDTs), bins from the applicable interim program would be available to enhance the flexibility of the program by providing manufacturers with additional bins having NO_X standards above 0.07 g/mi. In the NPRM, we showed the interim bins in separate tables for LDV/LLDTs and HLDTs. There was considerable overlap across the two tables and with the Tier 2 bins. In this final rule, we have consolidated the interim bins and the Tier 2 bins into one table for simplicity and ease of reference. The interim programs for non-Tier 2 vehicles are described in detail in section IV.B.4.e.

While some commenters were concerned about the existence of bins above NO_X = 0.07 g/mi, we believe that the additional higher bins actually provide incentive for manufacturers to produce vehicles below 0.07 g/mi of NO_X. We believe this incentive exists because manufacturers will have some vehicles (especially larger LDTs) that they might find more cost effective to certify to levels above the 0.07 g/mi average standard. However, to do this they will have to offset those vehicles in our NO_X averaging system with vehicles certified below 0.07 g/mi. The bins at NO_X = 0.04 g/mi and NO_X = 0.03 g/mi will provide greater opportunity to do this. Thus, the extra bins serve two purposes; they provide additional flexibility to manufacturers to address technological differences and costs, and they provide those manufacturers with incentives to produce cleaner vehicles and thus advance emission control technology.

We are finalizing a bins approach with the bins shown in Tables IV.B.4 and 5 to provide adequate and appropriate emission reductions and manufacturer flexibility. This structure will help to accelerate technological innovation. We requested comment on whether we should include up to two additional bins between NO_X = 0.07 and NO_X = 0.15. Based upon manufacturer comment, we have added an additional bin (bin 6) with NO_X = 0.10. This bin will provide greater flexibility for manufacturers who may find it more cost-effective to produce some vehicles slightly above 0.07 but have difficulties meeting a 0.07 g/mi average NO_X standard if they must certify them to a NO_X level of 0.15 g/mi.

We requested comment on whether our Tier 2 bin in the NPRM with NO_X = 0.20 (our final bin 8) should be eliminated when the Tier 2 phase-in is completed (after 2007 for LDV/LLDTs and after 2009 for HLDTs). Numerous commenters argued that our highest bins were too lenient. Comments from manufacturers were opposed to eliminating bin 8 and we see little downside to having bins higher than the 0.07 NO_X standard, given that, for all of the vehicles that will use this bin, manufacturers will have to offset the excess emissions by selling vehicles certified below 0.07 g/mi NO_X under the averaging requirement. Thus, we are retaining bin 8.

b. The Program Will Phase in the Tier 2 Vehicle Standards Over Several Years

i. Primary Phase-In Schedule

We are finalizing as proposed our plan to phase in the Tier 2 standards for LDV/LLDTs over a four year period beginning in 2004 and we are also finalizing as proposed a delayed two year phase-in beginning in 2008 for HLDTs. These phase-in schedules are shown in Table IV.B.–2 and are also shown separately in Tables IV.B.–6 and 7. We believe the flexibility of this dual phase-in approach is appropriate because the Tier 2 program will encompass all light-duty vehicles and trucks and will result in widespread applications of upgraded and improved technology across the fleet. The program will require research, development, proveout, and certification of all light-duty models, and manufacturers may need longer lead time for some vehicles, especially HLDTs. Also, manufacturers may wish to time compliance with the Tier 2 standards to coincide with other changes such as the roll out of new engines or new models. In order to begin the introduction of very clean vehicles as soon as possible while avoiding imposing unnecessary inefficiencies on vehicle manufacturers, we believe this practical but aggressive phase-in schedule effectively balances air quality, technology, and cost considerations.

In each year, manufacturers will have to ensure that the specified fraction of their U.S. sales: [67]

- Meets Tier 2 standards for exhaust emissions, including Supplemental Federal Test Procedure (SFTP) standards (discussed in Section V.A.–3. below);
- Meets Tier 2 standards for evaporative emissions (discussed in Section IV.B.–4.f. below); and
- Meets the corporate average Tier 2 NO_X standard.

[67] For Tier 2 vehicles (and for interim vehicles), the term ''U.S. sales'' means, for a given model year, those sales in states other than California and any states that have adopted the California program.

Manufacturers will have to meet the Tier 2 exhaust requirements (i.e., all the standards of a particular bin plus the SFTP standards) using the same vehicles. Vehicles not covered by the Tier 2 standards during the phase-in years (2004–2008) will have to meet interim standards described in Section IV.B.4.e. below and the existing evaporative emission as well as the applicable SFTP standards.

Manufacturers can elect to meet the percentage phase-in requirements for evaporative and exhaust emissions using two different sets of vehicles. We believe that because of interactions between evaporative and exhaust control strategies, manufacturers will generally address the Tier 2 evaporative phase-in with the same vehicles that they use to meet the exhaust phase-in. However, the primary focus of today's proposal is on exhaust emissions, and the flexibility for manufacturers to use different sets of vehicles in complying with the phase-in schedule for evaporative standards and for the exhaust standards will have no environmental down side that we are aware of. It is possible that some exhaust emission improvements might even occur sooner than they otherwise would if a manufacturer is able to move ahead with the roll-out of a model with cleaner exhaust emissions without having to wait for the development of suitable evaporative controls to be completed for that model.

TABLE IV.B.–6.—PRIMARY PHASE-IN SCHEDULE FOR SALES OF TIER 2 LDVS AND LLDTS

Model year	Required percentage of light-duty vehicles and light light-duty trucks (percent)
2004	25
2005	50
2006	75
2007	100

TABLE IV.B.–7.—PRIMARY PHASE-IN SCHEDULE FOR SALES OF TIER 2 HLDTS

Model year	Required percentage of heavy light-duty trucks (percent)
2008	50
2009	100

We are finalizing our proposed phase-in approach, in which vehicle sales will be determined according to the ''point of first sale'' method outlined in the NLEV rule. Vehicles with points of first sale in California or a state that has adopted the California LEV II program (if any) will be excluded from the calculation. The ''point of first sale'' method recognizes that most vehicle sales will be to dealers and that the dealers' sales will generally be to customers in the same geographic area. While some sales to California residents (or residents of states that adopt California standards) may occur from other states and vice-versa, we believe these sales will be far too small to have any significant impact on the air quality benefits of the Tier 2 program or the manufacturers' ability to demonstrate compliance.

ii. Alternative Phase-In Schedule

We are finalizing, as proposed, that manufacturers may introduce vehicles earlier than required to earn the flexibility to make offsetting adjustments, on a one-for one basis, to the phase-in percentages in later years. However, they will still need to reach 100% of sales in the 2007 model year (2009 for HLDTs). Manufacturers will have the option to use this alternative to meet phase-in requirements for LDV/LLDTs and/or HLDTs. They can use separate alternative phase-in schedules for exhaust and evaporative emissions, or an alternative phase-in schedule for one set of standards and the primary (25/50/75/100% or 50%/100%) schedule for the other.

Under these alternative schedules, manufacturers will have to introduce vehicles that meet or surpass the 0.07 g/mi Tier 2 NO_X average standard before they are required to do so, or else introduce vehicles that meet or surpass the 0.07 standard in greater quantities than required. Alternative phase-in schedules essentially credit the manufacturer for its early or accelerated efforts and allow the manufacturer greater flexibility in subsequent years during the phase-in. Thus, the alternative phase-in schedule provisions provide incentive and flexibility to manufacturers to introduce Tier 2 vehicles before 2004 (or 2008 for HLDTs).

As outlined in the NPRM, an alternative phase-in schedule will be acceptable if it passes a specific mathematical test. We have designed the test to provide manufacturers benefit from certifying to the Tier 2 standards early while ensuring that significant numbers of Tier 2 vehicles are introduced during each year of the alternative phase-in schedule. To test an alternative schedule, a manufacturer must sum its yearly percentages of Tier 2 vehicles beginning with model year 2001 and compare the result to the sum that results from the primary phase-in schedule. If an alternative schedule scores as high or higher than the base option, then the alternative schedule is acceptable. The mathematical technique to evaluate alternative phase-in schemes is somewhat similar to that used in our NLEV rule and in California rules.

For LDV/LLDTs, the final sum of percentages must equal or exceed 250—the sum that results from a 25/50/75/100 percent phase-in. For example, a 10/25/50/65/100 percent phase-in that begins in 2003 will have a sum of 250 percent and is acceptable. In this example, assuming constant levels of production, each Tier 2 vehicle sold early (*i.e.* in 2003) will permit the manufacturer to sell one less Tier 2 vehicle in the last phase-in year (2006). A 10/20/40/70/100 percent phase-in that begins the same year has a sum of 240 percent and is not acceptable. For HLDTs, the sum must equal or exceed 150 percent.

To ensure that significant numbers of Tier 2 vehicles are introduced in the 2004 time frame, manufacturers will not be permitted to use alternative phase-in schedules that delay the implementation of the Tier 2 LDV/LLDT requirements, even if the sum of the phase-in percentages meets or exceeds 250. Such a situation could occur if a manufacturer delayed implementation of its Tier 2 production until 2005 and began a 75/85/100 percent phase-in that year. To protect against this possibility, we are finalizing the proposed requirement that for any alternative phase-in schedule, a manufacturer's phase-in percentages from the 2004 and earlier model years sum to at least 25%. In the final rule we are including an additional measure of flexibility to the requirements for alternative phase-in schedules. We will permit manufacturers to achieve a 2004 phase-in of less than 25%, but no less than 20%, provided that in 2005 they make up the shortfall in a two-for-one manner. So, as an example, a manufacturer that phased in 5% in 2003 and 15% in 2004 would achieve a total of 20% through the 2004 model year and would need to comply with Tier 2 requirements for at least 60% of its LDV/LLDTs in 2005. We believe that this flexibility is appropriate because the required response for 2005 model year vehicles more than makes up for the environmental loss from the 2004 model year vehicles.

We requested comment on whether alternative phase-in schedules should be structured to permit manufacturers to extend phase in past the final year of the primary phase-in schedule (2007 or 2009). While the Alliance proposal and comments clearly support phase-ins that run past 2007 and 2009, other commenters were opposed to any extensions of the phase-in period. In fact most commenters who addressed the length of the phase-in indicated, as previously discussed, that the phase-in for HLDTs should be moved ahead to 2007 to coincide with LDV/LLDTs. We are not finalizing any provisions that will permit alternative phase-in schedules to provide additional time for manufacturers to meet any final 100% compliance year.

In the NPRM, we pointed out that phase-in schedules, in general, add little flexibility for manufacturers with limited product offerings because a manufacturer with only one or two test groups can not take full advantage of a 25/50/75/100 percent or similar phase-in. For manufacturers meeting EPA's definition of "small volume manufacturer," we proposed to exempt those manufacturers from the phase-in schedules and require them to simply comply with the final 100% compliance requirement. We are finalizing this provision for small volume manufacturers. This provision is only intended to apply to small volume manufacturers and not to small test groups of larger manufacturers.

For larger manufacturers having a limited product line, we recognize that our phase-in schedule may lack flexibility, however, we are not including any provisions to address this issue as we are for small volume manufacturers because we do not believe these manufacturers need the relief and we do not want to sacrifice any air quality benefits of the program.

c. Manufacturers Will Meet a "Corporate Average" NO_X Standard

While the manufacturer will be free to certify a test group to any applicable bin of standards in Table IV.B.–2, it will have to ensure that the sales-weighted average of NO_X standards from all of its test groups of Tier 2 vehicles meet a full useful life standard of 0.07 g/mi.[68] Using a calculation similar to that for the NMOG corporate average standard in the California and NLEV programs, manufacturers must determine their compliance with the corporate average NO_X standard at the end of the model year by computing a sales weighted average of the full useful life NO_X standards from each bin. Manufacturers must use the following formula:

$$\text{Corporate Average NO}_X = \frac{\sum(\text{Tier 2 NO}_X \text{ std for each bin}) \times (\text{sales for each bin})}{\text{total Tier 2 sales}}$$

Manufacturers must exclude vehicles sold in California or states adopting California LEV II standards from the calculation. As indicated above, manufacturers must compute separate NO_X averages for LDV/LLDTs and HLDTs through model year 2008.

The corporate average NO_X standards of the primary Tier 2 program and the interim programs for LDV/LLDTs and HLDTs will ensure that expected fleet-wide emission reductions are achieved. At the same time, the corporate average standards allow us to permit the sale of some vehicles above the levels of the average standards to address the greater technological challenges some vehicles face and to reduce the overall costs of the program. We discuss how manufacturers can generate, use, buy and sell NO_X credits under the interim and Tier 2 programs in the next subsection.

Given the corporate average NO_X standards, we do not believe a corporate average NMOG standard as used by California is essential because meeting the corporate average NO_X standard will automatically bring the NMOG fleet average to approximately 0.09 g/mi or below.

d. Manufacturers Can Generate, Bank, and Trade NO_X Credits

i. General Provisions

As mentioned in the Overview above, we are finalizing our proposal that manufacturers with year-end corporate average NO_X emissions for their Tier 2 vehicles below 0.07 g/mi can generate Tier 2 NO_X credits. Credits can be saved (banked) for use in a future model year

[68] For interim vehicles, this average NO_X standard will be 0.20 for HLDTs and 0.30 for LDV/LLDTs. Compliance with these interim average standards will be calculated in the same manner as compliance with the 0.07 standard.

or for trading (sale) to another manufacturer. Manufacturers can use credits if their corporate average NO_X emissions are above 0.07 g/mi.

As proposed, the Tier 2 standards will apply regardless of the fuel the vehicle is designed for, and there will be no restrictions on averaging, banking or trading of credits across vehicles of different fuel types. Consequently, a gasoline fueled LDV might help a manufacturer generate NOx credits in one year that could be banked for the next year when they could be used to average against NO_X emissions of a diesel fueled LDT within the appropriate averaging structure.

Because of the split phase-in and the different interim programs we are finalizing for the two different groups of vehicles (LDV/LLDTs and HLDTs), we are also finalizing the proposed requirement that manufacturers compute their corporate Tier 2 NO_X averages separately for LDV/LLDTs and HLDTs through 2008. As we proposed, credit exchanges between LDVs/LLDTs and HLDTs will not be allowed nor will credit exchanges across the interim programs or between the interim programs and the final Tier 2 program be allowed. These restrictions will end with the 2009 model year at which time both phase-ins and all interim standards will have ended and the program will permit free averaging across all Tier 2 vehicles. As noted in the NPRM, we are concerned that allowing cross-trading between interim and Tier 2 vehicles will reduce the expected benefits of the program and delay fleet turnover to Tier 2 emission levels. For this reason we did not propose and are not finalizing to permit such exchanges.

ii. Averaging, Banking, and Trading of NO_X Credits Fulfills Several Goals

We explained in the NPRM why we believe the provisions for averaging, banking, and trading of NO_X credits (ABT) will be valuable. In short:

- An ABT program is an important factor that EPA takes into consideration in setting emission standards that are appropriate under section 202 of the Clean Air Act. ABT allows us to consider a more stringent emission standard than might otherwise be appropriate under the CAA, since ABT reduces the cost and improves the technological feasibility of achieving the standard;
- ABT enhances the technological feasibility and cost effectiveness of the proposed standard and allows the standard to be attainable earlier than might otherwise be possible;
- ABT provides manufacturers with additional product planning flexibility and the opportunity for a more cost effective introduction of product lines;
- ABT creates incentive for early introduction of new technology, allowing certain engine families to act as trail blazers for new technology;

We view the ABT provisions in today's rule as environmentally neutral because the use of credits by some vehicles is offset by credits generated by other vehicles. However, when coupled with the new standards, ABT will have environmental benefits because it allows the new standards to be implemented earlier than would otherwise be appropriate.

iii. How Manufacturers Can Generate and Use NO_X Credits

Manufacturers will determine their year-end corporate average NO_X emission level by computing a sales-weighted average of the NO_X standard from each bin to which the manufacturer certifies any LDVs or LDTs. Tier 2 NO_X credits will be generated when a manufacturer's average is below the 0.07 gram per mile corporate average NO_X standard, according to this formula:

$$NO_X\ Credits=(0.07\ g/mi - Corporate\ Average\ NO_X)\times Sales$$

The manufacturer can use these NO_X credits in future years if its corporate NO_X average is above 0.07, or it can trade (sell) the credits to other manufacturers. Tier 2 credits can be generated via this mechanism beginning in the first phase-in year, *i.e.,* 2004 for LDV/LLDTs and 2008 for HLDTs. The use of NO_X credits will not be permitted to address Selective Enforcement Auditing or in-use testing failures.

The enforcement of the NO_X averaging standard will occur through the vehicle's certificate of conformity. A manufacturer's certificate of conformity will be conditioned upon compliance with the averaging provisions. The certificate will be void *ab initio* if a manufacturer fails to meet the corporate average NO_X standard and does not obtain appropriate credits to cover its shortfall in that model year or in the next three model years (see deficit carryforward provision below). Manufacturers will need to track their certification levels and sales unless they produce only vehicles certified to bins containing NO_X levels of 0.07 g/mi or below and do not plan to bank NO_X credits.

iv. Manufacturers Can Earn and Bank Credits for Early NO_X Reductions

In the NPRM, we proposed that to the extent a manufacturer's corporate average NO_X level of its "early Tier 2" vehicles was below 0.07 g/mi, the manufacturer could bank NO_X credits for later use. We recognize (and the comments assert) that this provision may be lightly used, because it requires a large reduction from prior standards to produce any credits. However, our goal is to bring vehicles to Tier 2 levels as quickly as possible and we are concerned that any other approach could provide credits for reductions manufacturers would make relatively easily from previous, higher standards. Such credits would then be used to delay the impact of the 0.07 g/mi NO_X standard. Further, we believe that our provision for alternative phase-in schedules provides what is essentially a supplemental, or perhaps even primary, early banking program, in that it permits manufacturers to trade-off earlier phase-in percentages for later phase-in percentages. To provide manufacturers with greater flexibility and with incentives to certify, produce and sell Tier 2 vehicles as early as possible, we are finalizing the alternative phase-in provisions. (See IV.B.4.b.ii above.) Under such schedules, a manufacturer can certify vehicles to an average NO_X level of 0.07 g/mi or below in years prior to the first required phase-in year and then phase its remaining vehicles in over a more gradual phase-in schedule that will still lead to 100% compliance by 2007 (2009 for HLDTs).

Thus, we are finalizing our provision for early NO_X credits essentially as proposed. To the extent that a manufacturer's corporate average NO_X level of its "early Tier 2" vehicles is below 0.07 g/mi, the manufacturer can bank NO_X credits for later use. Manufacturers will compute these early credits by calculating a sales-weighted corporate average NO_X emission level of their Tier 2 vehicles, as in the basic Tier 2 program described above. In section IV.B.4.d.vii. below, we describe provisions we are adding to the final rule that will enable manufacturers to generate extra credits from vehicles certified to very low levels. In addition to encouraging production of very clean vehicles, these provisions, which apply beginning in 2001, will enhance the abilities of manufacturers to generate early credits.

Early Tier 2 credits will have all the same properties as credits generated by vehicles subject to the primary phase-in schedule. We proposed that these credits could not be used in the NLEV, Tier 1 or interim program for non-Tier 2 vehicles in any way. We are finalizing this restriction as proposed. We are also finalizing as proposed that the NMOG emissions of these vehicles (LDVs and LLDTs only) can be used in the calculation of the manufacturer's corporate average NMOG emissions under NLEV through 2003.

To provide manufacturers with maximum flexibility in the period prior to 2004, when LDV/LLDT useful lives will still be at 100,000 miles, we proposed and are finalizing that manufacturers may choose between the Tier 2 120,000 mile useful life or the current 100,000 mile useful life requirement for early Tier 2 LDV/LLDTs. (HLDTs already have a 120,000 mile useful life.) Early LDV/LLDT NO_X credits for 100,000 mile useful life vehicles will have to be prorated by 100,000/120,000 (5/6) so that they can be properly applied to 120,000 mile Tier 2 vehicles in 2004 or later.

We proposed to restrict early banking of HLDT Tier 2 NO_X credits to the four year period from 2004–2007. This restriction was due to a concern about excessive credits generation if a longer credit generation period was available. Based on our review of the comments and from reconsideration of the restrictive nature of our approach for early credits, we are much less concerned that allowing generation of early HLDT Tier 2 credits in years prior to 2004 will result in excessive credits. Prior to 2004, manufacturers will only be required to meet the Tier 1 standards which are much higher than the final Tier 2 standards. Manufacturers will have to make large cuts in emissions to bank the small amount of credits offered by our early banking provision. Further, we recognize that vehicles that meet the Tier 2 standards early provide an environmental benefit, and the earlier that benefit occurs, the earlier that areas can use such benefits to reach or come close to attainment. Lastly, we believe it is appropriate to match the period of early credit generation with the years in which we will permit alternative phase-in schedules. Consequently, we are finalizing our provisions for early banking such that manufacturers may bank early Tier 2 NO_X credits in model years 2001–2007.

We recognize that vehicles generating early Tier 2 NO_X credits may be doing so without the emissions benefit of low sulfur fuel, and thus these vehicles may not achieve the full in-use emission reduction for which they received credit. When these credits are used to permit the sale of higher-emitting vehicles, there may be a net increase in emissions. For the most part, this is a problem anyway, since NLEV vehicles are also sensitive to gasoline sulfur. We believe that the benefits of early introduction of Tier 2 technology described above are significant enough that they are worth the risk of some emission losses that might occur if and when the early credits are used. Also, we believe that some fuel sulfur reductions will occur prior to 2004 as refiners upgrade their refineries or bring new refining capacity on stream in anticipation of the 2004 requirements and take advantage of the phase-in proposed in the gasoline sulfur ABT program (described in Section IV.C. below).

v. Tier 2 NO_X Credits Will Have Unlimited Life

We discussed in the preamble to the NPRM why we did not propose to apply the California schedule of discounting unused credits adopted for NMOG credits in the NLEV program. This schedule serves to limit credit life throughout the program by reducing unused credits to 50, 25 and 0 percent of their original number at the end of the second, third and fourth year, respectively, following the year in which they were generated. We agree that such a scheme may be appropriate in the California program with its declining NMOG average standard, but in the federal program, once the phase-in period ends in model year 2009, all LDVs and LDTs will comply on average with a fixed Tier 2 NO_X standard.

Credits allow manufacturers flexibility to meet standards cost effectively and to address unexpected shifts in sales mix. When matched with a NO_X average standard, credits provide flexibility constrained by the requirement that all vehicles, on average, must comply with a fixed standard. Defined bins of standards prevent any one vehicle from having extremely high emissions, while the need to offset higher vehicles with lower vehicles to meet an average NO_X standard prevents large numbers of vehicles from utilizing the higher bins.

We requested comment in the NPRM on the need for discounting of credits or limits on credit life and what those discount rates or limits, if any, should be. The 0.07 NO_X emission standard in the Tier 2 program is quite stringent and does not present easy opportunities to generate credits. The degree to which manufacturers invest the resources to achieve extra NO_X reductions provides environmental benefit for years to come and it is appropriate that the manufacturer get credits. We do not want to take measures to reduce the incentive for manufacturers to bank credits nor do we want to take measures to encourage unnecessary credit use. Consequently we are finalizing our proposal that Tier 2 NO_X credits, including early credits, have unlimited lives.

vi. NO_X Credit Deficits Can Be Carried Forward

When a manufacturer has a NO_X deficit at the end of a model year—that is, its corporate average NO_X level is above the required corporate average NO_X standard—we proposed that the manufacturer could carry that deficit forward into the next model year. Such a carry-forward could only occur after the manufacturer used any banked credits. If the deficit still existed and the manufacturer chose not to or was unable to purchase credits, the deficit could be carried over. At the end of that next model year, according to our proposal, the deficit would need to be covered with an appropriate number of NO_X credits that the manufacturer generated or purchased. Any remaining deficit would be subject to an enforcement action. To prevent deficits from being carried forward indefinitely, the manufacturer would not be permitted to run a deficit for two years in a row.[69]

Manufacturers made the persuasive case that by the time they can tabulate their average NO_X emissions for a particular model year, the next model year is likely well underway and it is too late to make calibration, marketing or sales mix changes to adjust that year's credit generation. Therefore, based upon comments, we are finalizing a modified approach to credit deficits such that a manufacturer having a credit deficit in the interim or Tier 2 program can carry that deficit forward for a total of three years, but the manufacturer must apply all its available credits to that deficit on a one-for-one basis in each of the first two succeeding model years. If the deficit is not covered by the third model year, the manufacturer must apply credits at a rate of 1.2:1. No deficit may be carried into the fourth year. In order to accommodate this modification to our proposal, we must also modify our proposed provision that would have prevented manufacturers from running a deficit in two consecutive model years so that deficits can not be shifted from one year to the next and thus carried forward indefinitely. Because we are permitting, in this final rule, deficits to be carried forward for as long as three years we are finalizing that manufacturers can not run a deficit in any year in which it is paying off a deficit from a previous year. The effect of this provision is the same as that in

[69] Because of the limited duration of the interim programs, we proposed that a manufacturer could carry a credit deficit in the interim program forward until the 2006 model year (2008 for HLDTs). The interim program, in its entirety, lasts only five years and therefore we saw little risk of prolonged deficits.

the NPRM— to keep manufacturers from shifting deficits forward indefinitely.

We note that under our modified final approach, manufacturers will have the flexibility to carry deficits from the interim program forward into the final Tier 2 program. This feature is likely to be used only in an extreme situation since the Tier 2 credits needed to offset the interim credit deficit will be more difficult to generate. Consequently, we do not believe this provision is inconsistent with our approach of segregating interim and Tier 2 credits. In fact, manufacturers electing to cover an interim credit deficit with Tier 2 credits will likely have to accelerate the introduction of Tier 2 vehicles to get the necessary credits to cover the deficit.

We are finalizing that small volume manufacturers may not use the credit deficit carryforward provision until they have been in compliance with the relevant average NO_X standard for one model year. In section V of this preamble we explain that we are not requiring small volume manufacturers to comply with intermediate phase-in requirements under our interim or Tier 2 phase-ins. Rather, they will just have to comply for all of their vehicles in the last phase-in year. Because they do not have to comply with intermediate phase-in requirements, small volume manufacturers effectively get more time to comply (as much as three years). We do not want to create a situation where they could get even more time to comply by using the credit deficit carryforward provision.

vii. Encouraging the Introduction of Ultra-Clean Vehicles

We requested comment in the NPRM as to whether we should provide additional NO_X credits for vehicles that certify to very low levels. We stated in the NPRM that we believe it is appropriate to provide inducements to manufacturers to certify vehicles to very low levels and that these inducements may help pave the way for greater and/or more cost effective emission reductions from future vehicles. We believe it is important in a rule of this nature to provide extra incentive to encourage manufacturers to produce and market very clean vehicles. We believe this is especially important in the earliest years of the program when manufacturers must make resource commitments to technologies and vehicle designs that will have multi-year life spans. We believe this program provides a strong incentive for manufacturers to maximize their development and introduction of the best available vehicle/engine emission control technology, and this in turn provides a stepping stone to the broader introduction of this technology soon thereafter. Early production of cleaner vehicles enhances the early benefits of our program and vehicles certified to these lowest bins produce not just lower NO_X but also lower NMOG, CO and HCHO emissions. If a manufacturer can be induced to certify to a lower bin by the promise of reasonable extra credits, the benefits of that decision to the program may last for many years.

We are finalizing provisions to permit manufacturers, at the beginning of the program, to weight LDV/Ts certified to the lowest two bins more heavily when calculating their fleet average NO_X emissions. Under this provision, which applies through the 2005 model year, manufacturers may apply a multiplier to the number of LDV/Ts sold that are certified to bins 1 and 2 (ZEVs and SULEVs in California terms). This adjusted number will be used in the calculation of fleet average NO_X emissions for a given model year and will allow manufacturers having vehicles certified to these bins to generate additional credits (or use fewer credits) that year.

The multipliers that manufacturers may use are found in Table IV.B.–8 below:

TABLE IV.B.–8.—MULTIPLIERS FOR ADDITIONAL CREDITS FOR BIN 1 AND 2 LDV/T

Bin	Model year	Multiplier
2	2001, 2002, 2003, 2004, 2005	1.5
1	2001, 2002, 2003, 2004, 2005	2.0

e. Interim Standards

i. Interim Exhaust Emission Standards for LDV/LLDTs

The NLEV program referenced throughout this discussion is a voluntary program in which all major manufacturers have opted to produce LDVs and LLDTs to tighter standards than those required by EPA's Tier 1 regulations. Under the NLEV program, manufacturers must meet an NMOG average outside of California that is equivalent to California's current intermediate-life LEV requirement—0.075 g/mi for LDVs and LDT1s (0.10 g/mi for LDT2s). NLEV requirements apply only to LDVs and LLDTs, not to HLDTs.

The NLEV program is effective beginning in the northeastern states in 1999 and in the remaining states in 2001, except that the program does not apply to vehicles sold in California or in states that adopted California's LEV program. The program runs at least through model year 2003 and can run through model year 2005.

Under the Tier 2 phase-in we are finalizing today, not all LDV/LLDTs covered under NLEV will be subject to Tier 2 standards in the 2004 to 2006 period. Without a program for full Tier 2 compliance in 2004 (*i.e.,* because of the phase-in), these vehicles could revert to Tier 1 standards. The NLEV program, moreover, is a voluntary program that contains several provisions that restrict EPA's flexibility and that could lead to a manufacturer or a covered Northeastern state leaving the program in or prior to 2004. To resolve these concerns we are finalizing the proposed interim program for all non-Tier 2 LDV/LLDTs for the 2004–2006 model years. Our interim program will replace the NLEV program, which will terminate at the end of 2003. The transition from NLEV to the interim program should be smooth because the interim program will employ several bins derived from the NLEV standards for LDVs, LDT1s and LDT2s. The interim program will ensure that all LDVs, LDT1s and LDT2s that are not certified to Tier 2 levels during the 2004–2006 phase-in period remain at levels at least as stringent, on average, as NLEV levels. The interim program will also bring the emission standards for LDT2s more into line with those for the LDVs and LDT1s by requiring that they be averaged under the same NO_X standard rather than under separate standards as is the case in the NLEV program.

In the NPRM, we included separate sets of bins for the interim program and Tier 2 program. However, we indicated that manufacturers could use either set for interim vehicles. In today's final rule we have combined all bins into one table for simplicity. We have also added two new bins having NO_X values of 0.03 g/mi and 0.10 g/mi.